RF power solutions for medical applications
Disclaimer for critical applications

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RF power in medical application

• RF Power has been used in medical applications for many years*

• The main application of RF Power is Magnetic Resonance Imaging, but it can be used also for Cosmetic Therapy, Ablation, and Diathermy

• ST offers a broad portfolio of RF DMOS (double-diffused metal oxide semiconductor) and LDMOS (lateral double-diffused metal oxide semiconductor) transistors operating from a supply voltage ranging from 50 up to 100 V with high reliability (1 million power cycles).

*Back in the nineteen century, Nikola Tesla was the first to study the effect of high frequency current in human body. The first physiological reaction studied was the warmness of the impacted tissues and its links with the RF frequency
What is RF power?

A RF power amplifier converts a low-power radio-frequency signal into a higher power signal.

**Design goals:**
Gain, power output, bandwidth, power efficiency, linearity, input and output impedance matching, and heat dissipation.

LDMOS (laterally-diffused metal-oxide semiconductor) is a planar double-diffused MOSFET used in RF power amplifiers.

Low-power RF signal

High-power RF signal
ST RF power technology family

Available technologies

- **LDMOS**
  - 7 V to 50 V
  - 1 W to 2 kW
  - Up to 4.2 GHz

- **DMOS**
  - 50 V to 100 V
  - Up to 250 MHz

In development 2021

- LDMOS
  - Enlarging LDMOS portfolio

Applications

- **Plasma generator**
- **Laser driver**
- **Magnetic Resonance Imaging**
- **Particle accelerators**

Wideband communication
Wireless infrastructure
Automotive applications
Portable & Mobile radios
Avionics & Radar

- **Plasma generator**
- **Laser driver**
- **Magnetic Resonance Imaging**
- **Induction & dielectric heating**

Benefits

- High efficiency
- Higher reliability
- Cost effective solution

Features

- Lower current consumption
- Low thermal resistance
- Optimized packaging

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- Low thermal resistance
- Optimized packaging
MRI scanners rely on detecting a RF signal emitted by excited hydrogen atoms in the body (water molecules), using energy from an RF magnetic field applied at the appropriate resonance frequency.

The LDMOS in the RF amplifier provides the high-power RF signal to the system.

<table>
<thead>
<tr>
<th>Magnetic field</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 Tesla</td>
<td>Typ. 61-64 MHz</td>
</tr>
<tr>
<td>3 Tesla</td>
<td>Typ. 123-128 MHz</td>
</tr>
<tr>
<td>7 Tesla</td>
<td>Up to 433 MHz</td>
</tr>
</tbody>
</table>
# LDMOS product package portfolio

## RFXL family

<table>
<thead>
<tr>
<th>2 leads flangeless</th>
<th>4 leads bolt down</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>B2</td>
</tr>
<tr>
<td>B2</td>
<td>C2</td>
</tr>
<tr>
<td>C2</td>
<td>E2</td>
</tr>
<tr>
<td>GXB</td>
<td>D4E*</td>
</tr>
</tbody>
</table>

### Applications

**2 leads flangeless**
- A2: Wideband radio
- B2: Military communications
- C2: Industrial
- E2: Scientific and medical
- GXB: RF energy
- B: Broadcast
- Avionics and radar
- Telecom and sat com

**4 leads bolt down**
- LBB: Industrial
- B4E: Scientific and medical
- D4E*: Broadcast
- Wideband radio
- Military comm
- Avionics and radar

* Engineering sample available
Products portfolio for medical

HF to 433 MHz
- 1.5 T - 3 T and 7 T MRI
- RF Ablation
- RF Diathermy
- Medical laser

915 MHz
- Microwave ablation
- Microwave Diathermy

2.45 GHz
- Microwave ablation
- Microwave Diathermy
## RF new products nomenclature

**VOLTAGE (V x 10)**
- 1 = 12V
- 2 = 28V
- 3 = 32/36V
- 4 = 40V
- 5 = 50V

**FREQUENCY (MHz x 100)**
- 05 = 500 MHz
- 16 = 1600 MHz
- 25 = 2500 MHz
- 1214 = 1200 – 1400 MHz

**OUTPUT POWER**
- 045 = 45W
- 120 = 120W
- 1K4 = 1.4KW
- 1K5 = 1.5KW
- 2K0 = 2.0KW

**PACKAGE TYPE**
- P = Plastic Device
- C = Ceramic device
- A = Air Cavity
- I = Integrated Circuit
- M = Multi Chip Module

**PACKAGE CONFIGURATION**
- B2 = Boltdown 2 Leads
- B4 = Boltdown 4 Leads
- FS = Flangeless with back solder
- F2 = Flangeless 2 Leads
- F4 = Flangeless 4 Leads
- G2 = Gull Wing 2 Leads
- G4 = Gull Wing 4 Leads
- S = Straight leads
- MR = Moisture resistant
- Q = QFN

<table>
<thead>
<tr>
<th>RF</th>
<th>5L</th>
<th>05</th>
<th>1K4</th>
<th>P</th>
<th>F</th>
<th>xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLTAGE (V x 10) (1 digit)</td>
<td></td>
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<tr>
<td>FREQUENCY (MHz x 100) (2 or 4 digits)</td>
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<tr>
<td>OUTPUT POWER (3 digits)</td>
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<td>PACKAGE TYPE (1 digit)</td>
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<tr>
<td>PACKAGE CONFIGURATION (1 or 2 digits)</td>
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Thank you