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# RF Power Amplifier

PA15W

Owner's Manual

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SpinCore Technologies, Inc.  
<http://www.spincore.com>

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SpinCore Technologies, Inc.**

**We appreciate your business!**

**At SpinCore we try to fully support the needs of our customers. If you  
are in need of assistance, please contact us and we will strive to provide  
the necessary support.**

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## **I. Precautions**

Working with RF power amplifiers can be dangerous and even fatal if not handled properly. Output voltages can reach values greater than 90 V peak-to-peak and can be fatal. Follow these steps to avoid damaging the amplifier or inflicting serious injuries.

### ***Connecting & Disconnecting Power Amplifiers***

When connecting the power amplifier, follow these steps in order to avoid damaging the amplifier or inflicting serious injuries.

- 1) Apply the load to the amplifier (make sure a load is ALWAYS present when working with power amplifiers).
- 2) Apply the DC power to the amplifier.
- 3) Apply the RF input to the amplifier.

Repeat the steps in reverse order when disconnecting the amplifier.

### ***Power Considerations***

Make sure the following considerations have been made before applying power to the amplifier.

- 1) Be sure your load can appropriately dissipate the maximum power being applied by the amplifier.
- 2) When applying an RF signal, work with low duty cycles to limit the power being dissipated. The duty cycle ratio should be below 1% for safe operation. If you would like to operate at high duty cycles or in continuous operation, please inquire with SpinCore Technologies.
- 3) Do not input a sinusoidal RF signal to the amplifier with an amplitude greater than 1 Volt peak-to-peak, as values beyond this can damage the amplifier.

## **II. PA15W – 15 W Power Amplifier Module**

### **1. Overview**

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The PA15W RF power amplifier comes in a very compact broadband module capable of delivering up to 15 Watts RMS into a 50-ohm load. It has a 3 dB bandwidth from 4 MHz to 100 MHz. The rise and fall time of the power amplifier for the RF pulse output is typically around 200 ns. The PA15W has standard female SMA jack connectors for RF input and output, and screw terminal connectors for DC input power.

The product comes with blanking circuitry – the blanking circuitry keeps the PA15W blanked (turned off) until a TTL input (logical high) is applied. The blanking circuitry helps to conserve power, keeps the amplifier cool under typical operating conditions, and provides noise reduction during the reception of NMR signals. To deblank the power amplifier, a TTL pulse needs to be applied to the control circuitry at least 15  $\mu$ s prior to the RF pulse being applied at the input.

The PA15W module measures 2.5" x 2.25" x 2.5" (64 x 57 x 64 mm). There are multiple packaging options available, such as enclosures with integrated AC power supplies and complete mobile NMR, NQR and MRI systems that include preamplifiers, filters and SpinCore's RadioProcessorUSB board along with the PA15W. See the "Packaging Options" section later in this document for more information. The use of a low pass (or band pass) filter at the output of the PA15W is recommended to reduce high frequency noise and improve performance.

## 2. Electrical Specifications

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**Table 1:** Basic electrical specifications for the PA15W power amplifier module.

Parameter	Specification	Units
DC Power Input	12	V (DC)
Max. RF input power	10	mW
Max. continuous RF output power	15	W (RMS)
Minimum deblanking time	15	µs
TTL Input	3.3	V

## 3. Typical Performance Data

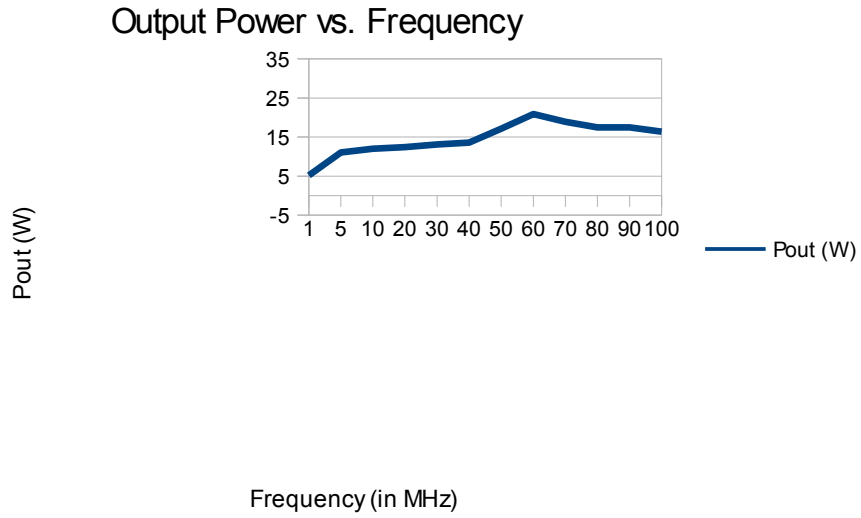
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When powered by 12 V DC, driven by 1.8 V peak-to-peak (7.81 mW) RF input and with the output terminated with 50 Ohms, the PA15W provides the performance values contained in Table 2.

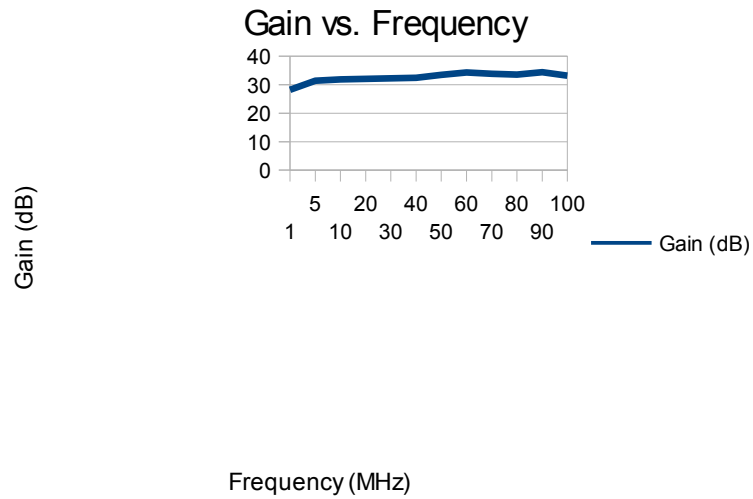
**Table 2:** Typical PA15W performance from 1 MHz to 100 MHz

Frequency (MHz)	Output Voltage (V pk-pk)	Output power (W RMS)	Output power (dBm)	Gain (dB)
1	45.52	5.18	37.6	28.22
5	66.45	11.04	40.44	31.42
10	69.22	11.98	40.8	31.86
20	70.37	12.38	40.94	32
30	72.39	13.1	41.18	32.25
40	73.65	13.56	41.33	32.4
50	82.78	17.13	42.35	33.41
60	91.37	20.87	43.21	34.27
70	86.93	18.89	42.77	33.84
80	83.55	17.45	42.43	33.49
90	83.5	17.43	42.28	33.34
100	80.8	16.32	42.14	33.2

# RF Power Amplifier PA15W



**Figure 1:** Output Power vs. Frequency of the PA15W RF Power Amplifier.



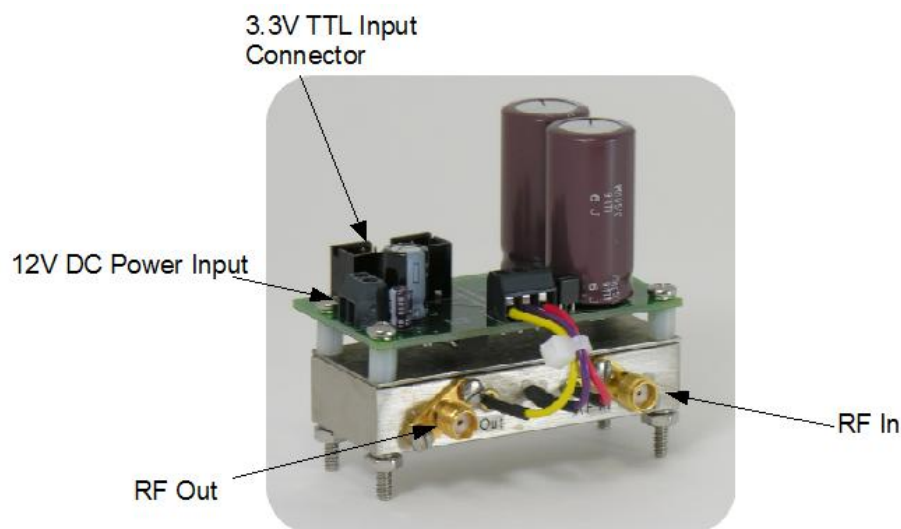
**Figure 2:** Gain vs. Frequency of the PA15W RF Power Amplifier.

# *RF Power Amplifier PA15W*

## 4. PA15W RF Module with Deblanking Circuitry

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This is the simplest option, shown in Figure 3, which along with the power amplifier module includes only the switching circuitry mounted on top of the power amplifier to enable it when a TTL pulse is applied to the input pin. PA15W RF module connector information is described on the next page.



**Figure 3:** PA15W Connections (Front View).

### 12 V DC Power Input

- Left screw on terminal block is DC Power, which can be identified by the small 1 marked along side it on the board. *Must be stabilized +12 V (DC)! If voltage applied is higher or lower than +12 V (DC), the power amplifier will fail.* Right screw on terminal block is DC Ground, which can be identified by the small C13 marked along side it on the board.

### RF Ports

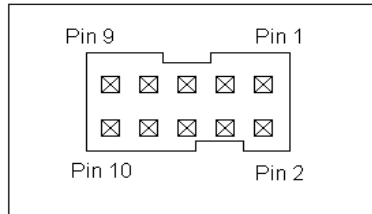
- RF In – SMA jack connector (do not exceed 10 mW RF input power)
- RF Out – SMA jack connector. A 50  $\Omega$  load must be connected to RF Out.



# RF Power Amplifier PA15W

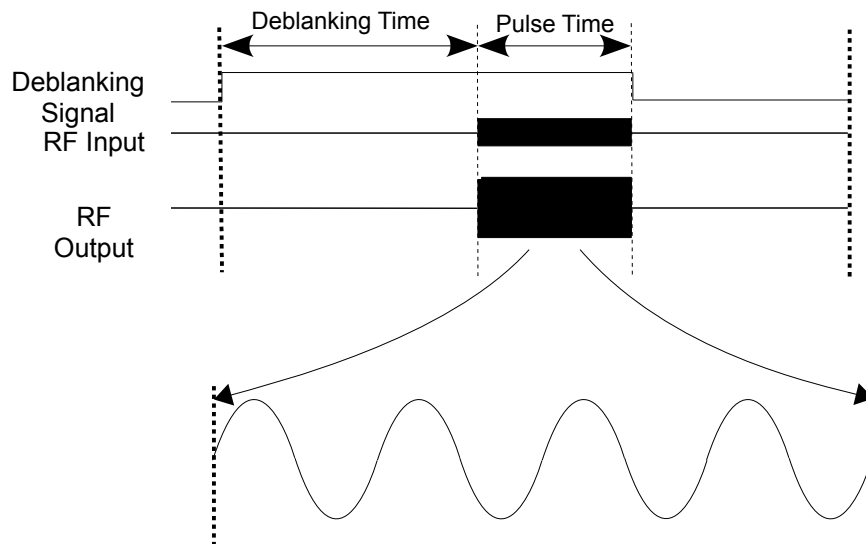
## 3.3 V TTL Input Connector

- 10-pin IDC connector. *Must be 3.3 V NOT 5 V!* The input impedance is 100  $\Omega$ . The deblanking signal should be connected to pin 8 of the IDC connector (with pin 7 serving as the corresponding ground). See Figure 4 below for pinout information.



**Figure 4:** 10-pin IDC connector (Front View: Digi-Key part A33159-ND). Mates with Digi-Key part HKC10H-ND or similar.

The timing diagram of a typical application of PA15W with the deblanking pulse applied prior to the RF pulse is presented in Figure 5, below. When working with short RF pulses, on the order of 1  $\mu\text{s}$  or so, triggering the oscilloscope on the falling edge of the deblanking pulse will help with identifying and capturing the RF pulse on the scope.



**Figure 5.** Representation of the deblanking and RF input and output signals to the PA15W. The PA15W requires at least 15  $\mu\text{s}$  deblanking time prior to the RF pulse for full output power. Note: when operating the power amplifier the duty-cycle for the deblanking signal should be kept low to avoid damage to the amplifier.

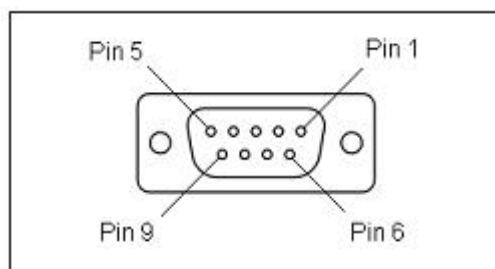
## **5. PA15W RF Module Enclosure Options**

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Multiple packaging options are available when ordering the PA15W RF power amplifier module. There are two standard enclosure configurations available: single-bay and dual-bay enclosures.

### **1. PA15W RF module enclosed in a single-bay enclosure**

The PA15W RF power amplifier can also be delivered in various external enclosures which protect the RF power amplifier circuitry and include an AC/DC power supply, internal RF cables and output low-pass (or band-pass) filter (please specify your operating frequency at the time of purchase). For typical enclosures the power input is 90-264 V AC, the RF input and output signals are provided on external BNC connectors, and the TTL inputs are routed through female DB-9 input connector (shown in Figure 6 on the next page). There are two options for the TTL signal and ground connector pins on the DB-9 connector. On the first, the active TTL signal needs to be connected to pin 4, with the corresponding ground line connected to pin 8. On the second, the active TTL signal needs to be connected to pin 9, with the corresponding ground line connected to pin 5. You will be notified by SpinCore at the time of shipment which option you have. If you do not know which option you have you can contact SpinCore to find out.



**Figure 5:** DB-9 Female Input Connector.

## *RF Power Amplifier PA15W*

Single-bay enclosure additional specifications include:

- Excellent EMI/RFI shielding meets FCC & CE regulations.
- Built-in 4x4 cm quiet cooling fan.
- High quality 50 Watt AC input switching power supply.
- Dimensions are approximately 10.25" x 7.75" x 2.25" (26 x 19.5 x 6 cm).

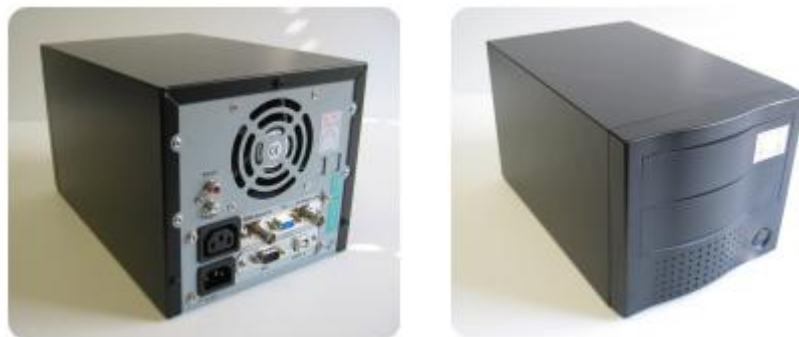


**Figure 6:** A sample photo of a PA15W RF power amplifier in a single-bay enclosure.

### **2. PA15W RF module enclosed in a dual-bay enclosure**

Dual-bay enclosure additional specifications include:

- Metal body with streamlined plastic front panel.
- Built-in 8x8 cm quiet cooling fan.
- High quality 80 Watt AC input switching power supply.
- Dimensions are approximately 11" x 7" x 6.75" (28 x 18 x 17 cm).
- Optional heatsink and fan assembly to allow continuous operation of the amplifier.
- Available as part of a complete iSpin-NMR™ system or as a stand-alone PA15W.



**Figure 7:** PA15W RF power amplifier – enclosed in a dual-bay enclosure.

### III. Related Products and Accessories

1. Alternative RF Power Amplifier modules are available: PA10W, PA15W-500, PA75W and PA100W. For more information, please visit the URL <http://www.spincore.com/products/RFPA/>
2. **iSpin-NMR™** is SpinCore Technologies' complete, portable NMR system. For more information, please visit <http://spincore.com/products/iSpinNMR/>
3. **RadioProcessor** is SpinCore Technologies' general purpose, broadband, radio frequency (RF) digital data acquisition and excitation system. For more information, please visit <http://www.spincore.com/products/RadioProcessor/>
4. If you require a custom power level, please inquire with SpinCore Technologies through our contact form, which is available at <http://www.spincore.com/contact.shtml>

### IV. Contact Information

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**Web Contact Form:** <http://www.spincore.com/contact.shtml>

### V. Document Information

Revision history available at SpinCore.