

## Counter Preamp II kit from Jackson Harbor Press

### Introduction:

This kit is a pre-amplifier kit for use with a frequency counter such as the Mcount kit from Jackson Harbor Press. This kit uses a JFET input circuit seen in ARRL handbooks from the 1980s. This circuit has a high input impedance with good stability and high gain. A few changes have been made, adding feedback on the final stage and using more recent transistors.

### General notes on building the Counter Preamp II kit

Q1 (MPF102) is a JFET transistor. This means that it should be handled as little as possible to prevent static damage. The builder should use a grounding strap and anti-static mat if available or at the very least, work on a grounded metal surface and be sure to touch ground prior to touching this part.

One decision the builder should make before starting construction of the Counter Preamp kit is how the project will be mounted in the case.

The pads and traces are small and delicate - a small tipped, low power (25 watts or less) soldering iron should be used.

### Building the Counter Preamp II kit

Step 1) Get the parts together: All of the board mounted components have been supplied but you will still have to provide off-board items to fully implement the kit. These items are mentioned at the end of the kit parts list

Step 2) Identify and orient the components: Most of the components should be fairly easy to identify and place - see the parts list and the parts placement diagram for descriptions.

step 3) Form the leads, place and solder the components on the main circuit board: Use the parts placement diagram for information on the placement and orientation of the parts. Clip the leads of the parts after soldering. The following sequence works from the left side of the board to the right:

- a) C1, .01 uF multilayer ceramic yellow cap (marked 103). Place C1 as shown on the parts placement diagram, at the top left of the circuit board and solder in place.
- b) R1, 1 k ohm resistor (brown, black, red, gold). Place R1 as shown on the parts placement diagram, just below C1 and solder in place.
- c) The leads for the diodes should be formed with the lead at the anode (NON-banded) end bent around, this will insure the correct polarity if the diodes are placed per the diagram. Diodes D1 and D2 (1n4148) as shown on the parts placement diagram, to the right of R1 with leads bent as described above to insure the correct polarity
- d) R2, 1 meg ohm resistor (brown, black, green, gold). Place R2 as shown on the parts placement diagram, to the right of D1 and D2 and solder in place.
- e) R3, 4.7 k ohm resistor (yellow, violet, red, gold). Place R3 as shown on the parts placement diagram, to the right of R2 and solder in place.
- f) R4, 390 ohm resistor (orange, white, brown, gold). Place R4 as shown on the parts placement diagram, to the right of R3 and solder in place.
- g) Q1, MPF102 transistor (remember that this part is static sensitive) . Place Q1 as shown on the parts placement diagram below R3 and R4 with the flat edge of Q1 oriented to the top edge of the board and solder in place.
- h) C2, .1 uF multilayer ceramic yellow cap (marked 104). Place C2 as shown on the parts placement diagram, at the top edge of the circuit board to the right of R4 and solder in place.
- I) Q2, PN2222 transistor. . Place Q1 as shown on the parts placement diagram below C2 and to the right of R4 with the flat edge of Q2 oriented to the right edge of the board and solder in place.
- j) R5, 240 ohm resistor (red, yellow, brown, gold). Place R5 as shown on the parts placement diagram to the right of C2 and Q2 and solder in place.

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- k) C5, .1 uF multilayer ceramic yellow cap (marked 104). Place C5 as shown on the parts placement diagram, below R5 and solder in place.
- l) C3, 10 uF electrolytic cap (marked 10 uF, 25 V). Place C3 as shown on the parts placement diagram, to the right of R5 with the minus stripe towards the center of the board and solder in place. The builder may want to leave the leads of C3 slightly long if a lower profile (with C3 bent over) is desired.
- m) U1, 5V regulator (78L05). Place U1 as shown on the parts placement diagram just below C5 at the bottom edge of the board with the flat edge of U1 oriented to the bottom edge of the board and solder in place.
- n) Q3, PN2222 transistor. . Place Q3 as shown on the parts placement diagram below and to the right of C3 with the flat edge of Q3 oriented to the left edge of the board and solder in place.
- o) R6, 4.7 k ohm resistor (yellow, violet, red, gold). Place R6 as shown on the parts placement diagram, to the right of C3 and solder in place.
- p) R7, 10 k ohm 1/8 watt (small) resistor (brown, black, orange, gold). Place R7 as shown on the parts placement diagram, to the right of Q3 and solder in place.
- q) R8, 1 k ohm resistor (brown, black, red, gold). Place R8 as shown on the parts placement diagram, below and to the right of R7 and solder in place.
- r) C4, .1 uF multilayer ceramic yellow cap (marked 104). Place C4 as shown on the parts placement diagram, below and to the left of R8 and solder in place.
- s) Solder the 9V battery snap (or other power input connector to the ground and +Vin holes on the right, bottom side of the board, don't forget to add a power switch if desired in series with the positive lead.

Step 4) Check the board: Before proceeding, take the time to check the top (mostly) and the bottom of the board for solder bridges. Use the parts placement and bottom view diagrams as a guide to visually check for these shorts. It may help to clean the flux from the board and then use a strong light in conjunction with a magnifying glass to see these problems. Also, double check the orientation of the critical components such as U1 and the transistors. Connect the board to a 9V battery or a 13.8 Volt supply using a VOM to measure the current used. Current should be 7 to 30 mA with no input signal connected (housed in a metal box). If the supply current is much larger, or if it's too low (should be at least a few ma) power down and re-check the board for shorts and polarity problems. The builder can also do DC voltage checks at the five points on the circuit schematic indicated with a black box. These measurements were done with an inexpensive DVM on the 20 volt range with the input shorted and the output open, supply voltage was 13.8 volts.

### Operation:

Connect the preamp kit output to the input of the frequency counter - a series capacitor may be needed if none is used in the frequency counter input. Connect the signal to be measured to the input of the kit and start measuring.

### Modification ideas:

- 0) add a series diode between the battery or power supply and +Vin to prevent damage to the voltage regulator, U1. I'd use a 1n5818 or BAT42 Schottky diode for lower voltage drop but a regular 1n400x rectifier diode could also be used. The cathode (banded end) of the diode should be connected to +Vin. The anode (non-banded end) of the diode should be connected to the positive supply voltage.
- 1) an ON/OFF switch: especially if you are using a 9V battery as a power source, it won't last long connected to the Counter Preamp II. One other idea would be to use a battery saver circuit such as the kit of the same name from Jackson Harbor Press.
- 2) for a lower input capacitance, which should enhance the higher frequency impedance of the preamp, the builder may elect to either remove or not use the protection diodes. R1 could probably also be replaced with a short as it is used to limit the current through the now non-existent diodes.. Removing

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these diodes may result in the destruction of the JFET from static or overvoltage damage. Another idea would be to use a couple of Schottky diodes (such as the BAT42) in series to replace each of the 1n4148 diodes.

3) At audio frequencies the counter may not be as sensitive - if more audio gain is required, larger coupling capacitors could be added in parallel to C1.

4) If the gain isn't high enough as built, consider changing R3 (the 4.7 kohm source resistor of Q1), lowering the value will increase the current used but should also increase the sensitivity. One easy way to do this if R3 is already installed might be to add another resistor (or even a pot) in parallel with R3. A set of four extra resistors has been included with your kit (240, 470, 1000 and 2000 ohms) to experiment with.

Please feel free to email with any questions, comments, suggestion or problems with this kit. My email address is:

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Thanks for choosing the Counter Preamp II kit and  
Best Regards,

Chuck Olson, WB9KZY  
by Charles J. Olson

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### List of parts included with the Counter Preamp II kit

Ref	designation	Description
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C1		.01 uF multilayer ceramic capacitor, .1" lead space
C2		.1 uF multilayer ceramic capacitor, .1" lead space
C3		10 uF electrolytic capacitor, radial
C4		.1 uF multilayer ceramic capacitor, .1" lead space
C5		.1 uF multilayer ceramic capacitor, .1" lead space
D1		In4148 glass switching diode
D2		In4148 glass switching diode
Q1	MPF102	MPF102 JFET transistor, TO-92 package
Q2	PN2222	PN2222 NPN transistor, TO-92 package
Q3	PN2222	PN2222 NPN transistor, TO-92 package
R1		1 k ohm resistor, brown, black, red, gold
R2		1 meg ohm resistor, brown, black, green, gold
R3		4.7 k ohm resistor, yellow, violet, red, gold
R4		390 ohm resistor, orange, white, brown, gold
R5		240 ohm resistor, red, yellow, brown, gold
R6		4.7 k ohm resistor, yellow, violet, red, gold
R7		10 k ohm resistor - small 1/8 watt, brown, black, orange, gold
R8		1 k ohm resistor, brown, black, red, gold
U1	78L05	5 volt regulator circuit board

### Items you may need to provide to complete the Counter Preamp kit

- Metal case (an Altoids candy tin is fine)
- 4-40 sized mounting hardware
- input power jack (9V battery snap connector OR other power connector)
- input and output jacks
- SPST power switch (optional)
- solder, wire