24 V Dual Motor Power Board hardware (KIT_DUALMOT_500W) user guide

About this document

Scope and purpose

This document describes in technical details the implementation and use of a 3-phase dual motor power card. The card has been designed to operate in various configurations and conditions, such as input voltages and control algorithms. The hardware is compatible with "XMC7000 Drive Card" and PSOC™ Control Drive cards having 100-pin HD connectors, and ModusToolbox™ configurations.

Attention: This board is intended for evaluation purposes only and is not intended to be an end product.

The design of this board originates from the need for a simple plug-and-play dual motor drive power card to be used for evaluation purposes in motor drive applications. The layout of the board has been studied to offer a good starting reference to designers.

Intended audience

The design engineers are approaching a low-voltage motor drive system either in H-Bridge or in 3-Phase full bridge configuration

Safety precaution

***Note**: Please note the following warnings regarding the hazards associated with development systems*

Table 1 Safety precautions

	**Warning:** The DC link potential of this board is up to 1000 VDC. When measuring voltage waveforms by oscilloscope, high voltage differential probes must be used. Failure to do so may result in personal injury or death.
	**Warning:** The evaluation or reference board contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the drive system, wait five minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.
	**Warning:** The evaluation or reference board is connected to the grid input during testing. Hence, high-voltage differential probes must be used when measuring voltage wave forms by oscilloscope. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.
	**Warning:** Remove or disconnect power from the drive before you disconnect or reconnect wires, or perform maintenance work. Wait five minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have discharged to zero. Failure to do so may result in personal injury or death.
	**Caution:** The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.
	**Caution:** Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.

(table continues...)

Table 1 (continued) Safety precautions

	**Caution:** The evaluation or reference board contains parts and assemblies sensitive to Electrostatic Discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.
	**Caution:** A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.
	**Caution:** The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.

Table of contents

About this document . . . 1
Safety precaution . . . 2
Table of contents . . . 4
1 Introduction . . . 5
2 Block diagram . . . 6
3 Hardware description . . . 7
3.1 High-density (HD) signal connector . . . 7
3.2 Input power and motor connectors . . . 10
3.3 3-phase bridge . . . 11
3.4 Current sensing . . . 14
3.4.1 Leg-shunt current sensing . . . 14
3.4.2 Pseudo-differential current sensing . . . 16
3.4.3 Magnetic in-phase current sensor . . . 17
3.5 DC bus voltage sensing . . . 18
3.6 Phase voltage sensing . . . 19
3.7 DC/DC converters . . . 20
3.8 Miscellaneous . . . 21
3.9 Digital sensor interface . . . 23
3.10 PWM signals . . . 23
4 Operating the board using the Motor Suite GUI . . . 24
5 Bill of materials (BOM) . . . 28
6 PCB layout . . . 31
Related resources . . . 34
Revision history . . . 35
Disclaimer . . . 36

1 Introduction

This document describes the features and hardware details of the “3-phase dual motor power board”, which is designed to work with Infineon’s PSOC™ Control Drive Cards. Drive Cards are microcontroller boards with an isolated debug interface, best suited for motor control applications. This power board works with XMC™ kit `KIT_XMC7200_DC_V1`, and PSOC™ Control kits `KIT_PSC3M5_MC1, KIT_PSC3M5_CC2`.

The “3-phase dual motor control Power Card” is designed to work under several supply voltage levels, which are described in Table 2. A first buck converter produces the regulated 12 V supply for the MOSFETs gate driving, and a second buck converter generates the regulated 5 V supply for the microcontroller and the analog signal conditioning.

The 3-phase bridge consists of three Half-Bridges with SO8 gate driver IC and SSO8 power MOSFETs. Each leg provides a shunt resistor with an amplifier for reconstruction of the phase current. A DC-link shunt is also provided. With the provided shunt configuration, the board provides flexibility to adopt many different control algorithms, such as three-phase trapezoidal and sensorless FOC control.

The board has two power stages to connect and run two motors simultaneously, allowing the users to test and evaluate dual motor control applications.

2 Block diagram

Figure 1 shows a simplified block diagram of the hardware, which includes:

- 3-phase motor drive bridge, equipped with 6 x ISC031N08NM6 from OPTIMOS™ 80 V family, 3.1 mΩ (max) power MOSFETs in SSO8 package (per motor)
- 3 x Half-Bridge gate driver IC 2EDL05N06PF from EiceDRIVER™ COMPACT family in SO8 package with SOI technology (per motor)
- Switched mode DC/DC buck converter TLS205B0EJV50 VDD5 for 5 V supply
- Switched mode DC/DC buck converter for 12 V supply
- Leg shunts to measure phase currents and DC-link current, with Op-amp for conditioning to the microcontroller
- Resistor dividers to sense leg voltages and DC-link voltage, to the microcontroller
- Additional general purpose Green LED (EN, Enable port), 5 V Green LED and 12 V Green LED
- 2x Green LED for Enable (EN) port for both motors, and 5 V Green-LED
- 3x TLI5570 magnetic current sensor to sense 3-phase current for Motor 1 (optional) and 1x TLI5570 magnetic current sensor to sense DC Link current for Motor 2 (optional)
- Pseudo differential current measurement option using 1 and 3-leg shunt for Motor 1, single shunt option for Motor 2

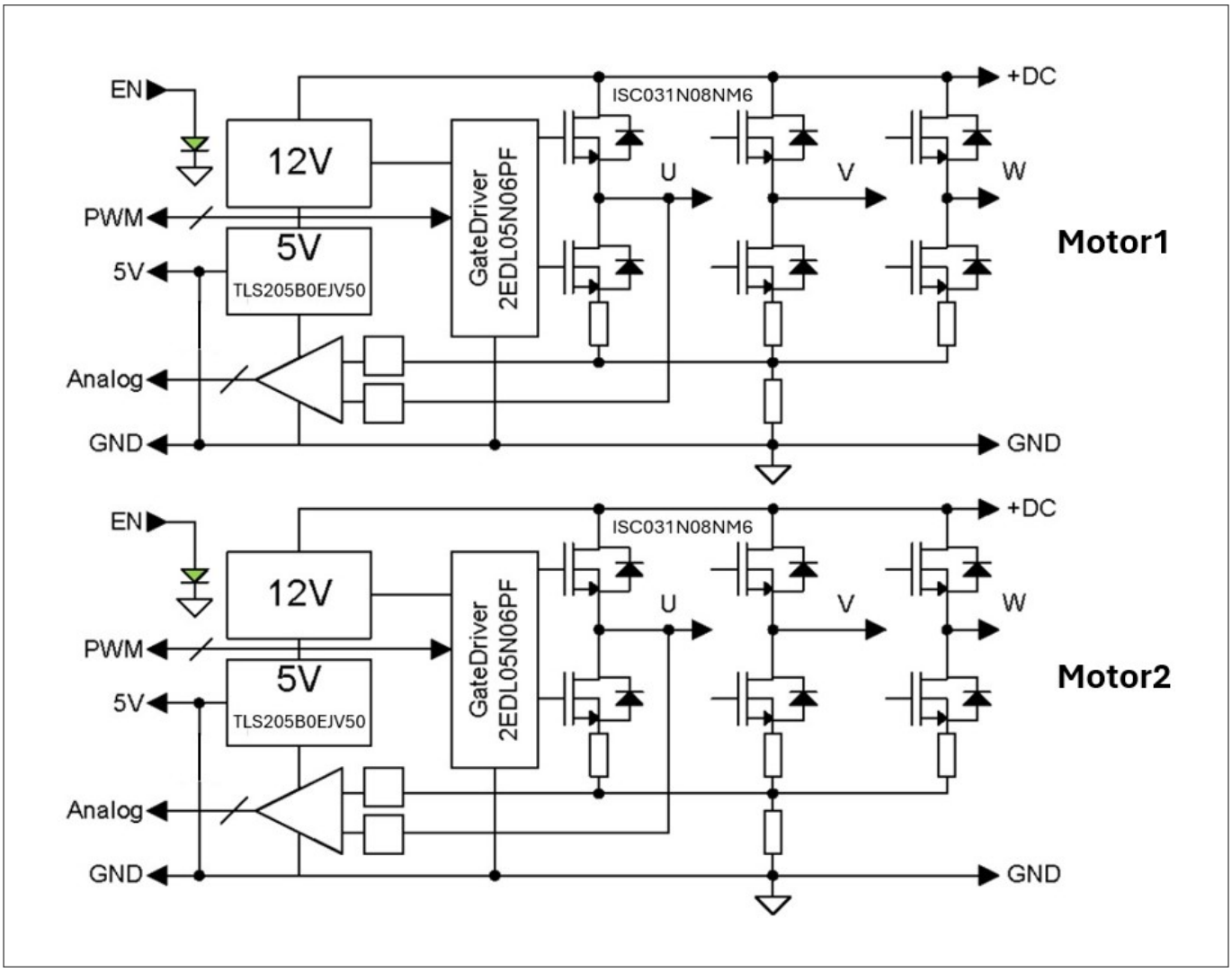


Figure 1 Simplified block diagram

3 Hardware description

The following sections provide a description of the hardware.

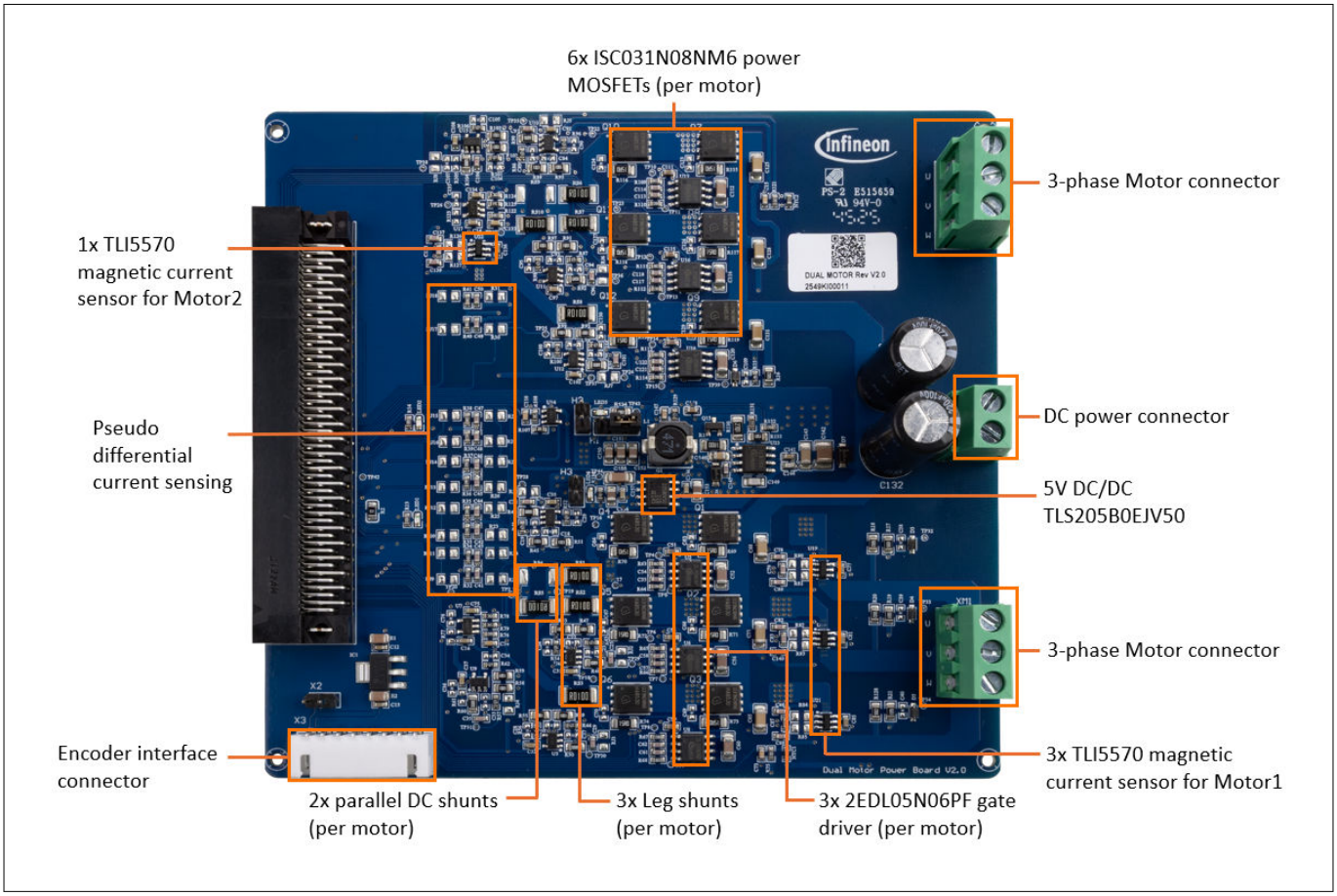


Figure 2 Hardware top overview

Table 2 Ratings

Description	Max	Typ	Notes
DC link input voltage	80 V absolute max	24V	DC input support from 12.5 V to 52 V (default 24 V)
Output power	500 W	–	No heat sink, still air, and ambient temperature
Power MOSFET ratings	80 V BVDss abs max	–	ISC031N08NM6 3.1 mΩ Rdson Max

3.1 High-density (HD) signal connector

The HD connector (X1) schematic is shown in Figure 3. Connector pinout is listed in Table 3.

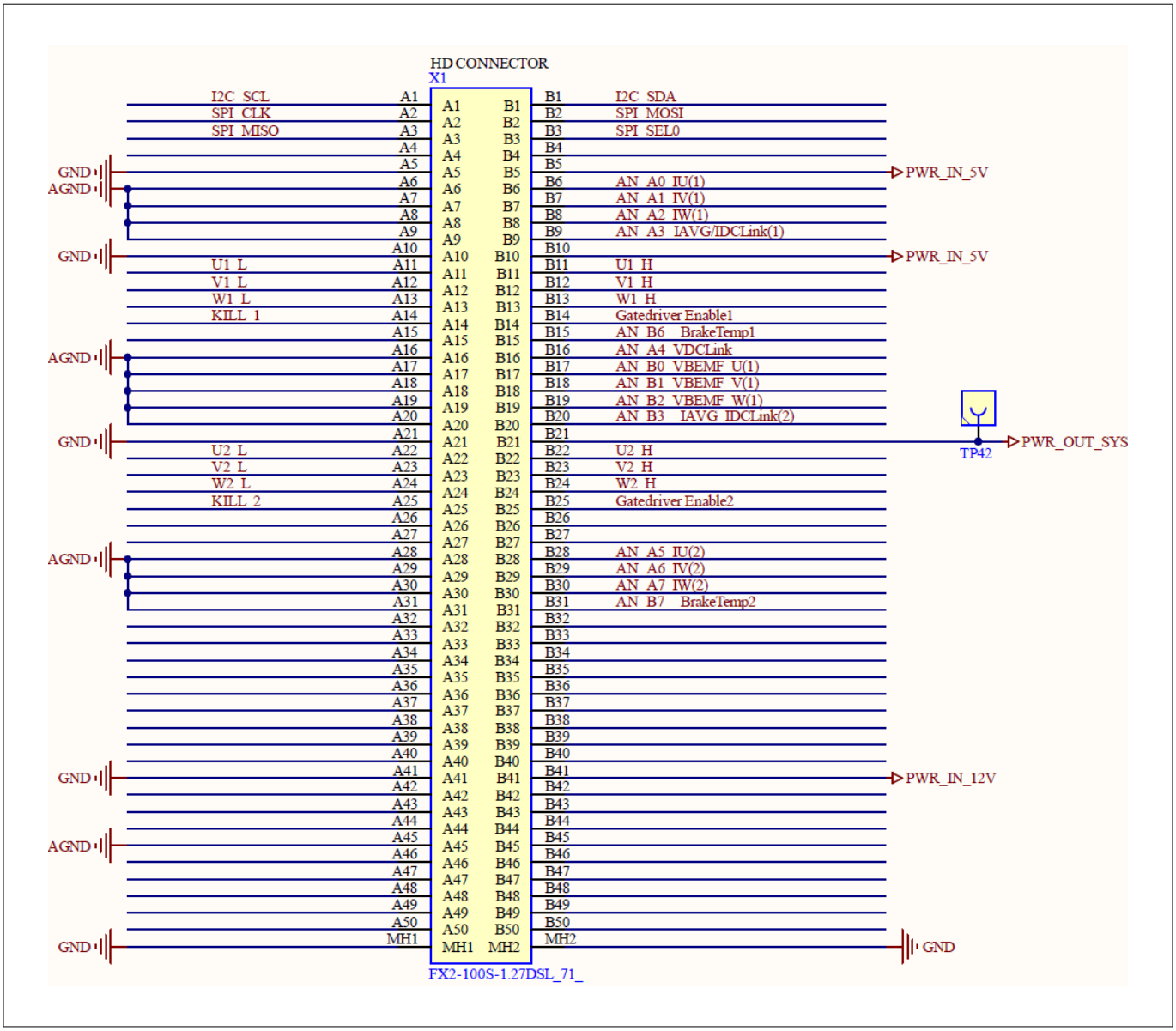


Figure 3 HD connector (X1) schematic

Table 3 Signal connector pinout

Row A (inner row)	Name	Notes	Row B (outer row)	Name	Notes
A1	I2C_SCL	I2C Clock	B1	I2C_SDA	I2C Serial Data
A2	SPI_CLK	SPI Clock	B2	SPI_MOSI	SPI Master Output Slave Input
A3	SPI_MISO	SPI Master Input Slave Output	B3	SPI_SEL0	SPI Chip Select
A4	-	-	B4	-	-
A5	GND	Ground	B5	PWR_IN_5V	Power 5 V input

(table continues...)

Table 3 (continued) Signal connector pinout

Row A (inner row)	Name	Notes	Row B (outer row)	Name	Notes
A6	AGND	Analog ground	B6	AN_A0_IU (1)	Current sense U (Motor 1)
A7	AGND	Analog ground	B7	AN_A1_IV (1)	Current sense V (Motor 1)
A8	AGND	Analog ground	B8	AN_A2_IW (1)	Current sense W (Motor 1)
A9	AGND	Analog ground	B9	AN_A3_IAVG/IDCLink (1)	DC Link current for Motor 1
A10	GND	Ground	B10	PWR_IN_5V	Power 5 V input
A11	U1_L	Phase U low-side command (Motor 1)	B11	U1_H	Phase U high- side command (Motor 1)
A12	V1_L	Phase V low-side command (Motor 1)	B12	V1_H	Phase V high-side command (Motor 1)
A13	W1_L	Phase W low-side command (Motor 1)	B13	W1_H	Phase W high-side command (Motor 1)
A14	KILL_1	Kill signal Motor 1	B14	GatedriverEnable1	Driver enable (Motor 1)
A15	-	-	B15	AN_B6_BrakeTemp1	Temperature
A16	AGND	Analog ground	B16	AN_A4_VDCLink	DC Link Voltage
A17	AGND	Analog ground	B17	AN_B0_VBEMF_U (1)	Voltage sense phase U (Motor 1)
A18	AGND	Analog ground	B18	AN_B1_VBEMF_V (1)	Voltage sense phase V (Motor 1)
A19	AGND	Analog ground	B19	AN_B2_VBEMF_W (1)	Voltage sense phase W (Motor 1)
A20	AGND	Analog ground	B20	AN_B3_IAVG_IDCLink (2)	DC Link current for Motor 2
A21	GND	Ground	B21	PWR_OUT_SYS	Power 3.3 V output
A22	U2_L	Phase U low-side command (Motor 2)	B22	U2_H	Phase U high-side command (Motor 2)
A23	V2_L	Phase V low-side command (Motor 2)	B23	V2_H	Phase V high- side command (Motor 2)

(table continues...)

Table 3 (continued) Signal connector pinout

Row A (inner row)	Name	Notes	Row B (outer row)	Name	Notes
A24	W2_L	Phase W low-side command (Motor 2)	B24	W2_H	Phase W high-side command (Motor 2)
A25	KILL_2	Kill signal Motor 2	B25	GatedriverEnable2	Driver enable (Motor 2)
A26	-	-	B26	-	-
A27	-	-	B27	-	-
A28	AGND	Analog ground	B28	AN_A5_IU (2)	Current sense U (Motor 2)
A29	AGND	Analog ground	B29	AN_A6_IV (2)	Current sense V (Motor 2)
A30	AGND	Analog ground	B30	AN_A7_IW (2)	Current sense W (Motor 2)
A31	AGND	Analog ground	B31	AN_B7_BrakeTemp2	Temperature
A32 to A40	-	-	B32 to B40	-	-
A41	GND	Ground	B41	PWR_IN_12V	Power 12 V input
A42	-	-	B42	-	-
A43	-	-	B43	-	-
A44	-	-	B44	-	-
A45	AGND	Analog ground	B45	-	-
A46 to A50	-	-	B46 to B50	-	-
MH1	GND	Ground	MH2	GND	Ground

3.2 Input power and motor connectors

This power board operates by default with 24 V DC supply. Figure 4 shows the power and three-phase motor connections.

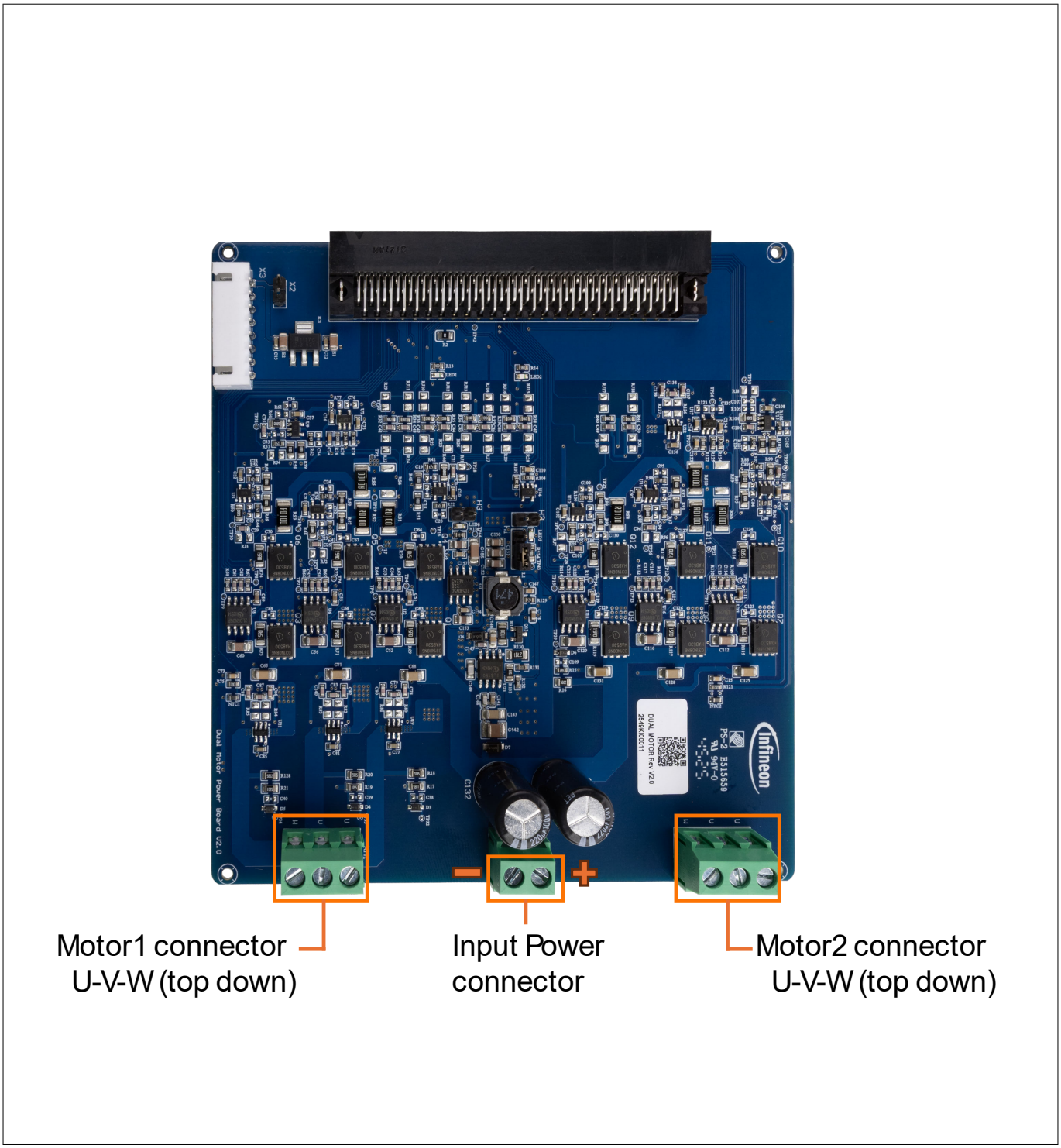


Figure 4 Power connector view for both motors

3.3 3-phase bridge

The 3-phase MOSFET bridge in Figure 5 shows MOSFETs, gate resistors and shunts. The U7 and U17 comparator for the overcurrent DC-link protection is also shown, providing an active-low FO (Fault) signal to the microcontroller via PSOC™ Control Drive Card KIT_PSC3M5_CC2 signal connector. Current trip for Motor1 is set by the resistor divider R78/R79 following (1).

$$V_{TH} = 2.5 \quad V \quad \frac{R_{78}}{R_{78} + R_{79}} = 2.5 \quad V \quad \frac{10 \quad K}{10 \quad K + 40 \quad K} = 0.5 \quad V$$
$$I_{TRIP} = \frac{V_{TH}}{R_{SHUNT}} = \frac{0.5 \quad V}{0.02 \quad \Omega} = 25 \quad A \tag{1}$$

A single-pole filter (represented by R76, C74) is added to trim noise immunity. Values are R76=1 KΩ, C74=1 nF.

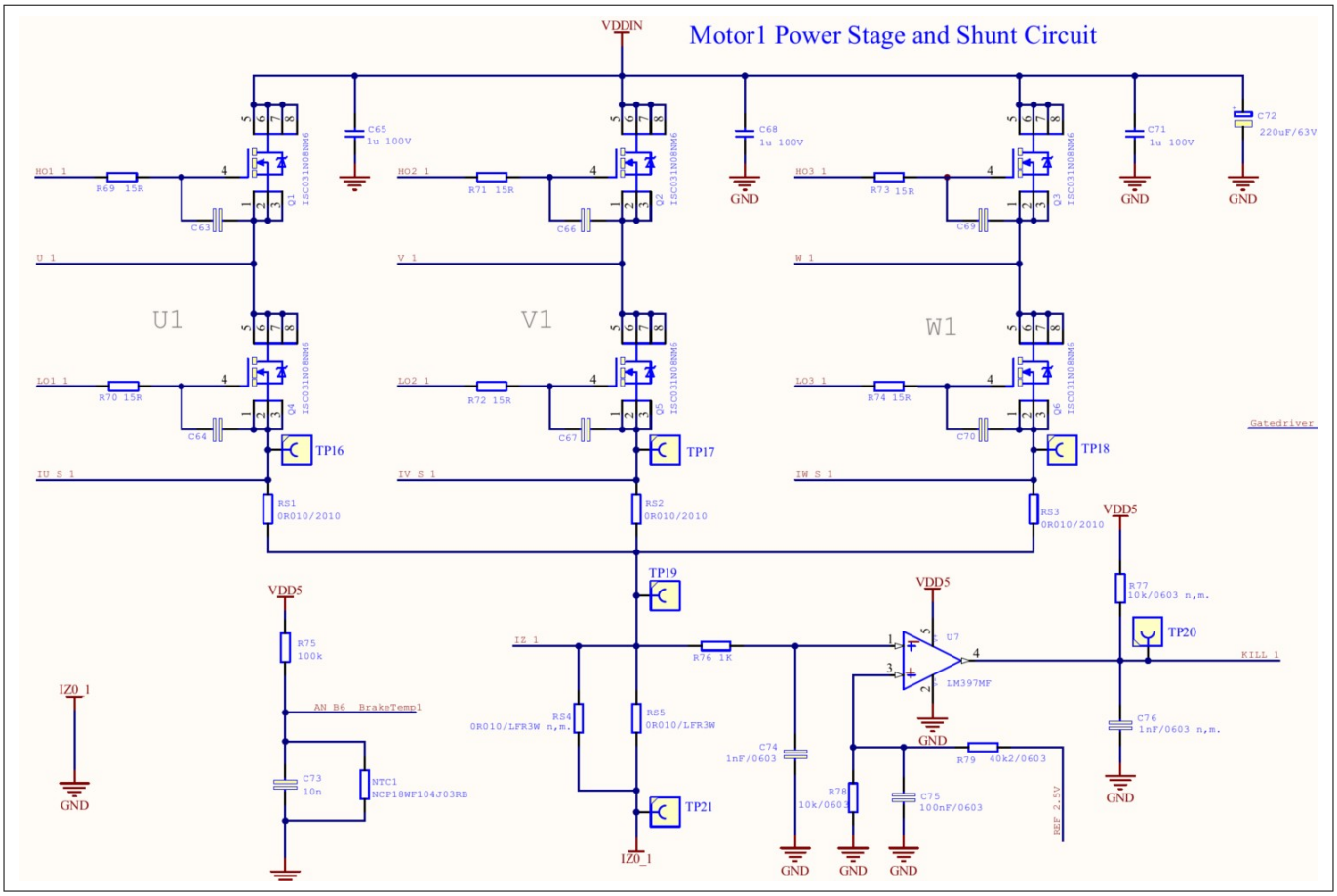


Figure 5 3-phase MOSFET bridge for motor 1

For Motor 1, shunt voltages are fed into the Drive Card signal connector at `AN_A0_IU (1)`, `AN_A1_IV (1)`, `AN_A2_IW (1)`, `AN_A3_IAVG/IDCLink (1)` pins as shown in Table 3. Signal amplifiers are set as follows for emitter-shunt sensing.

$$Gain_{I_{U1}} = \frac{I_{U1}}{I_{motor1}} = 12 . R_{S1} = \frac{[V]}{[A]} \tag{2}$$

$$Offset_{I_{U1}} = V_{REF_2.5\,V} = \quad 2.5V$$

While for Bus-shunt sensing (see Figure 8, `AN_A3_IAVG/IDCLink (1)` signal):

$$Gain = \frac{I_{U1}}{I_{motor1}} = 12 . R_{S4} // R_{S5} = \frac{[V]}{[A]} \quad (3)$$

$$Offset = V_{REF_2.5\,V} = \quad 2.5V$$

I_DC_LINK_AVG, averaged version of the I_DC_LINK_0, is available as well at the connector.

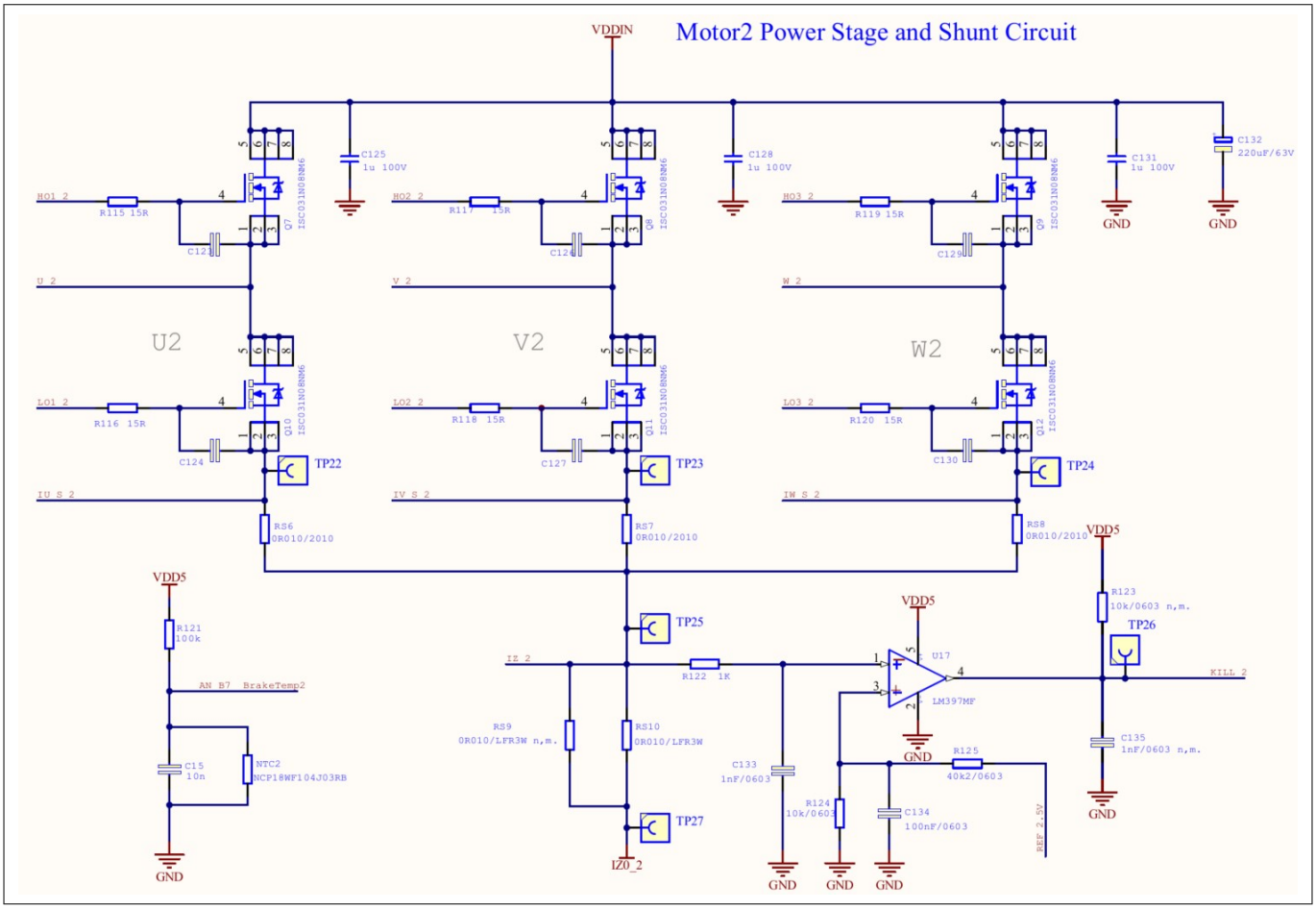


Figure 6 3-phase MOSFET bridge for Motor 2

For Motor 2, shunt voltages are fed into the drive card signal connector at AN_A5_IU (2), AN_A6_IV (2), AN_A7_IW (2), AN_B3_IAVG_IDCLink (2) pins as shown in Table 3. Signal amplifiers are set as follows for emitter-shunt sensing.

$$Gain_{I_{U2}} = \frac{I_{U2}}{I_{motor2}} = 12 . R_{S6} = \frac{[V]}{[A]} \quad (4)$$

$$Offset_{I_{U2}} = V_{REF_2.5\,V} = \quad 2.5V$$

While for Bus-shunt sensing (refer to Figure 8, AN_B3_IAVG_IDCLink (2) signal):

$$Gain = \frac{I_{U2}}{I_{motor2}} = 12 \, . \, R_{S9} // R_{S9} = \frac{[V]}{[A]} \tag{5}$$

$$Offset = V_{REF_2.5\,V} = \quad 2.5V$$

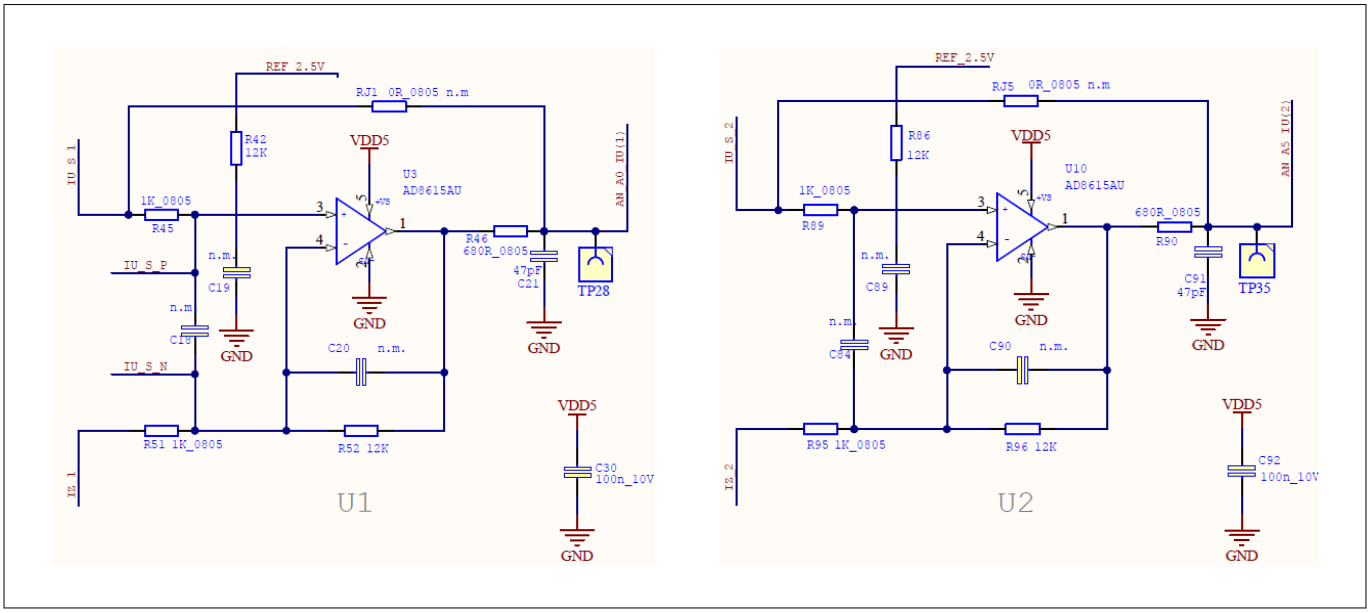


Figure 7 **Emitter-shunt current amplifier (U phase) for motor 1 and motor 2**

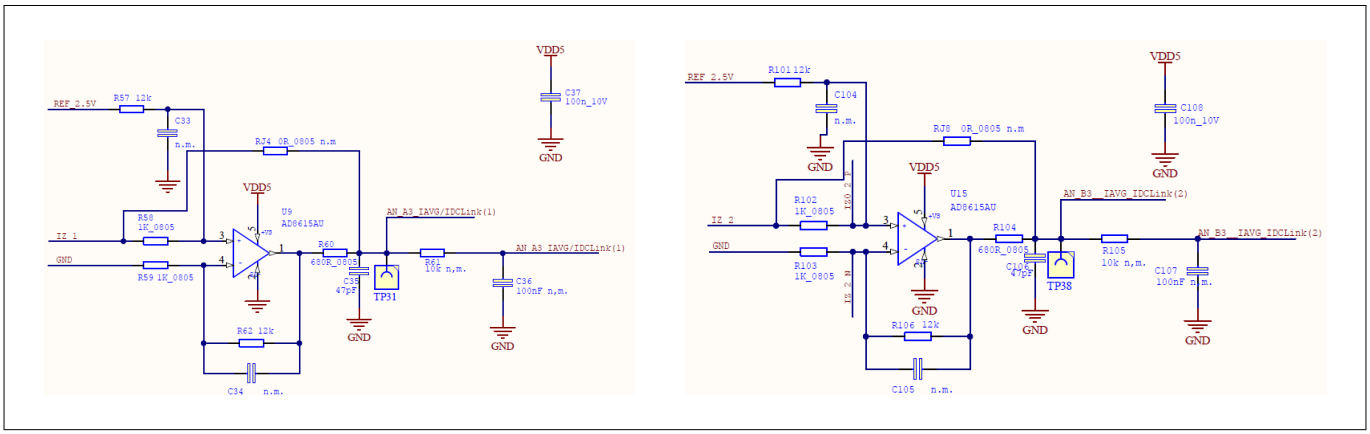


Figure 8 **DC bus current sensing (single shunt) for motor 1 and motor 2**

3.4 Current sensing

The dual motor power card provides various options for current sensing.

3.4.1 Leg-shunt current sensing

Leg-shunt current sensing is the default hardware configuration of the board. The signal names and resistor values for both motors are provided in the tables below:

Table 4 Leg-shunt current sensing for motor 1

Current	Shunt resistor	Resistor value	Shunt signal
DC link	RS5	0.01 Ω	IZ_1
Phase (U)	RS1	0.01 Ω	IU_S_1
Phase (V)	RS2	0.01 Ω	IV_S_1
Phase (W)	RS3	0.01 Ω	IW_S_1

Table 5 Leg-shunt current sensing for motor 2

Current	Shunt resistor	Resistor value	Shunt signal
DC link	RS10	0.01 Ω	IZ_2
Phase (U)	RS6	0.01 Ω	IU_S_2
Phase (V)	RS7	0.01 Ω	IV_S_2
Phase (W)	RS8	0.01 Ω	IW_S_2

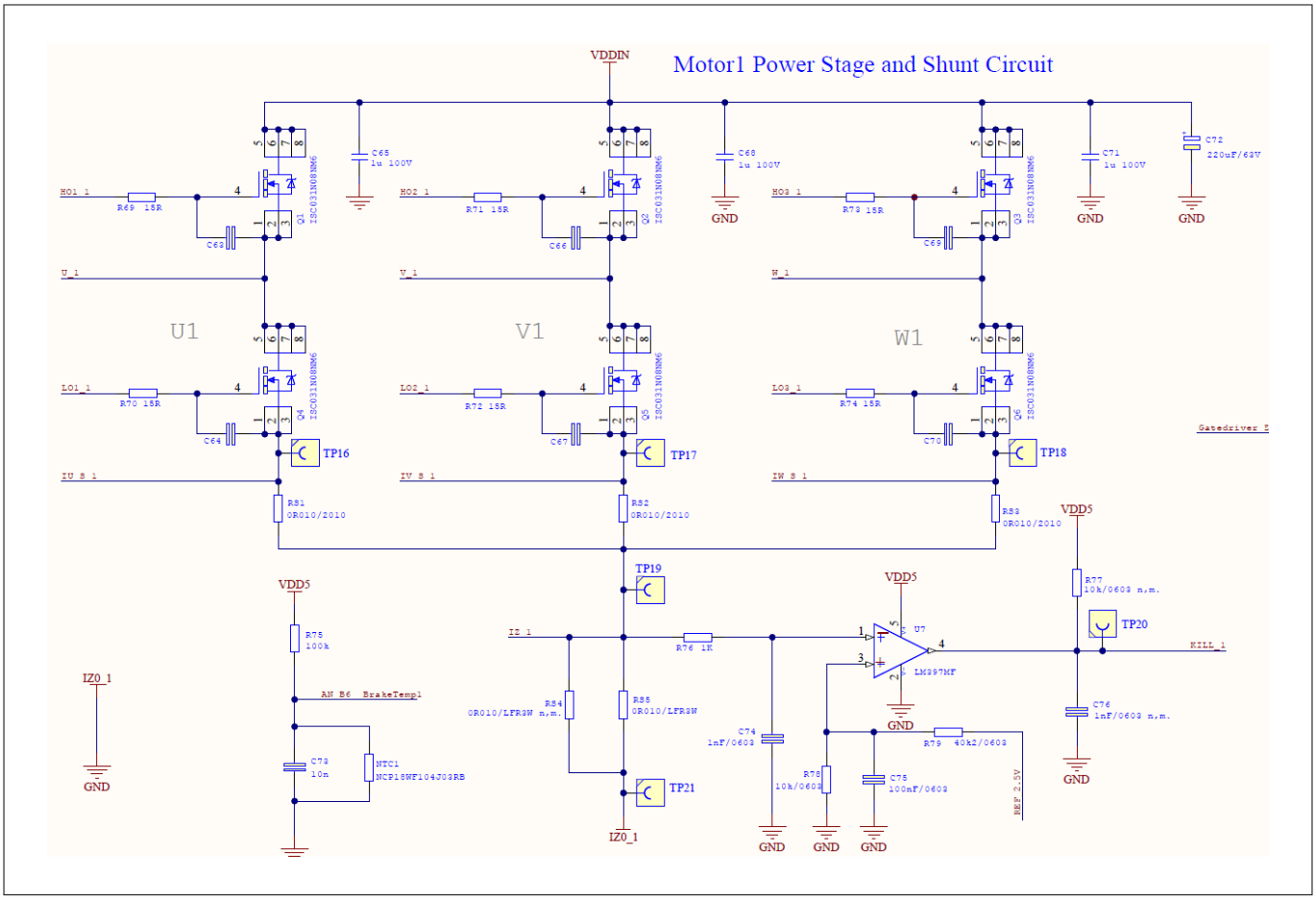


Figure 9 Motor 1 leg-shunt sensing circuit

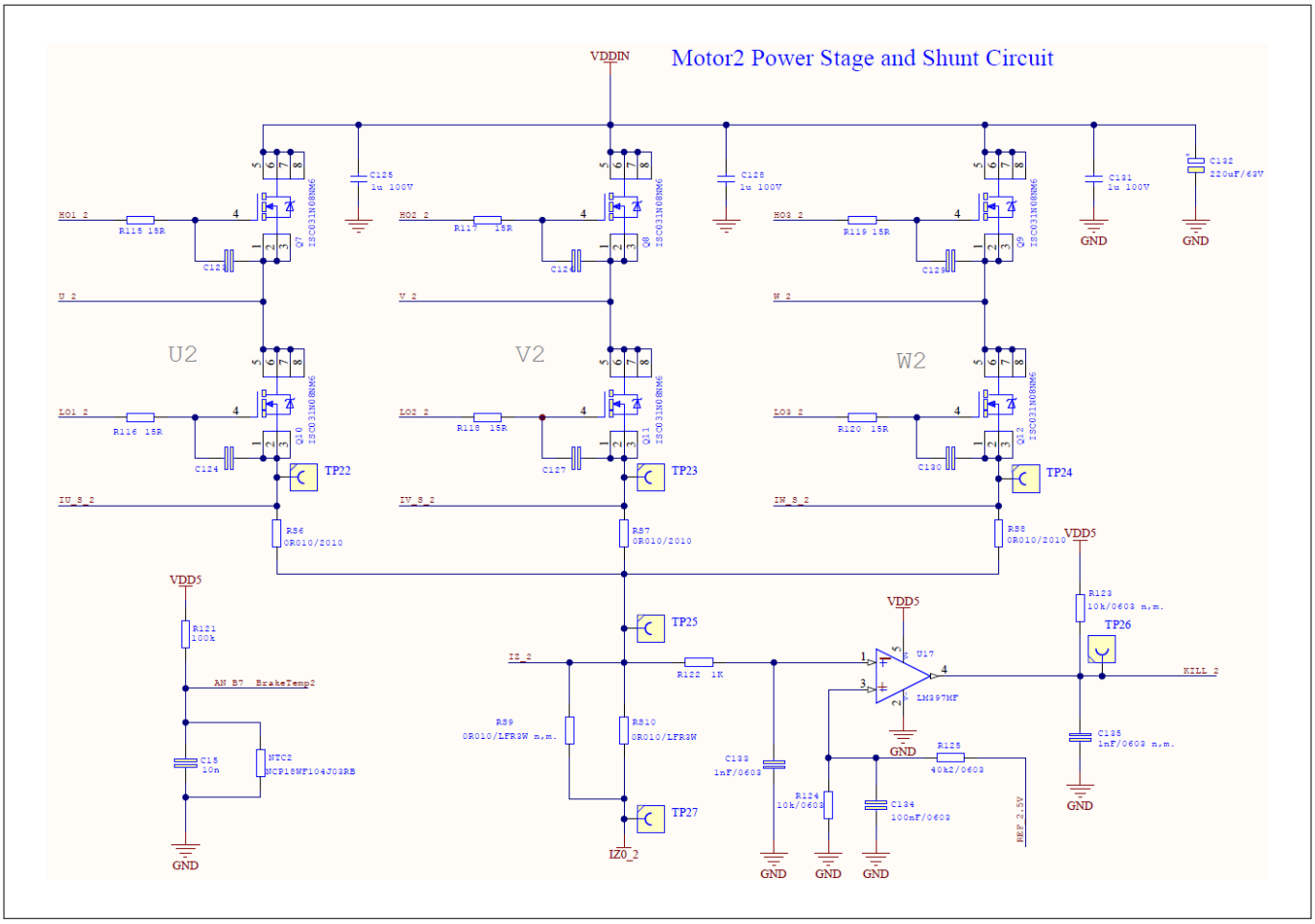


Figure 10 **Motor 2 leg-shunt sensing circuit**

3.4.2 Pseudo-differential current sensing

Enabling pseudo-differential current sensing requires soldering/unsoldering some resistances as described in Table 6. For motor 1, pseudo differential current sensing options are available as a single shunt or three shunts. For motor 2, only a single shunt is available.

Table 6 **Pseudo-differential signal pairs and resistors for current sensing**

Motor	Shunt options	Pseudo-differential pair	ADC channel	Solder	Unsolder
Motor1	Three shunt	IU_S_1 and IZ_1	AN_A0 and AN_A1	R24, R25, RJ11, RJ12	R22, RJ9, R23, RJ10, R45, R46, R51, R58, RJ1, RJ2, R59, R47, R48, R53, R59
Motor1	Three shunt	IV_S_1 and IZ_1	AN_A2 and AN_A3	R26, RJ13, R27, RJ14	R22, RJ9, R23, RJ10, R47, R53, R50, RJ3, R55, R60, R61, RJ4, R51, R53, R55, R58, R59

(table continues...)

Table 6 (continued) Pseudo-differential signal pairs and resistors for current sensing

Motor	Shunt options	Pseudo-differential pair	ADC channel	Solder	Unsolder
Motor1	Three shunt	IW_S_1 and IZ_1	AN_B0 and AN_B1	R28, RJ15, R29, RJ16	R22, RJ9, R23, RJ10, R17, R18, R19, R20, R49, R50, R53, R55, R58, R59, RJ4
Motor1	Single shunt	IZ_1 and GND	AN_A0 and AN_A1	R22, RJ9, R23, RJ10	R24, RJ11, R25, RJ12, R27, R29, R46, R48, R51, R53, R55, R58, R59, R60, RJ1, RJ2, RJ4
Motor2	Single shunt	IZ_2 and GND	AN_A5 and AN_A6	R30, RJ17, R31, RJ18	R95, R97, R99, R102, RJ8, RJ5, RJ6, R103, R90, R92

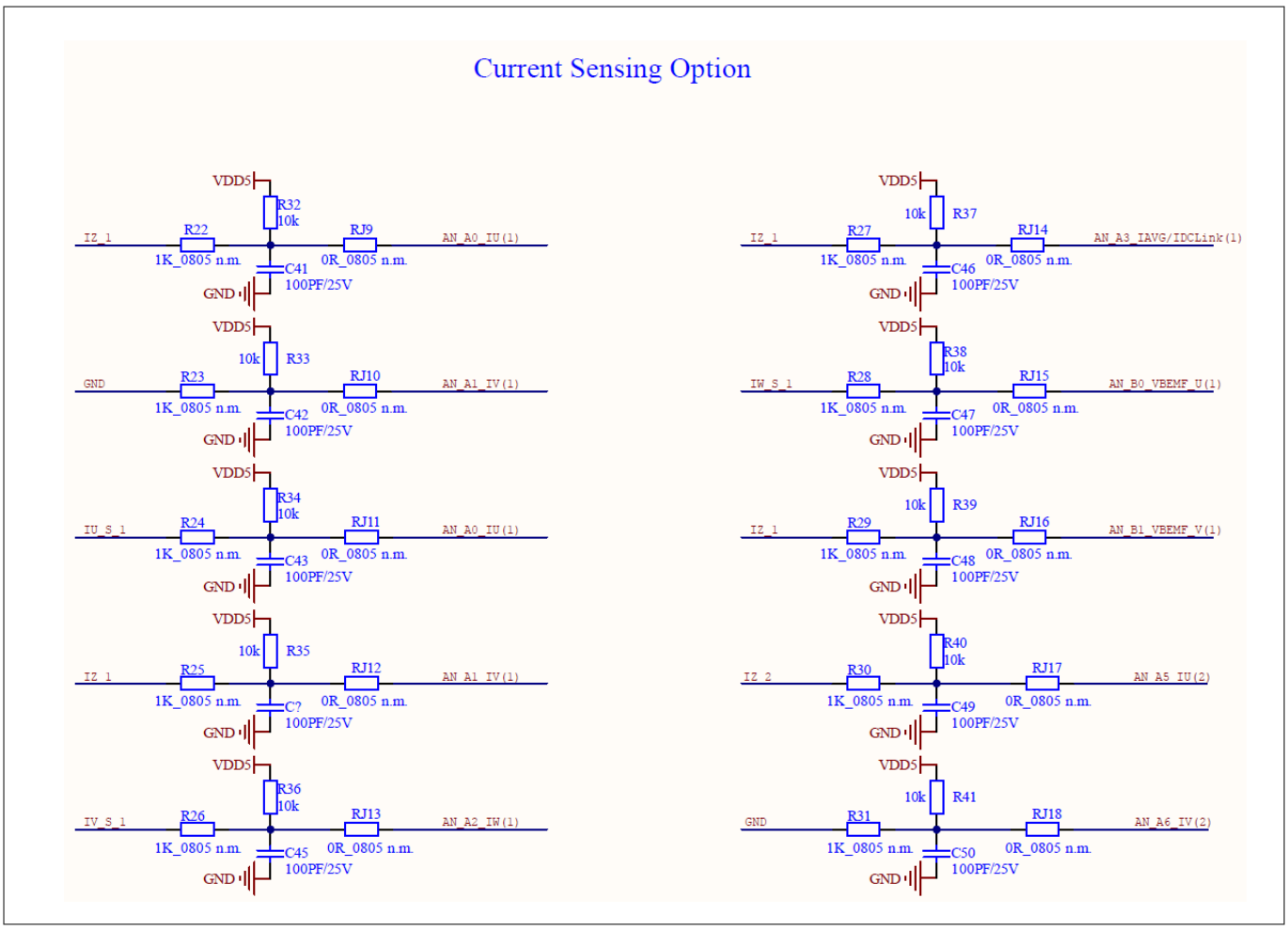


Figure 11 Pseudo-differential current sensing

3.4.3 Magnetic in-phase current sensor

To use magnetic in-phase current sensors, some resistor changes are needed on the board. The leg-shunt and pseudo-differential sensing should be disabled to use magnetic in-phase current sensing. See Table 7 for the

required resistor changes to enable in-phase current sensing. These configurations disable the leg-shunt current sensing and enable the magnetic in-phase current sensing. This step disables the leg shunt current sensing and enables the magnetic in-phase current sensing.

Table 7 Magnetic in-phase current sensor configuration

Motor	Current sensing	Solder	Unsolder
Motor1	Phase U	R80, R81	R45, R51, RJ1
Motor1	Phase V	R82, R83	R47, R53, RJ2
Motor1	Phase W	R84, R85	R49, R55, RJ3
Motor2	IDC link	R126, R127	R102, R103, RJ8

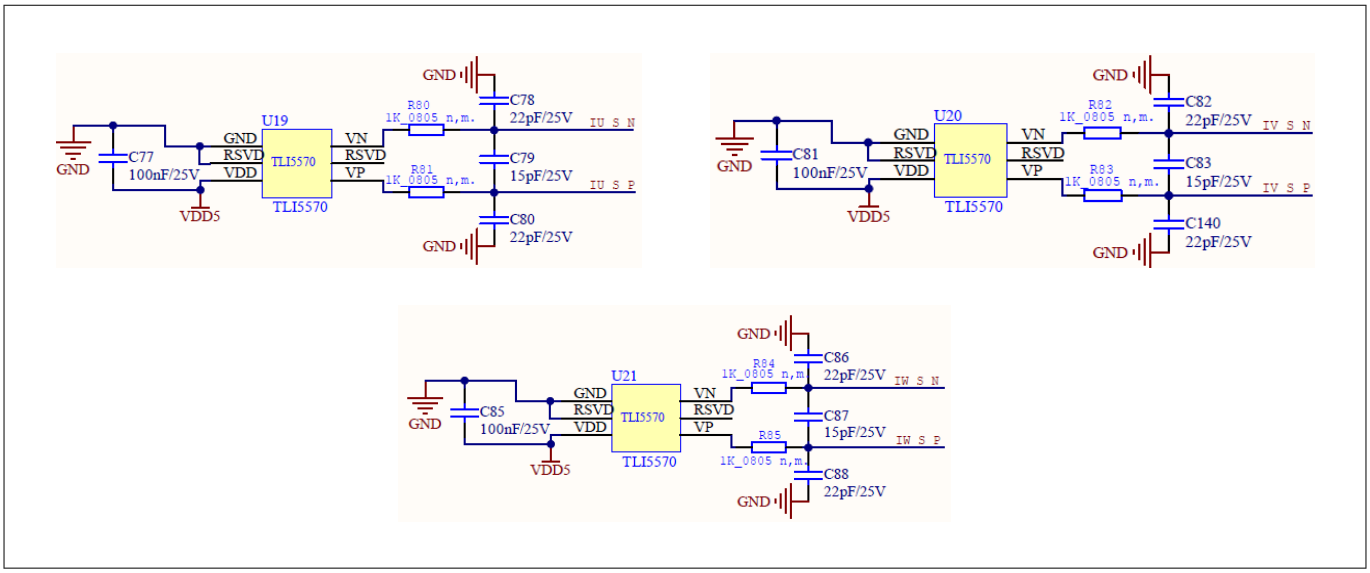


Figure 12 3-phase magnetic in-phase current sensors for motor 1

- Motor 1: phase U, V, and W are supported for current sensing
- Motor 2: IDC link is supported for current sensing

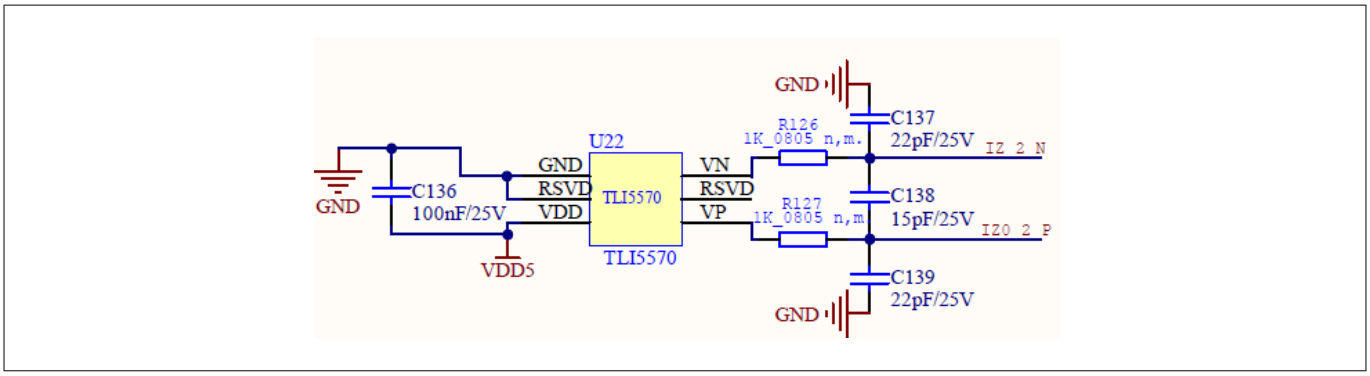


Figure 13 Single-phase magnetic in-phase current sensors for motor 2

3.5 DC bus voltage sensing

The DC bus (VDCLink) voltage is available at AN_A4_VDCLink, on pin B-16 of the HD connector pin. The voltage at the pin is clamped to 5V1.

The resistor divider is set to: R15=5.6 kΩ; R16=56 kΩ

$$AN_A4_VDCLink = V_{DCbus} \cdot \frac{R_{15}}{R_{15} + R_{16}}$$

$$@24V \ \ busvoltage: \ \ AN_A4_VDCLink = 24V \cdot \frac{5.6 \ K\Omega}{5.6 \ K\Omega + 56 \ K\Omega} = 2.18 \ V \quad (6)$$

$$@48V \ \ busvoltage: \ \ AN_A4_VDCLink = 48V \cdot \frac{5.6 \ K\Omega}{5.6 \ K\Omega + 56 \ K\Omega} = 4.36 \ V$$

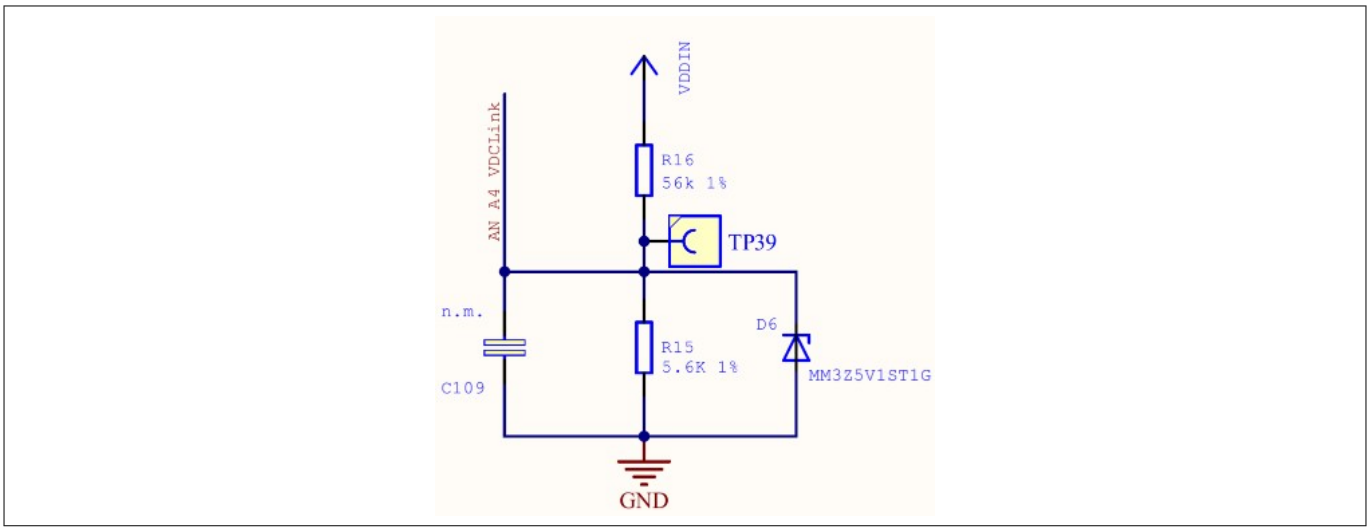


Figure 14 DC bus sensing divider

3.6 Phase voltage sensing

Phase voltage sensing is available at AN_B0_VBEMF_U (1), AN_B1_VBEMF_V (1), AN_B2_VBEMF_W (1) pins of the signal connector for Motor 1, as mentioned in Table 3. It is not available for Motor 2.

$$AN_B0_VBEMF_U = U \cdot \frac{R_{17}}{R_{17} + R_{18}} \quad (7)$$

Phase voltage sensing is available for sensorless BLDC scalar control using a 6-step modulation scheme as well as for various other scopes. The pin voltage is clamped by a 5.1 V Zener to protect the uC pin. Note that the Zener diode might have considerable capacitive behaviour, which may require removing it from the board.

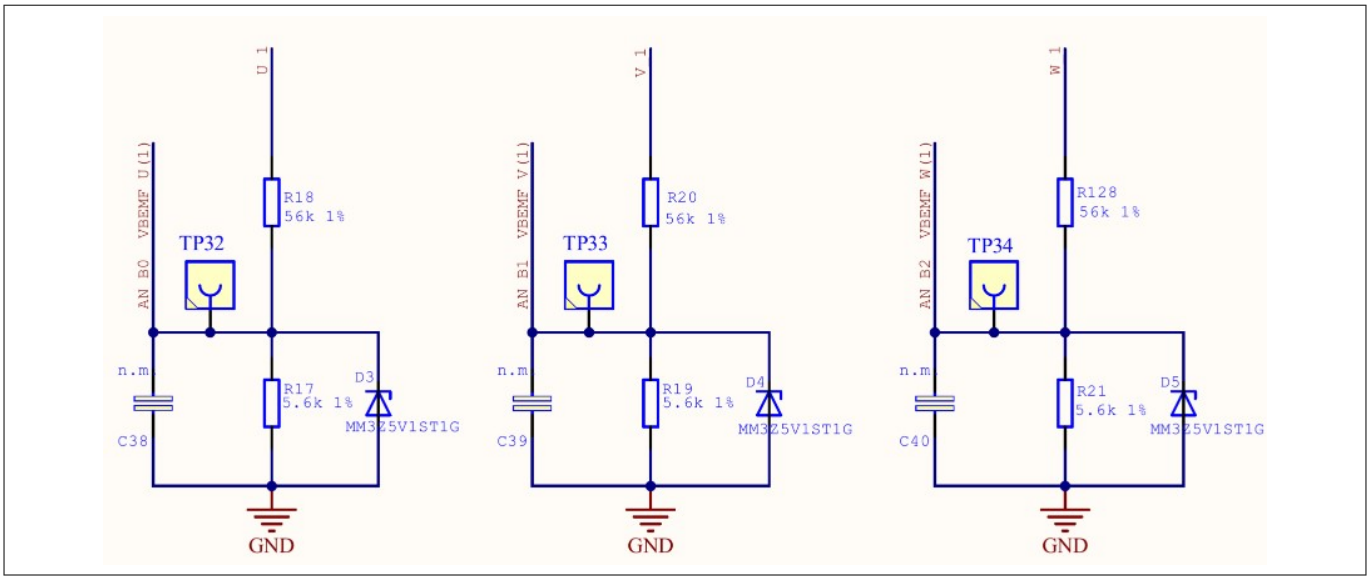


Figure 15 Phase voltage sensing divider

3.7 DC/DC converters

The present board embeds two step-down converters. The first one brings the DC bus voltage down to 12 V, and it is shown in Figure 16. The second one brings the supply to the µC and analog circuits from 12 V to 5 V (Figure 17).

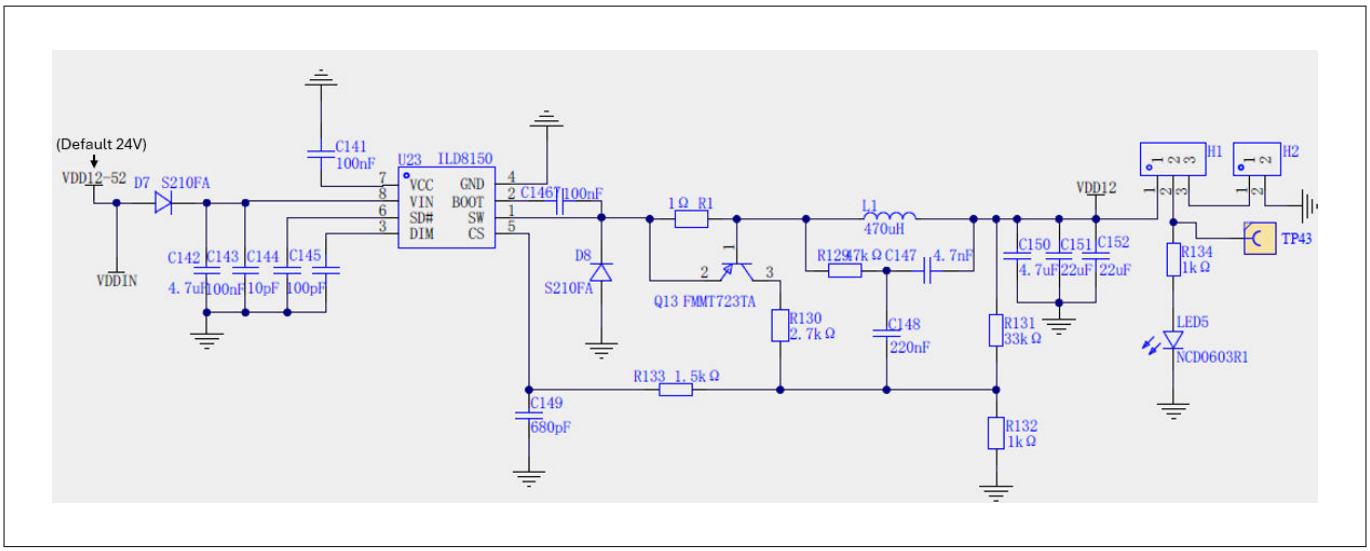


Figure 16 Step-down converter from DC bus to 12 V

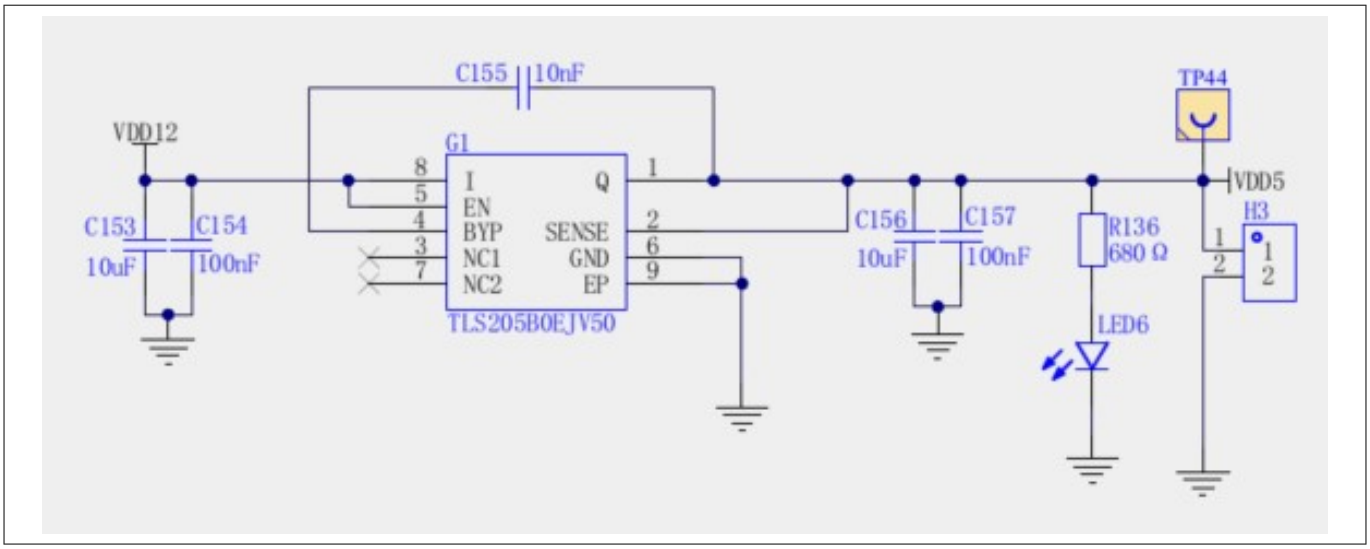


Figure 17 Step-down converter from 12 V to 5 V

3.8 Miscellaneous

One green LED (LED6) indicates the presence of a 5 V supply. It should be turned on when the board is operative. Two green LEDs (LED1, LED2) are connected to the Gatedriver_Enable1 and Gatedriver_Enable2 pins of the signal connector. They are available as a general-purpose indicator for the microcontroller. See Figure 18for more details.

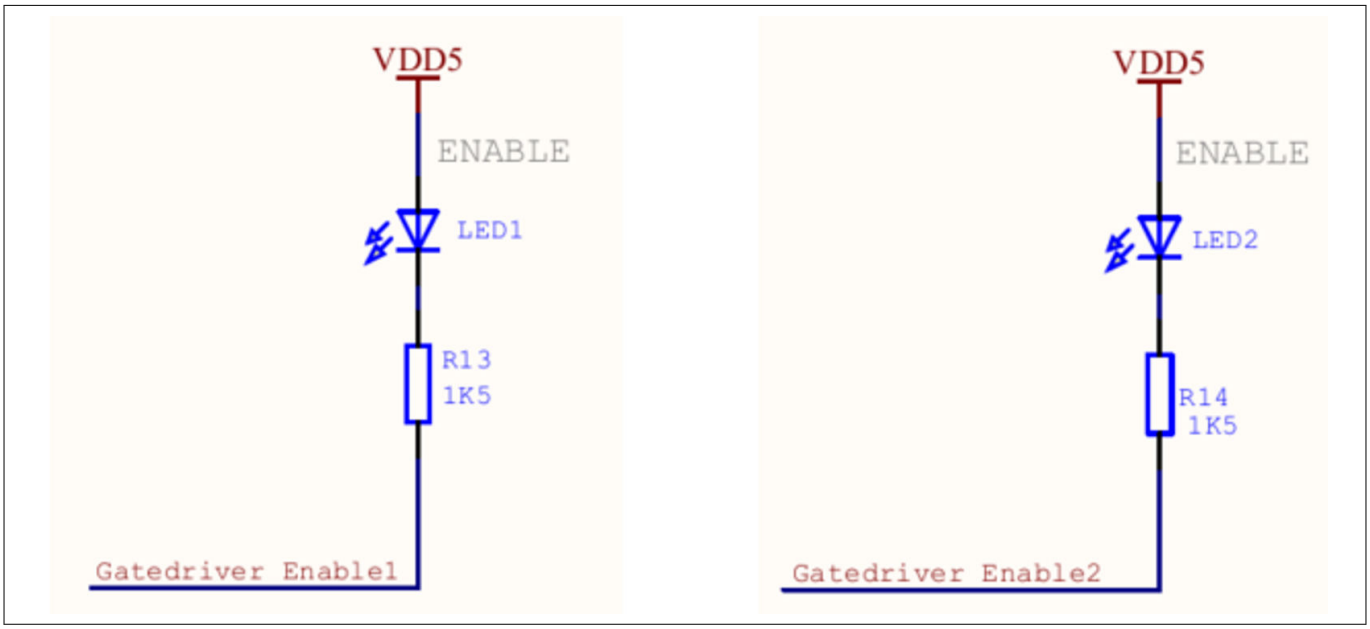


Figure 18 Enable general-purpose LEDs

Two NTC (NTC1, NTC2) thermistors are also available on the board, with the temperature dependence shown in Figure 19. NTC1 and NTC2 values at room temperature are 100 kΩ.

$$R = R_0 . e^{B\left(\frac{1}{T} - \frac{1}{T_0}\right)} = \frac{R_{17}}{R_{17} + R_{18}}$$

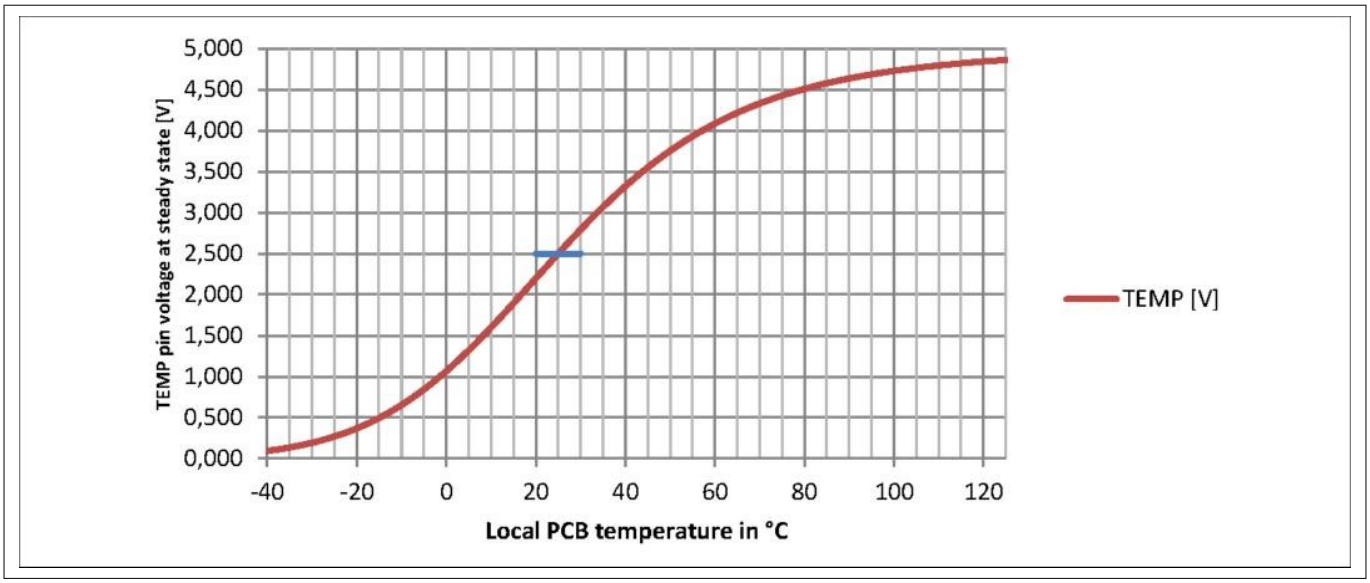


Figure 19 TEMP pin voltage as a function of local PCB temperature

NTC1 and NTC2 are located as shown in Figure 20.

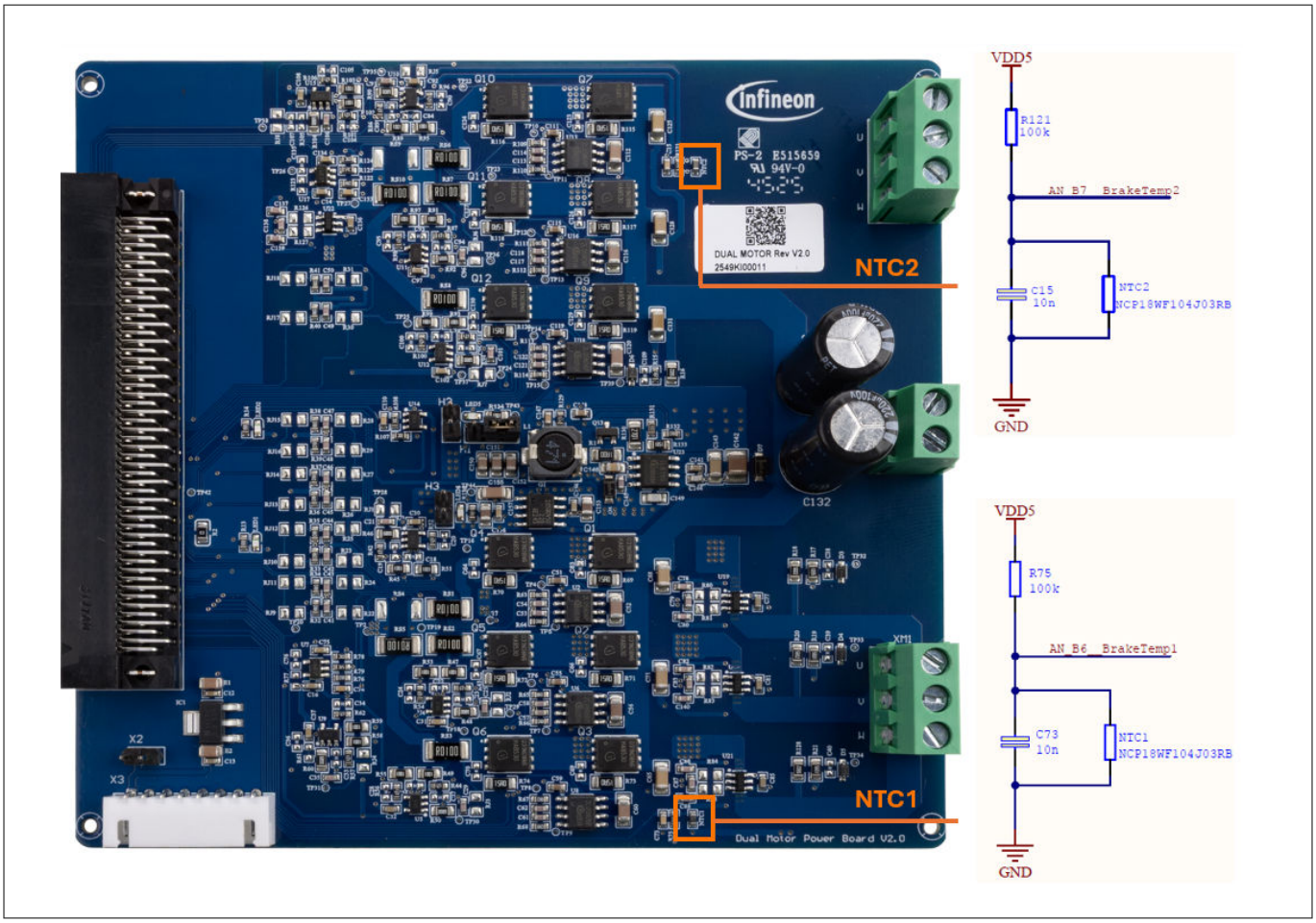


Figure 20 Position of the NTC thermistor

Thermistor capability to sense real MOSFET temperature is very limited. It can be used just to have a superficial indication of local PCB temperature.

3.9 Digital sensor interface

This board can enable a digital sensor interface via SPI connection. For example, Encoder or Resolver-based motor sensors signals can be connected to the X3 connector, which is directly mapped to the MCU. The connector signals are shown in Table 8.

Table 8 Digital sensor interface signal description

X3 pins	Name	Notes	HD connector (X1) pins
1	3V3	3V3 Power output	B21
2	I2C_SCL	I2C Clock	A1
3	I2C_SDA	I2C Serial Data	B1
4	SPI_CLK	SPI Clock	A2
5	SPI_MOSI	SPI Master Output Slave Input	B2
6	SPI_MISO	SPI Master Input Slave Output	A3
7	SPI_SEL0	SPI Chip Select	B3
8	GND	Ground	A5

3.10 PWM signals

This board uses a gate driver IC, the Compact series EiceDRIVER™ 2EDL05N06PF. For detailed specification, see Gate driver ICs and look for Isolated Gate Driver ICs. The main characteristics of the Gate Driver IC follow:

- Technology: Rugged silicon on insulator (SOI) technology, allows negative voltage spikes at VB pin
- Output: +360/-700 mA gate drive output current capability
- Protection: Interlocking function with minimum dead time insertion (typ 75 ns)
- UVLO: MOSFET tailored undervoltage lock out (rising 9.1 V, falling 8.3 V typ), suitable for 12 V driving voltage
- Bootstrap: Low-Ohmic Integrated bootstrap diode (BSD)

To drive the MOSFET stage correctly, follow the suggested parameter choice:

Table 9 Motor control configuration

Parameter	Value	Unit
Deadtime	>500	ns
Switch delay time	400	ns
Amplifier gain	12	V/V
DCLink voltage divider ratio	0.035 or 3.5%	–
Enable pin is deactivated	Active high → LED ON	–

4 Operating the board using the Motor Suite GUI

The reference board must be set up properly in order to drive the motors. Figure 21 shows the external connections that are used to connect the motor phases, debugger, and power supply. Once the external connections are made, the power supply can be set using the proper voltage and current limits and enabled (see specifications). This power board can be tested using the default dual motor code example that uses a 24 V supply with two DB42M03 motors and `KIT_PSC3M5_CC2` by default.

The steps for connecting the board are as follows:

1. Connect the motor cables to the phase terminals on the board (cable order does not matter)
2. Connect the power supply to positive (+ve) and negative (-ve) terminals of the supply connector (P1)
3. Set the power supply to 24 V and the current limit to 0.5 A, but do not enable the power supply
4. Set the potentiometer to zero (rotate the knob counter-clockwise until it cannot turn anymore)
5. Connect the PSOC™ Control drive card to the dual motor power board via HD connector (X1)
6. Connect the PSOC™ Control drive card to the PC via USB-C to enable JLINK debugger
7. Enable the power supply

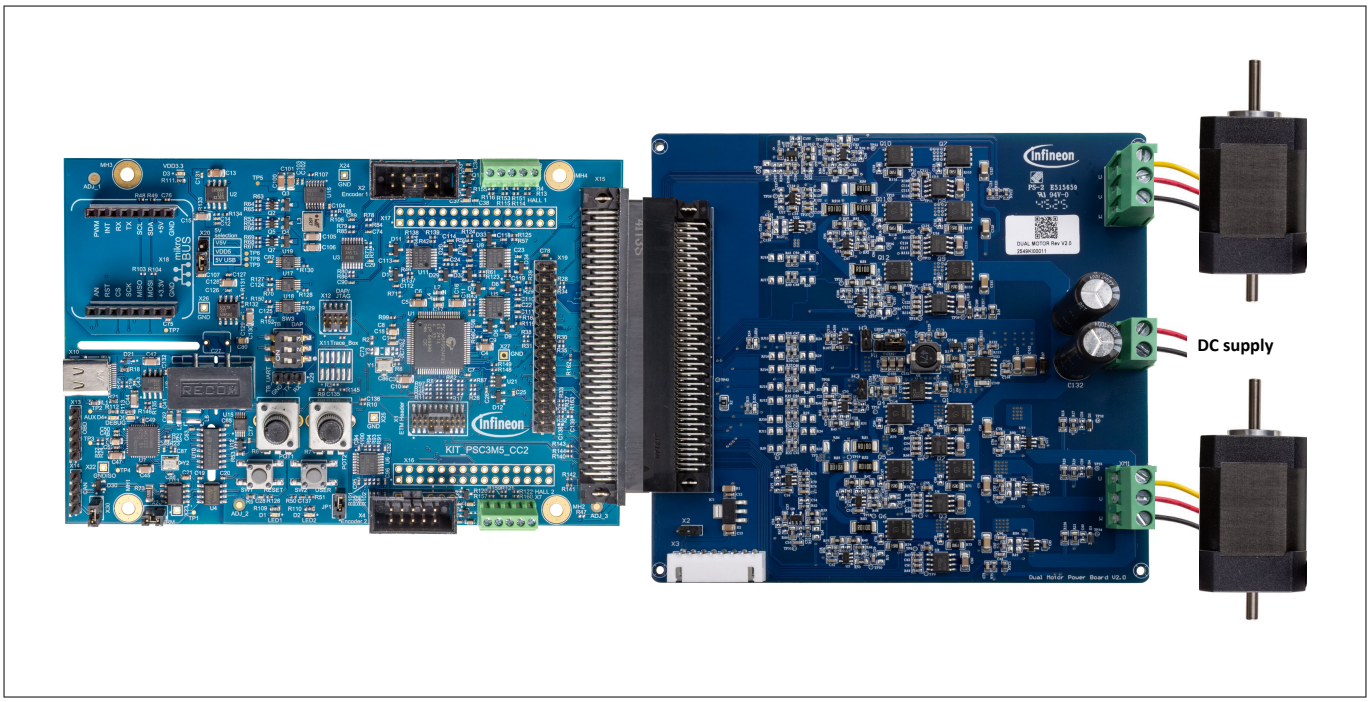


Figure 21 Complete dual motor setup with PSOC™ Control drive card

The motor control GUI flashes control firmware and configuration settings for the MCU on the motor control boards operating with FOC with one or three shunts. You can use the workbench to select the parameters for a project and then save the configuration. You can also import and flash firmware using the GUI. The steps to download and use the GUI are as follows:

1. Download the Infineon Developer Center Launcher application and log in using your Infineon credentials
2. Download and install the **Infineon Developer Center Launcher**. Once open, search for ModusToolbox™ Motor Suite (v2.8.0 or latest) by navigating to the Manage Tools in the search bar

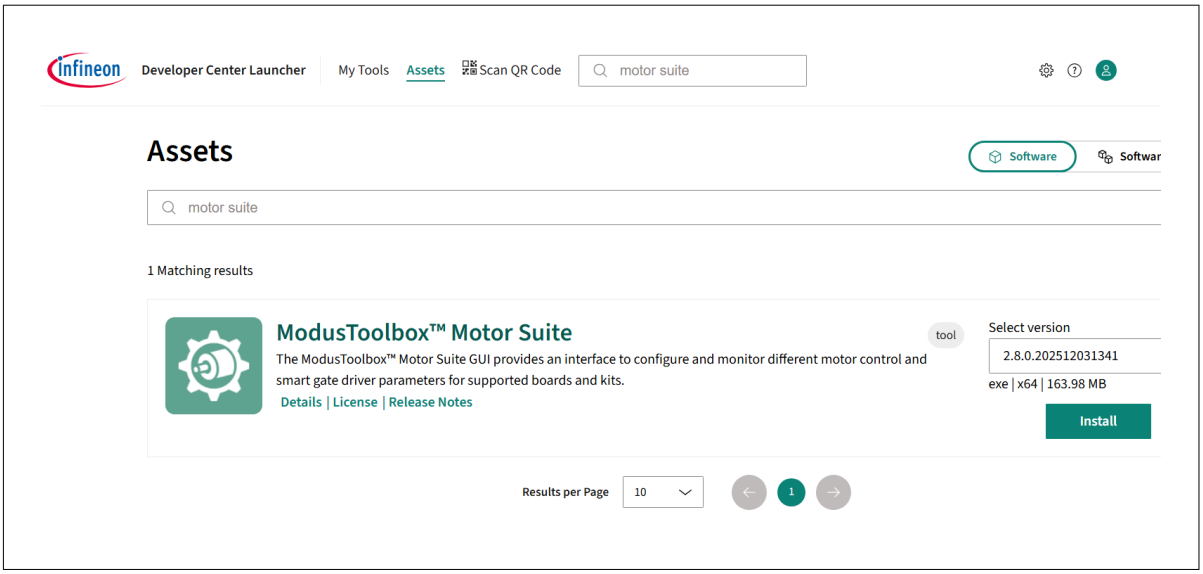


Figure 22 Infineon developer center

3. Click **Start** on ModusToolbox™ Motor Suite
4. Create a new project by selecting **PSOC™ Control C3M5 Dual Motor Kit** and selecting **RFO** using the drop-down menu
5. Connect the board to the computer via J-link Debugger and the 24 V power supply
6. Enable power supply and connect the GUI to the board via the GUI, as shown in Figure 24
7. Expand the drop-down menu from the **PSOC™ Control C3** option in the Parameter Controls panel

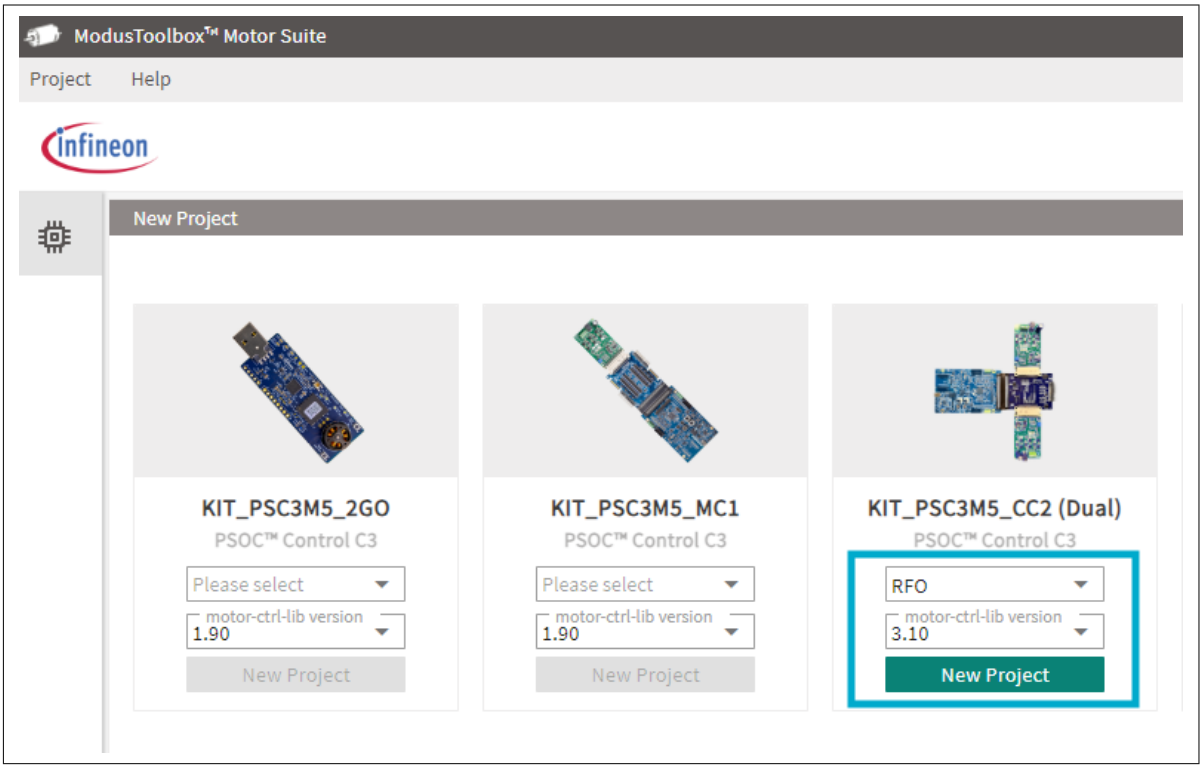


Figure 23 Motor Control GUI launch screen

8. Once the configuration page appears, turn on the power supply. Connect the GUI to the board by selecting **Disconnected** on the bottom right of the screen and then the Segger Serial Number option

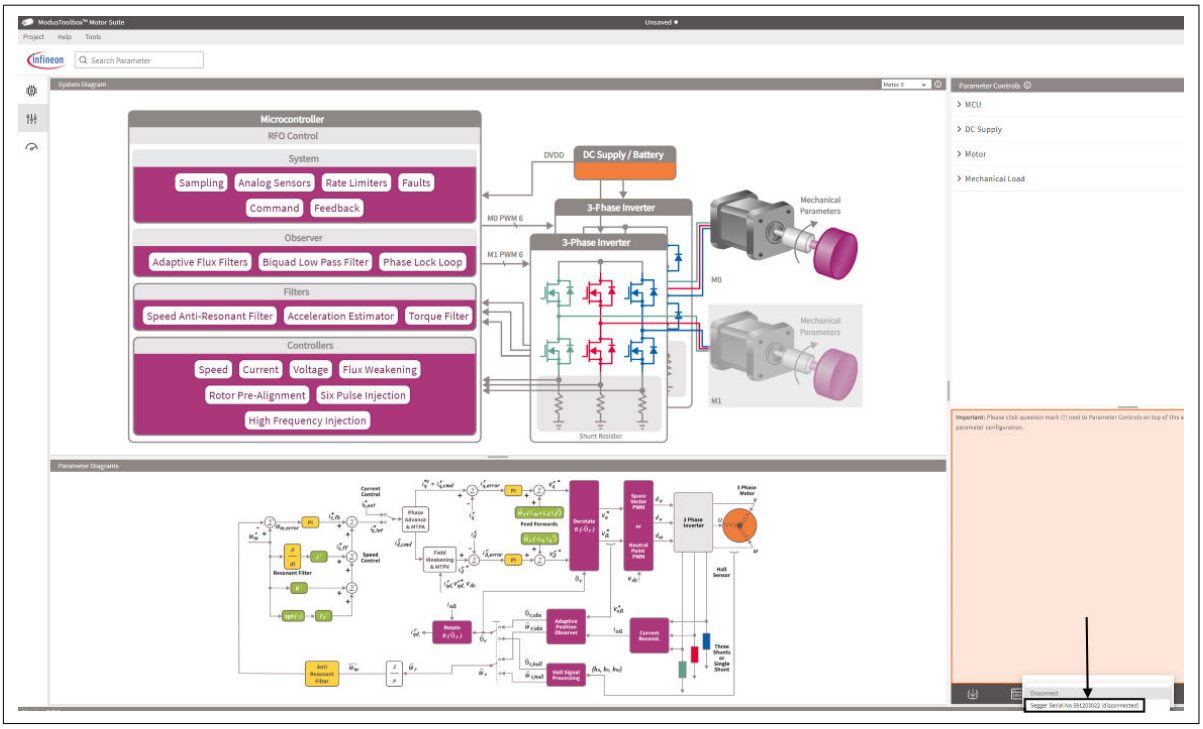


Figure 24 Connecting GUI to Board

9. From the bottom-right dropdown menu, click **Flash Firmware** and select **Default** in the pop-up window to program the board with the default dual motor control firmware
10. Go to the **Test Bench** by selecting the speed icon on the left-hand side of the screen, as shown in Figure 25
11. Start turning the potentiometers on the PSOC™ Control board to run the motors. POT1 can be used for motor 1, POT2 for motor 2
12. If you prefer controlling the motors exclusively via the GUI, disable **Potentiometer Control** and enable **Drive** in the Command panel. You can then use the **Target Set** slider to adjust the speed to your desired level
13. The previously explained controls apply only to Motor 1. To switch to the second motor controls, change the motor selection from the upper-right corner, as shown in Figure 25



Figure 25 Test bench

14. You can observe the waveforms of both motors using the GUI. Select **Launch Oscilloscope** option from the upper-right corner, . Inside the new window, click **Auto Scale** or **Auto Fit all traces** to view both motor waveforms as in Figure 26

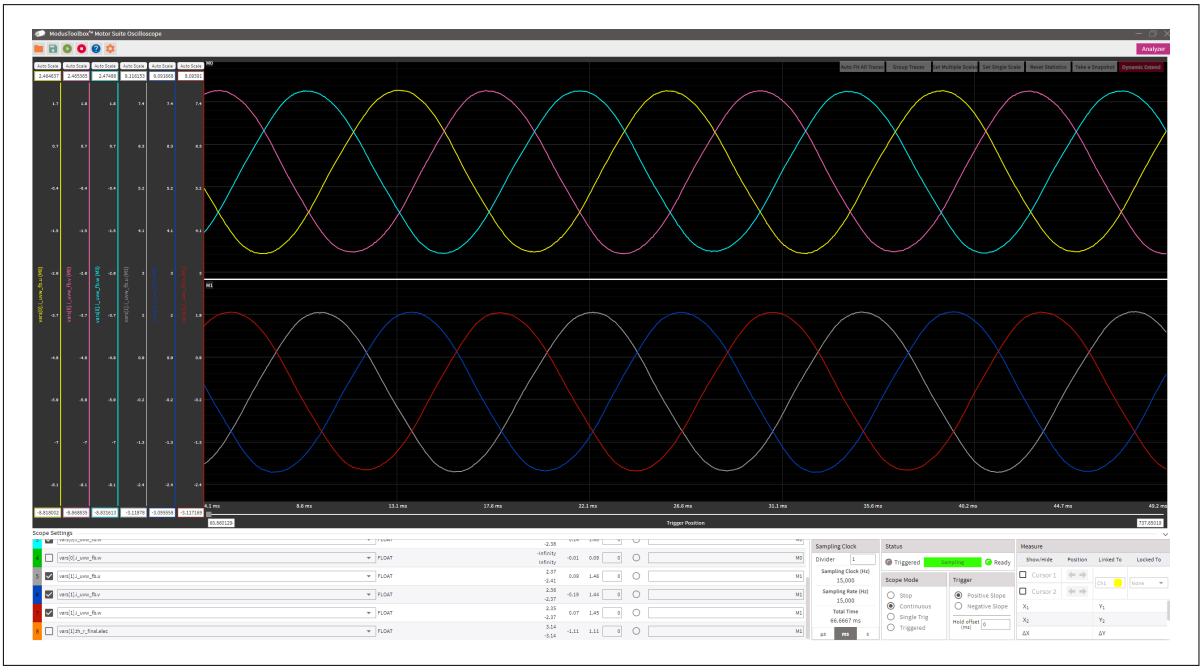


Figure 26 Oscilloscope view of the GUI

5 Bill of materials (BOM)

Table 10 Bill of materials (BOM)

Reference	Qty	Type	Value/rating	Part number
C12, C13, C14, C16, C75,C30, C31, C32, C37, C92, C97,C102,C108, C77, C81, C85, C134, C136, C141,C154, C157	21	Capacitance	100 nF 10%	CL10B104KB8NNNC
C15, C73	2	Capacitance	10 nF 10%	CL10B103KB8NNNC
C53, C54,C113, C114	4	Capacitance	100 pF 5%	CL10C101JB8NNNC
C21, C25, C29, C35, C91, C96, C101, C106	8	Capacitance	47 pF 5%	CL10C470JB8NNNC
C146	1	Capacitance	100 nF 10%	CL21B104KBCNNNC
C143	1	Capacitance	100 nF 10%	CL31B104KBCNNNC
C57, C58, C61, C62, C117, C118, C121, C122	8	Capacitance	100 pF 5%	CL10C101JB8NNNC
C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C145	11	Capacitance	100 pF 5%	CL10C101JB8NNNC
C51, C55, C59, C111, C115, C119	6	Capacitance	2.2 µF 10%	CL10A225KB8NNNC
C153, C156	2	Capacitance	10 µF 10%	CL21A106KBYQNNE
C52, C56, C60, C112, C116, C120,E1, E2	8	Capacitance	10 µF 10%	CL31A106KBHNNNE
C65, C68, C71, C125, C128, C131	6	Capacitance	1 µF 5%	CC1206JKX7R9BB105
C72, C132	2	Electrolytic capacitor	220 µF/100V	ECG1KM221G25OTBO
C74,C133	2	Capacitance	1 nF 10%	CL10B102KB8NNNC
C78, C80, C82, C86, C88, C137, C139, C140	8	Capacitance	22 pF 5%	CL10C220JB8NNNC
C79, C83, C87, C138	4	Capacitance	15 pF 5%	CL10C150JB8NNNC
C155	1	Capacitance	10 nF 10%	CC1206KKX7RCBB103
C110	1	Capacitance	10 nF 10%	CL10B103KB8NNNC
C150	1	Capacitance	4.7 µF 10%	CL21A475KAQNNNE
C142	1	Capacitance	4.7 µF 10%	CL32B475KBUYNNE
C144	1	Capacitance	10 pF 5%	CL10C100JB8NNNC
C147	1	Capacitance	4.7 nF 10%	CL10B472KB8NNNC

(table continues...)

Table 10 (continued) Bill of materials (BOM)

Reference	Qty	Type	Value/rating	Part number
C148	1	Capacitance	220 nF 10%	CL10B224KA8NNNC
C149	1	Capacitance	680 pF 10%	CC0805JRNPO9BN681
C151, C152	2	Capacitance	22 µF 20%	CL21A226MAQNNNE
D3, D4, D5, D6	4	Diode tube	-	MM3Z5V1ST1G
D7, D8	2	Diode tube	-	S210FA
G1	1	IC	-	TLS205B0EJV50XUMA1
H1	1	Connector	2.54-3pin-Dip	PZ254V-11-03P
H2, H3	2	Connector	2.54-2pin-Dip	PZ254V-11-02P
IC1	1	IC	-	LM1117S-3.3
L1	1	Inductance	470 µH	APCI00070746471M80
R2	1	Resistance	0 Ω	RC0805FR-070RL
LED1, LED2, LED5, LED6	4	Diode tube	-	NCD0603G1
NTC1, NTC2	2	NTC	-	NCP18WF104J03RB
P1	1	Connector	-	WJ500V-5.08-2P
Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12	12	IGBT	-	ISC031N08NM6
Q13	1	Transistor	-	FMMT723TA
R1	1	Resistance	1 Ω 1%	RC1206FR-071RL
R133	1	Resistance	1.5 kΩ 1%	RC0805FR-071K5L
R13, R14	2	Resistance	1.5 kΩ 1%	RC0603FR-071K5L
R42, R43, R44, R52, R54, R56, R57, R62, R86, R87, R88, R96, R98, R100, R101, R106	16	Resistance	12 kΩ 1%	RC0603FR-0712KL
R15	1	Resistance	5.6 kΩ 1%	RC0603FR-105K6L
R16, R18, R20, R128	4	Resistance	56 kΩ 1%	RC0805FR-0756KL
R17, R19, R21	3	Resistance	5.6 kΩ 1%	RC0805FR-075K6L
R45, R47, R49, R51, R53, R55, R58, R59, R89, R91, R93, R95, R97, R99, R102, R103	16	Resistance	1 K 1%	RC0805FR-071KL
R32, R33, R34, R35, R36, R37, R38, R39, R40, R41	10	Resistance	10 K 1%	RC0603FR-071KL
R136	1	Resistance	680 Ω 1%	RC0603FR-07680RL

(table continues...)

Table 10 (continued) Bill of materials (BOM)

Reference	Qty	Type	Value/rating	Part number
R46, R48, R50, R60, R90, R92, R94, R104	8	Resistance	680 Ω 1%	RC0805FR-07680RL
R134	1	Resistance	1 kΩ 1%	RC0805FR-071KL
R63, R64, R65, R66, R67, R68, R76, R109, R110, R111, R112, R113, R114, R122	14	Resistance	1 kΩ 1%	RC0603FR-071KL
R69, R70, R71, R72, R73, R74, R115, R116, R117, R118, R119, R120	12	Resistance	15 Ω 1%	RC1206FR-0715RL
R75, R121	2	Resistance	100 kΩ 1%	RC0603FR-07100KL
R78, R124	2	Resistance	10 K 1%	RC0603FR-0710KL
R79, R125	2	Resistance	40.2 K 1%	RC0603FR-0740K2L
R107, R108	2	Resistance	20 K 1%	RC0603FR-0720KL
R129	1	Resistance	47 kΩ 1%	RC0603FR-0747KL
R130	1	Resistance	2.7 kΩ 1%	RC1206FR-072K7L
R131	1	Resistance	33 kΩ 5%	RC0603FR-0733KL
R132	1	Resistance	1 kΩ 1%	RC0603FR-071KL
RS1, RS2, RS3, RS6, RS7, RS8	6	Resistance	0.01 Ω 1% 3W	WFMA2010R0100FEA / WSLP2010R0100FEA
RS5,RS10	2	Resistance	0.01 Ω 1% 3W	WFMA2010R0100FEA / WSLP2010R0100FEA
U2, U6, U8, U13, U16, U18	6	IC	-	2EDL05N06PF
U3, U4, U5, U9, U10, U11, U12, U14, U15	9	IC	-	AD8615AUJZ-REEL7
U7, U17	2	IC	-	LM397MFX/NOPB
U19, U20, U21, U22	4	IC	-	TLI5570
U23	1	IC	-	ILD8150
X1	1	Connector	Dip	FX2-100P-1.27DSL(71)
X2	1	Connector	-	PZ254V-11-02P
X3	1	Connector	-	ZX-XH2.54-8PWZ
XM1, XM2	2	Connector	-	WJ500V-5.08-3P

6 PCB layout

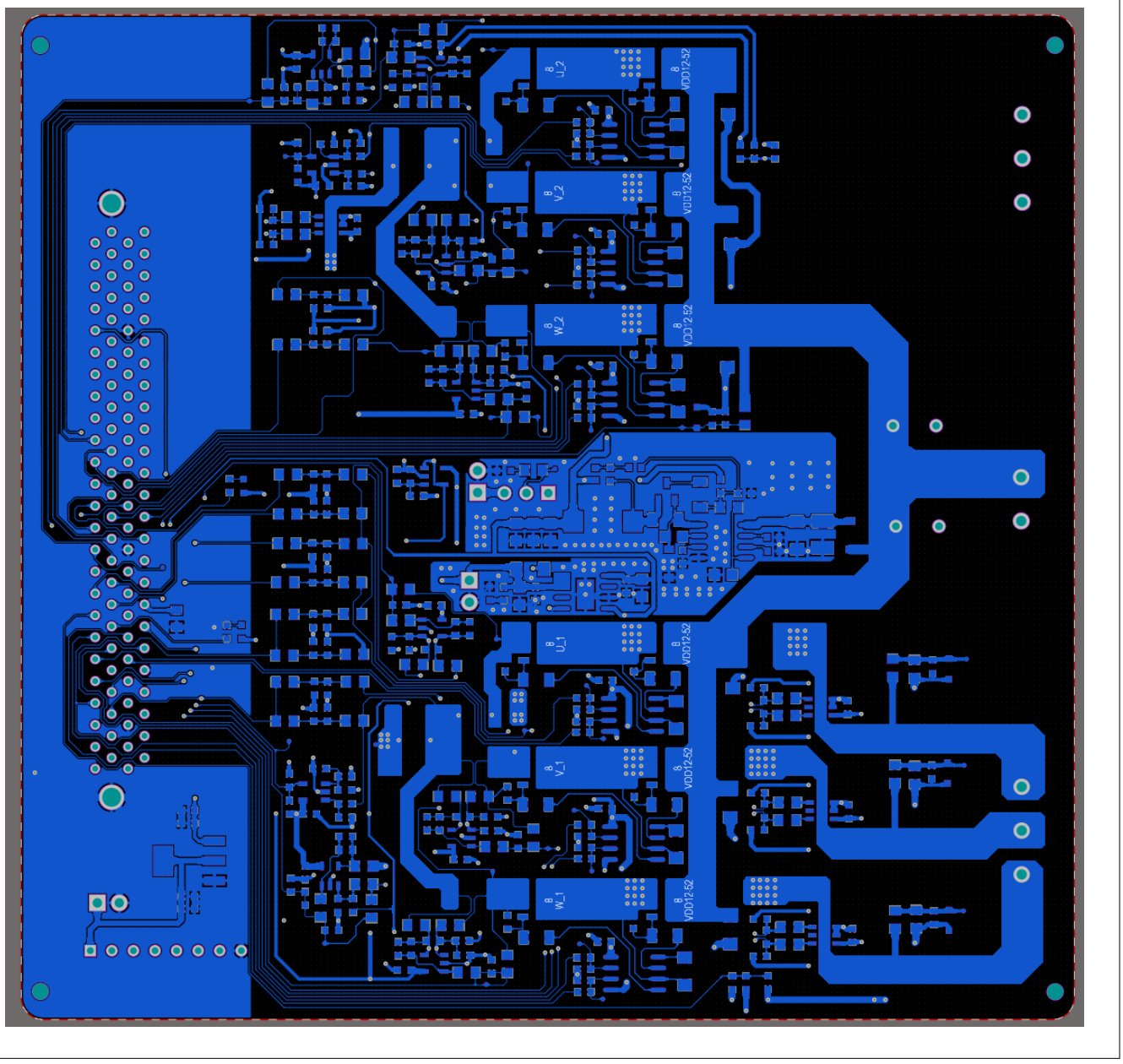


Figure 27 Top layer

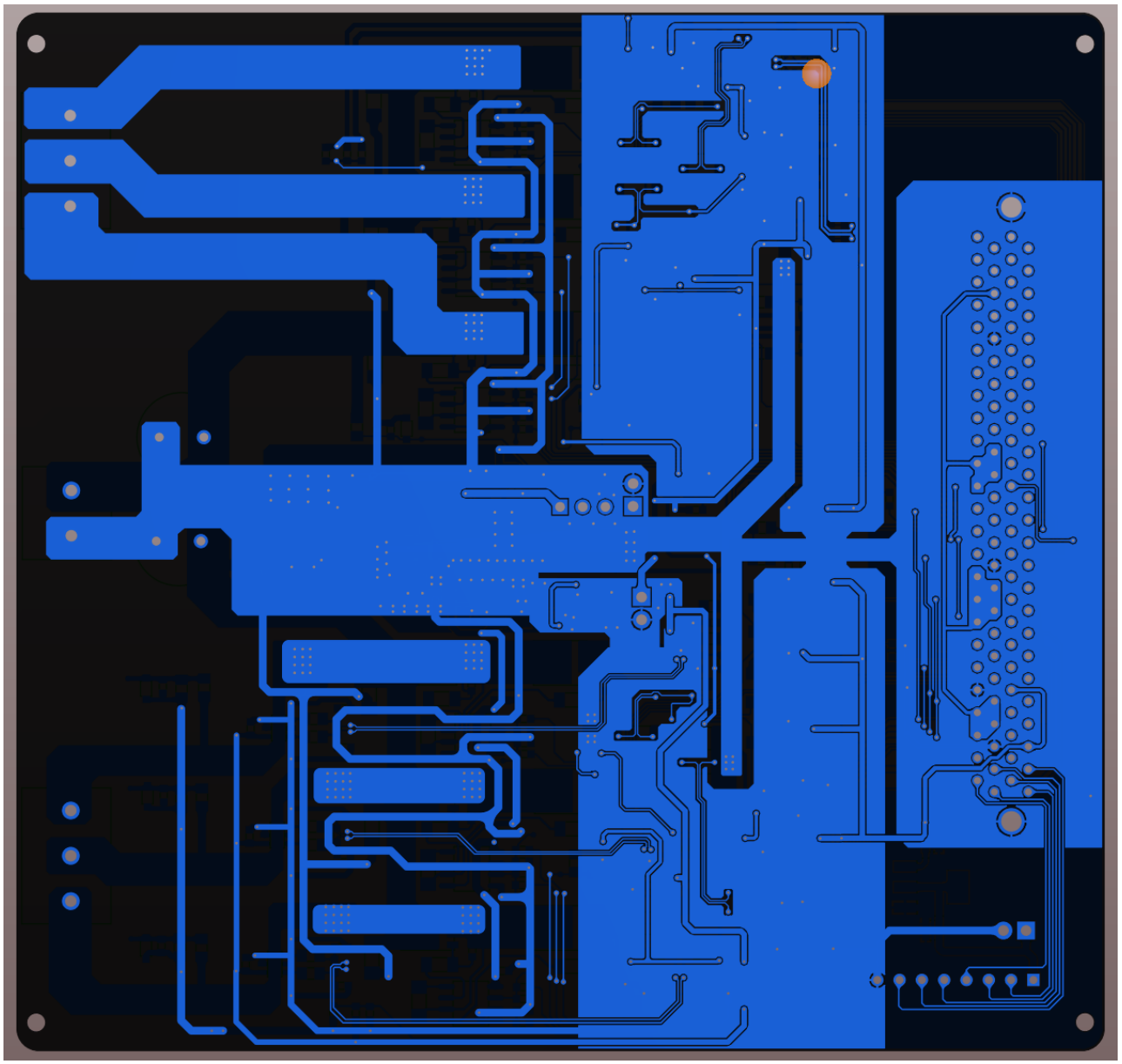


Figure 28 Bottom layer

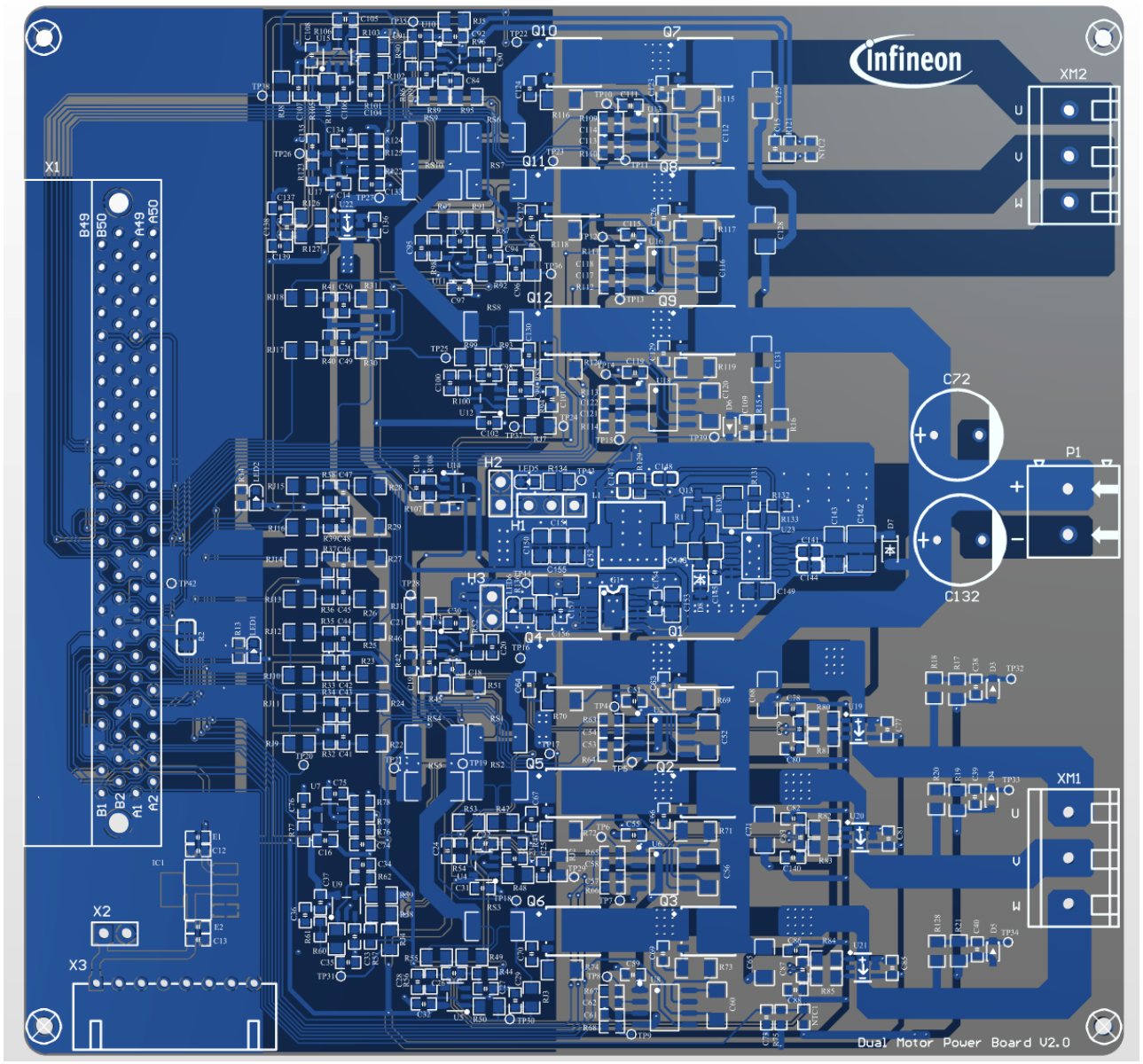


Figure 29 Component placement

Related resources

[1] PSOC™ Control product page
[2] PSOC™ Control CC2 kit page
[3] ModusToolbox™ Motor Suite GUI user guide
[4] Infineon/GitHub dual motor control code example
[5] KIT_DUALMOT_500W24V power board hardware schematics

Revision history

Document revision	Date	Description of changes
**	2026-06-17	Initial release

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Customer shall not touch the Evaluation Board during operation and keep a safe distance.
Customer shall not touch the Evaluation Board after disconnecting the power supply, several components may still store electrical voltage and can discharge through physical contact. Several parts, like heat sinks and transformers, may still be very hot. Allow the components to cool before touching or servicing.
The electrical installation must be completed in accordance with the appropriate safety requirements.