

# TCAN284x-Q1 / TCAN285x-Q1

CAN FD / CAN FD SIC / LIN SBC

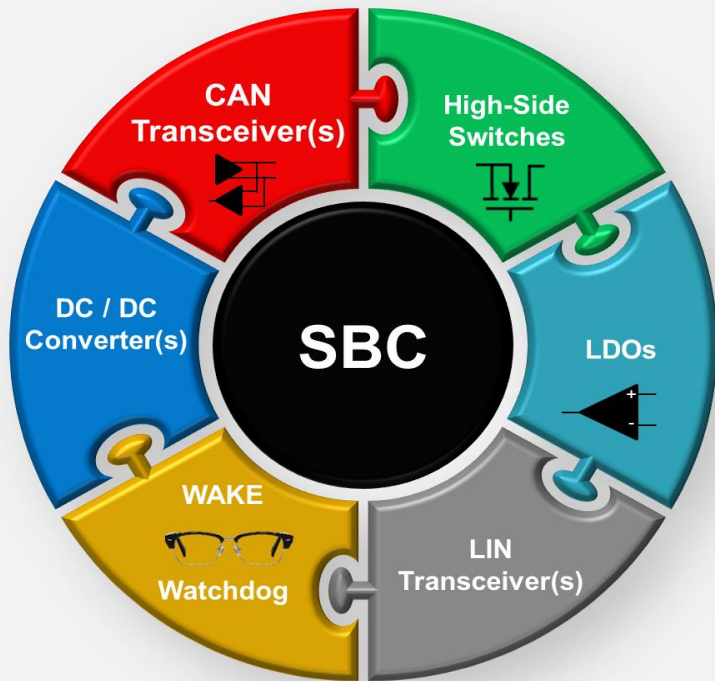
Family Overview

1Q22



TI Information – Selective Disclosure

# TI's System Basis Chip investment



- TI's System Basis Chip (SBC) portfolio leverages our large catalog of interface, power, and analog components to deliver complete, high performance solutions
- Designed for performance and cost optimized for end application use
- Utilizes TI's CAN FD, CAN FD SIC, CAN w/ Partial networking, and LIN transceivers
- Industry tested solutions with full OEM approvals for use

# TI CAN / LIN SBC Portfolio

## Mid-level SBCs

Featuring CAN FD w/ or w/o LIN transceiver SBCs, Mid-level SBCs add an additional transceiver(s) or power solutions

**TLIN14x1x-Q1, TCAN284x-Q1, TCAN285x-Q1**

## Advanced Function SBCs

SBCs Delivering additional special functionality to further simplify your next generation designs

**TCAN4550-Q1**

## CAN FD SBCs

Basic CAN FD SBCs developed upon our popular CAN FD transceivers with an integrated power element

**TCAN1162x-Q1, TCAN1164-Q1, TCAN1167-Q1**

## LIN SBCs

Our family of LIN based SBCs deliver full LIN functionality while supporting a LDO or other power feature

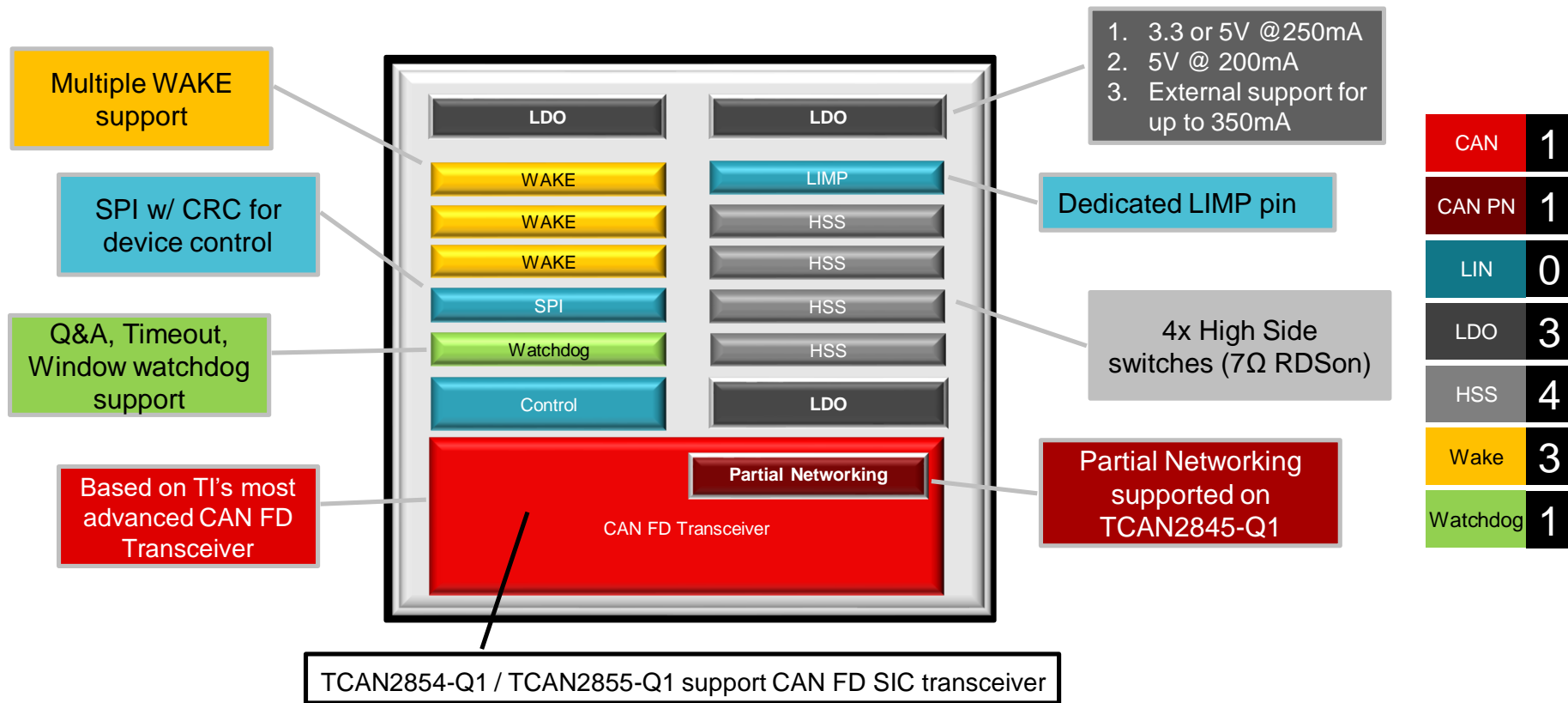
**TLIN1028-Q1**

## CAN FD Transceivers

## LIN Transceivers

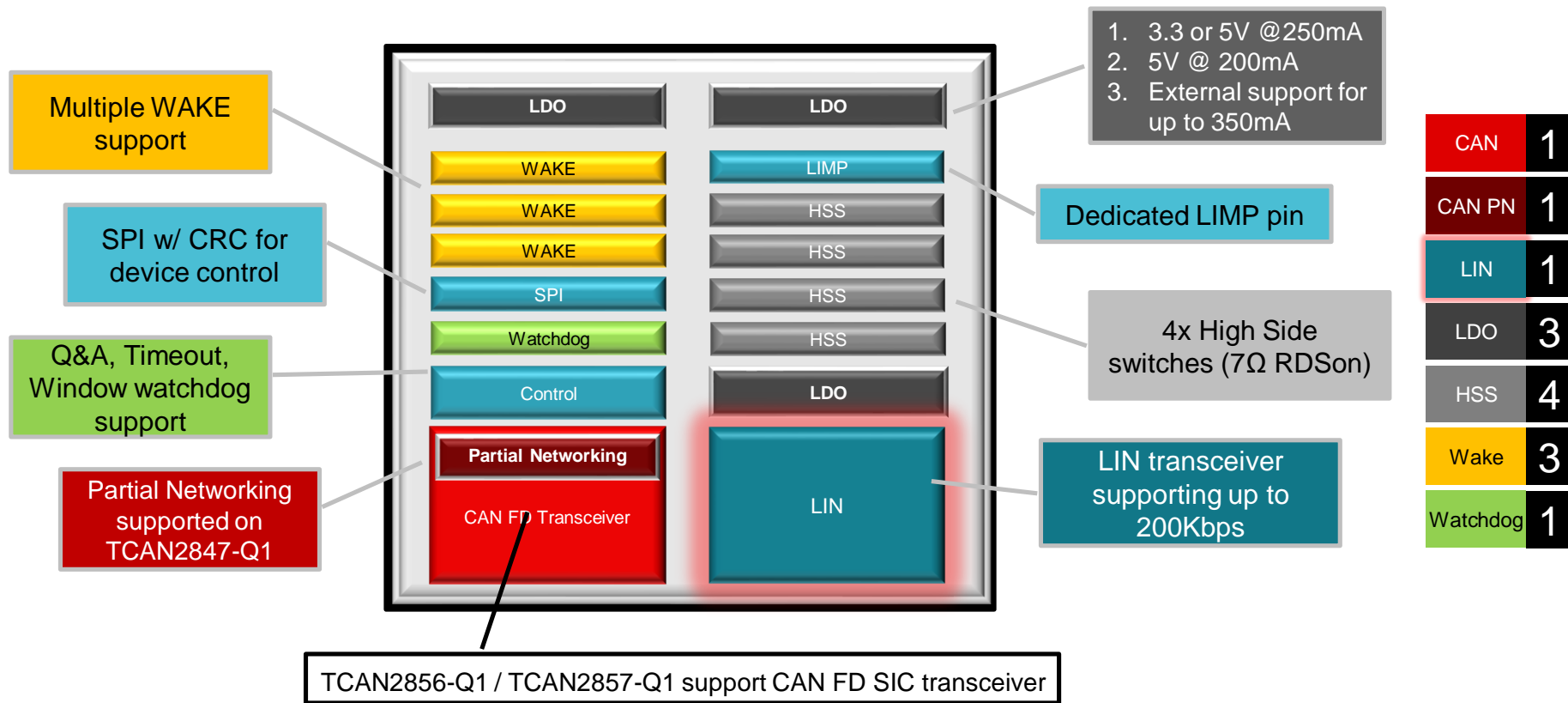
**SBCs and transceivers can be combined for advanced and optimized functionality**

# TCAN2844-Q1 / TCAN2845-Q1

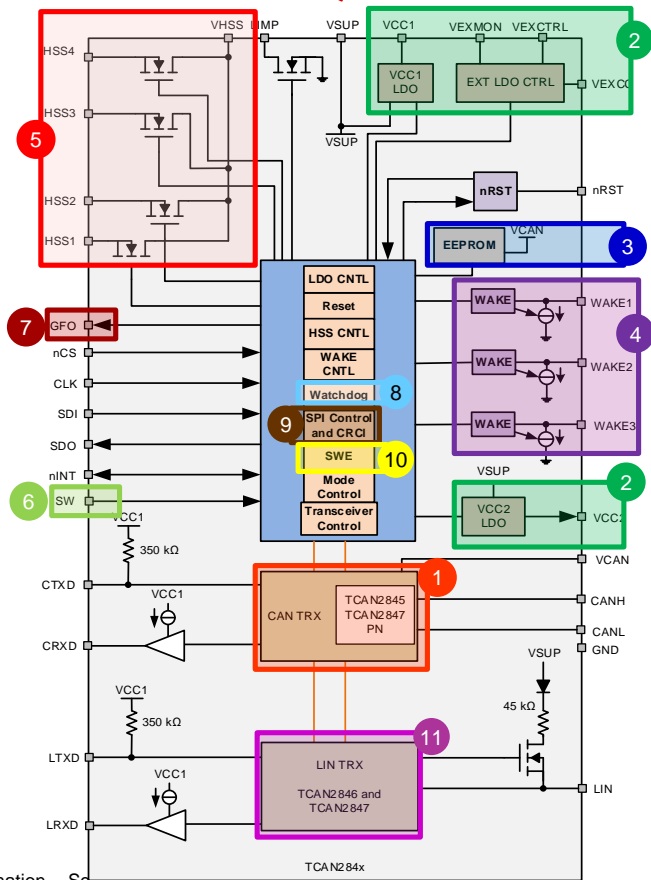


CAN	1
CAN PN	1
LIN	0
LDO	3
HSS	4
Wake	3
Watchdog	1

# TCAN2846-Q1 / TCAN2847-Q1



# TCAN284x-Q1 / TCAN285x-Q1 Device Features

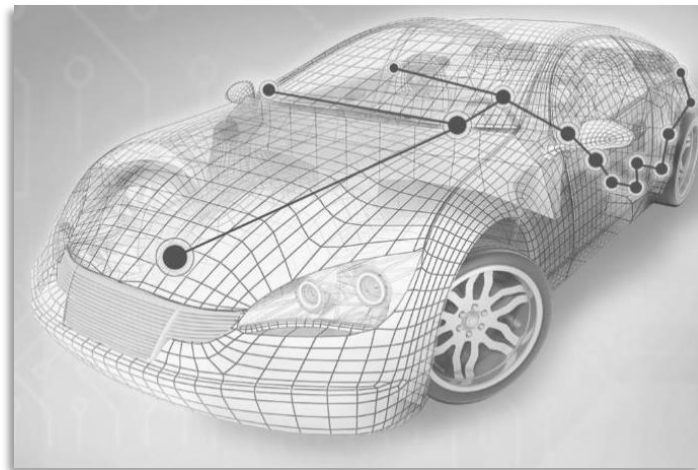


1. CAN FD/CAN FD SIC Transceiver
2. Three LDOs:
3. Device Configurable EEPROM
4. Programmable WAKE pins
5. Four high-side switches
6. Multi-function SW pin
7. Multi-function GFO
8. Watchdog
9. SPI control (CRC)
10. Sleep Wake Error (SWE) timer
11. LIN Fast Mode

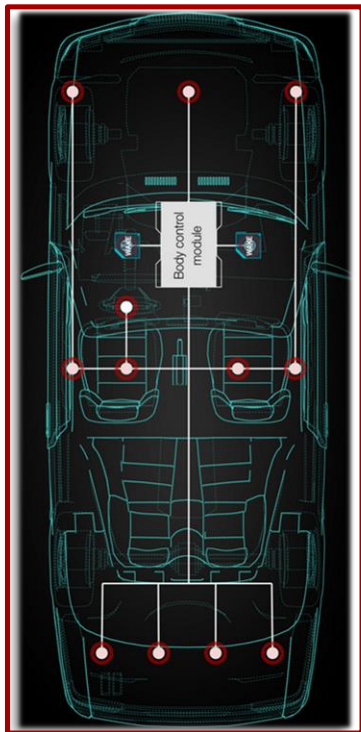
**NOTE: Best if viewed in presentation mode:**  
 Hover mouse over blocks for additional information

# CAN FD / CAN FD SIC / LIN Transceivers

- TI's SBCs are based on our extensive portfolio of CAN and LIN transceivers
- Over 1.4 Billion transceivers sold
- OEM approved transceivers
- High bus fault protection
- Maximum data rates
  - CAN FD – 5Mbps
  - LIN – 10/200kbps (end of line programming)
- Fail safe modes
- Advance bus fault diagnostics
- Utilizing latest wafer fab technologies



# Partial Networking



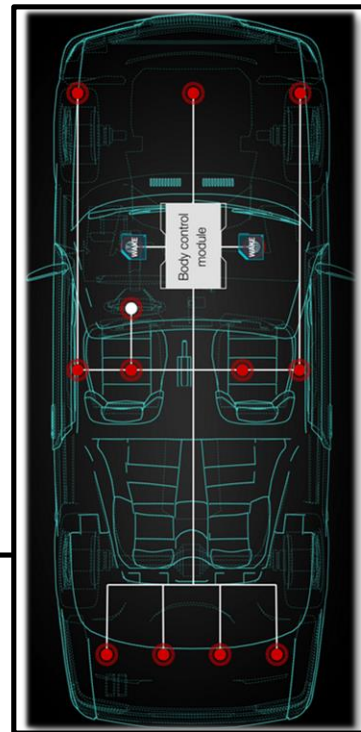
**CAN**

- Standby and Silent modes are supported as low power modes in CAN transceivers
- In standard CAN networks, wake events cause the entire bus (all nodes) to wake from these low power modes ○
- This causes higher than necessary power consumption and increase emissions

Standby-enabled CAN transceivers are included in TCAN2844/2846-Q1

- Partial Networking transceivers support the same low power modes
- Upon a wake event, only the targeted node will wake and complete the action ●
- Meanwhile, all other nodes stay in their low power state maximizing power and bus efficiency

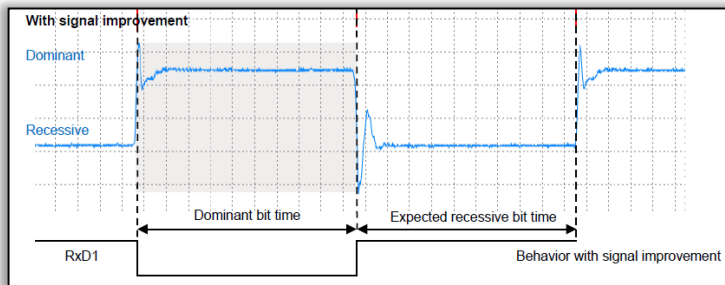
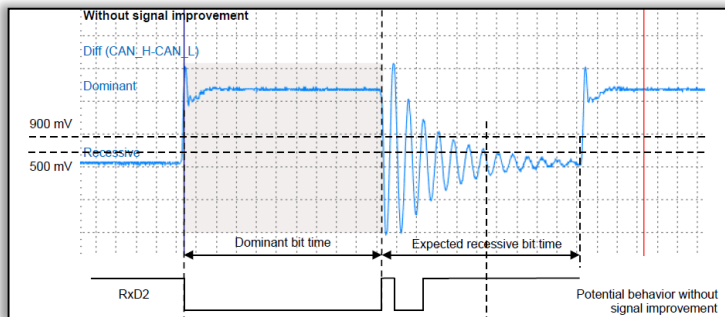
Partial networking is available in TCAN2845-Q1 / TCAN2847-Q1



**CAN w/ Partial Networking**



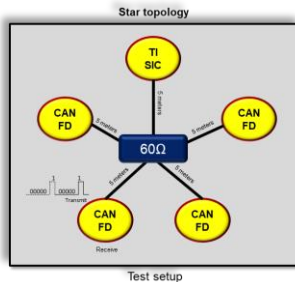
# What's CAN FD SIC?



- **S**ignal **I**mprovement **C**apability- Eliminate signal ringing at dominant-to-recessive edges and enable higher throughput with complex topologies
- Extract real benefit of CAN FD (correct signal at sampling point of 2Mbps, 5Mbps and even beyond)
- Plug-and-play in existing network topology, enabling reduced cabling/connectors → Lesser cabling, Lower cost/vehicle weight, better mileage
- Backwards compatible with CAN, CAN FD protocols and to ISO11898-2 specs

# CAN FD SIC

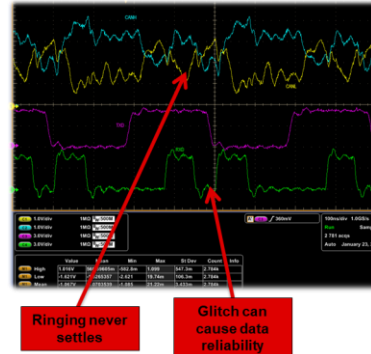
- CIA 601-4 enabled solutions
- Eliminate signal ringing at dominant-to-recessive edge and enable higher throughput with complex topologies
- Extract real benefit of CAN FD (correct signal at sampling point of 2Mbps, 5Mbps and even beyond)
- Plug-and-play in existing network topology, enabling reduced cabling/connectors → Lesser cabling, Lower cost/vehicle weight, and better mileage
- Backwards compatible with CAN, CAN FD protocols and to ISO11898-2 specs
- Supported in TCAN285x-Q1 SBCs



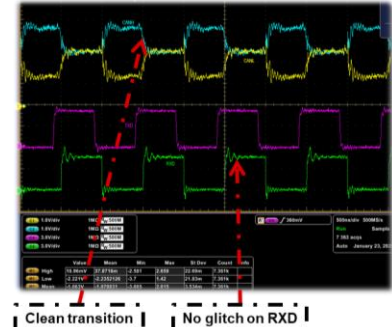
2Mbps  
TCAN1042-Q1 : CAN FD



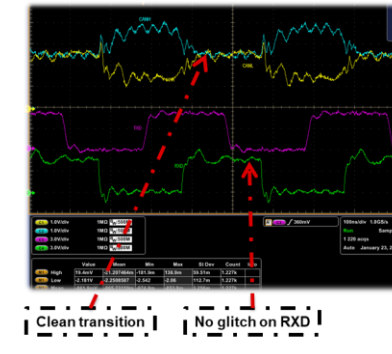
TCAN1042-Q1 : CAN FD



5Mbps  
TI CAN FD SIC transceiver

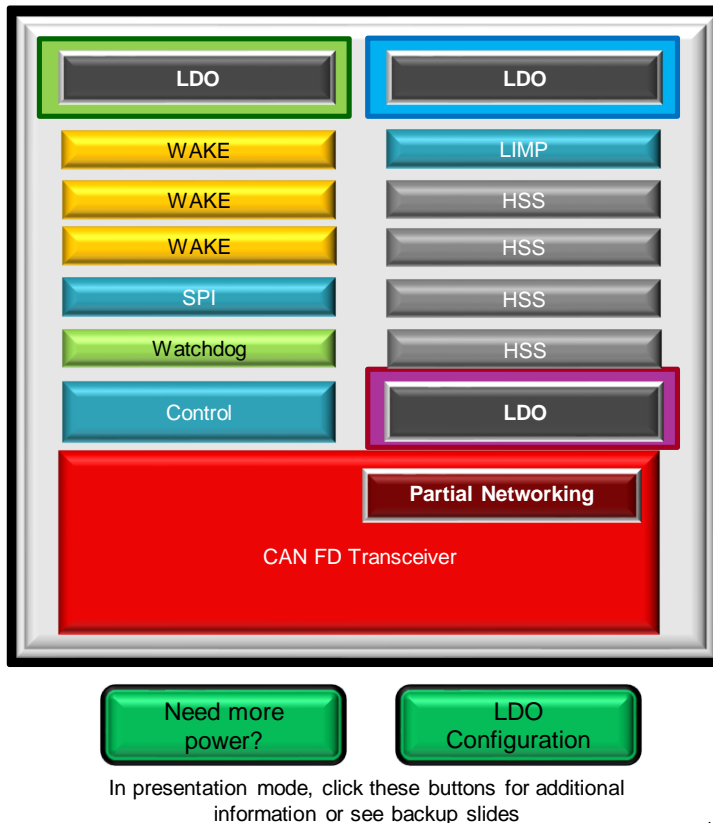


TI CAN SIC transceiver



# LDOs

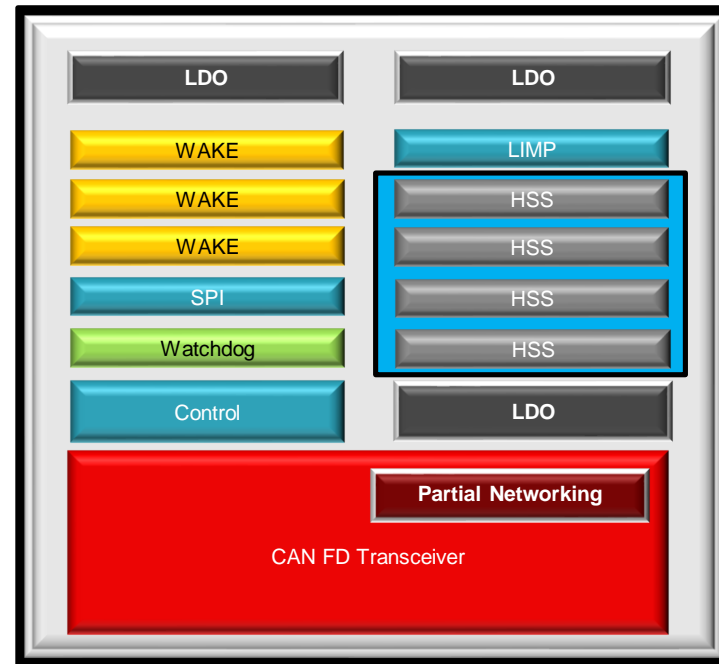
- TCAN284x-Q1 supports 3 LDOs
  - **VCC1**, **VCC2** and **VEXCC** (external PNP control)
- Devices support either 3.3V or 5V LDO versions for **VCC1**
  - Up to 250mA output
  - Supply for digital IO
- Secondary LDO (**VCC2**)
  - 200mA @ 5V with 28 V short to battery protection
- **VEXCC** (VEXMON and VEXCTRL) can control an external PNP transistor for additional power
  - Support up to 350mA via programmable voltage levels of 1.8V, 2.5V, 3.3V or 5V with 28 V short to battery protection
  - VEXCC is not auto enabled at initial power up



# High-side Switches

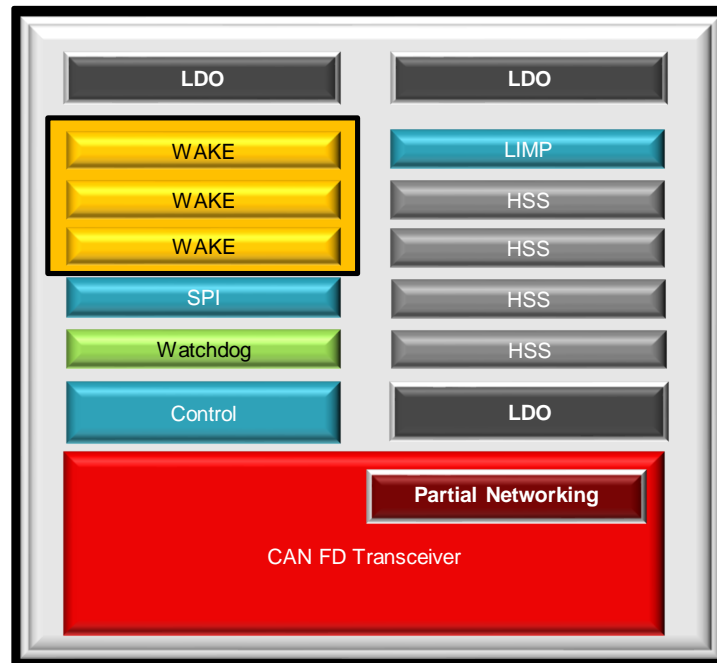
- Four (4) High-side switches are supported
  - RDSON 7Ω, 100mA
  - HSS4 is used for cyclic sensing wake
- Programmable to work with four 10-bit PWMs (200Hz & 400Hz) or two timers
- Fault detection for Open load and over current situations
- HSS1 and HSS2 can be connected and synchronized for a lower total RSDON supporting higher current
  - The timing mechanism for the synchronized pair will be determined by the selected HSS1 timing configuration
- Dedicated high-side switch supply, VHSS with OV and UV detection

TI Information – Selective Disclosure



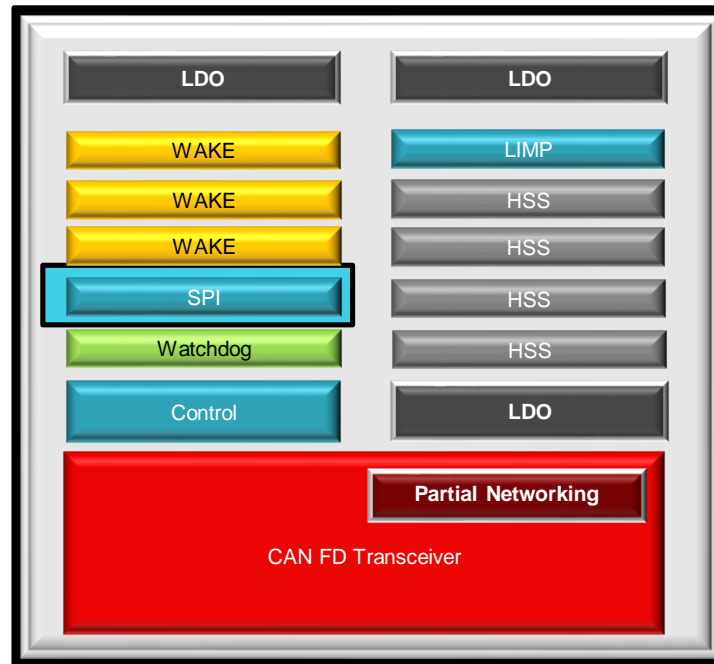
# WAKE pins

- Support multiple wake events with 3 dedicated wake pins – bus wake also supported
- Programmable for Static or Cyclic sensing
- Threshold levels programmable for VCC1, 2.5V, 4V, or 6V
- Ground based WAKE pins can be treated as a digital wake input



# SPI Cyclic Redundancy Check (CRC)

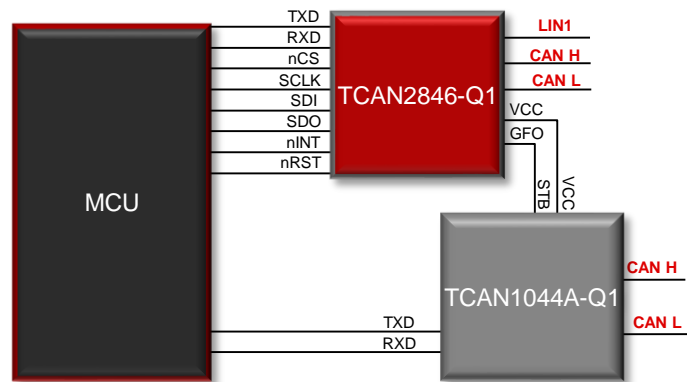
- TCAN284x-Q1 supports up to 4Mhz SPI for device configuration
- Includes the added benefit of 8-bit CRC for SPI transactions
  - Feature is disabled by default (Register 8'h0A[0])
- Register 8'h0B[0] determine which of two 8-bit polynomials are used
- Supports AutoSAR



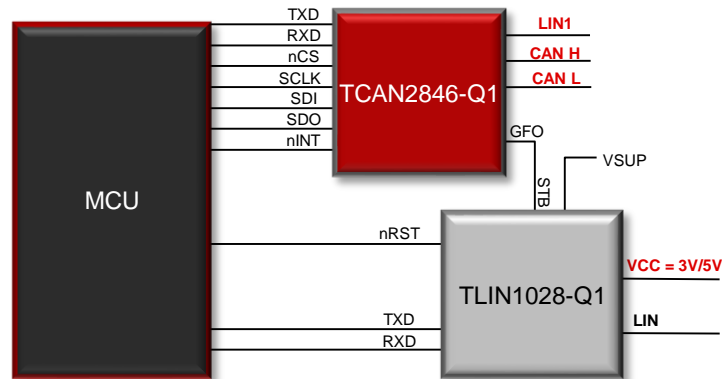
# Channel expansion (GFO pin)

- TCAN284x-Q1 / TCAN285x-Q1 SBCs provide maximum system-level flexibility by enabling channel expansion
  - TCAN284x-Q1/TCAN285x-Q1 can be combined with existing OEM-approved CAN and LIN transceivers for optimized system-level functionality
  - Channel expansion can also be accomplished by utilizing other SBCs such as the TCAN116x-Q1 or TLIN1028-Q1
- Channel expansion simplifies system design to support multiple build options
  - Processor GPIO savings
  - Simplified software implementation through SPI
  - Reduced sleep mode current consumption and node power
  - Implement an additional LIN channel (TLIN1039-Q1) and LDO (TLIN1028x-Q1) or LDO + High side switch (TLIN1431-Q1)
- Patent pending

TI Information – Selective Disclosure

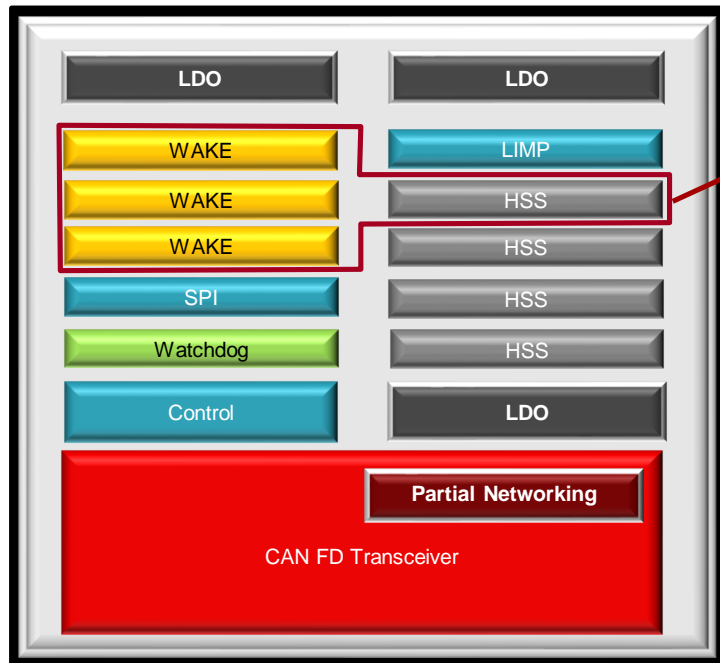


Channel expansion (CAN trx)



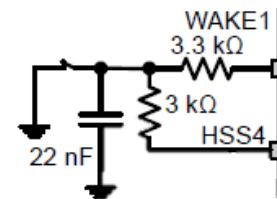
Channel expansion (SBC)

# Cyclic Sensing / Wake



## Cyclic Sensing

- Utilizing HSS4 with WAKE1, WAKE2, or WAKE3 pin allows for static or cyclic sensing
- Reduces overall sleep current
  - WAKE only active during on time of HSS4
- Fail-safe mode can utilize to wake up and check for a wake event
- Can be active in both sleep and fail-safe mode



## Cyclic Wake

- Feature allows user to periodically wake up and insert an interrupt to the processor
- Processor then will wake and search for changes
- Utilizes timer 1 or 2 but is not associated with WAKE or HSS pins as Cyclic Sensing
- Active during normal and standby modes
  - Can be enabled for sleep and fail-safe modes





# Fail-safe / Diagnostic Features

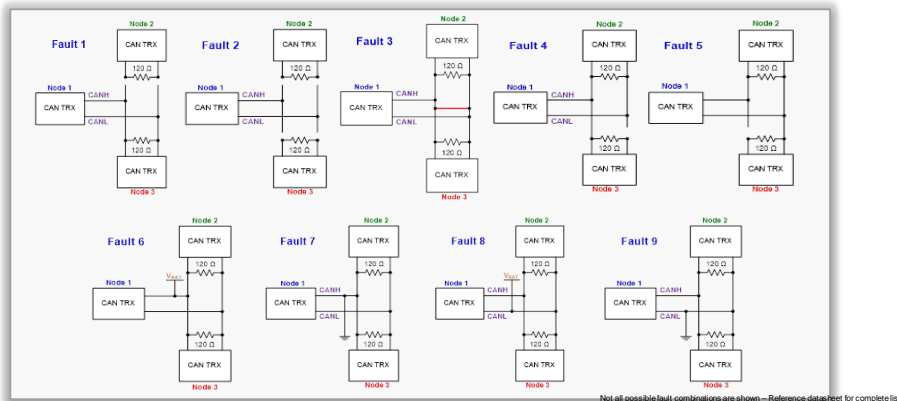
- Sleep Wake Error (SWE) timer : used to determine device function health
- LIMP
- Thermal Shut Down / Thermal detect for LDO
- Under/Over Voltage Lockout / Unpowered device
- Under Voltage Input (UVCAN)
- Short circuit
- Watchdog
  - Q&A, Timeout, Window
  - WD error counter
  - WD SPI programming
- High-side switch
  - Open Load and over current detection
  - Under / Over Voltage capability
- Bus Fault Detection and Communication



# Fault detection / communication

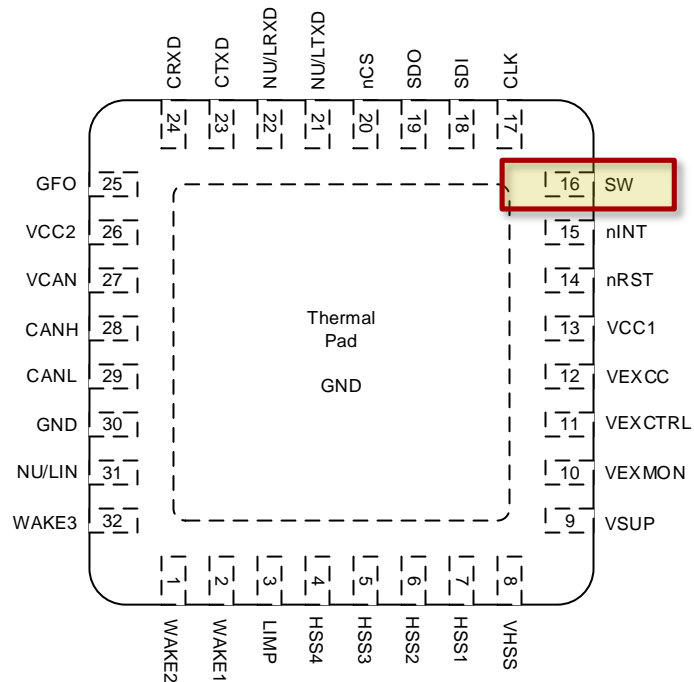
Patent Pending

- Fault detection monitors CANH and CANL for:
  - Short to battery
  - Short to GND
  - Short to each other or opens
- Communication consists of a status/interrupt flag for MCU communication
- Provides fault and device location
  - Network configuration and termination can affect location and detection



# SW Pin

- Programmable Multi-Function input
- Watchdog action suppressor
  - WD active and only provides an interrupt to occur
  - Increment/decrement watchdog counter
- Digital Wake
  - Sleep Mode / Fail-safe mode
    - Automatically changes from watchdog action suppressor to digital wake when the device enters Sleep Mode, register 8'h0E[1]
    - Automatically changes from watchdog action suppressor to digital wake when the device enters Fail-safe Mode, register 8'h0E[2]
  - With or without VCC1



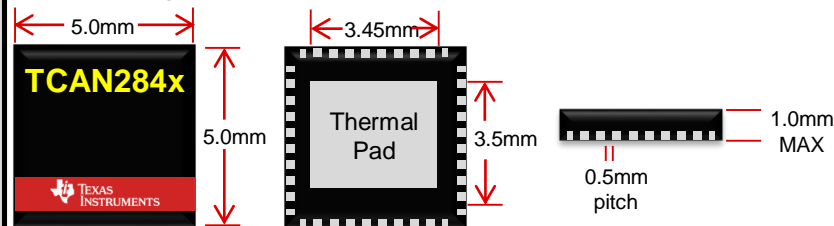
# TCAN284x-Q1 / TCAN285x-Q1 EEPROM & package

## EEPROM

- Ability to save device configuration
- CRC value check
  - Must be enabled for save function
  - Reload from EEPROM if difference
- Interrupt generated after 8 attempts
- Device Configuration reloaded upon POR

## Package

- Available in a small 5mm x 5mm QFN package
- Thermal pad for heat dissipation
- Pins: 32-pin
- Designator : RHB



# Functional Safety offering



## Functional Safety-Capable

Low-complexity products that can be evaluated for use in a functionally safe system

## Functional Safety Quality-Managed

Previously-released, complex products that have had additional documentation developed to enable their use in functional safety applications.

## Functional Safety-Compliant

Products specifically developed to be compliant to functional safety standards that can be used in functional safety applications

## Functional Safety – Quality Managed:

**TCAN284x-Q1**  
**TCAN285x-Q1**

Development process	TI quality-managed process	✓	✓	✓
	TI functional safety process			✓
Analysis report	Functional safety FIT rate calculation	✓	Included in FMEDA	✓
	Failure mode distribution (FMD) and/or pin FMA*	✓	Included in FMEDA	Included in FMEDA
	FMEDA		✓	✓
	Fault-tree analysis (FTA)*			✓
Diagnostics description	Functional safety manual		✓	✓
Certification	Functional safety product certificate**			✓



TI Information – Selective Disclosure

\* May only be available for analog power and signal chain products. \*\* Available for select products.

# TCAN284x-Q1 / TCAN285x-Q1 Functional Safety

Product developed following TI's quality-managed process (QSS024-000) and FS information supplied to help customers meet ISO 26252, IEC 61508, IEC60730 and other functional safety standards

## FMEDA

Failure Modes Effects and  
Diagnostic Analysis

- Validates effectiveness of device safety architecture and mechanisms
- Used to validate safety coverage levels for define requirements (ASIL)
- Includes:
  - FIT rate
  - Device Failure Modes
  - Device Safety mechanism definitions
  - Fault metrics for modules
- Requires NDA - Available at production for each package type

## Safety Manual

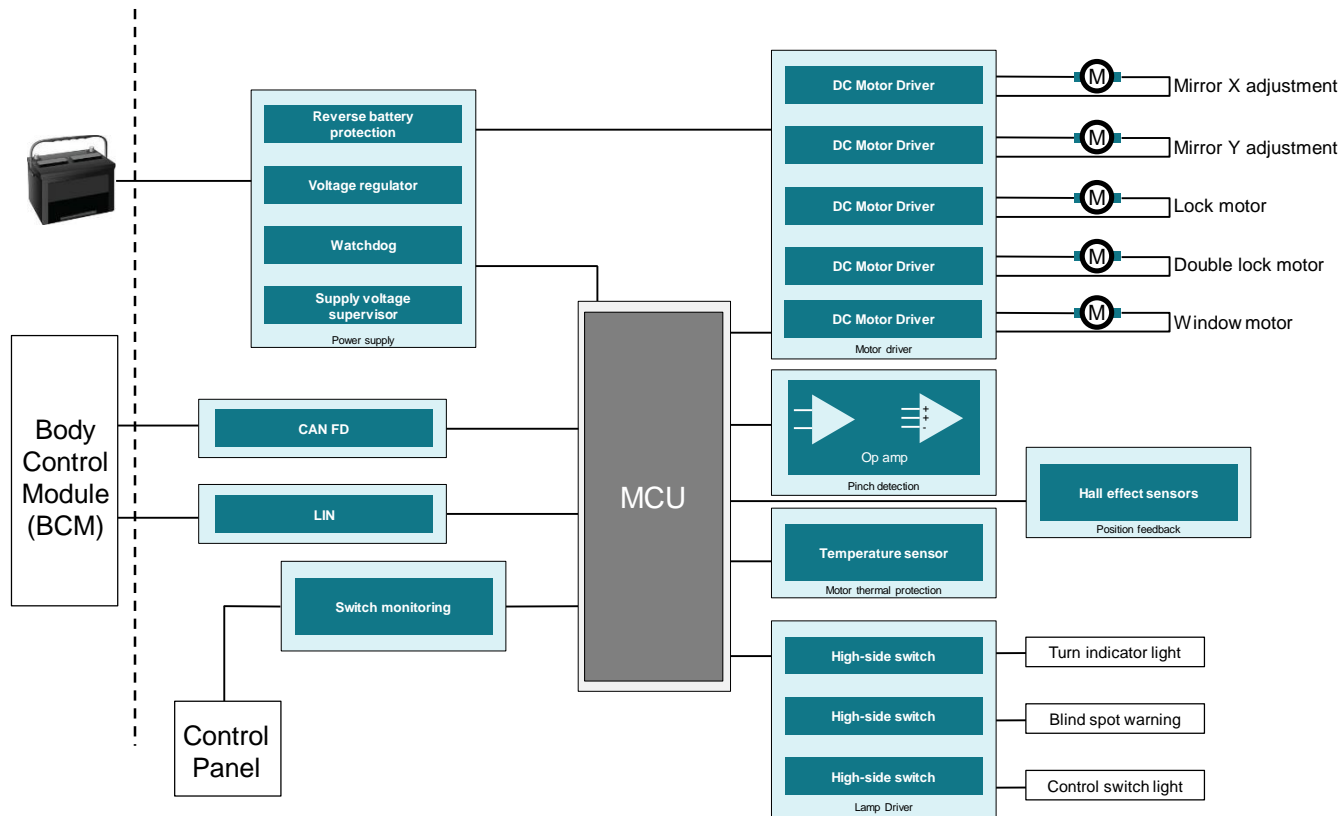
- Application manual describes the diagnostics and fault detection and associate reaction
- Includes Information on:
  - Product Architecture
  - Development process
  - Safety Architecture
  - Architecture Partitions, implemented safety mechanisms, and recommended usage
- Available at production

## Other

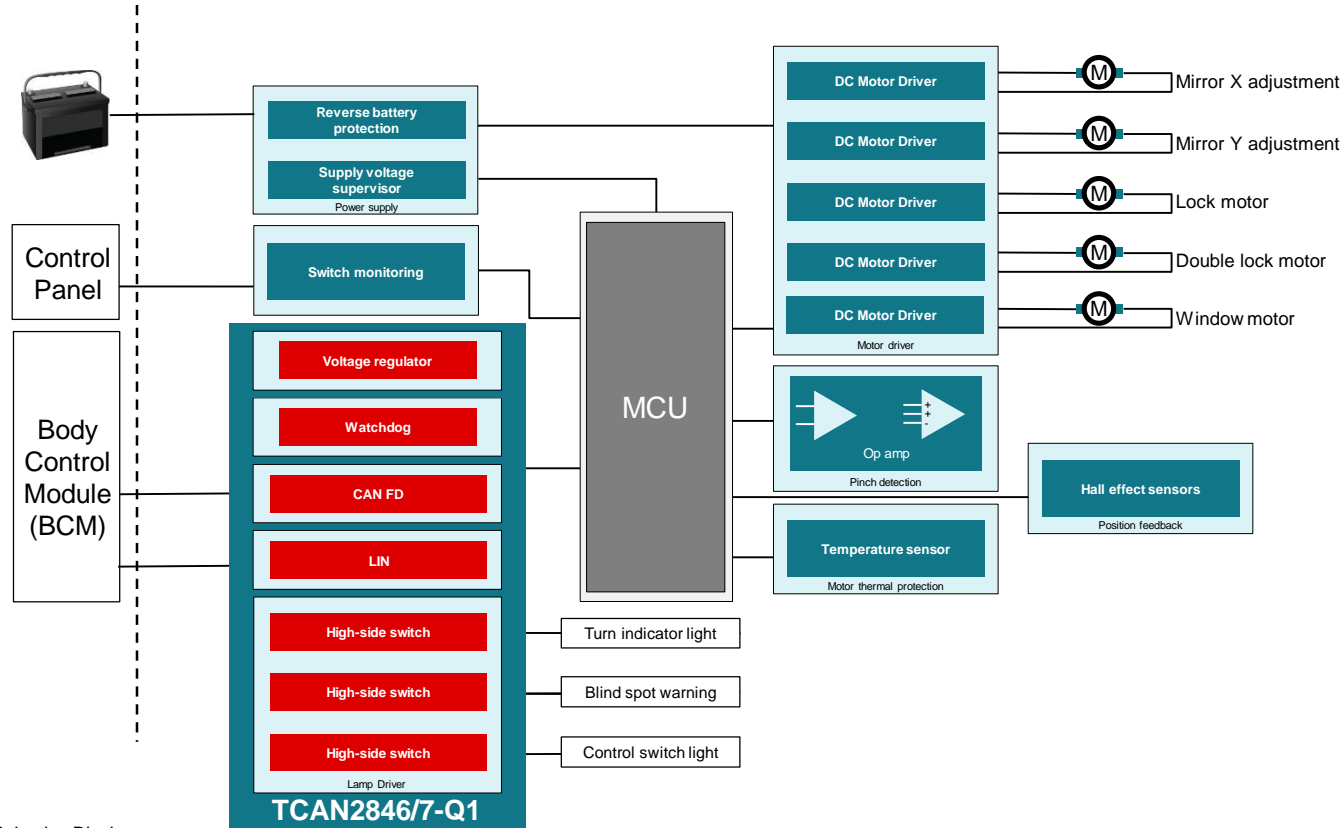
- Datasheet
- AEC-Q100 qualified
- PPAP (requires NDA)
- Application notes

[ti.com/functionalsafety](https://www.ti.com/functionalsafety)

# TCAN284x-Q1-based Door module



# TCAN284x-Q1-based Door module









# TCAN284x-Q1 / TCAN285x-Q1 feature comparison

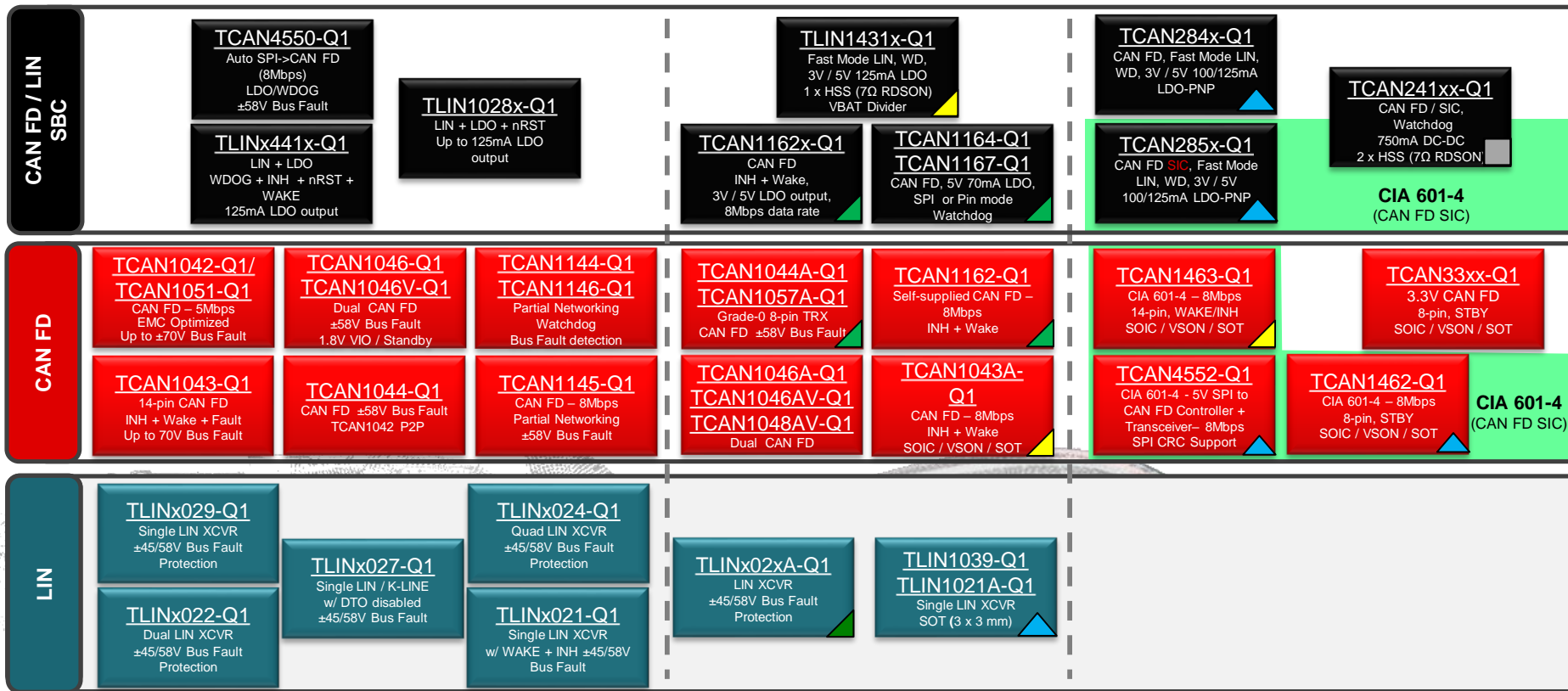
Block	Feature / Device	TCAN2844-Q1	TCAN2854-Q1	TCAN2845-Q1	TCAN2855-Q1	TCAN2846-Q1	TCAN2856-Q1	TCAN2847-Q1	TCAN2857-Q1
CAN	CAN FD	•				•			
	CAN Partial Networking			•	•			•	•
	CAN FD SIC		•		•		•		•
	CAN FD Max data rate	5 Mbps							
	Bus fault protection	±58V							
LIN	LIN					1			
	LIN Max data rate	200 Kbps							
	Bus fault protection	±58V							
LDO	VCC1	3.3V or 5V at 250mA							
	VCC2	5V at 200mA with 28V short to battery protection							
	EXT PNP	1.8V, 2.5V, 3.3V, or 5V at 350mA with 28V short to battery protection							
	VCAN input	5V							
HSS	High side switch	4							
	RDSON	7Ω							
	Current	100mA							
	HSS1 & HSS2 sync	200mA							
Wake	Wake PINs	3							
	Static or Cyclic sensing	Yes							
WD	Watchdog	Timeout, Window, or Q&A							
GFO	Channel Expansion	Yes							

# TCAN284x-Q1 / TCAN285x-Q1 Competitive (Infineon)

Feature	TCAN284xx	TLE9263	TLE9262	TLE9261	TLE9260
Functional Safety	Quality Managed	NA	NA	NA	NA
CAN	1	1	1	1	1
CAN DR (Mbps)	5	5	5	5	2
Bus Fault Tolerance (V)	±58	-27 to 40	-27 to 40	-27 to 40	-27 to 40
Advanced Bus Fault Diagnostics	CAN	NA	NA	NA	NA
LIN	1	2	1	0	0
LIN DR (Kbps) (Programming)	200	115	115	0	0
Bus Fault Tolerance (V)	±58	-27 to 40	-27 to 40	-27 to 40	-27 to 40
LDO	3	3	3	3	3
EXT PNP output (V)	1.8V/2.5V/3.3V/5V	1.8/3.3V/5V	1.8/3.3V/5V	1.8/3.3V/5V	NA
Ext PNP output (mA)	350	350	350	350	NA
VCC1 (V)/(mA)	VCC1 - 3.3 & 5/250	VCC1 - 3.3 & 5/250	VCC1 - 3.3 & 5/250	VCC1 - 3.3 & 5/250	VCC1 - 3.3 & 5/250
VCC2: CAN LDO + (V)/(mA)	VCC2 - 5/200	VCC2 - 5/100	VCC2 - 5/100	VCC2 - 5/100	VCC2 - 5/100
VCAN	VCC1	VCC1	VCC1	VCC1	VCC1
# of HSS	4	4	4	4	4
HSSx (RDSON)	7 Ω	7 Ω	7 Ω	7 Ω	7 Ω
HSSx current (mA)	100	100	100	100	100
HSS1 & HSS2 Synchronization	Connect together for higher current	NA	NA	NA	NA
GFO (channel Expansion)	All	NA	NA	NA	NA
nRST connection	VCC1	VCC1	VCC1	VCC1	VCC1
FO outputs (HVIO)	LIMP	3	3	3	3
# WAKE Pins	3	3 + 2 FO	3 + 2 FO	3 + 2 FO	3 + 2 FO
Watchdog	TO, WWVD, Q&A	TO, WWVD	TO, WWVD	TO, WWVD	TO, WWVD
EEPROM (Customer initiated Config)	Configuration Bits stored	NA	NA	NA	NA
SW pin	Software development and digital wake up	NA	NA	NA	NA
HBM non-CAN/LIN (kV)	±4	±2	±2	±2	±2
HBM Xn/LIN (kV)	±8	±8	±8	±8	±8
IEC (kV)	±15	±6	±6	±6	±6
Package	32-pin; 5mmx5mm w/0.5mm pitch	48-pin; 7mmx7mm w/0.5mm pitch			
WAKE Features	Digital IO input capable	WK1 & WK2 Vbat Monitor			
FO		FO2/FO3 are multi-function HVGPIIO: HSS, LSS, WK4, WK5,			

# CAN / LIN / SBC Auto Roadmap

 Final samples 
  Sampling 
  Development 
  Concept



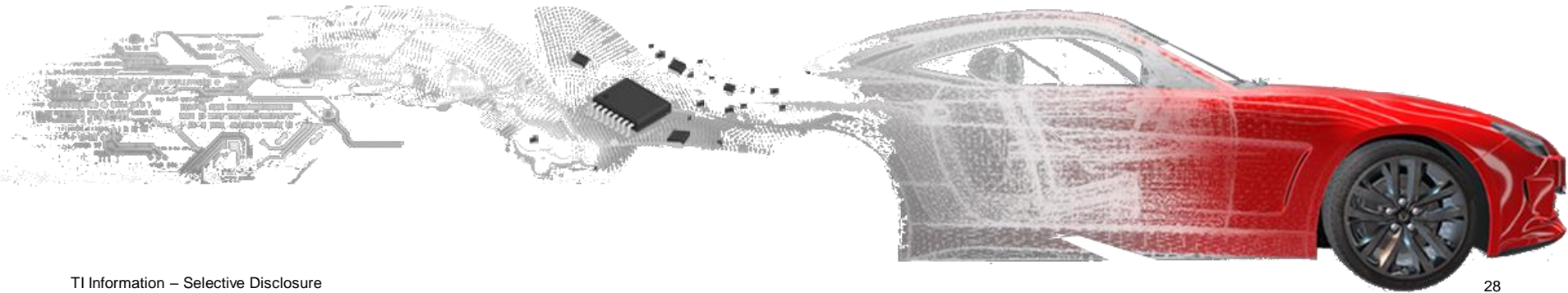
In Production

2021 Production

> 2021 Production

TI Information – Selective Disclosure

# Backup

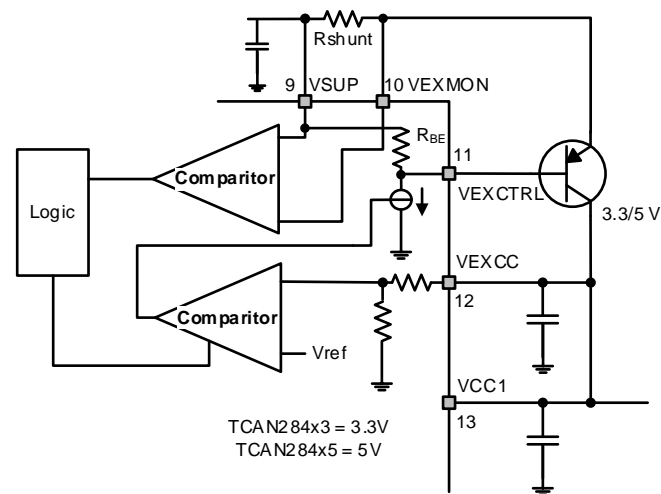


TI Information – Selective Disclosure

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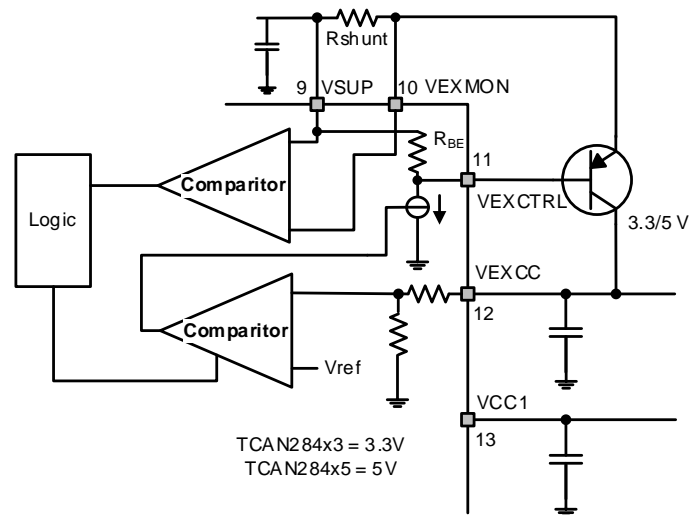
# LDO Load Sharing

- Need more power?
- VCC1 and VEXCC can be connected together for load sharing
  - Enabling up to 500mA at either 3.3V or 5V
  - VCC1 (primary LDO) supports the Over-Voltage, Under-Voltage, and short circuit protection circuit
- VEXCC cannot support 1.8V or 2.5V in this mode
- Provides increased flexibility to suit many end application requirements



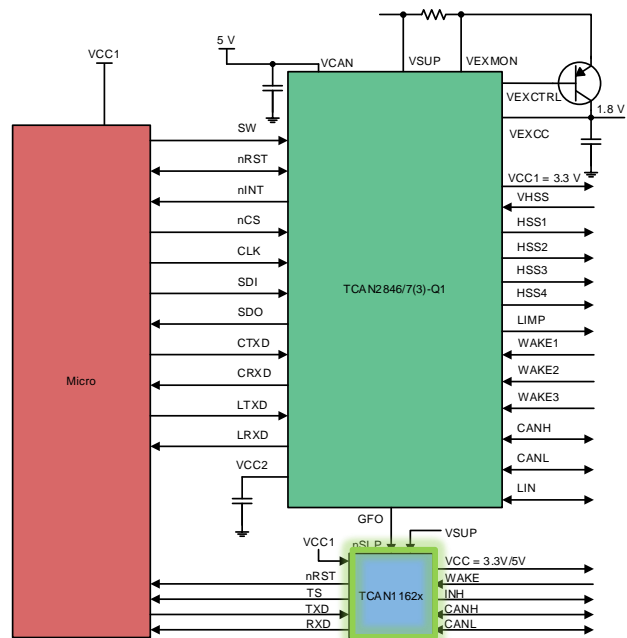
# LDO Configuration

- **LDOs support highly-flexible configurations**
  - Registers 8'h0C - 8'h0E are used for LDO configuration
  - Each LDO can be programmed on, off and SBC mode controlled
    - When programmed on, this allows them to be on in sleep mode
- **Pass through mode**
  - VCC1 and VCC2 have a pass through mode
  - Between 3V and 5.5V the VSUP voltage is passed through
  - Pass through is disabled when VSUP reaches a level that can be regulated
- **Sink Capability**
  - VCC1 and VCC2 supports sinking up to 10mA of current for ~ 150 ms when turned on.

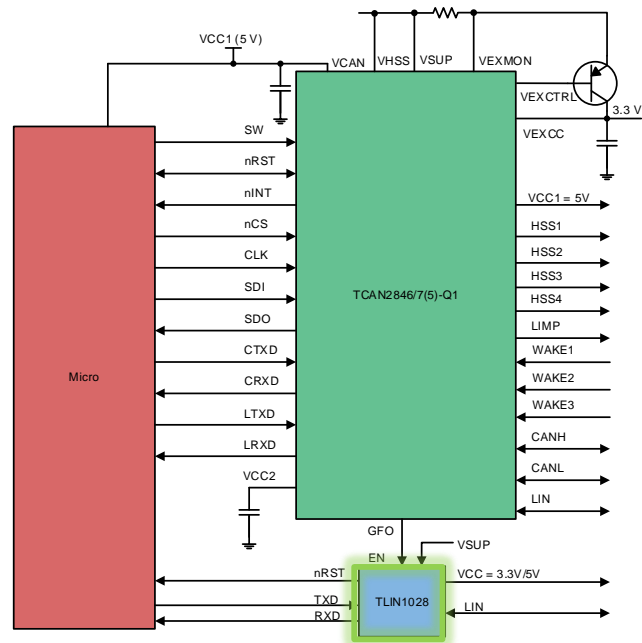


[Return to LDO](#)

# Channel expansion example - SBC

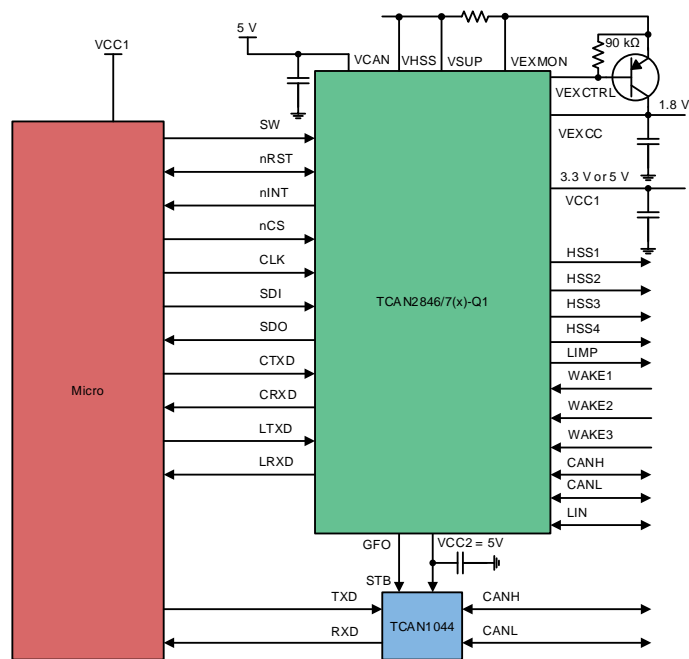


Feature	Number
LDO (4)	<ul style="list-style-type: none"> <li>1.8V/2.5V/3.3V/5V @ 350mA</li> <li>3.3V/5V @ 250mA</li> <li>5V @ 200mA</li> <li>3.3V @ 70mA/5V @ 100mA</li> </ul>
CAN FD TRX	2
LIN TRX	1

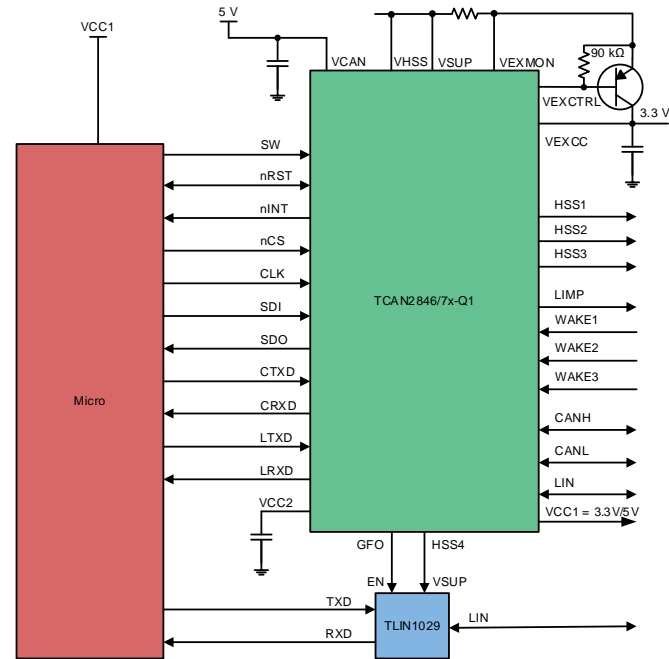


Feature	Number
LDO (3)	<ul style="list-style-type: none"> <li>1.8V/2.5V/3.3V/5V @ 350mA</li> <li>3.3V/5V @ 250mA</li> <li>5V @ 200mA</li> <li>3.3V/5V @ 125mA</li> </ul>
CAN FD TRX	1
LIN TRX	2

# Channel expansion example - Transceiver



Feature	Number
LDO (1)	1.8V to 5V @ 350mA 3.3V/5V @ 250mA
CAN FD TRX	2
LIN TRX	1



Feature	Number
LDO (2)	1.8V to 5V @ 350mA 3.3V/5V @ 250mA 5V @ 200mA
CAN FD TRX	1
LIN TRX	2

TI

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