SMART ARM-based Microcontrollers

ATSAMD21E16LMOTOR

USER GUIDE

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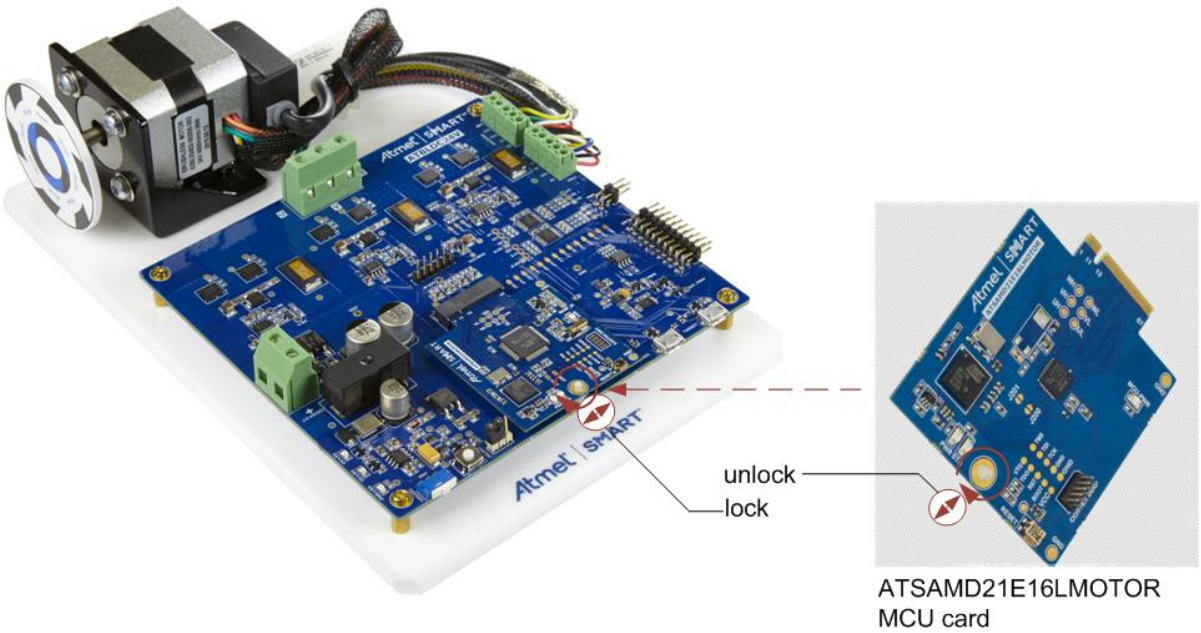
1. ATSAMD21E16L Microcontroller Card for Atmel Motor Control Starter Kit

The ATSAMD21E16LMOTOR is an MCU card for Atmel® Motor control starter kits. The hardware has the Atmel | SMART ARM®-based MCU, ATSAMD21E16L, with integrated on-board debug support. The MCU card can be directly used with 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 ATSAMD21E16L 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.



ATSAMD21E16LMOTOR
MCU card

2. ATSAMD21E16LMOTOR Features

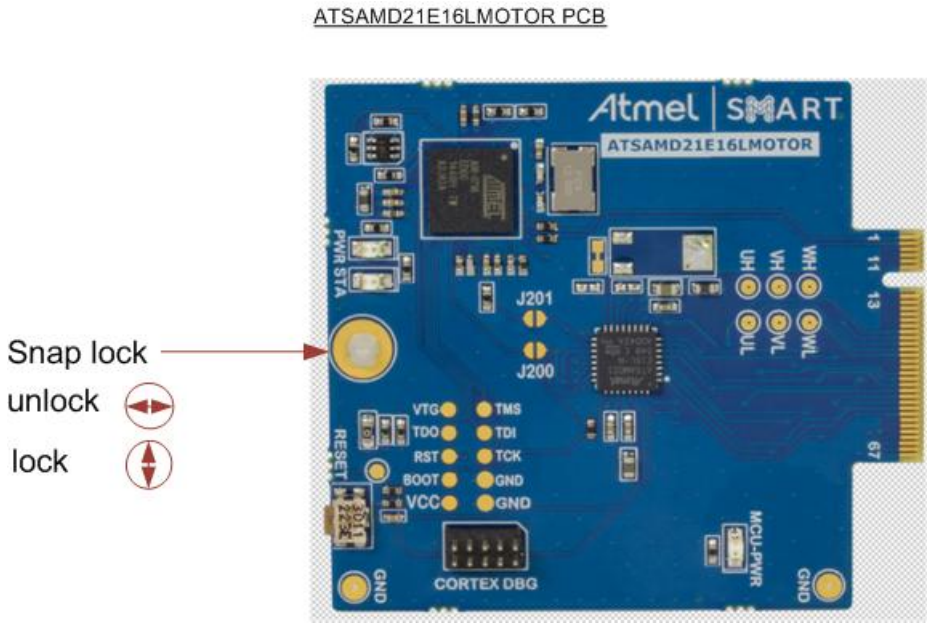
ATSAMD21E16LMOTOR has the following features:

- 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
- AC channels for BEMF signals
- EXTINT hall sensor interface
- EXTINT encoder sensor interface
- Atmel Xplained PRO extension signals support
- Communication and Power status LEDs

3. ATSAMD21E16LMOTOR Kit Content

ATSAMD21E16LMOTOR Kit contains ATSAMD21E16L MCU card that is pre-programmed with hall sensor based block commutation firmware for the ATSAMD21BLDC24V-STK setup. Quick start guide can be found in , **ATSAMBLDC24V-STK User quide** user guide 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. ATSADM21E16LMOTOR Kit Content



4. Design Documentation and Relevant Links

The following list contains links to the most relevant documents and software for ATSAMD21E16LMOTOR:

- **ATSAMD21E16LMOTOR** - Product page.
- **ATSAMD21E16LMOTOR User Guide** - PDF version of this User Guide.
- **ATSAMD21BLDC24V-STK** - Product page.
- **ATSAMBLDC24V-STK User quide** - 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.
- **ATSAMD21E16L** - MCU datasheet.

5. ATSAMD21E16L MCU Board

The main components on the ATSAMD21E16LMOTOR MCU card are highlighted in the PCB and block diagram given below.

Figure 5-1. MCU Board PCB

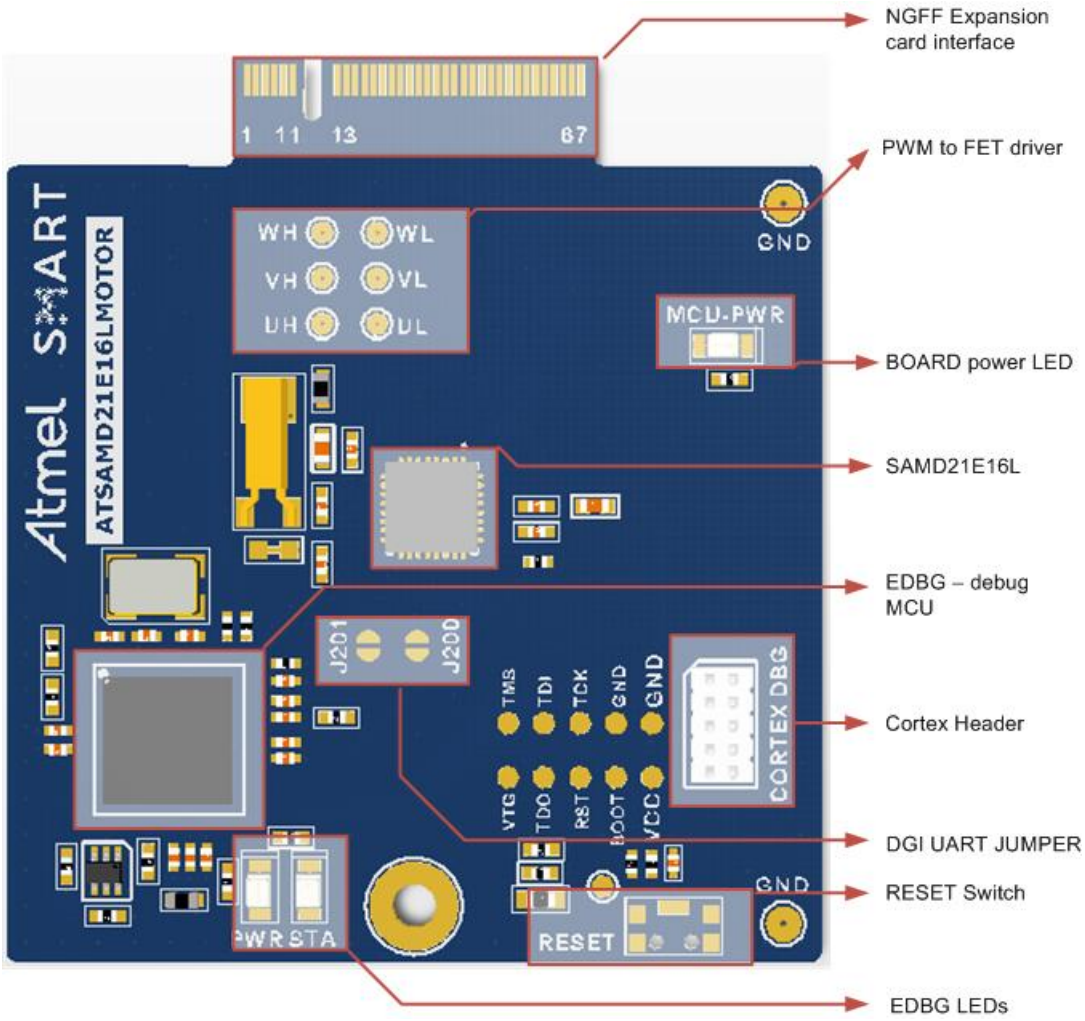
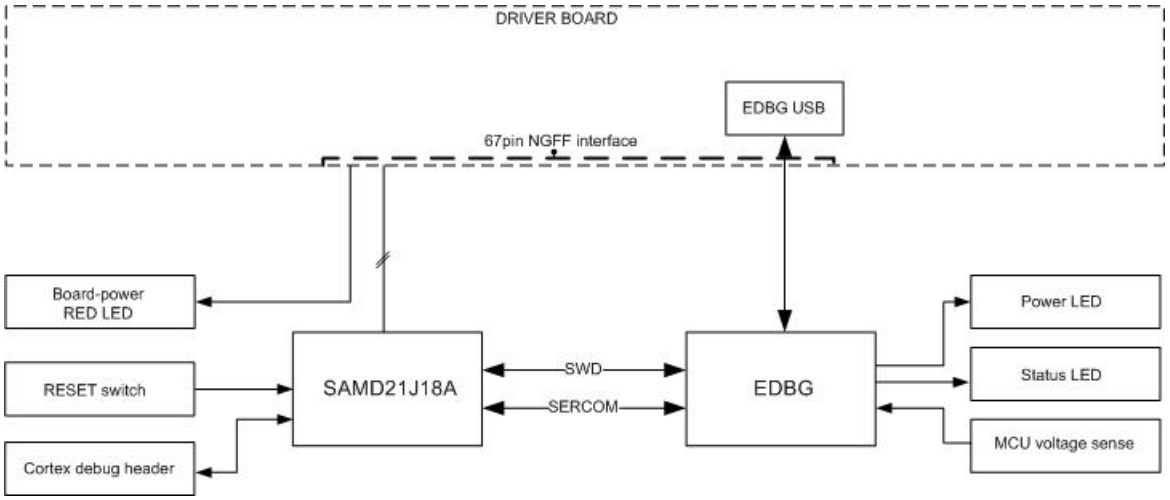


Figure 5-2. MCU Board Block Diagram



5.1. Power Supply

The ATSAMD21E16LMOTOR MCU card takes 3.3VDC supply from the 67-pin edge connector. Both the EDBG device and the Main MCU operates from 3.3VDC. The power supply selection jumper on the Driver board should be connected to 3V3 (silk screen text) selection.

5.2. Main MCU Circuit

The ATSAMD21E16LMOTOR has an ATSAMD21E16L 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 ATSADM21E16L 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 SERCOM3 of the ATSAMD21E16L connected to the EDBG device, supports the DGI SPI interface and uses the Atmel ADP protocol. The MCU SERCOM3 is also connected to the UART channel of the EDBG through a pair of "normally open" jumpers, the J200 and J201. 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.

The USB port of the ATSAMD21J18A is connected to the Micro-USB connecter on the driver board.

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

another 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 driver board, ATSAMD21E16LMOTOR MCU Board Interface

PIN	LV INTERFACE Name	LV DRIVER BOARD function	SAM D21E16L PIN	D21E16L FUNCTION
1	EDBG USB HSP	EDBG USB	EDBG_DPHS	EDBG_USB_HS_P
2	NC	NC	NC	NC
3	EDBG USB HSN	EDBG USB	EDBG_DMHS	EDBG_USB_HS_N
4	EDBG ID2	EDBG_ID2/EXT1_1	EDBG PB01	EDBG ID2
5	NC	NC	NC	NC
6	EDBG ID1	EDBG_ID1	EDBG PA28	EDBG ID1
7	MCU USB DP	TARGET_USB_HS_P	PA25	MCU_USB_P
8	TARGET USB VBUS	VCC_TARGET_USB_P5V0	PA27	MCU USB VBUS SENSE
9	MCU USB DN	TARGET_USB_HS_N	PA24	MCU_USB_N
10	EDBG USB VBUS	VCC_EDBG_USB_P5V0	EDBG A10	EDBG USB VBUS SENSE
11	TARGET_USB_ID	TARGET_USB_ID	NC	NC
12	TEMP SDA	TWI_SDA, EXT1_11	NC	NC
13	TEMP SCL	TWI_SCL, EXT_12	NC	NC
14	FLASH SS	SPI_SS	NC	NC
15	FLASH MISO	SPI_MISO, EXT1_17	NC	NC
16	FLASH SCK	SPI_SCK, EXT1_18	NC	NC
17	FLASH MOSI	SPI_MOSI, EXT1_16	NC	NC
18	MCU GPIO1	EXT1_7(GPIO1)	NC	NC
19	MCU GPIO2	EXT1_8(GPIO2)	NC	NC
20	MCU GPIO3	EXT_3	NC	NC
21	MCU GPIO4	NC(GPIO4)	NC	NC
22	MCU GPIO5	EXT1_5(GPIO5)	NC	NC
23	MCU GPIO6	EXT1_6(GPIO6)	NC	NC
24	MCU GPIO7	Temp_Alert(GPIO7)	NC	NC
25	OCP	OCP(GPIO8)	PB03	GPIO
26	EXT1 RXD	UART RXD_ EXT1_13	PA19	SERCOM1(PAD3)
27	EXT1 TXD	UART TXD_EXT1_14	PA18||	SERCOM1(PAD2)
28	PWM UH	FET Driver	PA08	TCC0(WO0)

PIN	LV INTERFACE Name	LV DRIVER BOARD function	SAM D21E16L PIN	D21E16L FUNCTION
29	PWM UL	FET Driver	PA14	TCC0(WO4)
30	PWM VH	FET Driver	PA09	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	PA02||	ADC(AIN0)
35	ATA RESET	EXT1_4(GPIO10)	NC	NC
36	ATA WD	EXT1_10(GPIO11)	NC	NC
37	ATA SLEEP	EXT1_9(GPIO12)	NC	NC
38	USHUNT_ADC	Current sense	PB04||	ADC(AIN12)
39	VSHUNT_ADC	Current sense	PB05||	ADC(AIN13)
40	WSHUNT_ADC	Current sense	PA11	ADC(AIN7)
41	MOTOR VDC (V SENSE)	MOTOR_ADC	PB02	ADC(AIN10)
42	BEMF U_ADC	BEMF sense ADC	PA04	ADC(AIN4)
43	BEMF V_ADC	BEMF sense ADC	PA05	ADC(AIN5)
44	BEMF_W_ADC	BEMF sense ADC	PA06	ADC(AIN6)
45	BEMF UP	BEMD sense AC	PA04 ||	AC0(AIN0)
46	BEMF UN	BEMD sense AC	PA05 ||	AC0(AIN1)
47	BEMF VP	BEMD sense AC	PA06 ||	AC0(AIN2)
48	BEMF VN	BEMD sense AC	PA07 ||	AC0(AIN3)
49	BEMF WP	BEMD sense AC	PB04	AC1(AIN0)
50	BEMF WN	BEMD sense AC	PB05	AC1(AIN1)
51	HALL1	Hall interface	PA03	EXTINT3
52	HALL2	Hall interface	PA02	EXTINT2
53	HALL3	Hall interface	PA07	EXTINT7
54	HALL TRX OE	HALL_TRX_OE	NC	NC
55	ENCODER_A	Encoder Interface	NC	NC
56	ENCODER_B	Encoder Interface	NC	NC
57	ENCODER_Z	Encoder Interface	NC	NC
58	ENCODER_EN	ENCODER EN	NC	NC
59	NC	NC	NC	NC

PIN	LV INTERFACE Name	LV DRIVER BOARD function	SAM D21E16L PIN	D21E16L FUNCTION
60	MCU BRAKE	NC	NC	NC
61	NC	NC	NC	NC
62	3V3 SUPPLY for MCU	VCC_P	3V3 SUPPLY for MCU	3V3 SUPPLY for MCU
63	3V3 SUPPLY for MCU	VCC_P	3V3 SUPPLY for MCU	3V3 SUPPLY for MCU
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 ATSAMD21E16LMOTOR 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 ATSAMD21E16LMOTOR 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 ATSAMD21E16LMOTOR 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 ATSAMD21E16LMOTOR is A09-2684.

8. Revision

Kit assembly revision for initial version is A09-2684/04. There are no known issues in this revision.

9. Document Revision History

Doc. rev.	Date	Comment
42747A	08/2016	Initial document release

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