Product Review Column from *QST* Magazine

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Cushcraft A3 Triband Antenna

Kenwood TS-830S HF Transceiver

Mirage B-23 2-Meter, 30-Watt, All-Mode Amplifier

Product Review

Conducted By Paul K. Pagel,* N1FB

Kenwood TS-830S HF Transceiver

Intense interest? That would be an understatement of the atmosphere created at Hq. by the announcement and subsequent arrival of the TS-830S. Why? Well, some of its more salient features are a double-conversion receiving system, a choice of a number of cw filter options at *both* intermediate frequencies, the inclusion of independent variable bandwidth tuning (VBT), and IF SHIFT with a tunable i-f NOTCH as well as receiver and transmitter incremental tuning (RIT, XIT). Fixed-frequency control (FIX), ssb off-the-air monitoring (MONI), a 20-dB receiver front-end attenuator, noise blanker and transmitter rf-type speech processor are all push button selectable. The display hold (DH) switch will maintain digital readout of a chosen frequency while the VFO is tuned to another frequency — like an electronic note pad. There's also a built-in 25-kHz marker generator, manually selectable age functions (OFF, FAST, SLOW), and LEDs which indicate the operator's choice of RIT, XIT, RF ATTenuator, VFO, FIX and NOTCH.

Connections to and from a linear amplifier, monitor scope, and transverter are provided for on the rear panel by means of one 7-pin and two 8-pin DIN jacks. The 1/4-inch (6.4 mm) key jack, 1/8-inch (3.2 mm) external speaker jack, anti-VOX, bias, and rf output voltmeter controls, antenna and ground connectors, fuse, screen voltage on/off switch, and a very quiet PA cooling fan are also on the rear panel. The two-conductor (ungrounded) power cable is permanently wired into the unit; no multi-pin connector is used. Two predrilled holes are provided for additional phono jacks if required for some added function. All of the previously mentioned "goodies" are contained in a package smaller than that of the TS-820.[1] Unlike the '820, no provisions have been made for use with a 13.8-V dc supply or fsk.

Some Features

A PLL circuit and programmable divider are used in the TS-830S which eliminates the need for separate heterodyne oscillator crystals for each band. This circuit uses a single 10-MHz crystal and with the 5.5- to 6-MHz VFO provides all the injection frequencies required by the transceiver.

QRM may be fought by using the variable bandwidth tuning (VBT), IF SHIFT and i-f NOTCH controls of the '830. These features may be used independently or in conjunction with one another. VBT permits the operator to vary the i-f passband width within limits determined by i-f filters installed. With only the stock 2.4-kHz filter in the transceiver, an effective bandwidth of 500 Hz may be obtained at the narrowest setting of the control. The IF SHIFT moves the i-f passband frequencies higher or lower without upsetting the frequency to which the receiver is tuned, and it has an adjustment range of approximately ±1.2 kHz. An interfering carrier within the passband of the filter may be reduced or eliminated by the NOTCH filter in the receiver second i-f.

Age is manually switched. Three switch positions are provided: FAST, SLOW or OFF. This is a welcome feature, especially for cw operators. Age action is smooth with no evidence of popping.

One attraction of the '830 for many amateurs is the use of reliable 6146B tubes in the final amplifier stage. They're proven performers and are still preferred by many operators. The '830 provides a bit more output than was available from the '820, too.

Operational Notes

One word could be used to sum up the on-the-air behavior of the '830 — smooth. The review unit was put into service in several "shacks" over a period of months. Contest operators commented favorably about the control locations. Audio-level balance between the internal speaker and headphones is excellent; tweaking the audio gain during such a changeover is unnecessary. The audio quality of the internal 3-inch (76 mm) speaker is quite good, better than that of many units I have heard.

The digital frequency display will show the proper receive or transmit frequency, including the cw offset. It is fully operational beyond the 500-kHz frequency segments (unlike the TS-120),[2] and the analog dial is like that of the TS-120. Analog-dial linearity error never exceeded approximately 800 Hz.

VFO stability is excellent both electrically and mechanically. To test the mechanical stability, I used the gravitational-attraction and manual-persuasion methods — dropping the front of the transceiver about 3 inches (76 mm) to the desk top and pounding on the top of the cabinet with a clenched fist. A considerable amount of physical abuse was required to shift

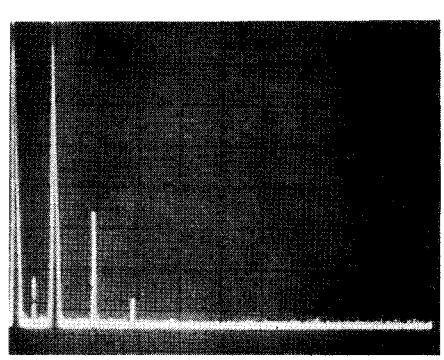

Fig. 1 — Spectral display of the TS-830S on 160 meters (worst case). Vertical divisions are 10 dB each; horizontal divisions, 2 MHz. Second harmonic output is approximately 45 dB below the peak of the fundamental. The TS-830S complies with current FCC regulations regarding spectral purity.

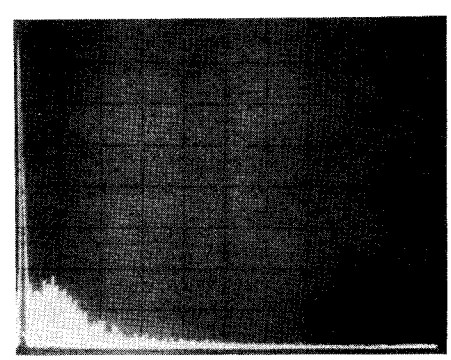

Fig. 2 — Spectral display of noise about the carrier frequency of the TS-830S. The carrier is at the left. Output power is 100 watts at a frequency of 14.25 MHz. Vertical divisions are 10 dB each; horizontal divisions are 20 kHz each. The bottom line of the trace is the analyzer noise floor at 80 dB below peak output.

*Assistant Technical Editor

[1]"Product Review," *QST*, September 1976.

[2]"Product Review," *QST*, February 1980.

the VFO frequency even slightly.

Receiver "birdies" are at a bare minimum and very weak; in no instance did one cause the S meter to move. With an antenna connected to the transceiver, none was discernible. Only one response was noted to be in-band (1.843 MHz), two are out of band (7.343 and 7.464 MHz), and all others occur at frequency segment edges (0 or 500 kHz).

Many airborne pulse-type noises were effectively reduced or eliminated by the noise blanker. The effectiveness of the blanker is dependent on the frequency of operation and the noise source itself. In some instances, it was found to work well against the "woodpecker."[3] The blanker threshold is adjustable from the front panel. Care should be taken to avoid excessive blanker gain, especially with crowded band conditions, because distortion products will become evident within the receiver — you'll hear QRM you ordinarily wouldn't.

The receiver and transmitter incremental-tuning controls (RIT/XIT) are useful in avoiding interference and also in snagging that hard-to-get DX station in a pileup. The range is somewhat limited, approximately ±2 kHz, and I felt a range of ±5 kHz would be more suitable.

WARC, AUX and FIX

In the stock transceiver, the three WARC bands (10, 18 and 24.5 MHz)[4] are operational during receive only, but a simple modification outlined in the manual enables transmission. The bands may be added singly (by removing individual diodes) or simultaneously (by cutting a wire). The latter method is far easier because the diodes are somewhat inaccessible.

An auxiliary (AUX) position on the BAND switch permits the user to install components to provide for *receive only* operation on yet another frequency range of choice. The FIX button selects a single, user-supplied crystal for operation on a specific frequency (MARS or AUTOSTART, for instance). To gain access to the crystal socket, the bottom cover of the '830 must be removed, but the crystal trimmer can be reached by means of an access hole in the cabinet bottom.

Table 1

Kenwood TS-830S Transceiver, Serial No. 1020313

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 160-10 meters, WARC bands included.	As specified plus approximately 70 kHz beyond upper and lower band edges.
Modes of operation: ssb/cw.	As specified.
Readout: analog and digital; 6-digit, fluorescent-blue digital display.	0.25-inch (6.4 mm) digits
Resolution: analog, 1 kHz; digital, 100 Hz.	As specified.
kHz/turn of knob: not specified.	25
Backlash: not specified.	Nil
RIT/XIT range: ±2 kHz.	−1.5, +1.9 kHz
I-f notch depth: >40 dB.	30 dB
Receiver attenuator: 20 dB.	As specified.
S-meter sensitivity (μV/S9): not specified.	160 m, 56; 80 m, 56; 40 m, 56; 30 m, 100; 20 m, 56; 17 m, 48; 15 m, 75; 12 m, 54; 10 m, 67.
dB/S unit: not specified.	From S5 to S9, 5 dB; below S5, non-linear and less than 5 dB/unit.
Receiver sensitivity: 0.25 μV for 10 dB S + N/N.	Receiver dynamics measured with optional YK-88C and YG-455C 500-Hz i-f filters installed.

	80 m	*20 m*
Noise floor (MDS) dBm:	−136	−136
Blocking DR (dB):	129	noise limited
Two-tone 3rd order IMD DR (dB), high- and low-frequency products.	83 (h) 89 (l)	82 (h) 89 (l)
Third-order input intercept	−13.5 (h) −5 (l)	−13 (h) −5 (l)

Audio power output (8-ohm load): 1.5 W	As specified.
Power consumption: receive (heaters off), 32 W; transmit, 295 W.	Not measured.
Transmitter rf power output: not specified.	>100 W every band.
Spurious suppression: better than 60 dB.	−62 dB
Harmonic suppression: better than 40 dB.	Approximately −45 dB on 160 m (worst case).
Carrier suppression: better than 40 dB.	As specified.
Third-order IMD: better than −36 dB.	−32 dB (see spectral photos).
Key-down time limitation: cw — 1 minute.	
Frequency stability: within 1 kHz during the first hour after 1 minute of warmup; within 100 Hz during any 30-minute period after warmup.	<10-Hz drift from a cold start to 30 minutes later. (Measured with transmitter operating at 80-W input, key down.)
Size (HWD): 5.3 × 13.3 × 13.3 inches (133 × 333 × 333 mm).	
Weight: 29.8 lb (13.5 kg).	
Color: gold-brown gray.	

SSB

DX-station reports repeatedly attested to the effectiveness of the speech processor; it is an rf type and utilizes the 8.83-MHz i-f filter to "scrub" the signal. Therefore, substitution of the narrower YK-88SN (1.8-kHz) optional filter is not advised in an attempt to narrow the receiver passband; the VBT (variable bandwidth tuning) function may be used instead. Some of the natural voice quality is lost when the processor is used, but this is characteristic of these devices. In addition to the use of the transceiver metering system, operation of the processor can be readily verified by observing the output waveform displayed on the station monitor scope (what do you mean, you don't have one?) and by using headphones (to avoid feedback) with the MONitoring feature of the '830. Some "talk-back" was noted during ssb operation while wearing headphones (MONI switched off), but it was not noticed when using a speaker.

The operator should ensure that the DRIVE control of the '830 is properly peaked. Otherwise the alc meter indications will be low. This might lead to improper adjustment of the MIC gain or PROCESSOR LEVEL controls and earn you a bad on-the-air reputation. When the controls are properly adjusted, the meter alc indications are sharp and reliable.

Both high- and low-impedance microphones may be used with the TS-830S. With low-impedance types, the MICrophone gain will simply be set at a higher level. A four-pin microphone connector is used.

CW

Early in the review period, cw operation was undertaken with only the 2.4-kHz ssb filter in the transceiver. By using the VBT, IF SHIFT, NOTCH and TONE controls to advantage, I was quite satisfied with the receiver performance. It

[3][Editor's Note: The "woodpecker" is a pulse transmission frequently heard in the 20-meter amateur band, occasionally in others. The pulse duration and repetition rate create a woodpecker-like sound when the signal is tuned in a receiver.]

[4]Baldwin and Sumner, "The Geneva Story," *QST*, February 1980, p. 53.

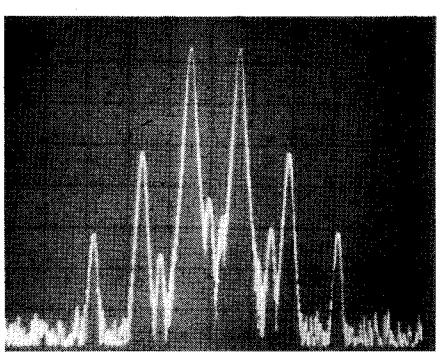

Fig. 3 — Two-tone, third-order transmitter IMD spectral display of the TS-830S. Operating frequency is 14.250 MHz; power input, 110 watts average; vertical divisions, 10 dB; horizontal divisions, 1 kHz. The third-order distortion products are approximately 32 dB below PEP output; individual tones are 6 dB below PEP output. All measurements were made in the ARRL lab.

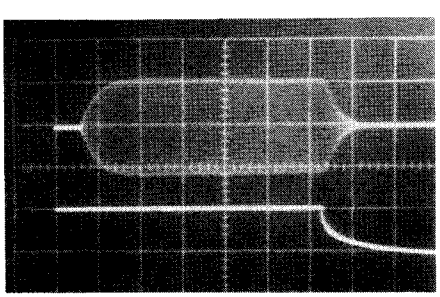

Fig. 4 — Keyed cw waveform of the TS-830S. The CAR control has been adjusted for no alc indication as described in the text. This waveform is essentially click free.

is conceivable that the occasional cw operator might never need to add the sharper cw filters; you can always install them at your leisure. But dyed-in-the-wool cw operators will rejoice at the choice of options afforded them. The review unit was later operated with 500-Hz filters in both i-fs and then with the 250-Hz filter in the second i-f. My opinion (and that of many other operators) is that the combination of the two 500-Hz filters provides sufficient selectivity for all but the most critical situations. There's even an optional 270-Hz filter for the first i-f, if you're not satisfied! Filter installation takes only about 10 minutes. I'm sure someone is bound to offer a filter-switching addition for the '830. Perhaps a post-filter amplifier stage will also be included since there is none supplied with the '830 to make up for the additional filter loss, although this created no great difficulty.

The cw-output waveform is well-shaped. Care must be taken to ensure that the CAR level control is adjusted to the point where no alc reading is indicated on the meter. This manner of adjustment is not pointed out in the operator's manual, but should be observed in order to prevent making the wavefront too sharp, which would result in the generation of key clicks.

When using VOX-keyed cw (so-called "semi break-in") the initial code element is shortened, and a steep wavefront is created that definitely will produce a click. This is characteristic of all transceivers which use similar VOX-keyed T-R systems for cw operation. Also, the VOX will drop out between words at slow cw speeds even with the DELAY control set at maximum. One way to avoid both these situations is to use the SEND/REC switch or PTT operation; a foot switch may be connected by means of the ACCessory jack if desired. I modified the VOX delay circuitry for a longer delay time constant to suit my operating tastes. The procedure is outlined in the "Hints and Kinks" section of this issue.

In the CW positions of the MODE switch, a low-pass filter is switched into the audio chain to attenuate the higher audio frequencies and make copying a bit less tiring. Use of the TONE control will also help.

RTTY, SSTV and ASCII

To operate these modes, interconnections are made to the MIC and SPEAKER jacks. There is no RTTY position on the MODE switch, and operation takes place with the ssb filter in place on lsb. Here, the VBT and IF SHIFT functions will come in handy during reception. The manufacturer recommends that the final-amplifier input power be reduced to less than 100 watts during these modes of operation. However, the measured efficiency at that power-input level is poor — about 20%.

The instruction manual contains a number of errors of different types, and some information I felt would be helpful is lacking. The description of the location and means of access to the final-amplifier neutralizing capacitor is incorrect. This capacitor may be found mounted in an inverted position beneath the plate tuning capacitor with the shaft protruding near a notch in the final-amplifier tube-socket mounting board. Switches S19 and S21, which appear on the schematic, are not mentioned in the text, but are part of the XVTR and EXT VFO jacks respectively. When the appropriate plug is inserted into the jack, the switches are automatically activated.

A 7-pin DIN plug is supplied for use with the REMOTE jack, but no 8-pin plug for the XVTR jack. These 8-pin plugs may be obtained directly from Kenwood.

Some TS-830S owners have reported an intermittent shift in display and operating frequency (no such problem was experienced with the review unit). The cause may be traced to a loose self-tapping screw on the AT-AVR unit (X49-1140-00). Kenwood service bulletin no. 840 recommends placing a toothed lock washer between the pc board and heat sink at two screw locations.

Conclusions

Did I like its performance? You bet! So did everyone else who had a chance to use it. The '830 is an ideal unit for fixed-station operation and small enough to grab by its built-in handle and take on vacation with you. Whether your operating style is casual or contest, the TS-830S has a lot to offer you.

Among the extra "goodies" available to accompany the '830 are two VFOs, the VFO-230 and VFO-120. The '230 is a 20-Hz-step digital VFO with five memories while the '120 is the analog unit which also mates with the TS-120 transceiver. The TS-830S is available from Trio-Kenwood Communications, Inc., 1111 W. Walnut St., Compton, CA 90220. Price class: TS-830S, $930; VFO-120, $160; VFO-230, $300. — *Paul K. Pagel, N1FB*

CUSHCRAFT A3 TRIBAND ANTENNA

The arrival of the A3 had been perfectly timed — just before the beginning of a spring holiday weekend — and the prospect of good weather was encouraging. Three hours (and a couple of big insect bites) after the box was opened, the A3 was ready to have the coaxial feed line attached. No parts were missing except the weatherproof connector boots which the enclosed literature stated were supplied for use with the PL-259 connectors. I was later informed by the manufacturer that no such boots are included in the A3 package and that the paperwork had been mistakenly packaged with some of the earlier A3s.

Mechanical Aspects

A 3/16 inch (4.8 mm) thick, 6 inch (152 mm) square plate is used for the boom-to-mast adaptor. Solid aluminum V blocks are used for the plate-to-mast clamping pieces, not a type of plastic as found on some antennas. The element ends are slotted to provide a good mechanical and electrical connection between the sections of telescoping tubing, but no conductive grease is supplied.

The 12 traps are rated for full-legal-power handling capability, separate traps being used for the 10- and 15-meter bands on each element. All parts are rugged and of good quality. I would have preferred stainless-steel worm-gear clamps at all the required positions; that type is used only at the boom splice and on the center section of the driven element. The other clamps are those which employ a machine screw for tightening the clamp.

If any newcomers may be contemplating the assembly of the A3, remember to check the trap labels, keep the arrows on the labels pointing toward the boom, and keep the drain holes in the traps pointing downward. Otherwise, you'll have the traps reversed, and in the second instance, you'll not allow for proper drainage of accumulated moisture from the traps.

Three sets of element-length measurements are suggested by the manufacturer for different portions of the bands: phone, cw and midband. A glance at the manufacturer's VSWR charts for the A3 and some thinking about which mode you most often use will help you make your choice. I used center-band lengths. Some touching up of element lengths may be required at any one particular installation. In my case, I elected to lengthen the element tips by 1/2 inch (13 mm) to move the 20-meter VSWR curve slightly to favor the cw portion of the band. This resulted in the curve being shifted approximately 50 kHz lower, still providing good coverage of the whole band without an excessively high VSWR. The SWR curves shown in Fig. 5 are the results obtained at these settings.

Fig. 6 shows a close-up of the driven element. The center section of the driven element is a piece of fiberglass tubing 1/8 inch (4 mm) thick, 10 inches (254 mm) long and 1 inch (25.4 mm) in diameter. This insulates the feed point from the boom. The coaxial feed line has the braid and center conductor separated for a length of 4 inches (102 mm) for attachment to the feed point. An 8-turn, 6 inch (152 mm) diameter feed-line choke is formed from part

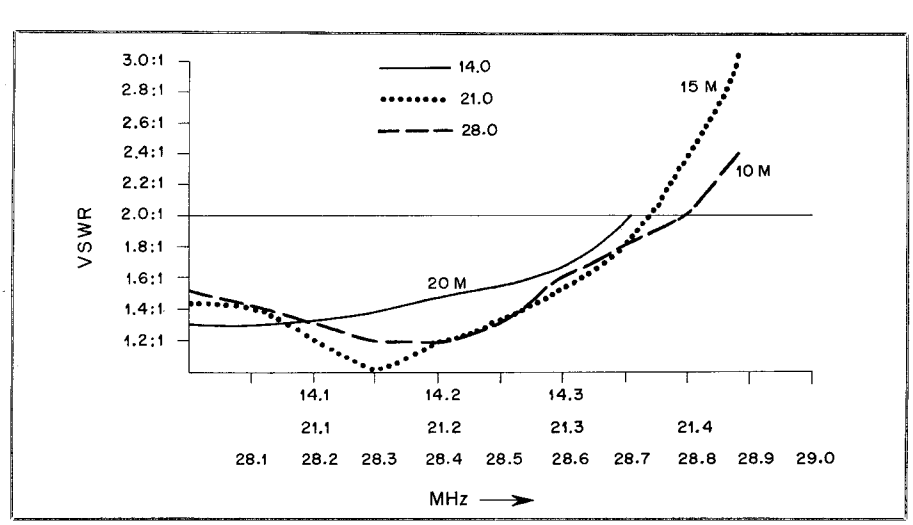

Fig. 5 — SWR curves for the Cushcraft A3 installed at N1FB. Midband settings were used and the beam installed at a height of 30 feet (10 m).

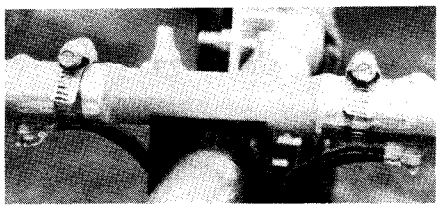

Fig. 6 — A piece of fiberglass tubing serves as a driven element insulator. The clamps, screws and bolts have been coated with a clear waterproof sealant for weatherproofing.

Table 2

Mirage B-23 Serial No. 868-980

Manufacturers Claimed Specifications	*Measured in ARRL Lab*
Frequency range: 144 to 148 MHz	144 to 148 MHz
Power input: 100 mW to 5 W maximum	100 mW to 5 W
Power output: 30 W for 2-W input	30 W for 5-W input, 25 W for 1.5-W input
Modes: fm, cw and ssb	
DC power input: 13.6 V dc at 5 A nominal	3.5 to 3.8 A at 13.8 V dc (varies with drive).
Size: 2.25 × 4.75 × 4 in. (57 × 120 × 102 mm)	
Weight: 1.25 lb (0.57 kg).	

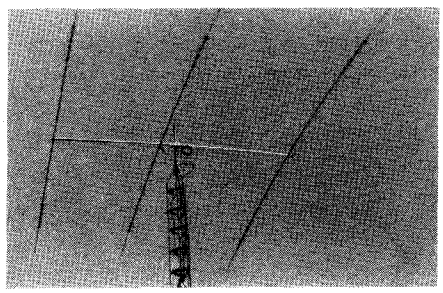

Fig. 7 — The Cushcraft A3 triband beam is shown here ready for action on 20, 15 or 10 meters. The feed-line choke is attached to the boom.

of the feed line.[1] I taped and clamped the choke to the boom with a stainless-steel hose clamp. This choke may be seen in Fig. 7.

The A3 has been a good performer during the many months it's been in service. Good front-to-back and front-to-side ratios have been observed on both DX and local signals on all three bands. No "cold" numbers are available for such ratios. The ARRL does not have an antenna testing range to accurately measure such parameters, and measurements performed at different station locations with the same antenna would likely produce varying results.[2] No structural failures have occurred since the antenna was installed despite some rough New England weather conditions.

The low values of SWR encountered have made operating with broadbanded transceivers a pleasure. Changing bands becomes a simple matter of flipping the band switch to the desired band of operation. It would be somewhat ridiculous to use a "no-tune" transceiver and have to use a Transmatch!

The Cushcraft A3 is available from: Cushcraft Corp., 48 Perimeter Rd., P. O. Box 4680, Manchester, NH 03108. Price class: $220. — *Paul K. Pagel, N1FB*

MIRAGE B-23 2-METER, 30-WATT, ALL-MODE AMPLIFIER

If a piece of equipment has a lot of knobs and switches, a reviewer can go on ad nauseam listing every detail of operation. But what do you say about something that has no switches or knobs to fiddle with? Well, it is certainly simple to operate. In fact the B-23 is so simple to use that one can easily install it out of sight (under the dash?) and forget about it.

The active device in the circuit is a Motorola MRF-240, which is a relatively new 40-W vhf device that is capable of being operated in a linear mode. The circuit is designed so that the amplifier is limited to about 30-W output when operated within specifications, thus contributing to the safety margin and longevity of the MRF-240. With about 1-1/2 W drive (fm carrier), the amplifier produces an output power of 25 W. Under these conditions, it draws about 3.5 A from a 13.8-V source. If the driving power is raised to 5 W, the output power increases to 30 W and current consumption to 3.8 A. The MRF-240 is designed to withstand high VSWR without self-destruction, but at reduced output. When operated into a load with a VSWR of 2:1, the B-23 output power was reduced by about 20%.

I used the amplifier strictly with a low-powered fm driver — it certainly seems to be ideal for that. But there is another side to the B-23; it can be used as a linear amplifier for low-level ssb signals. Spectral examination indicates that its linearity is as good as any other solid-state, 2-meter linear power amplifier that we have checked in the lab. It would appear that the B-23 is also a good choice for those having a low-powered, 2-meter ssb unit.

The B-23 has adequate output filtering to ensure that spurious signals outside the passband are attenuated more than enough to meet current FCC specifications. Part of this filter, including two harmonic traps, is always in the circuit whether the B-23 is powered or not. This is significant because the amplifier has a T-R relay that is actuated by an rf-sensing circuit. A small portion of the signal present at the input is diode rectified and triggers a transistor relay driver. A diode is a nonlinear device that does an excellent job of generating harmonics. Therefore, if all the filter sections were switched out of circuit when the amplifier was not powered, the resultant output could contain harmonics with amplitudes well above the maximum allowed. A number of amplifiers currently being sold suffer from this design problem — they are not advertised in *QST* because of this. Happily, the B-23 passed this check with flying colors.

With dc power applied and with no signal present at the input, the B-23 draws less than 4 mA. Theoretically, a typical automobile battery could be expected to last for several thousand hours under this current drain without need of recharging. However, my personal inclination is to turn everything off when I get out of my car (actually, a heavy-duty relay energized by the ignition switch does this for me). I would recommend that the user install a toggle switch of adequate rating so that he may turn the amplifier on and off at will. An LED and a current-limiting resistor could be added as a visual indicator of the status of the amplifier. In a mobile installation, the switch, LED and resistor could be placed conveniently near the operating position with the amplifier mounted safely out of sight.

A few words about the B-23 construction are in order. The circuit board is the usual glass epoxy, silver-plated stripline style that has become the vhf standard. The case and heat sink are made of heavy-duty, black anodized aluminum which contributes to durability and heat dissipation. It appears that quality components have been used throughout. A reverse-polarity protection diode is connected across the dc line after the fuse.

In short, I am pleased with the performance, construction and design of this amplifier. Anyone looking for an amplifier to go with his hand-held should give consideration to the B-23 — particularly if low-power ssb operation is contemplated. Further information may be obtained from Mirage Communications Equipment, Inc., Box 1393, Gilroy, CA 95020. Price class: $90. — *Peter O'Dell, KB1N* [QST]

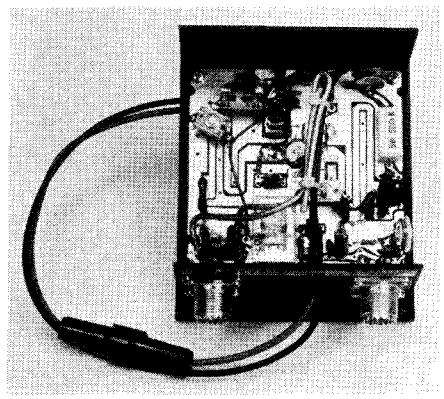

Fig. 8 — Neat, compact layout of the B-23 amplifier. This package can easily be tucked out of sight — even in today's compact cars.

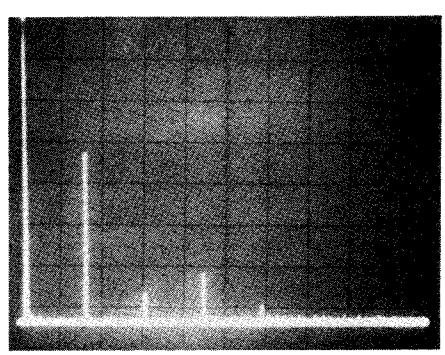

Fig. 9 — ARRL-lab spectral photograph of the output of the Mirage B-23 amplifier. Vertical divisions are 10 dB each; horizontal divisions, 100 MHz. The fundamental frequency at 144.05 MHz has been attenuated approximately 32 dB by means of a two-cavity notch filter in order to prevent overload distortion in the spectrum analyzer. The B-23 complies with current FCC specifications regarding spectral purity.

[1] *The ARRL Antenna Book*, thirteenth edition, pp. 115-116.
[2] *The ARRL Antenna Anthology*, pp. 145-148.