Sammy-D21 Infosheet

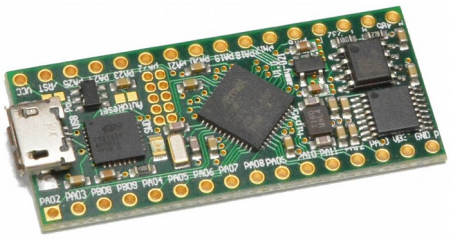
OEM module with Atmel/Microchip ATSAMD21 processor, USB UART, RS232 and RS485.

Available Options

Module	Processor	Flash	RAM	Peripherals on Module
Sammy-D21 V1.0	SAMD21G18A-MU	256kB	32k	- 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
Sammy-D21 V1.0 Plus	SAMD21G18A-MU	256kB	32k	like above plus - RS232 and RS485 transceivers

Note: In this document, the term Sammy-D21 refers to both Sammy-D21 and -D21 Plus. Differences are named explicitely.

Module Overview



The Sammy-D21 module comes in a standard DIL32 form factor. Based on Atmel/Microchip's SAMD21G18A 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. For standard control and monitoring applications, the Sammy-D21 Plus version provides both an RS232 and RS485 transceiver, thus allowing direct connection to serial busses. For simple host PC connection a USB UART converter with micro USB connector is present. Further components are 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 SAMD21G18A provides a powerful Cortex-M0+ CPU running at up to 48MHz, 256kB flash memory, 8kB flash for EEPROM emulation, 32kB SRAM main memory plus an extensive set of microcontroller peripherals (see table right). For a full description of the SAMD21G18A plus data sheet and comprehensive application notes, see the following link:

http://www.microchip.com/wwwproducts/en/ATSAMD21G18

Parameter Name	Value
Family	SAM D21
Max Speed MHz	48
Program Memory Size (KB)	256
RAM (KB)	32
Auxiliary Flash (KB)	0.064
Temperature Range (C)	-40 to 85
Operating Voltage Range (V)	1.62 to 3.63
DMA Channels	12
SPI™	6
I²C™ Compatible	6
Peripheral Pin Select (PPS) Crossbar	Yes
USB	1
USB Interface	Host, Device
A/D channels	14
Max A/D Resolution	12
Max A/D Sample Rate (KSPS)	350
Input Capture	6
Motor Control PWM Channels	6
16-bit Digital Timers	5
Parallel Port	GPIO
Comparators	2
Internal Oscillator	32khz, 32Khz ULP, 8Mhz
RTCC	Yes
I/O Pins	38
Pin Count	48

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

RS232 and RS485 Interface

The Sammy-D21 Plus provides an industry standard MAX3221 full-duplex RS232 transceiver and a half-duplex RS485 transceiver. For detailed information about the devices, see the following links:

http://www.ti.com/lit/ds/symlink/max3221.pdf, https://www.exar.com/content/document.ashx?id=643

The RS232 TXD/RXD and RS485 A/B signals are available on the 16 pin expansion headers, see „Pinout and Dimensions“ for location. These signals are only available on the Sammy-D21 Plus version.

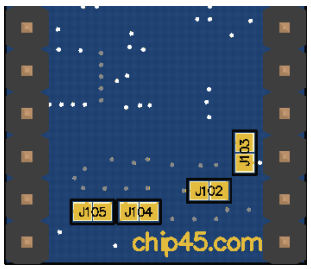
Transceiver Control Signals

The RS232 transceiver can be forced into 1µA standby mode by driving PA30 to high. For normal operation PA30 must be set to low.

Since the RS485 bus is half-duplex, the driver enable and receiver enable signals are tied together and must be controlled from the MCU during operation. Driving PA27 to high enables sending through RS485, while setting PA27 to low enabled reception.

Using the RS232/RS485 related GPIOs on the non-Plus version

On the non-Plus version, the four RS232/RS485 related GPIO signals can be routed to the expansion header, by closing four solder jumpers on the bottoms side of the module. See picture right for location of the jumpers. This gives access to four addition GPIOs PA16/17 and PB10/11. See „Pinout and Dimension“ for location of the signals.



Clock Options

The SAMD21G18A 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 SAMD21G18A 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 ATSAMD21G18A microcontroller. Driving this pin to high will turn on the LED.

Power Supply

The Sammy-D21 module operates from 3.7V to 5.5V (4.5V to 5.5V for Plus version) through VCC pin or from USB bus power (see „Configuration Jumpers“ for details). This voltage directly powers the RS485 transceiver of the Plus version. The remaining parts of the module, including RS232, 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-D21. 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.

Note 1: The LDO could in principle operate on a VCC voltage from ~3.7V to 6.0V to generate a proper 3.3V output voltage, but since the RS485 transceiver is operated from VCC directly, its power supply voltage range applies to the whole Plus module.

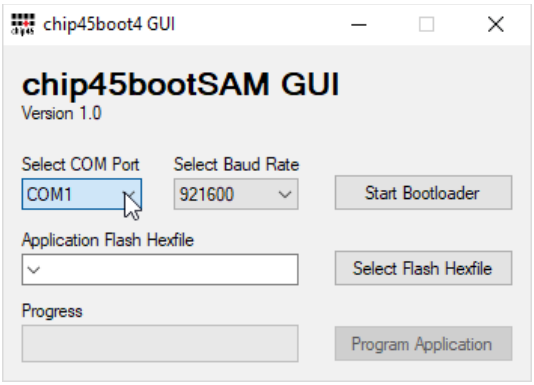
External 3.3V Supply

For the non-Plus version 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!

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.

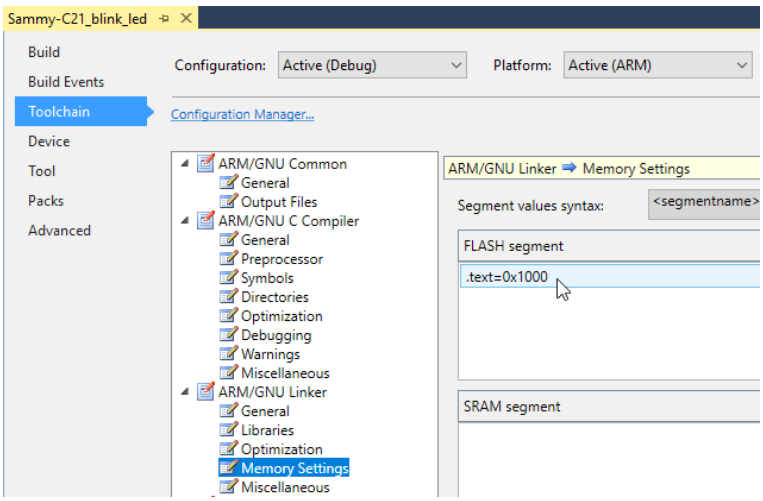
The picture right shows a screenshot of the GUI. Select the proper COM port, do not change the baudrate setting, since it is fixed set to 921600 baud in the bootloader and press „Start Bootloader“. If J101 is set, the GUI will reset the target, bootloader will start and will connect to the GUI. If connection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

```
:10100000682000202D110000291100002911000086
:10101000000000000000000000000000000000D0
```

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

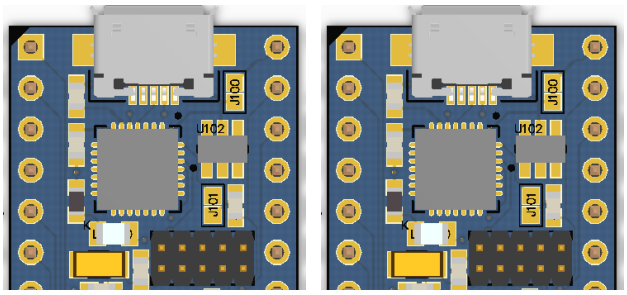
Configuration Jumpers

The Sammy-D21 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.

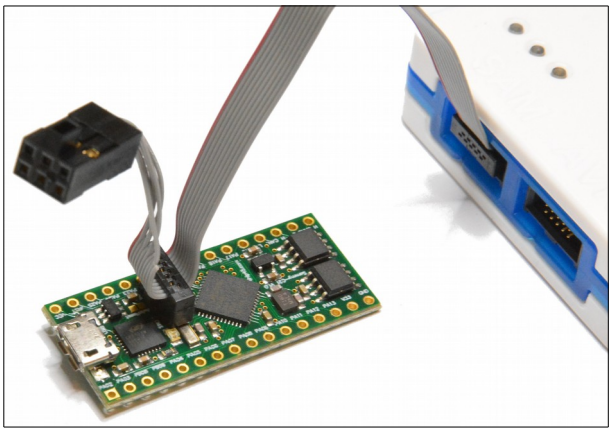
See picture right for location of the two jumpers.



Programming and Debugging

The Sammy-D21 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-D21 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-D21 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.

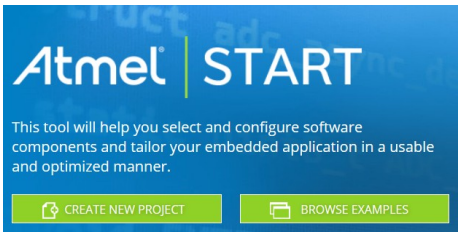
Additionally, Studio includes Atmel Gallery, an online app store that allows you to extend your development environment with plug-ins developed by Microchip as well as third-party tool and embedded software vendors. Studio 7 can also seamlessly import your Arduino sketches as C++ projects, providing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

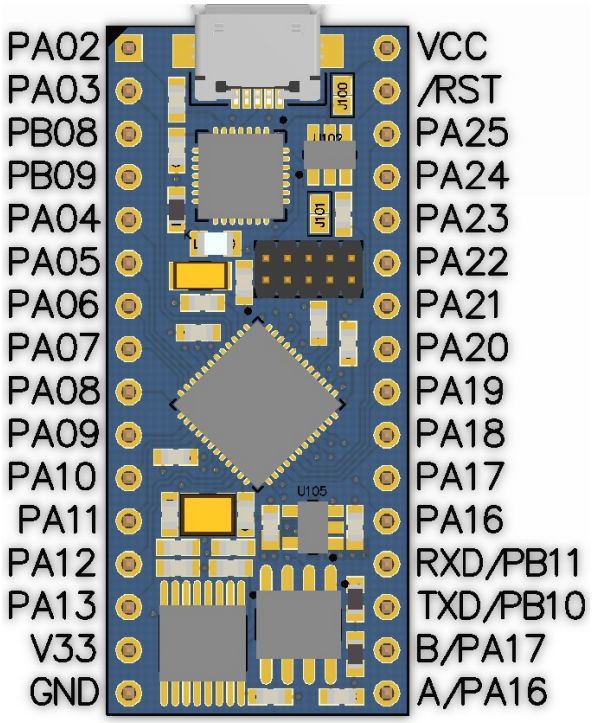
Operating Characteristics

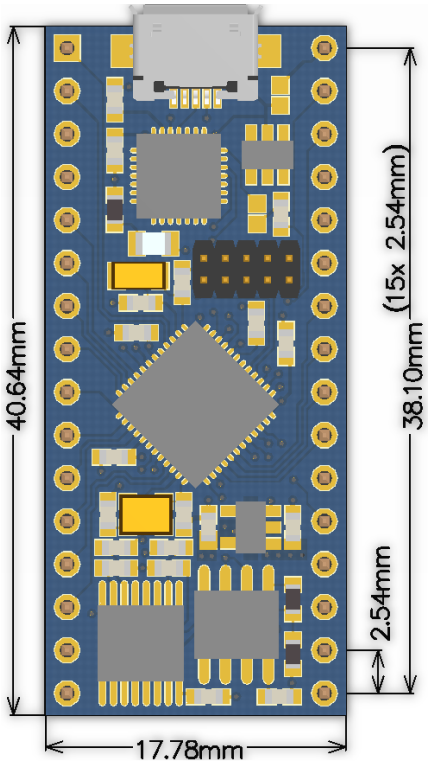
The following table shows the main characteristics for reference. Always refer to the components data sheets for detailed description of electrical and thermal characteristics.

Symbol	Parameter	Condition	Min	Typ	Max	Units
Vcc	External Supply Voltage	D21	3.7		5.5	V
		D21 Plus w. RS485	4.5	5.0	5.5	
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	3.7	5.0	5.8	mA
		MCU IDLE	1.3		2.6	mA
		RS232 active		t.b.d.		mA
		RS485 active (50 Ohm load)		40		mA
T	Operating Temperature		-40		+85	°C

Pinout and Dimensions

Check ATSAMD21G18A data sheet for mapping of the MCU peripherals to GPIO signals.

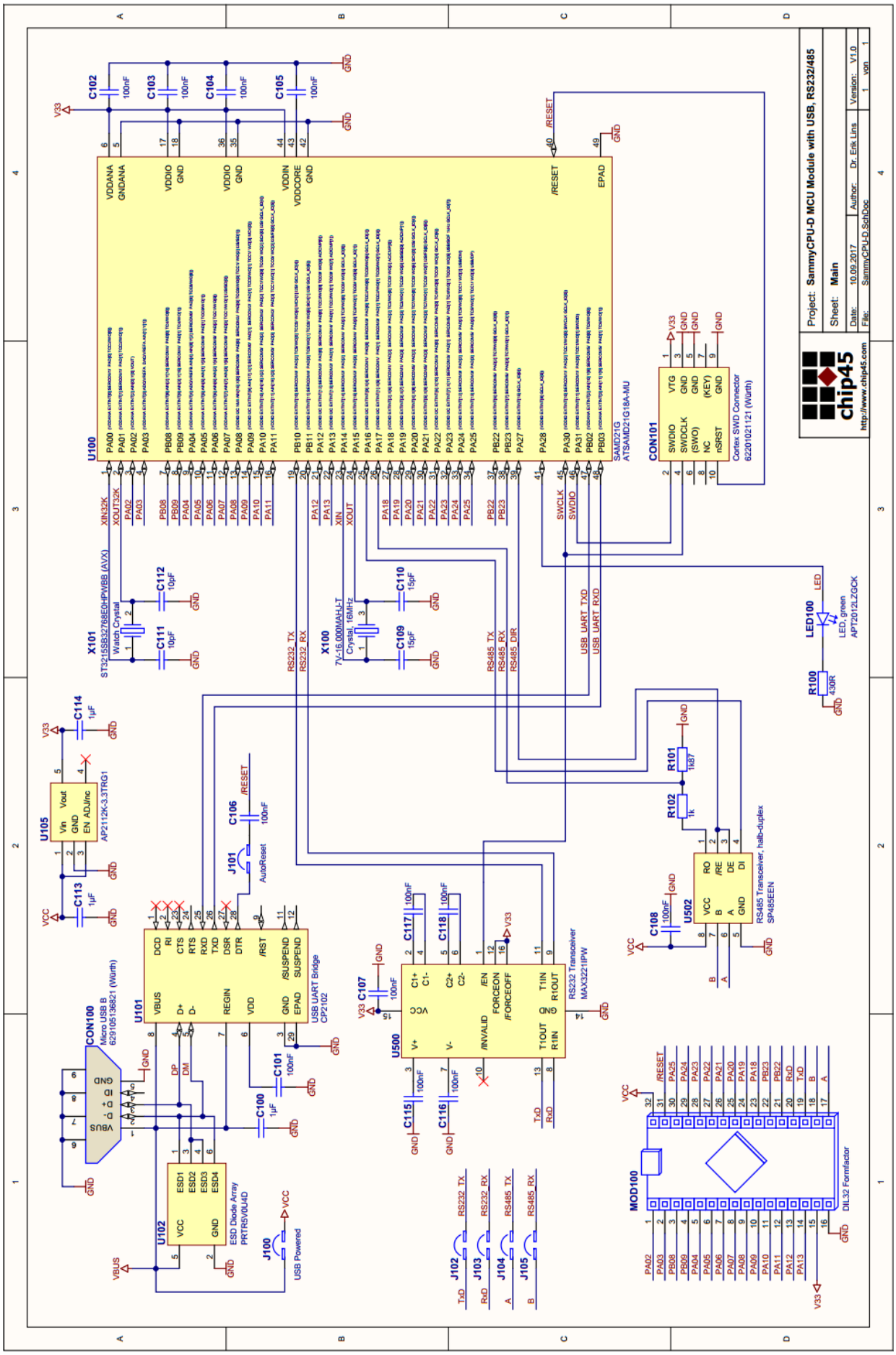




Design and Handling Precautions

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



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CE

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