EVAL-M7-D112T user guide

iMOTION™ evaluation board for smart drivers

About this document

Scope and purpose

This user guide provides an overview of the evaluation board EVAL-M7-D112T, including its main features, key-technical data, pin assignments, and mechanical dimensions.

EVAL-M7-D112T is an iMOTION™ application design kit based on Infineon's IMD112T smart driver. This board features and demonstrates Infineon's advanced motion control engine technology for permanent magnet synchronous motors drive over the full speed range, combined with a fully integrated, 3-phase high-voltage gate driver, and a 5 V voltage regulator in a very compact QFP 40-pins package. A boost power factor correction (PFC) control function is also integrated into IMD112T.

The evaluation board EVAL-M7-D112T has been developed to support users during their first steps designing applications in which running a permanent magnet motor via a sensor less, sinusoidal, field-oriented control, and PFC function are necessary.

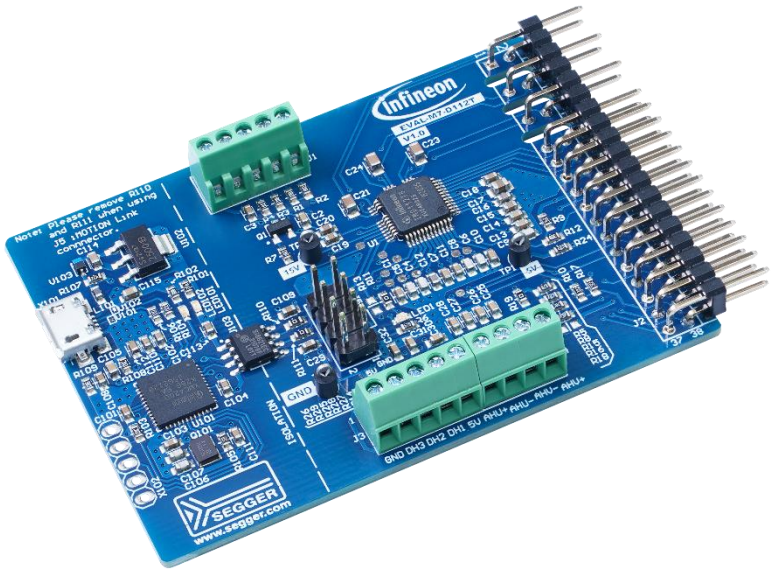
Intended audience

This evaluation board is intended for all technical specialists familiar with motor control and power electronics converter systems.

Evaluation board

This board is to be used during the design-in process for evaluating and measuring characteristic curves, and for checking datasheet specifications. This board is intended to be used under laboratory conditions only.

Note: *PCB and auxiliary circuits are NOT optimized for final customer design.*



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Safety precautions

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 waveforms 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.*
	**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.*

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1 The board at a glance

The EVAL-M7-D112T evaluation board is an iMOTION™ smart driver application design kit for small motor drives, of up to 400 W output power with cooling fan when matched with Infineon's EVAL-M7- HVIGBT-PFCINV4 power board. Of course, other power boards compatible with M7 connectors can be used for different power stages. It is a full system control evaluation board including power factor correction, 5 V power supply output, and 3-phase motor drive PWM output.

The main device on the evaluation board is the iMOTION™ smart driver IC, IMD112T. This device is a highly integrated IC for controlling variable speed drives. It includes a motor control processor, a high-voltage 3-phase gate driver, boost PFC control PWM output, and a 5 V voltage regulator. An external gate driver is needed to drive the PFC with an IGBT/MOSFET. IMD112T is capable of controlling input PFC and permanent magnet synchronous motor/brushless direct current motor (PMSM/BLDC) using sensor less or sensored rotor angle and speed feedback. It can support up to 100 kHz PFC frequency. The target applications are home appliances, fans, pumps, and so on. The system enables rapid configuration and quick motor system set up, start up, and tune up using iMOTION™ Solution Designer (iSD) tools. The key features and functionality of this board are described in Section 1.3 of this user guide. The rest of the guide provides information to help users set up and use this evaluation board, and to copy or modify the design according to their own specific requirements.

Figure 1 shows the evaluation board EVAL-M7-D112T. This user guide explains the features and design of the board as well as the smart driver, IMD112T.

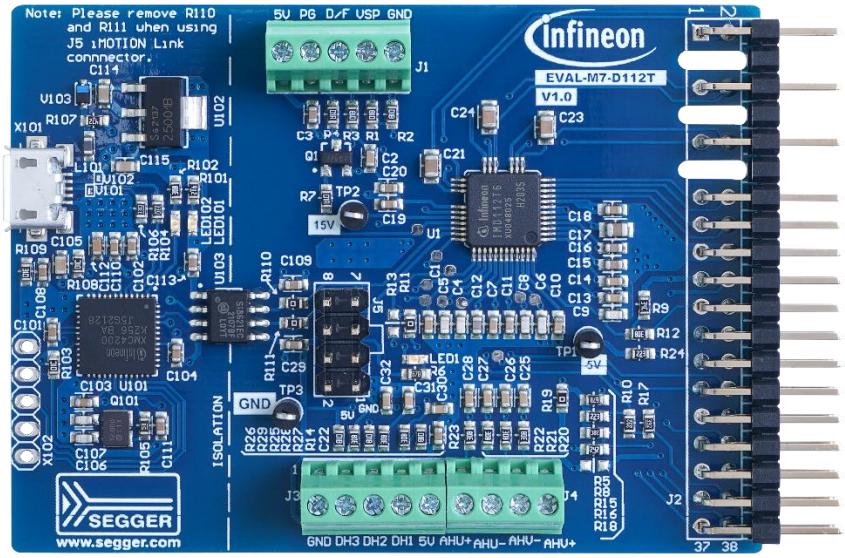

Figure 1 EVAL-M7-D112T evaluation board

1.1 Scope of supply

The delivery content only contains the board shown in Figure 1. The ordering information is listed in Table 1.

The USB cable shown in the Figure 3 is mandatory for tuning, but is not included with the delivery content. The iMOTION™ Link connector on the board is an optional tuning method for users who want to tune the board using the iMOTON™ Link isolated debug probe. If required, users can buy it from here.

Table 1 Delivery content

Base part number	Package	Standard pack		Orderable part number
		Form	Quantity	
EVAL-M7-D112T		Boxed	1	SP004177784

1.2 Block diagram

Figure 2 shows the block diagram of EVAL-M7-D112T and its connections with the power stage. EVAL-M7-D112T is a control board for PFC and motor control with sensor less or rotor angle and speed feedback. IMD112T includes a 3-phase high-voltage gate driver, PFC control, and a 5 V voltage regulator. An external high-voltage low-side gate driver is needed to drive the PFC switch IGBT/MOSFET for boost topology.

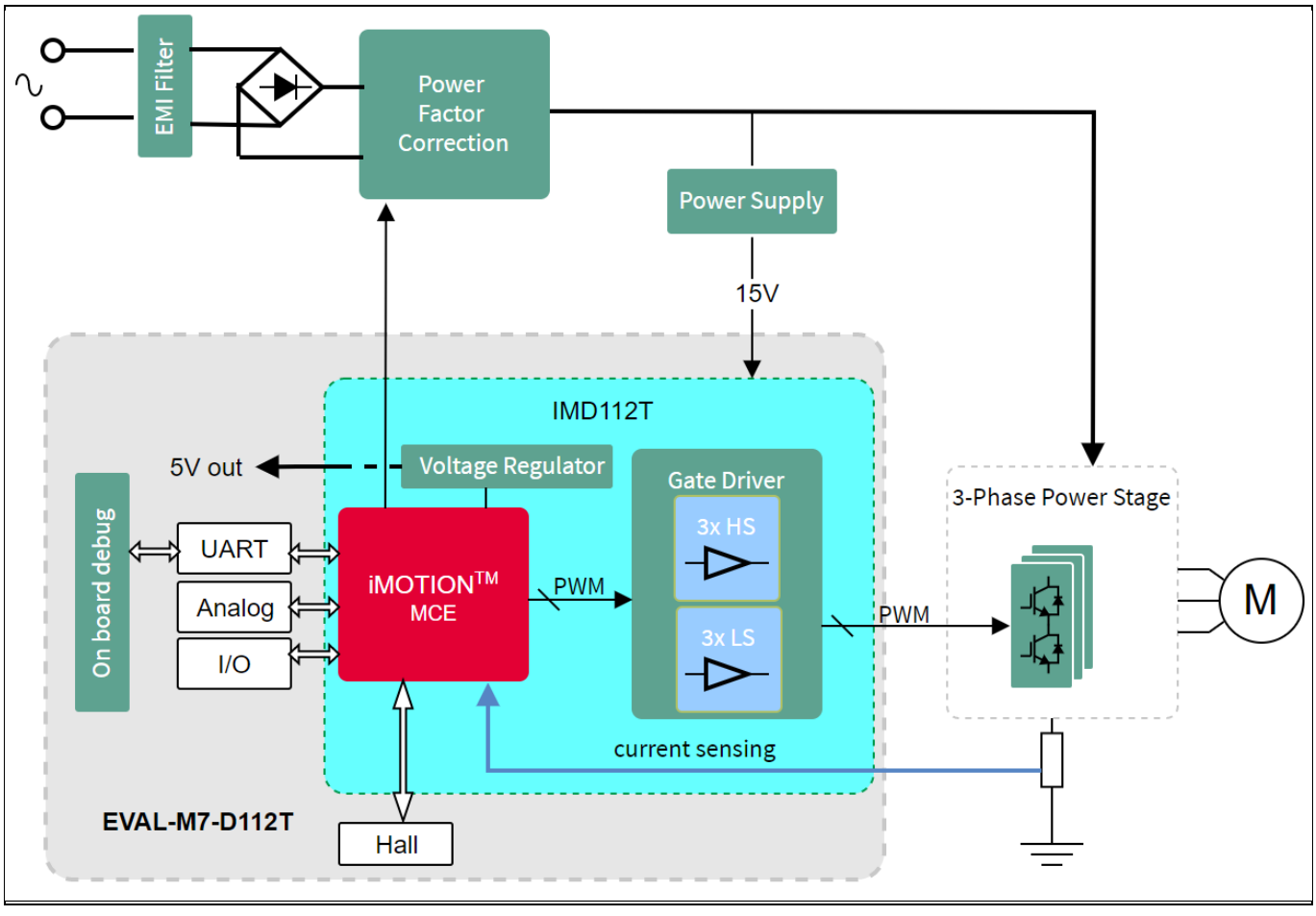

Figure 2 Block diagram of EVAL-M7-D112T

1.3 Main features

EVAL-M7-D112T is an evaluation board with Infineon's smart driver, IMD112T. This board is suitable for PMSM or BLDC motor control for home appliances, fans, pumps, and so on, and for applications that require PFC.

The main features of the IMD112T smart driver are as follows:

- Motor controller with integrated high-voltage gate driver and voltage regulator
- Integrated 5 V low dropout regulator (LDO) that allows single 15 V supply voltage input
- Robust 600 V gate driver with thin-film silicon-on-insulator (SOI) technology
- Gate driver integrated with ultra-fast bootstrap diodes
- Space saving LQFP-40pin package with high-voltage creepage
- Motion control engine (MCE) as ready-to-use solution for variable speed drives
- Sensor less field oriented control (FOC) for permanent magnet synchronous motor
- Flexible space vector PWM (3-phase or 2-phase)
- Motor current sensing via single or leg shunt
- Optional analog or digital Hall sensor interface
- Flexible host interface options for motor control commands — Universal asynchronous receiver/transmitter (UART), frequency/duty cycle, or analog variable speed control (VSP)
- Boost PFC control

The main features of the EVAL-M7-D112T evaluation board are as follows:

- Debug included onboard
- iMOTION™ Link connector as an optional communication interface
- Single-shunt current feedback configuration for the inverter
- Boost PFC configuration
- Optional VSP or duty/frequency control
- 51 mm x 70 mm PCB with two layers and 1 oz copper

1.4 Board parameters and technical data

Table 2 lists the parameters and technical data of the evaluation board.

Table 2 Board specification

Parameter	Symbol	Conditions	Value	Unit
15 V input voltage	+15V	Maximum 25 mA current for controller	15±5%	V
5 V output voltage	+5V	Maximum 10 mA output for external devices	5±4%	V
Communication				
Mini USB	X101	On board debug incorporated	UART0	
iMOTION™ Link connector	J3	iMOTION™ Link isolated debug probe must be used	UART0	
PCB characteristics				
Material		1.6 mm thickness, 1 oz copper, 2 layers	FR4	
dimension		Length × width × height	77 × 51 × 14	mm

2 System and functional description

2.1 Getting started

2.1.1 Setting up the system

After downloading and installing the iMOTION™ development tool — iMOTION™ Solution Designer (iSD), perform the following steps to run the PFC and motor. Please refer to [2] to learn how to use the iSD tool.

1. Check and update the latest iSD package available in the iSD tool.

2. Connect the PC and evaluation board via a USB cable or iMOTION™ Link.

3. Connect the AC source and target motor.

4. Use the parameter configuration wizard of the iSD tool to calculate and create the parameters. Regarding current feedback gain/offset calculation, see Section 2.2.2.

5. Power on the system and click **Program** to program the code into the IMD112T smart driver.

6. After the programming finishes successfully, click the **Dashboard** icon to go to the Running and Tuning window.

After the entire system is ready, users can start or stop the motor and/or the PFC by clicking the start/stop button.

Figure 3 is shows an example of the system setup — the EVAL-M7-D112T control board connected with the M7 connector-compatible power board, EVAL-M7-HVIGBT-PFCINV4.

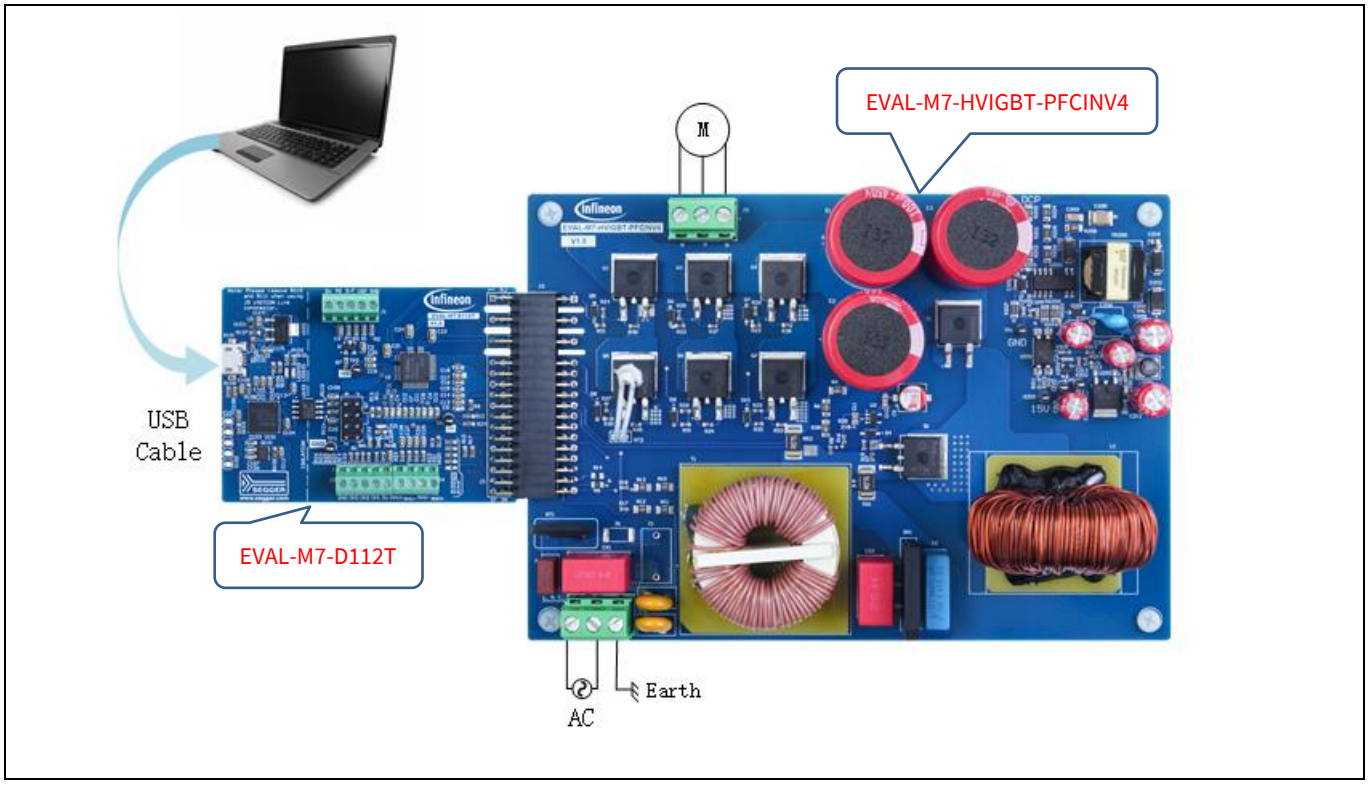

Figure 3 Example of system setup

2.1.2 iMOTION™ development tool

To test and evaluate EVAL-M7-D112T, users need to calculate the variable parameters for the motor using the configuration wizard in the iSD tool. They can then move to the dashboard window to tune the motor. For this, the iMOTION™ Solution Designer tool must be installed on the computer. The software can be downloaded from Infineon's website.

Note: Please note that the iMOTION™ development tools described here are based on the released iSD package version V5.01.17. Some features may change in different versions. Please refer to the user guide of iMOTION™ Solution Designer's relevant version.

Figure 4 shows the parameter configuration page of the wizard. Users need to set all parameters related to system hardware design and motor under test. Please refer to [2] for details.

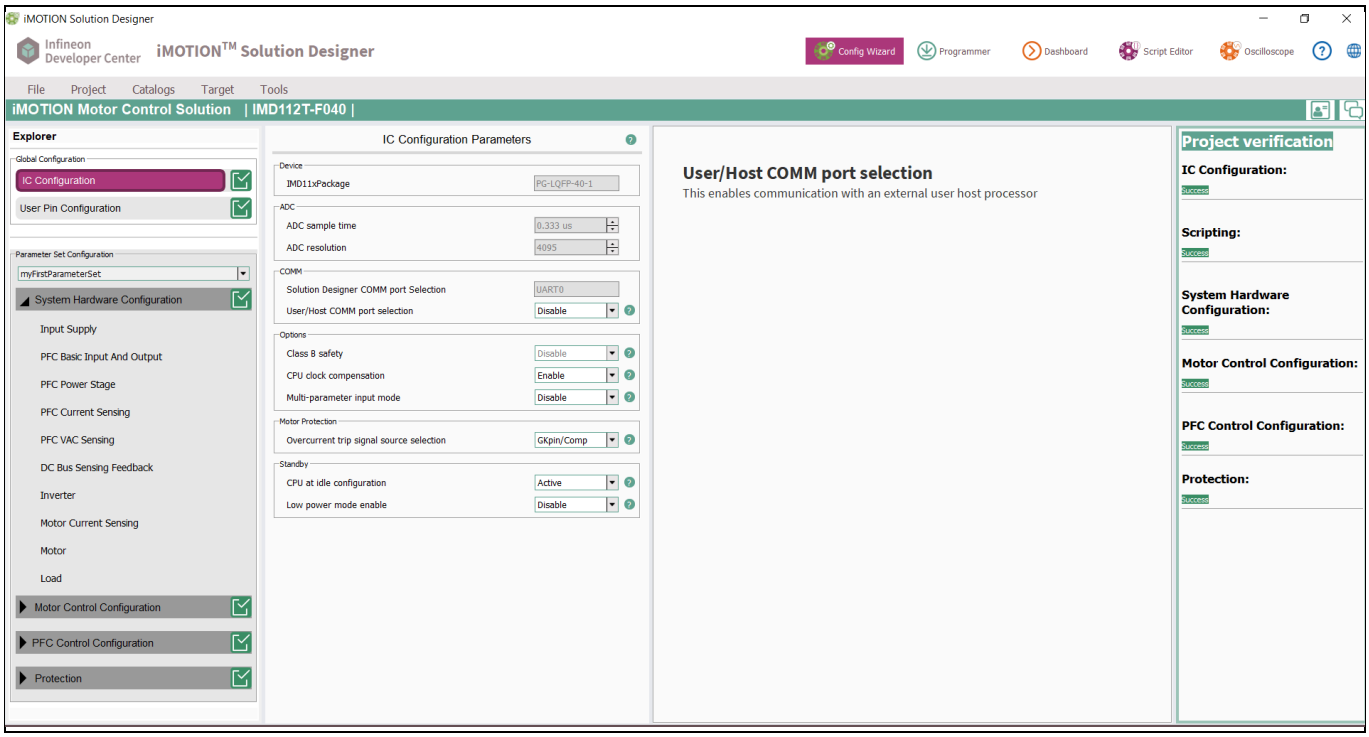

Figure 4 iSD Configuration page

Table 3 lists key parameters that need to be set in the configuration wizard to set up the system based on the evaluation board. The remaining group of parameters also need to be set by users in wizard of iSD, such as Overvoltage/Undervoltage protection, fault conditions, startup setting, and so on.

Please note that some values listed in Table 3 are based on the power board, EVAL-M7-HVIGBT-PFCINV4. These values should be changed if a different power board is used.

Table 3 Overview table for parameter configuration in the wizard

Parameter	Value	Comment
Motor control configuration	Fc < 20 kHz	Key parameter for selecting IC working status

Parameter	Value	Comment
User motor parameters	Depends on the motor under test	E.g., Rated current, poles, motor stator inductance (Ls), maximum RPM, etc.
DC bus sensing upper resistor	2040 kΩ on board	These resistors are on the power board
DC bus sensing lower resistor	13.3 kΩ on board	The resistor is on the power board
Motor feedback pull-up resistor	22.1 kΩ	Depends on the hardware design
Motor feedback pull-down resistor	2 kΩ	Depends on the hardware design
PFC overcurrent protection threshold	4.8 A	Can be changed by the selection of PFC reference upper/lower resistor
PFC current sensing gain	0.8490	Depends on the hardware design
PFC inductance	3.5 mH	Inductance at zero current
	1.8 mH	Inductance at rated current
PFC PWM frequency	Maximum 100 kHz	Depends on the power board selection
PFC current sense offset	752.9 mV	Depends on the hardware design

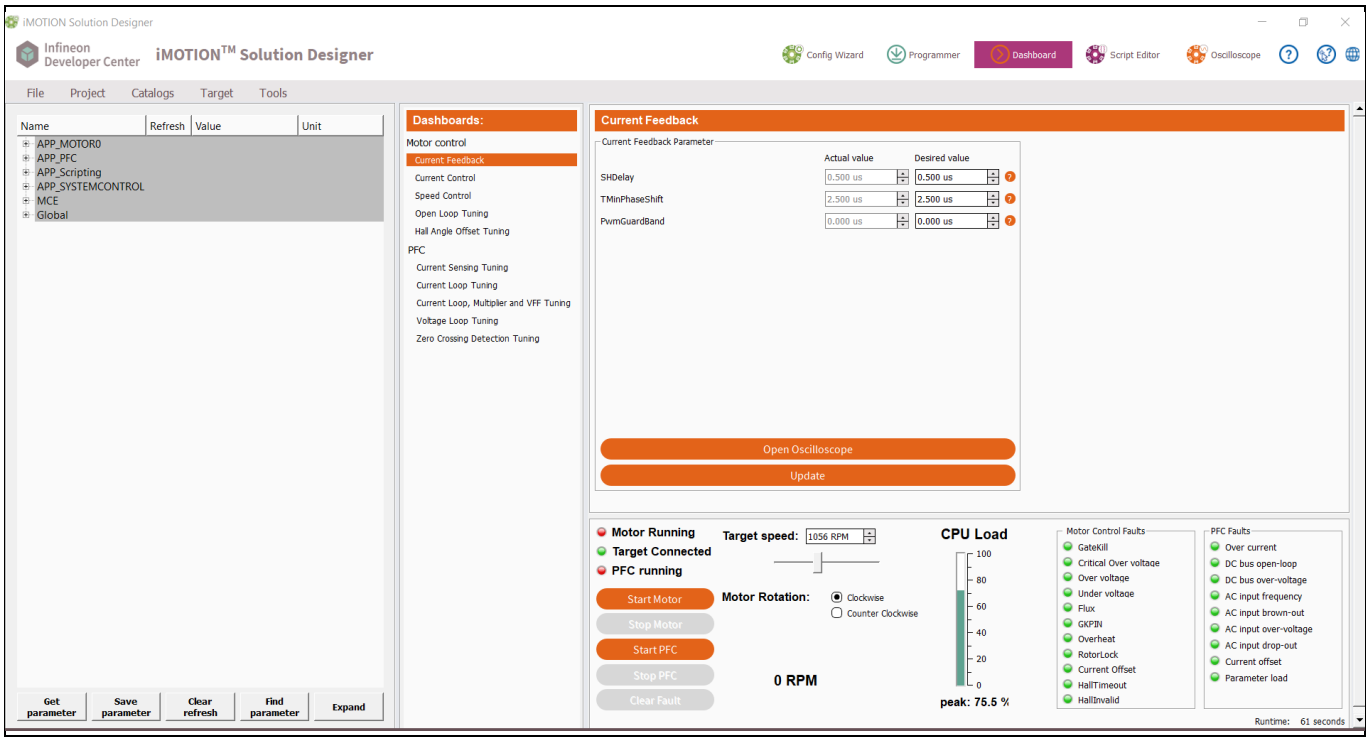

Figure 5 Dashboard page of iSD

After setting all the parameters, users need to program the parameters into IMD112T flash, and then move to the dashboard page (see Figure 5). On the dashboard page, users can start or stop the PFC/motor and test the board. Tuning the parameters for better performance can also be done through this page. Please refer to [2] for details.

2.2 Description of functional blocks

This section covers the hardware design of EVAL-M7-D112T in detail so that users can understand some key circuitry on this board. This will help them easily use the configuration wizard to calculate parameters and develop their solution based on the evaluation board's design.

2.2.1 EVAL-M7-D112T pinout assignment and functional groups

Figure 6 shows the pinout assignments and functional groups on the EVAL-M7-D112T evaluation board.

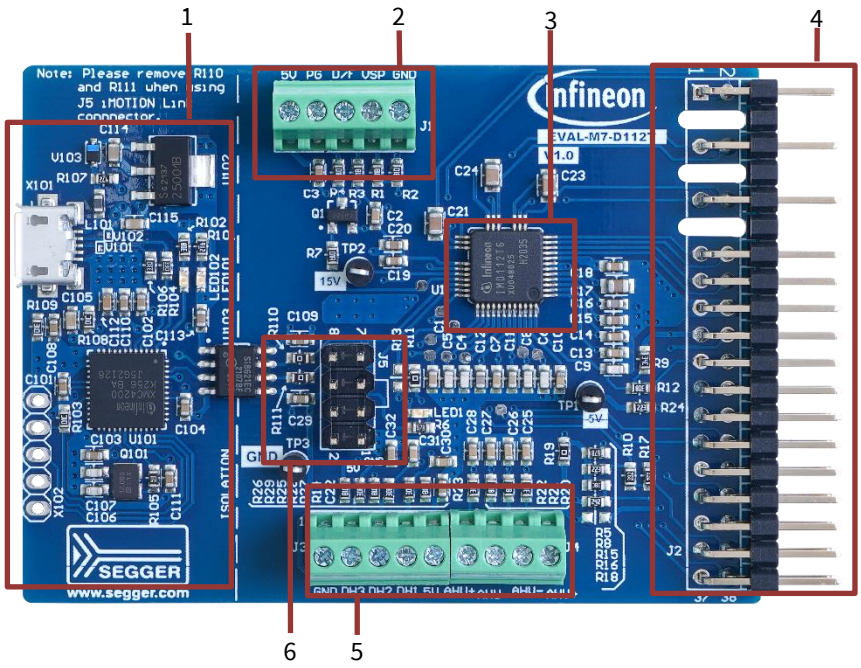

Figure 6 Pinout assignments and functional groups

1. Onboard debug
2. Variable speed control (VSP), duty/frequency, and pulse generator (PG) output
3. IMD112T
4. M7 connector
5. Digital (Hall)/analog position feedback inputs
6. iMOTION™ Link connector

There are several connectors on the EVAL-M7-D112T board. All the connectors' pin assignments are listed in Table 4~Table 8.

Table 4 Variable speed control connector–J1

Pin Number	Symbol	Assignment
1	GND	Signal return
2	VSP	Variable speed control input
3	D/F	Duty/frequency speed control input
4	PG	Speed feedback output
5	+5V	5 V power supply

Table 5 M7 connector–J2

Pin Number	Symbol	Assignment
1	GUH	U phase high-side gate PWM
2	VSV	U phase high-side floating return
3, 4, 7, 8, 11, 12	-	Not used
5	GVH	V phase high-side gate PWM
6	VSV	V phase high-side floating return
9	GWH	W phase high-side gate PWM
10	VSW	W phase high-side floating return
13	GUL	U phase low-side gate PWM
14	GVL	V phase low-side gate PWM
15	GWL	W phase low -side gate PWM
16	COM	Gate driver low-side return
17, 18, 32	GND	Ground
19	VDD	Internal LDO output
20	VDD1	External VDD supply voltage
21	IU+	U phase current sensing signal positive
22	IU-	U phase current sensing signal negative
23	IV+	V phase current sensing signal positive
24	IV-	V phase current sensing signal negative
25	IW+	W phase current sensing signal positive
26	IW-	W phase current sensing signal negative
27	VTH	NTC output voltage
28	VDC	Vbus voltage sensing
29	GK	Inverter gate kill signal
30	VCC	Gate driver supply voltage
31	PFCG0	PFC gate driving PWM 0
33	PFCG1	PFC gate driving PWM 1
34	PFCGK	PFC gate kill signal
35	IPFC+	PFC current sensing positive
36	IPFC-	PFC current sensing negative
37	VAC1	AC voltage sensing input 1

Pin Number	Symbol	Assignment
38	VAC2	AC voltage sensing input 2

Table 6 Digital hall feedback connector–J3

Pin Number	Symbol	Assignment
1	GND	Ground
2	DH3	Digital Hall sensor input 3
3	DH2	Digital Hall sensor input 2
4	DH1	Digital Hall sensor input 1
5	5V	5 V power supply

Table 7 Analog position feedback connector–J4

Pin Number	Symbol	Assignment
1	AHU+	Analog Hall element input 1 (+)
2	AHU-	Analog Hall element input 1 (-)
3	AHV-	Analog Hall element input 2 (-)
4	AHV+	Analog Hall element input 2 (+)

Table 8 iMOTION™ Link connector–J5

Pin Number	Symbol	Assignment
1~4	-	Not used
5	GND	Ground
6	VDD	5 V power supply
7	RXD0	Serial port 0, receive input
8	TXD0	Serial port 0, transmit output

2.2.2 Current feedback circuitry

2.2.2.1 Current sampling

For IMD112T, there are two types of current feedback circuitry — inverter current feedback and PFC current feedback. Inverter current feedback is designed as single-shunt configuration on the EVAL-M7-D112T board. To minimize external components, for this evaluation board, both the PFC and inverter sense the current via a passive gain/offset circuit directly without using an external active gain/offset stage. An external active gain/offset stage can improve sensitivity of current sensing.

For the inverter current feedback gain and offset, users only need to enter the passive gain/offset circuit resistor values in the iSD tool. The configuration wizard will calculate the gain and offset automatically. When the pull-up resistor is 22.1 kΩ, pull-down resistor is 2 kΩ, and the digital power supply is 5 V, the wizard gives the voltage offset as 414.95 mV and current gain as 68.78 mV/A.

Figure 7 shows the block diagram of the PFC current feedback gain and offset. These gain and offset values need to be calculated and entered into the Config MCEWizard of iSD. The PFC external passive gain can be calculated using the following equation:

$$G\_ext = \frac{R1}{R1 + R2}$$

Based on the PFC current feedback circuit of this evaluation board, if, for example, R1 is 22 kΩ and R2 is 3.9 kΩ, then the PFC gain will be 0.849.

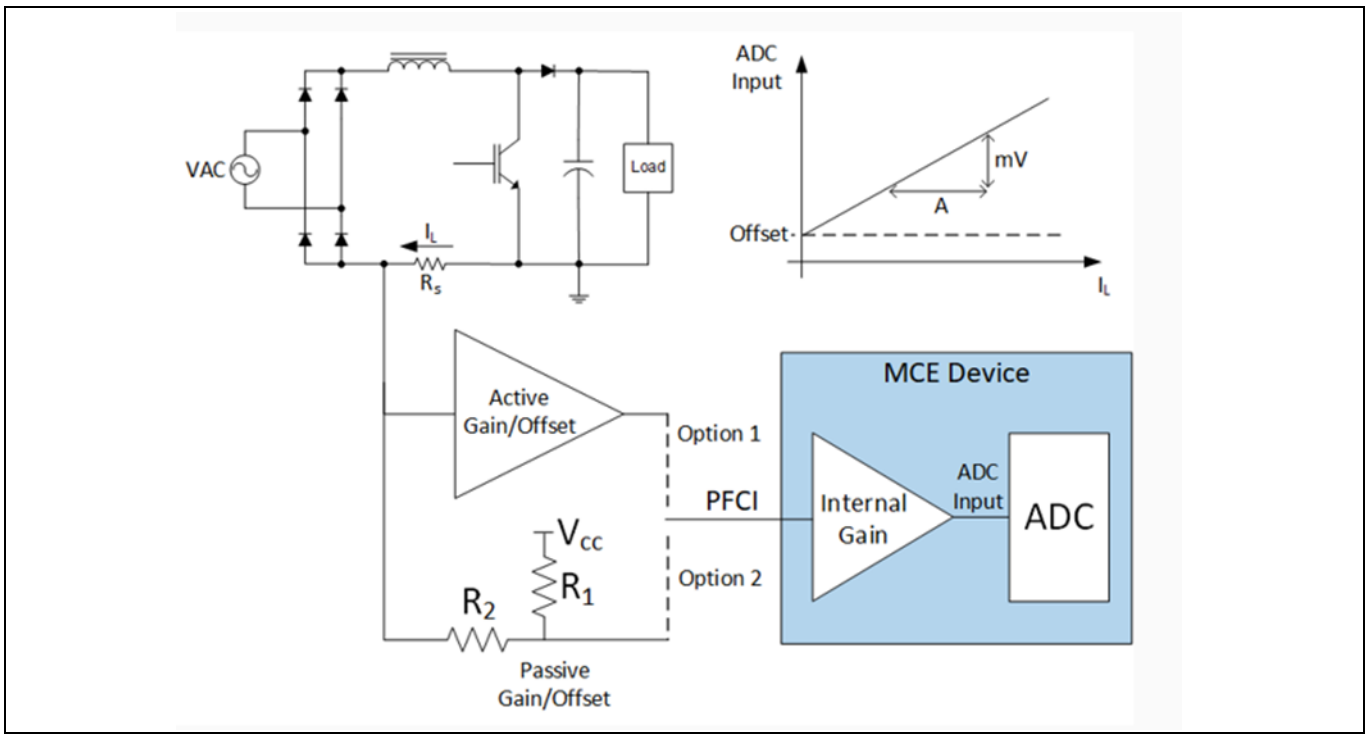

Figure 7 PFC current feedback gain and offset

2.2.2.2 PFC offset voltage calculation

From Figure 7, users can also estimate the offset voltage that needs to be entered into the wizard. This parameter is the voltage, in mV, at the current sense pin when the shunt current is zero. Using the evaluation board's design example where R1 is 22 kΩ and R2 is 3.9 kΩ, the offset voltage will be:

$$V_{off} = \frac{\mathrm{R2}}{\mathrm{R1} + \mathrm{R2}} \times V_{DD} = \frac{3.9}{22 + 3.9} \times 5 = 0.7529\,V = 752.9\,mV$$

Based on the current PFC external passive gain configuration, selecting the PFC internal gain as 6 in the iSD tool is recommended.

3 System design

3.1 Schematics

The schematics of IMD112T control board, EVAL-M7-D112, include digital Hall feedback inputs and analog position feedback input terminals. The onboard debug circuitry is placed on the control board and users can conveniently tune the board using a USB cable. The onboard debug circuitry has an isolation function between the computer's USB port and the IMD112T control board. An optional communication interface, iMOTION™ Link connector (J5) is also on the board. The two resistors, R110 and R111, should be removed when using the iMOTION™ Link debug tool.

IMD112T supports boost PFC topology. Figure 8 shows the boost PFC topology of the EVAL-M7-HVIGBT-PFCINV4 board.

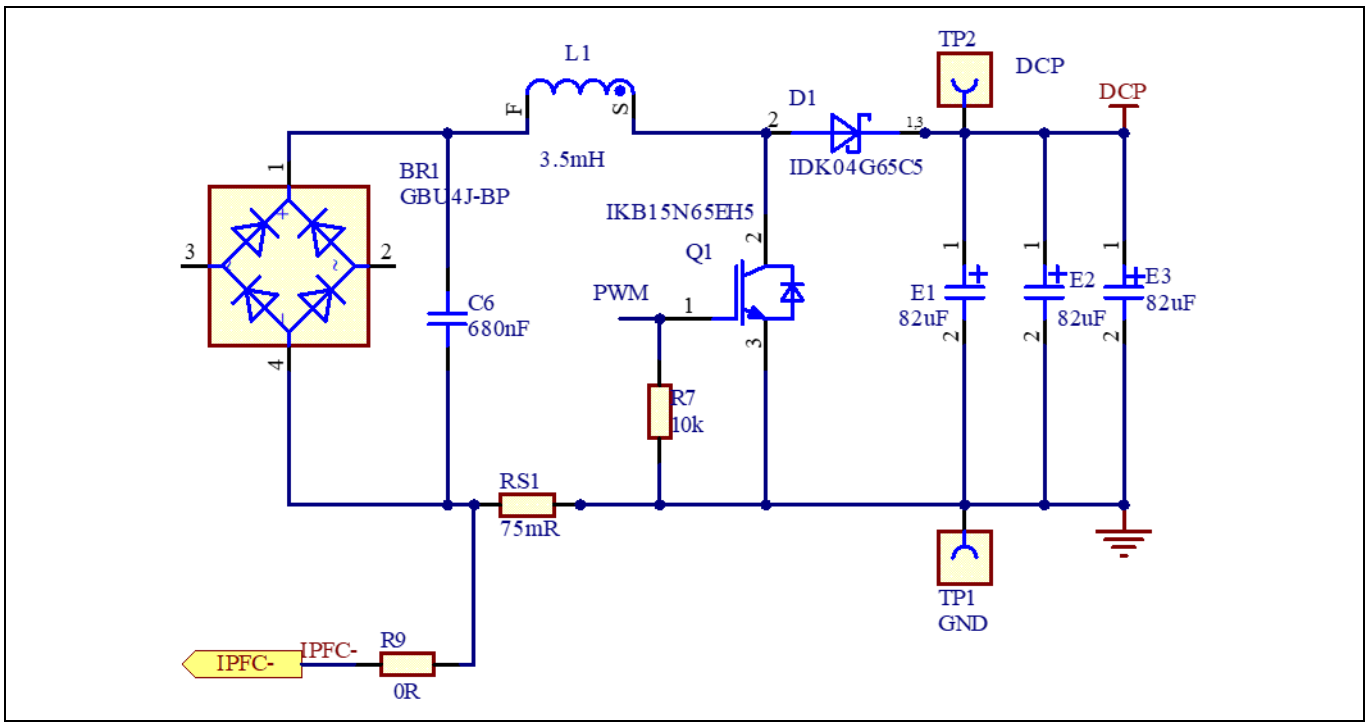

Figure 8 Boost PFC circuitry

Figure 9 shows the schematic of the smart driver, IMD112T. The complete schematics are available in the download section on the homepage of Infineon's website. Login credentials are required to download this material.

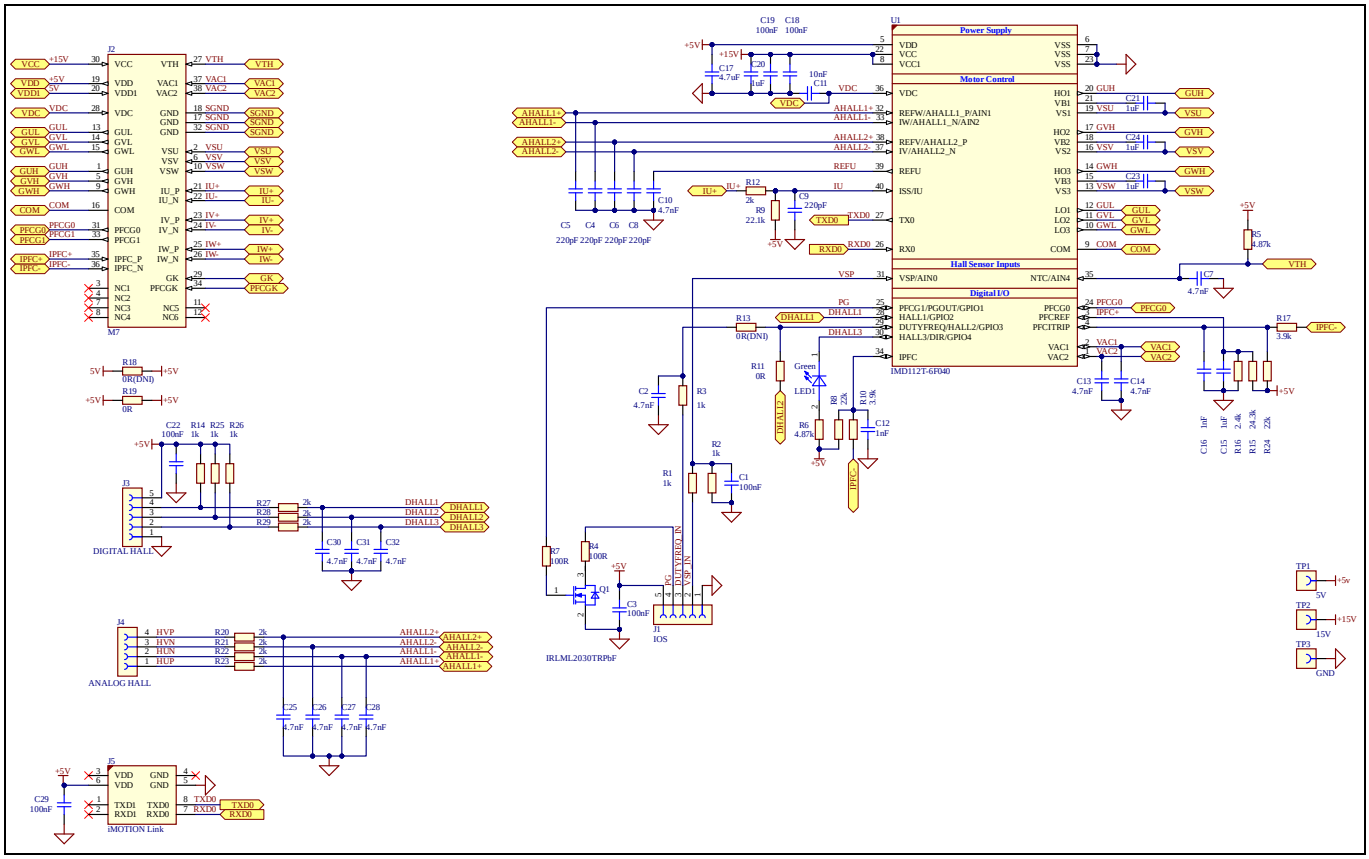

Figure 9 Schematics of IMD112T

3.2 Layout

The EVAL-M7-D112T board consists of two copper PCB layers. The copper thickness is 35 µm and the board's size is 70 mm x 51 mm. The board material is FR4 grade with 1.6 mm thickness. Check Infineon's website or contact Infineon's technical support team for detailed information. The Gerber files are available in the download section on the homepage of Infineon's website. Login credentials are required to download these files.

The layout of the top and bottom layers of the PCB are shown in Figure 10 and Figure 11. On the PCB layout, users should place the decoupling capacitors as close as possible to the input pins, especially for current feedback sensing and bus voltage sensing input decoupling capacitors.

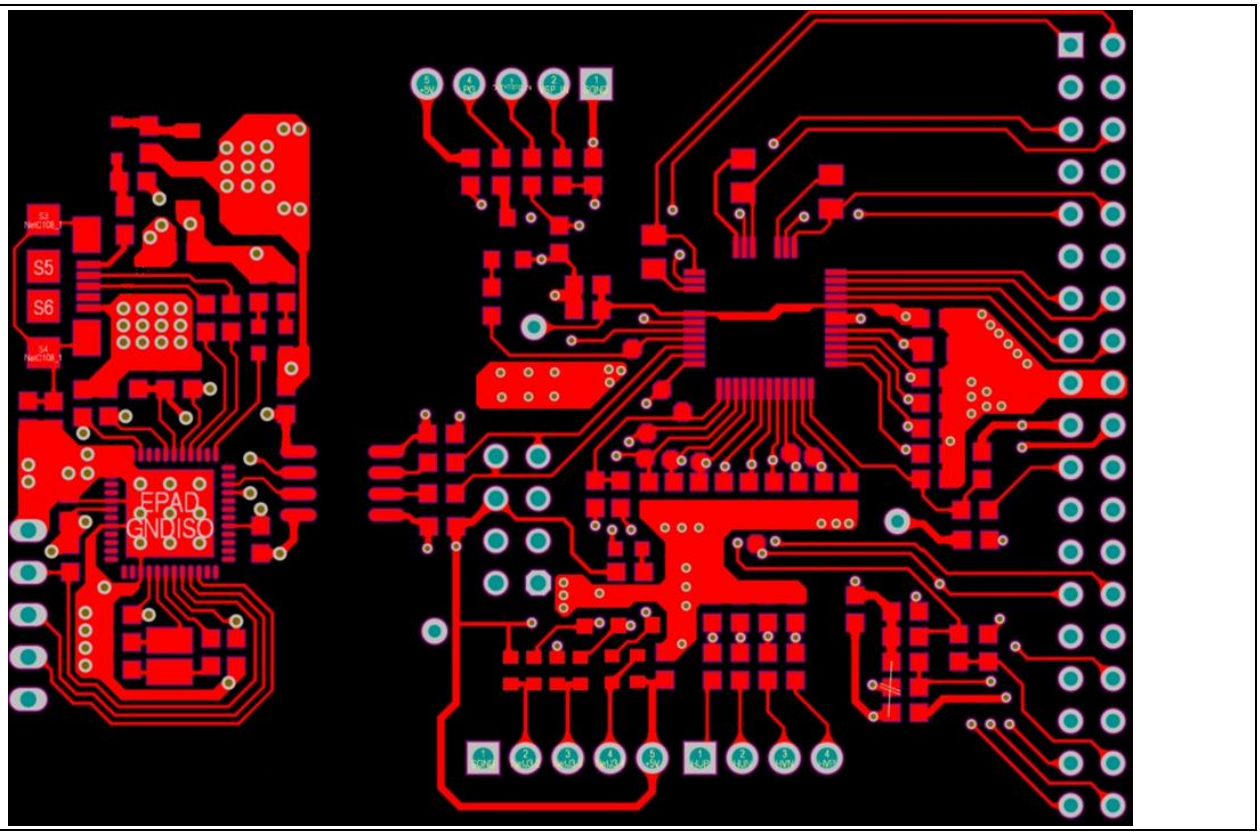

Figure 10 Top layer

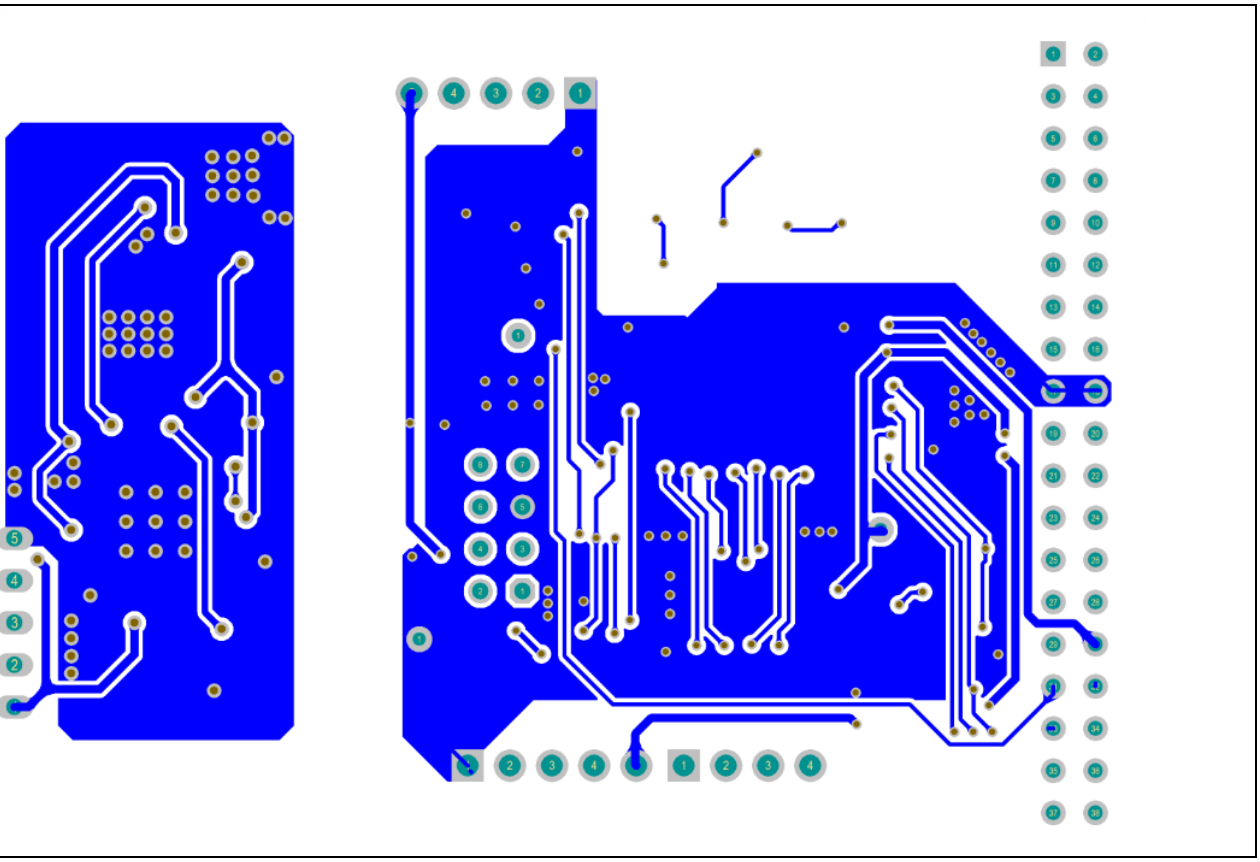

Figure 11 Bottom layer

3.3 Bill of material

The complete bill of material (BOM) is available in the download section on the homepage of Infineon's website. Login credentials are required to download this material. Table 9 lists the BOM of EVAL-M7-D112T.

Table 9 BOM of the most important/critical parts of the evaluation board

S. No.	Ref Designator	Description	Manufacturer	Manufacturer P/N
1	C1, C3, C18, C19, C22, C29, C101, C102, C103, C104, C108, C110, C111	CAP / CERA / 100 nF / 50 V / 5% / X7R (EIA) / -55℃ to 125℃ / 603 / SMD / -, CAP / - / 100 nF / 16 V / 5% / X7R (EIA) / - / 0603 / SMD	AVX	06035C104JAT2A
2	C2, C7, C10, C13, C14, C25, C26, C27, C28	CAP / CERA / 4.7 nF / 50 V / 5% / C0G (EIA) / NP0 / -55℃ to 125℃ / 0603(1608) / SMD / -, CAP / CERA / 4.7 nF / 25 V / 5% / X7R (EIA) / -55℃ to 125℃ / 0603(1608) / SMD	MuRata	GRM1885C1H472JA01
3	C4, C5, C6, C8, C9	CAP / CERA / 220 pF / 50 V / 2% / C0G (EIA) / NP0 / -55℃ to 125℃ / 0603(1608) / SMD / -	Kemet	C0603C221G5GAC
4	C11	CAP / CERA / 10 nF / 50 V / 10% / X5R (EIA) / -55℃ to 85℃ / 0603(1608) / SMD / -	MuRata	GRM188R61H103KA01
5	C12, C16	CAP / CERA / 1 nF / 50 V / 1% / C0G (EIA) / NP0 / -55℃ to 125℃ / 0603(1608) / SMD / -	Kemet	C0603C102F5GAC
6	C15, C20, C109, C113	CAP / CERA / 1 uF / 25 V / 10% / X5R (EIA) / -55℃ to 85℃ / 0603(1608) / SMD / -, CAP / CERA / 1 uF / 10 V / 10% / X5R (EIA) / -55℃ to 85℃ / 0603(1608) / SMD / -	MuRata	GRM188R61E105KAAD
7	C17	CAP / CERA / 4.7 uF / 25 V / 10% / X5R (EIA) / -55℃ to 85℃ / 0805(2012) / SMD / -	MuRata	GRM219R61E475KA73
8	C21, C23, C24	CAP / CERA / 1 uF / 50 V / 10% / X7R (EIA) / -55℃ to 125℃ / 0805 / SMD / -	TDK Corporation	CGA4J3X7R1H105K125AB
9	C30, C31, C32	CAP / CERA / 4.7 nF / 25 V / 1% / C0G (EIA) / NP0 / -55℃ to 125℃ / 0603 / SMD / -	Kemet	C0603C472F3GAC
10	C105, C114, C115	CAP / CERA / 10 uF / 10 V / 20% / X7T (EIA) / -55℃ to 125℃ / 0603(1608) / SMD / -	MuRata	GRM188D71A106MA73D

S. No.	Ref Designator	Description	Manufacturer	Manufacturer P/N
11	C106, C107	CAP / CERA / 15 pF / 10 V / 5% / C0G (EIA) / NP0 / -55℃ to 125℃ / 0603(1608) / SMD / -	Wurth Elektronik	885012006003’
12	C112	CAP / CERA / 4.7 uF / 10 V / 10% / X5R (EIA) / -55℃ to 85℃ / 0603(1608) / SMD / -	MuRata	GRM188R61A475KAAJ
13	J1	Terminal Block 5-Pin	Wurth Elektronik	691210910005‘
14	J2	The part can be named as M7-38-M, connector, 38-pins, 2.54 mm pitch, Board-to-board, Male, Right angle	Molex	879113811
15	J3	Terminal block 5-Pin	Wurth Elektronik	691210910005’
16	J4	Terminal block 4-Pin	Wurth Elektronik	691210910004‘
17	J5	Connector, 2.54 mm pitch, 8-pins, board-to-board, through hole	Wurth Elektronik	61300821121
18	L101	IND / FERR / 60 R / 500 mA / - / -55℃ to 125℃ / 100 mR / 0603(1608) / Inductor, Chip: 1.60 mm L X 0.80 mm W X 0.95 mm H / SMD / -	MuRata	BLM18PG600SN1
19	LED1	Surface mount LED, Green, 570 nm	OSRAM Opto Semiconductors	LG Q971-KN-1
20	LED101	WL-SMCW SMT Mono-color Chip LED Waterclear, Green, 515 nm	Wurth Elektronik	150060GS75000
21	LED102	WL-SMCW SMT Mono-color Chip LED Waterclear, Blue, 465 nm	Wurth Elektronik	150060BS75000
22	Q1	HEXFET Power MOSFET VDS 30 V	Infineon Technologies	IRLML2030TRPbF
23	Q101	Surface-mount compact crystal unit suitable for automotive	Nihon Dempa Kogyo	NX3225GA-12.000M-STD-CRG-2
24	R1, R2, R3	RES / STD / 1 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW06031K00FK
25	R4, R7	RES / STD / 100 R / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Yageo	RC0603FR-07100RL
26	R5, R6	RES / STD / 4.87 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW06034K87FK
27	R8, R24	RES / STD / 22 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603(1608) / SMD / -	Vishay	CRCW060322K0FK

S. No.	Ref Designator	Description	Manufacturer	Manufacturer P/N
28	R9	RES / STD / 22.1 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW060322K1FK
29	R10, R17	RES / STD / 3.9 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603(1608) / SMD / -	Vishay	CRCW06033K90FK
30	R18	RES / STD / 0R / 100 mW / 0 R / 0 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Yageo	RC0603JR-070RL
31	R11, R19	RES / STD / 0 R / 100 mW / 0 R / 0 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Yageo	RC0603JR-070RL
32	R12, R20, R21, R22, R23	RES / STD / 2 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW06032K00FK
33	R13	RES / STD / 0 R / 100 mW / 0 R / 0 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Yageo	RC0603JR-070RL
34	R14, R25, R26	RES / STD / 1 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Yageo	RC0603FR-071KL
35	R15	RES / STD / 24.3 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW060324K3FK
36	R16	RES / STD / 2.4- k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603(1608) / SMD / -	Vishay	CRCW06032K40FK
37	R105	RES / STD / 510 R / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603(1608) / SMD / -, RES / STD / 510 R / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW0603510RFK
38	R27, R28, R29, R102	RES / STD / 2 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 603 / SMD / -	Yageo	AC0603FR-072KL
39	R101	RES / STD / 9.1 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW06039K10FK
40	R103, R108	RES / STD / 10 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW060310K0FK

S. No.	Ref Designator	Description	Manufacturer	Manufacturer P/N
41	R104, R106	RES / STD / 33 R / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW060333R0FK
42	R107	RES / STD / 4.7 k / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Yageo	RC0603FR-074K7L
43	R109	RES / STD / 1 MEG / 100 mW / 1% / 100 ppm/K / -55℃ to 155℃ / 0603 / SMD / -	Yageo	RC0603FR-071ML
44	R110, R111	RES / STD / 0 R / - / 0 R / - / -55℃ to 155℃ / 0603 / SMD / -	Vishay	CRCW06030000Z0
45	TP1, TP2, TP3	Test point THT, Black	Keystone	5001
46	U1	Motor controller with integrated high-voltage gate driver, Integrated script engine for application control customization	Infineon Technologies	IMD112T-6F040
47	U101	80 MHz XMC4200 MCU with 256 KB program memory, 40 kB SRAM, 3.3 V, -40° to 85°C, PG-VQFN-48, Green	Infineon Technologies	XMC4200-Q48F256 BA
48	U102	Low dropout voltage regulator, 3.3 V Output	Infineon Technologies	IFX25001ME V33
49	U103	Low power, dual-channel digital isolator	Silicon Labs	SI8621EC-B-IS
50	V101, V102	Bi-directional, TVS protection device, 8 V, 7 pF	Infineon Technologies	ESD237-B1-W0201
51	V103	Medium power AF Schottky diode	Infineon Technologies	BAS3010A-03W
52	X101	Micro-USB 2.0 standard, Type AB, Bottom mount, Shell SMT	Hirose Connectors	ZX62-AB-5PA (31)

4 System performance

4.1 Test results

The IMD112T control board EVAL-M7-D112T was tested with EVAL-M7-HVIGBT-PFCINV4 and EVAL-M7-HVIGBT-PFCINV1 power boards. The two power boards have different PFC frequencies — 40 kHz and 100 kHz. The inverter was tested at 6 kHz, 10 kHz, and 15 kHz carrier frequency. The two power boards can support up to 200 W output power with natural cooling and 400 W output power with forced cooling (using a 24 VDC/0.18 A cooling fan). Of course, the EVAL-M7-D112T can drive higher power output when matched with an M7 connector-compatible power board with larger rating.

For test results and more details, please refer to the power board's user guide, UG-2023-05 [3].

5 Appendices

5.1 Abbreviations and definitions

Table 10 Abbreviations

Abbreviation	Meaning
THD	Total harmonic distortion
EMI	Electromagnetic interference
PFC	Power factor correction
PF	Power factor
iSD	iMOTION™ Solution Designer
FOC	Field oriented control
PMSM	Permanent magnet synchronous motor
BLDC	Brushless direct current motor

References

[1] Infineon Technologies AG: Datasheet (2020): iMOTION™ IMD111T/IMD112T - Smart driver for motor control. V1.0, www.infineon.com

[2] Infineon Technologies AG. User manual (2022): Getting Started with iMOTION™ Solution Designer. www.infineon.com

[3] Infineon Technologies AG. User guide (2023): EVAL-M7-HVIGBT-PFCINV user guide. www.infineon.com

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