THE WEST RAND AMATEUR RADIO CLUB

November 2001
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ANODE

Inside this issue:

Editor's Comments

We have quite a few good articles this month. John Friend has bared his sole regarding why he became an Amateur. The FM deviation meter came from that great magazine Radio & Electronics World. Unfortunately it disappeared in the late '80s.

The magazine's disappearance tells us that electronic construction and experimentation is on the decline. Most youngsters today would rather surf the Internet, take up fishing or watch celebrity tennis.

Nappy New Year

Its time to plan your New Years Resolution. After all if Christmas started in the malls in October, surely it is 'now' New Year in the mall.

Maybe your resolution is going to be that 10MHz antenna project. You know the one that uses the washing line draped on a set of spokes mounted on a pole in the back yard. Its really a DDR antenna with a low angle of radiation. It also dries out the washing rapidly and makes it glow in the dark, just like the adverts on tv!

In this day and age does your hobby innovate like others?

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WHY I BECAME AN AMATEUR

My first insight to Amateur Radio must have been in the late sixties. With JOTA just having come and gone this made me think of the time when I was a boy scout, it was at this time I first saw Amateur Radio in use. At the time it seemed quite magical that you could talk to someone else who lived in another part of the world by another means other than the telephone. Being young at the time my intentions were more about playing soccer and being with my friends and never thought about this means of communication again until the late seventies. At this time it came to light once more when the Four Wheel Drive Club organized a desert race in Botswana of a thousand kms where radio Amateurs were placed every 100kms to help the organizers keep a check on the progress of the race and any incident that might have occurred. Their service was of tremendous help and still is today. It was also about this time that 3 4WD clubs got together and formed ORRA (Off Road Radio Association) made up of the following, 4WD Club of SA, Jeep Club SA and the Land Rover Owners Club SA.

The Association approached the Post Office and applied for a Group Licence and the Association held the licence and members of ORRA were given a call sign within the group, this was before the time of CB and the licence was for 3 channels on the 27MHz band. My first radio was a small Pace, which at the time sufficed its purpose; my

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Special points of interest:

- Measure V.S.W.R automatically
- Check your deviation for the new band plan.
- Contact details on back page

WHY I BECAME AN AMATEUR

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second was a Johnson Viking, which was a SSB, set (Hot Stuff).

The Association was approached in about 1979 by the Post Office and asked if we would like to stay on 27MHz, as they were going to open CB in the country, or move to 29megs, a decision was made to move. I must say that it was a lot of fun to have communication between vehicles when in convoy. The Association grew to such a stage that we were also granted two Base Station Licences. One was placed at St. Giles Home in Johannesburg and the other in Pretoria. You could give a call at most times throughout the day and then be able to speak to someone within the Association. As we all know your distance is limited by the power you use and 5 watts is not a lot. Having seen what Amateurs could do with their equipment and being frustrated with the limited distance we could talk, in 1992 six of us from the Four Wheel Drive Club joined Garth's classes at the West Rand Radio Club where we were taught the basics of radios, antennas, propagation which we needed to know for the RAE exam.

Most of us passed the first time and can you believe it 2 failed on the regulations, which they duly passed the next sitting, bearing in mind that this exam was written at the Joubert Park Post Office itself in those days. I had to apply directly to Pretoria Post Office for my call sign. It's a funny thing when we all became ZR's we never spoke to each other on 2 meters, not even to my late Dad ZR6FRI, but plenty on 29megs. I think it must have been too much of a drastic change from being very informal when call signs were given only as a means to let the others know who you wanted to talk to and never given again during the conversation, whereas Amateurs are a lot more formal as call signs are given at the start of transmission and at the end. The one and only QSO I had was using Jeff Simpson's (ZS6AUG now ZS5AUG) equipment at the bakery to the one and only Vince (ZS6RU).

It has taken me 9 years to complete the cycle from being a ZR

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An Automatic FM Deviation Meter

An FM Deviation Meter covering CB, Amateur and PMR allocation from 20-175MHz.

Part 1 covers the circuitry and theory of operation while Part 2 gives constructional information and ideas for adding percentage AM readout. This article takes the basis of the CB Band Deviation Meter (R&EW October 1981) and expands it into a fully automatic meter covering 20-175MHz (500MHz with reduced accuracy).

The operation of the instrument is such that it will lock on to any signal applied to the input. Provided of course it is in the working frequency range and of sufficient level (>20mV)

If that signal is FM the frequency deviation will be displayed on the meter, if AM is present the brilliance of the AM LED will vary with modulation.

Two switched ranges of 2.1kHz and 10kHz deviation are provided. An audio output is available allowing the AF waveform to be displayed on an oscilloscope.

Theory of operation

The block diagram (Figure 1) gives insight into the operation of the circuit as a whole.

Signals in the range 20-175MHz applied to the input pass through the high pass filter and attenuator, to the RF port of the mixer. If an oscillator is connected to the mixer LO port and its frequency is +/- 10.7MHz from the input signal, the product will pass through the IF amplifier.

The oscillator being used is swept in frequency from 30-55MHz. Therefore if the input signal is in the range 19.3 to 65.7MHz at some point during the sweep a product will be present in the IF amplifier. By

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WHY I BECAME AN AMATEUR

(Continued from page 2)
to ZS and this only came about when I joined the West Rand Club to keep up my interest in the hobby (motivation) to achieve my dream and have that magical feeling of being able to communicate with friends. I have learnt a lot and met a group of nice people at the West Rand Radio Club.

73
ZS6FJ
FRIENDLEIGH JOHN

PS The only problem now is that I am too shy to speak on the air.

Editors Comments

(Continued from page 1)
Philip's recent talk on NiCad/ rechargeable batteries brings to light how Amateur Radio can help us make more of what we have. Most of us and the cell phone masses have been maltreating our batteries for years!

'HF Rage'

It seems the 'old fogies' have yet again managed to discourage some more ZR's from becoming ZS's by rejecting their participation in a contest. The claim was that ZR's are not allowed to take part in HF contests even if supervised by ZS's. Why should the youngsters retain any interest in Amateur Radio or becoming a ZS, if they are going to have to contend with you lot!

The West Rand Xmas Party and Tree

Have you kids that would want to come to the Christmas Tree? Then fill in the form that was in the previous Anode. There will be a braai after the Xmas tree. Please bring everything you need, but the booze. The bar will be open.

An Automatic FM Deviation Meter

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generating the second and third harmonic of the oscillator and adding them to the fundamental, the input range is increased to 19.3 to 175.7MHz (Figure 21.

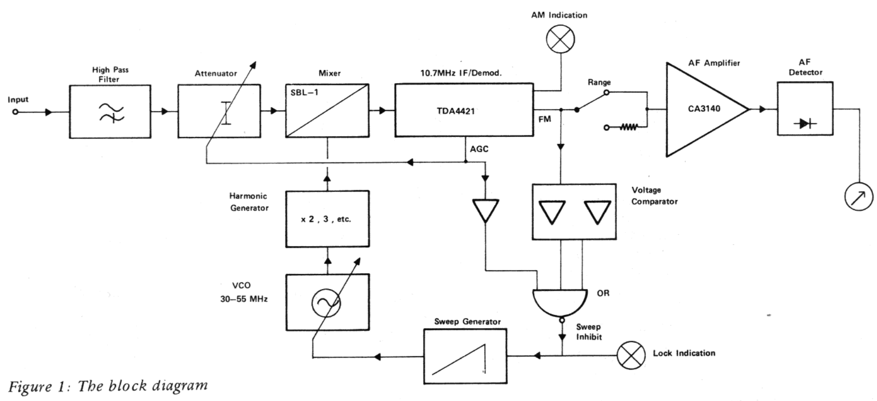

Figure 1: The block diagram

The IF amplifier is 300kHz wide (10.7MHz +/- 150kHZ) and the FM demodulator 'S' curve is linear over that bandwidth. Therefore a CW signal within the IF passband will give a DC output from the FM demodulator. This DC voltage will be dependent on the signals position on the 'S' curve (See Figure 3). The FM demodulator output is connected to a pair of voltage comparators. These act as a window detector sensing when the DC voltage applied to them, is between 3 and 8 volts (Linear region of the 'S' curve).

A sweep generator producing a linear ramp is sweeping the VCO (Voltage Controlled Oscillator) over the range 30-55MHz. The sweep generator develops a voltage across a capacitor which is connected to the frequency controlling element of the VCO. When an

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An Automatic FM Deviation Meter

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output is given from the window detector, the control voltage is held at that instant by being stored in the capacitor.

This means that if while the VCO is being swept, a signal appears in the IF amplifier, causing a DC output within the detected window. The frequency of the VCO will be held at that point, keeping the signal within the IF pass band. Thus the instrument will 'lock' onto the applied input signal. If the IF signal moves outside the linear region of the 'S' curve, the sweep circuitry will again be activated until 'lock' is again established.

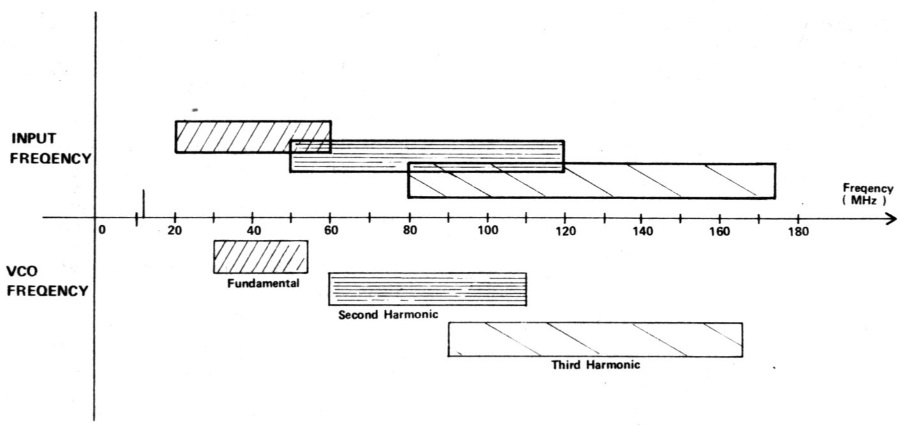

Figure 2:
Bar diagram showing the VCO frequency range and its harmonics - together with the input frequency range. Operation at higher frequencies (although possible with increased 'jitter') is not shown here. The circuit will work up to 500MHz with increased settling time.

Figure 2: Bar diagram showing the VCO frequency range and its harmonics - together with the input frequency range. Operation at higher frequencies (although possible with increased 'jitter') is not shown here. The circuit will work up to 500MHz with increased settling time.

The operation is slightly more complicated than this, because the FM demodulator DC output can be within the window when no signal is present. To overcome this the AFC output is required to be above a certain level before the sweep can be inhibited. This is simply accomplished by combining AGC and voltage comparator outputs in a logic OR gate. The OR gate output inhibits the sweep generator and illuminates a 'lock' LED. If the input signal is frequency modulated when the circuit is in the 'locked' condition. The signal will be demodulated, the audio being passed through the AF amplifier. The amplified audio is then detected and the resultant DC used to drive a meter calibrated in kHz frequency deviation.

Circuit description

The input 20MHz high pass consists of C1, C2, C3, L1 and L2. A pin diode D1 shunts the signal path at high signal levels avoiding over-driving of the SBL-I mixer. The double balanced mixer greatly eases the design of the circuit, providing wide frequency range, good isolation, and superior cross modulation performance. A J310 J-FET (Q2) is used for the VCO in a Hartley configuration. A high capacitance swing varactor (D6) tunes with L3 to comprise the resonant circuit.

The tap on L3 provides a low impedance point to drive the multiplier Q3. The BFW92 makes a high efficiency multiplier. Limiting the collector current through the device with the high value of R17 (470R) results in a relatively flat amplitude/frequency response. The level into the mixer LO port is about 5mW. IC1 is a combined AM and FM, IF amplifier and demodulator working at 10.7MHz. Transformer T2 centres the FM demodulation point, while T3 provides the AM and AGC tuning. Audio output from the FM section is amplified in IC2 and then rectified by D7 and D8. As the meter would read maximum with no signal present (due to noise from the FM demodulator), the meter is clamped by transistor Q4. This transistor being turned on, when the instrument is in

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VSWR Automatically!

By Cary L. Anderson WB0CWP 1528 34th Street S. E. Cedar Rapids IA 52403

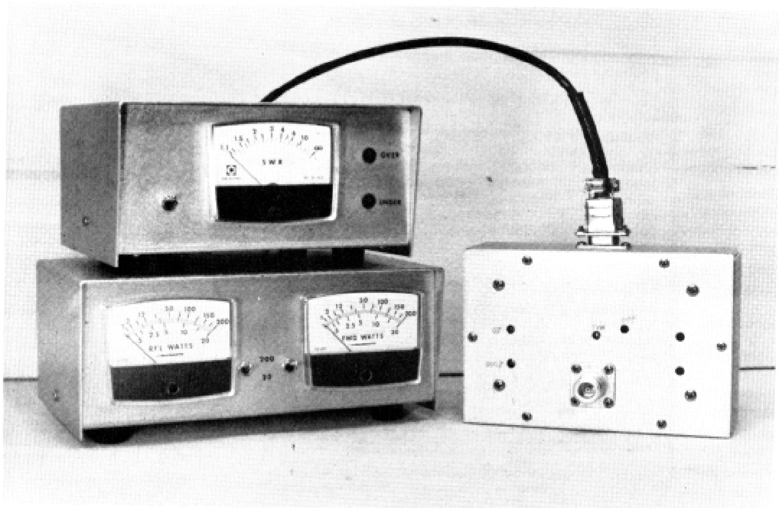

Photo A. Finished design of power sensor, dual wattmeter, and automatic vswr meter.

Simplify antenna matching with this self-calibrating tune-up aid

The antennas used at my station have always been simple-usually a dipole cut for 80 meters, fed with about 52 feet of 300-Ohm twinlead and tuned with a transmatch, resulting in complete 80 through 10 coverage. The one station accessory always present is the common v.s.w.r meter.

Over the years, I have used two types, the single-meter version, with the adjust pot and forward-reflected switch, and the dual-meter version, with only the adjust pot.

The Problem

Assuming you have used one or both of the above examples, you know the frustration of trying a new antenna, changing bands, or even just moving within a band. There are at least a half-dozen adjustments to make to get tuned up: grid, plate, and loading on the rig, assuming tube finals which most of us have, full scale forward set, and forward-reflected switch on the v.s.w.r meter, and, finally, two or three adjustments on the transmatch. This can be quite a juggling act. There are times when v.s.w.r decreases and so does forward power, and times when forward power increases as well as v.s.w.r. During tune-up, the transmitter. power level constantly changes due to a changing load and so does the v.s.w.r. Indications change so drastically that, in some cases, quite a bit of time is used hunting for resonance. This can result in lost contacts and some worry to those who own rigs with solid state finals. This all occurs because the standard v.s.w.r meter is also sensitive to power level and this condition helps mask what we are really trying to do; correct-the source-to-load mismatch.

The Solution

What is needed is a v.s.w.r meter which does not react to power levels, but displays only the mismatch. Tune-up would then only require: (1) nulling the v.s.w.r

Power Sensor and Dual Wattmeter

Fig. 1 shows the schematic of the power sensor and dual wattmeter.

The power sensor was designed around two circuit boards and their associated parts purchased from the Heath Company. The circuit board comes from Heath's v.s.w.r wattmeter kit. The 200-Watt adjustment is the same as the original Heath design, but the line used for forward v.s.w.r set is now used for the 20-Watt position with the addition of a 50k-Ohm pot. There is also an adjustment provided for 2000-Watt capability, if desired. The lines going to the null position of the calibration switches in the dual wattmeter were originally used for the reflected v.s.w.r position in Heath's v.s.w.r wattmeter and are now used for calibration of the power

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sensor that will be discussed later. Ferrite beads (not shown) are used on each internal and external lead at the power sensor to reduce rf currents. The dual wattmeter uses two 0-50-uA meter movements from Radio Shack. The 1.54k-Ohm resistors let the meters appear to have the same impedance as

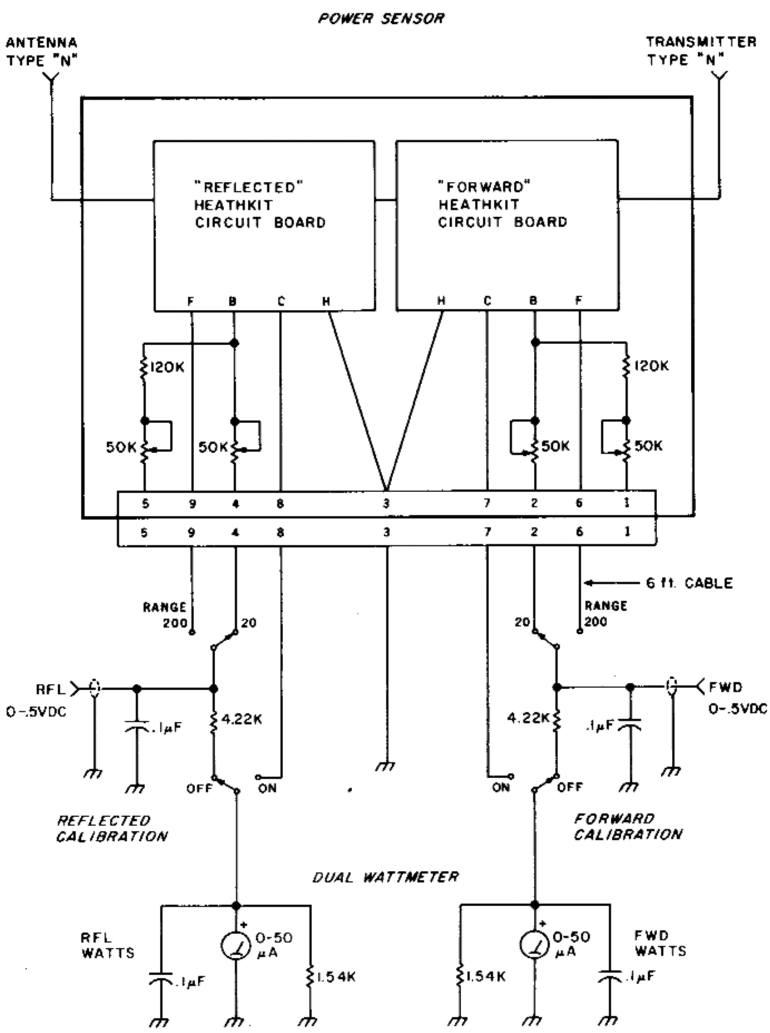

Fig. 1. Schematic of power sensor and dual wattmeter.

Heath's. The 4.22k-Ohm resistors in series with the power meters raise the voltage that will drive the automatic v.s.w.r meter such that a full-scale deflection on a power meter will be equivalent to 500 mV dc at the v.s.w.r meter.

The 0.1-uF bypass capacitors were added to minimize rf pickup on the forward and reflected lines and across the meters.

Automatic V.s.w.r Meter

The circuit of Fig. 2 does nothing but compute the ratio of two dc voltages. If the meter scale were left at 0-1mA, then it would read the ratio of V dc-reflected / V dc-forward directly. First of all, the two dc voltages are filtered to keep out rf and then amplified by a gain of about 20 in the LM108As.

Note the relatively large values, 0.001 uF, of frequency compensation capacitors on pins 1 and 8 of the LM108As. This also helps in keeping rf from causing erratic operation of the circuit. Next, these two amplified dc voltages are compared against a ramp generated by the digital-to-analog converter as implemented by the 4040 counter IC and the R/2R ladder network. This comparison takes place at the LF356Hs (note the positive feedback for hysteresis). The output of the LF356Hs is a square wave, going from about +11 V dc to -11 V dc since bipolar op amps do not conduct to the supply rail. The negative portion of the square wave is clipped off by the 15k-Ohm resistor and at the transmatch and

(2) peaking the transmitter. This would be the end of tune-up. With solid-state finals, step two is omitted and tune-up becomes a real breeze. Photo A shows the finished design, which consists of a power sensor, dual wattmeter, and automatic v.s.w.r meter.

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I know of another project article on an automatic v.s.w.r meter and I credit this one for getting me interested in this idea. However, there were some things that I felt needed to be changed.

First of all, I have always had trouble in the past constructing a power sensor with a flat enough frequency response to cover 80 through 10 meters. Instead of building one from scratch, I used some circuit boards which were purchased from a popular kit manufacturer and which have worked out great.

Second, the earlier design incorporated a dual wattmeter into the solid-state circuitry. If you do not have 115 V ac, you do not have any way to measure power for mobile or battery operation. My design separates the wattmeter and the v.s.w.r meter and treats the latter as an attachment to be used when 115 V ac is available.

Third, the earlier design has five calibration adjustments in the v.s.w.r meter portion of the circuit. After some work, I got that down to one. Calibration of my v.s.w.r meter is very easy and accurate.

Finally, the wattmeter scales in the earlier design were obtained through calibration and the v.s.w.r scale through theoretical computations.

Unfortunately, they do not match very well: 25 percent reflected power is a 3:1 v.s.w.r and not 2.5:1. My v.s.w.r meter scale was derived from the wattmeter scale data which provides for a much more accurate indication.

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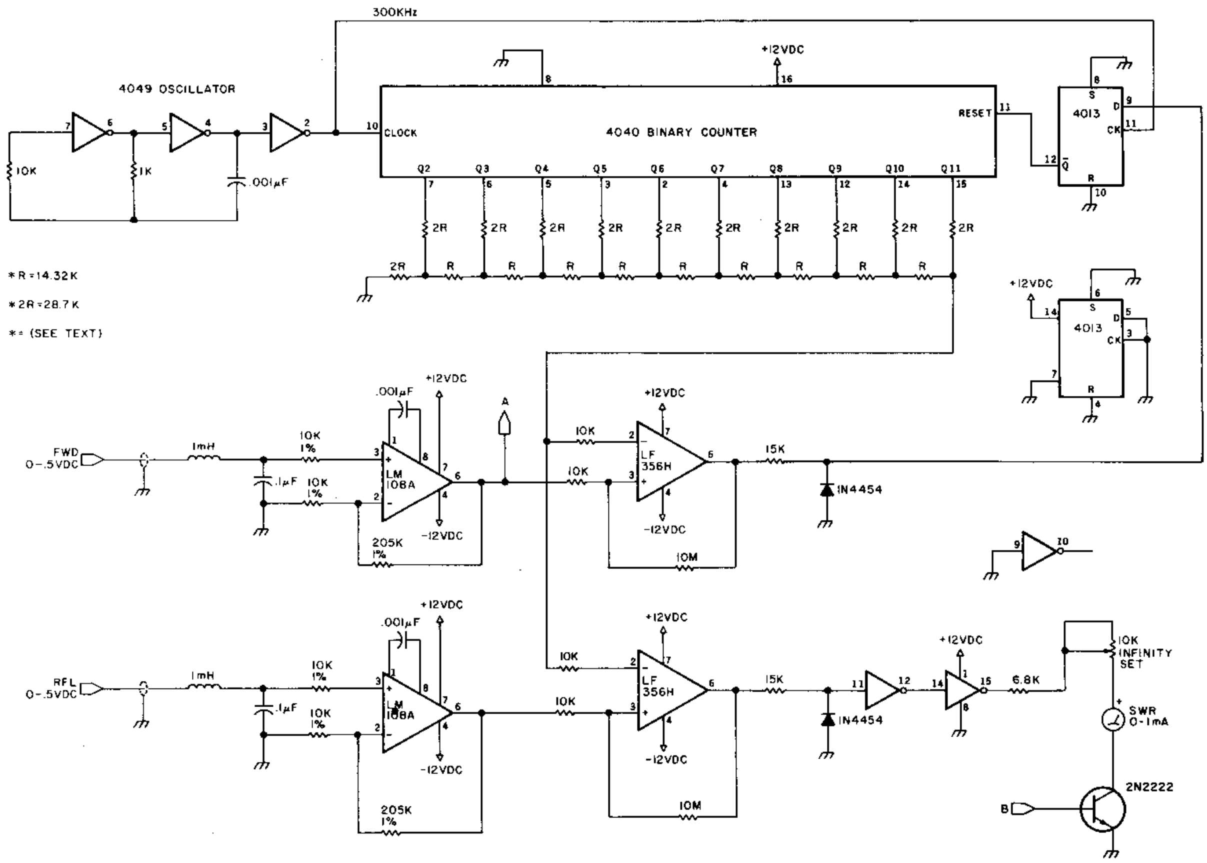

Fig. 2. Schematic of computing portion of automatic vswr meter.

VSWR Automatically!

1N4454 diode combination. From here, the signals go to digital circuitry. The reflected side gets buffered by two sections of a 4049 hex inverter IC, then drives the meter directly through a calibration pot-that's right, a square wave drives the meter. The forward side generates a reset pulse with the 4013 flip-flop IC which clears the 4040 and starts the ramp all over again. The end result of all this is a meter driven by a square wave whose duty cycle is directly proportional to the ratio of the two voltages V dc-reflected/V dc-forward.

Fig. 3 shows that as the forward component changes in amplitude, the maximum amplitude of the ramp changes also, since it is this comparison which ultimately generates the reset pulse. Consequently, the frequency of the square wave driving the meter also changes, but since the meter is not sensitive to frequency, only duty cycle, this is of no importance. Also, note the absence of a filter cap across the meter. The square wave is at a fast enough frequency such that no meter jitter is observed. The frequency of the 4049 oscillator is approximately 300 kHz. The frequency of the square wave driving the meter will vary from approximately 2000 Hz at a low forward power reading to 175 Hz for a full-scale forward power reading. The exact frequency is not critical, so no adjustment of the oscillator was provided. The oscillator also clocks the 4013 flip-flop IC to generate a clean reset pulse which starts the ramp over again.

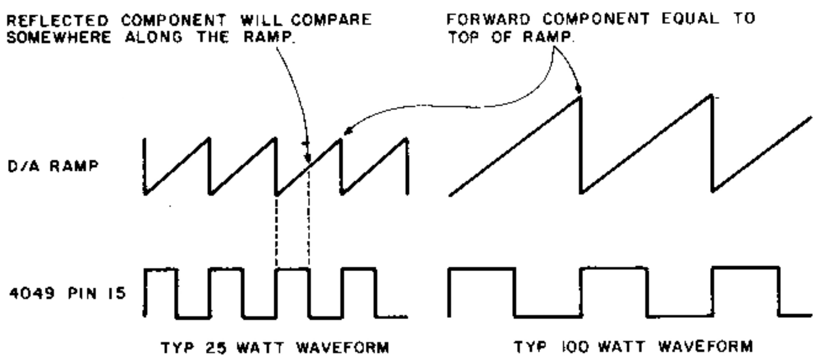

Fig. 3. Waveforms showing change in frequency of the square wave driving the meter with change in power level. A 50% duty cycle, as shown here, equals a 3:1 vswr in both cases (25 and 100 Watts).

The reason for buffering the square wave with the 4049 inverter IC was to add stability to the amplitude of this signal driving the meter. CMOS logic conducts to the supply rail and the +12 V dc supply is regulated. The result is a nice, amplitude-stable square wave.

The value of R in the ladder network (Fig. 2) is not that critical. I would stay between 10k Ohms and 15k. The important thing here is that the value of 2R must be exactly double. These resistors must also be 1% in tolerance for a smooth ramp.

A Few Problems

1. During times of no forward or reflected power, as during receive, the v.s.w.r computer tries to generate a square wave whose characteristics would indicate a v.s.w.r of infinity-this is unacceptable.
2. At low forward-power levels for the range selected, the resolution of the circuit becomes degraded. Consider that the maximum count of the D/A converter is 1,024. A reflected component wouldn't then have one of 1,1024 counts to compare against if the forward component was high enough to cause a count of 1,024. However, if the forward component caused a count of only 10, that would mean that the reflected component would have only 10 counts to compare against, resulting in a visibly stepped meter response.
3. An over-range forward component causes erroneously high v.s.w.r readings. When watching the v.s.w.r meter during tune-up, you may not be aware of the forward power level. Example:

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Let's say both forward and reflected range switches are in the 20-Watt position, but you are putting out much more than 20 Watts forward, let's say 100 Watts. The LM108A op amp that amplifies the forward dc component will have peaked out at slightly over 20 Watts and will remain saturated at 100 Watts.

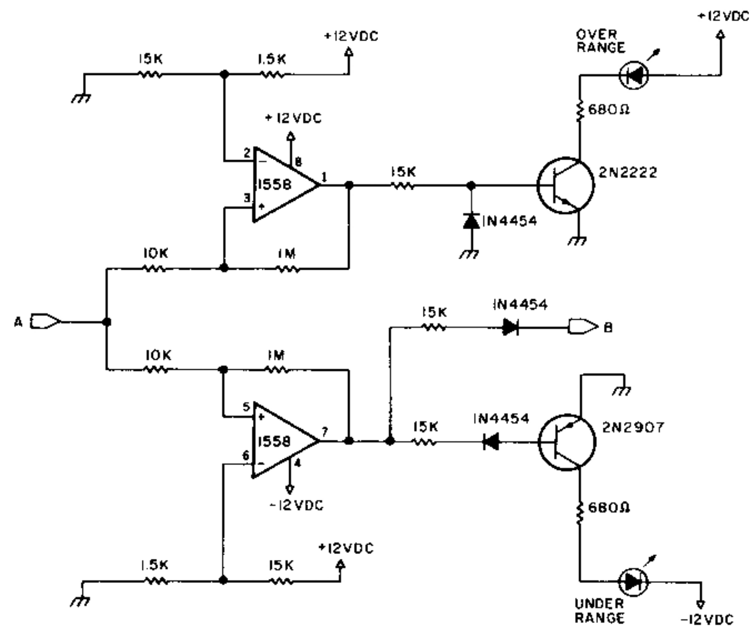

Fig. 4.

Now let's say the reflected power is around 5 Watts. The meter will display around a 1.1 v.s.w.r when, in fact, it is around 1.5:1.

The Fixes

For problems 1 and 2, I chose to disable the 0-1mA meter when the forward power was at the low end of the range. I picked a point at about 3 Watts on the 200-Watt range and 0.5 Watts on the 20-Watt range. As shown in Fig. 4, this was implemented by one section of a 1558 dual op amp IC in a comparator configuration. When the forward component gets too low, the base drive is removed from the 2N2222 that provides the ground for the 0-1mA meter movement. At the same time, the under-range light-emitting diode is turned on giving you a solid indication that the meter is turned off and not indicating a 1:1 v.s.w.r.

For problem 3, I chose to provide an over-range indication to aid the operator. This was implemented by the other half of the 1558 op amp, also in a comparator configuration. The only difference is that the trip point is at the high end of the range instead of at the low end.

The power supply in Fig. 5 is as simple as I could make it: a voltage doubler configuration with the capacitors center-tapped to obtain both polarities, a pair of three-terminal regulators, and then some 0.1-uF bypass capacitors. The current consumption is relatively small, about 30mA for the negative supply and 50mA for the positive supply. No power-on indicator was included because the under-range light emitting diode effectively fulfills this function.

Construction Notes

Power Sensor. Photo B shows the wattmeter head "sandwich." Keep in mind that in order for one circuit board to@ be used for forward Watts and the other for reflected Watts, they must be mounted back to back. One of the sides is removable by modifying one of the type "N" connectors. There are retaining rings holding the center pin in place. Remove the ring from the front of the connector so the pin can slide out the back. Solder the pin to the piece of heavy-gauge bus wire which goes through the toroids of the circuit boards. Do not forget to insulate the bus wire as it goes through the eyelet holding the toroid. A list of the parts needed for the circuit boards can be obtained by ordering the manual from the Heath Company for the HM-102 HF Wattmeter/SWR Bridge.

Dual Wattmeter.

Photo C shows the enclosure

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holding the dual wattmeter.

The enclosure was homemade out of aluminium and measures 8"X3"X5". The two null-calibration switches were mounted inside the wattmeter enclosure to keep them out of the way. I decided to use two separate SPDT switches for the wattmeter ranges instead of one DPDT switch. I like the added flexibility of being able to look at low levels of reflected power while on the 200-Watt forward power range. Keep in mind that when the two range switches are not in the same position, the v.s.w.r meter will not give totally accurate readings. V.s.w.r Meter. Photos D and E show the v.s.w.r meter enclosure which measures 61/2" X 3"1 X 5 1/2 "'. An important point to remember is to insulate the tab of the LM320T-1 2 from the chassis because the tab is not at ground potential. The circuit board measures 5"/ X 611 and was -mounted on 3/8"" standoffs. The circuit board foil pattern and component layout are shown in Figs. 6 and 7. respectively.

Meter Scales. Photo F shows the forward Watts meter scale. The reflected Watts meter scale is identical. The data was obtained by using the equipment in the calibration lab at work. From 80 through 15 meters, the accuracy is within 5% and on 10 meters, it is within 8%. I removed the existing nomenclature on the 0-50uA meter scales with the use of an electric eraser.

Use great care, when using this method, not to go through the paint to bare metal. All of the lettering was done by using rub-on letters. The data for the v.s.w.r meter scale as shown in Photo C was obtained from the 200-Watt range data and the formula:

V.s.w.r = (1 + Sqr(Pref/Pfwd)) / (1 - Sqr(Pref/Pfwd))

The 20-Watt range data did not quite match the 200-Watt range data, so some error will exist when using the 20-Watt range to measure v.s.w.r.

Two pieces of equipment are needed to calibrate the power sensor and dual wattmeter: a 50-Ohm resistive load and a watt-meter of known accuracy. I chose not to incorporate Heath's method for calibrating their wattmeter circuit boards because of the availability of the rf calibration equipment at work. Thus, the parts Heath used were omitted from the power sensor circuit boards.

The forward-power watt-meter is calibrated first. Place the forward calibration switch to the on position. With enough rf power applied to give a meter deflection, adjust the trimmer cap on the forward Watts circuit board for a null on the FWD WATTS meter. Keep increasing the rf power and maintain the null.

Place the forward calibration switch to the off position and the forward range switch to the 20Watt position. Apply 20 Watts as measured by the wattmeter of known accuracy and adjust the 20-Watt potentiometer for a full-scale deflection. The 200-Watt scale was determined using a 200Watt source, but one is not necessary to calibrate this range. Since most rigs will put out 1 00 Watts, I will use this as an example. Apply 100 Watts as measured by the wattmeter of known accuracy and adjust the 200-Watt potentiometer mounted on the circuit board for a 100-Watt indication. A 2000-Watt adjustment was incorporated in the wattmeter head in case I decide to add it on later. Now reverse the wattmeter head in the line and adjust the reflected side exactly as the forward side. I found the most accurate results were obtained by calibrating the wattmeter at either 7 or 14 MHz. Calibrate the v.s.w.r meter by using the circuit of Fig. 8. Apply 470 mV dc to both the forward and reflected inputs, which simulates a v.s.w.r of infinity. Then adjust the Infinity Set potentiometer in series with the v.s.w.r meter for full scale.

Operation Field Day

The dual wattmeter automatic v.s.w.r meter combination was extensively tested during Field Day, 1979. The tent it was used in had a long wire

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and dipole for its antennas and a transmatch for tune-up. Changing frequencies was a snap.

While applying low rf power, all the operator had to do was null the v.s.w.r with the transmatch and then peak the finals of the rig. Needless to say, the total number of contacts this time was higher than last. You really have no idea how easy tune-up can be until you have tried an automatic v.s.w.r meter. Circuit boards for the automatic v.s.w.r meter are obtainable from me for $10 a copy. Also, any correspondence must include an SASE for a reply. Special thanks go to my brother, Cari WB0DFH, for getting me interested in amateur radio back in 1972, Ray who took the photos, Dave, who helped calibrate the wattmeter ranges at work, and the Field Day gang of No 11/0 who let me use one of the tents at the site for the acid test.

References

1. David L. Fayman, "A Simple Computing SWR Meter," QST, July, 1973.
2. Hank Perras, "Broadband Power-Tracking VSWR Bridge," Ham Radio, August, 1979.
3. Staff, "impedance and Other Ogres," 73, February, 1979.

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(Continued from page 4)

the 'unlocked' state. Range switching is provided by S1. VR4 is used to calibrate the meter on the 2.5kHz range, and VR3 on the 10kHz range.

AM derived audio from lC1 is rectified by D3 D4 and the resultant DC used to drive Q1. AM modulation will cause the LED in Q1's collector circuit to light, and vary in brilliance with modulation. DC output from the FM demodulator is connected to a pair of voltage comparators (IC4). The switching point of the low voltage comparator is adjusted by VR7, while the high voltage switching point is adjusted by VR6. The 'window' between these points is adjusted to be within the linear region of the FM demodulator 'S' curve (Figure 3). The voltage comparator outputs are connected to the CMOS OR gate (IC3 triple 3 input NOR function). The other OR gate input is driven from the AGC switch Q11 via another section of the 4023 wired as an inverter. The point at which Q11 switches is dependent on the setting of VR2 (delayed AGC from IC1). Output from Pin 9 of the 4023 is only 'high' when an AGC output is present and the FM DC output is within the window set by IC4. The sweep generator consists of a constant current generator (Q6) charging a capacitor (C27). At the high voltage end of the sweep Q8 is turned on causing current to be drawn through R29. This turns on Q7 causing Q8 to be turned on harder giving a Schmitt trigger action.

Transistor Q9 is turned on by Q7 rapidly discharging C27. Q8 is now turned off so the capacitor starts charging again and the process is repeated. The point on the ramp where switching occurs is adjusted by VR5. A manual reset is also provided by S2. The voltage across the capacitor C27 controls the frequency of the VCO by varying the capacitance of D6. Transistor switch Q5 is ON when the OR gate output is a 0 (Pin 9 IC3). When IC3 output is a 1, Q5 is turned OFF and C27 stops being charged. The voltage of the ramp, at the instant Q5 was turned OFF is held on C27. This completes the control loop, Q10 also being turned on from IC3's output illuminating the 'LOCK' indication D9. Mains power supply for the instrument comprises T4, D11 and C31. 12Volt regulation being provided by IC5.

[Continued in part 2 Next month]

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Bulletins (Sundays at ...)
11h15 Start call in of stations
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Please note this has been just been registered. Our site will be up in the new year.

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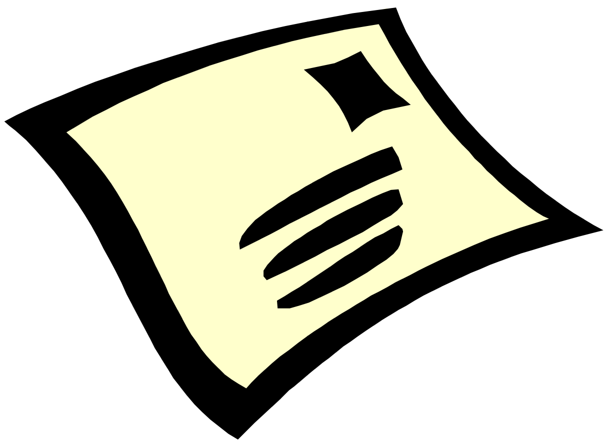

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