CQ REVIEWS:

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The Yaesu FT-102 H.F. Transceiver

The Yaesu FT-102 high-performance h.f. transceiver. The unit offers internal a.c. power supply, triple 6146B finals, dual panel meters, and a host of other features.

If you were an active radio amateur during the 1960s, your selection of an h.f. transceiver was basically a simple matter. There were only a few models from which to choose, and special "bells and whistles" were relatively unknown in the commercial market. Home constructing was popular because it allowed us to personalize our setups with one or two special frills at a reasonable cost. Over the years situations changed. The cost of electronic components began to rise and homebrewing began to decline. American-produced gear became more expensive for its capabilities, while the price of Japanese gear declined. Significant advancements have transpired, and today's array of imported amateur gear offers a variety of features to fulfill anyone's desires. During recent months we have seen the introduction of some high-performance, imported transceivers capable of producing exceptionally good results and clean signals.

The FT-102 is a medium-size and extremely professional-looking h.f. transceiver. Dual panel meters, a perfectly balanced and rubber-coated tuning knob, plus numerous chrome and skirted knobs give the FT-102 a very sleek appearance. There's more than mere appearance in the FT-102, however, as the prime focus of this transceiver is high-quality signal transmission and reception. The receiver's high dynamic range and selectivity are complimented by three 6146B finals which produce a very clean transmitted signal. If you prefer tube-type finals and front-panel loading controls rather than solid state and broadbanded rigs (no tune-up), you'll love the FT-102. It's a classic in the "one v.f.o. and tube final" category. The unit is slightly wider but not quite as tall as Kenwood's TS-830. Exact dimensions are 368 by 129 by 310 mm (W, H, D), and the unit weighs approximately 15 kg. The front panel and back cabinet areas are very dark gray. The digital display and panel meter illuminate light green. A massive power transformer is situated in the mid-rear area, and the complete transceiver is cooled by a muffin fan mounted behind the final amplifier compartment. Bottom access holes permit adjustment of transmit audio bass and treble, sidetone volume, and frequency. A hand-held mike with "up" and "down" buttons is supplied with the FT-102, but the optional FV-102DM synthesized and scanning v.f.o. is required for scan operation.

As supplied, the FT-102 is operational on all amateur bands 160 through 10 meters including WARC bands. Indeed, the unit produces a quite respectable signal on the new 30 meter band. R.f. output power is nominally 120 to 140 watts, although heavy loading can push that figure slightly above 160 watts. The unit's speech processor is also a gem, providing a creditable amount of talk power.

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First Impressions

Unlike broadband and minimum-adjustment transceivers, the FT-102 might easily be considered a "knob twister's delight." There are four knobs for transmitter tuning (preselector, drive, plate load, and tune), plus several other variables which are not apparent until the transceiver is put to use. S.s.b. operation, for example, includes setting the mike gain and compression while watching both panel meters. Switching to c.w. involves retuning the final's controls for that portion of the band and switching on the monitor (if it wasn't used for s.s.b. transmission monitoring) for sidetone. If VOX wasn't previously employed, that control must be pushed (it pops out slightly), increased to approximately 9 o'clock, and returned to its recessed position. Other "extendable" controls which come into action are the VOX/c.w. delay, noise blanker level, mike gain, compression, and squelch (for use on 10 meter f.m.). Controls for setting transmitted audio response, c.w. sidetone volume (which is independent of front-panel volume settings), and frequency are recessed under the rig's bottom. An alignment tool is provided for reaching those adjustments.

The FT-102 includes both RIT and XIT with a liberal ± 4 kHz range, a very useful feature for checking/working adjacent frequencies, etc. The concentric **I.F. Notch** and **Audio Peak Filter** controls are fairly effective—better than many rigs, but not quite equal to the classic FT-901DM. The **I.F. Notch** can also be used in conjunction with the noise blanker to produce an additional one or two S-unit drop in line or band noises. LED indicators are not provided for these controls, so you'll need to watch against leaving them "on" accidentally. The a.l.c. metering circuit includes a selectable "peak hold" circuit for precise adjustments—a nice feature which takes only a few seconds to appreciate. Considering all these variables along with our natural laziness brought on by today's fully solid state rigs, we must say the FT-102 lets you do a little work for those QSO's.

FT-102 Circuitry Overview

There is a substantial amount of circuitry packed inside the FT-102's cabinet, resulting in what initially may seem a complex unit (see fig. 2). As a means of simplifying our discussion, let's briefly ignore some of the "support" or "extra" blocks and step through the rig's basic circuits. Since this diagram isn't published in color, I suggest following receive paths with a blue pen and transmit paths with a red pen; the resultant color codes should prove quite helpful.

During receive, signals from the antenna are directed through preselector coils to a front-panel-controlled relay which enables or bypasses r.f. amplifiers Q1001 and Q1002. The S meter indicates an approximate 15 dB gain in this stage; thus, its use is primarily for weak signal reception. An approximate 5 dB increase in dynamic range is achieved when the r.f. amplifier is not used—an important

GENERAL

Frequency coverage:

Band	Range
1.8	1.8–2.0 MHz
3.5	3.5–4.0 MHz
7	7.0–7.5 MHz
10	10.0–10.5 MHz*
14	14.0–14.5 MHz
18	18.0–18.5 MHz
21	21.0–21.5 MHz
24.5	24.5–25.0 MHz
28, 29	28.0–29.9 MHz

Operating Modes:
LSB, USB(A3J/J3E); CW(A1/A1A); AM(A3/A3E) and FM(F3/F3E)**

Power requirements:
100, 117, 200, or 234 VAC, 50/60 Hz

Power consumption:
Receive: 95 VA (73 VA with heaters off)
Transmit: 440 VA (for 100 W output)

Dimensions (WHD):
368 x 129 x 309 (mm)

Weight:
Approx. 15 kg

TRANSMITTER

Power Input:	(1.8–25 MHz)	(28–29.9 MHz)
SSB, CW	240 W DC	160 W DC
AM**	80 W DC	80 W DC
SSTV, FM**	–	120 W DC

Carrier suppression:
Better than -40 dB at 14 MHz

Sideband suppression:
Better than -60 dB (14 MHz, 1 kHz tone)

Spurious radiation:
Better than -40 dB

Transmitter audio frequency response:
300–2900 Hz (-6 dB) adjustable

Third order intermodulation products:
Better than -40 dB (14 MHz, 100 W PEP)

Negative feedback level:
Approx. -6 dB at 14 MHz

Frequency stability:
Less than 300 Hz drift during the first 30 minutes after 10 minutes warm-up; less than 100 Hz every 30 minutes thereafter.

Modulation types:
A3J/J3E: balanced modulator
A3/A3E**: low level amplitude modulator
F3/F3E**: variable reactance modulator

Microphone input impedance:
Low, 200 to 600 ohms

RECEIVER

Image rejection:
Better than 70 dB from 1.8–21.5 MHz
Better than 50 dB from 24.5–29.9 MHz

IF rejection:
Better than 70 dB

AF output:
1.5 W minimum (8 ohms, 10% THD)

AF output impedance:
4–16 ohms

Selectivity: (-6 dB/-60 dB):
SSB, CW, AM; 2.7/4.8 kHz (with no optional filters), Width adjusts continuously from 2.7 kHz to 500 Hz (-6 dB)
Options:
SSB nar.; CW wide; 1.8/3.1 kHz with XF-8.2HSN filter
CW nar.; 600/1300 Hz with XF-8.2HC filter
CW nar.; 300/800 Hz with XF-8.2HCN filter
CW nar.; 500/1000 Hz with XF-455C filter
CW nar.; 270/600 Hz with XF-455CN filter
AM; 6/12.4 kHz with XF-8.2GA filter

IF notch depth:
Better than 40 dB

* No reception at 10.33 MHz ($f_{LO1} - f_{LO2}$)
** Optional AM/FM Unit required for AM transmission and FM operation.

Fig. 1– FT-102 specifications.

point for "busy band operators." Incoming signals, along with a first local oscillator signal, are then applied to Q1005 and Q1006, a dual FET balanced mixer. The resultant 8.2 MHz first i.f. signal is then fed to Q2001 and Q2002. All of the previous stages are operated at the 24 volt level for high signal-handling ability.

Following the "externally controlled" gate (D2001 through D2003), signals are applied to ceramic filters and then to the second i.f. (Q2003). The FT-102's supplied filter (XF2001) is 2.9 kHz, 8 poles. Optional filters are 2.9 kHz or 1.8 kHz, 8 poles (s.s.b.); 600 Hz or 300 Hz, 8 poles (c.w.); and 6 kHz, 3 poles (a.m.). I might add that adding the 1.8 kHz and 600 Hz filters here is the key to creating a super FT-102.

Signals are next converted to the second i.f. of 455 kHz (Q2004) and passed through a second filter, CF2001 (455 kHz center, with 2900 Hz bandwidth, 3 poles). Next, it's on to the Q multiplier, notch filter, 455 kHz i.f. amplifier (Q2010), and product detector. Two signals are felt on D3021 through D3024: 455 kHz ± 2900 Hz (audio) from Q2010 and 455.000 kHz from Q3018 (driven from third L.O. in v.f.o. unit). The "difference signal" (300 to 2900 Hz audio) then passes through Q3022, Q3023, Q3019, Q3030, and Q3025 to the speaker.

Now let's use another color pen and trace the s.s.b. transmit path. Signals from the mike proceed through the three amplifiers Q3001, Q3002 (note VOX takeoff), and Q3003. Tunable filters "between" Q3003 and Q3004 tailor audio to personal voices (adjustments underneath the cabinet). Follow the left side line from Q3004 to D3002 through D3005. Here audio and 455 kHz r.f. from Q3017 (and the v.f.o. unit) are applied to this balance modulator. That suppressed carrier double-sideband 455 kHz signal proceeds through Q2005 and CF2001 (attenuate one sideband, giving s.s.b.), on through Q2010, Q2015, and Q2016 to Q2017. This mixer beats the 8.6 MHz second L.O. with 455 kHz, producing an 8.2 MHz signal which proceeds through XF2001 and Q2003 and over to Q1008. This mixer heterodynes 8.2 MHz with the first L.O., producing the desired output frequency. That signal is amplified by Q1007, Q1009, Q1010, the 12 by 7 driver, and the three 6146B's, and applied to the antenna.

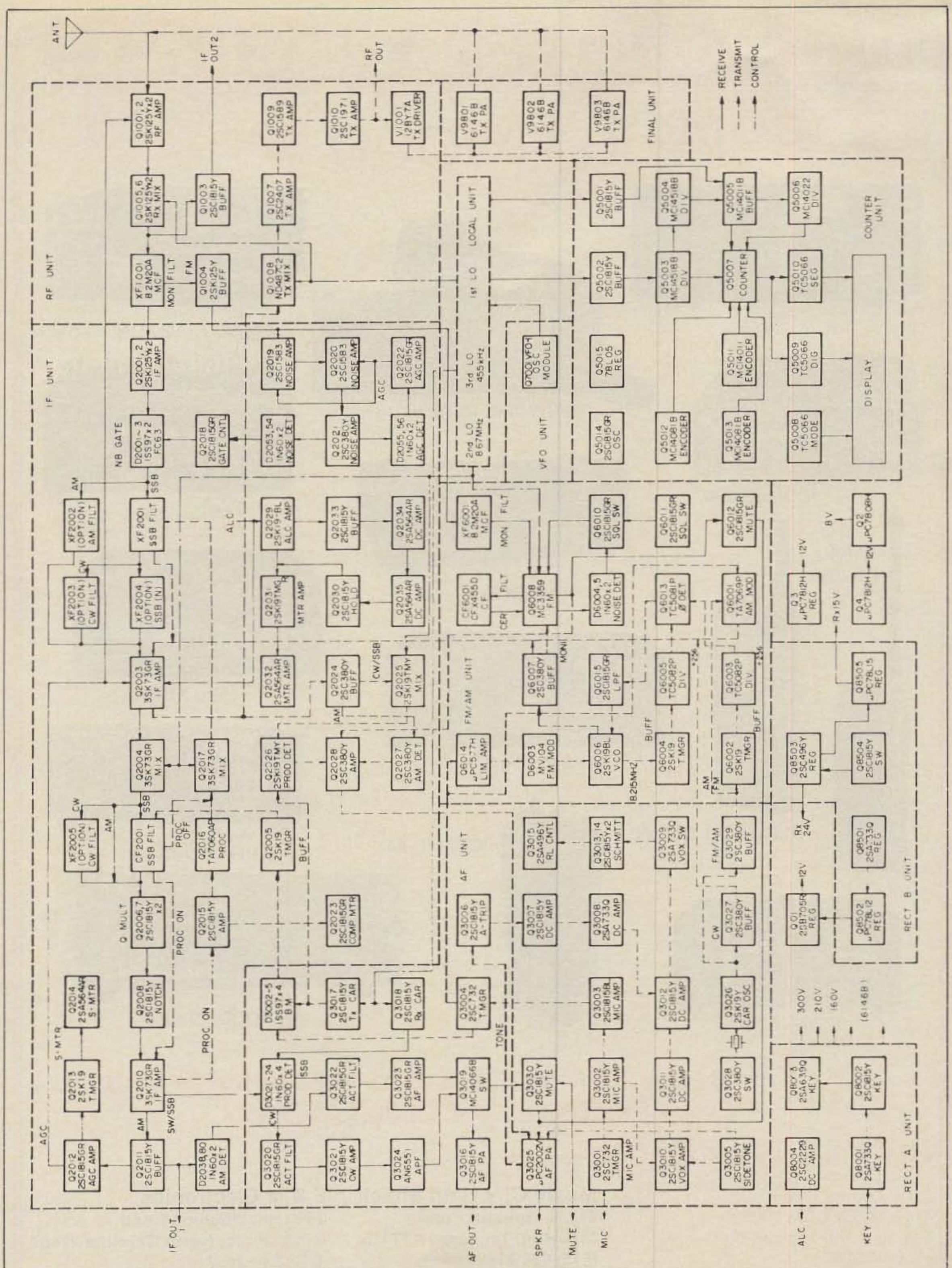

Fig. 2– Block diagram of the Yaesu FT-102. A discussion is presented in the text.

Giving an overview of the full diagram, right bottom blocks comprise the v.f.o. proper. Beside it are blocks comprising the a.m. and f.m. circuits. Additional support circuitry is "blocked" on the far left and bottom.

Comparing the FT-102's block diagram with those of other transceivers reveals some interesting similarities. The receiver's front end, for example, uses 25K125's—a device used in the TS-830, TS-930, and TS-430. The 3SK73's (Q2003, Q2004) were also used in this configuration in the TS-830. The FT-102 noise blanker's gating (D2001 through D2003) is similar to that of the other rigs, but its control and detectors are a mite new. All aspects considered, the rig seems relatively straightforward and reasonably traditional rather than strangely new in design. Armed with a color-coded and simplified block diagram (as we've just done), few difficult problems should be encountered in the future.

Operating the FT-102

The FT-102 is quite enjoyable to operate from several standpoints. Amateurs consistently compliment the transmitter's audio quality, while ample talk power is available for driving larger amplifiers to maximum output. Likewise, the independent controls provide the capability of handling a wide variety of operating conditions.

The receiver's on-the-air sensitivity and selectivity are comparable to other top-of-the-line competitive rigs, and the r.f. amplifier may be left off during normal activities on 160 through 30 meters. As previously mentioned, the optional 1.8 kHz s.s.b. and 600 Hz c.w. filter are definitely worth their cost when adjacent frequency interference mounts. The i.f. width and shift controls are useful for tailoring received audio and attenuating minor QRM, but that's about all. These two controls, incidentally, are independently adjustable, but also friction-track with a single knob. In other words, the bandwidth can be changed as desired, and the resultant i.f. center can be moved across the bandpass. The separate bandpass filters still perform better. The noise blanker is only fair in reducing power-line noises; I would classify it between that of an FT-901 and an Icom 740 or TS-830. The blanker provides slight "woodpecker" attenuation, however. Since a monitor LED isn't included for the notch filter or audio peak filter, we continuously forget to switch them out after use—a minor point, I'm sure. These circuits, incidentally, can be used for either c.w. or s.s.b. operations.

The a.l.c hold circuit is quite useful for precise setting of the mike gain. The other panel meter can be used simultaneously for setting the speech processor's level. The end result is a very accurately set level.

Our first contacts with the FT-102 barefoot included UA0, 3B8, and VK7 on 20 meters s.s.b. Switching to 15 meters, we worked GI's and DL's on the first calls. The rig definitely gets out! At times our trusted old wattmeter indicated average s.s.b. levels approaching our smaller 100 watt rig and kw amplifier (when used without a processor). I haven't tried the FT-102 with that amplifier. It would probably overdrive it significantly.

The FV-102DM External V.F.O.

This optional item adds a completely different character to the FT-102, and must be experienced to be appreciated. In addition to functioning as a regular second v.f.o., it contains 12 programmable memories, scanning at two rates, and direct frequency entry (to dial or memory) via a front keypad. Memory-stored frequencies may be used as fixed frequencies (no tuning) or as separate tuned v.f.o.'s (store one frequency, tune to a new frequency, switch to v.f.o.'s, etc., and then return to the new frequency in memory). The clarifier button can also be used with the **M-VFO** button for quick memory checks without interrupting dial settings or QSO's. Actually, the FV-102DM's capabilities are almost unlimited. Operators heavily into contesting will love the many functions, the frequency control mixing, and rapid check capabilities. It's great!

Summary

The FT-102 transceiver is a very good rig in the tube final category, filling a need expressed by many old-time and/or full-duty-cycle operators. The number of controllable variables and the wide s.s.b. bandpass provide often sought audio quality that is lost with many rigs. The optional 1.8 kHz filter, however, can change the unit to a DX machine quite easily.

Some amateurs prefer single v.f.o.'s, tuned finals, and calm operating. Others prefer multiple v.f.o.'s and numerous bells and whistles. Study your own particular situation, and then consider the FT-102. Might this be the rig of your dreams? You're the most logical one to answer that question.

The retail price of the FT-102 is $1149.00; FV-102DM external v.f.o. is $329.95; XF-8.2HSN 1.8 kHz filter is $40.00; and XF-8.2HC 600 Hz filter is $40.00. For more information, contact Yaesu Electronics Corp., P.O. Box 49, Paramount, CA 20723. CQ