SMART ARM-based Microcontrollers

ATSAMC21MOTOR

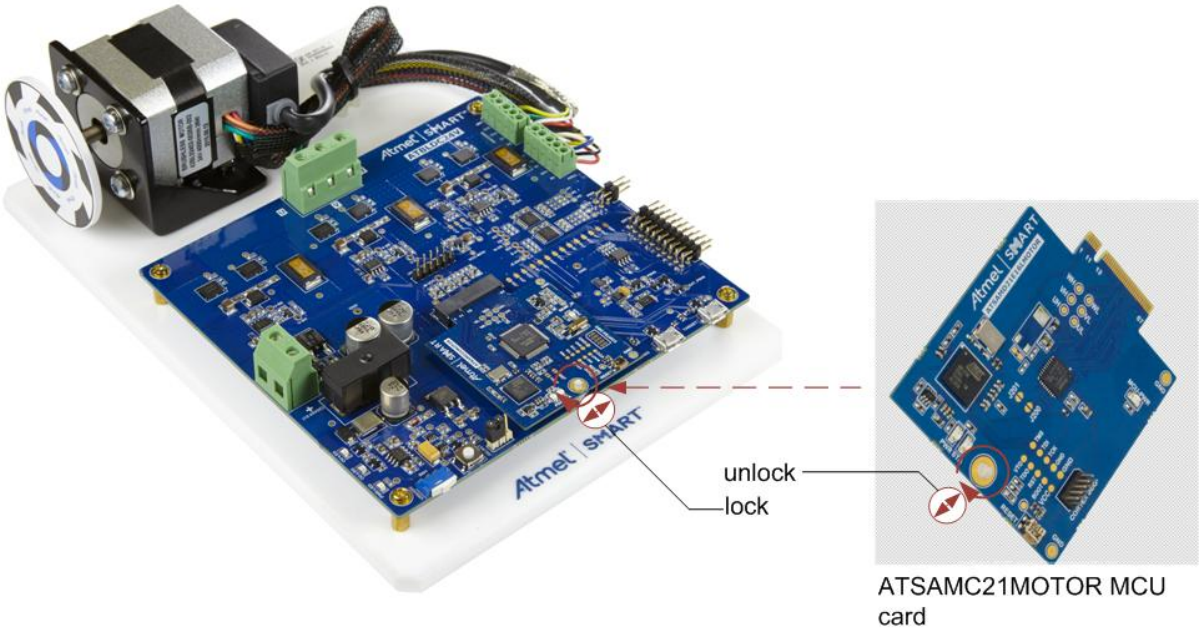
USER GUIDE

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1. ATSAMC21 Microcontroller Card for Atmel Motor Control Starter Kit

The ATSAMC21J18A is an MCU card for Atmel® Motor control starter kits. The hardware has the Atmel | SMART ARM®-based MCU, ATSAMC21J18A, with integrated on-board debug support. The MCU card can be directly used with the ATSAMBLDCHV-STK® high voltage motor control kit and the currently available ATSAMD21BLDC24V-STK, a low voltage BLDC, PMSM motor control starter kit. The kit contains a driver board hardware with half-bridge power MOSFET drivers, current and voltage sensing circuit, Hall, and Encoder interface, fault protection circuits, etc. Supported by the Atmel studio integrated development platform, the kit provides easy access to the features of ATSAMC21J18A MCU and explains how to integrate the device in a custom motor control application. Plug-able MCU cards are available from Atmel, supporting other SMART ARM MCUs.



2. ATSAMC21MOTOR Features

ATSAMC21MOTOR has the following features:

The same port pins are multiplexed between multiple functionalities. PFC, CAN, QTouch®, etc. interfaces are supported only in ATSAMBLDCHV-STK hardware as indicated below.

- Debug support using on-board Atmel EDBG device
- TCC PWM signals for three-phase half-bridge drive
- ADC channels for common shunt and individual shunt phase current sensing
- ADC channels for motor BEMF sensing
- TCC PWM signals for PFC hardware drive (High Voltage kit)
- ADC channels for PFC current sensing (High Voltage kit)
- AC channels for BEMF signals (Low Voltage kit)
- EXTINT hall sensor interface
- EXTINT encoder sensor interface
- PTC QTouch Interface signals (High Voltage kit)
- CAN interface (High Voltage kit)
- Atmel Xplained PRO extension signals support (Low Voltage kit)
- Communication and Power status LEDs

3. ATSAMC21MOTOR Kit Content

ATSAMC21MOTOR Kit contains an ATSAMC21J18A MCU card that is pre-programmed with hall sensor based block commutation firmware for the ATSAMD21BLDC24V-STK setup. A quick start guide can be found in the **ATSAMBLDC24V-STK User quide** for Atmel Low voltage BLDC motor control kit. A nylon snap lock is attached to the MCU card that can be rotated to attach the card to the Driver base board in ATSAMD21BLDC24V-STK.

Figure 3-1. ATSAMC21MOTOR Kit Content



4. Design Documentation and Relevant Links

The following list contains links to the most relevant documents and software for ATSAMC21MOTOR:

- **ATSAMC21MOTOR** - Product page.
- **ATSAMC21MOTOR User Guide** - PDF version of this User Guide.
- **ATSAMD21BLDC24V-STK** - Product page.
- **ATSAMBLDC24V-STK User guide** - User guide for Atmel Low voltage BLDC motor control kit. It contains the quick start guide instructions and driver board descriptions.
- **ATSAMD21BLDC24V-STK Design Documentation** - Package containing schematics, BOM, assembly drawings, 3D plots, layer plots, etc.
- **Atmel Studio** - Free Atmel IDE for development of C/C++ and assembler code for Atmel microcontrollers.
- **EDBG User Guide** - User guide containing more information about the on-board Embedded Debugger.
- **Atmel Data Visualizer** - Atmel Data Visualizer is a program used for processing and visualizing data. Data Visualizer can receive data from various sources such as the Embedded Debugger Data Gateway Interface found on Xplained Pro boards and COM ports.
- **Xplained Pro products** - Atmel Xplained Pro is a series of small-sized and easy-to-use evaluation kits for Atmel microcontrollers and other Atmel products. It consists of a series of low-cost MCU boards for evaluation and demonstration of features and capabilities of different MCU families.
- **ATSAMC21MOTOR** - MCU datasheet.

5. ATSAMC21J18A MCU Board

The main components on the ATSAMC21MOTOR MCU card are highlighted in the PCB and in the block diagram given below.

Figure 5-1. MCU Board PCB

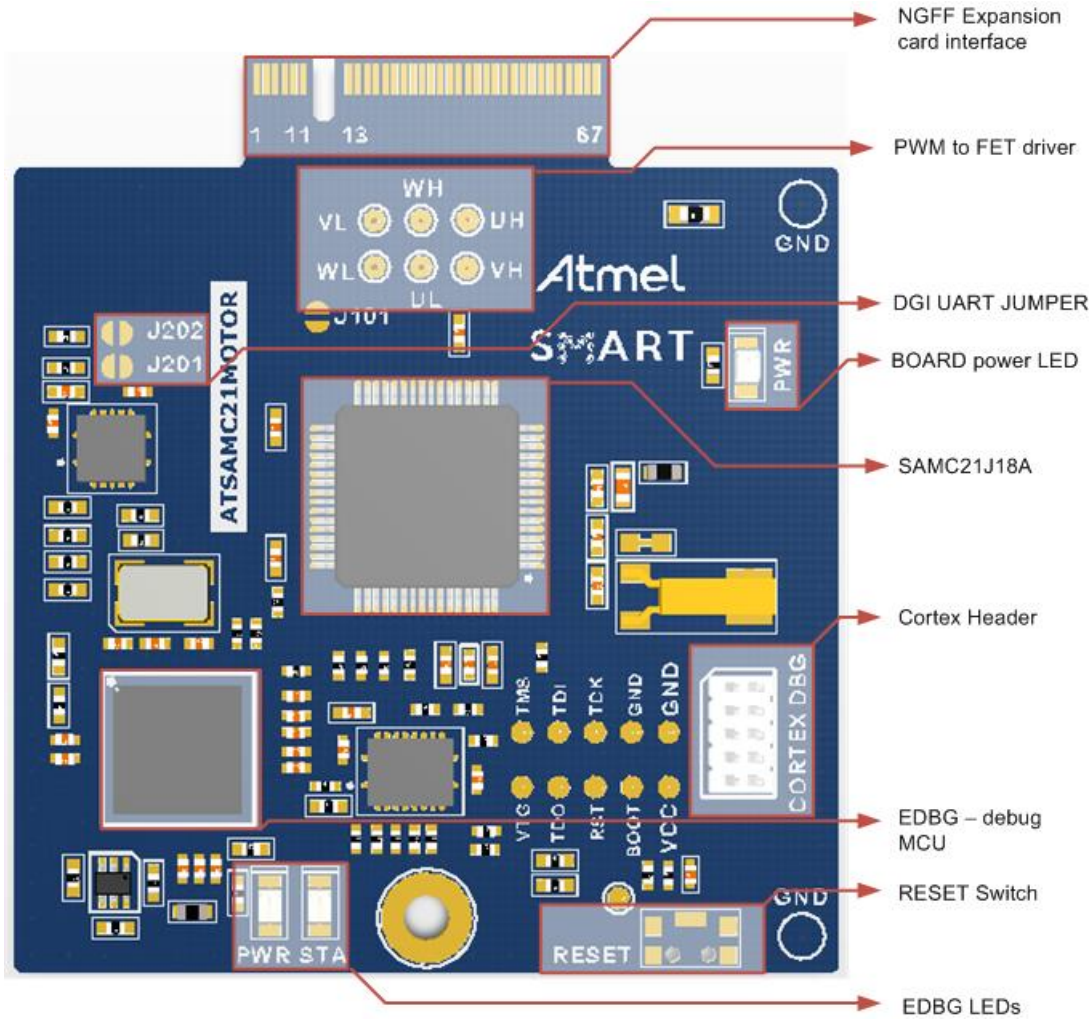
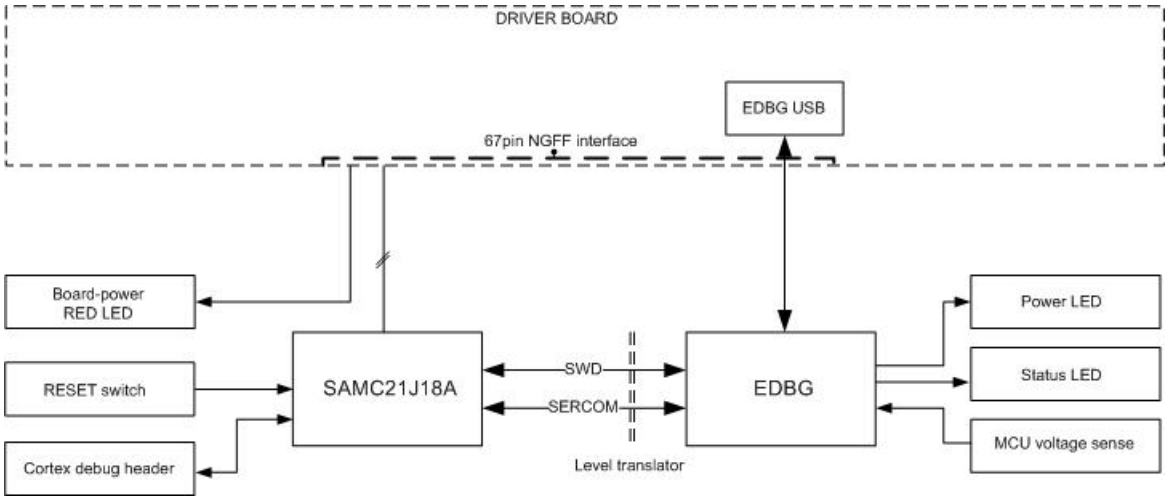


Figure 5-2. MCU Board Block Diagram



5.1. Power Supply

The ATSAMC21J18A MCU takes 5VDC supply from the 67-pin edge connector. The EDBG debug MCU operates on a 3.3VDC supply from the same edge connector. The power supply selection jumper on the Driver board (ATSAMBLDCHV-STK and ATSAMBLDC24V-STK) should be connected to 5V (silk screen text) selection.

5.2. Main MCU Circuit

The ATSAMC21MOTOR has an ATSAMC21 device. The device is intended to work with the MCU internal clock source. An external reset switch is connected to the MCU RESET pin.

5.3. Embedded Debugger

The ATSAMC21J18A MCU is interfaced to the EDBG debug device. The EDBG uses SWD interface for programming and debugging the main MCU. A debug header is also provided on the MCU board with ARM Cortex® debug pinout. An external debugger can be connected to this debug port.

The DGI is a proprietary communication interface used by the Atmel Data Visualizer software to communicate with the development kits through the EDBG. The SERCOM5 of the ATSAMC21J18A connected to the EDBG device, supports the DGI SPI interface and uses the Atmel ADP protocol. The MCU SERCOM5 is also connected to the UART channel of the EDBG through a pair of "normally open" jumpers; J201 and J202. Shorting these jumpers will enable the CDC UART interface for the main MCU.

High Speed USB port of the EDBG is accessible at the driver board. EDBG USB enumerates as a composite device supporting debug, DGI SPI, and CDC interfaces.

5.4. 67-pin MCU-DRIVER Board Interface

MCU pins are connected to the 67-pin interface header as given in the table below. The MCU card can be used with the Motor control driver kits from Atmel. The table given below describes the interface with Atmel low voltage motor control starter kit. Signals indicated by "||" are jumper connected pins that share directly connected functionality. The normally-open jumper needs to be shorted in the PCB in order to access these additional features.

Table 5-1. ATSAMBLDC24V-STK and ATSAMC21J18A MCU Card Interface (67 pin NGFF connector) Description

PIN	LV INTERFACE Name	LV DRIVER BOARD function	SAM C21 PIN	SAM C21 function
1	EDBG USB HSP	EDBG USB	EDBG_USB_HS_P	EDBG_USB_HS_P
2	NC	NC	PA24	CAN TX
3	EDBG USB HSN	EDBG USB	EDBG_USB_HS_N	EDBG_USB_HS_N
4	EDBG ID2	EDBG_ID2/EXT1_1	EDBG PB01	EDBG ID2
5	NC	NC	PA25	CAN RX
6	EDBG ID1	EDBG_ID1	EDBG PA28	EDBG_ID1
7	MCU USB DP	TARGET_USB_HS_P	NC	NC
8	TARGET USB VBUS	VCC_TARGET_USB_P5V0	NC	NC
9	MCU USB DN	TARGET_USB_HS_N	NC	NC
10	EDBG USB VBUS	VCC_EDBG_USB_P5V0	VCC_EDBG_USB_P5V0	VCC_EDBG_USB_P5V0
11	TARGET_USB_ID	TARGET_USB_ID	NC	NC
12	TEMP SDA	TWI_SDA, EXT1_11	PA22	SERCOM3(PAD0)
13	TEMP SCL	TWI_SCL, EXT_12	PA23	SERCOM3(PAD1)
14	FLASH SS	SPI_SS	PB13	SERCOM4(PAD1)
15	FLASH MISO	SPI_MISO, EXT1_17	PB12	SERCOM4(PAD0)
16	FLASH SCK	SPI_SCK, EXT1_18	PB15	SERCOM4(PAD3)
17	FLASH MOSI	SPI_MOSI, EXT1_16	PB14	SERCOM4(PAD2)
18	MCU GPIO1	EXT1_7(GPIO1)	PA19	PTC(X5)
19	MCU GPIO2	EXT1_8(GPIO2)	PB03	TC6(W1)
20	MCU GPIO3	EXT_3	PA02	ADC0(AIN0)
21	MCU GPIO4	NC(GPIO4)	PB22	TC7(WO0)
22	MCU GPIO5	EXT1_5(GPIO5)	PB31	GPIO
23	MCU GPIO6	EXT1_6(GPIO6)	PA17	EXTINT1
24	MCU GPIO7	Temp_Alert(GPIO7)	PA27	EXTINT15
25	OCP	OCP(GPIO8)	PA03	ADC0(AIN1)
26	EXT1 RXD	UART RXD_ EXT1_13	PB17	SERCOM5(PAD1)
27	EXT1 TXD	UART TXD_EXT1_14	PB02	SERCOM5(PAD0)
28	PWM UH	FET Driver	PB30	TCC0(WO0)
29	PWM UL	FET Driver	PA14	TCC0(WO4)

30	PWM VH	FET Driver	PA05	TCC0(WO1)
31	PWM VL	FET Driver	PA15	TCC0(WO5)
32	PWM WH	FET Driver	PA10	TCC0(WO2)
33	PWM WL	FET Driver	PA16	TCC0(WO6)
34	MCU_GPIO8 (ISENSE_COMMON)	EXT_15	PB05	ADC1(AIN7)
35	ATA RESET	EXT1_4(GPIO10)	PB16	GPIO
36	ATA WD	EXT1_10(GPIO11)	PA12	TCC2(WO0)
37	ATA SLEEP	EXT1_9(GPIO12)	PA13	TCC2(WO1)
38	USHUNT_ADC	Current sense	PB08	ADC0(AIN2)
39	VSHUNT_ADC	Current sense	PB09	ADC0(AIN3)
40	WSHUNT_ADC	Current sense	PA08	ADC0(AIN8)
41	MOTOR VDC (V SENSE)	MOTOR_ADC	PA09	ADC0(AIN9)
42	BEMF U_ADC	BEMF sense ADC	PB00	ADC1(AIN0)
43	BEMF V_ADC	BEMF sense ADC	PB01	ADC1(AIN1)
44	BEMF_W_ADC	BEMF sense ADC	PB06	ADC1(AIN8)
45	BEMF UP	BEMD sense AC	PA04	ADC0(AIN4)
46	BEMF UN	BEMD sense AC	PB07	ADC1(AIN9)
47	BEMF VP	BEMD sense AC	PA06	ADC0(AIN6)
48	BEMF VN	BEMD sense AC	NC	NC
49	BEMF WP	BEMD sense AC	PA07	ADC0(AIN7)
50	BEMF WN	BEMD sense AC	NC	NC
51	HALL1	Hall interface	PB11	EXTINT11
52	HALL2	Hall interface	PB04	EXTINT4
53	HALL3	Hall interface	PA28	EXTINT8
54	HALL TRX OE	HALL_TRX_OE	NC	NC
55	ENCODER_A	Encoder Interface	PA18	EXTINT2
56	ENCODER_B	Encoder Interface	PB10	EXTINT10
57	ENCODER_Z	Encoder Interface	PB23	EXTINT7
58	ENCODER_EN	ENCODER EN	NC	NC
59	NC	NC	VCC_P3V3	VCC_P3V3
60	MCU BRAKE	NC	PA11	TC1(WO1)
61	NC	NC	VCC-P3V3	VCC_P3V3

62	3V3 SUPPLY for MCU	VCC_P	VCC_TARGET_P5V0	VCC_TARGET_P5V0
63	3V3 SUPPLY for MCU	VCC_P	VCC_TARGET_P5V0	VCC_TARGET_P5V0
64	GND	GND	GND	GND
65	GND	GND	GND	GND
66	GND	GND	GND	GND
67	GND	GND	GND	GND

6. Product Compliance

RoHS and WEEE

The Atmel ATSAMC21MOTOR and its accessories are manufactured in accordance to both the RoHS Directive (2002/95/EC) and the WEEE Directive (2002/96/EC).

CE and FCC

The Atmel ATSAMC21MOTOR unit has been tested in accordance to the essential requirements and other relevant provisions of Directives:

- Directive 2004/108/EC (class B)
- FCC rules part 15 subpart B

The following standards are used for evaluation:

- EN 61326-1 (2013)
- FCC CFR 47 Part 15 (2013)

The Technical Construction File is located at:

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Atmel Norway
Vestre Rosten 79
7075 Tiller
Norway
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Every effort has been made to minimize electromagnetic emissions from this product. However, under certain conditions, the system (this product connected to a target application circuit) may emit individual electromagnetic component frequencies which exceed the maximum values allowed by the above-mentioned standards. The frequency and magnitude of the emissions will be determined by several factors, including layout and routing of the target application with which the product is used.

7. Identifying Product ID and Revision

The revision and product identifier of the ATSAMC21MOTOR can be found by looking at the sticker on the bottom side of the PCB. The identifier and revision are printed in plain text as A09-nnnn\rr, where nnnn is the identifier and rr is the revision. Also the label contains a 10-digit unique serial number.

The product identifier for ATSAMC21MOTOR is A09-2550.

8. Revision

Kit assembly revision for initial version is A09-2550/03. Known issues in this revision are:

- PWM silk text for WH and UH are swapped

9. Document Revision History

Doc. rev.	Date	Comment
42747A	09/2016	Initial document release



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