APPLICATION NOTE

Atmel AVR1014: MC303 Hardware User Guide

Atmel AVR 8-bit Microcontrollers

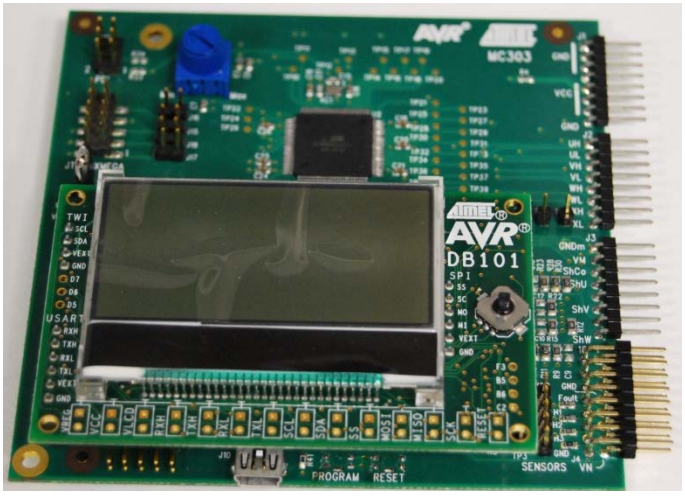
Features

- Motor Control device board for Atmel® ATxmega128A1
- Modular system with 2.54mm pin header connector for power board MC300
- Sensor & sensorless modes capabilities
- Hall sensor header, Potentiometer for motor control
- Headers for Atmel DB101 Display module
- USB interface for PC connection and usage of Atmel Motor Control Center software
- ISP & debug interface for both ATxmega128A1 & USB device
- Electric specifications:
  - Supplied with Power board MC300 from 3.3V up to 5V
- Dimension: 100x100mm

Description

The MC303 is the device board for ATxmega128A1 AVR® microcontroller which can be connected to the general-purpose power stage board MC300 for driving brushless DC, brushed DC and stepper motors. This board is also designed to be connected on any other driver board which could share the same interface. Power and all signals needed for a power stage board are available on the right side of the board. Jumpers allow demonstrating sensor or sensorless modes of motor control. Finally, interfaces like USB or Atmel DB101 Display module is also available.

Figure 1. MC303 Motor control ATxmega128A1 processor board.



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1. Hardware overview

Please refer to schematics, layout and BOM available at http://www.atmel.com.

The MC303 motor control processor board is an ATxmega128A1 AVR microcontroller solution connected to a power stage board intended for driving DC motors (Brushless or brushed). All signals coming from the power stage board are connected to the microcontroller either directly or through jumpers for sensorless or sensor configuration. External comparators present on the board or internal comparators of the ATxmega128A1 allow for sensorless control mode.

A potentiometer enables the user to control the motor: speed & direction in sensor mode and speed only in sensorless mode.

A Usart to USB bridge is available to transfer motor control status & commands to a PC software interface: Atmel Motor Control Center.

Three 2.54mm headers are available to add the Atmel DB101 Display module in order to enhance visualization of motor control data & commands.

Three 8-pin & one 16-pin 2.54mm (100mil) horizontal male pin headers on the right side of the board form a system connector for the power boards like MC300.

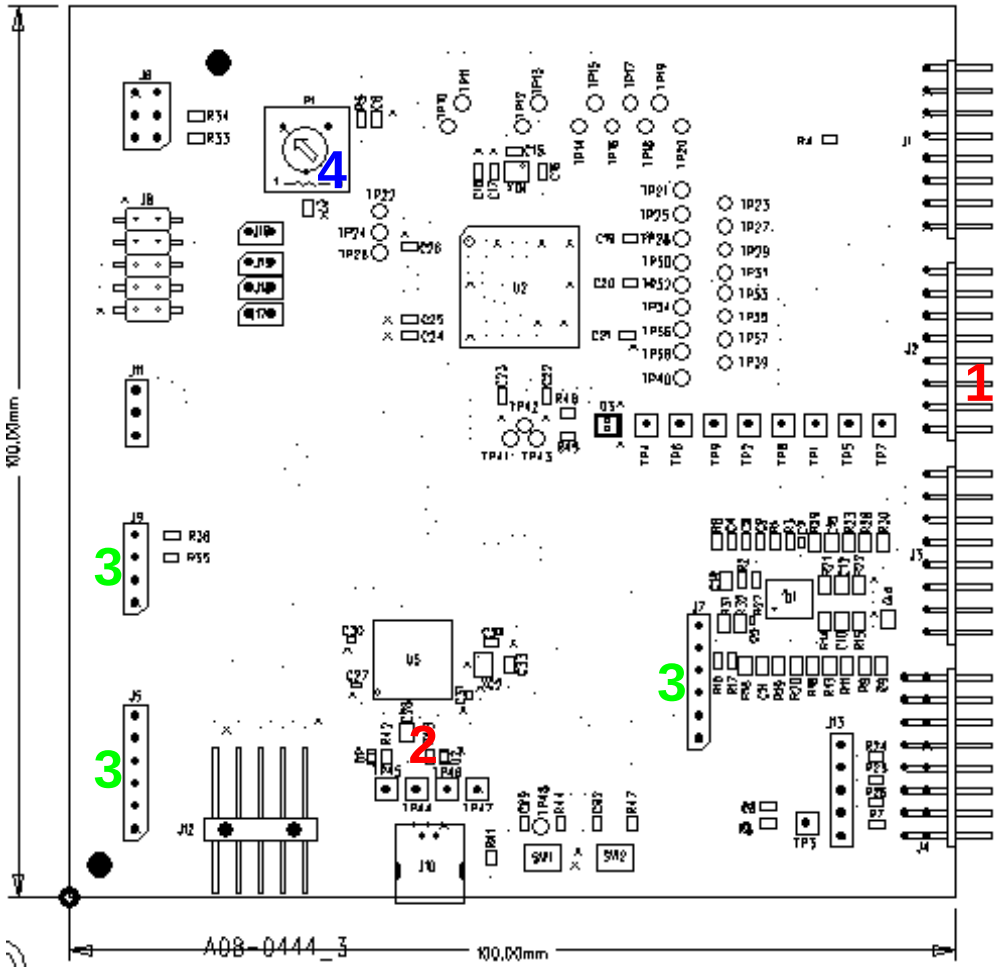
Both microcontrollers: ATxmega128A1 & AT90USB1287 have their own JTAG interface for user's specific developments.

Test points either mounted or not, are also available for instrumentation.

1.1 PCB Layout

The MC303 is organized as shown in Figure 1-1. Most signals, important components and jumper information are written on the silk screen. Test points are also available for user instrumentation. For individual component placement refer to the component floor plan.

Figure 1-1. MC303 PCB layout.



In Figure 1-1 the following areas are marked:

1. Power board connector
2. USB bridge
3. Atmel DB101 Display module headers
4. Potentiometer for manual command

1.2 Specifications

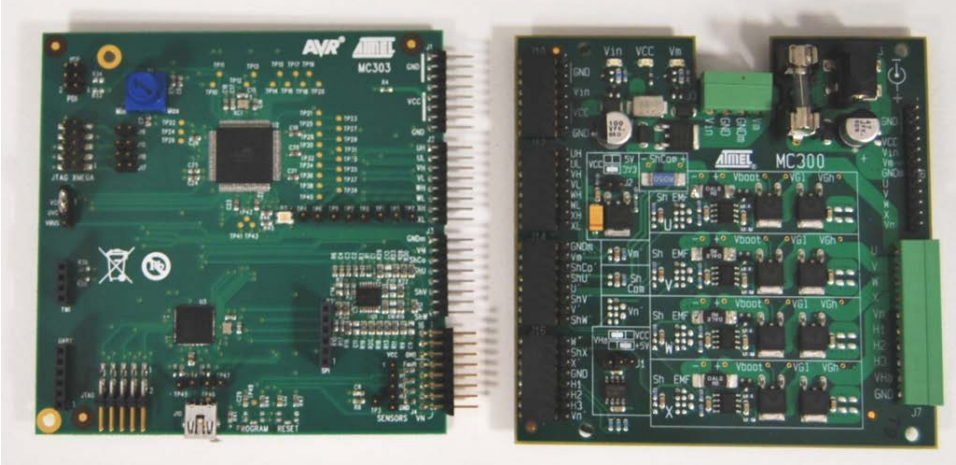
MC303 maximum ratings with components as delivered:

- Vcc = 3.3V, Imax = 0.5A

When working at Vcc 2.7V-3.3V, the user can keep USB functional by selecting power supply for USB coming from VBUS rather than from Vcc.The selection is made on the J11 jumper.

1.3 Connections

Figure 1-2. MC303 device board with power board MC300.



1.3.1 Power board connector

The MC303 processor board can connect directly to a driver board (typically the MC300 power board). This is accomplished by a horizontal male pin header connectors located on the right side of the board, shown in Figure 1-2.

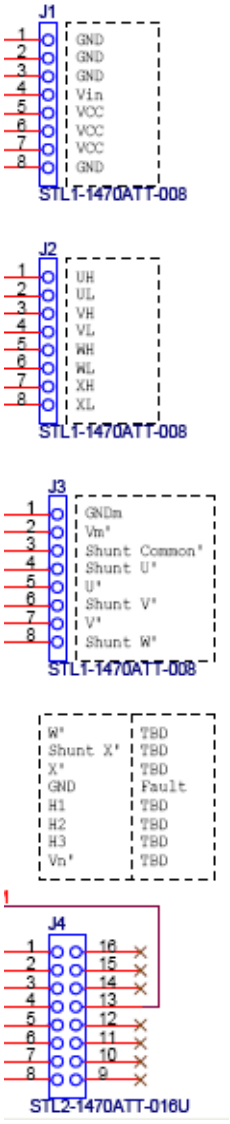
The device board interface on MC303 connector is split into four eight-pin connectors. Electric schematics and mechanical specifications are shown in Figure 1-3 and signal description in Table 1-1**.**

Table 1-1. MC303 device board connector signal description.

Pin	Located	Name	Direction	Description
1	J1p1	GND	-	
2	J1p2	GND	-	System ground (Vin/VCC)
3	J1p3	GND	-	
4	J1p4	Vin	Input	Input power Vin (10-20V)
5	J1p5	VCC	Input	
6	J1p6	VCC	Input	Regulated power Vcc (3.3V/5V)
7	J1p7	VCC	Input	
8	J1p8	GND	-	System ground (Vin/VCC)
9	J2p1	UH	Output	Phase U Highside control output
10	J2p2	UL	Output	Phase U Lowside control output
11	J2p3	VH	Output	Phase V Highside control output
12	J2p4	VL	Output	Phase V Lowside control output
13	J2p5	WH	Output	Phase W Highside control output
14	J2p6	WL	Output	Phase W Lowside control output
15	J2p7	XH	Output	Phase X Highside control output
16	J2p8	XL	Output	Phase X Lowside control output
17	J3p1	GNDm	-	Motor ground (Vmotor)
18	J3p2	Vmotor’	Input	Vmotor filtered/divided

Pin	Located	Name	Direction	Description
19	J3p3	ShCom’	Input	Voltage over ShCom filtered/divided
20	J3p4	ShU’	Input	Voltage over ShU filtered/divided
21	J3p5	U’	Input	BackEMF phase U filtered/divided
22	J3p6	ShV’	Input	Voltage over ShV filtered/divided
23	J3p7	V’	Input	BackEMF phase V filtered/divided
24	J3p8	ShW’	Input	Voltage over ShW filtered/divided
25	J4p1	W’	Input	BackEMF phase W filtered/divided
26	J4p2	ShX’	Input	Voltage over ShX filtered/divided
27	J4p3	X’	Input	BackEMF phase X filtered/divided
28	J4p4	GND	-	System ground (Vin/VCC)
29	J4p5	H1	Input	Hall sensor 1 signal
30	J4p6	H2	Input	Hall sensor 2 signal
31	J4p7	H3	Input	Hall sensor 3 signal
32	J4p8	Vn’	Input	Vn (neutral point) filtered/divided
33	J4p9	PFC_OC	Input	Power Factor Corrector Over Current signal
34	J4p10	nc	-	
35	J4p11	PFC_ZC	Input	Power Factor Corrector Zero Crossing signal
36	J4p12	nc	-	
37	J4p13	FAULT	Input	Fault signal from Power board
38	J4p14	Temp	Input	Temperature sensor input
39	J4p15	nc	-	
40	J4p16	Spare	Input/ Output	Reserved

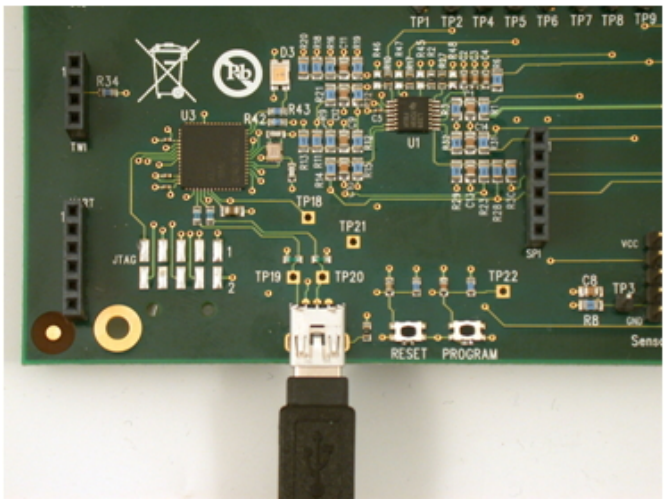
Figure 1-3. Device board connector schematics.



1.3.2 USB connector

The board has a USB mini B receptacle (J10) to interface with a PC using the USB cable included in the kit.

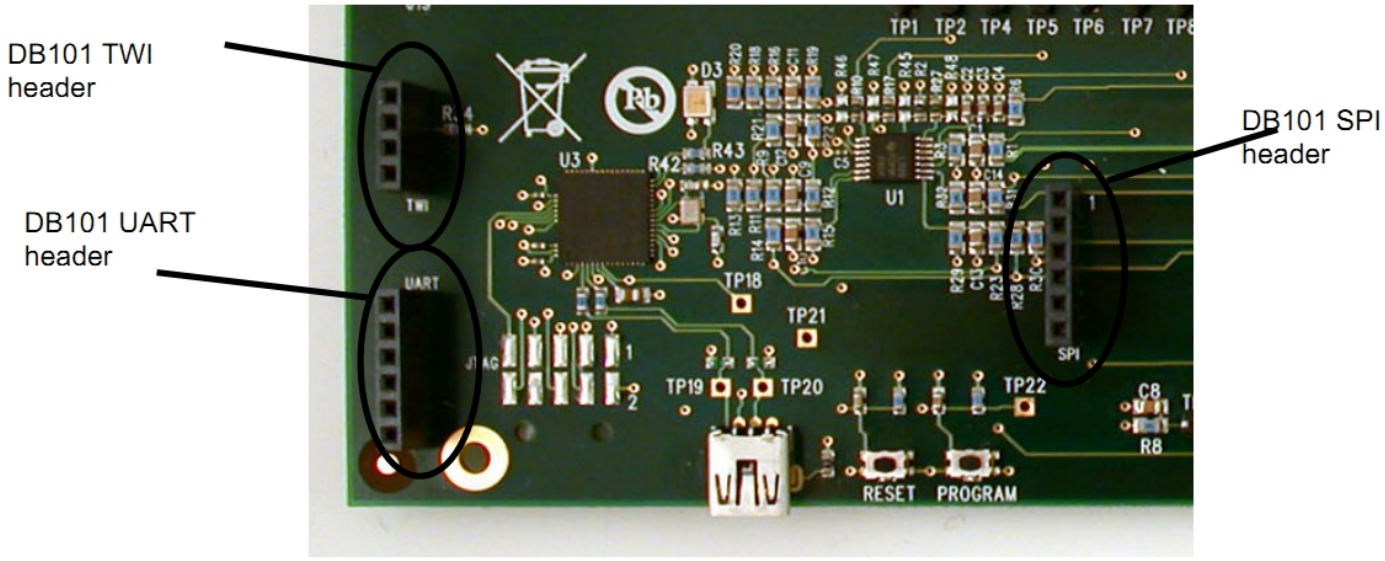
Figure 1-4. USB Connection



1.3.3 DB101 Display module connectors

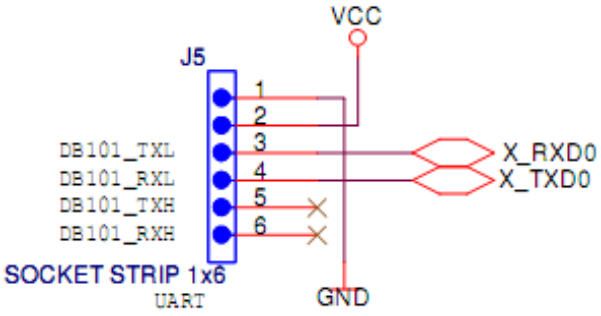
The board has three 2.54 mm header to mount the Atmel DB101 Display module: J5, J7 & J9 (respectively UART, SPI, and TWI). The MC303 uses the UART.

Figure 1-5. DB101 Display module



See the following description for the DB101 headers:

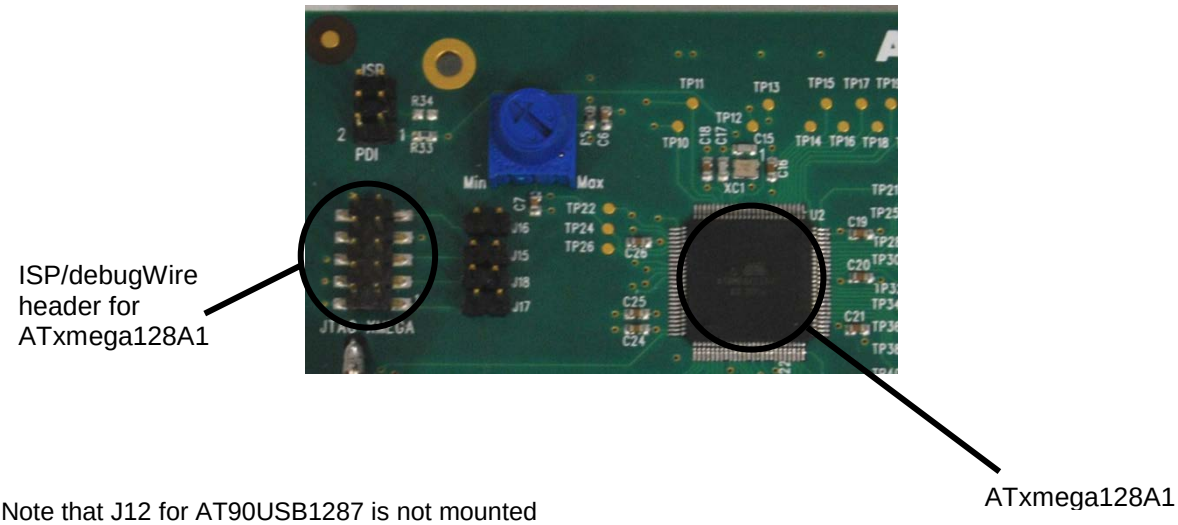
Figure 1-6. DB101 Header



1.3.4 JTAG/Debug connectors

The board has one JTAG/Debug connector, one populated for interfacing the ATxmega128A1 (J8), one not populated for the AT90USB1287 (USB bridge) (J12).

Figure 1-7. ATxmega128A1 ISP/ JTAG header



Note that J12 for AT90USB1287 is not mounted

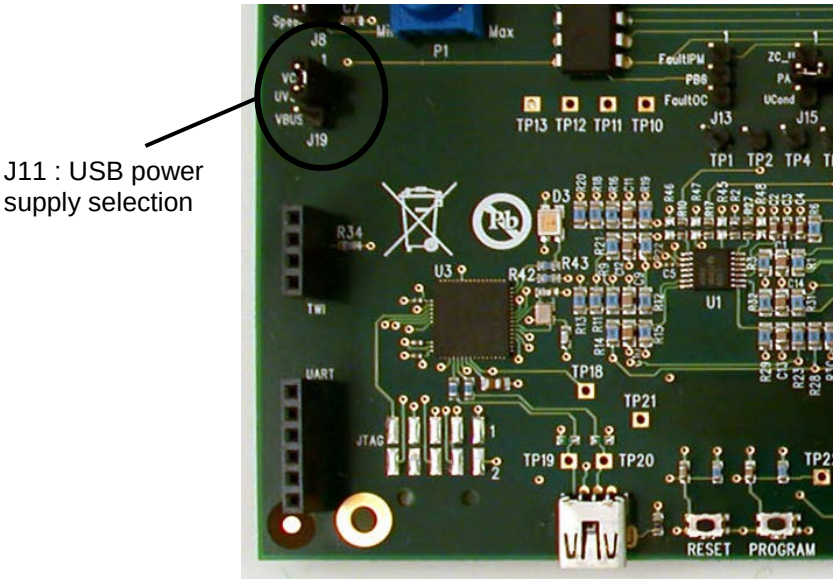
1.4 Jumpers

Refer to component floorplan for the location of the jumpers.

Table 1-2. Jumpers and their function.

Jumper	Function
J11	Selects voltage source UVCC (Power supply for USB stage) When working at Vcc 2.7V-3.3V, the user can keep USB functional by selecting power supply for USB coming from VBUS rather than from Vcc. J11 open – UVCC not connected, USB bridge not usable J11 pin 1 & 2 connected – UVCC connected to Vcc coming from Power board (default configuration) J11 pin 2 & 3 connected – UVCC connected to Vbus coming from USB line (See picture below)

Figure 1-8. J11: USB Power supply selection

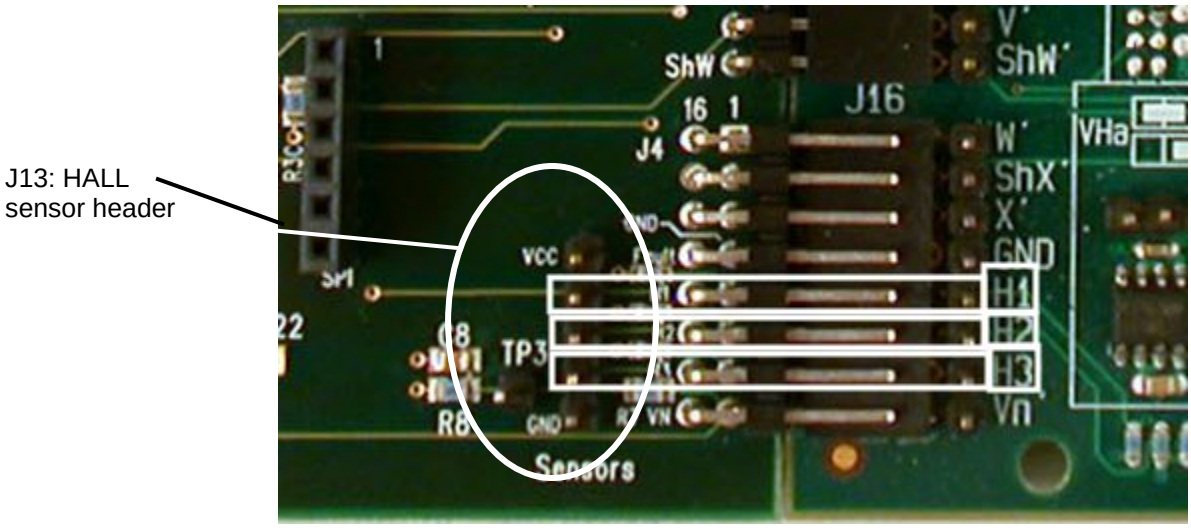


1.5 Headers

Table 1-3. MC303 device board J13 Hall sensors header description

Pin	Located	Name	Direction	Description
1	J13p1	VCC	-	Regulated power Vcc (3.3V/5V) coming from power board
2	J13p2	H1		Hall sensor output 1
3	J13p3	H2		Hall sensor output 2
4	J13p4	H3		Hall sensor output 3
5	J13p5	GND	-	System ground (Vin/VCC)

Figure 1-9. J13: HALL sensors header



1.6 Schematics, component floorplan and bill of materials

The schematics, component floorplan and bill of materials (BOM) for MC303 are found as separate PDF files distributed with this application note. They can be downloaded from http://www.atmel.com.

2. Detailed description

2.1 Sensor mode

The MC303 can be configured in sensor mode using the Hall sensors of the motor through the Power board interface (J1).

H1, H2 & H3 are connected to PE0, PE1 & PE2 of the ATxmega128A1.

2.2 Sensorless modes

The MC303 can be configured in sensorless mode thanks to the comparator circuitry populated on the MC303 board or the filtered U, V, W signals coming from the MC300 power board. It supports both configurations at the same time.

When using the zero crossing signals output from comparators, ZC_U, ZC_V & ZC_W are connected to PH0, PH1 & PH2 of the ATxmega128A1.

When using the filtered U, V, W signals coming from the MC300 power board, (U_Conditioned, V_ Conditioned, W_ Conditioned) & (U_cond_neg, V_cond_neg, W_cond_neg) are connected to (PA2, PA3, PA4) & (PA0, PA1, PA7) of the ATxmega128A1.

2.3 Interfacing MC303 with PC through USB

Commands & status can be transferred to a PC through a USB link thanks to the USB bridge on the MC303.

2.3.1 Connection

Connect the USB mini B cable to the MC303 board and to a PC. Make sure J11 (power supply of USB bridge) is properly configured.

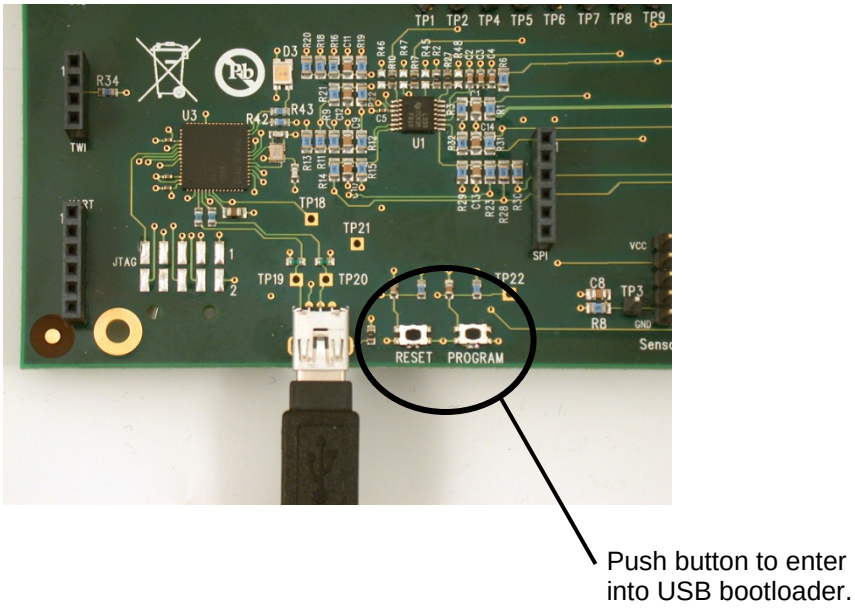
2.3.2 Communication

MC303 USB interface uses USB CDC class for communication. As the Atmel Motor Control Center software uses the RS232 interface, CDC class fits perfectly with the needs of this software. MC303 is delivered with a native USB CDC firmware in the AT90USB1287.

2.3.3 USB bridge update

MC303 USB bridge can be updated thanks to the Atmel Bootloader in the AT90USB1287. Press Program Push button then Reset the USB device by pressing the Reset Push button. AT90USB1278 will then enumerate in DFU class (Device Firmware Upgrade class). See Atmel FLIP user's guide for upgrading the AT90USB1287 device on Atmel web site: www.atmel.com

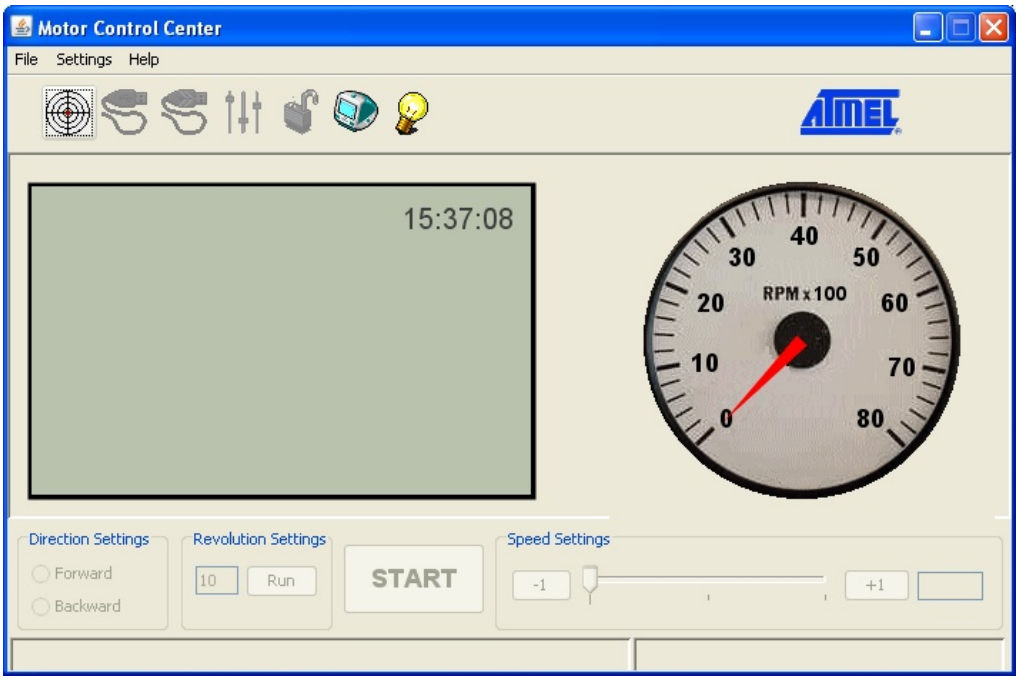
Figure 2-1. Entering in bootloader or start the application.



2.3.4 Atmel Motor Control Center

The Atmel Motor Control Center used with the MC303 is available on the Atmel website: www.atmel.com.

Figure 2-2. Motor Control Center User Interface.



See Atmel Motor control center user's guide & the application notes using MC303+MC300 & Atmel Motor Control center for further explanation on this PC software usage.

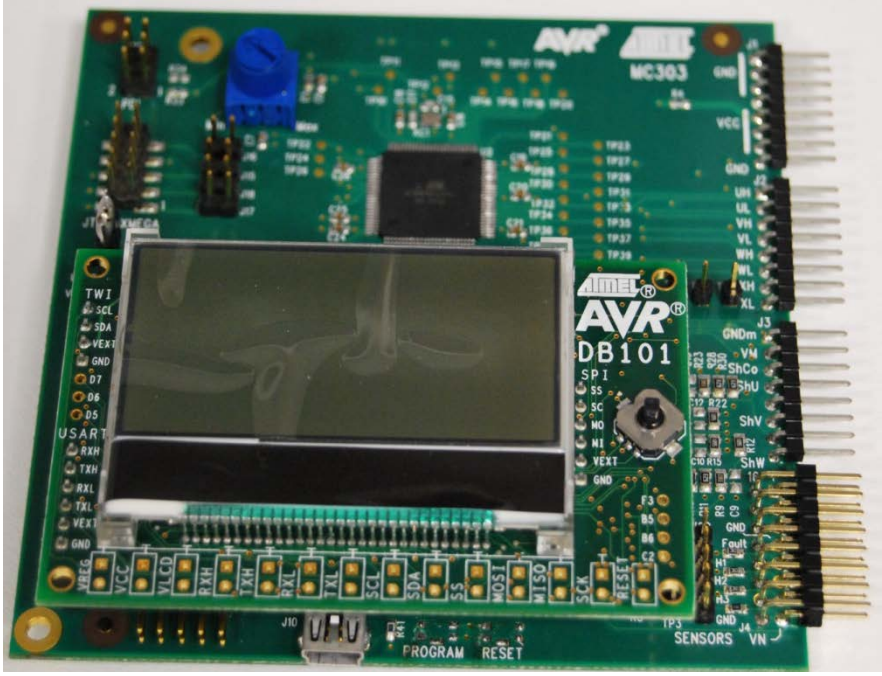
2.4 Interfacing MC303 with Atmel DB101 Display modules

The DB101 display module can be added to the MC303 (See application notes AVR481, AVR482, and AVR483 on www.atmel.com).

2.4.1 Connection

DB101 connects using 3 headers J5, J6 & J7 (respectively UART, SPI, and TWI). See Figure 1-1 MC303 PCB layout

Figure 2-3. DB101 Display Module



2.4.2 Communication

DB101 uses the Usart with ATxmega128A1 through J5 header.

2.5 Upgrading the MC303 Motor control firmware

Firmware on the MC303 can be updated through Atmel Studio using JTAGICE mkII or JTAGICE 3 connected to J8.

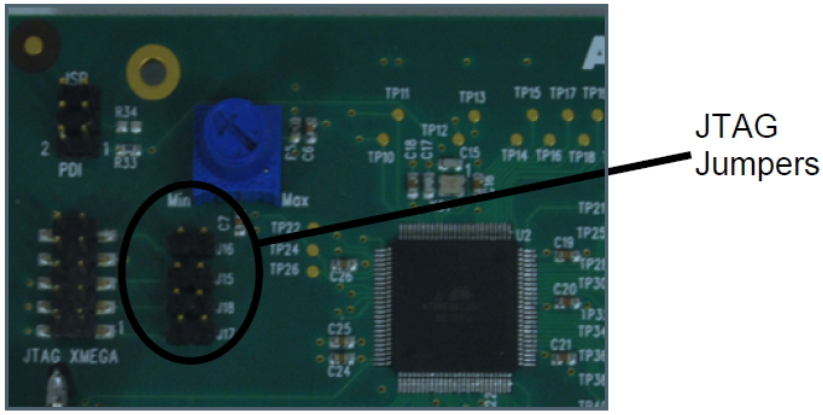
Select the ATxmega128A1 device in the device list.

The list of jumpers J15, J16, J17 and J18 should be left open to activate the JTAG lines on the board:

Table 2-1. JTAG enable jumpers

Jumper	JTAG Signal
J15	TMS
J16	TDI
J17	TCK
J18	TDO

Figure 2-4. JTAG Jumpers



Caution: While updating the firmware, it is recommended to disconnect the motor on the MC300 power board.

3. Revision History

Doc. Rev.	Date	Comments
8296B	08/2013	Error correction and new document template
8296A	03/2010	Initial document release

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