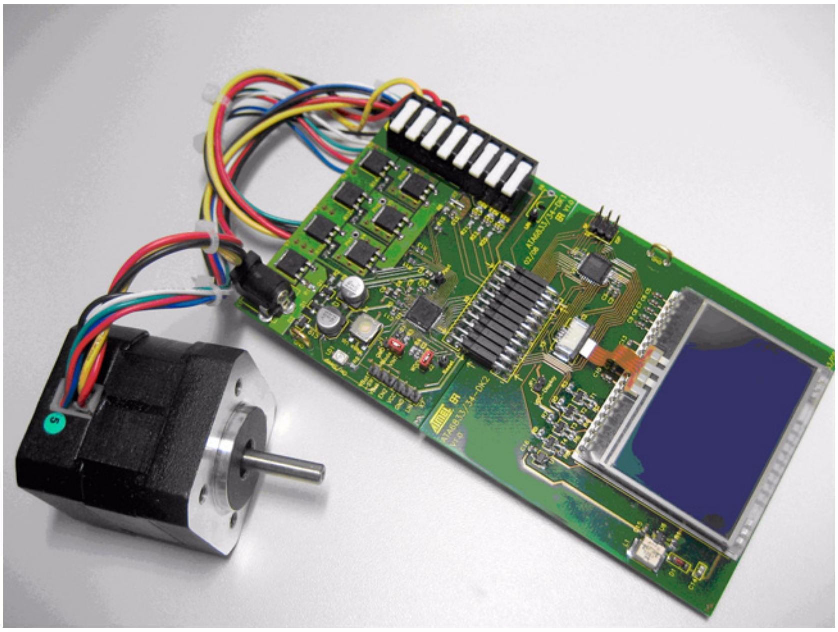
BLDC Motor Control Kit with ATA6833/ATA6834



BLDC Motor Control Kit with ATA6833/ ATA6834

Application Note

1. Introduction

This document provides details on using the ATA6834-DK for BLDC motor control applications. The BLDC Motor Control Kit consists of two boards:

- Basic board with a BLDC Gate Driver SBC (System Basis Chip) ATA6833/ATA6834 and external MOSFETs
- Controller board with a microcontroller ATmega32M1 and a user interface

The temperature range is the primary difference between the ATA6833 and ATA6834. The maximum junction temperature of 200°C allows designing under-the-hood applications with the ATA6834, while the maximum junction temperature of the ATA6833 is 150°C.

If not otherwise stated, the ATA6833 stands for the two of the devices.

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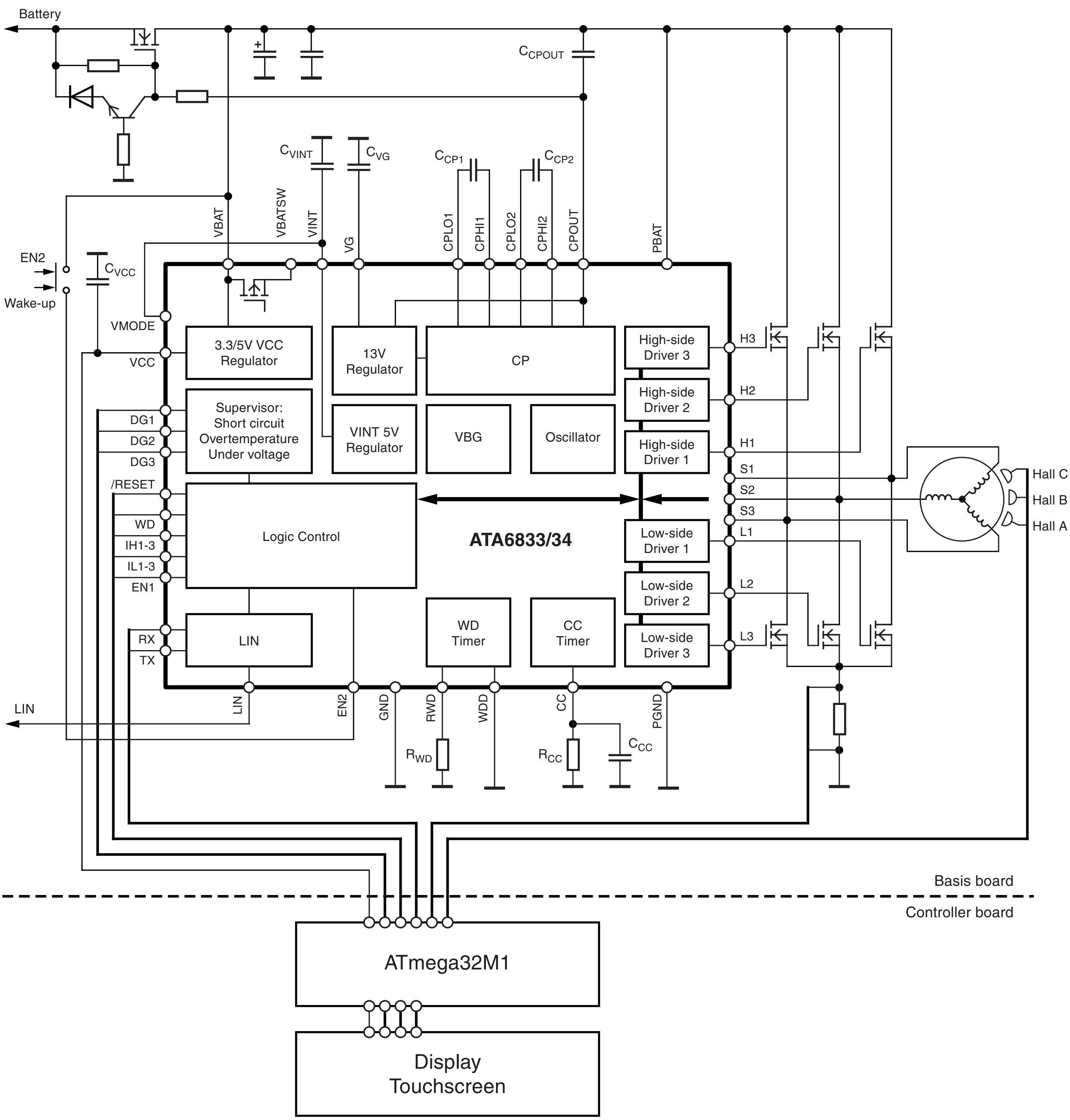
2. BLDC Motor Control Kit with ATA6833/ATA6834

Figure 2-1. Block Diagram



The BLDC control unit consists of two integrated circuits: Microcontroller ATmega32M1 and LIN gate driver System - Basis - Chip ATA6833/ATA6834 (Figure 2-1).

The SBC ATA6833/ATA6834 includes a Voltage Regulator, Window Watchdog, LIN Transceiver and Gate Driver for N-channel MOSFETs. The Voltage Regulator provides the ECU with digital voltage supply, either 5V or 3.3V depending on a jumper setting. The window watchdog is mandatory for lots of automotive applications. It can be deactivated via a jumper, which is useful for debugging. The LIN transceiver enables the communication with the automotive environment.

The ATA6833/ATA6834 works with a two-stage charge pump to run down to very low battery supply voltages. The charge pump facilitates low-drop reverse-voltage protection with an N-channel MOSFET.

The microcontroller ATmega32M1 on the controller board communicates with the user interface. A back-illuminated LCD display with touch panel is also implemented on the controller board.

The loop between motor movement and microcontroller is achieved using Hall sensors. The commutation is done by the microcontroller ATmega32M1, which generates the digital output signals to control the coils. The microcontroller also handles different commutation shapes as well as the diagnostic outputs of the ATA6833/ATA6834.

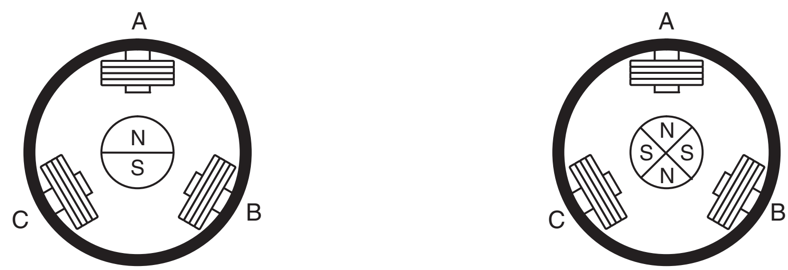
3. BLDC Operation

Brushless DC motors are used in a growing number of applications as they offer several advantages including reduced noise, long life time (no brush erosion), good weight/size to power ratio. Brushless DC motors can also be used in hazardous operation environments such as in the vicinity of flammable products.

These types of motors have a little rotor inertia. Coils are attached to the stator. Commutation is controlled by electronics using position sensors feedback or back electromotive force measurements.

BLDC motor stator basically includes three coils, which can be replicated to reduce torque ripple. The rotor includes permanent magnets composed of one to multiple pair of poles. This also affects step size (see Figure 2). Position can be estimated using three hall sensors, spread around the stator and attached according to the count of the stator pole pairs every 120°.

Figure 3-1. Three-coil BLDC Motor, 1 and 2 Pair Poles



BLDC motor operation can be simplified by considering only three coils and one pair pole. The Phase commutation depends on position, in our case, hall sensors value. When motor coils are supplied, a magnetic field is created and the rotor moves. The most elementary commutation driving method is an on-off scheme: a coil is either conducting or not. Only two coils are supplied at the same time, the third is floating. This is referred as trapezoidal commutation or block commutation.

Figure 3-2. Power Stage

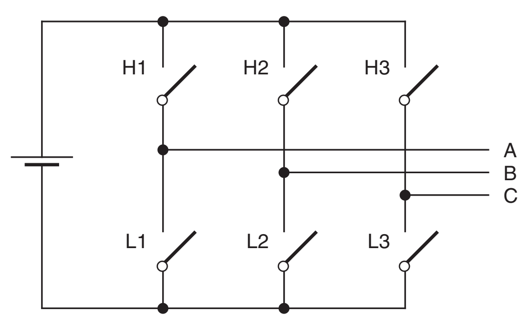
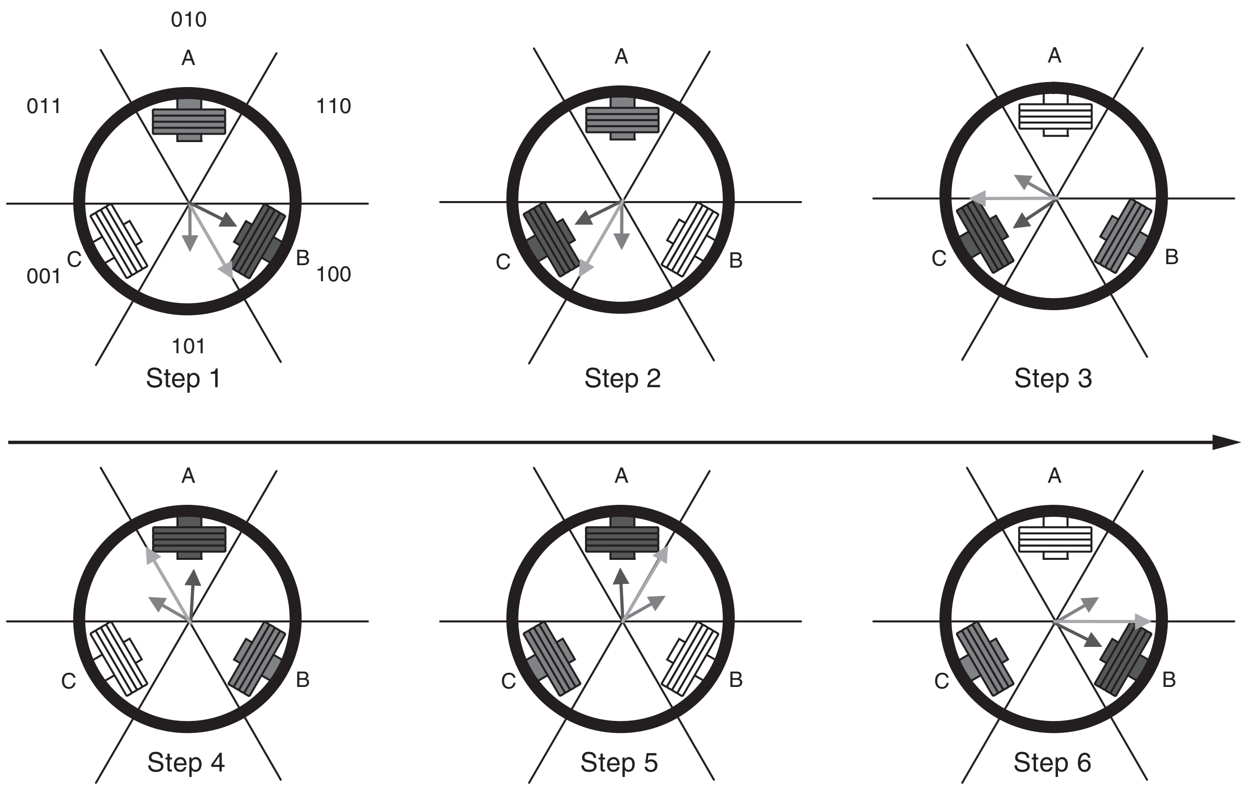


Figure 3-3. Commutation Steps for CW Operation



Reading the hall sensors values indicates the commutation to be performed. For multiple pole motors, electrical rotation corresponds to mechanical rotation with the pair pole number factor.

Table 3-1. Switches Commutation for CW and CCW Rotation

Hall Sensors Value (CBA)	Switches Commutation for CW Rotation		Switches commutation for CCW rotation	
	Coils	Switches	Coils	Switches
101	A - B	H1 - L2	B - A	H2 - L1
001	A - C	H1 - L3	C - A	H3 - L1
011	B - C	H2 - L3	C - B	H3 - L2
010	B - A	H2 - L1	A - B	H1 - L2
110	C - A	H3 - L1	A - C	H1 - L3
100	C - B	H3 - L2	B - C	H2 - L3

Commutations are updated at each step to create a rotating magnetic field as shown in Figure 3-3.

This method takes full advantage of the ATA6833/ATA6834 in combination with the ATmega32M1 as commutations can be transmitted at each step, while PWM allow magnetic field magnitude tuning independently to act on motor torque and speed.

4. System Basis Chip ATA6833/ATA6834

The ATA6833/ATA6834 is designed specifically for automotive applications that require high-power BLDC motors. The six high current gate drivers are capable of driving a wide range of n-channel power MOSFETs. To guarantee steady operation down to crank pulse, a two-stage charge pump provides the voltages to drive the external MOSFETs. Direct control of each gate output allows running the BLDC in different commutation shapes.

Diagnostic outputs immediately indicate short-to-battery, short-to-ground, battery over/under-voltage conditions, charge pump failure and overtemperature prewarning. A dead time control protection feature is also available

The SBC (System Basis Chip) enables designs with reduced component lists and limited PCB space. The ATA6833/ATA6834 includes a Voltage Regulator, LIN transceiver and Window Watchdog.

4.1 Cooling Area Design

The driver IC ATA6833/ATA6834 is housed in a QFN package. QFN package is suitable for power package due to the exposed die pad; however, ensure the heat slug is completely soldered to the PCB.

To reduce thermal resistance, vias down to the soldering layer are necessary. A sufficient ground plane has to be placed on the soldering layer to get rid of the thermal energy.

A via diameter of 0.3 mm to 0.4 mm and a spacing of 1 mm to 1.5 mm has proven to be most suitable. Some care should be taken of the copper area's planarity; in particular, avoid solder bumps arising at the thermal vias.

4.2 Ground Area Design

The common ground reference point of the BLDC ECU (electronic control unit) is located under the ATA6833/ATA6834. On the one side there is the Power Ground Plane, from the ECU power input to the half-bridge foot point. On the other side there is the Digital Ground Plane, including all the circuitry around the Gate Driver SBC. It's reference point is the die pad of the ATA6833/ATA6834.

The exposed die pad must be soldered completely. Through vias, the exposed die pad should be connected with the ground layer. The two ground pins GND (11) and PGND (43) should be connected directly to the die pad.

The N.C. pins (9, 10, 12, 14, 37, 45) are connected internally to the die pad and should also be connected to GND.

The ATA6833/ATA6834 has a lot of regulation loops. To get good EMC performance, the loops should be as short as possible.

The input capacitor at VBAT 100 nF and larger electrolytic capacitor should be connected directly to the die pad of the ATA6833/ATA6834.

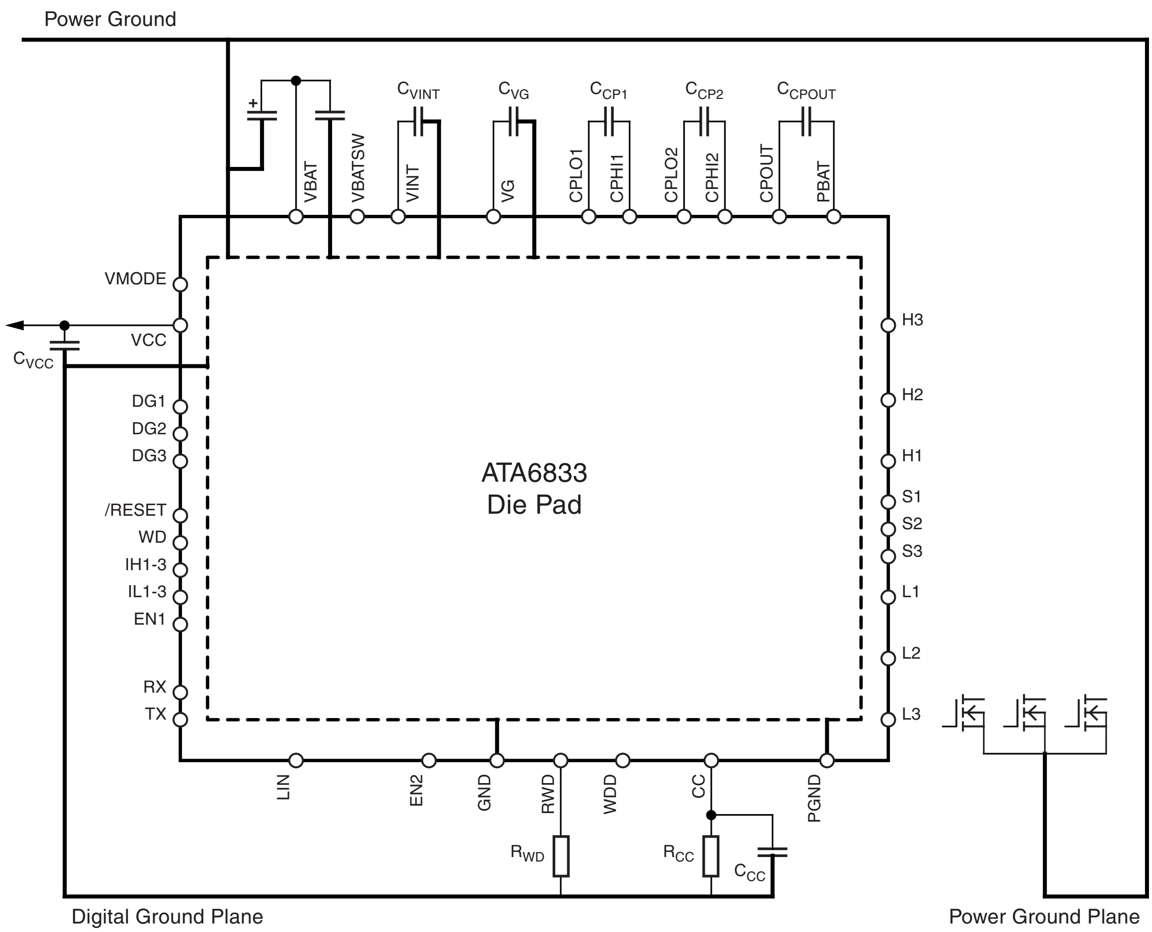
The ground of the VINT capacitor should be connected in star formation directly to the die pad as well the VMODE pin depending on the VCC output voltage.

The ground of the logic part should be separated and also connected in star-formation directly to the die pad. This is the complete microcontroller circuitry.

The charge pump shuffle capacitors should be connected in a short loop. The VG capacitor should be connected in a short loop to the ground reference point. The reservoir capacitor at CPOUT can be connected to PBAT to reduce maximum voltage at the capacitor. Therefore, electrical voltage rating up to 25V is sufficient.

Due to the high gate charge peak currents, the loops for the high-side and low-side MOSFET gate drives should be as short as possible. The source lines are also part of these loops. On the high side, there are the three sense pins Sx. For the low side, this is the common ground pin, which should be connected close to the three source pins of the external low side MOSFETs.

Figure 4-1. Ground Area Connections: Reference Point is ATA6833 Die Pad



5. Microcontroller ATmega32M1

The ATmega32M1 has been developed to provide an integrated solution for advanced motor control applications with CAN and LIN connectivity. Based on the high performance Atmel® AVR® 8-bit RISC architecture, the ATmega32M1 integrates all of the basic peripherals necessary to satisfy the needs of complex algorithms. It integrates analog blocks like 10-bit ADC, with differential amplifiers and programmable gain options. Analog comparators with selectable comparison levels, and interrupts on pin change I/Os. Clocked up to 64-MHz, the 12-bit versatile synchronous Power Stage Controller generates 6 complementary programmable high speed and precision signals to control the 3 half bridges of a motor. A frequency of 64 kHz can be achieved, with a resulting duty cycle resolution of about 1/1000. A comparator is available for over-current detection. The reference level can be fixed using the DAC output. Hardware fault detection will automatically and immediately put the motor in a safe position in case a failure is detected.

The microcontrollers provide all necessary resources to control BLDC motors in their system environments.

ATmega32M1 Main Features

- **Data and Non-Volatile Program Memory**
  - **32 Kbytes Flash of In-System Programmable Program Memory**
  - **1024 Bytes of In-System Programmable EEPROM**
  - **2048 Bytes Internal SRAM**
- **Peripheral Features**
  - **One 12-bit High Speed PSC (Power Stage Controller)**
    - **6 Non-overlapping Inverted PWM Output Channels with Flexible Dead-Time**
    - **Variable PWM duty Cycle and Frequency**
    - **Synchronous Update of all PWM Registers**
    - **Auto Stop Function for Emergency Event**
  - **One 8-bit General purpose Timer/Counter with Separate Prescaler, Compare Mode and Capture Mode**
  - **One 16-bit General purpose Timer/Counter with Separate Prescaler, Compare Mode and Capture Mode**
  - **CAN 2.0A/B with 6 Message Objects**
  - **LIN 2.1 and 1.3 Controller or 8-bit UART**
  - **One Master/Slave SPI Serial Interface**
  - **10-bit ADC with up to 11 Single Ended Channels and 3 Fully Differential ADC Channel Pairs**
  - **10-bit DAC for Variable Voltage Reference (Comparators, ADC)**
  - **Four Analog Comparators with Variable Threshold Detection**
  - **Interrupt and Wake-up on Pin Change**
  - **Programmable Watchdog Timer with Separate On-Chip Oscillator**
  - **On-chip Temperature Sensor**
- **Special Microcontroller Features**
  - **Low Power Idle, Noise Reduction, and Power Down Modes**
  - **Power On Reset and Programmable Brown Out Detection**
  - **In-System Programmable via SPI Port**
  - **Internal Calibrated RC Oscillator (8 MHz)**
  - **On-chip PLL for fast PWM (64 MHz) and CPU (16 MHz)**

Note: Refer to the ATmega32M1 datasheet for the complete description of the ATmega32M1 microcontroller.

6. High Ambient Temperature

The ATmega32M1 is available in automotive temperature range according to AEC-Q100 up to grade 0. This allows operating temperature up to 150°C.

The maximum junction temperature of the ATA6834 is 200°C. Therefore for 150°C ambient temperature applications a margin of 50K for power dissipation is available. Basically there are three heat sources in the ATA6833: VCC voltage regulator, charge pump and all the rest of internal operating circuitry.

1. The VCC voltage regulator is the main heating source on the device. Typical VCC regulator parameters are 5V VCC output voltage, 30 mA VCC output current and 15V VBAT supply voltage. Based on these parameters, the thermal energy to dissipate is $P_{VCC} = (U_{VBAT} - U_{VCC}) \times I_{VCC} = (15V - 5V) \times 30\ mA = 300\ mW$. (1)
2. The current consumption of the internal operating circuitry is specified in the datasheet as maximum 7 mA. At VBAT = 15V the power dissipation is $P_{INTERNAL} = U_{VBAT} \times I_{VBAT} = 15V \times 7\ mA = 105\ mW$. (2)
3. The power dissipation of the charge pump depends on the dedicated n-channel output MOSFETs and the PWM frequency. Due to the design of the charge pump, approximately the triple charge is needed into VBAT to charge the gates of the external MOSFETs. The ATA6833 needs to dissipate the complete power absorbed through PBAT - inside the charge pump, the on and off switches. The gates of the external MOSFETs are considered as ideal capacitors.

Example: 100 nC gate charge capacity, 20 kHz PWM frequency, only one half bridge is switched once, high side gate source voltage = low side gate source voltage = 15V

$$P_{PBAT} = 3 \times U_{GS} \times I_{GATE} = 3 \times U_{GS} \times Q_{GATE} \times f_{PWM} \quad (3)$$

$$P_{CP} = 3 \times 15V \times 100\ nC \times 20\ kHz = 3 \times 15V \times 2\ mA = 90\ mW$$

Total power dissipation is $P_{TOTAL} = P_{VCC} + P_{PBAT} + P_{INTERNAL} = 495\ mW$ (4)

The SBC ATA6833 has enhanced temperature monitoring. A first temperature threshold 5K lower than maximum specified junction temperature indicates at pin DG3 a temperature pre-warning. If the junction temperature is increased by further 25K, the outputs, voltage regulator and LIN transceiver are switched off. Maximum junction temperature of the ATA6833 is 150°C and of the ATA6834 is 200°C. The maximum ambient temperature depends on the power dissipation of the device; a better thermal contact allows a higher ambient temperature.

For exact behavior please see the ATA6833/ATA6834 datasheet on the Atmel website.

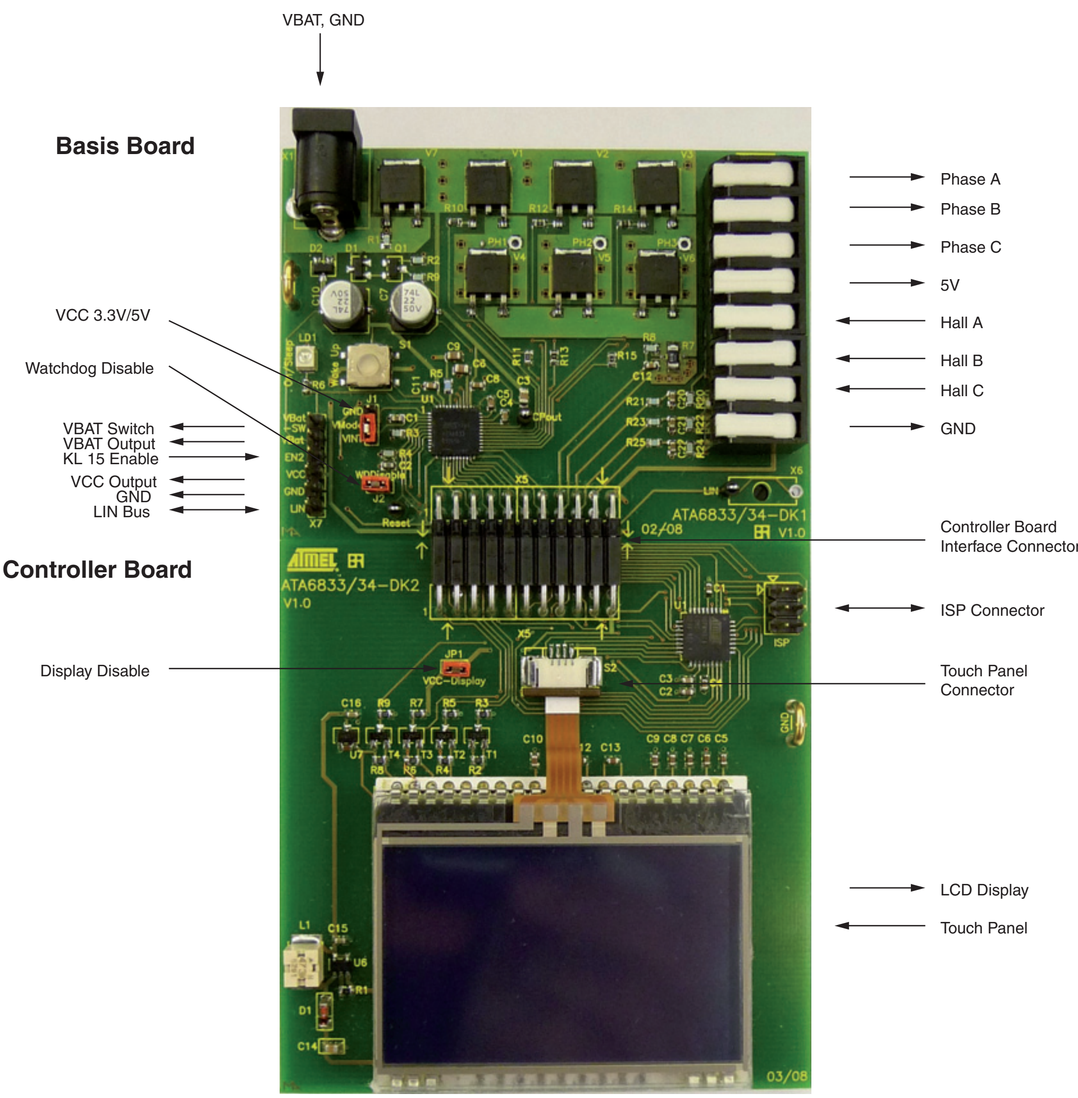
7. Application Board

The application board is ready to run when connected to 12V at connector X1 on the Basis Board. The Basis Board and Controller Board must be connected to each other via connector X5 on both boards.

The board can be connected to the automotive environment over LIN bus by the LIN clamp. There is no LIN protocol handler implemented in the microcontroller. A touch-screen display on the Controller Board acts as the user interface. To the application board running, the following two steps need to be done:

1. Jumper J1 on the Controller Board should be placed to supply the display. After this interaction with the resistive touch panel is possible. If this is not done, the display remains dark and the VCC current demand is only the demand of the Hall sensors. The microcontroller and BLDC operation can also run without J1. In this case, interaction with the panel is possible; however, the touch panel works only resistively.
2. The application system needs to be woken up. For this purpose, push the button S1.

Figure 7-1. Application Board Top View, and Connector's Usage



7.1 Basis Board

7.1.1 On-board Features

The Basis board provides the following features:

- **ATA6833/ATA6834 QFN48 7 mm x 7 mm**
  - **Gate Drivers for External N-channel MOSFETs**
  - **VCC Regulator for 5V or 3.3V Operation, Window Watchdog, LIN Transceiver up to LIN 2.1 Compliant**
- **6 External MOSFETs SQD50N04-09H up to 50A DC Current**
- **Low-drop Reverse-voltage Protection with SQD50N04-09H**
- **S1 Button for Wake Up**
- **LED On/Sleep Controlled by VBATSW to Indicate Normal Mode/Sleep Mode**
- **Hall Sensor Feedback**
  - **Feedback Loop by Hall Sensors**
  - **Designed for Integrated Hall Sensors with Digital Supply 5V**
  - **ATA6833/ATA6834 Capable of Generating 5V and 3.3V Digital Output Voltage**
    Note, the integrated Hall sensors usually only work with 5V supply
    BLDC movement is not possible at 3.3V
- **LIN Transceiver**
  - **Board is Configured as a LIN Slave without Pull Up and Diode for Master Mode Configuration**
  - **Access to the Pin via Test Point, 2 mm Banana Plug Layout Placed on the PCB**
- **Connectors**
  - **Power Supply (Battery Voltage)**
  - **Automotive Environment (LIN, EN2, VBATSW)**
  - **BLDC Motor Connector (3 Phase)**
  - **Hall Sensors Inputs and Supply (3 Filtered Inputs and 5V Regulated Supply Voltage)**
  - **Microcontroller Interface**
- **Dimensions: 80 mm × 59 mm**

There are two monitoring pins on the Basis board:

- For investigations, Watchdog can be disabled by setting the WDD Jumper to ON
- VCC voltage should be set via VMODE jumper to 5V mode by connection VMODE - VINT
- At normal function, the Reset pin is always on high level. Otherwise some failures may occur, see datasheet ATA6833/ATA6834
- At CPout, the charge pump voltage is measurable. The charge pump voltage level U_{CPOUT} is approximately 15V higher than U_{VBAT}.
- If the ATA6833/ATA6834 is in standby mode, the high voltage output switch pin VBATSW is off and LED On/Sleep is off. There are two possibilities to wake up the Basis board: press S1 “Wake Up” or generate a falling edge at the LIN pin.

7.2 Controller Board

7.2.1 On Board Features

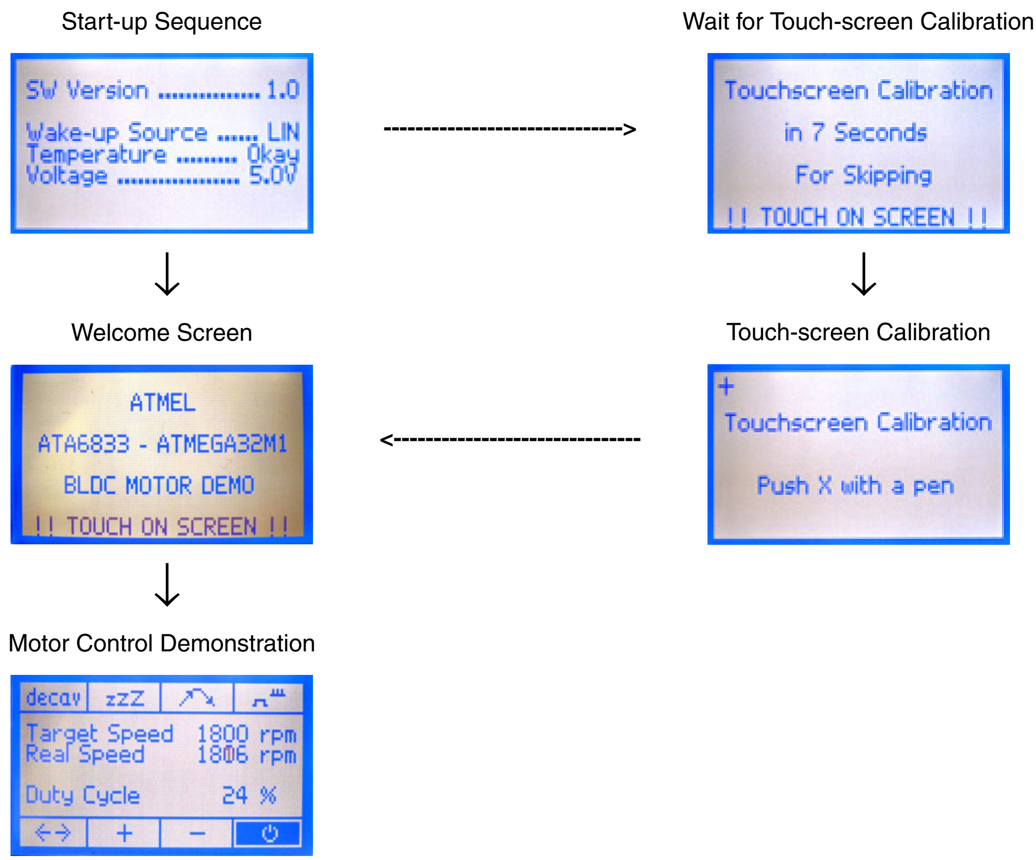
The Controller board provides the following features:

- **ATmega32M1 QFN32 7 mm x 7 mm**
  - **8-bit AVR Microcontroller**
  - **8-MHz Internal RC Oscillator, Using 64 MHz Internal PLL, CPU Frequency of 16 MHz at 5V VCC Supply Voltage**
- **Display/Touch Panel Unit**
  - **Display DOGM128 128 × 64 Pixel, 3.3V SPI Interface, Control via Level Shifters**
  - **White LED-Backlight**
  - **Touch Panel EA Touch128-1**
  - **Display Unit Disable via Jumper J1**
- **Current Source for LED-Backlight**
- **Connectors**
  - **Microcontroller Interface to BLDC Basis Board**
  - **6-Pin ISP Connector for In-System Programming and On-chip Debugging via debugWIRE Using JTAGICEmkII**
  - **Connector for Touch Panel**
- **Dimensions: 80 mm × 82 mm**

The only component on the controller board, which is necessary for BLDC application is the ATmega32M1. The rest of the components are needed to support the display/touch panel unit.

8. Software Description

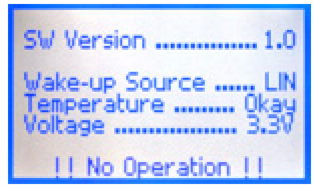
8.1 Menu Description



8.1.1 Start-up Sequence

During the start-up sequence the reset or wake-up source will analyzed as well as the diagnostics pins (DG1..3) of the ATA6833/ATA6834. When “LIN” is shown as wake-up source, then power cycling or a wake-up signal on the LIN bus can be the source. “EN2” means that the Wake-up Button on the Basis board was pressed to wake up the system. The DG3 pin of the ATA6833/ATA6834 signals temperature warning. When this pin is high, the temperature warning will be shown on the display. When this pin is low, temperature will signed as okay. The DG2 pins signal voltage failures like undervoltage, overvoltage, or a charge pump failure. In these cases, the voltage failure message will be shown. Otherwise, the internal VCC voltage of the microcontroller (VCC = 3.3V or VCC = 5.0V) is detected and is visible on the display. Due to the 16 MHz, the AVR and the integrated hall sensors can only operate at minimum VCC voltage of 4.5V. When VCC is 3.3V, the operation is stopped with the screen as shown in Figure 8-1 on page 14.

Figure 8-1. Start-up Sequence



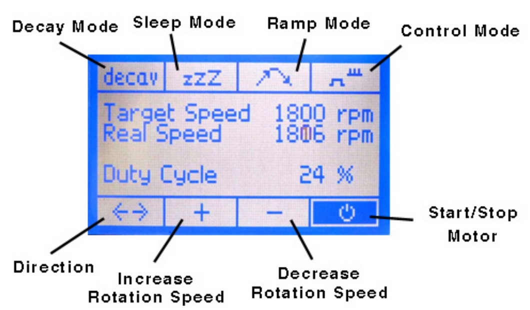
8.1.2 Touch-screen Calibration

In order to improve touch recognition, a calibration routine is implemented. As long as the touchscreen is not calibrated, the calibration routine will be executed after each start-up. The touch-screen calibration requires a minimum of one touch event on each corner and has a plausibility check. The calibration procedure is repeated until the plausibility check is successfull. Default values will be used if the calibration is skipped.

Note: Touch-screen calibration is done in factory and is only required if the microcontroller is reprogrammed or the EEPROM is erased.

8.1.3 Motor Control Demonstration

Figure 8-2. Motor Control Demonstration



8.1.4 Functional Description of the Touch Buttons

Start/Stop Motor:

- Motor starts and accelerates the rotation up to the target speed.

Increase Rotation Speed:

- Increases the rotation by 50 rpm (round per minutes).

Decrease Rotation Speed:

- Decreases the rotation speed by 50 rpm.

Direction:

- Switches between clockwise and counterclockwise direction.

Control Mode:

- Switches between three different modes of the half-bridges control.
  Note, this button can only be used when the motor is stopped.

Ramp Mode:

- Enables ramp mode. The rotation speed is automatically increased up to 7000 rpm and then decreased down to 300 rpm. This function repeats until the ramp mode is disabled.

Sleep Mode:

- This function activates a countdown of 3 seconds. After this, the ATA6833/ATA6834 is set into sleep mode. Pressing the wake-up button on the Basis board restarts the ATA6833/ATA6834.

Decay Mode:

- Enables a slow decay of the half-bridge control.
  Note: this button can only be used when the motor is stopped.

8.1.5 ATA6833/ATA6834 Diagnostic Function

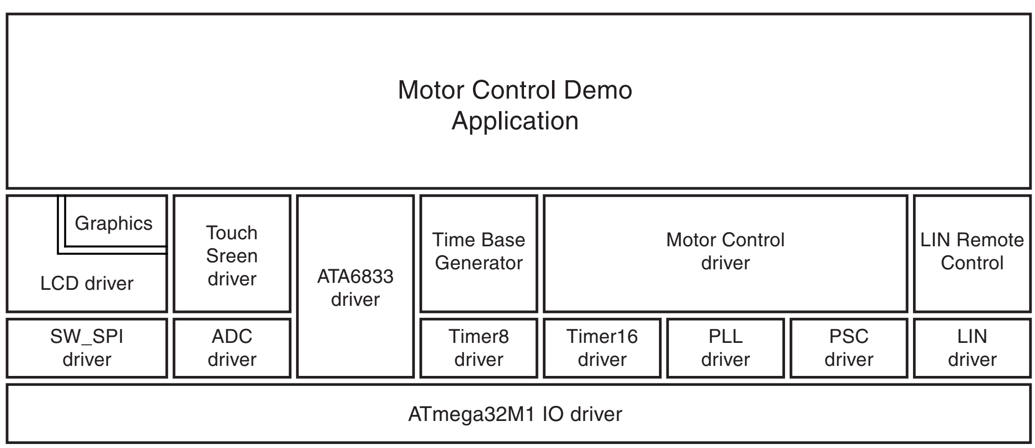
If a voltage failure, temperature warning, or short-circuit detection occurs, a message will be displayed as long as the voltage failure or temperature warning is present. For the short circuit detection, the message must be acknowledged by touching the screen.

Figure 8-3. Diagnostic Function

8.1.6 Software Module Overview

The software is implemented in C language and the source code can be compiled using compilers from IAR Systems as well as from GCC for AVR.

Figure 8-4. Software Module Overview



The software consists of several modules. The modules Graphics, LCD, Touch, ADC and SW SPI driver are only needed for the user interface. For motor control the following modules are necessary: Time Base Generator, Motor Control, ATA6833, Timer8, Timer16, PLL and PSC driver. ALIN remote control function is also implemented.

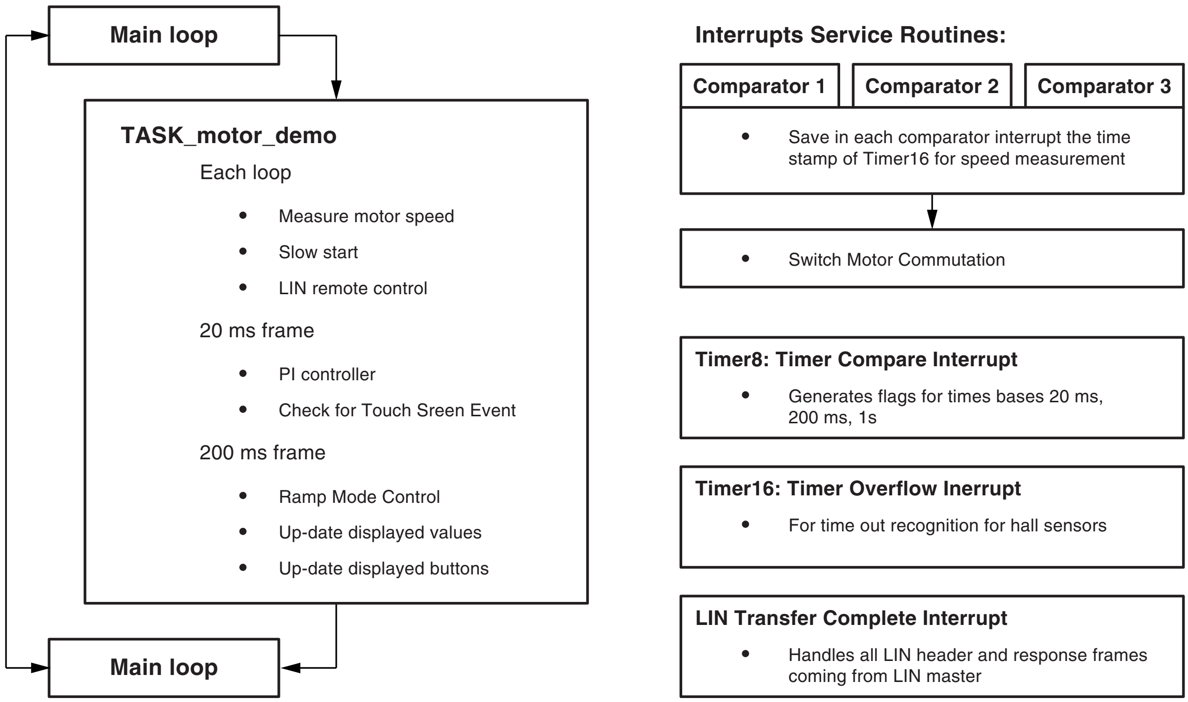
The following MCU peripherals are used:

- PSC - Power Stage Controller
  - All 6 PSC output channels are used for controlling the half-bridges
  - 64 MHz input clock
  - 10-bit bandwidth and the center-aligned mode of the PWM signal result in a switching frequency of 31.280 kHz
- 8-bit Timer/Counter 0
  - This timer is used to generate different time bases (e.g. 250 µs, 20 ms, 200 ms and 1s time windows)
- 16-bit Timer/Counter 1
  - This timer is used to measure the rotation speed and to detect time out when the motor is stopped
- 10-bit ADC
  - ADC channel 6 gives the X position of the touch event
  - ADC channel 5 gives the Y position of the touch event
- 64 MHz PLL
  - 16 MHz as input clock for CPU
  - 64 MHz as input clock for PSC
- Analog Comparators
  - Analog Comparator AC1, AC2 and AC3 are used for Hall sensors edge detection to find motor position and to drive the commutation
- LIN/UART interface
  - Configured as LIN 1.3 slave, baud rate 19200

8.2 Diagrams

The following diagram shows the flow chart in normal operation.

Figure 8-5. Flow Chart in Normal Operation



8.3 Modules

Doxygen documentation is included in the software package. Use the DOC/index.html file in the root directory to open the documentation.

The following description contains all relevant function modules for the motor control.

`int main(void)`

Initialize peripherals (e.g. ADC, timers, etc.) and service modules (e.g. LCD, Touch screen and Motor Control etc.). Shows Startup Screen and launches Touch Screen Calibration (in first usage only). Starts Motor Control Application (call of TASK_motor_demo).

`void TASK_motor_demo(void)`

This function is called frequently by the main function. It handles the motor control commandos depending on the touch screen user input and displays the corresponding values for speed and duty cycle. At each call the motor speed is updated (by calling mc_update_measured_speed_rpm). Every 20 ms the PI controller (mc_control_speed) is executed and different motor control commandos are performed depending on the touch screen activity. The display content is updated every 200 ms and the speed is regulated in ramp mode.

`void mc_init(void)`

This function initializes the PLL (64 MHz) as input clock for the PSC and the PSC (Power Stage Controller) for the PWM signal generation, the 16-bit timer and the analog comparators for each hall sensor.

`void` mc_start_motor`(void)`

Enables peripherals like analog comparators and timer to start the motor rotation.

`void` mc_stop_motor`(void)`

Stops the motor rotation by disabling of the 16-bit timer and analog comparators. The PSC output pins are switched.

`U8` mc_get_run_stop`(void)`

Returns the status of the motor (use definitions TRUE or FALSE).

`void` mc_control_speed`(void)`

This function contains a PI controller to control the rotation speed by adjusting the duty cycle of the PWM signals.

`void` mc_switch_commutation`(void)`

Performs the commutation depending on rotation direction and the commutation type.

`U16` mc_get_dutycycle`(void)`

Returns the current used value for the output compare register of the PSC (0..1000).

`void` mc_set_direction`(U8) - U8` mc_get_direction`(void)`

These functions set or return the rotation direction (use definitions MC_LEFT_ROTATION or MC_RIGHT_ROTATION).

`void` mc_set_cmd_speed`(U16) - U16` mc_get_cmd_speed`(void)`

These functions set or return the target speed.

`U16` mc_get_measured_speed_rpm`(void)`

Returns the current measured speed in rpm (rounds per minute).

`void` mc_ramp_mode_down`(void) - void` mc_ramp_mode_up`(void)`

Enables the ramp mode and the direction of the speed alternation.

`void` mc_stop_ramp_mode`(void)`

Disables the ramp mode.

`U8` mc_get_ramp_mode_status`(void)`

Returns the ramp mode status and current running up or down direction (use definitions MC_RAMP_UP, MC_RAMP_DOWN or FALSE).

`void` mc_enable_slow_decay_mode`(U8)`

Enables the slow decay mode (use definitions MC_SLOW_DECAY_MODE_HS or MC_SLOW_DECAY_MODE_LS).

`void` mc_disable_slow_decay_mode`(void)`

Disables the slow decay mode.

`U8` mc_get_slow_decay_mode`(void)`

Returns the current used decay mode (use definitions MC_SLOW_DECAY_MODE_HS or MC_SLOW_DECAY_MODE_LS).

`void` mc_set_commutation_type`(u8)`

Sets commutation type (use definitions MC_COM_HS or MC_COM_LS or MC_COM_HLS).

`U8` mc_get_ commutation_type `(void)`

Returns the on-going commutation type (use definitions MC_COM_HS or MC_COM_LS or MC_COM_HLS).

8.3.1 LIN Remote Control

The demonstration software for the ATA6833/ATA6834-DK includes a LIN remote control function. This application represents a LIN slave node based on LIN1.3. It is possible to control the motor by several commands.

8.3.1.1 LIN properties

- LIN1.3, 19200 baud rate
- LIN ID 0x03 is implemented as TX message handler and returns motor speed when a header frame is received from LIN master
- LIN ID 0x02 is RX message handler and expects header+data frame from LIN master. The data frame has to contain motor control commands like it is shown in the list below.
- Message length of LIN ID 0x02 and 0x03 is 2 bytes

When the application receives a valid command then the display information will be updated accordingly. Command behavior is similar to a switched button. For example, sending the command LIN_MOTOR_START_STOP at the first time, the motor will start. At the second time the motor will be stopped.

Table 8-1. LIN Remote Control - Command List

Command Value (1st and 2nd Byte)	Description
0x02 0x00	LIN_MOTOR_START_STOP
0x03 0x00	LIN_MOTOR_SPEED_UP
0x04 0x00	LIN_MOTOR_SPEED_DOWN
0x05 0x00	LIN_MOTOR_LEFT_RIGHT
0x07 0x00	LIN_MOTOR_RAMP_MODE
0x08 0x00	LIN_MOTOR_SLEEP
0x09 0x00	LIN_MOTOR_SLOW_DECAY
0x0A 0x00	LIN_MOTOR_COM_TYPE

9. Application Board Full Description

9.1 BLDC Application Basis Board ATA6833-DK1

Figure 9-1. BLDC Application Basis Board Schematic ATA6833-DK1

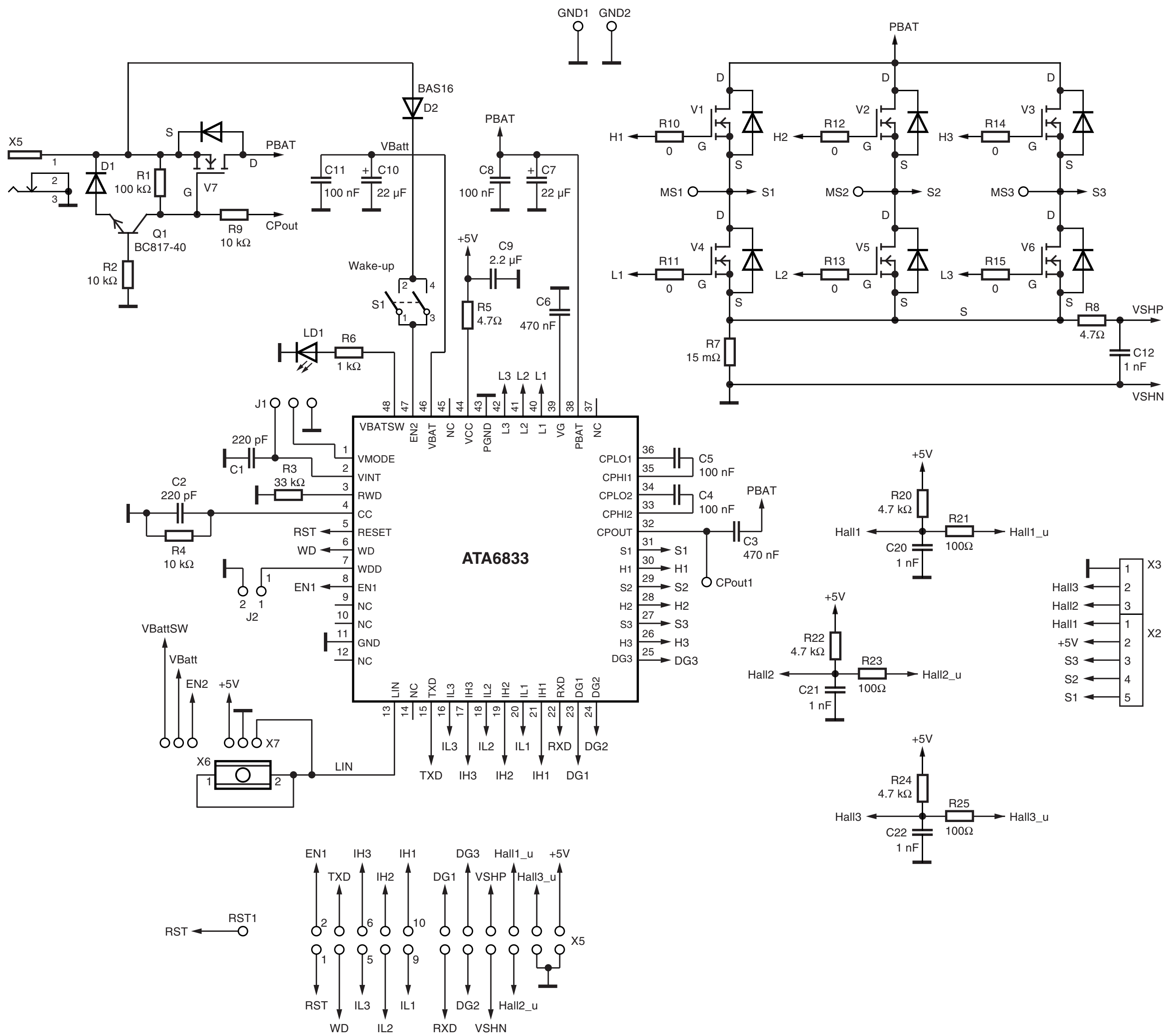


Figure 9-2. Application Basis Board Top View Component Placement ATA6833/ATA6834-DK1

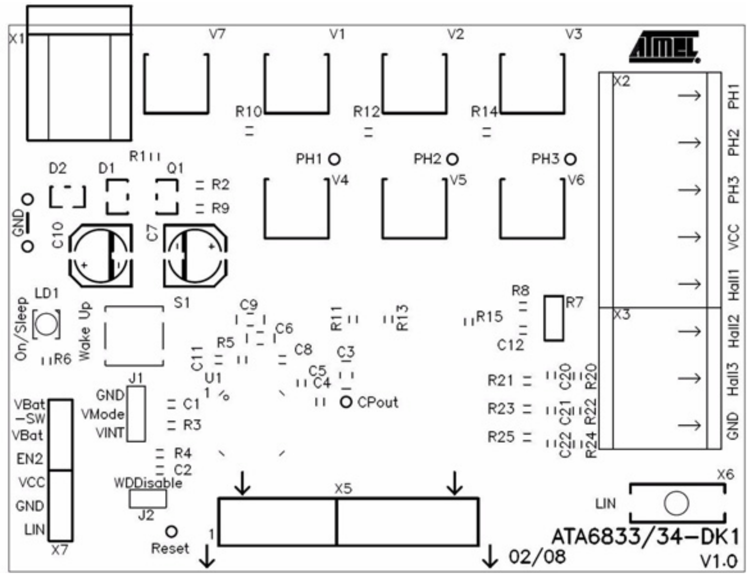


Figure 9-3. Application Basis Board Top View PCB Layout ATA6833/ATA6834-DK1

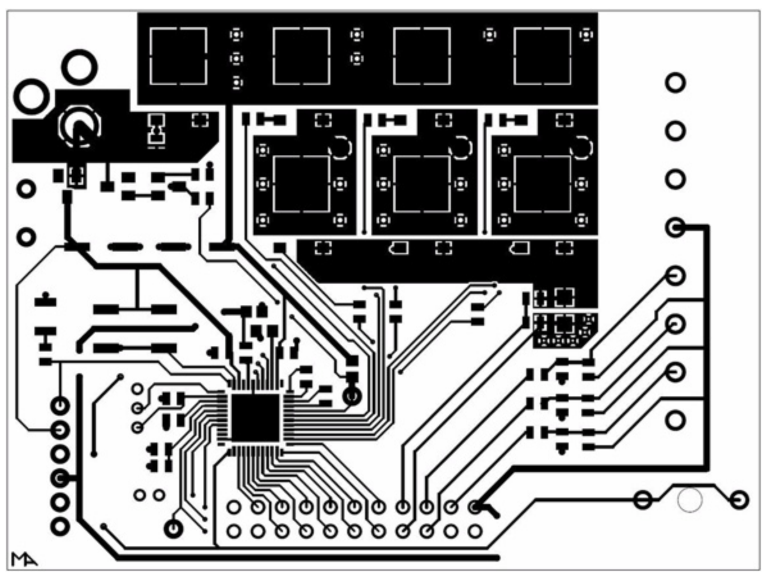


Figure 9-4. Application Basis Board Bottom Side (Top View) PCB Layout ATA6833/ATA6834-DK1

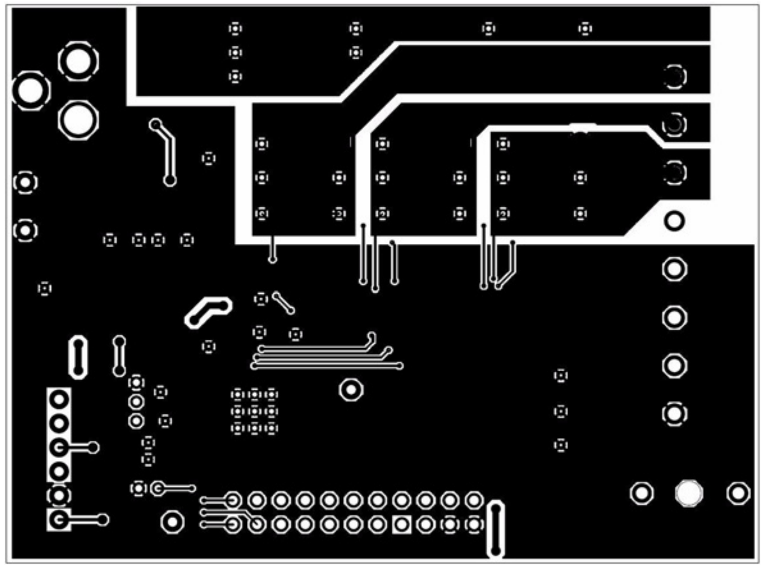


Table 9-1. BLDC Application Basis Board Connectors

Connector	Clamp	Function	Direction
X1	1	Power 12V	Power
	2	GND	Power
X2	1	Motor Phase A	Output
	2	Motor Phase B	Output
	3	Motor Phase C	Output
	4	Power 5V	Output
	5	Hall A	Input
X3	1	Hall B	Input
	2	Hall C	Input
	3	Power GND	Output
X5	All	Microcontroller Interface	I/O
X7	1	VBATSW	Output
	2	VBAT	Output
	3	EN2	Input
	4	VCC	Output
	5	GND	Power
	6	LIN	Input

Table 9-2. BLDC Application Basis Board Jumpers

Jumper	Clamp	Function	Direction
J1	1 to 2	VMODE to GND	VCC = 3.3V
	2 to 3	VMODE to VINT	VCC = 5V
	OFF	Not allowed	-
J2	ON	Watchdog	Disabled
	OFF	Watchdog	Enabled

Table 9-3. BLDC Application Basis Board Switches

Switch	Function
S1	Wake Up to EN2

9.2 BLDC Application Controller Board ATA6833-DK2

Figure 9-5. BLDC Application Controller Board Schematic ATA6833-DK2

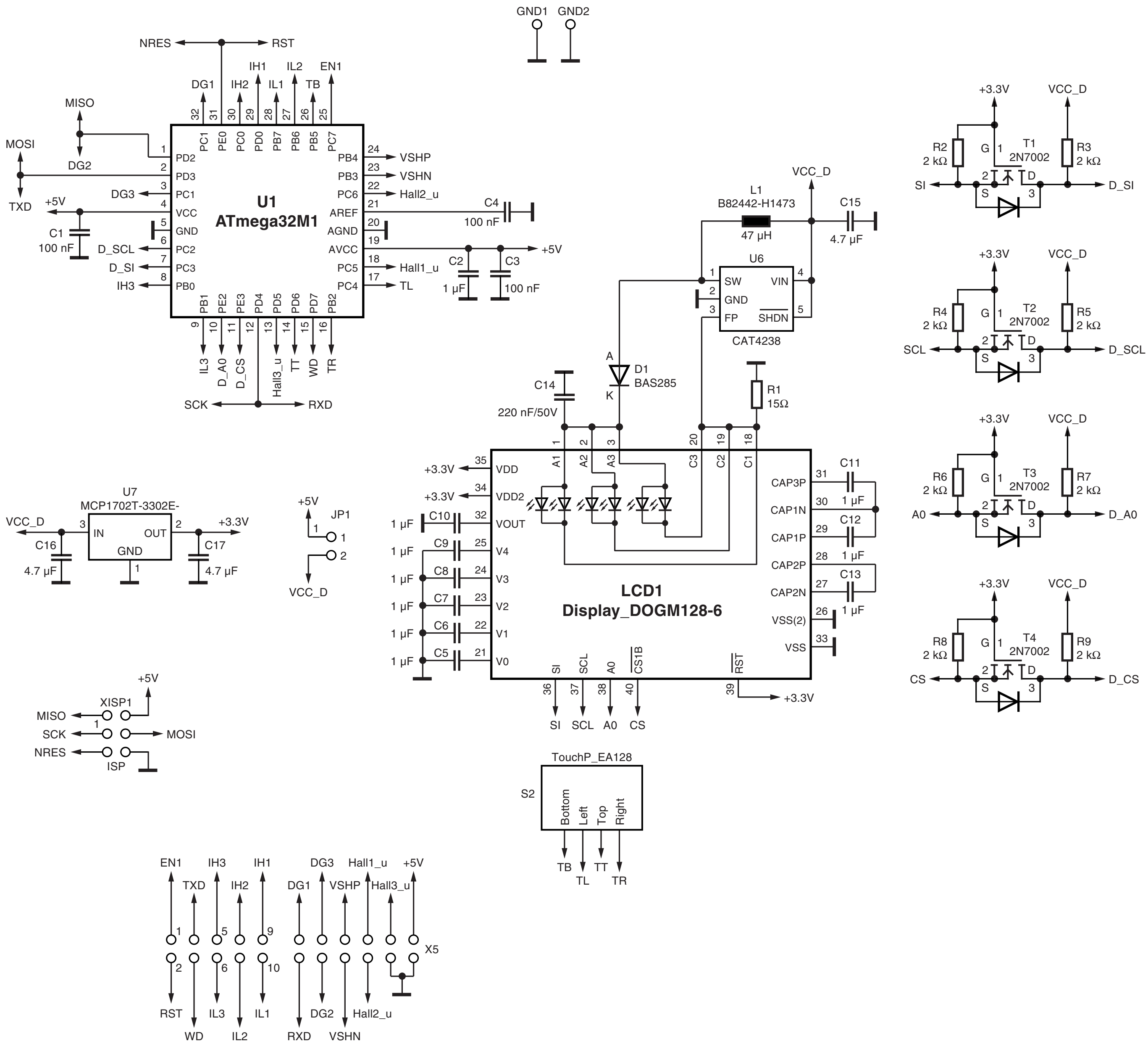


Figure 9-6. Application Controller Board Top View Component Placement ATA6833/ATA6834-DK2

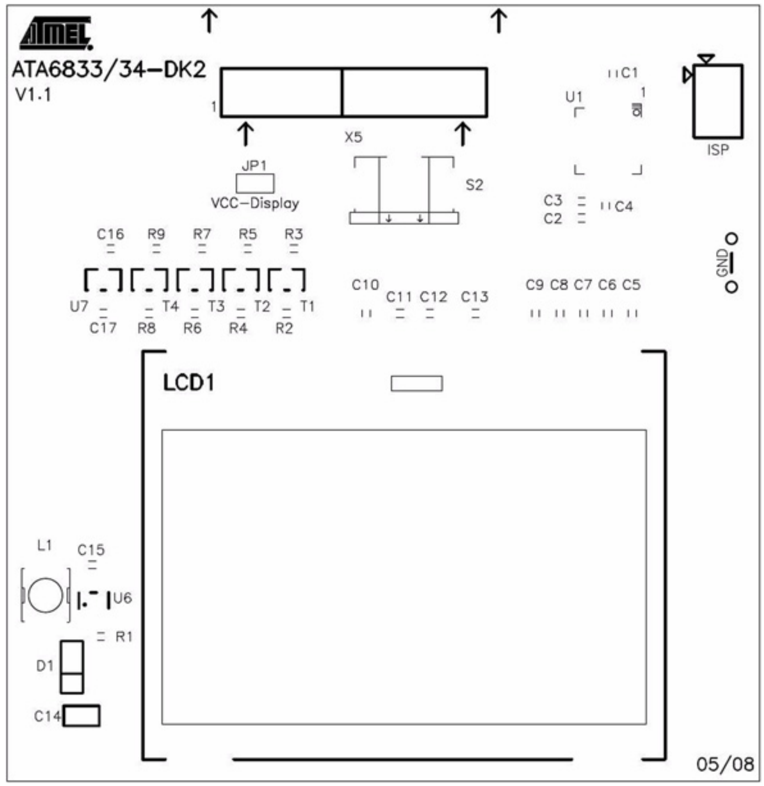


Figure 9-7. Application Controller Board Top View PCB Layout ATA6833/ATA6834-DK2

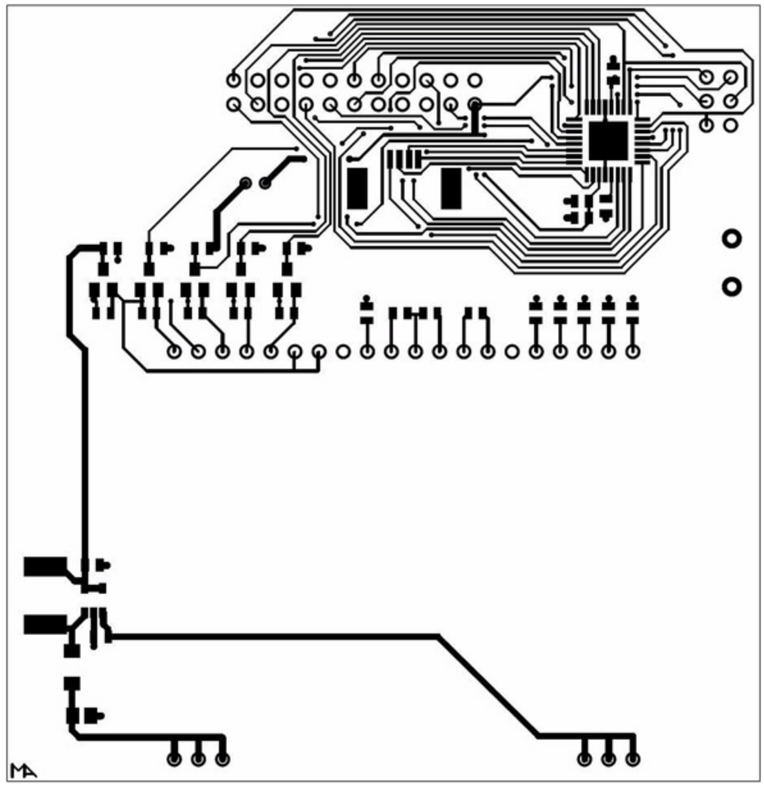


Figure 9-8. Application Controller Board Bottom Side (Top View) PCB Layout ATA6833/ATA6834-DK2

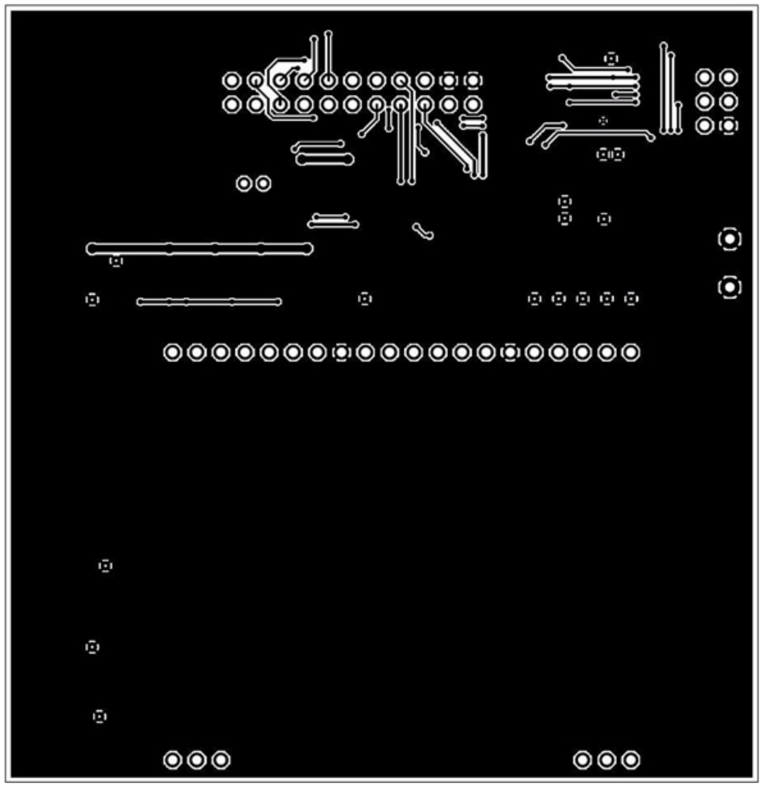


Table 9-4. BLDC Application Controller Board Connectors

Connector	Clamp	Function	Direction
X5	All	Microcontroller Interface	I/O
ISP	1-6	ISP Connector	Output

Table 9-5. BLDC Application Controller Board Jumper

Jumper	Clamp	Function
J1	ON	Supply for display ON
	OFF	Supply for display OFF

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