The DG8 – a Low-Cost, High-Performance Masthead Preamp for 2m

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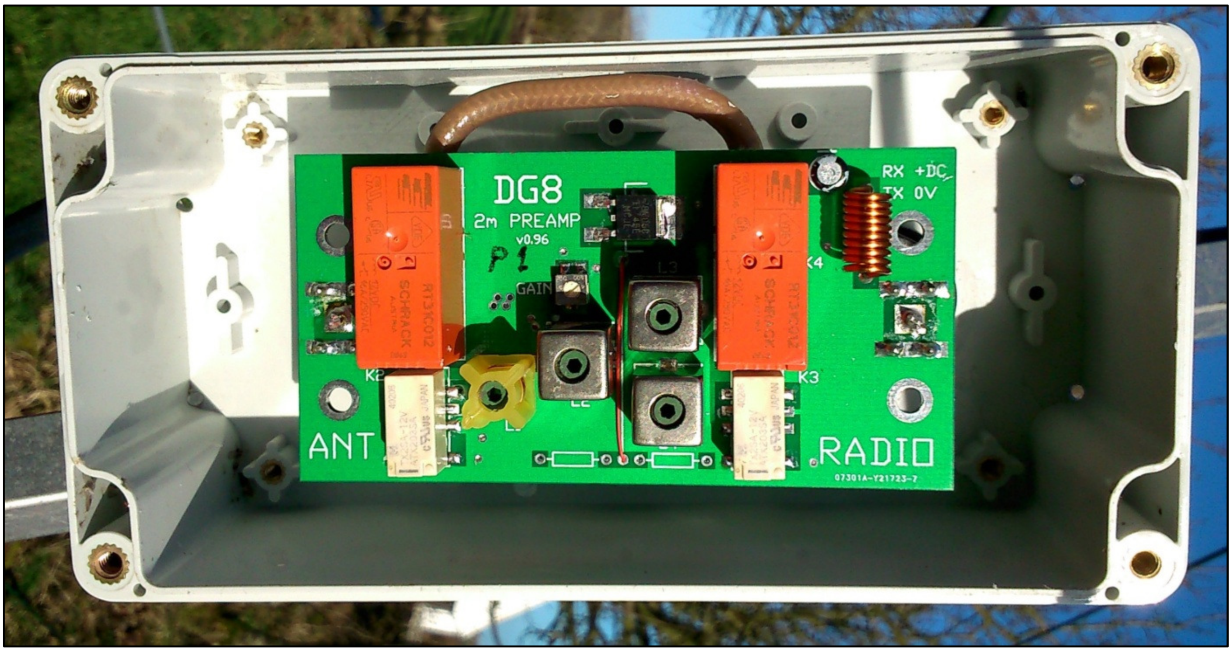


A masthead preamplifier is the greatest single improvement you can make to your receiving performance for VHF/UHF DX and contesting. But the preamp **MUST** be at the masthead for optimum performance, and unfortunately many preamp designs leave the user to provide the necessary RF switching and weatherproofing. As a result, the preamp tends to remain in the shack where it cannot deliver the optimum performance. Meanwhile, many commercial masthead preamps seem expensive for what you get, and the weatherproofing still leaves much to be desired.

The **DG8 Masthead Preamp for 2m** is designed specifically for outdoor use, close to the antenna. The integrated single-board design avoids the expense of coaxial relays without any significant impact on performance (see below). The weather-

Performance Data

Frequency range: 144–147MHz

Noise Figure: 1.2-1.3dB typical
(including relay losses)

Gain: adjustable, 18dB to 11dB

TX Power Handling: 500–750W
(full carrier, JT65 transmit cycle)

TX VSWR: < 1.1

proof packaging uses simple low-cost plastic enclosures and waterproof cable glands. As well as coping with the weather on the West Coast of Scotland, this method of construction offers better RF performance by eliminating unnecessary connectors.

The complete **DG8** design is the fusion of three different strands of ideas which the rest of this article will explore in more detail.

1. The heart of the **DG8** preamp is the 144-147MHz RF front-end from the highly successful *Anglian* transverter by G4DDK, G4SWX and G7OCD (and this part of the circuit is of course being used with their kind permission.) The *Anglian* RF front-end begins with a simple bandpass input filter which protects against all but the strongest signals in the FM and TV broadcast bands. The RF amplifier device is a SPF5043, chosen for its low Noise Figure (0.8dB), gain of 22dB and very good strong signal handling. That is followed by a much narrower 3-pole bandpass filter covering 144-147MHz. I also added a variable attenuator, so that each individual user can optimise the preamp gain for the best overall system performance.
2. A masthead preamplifier also requires RF input and output switching, capable of handling several hundred watts on transmit but also providing low losses and good RF isolation on receive. But a *low-cost* masthead preamp doesn't use expensive coaxial relays when they aren't actually necessary. With careful design and the use of VHF stripline techniques, compact PCB-mounted mains power relays can handle high RF power at 144MHz with low loss and low VSWR. These power relays are backed up by miniature SMD relays for improved RF isolation. The use of PCB-mounted relays for high power RF switching was pioneered by Chris Bartram GW4DGU in his muTek designs, and this work was carried forward more recently by Gyula Nagy HA8ET who identified relays that can handle at least the German power limit of 750W [1].
3. To all this, I added my own experience about performance priorities and the overall system design [2, 3] along with some proven techniques for low-cost, lightweight and thoroughly weatherproof packaging.

This article takes a 'top-down' design approach. First we are going to identify everything that the preamp will need to accomplish. Then we'll set about designing and building it.

Performance Priorities

The first priority for VHF/UHF DXers and contesters is to be able to copy weak signals. That requires a low Noise Figure (NF) for the receiving system as a whole. But we also need to maintain that good weak-signal performance when extremely strong local signals appear on the band.

There is always some conflict between those two performance priorities – as we shall see, preamplifier gain can be both your best friend and your worst enemy. An optimised receiving system design will always need to find the best balance.

Our ability to copy a weak signal is measured by its Signal-to-Noise Ratio (SNR). For any given signal level, the SNR will be determined by the competing level of noise, which is the sum of two separate components: the internal noise generated within the receiver itself, plus external background noise picked up by the antenna. If we aim for the receiver's internal noise level to be the same as the **minimum likely** level of external noise at a quiet site, then the receiver will be about as sensitive as it needs to be for terrestrial DXing and contesting. There is no point in striving to reduce receiver noise much further because (a) the SNR will still be limited by external noise, and (b) the strong-signal handling will rapidly become worse.

For the 2m band, a NF of around 2dB is well established as a good design target for the receiving system as a whole [2, 3]. Relatively few people except moonbounce and satellite operators can make practical use of a NF lower than this; while many urban dwellers may find 2dB is lower than they need.

To achieve the goal of 2dB for the complete receiving system, the NF of the preamplifier will need to be lower than 2dB, and the NF of the RF amplifier device inside the preamp will need to be lower still. With that in mind, the **DG8** preamp uses an SPF5043 RF amplifier device with a NF of 0.8dB, giving a NF of about 1.2-1.3dB for the complete preamp (including the RF switching relays). The gain is adjustable between about 12dB and 18dB, which will be enough to meet the target of a 2dB NF for the complete receiving system.

But meanwhile, don't forget our other major priority: to be able to copy weak signals without overloading by strong signals. The main causes of receiver overload are:

Third-order intermodulation – spurious signals generated within the receiver caused by *two* strong signals that are not on the receiving frequency. Typically these strong signals would be either inside the 2m amateur band or just outside the band. A defining feature of 'intermod' problems is that if either one of the two stations stops transmitting, the spurious signal disappears completely.

Blocking, limiting or gain compression – three names for essentially the same problem, where *one* extremely strong signal drives an amplifier or mixer device within the receiver to the physical limit of its available output. Any further increase in input level can cause no further increase in output from the affected stage, which corresponds to a reduction in gain – and that will be for *all* signals, including the one you're trying to copy. In extreme cases of limiting, a strong carrier makes the whole receiver fall quiet (which is what FM receivers are specifically designed to do, but SSB/CW receivers definitely are not!). Blocking can be caused either by strong signals inside the amateur band or by extremely strong out-of-band signals from nearby commercial transmitters.

Phase noise, noise sidebands and reciprocal mixing are all problems connected mainly with the Local Oscillator of your transceiver so they are not the main focus of this article.

All of that interference is being **created within your own receiving system** when other strong stations appear on the band, **and is entirely your problem** – you can't blame other stations merely for being there, and being strong! Other stations certainly do transmit spurious signals as well, but you won't be able to resolve those problems unless you first understand the performance and limitations of your own receiving system.

How Much Gain Do I Really Need?

Gain in a preamplifier is your best friend and your worst enemy. Low-noise amplification is a necessary part of achieving a low system NF; but too much amplification will make **all** signals stronger, which plays havoc with the strong-signal handling.

That is why we always need to think about finding the optimum balance – **enough gain, but not too much**. This is where a preamp at the masthead allows us to find a better optimum.

A preamp in the shack is the perfect example of a 'lose-lose' strategy. The losses in the long run of feedline will add directly to the system NF, and that degradation in weak-signal performance cannot be completely recovered by a preamp in the shack. Worse still, recovering even part of that lost performance will require high levels of preamp gain, so we have lost performance on both weak signals **and** strong signals.

But that same preamp at the masthead will avoid the feedline losses on receive, and so will give us a lower system NF using less preamp gain. Simply by moving the preamp to the masthead, we have transformed a 'lose-lose' situation into a 'win-win'.

Optimization is a numbers game, which is why I have included a downloadable Excel spreadsheet http://www.ifwtech.co.uk/g3sek/vhfdx/dg8-design-calcs.xls which you can use to analyse your own station. Simply overtype my cable losses with estimates of your own, and then you can then calculate the effects on your receiving system NF. Further technical details are beyond the scope of this article but the whole spreadsheet is based on information from *The VHF/UHF DX Book* [2, 3].

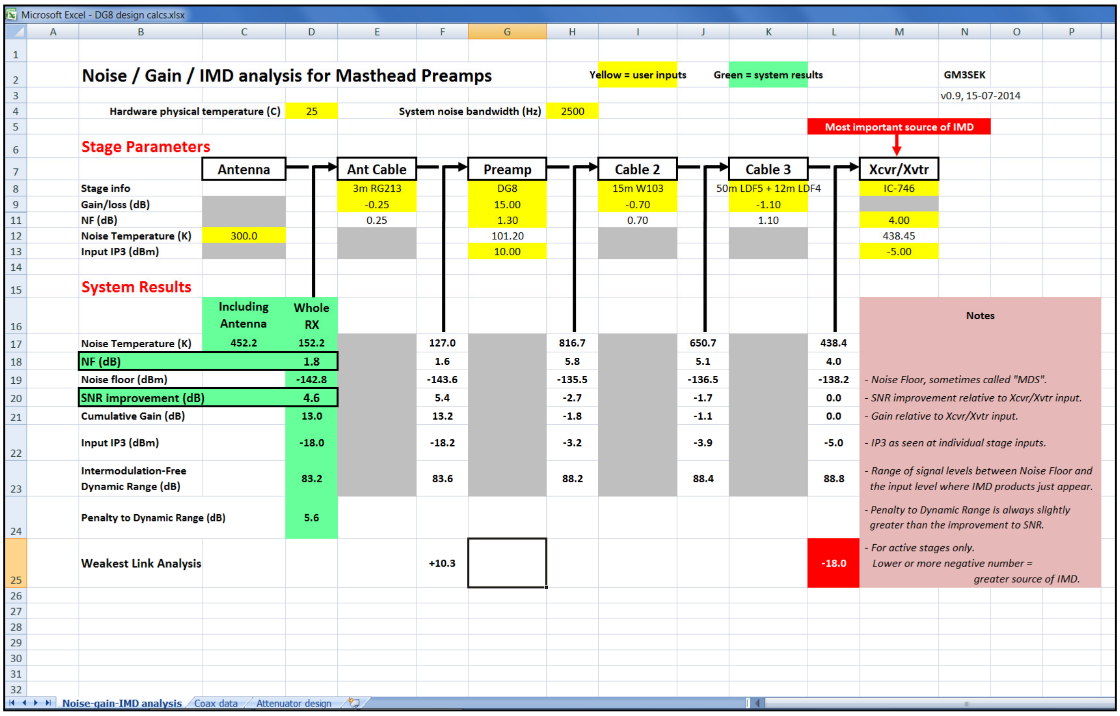


Fig.1: Spreadsheet to calculate receiving system NF and strong-signal performance

The spreadsheet also estimates the effects of gains and losses on strong-signal performance, and the highlighted red box shows that **the 'weakest link' in strong-signal performance is always the transceiver – not the preamp**. The point where overload takes place is probably quite deep inside the transceiver, at the output of an amplifier or mixer stage where signal levels have built up to a substantial fraction of a volt. An external preamplifier makes all incoming signals even stronger, which causes that stage inside the transceiver to overload more readily. It is actually quite difficult to overload the preamp itself, especially a design like the **DG8** which uses a high dynamic range RF amplifier device devices and good filtering for out-of-band signals (which is why I adopted those proven features straight from the *Anglian* transverter).

If you are using a preamp ahead of a VHF/UHF transverter followed by an HF transceiver, the transverter will provide even more gain for all in-band signals, so most likely point of overload will then become the HF transceiver.

This is why it is vital to **use the minimum possible amount of preamp gain**... which can only be achieved by mounting the preamp **at the masthead** and then carefully adjusting its RF gain with an aim to reduce it even further if possible. And having done all that...

Switch OFF the internal preamp in the transceiver!

You only need ONE preamp – the one at the masthead.

RF Switching and Sequencing

Enough now about receiving. A masthead preamp must also provide switching for the transmitted signal. This requires relays that have a low VSWR at VHF/UHF and are capable of carrying full legal power. Digital modes like JT65 also require that everything is rated for alternating 60-second periods of full carrier.

Fortunately, traditional coaxial relays are not needed at 145MHz – at least, not for terrestrial applications where the ultimate in low receiver noise is not required. With careful design, compact PCB-mounted power relays can handle high RF power at 144MHz with low losses and low VSWR. The use of PCB-mounted relays for high power RF switching at VHF was pioneered by Chris Bartram GW4DGU in some of his muTek designs, and this work was carried forward more recently by Gyula Nagy HA8ET [1]. The changeover relays identified by HA8ETcan handle at least the German power limit of 750W, and many thousands of similar relays have proved themselves capable of carrying 1.5kW at HF with excellent reliability.

The only minor problem is that the large contacts and close spacing provide relatively poor isolation to the open-circuit port, especially at VHF. HA8ET solved that problem by using compact SMD relays at the input and output of the receiving preamp to provide the additional isolation, and that idea has also worked very well here.

To make the **DG8** preamp as easy as possible to install at the masthead, I decided that no additional cables should be required – no DC power/control cables, and no separate coax downlead for the receive signal either. Instead, the **DG8** is simply connected into the existing coax feedline, as close as possible to the antenna, and the switched DC power for the preamp and the relays arrives on the centre conductor of the main feedline from the shack. When no DC power is applied, the preamp reverts to a 'safe' state with the RF amplifier fully isolated and a direct RF connection from input to output.

Because the DC power is fed through the coax, the DG8 has to include an on-board 'bias tee' to separate the DC supply from the RF. You will also need a similar bias tee in the shack to inject the switched DC power onto the centre conductor of the coax. The DC blocking capacitors at both ends of the line have to carry the full transmit power, so these are special SMD mica components. Only one capacitor is required for power levels up to about 500W, but the **DG8** board makes provision to use two in parallel for higher power levels.

All preamplifiers require a sequenced TX/RX changeover system to avoid transmitting before all the relays have changed over. TX/RX sequencing is another topic that would need a full-length article on its own, but fortunately there are some good articles on the web. The **DG8** is fully compatible with a number of modern TX/RX sequencers which also include the bias tee, such as the SSB Electronic DCW 2004B [4] and many lower-cost and DIY alternatives such as the boards from W6PQL [5] and W1GHZ [6].

If TX/RX sequencing is new to you, the web pages by those two US authors make an excellent introduction, along with Chapter 11 (Transmit/Receive Control) in *The VHF/UHF DX Book* [2].

Weatherproofing

The other major priority for a masthead preamp is to keep it working in all weathers!

Many people avoid using masthead preamps because of poor reliability – but here is some good news. A home-built masthead preamp can have far better long-term reliability than a commercial product, because we have freedom to do things that commercial manufacturers can't.

What's wrong with bulkhead connectors?

Most commercial preamps and antenna switches use metal enclosures with ordinary N or 'UHF' flanged sockets that were never designed for outdoor use. Water can easily get underneath the bolted flanges and a connector mounted on a flat surface is very difficult to seal by wrapping with tape. Bulkhead sockets also bring technical problems inside the enclosure, either requiring internal connectors and jumper cables or else encouraging poor RF termination techniques. So why do commercial manufacturers use bulkhead connectors at all? The only reason is marketability – so that the product can be packaged neatly for shipping and sale. **Bulkhead connectors are not used for any reason related to performance.**

DIY is better

If you choose to build your own preamp, none of those problems need affect you. As a home constructor, you can build a masthead preamp with **much better weatherproofing**, with **better performance** due to eliminating unnecessary connectors – and all at a **much lower cost**.

My Prime Directive for weatherproofing is: **no exposed metal parts**! No metal cases, no bulkhead coax sockets, no metal power connectors and no fixing bolts penetrating the enclosure. This is very easy to achieve as shown here, using an inexpensive IP65 waterproof plastic box, with 'tails' of coax and control cable coming out through waterproof plastic cable glands. All connections are made using inline plugs and jacks – your choice, to eliminate all unnecessary back-to-back adapters or jumpers. These inline connections can then be easily and completely waterproofed by wrapping with tape.

But sealing against rainwater is not enough! Even an IP65 enclosure is not gas-tight, so the daily cycle of atmospheric warming and cooling can draw water vapour into the enclosure where it condenses – and then accumulates because it cannot get out. For that reason, it is much better to drill small vent holes in the enclosure to allow the pressure to equalise and any liquid water to escape. To provide additional protection for the internal electronics, use a conformal coating spray (see the Construction Notes later).

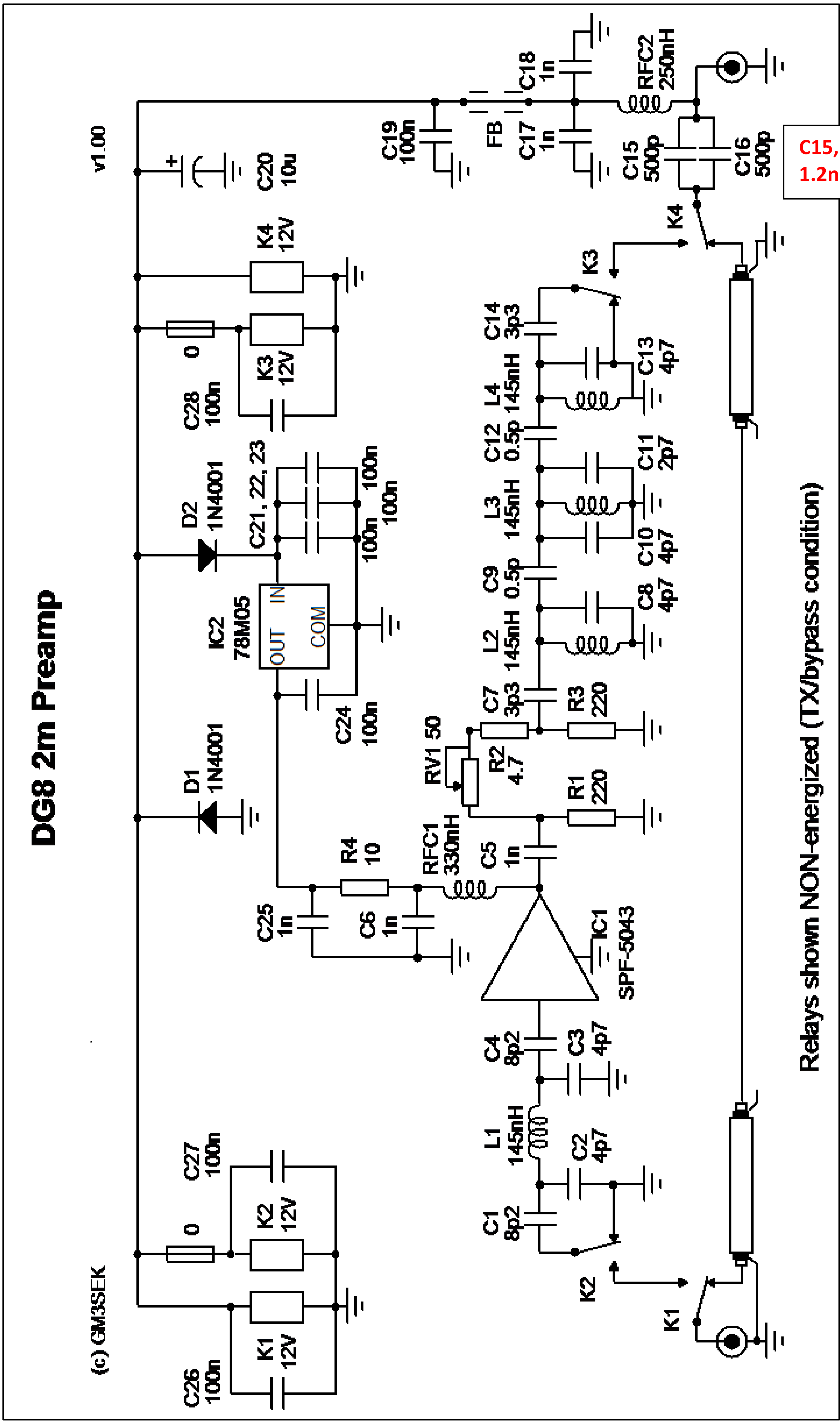
Use Custom Cables for Minimum RF Losses

To reduce RF losses even further, **use the exact lengths of coax that YOU need** for **your** particular installation. The lead photo shows how the input cable for my own DG8 preamp is just long enough to connect with the short length of RG213 coming from the antenna feedpoint. RG213 was chosen for flexibility and reliability, so the output cable is a longer continuous length of RG213 that also includes the rotator loop, ending with the correct connector to mate with the lower-loss but less flexible cable coming up the tower.

Proven Performance

These techniques for cable termination and waterproofing have proved 100% reliable over several years, at a location that experiences frequent driving rain and wind-driven salt spray. They work where other techniques have failed.

Main updates marked in red.



C15, C16 = 1nF or 1.2nF, 1kV

Fig.2: Circuit diagram

Construction Notes

Construction of the **DG8 Masthead Preamplifier** is very straightforward. Experienced constructors can probably "Just Do It", though you may still find it easier to follow the sequence below.

The Circuit Diagram is on the previous page (**Figure 2**) and the complete Components List is at the end of this article.

Enclosure preparation

Use the bare PC board to mark the hole centres for the cable glands (**Figure 3a**). Drill pilot holes at the marked locations and then open out the holes in several careful steps to 16mm diameter. Also drill four 2mm weep holes near the corners of the box to equalize the air pressure and allow drainage of any condensation. **Figure 3b** shows the four holes and installation of the cable glands. Fit the rubber washers inside the box (no further sealant is required) and tighten the 16mm plastic nuts down very firmly.

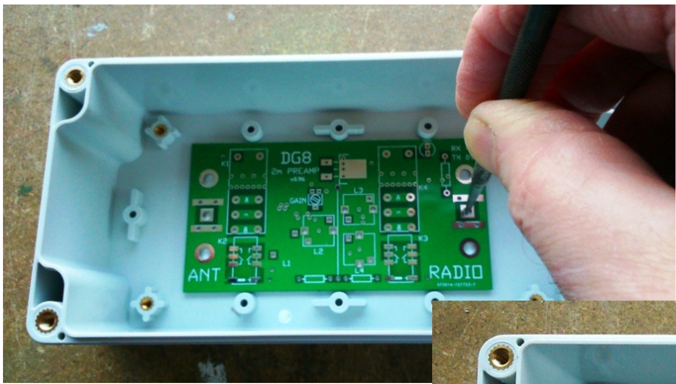
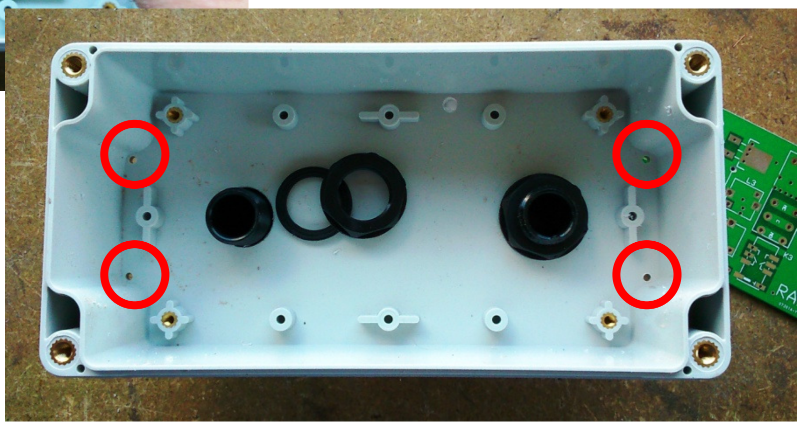


Fig.3: (a) Marking out for cable glands, (b) Installation of cable glands – note the four small drainage holes.



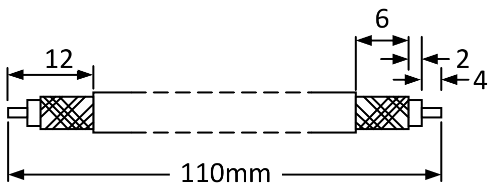
The completed enclosure can be seen in the lead photographs on page 1.

As an alternative to the drilled holes, you could fit an engineered breather vent on the lower long edge of the box – the edge opposite the coax loop. This vent is designed to equalise the pressures inside and outside the enclosure, allowing water vapour to escape while keeping liquid water out. The engineered vent plug requires a single 12mm hole and an M12 retaining nut.

Circuit board assembly

Begin with the underside of the board (**Figure 4**).

1. ***Install the coax bypass link between K1 and K3, underneath the board. This coax has to carry 400W or more, so the recommended cable is a 6mm OD, PTFE insulated type such as RG303 or RG142.***



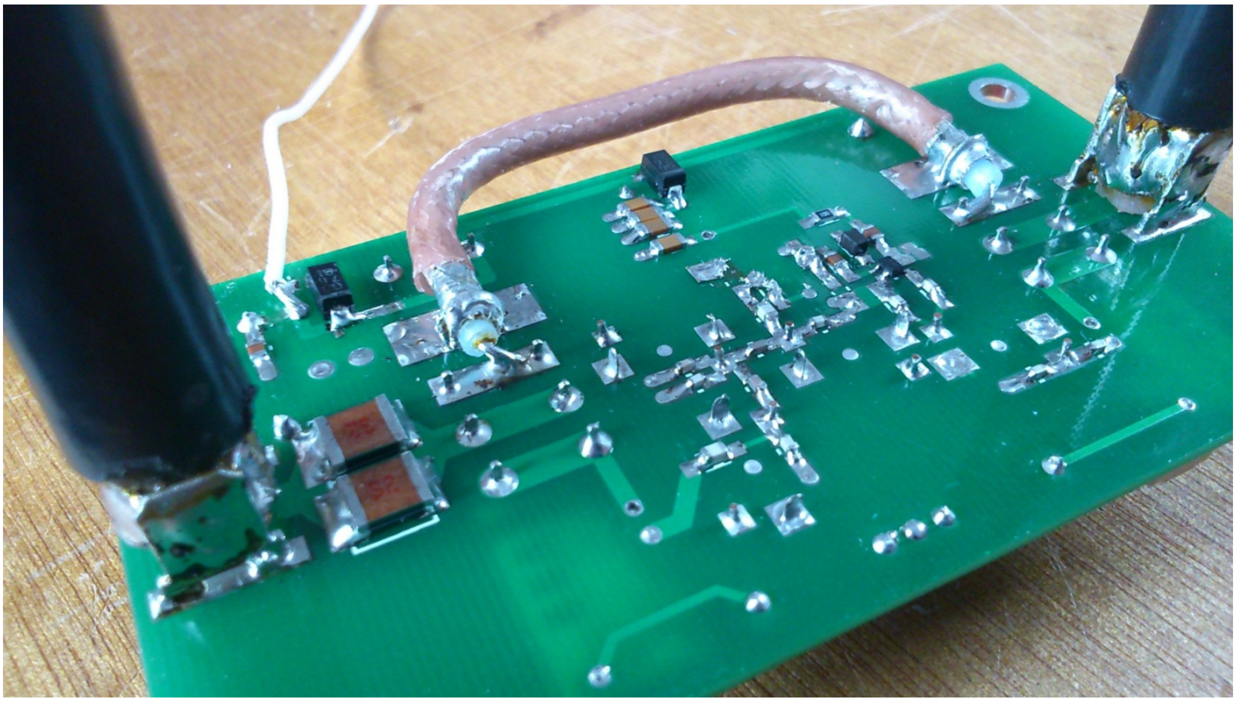


Fig.4: Underside component layout (production boards have printed component markings). Note the coax bypass link (Step 1) and the RG213 input/output terminations (Step 5).

a) The overall length of cable is 110mm. Remove 12mm of jacket from each end and prepare as shown below. (Tip: pre-tin the whole 12mm of bared shield, score around at 6mm and snap off the unwanted end by bending back and forth.) **Carefully remove any loose strands of braid.** Bend the cable into a parallel-sided U shape as shown in the photograph. To avoid kinking the cable, make the bends around a solid former. Tie each bared end of the shield to the board using loops of 1mm tinned copper wire, threaded through the holes in the large rectangular solder pads (see Figure 4). Tighten each loop by twisting the wires on the topside of the board. Solder the coax shield onto the solder pads and the U-shaped tie wires. (Only solder the tie wires on the underside of the board, not the topside.) When cool, turn the board over and cut the wires off flush to the topside. Use a craft knife to make a really flush cut, so that K1 and K3 can sit tight down onto the board.

b) Finally, bend each end of the centre conductor down to touch the pad between the relay pins, and solder.

2. Install components on underside of board.

   Install all of the underside SMD components shown in Figure 4, except for IC1 and the ferrite bead.

3. Install components on topside of board.

   For ease of access with a hot soldering iron, follow the sequence below.

   a) Wire link W1 (Kynar or PTFE insulated wire is recommended)

   b) IC2 (78M05)

   c) K2, K4 and RV1. (Do not install K1 and K3 yet.)

   d) L1-L4: Pull off the screening cans so you can see which is the upper end of each winding (furthest away from the groundplane). Upper end of L1 goes nearest to L2. Upper ends of L2, L3 and L4 connect down to the groundplane.

   e) Screening cans for L2, L3 and L4 (no screening can for L1). Solder from underside of board, and fill the holes with solder.

   f) K1 and K3: Press these relays tight down onto the board (see earlier). When soldering close to the coax bridge, avoid melting the coax jacket.

   g) RFC2: 10 turns 1mm enameled copper wire, close wound on 5.5mm drill. Mount with 3mm spacing above the board. RFC2 is part of the VSWR compensation, so make it exactly as specified.

   h) C20, the wire-ended electrolytic capacitor.

   All of the topside components should now be in place.

4. Install IC1 and test voltages/currents

   a) On the underside, install IC1. Take great care to install this IC the correct way around – one of the pins is broader than the other three, and that goes onto the broad PC pad connected to the grounded area nearest the centre of the board.

   b) Connect a current-limited +12V DC supply to the positive side of C20. You should hear all four relays click, and the total current draw should be close to 130mA. The voltage at the junction of C24 and R4 should be very close to 5.0V and the voltage drop across R4 (10R) should be about 0.45V.

      Correct any faults before proceeding further!

5. RG213 coax terminations

   Figure 4 shows how the cable shields are soldered between two large solder tags (listed in catalogues as "6.3mm/¼in blade connectors"). This DIY termination method doesn't look pretty but don't let that fool you – it has excellent RF performance.

   a) Solder the large tags into place on the **underside** of the board (two tags per termination). Re-tin the inside facing surfaces of the tags.

   b) Decide what lengths of RG213 you wish to attach to the input and output. Remember, this is your chance to eliminate unnecessary adapters and jumpers. Measure the lengths of cable and cut the ends accurately square.

   c) Remove 15mm of the RG213 outer jacket, then lightly solder-tin the outer shield braid to prevent any loose strands. Cut through the braid (but not the centre insulation) to leave 10mm of bare tinned shield exposed beyond the end of the jacket.

d) Leave 2-3mm of bared centre insulator beyond the end of the shield, and then remove the remaining insulation to leave a final 3mm of centre conductor. Check again for loose strands.

e) Now is the moment to pass the prepared ends of the cable through the cable glands and through the holes in the waterproof box. **Don't forget to do this!**

f) Feed the prepared end of the cable between the solder tags and push the centre conductor through the board. Make sure the end of the insulation presses firmly against the underside of the board, and make a final check for loose strands of braid. Then solder the centre conductor on the topside of the board and trim off any excess length.

g) Use pliers to squeeze the two solder tags inward so they grip the coax, and then quickly solder the braid to the tags using a large iron. Aim for a solid line of solder along both edges of each tag – see Figure 4.

6. Final cleanup

   Before alignment, clean up the board with flux solvent. Rinse at least two times until the board no longer feels sticky. Take care not to allow solvent inside the screening cans of L2, L3 and L4.

Power-up and Alignment Instructions

If you have followed the list above, you already completed all the DC tests in step 4(b).

Alignment consists only of optimizing the bandpass filter L2-3-4 followed by a very small adjustment of L1 for minimum NF. Use the correct plastic trimming tool to avoid breaking the fragile ferrite cores!

1. The best way to power the preamp board for these tests is to remove the SMD ferrite bead and connect a +12V DC supply directly to the board (the white wire in Figure 4).
2. Connect the input of the preamp to a 2m antenna, and the output to a receiver tuned to 145.0MHz SSB with the AGC switched **OFF**. You may also find it useful to set up three quick-access memory channels at 144.0, 145.0 and 146.0MHz (all SSB).
3. When you apply power, the noise in the receiver should increase (it may still be quite low level at this stage). Rotate the trimpot RV1 fully anti-clockwise to maximize the noise level.
4. Set the cores of L2, L3 and L4 exactly one turn below the top of the screening can. The noise level should increase slightly. Adjust the core of L3 inward by about one more turn. The noise level should increase noticeably.
5. Adjust L2 and L4 to increase the noise level. Re-adjust L3 if necessary.
6. By careful setting of the cores of these three inductors it should be possible to equalise the noise levels as you flick between the memory channels on 144.0, 145.0 and 146.0MHz. (If you have access to a spectrum analyser and tracking generator, then of course use it; but remember to keep the RF input level well below 0dBm.)
7. With the receiver manually tuned to 144.30MHz, carefully adjust the core of L1 to maximize the noise. Do this as accurately as you possibly can, and then adjust the core of L1 inward by exactly a quarter-turn.

8. Where we go next will depend on your access to test equipment:

   a) If you have no test equipment at all, don't worry – if you were careful and accurate when carrying out Step 7, you are already very close to the optimum NF.

   b) Another simple method is to switch to FM and find a very weak and 'noisy' FM signal that is right at the threshold of demodulation. Now very carefully adjust L1 for the clearest possible modulation relative to the noise, in other words for the best possible SNR.

   c) If you have access to a Noise Figure Meter, it should be possible to optimize the noise figure to around 1.3dB at 144.3MHz.

   By any of those methods, the core of L1 should still be very close to where it was at the end of Step 7.

9. Rotate RV1 fully clockwise and notice that the noise level decreases. Then advance RV1 counter-clockwise until you hear a clear increase in noise level; but no further. In most stations this will be close to the optimum balance between good sensitivity and good dynamic range.

10. Connect a 2m antenna and switch on the receiver AGC. **The noise level arriving from the preamp must not be high enough to activate the AGC** – that would be a sure sign of too much preamp gain. If there is any movement of the S-meter due to background noise (apart from intermittent impulse noise) then return to Step 9 and reduce the preamp gain.

11. Remove the temporary +12V DC connection, replace the ferrite bead (FB) so that the preamp can be powered through the coax, and check for correct operation with your TX/RX sequencer.

Final Weatherproofing and Installation

When everything is OK, apply an acrylic conformal coating for weatherproofing (see Components List below). Mask off the adjusting screws of L1, L2, L3, L4 and RV1 with small pieces of tape, and then lightly spray both sides of the board including the ends of the RG213 coax. Allow to dry in a well ventilated area.

Slide the preamp board back into the enclosure and hand-tighten the cable glands to make them fully waterproof. Your completed DG8 preamp should look like the lead photograph.

Finally, tighten down the lid that seals the enclosure, making sure that the gasket is correctly seated into its groove.... and your preamp is ready to install. As you see from the lead photograph, I simply taped mine to the boom of the Yagi, close to the feedpoint.

Components List

Most components are available from the well-known suppliers Farnell (http://uk.farnell.com) and CPC (http://cpc.farnell.com). The PC board and other specialised items are available as a 'short kit' from G4HUP (http://g4hup.com).

A parts list is also available that can be pasted directly into the Farnell ordering system: http://www.ifwtech.co.uk/g3sek/vhfdx/dg8-farnell-order.xls Unfortunately some items are only available in larger quantities, so the Farnell system automatically increases the numbers. Try to share with a friend!

Capacitors All 0805-size SMD unless otherwise noted.

Value	Ref	Notes	Supplier and Order Code
0p5	C9, C12	Close tolerance +/- 0.5pF	Farnell 1740744
2p7	C11		Farnell 2332766
3p3	C7, C14		Farnell 1856217
4p7	C2, C3, C8, C10, C13		Farnell 1855762
8p2	C1, C4		Farnell 2332712
1000p 1kV or 1200pF	C15, C16 (use one capacitor for 500W RF, two for 750W+)	CDE mica	Farnell 2112927 or 2420172
1n0 50V	C5, C6, C17, C18, C25	Use C0G ceramic only!	Farnell 317457 or similar
100n 50V	C19, C21, C22, C23, C24, C26, C27, C28		Farnell 1759266 or similar
10u 35V	C20 wire ended radial electrolytic		Farnell 9451242 or similar

Resistors All 0805-size SMD unless otherwise noted.

Value	Ref	Notes	Supplier and Order Code
4R7	R2		Farnell 2447677 or similar
10R	R4		Farnell 2447556 or similar
220R	R1, R3		Farnell 2447606 or similar
50R	RV1	Trimpot	Farnell 2321831

Other components

Value	Ref	Notes	Supplier and Order Code
L1-L4	Coilcraft 10K series inductors , 142-04SL		G4HUP
RFC1	330nH, Coilcraft 0805CS-331XJLB		Farnell 2286428
RFC2	Hand made		See Construction Notes above.
FB	SMD ferrite bead		Farnell 1651723
K1, K4	Schrack/TE RTC31C012		Farnell 1770612
K2, K3	PANASONIC EW - TX2SA-12V		Farnell 910480 or similar, eg 9950036
S1M	D1, D2	1A, 1000PIV	Farnell 1791846 or similar
78M05	IC2		Farnell 2323452 or similar
SPF-5043 IC1			G4HUP
Coax cable	110mm of RG303 or RG142 PTFE cable		See Construction Notes above.

Hardware

Notes	Supplier and Order Code
PC Board	G4HUP
2-pin PCB blade terminals (4 required)	G4HUP
Enclosure, HITALTECH - SE-226-0-0-D-0	CPC EN82698
Cable glands, Hellermann Tyton - NGM16-BK (2 reqd)	CPC CB15745
Venting plug (see text), Hylec JDAE12PA7035 (NB: requires M12 securing nut.)	CPC EN83189
Conformal coating spray, Electrolube APL400H	Farnell 3026838 or similar

References

[1] *Mast-Mounted EXTRA-2 144 MHz Contest Preamplifier* by Gyula Nagy HA8ET http://www.ha8et.hu/Mast_Mounted_EXTRA_2/Mast_Mounted.htm

[2] *The VHF/UHF DX Book* edited by Ian White G3SEK. (Out of print, occasionally available on eBay or from dealers.)

[3] *Modern VHF/UHF Front-end Design* by Ian White G3SEK. Parts 1–4, *Radio Communication* April–July 1985.

[4] http://www.radioworld.co.uk/DCW-2004B_SSB_ELECTRONICS_Sequencer_for_6m2m70cm

[5] http://w6pql.com/lna_sequencing_and_protection.htm

[6] http://www.w1ghz.org/small_proj/small_proj.htm