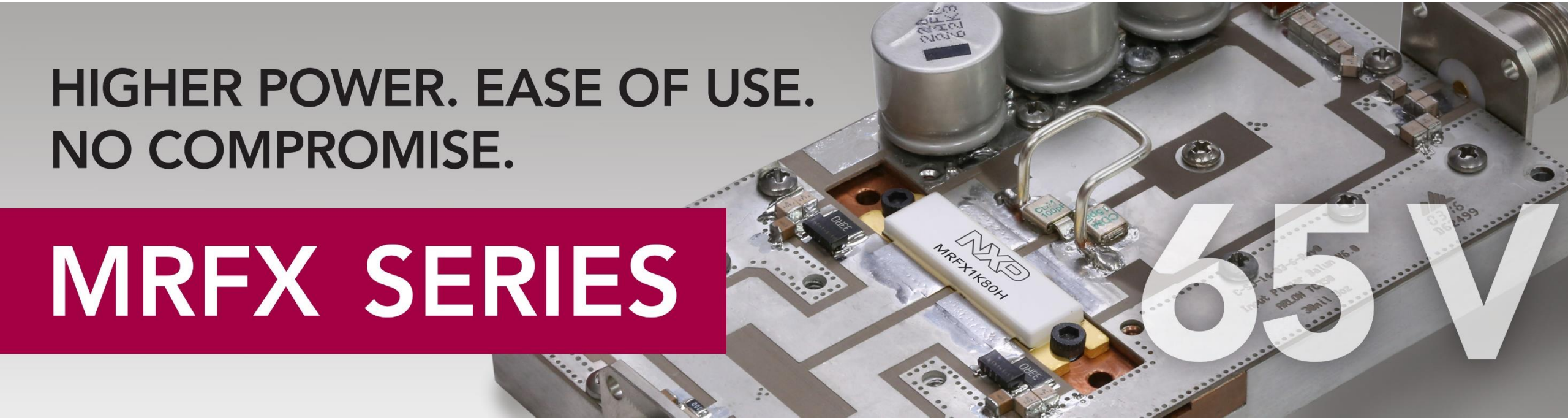
65 V LDMOS INTRODUCTION



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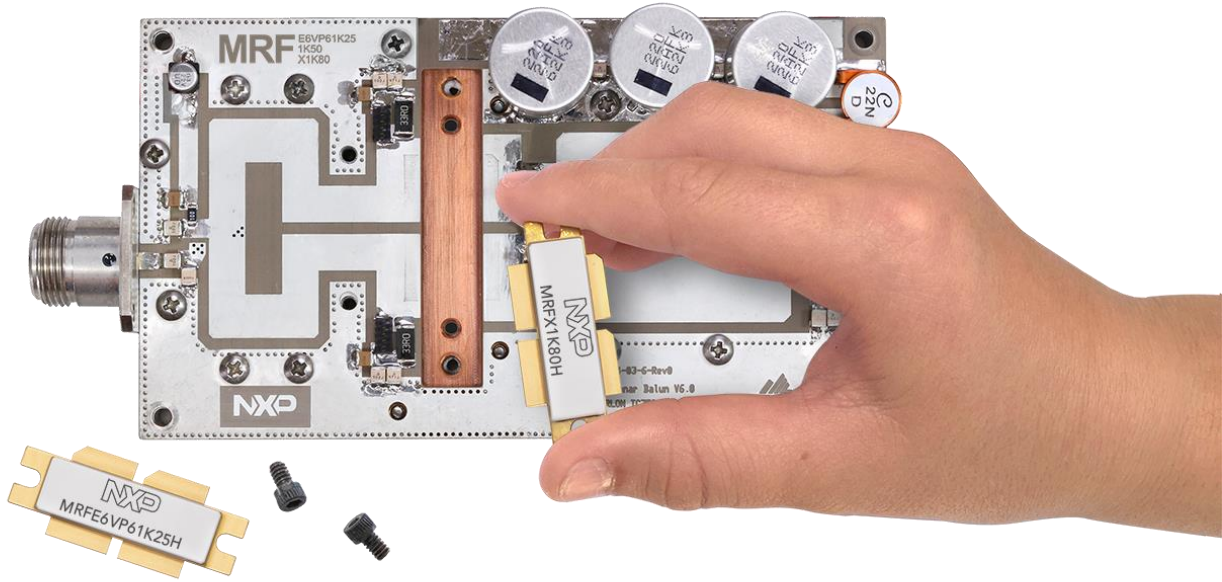
Introduction

- NXP is announcing a new LDMOS technology using 65 V drain voltage, focused on **ease of use**.
  - Higher voltage enables a higher RF output power with no compromise.

- The first transistor of the 65 V MRF**X** series is the MRF**X**1K80, the industry's most powerful CW RF transistor: 1800 W.

- The MRF**X**1K80 is pin-compatible with existing 50 V transistors, to reduce design cycle times.



A Brief History

- **2006-2009**: first to release a **1kW** LDMOS transistor, followed by four other lower power devices.
- **2010-2012**: launched industry-first portfolio of 5 **extremely rugged** 50 V LDMOS transistors in ceramic packaging, from 25 to 1250 W.
- **2014-2015**: complemented this portfolio with 5 transistors in **plastic package**, enabling lower thermal resistance.
- **2016**: launched the 1500 W **MRF1K50**, pushing 50 V LDMOS close to its limits of usability (higher power levels at 50V are challenging to match to 50 ohm).
- **2017**: introducing the MRF**X** series with the 1800 W **MRFX1K80**, based on new 65 V LDMOS technology developed in NXP's internal fab. Designed for ease of use.

Why 65V? Ease of use.

More power – Higher voltage enables higher power density, which helps reduce the number of transistors to combine.

Fewer combining losses, smaller PAs, simpler power supply management.

Faster development time – With higher voltage, the output power can be increased while retaining a reasonable output impedance.

Easier matching to 50 ohms; transistors can be used wideband.

Design reuse – This impedance benefit also ensures pin-compatibility with current 50 V LDMOS transistors for better scalability.

Little to no retuning from existing 50 V power amplifiers.

Manageable current level – Higher voltage reduces the current losses in the system.

Fewer stresses on DC supplies, better system efficiency, less magnetic radiation.

Wide safety margin – The higher breakdown voltage of 182 V improves ruggedness and allows for higher efficiency classes of operation.

Better reliability, higher efficiency.

NXP RF Technology Design Strategy: Focus on **Ease of Use**

To keep a reasonable output impedance above 1500 W, NXP is raising the voltage

Output impedance
Higher impedance makes it easier to match to 50 ohm.

$$R_L = \frac{V^2}{2P}$$

Drain voltage
NXP is raising the voltage V to increase the output power P, while keeping the output impedance R_L reasonable.
$R_L = (65^2 / 2x900W) \times 2$ sides = 4.7 ohm*
(transformation ratio to 50 ohms = ~10)

*: examples for a 1800W push-pull transistor.

Output power.
NXP's competitors increase output power P while retaining V = 50 V. Consequence: reduced output resistance, making the transistors difficult to match and very challenging to use wideband.
$R_L = (50^2 / 2x900W) \times 2$ sides = 2.8 ohm*
(transformation ratio to 50 ohms = ~18)

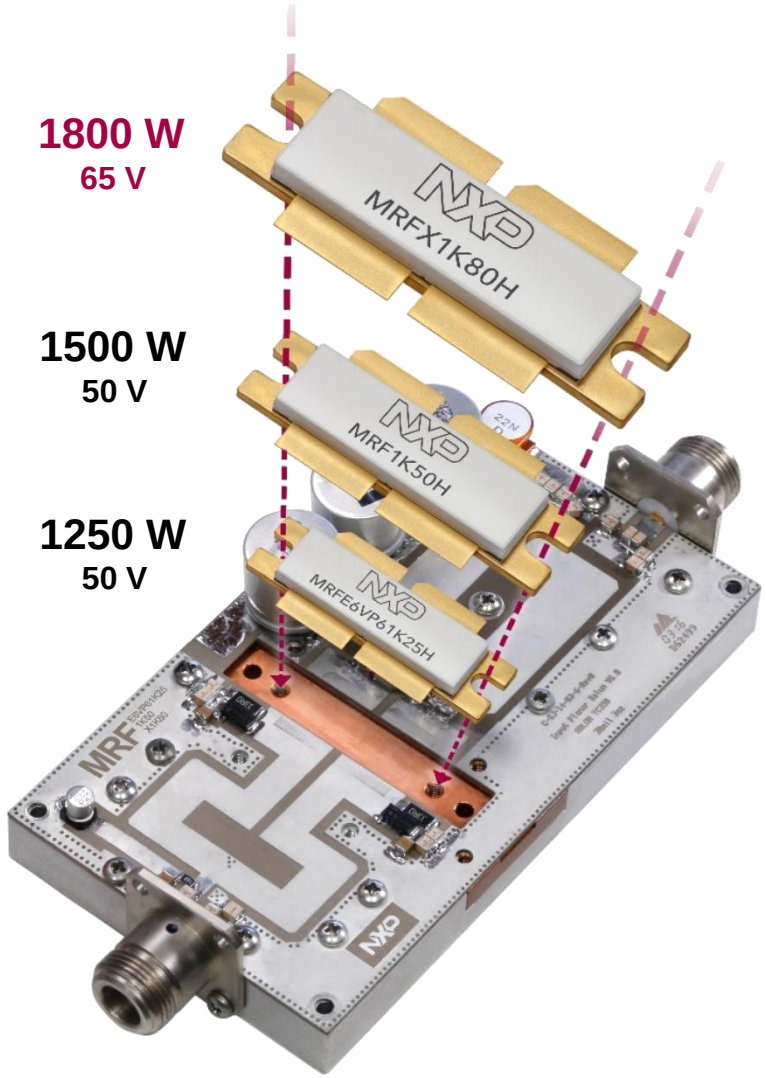
Ease of use = higher power WITH higher voltage.

NXP RF Transistor Design Strategy: Focus on **Scalability**

Transistors from the MRFX series fit into existing PCBs designed for previous 50 V transistors

- Same PCB for
  MRFE6VP61K25H
  MRE6VP61K25N
  MRF1K50H
  MRF1K50N
  MRFX1K80H
  MRFX1K80N

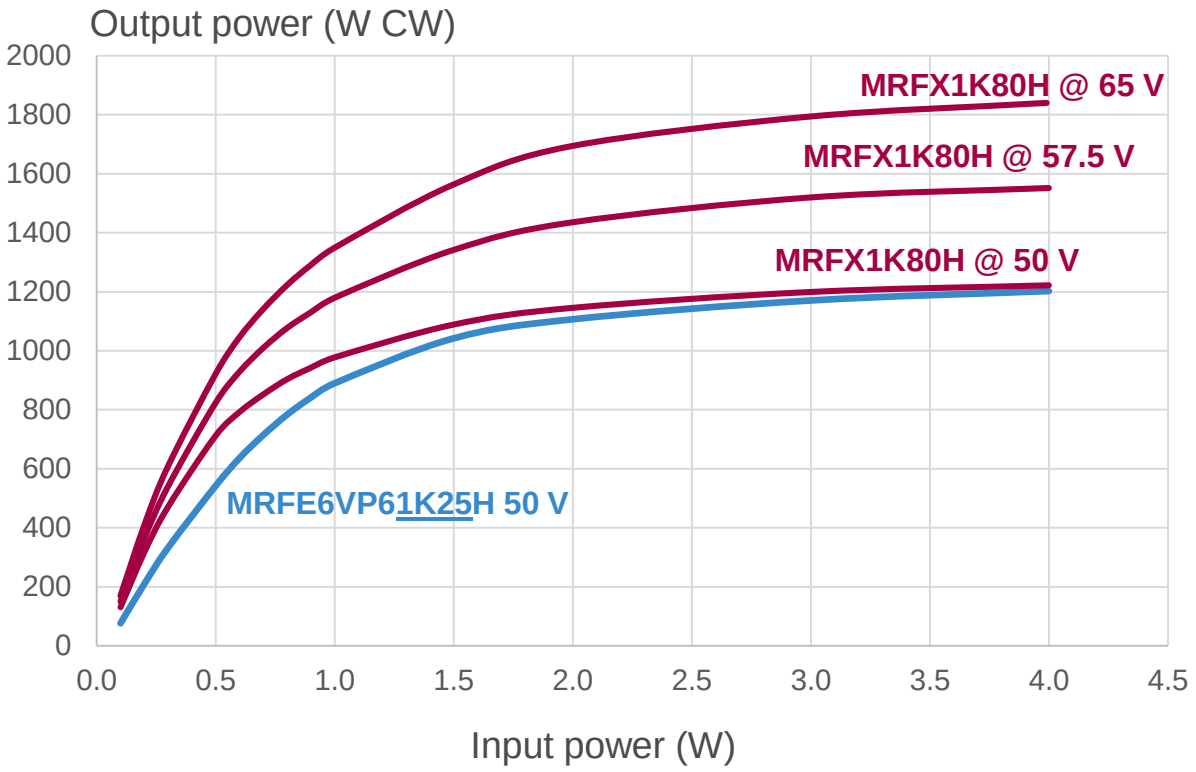
- Little to no retuning needed

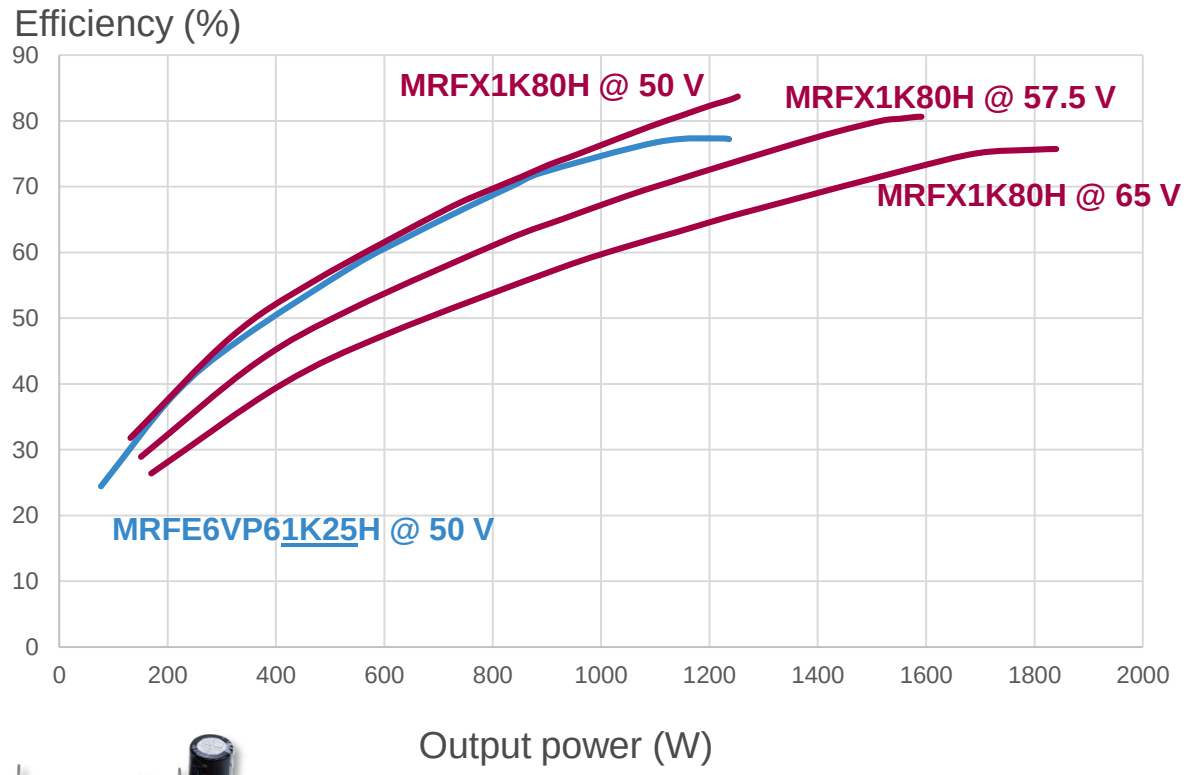


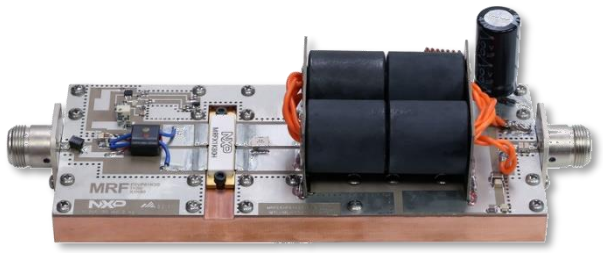
- Faster Time-To-Market
- One platform, multiple products

Easy Upgrade from Existing 50 V Solutions

Data taken on the same 27 MHz reference circuit: no retuning







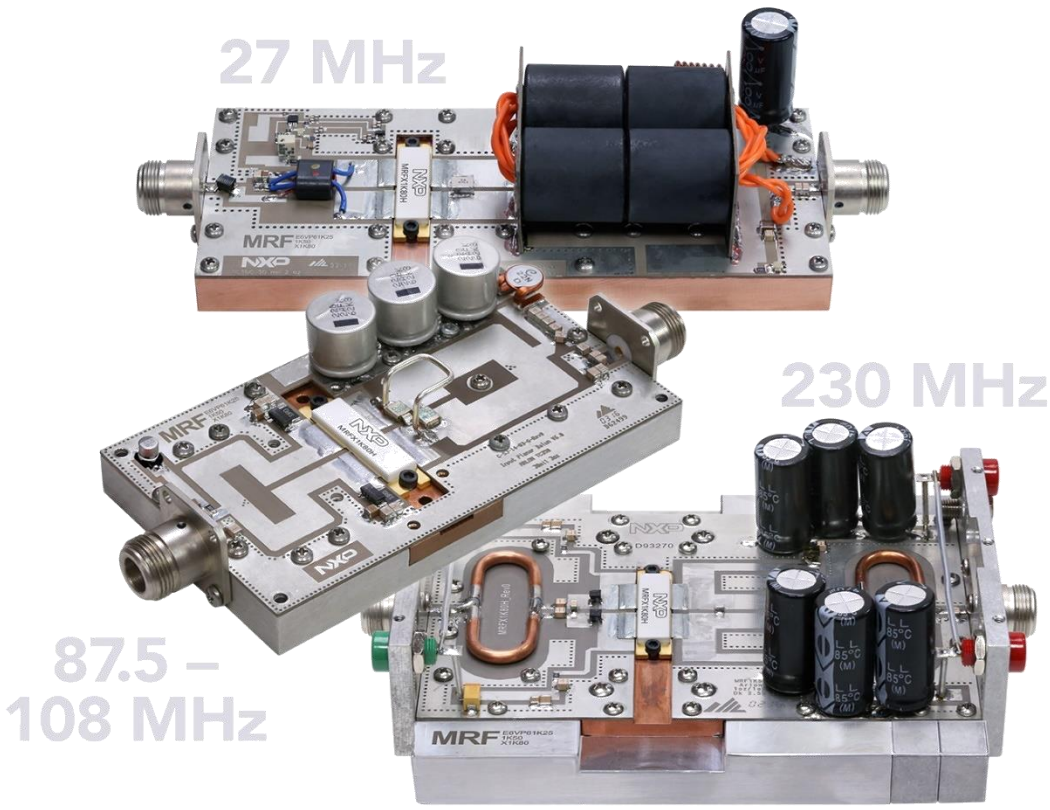
MRFX1K80 Specifications

- 1800 W CW
- 1.8-470 MHz (unmatched input and output)
- 65 V LDMOS for 30-65 V operations
- 182 V min breakdown voltage $V_{(BR)DSS}$
- Extreme ruggedness: handles 65:1 VSWR
- Warranted availability until 2032 minimum

- **MRFX1K80H**: housed in NI-1230 air cavity ceramic package
  - Thermal resistance 0.09°C/W
  - ***Sampling now, production August 2017***

- **MRFX1K80N**: housed in OM-1230 over-molded plastic package
  - Thermal resistance typically 30% lower than ceramic
  - ***Sampling August, production November 2017***

MRFX1K80H Reference Circuits



Frequency	Signal type	Voltage	Output Power	Gain	Drain efficiency	*Availability*
27 MHz	CW	50 V	1200 W	26.0 dB	82.3%	*Now*
		57.5 V	1520 W	27.0 dB	80.1%	
		65 V	1800 W	27.8 dB	75.6%	
87.5-108 MHz	CW	60 V	1550 W	21.9 dB	82.2%	*Now*
144 MHz	CW	65 V	1800 W	23.5 dB	77.5%	*July*
230 MHz	Pulse	65 V	1800 W	24.0 dB	74.0%	*July*

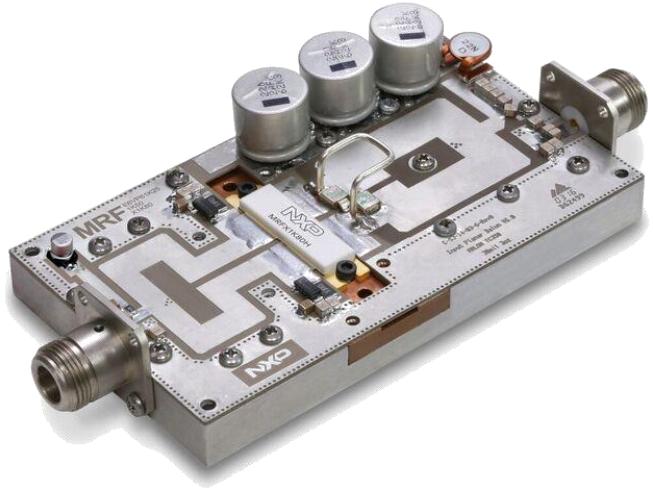
MRFX1K80 Target Markets

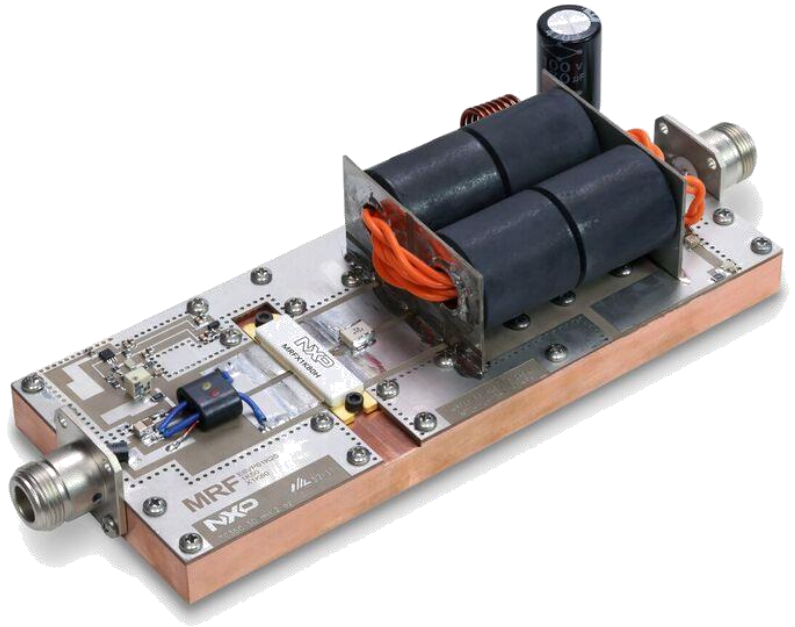
- **Industrial, Scientific, Medical (ISM)**
  - Laser generation
  - Plasma etching
  - Magnetic Resonance Imaging (MRI)
  - Diathermy, skin laser, RF ablation
  - Industrial heating, welding and drying systems
  - Particle accelerators
- **Broadcast**
  - Radio broadcast (FM/DAB)
  - VHF TV broadcast
- **Aerospace**
  - VHF omnidirectional range (VOR)
  - HF and VHF communications
  - Weather radar
- **Mobile Radio**
  - VHF base stations

For more information

- 65 V LDMOS web page: www.nxp.com/65V

- MRFX1K80H web page with datasheet: www.nxp.com/MRFX1K80H



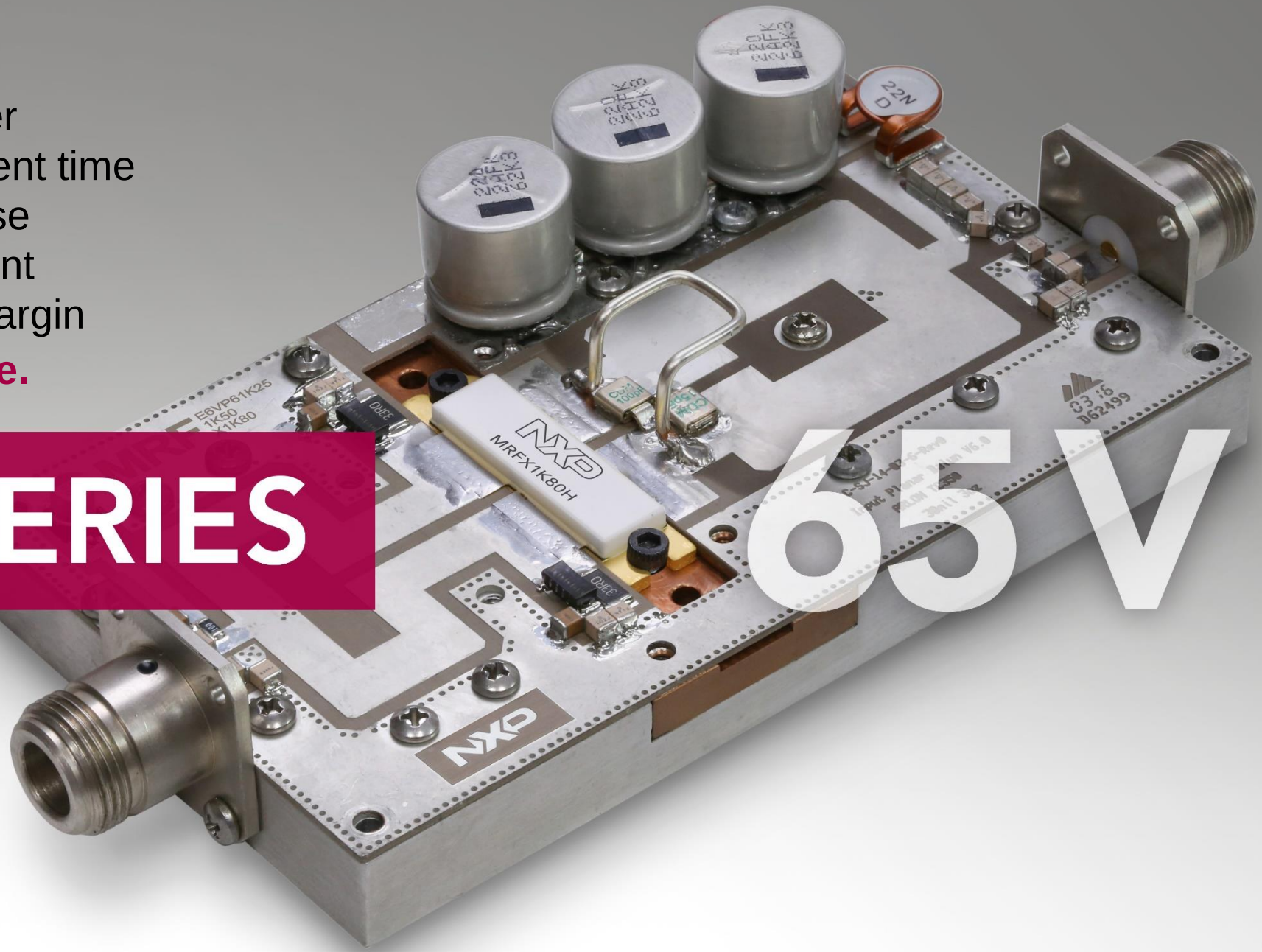


More power
Faster development time
Design reuse
Lower current
Wide safety margin

Easy to use.

MRFX SERIES

65 V



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