

EVAL-M1-183M User Manual

iMOTION™ Modular Application Design Kit

About this document

Scope and purpose

This application note provides an overview of the evaluation board Eval-M1-183M including its main features, key data, pin assignments, mechanical dimensions and its application.

Eval-M1-183M is an evaluation-board as part of the iMOTION™ Modular Application Design Kit (MADK). This board features and demonstrates Infineon's advanced Motion Control Engine (MCE) for permanent magnet motors drive over the full speed range.

The evaluation board Eval-M1-183M was developed to support customers during their first steps designing applications with running any permanent magnet motor via sensorless sinusoidal control.

Intended audience

This application note is intended for all technical specialists working for motor control with the Eval-M1-183M board under laboratory conditions.

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Safety precautions

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**

	<p>Attention: <i>The ground potential of the EVAL-M1-183M 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 equipment damage or personal injury or death.</i></p>
	<p>Attention: <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>Attention: <i>The surfaces of the drive may become hot, which may cause injury.</i></p>
	<p>Attention: <i>EVAL-M1-183M 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.</i></p>
	<p>Attention: <i>A control board, 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 DC supply or excessive ambient temperatures may result in system malfunction.</i></p>
	<p>Attention: <i>Remove or connect this 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>Attention: <i>EVAL-M1-183M 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.</i></p>

Introduction

2 Introduction

The Eval-M1-183M evaluation board is a part of the iMOTION™ **Modular Application Design Kit** for drives (iMOTION™ MADK). In order to run a motor, the mating power board is required to interface this evaluation board.

The MADK platform is intended to use various power stages with different control boards. These boards can easily be interfaced through the 20 pins iMOTION™ MADK-M1 or the 30 pins iMOTION™ MADK-M3 interface connector. This board is equipped with 20 pins connector.

This evaluation board is designed to give comprehensible solutions of sensorless control of permanent magnet motors over the full speed range. It consists of IRMCF183M Motor Control IC capable of 3-phase and three types of 2-phase modulation, JTAG and UART interface which are isolated via opto-isolation box (MCETOOLV2), and needs a single 3.3V supply. Required isolation box MCETOOLV2 is not part of the EVAL-M1-183M kit and needs to be ordered separately. For details of isolation box please refer to its Application Note. Figure 1 shows the evaluation board Eval-M1-183M. This document explains the features and details of this board as well as IRMCF183 control IC.

The Eval-M1-183M evaluation board is available from Infineon its distribution partners. 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-M1-183M. 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.

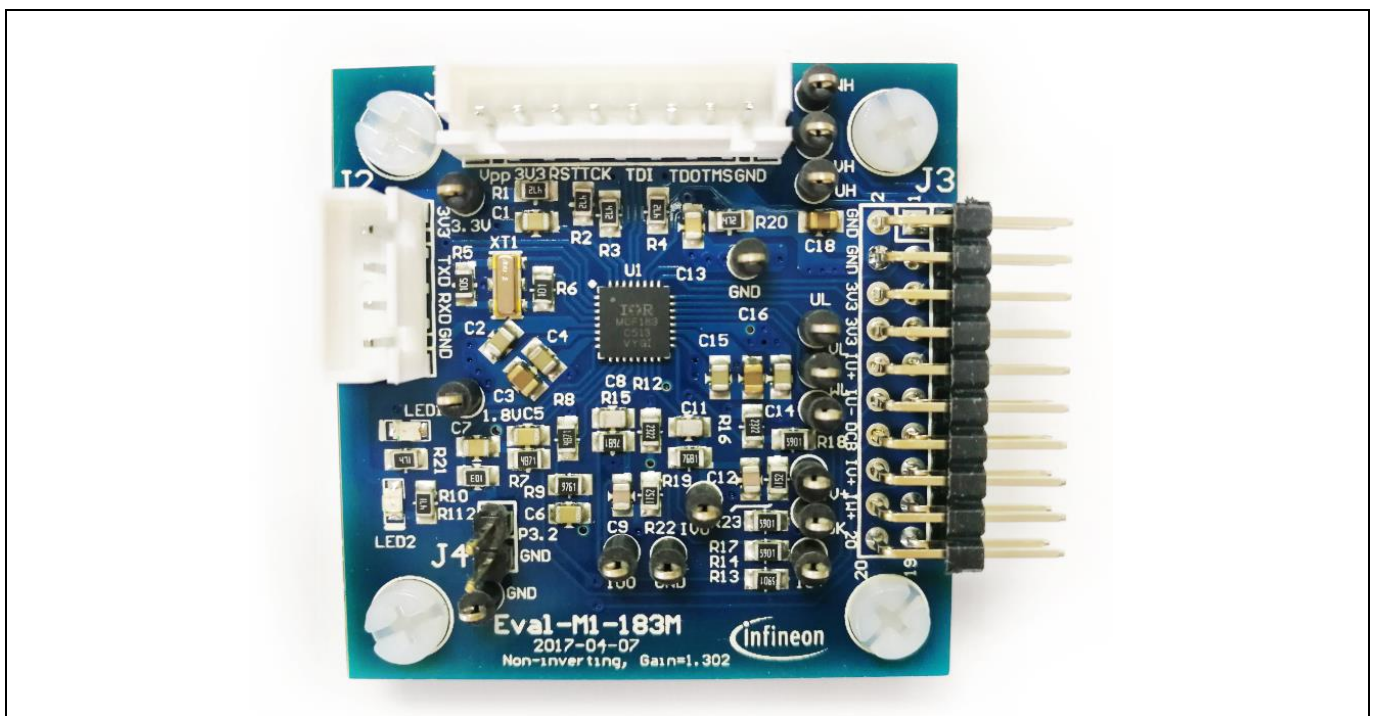


Figure 1 Evaluation board Eval-M1-183M

Main features

3 Main features

Eval-M1-183M is a control evaluation board for motor control application. The kit demonstrates Infineon's motion control IC technology.

Main features of Motion Control IC are:

- MCE™ (Flexible Motion Control Engine) - Dedicated computation engine for high efficiency sinusoidal sensorless motor control
- Built-in hardware peripheral for single shunt or leg shunt current feedback reconstruction and analog circuits
- Embedded 8-bit high speed microcontroller (8051) for flexible I/O and man-machine control
- JTAG programming port for emulation/debugger
- Serial communication interface (UART)
- Watchdog timer with independent internal clock
- Internal 64Kbyte Flash
- 3.3V single supply

The evaluation board characteristics are:

- Complete kit for running any permanent magnet motor via sensorless sinusoidal control
- 3.3V single power supply
- JTAG and UART interface, isolated via opto-isolation box
- 20 pins connector
- RoHS complaint
- PCB is 45x 45 mm and has two layers with 35 µm copper each

Main features

3.1 Key data

Figure 2 provides a typical application Block Diagram using the Eval-M1-183M in which IRMCF183M controller is used. The IRMCF183M provides a built-in closed loop sensorless control algorithm using the unique flexible Motion Control Engine (MCE™) for permanent magnet motors as well as induction motors. The MCE™ consists of a collection of control elements, motion peripherals, a dedicated motion control sequencer and dual port RAM to map internal signal nodes. IRMCF183M also employs a unique single shunt current reconstruction circuit in addition to two leg shunt current sensing circuit to eliminate additional analog/digital circuitry and enables a direct shunt resistor interface to the IC. Motion control programming is achieved using a dedicated graphical compiler integrated into the MATLAB/Simulink™ development environment. Sequencing, user interface, host communication, and upper layer control tasks can be implemented in the 8051 high-speed 8-bit microcontroller. The 8051 microcontroller is equipped with a JTAG port to facilitate emulation and debugging tools.

IRMCF183M is available in a 32-pin QFN package.

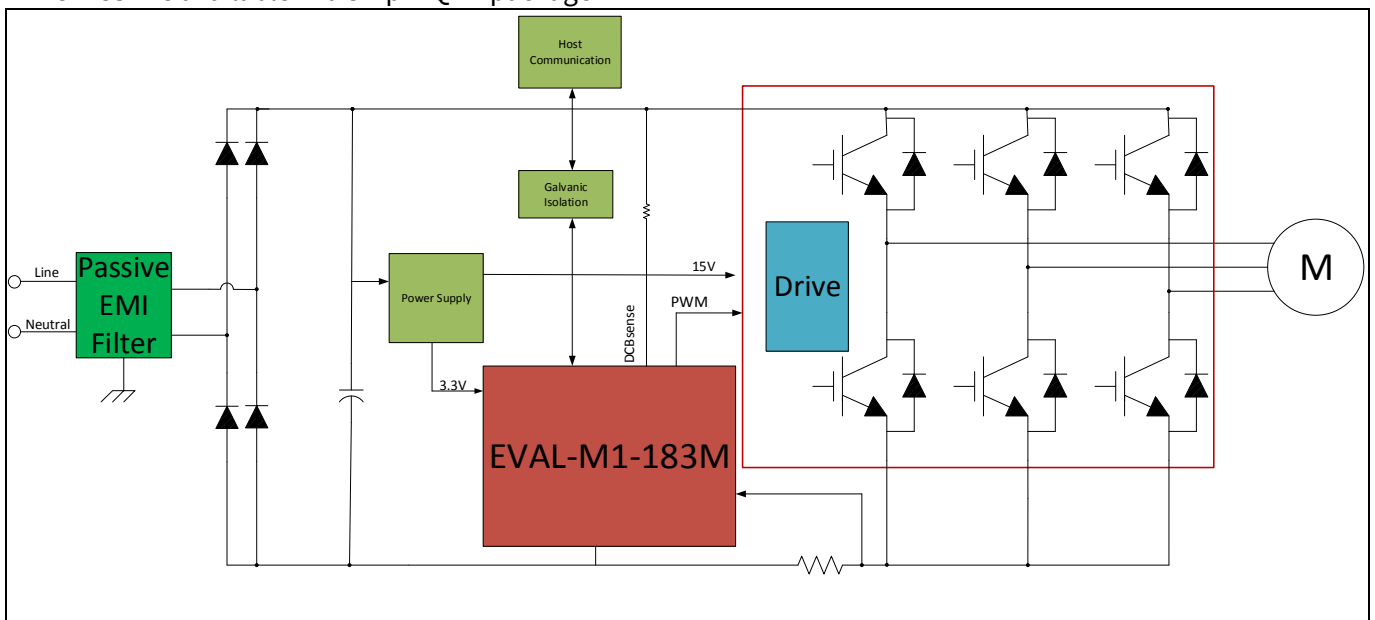


Figure 2 Typical Application Block Diagram Using Eval-M1-183M

Main features

Table 2 depicts the important specifications of the evaluation board Eval-M1-183M.

Table 2 Eval-M1-183M board specifications

Parameters	Values	Conditions / comments
Host Interface (Non isolation)		
UART(TXD RXD)	3.3V	Typical 5.76 kbps. single ended
TMS TDI TCK TDO	3.3V	Interface with FS2 or MCETOOL V2
8 Bit 2 Channel	0-3.3V output	GPIO Configurable to DAC
12 Bit	0-1.2V	
Input		
Voltage	3.3V	Power supply
DC Bus		
DC Bus Scaling	8.29 counts/v	Power board has 2MΩ resistor
DC Bus sensing range	494.0V max	
Current feedback		
Current sensing device	Single shunt resistor or Leg shunt resistor	Single shunt resistor Leg shunt resistor
Current Op-amp Configuration	Non-Inverting	
Current Op-amp Gain	1.302	
Resolution	12-bit	Power board may reduce the resolution
Latency	1 pwm cycle	
Protections		
Internal current trip level	1.2V Average	
On board power supply		
1.8V	1.8V+/-5%	From IC for ADC reference
PCB characteristics		
Material	FR4, 1.6MM thickness Copper thickness = 1oz (35um)	
Dimension	45mmx45mm	
System environment		
Ambient temperature	0-70°C	95%RH Max (Non-Condensing)

Main features

3.2 IRMCF183 installer

In order to run this evaluation board, the user has to download iMOTION™ installer from Infineon iMOTION™ Web, it contains information about all the iMOTION™ control IC including IRMCF183M development software at Infineon web.

<http://www.infineon.com/imotion-software> - for 100 series installer software and demo project downloading, please select “Software & Tools” on right column. And all the updated version software is there.

Figure 3 hints out the functional groups of the Eval-M1-183M evaluation board.

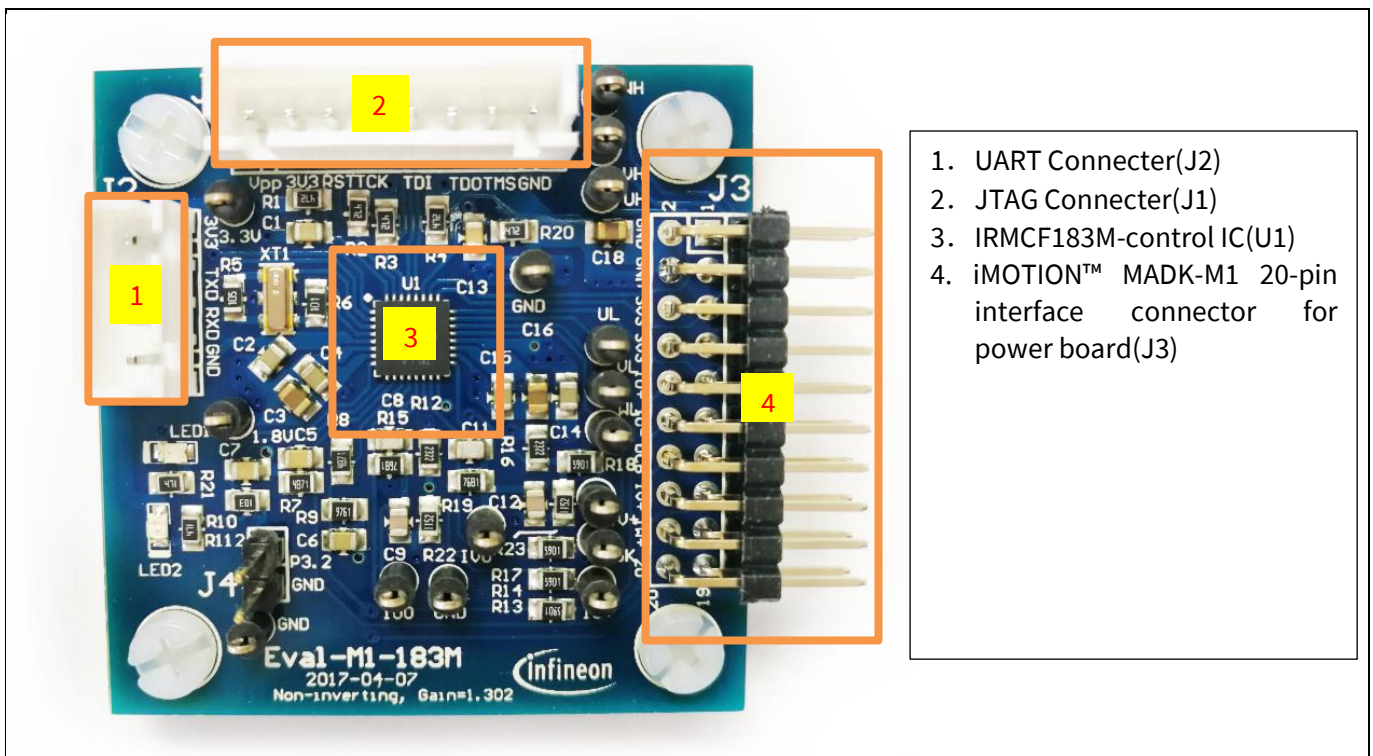


Figure 3 Top side of functional groups of the Eval-M1-183M evaluation board

Pin assignments

4 Pin assignments

General information about the connectors of the Eval-M1-183M evaluation board is reported.

Table 3 and Table 4 include the details of JTAG and UART connectors.

Table 3 J2- UART Connector

S. No.	Pin	Details
1	GND	Ground
2	RXD	Input, Receive data to IRMCF183M, can be configured to GPIO pins
3	TXD	Output, Transmit data from IRMCF183M, can be configured to GPIO pins
4	+3.3V	On board 3.3V supply

Table 4 J1-JTAG Connector

S. No.	Pin	Details
1	GND	Ground
2	TMS	TMS (test mode)
3	TDO	TDO (data output)
4	TDI	TDI (data input)
5	TCK	TCK (clock)
6	RST	IRMCF183M Reset
7	+3.3V	3.3V power supply(see Specification for max current)
8	VPP	Not Connected

Table 5 provides the pin assignments of the iMOTION™ MADK-M1 20 pins interface connector J3. This connector is the interface to the power board.

Table 5 J3- iMOTION™ MADK-M1 20-pin interface connector for power board

Pin	Name	Pin Name Connectors
1	PWMUH	3.3 V compatible logic output for high side gate driver-Phase U
2	GND	Ground
3	PWMUL	3.3 V compatible logic output for low side gate driver-Phase U
4	GND	Ground
5	PWMVH	3.3 V compatible logic output for high side gate driver-Phase V
6	+3.3V	3.3 V supply input
7	PWMVL	3.3 V compatible logic output for low side gate driver-Phase V
8	+3.3V	3.3 V supply input
9	PWMWH	3.3 V compatible logic output for high side gate driver-Phase W
10	IU+	Positive shunt voltage of phase U
11	PWMWL	3.3 V compatible logic output for low side gate driver-Phase W
12	IU-	Negative Shunt voltage of phase U or Ground if using single end current feedback
13	GK	Gate kill signal – active low when over current is detected

Pin assignments

Pin	Name	Pin Name Connectors
14	DCBSENSE	DC bus positive voltage, scaled in 0-3.3 V range by a voltage divider
15	VTH	Thermistor input
16	IV+	Positive shunt voltage of phase V
17	IV-	Negative Shunt voltage of phase V or Ground if using single end current feedback
18	IW+	Positive shunt voltage of phase W
19	IW-	Negative Shunt voltage of phase W or Ground if using single end current feedback
20	VCC	Not used

5 Schematics and Layout

To meet individual customer requirements and make the Eval-M1-183M evaluation board a basis for development or modification, all necessary technical data like schematics, layout and components are included in this chapter.

5.1 IRMCF183M Schematic Overview

Figure 4 shows the schematic of Eval-M1-183M evaluation board with IRMCF183M controller.

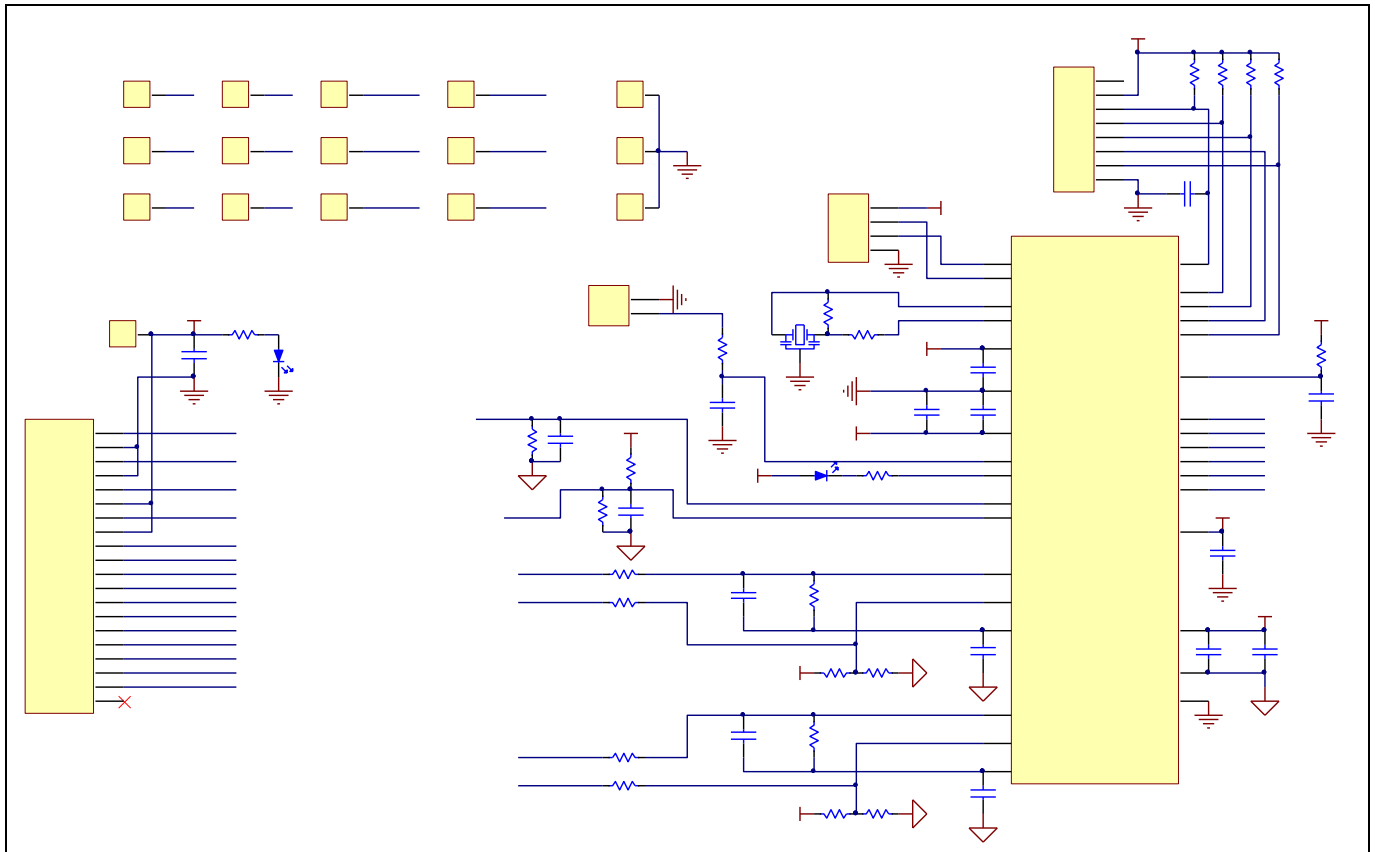


Figure 4 The schematics for the Eval-M1-183M evaluation board

5.2 Current feedback

Figure 5 depicts the Eval-M1-183M evaluation board is suitable for single shunt and leg shunt for current feedback.

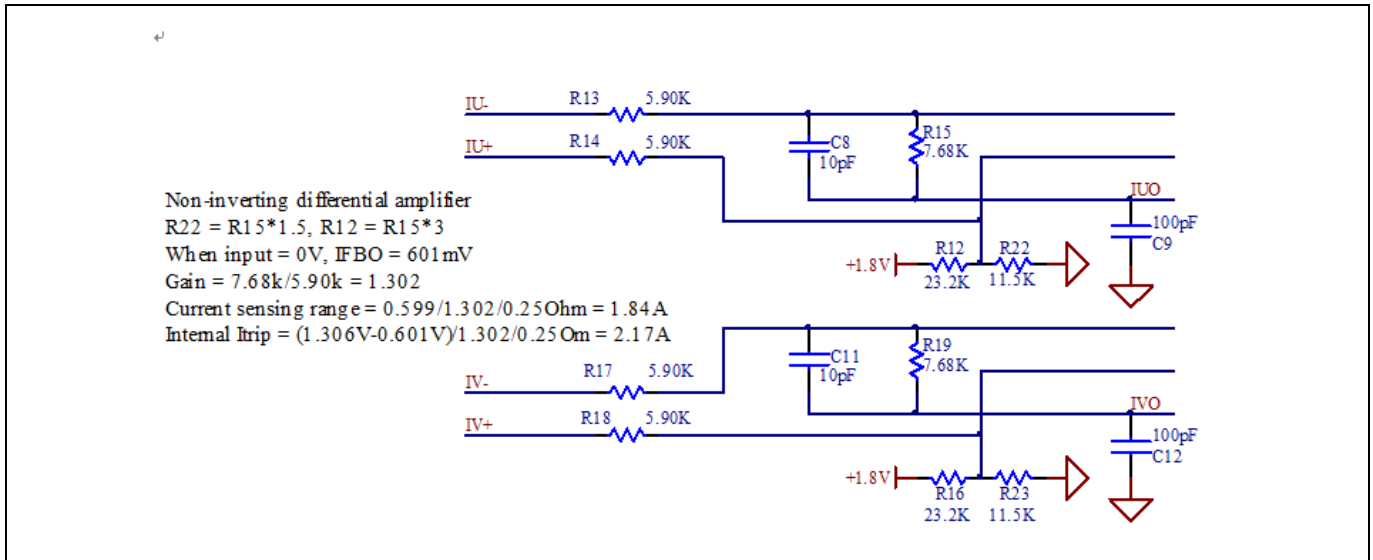


Figure 5 The part of Current feedback on the Eval-M1-183M evaluation board

5.3 AD port Input

Figure 6 depicts AD input for IRMCF183M. Temperature input should fit to the design recommendation in the IRMCF183M application note.

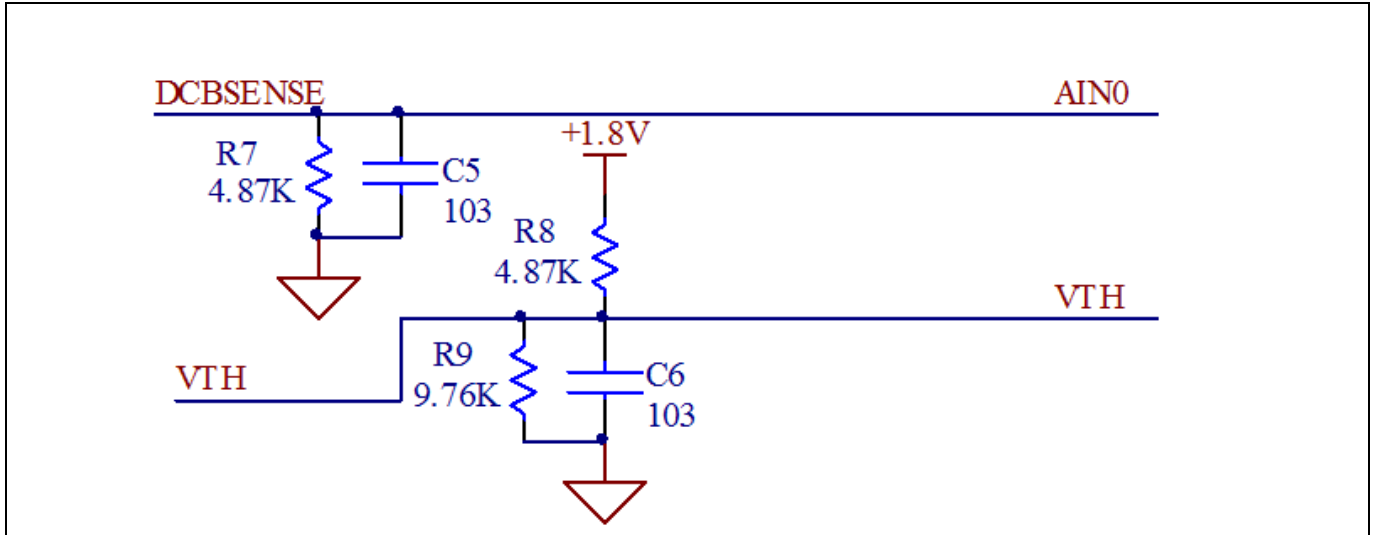


Figure 6 AD input on the Eval-M1-183M evaluation board

5.4 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 45 mm × 45 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 7 illustrates the top assembly print of the Eval-M1-183M evaluation board.

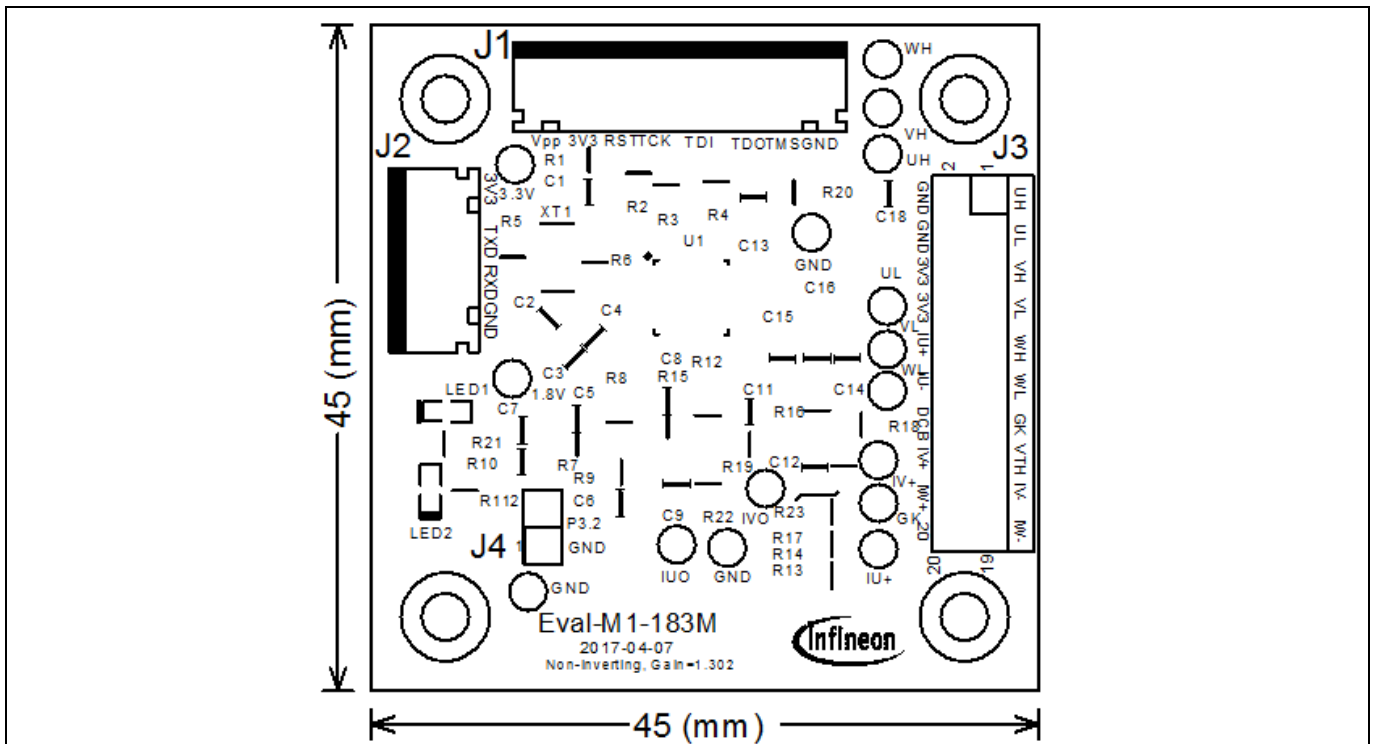


Figure 7 Top overlay print of the Eval-M1-183M evaluation board

Figure 8 depicts the bottom assembly print of the evaluation board.

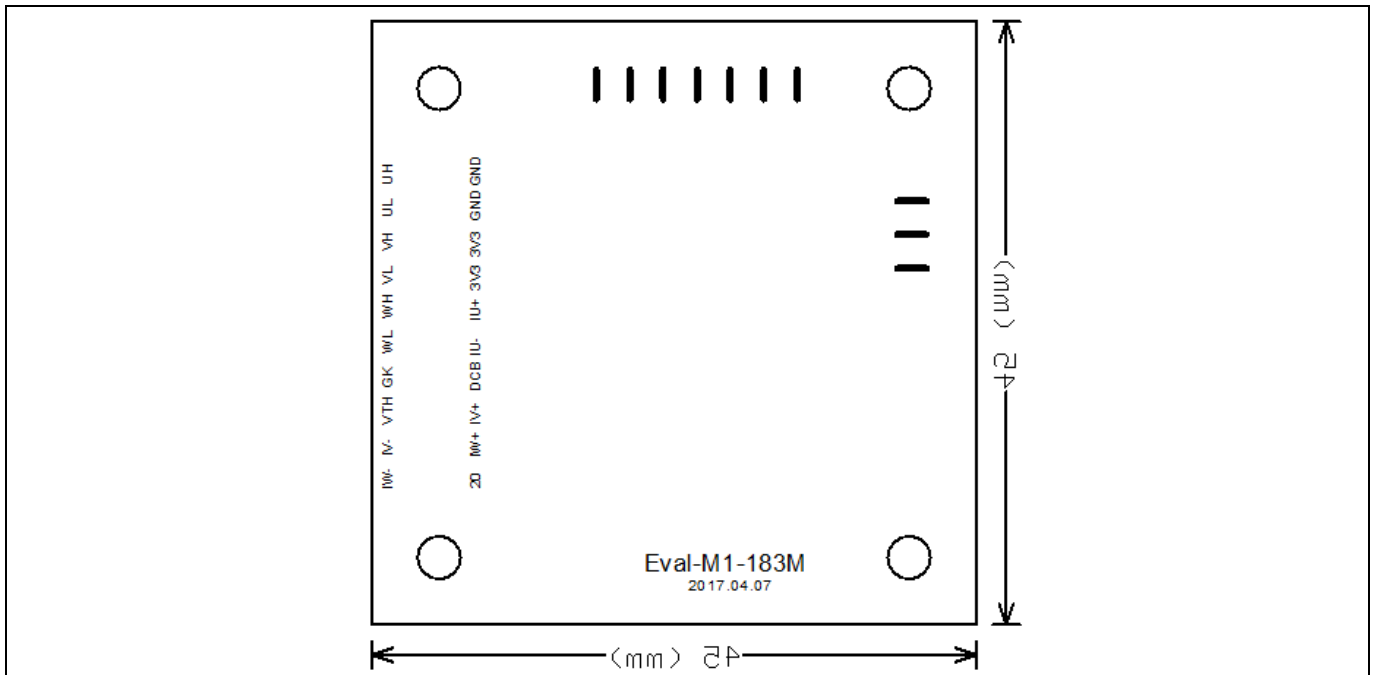


Figure 8 Bottom overlay print of the Eval-M1-183M evaluation board

The top layer routing of the PCB is provided in the following Figure 9.

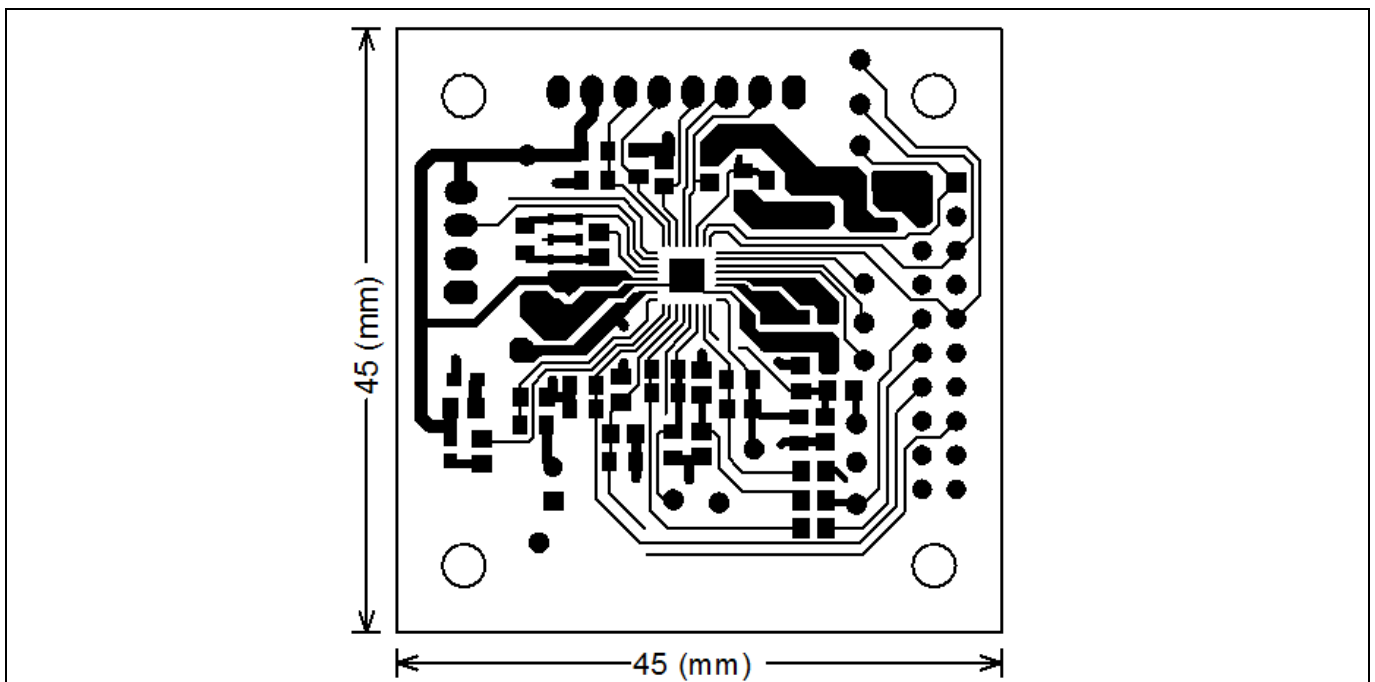


Figure 9 Top layer routing of the Eval-M1-183M

Figure 10 illustrates the bottom layer routing of the PCB.

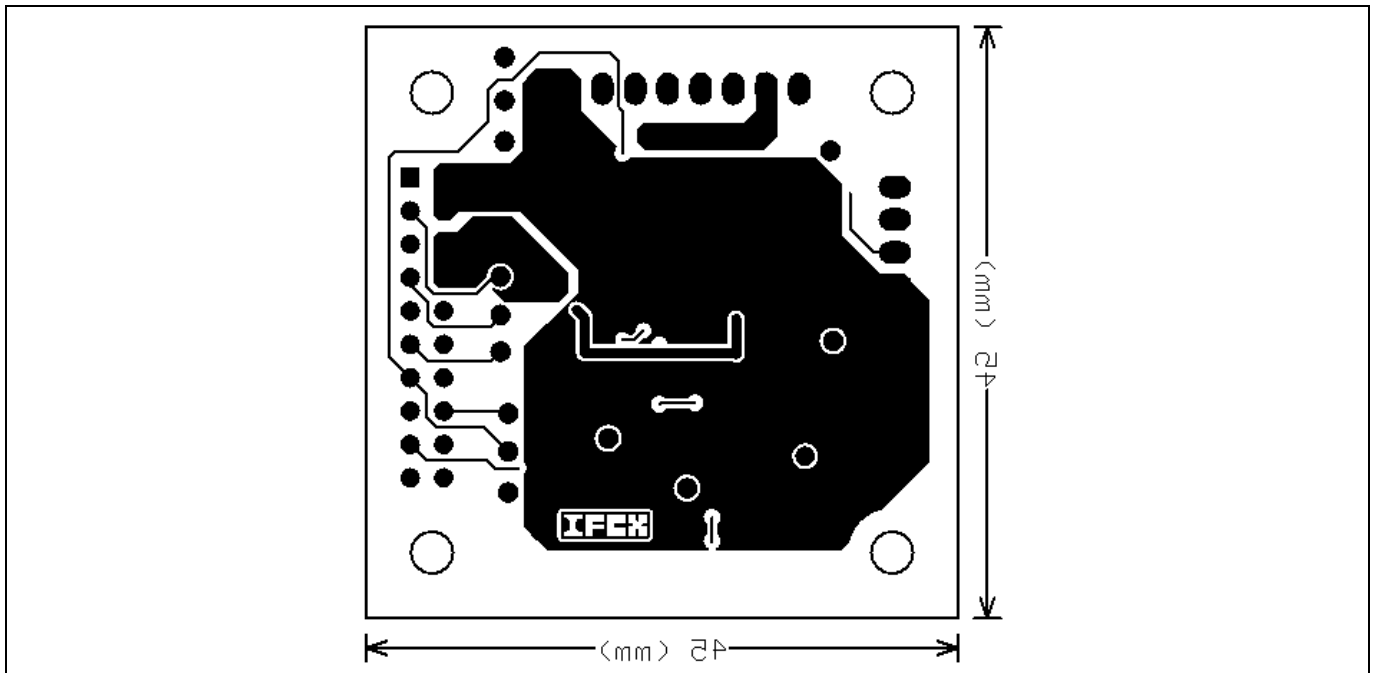


Figure 10 Bottom layer routing of the Eval-M1-183M

6 Bill of Materials of Eval-M1-183M

Table 6 provides the complete bill of materials for the Eval-M1-183M board.

Table 6 Bill of materials

No.	Qty.	Part description	Designator	Part Number	Manufacturer
1	4	CAP CER 10000PF 50V X7R 0805	C1, C5, C6, C7	C0805C103M5RACTU	Kemet
2	4	CAP CER 0.1µF 25V Y5V 0805	C2, C4, C14, C15	C0805C104Z3VACTU	Kemet
3	3	CAP CER 10UF 6.3V X5R 0805	C3, C16, C18	C0805C106M9PACTU	Kemet
4	2	CAP CER 10PF 16V COG/NP0 0805	C8, C11	C0805C100M4GACTU	Kemet
5	2	CAP CER 100PF 50V COG/NP0 0805	C9, C12	C0805C101J5GACTU	Kemet
6	1	CAP CER 1000PF 50V X7R 0805	C13	C0805C102K5RACTU	Kemet
7	1	CONN HEADER XH TOP	J1	B8B-XH-A(LF)(SN)	JST Sales America Inc.
8	1	CONN HEADER XH TOP 4POS 2.5MM	J2	B4B-XH-A(LF)(SN)	JST Sales America Inc.
9	1	CONN HDR DUAL 20POS .100 R/A TIN	J3	0717640020	Molex, LLC.
10	1	CONN HEADR BRKWAY .100 2POS STR	J4	4-103328-1	TE Connectivity AMP connectors
11	1	LED RED CLEAR 0603 R/A SMD	LED1	LTST-S270EKT	Lite-On Inc.
12	1	LED GREEN CLEAR 0603 R/A SMD	LED2	LTST-S270EKT	Lite-On Inc.
13	4	RES SMD 4.7K OHM 5% 1/8W 0805	R1, R2, R3, R4, R20	CR0805-JW-472GLF	Bourns Inc.
14	1	RES SMD 1M OHM 5% 1/8W 0805	R5	CR0805-JW-105ELF	Bourns Inc.
15	1	RES SMD 100 OHM 5% 1/8W 0805	R6	ERJ-6GEYJ101V	Panasonic Electronic Components
16	2	RES SMD 4.87K OHM 0.5% 1/4W 0805	R7, R8	ERJ-PB6D4871V	Panasonic Electronic Components
17	1	RES SMD 9.76K OHM 1% 1/8W 0805	R9	ERJ-6ENF9761V	Panasonic Electronic Components
18	1	RES SMD 10K OHM 1% 1/8W 0805	R10	CR0805-FX-1002GLF	Bourns Inc.

Bill of Materials of Eval-M1-183M

No.	Qty.	Part description	Designator	Part Number	Manufacturer
19	2	RES SMD 470 OHM 5% 1/8W 0805	R11, R21	ERJ-6GEYJ471V	Panasonic Electronic Components
20	2	RES SMD 23.2K OHM 1% 1/8W 0805	R12, R16	ERJ-6ENF2322V	Panasonic Electronic Components
21	4	RES SMD 5.9K OHM 1% 1/8W 0805	R13, R14, R17, R18	ERJ-6ENF5901V	Panasonic Electronic Components
22	2	RES SMD 7.68K OHM 1% 1/8W 0805	R15, R19	ERJ-6ENF7681V	Panasonic Electronic Components
23	2	RES SMD 11.5K OHM 1% 1/8W 0805	R22, R23	ERJ-6ENF1152V	Panasonic Electronic Components
24	16	TEST POINT PC MINI .040"D WHITE	TP1, TP2, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14 TP15, TP16, TP17	5002	Keystone Electronics
25	1	IRMCF183M	U1	Control IC	Infineon Technologies
26	1	CER RES 4.0000MHZ 15PF SMD	XT1	CSTCR4M00G53-R0	Murata Electronics North America

7 Reference

[1] Datasheet of Infineon IRMCF183M

[2] Application Note of 2017-03_AN2017-08_EVAL-M1-099M_V1.0_EN

[3] IRMCx100 Reference Manual

[4] IRMCx100 Software Developer's Guide

[5] IRMCx100 System Overview

Note1: Above all reference materials are available for download on Infineon's website www.infineon.com

Revision History

Major changes since the last revision

Version number	Revision Date	Revision description
1.0	2017-06-01	First release
1.1	2017-07-25	1. Remove MCETOOL v2 description 2. Software download link updated

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AN2017-13 EVAL-M1-183M User
Document reference
Manual

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