

# Smart, connected high-power pumps for Industry 4.0



인피니언 전력반도체 솔루션  
가상부스에 오신 걸 환영합니다!



# Enabling IoT solutions for Industry 4.0



**Security**  
Encrypting data  
transfer and protecting  
intellectual property



**Sensing**  
Collecting and  
generating  
data for the IoT



**Control**  
Interpreting the  
data and  
processing it



**Power**  
Smart actuating  
of devices



# Smart & connected high-power pump Industry 4.0



Life is easy when you only  
have one pump to worry about....

Source: publicdomainpictures.net

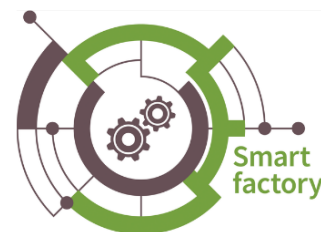
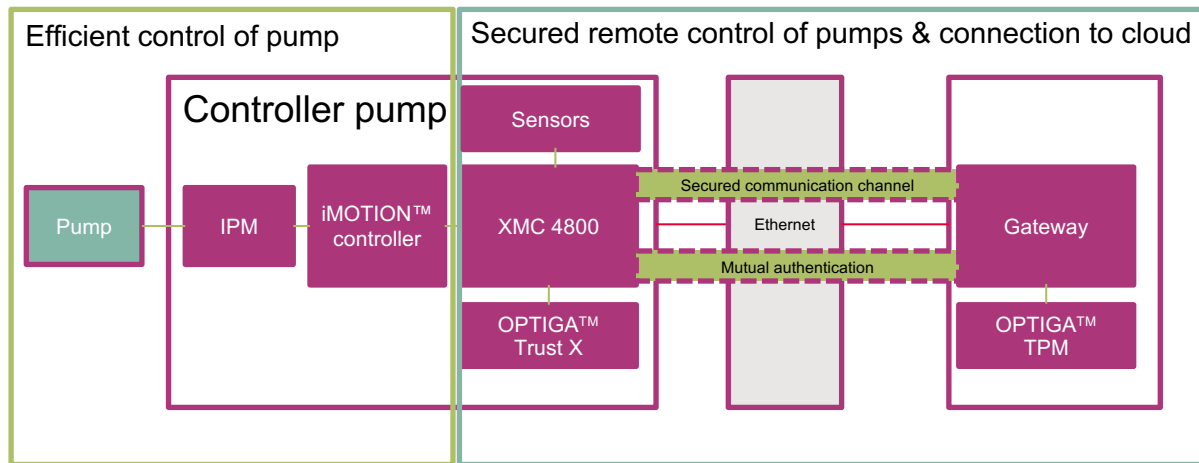


.... but what if your factory has 3000 pumps?



# Smart & connected high-power pump

## System overview



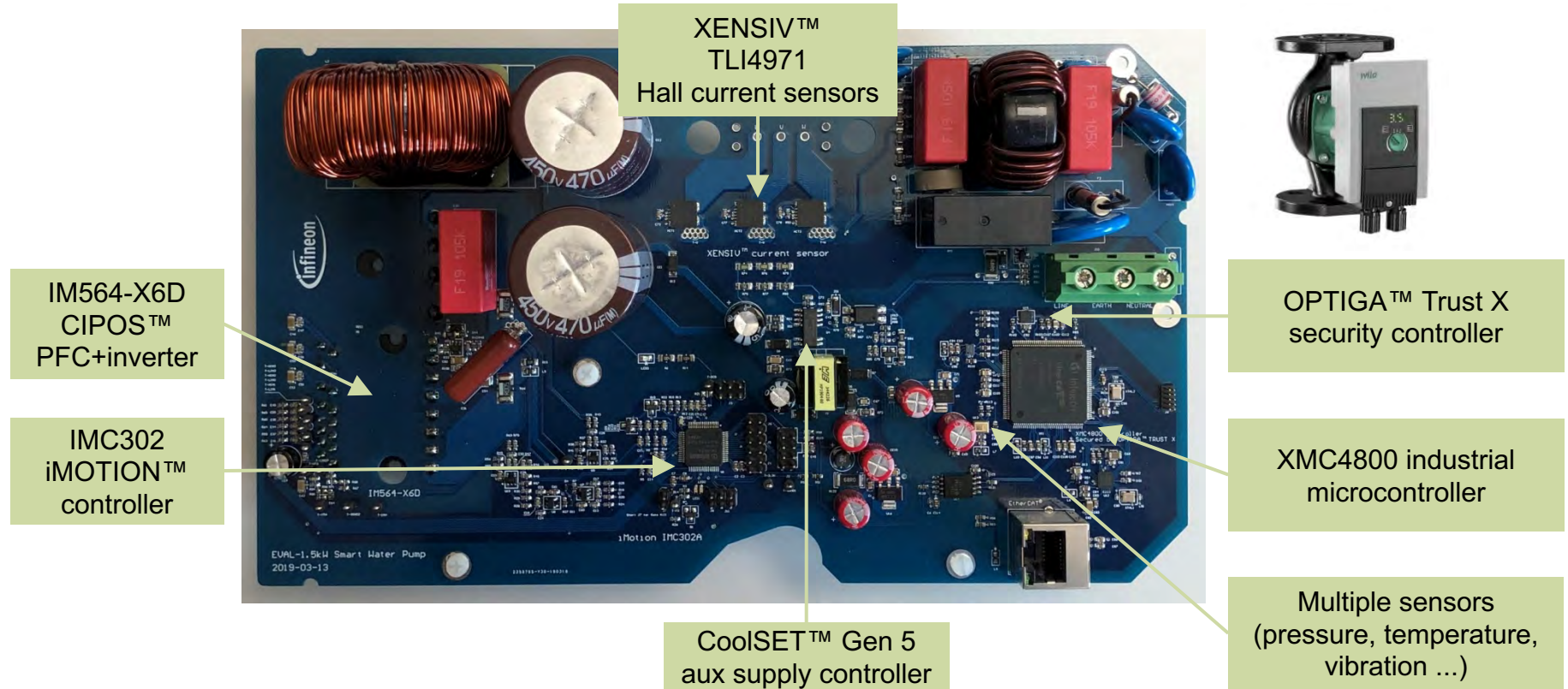
**Highest power density** and small system size

- › Full set of features and protective functions
- › **Smart and precise process control**
- › Highest energy efficiency

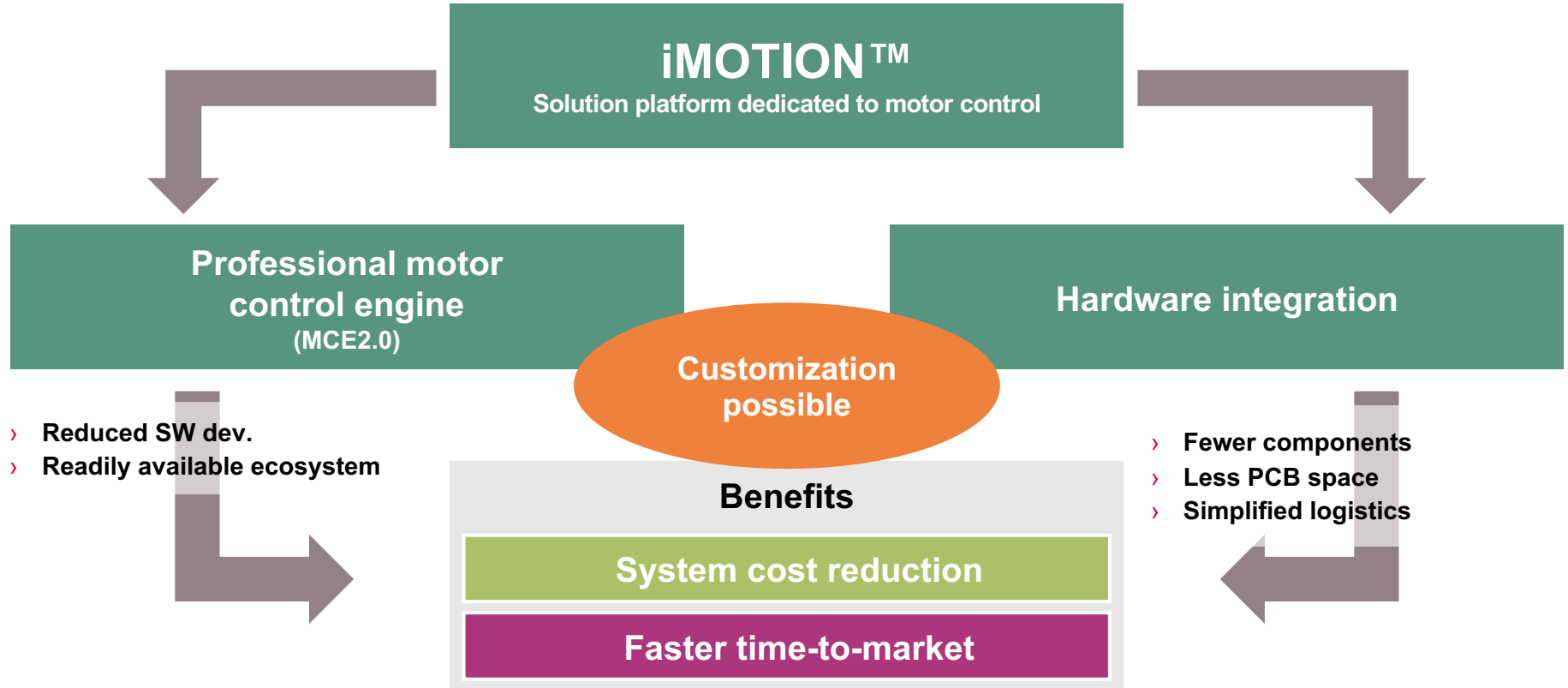
- › Full connectivity and communication
- › Full set of sensors
- › **Secured device ID and communication**
- › **Smart predictive maintenance**

- › **Full cloud integration**
- › Secure remote control and telemetry
- › **Secure integration** into factory environment
- › Big data processing for secure operation

# Reference design for smart connected pump Based on WILO Yonos Maxo 80 (1.6 kW)



# Smart & connected high-power pump iMOTION™ - next level of system integration



# Smart & connected high-power pump iMOTION™ - IMC102T-F064 controller



## Improving harmonic distortion with active power factor correction (PFC)

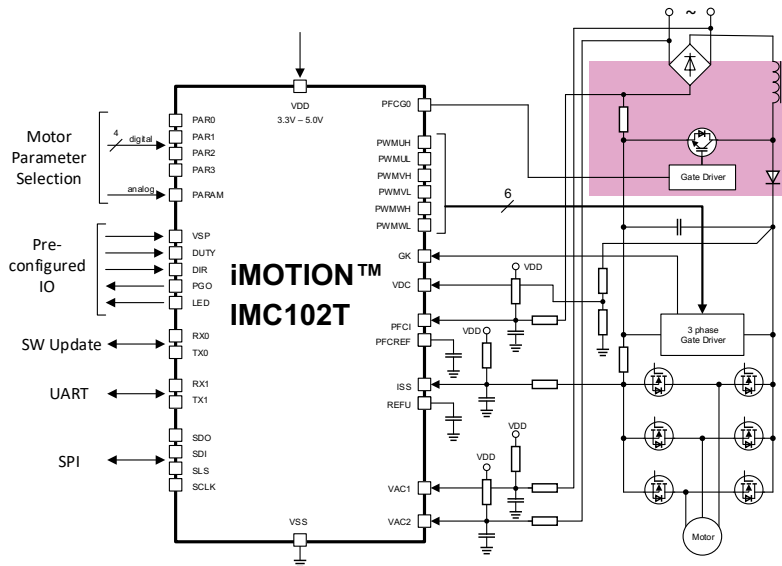
- › **Fully integrated boost PFC** independent of motor control
- › **Minimum solution cost:** No external op-amps + sensorless operation + single-shunt current measurement
- › **Highest efficiency** with space vector PWM + sinusoidal commutation
- › **Script interpreter** integrated for application flexibility in QFP-64 package

## Multi-motor support

- › Configurations stored in flash
- › Selectable via digital or analog inputs

## Flexible interfaces

- › Easy control via fixed functions
  - analog, pulse, direction, ...
- › Host interface via UART or SPI
  - motor control and reporting
  - PFC control
  - motor/PFC parameter update
  - control software update



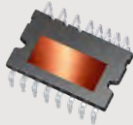
# Smart & connected high-power pump

## CIPOS™ Mini IPM: PFC-integrated IPM product family



### Key features

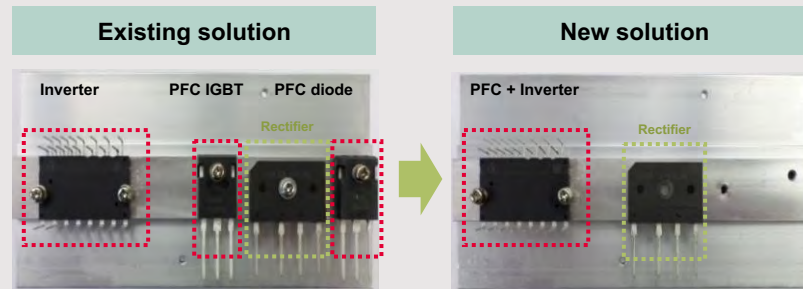
- › Dual in-line molded module with DCB substrate
- › Inverter + PFC in one package
- › Inverter current rating 10/15/20 A
- › Robust gate driver in SOI technology
- › Various PFC switches: IGBT or CoolMOS™
- › PFC switching frequency up to 150 kHz
- › PFC 650 V rating for CoolMOS™ / IGBT and diode
- › Customer can control switching speed of IGBT (open gate)
- › Power capability: 2 kW
- › UL-certified thermistor (85 kΩ)



### Typical applications



### Solution configuration on a heatsink



### Value proposition

- › Significant system size reduction with PFC integration into inverter module
- › Cost down due to lower BOM count and lower assembly cost
- › Smaller and cheaper heatsink
- › Customer can design switching performance of PFC IGBT by using external driver circuit



# Smart & connected high-power pump

## CIPOS™ Mini IPM: PFC-integrated IM564-X6D



### Package

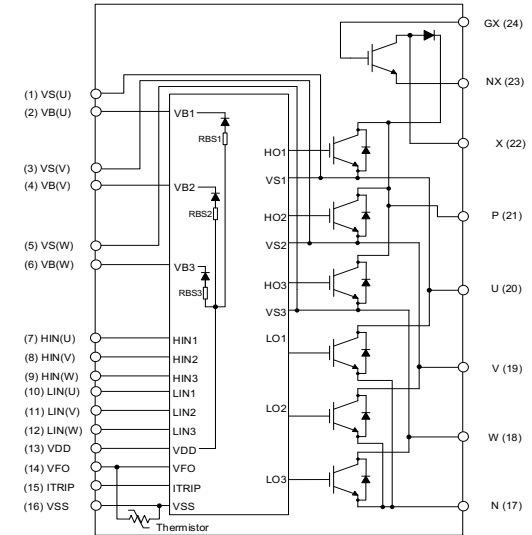
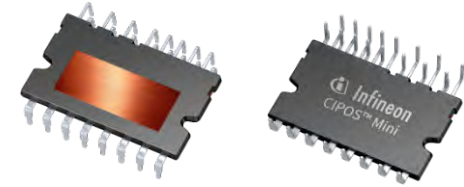
- › Fully isolated dual in-line molded module
- › Very low thermal resistance due to DCB substrate
- › Lead-free terminal plating; RoHS compliance

### Inverter

- › TRENCHSTOP™ IGBTs for inverter
- › Rugged SOI gate driver technology with stability against transient and negative voltages
- › Allowable negative  $V_S$  potential up to -11 V for signal transmission at  $V_{BS} = 15$  V
- › Integrated bootstrap functionality
- › Overcurrent shutdown
- › Built-in NTC thermistor for temperature monitor
- › Undervoltage lockout at all channels
- › Low-side common emitter
- › Sleep function
- › Fast-track shutdown
- › Cross-conduction prevention
- › All of 6 switches turn off during protection

### Power factor correction

- › CoolMOS™ Power MOSFET for PFC
- › Fast-switching emitter-controlled diode



# Smart & connected high-power pump

## XMC4800 industrial microcontroller

### SYSTEM PERFORMANCE

<b>ARM®</b> Cortex®-M4 @144 MHz	FPU	Programmable interconnect matrix	RTC
	DMA 12-ch	SysTick	CRC engine
	Flash (ECC) up to 2 MB	RAM up to 352 kB	Cache 8 kB

### Timers / PWM

4x PWM timers (CCU4) 16-64-bit, 4-ch	2x PWM timers (CCU8) 16-64-bit, 8-ch + dead time	2x POSIF (position interface)
---	--	----------------------------------

### Communication

6x CAN 256 MO	USIC 6-ch [SPI/dual SPI/quad SPI, SCI/UART, I²C, I³S]	<b>EtherCAT™</b>
10/100 Ethernet MAC (/w IEEE 1588)	USB (FS OTG)	SDIO/SD/MMC interface
External memory interface (EBU)		

### Analog

4x 8-ch, 12-bit ADC / 4 Msps	2x 12-bit DAC	4x $\Delta\Sigma$ demodulator
------------------------------------	------------------	----------------------------------

### Description

#### Application / target markets

- › Industrial control
- › Industrial communication
- › Transportation

#### A perfect combination for real-time control and industrial connectivity:

- › **ARM® Cortex®-M4 at 144 MHz**
- › **EtherCAT®**
- › Large on-chip memories **2 MB flash, 352 kB RAM**
- › **6 CAN nodes with 256 message objects**
- › Rich industrial and external media connectivity
- › **Safety package supporting SIL-2/3**
- › **125°C** extended temperature range
- › Long-term availability with >15 years
- › IEC 60730 class B-compliant LIB
- › Free DAVE™ IDE and DAVE™ Apps

### Packages



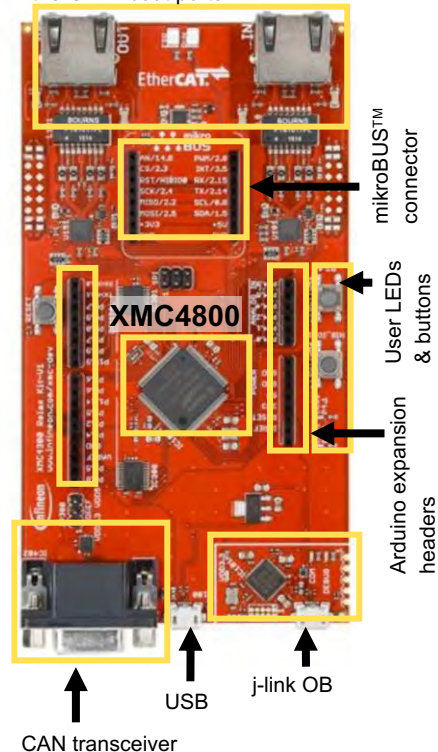
LQFP100  
LQFP144  
LFBGA196



...get more information...

### IoT connectivity kit

#### EtherCAT in/out ports

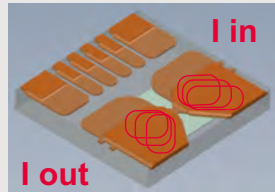


# Smart & connected high-power pump XENSIV™ magnetic current sensors

## Challenges of miniaturization

### Current handling

- › Balance current density with magnetic field strength



### Galvanic isolation

- › Isolation thickness vs. field strength
- › Mechanical stiffness



### Sensing

- › High accuracy
- › Stray field suppression
- › Robustness










## Minimum size combined with maximum accuracy



# Magnetic current sensor TLI4971

## Our magnetic current sensors in a nutshell

PRODUCTS							AEC Q100, UL Qualified Products
<b>XENSIV™ high-precision coreless current sensor TLI4971</b> Flexible, power-enhanced sensor for industrial applications							
HOW TO READ THE CURRENT SENSOR NOMENCLATURE							
<b>TLI</b> ↓	<b>49</b> ↓	<b>71</b> ↓	<b>-</b>	<b>A</b> ↓	<b>120</b> ↓	<b>T</b> ↓	<b>5</b> ↓
Target market:	Technology:	Family type:		Output/interface	Current range [A <sub>RMS</sub> ]:	Package denomination:	Accuracy:
<b>TLI</b> : Industrial	<b>49</b> : Hall	<b>71</b> : BW≤150 kHz		<b>A</b> : Analog	<b>120</b> : 0 A to ±120 A	<b>T</b> : TISON	<b>5</b> : 3%
KEY FEATURES AND BENEFITS							
<ul style="list-style-type: none"><li>› Measurement up to 70 ARMS at 690 VRMS within ±120 A FSR</li><li>› Typical error at 25°C &lt; 2 percent</li><li>› Current rail resistance specified at 225 µΩ typical</li><li>› Analog output signal with 120 kHz bandwidth</li><li>› Fast overcurrent detection up to 2 x measurement range</li><li>› Ultra-low power loss due to low resistance of current rail</li><li>› Reliable current measurement over lifetime (no re-calibration)</li><li>› Functional isolation for high-voltage applications</li><li>› Easy and compact package allows high power density designs</li></ul>							
USE CASES							
							

 A global support structure with magnetic current sensor experts to address customers' requirements



# Magnetic current sensor TLI4971

## Key features and benefits



Key features	Key benefits	Value
Magnetic coreless differential sensor	<ul style="list-style-type: none"><li>› No hysteresis</li><li>› Overload capability</li><li>› Stray field immunity</li><li>› Very low power dissipation</li><li>› Superior system accuracy</li><li>› Support for ISO61508 / ISO26262 requirements</li><li>› Easy system integration</li><li>› Protection capability for upcoming IGBT technologies</li></ul>	Improved system performance
Power package		Simplified layout, reduced design risk
Best-in-class temperature and lifetime accuracy		Support for upcoming power technologies
		Space and cost savings

# OPTIGA™ Trust X

## Fully featured device security solution



### Premium security

- › Based on CC EAL 6+ (high) certified security controller
- › DTLS/TLS support
- › X.509 certificate supported
- › TRNG AIS-31 certified
- › USB type C authentication supported
- › Cryptographic ToolBox for flexible customization

### Extended operating temperatures

- › -25 to +85°C
- › -40 to +105°C

### Extensive set of use cases

- › Mutual authentication
- › Secure communication
- › Data store protection
- › Lifecycle management
- › Power management
- › Secure update
- › Platform integrity protection

### Easy to integrate

- › Full turnkey solution
- › Customer-specific public key system provided
- › Host code provided
- › Evaluation kit



### Product details (SLS 32AIA)

Set-up	Turnkey	Interface	I <sup>2</sup> C
Data store	10 kB	Interface speed	1 Mbit/sec
Cryptography	ECC, AES, SHA2	Package	USON-10
Available	now	Size	3 x 3 mm

# OPTIGA™ Trust X is the optimized solution for IoT security



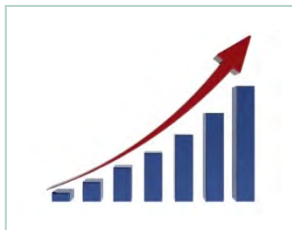
## Reduced effort for faster time-to-market

The turnkey product is easy to integrate and work with, reducing your design effort for faster time-to-market.



## Protection

The best-fit security solution for IoT devices, this product protects your business as well as your customers' data and IP.

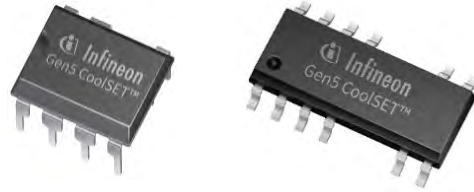
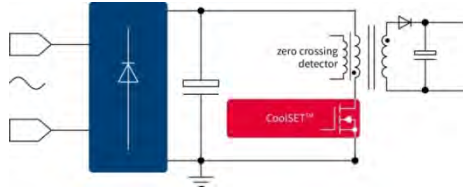


## Differentiation

The product enables new features and business models that empower you to differentiate your offering, stay ahead of the competition and grow.

# Smart & connected high-power pump

## CoolSET™ Gen5 – Aux. power for industrial applications



### Key value proposition

- › Choice of quasi-resonant or fixed frequency (100 kHz & 125 kHz) switching scheme
- › Robust line input and pin protection against fault conditions
- › Support for both DCM and CCM operation with integrated slope compensation
- › High degree of integration with integrated error amplifier for non-isolated design
- › Highest power delivery of up to 43 W with 800 V integrated MOSFET

### Target applications

- › Auxiliary supply circuit in industrial applications (pumps, fans, GPD, robotics, ...)
- › Adapters, settop boxes, water purifiers & POE
- › Auxiliary power supply for major home appliances, audio & metering systems, telecom devices & servers

### Availability

- › Integrated with either 700 V or 800 V MOSFET in DIP or SMD package
- › More information → <http://www.infineon.com/CoolSET>





Part of your life. Part of tomorrow.