



We are the link
between the real and
the digital world.

Infineon PROFET™ & EiceDRIVER™ APD for Power Distribution

Infineon's virtual show 2020



Agenda

1

Power Distribution: Introduction

2

Gate Drivers up to 100A: EiceDRIVER™ APD

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High-side switches up to 40A: Power PROFET™

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High-side switches up to 32A: PROFET™+2 12V

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High-side switches with extended junction temperature: PROFET™+2 12V Grade0

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High-side switches with SPI up to 15A: SPOC™+2

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G2M support material

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High-side switches with extended junction temperature: PROFET™+2 12V Grade0

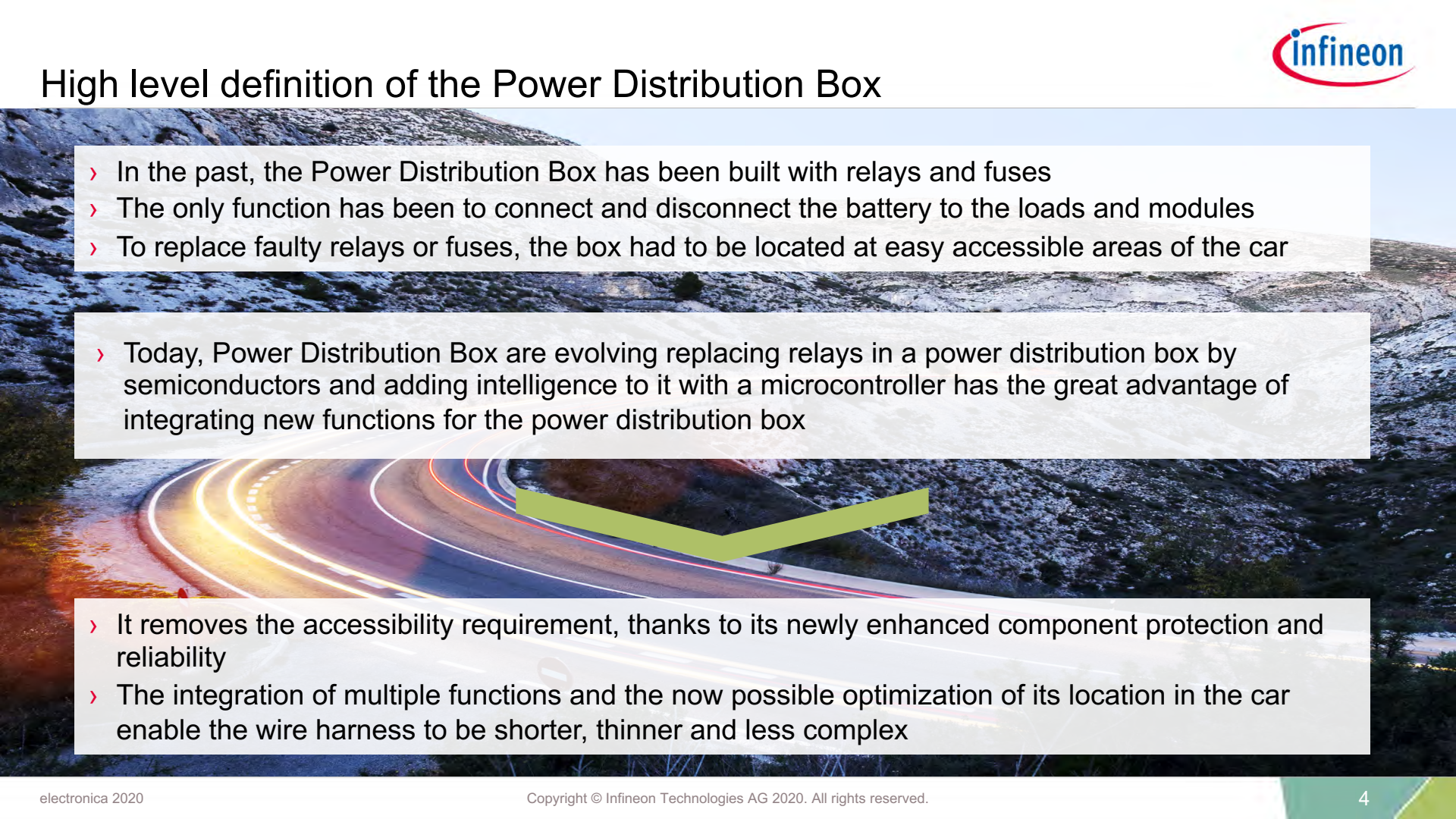
6

High-side switches with SPI up to 15A: SPOC™+2

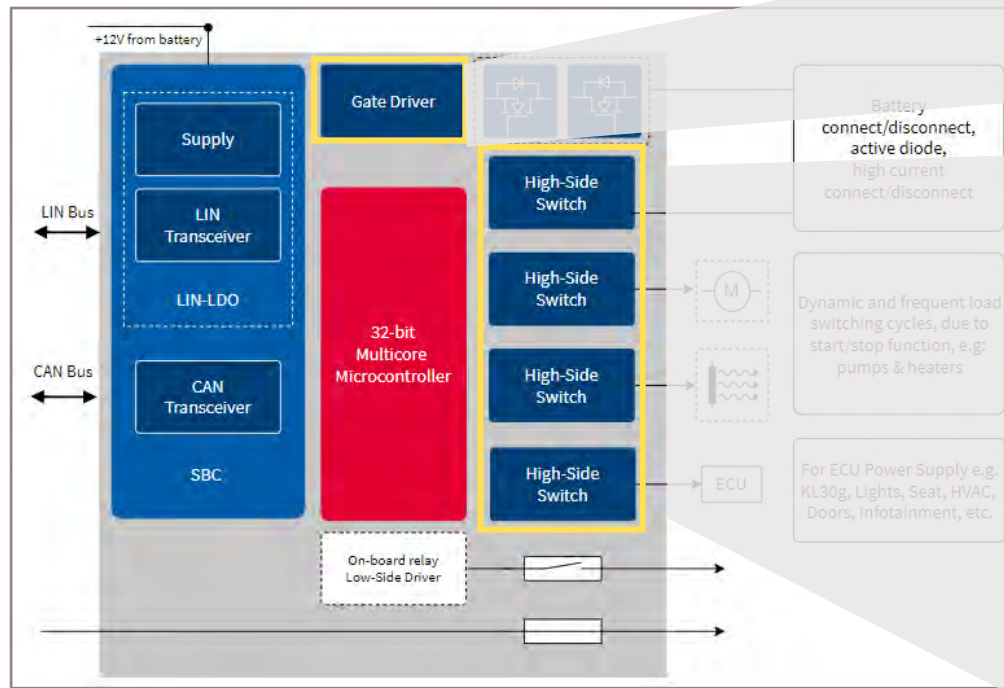
7

G2M support material

High level definition of the Power Distribution Box

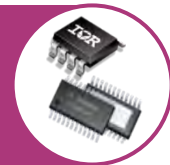
- 
- The background of the slide is a photograph of a winding road at night. The road curves through a dark, rocky landscape. Long-exposure light trails from cars are visible, showing yellow and white for headlights and red for taillights. A large, semi-transparent white box is overlaid on the image, containing the text. A green arrow points from the top box to the bottom box.
- › In the past, the Power Distribution Box has been built with relays and fuses
 - › The only function has been to connect and disconnect the battery to the loads and modules
 - › To replace faulty relays or fuses, the box had to be located at easy accessible areas of the car
-
- › Today, Power Distribution Box are evolving replacing relays in a power distribution box by semiconductors and adding intelligence to it with a microcontroller has the great advantage of integrating new functions for the power distribution box
-
- › It removes the accessibility requirement, thanks to its newly enhanced component protection and reliability
 - › The integration of multiple functions and the now possible optimization of its location in the car enable the wire harness to be shorter, thinner and less complex

Infiniteon offers the most comprehensive portfolio of Intelligent Power Devices

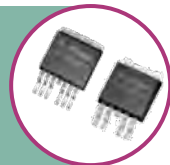


[Power Distribution Box application page](#)

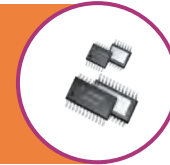
EiceDRIVER™ APD
[40A–100A]
Gate Driver



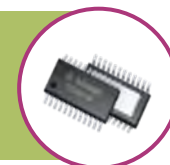
Power PROFET™
[20A–40A]
Discrete HSS



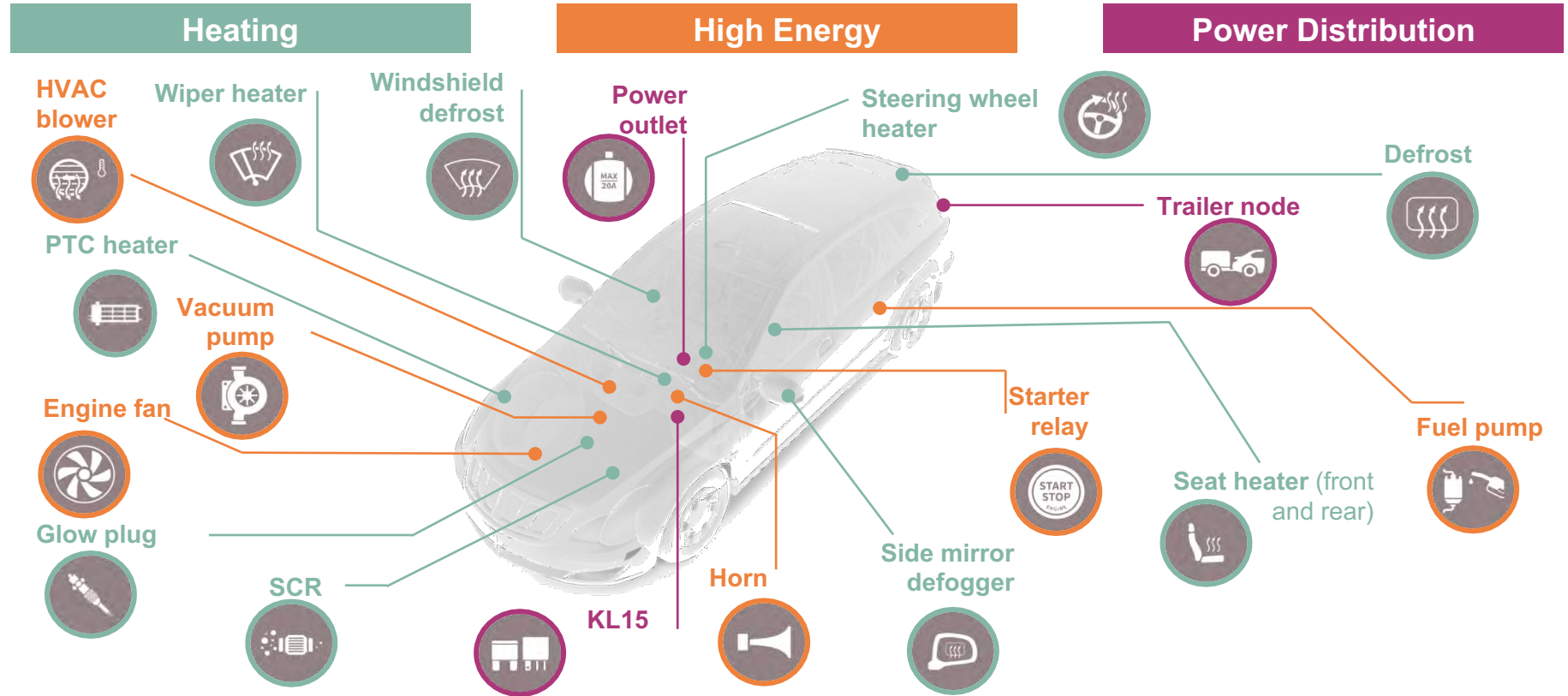
PROFET™+2 12V
[0A–32A]
Discrete HSS



SPOC™+2
[0.5A–15A]
Multi-channel HSS w/ SPI interface



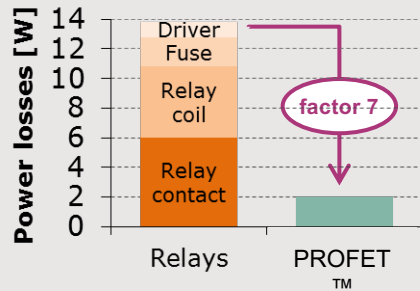
New body switches for resistive, inductive and capacitive loads driven from relay boxes, junction boxes or modules



One of the major trends in Power Distribution Box is the replacement of relays & fuses by semiconductors

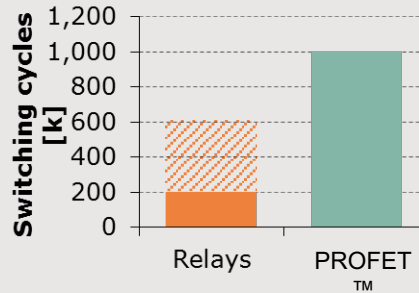
For Relay & Fuse replacement, Infineon offers Power Switch ICs with the most scalable portfolio of high side switches in the market

Low power losses



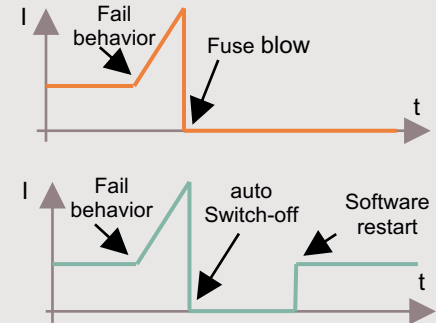
Higher current density in a smaller footprint

Support start-stop



Almost unlimited number of switching cycles to fulfill start-stop requirements

Short-circuit restart



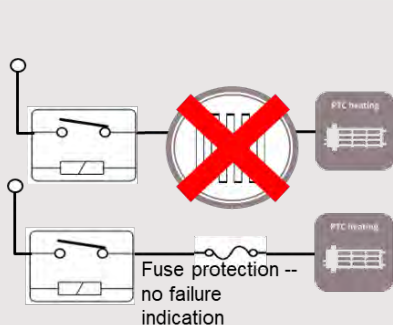
Benchmark performance, short circuit protection (AEC-Q100)

If you want to learn more about Relay Replacement: [Relay Replacement I](#) [Relay Replacement II](#) In [Power Distribution](#)

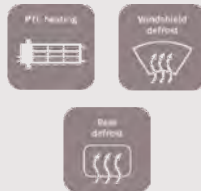
One of the major trends in Power Distribution Box is the replacement of relays & fuses by semiconductors

For Relay & Fuse replacement, Infineon offers Power Switch ICs with the most scalable portfolio of high side switches in the market

PROFET™: PWM / Diagnostics



Heating applications require PWM for optimal performance



PROFET™ provide diagnostic feedback for: Load current, Open and short circuit...

Tier1 benefits

- › Increased functionality / diagnosis enhances value to OEMs

OEM benefits

- › Enhanced features to meet requirements / market
- › Reduced vehicle power consumption

Driver benefits

- › Improved Comfort
- › Optimized performance

If you want to learn more about Relay Replacement: [Relay Replacement I](#) [Relay Replacement II](#) In [Power Distribution](#)

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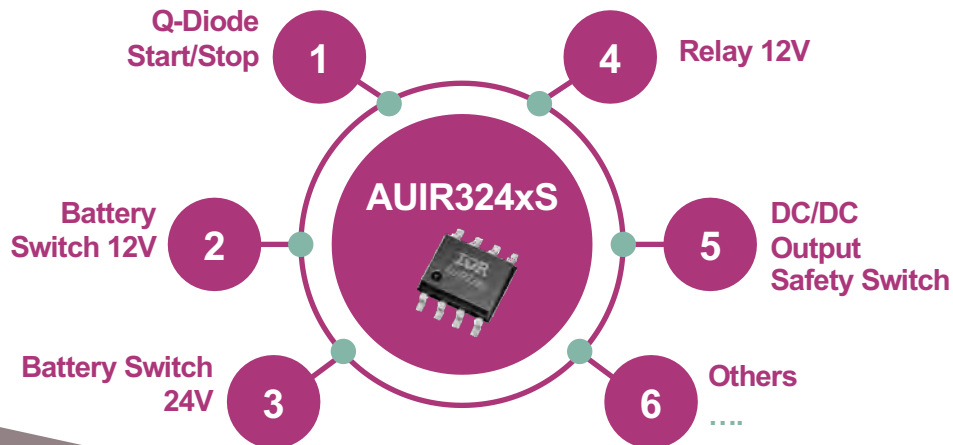
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G2M support material

AUIR324xS family overview: One output channel gate driver

	AUIR 3241S	AUIR 3242S
Preferred for new designs	yes	yes
Web-Link	Link	Link
Package	S0-8	S0-8
Qualification	AEC Qualified	AEC Qualified
Output / Controlled Channel(s)	1 / 1 ¹⁾	1 / 1 ¹⁾
Gate Output Voltage	12,5V	12,5V
Gate Discharge Current	350mA	350mA
Gate Voltage Supply type	Boost	Boost
Input (max. frequency)	Active = high (< 1 kHz)	Active = low (< 1 kHz)
Operating Voltage (nom. ext.)	6-16V 3-36V	6-16V 3-36V
Low Quiescent Current (On State)	Yes (< 50 µA)	Yes (< 50 µA)
NTC Interface	no	no
Short Circuit Protection	no	no
Ground Loss Protection	yes	yes
Failure Status Indication	no	no
Analog gate current monitoring (Rs Pin)	yes	yes
Gate - Undervoltage Lockout	yes	yes

Application in focus



¹⁾ Support Back to Back applications (VCC and Source expanded)

AUIR324xS family: Product positioning and key features



Why AUIR324x family?

- › Ensure **reliable switching** of **medium/large currents**
- › **Reduced current consumption** for active supply during parking mode
- › Enabled for use in **ASIL rated application**
- › Operation ensured **at 12V cold cranking conditions**



Applications in focus

- › Q-Diode Start/Stop 12V
- › Battery Switch 12V/(24V)
- › Relay 12V
- › DC/DC output safety switch 12V



SOIC-8N

Wide operation voltage

- › Wide operating voltage between 3V – 36V combined with gate discharge current of typ. 350mA due to boost converter topology

Idle Mode

- › Low quiescent current ($< 50\mu\text{A}$) consumption for active supply

Reliability

- › Low FIT rate ($< 20\text{FIT}$) enables use in ASIL rated applications
- › Analog Mosfet gate current monitoring
- › AEC Q100 qualified



Portfolio

- › **AUIR3241S**
- › **AUIR3242S**

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Robust & high power capable: Power PROFET™

Power PROFET™ Portfolio		
Current Load	DPAK	D ² PAK
1.0mΩ		BTS50010-1TAD
1.5mΩ		BTS50015-1TAD
2.5mΩ	BTS50025-1TEA	BTS50025-1TAD

Lowest on-resistance with **enhanced energy** and **thermal capability** on the market

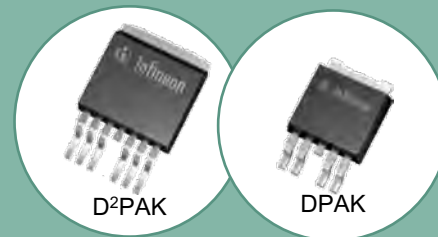
BTS50010-1TAD

Lowest Ohmic smart switch on the market

BTS50025-1TEA

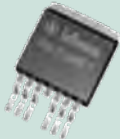
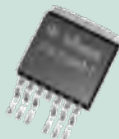
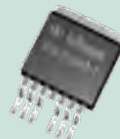

Best compromise between small footprint, low $R_{DS(on)}$ & high energy capability

NEW



- › **Benchmark current capability** (40A DC)
- › **Benchmark energy capability** (EAR 550mJ @33A DC, Grade A AEC-Q100)

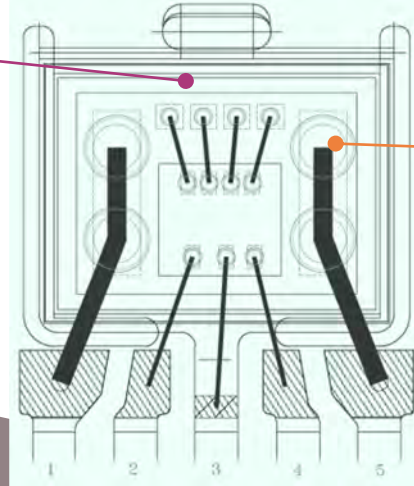
Overview electrical and mechanical parameter

	BTS50010-1TAD	BTS50015-1TAD	BTS50025-1TAD	BTS50025-1TEA
	 D²PAK	 D²PAK	 D²PAK	 DPAK
Footprint	15mm x 10mm	15mm x 10mm	15mm x 10mm	9.9mm x 6.5mm
R_{THJA}	20K/W	20K/W	20K/W	22K/W
R_{DS_ON} (typ @ 25°C)	1.0mΩ	1.5mΩ	2.5mΩ	2.5mΩ
R_{DS_ON} (max @ 150°C)	2.0mΩ	3.0mΩ	5.0mΩ	5.0mΩ
I_{NOM}	40A	33A	25A	24A
I_{TRIP} (min)	150A	135A	70A	60A
E_{AS} @ I_{NOM}	3000mJ	3000mJ	1050mJ	400mJ
E_{AR} @ I_{NOM}	460mJ	550mJ	120mJ	-

BTS50025-TEA: the best compromise between small footprint, low $R_{DS(ON)}$ & energy capability

Package

- › **DDPAK -57% footprint shrink** compared to D²PAK
- › Excellent thermal capability (R_{THJA} **22K/W**)



Power Chip

- › **Lowest ohmic protected switch** in the market (2.5mΩ) in DPAK
- › **Outstanding energy capability up to 400mJ @ 20A (single pulse)**

Customer Benefits

- › Low R_{TH} : fast heat dissipation
- › 16% lower price than D²PAK counterpart
- › Able to drive bigger inrush currents than PROFET™+2 12V

The three key features and benefits

Key Feature	Description	Benefit
Benchmark Current Capability	The Power PROFET™ is the only protected device family capable to replace relays & fuses from 20A up to 40A DC	Integrated turn-key solution enabling fast time to market
Benchmark Energy Capability	The Power PROFET™ family offers the highest energy ratings ever specified for a PROFET™ and allowed repetitive clamping	Up to 0.20€ savings by removing the need for free wheeling diode for many application
Short Circuit Grade A (AEC-Q100) >1Million Cycles	The Power PROFET™ achieved the highest rating for short circuit performance under the AEC-Q100 test conditions	The safest solution to replace relays and fuses

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G2M support material

PROFET™+2 12V – flexibility & efficiency to drive loads with protection and diagnosis

Load current	Single Channel	Load current	Dual Channel
32A	BTS70012-1ESP	SOP Q2 2021 Samples and demoboards available!	
28A	BTS70015-1ESP		
24A	BTS70020-1ESP		
21A	BTS7002-1EPP		
15A	BTS7004-1EPP		
	BTS7004-1EPZ		
13A	BTS7006-1EPP		
	BTS7006-1EPZ		
10–11 A	BTS7008-1EPP		
10–11 A	BTS7008-1EPA	7–7.5 A	BTS7008-2EPA
	BTS7008-1EPZ		BTS7008-2EPZ
8–9 A	BTS7010-1EPA	6–6.5 A	BTS7010-2EPA
8–9 A	BTS7012-1EPA	6–6.5 A	BTS7012-2EPA
		5–5.5 A	BTS7020-2EPA
		4–4.5 A	BTS7030-2EPA
4–4.5 A	BTS7040-1EPA	3–3.5 A	BTS7040-2EPA
	BTS7040-1EPZ		
		3–3.5 A	BTS7080-2EPA
			BTS7080-2EPZ
		2–2.5 A	BTS7120-2EPA
		1–1.5 A	BTS7200-2EPA BTS7200-2EPC
		1–1.5 A	BTS7200-4EPA

Key applications: Heating and Power Distribution

- › Nominal load currents up to 32A
- › Current trip with latch
- › Over temperature protection
- › ReverseON and inverse mode capability
- › Current sense diagnosis with failure signal up to I_{TRIP} level
- › Optimized turn-on and turn-off slew rates for high currents

Key applications: Powertrain & "under the hood"

- › Based on EPA or EPP variant
- › Same characteristic as the base variant
- › With extended junction temperature range up to 175°C
- › k_{ILIS} optimized for power distribution applications

Key application: Lighting and Body

- › Current trip with intelligent restart control
- › Low-mid currents (1.0-11A)
- › Over temperature protection
- › Partially with ReverseON
- › Current sense diagnostics up to $2xI_{NOM}$

PROFET™+2 12V TSDSO-24 family (-1ESP)

High end feature set up to 32A!



Why PROFET™-2 12V?

- › **Lowest power losses** thanks to technology shrinking
- › **Advanced diagnosis** thanks to improved current sense accuracy
- › **Scalable family concept** (pin and function compatible) for high design flexibility



Applications in focus

- › Power Distribution and Heating



PG-TSDSO-24

Basic feature-set

- › High-Side Switch with diagnosis and embedded protection

Pin2pin compatibility

- › **High design flexibility** thanks to the footprint and function compatibility with PROFET™+2 in TSDSO-14

Capacitive Load Switching Mode

- › Switching capacitive loads in the safe operating area
- › Enables to switch big capacitors

Cost optimized solution

- › Load driving capability up to 32A & still within a monolithic chip!

NEW

Samples and demoboards already available!

SOP: Q2 2021

I _{L(NOM)}	Single Channel
32A	BTS70012-1ESP
28A	BTS70015-1ESP
24A	BTS70020-1ESP

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G2M support material

PROFET™+2 12V Grade0:

Extended junction temperature range up to 175°C



PROFET™+2 12V Grade0 Portfolio

BTS7004-1EPZ

BTS7006-1EPZ

BTS7008-1EPZ

BTS7008-2EPZ

BTS7040-1EPZ

BTS7080-2EPZ



Target applications

- › **Powertrain systems** require Grade0 qualified switches due to increased ambient temperature
- › The increased thermal budget enables partitionings with higher ohmic parts for **under the hood modules**

If you want to learn more about PROFET™+2 12V Grade0

- › [PROFET™+2 12 V Grade0 promotion page](#)
- › [PROFET™ +2 12V Grade0 nominal current calculation](#)

Customer Benefit



PROFET™+2 12V family approach

High design flexibility on reduced PCB area with low power losses and high accuracy

Partitioning at high ambient temperatures with **higher ohmic parts**

Thanks to the **extended thermal budget** Grade 0 devices are conducting **higher current** at **higher PCB temperature**

Extended lifetime at elevated temperatures

Thanks to **additional qualification** PROFET™+2 12V Grade 0 can fulfill the extended mission profile

Diagnosis concept tailored to address power distribution applications thanks to **higher k_{ILIS}**

Best fit for PD applications: Possibility to distinguish between the nominal and the fault current

Cost optimized, robust & high power capable: The right fit product for power distribution

PROFET™+2 12V -ESP

- › **-ESP portfolio in development:**
Capability to drive load up to 32A
- › **Scalable family concept**
(pin and function compatible) for high design flexibility



TSDSO-14



TSDSO-24

SOP Q2 2021

BTS70012-1ESP

BTS70015-1ESP

BTS70020-1ESP

PROFET™+2 12V Grade0

- › **Extended junction temperature up to 175°C**
- › k_{ILIS} optimized for power distribution applications



TSDSO-14

BTS7004-1EPZ

BTS7006-1EPZ

BTS7008-1EPZ

BTS7008-2EPZ

BTS7040-1EPZ

BTS7080-2EPZ

Power PROFET™ (BTS500xx-1TAD/TEA)

- › Lowest on-resistance with **enhanced energy** and **thermal capability** on the market



D²PAK



DPAK

BTS50010-1TAD

Lowest Ohmic smart switch
on the market

BTS50025-1TEA

Best compromise between small
footprint, low R_{DSon} & high
energy capability

NEW

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G2M support material

SPOC™+2 with SPI and multichannel integration enables reduction of external components while reducing space and cost on PCB

SPOC™+2 SPI solution

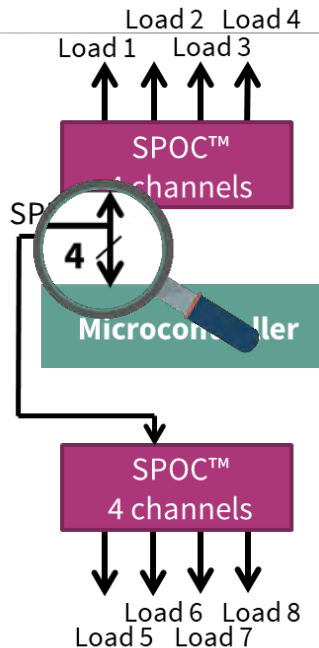
Discrete solution (like PROFET™+2 12V)

Daisy chain implementation

Benefits

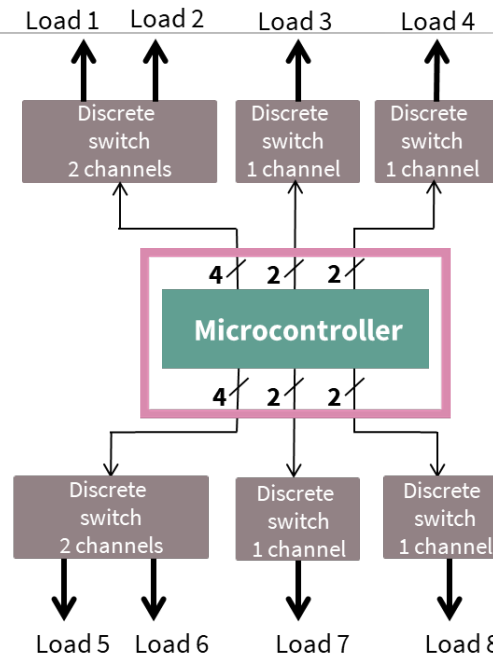
SPI: Less traces on PCB

Multichannel integration: Reduction of external components



-12 GPIOs

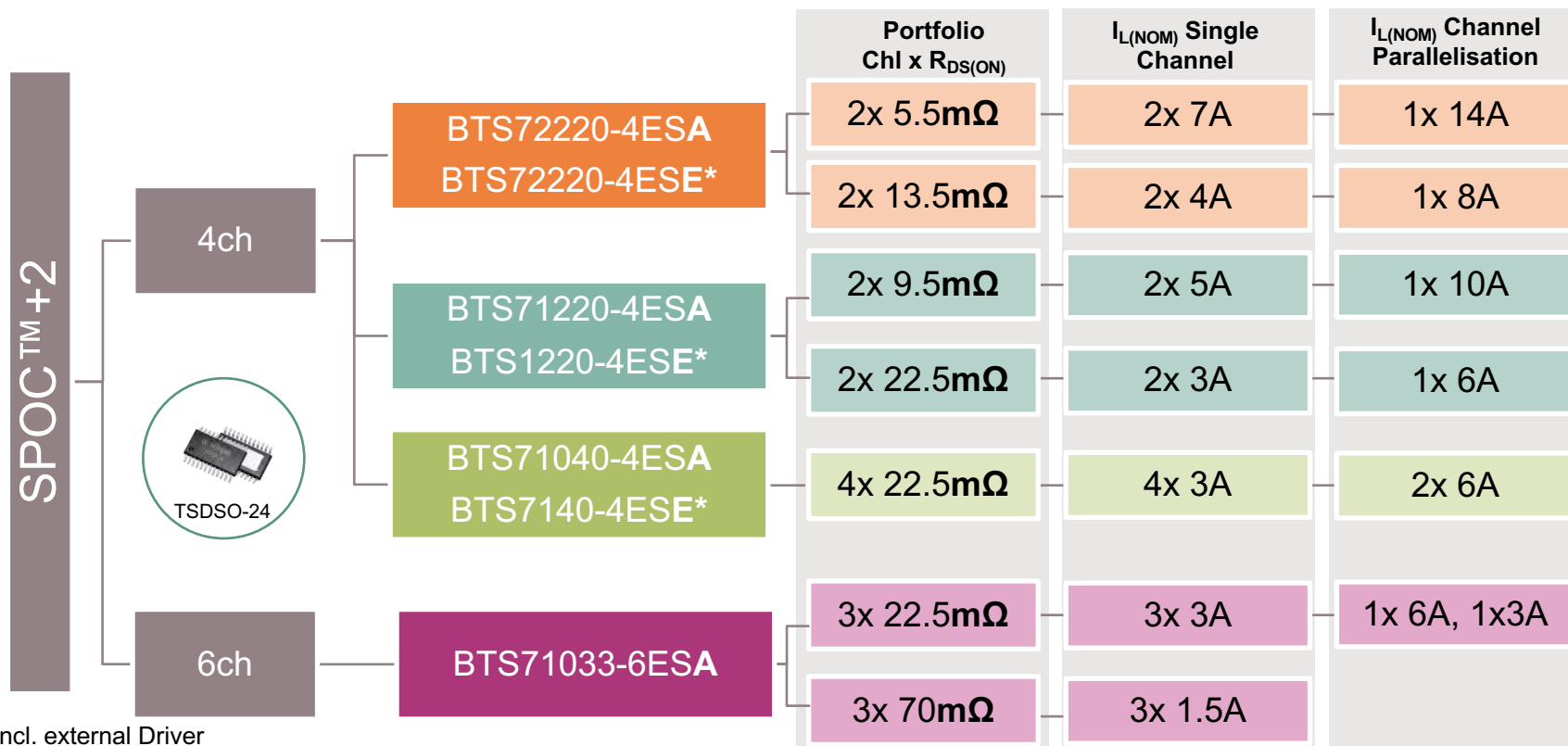
- › Save μ C I/O & board space
- › Smaller microcontroller
- › Cost and PCB area savings



2 connections:
channel +
diagnosis

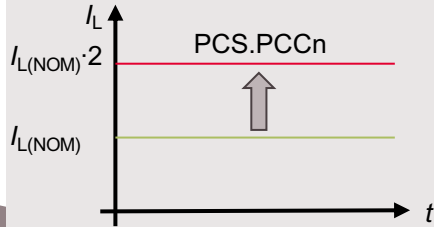
**16
output
pins**

SPOC+2 Portfolio Overview



SPOC™+2 offers an advanced feature-set with high flexibility programmable via SPI

Parallel Channel Configuration

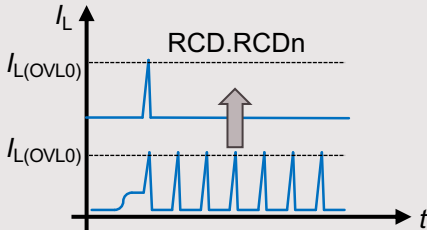


SPOC™+2 offers **high flexibility with configurable features** to support the trend of **intelligent power distribution**

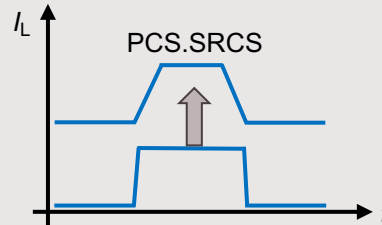
SPI Check sum

Check sum data communication to support functional safety

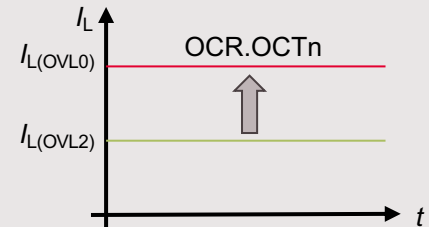
Restart Strategy for Channel n



Slew Rate control for Channel n



Overcurrent threshold adjustment



If you want to learn more about SPOC™+2:

[Getting Started with SPOC™+2 Evaluation Kit](#) & [Explore the possibilities of the SPOC™+2 PSPIICE model and learn how to configure it](#)

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G2M support material



Download our Application Note for
[Relay replacement I](#) and [Relay Replacement II](#)
[PROFET™ +2 12V Grade0 nominal current calculation](#)



Learn more on our Power Distribution Box
[Application Page](#)



Related videos on the Body Control Module Application Page:

- › [Discover the full potential of the new PROFET+2 12V Arduino Shield](#)
- › [PROFET™+2 12 V Grade0 promotion page](#)
- › [Getting Started with SPOC™+2 Evaluation Kit](#)
- › [How to size the current capability of a PROFET™ while taking its environment \(PCB\) into account](#)
- › [Power PROFET™, Infineon's automotive high-side switches](#)
- › And many more ...



Part of your life. Part of tomorrow.