

EVAL-M1-IM818-A 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-IM818-A including its main features, key data, pin assignments and mechanical dimensions.

EVAL-M1-IM818-A is a complete evaluation board including a 3-phase CIPOS™ Maxi Intelligent Power Module (IPM) for motor drive application. In combination with control-boards equipped with the M1 20pin interface connector, like EVAL-M1-101T or EVAL-M1-099M, it features and demonstrates Infineon's CIPOS™ Maxi IPM technology for motor drive.

The evaluation board EVAL-M1-IM818-A was developed to support customers during their first steps designing applications with CIPOS™ Maxi IPM.

CIPOS™ Maxi IPM in this board is IM818-MCC which has three phase inverter with 1200V TRENCHSTOP™ IGBTs and Emitter Controlled diodes are combined with an optimized 6-channel SOI gate driver. It is Optimized to industrial applications like Ventilation and Air Conditioning.

Intended audience

This application note is intended for all technical specialists working with the EVAL-M1-IM818-A board.

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Safety precautions









7 **Reference32**

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

Safety precautions

	<p>Caution: <i>The ground potential of the EVAL-M1-IM818-A board 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, and equipment damage. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.</i></p>
	<p>Caution: <i>EVAL-M1-IM818-A 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.</i></p>
	<p>Caution: <i>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.</i></p>
	<p>Caution: <i>The surfaces of the drive may become hot, which may cause injury.</i></p>
	<p>Caution: <i>The EVAL-M1-IM818-A board 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.</i></p>
	<p>Caution: <i>An incorrectly applied or installed drive can result in component damage or reduction in product lifetime. Wiring or application errors such as undersized motor, incorrect or inadequate DC supply, or excessive ambient temperatures may result in system malfunction.</i></p>
	<p>Caution: <i>Remove or connect the control board from or to the power drive. Wait three minutes after removing power from the power drive 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.</i></p>
	<p>Caution: <i>The EVAL-M1-IM818-A board 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.</i></p>

Introduction

2 Introduction

The EVAL-M1-IM818-A evaluation board is a part of the iMOTION™ Modular Application Design Kit for drives (iMOTION™ MADK).

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

This evaluation board is designed to give easy-to-use power stage based on the Infineon's CIPOS™ Maxi Intelligent Power Module (IPM). The board is equipped with all assembly circuit for sensorless field oriented control (FOC). It provides a single-phase AC-connector, rectifier and 3-phase output for connecting the motor. The power stage also contains emitter (leg) shunts for current sensing and a voltage divider for DC-link voltage measurement.

The EVAL-M1-IM818-A evaluation board is available through regular Infineon distribution partners as well as on Infineon's website. 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-IM818-A. 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 and by trained specialists only.

The block diagram of the EVAL-M1-IM818-A is depicted in Figure 1. This evaluation board includes a DC EMI filter and soft power up circuit, 20-pin iMOTION™ MADK-M1 interface connector, auxiliary power supply to provide 15 V and 3.3 V, and the CIPOS™ Maxi IPM IM818-MCC.

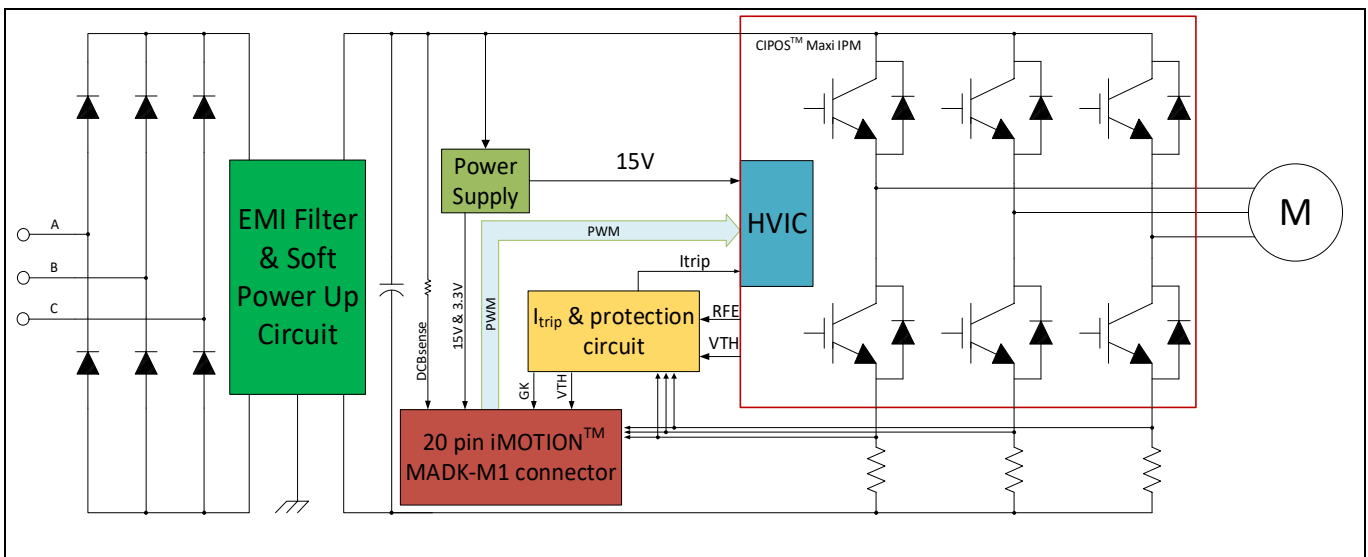


Figure 1 The Block Diagram of the EVAL-M1-IM818-A

CIPOS™ Maxi IPM in this board is IM818-MCC which has 1200 V of voltage and 10A of current rating. It is Optimized 6-channel SOI gate driver for excellent electrical performance. It is designed to control 3 phase AC motors and permanent magnet motors in variable speed drives applications such as low power motor drives.

Main features

3 Main features

EVAL-M1-IM818-A is an evaluation board for motor drive applications based on a 3-phase IPM. Combined with one of the available MADK control board options, it demonstrates Infineon's IPM technology for motor drives. The kit demonstrates Infineon's IPM technology for motor drives.

Main features of CIPOS™ Maxi IPM IM818-MCC are:

- 1200 V TRENCHSTOP™ IGBT4
- Maximum blocking voltage $V_{CES} = 1200\text{ V}$
- Maximum output current at 25 °C case temperature $I_C = 16\text{ A}$
- Rugged 1200 V SOI gate driver technology with stability against transient and negative voltage
- Allowable negative V_S potential up to -11 V for signal transmission at $V_{BS} = 15\text{ V}$
- Integrated bootstrap functionality
- Overcurrent shutdown
- Built-in NTC thermistor for temperature monitoring
- Under-voltage lockout at all channels
- Low side emitter pins accessible
- For all phase current monitoring (open emitter)
- Cross-conduction prevention
- All of 6 switches turn off during protection
- Programmable fault clear timing and enable input
- Lead-free terminal plating; RoHS compliant

The evaluation board characteristics are:

- Nominal input voltage 380 VAC
- Default 1.5 kW motor power output
- On board EMI filter
- Current sensing for each leg configured by default
- Sensing of DC-link voltage
- Measurement test-points compatible to standard oscilloscope probes
- PCB size is 197 mm x 140 mm and has two layers with 35 μm copper each
- RoHS compliant

Main features

3.1 EVAL-M1-IM818-A board specifications

Table 2 depicts the important specifications of the evaluation board EVAL-M1-IM818-A.

Table 2 EVAL-M1-IM818-A board specifications

Parameters	Values	Conditions / comments
Input		
Voltage	380 V _{rms}	±20% V _{AC} input
Input current	6 A _{rms}	Input 380 V _{AC} , Ta=25°C
Output		
Power (3 phases)	1500 W	Input 380V _{AC} , f _{PWM} =6 kHz, Ta=25°C, T _C =100°C, Natural convection
Phase Current	2.35A _{rms}	Input 380V _{AC} , f _{PWM} =6 kHz, Ta=25°C, T _C =100°C, Natural convection
DC Bus Voltage		
Maximum DC bus voltage	820 V	Limited by electrolytic capacitor which max voltage is 900V
Minimum DC bus voltage	400 V	Aux power supply can start
Current feedback		
Current sensing resistors RSU, RSV, RSW	25mΩ X 3	Two 50mΩ in parallel for one leg
Protections		
Output current trip level	20 A _{peak}	Current feedback to controller, so over current protection level is decided by controller. This Itrip level for IPM
Temperature trip level	100 °C	Internal NTC temperature to controller. Recommend to set this level for protection
On board power supply		
15 V	15 V ± 5 %, max. 250 mA	Used for CIPOST™ IPM gate driver and LDO
3.3 V	3.3 V ± 2 %, max. 200mA	Supplying the 3.3V to the controller board
PCB characteristics		
Material	FR4, 1.6 mm thickness, 2 layers. 35 μm copper thickness	
Dimension	197 mm x 140 mm x 70mm	
System environment		
Ambient temperature	From 0 to 43°C	Non-condensing, maximum RH of 95 %

Main features

Figure 2 points out the functional groups on the top side of the EVAL-M1-IM818-A evaluation board.

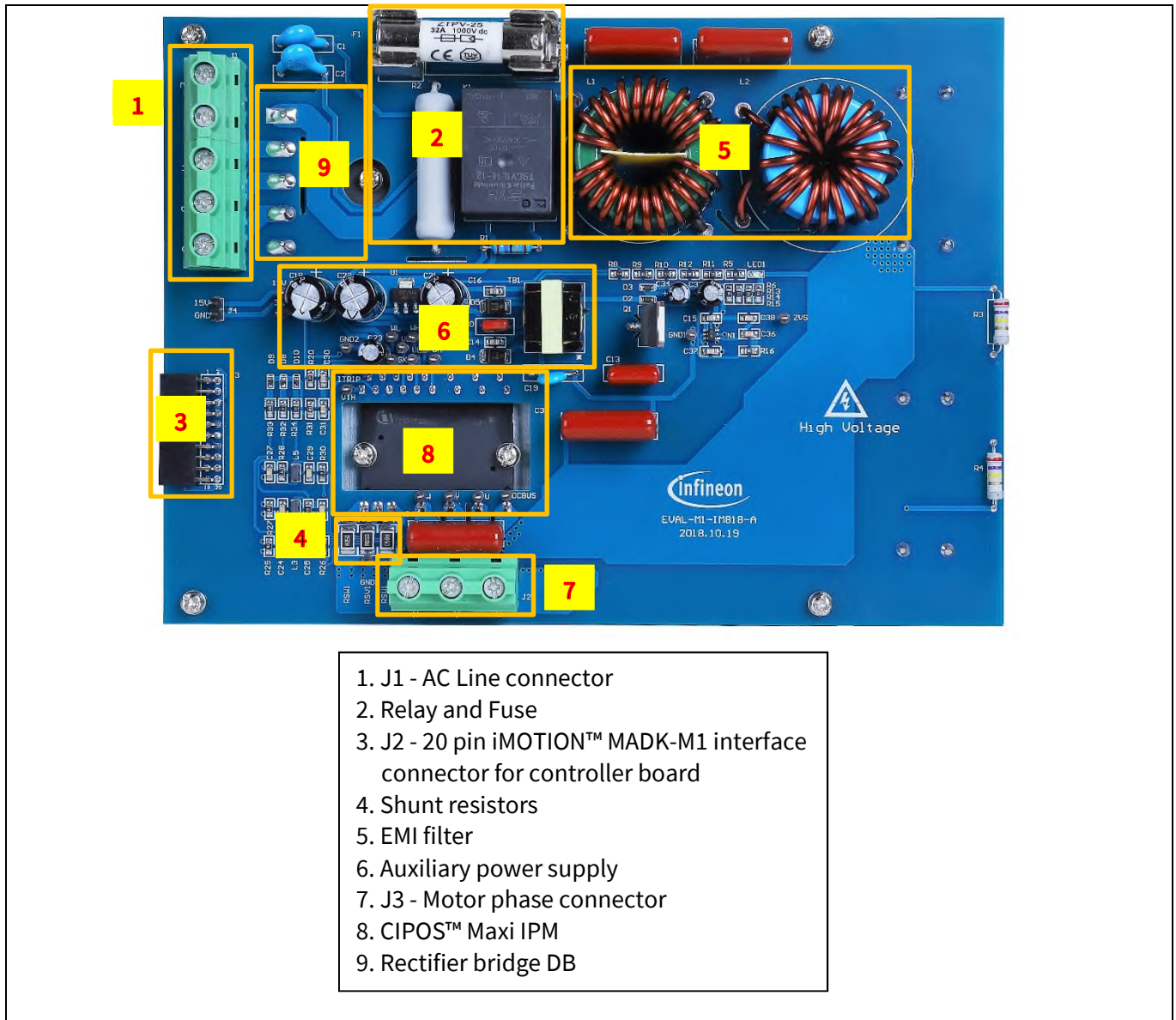


Figure 2 Functional groups of the EVAL-M1-IM818-A evaluation board's top side

Main features

3.2 Pin assignments

General information about the connectors of the EVAL-M1-IM818-A evaluation board is reported. Table 3 includes the details of the AC line connector J1.

Table 3 J1- AC Line connector

S. No.	Pin	Details
1	EARTH	Earth ground
2	Not used	Not used
3	A	AC line input (380V)
4	B	AC line input (380V)
5	C	AC line input (380V)

Table 4 provides the pin assignments of the 20 pin iMOTION™ MADK-M1 interface connector J2. This connector is the interface to the controller board.

Table 4 J2 - iMOTION™ MADK-M1 20 pin interface connector for controller 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	On board 3.3 V supply
7	PWMVL	3.3 V compatible logic input for low side gate driver-Phase V
8	+3.3V	On board 3.3 V supply
9	PWMWH	3.3 V compatible logic input for high side gate driver-Phase W
10	I_U	Shunt voltage phase U
11	PWMWL	3.3 V compatible logic input for low side gate driver-Phase W
12	I_U-	Ground
13	GK	Gate kill signal – active low when overcurrent is detected
14	DCBSENSE	DC bus positive voltage, scaled in 0-3.3 V range by a voltage divider
15	VTH	Thermistor Output
16	I_V	Shunt voltage phase V
17	I_V-	Ground
18	I_W	Shunt voltage phase W
19	I_W-	Ground
20	VCC	15 V Power Supply

Main features

Table 5 denotes the details of the motor side connector J2.

Table 5 J2- Motor side connector

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

4 Getting Started with EVAL-M1-IM818-A

In order to run the motor system, a combination of the iMOTION™ MADK power board (EVAL-M1-IM818-A) and the matching MADK control board 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.

4.1 Setting up the system

After downloading and installing the iMOTION™ PC Tools (MCEWizard and MCEDesigner), following steps needs to be executed in order to run the motor. Refer to user manual for iMOTION™ MADK control board such as (EVAL-M1-101T), MCEWizard and MCEDesigner documentation for more information.

Figure 3 shows the system connection using EVAL-M1-IM818-A and control board (used control board EVAL-M1-101T for example).

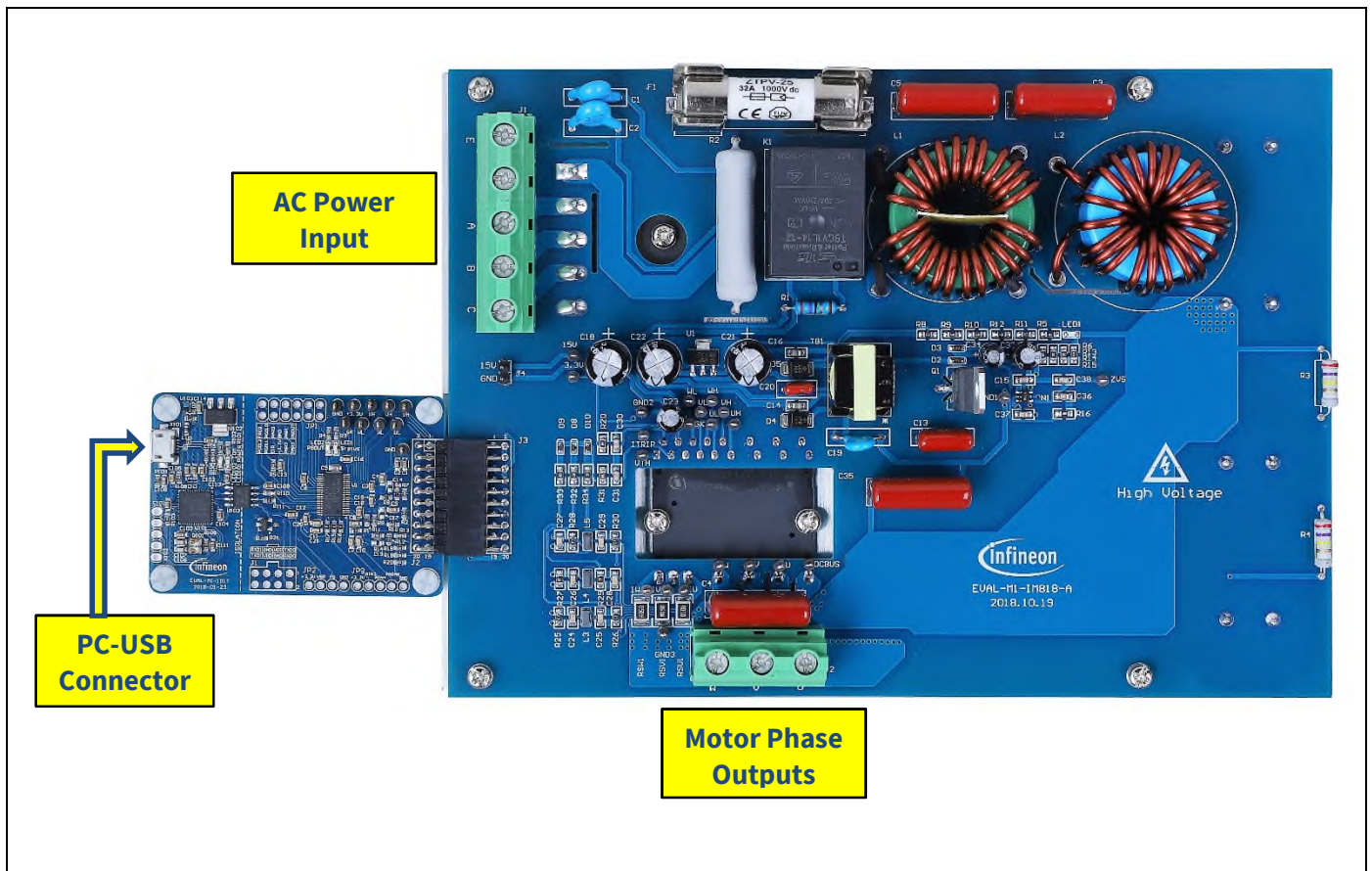


Figure 3 System connection example using EVAL-M1-IM818-A and EVAL-M1-101T

1. Connect PC-USB connector on the on-board-debugger to the PC via USB cable.
2. Connect EVAL-M1-IM818-A's MADK M1 20-pin interface connector (J3) to control board (see Figure 3).
3. Get the latest "IMC101T-T038 MCE Software Package" available on www.infineon.com/imotion-software web page. (Infineon iMOTION™ control IC IMC101T-T038 is used for control board EVAL-M1-101T).
4. Connect motor phase outputs to the motor.
5. Use MCEWizard to enter the motor and evaluation board hardware parameters and click button "Export to Designer file (.txt)" to system drive parameters file which will be used by MCEDesigner.

Getting Started with EVAL-M1-IM818-A

6. Connect AC power to power input connector (J1) and power on system.
7. Open MCEDesigner and open MCEDesigner default configuration file (.irc) for IMC101T devices (IMC101T_xx.irc) by clicking “File” menu and select “Open” in the pull down list.
8. Import system drive parameters file (generated in step 5) into MCEDesigner by clicking “File” > “Import Drive Parameters”. Select “Update All” radio button.
9. Program the MCE Firmware and system parameters into the internal Flash memory of iMOTION™ IC by clicking “Tools > Programmer” in the pull down menu, and then clicking on the “Program Firmware and Parameter” radio button. See chapter MCEDesigner setup overview section 4.2.2 for more details. If the latest version of MCE firmware is already programmed into the IMC101T-T038 IC, then programming firmware can be skipped by selecting “Program Parameters” radio button option. Finally click “Start” button to program firmware and parameter (or parameters only when programming firmware was skipped).
10. Start the motor by clicking the green traffic light button in the control bar.

4.2 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 the available tools and software variants are listed there.

On-board debugger uses the SEGGER J-Link's 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”.

4.2.1 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 4 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 User Manual 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 4.

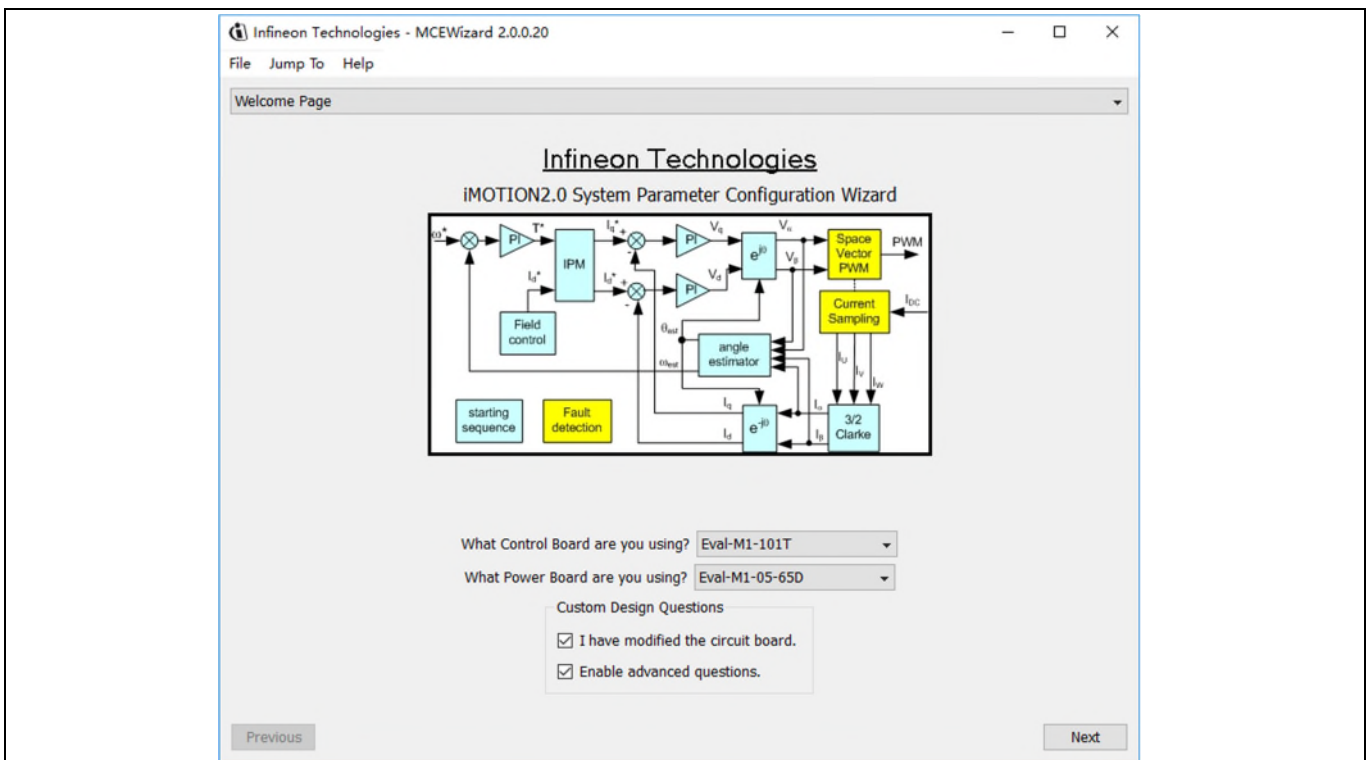


Figure 4 Welcome Page of MCEWizard

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.

Getting Started with EVAL-M1-IM818-A

There are very limited numbers of parameters which are specific to the control board or power board hardware.

Table 6 provides the MCEWizard setup overview for hardware related parameters specific to EVAL-M1-IM818-A power board. Similar tables will be available in each control board’s User Manual. Combination of this table and the corresponding table of the control board provides enough information to setup the MADK-based motor drive system in shortest time.

Table 6 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-IM818-A	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	820V	
Question 23	DC Bus Sensing High Resistor	5000 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	
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 in the corresponding Section in control board user manual	

After all the MCEWizard questions are answered, the “Verify & Save Page” will be shown as in Figure 5

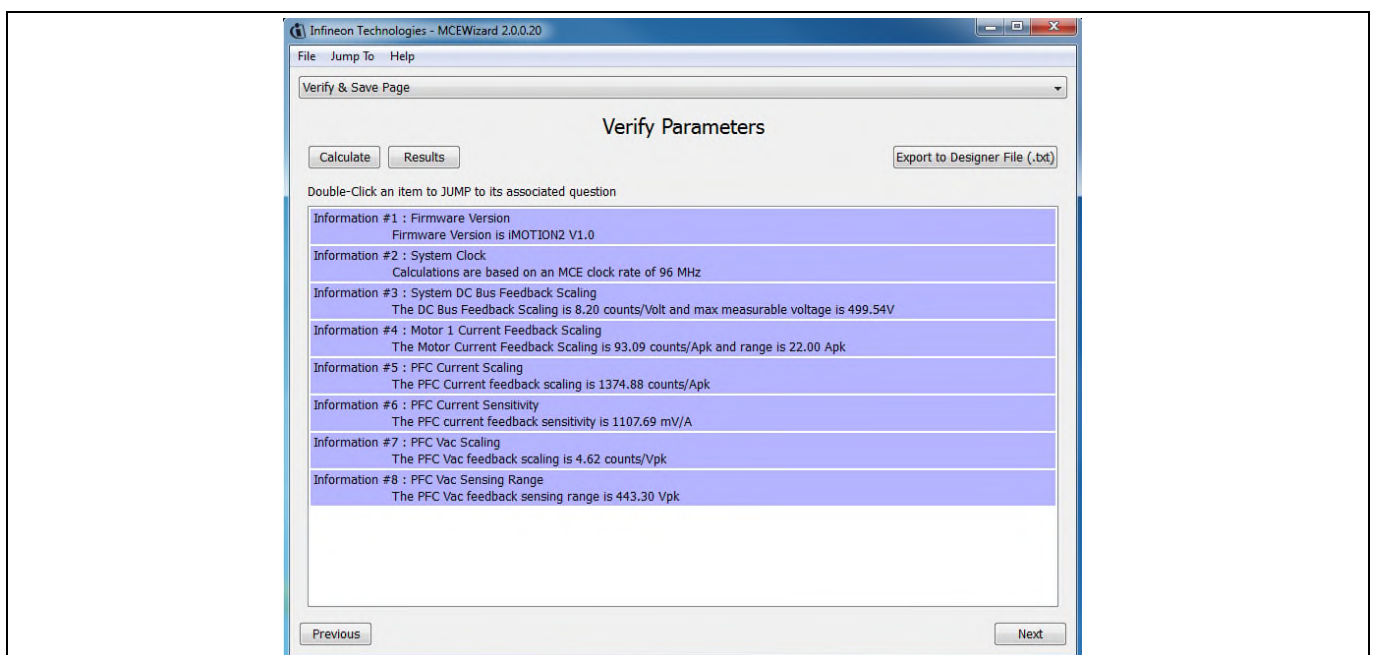


Figure 5 Verify and Save page for MCEWizard

Getting Started with EVAL-M1-IM818-A

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.

4.2.2 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 Table 6.

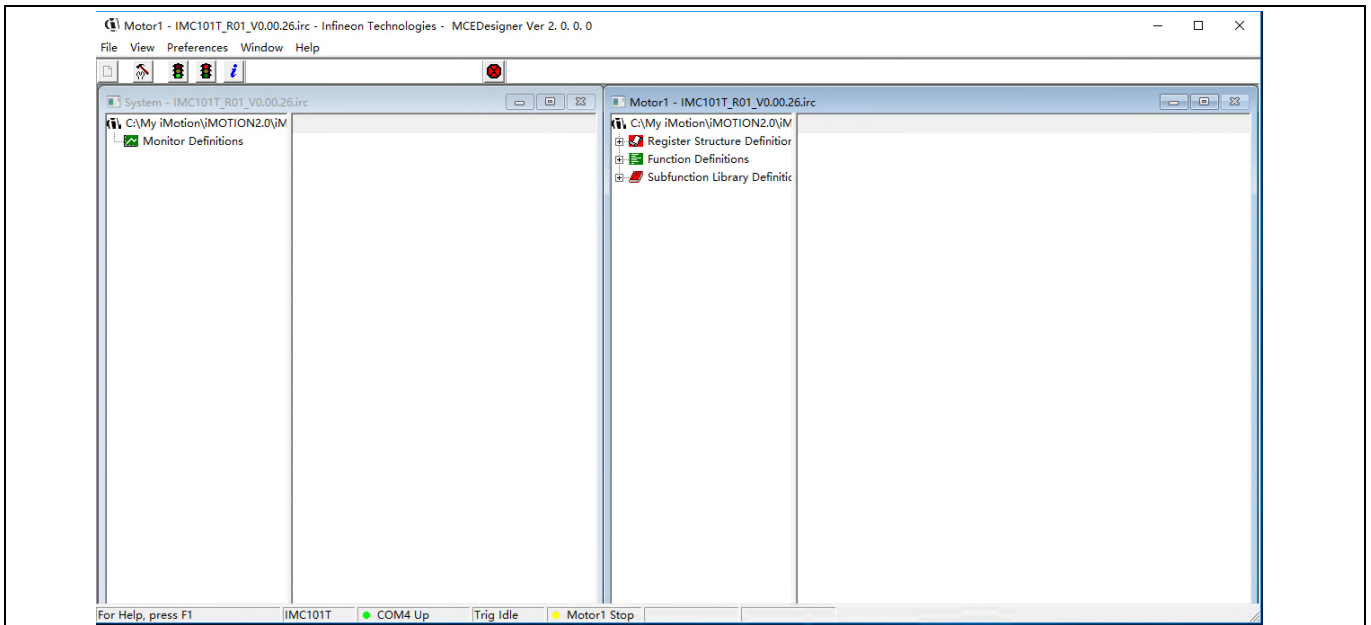


Figure 6 MCEDesigner’s Main Display for EVAL-M1-101T

To program system drive parameters 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 7. 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.

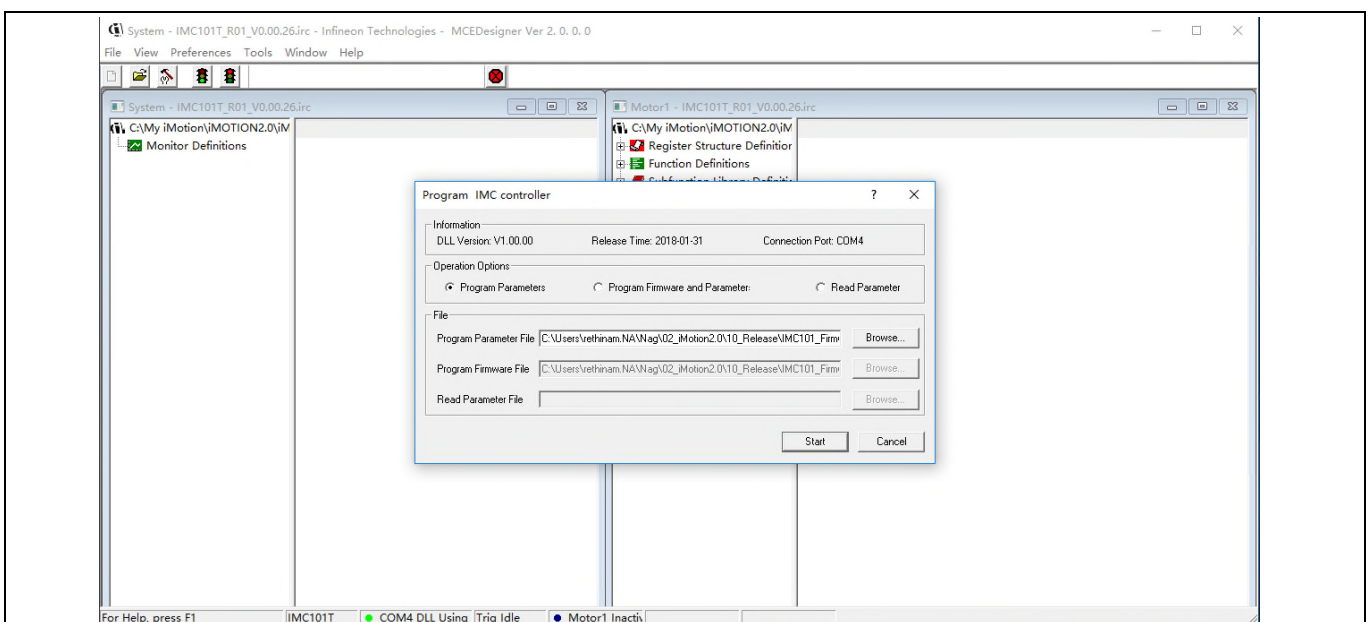


Figure 7 “Program IMC Controller” pop-up window

Getting Started with EVAL-M1-IM818-A

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 speeds, 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 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 8. 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.

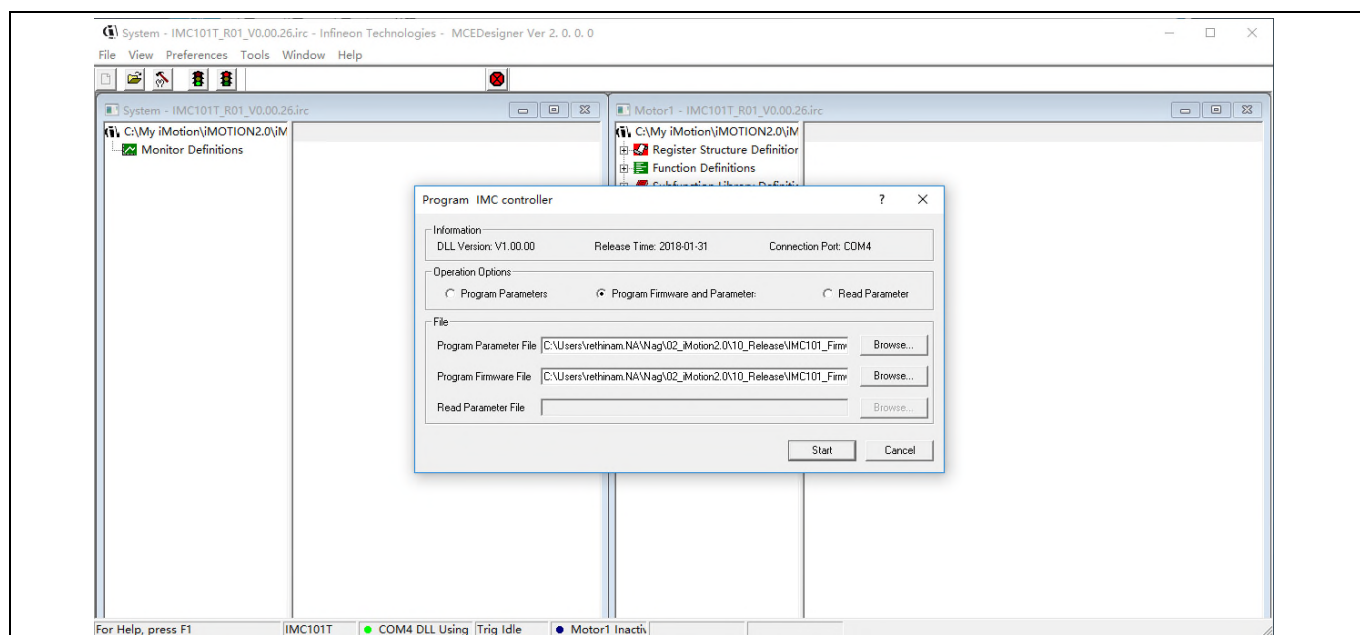


Figure 8 Program Firmware and Parameter in “Program IMC Controller” pop-up window

All the latest firmware files for different types of iMOTION™ motor control ICs are available for download via Infineon iMOTION™ website (<http://www.infineon.com/imotion-software>).

5 Hardware description of EVAL-M1-IM818-A

To meet individual customer requirements and make the EVAL-M1-IM818-A evaluation board a basis for development or modification, all necessary technical data like schematics, layout and components are included in this chapter.

5.1 DC bus Measurement and MCEWizard configuration

Pin 14 of connector J3 provides access to the DC-link voltage. Three possible feedback cases are associated with this pin. Figure 9 provides the DC bus sense resistor details. By default, the resistor R8 is mounted on EVAL-M1-IM818-A.

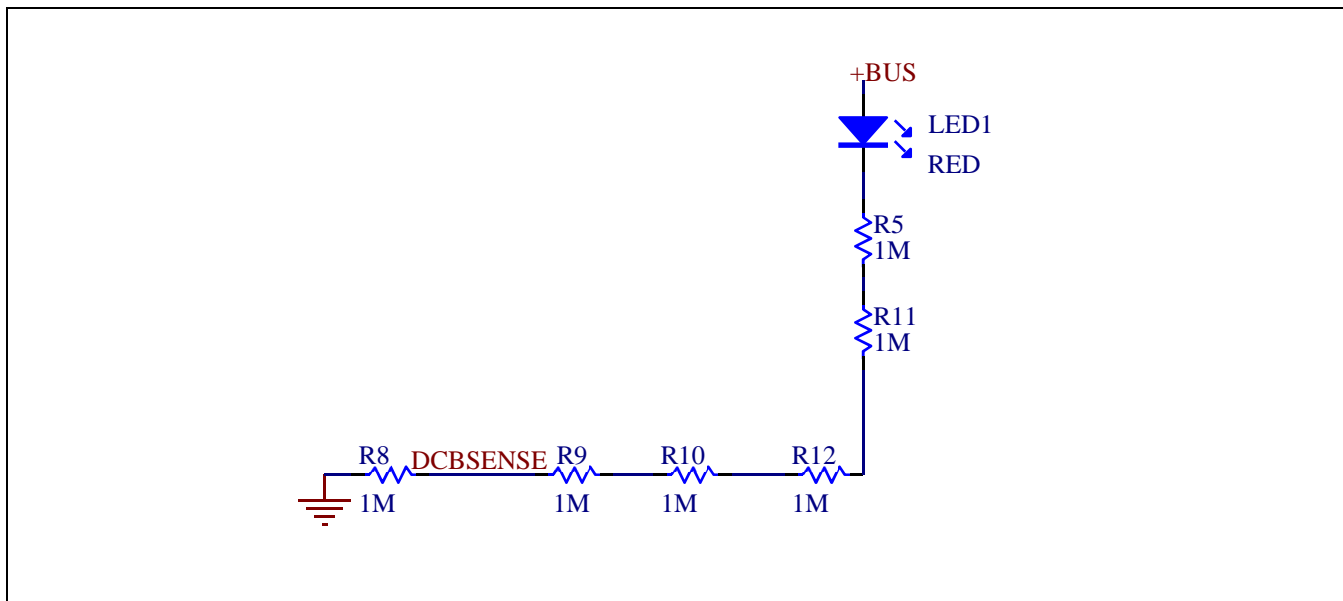


Figure 9 DC bus sense resistor on EVAL-M1-IM818-A evaluation board

The pull down resistor R8 of 1 MΩ referred to ground is inserted on the EVAL-M1-IM818-A evaluation board to prevent the high BUS voltage +BUS directly connecting to the connector J3. And a pull down resistor of 13.3 kΩ for EVAL-M1-101T or 4.87 kΩ for EVAL-M1-183M must be inserted on the control board, and then the DCBSENSE voltage results in the range of 0 to 3.3 V on the pin reflecting a DC bus voltage range of 0 to 800 V.

Question 31 : System DC Bus - DC Bus Sensing High Resistor

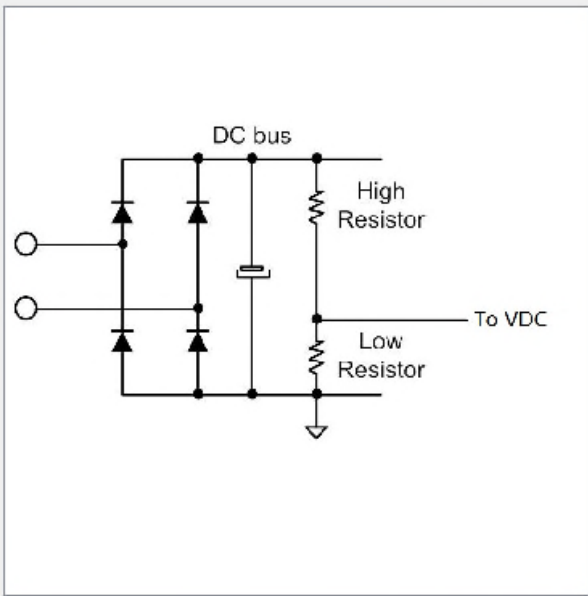
System DC Bus

Question 31 - DC Bus Sensing High Resistor Expand Picture

Normally a resistor divider is used for DC bus voltage sensing. Please specify the high resistor value.

so that the internal voltage scaling can be calculated based on attenuation of resistor divider.

Warning: Wrong value may lead to under/over voltage fault at wrong voltage levels or under/over voltage faults may not happen at all



Answer: KOhms

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Figure 10 DC bus sensing configuration in MCEWizard

5.1.1 Motor External Current feedback configuration and calculation

The current input value is product of the shunt resistance in milliohms and gain of External current sense amplifier for EVAL-M1-101T as shown in Figure 11.

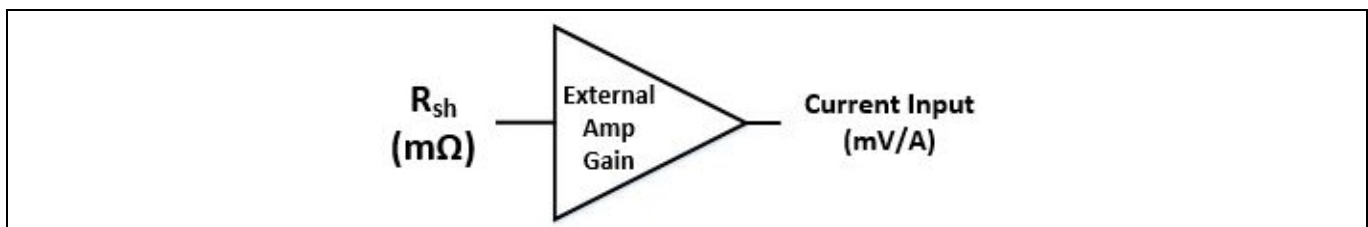


Figure 11 Current shunt feedback and sample timing for EVAL-M1-101T

The external amplifier gain circuit can be found in the schematics or user manual for the control board (For example, EVAL-M1-101T see Figure 12).

Hardware description of EVAL-M1-IM818-A

Figure 12 depicts IU+ current feedback sensing circuitry on EVAL-M1-101T evaluation board. Please note that the default external amplification gain is less than 1 for current sense in this evaluation board.

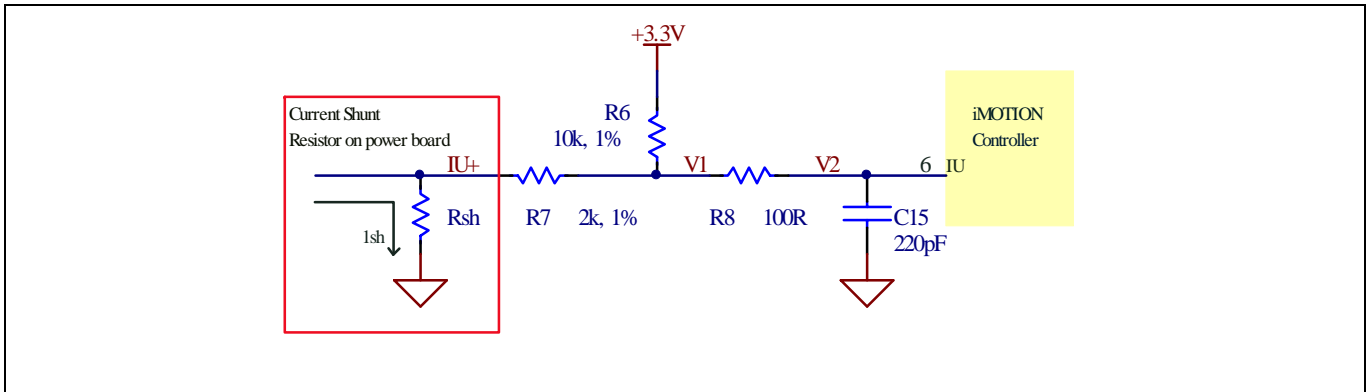


Figure 12 The part of Current feedback on the EVAL-M1-101T evaluation board

Based on the principle of Kirchhoff's voltage law,

$$V_2 \approx V_1 \approx (V_{DD} - I_{sh} * R_{sh}) * \frac{R_7}{R_6 + R_7} + I_{sh} * R_{sh} = \frac{R_7}{R_6 + R_7} V_{DD} + \frac{R_6}{R_6 + R_7} R_{sh} * I_{sh}$$

$$\text{Current input} = \frac{R_6}{R_6 + R_7} R_{sh} = \frac{5}{6} R_{sh}$$

Based on this calculation, the current input for the MADK combination of EVAL-M1-101T and EVAL-M1-IM818-A is 20.83mV/A.

Please use same procedure to calculate the current input for other combinations of MADK boards and enter it into MCEWizard as shown in Figure 13.

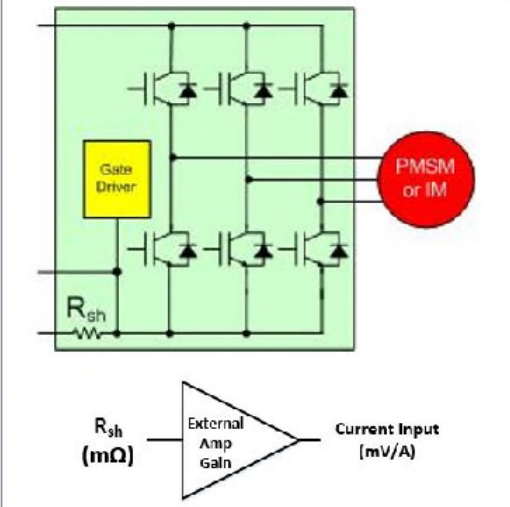
File Jump To Help

Question 82 : Motor 1 Current Feedback and Sample Timing - Motor 1 Current Input Scaling

Motor 1 Current Feedback and Sample Timing

Question 82 - Motor 1 Current Input Scaling Expand Picture

This value is product of shunt resistance in mili ohms and gain of external current sense amplifier.



Answer: mV/A

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Figure 13 Current feedback configuration in MCEWizard for EVAL-M1-101T and EVAL-M1-IM818-A

5.2 EMI filter and soft power up circuit

Figure 14 depicts the schematic from the AC line input connector J1 to the rectified DC bus voltage. This circuitry includes a passive EMI filter consisting of elements C1, C2, L1, L2 and a 40 A/1200 V rectifier block DB, a fuse F1 for inrush current protection, and a relay K1 for soft powering up and reducing conduction losses in steady state. Four electrolytic capacitors C6, C7, C8 and C9 are used for buffering the rectified DC bus voltage DCP.

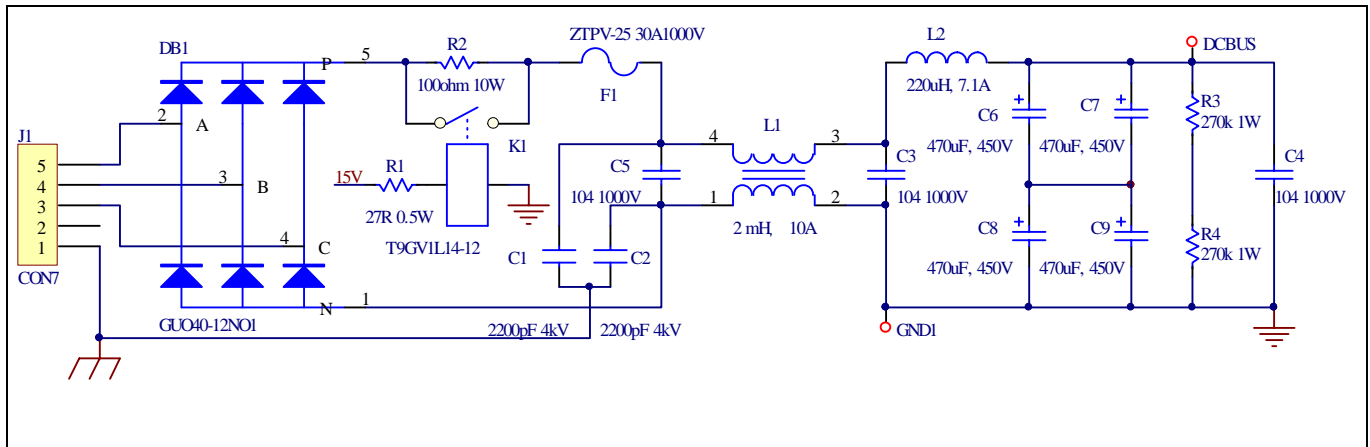


Figure 14 Schematic for EMI filter and AC/DC section of the EVAL-M1-IM818-A evaluation board

5.3 Inverter section using CIPOS™ Maxi IPM

The inverter section is implemented using the CIPOS™ Maxi IPM as sketched in Figure 15. The module includes an optimized SOI gate driver and three phase inverter with 1200V TRENCHSTOP™ IGBTs and Emitter Controlled diodes.

The three capacitors C10, C11 and C12 are used as bootstrap capacitors to provide the necessary floating supply voltages V_{BS1} , V_{BS2} and V_{BS3} respectively.

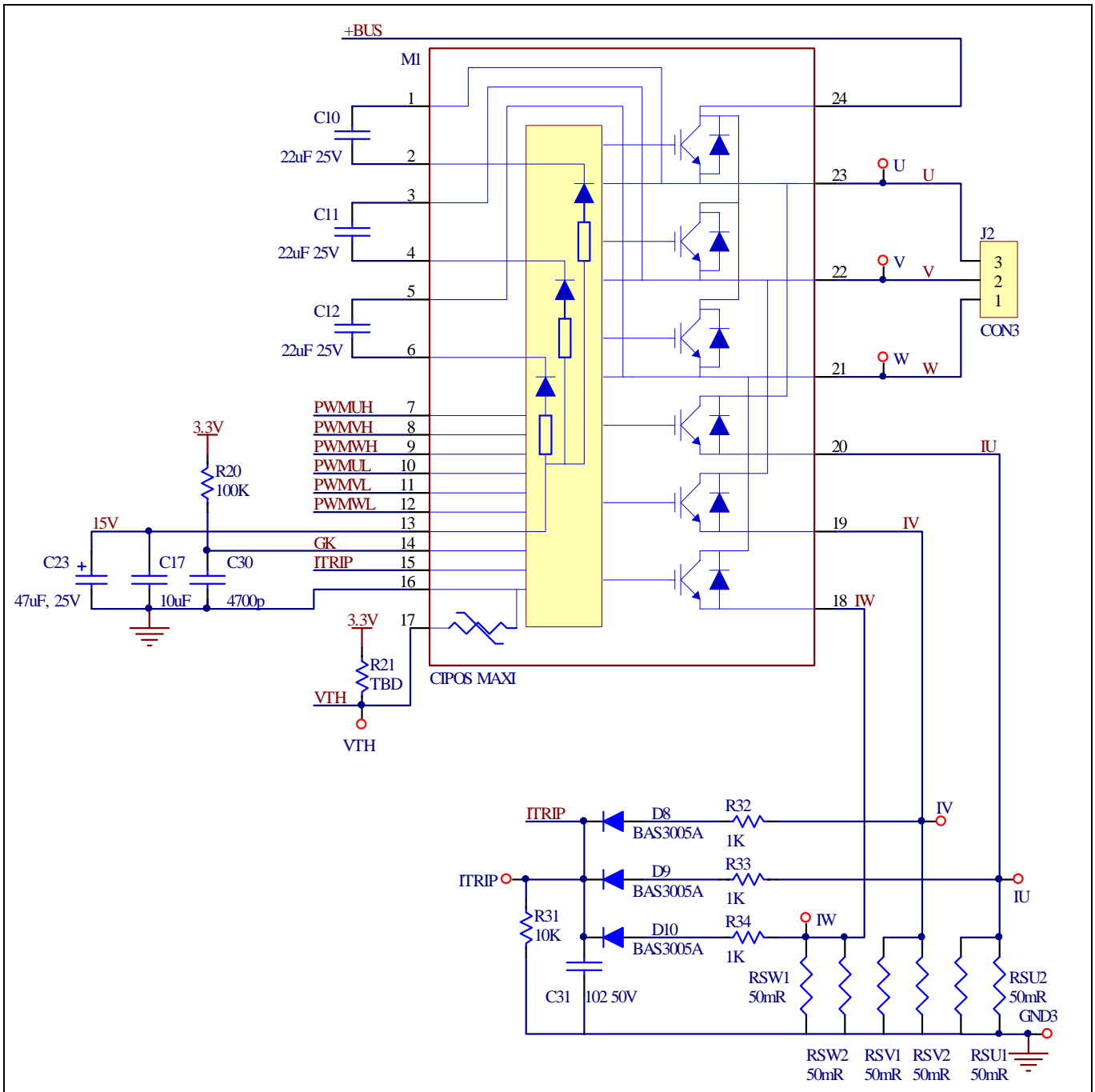


Figure 15 Schematic of the 3-phase inverter section using CIPOS™ Maxi IPM on EVAL-M1-IM818-A

5.4 Auxiliary power supply

Figure 16 depicts the schematic of the auxiliary power supply available on the EVAL-M1-IM818-A board. The circuit includes IRS2505L that is used to generate 15 V directly from the DC bus. V_{CC} is connected to the gate drivers inside the CIPOS™ IPM.

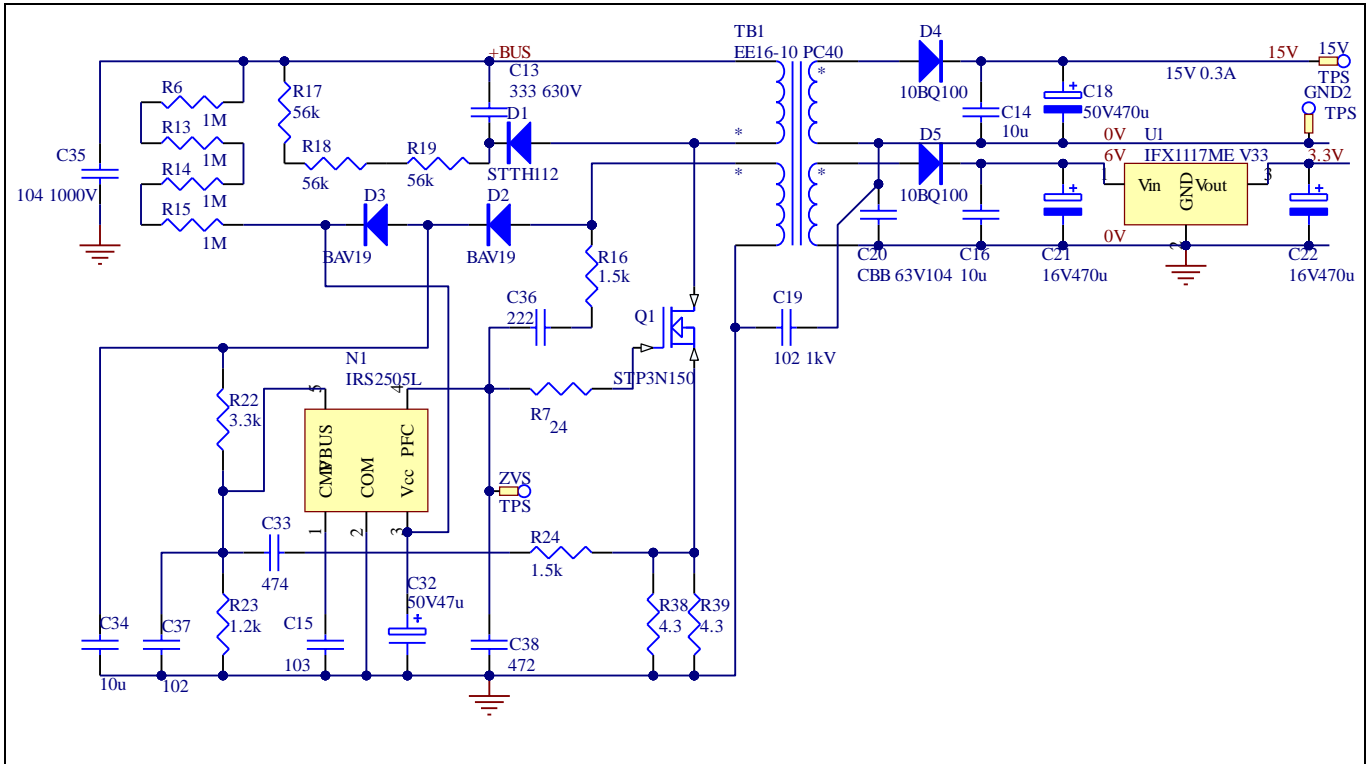


Figure 16 Power supply section of the EVAL-M1-IM818-A evaluation board

The linear voltage regulator IFX1117ME V33 generates 3.3 V from 15 V power supply V_{CC} . Both V_{CC} and 3.3 V are also present on the 20 pin interface connector J2 to power circuitry on the controller board

5.5 Schematic with EVAL-M1-IM818-A evaluation board

Figure 17 displays schematic with EVAL-M1-IM818-A board

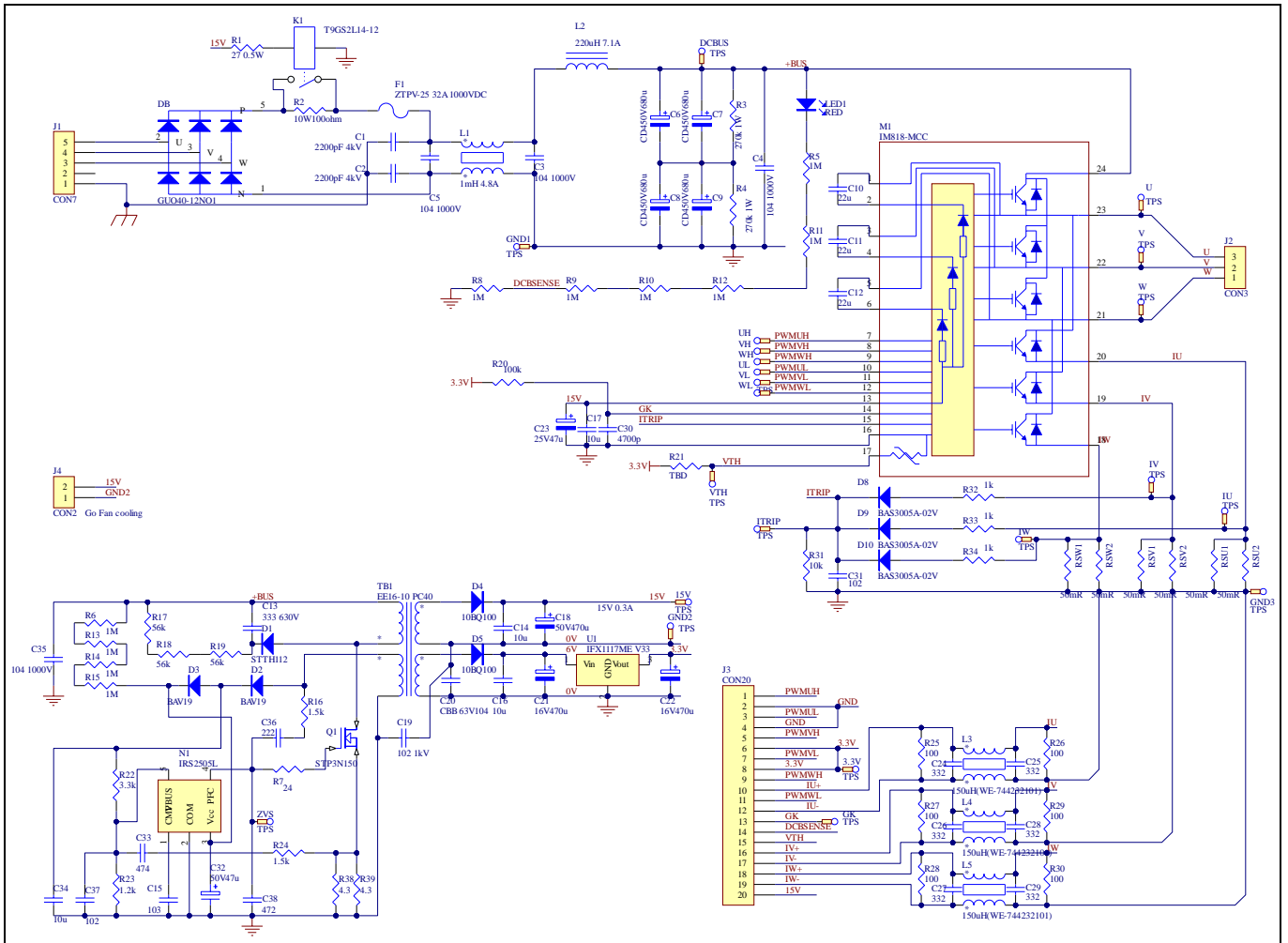


Figure 17 Schematic on the EVAL-M1-IM818-A evaluation board

5.6 PCB Layout

The layout of this board can be used for different voltage or power classes. The PCB has two electrical layers with 35µm copper by default and its size is 197 mm × 140 mm. 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 18 illustrates the top assembly print of the evaluation board.

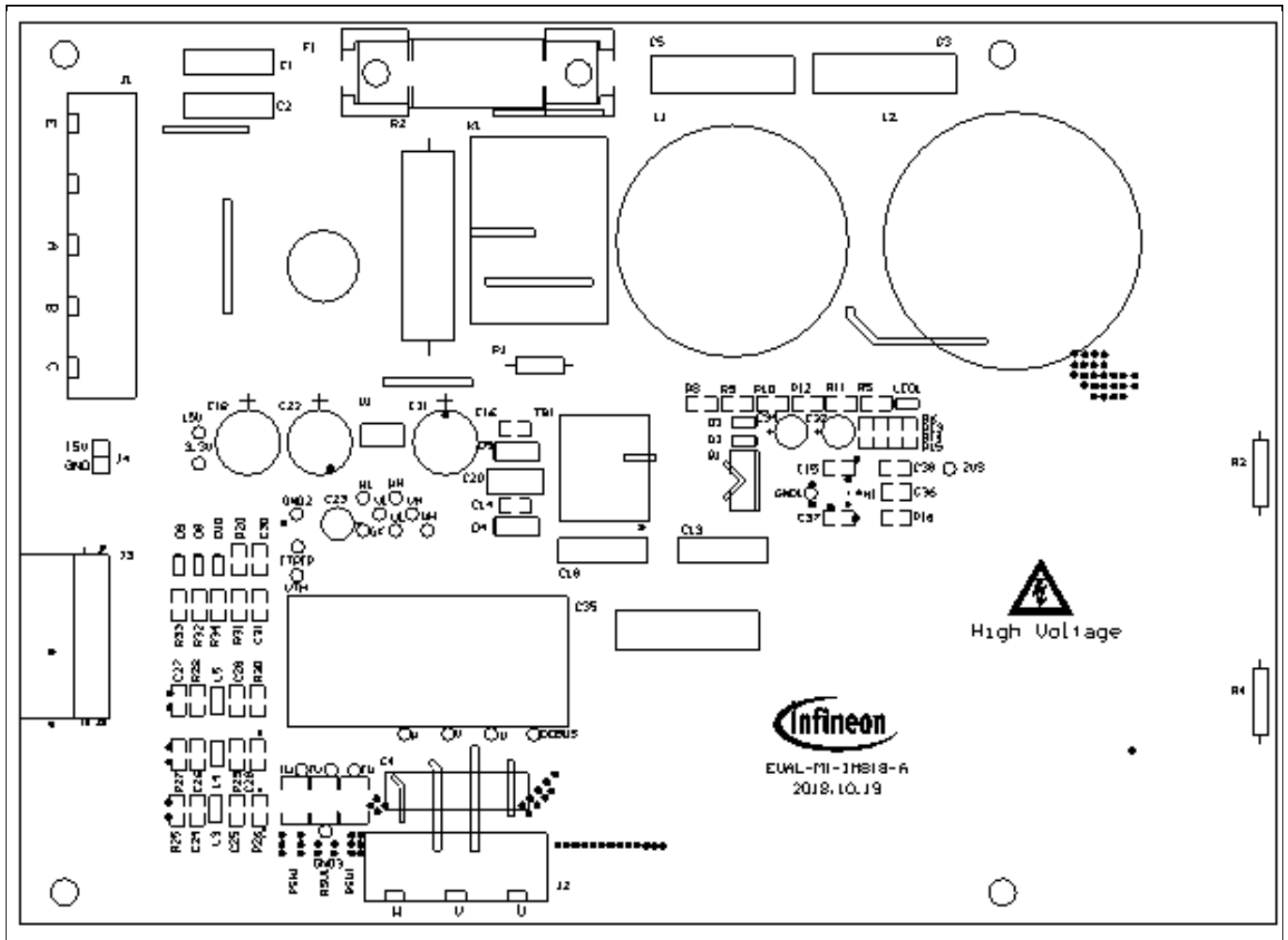


Figure 18 Top assembly print of the EVAL-M1-IM818-A evaluation board

Figure 19 depicts the bottom assembly print of the evaluation board.

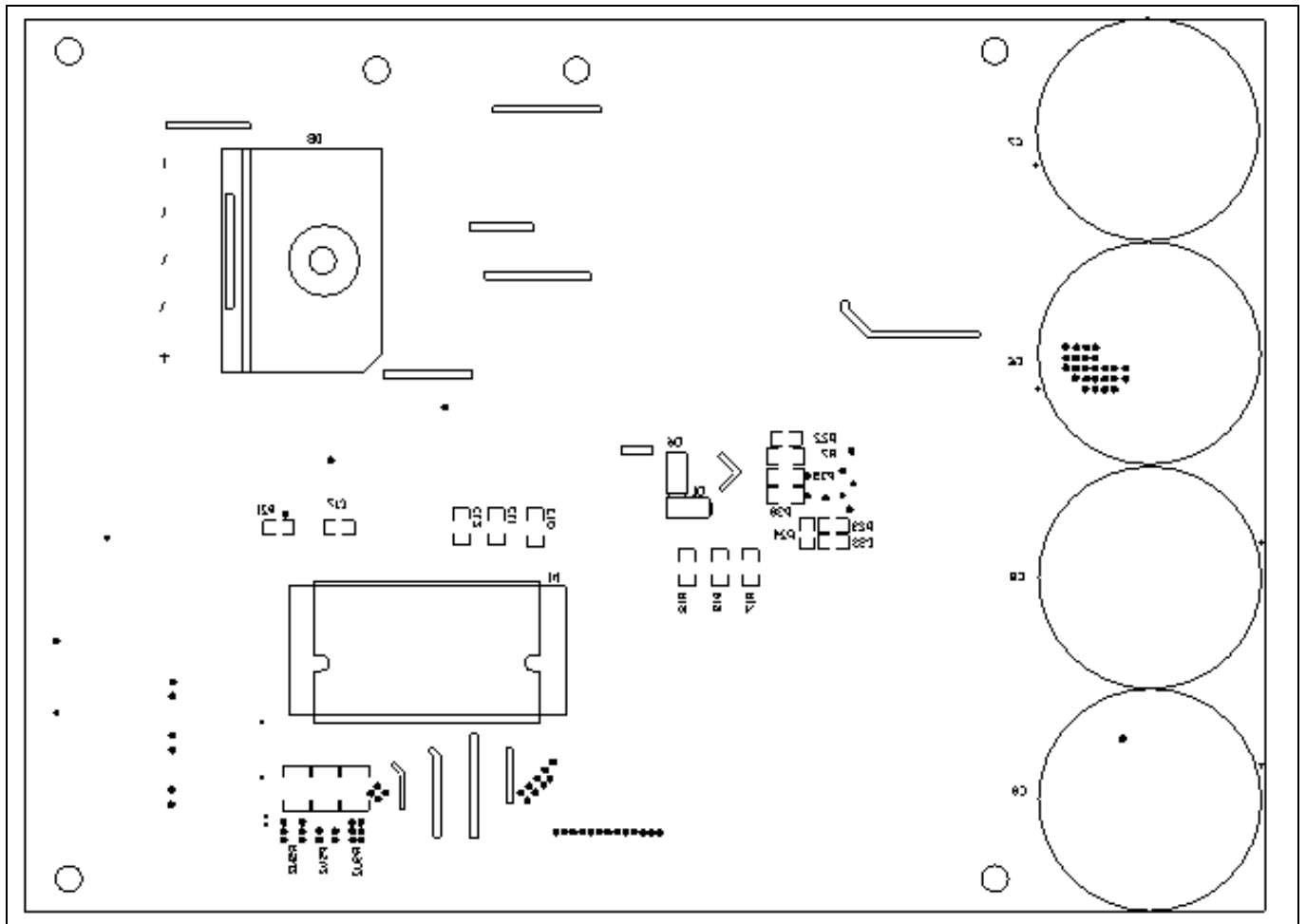


Figure 19 Bottom assembly print of the EVAL-M1-IM818-A evaluation board

The top layer routing of the PCB is provided in Figure 20.

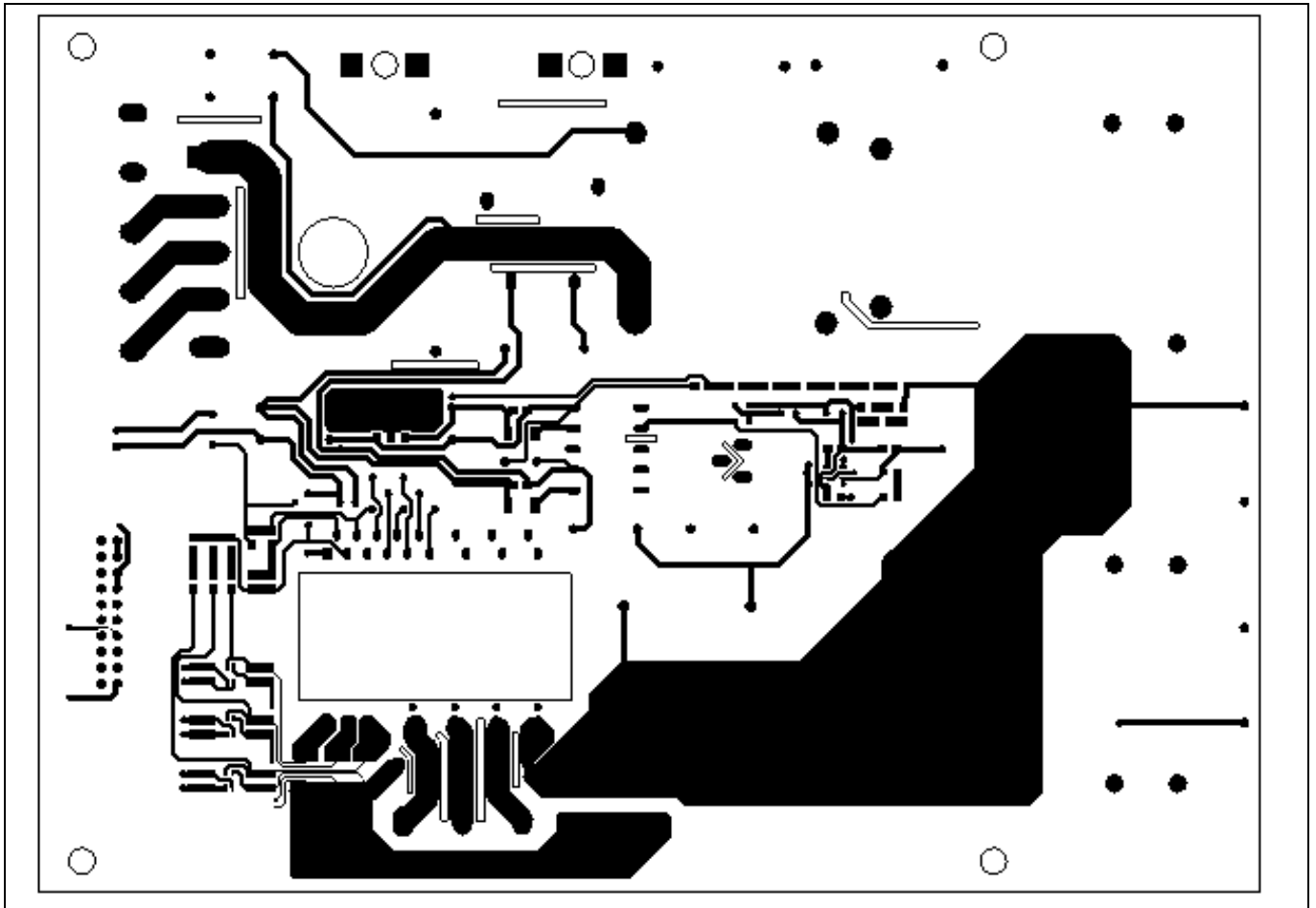


Figure 20 Top layer routing of the EVAL-M1-IM818-A

Figure 21 illustrates the bottom layer routing of the PCB.

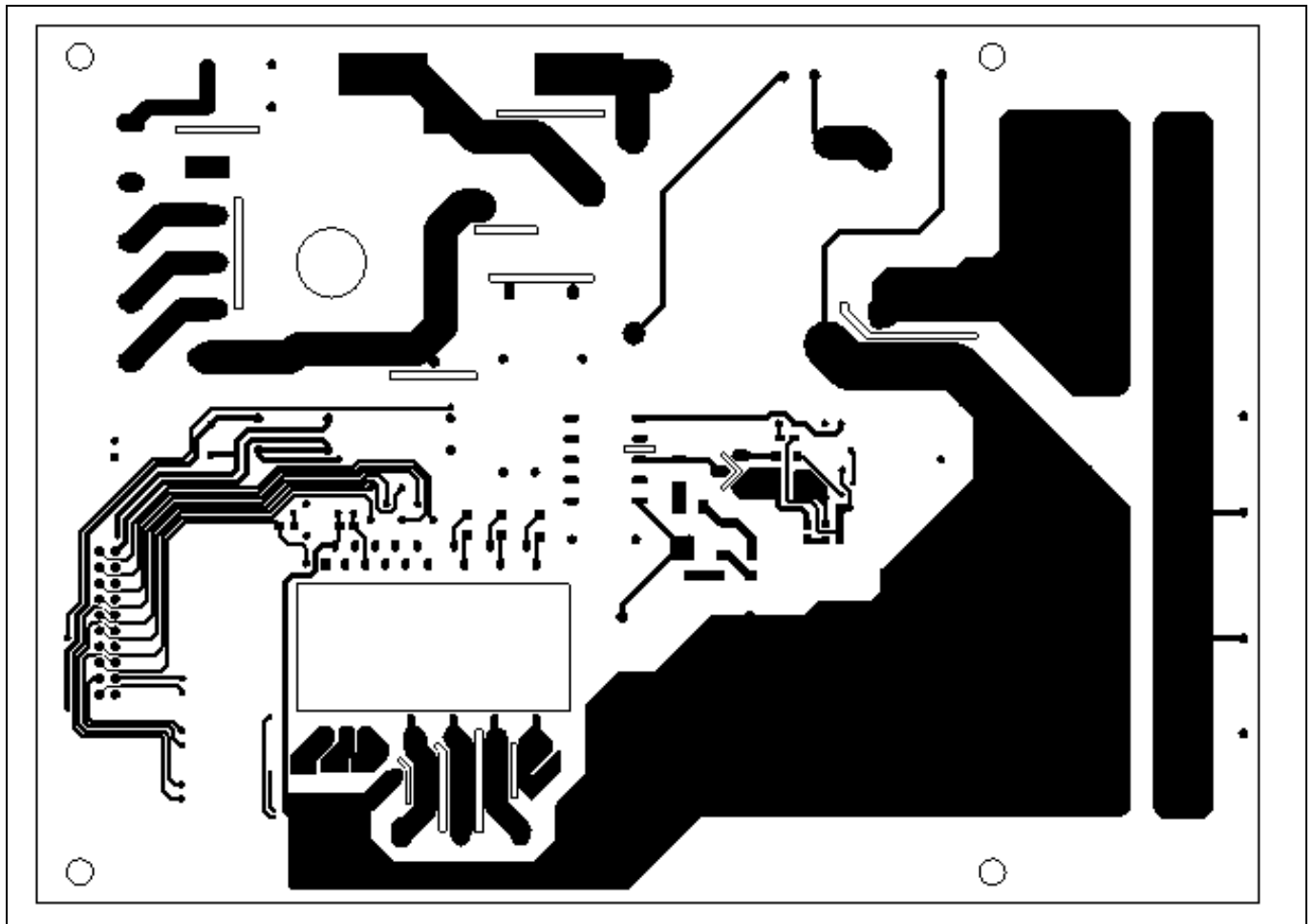


Figure 21 Bottom layer routing of the EVAL-M1-IM818-A

6 Bill of Materials of EVAL-M1-IM818-A

Table 7 provides the complete bill of materials of the evaluation board.

Table 7 Bill of materials

No.	Qty	Part description	Designator	Part number	Manufacturer
1	2	CAP Safety 2200PF 4KV	C1, C2	HDE2200pF4kVEF0KR	Vishay Vitramon
2	4	CAP FILM 0.1UF 5% 1KVDC RADIAL	C3, C4, C5, C35	B32653A0104K189	EPCOS (TDK)
3	4	CAP ALUM 470UF 20% 450V SNAP	C6, C7, C8, C9	861221486023	Wurth Electronics Inc.
4	3	CAP CER 22UF 16V X5R 1206	C10, C11, C12	885012108018	Wurth Electronics Inc.
5	1	CAP 0.033μF 630V	C13	890303322005CS	Wurth Electronics Inc.
6	3	CAP CER 10μF 25V X5R 0805	C14, C16, C17	C2012X5R1E106M125 AB	TDK Corporation
7	1	CAP CER 0.01μF 50V X7R 0805	C15	885012207092	Wurth Electronics Inc.
8	1	CAP ALUM 470UF 20% 50V RADIAL	C18,	860020675022	Wurth Electronics Inc.
9	1	CAP ALUM 47UF 20% 50V RADIAL	C32	860020673013	Wurth Electronics Inc.
10	1	CAP CER 1000PF 1KV RADIAL	C19	CK45-R3AD102K-NRA	TDK Corporation
11	1	CAP FILM 0.1UF 10% 63VDC RADIAL	C20	B32529C0104K189	TDK Corporation
13	2	CAP ALUM 470UF 20% 16V RADIAL	C21, C22	860020374012	Wurth Electronics Inc.
14	1	CAP ALUM POLY 47UF 20% 25V T/H	C23	870025574002	Wurth Electronics Inc.
15	6	CAP CER 3300PF 50V C0G/NP0 0805	C24, C25, C26, C27, C28, C29	885012007066	Wurth Electronics Inc.
16	2	CAP CER 4700PF 50V C0G/NP0 0805	C30, C38	885012007067	Wurth Electronics Inc.
17	2	CAP CER 1000PF 50V C0G/NP0 0805	C31, C37	885012007063	Wurth Electronics Inc.
18	1	CAP CER 0.47UF 50V X7R 0805	C33	885012207102	Wurth Electronics Inc.
19	1	CAP ALUM 10UF 20% 25V RADIAL	C34	860020472003	Wurth Electronics Inc.
20	1	CAP CER 2200PF 50V C0G/NP0 0805	C36	885012007065	Wurth Electronics Inc.
21	2	DIODE GEN PURP 1.2KV 1A SMA	D1, D6	STTH112A	STMicroelectronics
22	2	DIODE GEN PURP 100V 200MA SOD123	D2, D3	BAV19W-7-F	Diodes Incorporated
23	2	DIODE SCHOTTKY 100V 1A SMB	D4, D5	10BQ100	Vishay Semiconductor Diodes Division

Bill of Materials of EVAL-M1-IM818-A

No.	Qty	Part description	Designator	Part number	Manufacturer
24	1	3-PHASE BRIDGE RECT 1200V 40A	DB	GUO40-12NO1	IXYS
25	1	FUSE CERAMIC 32A 1000VDC	F1	ZTPV-32	LKET
26	1	CONN TERM BLOCK 5POS 9.52MM PCB	J1	691250910003 691250910002	Würth Electronics Inc.
27	1	CONN TERM BLOCK 3POS 9.52MM PCB	J2	691250910003	Würth Electronics Inc.
28	1	CONN RCPT .100" 20PS DL R/A GOLD	J3	613020243121	Würth Electronics Inc.
29	1	CONN HEADER 2 POS 2.54	J4	61300211121	Würth Electronics Inc.
30	1	RELAY GEN PURPOSE SPST 30A 12V	K1	T9GV1L14-12	TE Connectivity Potter & Brumfield Relays
31	1	1mH 4.8A	L1	Bourns 8103-RC	Bourns Inc.
32	1	220uH 7.1A	L2	NPH130060	Poco Holding
33	3	WE-CNSW SMD Common Mode Line Filter	L3, L4, L5	744232101	Würth Electronics Inc.
34	1	LED RED CLEAR 0805 SMD	LED1	150080RS75000	Würth Electronics Inc.
35	7	MOSFET N-CH 1500V 2.5A TO-220	Q1	STP3N150	STMicroelectronics
36	1	RES 27 OHM 1/2W 5% AXIAL	R1	CFR-50JB-52-27R	Yageo
37	1	RES 100 OHM 10W 5% AXIAL	R2	PNP10VJT-91-100R	Yageo
38	2	RES 270K OHM 1W 5% AXIAL	R3, R4	FMP100JR-52-270K	Yageo
39	10	RES SMD 1M OHM 0.1% 1/8W 0805	R5, R6, R8, R9, R10, R11, R12, R13, R14, R15	RG2012P-105-B-T5	Yageo
40	1	RES SMD 24 OHM 5% 1/4W 1206	R7	RC1206JR-0724RL	Yageo
41	2	RES SMD 1.5K OHM 1% 1/10W 0805	R16, R24	RT0805FRE071K5L	Yageo
42	3	RES SMD 56K OHM 0.5% 1/4W 1206	R17, R18, R19	RT1206DRD0775KL	Yageo
43	1	RES SMD 100K OHM 1% 1/8W 0805	R20	RC0805FR-07100KL	Yageo
44	1	DNI	R21	RC0603JR-07110KL	Yageo
45	1	RES SMD 3.3K OHM 5% 1/8W 0805	R22	RC0805JR-073K3L	Yageo
45	2	RES SMD 10K OHM 5% 1/8W 0805	R31	RC0805JR-0710KL	Yageo
46	1	RES SMD 3.9K OHM 0.1% 1/8W 0805	R23	RT0805BRD073K9L	Yageo
47	6	RES SMD 100 OHM 1% 1/8W 0805	R25, R26, R27, R28, R29, R30	RC0805FR-07100RL	Yageo

Bill of Materials of EVAL-M1-IM818-A

No.	Qty	Part description	Designator	Part number	Manufacturer
48	3	RES SMD 1K OHM 1% 1/8W 0805	R32, R33, R34	RC0805FR-071KL	Yageo
49	2	RES SMD 4.3 OHM 1% 1/4W 1206	R38, R39	RC1206FR-074R3L	Yageo
50	6	RES 0.05 OHM 1W 1812 WIDE	RSU1, RSU2, RSV1, RSV2, RSW1, RSW2	RL1218JK-070R05L	Yageo
51	1	Transformer EE16-10P	TB1	EE16-10P	PC40
52	22	TEST POINT PC MAXI .040""D RED	3.3V, 15V, DCBUS, GK, GND1, GND2, GND3, ITRIP, IU, IV, IW, U, UH, UL, V, VH, VL, VTH, W, WH, WL, ZVS	5001	Keystone Electronics
53	1	IC REG LINEAR 3.3V 1A SOT223-4	U1	IFX1117MEV33HTMA1	Infineon Technologies
54	3	DIODE SCHOTTKY 30V 500MA SC79-2	D8, D9, D10	BAS3005A02VH6327X TSA1	Infineon Technologies
55	1	1200 V, 3-phase Intelligent Power Module	M1	IM818-MCC	Infineon Technologies
56	1	IC PFC MOSFET SOT-23-5	N1	IRS2505LTRPBF	Infineon Technologies

7 Reference

[1] Datasheet of Infineon CIPOS™ Maxi IM818, is available for download on Infineon's website

<https://www.infineon.com/cms/en/product/power/intelligent-power-modules-ipm/cipos-maxi/>

[2] Application Note AN2016-10 CIPOS Maxi Technical Description, 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	2018-11-15	First release
1.1	2019-04-02	Change output power to 1500W and Current to 2.35A. Optimization schematic
1.2	2021-03-03	Change current feedback sensing value to 20.83mV/A
1.3	2021-04-30	BOM and SCH update

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AN2018-35 EVAL-M1-IM818-A User Document reference Manual

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