Motor Controller
for battery vacuum cleaner

2020/7/21

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Low voltage vacuum cleaner

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Basic Block diagram

Infineon has a lot of parts for Power electronics.
e.g. MOSFET/IGBT, GateDriver and DC-DC

- AC-DC Adapter
- Secondary battery
- DC bus
- BMS
- DC-DC LDO
- Processor
  - PWM
  - ADC Op-Amp
  - I2C UART
- Motor Controller
- User Interface
- Sensors
- DC Motor for brush head
- Switch
- LED
- 3 phase Gate Driver
- Motor
- three phase BLDC motor
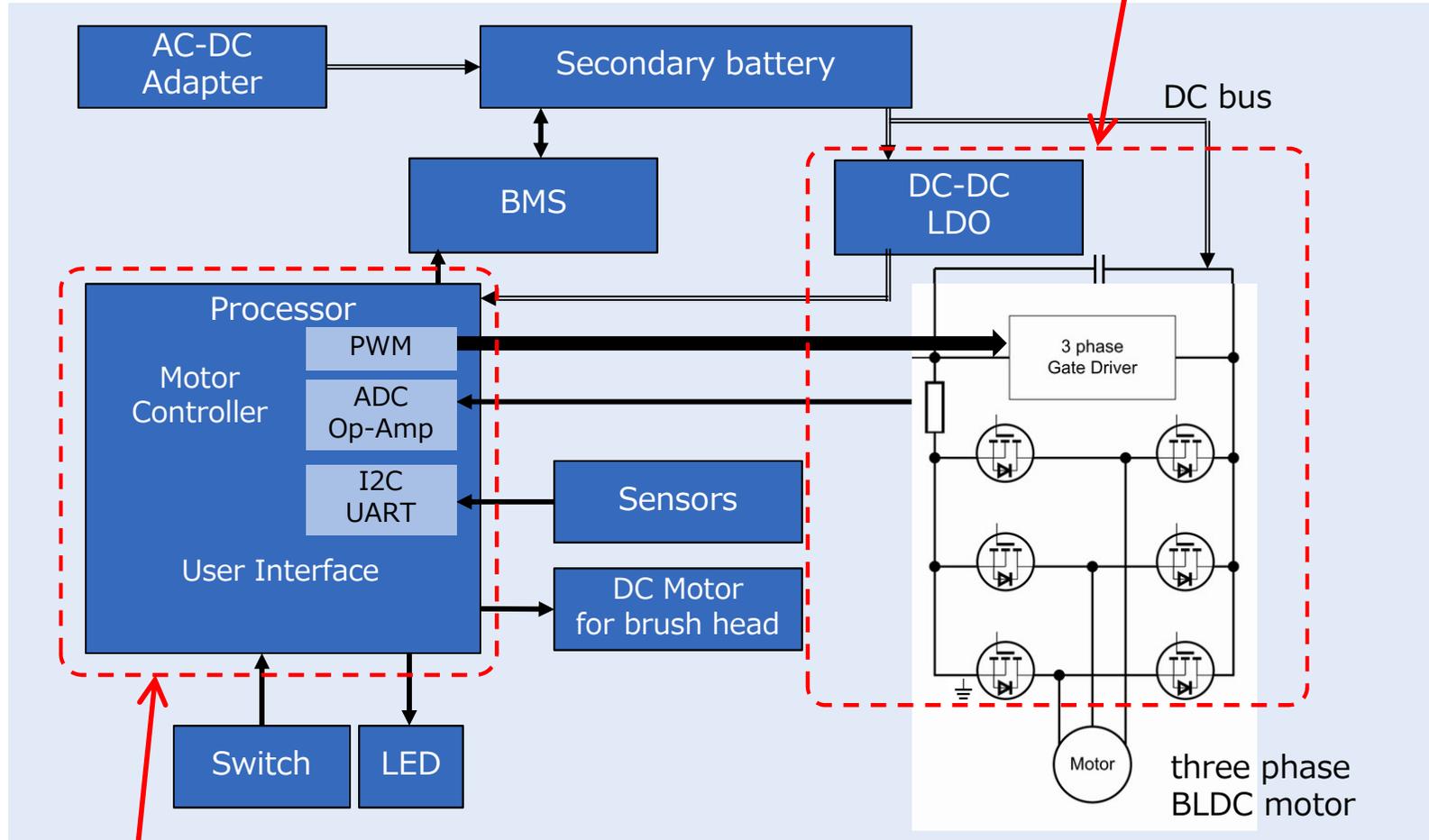
This document introduces the motor control parts.

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What is iMOTION™ ?

Keywords about iMOTION™

- ✓ Motor Controller by Infineon Technologies AG

- ✓ Dedicated to Brush Less DC (BLDC) Motor

- ✓ MCE2.0 (Motor Control Engine 2.0)

  - • Sensorless

  - • Field-oriented control (FOC)

  - • Space vector PWM with sinusoidal commutation

  - • maximum speed 100krpm

  - • no software development

  - • Class B pre-certification (IEC60335, Household and similar electrical appliances)

- ✓ Three product families

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What is iMOTION™ ?

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Benefits by iMOTION

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iMOTION™
Solution Platform Dedicated to Motor Control

MCE2.0
Professional Mtor Control Engine

Hardware Integration

Customization Possible

› **Reduced SW dev.**
› **Easy Ecosystem**

› **Less Components**
› **Less PCB space**
› **Simplified Logistic**

Benefits

System Cost Reduction

Time to Market

What is iMOTION™ ?

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Functions of iMOTION

iMOTION has a wide variety of products.
But the following basic functions are commonly provided for all products.

Basic functions	
Control functions	**Protections**
› Field-Oriented Control (FOC)	› Over voltage and Under voltage
› Sensor less and Sensor	› Over Current
› 3- or 2-phase modulation	› High Templature
› Field weakening	› Rotor Lock
› Zero vector braking	› Motor Gatekill
› Integrated PFC (opt.)	› Fault Indication

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Three Procuct families

1 iMOTION™ Controller
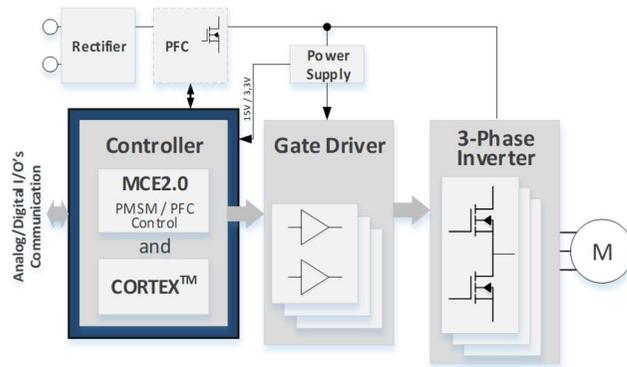
Digital Controller

MCE 2.0 and Arm® Cortex® M0

Controller   Gate Driver   MOSFET's

Controller   IPM

2 iMOTION™ SmartDriver
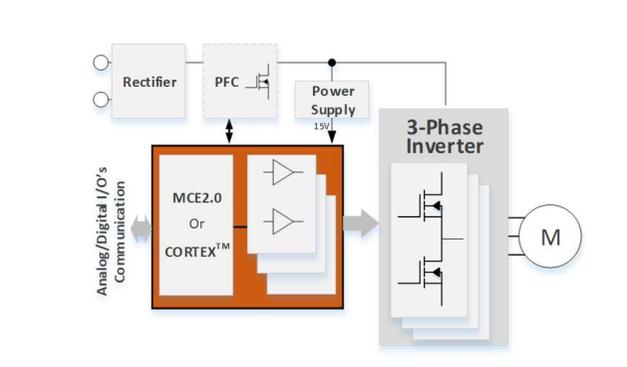
Digital Controller

MCE 2.0 or Arm® Cortex® M0

+600V Gate Driver

Smart Driver   IGBT's / MOSFET's

in development

**3** iMOTION™ SmartIPM
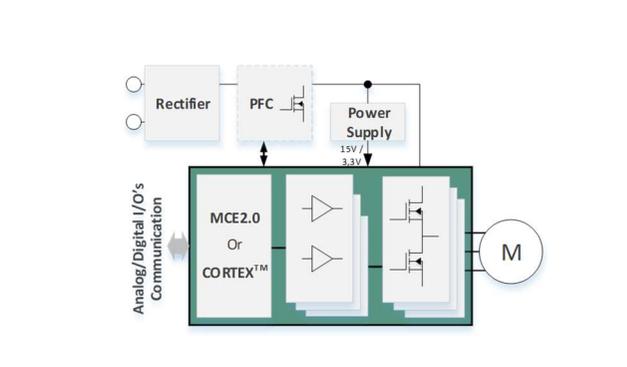
Digital Controller

MCE 2.0 or Arm® Cortex® M0

+600V Gate Driver

+3ph 600V MOSFET power stage

Flexibility

Integration

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What is iMOTION™ ?

③ "Controler＋GateDriver+MOSFET" All in one = IMM101T

Controller   Gate Driver   MOSFET
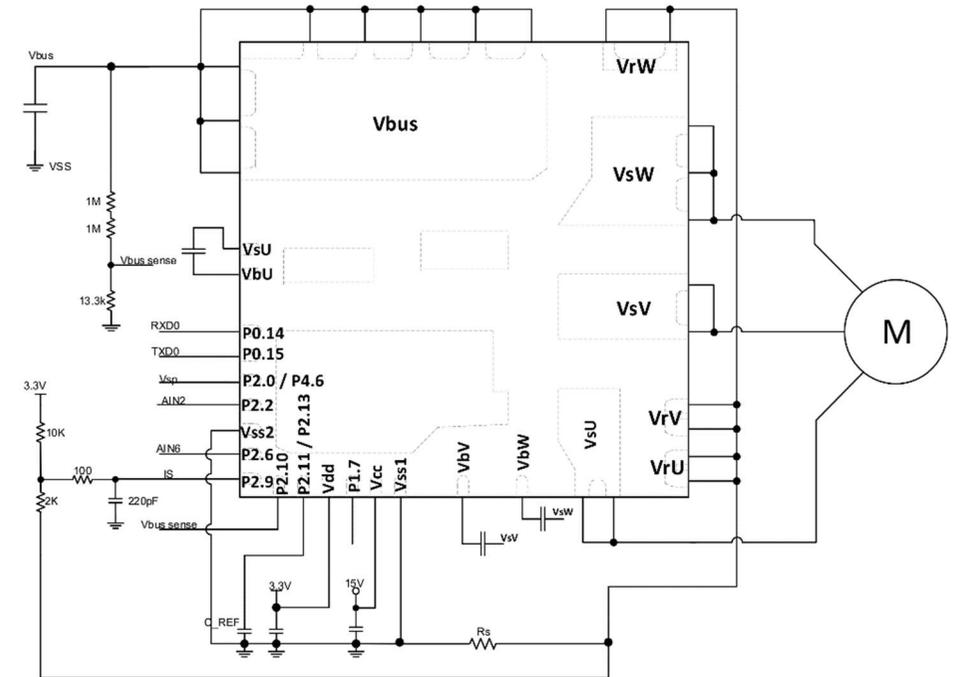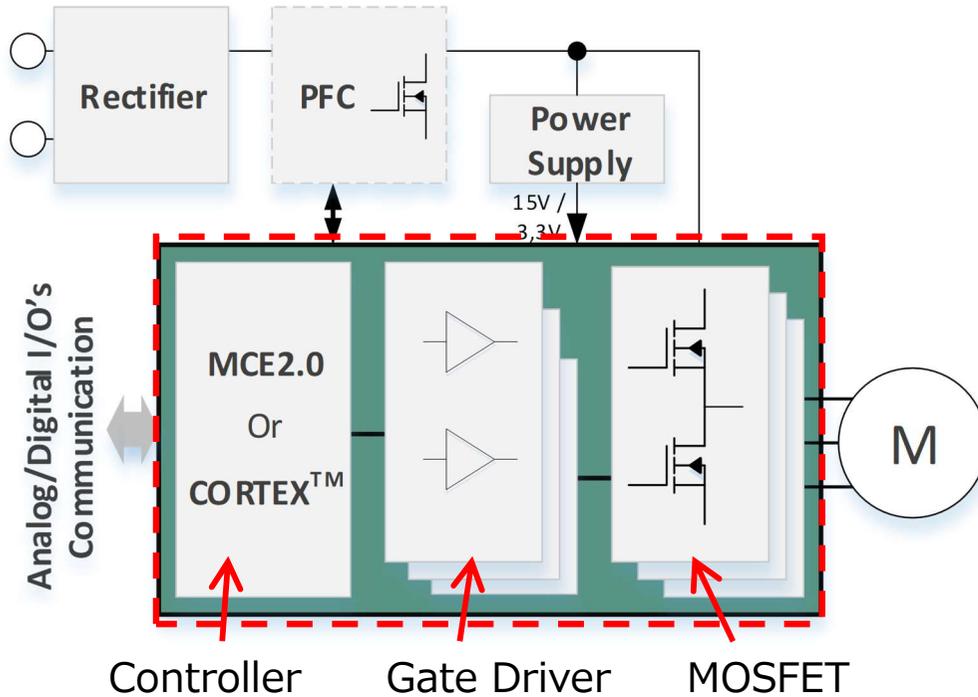
Schematics Example (Single Shunt)

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

12 x 12 (mm)

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What is iMOTION™ ?

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1 Motor controller and ARM core = Dual core IMC300

Motor controller like IMC100

ARM core

Product Type	Application	Package
IMC301A-F048	Single motor	LQFP-48
IMC301A-F064		LQFP-64
IMC302A-F048	Single motor + PFC (boost, totem pole)	LQFP-48
IMC302A-F064		LQFP-64
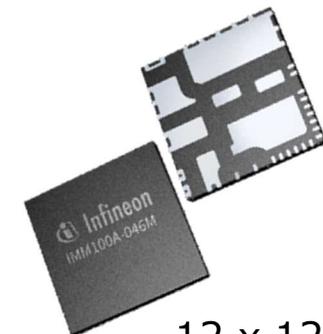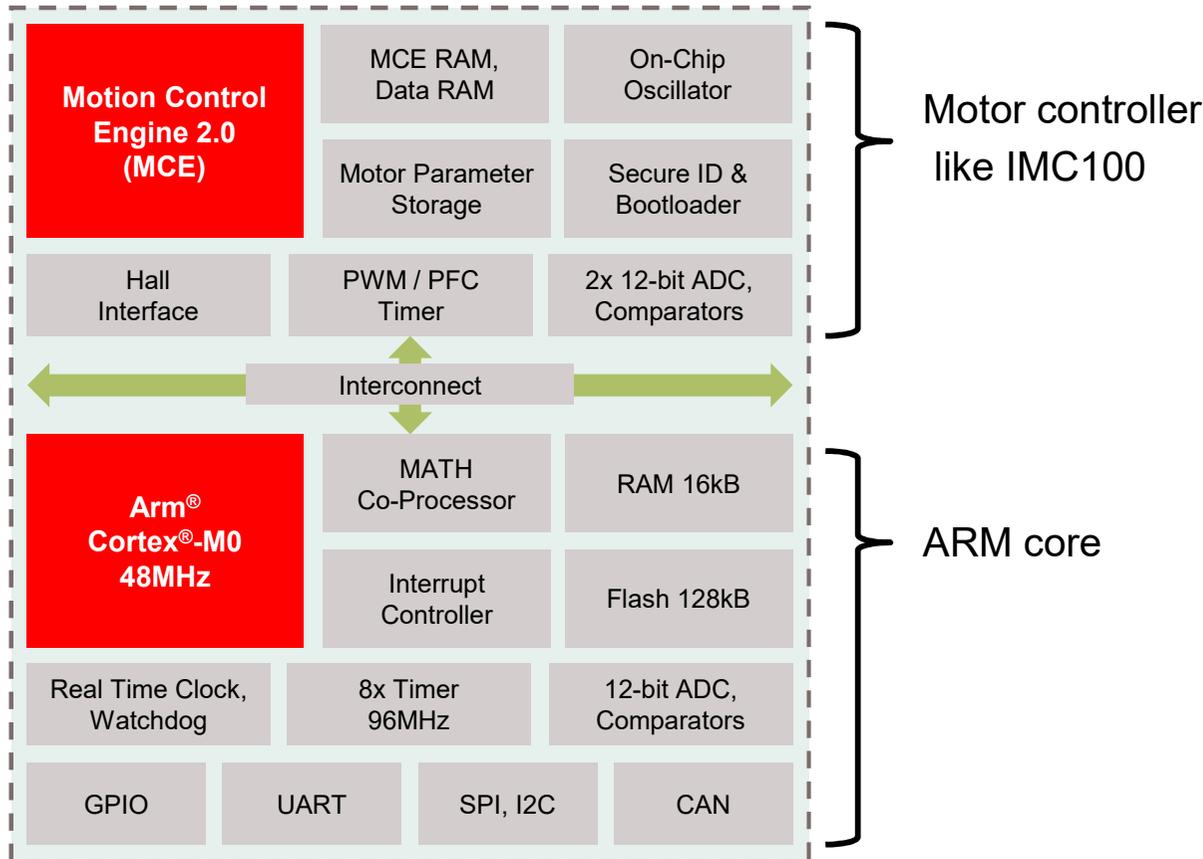
仕様概略

MCE 2.0
› Highly efficient 3-phase motor control
› Flexible sensing options (single/leg shunt, sensorless, hall, encoder)
› Storage of motor parameters
› PFC control integrated
› Multiple protections features

IEC 60335 ('class B')

ARM® Cortex® -M0
› 48/96MHz clock
› MATH coprocessor
› 128kB Flash / 16kB RAM
› High Performance Timers
› 12Bit ADC and high speed comparators
› Flexible communication options (UART, I2C, SPI, CAN)

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Solution for Low voltage vacuum cleaner

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1 Motor controller and ARM core = Dual core IMC300

Function of Low voltage vacuum cleaner

Motion Control Engine 2.0 (MCE)	MCE RAM, Data RAM	On-Chip Oscillator
IEC 60335 ('class B')	Motor Parameter Storage	Secure ID & Bootloader
Hall Interface	PWM / PFC Timer	2x 12-bit ADC, Comparators

Interconnect

Arm® Cortex®-M0 48MHz	MATH Co-Processor	RAM 16kB
	Interrupt Controller	Flash 128kB
Real Time Clock, Watchdog	8x Timer 96MHz	12-bit ADC, Comparators
GPIO	UART	SPI, I2C	CAN

Dual core iMOTION™

Infineon
IMC301A-F064
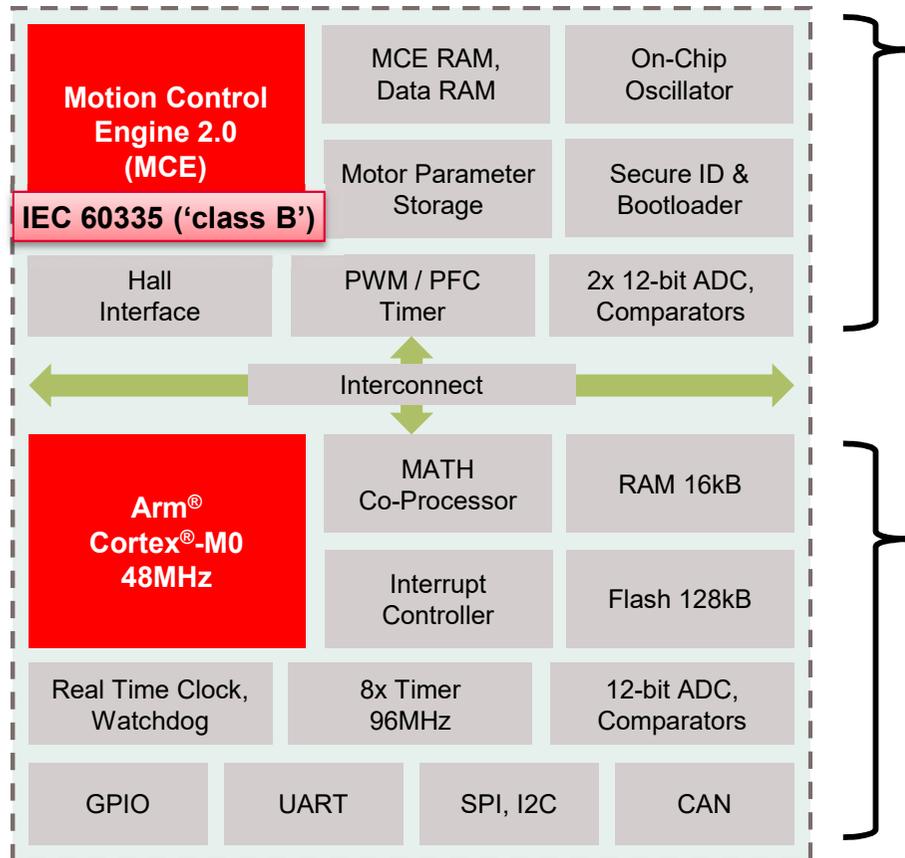
① Vacuum BLDC
　　Power efficency by
　　　　- sinusoidal commutation
　　　　- FOC
　　　　- sensorless
　　up to 100krpm
　　Constant vacuum power
　　failsafe detect during vacuum
　　dedicated UI

② UI
　　DC motor in brush head unit
　　LED/KEY
　　Sensor hum
　　BMS
　　Check quality and authenticity of battery pack

② Parameter configuration by MCEWizard tool

③ Ecosystem for ARM development

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Solution for Low voltage vacuum cleaner

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Starter kit, turnkey low-voltage motor drive (Released on May 2020)


Input power : 18~30V DC (6S ~ 7S Li battery)

Maximum 600 W at 25 A with on-board cooling fan

How to use : Schematics and BOM is shared at Infineon's HP
https://www.infineon.com/cms/jp/product/evaluation-boards/ref-vacuum_c101_2ed/

Block diagram
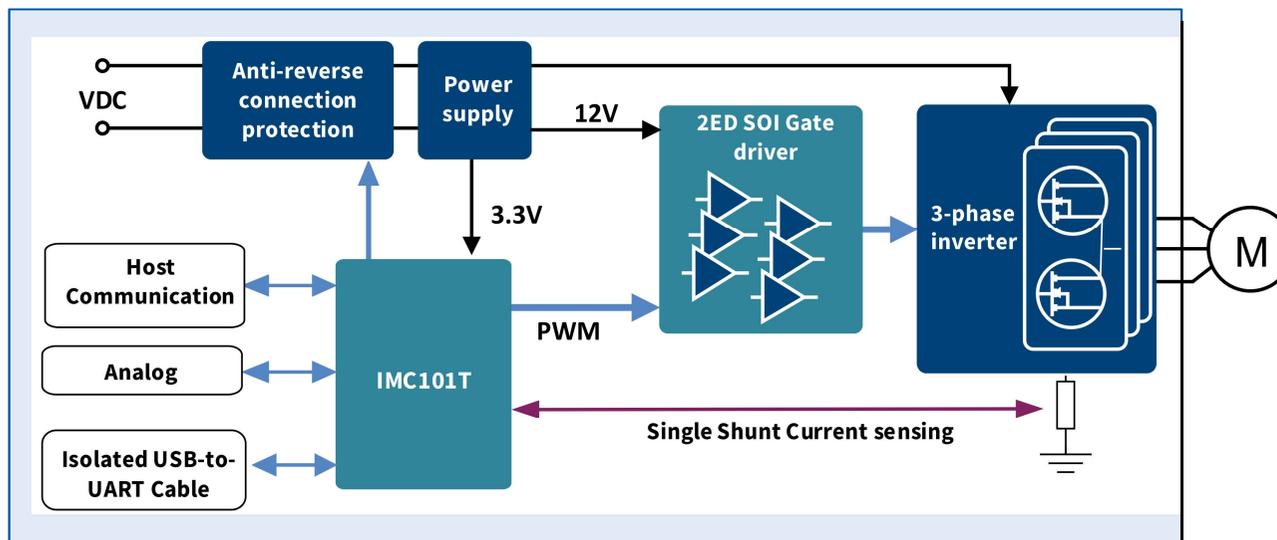
Board name and Main parts

Base Part Number	Package
REF-VACUUM-C101-2ED	EVAL
IMC101T-T038	PG-TSSOP-38-9
BSC030N04NS G	PG-TDSON-8
2ED2304S06F	PG-DSO-8

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iMOTION™ Development Tools

iMOTION™ Evaluation boards

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Controller boards

EVAL-M1-101T
iMOTION™
IMC101T-T038

EVAL-M1-099M-C
iMOTION™
IRMCK099

EVAL-M3-102T
iMOTION™
IMC102T-F064

EVAL-M3-302F
iMOTION™
IMC302A-F064

Power boards

M1 platform interface

EVAL-M1-IM818-A
CIPOS™ Maxi IM818-MCC; 1200V

EVAL-M1-CTE620N3
CIPOS™ Tiny IM393-X6E; 600V; DIP

EVAL-M1-CTF620N3
CIPOS™ Tiny IM393-X6F; 600V; SIP

EVAL-M1-CM610N3
CIPOS™ Mini IKCM10H60GA; 600V

EVAL-M1-CTE610N3
CIPOS™ Tiny IM393-M6E; 600V; DIP

EVAL-M1-IM231
CIPOS™ Micro IM231-L6S1B; 600V; SOP
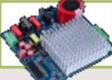
EVAL-M1-05-65D
CIPOS™ Micro IRSM505-065DA2; 500V

EVAL-M1-05-84D
CIPOS™ Micro IRSM505-084DA2; 250V

EVAL-M1-36-45A
CIPOS™ Nano IRSM836-045MA; 500V

EVAL-M1-36-84A
CIPOS™ Nano IRSM836-084MA; 250V

M3 platform interface

EVAL-M3-CM615PN
CIPOS™ Mini with PFC
IFCM15P60GD; 600V

Up to
1.5 kW
600 W
250 W
20 W
650 W

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M3 platform includes active power factor correction (PFC)

iMOTION™ Evaluation boards

Get any motor running in less than 1 hour

› **Modular and scalable** evaluation platform for PMSM up to 1.5 kW
› Wide range of compatible **control and power board** options
› Integrated **Motion Control Engine** (MCE 2.0)
  › No programming required – ready-2-run
  › Easy motor (and PFC) setup and control
› Galvanically **isolated USB** interface for parameterization and tuning

EVAL-M1-101T

› For single motor control
› IMC101T-T038
› Compatible with all 'M1' power boards

EVAL-M3-102T

› For motor control plus PFC
› IMC102T-F064
› Compatible with all 'M3' power boards

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iMOTION™ Debug tool
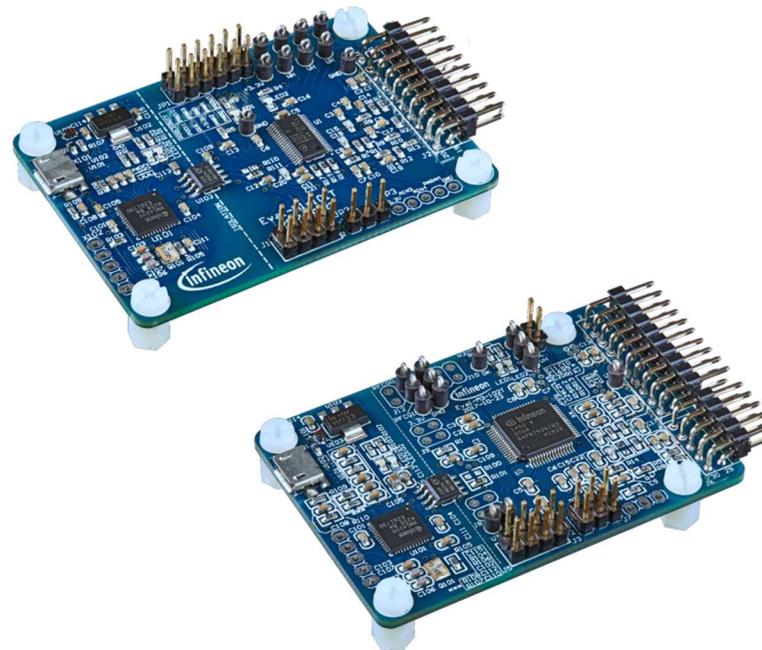
Universal interface to customer application board

› **Isolated interface** for all iMOTION™ 2.0 devices
  1kV DC isolation
› Tool for programming and configuring the MCE
› Configuring and exporting **device parameter sets**
› Tuning of the motor control system in combination with iMOTION™ software tools
  MCEWizard, MCEDesigner
› Optional **3.3V output** power for the target board

MCE Configuration

› Virtual COM port support (UART)
› Control, monitor and tune the drive

MCU Debug Interface

› Arm® Cortex® debug
  (programmable 'A' products)
› SWD (Arm® standard) &
  SPD (Infineon) interface

iMOTION™ Link Connector

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iMOTION™ parameter and tuning software
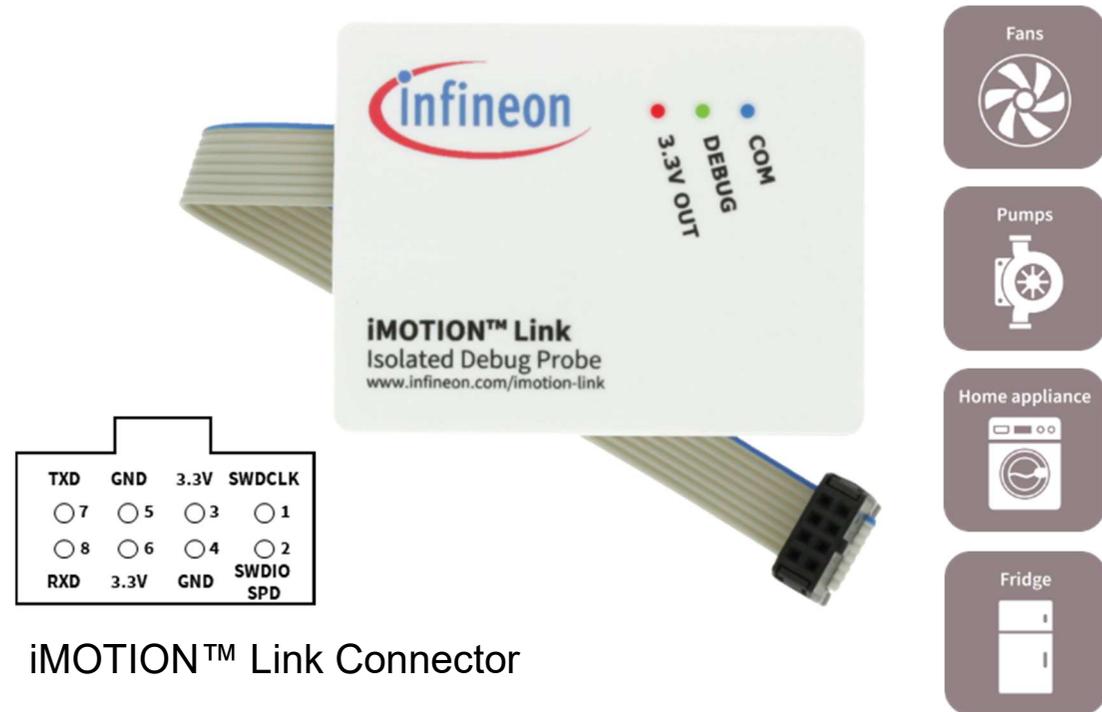
Get any motor running in less than 1 hour

› **PC Tools** for easy drive setup and tuning
› Download latest motor control software (MCE) from Infineon website
  › Guaranteed compatibility via secure chip-ID
› **Three easy steps** to get the drive up and running
  › Generate initial parameters for motor (& PFC)
  › Download parameter set to evaluation board
  › Start, monitor & fine-tune the motor drive

MCEWizard

› Generate initial drive control parameters
› Guiding through several self-explanatory questions

MCEDesigner

› Program and update MCE and drive parameters
› Control, monitor and tune the drive

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http://www.nexty-ele.com

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