

# Experts in Automotive Experts in FlexRay™ Transceiver Products





## **austriamicrosystems and FlexRay**

Since austriamicrosystems joined the FlexRay Consortium as Premium Associate Member in 2006, the contribution is shown in the FlexRay Physical Layer and Conformance Test specifications. We are committed to enhance the FlexRay system based on the standard and are committed to our customers to provide state-of-the-art FlexRay Transceiver products for the next generation in-vehicle network.

Innovation and continuously improvements in design are implemented in our FlexRay products and we are focused in product enhancements where the system can be made more reliable and more safe.

Asymmetric delays caused by FlexRay components and as well external influences like electro magnetic interferences turned out to be a limiting factor in expanding FlexRay network topologies. An ingenious circuit design provides in all austriamicrosystems FlexRay Transceiver products a very low device related receiving and transmitting asymmetric delay in order to keep to overall summation of asymmetric delays low.

Higher typical differential voltage levels in the austriamicrosystems implementation at the transmitter ensure higher safety margin for the FlexRay networks.

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## AS8220 FlexRay Basis Transceiver

### Functional Description

The AS8220 is a high speed automotive bus driver according the FlexRay Electrical Physical Layer Specification V2.1 Rev B operating as bi-directional interface between the FlexRay Communication Controller and the twisted-pair copper wiring.

The device provides an optimized host controller interface consisting of two low-active pins. The Standby input pin for mode handling by the microcontroller and the Error out pin where system, chip failures or simply status information are signalled to the microcontroller. Signalling logic high on the Standby pin the device will enter Normal mode in case no fault condition is given and in this mode the device is fully operational meaning FlexRay communication is possible. In the low power modes (Standby and Sleep mode) very low power consumption is achieved.

The AS8220 FlexRay Basis Transceiver provides a voltage monitoring circuitry, ensuring that the both input supply pins  $V_{cc}$  and  $V_{io}$  are correctly applied. In case of undervoltage on  $V_{cc}$  is detected the device will signal an error and will enter the Power Off state. In case the logic level input interface  $V_{io}$  is below its thresholds the device will not be fully operational and will remain in Standby mode.

Activation of the transmitter is not possible in case the TxD pin is on logic high, in order to avoid start of transmission with Data1 on the FlexRay bus.

Ensuring application in safety critical environments a one-wire bus-guardian interface is implemented where additional monitoring circuitries on the electronic-control-unit can activate and deactivate the transmitter. A thermal sensor circuit with an integral shutdown mechanism prevents damage to the device in extreme temperature conditions. The symmetrical transient control for the high- and low-side driver for both the bus-minus and bus-plus line allows an ideal balance of communications over different network topologies, with excellent EMC performance.

All austriamicrosystems FlexRay Transceivers provide an high-end diagnosis mechanism for the bus failure detection consisting of a high speed mechanism while comparing in transmitting mode the transmitter output with the receiving input signals and the highly accurate current measurement mechanism with measuring on both bus pins the current on the high and low side driver. The current measurement mechanism is most effective if during the FlexRay communication start-up continuously Data0 and Data1 phases for longer than 20µsec are transmitted.

### Applications

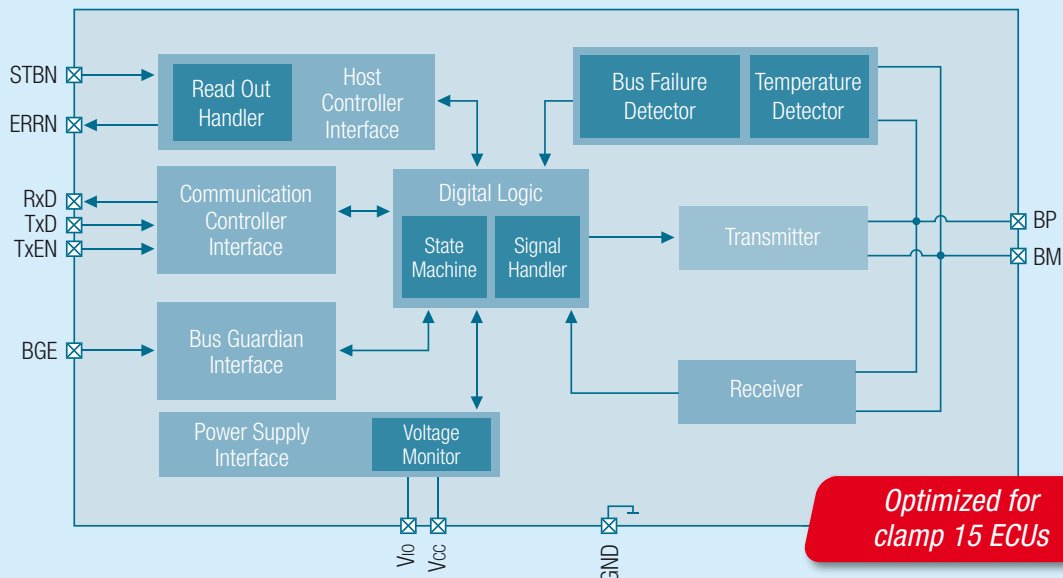
The AS8220 FlexRay Basis Transceiver is best fitting for automotive applications where the electronic-control-unit is connected to the switched battery voltage (Clamp 15). The wake-up of the ECU is performed by the clamp 15

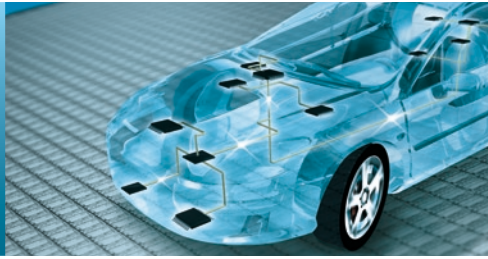
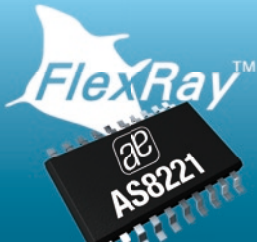
and the AS8220 automatically is in Standby when  $V_{cc}$  is sufficient supplied. The AS8220 addresses applications where the power management is handled by the ECU and is optimized for FlexRay nodes where FlexRay bus wake-up is not needed.

### Key features

- Compliant with FlexRay Electrical Physical Layer Specification V2.1 Rev. B
- Data transfer up to 10 Mbps
- Excellent EMC performances. High common mode range insure excellent EMI
- Transmit enable pin for Bus Guardian or supervision circuits
- Automatic thermal shutdown protection
- Very low standby current
- Supports 2.5, 3, 3.3, 5 V microcontrollers and automatically adapts to interface levels
- Protection against damage due to short circuit conditions on the bus (positive and negative battery voltage)
- Operating temperature range -40°C to +125°C
- Lead-free SSOP14 package
- RoHS conformance

### Block Diagram





# AS8221 FlexRay Standard Transceiver

## General Description

The AS8221 is a high speed automotive bus driver according the FlexRay Electrical Physical Layer Specification V2.1 Rev B operating as bi-directional interface between the FlexRay Communication Controller and the twisted-pair copper wiring.

The device provides an optimized host controller interface consisting of three low-active pins. The Enable and Standby input pins for mode handling by the microcontroller and the Error out pin where system, chip failures or status information are signalled to the microcontroller. Signalling logic high on the Enable and Standby pin the device will enter Normal mode in case no fault condition is given and in this mode the device is fully operational meaning FlexRay communication is possible. Additionally a Receive Only mode is implemented, which can be accessed by the microcontroller where only FlexRay streams can be received in order to avoid unwanted disturbances on the FlexRay bus while listening on the bus traffic. In the low power modes (Standby and Sleep mode) very low power consumption is achieved.

In case of undervoltage on one of the supply voltages ( $V_{BAT}$ ,  $V_{CC}$  and  $V_{IO}$ ) the device will change its mode to a low power mode (either Standby or Sleep mode) and the device will signal an error accordingly. In case of low voltage is detected on both  $V_{BAT}$  and  $V_{CC}$  the device will enter the

Power Off mode, where no operation is possible. A safe mechanism from the low power modes to Power Off mode and vice versa is implemented ensuring that no deadlock can happen during the startup phase.

Ensuring application in safety critical environments a two-wire bus-guardian interface is implemented where additional monitoring circuitries on the electronic-control-unit can activate and deactivate the transmitter and additionally on the receive enable output in low power modes the wake conditions and in normal power modes the received FlexRay streams can be monitored.

A thermal sensor circuit with an integral shutdown mechanism prevents damage to the device in extreme temperature conditions. The symmetrical transient control for the high- and low-side driver for both the bus-minus and bus-plus line allows an ideal balance of communications over different network topologies, with excellent EMC performance.

## Applications

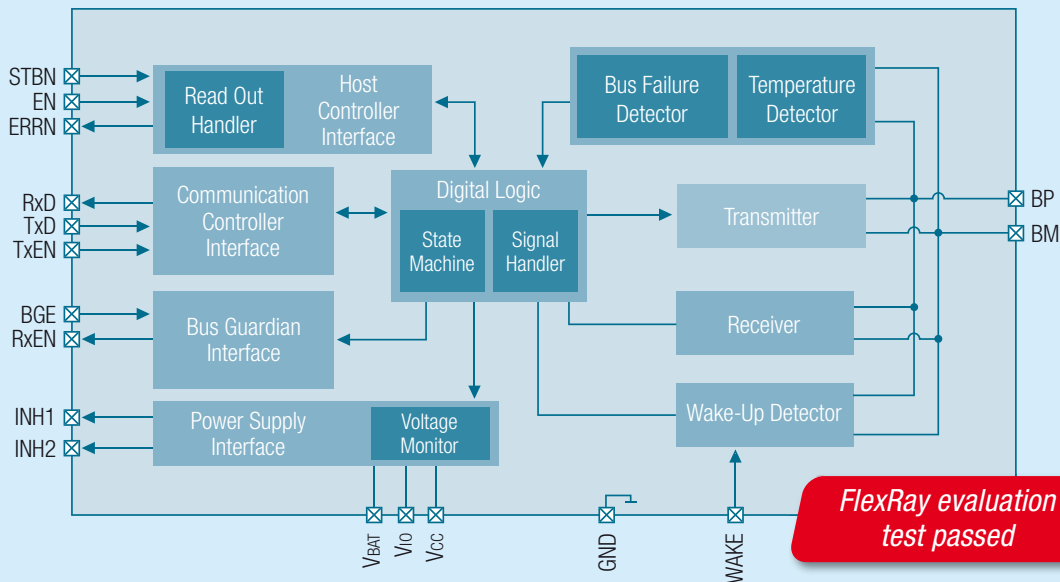
The AS8221 FlexRay Standard Transceiver is best fitting for all automotive applications where the full functionality of the FlexRay bus driver is needed in the electronic-control-unit like bus wake-up and control for voltage supplies. The device addresses all ECUs connected to the permanent

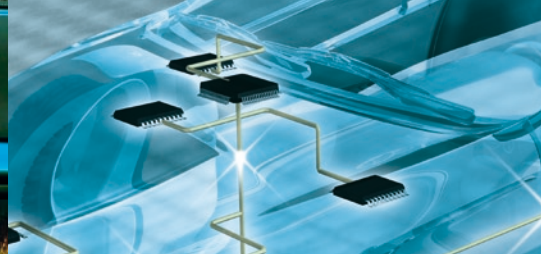
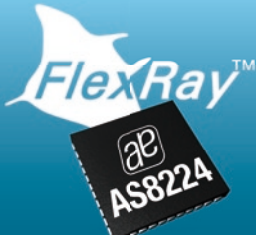
battery supply (clamp 30). The AS8221 is connected to the battery voltage and therefore can be used as the only ECU wake-up component with very low power consumption in Sleep mode.

## Key features

- Compliant with FlexRay Electrical Physical Layer Specification V2.1 Rev. B
- Data transfer up to 10 Mbps
- Excellent EMC performances. High common mode range insure excellent EMI
- Interface for Bus Guardian or supervision circuits
- Automatic thermal shutdown protection
- Supports 12V and 24V systems with very low sleep current
- Integrated power management system
  - Two inhibit pins for external voltage supply control
  - Local wake-up input
  - Remote wake-up capability via FlexRay bus in low power modes
- Supports 2.5, 3, 3.3, 5 V microcontrollers and automatically adapts to interface levels
- Protection against damage due to short circuit conditions on the bus (positive and negative battery voltage)
- Operating temperature range -40°C to +125°C
- Lead-free SSOP20 package
- RoHS conformance

## Block Diagram





# AS8224 FlexRay Active Star Device

## General Description

The AS8224 is an Active Star device according to the FlexRay Electrical Physical Layer Specification V2.1 Rev B operating as an active hub for 4 FlexRay network branches, the Communication Controller interface and an Interstar interface. The Interstar interface is used for expanding the FlexRay branches for an Active Star. Message forwarding including this 6 communication paths is performed.

The AS8224 is the world-wide first device with a bit-reshaping mechanism for correcting asymmetric delays.

The bit-reshaping function can be optionally used and will be functional if an external clock is connected to the device. Otherwise the bit-reshaper will be bypassed and the device acts as a standard Active Star where no timing reshaping is performed. When activating the bit-reshaper, the device is capable to correct bit timing mismatches in 12.5ns steps (microticks). The AS8224 bit-reshaper is capable to lengthen and shorten distorted bits by about 37.5ns in total. The mechanism ensures that the asymmetric delays are corrected whenever the delay becomes higher than 12.5ns if a branch is the input source. The bit-reshaper enables FlexRay topologies beyond today used applications and allows network topologies with more than one Active Star.

The AS8224 provides an SPI interface for the microcontroller for the mode handling and as well for status and failure

read-out. The low active interrupt pin signals failures and condition changes like wake-up events to the microcontroller. Every branch has its state machine implemented so that the branches independently will change the mode on bus events, bus failures, events on the Active Star state machine and allows in the same time full control to the microcontroller. The device will be fully operational without microcontroller interaction although higher priority is assigned to the host interface.

Very low bus activity and idle detection time at the Interstar interface are guaranteed in order that additional TSS truncation and ringing effects are avoided if two or more Active Star Devices are connected via the Interstar interface.

In general the AS8224 Active Star device provides an optimized Interstar interface and trimmed Signal Handler so that enhanced Active Stars with two or more AS8224 devices have a similar timing behavior to a monolithic implementation of only one Active Star Device.

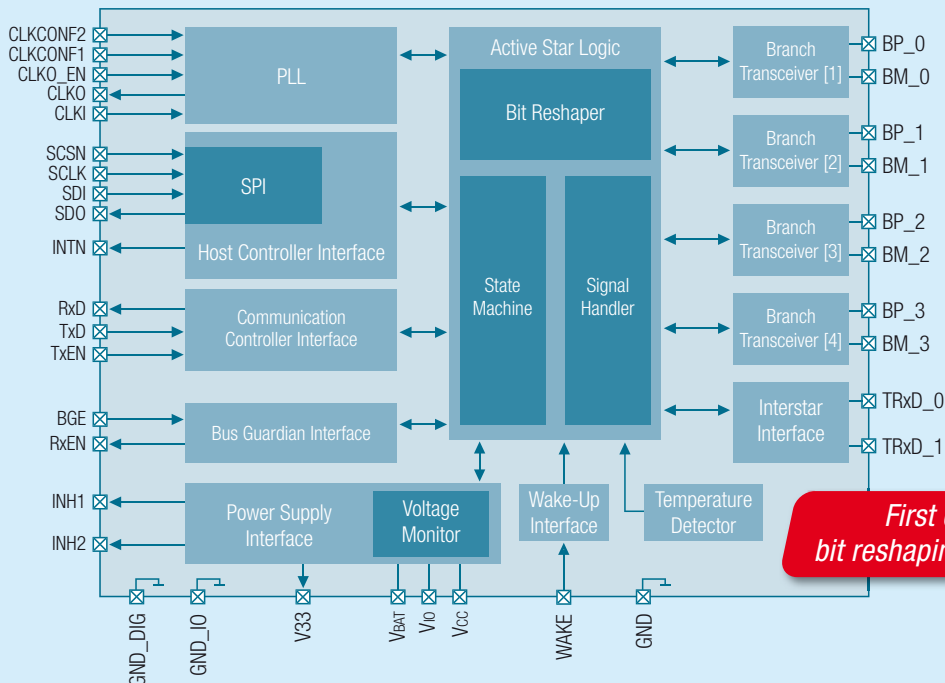
## Applications

The AS8224 FlexRay Active Star device is best fitting for automotive gateways, interconnecting several FlexRay branches. With the bit-reshaping unit the AS8224 enables enhanced FlexRay topologies which makes the device capable to be applied in FlexRay networks in very tough conditions.

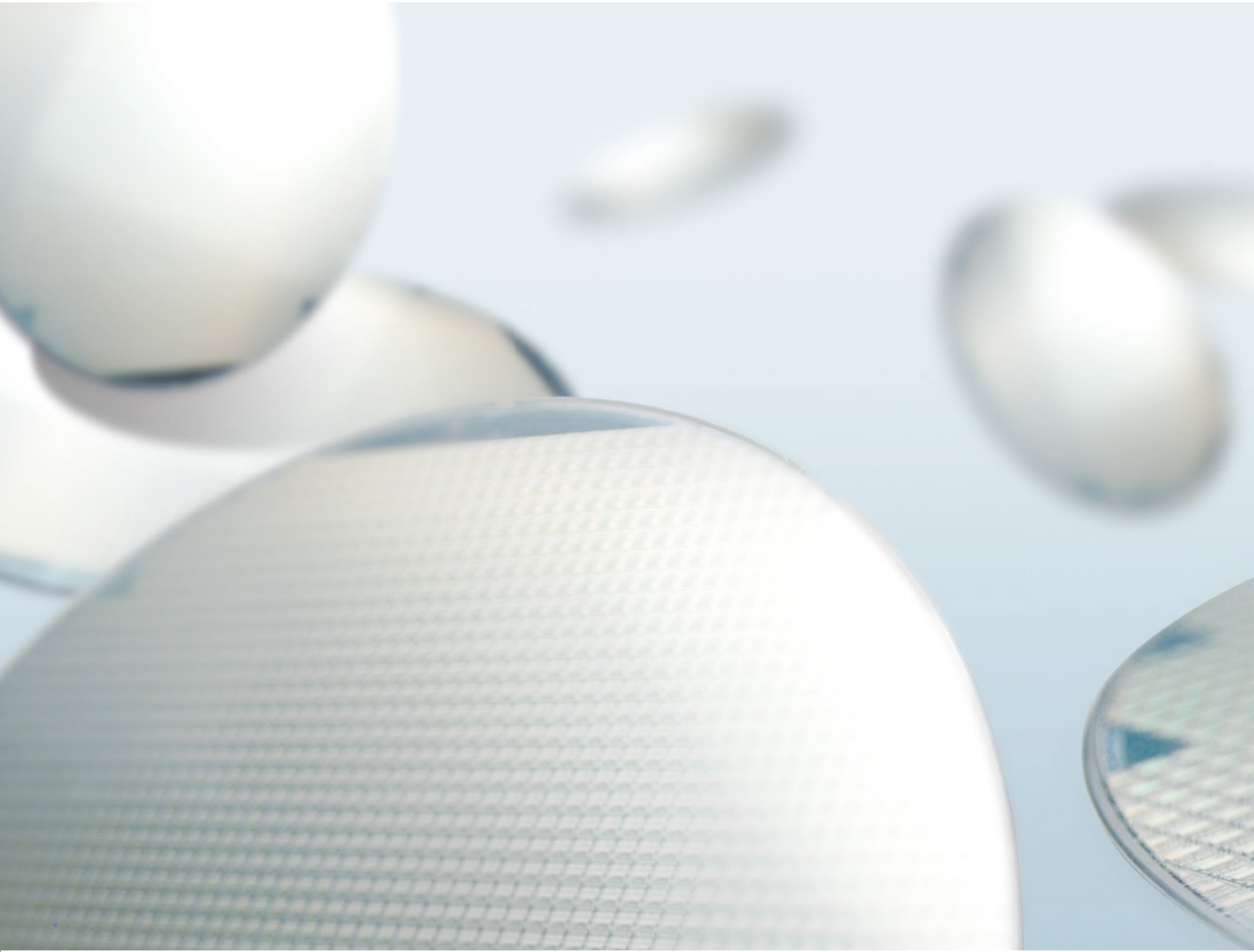
## Key features

- Compliant with FlexRay Electrical Physical Layer Specification V2.1 Rev B
- Active Star device with 4 branches
- Message forwarding on 6 communication paths
- Data transfer up to 10 Mbps
- Bit-reshaping unit
- Excellent EMC performance
- High common mode range insure excellent EMI
- Interface for Bus Guardian or supervision circuits
- Automatic thermal shutdown protection
- Supports 12, 24V systems with low sleep current
- Integrated power management system
  - Two INH pins for the external voltage regulators control
  - Local wake-up input
  - Remote wake-up capability via FlexRay bus
- Supports autonomous mode and host controlled mode management
- Supports 2.5, 3, 3.3 and 5 V microcontrollers and automatically adapts to interface levels
- Protection against damage due to short circuit conditions on the FlexRay branches (positive and negative battery voltage)
- Operating ambient temperature range -40°C to +125°C
- Lead-free QFN44 package
- RoHS conformance

## Block Diagram



**First device with bit reshaping unit worldwide**



 **austriamicrosystems**  
*a leap ahead in analog*