# Product Review Column from *QST* Magazine

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Conducted By Paul K. Pagel,* N1FB

# The Swan Astro-150 Transceiver

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*Claimed Specifications*

Frequency coverage: 3.0-4.5, 6.0-8.3, 13.8-16.0, 20.8-23.0 and 28.0-30.0 MHz.
Power requirement: 12-14 V dc at 20 A peak.
Dimensions (HWD): 3.75 × 9.75 × 11.75 inches (953 × 248 × 299 mm).
Receiver sensitivity: 0.35 μV for 10 dB S + N/N typical.
Transmitter power output: 100 W PEP.
Price class: Astro-150, $925. PSU-5, $180.

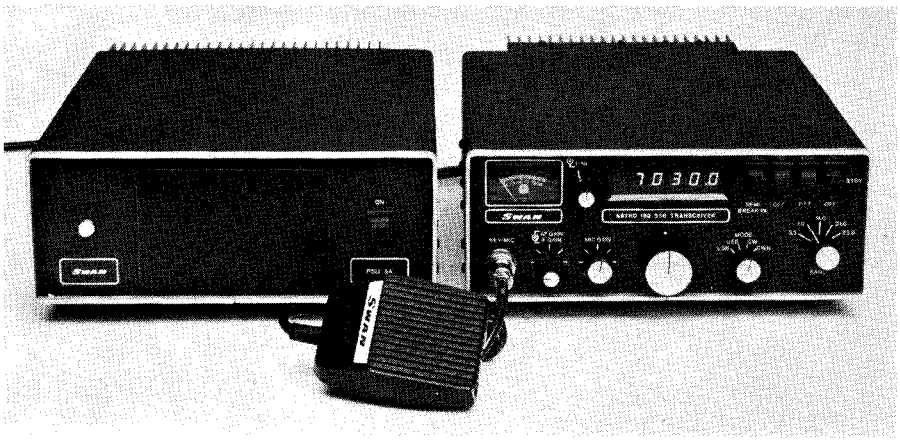

Fig. 1 — The Swan Astro-150 and matching power supply/speaker unit. The "Variable Rate Scanning" knob is the large one in the center of the panel. The microphone shown is included in the price of the Astro-150. Frequency tuning can also be accomplished by using two buttons (not visible) on the top surface of the microphone.

Mention of the name "Swan" calls to mind radios such as the well-known Swan 350 or Swan 500C, along with a particular period in the evolution of Amateur Radio equipment. But the Swan brand name hasn't been heard from much since those days of a decade ago, so it was with particular interest that this offering from Swan was unpacked.

The Swan Astro-150 is an extremely compact, solid-state, 80- through 10-meter ssb and cw transceiver. A matching power supply/speaker combination of equal size is also available. The PEP input of this little Goliath is 235 watts, with a 100-watt output. No receiver peaking or transmitter tuning is necessary. Band-pass filter techniques are used throughout. Also included in the small package are a noise blanker, VOX, RIT (receiver incremental tuning), full break-in cw operation and an easy-to-read digital frequency display (no analog readout is provided).

The quality of construction found upon examining the innards of this unit is second to none. In fact, the reviewer was reminded of a well-executed piece of expensive commercial or industrial test gear. Nine double-sided, glass-epoxy boards are used, and while they don't all plug into a neat row of sockets, the boards can be freed for component replacement relatively easily. Each board is held in place by screws and standoffs (they're captive, so don't worry about them falling into the rig), and all the connections to the board unplug without desoldering. Point-to-point wiring is minimized inside the unit; instead of a mass of wires leading to the front panel controls, a single large circuit board is used. The terminals on the back of all the controls are soldered directly to this board! All in all, looking inside gives the impression of extreme reliability and ruggedness.

### The Circuit

Single-conversion, as is usual for Swan, is used. The receive signal is filtered first by the transmit low-pass filters, then a three-section band-pass filter before being amplified by a dual-gate MOSFET. The amplified signal is fed to a doubly balanced, diode-ring passive mixer. It is this design choice that is probably responsible for the excellent dynamic range of the receiver. The reviewer's location (1/2 mile from W1AW) is a good dynamic-range test bed. At no time on any band was any "buckshot" or IMD product heard when W1AW was transmitting. No receiver desensing was ever evident either, even 3 kHz away from W1AW's transmitting frequency. Receiver dynamic-range measurements were made on 80 and 20 meters. On 80 meters, the receiver noise floor measured −127 dBm, blocking occurred at greater than 114 dB and the IMD dynamic range measured 84 dB. This data equates to an input intercept figure of −1 dBm. On 20 meters, the noise floor was −131 dBm, blocking occurred at greater than 118 dB, IMD dynamic range was 86 dB and the input intercept was calculated to be −2 dBm.

Six "birdies" were found in the receiver tuning range. Three of these (at 21.280, 28.010 and 29.010 MHz) were quite strong, reading S5 on the S meter. They were bothersome when operating in their vicinities.

Audio-derived fast-attack, slow-decay age is used, and in my opinion the attack isn't fast enough. Also, some age "pumping" on strong signals is evident. Plenty of audio output power is available from the single integrated-circuit audio amplifier, a good feature for mobile use.

The only relay used in the transceiver is an spst reed relay which disconnects the receiver from the transmitter low-pass filters during transmit periods. All other T-R switching is solid-state. This facilitates the incorporation of true cw break-in, with the reed relay following each transmitted dit and dah. The reed relay is extremely quiet, and QSK operation is a joy! If band conditions are such that QSK is not desired, the operator may revert to semi-break-in with a front-panel switch.

A frequency synthesizer in the Astro-150 generates both the variable LO frequency and the usb/lsb carrier oscillator frequencies. The heart of the synthesizer is a Signetics microprocessor LSI chip, nestled deep in the center of the transceiver. It takes input data from the bandswitch, mode-switch and tuning knob and determines the required number for a programmable divider in the phase-locked loop. When this number varies, the LO output frequency varies, tuning the transceiver. Each frequency thus generated is as stable and as accurate as the crystal oscillator used for a reference. Digital outputs are also provided to drive the LED readout. This micro-computer chip also has a memory. As long as power is continuously applied, it will remember the last frequency tuned on each band and return to that frequency when the band is selected again. A third position is provided on the power switch that removes power from all the circuitry except the memory. Thus, the unit can be turned "off" without losing the stored frequencies.

The synthesizer covers a significant range of frequencies outside of each amateur band, which should be a delight to MARS operators. Reception of 15-MHz shortwave broadcasting (and 15-MHz WWV) is provided, perhaps inadvertently, because on 20 meters the synthesizer will tune all the way up to 16 MHz! (Note to hf-ers: Tuning below 28.0 MHz is *not* possible!) When the bandswitch position is

*Asst. Technical Editor, *QST*

changed, the synthesizer is unlocked for a few seconds until all of the new frequency information is sorted out. This is indicated by the muting of the receiver audio and the illumination of all the decimal points in the frequency display. However, when the synthesizer is unlocked, keying the transmitter still produces rf output! The rf output sweeps up and down the band as the synthesizer hunts for a locked condition. These sweeps can be as much as several hundred kHz in width, so an out-of-band emission is a possibility, especially if the frequency is set near a band edge. Don't transmit while the synthesizer is unlocked! It's too bad Swan didn't see fit to mute the transmitter as well as the receiver.

### Operating Characteristics

Perhaps the most notable operating feature of the Astro-150 is what Swan calls "variable rate scanning." The scanning rate is determined by the position of the large knob in the center of the front panel. This "tuning knob" is not really a tuning knob at all; it is a potentiometer with a center detent. With the knob in the detent, no scanning occurs. A slight clockwise rotation of the knob starts a scan upward in frequency, and counterclockwise rotation initiates downward scan. The scan rate depends on how far the knob is rotated from the center detent: The rate is variable from approximately 200 Hz to 100 kHz per second.

It is also possible to change frequency with the hand-held microphone supplied with the unit. Two buttons are located on the top surface of the mic, one to scan up in frequency, the other, down. A single push on a button will jog the frequency by one 100-Hz increment. If the button is held, the synthesizer will scan at about 1 kHz per second. It is worth noting that when the synthesizer is scanning, the frequency does not change in discrete 100-Hz steps (as in the ICOM IC-701). Instead, it sweeps smoothly across the band, coming gently to rest on the selected 100-Hz increment. In case these fixed 100-Hz steps do not allow ssb tuning as precise as the operator would desire, a fine-tuning control is provided which can vary the transmit *and* receive frequencies ±75 Hz from the synthesizer-determined frequency. RIT is also provided, but its range is a paltry ±300 Hz. A much wider range (say ±5 kHz) would be desirable for limited split-frequency cw or DX work. Also, the RIT is always active with no defeat switch included. Not even a center detent has been provided. Thus the operator is always unsure that he is transmitting and receiving on *exactly* the same frequency. In all fairness, it must be mentioned that the circuit was perfectly calibrated: True transceive occurred with the knob precisely at 12 o'clock.

Even after several weeks of use, I never quite got used to the variable-rate scanning. I felt constrained and frustrated. Its somewhat like telling another person to do your tuning for you, following your verbal commands: "Tune higher. There's a signal — stop! Now tune a little lower. Oops, you overshot, tune a little higher." Since the frequency and many other functions are microprocessor controlled, it's a pity that a few user-programmable memories weren't included. This couldn't have been too difficult to do, and would have ameliorated the disadvantages of the tuning system somewhat.

As received from the factory, the built-in, peak-reading wattmeter was slightly generous when compared to an accurate in-line wattmeter. An internal wattmeter reading of 100 watts corresponded to 80 watts of actual rf output. A quick adjustment of the internal calibration control dispatched this problem!

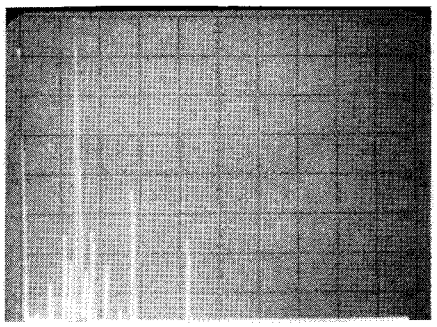

Fig. 2 — Spectral display of the Astro-150 rf output on 40 meters (worst case). Vertical divisions are each 10 dB. Horizontal divisions are each 5 MHz. The response at the far left is the zero-frequency reference of the analyzer. The full scale pip is the 7-MHz carrier. Note the spurious signals (probably synthesizer byproducts) clustered about the carrier. The second harmonic is down 44 dB from the fundamental, and the third harmonic is suppressed 57 dB. The '150 is in compliance with current FCC regulations regarding spectral purity. All measurements were made in the ARRL lab.

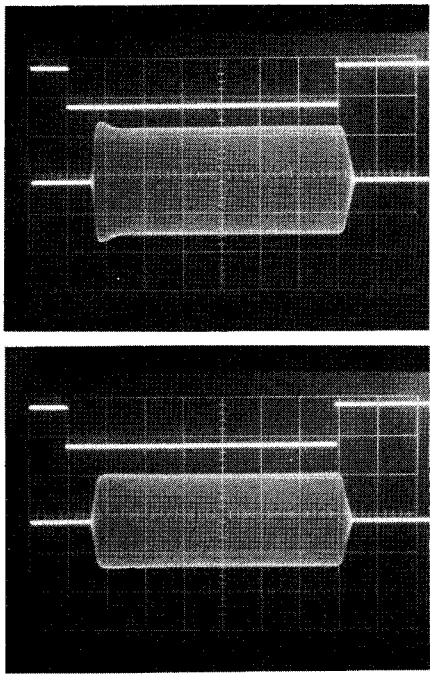

Fig. 4 — Two pairs of keying waveforms are shown. The upper waveform in each pair is the actual key-down time, while the lower is the resultant rf output. The upper rf output waveform is typical of that obtained when the carrier level is advanced just to the clipping point. This waveform did not sound bad on the air. When the drive was reduced slightly, the more ideal lower-output waveform resulted.

An alc circuit in the '150 works in combination with the forward- and reverse-power outputs of the wattmeter. It acts on a low-level transmitter stage and reduces the drive if either forward or reverse power exceeds preset levels. This circuit was initially responsible for a rather poorly shaped cw keying envelope and moderate on-air key clicks. After a slight adjustment of R103 (FWD alc sensitivity), the cw envelope became near perfect. And as an added bonus, the maximum power output level increased slightly to about 110 watts.

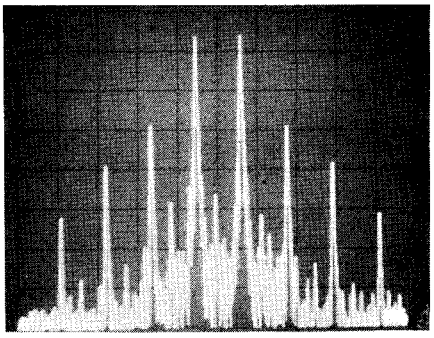

Fig. 3 — Spectral display of the transmitter IMD characteristics at rated power. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. Third-order IMD products are down 29 dB from the PEP level while fifth-order products are down 39 dB.

An omission on the part of the manufacturer is the absence of a front-panel headphone jack. An audio output jack *is* provided on the rear panel which mutes the built-in speaker, but it is usually stuffed with the external speaker plug if the matching power supply/speaker is used. No headphone jack is provided on the power supply either, although it would be very easy for the owner to add one.

The Astro-150 appears to have been designed with cw operation as a primary concern, not an afterthought. In addition to the full break-in mentioned earlier, two VOX delay potentiometers are provided — one for cw when using semi break-in and the other for 'phone. Also, two degrees of selectivity, 2.7 kHz normal and "narrow," are selectable from the front panel while in the cw mode. The characteristics of the narrow cw filter are not specified in the owner's manual, but appear to be approximately a 500-Hz bandwidth with reasonably sharp skirts; suitable for all but the most demanding cw operating. These are nice touches — other manufacturers please take note! The sidetone used for cw monitoring has very heavy weighting. This is not evident in the transmitted signal, but is annoying at first and takes some getting used to.

The features of the Astro-150 add up to make it a nifty little mobile rig as well. Its diminutive size will allow it to squeeze into spots where no ordinary hf rig would fit. Its hefty audio output and microphone tuning buttons are also well suited to mobile use.

On ssb, the performance of this transceiver left little to be desired. Both receive and transmit audio quality were good. The action of the alc circuit on ssb was excellent. The Astro-150 was very difficult to overdrive. A clean-sounding signal was maintained even when the mic gain control was advanced far beyond the correct setting.

The owner's manual supplied with the unit is very well written and informative, especially the theory of operation section. It includes a brief alignment routine consisting of only those adjustments which Swan feels are within the owner's capabilities. These include VOX, S-meter sensitivity and carrier-oscillator frequency. Not included are the more complex synthesizer, reference generator, alc circuit or bandpass filter adjustments. Further information on the Swan Astro-150 is available from Swan Electronics, 305 Airport Rd., Oceanside, CA 92054. — *John C. Pelham, W1JA*

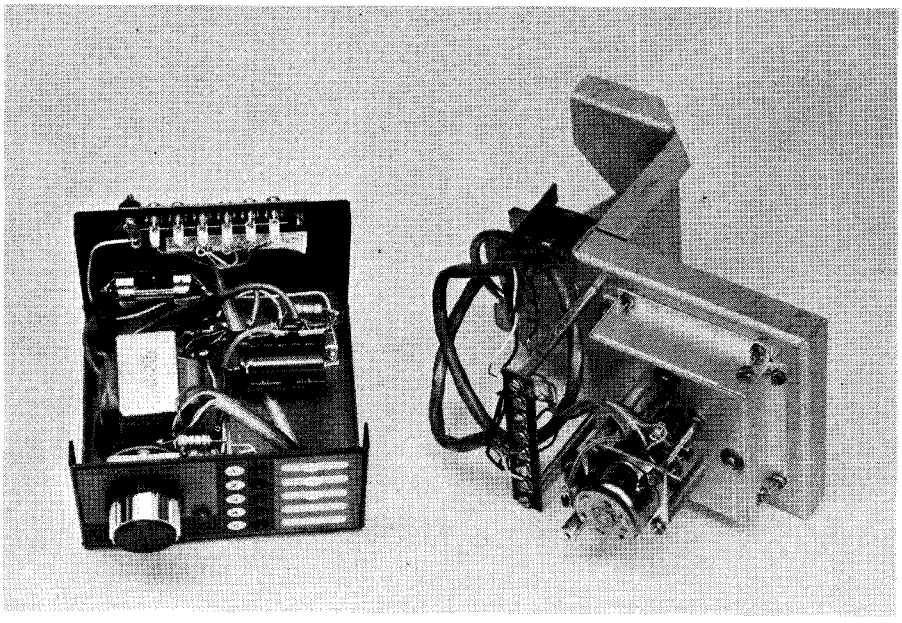

Fig. 5 — The Heath SA-1480 Remote Coax Switch. The actual coaxial switch is within the shielded portion of the right-hand assembly. LED indicators and an erasable front panel are featured on the station control unit.

## HEATHKIT SA-1480 REMOTE ANTENNA SWITCH

After replacing my tribander with monobanders last summer and noting the high price of separate runs of coaxial cable, I decided a remote antenna switch was the best way to go. A look at the commercial antenna switches available told me that none of them satisfied my requirements for price and number of positions, so I built my own. During a storm, my homebuilt remote antenna switch filled up with water. As I was lamenting its loss, the annoucement of the new Heathkit SA-1480 remote antenna switch caught my eye. The advertisement indicated that the remote switch required an eight-conductor control cable and that it would switch up to five different antennas. It couldn't have fit my needs more closely.[1]

Construction of the remote antenna switch required approximately five hours and was relatively straightforward: Just make sure the polarities of the diodes and LEDs are observed. The complete unit consists of two basic pieces, the remote switch that mounts on your tower or mast, and the control box which is placed at the operating position. The control box is a compact unit using LEDs to indicate which antenna is in use. The switch can be set so that all antennas are grounded and the feed line left open.

The remote switch box is solidly built, with silver-plated switch contacts on a ceramic switch wafer, and good shielding of the rf compartment. A one-piece cover protects the entire unit from the weather. An ample supply of sealant is provided to assure a watertight seal. When assembling the remote unit, be certain to wire the switch and switch motor carefully. Though the instructions are adequate, the wiring is tricky and a mistake can be made. Two little capsules of locking compound are provided to ensure that all hardware remains tight. This compound is particularly nasty stuff when it gets onto your workbench, so read the warnings carefully.

After everything was soldered and assembled, a short piece of cable was used to test the operation of both units. The first attempt resulted in the loss of the 3/16-A slow-blow fuse in the control box. Thorough checking found no errors in wiring, and after an afternoon of searching for a replacement fuse, the second test went perfectly. Possibly the remote unit switch motor (pulse switching) required an extra amount of current to start the first time. In any case, no further difficulties have occurred.

Mounting the remote unit on the tower proved to be very easy. Clamps were provided which accept a mast or tower leg of up to 1-1/2 inches in diameter. It took only about 15 minutes to mount the remote unit and attach the cables from the three antennas. Only three of the five positions available were originally used. Caps are provided to weatherproof the unused connections (all are type SO-239). A multidirectional sloper array for 40 or 80 meters could be switched from this remote antenna switch quite easily. The switch has been in use for several months now with no problems encountered. Less than a second is required to go between any of the switch positions, and the pulse switching generates no noise in the local receiver.

Heath has again come out with the right product at the right time. I would have spent more money for coax than for the remote antenna switch. See if your calculations tell you the same thing! — *Tom Frenaye, K1KI*

[1]One comment: The description Heathkit gives of the remote antenna switch in their general catalog wasn't exactly clear. According to the manufacturer's specifications, the use of the SA-1480 will introduce no more than a 1.05:1 VSWR under 30 MHz and less than 1.2:1 under 150 MHz. The catalog description could be read by inexperienced amateurs to mean that the *switch* would reduce VSWR, which isn't correct.

## THE BIRD 4381 RF POWER ANALYST

Microwave ovens, keyers, sewing machines and rf power meters — what do they have in common? A few years ago, that would have been a most puzzling question, but today the answer is easy — microcomputers! By utilizing a single-chip microcomputer, A/D converter and a dual-element THRULINE, Bird Electronic Corp. has produced a convenient and versatile rf power-measuring instrument, the model 4381 RF Power Analyst.

The 4381 will measure forward and reflected power in watts; it will also display power in dBm, measure PEP in watts or dBm, and calculate SWR, percent of modulation and return loss. It records the minimum and maximum value of any of the above quantities and has a peaking-aid mode.

The THRULINE used in the 4381 is similar to that used in the Bird model 43 wattmeter, using the same plug-in elements, but the 4381 has two elements in the THRULINE. This allows the microcomputer to completely control measurement of both the forward and reflected wave. Two "range" slide switches, located just above the display, are used to tell the microcomputer which plug-ins are being used, thus enabling it to correctly interpret the voltage levels received from the THRULINE. The range switches must be set to correspond to the full-scale power rating of the forward plug-in. When both the forward and reflected elements are used for a measurement, as in the case of SWR or return loss, it is assumed that their power ratings are in a 10 to 1 ratio. Readout is by means of a four-digit LED display, and the power for the unit is provided by self-contained, rechargeable NiCad batteries. The NiCads will power the 4381 for about eight hours of continuous operation without recharging.

While most of the functions of the 4381 are straightforward, certain features deserve mention, namely the minimum and maximum reading memories and the peaking-aid mode. By pressing the maximum key, the highest reading obtained since the last clearing of the memories can be displayed. I found this very useful while measuring PEP output of an ssb transmitter when using voice-waveform inputs. Under such conditions, it is difficult to follow the rapidly changing digital display and it is easy to miss the highest value measured. By using the memory, the maximum PEP obtained is easily read.

**Bird 4381 RF Power Analyst**

*Manufacturer's Claimed Specifications*

Power range[1]: 100 mW to 10 kW full scale using Bird plug-in elements. Accuracy not guaranteed with components not supplied by Bird.
Usable over-range: To 120% of scale on cw, PEP, SWR and return loss functions. To 400% of scale (PEP) on dBm and % modulation.
Frequency range[1]: 450 kHz to 2.3 GHz.
Sampling rate: 2-3 readings per second.
Accuracy
  Power readings: ±5% of full scale.
  SWR: ±10% of reading.
  % modulation: ±5%.
  Return loss: ±0.3 dB to corresponding SWR value.
Modulation frequency: 50-10,000 Hz.
Impedance: 50 ohms.
Insertion SWR: 1.05 max. to 1000 MHz.
Weight: 4.0 lb (1.8 kg).
Battery life: (Rechargeable) 8 hours approx.
Ac power: (Using adaptor) 115 V, 50-60 Hz 6 W 230 V, 50-60 Hz 6 W.

Fig. 6 — The Bird Model 4381 RF Power Analyst. A collapsible bail permits positioning the unit for easy readability.

When using a constant two-tone input, the 4381 reads PEP directly. The minimum memory can be used in this same manner to adjust matching networks for minimum SWR. For those familiar with making such adjustments using an analog meter, the transition to digital readout may be difficult. To help in this respect, the 4381 has a peaking mode. In this mode, the selected quantity is monitored. If successive readings show increasing values, a right-facing arrow is displayed, decreasing values produce a left-facing arrow, and a blank digit is displayed if the values are constant. This reviewer, being accustomed to analog meters, found it very difficult to peak a transmitter output rapidly, but had little trouble quickly adjusting a matching network. The difficulty no doubt arises from differences in smoothness and rate of tuning. In any event, I found myself opting for the analog meter to make such adjustments and then going to the 4381 for precise measurement of the resulting value. While measurement of forward and reflected power (using a conventional meter) and some calculations will produce parameters such as SWR and return loss, I found the 4381's direct readout a nice convenience.

The 4381 is normally supplied with two female N-type connectors; these are easily interchanged with a variety of connector types. The construction of the unit is excellent, and the instruction manual is complete and well written. While the 4381 is without doubt a "professional" instrument and perhaps somewhat expensive for many amateurs, it definitely represents an outstanding measurement instrument. The 4381 is available from the Bird Electronic Corp., 30303 Aurora Rd., Solon, OH 44139. The unit measures 3-21/32 × 6-7/32 × 8-29/32 in. (93 × 158 × 226 mm), HWD. Price class: $590, including connectors and either 117- or 235-V ac adapter. Element prices are $47 each for the 2- to 30-MHz range and $39 each for the 25- to 1000-MHz range. — *George Collins, AD0W*

[1]Frequency band and power range is determined by plug-in element selected. See Bird catalog for availability. Some modes require two elements in a 10:1 power ratio.

[2]For cw power levels greater than one-third of full scale, accuracy of the % modulation mode is ±5% from 0 to 90% and ±10% from 90 to 100%.

[3]For pulse modulation the minimum parameters are: 50 μs pulse width, 100 pps repetition rate and 1% duty cycle.

## AUTEK QF-1A ACTIVE AUDIO FILTER

We gave a hefty rundown of the Autek QF-1 audio filter in March 1977 *QST*. Since there are many similarities between that model and the QF-1A, we will ignore the "sameness" and dwell on updates of the original circuit. Outwardly, the QF-1A resides in a new low-profile cabinet of rectangular format. A new control has appeared on the front panel — the AUXILIARY NOTCH FREQUENCY. The color scheme has been changed from black to gray, with noticeably better quality in the cabinetry and the silk screening on the panel.

We were pleased to note that the power on-off switch has been changed to include bypassing the filter when the switch is in the OFF position. The earlier model was awkward to use, because the operator had to disconnect it from the receiver (PL-55 plug) when filtering was not desired.

Autek Research has made another improvement: The previous model used a pair of small-signal bipolar transistors in the audio-output section. Distortion was apt to occur at medium-to-high audio output levels from the receiver, but the QF-1A has an audio IC at the output, and its output is substantially cleaner than that of the QF-1 amplifier. It is worth saying, however, that the new unit can still be saturated at high receiver-output levels.

### Auxiliary Notch Frequency

This feature needs to be described in some detail, as it represents the most important change in the circuit. What it gives the operator is the ability to null out annoying heterodynes during cw or ssb reception, irrespective of the filter operating mode (BANDPASS, HIGH PASS, LOW PASS or NOTCH). The null depth is not as great (approximately 40 dB) as is the depth in the NOTCH position of the filter (up to −70 dB), but it is entirely adequate for most forms of steady-tone and cw QRM from 80 to 11,000 Hz. The null frequency is adjustable from the front panel. To disable the circuit, one simply turns the control to one or the other extreme of its range. Although this circuit is not specified as a "notcher" for some forms of ssb splatter, chatter or whatever, the writer has found that it does help in reducing the annoyance of adjacent-frequency ssb QRM.

### Other Features

The innards of the QF-1A are more organized and professional than those of the QF-1. Susceptance to RFI has been greatly reduced through the shortening and bypassing of critical leads. No RFI effects could be detected at W1FB when running 1 kW from 3.5 to 29 MHz. The antennas used during this test were 50-ohm types, fed with coaxial cable, and well removed from the station equipment. Different results might be had while using an end-fed horizontal type of antenna, or if there is a high VSWR on the coaxial transmission line.

The new model of filter has SELECTIVITY and FREQUENCY controls which operate more smoothly than those of the old model. Furthermore, the selectivity is reduced automatically when the filter is switched to the LOW-PASS and HIGH-PASS modes. This prevents "blasting" at high settings of the SELECTIVITY control — a definite improvement!

**Autek Research QF-1A Active Audio Filter**

*Claimed Specifications*

Size (HWD): 2-1/2 × 6-1/2 × 5 inches (63 × 165 × 127 mm).
Color: Two-tone gray.
Audio output: 1 watt.
Center-frequency range: 250 to 2500 Hz, all modes.
Power requirements: 117 V ac, 50/60 Hz or external +12 V.
Installation: Connects externally to receiver output. Requires external speaker or phones.
Bandwidth: Variable from 20 Hz to flat response.
Price class: $65.
Manufacturer: Autek Research, Box 5127E, Sherman Oaks, CA 91403. Tel. 800-854-2003, ext. 842.

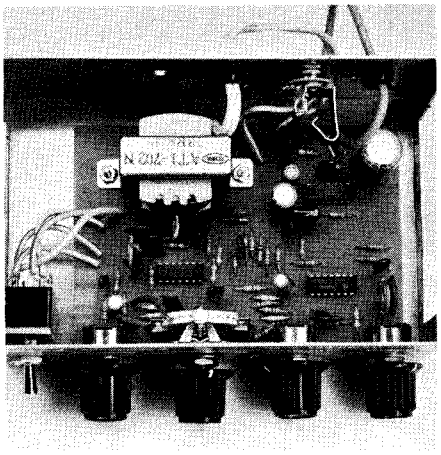

Fig. 7 — A neat, uncluttered layout greets the eye inside the Autek QF-1A audio filter.

### Summary Remarks

If there really is such a person as a "serious DXer" (an oft-heard expression), then that person probably knows what can be gained from using a good R-C active audio filter. The uninitiated can learn more on this subject by reading the QF-1 product review, referenced earlier. A good example of how the QF-1 filter "saved the day" (actually, two weeks) for the reviewer was seen during a DXpedition to Montserrat late in 1979, where W1FB/VP2MFW was unable to pull signals out of the noise on 160-meter cw without the audio filter. Signals that were unreadable without the QF-1 became "solid copy" when it was used in the high-selectivity mode. The same filter was used early in 1980 by K1ZZ during his operations on 160 meters from Montserrat.

A good R-C active audio filter can provide the same benefits as a second i-f filter (tail-end filter) in a receiver: It greatly diminishes receiver wide-band noise, thereby improving the overall signal-to-noise ratio. The owner of this type of unit may find himself addicted to its use, even when copying strong signals! — *Doug DeMaw, W1FB*