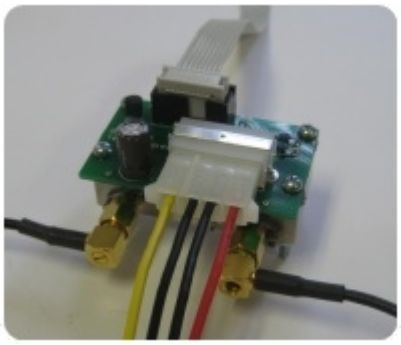
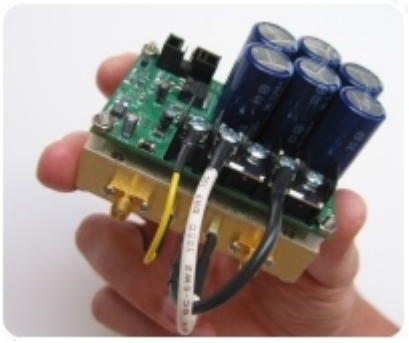
RF Power Amplifiers

Models PA10W and PA100W

Owner's Manual





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

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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 200 V peak-to-peak (PA100W) 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 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.

II. PA10W – 10 W Power Amplifier Module

1. Overview

The PA10W RF power amplifier comes in a very compact broadband module delivering 10 Watts RMS (20 Watts PEP, Peak Envelope Power) into a 50-ohm load. It has a 3 dB range of 10 MHz to 75 MHz and is powered by a DC +12 V power supply (with the negative terminal grounded). The PA10W has standard female SMA jacks for RF input and output, and a standard 4-pin ATX connector for the input DC power. The PA10W typically operates in Class AB.

The product comes with blanking circuitry – the blanking circuitry keeps the PA10W 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.

The PA10W module measures 2.25" x 1.4" x 1.4" (57 x 36 x 36 mm). There are multiple ordering options available, such as enclosures with integrated AC power supplies and enclosures with a complete RF front-end with preamplifiers and filters for a complete mobile NMR, NQR and MRI system. See the “Configuration Options” section later in this document for more information. The use of a low pass (or band pass) filter at the output of the PA10W is recommended to reduce high frequency noise and improve performance.

2. Electrical Specifications

Parameter	Specification	Units
DC Input Voltage	12	V (DC)
Max RF input power	50	mW
Max. continuous RF output power	10	W (RMS)

Table 1: Basic electrical specifications for the PA10W power amplifier module.

3. Connector Information

RF Input and Output Connectors

A top view of the PA10W module depicting RF input and output connectors is shown below in Figure 1. When connecting the PA10W power amplifier, the RF signal source should be connected to the SMA jack on the right hand side (top view) of the circuit (RF in). The SMA jack on the left hand side (top view) is the RF output from the power amplifier (RF out).

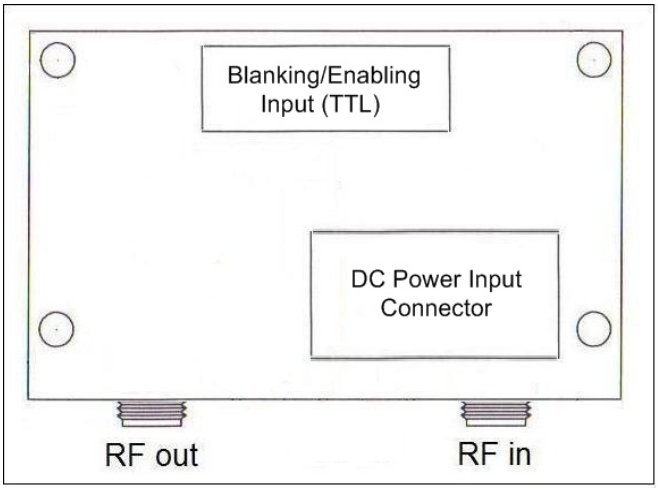

Figure 1: Diagram of power amplifier RF connectors (top view). RF out and RF in are SMA jack connectors.

TTL Control Input Connector

The PA10W power amplifier module has a 10-pin shrouded male IDC connector, also shown in Figure 1 above, which supplies the input TTL control signal. The control signal is pin 8 on the IDC header and the corresponding ground is pin 7. The input is terminated by a 100-ohm load and requires an external TTL signal source capable of sourcing at least 10 mA. A logical high signal is required to deblank (enable) the PA10W. The deblanking bit must be set at least 3 ms prior to sending the RF signal or optimal power will not be achieved.

Note: The deblanking TTL input header is denoted P2 on the circuit board. Please see Figure 2 below, for pin diagram.

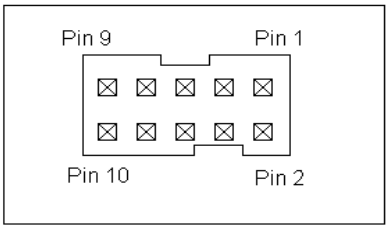

Figure 2: 10-pin IDC connector (Digi-Key part A33159-ND). Mates with Digi-Key part HKC10H-ND or similar.

The timing diagram of a typical application of PA10W with the deblanking pulse applied prior to the RF pulse is presented in Figure 3, below. When working with short RF pulses, on the order of 1 us or so, triggering the oscilloscope on the falling edge of the deblanking pulse will help identifying and capturing the RF pulse on the scope.

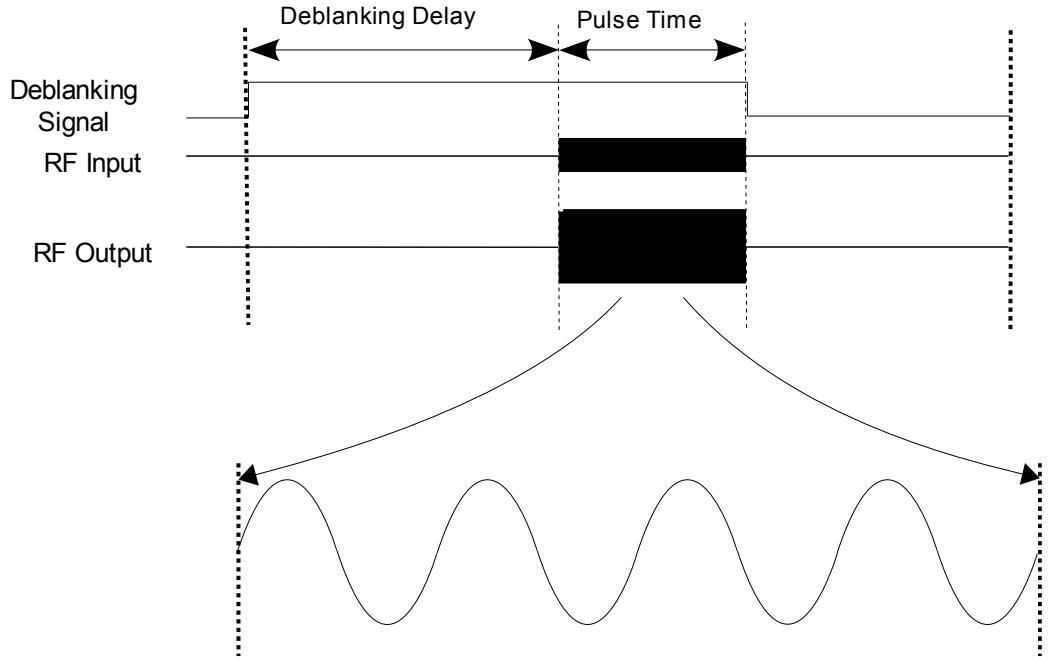

Figure 3: Representation of the deblanking and RF input and output signals to the PA10W. The PA10W requires at least 3.0 ms of deblanking time prior to the RF pulse for full output power.

DC Power Input Connector

The PA10W RF power amplifier has a 4-pin input power connector. The input is for use with a standard PC ATX power supply connector. The pin arrangements for this connector are shown below in Figure 4.

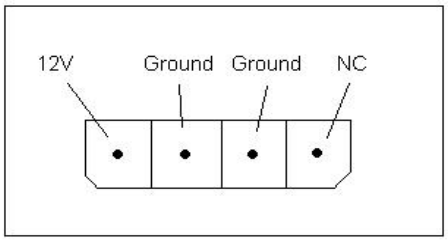

Figure 4: 4-Pin input connector (Molex part 0531090410). Mates with standard PC power supply connector or Molex part 0015244048.

4. Configuration Options

Multiple configurations are available when ordering the PA10W RF power amplifier unit.

1. PA10W RF Module with deblanking circuitry, no enclosure

This configuration shown in Figure 5 does not have an enclosure and includes the switching circuitry mounted on top of the power amplifier to enable it when a TTL pulse is applied to the input pin. This feature reduces power consumption and keeps the power amplifier cool.

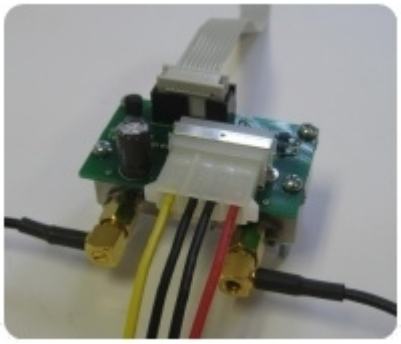

Figure 5: PA10W RF power amplifier – no enclosure.

2. PA10W RF module with enclosure

The PA10W RF power amplifier can 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). The power input is 90-264 V AC, the RF input/output signals are provided on external BNC connectors, and the TTL inputs are routed through female DB-9 input connectors. The active TTL signal needs to be connected to pin 4, with the corresponding ground line connected to pin 8. Three standard enclosure configurations are available:

i) PA10W in a single bay enclosure (Figure 6)

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: PA10W RF power amplifier – single bay enclosure.

ii) PA10W enclosed with iSpin-NMR™ system (Figure 7)

iSpin-NMR™ 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).

Figure 7: PA10W RF power amplifier – enclosed with iSpin system.

iii) PA10W in Lightweight aluminum enclosure (Figure 8)

Small aluminum enclosure additional specifications include:

-Lightweight aluminum enclosure.

-High quality external 60 Watt AC input switching power supply.

-Dimensions are approximately 4” x 2.4” x 3” (10 x 6 x 8 cm).

Figure 8: PA10W RF power amplifier – lightweight aluminum enclosure.

3. PA10W RF module enclosure with Preamplifier Option

The enclosure can also include input preamplifiers (approx 45 or 60 dB of gain – please specify when ordering) to the RadioProcessor board. This option is perfect in combination with the iSpin-Mini system to provide a complete mobile NMR system (see Figure 9).

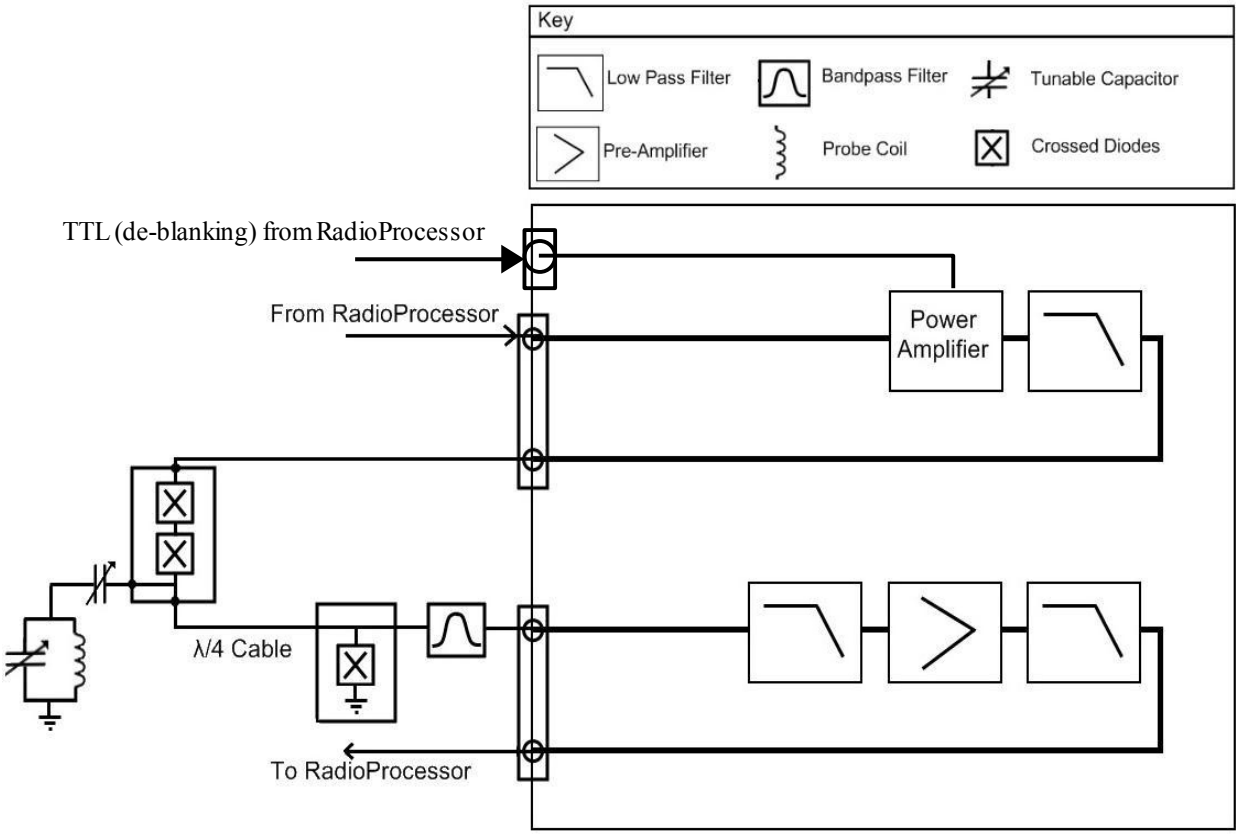

Figure 9: Block diagram of RF front-end for the RadioProcessor; typical applications include NMR, NQR, and MRI experiments.

5. Higher RF output power

The following section introduces the PA100W RF power amplifier module. This module is a very compact broadband 100-Watt RMS power amplifier with frequency range from 10 MHz to 100 MHz. The PA100W is available in several different configurations, including enclosures with or without power supplies.

III. PA100W – 100 W Power Amplifier Module

1. Overview

The PA100W RF power amplifier comes in a very compact broadband module delivering 100 Watts into a 50-ohm load. It has a frequency range of 10 MHz to 100 MHz and is powered by a DC +24 to +28 V power supply (with the negative terminal grounded). The PA100W has standard female SMA jacks for RF input and output, and a screw terminal block for the DC power input. The PA100W typically operates in Class AB. The PA100W measures 3.15" x 2.54" x 2.33" (80 x 65 x 59 mm).

The product comes with blanking circuitry – the blanking circuitry keeps the PA100W 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 enable (deblank) the power amplifier, a TTL pulse (logical high) needs to be applied to the control circuitry.

The PA100W power amplifier can be delivered as a module (with the blanking circuitry) or in various enclosures - see the “Configuration Options” section later in the document for more information.

2. Specifications

DC Electrical Specifications

Parameter	Specification	Units
Max DC Input Voltage	28	V (DC)
Max RF input power	2.3	W
Max. continuous RF output power	100	W (RMS)

Table 2: Basic electrical specifications for the PA100W power amplifier module.

RF Specifications

Frequency	Input Power (Watts RMS)
10 MHz	0.64
20 MHz	0.86
30 MHz	1.02
40 MHz	1.08
50 MHz	1.02
60 MHz	1.02
70 MHz	0.98
80 MHz	1.12
90 MHz	0.90
100 MHz	1.56

Table 3: Input power necessary to achieve 100 watts output power at a given frequency when the power amplifier is supplied by a 28 V DC source.

Table 3 shows data for the PA100W when supplied by +28 V. The PA100W is capable of outputs greater than 100 W - however, it is important not to exceed the input power parameters for the specific operating frequency (Table 3) to avoid damaging the module. Also note that if the power amplifier is supplied by a +24 V DC source the gain is reduced and a maximum value of approximately 150 W PEP can be achieved.

3. Connector Information

RF Input and Output Connectors

When connecting the PA100W RF power Amplifier, the RF signal source should be connected to the SMA jack on the left hand side (top view) of the circuit (RF in). The SMA jack on the right hand side (top view) is the RF output from the power amplifier (RF out). See Figure 10 (next page) for details.

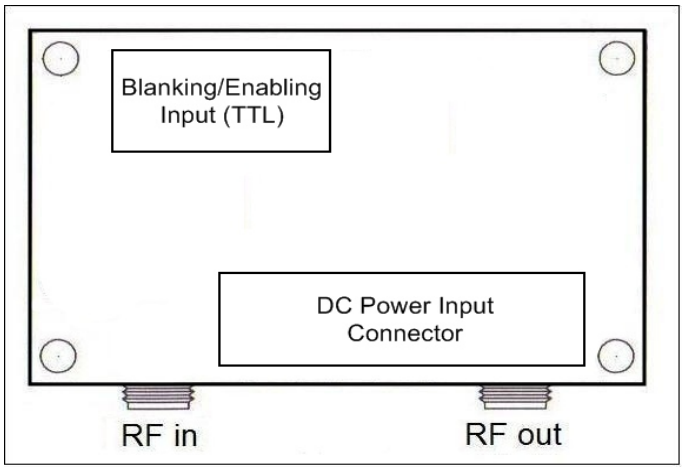

Figure 10: Top view of the PA100W power amplifier module depicting connectors. RF in and RF out are SMA jack connectors, Input TTL is an IDC connector and the input DC power connector is a screw terminal block.

TTL Control Input Connector

The PA100W power amplifier module has a 10-pin shrouded male IDC connector, pin diagram shown in Figure 11, which supplies the input TTL control signal. The control signal is pin 8 on the IDC header and the corresponding ground is pin 7. The input is terminated by a 100-ohm load and requires an external source capable of sourcing at least 10 mA. The TTL requirements for the de-blanking control input are standard TTL values. A logical high signal is required to deblank (enable) the PA100W. In testing, the TTL deblanking pulse is typically applied 300 us prior to the application of the RF pulse. The end of the deblanking signal coincides with the end of the RF pulse. See Figure 12 (next page) for details.

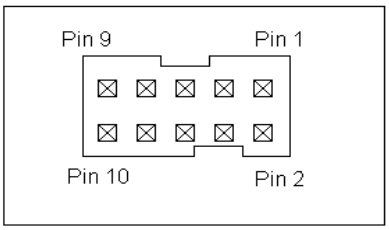

Figure 11: 10-pin IDC connector (Digi-Key part A33159-ND). Mates with Digi-Key part HKC10H-ND or similar.

The timing diagram of a typical application of PA100W with the deblanking pulse applied prior to the RF pulse is presented in Figure 12, below. When working with short RF pulses, on the order of 1 us or so, triggering the oscilloscope on the falling edge of the deblanking pulse will help identifying and capturing the RF pulse on the scope.

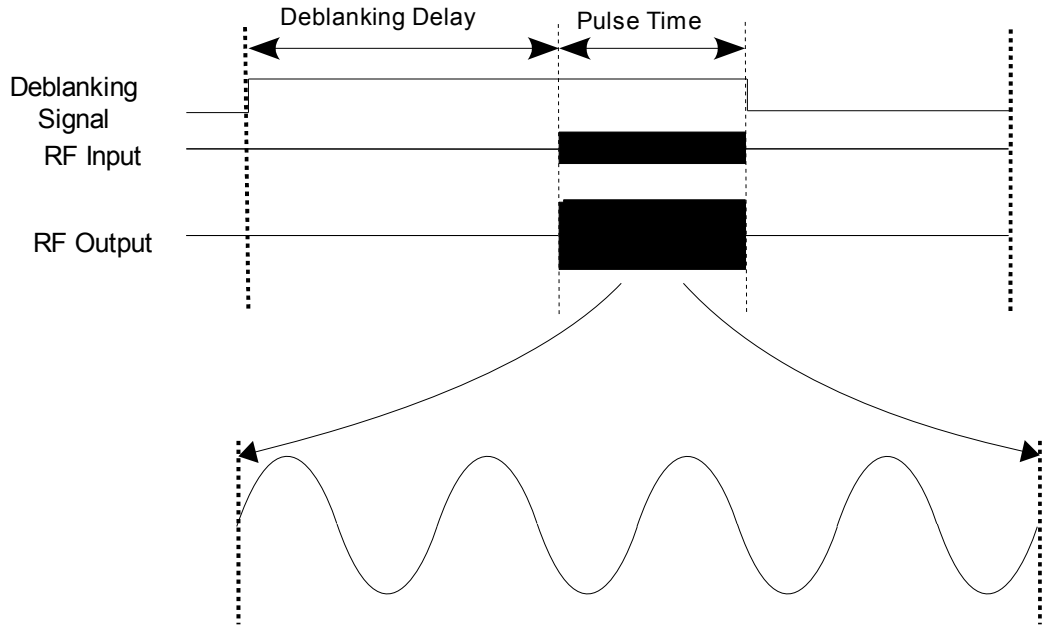

Figure 12: Representation of the deblanking and RF input and output signals to the PA100W.

DC Power Input Connector

The RF power amplifier has a 5-pin screw-terminal input power connector. The pin arrangements for this connector are shown below in Figure 13 (top view).

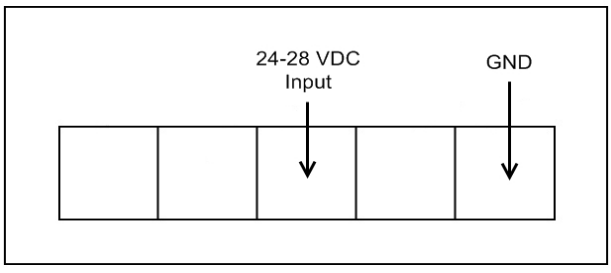

Figure 13: Top view of the 5-position power input connector (Molex part 38720-6305).

4. Configuration Options

1. PA100W RF Module with deblanking circuitry, no enclosure

This configuration does not have any enclosure for the PA100W RF module. It includes the deblanking circuitry mounted on top of the power amplifier to enable it when a TTL pulse is applied to the control input pin. This feature reduces power consumption and keeps the power amplifier cool. The module with no enclosure is shown below in Figure 14.

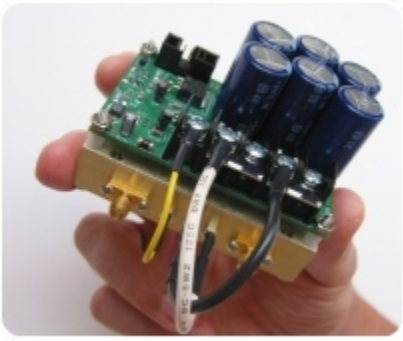

Figure 14: PA100W RF power amplifier – no enclosure.

2. PA100W RF module with enclosure

The PA100W RF power amplifier can optionally be delivered in various external enclosures which protect the RF power amplifier circuit and include an AC/DC power supply and internal RF cables. Configurations ii) and iii) below have power inputs of 90V-264V AC. All enclosures have the RF input/output signals provided on external BNC connectors. The TTL inputs are routed through female DB-9 input connectors. The active TTL signal needs to be connected to pin 4, with the corresponding ground line connected to pin 8. Available enclosure configurations are listed on the next page and they include the following: a single bay enclosure, a rack mount enclosure, and an enclosure with adjustable DC power supply.

i) PA100W module enclosed in a single bay enclosure (external +24-28 V power supply required - Figure 15)

Single bay enclosure additional specifications include:

-Excellent EMI/RFI shielding meets FCC & CE regulations.

-Built-in 4 x 4 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 15: PA100W RF power amplifier – single bay enclosure (external power supply required).

ii) PA100W module fully enclosed in a rack-mount enclosure with an integrated +24 V quiet linear power supply (reduced output power - Figure 16).

Rack-mount enclosure additional specifications include:

-Industrial steel 4U rack-mount enclosure.

-High quality quiet +24 V linear power supply.

-Built-in 12 x 12 cm quiet cooling fan.

-Dimensions are approximately 17.7” x 17.3” x 7” (45 x 44 x 18 cm).

Figure 16: PA100W RF power amplifier – rack-mount enclosure with integrated power supply

iii) PA100W module enclosed with an adjustable DC power supply (Figure 17).

DC power supply enclosure additional specifications include:

-0-+30 VDC @ 10 A adjustable power supply.

-Built-in 10x10 cm quiet cooling fan.

-Dual LED displays for output Volts & Amps.

-.02% Line & .01% +15mV Load regulation, <1mV RMS ripple.

-Dimensions are approximately 13” x 10.25” x 6.25” (28 x 18 x 17 cm).

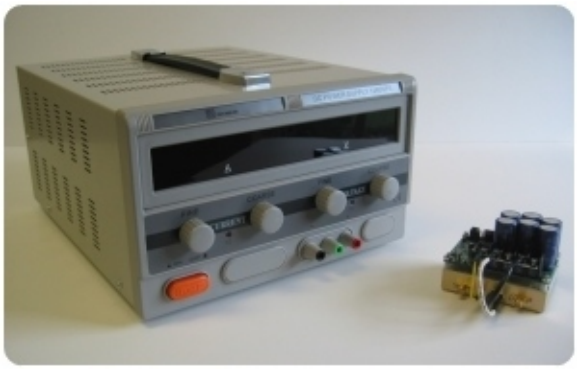

Figure 17: PA100W RF power amplifier – enclosed with DC power supply.

5. Typical Set-Up For NMR Experiments

Figure 18 shows a typical connection diagram in which both the PA10W and PA100W are used with SpinCore's iSpin-NMR system to run NMR experiments.

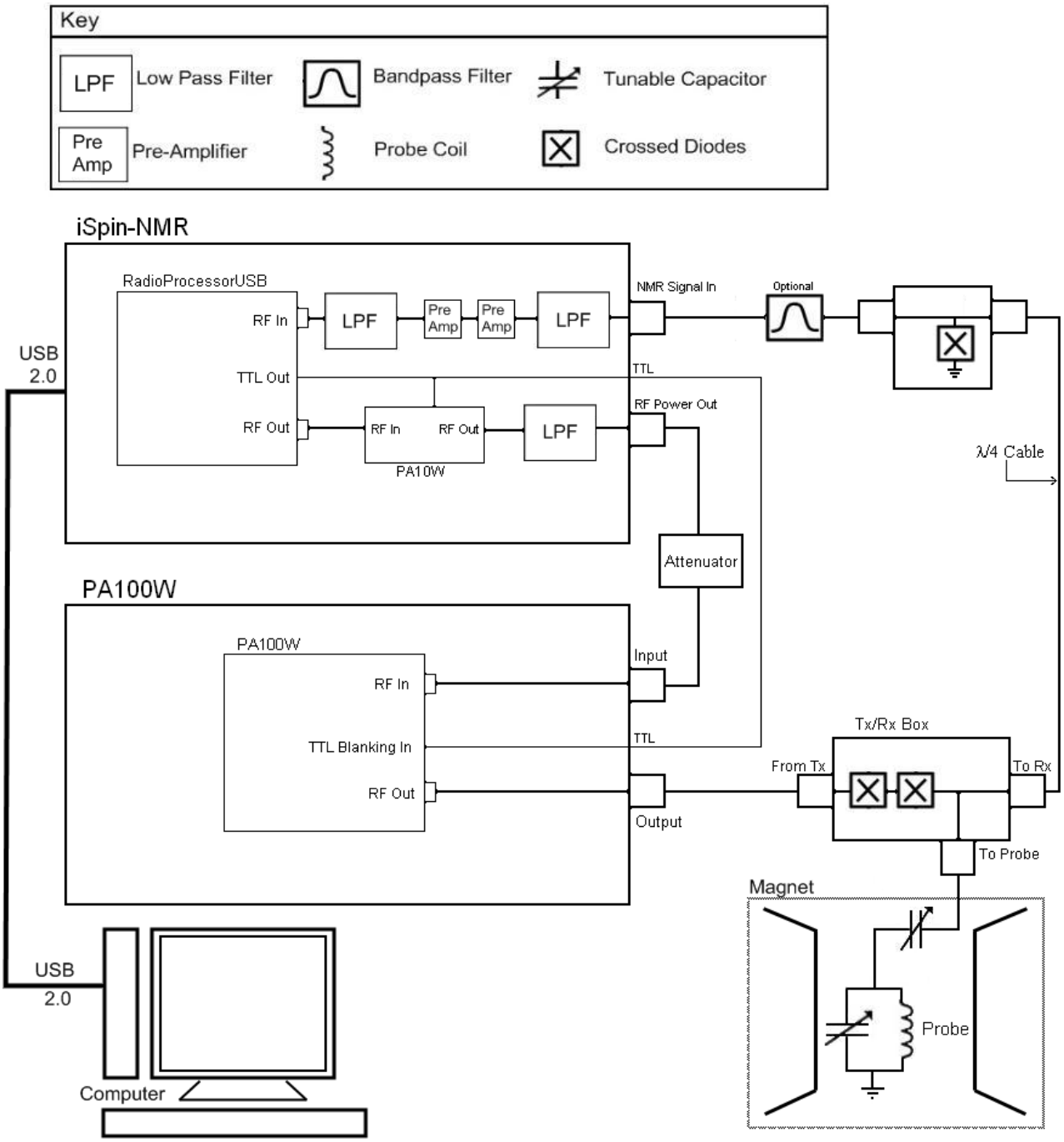

Figure 18: Typical NMR setup with iSpin-NMR, PA10W, and PA100W with enclosure.

IV. Contact Information

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