



## Applications of RF Power Amplifiers in Medical Devices

---

RF Power Amplifiers (RF PA) have a wide range of key applications in modern medical devices, including fields such as high-frequency hyperthermia, Magnetic Resonance Imaging (MRI), Radiofrequency Ablation (RF Ablation), and Ultrasound Imaging. Each application has specific system block diagrams and performance requirements.

### 1. Application in High-Frequency Hyperthermia Equipment

System Block Diagram:

Signal Source Module: Generates RF signals of specific frequencies.

Power Amplifier Module: Amplifies the RF signal to the required power level for heating tumor tissues.

Antenna or Heating Probe: Delivers the RF signal to the target tissue area.

Temperature Monitoring Module: Monitors tissue temperature in real time.

Frequency and Output Power:

Frequency: Typically in the 13.56 MHz, 27.12 MHz, or 40.68 MHz Industrial, Scientific, and Medical (ISM) bands.

Output Power: Ranges from 50 W to 1000 W, depending on treatment depth and tissue type.

Key Measurement Parameters:

Stability of output power.

Signal linearity to prevent overheating of tissues.

Thermal management to ensure long-term operation.

### 2. Application in Magnetic Resonance Imaging (MRI)

System Block Diagram:

RF Signal Generator: Generates wideband RF pulse signals.

Power Amplifier Module: Amplifies the signal and sends it to the transmit coil.

Transmit Coil: Converts RF signals into magnetic fields to excite hydrogen nuclei in the body.

Receive Coil and Module: Receives the nuclear magnetic resonance signals.

Frequency and Output Power:

Frequency: 64 MHz (1.5 T magnetic field strength), 128 MHz (3 T magnetic field strength), or higher.



南京轩微特微波技术有限公司  
Nanjing Shinewave Technology Co., Ltd.

Output Power: From 500 W to 10 kW, depending on equipment performance and application requirements.

Key Measurement Parameters:

Linearity: Ensures quality MRI images.

Power Gain: Provides sufficient signal to excite the magnetic field.

Thermal management: Prevents overheating of equipment due to high power.

### 3. Application in Radiofrequency Ablation Devices

System Block Diagram:

RF Signal Generator: Provides high-frequency RF signals.

Power Amplifier Module: Amplifies the RF signal and sends it to the ablation needle.

Ablation Needle: Delivers RF energy directly to the diseased tissue.

Monitoring Module: Monitors tissue resistance and temperature changes.

Frequency and Output Power:

Frequency: 400 kHz to 500 kHz.

Output Power: From 10 W to 200 W for localized tissue ablation.

Key Measurement Parameters:

Precise control of output power to prevent excessive tissue damage.

Reliable thermal management for continuous operation.

Electromagnetic compatibility (EMC) of the system.

### 4. Application in Ultrasound Imaging Devices

System Block Diagram:

Signal Source Module: Generates high-frequency sound wave signals.

Power Amplifier Module: Amplifies the signal and drives the ultrasound transducer.

Ultrasound Transducer: Converts electrical signals into sound waves and receives echo signals.

Image Processing Module: Converts received signals into medical images.

Frequency and Output Power:

Frequency: From 1 MHz to 15 MHz.

Output Power: From a few watts to tens of watts.

Key Measurement Parameters:

Efficiency and precision of power amplification.

High linearity to avoid sound wave distortion.

Frequency response of the system.



## How to Choose a Power Amplifier for Medical Devices

### 1. Frequency Band Matching

Select power amplifiers that cover the target frequency bands, such as the ISM bands, specific MRI frequencies, or ultrasound frequencies.

### 2. Output Power Requirements

Choose an appropriate power range for specific applications. For example, high-frequency hyperthermia requires output from hundreds of watts to kilowatts, while RF ablation requires more precise lower power.

### 3. Linearity and Stability

Ensure that the amplifier provides good linearity across wideband operation, avoiding signal distortion.

### 4. Thermal Management

Medical devices need to operate for extended periods, so power amplifiers should have efficient thermal management, such as air or liquid cooling solutions.

### 5. Size and Integration

In medical devices with limited space, compact and modular power amplifier designs are preferred.

## Conclusion

RF power amplifiers play a crucial role in medical devices, covering applications such as high-frequency hyperthermia, MRI, radiofrequency ablation, and ultrasound imaging. Depending on the application scenario, the power amplifier must meet specific frequency, output power, and performance requirements. When designing and selecting power amplifiers, considerations such as frequency range, power level, linearity, and thermal performance must be taken into account to ensure the safety and reliability of the equipment.