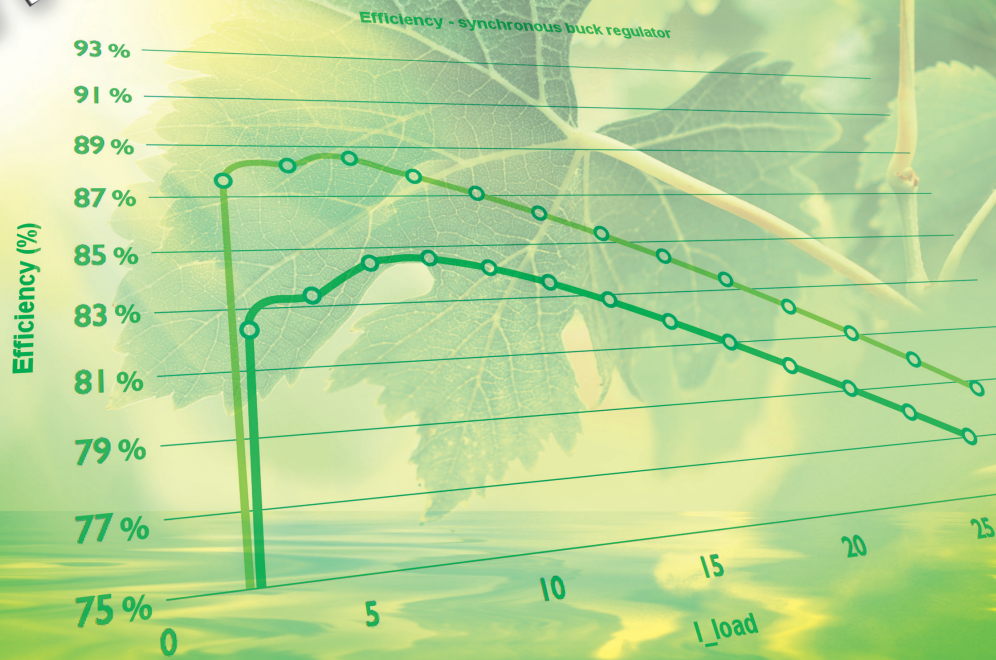




# NextPower MOSFETs

Smaller, Faster, Cooler



# NextPower 25 V & 30 V MOSFETs in LFPAK (Power-SO8)

## NXP introduces a range of high performance N-channel, logic-level MOSFETs in LFPAK

As a power design engineer, compromise is never far from your mind. Do I choose a low  $R_{DS(on)}$  device and accept the higher output capacitance? Do I demand the lowest gate charge characteristics to reduce switching losses but then find that the package options are no longer ideal in my application?

The NextPower range of MOSFETs from NXP provides uniquely balanced characteristics across the six most important parameters essential for your latest high efficiency and high reliability designs. More performance, less compromise...

Many competitors focus only on optimising  $R_{DS(on)}$  and  $Q_g$ . As  $Q_g$  gets lower then losses due to  $Q_{oss}$  and  $Q_{gd}$  become more significant. NextPower uses Superjunction technology to provide the optimum balance between low  $R_{DS(on)}$ , low  $Q_{oss}$ , low  $Q_{g(tot)}$  and  $Q_{gd}$  to give optimum switching performance. NextPower delivers superior SOA performance, and low  $Q_{oss}$  reduces the losses between the output DRAIN & SOURCE terminals. NextPower also delivers the lowest  $R_{DS(on)}$  with sub 1 m $\Omega$  types at both 25 V and 30 V.

LFPAK packaging provides rugged power switching on a compact 5 mm x 6 mm footprint compatible with other Power-SO8 vendors. The unique benefits of LFPAK make it the best package choice for demanding applications or where high-reliability is required. It also allows for visual inspection, reducing the need for costly X-ray equipment to detect solder defects as is common with QFN style Power-SO8 packages.

### Key benefits

- ▶ High efficiency in power switching applications
- ▶ Industry's lowest  $R_{DS(on)}$  Power-SO8 - Less than 1 m $\Omega$  at 25 V and 30 V
- ▶ Low  $Q_{oss}$  for reduced output losses between DRAIN & SOURCE
- ▶ Low  $Q_{gd}$  for reduced switching losses and high frequency switching
- ▶ 20 V rated GATE provides better tolerance to voltage transients than lateral MOSFET types
- ▶ Superior 'Safe Operating Area' performance compared to other Trench MOSFET vendors
- ▶ Optimised for 4.5 V gate drive voltage

- ▶ Optimum switching performance under light & heavy load conditions
- ▶ LFPAK package for compatibility with other vendor Power-SO8 types
- ▶ Eliminates costly X-ray inspection – LFPAK solder joints can be optically inspected

### Key applications

- ▶ Synchronous buck regulators
- ▶ DC-DC conversion
- ▶ Voltage regulator modules (VRM)
- ▶ Power OR-ing

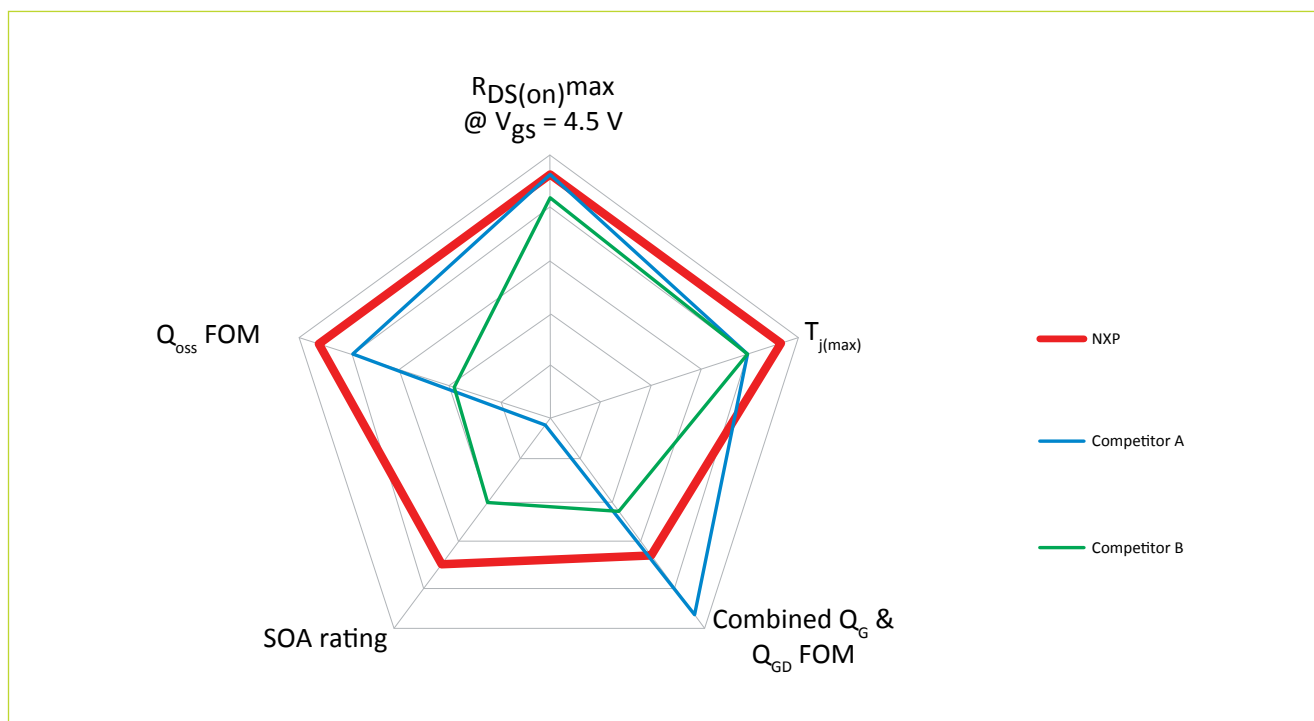
# Benefits of Superjunction technology

Many suppliers focus on two favourable indicators when defining MOSFET performance, but this only tells part of the story.

The spider chart below shows the relative performance of NextPower versus the leading MOSFET vendors, comparing the six most important MOSFET parameters required for high-performance & high reliability switching applications. The outside edge of the graph represents the 'best-in-class' performance, whilst scoring towards the centre of the graph represents a weakness.

- ▶ Low  $R_{DS(on)}$  gives low  $I^2R$  losses and superior performance when used in a SYNC FET or power OR-ing application
- ▶ Low  $Q_{oss}$  gives reduced losses between the drain & source terminals since the energy stored in the output capacitance ( $C_{oss}$ ) is wasted whenever the voltage changes across the output terminals
- ▶ SOA performance provides tolerance to overload & fault conditions. The graph shows the maximum allowable current for a 1 mS pulse at  $V_{DS}=10$  V
- ▶ Low Miller charge ( $Q_{GD}$ ) gives reduced switching losses between the MOSFET's drain & source terminals when the MOSFET turns ON or turns OFF
- ▶ Low gate charge ( $Q_G$ ) gives reduced losses in the gate drive circuit since less energy is required to turn the MOSFET ON & OFF
- ▶ Superior junction temperature rating,  $T_{j(max)}$ , is proof that LFPAC is the most rugged Power-SO8 package available. LFPAC is the best choice for demanding environments and where high reliability is required

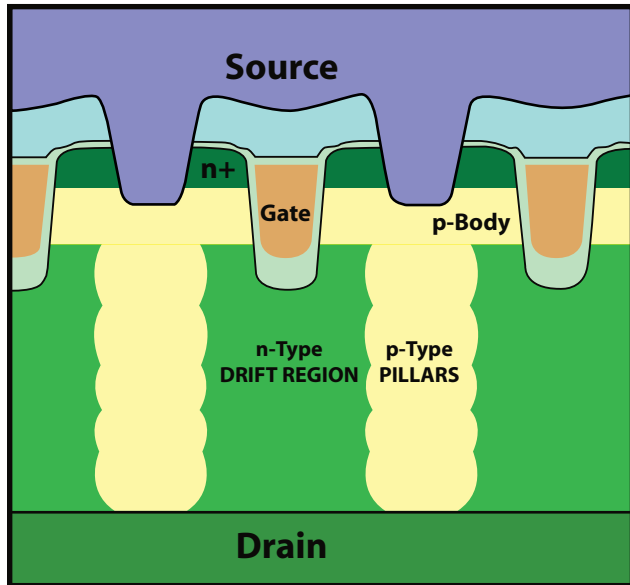
## Comparison of NextPower technology with key competitor types



# Superjunction technology

NextPower MOSFETs use 'Superjunction' silicon technology to deliver the optimum balance between low  $R_{DS}$ , low  $Q_{G(tot)}$ , low  $Q_{GD}$ , high SOA performance and low  $C_{oss}$  at 25 V and 30 V.

Superjunction technology combines the benefits of a lateral MOSFET, (low  $Q_{g(tot)}$  and low  $Q_{GD}$ ) with the benefits of a Trench-MOSFET (low  $R_{DS(on)}$  and 20 V rugged GATE rating) resulting in a uniquely balanced specification.



NextPower uses an optimized balance of the different resistance elements in the MOSFET to achieve a lower on-resistance for every cell. The low cell resistance means that NextPower types typically require fewer cells than competitor devices to achieve the same  $R_{DS(on)}$ , and a lower cell count provides lower  $Q_{G(tot)}$ , low  $Q_{GD}$ , low  $C_{oss}$  and superior 'Safe operating area' ruggedness.

*NextPower technology uses p-Type pillars to improve the breakdown voltage in the OFF state, and a heavily doped n-Type drift region to achieve exceptionally low ON resistance.*

*Since fewer cells are required to achieve a given  $R_{DS}$  rating, then gate charge ( $Q_G$ ), Miller charge ( $Q_{GD}$ ), output capacitance ( $C_{oss}$ ) are all reduced and optimum ruggedness (denoted by the safe operating area characteristics) is achieved.*

## NextPower types – parametric data

The 25 V and 30 V types shown below are recommended for synchronous buck regulators, the low  $R_{DS(on)}$  types are also highly recommended for Power OR-ing applications and low voltage isolated power supply topologies.

### 25 V NextPower types

| Type          | Voltage (V) | $R_{DS(on)}^{typ}$<br>$V_{GS} = 4.5 \text{ V (m}\Omega\text{)}$ | $Q_G^{(typ)}$<br>$V_{GS} = 4.5 \text{ V (nC)}$ | $Q_{GD}^{(typ)}$<br>$V_{GS} = 4.5 \text{ V (nC)}$ | $C_{oss}$ (pF) |
|---------------|-------------|-----------------------------------------------------------------|------------------------------------------------|---------------------------------------------------|----------------|
| PSMN0R9-25YLC | 25          | 0.95                                                            | 51                                             | 14                                                | 1437           |
| PSMN1R1-25YLC | 25          | 1.2                                                             | 39                                             | 11                                                | 1121           |
| PSMN1R2-25YLC | 25          | 1.35                                                            | 31                                             | 8.3                                               | 994            |
| PSMN1R7-25YLC | 25          | 2                                                               | 28                                             | 7.8                                               | 880            |
| PSMN1R9-25YLC | 25          | 2.2                                                             | 27                                             | 7.4                                               | 761            |
| PSMN2R2-25YLC | 25          | 2.6                                                             | 18                                             | 5.2                                               | 617            |
| PSMN2R9-25YLC | 25          | 3.45                                                            | 16                                             | 4.4                                               | 501            |
| PSMN3R2-25YLC | 25          | 3.7                                                             | 14                                             | 4                                                 | 462            |
| PSMN3R7-25YLC | 25          | 4.25                                                            | 10.1                                           | 3                                                 | 370            |
| PSMN4R0-25YLC | 25          | 4.5                                                             | 10.9                                           | 3.5                                               | 354            |

## 30 V NextPower types

| Type          | Voltage (V) | $R_{DS(on)}$ typ<br>$V_{GS} = 4.5 \text{ V}$ (m $\Omega$ ) | $Q_G$ (typ)<br>$V_{GS} = 4.5 \text{ V}$ (nC) | $Q_{GD}$ (typ)<br>$V_{GS} = 4.5 \text{ V}$ (nC) | $C_{OSS}$ (pF) |
|---------------|-------------|------------------------------------------------------------|----------------------------------------------|-------------------------------------------------|----------------|
| PSMN1R0-30YLC | 30          | 1.1                                                        | 50                                           | 14.6                                            | 1210           |
| PSMN1R2-30YLC | 30          | 1.35                                                       | 38                                           | 11.6                                            | 977            |
| PSMN1R5-30YLC | 30          | 1.65                                                       | 30                                           | 8.6                                             | 860            |
| PSMN2R2-30YLC | 30          | 2.3                                                        | 26                                           | 8                                               | 651            |
| PSMN2R6-30YLC | 30          | 3.1                                                        | 18                                           | 5.5                                             | 549            |
| PSMN3R2-30YLC | 30          | 3.75                                                       | 14.2                                         | 4.1                                             | 432            |
| PSMN3R7-30YLC | 30          | 4.25                                                       | 14                                           | 4.2                                             | 380            |
| PSMN4R1-30YLC | 30          | 4.75                                                       | 11                                           | 3.5                                             | 316            |
| PSMN4R5-30YLC | 30          | 5.1                                                        | 9.6                                          | 2.85                                            | 288            |

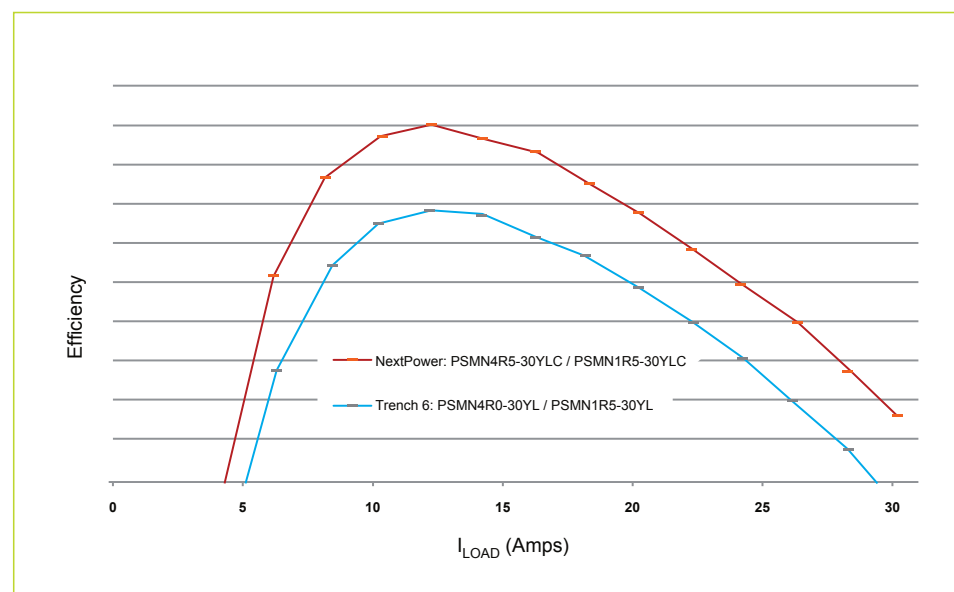
## Benchmarking

### Comparing NXP NextPower with NXP Trench 6 technology

Benchmark testing for NextPower types shows a 1% efficiency gain compared to equivalent Trench 6 types:

#### 30 V NextPower types

| Type          | Voltage (V) | $R_{DS(on)}$ typ<br>$V_{GS} = 4.5 \text{ V}$ (m $\Omega$ ) | $Q_G$ (typ)<br>$V_{GS} = 4.5 \text{ V}$ (nC) | $Q_{GD}$ (typ)<br>$V_{GS} = 4.5 \text{ V}$ (nC) | $C_{OSS}$ (pF) |
|---------------|-------------|------------------------------------------------------------|----------------------------------------------|-------------------------------------------------|----------------|
| PSMN1R5-30YL  | 30          | 1.8                                                        | 36                                           | 8.7                                             | 1082           |
| PSMN1R5-30YLC | 30          | 1.65                                                       | 30                                           | 8.6                                             | 860            |
| PSMN4R0-30YL  | 30          | 3.7                                                        | 18                                           | 4.3                                             | 469            |
| PSMN4R5-30YLC | 30          | 5.1                                                        | 9.6                                          | 2.85                                            | 288            |

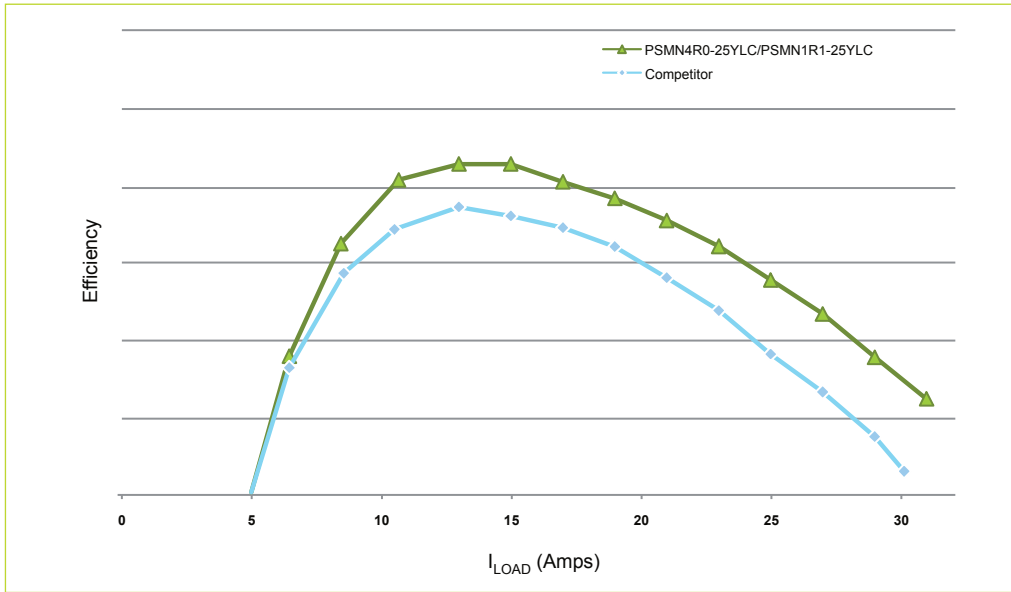


#### Test conditions

- ▶ Input Voltage: 12 V
- ▶ Output Voltage: 1.2 V
- ▶ 1 phase
- ▶ Frequency: 500 KHz
- ▶ Air flow: 200 LFM

## Comparing NextPower with a leading competitor

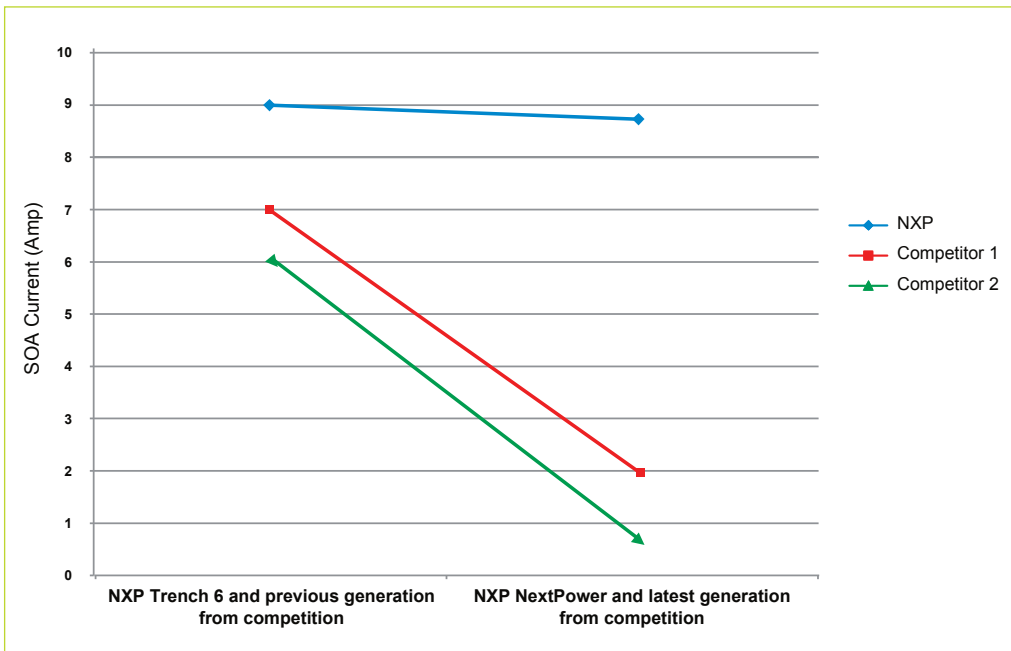
Benchmarking tests show that NextPower types deliver 1% efficiency gains compared to the nearest competitor types:



### Test conditions

- ▶ Input Voltage: 12 V
- ▶ Output Voltage: 1.2 V
- ▶ 1 phase
- ▶ Frequency: 500 KHz
- ▶ Air flow: 200 LFM

## Safe Operating Area comparison



Condition: SOA Drain current (Amp) @  $V_{ds} = 10$  V, 10 ms pulse for a 5 m $\Omega$  (@ 10 V) in Power SO8



### Why Choose LPAK?

- ▶ Reduced electrical resistance and inductance
- ▶ Outstanding thermal performance
- ▶ Rugged design, qualified to AEC-Q101 (stringent automotive standard)
- ▶ Easy to handle, solder and inspect
- ▶ Power-SO8 footprint compatible

# NextPower types - Coming in Q3-2011

Further NextPower types are planned for release in Q3-2011. Preliminary data is provided in the tables below. These types are recommended for control-FET applications in synchronous-buck regulators. YLB types have an integrated snubber circuit to further reduce spiking levels for critical applications.

| Type                        | Voltage (V) | $R_{DS(on)}^{typ}$<br>$V_{GS} = 4.5 \text{ V}$ (mΩ) |
|-----------------------------|-------------|-----------------------------------------------------|
| <b><i>PSMN5R0-25YLB</i></b> | 25          | 6.1                                                 |
| <b><i>PSMN5R0-25YLC</i></b> | 25          | 6.6                                                 |
| <b><i>PSMN6R0-25YLC</i></b> | 25          | 7.3                                                 |
| <b><i>PSMN7R3-25YLC</i></b> | 25          | 8.9                                                 |
| <b><i>PSMN9R0-25YLC</i></b> | 25          | 10.7                                                |
| <b><i>PSMN011-25YLC</i></b> | 25          | 12.7                                                |

| Type                        | Voltage (V) | $R_{DS(on)}^{typ}$<br>$V_{GS} = 4.5 \text{ V}$ (mΩ) |
|-----------------------------|-------------|-----------------------------------------------------|
| <b><i>PSMN6R0-30YLB</i></b> | 30          | 6.7                                                 |
| <b><i>PSMN6R0-30YLC</i></b> | 30          | 7.6                                                 |
| <b><i>PSMN7R0-30YLC</i></b> | 30          | 8.5                                                 |
| <b><i>PSMN8R6-30YLC</i></b> | 30          | 10.3                                                |
| <b><i>PSMN011-30YLC</i></b> | 30          | 11.7                                                |
| <b><i>PSMN012-30YLC</i></b> | 30          | 13.8                                                |

types in ***bold red italic underline*** represent products in development

## Part numbering for NXP MOSFETs

| MOSFET BRAND NAME |   |   | MOSFET type<br>N-ch or P-ch | MOSFET on-resistance<br>$R_{DS(on)}$ |   |   | - | MOSFET voltage<br>$BV_{DS}$ | Package type                  | Gate threshold voltage | NextPower special features     |
|-------------------|---|---|-----------------------------|--------------------------------------|---|---|---|-----------------------------|-------------------------------|------------------------|--------------------------------|
| P                 | S | M | N                           | 1                                    | R | 7 | - | 25                          | Y                             | L                      | C                              |
| Power Silicon Max |   |   | N = N-ch                    | R95 = 0.95 mΩ                        |   |   | - | 25 = 25 V                   | B = D <sup>2</sup> PAK SOT404 | L = Logic-level        | C = Optimised for $O_{g(fom)}$ |
|                   |   |   | P = P-ch                    | 1R7 = 1.7 mΩ                         |   |   | - | 30 = 30 V                   | D = DPAK SOT428               | S = Standard-level     | B = integrated snubber         |
|                   |   |   | X = Dual N-ch               | 014 = 14 mΩ                          |   |   | - | 40 = 40 V                   | E = I <sup>2</sup> PAK SOT226 |                        |                                |
|                   |   |   | Y = Dual P-ch               | 125 = 125 mΩ                         |   |   | - | 60 = 60 V                   | K = SO8 SOT96                 |                        |                                |
|                   |   |   | Z = N-ch + P-ch             |                                      |   |   | - | 80 = 80 V                   | L = QFN3333 SOT873            |                        |                                |
|                   |   |   |                             |                                      |   |   | - | 100 = 100 V                 | P = TO220 SOT78               |                        |                                |
|                   |   |   |                             |                                      |   |   | - | 110 = 110 V                 | Y = LFPK SOT669 & SOT1023     |                        |                                |
|                   |   |   |                             |                                      |   |   | - | 120 = 120 V                 | X = TO220F (FULLPACK) SOT186A |                        |                                |

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