THE JUMA PA1000

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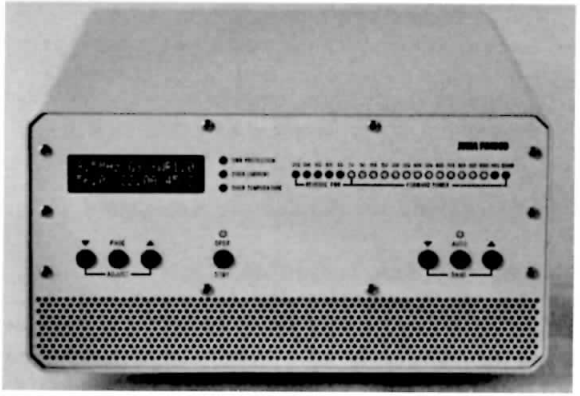
The Juma PA-1000 is an HF to 6m 1kW amplifier that weighs just 5.5 kg including its mains power supply – what's not to like?



The importance of low weight

DXpeditions who take all their kit with them (as opposed to shipping it ahead) always face an airline weight and size restriction. Over the last couple of decades rigs have become smaller and lighter and in more recent times coax cable has seen dramatic reductions in weight for the same loss/m - but a linear amplifier is always a heavy, bulky item. There are heroic stories of teams carrying ACOM 1000 amplifiers, but for an individual with a 7kg carry on and 23kg check down that is just not a realistic proposition. Until recently excess baggage costs were not unreasonable, but these have increased sharply as airlines, even National carriers, have used additional bags as a way of increasing revenues. The advent of solid state amplifiers and in particular the LDMOS chip has opened up new possibilities for lightweight PA's.

The table shows currently available amplifiers and their performance. All are available world-wide, many with local distributors, but I have used the December 2016 UK prices for my comparisons. The table is sorted lightest to heaviest. Reviewing the table it is clearly evident that the Juma PA-1000 looks attractive. Essentially it is ACOM 1000 performance at close to one third the size and one quarter the weight - and is currently slightly cheaper.

Manufacturer	Model	Pmax	Weight (kg)	Volume (l)	Price
Juma	PA1000	1000w	5.5	10.6	£2,320
SPE	Expert 1.3K	1300w	7.5	12.1	£2,600
SPE	Expert 1.3K (with ATU)	1300w	9.5	12.1	£3,530
Elecraft	KPA-500	500w	12	9.5	£2,650
ACOM	600s	600w	12	20.7	£2,400
Linear Amp	Gemini 1K	1000w	15	24	£2,200
ACOM	1000	1000w	22	27.3	£2,400

Of course there are other parameters that could be important; the Expert 1.3K can be bought with a built-in ATU, the KPA-500 integrates easily with Elecraft rigs, ACOM have a superb reputation for longevity etc. etc. but for me size and weight were the two important parameters for a KW-class amplifier for DXpedition use.

When Justin, G4TSH and I were at the Finnish Contest Club meeting in Helsinki in February 2016 we met with Matti OH7SV who along with Juha OH2NLT produces the Juma products [1]. We were aware that Michael, G7VJR also had one on order, and we duly placed our orders before leaving Helsinki. It is important to note that the delivery for a Juma PA1000 is 'around six months' and they can only be purchased directly from Juma in Finland. Our plan was to take two of these lightweight amplifiers on the 6G's Dxpedition to ZL7G [2] in place of two Elecraft KPA-500's. In the event, with the Juma's being delivered just four weeks before we set off we took a spare KPA-500 'just in case' (and that turned out to be a good decision).

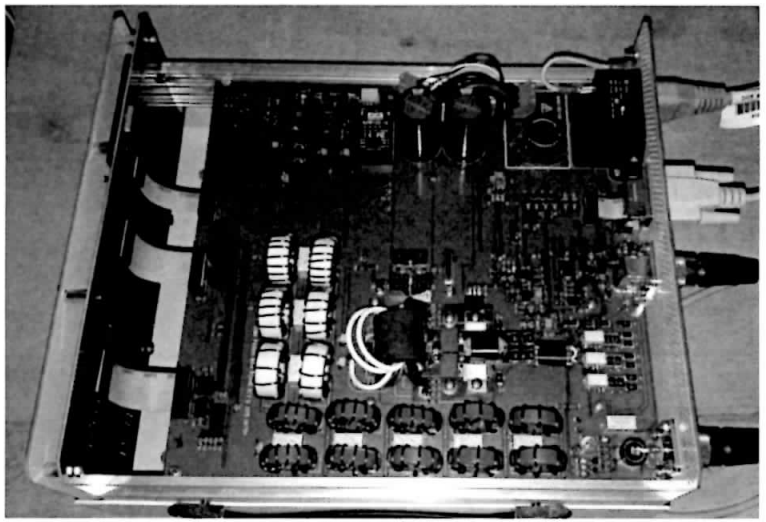
Juma PA1000 description

In common with the Expert the Juma uses a Freescale LDMOS chip. (The Gemini uses two LDMOS chips to gain, they say, greater linearity). The Juma saves its weight by using a smaller heatsink and 'a light weight resonance power supply' (Elecraft for example uses a linear PSU in its KPA-500 and the transformer constitutes a large percentage of its weight).

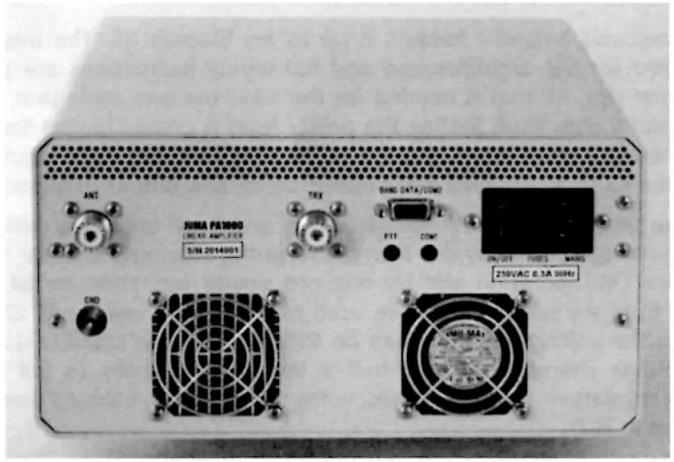
There are eight gain settings which are accessed from the front panel (i.e. not factory set) and these can be set and remembered per band. Running into a dummy load – i.e. a perfect match – I found the gain settings could be used to provide 1kW output with drive levels between 4w and 10w (highest gain setting) and between 18w and 25w (lowest gain setting) from 160m to 6m. This opens up the very real possibility of using a 10w rig to drive the amplifier, more of which later. One real concern is that of putting too much drive power into the amplifier. There is a front panel control that allows you set to the maximum power from the rig you are driving from which protects the final transistors by limiting the gain setting range. Juma say they have added protection to prevent a disaster, but I would prefer a feedback loop that tells your rig that an amplifier is connected – the Elecraft KPA-500/K3 combination does this. A simple inhibit would not have been too difficult for Juma to engineer.

Band control is either manual or automatic using the standard 4-wire BCD output that most rigs provide. The Juma covers all bands from 160m to 6m with the exception of 60m. It has an 'unfiltered' band where all of the output filters are bypassed which would allow 60m to be used if you provide your own filtering – but would be a complete disaster if used without an output filter! There is no in-built ATU and no option for one.

The external appearance of the box is clean and functional and different from what we have been accustomed to seeing from major manufacturers of late. Inside it is clear that this is not a mass-produced item but the workmanship is good. The LCD display is blue and slow to update, this could probably be fixed with a firmware change (the speed, not the colour!), but you get used to it. The rear panel is clean and functional.



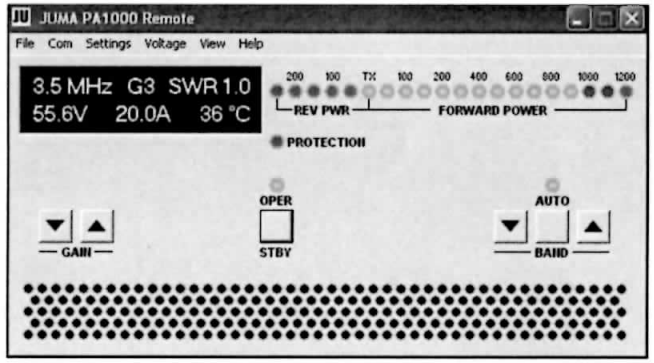
Internal view



Rear panel

Another really nice feature, but not so useful for a DXpedition, is the ability to remote control the amplifier over an RS232 link. The picture shows the remote screen which looks neat and there is also a small 'widget' which takes up little screen real estate but tells the operator all he really needs to know in normal operation.

The Juma documentation shows how to configure the amplifier for remote use over the internet, but Justin and I have yet to try that.



Remote screen

On-screen widget

First switch on

As soon as my unit arrived I hooked it up to my Elecraft K3. The interface cable is supplied pre-wired for the amplifier end and full wiring instructions are provided for a number of popular rigs. All that is needed for the K3 is the one cable that provides band data and PTT - and a coax lead. Setting the power level is critical in that too much power could blow up the input attenuators. But the gain settings and low drive requirements allow the 100w PA in the K3 to be disabled and a maximum of 12w output to be fed to the Juma.

There are two settings for the PA voltage: 'High' and 'Low' but these correspond to just a 10% change in voltage. Juma say this is to optimize the efficiency and the 'Low' setting is recommended for CW operation and for reduced power operation on all modes below 700w especially in heavy use. At ZL7G we used the amplifiers mainly on CW and usually forgot to change the voltage setting when on SSB! The voltage stability is quite amazing with the PA voltage changing by only half a volt from standby to full power – that represents a 1% regulation. (NB: before you write to the Editor, I should point out that we had a 1kW licence in ZL7).

Various test data is available on the Juma website for spectral purity [3] and Michael, G7VJR and Bob, G3PJT conducted other tests that they reported on the CDXC Reflector [4].

DXpedition use at ZL7G

Many owners will never use their linear in a multi-station environment. But at 6G's we typically manned four stations as long as there was propagation. In the two weeks we were there we had zero cross-station interference from the Juma's – and while we had a reasonable antenna farm, all antennas were verticals and on the low bands were within a wavelength of all other bands.

Like all solid state amplifiers, it is sensitive to SWR's above 1.5:1 and with no built in ATU it does require attention to antenna matching. I have long believed in matching antennas at their feedpoint and using switchable matching units at the base of low band

verticals/inverted L's. Above 40m most antenna bandwidths coupled with the feed coax 'flattening' are sufficient to meet the 1.5:1 criteria over the band segments. If that is not the case then an ATU will be required. At ZL7G with G3WPH's well-matched antennas we never had a problem, but in testing I can confirm that the high-SWR trip does work!

Station set up at ZL7G

With band-data connected and the per-band gain set this is really fit-and-forget operation. The low drive requirements allowed us to connect Justin's KX3 to the Juma PA1000 and we were able to get full power output (probably not quite if running the KX3 off batteries). This represents a fly-away 1KW package weighing in at 6.5kg. Quite something.

So it's perfect then?

At this point the Juma PA-1000 may sound like everything you ever wanted. But there is a downside: the cooling fan noise. Those with a technical background will know that power generating devices, be they valves or semiconductors, are less than 100% efficient in turning DC into RF. The inefficiency presents itself as heat which needs to be dissipated. Valves are often said to be more tolerant of this, but all modern kW amplifiers use ceramic valves and just see how long they last if the blower fails!

In the case of the PA1000 the designers claim to have achieved efficiencies of 75% which reduces the problem, but the power still needs to be dissipated from the LDMOS device. There are three ways to do this: (i) a very large (and heavy) heat sink, (ii) a smaller heatsink with a fan blowing air across it or (iii) water cooling of the heatsink. All solid state amplifiers above around 60w tend to use the fan-blown heatsink arrangement. The next design criterion is how small you can make the heatsink – and the smaller the heatsink the greater the airflow that is required to dissipate said heat. Juma take the 'small heatsink – move lots of air' approach. This in itself does not present a problem other than to move a set quantity of air per minute you can either use a large, slower moving fan or one or more smaller fast moving fans - the latter creating more noise. The PA1000 uses two small (50mm diameter) fans – one to dissipate waste heat from the PSU and one to dissipate waste heat from the PA. These are temperature controlled and, in the case of the PA, sense the temperature right at the device/heatsink interface.

Via a front panel control it is possible to set the temperature at which the fans run at full speed – the range is 50C to 95C and the hi-temperature cut out is pre-set at 105C LDMOS chip case temperature. At ZL7G we set the full-speed temperature to its lowest

setting and the PA temperature rarely rose above 65C. We were mindful of the fact that the amps would need to be available 24/7 for 11 days – some home amplifiers won't see that level of use in a year. We generally ran the amps at 800 – 900w although they will go to 1.2kW. And the fan noise was pretty bad! It was not so much the actual noise but that the fans ramp up immediately on key down and decay rapidly after then end of the over.

Since returning home I have done some tests on the bench into a dummy load running 1kW output using a seven second CQ at 28wpm with a two second gap. The PA temperature rises from 25C to 40C during the first CQ but after five minutes of continuous CQing (about 33 CQs) the PA temperature was sitting between 70C and 75C. All the time the fans are cycling up and down in speed and 'whine' in sympathy with the keying. I have experimented with setting the fan full-speed towards the top end of the temperature range and it certainly reduces the audible noise as the fans cut in later and run at lower speeds. Repeating the test above with the fan set to maximum at 90C increases the five-minute CQing temperature by only 5C. It would be better in my opinion if the fan(s) ran at a moderate constant speed and only ramped up when the temperature started to rise towards the maximum level.

We experienced a problem with one of the Juma amplifiers while at ZL7G. Around half way through the DXpedition we noticed when doing a rig and antenna change that Justin's amplifier was not delivering full power for the usual input drive. Furthermore, the bias current was different to that of my amplifier. Without test equipment or schematics we decided to retire it from use and investigate a repair when we returned home. It still generated RF and we know we did not overdrive it as we had the K3 PA bypassed. So it is uncertain what had failed. As at the time of writing we don't know the answer but it was clearly disappointing.

Concluding remarks

Other than the fan noise I have no complaints at all with the PA1000 and the ability to hand-carry it half way round the world and back was an added bonus. It is easy to set up and easy to use – especially if you have not been used to a 'no-tune' amplifier.

Buying a lightweight amplifier just to take on DXpeditions is a bit of a luxury, but I am now using the amplifier as my main station amp. At UK legal powers it is a delight to use – especially as I have mine mounted under the bench and wear noise-cancelling headphones!

The deterioration in exchange rate during the second half of 2016 added a reasonable amount to the price we had expected (full payment is due only on completion) – but we can expect all imported amplifiers to suffer from this as new stocks arrive in UK. Overseas members will have different exchange rate experiences.

I hope to experiment with remote control of the amplifier in the fullness of time and will report back.

References:

[1] www.jumaradio.com

[2] http://www.6Gs.org.uk

[3] http://www.jumaradio.com/juma-pa1000/JUMA-PA1000-performance.html

[4] http://g7vjr.org/2016/06/juma-pa-1000-harmonic-measurements/