Product Review

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.

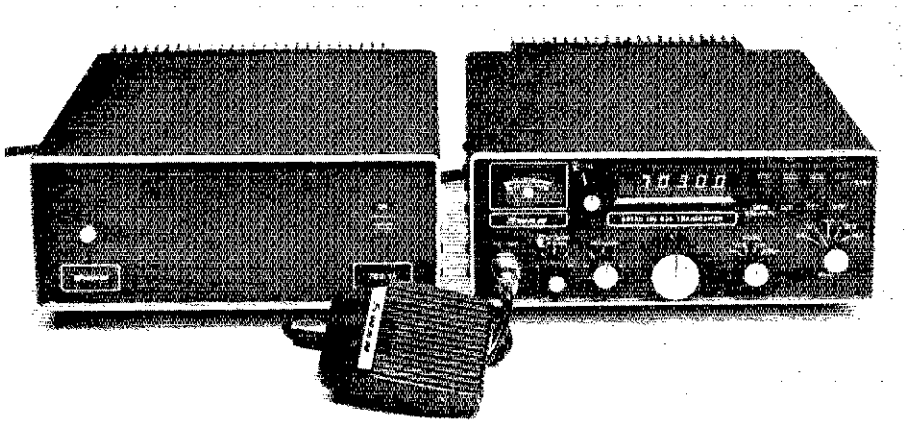

Fig. 1 — The Swan Astro-150 and matching power supply/speaker unit. The "Variable Rate Scanning" knob is the large one in the center of the panel. The microphone shown is included in the price of the Astro-150. Frequency tuning can also be accomplished by using two buttons (not visible) on the top surface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

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.

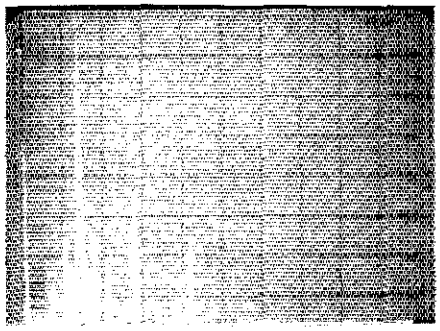

Fig. 2 — Spectral display of the Astro-150 rf output on 40 meters (worst case). Vertical divisions are each 10 dB. Horizontal divisions are each 5 MHz. The response at the far left is the zero-frequency reference of the analyzer. The full scale pip is the 7-MHz carrier. Note the spurious signals (probably 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.

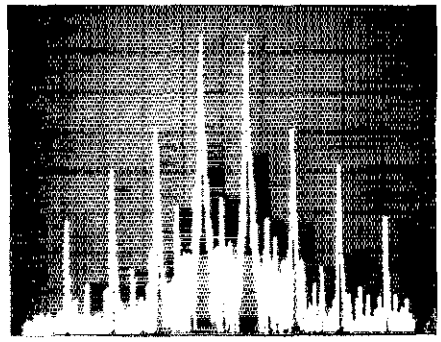

Fig. 3 — Spectral display of the transmitter IMD characteristics at rated power. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. Third-order IMD products are down 29 dB from the PEP level while fifth-order products are down 39 dB.

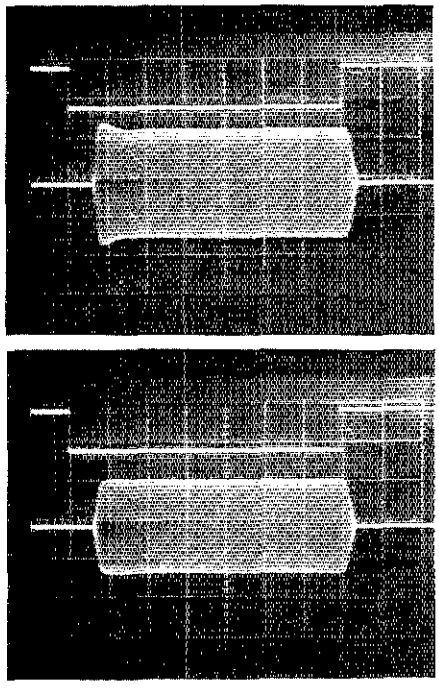

Fig. 4 — Two pairs of keying waveforms are shown. The upper waveform in each pair is the actual key-down time, while the lower is the resultant rf output. The upper rf output waveform is typical of that obtained when the carrier level is advanced just to the clipping point. This waveform did not sound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

An 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*