Eval-M3-CM615PN

iMOTION™ Modular Application Design Kit

About this document

Scope and purpose

This application note provides an overview of the evaluation board Eval-M3-CM615PN including its main features, key data, pin assignments and mechanical dimensions.

Eval-M3-CM615PN is a complete evaluation board including a PFC integrated 3-phase CIPOS™ Mini Intelligent Power Module (IPM) for motor drive application. In combination with control-boards equipped with the M3 30pin interface connector, like EVAL-M1-188, it features and demonstrates Infineon's CIPOS™ Mini IPM technology for motor drive.

The evaluation board Eval-M3-CM615PN was developed to support customers during their first steps designing applications with CIPOS™ Mini PFC integrated IPM IFCM15P60GD.

The inverter section has 600V of voltage and 15A of current rating, and the PFC section has 650V of voltage and 30A of current rating. It is optimized to major home appliances like air conditioners and low power motor dirve application with high frequency switching operation of power factor correction.

Intended audience

This application note is intended for all technical specialists working with the Eval-M3-CM615PN board.

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1 Safety precautions

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

Table 1 Precautions

	***Attention: The ground potential of the Eval-M3-CM615PN system is biased to a negative DC bus voltage potential. When measuring voltage waveform by oscilloscope, the scope's ground needs to be isolated. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.***
	***Attention: Eval-M3-CM615PN 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-M3-CM615PN system contains parts and assemblies sensitive to Electrostatic Discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to applicable ESD protection handbooks and guidelines.***
	***Attention: A drive, incorrectly applied or installed, can result in component damage or reduction in product lifetime. Wiring or application errors such as under sizing the motor, supplying an incorrect or inadequate AC supply or excessive ambient temperatures may result in system malfunction.***
	***Attention: Remove and lock out power from the drive before you disconnect or reconnect wires or perform service. Wait three minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have discharged to zero. Failure to do so may result in personal injury or death.***
	***Attention: Eval-M3-CM615PN 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-M3-CM615PN evaluation board is a part of the iMOTION™ Modular Application Design Kit for motor 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-M3 30 pins interface connector to control board such as Eval-M3-188.

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

The Eval-M3-CM615PN 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-M3-CM615PN. 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-M3-CM615PN is depicted in Figure 1. This evaluation board includes an EMI filter and soft power up circuit, 30 pins iMOTION™ MADK-M3 interface connector, auxiliary power supply to provide 15V and 3.3V, PFC gate dirve circuit and the CIPOS™ Mini IPM IFCM15P60GD.

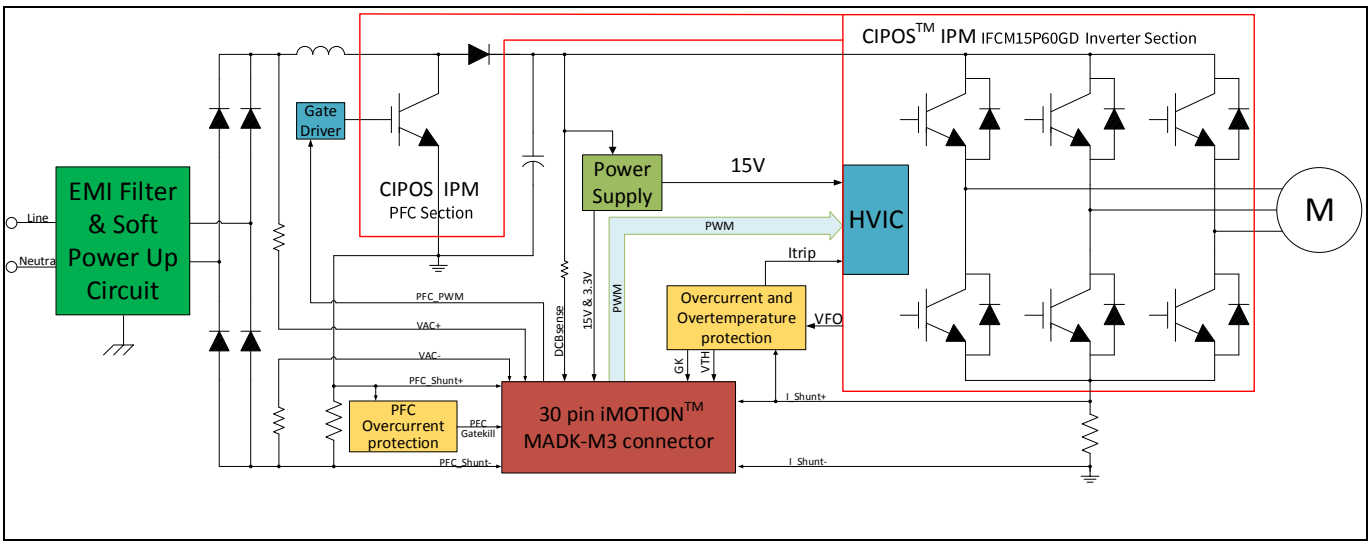


Figure 1 The Block Diagram of the Eval-M3-CM615PN

The hardware circuit regarding overtemperature and overcurrent protection is also included in this power board. The sense connection to common emitter shunt resistor is connected to the 30 pins iMOTION™ MADK-M3

interface connector. This power board is compatible with PFC integrated CIPOS™ Mini IPMs that feature 3 phase common emitter and built-in NTC considering motor power rating and IPM's current rating.

3 Main features

Eval-M3-CM615PN is an evaluation board for motor drive applications with single phase PFC integrated 3 phase IPM. Combined in a kit with one of the available MADK control board options, it demonstrates Infineon's motion control IC and IPM technology for motor drives with single phase PFC.

Main features of CIPOS™ Mini IPM IFCM15P60GD are:

o 3 half bridges with TRENCHSTOP™ IGBT3 15A/600V and antiparallel diodes for inverter section

o 30A/650V TRENCHSTOP™ 5 IGBT and rapid switching emitter controlled diode for PFC section

o Lead-free terminal plating; RoHS compliant

o Very low thermal resistance due to DCB

o Rugged SOI gate driver technology with stability against transient and negative voltage

o Negative potential allowed up to V_S =-11V for single transmission at V_{BS}=15V

o Integrated bootstrap functionality

o Overcurrent shutdown

o Temperature monitor

o Undervoltage lockout at all channels

o Low side common emitter

o Cross conduction prevention

o All six switches turn off during protection

The evaluation board characteristics are:

o Input voltage 160~265V_{AC}

o Maximum 650W motor power output

o Power Factor Correction

o On board EMI filter

o Current sensing with single shunt

o Auxiliary power supply with 15V, 3.3V

o Overcurrent protection

o Overtemperature hardware protection

o Sensing of DC-link voltage

o Thermistor output

o Fault diagnostic output

o Measurement test-points compatible to standard oscilloscope probes

o PCB is 120 mm × 120 mm and has two layers with 35µm copper each

Main features

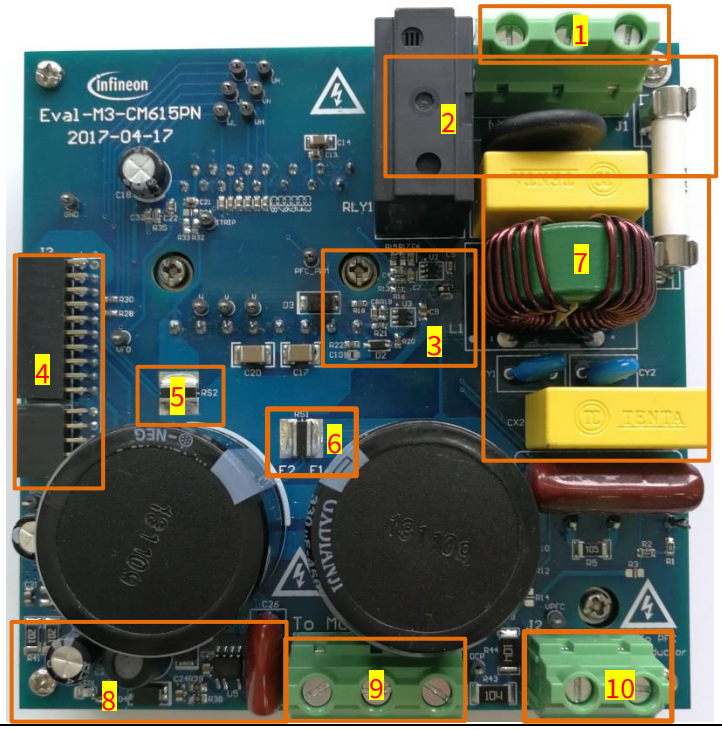
o RoHS complaint

Table 2 depicts the important specifications of the evaluation board Eval-M3-CM615PN.

Table 2 Eval-M3-CM615PN board specifications

Parameters	Values	Conditions / comments
Input		
Voltage	165 - 265 V_{rms}	lower AC input, less motor power output
Input current	3.15 A_{rms}	input 220 V_{AC}, T_a=25°C, IFCM15P60GD
Output		
Power (3phases)	650 W	input 220V_{AC}, f_{PWM}=6 kHz, T_a=25°C, T_h=80°C
Current per leg	2.32 A_{rms}	input 220V_{AC}, f_{PWM}=6 kHz, T_a=25°C, T_h=80°C
DC Bus Voltage		
Maximum DC bus voltage	400 V	
Minimum DC bus voltage	120 V	
Switching Frequency		
PFC switching frequency f_{PFC}	60 kHz (max)	Limited by controller board (maximum 42 kHz for Eval-M3-188)
Inverter switching frequency f_{PWM}	20 kHz (max)	
Current feedback		
PFC current sensing resistor R1	30 mΩ	
Inverter current sensing resistor RS2	30 mΩ	R2 is the IPM inverter section's common emitter current sensing resistor.
Protections		
PFC Gatekill protection level	15.5 A_{peak}	Configured by either PFC current sensing resistor RS1, or adapting comparator threshold divider resistor R17.
Output current trip level	15.7 A_{peak}	Configured by changing shunt resistor RS2. ITRIP positive going threshold is about 470mV.
Temperature trip level	100 °C	For controller board Eval-M3-188
On board power supply		
15 V	15 V ± 5 %, max. 50 mA	Used for CIPOS™ IPM gate driver and LDO
3.3 V	3.3 V ± 2 %, max. 20 mA	Supplying the 3.3V to the controller board and protection circuits
PCB characteristics		
Material	FR4, 1.6mm thickness, 2 layers. 35 µm copper thickness	
Dimension	120 mm x 120 mm	
System environment		
Ambient temperature	From 0 to 50°C	Non-condensing, maximum RH of 95 %

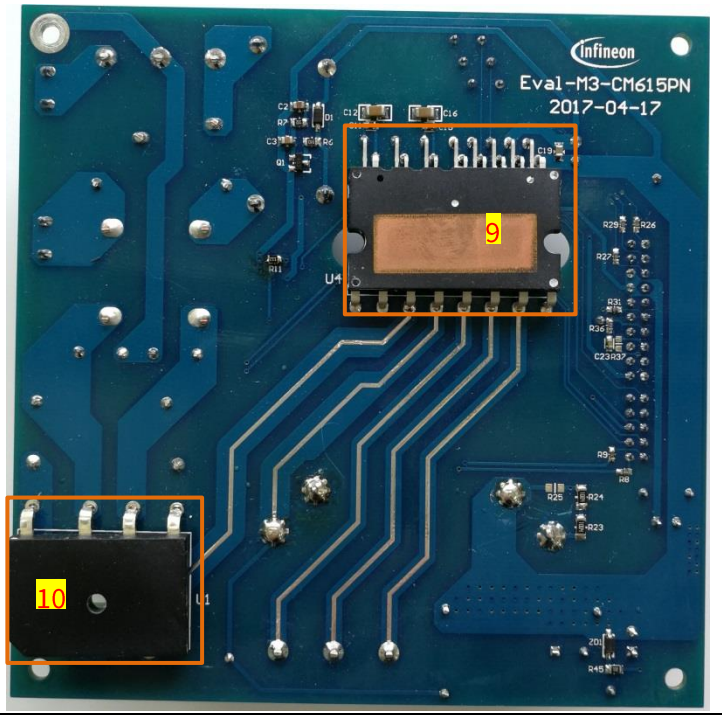
Figure 2 points out the functional groups on the top side of the Eval-M3-CM615PN evaluation board.



1. J1 - AC Input connector
2. Relay, NTC and Fuse
3. PFC gate drive and PFC overcurrent protection circuits
4. J3 - 30 pin iMOTION™ MADK-M3 interface connector for controller board
5. Current sensing shunt resistor RS2
6. PFC Current sensing resistor RS1
7. EMI filter
8. Auxiliary power supply
9. J4 - Motor phase connector
10. J2 – PFC inductor connector

Figure 2 Functional groups of the Eval-M3-CM615PN evaluation board's top side

Figure 3 points out the functional groups on the bottom side of the Eval-M3-CM615PN evaluation board.



9. CIPOS™ mini IPM U4
10. Rectifier bridge U1

Figure 3 Functional groups of the Eval-M3-CM615PN evaluation board's bottom side

4 Pin assignments

General information about the connectors of the Eval-M3-CM615PN evaluation board is reported. Table 3 includes the details of the AC input connector J1.

Table 3 J1- AC Line connector

S. No.	Pin	Details
1	Neutral	AC neutral input
2	EARTH	Earth ground
3	Line	AC line input

Table 4 denotes the details of the PFC inductor connector J2.

Table 4 J2- DC link connector

S. No.	Pin	Details
1	L+	Connected to one side of PFC inductor
2	L-	Connected to the other side of PFC inductor

Table 5 provides the details of the motor side connector J4.

Table 5 J4- 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 6 provides the pin assignments of the 30 pins iMOTION™ MADK-M3 interface connector J3. This connector is the interface to the controller board.

Table 6 J3 - iMOTION™ MADK-M3 30 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	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	Positive Current sense output
11	PWMWL	3.3 V compatible logic input for low side gate driver-Phase W
12	I_U-	Negative current sense output or 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	Not used
17	I_V-	Not used
18	I_W	Not used
19	I_W-	Not used
20	VCC	15 V Power Supply
21	PFCG0	3.3 V compatible logic input for PFC gate driver IC
22	GND	Ground
23	PFCG1	Not used
24	+3.3V	On board 3.3 V supply
25	PFCGK	PFC Gate kill signal – active low when PFC overcurrent is detected
26	DCBSense	DC bus positive voltage, scaled in 0-3.3 V range by a voltage divider
27	VAC+	AC voltage sensing positive cycle
28	VAC-	AC voltage sensing negative cycle
29	IPFC+	PFC current sensing positive
30	IPFC-	PFC current sensing negative

5 Schematics and Layout

To meet individual customer requirements and make the Eval-M3-CM615PN 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 and pin 26 of connector J3 provide access to the DC-link voltage. Three possible feedback cases are associated with this pin. Figure 4 provides the DC bus sense resistor details. By default, the resistor R25 is not mounted on Eval-M3-CM615PN. There must be a pull-down resistor mounted on the corresponding controller board.

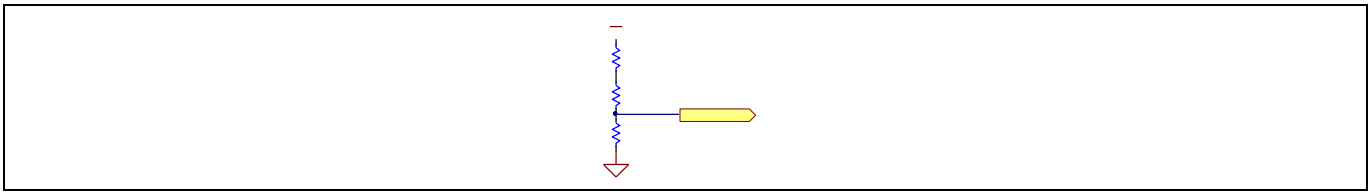


Figure 4 DC bus sense resistor on Eval-M3-CM615PN evaluation board

If a pull down resistor of 4.87 kΩ referred to ground is inserted either on the Eval-M3-CM615PN 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 420 V.If a pull down resistor of 4.87 kΩ is inserted on both, Eval-M3-CM615PN 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, R35 or R36 should be removed to avoid high voltage on the connector.

5.2 EMI filter and Boost PFC circuit

Figure 5 depicts the schematic from the AC 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 25 A/600 V rectifier bridge U1, a fuse F1 for inrush current protection, a NTC resistor RT1 and a relay RLY1 for soft powering up and reducing conduction losses in steady state. The PFC section is implemented using the CIPOS™ mini IPM as sketched in Figure 5. The IRS44273L is used to drive IGBT for PFC section. A PFC inductor should be connected to J2. PFC inductor is included in this evaluation kit.

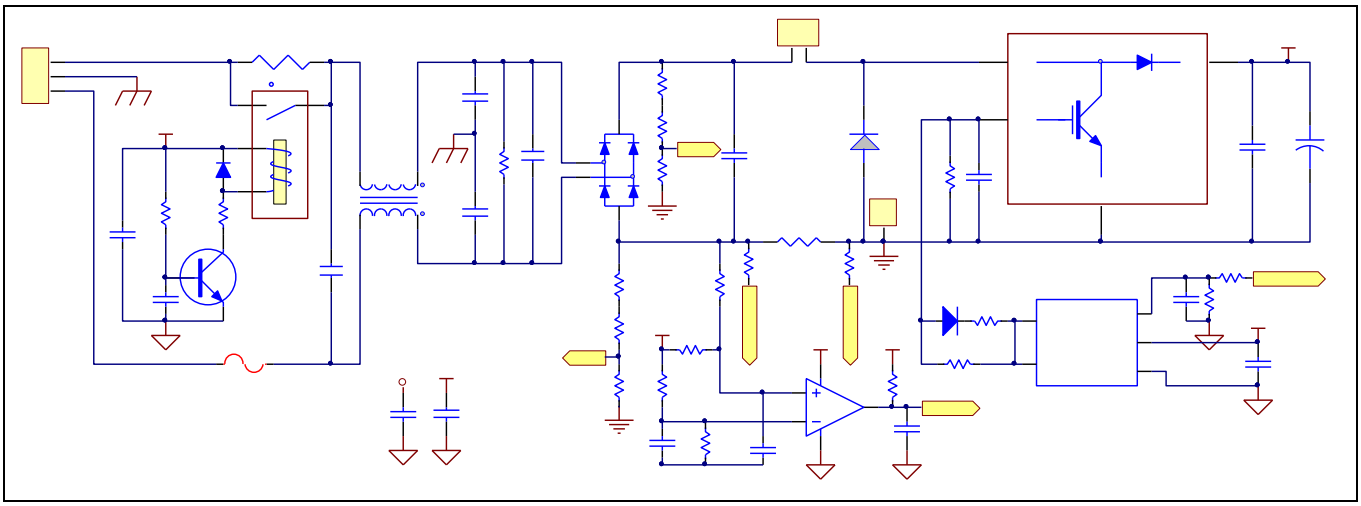


Figure 5 Schematic for EMI filter and PFC section of the Eval-M3-CM615PN evaluation board

The PFC section of CIPOS™ IPM IFCM15P60GD contains a TRENCHSTOP™ 5 IGBT and a rapid switching emitter controlled diode. The PFC IGBT's anti-parallel diode D3 is mandatory. For 650W power output, the inductance of PFC inductor should be larger than 3mH. Two electrolytic capacitors E1 and E2 are used for buffering the rectified DC bus voltage DCP.

5.3 Inverter section using CIPOS™ mini IPM

The inverter section is also implemented using the CIPOS™ mini IPM as sketched in Figure 6. The module includes an optimized SOI gate driver and a three-phase inverter consisting of TRENCHSTOP™ IGBTs and anti parallel diodes.

The three pairs of capacitors C11 and C12, C13 and C14, C15 and C16 are used as bootstrap capacitors to provide the necessary floating supply voltages V_{BS1}, V_{BS2} and V_{BS3} respectively.

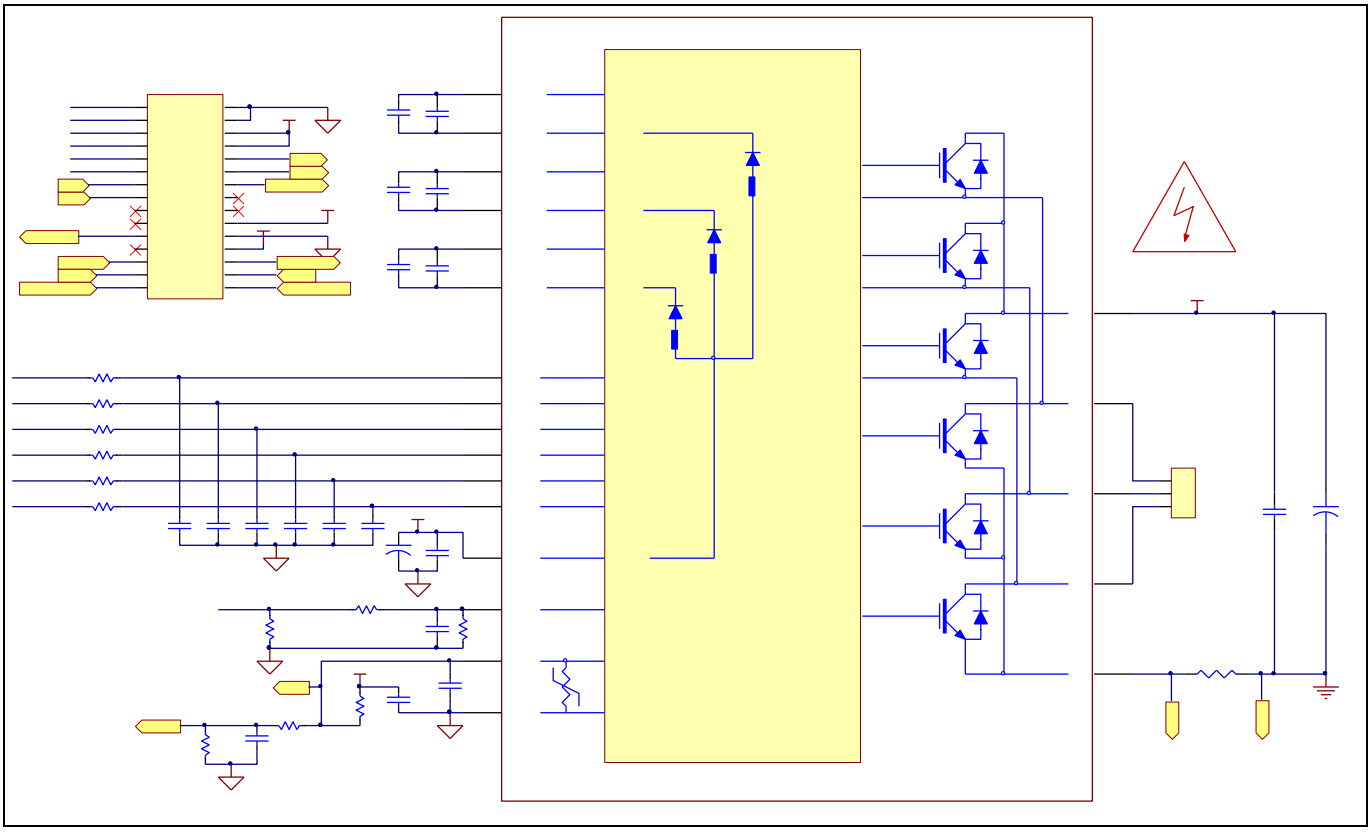


Figure 6 Schematic of the 3-phase inverter section using CIPOS™ mini IPM on Eval-M3-CM615PN

5.4 Auxiliary power supply

Figure 7 depicts the schematic of the auxiliary power supply available on the Eval-M3-CM615PN board. The circuit includes a LNK306 that is used to generate 15 V directly from the DC bus. V_{CC} is connected to the gate drivers inside the CIPOS™ IPM.

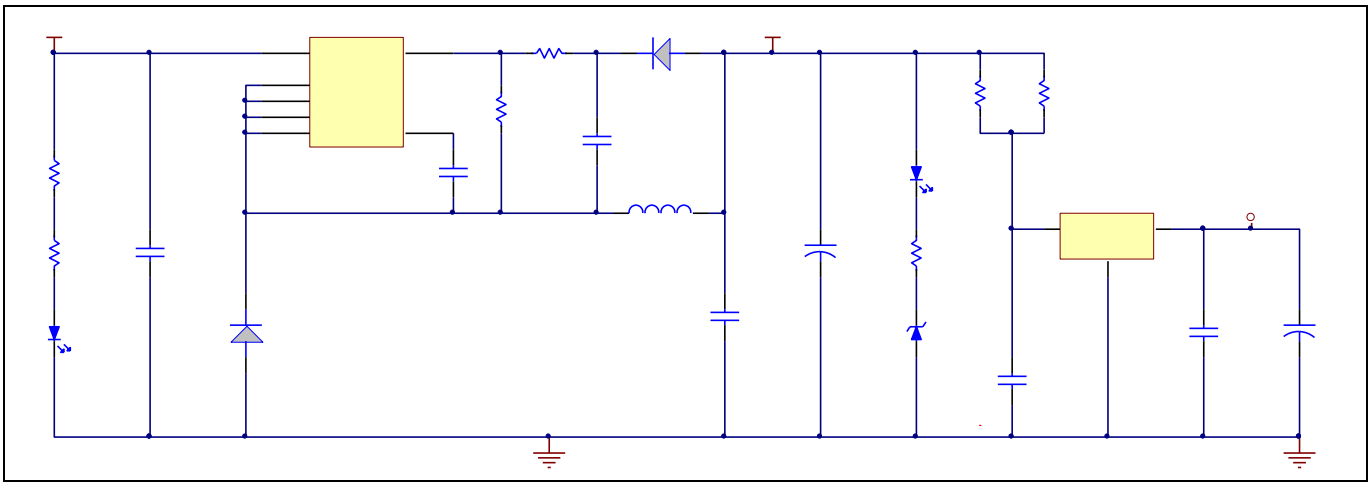


Figure 7 Power supply section of the Eval-M3-CM615PN evaluation board

The linear voltage regulator IFX1117ME V33 generates 3.3 V from 15 V power supply V_{CC}. The 3.3 V power supply is used in the PFC overcurrent comparator circuit and overtemperature hardware protection circuit. Both V_{CC} and 3.3 V are also present on the 30 pins iMOTION™ MADK-M3 interface connector J3 to power circuitry on the controller board.

5.5 Overcurrent protection circuit

Figure 8 displays the overcurrent protection circuitry. The current sensing output I_Shunt is connected to ITRIP via the resistor R32, and ITRIP is filtered through capacitor C21.

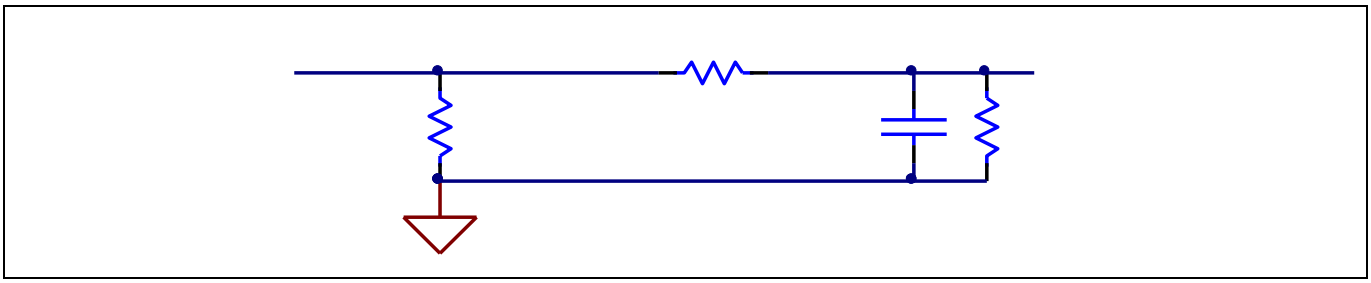


Figure 8 Overcurrent protection circuit on the Eval-M3-CM615PN evaluation board

The typical value of ITRIP positive going threshold $V_{IT,TH+}$ is 470mV. So the inverter output peak current is about 15.67A.

$$I_{trip} = \frac{V_{IT,TH+}}{R_{shunt}} = \frac{470mV}{30m\Omega} = 15.67A$$

5.6 Thermistor Output

This board provides Thermistor/NTC output on pin 15 of the 30 pins connector J3. Temperatures can be calculated by resistor measurement. The thermistor characteristics for CIPOS™ mini IPM with build in NTC are listed as summarized in Table 7.

Table 7 CIPOS™ Internal NTC – Thermistor Characteristics

Description	Condition	Symbol	Value			Unit
			min	typ	max	
Resistor	T_{NTC} = 25°C	R_{NTC}	79.638	85.000	90.362	kΩ
Resistor	T_{NTC} = 50°C	R_{NTC}	28.400	29.972	31.545	kΩ
Resistor	T_{NTC} = 60°C	R_{NTC}	19.517	20.515	21.514	kΩ
Resistor	T_{NTC} = 70°C	R_{NTC}	13.670	14.315	14.960	kΩ
Resistor	T_{NTC} = 80°C	R_{NTC}	9.745	10.169	10.593	kΩ
Resistor	T_{NTC} = 90°C	R_{NTC}	7.062	7.345	7.628	kΩ
Resistor	T_{NTC} = 100°C	R_{NTC}	5.199	5.388	5.576	kΩ
Resistor	T_{NTC} = 110°C	R_{NTC}	3.856	4.009	4.163	kΩ
Resistor	T_{NTC} = 120°C	R_{NTC}	2.900	3.024	3.149	kΩ
Resistor	T_{NTC} = 125°C	R_{NTC}	2.527	2.639	2.751	kΩ
B-constant of NTC		B(25/100)		4092		K

The VFO pin of CIPOS™-Modules provides direct access to the NTC, which is referenced to VSS. An external pull-up resistor connected to +3.3V ensures that the resulting voltage can be directly connected to the microcontroller.

Figure 9 depicts the CIPOS™ internal circuit at pin VFO. An external pull-up resistor is required to bias the NTC.

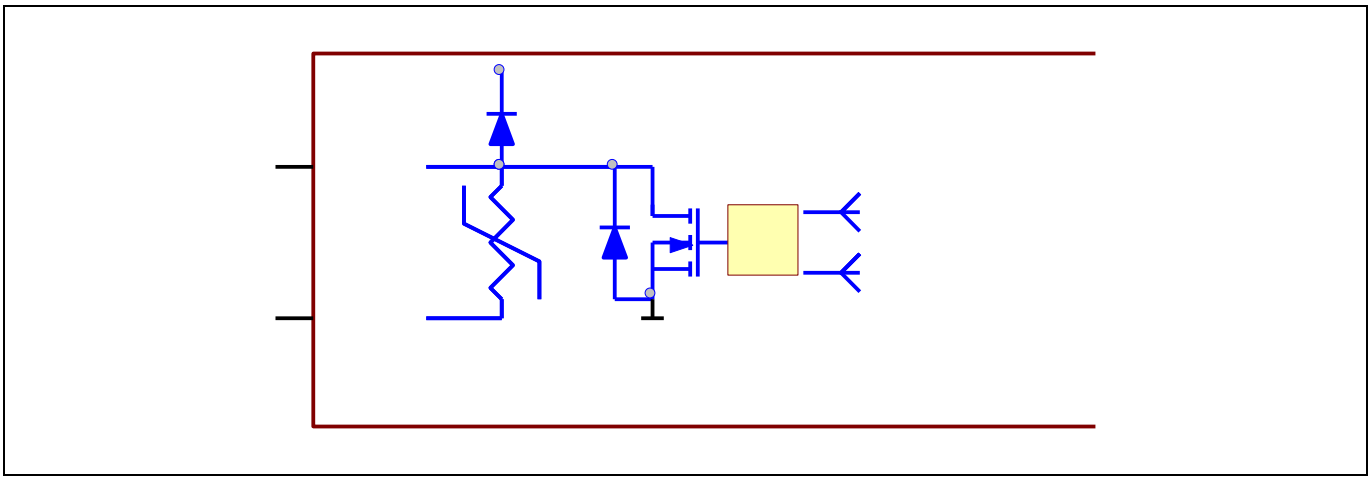


Figure 9 Internal circuit at pin VFO for CIPOS™ IPM IFCM15P60GD

5.7 Overtemperature Hardware Protection Circuit

The VFO pin not only provides direct access to the NTC, but also indicates a module failure in case of under voltage at pin VDD or in case of triggered overcurrent detection at ITRIP. In this evaluation design kits Eval-M3-CM615PN and Eval-M3-188, the VFO pin is directly connected to the Gatekill pin for controller IC IRMCF188. The maximum input low voltage of Gatekill for IRMCF188 is 0.8V. And NTC thermal resistor is about 3.0 kΩ at 120°C. The resistors R35 and R36 for the power board Eval-M3-CM615PN are chosen properly to make sure the voltage of VFO is 0.8V at 120°C. And then the Gatekill will ask the microcontroller to stop generating PWM pulses if the temperature of NTC continues to rise.

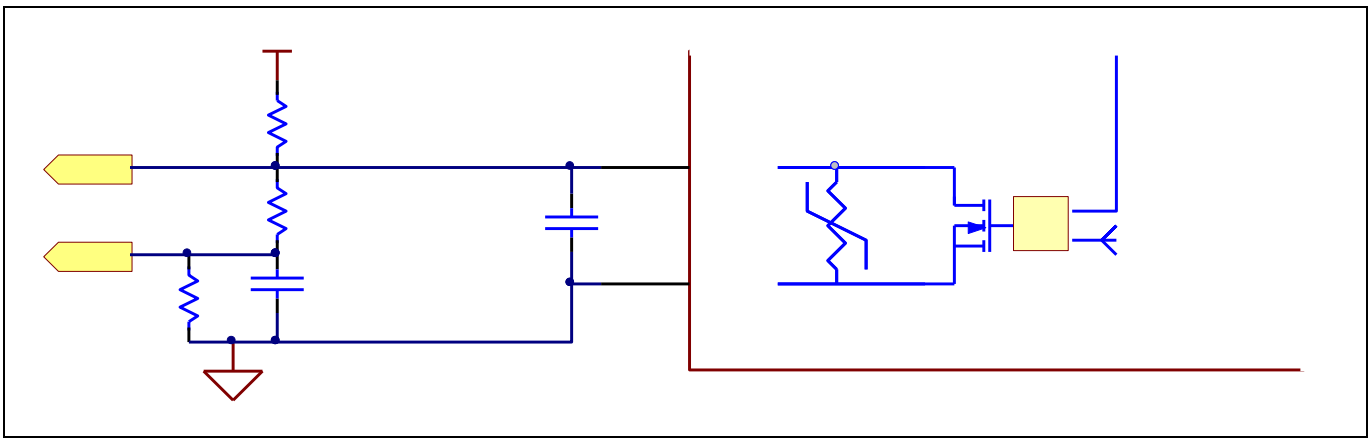


Figure 10 Overtemperature protection circuit schematic for Eval-M3-CM615PN

If a pull down resistor of 9.76 kΩ referred to ground is inserted either on the Eval-M3-CM615PN evaluation board or on the control board, the VTH voltage results in the range of 0 to 1.2 V on the pin reflecting a NTC temperature range of 0 to 150 °C.

If a pull down resistor of 9.76 kΩ is inserted on both, Eval-M3-CM615PN evaluation board and on the control card, the NTC temperature range is still from 0 to 150 °C. However NTC temperature is about 118°C when the voltage of VFO is 0.8V. No safety issue occurs.

If there is no pull down resistor inserted on both, the voltage of VTH is almost the same as VFO. AIN4 (Analog input channel 4) is used for VTH in control board Eval-M3-188. And the maximum analog Input Voltage for IRMCF188 is only 1.98V. Permanent damage for pin AIN4 may be caused by larger voltage of VFO.

5.8 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 120 mm × 120 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 11 illustrates the top assembly print of the evaluation board.

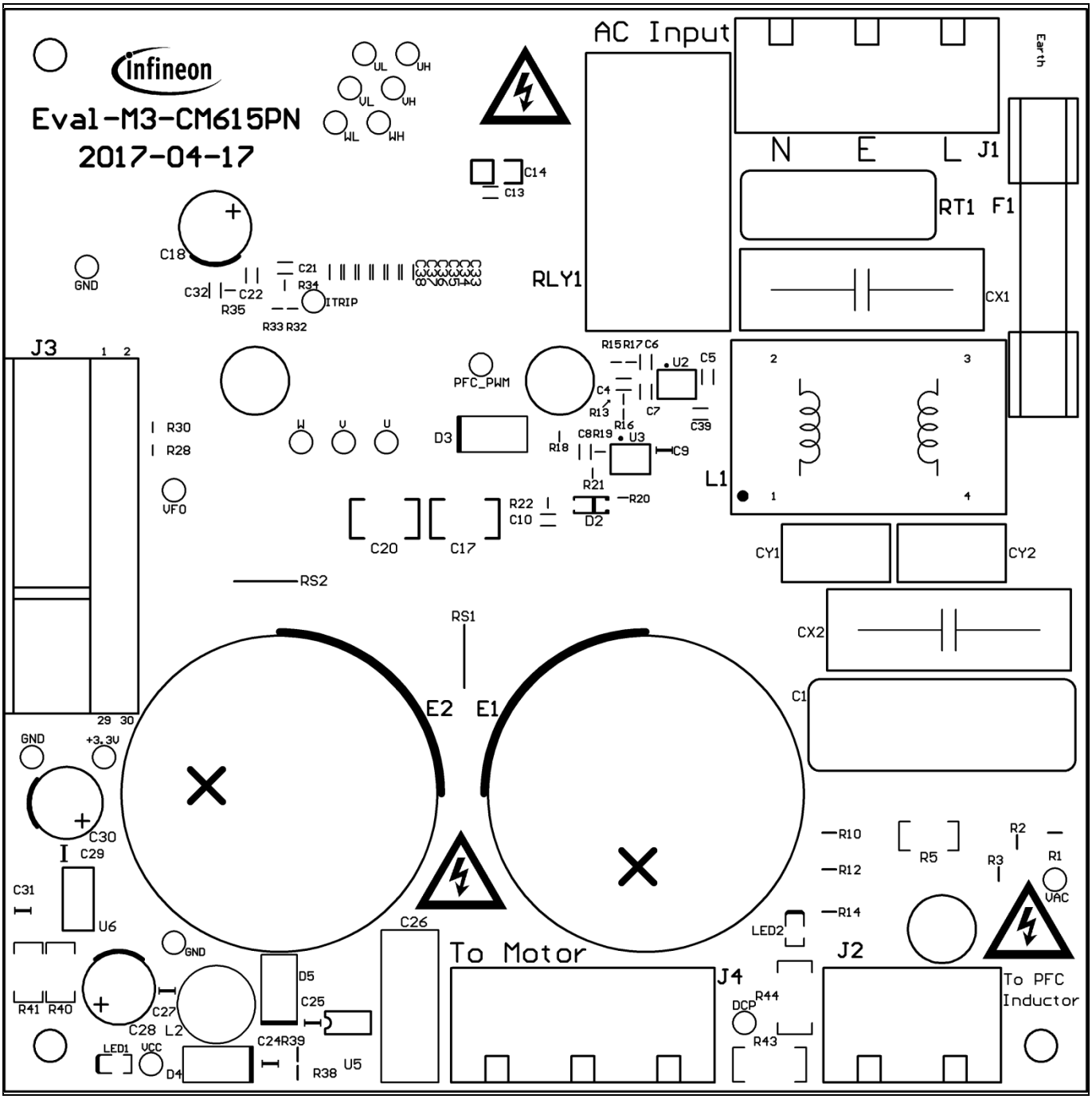


Figure 11 Top assembly print of the Eval-M3-CM615PN evaluation board

Figure 12 depicts the bottom assembly print of the evaluation board.

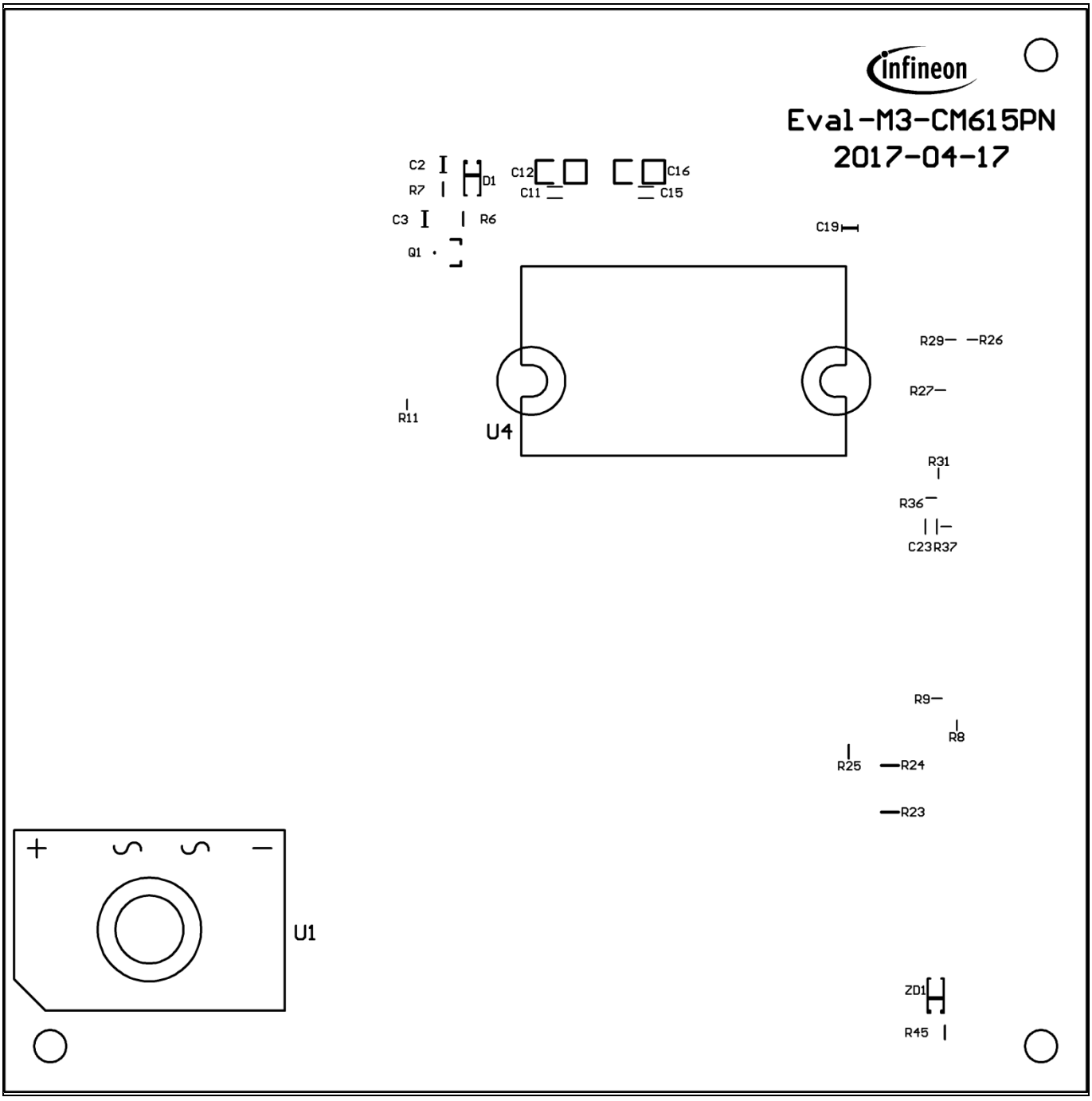


Figure 12 Bottom assembly print of the Eval-M3-CM615PN evaluation board

The top layer routing of the PCB is provided in Figure 13.

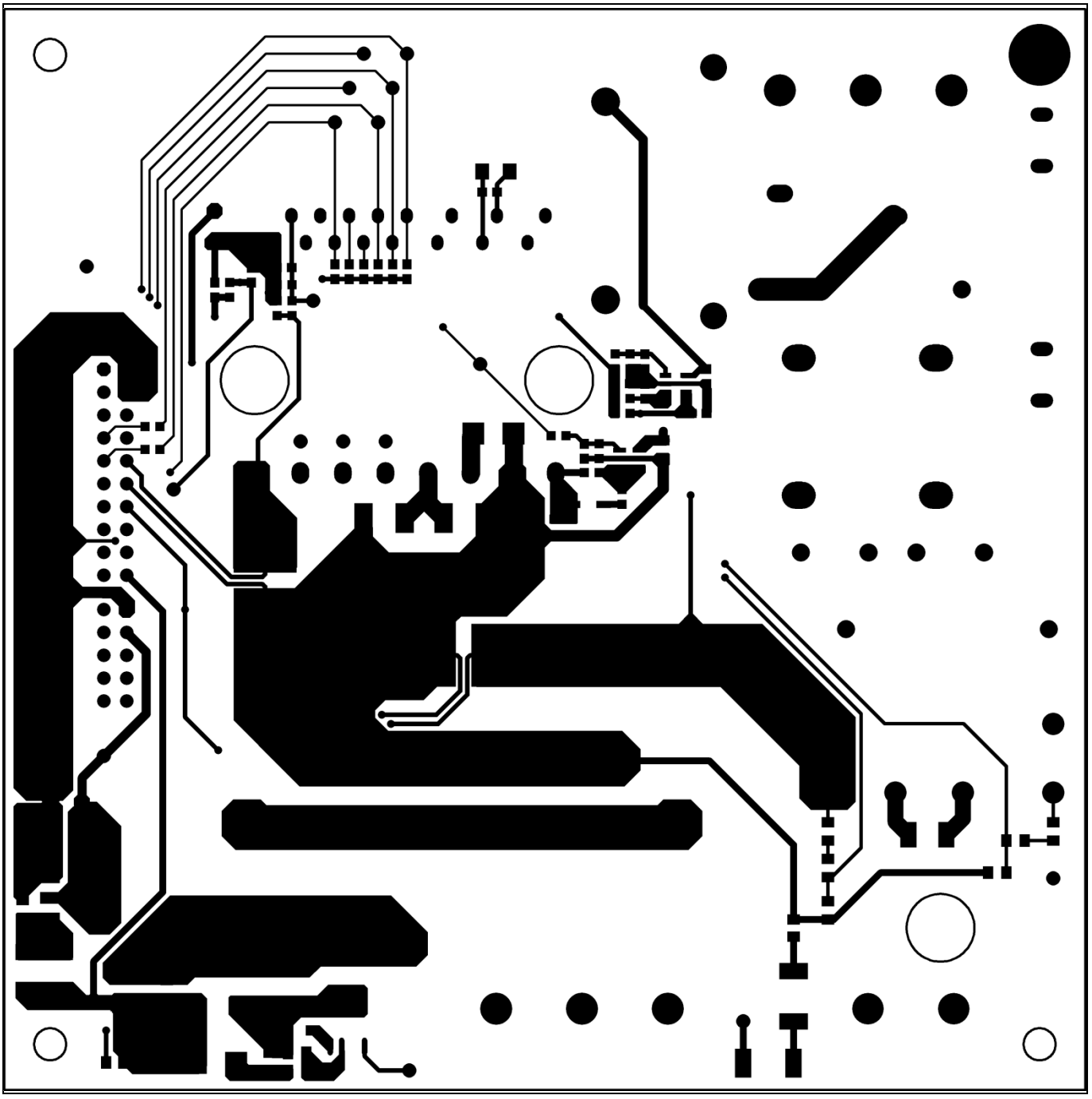


Figure 13 Top layer routing of the Eval-M3-CM615PN

Figure 14 illustrates the bottom layer routing of the PCB.

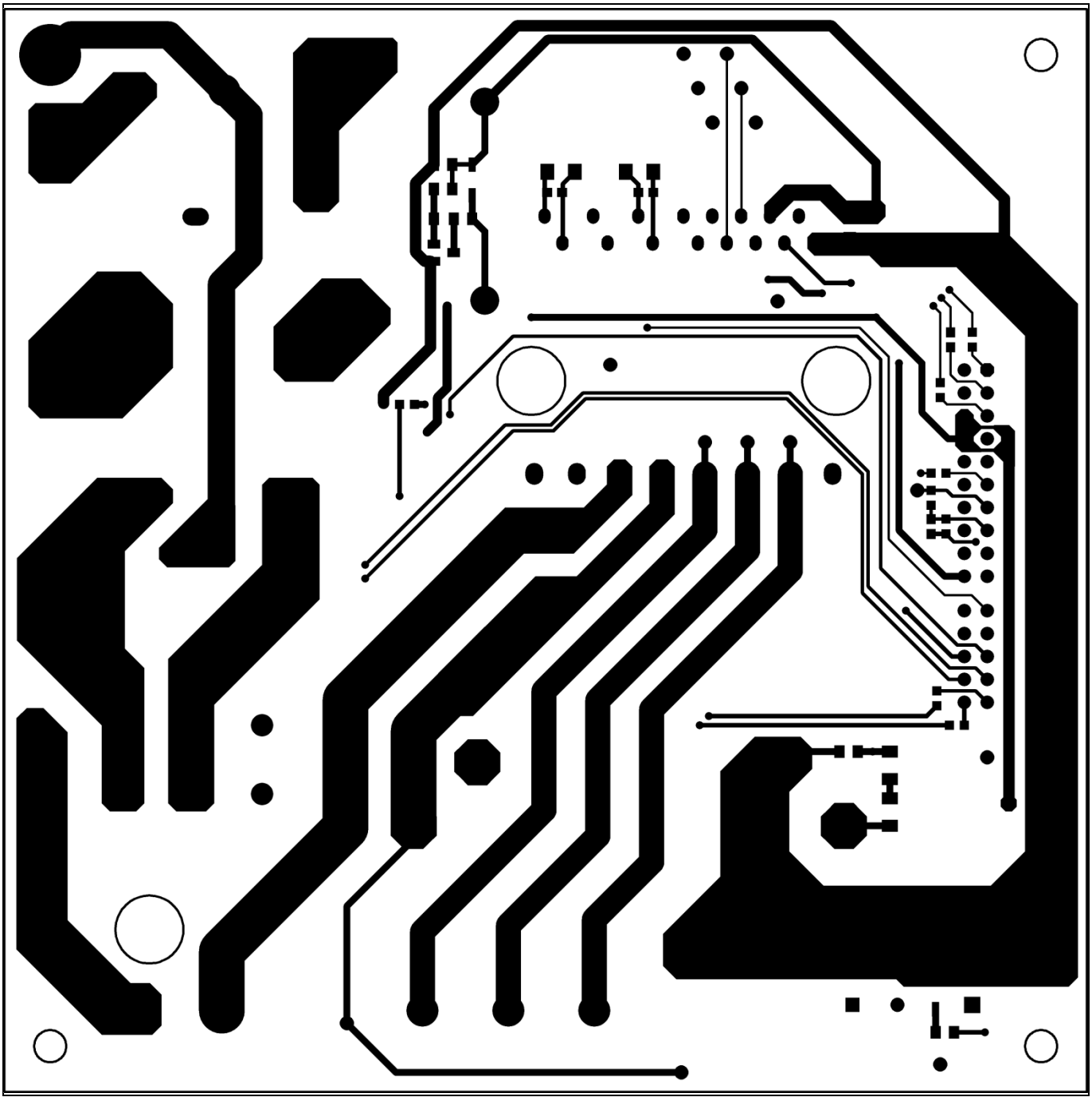


Figure 14 Bottom layer routing of the Eval-M3-CM615PN

6 Bill of Materials of Eval-M3-CM615PN

Table 8 provides the complete bill of materials of the evaluation board.

Table 8 Bill of materials

No.	Qty	Part description	Designator	Part number	Manufacturer
01	1	CAP FILM 1µF 5% 630VDC RADIAL	C1	ECW-F6105JL	Panasonic Electronic
02	1	CAP CER 10µF 25V 0805	C2	TMK212BBJ106KG-T	Taiyo Yuden
03	1	CAP CER 4.7µF 25V 0805	C3	TMK212AB7475KG-T	Taiyo Yuden
04	2	CAP CER 10µF 6.3V 0603	C4, C32	GRM188R60J106ME47D	Murata Electronics North America
05	1	CAP CER 10µF 25V 0603	C5	GRM188R61E106MA73D	Murata Electronics North America
06	3	CAP CER 1000pF 25V 0603	C6, C7, C39	C0603C102K3RACTU	Kemet
07	1	CAP CER 2200pF 25V 0603	C8	C0603C222K3RACTU	Kemet
08	3	CAP CER 10µF 25V 0805	C9, C24, C29	TMK212BBJ106KG-T	Taiyo Yuden
09	3	CAP CER 0.1µF 25V 0603	C11, C13, C15	06033C104KAT2A	AVX Corporation
10	3	CAP CER 22µF 25V 1206	C12, C14, C16	12063D226KAT2A	AVX Corporation
11	2	CAP CER 0.1µF 630V X7R 1812	C17, C20	C4532X7R2J104K230KA	TDK Corporation
12	1	CAP ALUM 100µF 25V RADIAL	C18	UTT1E101MPD1TD	Nichicon
13	1	CAP CER 0.1µF 25V 0805	C19	C0805C104K3RACTU	Kemet
14	1	CAP CER 0.022µF 25V X7R 0603	C21	C0603C223K3RACTU	Kemet
15	1	CAP CER 4700pF 25V X7R 0603	C22	C0603C472K3RACTU	Kemet
16	1	CAP CER 1µF 25V X7R 0603	C23	C1608X7R1E105K080AB	TDK Corporation
17	1	CAP CER 0.1µF 25V X7R 0603	C25	06033C104KAT2A	AVX Corporation
18	1	CAP FILM 0.1µF 630V RADIAL	C26	ECW-FA2J104J	Panasonic Electronic
19	1	CAP CER 0.22µF 25V 0805	C27	C0805X224K3RAC7800	Kemet
20	1	CAP ALUM 220µF 35V RADIAL	C28	35ZLS220MEFC8X11.5	Rubycon
21	1	CAP ALUM 470µF 16V RADIAL	C30	16ZLH470MEFC8X11.5	Rubycon
22	1	CAP CER 10µF 25V 0805	C31	TMK212BBJ106KG-T	Taiyo Yuden
23	6	CAP CER 1000pF 16V X7R 0603	C33, C34, C35, C36, C37, C38	C0603C102K4RACTU	Kemet
24	2	CAP FILM 0.47µF 10% 275VAC RADIAL	CX1, CX2	MKP275VAC474PF	JIMSON
25	2	CAP CER 3300pF 440VAC Y5U RADIAL	CY1, CY2	ECK-ATS332ME	Panasonic Electronic Components
26	2	Diode GEN PURP 100V 300mA SOD123	D1, D2	1N4148W-7-F	Diodes Incorporated
27	3	Diode Standard 600V 1A Surface Mount SMA	D3, D4, D5	US1J-13-F	Diodes Incorporated
28	2	CAP ALUM 330µF 20% 450V SNAP	E1, E2	EET-UQ2W331EA	Panasonic

No.	Qty	Part description	Designator	Part number	Manufacturer
					Electronic
29	1	FUSE CERAMIC 10A 250V Φ6X30	F1	RO58 /BS1362-10A	Zhenghao Fuse Co.
30	2	CONN TERM BLOCK 3POS 9.52MM PCB	J1, J4	1714984	Phoenix Contact
31	1	CONN TERM BLOCK 2POS 9.52MM PCB	J2	1714971	Phoenix Contact
32	1	CONN RCPT .100" 20 PS DL R/A GOLD CONN RCPT .100" 10 PS DL R/A GOLD	J3	SSW-110-02-S-D-RA SSW-105-02-S-D-RA	Samtec Inc.
33	1	8108-RC	L1	JWMILLER_8108	Bourns, Inc.
34	1	FIXED IND 2.2mH THROUGH HOLE	L2	RLB0914-222KL	Bourns Inc.
35	1	LED GREEN CLEAR 0805 SMD	LED1	LTST-C171GKT	Lite-On Inc.
36	1	LED RED CLEAR 0805 SMD	LED2	LTST-C171KRKT	Lite-On Inc.
37	1	TRANS NPN 100V 1A SOT23-3	Q1	FMMT493TA	Diodes Incorporated
38	4	RES SMD 1MΩ 1% 1/5W 0805	R1, R2, R10, R12	MCU08050C1004FP500	Vishay Beyschlag
39	1	RES SMD 1MΩ 5% 3/4W 2010	R5	CRCW20101M00JNEF	Vishay Dale
40	1	RES SMD 91Ω 5% 1/8W 0805	R6	RC0805JR-0791RL	Yageo
41	1	RES SMD 3.3kΩ 5% 1/8W 0805	R7	RMCF0805JT3K30	Stackpole Electronics Inc.
42	4	RES SMD 1kΩ 1% 1/10W 0603	R8, R9, R11, R17	RC0603FR-071KL	Yageo
43	1	RES SMD 3.92kΩ 1% 1/10W 0603	R13	RC0603FR-073K92L	Yageo
44	1	RES SMD 10kΩ 1% 1/10W 0603	R15	RC0603FR-0710KL	Yageo
45	2	RES SMD 4.7kΩ 5% 1/10W 0603	R16, R19	RC0603JR-074K7L	Yageo
46	1	RES SMD 10Ω 5% 1/10W 0603	R20	RC0603JR-0710RL	Yageo
47	1	RES SMD 47Ω 5% 1/10W 0603	R21	RC0603JR-0747RL	Yageo
48	1	RES SMD 12kΩ 5% 1/10W 0603	R22	RC0603JR-0712KL	Yageo
49	2	RES SMD 1MΩ 1% 1/3W 1206	R23, R24	HVCB1206FKC1M00	Stackpole Electronics Inc.
50	8	RES SMD 100Ω 5% 1/10W 0603	R18, R26, R27, R28, R29, R30, R31, R32	RC0603JR-07100RL	Yageo
51	1	RES SMD 9.1kΩ 1% 1/10W 0603	R35	RC0603FR-079K1L	Yageo
52	1	RES SMD 10kΩ 1% 1/8W 0805	R36	RC0805FR-0710KL	Yageo
53	1	RES SMD 15.8kΩ 1% 1/8W 0805	R38	RC0805FR-0715K8L	Yageo
54	1	RES SMD 2kΩ 1% 1/8W 0805	R39	RC0805FR-072KL	Yageo
55	2	RES SMD 200Ω 5% 3/4W 2010	R40, R41	RC2010JK-07200RL	Yageo
56	2	RES SMD 100kΩ 5% 1W 2512	R43, R44	AC2512JK-07100KL	Yageo

Bill of Materials of Eval-M3-CM615PN

No.	Qty	Part description	Designator	Part number	Manufacturer
57	1	RES SMD 10kΩ 5% 1/8W 0805	R45	RC0805JR-0710KL	Yageo
58	1	RELAY GEN PURPOSE SPST 20A	RLY1	G4A-1A-PE DC12	Omron Electronics Inc-EMC Div
59	2	RES SMD 0.03Ω 1% 2W 2512 wide	RS1, RS2	FC4L64R030FER	Ohmite
60	1	NTC thermistors for inrush	RT1	NTC5D-20	Yuanlindianzi
61	1	RECT BRIDGE GPP 600V 25A GBJ	U1	GBJ2506-F	Diodes Incorporated
62	1	IC COMPARATOR VOLT SGL	U2	LM397MF/NOPB	Texas Instruments
63	1	IC DRIVER LOW SIDE 1.5A SOT23-5	U3	IRS44273LTRPBF	Infineon Technologies
64	1	15A 600V CIPOS™ Mini PFC integrated DIP IPM	U4	IFCM15P60GD	Infineon Technologies
65	1	IC OFFLINE SWIT OCP 8SOIC	U5	LNK306DN	Power Integrations
66	1	IC REG LDO 3.3V 1A SOT223-4	U6	IFX1117ME V33	Infineon Technologies
67	1	DIODE ZENER 10V 500mW SOD123	ZD1	BZT52C10-7-F	Diodes Incorporated

7 Reference

[1] Datasheet of Infineon CIPOS™ mini IPM IFCM15P60GD

[2] Datasheet of Infineon Digital Motor Controller IRMCF188

[3] Application Note AN2016-10 CIPOS Mini Technical Description

[4] Application Note 2017-05_AN2017-11 EVAL-M3-188_V1.0_EN

Above documents are available for download on Infineon’s website

Revision History

Major changes since the last revision

Version number	Revision Date	Revision description
1.0	2017-07-01	First release

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