iMOTION™ IMM101T/IMM102T - Smart IPM for motor control

Fully integrated high-performance turnkey motor control system

Quality requirement category: Industry

IMM101T/IMM102T series is a family of fully-integrated, turnkey high-voltage Motor Drive Module designed for high-performance, high-efficiency PMSM/BLDC motor drive applications such as fans, pumps and compressors. It integrates Infineon's Advanced Motion Control Engine (MCE), gate driver and six power MOSFETs in a single 12x12mm package.

Feature list

- Motion control engine (MCE) as ready-to-use controller solution for variable speed drives
- Field oriented control (FOC) for permanent magnet synchronous motor (PMSM)
- Space vector PWM with sinusoidal commutation and integrated protection features
- Current sensing via single or leg shunt through direct interface
- Sensorless operation
- Integrated analog comparators for over-current protection
- Built-in temperature sensor
- 3.3V or 5.0V supply voltage options for controller
- 15V supply voltage for gate driver
- 3 different power MOSFET options: 6Ω/500V, 1.4Ω/650V and 0.95Ω/650V
- Integrated bootstrap FET
- Support for hall sensors
- Boost PFC control (IMM102T only)
- Flexible host interface options for speed commands: UART, PWM or analog signal
- Support for IEC 60335 ('Class B')
- Isolation $1500V_{RMS}$ 1min
- Very compact 12x12mm PQFN package

Applications

- Fans
- Pumps
- Compressors

IMM100 series description

IMM101T/IMM102T devices belong to IMM100 series of iMOTION™ Smart IPMs. IMM100 series is a family of fully-integrated, programmable or configurable (“turnkey”) high-voltage Motor Drive Modules designed for high-performance, high-efficiency PMSM (BLDC) motor drive applications such as fans, pumps and compressors. It integrates a controller, a gate driver and six power MOSFETs. IMM100 series is available in two variants: “A”-variant and “T”-variant. “A”-variant (IMM100A-xxx) includes a fully programmable ARM® Cortex®-M0 controller, while “T”-variant (IMM10xT-xxx) features the Infineon’s patented Motion Control Engine (MCE).

Both variants offer different control configuration options for PMSM motor-drive system in a compact 12x12mm surface-mount package which minimizes external components count and PCB area. This thermally enhanced package provides excellent thermal performance working with or without heatsink. The package features a 1.3mm creepage distance between the high-voltage pads beneath the package to ease the surface mounting with standard SMT process and increase the robustness of the system.

IMM100 series integrates either 500V FredFET or 650V CoolMOS and the industry benchmark 3-phase high-voltage, rugged gate driver with integrated bootstrap functionality. Depending on the power MOSFETs employed in the package, IMM100 series covers applications with a rated output power from 25W to 80W with 500V/600V maximum DC voltage. In the 600V versions, the Power MOS technology is rated 650V, while the gate driver is rated 600V, which determines the maximum allowable DC voltage of the system.

Ordering information

IMM100T devices integrate an MCE for the control of variable speed drives. By integrating both the required hardware and software to perform control of a permanent magnet synchronous motor (PMSM) they provide the shortest time to market for any motor system at the lowest system and development cost.

Product type	Application	Output Rating	$R_{DS(ON)}$ Typ
IMM101T-015M	Single Motor Control	500V / 1A	4.8 Ω
IMM101T-046M	Single Motor Control	600V / 4A	1.26 Ω
IMM101T-056M	Single Motor Control	600V / 4A (optimized for low-frequency operation)	0.86 Ω
IMM102T-015M	Single Motor Control + Boost PFC	500V / 1A	4.8 Ω
IMM102T-046M	Single Motor Control + Boost PFC	600V / 4A	1.26 Ω
IMM102T-056M	Single Motor Control + Boost PFC	600V / 4A (optimized for low-frequency operation)	0.86 Ω

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1 Overview

IMM100T modules contain a processor core that can address the real-time control needs of motor control. It can use low-cost single shunt or leg shunts as motor current feedback by a combination of on-chip hardware and firmware. Complex FOC control algorithms either sensorless or with sensors, as well as system level control can be easily implemented inside IC and meet fan, pump and compressor applications requirements.
A standby mode helps to decrease system power consumption when the motor is stopped. The high-voltage level shifting function with boot strap diode function is integrated into the gate driver IC. The device also contains the six low-loss 500V power FET or 650V CoolMOS which form the three phase inverter circuit.

1.1 IMM100T – Motion Control Engine

iMOTION™ IMM100T is the latest generation inverter including controller designed as a single package solution for inverterized motor control applications with or without power factor correction. The IMM100T series provides a built-in closed loop sensorless (or optionally sensor based) control algorithm using the unique flexible Motion Control Engine (MCE) for permanent magnet motors. Infineon's patented and field proven MCE implements field oriented control (FOC) using single or leg shunt current feedback and uses space vector PWM with sinusoidal signals to achieve highest energy efficiency. In addition to the motor control algorithm it also integrates multiple protection features like over- and under-voltage, over current, rotor lock etc. The IMM100T series takes advantage of a new hardware platform combining an ARM® Cortex® core with an innovative set of analog and motor control peripherals. The high-level of integration in terms of hardware and software results in a minimum number of external components required for the implementation of the inverter control.
The next generation of the MCE not only further improves the performance of the control algorithm but also adds functionality like sensor support for accurate rotor positioning, ready-to-use PFC algorithm as well as more and flexible and faster host interface options.
The IMM100T series is offered in several device variants ranging from single motor control to motor control plus PFC. All devices can be used in applications requiring functional safety according to IEC 60335 ('Class B').
This data sheet provides all electrical, mechanical, thermal and quality parameters. A more detailed description of the features and functionality can be found in the respective reference manual of the MCE software.
There are multiple versions of the MCE software offered from Infineon and made available via download from the Infineon web site. By using a special secure boot algorithm it is assured that the MCE software versions can only be installed onto the matching hardware derivative, i.e. IMM100T variants for which the software has been tested and released. Infineon provides the tools to program these software images.

1.2 Gate Driver

The gate driver is designed to work with MCE within an integrated power module. It has integrated boot strap bootFET structure, only external bootstrap capacitors are needed outside the module. The gate driver includes an under voltage protection and a fault reporting system. The gate driver is based on 600V High-Voltage Junction Isolation technology.

1.3 Switches

The IMM100T modules are available in three different power stage options

- 6 Ohm 500V Trench MOSFETs in versions IMM101T-015 and IMM102T-015
- 1.4 Ohm 650V CoolMOS™ in versions IMM101T-046 and IMM102T-046 (600V maximum voltage is defined by gate driver technology)

- 0.95 Ohm 650V CoolMOS™ in versions IMM101T-056 and IMM102T-056 (600V maximum voltage is defined by gate driver technology)

1.4 Application Diagrams

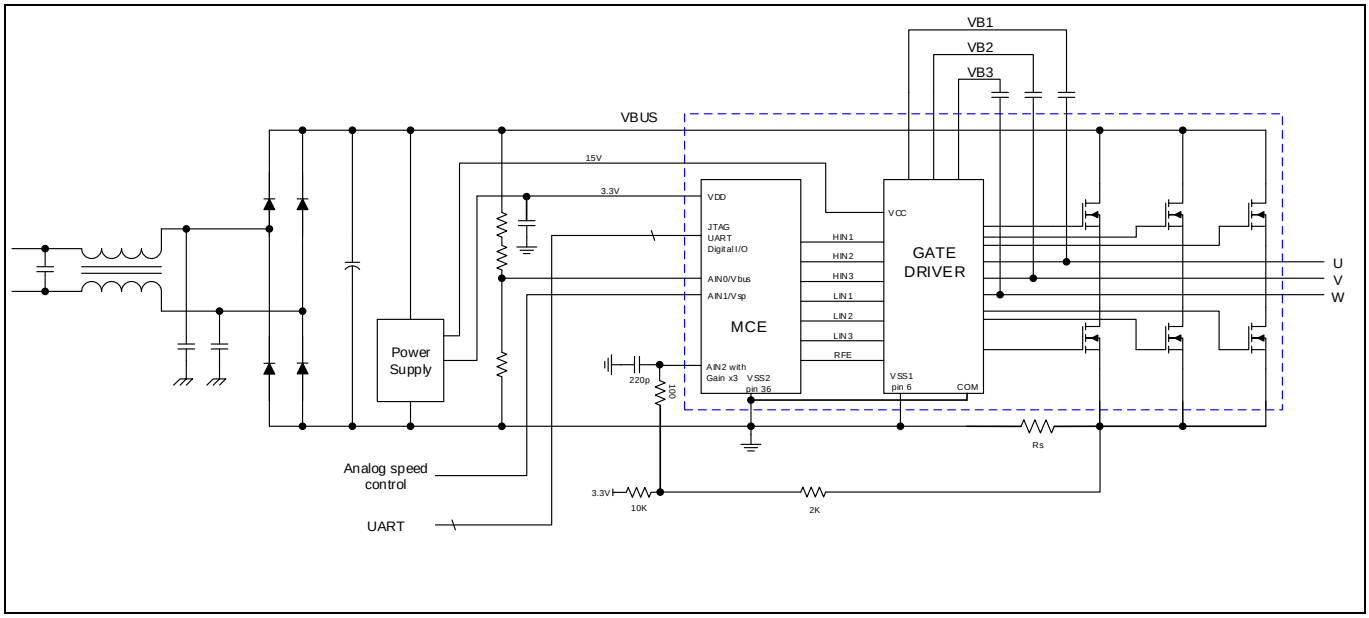


Figure 1 Application Block Diagram using IMM101T – Single Shunt Configuration

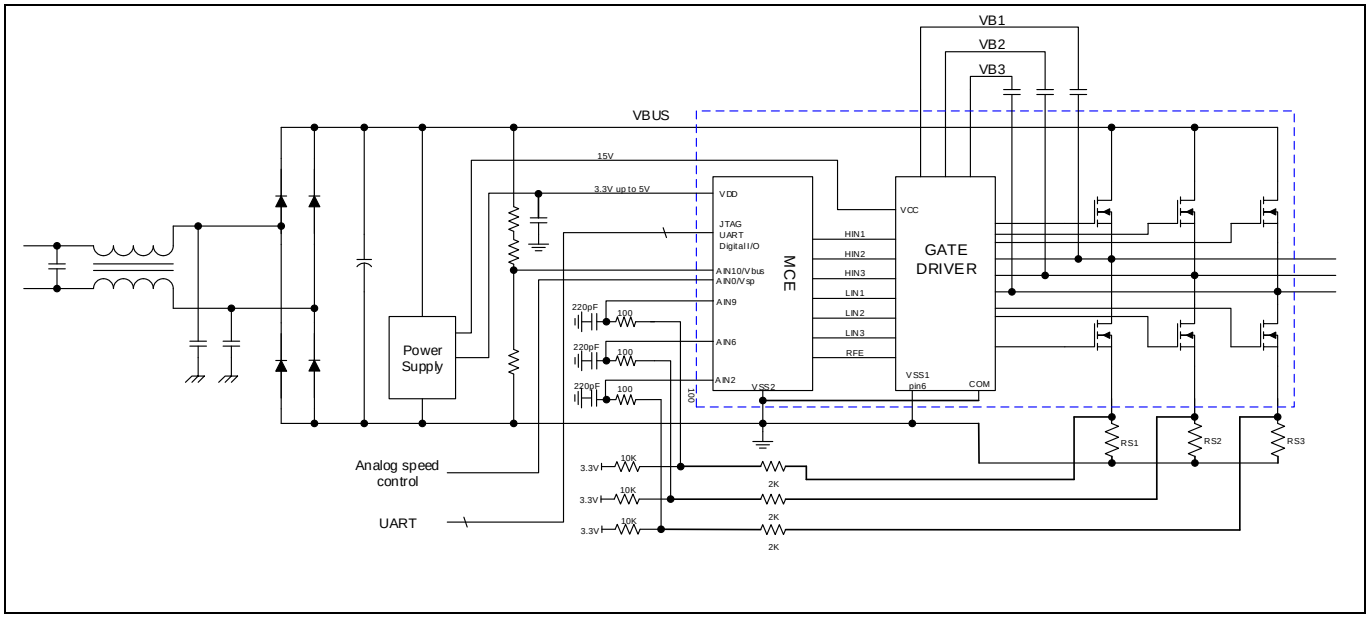


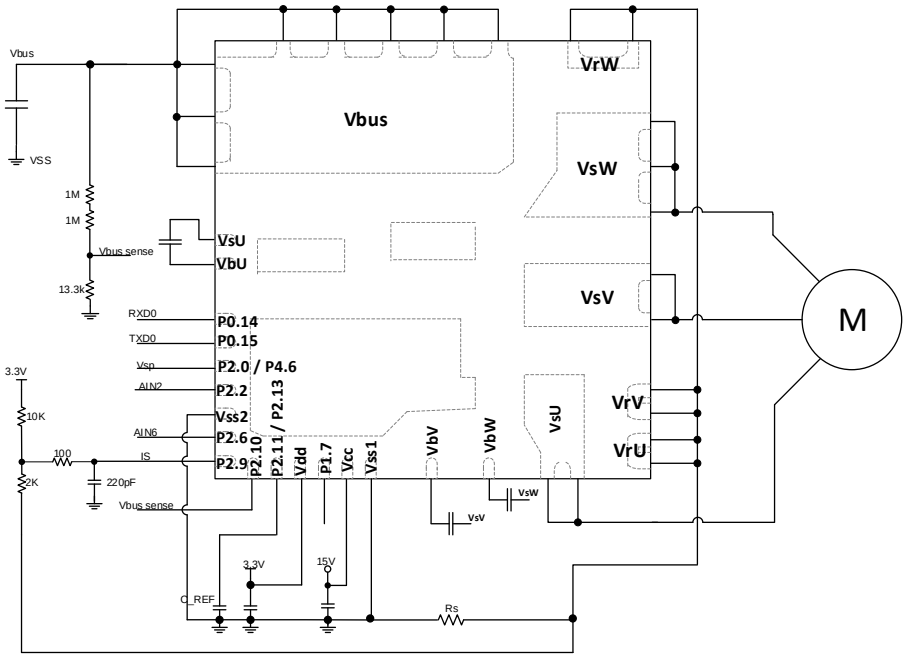
Figure 2 Application Block Diagram using IMM101T – Leg Shunts Configuration

1.5 IMM100T Application Use Cases

This chapter provides more details about most common application use cases for IMM100 series' devices, including necessary passive components and pin connections. For full information about each pin functionality, refer to Table1.

1.5.1 Sensorless Single-Shunt

The sensorless single-shunt use case shown below is a most common application use case for IMM100 devices, alowing lowest BOM cost and highest number of available programmable pins for system-level functions.



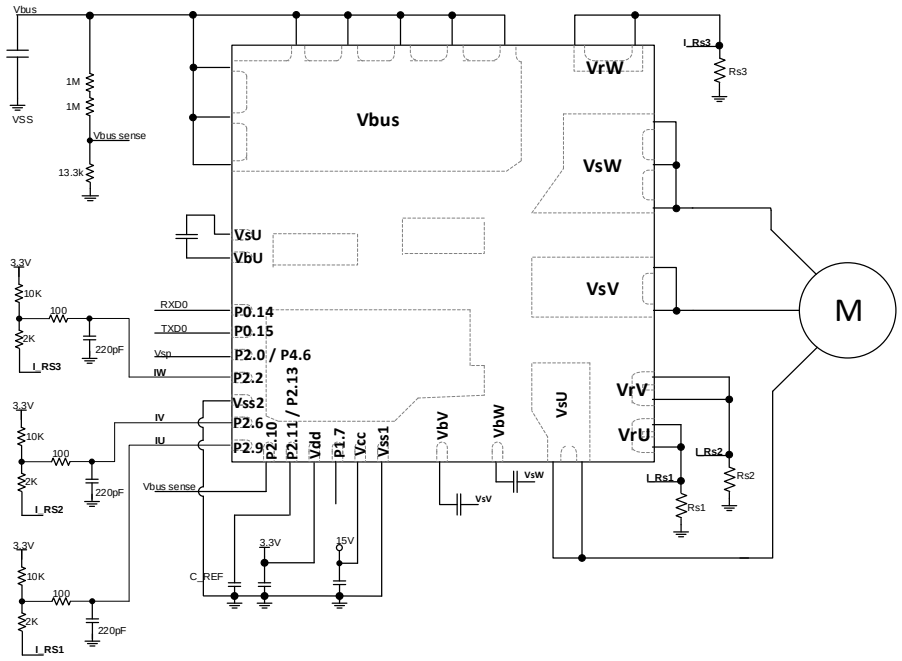
Options for Input Set Point:
1- Analog Input Vsp to pin34 P2.0
2- UART input through P0.14 and P0.15
3- Duty (PWM) or frequency input on pin34 P4.6

Other Pins available to the user:
P2.6, P2.2, P1.7

Figure 3 IMM101T Sensorless, single shunt configuration

1.5.2 Sensorless Leg Shunts

The sensorless leg shunts configuration may be used in applications where only very low acoustic noise is requrired.

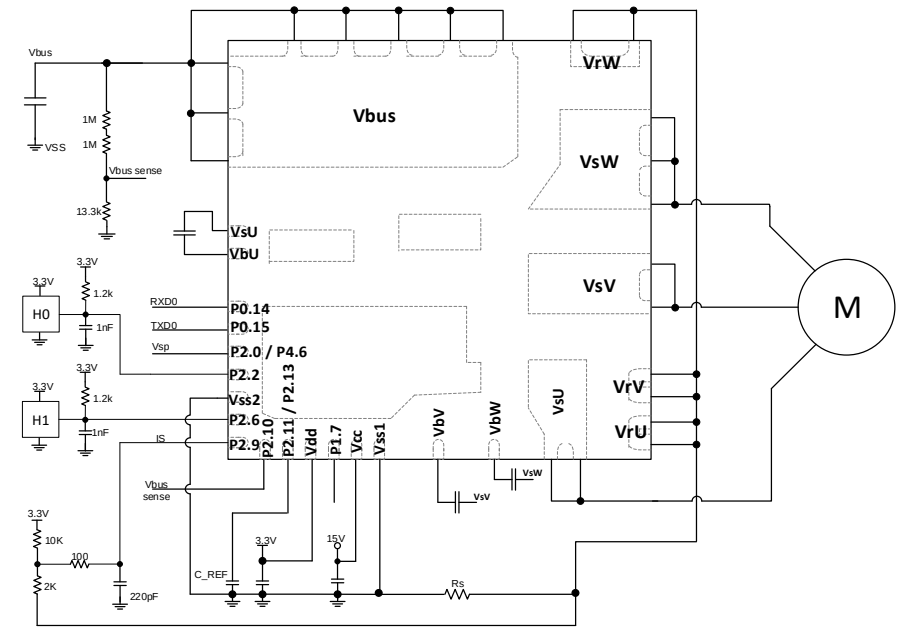


Options for Input Set Point:
1- Analog Input Vsp to pin34 P2.0
2- UART input through P0.14 and P0.15
3- Duty (PWM) or frequency input on pin34 P4.6

Other Pins available to the user:
P1.7
If only two shunts are used, P2.2 is available

Figure 4 IMM101T Sensorless, three leg shunts configuration

1.5.3 Configuration with 2 Hall Sensors



Options for Input Set Point:
1- Analog Input Vsp to pin34 P2.0
2- UART input through P0.14 and P0.15
3- Duty (PWM) or frequency input on pin 34 P4.6

Other Pins available to the user:
P1.7
If DcBus is not measured, P2.10 is available

Figure 5 IMM101T Two Hall sensors, single shunt configuration

1.5.4 Sensorless single-shunt with boost PFC

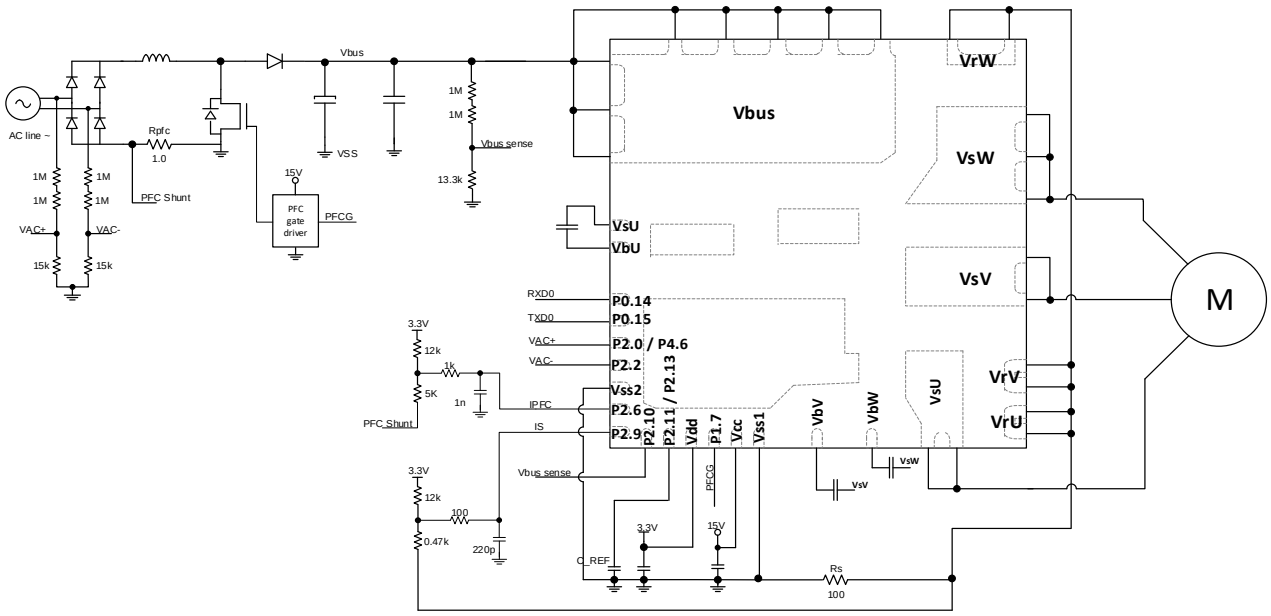
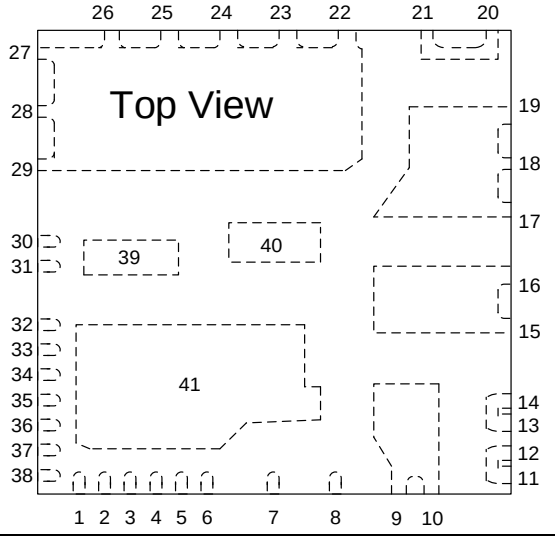


Figure 6 IMM102T Sensorless Single shunt with Boost PFC function

2 Pinout – IMM100T series

Table 1 Pinout description IMM101T series – single motor control – typical configuration

Pin	Name	Type	Description
1	Vbus scaled	I	Vbus scaled ADC input
2	CREF	I/O	Analog Overcurrent Comparator threshold DAC
3	V_{DD}	P	Digital V_{DD} input [3.3V – 5.0V]
4	P1.7	I/O	Digital Input --- Analog and Digital Output
5	Vcc	P	15V gate driver power supply input
6	$V_{SS}1$	P	Gate Driver Power ground, connect externally via PCB to pin 36
7	VbV	P	V phase bootstrap capacitor positive
8	VbW	P	W phase bootstrap capacitor positive
9,10	VsU	P	U phase output
11,12	VrU	P	Leg U return – Low-Side MOS source
13,14	VrV	P	Leg V return – Low-Side MOS source
15,16, 40	VsV	P	V phase output and V phase bootstrap capacitor negative
17,18,19	VsW	P	W phase output and W phase bootstrap capacitor negative
20,21	VrW	P	Leg W return – Low-Side MOS source
22~29	Vbus	P	DC bus voltage
30, 39	VsU	P	U phase bootstrap capacitor negative
31	VbU	P	U phase bootstrap capacitor positive
32	RX0	I	Serial Port Receive input
33	TX0	O	Serial Port transmit output
34	Vsp/AIN 0	I	Analog Voltage Set Point Input
35	IW (or H0)/AIN 2	I	Analog Current sense input phase W or Hall0 input
36,41	$V_{SS}2$	P	Signal ground --- Connect externally via PCB to pin 6
37	IV (or H1)/AIN 6	I	Analog Current sense input phase V or Hall1 input
38	ISS or IU	I	Analog Current sense input phase U or single Shunt



Note
Pins 39 and 40 are not required to be connected electrically on the PCB but are recommended to be soldered for mechanical stability.

Figure 7 IMM100T series pinout

Table 2 Pinout description IMM102T series – single motor + PFC – typical configuration

Pin	Name	Type	Description
1	Vbus scaled	I	Vbus scaled ADC input
2	CREF	I/O	Analog Overcurrent Comparator t hreshold DAC
3	V_{DD}	P	Digital V_{DD} input [3.3V – 5.0V]
4	PFCG	O	PWM Output to PFC gate driver
5	Vcc	P	15V gate driver power supply input
6	$V_{SS}1$	P	Gate Driver Power ground, connect externally via PCB to pin 36
7	VbV	P	V phase bootstrap capacitor positive
8	VbW	P	W phase bootstrap capacitor positive
9,10	VsU	P	U phase output
11,12	VrU	P	Leg U return – Low-Side MOS source
13,14	VrV	P	Leg V return – Low-Side MOS source
15,16, 40	VsV	P	V phase output and V phase bootstrap capacitor negative
17,18,19	VsW	P	W phase output and W phase bootstrap capacitor negative
20,21	VrW	P	Leg W return – Low-Side MOS source
22~29	Vbus	P	DC bus voltage
30, 39	VsU	P	U phase bootstrap capacitor negative
31	VbU	P	U phase bootstrap capacitor positive
32	RX0	I	Serial Port Receive input
33	TX0	O	Serial Port transmit output
34	Vac+	I	Vac input ac+ voltage sensing through resistor external divider
35	Vac-	I	Vac input ac- voltage sensing through resistor external divider
36,41	$V_{SS}2$	P	Signal ground --- Connect externally via PCB to pin 6
37	IPFC	I	Analog Current sense input PFC
38	ISS	I	Analog Current sense input single Shunt

Note: IMM101T and IMM102T share same package footprint.

3 Gate Driver Function

3.1 Features and Protections

The 3-phase high-voltage gate driver function is integrated in IMM100 series product. The driver output impedance is designed to meet an optimal dv/dt for EMI and switching loss trade offs. It is designed for 5-6 V/nsec at a rated current condition. The driver employs the anti-shoot-through protection, the integrated bootstrap function for high-side floating supplies, the low standby power and the undervoltage lockout protection function for VCC and high-side VBS supplies. The under voltage lockout for Vcc is reported as latched fault at pin RFE. The ITRIP comparator between COM and V_{SS} pin is disabled in IMM100. The gate driver block diagram is shown in Figure 10.

3.1.1 Integrated Bootstrap Functionality

The IMM100 series embeds an integrated bootstrap FET (BootFet) that allows an alternative drive of the bootstrap supply for a wide range of applications. Each bootstrap FET is connected between the respective floating supply VB (e.g. VBU, VBV and VBW, see page 15) and V_{CC}:

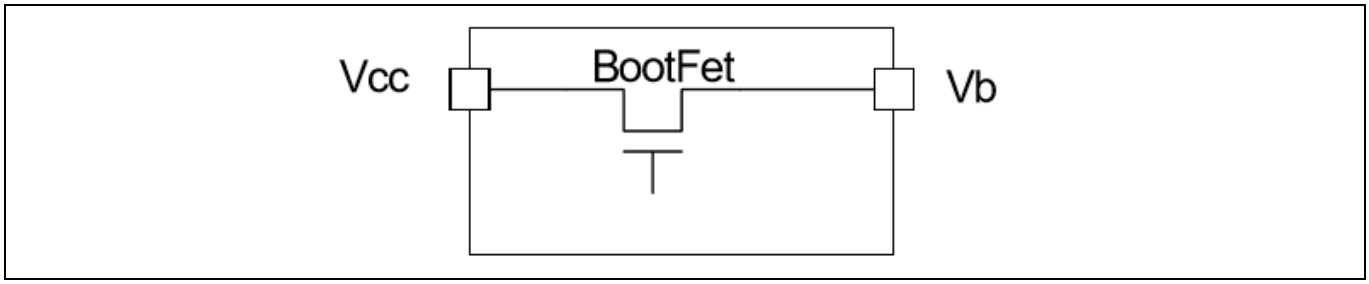


Figure 8 Simplified BootFET connection

The bootstrap FET is suitable for most PWM modulation schemes, including trapezoidal control, and can be used either in parallel with the external bootstrap network (diode+ resistor) or as a replacement of it. The use of the integrated bootstrap FET as a replacement of the external bootstrap network may have some limitations at a very high PWM duty cycle due to the bootstrap FET equivalent resistance (R_{BS}, see page 17).

The integrated bootstrap FET is turned on during the time when LO is 'high' (e.g. LOU, LOV, LOW, see page 15), and it has a limited source current due to R_{BS}. The V_{BS} voltage will be charged each cycle depending on the on-time of LO and the value of the C_{BS} capacitor, the drain-source drop of the MOSFET, and the low-side free-wheeling diode drop.

The bootstrap FET follows the state of low-side output stage, the bootstrap FET is ON when LO is high, unless the V_B voltage is higher than approximately V_{CC}. In that case, the bootstrap FET is designed to remain off until V_B returns below that threshold; this concept is illustrated in Figure 9.

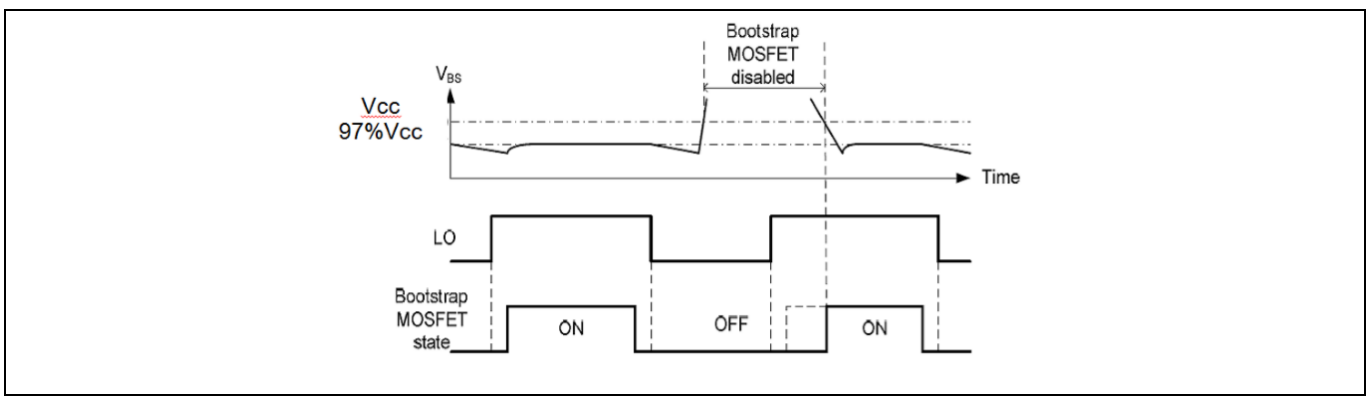


Figure 9 Bootstrap FET timing diagram

3.1.2 Undervoltage Lockout Protection

This IC provides under-voltage lockout protection on both the V_{CC} (logic and low-side circuitry) power supply and the V_{BS} (highside circuitry) power supply. Figure 10 is used to illustrate this concept; V_{CC} (or V_{BS}) is plotted over time and as the waveform crosses the UVLO threshold ($V_{CCUV+/-}$ or $V_{BSUV+/-}$) the under-voltage protection is enabled or disabled.

Upon power-up, should the V_{CC} voltage fail to reach the V_{CCUV+} threshold, the IC will not turn-on. Additionally, if the V_{CC} voltage decreases below the V_{CCUV-} threshold during operation, the under-voltage lockout circuitry will recognize a fault condition and shutdown the high and low-side gate drive outputs.

Upon power-up, should the V_{BS} voltage fail to reach the V_{BSUV+} threshold, the IC will not turn-on. Additionally, if the V_{BS} voltage decreases below the V_{BSUV-} threshold during operation, the under-voltage lockout circuitry will recognize a fault condition, and shutdown the high-side gate drive outputs of the IC.

The UVLO protection ensures that the IC drives the external power devices only when the gate supply voltage is sufficient to fully enhance the power devices. Without this feature, the gates of the external power switch could be driven with a low voltage, resulting in the power switch conducting current while the channel impedance is high; this could result in very high conduction losses within the power device and could lead to power device failure. ($V_{CCUV+/-}$ and $V_{BSUV+/-}$, see page 25)

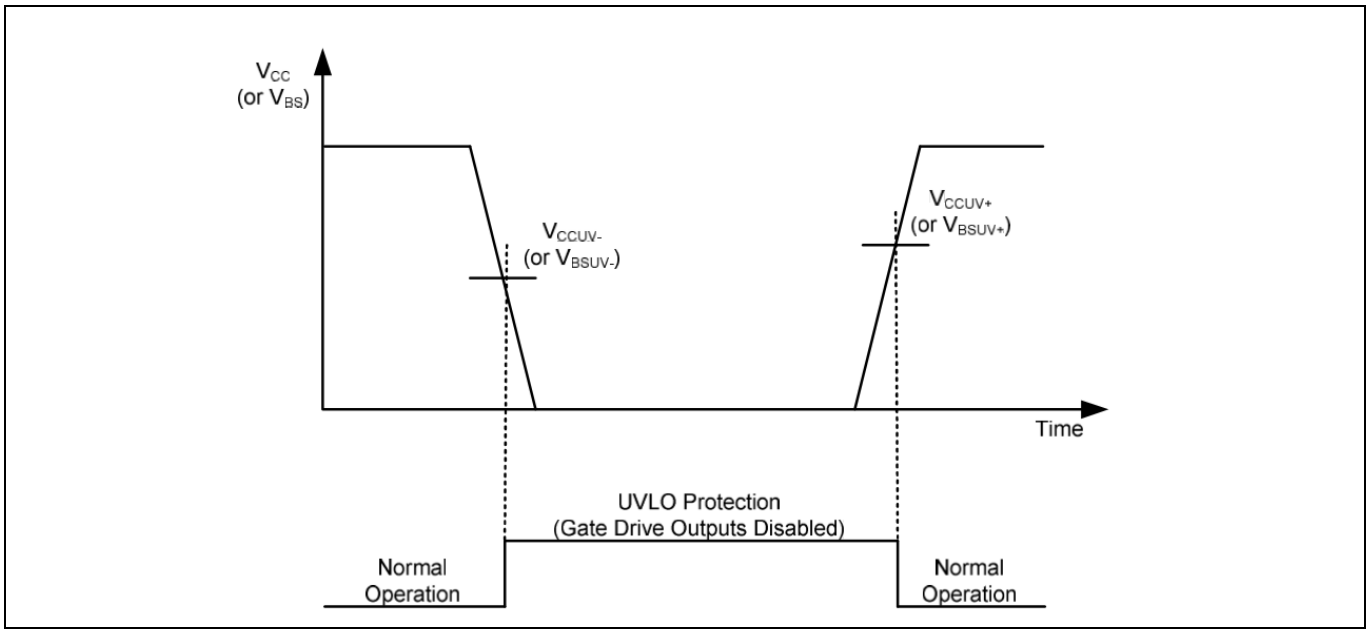


Figure 10 UVLO protection

3.2 Block Diagram

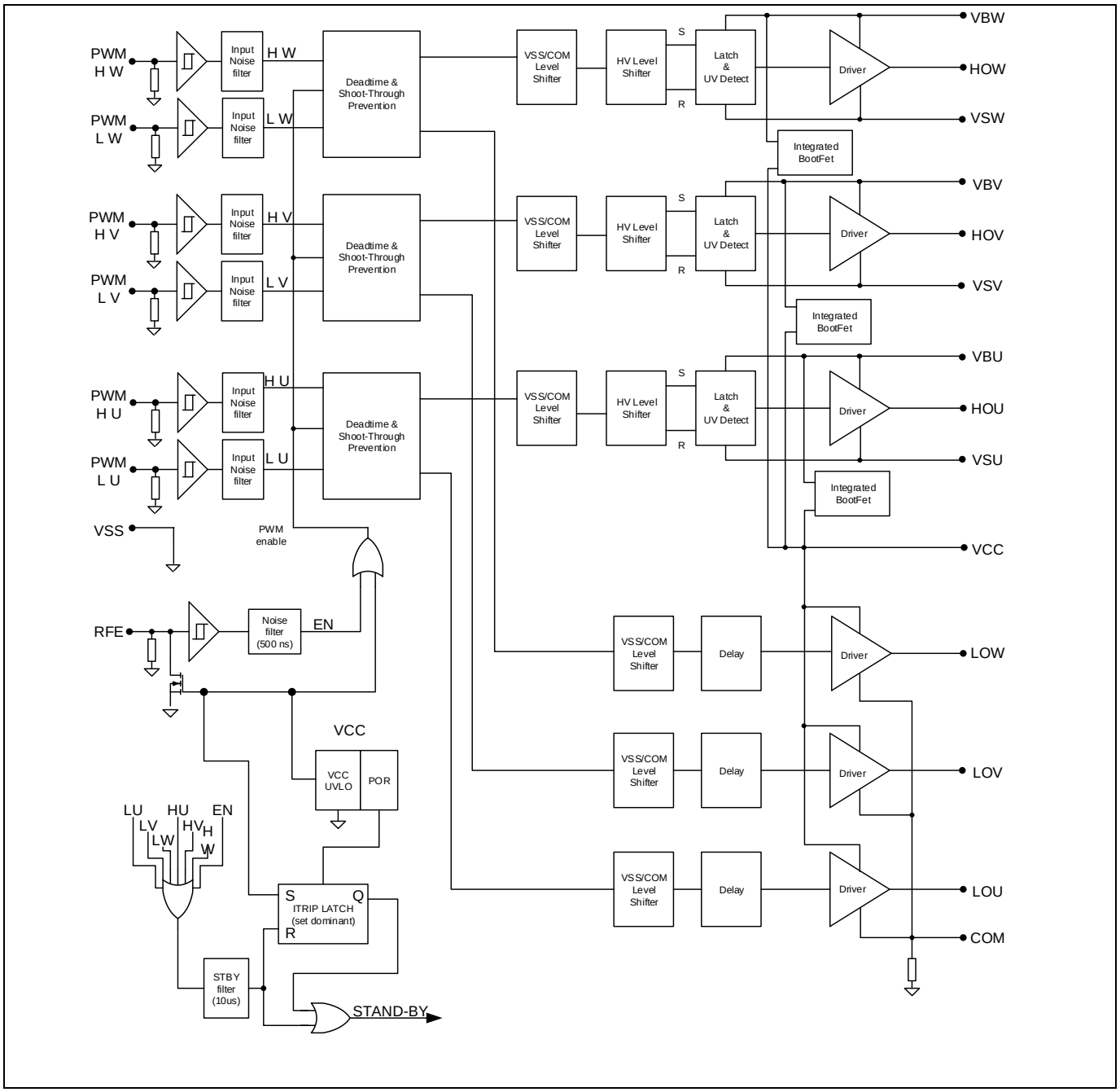


Figure 11 Block diagram of gate driver function

4 DC Characteristics

4.1 Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the module may occur. These are not tested at manufacturing. All voltage parameters are absolute voltages referenced to V_{SS} unless otherwise stated in Table 2.

Table 2 Absolute Maximum Rating

Symbol	Description		Min	Max	Unit
BV_{DSS}	MOSFET Blocking Voltage	-015M	---	500	V
		-046M and -056M	---	650	V
I_O @T_C=25°C	DC Output Current per MOSFET	-015M	---	1	A
		-046M and -056M	---	4	A
I_{OP}	Pulsed Output Current [1]	-015M	---	6	A
		-046M	---	8.2	A
		-056M	---	11	A
P_D @T_C=25°C	Maximum Power Dissipation per MOSFET [2]	-015M	---	11	W
		-046M	---	28.4	W
		-056M	---	36.7	W
$V_{S\,U,V,W}$	Gate Driver High-Side Floating Supply Offset Voltage		$V_{B\,U,V,W}$-20	$V_{B\,U,V,W}$+0.3	V
$V_{B\,U,V,W}$	Gate Driver High-Side Floating Rated Voltage - 015		-0.3	600	V
	Gate Driver High-Side Floating Rated Voltage - 046 --- 056		-0.3	600	V
V_{CC}	Gate Driver Low-Side Supply Voltage		-0.3	20	V
BV_{MODULE}	Power Module Max Voltage -015M		---	500	V
	Power Module Max Voltage -046M -056M		---	600	V
V_{DD}	Digital IC Supply Voltage		-0.3	6	V
V_{ID}	Digital and Analog Pin Voltage		-0.3	V_{DD}+0.3	V
T_J	Operating Junction Temperature - defined by Controller technology		-40	115	°C
T_L	Lead Temperature (Soldering, 30 seconds)		---	260	°C
T_S	Storage Temperature		-40	125	°C
V_{ISO}	Isolation Voltage (1min)		---	1500	V_{RMS}
I_{IN}	Input current on any controller pin during overload condition		-10	10	mA
ΣI_{IN}	Absolute sum of all controller input currents during overload condition		-50	50	mA

[1] Pulse Width=100µs, T_C=25°C, Duty=1%.

[2] Single MOSFET in TO220 package at Tcase = 25°C

Note: Characterized, not tested at manufacturing.

4.2 Recommended Operating Conditions

All voltage parameters are referenced to V_{SS}.

Table 3 Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Unit
V_{DCP}	Positive DC Bus Input Voltage - 015	---	380	400	V
	Positive DC Bus Input Voltage – 046 -- 056	---	400	480	V
$V_{B\,U,V,W}$	Gate Driver High-Side Floating Supply Voltage	V_S+12	---	V_S+18	V
V_{CC}	Gate Driver Low-Side Supply Voltage	13.5	15.0	16.5	V
V_{DD}	Digital IC Supply Voltage (3.3 V +/- 10%)	2.97	3.3	3.63	V
V_{DD}	Digital IC Supply Voltage (5.0V +/- 10%)	4.5	5.0	5.5	V
MCLK	Master clock frequency	---	48.0	---	MHz
PCLK	Peripheral clock frequency	---	96.0	---	MHz
I_{OV}	Input current on any port pin during overload condition	-5	---	5	mA
I_{OVS}	Absolute sum of all input circuit currents during overload condition	---	---	25	mA

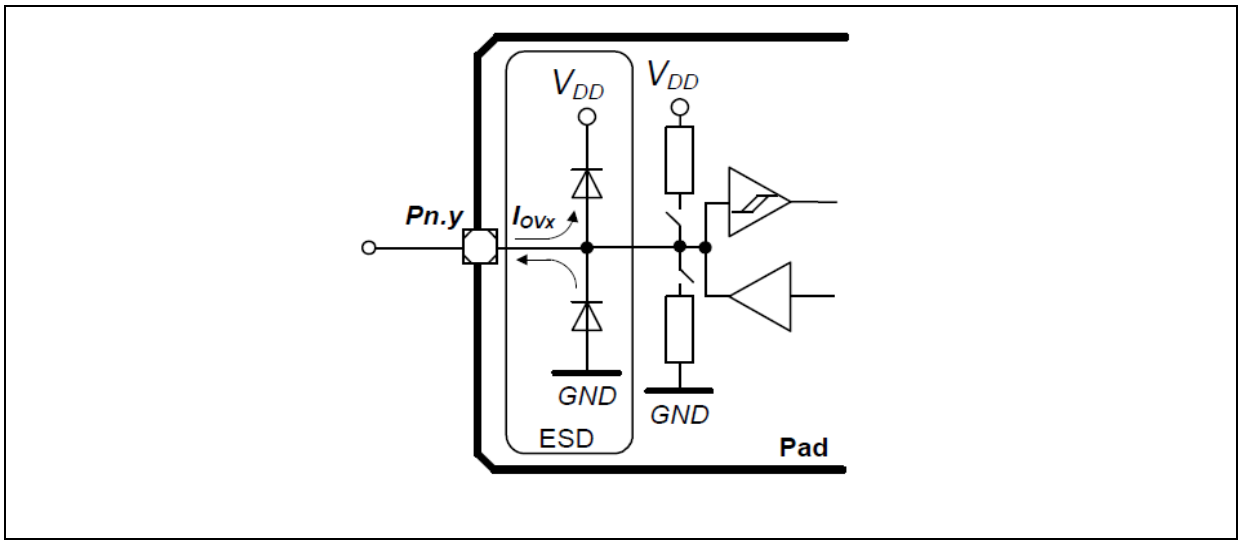


Figure 12 Input Overload Current via ESD structures

4.3 Static Electrical Characteristic

V_{cc}=15 V, T_A=25°C unless otherwise specified.

Table 4 Static Electrical Characteristic

Symbol	Description		Min	Typ	Max	Units
I_{LKH} @T_J=25°C, V_{DS}=500/650V	Leakage Current of High-Side FETs in Parallel	-015M	---	1	---	µA
		-046M	---	1	---	
		-056M	---	1	---	
I_{LKL} @T_J=25°C, V_{DS}=500/650V	Leakage Current of Low-Side FETs with	-015M	---	4	---	µA
		-046M	---	4	---	
		-056M	---	4	---	

DC Characteristics

Symbol	Description		Min	Typ	Max	Units
	Gate Drive IC in Parallel					
$R_{DS(ON)}$ @T_J=25°C, V_{GS}=10V, I_D=1.5A	Drain to Source ON Resistance	-015M	---	4.8	6	Ω
		-046M	---	1.26	1.4	
		-056M	---	0.855	0.95	
I_{DSS} @T_J=25°C, V_{DS}=500/650 V, V_{GS}=0 V	Zero Gate Voltage Drain Current	-015M	---	---	1	µA
		-046M	---	---	1	
		-056M	---	---	1	
V_{SD} @T_J=25 °C, V_{GS}=0 V, I_F=0.5 A (-015M), I_F=1.5 A (-046M), I_F=2.2 A (-056M)	MOSFET Diode Forward Voltage Drop	-015M	---	0.8	---	V
		-046M	---	0.9	---	
		-056M	---	0.9	---	
R_{BS}	Bootstrap FET Resistance	-015M	---	200	---	Ω
		-046M	---	200	---	
		-056M	---	200	---	

Note: All values obtained during characterization, not tested at munfacturing.

4.4 Dynamic Electric Characterisitic

V_{CC}=15 V, T_A=25°C, all voltage parameters are referenced to V_{SS} unless otherwise specified.

Table 5 Dynamic Electric Characteristic

Symbol	Description		Min	Typ	Max	Units
E_{ON} @T_J=25 °C, V^+=300 V, I_D=0.5 A	Switching Energy, Turn On Condition	-015M	---	27.2	---	µJ
		-046M	---	36.6	---	
		-056M	---	44.4	---	
E_{OFF} @T_J=25 °C, V^+=300 V, I_D=0.5 A	Switching Energy, Turn Off Condition	-015M	---	2.00	---	µJ
		-046M	---	1.97	---	
		-056M	---	2.53	---	
E_{REC} @T_J=25 °C, V^+=300 V, I_D=0.5 A	Switching Energy, Diode Reverse Recovery	-015M	---	10.8	---	µJ
		-046M	---	8.43	---	
		-056M	---	9.88	---	
E_{ON} @T_J=115 °C, V^+=300 V, I_D=0.5 A	Switching Energy, Turn On Condition	-015M	---	31.8	---	µJ
		-046M	---	49.7	---	
		-056M	---	59.7	---	
E_{OFF} @T_J=115 °C, V^+=300 V, I_D=0.5 A	Switching Energy, Turn Off Condition	-015M	---	1.96	---	µJ
		-046M	---	1.81	---	
		-056M	---	2.27	---	
		-015M	---	12.6	---	µJ

DC Characteristics

Symbol	Description		Min	Typ	Max	Units
E_{REC} @T_J=115 °C, V^+=300 V, I_D=0.5 A	Switching Energy, Diode Reverse Recovery	-046M	---	7.94	---	
		-056M	---	9.91	---	

Note: All values obtained during characterization, not tested at munfacturing.

4.5 MOSFET Avalanche Characteristics

Table 6 MOSFET Avalanche Characteristic

Symbol	Description		Min	Typ	Max	Units
EAS, V^+=100 V, I_D=1.7 A	Single Pulse Avalanche Energy	-015M	---	---	49	mJ
EAS, V^+=50 V, I_D=0.6 A		-046M	---	---	26	
EAS, V^+=50 V, I_D=1 A		-056M	---	---	50	

Note: All values obtained during characterization, not tested at munfacturing.

4.6 Thermal Characteristics

Table 7 Thermal Characteristics

Symbol	Description	Min	Typ	Max	Units
$R_{th(J\text{-}amb)}$	Total Thermal Resistance Junction to Ambient	---	27.7	---	°C/W

Note: All values obtained during characterization, not tested at munfacturing.

The previous value of $R_{th(J\text{-}amb)}$ has been obtained under the following testing condition: T_{amb}=25°C, $T_{hotspot}$=51.6°C and a dissipated power of 1W. A FR4 PCB with 2oz copper has been used and the PCB layout is shown in Figure 13.

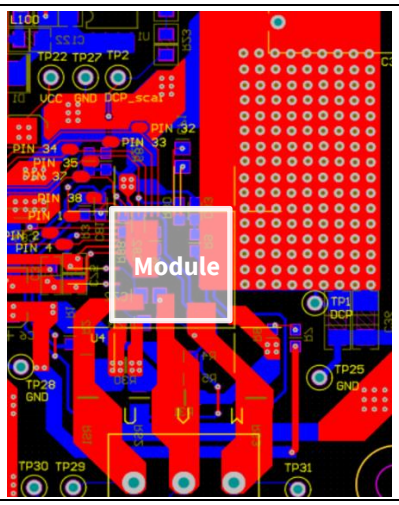


Figure 13 PCB layout used for thermal characterization: 2oz copper, 2 layers. DcBus Pad: 3,0 cm x 1,8 cm on both layers with 144 vias.

4.7 Thermal Characterization

Figure 14, 15, 16, 17, 18, 19 show the thermal characterizations of the three part numbers. The tests reported in Figure 14, 15, 16 have been performed under the following conditions: T_{amb}=25°C, different phase current values until the case reaches 105°C, two PWM frequencies (6 and 16kHz) and two different modulation types (3-phase modulation and 2-phase flat bottom modulation). The tests reported in Figure 17, 18, 19 have been performed under the following conditions: T_{amb}=60°C, different phase current values until the case reaches 105°C, two PWM frequencies (6 and 16kHz) and two different modulation type (3-phase modulation and 2-phase flat bottom modulation). 2-ph flat bottom modulation allows the reduction of the switching losses compared with 3-phase SVPWM (symmetrical placement of zero vectors). For the test with T_{amb}=60°C, the 3-phase modulation has not been used. For all the tests, the phase current has been limited to 600 mArms in order to avoid damage to the motor used for the tests. A FR4 PCB with 2oz copper has been used and the PCB layout is shown in Figure 13.

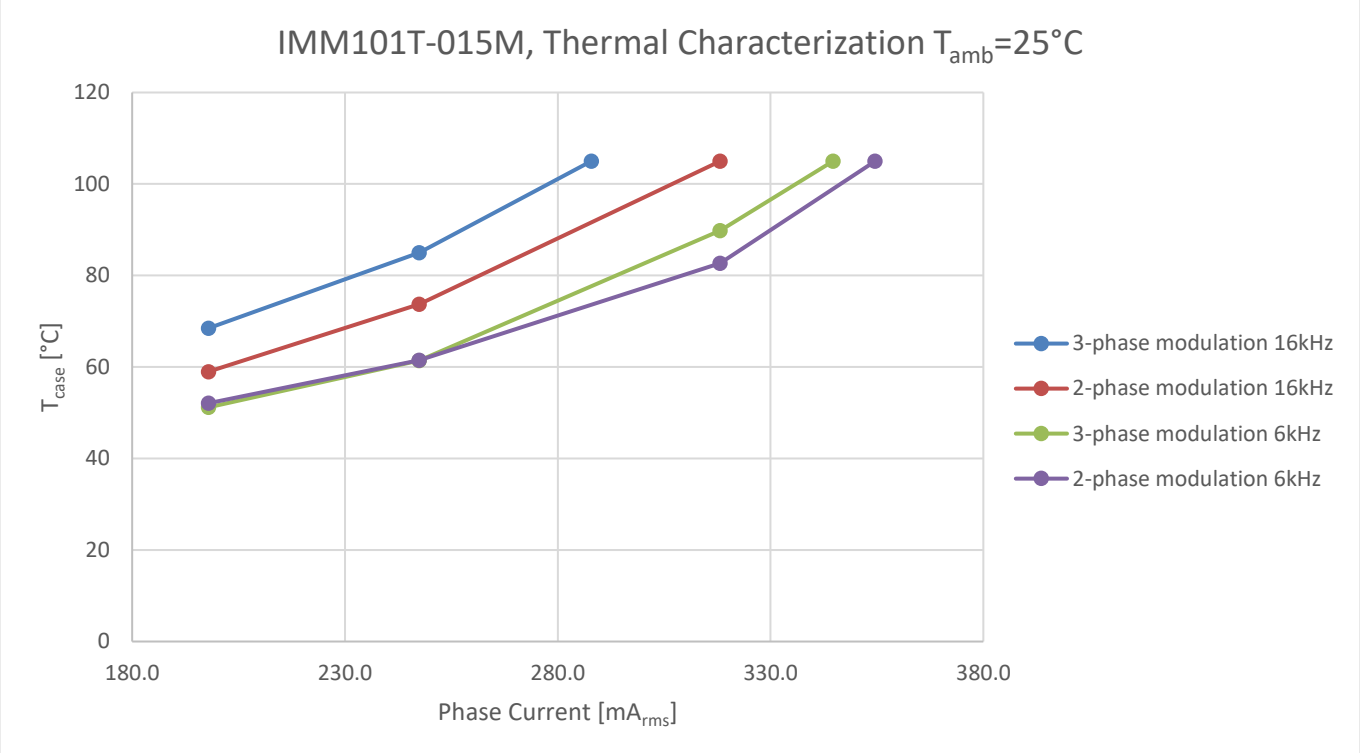


Figure 14 IMM101T-015M Thermal Characterization, T_{amb}=25°C, different phase current values until the case reaches 105°C, FR4 PCB with 2oz copper

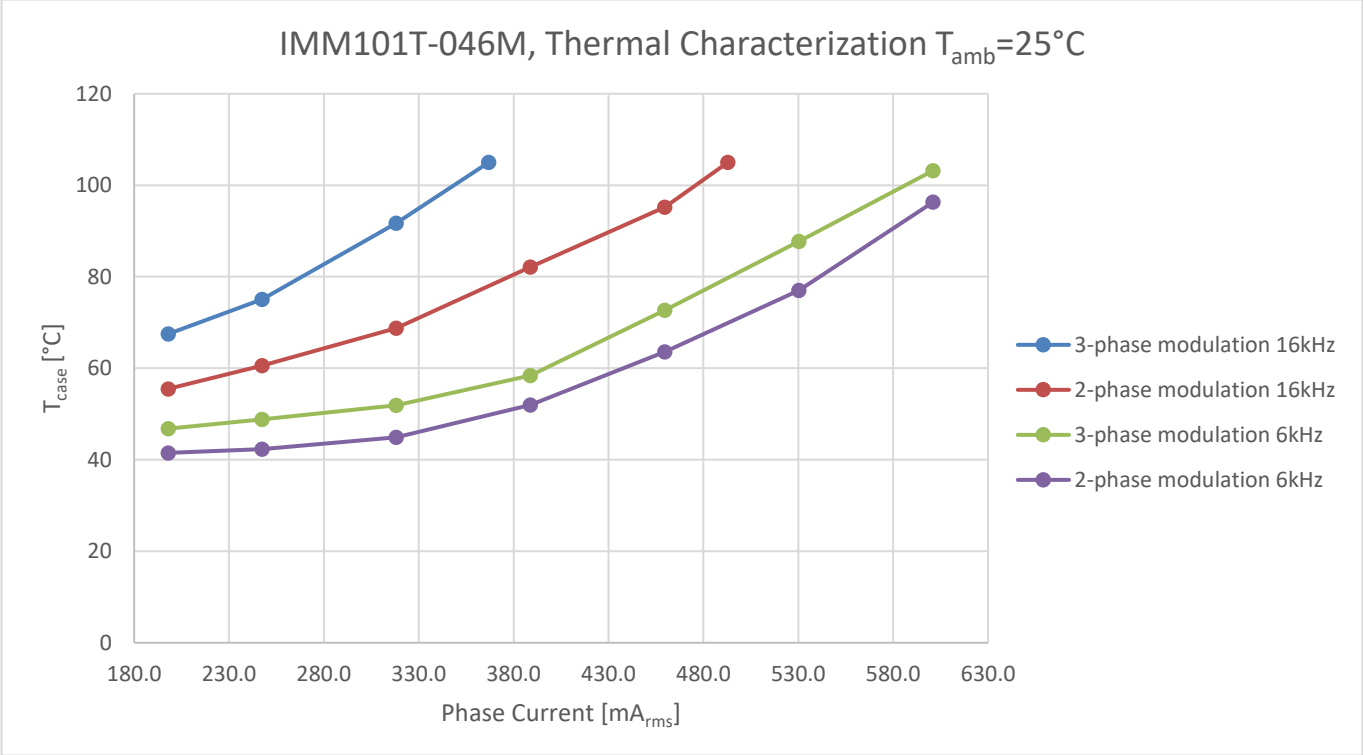


Figure 15 IMM101T-046M Thermal Characterization, T_{amb}=25°C, different phase current values until the case reaches 105°C, FR4 PCB with 2oz copper

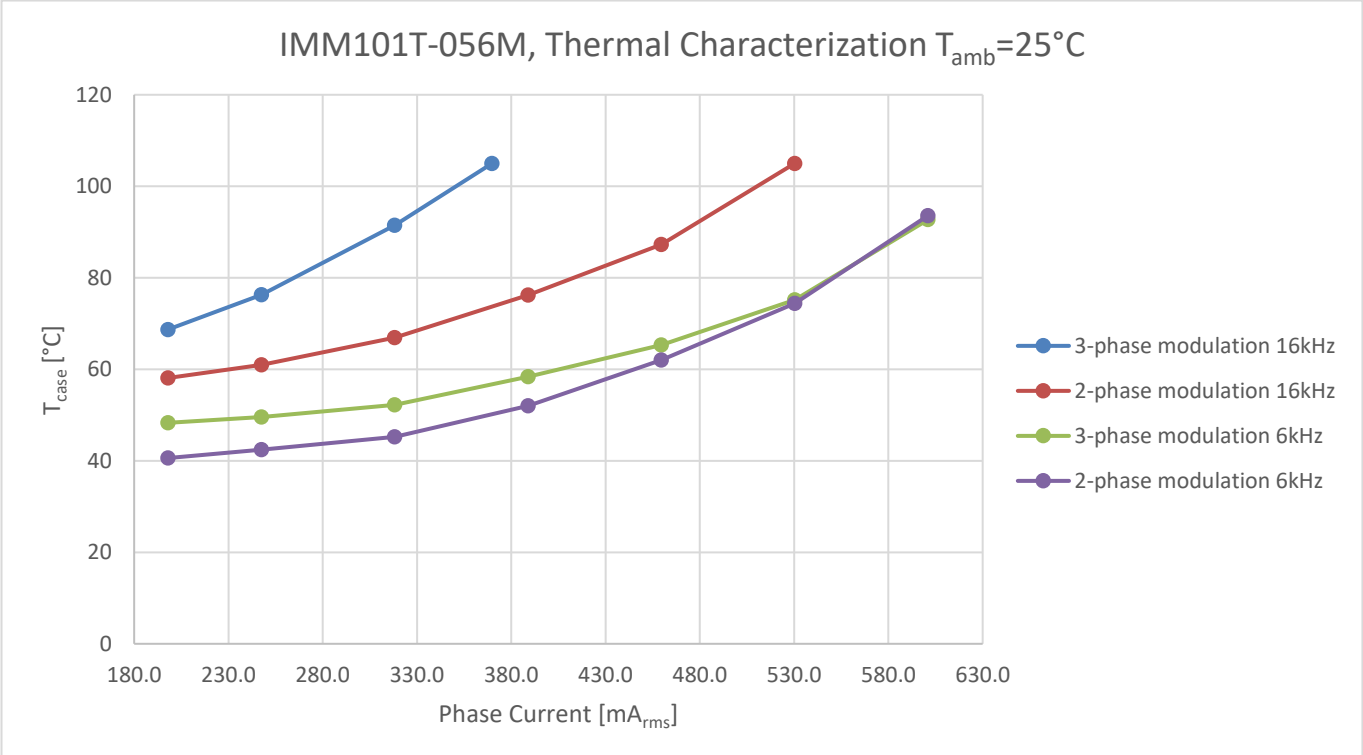


Figure 16 IMM101T-056M Thermal Characterization, T_{amb}=25°C, different phase current values until the case reaches 105°C, FR4 PCB with 2oz copper

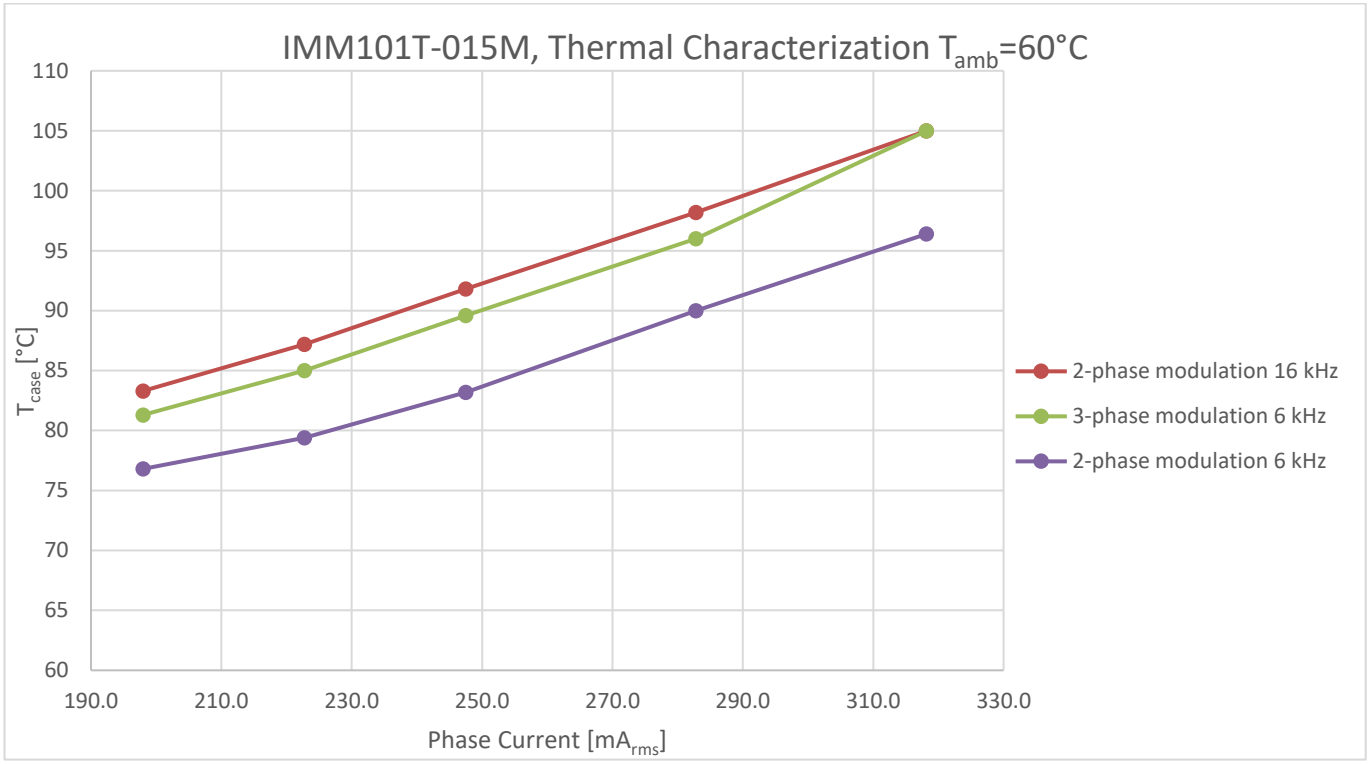


Figure 17 IMM101T-015M Thermal Characterization, T_{amb}=60°C, different phase current values until the case reaches 105°C, FR4 PCB with 2oz copper

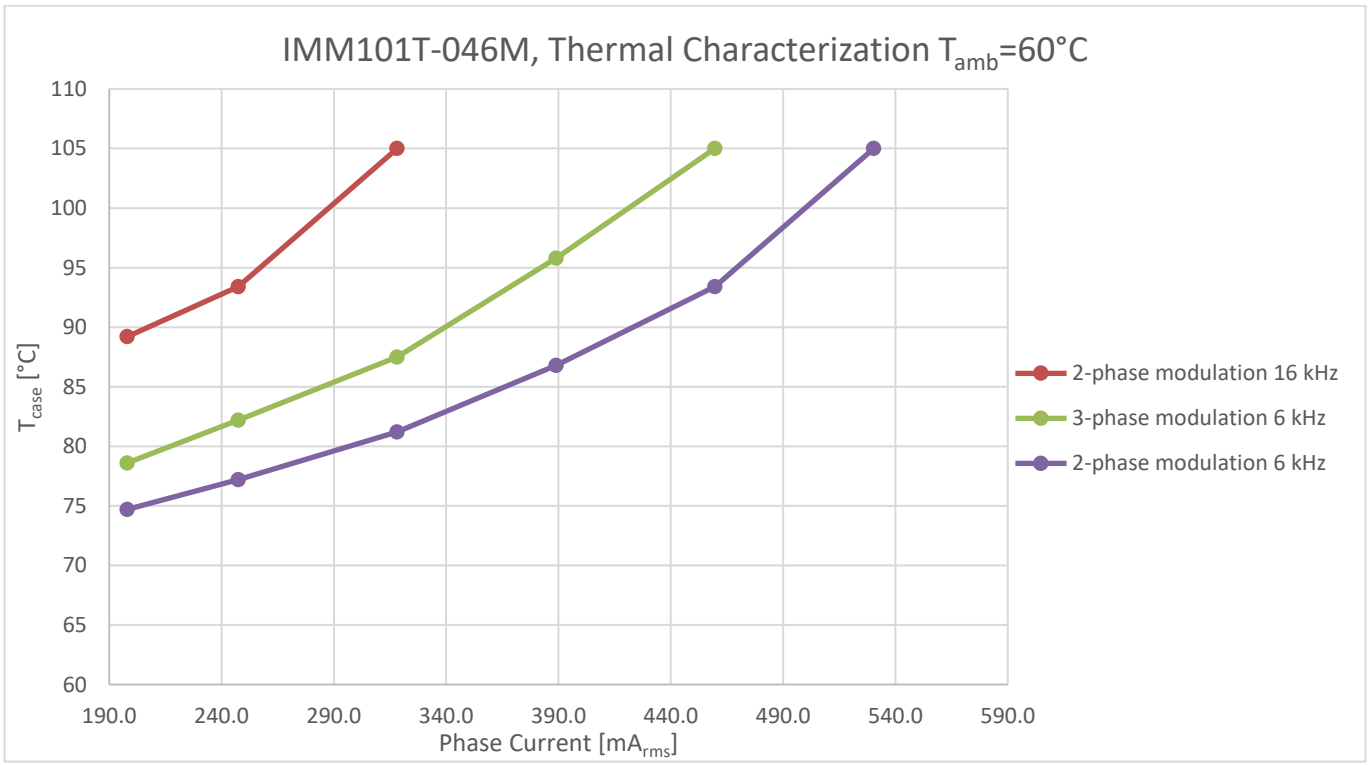


Figure 18 IMM101T-046M Thermal Characterization, T_{amb}=60°C, different phase current values until the case reaches 105°C, FR4 PCB with 2oz copper

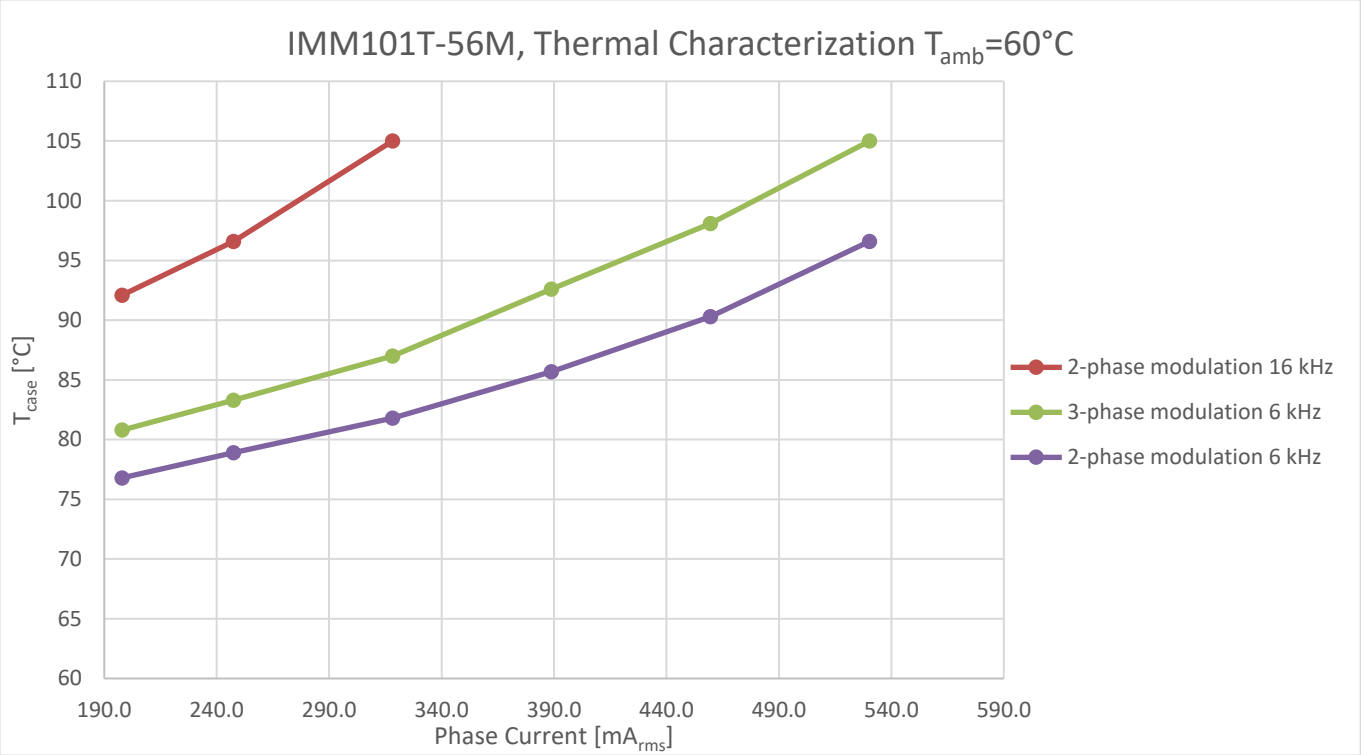


Figure 19 IMM101T-056M Thermal Characterization, T_{amb}=60°C, different phase current values until the case reaches 105°C, FR4 PCB with 2oz copper

Note: Characterized, not tested at manufacturing.

4.8 Power Consumption IMM100T series

V_{CC}=15V, V_{DD}=5V, V_{BUS} = 300V, Ta = 25 ˚C, unless specified otherwise.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 8 Power Consumption – IMM100T series

Symbol	Parameter	Min	Typ	Max	Unit	Condition
P_{MOTOR}	Power Consumption – motor active and PFC not active	---	50	100	mW	
$P_{MOTOR+PFC}$	Power Consumption – motor and PFC active	---	70	100	mW	IMM102T only
I_{DDPDS}	Deep Sleep mode controller current	---	0.27	---	mA	
t_{SSA}	Controller Wake-up time from Sleep to Active mode	----	6	---	Clock cycles	
t_{DSA}	Controller Wake-up time from Deep Sleep to Active mode	---	290	---	µs	

4.9 Flash Memory Parameters

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 9

Symbol	Parameter	Min	Typ	Max	Unit	Condition
t_{RET}	Data Retention Time	10	---	---	years	Max. 100 erase / program cycle
N_{ECYC}	Erase Cycles	---	---	5×10^4	cycles	Sum of pages and sector erase cycles
N_{TECYC}	Total Erase Cycles	---	---	2×10^6	cycles	

4.10 Digital I/O DC Characteristics

V_{DD}=3.3V, Ta = 25 ˚C, all voltage parameters are referenced to V_{SS} unless specified otherwise.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 10 Digital I/O Charasteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
V_{ILPS}	Input Low-Voltage on port pins with std Hysteresis	---	---	0.19 x V_{DD}	V	
V_{IHPS}	Input High-Voltage on port pins with std Hysteresis	0.7 x V_{DD}	---	---	V	
V_{ILPL}	Input Low-Voltage on port pins with large Hysteresis	---	---	0.08 x V_{DD}	V	
V_{IHPL}	Input High-Voltage on port pins with Large Hysteresis	0.85 x V_{DD}	---	---	V	
V_{OLP}	Output Low-Voltage on port pins (with standard pads)	---	---	0.4	V	I_{OL} = 3.5 mA
V_{OLP1}	Output Low-Voltage on high-current pads	---	---	0.32	V	I_{OL} = 10 mA
V_{OHP}	Output High-Voltage on port pins (with standard pads)	V_{DD}-0.4	---	---	V	I_{OH} = -2.5 mA
V_{OHP1}	Output High-Voltage on high-current pads	V_{DD} – 0.32	---	---	V	I_{OH} = -6 mA
I_L	Input leakage current	-1	---	+1	µA	V_O = 3.3V or 0V
I_{OL}	Low-Level output current	---	---	5	mA	V_O = 0.4V
I_{OH}	High-Level output current	---	---	-7	mA	V_O = 2.4V
t_{HCPR} t_{HCPF}	Rise/fall time on High-Current Pad	---	---	12	ns	50 pF
t_R t_F	Rise/fall time on std Pad	---	---	15	ns	50 pF

DC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
C_{IO}	Pin capacitance (digital inputs/outputs)	---	---	10	pF	
I_{PUP}	Pull-up current on port pins	---	---	-50	µA	V_{IH},min
	Pull-up current on port pins	-65	---	---	µA	V_{IL},max
I_{PDP}	Pull-down current on port pins	---	---	30	µA	V_{IL},max
	Pull-down current on port pins	60	---	---	µA	V_{IH},min
V_{PO}	Voltage on any pin during V_{DD} power off	---	---	0.3	V	

4.11 Analog I/O DC Characteristics

V_{DD}=3.3V, Ta = 25 ˚C, all voltage parameters are referenced to V_{SS} unless specified otherwise.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 11 Analog I/O Charasteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
C_{IN}	Switched capacitance of analog inputs	---	1.2	2	pF	Gain 1, 3
		---	4.5	6	pF	Gain 6, 12
ADC_{GAIN}	ADC Configurable Gain	---	1 – 3 – 6 – 12	---		
C_{AINT}	Total capacitance of an analog input	---	---	10	pF	
C_{AREFT}	Total capacitance of reference input	---	---	10	pF	

4.12 Under Voltage Lockout DC characteristics

Ta = 25 ˚C, all voltage parameters are referenced to V_{SS} unless specified otherwise.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 12 Undervoltage Lockout DC Charasteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
V_{DDPBO}	V_{DD} Brownout reset voltage	1.55	1.62	1.75	V	
V_{DDPA}	V_{DD} voltage to ensure defined pad states	---	1.0	---	V	
t_{SSW}	Start-up time from power-on reset	---	260	---	µs	
t_{BMI}	BMI program time	---	8.25	---	ms	
V_{CCUV+} V_{BSUV+}	V_{CC} and V_{BS} supply undervoltage positive going threshold - gate driver	8.0	8.9	9.8	V	
V_{CCUV-} V_{BSUV-}	V_{CC} and V_{BS} supply undervoltage negative going threshold - gate driver	7.4	8.2	9.0	V	

V_{CCUVH} V_{BSUVH}	V_{CC} and V_{BS} supply under voltage hysteresis – gate driver	---	0.7	---	V	

4.13 Analog to Digital Converter – IMM100T series

The following table shows the Analog to Digital Converter (ADC) characteristics. This specification applies to all analog input as given in the pin configuration list.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 13 ADC Characteristics – IMM100T series

Symbol	Parameter	Min	Typ	Max	Unit	Condition
V_{AIN}	Analog input voltage range	Vss – 0.05	---	V_{DD} + 0.05	V	
t_{sample}	Sample Time	---	200	---	ns	
EN_{RMS}	RMS noise	---	1.5	---	LSB 12	
EA_{DNL}	DNL error	---	+/- 2.0	---	LSB 12	
EA_{INL}	INL error	---	+/- 4.0	---	LSB 12	
EA_{GAIN}	Gain error with external reference	---	+/- 0.5	---	%	
EA_{OFF}	Offset error	---	+/- 8.0	---	mV	

4.14 Temperature Sensor Characteristic

IMM101T and IMM102T have an internal temperature sensor that is used by MCE to linearly derate the power consumption and protect the power section. The linear power derating function with temperature shutdown is defined by parameters programmed by the user.
The power dissipation must be limited so that the average controller junction temperature does not exceed 115 °C.

Note: Temperature sensor characteristic is not subject to production test, but verified by design and/or characterization.

Table 14 Temperature Sensor Characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
t_M	Measurement time[2)]	---	---	10	ms	
T_{SR}	Temperature sensor range	-40	---	115	°C	
T_{TSAL}	Sensor Accuracy[1)]	-6	---	6	°C	$T_J > 20°C$
		-10	---	10	°C	$0°C \le T_J \le 20°C$
		---	+/-8	---	°C	$T_J < 0°C$

1) The temperature sensor accuracy is independent of the supply voltage.

2) The temperature of the different parts of the IMM100 is strongly impacted by the thermal design of the application and may be different from the temperature sensor reading. It is the designers' responsibility to always ensure that the maximum ratings given in this datasheet are never exceeded.

5 AC Characteristics

5.1 Internal Oscillator AC Characteristics

V_{DD}=3.3V, Ta = 25 ˚C unless specified otherwise.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Table 15 96MHz DCO1 Oscillator characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
f_{NOM} CC	Nominal Frequency	-	96	-	MHz	Under nominal conditions after trimming
Δf_{LTX} CC	Accuracy with adjustment based on XTAL as reference	-0.3	-	+0.3	%	With respect to f_{NOM} (typ), Ta = -40 °C ~ 105 °C
Δf_{LTTS} CC	Accuracy with adjustment algorithm[1] based on temperature sensor	-0.6	-	+0.6	%	With respect to f_{NOM} (typ), Ta = 0 °C ~ 105 °C
		-1.9	-	+1.0	%	With respect to f_{NOM} (typ), Ta = -25 °C ~ 105 °C
		-2.6	-	+1.3	%	With respect to f_{NOM} (typ), Ta = -40 °C ~ 105 °C
Δf_{LT} CC	Accuracy	-1.7	-	+3.4	%	With respect to f_{NOM} (typ), Ta = 0 °C ~ 85 °C
		-3.9	-	+4.0	%	With respect to f_{NOM} (typ), Ta = -40 °C ~ 105 °C

1) MCE version newer or equal to V1.03.00, clock adjustment algorithm for improved accuracy enable.

Table 16 32kHz DCO2 Oscillator characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
f_{NOM} CC	Nominal Frequency	32.5	32.75	33	MHz	Under nominal conditions[1] after trimming
Δf_{ST} CC	Short term frequency deviation (over VDD)	-1	-	+1	%	With respect to f_{NOM} (typ), Ta = 25°C
Δf_{LT} CC	Accuracy	-1.7	-	+3.4	%	With respect to f_{NOM} (typ), Ta = 0 °C ~ 85 °C
		-3.9	-	+4.0	%	With respect to f_{NOM} (typ), Ta = -40 °C ~ 105 °C

1) The deviation is related to the factory trimmed frequency at nominal VDD and Ta=+25C°

5.2 Power-Up and Supply Threshold Characteristics

The guard band between the lowest valid operating voltage and the brownout reset threshold provides a margin for noise immunity and hysteresis. The electrical parameters may be violated while V_{DD} is outside its operating range. The brownout detection triggers a reset within the defined range. The prewarning detection can be used to trigger an early warning and issue corrective and/or fail-safe actions in case of a critical supply voltage drop.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

Note: Operating Conditions apply.

V_{DD}=3.3V, Ta = 25 °C unless specified otherwise. C=100nF between V_{DD} and V_{SS}.

Table 17 Power-Up and Supply

Symbol	Parameter	Min	Typ	Max	Unit	Condition
t_{RAMPUP}	V_{DD} ramp-up time	---	---	10^7	µs	
S_{VDDPOP}	V_{DD} slew rate	---	---	0.1	V/µs	Slope during normal operation
S_{VDDP10}		---	---	10	V/µs	Slope during fast transient within +/-10% of V_{DD}
$S_{VDDPrise}$		---	---	10	V/µs	Slope during power-on or restart after brownout event
$S_{VDDPfail}$		---	---	0.25	V/µs	Slope during supply falling out of the +/-10% limits

5.3 Motor Control Parameters – IMM100T series

Motion Control parameters that are defined in the iMOTION™ motion control engine (MCE) software are defined and explained in iMOTION™ reference Manual.

5.3.1 PWM Characteristics – IMM100T series

Table 18 PWM timing in IMM100T

Symbol	Parameter	Min	Typ	Max	Unit	Condition
f_{PWM}	PWM frequency	5	16	40	kHz	

5.3.2 Fault timing – IMM100T series

Table 19 Fault timing in IMM100T

Symbol	Parameter	Min	Typ	Max	Unit	Condition
$t_{FLTwidth}$	Minimum pulse width of fault event to be acknowledged at input over current comparators	1.0	---	---	µs	
t_{TRAP}	reaction time to acknowledged overcurrent at input comparators – Fault to PWM disable propoagation time	---	1.3	---	µs	

5.4 Power Factor Correction (PFC) parameters – IMM102T

The PFC parameters only refer to the IMM102T with integrated PFC control algorithm and are defined and explained in iMOTION™ reference Manual.

5.4.1 Boost PFC characteristics – IMM102T

Table 20 PFC PWM timing in IMM102T

Symbol	Parameter	Min	Typ	Max	Unit	Condition
f_{PFCPWM}	PFC PWM frequency	---	20	70	kHz	

5.5 Communication interface parameters – IMM100T series

The IMM100T series provides the following communication interfaces.

Note: These parameters are not subject to production test, but verified by design and/or characterization.

5.5.1 UART interface - IMM100T series

The UART interface is configured as given below.

Note: Operating Conditions apply.

Note: Each bit including start and stop bit is sampled three times at center of a bit at an interval of 1/16 T_{BAUD}.

Table 21 UART timing in IMM100T - series

Symbol	Parameter	Min	Typ	Max	Unit	Condition
f_{UART}	UART baud rate	1200	57600	---	bps	
	UART mode	---	8-N-1	---		data-parity-stop bit
$t_{UARTFIL}$	UART sampling filter period	---	1/16	---	T_{BAUD} =1/f_{UART}	

6 I/O Structure

The following figure shows the I/O structure for all digital I/O pins.

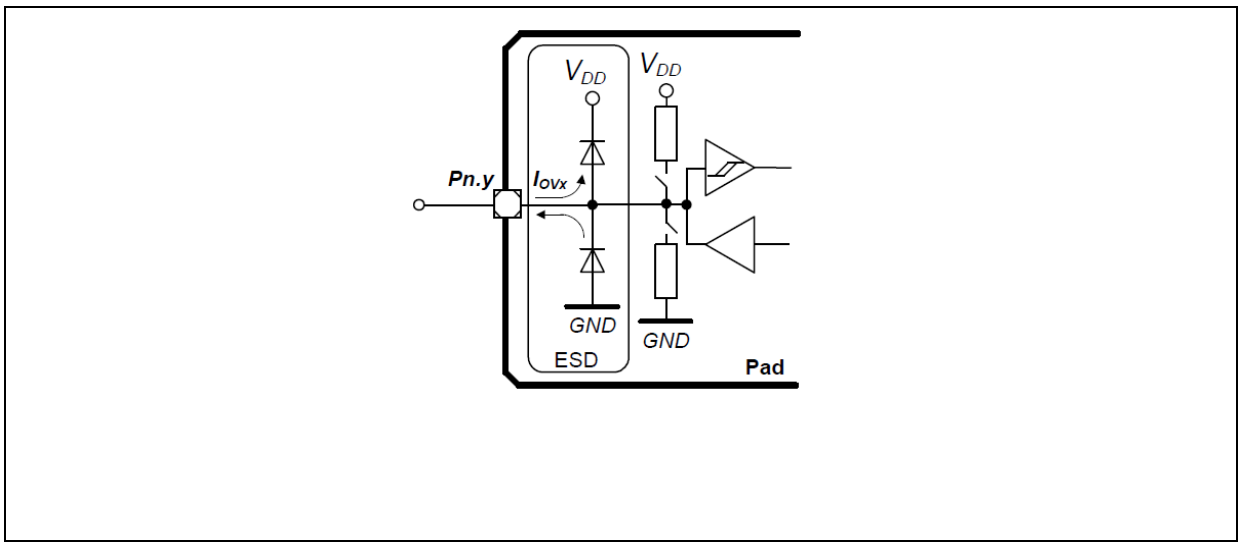


Figure 20 Digital I/O Structure

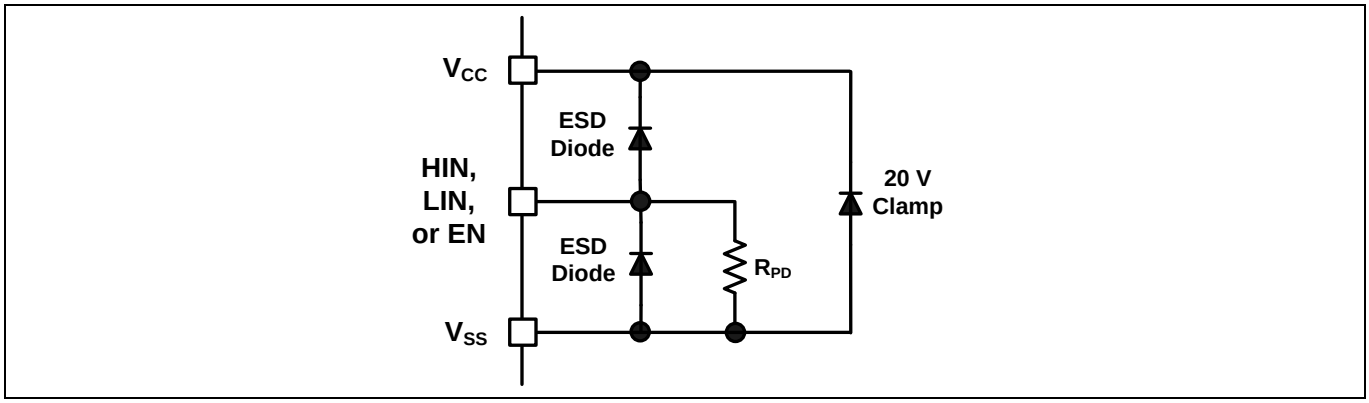


Figure 21 VCC pin I/O gate driver structure

7 Package Outline

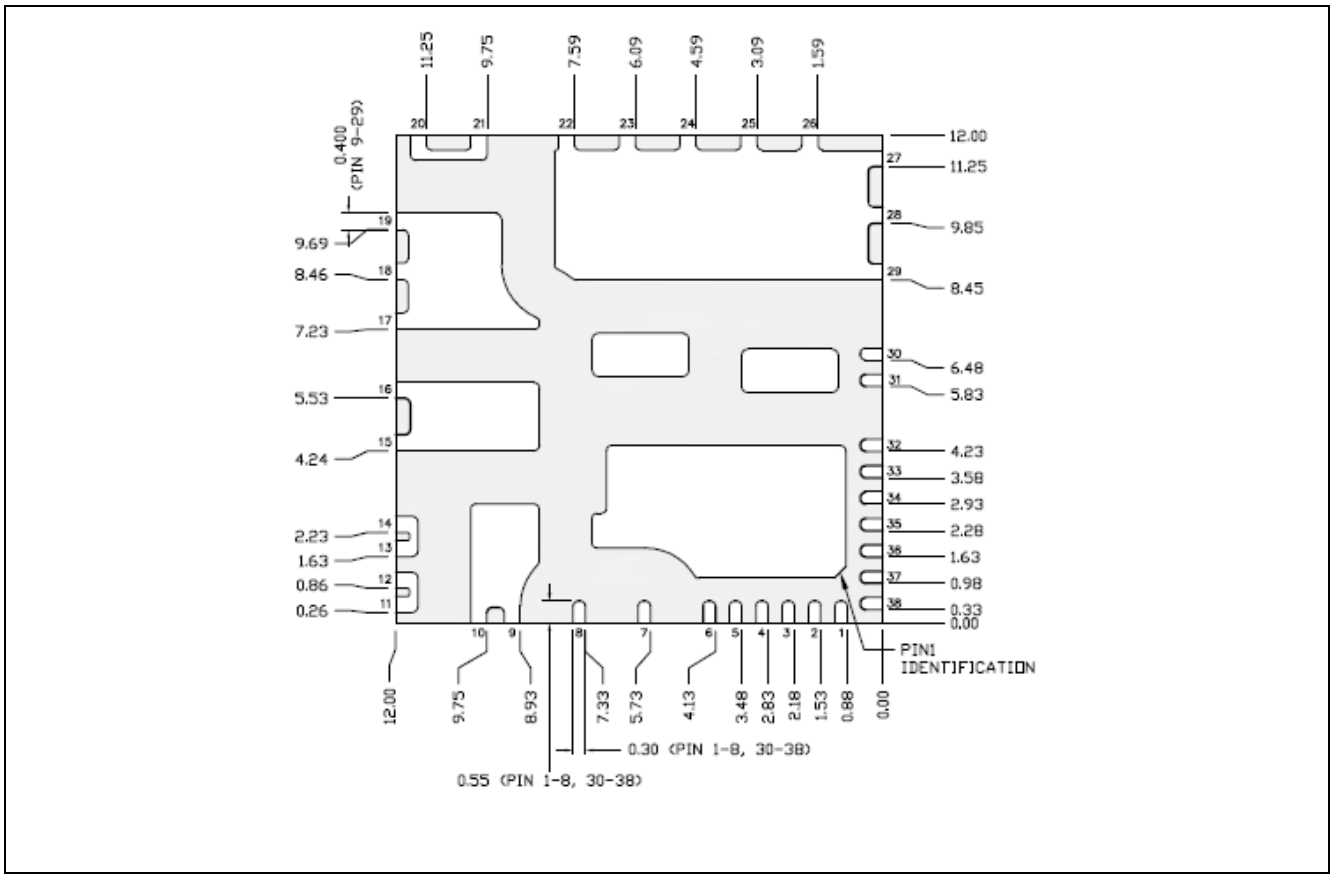


Figure 22 Bottom View, Dimensions in mm

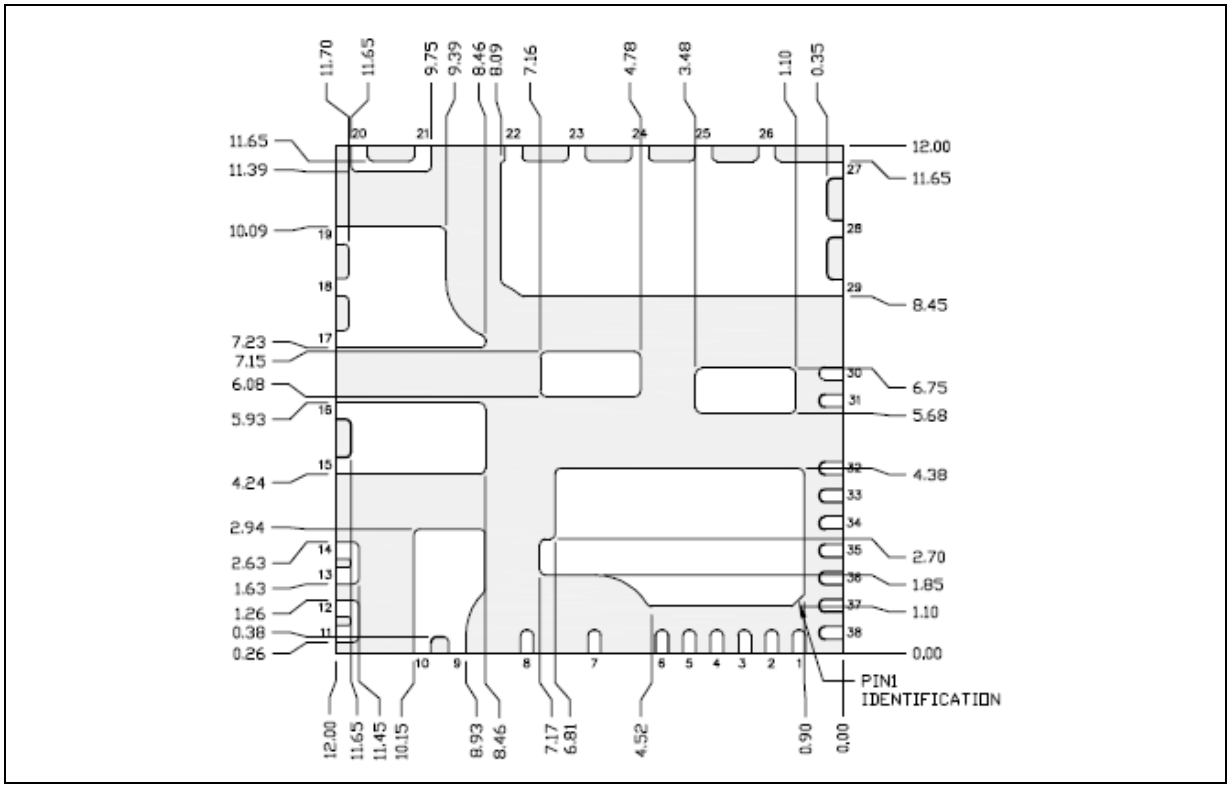


Figure 23 Bottom View, Dimensions in mm

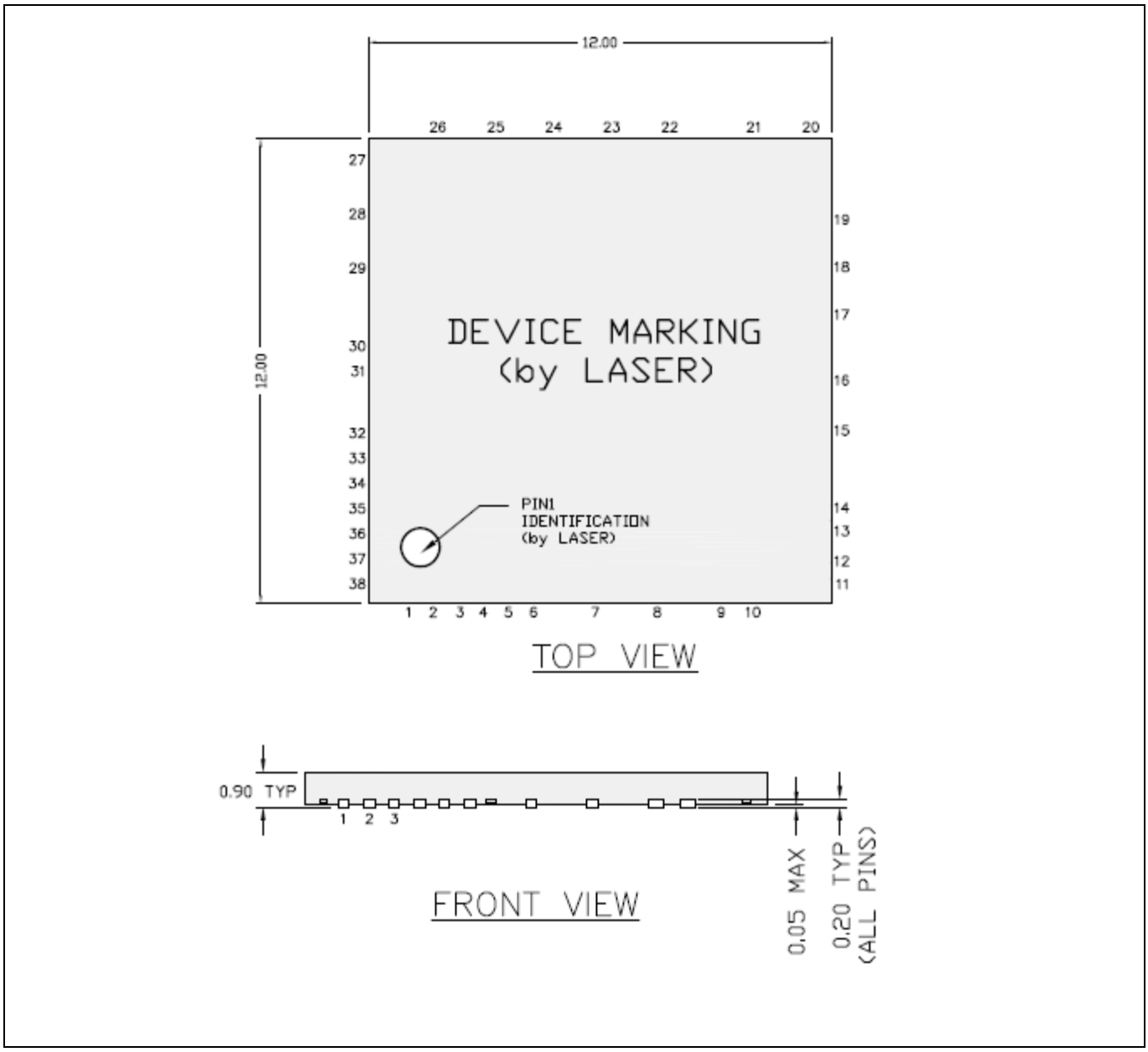


Figure 24 Top View and Dimensions

8 Part Marking Information

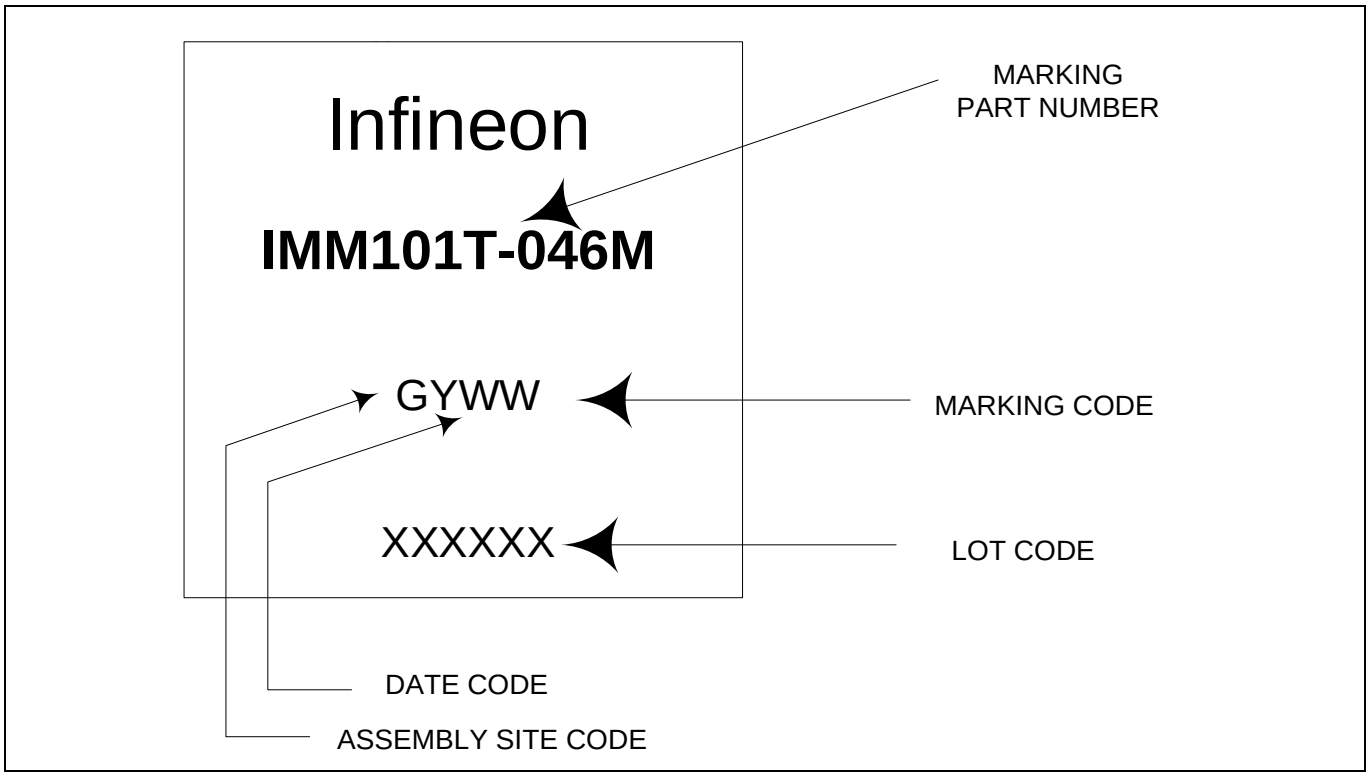


Figure 25 Part Marking

9 Quality Declaration

Table 22 Quality Parameters

Qualification Level		Qualified for industrial applications according to the relevant tests of JEDEC47/20/22
Moisture Sensitivity Level		MSL3 (per IPC/JEDEC J-STD-020C)
ESD	**Charged Device Model**	Class C2B (per ANSI/ESDA/JEDEC standard JS -002)
	Human Body Model	Class C2 (per EIA/JEDEC standard EIA/JESD22-A114-F)
RoHS Compliant		Yes

Note: Test condition for Temperature Cycling test is -40C to 125C.

Revision history

Document Version	Date of Release	Description of changes
v01_00	2019-04-10	Initial version
v01_01	2019-06-05	Typo Corrections
V01_02	2020-04-24	Revised oscillator accuracy specs. Changed max PWM frequency.

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Intelligent Power Modules (IPM)

Selection guide 2019

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Infineon CIPOS™ IPMs are families of highly integrated, compact power modules designed to drive motors in applications ranging from home appliances, fans, pumps to general purpose drives.

Contents

CIPOS™ IPM family overview

Control Integrated Power System (CIPOS™) Intelligent Power Modules (IPM)

Depending on the level of integration and power required, Infineon offers a variety of IPMs comprised of semiconductors and drivers in numerous packages options, covering a large range of voltage and current classes. CIPOS™ IPMs are families of highly integrated, compact power modules designed to drive motors in applications ranging from home appliances to fans, pumps, and general-purpose drives.

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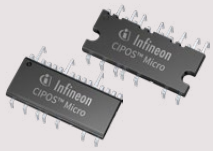
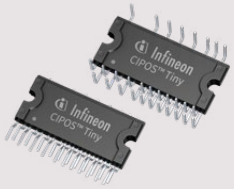
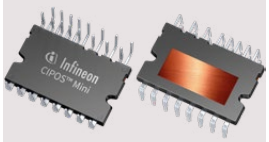
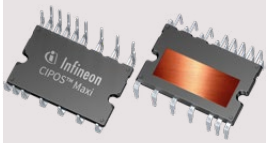
Product lineup

CIPOS™ Nano	CIPOS™ Micro	CIPOS™ Tiny	CIPOS™ Mini	CIPOS™ Maxi
MOSFET 40/100/250/500 V	MOSFET: 250/500 V IGBT: 600 V	IGBT: 600 V	IGBT: 600 V MOSFET: 600 V	IGBT: 1200 V
				

Compact IPM → Standard IPM → Performance IPM

Motor current

0.1 A_{rms} ⟶ **20 A_{rms}**

Key benefits

- Shorter time-to-market
- Increased reliability
- Reduced system cost
- Reduced space
- Improved manufacturability

CIPOS™ Nano overview

Ultra compact three-phase or half-bridge MOSFET IPMs

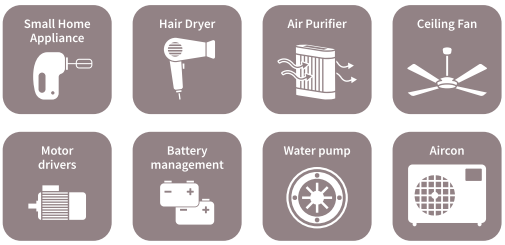
CIPOS™ Nano is a family of highly integrated, ultra-compact IPMs for high efficiency appliance and light industrial applications. This includes the rectifier, converter, and inverter stage in power management circuits and motor drives for applications like hair dryer, air purifier, ceiling fan, circulation pump and ventilator. By implementing an innovative packaging solution, CIPOS™ Nano family delivers a new benchmark in device size, offering up to a 60 percent smaller footprint than existing three-phase motor control power IPMs.

CIPOS™ Nano IPM series is comprised of fully integrated three-phase or half-bridge surface-mount motor control circuit solutions. The advanced QFN package is designed to utilize PCB copper traces to dissipate heat from the module, providing cost savings through a smaller package design and even eliminating the need for an external heat sink.

Key features

- 3-phase or half-bridge MOSFET configurations with gate driver
- Current rating from 0.15 A to 10 A, power rating up to 300 W
- Integrated bootstrap functionality
- Motor drive-optimized fast recovery FETs
- Heat sink-less operation
- Additional space saving with iMOTION™ Smart IPM
- Wide range of footprint compatible parts
- Sensorless FOC algorithm included in iMOTION™ Smart IPM – no programming is required

Major applications



Key benefits

- Cost savings from smaller footprint and reduced PCB space
- Reduced R&D time and cost for both hardware and software (MOTION™ Smart IPM)
- IPMs distribute heat dissipation and enable elimination of heat sink
- Same PCB footprint to address multiple application markets (100-230 V_{AC})

Package overview

QFN 12x12 (12 x 12 x 0.9 mm)	QFN 8x9 (8 x 9 x 0.9 mm)	QFN 7x8 (7 x 8 x 0.9 mm)
		

CIPOS™ Micro overview

Solution for low power motor drive applications

CIPOS™ Micro is a family of compact IPMs for low power motor drive applications including ventilation fans, washing machine & dishwasher pumps, hydronic circulators, window shutters, air purifiers and refrigerator compressor drives.

CIPOS™ Micro IPMs offer a cost effective power solution by leveraging industry standard footprints and processes compatible with various PCB substrates. The family features rugged and efficient high voltage MOSFETs and IGBTs specifically optimized for variable frequency drives with voltage ratings of 250-600 V.

Internally, the power switches are paired with advanced high voltage driver ICs tuned to achieve optimal balance between EMI and switching losses. The family offers DC current ratings ranging up to 6 A, driving motors up to 100 W without heatsink and up to 450 W with heatsink. These IPMs are available in both through-hole and surface mount package options.

Key features

- 3-phase MOSFET or IGBT configurations including gate drivers
- Current rating from 0.25 A to 2.3 A, power rating up to 450 W
- Advance input filter with shoot-through protection
- Optimized dV/dt for loss and EMI tradeoff
- Under-voltage lockout for all channels
- Matched propagation delay for all channels
- Separate low-side emitter pins for single or leg-shunt current sensing
- UL-certified NTC thermistor

Major applications

Key benefits

- Ease of design and fast time-to-market
- Address 20 W to 450 W with the same footprint
- Wide range of modules for 110 VAC or 230 VAC applications in same footprint
- Lower losses than similar modules in the market

Package overview

DIP 29x12F (29 x 12 x 3.1 mm)	SOP 29x12F (29 x 12 x 3.1 mm)	DIP 29x12 (29 x 12 x 3.1 mm)	SOP 29x12 (29 x 12 x 3.1 mm)
			

CIPOS™ Tiny overview

Maximum efficiency and design flexibility

The CIPOS™ Tiny family of three-phase inverter modules is Infineon's newest generation of IPMs ideal for advanced appliance motor drives. This includes applications such as washing machines, air conditioners, refrigerators, and industrial drives ranging from 6 A to 20 A current requirements. In addition, system mechanical design flexibility is also considered by offering both CIPOS™ Tiny SIP and DIP form factors.

By utilizing Infineon's latest generation low $V_{CE(on)}$ TRENCHSTOP™ IGBT technology, optimized for best trade-off between conduction and switching losses, and a level-shifting high voltage high speed driver, CIPOS™ Tiny is able to achieve max efficiency and ruggedness in a fully-isolated thermally-enhanced package.

Key features

- 3-phase IGBT configuration including gate driver
- Current rating from 6A to 20 A, power rating up to 1.5 kW
- Integrated bootstrap functionality
- Fully isolated thermally enhanced package.
- Low $V_{CE(on)}$ TRENCHSTOP™ IGBT technology
- Both Single / Dual-in-line transfer molded package available
- Under-voltage lockout for all channels
- Matched propagation delay for all channels
- Isolation 2000 V_{RMS} min and CTI > 600
- UL certified package and NTC thermistor

Major applications

Key benefits

- Single platform possible from 6 A to 20 A
- Compact package, allowing for reduced PCB space
- SIP package option allows for alternative heatsink mounting
- Multiple lead-length options available for design flexibility

Package overview

DIP 34x15 (34 x 15 x 4.45 mm)	SIP 34x15 (34 x 15 x 4.45 mm)
	

CIPOS™ Mini overview

Broad range of applications from PFC to inverter

The energy efficient CIPOS™ Mini IPMs integrate various power and control components to increase reliability and optimize PCB size and system cost. This simplifies the power design and significantly reduces the time-to-market.

Utilizing multiple configurations, CIPOS™ Mini IPMs are designed to control AC motors in variable speed drives for applications such as air conditioners, washing machines, refrigerators, vacuum cleaners, compressors, and industrial drives up to 3 kW. The configurations offered within the CIPOS™ Mini family are 2-phase MOSFET, 3-phase MOSFET and IGBT, integrated PFC, and 2-phase and 3-phase interleaved PFC. All options include an integrated gate driver and NTC thermistor.

CIPOS™ Mini IPM's package concept is specially adapted to power applications that need good thermal conduction and electrical isolation but also EMI-safe control, innovative FAULT indication, and overload protection. Infineon's TRENCHSTOP™ IGBT, reverse conducting IGBT, and CoolMOS™ are combined with newly optimized Infineon SOI gate driver IC for excellent electrical performance. To enhance thermal performance, CIPOS™ Mini family offers IPMs with an embedded DCB substrate, improving heat transfer to heatsink.

Key features

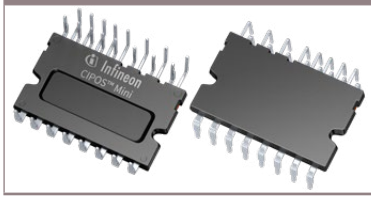
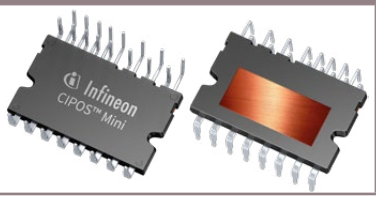
- 2-phase, 3-phase and PFC configurations including gate driver
- Current rating from 4 A to 30 A, power rating up to 3 kW
- Integrated bootstrap functionality
- Dual-in-line transfer molded package
- Under-voltage lockout for all channels
- Rugged SOI gate driver IC technology
- Advanced protection features
- UL-certified NTC thermistor

Major applications

Key benefits

- Easy power extension from 300 W to 3 kW
- Optimized performance for each application
- Enhanced robustness of the advanced IGBT and gate driver IC technology
- High power density
- Two substrate types provide a cost efficient solution for home appliances

Package overview

DIP 36x21 (36 x 21 x 3.1 mm)	DIP 36x21D (36 x 21 x 3.1 mm)
	

CIPOS™ Maxi overview

Solutions for high reliability and performance application

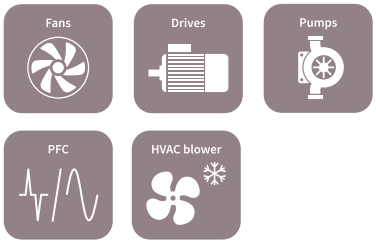
CIPOS™ Maxi IPMs integrate multiple power and control components to increase reliability, optimize PCB size and system costs. They are designed to control three-phase AC motors and permanent magnet motors in variable speed drives applications such as low-power motor drives, pumps, fans, and active filters for HVAC (heating, ventilation, and air conditioning).

This new portfolio includes 1200 V, 5 A and 10 A options for up to a 1.8 kW motor drive solution. CIPOS™ Maxi has achieved the smallest package in the 1200 V IPM class while still offering high power density and best performance.

Key features

- 3-phase IGBT configuration including gate driver
- Current rating from 5 A to 10 A, power rating up to 1.8 kW
- Fully isolated dual in-line molded module with DCB
- 1200 V TRENCHSTOP™ IGBT 4
- Rugged 1200 V SOI gate driver technology
- Under-voltage lockout for all channels
- All of six switches turn-off during protection
- Cross-conduction prevention
- Programmable fault clear timing

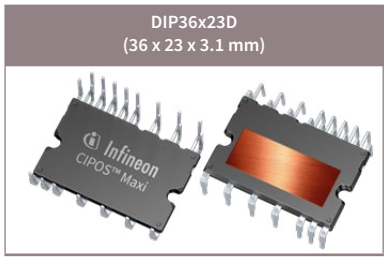
Major applications



Key benefits

- Smallest package size in 1200 V IPM class with high power density and best performance
- Enhanced robustness of gate driver technology for excellent protection
- Adapted to high switching application with lower power loss
- Simplified design and manufacturing

Package overview



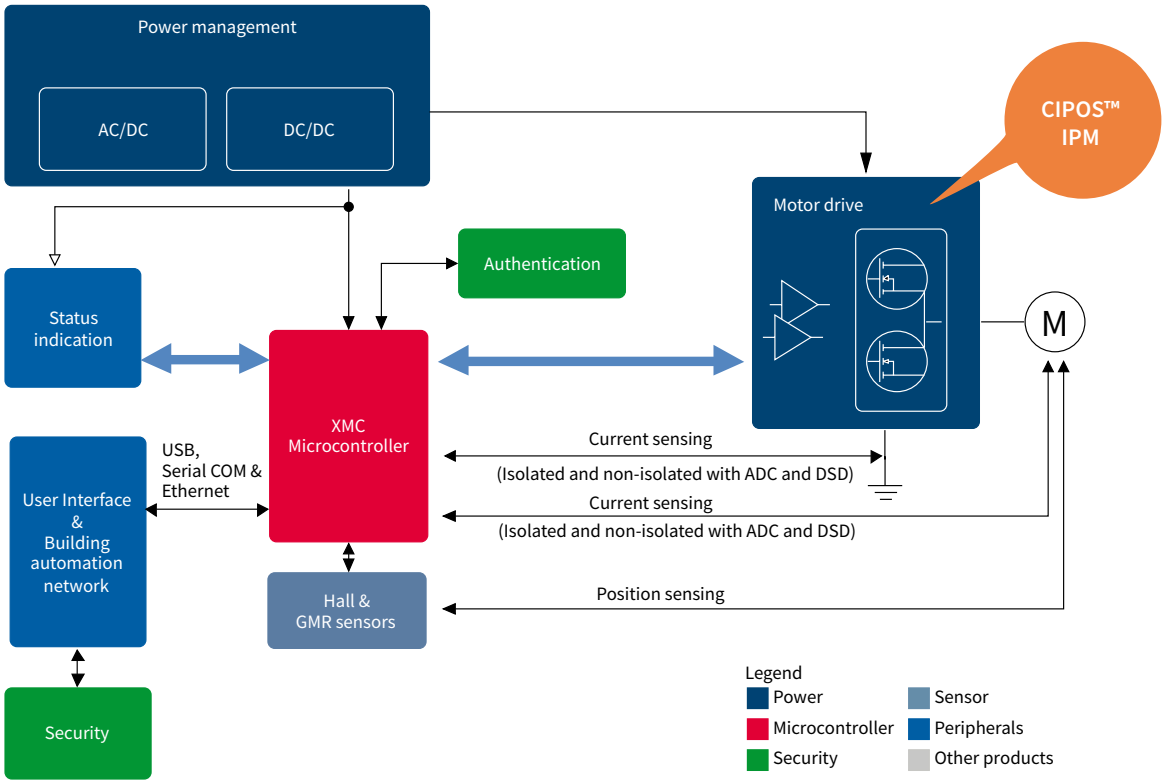
CIPOS™ IPM's major applications

High performance products with seamless functionality

Home appliances perform tasks essential to make busy everyday life easier – whether it be aid in cleaning with a washing machine or increased comfort with an air conditioning system. Historically home appliances have been big energy consumers, but at an age of heightened awareness for the environment and financial costs, the demand for energy-efficient systems is rapidly growing. At the same time, consumers expect the sleekest, quietest, most compact and visually appealing home appliances available. In addition, advanced connectivity between an increasing number of devices requires a fallback for user privacy.

With all this in mind, product designers are continuously being challenged in terms of form and function. They must deliver smaller, smarter, and more secure solutions with the most power and highest energy efficiency possible.

Industry-leading technology and manufacturing expertise from Infineon helps customers overcome these unique challenges of designing major home appliances. Our line of CIPOS™ IPMs meets and exceeds even the most rigorous requirements for reliability, quality, security and energy efficiency. Explore applications of interest to learn more about innovative design options and to find dedicated CIPOS™ IPM solutions.



Buzzword: inverterization

More and more home appliances like refrigerators, freezers, washers, dryers and air conditioning units are getting a boost in the motor drive stage. Moving away from fixed speed drives, inverter-based motor control is becoming ever more popular. This form of control can vary the speed and torque of the motor instead of just turning the motor on and off like fixed speed drives. While this type of control clearly has its benefits in terms of efficiency, consumers also benefit from the inverterization trend: appliances with digital inverters have longer lifetimes, make less noise, consume less energy, and ultimately save consumers' money.

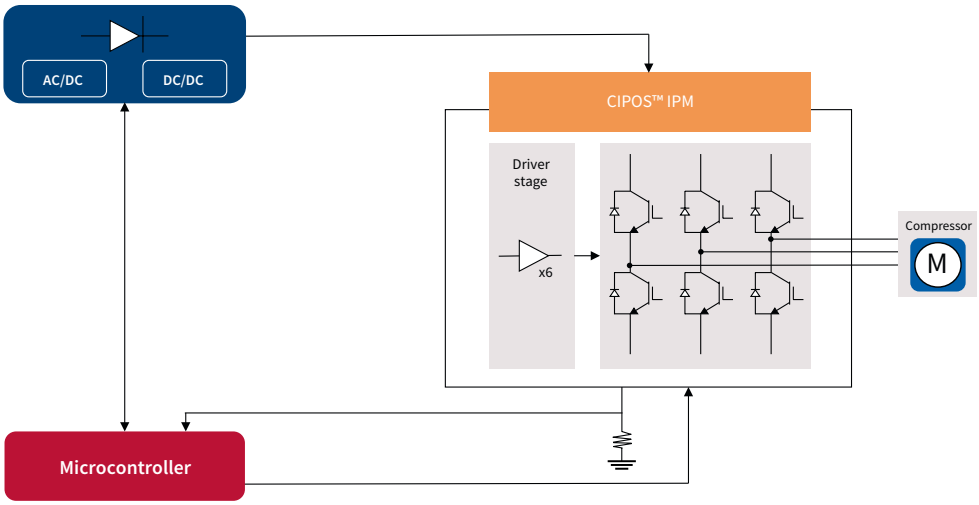
Variable speed refrigerators

Less noise, better efficiency – just what consumers want

When the time comes to select a new refrigerator, today's consumers typically focus on two aspects: more energy efficiency, and reduction or even suppression of audible noise. Compact design is a third factor that frequently comes into play. Meanwhile, refrigerator manufacturers currently face more stringent regulations of the appliance's form factor and are under constant pressure to reduce costs.

Infineon's products and expertise will allow engineers to embed all these expectations into the design of a variable speed refrigerator. The result is an advanced technical solution for the consumer that meets target cost constraints.

Variable speed refrigerators – 3-phase IPM solutions



IPM solution for variable speed refrigerators

Product family	Switch type	Voltage class [V]	Package name	Rated current [A]	$R_{DS(on)}$ max. [Ω]	Configuration	Product name
CIPOS™ Nano	MOSFET	250	QFN 8x9	-	0.15	Half-bridge	IRSM808-204MH
			QFN 12x12	-	0.45 / 1.05 / 2.20	3-phase inverter	IRSM836-084MA / IRSM836-044MA IRSM836-024MA
		500	QFN 8x9	-	0.8 / 1.7	Half-bridge	IRSM807-105MH / IRSM807-045MH
CIPOS™ Micro	IGBT	600	DIP 29x12	4 / 6	-	3-phase inverter	IM231-M6T2B / IM231-L6T2B
			SOP 29x12	4 / 6	-		IM231-M6S1B / IM231-L6S1B
CIPOS™ Tiny	IGBT	600	DIP 34X15	6		3-phase inverter	IM393-S6Ex / IM393-M6Ex / IM393-L6Ex [1]
			SIP 34X15	6			IM393-S6Fx / IM393-M6Fx / IM393-L6Fx [1]
CIPOS™ Mini	MOSFET	600	DIP 36x21	-	0.33	2-phase inverter	IM512-L6A
				-	0.33	3-phase inverter	IM513-L6A
	IGBT	600	DIP 36x21	4 / 6		3-phase inverter	IGCM04F60GA / IGCM04G60HA IGCM04G60GA / IGCM06F60GA IGCM06G60GA

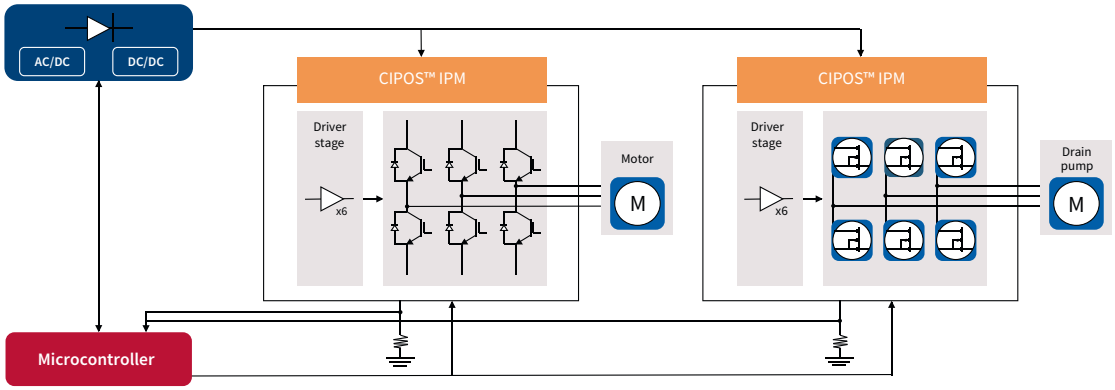
1) x = black (5.55 mm), x = 2 (2.90 mm) x = 3 (3.60 mm)

Washing machines

From inverterization to smart appliances

Washing machines have become an essential appliance that people can no longer imagine life without. Today's consumers seek quiet, highly efficient systems with enhanced features and multiple washing options. Like all commodities, washing machine designs require electrical components with an attractive price-performance ratio while still providing high reliability and energy efficiency. Furthermore, new features and design innovations can now reduce vibration and noise when handling heavy or light loads.

Variable speed washing machine system diagram



IPM solution for variable speed washing machines

IPMs for motor / compressor

Product family	Switch type	Voltage class [V]	Package name	Rated current [A]	Configuration	Product name
CIPOS™ Tiny	IGBT	600	DIP 34X15	6 / 10 / 15	3-phase inverter	IM393-S6Ex / IM393-M6Ex / IM393-L6Ex [1]
			SIP 34X15	6 / 10 / 15		IM393-S6Fx / IM393-M6Fx / IM393-L6Fx [1]
CIPOS™ Mini	IGBT	600	DIP 36x21	6 / 10 / 15		IGCM06F60GA / IGCM06G60GA / IGCM10F60GA IKCM10H60GA / IKCM10L60GA / IGCM15F60GA IKCM15H60GA / IKCM15F60GA / IKCM15L60GA

1) x = black (5.55mm), x = 2 (2.90mm) x = 3 (3.60mm)

IPMs for drain pump

Product family	Switch type	Voltage class [V]	Package name	Rated current [A]	$R_{DS(on)}$ max. [Ω]	Configuration	Product name
CIPOS™ Nano	MOSFET	250	QFN 12x12	-	0.45 / 1.05 / 2.20	3-phase inverter	IRSM836-084MA / IRSM836-044MA IRSM836-024MA
		500	QFN 12x12	-	1.70 ~ 6.00		IRSM836-045MA
CIPOS™ Micro	MOSFET	250	DIP 29 x12F	-	0.45 / 1.05 / 2.20		IRSM5y5-084DA / IRSM5y5-044DA [1] IRSM5y5-024DA [1]
			SOP 29x12F	-	0.45 / 1.05 / 2.20		IRSM5y5-084PA / IRSM5y5-044PA [1] IRSM5y5-024PA [1]
		500	DIP 29 x12F	-	1.3 ~ 6.0		IRSM5y5-065DA / IRSM5y5-055DA [1] IRSM5y5-035DA / IRSM5y5-025DA [1] IRSM5y5-015DA [1]
			SOP 29x12F	-	1.3 ~ 6.0		IRSM5y5-065PA / IRSM5y5-055PA [1] IRSM5y5-035PA / IRSM5y5-025PA [1] IRSM5y5-015PA [1]
	IGBT	600	DIP 29x12F	3 / 4	-		IM240-S6YaB [2] / IM240-M6YaB [2] IRSM5y6-076DA [1]
			DIP 29x12	4 / 6	-		IM231-M6T2B / IM231-L6T2B
			SOP 29x12F	3 / 4	-		IM240-S6Z1B / IM240-M6Z1B IRSM5y6-076PA [1]
			SOP 29x12	4 / 6	-		IM231-M6S1B / IM231-L6S1B

1) y = 0 (with NTC), y = 1 (without NTC)
2) a = 1 (standard package), a = 2 (clearance distance improved package)

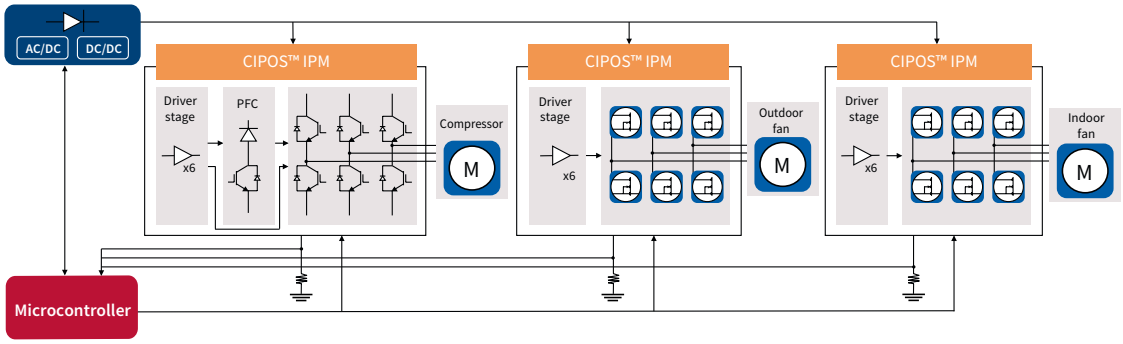
Room air conditioners

Quiet, stable, and smooth

Smarter and smaller, more powerful and energy-efficient: today's room air conditioning units must fulfill a growing list of demands. Because most are used in private homes, quiet air conditioning systems are highly sought after. Functions such as a smooth start and variable operating speeds round out the list of must-haves.

Designing room air conditioners that boast such capabilities requires everything from low-vibration components and a low acoustic noise compressor to reliable fan and sensor-less field-oriented control. Not only this, but semiconductor solutions must also be energy-efficient and reflect the increasing demand for small form factors.

Air conditioning systems diagram



IPM solution for room air conditioners

IPMs for compressor / PFC

Product family	Switch type	Voltage class [V]	Package name	Rated current [A]	Configuration	Product name
CIPOS™ Tiny	IGBT	600	DIP 34X15	10 / 15 / 20	3-phase inverter	IM393-M6Ex / IM393-L6Ex / IM393-X6Ex [1]
			SIP 34X15	10 / 15 / 20		IM393-M6Fx / IM393-L6Fx / IM393-X6Fx [1]
CIPOS™ Mini	IGBT	600	DIP 36x21	10 ~ 30	3-phase inverter	IGCM10F60GA / IKCM10L60GA IGCM15F60GA / IKCM15F60GA / IKCM15L60GA IGCM20F60GA / IKCM20L60GA IKCM30F60GA
			DIP 36x21D	15 / 20 /30	3-phase inverter	IKCM15L60GD / IKCM20L60GD / IKCM30F60GD
				10 / 15	3-phase inverter + PFC	IFCM10z60GD / IFCM15z60GD [2]
		650	DIP 36x21D	20 / 30	2-phase Interleaved PFC	IFCM20T65GD / IFCM30T65GD
				20 / 30	3-phase Interleaved PFC	IFCM20U65GD / IFCM30U65GD

1) z = A (3-phase open source), z = B (3-phase common)
2) y = 0 (with NTC), y = 1 (without NTC)

IPMs for outdoor fans

Product family	Switch type	Voltage class [V]	Package name	Rated current [A]	$R_{DS(on)}$ max. [Ω]	Configuration	Product name
CIPOS™ Micro	MOSFET	250	DIP 29 x12F	-	0.45 / 1.05 / 2.20	3-phase inverter	IRSM5y5-084DA / IRSM5y5-044DA [1] IRSM5y5-024DA [1]
			SOP 29x12F	-	0.45 / 1.05 / 2.20	3-phase inverter	IRSM5y5-084PA / IRSM5y5-044PA [1] IRSM5y5-024PA [1]
		500	DIP 29 x12F	-	1.3 ~ 4.0	3-phase inverter	IRSM5y5-065DA / IRSM5y5-055DA [1] IRSM5y5-035DA / IRSM5y5-025DA [1]
			SOP 29x12F	-	1.3 ~ 4.0	3-phase inverter	IRSM5y5-065PA / IRSM5y5-055PA [1] IRSM5y5-035PA / IRSM5y5-025PA [1]
	IGBT	600	DIP 29x12F	3 / 4	-	3-phase inverter	IM240-S6YaB [2] IM240-M6YaB [2] / IRSM5y6-076DA [1]
			DIP 29x12	4 / 6	-		IM231-M6T2B / IM231-L6T2B
			SOP 29x12F	3 / 4	-	3-phase inverter	IM240-S6Z1B IM240-M6Z1B / IRSM5y6-076PA [1]
			SOP 29x12	4 / 6	-		IM231-M6S1B / IM231-L6S1B
CIPOS™ Tiny	IGBT	600	DIP 34X15	6	-	3-phase inverter	IM393-S6Ex [2]
			SIP 34X15	6	-		IM393-S6Fx [2]

1) y = 0 (with NTC), y = 1 (without NTC)
2) x = black (5.55mm), x = 2 (2.90mm), x = 3 (3.60mm)
3) a = 1 (Standard package), a = 2 (Clearance distance improved package)

IPMs for indoor fan

Product family	Switch type	Voltage class [V]	Package name	Rated current [A]	$R_{DS(on)}$ max. [Ω]	Configuration	Product name
iMOTION™ Smart IPM	MOSFET	500	QFN 12x12	-	6.0	3-phase inverter	IMM101T-015M
		600	QFN 12x12	-	1.4 / 0.95	3-phase inverter	IMM101T-046M / IMM101T-056M
CIPOS™ Nano	MOSFET	250	QFN 8x9	-	0.15	Half-bridge	IRSM808-204MH
			QFN 12x12	-	0.45 / 1.05 / 2.20	3-phase inverter	IRSM836-084MA / IRSM836-044MA IRSM836-024MA
		500	QFN 8x9	-	0.8 / 1.7	Half-bridge	IRSM807-105MH / IRSM808-105MH IRSM807-045MH
			QFN 12x12	-	1.7 ~ 6.0	3-phase inverter	IRSM836-045MA / IRSM836-035Mz [1] IRSM836-025MA / IRSM836-015MA
CIPOS™ Micro	MOSFET	500	DIP 29x12F	-	1.3 ~ 6.0	3-phase inverter	IRSM5y5-065DA / IRSM5y5-055DA [2] IRSM5y5-035DA / IRSM5y5-025DA [2] IRSM5y5-015DA [2]
			SOP 29x12F	-	1.3 ~ 6.0	3-phase inverter	IRSM5y5-065PA / IRSM5y5-055PA [2] IRSM5y5-035PA / IRSM5y5-025PA [2] IRSM5y5-015PA [2]
	IGBT	600	DIP 29x12F	3 / 4	-	3-phase inverter	IM240-S6YaB [3] IM240-M6YaB [3] / IRSM5y6-076DA [1]
			DIP 29x12	4 / 6	-		IM231-M6T2B / IM231-L6T2B
			SOP 29x12F	3 / 4	-	3-phase inverter	IM240-S6Z1B IM240-M6Z1B / IRSM5y6-076PA [1]
			SOP 29x12	4 / 6	-		IM231-M6S1B / IM231-L6S1B

1) z = A (3-phase open source), z = B (3-phase common)
2) y = 0 (with NTC), y = 1 (without NTC)
3) a = 1 (standard package), a = 2(clearance distance improved package)

Variable speed fans

Efficiency, power density, and reliability

What are today's consumers looking for in a fan? Less noise and energy consumption, increased power, and smart features. Low acoustic noise is highly desirable in a fan motor, as well as functions such as stable and smooth starting, having a wide range of operating speeds, and vibration suppression.

Reliable and energy-efficient components are key to a fan motor that is synchronized with consumer needs. Additionally, new form factors to achieve smaller designs are essential and the price-performance ratio needs to be just right. In a world where applications are becoming smarter, an ideal solution must enable feature novelties that render a fan an intelligent appliance. CIPOS™ IPMs go beyond just connectivity and gives consumers a reliable and highly efficient solution.

IPM solution for fan motors

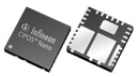
Product family	Switch type	Voltage class [V]	Package name	Rated current [A]	$R_{DS(on)}$ max. [Ω]	Configuration	Product name
iMOTION™ Smart IPM	MOSFET	500	QFN 12x12	-	6.0	3-phase inverter	IMM101T-015M
		600	QFN 12x12	-	1.4 / 0.95	3-phase inverter	IMM101T-046M / IMM101T-056M
CIPOS™ Nano	MOSFET	40	QFN 7x8	-	0,05	Half-bridge	IRSM005-301MH
		100	QFN 7x8	-	0,02	Half-bridge	IRSM005-800MH
		250	QFN 8x9	-	0,15	Half-bridge	IRSM808-204MH
			QFN 12x12	-	0.45 / 1.05 / 2.20	3-phase inverter	IRSM836-084MA / IRSM836-044MA IRSM836-024MA
		500	QFN 8x9	-	0.8 / 1.7	Half-bridge	IRSM807-105MH / IRSM808-105MH IRSM807-045MH
			QFN 12x12	-	1.7 ~ 6.0	3-phase inverter	IRSM836-045MA / IRSM836-035Mz [1] IRSM836-025MA / IRSM836-015MA
CIPOS™ Micro	MOSFET	500	DIP 29x12F	-	1.3 ~ 6.0	3-phase inverter	IRSM5y5-065DA / IRSM5y5-055DA [2] IRSM5y5-035DA / IRSM5y5-025DA [2] IRSM5y5-015DA [2]
			SOP 29x12F	-	1.3 ~ 6.0	3-phase inverter	IRSM5y5-065PA / IRSM5y5-055PA [2] IRSM5y5-035PA / IRSM5y5-025PA [2] IRSM5y5-015PA [2]
	IGBT	600	DIP 29x12F	3 / 4	-	3-phase inverter	IM240-S6YaB [3] IM240-M6Y1aB [3] / IRSM5y6-076DA [2]
			DIP 29x12	4 / 6	-		IM231-M6T2B / IM231-L6T2B
			SOP 29x12F	3 / 4	-	3-phase inverter	IM240-S6Z1B IM240-M6Z1B / IRSM5y6-076PA [2]
			SOP 29x12	4 / 6	-		IM231-M6S1B / IM231-L6S1B
CIPOS™ Tiny	IGBT	600	DIP 34x15	6 ~ 20	-	3-phase inverter	IM393-S6Ex / IM393-M6Ex [4] IM393-L6Ex / IM393-X6Ex [4]
			SIP 34x15	6 ~ 20	-		IM393-S6Fx / IM393-M6Fx [4] IM393-L6Fx / IM393-X6Fx [4]
CIPOS™ Mini	MOSFET	600	DIP 36x21	-	0,33	2-phase inverter	IM512-L6A
				-	0,33	3-phase inverter	IM513-L6A
	IGBT	600	DIP 36x21	6 ~ 30	-	3-phase inverter	IGCM04F60GA / IGCM04G60HA / IGCM04G60GA IGCM06F60GA / IGCM06G60GA IGCM10F60GA / IKCM10H60GA / IKCM10L60GA IGCM15F60GA / IKCM15H60GA / IKCM15L60GA IGCM20F60GA / IKCM20L60GA / IKCM30F60GA
			DIP 36x21D	15 / 20 / 30	-	3-phase inverter	IKCM15L60GD / IKCM20L60GD / IKCM30F60GD

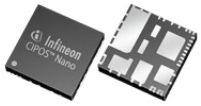
1) z = A (3-phase open source), x = B (3-phase common)
2) y = 0 (with NTC), y = 1 (without NTC)
3) a = 1 (standard package), a = 2(clearance distance improved package)
4) x = black (5.55mm), x = 2 (2.90mm) x = 3 (3.60mm)

Product portfolio

Infineon's CIPOS™ IPM solutions are the expert's choice. With more than 100 reliable and efficient IPM solutions, Infineon provides a comprehensive portfolio for virtually any application. To ease the selection process, this overview is structured along the CIPOS™ families.

CIPOS™ Nano





Switch type	Voltage class [V]	$R_{DS(on)}$ max. [Ω]	P_{mot} [W][1]	Product name	Configuration: Half-bridge	Configuration: 3-phase open source	Configuration: 3-phase common source	Package: QFN 7x8	Package: QFN 8x9	Package: QFN 12x12	Others: Built in NTC
MOSFET	40	0.05	165	IRSM005-800MH	●			●			
	100	0.02	165	IRSM005-301MH	●			●			
	250	0.15	205	IRSM808-204MH	●			●			
		0.45	84	IRSM836-084MA		●				●	
		1.05	60	IRSM836-044MA		●				●	
		2.20	40	IRSM836-024MA		●				●	
	500	0.80	205	IRSM807-105MH	●				●		
		0.80	205	IRSM808-105MH	●				●		
		1.70	80	IRSM836-045MA		●				●	
		1.70	130	IRSM807-045MH	●				●		
		2.20	70	IRSM836-035MA		●				●	
		2.20	70	IRSM836-035MB			●			●	
		4.00	55	IRSM836-025MA		●				●	
		6.00	50	IRSM836-015MA		●				●	

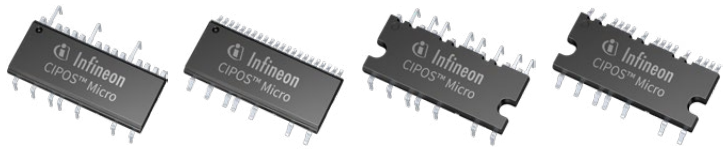
1) P_{mot} (16 kHz) without heatsink

iMOTION™ Smart IPM

Switch type	Voltage class [V]	$R_{DS(on)}$ max. [Ω]	P_{mot} [W][1]	Product name	Configuration: 3-phase inverter	Configuration: 3-phase inverter + PFC	Package: QFN 12x12	Others: MCE 2.0
MOSFET	500	6.00	30	IMM101T-015M	●		●	●
				IMM102T-015M		●	●	●
	600	0.95	80	IMM101T-056M	●		●	●
				IMM102T-056M		●	●	●
		1.40	60	IMM101T-046M	●		●	●
				IMM102T-046M		●	●	●

1) P_{mot} (16 kHz) without heatsink

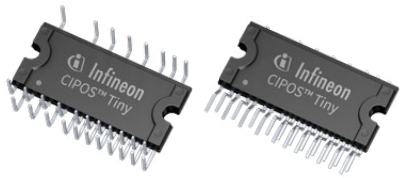
CIPOS™ Micro



Switch type	Voltage class [V]	$R_{DS(on)}$ max. [Ω]	Rated current [A]	P_{mot} [W][1]	Product name	Configuration		Package				Others
						3-phase open emitter	3-phase open source	SOP 29x12F	SOP 29x12	DIP 29x12F	DIP 29x12	Built in NTC
IGBT	600	-	4.00	320	IM231-M6S1B	●			●			●
		-	4.00	320	IM231-M6T2B	●					●	●
		-	4.00	105	IRSM506-076DA	●			●			●
		-	4.00	105	IRSM506-076PA	●					●	●
		-	4.00	105	IRSM516-076DA	●			●			
		-	4.00	105	IRSM516-076PA	●					●	
		-	6.00	400	IM231-L6S1B	●			●			●
		-	6.00	400	IM231-L6T2B	●					●	●
MOSFET	250	0.45	-	95	IRSM505-084DA		●			●		
		0.45	-	95	IRSM505-084PA		●	●				
		0.45	-	95	IRSM515-084DA		●			●		
		0.45	-	95	IRSM515-084PA		●	●				
		1.05	-	65	IRSM505-044DA		●			●		
		1.05	-	65	IRSM505-044PA		●	●				
		1.05	-	65	IRSM515-044DA		●			●		
		1.05	-	65	IRSM515-044PA		●	●				
		2.20	-	40	IRSM505-024DA		●			●		
		2.20	-	40	IRSM505-024PA		●	●				
		2.20	-	40	IRSM515-024DA		●			●		
		2.20	-	40	IRSM515-024PA		●	●				
	500	1.30	-	85	IRSM505-065DA		●					
		1.30	-	85	IRSM505-065PA		●					
		1.30	-	85	IRSM515-065DA		●					
		1.30	-	85	IRSM515-065PA		●					
		1.70	-	85	IRSM505-055DA		●					
		1.70	-	85	IRSM505-055PA		●					
		1.70	-	85	IRSM515-055DA		●					
		1.70	-	85	IRSM515-055PA		●					
		2.20	-	75	IRSM505-035DA		●					
		2.20	-	75	IRSM505-035PA		●					
		2.20	-	75	IRSM515-035DA		●					
		2.20	-	75	IRSM515-035PA		●					
		4.00	-	60	IRSM505-025DA		●					
		4.00	-	60	IRSM505-025PA		●					
		4.00	-	60	IRSM515-025DA		●					
		4.00	-	60	IRSM515-025PA		●					
		6.00	-	50	IRSM505-015DA		●					
		6.00	-	50	IRSM505-015PA		●					
		6.00	-	50	IRSM515-015DA		●					
		6.00	-	50	IRSM515-015PA		●					

1) P_{mot} (16 kHz) without heatsink

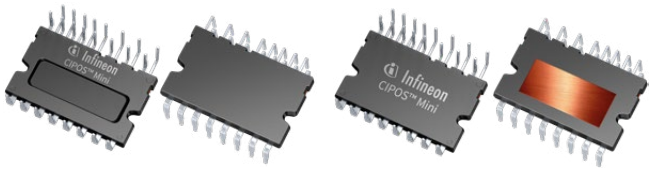
CIPOS™ Tiny



Switch type	Voltage class [V]	$R_{DS(on)}$ max. [Ω]	P_{mot} [W][1)]	Product name	Config.	Package			Others
					3-phase open source	DIP 34x15	SIP 34x15	Lead length options	Built in NTC
IGBT	600	6.0	400	IM393-S6E	●	●		●	●
		6.0	400	IM393-S6F	●		●		●
		10.0	600	IM393-M6E	●	●		●	●
		10.0	600	IM393-M6F	●		●		●
		15.0	750	IM393-L6E	●	●		●	●
		15.0	750	IM393-L6F	●		●		●
		20.0	1200	IM393-X6E	●	●		●	●
		20.0	1200	IM393-X6F	●		●		●

1) P_{mot} (16 kHz) without heatsink

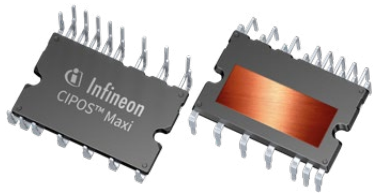
CIPOS™ Mini



Switch type	Voltage class [V]	$R_{DS(on)}$ max. [Ω]	Rated current [A]	P_{mot} [W][1)]	Product name	Configuration								Package		Others
						2-phase Open Source	3-phase Open Source	3-phase Closed Emitter	3-phase Open Emitter	2-phase Interleaved PFC	3-phase Interleaved PFC	2-phase Asymmetric Inverter	PFC Integrated	DIP 36x21D	DIP 36x21	Built in NTC
IGBT	600	-	10.0	1200	IFCM10P60GD								●	●		●
		-	10.0	1200	IFCM10S60GD								●	●		●
		-	15.0	1800	IFCM15P60GD								●	●		●
		-	15.0	1800	IFCM15S60GD								●	●		●
	650	-	20.0	3600	IFCM20T65GD					●				●		●
		-	20.0	4400	IFCM20U65GD						●			●		●
		-	30.0	5400	IFCM30T65GD					●				●		●
		-	30.0	6400	IFCM30U65GD						●			●		●
	600	-	4.0	600	IGCM04G60GA			●							●	●
		-	4.0	600	IGCM04G60HA			●							●	
		-	6.0	800	IGCM06G60GA			●							●	●
		-	4.0	600	IGCM04F60GA				●						●	●
		-	6.0	800	IGCM06F60GA				●						●	●
		-	10.0	1000	IGCM10F60GA				●						●	●
		-	15.0	1200	IGCM15F60GA				●						●	●
		-	20.0	1600	IGCM20F60GA				●						●	●
		-	10.0	1000	IKCM10H60GA				●						●	●
		-	10.0	1200	IKCM10L60GA				●						●	●
		-	15.0	1600	IKCM15F60GA				●						●	●
		-	15.0	1200	IKCM15H60GA				●						●	●
		-	15.0	1600	IKCM15L60GA				●						●	●
		-	15.0	2200	IKCM15L60GD				●					●		●
		-	20.0	1800	IKCM20L60GA				●						●	●
		-	20.0	2400	IKCM20L60GD				●					●		●
		-	30.0	2000	IKCM30F60GA				●						●	●
		-	30.0	2600	IKCM30F60GD				●					●		●
		-	15.0	2200	IKCM15R60GD							●		●		●
		-	20.0	2400	IKCM20R60GD							●		●		●
MOSFET	600	0.33	-	400	IM512-L6A	●										●
		0.33	-	600	IM513-L6A		●									●

1) P_{mot} (16 kHz) without heatsink

CIPOS™ Maxi



Switch type	Voltage class [V]	Rated current [A]	P_{mot} [W][1)]	Product name	Config.	Package	Others
					3-phase Open Emitter	DIP 36x23D	Built in NTC
Maxi	1200	5.0	1200	IM818-SCC	●	●	●
		10.0	1800	IM818-MCC	●	●	●

1) P_{mot} (16 kHz) without heatsink

New product highlights

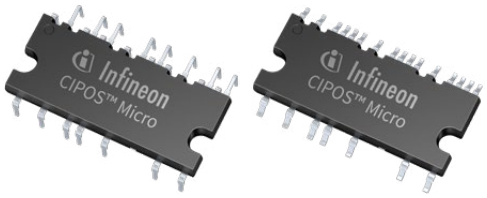
600 V 4/6 A IM231 Series

Optimized solution for system cost savings in a small footprint

IM231 series are designed for high-efficiency appliance motor drives such as air-conditioner fans and refrigerator compressors. These advanced IPMs, available in both surface mount and through-hole configurations, offer a combination of low $V_{CE(sat)}$ TRENCHSTOP™ IGBT6 technology and the industry benchmark rugged half-bridge drivers. The IPMs have various protection features including precise overcurrent protection and temperature feedback.

Key features

- 600V 3-phase inverter including gate drivers
- Low $V_{CE(sat)}$ TRENCHSTOP™ IGBT6
- Fault reporting and programmable fault clear
- Advanced input filter with shoot-through protection
- Open-emitter for single and leg-shunt current sensing
- UL-certified NTC thermistor



Key benefits

- Multiple markets (AC100 V – AC230 V) coverage with small footprint
- Multiple package options available
- Easy to design-in – fast time to market
- Best optimized solution for system cost saving

Product portfolio

Product name	Voltage class [V]	[A]	Configuration	Package name
IM231-M6T2B	600	4	3-phase inverter	DIP 29x12
IM231-L6T2B	600	6	3-phase inverter	DIP 29x12
IM231-M6S1B	600	4	3-phase inverter	SOP 29x12
IM231-L6S1B	600	6	3-phase inverter	SOP 29x12

New product highlights

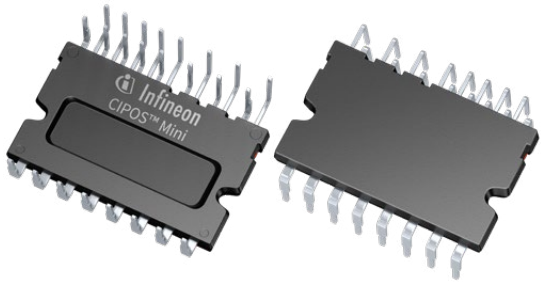
600 V 0.33 Ω IM51x Series

High efficiency solution for low power motor drives

IM51x series are high efficient intelligent power modules (IPM) to control AC motors for low power motor drives up to 600 W. Optimized to operate under light load conditions, the integrated CoolMOS™ MOSFETs significantly improve power efficiency when compared to IGBT based IPMs. This enables overall system energy and cost savings through reduced power consumption.

Key features

- 2-phase and 3-phase inverter including gate drivers
- Rugged SOI gate driver technology with stability against transient
- and negative voltage
- Based on CoolMOS™ CFD2 Power MOSFETs
- Integrated bootstrap circuit
- Under-voltage lockout at all channels
- Over-current protection
- Cross-conduction prevention



Key benefits

- Easy to design-in, fast time to market
- Excellent light load efficiency improves overall power consumption
- Allow system cost savings through thinner insulation panel usage

Product portfolio

Product name	Voltage class [V]	$R_{DS(on)}$ [Ω]	Configuration	Package name
IM512-L6A	600	0.33	2-phase inverter	DIP 36x21
IM513-L6A	600	0.33	3-phase inverter	DIP 36x21

New product highlights

500/600 V iMOTION™ Smart IPM IMM100 Series

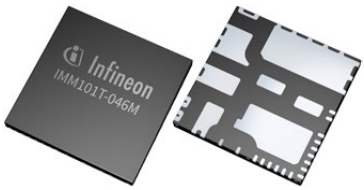
Fully integrated iMOTION™ Smart IPM for BLDC motor control

iMOTION™ IMM100 is a series of fully integrated Smart IPMs implementing sensorless Field Oriented Control (FOC) of a Permanent Magnet Synchronous Motor (PMSM).

The combination of the iMOTION™ Motion Control Engine ("T"- variants) with the gate driver and six MOSFETs offers a complete motor drive system in a compact 12 x 12 mm^2 surface mount package, minimizing external components count and PCB area.

Key features

- Fully integrated 3-phase driver with motor control IC
- 3 different MOSFET options
- Multiple sensing topology options – sensored and sensorless
- Integrated bootstrap diodes
- Sensorless FOC algorithm included – No programming required
- Optional PFC control on IMM102 devices
- Integrated protection features



Key benefits

- Lowest BOM count
- PCB size and system cost saving
- No heatsink up to 80 W required
- Fast time-to-market
- Reduced hardware and software R&D costs

Product portfolio

Product name	Voltage class [V]	$R_{DS(on)}$ max. [Ω]	Features	Configuration	Package name
IMM101T-015M	500	6.00	MCE 2.0	3-phase inverter	QFN 12x12
IMM101T-046M	600	1.40	MCE 2.0	3-phase inverter	QFN 12x12
IMM101T-056M	600	0.95	MCE 2.0	3-phase inverter	QFN 12x12
IMM102T-016M	500	6.00	MCE 2.0	3-phase inverter + PFC	QFN 12x12
IMM102T-046M	600	1.40	MCE 2.0	3-phase inverter +PFC	QFN 12x12
IMM102T-056M	600	0.95	MCE 2.0	3-phase inverter +PFC	QFN 12x12

IPM support tools

CIPOS™ IPM simulation tool (motor drive and PFC boost)

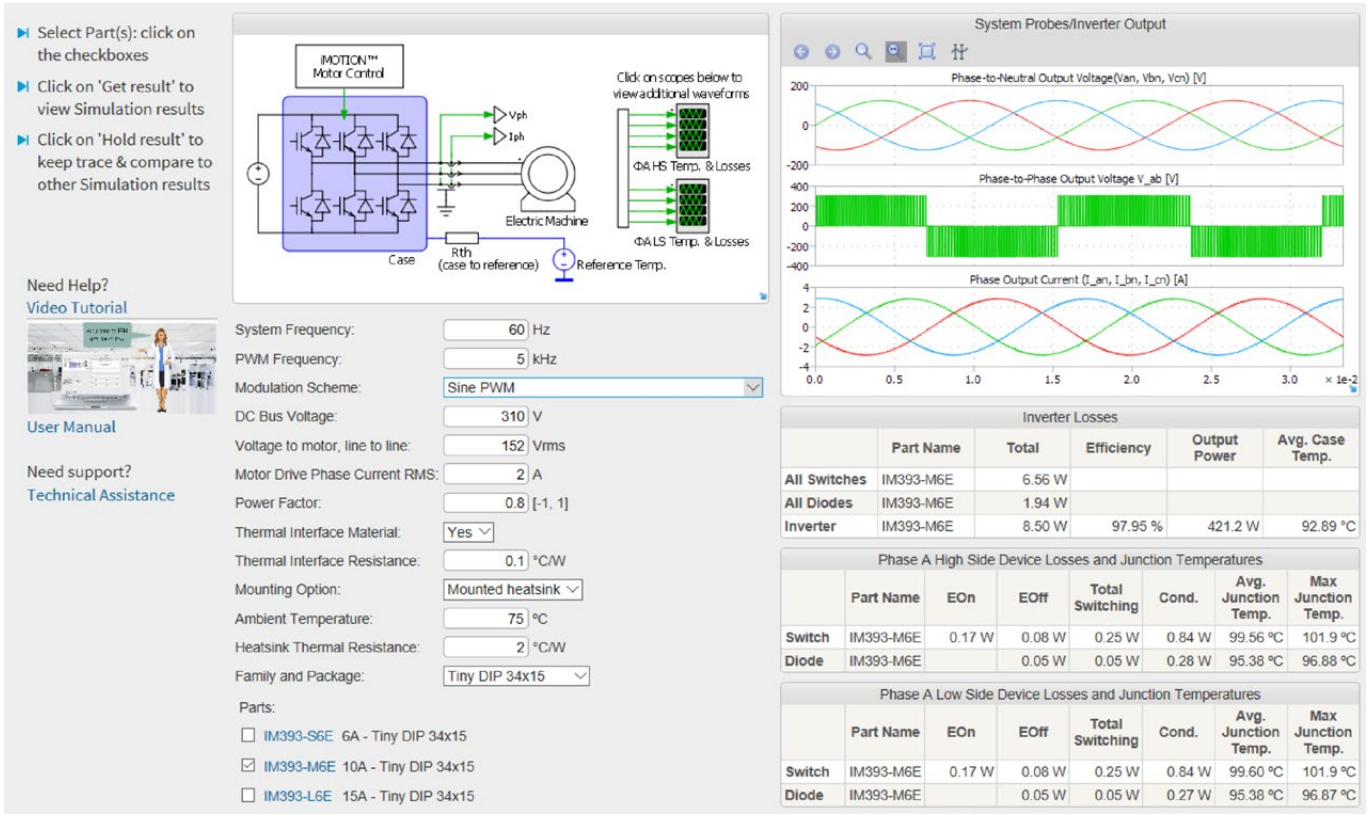
The CIPOS™ IPM simulation tool allows the user to simulate and compare IPMs under user-specified application conditions to help determine which part will best suit their needs. Currently, there are two simulation applications available: 3-phase inverter motor drive and PFC boost.

IPM Motor Drive Simulation Tool:
https://plex.infineon.com/plexim/ipmmotor.html

IPM PFC Boost Simulation Tool:
https://plex.infineon.com/plexim/ipmpfcboost.html

Both tools shows expected temperature of the selected IPM, the approximate losses of the IPM, and waveforms corresponding to the output voltage, output current, junction temperature, and power losses.

For aid in getting started, a video tutorial and detailed user manual are available on both simulation tool webpages.



IPM evaluation boards

Motor running in less than 1 hour!

IPM evaluation boards, also known as IPM Modular Application Design Kits (MADKs), are available at www.infineon.com/ipm. These boards are a full motor drive solution providing quick and easy evaluation of CIPOS™ IPMs without requiring the customer to spend time on system design. All MADKs are designed to work with iMOTION™ motor control ICs allowing the customer to get their motor running in less than 1 hour without the need for any coding.

EVAL–M1-05-65D
- IPM: IRSM505-065DA
- Power rating: 250 W
- Max output current: 0.65 Arms

EVAL-M1-05-84D
- IPM: IRSM505-084DA
- Power rating: 250 W
- Max output current: 1.0 Arms

EVAL-M1-05F804
- IPM: IRSM005-800MH
- Power rating: 165 W
- Max output current: 10.5 Arms

EVAL-M1-05F310
- IPM: IRSM005-310MH
- Power rating: 165 W
- Max output current: 5.5 Arms

EVAL-M1-36-45A
- IPM: IRSM836-045MA
- Power rating: 85 W
- Max output current: 0.5 Arms

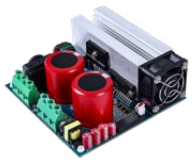
EVAL-M1-36-84A
- IPM: IRSM836-084MA
- Power rating: 150 W
- Max output current: 1.0 Arms

EVAL-M1-CM610N3
- IPM: IKCM10H60GA
- Power rating: 750 W
- Max output current: 2.7 Arms

EVAL-M3-CM615PN
- IPM: IFCM15S60GD
- Power rating: 650 W
- Max output current: 3.0 Arms

EVAL-M1-CTE/F610N3
- IPM: IM393-M6E
- Power rating: 600 W
- Max output current: 3.6 Arms

EVAL-M1-CTE/F620N3
- IPM: IM393-X6E
- Power rating: 1200 W
- Max output current: 6.8 Arms



EVAL-M1-IM818-A
- IPM: IM818-MCC
- Power rating: 2600 W
- Max output current: 4.0 Arms

EVAL-M1-IM231-A
- IPM: IM231-L6S1B
- Power rating: 350 W
- Max output current: 1.5 Arms

EVAL–M1-IM240
- IPM: IM240-S6
- Power rating: 200W
- Max output current: 1.5 Arms

EVAL-IMM101T-015
- IPM: IMM101T-015M
- Power rating*: 30 W
- Max output current: 0.28 Arms

EVAL-IMM101T-046
- IPM: IMM101T-046M
- Power rating*: 60 W
- Max output current: 0.43 Arms

*Nominal value. Actual power rating and max output current depend on the switing frequency, modulation type and external temperature

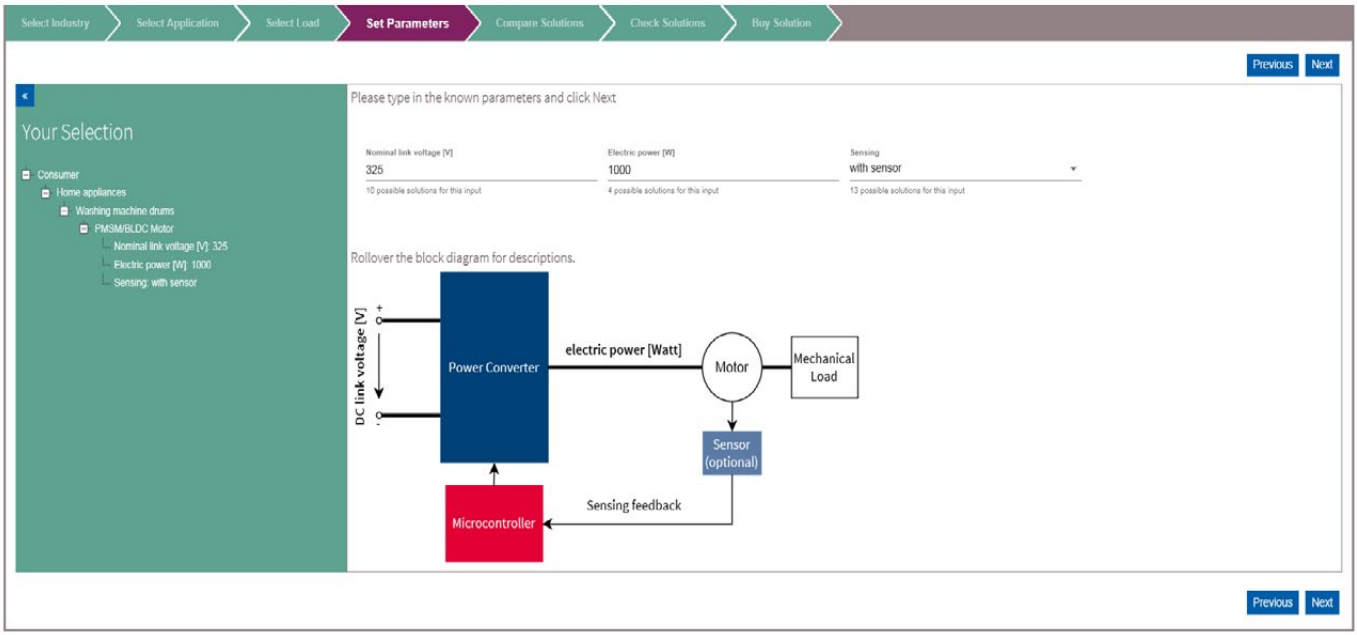
Solution Finder

Use Solution Finder to compare and purchase IPMs for your project

Infineon Solution Finder is an easy to use online tool for finding, comparing and buying semiconductor products in an application context visualized by block diagrams and combined with electrical and thermal simulations powered by Infineon Designer, PLECS and PowerEsim.

You can already access solutions for motor control and drives, power supplies and lighting applications with this tool.

Infineon Solution Finder:
https://solutionfinder.infineon.com/application/en



Notes

Notes

Where to buy

Infineon distribution partners and sales offices:
www.infineon.com/WhereToBuy

Service hotline

Infineon offers its toll-free 0800/4001 service hotline as one central number, available 24/7 in English, Mandarin and German.

- Germany ..... 0800 951 951 951 (German/English)
- China, mainland ..... 4001 200 951 (Mandarin/English)
- India ..... 000 800 4402 951 (English)
- USA ..... 1-866 951 9519 (English/German)
- Other countries ..... 00* 800 951 951 951 (English/German)
- Direct access ..... +49 89 234-0 (interconnection fee, German/English)

* Please note: Some countries may require you to dial a code other than "00" to access this international number.
Please visit www.infineon.com/service for your country!

Mobile product catalog

Mobile app for iOS and Android.

www.infineon.com

Published by
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9500 Villach, Austria

Order number: B159-I0827-V1-7600-EU-EC-P
Date: 05 / 2019

Parametrics

Parametrics	IMM101T-046M
Control Option	1 motor
Description	3-phase inverter Smart IPM with 600V/1.4Ω MOSFETs and MCE 2.0 with scripting
Integration Level	Smart IPM + MCE
Language	PLECS
Moisture Sensitivity Level	3
Online Simulation	https://plex.infineon.com/plexim/ipmmotor.html?Parts=IMM101T-046M&Vdc=300&V_vsi=150&I_vsi=0.4&cos_phi=0.95&mount=2&Tref=40&THinterface=2&startSimulation=Steady-State%20Analysis
Package	PG-IQFN-38-1
Processor Type	MCE 2.0
Product Category	Motor Control ICs
Type of Memory	Flash

Order

Sales Product Name	IMM101T-046M
OPN	IMM101T046MXUMA1
Product Status	active and preferred
Package name	PG-IQFN-38
Order online	Buy online
Completely lead free	yes
Halogen free	yes
RoHS compliant	yes
Packing Size	2000
Packing Type	TAPE & REEL
Moisture Level	3
Moisture Packing	DRY