December 2003
Volume 4, Issue 5

ANODE

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Editor's Comments

December 2003
I have put a couple of articles together for you to read over the Christmas holiday period. The RF Inductance meter should provide some useful information on making an inductance/coil meter. The second is one that came about from questions asked about how you can connect a personal computer to a radio or other control unit. This should provide a suitable reference for enthusiasts who want to communicate with their equipment. There will more articles in this series as the "PC" nowadays has many more 'ports' and ways of connecting to the outside world.

WELCOMING NO CODE "DOWN-UNDER"

Last week Australian's decided to abolish code exams on the 1st of January.

Now it's planning a worldwide on-the-air celebration as 2003 gives way to 2004 and Morse testing disappears. Jim Linton, VK3PC, has the story and an invitation for you to take part:

On New Year's Day 2004 Australian radio amateurs will gain access to the High Frequency bands using licenses that don't require the passing of Morse code telegraphy tests. The Wireless Institute of Australia invites the world's amateur radio fraternity to join an on-air celebration of this special occasion.

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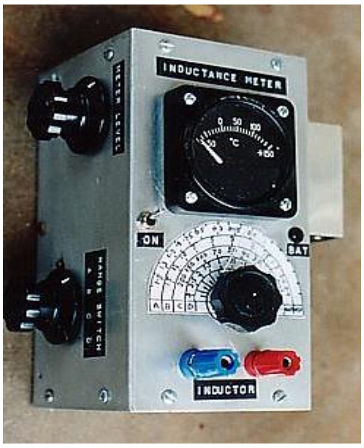
An RF Inductance Meter

A Simple unit which measures 0.1 micro-Henry to 3 milli-Henries

By Lloyd Butler VK5BR

(Originally Published in Amateur Radio June 1997)



Introduction

If the radio amateur builds or services his own gear, he needs, if nothing else, some means to measure the basic units of resistance, capacitance and inductance.
Most amateurs would have a multimeter which can measure resistance. Some digital multimeters include capacitance measurement. Bridges which measure both resistance and capacitance are quite common items in the radio shack but not many radio amateurs have the means to measure inductance.

If one has access to a Q meter, an unknown RF inductor can be resonated with the tuning capacitor on the Q meter. The inductance is then calculated from the frequency used and capacitance indicated on the tuning ca-

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Editor's Comments

(Continued from page 1)
To celebrate the event, there will be a "WIA Welcome to HF QSO Party" beginning at 0001 Australian Eastern Daylight Time and conclude at 2400 UTC on New Year's Day - a total of 35 hours. The VK radio amateurs appearing on HF bands for the first time can be identified by three-letter VK call sign suffixes that begin with the letters H, T, U, X, Y and Z.

WIA amateur stations will be on air to join the HF QSO Party, and these have two-letter call sign suffixes "WI" or three letter suffixes starting with "WI." Listen for the call "CQ WIA Welcome to HF QSO Party".

Many in Amateur Radio have been campaigning for years to have code tests removed as a license requirement to operate on amateur bands below 30 MHz. For Australia this will happen on the 1st of January 2004 with this very special on-the-air celebration.

INTERNATIONAL - NEW ZEALAND: A PROPOSAL TO REPLACE VNG

Still down-under, word that well known "Digital Modes" Amateur, Murray Greenman, ZL1BPU, has proposed that New Zealand and Australian hams put together a network of simple and inexpensive transmitters. This is to provide a high accuracy Standard Frequency Service replacing the VNG standards station that has now gone QRT. Amateur Radio Newslines Jim Meachen ZL2BHF is in Auckland with the details:

Amateurs in the South Pacific have for many years relied on VNG transmissions as a prime source of accurate frequency reference. With the closure of VNG in December 2002, the sole remaining precision signal source in our area is WWVH, in Hawaii. Unfortunately the WWVH signal quality in the South Pacific is generally too poor for reliable use, either to zero beat a simple calibrator, or using more sophisticated computer based techniques.

ZL1BPU says that a series of tests over the last two years has shown that simple low power carrier transmissions on the 80m band would fulfil most of the requirements of a Standard Frequency Service:

Greenman: Using simple HF transmitters that I've designed, we have confirmed that low power transmissions are very useful, for both calibration and propagation study, up to at least 3000 km range.

Anyone can monitor these signals, using a stable receiver and freely available software to look for small frequency shifts that accompany each propagation path. Classic effects such as multiple paths with different refractive indices for different signal polarizations are easily observable. Doppler shift is particularly marked around sunrise and sunset. Observing these signals gives a better understanding of propagation, which is the key to accurate on-air frequency measurement.

The Service now operates on a test basis with transmissions from a high precision local reference on an exact kHz point 80m frequency using a carrier power of 1-5W. The Transmissions are identified in Morse every 30 minutes. Operation is from a different geographical location each weekend. Transmission times are announced and coordinated beforehand by e-mail.

Reporting from Auckland New Zealand I'm Jim Meachen ZL2BHF for Newsline

ZL1BPU adds that these are privately owned, operated and attended test transmissions, not beacons. Establishing a Standard Frequency Service formally, perhaps under the auspices of the NZART, might be considered in the future. (NZART News)

From: "Stewart Bryant" <stbryant@cisco.com>
Subject: Re: **A New Concept: Virtual Spectrum**
Date: 2003-12-04 15:38

We have been running a community receiver for the 136KHz band for a couple of years in the UK.

(Continued on page 10)

An RF Inductance Meter

(Continued from page 1)
pacitor scale. This is a method I have used in the past but I felt I needed something which could give me a direct reading of inductance to eliminate the calculation and speed up the process.

For my own experimental use, I keep a range of miniature inductors (or chokes, as shown in the catalogues). These are made by a number of different manufacturers and are normally available from electronics stores in preferred values starting at 1 micro Henry and sometimes going as high as 10 milli Henries.

Some look like small resistors and some like small capacitors. Some are colour coded and some are marked in inductance value. They generally have quite high Q and measure quite close to their nominated value. I find these inductors very useful for application in filters and tuned circuits which use two pole inductors (i.e. no taps or secondary winding). Sometimes I find I am confused in reading the coded or marked value and need some means to check it out.

The inductance of air wound coils can be calculated by using established methods such as Wheeler's formula. The inductance of coils with Ferromagnetic cores can also be estimated using the Al factor data supplied by makers of the core material. However, a means to measure the inductance is useful to check if one is in the right ball game.

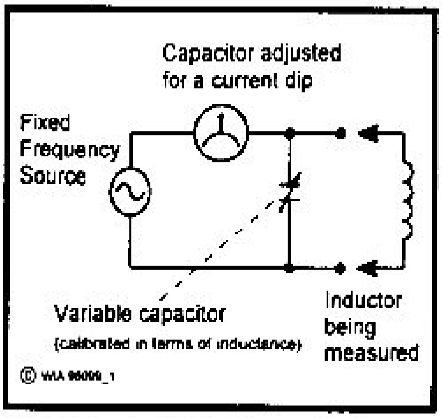

Figure 1 - RF Inductance Meter - principle of measurement.

These are the reasons which led me to build the inductance meter described in this article. This instrument measures inductances from 0.1 micro Henry to 3 milli Henries divided into four ranges set by a switch. It operates from 12 volts, and is powered by eight AA type cells attached to the unit.

Background

I initially referred to Drew Diamond's unit in Amateur Radio, November 1992 to see if it fitted my needs. Drew used a fixed crystal oscillator at around 3.5 MHz to source a bridge where he compared the unknown inductor against a known 5 uH inductor. The bridge was balanced by adjusting a potentiometer which had its scale calibrated in terms of inductance. The meter measured a range of 0.5 to 20 uH.

I needed a wider inductance range than this. Also, I was a bit concerned that no provision had been made in Drew's circuit to balance out the resistance components of the reference and unknown inductors. If the two resistance components were largely different, and particularly if one of them (the unknown) was fairly low in Q, the dip shown in the balance meter would occur with the potentiometer reading offset from the calibration. I guess I could have modified the bridge to include resistance balance but I decided to operate my circuit in a different way.

I have used a fixed frequency source as in Drew's circuit but extended this to four frequencies to expand the inductance range. Instead of using the bridge, the unknown inductor is resonated by adjusting a variable capacitor in parallel with the inductor. The parallel tuned circuit is energised from the oscillator source via a meter which monitors the current into the circuit. The system is illustrated in Fig 1. Resonance is indicated by a dip in current as shown on the meter. A dial attached to the variable capacitor is calibrated in terms of inductance.

Circuit Detail

Influenced by Drew's crystal controlled, Colpitts type oscillator circuit, I wired up the cir-

(Continued on page 4)

An RF Inductance Meter

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cuit and proceeded to search through my box of crystals for precise frequencies which would give me the frequency spread I needed.

This proved to be a bit difficult as I needed to space the frequencies carefully so that each inductance range just overlapped the adjacent one. I finally decided that crystal controlled stability was not needed and substituted selected inductors from my store of miniature chokes. I settled on four frequencies of 16 MHz, 5.2 MHz, 1.32 MHz and 350 kHz for four ranges labelled A, B, C and D.

ductance meter, which includes the oscillator (V1), is shown in Fig 2. The oscillator inductors LI to L4, switched by S1a, are 1 uH, 12 uH, 180 uH and 680 uH. With capacitors C4 and C5 fixed, I found difficulty in making the circuit work over the whole frequency range without some other component change apart from the inductors. Switch S1b, ganged with S1a, connects in C2 and C3 on the lowest frequency. R3 or R4 are paralleled with R5 to increase emitter current on the higher frequencies.

In retrospect, if I decided to build the unit again, I think I

lambda circuit did not require the extra switching and its waveform was much better.

The transistor used for V1 is a type 2N3563 but any other small signal NPN transistor with a high frequency cut-off would do the job.

The inductance measuring circuit is isolated from the oscillator by emitter follower stage V2. The tuning capacitor C9, in the measuring circuit, is a two gang 450 pF miniature variable with both sections paralleled to provide a capacitance range of around 40 to 900pf.

The current into the measuring

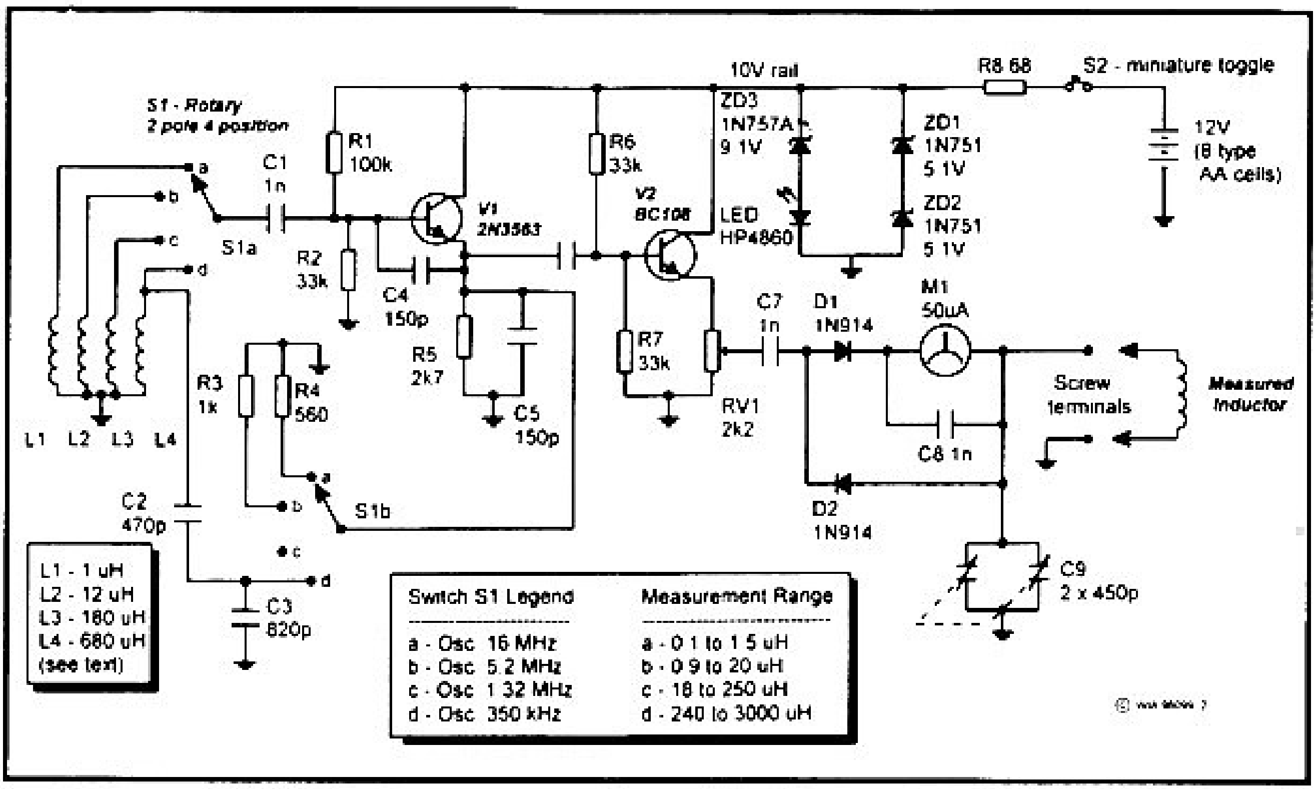

Figure 2 RF Inductance Meter - Circuit Diagram

The complete circuit of the in-

would prefer to use the lambda negative resistance circuit which I recently described in a dip meter. The

tuned circuit is monitored by a 50 micro-amp meter connected via an associated rectifier cir-

(Continued on page 5)

An RF Inductance Meter

(Continued from page 4)
cuit. RF drive is set by potentiometer RVI. This must be adjusted when making a measurement as the off-resonant current varies quite a bit, particularly in changing from one range to the other.

The test procedure is as follows: First set the drive to minimum. Connect the unknown inductor. Advance the drive to near full scale deflection. Adjust the capacitor for a dip and read off the inductance. Return the drive to minimum in case the meter goes beyond full scale next time it is used for a measurement.

Using the frequencies and variable capacitor nominated, the inductance range is as follows: Range A, 0.1 to 1.5 micro Henries; Range B, 0.9 to 20 micro Henries; Range C, 18 to 250 micro Henries; and Range D, 240 to 3000 microHenries.

Powering

To make the unit more portable, it is powered from a dry battery. The oscillator was not stable at a supply voltage below 8 V and operation could be marginal from a 9 V battery when it is partly discharged. Because of this I decided to use a 12 V battery and stabilise the voltage at 10V.

The 10V is set by two 5.1V 400 mW zeners (ZD1 and ZD2) connected in series, only because I didn't have a 10V zener on hand. The LED with the 9V zener (ZD3) in series is a little circuit to indicate when the battery needs replacing.

Normally the LED glows dimly but, if the rail voltage falls much below 10V, the LED extinguishes. The type of LED shown has an internal series resistor. This is a type I had available but an external resistor of at least 1000 ohms would be needed for the usual LED to limit current through the diode.

Assembly

Most of the components used, including the aluminium box, the 50 uA Calibration meter and the variable capacitor, were recycled from dismantled gear. The meter, mounted in a deep tubular housing and calibrated with a temperature scale, must have been originally recovered from an aircraft instrument panel. The calibration in temperature was of no concern as the meter is only used to indicate the tuned circuit current dip.

Inductors L1 -L4 and components C2, C3, R3 and R4 were mounted around rotary switch S1. The rest of the minor components were mounted on several single-row tag strips at convenient places inside the box.

For the critical capacitors in the oscillator circuit (Cl to C5), silver mica was used (I have little faith in ceramic capacitors for such applications).

There were no special precautions taken with the wiring and some leads were a little longer than they ought have been. However, I experienced no problems because of this and it all worked fine once I had won my battle with the oscillator. Minimising lead length between the variable capacitor and the test terminals is important as these add inductance in series with the test sample.

This is corrected for in the calibration but it could be a problem in measuring small inductors if the leads are too large.

The layout of meter and controls is shown in the photograph. As the case was recycled it was not quite made to order. With the meter and calibrated scale on the top, there was insufficient room for the drive control and the range switch and these were mounted on the side. Also, whilst the inside was by no means cramped, there wasn't quite room to mount the 12 V battery holder internally and this was fitted externally on the side opposite to the drive and range switch.

The dial calibration scale was drawn up on paper in four sections without calibration points and the scale was glued to the box.. Calibration points were added later. A cursor

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An RF Inductance Meter

(Continued from page 5)

was made from Perspex sheet and glued to a knob mounted on the variable capacitor shaft.

Calibration

Without access to another accurate instrument calibrated for small values of inductance, a little bit of ingenuity was needed to calibrate the unit. In my case, I was able to make use of my own range of miniature chokes. Obviously these are made to a tolerance but, by using a number of samples, including different samples from different brands and using various combinations in series and parallel, I averaged out readings to obtain each calibration point marked on the scale.

Had the range of reference inductors not been available, I might have used the following method: Firstly a reference unit scale (say 0 to 100) is provided as a further scale section. Disconnect the variable capacitor from its circuit and, using a digital capacitance meter or a capacitance bridge, measure the capacitance at a number of points over its adjustable range. Record these capacitance values against the dial calibration points. For one of the four oscillator frequencies, calculate the inductance required for resonance at each capacitance value using the normal resonance formula. Using graph paper, inductance can now be plotted against calibration units by joining up the reference points derived. Repeat the exercise for the other three frequencies resulting in a set of calibration curves to mark off the scale at will.

Alternatively (but not so convenient), one might choose to only have the unit scale on the instrument and always refer to the calibration curves when taking a measurement.

Using this second method, a correction factor would need to be made on the lowest inductance scale because of inductance in the leads between the capacitor and the test terminals. For example, a lead length of 10cm would add in around 0.1uH. For the lowest scale, it would be wise to make up several small air-wound inductors, calculate their inductance using Wheeler's formula and use them as a reference for correction.

Some Final Thoughts

The article describes a simple circuit which can check out inductors in the range of 0.1uH to 3mH. In fact, the main circuit complication is the provision of an oscillator which can work on four widely different frequencies. A Colpitts type oscillator has been used in the unit described but any other form of oscillator could be made to do the job. The actual frequencies are not too important, except that they need to be spaced so that the inductance ranges are complementary and slightly overlap each other to ensure a defined dip. The frequency spacing might also be dependent on what variable capacitor can be obtained and what tuneable capacitance range it can provide.

Concerning the oscillator as built, suitable frequencies were achievable using four fixed off-the-shelf inductors to set tuning for the oscillator.

However, because of variations in tolerance of these components and associated capacitors, a repeat of the circuit might involve some trimming of the inductor values. One might also choose to wind up the coils, perhaps with provision of a tuning slug so that precise frequencies could be set.

Some ingenuity is needed to calibrate the unit and I have discussed ways of how this can be done. Having completed this, the unit becomes a very useful instrument to have at the test bench.

The Radio Amateur's guide to the PC's serial port and RS232

1 The serial port of the PC

1.a What is the serial port today?

The 'com port' or serial connection on most Pc's today is a 9 pin male connector situated on the rear panel of the machine. Quite often there is only one supplied and an additional cable needs to be fitted internally to the motherboard for the second 'com port' to be available. In the early days of the IBM PC the XT didn't even come supplied with a serial port. You would have had to buy a card and fit it to the machine. Since cost was a consideration, these quite often were single port cards with an empty socket waiting for you to buy and fit another chip. These cards and chips were not designed for high-speed operation and usually didn't get connected to anything that ran faster than 9600 Baud. Quite a few of these XT rated cards were fitted into the AT machines that became available later. This caused a lot of misery to the support persons that had to figure out the card was using the older chip an 8250. The 8250 used to interrupt the CPU randomly as well and the XT Bios was adjusted for this 'foible'. The AT Bios wasn't and all sorts of mystifying incidents would occur. The correct chip in the AT (16450) could run at bit rates up to 19200 bits per second. However most modems in those days couldn't operate faster than 9600 bps so it didn't matter much. Today's (2003) 'com port' can run at 115000 bits per second and uses a double-buffered chip that stores the data internally.

Baud is not bits-per-second. Baud rate depends on the number of bits used to describe characters transmitted or received. In the case of RTTY there are only five bits used as well as a start and one and a half stop bit. With ASCII used on Packet there are generally eight bits used as we may transmit binary data.

When IBM released the PS/2 in 1987, the serial adapter used a 16550 UART. This chip is a vastly improved and featured version of the 8250. Unfortunately IBM did not know about the manufacturing problems and large numbers of PS/2's could not make use of the features in the UART. The 16550A replaces the faulty chip and provides a FIFO buffer arrangement that dramatically improves the performance. Windows from Version 3.1 to XP can make use of the FIFO buffers in its serial drivers.

Why the buffering?

To receive data bytes at 1200 Baud, a cpu must read data from the UART every six milliseconds. Not an arduous task for an 80286 AT. But at 9600 Baud, it must read a byte every 83 microseconds. With the CPU (central processing unit) being used for more intensive processes, it does not have a lot of time to get characters from the UART and stuff them into a memory buffer. In a multitasking operating system the CPU may be too busy to read data from the UART. The FIFO (first in, first out) buffers are internal to the 16550A and can hold 16 bytes of received and transmitted characters. This means that the CPU only has to read every 16-character periods apart. This reduces the load such that a 9600 Baud link will seem like a 600 Baud link to the CPU.

1.b What connections are there?

The Pc's serial port has a reduced set of connecting pins today. Usually only the small 9 pin connector is supplied on the back of the case. The original connector was the 25 pin DB connector. Both types are for use with EIA RS232D specified equipment. The voltages are non-lethal, around +/- 15 Volts. They are supposed to be short circuit proof. However they are not lightning proof and should be protected against possible spikes or surges coming from external equipment. The pin outs and specifications are given in the appendix.

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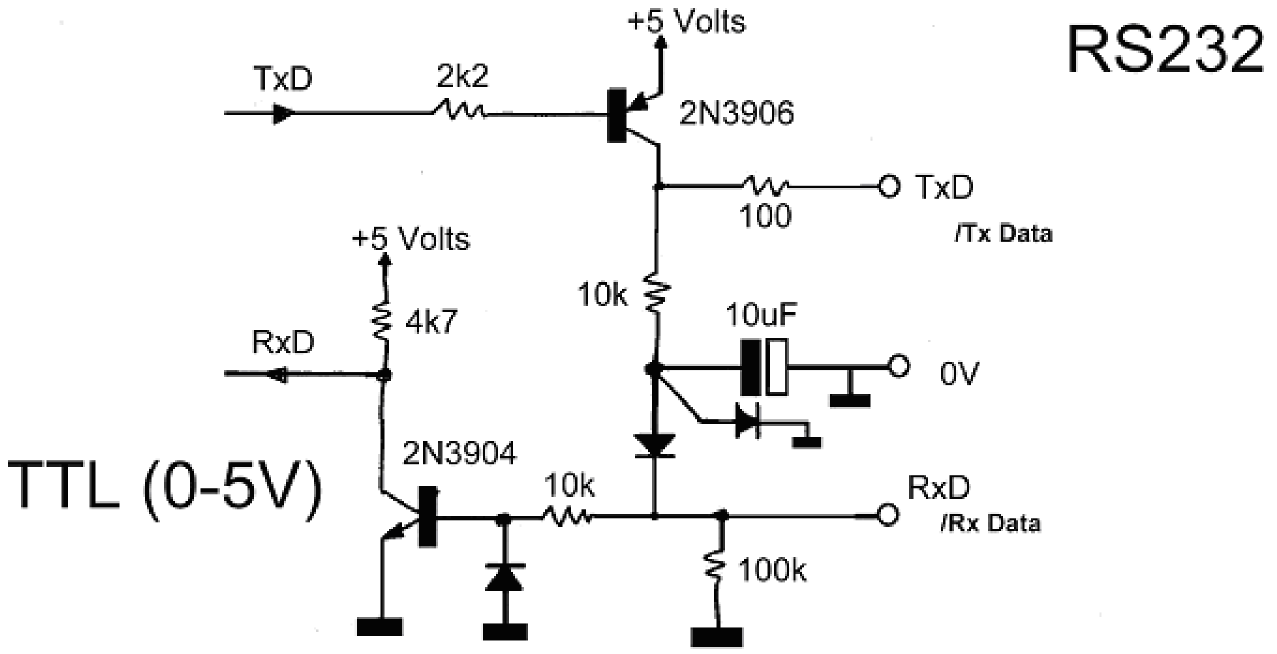
The Radio Amateur's guide to the PC's serial port and RS232

(Continued from page 7)
Some connections have been adjusted by biasing the inputs slightly negative. This causes no end of misery to packet t.n.c. users and other pieces of equipment that don't take their outputs negative. These usually are modem type units that use TTL chips to drive the RS232 output port such as the Baycom TNC. Whilst the RS232 port complies with the specification the unit does not as there is no negative voltage internal to the unit. So the output cannot swing negative sufficient to switch the RS232 input properly. This is usually done to improve the noise immunity of the RS232 input. Coupled with this is the earthing of the two units, which may or may not be at the same potential. If there is a small voltage difference between the two, it probably won't work. (Murphy's Law) See below for an adaption circuit that can be fitted into the TTL unit and will drive the RS232 lines correctly. Note that this circuit inverts the signals and may need connection to inverted outputs inside the unit. Either add a TTL inverter gate between the circuit and the adapter or connect the adapter to the inverted output/input. [Circuit originally from last century's Elektor magazine.]

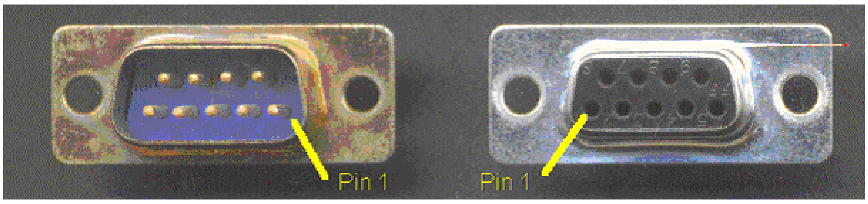


TTL to RS232 Level translation

The simplest possible connection consists of only three wires. Transmit data; receive data and ground (0V). Modems and devices that 'look like' modems use the hardware handshake lines to temporarily stop the data flow in both directions. These are Data Set Ready, Data Terminal Ready, Request To Send and Clear To Send. DCD or Carrier Detect is used to indicate to the 'terminal equipment' that the modem has connected to another modem.

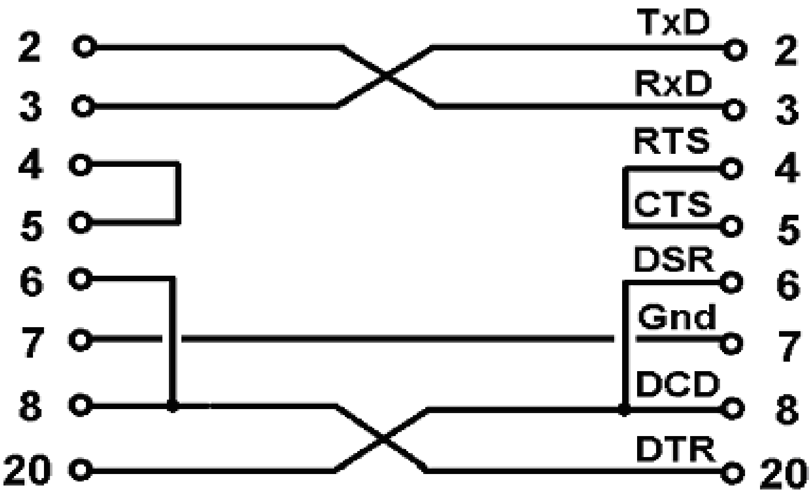
If you have a piece of equipment with more RS232 lines used than the basic three, I recommend you adapt the
(Continued on page 9)

The Radio Amateur's guide to the PC's serial port and RS232



9 Pin pin no.	Signal name	25 pin connector RS232
1	Carrier detect	8
2	Receive data input	3
3	Transmit data output	2
4	Data terminal ready	20
5	Signal ground	7
6	Data Set ready	6
7	Request to send	4
8	Clear to send	5
9	Ring indicator	22

Should you need to connect two similar pieces of equipment with RS232, such as two PC's, here is one of the many RS232 connection diagrams :-



DTE to DTE | DCE to DCE

(Continued from page 8)
unit using a Maxim chip. There are many types of chip available from Maxim. The one you want is the one that takes all the TTL lines and translates them to the RS232 levels. The chip has an internal dc-to-dc generator to supply the negative voltage for the RS232 output. Try browsing to www.maxim.com for more information.

Other useful connections

The serial port isn't the only external connection to the pc. The Joystick port, a 15-pin DB connector, nowadays sometimes called the MIDI port is still supplied. It's usually associated with the sound card adapter. This port has four closing contacts inputs and four analogue inputs. The contact types are for button pushes, typically the fire button on the joystick. The other four are for the joystick potentiometer connections for X and Y positioning. I have seen the analogue inputs used for Slow Scan TV quite successfully. The other four inputs can be used to monitor transmitter or receiver states by connecting them to TTL circuits. Alternatively you could connect some low power circuits to this port running it at 5Volts. Be careful not to short circuit it though as the 5Volt supply has a very large current capability so it could start a small fire!

Don't forget the printer port can also be used to input as well as output data to the PC. These used to be fairly limited to just sending 8 bit strobed data to the printer with a few input lines for sensing. Nowadays these are bi-directional and much more versatile. Whilst only low voltage operation is possible (TTL/5V CMOS), suitable buffering can be connected to allow switching of all sorts of external equipment.

The sound card can also pro-
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The Radio Amateur's guide to the PC's serial port and RS232

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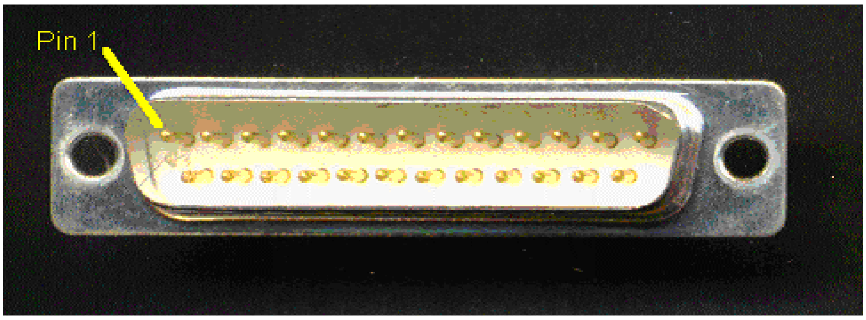
vide data input and output. Usually analogue type data such as speech or audio can be handled or sampled. There is a simple two-channel oscilloscope available for download from the Internet. This could come in handy for someone who hasn't got any means of monitoring their modulation on a transmitter.

Since the 1990's pc's have been supplied with USB ports, usually two, at the rear and two more recently at the front of the PC. These provide low power and a connection of to up to 255 devices. An ever growing number of devices are being supplied that can connect into these ports. Sound cards, Audio and radio adapters as well as microscopes. Some of you may have come across the 'WaveFinder' satellite digital radio receiver, which also plugs into the USB port.

More in the next article....JB



Pin	Signal Name	RS232
1	Shield ground	1
2	Transmit data output	2
3	Receive data input	3
4	Request to send	4
5	Clear to send	5
6	Data set ready	6
7	Signal ground	7
8	Carrier detect	8
9	Transmit data (Current Loop)	9
10	no connection	10
11	Transmit data return - (Current Loop)	11
12-17	no connection	12-17
18	Receive data (Current Loop)	18
19	no connection	19
20	Data terminal ready	20
21	no connection	21
22	Ring indicator	22
23,24	no connection	23,24
25	Receive data return - (Current Loop)	25

Editor's Comments

(Continued from page 2)
A number of amateurs had trouble with noise on the band (TV, a data circuit into a hospital and a mobile phone basestation with faulty SM PSUs just to name three).

We have a receiver located in a quiet part of Crawley (at our radio club station), and this relays the whole of the 136Khz band on 2m (135.4KHz = 144.9854MHz)

This is done with an FT-847 running in satellite mode with the two IFs linked together. We get quite good coverage over the South East, and good dynamic range. We are proposing as an experiment to try relaying a 6KHz segment of the CW segment of 40m band for a few weeks to get a better feel on the dynamic range issues.

The system is MB7LF and is licensed as a data system.
73 Stewart G3YSX

Happy Christmas to you all and a prosperous and interesting New Year. JB

The West Rand Amateur Radio Club
26.14122 South - 27.91870 East

P.O. Box 562
Roodepoort
1725

Phone: +27 11 475 0566
Email: john.brock@pixie.co.za

Bulletins (Sundays at …)
11h15 Start call in of stations
11h30 Main bulletin start

Frequencies
439.000MHz 7.6MHz split
(West Rand Repeater)
145,625 MHz (West Rand Repeater)
10,135 MHz (HF Relay)

Radio Amateurs do it with more frequency!

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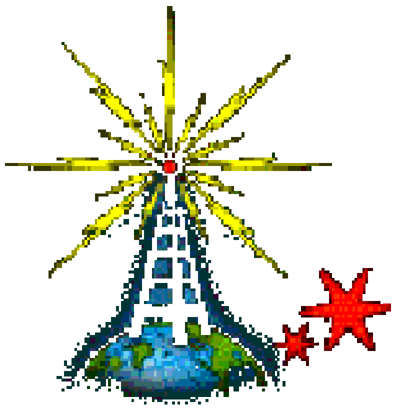
West Rand members - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In July 2003, we re-published an Anode Compendium on CD. It has the issues from July 2000 until June this year. This included the new Adobe reader. It has been updated, check with the chairman for details.



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