Radio Homebrew and Experimenter's Group

An official function of the
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The Radio Homebrew and Experimenter's Group workshop meetings are free to Amateur Radio NSW (WIA NSW) members. A $5 cover charge **may** apply to non-members. Meetings are currently held at Amateur Radio House in Parramatta on the first Tuesday night of each month around 6:30pm to 9pm (doors locked by 9:30pm) **and** on the last Sunday of each ODD numbered month around 12:30pm to 4:30pm (that is after the Trash-n-Treasure). The Technical Book Shop and Technical Library are also usually open at these times for those who can't get in during the week. Cold drinks (leave your money in the fridge) and tea/coffee making facilities (FREE) are also available. Plenty of shops just up the road if you would like to grab something to eat in the hour or so break between the T&T and the Homebrew Meeting. Only a short walk from either Harris Park or Parramatta Stations and usually plenty of on-street parking for these meetings. The Sunday afternoon meeting is usually first a show-n-tell for any works-in-progress or completed projects members are working on and followed by a Technical discussion or demonstration. The Tuesday nights are an informal Technical meeting where people bring in works-in-progress to get help or ideas from the rest of those attending. These workshop meetings are informal get-togethers of amateurs interested in building, or repairing their own radio equipment. Some people bring their latest piece of equipment along to work on or to receive advice, while others offer their experience and advice in helping others.

The group has some pieces of test equipment at Parramatta, while others are brought in for the occasion. If you think that you may need some equipment, then **please contact Peter O'Connell VK2EMU by email or leave a message for him at the Parramatta office** and he will endeavor to have the appropriate piece of equipment available.

This Month

This Newsletter is online at Amateur Radio NSW http://arnsw.org.au/

Radio Homebrew and Experimenter's Group News

Sorry, I have not been very well over the last few months and have missed most of the meetings, so not a lot to report from other clubs.

However out I must say that our meetings just lately have been extremely interesting and thanks to all involved especially Peter VK2EMU for chasing up interesting people and Mark VK2XOF who organizes a lot of the technical side of meetings. Following are some of the items covered in demos or light discussion at recent meetings.

Tuesday 5th July 2005

Stepper Motors – Peter VK2EMU brought in a couple of stepper motors he had scavenged out of an old printer. He had wired up a couple of toggle switches to control the windings, so with rapid switching first of one winding and then the other he caused the motor to step either clockwise or anti-clockwise. He has since lashed up a simple controller board and using a Basic program via the printer port on his laptop can step them even faster. This then led to discussion of the XYZ Router/Drill Table that Peter and myself had been planning.

2m Txvr – One of the guys brought in a commercial 2m Txvr and with a little help fixed an audio problem.

Convert AM/FM radios to Ham frequencies – John VK2ASU brought in an AM/FM radio he had picked up at a $2 shop and detailed his conversion of the set to tune the 2m band. This is an interesting use of some cheap technology to get a project running quickly.

Photography – A bunch of us discussed the pros and cons of film versus digital cameras and equipment. John ASU mentioned in a recent overseas trip he gave the whole idea of a digital camera a miss when he discovered all the extra bits and pieces required to support a small digital camera. He instead purchased a small automatic 35mm camera and enough film for the trip. When he got home he had the film developed and the pictures loaded onto a CD from which using his computer he chose those he liked or needed some fixing up, before printing and distributing to he friends and relatives. This led to further discussion on whether the current stage of development of domestic digital cameras warranted the dumping of our tried and tested 35mm equipment.

Wind Generators – A few of the guys are experimenting with wind generators for use on Field Days, when operating in remote locations or to power repeaters etc. There was a wide range of discussion on various types of motors/generators. Stepper motors, DC motors, Alternators and rewound washing machine motors have all been tried with varying success. To limit the size and cost of this equipment it would seem that it is best used to keep a bank of batteries charged up, especially during non operating periods. There are some excellent ideas in a few of the earlier issues of 73 Magazine and also recent issues of Silicon Chip.

Pre-Loved Test Equipment – Mark VK2XOF detailed some of his experiences in re-building older test equipment, especially items built in Australia by such companies as AWA. Careful buying on the disposals market can often produce equipment for a Hams workshop at very reasonable prices and often of a technical standard well beyond a Hams dreams.

Sunday 31st July 2005

Meeting started off with the usual Show -n-Tell session with Les VK2KYJ showing off his new AVR controlled Morse message generator for Dural.

Mark VK2XOF then gave an excellent and practical demonstration on Circuit Simulation and provided some sample disks of his simulation files for others to try. The software was based on the very popular SPICE series of simulators and allowed simulation of Analog (AC and DC) as well as Digital circuits, thus allowing a user to prove a circuit configuration and optimize components before actual construction.

Tuesday 2nd August 2005

Steven VK2BLQ showed his latest project a valve 80m Transceiver powered by a 12VDC to 250VDC inverter, very neat job indeed in an aluminum cabinet. At a previous meeting he had brought in a valve Ham Band Receiver whose high voltage power supply used some custom wound transformers he had sourced in Sydney. This was a beautiful set built into an old style varnished wooden cabinet with even the knobs from old antique radios, you know those old bakelite ones. He had built the cabinet himself out of off-cuts of MDF and chipboard, using a cheap router to sculpt the edges just like an old radio and then multiple coats of clear varnish to make it looks aged and genuine.

Another member brought in a couple of boxes (big ones) of printed circuit boards, power supplies and other components he had gleaned from his shack after a clean out (no doubt to make room for some more "stuff"). We all found something of interest from RF components through to cables/connectors and wall warts.

Tuesday 6th September 2005

We spent most of this meeting helping Seppo VK2SMA sort out "stuff" for the forthcoming Trash-n-Treasure. We have a good collection of variable capacitors Mark measuring caps for which Mark VK2XOF had brought in a HP Capacitance Meter to check and mark the values of the components.

"WE" all had a final "rat" amongst the remaining parts in the boxes from last meeting with only a few bits of real junk left to throw away (no body wanted the boxes !!).

So obviously the Experimenters Group is alive and well with a number of projects under way, just check out the index of this issue to see what we are involved in.

Next Meetings :

Sunday 25th Sept 2005 (1pm after the Trash-n-Treasure meeting at Wigram St) Peter Vk2EMU is organizing a "Safety in the Workshop" demo along with the use of various power tools.
(due to the Library being used for National WIA business the Homebrew meeting will be held in the garage area)
Tuesday 4th October 2005 (6:30pm at Wigram St)
Tuesday 1st November 2005 (6:30pm at Wigram St)
Sunday 27th November 2005 - At this time there are plans for this meeting along with the Trash-n-Treasure to be held at our Dural site. Peter VK2EMU is currently organizing an "Antennae" installation demonstration.

Technical – Noise Bridge for Measuring HF Impedance (2)

Testing and Calibration

(The text is written and compiled by your editor Brian VK2TOX from personal experience and items in various publications including ARRL Handbooks. This part of the article in its original form and authored by VK2TOX appeared in "Dragnet" the newsletter of the St George Amateur Radio Society, but has been updated and slightly modified to appear in these pages)

This issue we will deal with Testing and Calibration of our HF Impedance Bridge.

Testing and Calibration

The calibration of this bridge actually depends on how accurately you need to measure external devices or components. For the purpose of this article I will take the middle road in that it is not a toy nor is it a precision piece of test equipment. For more exacting calibration and cancellation of internal stray capacitance and inductance I would recommend you to more recent editions of ARRL Handbook for excellent coverage of these procedures. Make up a few connectors with say Zero ohms, 50R and 100R in them for calibration depending on how many points on P1 you wish to calibrate.

1. Check all your wiring and if satisfied apply power to the circuit, make sure nothing gets hot. You now that bits don't work anymore if you let the smoke out of them.
2. Set the C1 to center of its capacitance value, fit pointer and mark this position on front panel. Also mark extremes of travel of the plates on the front panel also (i.e. full mesh and open mesh)
3. Connect a receiver tuned to around 10MHz to the Rx terminal and fit the 50R connector to Ant terminal. Don't touch C1 but adjust P1 for balance of bridge (i.e. Minimum signal in receiver s-meter). Mark the front panel with this as the 50ohm position. Note that this position will not necessarily be the 50R position of the pots track because of reactance in the wiring. Now you can use the other connectors with resistors fitted to find and temporarily mark a few further points on the P1 using this procedure.
4. To complete the calibration of P1 with reasonable accuracy carefully disconnect the P1 and then using an ohm-meter and without moving P1 knob measure the actual DC value of resistance of the pot setting, it might be say 55R then move the pot so that it's resistance is say 65R and mark this point as 60 ohms then to 75R and mark panel as 70 ohms etc. Do the same with the other side of 50 ohms marking so that 45R becomes 40 ohms and 5R becomes Zero ohms. Check that your new calibration points reasonably agree with the 100R and Zero points temporarily marked before in (3).

5. Reconnect the P1 and using the connectors with resistors mounted check calibration points again using receiver to get balance point of bridge.

6. The variable capacitor is calibrated in a similar fashion. Connect up the bridge, fit the connector with 50R to the Ant terminal. Adjust P1 for null balance then adjust C1 to further enhance the null balance. If the position of the C1 pointer is different from the previously marked center of mesh then the 100pF cap (C2) across Ant will need adjustment until the null point of C1 corresponds to center of mesh. This then becomes the zero reactance point of C1 calibration.

7. The fit a 20pF close tolerance capacitor in **series** with the 50R load connected to Ant terminal and adjust C1 for null balance and mark this as 20pf on the **Plus** side of the reactance calibration. Continue this process with different values of capacitors in series with the 50R load to get further positive calibration points.

8. The fit a 20pF close tolerance capacitor in **parallel** with the 50R load connected to Ant terminal and adjust C1 for null balance and mark this as 20pf on the **Negative** side of the reactance calibration. Continue this process with different values of capacitors in parallel with the 50R load to get further negative reactance calibration points.

Box it up and play, next article in this series will cover practical measurements with this instrument. I will also in the meantime be building a couple of variations of the basic instrument to compare functionality and accuracy. I am also looking at a VHF version of the bridge for 2m and 70cm measurements.

To be continued ..

Technical – (Comments and Corrections to "Make your own Printed Circuit Boards (2)")

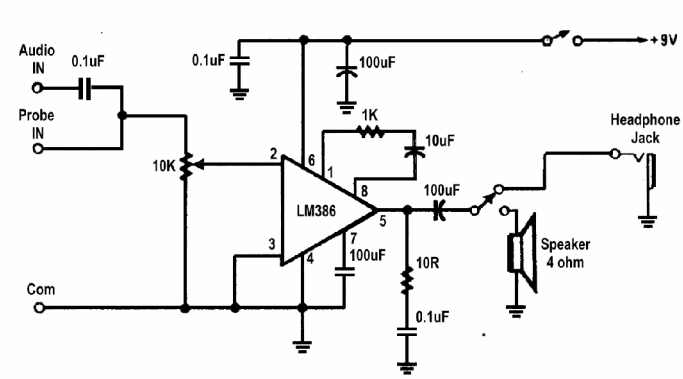
Sorry people, my little Irish mate "Murphy" was looking over my shoulder when I was writing this article in the last issue.

About four paragraphs into the discussion on making **Single Sided Boards** there is mention of covering larger sections of copper with overlapping strips of tape and to make sure that there is no air space under the overlapping sections of tape. If there is, then the enchant will get under the tape and corrupt your PCB pattern.

Peter VK2EMU rang me and mentioned that to overcome this problem he uses sheets of contact adhesive as used to cover books and bench tops, thus does not have the leaking problem and can cover boards up to 300mm wide.

To be honest, Peter, I do the same thing and this was where I was headed with the article until "Murphy" sidetracked me. Thanks for the heads-up, that means at least one person read the article.

Quick Projects – Signal Tracer – Audio Signals



Hands-On Electronics Aug 1988

When testing or constructing either analog or digital equipment it often very useful to be able to trace a signal through a piece of equipment. In most cases all that is required is a self contained audio amplifier with reasonable gain and a speaker output.

If you need to trace very small signals then a suitable pre-amplifier in a probe housing would be required so as to reduce the lead length between the tested circuit and the audio amplifier. It would also minimize loading and disruption of the circuit under test. To trace RF or modulated signals a Demodulator or Detector probe would be required again to minimize loading and detuning of the RF circuits. Both of these units will be covered in a later article.

The LM386 is a magic little amplifier chip, with a 6V supply its only consumes a quiesant power of 24mW, making it very suitable for battery operated equipment.

The RC between pins 1 and 8 set the gain of the chip to 50 and the RC hanging off pin 5 to ground cause a high frequency cut on the output (no AM stations) and also a minimum load for the output of the chip.

This is a high gain amplifier so care with the power supply routing and also the leads to the speaker. If not on a PCXB these should be tightly wound together to keep them bypassed to ground.

Other than that the circuit is fairly self explanatory, as shown the 10K pot adjusts the sensitivity of the amplifier and for audio signal tracing use the input with the blocking capacitor in it. A simple probe using a multimeter test prod or a BIC ™ case could be used, but put say a 1K resistor in series with the lead to minimize loading on the circuit being tested and run back to the amplifier in shielded cable.

I have built a couple of these up over a period of time and eventually I have problems with the 10K pot going noisy, think I might try building one with the 10K pot in the feedback loop (pins 1 – 8) to get the pot out of the signal path and a series 10K resistor to protect the input.

Technical – Conversion of Wagner HF Transceivers (Peter VK2EMU)

Several years ago, WICEN were given a number of Wagner 1729 HF Transceivers. These units are 100W solid state crystal locked Single Sideband covering 2MHz to 12MHz. unfortunately for most amateur operation, they are upper sideband. Traditionally amateur radio is lower sideband on 80m and 40m.

Some previous investigation showed me that the 9MHz crystal filters used in these radios were symmetrical (or close to). The carrier insertion oscillator for the radios runs at 9001.8 kHz (9000 kHz + 1800 Hz), so by changing the oscillator to 8998.2MHz (9000 kHz - 1800MHz) the radio should become a lower sideband unit. With this in mind, I ordered a new carrier insertion crystal and a single crystal to convert the radio to 3595 kHz, the Dural Sunday broadcast frequency.

For many years, I have ordered crystals from "Beacon Crystals" in South Australia. It's about 18 months since I last place an order with them and during that time, the business was sold, run for a while and then closed down. That left only a choice between Bright-Star and Hy-Q, both in Melbourne. I tracked down Bright-Star's address and the email address of the manager and got a quote for the two crystals (slightly more expensive than Beacon Crystals used to be). So off went an order. A few days later I received an email. Between my getting a quote on the crystals and my order arriving, Bright-Star had been bought out by Hy-Q!

The crystals have arrived and have been fitted to the radio. It tunes up O.K. on the bench, but it still needs an on-air test. Should the modified radio work successfully, I will add to it crystals for the 40m (7146kHz) and 160m (1845 kHz) Dural broadcast frequencies. The 40m should be no problem, but whether or not the radio will tune from 2MHz down to 1.845 kHz needs to be seen.

Provided the 80m and 40m channels work O.K., then the homebrew group is in for a job. I've volunteered one of the Tuesday evening workshop meetings as a conversion night. The proposal is to convert 10 of the radios for WICEN and to be crystallized for the national WICEN channels of 3600 kHz and 7050 kHz. This will still be a few months down the track, but it should prove to be an interesting project.

On-air tests to date that the carrier frequency is a bit high and recovered audio is also a bit high in tone. Internal adjustment available for the two xtal oscillators does not allow correction of this problem so two new xtals have been ordered. Crystal locked transceivers are apparently such a rarity on the air these days on ham bands that initially the Ham I was talking to could not understand why my Wagner set could not be adjusted down to the net frequency I was working until I explained that the set was xtal locked.

Technical – HF/VHF Signal Sniffer with audible output (Max VK2ARZ)

Max VK2ARZ has been involved in Aero-Gliding for many years and even with his failing eyesight still enjoys it tremendously. Being a Full-Call Amateur Radio Operator he of course has a special interest in the radio equipment used for safety communications between ground and the airplanes. He has long been involved in helping pilots and ground crew sort out RF, Audio and Antennae problems especially those in the aircraft themselves.

To do this he has developed a couple of pieces of test equipment uniquely suited to the aircraft and his failing eyesight. The first is a Wideband HF/VHF RF Signal Strength Meter or “Sniffer” and the second is an Audible Indicator Unit. Both of these have undergone various modifications over the years. Recently I helped him modify the Sniffer Unit and rebuild the Audible Indicator Unit, then mount them on a small wooden paddle so that these days he has a very useful and compact test set.

We are working on a technical article which hopefully will appear in AR in the near future.

Group Project – 10GHz Transceiver (1) – Case and Control Panel

Peter VK2EMU is coordinating a project based on an EA project of the early 1980’s using PWM of a little 10GHz door opener module. A number of us are involved and Peter using his you-beaut ferrous bladed drop saw has cut up some aluminum panels to form a very substantial enclosure for this RX/TX unit. The sides of the box open out to provide access to the internal circuitry. Most of us have built our boxes up and another member with some good test

equipment is testing and calibrating the microwave modules. In this issue we will introduce the project and subsequent issues will expand on the project all the way to antennas and testing/alignment of the completed set.

10GHz Project - Introduction

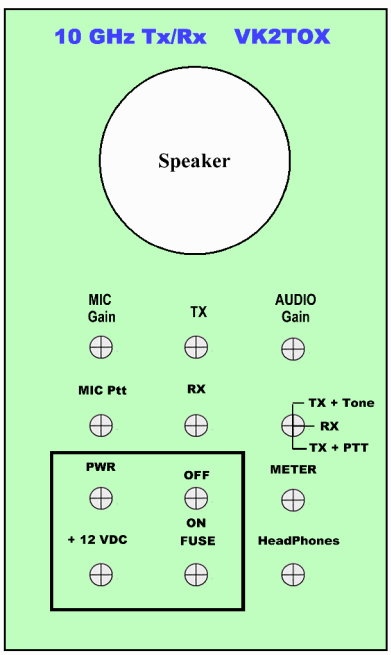
For about 20 years, I have been interested in doing something on 10GHz. My interest was stirred when I came across a project published in Electronics Australia September 1975, using Pulse Width Modulation. Fairly early on, I purchased a pair of Gunn modules, both of which have disappeared. A year or so ago I obtained several from an amateur who is also a burglar alarm installer and more recently half a dozen from an advertisement on VKHAMS.

One of the problems with a project like 10GHz is finding someone to talk to, but with the advent of the homebrew group, this is no longer a problem with several members in the group interested.

Another problem with many projects is all the peripheral that surrounds the central core. In the case of a 10GHz Gunn module, there is the mounting of the Gunn module as well as the microphone, speaker, volume control as well as the box it all fits into. While talking to others about various projects Owen VK2AEJ had mentioned several times that he was interested in DELTA modulation. I had also seen a simple project in an old Tandy Electronics book of Pulse Frequency Modulation using an infra-red LED and a photo-transistor. All these modulation modes of have one thing in common; they are all pulse modes. 10 GHz Gunn modules are easy to pulse, you just switch them on and switch them off. There is also the ultimate pulse mode of full digital encoded voice.

So now I had several different types of modulation schemes to play with, but they all involved simply switching the Gunn unit on and off. They also had a number of other common parts, such as the need for a microphone, speaker, volume control, PTT etc.

An idea began to form. I could design and build a standard box to house the 10GHz Gunn module as well as all the peripherals. With a number of boxes of common design being built, then it would be a fairly easy matter to change from one type of modulation to another as the experiment progressed. With a box of a common design, it would have to be something reproducible as well as sturdy and cheap. There are not many boxes in the electronic stores these days and those which are, are generally plastic or very light gauge metal with holes in the wrong places. Neither of these types of boxes were suitable for a 10GHz transmitter. There are however some supplies (RS & Farnell) that carry large die-cast boxes or heavy gauge aluminum, but are generally very expensive for amateur use. If a suitable box could not be easily purchased then why not build my own. While at Carpal Aluminum, I saw that they had sheets of 1.6mm aluminum, which would be useful for such a box. A design was finalized with 1.6mm sheet aluminum and angle for the edges and a bottom of 10mm thick by 100mm wide bar. The box is held together by pop rivets and 3mm bolts screwed into holes drilled and tapped into either the 10mm thick bottom plate or the 3mm thick pieces of angle.



10GHz Tranceiver Back Panel

The finished box is 100mm wide by 170mm high and 240mm long. The Gunn module will mount on the inside of the front plate (with a suitable size hole cut into it), while on the rear is mounted the controls and speaker. The electronics will be mounted on a pair of mounting plates on the inside of the side panels. On the top of the box is a standard screen door handle for carrying, while the bottom plate is drilled with a 5.1mm drill bit and tapped with a ¼" Whitworth thread allowing the whole box to mount on top of a standard photograph tripod.

Here is the layout of the back panel for the unit being built by Brian VK2TOX. A few extra controls/sockets have been fitted to allow for other future functions. MIC and +12VDC sockets are 4 pin microphone sockets. PWR and RX lights will be green LEDs and the TX light will be a red LED. MIC and AUDIO Gains are pots for the appropriate function. The jack marked "Headphones" is a 3.5 stereo jack for external headphones, will disconnect the internal speaker when a plug is inserted. The Meter jack is for whatever needs metering (Gunn current, signal strength, unit current etc). Above this is a three position toggle switch which selects RX (unit is receive mode), TX+PTT (unit transmit controlled by the PIC PTT switch) or TX+Tone (unit transmits a continuous 1 KHz tone). In the TX+Tone mode the TX light will blink to warn operator of the mode and that unit is transmitting. There may also be a warning tone superimposed on the speaker as well so that anyone near the unit knows that it is transmitting.

The next parts of the project involve standard microphone preamplifier, standard audio amplifier stage and standard Gunn module driver stage. I have obtained a number of surplus micro-phones which can be used for the project.

Technical – HV Power Supplies for Homebrew projects (1)

First let's clear up what I mean by HV Power Supplies, I am referring to a PSU delivering between say 100VDC and under 1KVDC. I would class anything at and above 1KV as an EHT supply.

WARNING !! The equipment to be mentioned in this article contains voltages which could be lethal. Do not work on this or any mains equipment without proper safety precautions and equipment. If you get the shakes, your eye sight is not so good or in doubt, get a more experienced mate to do it for you. If you are re-using an old or ex-equipment transformer then get a mate with a Megger to check the insulation between the windings and the frame of the unit. Make sure you use mains rated wire, switches and fittings, **NOT!!** Automotive hook-up wire or those 12VDC switches you have left over from fitting a thingy in your boat.

So, in this day and age of solid state components what do we need a HV supply for? A low current supply for testing the PIV and Leakage of pre-loved power diodes. I have lots of these salvaged from PCBs and equipment. So they are only a few cents each to buy new, but that's a few more cents toward the new stuff you occasionally need to buy. Video deflection transistors and SMPS drivers have ratings in 100's of volts, both need testing. HV Capacitors for this and valve equipment can be quite expensive, especially if it is a "love" job for your Uncle, so the need to test and or re-form these components is often required.

Of course, if you repair valve gear you often need a substitute PSU to determine if the remainder of the equipment is functional, before diving in and obtaining parts. If you build valve gear you will need a good HV PSU of 200 to 300V at say 50mA for receivers and up to say 800 or 900 volts at a few hundred mA for a transmitter.

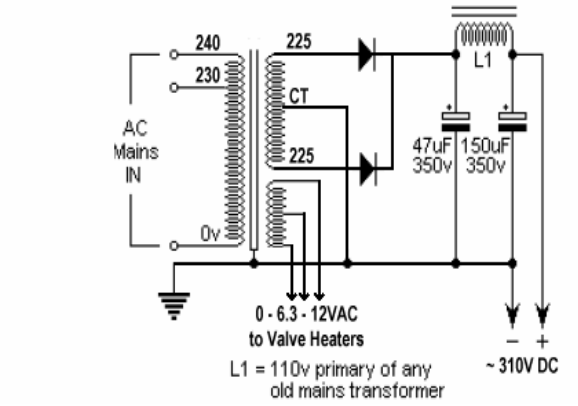
Just for the fun of it a few of us have decided to build a valve RF amplifier for the Ham HF bands. Some of us are building a single band unit and some others a unit for two or more bands, obviously the difference is mainly in the input/output tuned and loading circuits, and of course the size and complexity of the finished unit. But first, we need a PSU for it, mine will require 700VDC at 150mA. I have seen some really neat example of the following ideas in recently completed valve projects.

Most of us lesser-healed Hams will usually baulk at paying literally hundreds of dollars for a suitable mains transformer (they are still available, for a price) and usually have to resort to various other "means" of obtaining the required parts. In fact it pays to look at exactly how you might generate the voltages required, so lets look at a couple of ways:

(1) Specific Mains Transformer (240VAC to 225-0-225 @ 40mA to 200mA)
(2) Mains IsolationTransformer (240VAC to 240VAC)
(3) Back to Back Mains Transformers with LV secondaries (2 of 240VAC to LV)
(4) Variations in use of primary/secondary windings in above (Incl a Variac ®)
(5) Any of above with Voltage Multipliers
(6) Transistor or MOSFET Inverter (12VDC to 250VDC)
(7) Oscillator and Voltage multipliers (555 timer and diodes, usually only low current)
(8) Switch Mode PSU (specific design or re-cycled PC PSU)

Specific Mains Transformer

With this method a specific transformer is selected and purchased. Now this can be "new" (expensive) or liberated from an unused piece of gear (much cheaper). A good source is your next Trash-n-Treasure meeting or swap something else with a mate.
This is usually a more compact approach, certainly the circuit and construction is simpler and quicker.
These days L1 is usually replaced by a high wattage resistor of 1 to 5K ohms, although this will usually give a higher voltage drop than a good choke. As suggested the primary winding of an old mains transformer (provided it can carry



the required current or a field coil from one of the very old speakers. Not shown are of course appropriate mains switch, fuses and any indicators required.

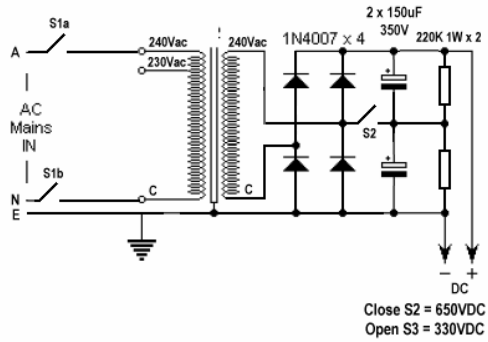
Shown with this transformer is a Full Wave capacitor input circuit which will produce around 1.4 times the AC volts on one side of the secondary i.e. 1.4 X 225 = 315 VDC, but this depends on the regulation characteristics of the transformer and also voltage drops in the circuit.

Mains Isolation Transformer

Mains isolation transformers are normally fairly expensive but can often be purchased on the surplus market or a part of a piece of medical equipment quite cheaply. By the nature of their construction and use they are well built and with good insulation between primary and secondary.

Often the primary and sometimes the secondary have tapings to allow for varying mains voltages but usually not, they are more often simply a 1:1 ratio transformer to isolate equipment from the mains.

So not much choice where output voltage is concerned and of course if you have need for heater voltage then a separate LV transformer will be required also.



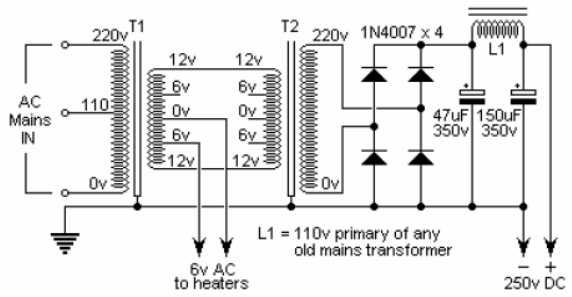
With the transformer shown is a rectifier/filter circuit which can be switched between ordinary Full Wave output and that of a Voltage Doubler, more about this later in the article.

Back to Back Mains Transformers with LV secondaries.

In these days of expensive HV transformers this is a neat trick to get a HV DC output. Also 30W LV transformers don't cost a lot and with careful selection you could use a couple out of your junk box.

As shown T1 has mains applied to its primary, its LV secondary is connected to the LV secondary of T2 and output voltage is taken from what is normally the primary winding of T2.

You need to careful here as this winding of T2 has to provide (with a safety margin) the current for the DC output. So selection of the transformers starts with the wattage required for the DC output. Following are ball-park figures presented to demonstrate the selection of the components.



Lets say we need 330VDC at 50mA for the equipment and S2 is open (or not there) so we have a full wave bridge rectifier with capacitor input filter so output will be Vdc = Vac x 1.4 and Idc = 0.62 x Iac.

In the following example we have obviously cheated a bit by needing a 240VAC winding for the rectifier if you need another voltage then you will have to do the math's and in (f) connect the two LV windings to produce the required voltage but be careful you can't draw 50W out of a 20W winding.

(a) The secondary voltage Vac will need to be Vdc / 1.4 so 330 / 1.4 = 240VAC
(b) The secondary current Iac will be Idc / 0.62 = 80mA
(c) Secondary wattage required is 240 VAC x 80mA = 19.2W
(d) To allow for transformer regulation and inefficiencies lets assume 90% efficiency
(e) So 19.2W at 90% efficiency becomes 21.3W, the nearest standard transformer is 30W so use that which will allow for inefficiencies in the back to back connection of the transformers.
(f) So now setup the two transformers as shown and connect the secondaries 0V to 0V and top of secondary T1 to top of secondary on T2.

Variations in use of primary/secondary windings in above (Incl a Variac ®)

In all of the above transformer configurations we can mix and match the ideas. If you have the 225-0-225Vac with rated output of 50mA you can use the whole winding (ignore the center tap) and produce a nominal 630VDC using a bridge rectifier but remember the winding is now only rated at 25mA output current which will allow about 16mA (25mA

x 0.62), as this supply will have a fairly high source impedance it would be ideal for testing power diode PIV rating and high voltage Zeners.

In all the examples presented above adjust the primary tapping (T1 in back to back unit) to fine tune the output volts. As already mentioned adjust the LV windings of the back to back unit to get quite considerable changes in output DC, but be careful, do some calcs before loading it up.

In fact in all of the above be aware that in a lot of modern transformers there is a thermal fuse built into the primary winding to protect against over current and over heating of that winding. Once it blows you might as well throw the transformer away, unless of course you intend to dismantle and rewind it, obviously replacing the fuse when you do so.

Any of above with Voltage Multipliers

Depending on the voltages and currents required you can as shown above use Voltage Multiplier rectifier/filter circuits to higher voltages. A Full Wave voltage doubler produces around 2.8 times the Vac input. See the ARRL or RSGB handbooks for details of various configurations, but remember no free lunches. If you double the voltage you halve the available current (approximately) it's all back to "Watts" of power in and out of the windings.

In test equipment or to switch a transmitter from low to high power a simple way of changing the output voltage is often required. Most PC switch mode power supplies are fitted with a 110/240 volts selector switch to allow the changing of the input mains voltages to the PSU. This is usually achieved with a simple single pole switch (mains rated) which very sneakily changes the rectifier/filter circuit from a bridge rectifier to a full wave voltage doubler. The voltage doubler obviously being used when 110VAC is the mains voltage. However if you have a fixed voltage input to the circuit (Vac) and operate the switch you can have either 1.4 x Vac or 2.8 x Vac as the output voltage at the appropriate current (remember Mr Watts again).

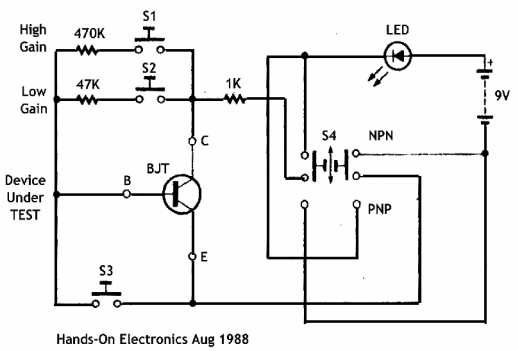
This concept could also be used in LV power supplies as well, especially if you don't have tapings in the secondary of the transformer. It is often desirable to limit the dissipation in the PSU regulator circuits by reducing the input voltage to the regulator when low voltages are required.

Next Newsletter

That concludes this introduction to HV power supplies. Next issue we will follow up with various means of regulating or adjusting the HV output, including current limiting, which is easily accomplished when solid state components are used.

Valve and semiconductor regulators will be looked at. Peter VK2EMU and Mark VK2XOF are helping me source parts for a HV regulator circuit, I think Mark is even producing a PCB for it, so we have another! Group project.

Quick Projects – Transistor Tester – DC Gain



Hands-On Electronics Aug 1988

I recently obtained some "grab-bags" of semiconductors from one of my suppliers and have been looking for a quick way to do at least an initial sort of the components. Most of the components are marked with recognizable type numbers, so this tells me if they are NPN or PNP and if for Audio or RF usage. These simply need to be sorted out into some groups of Low and Medium to High Gain and of course whether they actually work or not.

Testing for specific DC and AC parameters and also F_T needs more specialized equipment which will be covered in later articles.

This circuit gives a good indication of the DC Gain of most NPN and PNP low power silicon and some of the older germanium type transistors. It can be built ugly style just on a piece of Vero board and fitted into a small plastic case if you want to be fancy, with a transistor socket or short leads with alligator clips to connect to the device being tested. The 1K resistor may need some adjustment in value depending on type and size of LED used. With S4 in either position short the collector and emitter test leads together

In my case I know which units are NPN and which are PNP so to use it:

(1) Set S4 to NPN or PNP depending on the device being tested.
(2) The LED should not light up, if it does then the device possible has an internal short or at least a high leakage between the collector and emitter. Dump it or use the base/collector diode junction for some other project.
(3) If LED is dark then press S1 and a medium to high gain device will cause the LED to light brightly.
(4) If the LED is dim when S1 is pressed then press S2 instead and LED should glow brightly indicating a low gain device.
(5) If the LED still does not glow fairly bright then either the device is VERY low gain or is well past retirement.

(6) Another useful test on the device is to check base to collector leakage current. With S4 in the correct position and the device connected press S3. If LED lights any more than a dim glow then the device is defective.

Quite obviously you can also use this little tester to check out the basic functionality of diodes and LEDs by using the collector and emitter test leads, this circuit should provide enough voltage and current in a device to turn it on. I use it to confirm the polarity of leads on various LEDs before cutting the leads to length and soldering them in, it's a real pain when you install them the wrong way and the don't do their thing. The long lead is usually to the positive side of the supply but not always. Besides I am a firm believer in testing ALL components before fitting them to a circuit. At least if the finished circuit does not work then you have a reasonable assumption that the components did work (unless you have let the smoke out of them !!) before you installed them.

This Newsletter online at Amateur Radio NSW web page

The Radio Homebrew and Experimenters Group is on the net, just go to www.arnsw.org.au and look for "Homebrew News" for latest news on the group and a "pdf" copy of this newsletter. Let your friends know too. We will shortly have our own email address, meantime just send any email to Parramatta office.

Planned for next issue

In the next issue we will continue the series on the fabricating PCBs.

Hopefully a bit more news on the various Ham clubs around Sydney and news on the various projects being designed and built at the Homebrew meetings.

For "Quick Circuits" we will expand our Transistor Tester to do some quick tests on FETs, Diodes and later continue the series with a SCRs Tester. Using our Signal Tracer will also be expanded with a Demodulator probe.

The series on the 10GHz transceiver, the Wagner conversion and HV power supplies will continue along with the articles and practical projects related to both.

A new series on Low Voltage power supplies will start and include variations on the theme of the recent variable supply presented in AR magazine earlier this year (there are at least three versions presently under construction), included will also be various projects based around the use of old PC power supplies. We will also look at batteries, power packs, chargers and power distribution for field use of ham gear. Accompanying this series will be a short group of articles and projects of testing of LV PSU's including both passive and active PSU loads. Max VK2ARV has a 2N3055 based piece of gear he has used for years and I have various configurations up to 600w. These will be needed to test and setup the various LV PSUs to be covered.

A new project under way by a few of the members is a valve HF amplifier (just for the fun of it), mine is uses a 6146 and is based on a late 1950's ARRL handbook circuit of a 90Watt Multiband AM/SSB amplifier. Other units are based on 813's and 6DQ6's. To some this is an excuse to complete un-finished projects sitting in the garage.

Peter and myself have been using 160m just recently but finding our ATU's etc a bit wanting on this band, he is building a high power ATU for use on this band and I am looking at modifying my Yaesu tuner to cover 160m, hopefully we will get some projects out of these efforts. We will also be looking at cross band splitters to allow a multiband transceiver to work into separate anteneas for each band (say 2m and 70cm) and also band pass filters to allow field day operators to work adjacent bands without crunching each other when they fire up.

I hope to have an article from Peter VK2JTV on his beaut coax based dipoles we used at last years Lighthouse Day contest. They are based on a project in an ARRL handbook of a few years ago.

John is well under way with his various flea power HF gear so hopefully we will see some projects out of his efforts also.

A new series on construction of an XYZ Table, using stepper motors to control a moving platform allowing routing of PCB tracks, precision drilling and drawing. Based on the concepts presented in Silicon Chip magazine in 1999, but using different parts and construction. Current prototypes involve quite different construction and built mainly from scavenged parts from old printers etc.

OH!! nearly forgot, from a deceased estate we have sourced a bunch of unfinished ex PMG Audio Oscilator boards and front panels. They are Wien Bridge configuration using Ge transistors, but Mark VK2XOF has reworked the circuit to use Si transistors. I have taken it a step further in inverting his selection of transistors to allow the more modern positive supply line and am also working on getting the project into an un-used PC power supply case as a group project.

..END..