EVAL-M1-05F310 User Manual

iMOTION™ Modular Application Design Kit

About this document

Scope and purpose

This application note provides an overview of the evaluation board EVAL-M1-05F310 including its main features, key data, pin assignments and mechanical dimensions.

EVAL-M1-05F310 is a complete power evaluation board including three CIPOS™ Nano 100V half-bridge modules for motor drive application. In combination with either EVAL-M1-101T or EVAL-M1-099M it features and demonstrates Infineon's CIPOS™ technology for motor drive.

The evaluation board EVAL-M1-05F310 was developed to support customers during their first steps designing Applications with IRSM005-301MH CIPOS™ Nano power modules.

Intended audience

This application note is intended for all technical specialists working with the EVAL-M1-05F310 board.

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1 Safety precautions

In addition to the precautions listed throughout this manual, please read and understand the following statements regarding hazards associated with development systems.

Table 1 **Precautions**

⚠	*Attention: The ground potential of the EVAL-M1-05F310 system is biased to a negative DC bus voltage potential. When measuring voltage waveform by oscilloscope, the scope's ground needs to be isolated. 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.*
⚠	*Attention: EVAL-M1-05F310 system contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the drive system, wait three 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.*
⚠	*Attention: Only personnel familiar with the drive and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.*
⚠	*Attention: The surfaces of the drive may become hot, which may cause injury.*
⚠	*Attention: EVAL-M1-05F310 system contains parts and assemblies sensitive to Electrostatic Discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to applicable ESD protection handbooks and guidelines.*
⚠	*Attention: A drive, incorrectly applied or installed, can result in component damage or reduction in product lifetime. Wiring or application errors such as under sizing the motor, supplying an incorrect or inadequate AC supply or excessive ambient temperatures may result in system malfunction.*

⚠	*Attention: Remove and lock out power from the drive before you disconnect or reconnect wires or perform service. Wait three 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.*
⚠	*Attention: EVAL-M1-05F310 system is shipped with packing materials that need to be Removed prior to installation. Failure to remove all packing materials which are unnecessary for system installation may result in overheating or abnormal operating condition.*

2 Introduction

The EVAL-M1-05F310 evaluation board is a part of the iMOTION™ Modular Application Design Kit for motor control (iMOTION™ MADK).

The MADK platform is intended to use various power stages with different control boards. These boards can easily be interfaced through the 20 pin iMOTION™ MADK-M1 interface connector.

This evaluation board is designed to give comprehensible solutions of a power stage featuring CIPOS™. It provides a DC input and 3-phase output for power. It contains three emitter-shunts for current sensing and a voltage divider for DC-link voltage measurement.

The EVAL-M1-05F310 evaluation board is available from Infineon. The features of this board are described in the design feature chapter of this document, whereas the remaining paragraphs provide information to enable the customers to copy, modify and qualify the design for production according to their own specific requirements.

Environmental conditions were considered in the design of the EVAL-M1-05F310. The design was tested as described in this document but not qualified regarding safety requirements or manufacturing and operation over the whole operating temperature range or lifetime. The boards provided by Infineon are subject to functional testing only.

Evaluation boards are not subject to the same procedures as regular products regarding Returned Material Analysis (RMA), Process Change Notification (PCN) and Product Discontinuation (PD). Evaluation boards are intended to be used under laboratory conditions by specialists only.

Figure 1   Evaluation board EVAL-M1-05F310
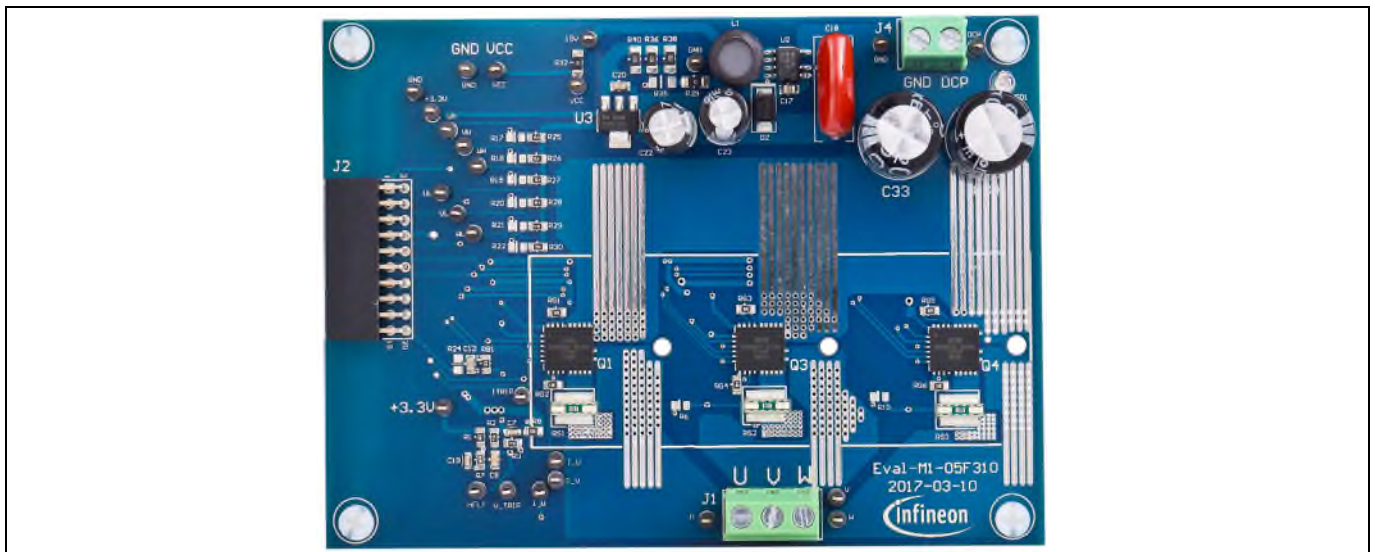
Figure 1 shows the picture of evaluation board EVAL-M1-05F310. This board is compatible with surface mount CIPOS™ modules. This document explains the features and details of this board in combination with CIPOS™ Nano IRSM005-301MH. The difference between these modules is current and voltage. Ratings and other details of the board are explained in the subsequent sections.

3   Main features

EVAL-M1-05F310 is a complete power evaluation board including a 3-phase IPM for motor drive application. The kit demonstrates Infineon's IPM technology for motor drives.

Main features of CIPOS™ Nano Intelligent Power Module IRSM005-301MH are:

- MOSFET Drain-to-Source Voltage 100V
- Maximum DC current at 25℃ case temperature I_c = 30A
- Up to 165W power output at 10 kHz PWM frequency
- Package with low thermal resistance and minimal parasitics
- Independent gate driver in phase with logic input
- Gate drive supply range from 10V to 20V
- Propagation delay matched to defined spec
- 3V, 5V and 15V logic input compatible
- Under-voltage lockout protection inside the driver
- On board overcurrent protection
- Exposed driver outputs and HEXFET gate terminals for dV/dt setting through a resistor

The evaluation board characteristics are:

- Up to165W motor power range
- Possibility to easy change between 3 Leg shunt to single shunt configuration
- Compatible with the following CIPOS™ Nano module:
  IRSM005-301MH   30A / 16mΩ, 100V
- RoHS compliant
- PCB is 118 x 85 mm and has two layers with 35 µm copper each

3.1 Key data

Figure 2 provides the overview of the IRSM005-301MH internal electrical schematics. For further information regarding these CIPOS™ like static and dynamic electrical behavior, as well as thermal and mechanical characteristics please refer to the datasheet of the IRSM005-301MH.
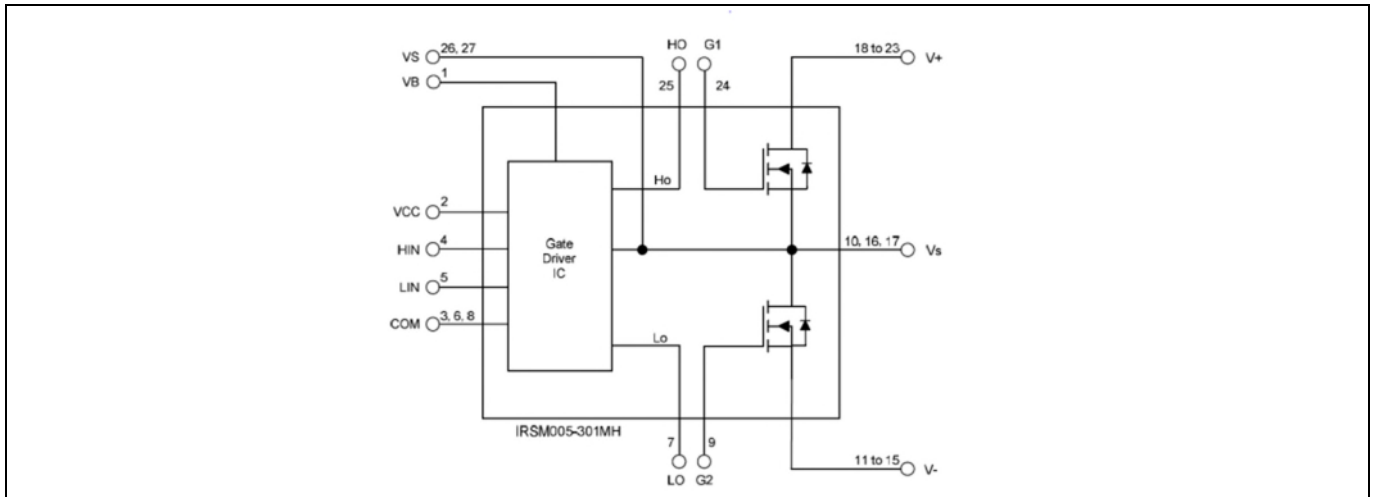

Figure 2 **CIPOS™ Nano internal electrical schematic**

Table 2 Provide the absolute maximum ratings of the IRSM005-301MH.

Table 2 **Absolute Maximum Ratings of IRSM005-301MH**

Symbol	Description	Min	Max	Unit
V_{DS}	MOSFET Drain-to-Source Voltage	--	100	V
I_O	Maximum DC Current per MOSFET @ T_C =25°C (Note1)	--	30	A
P_d	Maximum Power Dissipation per MOSFET@ T_C =100°C	--	13.5	W
T_J (MOSFET & IC)	Operating Junction Temperature	--	150	°C
T_S	Storage Temperature range	-40	150	°C
V_B	High Side Floating Supply Voltage	-0.3	VS+20	V
V_S	High Side Floating Supply Offset Voltage	VB-20	VB+0.3	V
V_{CC}	Low Side Fixed Supply voltage	-0.3	20	V
V_{IN}	Low Input Voltage of LIN, HIN	-0.3	VCC+0.3V	V

Note 1：Calculated based on maximum junction temperature. Bond wires current limit is 20A.

Main features

Table 3 depicts the recommended operating conditions of IRSM005-301MH.

Table 3   Recommended operating conditions of CIPOS™ Nano IRSM005-301MH

Symbol	Description	Min	Typ	Max	Unit
VB	High Side Floating Supply Voltage	VS +10	VS +15	VS +20	V
V_S	High Side Floating Supply Offset Voltage	Note1	--	100	V
V_{CC}	Low Side and Logic fixed Supply Voltage	10	15	20	V
L_{IN}	Logic input Voltage LIN, HIN	COM	--	V_{CC}	V
H_{IN}	High side PWM pulse width	1	--	--	µs
Dead time	Suggested dead time between LIN and HIN	0.3	0.5	--	µs

Table 4 shows the important specifications of the evaluation board EVAL-M1-05F310.

Table 4   Eval-M1-05F310 board specifications

Parameters	Values	Conditions / comments
Output Power		
Watts (Note2)	165W	IRSM005-301MH
Current (Note2)	5.5A*	IRSM005-301MH *rms, DcBus=64V, Fc=16kHz, 3-phase PWM, ΔTca=70C, Ta=25C
Power device		
IRSM005-301MH	27L CIPOS Nano IPM	
DC Bus voltage		
Maximum DC bus voltage	80V	With IRSM005-301MH modules mounted
Minimum DC bus voltage	36V	With IRSM005-301MH, only if on board generated 15V supply is used.
Current feedback		
Current sensing device Rs1,Rs2,Rs3	10 mΩ	Three leg shunt configuration is set. To implement single shunt, remove RS2 and RS3 and include R6 and R10 resistors (0 Ω)
Protections		
Output current trip level	20Apk	Configure by changing shunt resistors
On board power supply		
3.3V	3.3V+/-5%, Max 50mA	Used for Eval-M1-05F310
15V	15V+/-5%, Max 20mA	Used for interface signals with control board and alarm signal (I_TRIP)
PCB characteristics		

Parameters	Values	Conditions / comments
Material	FR4, 1.6MM thickness Copper thickness = 1oz (35um)	
Dimension	118mmx85mm	
System environment		
Ambient temperature	0-70°C	95%RH Max (Non-Condensing)

Note2: please refer to IRSM005-301 datasheet for data about maximum current and power, changing Fc, modulation, ΔTca, use of a heat sink.

Figure 3 and Figure 4 hint out the functional groups of the EVAL-M1-05F310 evaluation board.

1. DC Line connector (J4)
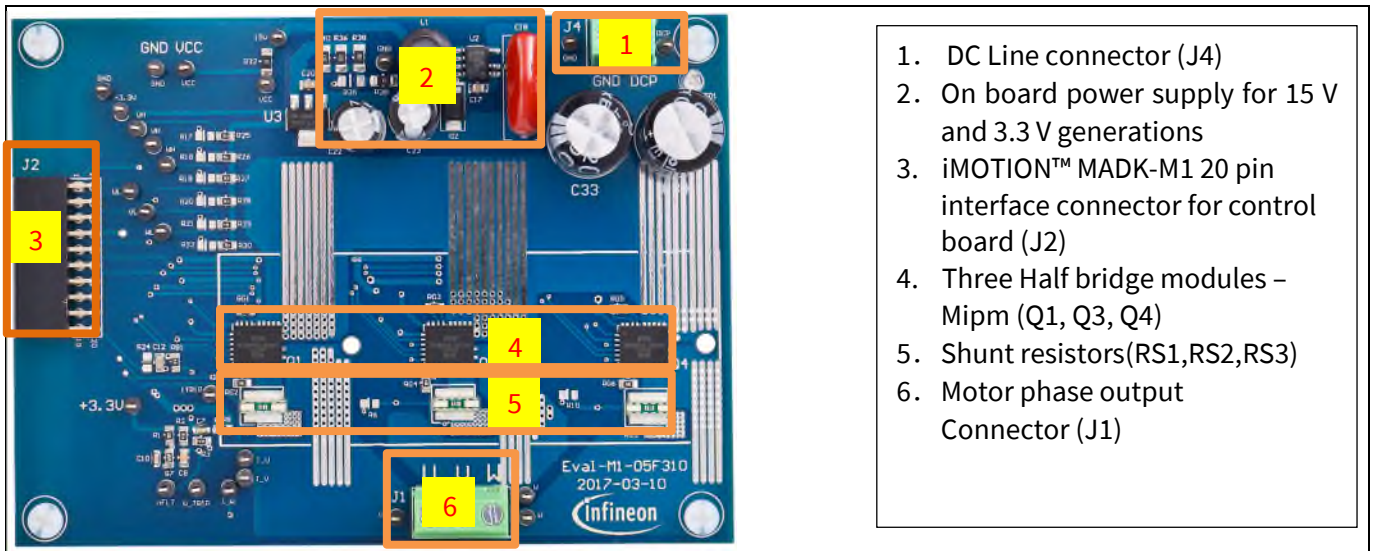2. On board power supply for 15 V and 3.3 V generations
3. iMOTION™ MADK-M1 20 pin interface connector for control board (J2)
4. Three Half bridge modules – Mipm (Q1, Q3, Q4)
5. Shunt resistors(RS1,RS2,RS3)
6. Motor phase output Connector (J1)

Figure 3   Functional groups of the EVAL-M1-05F310 evaluation board's top side
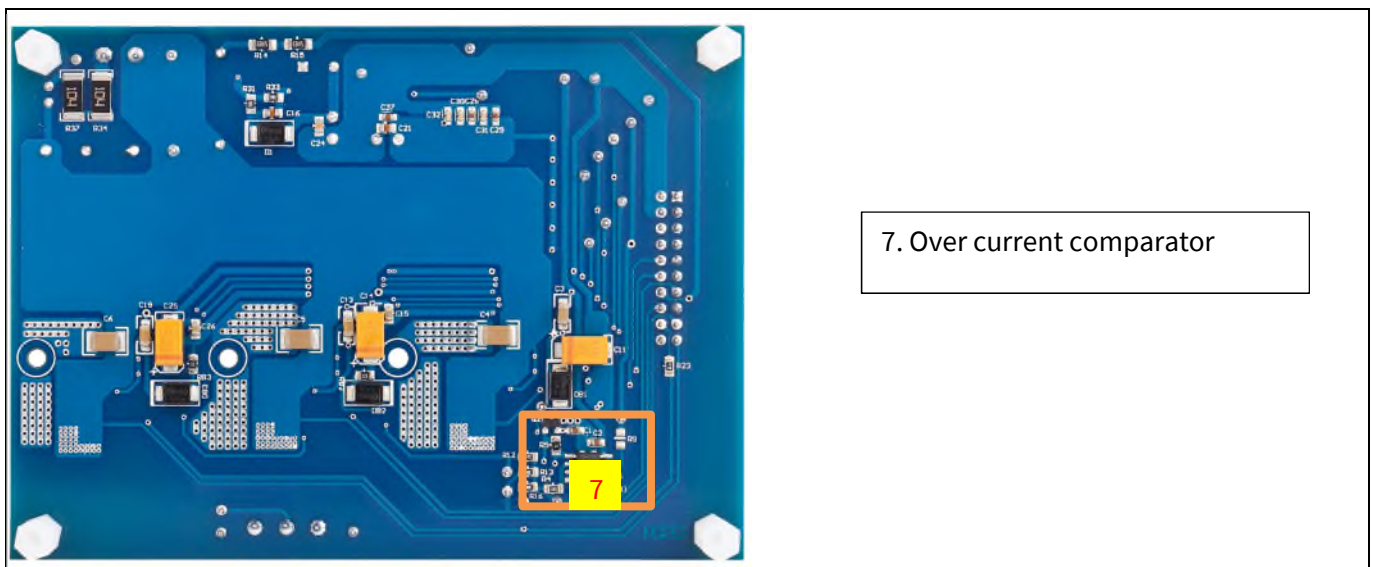

7. Over current comparator

Figure 4   Functional groups of the EVAL-M1-05F310 evaluation board's bottom side

4   Pin assignments

General information about the connectors of the EVAL-M1-05F310 evaluation board is reported.

Table 5 Include the details of the DC input connector J4-DC.

Table 6 denotes the details of the motor side connector J1.

Table 5   J4- DC input connector

S. No.	Pin	Details
1	GND	DC - connector
2	DCP	DC + connector

Table 6   J1- Motor side connector

S. No.	Pin	Details
1	U	Connected to motor phase U
2	V	Connected to motor phase V
3	W	Connected to motor phase W

Table 7 provides the pin assignments of the iMOTION™ MADK-M1 20 pin interface connector J3. This connector is the interface to the power board.

Table 7   J2- iMOTION™ MADK-M1 20 pin interface connector for power board

Pin	Name	Pin Name Connectors
1	PWMUH	3.3 V compatible logic input for high side gate driver-Phase U
2	GND	Ground
3	PWMUL	3.3 V compatible logic input for low side gate driver-Phase U
4	GND	Ground
5	PWMVH	3.3 V compatible logic input for high side gate driver-Phase V
6	+3.3V	3.3V power supply
7	PWMVL	3.3 V compatible logic input for low side gate driver-Phase V
8	+3.3V	3.3V power supply
9	PWMWH	3.3 V compatible logic input for high side gate driver-Phase W
10	IU+	Shunt voltage phase U
11	PWMWL	3.3 V compatible logic input for low side gate driver-Phase W
12	IU-	Ground
13	GK	Gatekill
14	DCBSENSE	Input, DC bus voltage to AIN1 after 2Mohm registers
15	VTH	Input, Voltage input of Power Module's Temperature sense
16	IV+	Shunt voltage phase V
17	IV-	Ground
18	IW+	Shunt voltage phase W
19	IW-	Ground
20	VCC	Defined for 15 V Power Supply

5 Getting Started with EVAL-M1-05F310

In order to run the motor system, a combination of the iMOTION™ MADK power board EVAL-M1-05F310 and the matching MADK control board (with M1 connector, EVAL-M1-101T for example in this chapter) is required. The iMOTION™ Software Tools MCEDesigner and MCEWizard are also required in order to initially setup the system, as well as to control and fine-tune the system performance to match users exact needs. This chapter provides more details on setting up the system and getting started with iMOTION™ MADK development platform.

5.1 Setting up the system

After downloading and installing the iMOTION™ PC Tools (MCEWizard and MCEDesigner), following steps need to be executed in order to run the motor. Refer to chapters 5.2.1 and 5.2.2 as well as MCEWizard and MCEDesigner documentation for more information.
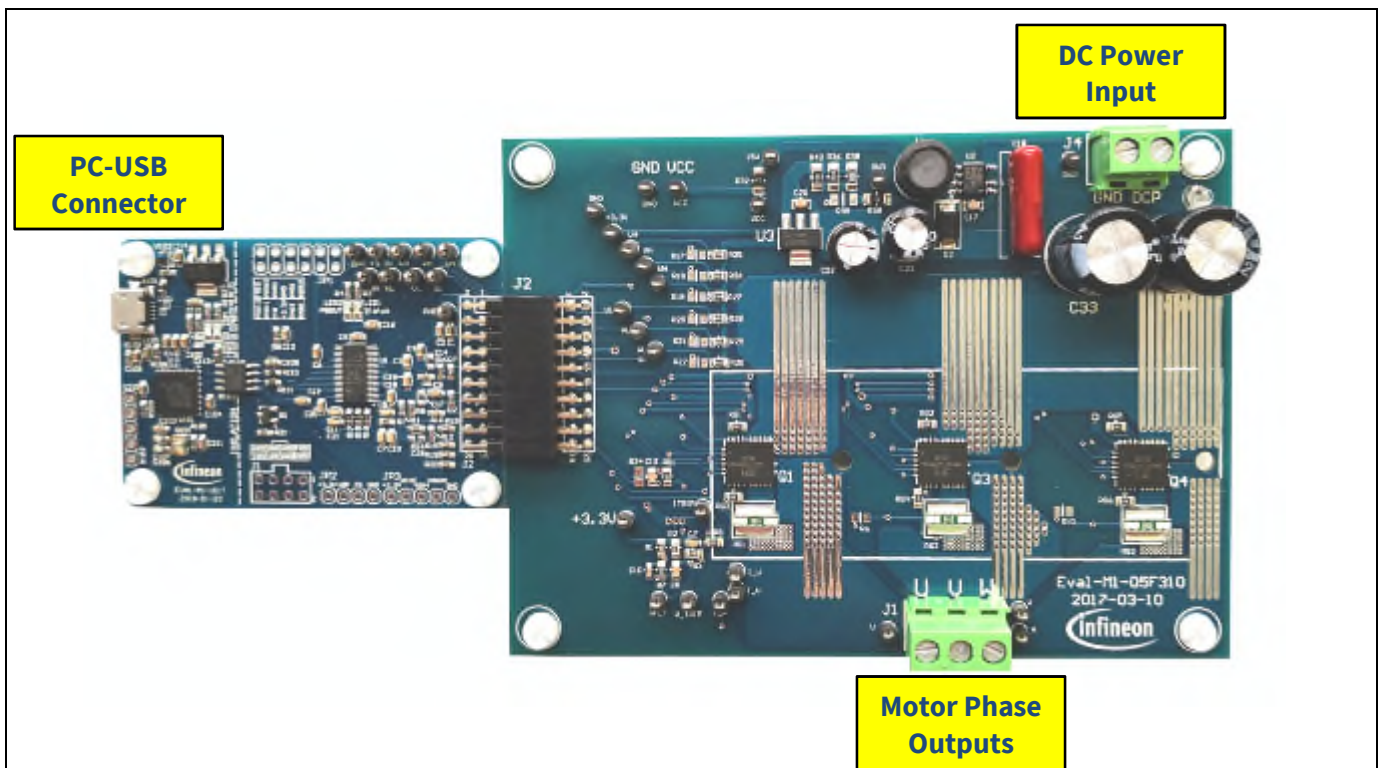

Figure 5   System connection example using EVAL-M1-101T and EVAL-M1-05F310

1. Get the latest "IMC101T-T038 MCE Software Package" available on www.infineon.com/imotion-software web page.
2. Connect PC-USB connector on the on-board-debugger to the PC via USB cable.
3. Connect EVAL-M1-101T's M1 20-pin interface connector (J2) to power board (For example EVAL-M1-05F310, see Figure 5).
4. Use MCEWizard to enter the target motor's system and operating parameters, as well as evaluation board's hardware parameters, which will then be used to calculate controller's digital parameter set representing complete motor drive system. First click "Calculate" button on the "Verify & Save Page" and then save the drive parameter set into your project directory by clicking "Export to Designer file (.txt)". Saved Drive System Parameter File will be later used by the MCEDesigner. Refer to Chapter 5.2.1 or MCEWizard User Guide for more details.
5. Connect motor phase outputs to the motor.

6. Connect AC power to power input connector and power on system.

7. Start MCEDesigner tool and open MCEDesigner default configuration file (.irc) for IMC101T-T038 controller (IMC101T_Vxxx.irc) by clicking "File" > "Open". IMC101T_Vxxx.irc file is included in "IMC101T-T038 MCE Software Package" downloaded in step 1.

8. MCEDesigner should automatically connect to the EVAL-M1-101T control board using default COM port (Indicated by green circle next to "COMx Up" status in the bottom frame of the MCEDesigner GUI). If it cannot establish the connection, change COM port by doing following steps: ("System" window active) > Preferences > Connection > Connect using (Chose one of the other available COM ports from the drop-down menu).

9. Use following steps to program the system parameters into the internal SRAM of iMOTION™ IC: Click "Tools" > "Programmer" and select "Program Parameters". Browse and select the System Drive Parameters .txt file created in step 4. See chapter MCEDesigner setup overview 5.2.2 for more details.

10. Start the motor by clicking the green traffic light button in the control bar.

5.2 iMOTION™ development tools and software

The iMOTION™ Development Tool installers for MCEDesigner and MCEWizard are available for download via Infineon iMOTION™ website (http://www.infineon.com/imotion-software). All supported tools and software variants are listed there. Please visit this page periodically to check for tool/software updates.

Isolated on-board debugger provides the USB to UART bridge between the PC and the target iMOTION™ device with 1kV DC galvanic isolation between the motor drive system (hot side) and the PC/debugger (cold) side. On-board debugger uses the SEGGER J-Link driver for UART communication with IMC101T-T038. J-Link driver will be installed during the MCEDesigner installation. In case the driver is not installed properly, please go to SEGGER J-Link website to download and install the latest J-Link "Software and Documentation pack for Windows".

5.2.1 MCEWizard setup overview

After installing the MCEWizard, the shortcut for MCEWizard appears on the Windows desktop. Double click the shortcut to open the MCEWizard and configure the parameters for evaluation boards or motor. Figure 6 shows the "Welcome Page" for MCEWizard, where the MADK control board or power board can be selected through the pull-down list. Infineon keeps releasing new MADK controller and power boards. Therefore, it could happen that some of the newest power boards are not pre-configured in the MCEWizard tool and cannot be selected through the pull-down menu. In that case, the user should select any other power board (as similar as possible) and follow the MCEWizard setup steps by entering the parameter values which are specific to the chosen board. Make sure both "I have modified the circuit board" and "Enable advanced question" checkmarks are selected. Please refer to the Application Note of the corresponding power board for additional information.

After selecting the MADK control and the power board, start the MCEWizard system setup procedure by clicking the "Next" button in the right bottom corner as shown in Figure 6.
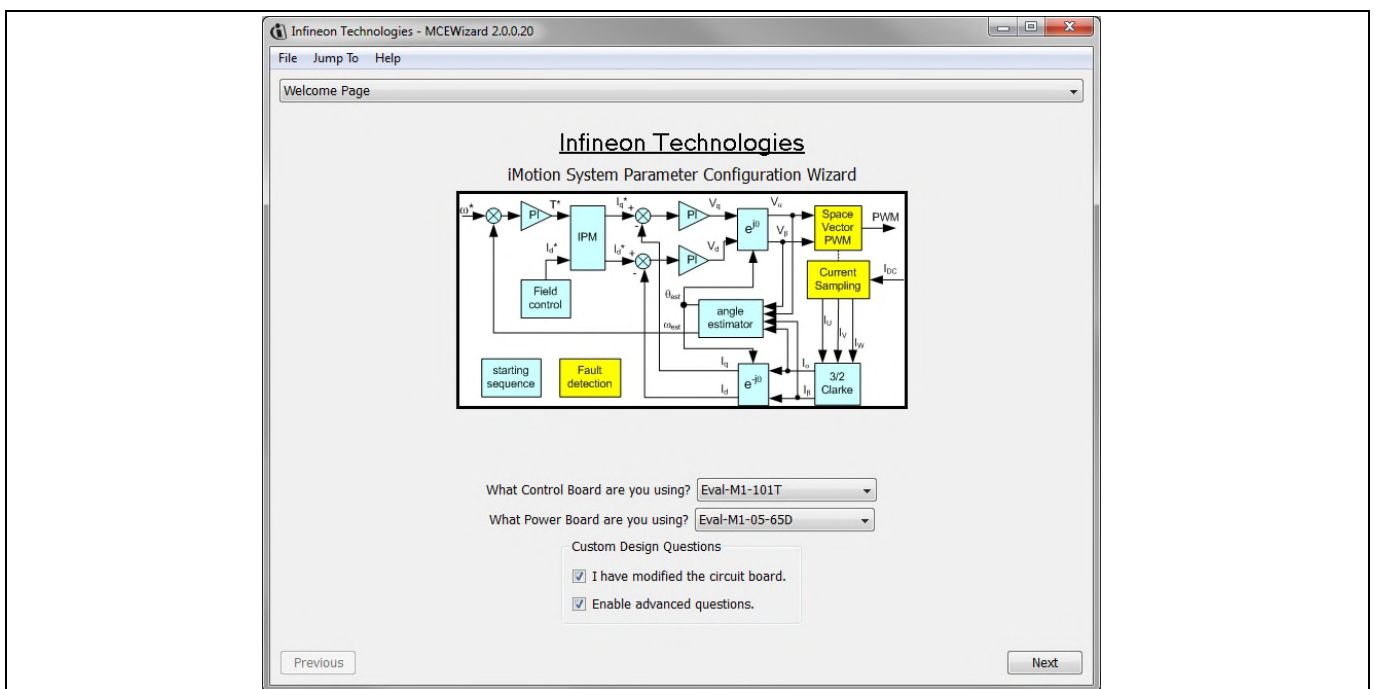

Figure 6   Welcome Page of MCEWizard

iMOTION™ MADK system enables users to easily test different combination of control and power board with their motors. User should be familiar with the system level parameters which are related to the motor used. There is a very limited number of parameters which are specific to the control board or power board hardware.

Table 8 provides the MCEWizard setup overview for hardware related parameters. Similar tables will be available in each power board's Application Note. Combination of this table and the corresponding table of the power board provides enough information to setup the MADK-based motor drive system in shortest time.

Table 8   MCEWizard setup overview table

Page	Parameter	Value	Comment
Welcome Page	Control Board selecting	EVAL-M1-101T for example	
Welcome Page	Power Board selecting	EVAL-M1-05F310	If no, select similar power board to modify
Options Page	Motor 1 Shunt Configuration	Leg shunt	
Question 3	Controller Supply Voltage	+3.3V	VDD is 3.3V by default
Question 19	Max DC Bus Voltage	80V	
Question 23	DC Bus Sensing High Resistor	1100 kΩ	
Question 24	DC Bus Sensing Low Resistor	Refer to the control board user manual	
Question 54	NTC Temperature Shutdown value	Refer to the control board user manual	For iMTOION 2.0 series control IC only
Question 63	GateSense Low-Side Devices	High is true	
Question 64	GateSense High-Side Devices	High is true	
Question 69	Motor 1 Current Input	Calculated as the Section in control board user manual	For iMTOION 2.0 series control IC only

After all the MCEWizard questions are answered, the "Verify & Save Page" will be shown as in Figure 7.
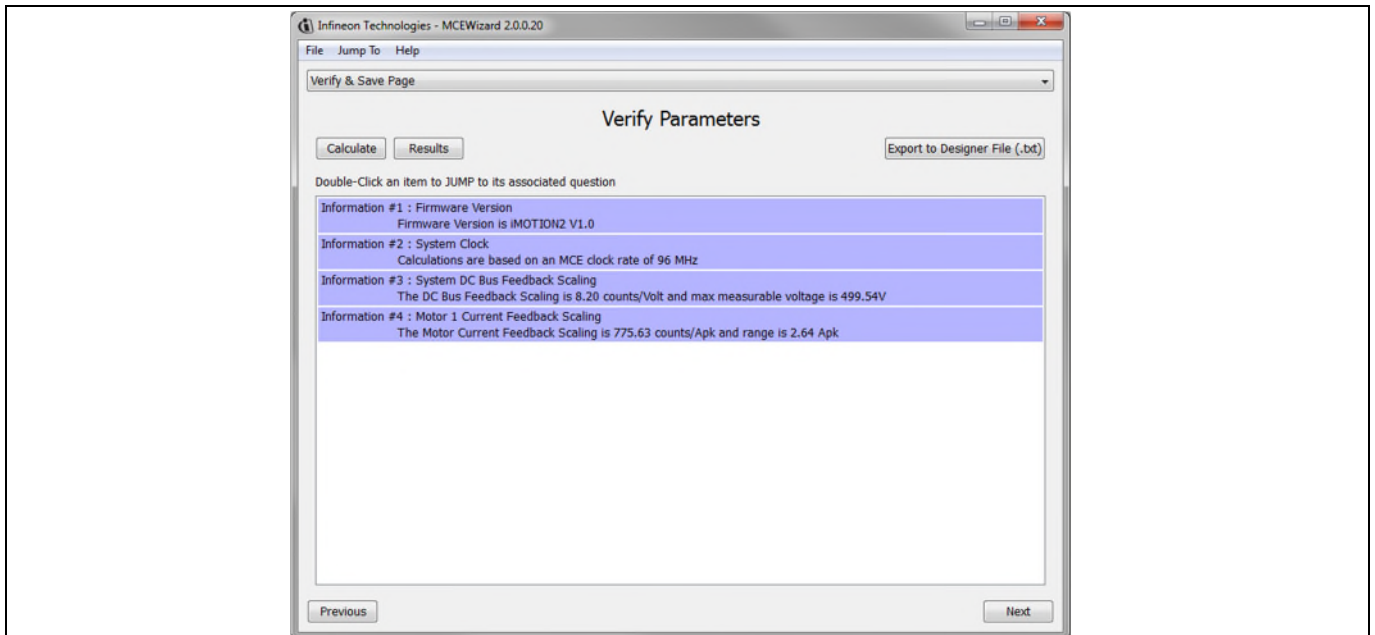

Figure 7   Verify and Save page for MCEWizard

Click "Calculate" button and "Export to Designer File (.txt)" button to save the parameter file which will be used by the MCEDesigner in the next steps.

5.2.2   MCEDesigner setup overview

After installing MCEDesigner installer, there is a shortcut for MCEDesigner on Windows desktop. Double click the shortcut to open MCEDesigner and then open "IMC101T_xx.irc" file as shown in Figure 8.
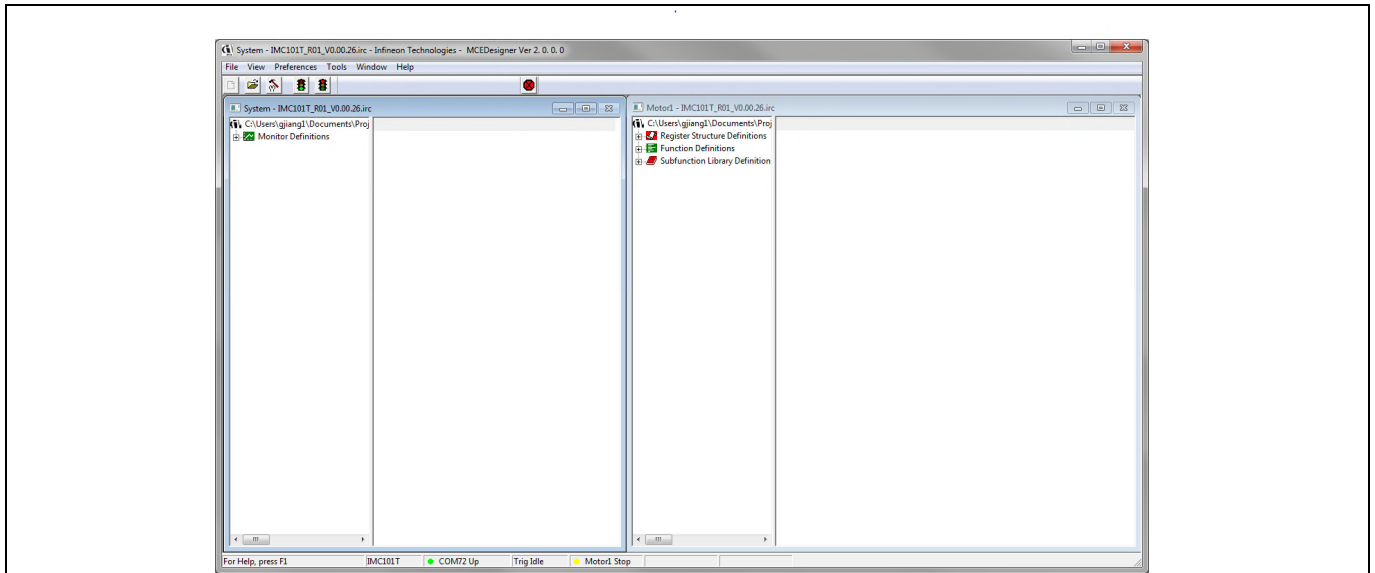

Figure 8   MCEDesigner's Main Display for EVAL-M1-101T

To program Drive System Parameter file into IMC101T-T038, please click "Tools" menu and select "Programmer" in the pull down list. The pop-up window "Program IMC controller" will show up as in Figure 9. Click on the "Program Parameters" radio button (this is the default option), and then select the Drive System Parameter file created using MCEWizard by clicking on "Browse". Finally, click on the "Start" button to program the parameter file into the IMC101T-T038 IC.
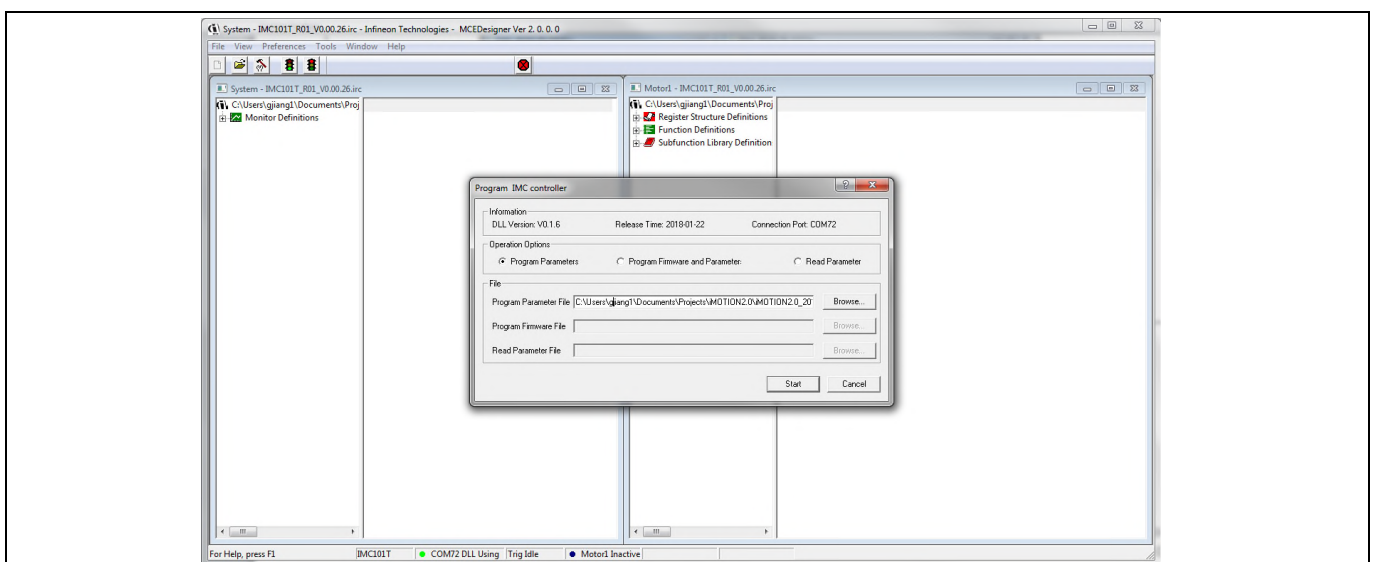
Figure 9   "Program IMC Controller" pop-up window

After Drive System Parameter file has been programmed into IMC101 controller, and the motor drive system is powered, the MCEDesigner can be used to start/stop the motor, display motor current traces, change the motor

speed, modify drive parameters and many other functions. Please refer to the MCEDesigner documentation for more details.

Note: *On-board Debugger portion of EVAL-M1-101T is galvanically isolated from the controller portion and the attached power board. In order to program the parameters or firmware to the IMC101T-T038 controller, the 3.3V DC voltage needs to be supplied to the controller portion of the EVAL-M1-101T. This voltage can either be supplied by the power board (MADK power boards are designed to supply the 3.3V to the control board through M1 or M3 connector) or by feeding the 3.3V DC voltage to the control board through some of the available 3.3V access/test points if the power board is not attached to the EVAL-M1-101T control board.*

To program new firmware and Drive System Parameter into IMC101T-T038, please click "Tools" menu and select "Programmer" in the pull down list. The pop-up window "Program IMC controller" will show up as in Figure 10. Click on the "Program Firmware and Parameter" radio button, and select the Drive System Parameter file created using MCEWizard by clicking on the "Browse" button on the row of "Program Parameter File", and then select the firmware file by clicking on the "Browse" button on the row of "Program Firmware File". Finally, click on the "Start" button to program the parameter file into the IMC101T-T038 IC.
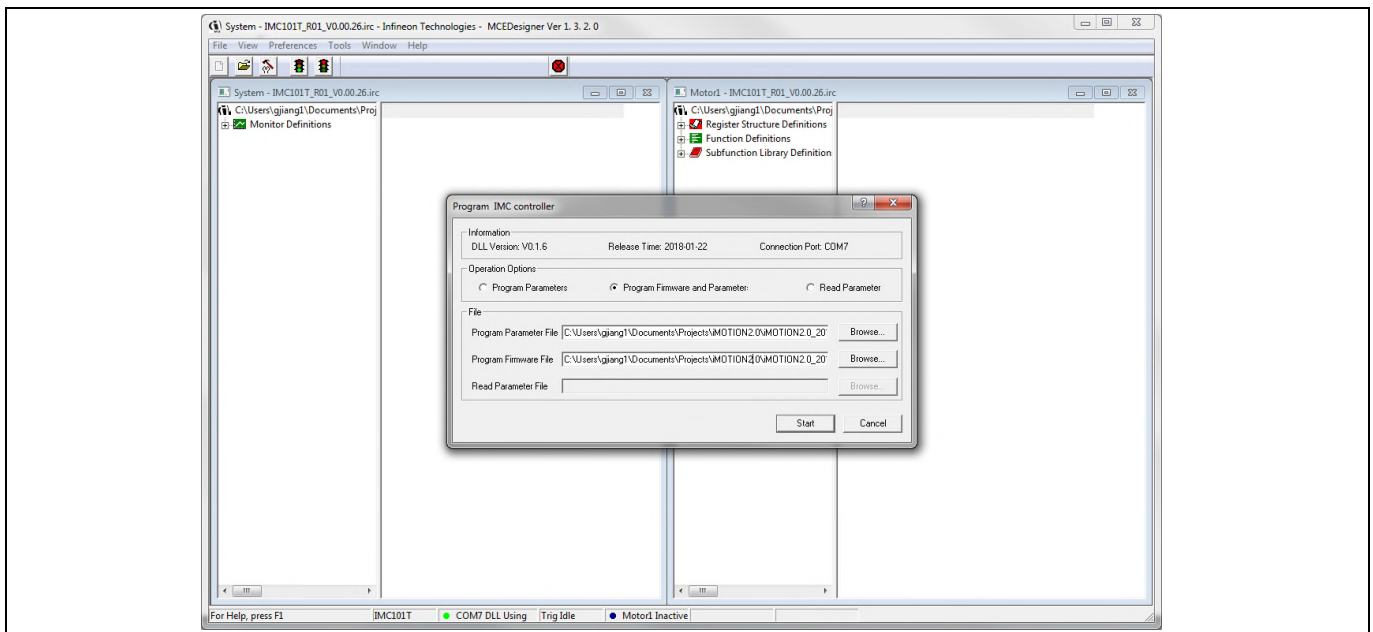

Figure 10   **Program Firmware and Parameter in "Program IMC Controller" pop-up window**

All latest firmware file for different type of iMOTION™ control ICs are available for download via Infineon iMOTION™ website (http://www.infineon.com/imotion-software).

6   Schematics and Layout

To meet individual customer requirements and make the EVAL-M1-05F310 evaluation board a basis for development or modification, all necessary technical data like schematics, layout and components are included in this chapter.

6.1   DC-Link Voltage Measurement

Pin 14 of connector J2 provides access to the DC-link voltage. Three possible feedback cases are associated with this pin.
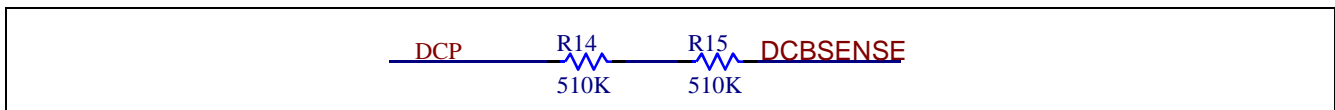
Figure 11 provides the DC bus sense resistor details.

Figure 11   DC bus sense resistor on EVAL-M1-05F310 evaluation board

- If a pull down resistor of 4.87 kΩ referred to ground is inserted either on the Eval-M1-05F310 evaluation board or the additional control board, DCBSENSE positive voltage results scaled in the range of 0-3.3V on the pin.
- If no pull-down resistor of 4.87 kΩ is present on the Eval-M1-05F310 evaluation board or the additional control board, the DCBSENSE -pin remains high voltage (up to DC input).
- If no feedback is desired on the DCBSENSE-pin, please remove either R14 or R15 or both of them.
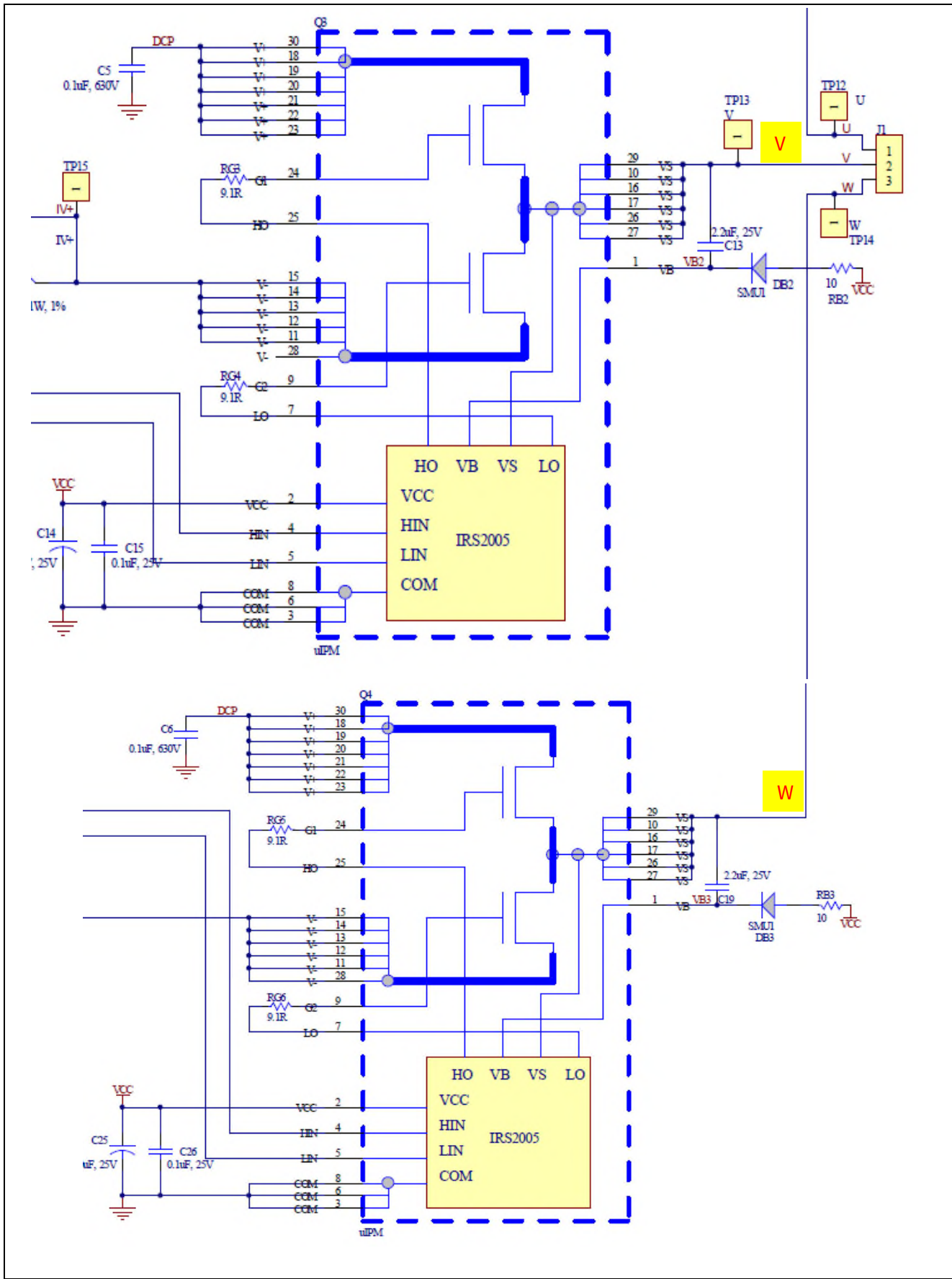
6.2 Inverter section using CIPOS™ Nano

The inverter section is implemented using the CIPOS™ Nano as sketched in Figure 12 and Figure 13 . Three half bridge modules as 3-phase inverter bridge section. Every half bridge module includes two power MOSFETs and one half bridge gate driver. The shunt resistor section is also given. The three capacitors C3, C13 and C19 are used as bootstrap capacitors to provide the necessary floating supply voltages VBU, VBV and VBW respectively.

Figure 12   Schematic of the U-phase inverter section using CIPOS™ Nano on EVAL-M1-05F310 evaluation board

Figure 13   Schematic of the V-phase and W-phase inverter section using CIPOS™ Nano on EVAL-M1-05F310 evaluation board

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6.3 Power supply

Figure 14 depicts the schematic of the power supply available on the EVAL-M1-05F310 board. The circuit includes a LNK304 that is used to generate 15 V (VCC) directly from the DC bus. VCC is connected to the gate drivers inside the CIPOS™ Nano. The linear regulator IFX1117-ME V33 generates 3.3 V from VCC. The 3.3 V power supply is used in the over current comparator circuit. Led LED1 is used to signal whether the board is powered or not. Both, VCC and 3.3 V are also present on the 20 pin interface connector J2 to power circuitry on the controller board.
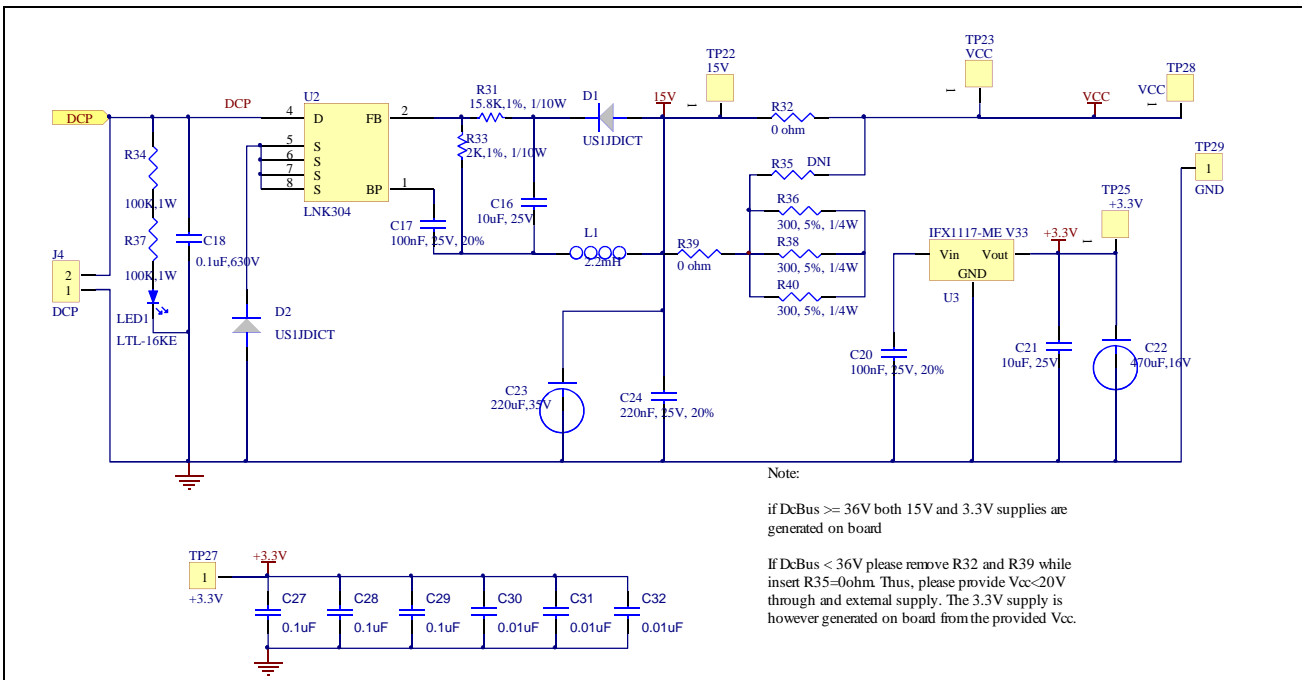
Figure 14   Power supply section of the EVAL-M1-05F310 evaluation board

6.4 Over current protection circuitry

Figure 15 displays the over current protection circuitry. The open collector output GK of the comparator is pulled up to 3.3V and filtered through resistor R2 and capacitor C8.

The comparator threshold can be set through the voltage divider provided by resistors R1 and R7. By default for emitter shunt trip, R7 is 660R 1 %. In single shunt application R7 needs to be changed to 3.48kΩ.
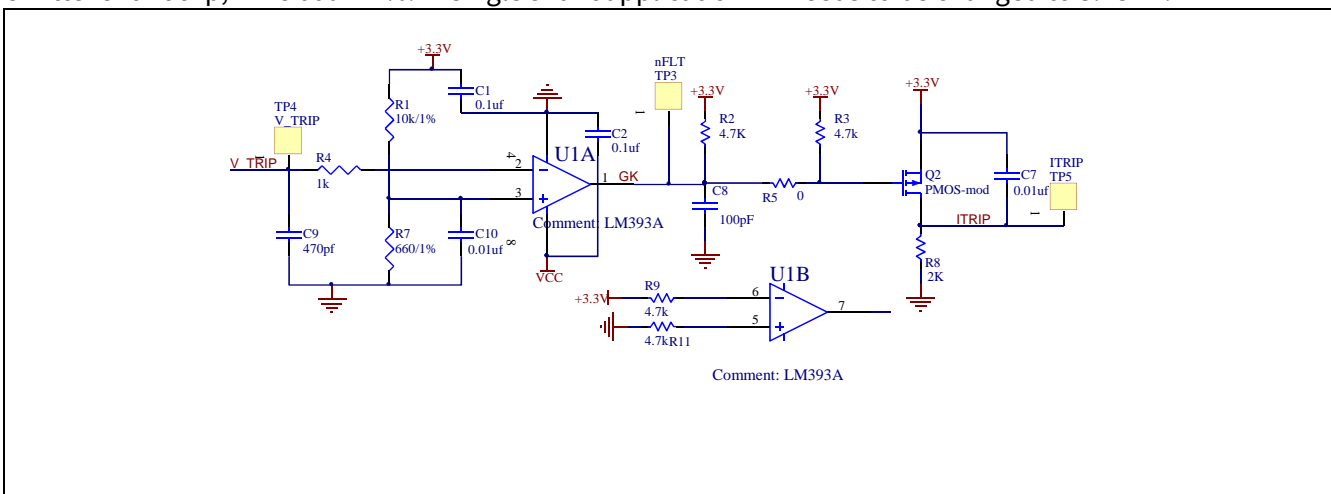
Figure 15   Over current protection circuit on the EVAL-M1-05F310 evaluation board

6.5   PCB Layout

The layout of this board can be used for different voltage or power classes of power board. The PCB has two electrical layers with 35μm copper by default and its size is 118 × 85mm. The PCB board thickness is 1.6mm. Get in contact with our technical support team to get more detailed information and the latest Gerber-files.

Figure 16 illustrates the top assembly print of the evaluation board.
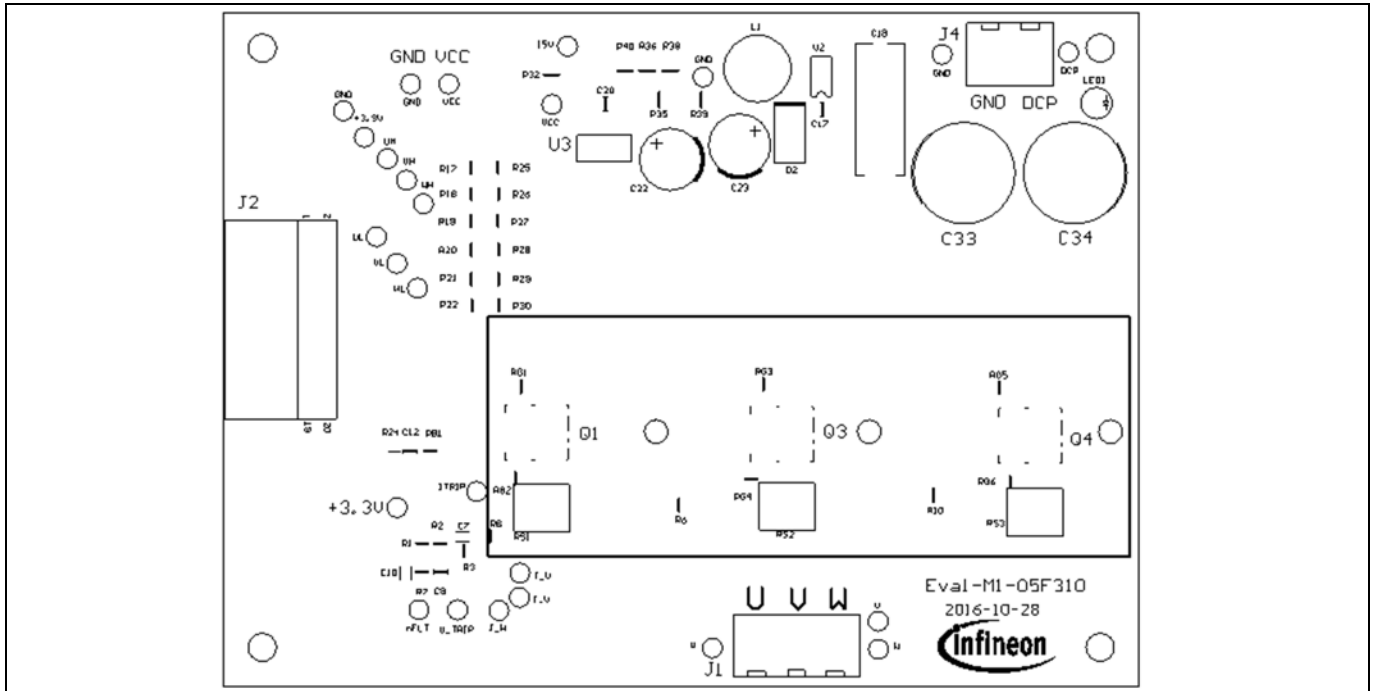

Figure 16   Top assembly print of the EVAL-M1-05F310 evaluation board

Figure 17 depicts the bottom assembly print of the evaluation board.
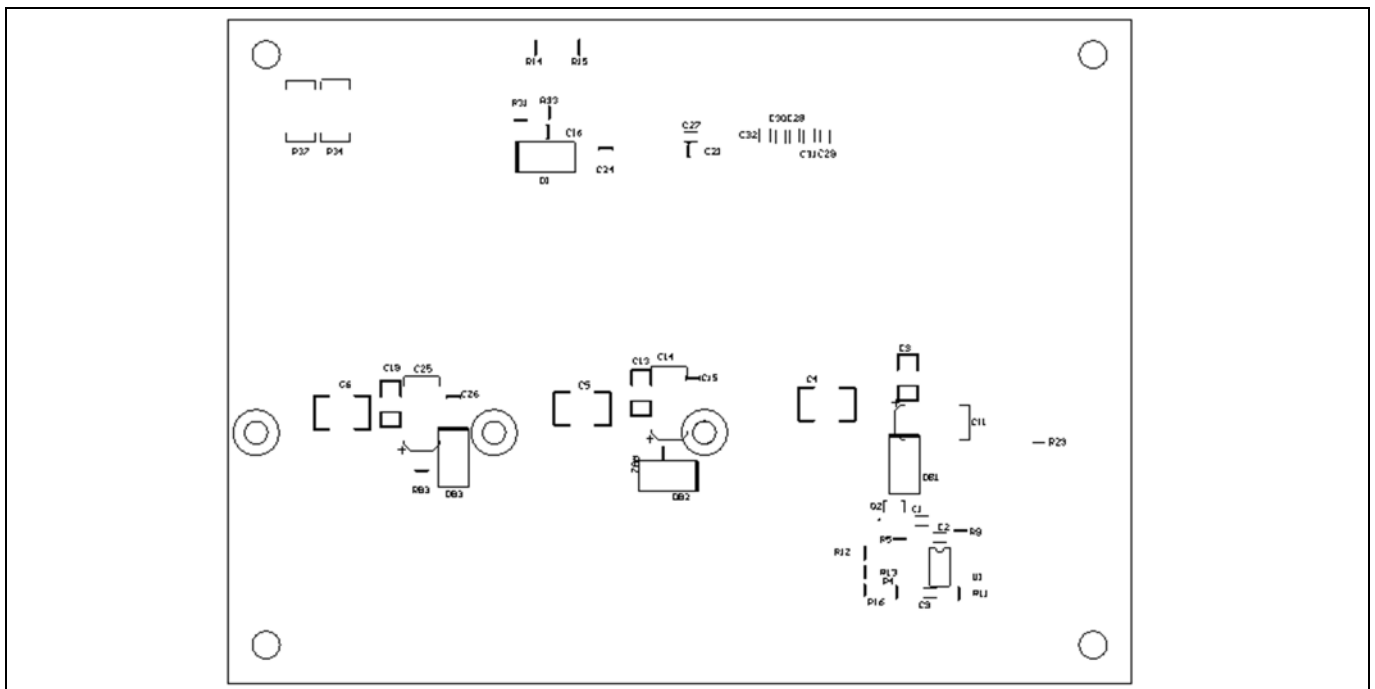
Figure 17   Bottom assembly print of the EVAL-M1-05F310 evaluation board

The top layer routing of the PCB is provided in the following Figure 18.
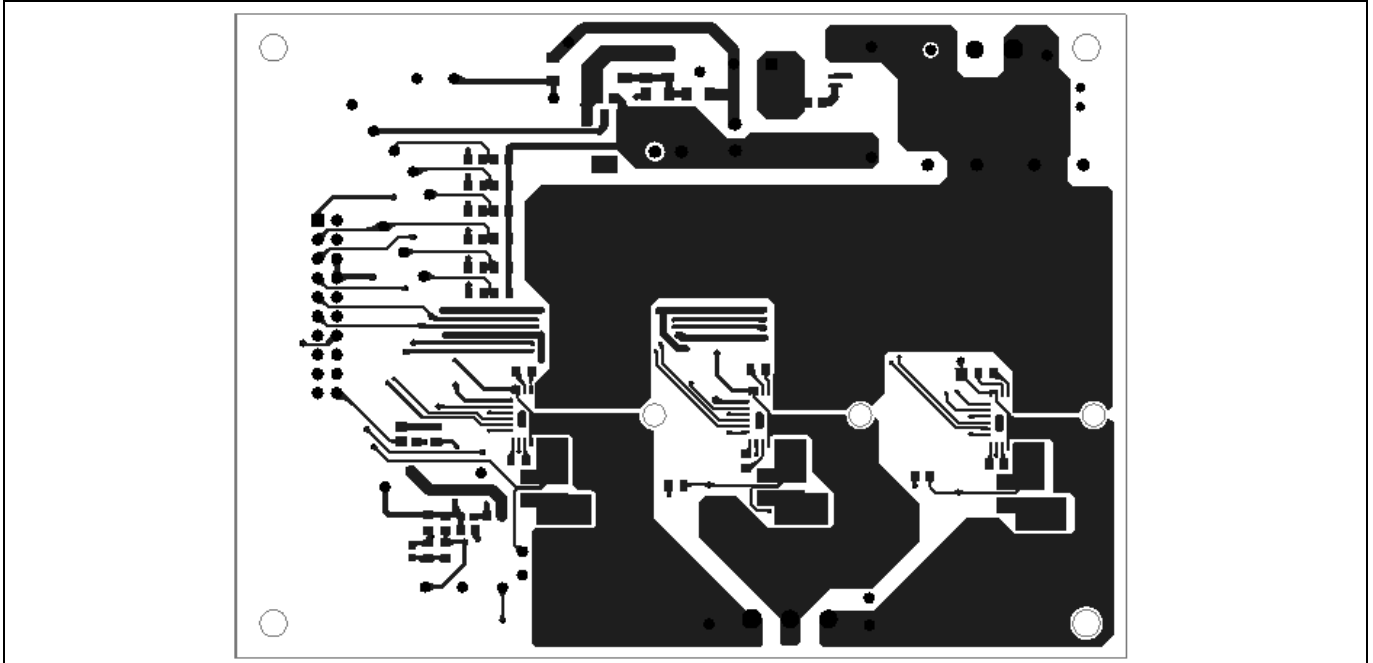
Figure 18   Top layer routing of the EVAL-M1-05F310 evaluation board

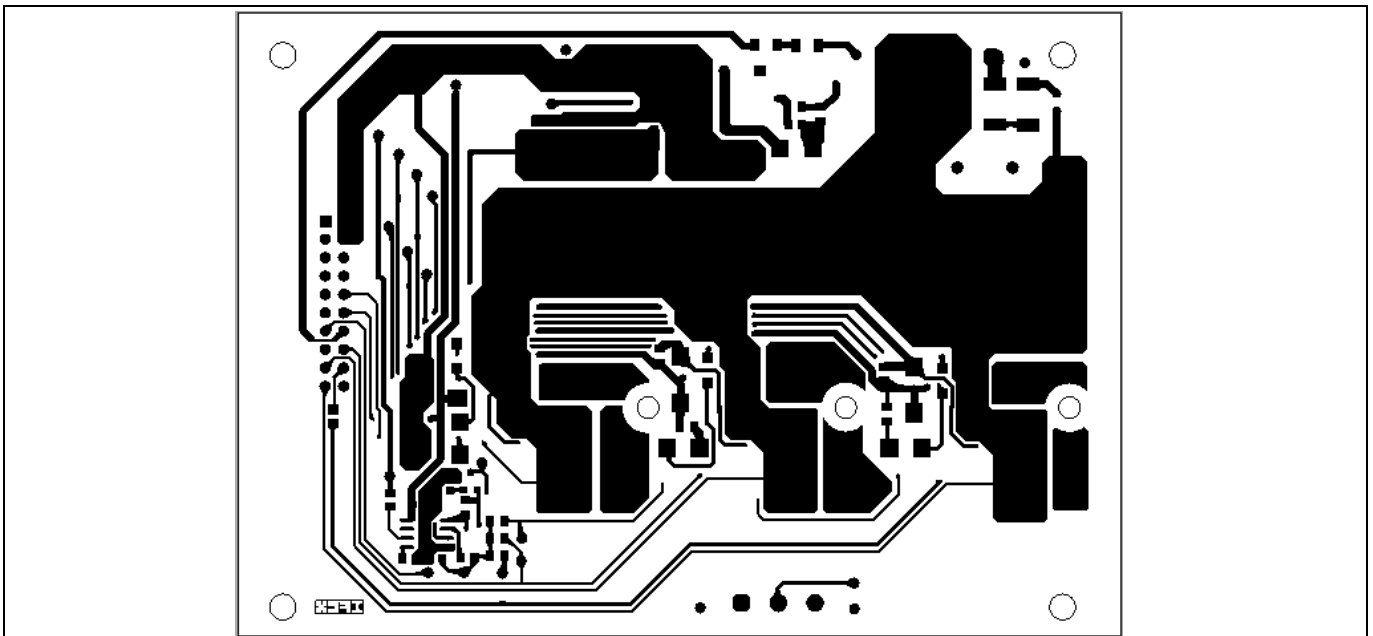Figure 19 illustrates the bottom layer routing of the PCB.

Figure 19   Bottom layer routing of the EVAL-M1-05F310 evaluation board

7   Bill of Materials of EVAL-M1-05F310

Table 9 provides the complete bill of materials for the EVAL-M1-05F310 board.

Table 9   Bill of materials

No.	Qty.	Part description	Designator	Part Number	Manufacturer
1	5	CAP CER 0.1µF 50V X7R 0603	C1, C2, C27, C28, C29	885012206095	Wurth Electronics Inc.
2	3	CAP CER 2.2µF 25V X7R 1206	C3, C13, C19	885012208066	Wurth Electronics Inc.
3	3	CAP CER 0.1µF 630V X7R 1812	C4, C5, C6	885342211006	Wurth Electronics Inc.
4	5	CAP CER 10000pF 50V X7R 0603	C7, C10, C30, C31, C32	885012206089	Wurth Electronics Inc.
5	1	CAP CER 100pF 50V NP0 0805	C8	885012207080	Wurth Electronics Inc.
6	1	CAP CER 470PF 50V C0G/NP0 0805	C9	885012007061	Wurth Electronics Inc.
7	3	CAP TANT 10µF 25V 10% 2917	C11, C14, C25	T491D106K025AT	Kemet
8	2	CAP CER 10µF 16V X5R 0805	C16, C21	885012107014	Kemet
9	1	WCAP-FTBE GENERAL PURPOSE FILM	C18	890303425004CS	Wurth Electronics Inc.
10	3	CAP CER 0.1µF 25V X7R 0805	C12, C15, C26, C17, C20	885012207072	Wurth Electronics Inc.
11	1	CAP ALUM 470µF 20% 16V RADIAL	C22	860020374012	Wurth Electronics Inc.
12					
13	1	CAP ALUM 220µF 20% 35V RADIAL	C23	860020574012	Wurth Electronics Inc.
14	2	CAP ALUM 220µF 20% 100V RADIAL	C33,C34	ECA-2AM221	Panasonic Electronic Components
15	1	CAP CER 0.22µF 25V X7R 0805	C24	885012207074	Kemet
16	5	Diode Standard 600V 1A Surface Mount SMA	D1, D2, DB1, DB2, DB3	US1J-13-F	Diodes Incorporated
17	1	2.54MM ANGLED DUAL SOCKET HEADER	J2	613020243121	Wurth Electronics Inc.
18	1	SERIE 2165S - 5.08 MM - HORIZONTAL CABLE ENTRY WITH RISING CAGE CLAMP - WR-TBL 3POS SIDE ENTY	J1	691216510003S	Wurth Electronics Inc.
19	1	SERIE 2165S - 5.08 MM - HORIZONTAL CABLE ENTRY WITH	J4	691216510002S	Wurth Electronics Inc.

No.	Qty.	Part description	Designator	Part Number	Manufacturer
		RISING CAGE CLAMP - WR-TBL 2POS SIDE ENTY			
20	1	FIXED IND 2.2MH THROUGH HOLE	L1	RLB0914-222KL	Bourns Inc
21	1	LED RED CLEAR ROUND T/H	LED1	151034RS03000	Lite-On Inc
22	3	IC GATE DRIVER 100V QFN	Q1, Q3, Q4	IRSM005-301MH	Infineon Technologies
23	1	MOSFET P-CH 20V 3.7A SOT-23	Q2	IRLML6402TRPBF-1	Infineon Technologies
24	1	RES SMD 10 kΩ5% 1/8W 0805	R1	RC0805JR-0710KL	Yageo
25	10	RES SMD 4.7 kΩ1% 1/8W 0805	R2, R3, R9, R11, R25, R26, R27, R28, R29, R30	RC0805FR-074K7L	Yageo
26	4	RES SMD 1 kΩ1% 1/8W 0805	R4, R12, R13, R16	RC0805FR-071KL	Yageo
27	10	DIN	R6, R10, R17, R18, R19, R20, R21, R22, R23, R24	R0805	Yageo
28	2	RES SMD 2 kΩ1% 1/8W 0805	R8,R33	RC0805FR-072KL	Yageo
29	2	RES SMD 1M Ω 1% 1/8W 0805	R14,R15	RT0805BRD071ML	Yageo
30	1	RES SMD 15.8 kΩ1% 1/8W 0805	R31	RC0805FR-0715K8L	Yageo
31	2	RES SMD 0.0 Ω JUMPER 1/4W 1206 NO ASS.	R32,R39	9C12063A0R00JLHFT	Yageo
32	2	RES SMD 100 kΩ5% 1W 2512	R34, R37	AC2512JK-07100KL	Yageo
33	1	DIN	R35	R1206	Yageo
34	3	RES SMD 300 Ω 5% 1/4W 1206	R36, R38, R40	RC1206JR-07300RL	Yageo
35	3	RES SMD 10 Ω 5% 1/8W 0805	RB1, RB2, RB3	RT0805DRE0710RL	Yageo
36	6	RES SMD 9.1 Ω 5% 1/8W 0805	RG1, RG2, RG3, RG4, RG5, RG6	RC0805JR-079R1L	Yageo
37	3	1225 1% TCR150 0.01Ω	RS1, RS2, RS3	CS25FTFR010N	Viking
38	15	TEST POINT PC MINI .040"D BLACK	DCP, ITRIP, GND,U,V,W,UH, VH,WH, UL,VL,WL,15V,V CC,+3.3V	5002	Keystone Electronics
39	1	IC DUAL DIFF COMPARATOR 8-SOIC	U1	LM393ADR	Texas Instruments
40	1	IC OFFLINE SWIT OCP 8SOIC	U2	LNK304DN-TL	Power Integrations
41	1	IC REG LINEAR 3.3V 1A SOT223-4	U3	IFX1117MEV33HTMA1	Infineon Technologies

8   Reference

[1]   Datasheet of Infineon IPM IRSM005-301MH, is available for download on Infineon's website

[2]   Application Note of AN2016-24 for EVAL-M1-05-65D power board, is available for download on Infineon's website

[3]   EVAL-M1-101T User Manual is available for download on Infineon's website

[4]   EVAL-M1-183M User Manual is available for download on Infineon's website

Note: *All listed reference materials are available for download on Infineon's website*
              www.infineon.com/. All the iMOTION MADK evaluation board's User Manuals are available at
              www.infineon.com/MADK

Revision History

Major changes since the last revision

Version number	Revision Date	Revision description
1.0	2017-03-28	First release
1.1	2018-07-09	Update BOM. Add WE Part Number, and add Getting Started with EVAL-M1-05F310

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