# OptiMOS™ 8 100 V power MOSFETs revolutionizing motor drive and battery protection applications

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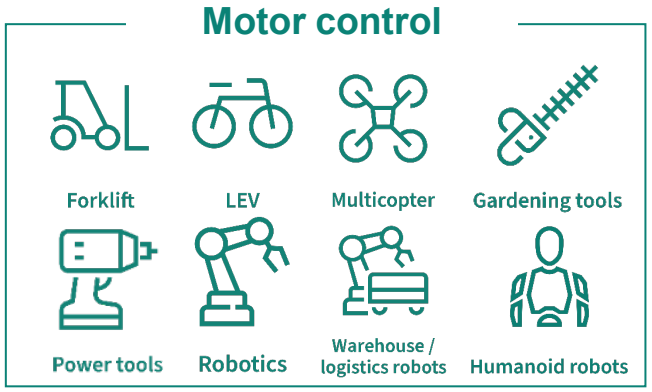
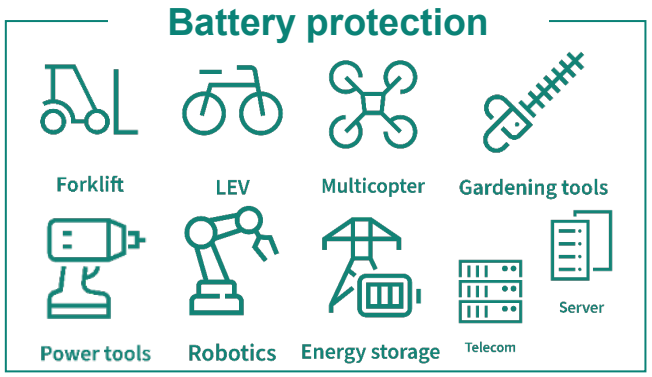
# OptiMOS™ 8 power MOSFETs in 100 V
## The preferred choice powering various applications




- Efficient power handling
- Price/performance optimized
- Power density for space-constrained applications
- Offers high reliability

# OptiMOS™ 8 power MOSFETs in 100 V - Powering a wide variety of motor control applications at attractive cost/performance

Drives

Powerful vehicles and tools currently operated by combustion engines

Cost sensitivity for high volume goods

Equivalent performance expected from battery-powered variant

Need for system-level cost down

Requires MOSFETs with capability of reliably handling high power

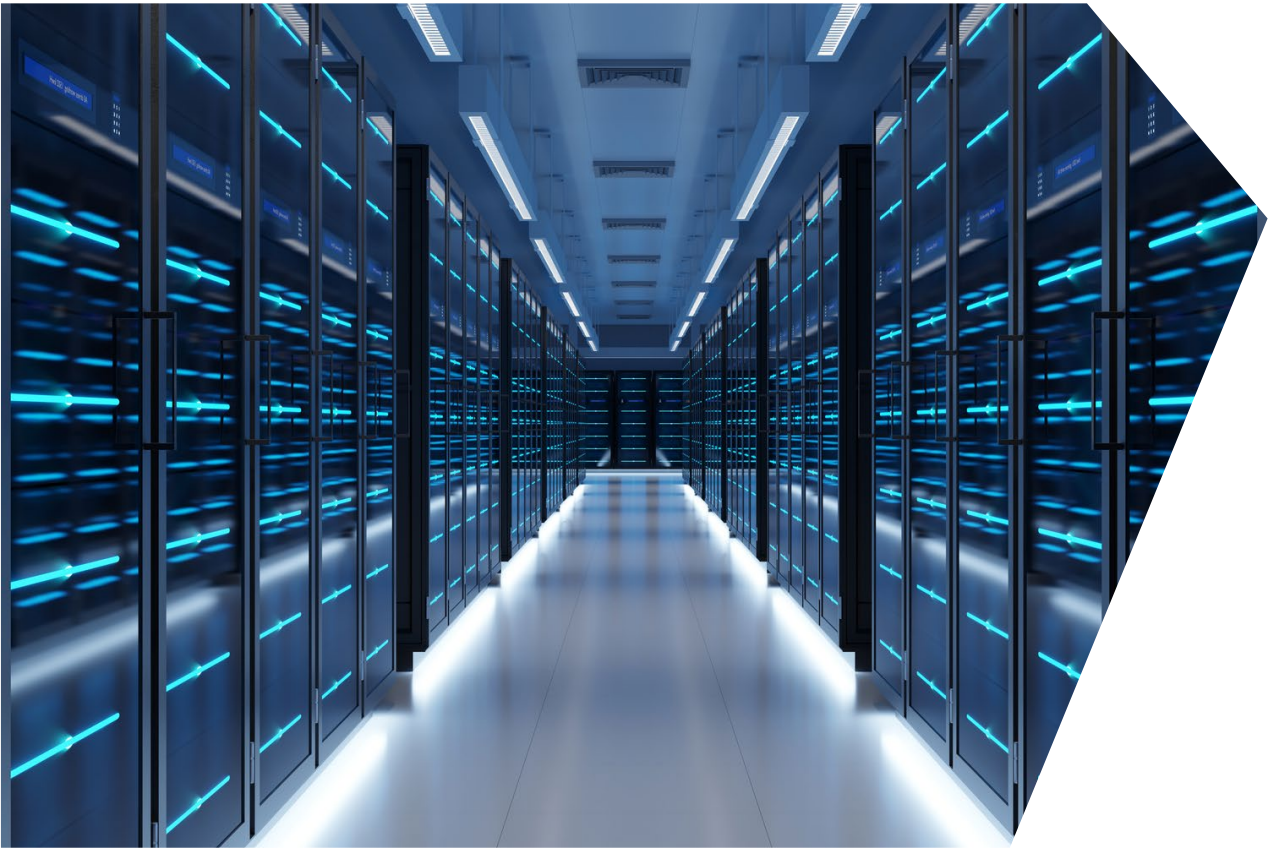
Requires cost/performance optimized MOSFETs

**OptiMOS™ 8 power MOSFETs in 100 V for:**

- ✓ **Highest peak and steady-state current capability through low conduction losses**
- ✓ **Attractive price/performance and part count reduction**

# Substantial increase in compute driven by AI, resulting in the need for efficient power management

Battery protection



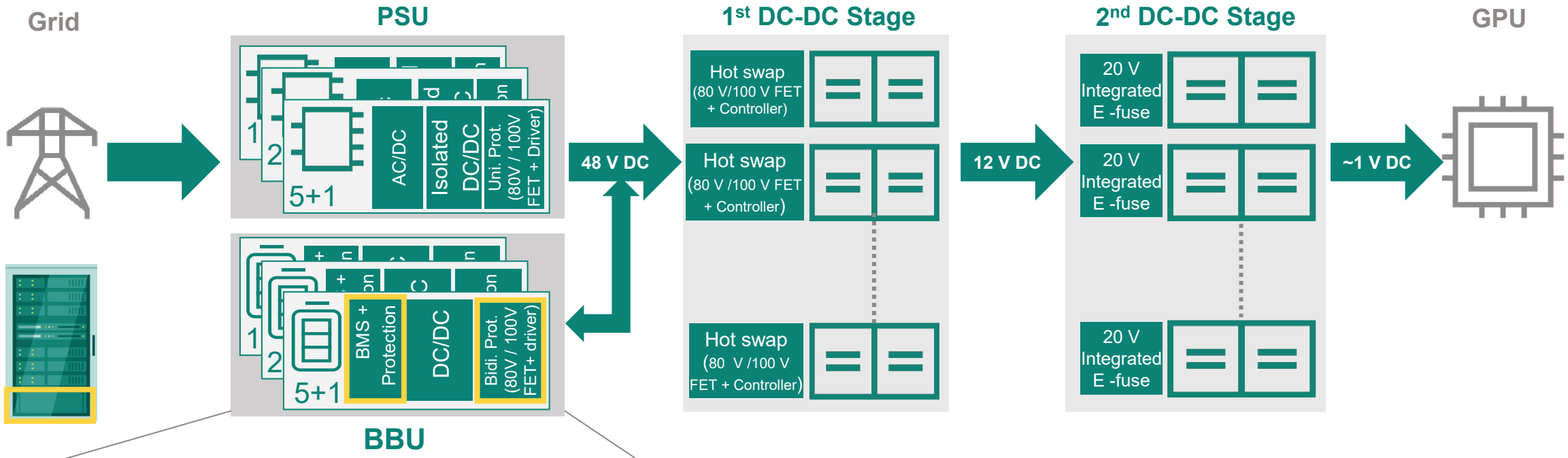
Exponential growth in global data forecasted by 2030

Rapidly increasing GPU power consumption

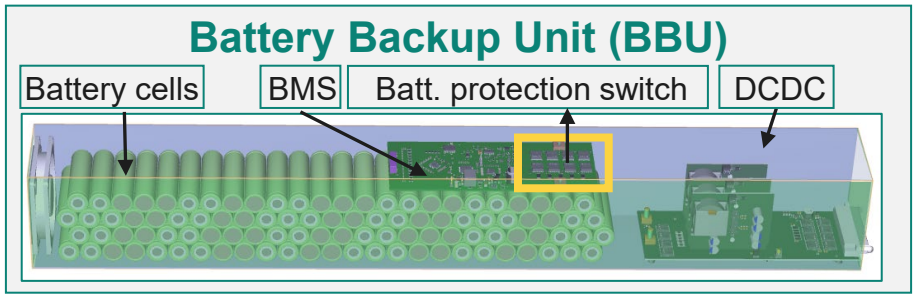
Requires the capability to handle high power levels in constrained space

# Space efficiency in AI server BBUs required due to unchanged module size with larger batteries

Battery protection




| | Battery voltages (V) | | | Power levels | | |
|---|---|---|---|---|---|---|
| #Cells in series | Min. | Nom. | Max. | 10 kW | 12 kW | 25+ kW |
| 11 | 26.4 | 39.6 | 46.2 | | | |
| 12 | 28.8 | 43.2 | 50.4 | | | |
| 14 | 33.6 | 50.4 | 58.8 | ✓ | ✓ | ✓ |




**OptiMOS™ 8 power MOSFETs in 100 V enabling highest power density for 48 V systems with lowest $R_{DS(on)}$ and sufficient SOA rating**

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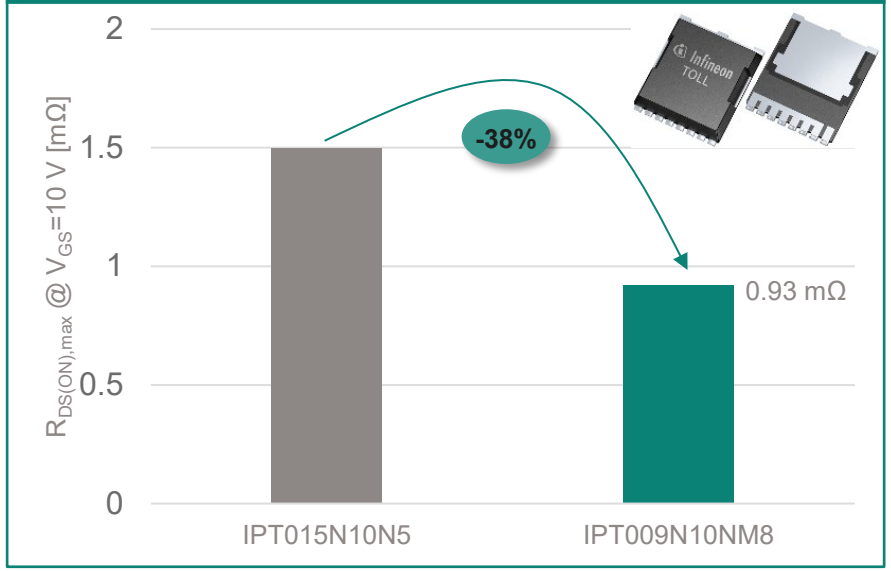
# Drive applications

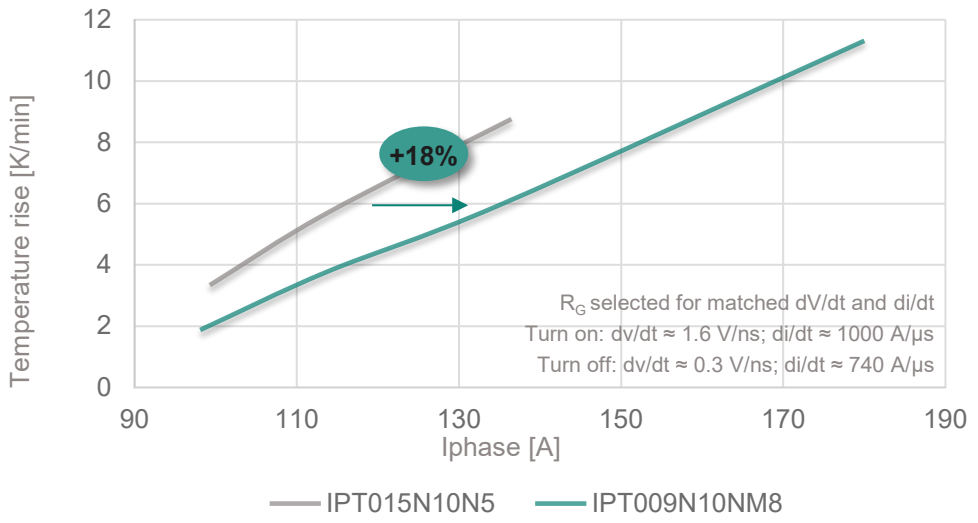
# OptiMOS™ 8 power MOSFETs in 100 V
# Widened operating range through the lowest conduction losses

Drives

## TO-Leadless




## Phase current vs. temperature rise in 3PH motor inverter



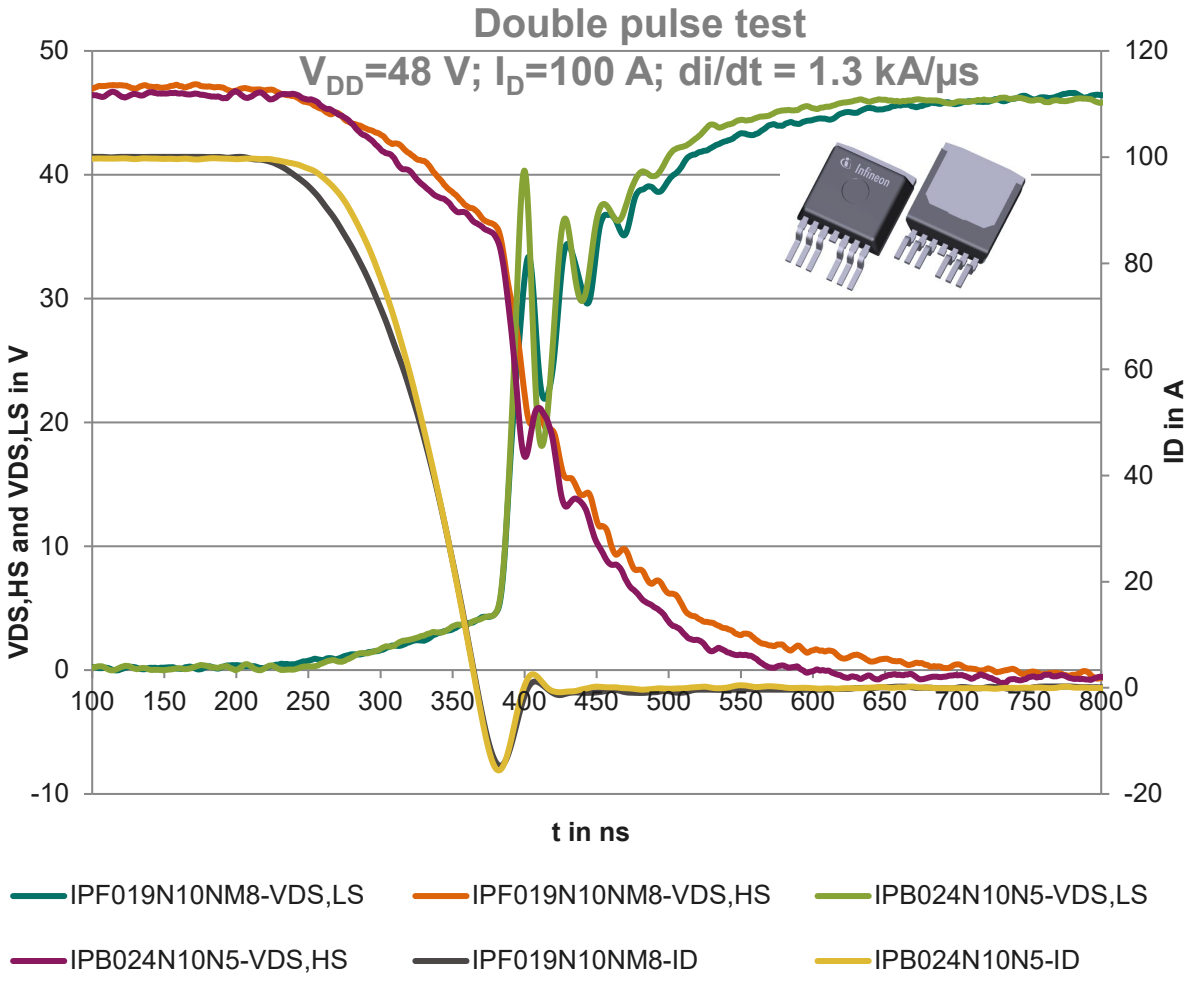

38% $R_{DS(on)}$ reduction → 18% (20 A) higher inverter output power or prolonged peak-power mode (using typical drives operating conditions)

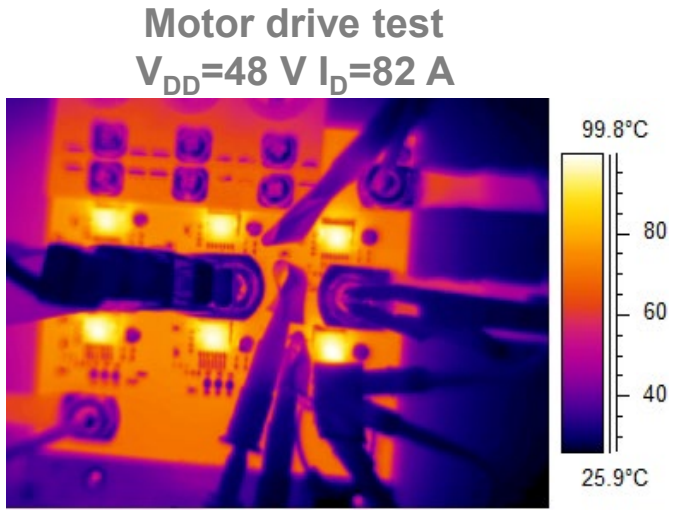
System cost savings →
- Part count reduction resulting in smaller PCB
- Enables lower parasitic inductance FR4 PCB due to lower power losses

**Source:** Final Datasheet and lab test

# Switching and thermal performance OptiMOS™ 5 vs OptiMOS™ 8

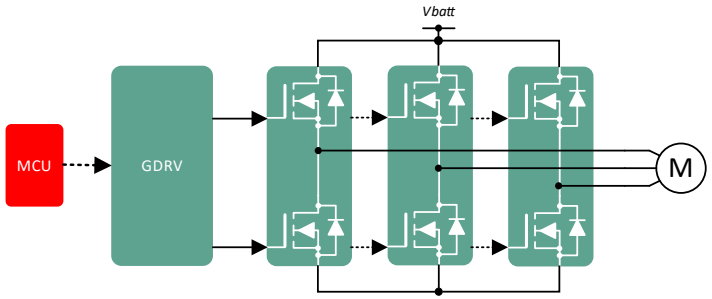
Drives




3-phase motor drive with IPF019N10NM8
Continuous test at 82 A,rms

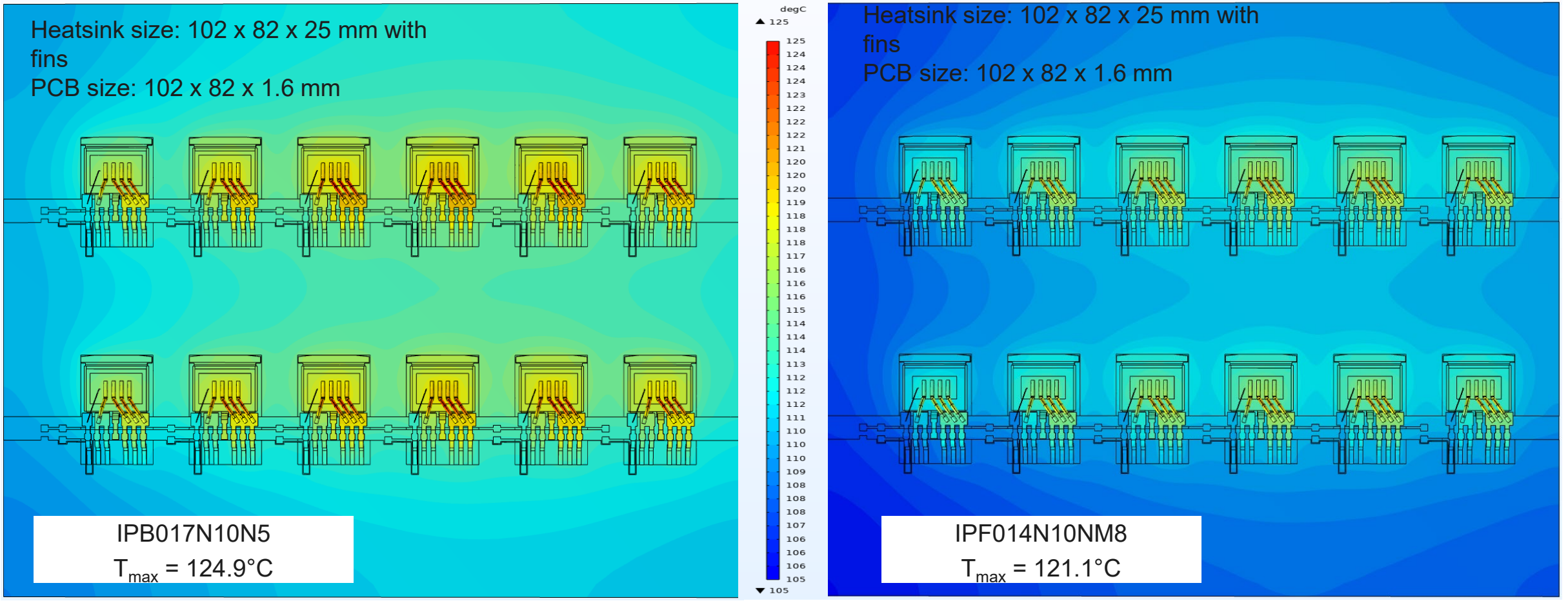
3-phase motor drive bench




**OptiMOS™ 8 MOSFETs offer lower voltage overshoot, the same Qrr + Qoss and body diode softness at lower $R_{DS(on)}$**

# Thermal simulation
# OptiMOS™ 5 vs OptiMOS™ 8

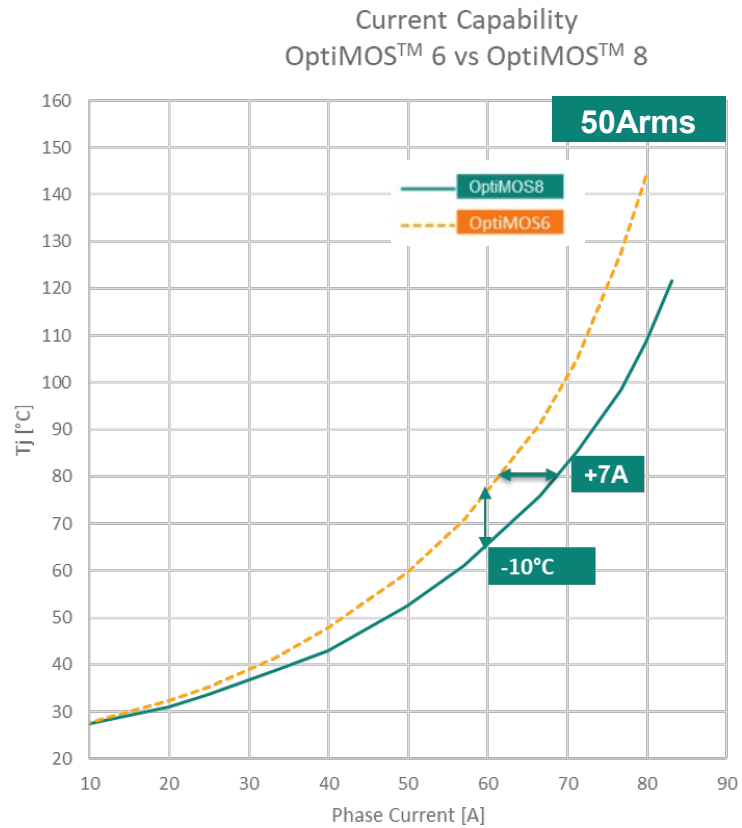
- Steady-state operation for one half-bridge with 6 FETs in parallel at **145 A / MOSFET**
- Typical motor drive continuous current test with 60% MOSFET conduction loss
- At peak power, the percentage of conduction loss increases, leading to a higher temperature difference in favor of IPF014N10NM8.

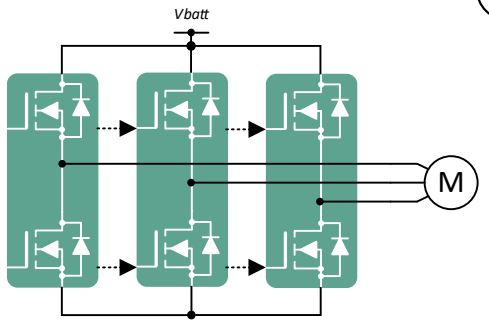


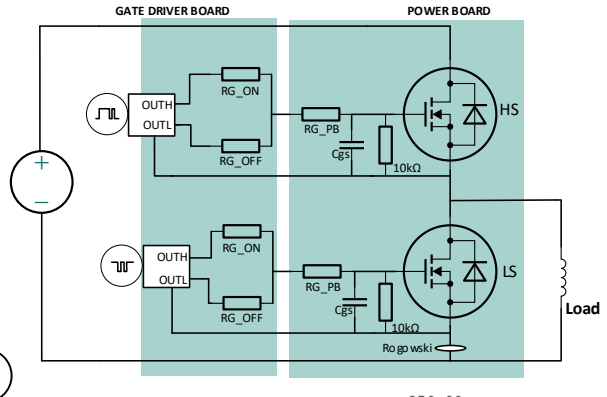
# OptiMOS™ 6 vs OptiMOS™ 8 in SuperSO8 for 48 V servo drive applications

Drives

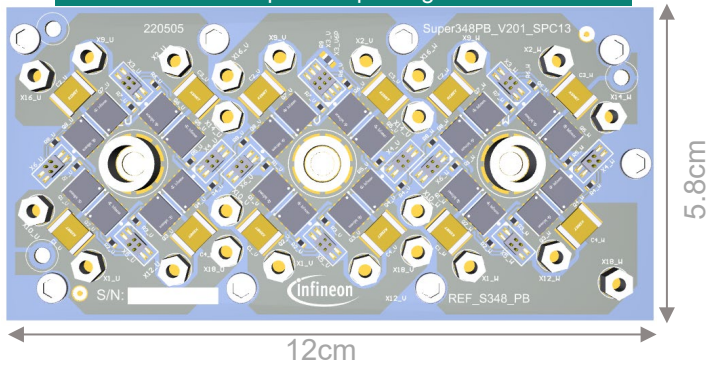
| Test Conditions | | | | | | |
|---|---|---|---|---|---|---|
| DUT | $R_{G-ON}$ [ Ω ] | $R_{G-OFF}$ [ Ω ] | $R_{G-PowerBoard}$ [ Ω ] | $C_{gs}$ [ nF ] | Turn ON di/dt [ A/us ] | Turn OFF di/dt [ A/us ] |
| ISC022N10NM6 | 85 | 15 | 10 | 0 | 950 | 1400 |
| ISC019N10NM8 | 40 | 3 | 10 | 3.2 | 905 | 1750 |



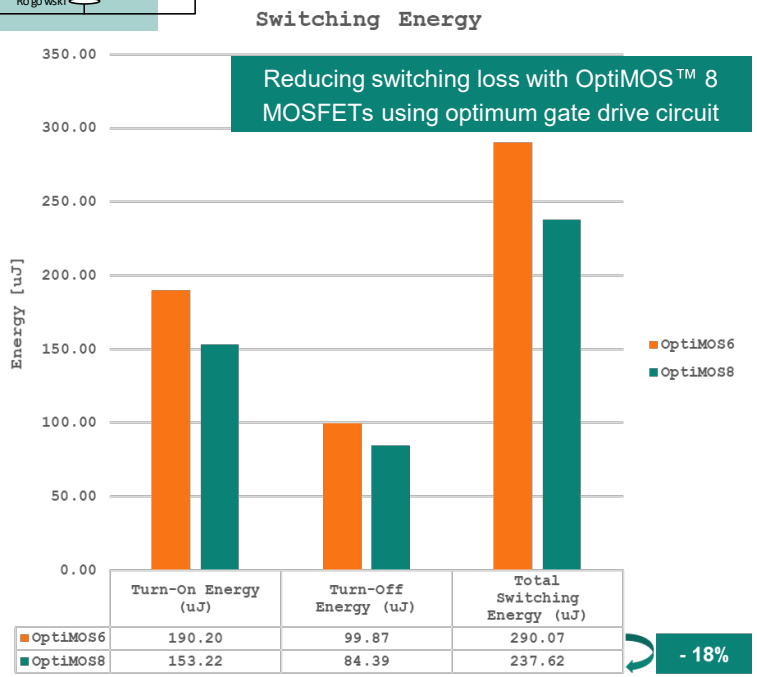




3ph inverter with **4 parallel OptiMOS™ 8** SuperSO8 package




Reducing switching loss with OptiMOS™ 8 MOSFETs using optimum gate drive circuit




| | Turn-On Energy (uJ) | Turn-Off Energy (uJ) | Total Switching Energy (uJ) |
|---|---|---|---|
| OptiMOS6 | 190.20 | 99.87 | 290.07 |
| OptiMOS8 | 153.22 | 84.39 | 237.62 |

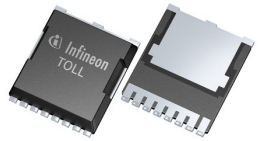
- 18%

**OptiMOS™ 8 offers higher output power than OptiMOS™ 6 at the same $T_J$ or lower temperature for the same output current**

# Battery protection switch

# OptiMOS™ 8 power MOSFETs in 100 V
# Technology positioning for battery protection applications

Battery protection





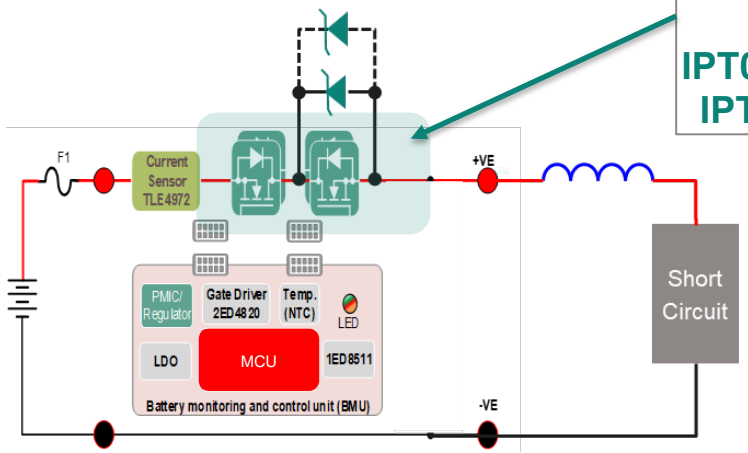


**OptiMOS™ 8 is the best choice when a high number of paralleled MOSFETs and the lowest $R_{DS(on)}$ is required**

# Overshoot clamping to reduce the number of protection MOSFETs using 100 V OptiMOS™ 8

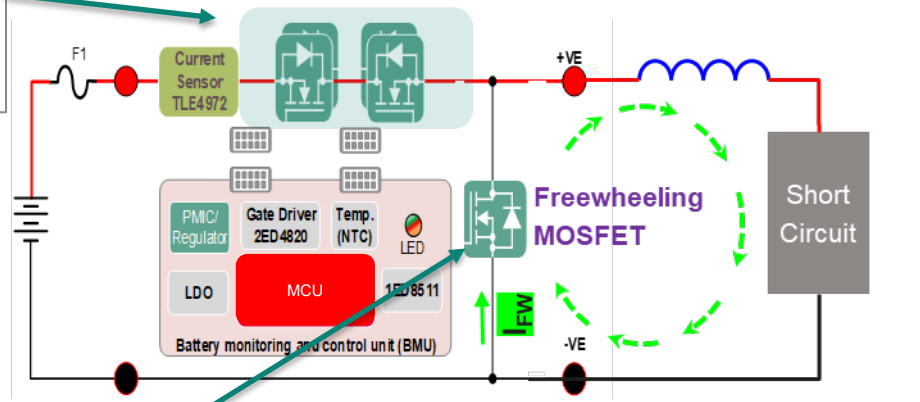
Battery protection

## TVS Diodes for $V_{DS}$ Clamping

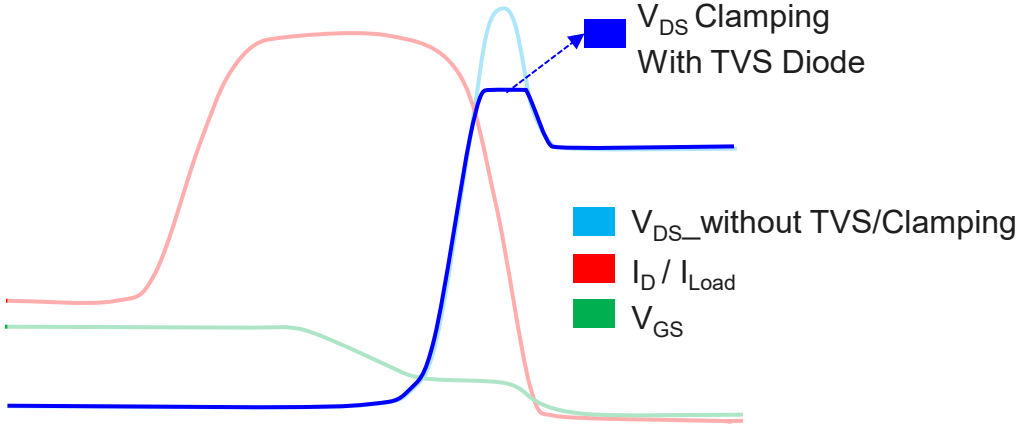


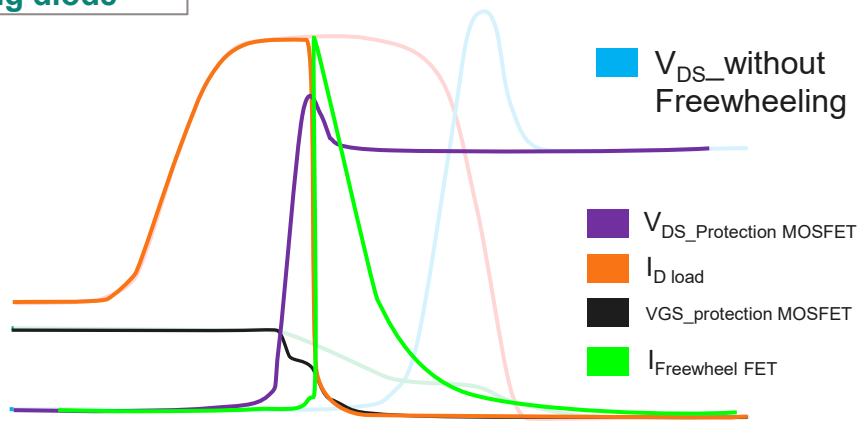

**OptiMOS™ 8 as a protection MOSFET in BBU AI Server application**
**Best-fit part Nr:**
**IPT009N10NM8 - 0.9 mΩ,max - price/perf.**
**IPTH83N10NM8S - 0.83 mΩ,max. - perf.**

## Freewheeling FET for $V_{DS}$ Clamping




**OptiMOS™ 5 BSC040N10NS5 as freewheeling diode**

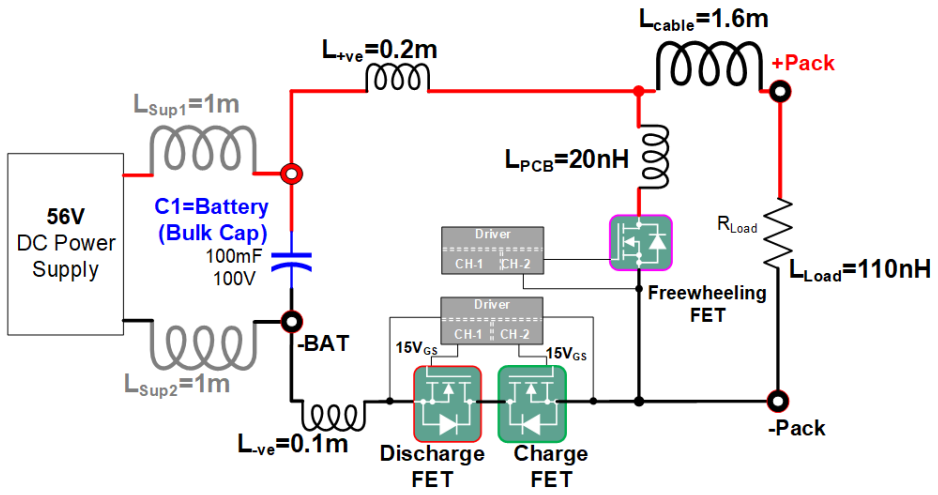


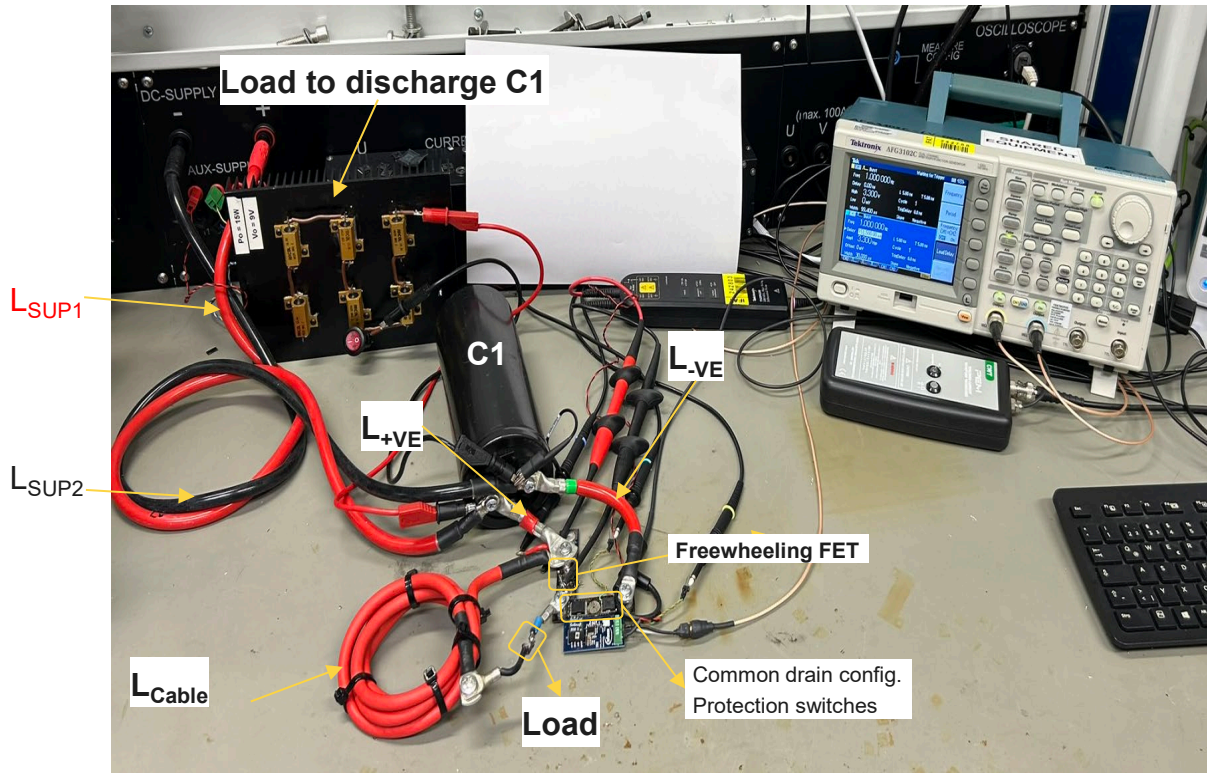
# Short circuit current test setup

Battery protection

## Circuit diagram of test setup



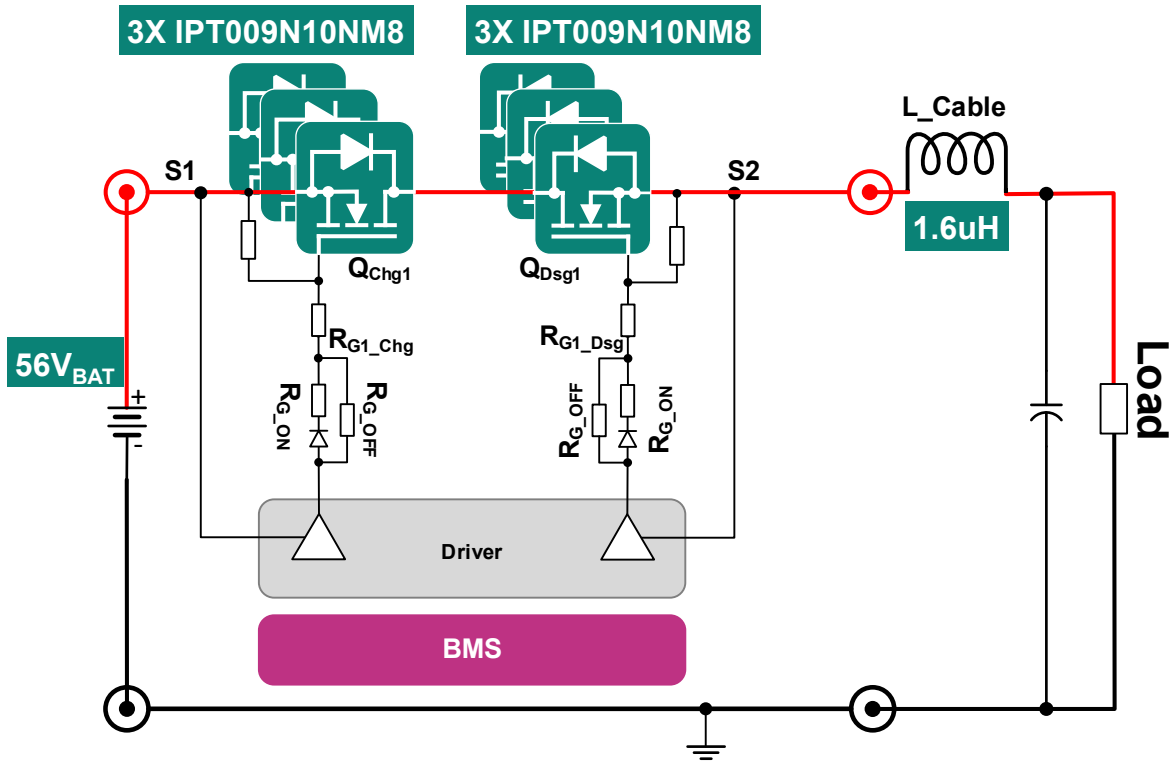

## Bench test setup



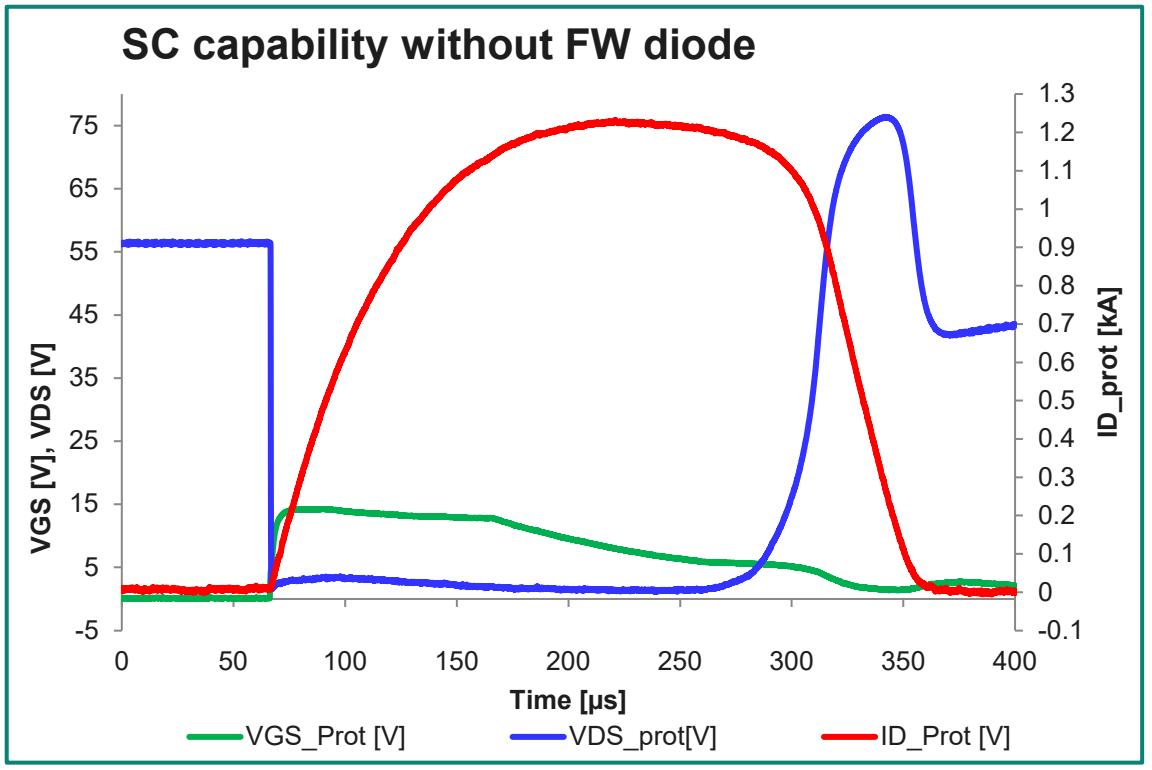
# Battery Protection Switch (BPS) bench test
## Linear mode of operation → slow MOSFET turn-off to reduce VDS overshoot

Battery protection

### Schematic




### Waveforms

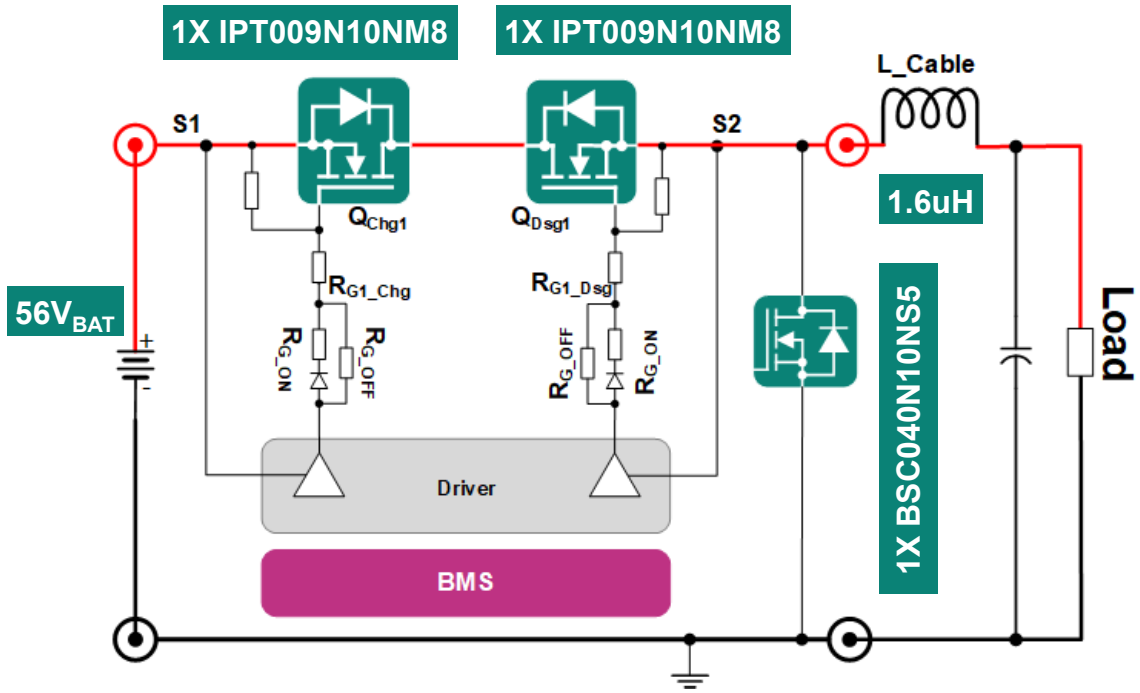



**Maximum short circuit current of 1200 A using 3X IPT009N10NM8 with 1.6 µH inductor@75 µs linear mode operation**

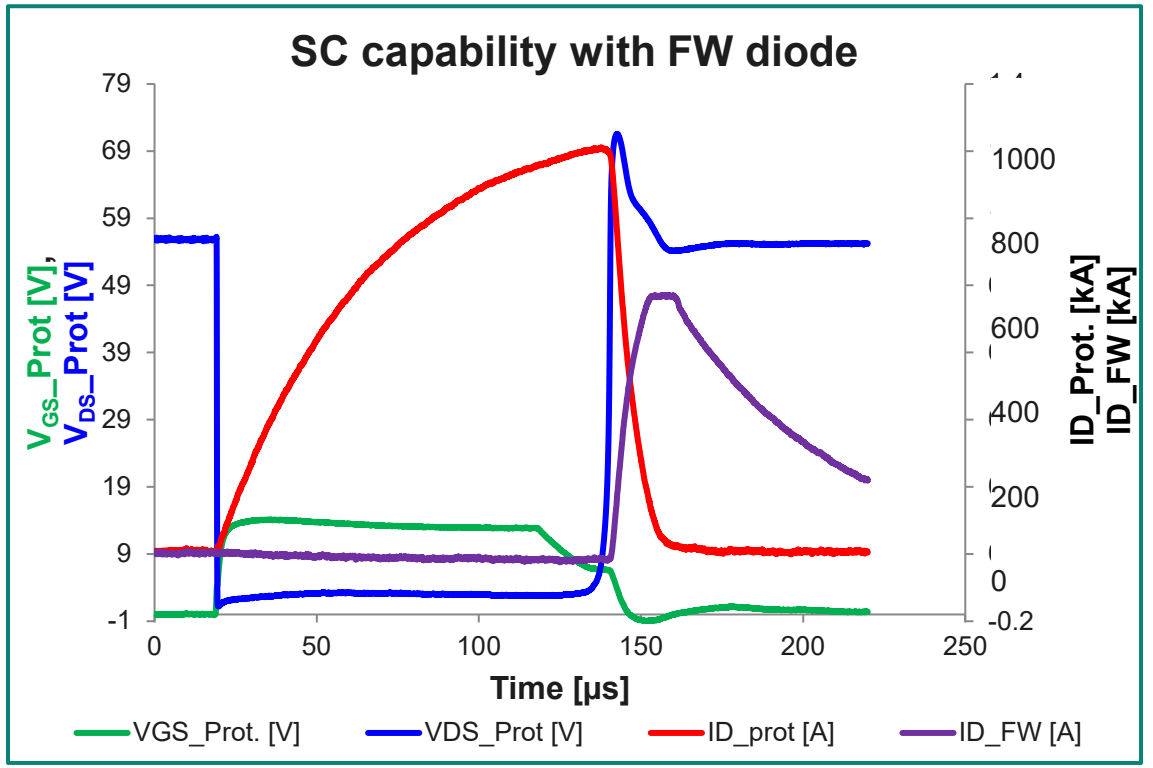
# Battery Protection Switch (BPS)
# Linear mode + Freewheeling diode

Battery protection

## Schematic




## Waveforms




**Maximum short circuit current of 900 A using 1X IPT009N10NM8 & BSC040N10NS5 as a freewheeling diode with 1.6µH inductor at 18 µs linear mode operation**

# Summary

| Short circuit with only 1-MOSFET | | |
|---|---|---|
| | Without Freewheeling | With Freewheeling |
| Short circuit current | 620 A | 900 A |
| Linear mode operation period | 62 µs | 18 µs |

| Short circuit with 3-MOSFETs in parallel | | |
|---|---|---|
| | Without Freewheeling | With Freewheeling |
| Short circuit current | 1200 A | 2000 A |
| Linear mode operation period | 75 µs | 20 µs |

Using freewheeling:

- A single protection MOSFET with a freewheeling circuit can handle 75% of the current of three paralleled protection MOSFETS without freewheeling (900 A vs. 1200 A)
- Reduces time in linear mode, consequently reducing SOA requirements

**Significant SOA requirement reduction → MOSFET paralleling purely driven by $R_{DS(on)}$**
**→ Highest value of OptiMOS™ 8 due to lowest $R_{DS(on)}$ available on the market today**

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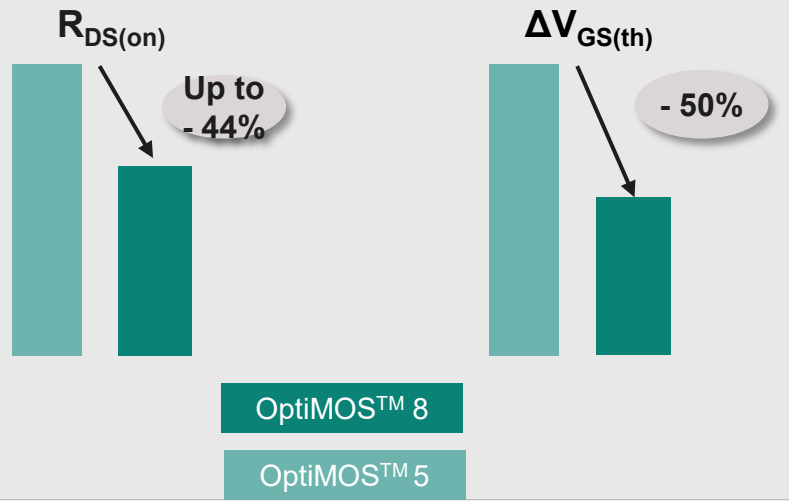
# OptiMOS™ 8 power MOSFETs in 100 V
# Revolutionizing drives and battery protection applications

## Value proposition (vs. OptiMOS™ 5)

- **Best price/performance technology**
- **Lower conduction losses** due to **lower $R_{DS(on)}$**
  - Higher peak & steady state current capability
  - Enabling potential use of FR-4 instead of costly IMS PCB
- **Improved** parallel MOSFET **current sharing** with low **(0.8 V)** $V_{GS(th)}$ spread
- **Easy design transition from OptiMOS™ 5** with small gate drive circuit adjustment




| Package | Product Name | Target $R_{DS(on)}$ max. @15 V [mΩ] | Category |
|---|---|---|---|
| SuperSO8 5x6 | **ISC019N10NM8** | 1.93 | BiC |
| | **ISC033N10NM8** | 3.33 | Price/Performance vs. BSC035N10NS5 |
| | **ISC040N10NM8** | 4.04 | Price/Performance vs. BSC040N10NS5 |
| SuperSO8 5x6 DSC | **ISC019N10NM8SC** | 1.93 | BiC |
| TOLL w/ Cu-Clip | **IPTH83N10NM8S** | 0.83 | BiC |
| TOLL | **IPT009N10NM8** | 0.93 | BiC |
| | **IPT014N10NM8** | 1.38 | Price/Performance vs. IPT015N10N5 |
| | **IPT018N10NM8** | 1.84 | Price/Performance vs. IPT020N10N5 |
| D²PAK 7-pin | **IPF009N10NM8** | 0.94 | BiC |
| | **IPF014N10NM8** | 1.42 | Price/Performance vs. IPB017N10N5 |
| | **IPF019N10NM8** | 1.94 | Price/Performance vs. IPB024N10N5 IPB025N10N3 |
| D²PAK 3-pin | **IPB013N10NM8** | 1.34 | BiC |
| | **IPB018N10NM8** | 1.76 | Price/Performance vs. IPB020N10N5 |


Infineon