

8-bit

Microcontroller

AP08088

Hardware Description
XC878CM DriveCard

Application Note

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Microcontrollers

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XC878CM DriveCard

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none

Page	Subjects (major changes since last revision)

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1 Overview

The XC878CM DriveCard is designed to be used in motor control systems. It provides all the signals necessary to drive a power Inverter, including feedback signals.

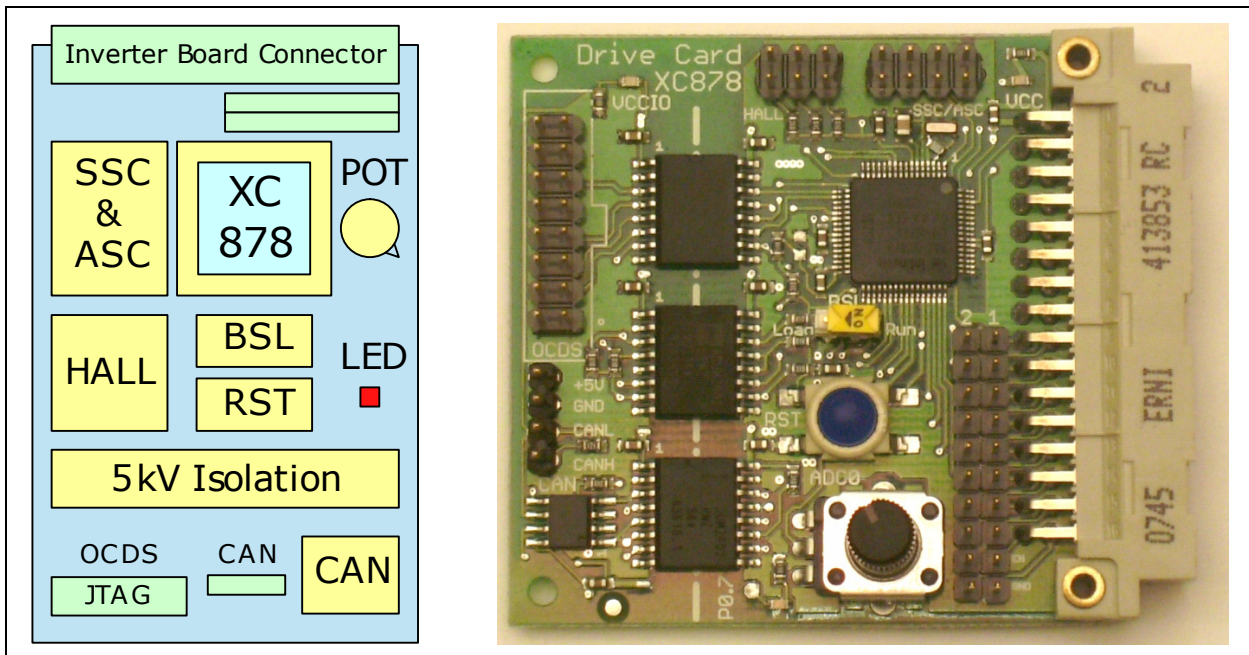


Figure 1 XC878CM DriveCard

This DriveCard, featuring the cost-effective 8-bit microcontroller XC878CM with 16-bit motor control performance, provides the following interfaces:

- SSC: A synchronous serial interface like SPI
- ASC: An asynchronous serial interface based on UART protocol
- HALL: The HALL interface can be used to directly connect HALL sensors of a motor
- Digital isolated JTAG: Programming and debugging interface
- Digital isolated CAN: Controller Area Network e.g. for real-time monitoring and parameter setup
- User interface: A POT and an LED can be used as the user interface in standalone operation

The inverter board connector provides the following signals:

- Six PWM channels for 3-phase motor control (CAPCOM6E)
- Six PWM channels for 3-phase motor control (T2CCU)
- PWM and feedback signals for digital PFC (T2CCU)
- Shut down signal for PWM channels (CTRAP)
- Enable signal for power inverter
- Seven ADC channels for fast analog signals such as DC-link current and phase voltages, as well as slow signals such as temperatures
- The power supply (5 V) for the DriveCard

1.1 Key Features of XC878CM for Motor Control Applications

- High performance 16-bit vector computer (CORDIC + MDU)
 - Vector rotation and transformations such as Park and Clarke transformation
 - Normalizing and scaling
 - Interrupt based operation with minimum CPU load
- PWM unit for advanced motor control (CapCom6E)
 - 16-bit resolution for high precision space vector PWM generation
 - Dead time control for minimum hardware effort (direct control of MOSFET/IGBT)
 - CTRAP provides hardware overload protection
- PWM unit for motor control or power factor correction (T2CCU)
 - 16-bit resolution for PWM generation
- A fast 10-bit A/D Converter
 - Hardware synchronization to PWM units reduces CPU load
 - Eight ADC channels with a sample time of less than 200 ns
 - Four result registers to maximize sampling performance
 - Enables phase current reconstruction at single shunt current measurement
 - Fast ADC reduces torque ripple due to minimized blind angle in sensorless FOC

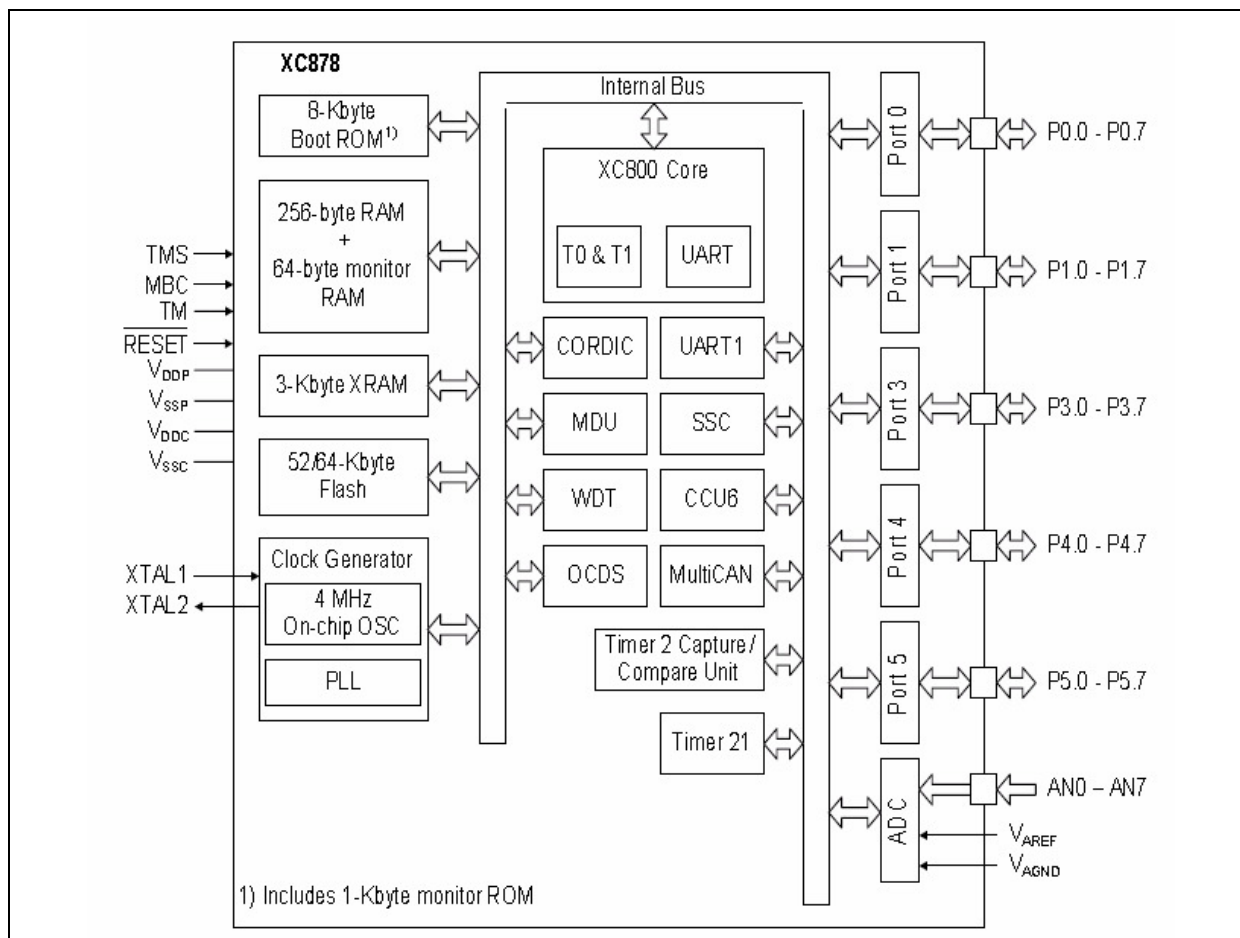


Figure 2 Block Diagram of XC878CM

2 Hardware Description

2.1 Power Supply

The XC878CM DriveCard is supplied by two power supply domains.

The main supply (VCC) is fed from the Inverter board connector ([Section 2.5](#)) and is connected to the MCU and all associated blocks.

A second supply domain (VCCIO) exists for the digital isolation and the CAN transceiver. This can be provided via the CAN or the JTAG connector. Please refer to [Section 2.4](#) for details.

Two LEDs indicate the presence of these supply voltages.

2.2 MCU (Microcontroller)

The microcontroller unit XC878CM is directly connected to the dedicated interfaces. Next to the integrated clock oscillator, an external resonator is available.

A software download can be performed via JTAG or CAN. Note that in the case of the CAN download, the switch BSL (Boot Strap Loader) has to be set to "load". For normal operation the position "run" has to be selected. A reset button is available to trigger a hardware reset.

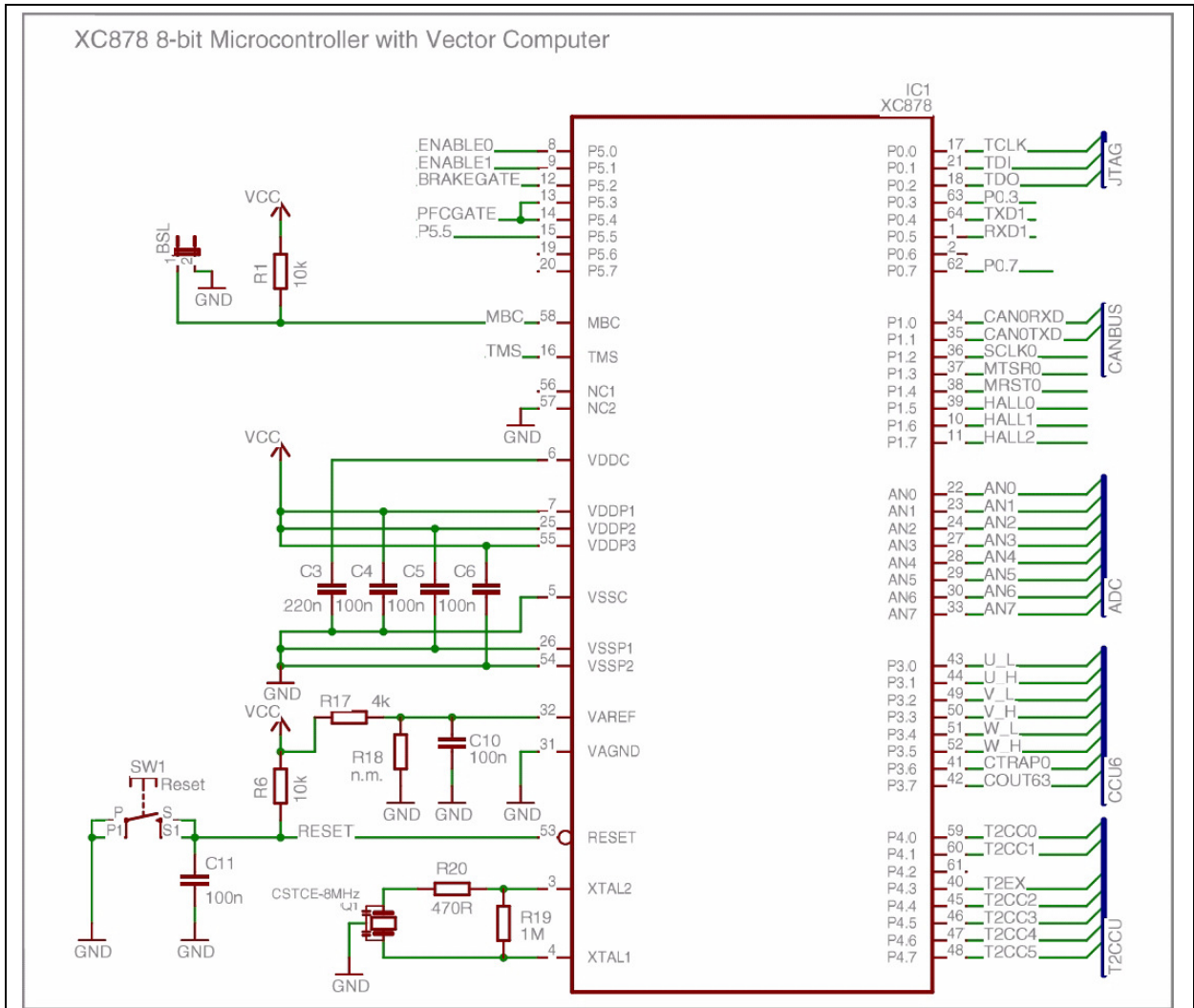


Figure 3 XC878CM

2.3 User Interface

A user interface is available by making use of a POT and an LED. The POT is connected to ADC channel 0, the LED is connected to port 0.7. A test pad is also connected to this port in order to measure fast signals at an oscilloscope.

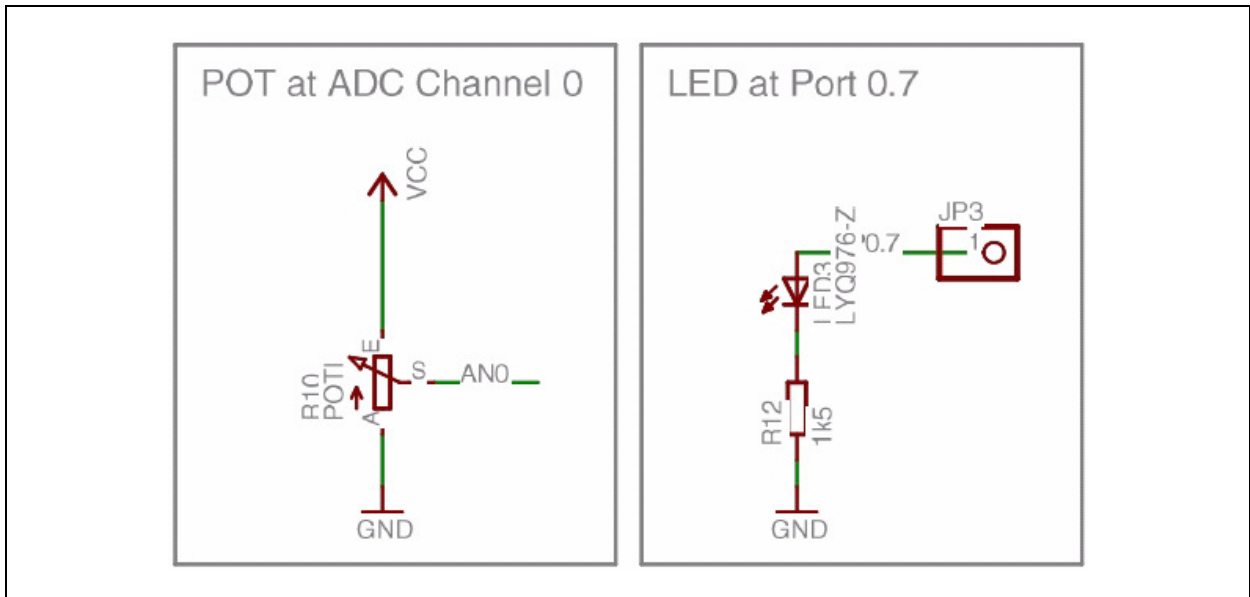


Figure 4 User interface: POT and LED

2.4 Digitally Isolated Debug Interface (JTAG and CAN)

The XC878CM DriveCard is equipped with a digital isolation for JTAG and CAN interfaces. The 5 kV digital isolation securely disconnects any debug and CAN devices from the high voltage levels. As there is a separate power domain for the PC part of the XC878CM DriveCard, a 5 V power supply must be provided separately at VCCIO and GNDIO. LED1 indicates the availability of this supply domain.

There is a DriveMonitor USB Stick available at Infineon Technologies that provides JTAG and CAN as well as the 5 V power supply in one device. Please refer to application note AP08071 for details.

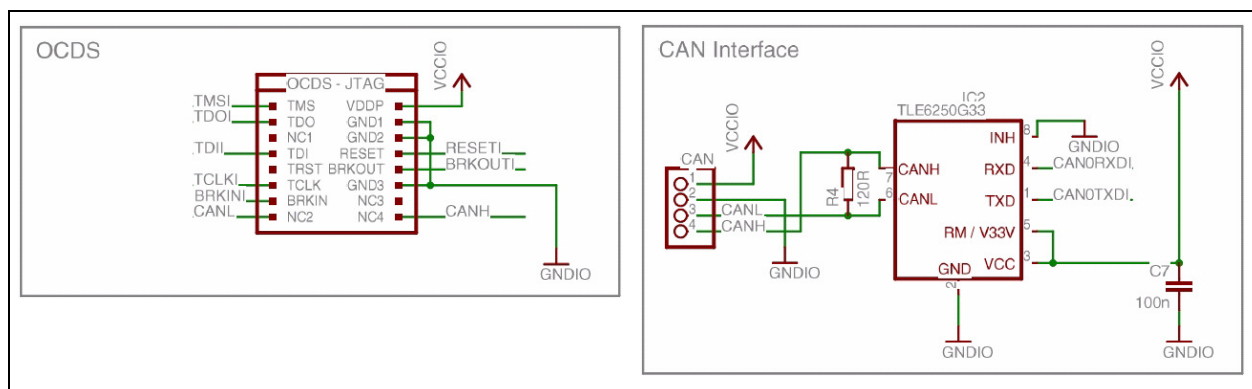


Figure 5 JTAG and CAN: Debugger and Real Time Monitoring Interface

Note: When a standard JTAG box is used, the VCCIO power supply must be provided at the CAN connector.

2.5 Inverter Board Connection

The standard 32-pin connector (DIN 41612, B/2) provides all signals needed for control of a 3-phase power Inverter.

The Lowside (_L) and Highside (_H) switches of the three power stages U, V and W are to be connected to the signals U_L, U_H, V_L, V_H, W_L and W_H.

They are connected to the MCU's CAPCOM6E peripheral, a flexible and powerful PWM unit very well suited for motor control. A low signal at the CTRAP pin of the CAPCOM6E immediately switches all power stages in passive state and acts as an emergency shut-down for the Inverter. All CAPCOM6E signals, including COUT63, are available at pin header JP1.

The XC878 provides another PWM unit based on timer T2. This T2CCU can generate six PWM signals each based on its own compare value. The T2CCU can be found at the signals T2CC0 .. T2CC6 and at signal PFCGATE. They are available at JP2 as well.

Two enable signals for the power stages are provided via signal ENABLE0 and ENABLE1, which are connected to the MCU's GPIO ports 5.0 and 5.1 respectively.

Hardware Description

ADC channel 0 is directly connected to a POT (see [Section 2.3](#)). All remaining ADC signals are connected to the Inverter board connector. Using the XC878CM DriveCard in motor control applications, it is recommended to use the channels as follows:

- Channel 3&4 are used for DC link current measurement
- Channels 5 to 7 can be used for output voltage (e.g. BEMF detection) or phase current measurement
- Channel 1 is used to monitor DC link voltage
- Channel 2 is reserved for auxiliary signals like temperature or analog control information

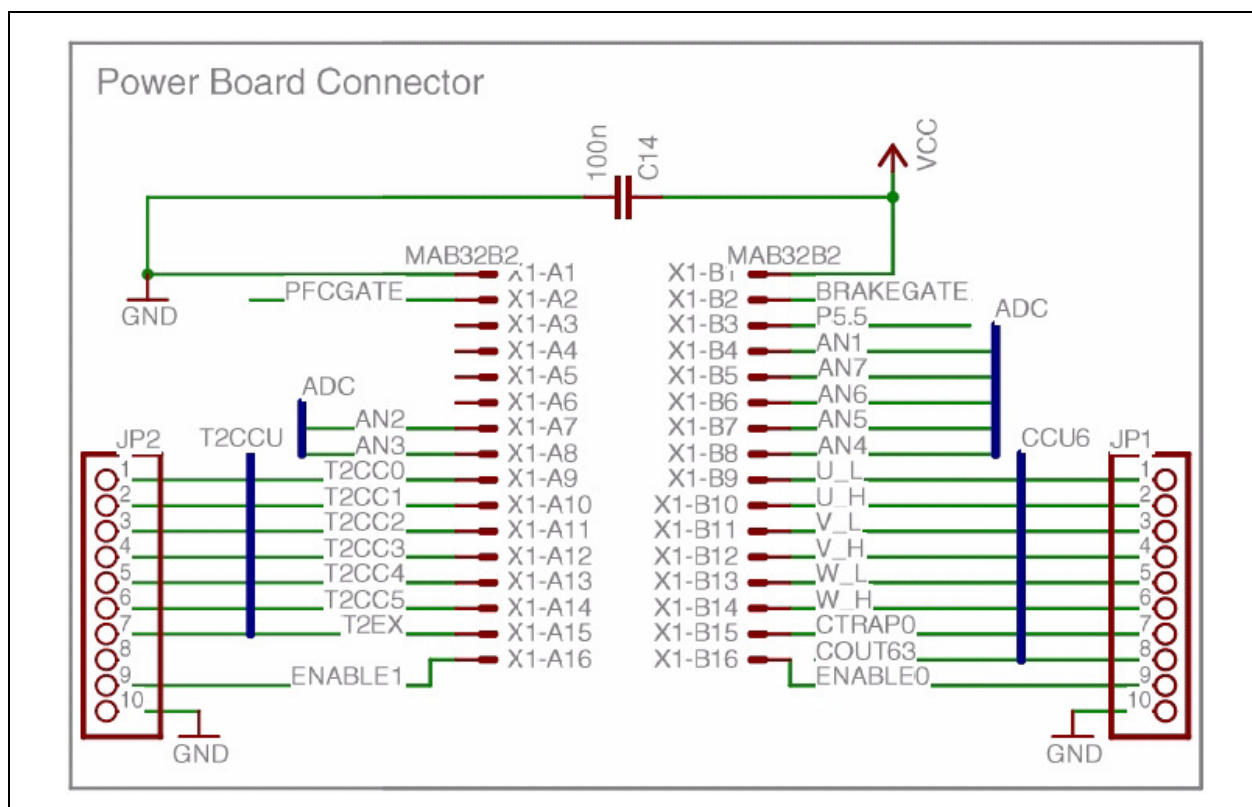


Figure 6 Inverter Board Connector

Note: A 5 V power supply is expected at pins A1-B1 of the Inverter board connector in order to supply the MCU and peripheral components.

2.6 Hall Sensor Interface

The MCU provides a HALL sensor interface which can be accessed via JP5. Next to the HALL signals that are pulled up to $VCC = 5\text{ V}$, the VCC and GND signals are also available.

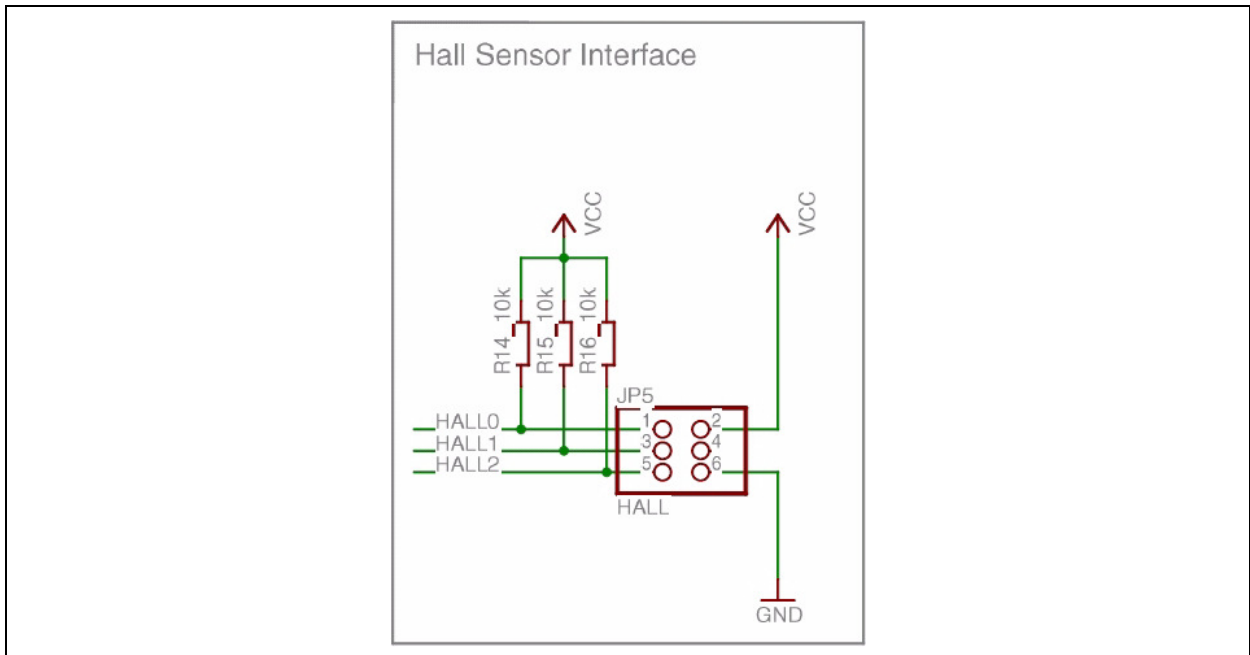


Figure 7 HALL Sensor Interface

2.7 SSC and ASC Interface

The SSC and ASC interface from the MCU are provided at JP4. These interfaces are connected directly to the MCU and are therefore not isolated from the hot ground of the power Inverter. The signals of JP4 can be mapped to GPIOs of the MCU as well.

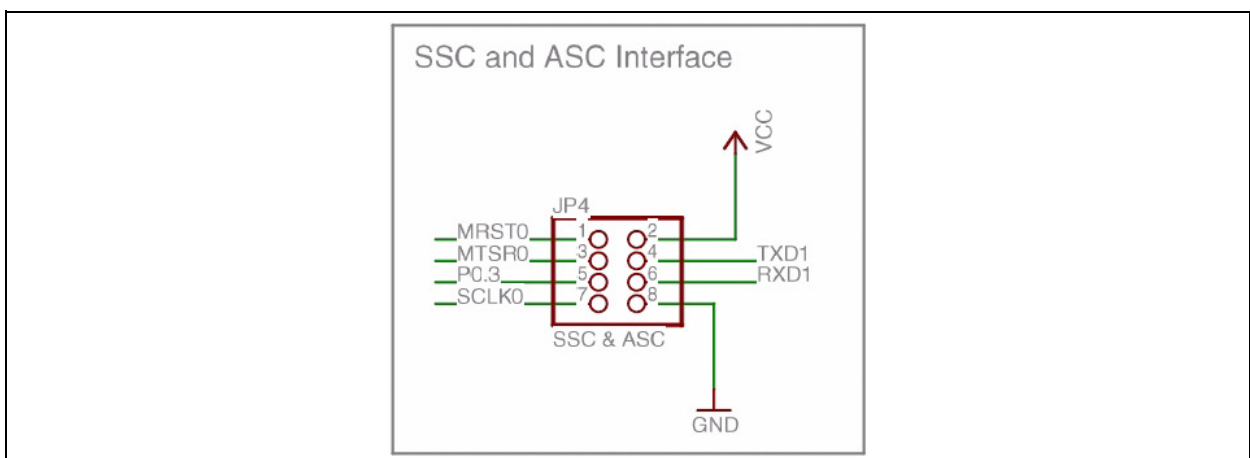


Figure 8 SSC and ASC Interface

2.8 PCB Layout

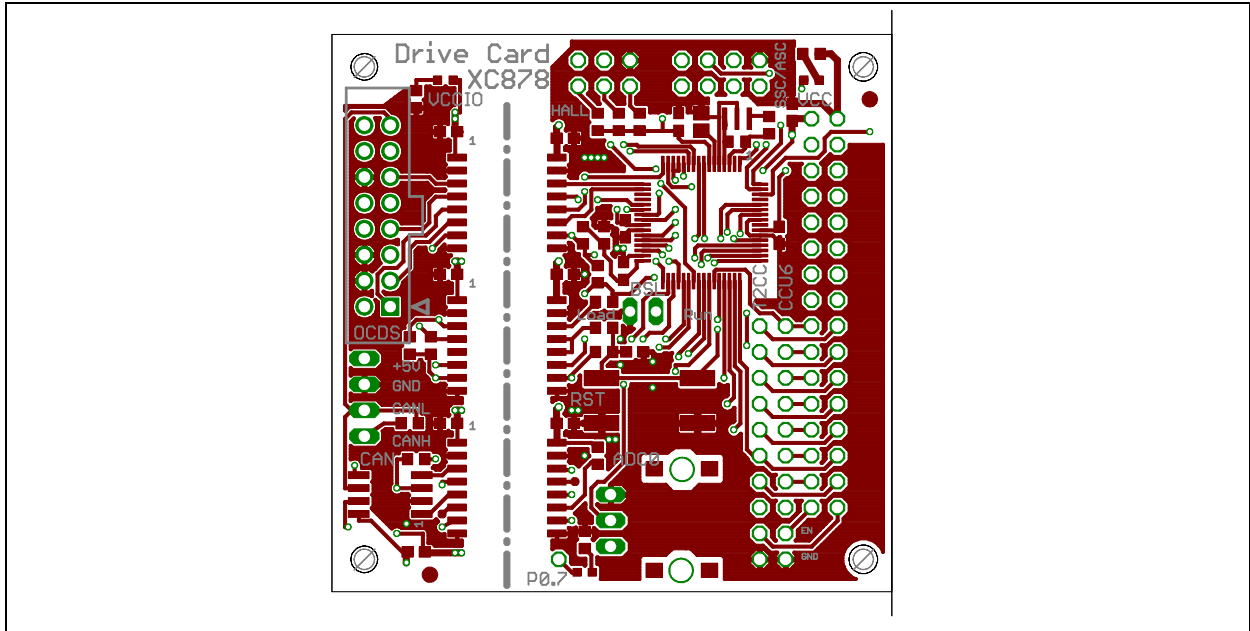


Figure 9 Top Layer + Text

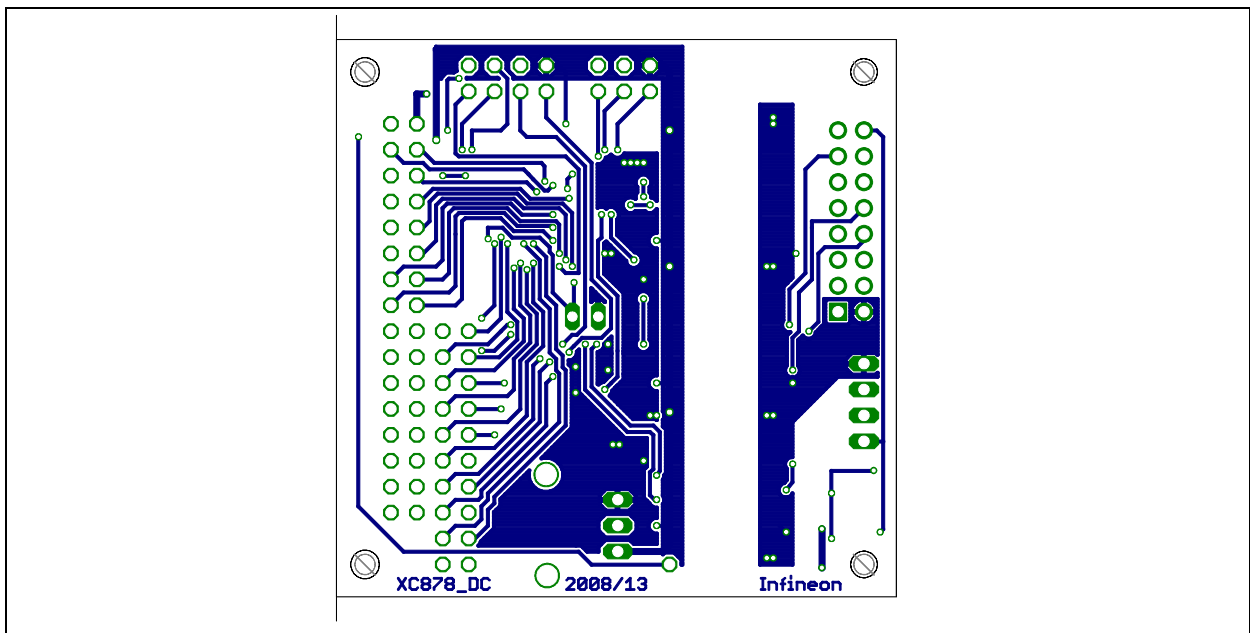


Figure 10 Bottom Layer

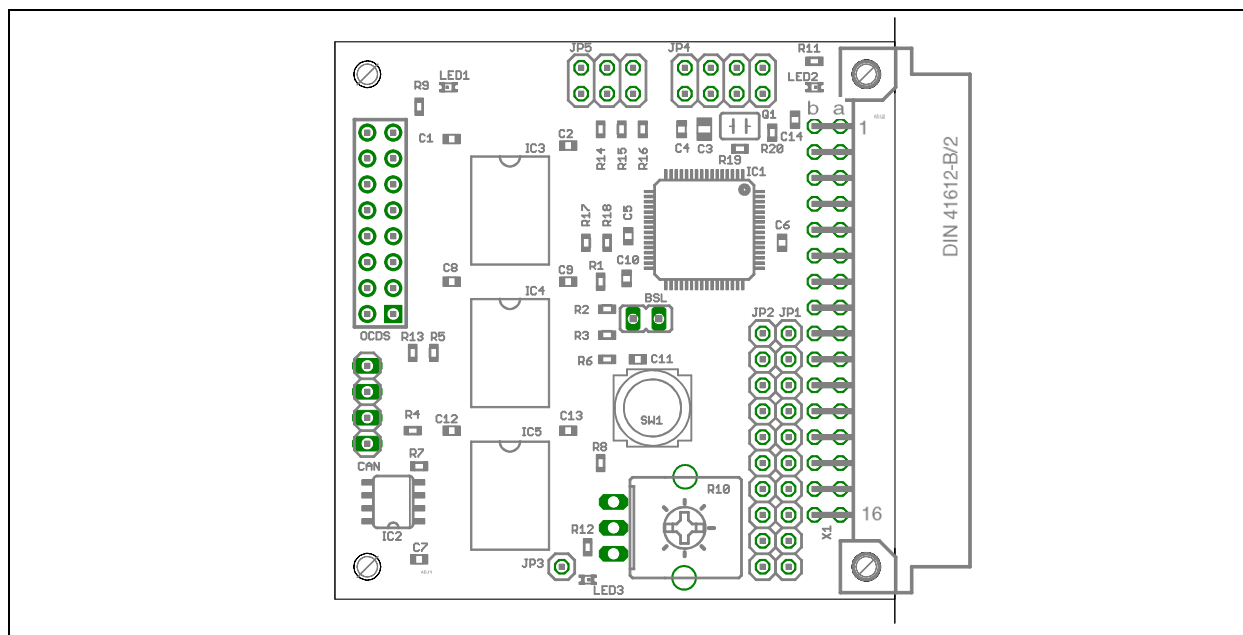


Figure 11 Placement of the Components

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