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	Model PB3 100 & 300 Watts How to reconfigure the PB3 matching network section from an “L” to a “PI” configuration.	Rev. date	Rev. 0

Product: Model PB-3

Subject: How to reconfigure the PB3 matching network section from an “L” to a “PI” configuration.

The Model PB3 is typically manufactured and delivered to the customer with an “L” type internal matching circuit. In some applications such as driving an ICP or coil over tube type plasma source (antenna coil NOT immersed into the plasma), it is necessary to perform a field modification to a “PI” configuration. This enables proper matching of the plasma load.

This document details the components and procedure to do this modification.

- **STEP 1 – Add fixed shunt capacitance**

Remove the top lid of the PB3 and locate the factory installed fixed capacitor mounting strap.

It is assumed that the PB3 in question includes provisions for an additional fixed shunt capacitor. See the image below and look for the un-terminated silver plated copper strap. If the unit does NOT have this factory-installed strap – one may be ordered from Manitou. Locate the fixed capacitor installation kit.



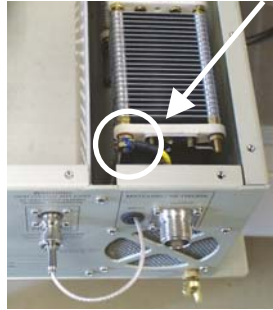
Install the fixed capacitor onto the exposed strap and enclosure side wall using the two Philips head 6-32 screws.

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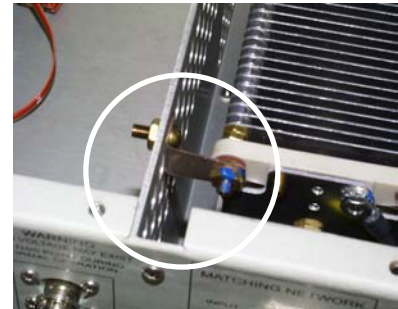
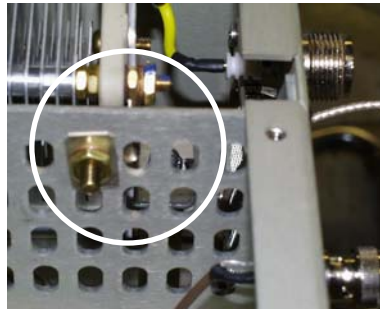
- **STEP 2 – Change position of output lead**

Position the PB3 so that you are looking at the rear panel. See the image below and locate the rear of the series capacitor and its connection to the yellow output wire. Remove the brass nut and the 2 lock washers – set them aside for reassembly. Position the lug (and yellow wire) onto the exposed brass stud on the capacitor's rear stator plate. Fasten this lug using the included steel Kep nut.



- **STEP 3 – Add series capacitor ground strap**

See the images below. Locate the series capacitor ground strap kit and install onto the rear end of the series capacitor. Use the 2 brass #10 internal lock washers set aside from the disassembly process.



- **STEP 4 – Add additional generator to match coax cable**

Locate the additional coax cable kit (12' long (1/4 wavelength) coax cable with a BNC male to BNC female connector). Install this cable in series with the pigtail BNC connection on the PB3's rear panel. See the image below. This cable kit may consist of the cable described above or be made from a cable with two BNC male connectors and a dual female adapter.

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- **STEP 5 - Theory**

Now it is time to test the system. For these tests, do not install the top lid however, position it in place on top of the system.

Some basic theory is necessary to better understand the process and what to look for in the event that proper tuning or even plasma ignition is not achieved.

The typical PB3 RF power system is designed to drive a conventional parallel plate plasma etch system or magnetron sputtering cathode. In some cases, the “L” network may need modification to the value of two components (variable shunt capacitor and series inductor) to enable tuning the reactive plasma load impedance to the resistive load requirement of the RF generator section.

These modifications typically include the addition of fixed shunt capacitance across the variable shunt capacitor. An increased value placed here counters the load capacitance outside the network including long match-plasma load cables or a large area, highly capacitive plasma electrode.

The second modification is increasing the value of the series inductor in the event that a high impedance load is used. This would be a small magnetron sputtering cathode (~1” diameter).

If you are driving flat coil ICP or coil over tube plasma sources it may be necessary to modify the “L” network from its original configuration. A flat coil ICP source will require removing the series inductor entirely as the ICP coil acts as the series inductor. Another modification would be to reverse the input and output of the matching network so that the shunt capacitor is placed across the ICP coil and the series capacitor is connected to the 50 ohm input (connected to the RF generator section’s output).

To drive a highly inductive coil over tube plasma source we will start by connecting the coil to the end of a 3’ long Teflon coaxial cable – we suggest the use of a type RG393. Do not ground either the center conductor or shield of this end. The opposite end connected to the matching network output will be grounded through the PB3 enclosure. The opposite end will require an HN male connector to mate with the PB3.

A few technical details to note before proceeding:

- The value of the fixed shunt capacitor included with the kit is 400pF. This value has been tested to work with most applications however please be aware that a higher value may be necessary.
- The series inductor tap setting inside the PB3 should be pre-positioned at almost the highest inductance – the 2nd tap located away from the front wall.

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- The additional $\frac{1}{4}$ wavelength cable may or may not be needed based on each individual application. The use of this cable is required when the PB3 is successful in generating a plasma discharge in the tube however the matching network cannot reduce the reflected power to 0. Both Load & Tune Dials will indicate values between 10 and 90 %. If this condition exists with one or both of the dials stopped at either end, this means that there is a problem with the fixed capacitor or inductor values in the circuit.

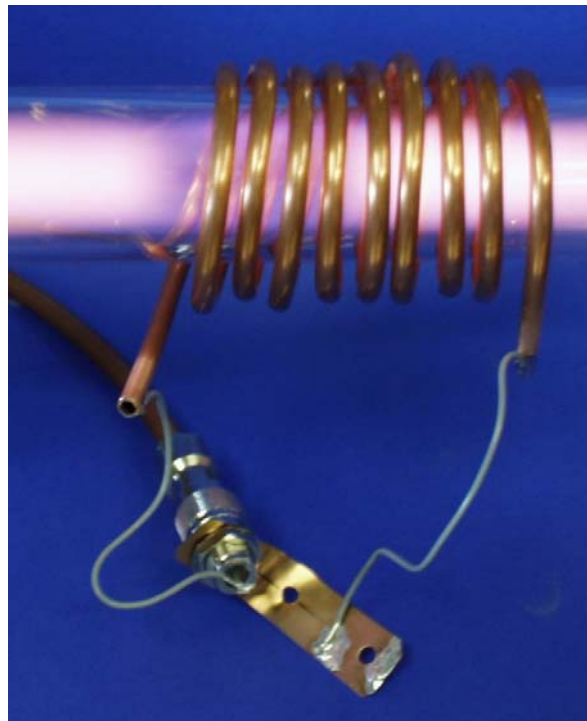
- **STEP 6 – Testing the system**

Verify that the RF system is properly connected and you are familiar with the operation of the PB3 (read the owner's manual). Preset the process gas flow and adjust the process pressure. Preset the PB3 to a low power ~50 watts and both match dials to 50%.

Turn on the RF power and determine if the plasma ignited. If so, adjust the series dial (while pressing the meter mode button) for a dip in reflected power. Do the same for the Load dial. If the plasma is lit then you will see a dip. Please note that the Load dial has a broad feel while the Tune dial will have a sharp null point. This is typical for the coil over tube load.

At this point you should have plasma ignited and the load should be tuned to a low value ~1-5% of the forward value. If you still experience problems please contact Manitou Systems.

Below is the image of our test plasma reactor. It shows a well tuned air plasma in a 2" diameter process tube with a 9 turn $\frac{1}{4}$ " copper coil as the antenna.



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