G4HUP

# Buffer Amplifier/Filter for K3 IF output

# Technical Manual


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# Unit Specifications

**Model Ref** PA K3

Serial No

| | | |
|---|---|---|
| Input Frequency[1] | 8.215MHz | MHz |
| Gain | 20±0.5 | dB |
| Supply Voltage | 10 – 15 | V |
| Supply Current | 9.5 ±0.5 | mA @ 13.8vdc |
| 3dB bandwidth | >200 | kHz |
| Stop band rejection | >65 | dB above 16MHz |

Notes:

1 PA K3 units are aligned for the centre of the K3/K3S IF passband at 8.215MHz.

## Scope of Document

This document is intended to provide all necessary information to guide users in the construction and installation of the G4HUP Buffer Amplifier and Filter PA K3

Units are supplied built and aligned ready for installation in the housing. Each unit is accompanied by a through gain measurement. Kits and fully assembled units are not available.

This document is relevant for PA K3 units constructed on PA K3 V1.0 PCB's.

Further information can be found on the PA K3 pages of the G4HUP web-site, including any identified issues or problems – http://g4hup.com/PAT/PAK3.html.

## PA K3 Amplifier Outline

The excellent and well respected K3 series of transceivers already have an IF port available, primarily intended for connecting to the P3 panoramic display adaptor. Of course, this can easily be used to connect to any SDR, which then gives you the option to use your favourite SDR software.

The IF output port does suffer two disadvantages when used in this way – the output level is rather low compared to the main signal path, and there are significant levels of local oscillator signal from the K3 present. Testing on the K3, K3S and P3 IF outputs has confirmed that these issues are common to all three.

The PA K3 is a small external buffer module that deals with both of these issues – it has a nominal 20dB gain, and contains a band pass filter at 8.215MHz to minimise any LO signals reaching your SDR.

# Overall Description

The PA K3 has a 3 stage bandpass filter centered on 8.215MHz, followed by a combination JFET and bipolar amplifier to give 20dB of gain at the centre frequency.

## *PA K3 Filter*

The response of the filter is shown in Fig 1, below, over the range 0 to 16.4MHz. Over the centre 200kHz of the passband, the response is flat within 3dB, but the attenuation is steep on the sides of the filter. Typical 3dB bandwidth of the filter, in practice , is of the order of 350kHz, with a flatness of about 1.5dB across the centre 200kHz. In normal operation of the K3/K3S, the nearest LO signals to the IF are when operating on Top Band (160m) - see Fig 2 below which was taken from a recent K3S. Without using a filter, the SDR connected to the IF port is subjected to high level signals at around -45dBm, just 2MHz away from the weak IF signals – there is a danger of overloading of the SDR input.

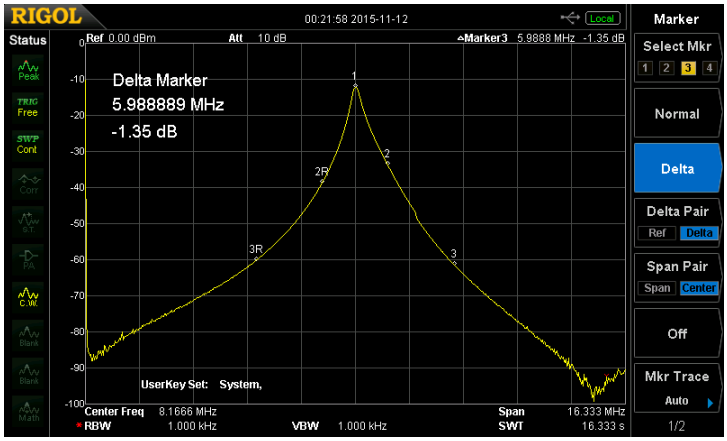



**Fig 1 – Passband of PA K3 Filter**

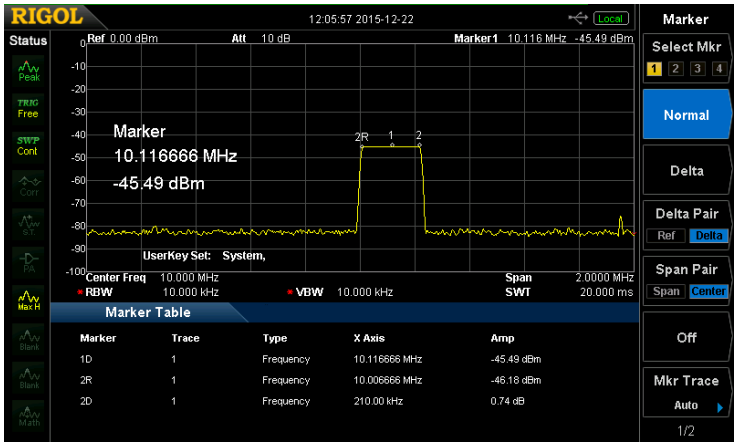



**Fig 2 – LO signal at IF output of K3S when tuned across 160m**

As can be seen from Fig 1, the attenuation of the filter at 2MHz away from the peak suppresses the LO signal by approx. 45dB. In practice, when viewed through the PA K3, these same LO signals are reduced by about 25dB (due to the 20dB gain of the following amplifier), and the levels of LO present reduce as the operating band increases. As a result, you are less likely to overload the front end of your SDR. You can see the resulting signals on the 160m band on the spectrum analyser in Fig 3.

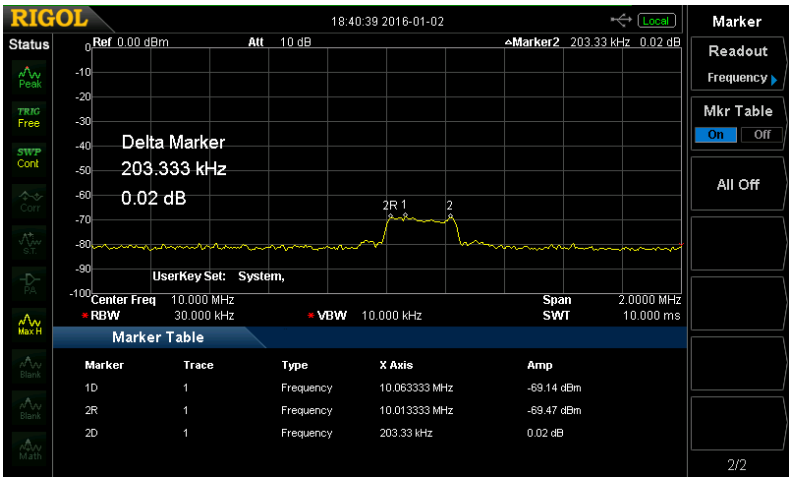



**Fig 3 – Output from K3 IF port via PA K3. Rx tuned in 160m band**

## *PA K3 Amplifier*

The amplifier stage following the filter is a two stage circuit – a JFET stage terminates the filter and provides some gain, while a bipolar stage is used to provide further amplification. Pads are provided on the PCB for a Pi attenuator at the output, should the signal levels be too high for the SDR being used.

The overall circuit is shown at Fig 5.

## *Using the PA K3*

The PA K3 connects directly to the IF output of the K3 or K3S via a short BNC cable (not supplied) to the IF in connector. The IF out BNC must be connected to the SDR RF input.

When used with a P3, it is important that the K3 or K3S is directly connected to the P3, and the PA K3 is used on the IF Out side of the P3, before the SDR. Overloading of the P3 will result if it is not connected this way.

# Physical Description

The PA K3 is housed in an extruded aluminium case, measuring 63 x 45 x 30 mm (2.5 x 1.75 x 1.25 inches approx), excluding the connectors. Fig 4 below shows the package contents you should receive.

External connections are provided for:

- Input signal - BNC
- Output signal –BNC
- 2 pole 0.1mm pitch DC power connector

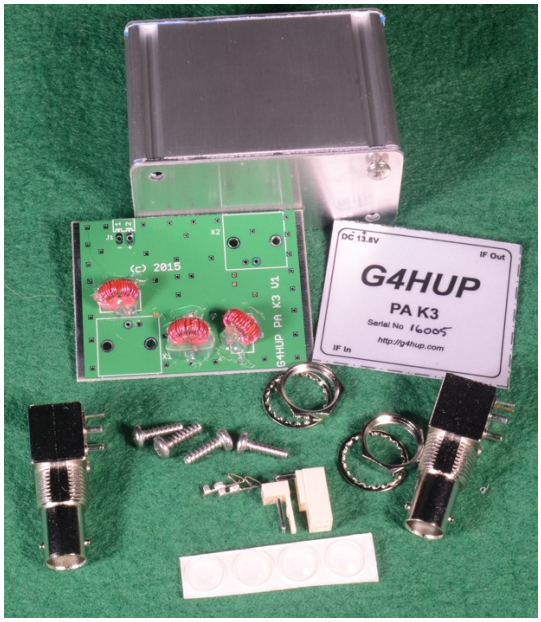



**Fig 4 – PA K3 kit contents**

## Construction Notes

Check your package – it should contain:

- The extruded case with front and rear panels
- The assembled and aligned PCB (packed inside the case)
- The adhesive label (packed inside the case)
- In a separate bag you will find 2 screened PCB mounting BNC sockets, 4 panel screws, power connector parts, set of four adhesive feet.

No work is required on the PCB, apart from mounting the BNC connectors, and the power connector.

If you prefer, you can put the power connectors to one side, and connect the +12v and 0v power wires directly to the PCB – a simple round hole in the rear panel will suffice – this avoids having to make a rectangular hole in the panel.

### *Case Preparation*

The PCB slides into the lowest slots in the extruded case. Front and rear panels must be drilled to accommodate the BNC connectors and power connector.

Fig 8 is a drilling guide for the panels. Two important points to note are:

- The BNC location is identical on both front and rear panels
- Only the rear panel needs the drilling for the power connections.

Note that the aluminium panels are **not** symmetrical! Take care to get the panel the right way up before you mark out the drilling positions, and mark on the side with the protective film – this will be the visible outside once assembled! The view in Fig 8 is as you should mark on the film side of the panel before drilling.

At this stage the circuit can be tested – it does not need to be in the case for initial testing.

If an attenuator is required to reduce the output level, it can be installed at this stage. See Table A1 in the Appendix.

Once testing is complete, re-install the assembly into the case, and attach the front panel.

The four rubber feet can be attached to the underside of the case.

Finally, remove the backing from the adhesive label and install it on the top of the case - make sure you get it the right way round!

# Errata and Addenda

This section contains information about components that have been changed or added compared with the original PCB design.

There are currently no recorded issues against the PA K3 V1 PCB, but for the future, they will be recorded at the url below.

See http://g4hup.com/PAT/PAK3errata.html for full details, versions impacted and resolution guidance, including pictorial support.

# Component Locations

Figs 6 and 7 respectively show the locations of components on the top side and lower side of the PCB.

# Maintenance

## Construction Practices

The board has been assembled using lead bearing solder for maximum reliability. Any repairs or adjustments should also be made using lead based solder.

It is recommended that lead based solder is used for maximum reliability of soldered joints.

## Change History

| Date | Iss No | Comment | Author |
|---|---|---|---|
| 2 Jan 2016 | 0.A | First Draft version | G4HUP |
| 9 Jan 2016 | 1.0 | Issue 1 | G4HUP |
| 3 Mar 2016 | 1.1 | Fig 8 dimensions corrected | G4HUP |

End of text – Diagrams follow

# Diagrams

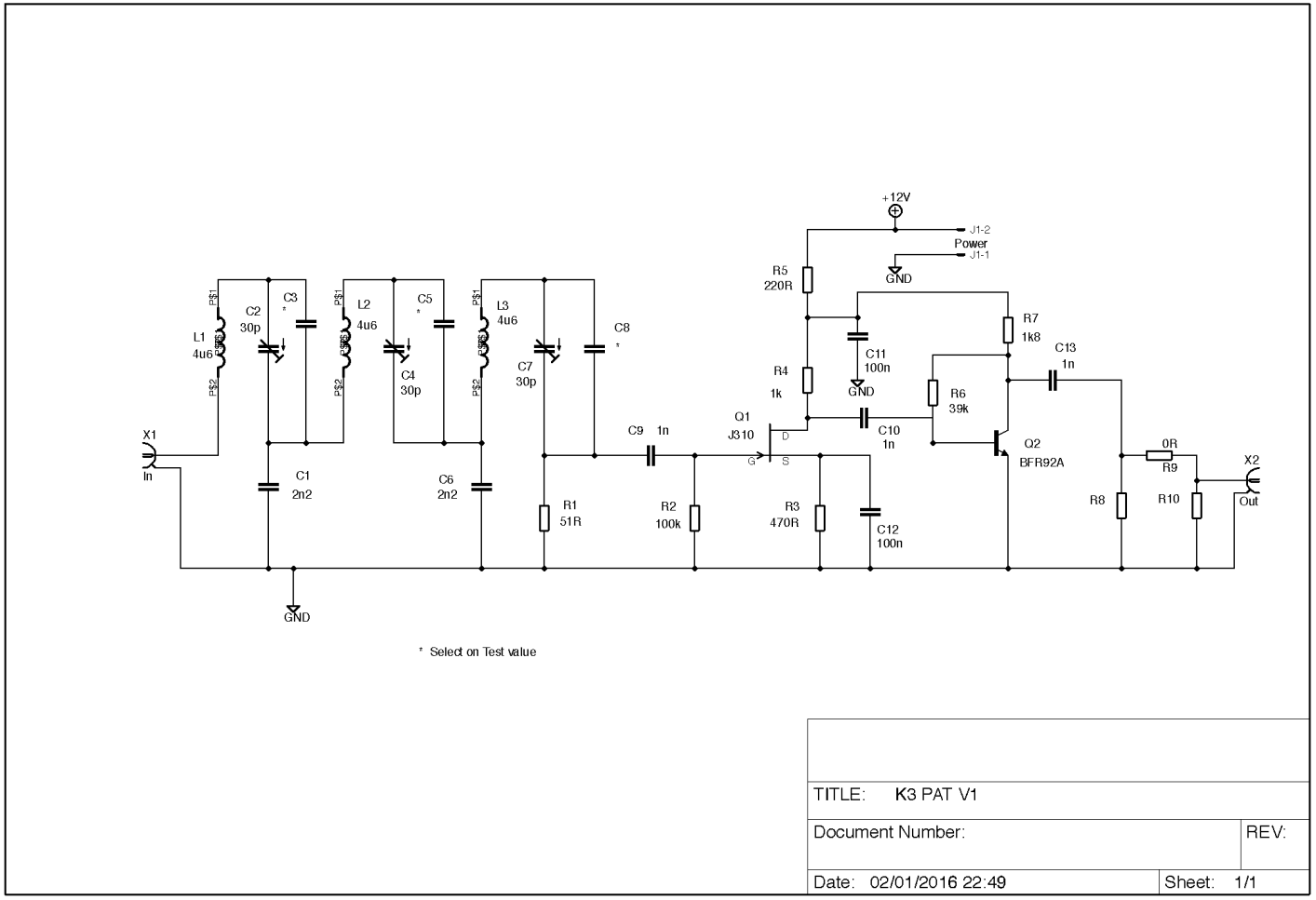



**Fig 5 – PA K3 V1.0 Circuit Schematic Diagram**

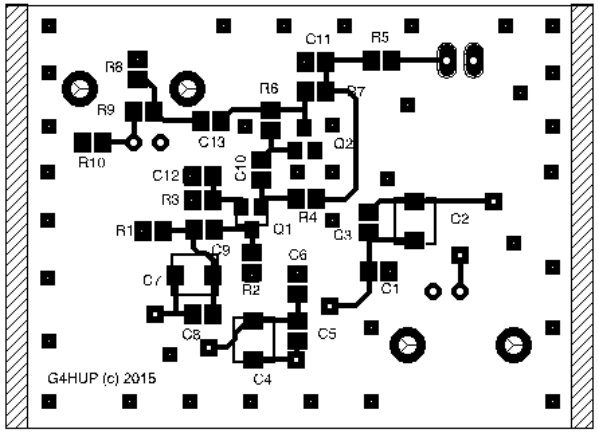



**Fig 6 – PCB Component side Locations**

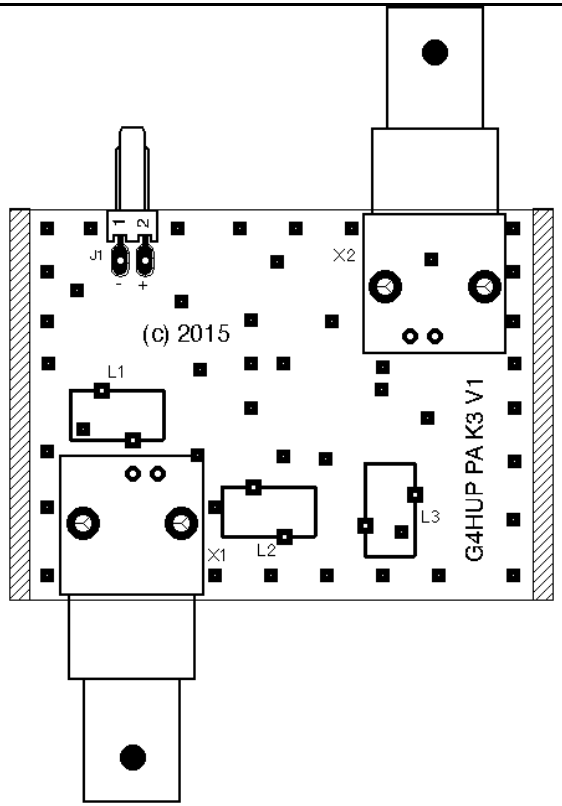
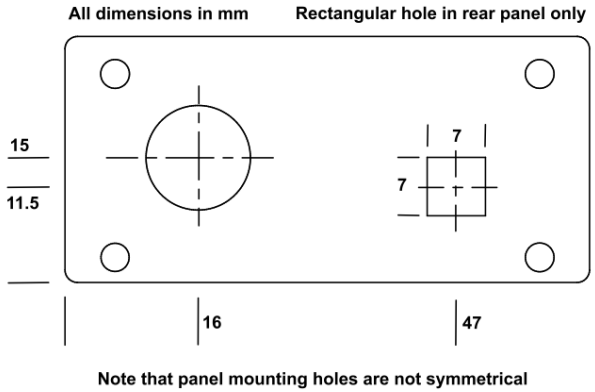



**Fig 7 – Top side PCB overlay**




CAUTION!! Blank panel is not symmetrical
– ensure that screw holes are offset as shown

**Fig 8 - Panel drilling guide**

## *Appendix 1 – Pi Attenuator Resistor Values*

The following table gives data for construction of resistive Pi type attenuators. It is taken from the RSGB published Microwave Handbook, Volume 2, page 10.6. In the table R1 refers to the shunt resistors to ground (2 off) while R2 refers to the series reistor.

Many of the values are not readily available within the standard E24 series – so if you decide not to use precision resistors, but to round the values to suit availability, then you should round both R1 and R2 values in the same direction – ie up or down, to preserve the correct ratio. However, this will result in the impedance being slightly away from the intended 50R.

| dB | R1 | R2 |
|---|---|---|
| 1 | 870 | 5.8 |
| 2 | 436 | 11.6 |
| 3 | 292 | 17.6 |
| 4 | 221 | 23.9 |
| 5 | 178 | 30.4 |
| 6 | 150 | 37.4 |
| 7 | 131 | 44.8 |
| 8 | 116 | 53 |
| 9 | 105 | 62 |
| 10 | 96 | 71 |
| 12 | 84 | 93 |
| 14 | 75 | 120 |
| 16 | 69 | 154 |
| 18 | 64 | 196 |
| 20 | 61 | 248 |
| 25 | 56 | 443 |
| 30 | 53 | 790 |

**Table A1 – Pi Attenuator resistors**