TAPR PSR #115 SPRING 2011

President's Corner

By Steven Bible, N7HPR, President, TAPR

Are you ready for the biggest Amateur Radio show on Earth?

TAPR is ready and will be at the Dayton Hamvention, May 20-22, with bells and whistles, push-buttons and LEDs!

The long ham radio weekend begins with the TAPR Board of Directors meeting Thursday evening at the Ramada Plaza Hotel Dayton, where the directors will hammer out all the issues related to the operation of the organization. All TAPR members are welcome to attend the meeting which kicks off at 7 PM.

The real fun starts shortly after the doors open at the Hara Arena with the TAPR Forum running from 9:15 to 11:15 AM in Room 1. Besides yours truly, the forum will hear words from Scotty Cowling (WA2DFI), Bruce Perens (K6BP) and Phil Harman (VK6APH). See the detailed TAPR Forum schedule on page 2

Friday evening is the annual TAPR-AMSAT, or depending on your perspective, AMSAT-TAPR Banquet, at Kohler Presidential Banquet Center in Kettering, OH just south of Dayton. Bob Bruninga, WB4APR, the "father of APRS" is our after dinner speaker. Time is running out, so make reservations at <http://www.amsat.org/amsat-new/hamvention/2011/Banquet.php> ASAP.

Throughout the Hamvention, the TAPR booth will be buzzing with activity as TAPR shows off the cutting edge of Amateur Radio ware (see page 3). TAPR will be at booths 455-458 in the Ball Arena of the Hara Arena --- same place as last year in the same neighborhood as ARRL and AMSAT.

Right after the Hamvention, TAPR will be finalizing plans for the biggest digital Amateur Radio show on Earth: the TAPR-ARRL Digital Communications Conference (DCC, see pages 15 and 16).

This year's DCC is an East Coast affair: Baltimore, to be specific, on September 16-18. The Four Points by Sheraton at Baltimore Washington International Airport (BWI) is the DCC's specific location.

We will have lots more about the DCC in the next issue of PSR. But for now, I just want to remind you that the deadline for papers is July 31, so finish composing your thoughts for the presentations you would like to make at the conference on any topic dealing with cutting edge communication technology and get your papers to Maty Weinberg (maty@arrl.org) at ARRL Headquarters before the deadline.

I hope to see you at Hamvention!

Steve, N7HPR

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TAPR is a community that provides leadership and resources to radio amateurs for the purpose of advancing the radio art.

TAPR Digital Forum

Dayton Hamvention, Friday May 20, 2011

09:15 – Welcome and TAPR Update by Steven Bible, N7HPR

09:30 – HPSDR Update by Scotty Cowling WA2DFI

An update on the High Performance Software Defined Radio (HPSDR) project (www.openhpsdr.org). Existing and future projects as well as board availability.

10:00 – Griffin: a Whisper and a Chirp by Phil Harman, VK6APH

Griffin is a new HPSDR project that will provide a low power beacon exciter. Covering HF, 6m and 2m, Griffin will generate simultaneous beacons on multiple bands, each modulated independently. Basing Griffin around a large FPGA provides modulation modes such as CW, RTTY, WSPR etc as well as future, as yet unknown, modes.

An on-board GPS receiver will provide highly accuracy frequency and time control of all beacons. An Ethernet connection will enable remote control and configuration via the Internet.

In addition, a revolutionary new beacon mode will enable real time propagation measurement and reporting for all HF and VHF bands.

10:30 – CODEC 2 and Open Hardware by Bruce Perens, K6BP

(At the last minute, David Rowe, VK5DGR, had to cancel his trip to Dayton for personal reasons.)

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Late Breaking News:

WB4APR to Speak at TAPR-AMSAT Hamvention Banquet

"Mr. APRS," Bob Bruninga, WB4APR, will be the after-dinner speaker at the TAPR-AMSAT Hamvention Banquet on May 20 at Kohler Presidential Banquet Center in Kettering, OH just south of Dayton. The topic of Bob's talk will be "Power from Space and in Your Shack."

For more information, as well as how to make a dinner reservation, visit http://www.amsat.org/amsat-new/hamvention/2011/Banquet.php ASAP.

###

Research Opportunity Related to Packet Switched Communication Networks

Greg Jones, WD5IVD, received the following e-mail and passed it on to PSR*:*

My name is Oscar Bruce, and I work for Article One Partners. We work closely with researchers in the field of packet switched communication networks, and we came across your name when searching for experts in this field. We recently launched a research competition related to the industry, and I believe that your interest, knowledge, and skills in this field can potentially earn you as much as $5,000 in rewards. To date, we have paid out $1,105,000 in rewards, proof that patents and research demonstrating their quality are incredibly valuable to companies.

Article One Partners has built an online community of researchers on our site. We post Patent Studies, which are requests for prior art or publicly available documents in any language from anywhere in the world that describe particular technologies as of a specific date. Our registered researchers or Advisors submit these documents in response to the Studies. The rewards stated in the Patent Studies are distributed when Article One determines that an Advisor's submission best matches the requirements of the Study.

One Study, which may be of interest to you, is HPS 090. I personally invite you to work with us by participating in the Study (http://www.articleonepartners.com/study.php?id=732) for a chance to receive the HPS 090 reward. To begin researching this Study, all you need to do is to register as an Advisor. Registration is completely free and it grants you access to all of our Studies, education materials and community forum. When registering, please use the referral code "hps090reach."

Feel free to e-mail me at studymanager@articleonenet.com if you have any questions about Article One and our Studies. We look forward to working with you. See you on the site!

Regards,

Oscar Bruce, Team AOP

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openHPSDR Update

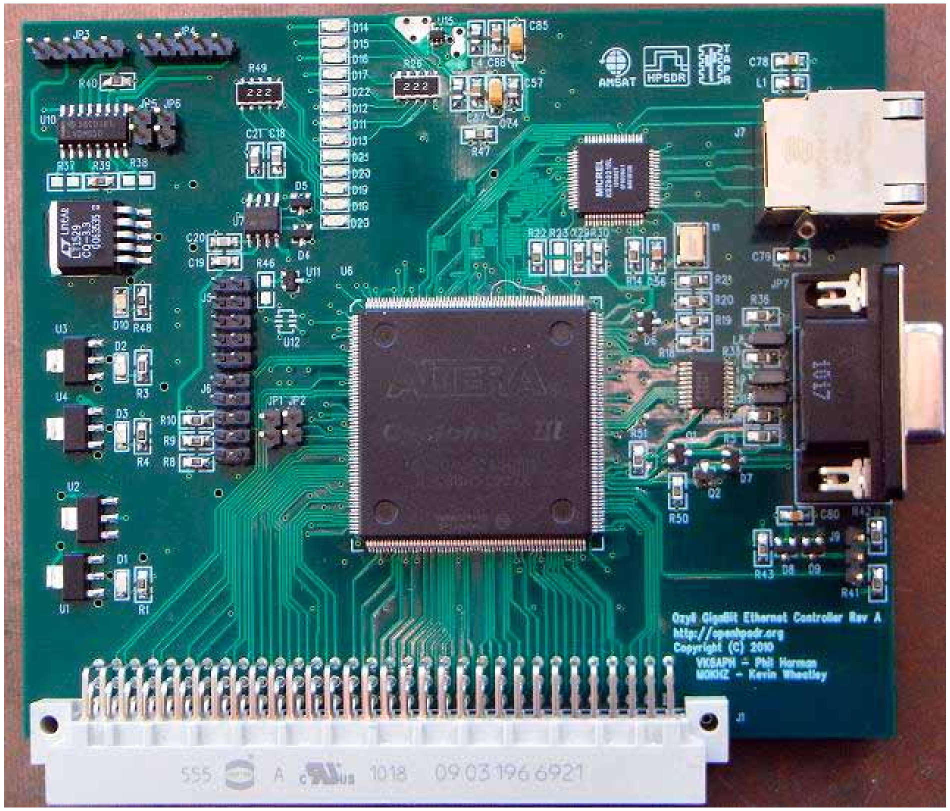
By Scotty Cowling WA2DFI

Lots of exciting things are happening with the openHPSDR project <http://www.openHPSDR.org/> these days. Here, I'll give you a quick update along with some sources for openHPSDR boards and kits. If you are coming to Dayton, don't miss the TAPR Forum at 9:15 AM in Room 1 (forum talks are described on page 2).

The most recent TAPR offering is the Metis board. Metis is an assembled and tested Gigabit-Ethernet board for the Atlas bus that replaces the Ozy/Magister USB interface board. This is a real game-changer for the openHPSDR system, providing a hardware interface to standard Ethernet networks for the I/Q data to and from the openHPSDR system. Thanks to John G0ORXN6LYT, Jeremy NH6Z, and Phil VK6APH, Metis can remotely remotely update the FPGA images of Mercury, Penelope, and Pennylane via Ethernet with a program called *HPSDRProgrammer*.

Perhaps the longest awaited openHPSDR boards of them all, Alexiares (Alex for short) is almost here! Alex consists of three parts: a receiver high-pass filter board (RX/HPF), a transmitter low pass filter board (TX/LPF) and an Alex enclosure kit. If you are mounting Alex inside Pandora, you will need the Alex enclosure kit (or something similar) to provide the necessary shielding. (Pandora is pre-punched and screened for Alex.) The Alex enclosure also comes with punched and screened end plates, making it usable either within Pandora or as a standalone box for the RX/HPF and TX/LPF board set. With all of the toroid problems resolved and the long lead parts issues solved, Alex should be available right after Dayton (June 2011).

For those of you waiting patiently for the new production runs of Magister, Mercury, and Penelope after TAPR sold out of these boards, there is good news. Your wait is almost over. Dan, N4XWE, and I have set up a new storefront called iQuadLabs, LLC to offer openHPSDR boards. Our intent is to make openHPSDR boards available after TAPR's initial production run sells out. Continue to look to TAPR for new, state-of-the-art, leading-edge technology, but look to iQuadLabs for ongoing production. The new production boards

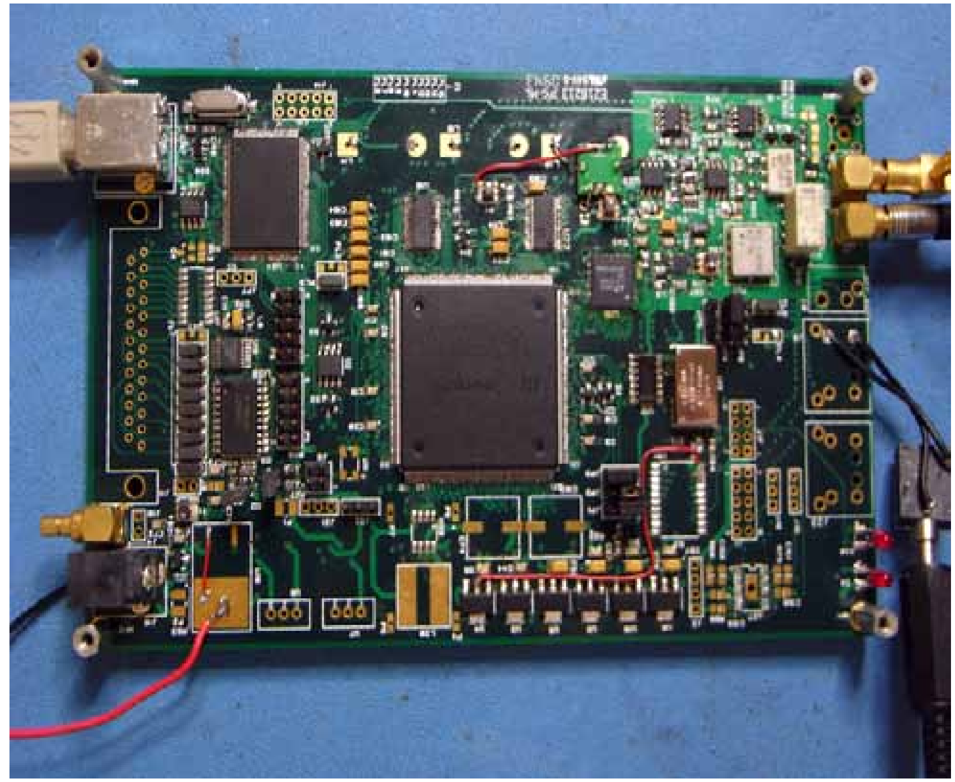


Metis

offered by iQuadLabs are assembled by the same manufacturer that built the TAPR units, so there will be consistency between builds.

One other note on the new production: the new improved Pennylane replaces the original Penelope transmitter. It has a two-stage PA for better output on 6M and implements DAC level control for better linearity at low output power

Pennylane, the new, improved transmitter



Hermes

levels. All other features remain the same.

The most exciting openHPSDR project is the Hermes transceiver and its companion 15W PA/LPF/ATU board, Apollo. These two euro-card size boards fit in a single housing for a complete openHPSDR DUC/DDC transceiver! Kevin, M0KHZ, leads the Hermes project and Kjell, LA2NI, is the project leader for Apollo.

If you stopped by the TAPR booth last year, you will remember that we had a working Hermes/Apollo transceiver prototype. What is taking so long, you ask? It is a year later, and I still can't buy one yet?! The reason is simple: it is all Metis' fault! The temptation to fit a GbE port to Hermes in place of the high-speed USB proved to be too much. Hermes has been reworked to now use Ethernet in place of USB for the computer interface. Come by the TAPR booth (spaces 455-458) this year and meet Kjell and see the new Ethernet-connected Hermes. TAPR hopes to have them in production by the fall. For sure this time.

Come visit www.openHPSDR.org to see what's new. Phil, VK6APH, will be at Dayton this year. You can probably find him at the TAPR booth sharing his considerable expertise with all interested passersby.

You can subscribe to the openHPSDR mailing list and/or announcement list by clicking the link on the left side of the above page. Assembled boards and kits are (or soon will be) available at the following places:

www.TAPR.org:

- Atlas Back plane kit (in stock)
- Janus A/D and D/A board (in stock)
- Pandora Enclosure (in stock)
- Pennywhistle 20W PA kit (in stock)
- Excalibur Frequency Reference kit (in stock)
- Metis Ethernet Interface board (in stock)
- Alex TX/LPF and RX/HPF Filter bards (available June 2011)

www.iQuadLabs.com:

- Magister USB Interface board (available June 2011)
- Mercury Receiver board (available June 2011)
- Pennylane Transmitter board (available June 2011)

Gerd, DJ8AY (reach him at <g.loch@nt-electronics.de> for availability):

- Mercury EU Receiver board
- Penelope Transmitter board
- Hercules 100W PA
- Antenna T/R Switch/6M LNA

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Present at the Creation

By Bill Horne, W1AC

It was the early 1990s. I was back on 2 meters after a very long absence. I had splurged on an Icom IC-230, which was a crystal-plexed FM transceiver that covered 146 to 148 and had really nice audio.

I had been reading a lot about packet radio, both in *QST* and in *73* magazines, and I decided that I would try it out: the IC-230, however, wouldn't reach the packet frequencies around 145 MHz, so I traded up to an Ken KP-202 HT that had been imported by a student at Boston University. I bought an MFJ 1278 TNC, and drilled a hole in the shell of my HT, so I could feed audio in to the modulator without the "voiceband" filter getting in the way.

With my TNC and HT joined by cables I had soldered together, I tuned to 145.01 and set the TNC to listen. There were plenty of signals, many times cutting into each other and capturing my receiver. Satisfied that I could receive OK, I started trying to connect to a nearby bulletin board station.

Many a slip, as they say, between the cup and the lip. While I was pretty sure that I was "getting out" – after all, I could hit the local voice repeaters just fine – I couldn't seem to raise anyone on packet. It was only through the kind help of another local ham that I found out about digipeating, and he left his rig on so that I could use his station to bootstrap into the bulletin board. For a few days, it worked OK, but I couldn't get to any of the other major nodes, and I didn't want to keep imposing on my packet Elmer.

My first VHF rig was a Clegg 99'er, which is a "hollow state" AM transceiver for 6 meters. Having a plumber's delight beam up on my family's roof was an incredible achievement in the 1960s, but the antenna didn't survive the winter and my Dad wouldn't let me put up another. Still, I had learned a lot about how much a little bit of height could help, and I decided to apply the lesson from my teenage years to the current situation.

As it happens, I have a lot of pine trees on my lot, so I climbed up to the top of one, cut off the very tip of the tree, and then mounted a two meter ground plane on it using PVC pipe: the ground plane was made from an SO-239 connector mounted inside a PVC pipe cap, and I used RG-8 coaxial cable, brand new, to get to the shack. The difference was astonishing: I had forgotten how much FM repeaters help for voice traffic, and had rediscovered the maxim of all commercial radio techs: "Height is Might!."

With my newfound signal strength, I was able to reach bulletin boards as far away as 20 miles from my QTH, including one at W1MX, the M.I.T. Club station, and packet nodes on Cape Cod. I could reach out, access the boards, and trade "e-mails" – wonder of wonders! – with other hams.

This was, I'm sure you recall, prior to the "Internet Revolution." The World Wide Web hadn't been invented yet, but I still had an account at my *alma mater*, and I could send e-mails to other users from there, but there wasn't any way to get from the packet BBSs to the Internet e-mail system.

After I'd been using packet for a few weeks, I was monitoring 145.01, and saw some packets that seemed to be have IP addresses in them. I called up the station that was transmitting, and I wound up talking to Neil Grossman, KA1PPG, for over an hour; it was my introduction to TCP/IP on ham radio. Neil explained the need for a *NOS* program, the principles of "KISS" operation, and even the way I would need to apply for an "ampr.org" domain name for a TCP/IP packet station.

I hanged up the phone with my head buzzing. There were so many new terms to absorb, and so much to learn, that I didn't get to sleep until 2 o'clock the next morning. The very thought that I – an individual citizen – could have my own Internet domain name was like a thunderbolt in my head.

Now, I could explain what a *NOS* is, the acronym means "Network Operating System", but that sounds routine after all this time has passed. I found out that Phil Karn, KA9Q, had written one, as hard other hams, but the software details were beyond me, then and now. Suffice to say that back in the days of MS-DOS and 386-based computers, Phil Karn's *NOS* enabled me to connect my TNC so that it could be used to relay IP packets "inside" AX.25. It wasn't very fast by today's standards, 1200 bps. Keep in mind, though, that modems were still the default method for connecting my PC to the Internet, and America On Line was the only "graphical user interface" in use.

Well, one thing led to another. I became one of the Directors of the New England TCP Association when I helped to reactivate it, and started to talk about high speeds and higher ambitions. I was determined to increase the connection speeds of the TCP/IP network, and to do that, I knew that I would have to upgrade to a "physical layer" on 1280 MHz or higher. That meant, of course, that I needed a line-of-sight to some place high, and from there to other TCP/IP nodes. The designs were available, and I was willing to etch the circuit boards and learn about microwave.

But, "Height is Might!" came back to haunt me. I bought copies of the topographic maps for my area, and set my sights, pardon the pun, on getting from my QTH to a fire watch tower on a nearby hill. The topo maps delivered bad news, again and again: there was no place I could aim at what was also available for use. I realized that every packet station I could hit reliably was north of me or south, nothing to the west and just a few stations to the east. It couldn't have been more clear: if I wanted to complete a link to the gateway at M.I.T.'s W1MX station, I would have to arrange at least two doglegs, and the route I considered was via water towers and/or fire watch towers that were already festooned with antennas – and, sad to say, already overburdened with wind loads. The municipal employees I spoke too were sympathetic, but unable to help; every paging company, taxicab, and cement truck owner had been there before me, not even to mention the fire and police departments, who had been given first claim.

I went to "Plan B." I chatted up Boston-area hams, one of which had a house on the Arlington heights overlooking Boston, and sketched a plan to get us all together on 1296. As fate would have it, other concerns intervened. I got some very bad news about my young son's medical condition, and decided that I would hang up the mike to spend more time with him. It wasn't meant to be.

How time flies.

I now have an Internet connection that is faster than a T-1 line, a computer that can run rings around my old 386, and a somewhat more jaundiced view of the Internet revolution. Still, there are times it all comes back: I see an MFJ TNC on eBay, and I think "Why not?"

###

Write Here!

PSR is looking for a few good writers, particularly ham radio operators working on the digital side of our hobby, who would like to publicize their activities here.

You don't have to be Hiram Percy Maxim to contribute to *PSR* and you don't have to use Microsoft Word to compose your thoughts. The *PSR* editorial staff can handle just about any text and graphic format, so don't be afraid to submit whatever you have to wa1lou@tapr.org .

The deadline for the next issue of *PSR* is August 15, so write early and write often.

###

100W Class-A Amplifier for HPSDR-Penelope

By Hans Hartfuss, DL2MDQ; e-mail DL2MDQ@t-online.de

Introduction

The HPSDR transmitter Penelope has excellent linearity specifications demanding adequate subsequent amplifier stages. With this project, we were aiming at reaching 100W of output power with IMD values clearly below about -40dB for 3rd order intermodulation products IMD3. Since cascading amplifier stages worsens the overall IMD significantly, great efforts are necessary to maintain the overall IMD3 at the level envisaged, demanding for excellent linearity of all subsequent stages.

The paper describes measurements conducted with a test setup consisting of two reliable, slightly-modified CCI amplifier kits (http://www.communication-concepts.com/) behind Penelope, the first one, AN779H, to reach the 5 to 10W and the second, AN758, the 50 to 100W level. Both bipolar push-pull transistor stages are operated in class-A mode with high quiescent currents, low efficiency, and therefore, high permanent power dissipation. In this respect, the project seems old fashioned and not very elegant.

However, the overall results are hard to top and are comparable to what might be obtained with the application of adaptive pre-distortion by software. In this concept, for which the HPSDR project is ideally suited, the result of non-linearity of all the analog stages following the DAC is compensated by introducing the inverse processes in the digital signal path. First experiments with this most modern approach are being planned, nevertheless, the well-tried one described here is a simple alternative, at least a good interim solution.

Penelope

The linearity specifications of Penelope (from TAPR) have been measured in a two-tone test set-up as a function of power and frequency. Figure 1 gives the excellent results obtained at the maximum power level of 400mW PEP (100mW in each tone) as a function of frequency. The intermodulation distortion IMD as given is related to one of the two test tones. If referred to PEP, all IMD products are lower by additional -6dB. In Penelope, IMD products increase with output

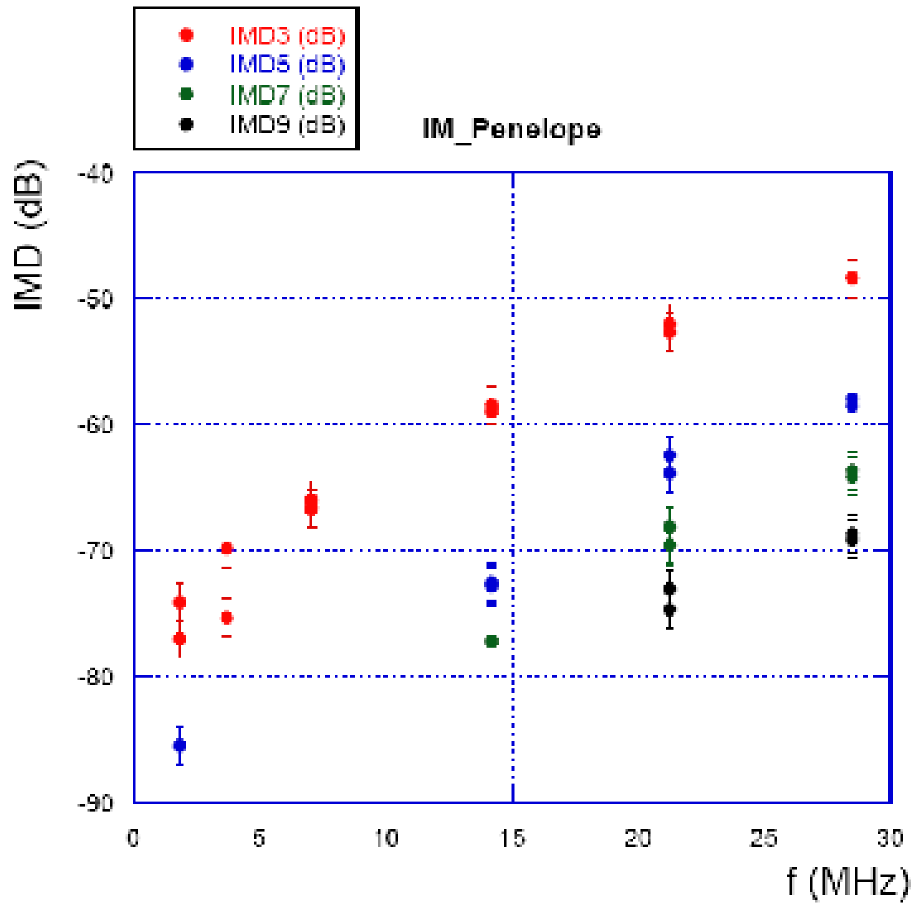


Figure 1: The various orders of intermodulation distortion IMD as measured at 400mW PEP output power on the TAPR Penelope module. IMD is given in dB below one of the two test tones used (not to PEP). Several measurements have been conducted. The error bars are based on estimated accuracy and reproducibility. Because of their small amplitudes, the higher IMD orders could not be measured at frequencies below about 10 MHz.

Both trends have been reduced in the Pennylane design by distributing the total gain to two subsequent identical push-pull stages with the OPA26741 following the DAC.

Penelope + 10W driver

In my HPSDR transceiver setup (see PSR #109), the CCI amplifier AN779H is used as the stage following Penelope. This kit uses a pair of MRF433 transistors which I run in class-A operation mode to keep the excellent IMD values of Penelope. The total quiescent current is 3A at 13.8V. The driver stage is delivering about 8-10W of output power.

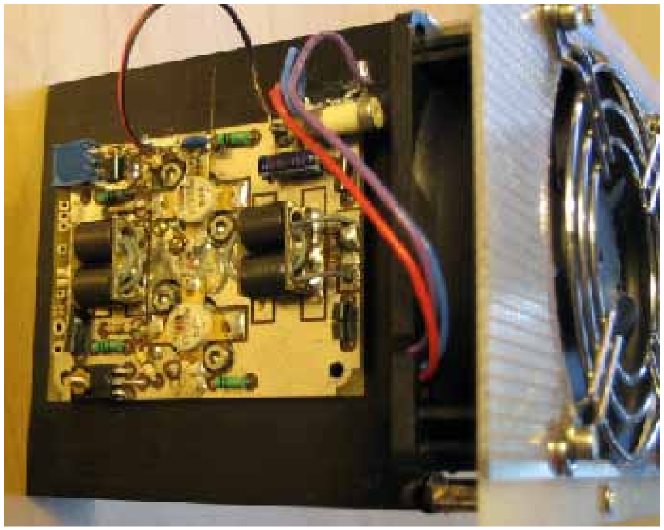


Figure 2: The driver amplifier AN779H mounted on a heat sink with blower. It delivers about 8-10W and it is in-stalled inside a cabinet that houses the TAPR boards Mercury (receiver), Penelope (transmitter), Ozymandias (bus and control) together with the corresponding power supplies.

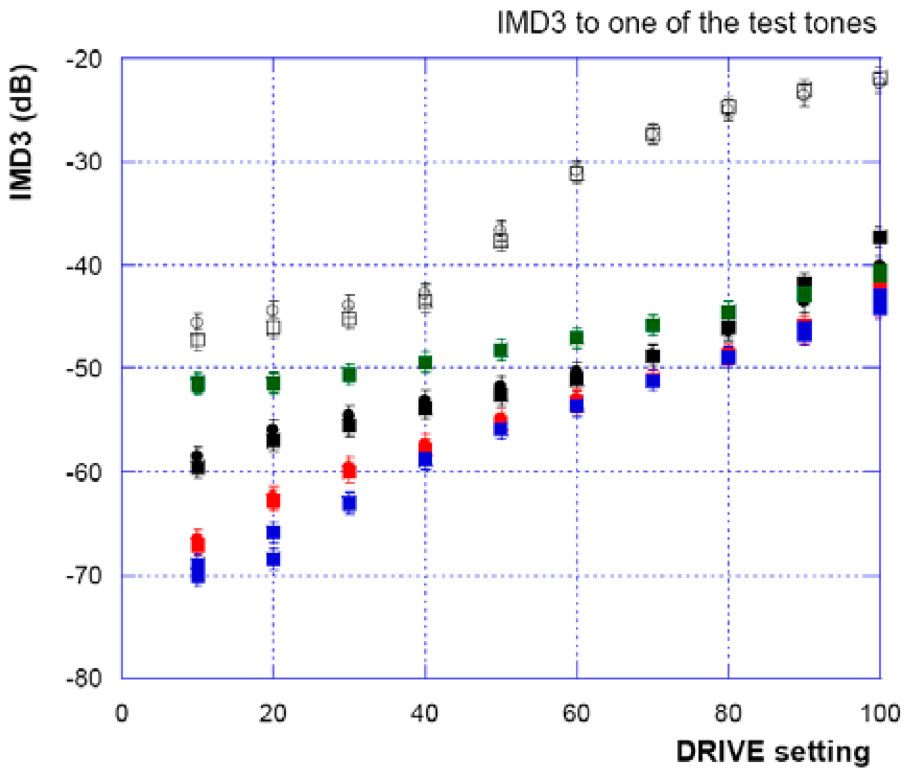


Figure 3: IMD3 for Penelope with driver amplifier as a function of the Drive setting in PowerSDR, which is directly proportional to the output power; Drive=100 corresponds, in this case, to (8-10)W. The colors distinguish the measurements on different bands: black=80m, red=40m, blue=20m, green= 15m, open black symbols=160m (see text). Really excellent results are obtained for settings below about Drive=50 (about 4W PEP) and for the bands 80 to 15m.

Figure 3 gives the IMD values for the combination Penelope + AN779H driver amplifier as a function of the Drive setting for various bands between 160 and 15m. The Drive setting can be used alternatively to power, since the Penelope output power exactly follows the Drive setting in PowerSDR –if the very small non-linearity of the analog output stage is ignored (see also Figure 9).

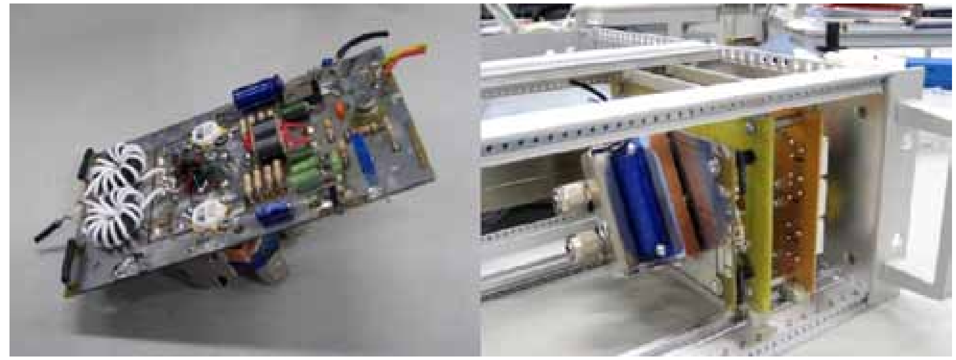
Again, as with Penelope alone, the level of IMD3 products of Penelope + driver increases with power and frequency. Below Drive=60, corresponding to about 4W, the overall IMD level is excellent and smaller than

-50dB. On the other hand, unacceptable high IMD values are measured on 160m since the AN779 amplifier is designed for operation at frequencies higher than 2MHz only (transformer core material?), meaning that 160m operation is not possible with the setup described here.

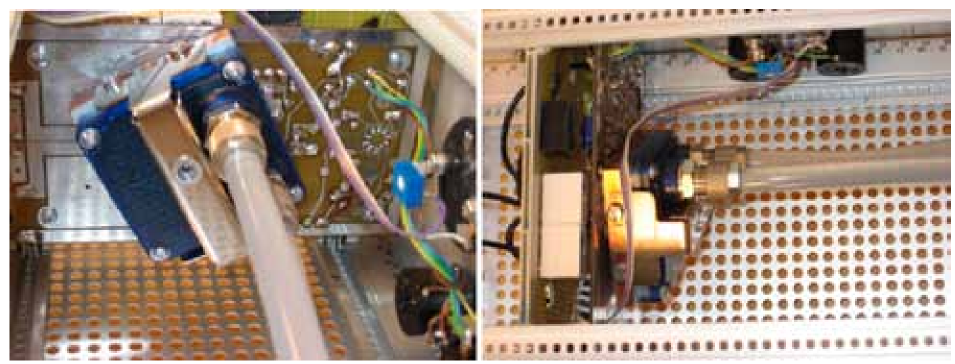
For better stability of the operating point, the original bias supply of the AN779 kit has been replaced by a current control loop, measuring the current at a series resistor in the supply path comparing it with a target value and controlling the bias voltage to keep the total collector current for both transistors at 3A, a measure of course only possible with class-A operation where current is constant, independent of drive.

Penelope + driver + PA

With this highly linear driver signal, the next stage, the CCI AN758 amplifier with power gain of about 14dB is being excited (http://www.communication-concepts.com/appnotes/AN758300Sharp.pdf). It uses a pair of MRF429, rugged bipolar transistors out of the 150W class, run at 50V. It is originally designed to deliver 300W in class-AB. With a minor modification of the bias supply, the quiescent current can be increased to about 8A sufficient for class-A operation and the envisaged output power. An earlier test setup of this amplifier, in particular the heat sink with its blower, originally built for class-AB operation, was not suited to dissipate 400W quiescent input power. Therefore, a water cooling system has been applied primarily designed for computer



Figures 4: Left: The AN758 amplifier board with the transistors in close contact with the water cooled copper plate of the processor heat exchanger. Due to the limited size of the cooler of 63x63mm2, it had to be mounted diagonally. Right: The amplifier board is connected with two other EU-standard boards that carry the low pass filters and some control units; the module has been built up as plug-in unit to a 19-inch cabinet. In this picture, the front plate is still not installed.



Figures 5: Left: The AN758 amplifier board with the cooling system installed. The front plate is on the right. The bracket next to the water pipes fixes the heat exchanger to the copper plate to which the transistors are mounted. Right: A different view of the cooler.

processor cooling (http://www.webshop-innovatek.de/shop/), consisting of the heat exchangers transistor-to-water and water-to-air plus a small water pump with pumping capacity of the order liters per minute. Figures 4 to 6 show the components and how they are assembled within a 19-inch housing in an experimental setup.

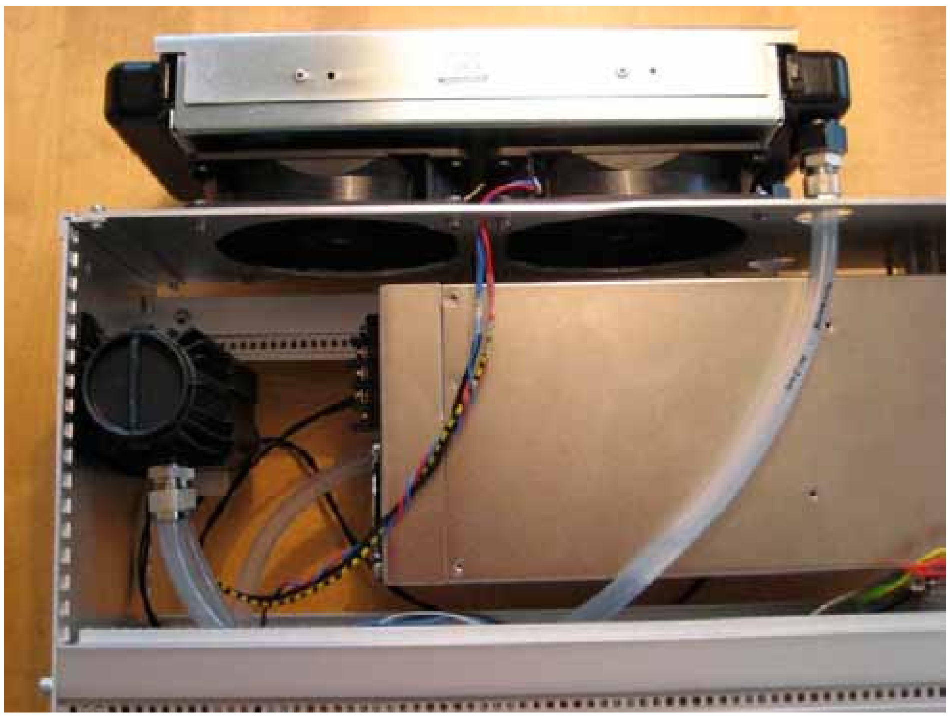


Figure 6: The rear part of the 19-inch cabinet with the water-to-air heat exchanger with two blowers and the water pump in the left corner. The large metallic box to the right is a 50V, 750W switching power supply.

The amplifier is working temperature stable resulting in good stability of the quiescent current; quiescent current adjusted to 8A decreases by about 150mA during warm up and is running surprisingly quietly despite the water pump and the two blowers of the heat exchanger. In steady state, after about 10 minutes, the water temperature barely reaches 40°C.

It turned out that optimizing the heat transfer from the transistors to the processor cooler is an extremely important point. Liquid metal was used in between the metallic contact surfaces to make the heat transfer as efficient as possible. Figure 8 gives the temperature at the copper plate as a function of time with liquid metal between both the transistors and the copper plate they are mounted to, and the cooler plate of the processor in comparison to the standard silicon paste normally used. Heat transfer is clearly increased by this measure, thus resulting in about 20°C lower temperature of the copper plate's steady state temperature.

Figure 7: Front view of the water-cooled amplifier. The AN758 amplifier is mounted on the right side. Behind the left side of the front plate, a 13.8V power supply is mounted. The instrument shows the total collector current of 8A. The amplifier can be switched between class-AB and class-A mode of operation; the operating points are adjusted with the two 10-turn Heli-potentiometers below the instrument.

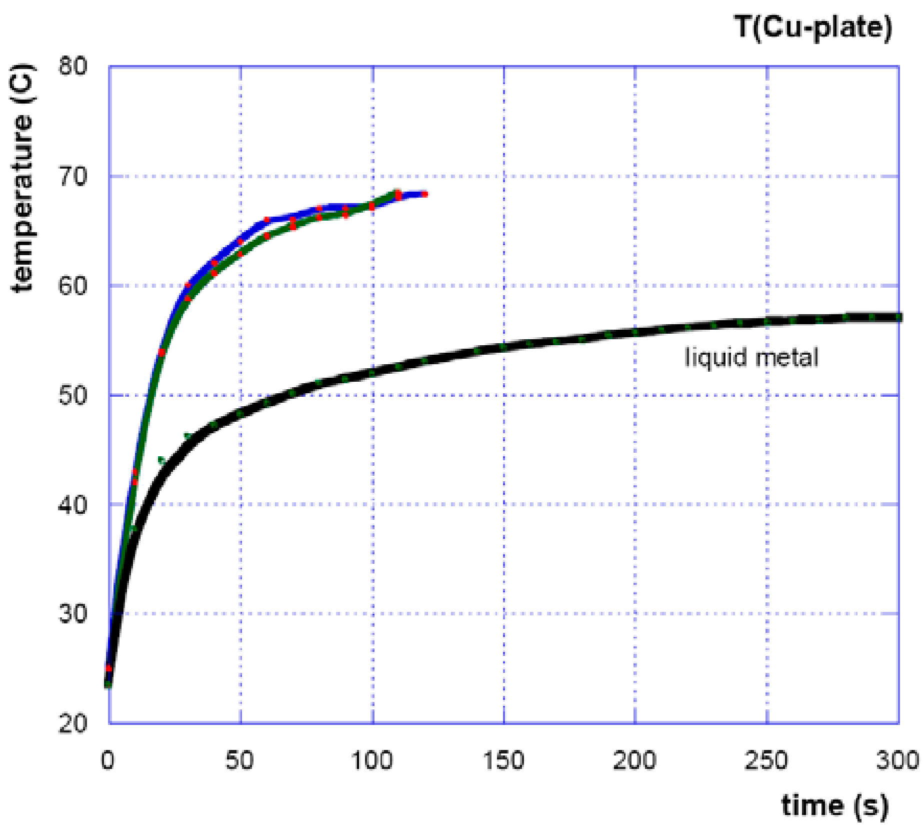


Figure 8: Temperature of the copper plate the PA transistors are mounted to for two different materials used for heat transfer improvement. The upper curve corresponds to the standard silicon paste (Thermaflow), the lower one to liquid metal.

Overall results

The IMD3 measurements of Penelope + driver (see Figure 3) show that Penelope should be operated with a Drive setting in PowerSDR not higher than about 60 corresponding to about 4W to stay within the excellent low IMD range below about -50dB. The subsequent AN758 push-pull stage has enough gain to reach the 100W level with these settings (Gain-By-Band settings in PowerSDR set-up have been adjusted accordingly to about 41dB).

Figure 9 gives the overall power output as a function of the Drive setting. The figure shows first the excellent linearity between the Drive setting and power and secondly, that the 100W level is indeed reached with the Drive setting below about 60.

All IMD3 measurements are conducted using the FLEX-5000A as a spectrum analyzer. Its linearity and accuracy has been checked against commercial spectrum analyzers, as well as against high accuracy step attenuators. It turned out that the FLEX approaches laboratory test equipment quality, excellently suited for this kind of amateur developments.

Figure 10 gives as an example during a two tone test; the spectrum display of the PowerSDR console (Panadapter) with the DUT's output signal coupled to a dummy load and a small amount (-80dB) fed to the FLEX input.

Quantitative IMD measurements are conducted by narrowing the FLEX filter bandwidth to about 100Hz and shifting it subsequently to one of the test tones and to the 3rd order intermodulation product next to it. The corresponding power in the spectral lines is obtained with high accuracy from the digital S-meter readout in dBm (this reading gives the total power within the bandwidth; the very small contribution from background white noise can be ignored). The difference gives the quantity of interest, the ratio of the IMD3 component to one of the test tones in dB. As mentioned before, referring to PEP, this ratio is higher by -6dB.

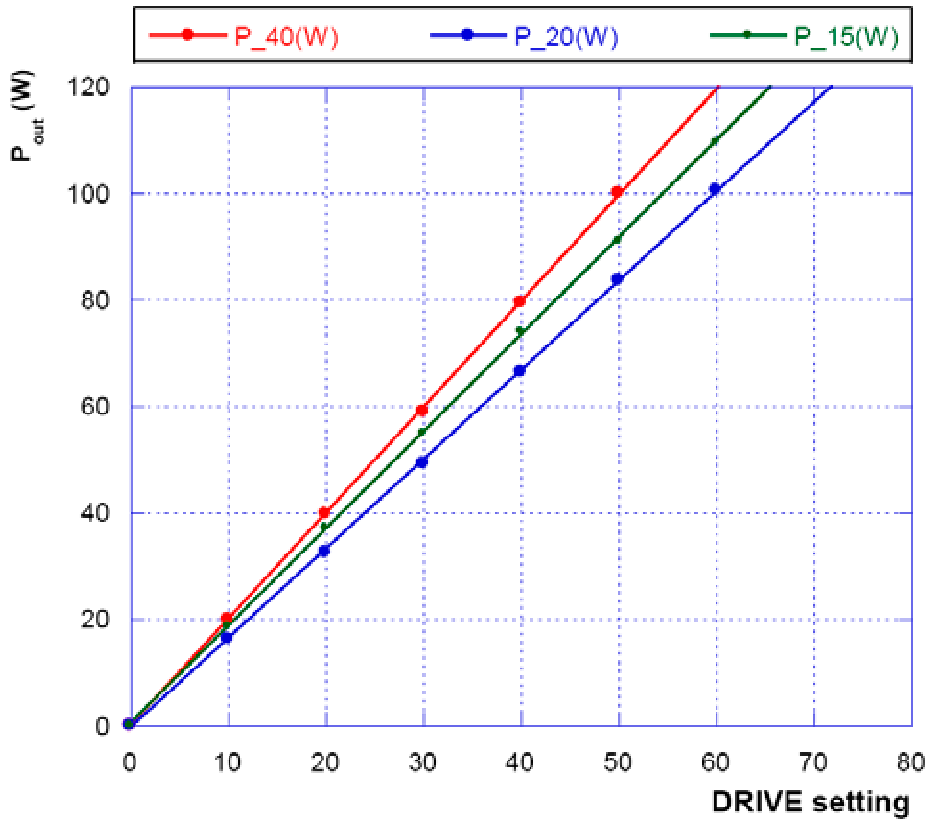


Figure 9: Power output for three bands, 40, 20, 15m as a function of the Drive setting in PowerSDR for Penelope + driver + PA verifying the linear relation between the two and in addition, demonstrating that the 100W level can be reached with this combination with Drive below about 60 where IMD3 of Penelope + driver are below -50dB.

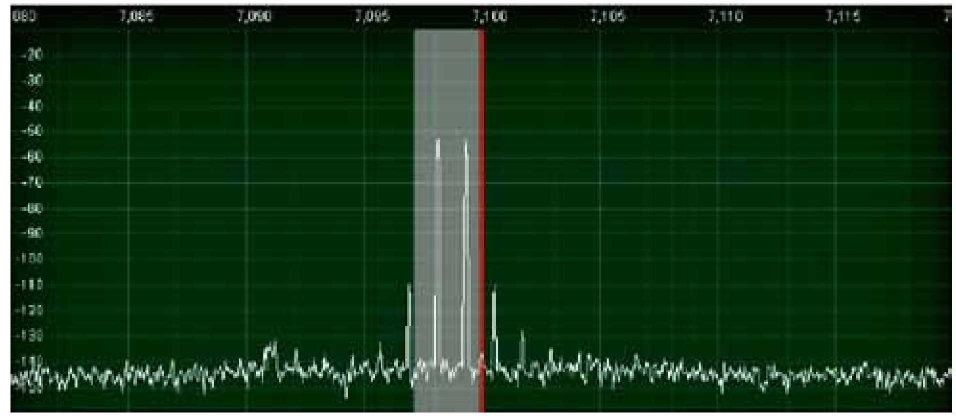


Figure 10: Spectral display (Panadapter) of the PowerSDR software measuring the overall emission of Penelope and the subsequent driver and PA CCI kits at about 50W PEP at 7.1 MHz: vertical scale 10dB per division, horizontal 1kHz. IMD3 is down by more than -50dB compared to one of the test tones.

Figure 11 gives IMD3 as a function of power for two selected bands, 15m with the worst results, and 40m with the best. However, 80m and 20m are almost identical within error bars to 40m deviating by only a few dB at the maximum.

At the 50W level, the overall IMD3 is worse by 5 to 8dB compared to the IMD3 of Penelope with the driver alone (see Figure 3, Drive=25-30). This finding is a consequence of cascading amplifiers. IMD3 of a driver stage can only be maintained by an absolutely linear amplifier stage following. In case the second stage is characterized by the same IMD3 value as its driver, the total IMD3 value will be worse by 6dB after cascading. Worsening by about 8dB as observed here when cascading means that the second stage AN758 is characterized by an IMD3 4dB worse than the IMD3 of the AN779 driver.

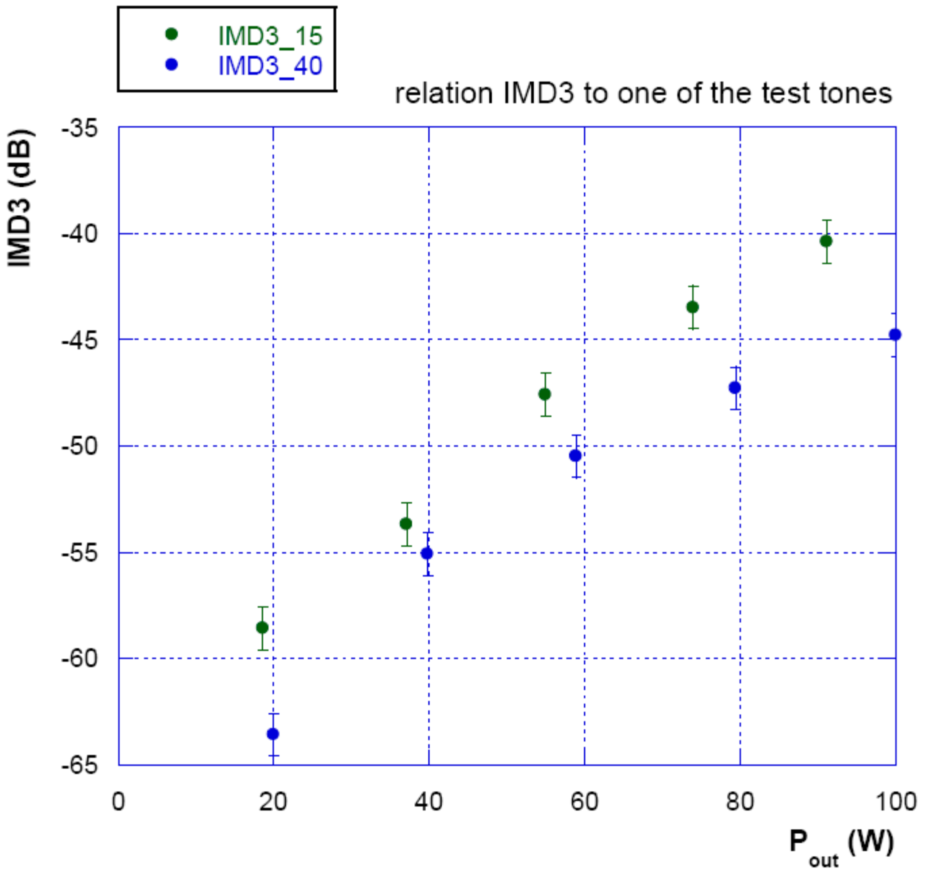


Figure 11: Overall IMD3 as a function of PEP output power for Penelope + driver + PA for two bands, 15m (green) and 40m (blue).

Figure 11 demonstrates that the 100W level can indeed be reached at an overall IMD3 of about -45dB with this rather conventional equipment. The level of IMD5, the next higher order of intermodulation products, is lower by almost -20dB (not shown here). At the 50W level sufficient to drive most of the commercial tube amplifiers in the kW range, the overall IMD3 is around -50dB for all bands between 80 and 15m, an unexpected good result.

As an additional demonstration of the purity of the generated spectrum, Figure 12 gives the accumulated spectral power density in the FLEX Panadapter when running PowerSDR in "Peak" mode and talking for about 30 seconds into the microphone at about 80W PEP. Due to the low IMD, an extremely clean spectrum results characterized by a sharp and deep decay at zero beat by almost -60dB.

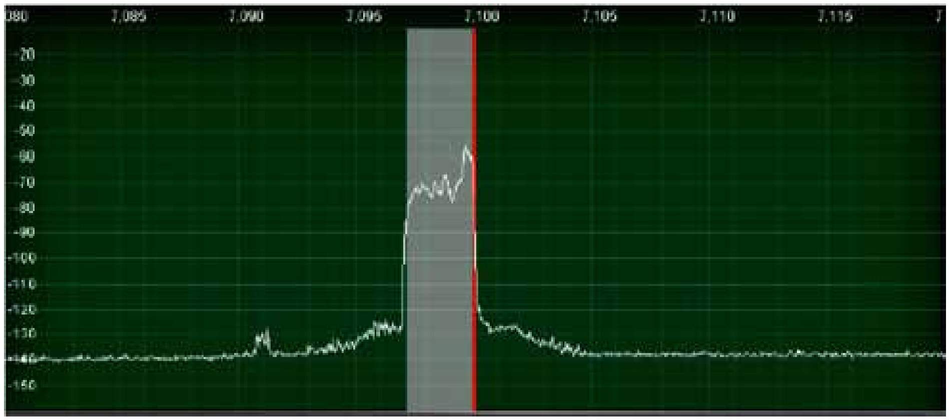


Figure 12: Accumulated spectrum applying the "Peak" function of PowerSDR with a FLEX-5000A as measuring instrument with scaling the same as in Figure 9. The spectrum gives the maxima within the wanted LSB as well as IMD maxima outside; the latter being down by almost 60dB compared to the maximum in-band power density.

###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###

A Little TAPR History

By Stan Horzepa, WA1LOU

A few months ago, a question came up on the TAPR Board of Directors e-mail list concerning past members of the Board. At that point, we realized that there was no history of who served on the Board in the past.

Being a history major, I decided to research the matter and come up with a history of the Board membership. While I was at it, I decided to research the past officers of TAPR, too. One thing led to another and I also researched the history of *PSR* editors, as well as the TAPR Office managers.

The following three pages represents the results of my research.

Each column in the following table represents one elected office term. For example, the first column, "1982 07 to 1983 01," indicates that the officers in that column began serving in July 1982 and that their term of office ended in January 1983.

Board members serve three-year terms, which is represented by the three column color coding. By the way, early on, there were 15 board members, but in the early 1990s, there was a transition from 15 to the present 9 board members.

History is always a work-in-progress and this project is no different. If you discover any errors, omissions, etc., please let me know so I can make corrections and this project as accurate as possible.

###

	1982 07 to 1983 01	1983 02 to 1984 01	1984 02 to 1985 01	1985 02 to 1986 01	1986 02 to 1987 01	1987 02 to 1988 01	1988 02 to 1989 01	1989 02 to 1990 01	1990 02 to 1991 01	1991 02 to 1992 02	1992 03 to 1993 02
President	KD2S	WA7GXD	WA7GXD	WA7GXD	WA7GXD	WA7GXD	N0CCZ	N0CCZ	WA7GXD	W6SWE	W6SWE
Vice President	KV7D										VE3GYQ
Exec Vice President	WA7GXD	KD2S	WB9FLW*	WB9FLW	WB9FLW	W3IWI	W3IWI	WB9FLW	NK6K	NK6K	
Secretary	Mbaker	N7DZU	N7DZU	WA0TTW	N7DZU	AL7FG	W3VS	VE3GYQ	WD5IVD	WD5IVD	WB6RTH
Treasurer		N0ADI	N0ADI	KV7B	N6HBB	N6HBB	W3VS	N3EUA	WD5IVD	WD5IVD	WB6RTH
President Emeritus											
BOD		W1HDX	WA0TTW	WA0TTW	WA0TTW	VE3GYQ	VE3GYQ	VE3GYQ	VE3GYQ	VE3GYQ	VE3GYQ
BOD		W3IWI	W3IWI	W3IWI	W3IWI	W3IWI	W3IWI	W3IWI	W3IWI	W3IWI	W3IWI
BOD		WB9FLW	WB9FLW	WB9FLW	WB9FLW	AL7FG	WB9FLW	WB9FLW	WB9FLW	WB9FLW	WB9FLW
BOD		NK6K	NK6K	NK6K	NK6K	NK6K	NK6K	NK6K	NK6K	NK6K	NK6K
BOD		KV7D	KV7D	KV7D	KV7D	KB6QH	KB6QH	KB6QH	N4PCR	N4PCR	
BOD		WB6HHV	WB6HHV	WB6HHV	WB6HHV	WB6HHV	WB6HHV	WB6HHV	WB6HHV		
BOD		KD4NL	KD4NL	WB6YMH	WB6YMH	WB6YMH	WB6YMH	WB6YMH	WB6YMH	WD5IVD	WD5IVD
BOD		WD0ETZ	WD0ETZ	WD0ETZ	WD0ETZ	WD0ETZ	KA9Q	KA9Q	KA9Q	K7UPJ	K7UPJ
BOD		KV7B	KV7B	KV7B	KV7B	KV7B	KV7B	KV7B	KV7B	KV7B	KV7B
BOD		KT7D	KT7D	N0CCZ	N0CCZ	N0CCZ	N0CCZ	N0CCZ	N0CCZ	N0CCZ	WA4EJR
BOD	MarkBaker	MarkBaker	MarkBaker	MarkBaker	W1BEL	N4HY	N4HY	N3EUA	N3EUA	N3EUA	W6SWE
BOD	WA7PXW	WA7PXW	WA7PXW	WA7PXW	K9NG	K9NG	K9NG	K9NG	K9NG	K9NG	
BOD	KD2S	KD2S	KD2S	KD2S	W3VS	W3VS	W3VS	N6NKF	N6NKF	N6NKF	
BOD	N0ADI	N0ADI	N0ADI	N0ADI	N7CL	N7CL	N7CL	N7CL	N7CL	N7CL	
BOD	WA7GXD	WA7GXD	WA7GXD	WA7GXD	WA7GXD	WA7GXD	WA7GXD	WA7GXD	WA7GXD	WA7GXD	
PSR Editor	group	KV7D	KV7D	WA0TTW	W1BEL	W3VS	W3VS	WD5IVD	W6SWE	N2GDE	N2GDE
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			* resigned May 1984								

	1993 03 to 1994 02	1994 03 to 1995 02	1995 03 to 1996 02	1996 03 to 1997 02	1997 03 to 1998 02	1998 03 to 1999 02	1999 03 to 2000 02	2000 02 to 2001 08	2001 09 to 2002 08	2002 09 to 2003 08
President	WD5IVD	WD5IVD	WD5IVD	WD5IVD	WD5IVD	WD5IVD	WD5IVD	N8UR	N8UR	N8UR
Vice President	W6SWE	KF7TP	AG9V	AG9V	N8UR	N8UR	N8UR	N7HPR	N7HPR	N7HPR
Exec Vice President										
Secretary	N4CHV	N4CHV	N4CHV	N8GNJ	N8GNJ	N8GNJ	N2GDE	KC5GOI	KC5GOI	KC5GOI
Treasurer	WA5LHS	WA5LHS	WA5LHS	WA5LHS	WA5LHS	WA5LHS	WA5LHS	WA5LHS	WA5LHS	WA5LHS
President Emeritus										
BOD	AG7H	AG7H	AG9V	AG9V	N8UR	N8UR	N8UR	N8UR	N8UR	N8UR
BOD	WA4EJR	WA4EJR	VE3JF	VE3JF	VE3JF	VE3JF	VE3JF	N6BG	N6BG	N6BG
BOD	WA5LHS	WA5LHS	KC3RL	KC3RL	KC3RL	KC3RL	KC3RL	KC3RL	KC3RL	KC3RL
BOD	KF7TP	KF7TP	KF7TP	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR
BOD	N2GDE	N2GDE	N2GDE	N2GDE	N2GDE	N2GDE	N2GDE	N2GDE	N2GDE	WA1LOU
BOD	N4CHV	N4CHV	N4CHV	N4CHV	N4CHV	N4CHV	K4HG	K4HG	K4HG	VK2TDS
BOD	WD5IVD	WD5IVD	WD5IVD	WD5IVD	WD5IVD	WD5IVD	WD5IVD	N8GNJ	N8GNJ	N8GNJ
BOD	K7UPJ	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD
BOD	KV7B	K0PFX	K0PFX	K0PFX	K0PFX	K0PFX	K0PFX	K0PFX	K0PFX	K0PFX
BOD	WA4EJR									
BOD	W6SWE									
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Vice President	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR	WA2DFI	WA2DFI		
Exec Vice President										
Secretary	WA1LOU	WA1LOU	WA1LOU	WA1LOU	WA1LOU	WA1LOU	WA1LOU	WA1LOU		
Treasurer	N8ZM	N8ZM	N8ZM	N8ZM	N8ZM	N8ZM	N8ZM	N8ZM		
President Emeritus							VE3GYQ	VE3GYQ		
BOD	N8UR	N8UR	N8UR	N8UR	N8UR	N8UR	N8UR	N8UR	N8UR	N8UR
BOD	N6BG	VE3GYQ	VE3GYQ	VE3GYQ	VE3GYQ	VE3GYQ	VE3GYQ	N4XWE	N4XWE	N4XWE
BOD	KC3RL	WA7NWP	WA7NWP	WA7NWP	WA7NWP	WA7NWP	WA7NWP	NH6Z	NH6Z	NH6Z
BOD	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR	N7HPR		
BOD	WA1LOU	WA1LOU	WA1LOU	WA1LOU	WA1LOU	WA1LOU	WA1LOU	WA1LOU		
BOD	VK2TDS	VK2TDS	VK2TDS	VK2TDS	VK2TDS	VK2TDS	VK2TDS	VK2TDS		
BOD	N8GNJ	N8GNJ	N8GNJ	WA2DFI	WA2DFI	WA2DFI	WA2DFI	WA2DFI	WA2DFI	
BOD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	W9DDD	
BOD	WA8WDQ	WA8WDQ	WA8WDQ	AA4SW	AA4SW	AA4SW	WB9QZB	WB9QZB	WB9QZB	
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