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<table>
<thead>
<tr>
<th>Drive Power</th>
<th>Output</th>
<th>Model No.</th>
<th>Price</th>
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Rate selectable tuning to 10 Hz with frequency memory and split VFO provide excellent operational flexibility.

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December 1981
The hospitality extended to my wife and me by Canadian Radio Amateurs during our trailer trip across that country is something I'll never forget. Trailering with a mobile ham station is a great way to make friends, and I want to thank all the hams I met from British Columbia to Quebec for their warmth and generosity.

I had no idea what was involved in obtaining permission to operate in Canada. I wrote to the Canadian Department of Communications for information and even included a copy of my license. I was told just to bring my gear and operate as if I were in the U.S. No fuss, no bother. With the reciprocal licensing agreement, I was allowed to work essentially all the ham bands with the same privileges I have at home as an Advanced-class licensee.

We had no problems whatever crossing into Canada.

"Where are you from?"
"San Diego."
"Where are you going?"
"Across Canada!"
"How long are you going to be in the country?"
"Two or three months."
"Okay, go ahead."

Unbelievable! I was prepared to pay duty on food, my equipment, and so forth, but there was no inspection and no hassle.

One of the highlights of the trip occurred after we'd stopped at a KOA campground just outside Calgary. I called Fred Dettmers, VE2BQY, (whom I'd met previously) on the radio and asked if there was an autopatch on the local repeater. I was told, "Oh yes. Standard access: star up; pound down." I was amazed! No secret codes, no PL tones — just star up and pound down. Another example of Canadian hospitality.

While visiting with Fred and his wife, I had an opportunity to obtain an insight into the differences between Amateur Radio in Canada and the United States. Consider, for example, that the Amateur population in Canada is only about 21,000, compared with 53,000 in California alone. It's easy to understand the concern of the Canadian ham who must contend with the terrific wall of signals coming up from south of the border, especially when Canadians are trying to work into Europe.

The licensing structure in Canada is interesting. Three classes of license are offered: Amateur, Advanced, and Digital. For the Amateur license, the applicant must pass a ten-WPM code test, a written exam, and an oral exam. This license class grants all-band privileges, code only, plus VHF phone. After six months and proof of at least twelve contacts, a 10-meter-phone endorsement and full power privileges are granted. The Digital license allows digital operation at VHF/UHF.

The Amateur-class licensee is eligible to apply for the Advanced license after one year. This exam consists of a fifteen-WPM code test and another written test. The Advanced license permits full band and mode privileges. After five years, the Advanced-class Amateur may obtain a two-letter call sign if available. Licenses are issued for five years, with an annual fee payable to the DOC.

Our trip lasted 2½ months. I had a chance to operate in all the VE districts except VE1 and to meet a fine group of people. One real challenge was a request I received to explain the new American call sign system. It seems that no one in Canada really understands what's going on, who's who, or what's what with our new calls. I'm not sure I understand either.

Bill Gay, WA6PNY
Multi mode operation
includes CW/AM/SSB/RTTY — Normally used side band selected automatically.

Continuously variable power from 10W to full power — speech processor — LDA channeling module included provides auto band changing capability when increasing your power using the IC-2KL broad banded solid state linear.

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coaxed into noticing

Dear HR:
Your July article "Buying Parts By Mail" left out a very reliable source of coaxial cable and other parts. Please notice that Nemal Electronics (5685 S.W. 80th St., Miami, Florida 33143) has a wide selection of coaxial cable and cable accessories for sale at very attractive prices. In addition to that, their service is excellent. I can usually expect to get my order from them in little more than a week's time. Next time you need something in the cable line, I suggest you give them a call.

Dave Karpiej, K1THP
Plainville, Connecticut

a new breed

Dear HR:
What is wrong with this new breed of Amateur operator? Is it that we're friendly, considerate, and delighted with the idea of being a ham operator? Is it that we're antiquated ones.

There are those of us who will become the ideal ham operator, knowledgeable in all phases of electronics, capable of tearing a radio apart and arranging it in perhaps better-than-new condition. And there will be those of us who will wish we could but cannot, who will resort to the Bash book and memorization in order to escape the trials of 11 meters. It behooves the well-versed Amateur operator to use his expertise to help others and to turn his attention to more constructive matters — perhaps new rules and regulations to replace antiquated ones.

So I say Viva La Nuevo Amateur operator and remember you are now a part of the elite. Handle it with dignity and care and to you who did it the hard way — understanding is the name of the game.

Judith M. Stevens, KA4IZU
Clearwater, Florida

RFI cures

Dear HR:
In regards to John Frank's article about RFI (September, 1981), I think the rule of thumb he speaks of in reference to fig. 2 is misleading. The rule is implemented when no ac signal is desired across the resistor being bypassed, as in an emitter or cathode lead. This is not the case for a preamp input. The rule should be tied to the interfering signal. The bypass cap must have a high impedance with respect to the circuit impedance at the highest audio frequency presented to the amplifier.

Al Izatt, WB7SYB
Aberdeen, Washington

Part of the problem in selecting bypass capacitors for RFI cures is that there are two frequencies involved (audio and radio), and we want to bypass only one of them.

The rule of thumb I mentioned in my article provides a starting point for determining how much capacitance should be added to bypass rf without affecting audio. The optimum value of the bypass capacitor will depend on the impedances involved, the severity of the interference, and the frequency of the offending signal.

My own experience shows that bigger is not necessarily better when you are adding bypass capacitors to cure RFI. I prefer using the smallest amount of capacitance that will solve the RFI problem.

John W. Frank, WB9TQG
Madison, Wisconsin

low SWR

Dear HR:
I enjoyed the article by Stan Gibilisco, W1GV/4, entitled "How Important Is Low SWR?" in the August, 1981, issue. It is an excellent article and I believe it will help many people, especially me. I believe, however, that there is one small mistake in fig. 2. All the cable losses are off by a factor of two. This I believe is because the cable loss is actually one-half the measured value because the measured value is a two-way cable loss. I refer you to the article by K9MM.*

John Biro, K1KSY
Chelmsford, Massachusetts

In response to the letter from John Biro, K1KSY, I have performed my own calculation, as follows:

Let \( m \) = line loss when matched;
\[ E = \text{"forward" voltage as measured at transmitter;} \]
\[ e = \text{"reflected" voltage as measured at transmitter} \]
\[ r = \text{SWR} \]
\[ \rho = \text{reflection coefficient} = \frac{r-1}{r+1} \]

Then, with the far end of the line short-circuited,
\[ 2m = 20 \log_{10} \left( \frac{e}{E} \right) \]
\[ = 20 \log_{10}(\rho) = 20 \log_{10} \left[\frac{(r-1)}{(r+1)}\right] \]

Thus \( m = -10 \log_{10} \left[\frac{(r-1)}{(r+1)}\right] \)

This formula produces results that agree with John's and show that fig. 2 in my article is in fact off by a factor of 2.

Stan Gibilisco, W1GV/4
Miami, Florida

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- Dot-dash memories. 8.50 WPM. "On" LED. Use 9V battery, or 110 VAC with optional AC adapter. MFJ-1305, $9.95. Eggshell white, walnut sides. 8x2x6 inches. MFJ-401, $59.95, like MFJ-401.

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- Dot-dash memories. 8.50 WPM. "On" LED. Use 9V battery, or 110 VAC with optional AC adapter. MFJ-1305, $9.95. Eggshell white, walnut sides. 8x2x6 inches. MFJ-401, $59.95, like MFJ-401.

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- Speedmeter lets you read speed to 100 WPM
- Socket for external Curtis memory, random code generator, keyboard. Optional cable, $4.95.
- Dot-dash memory, self-clearing dots and dashes, jam-proof spacing, instant start.
- Alarm, solid-state keypad, black block, solid-state xmt.
- Front panel controls: linear speed, weight, tone, volume, function switch. 10 to 50 WPM.
- Weight control adjusts dot-dash space ratio. Makes your signal distinct to penetrate QRM.
- Tone control. Speaker. Ideal for classroom.
- Function switch selects off, on, semi-automatic, manual, tune. Tone keys transmitter for tuning.
- Uses 4 C-cells, 2.5 mm jack for power (6 9 VDC). Optional AC adapter MFJ-1305, $9.95. Eggshell white, walnut sides. 8x2x6 inches. MFJ-408, $32.95, like MFJ-408.

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December 1981
PROJECTED FCC STAFF CUTS could drastically alter the agency over the next two years. According to Communications Daily of October 8, over 500 Commission jobs are due to be cut during fiscal 1982 and 1983. The Reagan-administration-mandated cuts will be particularly severe in the Private Radio Bureau, which had 258 positions (250 of them filled) when fiscal 1981 ended. It's to be reduced to only 193 people in the next 12 months, and to 176 the following year. Of the Bureau's present 250 people, 145 work in licensing at Gettysburg and are thus considered essential. As a result, all of the FRB's cutback will be in Washington, where it employs 105. The planned reduction will leave only 31 people doing the Bureau's Washington work two years from now! This will undoubtedly mean a great deal of workload doubling up, with the attention paid to each of the services the Bureau administers reduced accordingly.

The Field Office Bureau will fare just as poorly under the recently announced plans, with its staff to be reduced from the present 455 to 311. A number of Field Offices will have to be closed, and the services provided by others drastically reduced. Enforcement efforts will also have to be sharply curtailed as well. Of course, other FCC bureaus will also be feeling the pinch, and there's even a rumor the FCC's Laurel (Maryland) Lab will close.

Some Key Provisions of Senator Goldwater's bill, S.929, take on a new meaning as the impact of the FCC cutback sinks in. Amateurs administering exams, and taking an active part in enforcement, could help the Commission greatly should it no longer be able to properly support these activities itself.

Chairman Fowler Has Announced his intention to seek a relaxation of the projected cuts from the Office of Management and Budget. Because of the importance of the FCC to a healthy Amateur Service, Amateurs could do themselves a service by asking their Congressmen to provide more FCC funding.

SENATOR GOLDWATER'S PRO-AMATEUR RADIO BILL was passed by the Senate September 25 by unanimous consent. This important piece of legislation, S.929, would affect not only the Amateur Service but would also affect CB and radio control licensees as well as the electronics manufacturing industry.

Establishment Of RFI Susceptibility standards for the TV and home entertainment electronics industry could well be the most significant result of this comprehensive bill, if it becomes law. It would vest in the FCC the authority to set such standards, as a means of reducing escalating RFI problems. It would also increase the term of an Amateur license from five to ten years, while a last-minute amendment by Senator Goldwater would also permit the FCC to discontinue the licensing of CB and radio control operators entirely, a deregulatory measure that has received some support from both FCC staff and Commissioners recently. In addition, it would specifically exempt Amateur transmissions from the secrecy provisions (Section 605) of the Communications Act. Though it was long assumed that Amateurs were not included in Section 605 coverage, recent legal decisions have generally applied its limitations to Amateur operations.

The Commission Could Enlist Volunteer assistants from both the Amateur Radio and CB communities, under still another provision of Senator Goldwater's bill. These volunteers would be permitted to work directly with FCC engineers in monitoring both Amateur and CB frequencies for unlicensed or otherwise improper operations. Amateur Radio licensees would also be permitted to serve as volunteer examiners for "entry level" Amateur license applicants, a long-standing practice in Amateur Radio that has recently been termed "illegal" under present laws by the FCC legal staff.

One Key Provision Of S.929, as introduced by Senator Goldwater, was not included in the bill the Senate passed. This was the provision that would have given the Commission the power to restrict the purchase of transmitting equipment to those having the appropriate license to use it. Though generally supported by the Amateur community, this provision contradicts the deregulatory philosophy of the present administration.

The Next Step For S.929 is in the House of Representatives, where it could be tied to appropriate legislation already pending there. More likely, it will be considered by itself, possibly replacing existing legislation such as Rep. Dannemeyer's HR 2203. It will go to the House Committee on Communications, chaired by Rep. Timothy Wirth, and it's possible that some action could be taken on it by early next year.

Support Of S.929 By Amateurs, expressed to their Representatives, should help to keep the Bill moving toward passage.

AVAILABILITY OF THE NEW 10-MHZ BAND looks farther and farther away. First, the WARC treaty hasn't yet been ratified by the Senate, and, though that could happen soon, until it does there will be little further FCC action on new allocations. When those new allocations do become official by revision of Part 2 of the FCC Rules, U.S. Amateurs will still face a rule-making proceeding to determine how the new band will be used: class of licensee, power, and type of emissions. At best, the whole procedure could take many months, and with the severe staff cuts the Commission is facing it could stretch out indefinitely.

10-MHZ Operation on January 1, 1982, is expected by Amateurs of a number of countries whose administrations have already implemented the WARC changes.
Introducing incredible tuning accuracy at an incredibly affordable price: The Command Series RF-3100 31-band AM/FM/SW receiver.* No other shortwave receiver brings in PLL quartz synthesized tuning and all-band digital readout for as low a price.* The tuner tracks and "locks" onto your signal, and the 5-digit display shows exactly what frequency you're on.

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just slightly ahead of our time.
In recent years, facsimile transmission by Amateur Radio has been attracting increasing interest. Thus, since September, 1980, the official bulletin of the DARC is regularly transmitted in facsimile by DJ8BT at Frankfurt. Most Amateur stations operating in this mode are using second-hand commercial or military equipment, although a number of home-built facsimile recorders are in use as well.

In the facsimile transmitter, the picture or document to be transmitted is scanned photoelectrically, the resulting video signal being used to amplitude modulate a carrier of constant frequency, conventionally in the range from 1300 to 1900 Hz. The modulated carrier is sent via a line or radio channel to the facsimile recorder, which converts the amplitude variations into a copy of the original picture or document.

The amplitude-modulated facsimile signal is most suitable for transmission over line circuits, where the transmission-loss variations with time can be kept within ±1 dB. When sent by radio, however, especially over long-range circuits, it is particularly vulnerable to amplitude changes caused by fading. One solution to this problem is the transmission of the a-m facsimile signal by a frequency-modulated voice channel of sufficient quality, thus employing double-modulation technique (emission F4 with amplitude-modulated subcarrier). Due to the large bandwidth required, this procedure is confined to UHF.

By Karl-Gustav Strid, SM6FJB, Sofiagatan 83, S-416 72 Gothenburg, Sweden

For high-frequency radio circuits, therefore, other techniques have to be used. One implies that the a-m signal from the facsimile scanner is demodulated to produce the video signal, which is then used for modulating the carrier frequency of the high-frequency transmitter (emission F4 without subcarrier). For most purposes, the frequency is chosen to be $f_0 - 400$ Hz for white and $f_0 + 400$ Hz for black, $f_0$ being the nominal transmitting frequency. However, for meteorological charts the black and white limits are reversed, and on low-frequency circuits the limits $f_0 ± 150$ Hz are used.

Alternatively, the a-m facsimile signal is converted into an audible frequency-modulated signal, which is then used to modulate a high-frequency radiotelephone transmitter (emission A4 with frequency-modulated subcarrier). Especially, if a properly adjusted SSB transmitter is used, the emission (A4J with fm subcarrier) will be equivalent to F4 without subcarrier. This is the method preferred by the International Radio Consultative Committee (CCIR). As a standard, the subcarrier frequency is set to 1500 Hz for white and 2300 Hz for black, with the limits reversed for weather charts.

Because most commercial and military facsimile apparatus on the surplus market lacks the fm-subcarrier facility, the need arises for modulation conversion when such apparatus is to be used on high-frequency channels. Whereas an a-m/fm converter is always required at the transmitting end, the F4 signal can often be received rather satisfactorily without any additional equipment, simply by detuning the high-frequency receiver. However, fm/a-m converters are available, like the one recently described by PE1CMX.

The facsimile apparatus I use is an FX-1-B, one of the classical facsimile transceivers designed and manufactured in the early 1940s by the Times Facsimile Corporation for the U.S. Army Signal
Corps. Part of facsimile equipment RC-120-B, it scans an 18 x 22 cm original at 90 strokes per minute with index of cooperation $M = 264$. The transmitted signal consists of an amplitude-modulated 1800 Hz carrier, the contrast (that is, the level difference between white and black) amounting to 8-15 dB, depending on the recording technique employed at the receiving end. For such a set to be useful on long-range radio circuits, modulation converters for both the transmitting and the receiving end were designed and built. As a basic requirement, fm transmission was to conform with the 1500/2300 Hz standard. Furthermore, the contrast of the a-m signal was to be adjustable to any value up to 30 dB, positive or negative.

**design of a transmitting converter**

As an example of an existing facsimile a-m/fm converter, fig. 1 shows the block diagram of the transmitting circuits of facsimile converter CV-2/TX used by U.S. Army Signal Corps. The a-m facsimile signal is full-wave rectified and the carrier frequency suppressed by a lowpass filter. The video voltage thus produced is passed to a reactance-modulator stage controlling the frequency of an oscillator working slightly below 100 kHz. Beating this variable-frequency output with that from a fixed oscillator at 100 kHz yields the desired audible fm signal, which after lowpass filtering and amplification, is fed to the microphone input of the radio transmitter. (A similar heterodyne technique has been used by HA5WH for generating teleprinter AFSK signals.)

The present design is based on a different approach, as shown in fig. 2. The video signal obtained by full-wave rectification and lowpass filtering of the a-m facsimile signal is used, after contrast adjustment, to control the frequency of a square-wave oscillator, whose output is lowpass filtered to produce a sinusoidal fm signal.

The a-m facsimile signal may be presented to the converter with either positive or negative contrast. In the former case the white level is nominally 1 mW across 600 ohms (775 mV), the black level lying 8 to 30 dB lower; in the latter case these levels are reversed. The fm signal output to the radio transmitter conforms with the recommendations of the CCIR and the International Telegraph and Telephone Consultative Committee (CCITT), white corresponding to 1500 Hz and black to 2300 Hz.

**circuit description**

The complete circuit of the facsimile transmitting converter appears in fig. 3, and its various parts are analyzed below.

**Rectifier and video filter.** A small input transformer, T1, isolates the converter from the facsimile apparatus; it can be omitted if the units have a common ground potential. A precision half-wave rectifier is built around amplifier U1A. The negative half-periods of the a-m signal are presented with reversed sign across R4 at the summing point of the amplifier U1B, where the original signal is added through R5 and R6; balanced full-wave rectification occurs by adjustment of R6.

The video voltage is separated from the carrier by an active filter of third-order Darlington response, consisting of a simple lag circuit, U1B, and a Sallen-and-Key lowpass circuit, U1D, with an added highpass path, U1C, to insert a notch at twice the carrier frequency. The frequency-agile output of the lowpass filter is then fed to the video modulator of the oscillator, which is based on the VCO circuit of fig. 4.

**Fig. 1. Block diagram of transmitting portion of facsimile converter CV-2/TX.**

**Fig. 2. Block diagram of alternative facsimile transmitting converter.**
frequency (3600 Hz). The filter was built with readily available plastic-film capacitors of 2.5 percent tolerance and metal-film resistors of the E48 series having 1 percent tolerance. Fig. 4 shows the response of the video filter.

The video signal is delivered negative with respect to ground; it can be measured at test point TP1. The input potentiometer, R1, is set to yield approximately -2.5 volts at TP1 for maximum input signal. Due to video filter amplifier offset, an output is likely to be present at

capacitors (polystyrene-film capacitors unless otherwise stated)

- C1, C2, C9: 100 pF ± 2.5%
- C3: 1100 pF ± 2.5%
- C4, C12: 0.01 µF ± 2.5%
- C5, C6, C8: 1 µF 10 volt tantalum electrolytic
- C7: 0.01 µF
- C14: 100 µF ± 2.5%
- C16: 0.015 µF ± 2.5%
- C18: 100 µF

resistors (0.25 watt carbon-film resistors unless otherwise stated)

- R1: 10k potentiometer
- R2, R3: 56k
- R4: 24k
- R5: 43k
- R6, R13, R18, R19: 10k trimmer potentiometer
- R7: 16k ± 1% metal film
- R8, R9: 16k ± 1% metal film
- R10, R11: 23.7k ± 1% metal film
- R12, R37: 10k
- R14, R15: 15k
- R16 (trimmer potentiometer; number as required; see test)
- R16, R17, R21, R22: 10k ± 1% metal film
- R20: 22k0
- R23, R24, R31: 27k
- R25: 100k
- R26: 5100
- R28: 68k

integrated circuits

- U1, U2, U5: MC 3403, P (CA 3403E, LA 3403 PC)
- U3: MC 3403, P (CA 3403E, LA 3403 PC)
- U4: MC 3403, P (CA 3403E, LA 3403 PC)
- U6: MC 14013, BCP, 4073, BPC
- U7: MC 1723, CP, 723, CP
- U8: TO8, 723, E, MC 1723, CP
- U9: ICL 7660, CPA

NOTES:
1. RESISTORS ARE METAL FILM TYPES UNLESS NOTED OTHERWISE
2. CAPACITORS ARE POLYSTYRENE FILM TYPE UNLESS NOTED OTHERWISE

POWER SUPPLY
TP1 for zero-input signal; this error will be eliminated in contrast adjustment.

**Contrast adjustment.** Video contrast, which may be positive or negative and of arbitrary magnitude (to about 30 dB), is adjusted in a two-stage dc processor (U2A, U2B), shown in simplified form in fig. 5.

In the first stage, a constant voltage, \( u_p \), is added to the video signal, \( u_1 \), so that zero output is produced at test point TP2 when the a-m facsimile signal is set to its nominal maximum amplitude. The stage gain (\( A \), determined by the resistance ratio of R15 to R12) is adjusted to obtain \(-800 \text{ mV}\) at TP2 when the input a-m signal is reduced by the nominal contrast. If the converter is to be used with several different facsimile scanners, any relevant number of contrast-setting resistors (R15) may be used; the actual contrast is selectable by switch S1.

The second stage is used as a summing or subtracting amplifier. Resistors R16, R17, R21, and R22 have a 1 percent tolerance. For an a-m facsimile input of positive contrast, a further constant voltage (\( u_L = 1500 \text{ mV} \)) is subtracted from the signal to yield at test point TP3:

\[
u_2 = -u_L - A(u_1 + u_p)
\]
where \( A \) is the stage gain of the first stage (U2A).

Observing the negative sign of \( u_1 \), we find
\[
u_2 = -1500 \text{ mV}
\]
for a maximum (white) and
\[
u_2 = -2300 \text{ mV}
\]
for a minimum (black) input signal.

For an input of negative contrast, the sign of the video signal is reversed, and a constant voltage \((u_H = 2300 \text{ mV})\) subtracted so that, at TP3,
\[
u_2 = -u_H + A(u_1 + u_0)
\]
(2)

Thus, \( u_2 = -2300 \text{ mV} \) for maximum (black) and \( u_2 = -1500 \text{ mV} \) for minimum (white) signal.

Transistor Q1 provides a low-impedance source for the voltage fed to R21; otherwise the source impedance would affect the stage gain of U2B in transmission with positive contrast.

Those who wish to transmit facsimile by direct frequency modulation of the transmitter's carrier oscillator may use the adjusted video signal at TP3 as the input.

**Voltage-controlled oscillator.** The heart of the oscillator is U3, a monolithic IC comprising a comparator, single-shot multivibrator, and a gated precision current source with an internal voltage reference.

The device is manufactured by Raytheon. Besides the original version RC (RM, RV) 4151, an improved version, the RC 4152, has been announced; the latter was not, however, available to me.

The negative video voltage at TP3 is summed with positive-charge pulses from pin 1 of U3 into an integrator, U2C. The integrator output is fed into the comparator at pin 7 of U3, thus controlling the multivibrator. The pulse-repetition frequency will settle so that the average value of the current at pin 1 will equal the current due to video input. The magnitude of the charge pulses is determined by R29 and R30, which set the oscillator's voltage-to-frequency conversion factor.

Having a duty cycle that varies with frequency, the pulse train produced by U3 is passed to the two-stage flip-flop, U4, which provides a symmetrical square-wave train at one-fourth the original pulse-repetition rate. The overall conversion factor is chosen to be 1 Hz/mV, that is, the limits 1500 and 2300 mV of the adjusted video voltage will correspond to 1500 and 2300 Hz respectively in the square-wave output.

No measure for offset compensation of U2C was found necessary.

**Output filter.** The square-wave train from U4 can be resolved into odd harmonics of its fundamental frequency, which implies that it can be changed into a sinusoidal signal by a filter that suppresses all components of frequency above three times the lowest.

**fig. 4.** Calculated (solid line) and measured (dots) characteristic of video filter. The carrier-suppression notch was measured at \(-60 \text{ dB} \) at 3518 Hz.

**fig. 5.** Processing of video signal. Switch S2 selects between positive and negative contrast of the input a-m signal.
carrier frequency used; that is, above 4500 Hz. On the other hand, this filter must pass the entire spectrum of interest — for a maximum carrier frequency of 2300 Hz and a maximum video frequency of 750 Hz, the filter cutoff frequency should not occur below

$$2300 \text{ Hz} + 1.6 \times 750 \text{ Hz} = 3500 \text{ Hz}$$

To achieve such steep cutoff, the filter was given a fifth-order Darlington response. A simple lag circuit, U2D, is followed by two cascaded Sallen-and-Key stages, U5B and U5D, with additional highpass paths, U5A and U5C respectively. Thus, notches are produced at 7010 Hz and 4760 Hz respectively, yielding attenuation in excess of 40 dB above 4400 Hz and still keeping the passband attenuation below 1 dB up to 3400 Hz (fig. 6). The filter was implemented with 2.5 percent plastic-film capacitors and 1 percent metal-film resistors.

The final stage, U5D, is coupled to the transmitter through a small transformer, T2, if required; otherwise capacitive coupling may be used. Resistor R42 was included to provide a matched 600-ohm output at T2; it may be omitted. The level of the output fm signal may be adjusted by changing the resistance of R32.

**Power supply.** The converter operates from a negative-ground dc source of 12 volts nominal. For the contrast adjustment and voltage-controlled oscillator to work unaffected by any supply-voltage variations, a regulated supply is provided at 8.25 volts; the voltage regulator, U6, is internally compensated for temperature drift. In addition, the operational amplifiers require a negative supply of –7.25 volts, which is furnished by a monolithic voltage inverter, U7. This device is a type ICL 7660 by Datel Intersil.

Proper operation occurs over the input-voltage range of 10.5 — 40 volts; current consumption is 25 mA throughout this range.

**construction notes**

The prototype converter was built on a 3.7 by 4.3-inch (95 by 110 mm) piece of perf board, but the design can be readily transferred to an etched circuit board. In a definitive design, the simple carbon trimmer potentiometers used with the prototype will be replaced by multi-turn Cermet trimmers.

**alignment procedure**

The instruments required for alignment of the facsimile converter comprise a dc voltmeter, a cathode-ray oscilloscope and, preferably, a frequency counter. Moreover, a sine-wave signal source is necessary; this may be the facsimile scanner.

Alignment is carried out as follows:

1. With a low-frequency (50-Hz) sinusoidal signal applied to the converter input, R6 is adjusted to produce a symmetrical full-wave-rectified output signal at test point TP1, as shown on the oscilloscope screen.

2. A signal at the nominal carrier frequency (1800 Hz) and the nominal maximum level (775 mV) is fed into the converter. R1 is set to yield approximately –2.5 volts at TP1. Then R13 is adjusted for zero voltage at TP2.

3. The input signal level is reduced by the nominal contrast (typically 8-30 dB), and R15 is adjusted to obtain –800 mV at TP2. If the converter is to be used with several contrast settings, this procedure is repeated for each position of S1.

4. The input signal is removed and TP2 is shorted to ground. With S2 set at position POSITIVE, R18 is set for –1500 mV at TP3, and with S2 at NEGATIVE, R19 is set for –2300 mV at TP3.

5. With –2300 mV at TP3 (S2 at NEGATIVE), R30 is adjusted for a frequency of 2300 Hz measured at the converter output. With –1500 mV at TP3 (S2 switched to POSITIVE), the frequency should then read 1500 Hz. The short at TP2 is removed.

The converter is now ready for use.

**performance**

Factors of importance to the converter’s functioning are the responses of the filters and the linearity of
the voltage-controlled oscillator.

The measured characteristic of the video filter was found to closely reproduce the calculated behavior (fig. 4). Its step response (fig. 7, left) shows 340 $\mu$s rise time, about 12 percent overshoot and a slight oscillation of 400 $\mu$s half-period. The smallest picture element to be resolved in a facsimile transmission with $M = 264$ and 90 scanning strokes per minute, having a duration of some 804 $\mu$s (corresponding to a 622 Hz square-wave train), is well rendered by the filter (fig. 7, right).
No deviation from linearity could be observed between input voltage and output frequency (fig. 8). With TP3 shorted to ground, the frequency of oscillation was measured to 5.7 Hz at pin 3 of U3, confirming that any offset adjustment of the oscillator could be omitted.

The output filter showed a slightly elevated response in the passband near cutoff (fig. 6) as compared to its calculated performance. This was due to tolerances of the filter components, especially the capacitors, and resulted in a 3 percent (0.3 dB) increase in output amplitude from 1500 Hz to 2300 Hz. However, in view of the baseband response of the transmitter to be used, no correcting measures were taken.

The overall response of the converter (figs. 9 and 10) is sufficient to reproduce the 800-μs bursts representing the smallest picture elements. For abrupt changes in input level, a slight overshoot occurs in the output envelope; the observed 7 percent (0.6 dB) fluctuation is smaller than will be seen with certain teleprinter audio-frequency-shift keyers.7

The rms output signal at pin 14 of U5D amounts to 1.0 volt. The signal magnitude may be altered by a change of R32, the output amplitude varying inversely with resistance.

references

part two: audio and AGC board, synthesizer, and power supply

up-conversion receiver for the high-frequency bands

Last month, in part one of this two-part article, I described the basic design of my up-conversion receiver, then went on to discuss the mixer stages, i-f filter, and BFO. This month, in part two, I will complete my discussion of the up-conversion high-frequency receiver, beginning with the audio and AGC board.

audio and AGC board

The product-detector output is terminated in 51 ohms on the audio board and drives both the audio output circuitry and the AGC circuitry as shown in fig. 10. A two-pole Butterworth lowpass active filter provides 20 dB gain and reduces the wideband noise from the i-f output. A summing amplifier provides an auxiliary audio input for CW sidetone or a DX spotting net receiver. Power gain is provided by an LM380. A few additional dB of negative feedback is used to reduce the LM380 hiss and distortion to a negligible level. The over-all audio gain is 48 dB maximum. The bandwidth is 150-2400 Hz. Total harmonic distortion is better than \(-60\) dB at 0.8 watt output.

The AGC is an audio-driven hang-type system. Much time was spent deciding what arrangement to

By George Cutsogeorge, W2VJN, Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, New Jersey 08544
use, because much of the "operating character" of the receiver stems from its AGC system. One need only to listen to some of the modern transceivers to note that an otherwise adequate receiver can be almost ruined by poor AGC system design.

The hang-AGC system allows the decay time constant to be set very long to eliminate overshoot on strong CW signals. Many tests were run, and I found that an attack time faster than 10 milliseconds would result in the receiver responding too readily to single noise spikes, such as those produced by oil burners and wall switches. Of course, if the attack time constant is too long, each transition from weaker to stronger is accompanied by a large overshoot. The required attack time is easily obtained at audio frequencies rather than at i-f, and the resulting circuitry is easy to implement and is noncritical. For a step input of no signal to one millivolt, this receiver overshoots less than 2 dB. There is no overshoot on dots and dashes of a CW signal after the initial acquisition. It sounds quite smooth on SSB and CW.

The gain of op amp U3A determines the normal operating level in the product detector. This is because the minimum signal that will create AGC voltage has a peak voltage just adequate to overcome the drop in the IN914 rectifier. For the AGC threshold, the level at the product detector input is \(-17\) dBm. The attack time is controlled by the 1k resistor. The gain of U3B is set so that the 2N5640 FET is biased off for the signals that would normally activate the AGC. When the signal drops in level or disappears, the 2N5640 turns on and rapidly discharges the AGC capacitor through a 100k resistor. The hold time is determined by the 15 \(\mu\)F capacitor in the 2N5640 gate circuit. The AGC switch allows for selection of 0.3 second or 0.7 second. U3C provides the offset voltage required by the MC1590 i-f amplifiers. The gain of the U3C circuit is held low to provide a slope of about 7 dB to the over-all AGC characteristic. Control voltage for the front-end attenuator is supplied by U3D. The threshold adjustment is normally set for 100 microvolts.

**synthesizer**

The synthesizer locks a 45- to 75-MHz VCO to a 5.05-5.55-MHz VFO in 0.5-MHz bands, as selected by an offset crystal oscillator. The offset signal could also be synthesized, but in the interest of simplicity and minimizing spurious outputs, a crystal oscillator was chosen.

**45-75 MHz VCO.** This VCO uses a grounded-gate U310 FET in the Colpitts configuration. See fig. 11. One of four ranges may be selected by applying 8 volts to a range-select input. PIN diodes are used to minimize stray capacitance. Tuning is accomplished by an MV104 varactor. The varactor is returned to \(-8\) volts, and the normal range of the tuning voltage is \(\pm 5\) volts. The coils are adjusted so that the maximum of each range is the fourth root of the over-all ratio times the minimum frequency; that is,

\[
\text{range 1 max} = 4 \sqrt[4]{\frac{75}{45}} \times 45 = 51.13 \text{ MHz} \quad (1)
\]
\[
\text{range 2 max} = 4 \sqrt[4]{\frac{75}{45}} \times 51.13 = 58.09 \text{ MHz} \quad (2)
\]
\[
\text{range 3 max} = 4 \sqrt[4]{\frac{75}{45}} \times 58.09 = 66.01 \text{ MHz} \quad (3)
\]
\[
\text{range 4 max} = 4 \sqrt[4]{\frac{75}{45}} \times 66.01 = 75.00 \text{ MHz} \quad (4)
\]

The purpose of range selection is to improve oscillator stability and to minimize the VCO gain constant for reducing phase noise. The VCO range is selected by a diode matrix on the crystal-oscillator board.
fig. 10-2. Audio and AGC schematic (B3 board), continued from previous page.

fig. 11. 45 to 75-MHz VCO schematic (part of M7 module). Unit uses a grounded-gate U310 FET in a Colpitts circuit. One of four ranges may be selected by applying 8 volts to a range-select input. Tuning is by an MV104 varactor.
A 2N5179 isolation amplifier couples a small amount of VCO output power to a 2N5109 power amplifier. This amplifier drives a two-way power divider. One output goes to the first mixer module at a 3-dBm level. The other output is split to provide synthesizer feedback to drive the display module.

Crystal oscillator. Twelve crystal oscillators are used to select 12 bands. The limitation is in the switch itself, although twelve bands are more than adequate for my use. The receiver frequency coverage is shown in fig. 12. With this arrangement, all currently available bands are covered except for the top 200 kHz of the 10-meter band. Also, the three new bands are covered, and one spare (12) remains unused. The oscillator in use is selected by an 8-volt level from the bandswitch.

Two types of oscillator circuit are used: the A type is for third-overtone and the B type is for fifth-overtone crystals (fig. 12). These circuits are very simple, and the price paid for this simplicity is that a certain amount of adjusting must be made with component values for reliable operation.

Each oscillator is adjusted to start and operate on the correct overtone, to remain there for B+ varia-

![Crystal oscillator schematic](image1.png)

**fig. 12.** Crystal-oscillator schematic (85 board). Twelve oscillators are used to select 12 bands. Two types of oscillator circuit are used. Circuit in A is for third-overtone and that in B is for fifth-overtone crystals. Receiver frequency coverage is shown in the table.
Phase detector. The VCO and crystal outputs are mixed in an MC12002 double-balanced modulator IC. See fig. 13. A lowpass filter selects the difference sideband signal, and one-half of a MECL comparator (MC10115) changes it to a square wave. Another half of the MECL comparator squares up the VFO output, and the two square waves are then processed by an MC12040 phase and frequency detector. This unit is functionally identical to the MC4044 but it is an MECL implementation and is usable to 80 MHz. Also, at any frequency, it provides less random jitter due to differential propagation delays between input and output. The MC12040 output drives a differential loop filter using an LF356. Some attenuation of the sampling frequency spikes is provided by the 180 pF capacitors in the loop filter.

The normal VCO operation voltage range is ±5 volts. Under some conditions the VCO output can go below the crystal frequency. When this occurs, the feedback sense shifts to positive, and the loop will latch up with the VCO drive voltage at the negative rail. A second LF356 senses this condition, and jams the loop to a normal lock.

5-MHz VFO. This VFO uses a 2N5397 FET in the Vackar configuration, as shown in fig. 14. A surplus BC221 tuning capacitor is the main tuning element. I used it because of the high-quality worm drive that comes with it. The over-all tuning rate is about 14 kHz per knob revolution.

The output is taken through the capacitive tap across the tuned circuit. This method gives a good sine wave because of the high circuit Q. Two isolation stages buffer the output.
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The VFO has been very satisfactory in operation; however, I could have used heavier material than a minibox, because a shift of 100 Hz is noticeable if the receiver is turned upside down while listening to a CW signal. Flexing of the tuned circuit components causes this problem.

The short-term stability characteristics of this oscillator determine the over-all receiver performance. Therefore, high-Q components should be used in the oscillator tank circuit.

**power supply**

The power supply module schematic is shown in fig. 15, and the wiring diagram of the receiver in fig. 16.

**display module**

A six-digit counter displays receiver frequency. The counter is preset to minus 450,000 counts to subtract the first i-f from the displayed value. The counter then counts the synthesizer frequency but displays the signal frequency. A 10-MHz clock generates the count gate. This oscillator can be set to zero beat with WWV to calibrate the display. The schematic is shown in fig. 17.

**construction**

The receiver is designed as a group of modules and boards with 50-ohm interfaces. This design allows for flexibility during the construction phase; several of the modules were modified or reconstructed in some way. This receiver is strictly a breadboard unit, although it's easy to work on and is fairly sturdy from an electrical and mechanical viewpoint. Many of the modules are fastened to the sides of the frame and are easily removable. The sides may be unscrewed to gain access to the inner portions of the receiver; yet, the unit is operational in this condition. Some of the boards are fastened under the main deck and covered by shield cans. Module and board layouts are shown in the photos.
Several board construction techniques are used. The rf circuitry is built onto blank printed-circuit material. Miniature terminal strips are soldered to the boards, and the components are mounted on the strips. This method requires no hole drilling except for the four mounting holes. The audio-AGC board is built on a VERO™ card, and the display module uses wire wrap. All boards have ground planes and use extensive bypassing.

All parts are readily available through mail-order houses. Suitable and equivalent SSB and CW filters are available from Fox-Tango Corp. The PTI and Minicircuits™ components may be purchased direct.

Although an account was not kept, the cost was of the order of several hundred dollars for the receiver.

in conclusion

Was it worth the effort? Yes! I learned a great deal. I now have the feeling that a good transceiver can be built for about half the price of available units.

As for improvements, a few came to mind: There should be more filtering at the 5-MHz sampling frequency. The switching sidebands are only down 80 to 85 dB. This is not sufficient with an open front-end design. The VCO and VFO should have better har-
monic filtering, which will eliminate the VFO fourth harmonic response from appearing at 21.2667 MHz as well as other spurious signals.

The VFO and synthesizer should be mounted in separate shielded boxes. Tank-circuit voltage in the VFO is quite high, and this field contributes to the filtering problem. Space should be allowed for more 3.18-MHz crystal filters for operating flexibility.

acknowledgments
Credit is due to WB2DGJ, KB2NJ, and WA2QAF for helping with the construction, and to WA2IFG (my XYL) and Grace (my secretary) for helping with the typing. Pictures were furnished by W2PJK.

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Figure 1: Circuit diagram of the proposed single-stage transceiver, April 1937. Words: "Ham Radio"
The single-sideband transceiver is the standard "black box" of the modern station. Was there a time when Amateurs were without this popular means of communicating?

Old-timers can recall the days of the mid-fifties when SSB was new and exciting. In 1957, the Collins

Neverthelesss, the basic idea for the SSB transceiver came about in April, 1937, when James J. Lamb, W1AL, then the Technical Editor of QST, completed the design of a "single-sideband duplex communication system" and had his sketch witnessed for posterity (fig. 1).

Nevertheless, the basic idea for the SSB transceiver came about in April, 1937, when James J. Lamb, W1AL, then the Technical Editor of QST, completed the design of a "single-sideband duplex communication system" and had his sketch witnessed for posterity (fig. 1).

Jim’s novel transceiver worked in the 80-meter Amateur band on a fixed frequency (4.000 MHz). A block diagram is shown in fig. 2. This clever design anticipated frequency synthesis decades before its time. The transmitter portion of the transceiver is at the top of the sketch. Starting, for example, with an audio tone of 1 kHz, the signal is amplified and mixed with a 500-kHz carrier from a crystal oscillator. The sum and difference frequencies (499 kHz and 501 kHz) are passed through a crystal filter, which passes the lower (difference) sideband of 499 kHz and rejects the 501-kHz signal. The wanted signal is amplified in a 500-kHz passband amplifier and fed to a mixer for conversion.

The mixer injection signal is at 4.5 MHz and is derived from the ninth harmonic of the 500-kHz oscillator by virtue of a times-nine multiplier, or harmonic generator. The resulting signal is upper sideband, with the 1-kHz tone at 4.001 kHz.

Jim Lamb added a "replacement carrier" generator to supply a carrier at 4.000 kHz. Note that the carrier was radiated by a separate antenna. The purpose of the carrier, it is thought, was to ensure a reference frequency for the unstable receivers of those days. No information is provided in the drawing as to the relative

Radio Company introduced the KWM-1 SSB transceiver; Herb Johnson, W6QKI, was hard at work designing the prototype of the famous Swan series of transceivers.

But the concept of the SSB transceiver was actually developed in the spring of 1937! For twenty years the idea had lain dormant. War, and the lack of suitable sideband filters and stable oscillators, put SSB on the back burner for all except a few experimenters who toyed with this exotic form of communications.
signal amplitudes of the carrier and the sideband signal.

The lower portion of the sketch represents the receiver portion of the transceiver. Referring to the block diagram, the incoming signal at 4.001 kHz is mixed with the 4.5-MHz injection signal and the resulting signal, at 499 kHz, is amplified and passed to a diode detector receiving mixing voltage from the 500-kHz crystal oscillator. The audio signal developed is passed to a headset and the eager operator.

W1AL clearly understood the principle of frequency synthesis, as all his mixing voltages were derived from a single crystal-controlled oscillator. To make sure everything functioned as it should, a diode monitor was added that sampled the carrier and the sideband signal.

So there it was! A breath-taking new concept that eventually would change Amateur Radio and commercial high-frequency communications techniques. But did this startling technique ever appear in QST? A look through the 1938 index and a search of the individual issues of the magazine reveal nothing. What had happened to the great idea?

In a personal discussion with Jim Lamb (now living in California), I learned that the idea had been rejected by the General Manager of the League, at that time Kenneth Warner, because there was no interest in single sideband among Amateurs: the concept was too complex for Amateurs to understand, and the transceiver would be too expensive to build and too complicated to align. Thus the transceiver slumbered for two decades until postwar interest in this novel means of communicating brought SSB into the Amateur bands to stay.

QST comfortably avoided SSB until the fall of 1947, when Mike Villard, W6QYT, and Art Nichols, W8TQK, appeared on SSB working Amateurs on 80 and 20 meters. (Before this date, one or two experimental Amateur SSB stations had been on the air, but their transmissions seemed not to be of general interest.) Now, the time was ripe. The January, 1948, issue of QST editorialized on the virtues of ”single-sideband, suppressed carrier” transmission, and actual operational SSB equipment was featured. But by now Jim Lamb had left the League; it would be up to others to carry forward his far-sighted communications concepts.

a six-element wide-band beam for 10

As every 10-meter enthusiast knows, it is a difficult task to cover the whole 10-meter band with most of the common Yagi or quad antenna designs. If the beam is tuned at, say, 28.6 MHz for operation at the lower end of the band, gain and front-to-back ratio start going to pot near 29 MHz — and at the top end of the band, 29.7 MHz, the beam is relatively worthless. The same is true for beams peaked at the high end of the band: operation is severely hampered at the low-frequency end.

JH1ZGA, a Japanese Amateur
writing in *CQ-ham radio* magazine (Japan), has solved this problem with an adaptation of the log-periodic principle to the Yagi antenna. He describes a homemade LPY (log-periodic-Yagi) beam consisting of four LPY elements plus a reflector and a director (fig. 3). The beam is easy to build, requires no adjustment, provides nearly uniform gain across the band, and exhibits an SWR figure ranging from about 1.5-to-1 at 28.0 and 29.7 MHz to 1.1-to-1 at the design frequency of 28.6 MHz. Now, that's hard to beat!

The beam is built on a 2-inch (5-cm) diameter boom, 15 feet 8 inches (4.8 meters) long. The elements are tapered, made of telescoping sections of aluminum tubing, the largest sections being 1 inch (2.5 cm) in diameter and the smallest being about 7/8 inch (2 cm) in diameter. Element lengths and spacings are given in the drawing.

The transposed transmission line running between the elements is made of 1/4-inch-diameter tubing, with the ends flattened to fit over the inner mounting bolts of the elements. The reflector and director elements are clamped directly to the metal boom, whereas the four driven elements of the log-periodic cell must be insulated from the boom. There are a number of ways of doing this. The original JH1ZGA design calls for the elements to be slipped within a short length of plastic (PVC) conduit pipe, as shown in fig. 4. The conduit is then affixed to the boom by means of a U-bolt and mounting plate.

Impedance at the feedpoint (F-F) is about 200 ohms, so a 50-ohm transmission line and a 4-to-1 balun transformer are used to provide a good match.

Since the log periodic cell of four elements provides gain, as do the parasitic elements, the overall gain figure of the beam is approximately equivalent to that of a six-element Yagi. Best of all, the gain and front-to-back ratio are realized across the whole 10-meter band.

**a word to the wise**

The winter season is coming, with rain, snow, wind, and ice. Before the onslaught of bad weather it is a good idea to examine your antenna installation to make sure it will stay up when bad weather hits. The *before* and *after* photos of figs. 5 and 6 show what happened to one East Coast Amateur whose enthusiasm for a big signal was greater than his ability to install a proper support structure. The 90-foot telescoping tower had three stacked monoband beams mounted on a heavy steel mast protruding from the top of the tower. A huge rotator was mounted at the top of the tower, too. The tower was firmly anchored at the base and house roof, and was self-supporting. But the designers of the tower clearly indicated in the data sheet what the maximum wind loading for the tower was; it was ignored. The result was that the tower twisted in heavy gusts of wind and the whole schmeer came crashing down one stormy night. Luckily, the mess landed in the yard and no one was injured.

The unlucky Amateur is now back on the air with his big beams, but the whole antenna installation has been redesigned by a certified mechanical engineer to make sure that it will withstand winter weather.

You may not have a problem as serious as this, but the moral is clear — make sure your antenna installation is robust enough to withstand the coming winter storms!

**more on interference**

My remarks last month on RFI (radio frequency interference) merely touched the tip of the iceberg. RFI is rapidly getting out of hand. RFI is a double problem that comprises both interference to communicators (Amateurs, CBers, and commercial communication circuits) and interference to others by communicators. RFI travels from place to place by radiation, induction, or conduction. Radiation is electromagnetic propa-
gation through space. Conduction is transmission through an electrical circuit. Induction is transmission by means of a magnetic field. Transmission of RFI by an electrostatic field is also possible.

In practical terms, this means that radio noise can be radiated from the source to a nearby receiver, or can be coupled to the receiver through a common power source, or radiated from the power line to the receiver, or induced by proximity of source and receiver power lines.

RFI can be cured or attenuated in the majority of cases by a systematic investigation of the noise source and the transmission path. An important tool in the investigation of power-line RFI is a portable, multiband, battery-operated receiver with a built-in loopstick antenna. The directional properties on the broadcast band of such a receiver will indicate a direction in which the interference source probably lies. Driving about an area "infested" with power-line noise usually provides a general indication of the noise source.

An important point to remember is that the area blanketed by interference is inversely proportional to the frequency of reception. That is, the closer the investigator gets to the noise source, the higher in frequency it can be heard. Thus, while listening a great distance from the noise source, it may be heard at the broadcast band but not at 5 MHz. Drawing closer to the source, it can then be heard at 5 MHz but not at 30 MHz. Drawing still closer, the noise may be loud at 30 MHz, but barely audible at 100 MHz. At this point, the search can be shifted into the fm broadcast band (88-108 MHz) or into the Amateur 2-meter band.

Interference caused by radio transmitters of all types can be tracked in much the same manner with a directional antenna, although tracking is done on the frequency of transmission (or on a harmonic frequency). Perseverance, experience, and several receivers in an automobile can work wonders in the interesting and practical art of RFI tracking.

the spark discharge

The spark discharge is a common source of radio noise and TV interference, and it can be generated by a number of sources. The discharge sounds like a buzzing, rasping, popping noise, and appears as a band of horizontal dot-dash lines moving slowly up the screen of a television receiver. The width and intensity of the lines are dependent upon the strength and severity of the interference.

One prolific source of radio noise caused by spark discharge is the neon sign. High voltage is required to operate a neon sign, and radio noise can be caused when the neon pressure in the sign drops, causing flickering. The on-off ionization of the gas causes the radiation of a rough, spark-like radio noise that can travel for a great distance.

WA6FQG, Bill Nelson, an experienced RFI investigator, discovered bad interference on his own ham set one day. With the aid of his rotary beam he found the general direction of the noise and tracked it to a neon sign more than three miles distant. It was an animated sign over a nightclub. First, the letters TOP would flash, followed by the letters LESS, and then the complete word TOP-LESS would flash.

Bill told the owner of the sign that it was causing severe interference to radios in the vicinity, but the owner couldn't care less. He told Bill that he
was probably the ham they were always hearing on the stereo whenever the topless dancers were at their best.

The sign is still flashing, but, luckily, Bill was planning to move away soon. Information Bill provided about RFI filters and sign maintenance fell on deaf ears. The dancers are still twirling their tassels and the neon sign flickers to this day. You win some, you lose some.

Bill Nelson is one of the nation’s top-notch RFI investigators, who’s done this type of work for over two decades for a large California public utility. He’s summed up his vast knowledge of RFI in a new handbook, Radio Frequency Interference (Radio Publications, Wilton, Connecticut 06897). It’s available from Ham Radio’s Bookstore, Greenville, New Hampshire 03048, for $8.95 plus $1.00 for shipping and handling. I’ve had a pre-publication look at Bill’s book and it is good.

an interesting observation on TVI

Interference caused by harmonics of the television receiver’s sweep oscillator can be a nuisance on the Amateur high-frequency bands. They were not much of a problem to me on 20 meters, but recently when I tried 80 meters, the devilish buzzing signals nearly obliterated the band. While gazing at the TV receiver and wondering what to do, I noticed that the receiver has a three-wire, 120-volt power cable and that it was plugged into a two-pronged wall outlet. An adapter plug was used that matched the three-prong TV plug to the wall plate. The ground wire of the three-wire cable was attached to a pig-tail on the adapter. I noticed the pig-tail had not been grounded to the conduit bolt on the wall plate, but left hanging in midair.

Grabbing a screwdriver, I immediately attached the pig-tail to the wall plate bolt (fig. 7). Checking my receiver on 80 meters, I noted happily that the S-meter reading on the TV oscillator harmonics had dropped nearly a quarter-scale! In 20 seconds of work I had reduced the racket from unbearable to merely annoying! Moral: Check your TV receiver. If the ground prong of the power plug is not grounded to the equipment ground wire of your wiring system, it would be a good idea to make this connection.

A few days later I tossed out the two-prong wall plate and substituted a new three-prong plate which automatically grounded the equipment ground wire of the TV power cord. Since modern appliances are all equipped with a three-wire power cable, examine your wall receptacles. If they have two conductors plus an equipment grounding wire, replace the old two-connector receptacles with modern three-connector designs. Wiring instructions are included with the new receptacles.

ham radio

December 1981 35
Feedback amplifiers, i-f filters, i-f detectors, frequency synthesizers: part 2

Part 1 of this article, which appeared in the November, 1981, issue discussed new approaches to receiver design, microprocessor applications in receivers, input filters, and input mixers. In this, the second and final part, I address feedback amplifiers, i-f filters, i-f detectors, and frequency synthesizers.

Feedback amplifiers

The grounded field-effect transistor circuit using the CP643 has an intercept point of 35-40 dBm relative to the output, which means that the gain (about 10 dB) must be deducted from the input. The noise figure depends on the source resistor. If the driving source is in the vicinity of 50 ohms, the noise figure will be about 3 dB. To get a lower noise figure a higher drive impedance is required.

Texas Instruments in Germany made a high-power field-effect transistor called the P8000, then replaced it with the P8002. This transistor has about 2-dB noise figure when driven at 50 ohms. In addition, it uses a special metal housing and can dissipate more heat. This transistor appears to have been discontinued, but some are available from me (send an SASE).

A further reduction in noise with the same intercept point can be obtained by using feedback. The BFT66, made by Siemens (about $3 each) exhibits a noise figure of about 1 dB and an intercept point of almost 40 dBm when used in the feedback circuit shown in fig. 6.

Noiseless feedback circuit. The circuit can be analyzed under the simplifying assumption that the common-base transistor has an input impedance of 5 ohms, an infinite output impedance, and unity current gain, while the transformer is considered to be ideal. With these assumptions, it can easily be shown that a two-way impedance match to \( Z_o \) will be obtained if the transformer ratio is chosen such that \( n = m^2 - m - 1 \). With this choice the power gain will equal \( m^2 \), the load impedance presented to the collector will be \( Z_o (n + m) \), and the source impedance presented to the emitter will be \( 2 \times Z_o \).

Usable turns ratios are obtained for \( m = 2, 3, \) and \( 4 \), yielding gains of 6, 9.5, and 12 dB and load impedances of 3, 8, and \( 15 \times Z_o \) respectively.

It is seen that, similar to a conventional common-base amplifier, the gain of the stage is determined by the ratio of load impedance, \( Z_L \), to the input impedance, \( Z_{in} \). In this case, the gain is given by \( \frac{Z_L}{Z_{in} + 1} \); whereas it is just \( \frac{Z_L}{Z_{in}} \) in the conventional configuration. The significant difference is that the transformer-coupled device provides a two-way impedance match, which is obtained by coupling the load impedance to the input and the source impedance to the output through the action of the transformer.

The dynamic range considerations for this device are similar to those of the directional-coupler circuit but with some important differences. First, the operation of the circuit depends on the completely mismatched conditions presented by the transistor to the circuit; that is, the emitter presents a short circuit and the collector an open circuit. Hence there is no requirement to introduce resistive elements for impedance matching as there was in the directional-coupler circuit. Therefore, a noise figure advantage is obtained with this circuit. Secondly, the source impedance of \( 2 \times Z_o \) presented to the emitter tends to give optimum noise figures. Finally, despite the small currents involved, relatively large output powers can be provided because of the high load impedance, which goes along with the higher gain versions.

The main disadvantage of the circuit is that the
high load impedance tends to limit the bandwidth. Nevertheless, sufficient bandwidth can be achieved to provide broadband i-f gain with noise figures competitive with those which could previously be obtained only in very narrowband units.

As it is desirable to keep the dc operating level over a wide temperature range, an additional bias circuit was developed that maintains almost temperature-independent biasing.

**Two-stage low-noise amplifier.** Fig. 7 shows a two-stage amplifier that will operate up to 1,000 MHz using this low-noise technique. The output lowpass filter prevents harmonics from occurring at the output. If this circuit is used as the second i-f following the crystal filter of a receiver and drives the second mixer to obtain a lower i-f of, say, 9 MHz, we don’t want any harmonics at the output that may cause intermodulation distortion products.

Two BFT66 stages are shown cascaded; the first with temperature-compensating bias. Depending on the turns ratio of transformers T1 and T2, different gains can be obtained. It’s desirable to place the tap at the output transformer output so that the transformed input impedance is equal to 50 ohms.

Several other combinations of this amplifier are possible, and its significant advantage over previously published circuits is that it uses transformer, or “noiseless,” feedback rather than resistive feedback; therefore the noise figure is substantially lower.

**High-dynamic-range amplifiers**

Conventional amplifiers built from single-stage circuits suffer from in-band intermodulation distortion, and the previously described noiseless feedback circuit can only be set at gain values depending upon even turn ratios, as discussed.

Let’s look at fig. 8, in which we see the second mixer of a receiver where the first i-f is converted to a lower i-f such as 9 MHz. The output of the second mixer operates into a diplexer and, therefore, splits up the energy. The drive into the amplifier is therefore reduced by 3 dB, as only one sideband is available.

We find the familiar BFT66 circuit and a PNP/NPN output stage. Since this stage really is an emitter follower, its inherent feedback keeps the distortion low and the low drive impedance allows matching into various impedances.

This circuit is driven from the high-input-impedance point (collector) of the BFT66. To prevent any changes in output impedance, the output transformer of the BFT66 is terminated with 56 ohms. As a result, the PNP/NPN circuit has power gain, very little...
feedback, and extremely low distortion. The noise figure is now determined by the BFT66 stage, and the second stage contributes very little. The other advantage of this circuit is that there are no tuned circuits; therefore, it can be used from a few hundred kHz to almost 100 MHz. This makes this circuit design very useful.

**i-f filters**

I mentioned earlier that there is a distinct difference between static and dynamic selectivity. Static selectivity of a filter is defined as the selectivity one measures if a point-to-point measurement is taken and the curve is then plotted. If this is done more rapidly and we start to sweep the filter, then depending upon the sweep time the picture is going to change.

First, the filter shows a delay, which means it takes a certain number of milliseconds or microseconds before the signal arrives at the output. From the use of noise blankers, we note that a crystal in the receiving passband acts as a pulse stretcher, which means that the pulse of extreme amplitude and longer duration is changed into one of considerably lower amplitude and substantially lower duration. This effect is equal to the ringing noticed in reception of Morse code.

From the literature we know that several crystal filter types are available. Originally, one started out with mechanical filters, and the earlier mechanical filters also exhibited excessive ringing. The dynamic response of a filter is determined by its design. A filter with a rectangular-shaped response has the highest selectivity and the highest ringing.

Let's consider a 200-Hz CW filter with a shape factor of 3 and a substantial phase jump on the corners, which therefore results in excessive nonlinear distortion and ringing. In my recent paper, I presented several crystal filter computer programs and showed how to design crystal filters that avoid this ringing.

First of all, from filter theory, it is known that a single-tuned circuit has the least amount of ringing but insufficient selectivity. To duplicate a 6-8 pole crystal filter, 6-8 discrete tuned circuits isolated by an amplifier are required. This is called synchronous tuning, and modern spectrum analyzers are still using this approach. If the bandwidth must be changed,
each filter circuit must be tuned with a tracking circuit, which makes these analyzers expensive but gives perfect response. Mathematically, the equivalent of such a filter is "Gaussian shaped." It has the poorest selectivity but the best pulse response.

It should be noted that, for Amateur purposes, both CW and SSB are basically pulse-type modulation. In both cases, there is no carrier and no constant level. However, in the case of single sideband signals, several frequencies of different amplitude are available simultaneously. The human voice has harmonics, and if the circuit introduces distortion, we have a wider or splattered signal. Therefore, the single-sideband filter energy both inside the bandwidth and outside the bandwidth bounces against the skirts.

Let's take a look at fig. 9, which shows the three most important types of filter curves: Bessel response, flat delay, and Chebyshev. The Bessel response is an approximation of the Gaussian filter with improved skirt selectivity. The flat delay filter exhibits a constant group delay, or a group delay with an extremely small ripple. As a result, the pulse response and skirt selectivity are excellent. The disadvantage of this filter is its somewhat higher insertion loss. Finally, as a comparison, we see the Chebyshev filter with the familiar flat top in the passband, while the flat-delay filter shows a slight dip.

These filters are based on certain mathematical equations, as is the elliptical filter, which is not elliptical in the sense that it looks elliptical, but rather certain equations, called elliptical integrals, are used to calculate its characteristics. Modern computers and desktop calculators use these filters. I am currently evaluating some new types of filters that are computer optimized and easy to build.

The ultimate rejection of these filters is an important parameter, and also the termination on both sides affect performance. It is therefore very important how these filters are inserted into the circuit. Fig. 10 shows a recommended method using switching diodes and having a provision to adjust for the different gains at the different bandwidths. The German company, KVG, makes excellent filters. Their CW filter, XF9NB (available from Spectrum International), has a superior ringing performance.

For single sideband we find only one filter. If we change both the BFO as well as the second LO frequency in the receiver by 3 kHz, we can eliminate the second filter and still maintain a correct dial reading. In the section on frequency synthesizers, I show a simple circuit that can be used for the second LO and the BFO to shift the crystal frequency against an internal standard — a less expensive solution than using two filters.
fig. 11. Schematic diagram of a single-loop synthesizer synchronizing a 66-MHz crystal, used as a second LO, against 500 Hz from the standard.
i-f detectors

Multimode receivers require a-m, fm, and SSB detectors. Since we want the audio at the same level, gain adjustments must be provided. Probably the best and least expensive solution for this problem is to use the SL624 Plessey IC. This chip contains the detection circuits for all three modes of operation.

Another attractive solution is to use the SL624 for fm only and the SL623 only for SSB and a-m, which allows somewhat greater flexibility in the design parameters. A third solution is to use the SL640/41 as the product detector if only SSB is required. This product detector requires the least amount of components but is not used very frequently. While it is more forgiving as far as high i-f levels are concerned, it is also less well known. A summary of i-f circuits is found in reference 4.

frequency synthesizers

Earlier I mentioned that we need a synthesizer for the BFO and for the LO. Having the BFO and LO synthesized allows i-f shifts and/or allows the use of the 2.4-kHz filter for both upper and lower sideband. Fig. 11 is the schematic diagram of a synthesizer with a voltage-controlled crystal oscillator that is used as the second LO, and the 66-MHz crystal can be pulled ± 1.5 kHz. The same technique can be used to build a BFO synthesizer by expanding the number of dividers and using a "soft" 9-MHz crystal. It is possible to pull a 10-MHz crystal about 1 or 2 kHz, and if the reference frequency is set at 100 Hz, this should be sufficient resolution to build an i-f shift system. New approaches are being developed to design simpler synthesizers. The most important is the fractional-N synthesizer, which is discussed below.

Conventional single-loop synthesizers use frequency dividers in which the division ratio, N, is an integer between 1 and several hundred thousand, and the step size is equal to the reference frequency. Because of loop-filter requirements, the decrease of reference frequency automatically means an increase of settling time.

It would be unrealistic to assume that a synthesizer with a reference lower than 100 Hz can be built, because the large division ratio in the loop would reduce loop gain so much that tracking would be very poor and the settling time would be several seconds.

If it were possible to build a frequency synthesizer with a 100-Hz reference and fine resolution, this would be ideal because the VCO noise from 2 or 3 kHz off the carrier could determine the noise sideband; while the phase noise of frequencies from basically no offset from the carrier to 3 kHz off the carrier would be determined by the loop gain, division ratio, and reference. Because of the higher reference frequency, the division ratio would be kept smaller. Traditionally, this conflicting requirement has resulted in multiloop synthesizers.

An alternative would be for N to take on fractional values. The output frequency could then be changed in fractional increments of the reference frequency. Although a digital divider cannot provide a fractional division ratio, ways can be found to accomplish the same task. The most frequently used method is to divide the output frequency by $N + 1$ every $M$ cycles and to divide by $N$ the rest of the time. The effective division ratio is then $N + 1/M$, and the average output frequency is given by:

$$f_o = \left( N + \frac{1}{M} \right) f_r \quad (1)$$

This expression shows that $f_o$ can be varied in fractional increments of the reference frequency by varying $M$. The technique is equivalent to constructing a fractional divider, but the fractional part of the division is actually implemented using a phase accumulator. The phase accumulator approach is illustrated by the following example.

Consider the problem of generating 455 kHz using a fractional-N loop with a 100-kHz reference frequency. The integral part of the division is $N = 4$, and the fractional part is $1/M = 0.55$ or $M = 1.8$ ($M$ is not an integer). The VCO output is to be divided by five $(N + 1)$ every 1.8 cycles, or 55 times every 100 cycles. This can be easily implemented by adding the number 0.55 to the contents of an accumulator every cycle. Each time the accumulator overflows (contents exceed 1), the divider divides by five rather than four. Only the fractional value of the addition is retained in the phase accumulator.

Arbitrarily fine frequency resolution can be obtained by increasing the size of the phase accumulator. For example, with a 100-kHz reference frequency, a resolution of $10^5/10^5 = 1$ Hz can be obtained using a 5-BCD accumulator.

This technique is being used in the Racal RA6790 and in some Hewlett-Packard signal generators. A more detailed description of this can be found in reference 5. Research engineers at Phillips have recently used a similar technique and have built a two-chip frequency synthesizer, HEF 4750 and HEF 4751, which is being distributed by Signetics. With these two chips and very little external circuitry, it is possible to build a synthesizer system to more than 1000 MHz with 100-Hz step size. As the single-loop synthesizer is the cleanest of all the synthesizers, and as the noise sideband depends highly on the VCO, this new technique will mean a reduction in price and an increase in performance of simple synthesizers.

Signetics has several good application reports...
fig. 12. Schematic diagram of three low-noise VCOs with coarse and fine tuning input, select circuits, and 23-dBm post amplifier, recommended for shortwave receivers.
by K.V.G.

NEW CRYSTAL FILTERS

KVG announces a new series of 9 MHz crystal filters complementing the standard XF-9xx model series. The new XF-M9xx series are Monolithic Crystal Filters with characteristics equivalent to the classical discrete crystal filters with corresponding part numbers.

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<td>XF-9M</td>
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<td>3</td>
<td>2.4 kHz</td>
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</table>

Also NEW standard filters:
- A new 10 pole SSB filter, model XF-9B-10
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available for this synthesizer device. Its prime advantage is that a single-loop synthesizer can be built that uses a reference such as 1 kHz, and a resolution or step size of 100 Hz can be obtained, which is ten times the resolution. This is done in a technique similar to that of the fractional N, and the lockup time is determined by the 1-KHz reference loop filter rather than the 100-Hz filter system.

As the VCOs are so important, fig. 12 shows a combination of three VCOs, each covering 10 MHz. They can be used for a 10-kHz to 30-MHz receiver with a 75-MHz i-f. The coarse tuning can be accomplished using a digital/analog converter, and the fine tuning can be done by the synthesizer. It is recommended that a two-bit D/A converter be used, which means that the frequency is coarse and preset with 100 kHz.

references


bibliography

H.P. 33985A Synthesizer/Level Generator Operating & Service Manual.

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December 1981
The problem of rf-power distribution in an Amateur Radio station has been solved using many methods. While visiting other Amateur stations I’ve observed techniques ranging from manually operated patch cords to the complex, remotely operated, coaxial-relay box.

The rf-power distributor described here will appeal to any Amateur who has several coaxial cables entering his station and the choice of operating more than one transmitter. The unit offers fingertip selection for instant optimizing of any antenna and transceiver combination. It is virtually maintenance free.

obtaining parts

With a well-supplied junk box or a few visits to local hamfests, this project can be produced with a minimum of cost in just a few evenings. The main parts are a handful of SO-239 connectors and two good-quality ceramic rotary switches. The antenna rotary selector switch preferably should be the type that shorts out all but one position. This is a good feature that can be used to ground all but one antenna.

For the cabinet I used a 5 x 7 x 2-inch (12 x 18 x 5 cm) inverted aluminum chassis. The removable top was cut and formed from a piece of vinyl-covered aluminum. I wired the unit with No. 14 AWG (1.6 mm) bus wire using direct routes. The schematic is shown in fig. 1.

construction notes

Two auxiliary positions were included: one for each of the selector switches. I had a limited amount of rear panel space for the connectors, so I wired my auxiliary connector to the antenna selector. If you have more than two rigs and no auxiliary antenna, a simple rewiring job can accommodate your situation. The front panel (photo) is labeled to satisfy either
condition. Of course, if you use a larger chassis, the problem will disappear with added connectors.*

The chassis was finished with several coats of DS-GM-283 Green Dupli-Color™ automotive paint. Remember to mask the connector openings to prevent the paint from forming an insulator. The project was completed by installing four rubber feet and a pair of Heathkit knobs. I also included a selector position for my dummy load. For troubleshooting and off-the-air tune-ups this position has been used many times.

Most of my coax cables are the larger type RG-8/U. As a result, they influence the natural resting position of the unit. I solved this problem by sandwiching the unit between my rotator control box and speaker cabinet.

The ceramic rotary switches have a dc-current capability of 3 A. This is adequate for any input-power level up to the legal limit. I use these switches to carry power levels varying from 3 to 1000 W input with no contact degradation or change in the standing-wave ratio. By quickly selecting the proper antenna, I can optimize my station for the band conditions at the moment.

Commercial coaxial-switch boxes have been available for many years. Two of them, at considerable cost, would provide this function. On the other hand, the rf-power distributor described here will do the same job and demonstrates that practical equipment can be inexpensive.

*In this case, you might want to break the line between S1 and S2 in fig. 1 and add two connectors to accommodate accessories such as an SWR bridge or antenna matcher. Editor.
the half-square antenna

Practical information on feeding and operating this popular radiator

The half-bobtail or half-square antenna has begun to receive a substantial amount of attention in recent Amateur publications. This versatile antenna has yet to make the impression it deserves in actual field use, however. This is due, in my opinion, to a lack of practical information regarding methods of feeding it.

The purpose of this article is twofold. First, it is to discuss examples of feed systems for the half-square antenna that are currently in use at several stations in widely varying environments. Second, it explores the virtues of this antenna as a multiband performer.

The theory of operation of this antenna has been discussed by Ben Vester, K3BC.1 Interested readers may refer to the bibliography for additional background.

feed system

The basic layout of the antenna is shown in fig. 1. Of primary interest to most Amateurs (beyond performance) is how to connect the coax and get the antenna fired up.

Several feed methods have been examined in terms of available parts, weathering, and ease of adjustment. By far the simplest is the parallel-tuned tank circuit (fig. 2).

Network \( L1 C1 \) should resonate at the desired operating frequency. The values of \( L1 \) and \( C1 \) are calculated by:

\[
LC = \frac{25,350}{f^2}
\]

where \( L = \) inductance (mH)  
\( C = \) capacitance (pF)  
\( f = \) frequency (MHz)

A large value of \( L \) for a given frequency is desirable, because it decreases the \( Q \) of the \( LC \) network, thus increasing the bandwidth of the feedpoint. A value of 13 \( \mu \)H was chosen for \( L \); therefore, for \( C \) at 7.15 MHz:

\[
C = \frac{25,350/7.15^2}{13} = 38.1 \text{ pF}
\]

In practice, a few additional turns for \( L1 \) are needed. So two or three turns are added (3 \( \mu \)H) to the calculated value for \( L1 \). In my case, \( L \) is made of 15 turns of B&W No. 3033 3-inch (7.6-cm) diameter coil stock, but any 15-\( \mu \)H coil of No. 14 (1.6 mm) or larger wire will handle a kilowatt output.

Coils are easy to procure or wind, but capacitors are expensive, difficult to find, or both. Also, should a variable capacitor be desired for \( C1 \), weather-proofing becomes a problem. Because of these constraints, I chose a homemade capacitor that could be made from inexpensive RG-8/U coax and easily weather-proofed with silicone sealant.

The capacitor value is calculated using eq. 2, and the appropriate length of RG-8/U cable is determined by the distributed capacitance listed in the literature for the properties of common transmission lines. For RG-8/U the value is approximately 30 pF/foot (98.4

By Robert "Hasan" Schiers, N0AN, Box 1024, ISU Station, Ames, Iowa 50010
pF/meter). Therefore, if 38 pF is required, the desired length is found by dividing the capacitance per unit length for RG-8/U into the desired number of picofarads. That is, 30 pF/12 inches = 2.5 pF/inch (0.98 pF/cm), so that 38 pF/2.5 pF/inch = 15.2 inches or 38.6 cm. A 15.2-inch (38.6 cm) length of RG-8/U will provide a 5-kV capacitor at inconsiderable cost. Weather-proofing is important.

It is important to note, however, that until the seal-ant has cured, it is not an insulator and will short out the capacitor at the treated ends. The capacitor need not slow the project down; rather, it can be assembled and weather-proofed first and set aside to cure while the rest of the project is carried out.

Refer to fig. 3 for capacitor details. The capacitor is formed by the center conductor on one end and the shield on the opposite end. Treat both ends (except for the wire at the connection point) liberally with silicone sealant. This produces a reliable capacitor that will stand high power levels.

The feed system is completed by the input tap setting. A good initial setting is to tap up from the ground side two to three turns for 50 ohms. By using an SWR bridge at the antenna, the tap may be set exactly for a 1:1 SWR at any part of the band you desire. The following is an adjustment procedure that has proven effective (refer to fig. 4):

1. Set input (low-side) tap at 2½ turns up from ground.
2. Set high-side tap at one turn greater than predicted in calculations.
3. Measure SWR across band and note the low point; this is primarily influenced by the high-side tap. If the low point is not in the area of the band you desire, move the tap higher for a decrease in frequency or move the tap lower for an increase in frequency.
4. Once the low point of SWR has been set at the desired portion of the band (no matter what its value), proceed to adjust the low-side tap ¼ to ½ turn at a time to get a match of 1.2:1 or better at the desired operating frequency.

I've used this approach in three different environments. It has resulted in a match of 1.1:1 in no more than twenty minutes.

**multiband operation**

As may be seen from the wavelength relationships of fig. 1, this antenna, when constructed for 40 meters, is resonant on several other bands. By merely changing the feed system slightly, the antenna will perform very well on harmonically related bands. For example, the 40-meter array may be operated on 20 meters as a pair of half-wave verticals spaced one wavelength apart. While the phasing is not ideal, the performance of this antenna is very impressive, given the investment of time and money it requires. Table 1 shows the manner in which the antenna can be operated on harmonically related bands and what feed point changes are needed.

**performance**

At the time of this writing, this antenna has been evaluated in two ways. First, it has been compared...
(by instant switching) with on-site antennas. In comparison with a full-wave loop vertically polarized and mounted 8 feet (2.4 meters) off the ground, the half-square array consistently outperformed the loop by two to three S-units. There were virtually no instances where the loop was superior to the half-square, regardless of time of day, bearing, or distance. The period of these observations was approximately one month of daily use.

This same comparison, that is, loop to half-square, was made in terms of communication effectiveness during the recent ARRL phone SS contest. For a similar 15-minute period (in the same half hour) the half-square array produced over double the number of contacts that were achieved with the loop.

In a second comparison, the half-square array was compared with a roof-mounted trap vertical with eight radials. Again, in virtually every case, the half-square array was superior. The half-square's superiority was 3 to 5 S-units.

In my own application, the half-square was compared with a center fed 130-foot (40-meter) dipole, at 35 feet (10.7 meters), using balanced wire feed and a tuner. During the day, the systems were nearly equal, with a slight edge given to the dipole. As soon as the sun set, however, the half-square array emerged as a truly superior, if not an amazing performer. My half-square pattern is broadside east-west. I frequently operate between 1130 and 1300Z from fall through spring. Each morning, I work approximately five to ten JAs with a mean signal report of 589 using a kW. In addition, I have worked VKs, ZLs, H44, and YB9 as well as other scattered Pacific and Asian countries. In the recent CQ WW phone contest, I was able to compete in the pileups with the "big guns" for the very first time. It was rare for me to make more than four attempts to raise anyone. Countries in Africa and Europe were worked during the test as well as in Asia and the Pacific.

closing remarks

It seems we may have hit upon a complete antenna for a variety of Amateurs. It has proven to give high performance for DX as well as being more than adequate for normal use. It is efficient and easily fed. The half-square array is economical both in terms of initial investment and multiband applicability. The next time you get the bug to experiment with an antenna, try the half-square array. It may end your experimental urges (because of its high performance), or it may further stimulate you to try the extended approaches of parallel arrays recommended by the original author, Ben Vester. See you on 40, 160, 80, 20 and 10.

acknowledgment

I wish to thank K0CQ for advice as well as AI0Z and W9DERH for their hours of comparisons and willingness to try something new with something old.

reference


bibliography


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extending the range of the K9LHA 2-meter synthesizer

Although my CMOS 2-meter synthesizer, described earlier in ham radio,1 tuned only 146 to 148 MHz, capability was designed into the circuit and circuit boards for wider coverage. This was mentioned in my article, and it prompted a number of letters asking how to add 144-146 MHz coverage. Until recently I’d not tried using that capability for a wider tuning range and could only indicate how the design was planned. Now, having actually modified a synthesizer, I’d like to share the results.

extending frequency coverage

Extending the range of my synthesizer involves the addition of one or two switches and some minor circuit changes as follows:

1. Remove the jumpers under U1 connected to pins 8 and 9.
2. Connect the range switching circuit of fig. 1 to the input pads next to pins 8 and 9 of U1.
3. Change crystal Y2 to 47.3333 MHz.
4. Change crystal Y1 to \( f_{Y1} = \frac{(47.3333 - f_{i-f})}{3} \) MHz. If \( f_{i-f} = 10.7 \) MHz, \( f_{Y1} = 43.7666 \) MHz.
5. Increase C12 to 39 pF and retune the VCO for a tuning voltage of 1.0 volt at 144.000 MHz in both receive and transmit modes by adjusting T1 and C14.
6. Readjust T2 and T3 to the new crystal frequencies so that you don’t overdrive the squaring amplifier (Q8/Q9). It may be necessary to increase R39 and R43 to 470 ohms or so, depending on the activity of your crystals.
7. Increase R25 to 1.5k.

So that you can understand the reasons behind these changes, or improve upon the changes if you wish, let me briefly explain their intent. First, I suggest you spend a few minutes reviewing fig. 2 and the numbers directly beneath it in the synthesizer article.1

potential problems

A mixer in the synthesizer loop means that there are two VCO frequencies that will produce the same output frequency from the variable divider. Unfortunately, one of the two frequencies causes the phase detector to push the VCO away from, rather than toward, lock. In fact, lock will not occur unless it’s forced in some way; preventing this condition is crucial in the design. One method is to restrict the VCO tuning range so that the wrong frequency cannot be reached; another is to select a high mixer i-f, so that the desired and image frequencies are separated as much as possible. The receive/transmit pulling circuit also helps since it

---


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Fig. 1. New range switch.
permitted use of two, more precisely controlled tuning ranges for the VCO.

Because the desired and image VCO frequencies are separated by twice the variable divider input frequency (the "i-f"), the minimum divide ratio plays a very important role in avoiding the unlock problem. Unfortunately, while a large minimum divide ratio is desired, dividers are limited in speed capability, and a compromise is necessary. I found a value of \( N = 400 \) worked fine in my original design as well as in the full-coverage version.

The formula in fig. 2 (reference 1) shows that both receive and transmit crystals (Y1 and Y2) must be changed to cover the new frequency range, and the new frequencies are shown here. When the new crystals are installed the oscillators can be retuned.

The nature of these oscillators is such that they must be tuned to the high side of the crystal frequency to ensure reliable starting. The slugs of T2 and T3 also serve to adjust the output level from the squaring amplifier (Q8/Q9).

**tuning transformers T2 and T3**

In making this adjustment, I found that the squaring amplifier behaved very badly if overdriven at the upper range of frequencies. It is therefore important that T2 and T3 be set so that the squaring amplifier just reaches clipping level. I also noted that T2 and T3 had to be detuned considerably from resonance. This resulted in an error in oscillator frequency. To allow tuning closer to resonance it was necessary to increase the value of the two emitter resistors, R39 and R43, to reduce oscillator output. Again, your need to do this will depend upon the activity of your crystals.

Although retuning alone allowed the VCO to cover the full 144-148 MHz range, the tuning voltage came uncomfortably close to the supply voltage at the top end. Since I wanted to keep the tuning voltage within 1.0-5.0 volts to allow for temperature drift, I made a slight increase in the padder capacitor value, C12.

After tuning the synthesizer to the top of its new range, I found loop stability had been degraded and settling time was much too long. Therefore I increased the loop-filter damping resistor, R25, to 1.5k. A check with an f-m broadcast receiver showed that this change did not make any audible increase in sideband noise on the synthesizer output.

**variable divider**

The variable divider needs additional control inputs applied to pins 8 and 9 to tune the synthesizer over twice the range, as before. While it’s possible to use another thumbwheel switch section for the MHz digit, the code required is not BCD; and a code-changing scheme would have to be used. The approach in fig. 1 is simply to use an additional toggle switch to choose between low (144-146 MHz) and high (146-148 MHz) ranges. Although this makes it a bit more difficult to read the operating frequency directly, the cost and complexity are much reduced. If you feel there’s no need for receive and transmit frequencies on opposite sides of 146 MHz, only one range switch is required. The input to the switch comes from +8 (not +8RX or TX), and the four diodes are not needed.

Here’s hoping this information will help builders who wanted full band coverage. It’s been fun hearing from builders of my synthesizer, and I’m interested in both their successes as well as problems. As before, I’ll be glad to answer questions if accompanied by a self-addressed, stamped envelope.

I have plenty of the VCO coil forms ($1, postpaid, including wire), and I understand that RadioKit still has the circuit boards and parts available.*

*RadioKit, Box 411, Greenville, New Hampshire 03048.

**reference**


Tom Cornell, K9LHA

---

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medium-scan television

Recent developments in an interesting Amateur Radio communications mode

In 1958 when Copthorne MacDonald began experimenting with the fundamentals of slow-scan television, it was assumed that the only kind of image that could be sent over the high-frequency Amateur bands was unimportant, low-resolution still pictures. Time has passed, and it has turned out that even though the pictures are of relatively low resolution, now in color, they serve a very important place in Amateur communications.

With the low cost of digital memory today, it is certain that higher resolution digital scan converters will be designed and built that will improve the present quality of pictures by at least one hundred percent. Most of us today know that the original analog system did have more resolution than present day digital scan converters.

The real compromise in SSTV is the lack of motion. There is a great amount of information in each frame of television so that when many frames are transmitted giving motion, the required bandwidth is prohibitive. About the only hope that the Amateur has to transmit motion and still keep the bandwidth within legal allocations is to examine the image for electronic sampling "tricks" that can be used to increase the apparent motion.

background

In 1978 a group of Amateurs consisting of W0LMD, W9NTP, WB9LVI, W3EFG, and W6MXV applied for a Special Temporary Authorization (STA) from the FCC to test a narrow band MSTV system on 10 meters. Mathematical analysis easily shows that even a few fields per second of motion will require more than the normal amount of voice bandwidth, which is assumed to be about 3 kHz. It is very easy to calculate the required bandwidth. It will first be as-

\[ BW = \frac{128 \times 128 \times \text{number of frames per second}}{2} \]

The early experiments concerning motion showed that the minimum number of frames per second to give acceptable motion is 7.5. This results in a bandwidth of 65.5 kHz. The only place that bandwidths of this size can be found in the high-frequency part of the spectrum is on 10 meters. The FCC STA request was actually for as large a spectrum bandwidth that could be obtained. When the STA was granted, it showed that only 36 kHz were available in the vicinity of 29.0 MHz. All tests have since been performed on 29.150 MHz.

bandwidth restrictions

Several problems immediately surfaced when MSTV was considered to be restricted into this bandwidth. First of all, rf-transmission is almost always twice the base video bandwidth that is calculated by the above formula. Even if the video signal were transmitted as single sideband, it would not fit the 36-kHz spectrum allocation.

Several approaches are possible. Every parameter of the picture must now be considered to be vulnerable to restriction. If the motion were cut into one-half or one-quarter, the signal would fit into the 36-kHz band. Tests have shown that the picture becomes very jumpy and cannot really be considered true motion if the field time or frame rate is dropped much below 7.5 frames per second.

There are many other parameters that can be changed to keep the video low in bandwidth and still give apparent motion on the screen. Tests have been made in which the picture was divided into quarters. Only one fourth of the picture was transmitted at any

By Dr. Don C. Miller, W9NTP, RR1, Box 95, Waldron, Indiana 46182
one time. Other tests divided the picture into strips and transmitted one strip at a time. Still other formats sent every other line and combined the two transmissions similar to commercial interlaced television. All these schemes achieved the required 36-kHz bandwidth but left serious objectional artifacts on the screen that bothered the viewer.

The most ambitious test was to build a system employing a microprocessor that compared one stored image to a new image stored at a later time. The advantage of this system is that once the original image has been transmitted, only the changes need be transmitted in the future. Provision was made for periodic updates if the original picture had suffered interference. This system certainly works, but it is questionable that it could be made to work in a noisy, 10-meter-band environment. There is also the problem of transmitting the addresses of the changed pixels, which are liable to consume as much time and bandwidth as the redundant parts of the picture. I concluded that a better system for the Amateur is one that has a periodic update in all parts of the screen that is scanned into the memory rather than one that is addressed.

The Special Temporary Authorization (STA) permission from the FCC, which has been in effect from 1978, has been renewed by the FCC for an additional two year period. The original five Amateurs (plus one additional) have been given permission to transmit MSTV on 29.150 MHz with a maximum bandwidth of 36 kHz. These six Amateurs are N0LMD, W9NTP, WB9LVI, W3EFG, W6MXV, and N0AB. During these two years additional Amateurs can be added to the list. Each case will be considered by the FCC when permission is requested. I will be glad to work with anyone in preparing a request if they enlist my help.

Mathematical analysis shows that the maximum field rate that can be used for MSTV under these bandwidth restrictions is two fields per second for a 128-pixel by 128-line television picture. This results in a base video bandwidth of 16 kHz. One exception to this is the use of wideband single sideband. This will be considered in due time when a source of proper filters is located.

Since the last update, various motion formats have been tried, and some of the best ones were chosen for further tests. These tests have shown that if the full raster is transmitted, it is necessary to have an effective rate of at least 7.5 fields per second to give the illusion of reasonable motion. The 7.5 fields per second can be achieved easily by field grabbing at one eighth of 60 fields per second. The base bandwidth of such an image is 64 kHz, which is far beyond the capabilities of the allocated 36-kHz rf bandwidth.

**early work**

Some years ago one of the MSTV investigators, W3EFG, developed a bandwidth-reduction system called Sampledot for his employer (General Electric Company). The scheme was demonstrated in various mechanizations for several years. Sampledot works on the principle of transmitting only a fraction of the total number of pixels during any fast scan (60 Hz) field time. The chosen pixels for transmission are sampled from numerous small areas that are repeated many times throughout the total field time. The samples are taken in a pseudo-random fashion to reduce any repeated lines or edges that could result from regular sampling times.

The result is that, since each pixel is not transmitted every time the original field is scanned, the chosen pixel can be stretched in time, or "boxcar"-ed, to reduce the base video bandwidth. All the pixels in the entire field will be sampled after many pseudo-random passes through many different 60 Hz field times. The effect is to give continuous motion on a one partial field basis at less than 60 fields per second.

**recent work**

Recently, in the laboratory where various forms of adaptive picture bandwidth reduction were being tested, we set up the old Sampledot scan converter, which had also been converted to a field-grab system for comparison. Other digital scan converters were also available, to make it possible to demonstrate both Sampledot and field-grab systems simultaneously. A digital scan converter makes it possible to use field rates of other than 60 Hz for further bandwidth reduction. These two scan converters were coupled together to permit the demonstration of a Sampledot image derived from a 7.5-Hz field-grab image.

The image that viewers liked, in terms of minimum bandwidth, was a 4/1 Sampledot image at a field rate of 7.5 Hz. This gives a potential bandwidth reduction of $8 \times 4$, or 32. When divided into the 60-Hz field rate of the source television image, it results in an effective field rate of two fields per second, or a base video bandwidth of only 16 Hz (our objective for a transmission capability of 36-kHz rf bandwidth).

This experiment was based on a 128 x 128 pixel image. We feel that eventually the image should be 256 pixels by 128 lines. This means that the base bandwidth will be 32 kHz. If it evolves as wideband single sideband, the system of field-grab Sampledot will work out very well. Remember that no one has built this system yet, but the construction should be quite simple if you own a two-memory Robot 400. See the January 1981 issue of QST for how this can be accomplished.
SSB or fm?

The next standard to be set is the choice of transmission mode. Theory dictates that the maximum base bandwidth signal that can be transmitted through a 36-kHz rf bandwidth is 18 kHz. Single-sideband techniques would raise this to 36 kHz. But it would also add many unknowns to the detection and generation process; so fm has tentatively been chosen for MSTV.

After much testing of SSTV standards back in the 60s, the originators decided upon a base bandwidth of 900 Hz, a synchronization frequency of 1200 Hz, and a white frequency of 2300 Hz. Using some of the same logic that was called forth to determine the SSTV standards, I would like to suggest as a starting point that a particular spectrum be used for further tests (see fig.1). If it is found later that other frequencies are more useful, it will be an easy matter to readjust the oscillators and discriminators for different standards.

reception and transmission

My suggestion for reception is the modification of an existing transceiver. Many tranceivers can be modified in this way; one example is the FT-101. This transceiver has an i-f output for spectrum analyzers or panadapters that is brought out ahead of the SSB filter. This low-level i-f signal can be amplified by means of solid-state amplifiers. The bandwidth can be limited with filters (active, passive, or special filters that you might find at hamfests). It does not mean that filtering must be done at the frequency brought out of the special i-f output. A simple mixer and oscillator circuit can translate the signal to the frequency of your favorite “bargain” filter (see fig.2). (According to information received from the “FOX-TANGO club,” filters will be available from Yaesu.)

The detection can be done in a manner similar to that of the Robot 400. The tuned-filter discriminator works very well. The output frequency of some tranceivers is in the 3-MHz band. Good high-frequency operational amplifiers could be substituted for the types in the Robot 400. Of course the active filter elements must be redesigned for the new wide-band MSTV.

Fig. 2 also contains a block diagram of the suggested circuits for MSTV transmission. If you're interested in building circuits and testing them, get in touch with one of the six STA hams previously listed. We have no boards, just lots of messy connections on the bench, hundreds of ideas, and an enthusiastic, creative spirit reminiscent of the way ham radio “used to be.” Test signals are put on the air every Saturday, for the first ten minutes of each hour, beginning when the 10-meter band opens (29.150 MHz). Call in after the ten-minute tests for the latest updates, or give us a call on the SSTV net each Saturday at 1800 GMT on 14.230 MHz.

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HAM RADIO HORIZONS 348-849
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short circuits
dip meters
In the article entitled "A New Look at Dip Meters," on page 28 of the August, 1981, issue, varactor diode CR2 in fig. 7 should be rotated 180 degrees; otherwise the bias voltage will be returned to ground, and no tuning will occur.
The conversion factor for feet to meters in table 1, page 35 of the same issue should be 0.305, not 3.05 as shown.

transmission-line design

digital frequency display
The following corrections should be noted for the article "Digital Frequency Display For Single-Conversion Transceivers," which appeared on page 28 of the March issue. In fig. 2, U9 pin 14 should be connected to +5 volts, not to pin 13; pins 13, 12, and 8 should be tied together; pins 9 and 10 should be tied together. For U10-16, pin 14 on each should be connected to +5 volts, and in U10, 11, and 13 pin 7 of each should be connected only to ground. In fig. 1, note that, for U17-22, the grounded pin is pin 12.

operation upgrade
Part one of "Operation Upgrade" in the September, 1981, issue, contained an error. Energy = E/I, rather than E/I. If P =EI and I = Q/I, then P = E (Q/I). To remove time and leave pure energy the formula would have to be P = E (Q/I) times t.

digital techniques
In part 1 of the article on digital techniques by W1BG (page 44 of the September, 1981, issue), the A input of the first counter in fig. 4 should be at ground, not 5 volts.
New portable quad extends the range of low power two meter transceivers by providing the gain and front-to-back discrimination of a two element quad. Gives the gain of a linear amplifier but does not require additional battery power.

The entire beam slips into an 18" carrying case to go in your suitcase. For use, it unfolds to form a two element full size quad complete with stabilized mounting stand. Patented design lets you set it up or take it down in minutes. See the cover article QST September 1980 for full details.

Order direct or from your favorite dealer. Model A-502 portable 2-meter quad $87.50. Add $3 shipping/handling. California residents add sales tax.

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**Portable. Collapsible.**
**Folds into its own base for portability.**
**For boating, backpacking, mountaintopping, OSCAR.**

Tell 'em you saw it in HAM RADIO!
Clipper ships sailing to foreign shores. Sixteen amateurs primed for adventure, coming together as the first group in 20 years to set foot on the remote French Island, Clipperton. Their goal: 30,000 QSO's in just 7 days.

If you're like most of us, a rare DXpedition is more a dream than a reality, but the Clipperton Linear Amplifier from DenTron brings the thrill of a DXpedition to you.

The Clipperton-L™ was inspired by the famous DXpedition on which 3 MLA-2600's were used. We built the Clipperton with 4 rugged, economical, 572 B's in the final to provide a full 2KW PEP on SSB and 1KW CW on 15 through 160 meters. With features like hi-lo power selector for equal efficiencies at 1 or 2 KW, a power transformer that is vacuum impregnated, wide spaced tuning and loading capacitors, built-in ALC and an improved whisper-quiet cooling system, the excitement of crashing a pile-up can be yours.

Clipperton-L suggested price $799.50.
FCC Type accepted.
R-600
"Now hear this"...digital display, front speaker, easy tuning

The R-600 is a high performance, general coverage communications receiver covering 150 kHz to 30 MHz in 30 bands, at an affordable price. Use of PLL synthesized circuitry provides high accuracy of frequency with maximum ease of operation.

R-600 FEATURES:
- 150 KHz to 30 MHz, continuous coverage, AM, SSB, or CW.
- 30 bands, each 1 MHz wide, for easier tuning.
- Five digit frequency display, with 1 KHz resolution.
- 6 kHz IF filter for AM (wide), and 2.7 kHz filters for SSB, CW and AM (narrow).
- Up-conversion PLL circuit, for improved sensitivity, selectivity, and stability.
- Communications type noise blanker eliminates "pulse-type" noise.
- RF Attenuator allows 20 dB attenuation of strong signals.
- DCK-1 modulation kit for panel lights and digital display.

R-1000
"Hear there and everywhere"...easy tuning, digital display

The R-1000 is an amazingly easy-to-operate, high-performance, communications receiver, covering 200 kHz to 30 MHz in 30 bands. This PLL synthesized receiver features a digital frequency display and analog dial, plus a quartz digital clock and timer.

R-1000 FEATURES:
- Covers 200 kHz to 30 MHz continuously.
- 30 bands, each 1 MHz wide.
- Five digit frequency display with 1-kHz resolution and analog dial with precise gear dial mechanism.
- Built-in 12-hour quartz digital clock with timer to turn on radio for scheduled listening or control a recorder through remote terminal.
- Step attenuator to prevent overload.
- Three IF filters for optimum AM, SSB, CW, 12-kHz and 6-kHz (adaptable to 6-kHz and 2.7-kHz) for AM wide and narrow, and 2.7-kHz filter for high-quality SSB (USB and LSB) and CW reception.
- Effective noise blanker.
- Terminal for external tape recorder.
- Tone control.
- Built-in 4-inch speaker.
- Dimmer switch to control intensity of S-meter and other panel lights and digital display.

Digital world clock with two 24-hour displays, quartz time base

The HC-10 digital world clock with dual 24-hour display shows local time and the time in 10 preprogrammed plus two programmable time zones.

- 30 MHz. Wire terminals for 150 KHz to 2 MHz.
- 100, 120, 220, and 240 VAC, 50/60 Hz. Selector switch on rear panel.
- Optional 13.8 VDC operation, using DCK-1 cable kit.
- Other features include carrying handle, headphone jack, and record jack.

OPTIONAL ACCESSORIES:
- DCK-1 D.C. Cable kit.
- SP-100 External Speaker.
- Wire antenna terminals for 200 kHz to 2 MHz and 2 MHz to 30 MHz. Coax terminal for 2 MHz to 30 MHz.
- Voltage selector for 100, 120, 220, and 240 VAC. Also adaptable to operate on 13.8 VDC with optional DCK-1 kit.

OPTIONAL ACCESSORIES:
- SP-100 matching external speaker.
- HS-6 lightweight, open-air headphone set.
- HS-5 and HS-4 headphones.
- DCK-1 modification kit for 12-VDC operation.

KENWOOD
TRIO-KENWOOD COMMUNICATIONS
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**TS-530S**

IF shift, digital display, narrow-wide filter switch

The TS-530S SSB/CW transceiver covers 160-10 meters using the latest, most advanced circuit technology, yet at an affordable price.

**TS-530S FEATURES:**
- 160-10 meter, LSB, USB, CW, all amateur frequencies, including new 10, 18, and 24 MHz bands. Receives WWV on 10 MHz.
- Built-in digital display (six digits, fluorescent tubes), with analog dial.
- IF shift tunes out interfering signals.
- Narrow/ wide filter selector switch for CW and/or SSB.
- Built-in speech processor, for increased talk power.
- Wide receiver dynamic range, with greater immunity to overload.
- Two 6146B's in final, allows 220W PEP/180 W DC input on all bands.
- Advanced single-conversion PLL, for better stability, improved spurious characteristics.
- Adjustable noise-blanker, with front panel threshold control.
- RIT/XIT front panel control allows independent fine-tuning of transmit or receive frequencies.

**OPTIONAL ACCESSORIES:**
- SP-230 external speaker with selectable audio filters.
- VFO-240 remote analog VFO.
- VFO-230 remote digital VFO.
- AT-230 antenna tuner/SWR/ power meter.
- MC-50 desk microphone
- KB-1 deluxe VFO knob.
- YK-88C (500 Hz) or
- YK-88CN (270 Hz) CW filter.
- YK-88SN (1.8 kHz) narrow SSB filter.

**TS-660**

"Quad Bander"... dual VFOs, memory, scan, IF shift, FM, SSB, CW, AM

The TS-660 is a unique, all-mode transceiver designed for operation on 6, 10, 12, and 15 meters.

**TS-660 FEATURES:**
- FM, SSB (USB), CW and AM operation.
- 10 Hz step digital VFO. The frequency step is determined by mode of operation.
- F. STEP switch allows alternative step size in each mode.
- Dual VFOs built-in.
- 5 channel memory stores frequency and band information.
- Memory scan scans all bands, skips channels not in use.
- UP/DOWN push-button frequency control on microphone.
- UP/DOWN bandswitch.
- Frequency lock function switch.
- IF SHIFT circuit built-in.
- Fluorescent digital display shows TX/RX frequencies.
- Squelch circuit for FM, SSB, CW and AM.
- CW semi break-in circuit, with CW side tone.
- 10 W RF output on SSB, CW, FM, 4 W on AM.
- Two antenna terminals provided.
- RIT control.
- Noise blanker.

**OPTIONAL ACCESSORIES:**
- PS-20 power supply.
- SP-120 external speaker.
- MB-100 mobile mounting bracket.
- YK-88C normal CW (500 Hz) filter or YK-88CN narrow band CW (270 Hz) filter.
- YK-88A AM (6 kHz) filter.
- VOX-4 speech processor/VOX unit.
Maybe your friends were expecting *ham radio* last Christmas

Now that he has everything, why not give him something he'll really enjoy! Give *ham radio* this Christmas and your friends will thank you all year 'round. Each month they'll be introduced to the very latest technical advances in Amateur Radio, and become involved with such very special features as W9KNI's DX'ers Diary or Ham Radio Techniques by Bill Orr. Of course there will also be W6BNB's upgrade series and the many other exciting features that make *ham radio* such a special magazine for today's Amateur. So do your friends a favor and subscribe now at our very special gift price below. While you're at it, put your own name and address down — you deserve a money-saving gift too.

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☐ Bill me after January 1, 1982.
Continuous Frequency Coverage—The TR7 provides continuous coverage in receive from 1.5 to 30 MHz. Transmit coverage is provided for all amateur bands from 160 through 10 meters. The optional AUX7 Range Program Board allows out-of-band transmit coverage for MARS, Embassy, Government and Commercial services as well as future band expansions in the 1.8 through 30 MHz range. The AUX7 Board also provides 0 through 1.5 MHz receive coverage and crystal-controlled fixed-channel operation for Government, Amateur or Commercial applications anywhere in the 1.8 to 30 MHz range.

Synthesized/PTO Frequency Control—A Drake exclusive: carefully engineered high-performance synthesizer, combined with the famous Drake PTO, provides smooth, linear tuning with 1 kHz dial and 100 Hz digital readout resolution. 500 kHz up/down range switching is pushbutton controlled.

Advanced, High-Performance Receiver Design—The receiver section of the Drake TR7 is an advanced, up-conversion design. The first intermediate frequency of 48.05 MHz places the image frequency well outside the receiver input passband, and provides for true general coverage operation without i-f gaps or crossovers. In addition, the receiver section features a high-level double balanced mixer in the front end for superior spurious and dynamic range performance.

True Passband Tuning—The TR7 employs the famous Drake full passband tuning instead of the limited range “i-f shift” found in some other units. The Drake system allows the receiver passband to be varied from the top edge of one sideband, through center, to the bottom edge of the opposite sideband. In fact, the range is even wider to accommodate RTTY. This system greatly improves receiving performance in heavy QRM by allowing the operator to move interfering signals out of the passband, and it is so flexible that you can even transmit on one sideband and listen on the other.

Unique Independent Receiver Selectivity—Space is provided in the TR7 for up to 3 optional crystal filters. These filters are selected, along with the standard 2.3 kHz filter, by front panel pushbutton control, independent of the mode control. This permits the receiver response to be optimized for various operating conditions in any operational situation. Optional filter bandwidths include 6 kHz for a-m, 1.8 kHz for narrow ssb or RTTY, and 500 Hz and 300 Hz for cw.

Broadband, Solid State Design—100% solid state throughout. All circuits are broadbanded, eliminating the need for tuning adjustments of any kind. Merely select the correct band, dial up the desired frequency, and you’re ready to operate.

Rugged, Solid State Power Amplifier—The power amplifier is internally mounted, with nothing outboard subject to physical damage. A Drake designed custom heat sink makes this possible. The unique air ducting design of this heat sink allows an optional rear-mounted fan, the FA7, to provide continuous, full power transmit on SSTV/RTTY. The fan is not required for ssb/cw operation, since normal convection cooling allows continuous transmit in these modes.

Effective Noise Blanker—The optional NB7 Noise Blanker plugs into the TR7 to provide true impulse-type noise blanking performance. This unit is carefully designed to maximize both blanking and dynamic range in order to preserve the excellent strong-signal handling characteristics of the TR7.

NOTE: Transmitter coverage for MARS, Government, and future WARC bands is available only in ranges authorized by the FCC. Military, or other government agency for a specific service. Proof of license for that service must be submitted to the R. L. Drake Company, including the 500 kHz range to be covered. Upon approval, and at the discretion of the R. L. Drake Company, a special range IC will be supplied for use with the Aux7 Range Program Board. Prices quoted from the factory. See Operator’s Manual for details. (Not available for services requiring type acceptance.)

Specifications, availability and prices subject to change without notice or obligation.
CT2100
HAL Puts MORE Behind The Buttons

45-1200 Baud RTTY
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Black or White Characters
Unshift on Space (For Baudot)
Half or Full Duplex
Auto TX/RX Control

Communications Terminal

45-1200 Baud RTTY
1-100 WPM Morse

Black or White Characters
Unshift on Space (For Baudot)
Half or Full Duplex
Auto TX/RX Control

Four Internal RTTY Demodulators
- High Tones (U.S. Standard)
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- 202 Modem (1200/2200 Hz)

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CT2100 System:
- CT2100 Communications Terminal
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24 Line Display
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**December**

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| AMSAT Net. Coor. Net 3950
  8 PM EST 0100Z  Wednes-day Morning | GEORGE WASHINGTON
  UNIVERSITY OF ENGINEERING 
  & APPLIED SCIENCE - Dr. Ulrich
  Minute Dr. Jack Smith and give a
  short course at frequency
  unknown. If interested, contact
  the Office of Continuing
  Engineering Education at the
  university. The course number
  is R500, and the fee is $7.50.
  24. | PIKE COUNTY ARC 6 OLD
  POST ARS SPECIAL
  EVENTS STATION - Call
  sign W5CIN. Time 0002 UTC
  on Dec. 4th through 0002 UTC
  Dec. 6th. 6 - 8 PM. |              |

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| WEST COAST QUALIFYING RUN - 6 | WEST COAST BULLETIN - 8PM PST - 8PM EST - 1440
  UTC 3640 KCS A 1210 WPM | AMSAT Net. Coor. Net 3950
  8 PM EST 0100Z  Wednes-day Morning | WYAM QUALIFYING RUN 9 |              | 10-METER CONTEST - 12-13 |              |

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  8 PM EST 0100Z  Wednes-day Morning | AMSAT Mid Coor. Net 3950
  8 PM EST 0100Z  Wednes-day Morning | AMSAT East Coast Net 3950
  7 PM PST 0500Z  Wednes-day Morning | TRIPLE STATES RADIO
  AMATEUR CLUB - run
  operation from Rochester, WV
  2300 UTC daily 12 PM. |              |              |              |

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| AMSAT East Coast Net 3950
  8 PM EST 0100Z  Wednes-day Morning | AMSAT Mid Coor. Net 3950
  7 PM PST 0500Z  Wednes-day Evening | AMSAT East Coast Net 3950
  8 PM EST 0100Z  Wednes-day Morning | STRAIGHT KEY NIGHT - 31 |              |              |              |

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Cocktail Party hosted by Ham Radio Magazine, Friday evening, for all SAROC exhibitors and SAROC paid registered guests. Ladies program Saturday, included with Ladies SAROC paid registration. Two Aladdin Hotel Breakfast/Brunches included with each SAROC paid registration, one on Saturday and one on Sunday. Technical sessions and exhibits Friday and Saturday for all SAROC registered guests. Friday and Saturday hourly awards, main drawing, Saturday afternoon. Must be present to win. Ownership of award does not pass until picked up. SAROC advance registration is only $17.00 per person if postmarked before March 1, 1982. After March 1, 1982 it is $19.00 per person. Non-paying guests who only wish to visit SAROC exhibits will be issued an ID badge good for admission to exhibit area at no charge. Coupon book and cellophane badge holder may be picked up at SAROC registration desk. Send check or money order to SAROC, P.O. Box 14217, Las Vegas, Nevada 89114. Refunds will be made after SAROC is over to those requesting same in writing and postmarked before April 1, 1982. Special SAROC Aladdin Hotel room rate is $36.00, plus room tax, per night, single or double occupancy. Aladdin Hotel accommodations request card will be sent to all SAROC exhibitors and SAROC paid registered guests.


Enclosed is $__________ check or money order (no cash) for SAROC advance registration @ $17.00 each; after March 1, 1982 SAROC registration is $19.00 each. Extra drawing tickets for main drawing are $1.00 each, limit 10 for each SAROC paid registration.

OM  Call  Class
YL  Call  Class
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I have attended SAROC ________ times. I plan to attend Friday Cocktail Party ________
I am interested in: ARRL, Cocktail Party, CW, DX, FCC, FM, MARS, RTTY, TV, other ________
publications. Please circle ones received.
Listen to your planet on a shortwave receiver!

Communications Electronics, the world’s largest distributor of radio scanners, is pleased to introduce Panasonic Command Series shortwave receivers. Panasonic lets you listen to what the world has to say. Unlike a scanner, a Command Series radio lets you listen to shortwave broadcasts from countries around the world, as well as the U.S.A. It’s the space age shortwave performance you’ve been waiting for... at a down to earth price you can afford.

All Panasonic shortwave receivers sold by Communications Electronics bring the real live excitement of international radio to your home or office. With your Command Series receiver, you can monitor exciting radio transmissions such as the BBC, Radio Moscow, and others. Thousands of broadcasts in hundreds of different languages are beamed into North America every day. You can actually hear the news before it’s news. If you do not own a shortwave receiver for yourself, now’s the time to buy your new receiver from CE. Choose the receiver that’s right for you, then call our toll-free number to order today from CE.

We give you excellent service because CE distributes more shortwave and shortwave receivers worldwide than anyone else. Our warehouse facilities are equipped to process thousands of orders every week. We also export receivers to over 300 countries and military installations. Almost all items are in stock for quick shipment, so if you’re a person who needs to know what’s really happening around you, order today from CE.

Panasonic RF-4900

List price $549.95/CE price $389.00
Bands: MW 525-1610 KHz, SW1-1.6-30 MHz.
FM 88-108 MHz.

The Panasonic RF-4900 shortwave receiver features a 5-digit fluorescent display for all 8 SW bands, as well as AM/FM, AC/DC battery operation, full coverage of all SW, Covers SSB and CW, FM, Bandwidth switch, BFO switch, BFO pitch control, Pre-set tuning and PLL quartz synthesized receiver. Tuning-Battery meter with meter function switch. Separate bass and treble tone control. Dial light switch. Digital display on/off switch. Separate power switch. Rack type handle. Made in Japan.

Panasonic RF-3100

Allow 30-120 days for delivery after receipt of order due to the high demand for this product.
List price $339.95/CE price $269.00
Bands: MW 525-1610 KHz, SW1-1.6-30 MHz.
FM 88-108 MHz.

Panasonic RF-2900

List price $349.95/CE price $249.00
Bands: MW 525-1610 KHz, SW1-1.6-30 MHz.
FM 88-108 MHz.
The Panasonic RF-2900 is a portable five-band shortwave radio with digital five digit fluorescent frequency display. Full coverage from 3.2 to 30 MHz on SW, Covers SSB and CW. Double superheterodyne system. Fast/Slow speed tuning. AFC Switch on FM, narrow/wide selectivity switch for AM and SW. FET RF circuit. BFO pitch control and pitch control. RF gain control. Tuning battery meter. Separate bass/treble tone control. SW calibration control. Dial light switch. Digital display on/off switch. Separate power switch. Rack type handle. Includes whip antenna and ferrite core antenna, speaker, earphone, recording output jacks, AC line and detachable adjustable shoulder belt. Made in Japan.
The months of fall, October and November, are possibly the most exciting months of the year on the DXer’s calendar. The summer solstices are over, and the noontime null caused by solar absorption is greatly diminished as the sun moves further south. Thunderstorms and their attendant QRN are far less noticeable, and 40 and 80 meters are really snapping back to life.

Spring is in full sway in the Southern Hemisphere. As the sun crosses the equator, paths worldwide improve, giving DXers everywhere shots at far-flung places. Ten meters is hotter than a pistol, bringing new thrills to its devotees, while 15 to 20 are really strutting their stuff.

On the other side of the ledger are the spate of solar disturbances. The period after a peak in the sunspot cycle is the worst for frequent solar upheavals, which can devastate conditions for days on end, especially on the higher frequencies. Still, the storms peak out in the summer months and their intensity fades as we head into the months of late fall.

I settle into the operating chair and adjust the headphones till they’re comfortable. I glance over at my chalkboard, knowing what I’ll find — very little. A couple of forlorn notes on VK9NV, now over three months old. He seems to have disappeared from the bands. Maybe the incessant pileups of Japanese, American, and European DXers finally got to him. I guess I couldn’t blame him if they did. But it sure doesn’t help me if he’s given up operating.

There’s a note on the DXpedition to S9R, Sao Thome, West Africa. But yesterday’s “DXer’s Tout Sheet” said that the operation was going to be delayed at least six weeks, and very possibly would have to be cancelled. It figures; I need that one.

I move the bandswitch to 20 meters. Let’s put the antenna on NNE, bisecting the paths to Europe and the transpolar route. It’s 0000 Zulu. Europe will probably still be coming in if conditions are any good, and the path across the pole should be opening right now as morning sunlight chases the MUF up from its dog-watch lows.

I set the receiver right at the bottom edge of 20, at 14000 kHz, and start tuning up the band. It’s Friday night, so there’s hope of increased activity all over the world.

Hah. There’s G3FXB, in QSO with somebody, just starting a transmission. I listen, but it becomes obvious that Al is well into a ragchew with someone. I listen to that fine fist, 30 or 35 words per minute and music to the ear. Al’s one of the top dogs in the DXCC program Honor Roll, a fixture on the lists for many years. Al is active, and that’s part of the secret of staying on top. He’s always operating contests, usually in rivalry with his close friend G3MXJ. In between contests, Al is often heard ragchewing.

A chat with Al would be nice if nothing is happening on the band. I set my extra VFO on his frequency as a marker, so that I can easily find him again, and continue tuning higher up the band.

There’s a good strong signal calling CQ. Almost instantly I recognize it from the fist: it’s VU2BK. A retired Indian Army officer, he’s very active on the bands and generally the strongest signal from India. I pause and take a close look at his signal. I don’t need a contact but a look at his signal can tell you a lot about the band. The very fact that I’m copying him at all says something, and his S8 signal sure adds to the assessment that the band is in fairly good shape at the very least. Hmm. No trace of auroral buzz, and, really, very few of the usual characteristics of a long-haul signal. The really long-haul signals, while pleasant to listen to, often have tell-tale marks impressed on them that disclose their long-haul origins. These include subtle but continual tiny shifts in frequency (Doppler shifts) caused by the slightly different paths delivering the signal, softened keying characteristics caused by the time delay differentials of the different paths — and often at least a trace of auroral buzz.

No, this signal is very clean and pretty strong, which indicates good conditions and that his primary path is overwhelming the marks and signatures secondary paths would add.

One of the games that any DXer, but especially a CW operator, constantly has to practice is identifying whether a signal is DX or not without hearing the call, so that, while tuning a band, time won’t be wasted waiting for domestic stations in QSO to sign. The ability to quickly read that aspect of a signal is invaluable in contest and pileups as well.

A trained operator, even listening to a stateside station in QSO, can usually figure out whether the station you hear is into a good one; there are few operators who don’t show excitement when working a new one. It’s a subtle thing on CW, but it’s still noticeable. The tip-off is timing. A fellow who’s in contact with what is for him a new country usually has a very choppy timing and spacing on his fist, reflecting his excitement, and the world’s best keyer won’t cover it up.

Of course, the new one for him might be the fellow that you’ve been ragchewing with every Wednesday night for the last two years, or it could be a guest operator at some big gun’s station experiencing the thrill of his very first DJ QSO, but whenever you hear the signs that someone is excited about his QSO, you have to wait and see who he’s got.

I keep moving the receiver slowly up the band. Hmmm. There’s a loud and raucus signal. Obviously an intruder, not an Amateur station at all. Some exotic form of modulation, something that no ham ticket anywhere in the world would authorize for 20 meters. And not only is the sig-
nal 20 dB over S9, but it has nasty little sidebands as well, making the signal over a kHz wide. Probably a Moscow to Havana circuit. Oh well, it’s a good place to tune up my rig, where no legitimate ham will be bothered. I move the rig up, key down and check output and SWR. All’s well. I tune on up the band, getting clear of the sidebands of that illegal intruder.

The receiver dial tells me that I’m just above 14,050. I start to spin the dial back down, but stop. I’ve been covering the slot of 14,000 to 14,050 regularly for a long time, and recently, with very little to show for it. That area is where the action usually is, but what the heck, let’s tune higher.

As with almost every band, the higher on 20 meters you go the slower the fists, in general. It seems as if the newcomers are afraid of getting blown away by hot-shots down at the bottom end of the band, and so they stay higher up. It’s a good practice, just like the swimming pool; practice your strokes in the shallow end before you high dive into the deep end.

And DX stations do the same thing. So, perhaps a good one can be dredged up by working the high end. My tuning up this high in the band is slower, but still very interesting.

Almost immediately I come across a goody; a slow, hesitant fist, not too strong, “CQ CQ DE SV9MT SV9MT KN.” Crete, a nice catch, though not one I need. I chuckle at the KN at the end of his CQ; obviously a newcomer, but he’ll learn. The first couple pages of my first log book show me giving reports of 995.

As I pick up the 2-meter microphone I hear him start a CQ again. I call it in.

“Hey, I’ve found Crete on 20 meter CW, that’s SV9MT, Sugar Victor Nine Mexico Tango, fourteen oh sixty eight, fourteen oh sixty eight, from W9KNI.”

“Hey, W9KNI, here’s WD9IIC. Bob, I need that one, but I’ve got my station all torn apart. I can be back on in five or ten minutes. Are you working him?”

“WD9IIC from W9KNI. OK, Dick. Nah, he’s calling CQ, and not getting any takers. I don’t need him, but I tell you what. If nobody comes back to him after the call he’s making now, I’ll try to work him and hold him for you. He’s going real slow, so if I get a QSO, you’ll have ten minutes for sure. OK?”

“Fine, Bob. That would be real nice. Preciate it, I’ll get my stuff together here quick. W9KNI from WD9IIC.”

“Rah-jez.”

I listen to the SV9 — there, he signs. I listen closely. Yes, someone is coming back to him — about the same strength — sounds like another European. Yes, it’s a DF9, a German, going nice and slow, almost dead zero on the SV9. He signs.

The SV9 starts up, coming back to the German. I pick up the 2-meter microphone again.

“OK, Dick, you got a reprieve. A DF9 got him. You want I should watch the frequency till you’re ready? WD9IIC from W9KNI, go ahead.”

“OK, Bob, thanks. W9KNI from WD9IIC. I’ve got the receiver working again now and I’ll have the transmitter hooked back up in a couple minutes. Let me find that fellow now, so that you won’t have to sit around and wait. What was that frequency again?”

“Ah, he’s on fourteen oh sixty eight. He’s going real slow, and he’s pretty much in the clear.”

“OK, the one saying QTH HR CRETE? Yup, that’s got to be him. W9KNI from WD9IIC.”

“Yeah, good hunting, Dick. W9KNI clear.”

I start tuning higher again. Hmm. OK, there’s fellow really clipping along; got to be at least sixty words per. A keyboard artist, for sure.

Yeah, he signs it over; it’s W9TO with a W6. And right next to him, just above him, a slow, steady CQ, a DX station almost for sure from the sound of it. I keep listening. Yes, it’s LX1TK, Luxembourg. Not really rare, but not common either.

I decide to see if Dick caught the SV9 yet. I touch the VFO spotting button and move the receiver to the frequency. Right on time, too. There’s the SV9 signing clear with the DF9.

WD9IIC starts calling, dead zero on the frequency that the DF9 was on. But so is someone else. I pick up the 2-meter mike, “WD9IIC from W9KNI. Hey, you got competition, Dick. Make it a l-o-n-g call. I’ll tell you when to stop.”

I listen. Dick keeps signing his call. The other station ends his call. “OK, Dick, two more times, two more times.”

Just as Dick ends, the other station realizes that the SV9 hasn’t come back and starts calling again. But it’s too late. He’s been had. The SV9 starts coming back to WD9IIC.

“Way to go, Dick!”

“Thanks, Bob.” Dick’s response is brief; he’s busy copying.

It’s a good feeling to help a friend get a new one; almost as exciting as working a new one for yourself. The sense of pride feels good. And, at times, a little coaching on 2 meters can make all the difference.

Yes, Dick is in solid with the SV9. I call it in again on 2 meters, then resume tuning higher up the band.

There’s 9TO again, still burning up the frequency. And there are six or eight stations calling the LX. Funny how they’ll pick up on something like the LX and miss the rare SV9 a few kHz away. But it happens all the time.

Another CQ. OK, it’s an El. Someone calling a KP4; yes, an SP9. Hmm. Someone promising a direct QSL, wait and see what that one’s about for sure. There.

“GJ4CTS DE WD4KHJ.” I call the GJ4 in on 2 meters — not terribly rare but someone might want it. Nobody asks for a repeat, so I tune on.

A loud teletype signal tells me that perhaps I’m a little high. I look at the dial. Yup, it’s at 14087. OK. I decide to move back to 14050 and start up again. This end of the band seems interesting tonight.

“Hey, Bob, thanks a lot. That was a new one for me. Hope that I can re-
pay the favor. W9KNI from WD9IIIC."

"Ah, great, Dick. WD9IIIC, here's W9KNI. Fine. Hey — you can pay me back. I need Kamaran. I'll be on for another twenty minutes or so; find me one before I QRT, OK?"

"Hah. OK, I'll start now. Thanks again."

"Yeah, you do that! See you later."

I glance at the antenna rotor control; still set between the paths to Europe and the transpolar route to deep Asia. I haven't heard anything on the transpolar path except the VU2 earlier. I decide to swing the antenna a bit further south, to 45 degrees, dead on Europe. I'll still hear the transpolar signals, though perhaps an S-unit weaker, but, on the other hand, I'll have a better chance of hearing Africans.

I keep tuning higher, listening carefully as I go. There's an IS0 on Sardinia, working a PY in Brazil. There's a bit of a pileup; I listen. OK, it's various European stations chasing an HP1, a Panamanian.

There's a Frenchman calling CQ. There's a UP2 calling a WD4. There's another CQ, a slow one, using a hand key for sure. There, he's signing. His fist is a bit difficult. G0AL? No, that can't be. Sounds like it though. He's calling CQ again. Can't be a GB. Could it? There, he's signing again. Let's try it again. Hey! Hey! It's a TN8, not a GB. TN8AL, the Congo, and one I need. I didn't know that any one was on from there, but here one is.

Pull the VFO up zero on him. Turn on the linear. Zapp! It's up and running. He continues his CQ call, obviously a new operator. I move the VFO just above him and key down for a moment. Yes, everything is OK as I trim the drive level of the exciter. OK, re-zero him. Move the antenna. I glance at my great circle map on the wall. OK, 80 degrees should be close enough. There, he's signing again. Yes! It's definitely TN8AL. OK, he's done.

I pause a moment, Yes, there's someone else calling him, but he's 300 or 400 hertz off. I start my call — oops. Thirty or thirty-five words per minute is a little fast for a new fellow sending perhaps twelve! I move the keyer speed. That's better.

I give a two-by-three call; "TN8AL W9KNI W9KNI W9KNI AR K." I stand by.

The frequency is silent. Then the other station that was calling the TN8 starts to call again. I pause a moment longer. But, just as I'm about to start a second call, I hear:


"R TN8AL TN8AL DE W9KNI W9KNI W9KNI KNI KNI W9KNI AR KN."

I wait. A long pause. There, he starts again.

"W9KNI W9KNI ..." Great! He's got my call OK now . . . "TN8AL R HELLO OM ET MERCI EEEEE TXN QSO RST 489 489 QTH BOX 1293 BOX 1293 BRAZZAVILLE BRAZZAVILLE NOM CAMTI CAMTI OK? W9KNI DE TN8AL KN KN."

Wow!

"R TN8AL DE W9KNI . . ." Hmm. This fellow obviously speaks more French than English. Not surprising.

"MERCI CAMTI POUR LE QSO ET VOTRE RST 579 579 PRES DU CHICAGO QTH PRES DU CHICAGO ET NOM EST BOB BOB QSL SVP MA QSL BOX 1293 OK SURE RIG 600 WATTS ET YAGI WX 6C 6C TRES FROID HI HI OK CAMTI? TN8AL DE W9KNI AR KN."

"R W9KNI DE TN8AL R FB CHER AMI BOB ET MERCI POUR LE QSO RIG 100 WATTS ET DIPOLE QSL SURE 73 A BIENTOT SK W9KNI DE TN8AL SK."

"R 73 CHER AMI CAMTI ET BONNE CHANCE A BIENTOT DE W9KNI SK EE."

The slow QSO has given me time to get all the log data written while he was transmitting. I listen — no one is calling him except the fellow that I beat out when he was calling CQ. But I can change that. I pick up the 2-meter microphone . . .
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ARGOSY 80-10M Transceiver... List $899... SALE $849
HERGLES Solid State Line... List $1125... SALE $1025
225 AC Supply for Arsenal... List $179... SALE $159
255 Deluxe AC Supply for Omni... List $199... SALE $189
240 AC Supply for Delta... List $169... SALE $149
240WRF 150W Dry Drive Amplifier... List $259... SALE $249
LN-1000 100W Dry Drive Amplifier... List $259... SALE $249
LSN-1000 100W Tuner w/SWR Meters... List $319... SALE $299
29W KWP Tuner w/SWR Meter... List $269... SALE $249
29R KWP Tuner w/SWR Meter... List $269... SALE $249
29K Remote VFO for Omni C... List $119... SALE $109
28W 1000W Dry Drive Amplifier... List $529... SALE $519
28W 1000W Dry Drive Amplifier... List $529... SALE $519
COMPLETE STOCK OF ALL TEN-TEC FILTERS, BREAKERS AND OTHER ACCESSORIES IN STOCK FOR IMMEDIATE SHIPMENT - CALL ETO/ALPHA

76A 2 KW PEP Linear Ampl w/8775... $1495
76A 2 KW PEP Linear Ampl w/8775... $1495
474A No Tune Up Version of 76A... $1995
7B No Tune Up... $2795
710X Linear Ampl w/8775 Fm... $3995

VOCOM PRODUCTS

5/8 WAVE 2 mtr. Hand Held Antenna... $19
202-25W 2 mtr. Amplifier... $179
202-200W 2 mtr. Amplifier... $229
202-25W 2 mtr. Amplifier... $179
102-5W 2 mtr. Amplifier... $199
102-5W 2 mtr. Amplifier... $199
202-10W 2 mtr. Amplifier... $229
102-5W 2 mtr. Amplifier... $199
102-10W 2 mtr. Amplifier... $229
202-10W 2 mtr. Amplifier... $229

AZDEN

PC3000 2 mtr. FM XCV w/Twin Kit... $269

BENCHER

BY-1 Paddle w/Black Base... $26
BY-2 Paddle w/Chrome Base... $44
BY-3 Paddle w/Gold Plated Base... $129
ZA-1A 3-5.30 MHz Air Core Balon... $16
ZA-1A 3-5.30 MHz Air Core Balon... $16

DAIWA/J. W. MILLER

AT266 200W PEP Automatic Antenna Tuner... $699
CVA-1001 500W PEP Automatic Antenna Tuner... $299
CN 2698 1.5 MHz SWR/Power Meter... $112
CN 639 140-150 MHz SWR/Power Meter... $329
CN 7298 1.8-150 MHz SWR/Power Meter... $329
CS 280 2 Pos Crystal Type Cross Switch... $21
CS 402 4 Pos Crystal Type Cross Switch... $60
RF 448 RF Speech Processor w/AC Supply... $329

TEXAS TOWERS

A DIVISION OF TEXAS COMMUNICATIONS PRODUCTS
1108 Summit Pkwy, Suite 2
Plano, Texas 75074

More Details? CHECK - OFF Page 120

December 1981

Price subject to change without notice.
last-minute forecast

The 27-day solar maximum is expected to peak around the middle of the month, which leaves the beginning and end of the month with lower flux and flare activity. Geomagnetic disturbances can be expected about December 1, 11, 20, and 28. The two mid-month disturbances are solar flare effects, and the others are from coronal hole thinness, increasing the solar wind. From these solar/terrestrial relationships, the best DX is probably going to be at night on the lower-frequency bands during the first week and a half. Then the higher bands will be favored for long-haul DX for the next week and a half. DX conditions may be poorer during the last week and be best on the lower bands again.

December is probably the best month for winter DX. Although the hours of daylight are quite short now in the Northern Hemisphere, the ionosphere-propagated frequencies rise rapidly, with the rising sun, to the higher frequency bands of good DX. The sunspot number and solar flux remain high enough to ensure good MUFs during this winter DX season.

The earth is closest to the sun, which results in a 5 percent rise in solar flux and ionospheric density during winter. December is also one of the quietest months of the year in terms of geomagnetic disturbances. Radio noise propagated from the thunderstorm centers over the few land masses of the Southern Hemisphere are far from us, so the 80- and 160-meter bands are good for daytime use and become good possibilities for DX during the long winter nights. All these conditions make for good DX. The longest night — winter solstice — is on the 21st this year.

The Geminid meteor shower, which reaches its peak on December 13-14, provides the richest and most reliable display of the year, with rates of 60-70 per hour (measured mainly by radio because of the poor weather in December). Also, a smaller portion of the shower (15-20 per hour) is observed on December 22. Lunar perigee and full moon occur on December 11.

band-by-band summary

Six meters will open occasionally during time of 27-day solar flux maxima. The openings will follow the sun — east before noon, south at noontime, and west and transequatorial during the evening.

Ten and fifteen meters will be like the openings on six, except more frequent and longer in duration. Worldwide DX will abound from after sunrise until well after sunset during periods of high solar flux (listen to WWV at 18 minutes after the hour for the daily flux value).

Twenty meters, the universal DX band, will be open most days during December this year, to most parts of the world during the day and into the night. Best conditions can be expected just after sunrise and just before sunset. Long skip will be available as the band opens upon sunrise, and will last until well after sunset.

Forty meters is a transition band between the daytime bands at high frequencies and the nighttime bands at this and lower frequencies. Our new 1979 WARC 30-meter band will provide the in-between band that may allow round-the-clock communications on 350- to 2500-mile (560-4000 km) paths. As is, 40 meters is very active to most areas of the world during hours of darkness to just before sunrise. In late afternoon, the band will open to the east, covering Europe, then swing around to the south at about midnight, and west to the Pacific by dawn. Short skip will be available on most days.

Eighty and one-sixty meters are expected to be excellent on this best month of the year for the top bands. Low noise during the long nights will give hours of pleasure if you are looking for the rare ones on these bands. DX from the coastal areas over water to South Africa, South America, and Australia-Asia will be easiest; but rare ones from anywhere will be worth the effort. You ragchewers on these bands try some DXing.

Garth Stonehocker, K0RYW

DX FORECASTER

December 1981

Ham radio
Look at next higher band for possible openings.

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* Look at next higher band for possible openings.
Motorola MHW 252 VHF power amplifier.

**TRANSISTORS/IC'S**

Motorola 544-4001-002, Type NPN RCS 258.
RCA power transistors.
NPN RCS 258.

**TEST EQUIPMENT**

- HP 3450A Mult-function meter
- HP 694C Sweep Oscillator, 8.0 to 12.4 GHz
- HP 6600B Sweep Oscillator with 6651B plug in, 4.0 to 8.0 GHz
- HP 185A Oscilloscope with HP 185A TDA/Sampler & HP 185A Narrow-band TDA
- HP 5245C Frequency Counter with $253A plug-in, 100-500 MHz
- HP 174A Recorder Plug-in for HP 175A Oscilloscope
- HP 176A Time Mark Generator for HP 175A Oscilloscope
- HP 606A Signal Generator, 50 kHz to 65 MHz
- HP 508B 1000.00

**MEMORY EPROMS**

- C.P.U.'s ETC.

**CABLE TIES**

- TEKTRONIX OSCILLOSCOPES
  - New Tektronix Type 0.78" x 0.35" rect. 70-0100-2982-5
  - Scope Camera, 200.00 ea.

**SWITCHES**

- Sub miniature push button switch #T-18R... 100 per bag mil. spec. AMS-33685, 41
- DPDT miniature toggle switch used...

**CABLES**

- $2.50 per bag 10 bags - $20.00

**HIGH VOLTAGE CAPS**

- 420 MFD @ 400 VDC 3.99 each
- 600 MFD @ 400 VDC 3.99 each

**DOOR KNOB CAPS**

- 470 pF @ 15 KV 3.99 each
- Dual 500 pF @ 15 KV 5.99 each
- 600 pF @ 6 KV 3.99 each
- 800 pF @ 15 KV 3.99 each
- 2700 pF @ 40 KV 5.99 each

**CONTINUOUS TONE BUZZER**

- #MB12 "Soma" Freq. 450 Hz, size 5/8 x 5/8 12VDC...
  - $2.00 each

**SOLDER WICK**

- Size #2 Cat. #40-2-5...
- Size #4 Cat. #40-4-5...

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**SOLDER WICK**

- Size #2 Cat. #40-2-5...
- Size #4 Cat. #40-4-5...
NEW BCD SWITCHES
8 switch with end plates $8.99
350 MHz prescaler divide by 95H90DCQM...

New Fairchild Prescaler Chip
THM-6030 1.00 TO-220

Part
For one TO-3 type
Mln~ature Part
LED Bar Graph Display
5-9111

New
New video monitor
TVT....

WALL TYPE TRANSFORMERS
115 VAC input
6 VAC @ 10 MA ............ 2.99
12 V @ 700 MA ........... 4.99
15 V @ 300 MA ........... 3.99
115 VAC & 220 VAC input
15 V @ 300 MA ........... 3.99

NEW TRANSFORMERS

Semiconductors Surplus
2822 North 32nd Street, #1 • Phoenix, Arizona 85008 • Phone 602-956-9423

More Details? CHECK—OFF Page 120

December 1981
**IC’S**

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TRANSFORMERS

| #0169-2 | 4.99 each |
| 26 VCT 51 1 Amp and 2.5 V / 1 Apm | |
| New GE model 6C-9 9 V Niace | 4.29 |
| Battery | |

New MCM Moving Coil Type
Model M100 | 9.99 each |

New Mallory Mini Soultor
Model 150-18 Works at 12 VDC 3500 Hz | 4.69 each |

New T. V. Colorimeter Crystals
3.35054 | 99 each |

WIDE BAND RF TRANSFORMERS

Type T-6 | 6.90 each |
| Insertion Loss | 3 to 120 MHz | 3.00 |
| 7 to 80 MHz | 2.50 |
| 5 to 20 MHz | 1.99 |

RELAYS

Motor | 5000 each |
| 5 VDC SPTD |

AMF/P & B | 2.99 |
| R10-10×12-JL-0K | 0.5 MA |
| 6 VDC SPTD |

Ontron SHF-2016G | 2.99 |
| VA-DC12 SPTD |

AMF/P & B | 4.99 |
| KEMP14116 | 12 VDC SPTD |

Octal Controls | 1.99 |
| 13A | 120VAC DIPTD |

Magnetraft | 1.90 |
| 250 ohms | 12 VDC SPTD |

AMF/P & B | 2.60 |
| R50-K2-Y1 | 12 VDC 210 ohms DIPTD |

A/230-R-12-2 | 2.69 |
| 12 VDC 05 ohms DIPTD |

Ceraflex | 4.95 |
| 12 VDC SPPTD |

PK6 K14655-1 | 2.99 |
| 120 VAC DIPTD |

CERAMIC COIL FORMS

| $1.00 each |
| #4 |
| 3.8" x 7.8" |
| #5 |
| 3.8" x 5.8" |

All of the above have powdered iron cores

| 1/2" x 3/4" |
| #6 |

More Details? CHECK-OFF Page 120
## CRYSTALS

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<th>2N120</th>
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$9.50 each

## TRANSISTORS

### SEMICONDUCTORS SURPLUS

2N3903A 2.50
2N3949 3.80
2N3947 15.00
2N3940 6.00
2N3955 1.57
2N3918 1.00
2N3966 2.50
2N3966JAN 4.00
2N3935 10.00
2N3948 2.00
2N3950 25.00
2N3959 3.00

**HIGH VOLTAGE CAPS**

- **MFD @ 500 VDC**: 1.69
- **MFD @ 450 VDC**: 1.69
- **MFD @ 450 VDC**: 2.29
- **MFD @ 450 VDC**: 3.29
- **MFD @ 450 VDC**: 2.29

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<tr>
<td>0.001 μF</td>
<td>100 each</td>
<td>$1.99</td>
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**NEW 2ND ROUND SPEAKERS**

- **100 Ohm coil**: $3.99 each

## DIODES

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### MOTOROLA SCR

- **TO-92 Case**: 0.6 Amp, 30 V

### FAIRCHILD LEDS

- **FLY 5007 & 5009 red**: $1.00 ea., 10 for $9.00

### SCMS 10K

- **15 mA, 10,000 PIV**: $1.69 ea., 10 for $16.90

### DG-1005

- **1.5 A, 1000 PIV**: $1.99 ea., 10 for $19.90

### SKEWED SQUARE WAVES

- **100 Ohm coil**: $3.99 each

**MOTOROLA SCR**

**TO-92 Case**: 0.6 Amp, 30 V

**Fairchild LEDS**

**FLY 5007 & 5009 red**: $1.00 ea., 10 for $9.00

**Case type TO-92**: $6.00 ea., 10 for $58.00

**Motorola MA 752 Rectifier**

- **6 Amps, 2000 PIV**: $1.99 ea., 10 for $19.90

**High-voltage diode EK500**

- **5000 Volts, 50 mA**: $2.99 ea., 10 for $29.90

**Motorola SCR**

- **TO-92 Case**: 0.6 Amp, 30 V

**Fairchild LEDS**

- **FLY 5007 & 5009 red**: $1.00 ea., 10 for $9.00

**Case type TO-92**: $6.00 ea., 10 for $58.00

**Motorola MA 752 Rectifier**

- **6 Amps, 2000 PIV**: $1.99 ea., 10 for $19.90

**High-voltage diode EK500**

- **5000 Volts, 50 mA**: $2.99 ea., 10 for $29.90
ORDERING INSTRUCTIONS

Check, money order, or credit cards (Visa, Mastercard, and American Express only) accepted. No personal checks or money orders accepted. All orders must be paid in advance. Minimum shipping charge is $2.35 plus insurance. Please allow extra shipping charges for heavy or long distance items.

All parts returned due to customer error or decision will be subject to a 15% restock charge. If we are not at fault and return the item, we will refund your money. PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE. Prices supersede all previously published. Some items offered are limited in quantity and are subject to prior sale.

We now have a toll free number, but if you ask that we be used for that purpose, we will replace it.

Orders only. We are open from 8:00 a.m. to 5:00 p.m. Monday through Saturday. Our toll free number for charge orders only is 800-528-3611.

MINIMUM ORDER $10.00

NEW CHERRY ICD SWITCH

Type T-20 .......................... $ 0.95 each

JOHNSON AIR VARIABLES

T-5 .............................. 1 to 5 P F
T-6 5 .............................. 1 to 11 P F
T-7 5 .............................. 1 to 24 P F
189-6-1 .......................... 1 to 10 P F
189-502-Y ........................ 1.3 to 6.7 P F
189-503-105 ........................ 1.4 to 9.2 P F
189-504-5 ........................ 1.5 to 11.6 P F
189-505-7 ........................ 1.7 to 14.1 P F
189-505-107 ........................ 1.7 to 14.1 P F
189-506-0 ........................ 1.8 to 16.7 P F
189-507-05 ........................ 1.8 to 16.7 P F
189-508-5 ........................ 2 to 19.3 P F
189-510-5 ........................ 2.1 to 22.9 P F
189-515-5 ........................ 2.4 to 24.5 P F
545-043 .......................... 1.6 to 11.4 P F

CRYSTAL FILTERS

EFLC-455K13E .......................... 3.89
EFLC-384K1052 ........................ 2.99
FX-78000L .......................... 7.8 MHz 12.99
FHA 103-4, 10.7 MHz 12.99

MURATA CERAMIC FILTERS

SFD 455D .......................... 455 KHz 2.00
SBF 455D .......................... 455 KHz 1.60
CFSM 455E .......................... 455 KHz 5.00
CFU 455H .......................... 455 KHz 5.00
SFE 135 TMA 10.7 MHz 3.99

TWO ELEMENT TUNED-350P

6 x 220 aluminumc wire .......................... $ 9.50 each

ARCO CAPS

304 .............................. 100-550pF 1.50
400 .............................. 9-7pF 1.00
402 .............................. 1.5-20pF 1.00
422 .............................. 1-12pF 1.00
423 .............................. 1-100pF 1.00
426 .............................. 1-32pF 1.00
427 .............................. 1-160pF 1.00
446 .............................. 25-280pF 1.00
445 .............................. 50-500pF 1.00
467 .............................. 110-580pF 1.00

TUBES

6K6D .............................. 5.00
6L6G/6G6 .......................... 10.00
6M6G/6L6G/6GEC ........................ 5.00
6LP/6H6 .......................... 5.00
12AT7 .......................... 1.00
2E26 .......................... 2.00
4T50A .......................... 2.00
4CX250B .......................... 2.00
4CX250R .......................... 2.00
4CX300A .......................... 2.00
4CX300A/4/5 .......................... 2.00
4CX305F/4/504 .......................... 2.00
4CX1500/4/860 .......................... 2.00
6360 .......................... 6.00

RF TRANSISTORS

MRF203-1 .......................... 3.00
MRF210 .......................... 1.00
MRF211 .......................... 1.00
MRF220-1 .......................... 1.00
MRF222 .......................... 1.00
MRF230 .......................... 1.00
MRF240 .......................... 1.00
MRF250 .......................... 1.00
MRF260 .......................... 1.00
MRF270 .......................... 1.00
MRF280 .......................... 1.00
MRF290 .......................... 1.00
MRF310 .......................... 1.00
MRF420 .......................... 1.00
MRF421 .......................... 1.00
MRF422A .......................... 1.00
MRF423A .......................... 1.00
MRF424 .......................... 1.00
MRF425 .......................... 1.00
MRF426 .......................... 1.00
MRF428 .......................... 1.00
MRF429 .......................... 1.00
MRF430 .......................... 1.00
MRF450 .......................... 1.00
MRF450A .......................... 1.00
MRF452 .......................... 1.00

JOHNSON AIR VARIABLES

1/4 x 2 1/2" shaft
32.50 each
193-10-6 .......................... 2.2 to 34 pF
193-10-7 .......................... 2.7 to 34 pF
193-10-10 .......................... 2.2 to 34 pF
193-10-4 .......................... 3 to 30 pF
1/3" x 2.5 to 34 pF $1.00 each
1/2" x 2 to 34 pF .......................... .5 to 12 pF
193-10-3 .......................... 2 to 34 pF
193-10-5 .......................... 2 to 34 pF
193-10-4 .......................... 3 to 30 pF

RF POWER DEVICE

MRF454 Same as MRF458
12.5 VDC, 3-5 MHz
80 Watts output, 12dB gain
$17.95 ea.

EF.J. JOHNSTON TUBE SOCKETS

#124-0311-100 .......................... 6.99 each
#124-0317-001 ........................ 13.99 each
#124-0323-021 ........................ 50.95 each
#124-0311-001 .......................... 6.99 each

UHLECO CAPS

6.6pF .......................... 47pF
6.8pF .......................... 62pF
10pF .......................... 100pF
12pF .......................... 160pF
13pF .......................... 180pF
16pF .......................... 200pF
20pF .......................... 240pF
33pF .......................... 390pF
36pF .......................... 470pF
47pF .......................... 680pF
49pF .......................... 1000pF
50pF .......................... $1.00 each

TO-3 TRANSISTOR SOCKETS

NEW EMERSON 280-700 .......................... $0.99
RG174/U - $1.50 per 100 ft.
Factory new

PLASTIC TO-3 SOCKETS

4/$1.00

TRIMMER CAPS

Sprague Stable Polypropylene.
50 each or 10/4.00
not sold mixed
1.2 to 13pF
2 to 30pF
3.9 to 18pF
3.9 to 40pF
3.9 to 55pF
Carbide Circuit Board Drill Bits for PCB Boards
5 mix for $6.00

More Details? CHECK — OFF Page 120

December 1981 85
the Ultimate IAMBIG PADDLE

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At selected dealers or add $2.00 handling. Quotation for overseas postage on request.

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Gifts for the Amateur

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R-X Noise Bridge $31.95
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L-Meter 22.95

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Prices subject to change without notice. Please include $2.50 for shipping/handling.

B&W, Millen, Cardwell, J.W. Miller parts in stock.

Catalog — 25 cents

New Products

the MAXI TUNER

Clean and rugged design is featured in this antenna tuner offered by RF Power Components. No tapped inductor in this tuner. You can obtain continuous coverage from 1.7 to 30 MHz using the full legal power limit.

The MAXI TUNER design is based on the principle of conjugate matching. The circuit consists of a matching network arranged in the T configuration, with two variable capacitors forming the horizontal part of the T. A continuously variable inductor, connected to the midpoint of the two capacitors, forms the vertical part of the T. This arrangement avoids the step-function tuning in matching networks that use tapped inductors.

Rotary inductors and counter dials are very expensive, but they are the whole secret to efficient tuner operation. With this arrangement you can get the inductance exactly right, not just within “a turn or two,” which is typical of tuners using tapped coils.

The MAXI TUNER uses two massive 500-pF capacitors with 6:1 ratio ball drives for velvet-smooth tuning control. The inductor, a 28-μH unit, is extremely rugged and is wound on a ceramic form. Electrical contact with the inductor is provided by a roller wheel, which allows continuous tuning.

Two models are available: one with a built-in SWR metering circuit and one without. An optional 4:1 balun is also available for use with balanced transmission lines.
THE BIG SIGNAL® BALUN

- 160-6 meter spectrum coverage
- First with built-in lightning arrester
- Unconditionally guaranteed
- More efficient coverage than any competitive balun
- Can withstand 600 lb. pull
- Handles 2,000 watts
- Weatherproofed

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RFI LINE FILTER for line to line & line to ground noise suppression
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Rated: 50 amp.
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SELECT YOURKeyDown FOR 24 HOURS A DAY ON ANY FILTER WITH SEPARATE 4-150V ADJUSTABLE TONE, AND ANTI-PHASE WHATEVER HOUSE - ALL IN SYNTHESIZED ALANAZ.
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THE PiPo TROUBLE FREE TOUCH TONE ENCODER
An ultra high quality encoder for absolute reliability and function. Positive touch key action with non-malfunction gold contacts, totally serviceable and self contained. Easy level control, no frequency drift, operates any system, 4.5 - 60 V.D.C., operates in temperatures from -15°F to 160°F. Supplied with instructions, schematic, template and hardware.

DEALERS:
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Henry Radio, Los Angeles, California (800) 421-6631
Electronic Equipment, Virginia (703) 938-3350
CW Electronics, Denver (800) 525-6147

Mail Order
PipoCommunications® P.O. Box 3435
Hollywood, California 90029
(213) 952-1519

Floyd L. PiPo

More Details? CHECK—OFF Page 120

December 1981 87
The MAXI TUNER presents a 50-75 ohm resistive load to your transmitter. It matches antennas using unbalanced coaxial cables, random-length end-fed antennas, or antennas using open-wire transmission lines (with the optional balun). Power-handling capability is 3 kW PEP (2 kW PEP when the optional balun is used). A custom cabinet and handsome styling make this unit a welcome addition to any Amateur station. Dimensions: 14.5 inches wide, 6.5 inches high, and 13.5 inches deep (36.8 by 16.5 by 34.3 cm). Weight: 15 pounds (6.8 kg). For more information, write RF Power Components, 1249 Garfield, Niagara, Wisconsin 54151 (715) 251-4118.

Macrotronics TERMINALL

Macrotronics, Inc., has announced the introduction of TERMINALL, an integrated hardware and software system which converts the TRS-80 microcomputer (Model I or III) into a state-of-the-art communications terminal.

TERMINALL includes all the necessary computer interfacing, audio demodulating, AFSK tone generating, and transmitter keying hardware integrated in one cabinet. This reduces equipment interconnection to a minimum and allows the operator to be on the air receiving Morse or RTTY in minutes. Plug it into the receiver headphone jack and copy Morse code, Baudot, or ASCII. Plug it into the CW key jack and send Morse code. Attach a microphone connector and send Baudot or ASCII using audio tones (AFSK).

The software may be loaded into the computer from cassette or disk. Enter your callsign and the time to initiate the program. You begin receiving adjustments are necessary to receive Morse code — it’s fully automatic. Press BREAK to transmit, or return back to receive. Text may be typed while receiving or transmitting.

TERMINALL comes complete with

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TERMINALL comes complete with
HOLIDAY GIFT IDEAS
Ham Radio's Ultimate Flea

“Bumper” Sticker
Put 'em everywhere — they’re removeable! These durable vinyl 3½” X 15” stickers are color-fast and will not fade from weathering. Have fun with these snappy slogans.

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<th>Sticker</th>
<th>Reg. Price</th>
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<td>UBS2 Ohm’s Law Bumper</td>
<td>$1.95</td>
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<tr>
<td>UBS3 Monitoring .52 Bumper</td>
<td>$1.95</td>
<td>$1.75</td>
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T-Shirt Designs
Do-it-yourself and give that new or old T-shirt some real zing! “FLEX” Designs are colorful heat-sensitive transfers which are far superior to screen-painted T-shirts — FLEX Designs won’t crack or fade, they’re colorfast, too! Just iron-on transfer to any cotton-base garment.

Important: Machine washable. For best results turn shirt inside-out when machine drying.

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<td>UT4 Something New</td>
<td>$1.95</td>
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<tr>
<td>UT5 Ultimate Flea</td>
<td>$1.95</td>
<td>$1.75</td>
</tr>
</tbody>
</table>

I.D. Badges
No ham should be without an I.D. badge. It's just the thing for club meetings, conventions, and get-togethers, and The Ultimate Flea gives you a wide choice of color. Have your name and call engraved in either standard or script type on one of these plastic laminated I.D. badges. Wear it with pride!

Available in the following designs:
- UM-1: Ham Radio
- UM-2: OSCAR
- UM-3: HOMEBREW

These heavy-duty mugs are both functional and beautiful. They're made from quality grade porcelain and are a super gift for your hard-to-buy-for Ham friends. Come in the following designs:
- UM-1
- UM-2
- UM-3

Reg. $8.95 Now $6.95

Ceramic Beer Mugs
Next time you get together for a few cold "807's," pour them into a 16 oz. ceramic mug from the Ultimate Flea. Handsome designs and lettering are permanently glazed for long lasting use. These mugs come in the following designs:
- UM-1
- UM-2
- UM-3

Reg. $8.95 Now $6.95

Heath Wall Size Frequency Spectrum Chart
Now you can have the most complete and colorful radio frequency spectrum chart ever produced! From Very Low Frequency (3 kHz), to Extremely High Frequency (300 GHz), you'll locate ship to shore, international broadcasting, radio astronomy, space communications, the Amateur Radio bands, plus everything else that falls in-between! Color coded for easy reading. Printed in full color.

Reg. $22.1/2” X 31” $5.95

Please add $1 for shipping & handling.

Ham Radio's Ultimate Flea
GREENVILLE, NH 03048

HAMS OBEY OHM'S LAW
I'M HIGH ON HAM RADIO
I'M MONITORING .52 ARE YOU?

Software on cassette and disk, assembled and tested hardware, and an extensive instruction manual. List price is $999. For complete ordering information or name of dealer closest to you, contact Macrotronics, Inc., 1125 N. Golden State Blvd., Turlock, California 95380.

CW audio processor and keyer
Trac Electronics, Inc., announces the introduction of two unique products for the CW enthusiast. The TRAC*ONE CW processor, Model TE 424, is an advanced CW audio processor which receives the audio from any rig, passes it through a phased-locked-loop tone decoder, removing all QRN and QRM, and reproduces a fully adjustable CW audio signal. Front-panel controls allow full adjustment of frequency tone, delay, and gain. The frequency control is adjustable from 300 Hz to 2600 Hz, a match for any rig. While the CW signal is being decoded a front panel LED flashes in sync with the signal, establishing that the unit is locked onto the audio from the rig. The TRAC*ONE contains a built-in speaker and a headphone jack on the rear panel, and is operated on a 9-Vdc battery or with an ac-adapter. In the BYPASS position, the Model TE-424 TRAC*ONE may be left in line and the rig audio is passed through to the speaker.

The TRAC*ONE CMOS keyer, Model TE-464, combines the full featured TRAC*ONE with a deluxe state-of-the-art CMOS electronic keyer. The keyer contains self-completing dots and dashes, dot and dash memory, iambic keying with any squeeze paddle, 5-50 WPM, speed, volume, tune and weight controls, sidetone and speaker, rear panel switch for use with a bug or straight key, quarter-inch jacks for keying and output. The Model TE-464 keys both grid block and solid state rigs and operates on one 9-Vdc battery or a 9-Vdc/ac adapter.

For further information, contact Trac Electronics, Inc., 1106 Rand Bldg., Buffalo, New York 14203.
2300 MHz TRANSMITTER
1691 SATELLITE DOWNCONVERTER

SUPERVERTER I ..................... $99.95
The ultimate in converter technology! Dual stage selective preamp, mixer, i.f. amplifier and no-drift crystal controlled oscillator. We recommend this kit for the experienced kit builder.

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Please let us know what you think of this change, and whether you would prefer to see five- or ten-year cumulative indexes in future December issues of *ham radio*.

1977-1981

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The standard RP downconverter package shown above gives you a proven design mounted in a weather-tight antenna that features low wind loading and easy installation. With this package you are ready for hours of amateur television entertainment. Just aim the antenna, connect one 75 foot cable from the antenna to the power supply and a second line from the power supply to your TV and you are on the air.

All downconverter models use microstrip construction for long and reliable operation. A low noise microwave preamplifier is used for gaining in weak signals. The downconverter also includes a broad band output amplifier matched to 75 ohms. The RP model is recommended for up to 15 miles. Over a range of 15 to 25 miles, the RP+ which has a bower noise and higher gain RF amplifier stage, provides better television reception. These ranges are necessarily approximate. An signal strength is very sensitive to line of sight obstructions. For installations over 25 miles, an RF unit which uses a separate antenna is available. All models are warranted for one year.

Prices including UPS shipment are as follows:

- Model RP receiver package: $150
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- Model RP center package: $170

K. & S. Enterprises
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Communication Concepts Inc.
2848 N. Aragon Ave., Dayton, OH 45430
VISA or MASTERCARD for same day shipment.

December 1981
MBA READER™
A NAME YOU SHOULD KNOW

What does MBA mean? It stands for Morse-Baudot and ASCII. What does the MBA Reader do? The RO model (reader only) uses a 32 character alphanumeric vacuum fluorescent display and takes cw or tty audio from a receiver or tape recorder and visually presents it on the display.

The copy moves from right to left across the screen, much like the Times Square reader board. Is the AEA model MBA Reader different from other readers? It certainly is! It is the first to give 32 characters of copy (without a CRT), up to five words at one time. It can copy cw up to 99 wpm and Baudot at 60-67-75 and 100 wpm. Speeds in the ASCII mode are 110 and hand typed 300 baud. The expanded display allows easy copy even during high speed reception.

The AEA model MBA has an exclusive automatic speed tracking feature. If you are copying a signal at 3-5 wpm and tune to a new signal at 90 wpm, the MBA catches the increased speed without loss of copy.

The MBA Reader allows a visual display of your fist and improves your code proficiency. It is compact in size, and has an easily read vacuum fluorescent display.

The Reader operates from an external 12 VDC source. This allows for portable/mobile or fixed operation.

Check the AEA model MBA Reader at your favorite dealer and see all the features in this new equipment. If your dealer cannot supply you, contact Advanced Electronic Applications, Inc.
P.O. Box 2160, Lynnwood, WA 98036 Call 206/775-7373

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