

Bosch Semiconductors

Bosch Mobility Solutions

Sensors, System ICs and IP modules –
Autumn 2018



BOSCH

Invented for life

Smart and innovative components for new market requirements



ABOUT THIS CATALOG

This catalog shows our current range of electronic components and IP modules for automotive applications.

Bosch offers MEMS sensors, application-specific ICs and IP modules, based on almost half a century of experience. We stand for future innovative technologies – driven by customer-specific requirements.

That's what makes us proud: We are the largest manufacturer of micromechanical sensors, one of the biggest semiconductor makers for mobility solutions and one of the IP module drivers.

Our worldwide customer base includes OEMs, many well-known ECU producers in the mobility sector, and Bosch internal customers.

So whenever you design advanced safety and comfort systems or highly efficient powertrain electronics systems, contact us to benefit from our smart and innovative portfolio.

ABOUT OUR PRODUCTS

MEMS sensors (micro electro-mechanical systems) are a key technology for the mobile and connected world. Bosch has been at the forefront of MEMS technology for more than 20 years now and is today the world's leading supplier. Bosch MEMS sensors deliver high performance, are small, sturdy, and extremely cost-effective due to high volume series production.

Modern types of vehicles include a number of electronic control units. The integrated circuits (ICs) are an essential component of such units. The ICs interact with one another in the system and ensure movement, information and safety. As one of the first suppliers, Bosch began with the development and production of such sophisticated integrated circuits as early as the 1960s. Bosch ICs are customized for specific applications in the vehicle system (= application-specific ICs).

IP stands for intellectual property. IP modules allow chipmakers to quickly adopt complete ranges of functions in standard products such as microcontrollers, FPGAs and ASSPs, thus significantly reducing development times and costs. That is, they represent an assembly plan to implement these functions in hardware. Typical applications include e.g. control units for engine, transmission and safety systems.










ABOUT OUR KEY VISUAL

We at Bosch Automotive Electronics create products that offer significant benefits for our customers:

- ▶ Electronic components and control units for automotive applications
- ▶ Electric drive systems for Light eMobility
- ▶ Electronic components and systems for mobile devices, wearables and IoT
- ▶ Electronic components for Industry 4.0

Our robust and reliable electronic products help to make the world around us safer, cleaner and more enjoyable.

CUSTOMER BENEFITS

- | | |
|---|---|
|  Supports connectivity |  Inventive product |
|  Helps to save resources |  Helps to save lives |
|  Cost saving solution |  Secure communication |
|  For more driving fun | |
|  For more fun to play |  Supports fitness, vitality and well-being |



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Airbag systems

Acceleration sensors

Acceleration sensors in airbag systems measure strong negative acceleration values in fraction of a second. Depending on the airbag system and the number of existing airbags, our custom-

ers can install the MEMS sensors in the ECU or as a standalone component in the vehicle's front or side (satellite sensor).



HIGH-G SINGLE AXIS ACCELERATION SENSORS



Type	Product	Range [g]	Output	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Single axis (a _y)	SMA682	±120/240/480	PSI5, 10bit	7	4.5 – 11	-40	125	SOIC8n
Single axis (a _z)	SMA684	±120/240	PSI5, 10bit	7	4.5 – 11	-40	125	SOIC8n
Single axis (a _z)	SMA694	±480	PSI5, 10bit	7	4.5 – 11	-40	125	SOIC8n
Single axis (a _y)	SMA750	±120/240/480	PSI5, 10bit or 14bit	7	4.5 – 11	-40	125	SOIC8n
Single axis (a _z)	SMA751	±120/240/480	PSI5, 10bit or 14bit	7	4.5 – 11	-40	125	SOIC8n
Single axis (a _x)	SMA755	±240/480	PSI5, 10bit or 14bit	7	4.5 – 11	-40	125	SOIC8n
Single axis (a _x)	SMA758	±120/240/480	PSI5, 10bit or 14bit	7	4.5 – 11	-40	125	SOIC8n
Single axis (a _x)	SMA780	±120/240/480	PSI5, 10bit or 14bit	7	4.5 – 11	-40	125	LGA SiP
Single axis (a _z)	SMA781	±120/240/480	PSI5, 10bit or 14bit	7	4.5 – 11	-40	125	LGA SiP
Single axis (a _x)	SMA790	±240/480	PSI5, 10bit or 14bit	7	4.5 – 11	-40	125	LGA SiP

HIGH-G DUAL AXIS ACCELERATION SENSORS



Type	Product	Range [g]	Output	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Dual axis (a _{xz})	SMB200	±4.8	SPI, 10bit	9	3.3–5	–40	105	SOIC16w
Dual axis (a _{xy})	SMA660	±120	SPI, 12bit	5	3.3 or 5	–40	125	SOIC8n
Dual axis (a _{xz})	SMA665	±120	SPI, 12bit	5	3.3 or 5	–40	125	SOIC8n
Dual axis (a _{xz})	SMA720	±128 (a _x) ±32 (a _z)	SafeSPI, 32bit	5 (a _x) 7 (a _z)	3.3, 5 or 6.7	–40	125	SOIC8n
Dual axis (a _{xy})	SMA760	±128	SafeSPI, 32bit	5	3.3, 5 or 6.7	–40	125	SOIC8n
Dual axis (a _{xy})	SMA685	±120/240/480	PSI5, 10bit	7	4.5–11	–40	125	SOIC8n
Dual axis (a _{xz})	SMA686	±120/240	PSI5, 10bit	7	4.5–11	–40	125	SOIC8n
Dual axis (a _{xz})	SMA696	±480	PSI5, 10bit	7	4.5–11	–40	125	SOIC8n
Dual axis (a _{xy})	SMA752	±120/240/480	PSI5, 10bit or 14bit	7	4.5–11	–40	125	SOIC8n
Dual axis (a _{xz})	SMA753	±120/240/480	PSI5, 10bit or 14bit	7	4.5–11	–40	125	SOIC8n
Dual axis (a _{xy})	SMA757	±240/480	PSI5, 10bit or 14bit	7	4.5–11	–40	125	SOIC8n
Dual axis (a _{xy})	SMA773	±30/60	PSI5, 10bit or 14bit	7	4.5–11	–40	125	SOIC8n
Dual axis (a _{xz})	SMA774	±30/60	PSI5, 10bit or 14bit	7	4.5–11	–40	125	SOIC8n
Dual axis (a _{xy})	SMA777	±30/60	PSI5, 10bit or 14bit	7	4.5–11	–40	125	LGA SiP
Dual axis (a _{xz})	SMA778	±30/60	PSI5, 10bit or 14bit	7	4.5–11	–40	125	LGA SiP
Dual axis (a _{xy})	SMA782	±120/240/480	PSI5, 10bit or 14bit	7	4.5–11	–40	125	LGA SiP
Dual axis (a _{xz})	SMA783	±120/240/480	PSI5, 10bit or 14bit	7	4.5–11	–40	125	LGA SiP
Dual axis (a _{xy})	SMA792	±240/480	PSI5, 10bit or 14bit	7	4.5–11	–40	125	LGA SiP

Airbag systems

Angular rate sensors

Roll-over sensors (also known as RoSe sensors) are a kind of yaw-rate sensor. As part of the airbag system, the Bosch MEMS sensors immediately recognize change in a car's inclination – for instance, when there is risk of roll-over. This allows protective

seat-belt pretensioners, head and side airbags and roll-over bars to be activated before the vehicle's roof or side hits the ground.



ANGULAR RATE SENSORS FOR ROLLOVER SENSING



Type	Product	Range [°/s]	Output	Sensitivity	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Angular rate sensor (Ω_x)	SMG101	±240	SPI (open)	2 LSB/°/s	±7	5	-40	105	SOIC16w
Angular rate sensor (Ω_x)	SMG102	±240	SPI (Bosch)	2 LSB/°/s	±7	3.3	-40	105	SOIC16w
Angular rate sensor (Ω_x)	SMG103	±300	SPI (Bosch)	1.6 LSB/°/s	±7	5	-40	105	SOIC16w

Other configurations are possible on customer demand.

COMBINED INERTIAL SENSOR FOR ROLLOVER SENSING



Type	Product	Range	Output	Sensitivity	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Angular rate sensor (Ω_x) and single axis acceleration sensor (a_z)	SMI720	±300°/s ±5 g	SPI	100 LSB/°/s 5,000 LSB/g	±5 ±6	3.3	-40	105	BGA64

Driver information systems

Sensors for motion detection

Vehicle comfort features like navigation, tilt or inclination measurement, telematics, car key modules, car alarm or eCall systems are a rapidly growing field of application for MEMS sensors. Typically, the required performance level for these MEMS sensors is lower compared to sensors for sophisticated safety applications like airbag or vehicle stability systems.

Therefore, Bosch developed the concept for a new set of cost efficient MEMS sensors for motion detection in comfort applications.



ACCELERATION SENSOR FOR NON-SAFETY APPLICATIONS



Type	Product	Range [g]	Output	Sensitivity	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Tri-axis acceleration sensor (a _{xyz})	SMA130	±2 ±4 ±8 ±16	SPI, I ² C 14 bit	4,096 2,048 1,024 512	±4	1.62–3.6	–40	85	LGA12
Tri-axis acceleration sensor (a _{xyz})	SMA131	±2 ±4 ±8	SPI, I ² C 14 bit	4,096 2,048 1,024	±4	1.62–3.6	–40	85	LGA12

ANGULAR RATE SENSOR FOR NON-SAFETY APPLICATIONS



Type	Product	Range [°/s]	Output	Sensitivity [°/s]	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Tri-axis angular rate sensor (Ω _{xyz})	SMG130	±125 ±250 ±500 ±1,000 ±2,000	SPI, I ² C 16 bit	262.4 131.2 65.6 32.8 16.4	±1	2.4–3.6	–40	85	LGA16

Driver information systems

Sensors for motion detection



COMBINED INERTIAL SENSOR FOR NON-SAFETY APPLICATIONS



Type	Product	Range (switchable)	Output	Sensitivity Gyroscope [LSB/°/s]	Sensitivity Accelerometer [LSB/g]	Tolerance Gyroscope [%]	Tolerance Accelerometer [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Tri-axis angular rate sensor (Ω_{xyz}) and tri-axis acceleration sensor (a_{xyz})	SMI130	±125°/s, ±250°/s, ±500°/s, ±1,000°/s, ±2,000°/s ±2g ±4g ±8g ±16g	SPI, I ² C 16 bit (Ω) 142 bit (a)	262.4 131.2 65.6 32.8 16.4	1,024 512 256 128	±1	±4	2.4–3.6	-40	85	LGA16
Tri-axis angular rate sensor (Ω_{xyz}) and tri-axis acceleration sensor (a_{xyz})	SMI230	±125°/s, ±250°/s, ±500°/s, ±1,000°/s, ±2,000°/s ±2g ±4g ±8g ±16g	SPI, I ² C 16 bit (Ω) 16 bit (a)	262.4 131.2 65.6 32.8 16.4	16,384 8,192 4,096 2,048	±1	±1.35	2.4–3.6	-40	85	LGA16

Engine management systems

Barometric pressure sensors

Bosch barometric pressure sensors are a key component in engine management for diesel and gasoline engines. They are designed to measure the current ambient pressure accurately and with low drift. Atmospheric pressure is a function of height above sea level as well as of weather conditions. The engine management system uses the sensor measurement

data to ensure the optimum air-fuel mixture, irrespective of whether the vehicle is traveling along a coastal road or a road up in the mountains. The benefit of this constant rebalancing of the mixture ratio is that it reduces fuel consumption as well as emissions of CO₂ and other pollutants.



PRESSURE SENSORS FOR DIESEL OR GASOLINE ENGINE MANAGEMENT

Type	Product	Range [kPa]	Output	Tolerance [over lifetime and temperature]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Barometric pressure sensor	SMP580	40–115	SPI 10, 12, 16 bit	≤1.0 kPa (pressure) ≤3 K (temperature)	3.3–5	–40	125	SOIC8

Seat comfort systems

Barometric pressure sensors

Bosch barometric pressure sensors are a key component for pneumatic seat applications. The sensor regulates the correct inflation of the air chambers in multi-contoured seats and ensures that the seat adapts to the anatomy and the individual requirements of the driver and front-seat passenger. Thus, form-adjustable lumbar support as well as adjustable

side bolsters on the backrest and seat area stabilize the vehicle occupants. A massage function can also be realized.

Particularly when driving on winding roads and on long trips, the barometric pressure sensors provide increased comfort and help reduce driver fatigue.



PRESSURE SENSOR FOR PNEUMATIC SEAT APPLICATIONS



Type	Product	Range [kPa]	Output	Tolerance [over lifetime and temperature]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Barometric pressure sensor	SMP580	60–165	SPI 10bit	≤1.5 kPa (pressure) ≤5K (temperature)	3.3–5	–40	125	SOIC8

Transmission control systems

Hydraulic pressure sensors

MEMS sensors for automatic transmission detect the oil pressure in the hydraulic actuators of the gearbox – with a very precise response time of less than a millisecond. This is crucial for fast and ultra-smooth shifting of gears. The Bosch medium

hydraulic pressure sensors are characterized by very high media resistance and durability due to their hermetically sealed metal housing.



PRESSURE SENSORS FOR TRANSMISSION CONTROL



Type	Product	Range [bar]	Output	Tolerance [% FS]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Hydraulic pressure sensor	SMP142	0.5–22	Digital (analog) 12 bit	1.2–1.8	5	–40	150	Hermetically sealed metal package
Hydraulic pressure sensor	SMP144	0.5–40	Digital (analog) 12 bit	1.2–1.8	5	–40	150	Hermetically sealed metal package
Hydraulic pressure sensor	SMP147	0.5–70	Digital (analog) 12 bit	1.2–1.8	5	–40	150	Hermetically sealed metal package

Vehicle dynamics control (VDC)

Inertial sensors

In vehicle dynamics systems, MEMS sensors measure the vehicle rotation around the vertical axis and the lateral acceleration. This is essential to determine the dynamic state of the vehicle and to check the plausibility of the rotation rate signal.

Our inertial sensors combine both functions in one single housing.



COMBINED INERTIAL SENSORS FOR VDC



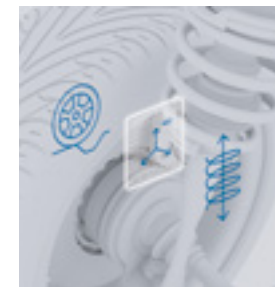
Type	Product	Range	Output	Sensitivity	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Angular rate sensor (Ω_z) and dual axis acceleration sensor (a_{xy})	SMI700	$\pm 300^\circ/\text{s}$ $\pm 5\text{g}$	SPI, PSI5, CAN	100 LSB/ $^\circ/\text{s}$ 5,000 LSB/g	± 3 ± 3	3.3 or 5	-40	125	BGA64
Angular rate sensor (Ω_x) and dual axis acceleration sensor (a_{yz})	SMI710	$\pm 300^\circ/\text{s}$ $\pm 5\text{g}$	SPI, PSI5, CAN	100 LSB/ $^\circ/\text{s}$ 5,000 LSB/g	± 3 ± 3	3.3 or 5	-40	125	BGA64
Dual angular rate sensor (Ω_{xz}) and tri-axis acceleration sensor (a_{xyz})	SMI860	$\pm 300^\circ/\text{s}$ $\pm 6\text{g}$	SafeSPI	100 LSB/ $^\circ/\text{s}$ 5,000 LSB/g	± 3 ± 3	3.3, 5 or 6.7	-40	125	BGA64

Active suspension systems

Acceleration sensors

Active suspension systems have an important impact on driving comfort and safety. They are based on low-g acceleration sensors that precisely record the dynamics of the chassis and body even under harsh conditions. Thus, the ECU regulates suspension damping and reduces body movement to make

driving safer and more comfortable. The braking distance is shortened and the danger of a rollover is reduced. Also, the vehicle's occupants experience higher driving comfort and less chassis movement.



LOW-G ACCELERATION SENSORS FOR VIBRATION CONTROL



Type	Product	Range [g]	Output	Sensitivity [LSB/g]	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Single axis (a _y)	SMB431, SMB437	1.6	PSI5	300	±5	5–11	–40	125	SOIC14n
Single axis (a _x)	SMB433	16	PSI5	30	±6	5–11	–40	125	SOIC14n

LOW-G ACCELERATION SATELLITE SENSORS FOR VIBRATION CONTROL



Type	Product	Range [g]	Output	Sensitivity [LSB/g]	Tolerance [%]	V _{DD} typ. [V]	T _{min} [°C]	T _{max} [°C]	Package
Single axis (a _y)	PSS1.31	1.6	PSI5	300	±5	5–11	–40	125	Details upon request
Single axis (a _x)	PSS1.33	16	PSI5	30	±6	5–11	–40	125	Details upon request

SYSTEM ICS FOR VARIOUS AIRBAG SYSTEM CONFIGURATIONS



Application	Product	V _{DD} typ. [V]	V _{VZP} typ. [V]	V _{VER} typ. [V]	Peripheral sensor interfaces	Analog interfaces	Interfaces	Firing loops	Features	T _{j min} [°C]	T _{j max} [°C]	Package
Single-chip integrated airbag system	CG903	3.3	14	23.75 or 33 (programmable)	4×PSI5 (V1.3)	10×AIN 2×AIO	SPI, 32 bit (3.3V), K-Line/LIN	12×5 firing modes (incl. 1.2A, 1.75A and LEA)	See CG904	-40	150	TQFP128_ePad
Single-chip integrated airbag system	CG902	3.3	14	23.75 or 33 (programmable)	2×PSI5 (V1.3)	10×AIN 2×AIO	SPI, 32 bit (3.3V), K-Line/LIN	8×5 firing modes (incl. 1.2A, 1.75A and LEA)	See CG904	-40	150	TQFP128_ePad
Single-chip integrated airbag system	CG912	3.3	14	23.75 or 33 (programmable)	2×PAS	4×AIN 2×AIO	SPI, 32 bit (3.3V), K-Line/LIN	4×5 firing modes (incl. 1.2A, 1.75A and LEA)	See CG904	-40	150	TQFP64_ePad

Airbag systems

Sensor interfaces

Digital interfaces connect peripheral sensors to the control unit. They provide supply power to the sensors and transfer the sensor readings to the microcontroller.



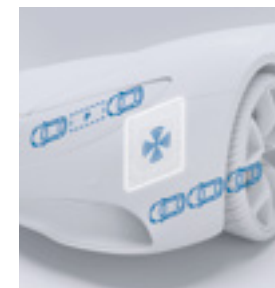
SENSOR SUPPLY AND DATA TRANSMISSION FOR DIGITAL PERIPHERAL SENSORS WITH PSI5 INTERFACE (V1.3)

Application	Product	Inputs	Peripheral sensor interfaces	Interfaces	Features	$T_{j\ min}$ [°C]	$T_{j\ max}$ [°C]	Package
2 channel PSI5 receiver	CF190	$V_{ER\ typ.}: (V_{AS} + 3.5V) - 35V$ $V_{SYNC\ typ.}: (V_{AS} + 4.6V) - 35V$	2 × PSI5 (V1.3)	SPI (3.3V or 5V)	<ul style="list-style-type: none"> ▶ Max. 8 sensors ▶ Bidirectional communication ▶ Bosch AB, EM and Open SPI protocol ▶ Integrated monitoring of voltages and overtemperature ▶ Integrated diagnosis 	-40	150	LQFP32, QFN36 (on request)

Driver assistance systems

Ultrasonic transducer ICs

The transducer IC causes the transducer to send out ultrasonic waves, interprets the reflected signals and returns the measurement data to the park control unit.



ULTRASONIC TRANSDUCER DRIVER AND EVALUATION IC

Application	Product	V _{DD} typ. [V]	Interfaces	Inputs	Outputs	V _{PAX} max.	I _{PAX}	f _{send}	Features	T _{min} [°C]	T _{max} [°C]	Package
Transducer IC for ultrasonic parking aid sensors	CA270 for up to 2.5 m applications	7–18	Single-wire, bi-directional interface for ECU communication and end-of-line adjustment	Reflected signal from ultrasonic transducer	Predriver for ultrasonic transducer	25 V	200–500 mA (with external PNP)	48 kHz	<ul style="list-style-type: none"> ▶ 1-wire I/O interface ▶ Modes: send and receive, receive only ▶ Configurable transducer current source ▶ Configurable reference ultrasonic curve ▶ Continuous monitoring of transducer driver current ▶ Offset cancellation after power on ▶ Noise level estimation and compensation ▶ Storage capability by PROM and RAM ▶ Status information queries 	-40	100	QFN 5×5 (MLF28)
Transducer IC for ultrasonic parking aid sensors	CA271 for up to 4.0 m applications	See CA270	See CA270	See CA270	See CA270	See CA270	See CA270	See CA270	See CA270	-40	100	QFN 5×5 (MLF28)

Driver assistance systems

System basis ICs

The system basis IC for radar sensors provides an extremely clean supply voltage for the sensitive analog RF part. Separated outputs power all other system blocks. The inte-

grated CAN FD driver allows fast data exchange with other control units.



SUPER-LOW NOISE POWER SUPPLY FOR MONOLITHIC MICROWAVE INTEGRATED CIRCUIT (MMIC) RADAR TRANSCEIVERS



Application	Product	V _{DD} typ. [V]	Interfaces	Supply voltages	Outputs	Features	T _{j min} [°C]	T _{j max} [°C]	Package
System basis IC for radar ECUs	CS520	14/28	SPI, CAN FD	<ul style="list-style-type: none"> ▶ 3.3V/1.8A SMPS for microcontroller and bus transceivers ▶ 3.3V/1.8A low noise LR for MMIC analog radar components ▶ 3.3V/0.9A LR for MMIC digital radar components ▶ 5V/100mA switch for partial network transceivers 	<ul style="list-style-type: none"> ▶ Reset ▶ Battery voltage monitoring switch ▶ Battery voltage drop detection 	<ul style="list-style-type: none"> ▶ Designed for passenger car and commercial vehicle applications ▶ Suitable for systems up to ASIL C ▶ Voltage monitoring and overcurrent protection for all regulators ▶ SPI interface for control and diagnostics ▶ CAN FD driver (up to 5Mbit/s) 	-40	150	TQFP64_ePad

Engine management systems

System basis ICs, power supply ICs

Bosch system ICs for engine management systems combine the power supply with additional peripheral functions. Virtually all current microcontrollers are supported.



POWER SUPPLY WITH INTEGRATED CONTROL AND I/O FUNCTIONS, RPM SENSOR SUPPLIES AND INTERFACES

Application	Product	V _{DD} typ. [V]	Inter-faces	Supply voltages	Inputs	Outputs	Features	T _{j min} [°C]	T _{j max} [°C]	Package
System basis IC	CY327	14	SPI, 16 bit (3.3V) 1 × CAN 1 × LIN	<ul style="list-style-type: none"> ▶ System: 5V/450mA, 3.3V/300mA, 5 or 3.3V/250mA ▶ Core supply 0.9–1.525V/1.2A switch-mode ▶ Sensors: 3 × 5V 	<ul style="list-style-type: none"> ▶ Ignition ▶ 3 wake up pins ▶ Wake up on CAN 	<ul style="list-style-type: none"> ▶ Main relay control: 1 × LSPS 	<ul style="list-style-type: none"> ▶ Buck/boost pre-regulator switched mode supply for μC core voltage ▶ Advanced 3-level watchdog operating range 3V–40V ▶ Stop counter functions ▶ Very low quiescent current 	–40	150	QFP64_ePad or TQFP100_ePad
System basis IC	CY324	14	SPI, 16 bit (3.3V) 1 × CAN (up to 2Mbit/s) 1 × LIN	<ul style="list-style-type: none"> ▶ System: 5V/450mA, 3.3V/300mA, 5 or 3.3V/250mA ▶ Core supply 0.125–1.3V/1.2A switch-mode ▶ Sensors: 3 × 5V 	<ul style="list-style-type: none"> ▶ Ignition ▶ 3 wake up pins ▶ Wake up on CAN 	<ul style="list-style-type: none"> ▶ Main relay control: 1 × LSPS 	<ul style="list-style-type: none"> ▶ Buck/boost pre-regulator switched mode supply for μC core voltage ▶ Advanced 3-level watchdog operating range 3V–40V ▶ Stop counter functions ▶ Capacitive load up to 50 μF ▶ Extended soft start-up ▶ Very low quiescent current 	–40	175	Bare die, other packages on demand

Engine management systems

System basis ICs, power supply ICs



POWER SUPPLY WITH INTEGRATED CONTROL AND I/O FUNCTIONS, RPM SENSOR SUPPLIES AND INTERFACES



Application	Product	V _{DD} typ. [V]	Inter-faces	Supply voltages	Inputs	Outputs	Features	T _{j min} [°C]	T _{j max} [°C]	Package
System basis IC	CY320	14	1 × CAN 1 × ISO SPI, 16bit (5V)	<ul style="list-style-type: none"> ▶ System: 5V, 3.3V, 2.6V, 1.5V ▶ Sensors: 3 × 3.3/5V programmable 	<ul style="list-style-type: none"> ▶ Ignition ▶ Wake up 	<ul style="list-style-type: none"> ▶ Main relay control: 1 × LSPS 	<ul style="list-style-type: none"> ▶ 2 pre-regulator modes (switched, linear) ▶ Advanced 3-level watchdog ▶ μC-reset and system reset ▶ Stop counter functions 	-40	150	PSO36
Pre-regulator for 24V boardnet main relay substitute	CY141	24...42	SPI, 16bit (5V)	<ul style="list-style-type: none"> ▶ 5.5...14V 		<ul style="list-style-type: none"> ▶ 5 × gate control for ext. main relay switches ▶ 1 × main relay 	<ul style="list-style-type: none"> ▶ Adjustable step-up/step-down regulator ▶ Short circuit monitoring 	-40	150	PSO36

Engine management systems

Low-side power switches

Robust power stages for driving electric loads around the engine: injectors, igniters and other peripheral devices.



POWER STAGE ARRAYS WITH INTEGRATED MONITORING FUNCTIONS



Application	Product	V _{bat} typ. [V]	V _{DD} typ. [V]	Interfaces	Inputs	Outputs	Features	T _{j min} [°C]	T _{j max} [°C]	Package
18-fold low-side power switch	CJ950	14	5	μs bus	TTL/CMOS logic, withstands 36V permanently	4×0.6A/1,800mΩ/55V 10×2.2A/500mΩ/55V 2×3A/260mΩ/55V 2×8A/150mΩ/55V	<ul style="list-style-type: none"> ▶ Diagnosis: OL, SCG, SCB and OT ▶ 5V monitoring ▶ 2nd independent shut down path ▶ 2× lambda sensor heater 	-40	150	PSO36
18-fold low-side power switch	CJ945	14	5	SPI, μs bus	TTL/CMOS logic	4×1.1A/780mΩ/45V 6×2.2A/380mΩ/45V 6×2.2A/400mΩ/70V 2×3A/280mΩ/45V	<ul style="list-style-type: none"> ▶ Open-circuit detection ▶ Overtemperature detection 	-40	150	HIQUAD64
8-fold low-side power switch	CJ960	14		SPI, μs bus		4×3.0A/230mΩ/55V 2×1.0A/700mΩ/55V 2×1.0A/550mΩ/55V	<ul style="list-style-type: none"> ▶ Diagnosis: OL, SCG, SCB and OT <ul style="list-style-type: none"> - Flexible control by MSC or SPI - Multiple safety features - Separate shutdown path for OUT1-4 - Current limit or shutdown on overcurrent 	-40	140	TQFP64_epad

Engine management systems

A/D converters, sensor interfaces

The microcontroller of an engine control unit requires digital input data. A/D converters and RPM sensor interfaces

convert readings from analog sensors into machine-readable digital data.



READOUT OF RPM SENSORS



Application	Product	V _{DD} typ. [V]	Inputs	Interfaces	Features	T _{j min} [°C]	T _{j max} [°C]	Package
Single-channel rotation speed signal evaluation	CY30	5	1 × RPM sensor	Analog	<ul style="list-style-type: none"> ▶ Differential inputs ▶ Selectable thresholds ▶ Open drain output 	-40	150	SOIC8n

Engine management systems

Injection valve drivers

Injection valve drivers open and close the engine's injection valves, allowing to exactly dose the amount of injected fuel.



GASOLINE DIRECT INJECTION (GDI) VALVE DRIVERS FOR 4-CYLINDER ENGINES



Application	Product	V _{bat} typ. V _{DD} typ. [V]	Interfaces	Inputs	Outputs	Features	T _{j min} [°C]	T _{j max} [°C]	Package
6-fold GDI injector driver for external power stage and shunts	CY335	14 5	SPI	TTL/CMOS logic	2 × HSPS (battery) 2 × HSPS (booster) 6 × driver for external power stages	<ul style="list-style-type: none"> ▶ 1- or 2-bank operation, parallel and/or double injection mode ▶ DC/DC boost converter ▶ Diagnosis via SPI ▶ Current levels and boost voltage adjustable via SPI ▶ External power stages and shunts for maximum flexibility 	-40	150	TQFP64

Engine management systems

Ignition stage driver

Efficient combustion requires a strong ignition spark at the spark plug. Ignition stage drivers convert the microcontroller's output signal in a driver current for the ignition coil.



INVERTING DRIVERS FOR EXTERNAL IGNITION STAGES IN 4 CYLINDER ENGINES



Application	Product	V _{DD} typ. [V]	Channels	Interfaces	Features	T _{j min} [°C]	T _{j max} [°C]	Package
4-channel inverting driver for external ignition stages	CK240	5	4	SPI	<ul style="list-style-type: none"> ▶ Short-circuit protection ▶ Diagnosis ▶ Wiring diagnosis 	-40	150	Bare die or SOIC16w

Engine management systems

Oxygen sensor interfaces

The oxygen sensor (or lambda sensor) interface IC permanently controls the probe for precise operation and provides

the sensor's readings to the microcontroller within the engine control unit.



OXYGEN SENSOR CONTROL AND READOUT WITH INTEGRATED MONITORING FUNCTIONS



Application	Product	V _{bat} typ. [V]	V _{DD} typ. [V]	Inputs	Interfaces	Features	T _{j min} [°C]	T _{j max} [°C]	Package
Oxygen sensor control for Bosch, NTK & Denso oxygen sensors	CJ138	14	3/5	Oxygen sensor signals	SPI	<ul style="list-style-type: none"> ▶ See CJ136 ▶ Pin pointing diagnosis for detection of sensor wire harness failures 	-40	150	TQFP32ePad, QFN36 (on demand)
Oxygen sensor control for Bosch, NTK & Denso oxygen sensors	CJ136	14	3/5	Oxygen sensor signals	SPI	<ul style="list-style-type: none"> ▶ See CJ135 ▶ UART interface for cylinder imbalance measurement 	-40	150	TQFP32ePad, QFN36 (on demand)
Oxygen sensor control for Bosch, NTK & Denso oxygen sensors	CJ135	14	3/5	Oxygen sensor signals	SPI	<ul style="list-style-type: none"> ▶ Lambda measurement ▶ Probe temperature evaluation ▶ SPI programmable controls ▶ Diagnostic features ▶ Supports LSU5.2 / 4.9 / ADV (Bosch) ▶ Supports ZFAS-U2 / U3 (NTK) ▶ Supports Plus 5 / 6 (Denso) 	-40	150	TQFP32ePad, QFN36 (on demand)
Bosch oxygen sensor (LSU)	CJ125	14	5	Oxygen sensor signals	SPI	<ul style="list-style-type: none"> ▶ Lambda measurement ▶ Probe temperature measurement ▶ Programmable reference pump current ▶ Diagnostics ▶ Supports LSU5.2 / 4.9 / ADV / 4.2 (Bosch) 	-40	150	SOIC24w, LQFP32

Engine management systems

B6 bridge

Comfortable one-chip solution for driving 3 phase BLDC motors.



SMART BRIDGES FOR THROTTLE VALVE DRIVES, PUMPS AND OTHER MOTOR-DRIVEN ACTUATORS



Application	Product	V _{bat} typ. [V]	Interfaces	Features	T _{j min} [°C]	T _{j max} [°C]	Package
Monolithic B6 bridge for motors up to 60W	CJ260	4.5–28	SPI, direct inputs	<ul style="list-style-type: none"> ▶ R_{DSon max}: 540 mΩ (@3A_{RMS}, 150°C) ▶ I_{out max}: 3A_{RMS} ▶ f_{PWM max}: 20kHz ▶ Current limiter function ▶ Extensive protection features ▶ Diagnosis functions ▶ Suitable for systems up to ASIL-B 	-40	150	Power SS0-36

Engine management systems

B6 bridge pre-driver

Pre-driver for 3 phase BLDC motors with integrated shunt voltage reading option.



PRE-DRIVER FOR POWERMOS BRIDGES



Application	Product	V _{DD} typ. [V]	Interfaces	Inputs	Outputs	Features	T _{j min} [°C]	T _{j max} [°C]	Package
Pre-driver for PowerMOS B6- or H-bridges with integrated PWM generator	CY146	5	SPI, 16 bit (3.3 or 5V) for control and diagnosis	UBAT, VDD: 5V CLK	6 × HS-/LS-switch	<ul style="list-style-type: none"> ▶ V_{BATmax}: 60V ▶ V_{Gmax}: 10V, I_{Gmax}: 500mA ▶ C_{Gmax}: 10 nF ▶ f_{PWM_Out}: 250/125/63/31 kHz ▶ Low-Side / High-Side switch configurations with or without PWM control ▶ Monitoring for short-circuit, open load or overtemperature, charge pump voltage 	-40	150	LQFP44

Transmission control systems

System basis ICs

In transmission control systems, the system basis chipset provides the system power, disables the starter in case of gearbox malfunction and ensures proper system function by various monitoring routines. Current regulators set the

currents for magnetic oil valves rapidly and precisely to the desired value – crucial for fast and smooth gear shifting.



2-CHIP CONCEPT FOR HIGH SYSTEM SAFETY: POWER SUPPLY, STARTER RELAIS CONTROL AND VARIOUS I/O



Application	Product	V _{DD} typ. [V]	Interfaces	Supply voltages	Inputs	Outputs	Features	T _{j min} [°C]	T _{j max} [°C]	Package
Safety IC for transmission control units	CG135	14	SPI (3.3V)	UBAT	<ul style="list-style-type: none"> ▶ 3 × voltage monitoring channels ▶ 3 × speed sensor interface 	<ul style="list-style-type: none"> ▶ System reset ▶ Power control 	<ul style="list-style-type: none"> ▶ Complies with ISO26262:2011 for ASIL-D capability in combination with system basis ICs, solenoid drivers and high-side switches ▶ Flexible parameter configuration ▶ Diagnostic capability 	-40	150	TQFP32ePad QFN36 (on demand)
System basis IC combination	CG124 CG130	14	ISO/LIN SPI (5V)	3.3V, 5V, 9V, UBAT	<ul style="list-style-type: none"> ▶ 3 × speed sensor ▶ 4 × position sensor ▶ Wake up 	<ul style="list-style-type: none"> ▶ 3 × driver for HS switches ▶ Starter disable ▶ Startup, reset, shutdown for μC 	<ul style="list-style-type: none"> ▶ Ideally suited for Renesas SH7 ▶ Reverse polarity protection for HS switches ▶ Reverse polarity protection for system supply ▶ HS switch for starter disable ▶ 2-fold voltage monitoring ▶ Question and answer watchdog ▶ Periphery clock monitoring ▶ 16 channel multiplexer for diagnosis: OL, SCG and SCB 	-40	150	TQFP64ePad (CG124) and LQFP32 (CG130) or bare die

Transmission control systems

Current regulators

High precision current regulators for driving hydraulic valves in automatic transmissions, allowing for fast gear changes.



PRECISE CONTROL OF OIL PRESSURE VALVES IN HYDRAULIC SYSTEMS



Application	Product	V _{bat} typ. [V]	V _{DD} typ. [V]	Interfaces	Outputs	Features	T _{j min} [°C]	T _{j max} [°C]	Package
10 channel current regulator for control units	CG270	14	5	1 × SPI (3.3V or 5V)	10 × regulated PWM signal for ext. power switches	<ul style="list-style-type: none"> ▶ Precise digital control loop for up to 10 solenoid valves in a transmission control system ▶ High accuracy current measurement ▶ Temperature and aging compensation ▶ Supports several external MOSFET configurations ▶ Low-loss shunts for efficient current sensing ▶ Constant current or direct PWM control ▶ Designed to build ASIL D systems 	-40	150	TQFP128ePad
Dual-channel fully integrated current regulator for inductive loads for low-side application	CG208	14	5	1 × SPI (3.3V or 5V)	2 × regulated load current	<ul style="list-style-type: none"> ▶ Power switch, shunt and free wheeling diode integrated current regulation range: 0...1,200 mA ▶ Accuracy < 1% ▶ Dither function ▶ Overcurrent protection ▶ Overtemperature protection ▶ SPI controlled regulation loop characteristics 	-40	150	Bare die, TQFP44ePad

Battery management systems

Pyro fuse driver

In case of an accident, pyro fuses physically separate the HV battery from the vehicle's power lines.

As part of the battery management system, CG985 can fire up to 4 pyro fuses separately.



SM PYRO FUSE DRIVER WITH SPI CONTROL, NUMEROUS SAFETY AND DIAGNOSIS FEATURES



Application	Product	μC supply [V]	V_{VZP} typ. [V]	HSS supply	Interfaces	Firing loops	Features	$T_{\text{J min}}$ [°C]	$T_{\text{J max}}$ [°C]	Package
4 channel pyro fuse driver	CG912	3.3	14	23.75 or 33 (programmable)	SPI, 32 bit (3.3V), K-Line/LIN	5 firing modes (incl. 1.2A, 1.75A and LEA)	<ul style="list-style-type: none"> ▶ 3 watchdogs ▶ Fully automatic diagnosis: C_{ER} diagnosis, power stage and squib diagnosis, cross coupling diagnosis, connector capacitor diagnosis, STB and STG diagnosis ▶ 2 independent 7 bit firing current counters per channel (max time: 3.2 ms) 	-40	150	TQFP64_ePad

Alternator electronics

Alternator regulators

By adjusting the rotor current, Bosch alternator regulators set the output voltage to a constant level, regardless of the actual engine rotation speed. Regulators with interfaces allow for

interaction with the engine control, i.e. provide status information, set the output voltage to a desired level or switch off the alternator during acceleration.



ALTERNATOR OUTPUT VOLTAGE CONTROL, PROGRAMMABLE FOR CUSTOMER SPECIFIC ALTERNATOR BEHAVIOUR

Application	Product	Interfaces	Outputs	Features	$T_{j\ min}$ [°C]	$T_{j\ max}$ [°C]	Package
Regulator for 14V alternators	CR719	n.a.	Excitation current	<ul style="list-style-type: none"> ▶ Autonomous regulator concept ▶ Smart load management 	-40	175	MultiWatt8
Regulator for 14V alternators	CR724	n.a.	Excitation current	<ul style="list-style-type: none"> ▶ Autonomous regulator concept ▶ Smart load management 	-40	175	MultiWatt8
Regulator for 14V alternators	CR665	LIN 1.3, 2.1	Excitation current	<ul style="list-style-type: none"> ▶ LIN control functions acc. to VDA spec. ▶ Programmable ▶ Smart load management 	-40	175	TO220-5
Regulator for 14V alternators	CR636	PWM	Excitation current	<ul style="list-style-type: none"> ▶ PWM controlled output ▶ Smart load management 	-40	175	MultiWatt8
Regulator for 14V alternators	CR760	C-Terminal	Excitation current	<ul style="list-style-type: none"> ▶ C-Terminal controlled output ▶ Smart load management 	-40	175	MultiWatt8
Regulator for 28V alternators	CR298	n.a.	Excitation current	<ul style="list-style-type: none"> ▶ Autonomous regulator concept ▶ Smart load management 	-40	175	MultiWatt8
Regulator for 28V alternators	CR291-294	n.a.	Excitation current	<ul style="list-style-type: none"> ▶ Autonomous regulator concept ▶ Smart load management 	-40	175	Bare die
Regulator for 28V alternators	CR250	LIN 1.3	Excitation current	<ul style="list-style-type: none"> ▶ LIN controlled output ▶ Programmable ▶ Smart load management 	-40	175	MultiWatt8
Regulator for 28V alternators	CR260	C-Terminal	Excitation current	<ul style="list-style-type: none"> ▶ C-Terminal controlled output ▶ Smart load management 	-40	175	MultiWatt8

IP modules

for networking applications



M_CAN AND M_TTCAN IP MODULE

The M_CAN is a CAN IP module that can be realized as a stand-alone device, as part of an ASIC or on an FPGA. It performs communication according to ISO11898-1:2015. It supports Classical CAN and CAN FD (CAN with Flexible Data-rate). Additional transceiver hardware is required for connection to the physical layer.

The message storage is intended to be a single or dual-ported Message RAM outside of the module. It is connected to the M_CAN via the Generic Master Interface. Depending on the chosen integration, multiple M_CAN controllers may share the same Message RAM. The Host CPU is connected via the 32-bit Generic Slave Interface.

C_CAN FD8 IP MODULE

The C_CAN FD8 is a CAN IP module that can be implemented as a standalone device, as part of an ASIC. It is software compatible to the well known C_CAN IP module. The C_CAN FD8 performs communication according to ISO11898-1:2015. It supports classical CAN and CAN FD (CAN with Flexible Data-rate) communication with up to 8 byte data fields. For connection to the physical layer additional transceiver hardware is required. For communication on a CAN network up to 32 Message Objects can be configured. The Message Objects and Identifier Masks for acceptance filtering of received messages are stored in the Message RAM.

The register set of the C_CAN FD8 can be accessed directly by an external CPU via the module interface. These registers are used to control/configure the CAN Core and the Message Handler and to access the Message RAM. The Module Interfaces delivered with the C_CAN FD8 module can easily be replaced by a customized module interface adapted to the needs of the user.

CAN FD

CAN FD (CAN with Flexible Data-rate) was introduced by Bosch in 2012 to overcome the Classical CAN's bit rate limitation to 1 Mbps and to expand the number of data bytes per CAN frame from up to 8 to up to 64, thereby closing the gap between Classical CAN and other protocols. This is achieved by a modified CAN frame format where the bit rate can be switched to faster value inside the CAN frame and by a new data length coding. CAN FD is standardized as ISO11898-1:2015. CAN FD protocol controllers are also able to perform Classical CAN communication.

CAN FD PROTOCOL

The CAN FD Protocol is developed by Robert Bosch GmbH and is patented. In addition to the CAN IP modules offered by Bosch, a CAN FD Protocol License is required. The CAN FD Protocol License is also required for self-developed CAN modules or for CAN modules purchased from other vendors.

VHDL REFERENCE CAN

The VHDL Reference CAN is intended for semiconductor designers/manufacturers who want to build their own implementation of a Classical CAN or CAN FD device using VHDL as hardware description language.



IP modules

for networking applications



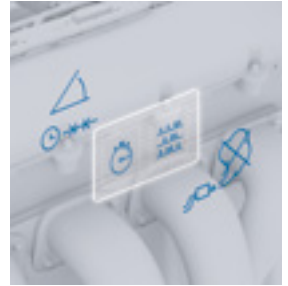
E-RAY:

FLEXRAY COMMUNICATION CONTROLLER IP MODULE

The E-Ray IP module can be integrated as standalone device, as part of an ASIC or as a microcontroller peripheral. It is described in VHDL on RTL level, prepared for synthesis. The E-Ray IP module performs communication according to the FlexRay protocol specification v2.1. Up to 128 message buffers with a payload of up to 254 data bytes can be configured for communication on a FlexRay network. The E-Ray IP module comes with an 8/16/32 bit generic CPU interface connectable to a wide range of customer-specific Host CPUs.

IP modules

for timer applications



GENERIC TIMER MODULE (GTM)

The GTM IP module forms a generic timer platform for complex applications in the automotive industry like powertrain, power steering, chassis and transmission control. To serve these different application domains, the GTM provides a wide range of timer functions like:

- ▶ Counters (free running and resettable)
- ▶ Multi-action capture/compare PWM input
- ▶ Complex PWM output function
- ▶ Duty-cycle measurement
- ▶ Global time bases
- ▶ Complex angle clock mechanism for powertrain applications
- ▶ Input signal filtering
- ▶ Internal RISC-like programmable cores for data processing and complex output sequence generation

The GTM IP is designed to offer flexible solutions for different application domains and for different application classes within one specific application domain. The IP is designed to run with minimal CPU interaction and to unload the CPU from handling interrupt service requests as much as possible.

Generic interfaces and the hierarchical system architecture make the GTM an ideal solution as IP core for various micro-controller architectures.

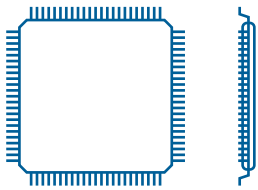
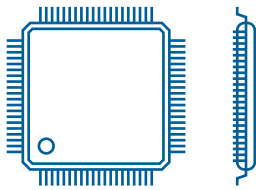
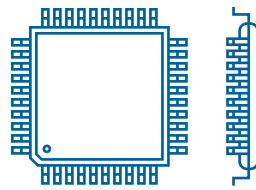
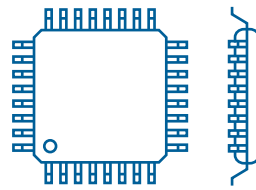
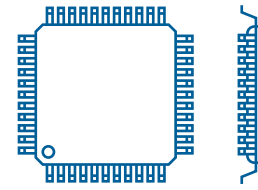
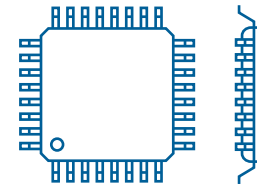
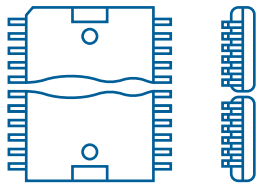
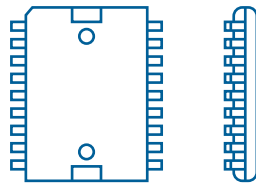
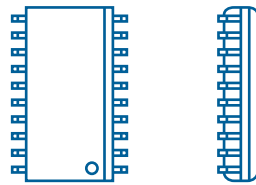
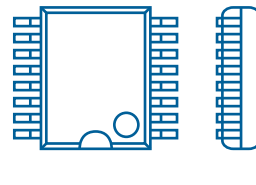
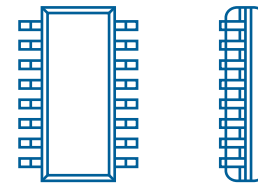
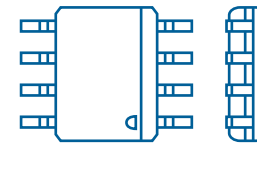
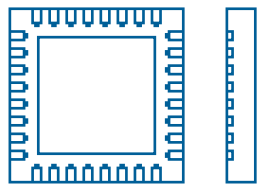
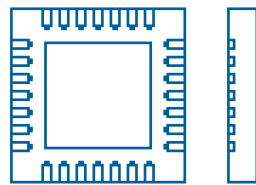
Abbreviations

As used in data tables

C_{ER}	Energy reserve capacitor
HS	High side switch
HSPS	High side power switch
LS	Low side switch
LSPS	Low side power switch
PAS	Peripheral airbag sensor interface
PSI	Peripheral sensor interface bus
SPI	Synchronous serial peripheral interface
V_{BAT}	Battery voltage
V_{DD}	System supply
V_{PASOx}	Sensor supply voltage
V_{VER}	Energy reserve voltage
V_{VZP}	Supply voltage

Packages

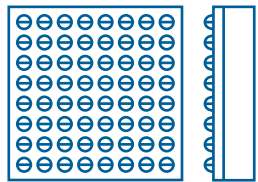
Body dimensions

TQFP128_ePad (14×14 mm²)TQFP64_ePad (10×10 mm²)TQFP_44ePad (10×10 mm²)TQFP_32ePad (7×7 mm²)LQFP44 (10×10 mm²)LQFP32 (7×7 mm²)PSO36 (11.1×16 mm²)PSO20 (11.1×16 mm²)SOIC24w (7.5×15.4 mm²)SOIC16w (7.5×10.3 mm²)SOIC14n (3.9×8.6 mm²)SOIC8n (3.9×4.9 mm²)QFN36 (6×6 mm²)QFN28 (5×5 mm²)

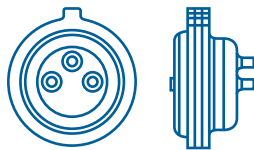
Packages

Body dimensions

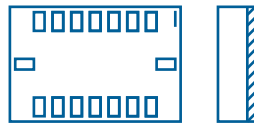
BGA64 (7 × 7 mm²)



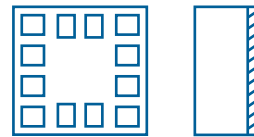
Metal housing (Ø 17.5 mm)



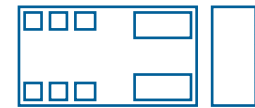
LGA16 (3 × 4.5 mm²)



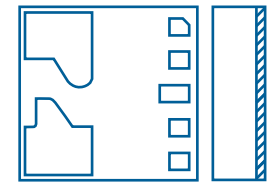
LGA12 (2 × 2 mm²)



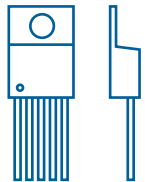
LGA8 (8.2 × 4.4 mm²)



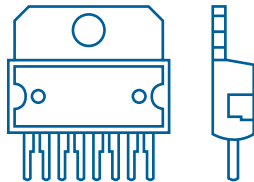
LGA SiP (4 × 5 mm²)



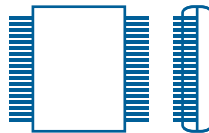
TO220-5



MultiWatt 8 (in-line)



PowerSSO36 (10.3 × 7.6 mm²)



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