

# ADVANCED STANDARD PRODUCTS PACKAGING FOR THE AUTOMOTIVE MARKET

AMF-AUT-T2366

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MAURIZIO ACOSTA - PAE MOSFET  
TOM WOLF - PAE LOGIC  
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PUBLIC



SECURE CONNECTIONS  
FOR A SMARTER WORLD

# Agenda

- Introduction and Overview (5 min)
  - What are Standard Products?
  - What will Nexperia be?
- Subminiature Packaging Innovations (15 minutes)
  - Innovations in GA (diodes, ESD): the smallest packages (Glenn)
- Power and Thermal Packaging (15 minutes)
  - Innovations in Power MOSFETS: testing the power and thermal limits (Maurizio)
- High Integration Packaging (15 minutes)
  - Innovations in Logic packaging (Tom)
- Summary, QA (10 minutes)

# OVERVIEW AND NEXPERIA



# NXP business segments

## NXP's High Performance Mixed Signal Segments

Secure Identification Solutions



Secure Connected Devices



Secure Interface and Power



Automotive



## NXP's Standard Products Segments

Discrete Semiconductors and Logic

GA DISCRETES

LOGIC

POWER MOSFETS &



# NXP business segments

## NXP's High Performance Mixed Signal Segments

Secure Identification Solutions



Secure Connected Devices



Secure Interface and Power



Automotive



## NXP's Standard Products Segments

nexperia

GA DISCRETES

LOGIC

POWER MOSFETS &



## MARKET SEGMENTS



Automotive



Portable devices



Industrial



Communication Infrastructure



Consumer



Computing

## REFLECTED IN >10,000 TYPES

- Small-signal Diodes & Transistors
- Medium Power Diodes & Transistors
- Protection & Signal Conditioning
- Small-Signal MOSFETs
- Power MOSFETs
- Logic Devices



## ENABLED BY

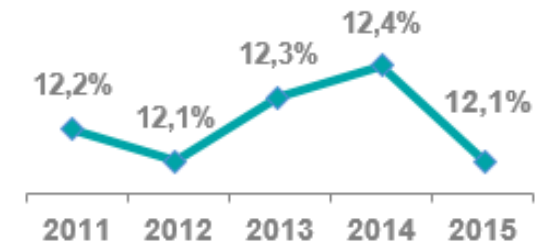
- Cost efficient supply chain
- High quality with <0.1 PPM failure rate
- Extended AECQ-100/101 portfolio
- Best in Class packages



## RESULTS

- #1 GA Discretes (incl. ESD protection)
- #2 PowerMOS Automotive
- #3 Logic

**STANDARD PRODUCTS IS YOUR 1<sup>ST</sup> CHOICE SUPPLIER WITH 12.1 % MARKET SHARE**

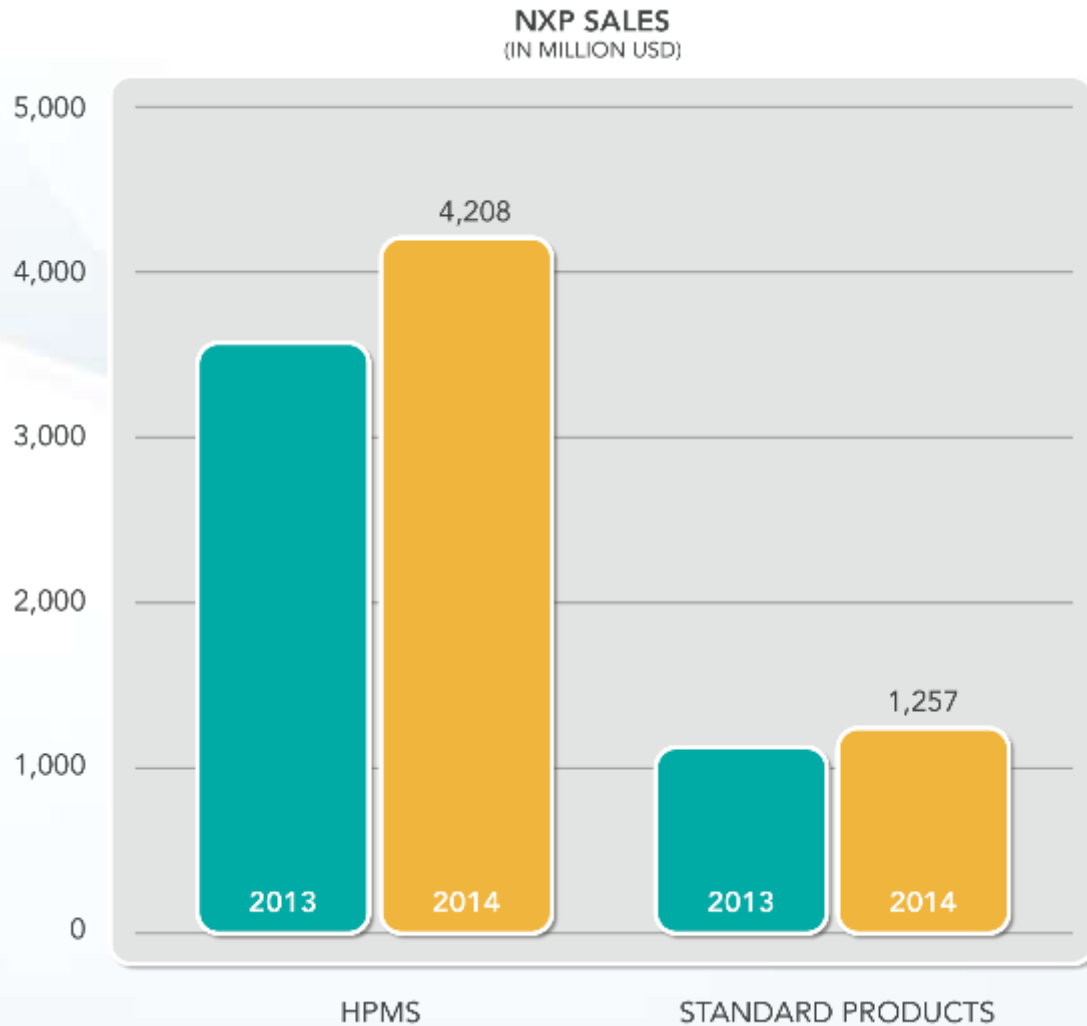


...AND UP TO 70 BLN PCS SHIPPED ANUALLY!



# BU Standard Products – Market Leader

## HPMS & Standard Product Sales



General Application Discretes  
(incl. ESD protection)



Logic



PowerMOS Automotive



**Standard Products (overall)**

>10% global market share for BU Standard Products

# Standard Products Business Lines

**BL GA Discretes**

**Hamburg, Germany**

**Small-Signal Discretes  
(D&T)**

**Small-Signal MOSFETs**

**Protection & Filtering**

**BL PowerMOS**

**Manchester, UK**

**Automotive PowerMOS**

**Standard PowerMOS**

**eSwitches**

**BL Logic**

**San Jose, US**

**Standard Logic**

**Mini Logic**

**Voltage Translation**





# CONCLUSION

- Nexperia
  - World #1 in Standard Products Market Share
  - Recognized Market Leader in Product Innovation and Packaging
  - Day 1 Target: January 2017
    - SP Sales will be PRIMARY contact
- Acquired by a Financial Institution- Private Company
- Headquartered in Nijmegen, Netherlands
  - Follow EU Laws and Regulations
- Management Team remains will transition to Nexperia
- NO CHANGE in Product Portfolio, Manufacturing (Front-end and Back-end) and Logistics, due to Nexperia divestiture
- NO CHANGE with Channel Partners
- More FLEXIBILITY in Product Development



# SUBMINIATURE PACKAGING INNOVATIONS



# NXP GA: Your global partner for discretes

## KEY FACTS

### #1 small-signal discretes

#### Sales 2015

645 Mio. US\$  
64.6 Bn. pieces

#### Market share

19.2 % worldwide  
(Source: WSTS)

#### Headquarters and Fab

Hamburg, Germany | 1200 Employees

#### Assemblies

Guangdong, China | Seremban, Malaysia  
Bangkok, Thailand | 5800 Employees

Full ownership of  
front- and backend  
manufacturing sites



HIGHEST  
CAPACITY  
COST-EFFICIENT



HIGH QUALITY  
LEVEL

AEC-Q101  
Zero-Defect Program  
Extended life testing

+4000 active types  
all discrete product  
segments

THE 1-STOP-  
SHOP FOR  
DISCRETES



STRONG  
CUSTOMER  
FOCUS

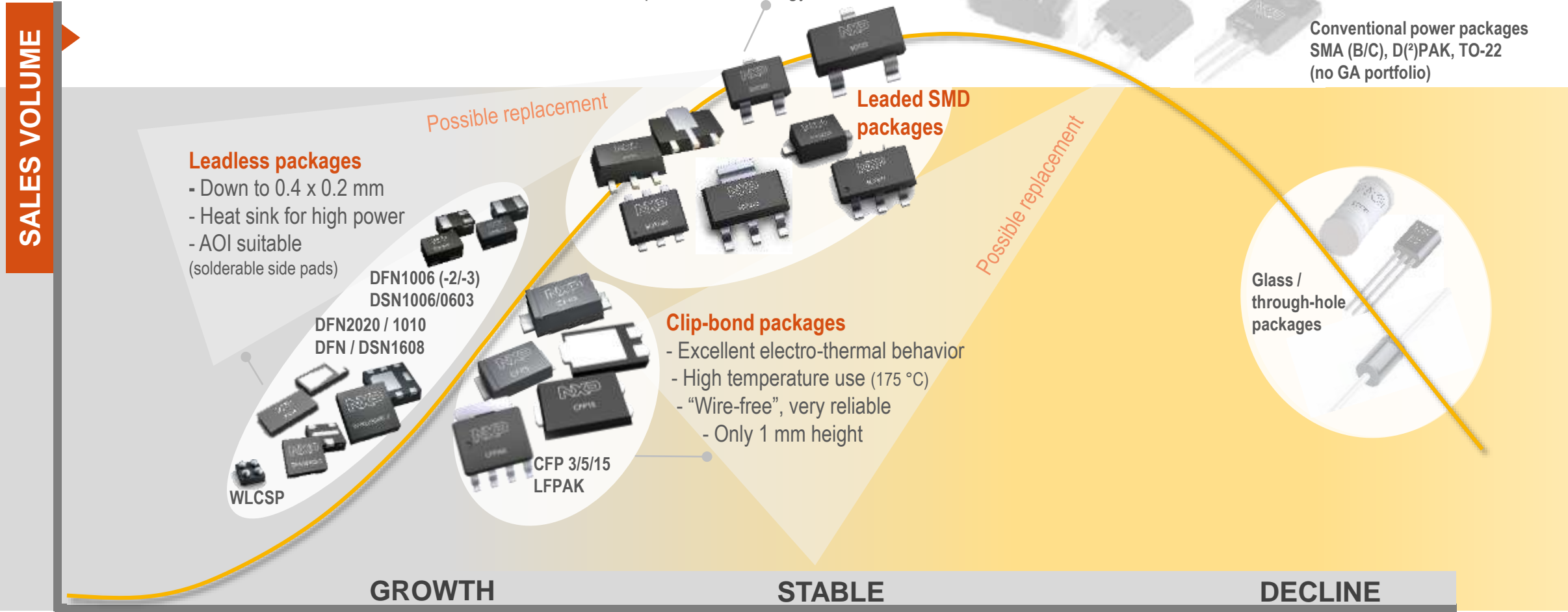


Long-term relations  
Preferred supplier  
status

# More than 60 years in discretetes



# Package range & life-cycle



Continuously investing in new technologies. True leader in SMD



# Our extensive package range provides maximum flexibility

Miniaturization

>>

Medium Power

2 Pins



DSN0402 (SOD992) 0.4x0.2x0.12   DSN0603-2 (SOD962) 0.6x0.3x0.3   DSN1006-2 (SOD993) 1.0x0.6x0.3   DSN1006U-2 (SOD995) 1.0x0.6x0.3   DFN1006D-2 (SOD882D) 1.0x0.6x0.37   DFN1006-2 (SOD882) 1.0x0.6x0.48   SOD523 1.2x0.8x0.6   DFN1608D-2 (SOD1608) 1.6x0.8x0.37   DSN1608-2 (SOD963/SOD964) 1.6x0.8x0.25/0.29   SOD323F 1.7x1.25x0.7   SOD323 1.7x1.25x0.95   SOD123F 2.6x1.6x1.1   CFP3 (SOD123W) 2.6x1.7x1.0   CFP5 (SOD128) 3.8x2.6x1.0   CFP15 (SOT1289) 5.8x4.3x0.78   D2PAK (SOT404) 11.0x10.0x4.3

3 Pins



DFN1006B-3 (SOT883B) 1.0x0.6x0.37   DFN1006-3 (SOT883) 1.0x0.6x0.48   DFN1010D-3 (SOT1215) 1.1x1.0x0.37   SOT663 1.6x1.2x0.55   SOT323 2.0x1.25x0.95   SOT23 2.9x1.3x1.0   DFN2020-3 (SOT1061) 2.0x2.0x0.62   DFN2020D-3 (SOT1061D) 2.0x2.0x0.62   SOT89 4.5x2.5x1.5   DPAK (SOT428) 6.6x6.1x2.3

4/5 Pins



WLCSP4\* 0.8x0.8x0.35   WLCSP5\* 1.51x1.14x0.65   SOT665 1.6x1.2x0.55   SOT353 2.0x1.25x0.95   SOT143B 2.9x1.3x1.0   LPAK56 (SOT669) 5.0x4.0x1.0   SOT223 6.5x3.5x1.65

6 Pins



DFN1010B-6 (SOT1216) 1.1x1.0x0.37   DFN1010-6 (SOT891) 1.0x1.0x0.48   DFN1410-6 (SOT886) 1.45x1.0x0.48   WLCSP6 1.48x0.98x0.25   SOT666 1.6x1.2x0.55   SOT363 2.0x1.25x0.95   DFN2020-6 (SOT1118) 2.0x2.0x0.62   DFN2020D-6 (SOT1118D) 2.0x2.0x0.62   DFN2020MD-6 (SOT1220) 2.0x2.0x0.62   SOT457 2.9x1.5x1.0

≥ 7 Pins



DFN2110-9 (SOT1178) 2.1x1.0x0.48   DFN2111-7 (SOT1358) 2.1x1.1x0.5   DFN2510A-10 (SOT1176) 2.5x1.0x0.48   DFN2520-9 (SOT1333) 2.5x2.0x0.48   DFN2521-12 (SOT1156-1) 2.5x2.1x0.5   LPAK33 (SOT1210) 3.3x3.3x0.85   DFN4020-14 (SOT1334) 4.0x2.0x0.48   DFN4040-32 (SOT1318-1) 4.0x4.0x0.5   DFN5050-32 (SOT617-3) 5.0x5.0x0.85   LPAK56D (SOT1205) 5.0x6.0x1.0

\* The exact position of the balls and package dimensions vary.

# NXP Package Portfolio for Automotive


Medium power  
3,8 – 6,5

Small  
2,6 – 2,9

Very small  
1,7 – 2,2

Ultra small  
1,0 – 1,6

6 pin	 <b>NEW</b> SOT1205 LPAK56D	 SOT457	 SOT363	 <b>SSP</b> <b>NEW</b> DFN2020-6 (SOT1118)	 <b>SSP</b> <b>NEW</b> DFN2020 MD-6 (SOT1220)	 SOT666*	 <b>SSP</b>  DFN1412-6	 <b>NEW</b> DFN1010D-6 (SOT1216)	
4/5 pin	 <b>NEW</b> SOT669 LPAK56	 SOT223	 SOT143 *	 SOT353		 SOT665*			
3 pin		 SOT89	 SOT23	 SOT323	 <b>SSP</b> <b>NEW</b> DFN2020-3 (SOT1061)	 SOT663*	 <b>SSP</b> <b>NEW</b> DFN1010D-6 (SOT1215)	 <b>NEW</b> DFN1006-3 (SOT883)	 <b>NEW</b> DFN1006B-3 (SOT883B)
2 pin	 <b>NEW</b> SOT1289 CFP15	 SOD128 CFP5	 SOD123W / SOD123F CFP3	 SOD323	 SOD323F	 SOD523	 <b>SSP</b> <b>NEW</b> DFN1608D-2 (SOD1608)	 <b>NEW</b> DFN1006-2 (SOD882)	 <b>SSP</b> <b>NEW</b> DFN1006D-2 (SOD882D)

 Package Idea

\* no portfolio extension

**SSP** = solderable-side-pads

# Broad portfolio for standard functions and state-of-the art applications

## PORTFOLIO

### Protection and filtering

- ESD protection devices with standard and low capacitance
- Surge protection (TVS) devices
- Common Mode and EMI filters

### Small-signal MOSFETs

- Low  $R_{DSon}$  Trench MOSFETs
- ESD protected types
- N/P-channel MOSFETs

### Medium power diodes & transistors

- High and medium power bipolar transistors / Low  $V_{CEsat}$  transistors
- High voltage bipolar transistors
- Low  $V_F$  Schottky and PN rectifier

### Small-signal diodes & transistors

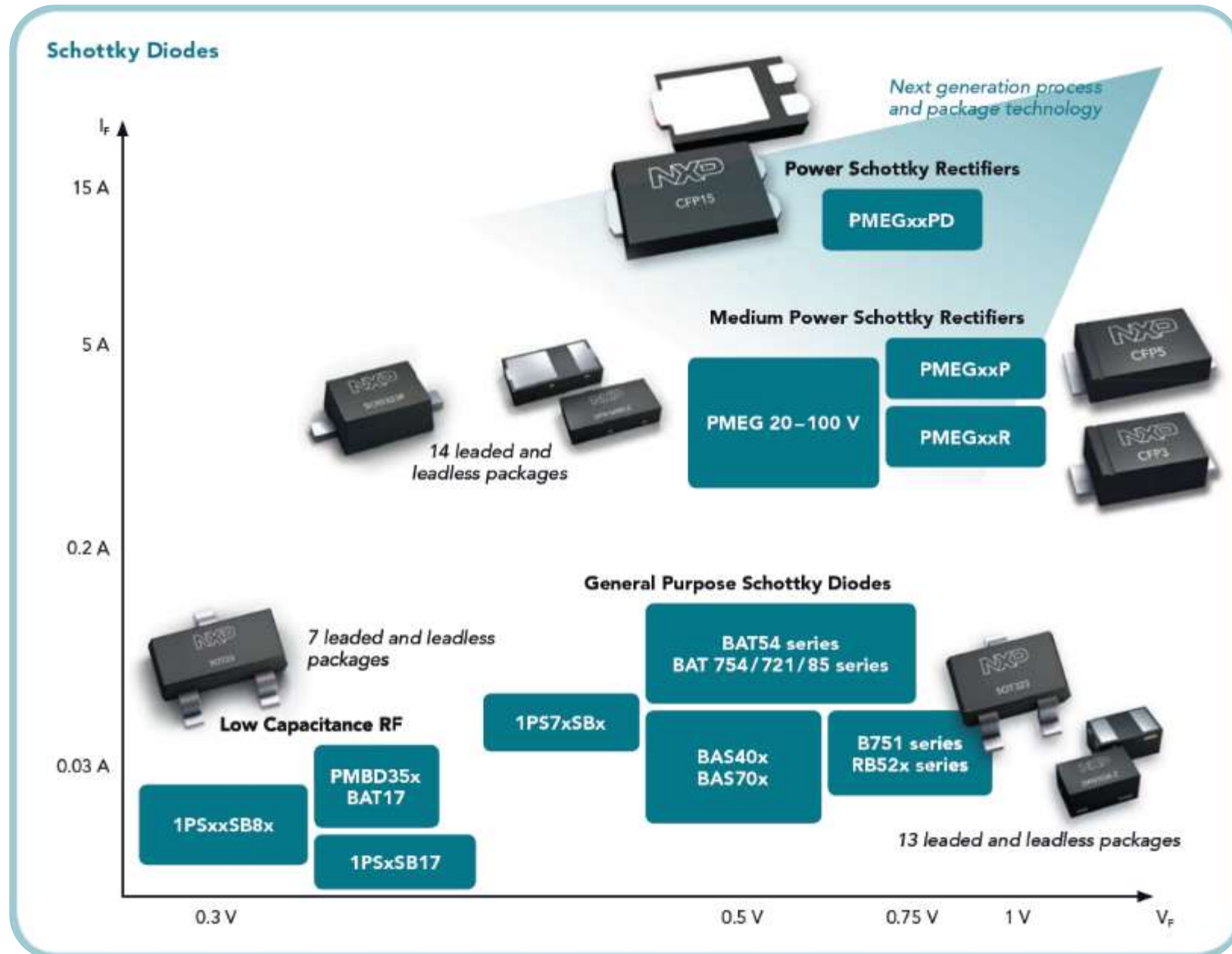
- General purpose diodes and transistors
- Zener, Schottky and switching diodes
- Resistor-equipped transistors (RETs)

### ON THE ROADMAP

- Expansion of medium-power diodes & transistor portfolio
- Expansion of MOSFET portfolio
- ESD protection / TVS devices for latest mobile and high-speed applications

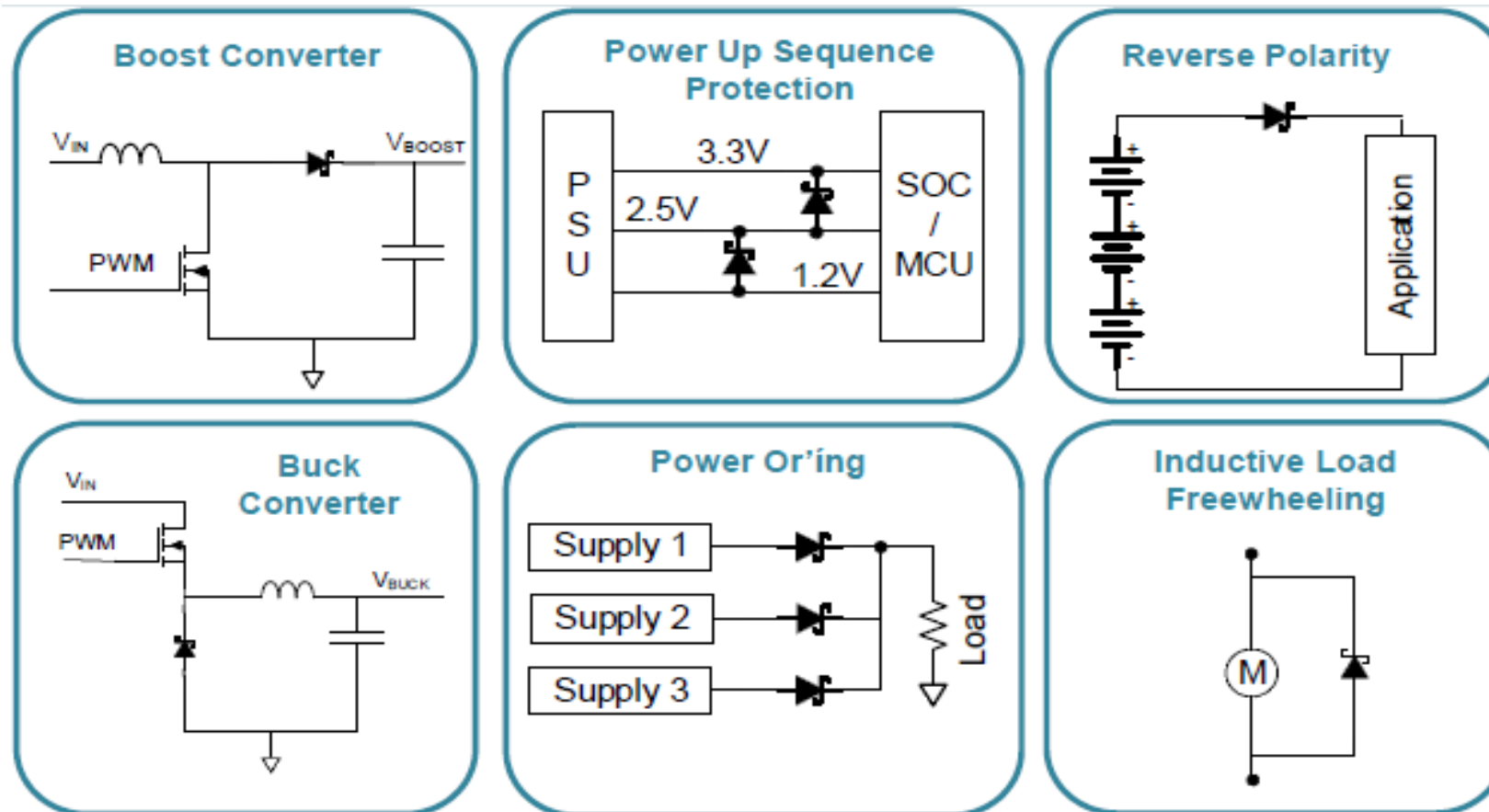


# Portfolio Overview Diodes - Schottky Diodes



# Application examples

General usage



# Medium Power Diode HIGHLIGHTS

Key Features &  
Value for the design:  
Current handling up to 3A  
Wide portfolio in Schottky



*SOD123W*  
(CFP3)

Replace: SMA

Key Features &  
Value for the design:  
Current handling up to 15A  
Solderable side leads  
Ultra flat



SOT1289  
(CFP15)

Replace: DPAK, TO220

Key Features & Value  
for the design:  
Current handling up to 5A  
Wide portfolio in Schottky



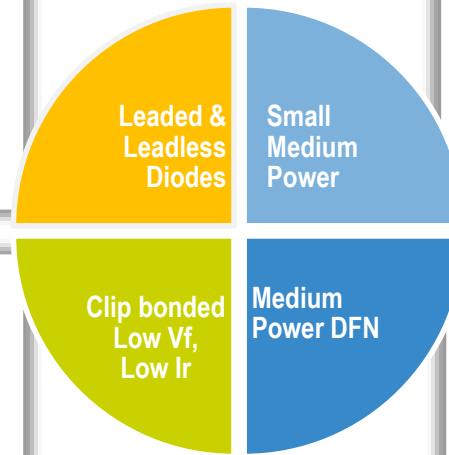
*SOD128*  
(CFP5)

Replace: SMA, SMB

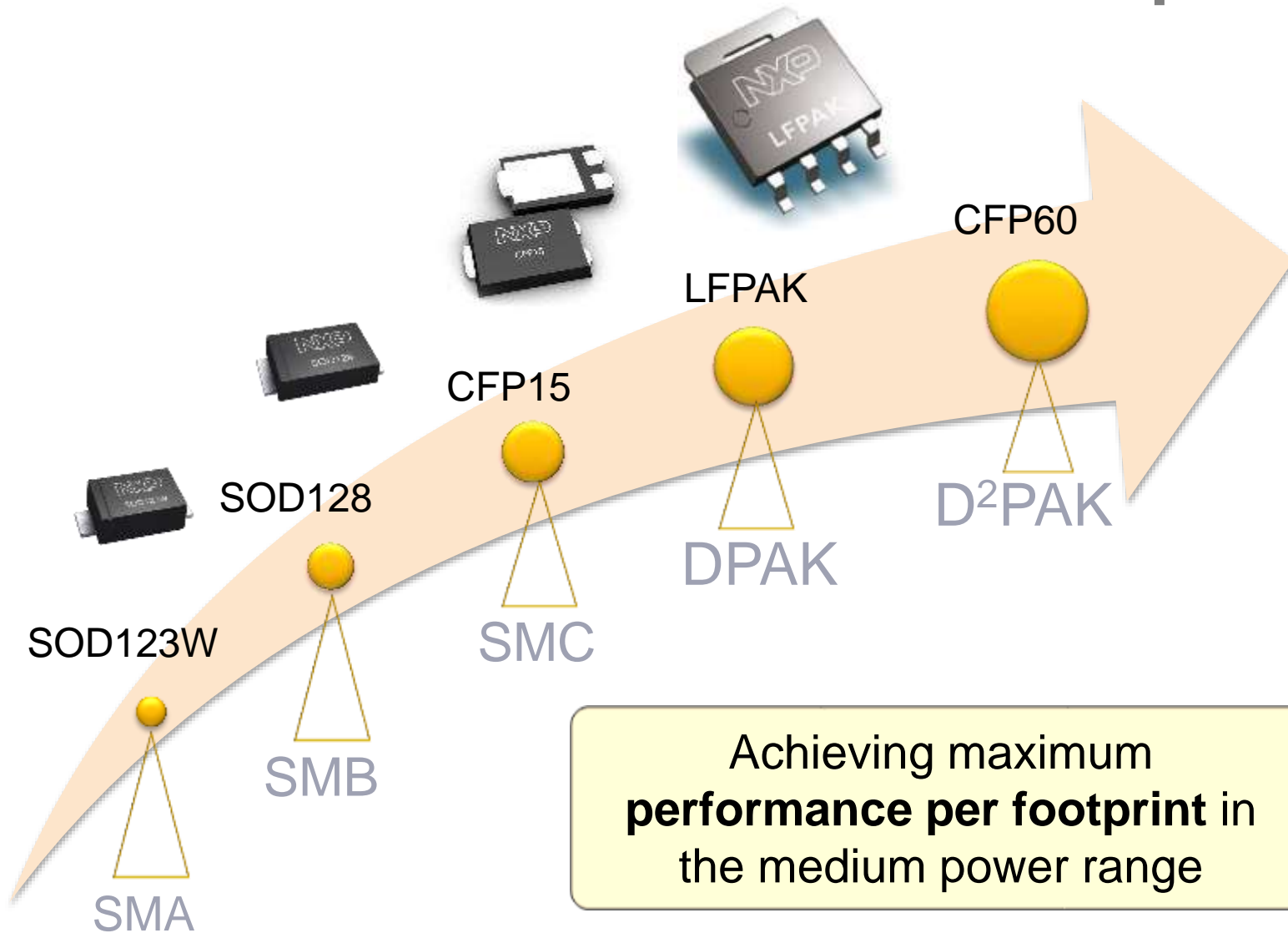
Key Features & Value for  
the design:  
High power & small package  
Solderable side pads



DFN2020D-3

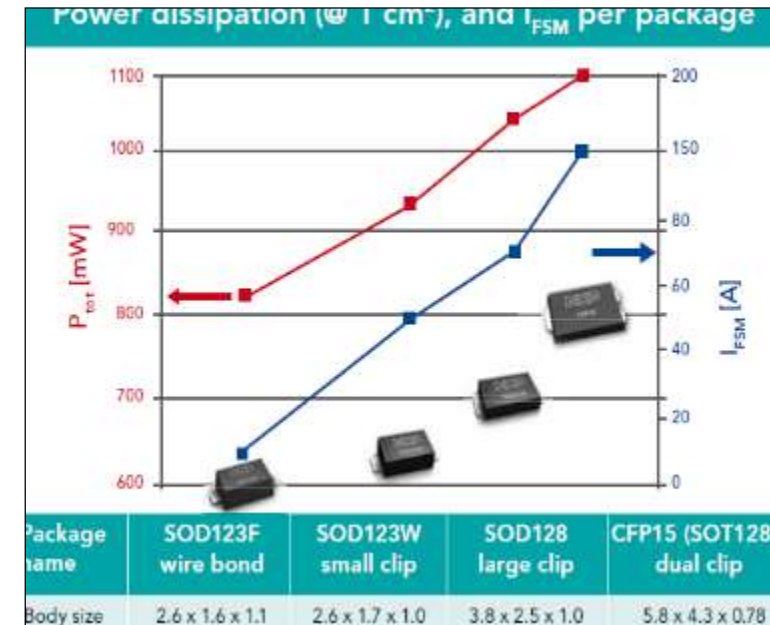


# NXP enables the miniaturization of power

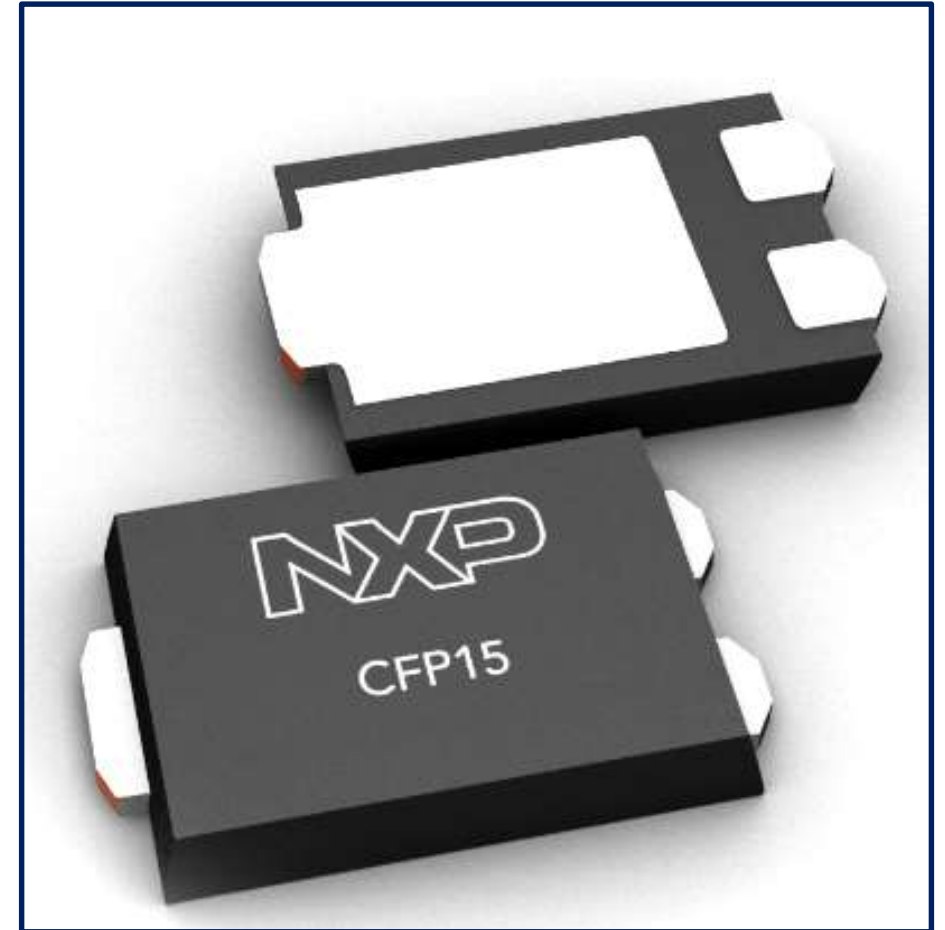
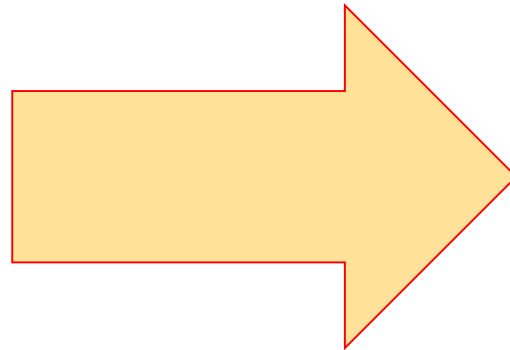
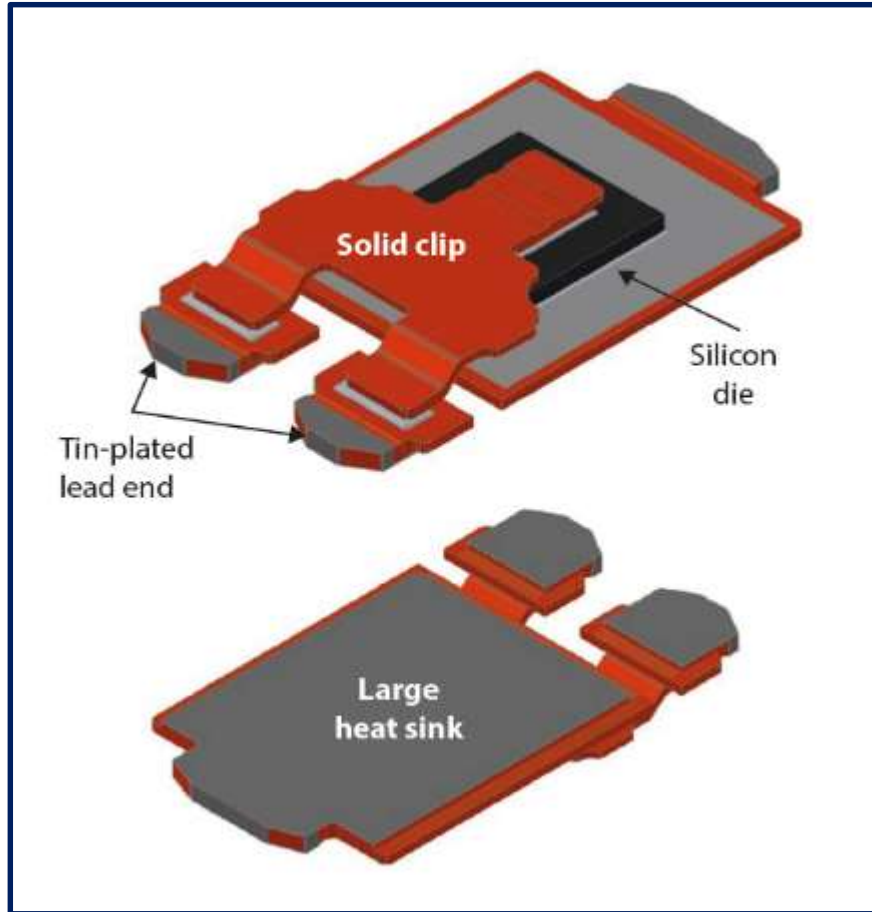


New small Power packages are designed for:

- Enabling shrunk design on pcb and tight pcb stacking
- Increasing power dissipation per footprint
- Reduced weight of the complete module

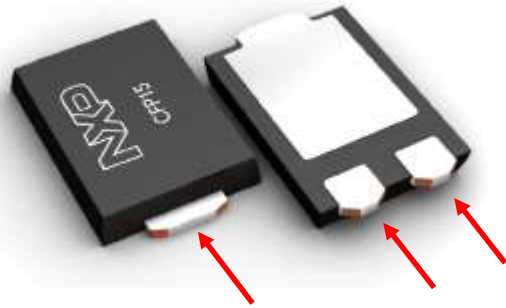


# NXP Clip Flat Power Portfolio



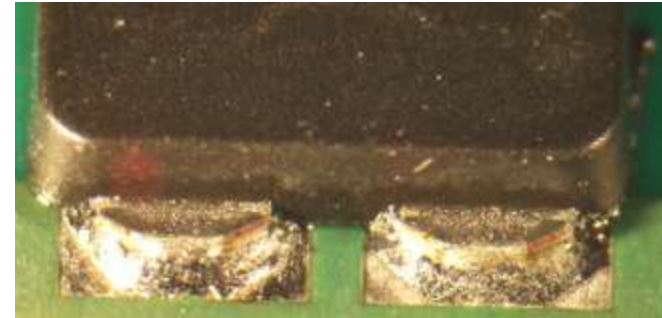
# FlatPower Schottky rectifier

## CFP15 (SOT1289) Solder ability

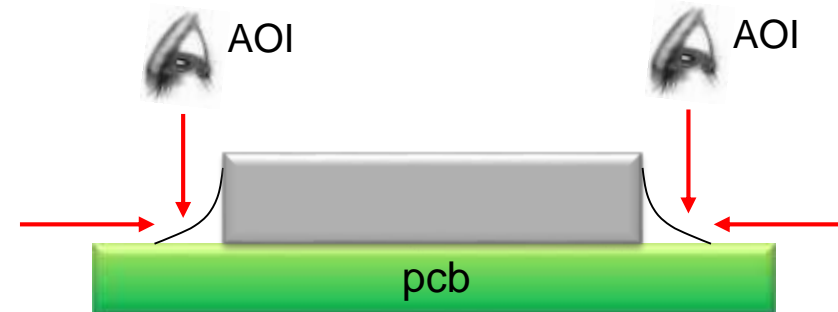


Tin plated lead ends enables visual solder inspection due to good visible solder meniscus

### Solder ability for visual solder inspection



Solder fillet (meniscus) formation

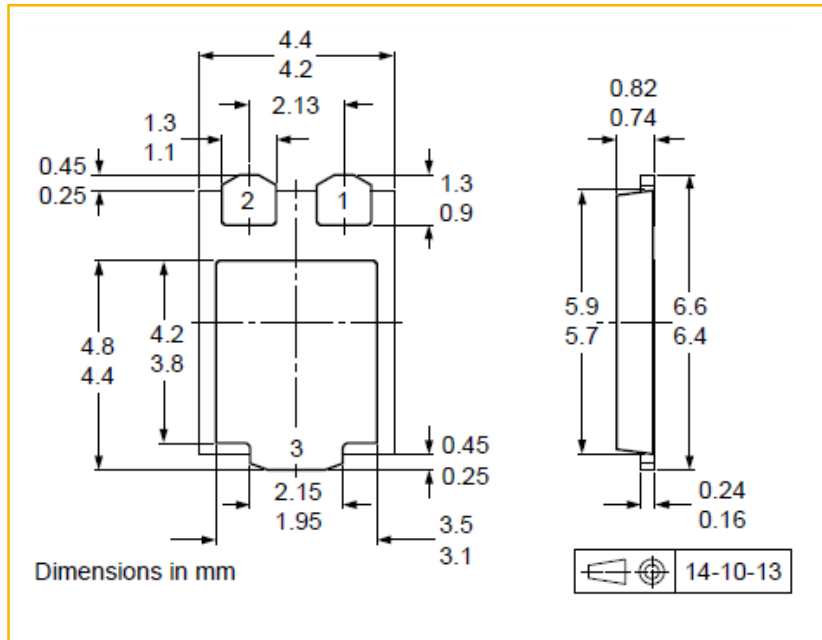


# FlatPower Schottky Portfolio

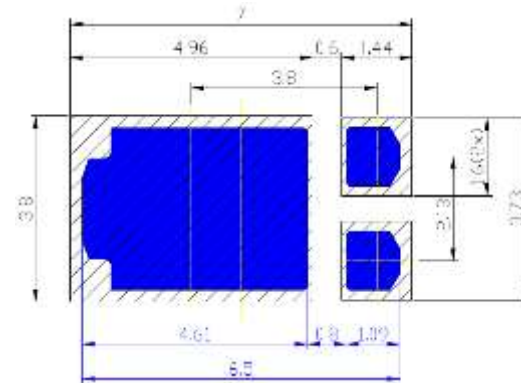
## package & footprint compatibility



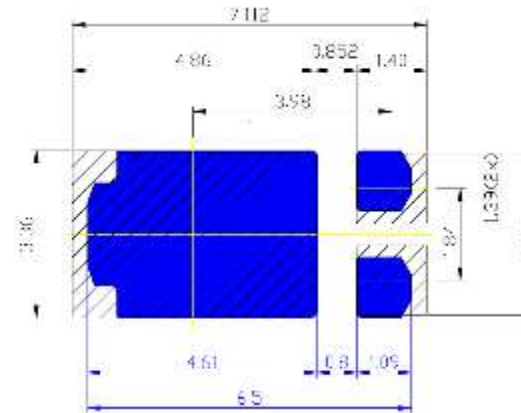
CFP15 (SOT1289)



Footprint compatibility: NXP with Vishay (or Diodes Inc)



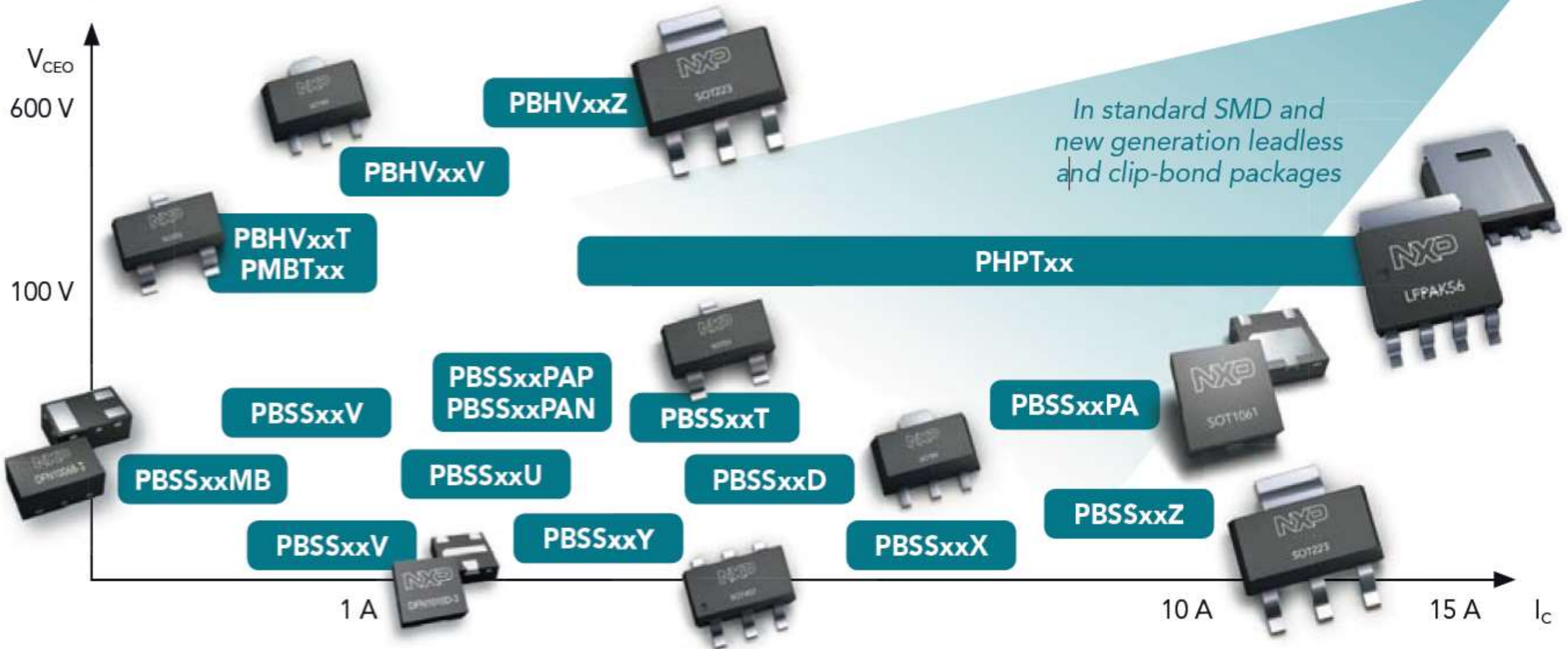
CFP15 on NXP footprint



CFP15 on Vishay (or Diodes Inc) footprint

# Bipolar transistors portfolio

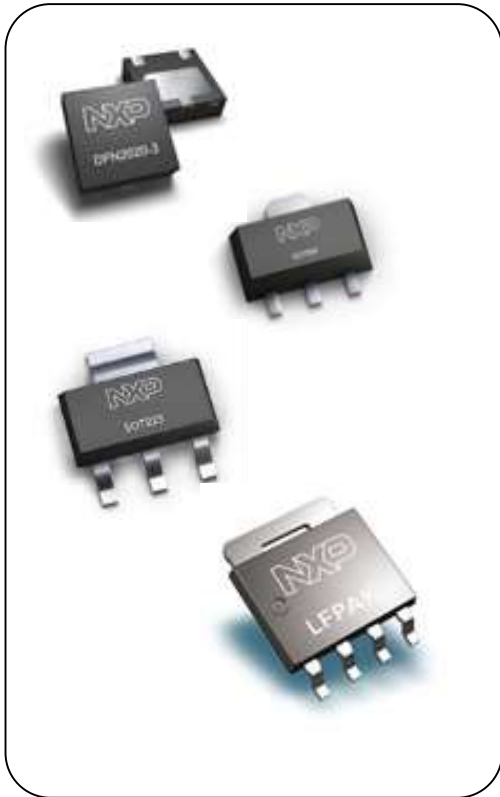
## Low $V_{CEsat}$ (BISS) transistors





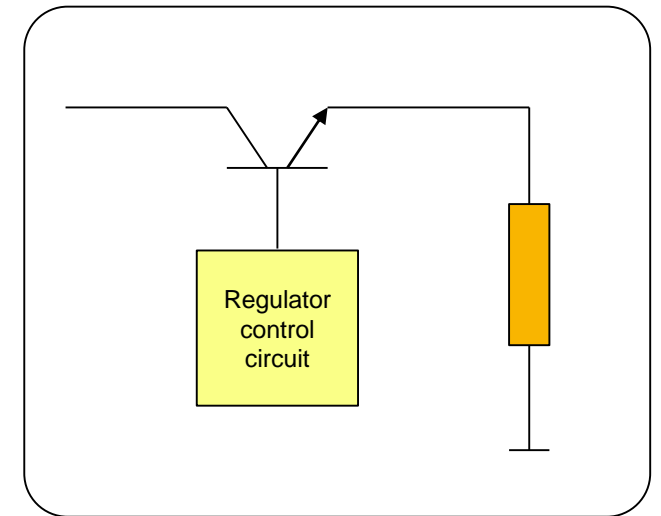
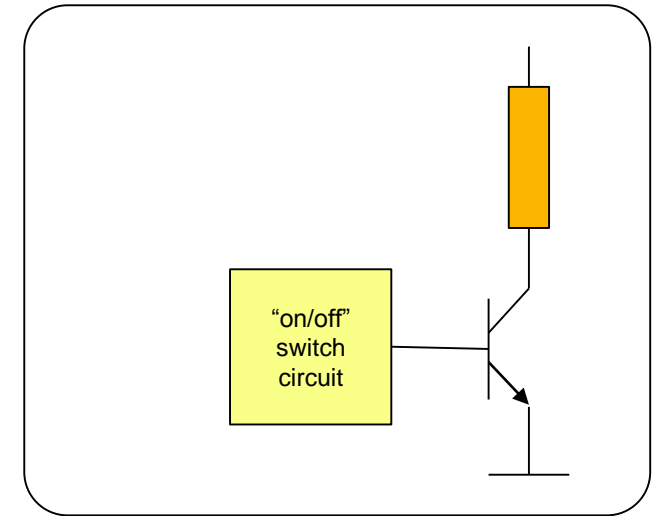
# Application examples

- Power Transistors



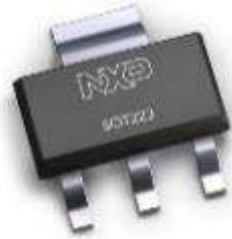
## Applications:

- Linear voltage regulator (RF applications)
- Constant current source e.g. LED lighting
- Load switching
- Relay replacement
- Relay driving
- IGBT driver
- MOSFET driver
- Motor driver



# Medium Power Transistors HIGHLIGHTS

Key Features & Value for the design:  
Medium power handling  
600V capability  
In low VCE SAT up to 7A current handling



SOT223

Key Features & Value for the design:  
Medium power handling  
400V capability  
In low VCE SAT up to 6A current handling



SOT89

Key Features & Value for the design:  
High power dissipation  
Current handling up to 15A  
Single & double



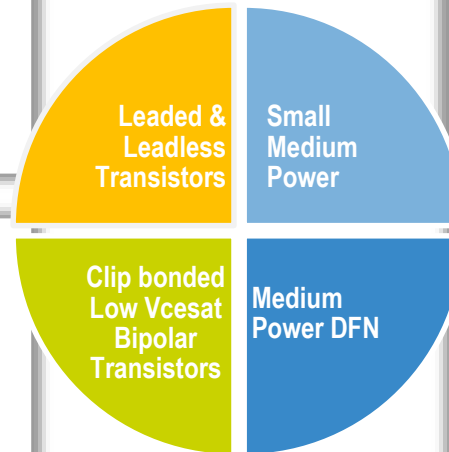
LFPAK56

Replace: DPAK, TO220

Key Features & Value for the design:  
High power & small package  
Single up to 6A, dual up to 2A current handling



DFN2020-3  
DFN2020D-6



# Medium-power Bipolar transistors in LFPAK56

In the spotlight

## Bipolar transistors in LFPAK56 and LFPAK56D power packages

High thermal power dissipation up to 3.7 W,  $V_{ce0}$  up to 100 V

Most types AECQ-101 qualified ( $I_c = 3$  A up to 15 A)

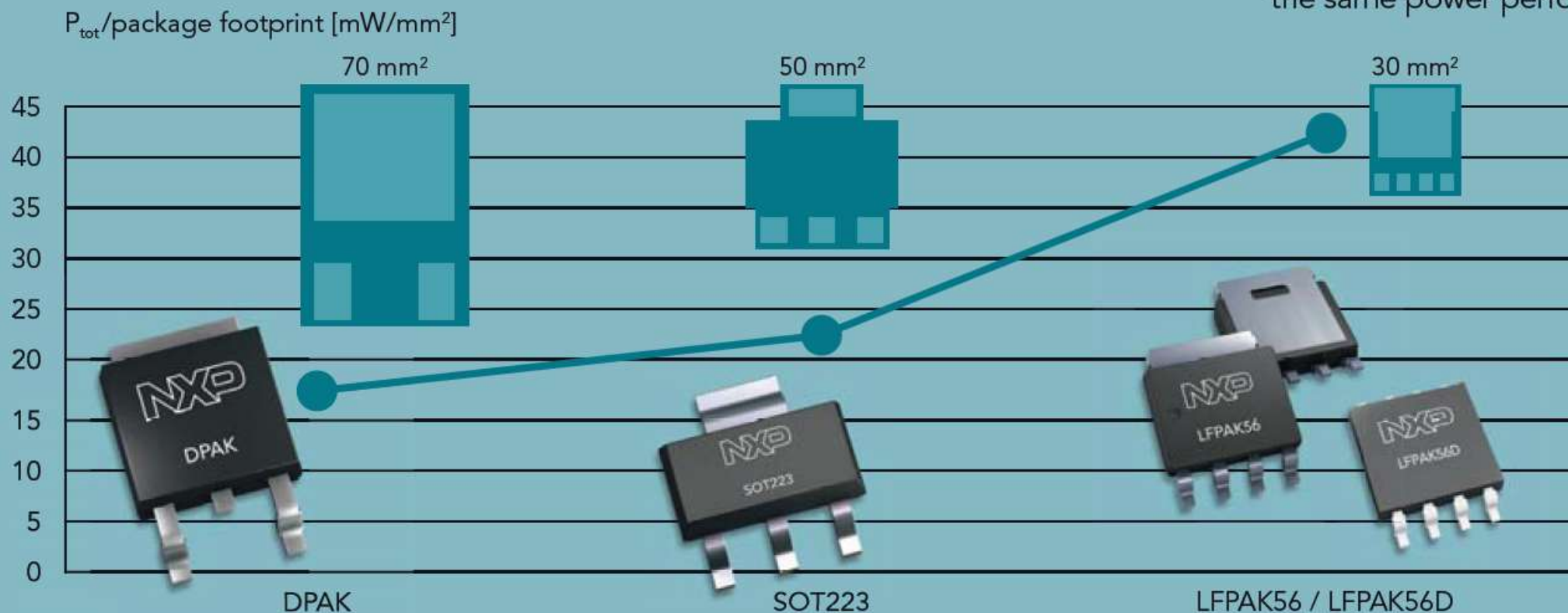
2 types in LFPAK56D with current gain matching of 5% and 10%

Reduced PCB area requirements compared to transistors in DPAK

Suitable for high-temperature applications up to 175 °C

## LFPAK: Same power dissipation but half the size

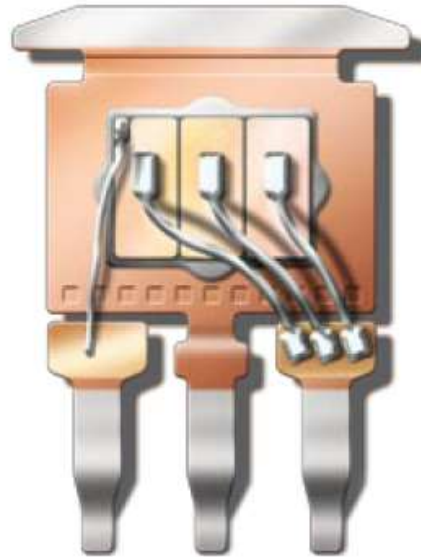
55% package size reduction while retaining the same power performance



# Clip Bonding



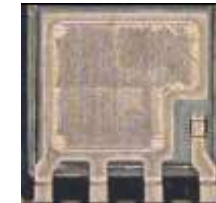
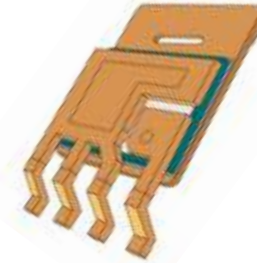
TO220



D2PAK



DPAK



LFPAK56

- The older package technology's use a lot of space to connect the die with PCB. Clip bonding is the compact solution by supporting a better electrical behavior (lower resistance, lower inductance)

# High power bipolar transistors in LFPAK56

## Product portfolio

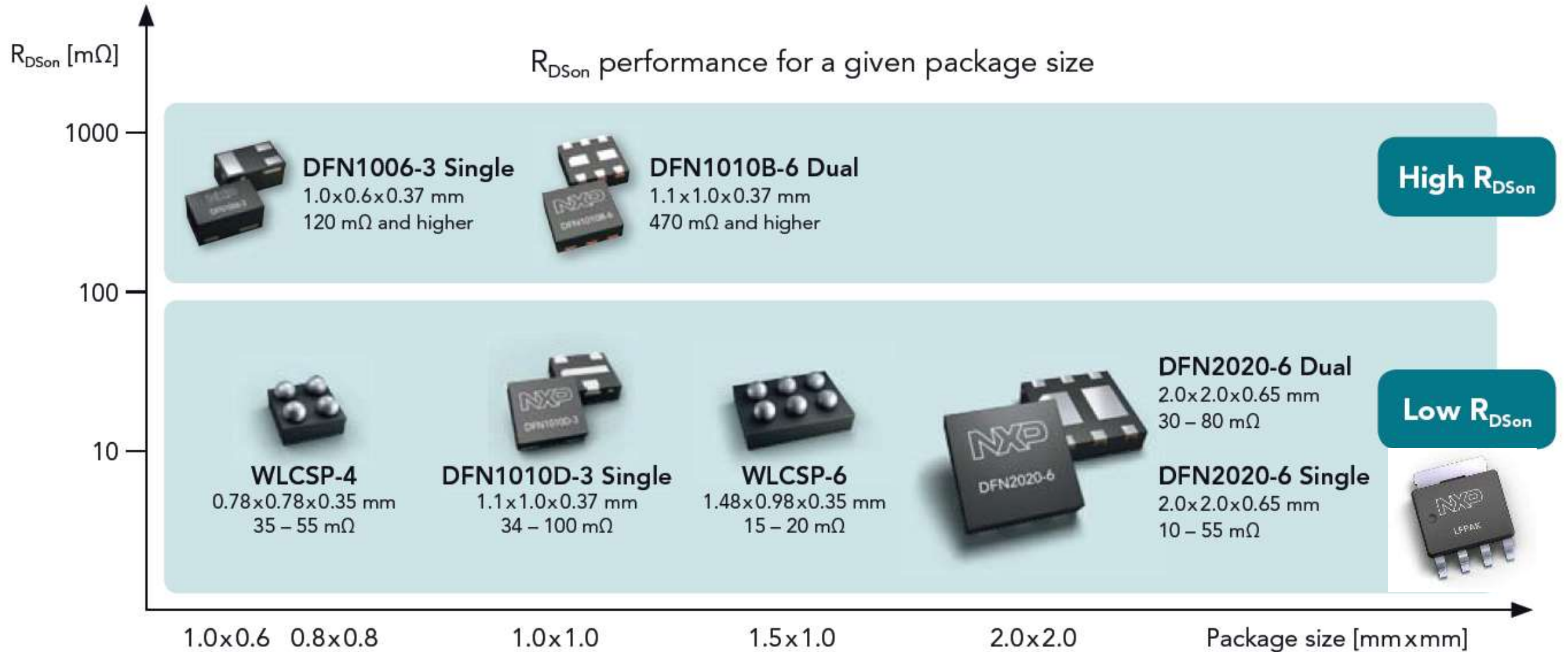
### Miniaturization of Power

Clip-bonded, wireless packages



- ✓ AECQ-101 qualified
- ✓ Only 1 mm height
- ✓ Similar performance as DPAK on smaller footprint
- ✓ Excellent electro-thermal behavior
- ✓ For high temperature use (up to 175 °C)
- ✓ Single and Dual version
- ✓ Dual matched pair

# Small-signal MOSFET portfolio



Leadless DFN and WLCSP packages – dedicated solutions for your application

# Small-signal MOSFET HIGHLIGHTS

## Key Features:

- Dual SOT363 package
- 30V N-channel
- 1.000 mΩ typ.



*NX3008NBKS*

## Key Features:

- SOT23 package
- Various N/P channel  
low  $R_{DSon} < 1 \Omega$   
automotive portfolio



*BSH205G2*

## Key Features:

- 20V,30V,40V&60V Pch  
 $R_{DSon}$  down to 4 mΩ  
(@4.5V) for 20V Pch
- AEC-Q 101 qualified



*PMY1631EPA*

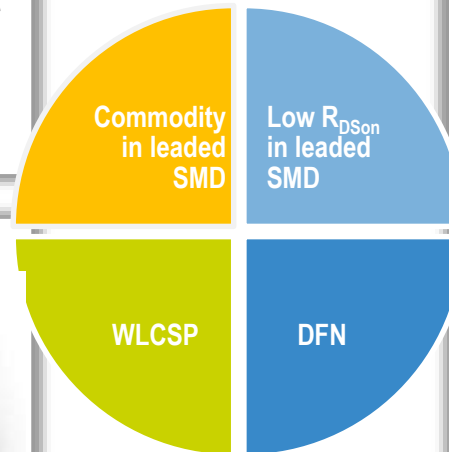
**Coming Soon!**

## Key Features:

- Dual 1.1 x 1.0 mm  
DFN1010D-3 package
- 80V N-channel
- 345mΩ typ. @ $V_{gs}=10V$



*PMXB360Enea*



# P-Channel MOSFET in LFPAK

## Key features

- 20V, 30V, 40V and 60V Pch portfolio
- $R_{DSon}$  down to 4 m $\Omega$  (@4.5V) for 20V Pch
- AEC-Q 101 qualified

## Key benefits

- Closing the gap in NXP P-channel power portfolio
- Well-known LFPAK package technology

## Key applications

Load switch, Reverse battery protection, High side switch in Motordrive, Battery FET

## Technical Details

Type	$V_{DS}$ (V)	$V_{GS}$ (V)	$R_{DSon}$ typ @ $V_{GS}=10V$	$R_{DSon}$ typ @ $V_{GS}=4.5V$
PMY521XPA	20	12	-	5 m $\Omega$
PMY821XPA	20	12	-	8.5 m $\Omega$
PMY931EPA	30	20	9 m $\Omega$	15 m $\Omega$
PMY1631EPA	30	20	16 m $\Omega$	27 m $\Omega$
PMY1141EPA	40	20	11 m $\Omega$	16 m $\Omega$
PMY1941EPA	40	20	19 m $\Omega$	28 m $\Omega$
PMY2361EPA	60	20	23 m $\Omega$	29 m $\Omega$
PMY4361EPA	60	20	43 m $\Omega$	56 m $\Omega$

## Package



LFPAK56 (Power SO8)



Clip bond technology

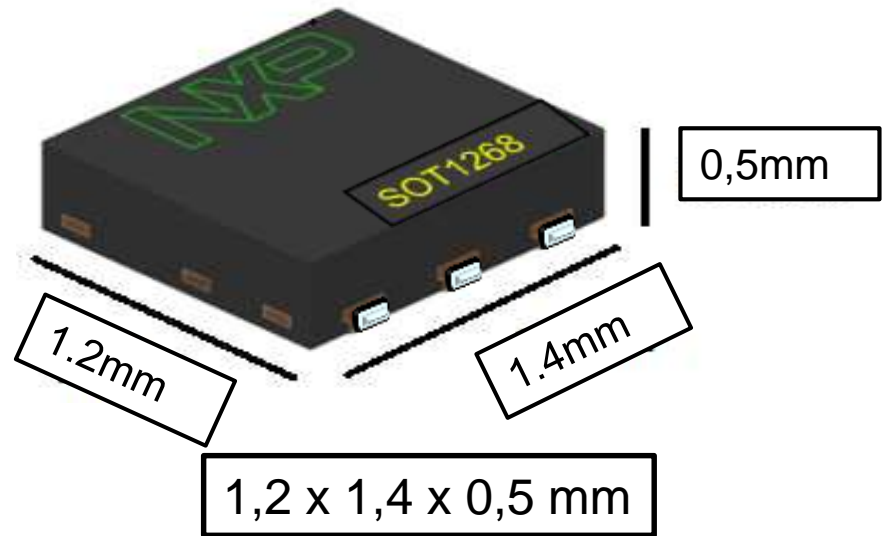




# SOT363/666 to leadless DFN1412/SOT1268



From leaded to leadless



First samples end of 2016 w/o solderable sidepads

# Summary: Automotive focus Application

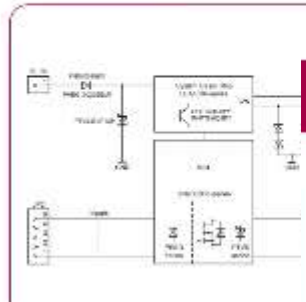
Function	Freewheeling in DC-DC buck and boost	Blocking, reverse polarity protection	linear voltage regulation / ext. ballast BJT	ESD and Surge Protection
Family	Schottky	PN-Rectifier & Schottky	medium to high power BJT	PESD, PTVS-families
Modules	ABS, Airbag, LED Lighting, EPS	ABS, Body Controller, Car Radio	Body Controller, EPS, Car Radio	nearly all modules in Automotive, always an opportunity

# Summary: Automotive focus Application



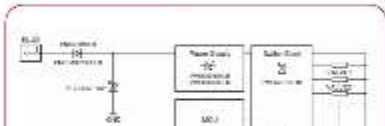
## Discretes for body controller

FEATURES & BENEFITS  
 •  $T_j = 125^\circ\text{C}$  (P14G001003 / P14F1000003)



## Discretes for ABS/ESP

FEATURES & BENEFITS  
 • Low leakage current of max. 200 nA (P14G010004EUE)  
 •  $T_j = 125^\circ\text{C}$  (P14G001007 / P14G010004EUE)  
 • Similar electrical performance as P14G010004EUE in smaller package (SOT143B/SOT143C)  
 • OEM-val. tested ESD protection



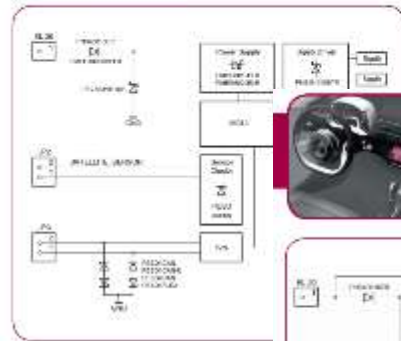
PRODUCT OPPORTUNITY TABLE

Type	Package	Symbol(s)	Package
Relay	SOT143B	P14G010007	SOT143B
Relay	SOT143C	P14G010004EUE	SOT143C
Relay	SOT143B	P14G010004EUE	SOT143B
Relay	SOT143C	P14G010007	SOT143C
Relay	SOT143B	P14G010004EUE	SOT143B
Relay	SOT143C	P14G010007	SOT143C
Relay	SOT143B	P14G010004EUE	SOT143B
Relay	SOT143C	P14G010007	SOT143C



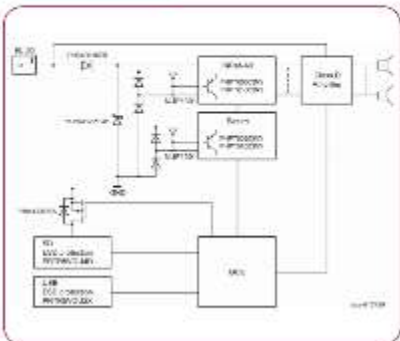
## Discretes for airbag

FEATURES & BENEFITS  
 • Low leakage current of max. 200 nA (P14G010004EUE)  
 •  $T_j = 125^\circ\text{C}$  (P14G010004EUE / SOT143B / SOT143C)  
 • Similar electrical performance as P14G010004EUE in smaller package (SOT143B/SOT143C)  
 • OEM-val. tested ESD protection



## Discretes for infotainment / car radio

FEATURES & BENEFITS  
 •  $T_j = 125^\circ\text{C}$  (P14G001008 / P14F1000280)  
 • Functional block voltage regulation with external feedback topology  
 • OEM-val. tested ESD protection



PRODUCT OPPORTUNITY TABLE

Type	Package	Symbol(s)	Package
Relay	SOT143B	P14G010007	SOT143B
Relay	SOT143C	P14G010004EUE	SOT143C
Relay	SOT143B	P14G010004EUE	SOT143B
Relay	SOT143C	P14G010007	SOT143C
Relay	SOT143B	P14G010004EUE	SOT143B
Relay	SOT143C	P14G010007	SOT143C
Relay	SOT143B	P14G010004EUE	SOT143B
Relay	SOT143C	P14G010007	SOT143C



- LED lamps, Airbag, Braking and much more
- block diagrams and product opportunities on a single slide





# HIGH INTEGRATION PACKAGING INNOVATIONS



# Improving Logic Packaging Reliability and Cost

- Automotive Package Overview
- Improvements thru Package Reduction Count
  - Configurable
  - Combination Logic
  - Dual Configurable
- Improvements thru Package Technology
  - Gold to Copper transition
  - Side Wettable Flanks
  - MiniLogic technology

# NXP Logic Market Segmentation

## PRODUCT FAMILIES

### HIGH VOLTAGE LOGIC

HC/HCT, HEF,  
AHC/ACHT, VHC/XC7,  
ABT, CBT, NPIC

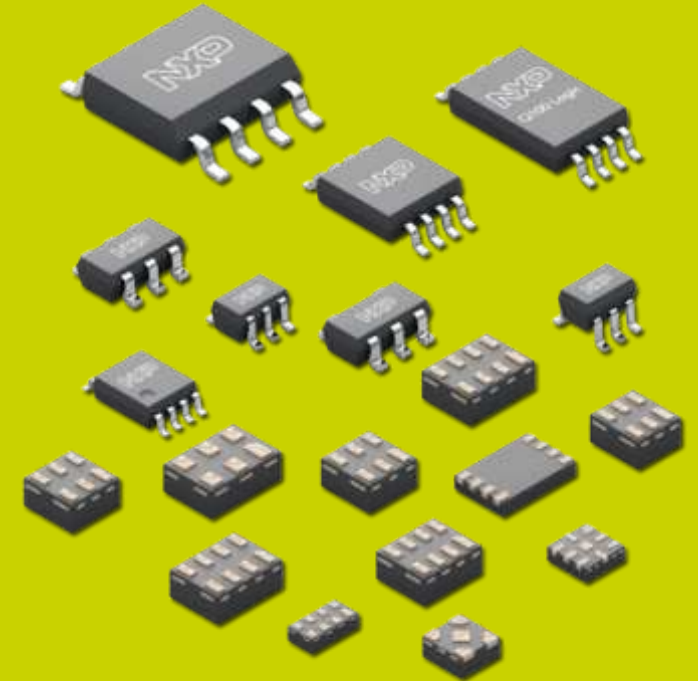
### LOW VOLTAGE LOGIC

LV, LVC, LVT,  
AUP, AXP, ALVC,  
AVC, ALVT, CBTLV, LV-A

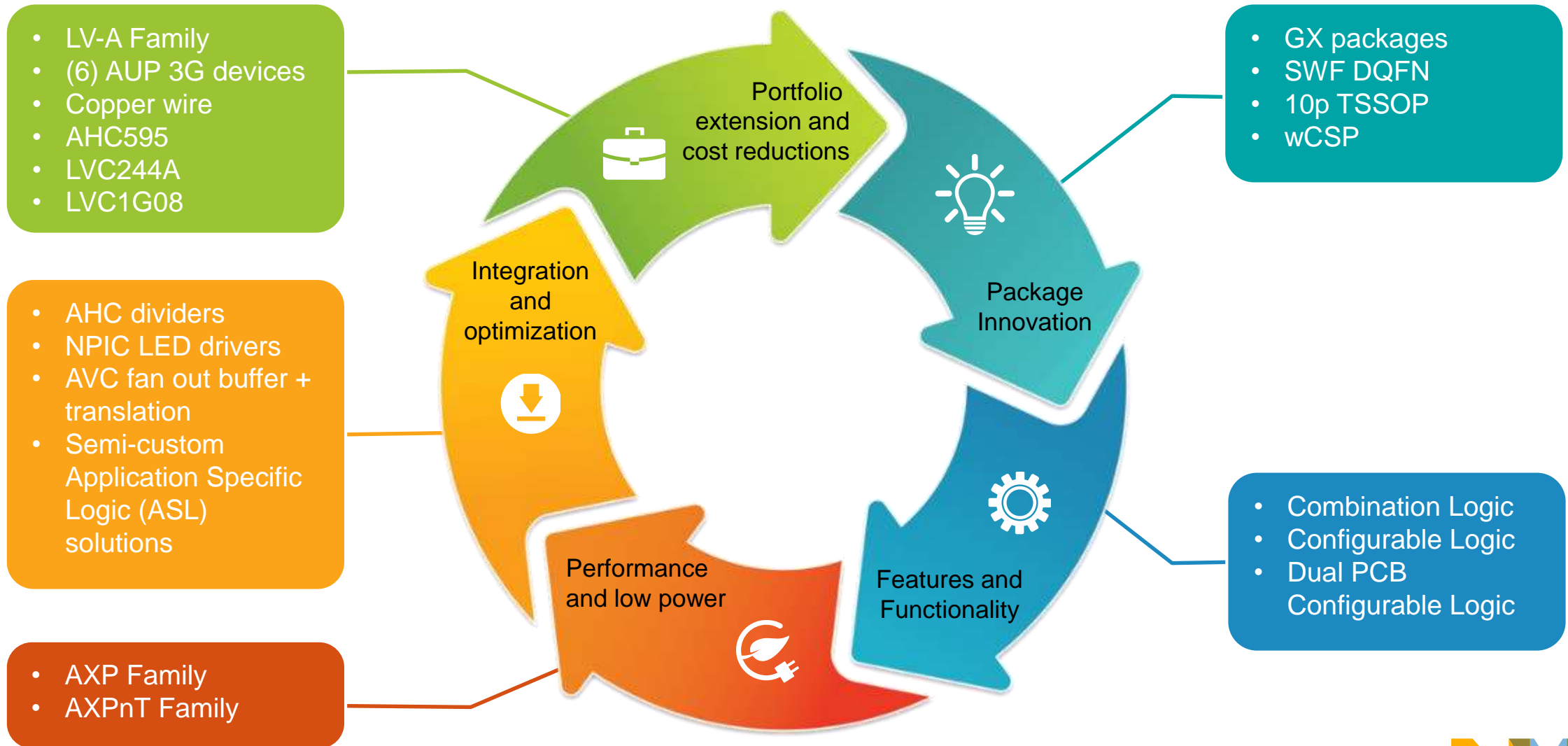
## STANDARD LOGIC (> 10 PINS)



## MINI LOGIC (UP TO 10 PINS)



# Innovation Leadership





# NXP Logic – Qualified for Automotive

- All production facilities are ISO/TS16949 certified.
- Product families are released according to NXP QRS and AEC-Q100
- Major supplier to the majority of Automotive customers.



**BOSCH**



DAIMLERCHRYSLER



**TRW**  
*Automotive*

DELPHI

Continental®



# Introduction of Cu-wire for -Q100 Logic products

## Executive summary

- Cu-wire package overview and introduction schedules

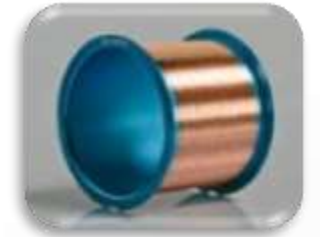
Name	Package Version	Suffix	Assembly location		Production start date	
					Commodity Logic	-Q100 Logic
TSSOP-5	SOT-353	GW	ATSN, Malaysia	-	Q1 2015	Q2 2017
TSSOP-6	SOT-363	GW	ATSN, Malaysia	-	Q1 2015	Q2 2017
TSSOP-14	SOT-402	PW	ATBK, Thailand	ASEN, China	Q4 2012	Q2 2017
TSSOP-16	SOT-403	PW	ATBK, Thailand	ASEN, China	Q4 2012	Q2 2017
TSSOP-20	SOT-360	PW	ATBK, Thailand	ASEN, China	Q4 2012	Q2 2017
SO-14	SOT-108	D	ATBK, Thailand	ASEN, China	Q4 2012	Q2 2017
SO16	SOT-109	D	ATBK, Thailand	ASEN, China	Q4 2012	Q2 2017

- To date the shipped Cu-wire quantity exceeds 7 Billion pcs.
  - Performance better than Au-wire (Failure rate < 10 PPB)
- Performed full re-qualification to show compliancy to new AEC-Q006 - Rev- A
- Traceability via assembly date code shortly after introduction

# Introduction of Cu-wire for -Q100 Logic products

## Features and benefits of Cu-wire bonding

- Superior electrical resistivity and better thermal conductivity result in better electrical performance of the products
- The higher mechanical strength of the copper wire results in stiffer wires in the products, with higher wire-sweep resistance levels and a stronger interconnect
- Better high temperature performance, minimal intermetallic compound formation
- Stable commodity pricing removing the effects of gold price volatility on product pricing
- When considering the overall ecological footprint copper is more environmentally friendly than gold



# Introduction of Cu-wire for -Q100 Logic products

## Characteristics of Cu-wire products vs. Au-wire products

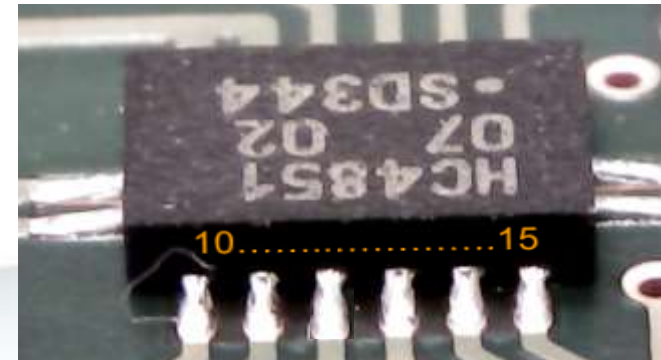
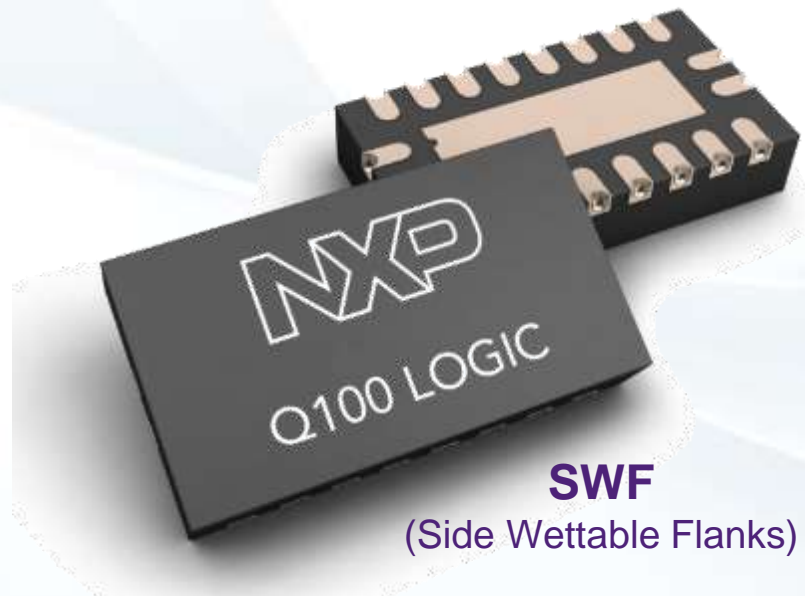
- No change on external dimensions and mechanical performance
- No change of electrical parameters (in specification and within the same distribution; incl. ESD)
- No change of reliability performance: Copper-wire products pass qualification requirements per AEC-Q100-rev.H and AEC-Q006-rev.A
- No change of datasheet
- No change in part-number and packing

# Introduction of Cu-wire for -Q100 Logic products

## Product Change Notification (PCN)

- PCN scheduled to be issued 30 September 2016
- PCN cycle expected to be completed March 2017
- -Q100 Cu-wire SO-14, SO-16, SO-20, TSSOP-14, TSSOP-16 and TSSOP-20 expected to be in production from Q2 2017
- Traceability via assembly date code shortly after introduction

# Side Wettable Flanks

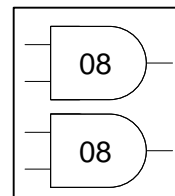
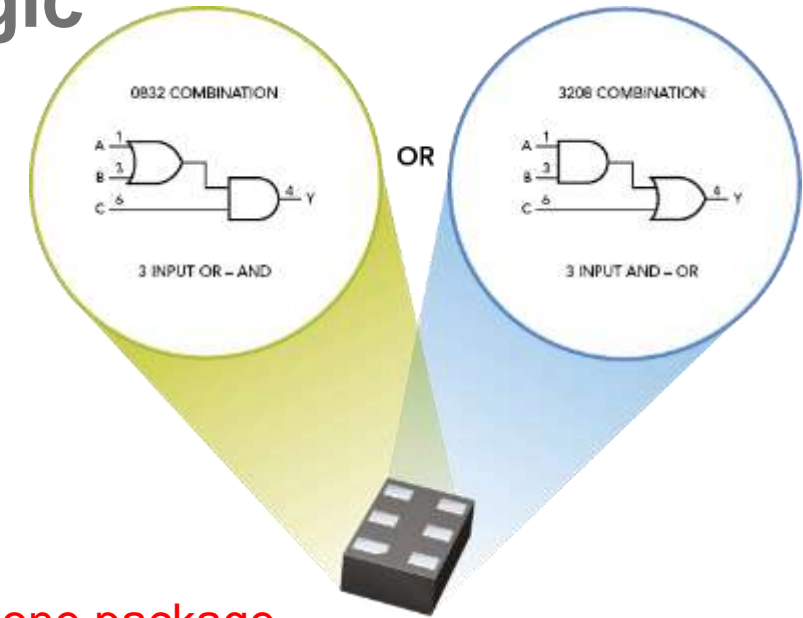


**AOI**  
(Automatic Optical Inspection)

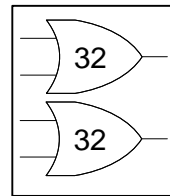
# Package Count Reduction: Combination Logic

## What is Combination Logic?

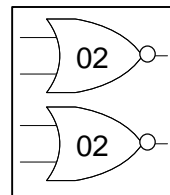
- More than one function in a package
- Historically we would put two or more of the same functions in one pkg



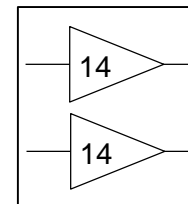
74LVC2G08  
74AUP2G08



74LVC2G32  
74AUP2G32



74LVC2G02  
74AUP2G02

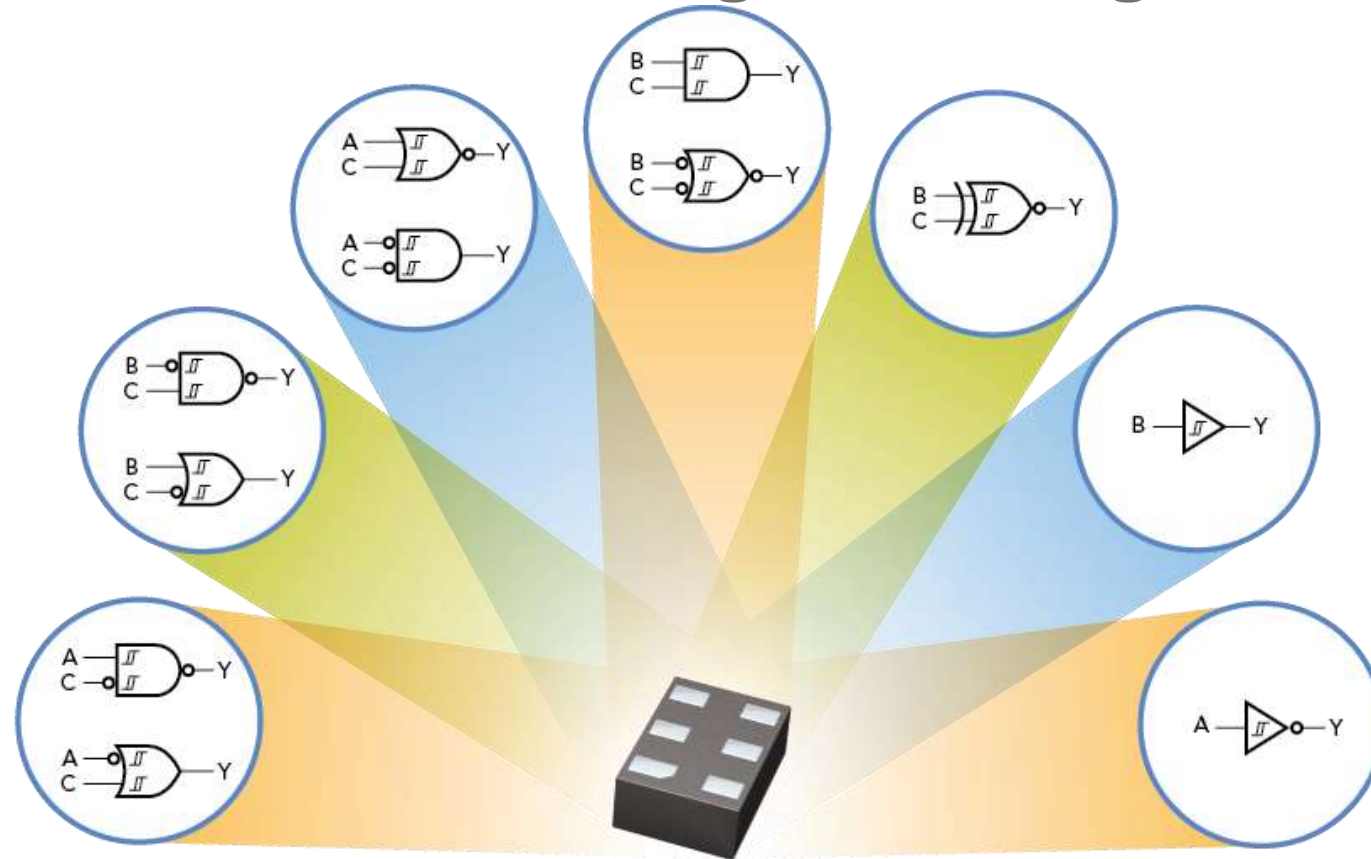


74LVC2G14  
74AUP2G14

Two of the same function in one package

Why not put two different functions in the same package?

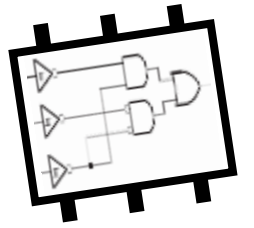
# Package Count Reduction: Configurable Logic



Configurable Logic solutions incorporate many different logic functions into a single package. The device is configured by connecting the pins to various sources



# PCB Configurable Devices (Single)



## Available functions

74LVC1G57 74AUP1G57 74AXP1G57							
74LVC1G58 74AUP1G58 74AXP1G58							
74LVC1G97 74AUP1G97 74AXP1G97							
74LVC1G98 74AUP1G98 74AXP1G98							



GW  
0.65



GM  
0.5



GF  
0.35



GN  
0.3



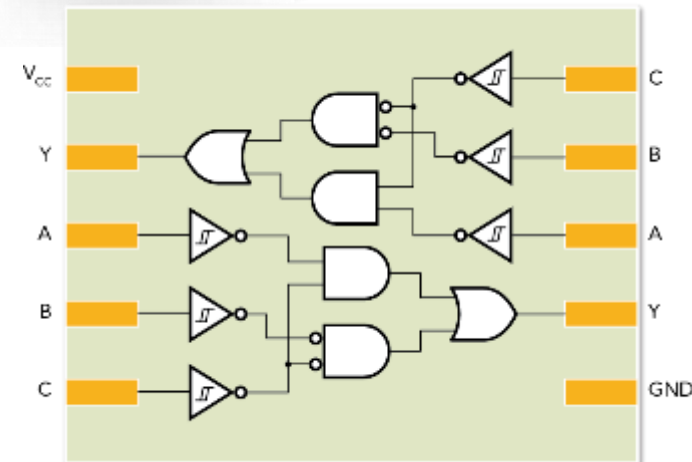
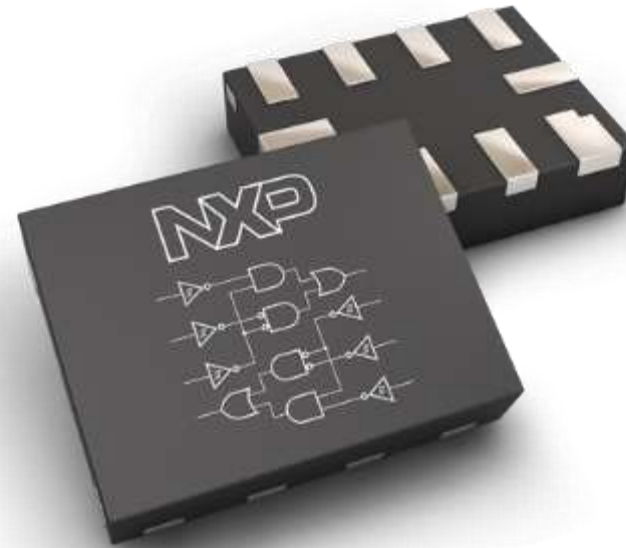
GX  
0.45

# Dual PCB Configurable Logic

Multiple configurable functions in a single package

Two sets of configurable gates

- Each set individually configurable (on the PCB)
- Configurable + Combination logic: dynamically create your own Combination Logic Device



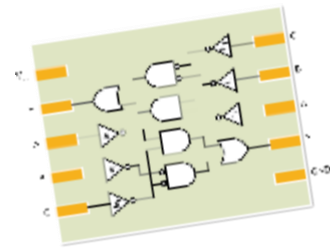


# Device Count Reduction Benefits (Summary)

- Device Count Reduction
  - Reliability is directly related to the number of devices / pin count failure points
  - Combination Logic reduces the number of devices/pins by a factor of 2:1 or 3:1
  - Configurable Logic (if using complex logic) can reduce the number of devices/pins as much as 3:1 (single configurable) to 6:1 (dual configurable)



# More Savings...



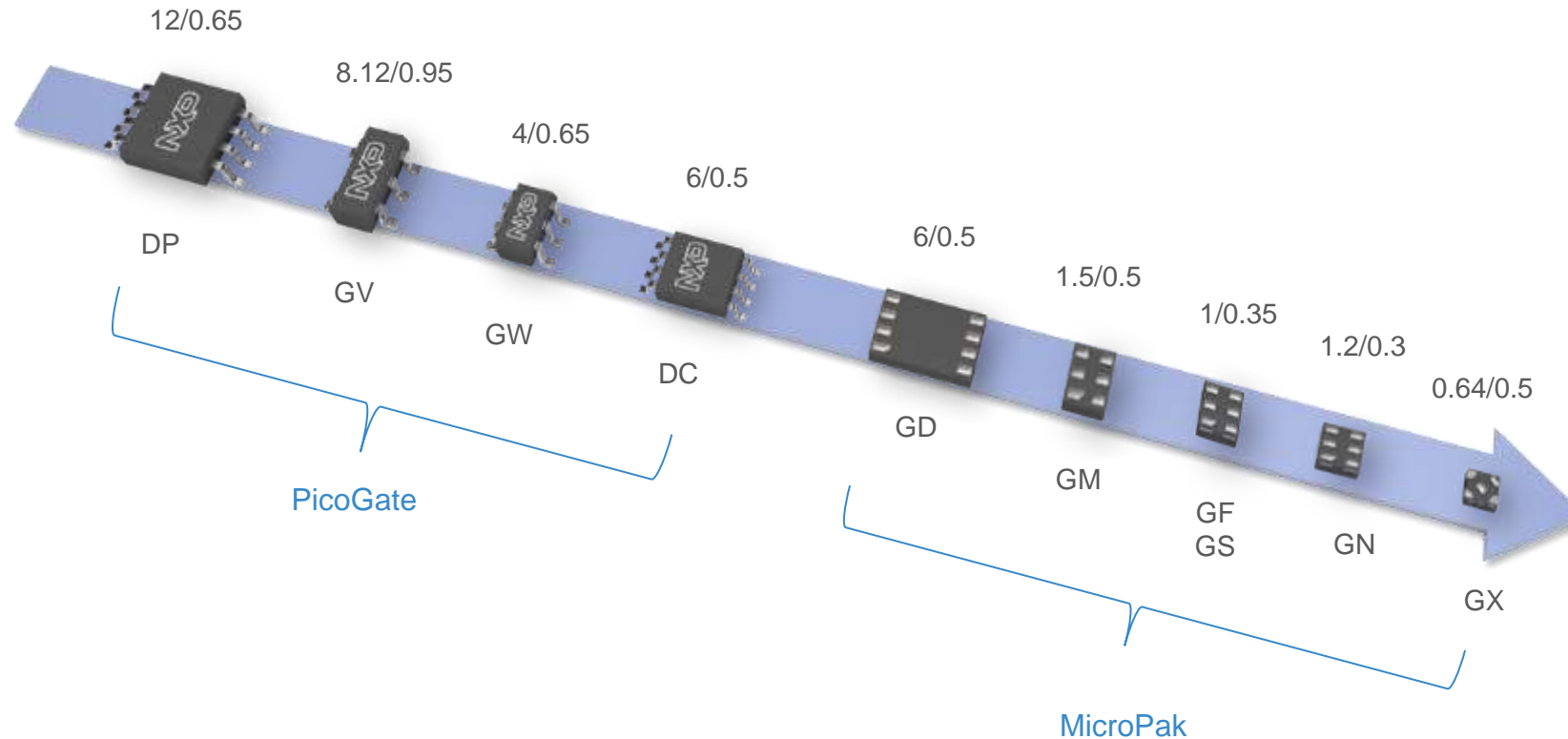
- **System/application**
  - Reduced power consumption
  - Reduced space
- **Designer**
  - Flexibility
  - Reduction in development time
- **Component Engineering**
  - Reduced qualification effort
- **Purchasing**
  - Reduced component costs
  - Reduced inventory management costs
- **Logistics**
  - Reduced number of components to manage
  - Reduced inventory
- **Manufacturing**
  - Increased machine assembly efficiency



Assembly pick-n-place

# MiniLogic Packaging

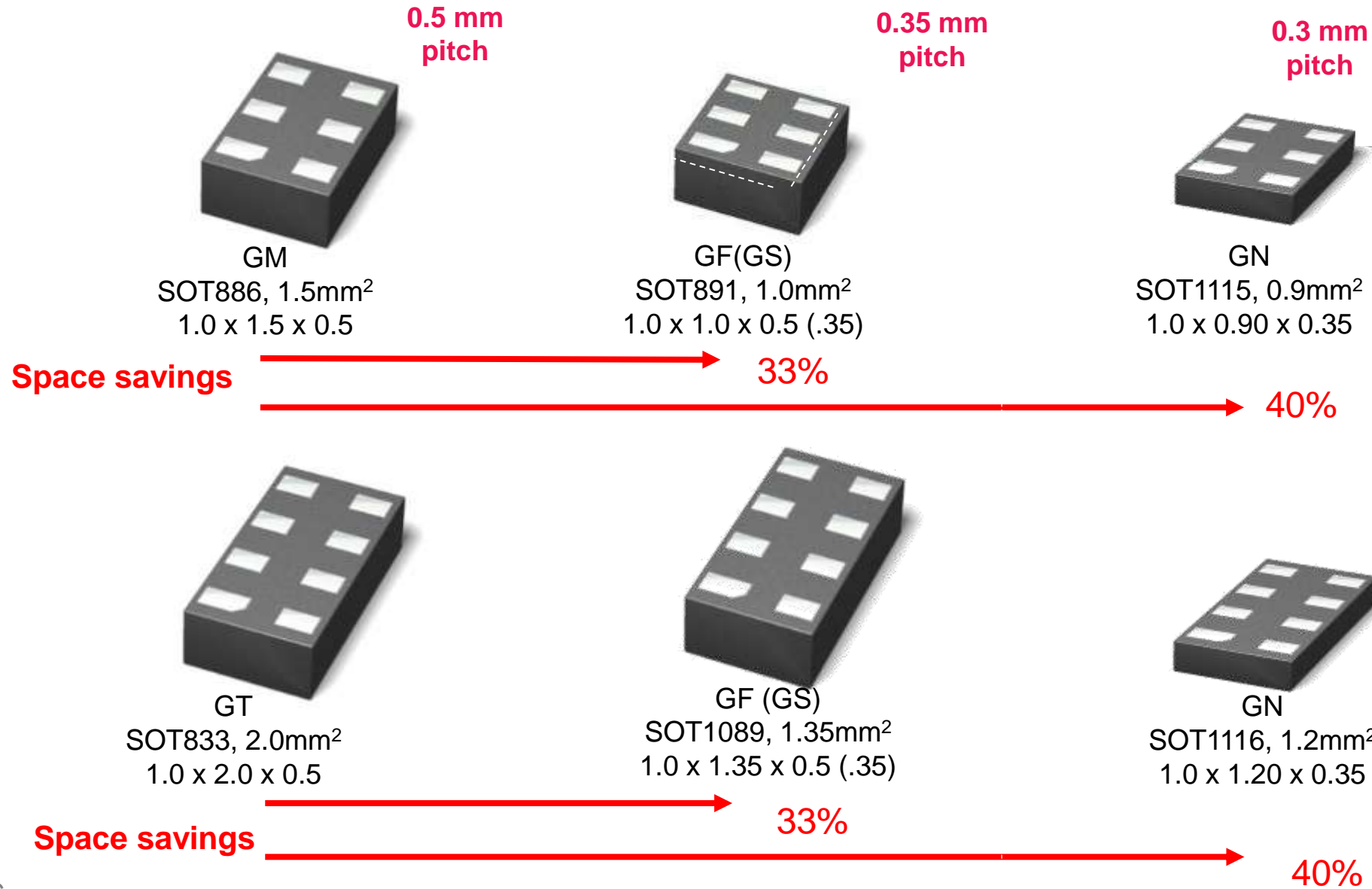
Addressing the trend to smaller and smaller packages



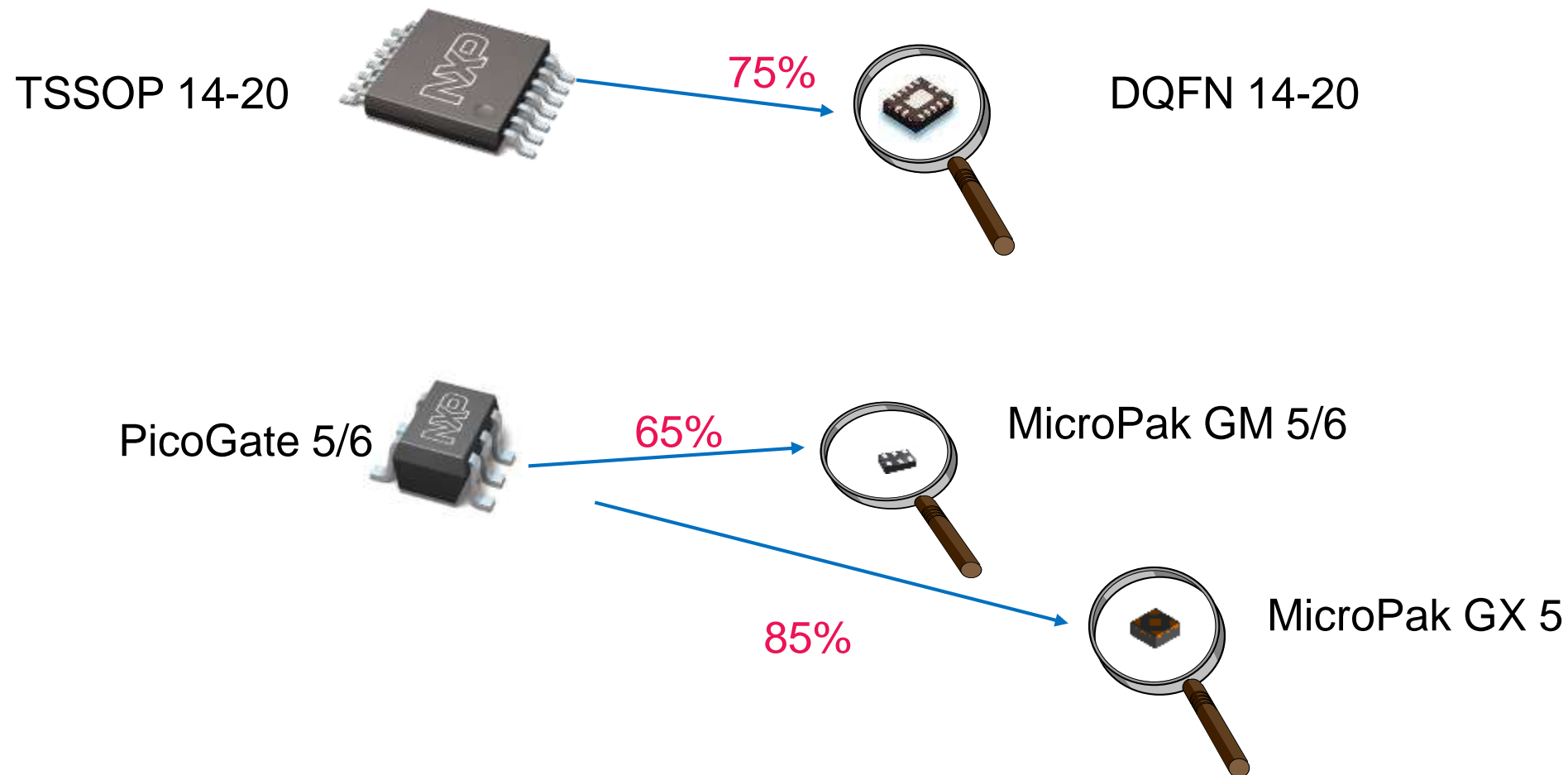
However, as the packages get smaller, the pitch also typically gets smaller/tighter



# Smaller Pitch for Even More PCB Space Savings

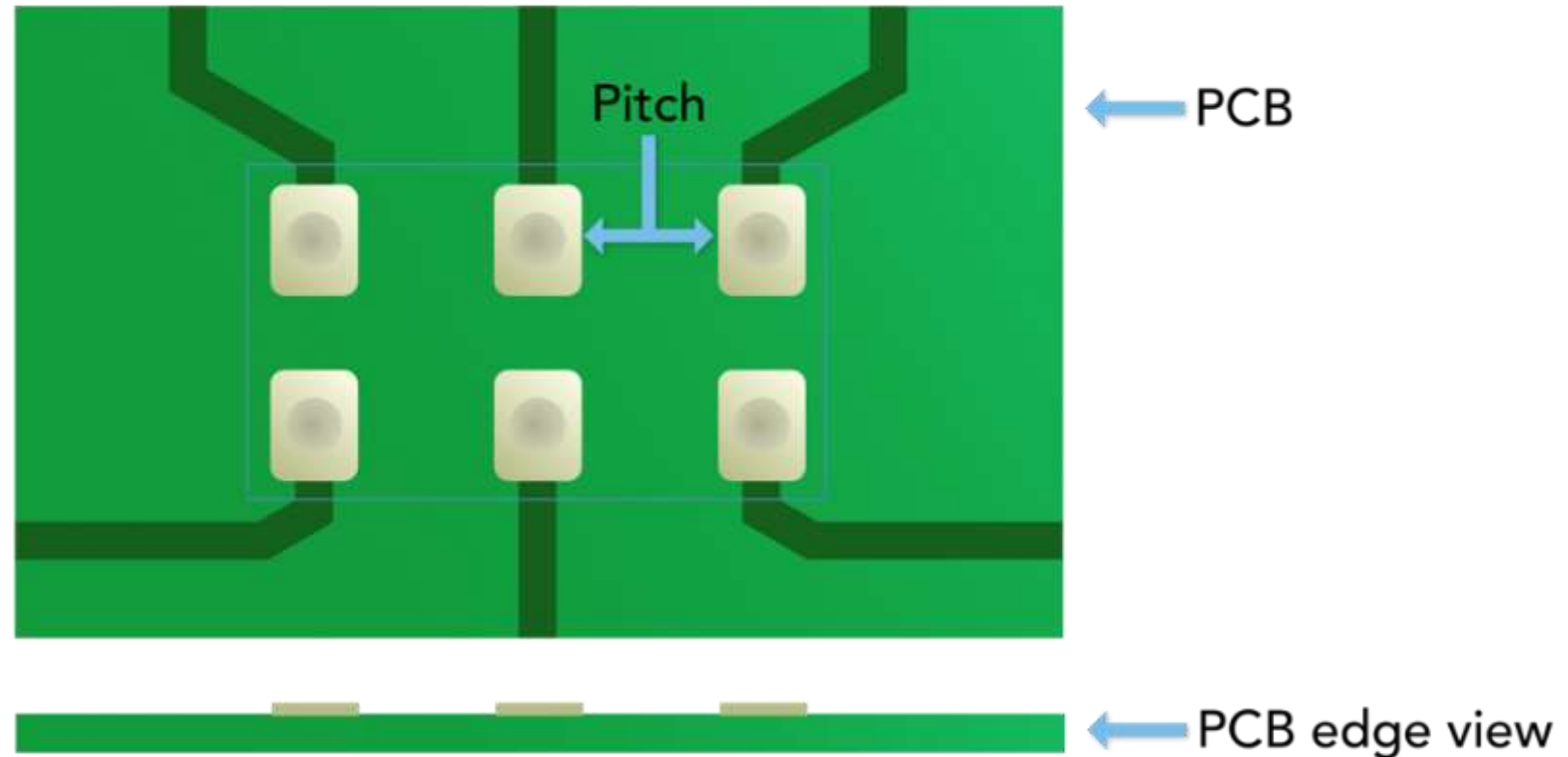


# PCB Space Savings



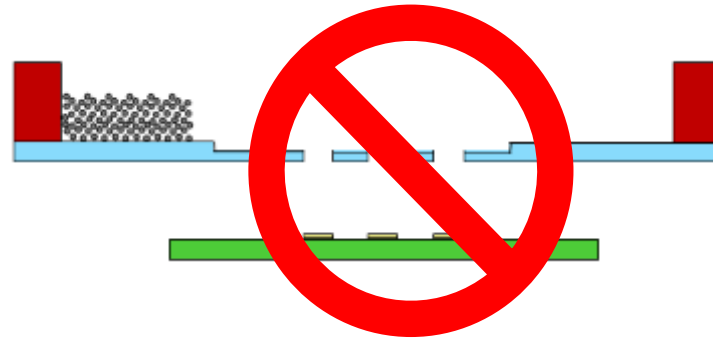
# The Trouble with smaller Pad Pitch...

...as the pad pitch reduces below 0.4 mm, special steps are taken to reduce the possible of bridge shorts



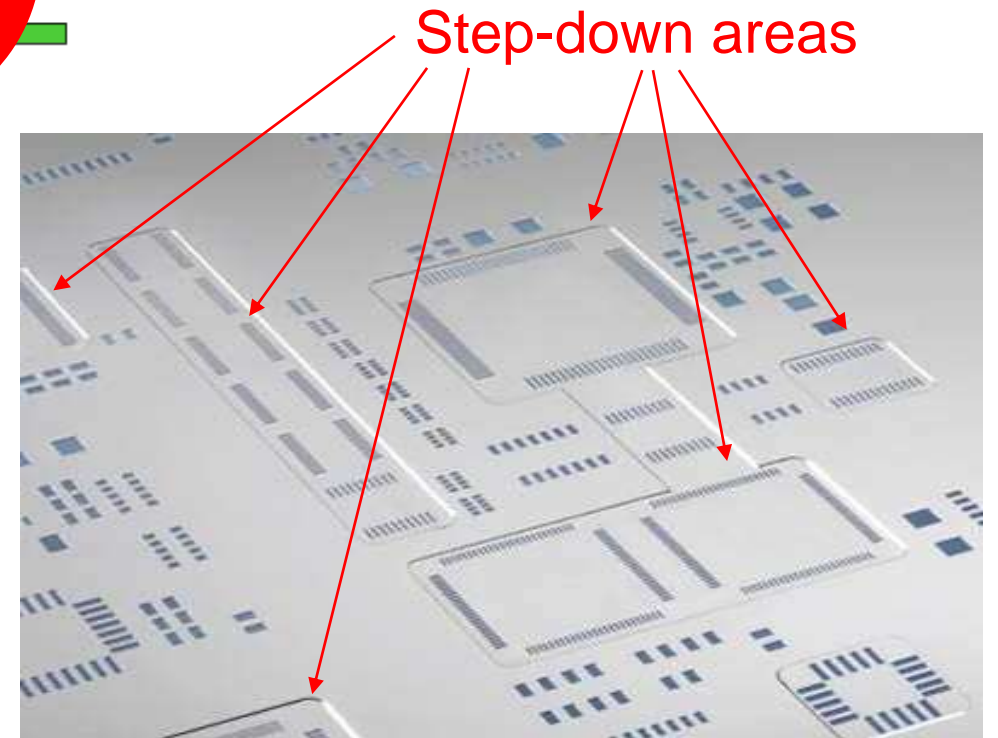


# Step-down Solder Mask Drawbacks



**GX package requires  
NO step-down mask**

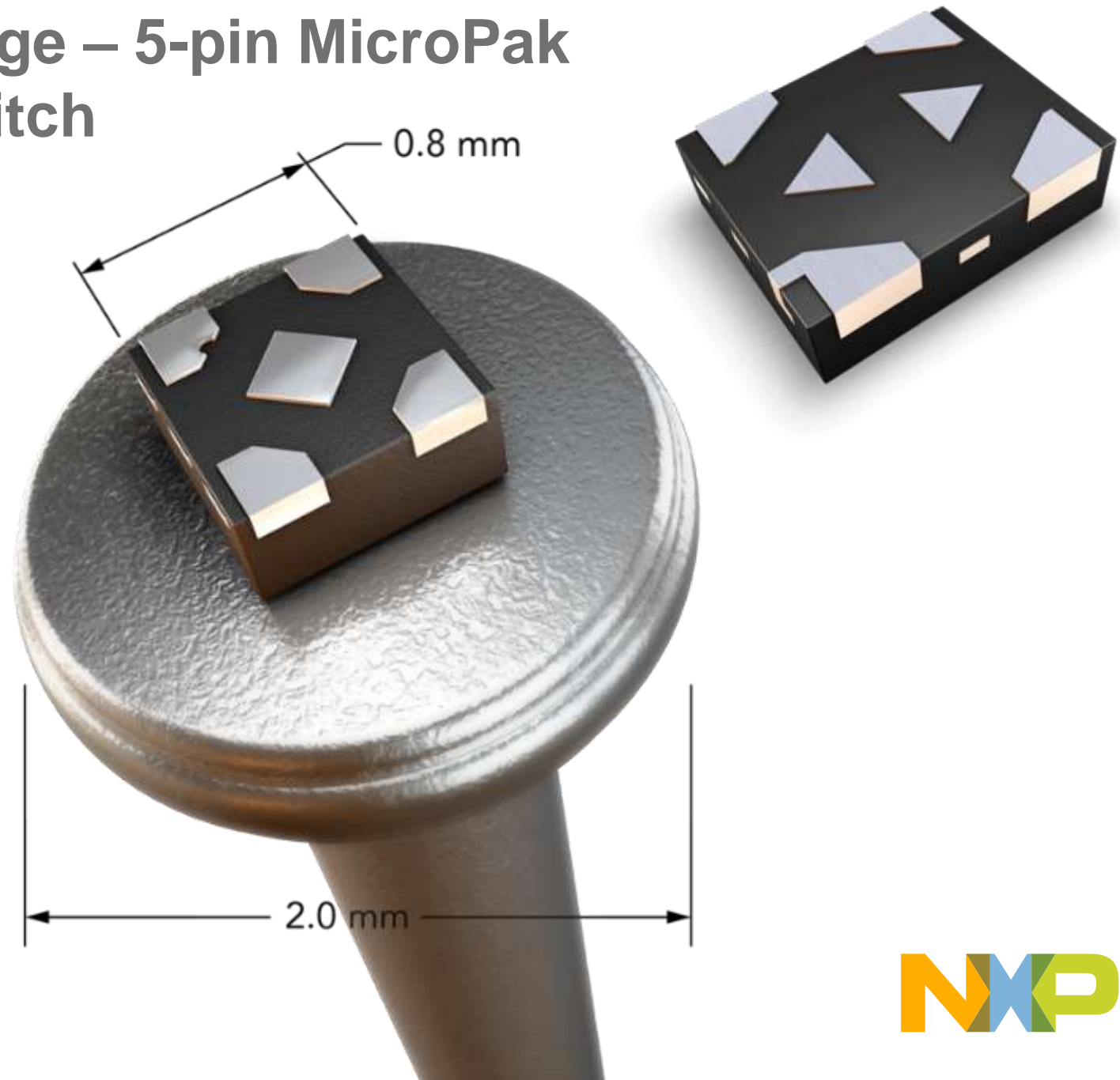
- Expensive to make
- Type 4 solder paste required
- Fragile, needs replacement more frequently in production than standard masks
- Restricts the placement of components



Step-down stencil

# The Solution: the GX Package – 5-pin MicroPak Small Package — Big Pin Pitch

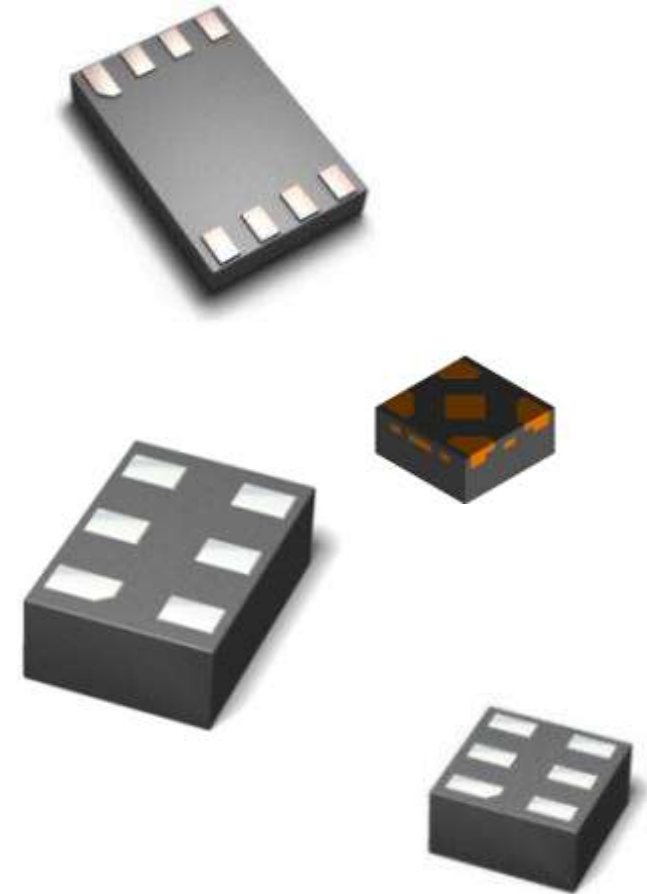
- 0.8w x 0.8l x 0.35h mm  
with pitch > 0.4 mm
- 36% smaller than  
smallest GF package
- No step down stencils
- More flexibility in device placement
- No Type 4 solder required



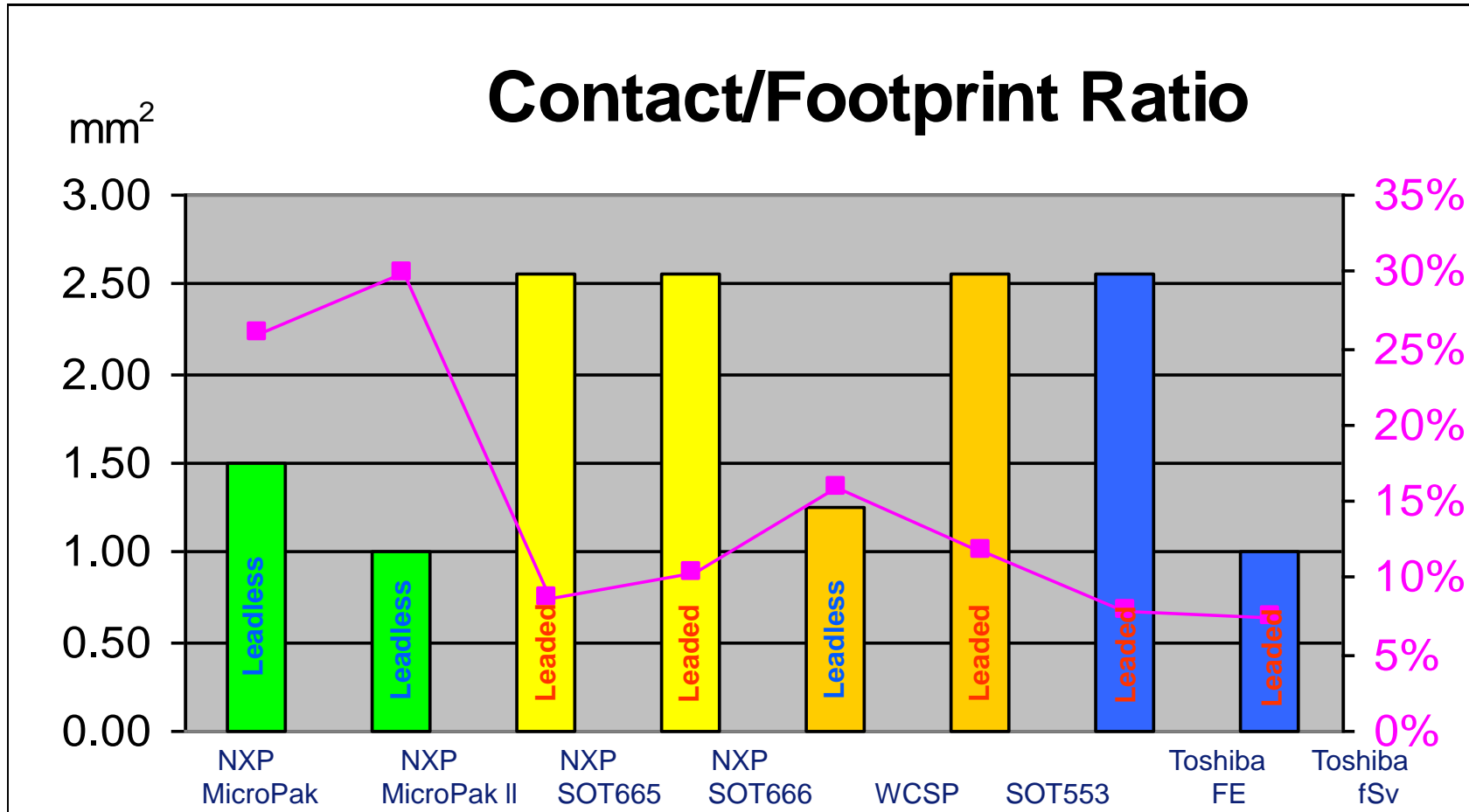
# MiniLogic Reliability Improvements



- Smaller mass
- Increased solder contact points
- Eliminated lead co-planarity issues (pin opens)
- Eliminated bent leads (pin shorts)
- Eliminated risk of whisker growth (NiPdAu)
- Unlimited out of bag floor life at 30°C/85% RH
- Better thermal dissipation (-40 +125 C)



# Contact/Footprint Ratio



# Summary of Logic Savings

- Technical
  - Reduced board size and total product size
  - Reduced power requirements and power supply needs, thermal dissipation
  - Improved performance due to internal package connections
- Cost Savings (Direct)
  - Lower device cost due to higher volume of single parts
  - Smaller packages = less materials = lower cost at volume
  - Reduced pick-n-place assembly time due to combined functions
- Cost Savings (Intangible)
  - Reduced manufacturing costs due to reduced reel count, lower cost stencils
  - Reduced procurement costs due to smaller BOMs, fewer qualifications
  - Improved reliability = less rework costs

# Q&A



SECURE CONNECTIONS  
FOR A SMARTER WORLD