MIP

MARKETING INNOVATIVE PRODUCTS

2021

01

FUTURE MOBILITY

EBV Elektronik
I An Avnet Company I

FUTURE MOBILITY

Ever since the dawn of civilization, humankind has been looking for new ways to explore and expand our world. Thanks to technological advances in the field of transportation, we managed to peek into every corner of our planet – and even beyond. Although not physically able to cross large distances, high mobility is one of the main features that define us as a species.

Today, we have a whole range of solutions at our disposal. Even though we have mastered transportation across the land, water, and even the sky, one of the most popular means of transportation is most certainly – the car. It has given us a tremendous amount of freedom, fundamentally changing our lives. However, since the first commercial car model was mass-produced (Ford Model T), the concept has remained virtually unchanged for more than 100 years: an internal combustion engine (ICE), which consumes fossil fuels and produces harmful emissions as a by-product of the combustion process. As the number of vehicles increased over the years, this concept became unsustainable – not only because of the detrimental impact on the environment but also on the very quality of life in the increasingly overcrowded cities.

Yet, the reality is not so bleak. There are many alternative options available, and we can say with a great deal of confidence that we have already started a new chapter in the history of transportation. As one of the purest form of energy, electricity has already gained a lot of traction in the automotive industry. Scientists and experts worldwide work vigorously on new semiconductor technologies that allow reliable operation, efficient energy management, and a high comfort level for the passengers. However, the concept of Future Mobility transcends the domain of the physical: we need to rethink the habits that defined our life in the past 100 years.

Future Mobility as a concept envisions highly efficient, eco-friendly vehicles that travel across a network of roads, sharing data on speed, distance, availability, and even remaining battery life, allowing for calculating optimal routes and reducing the traffic congestion. The entire network of charging stations communicates with the city's smart grid or with a local sub-grid. Unused vehicles continue to actively participate in the energy exchange, providing additional resources to the city's smart grid, further optimizing power consumption. In this futuristic concept, people do not have to use their own cars all the time: Car as a Service enables ordering a car when needed via a simple smartphone app, similar to how e-bike stations work today. Along with some other equally innovative ideas, such as the HyperLoop mass transport concept proposed by a Tesla and SpaceX joint team, or even flying drone-car hybrids and personal eVTOLs that are already being developed by many leading manufacturers from the automotive and aerospace industry, these ideas could significantly change the appearance of the future urban landscape, making it less crowded, less polluted, and more comfortable for living.

We're currently standing in a middle of a historic crossroads. We have the ideas, the technology, and the know-how. The only question that remains is which road to take: left, right, forward, or … up? EBV's dedicated automotive experts can help you make the right decision, whether you are exploring the exciting world of innovations or you just need a reliable supply chain for your existing solutions.

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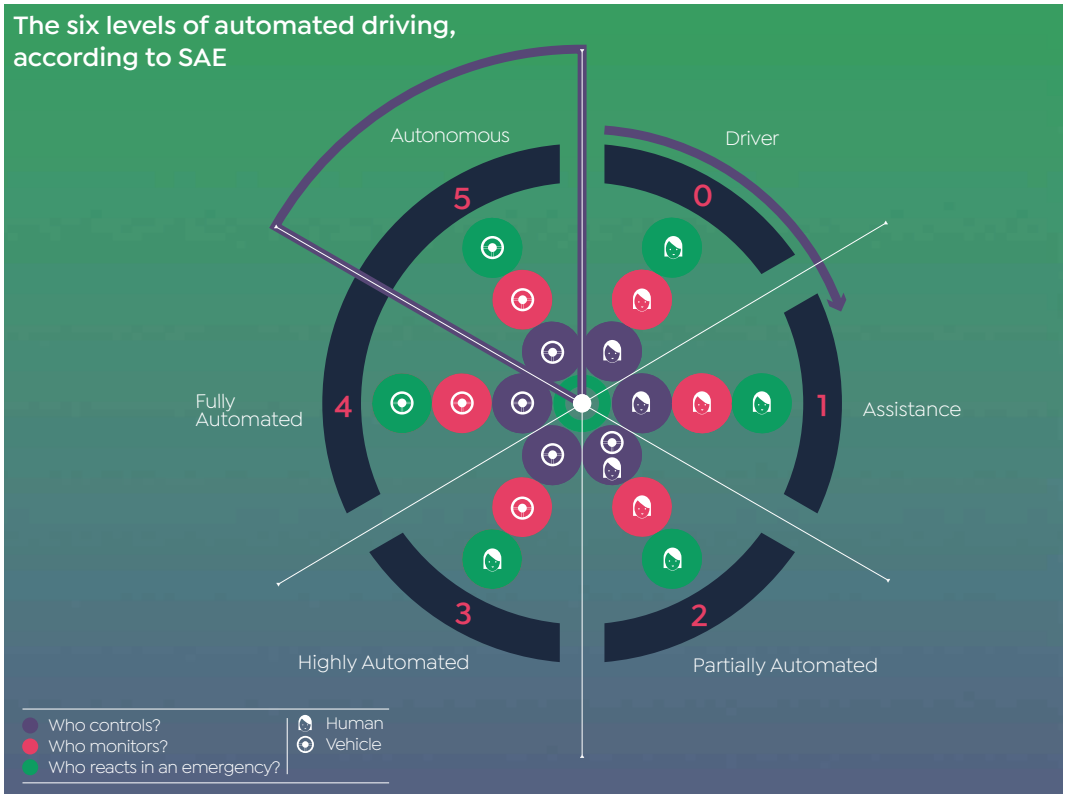
AUTONOMOUS DRIVING

Although the concept of Future Mobility offers many innovative solutions to current problems, the transition will not happen overnight: the path to a fully autonomous driving system is gradual, with developments on a sliding scale. The SAE International organization defined a system that recognizes six different automation levels, and it is used worldwide for various vehicle segments. According to this scale, level 0 corresponds to a vehicle without any assistance system, where the driver is solely responsible for all functions.

Level 1 includes some basic assistance systems such as cruise control. We can find more advanced Autonomous Driving Assistance System (ADAS) functions as we go further up the scale. These functions include automated parking, obstacle avoidance, lane guidance system, and similar driver assistance features. At level 3, the vehicle controls itself for the most part, and the driver no longer has to oversee the vehicle at all times. Fully-automated vehicles classed as level 4 can master even high-risk situations without human help. Only at level 5 can we find entirely autonomous driving functions in every environment and all situations.

Reaching such a high level of driving autonomy may prove challenging in urban areas. Still, as technology evolves, we are getting closer to achieving the level 5 functionality in mass-produced vehicles. According to one of the most influential Future Mobility visionaries and a CEO of Tesla Inc., Elon Musk, all new Tesla models will feature level 5 capable autopilot hardware – as he stated at the opening of Shangai's annual World AI Conference (WAIC 2020). Other manufacturers will have no other choice but to fall in line and embrace this concept if they want to keep their competitive edge on the global automotive market.



Within limited areas, such as agriculture, intralogistics, light-rail systems, or mining, highly and fully-automated vehicles at levels 3 and 4 are already in use for quite some time. Fully-automated Commercial, Construction & Agricultural Vehicles (CAVs) can work in managed fleets, maximizing their efficiency and multiplying their yield. However, CAVs are facing a different set of challenges. Since they usually operate under harsh conditions and at remote locations, the safety requirements for CAVs are not as stringent as for urban transport vehicles, where human lives can be at stake.

One of the main challenges for a fully autonomous level 4 or 5 vehicle is to process a lot of information in real-time to reach its destination with a predictable safety. It must pick up on the environment through which it moves as accurately and as fast as possible. Thus, autonomous vehicles are equipped with a vast range of sensors: for example, ultrasound sensors are required for automated driving, particularly for detecting close-up surroundings up to six meters away and at low speeds (e.g., autonomous parking). Radar sensors provide vital information on the environment at a greater distance, in a full 360 ° field of view.

A relatively new addition is the LIDAR sensor, which scans the environment with invisible laser light and generates a high-resolution 3D map of the surrounding. Video sensors in stereo-video cameras supply additional valuable visual information. Satellite navigation systems with dynamically updated high-resolution maps allow for real-time route calculations and timely route updates. The 5G mobile telecommunications standard could form the basis for such features, offering ultra-fast data access in urban areas. Data from multiple sources is combined, forming the sensor fusion – similar to how animals use all their senses to gain the full awareness of their surroundings.

With the advent of powerful onboard computing and AI algorithms that can make sense of all the incoming data, fully-autonomous vehicles will soon drive passengers across the cities worldwide, navigating through the traffic effortlessly and – reliably.

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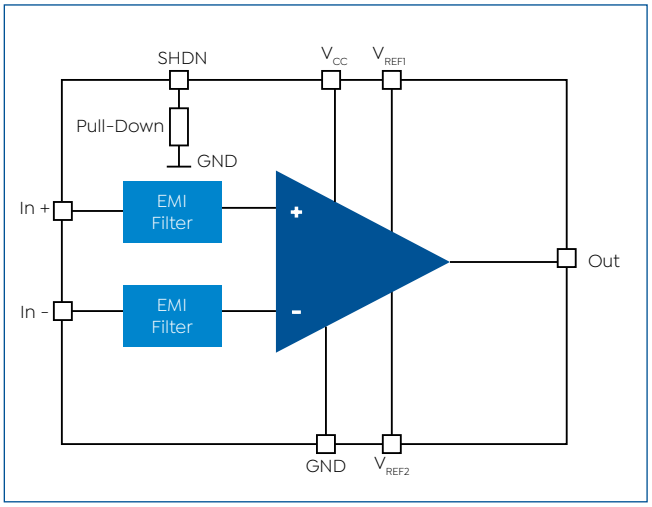
Product order code

- TSC2010IDT
- TSC2010IYDT
- TSC2011IDT
- TSC2011IST
- TSC2012IDT
- TSC2012IYST

TSC201x

High voltage, Precision, Bidirectional Current Sense Amplifiers



TSC201x Block Diagram

The TSC2010/2011/2012 series of precision bidirectional current sense amplifiers can be used for high- or low-side current sensing over a wide range of common-mode voltages. These amplifiers are able to accurately sense very low voltage drop across the shunt resistor, as low as 10 mV full scale, minimizing the measurement error. These current-sense amplifiers also provide additional VREF pins that can be used to set the output voltage offset for bi-directional or uni-directional current sensing, allowing them to be used in a broad range of different applications. There are multiple fixed-gain options available: 20V/V, 60V/V, and 100V/V.

- **Wide common mode voltage: -20 to 70 V**
- **Offset voltage: ±200 µV (max.) at 25 °C**
- **2.7 to 5.5 V supply voltage**
- **Shutdown function for energy saving**

Features

- Wide input common-mode voltage (V_{ICM}):
- From -20 to +70 V
- Offset voltage:
  - ±200 µV (max) at VICM = 1 V
- Offset drift vs. temperature: 5 µV/°C (max.)
- Supply voltage: 2.7 to 5.5 V
- Different fixed-gain options are available:
  - TSC2010: 20 V/V
  - TSC2011: 60 V/V
  - TSC2012: 100 V/V
- Common-mode rejection ratio (CMRR):
  - 115 dB (typ.)
- Gain error: 0.3% (max.)
- Low quiescent current:
  - 20 µA in shutdown mode
- Packages: SO-8 and MiniSO-8
- Extended temperature range: -40 to 125 °C
- Automotive-grade parts available
- Included in STM's 10 Years Longevity Commitment Program
- RoHS compliant

Key Applications

- High-side current sensing
- Low-side current sensing
- Data acquisition and instrumentation
- Test and measurement equipment
- Industrial process control
- Motor control
- Solenoid control
- Automotive

The TSC201x current sense amplifiers from STM deliver excellent operating performances, including a wide common-mode voltage range at the input terminals, low output voltage offset, very low offset drift over temperature, very low gain error, and a high CMR ratio for improved noise immunity. There is also an evaluation kit (EVK) available for these devices.

Inside the STEVAL-AETKT1V2 EVK, there is one main board and three daughter boards for the TSC2010, TSC2011, and TSC2012, which allows for easy replacement if another fixed-gain option is required.

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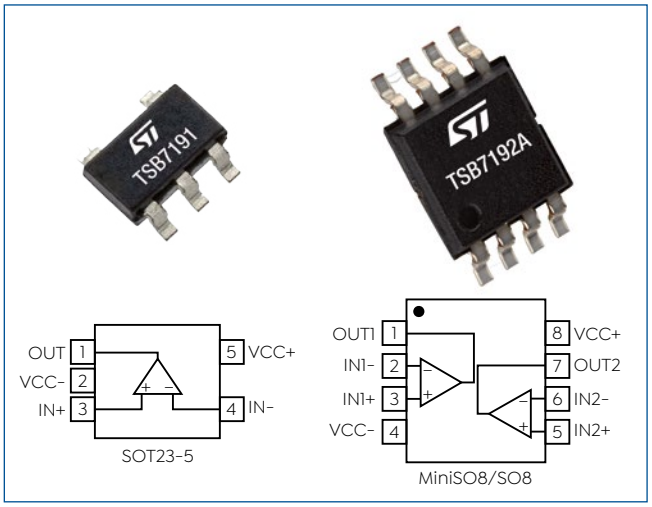
Product order code

- TSB7191AILT
- TSB7191AIYLT
- TSB7191ILT
- TSB7191IYLT
- TSB7192IDT
- TSB7192IYDT

TSB7191/A, TSB7192/A

Precision, 22 MHz, RR IO, 36 V BiCMOS Operational Amplifiers



TSB7191/A and TSB7192/A

The TSB7191/A and TSB7192/A 22 MHz bandwidth amplifiers feature rail-to-rail input and output, which is guaranteed to operate from +2.7 V to +36 V single supply as well as from ±1.35 V to ±18 V dual supplies. These amplifiers offer a large span of supply voltage and an excellent input offset voltage of 300 µV maximum at 25 °C.
The combination of wide bandwidth, slew rate, low noise, rail-to-rail capability, and precision makes the TSB7191, TSB7191A, TSB7192, and the TSB7192A useful in a wide variety of industrial, automotive, and consumer-grade applications.

- **Rail-to-rail input and output**
- **Low offset voltage: 300 µV (max.) at 25 °C**
- **Wide supply voltage range: 2.7 V to 36 V**
- **Gain bandwidth product: 22 MHz**

Features

- Slew rate: 12 V/µs
- Low noise: 12 nV/√Hz
- Stable over the full V_{CC} range with gain +10/-9 V/V
- Integrated EMI filter
- Common-mode rejection ratio (CMRR):
  - 95 db (min.) over the entire temperature range
  - 120 dB (typ.) at TA = 25 °C
- Total harmonic distortion + noise (THD+N):
  - 0.0022% (typ.)
- 2 kV HBM ESD tolerance
- included in STM's 10 Years Longevity Commitment Program
- Extended temperature range:
  - From -40 °C to +125 °C
- Automotive-grade parts available
- Available in SO8, MiniSO8, and SOT23-5 packages

Key Applications

- High-side and low-side current sensing
- Hall effect sensors
- Data acquisition and instrumentation
- Test and measurement equipment
- Motor control
- Industrial process control
- Strain gauge

Featuring a wide operating voltage range and excellent operating performances consistent over the entire supply voltage range, the TSB7191/A and TSB7192/A rail-to-rail operational amplifiers from STMicroelectronics represent the best choice for longevity, robustness, and performance in the broadest range of applications.

The TSB7191/A and TSB7192/A op-amps are included in STM's 10 Years Longevity Commitment program, ensuring a reliable supply chain for all customers.

Product order code
- N27-W1-011AS1
- N27-W3-011AS1

N27

Neoway NB-IoT/eMTC/EGPRS Module for M2M and IoT Applications

N27 Product Image

The N27 is an NB-IoT/eMTC module specially designed for M2M and IoT applications. Adopting the 3GPP Rel.14 LTE technology, it delivers 1119 kbps downlink and 588 kbps uplink data rates. An integrated GNSS greatly simplifies product design and provides faster, more accurate, and more reliable positioning functions. The N27 integrates industrial UART interfaces supports various network protocols, such as CoAP, UDP, TCP, and MQTT. It has excellent RF performance, low power consumption, and a wide operating temperature range.

- **Cat.M1/NB-IoT/EGPRS multi-mode operation with global frequency bands**
- **Built on Qualcomm 9205 with GNSS integrated**
- **Supports 450 MHz for LTE-M and output power class 3**
- **Compact size and low power consumption**

Features

- Cellular support:
  - Cat NB2, EDGE, Cat NB1, Cat M1
- Frequency bands:
  - Cat M1: B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B26/B27/B28/B31/B66/B72/B73/B85
  - Cat NB1/NB2: B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B25, B26, B28, B31, B66, B72,B73, B85
  - GPRS: 850/900/1800/1900 MHz
- Supply voltage: 3.1 to 4.3 V (typ: 3.6 V)
- Low current consumption:
  - PSM: less than 4 μA
  - Idle: less than 2 mA
  - Working: 250 mA (Cat M)
- GNSS: GPS/BDS/GLONASS/GALILEO/QZSS
- Network protocols: CoAP/UDP/TCP/MQTT/PPP/NTP/FTP/HTTP(S)/DTLS
- Data rates in kbps (DL/UL):
  - CatM1: 588/1119
  - CatNB1: 34/66.6
  - CatNB2: 127/158.5
  - EGPRS: 236.8/236.8
- Firmware upgrade: FOTA, USB
- USB drivers support:
  - MS Windows 7/8/8.1/10
  - Linux 2.6 to 4.4
  - Android 4.x/5.x/6.x/7.x/8.x/9.x
- Interfaces:
  - USB2.0, I2C, SPI, PCM/I2S, 2x ADC, 3x UART
  - USIM (1.8 V only)
  - 2G/4G/GNSS antenna intefaces
  - LCD inteface
- AT commands support:
  - 3GPP TS 27.007, 27.005
  - Neoway enhanced AT commands
- ESD protection (contact/air):
  - VBAT, GND, ANT: ±8 kV/±15 kV
  - Other: ±2 kV/±4 kV
- Operating temperature range: -40 to 85 °C
- Dimensions: 24.0 x 18.0 x 2.3 mm
- Form factor: 76-pin LGA

Key Applications

- Energy metering
- Telematics
- Tracking & monitoring
- Smart city

The N27 series products developed by Neoway Technology support a wide range of bands and deliver reliable performance. They can meet the application requirements of different regions and industries in the world.

After N27 is certified by FCC, PTCRB, GCF, and T-Mobile, more certification plans are in progress to provide better support and services to more IoT terminal customers with international needs.

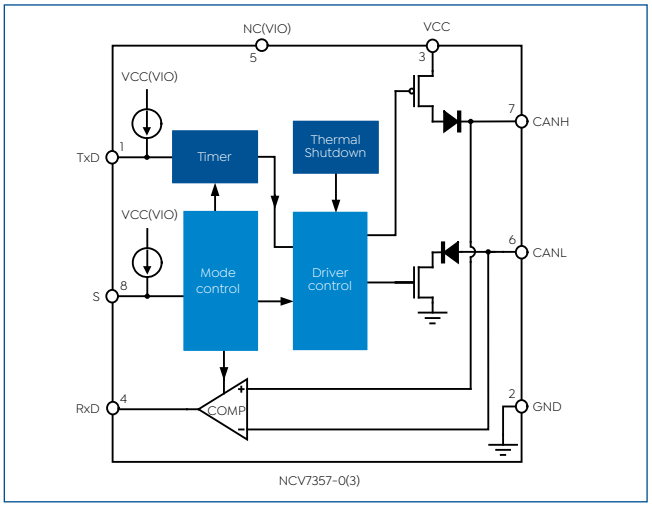
ON Semiconductor®

Product order code

- NCV7357D10R2G
- NCV7357D13R2G
- NCV7357MW0R2G
- NCV7357MW3R2G

NCV7357

CAN Flexible Data Rate (CAN FD) Transceiver



NCV7357-0/NCV7357-3 Block Diagram

The NCV7357 CAN transceiver is the interface between a Controller Area Network (CAN) protocol controller and the physical bus. It is also an addition to the CAN high-speed transceiver family complementing NCV735x CAN stand-alone transceivers and replacing previous generations.
The NCV7357 guarantees additional timing parameters to ensure robust communication at data rates beyond 1 Mbps to cope with CAN flexible data rate requirements (CAN FD). These features make the NCV7357 an excellent choice for all types of HS-CAN networks, in nodes that require a basic CAN capability.

- **CAN FD timing specified up to 5 Mbps**
- **Low current, Listen Only Silent mode**
- **Low electromagnetic (EM) emission, high electromagnetic immunity (EMI)**
- **High ESD Robustness of bus pins: more than 8 kV system ESD pulses**

Features

- Compatible with ISO 11898-2:2016
- V_{IO} pin on the NCV7357-3 version allows direct interfacing with 3 to 5 V MCUs
- Very low electromagnetic emission without common-mode (CM) choke
- No disturbance of the bus lines with an unpowered node
- Transmit data (TxD) dominant timeout function
- Thermal protection
- Bus pins short-circuit-proof to supply voltage and ground
- Bus pins protected against transients in an automotive environment
- AEC-Q100 qualified, PPAP capable
- Available in SOIC-8 and DFNW8 packages
- Pb-Free package options

Key Applications

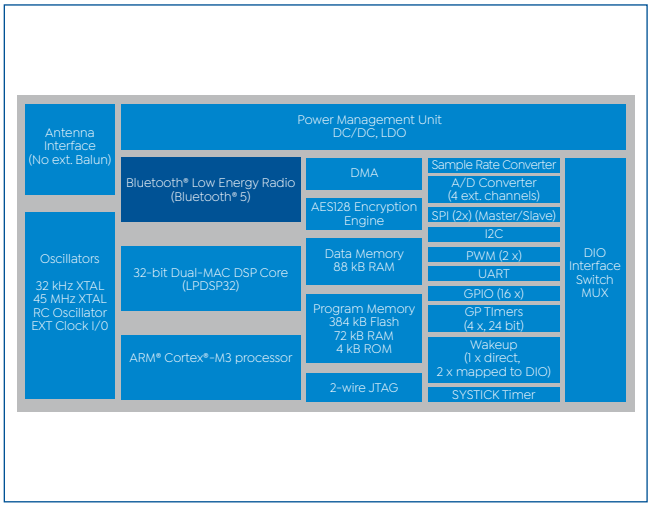
- Automotive
- Powertrain
- Body electronics
- Chassis
- Industrial networks

The NCV7357 implements a high-speed physical layer CAN-FD transceiver compatible with ISO11898-2, providing several optional features, such as extended bus load range, transmit dominant timeout (long), support for 5 Mbps bit rates, and normal bus biasing.

The NCV7357 CAN FD transceiver is available in a DFNW8 wettable flank package, which allows for enhanced optical inspection and improved reliability of solder joints, ensuring compliance with the stringent automotive requirements.

NCV-RSL10

Radio SoC, Ultra-Low-Power Multi-protocol Bluetooth® 5 Certified for Automotive



RLS10 – Block Diagram

The NCV-RSL10 is a member of the RSL10 family and brings one of the industry's lowest power Bluetooth® Low Energy modules to automotive. The wettable flank-plated packaging, built-in data encryption, and an operating temperature range of -40 °C to +105 °C make the NCV-RSL10 automotive-ready by any standard. While maximizing energy efficiency, the NCV-RSL10 helps to enable advanced new functionalities into automotive applications, including keyless entry using a fob or smartphone, active safety and diagnostic alerts, or enhanced infotainment controls.

- **Bluetooth 5 certified: supports 2 Mbps data rate latest generation of BLE**
- **Lowest power consumption**
- **AEC-Q100 qualified, PPAP capable**
- **Compact 7 x 7 mm wettable flank-plated QFN package**

Features

- Highly integrated SoC:
  - Arm Cortex-M3 32-bit core
  - LPDSP32, dual 32-bit DSP core
  - 384 kB of Flash memory total
  - BLE-compliant radio front-end at 2.4 GHz
- Bluetooth 5 certified:
  - Supports Bluetooth 5 features
  - Data rate up to 2 Mbps
- Improved Data Security:
  - Built-in AES128 encryption accelerator
- Lowest power consumption (3.3 V):
  - Tx peak (PHY) at 0 dBm: 4.3 mA
  - Rx peak (PHY): 2.7 mA
  - Deep Sleep, I/O Wake-up: 25 nA
  - Deep Sleep, external 32 kHz oscillator active: 40 nA
- Flexible supply voltage range: 1.1...3.3 V
- Supports Firmware-Over-The-Air (FOTA) updates
- Supported multiple Bluetooth profiles (more in RSL10 SDK):
  - Proximity
  - HID over GATT (HOG)
  - Alert notification
  - Phone alert status
  - Location and navigation
- Qualified for automotive:
  - AEC-Q100 Grade 2, ETSI, FCC Qualified
  - PPAP Capable
  - Operating temperature range: -40...105 °C
- Wettable flank-plated QFNW48 package
- RoHS Compliant device

Key Applications

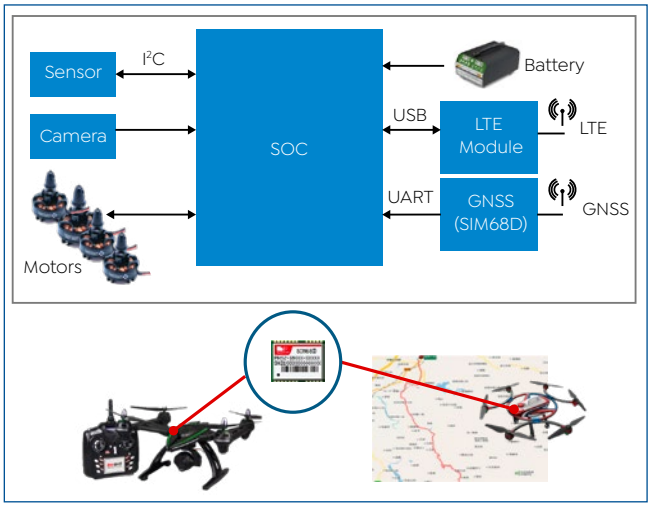
- Automotive:
  - Keyless entry
  - Infotainment control
  - Active safety
  - Diagnostic alerts
  - ADAS

The NCV-RSL10 is an automotive variant of the RSL10 SoC, an ultra-low-power, highly flexible multi-protocol 2.4 GHz radio SoC specifically designed for high-performance applications. The NCV-RSL10 represents a more robust alternative in a wettable flank-plated QFNW48 package, allowing it to meet stringent automotive safety requirements.

The RSL10-002GEVB is an Arduino form factor development board based on the NCV-RSL10 SoC. Supported by the RSL10 SDK, it enables the rapid development of ultra-low-power BLE applications.

SIM68D

GNSS module



SIM68D Application Example – Drone Navigation

The SIM68D is a high performance and reliable GNSS module. It is a standalone L1 + L5 dual-band GNSS module in an LCC type with AIROHA's high sensitivity navigation engine, which allows customers to achieve the industry's highest sensitivity levels, accuracy, and Time-to-First-Fix (TTFF), with extremely low power consumption.

The SIM68D module provides simultaneous GPS, GLONASS, BeiDou, Galileo, and QZSS open service L1 reception capability and GPS, BeiDou, Galileo, and QZSS open service L5 reception capability.

- **L1 and L5 dual-band GNSS receiver**
- **Support for EASY™ self-generated orbit prediction**
- **Support for EPO™ orbit prediction**
- **Support for SBAS ranging (WAAS, EGNOS, GAGAN, MSAS)**

Features

- L1: BeiDou/GPS/GLONASS/ Galileo/QZSS
- L5: BeiDou/GPS/Galileo/QZSS
- Jamming elimination
- Integrated low-noise amplifier
- DGPS (RTCM)
- Indoor and outdoor multi-path detection and compensation
- LOCUSTM logger function
- Receiver:
  - L1: 75 SVs; L5: 60 SVs
  - Max. update rate: 10 Hz
- Sensitivity (tested in a lab environment):
  - Tracking : -166 dBm
  - Reacquisition : -160 dBm
  - Cold starts : -148 dBm
- Time-To-First Fix (all SV at –130 dBm, GPS & GLONASS mode):
  - Cold start: 27 s
  - Warm start: 25 s
  - Hot start: less than 1 s
  - EPO Assist: 13 s
- Automatic Positioning accuracy:
  - 50% 24 hr static, -130 dBm, GPS & GLONASS mode: 1.5 m
- Operation temperature: -40...85 °C
- Serial interfaces:
  - UART, SPI, I²C
- Digital I/O:
  - Pulse-per-second (PPS)
  - EINT0 input
- Protocols: NMEA, PMTK
- Power supply: 2.8...4.3 V
- Backup power: 2.3...4.6 V
- Power consumption (3.3 V, passive antenna):
  - Acquisition: 23.3 mA
  - Tracking: 23.9 mA
  - Sleep current: 340 µA
  - Backup: 78 µA
- Antenna type: active and passive
- Antenna power:
  - external or internal VCC_RF
- Mechanical data:
  - Dimensions: 16 x 12.2 x 2.4 mm
  - Weight: 1 g

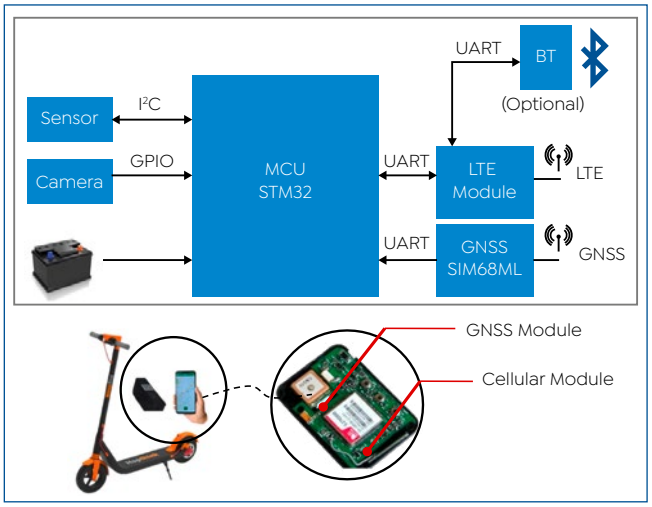
Key Applications

- Smart Sensing & Connectivity:
  - Smart payment
  - Wearables & portables
  - Smart industry
  - Environment monitoring
  - Position tracker (drones, goods)

The SIM68D GNSS module can acquire and track any mix of multiple satellite signals. Combining advanced AGPS called EASY™ (Embedded Assist System) with proven AlwaysLocate™ technology, SIM68D achieves the highest performance and fully meets the industrial standard.

SIM68ML

GNSS module



SIM68ML Application Example - Smart Terminal for e-Scooter

The SIM68ML is a high performance and reliable GNSS module. It is a GNSS module integrated with GPS & GLONASS system in an LCC package type with Airoha's high sensitivity navigation engine, which allows customers to achieve the industry's highest level of sensitivity, accuracy, and Time-to-First-Fix (TTFF) with lower power consumption.

The SIM68ML module provides simultaneous GPS, GLONASS, and QZSS open service L1 reception capability. With 33 tracking channels and 99 acquisition channels, SIM68ML can acquire and track any mix of multiple satellite signals.

- **Support for EASY™ self-generated orbit prediction**
- **Support for EPO™ orbit prediction**
- **Integrated low-noise amplifier**
- **Jamming elimination**

Features

- Supports GPS/GLONASS/QZSS
- L1 band receiver: 1575.42 MHz
- SBAS ranging (WAAS, EGNOS, GAGAN, MSAS)
- Receiver:
  - 33 tracking and 99 acquisition channels
  - Up to 210 PRN channels
  - Max. update rate: 10 Hz
- Sensitivity (tested in a lab environment):
  - Tracking : -165 dBm
  - Reacquisition : -160 dBm
  - Cold starts : -148 dBm
- Time-To-First Fix (all SV at –130 dBm, GPS & GLONASS mode):
  - Cold start: 28 s
  - Warm start: 26 s
  - Hot start: less than 1 s
  - EPO assist: 13 s (CTTFF)
- Automatic Position accuracy:
  - 50% 24 hr static, -130 dBm, GPS & GLONASS mode: < 2.5 m CEP
- Operation temperature: -40...85 °C
- Serial interfaces:
  - UART
- Digital I/O:
  - Pulse-per-second (PPS)
  - EINT0 input
- Protocols:
  - NMEA, PMTK
- Power supply: 2.8...4.3 V
- Backup power: 2.3...4.6 V
- Power consumption (at 3.3 V, passive antenna):
- Acquisition: 25 mA
- Tracking: 20 mA
- AlwaysLocate™ mode: 340 µA
- Sleep mode current: 350 µA
- Backup: 14 µA
- Antenna type: active and passive
- Antenna power: external or internal VCC_{RF}
- Mechanical data:
  - Dimensions: 10.1 x 9.7 x 2.5 mm
  - Weight: 0.5 g

Key Applications

- Smart Sensing & Connectivity:
  - Surveillance, parking & traffic control
  - Pet Tracker
  - Smart Payment
  - Environment monitor

Combining advanced AGPS called EASY™ (Embedded Assist System) with proven AlwaysLocate™ technology, the SIM68ML module achieves the highest performance and fully meets the industrial standard.

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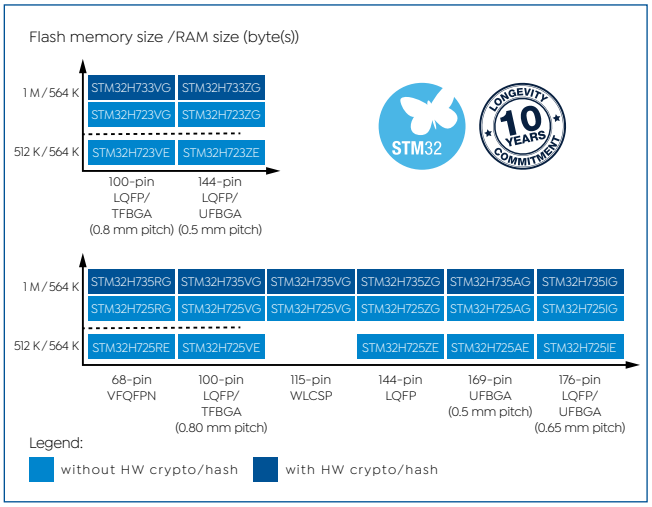
Product order code

- STM32H723VEH6
- STM32H723VET6
- STM32H723VGH6
- STM32H723VGT6
- STM32H723ZEI6
- STM32H723ZET6

STM32H723-733 725-735 & 730

ARM® Cortex®-M7 Core With Double-Precision FPU, Running up to 550 MHz



STM32H7 Family Overview

The STM32H723/733, STM32H725/735, and STM32H730 lines are leaning on the STM32H7 DNA. They provide maximum performance up to 550 MHz, high integration with embedded Flash memory of 128 KB, advanced features, ECC on all embedded memories, while maintaining support for high operating ambient temperature, up to 125 °C. This new series of microcontrollers will allow customers to execute from external encrypted flash memories, hence avoiding exposing their sensitive SW IP even on external memory.

- **Fast 16-bit and 12-bit ADCs**
- **LCD-TFT controller with Chrom-ART Accelerator™**
- **On-the-fly decryption of code stored in external memory**
- **Ethernet, FD-CAN, USB 2.0 HS/FS**

Features

- Max Frequency up to 550 MHz
- Octal-SPI support with On-The-Fly-Decryption for increased perf vs Quad-SPI, more security, and Octal-RAM support
- Math acceleration (Trigonometric and Filtering) to off-load the core
- ITCM RAM re-map capability for more flexibility in the code partitioning
- Fast 12-bit ADC (in addition to the 16-bit ADC) for more flexibility
- Parallel synchronous slave interface (PSSI) for more connectivity
- New VFQFPN68 introduced for a more aggressive entry price and integration
- Extended temperature range up to 125 °C for industrial uses
- **STM32H730 Value Line:**
  - Reduced Flash size down to 128 KB mainly for user Bootloader storage and adjust to external memories environment
  - Secure services/Crypto/On-The-Fly-Decrypt by default on the STM32H730xxx and STM32H730xxxQ part numbers

Key Applications

- Industrial control and automation
- Human-Machine Interfaces (HMI)
- Medical applications
- Edge computing
- Robotics

The Arm® Cortex®-M7-based STM32H7 MCU series leverages ST's Non-Volatile-Memory (NVM) technology to reach the industry's highest benchmark scores for Arm® Cortex®-M-based micro-controllers with up to 1327 DMIPS/ 3224 CoreMark executing from embedded Flash memory.

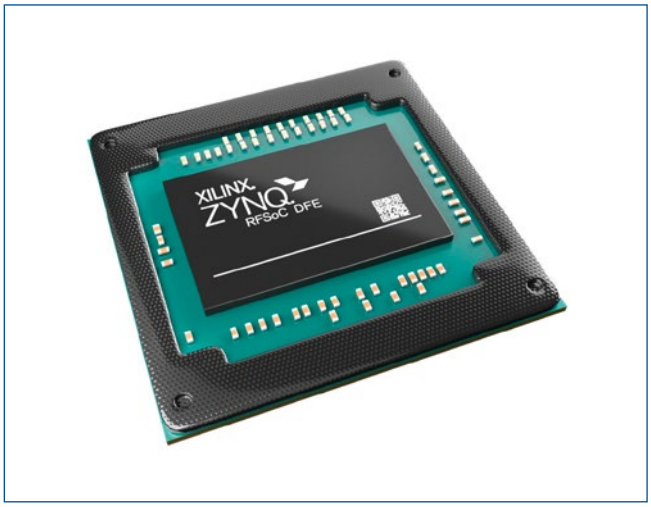
STM32H7 devices, featuring an integrated crypto/hash processor, support security services such as Secure Firmware Install and Secure Boot - Secure Firmware Upgrade, allowing new application code to be installed in a secure manner.

Product order code

- XLXXCZU42DR-2FFVE1156IES981
- XLXXCZU43DR-L2FFVE1156IES98
- XLXXCZU55DR-2FSVE1156I
- XLXXCZU57DR-L1FFVE1156I
- XLXXCZU65DR-L2FSVE1156I
- XLXXCZU67DR-1FSVE1156I

Zynq® RFSoC DFE

Xilinx Zynq® RFSoC DFE for Mass 5G Radio Deployments



Zynq® RFSoC DFE

Xilinx® Zynq® RFSoC DFE is a breakthrough radio platform that hardens the digital front-end (DFE) for 5G mass radio deployment and a breadth of other RF applications. Built on the only production-proven adaptive SoC that integrates the entire signal chain from RF to baseband, Zynq RFSoC DFE represents a new class of application-specific adaptive products that integrate hardened DFE IP along with Xilinx's proven Programmable Logic. Zynq RFSoC DFE offers the best balance of technologies - the cost economies of an SOC using hardened blocks with the flexibility, scalability, and time-to-market benefits of an application-specific adaptive platform.

- **2x performance per watt vs. Zynq® RFSoC Gen 3**
- **400 MHz instantaneous bandwidth in FR1 (8T8R)**
- **7.125 GHz direct RF bandwidth**
- **Flexibility to enhance hardened IP with adaptive logic**

Features

- Adaptive RFSoC platform integrates more hardened IP than soft logic
  - Enables flexible, high performance, power-efficient, and cost-effective solutions
- The instantaneous BW supported is 400 MHz and 1600 MHz in FR1 and FR2, respectively, to solve diverse multiband requirements
- Up to 8T8R with integrated feedback ADCs for single-chip FDD radio solution
- Hardened DPD IP is based on Xilinx production-proven soft-core and enhanced to support advanced wideband GaN power amplifiers to improve power efficiency

Key Applications

- Small cell nodes (power & cost-efficient)
- Fixed wireless access
- Multi-mode macrocell - support for 5G and 4G LTE
- Massive-MIMO macrocell - full sub-7 GHz direct RF
- Digital phased array radar
- Milcom and Satcom modems
- 5G for government/ private spectrum
- UE emulation/RF testers
- Portable test equipment

Zynq RFSoC DFE offers 2x performance per W compared to its prior generation and scales from a small cell to massive MIMO macrocells. It is the industry's only direct RF platform that enables carrier aggregation/sharing, multimode, multiband 400 MHz instantaneous bandwidth in all FR1 bands, and emerging bands up to 7.125 GHz. As a millimeter-wave intermediate frequency transceiver, it provides up to 1.6 GHz of instantaneous bandwidth.

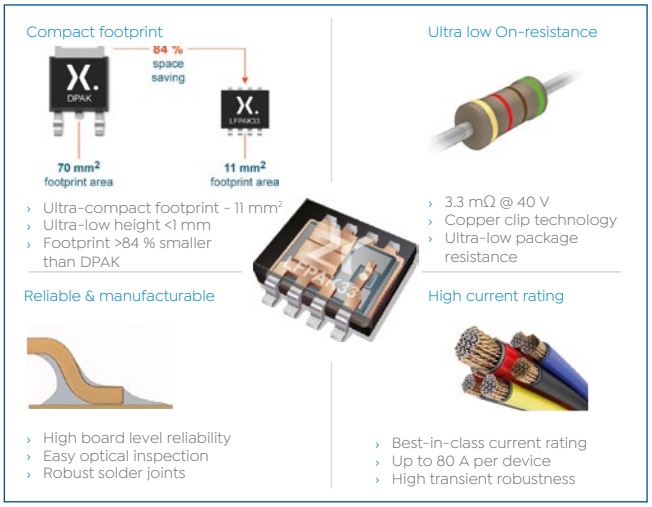
Zynq RFSoC DFE is architected so that customers can bypass or customize the hard IP blocks: they can leverage Xilinx's field-proven DPD that supports existing and emerging GaN power amplifiers or insert their own unique DPD IP.

Product order code

- BUK7M11-40HX
- BUK7M15-40HX
- BUK7M20-40HX
- BUK7M3R3-40HX
- BUK7M4R3-40HX
- BUK7M5R0-40HX

LFPAK33 Trench 9 Automotive

Trench 9 40 V Automotive MOSFETs – Shrinking the power footprint



Trench 9 Automotive MOSFETs in LFPAK33 Package

With ever-increasing pressure to reduce the size of modules while at the same time increasing their functionality, LFPAK33 provides the benchmark in low-resistance, small-footprint packaging, providing up to 80% space saving compared to traditional DPAK alternatives. Bringing Nexperia's robust and reliable copper clip technology to the Power33 (3.3 x 3.3 mm) footprint, qualified to AEC-Q101 standards. The Nexperia LFPAK33 Trench 9 automotive MOSFET portfolio is suitable for automotive applications such as powertrain, body control, and chassis and safety. Nexperia's broad released 40 V portfolio offers $R_{DS(ON)}$ from 3.3 to 20 mΩ.

- **Fully automotive AEC-Q101 qualified to 175 °C**
- **Ultra-campact footprint down to 10.9 mm²**
- **Devices with standard and logic-level gate threshold voltage (V_{TH}) available**
- **Clip bond LFPAK33 package**

Features

- Trench 9 SJ technology combined with clip-bonded LFPAK33 package:
  - Increased electrical performances on a smaller footprint
  - Outstanding R_{th} performance
  - Low switching losses
- Up to 80 A per device
- Up to 50% lower $R_{DS(ON)}$ compared to older generations
- Benchmark R_{th} for thermally demanding applications
- High avalanche capability
- Strong fault condition tolerance due to technology features
- Ultra-low height of less than 1 mm
- Footprint 84% smaller than other DPAK alternatives
- High transient robustness

Key Applications

- Automotive:
- Powertrain pumps & motors
  - Oil, water, fuel pump
- Engine fans and pumps
  - Various BLDC & DC Motors
- Solenoid control
- Reverse battery protection
- Auxiliary loads & motor control
- Body control
- Chassis and safety control

Nexperia's new Trench 9 LFPAK33 MOSFETs provide outstanding electrical and thermal performances in a very compact package, allowing them to cope successfully with the continuously increasing demands of the automotive industry.

Trench 9 superjunction MOSFET technology, combined with the clip-bonded LFPAK33 package, enables improved Safe Operating Area (SOA), higher avalanche capability, strong fault condition tolerance, and up to 50% lower ON-resistance. These features make Trench 9 LFPAK33 MOSFETs an ideal solution for automotive applications up to 300W.

Product order code

- BUK6D120-40EX
- BUK6D120-60PX
- BUK6D125-60EX
- BUK6D210-60EX
- BUK6D22-30EX
- BUK6D230-80EX

Small-Signal MOSFETs

A Comprehensive Portfolio of Automotive Small-Signal low $RDS_{(ON)}$ MOSFETs

Smal-Signal MOSFETs in DFN2020 Package

Nexperia provides the broadest portfolio of automotive-qualified and PPAP capable small-signal MOSFETs with low ON-resistance. The portfolio includes a wide range of package options from proven SMD to the latest DFN technology with side wettable flanks (SWF). Nexperia's small-signal MOSFETs offer high ESD robustness for a vast choice of applications in the automotive domain. The broad portfolio includes devices with VDS voltages from 20 to 80 V, max. drain currents up to 6 A, and RDS(ON) down to 15 mΩ. Small-signal automotive MOSFETs can be used in applications such as body control units, infotainment systems, and safety and control systems.

- **Most parts with ESD robustness of 2 kV**
- **$R_{DS(ON)}$ down to 15 mΩ, I_D up to 6 A (max.)**
- **Parts available with V_{DS} of 20, 30, 40, 60, 70, 80 V**
- **Largest portfolio of automotive small-signal MOSFETs on the market**

Features

- A growing portfolio of devices in leaded and leadless (DFN) packages:
  - Voltage (V_{DS}) options up to 80 V
  - Current (I_D) options up to 6 A
- Low $R_{DS(ON)}$:
  - Typically under 1 Ω, down to 15 mΩ
- High ESD robustness:
  - Most parts with 2 kV ESD protection
- Low thermal resistance (R_{TH}):
  - Less than 10 K/W for DFN2020
- Performance improvements in wafer and package technology:
  - Leadless (DFN) packages enable improved performance on a smaller footprint
  - Improved electrical and thermal performance
- A broad range of packages for optimized system design
- Side-wettable flanks for optical solder inspection
- New devices qualified up to 175 °C
- Full automotive compliance:
  - AEC-Q101 qualified
  - PPAP capable

Key Applications

- Automotive:
- Body control units:
  - Doors
  - Window lift
  - Seat control
- Infotainment system:
  - Car radio
  - Navigation
- Safety and control systems:
  - Airbag
  - LED lighting

Nexperia offers the largest portfolio of automotive small-signal low $RDS_{(ON)}$ MOSFETs on the market. By improving the wafer and package manufacturing technologies, Nexperia managed to achieve outstanding electrical and thermal performances of their devices - especially with the leadless DFN packages that enable improved performance on a smaller footprint.

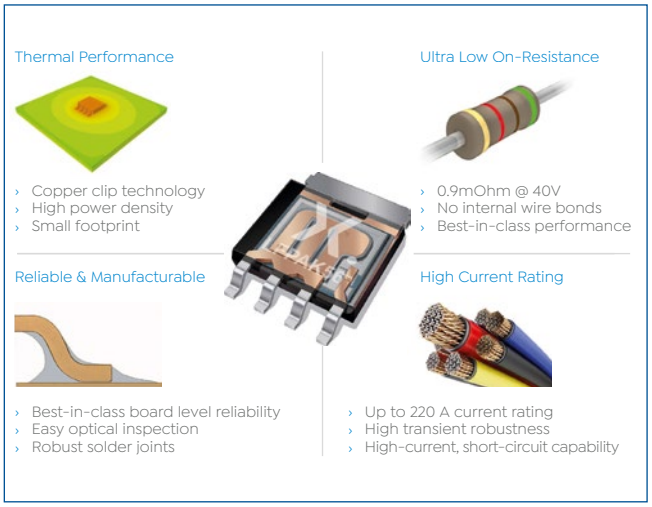
Nexperia's broad portfolio includes PPAP capable and AEC-Q101 qualified automotive devices capable of reliable operation at the extended automotive temperature ranges. These devices can withstand a junction temperature of up to 175 °C.

Product order code

- 934661707115
- 934661181115
- 934661579115
- 934661894115
- 934661182115
- 934661185115

LFPAK P-Channel MOSFETs

P-Channel MOSFET Series in the Popular LFPAK56 Package



P-Channel Automotive MOSFETs in LFPAK56 Package

Introducing automotive P-channel LFPAK56 MOSFETs, Nexperia further enhances its industry-leading portfolio of robust and reliable copper-clip packages. Providing design engineers with more flexibility and choice, the Power-SO8 footprint-compatible MOSFETs offer exceptional power density, qualification up to 175 °C, and up to 81% space saving compared to traditional DPAK and D2PAK alternatives. LFPAK56 MOSFETs are ideally suited for automotive power applications such as reverse battery protection. The new products are available in 30 to 60 V, with $R_{DS(ON)}$ down to 10 mΩ (30 V).

- **Copper-clip bonding for high I_D maximum rating up to 220 A**
- **Automotive grade AEC-Q101**
- **Flexible leads for improved reliability, exposed leads allow for easy optical inspection**
- **Enhanced die size for reduced $R_{DS(ON)}$**

Features

- P-channel enhancement-mode MOSFET family:
  - Trench MOSFET technology
  - Proven LFPAK56 (SOT669) package technology
- Copper-clip bonding provides improved performance:
  - High maximum current rating (up to 220 A)
  - Ultra-low package resistance and inductance
  - No internal wire bonds
  - Improved thermal performance
- Suitable for high-temperature applications: 175 °C $T_j$max.
- Well-suited for high side drive
  - No charge pump required
  - Simplified interface drive circuit requirements
- Best-in-class reliability and quality
- 100% footprint compatible with Power-SO8
- AEC-Q101 automotive grade qualified
- Industrial portfolio expansion:
  - RFS parts: PSMP061-60YE, PSMP033-60YE

Key Applications

- Reverse battery protection
- Power management
- High-side load switch
- Buck converter for low-power non-isolated Points of Load (PoL)
- LED driver switch
- EMC sensitive applications (seat adjustment, sunroof)
- Motor driver-inverter

P-channel MOSFETs require a simpler gate driving circuit than their N-channel equivalents when used as high-side switching devices. However, their ON-resistance is typically too high, limiting their use in such applications.

Nexperia's new P-channel e-mode MOSFETs feature very low ON-resistance, enabling compact and highly optimized designs with reduced BOM while maintaining superior switching efficiency throughout the extended automotive temperature range.

TOSHIBA

Product order code
- XPH4R10ANB,L1XHQ(O
- XPH6R30ANB,L1XHQ(O

XPH4R10ANB, XPH6R30ANB

100 V N-Channel MOSFETs with 5 x 6 mm Package

Toshiba XPH4R10ANB and XPH6R30ANB in SOP Advance (WF) Package

The XPH4R10ANB and XPH6R30ANB are Toshiba's 100 V N-channel MOSFETs with a 5 x 6 mm package, designed specifically for modern 48 V system applications. These devices improve the efficiency of automotive systems due to their low ON-resistance, significantly reducing system losses. The XPH4R10ANB and XPH6R30ANB are perfectly suited to be used in boost converters for integrated starter generators (ISG) and LED headlights, as well as motor drives, switching regulators, and load switches.

- **U-MOS series 100 V N-channel MOSFETs**
- **SOP Advance (WF) 5 x 6 mm package**
- **$R_{DS(ON)}$ max. of just 4.1 mΩ**
- **AEC-Q101 qualified**

Features

- Automotive enhanced mode 100 V N-channel MOSFETs
- Suitable for 48 V system applications
- Drain current (DC/pulsed):
  - XPH4R10ANB: 70 A/210 A (max.)
  - XPH6R30ANB: 45 A/135 A (max.)
- SOP Advance (WF) wettable flanks package:
  - Enables automated optical inspection of solder joints
- Low threshold voltage (V_{DS}= 10 V):
  - From 2.5 V to 3.5 V
- Low leakage current (V_{DS}= 100 V):
  - I_{DSS}= 10 µA (max.)
- Maximum operating temperature:
  - Up to 175 °C
  - Suitable for automotive needs
- AEC-Q101 qualified

Key Applications

- Automotive:
  - Automotive equipment
  - Power supply (DC/DC converter)
  - LED headlights
  - Motor drives
  - Switching regulators
  - Load switches

The XPH4R10ANB and XPH6R30ANB MOSFETs are housed in an SOP Advance (WF) package with wettable flanks. This package allows the use of automated optical inspection (AOI) to ensure the highest quality of solder joints, ensuring compliance with the stringent specifications for the automotive industry.

Both devices are part of Toshiba's U-MOSVIII-H series and can operate at up to 175 °C (max.). The XPH4R10ANB supports a maximum continuous drain current of 70 A and 210 A when pulsed. The figures for the XPH6R30ANB are 45 A and 135 A respectively.

Product order code

- AR0233AT2B17XUEA0-DPBR-E
- AR0233AT2B17XUEA0-DRBR-E
- AR0233AT2C17XUEA0-DPBR-E
- AR0233AT2C17XUEA0-DRBR-E
- AR0233AT2C17XUEAH3-GEVB

AR0233AT

CMOS Image Sensor, Automotive Grade, Rolling Shutter, 2.6 MP, 1/2.5-inch Optical Format

AR0233-Hires.jpg

The AR0233AT image sensor delivers exceptional sensitivity for a wide variety of automotive applications. Built on a 3 µm Back Side Illuminated (BSI) pixel, the sensor provides greater than 140 dB of dynamic range and excels in low light conditions. New pixel technology includes attenuation of LED flicker, limiting the appearance of flicker from light sources while maintaining a high dynamic range output for camera monitor systems and algorithms. The sensor features an active array size of 2048 x 1280 pixels with 1080 p output at 60 FPS. It supports ASIL-B camera designs and it is available in automotive-qualified package options.

- **3.0 µm dual conversion gain BSI pixel technology**
- **More than 95 dB dynamic range from one exposure, multi-exposure mode > 140 dB HDR**
- **ASIL-B safety design, ISO26262 compliant**
- **Low-noise, low-power analog architecture**

Features

- Super-Exposure with LED Flicker Mitigation
  - More than 95 dB dynamic range from a single exposure
- 120 db with Dual-Exposure (LFM + HDR)
- Multi-exposure mode for > 140 dB High Dynamic Range
- ASIL-B safety design, ISO26262 compliant
- Generation-3 motion compensation
- Adaptive noise reduction filter
- Advanced context switching
- 4-lane MIPI CSI-2 interface
- 2048 x 1280 at 45 FPS
- 1920 x 1080 at 60 FPS
- Available in multiple automotive-qualified package options

Key Applications

- Automotive:
  - Front view camera (ADAS)
  - High-end surround-view and RVC
  - ADAS + viewing fusion
  - Camera systems for mirror replacement

The AR0233AT image sensor is part of ON Semiconductor's Hayabusa sensor family, which enables customers to create flexible platform designs. Hayabusa image sensors are based on a common architecture and pixel platform ranging from resolutions from 1.3 MP to 3.1 MP.

All Hayabusa products offer key features necessary for automotive imaging applications such as simultaneous on-chip high dynamic range (HDR) with LED flicker mitigation (LFM) with Super-Exposure capability, real-time functional safety, and automotive grade qualification.

OpenRTK330LI EVK

Precise Positioning Development Platform with a Compact RTK INS module & Precision IMU

OpenRTK330LI EVK

The OpenRTK330LI EVK accelerates the development & time to market of custom navigation and guidance systems fusing inertial measurements and multi-band RTK/GNSS positioning. The OpenIMU330LI Module is a compact, low cost, state-of-the-art, high-performance RTK/GNSS receiver with built-in triple-redundant inertial sensors.
ACEINNA's OpenRTK330LI EVK provides the essential hardware, firmware, and development environment for engineers working on autonomous applications to quickly start developing algorithms and solutions. Within minutes of receiving the EVK, engineers can be logging and visualizing positioning data with centimeter precision.

- **Integrated INS with dual-band GNSS receiver, triple-redundant IMU, RTK positioning engine**
- **Open-source development, embedded web server & NTRIP client**
- **Centimeter-level positioning algorithms & sensor fusion**
- **Evaluation kit includes multiple connectors, L1/L2/L5 GNSS antennae, and ST-Link debugger**

Features

- Evaluation kit based on the OpenRTK330LI module:
  - Rapid application development
  - Easy integration into the final product
- 100 Hz GNSS + inertial solution
- GNSS: GPS, GLONASS, BeiDou, Galileo, QZSS
- Position, velocity, and attitude sensing (roll, pitch & heading/yaw)
- Centimeter-level positioning solution & algorithms
- 80 channels tracking and RTK algorithm support
- Integrated and calibrated triple-redundant MEMS inertial measurement unit (8 g and 400 °/s)
- On-board application processor with built-in NTRIP client and web server
- Ethernet, Bluetooth, UART, USB, and CAN Interfaces (J1939)
- Open-source GNSS/IMU data-flow framework enables users to build and implement their own GNSS/INS algorithms
- Android application for mobile device
- Web-based application GUI for visualization (Aceinna Navigation Studio)
- Visual Studio Code plugin

Key Applications

- 3D machine control
- Drones/UAV
- Surveying & mapping
- Last-mile delivery robots
- Automotive:
  - Guidance systems for construction vehicles
  - Navigation systems for autonomous agricultural vehicles
  - ADAS & lane-keeping enhancement

Aceinna's OpenRTK330LI EVK is an embedded sensor fusion platform that allows rapid development of custom navigation and guidance systems. It is complemented by an easy to use web-based application GUI and a rich set of embedded and published algorithms, allowing engineers to move directly into the development phase, thus reducing development costs.

The OpenRTK330LI EVK also represents a cost-effective turnkey solution that can be easily integrated into the final product, leveraging the benefits of its easy-to-use development ecosystem and reducing the time to market.

COMFORT & LIGHTING

Advanced transportation capabilities have allowed us to significantly shorten distances and increase the radius of our operating space. As mobility evolves, this trend will only continue. However, this modern way of life often means spending considerable time in personal or public transportation. For that reason, passenger comfort is highly important for designers of all classes and types of vehicles. As high-performance semiconductors become more compact, cheaper, and more readily available, the premium-class comfort features are slowly making their way to mass-produced vehicles. While in transport, passengers will be able to track their position, enjoy immersive multimedia content or even work on their business tasks, enjoying the increased availability of new ultra-fast WAN technologies, such as the 5G network.

With the recent breakthroughs in high-power & high-quality LED manufacturing technology, the transition to energy-efficient Solid State Lighting (SSL) quickly becomes a reality. LED lighting replaces traditional lighting solutions at a tremendous pace. Characterized by excellent efficiency, design flexibility, and compact dimensions, LEDs offer many new possibilities for an efficient, more reliable, and more comfortable vehicle lighting design.

Interior lighting can play a significant role in a vehicle, especially during long journeys. Some airlines have collaborated with sleep experts and experimented with specific wavelengths of cabin lighting that stimulate the body's production of the hormone melatonin. This, in turn, drives the so-called circadian biorhythm. Slight lighting coloration adjustments can help artificially lengthen or shorten a passenger's perception of the day so that their perceived time more closely matches the actual time at the destination. Differently customized LED lighting schemes can be used for each route to subtly revitalize the body at the appropriate time, making the flight less stressful while reducing the jet lag effect.

Existing traffic rules and regulations are being improved and updated continuously to ensure safety for all road users. However, most traffic accidents occur at night, mainly due to reduced visibility, especially in areas outside the city where there is no street lighting. There is a need for improved vehicle lighting that will not dazzle oncoming vehicles but will still provide enough light for drivers to clearly see the road ahead. The so-called Adaptive Driving Beam (ADB) headlights shine just as brightly as traditional high beam headlights but feature a technology that prevents dazzling drivers in the opposite lane.

These futuristic lights work as powerful LED projectors: they use multiple high-brightness LEDs organized into a matrix, shaping the resulting light beam according to road condition data obtained from image sensors. By utilizing modern object recognition systems based on AI and machine vision, the light beam can be adjusted to be brighter on signposts and dimmer on the oncoming vehicles. The headlights can also predict or track the road's slope and curvature, maintaining a constant beam width at all times. ADB matrix LED systems offer many possibilities, making night driving much safer

LEDs can also be very advantageous as the signal, brake, or fog lights. Thanks to their high brightness, LED signal or brake lights make it easier for other drivers to spot them, even in bad weather conditions. LEDs also have a virtually instantaneous response time. This feature makes them especially useful in emergency braking situations, providing the drivers behind more time to react. In fast-paced traffic, this can easily prevent an accident and save lives.

Product order code

- AUV3-SQ32-0RT0K
- AUV3-SQ62-0RT0K
- AUV3-SS32-0RU0K
- AUV3-SS62-0RU0K
- AUV3-ST32-0SV0K
- AUV3-ST62-0SV0K

AUV3-Sxxx – UV-A LEDs

Surface Mount UV LEDs for Curing and Horticulture

AUV3-Sxx2

Broadcom's AUV3-Sxxx 3535 surface-mount 3 W UV LEDs are energy-efficient LEDs that can be driven with high currents and can dissipate heat efficiently, resulting in higher reliability. Their low-profile package design addresses a wide variety of applications where superior robustness and high efficiency are required. They are packaged with ceramic-based materials, and the quartz lens on top of the package provides the product longevity needed for the respective end applications. To facilitate easy pick & place assembly, the LEDs are packed in tape and reel. Each reel is shipped in a single flux and single color bin to ensure close uniformity.

- **High-reliability package with quartz encapsulation**
- **High-radiant flux output using InGaN dice technolog**
- **Available in 360-nm to 400-nm wavelength range**
- **Available in 35 ° and 60 ° viewing angles**

Features

- Lens material:
  - Quartz lens
- Terminals finish:
  - Gold plated
- An electrically isolated thermal pad
- Manufacturing technology: InGaN
- Luminous flux:
  from 1020 to 1200 mW (typ.)
- Forward voltage:
  from 3.45 to 3.70 V (typ.)
- Absolute max. power:
  - 4000 mW
    (2800 mW for 360-nm devices)
- Absolute max. forward current:
  - 1000 mA
    (700 mA for 360-nm devices)
- Dimensions: 3.5 x 3.5 mm
- Compatible with the reflow soldering process
- JEDEC MSL 1
- RoHS6 compliant

Key Applications

- Industrial curing
- Photocatalyst purification
- Medical applications
- Horticulture

The AUV3-Sxxx series 3-watt UV LEDs are housed in a ceramic-based package that helps with thermal management, providing high reliability and robustness. In combination with their ability to produce a luminous flux of more than 1000 mW, the AUV3-Sxxx series UV LEDs are ideal for industrial applications that rely on photopolymerization.

These UV LEDs are also well-suited for applications in other industries, such as UV disinfection, photocatalyst purification (PCO), and horticulture.

OSRAM

Product order code

- Q65112A8150
- Q65112A8915
- Q65112A8917
- Q65112A9532
- Q65112A9533

OSLON® Compact PL (Gen 2)

Multi Chip LED Family Combining Excellent Brightness with Outstanding Luminance

Device	Brightness (I_F = 1 A)	Dimensions (mm)
KY CELNM2.FY	210 lm ... 310 lm	1.9 x 1.5 x 0.74
KW CELNM2.TK	355 lm ... 510 lm	1.9 x 1.5 x 0.73
KW2 CFLNM2.TK	700 lm ... 980 lm	3.1 x 2.46 x 0.73
KW3 CGLNM2.TK	1060 lm ... 1425 lm	3.56 x 3.1 x 0.73
KW4 CHLNM2.TK	1400 lm ... 1880 lm	4.66 x 3.1 x 0.73

OSLON® Compact PL Gen2 Series

OSLON® Compact PL series comprises single as well as multichip configurations for low/high beam application with best in class luminance performance. Its compact size enables narrow positioning especially beneficial for Adaptive Driving Beam (ADB) headlight solutions. The products combine the latest UX:3 chip technology with a homogeneous light-emitting area giving the highest flux performance for easier optical design and thermal management.

- **High luminance performance of up to 120 cd/mm**
- **Very small z-tolerance (±35 µm)**
- **Additional electrical isolated thermal pad to separate heat mgmt. from electrical circuit**
- **Latest chip technology providing typ. 395 lm at 1 A per mm**

Features

- Smallest possible distance between the light-emitting surface and optical system
- Distance from converter platelet to package edge:
  - 234 µm (left and right side)
  - 174 µm (top side)
- Isolated thermal pad for efficient heat management (3 pad design):
  - Isolates thermal management from the electric circuit
- Forward current (I_F) at T_S= 25 °C:
  - From 50 to 1500 mA
- Surge current (t ≤ 10 µs): 3000 mA
- ESD robustness:
  - 8 kV acc. to ANSI/ESDA/JEDEC JS-001 (HBM, Class 3B)
  - Internal ESD protection
- Corrosion robustness class: 3A
- Chip technology: UX:3
- Homogenous brightness and chromaticity:
  - Sorted in groups according to measured brightness and chromaticity
  - Dot Matrix Coded (DMC)
- Compact ceramic SMT package
  - Same footprint as OSLON Boost HM
- Operating temperature range:
  - From -40 to 135 °C
- AEC-Q102 qualified

Key Applications

- Automotive:
  - Adaptive Frontlight Systems (AFS)
  - Adaptive Driving Beam (ADB)
  - Low beam, High beam (HB/LB)
  - Turn indicators
  - Slim headlights
  - Daytime Running Light (DRL)
  - Fog lights
  - Special external lighting (glow, projection...)

OSLON® Compact PL is part of OSRAM Opto Semiconductors' successful OSLON® Compact brand family designed to meet the requirements of the miniaturization-driven headlight and turn indication applications. OSLON® Compact PL is interesting for both its small size and robust package and is therefore perfect for ADB HL applications.

With OSLON® Compact PL Series, customers are able to achieve a combination of excellent brightness and outstanding luminance.

OSRAM

Product order code

- Q65112A9451
- Q65112A9448
- Q65112A9872
- Q65112A9868
- Q65112A9970
- Q65112A9972

OSTUNE® E1608 & E3030

New Brand Family for High Quality Automotive Interior Lighting

OSTUNE E1608 & E3030 Product Image

Car interiors are becoming increasingly important in the latest generation of vehicles and are undergoing a fundamental image change. The OSTUNE® LED family from OSRAM Opto Semiconductors (OS) offers technological advantages and insights from the general lighting industry to the car – turning the driver's cab into a mobile living space.
These first two products of OSTUNE® cover a wide color temperature range and offer a coloring rending index (CRI) of more than 90, the highest CRI currently available for automotive applications.

- **High Color Rendering Index (CRI): 90+**
- **Fully automotive qualified: AEC-Q102**
- **Correlated Color Temperature (CCT): 2,700 K to 6,500 K**
- **Wide brightness range: 7 lm (E1608) to 80+ lm (E3030)**

Features

- Brightness range:
  - E1608: 1.8 to 3.9 cd at 30 mA
  - E3030: 18 to 33 lm at 60 mA
  - E3030: 45 to 82 lm at 140 mA
- Brightness binning: 1/3 bin
- Color temperature range:
  - 2,700 K (warm) to 6,500 K (cold)
- CCT binning: fine binning
- Viewing angle: 120 °
- Chip material: sapphire
- Corrosion robustness class:
  - E1608: 2B
  - E3030: 3B
- ESD: 2 kV acc. to ANSI/ESDA/JEDEC JS-001 (HBM, Class 2)
- Package:
  - E1608: pre-molded, solder control structure
  - E3030: QFN, solder control structure
- Size:
  - E1608: 1.8 x 0.8 mm footprint, 0.6 mm height
  - E3030: 3.0 x 3.0 mm footprint, 0.65 mm height
- Operating temperature range:
  - From -40 °C to 110 °C
- Binning Current:
  - E1608: 30 mA
  - E3030: 60 mA or 140 mA
- Max. current:
  - E1608: 33 mA
  - E3030: 200 mA

Key Applications

- Automotive interior illumination:
  - Reading light
  - Dome light
  - Make-up mirror
  - Glove box
  - Luggage & foot room illumination

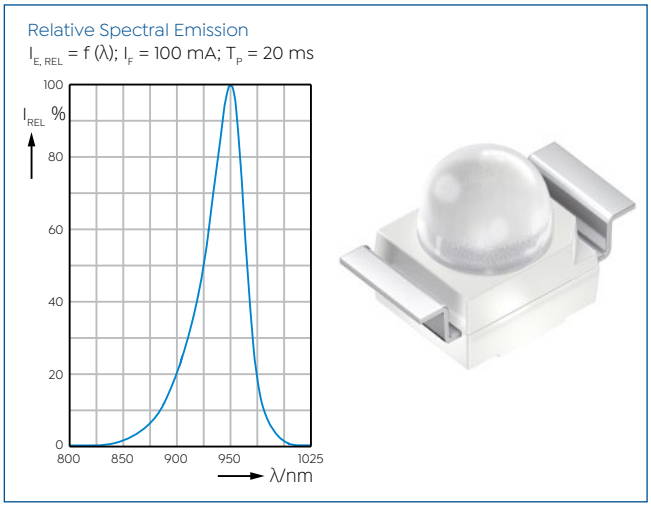
Automotive interior applications are changing and demanding two features, already well known at general lighting:

- Natural color rendering, requiring a CRI of 90+
- Supporting human centric lighting by tuning the color temperature from cold to warm.

OSRAM OSTUNE® products family features an excellent CRI of 90+ and covers the full range of CCT from 2,700 to 6,500 K.

SFH 4246R – IR Emitter

TOPLED® Reverse Gullwing Lens – 940 nm IR Emitter 24 °



SFH 4246R TOPLED® Reverse Gullwing Lens

Future vehicles will be equipped with more and more functions to make the interaction between occupants and vehicles more intuitive. Gesture control will be a major part of this trend. The new SFH 4246R TOPLED Reverse Gullwing is a perfect match for basic IC-based systems with discrete emitters and detectors to interpret simple gestures (left-right and up-down movements).

- **AEC-Q102 qualified**
- **940 nm IR Emitter**
- **Field of view: ±12 °**
- **High radiant intensity: 100 mW/sr at 100 mA**

Features

- Centroid wavelength 940 nm
- Spectral bandwidth: 42 nm (typ.)
- Highly efficient IR LED emitter
- Radiant intensity (I_F= 100 mA): 100 mW/sr
- Fast switching time (t_R/t_F): 12 ns/12 ns
- Maximum forward current (I_F): 100 mA
- Maximum surge current (t_P ≤ 200 µs): 1 A
- Forward voltage (I_F = 100 mA): 1.4...1.7 V
- ESD: 2 kV acc. to ANSI/ESDA/JEDEC JS-001 (HBM, Class 2)
- Corrosion robustness class: 3B
- Short switching times
- Dimensions of active chip area: 0.3 x 0.3 mm
- Package dimensions: 2.8 x 3.2 x 3.5 mm
- Reverse gullwing package
- Operating temperature range: -40...100 °C

Key Applications

- Automotive:
  - Gesture recognition & detection
- Industrial automation
  - Light barrier
  - Vision control
  - Machine control
- Electronic equipment

The SFH 4246R IR emitter is well-suited for space-constrained automotive gesture detection applications. Thanks to its reverse gullwing package, the SFH 4246R can be mounted upside down, allowing it to shine through the PCB (via opening), allowing a protective cover to be placed directly above the IR emitter - given that the bottom side of the PCB is unpopulated. It also allows for optimized placement relative to the IR photodetector.

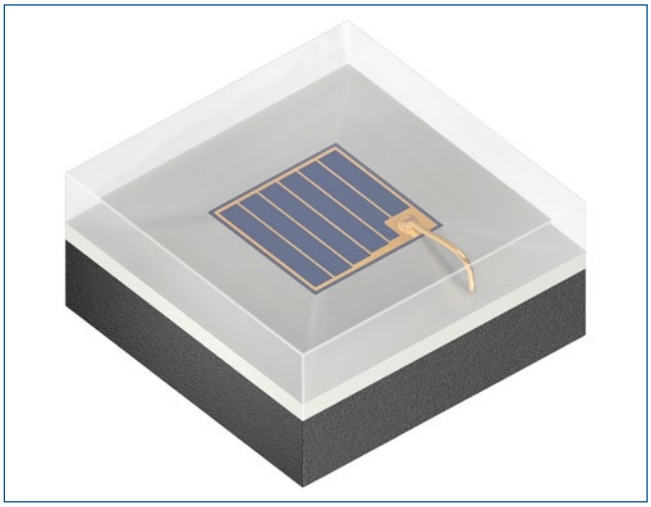
SFH 4246R features a focusing lens that narrows the beam to 24 °, allowing for accurate gesture detection in basic gesture detection applications.

OSRAM

Product order code
- Q65112A9015
- Q65112A9067

OSLON® Piccolo

High Power IR Emitter with AEC-Q102 Qualification



OSLON® Piccolo IR LED

The OSLON® Piccolo is a new member of OSRAMs Power IR Emitter family for automotive applications, which combines high optical power (1.15 W at 1 A) with a very small footprint of only 1.6 x 1.6 x 0.81 mm. It comes with two options (850 nm and 940 nm) and is perfectly suited for IR illumination applications that require small size components due to restricted board space, e.g., in modern slim displays. Short switching times around 10 ns also permit its use in 3D ToF systems, making the OSLON® Piccolo a useful fit for gesture sensing applications. A temperature range of -40 to 105 °C even exceeds the requirements of the AEC Q102 standard.

- **Smallest IR power emitter with more than 1 W optical output on the market**
- **Two wavelength options: 850 nm and 940 nm**
- **Fast response: rise time 9 ns, fall time 16 ns**
- **AEC Q102 qualified**

Features

- High-power IR LED emitter:
  - SFH 4170S A01: 850 nm
  - SFH 4180S A01: 940 nm
- Spectral bandwidth (typ.):
  - SFH 4170S A01: 30 nm
  - SFH 4180S A01: 37 nm
- Forward voltage (DC):
  - SFH 4170S A01: 3.25...3.6 V
  - SFH 4180S A01: 2.95...3.2 V
- Forward current (DC): 1 A (max.)
- High efficiency of up to 40%
- Double stack emitter technology
- ESD robustness:
  - 2 kV acc. to ANSI/ESDA/JEDEC JS-001 (HBM)
- Total radiant flux (typ.):
  - 1.15 W (I_F= 1 A, t_p= 10 ms)
- Package: clear silicone
- Corrosion robustness: 3B
- Package dimensions 1.6 x 1.6 x 0.81 mm
- Operating temperature range:
  - From -40 to 105 °C
- AEC-Q102 qualified

Key Applications

- Access control
  - Iris/retina scan
  - Face recognition
- Driver monitoring
- Seat occupancy detection
- Gesture recognition
- Eye-tracking
- Safety and security, CCTV

OSLON Piccolo high power IR LED emitters are housed in a specially developed compact package made of clear silicon. This ensures high robustness in a harsh environment, allowing them to comply with the stringent requirements of the AEC-Q102 standard. Double stack emitter technology enables high optical power of up to 1.15W at 1 A in DC operation, while its high efficiency reduces heat dissipation and facilitates proper thermal management.

Picollo IR emitters are sorted into three brightness groups (brightness binning): EB2, FA1, and FA2.

Product order code

- R7FA4M3AF3CFB#AA0
- R7FA4M3AF3CFP#AA0
- R7FA4M3AF3CFM#AA0
- RTK7EKA4M3S00001BE

RA4M3

32-bit 100 MHz Arm® Cortex®-M33 MCU with TrustZone® and Secure Element Functionality

Renesas RA4M3 with Enahnced Security Features - Application Examples

The Renesas RA4M3 group uses the high-performance Arm® Cortex®-M33 core with TrustZone®. In concert with the Secure Crypto Engine, it offers Secure Element functionality, as well as rich connectivity with USB 2.0 FS, SDHI, QSPI, and advanced analog.

The RA4M3 is supported by an open and flexible ecosystem concept - the Flexible Software Package (FSP), built on FreeRTOS, and it is expandable to other RTOSes and middleware. The RA4M3 is suitable for IoT applications that require future proof security, a large amount of embedded RAM, and low active power consumption (down to 119 µA/MHz while running the CoreMark® algorithm in Flash).

- **RA4M3 Arm® Cortex®-M33 based MCUs boost performance up to 100 MHz for IoT edge devices**
- **The latest ARMv8-M core architecture with TrustZone® and Secure Element (SE) functionality**
- **CTSU capacitive touch**
- **1 MB code FLASH, 8 KB data Flash (100,000 program/erase cycles), 128 KB SRAM**

Features

- Protected memory system architecture (PMSAv8)
- Secure MPU (MPU_S): 8 regions
- Non-secure MPU (MPU_NS): 8 regions
- DMA 8 channels + DTC 5 channels
- Multiple clock sources:
  - Clock trim function for HOCO/MOCO/LOCO
  - PLL/PLL2, Clock Out support
  - Dedicated on-chip oscillator for integrated WDT
- 12-bit ADC × 2, 12-bit DAC x 2
- Temperature Sensor (TSN)
- Serial Communications Interface (SCI) × 6, Asynchronous interfaces
- 8-bit clock-synchronous interface, Smart Card interface
- Manchester coding (SCI3, SCI4)
- I^2C bus interface × 2, Serial Peripheral Interface (SPI) × 1
- Quad Serial Peripheral Interface (QSPI)
- USB 2.0 Full-Speed module (USBFS)
- Control Area Network module (CAN) × 2
- SD/MMC Host Interface (SDHI), Serial Sound Interface Enhanced (SSIE)
- Security and Encryption:
  - Secure Crypto Engine 9
  - Symmetric & asymmetric algorithms: AES, RSA, ECC, DSA
  - Hash-value generation: SHA224, SHA256, GHASH, 128-bit unique ID
  - Individual security attribution for each peripheral
  - Device lifecycle management
  - Up to three tamper pins, secure pin multiplexing

Key Applications

- Secure gateway in industrial/home automation
- HMIs with robust capacitive touch
- Robots/Cobots
- Ethernet/CAN/GSM/Cloud gateway
- IoT communications platform & secure datalogger
- Alarm systems
- Control unit for power conversion applications
- Vending machines, cash registers

RA4M3 is a general purpose MCU, featuring cutting-edge security technology, and a rich set of peripherals. It has a very endurable built-in data flash of 8 KB with around 100,000 p/e cycles and 128 KB SRAM with Parity/ECC.

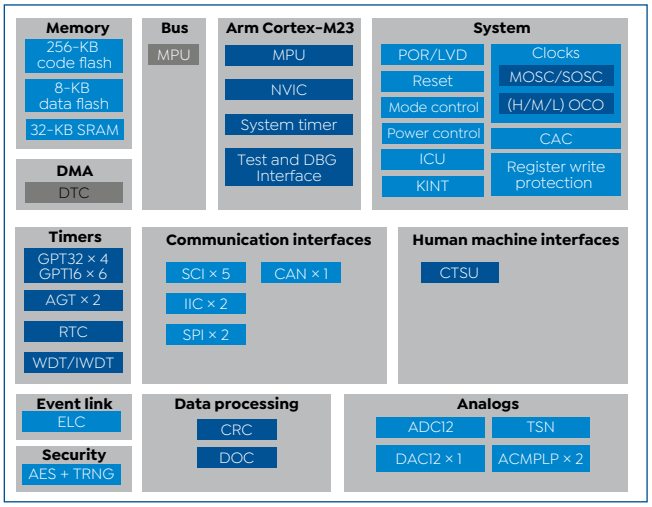
RA4M3 MCU is fully supported by Renesas's rich development ecosystem by Flexible Software Package (FSP), Intelligent pin mapping, TrustZone configurator, and more.

Product order code

- R7FA2L1AB2DFP#AA0
- R7FA2L1AB2DFM#AA0
- R7FA2L1AB2DFL#AA0
- RTK0EG0022S01001BJ
- RTK7EKA2L1S00001BE

RA2L1

Ultra-low Power Single-chip MCU Based on the 48-mhz Arm® Cortex®-M23 Core



RA2L1 Block Diagram

RA2L1 MCU Group is part of the RA2 MCU Series: It is a combination of a microcontroller with standard communication and timing peripherals, general-purpose analog, and new innovative capacitive touch sensing unit (CTSU2) with best-in-class performance. RA2L1 offers ultra-low power consumption ranked among the best in the industry using the company's well-known low-power 110 nm process. Moreover, RA2L1 products will be fully upward compatible with other members of the RA Family to support customers with additional needs for their other application designs.

- **Designed for ultra-low power consumption in both actvive and standby modes**
- **Higher integration support for wide operation voltage range and innovative perioherals**
- **On-chip peripheral functions enable system cost reduction**
- **Hardware safety and security features**

Features

- 48 MHz Arm®Cortex®-M23
- 128 KB & 256 KB Flash Memory and 32 KB SRAM with ECC
- 8 KB data flash memory (100,000 program/erase cycles)
- Low-power asynchronous general-purpose timer
- 32-bit & 16-bit general-purpose timers
- 12-bit A/D & D/A converters
- Low-power analog comparator
- Temperature sensor
- Enhanced capacitive touch sensing unit
- CAN 2.0A/2.0B
- Serial communications interfaces (UART, Simple SPI, Simple I²C)
- SPI/I²C Multimaster interface
- HW AES/TRNG & Unique ID
- HW safety features for IEC/UL60730 certification
- High current drive and 5 V tolerant I/O ports
- ±1% highly accurate integrated HS oscillator
- Wide operating voltage range: 1.6...5.5 V
- EEMBC ULP Mark certified score of 299
- Down to 64 uA/MHz in Active Mode, 250 nA in Software Standby Mode
- Flexible power architecture with fast wake up
- Best-in-class HAL driver code
- Support Arm® ecosystem and Renesas original development tool
- QFN 48, QFP-100, 80, 64, 48 pin package
- Operating ambient temperature (Ta): -40...105 °C

Key Applications

- Healthcare & Wearables:
  - User interface for medical & healthcare devices
  - Sensor management for detectors
- Smart Consumer & Building:
  - System control for HA
  - Power management for battery-powered applications
  - IoT nodes with low power consumption

The RA2L1 provides superior low power consumption in active and sleep/standby modes. Also, the RA2L1 integrates unique peripheral blocks such as CTSU2.

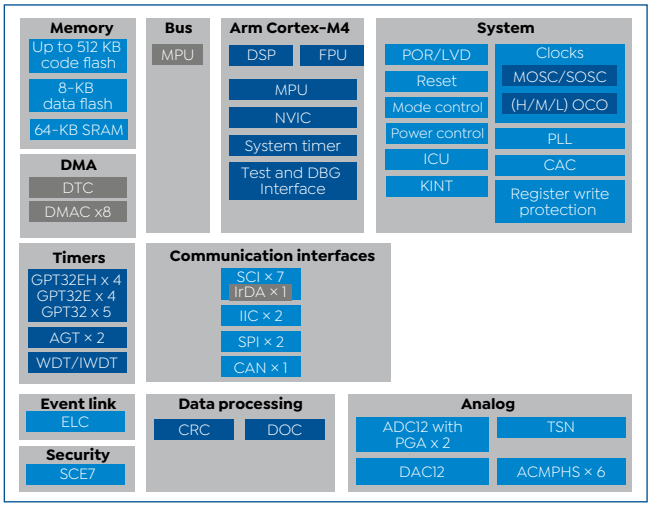
Designers can easily add touch interfaces that provide an impressively smooth and efficient user experience, even in the presence of moisture and noise, while maintaining low power consumption

Product order code

- R7FA6T1AD3CFP#AA0
- R7FA6T1AD3CFM#AA0
- R7FA6T1AB3CFP#AA0
- R7FA6T1AB3CFM#AA0
- RTK0EMA170S00020BJ

RA6T1

Arm® Cortex®-M4 core 32-bit MCU, 120MHz, Optimized for Motor Control



RA6T1 Block Diagram

Based on the Arm® Cortex®-M4 core, the new RA6T1 32-bit Microcontrollers (MCUs) operate at 120 MHz and feature a rich collection of peripherals optimized for high performance and precision motor control. The integrated peripheral functions with high-speed analog significantly reduce bill of materials (BOM) cost while boosting motor control performance. For example, a single RA6T1 MCU can simultaneously control up to two brushless DC (BLDC) motors. Also offers a new Renesas Solution Starter Kit (RSSK) for developers working on a motor control solution using the RA6T1 MCU.

- **Rich function PWM timer include high resolution mode (duty reatio at min 260 ps)**
- **High speed 12-bit A/D converter (up to 0.4 µs) with 3 ch sample and hold functions**
- **PWM shut-OFF function for protect the inverter circuit**
- **Easy motor control debugging and allows customers to immediately begin evaluating by RSSK**

Features

- Arm®Cortex®-M4 core working at 120 MHz
- 256 kB to 512 kB Flash memory and 64 kB SRAM
- 8kB Data Flash to store data as in EEPROM
- Scalable from 64-pin to 100-pin packages
- General PWM Timer - Enhanced High Resolution
- 12-bit A/D Converter with 3ch sample-and-hold functions
- High-Speed Analog Comparator
- Programmable Gain Amplifier
- CAN 2.0B
- SCI (UART, Simple SPI, Simple I^2C)
- SPI/I^2C Multimaster Interface
- LQFP64, 100-pin package
- Operating temperature (T_A): -40...105 °C

Key Applications

- Industrial:
  - Elevators, walkways
  - Robotics
  - Pumps, fans
  - Motion control, servo drives
- Smart Consumer & Building:
  - Home appliances
  - Ventilation, HVAC

RA6T1 group is a new member of the fast-growing 32-bit RA family. It is an ASSP product specialized in motor control. The utilized peripheral functions based on the motor control DNA, which Renesas has cultivated over many years thus far was inherited in RA and Arm® Cortex®-M4 CPU core.

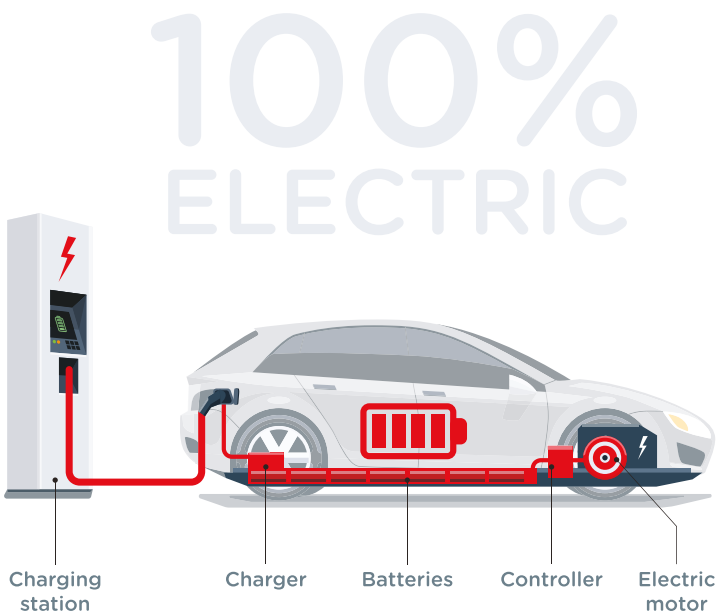
The RA6T1 MCU group is suitable for motor control in consumer, industrial automation, and building automation. For example, controlling the compressor and fan of an outdoor unit using RA6T1 can significantly reduce BOM costs.

THE POWERTRAIN

Energy consumption in the transport sector accounts for more than 31% of final energy consumption in the EU. The transport sector also records the fastest increase in total energy consumption per year, contributing to greenhouse gas (GHG) emissions by more than 23% (2012). If this were to continue, energy consumption and greenhouse gas emissions would increase by almost 50% by 2030. Fortunately, governments worldwide have understood the gravity of the situation and have already taken restrictive measures by imposing GHG emissions legislation. The plan is to reach the 'net-zero' GHG emissions by 2050, cutting them to 80% below 1990 levels. As a result, vehicle manufacturers are hard-pressed to develop more efficient and cleaner propulsion systems for their products.

As mentioned before, electricity is one of the cleanest forms of energy. However, achieving a sufficiently high energy density remains a real challenge for fully-electric vehicles (EVs), especially for aerial vehicles of any type, where weight is a crucial factor. Therefore, it's of the utmost importance for the vehicle's power distribution system to be extremely efficient. This issue has prompted the semiconductors industry to develop new and advanced solutions that enable the distribution and use of electric energy with virtually no losses. The most significant progress has been made recently in the field of wide-bandgap semiconductors (WBGs), allowing the semiconductors industry to push the envelope far enough to make EVs a viable solution to the ongoing pollution problem.

Given the prevalence of traditional ICE-powered vehicles and the supporting infrastructure, as well as the low production costs, the transition to vehicles with a fully-electric powertrain will be gradual, and again - with the developments on a sliding scale. Vehicles with partially electrified hybrid powertrains (HEVs) have already established themselves on the market, offering combined benefits from both worlds. However, there are a few problems that need to be solved before phasing out the ICE-based powertrain completely.



Current battery technologies provide a relatively low energy density compared to fossil fuels. Also, their charging time is significantly longer compared to refilling a fuel tank. Finally, most battery chargers are connected to the city's power grid, causing an additional load at the power plant, which in turn produces more GHG emissions. Although EVs do not yet provide a definitive solution to the zero GTG emissions problem, they do provide a significant level of reduction, thanks to their superior efficiency.

A possible solution to the GTG emissions problem is using renewable energy sources, such as photovoltaic cells. They can power some auxiliary systems while the vehicle is in motion or charge the primary batteries while parked. Although capable of eliminating GTG emissions, photovoltaic cells do not provide a feasible solution due to their low energy density, making the charging speed problem even more pronounced. However, as technology advances, we may be able to harvest solar energy much more efficiently sometime in the future.

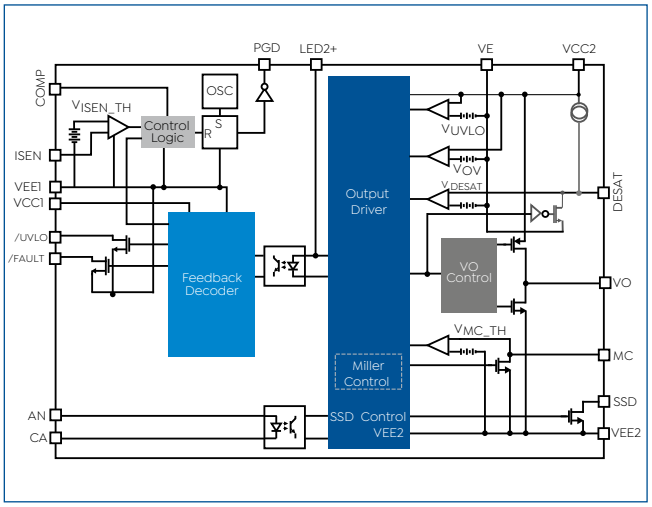
Another option could be using hydrogen-based fuel cells (FCs), which rely on the electrochemical principle to produce electricity. FCs do not generate GHG emissions as a byproduct of the reaction. Furthermore, the hydrogen tank can be charged just as quickly as a conventional fuel tank, which is a big advantage over electric battery chargers. However, the hydrogen-fueled powertrain concept still needs to overcome some early-stage development challenges: FC production is currently costly, hydrogen is difficult to store, and its production has not been perfected yet. Nevertheless, this concept represents a promising solution, which already seems like a good option to be adopted in heavy-duty vehicles, short term. Ultimately, this innovative technology could be a viable 'green' alternative to a hundred-year-old ICE design, which will help us reach the GTG emissions reduction target on time – before it's too late.

Product order code

- ACFJ-3530T-000E
- ACFJ-3530T-500E

ACFJ-3530T Automotive Coupler

Smart Gate Drive Optocoupler with Integrated Flyback Controller



ACFJ-3530T – Block Diagram

The ACFJ-3530T automotive R² Coupler™ smart gate drive optocoupler features an integrated flyback controller for isolated DC-DC converter, IGBT desaturation sensing with soft-shutdown protection and fault feedback, under-voltage lockout with feedback, and active Miller current clamping. The fast propagation delay with excellent timing skew performance enables excellent timing control and efficiency. This optocoupler comes in a compact, surface-mountable SO-24 package with 0.8 mm pitch for PCB space-saving, and is suitable for HEV and EV applications.

- **Qualified to AEC-Q100 Grade 1 test guidelines**
- **Automotive temperature range: -40 °C...+125 °C**
- **Minimum peak output current: ±1.5 A**
- **Minimum Miller clamp sinking current: 2 A**

Features

- Integrated flyback controller for isolated DC-DC converter for power supply control and diagnostic:
  - Regulated output supply voltage: 16 V ±5%
  - Programmable negative supply
  - Supply output overload protection
  - Supply output short circuit protection
  - External primary switch
- Maximum propagation delay: 200 ns
- Integrated fail-safe IGBT protection:
  - IGBT desaturation, overcurrent sensing, soft IGBT turn-OFF, and fault feedback
  - Undervoltage Lock-Out (UVLO) protection with feedback
- High noise immunity
  - Common Mode Rejection (CMR): 50 kV/µs at VCM = 1500 V
  - Miller current clamping
  - Direct LED input with low input impedance and low noise sensitivity
  - Negative gate bias
- SO-24 package with 8 mm creepage and clearance
- Regulatory approvals:
  - UL1577, CSA
  - IEC 60747-5-5
  - AEC-Q100 Grade 1

Key Applications

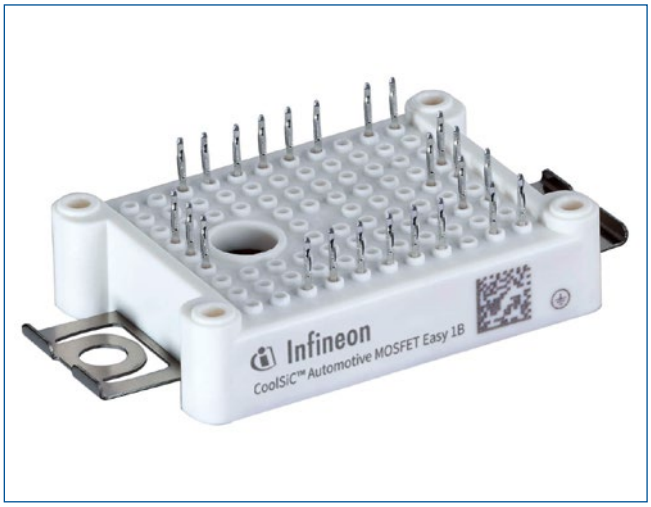
- Automotive:
- IGBT/SIC MOSFET gate driver applications:
  - Traction inverter
  - Charger and HVAC
  - In-wheel motor

The ACFJ-3530T automotive-grade smart gate driver simplifies the design of in-vehicle high-power circuits that incorporate IGBT/SIC MOSFETs, offering a rich set of features for their optimal performance. It features an integrated flyback controller for the isolated DC-DC converter that provides power supply control and diagnostic. It also includes features for improved noise immunity and reliable operation in a harsh automotive environment.

The ACFJ-3530T also includes Broadcom's R2Coupler™ isolation technology, which provides reinforced signal isolation, critical in automotive and high-temperature industrial applications.

EasyPACK™ CoolSiC™

Automotive MOSFET – FF08MR12W1MA1_B11A



Product picture

EasyPACK™ 1B is a 7.33 mΩ half-bridge module combining the new CoolSiC™ automotive MOSFET 1200 V technology, an NTC temperature sensor, and the proven PressFIT™ contact technology. With the full automotive qualification, the field of applications for CoolSIC™ is now extended to high voltage automotive applications with high efficiency and switching frequency requirements, such as HV/HV DC-DC step-up converters, multiphase inverters, and fast-switching auxiliary drives like fuel-cell compressors.

- **High gate threshold voltage preventing parasitic turn-ON (V_{th} = 4.4 V)**
- **Intrinsic diode with low reverse recovery**
- **IGBT compatible driving voltage (V_{GS} from -5 to +15 V)**
- **$R_{DS(ON)}$ = 7.33 mΩ (typical)**

Features

- Low stray inductance: 5 nH
- Blocking voltage: 1200 V
- Low switching losses
- Low gate charge (Q_G) and reverse transfer capacitance (C_{RSS})
- Operating junction temperature ($T_{VJ\,OP}$): 150 °C
- Integrated NTC temperature sensor
- Easy system assembly:
  - PressFIT contact technology for solder-less mounting
- Easy design:
  - Integrated module solution with optimized thermal management
- Superior reliability:
  - Gate oxide and cosmic ray robustness
- High flexibility:
  - The half-bridge concept for flexible inverter design
- Automotive qualified according to AQG 324
- RoHS compliant

Key Applications

- Automotive
  - Hybrid and electric vehicles (xEV)
  - Commercial, Construction and Agriculture Vehicles (CAV)
  - HV/HV DC-DC converters
  - Main inverters
  - Auxiliary drives

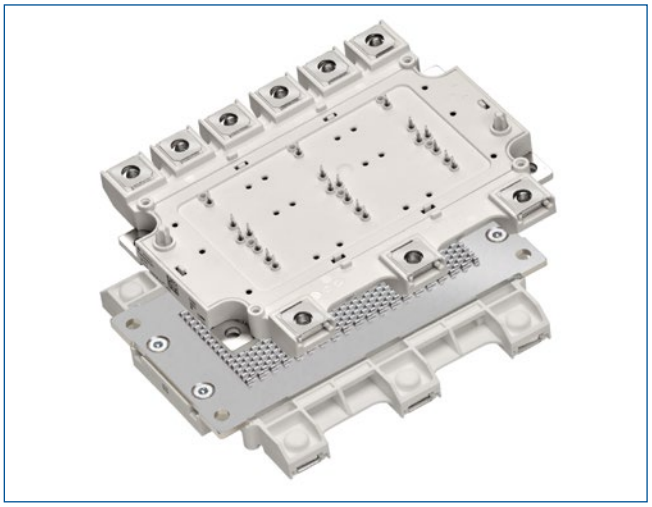
EasyPACK™ 1B automotive-rated CoolSiC™ MOSFET HB modules are perfectly suited for a broad range of automotive applications, featuring lower field failure rates due to superior gate oxide, less parasitic turn-ONs thanks to their high gate threshold voltage, and best-in-class Figure-of-Merit (FOM), ensuring compliance with the stringent automotive requirements.

CoolSiC™ automotive Trench-MOSFET devices feature very low switching losses combined with optimized conduction losses, especially under partial load conditions, which ensures an extended range for all types of hybrid and full-electric vehicles (xEV).

Product order code • SP001714512

HybridPACK™ DC6i

FS650R08A4P2



HybridPACK™ DC6i

HybridPACK™ DC6i 750 V, 650 A automotive-qualified IGBT module is a very compact six-pack module optimized for hybrid and electric vehicles. This power module combines the benchmark EDT2 IGBT generation with a direct-cooled baseplate with ribbon bonds (WAVE baseplate), an NTC temperature sensor, and PressFIT™ contact technology. It offers an upgrade path for HybridPACK™ 1 and DC6 modules, enabling inverter designs with an estimated power range of around 100 kW, with 400 A RMS, and 500 V DC capability (depending on the customer's design).

- **Blocking voltage 750 V**
- **Nominal current ($I_{C\,NOM}$): 650 A**
- **Direct-cooled baseplate with ribbon bonds (WAVE baseplate)**
- **Guiding elements for PCB**

Features

- Electrical:
  - $T_{VJ\,OP}$= 150 °C
  - Short-time extended operation temperature $T_{VJ\,OP}$= 175 °C
  - EDT2 chip technology optimized in the switching frequency range of 10 kHz
  - Superior efficiency by EDT2 technology for excellent light load power losses
  - 2.5 kW AC 1 min at 50 Hz
- Mechanical:
  - Integrated NTC temperature sensor
  - High creepage and clearance distances
  - Direct cooling via ribbon bond structure for improved heat dissipation
  - Compact design (25% smaller than HybridPack™ Drive)
  - Simplified assembly through PressFIT™ contact technology
  - Solderless mounting and guiding elements for PCB
- Highest reliability by short circuit ruggedness and increased blocking voltage
- Fully qualified for automotive (AQG324)
- RoHS compliant

Key Applications

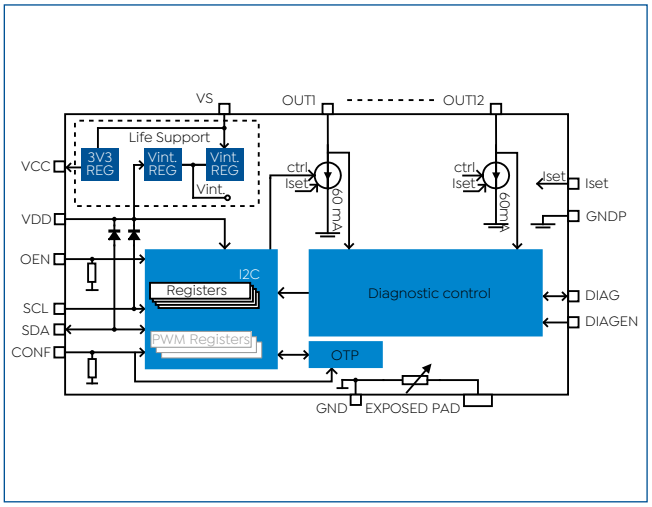
- Automotive:
  - Main Inverter
  - Hybrid and Battery Electric Vehicles (xEV)
  - Commercial, Construction and Agriculture Vehicles (CAVs)

HybridPACK™ DC6i compact automotive-qualified IGBT module represents a turnkey solution for faster time to market. This cost-optimized solution offers very high power density thanks to EDT2 technology while enabling easy and quick assembly using solderless PressFIT™ technology.

DC6 family of automotive IGBT modules offers great scalability for different power requirements (DC6 - DC6 Wave - DC6i). Providing industry-leading power density and efficiency with extremely low light-load losses, these devices are perfectly suited for the whole range of xEV applications.

NCV7685

12 Channel, 60 mA LED Linear Current Driver for Automotive Applications



NCV7685 – Block Diagram

The NCV7685 is designed for use in the regulation and control of LED in automotive applications and consists of 12 linear programmable constant current sources with common reference and up to 60 mA current per channel. The device can be used either in standalone or MCU-controlled applications. In MCU-controlled applications, it allows independent PWM duty cycle control via the I²C interface in 128 steps for eacht output channel.

The SECO-NCV7685-RGB-GEVB is an evaluation and reference design board for indoor and outdoor RGB LED automotive lighting applications, based on the NCV7685 and controlled by the NCH-RSL10. It is aimed at realizing general sequential or high-end pixelated LED lighting applications controlled from the in-vehicle network.

- **Twelve common current programmable sources up to 60 mA**
- **Independent PWM duty cycle control for each channel**
- **Open LED string diagnostics and protection features**
- **Low dropout operation for pre-regulator applications**

Features

- Independent PWM duty cycle control for each channel
- Global PWM duty cycle control via I²C
- Selectable 150, 300, 600, and 1200 Hz PWM frequency
- Selectable dimming response: linear or logarithmic
- Open LED string diagnostics
- Reduced EM radiation when all channels are activated at once
- Low dropout operation for pre-regulator applications
- Single resistor for global current setpoint (60 mA max.)
- Voltage reference 3.3 V, 1 mA
- 8-bit I²C interface with CRC8 error detection
- OTP bank for stand-alone operation (2 configurations)
- Output Enable pin
- Detection and protection against fault conditions
- Overtemperature detection and protection
- Low emission with spread spectrum oscillator
- AEC-Q100 and PPAP capable
- Compact SSOP24-EP package
- 8-ch, 100 mA option is also available (NCV7683)
- **SECO-NCV7685RGB-GEVB:**
  - Smart demo/eval board
  - Based on NCV768, NCH-RLS10 (BLE), NCV8170 (LDO), NCV891330 (3 A Buck Regulator), PCA9655E (16-bit Expander)

Key Applications

- Low-power exterior lighting
- Interior lighting
- Entry-level LED taillights
- Option level LED taillights with sequential turn indicator
- Turn signal and other externally modulated applications
- RGB LED driver

The NCV7685 is a scalable automotive LED driver solution, offering full flexibility for different functions: it can be used without a microcontroller in an entry-level and cost-effective LED lighting application, or it can be used in a microcontroller-based design, enabling fully animated LED lighting with minimal effort. Multiple devices can also be combined for more complex animation effects.

The SECO-NCV7685RGB-GEVB is a smart plug & play demonstrator with 16 RGB LEDs (48 channels), and BLE connectivity. It represents a proof of concept, demonstrating the simplicity of design for interior and exterior automotive LED lighting applications.

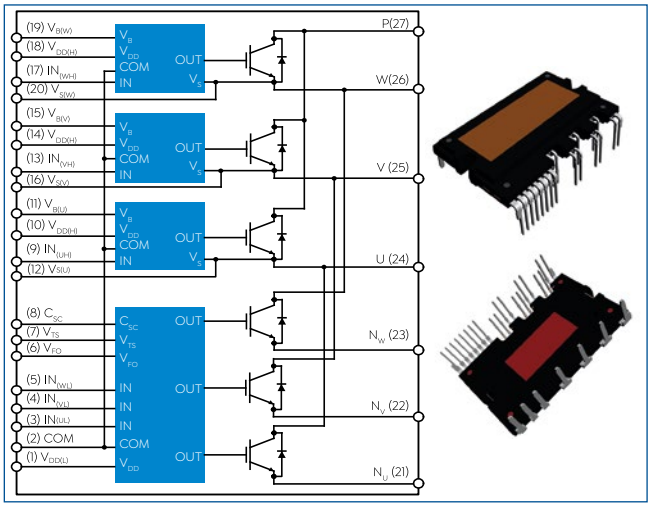
ON Semiconductor®

Product order code

- NFVA33065L32
- NFVA34065L32
- NFVA35065L32
- NFVA33065L42
- NFVA35065L42
- NFVA36065L42

NFVA3xx65L32/NFVA3xx65L42

ASPM27 Series, Automotive Three-Phase 650 V, IGBT Intelligent Power Module



NFVA35065L32-Diagram

The ASPM27 series advanced automotive Intelligent Power Modules (IPM) provide a fully-featured, high-performance inverter output stage for hybrid and electric vehicle applications. These modules integrate optimized gate drive for the built-in 650 V rated IGBTs to minimize EMI and losses, while also providing protection features enabling minimized EMI, compact system size, and increased reliability. The modules are qualified to AEC-Q100, Q101 & AQG324 and are available with a 30 A, 40 A, 50 A, and 60 A current ratings.

- **Automotive grade Intelligent Power Module (IPM) in 27-pin DIP Package**
- **30, 40, 50, 60 A/650 V three-phase IGBT Inverter with integrated gate drivers and protection**
- **AEC–Q100, Q101 & AQG324-qualified and PPAP capable**
- **Outstanding thermal resistance**

Features

- Automotive-grade Intelligent Power Module (IPM)
- 27-pin DIP Package
- Robust performance:
  - 175 °C guaranteed short-circuit rated FS Trench IGBTs with stable EMI performance
- Very low thermal resistance using AIN DBC substrate
- Separate open-emitter pins from low-side IGBTs for three-phase current sensing
- Single-grounded power supply
- LVIC temperature sensing built-in for thermal monitoring
- Isolation rating: 2500 V_{RMS}/1 min.
- AEC-Q100, Q101 & AQG324 Automotive-grade qualified, PPAP capable
- Pb-Free and RoHS compliant

Key Applications

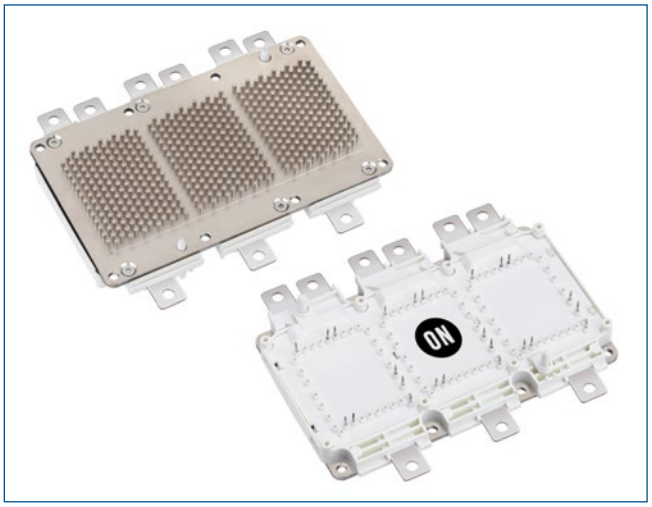
- Automotive & Industrial:
  - HV auxiliary motor applications, including:
  - Climate e-Compressor
  - Oil/water pump
  - Super/turbo chargers
  - Variety of fans

The ASPM27 series advanced IPMs are characterized by exceptional robustness, excellent EMI performance, and compact design. These features are achieved by integrating a high-voltage gate driver circuit (HVIC) optimized to drive built-in IGBTs with minimal losses while providing a full range of protection features. The HVIC requires only a single supply voltage and can be controlled by logic-level signals.

The ASPM27 series IPMs are perfectly suited for high-voltage auxiliary motor driving applications in the automotive industry.

NVH820S75L4SPB

VE-Trac™ Direct Power Module, Automotive 750 V, 820 A, 6-Pack



NVH820S75L4SPB_SSDC33

The NVH820S75L4SPB is a power module from the VE-Trac™ Direct family of highly integrated power modules with industry-standard footprints for Hybrid and Electric Vehicle (HEV) traction inverter application. The module integrates six Field Stop 4 (FS4) 750 V Narrow Mesa IGBTs in a 6-pack configuration.
The FS4 IGBTs show low power losses during lighter loads, which helps to improve overall system efficiency in automotive applications. For assembly ease and reliability, a new generation of press-fit pins is integrated into the power module signal terminals.

- **Direct cooling with integrated Pin-Fin heatsink**
- **Ultra-low stray inductance**
- **T_j (max.) 175 °C continuous operation**
- **AQG324 qualified FS4 750 V Narrow Mesa IGBT**

Features

- Direct cooling with integrated Pin-Fin heatsink
- Highly integrated 6-pack topology
- Collector to emitter voltage (V_{CES}): 750 V (max.)
- Implemented collector current (I_{CN}): 820 A (max.)
- Ultra-low stray inductance: 8 nH
- Continuous operation at T_j (max.) = 175 °C
- 4.2 kV isolated DBC substrate
- Low V_{CESAT} and switching losses
- Fast recovery diode chip technologies
- Integrated NTC resistors for temperature sensing
- AQG324 qualified FS4 750 V Narrow Mesa IGBT
- PB-Free, RoHS compliant
- The module frame meets the UL94V-0 flammability rating

Key Applications

- Automotive:
  - High voltage traction inverters
  - High power DC/DC converters

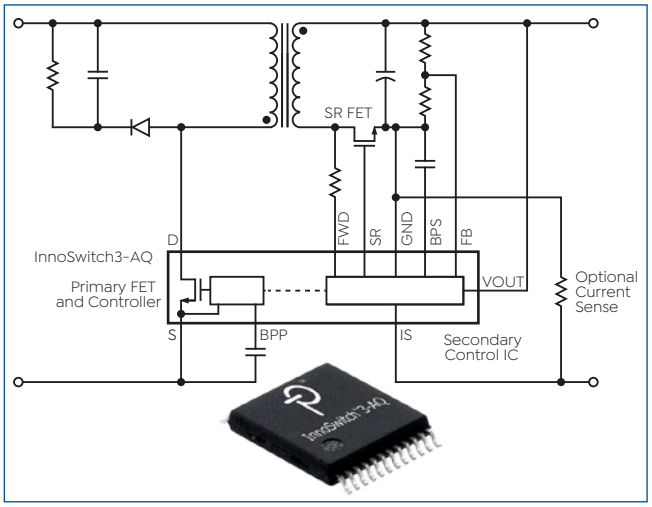
The NVH820S75L4SPB module is a perfect fit for the demanding traction inverter applications with 400 V battery architecture. The industry-standard package direct cooling helps make a seamless transition to ON Semiconductors and comes with an integrated Pin-Fin heatsink in the base plate that reduces overall system costs.

The module is integrated with press-fit pins for assembly and reliability. The device can operate continuously at a junction temperature of up to 175 °C, allowing more power to be delivered within the compact footprint of the inverter.

Product order code • INN3977CQ-TL

InnoSwitch3™-AQ

InnoSwitch3™ High-Voltage Switcher ICs for Automotive Applications



Innoswitch3-AQ Application Circuit

The AEC-Q100-qualified InnoSwitch3™-AQ is a flyback switcher family with an integrated quasi-resonant (QR)/CCM flyback controller, 750 or 900 V MOSFET, and secondary-side sensing. The InnoSwitch3™-AQ device family targets automotive EV applications, such as traction inverters, OBC (on-board charger), EMS (energy management DC/DC bus converters), and BMS (battery management systems). These devices can achieve ±3% accuracy for combined line and load regulation while eliminating isolated transformer sense-windings and optocouplers. The on-chip synchronous rectifier controller delivers over 90% efficiency at the nominal 400 V DC bus voltage and can be used at 800 V bus voltage with the Stack FET.

- **AEC-Q100 qualified**
- **Up to 90% efficient across full load range**
- **Lowest component count PSU implementation**
- **Smallest PCB area**

Features

- Accurate regulation of better than ±3%
- 30 to 550 V DC input voltage (up to 925 V DC with StackFET)
- Digitally controlled via the I²C interface
- Fault protection and reporting:
  - Line over and undervoltage protection
  - Output overvoltage and overcurrent limiting
  - Thermal protection
- EcoSmart™ energy efficiency:
  - Less than 15 mW with no load (including sensing)
  - Simplifies compliance with all global energy efficiency regulations
  - Low heat dissipation
  - Advanced protection and safety features
  - Auto-restart after fault events
- Full safety and regulatory compliance:
  - Reinforced isolation
  - Maximum transient peak isolation voltage (V_{IOTM}) > 4000 V AC
  - 100% production HIPOT testing
  - UL1577 and TUV (EN60950) safety approved
  - Excellent EMC and noise immunity
- Field-proven InSOP-24D package
- Halogen-free and RoHS compliant

Key Applications

- Automotive:
  - Traction Inverter
  - On-board charger (OBC)
  - Energy Management System (EMS)
  - Battery Management System (BMS)

The InnoSwitch3-AQ family of devices dramatically simplifies the design and manufacture of flyback power converters, especially those that require high efficiency and compact size. The InnoSwitch3-AQ family combines primary and secondary controllers and safety-rated feedback into a single IC, enabling accurate output voltage regulation even with a wide input voltage ranging from 30 to 550 V DC or 30 to 925 V DC with the Stack FET.

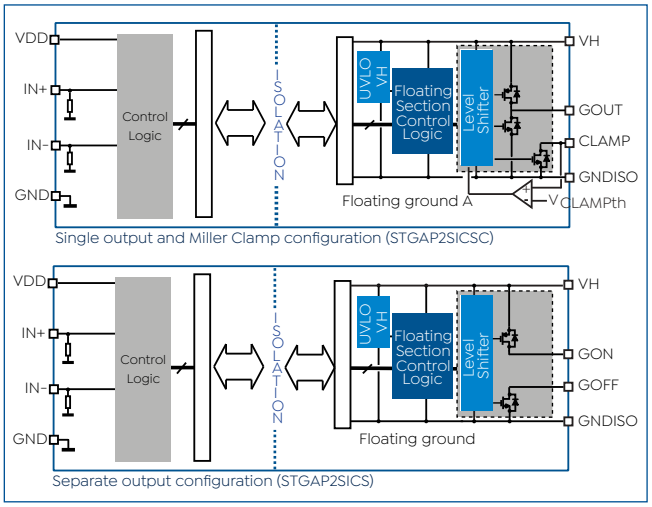
These ICs feature a range of fault protection features ensuring reliable operation and compliance with the strict safety requirements of the automotive industry.

Product order code

- STGAP2SICS
- STGAP2SICSC
- EVALSTGAP2SICS
- EVALSTGAP2SICSC

STGAP2SICS

6 kV galvanically isolated 4 A single gate driver for SiC MOSFETs



STGAP2SICS and STGAP2SICSC Block Diagram

The STGAP2SICS is a single isolated gate driver that provides galvanic isolation up to 6 kV between the gate driving channel and the low voltage control and interface circuitry. It is characterized by 4 A capability and rail-to-rail outputs, and is available in two different configurations:

The configuration with separated output pins allows to independently optimize turn-on and turn-off by using dedicated gate resistors.
The configuration featuring a single output pin and Miller CLAMP function prevents gate spikes during fast commutations in half-bridge topologies.

- **1200 V, 4 A sink/source capability**
- **6 kV galvanic isolation**
- **Miller CLAMP dedicated pin option**
- **UVLO & Watchdog functions**

Features

- High voltage rail up to 1200 V
- Driver current capability:
  - 4 A sink/source (at 25 °C)
- dV/dt transient immunity ±100 V/ns over the full temperature range
- Overall input-output propagation delay: 75 ns (typ)
- Separate sink and source option for easy gate driving configuration
- 4 A Miller CLAMP dedicated pin option
- Undervoltage Lockout (UVLO) function
- Overtemperature Shutdown Protection (OTP) function
- Gate driving voltage up to 26 V
- 3.3 V, 5 V TTL/CMOS inputs with hysteresis
- Stand-by function
- 6 kV galvanic isolation
- Operating junction temperature: -40...125 °C
- Maximum switching frequency: 1 MHz
- IC Package:
  - Wide-body SO-8W package

Key Applications

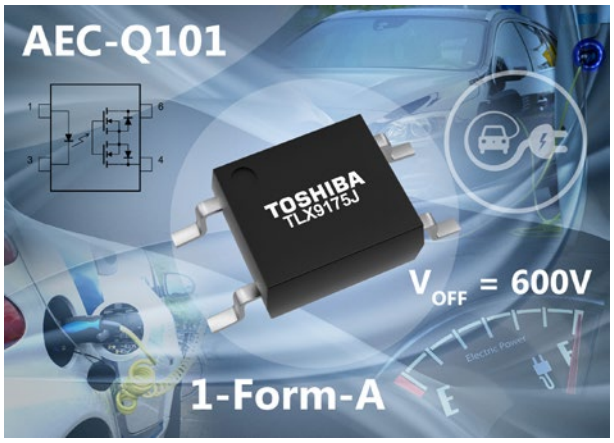
- Industrial:
  - Motor control
  - Factory automation
  - Industrial drives and fans
  - DC/DC converters
  - DC chargers
  - Welding

The STGAP2SICS isolated gate drivers offer extreme robustness for various applications, providing transient immunity of up to ± 100 V/ns and galvanic isolation up to 6 kV. These drivers also feature high switching frequency and extremely low signal propagation delay, enabling high PWM control accuracy.

Integrated protection functions, such as the OTP, UVLO optimized for SiC MOSFETs, and Standby Mode for reduced idle power consumption, facilitate the design of highly reliable applications, reducing both the design complexity and BOM costs.

TLX9175J Automotive Photorelay

AEC-Q101 Qualified Photorelay for BMS Applications



Toshiba TLX9175J

Toshiba's compact Automotive (AEC-Q101) qualified 600 V photorelay TLX9175J is the perfect device in 400 V EV/HEV battery systems.
TLX9175J integrates a long lifetime LED, a photosensitive photodiode-array, and a high voltage MOSFET between the relay's output terminals, which meets the needs of battery control and battery monitoring systems.

- **AEC-Q101 qualified photorelay**
- **600V OFF-state voltage, ideally suited for automotive battery control**
- **Compact 4-pin SO6 package**
- **Wide operation temperature range: from -55 °C to +105 °C**

Features

- An ideal solution for compact battery management and battery monitoring systems
- Addresses isolation requirements in automotive equipment and EV/HEV designs
- Normally open 1-Form-A device with a peak OFF-state voltage of 600 V (min.)
- Low LED trigger current of 3 mA (max.)
- Features an ON-state current of 15 mA (max.)
- Guaranteed switching times:
  - 0.35 ms (max.) over temperature
- Integrates a long lifetime LED, a photosensitive photodiode-array, and a high voltage MOSFET between the output terminals
- Wide operation temperature range:
  - From -55 to +105 °C
  - Ideally suited to the needs of automotive battery control
- AEC-Q101-qualified
- Supplied in a low-profile compact 4-pin SO6 package
  - Creepage/clearance distances: ≥ 5 mm
  - Internal isolation thickness: ≥ 0.4mm
  - Low-profile package ≤ 2.3 mm
  - Isolation voltage = 3750 V_{RMS} (min.)

Key Applications

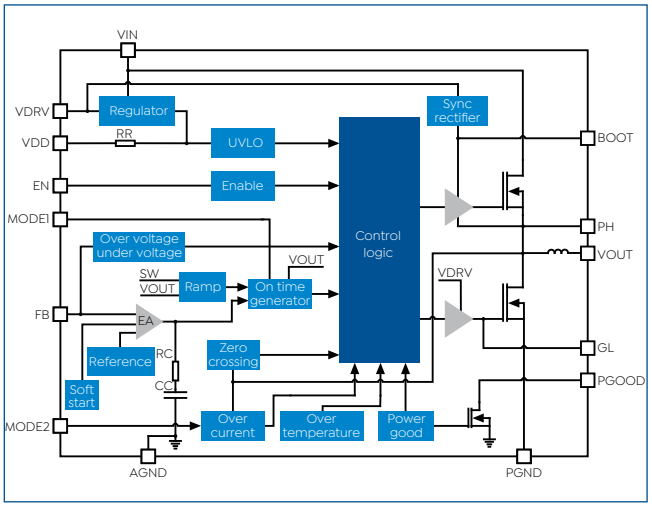
- Automotive:
  - Battery control and measurement
  - Battery Management Systems (BMS)
  - DC/DC converters
  - Other xEV-related applications

With more than 20 years of experience in the automotive photocouplers market, Toshiba provides suitable products for the increasing isolation requirements in today's automotive applications.

Toshiba's high-power infrared LEDs with a Multi Quantum Well (MQW) structure allow operation at high-temperature conditions and show much lower output degradation over time than standard LEDs. Performance remains very stable and design becomes very easy.

SIC931BED-T1-GE3

New microBRICK® SIC931BED-T1-GE3, 4.5 V to 18 V, 20 A



SiC931 - Block Diagram

One of the biggest challenges in system design is powering the next generation of microprocessors, DSPs, FPGAs, and ASICs. The SiC931 is the first member of the microBRICK® family, offering a simple solution for building efficient high-density DC/DC converters with a wide input voltage range. An innovative packaging solution offers several advantages, both thermal and electrical. Measuring only 10.6 mm by 6.5 mm with a low 3 mm profile, Vishay's microBRICK® modular solution occupies less than 30% of the area and less than 50% of the volume compared to the closest competing module.

- **Wide input voltage range, adjustable output voltage down to 0.6 V**
- **Very high peak efficiency of 95%**
- **Four programmable switching frequencies, up to 2 MHz**
- **A rich set of protection features with fault reporting**

Features

- High efficiency:
  - Peak efficiency at 1.5 MHz: 95%
  - 1 µA supply current in shutdown mode
  - 50 µA operating current
- Input voltage range: from 4.5 V to 18 V
- Adjustable output voltage: down to 0.6 V
- Output voltage accuracy: ±1% (-40...125 °C)
- Improved robustness and reliability:
  - Cycle-by-cycle current limiting
  - Output overvoltage/ undervoltage protection
  - Short circuit protection with auto-retry feature
  - Temperature protection
  - Power Good signal
- Adjustable soft start and current limit options
- Four programmable switching frequencies:
  - 600 kHz, 1 MHz, 1.5 MHz, 2 MHz
- Programmable operating modes:
  - Forced continuous, conduction, power save
- Tight ripple regulation at light loads
- Ease of design with reduced BOM cost
  - An integrated high-current output inductor
- Significant reduction in design cycle time
- Cost-effective modular solution
- Compact package size: 10.6 x 6.5 x 3 mm
- Operating temperature range: -40...125 °C
- Pb & Halogen-free, RoHS compliant

Key Applications

- Industrial & consumer applications:
  - FPGA power supply
  - 5 V and 12 V input rail POLs
  - Industrial automation applications
  - Consumer electronics

The highly-integrated SiC931 DC/DC regulator is housed in a compact package that provides excellent thermal performance. It operates at a low temperature, reducing the impact on the overall thermal performance of the underlying design.

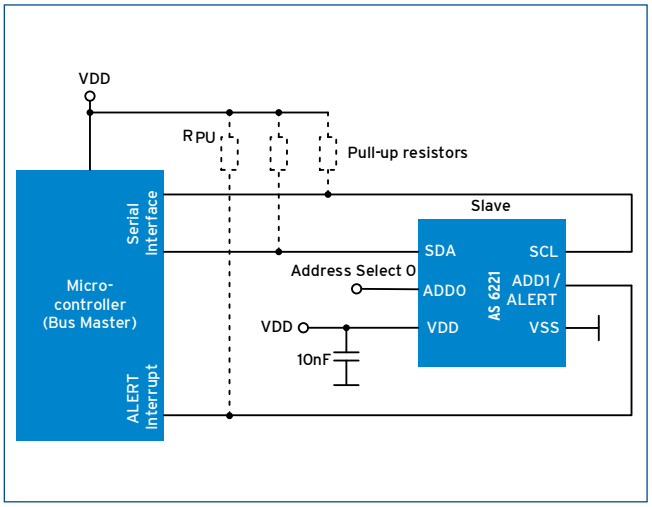
A selectable switching frequency of up to 2 MHz ensures low EMI and reduced size of the energy storage elements, while tight ripple regulation at light loads ensures reliable operation in power-sensitive embedded designs that include FPGAs, MPUs, DSPs or similar devices.

Product order code

- 505430040
- 505430041
- 990601151
- 990601152

AS6221

Highly Accurate Digital Temperature Sensor



AS6221 Application Circuit

The AS6221 is a highly accurate digital temperature sensor with an accuracy of 0.09 °C, which is ideal for healthcare applications, wearables, and devices requiring high-performance thermal information. The AS6221 is a complete digital sensor system, requires no calibration or linearization. The ultra-small size of the sensor (WLCSP 1.5 x 1.0 mm) enables accurate body/skin temperature measurements in health and lifestyle monitoring products. In addition to the high accuracy and the small form factor, the AS6221 offers very low power consumption: performing measurement with 4 samples per second (SPS), the current consumption is only 6 µA.

- **High temperature accuracy of ±0.09 °C (20...42 °C)**
- **Ultra-low-power consumption: 6 µA at 4 SPS (typ.) and 0.1 µA in standby (typ.)**
- **Small form factor WLCSP package: total size 1.5 X 1.0 mm**
- **No calibration or linearization required**

Features

- A fully-digital system with up to eight I²C addresses
  - Selectable by two address selection pins (ADD0, ADD1)
- Programmable Alert OUT pin:
  - No need to constantly poll the sensor
  - Reduces overall power consumption
- Best-in-class accuracy:
  - ±0.09 °C in the range from 20 to 42 °C
- Resolution: 16 bits
- Conversion time: 36 ms (typ.)
- Operating temperature range from -40 to 125 °C
- Other benefits:
  - Space-saving with an ultra-compact footprint
  - Superior power efficiency for longer battery life
  - Easy-to-use solution for rapid application development
  - Enables multi-device topology for multi-point measurement
  - Easy to integrate with a standard serial bus connection

Key Applications

- Healthcare & Wearables:
  - Temperature sensing on skin
  - Mobile health applications
  - Fitness trackers and bands

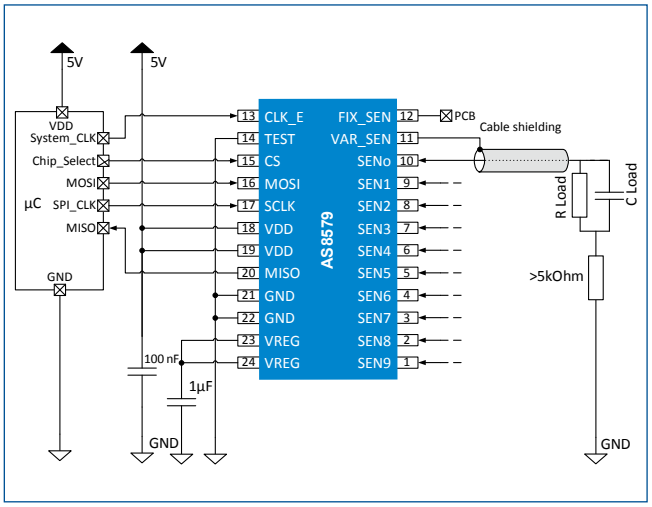
The AS6221 is a high-end digital temperature measurement solution from AMS, featuring extremely accurate temperature sensing in a very compact WLCSP form factor. It offers eight I²C addresses, allowing the development of multi-point temperature measurement applications on a single I²C bus, reducing the overall BOM costs.

High measurement accuracy combined with very low power consumption, makes the AS6221 a perfect choice for wearable applications, but also for other applications that require high accuracy and low power consumption.

Product order code
- 510210009
- 510210005
- 990601098

AS8579

Automotive-Grade Capacitive Sensor



AS8579 Application Circuit

AMS's highly accurate capacitive sensors enable reliable and accurate presence detection of humans in automotive systems. The AS8579 sensor is capable of detecting the change of capacity in different applications by measuring the relative change of the impedance, which is dependent on the circuit. Apart from using the AS8579 capacitive sensor for human detection, it can also be used for many other applications such as autonomous driving applications (e.g., hands on the steering wheel detection), fluid level sensing, or touchless trunk opening.

- **AEC-Q100 Grade 1 qualified**
- **Up to 10 independent measurement lines (10 SEN lines)**
- **VAR FIX_SEN function to avoid parasitic influence from the cables and PCB**
- **Designed according to the functional safety standard (ISO26262)**

Features

- System sensitivity: 12.5 LSB/pF (typ.)
- Overall system linearity: 1% (max.)
- Output total load capacitance (C_{LOAD}): 0...2000 pF
- Sensing capacity range (C_{SENSE}): 20...2000 pF
- Output resolution (accumulated): 14-bit
- Independent sensing lines: 10
- Programmable frequency at impedance measurement:
  - Improved EMC robustness
- SPI communication interface
  - SPI CLK frequency up to 10 MHz
- Built-in diagnostic features to meet safety requirements up to ASIL B
- I/Q-Signal demodulation for accurate capacitive measurement (RealCapSense):
  - Separation of resistive and capacitive readouts
  - Functions to avoid parasitic influence from the cables and PCB
- Other benefits include:
  - High durability and lower system costs
  - Enabler for safety-critical applications
  - Suitable for automotive applications

Key Applications

- Automotive:
  - ADAS applications (hands on the steering wheel detection)
  - Human presence detection inside the vehicle (seat occupancy detection)
  - Human presence detection outside the vehicle (automatic trunk opening detection)
  - Fluid level measurement

By using an advanced I/Q measurement principle with accumulated 14-bit resolution, the AS8579 sensor can reliably detect the target object (i.e., it is not so easy to fool the system into detecting the presence of a driver by placing an object on the steering wheel). High detection reliability under harsh EMI conditions, along with the AEC-Q100 qualification, enables the AS8579 to meet the ISO26262 functional safety requirements in automotive applications.

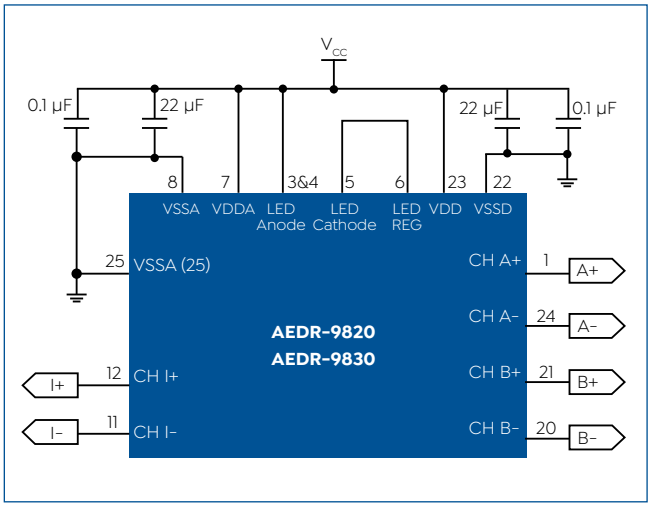
Combined Integration with a heating coil is also possible for further system cost reduction.

Product order code

- AEDR-9820-100
- AEDR-9820-102
- AEDR-9830-100
- AEDR-9830-102

AEDR-9820/9830

Three-Channel Reflective Analog or Digital Incremental Encoder



AEDR-9820/9830 Applicaiton Circuit

The AEDR-9820 and AEDR-9830 are miniature reflective incremental encoders with configurable outputs, operating at extended temperature and frequency ranges. They offer a 2-channel differential analog (AB) with a third channel (I) differential analog Index or digital Index output, or a 3-channel differential (ABI) digital index outputs for linear and rotary applications, starting at 4.6 mm optical radius. The differential or TTL compatible output signals can be directly interfaced to most signal processors. Their small size and programmable resolution provide easy integration into small motors, actuators, linear stages, and medical equipment.

- **Miniature size: 4 x 4 mm**
- **For small size motor, high speed and high temperature applications**
- **Built-in pin selectable interpolation**
- **Suitable for linear and rotary applications**

Features

- Operating Voltage: 3.3 V...5 V
- High encoding resolution (Lines Per Inch/mm):
  - AEDR-9820: 225 LPI (8.86 LPmm)
  - AEDR-9830: 318 LPI (12.52 LPmm)
- Examples:
  - AEDR-9820: RoP base 4.6 mm, 256 CPR
  - AEDR-9830: RoP base 7.95 mm, 625 CPR
- Base frequency 200 kHz and up to 2 MHz at 16 x interpolation
- Configurable analog or digital outputs:
  - Analog: 2-ch diff. output and diff. digital or analog index output
  - Digital: 2-ch quadrature (AB) outputs, 1-ch index output
  - Digital outputs configurable as differential or TTL-compatible
- Pin-selectable interpolation up to 16 x
- Pin-selectable analog or digital output
- Infrared (IR) light source:
  - More robust to contamination
- Compact dimensions: 4.0 x 4.0 x 1.05 mm
- Operating Temperature range:
  - -40...115 °C (extended industrial temperature range)
- Optional parts (AEDR-9820A and AEDR-9830A):
  - Automotive Grade 1 (-40...125 °C)
  - Automotive AEC-Q100 qualified

Key Applications

- Closed-loop stepper motors
- Small motors, actuators
- Industrial printers
- Robotics
- LiDAR
- Pan-tilt-zoom camera
- Portable medical equipment
- Linear stages

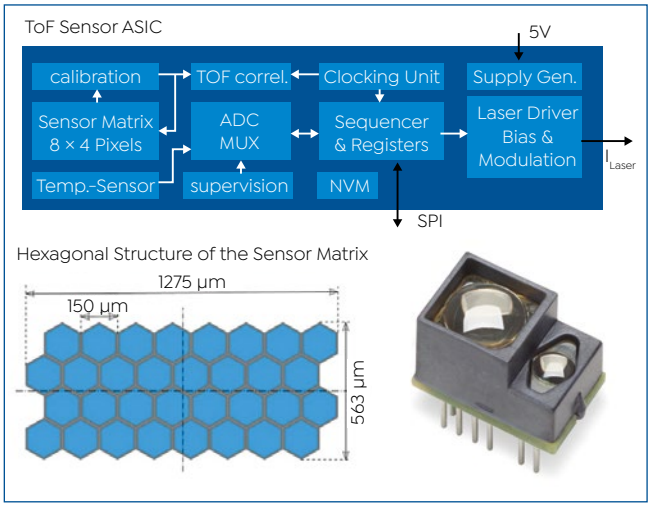
Broadcom's AEDR-9820/9830 reflective incremental encoders are designed to operate at high speeds and extended temperature range. These ICs integrate an IR light source and a photodetector in the same package, enabling high robustness against contamination. Automotive AEC-Q100 compliant options are also available.

The AEDR- 9820/9830 encoders represent a perfect choice for a broad range of applications where limited space is a primary concern, e.g., robotics or industrial printers.

Product order code
- AFBR-S50MV68B
- AFBR-S50MV68B-EK

AFBR-S50MV68B

Time-of-Flight Sensor Module for Distance Measurement



AFBR-S50MV68B

The AFBR-S50MV68B is a multi-pixel optical distance and motion measurement sensor module based on the optical Time-of-Flight (ToF) principle. It has been developed with a special focus on industrial and other applications with the need for the highest speed and accuracy at medium distance ranges (up to 10 m), with small size and very low power consumption. The module has an integrated 680 nm laser light source and due to a 1 ° x 1 ° emission cone, it can typically use between 1 and 2 pixels, depending on distance and remission of the measured object.

- **Integrated 680 nm laser light source**
- **Field-of-View (FoV) of 12.4 ° x 6.2 ° with 32 pixels**
- **Typical distance range up to 10 m and beyond**
- **Reference Pixel for system health monitoring**

Features

- Transmitter beam of 1 ° × 1 ° to illuminate between 1 and 2 pixels
- Receiver with 32 pixels
  - Field-of-View (FoV): 12.4 ° × 6.2 °
  - FoV per pixel: 1.55 ° × 1.55 °
- Distance range 10 m (typ.)
- Reference pixel for system health monitoring
- Measurement rates of up to 3 kHz
- Unambiguous range up to 100 m with dual-frequency mode
- Operation of up to 100 klx ambient light
- Single voltage supply of 5 V
- Current consumption: 33 mA (typ.)
- Integrated voltage and temperature sensors
- Integrated calibrated clock source
- Accuracy error typically below ±1%
- Laser Class 1 eye-safe ready
- Drop-in compatible within the AFBR-S50 sensor platform
- Size without pins, L × W × H: 12.4 × 7.6 × 7.9 mm
- Operating ambient temperature range: –20 °C...50 °C
- RoHS I and II, REACH compliance

Key Applications

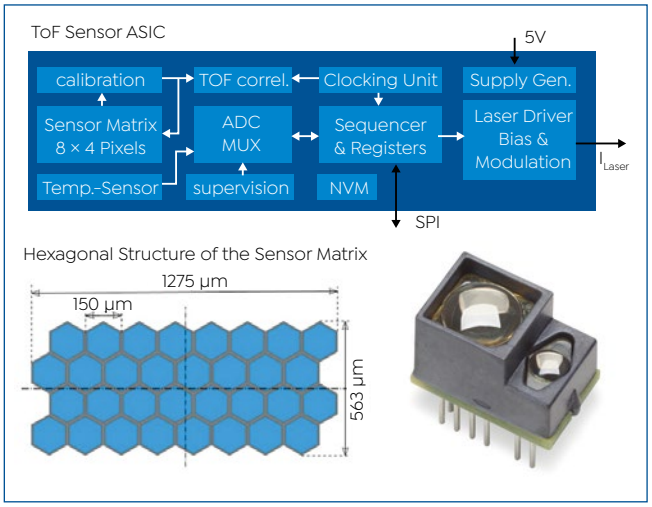
- Smart Consumer & Building:
  - Distance measurement
  - Security surveillance
- Industrial:
  - Robotics
  - Human Machine Interfaces (HMI)
  - Automation and control
  - Inventory monitoring
  - Light barrier
  - Industrial sensing

This high-performance ToF module has an integrated infrared laser light source and an internal clock source. A single 5.0 V power supply is required, while data is transferred via SPI using standard 3.3 V CMOS levels. For system health monitoring, a Reference Pixel is used in addition to the integrated voltage and temperature sensors.

For frame rates of up to 100 Hz, a dual-frequency (2f) mode can be used to achieve an unambiguous range of 50 m in short-range and 100 m in long-range mode.

AFBR-S50LV85D

Time-of-Flight Sensor Module for Distance and Motion Measurement



AFBR-S50 Series Block Diagram

The AFBR-S50LV85D is a multi-pixel optical distance and motion measurement sensor module based on the optical Time-of-Flight (ToF) principle. It has been developed with a special focus on industrial sensing applications for medium to long distances up to 30 m. The module has an integrated 850 nm laser light source, and due to a 2 ° × 2 ° emission cone, it typically uses 1 to 3 pixels at a time, depending on the distance and remission of the measured object. The sensor can measure the distance of objects regardless of their surface type.

- **Integrated 850 nm laser light source**
- **Field-of-View (FoV) of 1.55 ° x 3.1 ° with 32 pixels**
- **Typical distance range up to 30 m**
- **Works well on all surface conditions**

Features

- Transmitter beam of 2 ° x 2 ° to illuminate between 1 and 3 pixels
- Receiver with 32 pixels
  - Field-of-View (FoV): 1.55 ° × 3.1 °
  - FoV per pixel: 1.55 ° × 1.55 °
- Distance range:
  - Typical distance range up to 30 m
  - Unambiguous range up to 100 m with dual-frequency mode
- Reference pixel for system health monitoring
- Measurement rates of up to 3 kHz
- Operation of up to 200 klx ambient light
- Single voltage supply: 4.5 to 5.5 V
- Current consumption: 33 mA (typ.)
- Integrated voltage and temperature sensors
- SPI digital interface
- Integrated calibrated clock source
- Laser Class 1 eye-safe ready
- Drop-in compatible within the AFBR-S50 sensor platform
- Size without pins, L × W × H:
  - 12.4 × 7.6 × 7.9 mm
- Operating ambient temperature range:
  - –20 °C to 70 °C
- RoHS6 compliance

Key Applications

- Smart Consumer & Building:
  - Distance measurement
  - Security surveillance
- Industrial:
  - Robotics
  - Human Machine Interfaces (HMI)
  - Automation and control
  - Inventory monitoring
  - Drones

This high-performance ToF module has an integrated infrared laser light source and an internal clock source. A single 5.0 V power supply is required, while data is transferred via SPI using standard 3.3 V CMOS levels. For system health monitoring, a Reference Pixel is used in addition to the integrated voltage and temperature sensors.

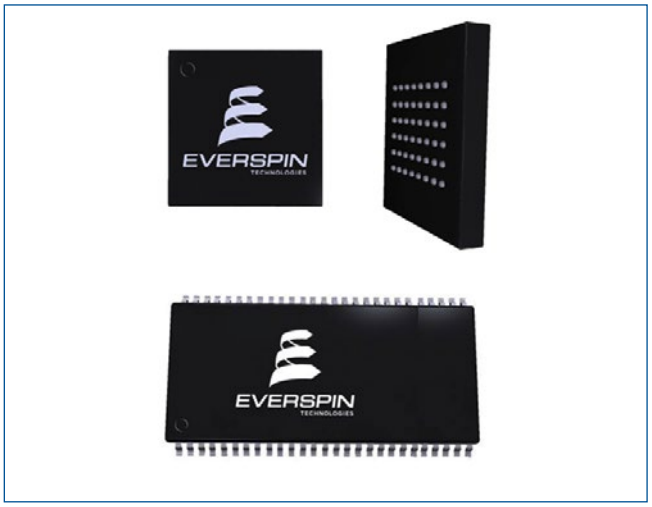
For frame rates of up to 100 Hz, a dual-frequency (2f) mode can be used to achieve an unambiguous range of 50 m in short-range and 100 m in long-range mode.

Product order code

- MR5A16ACYS35
- MR5A16AMA35
- MR5A16AMA35R
- MR5A16AYS35
- MR5A16AYS35R
- MR5A16ACMA35

MR5A16A – 32 Mb MRAM™

MR5A16A – 32 Mb 16-bit I/O Parallel Interface MRAM™



MR5A16A in TSOP2 and BGA Packages

Everspin Technologies, Inc. announced the world's first 32 Mb Toggle MRAM product. Everspin's new 32 Mb Toggle MRAM (MR5A16A) provides twice the capacity of its current 16 Mb solution and enables critical applications, such as storing configurations and setup and data logging in embedded systems that need a higher density option, while also providing the proven benefits of Everspin's Toggle MRAM. The MR5A16A is the ideal memory for applications that must permanently store and retrieve critical data and programs quickly. Commercial, industrial, and automotive operating temperature options are available.

- **Persistence: Maintains memory contents without power supply**
- **Performance: SRAM and DRAM-like performance with low latency**
- **Endurance: Superior durability supports memory workloads without sophisticated management**
- **Reliability: Best-in-class robustness, designed and tested for extreme conditions**

Features

- 33,554,432-bit MRAM device organized as 2,097,152 words of 16 bits
- Fast 35 ns read/write cycle (45 ns for automotive temperature range)
- SRAM-compatible timing
- Extremely high endurance:
  - Data retention period of 20 years
  - Unlimited number of program/erase cycles
- Simplified design and reduced BOM cost:
  - One memory can replace FLASH, SRAM, EEPROM, NVSRAM, and BBSRAM
- Operated by 3.3 V power supply voltage
- Improves reliability by replacing battery-backed SRAM
- Moisture sensitivity level:
  - MSL-3 (TSOP2)
  - MSL-6 (BGA)
- Several different temperature options available:
  - Commercial: 0...70 °C
  - Industrial: -40...85 °C
  - Automotive: -40...125 °C
- AEC-Q100 qualified for automotive applications
- RoHS-compliant small footprint 48-pin BGA and TSOP2 package

Key Applications

- Surveillance, traffic control
- ADAS, infotainment, and cluster applications
- DataCenter storage applications
- Industrial PLC and automation
- Industrial and consumer-grade IoT equipment
- Embedded storage and computing
- Medical applications
- Gaming, advertising panels, kiosks
- Aerospace and military applications

Everspin Technologies offers 32 Mb MRAM devices with a data retention period of 20 years, operating at consumer, automotive, and industrial temperature ranges. The key features of MRAM devices include unlimited write endurance, read and write cycles with no delay, and data retention even after power loss, which allows using them both as SRAM and typically slow NV storage modules (FLASH, EEPROM)

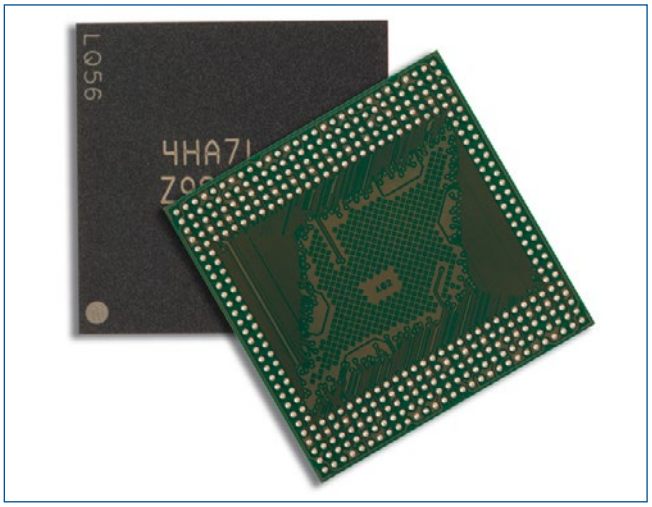
These MRAM devices offer a cost-effective and simplified solution for the widest range of applications that must permanently store and retrieve critical data very quickly.

Product order code

- MT53E128M32D2DS-046 WT:A
- MT53E256M32D2FW-046 IT:B
- MT53E384M32D2DS-046 AIT:E
- MT53D512M16D1DS-046 AAT:D
- MT53E768M32D4DT-046 AAT:E
- MT53D1024M32D4DT-046 AUT:D

Low Power DDR4 (LPDDR4)

Micron's LPDDR4: Balancing Performance, Power, Latency and Physical Space



LPDDR4 in 200b FBGA Package

LPDDR4 is a DRAM device specifically optimized to address the power consumption issues in battery-operated applications. It was initially developed for handsets and ultra-portables. Some of the reasons for using LPDDR4 over other options include up to 33% faster peak bandwidth compared to DDR4, an x32 configuration that offers BOM savings for particular low-density applications, up to five times lower power consumption in standby mode compared to standard DRAM, and compact MCP (Multi-chip package) and PoP (package-on-package) designs that save PCB space.

- **Densities from 2 Gb to 128 Gb offer high scalability for a variety of applications**
- **Configurations that allow the use of fewer components to support wide bus architectures**
- **Core voltages of 0.6 V and 1.1 V help reduce power consumption**
- **Temperature range options for high performance in extreme environments**

Features

- Available configurations:
  - x32, (2 channels, x16)
  - x64 (4 channels, x16)
- Core Voltages: 0.6 V, 1.1 V
- Clock frequencies: up to 2133 MHz
- Low power consumption in standby and active modes
- Special mobile features to reduce power for a more efficient design
- Temperature-compensated self-refresh (TCSR):
  - Adjusts refresh timing to minimize power consumption at lower temperatures
- Partial-array self-refresh (PASR):
  - Reduces power by refreshing only critical data
- Deep power-down (DPD):
  - Provides an ultra-low power state when data retention is not required
- Programmable drive strength and VOH signal level:
  - Enables adjustment for operation in point-to-point and point-to-2-point applications
- Temperature range options:
  - From -25 °C to 85 °C (WT)
  - From -40 °C to 95 °C (IT)
  - From -40 °C to 95 °C (AIT)
  - From -40 °C to 105 °C (AAT)
  - From -40 °C to 125 °C (AUT)
- Package solutions:
  - BGA (JEDEC-standard BGA ballout)
  - PoP (Package on Package)
  - MCP (Multichip Package)
  - KGD (Known Good Die)

Key Applications

- ADAS, infotainment, cluster
- Surveillance camera
- POS PC
- Edge computing
- Home automation
- Wearables
- Portable medical equipment
- Notebooks, tablets, ultrathins
- Handheld game consoles

Micron devices offer high reliability by undergoing stringent quality and reliability testing. Their automotive products operate reliably even under extreme conditions in an automotive environment and meet the ISO9001 and TS16949 certification requirements.

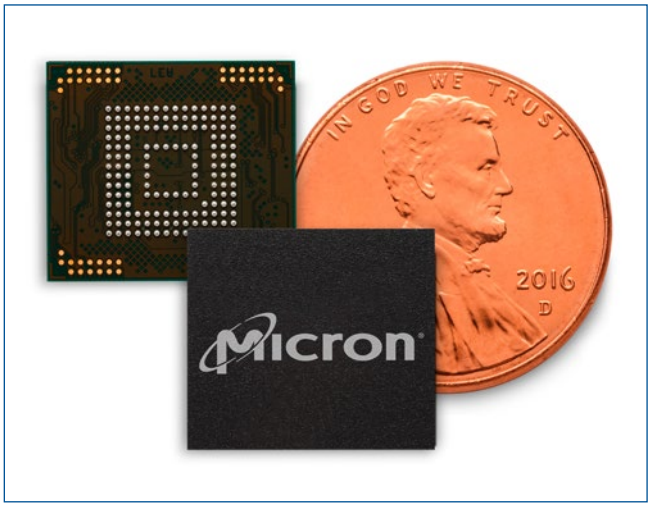
Optimized specifically to address the power consumption issues in battery-operated applications, Micron offers LPDDR4 DRAM devices in innovative packaging options such as MCP and PoP, enabling the development of the next-gen ultra-compact devices.

Product order code

- MTFC256GASAONS-IT
- MTFC32GASAONS-IT
- MTFC64GASAONS-IT
- MTFC128GASAONS-IT
- MTFC256GASAONS-AIT
- MTFC256GASAONS-AAT

UFS – Universal Flash Storage

UFS 2.1 High Speed 2-Lane Gear 3 Product



Micron 3D NAND with UFS

Defined to address the challenges associated with next-generation automotive and industrial storage, the UFS specification was optimized to deliver the traditional promise of "bigger, faster, cheaper" that comes with every generation of storage.

UFS addresses key areas including high-performance efficiency and responsiveness as well as instant-on, multitasking, and multiprocessing capabilities. Other focus areas include low power, extended battery life, high capacity, and a smaller physical footprint.

- **Significantly faster random read speeds than the e.MMC 5.1 interface**
- **Industry-leading sequential read performance**
- **Efficient multitasking and data ordering with UFS 2.1 Command Queue Technology**
- **Enabling simple solutions and accelerated time-to-market**

Features

- Better user experience
- High performance:
  - 941 MB/s reads and 651 MB/s writes
  - Up to 2x faster writes than e.MMC interfaces
- Reliable and cost-effective:
  - Industry-leading 64-layer triple-level-cell (TLC) 3D NAND with CMOS under array technology
- Expanded temperature range
- Full automotive and industrial-specific feature set
  - AEC-Q100 Grade 3 compliance (-40 to 105 °C)
  - AEC-Q100 Grade 2 compliance (-40 to 95 °C)
  - Compliant with Internal Automotive Task Force 16949 standards
- Fast boot
- Firmware focused on system reliability
- Fast response times
- Lower latency, higher efficiency
- High-speed PC Sync
- Low power consumption
- A broad portfolio:
  - 32, 64, 128, 256 GB densities
- Compact BGA-153 package

Key Applications

- Automotive:
  - Infotainment cluster
  - Central & boot storage for autonomous cars
  - Black Box recording
  - Telematics gateways
  - CR-V2X communication
- Industrial:
  - AI-based gesture and voice-based commands
  - POS PCs
  - Rear seat entertainment in aviation

As the leading memory partner with more than 25 years of experience serving the automotive industry, Micron provides advanced automotive memory solutions that meet stringent quality, reliability, and compliance requirements.

Micron's broad portfolio of volatile and nonvolatile memory products is optimized for automotive and supported by a formal product longevity program.

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