Sammy-L21 Infosheet

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OEM module with Atmel/Microchip ATSAML21 processor

Available Options

Module	Processor	Flash	RAM	Peripherals on Module
Sammy-L21 V1.0	SAML21G18B-MU	256kB	32k + 8k low-power	- 3.3V LDO voltage regulator - CP2102 USB UART converter (micro USB connector) - status LED - 16MHz main crystal - 32768Hz clock crystal - 10pin standard SWD program and debug connector

Module Overview

The Sammy-L21 module comes in a standard DIL32 form factor. Based on Atmel/Microchip's SAML21G18B microcontroller in 48pin package, the modules provides many standard peripherals, like UART, SPI, TWI/I²C, Timers, PWM, ADC, DAC, analog comparator, watchdog and many more. The MCU is complemented by additional components: a 5V->3.3V voltage regulator, 16MHz main crystal, 32768Hz clock crystal, standard SWD program and debug connector and a status LED.
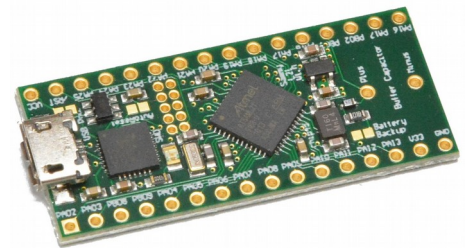
Microcontroller

Atmel/Microchip's SAML21G18B provides a powerful Cortex-M0+ CPU running at up to 48MHz, 256kB flash memory, 8kB flash for EEPROM emulation, 32kB SRAM main memory, 8kB SRAM low power memory plus an extensive set of microcontroller peripherals (see table right). For a full description of the SAML21G18B plus data sheet and comprehensive application notes, see the following link:

http://www.microchip.com/wwwproducts/en/ATSAML21G18B

Parameter Name	Value
Family	SAM L21
Max Speed MHz	48
Program Memory Size (KB)	256
RAM (KB)	40
Temperature Range (C)	-40 to 105
Operating Voltage Range (V)	1.62 to 3.63
DMA Channels	16
SPI™	6
I²C™ Compatible	6
Number of Op Amps	3
Peripheral Pin Select (PPS) Crossbar	Yes
USB	1
USB Interface	Full Speed
A/D channels	14
Max A/D Resolution	12
Max A/D Sample Rate (KSPS)	1000
Number of DACs	2
Input Capture	6
Output Compare/Std. PWM	20
Motor Control PWM Channels	14
16-bit Digital Timers	5
Parallel Port	GPIO
Comparators	2
Internal Oscillator	32Khz ULP, 16Mhz
RTCC	Yes
I/O Pins	37
Pin Count	48
Low Power	Yes
Crypto Engine	Yes

Expansion Headers

All relevant MCU signals are available on two 16-pin expansion headers with standard 2.54mm (1/10") spacing and hole size to fit almost any pin or receptacle headers. With pin headers, the module can be plugged into solderless breadboard or wirewrap PCBs easily. See „Pinout and Dimensions" for signal and pin configuration.

USB Interface

The USB interface is based on a CP2102 USB UART converter chipset by Silicon Labs. It is connected to SAMC21's SERCOM5 UART (PB02, PB03) and once connected to a PC or MAC, it will show up as virtual serial COM port. Driver installation is not necessary on current Windows or OS X version, but for older systems a virtual COM port driver is available.

See the following link for details on the CP2102 (e.g. data sheet) and optional virtual COM port driver:

https://www.silabs.com/products/interface/usb-bridges/classic-usb-bridges/device.cp2102

Clock Options

The SAML21G18B microcontroller provides a flexible clock system for clocking the CPU core and the peripherals. Beside several internal RC oscillators, two external clock options can be used and are already mounted on the SammyC21 module. First one is a 16MHz crystal, which can be used to clock the internal PLL system and the consecutive clock generators. The second one is a 32768Hz watch crystal as precise clock source for the internal realtime clock (RTC) timer. See SAML21G18B data sheet for further information.

Status LED

As simple yet effective status indicator, a low-power LED is onboard and connected to pin PA28 of the ATSAML21G18B microcontroller. Driving this pin to high will turn on the LED.

Power Supply

The Sammy-L21 module operates from 3.7V to 5.5V through VCC pin or from USB bus power (see „Configuration Jumpers" for details). All parts of the module are powered with 3.3V from the on-board LDO, hence all external GPIO signals operate on 3.3V levels. The 3.3V voltage from the LDO is also available at the V33 pin and can be used to supply external circuitry connected to the Sammy-L21. If using this, always keep the maximum current as well as (even more important!) the maximum power dissipation of the LDO in mind. The LDO provides a maximum of 600mA output current, but when you plan to e.g. use the module up to 70°C environment temperature, the maximum power dissipation drops to approx. 430mW, thus limiting the output current to approx. 250mA when operated at stable 5V VCC. Ask us, if you are unsure about your planned configuration.

External 3.3V Supply

It's possible to power the module with 3.3V directly through V33 pin, bypassing the onboard LDO. In this case, VCC must not be connected and USB power jumper must be open!

Battery Backup

The SAML21G18B MCU provides a battery backup option through pin PB03. This battery voltage supplies the 8k low-power SRAM memory during power loss. The Sammy-L21 provides an on-board area for a standard backup battery with 5mm pin spacing and 10mm diameter. To use the backup battery, jumper J120 has to be closed to connect the battery voltage to PB03.

A suitable backup battery is Panasonic EEC-S0HD224V, which is available as accessory in our online shop. See the following link for details:

https://industrial.panasonic.com/cdbs/www-data/pdf/RDG0000/ABC0000C84.pdf
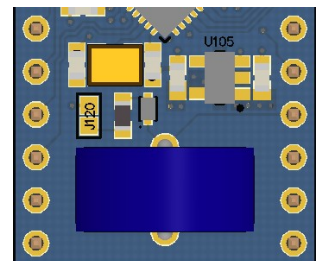
Preloaded chip45bootSAM Bootloader

You can order the module with preloaded chip45bootSAM bootloader in our shop. The bootloader provides application flash programming through USB (virtual COM port). You can download the Windows GUI executable from this link:

http://www.chip45.com/download/chip45bootSAM_GUI.zip

Before using the bootloader and GUI, it is good to close the auto-reset jumper J101, since it allows the GUI to start the bootloader automatically. See below for jumper settings and jumper location.

The picture right shows a screenshot of the GUI. Select the proper COM port, do not change the baudrate setting, since it is fixed set to 921600 baud in the bootloader and press „Start Bootloader". If J101 is set, the GUI will reset the target, bootloader will start and will connect to the GUI. If connection is successful, the „Start Bootloader" button will light green and

text will change to „Exit Bootloader". Also the onboard LED of the Sammy module will light green. Then select the application hex file to be programmed and press „Program Application". The progress bar should indicate progress and after successful programming, the „Program Application" button will light green as well.
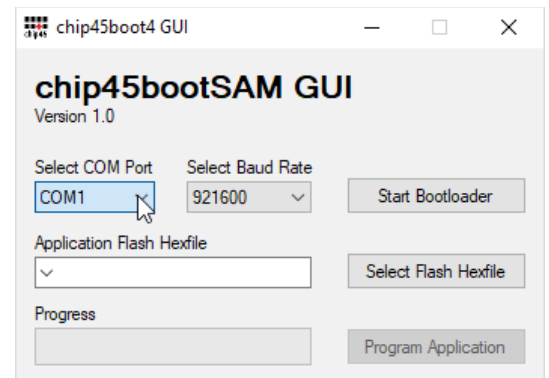
Finally press the „Exit Bootloader" button and your application will be started. If you will later reset or power cycle the module, the onboard will light green for about 3 seconds, indicating, that the bootloader was started and is waiting for the GUI to connect. If no connection attempt is made, the bootloader will timeout after 3 seconds, LED goes off and application is started. So using the bootloader will always introduce a delay of about three seconds before your application will be started.

Make sure to read the next chapter on how to modify you Atmel Studio 7 application project to be bootloader compatible.

Atmel Studio 7 Project Settings for Bootloader Operation

Other than e.g. the AVR ATmega or Xmega devices, the bootloader memory area is not at the top of flash memory, but starts at bottom of flash at address 0x0000. Since this is also the normal application start address, you have to modify the Atmel Studio 7 project settings of your application to let the application be located by the linker at a higher address after the bootloader.

Open the project settings of your Atmel Studio 7 project and go to Toolchain → ARM/GNU Linker → Memory Settings and add the following entry for the FLASH segment:

`.text=0x1000`
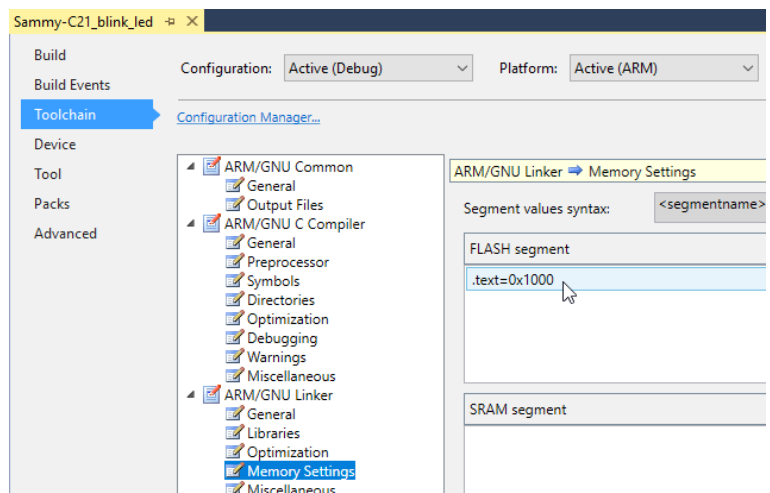
This will locate your application at start address 0x1000, thus leaving 4kbytes of space for the bootloader at bottom of flash. Recompile your application and check the generated hex file. The first hex record should start at address 0x1000 instead of 0x0000. The following screenshot shows an example of a proper hex file with the address 0x1000 highlighted:

```
:1010000068200020D110000291100002911000086
:101010000000000000000000000000000000000D0
```

The bootloader checks the to-be-programmed addresses and will not overwrite itself.

Configuration Jumpers

The Sammy-L21 module provides two configuration jumpers, which are carried out as solder-bridges and need to be closed by a small dot of solder.

J100: Close this jumper to power the on-board LDO from USB bus power.

**J101:** Close this jumper to enable bootloader auto-reset feature.

See picture right for location of the two jumpers.
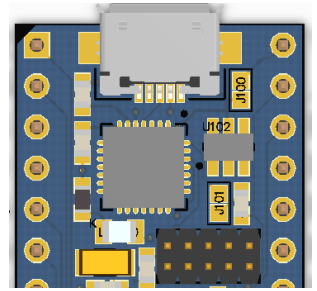
Programming and Debugging

The Sammy-L21 module provides a standard 10-pin Cortex SWD program and debug connector, which directly connects to many programmers and debuggers. Atmel/Microchip provides the ATMEL-ICE programmer/debugger in different configurations in terms of packaging with adapter cables (see http://www.atmel.com/tools/atatmel-ice.aspx). For programming and debugging the Sammy-L21 module, the ATMEL-ICE-BASIC is sufficient (providing a standard 10-pin SWD cable plus 6-pin ISP connector for e.g. Atmel/Microchip ATmega, ATtiny, Xmega, etc. devices).

See picture right for proper connection of the ATMEL-ICE SWD cable to the Sammy-L21 module.
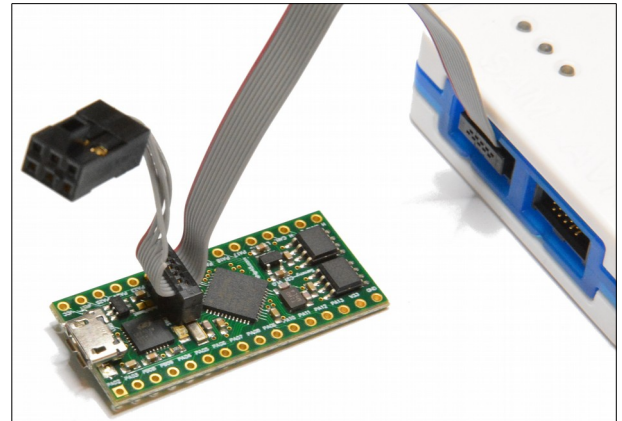
The ATMEL-ICE is available in our online shop:

sam_arm_cortex_avr_atmega_xmega_swd_isp_pdi_jtag_programmer_debugger.php

Software Development

Atmel Studio 7

Atmel Studio 7 is the integrated development platform (IDP) for developing and debugging all AVR® and SAM microcontroller applications. The Atmel Studio 7 IDP gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code. It also connects seamlessly to the debuggers, programmers and development kits that support AVR and SAM devices.

Additionally, Studio includes Atmel Gallery, an online app store that allows you to extend your development environment with plug-ins developed by Microchip as well as third-party tool and embedded software vendors. Studio 7 can also seamlessly import your Arduino sketches as C++ projects, providing a simple transition path from Makerspace to Marketplace.

See http://www.microchip.com/development-tools/atmel-studio-7 for details and free download.

Features

- Support for 500+ AVR and SAM devices

- Vast source code library, including drivers, communication stacks, 1,600+ project examples with source code, graphic services and touch functionality through Advanced Software Framework (ASF)

- IDE extensions through Atmel Gallery, the online apps store, for development tools and embedded software from Microchip and third parties

- Tune capacitive touch designs, validate system performance, monitor power consumption, and real-time data and trace graphing with Atmel QTouch Composer

- Configure and test the performance of wireless designs with the Wireless Composer running on the target

- Write and debug C/C++ and assembly code with the integrated compiler

- Advanced debugging features include complex data breakpoints, nonintrusive trace support (SAM3 and SAM4 devices), statistical code profiling, interrupt trace/monitoring, polled data tracing (Cortex-M0+ devices), real-time variable tracking with optional timestamping.

- Integrated editor with visual assist

- Project wizard allowing projects created from scratch or from a large library of design examples

- In-system programming and debugging provides interface to all Atmel in-circuit programmers and debuggers

- Create transparent debug views into CPU and peripherals for easy code development and debugging

- Full chip simulation for an accurate model of CPU, interrupts, peripherals, and external stimuli

Atmel START

Another starting point for Atmel SAM software development is Atmel START - an online tool, which will help you select and configure software components and tailor your embedded application in a usable and optimized manner.

To get started you can either create a new project from scratch or open an existing example. In both cases you can configure your software components and device settings such as clocks and pin layout. When you are done, you can export your project and open it using your favourite IDE for further development.
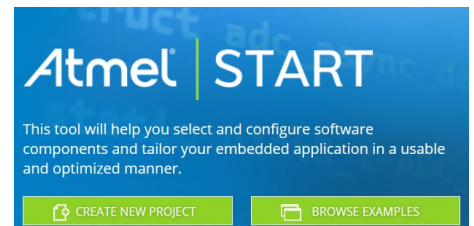
For more informations and video tutorials, see http://start.atmel.com/.

Operating Characteristics

The following table shows the main characteristics for reference. Always refer to the components data sheets for detailed description of electrical and thermal characteristics.

Symbol	Parameter	Condition	Min	Typ	Max	Units
Vcc	External Supply Voltage		3.7		5.5	V
V33	Internal Supply Voltage			3.3		V
Icc	Power Supply Current (Icc strongly depends on MCU activity, like frequency, power saving modes, etc. as well as external circuitry, io pin input and output current, etc. The values denoted here are for reference only and can differ from final application vallues.	MCU ACTIVE	80		173	µA/Mhz
		MCU IDLE		13		µA/Mhz
		MCU STANDBY	1.2		3.3	µA
		MCU BACKUP		0.4		µA
T	Operating Temperature		-40		+85	°C

Pinout and Dimensions

Check ATSAML21G18B data sheet for mapping of the MCU peripherals to GPIO signals.
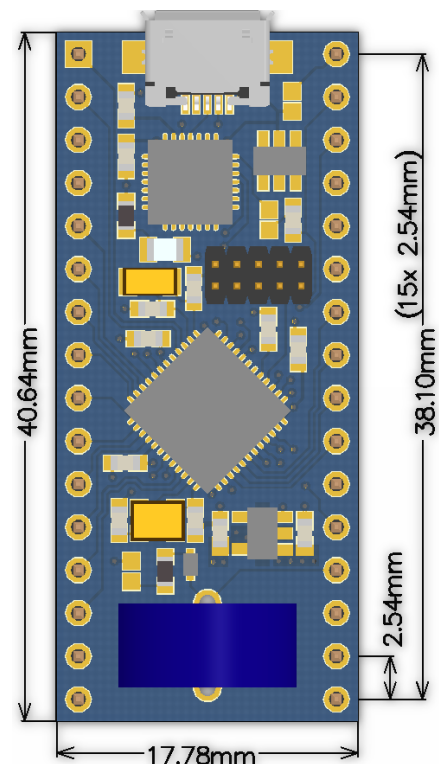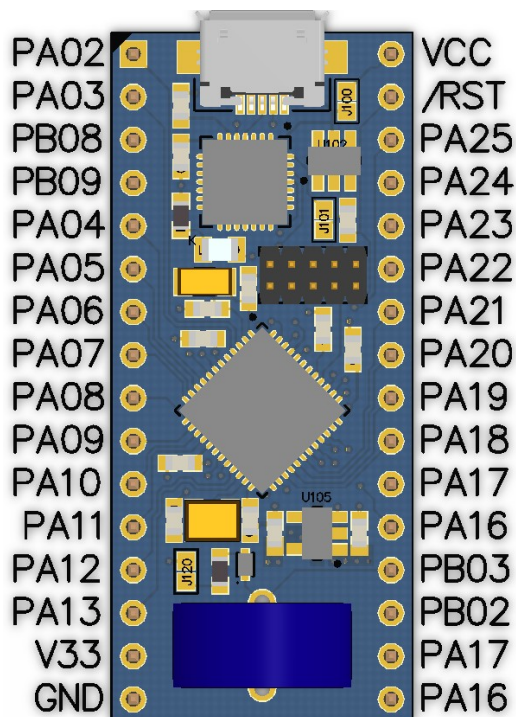
Design and Handling Precautions

This module – just like any other semiconductor devices – is susceptible to damage by ESD. Suitable precautions should be taken when handling and transporting devices. The possible damage to devices depends on the circumstances of the handling and transporting, and the nature of the device. The extent of damage can vary from immediate functional or parametric malfunction to degradation of function or performance in use over time. Devices suspected of being affected should be replaced.

Module Schematics
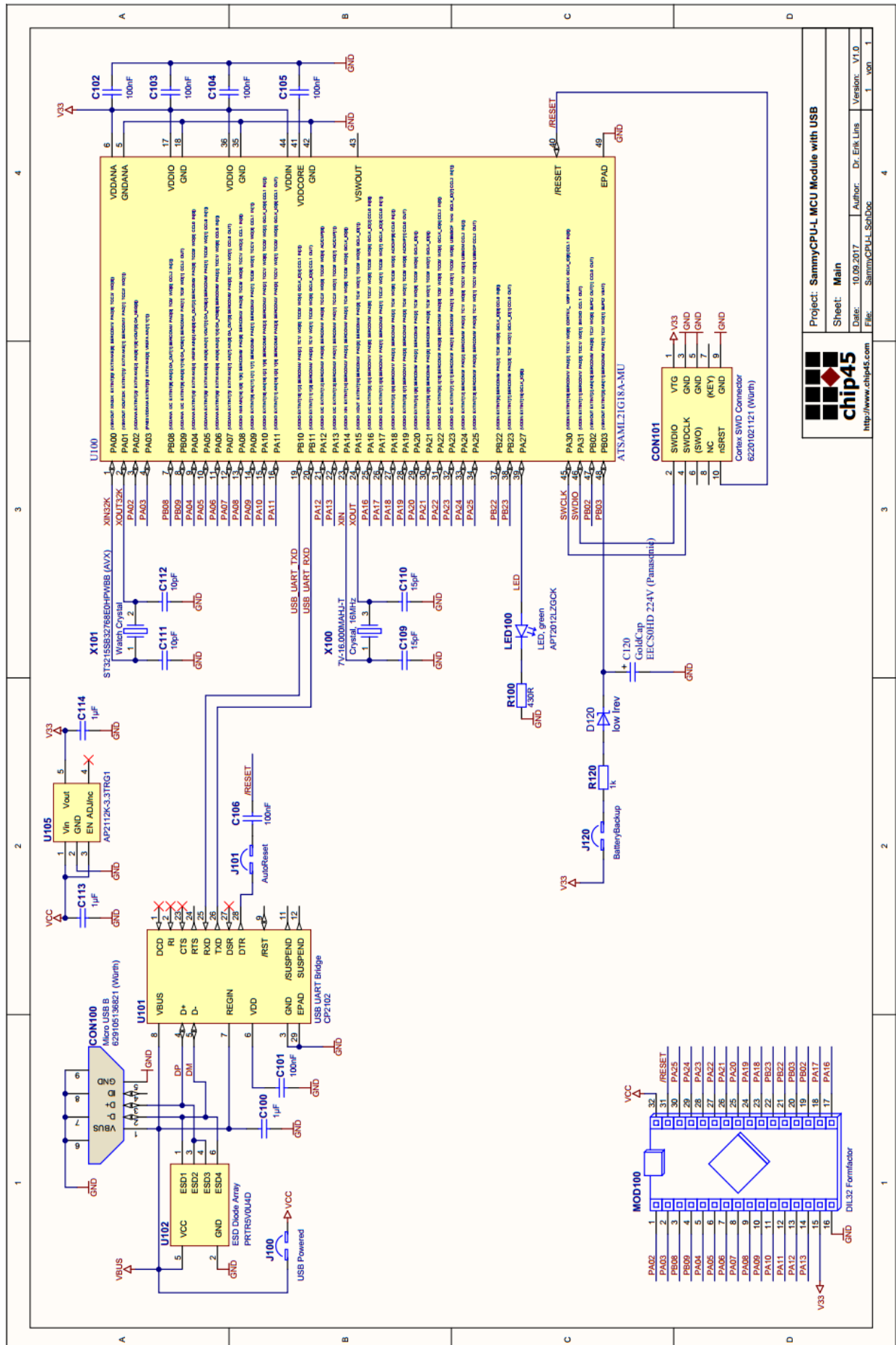
Project: SammyCPU-L MCU Module with USB
Sheet: Main
Date: 10.09.2017   Author: Dr. Erik Lins
File: SammyCPU-L_SchDoc
Version: V1.0
1 von 1

http://www.chip45.com

Declaration of Electro Magnetic Conformity of the CHIP45 „Sammy-L21"

CHIP45 embedded microcontroller modules (henceforce products) are designed for installation in electrical appliances or as dedicated evaluation boards (i.e.: for use as a test and prototype platform for hardware/software development) in laboratory environments.

CE

Caution:

CHIP45 products lacking protective enclosures are subject to damage by ESD and, hence, may only be unpacked, handled or operated in environments in which sufficient precautionary measures have been taken in respect to ESD-dangers. It is also necessary that only appropriately trained personnel (such as electricians, technicians and engineers) handle and/or operate these products. Moreover, CHIP45 products should not be operated without protection circuitry if connections to the product's pin header rows are longer than 3m.

CHIP45 products fulfill the norms of European Union's Directive for Electro Magnetic Conformity only in accordance to the descriptions and rules of usage indicated in this document (particularly in respect to the pin header row connectors, power connector and serial interface to a host-PC).

Implementation of CHIP45 products into target devices, as well as user modifications and extensions of CHIP45 products, is subject to renewed establishment of conformity to, and certification of, Electro Magnetic Directives. Users should ensure conformance following any modifications to the products as well as implementation of the products into target systems.

DISCLAIMER

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