# EVAL-M1-05-84D

## iMOTION™ Modular Application Design Kit

## About this document

### Scope and purpose

This application note provides an overview of the evaluation board EVAL-M1-05-84D including its main features, key data, pin assignments and mechanical dimensions.

EVAL-M1-05-84D is a complete evaluation board including a 3-phase IPM for motor drive application. In combination with either EVAL-M1-1302 or EVAL-M1-099M it features and demonstrates Infineon's IPM technology for motor drive.

The evaluation board EVAL-M1-05-84D for Intelligent Power Modules (IPM) was developed to support customers during their first steps designing applications with µIPM™ -DIP power modules.

### Intended audience

This application note is intended for all technical specialists working with the EVAL-M1-05-84D board.

## Table of Contents

# 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-M1-05-84D system is biased to a negative DC bus voltage potential. When measuring voltage waveforms 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-M1-05-84D 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-M1-05-84D 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.*** |

## Safety precautions

***Attention:*** ***EVAL-M1-05-84D 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-M1-05-84D 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 20 pin iMOTION™ MADK-M1 interface connector.

This evaluation board is designed to give comprehensible solutions of a power stage featuring µIPM™ -DIP. The board is equipped with all assembly groups for sensor less field oriented control (FOC). It provides a single-phase AC-connector, rectifier, DC-link and 3-phase output for power. It contains emitter-shunts for current sensing and a voltage divider for DC-link voltage measurement.

The EVAL-M1-05-84D 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-M1-05-84D. 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.

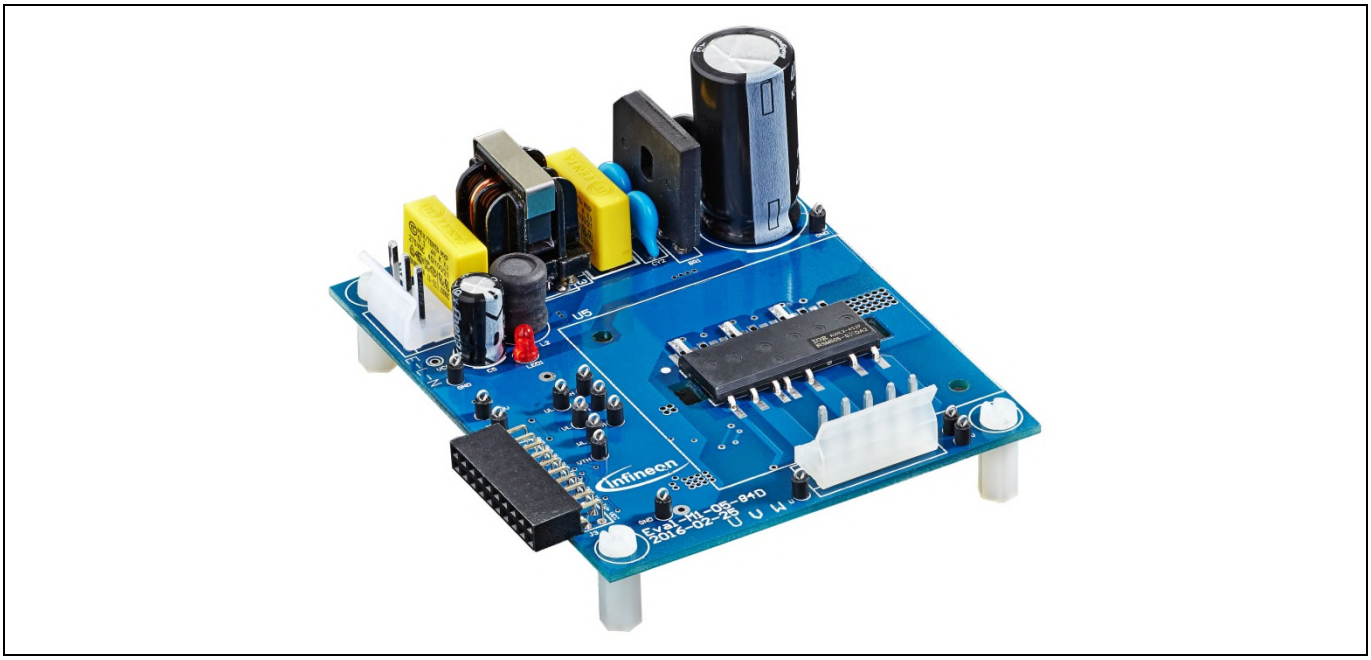


**Figure 1 Evaluation board EVAL-M1-05-84D**

Figure 1 shows the evaluation board EVAL-M1-05-84D. Although this board is compatible with on surface mount as well as through whole µIPM™ -DIP modules. This document explains the features and details of this board in combination with µIPM™ -DIP IRSM515-084 and IRSM505-084. The only difference between these modules is the presence of a NTC. IRSM505-084 has a NTC and IRSM515-084 does not. Both modules are rated 250 V. Ratings and other details of the board are explained in the subsequent sections.

# 3 Main features

EVAL-M1-05-84D is a complete evaluation board including a 3-phase IPM for motor drive application. The kit demonstrates Infineon's IPM technology for motor drives.

Main features of µIPM™ -DIP Intelligent Power Module IRSM515-084 and IRSM505-084 are:

- 3-phase inverter including high voltage gate drivers
- Integrated bootstrap functionality
- Trench FREDFET with $R_{DS(on)}$ of 0.45 Ω @ 25°C
- Under voltage lockout for all channels
- Matched propagation delay for all channels
- Temperature feedback via NTC applicable for IRSM505-084
- Optimized dV/dt for loss and EMI trade off
- 3.3 V logic compatible and advanced input filter
- Possibility to choose  single shunt or emittershunt current sensing
- Driver tolerant to negative transient voltage
- Isolation 1900 $V_{rms}$, 1min
- Certified by UL file number E252584

The evaluation board characteristics are:

- Nominal input voltage 110 $V_{AC}$
- 20 – 150 W motor power range without heatsink
- On board EMI filter
- Current sensing for each phase configured by default
- Over current protection
- Sensing of DC-link voltage
- Thermistor output
- Fault diagnostic output
- Measurement test-points compatible to standard oscilloscope probes
- PCB is 90 x 75 mm and has two layers with 35 µm copper each
- RoHS complaint

## 3.1 Key data

Figure 2 provides the overview of the IRSM505-084 and IRSM515-084 internal electrical schematics. For further information regarding these IPMs like static and dynamic electrical behavior, as well as thermal and mechanical characteristics please refer to the datasheet of the IRSM505-084 or IRSM515-084. Table 2 provides the absolute maximum ratings of the IRSM505-084 or IRSM515-084.

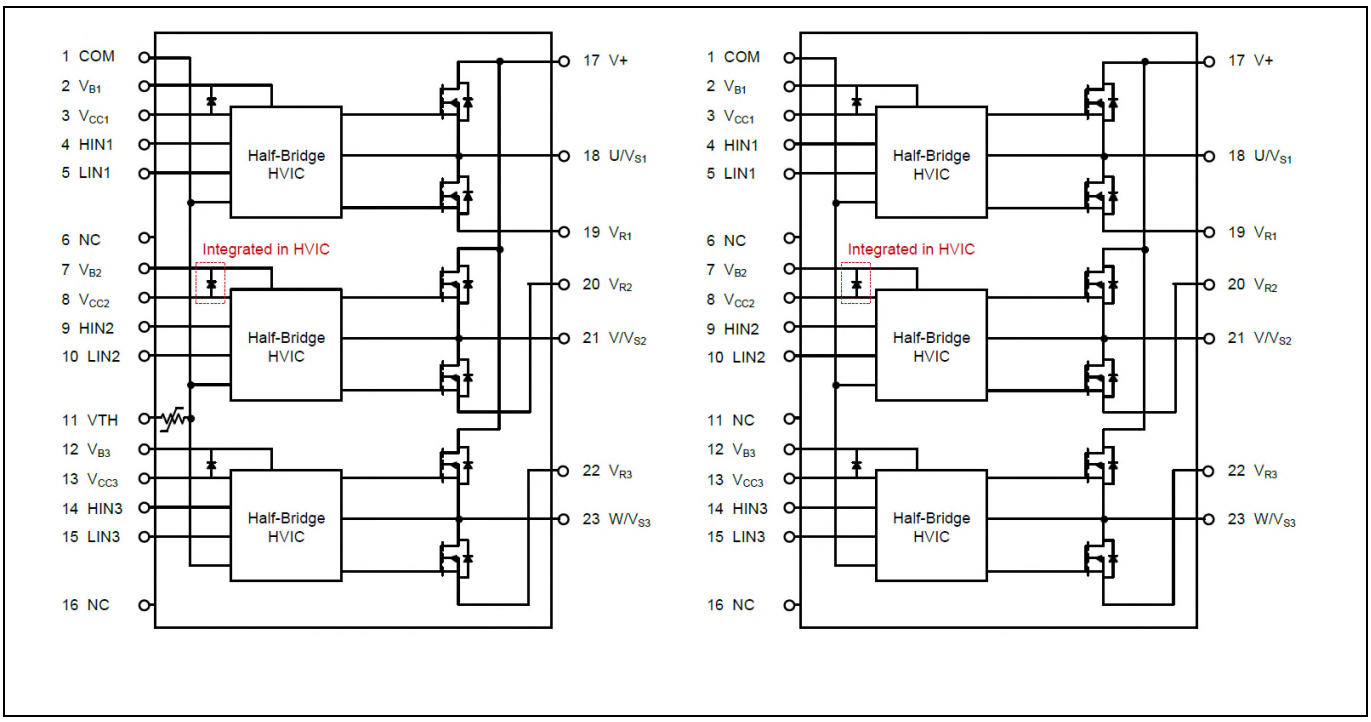



**Figure 2 µIPM™ -DIP internal electrical schematic**

**Table 2 µIPM™ -DIP Absolute Maximum Ratings of IRSM505-084 or IRSM515-084** [1]

| Symbol | Description | Min | Max | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | MOSFET Blocking Voltage | --- | 250 | V |
| $I_O$ @ T=25°C | DC Output Current per MOSFET | --- | 2.6 | A |
| $P_d$ @ $T_C$=25°C | Maximum Power Dissipation per MOSFET | --- | 19 | W |
| $V_{ISO}$ | Isolation Voltage (1min) | --- | 1900 | $V_{rms}$ |
| $T_J$ | Operating Junction Temperature | -40 | 150 | °C |
| $T_C$ | Operating Case Temperature | -40 | 150 | °C |
| $T_S$ | Storage Temperature | -40 | 150 | °C |
| $V_{S1,2,3}$ | High Side Floating Supply Offset Voltage | $V_{B1,2,3}$ - 20 | $V_{B1,2,3}$ +0.3 | V |
| $V_{B1,2,3}$ | High Side Floating Supply Voltage | -0.3 | 275 | V |
| $V_{CC}$ | Low Side and Logic Supply voltage | -0.3 | 25 | V |
| $V_{IN}$ | Input Voltage of LIN, HIN | -0.3 | $V_{CC}$+0.3 | V |

1. *Absolute maximum ratings are limitations which should not be less than minimum or higher than maximum ratings. Outside these limitations for safe operation, damage of the module should be expected.*

## Main features

Table 3 depicts the recommended operating conditions of IRSM505-084 or IRSM515-084.

**Table 3 Recommended operating conditions of µIPM™ -DIP IRSM505-084 or IRSM515-084**

| Symbol | Description | Min | Max | Unit |
|---|---|---|---|---|
| V+ | Positive DC Bus Input Voltage | $2 \cdot V_{CC}+5$ | 200 | V |
| $V_{S1,2,3}$ | High Side Floating Supply Offset Voltage | --- | 200 | V |
| $V_{B1,2,3}$ | High Side Floating Supply Voltage | $V_{Sx}+12$ | $V_{Sx}+20$ | V |
| $V_{CC}$ | Low Side and Logic Supply Voltage | 13.5 | 16.5 | V |
| $V_{IN}$ | Input Voltage of LIN, HIN, $I_{TRIP}$, EN, FLT | 0 | 5 | V |
| $f_{SW}$ | PWM Carrier Frequency | --- | 20 | kHz |

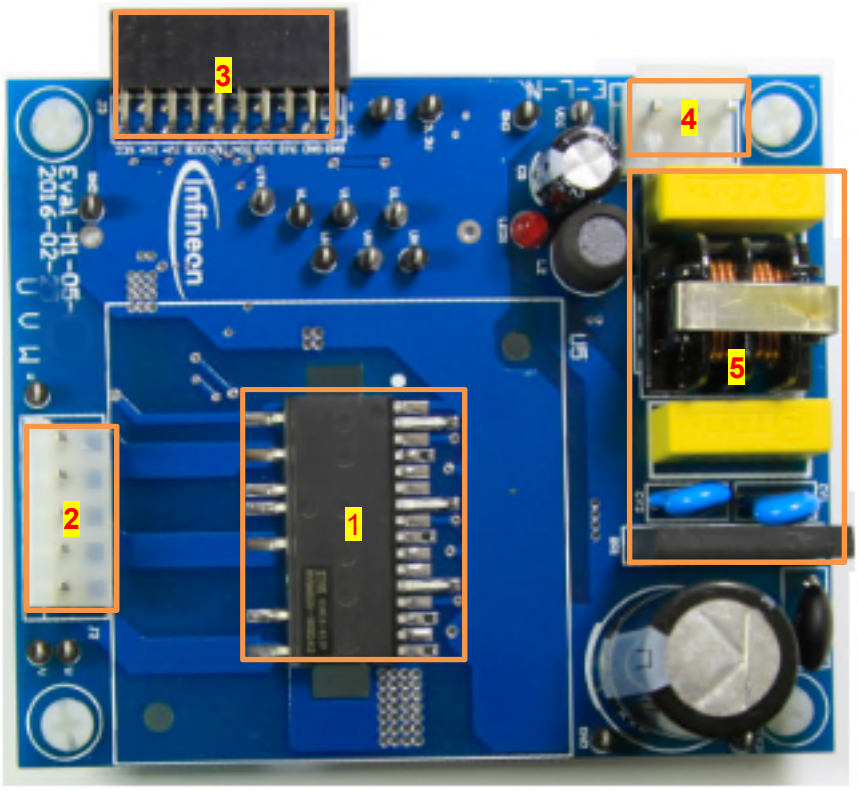
## Main features

Table 4 shows the important specifications of the evaluation board EVAL-M1-05-84D.

**Table 4 EVAL-M1-05-84D board specifications**

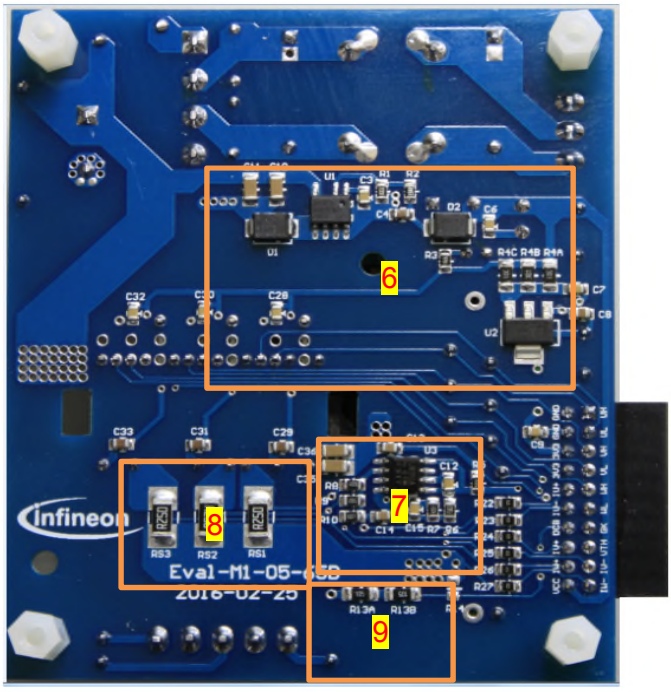
| Parameters | Value | Conditions |
|---|---|---|
| **Input** | | |
| Voltage | 90-140 $V_{rms}$ | |
| Frequency | 50/60 Hz | |
| Input current | 1.5 $A_{rms}$ | IRSM505-084DA/ IRSM515-084DA, module $T_c$ = 70°C without heatsink |
| **Output** | | |
| Power (3phases) | 60 W** | IRSM505-084DA/ IRSM515-084DA |
| Current per leg | 1000 mA* | IRSM505-084DA/ IRSM515-084DA |
| | *rms, $f_{PWM}$=6 kHz, $T_a$=25°C, **input 110$V_{AC}$, $T_c$=125°C, */**without heatsink | |
| **DC Bus** | | |
| Maximum DC bus voltage | 200 V | |
| Minimum DC bus voltage | 45 V | |
| **Current feedback** | | |
| Current sensing devices RS1, RS2, RS3 | 0.25 Ω | The default configuration uses three shunts in the emitter paths. To implement single shunt sensing,<br>- RS1 and RS3 have to be removed<br>- IU+,IV+,IW+ have to be connected,<br>- R7 has to be changed to 3.48 kΩ |
| **Protections** | | |
| Output current trip level | 2.5$A_{pk}$ | Configured by either changing shunt resistors RS1, RS2, RS3 or adapting comparator threshold changing resistor R7 |
| **On board power supply** | | |
| 15 V | 15 V±5 %, Max 20 mA | Used for µIPM™ -DIP gate driver power |
| 3.3 V | 3.3 V±5 %, Max 50 mA | Used for interface signals to the control board and alarm signals as $I_{TRIP}$, FLT/EN |
| **PCB characteristics** | | |
| Material | FR4, 1.6 mm thickness, 2-layers. 35 µm copper thickness | |
| Dimension | 90 mm x 75 mm | |
| **System environment** | | |
| Ambient temperature | From 0 to 70°C | Non-condensing, maximum RH of 95 % |

Figure 3 and Figure 4 hint out the functional groups of the EVAL-M1-05-84D evaluation board.




1. µIPM™ -DIP module
2. Motor phase connector (J2)
3. Interface 20 pin connector for control board (J3)
4. AC line input connector (J1)
5. EMI filter and rectifier group

**Figure 3 Functional groups of the EVAL-M1-05-84D evaluation board's top side**




6. On board power supply for 15 V and 3.3 V generation
7. Over current comparator
8. Shunt resistors
9. Voltage divider for DC bus voltage sensing

**Figure 4 Functional groups of the EVAL-M1-05-84D evaluation board's bottom side**

# 4 Pin assignments

General information about the connectors of the EVAL-M1-05-84D evaluation board is reported. Table 5 includes the details of the line connector J1-AC. It is possible to connect DC voltage to the AC connector. In this case a permanent DC-current will be conducted through the rectifier bridge. Maximum ratings are valid for AC as well as DC conditions. It is recommended to observe the temperature of the rectifier bridge. Due to the rectifier, DC supply's polarity at the connector is of no concern.

The evaluation board doesn't have a fuse. An external fuse is highly recommended during testing.

**Table 5 J1- AC Line connector**

| S. No. | Pin | Details |
|---|---|---|
| 1 | ETH | Earth ground |
| 2 | L | AC line input (60 V – 110 V) or DC connector |
| 3 | N | AC neutral input or DC connector |

Table 6 denotes the details of the motor side connector J2.

**Table 6 J2- 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 |

### Pin assignments

Table 7 provides the pin assignments of the M1 20 pin interface connector J3. This connector is the interface to the controller board.

**Table 7 J3 - 20 pin interface connector for controller board**

| Pin | Name | Connectors |
|---|---|---|
| 1 | PWMUH | 3.3 V compatible logic input for high side gate driver-Phase1 [2] |
| 2 | GND | Ground |
| 3 | PWMUL | 3.3 V compatible logic input for low side gate driver-Phase1 [2] |
| 4 | GND | Ground |
| 5 | PWMVH | 3.3 V compatible logic input for high side gate driver-Phase2 [2] |
| 6 | +3.3V | On board 3.3 V supply |
| 7 | PWMVL | 3.3 V compatible logic input for low side gate driver-Phase2 [2] |
| 8 | +3.3V | On board 3.3 V supply |
| 9 | PWMWH | 3.3 V compatible logic input for high side gate driver-Phase3 [2] |
| 10 | IU+ | Shunt voltage phase U |
| 11 | PWMWL | 3.3 V compatible logic input for low side gate driver-Phase3 [2] |
| 12 | IU- | Ground |
| 13 | GK | Gate kill signal – active low when over current is detected [3] |
| 14 | DCBSENSE | DC bus positive voltage, scaled in 0-3.3 V range by a voltage divider |
| 15 | VTH | Thermistor Output |
| 16 | IV+ | Shunt voltage phase V |
| 17 | IV- | Ground |
| 18 | IW+ | Shunt voltage phase W |
| 19 | IW- | Ground |
| 20 | VCC | 15 V Supply |

2. *Input signals are active high. Pull-down resistors are not inserted on the EVAL-M1-05-84D board and need to be assembled on control cards. iMOTION™ MADK control cards are already equipped with pull-down resistors.*
3. *Gate Kill signal (GK) is pulled low during over current condition. Chapter 5.6 explains the details of this circuit.*

# 5 Schematics and Layout

To meet individual customer requirements and make the EVAL-M1-05-84D 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-Link Voltage Measurement

Pin 14 of connector J3 provides access to the DC-link voltage. Three possible feedback cases are associated with this pin. Figure 5 provides the DC bus sense resistor details.

By default, R14 is not mounted on Eval-M1-05-84D. There must be a pull-down resistor mounted on the corresponding control card.

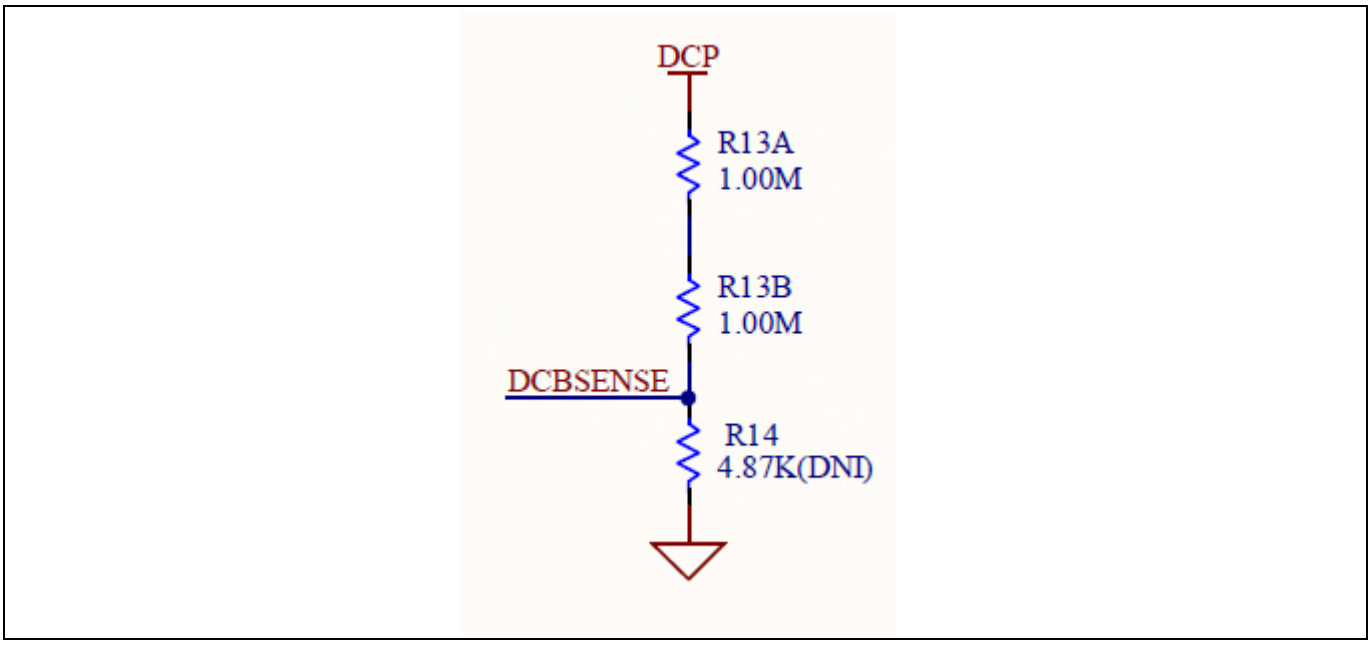



**Figure 5 DC bus sense resistor on EVAL-M1-05-84D evaluation board**

If a pull down resistor of 4.87 kΩ referred to ground is inserted either on the Eval-M1-05-84D evaluation board or on the control board, 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 400 V.

If a pull down resistor of 4.87 kΩis inserted on both, Eval-M1-05-84D evaluation board and on the control card, the DCBSENSE results scale to 0-1.65 V. No safety issue occurs.

If no feedback is desired on the DCBSENSE-pin, R13A or R13B should be removed to avoid high voltage on the connector.

## 5.2 Thermistor Output

This board provides Thermistor/NTC- output on pin 15 of the 20 pin connector J3. Temperatures can be calculated by resistor measurement. Within the µIPM™ -DIP datasheet, thermistor details are listed as summarized in Table 8. There is additional information in the datasheet of IRSM505-84D about how to use the NTC.

**Table 8 Internal NTC – Thermistor Characteristics (IRSM505-084 Only)**

| Symbol | Description | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| R25 | Resistance | - | 47 | - | kΩ | $T_C$=25°C, ±5% tolerance |
| R125 | GND | - | 1.41 | - | kΩ | $T_C$=125°C |
| B | PWMUL | - | 4050 | - | K | ±2% tolerance (Note 6) |
| Temperature Range | | -40 | | 120 | °C | |

## 5.3 EMI input filter and rectifier circuit

Figure 6 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 CX1, CX2, L1, CY1 and CY2, a 4 A/600 V rectifier block BR1 and a NTC resistor RT1 for surge current protection. An electrolytic capacitor C1 and two ceramic capacitors C10 and C11 are used for buffering the rectified DC bus voltage DCP. During testing it is advisable to include an external fuse.

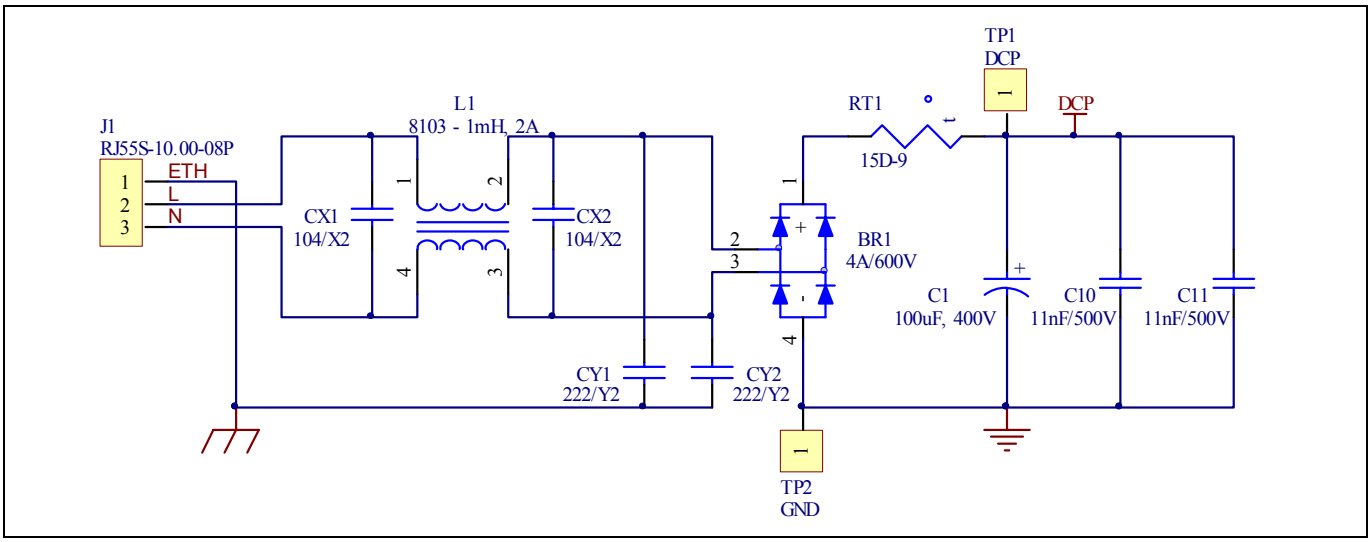



**Figure 6 Schematic for EMI input filter and AC/DC section of the EVAL-M1-05-84D evaluation board**

## 5.4 Inverter section using µIPM™ -DIP

The inverter section is implemented using the µIPM™ -DIP IPM as sketched in Figure 7. The module includes six power MOSFETs and three half bridge gate drivers. The shunt resistor section is also given, including the 0Ω resistors R22 to R27. These resistors allow connecting or disconnecting the shunts' signals to connector J3. The three capacitors C29, C31 and C33 are used as bootstrap capacitors to provide the necessary floating supply voltages $V_{BS1}$, $V_{BS2}$ and $V_{BS3}$ respectively.

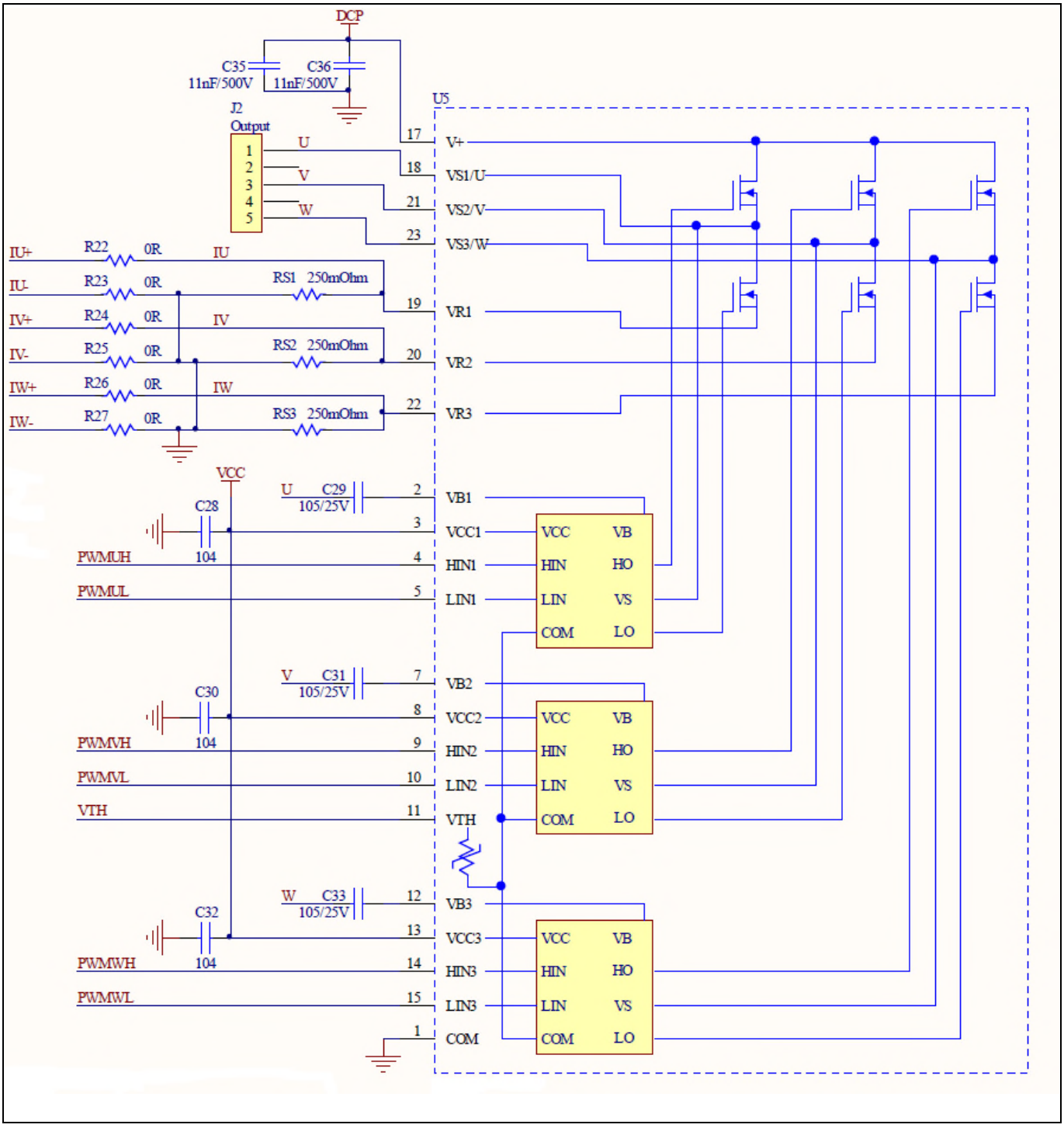



**Figure 7 Schematic of the 3-phase inverter section using µIPM™ -DIP on EVAL-M1-05-84D evaluation board**

## 5.5 Power supply

Figure 8 depicts the schematic of the power supply available on the EVAL-M1-05-84D board. The circuit includes a LNK304 that is used to generate 15 V ($V_{cc}$) directly from the DC bus. $V_{CC}$ is connected to the gate drivers inside the µIPM™ -DIP.

The linear regulator LD1117S33 generates 3.3 V from $V_{CC}$. 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, $V_{CC}$ and 3.3 V are also present on the 20 pin interface connector J3 to power circuitry on the controller board.

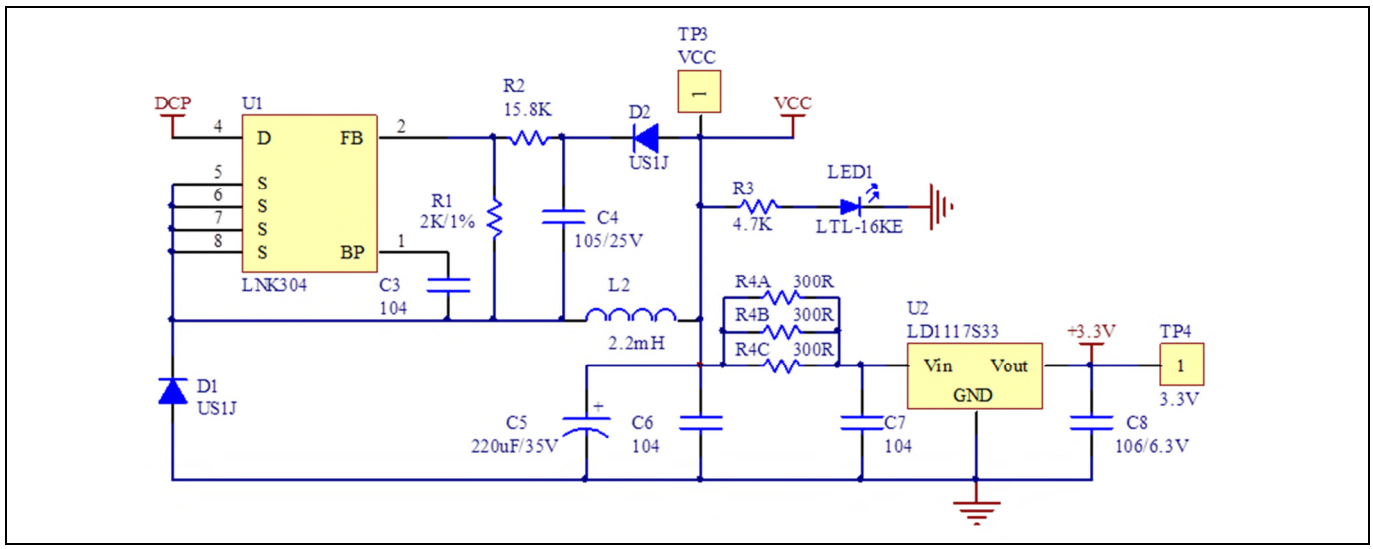



**Figure 8 Power supply section of the EVAL-M1-05-84D evaluation board**

## 5.6 Over current circuit

Figure 9 displays the over current protection circuitry. The open collector output GK of the comparator is pulled up to 3.3 V and filtered through resistor R5 and capacitor C13.

The comparator threshold can be set through the voltage divider provided by resistors R6 and R7. By default for emitter shunt trip, R7 is 1kΩ. In single shunt application R7 needs to be changed to 3.48kΩ.

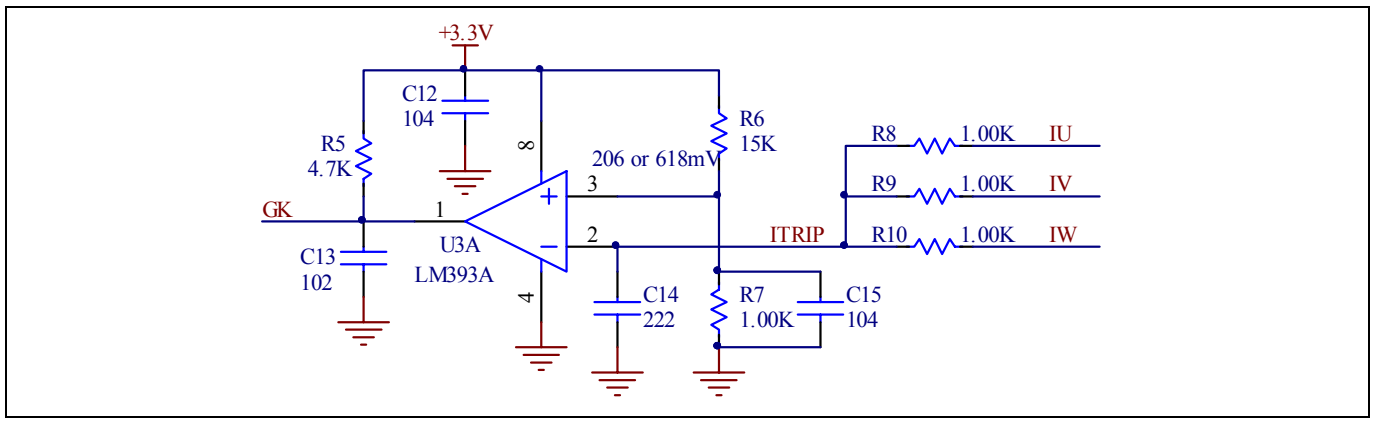



**Figure 9 Over current protection circuit on the EVAL-M1-05-84D evaluation board**

## 5.7 Layout

The layout of this board can be used for different voltage or power classes. The power PCB is a two layer PCB. Get in contact with our technical support team to get more detailed information and the latest Gerber-files.

Figure 10 illustrates the top assembly print of the evaluation board.

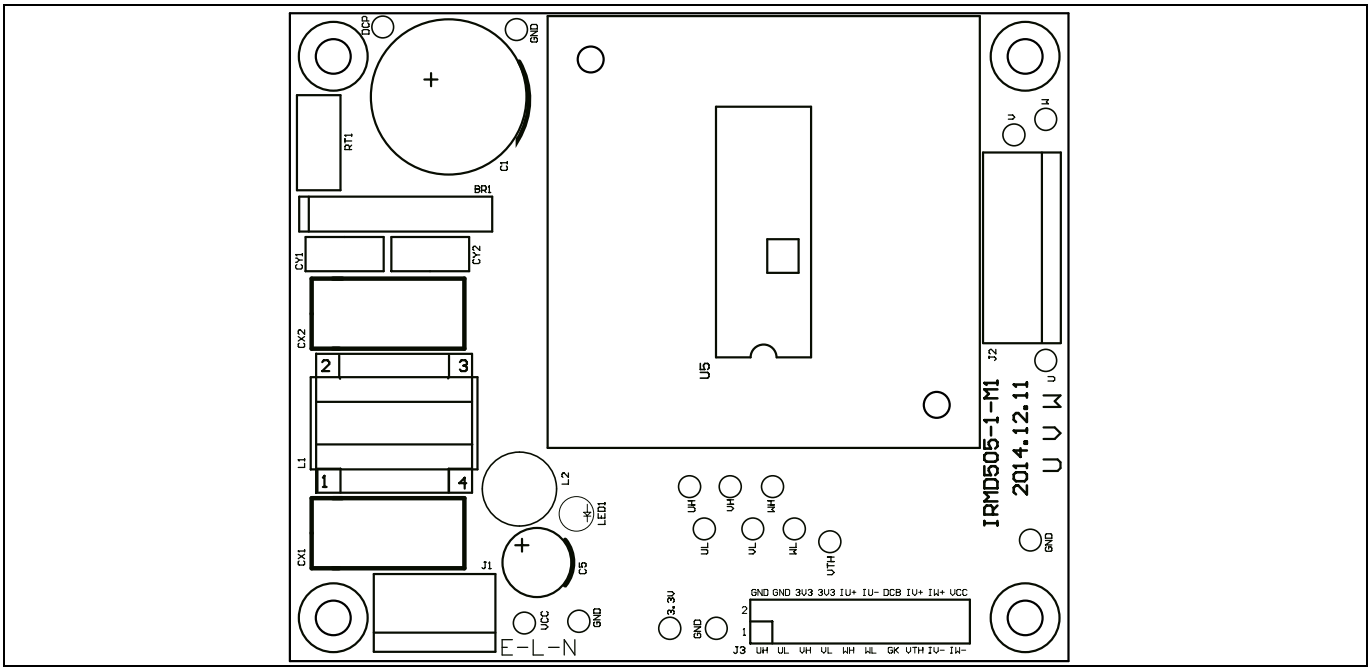



**Figure 10 Top assembly print of the EVAL-M1-05-84D evaluation board**

Figure 11 depicts the bottom assembly print of the evaluation board.

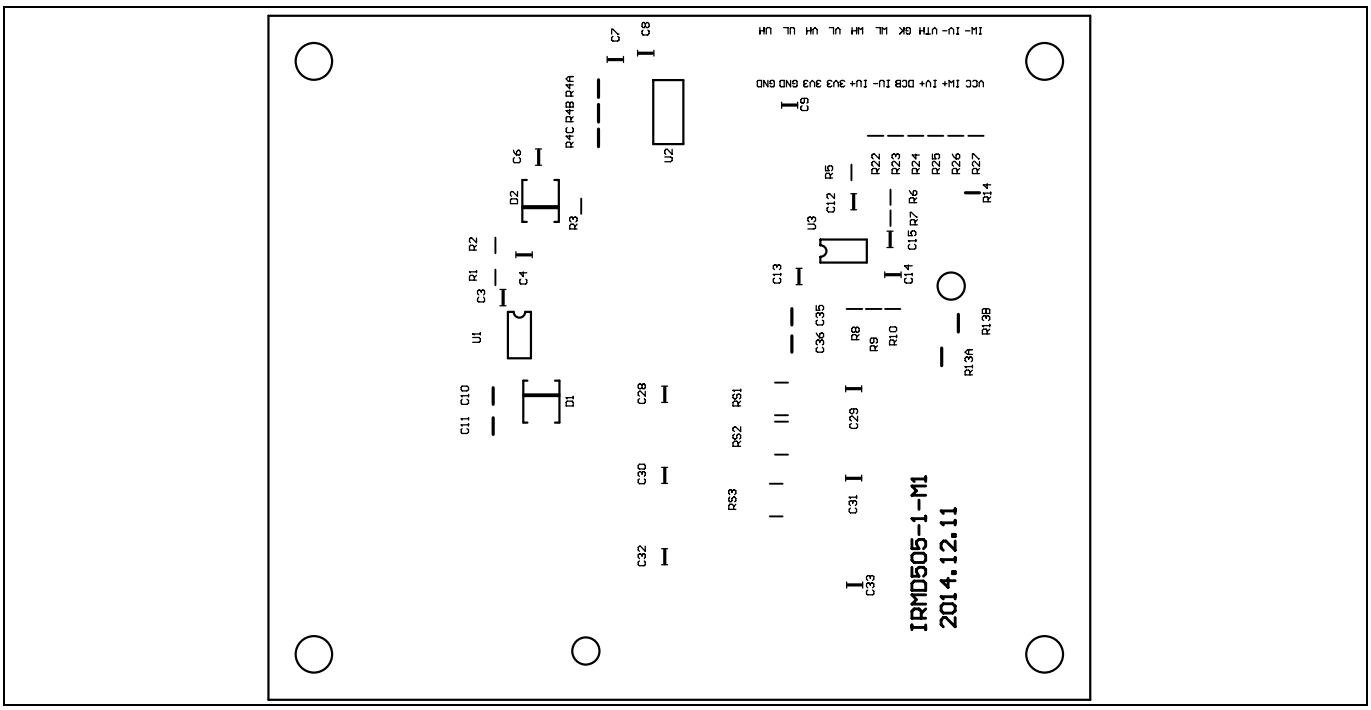



**Figure 11 Bottom assembly print of the EVAL-M1-05-84D evaluation board**

The top layer of the PCB is provided in Figure 12.

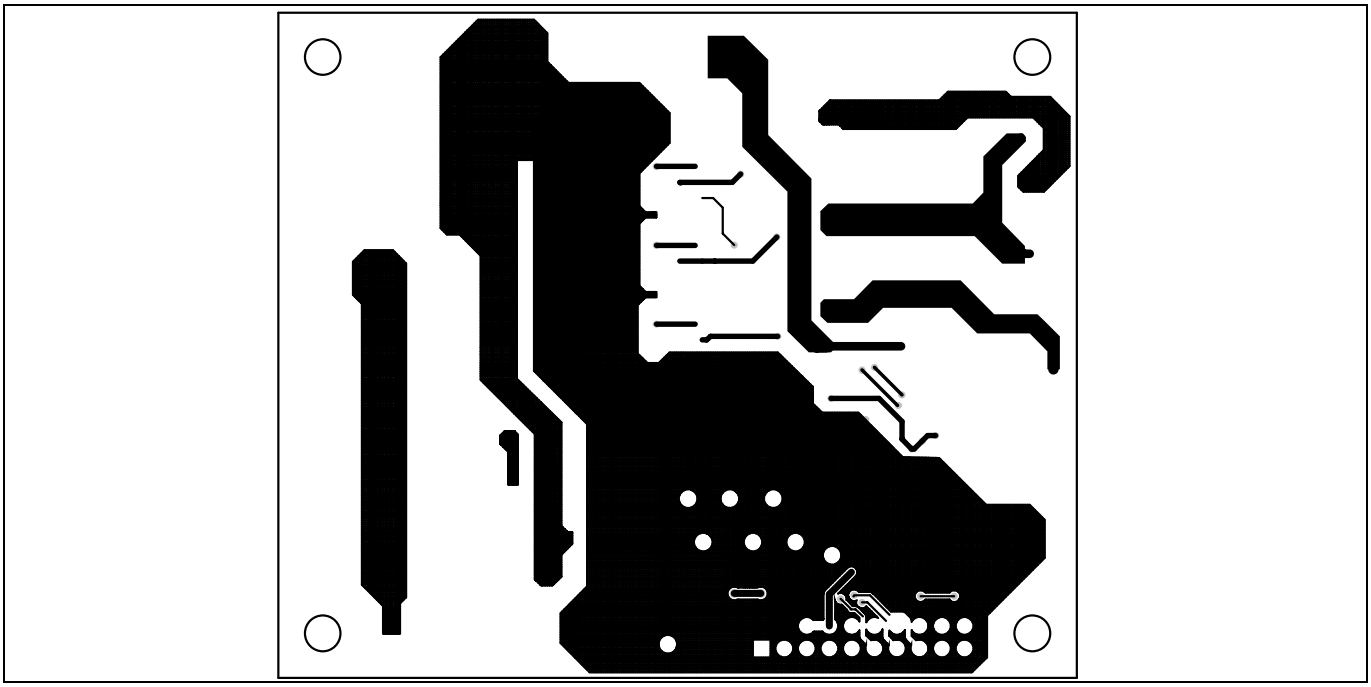


**Figure 12 Top layer of the EVAL-M1-05-84D**

Figure 13 illustrates the bottom layer routing of the PCB.

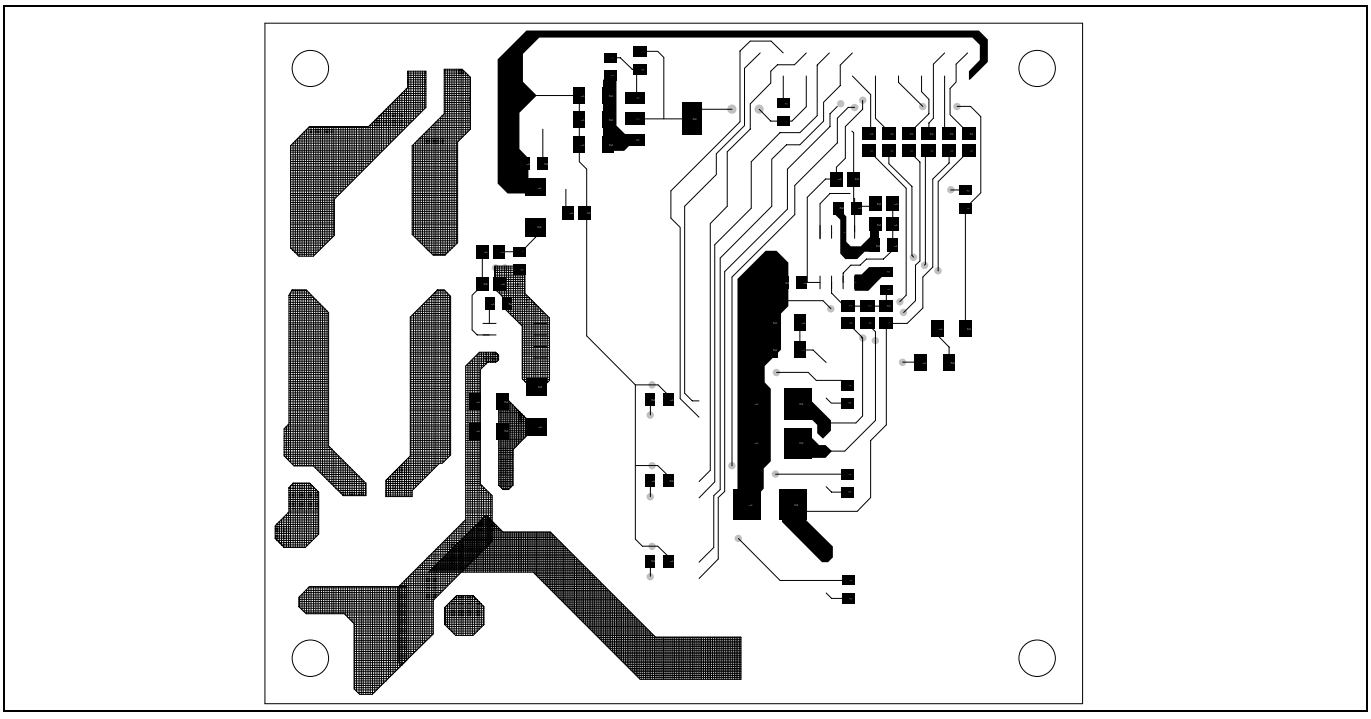


**Figure 13 Bottom layer routing of the EVAL-M1-05-84D**

# 6 Bill of Materials of EVAL-M1-05-84D

Table 9 provides the complete bill of materials of the evaluation board.

**Table 9 Bill of materials**

| S.No. | Designator | Part description | Part number | Manufacturer |
|---|---|---|---|---|
| 1 | BR1 | RECT BRIDGE GPP 4A 600V GBU | GBU406 | DIODES INCORPORATED |
| 2 | C1 | CAP ALUM 100µF 20% 200V RADIAL | 200TXW100MEFC18X30 | RUBYCON |
| 3 | C3, C6, C7, C9, C12, C15, C28, C30, C32 | CAP CER 0.1µF 50V X7R 0805 | 08055C104KAT2A | AVX CORPORATION |
| 4 | C4, C29, C31, C33 | CAP CER 1µF 25V X7R 0805 | CL21B105KAFNNNE | SAMSUNG ELECTRO-MECHANICS AMERICA,INC. |
| 5 | C5 | CAP ALUM 220µF 20% 35V RADIAL | 35ZLH220MEFC8X11.5 | RUBYCON |
| 6 | C8 | CAP CER 10µF 6.3V X7R 0805 | CL21B106KQQNNNE | SAMSUNG ELECTRO-MECHANICS AMERICA,INC. |
| 7 | C10, C11, C35, C36 | CAPACITOR, CERAMIC, MULTILAYER, 250 V, X7R, 0.011µF, SURFACE MOUNT, 1206 | 1206B113K501NT | NOVACAP |
| 8 | C13 | CAP CER 1000pF 50V X7R 0805 | C0805C102K5RACTU | KEMET |
| 9 | C14 | CAP CER 2200pF 50V X7R 0805 | 08055C222KAT2A | AVX CORPORATION |
| 10 | CX1, CX2 | CAP FILM 0.1µF 20% 275VAC RADIAL | PME271MB6100MR30 | KEMET |
| 11 | CY1, CY2 | CAP CER 2200pF 250VAC RADIAL | DE2E3KY222MN3AM02F | MURATA ELECTRONICS |
| 12 | D1, D2 | DIODE GEN PURP 600V 1A SMB | MURS160-13-F | DIODES INCORPORATED |
| 13 | J1 | 3 Positions Header, Unshrouded Connector 3.96mm | 26604030 | MOLEX,LLC |
| 14 | J2 | 5 Positions Header, Unshrouded Connector 3.96mm | 26604050 | MOLEX,LLC |
| 15 | J3 | 20 Position Header Connector 2.54mm | PPTC102LJBN-RC | SULLINS CONNECTOR SOLUTIONS |
| 16 | L1 | Inductor | 150µH/EMI inductor | Customized |

| | | | | |
|---|---|---|---|---|
| 17 | L2 | Inductor | 2.2mH/Filter inductor | Customized |
| 18 | LED1 | LED RED DIFF 3MM ROUND T/H | LTL-16KE | LITE-ON |
| 19 | R1 | RES 0805 2kΩ 1% | 0805F2001T5E | UNIOHM |
| 20 | R2 | RES 0805 15.8k 1% | 0805F1582T5E | UNIOHM |
| 21 | R3, R5 | RES 0805 4.7kΩ 1% | 0805J0472T5E | UNIOHM |
| 22 | R4A, R4B, R4C | RES 1206 300Ω 5% | 1206J0301T5E | UNIOHM |
| 23 | R6 | RES 0805 15kΩ 1% | 0805J0153T5E | UNIOHM |
| 24 | R7, R8, R9, R10 | RES 0805 1kΩ 1% | 0805J0102T5E | UNIOHM |
| 25 | R13A, R13B | RES 1206 1MΩ 5% | 1206J0105T5E | UNIOHM |
| 26 | R14 (DNP) | RES 0805 4.87kΩ 1% | 0805F4871T5E | UNIOHM |
| 27 | R22, R23, R24, R25, R26, R27 | RES 0805 0Ω 1% | 0805J0R00T5E | UNIOHM |
| 28 | RS1, RS2, RS3 | RES 2010 0.25Ω | 2010J0R25T5E | UNIOHM |
| 29 | RT1 | NTC 15Ω 9MM DIA | NTC15D-9 | SHIN-HANG |
| 30 | TP1,'TP2, TP22, TP23, TP24,TP3,TP4,TP7, TP13,TP14,TP15,TP16,TP17,TP18,TP19,TP20,TP21 | TEST POINT PC MINI .040"D WHITE | 2502 | KEYSTONE ELECTRONICS |
| 31 | U1 | IC OFFLINE SWITCHER | LNK304DN-TL | POWER INTEGRATIONS |
| 32 | U2 | IC REG LDO 3.3V 0.8A SOT223 | LD1117S33TR | ST MICRO-ELECTRONICS |
| 33 | U3 | IC DUAL DIFFERENTIAL COMPARATOR | LM393ADR | TI |
| 34 | U5 | IC MOTOR DRIVER 250V DIP 23 | IRSM515-084 / IRSM505-084 | INFINEON TECHNOLOGIES |

# 7 Reference

[1] Datasheet of Infineon IPM IRSM505-084 is available for download on Infineon's website

[2] Application Note AN2009-10 *Using the NTC inside a power electronic module*
Available for download on Infineon's website

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