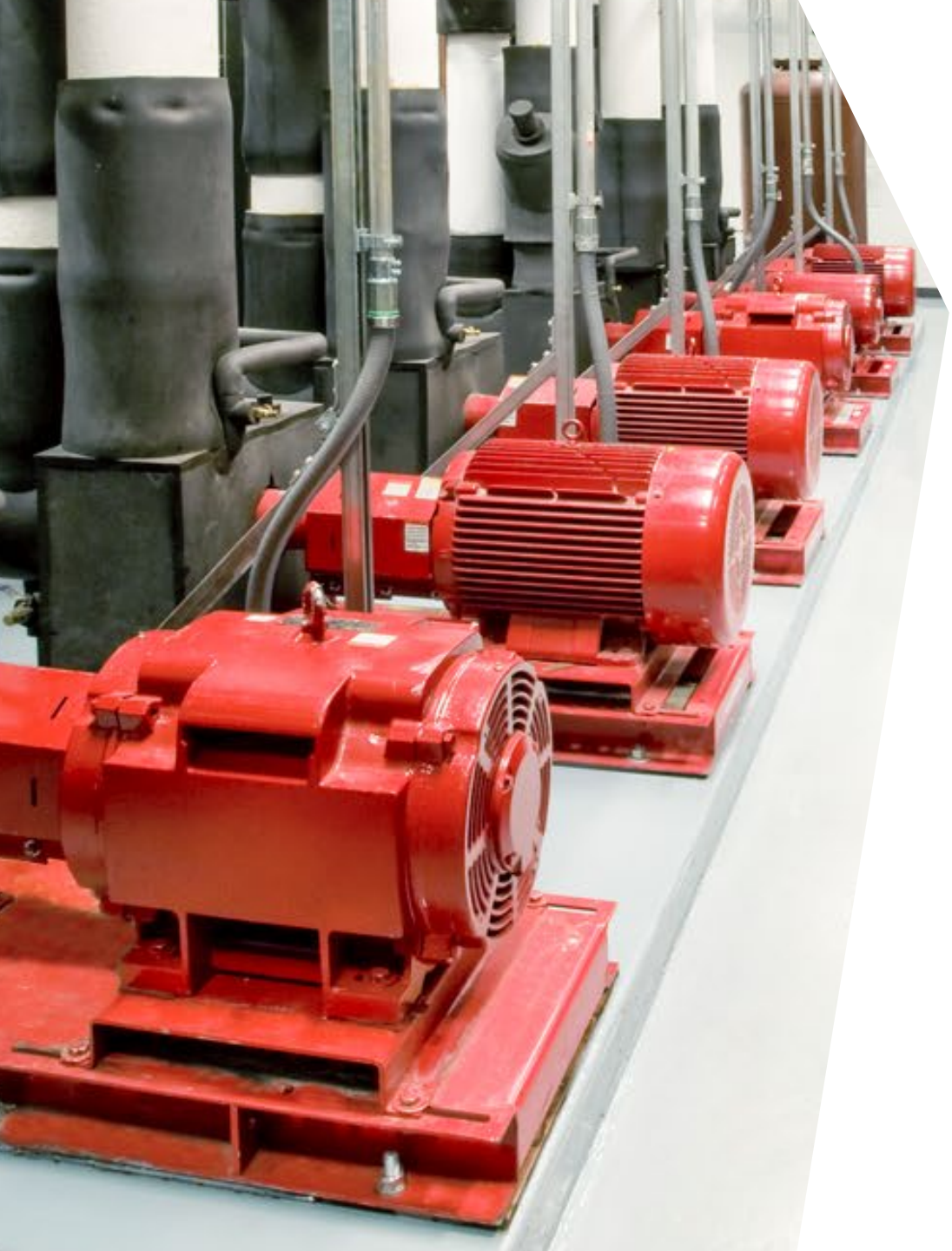

We drive efficiency in drives
–
Our expertise for your optimal drive systems

May 2023

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General-purpose drives at a glance

Requirements

- Performance and reliability
- Functional safety
- Good price / performance ratio

Key applications

- Pumps and fans
- Process automation
- Cranes
- Marine drives

Infineon products

- CIPOS™ IPM
- Discretes
- EasyPIM™
- EconoPIM™
- EconoDUAL™
- PrimePACK™
- 62mm
- EiceDRIVER™
- CoolSiC™ MOSFETs
- XMC™ MCU
- PSoC™ MCU
- OPTIGA™ Trust M
- AIROC™ Bluetooth
- AIROC™ Wi-Fi

1250 kW

370 W

Servo drives at a glance

Requirements

- High positioning accuracy
- Fast response with no overshoot
- High reliability
- Functional safety

Key applications

- Robotics
- Material handling
- Machine tools

Infineon products

- CIPOS™ IPM
- Discretes
- EasyPACK™
- EconoPACK™
- EconoDUAL™
- CoolSiC™ MOSFETs
- EiceDRIVER™
- XMC™ MCU
- PSoC™ MCU
- OPTIGA™ Trust M
- AIROC™ Bluetooth
- AIROC™ Wi-Fi

315 kW

370 W

Medium-voltage drives at a glance

Requirements

- Long life cycle
- Fast repair
- Redundancy
- High effiency

Key applications

- Water pumps
- Material handling
- Power generation
- Oil & gas

Infineon products

- PrimePACK™
- PrimePACK™ .XT
- XHP™
- EconoDUAL™
- 62mm
- EiceDRIVER™
- XMC™ MCU
- PSoC™ MCU
- OPTIGA™ Trust M

36 MW

250 kW

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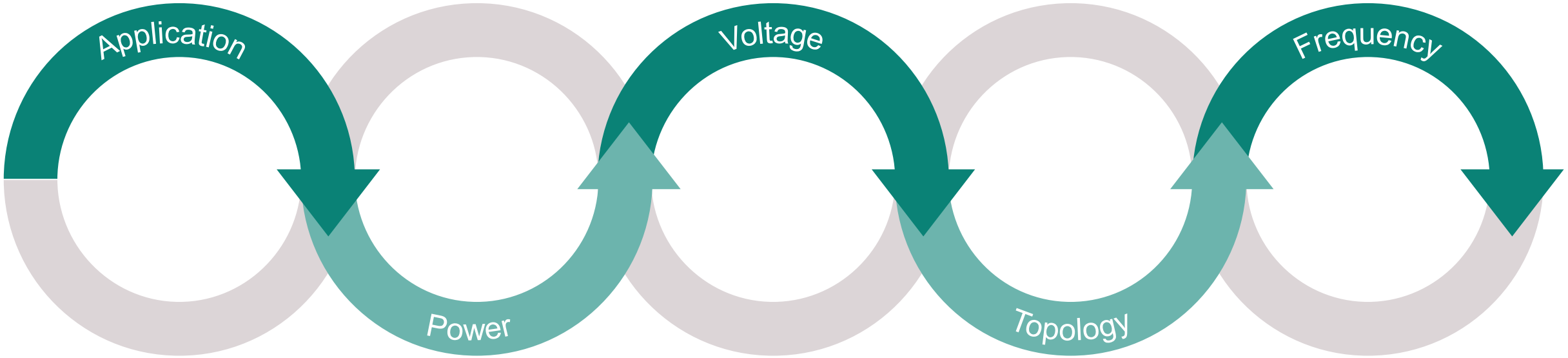
Key questions to design your drives inverter

What is the RMS current/motor power?

What is the topology?



What is your specific application?

What is the voltage AC/DC?

What is the switching frequency?

A closer look at a typical industrial drive

Power modulator

- **Function:** converts 1-/3-phase U-I into 3-phase U-I with right frequency
- **Components:** Power switches, gate drivers

Sensor systems

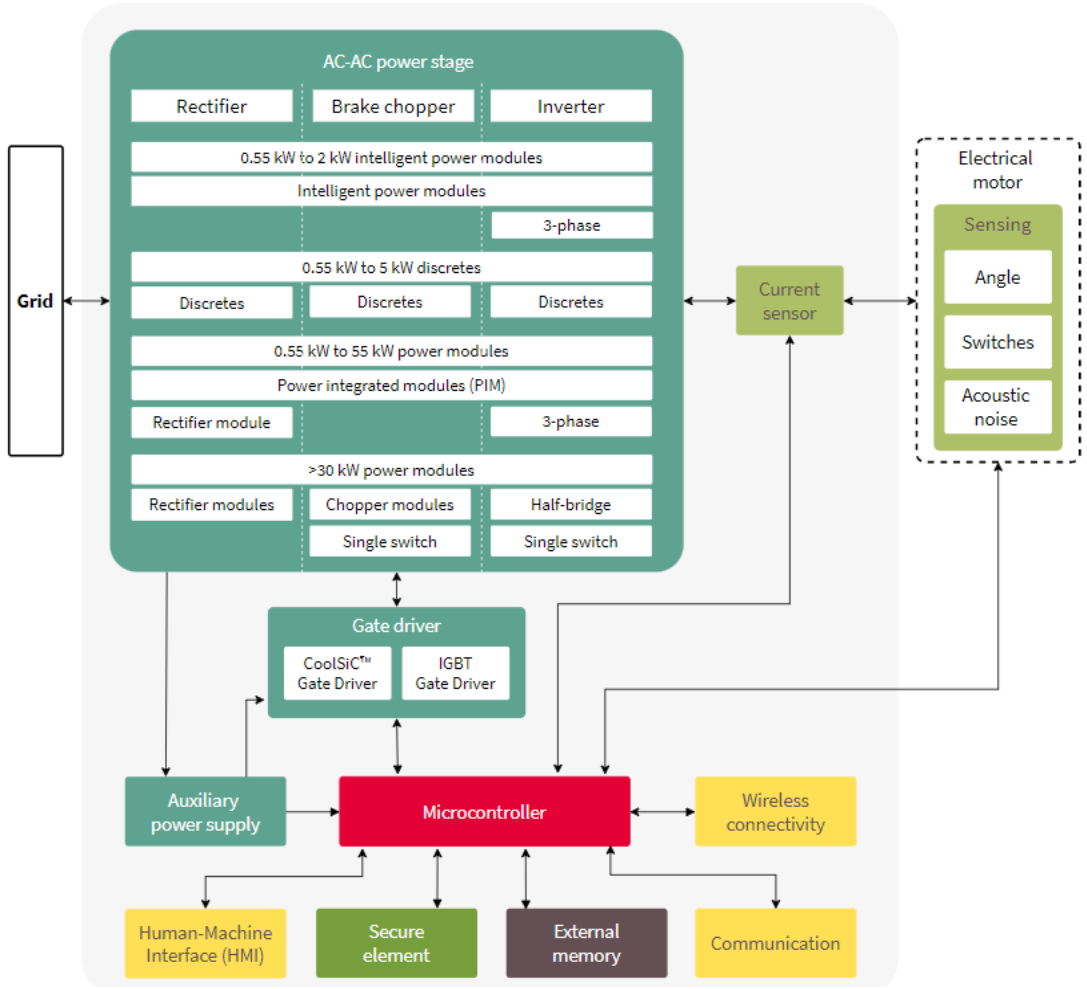
- **Function:** detects data such as current flowing into motor or temperature of switches
- **Components:** Current/voltage sensors, temperature sensors

Control

- **Function:** PWM signal, data storage, processing & analysis, programmability
- **Components:** MCU, components for aux power supply, memory, security

Connectivity

- **Function:** Communication with motor, PLC/automation computer & operator
- **Semi components:** HMI components, connectivity MCU, BlueTooth, WiFi



The levels of integration

Power electronics

- Discretes
- 3-phase PIM
- Sixpack
- Dual switch
- Single switch
- Thyristors & Diode Discs

Gate drivers

- Level shift driver
  - High side
  - Half bridge
  - High and low side
  - 3-phase
- Isolated driver (1 & 2 channel)
- Low side driver (1 & 2 channel)

Microcontrollers

- XMC™ microcontroller family based on ARM® Cortex®-M
- PSoC™ microcontroller family based on ARM® Cortex®-M
- Countless possibilities for motor control
- Best-in-class HMI performance

Sensors and security

- Magnetic sensor for position and speed
- Current sensor
- OPTIGA™ Trust family

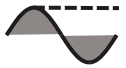
Wireless connectivity

- AIROC™ Wi-Fi Bluetooth Combo
- AIROC™ Bluetooth & Multiprotocol

External memory

- High-Performance Memories for Embedded Systems
- Flash
- RAM

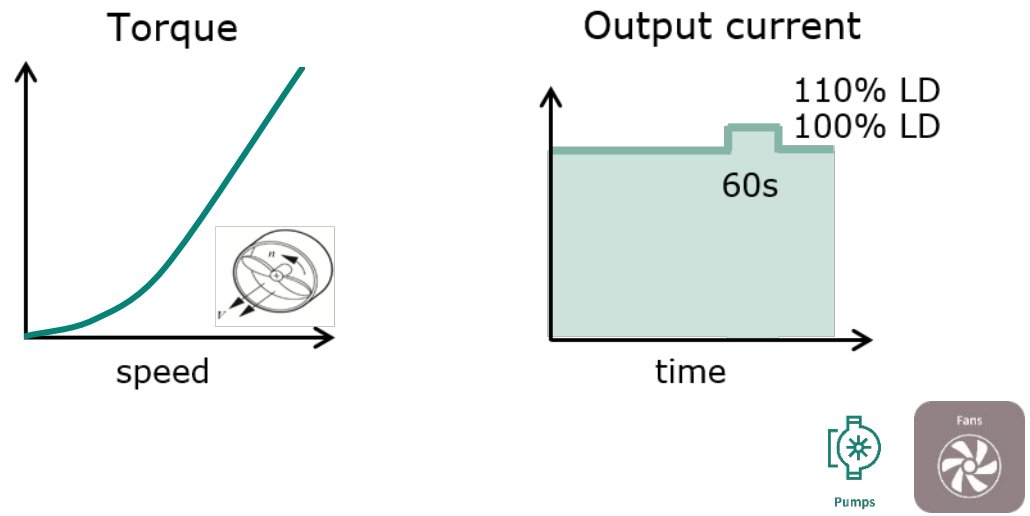
Application requirements for general-purpose and servo drives

	General-purpose drives	Servo drives	
Power	Broad portfolio (0.37… 1250 kW) 600 V, 1700 V and 1200 V switches (major)	Less broad portfolio (… ~315 kW or customized current classes) 600 V, 1200 V switches (major)	
f_{sw}	4 to 8 kHz <100 kW 2 to 4 kHz >100 kW	4 to 8 kHz, 16 kHz w/ derating	
dv/dt	≤ 5 kV/µs		
SC	Fast short circuit detection (e.g.: 8 µs for IGBT)		
f_{out}	a) Light duty – 50/60 Hz b) Heavy duty 1Hz w/ derating	Low f_{out} common down to 0 Hz (locked rotor)	
OL	a) Light duty e.g. 110% I_N 60 sec 100% I_N 240 sec b) Heavy duty e.g. 150% I_N 60 sec 100% I_N 240 sec	a) High overload e.g.: 200% I_N 3 sec 0% I_N 7 sec b) Very high overload e.g.: 300% I_N 0.25 sec 70% I_N 3.75 sec	

Overload ratings for low-voltage drives are key for reliability

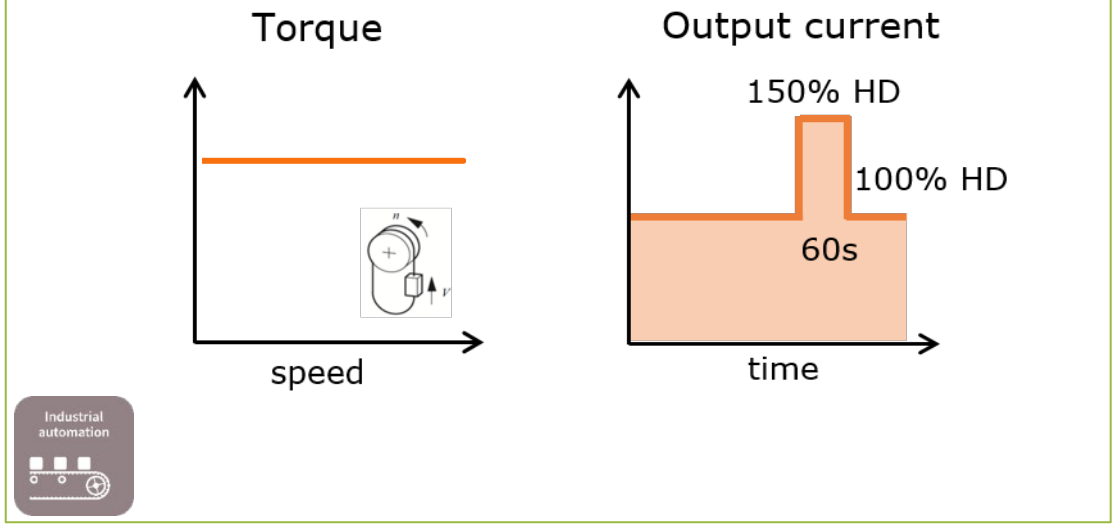
Overload capability is the property in which, during acceleration operations, the inverter temporarily delivers a higher current than the rated current. **There are two sorts of ratings used in industrial drives:**

Light/Normal Duty (LD/ND)



- Applied in fans and pumps, since they do not require high torque at low speed and have a 110% overload rating

Heavy Duty (HD)



- Applied in industrial automation and requires high torque at low speeds and a 150% overload rating
- The base load current is reduced when compared to normal duty

For servo drives the overload capability can increase up to 300% of rated current.

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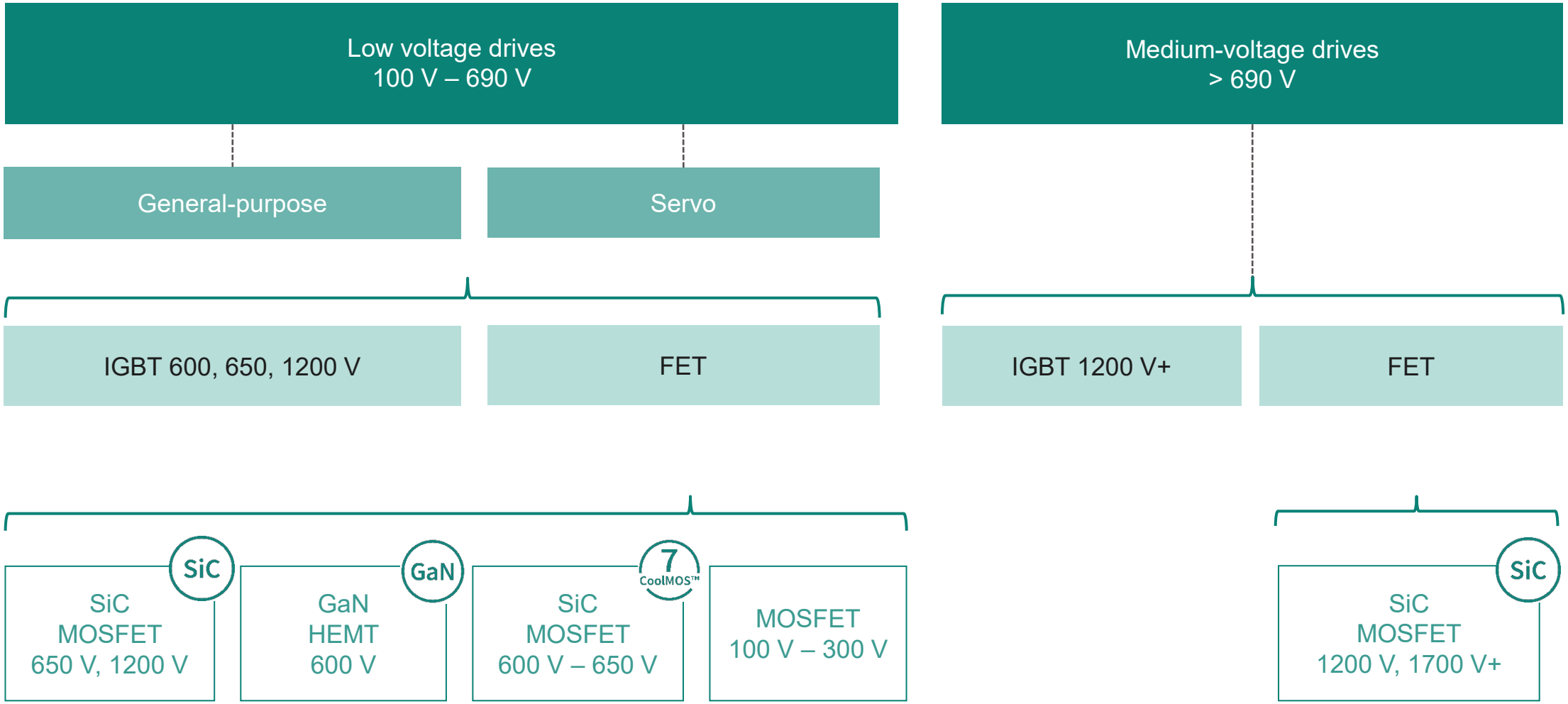
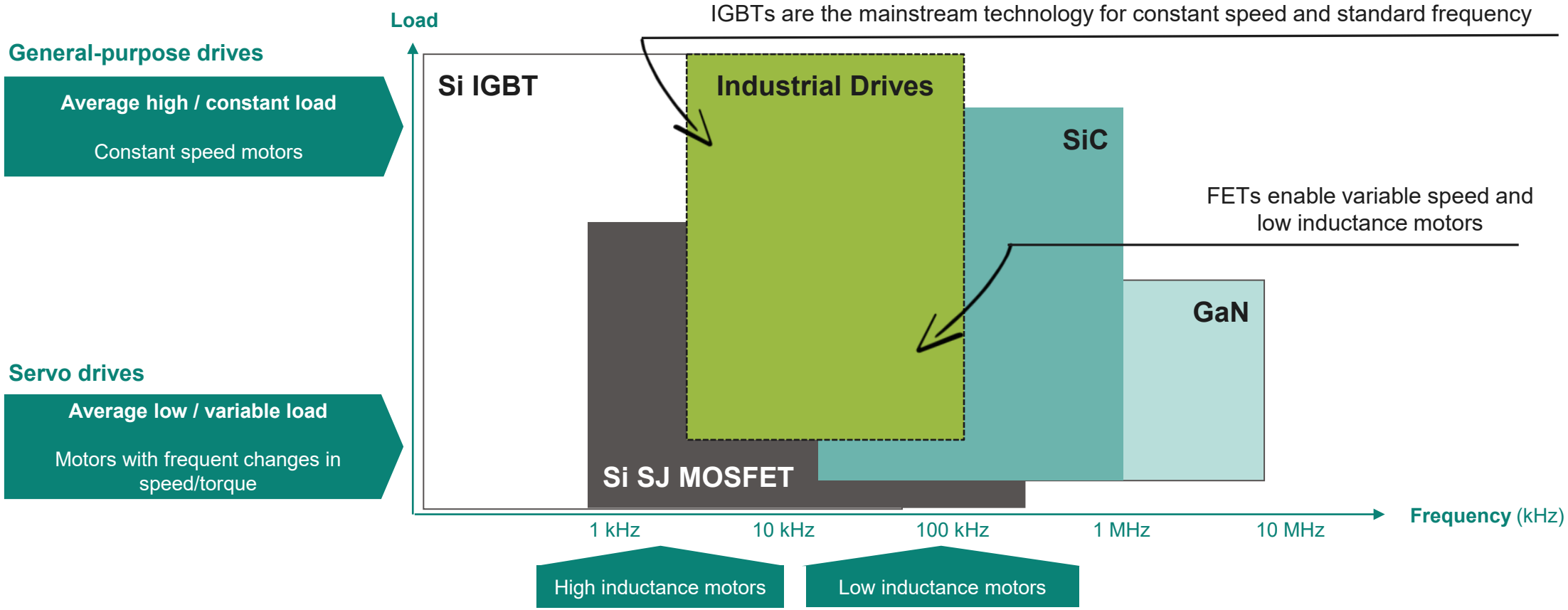
Discretes

Switching technologies for industrial drives – Mapping into motor drive types



Switching technologies for industrial drives – Technology positioning



Si IGBT

- Best $/Watt in low to mid frequency domains
- 650 V – 6.5 kV

Si SJ MOSFET

- Lower cost alternative for higher frequency and variable load
- 600 V/ 650 V

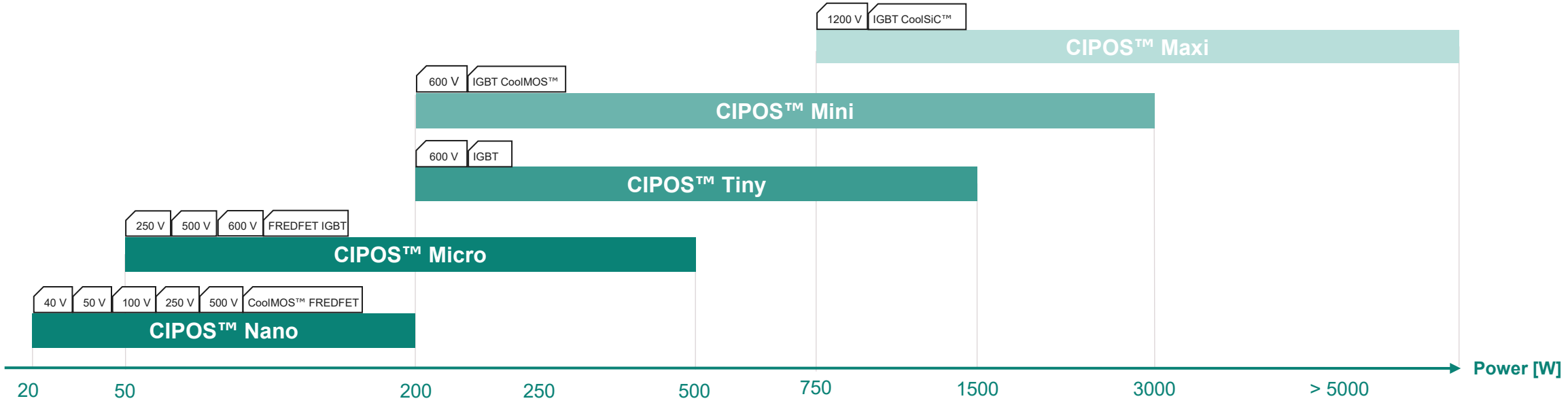
SiC MOSFET

- High power – higher frequency
- 650 V – 2 kV+

GaN HEMT

- Medium/low power – highest switching frequency
- 600 V

Broad Intelligent Power Module portfolio – Serving power ranges from 20 W to 5 kW plus



CIPOS™ Nano

For space constrained applications

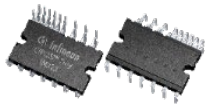
Powering millions of personal cares and low power application

CIPOS™ Micro

Compact solution

Optimized solution for low power fan & pump

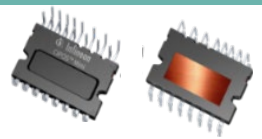
CIPOS™ Tiny



New solution for RAC compressor

Best optimized solution for RAC up to 1.5HP

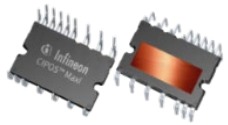
CIPOS™ Mini



Broad range portfolio

Proven solution for MHA/Industrial drives

CIPOS™ Maxi

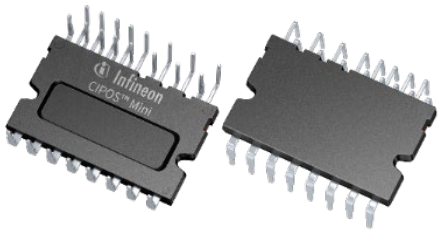


Highest power density

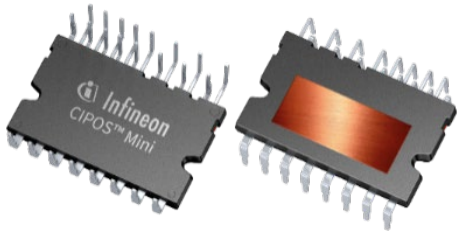
Ruggedized Industrial drives and CAC solution

CIPOS™ Mini provides fully featured compact inverter solution with wide current range up to 30 A

Product images

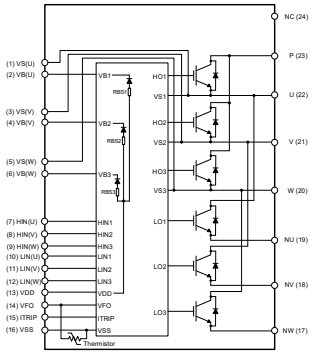


DIP 36x21



DIP 36x21D

Internal schematic and products



Product name	Related Current [A]	Package
IKCM10L60GA	10 A	DIP 36x21
IKCM15L60GA	15 A	
IKCM20L60GA	20 A	
IKCM15L60GD	15 A	DIP 36x21D
IKCM20L60GD	20 A	
IM535-U6D	30 A	

Key features

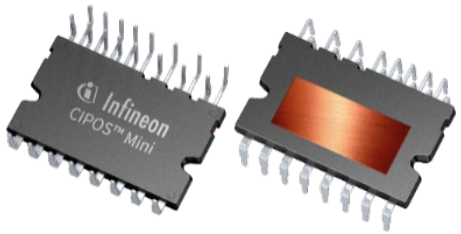
- Fully isolated dual-in-line transfer molded package
- Compact body size of 36x21x3.1mm and the smallest IPM with current rating up to 30 A
- One package platform covers wide current rating from 4 A to 30 A and it allows easy & fast platform design from small to larger power
- Two kinds of package types: DIP 36x21 with fullpack and DIP 36x21D with DCB substrate to support excellent thermal performance
- Integrated 600V TRENCHSTOP™ IGBT and rugged SOI gate driver technology with advanced protection features
- UL certified

Benefits

- High integrations (bootstrap circuit, thermistor) for easy design and saving system space
- Single platform possible from 4 A to 30 A
- Enhanced robustness of the advanced IGBT, gate driver IC technology
- Smaller package and high-power density
- Two kinds of substrates provide cost efficient solution for low to medium power motor drives

CIPOS™ Mini single boost PFC-integrated 3 phase inverter IPM enables system size reduction and cost improvement

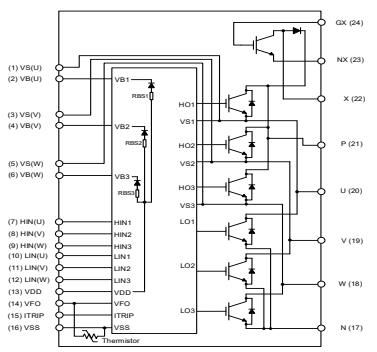
Product images



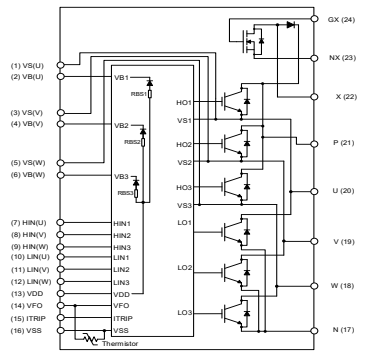
DIP 36x21D

Internal schematic and products

IFCM10/15S/P60GD



IM564-X6D



Rated current	PFC Fsw	
	20 kHz	40 kHz
10 A	IFCM10S60 GD	IFCM10P60 GD
15 A	IFCM15S60 GD	IFCM15P60 GD
20 A	IM564-X6D (over 100 kHz with CoolMOS™ for PFC)	

Key features

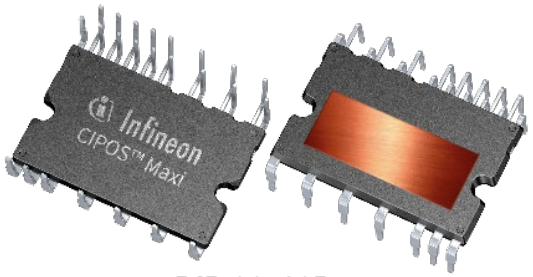
- Fully isolated dual-in-line transfer molded package
- Excellent thermal performance with DCB substrate
- Inverter + single boost PFC in one package
- Inverter current rating : 10 / 15 / 20A
- Various PFC switching available : 20 kHz or 40 kHz (for 10 / 15 A)
- High PFC switching over 100kHz with CoolMOS™ Power MOSFET for PFC (for 20 A)
- Robust gate driver in SOI technology
- Power capability over 2 kW
- UL certified

Benefits

- System size reduction with PFC integration into inverter module as well as significant inductor size reduction with high PFC switching
- Cost improvement from lower BOM count, reduced assembly cost, and smaller system size
- Smaller and cheaper heatsink
- Customer can design switching performance of PFC by using external driver circuit

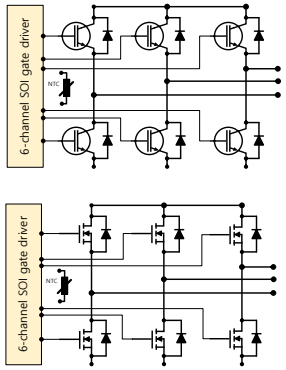
CIPOS™ Maxi IPM provide excellent performance with highest power density in 1200 V class for 3-phase motor drive application

Product images



DIP 36x23D

Internal schematic and products



Part No.	Package	Rds(on)/ Current Rating	Voltage Rating	Ver.
IM818-SCC	DIP 36x23D	5 A	1200 V	IGBT 4
IM818-MCC	DIP 36x23D	10 A	1200 V	IGBT 4
IM818-LCC	DIP 36x23D	15 A	1200 V	IGBT 4
IM828-XCC	DIP 36x23D	55 mohm / 20 A	1200 V	CoolSiC™ MOSFET

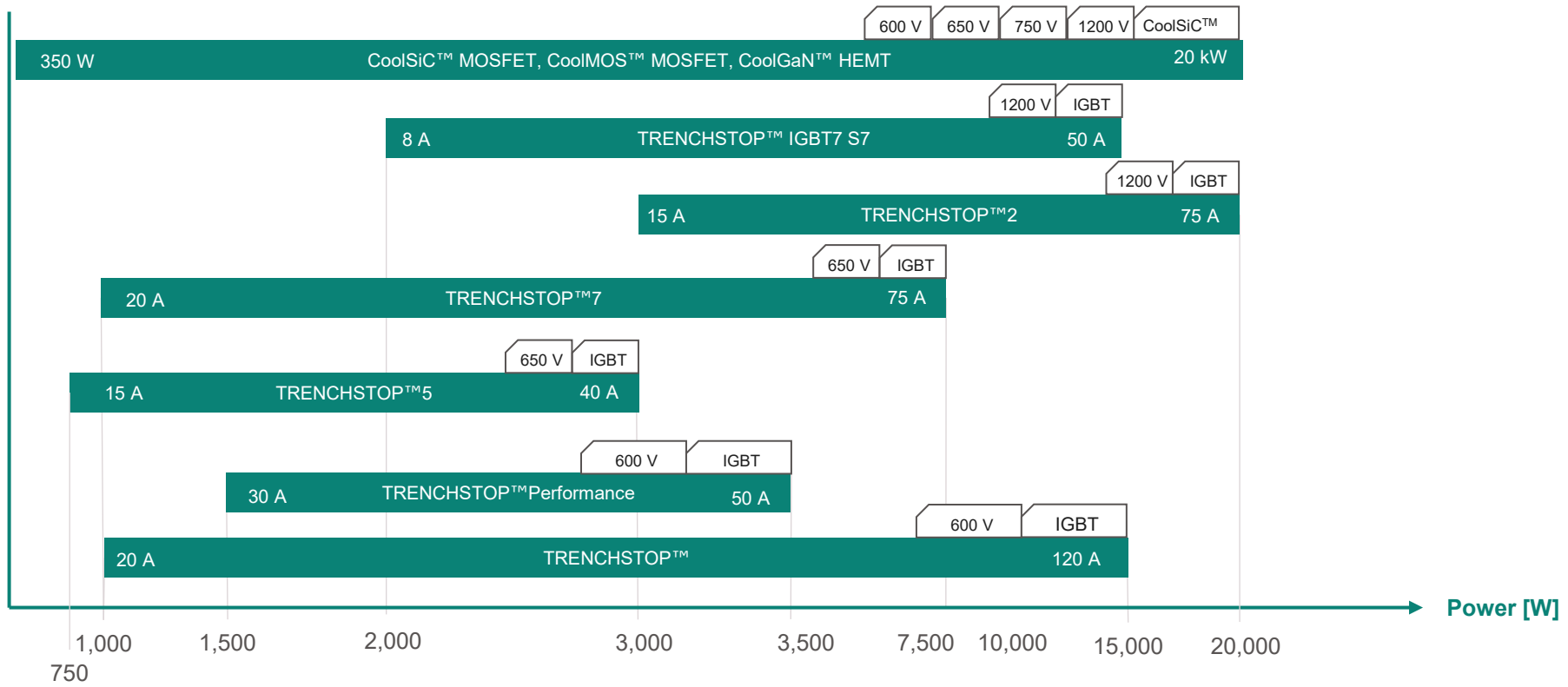
Key features

- Offers the smallest package in 1200 V IPM class
- Integrated 6 TRENCHSTOP™ IGBT 4 / CoolSiC™ MOSFET and a rugged 1200 V 6-channel SOI gate driver
- Integrated bootstrap functionality
- Over current shutdown
- Under-voltage lockout at all channels
- RFE pin with multi-functions
- An independent thermistor for temperature monitoring

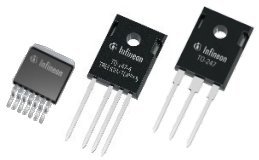
Benefits

- The smallest package size in 1200 V IPM class with high power density
- High output power up to 8 kW
- High efficiency up to 99.6%
- Enhanced robustness of gate driver technology for excellent protection
- Adapted to high switching application with lower power loss
- Simplified system design and manufacturing

Broad discrete IGBT and FET portfolio serving power ranges up to 20 kW



Discrete IGBT and CoolSiC™ MOSFET portfolio



CoolSiC™ and CoolMOS™ MOSFET

CoolGaN™ HEMT

TRENCHSTOP™ IGBT7 S7

TRENCHSTOP™2

TRENCHSTOP™5

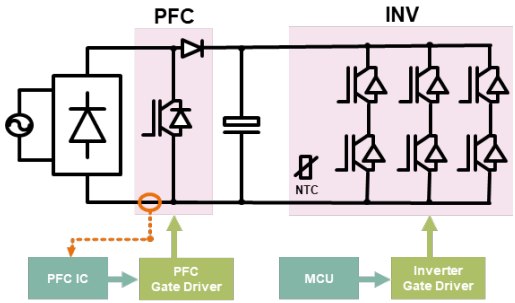
TRENCHSTOP™ Performance

TRENCHSTOP™

Discrete solutions for industrial drives – features and benefits

Product images

Internal schematic and products



Product type	Input Connection	Product name and Family
INV Switch IGBT	1-phase	IKW50N65ET7 TRENCHSTOP™ IGBT7
	3-phase	IKW40N120CS7 TRENCHSTOP™ IGBT7
INV Switch SiC MOSFET	1-phase	IMW65R072M1H CoolSiC™ MOSFET
	3-phase	IMW120R060M1H CoolSiC™ MOSFET

Key features

- IGBT7 T7 shows:
  - Improved humidity ruggedness
  - Low saturation and forward voltage
  - Optimized controllability below 5 kV/ µs
  - Short circuit ruggedness
- CoolSiC™ MOSFET has:
  - Exclusive 3 µs short circuit withstand time
  - Reliability as Si power transistor by Infineon
  - Lowest total losses at the same EMI level as IGBT

Benefits

- CoolSiC™ MOSFET provides:
  - Minimum switching losses, maximum cooling surface area, zero-voltage turn-off, minimized PCB board space and further power density improvements
- TRENCHSTOP™ IGBT7 is best in class device in motor drive applications, where it shows:
  - up to 25% higher power density or up to 15% lower temperature rise

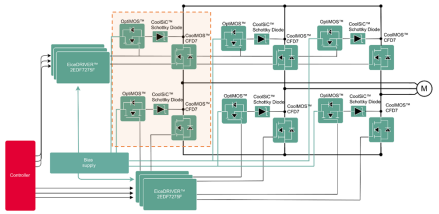
Discrete 600 V/ 650 V CoolMOS™ assisted hard commutation solution – Making CoolMOS™ work in motor drives

Product images

Bottom side cooling

Top side cooling

Internal schematic and products



Product type	Input Connection	Product name and Family
SJ MOSFET	3-phase	6 x IPT60R035CFD7 or 6 x IPDQ60R018CFD7*
Gate driver IC		6 x 2EDF7275F
SiC diode		6x IDL06G65C5 or 6x IDDD08G65C6
LV MOSFET		6x BSZ440N10NS3

Key features

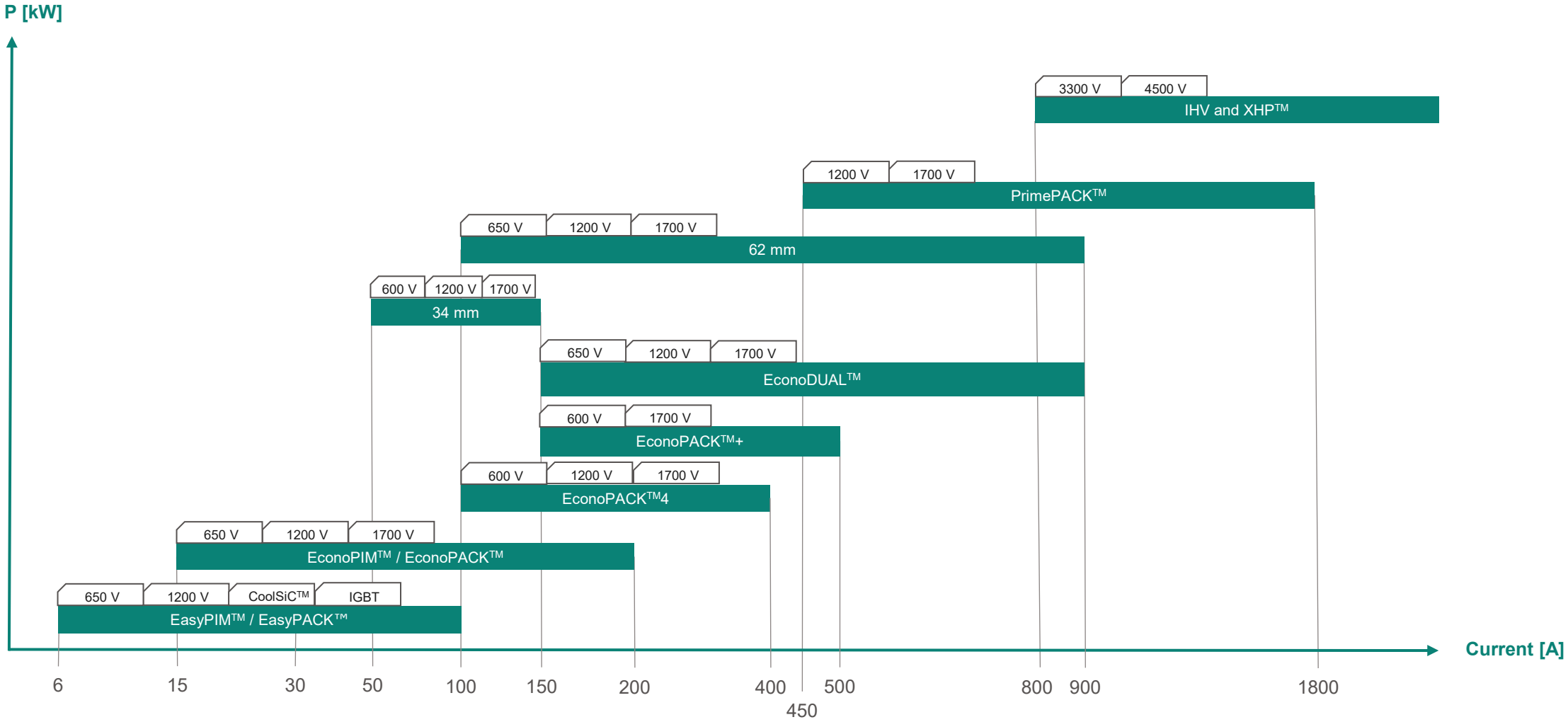
- A solution that enables the use of HV SJ MOSFETs (CoolMOS™) in hard commuting topologies, like half or full bridge topologies, so far addressable only by WBG devices or IGBTs
- Low Qrr and Qoss solution: SJ MOSFET can be used in hard commuting topologies
- Similar performance as WBG
- Ohmic behavior

Benefits

- Efficiency increase in hard commuting topologies
- BOM cost savings
- Power density improvement compared to state-of-the-art solutions
- Large CoolMOS portfolio with a large choice of SMD packages
- Leverage CoolMOS 20 years track record

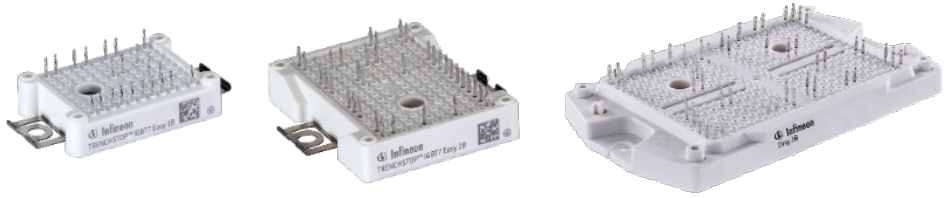
Modules

Broad IGBT package portfolio serving current ranges from 6 A to 3600 A

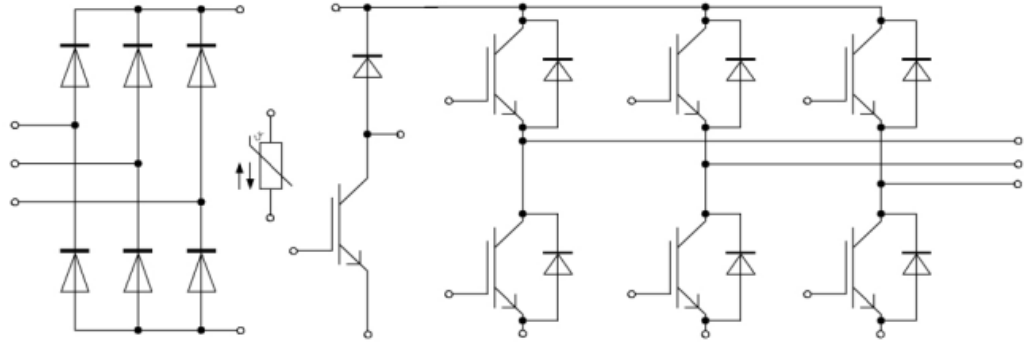


TRENCHSTOP™ IGBT7 with the Easy family – A perfect fit for platform-based design of industrial drives

Product images



Internal schematic and products



PIM with NTC

Key features

- The latest TRENCHSTOP™ IGBT7 and EC7 diode technology
- Lower on state voltage VCE(sat) and Vf
- Overload capability at Tvj,op=175°C
- Enhanced controllability of dv/dt
- Optimized for simple driving
- All packages have same mechanical height

Benefits

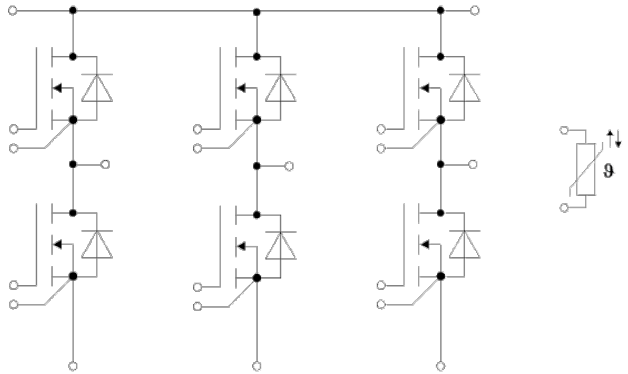
- **Higher power density** and lower power losses
- Optimized for **Drives** application
- Reduced system size and **lower system cost**
- **Power extension** up to 45 kW, fit for platform-based design and production

Easy modules with CoolSiC™ MOSFET chip technology for industrial drives

Product images

EasyPACK™ FS45MR12W1M1P_B11 also available with pre-applied TIM

Internal schematic and products



Key features

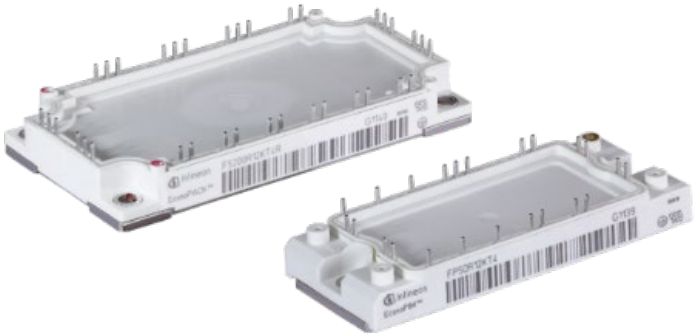
- EasyPACK™ 1B 1200 V / 4 mΩ sixpack module with CoolSiC™ MOSFET in 1200 V, NTC and PressFIT contact technology
- High current density
- Best in class switching and conduction losses
- Low inductive design
- Integrated NTC temperature sensor
- PressFIT contact technology
- RoHS-compliant modules

Benefits

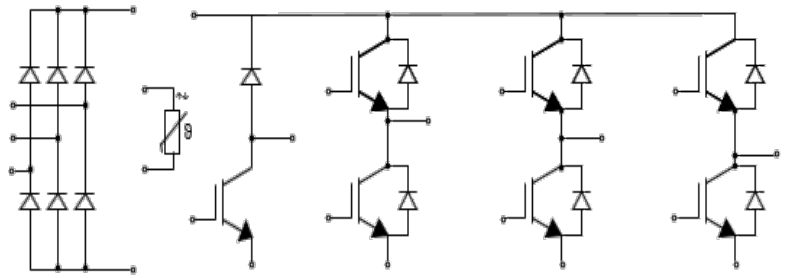
- Highest efficiency for reduced cooling effort
- Higher frequency operation
- Increased power density
- Optimized customer's development cycle time and cost

Econo2 and Econo3 modules – Established product for broad range of applications

Product images



Internal schematic and products



PIM with NTC

Key features

- Established RoHS-compliant housing concept for high volume production
- Modules with base plate for increased robustness in standard solder pins or high reliability PressFIT pins
- Available with state-of-the-art IGBT7 technology
- Numerous topologies, voltages (600V-1700V) and currents (15A-200A) for broad range of applications
- Integrated configurations includes NTC, shunt, pre-applied Thermal Interface Material (TIM), Advance H2S protection

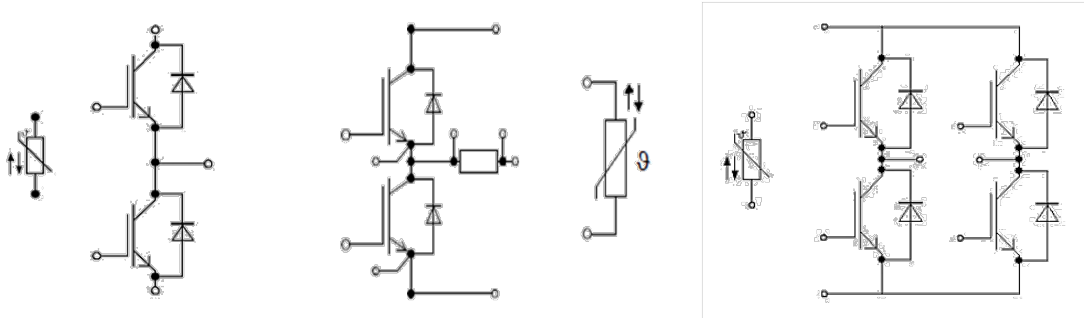
Benefits

- High reliability and quality
- Cost-efficient
- Fast, simplified, low-cost mounting
- Design flexibility and simple integration in power electronic applications
- High power density

EconoDUAL™ 3 – 1st choice for future system designs

Product images

Internal schematic and products



Half-bridge | Half-bridge with shunts | H-bridge

Key features

- Highest power cycling capability
- Excellent mechanical robustness
- Screw-type power terminals and PressFIT control pins
- TIM – pre-applied thermal interface material
- Available with integrated shunts
- NTC integration for temperature control
- Evaluation Boards to reduce design-in effort
- Tvjop 150°C (TRENCHSTOP™ IGBT4)
- Tvjop 175°C overload (TRENCHSTOP™ IGBT7)

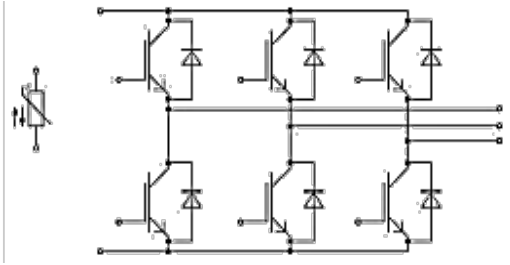
Benefits

- Optimized thermal resistance to heat sink
- Reduced mounting effort and increased interconnection reliability
- Compact configurations with only 17 mm height
- Parallel operation enabled by a symmetrical design
- Reduced system costs
- One module fits several applications

EconoPACK™ 4

Product images

Internal schematic and products



Product	Ic (A)
FS100R12PT4	100
FS150R12PT4	150
FS200R12PT4	200

Key features

- Robustness: rugged mechanical design with ultrasonic welded and injection-molded screw terminals
- Easy assembly: pressFIT control pins and screw power terminals for completely solderless connections
- Integration: compact rectifier, chopper, 6-pack and 3-level single-phase configurations with NTC

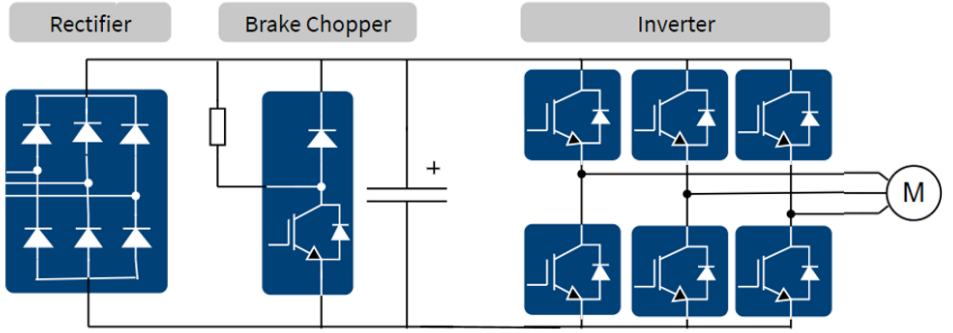
Benefits

- **Cost advantage** compared to using 3 x 34mm modules / 62mm modules
- Allows **more compact inverters** compared to using 3 x 34mm / 3 x 62mm modules

34mm and 62mm module family with its comprehensive portfolio offers more flexibility and highest reliability for inverter designs

Product images

Internal schematic and products



Key features

- IGBT7 and EC7 1200 V chipset
- Superior solution for frequency-controlled inverter drives
- UL/ CSA certification with UL1557 E83336
- Operating temperature up to 150°C, 20% overload 175°C
- Optimized switching characteristic
- Softness
- Robust package with high current capability
- RoHS compliant

Benefits

- Highest power density
- Allows to increase inverter output power with same frame size
- Reduced switching losses
- Improved humidity robustness

PrimePACK™ modules enable high system performance

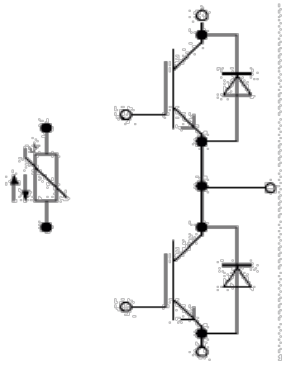
Product images

PrimePACK™ 2:
172 x 89 mm

PrimePACK™ 3:
250 x 89 mm

PrimePACK™ 3+:
250 x 89 mm

Internal schematic and products



Part Number	Voltage	IC [A]	Package
FF450R12IE4	1200 V	450	PP2
FF600R12IE4/P4		600	PP2
FF900R12IE4/P4		900	PP2
FF1400R12IP4		1400	PP3
FF1200R12IE5		1200	
FF1500R12IE5/R		1500	
FF1800R12IP5		1800	
FF450R17IE4	1700 V	450	PP2
FF650R17IE4		650	PP2
FF1000R17IE4		1000	PP3
FF1400R17IP4		1400	PP3
FF1200R17IP5		1200	
FF1500R17IP5/R		1500	
FF1800R12IP5		1800	

Key features

- Ultrasonic Welding between DCB and terminals for optimal mechanical and electrical interconnection
- Equal distance between the chips and the mounting positions
- Homogenous temperature distribution between the chips
- Improved thermal resistance Rthjc by optimized chip locations
- Fast switching (E4) and soft switching chips (P4)
- Modular design optimized for paralleling
- Pre-applied Thermal Interface Material (TIM) to achieve longest lifetime
- NTC integration for temperature control
- Tvjop 150°C

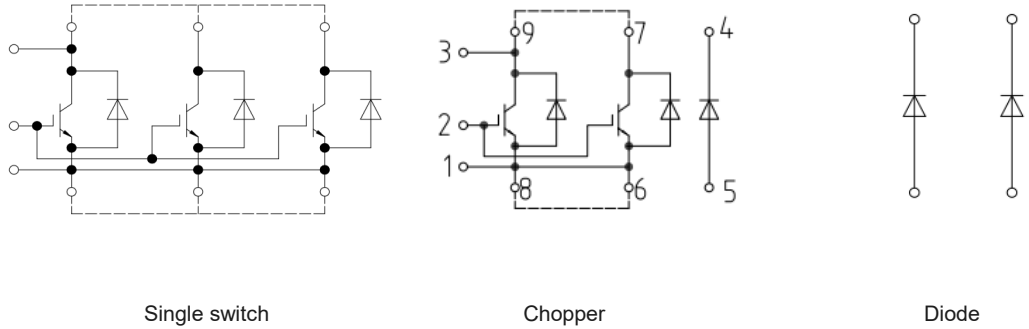
Benefits

- Multiple frame sizes on single platform
- Frame size scalability
- High lifetime in demanding applications
- High reliability and quality
- Optimized system-based costs
- High Irms/ Area
- High current terminals
- Compact inverter size

IHV and XHP™ the perfect match with drives trends

Product images

Internal schematic and products



Single switch | Chopper | Diode

Key features

- Low losses with high output RMS current on decreasing module dimensions
- Strict qualification tests and production test
- High TC (30.000 cycles @ Δ Tc=80K)
- PC capability at min. 2 Mio cycles @ Δ Tj=40K
- Latest 3.3 kV generation (IGBT4) offer 200% PC
- Cosmic radiation stability (100FIT e.g.: @ 2900V for 4.5 kV)
- Unbeatable Robustness

Benefits

- Above features enables more performant up to 50% smaller inverter design
- Higher PC allows lifetime conversion into higher output power and frequency (e.g.: 200% PC = 12% higher IRMS on same lifetime)
- Especially XHP™ 3 enables a very easy bus bar concept
- Robustness against overload and fault conditions and clean switching
- Assure required reliable lifetime of 5 to 30 years
- The benefits of Infineon's IGBTs & Diodes help >40% of the market, for 25 years

Press Pack IGBT‘s

Prime Switch – PPI offers outstanding features for best fit in drives applications

Product images

Internal schematic and products

- P3000ZE45X168
  - P3000ZL45X168
  - P3000ZE45X168
  - P3000ZL45X168APT
- P2000DE45X168
  - P2000DL45X168
  - P2000DE45X168
  - P2000DL45X168APT

Key features

- New direct Press Pack IGBTs with 4.5 kV blocking voltage. 2000 A with and 3000 A without internal freewheeling diodes based on Infineon's 4.5 kV trench IGBT chips. Using low-temperature sintering technology, the IGBT chips are sintered and directly connected to the pole pieces to enable double side cooling
- 4.5 kV trench IGBT chip
- Optimized loss trade off for MMC VSC and FACTS
- Full long-term short-on-fail; no springs inside
- Low-temperature sintering; LTS-technology
- Hermetically sealed, explosion-proof housing

Benefits

- IGBT control well known from many applications
- No di/dt limiting inductance is needed
- No snubber circuit needed
- Many driver boards for PPI are available
- Series connection of PPI possible
- 50% smaller footprint of inverter is possible

Prime Switch – Freewheeling diodes for PPIs and IGCTs

Product images

Internal schematic and products

- D1031SH45T
- D1331SH45T
- D1961SH45T
- D931SH65T
- D1131SH65T
- D1600U45T122
- D2700U45T122
- D4600U45T172

Key features

- Freewheeling Diodes with 4.5 and 6.5 kV blocking voltage for IGCT and modern IGBT applications such as HVDC voltage source converters and medium-voltage drives
- Pulse turn off losses up to 9 MW
- Maximal junction temperature of 140°C

Benefits

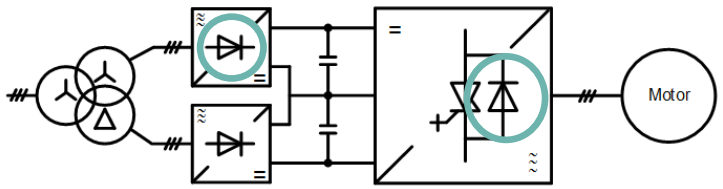
- Lowest thermal resistance
- Soft switching behavior optimized for IGCT or IGBT devices
- Current turn-off capability up to 5 kA/µs
- Less snubber effort
- On state losses reduced by 25% (comp. to "U", target)

Solution tree freewheeling diodes for medium-voltage drives

Medium-Voltage Rectifier

Rectifier Diodes (N)

- D6001N50T
- D711N60T
- D1481N65T
- D3001N68T
- D3041N68T
- D471N90T
- D2601N90T



Medium-Voltage IGCT Inverter

Freewheeling Diodes (SH)

Generation 1 (1kA/µs)

4.5 kV Diodes

- D1031SH45T
- D1331SH45T
- D1961SH45T

6.5 kV Diodes

- D931SH65T
- D1131SH65T

Medium-Voltage Press Pack IGBT Inverter

Press Pack IGBT (PPI)
(With and without internal FWD)

4.5 kV Trench

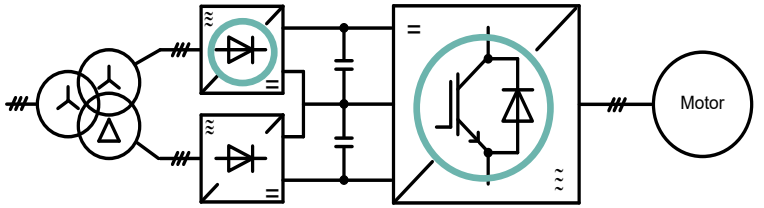
- P2000DE45X168
- P3000ZE45X168

Freewheeling Diodes (U)

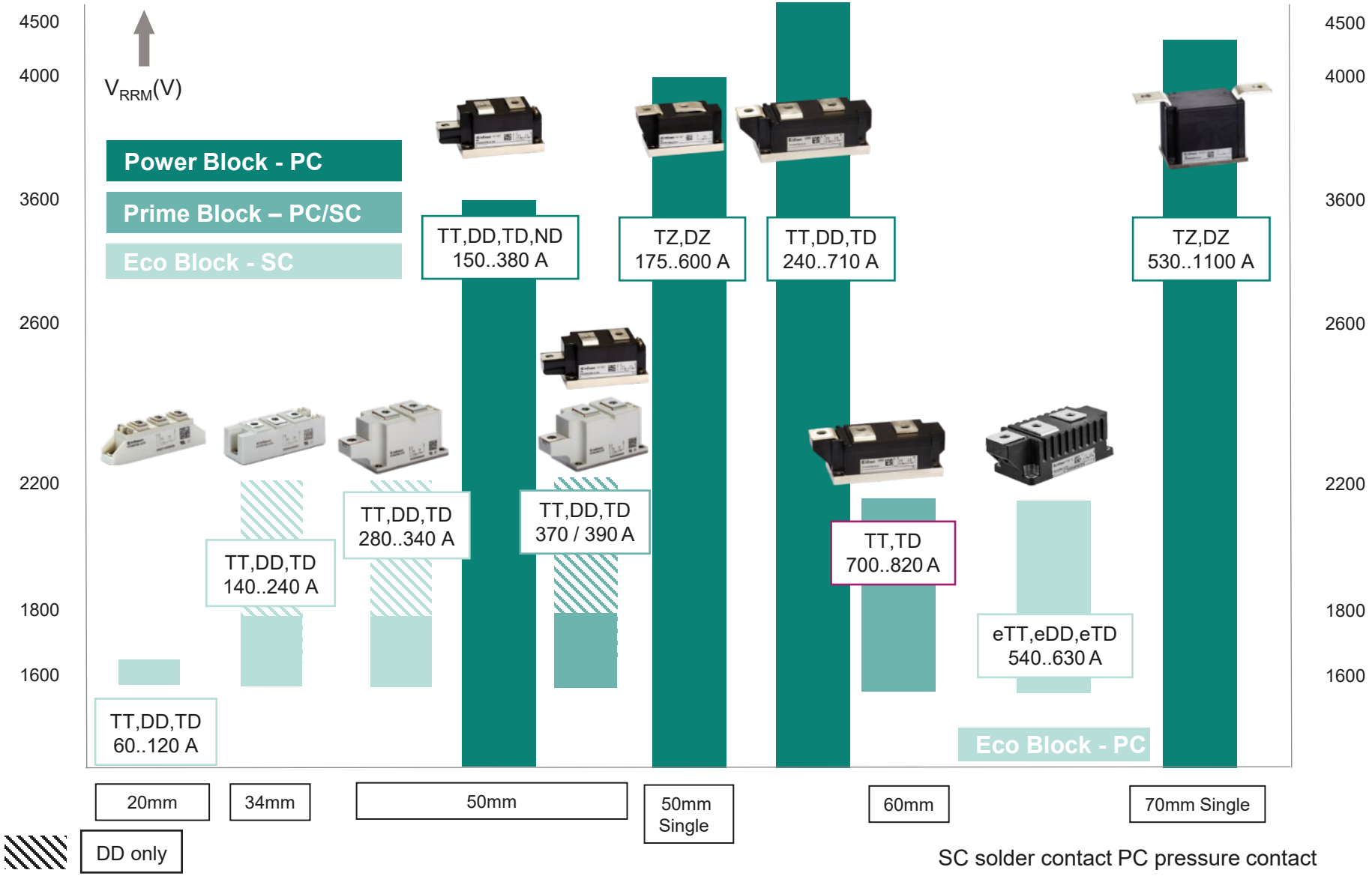
Generation 2 (5kA/µs)

4.5 kV Diodes

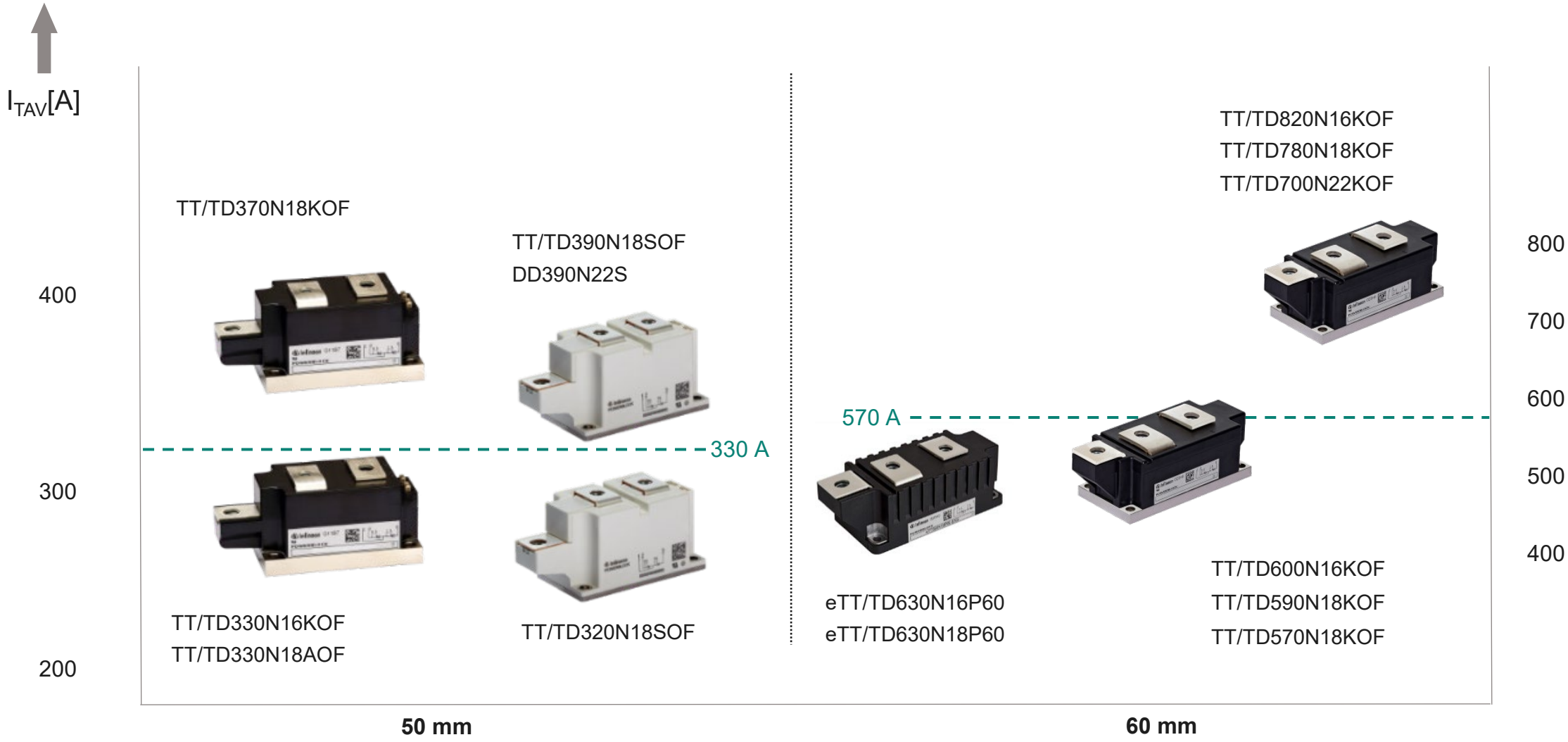
- D1600U45T122
- D2700U45T122
- D4600U45T172



Overview Power, Prime, and Eco Block modules (SC & PC)



Prime modules outperform the current market standards



Microcontroller

XMC™ portfolio

XMC4000-ARM® Cortex®-M4 (with FPU)
- CPU Frequency up to **144 MHz**
- Robust Flash technology: **Ta = -40 to 125°C**
- Timers CCU4, CCU8, Hall & Encoder I/F
- USB / Up to 6x CAN nodes / Up to 6x Serial Channels
- Up to 4x 12 Bit ADC / 2x DAC

XMC4100/4200
Up to 256 kB Flash / 40 kB RAM
48-64 pins

XMC4400
Up to 512 kB Flash / 80 kB RAM
64-100 pins
- 120 MHz Core
- Ethernet
- ΔΣ Demodulator

XMC4500
Up to 1 MB Flash / 160 kB RAM
100 – 144 pins
- EBU
- SD Card

XMC4700
Up to 2 MB Flash / 352 kB RAM
100 – 196 pins
- 144 MHz Core
- 6 ch CAN

XMC4800
Up to 2 MB Flash / 352 kB RAM
100 – 196 pins

XMC4300
256 kB Flash / 352 kB RAM
100 pin

EtherCAT

XMC1000-ARM® Cortex®-M0
- Core up to **48 MHz** / Peripherals up to **96 MHz**
- Timers CCU4,CCU8
- 2x Serial Channels
- 12 Bit ADC
- **1.8 V-5.5 V**
- Ta = -40 to 105°C

XMC1100
up to 64 kB Flash
16 – 40 pins
- 9 ch LED flicker free control (BCCU)
- 3x Analog Comparators

XMC1200
up to 200 kB Flash
16 – 40 pins
- Math Co-Processor
- CCU8 PWM Timer
- Hall & Encoder I/F

XMC1300
up to 200 kB Flash
16 – 40 pins
- 48 MHz/96 MHz clock
- 2x CAN
- 2x CCU8
- 4x Analog Comparators

>70% performance increase

XMC1400
up to 200 kB Flash
40 – 64 pins

XMC7100
4 MB Flash / 768 kB RAM,
250 MHz single/dual core
100 – 272 pin (QFP/BGA)

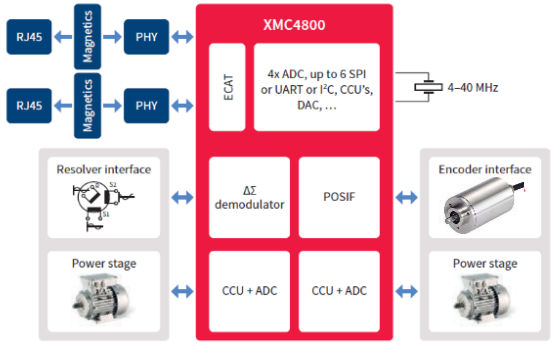
XMC7200
8 MB Flash / 1 MB RAM,
350 MHz single/dual core
176 – 272 pin (QFP/BGA)

- **Single** and **dual core** Arm® Cortex®-M7 and Cortex®-M0+
- M7 CPU core Frequency up to **350 MHz**
- Robust Flash technology: **Ta = -40 to 125°C**
- **Read While Write (RWW)** Flash capability
- Memory Up to **8 MB Flash, 1 MB RAM**
- **TCPWM** timers of 102Ch 16 bit and 16Ch 32 bit
- **Cryptography** Engine support
- Interfaces such as CAN-FD, **Gb Ethernet**
- **SMIF** and SDHC interface supported
- Extended voltage operating range: **2.7 to 5.5V**
- low power modes(LP/deep sleep, **hibernate**..)
- Add. timer, ADC, CAN FD and Serial COM. Chs

XMC4000 microcontroller units for industrial drives

Product images

Internal schematic and products



Key features

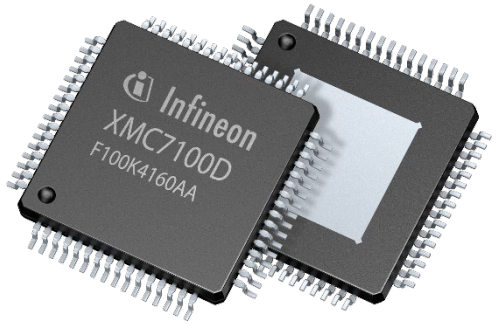
- 32-bit ARM® Cortex™-M4 core with FPU running at 80MHz to 144MHz
- Dedicated Inverter PWM generators (CCU8)
- Fast and flexible 12-bit ADC
- Interfaces for HALL sensors, encoders and resolvers
- Event Request Unit (ERU)
- EtherCAT interface
- Wide temperature range from -40°C to 125°C

Benefits

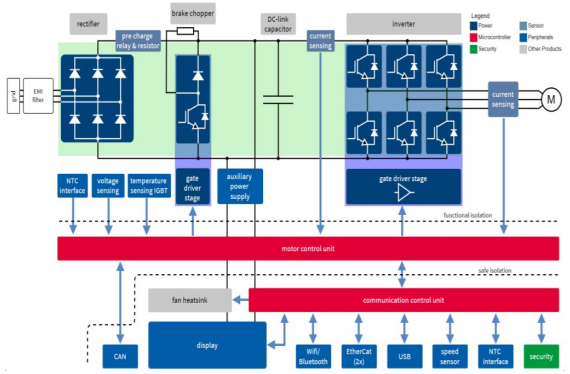
- Real-time performance combined with enhanced connectivity
- Based on the robust technology going beyond usual industrial requirements
- Motor Control Libraries and DAVE Apps for fast software development

XMC7000 microcontroller units for industrial drives

Product images



Internal schematic and products



Key features

- **Single** or **dual core** Arm® Cortex®-M7 (up to **350 MHz)** and Cortex®-M0+
- Memory Up to **8 MB Flash, 1 MB RAM**
- **TCPWM** timers of 102Ch 16 bit and 16Ch 32 bit
- 3 ADC covertor with 99 channels (3 dedicated for motor control)
- Interfaces such as CAN-FD, **Gb Ethernet**
- **SMIF** and SDHC interface supported
- Extended voltage operating range: **2.7 to 5.5V**
- Temperature range: **Ta = -40 to 125°C**

Benefits

- High processing performance and big memory foorprint
- Ability of task distribution
- Increased flexibility and quality
- Different core/memory/package combinations

AIROC™ Wi-Fi & Bluetooth® Combos

Broad AIROC™ Family Delivers Powerful Wi-Fi for your Application

Reliable

- **Most widely deployed wireless IP** - more than 1 Billion AIROC™ Wi-Fi and Bluetooth® devices in the field
- **Best interoperability** with installed base of Access Points and data-driven Wi-Fi algorithm improvement
- **Strength in Bluetooth® classic complements Wi-Fi** in streaming applications to ensure reliability

Low power

- **Ultra low power by design** – very low sleep, transmit, and receive current
- **Low power system architecture** – host offloads for keep-alive functions allowing host processor to sleep for longer periods
- High-performance RF ensures the **most robust connection** which substantially reduces power consumption
- **Data-driven Wi-Fi** with 300M datapoints per day for proven low power in real-world conditions

High performance

- High-performance RF design ensures your device works when needed in increasingly congested environments due to **longer range** (more than double some competitors)
- Industry's best **Coex performance**: configuration options per antenna design and system-level use cases
- Real-Time Simultaneous Dual Band enables **demanding applications** requiring connection to an AP and a local network of devices

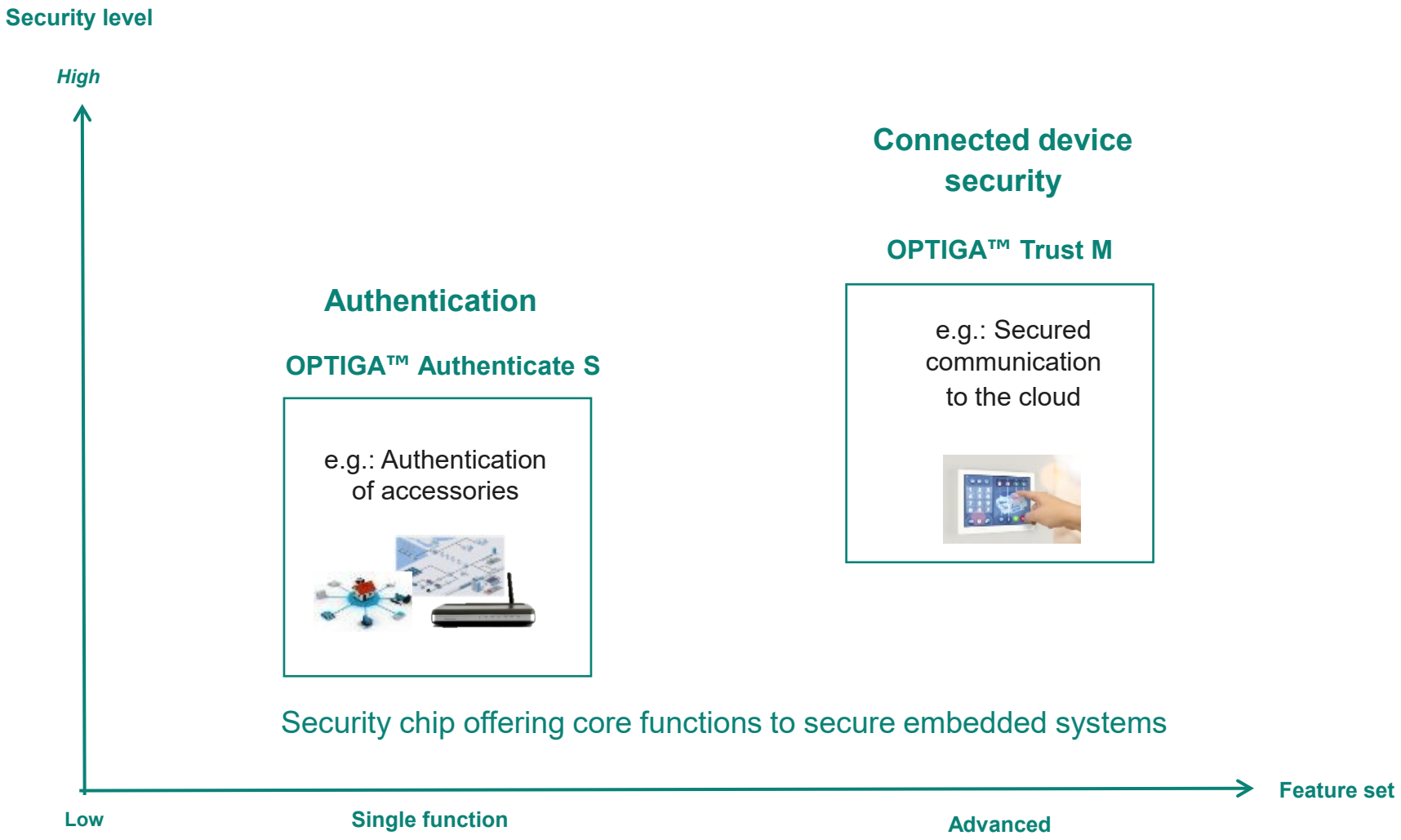
Overview of Wi-Fi Combo Families and Key Features

Device Type/Features	Wi-Fi + Bluetooth® Combo Devices				
Device	**CYW43439**	**CYW43012**	**CYW4373/E**	**CYW5459x**	**CYW5557x**
Reason To Choose	Entry level	Ultra Low power	Reliable High Throughput	Peak Throughput	Wi-Fi 6/ 6E
Wi-Fi Version	Wi-Fi 4 (11n)	Wi-Fi 4 (11n)	Wi-Fi 5 (11ac)	Wi-Fi 5 (11ac)	Wi-Fi 6/ 6E (11ax)
Bluetooth® Version	5.1	5.0	5.2	5.1	5.2
Band	Single Band 2.4GHz	Dual Band 2.4GHz, 5GHz	Dual Band 2.4GHz + 5GHz	Dual Band 2.4GHz, 5GHz	Triple Band 2.4 + 5 + 6GHz
Streams	1x1	1x1	1x1 w/Ant Diversity	2x2 (MIMO)	2x2 (MIMO)
Wi-Fi Host Interface	SDIO – shared, SPI	SDIO	SDIO, SPI, PCIe (4373E), USB (shared)	PCIe, SDIO	PCIe, SDIO
Bluetooth® Host Interface	UART, SDIO - shared	UART	UART, USB (shared)	UART	UART
ePA/eLNA	**X**	√	√	**X**	**X**
WPA3	√	√	√	√	√
Operating Temperature	-30C to +70C	-20C to +70C	-40C to 85C (4373E)	-40C to 85C	-40C to 85C

- Broad family of products covering all bands / Wi-Fi 4, 5, up to 6E
- Rock solid connectivity – best of breed RF performance over 20+ years
- Easy Development – Modules available from multiple vendors
- Built on Innovation – Ultra-Low power, Coexistence, new use cases

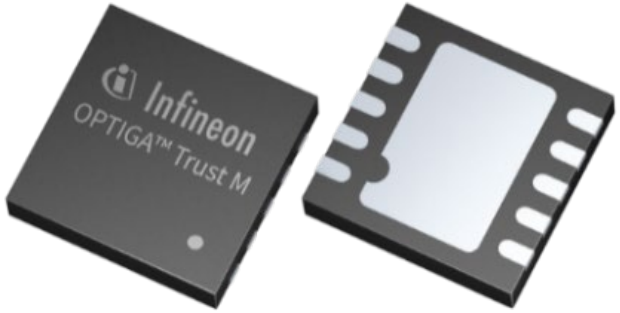
OPTIGA™ Trust

OPTIGA™ Trust Family –
The security answer to our customer´s concerns

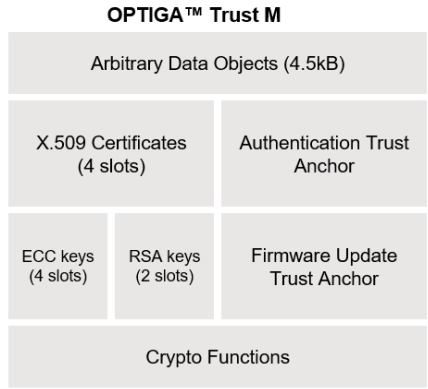


OPTIGA™ Trust M SLS32AIA

Product images



Internal schematic and products



Key features

- Based on CC EAL 6+ (high) certified security controller
- X.509 certificate supported
- TRNG AIS-31 certified
- CA certificate in-field update
- Cryptography ECC, RSA, AES, SHA
- Extended temperature range: -40° to 105°C
- Extended lifetime (20 years)

Benefits

- Secured zero-touch provisioning for leading cloud providers.
- Easy integration based on a range of turnkey use cases to minimize your integration efforts.
- Future-proof security provided by the most advanced cryptographic schemes.
- Open Source framework to benefit from direct support from developers.

OPTIGA™ solutions and relevant use cases

Use case	Description
Brand protection and authentication of accessories	OPTIGA™ Authenticate S can be used in accessories / consumables to verify that genuine parts are used.
Mutual authentication	OPTIGA™ Trust M can secure multiple secret keys and certificates. It can be used to perform mutual authentication with clouds and other systems. (e.g.: a device can authenticate with commissioners, controllers, ecosystems, and other entities)
Secured communication	OPTIGA™ Trust M can be used to establish secured communication with a cloud or other service or device
Secured storage	OPTIGA™ Trust M adopts a Common Criteria EAL6+ certified hardware trust anchor which offers protection against various physical and reverse-engineering attacks. Data stored in the Trust M is protected against various extraction techniques as verified by the Common Criteria certification.
Secured firmware update	OPTIGA™ Trust M can be used to cryptographically verify and perform secured firmware updates.

Galvanic isolators

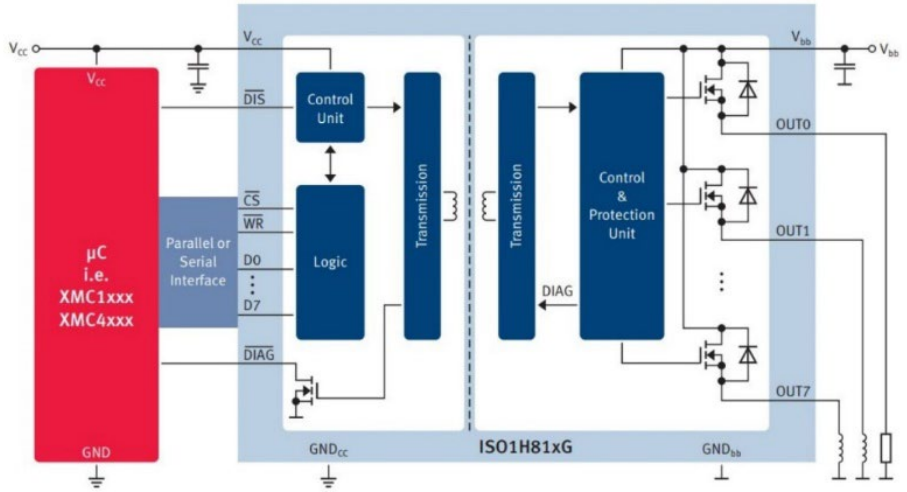
ISOFACE™ family – Galvanic isolation and integrated diagnostics

2nd gen

- H823V 8x 0.6 A
  12 x 12 VQFN

8-channel switch IC

- 2.5 kV galvanic isolation
- 3.3 V µC interface (SPI, parallel)
- Diagnostics per channel:
  - Open load
  - Short to V_{bb}
  - Short to GND & overload
  - Over temperature
- 5-fold global diagnostics



1st gen

- H811G 8x 0.6 A Parallel
- H812G 8x 0.6 A SPI
- H815G 8x 1.2 A Parallel
- H816G 8x 1.2 A SPI

8-channel switch ICs

- Integrated galvanic isolation
- Direct interface to µC
  - 3.3 V/5 V
  - Serial or parallel
- Short-circuit protection
- Inductive load switching
- Up to 1.2 A load current
- Integrated diagnostics:
  - Overload & short circuit

8-ch. digital input ICs

- Integrated galvanic isolation
- Direct interface to µC
  - 3.3 V/5 V
  - Serial or parallel
- IEC-input types: 1/2/3

	Sampling speed settings	Filter	Diagnostics V_{bb}-monitor	Wire-break
I811T	125 kHz	4 / IC		
I813T	500 kHz	9 / channel	✓	✓

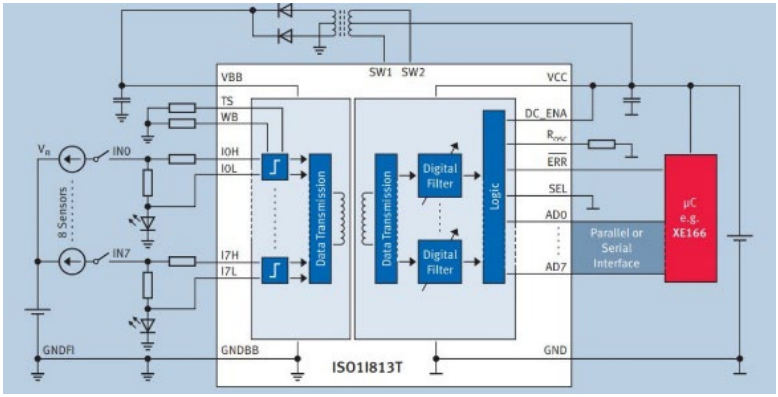
8-channel switch ICs

8-channel input ICs

ISOFACE™ - Galvanic isolated high-side switches & input ICs

Product images

Internal schematic and products



Key features

- Integrated galvanic isolation
- 8-channels
- Integrated clamping diode
- Programmable input filters
- Diagnostic feedback

Benefits

- Ideal for industrial applications operating at elevated temperatures
- Higher operational life-time
- Higher reliability
- Ideal for high-precision or high-speed applications
- At least 50% PCB area savings
- Inductive load switching
- Flexibility
- Over-load detection
- Strong maintenance support

Sensors

XENSIV™ angle-sensors in electrification for drives

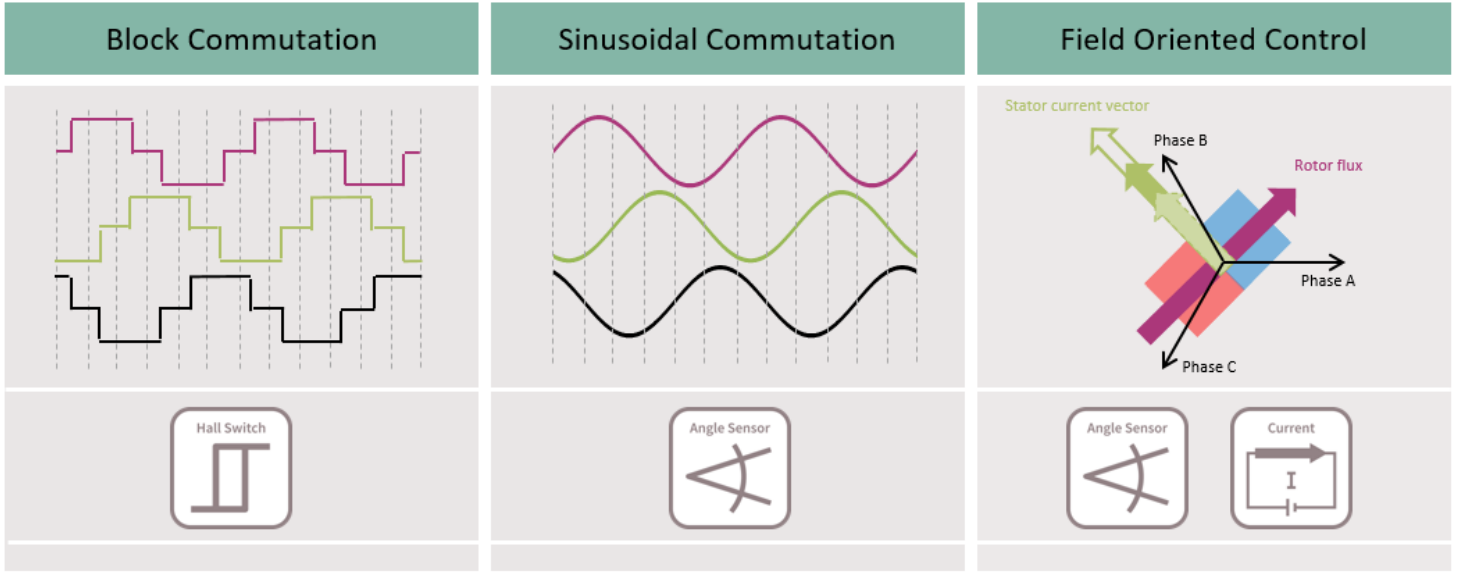
Key features

- Wide portfolio of magnetic position sensors
- Offering Hall, GMR, AMR and TMR sensors
- Digital and analog interfaces for angle sensors available

Benefits

- Suitable for all commutation types for motor control
- ISO ready and ISO compliant versions

Broad product portfolio for all kind of electric motor commutation types

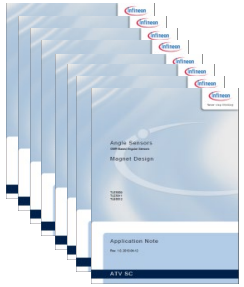


XENSIV™ enablement examples: Infineon provides supportive material for a short time-to-market

Documentation

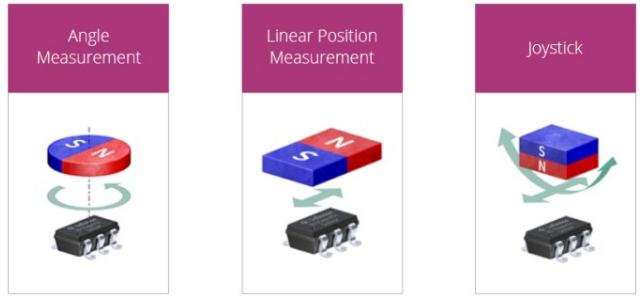
- Datasheets, product briefs, user manuals
- Updated product presentations

Application notes



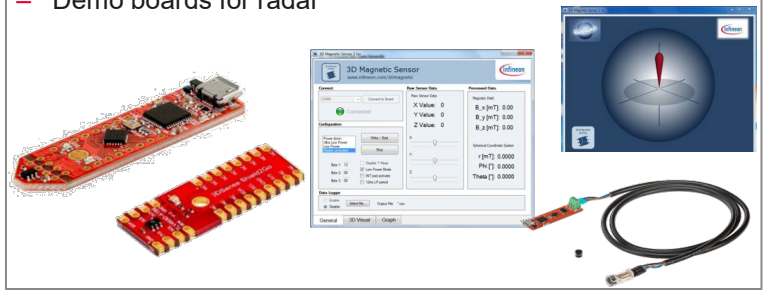
- Joystick
- 3D Hall for multifunction knob
- 3D Hall for gearstick
- 3D Hall for linear movement
- 3D Hall for angle measurement
- And more…

Online simulation tools



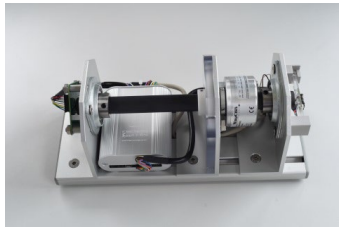
Evaluation tools & SW

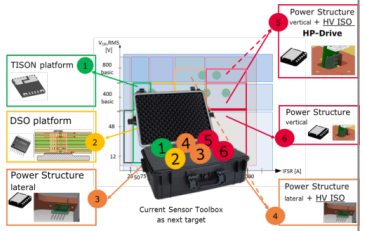
- Sensor-2-go kit for 3D Hall sensors incl. extensions
- Sensor-2-go kit for speed sensor & current sensor
- Shield2Go for 3D and current sensors
- Shield2Go for barometric pressure sensors
- Demo boards for radar



Sensing toolboxes

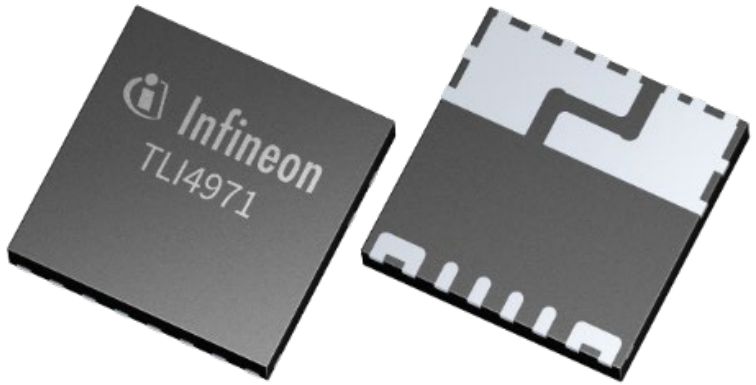
- Sensing toolbox for shaft sensing (end-of-shaft, integrated end-of-shaft) available
- Sensing toolbox for current sensing in work right now
- Main purpose: adapt fast to dedicated application



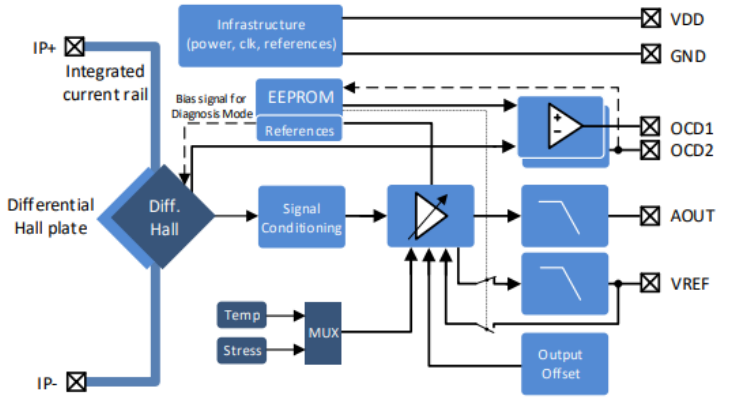


XENSIV™ TLI4971 - high precision coreless current sensor for industrial applications

Product images



Internal schematic and products



Key features

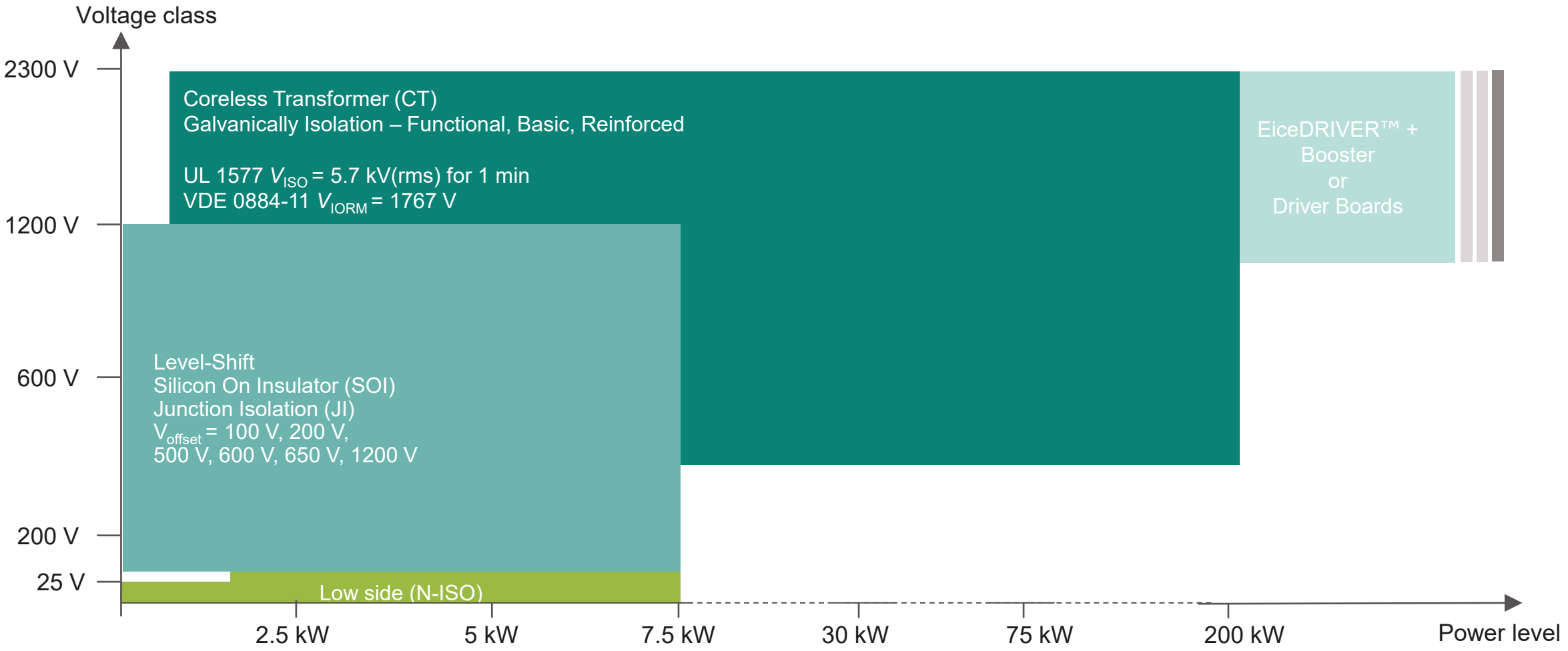
- Magnetic coreless differential sensor
- Power package
- Best-in-class temperature and lifetime accuracy
- Easy system integration
- Protection capability for upcoming IGBT technologies

Benefits

- No hysteresis
- Overload capability
- Stray field immunity
- Very low power dissipation
- Superior system accuracy
- Support of ISO61508/ISO26262 requirements
- Simplified layout, reduced design risk
- Space and cost saving

Gate Driver

Gate driver portfolio serving power ranges up to 200 kW and above

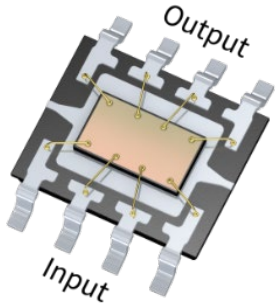


Note: Voltage class is defined base on different driver configurations for the Max Voltage class. 1. For high-side, high-and low-side, half bridge and three phase gate drivers, voltage class is defined as switch break down voltage in applications. 2. For low side drivers (N-ISO), voltage class is defined as maximum operating range supply voltage. 3. For special cases as 1EDN-TDI (N-ISO), voltage class is defined as maximum bus voltage (highest floating voltage it can manage).

EiceDRIVER™ gate driver IC technology overview – Wide portfolio to best fit with Drives application requirements

Non-isolated GD

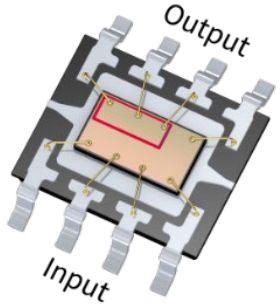
Low-side



- Monolithic construction of ground-reference gate drivers for 20 to 35 V supply voltage applications
- **Comprehensive families** of single- and dual-low-side drivers with flexible options for output current, logic configurations and UVLOs (plus non-isolated TDI)
- Uses **rugged and high-performance technologies** of HVIC process or the latest **state-of-the-art 130-nm** process
- **Industry-standard** DSO-8 and small form-factor SOT23, WSON and TSNP packages

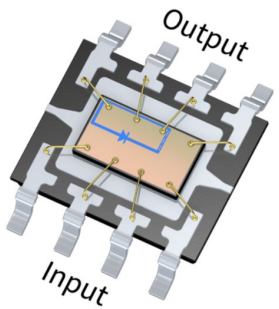
Level-shift GD

Junction isolation (JI)



- Monolithic construction of 1 to 6 gate drive channels up to 1200 V rating
- Industrial pioneering high-voltage IC **(HVIC) technology** used in all high-voltage gate drive applications
- Optional Integrated bootstrap- FET circuit (200 Ω typ.)
- **Negative transient immunity** to prevent latch-up: -40 V for 100 ns
- Common mode transient immunity (CMTI): 50 V/ns, typ
- **Gen 2** technology (**IR** prefix): Industrial pioneering HVIC process
- **Gen 5** technology (**IRS** prefix): Cost-effective pin-to-pin versions of Gen 2

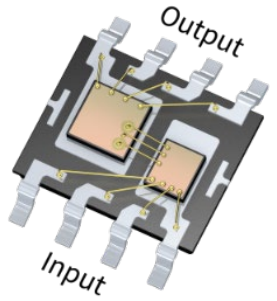
Silicon on insulator (SOI)



- Monolithic construction of 2 to 6 gate drive channels up to 1200 V rating
- **Infineon SOI technology** for high-voltage applications
- Built-in **PN-based bootstrap diode** (36 Ω typ.) for simplified bootstrap operation & reduced PCB area
- **Negative transient immunity** to prevent latch-up: -100 V for 300 ns
- Common mode transient immunity (CMTI): 50 V/ns, typ
- **>50% lower level-shift losses** allowing for higher efficiency, higher frequency operation, smaller heat sinks, and higher reliability

Isolated GD

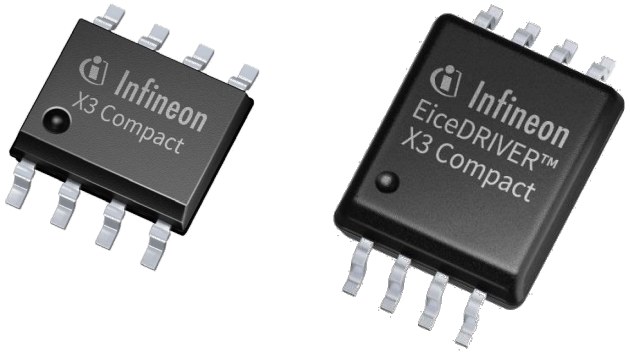
Coreless transformer



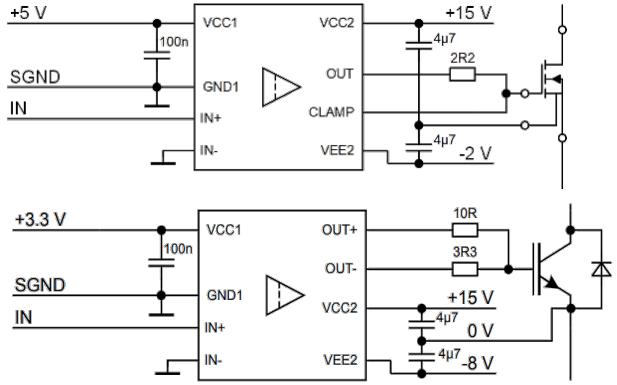
- Two separate chips solution with **magnetic coupling** providing **galvanically isolated** single- and dual channel gate drivers
- **VDE0884-11 isolation technology** providing **isolation up to 8 kV$_{pk}$ V$_{IOTM}$** and up to **±2300 V functional isolation**
- Common-mode transient immunity (**CMTI**) of **more than 300 V/ns**
- **Strongest gate drive output currents** (up to ±18 A) reducing need for external booster circuits
- **Reliable protection options** for each isolation rating in different packages

EiceDRIVER™ X3 Compact (1ED31xx) family
5.7 kV isolated driver with active Miller clamp or separate output

Product images



Internal schematic and products



Key features

- Single-channel isolated gate driver with 5.5 / 10 / 14 A (no booster required)
- Galvanic functional isolation voltages up to 2300 V
- 90 ns propagation delay with 30 ns input filter, 7 ns propagation delay matching
- Active Miller Clamp or Separate outputs
- Exceptional CMTI robustness > 200 kV/µs
- 40 V absolute maximum output supply voltage
- Isolation capabilities & certification
- DSO-8 150 mil (4 mm creepage) & 300 mil package (8 mm creepage)
- Evaluation board available

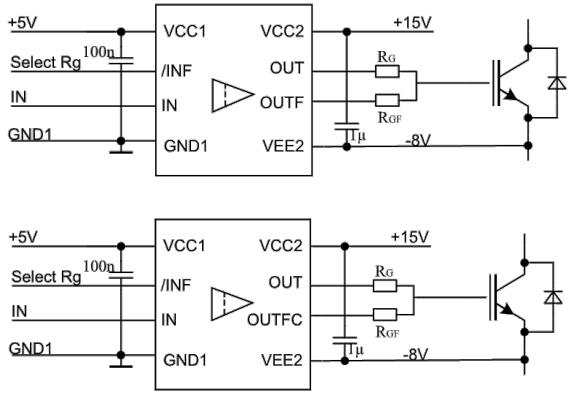
Benefits

- Cost-effective 8-pin gate driver (with 150-mil and 300-mil bodies) enabling easy to design-in
- 14 A driving capability & 40 V output supply voltage range
- Optimized specifications for driving SiC
- Fulfilling highest isolation standards
- UL1577 and VDE-11 (planned)

EiceDRIVER™ 2L-SRC Compact 1ED32xxMC12H – 5.7 kV isolated gate driver with 2-level slew rate control (2L-SRC)

Product images

Internal schematic and products



Key features

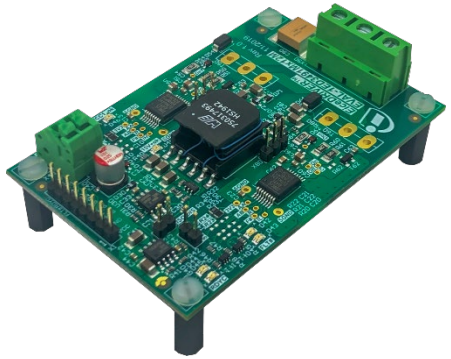
- Single-channel isolated gate driver with 10 / 18 A
- 2-level slew rate control (EMI & switching losses optimization)
- On-the-fly gate resistor change
- 100 ns propagation delay with 30 ns input filter
- 1 ns propagation delay matching (between OUT & OUTF)
- Standard output configuration and active Miller clamp option
- Exceptional CMTI robustness > 200 kV/µs
- 40 V absolute maximum output supply voltage
- Isolation capabilities & certification
- 300-mil wide-body package (8 mm creepage)
- For IGBTs, MOSFETs, CoolSiC™ SiC MOSFETs up to 2300 V
- Evaluation board available

Benefits

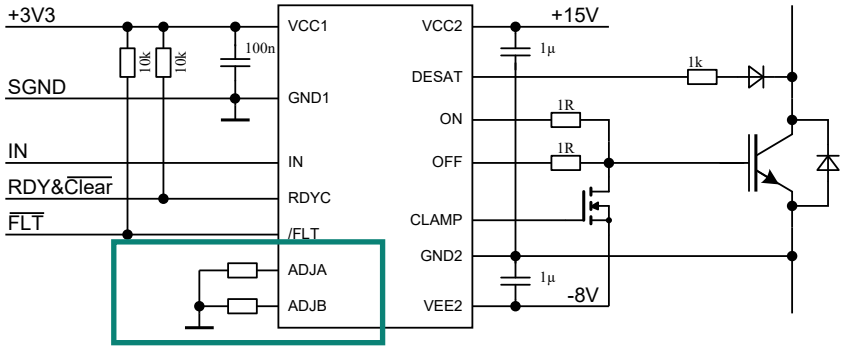
- 2-level slew rate control
- Separate outputs for two-level (fast & slow) turn-on to reduce dv/dt
- Reduction of switching losses
- Tight propagation delay matching between outputs
- 8-pin gate driver (with 300-mil bodies) enabling easy to design-in
- Fulfilling highest isolation standards
- UL1577 and VDE-11

EiceDRIVER™ Enhanced X3 Analog (1ED34xx) family
5.7 kV isolated driver with active Miller clamp, adjustable DESAT

Product images



Internal schematic and products



Key features

- Single-channel isolated gate driver with 3/ 6 /9 A
- Galvanic functional isolation voltages up to 2300 V
- Active Miller clamp (clamp driver), DESAT, soft-off, thermal shutdown
- Exceptional CMTI robustness > 200 kV/µs
- X3 Analog configurability
- Adjustable DESAT filter time & blanking time and soft-off current w external resistor
- Isolation capabilities and certification
- 1ED34x1MU12M: UL 1577 certified VISO=5.7 kV(rms)
- 1ED34x1MC12M: UL 1577 & VDE 0884-11 certified VIORM=1767 V (planned)
- DSO-16 fine pitch, 300 mil wide-body package (8 mm creepage)
- For IGBTs, MOSFETs, CoolSiC™ SiC MOSFETs
- Evaluation board available

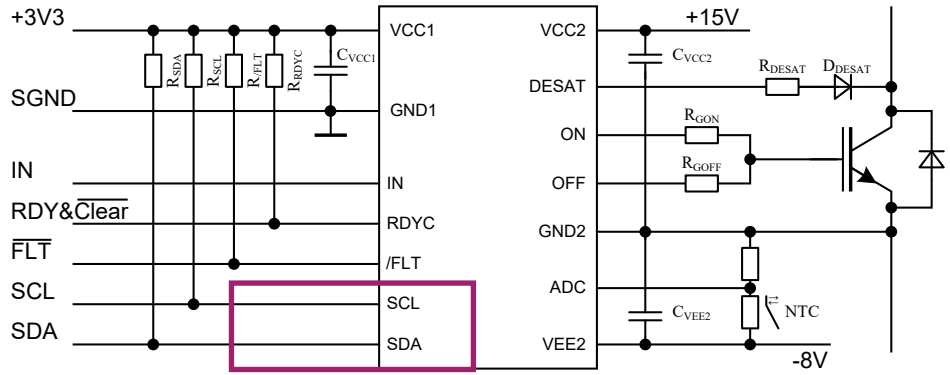
Benefits

- Flexibility based on register-based configuration adjustments
- Reduction in hardware complexity with less customer product variants
- Reduction in the evaluation time with adjustable parameters for faster time-to-market

EiceDRIVER™ Enhanced X3 Digital (1ED38xx) family
5.7 kV isolated driver with I2C bus configurability for DESAT

Product images

Internal schematic and products



Key features

- Single-channel isolated gate driver with 3/ 6 / 9 A
- Galvanic functional isolation voltages up to 2300 V
- Active Miller clamp (clamp driver), DESAT, soft-off, Thermal monitoring and shutdown
- Exceptional CMTI robustness > 200 kV/µs
- X3 Digital configurability
- Full adjustable via I2C bus: 3 address configuration, 27 parameter configuration, 16 status
- Configurable UVLO, DESAT², TLTO, Soft-off, Miller clamp
- Isolation capabilities & certification
- 1ED38x0MU12M: UL 1577 certified VISO=5.7 kV(rms)
- 1ED38x0MC12M: UL 1577 & VDE 0884-11 certified VIORM=1767 V
- DSO-16 fine pitch, 300-mil wide-body package (8 mm creepage)
- For IGBTs, MOSFETs, CoolSiC™ MOSFETs

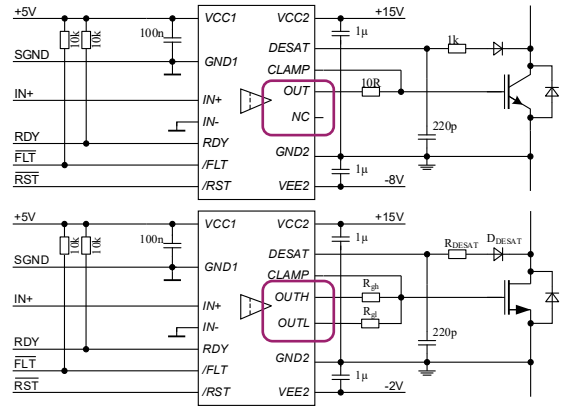
Benefits

- Highest flexibility introduced by register-based adjustments via I2C
- Reduction in hardware complexity with less customer product variants
- Reduction in the evaluation time with adjustable parameters for faster time-to-market

EiceDRIVER™ Enhanced F3 (1ED332xMx12N) – Product overview

Product images

Internal schematic and products



Key features

- Single-channel isolated gate driver with up to 6/8.5 A
- Active Miller clamp, DESAT, soft-off
- CMTI > ±300 kV/µs at 1.5 kV
- Propagation delay 85 ns typ. (with 35 ns typ. input filter)
- Prop. delay matching (part to part) +/- 15 ns
- DSO-16 300 mil package
- 8 mm creepage distance, standard 1.27 mm pitch
- Pin-compatible to 1ED020I12-F2/B2
- Isolation capabilities & certification
- UL 1577 certified VISO = 5.7 kV(rms)
- VDE 0884-11 certified VIORM = 1767 V(peak) reinforced isolation
- For IGBTs, MOSFETs, CoolSiC™/SiC MOSFETs up to 2300 V
- Evaluation board available: EVAL-1ED3321MC12N

Benefits

- Accurate short-circuit protection (DESAT) & soft shutdown
- Up to 8.5 A driving capability & 40 V output supply voltage range
- Optimized specifications for driving SiC
- Fulfilling highest isolation standards
- UL1577 and VDE-11

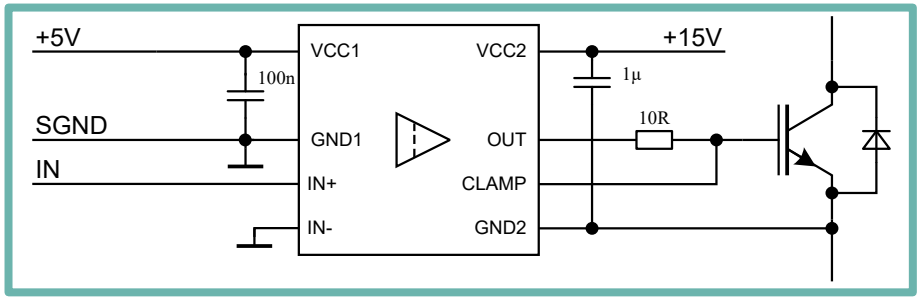
EiceDRIVER™ X3 Compact empower CoolSiC™ MOSFET
Avoid parasitic turn-on based on active Miller clamp

- How to prevent parasitic turn-on during high dV/dt situation
  - Negative VGE / VGS based on a bipolar power supply → Increase in design complexity
  - Active Miller Clamp (AMC) (i.e., bipolar power supply becomes obsolete)

- **For SiC MOS and IGBT7**
  - **For 0 V turn-off, Miller clamp function is highly recommended**

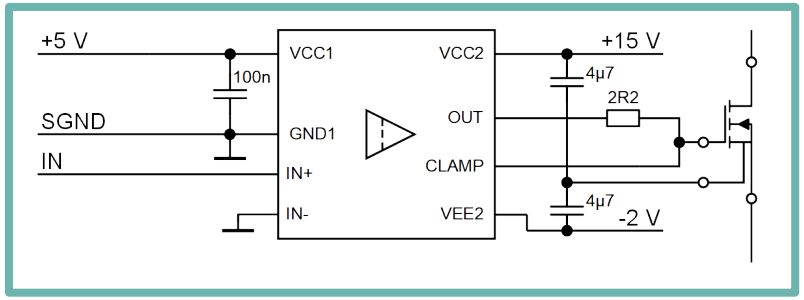
EiceDRIVER™ 1ED Compact

- Active Miller clamp option
- VCC2 = 20 V (max.)
- **Unipolar power supply sufficient**



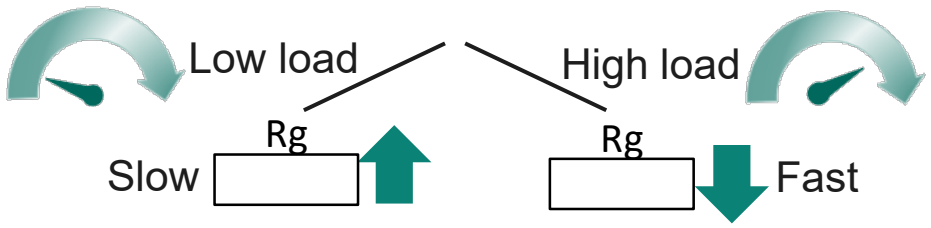
EiceDRIVER™ X3 Compact

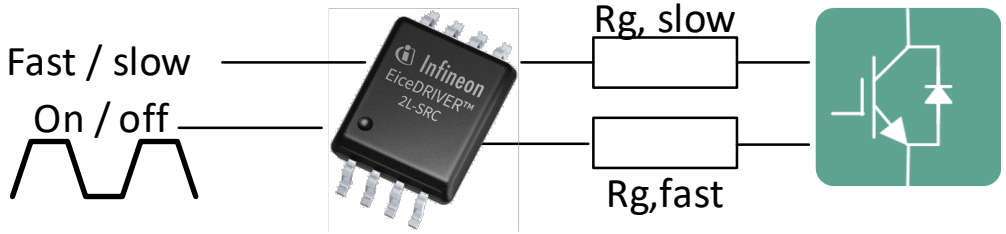
- Active Miller clamp option
- VCC2 = 40 V (max.)
- Two options:
  - **Unipolar power supply only**
  - **Bipolar power supply & AMC**



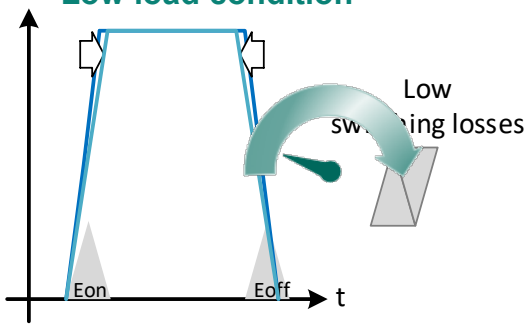
EiceDRIVER™ 2L-SRC Compact empower IGBT7 in Drive applications – Balancing efficiency vs. EMI

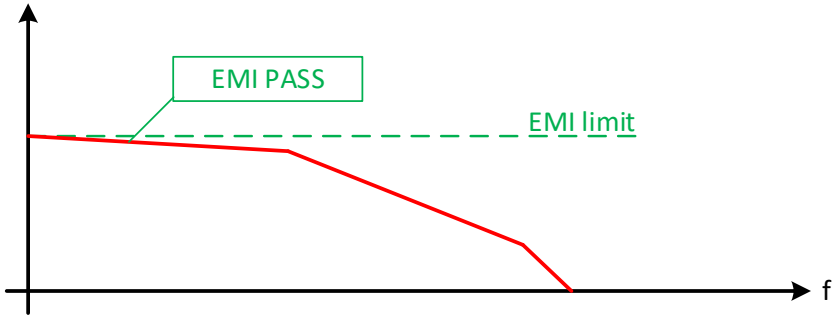
On-the-fly PWM cycle-to-cycle gate resistor change



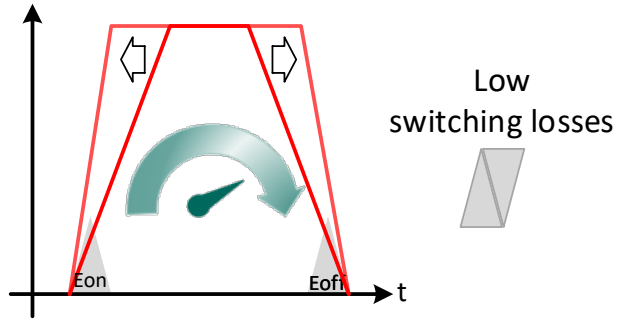


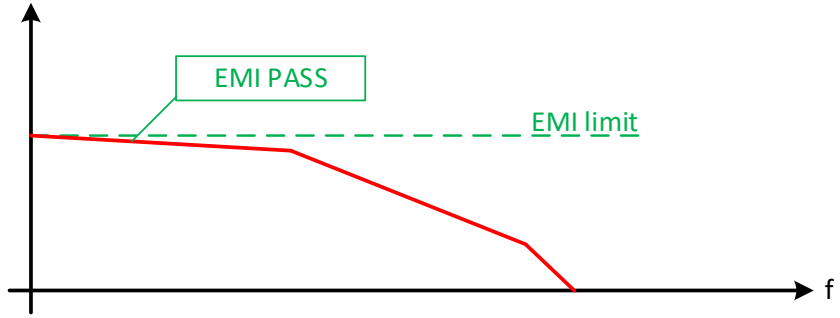
Low load condition





High load condition





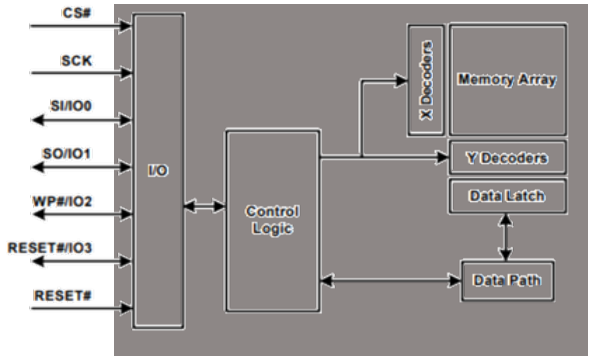
Memory

S25FL-L serial NOR Flash memories stores the boot code and application critical parameters even in rush environment

Product images

S25FL064L
S25FL128L
S25FL256L
Quad SPI
NOR Flash

Internal schematic and products



Key features

- Densities 64Mb to 256Mb – voltage level 3.3V (2.7V-3.6V)
- Easy to design in due to industrial standard floating gate technology
- 4KB Uniform Sector Size / Easy to connect to most microcontrollers
- 100,000 Program/Sector Erase Cycles, minimum
- 0.30-ms Program time per 256 bytes and a 50-ms Sector Erase time
- 20 Year Data Retention, minimum
- Temperature range up to 125°C, multiple packages

Benefits

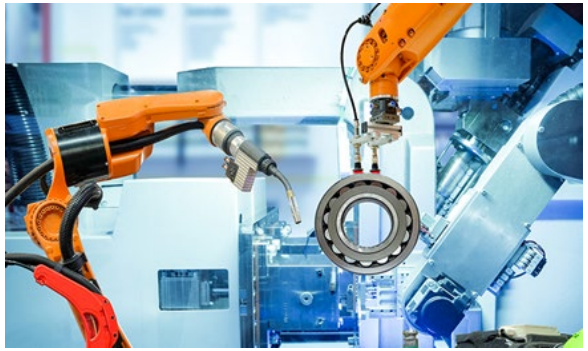
- Easy to use and compliant due to Industrial Standard QSPI Interface
- Robust design with high temperature grade products
- Available in different packages and scalable densities

Series	Density	Device	SOIC-8 208 mil	SOIC-16 300 mil	WSON 4 x 4 mm	WSON 6 x 5 mm	WSON 8 x 6 mm	BGA24 8 x 6 mm 5 x 5 Ball	BGA24 8 x 6 mm 4 x 6 Ball
FL-L	64Mb	S25FL064L	✓	✓	✓	✓		✓	✓
	128Mb	S25FL128L	✓	✓		✓		✓	✓
	256Mb	S25FL256L		✓			✓	✓	✓

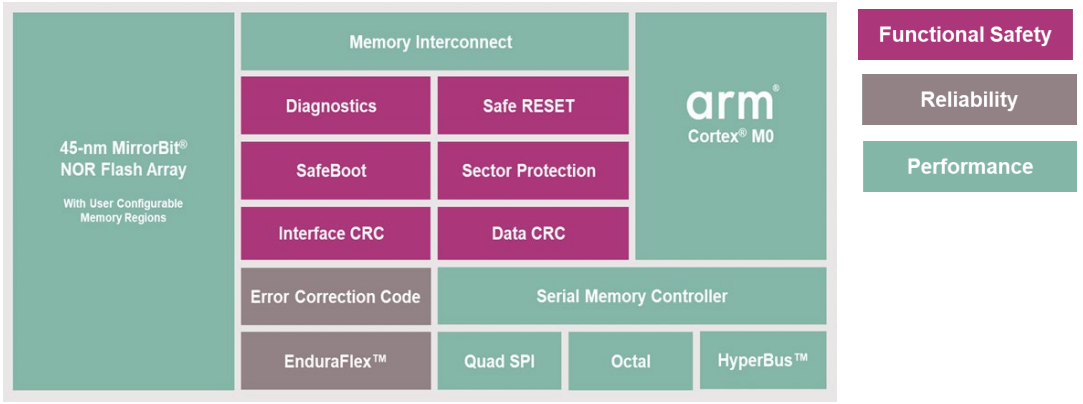
SemperFlash serial NOR Flash offers most flexibility, highest performance and functional safety with densities 256 Mb to 4 Gb

Product images

S25HL-T
S25HS-T
S26HL-T
S26HS-T
S28HL-T
S28HS-T
NOR Flash



Internal schematic and products



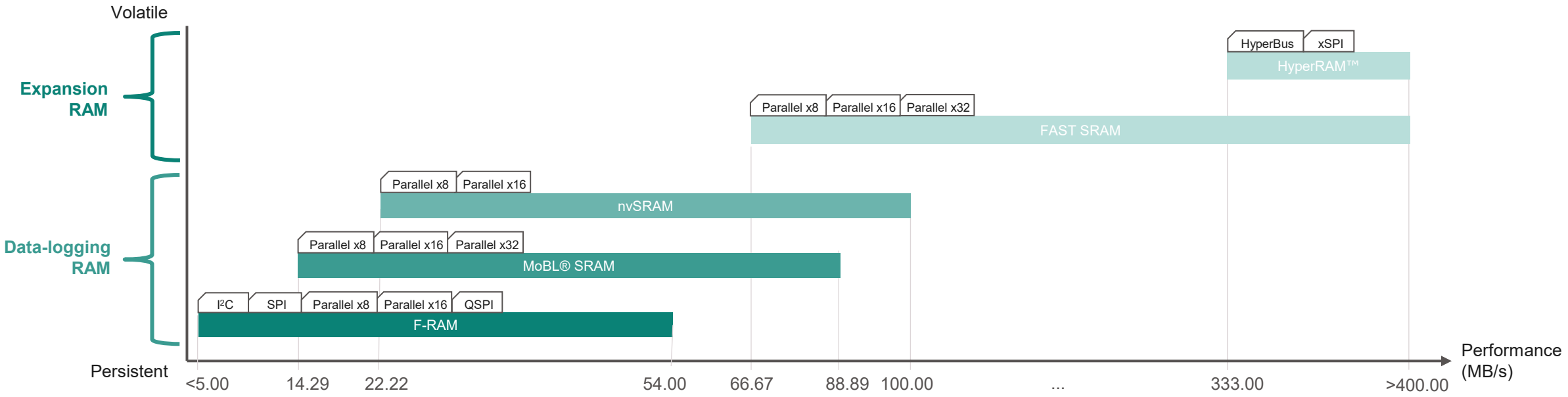
Key features

- ASIL-B / SIL-2 Functional safety compliance on component level
- Enhanced reliability (ECC and CRC)
- EnduraFlex™ Architecture – integrated wear leveling to optimize endurance and data retention
- Integrated diagnostic features for a safe and reliable operation
- High-Speed Read Bandwidth up to 400MB/s – instant on feature
- xSPI compliant – easy to adopt to microcontroller (QSPI, OctalSPI, Hyperbus – perfect match to use with HyperRAM)

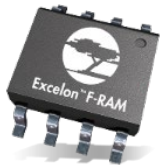
Benefits

- Cortex M0 offers enhanced diagnose and safety features
- High-speed reading for instant on
- EnduraFlex™ allows to partition the NOR Flash, reduced component count and increase reliability
- Functional safety compliant reduces certification time and shorten time-to-market
- Designed for high reliability in rough and higher temperature
- Longevity >10 years

Broad RAM product portfolio to meet performance requirements



F-RAM

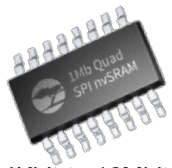


- 4Kbit to 16Mbit
- Serial and Parallel interface
- Instant non-volatility
- Optimized solution for low-power data-logging

MoBL® SRAM

- 256Kbit to 64Mbit
- Access time: 45 ns – 70 ns
- SER < 0.1 FIT/Mbit
- Ultra-low standby currents for extending battery life

nvSRAM



- 64Kbit to 16Mbit
- Access time: 20 ns – 45 ns
- Unlimited endurance
- Optional features including RTC, timer and alarm

FAST SRAM

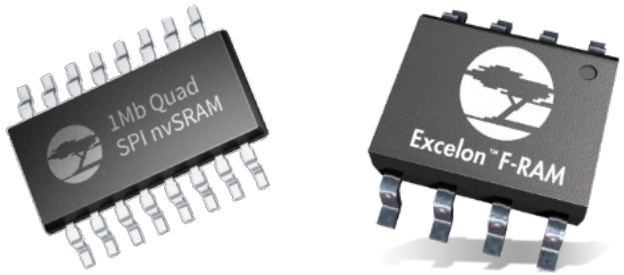
- 256Kbit to 32Mbit
- Access time: 10 ns – 15 ns
- SER < 0.1 FIT/Mbit
- Optimized solution for a high-speed cache memory

HyperRAM™

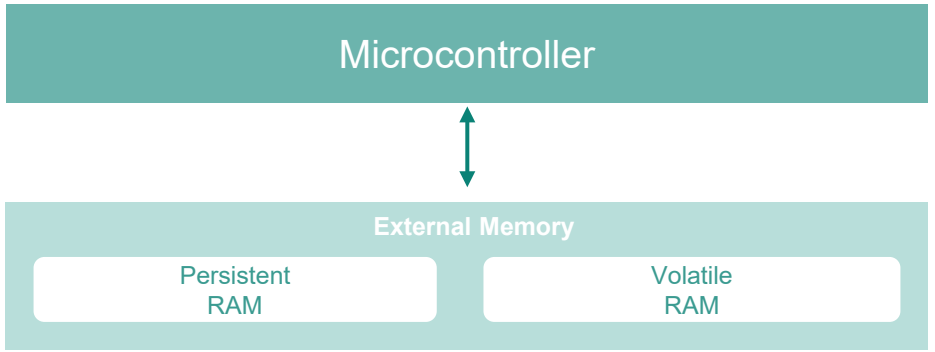
- 64Mbit to 128Mbit
- Serial HyperBus™ & xSPI
- Up to 400 MB/s speeds
- Ideal solution for a high-speed serial buffer memory

Persistent RAM Solutions for Industrial Motor Drives: NVRAM

Product images



Internal schematic and products



Key features

- nvSRAM
  - 256Kbit to 16Mbit in density
  - Parallel asynchronous interface with access speeds < 45 ns
  - Unlimited read/write cycles
  - Optional RTC, watchdog timer, and clock alarm
- F-RAM
  - 4Kbit to 16Mbit in density
  - Serial interface 40/50 MHz SPI and 108 MHz QSPI
  - 1014 read/write cycles – virtually unlimited endurance
  - Instant non-volatility with NoDelay Writ

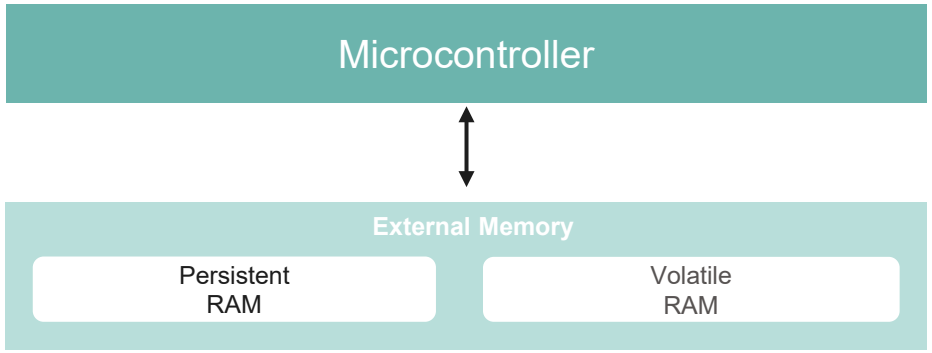
Benefits

- Eliminate battery for power back-up from the system
- Capture real-time, mission-critical system data at high speeds
- Retain data instantly on power-loss or system shutdown
- Log data continuously over a 15-year product lifespan
- Enhance system reliability with on-chip ECC and CRC
- Design with parallel or low-pin-count serial SPI and QSPI interface
- Support wide operating voltages and temperature grades
- Additionally, F-RAM technology is immune to data corruption due to magnetic fields and radiation exposure

Persistent RAM Solutions for Industrial Motor Drives: MoBL® SRAM

Product images

Internal schematic and products



Key features

- MoBL® SRAM with ECC
  - 4Mbit to 64Mbit in density
  - Access times: 45 ns – 55 ns
  - Parallel asynchronous interface
  - Bus-width configurations: x8, x16 and x32
  - Standby current (at 85°C) of 6.5 µA for 8Mbit, 8.0 µA for 16Mbit
  - Wide operating voltage range: 1.8V - 5.0V
  - High reliability with on-chip ECC
  - Industrial and Automotive temperature grades

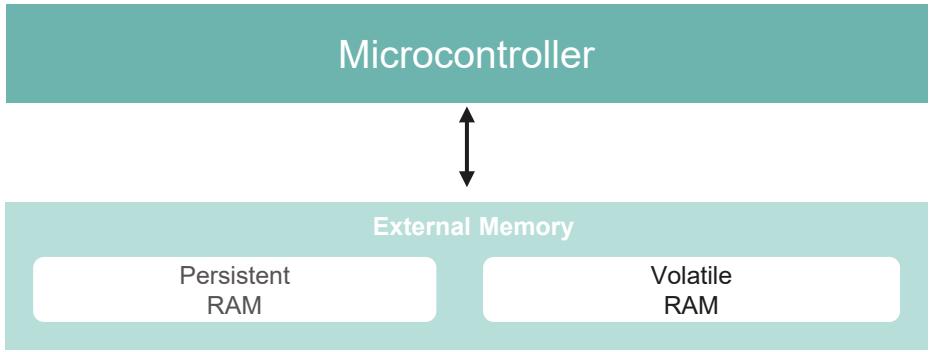
Benefits

- Capture real-time, mission-critical system data at high speeds
- Extend system battery life with best-in-class standby currents
- Log data continuously over a 15-year product lifespan
- Realize reliable systems with soft-error rates (SER) < 0.1 FIT/Mbit
- Support wide operating voltages and temperature grades
- Design with asynchronous interface compatible with 32-bit MCUs

Volatile RAM Solutions for Industrial Motor Drives: FAST SRAM

Product images

Internal schematic and products



Key features

- FAST Asynchronous SRAM with ECC
  - 2Mbit to 16Mbit in density
  - Fast access times: 10 ns – 15 ns
  - Parallel asynchronous interface
  - Bus-width configurations: x8, x16 and x32
  - Wide operating voltage range: 1.8V - 5.0V
  - High reliability with on-chip ECC
  - Industrial and Automotive temperature grades

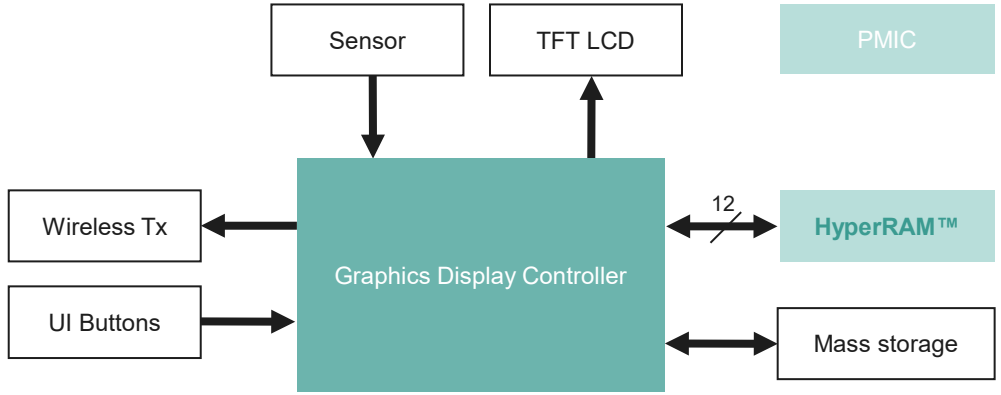
Benefits

- Achieve data throughput up to 3.2Gb/s with a fast, expansion RAM
- Ideal for systems requiring high-speed expansion RAMs for use as a scratch-pad memory to execute control algorithms
- Realize reliable systems with soft-error rates (SER) < 0.1 FIT/Mbit
- Support wide operating voltages and temperature grades
- Design with asynchronous interface compatible with 32-bit MCUs
- FAST asynchronous SRAMs with on-chip ECC have an optional PowerSnooze™ feature with a Deep-Sleep mode to save on idle currents (IDS = 15µA) while operating at 10 ns access time

Volatile RAM Solutions for Industrial HMI Systems: HyperRAM™

Product images

Internal schematic and products



Key features

- HyperRAM™
  - 64 Mbit to 128 Mbit in density
  - 200 MHz DDR, JEDEC-compliant (JESD251A) HyperBus™ and xSPI interface
  - Operating voltage support of 1.8 V and 3.0 V
  - High reliability with automotive AEC Q100 qualification
  - Industrial and Automotive temperature grades (up to 105 °C)
  - Provides Hybrid Sleep Mode, Deep Power Down Mode and Partial Memory Array Refresh to minimize power consumption

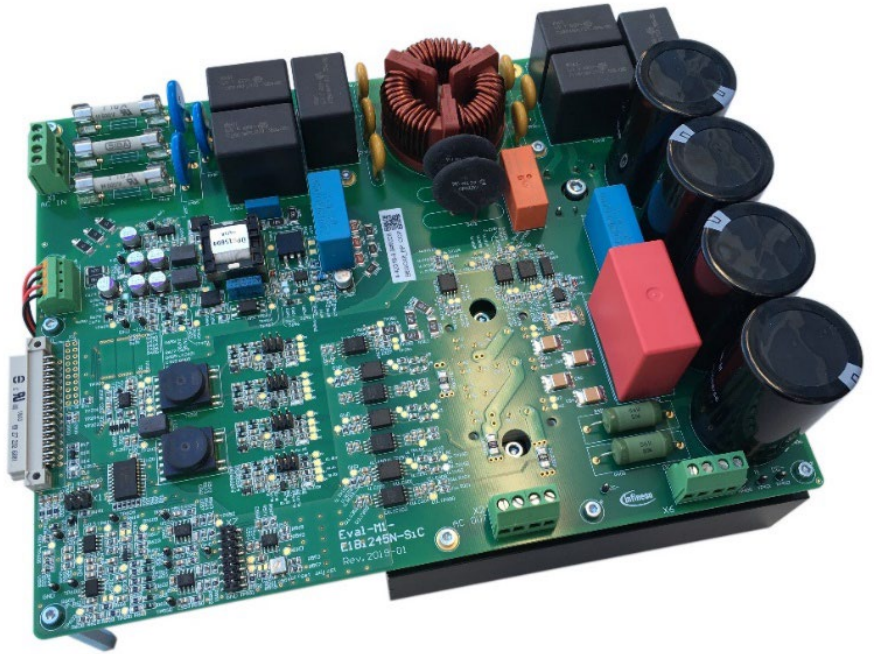
Benefits

- Achieve data throughput up to 3.2 Gb/s
- Ideal for systems requiring high-speed expansion RAMs for use as a display buffer for smooth graphics rendering
- Access both the HyperFlash™ and HyperRAM™ with only 11 control pins
- Support wide operating voltages and temperature grades
- Leverage HyperBus™ ecosystem to access IP for leading platforms

Application development support

Modular Application Design Kit (MADK) – CoolSiC™ MOSFET evaluation board for industrial drives

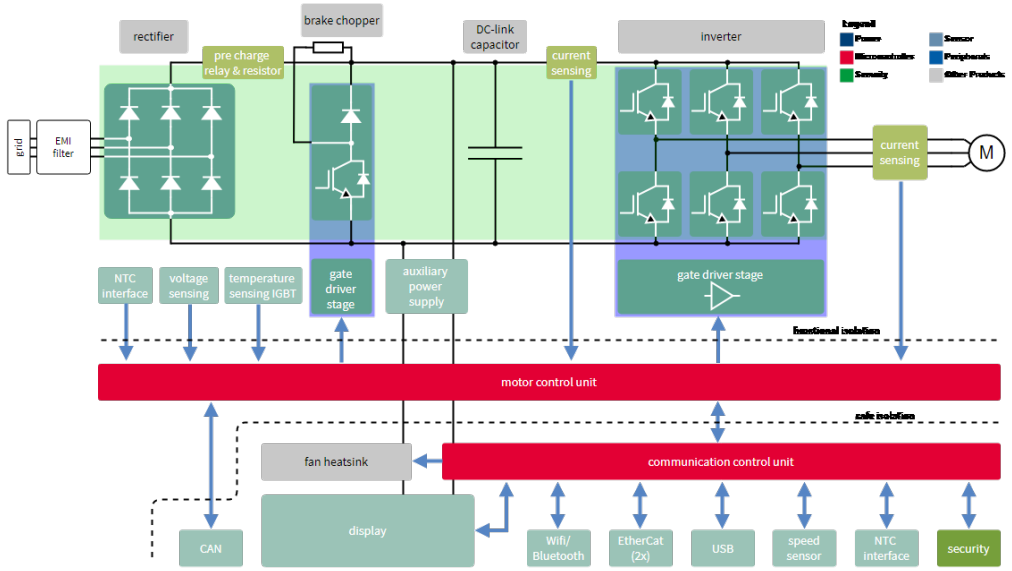
Parameters	Values	Conditions / Comments
Including FS45MR12W1M1_B11 and 1EDI20H12AH		
Input		
Voltage	340 – 480 V_{AC}	
Current	16 A_{rms}	Input 400 V_{AC}, Ta = 25 °C
DC bus voltage	530 V – 670 V typ.	
Switching frequency	18 kHz nom 100 kHz max	
Output		
3ph P_{out} with mains line choke	7.5 kW max	Input 400 V_{AC}, f_{sw} = 18 kHz, T_a = 25 °C, T_h = 70 °C, forced convection cooling
3ph P_{out} without mains line choke	6 kW	Input 400 V_{AC}, f_{sw} = 18 kHz, T_a = 25 °C, T_h = 70 °C, forced convection cooling, limited by input current
Current per leg at f_{sw_nom}	16 A_{rms}	Input 400 V_{AC}, f_{sw} = 18 kHz, T_a = 25 °C, T_h = 70 °C, forced convection cooling
Current per leg at f_{sw_max}	8 A_{rms}	Input 400 V_{AC}, f_{sw} = 100 kHz, T_a = 25 °C, T_h = 70 °C, forced convection cooling

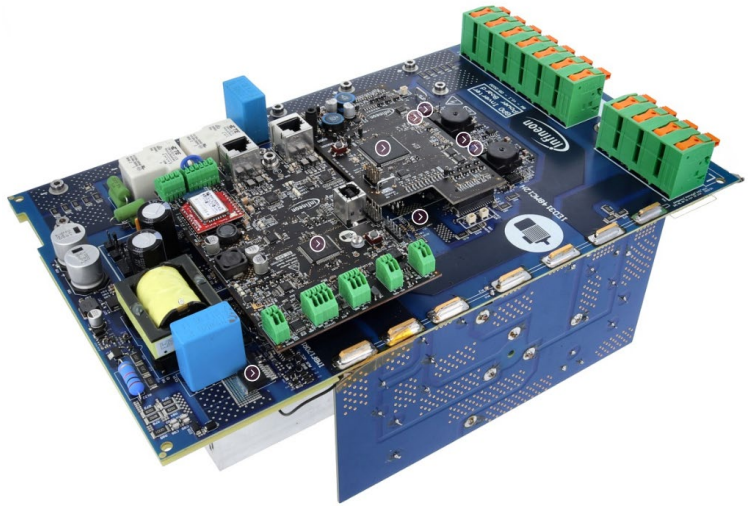


REF-22K-GPD-INV-Easy3B – General-purpose drive reference design

The reference design REF-22K-GPD-INV-EASY3B is an industrial motor drive for 3-phase 400 V AC grids and has a nominal power of 22 kW.

Product category	Product
IGBT Power Module	FP100R12W3T7_B11
Xensiv™ Current Sensor	TLI4971-A120T5
Gate Driver IC	1ED3131MC12H
1.7 kV SiC-MOSFET	IMBF170R1K0M1
Microcontroller	XMC4800-F144F2048





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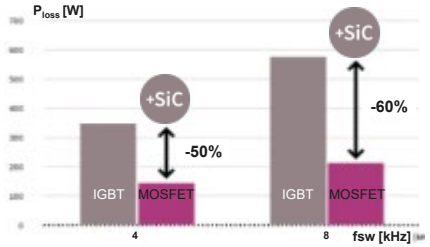
Benefits with SiC solutions for industrial drives

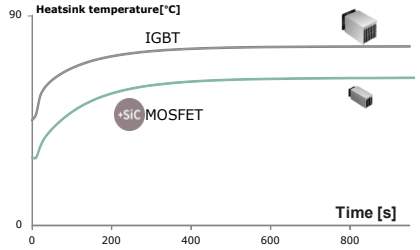
Increased performance

- Reduction of power losses lead to higher performance
- 60% reduction @ 8 kHz compared to IGBT-based



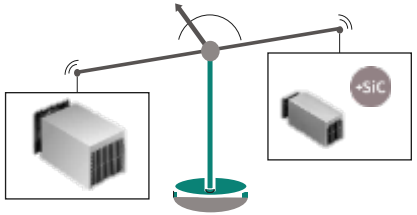
Higher robustness

- 10 K lower operating temperature of heatsink
- Cooling efforts significantly reduced



Higher power density and lower cost

- Heatsink can be reduced by 2/3 compared to IGBT
- Leads to a much higher system power density



Advantages of SiC

- Up to 80% of total loss reduction is enabled by more than 50% switching loss reduction
- 80% reduction of low current conduction loss by resistive behavior
- CoolSiC™ enables motor and drive integration and hence, reduces the complexity of cabling

CoolSiC™ MOSFET

- Enables new levels of power density and performance
- Highest thermal conductivity
- Simpler topologies possible
- Smaller device footprint

No more need for a cooling fan since passive cooling is sufficient, therefore reducing your maintenance effort to a minimum.

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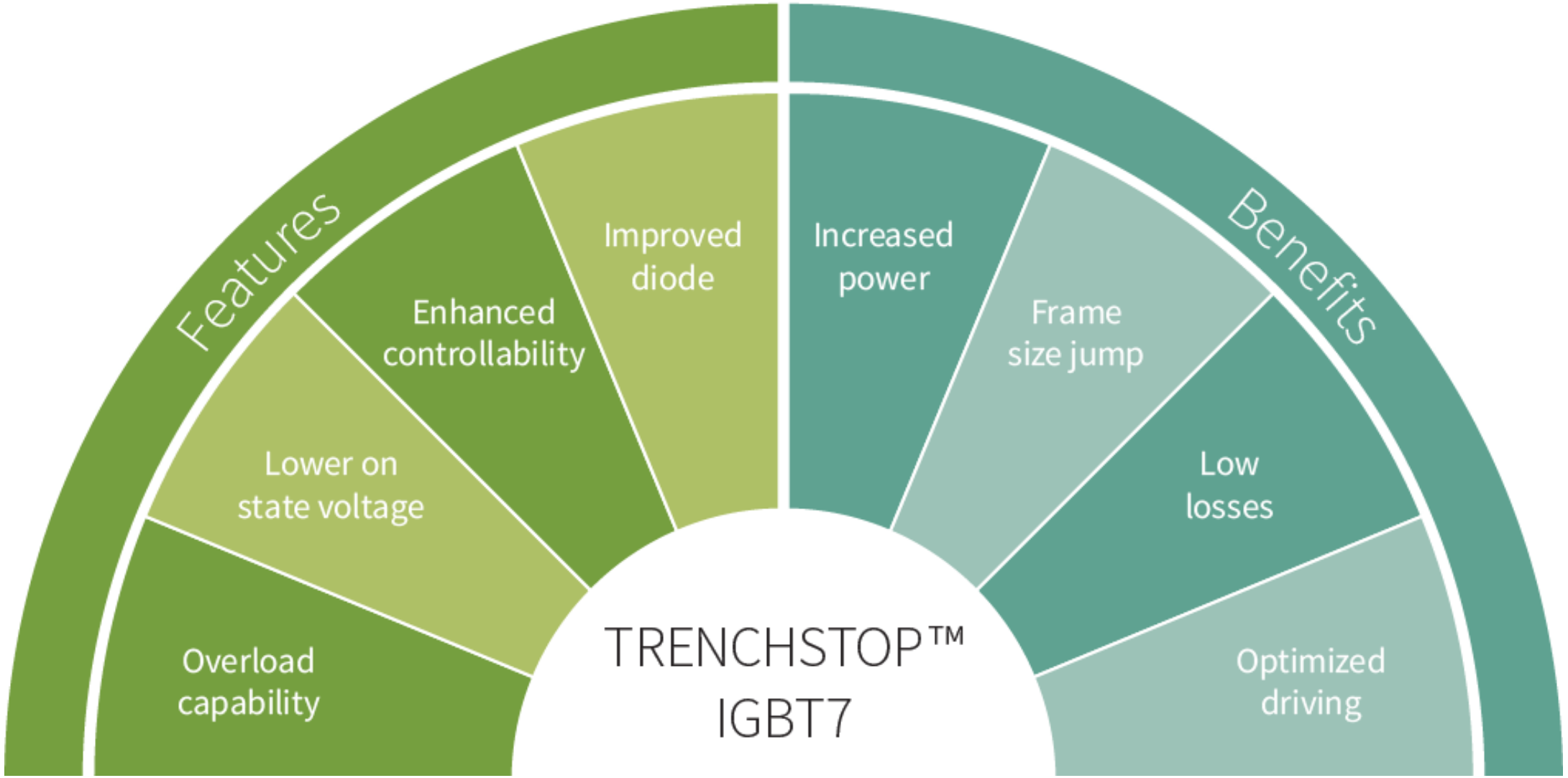
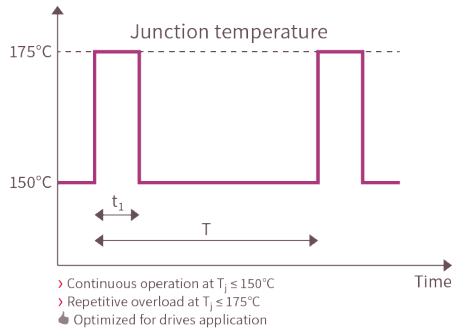
Features and benefits of TRENCHSTOP™ IGBT7



Technical features of TRENCHSTOP™ IGBT7

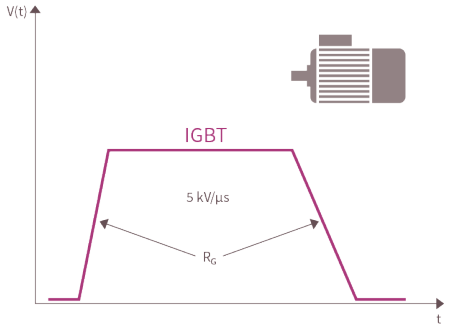
Overload capability

TRENCHSTOP™ IGBT7 allows a maximum junction temperature of 175°C where as TRENCHSTOP™ IGBT4 is limited to 150°C. It is beneficial for drives application due to the need of repetitive short overload operation.



Controllability

The TRENCHSTOP™ IGBT7 offers a high level of controllability to match the motor insulation requirements or EMI limitations. The controllability corresponds to the device's ability to vary the dv/dt by adjusting the value of the gate resistor (RG).

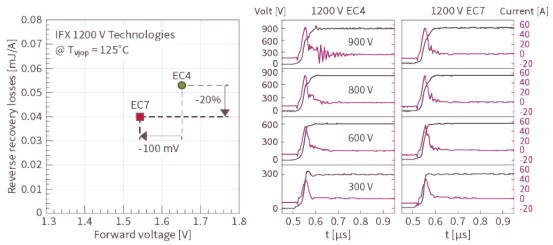


On state voltage

Compared to TRENCHSTOP™ IGBT4, IGBT7 lowers on-state voltage by around 20%. This brings a significant reduction in losses to target applications, especially to industrial drives, which usually operate with moderate switching frequencies.

Improved diode

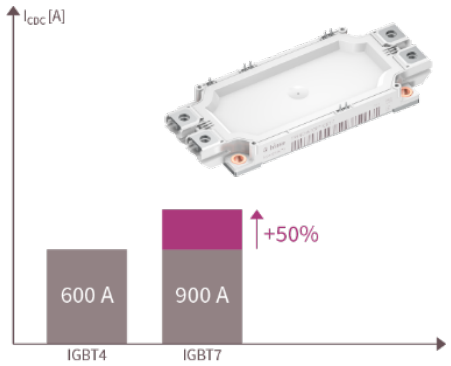
The EC7 emitter-controlled diode reduces the forward voltage by 100 mV relative to the previous generation EC4. This also lowers the reverse recovery losses. In addition, it improves softness, which benefits the inverter's EMI behavior.



Technical benefits of TRENCHSTOP™ IGBT7

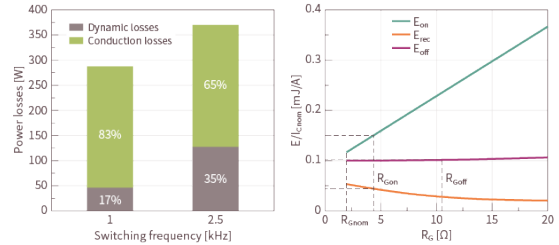
Increased power

The EconoDUAL™ 3 with TRENCHSTOP™ IGBT7 can reach up to 900 A. Benefit from higher inverter output current for the same frame size, reduced system cost by avoiding paralleling of modules.



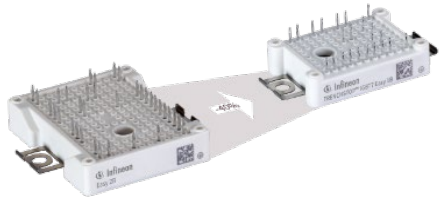
Low losses

The conduction losses at the given dv/dt limitation are significantly decreased. Moreover, there is a reduction in diode losses which leads to overall 15% lower power losses.



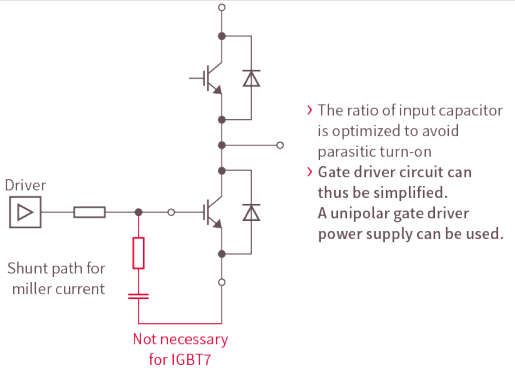
Frame size jump

An application example for general-purpose drives (GPD) compares modules built with IGBT4 and IGBT7 technologies. This illustrates how power density can be increased while lowering system cost.



Optimized driving

CGE and CGC are balanced to give the IGBT7 full control over the dv/dt, and to optimize the switching waveform. CGE is designed to avoid parasitic turn-on effects, zero voltage supply for turn-off is feasible (unipolar gate driver power supply).



Customer benefits of IGBT7 solutions

Plug and play

- Pin to pin compatibility with IGBT4 module
- Lower losses
- Higher robustness

Reduction of heatsink

- System cost saving
- Compact inverter design

Package Jump

- Cost saving on module side
- Compact inverter design
- Higher flexibility on inverter frame size
- Reduction of heatsink

Broad portfolio

- Will be available in a broad power range
- High volume production

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Key take-aways

Infineon offers optimized technologies

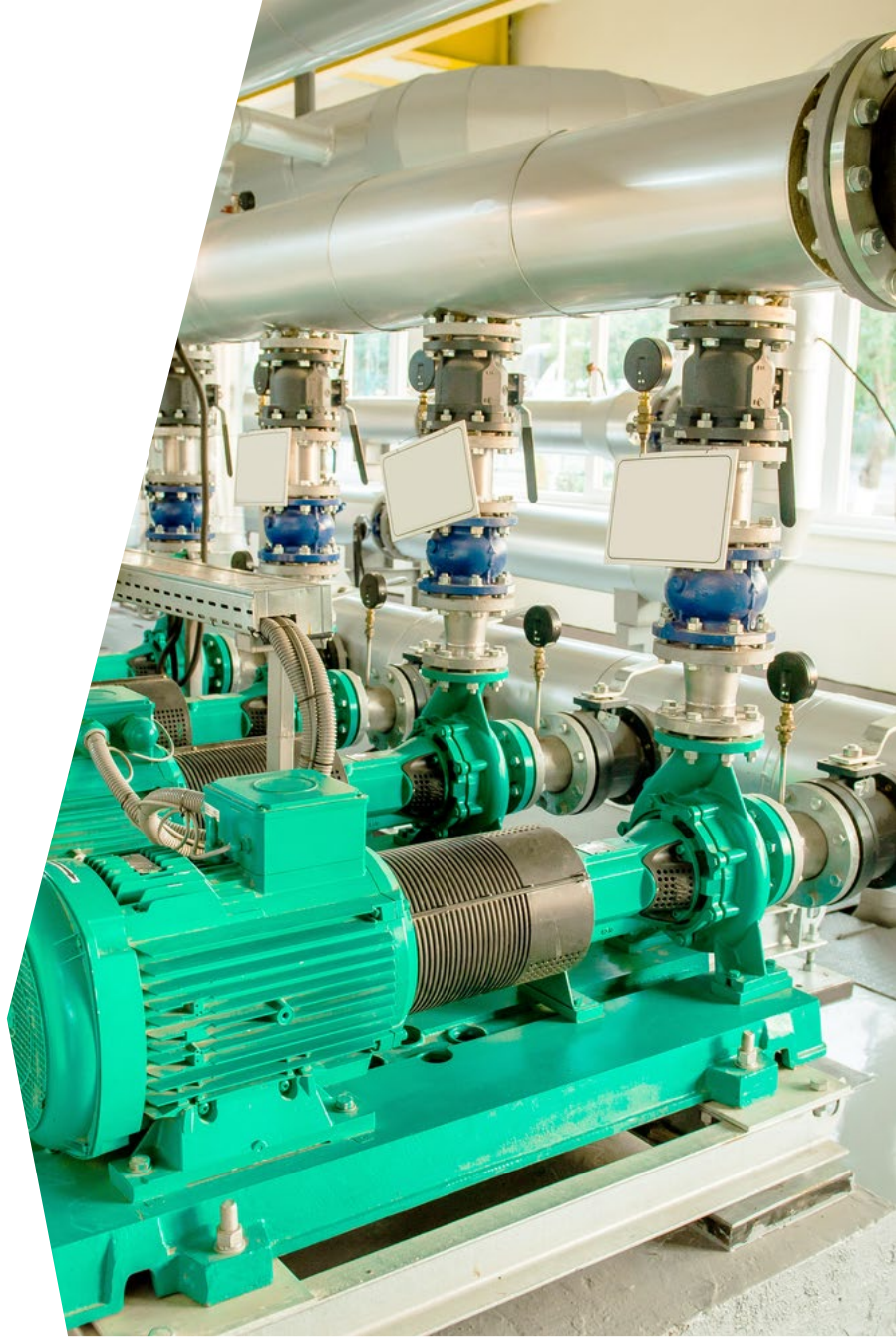
- IGBT7 perfectly matched to the needs of drives applications like overload and switching speed control
- SiC MOSFETs enabling a high degree of integration due to low losses

Infineon has a unique one shop offering for industrial drives

- The right fit package for the inverter in power range from a few Watt with IPM's and 100's of kilo Watt with EconoDUAL™ even up to Mega Watts and High Voltage with IHV & XHP™
- Gate Driver solutions with enhanced functionalities
- Current sensor solutions
- Peripherals like industrial interface IC's, security solutions and microcontrollers

Infineon is the right partner for customized solution and high-volume products

- With outstanding quality standards and production capability



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Useful information material and tools

Product page links

- CoolSiC™ MOSFETs
- TRENCHSTOP™ IGBT7
- CoolMOS™ MOSFETs
- CoolGaN™ HEMTs
- CIPOS™ IPM
- iMOTION™
- IGBT7 Discretes
- Easy power modules
- EconoPIM™ 2 & 3
- EconoDUAL™ IGBT modules
- EconoPACK™ 4
- PrimePACK™ IGBT modules
- 32-bit XMC™ microcontroller
- ISOFACE™ digital input ICs
- OPTIGA™ security solutions
- Magnetic sensors
- Current sensor
- EiceDRIVER™ gate driver
- External memory
- Wireless connectivity

Application pages

- Industrial Drives overview
- Induction motor
- Permanent magnet synchronized motor
- Servo motor
- Motor control for industrial automation
- Robotics

MADK

- iMOTION™ Modular Application Design Kit MADK

Online simulations

- IPOSIM
- Discrete IGBT Motor Drive Simulator
- IPM 3-phase Inverter Simulator

Online forums

- Silicon Carbide forum
- IGBT modules forum
- IGBT discretes forum


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