ATAVRAUTO200

User Guide

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Section 1

Introduction

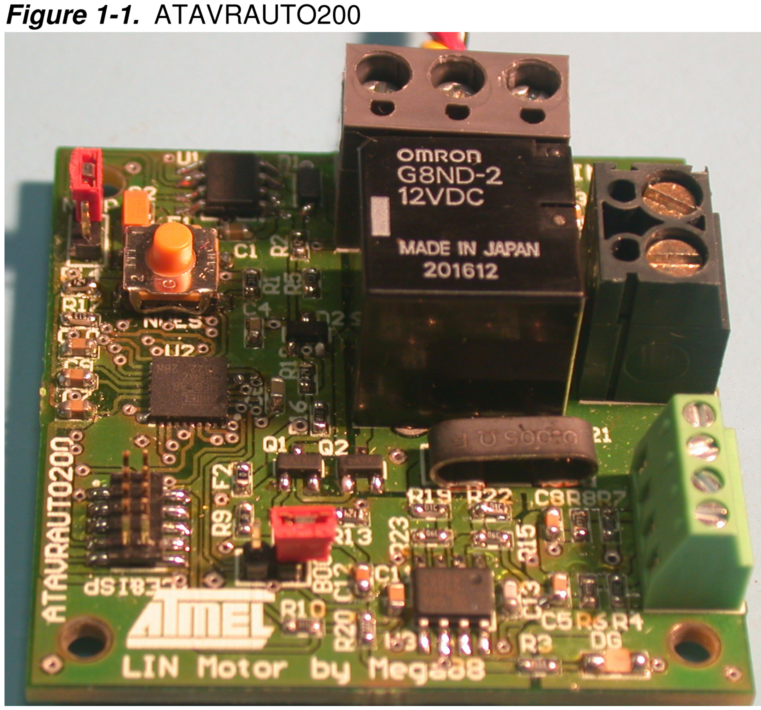
Congratulations on your purchase of the ATAVRAUTO200 board. This board includes all elements necessary for designers to quickly develop code related to LIN communication node implementing the ATmega88 and for prototyping and testing of new designs.

1.1 Overview

This document describes the ATAVRAUTO200 dedicated to the ATmega88 AVR micro controllers. This board is designed to allow an easy evaluation of the product using demonstration firmware.

To increase its demonstrative capabilities, this stand alone board has numerous on-board resources (motor relay, motor FET, hall sensor inputs, current measurements, power supply measurement, LIN, push buttons).

Figure 1-1. ATAVRAUTO200



1.2 ATAVRAUTO200 features

The ATAVRAUTO200 provides the following features:

- ATmega88 QFN32
- AVR Studio® software interface(1),
- Power supply
  - Regulated 5V
  - From LIN connector (LIN network power supply)
- JTAG connector:
  - for on-chip In Situ Programming (ISP)
  - for on-chip debugging using JTAG ICE
- DC Motor connector
  - DC Motor power supply output
  - Hall effect sensor(s) power supply and input(s)
- Serial interface:
  - 1 LIN interface 1.3 and 2.0 compliant (firmware library available on the ATMEL website for LIN 1.3).
- On-board resources:
  - 1 LIN transceiver with internal regulator
  - Relay for DC motor control
  - Shunt Resistor for motor current measurement
  - Speed/Position measurement Inputs
  - Power supply measurement
- System clock:
  - Internal RC oscillator
- Dimension: 45 mm x 45 mm

Note: The ATmega88 is supported by AVR Studio, version 4.12 or higher. For up-to-date information on this and other AVR tool products, please consult our web site. The newest version of AVR Studio, AVR tools and this user guide can be found in the AVR section of the Atmel web site, http://www.atmel.com.

Section 2

Using the ATAVRAUTO200

2.1 Overview

Figure 2-1. Board Overview

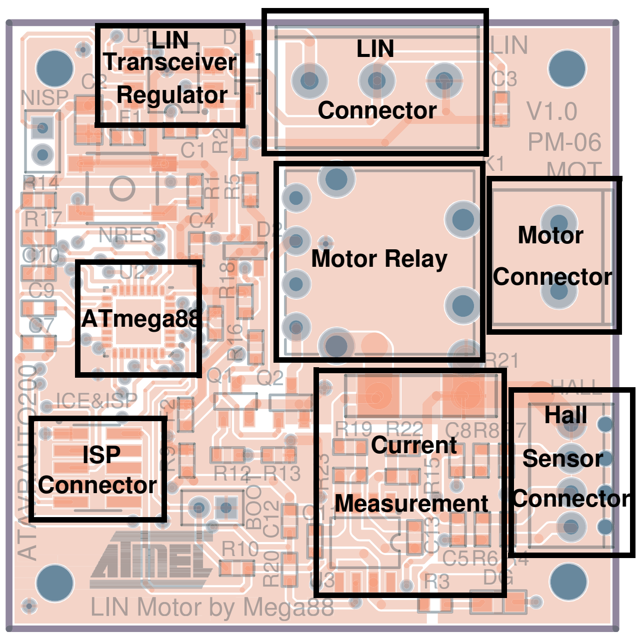
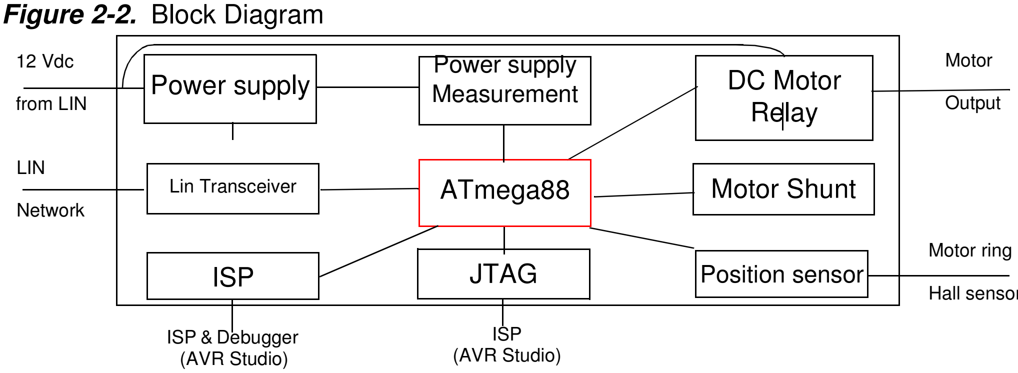


Figure 2-2. Block Diagram



2.2 Power Supply

The on-board power supply circuitry is supplied through the LIN connector.

2.2.1 LIN powered

The LIN connector power line is used to provide VBAT to the ATAVRAUTO200 LIN transceiver.

A LIN network has to be connected to have your LIN interface function (Input supply from 8 up to 18V DC, see Figure 2-3 on page 5) .

2.3 Oscillator Sources

The ATAVRAUTO200 board allows only one oscillator source:

- Internal RC oscillator (Default configuration).

Note: The "Divide by 8" Fuse is configured by default. The first step in the demonstration application is to clear the prescaler to have the internal RC oscillator running at 8MHz:

```
CLKPR = (1<<CLKPCE);   //! Clear  Prescaler
CLKPR = 0;
```

2.3.1 Interal RC oscillatorn

A LIN Slave node with a run-time oscillator calibration can be used with the internal RC oscillator.

At ambiant temperature and normal Vcc, the internal oscillator is precise enough to be compliant with LIN 1.3 and 2.0 specifications. For wider temperature and/or power ranges, a run-time calibration of the internal RC oscillator can be used as explained in the application note AVR140: "ATMega48/88/168 family run-time calibration of the internal RC oscillator" available on the Atmel website.

2.4 On-board Resources

2.4.1 LIN & Power supply

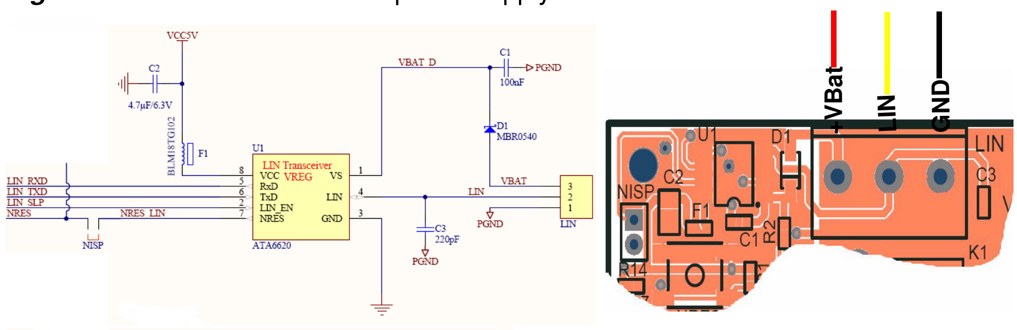
The LIN screwed connector allows the user to select his own connector.
Note: The LIN power supply input is reverse voltage protected.

LIN transceiver control is realized by the micrcontroller. All modes depend on microcontroller's ports configuration.

Table 2-1. LIN ressources

Function	Port	State	Description
LIN_NSLP	PD2	Low	LIN transceiver in Sleep mode
		High	LIN transceiver in normal mode
NRES_LIN	PC6	Low	Perform MCU reset when NISP Jumper is inserted
		High	No Action

Figure 2-3. LIN transceiver and power supply



Note: The LIN transceiver undervoltage protection can be disabled by removing the NISP jumper.

Note: The NISP jumper has to be removed when programming.

2.4.2 Power supply measurement

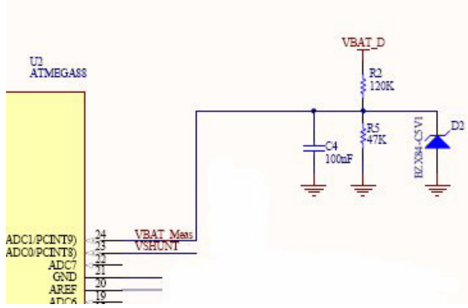
The voltage measurement is realized with a bridge of resistors. The read value is 0.281 of the LIN power supply (47 KΩ / (47 KΩ + 120 KΩ)). Input voltage on channel 1 of the ADC is limited to 5.1V by a zener diode. This will give a voltage reading range from 0 to 18.1V with Vcc as reference.

The power supply measurement can be performed using the A/D converter. See the ATmega48/88/168 datasheet for how to use the ADC. The input voltage value (V_{IN}) is calculated with the following expression:

$$V_{IN} = 3.55 \times V_{ADC1}$$

- Where: VIN = Input voltage value (V)
- VADC7 = Voltage value on ADC-1 input (V)

Figure 2-4. Power supply measurement through ADC1



2.4.3 Motor relay

DC Motor can be operated through a relay. It is supplied with Vbat, -Vbat or 0V.

- The relay allows the motor to be operated in two rotating directions, or to be stopped.

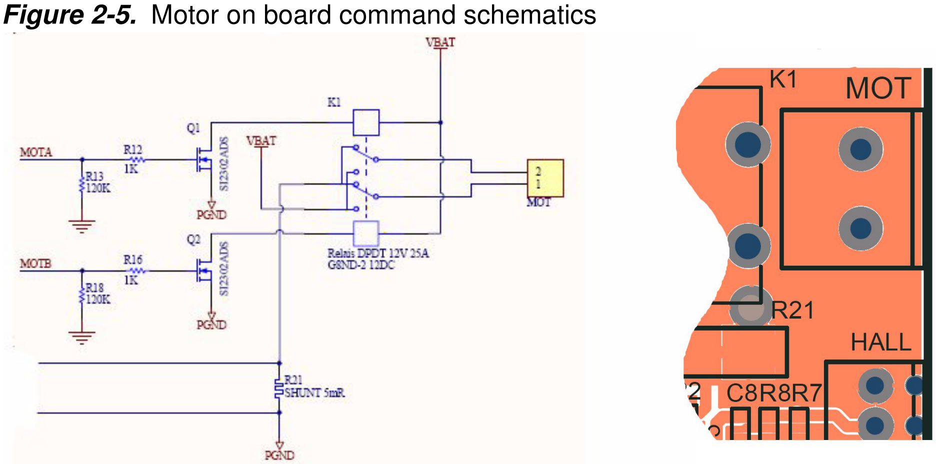
Table 2-2. Motor Relay commands

Function	Port	State	Description
Mot_A	PB1	Low/	Relay coil1 OFF (Normaly closed switch activated)
		High	Relay coil1 ON (Normaly opened switch activated)
Mot_B	PB2	Low	Relay coil2 OFF (Normaly closed switch activated)
		High	Relay coil2 ON (Normaly opened switch activated)

Table 2-3. Logical command table

Mot_A	Mot_B	Motor Supply	Description
L	L	0V	Motor stopped
L	H	-Vbat	Motor running (Direction B)
H	L	+Vbat	Motor running (DirectionA)
H	H	0V	Motor stopped

Figure 2-5. Motor on board command schematics



2.4.4 Current measurement

Motor current is measured using a shunt resistor. External differential amplifier (on board) is connected to ADC to measure shunt resistor voltage.

Amplifer output (current image voltage) is connected to

- ADC0 pin for current acquisition
- AIN1 pin to detect max current peak (compared to AIN0 through internal analog comparator)

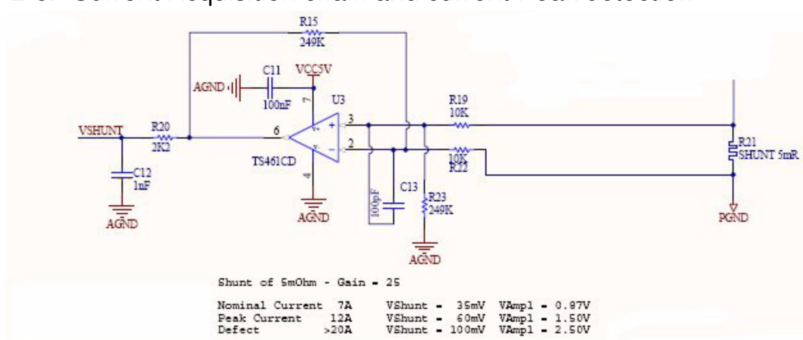
The current measurement (I) can be performed using the A/D converter. See the ATmega48/88/168 datasheet for how to use the ADC. The input voltage value ($V_{ADC\text{-}0}$) is calculated with the following expression:

$$\begin{cases} (V_{\text{ADC-0}} = Gain \times V_{\text{shunt}} = Gain \times R\text{shunt} \times I = 30{,}16 \times 0.005 \times I) \\ V_{\text{ADC-0}} = 0.151 \times I \end{cases}$$

Analog comparator allows peak current detection. It provides interrupts on analog comparator output change. See the ATmega48/88/168 datasheet for how to use the Analog comparator. Comparison voltage is determined for a 12A peak which leads to:

- $V_{AIN0} = 1.5V$

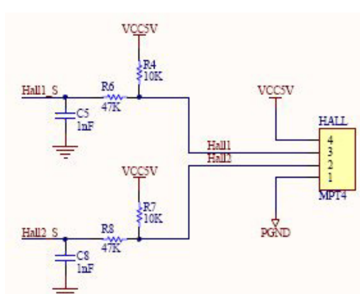
Figure 2-6. Current Acquisition chain and current Peak detection

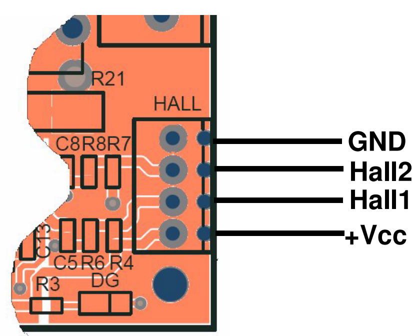


2.4.5 Speed/Position measurement inputs

A screw connector with 4 inputs can be used to plug two hall effect sensors. The two hall effect sensors inputs are connected to the two external interrupt pins (INT0 and INT1) of the microcontroller.

Figure 2-7. Hall sensor effect interface

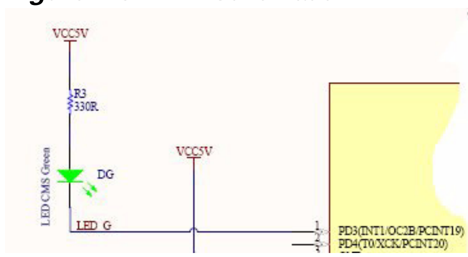


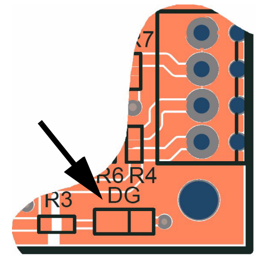


2.4.6 LED

The ATAVRAUTO200 includes one green LED implemented on one I/O pin. It is connected to the “PortD Pin3” of the ATmega48/88/168. To light On the LED, the corresponding port pin must drive a low level. To light Off the LED, the corresponding port pin must drive a high level.

Figure 2-8. LED schematic



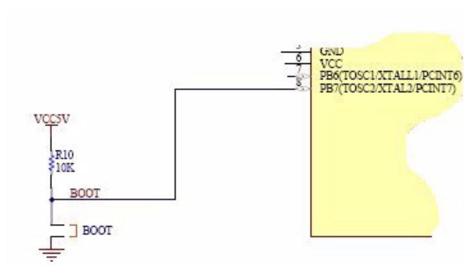


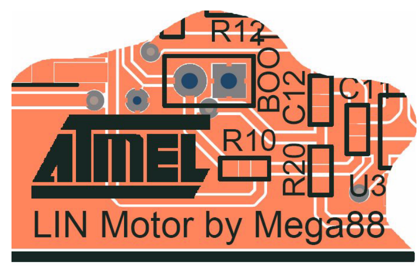
2.4.7 BOOT

An additional jumper (BOOT) has been added. This jumper is available for custom use.

For example : the BOOT jumper can be used to switch from the application to the bootloader by firmware (Not implemented in the example) by reading the pin7 of PortB.

Figure 2-9. BOOT Jumper





2.5 In-System Programming

The ATmega88 can be programmed using specific SPI serial links. This sub section will explain how to connect the programmer.

The Flash, EEPROM memory (and all Fuse and Lock Bit options ISP-programmable) can be programmed individually or with the sequential automatic programming option.

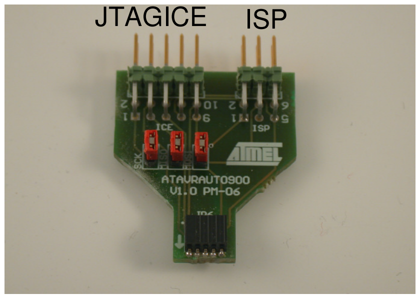
Note: If debugWire fuse is enabled, AVR ISP can’t be used. If debugWire fuse is disabled, JTAGICE mkII have to be used in ISP mode to enable debugWire fuse.

Note: When programming, the NISP jumper has to be removed.

2.5.1 Using the ATAVRAUTO900 Adaptator

An additionnal adaptator has to be used to program the board using IPS or JTAG mode. The 10 pins connector is used for the JTAGICE mkII device and the 6 pins connector is used for the AVRISP device. To plug the ATAVRAUTO900 connector to the board, the arrow (on the adaptator) has to be in front of the point (on the board).

Figure 2-10. ATAVRAUTO900 Connection



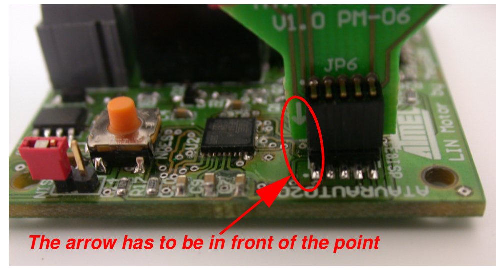


Table 2-4. ICE Connector

PIN	Function
1	TCK
2	GND
3	TDO
4	VCC
5	TMS
6	NRES
7	VCC
8	NC
9	TDI
10	GND

Table 2-5. ISP Connector

PIN	Function
1	MISO
2	VCC
3	SCK
4	MOSI
5	NRES
6	GND

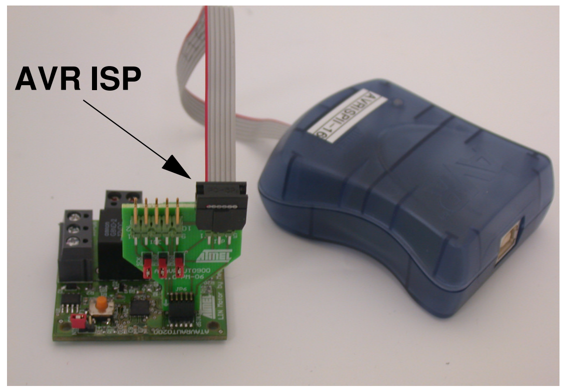
2.5.2 Programming with AVR ISP Programmer

The AVR ISP programmer is a compact and easy-to-use In-System Programming tool for developing applications with ATmega88. Due to its small size, it is also an excellent tool for field upgrades of existing applications. It is powered by the ATAVRAUTO200 and an additional power supply is thus not required.

The AVR ISP programming interface is integrated in AVR Studio.

To program the device using AVR ISP programmer, connect the AVR ISP to the adaptator (ATAVRAUTO900) and connect the adaptator to the connector of the ATAVRAUTO200.

Figure 2-11. Programming from AVR ISP programmer using ATAVRAUTO900.



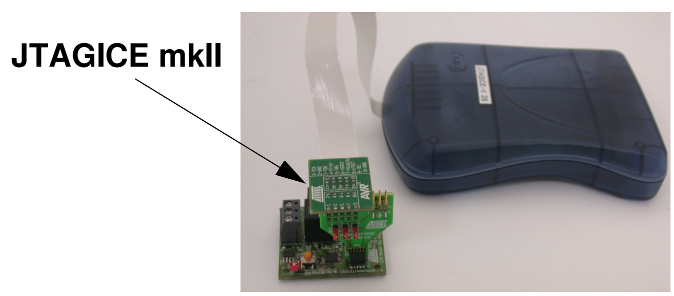
Note: See AVR Studio® on-line Help for information.

2.5.3 Programming with AVR JTAGICEmkII

The ATmega48/88/168 can be programmed using specific JTAG link: 3-wire debugWIRE interface. To use the AVR JTAGICEmkII with an ATAVRAUTO200 thr ATAVRAUTO900 adaptator has to be be used. Then the JTAG probe can be connected to the ATAVRAUTO200 as shown in the following Figure 2-12.

To use the JTAGICEmkII in ISP mode the 3 jumpers “SCK”, “MISO” and “MOSI” of the adaptator (ATAVRAUTO900) should be connected.

Figure 2-12. JTAGICE mkII probe connecting through debugWIRE interface



Note: When the debugWIRE Enable (DWEN) Fuse is programmed and Lock bits are unprogrammed, the debugWIRE system within the target device is activated. RESET pin is configured as communication gateway between ATmega48/88/168 and JTAG. JTAGICE mkII must have control over it.

Note: See AVR Studio® on-line Help for information.

2.6 Debugging

2.6.1 Debugging with AVR JTAGICEmkII

The ATAVRAUTO200 can be used for debugging with JTAG ICE MK II.

Connect the JTAG ICE mkII as shown in Figure 2-12 for debugging, please refer to AVR Studio Help information.

Section 3

Technical Specifications

- System Unit
  - Physical Dimensions...L=45 x W=45 x H=8 mm
  - Weight ....25 g
- Operating Conditions
  - Internal Voltage Supply 5.0V
  - External Voltage Supply ....7V -18V

Section 4

Technical Support

For Technical support, please contact avr@atmel.com. When requesting technical support, please include the following information:

- Which target AVR device is used (complete part number)
- Target voltage and speed
- Clock source and fuse setting of the AVR
- Programming method (ISP, JTAG or specific Boot-Loader)
- Hardware revisions of the AVR tools, found on the PCB
- Version number of AVR Studio. This can be found in the AVR Studio help menu.
- PC operating system and version/build
- PC processor type and speed
- A detailed description of the problem

Section 5

Complete Schematics

On the next pages, the following documents of ATAVRAUTO200 are shown:

- Complete schematics,
- Bill of materials,
- Assembly drawing.

Figure 5-1. ATAVRAUTO200 schematic

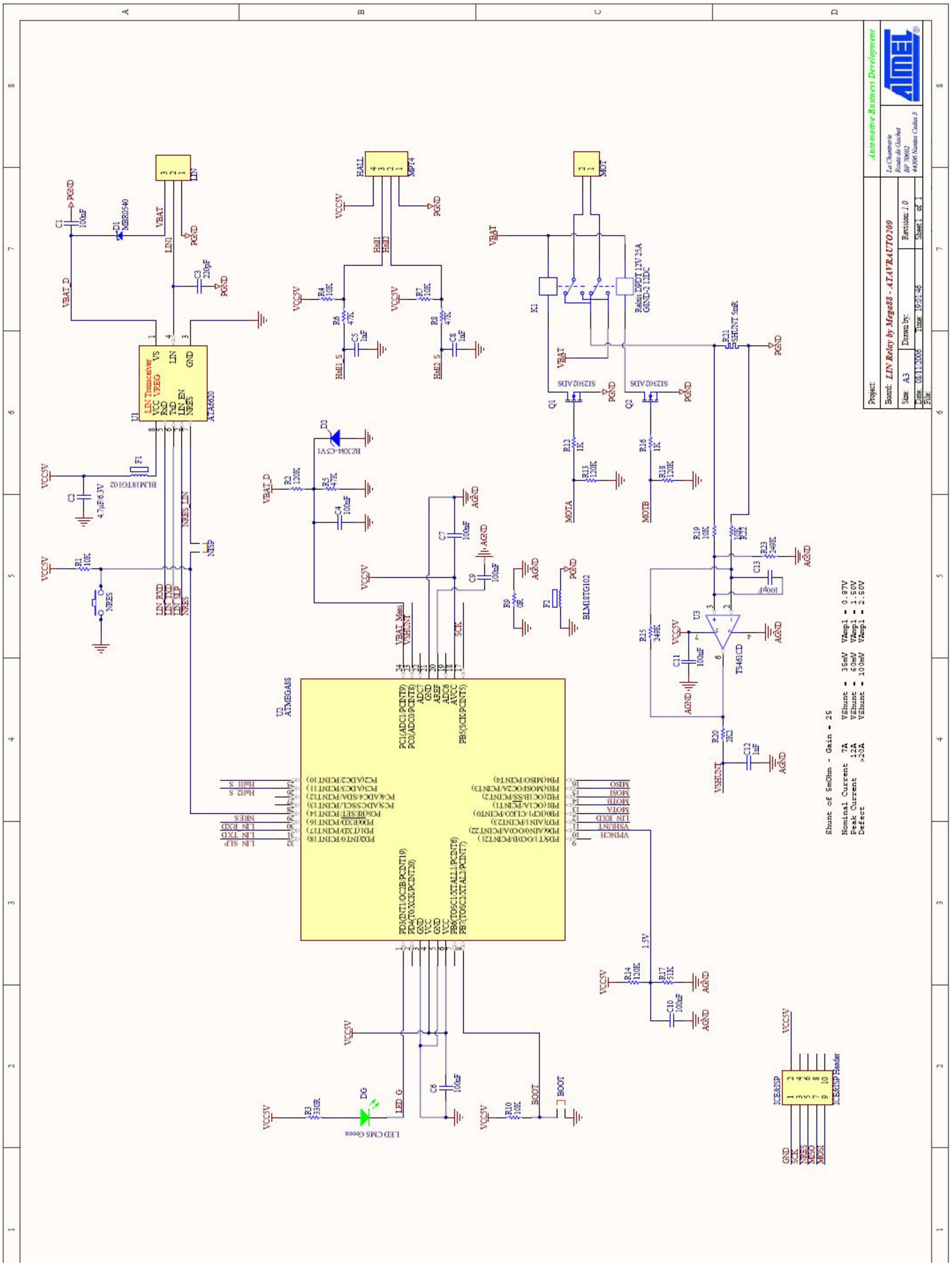


Figure 5-2. ATAVRAUTO200 Bill of Materials

Bill of Materials

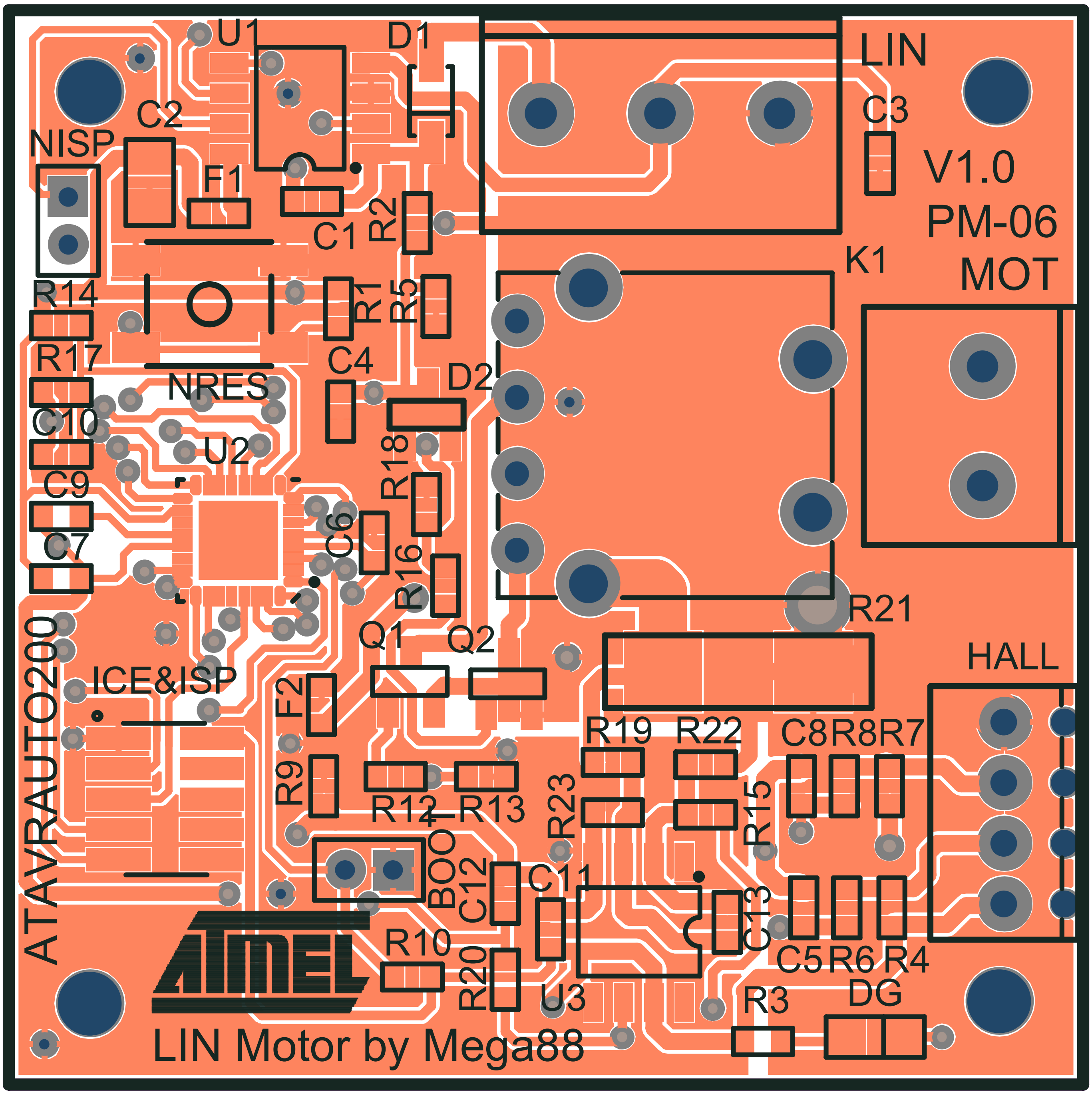
LIN Relay by Mega88 - ATAVRAUTO200

Source Data From: LIN Relay M88.PrjPcb
Project: LIN Relay M88.PrjPcb
Variant: None

Creation Date 09/11/2006 19:34:10
Print Date: 02-Jan-07 2:24:01 PM

Designator	Descriptions	Reference	Fabricant	Fournisseur	Code Commande	Unite de Vente	Quantity	Prix UDV	LibRef	Footprint
C1	100nF	X7R 16V	Phycomp	FARNELL	432210	10	1	0.63	Cap 100nF 0603 X7R 16V	0603
C10	100nF	X7R 16V	Phycomp	FARNELL	432210	10	1	0.63	Cap 100nF 0603 X7R 16V	0603
C11	100nF	X7R 16V	Phycomp	FARNELL	432210	10	1	0.63	Cap 100nF 0603 X7R 16V	0603
C4	100nF	X7R 16V	Phycomp	FARNELL	432210	10	1	0.63	Cap 100nF 0603 X7R 16V	0603
C6	100nF	X7R 16V	Phycomp	FARNELL	432210	10	1	0.63	Cap 100nF 0603 X7R 16V	0603
C7	100nF	X7R 16V	Phycomp	FARNELL	432210	10	1	0.63	Cap 100nF 0603 X7R 16V	0603
C9	100nF	X7R 16V	Phycomp	FARNELL	432210	10	1	0.63	Cap 100nF 0603 X7R 16V	0603
C13	100pF	COG	MURATA	FARNELL	8819866	10	1	0.54	Cap 100pF 0603 COG 50V	0603
C12	1nF	06035A102JAT2A	AVX	FARNELL	317202	25	1	2.25	Cap 1nF 0603 50V 5%	0603
C5	1nF	06035A102JAT2A	AVX	FARNELL	317202	25	1	2.25	Cap 1nF 0603 50V 5%	0603
C8	1nF	06035A102JAT2A	AVX	FARNELL	317202	25	1	2.25	Cap 1nF 0603 50V 5%	0603
C3	220pF	X7R 50V	Phycomp	FARNELL	722133	25	1	1	Cap 220pF 0603 X7R 50V	0603
C2	4.7µF/6.3V	X5R	MURATA	FARNELL	9522999	10	1	3.1	Cap 4.7µF 0805 6.3V	0805
MOT	Bornier 1X2	20.101/2	IMO	FARNELL	9632670	5	1	1.3	Bornier 1X2 24A	IMO2 5mm
LIN	Bornier 1X3	20.101/3	IMO	FARNELL	9632689	5	1	1.75	Bornier 1X3 24A	IMO3 5mm
ICE&ISP	ICE&ISP Header	M50-3600542	HARWIN	FARNELL	1022310	5	1	3.1	AVR ICE ISP PIN Header 2X5	PIN Header 2x5 1.27mm
HALL	MPT4	MPT 0,5/4-2,54	PHOENIX CONTAC	FARNELL	3041414	1	1	1.08	CON MPT 2.54 4-PIN	CON4_2.54
U1	ATA6620	ATA6620	ATMEL	ATMEL	ATA6620	1	1	0	ATA6620	SO8
U2	ATMEGA88	ATmega88-15AZ	ATMEL	ATMEL	ATmega88-15AZ	1	1	0	ATMEGA88	QFN5X5-32 NO VIA
U3	OPA251UA	OPA251UA	Burr-Brown	FARNELL	1097476	1	1	2.34	Ampli OP OPA251UA	SO8
F1	BLM18TG102	BLM18TG102TN1D	MURATA	FARNELL	1115051	1	1	0.18	EMI Filter BLM18TG102	0603
F2	BLM18TG102	BLM18TG102TN1D	MURATA	FARNELL	1115051	1	1	0.18	EMI Filter BLM18TG102	0603
BOOT	2mm V	M22-2010205	HARWIN	FARNELL	671915	10	1	1.12	Jump 2 Vert - 2mm	SIL2V2mm
NISP	2mm V	M22-2010205	HARWIN	FARNELL	671915	10	1	1.12	Jump 2 Vert - 2mm	SIL2V2mm
NRES	Bouton poussoir CM	KSC421JLFS	ITT CANNON	FARNELL	1201417	1	1	0.42	BP SPNO CMS	BP SPNO
D2	BZX84-C5V1	BZX84-C5V1	Philips	FARNELL	1081430	5	1	1	ZENER BZX84-C5V1	SOT23
K1	G8ND-2 12DC	G8ND-2 12DC	OMRON	RADIOSPARES	4349292	1	1	5.11	Relay-DPDT G8ND2 OMRON	G8ND2
DG	LED CMS Green	HSMG-C170	Agilent	FARNELL	5790852	5	1	0.8	LED CMS Green	LED CMS Agilent
D1	MBR0540	MBR0540T1G	ON	FARNELL	9556923	1	1	0.65	Schottky 40V 500mA MBR0540	SOD123
R9	0R	MC 0.063W 0603 1% 0R	MULTICOMP	FARNELL	9331662	50	1	1.4	Res 0R 0603	0603
R1	10K	RC21	Phycomp	FARNELL	9233504	50	1	1.9	Res 10K 0603 1%	0603
R10	10K	RC21	Phycomp	FARNELL	9233504	50	1	1.9	Res 10K 0603 1%	0603
R19	10K	MC 0.063W 0603 1% 10K	MULTICOMP	FARNELL	9330399	50	1	1.4	Res 10K 0603 1%	0603
R22	10K	MC 0.063W 0603 1% 10K	MULTICOMP	FARNELL	9330399	50	1	1.4	Res 10K 0603 1%	0603
R4	10K	MC 0.063W 0603 1% 10K	MULTICOMP	FARNELL	9330399	50	1	1.4	Res 10K 0603 1%	0603
R7	10K	MC 0.063W 0603 1% 10K	MULTICOMP	FARNELL	9330399	50	1	1.4	Res 10K 0603 1%	0603
R13	120K	MC 0.063W 0603 1% 120K	MULTICOMP	FARNELL	9238735	50	1	1.4	Res 120K 0603 1%	0603
R14	120K	MC 0.063W 0603 1% 120K	MULTICOMP	FARNELL	9238735	50	1	1.4	Res 120K 0603 1%	0603
R18	120K	MC 0.063W 0603 1% 120K	MULTICOMP	FARNELL	9238735	50	1	1.4	Res 120K 0603 1%	0603
R2	120K	MC 0.063W 0603 1% 120K	MULTICOMP	FARNELL	9238735	50	1	1.4	Res 120K 0603 1%	0603
R12	1K	MC 0.063W 0603 1% 1K	MULTICOMP	FARNELL	9330380	50	1	1.4	Res 1K 0603 1%	0603
R16	1K	MC 0.063W 0603 1% 1K	MULTICOMP	FARNELL	9330380	50	1	1.4	Res 1K 0603 1%	0603
R15	249K	MC 0.063W 0603 1% 249K	MULTICOMP	FARNELL	1171024	50	1	1	Res 249K 0603 1%	0603
R23	249K	MC 0.063W 0603 1% 249K	MULTICOMP	FARNELL	1171024	50	1	1	Res 249K 0603 1%	0603
R20	2K2	MC 0.063W 0603 1% 2K2	MULTICOMP	FARNELL	9330810	50	1	1.4	Res 2K2 0603 1%	0603
R3	330R	RC22H	Phycomp	FARNELL	9238425	50	1	2.17	Res 330R 0603 1%	0603
R5	47K	MC 0.063W 0603 1% 47K	MULTICOMP	FARNELL	9238689	50	1	1.4	Res 47K 0603 1%	0603
R6	47K	MC 0.063W 0603 1% 47K	MULTICOMP	FARNELL	9331255	50	1	1.4	Res 47K 0603 1%	0603
R8	47K	MC 0.063W 0603 1% 47K	MULTICOMP	FARNELL	9331255	50	1	1.4	Res 47K 0603 1%	0603
R17	51K	MC 0.063W 0603 1% 51K	MULTICOMP	FARNELL	9331310	50	1	1.4	Res 51K 0603 1%	0603
R21	SHUNT 5mR	OARS1 - R005FI	Welwyn	FARNELL	1200348	5	1	8	5 mOhm Shunt Resistor	Current SHUNT
Q1	SI2302ADS	SI2302ADS	VISHAY	FARNELL	8156689	5	1	3.55	SI2302ADS	SOT23-GSD
Q2	SI2302ADS	SI2302ADS	VISHAY	FARNELL	8156689	5	1	3.55	SI2302ADS	SOT23-GSD

Figure 5-3. ATAVRAUTO200 assembly drawing



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