

Product Review Column from QST Magazine

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Yaesu FT-890 MF/HF Transceiver

Command Technologies Commander II 2-Meter Linear Amplifier

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Yaesu FT-890 MF/HF Transceiver

Reviewed by David Newkirk, WJ1Z



I cannot tell a lie: I generally know what new Japanese ham equipment may be destined for release in the US because I read (well, scan, since I neither speak nor read Japanese) a Japanese Amateur Radio magazine called *CQ Ham Radio*. About 55% of that magazine, an inch-thick monthly that's more or less *QST*'s Japanese counterpart, consists of ads. As if its ads don't reveal enough, *CQ Ham Radio* regularly carries photo-packed new-product-overview pages. And it was on those pages that I first learned months ago of a new transceiver by Yaesu: the FT-850.

I did a double-take, too. Huh? FT-850? Is that a typo? No. The Yaesu FT-890 is known in Japan as the FT-850. I mention this because I think it will interest you—and because it explains the several FT-850 labels (at least one an oversight, others intentional) on graphics in the FT-890 *Operating Manual*.

Whatever you call it, the Yaesu FT-890 is an enticingly compact MF/HF transceiver. Though it uses the same top-cover and heat sink casting as the FT-757GXII, which it replaces in Yaesu's MF/HF line, the FT-890 is by no means a tweaked '757. Far from it. It's an entirely new design that fits in well with Yaesu's other latest-generation gear.

Capable of transmitting AM, CW, narrowband FM, LSB and USB on all amateur frequencies between 1.8 and 29.7 MHz, the FT-890 also receives these modes from 100 kHz to 30 MHz. Its transmitter can provide up to 25 W carrier output on AM and 100 W PEP output on CW, FM, LSB and USB. It offers manual, VOX and full break-in (QSK) transmit-receive switching and includes a built-in iambic keyer. Dual VFOs and 32 memories store frequency, mode, wide/narrow IF filter selection and

clarifier, repeater offset and split-frequency status.

You can computer-control the FT-890 via Yaesu's optional FIF-232C serial interface. This add-on is especially worthy of note because the FT-890 is the first new Yaesu radio to use the revised CAT interface standards for controlling the radio via computer logging software.

You can buy the FT-890 with its internal automatic antenna tuner (the ATU-2) already installed, or add it as an accessory later. You can replace the transceiver's standard 2.2-kHz-wide ceramic IF filter with a 2.4-kHz crystal job that offers better skirt selectivity and ultimate rejection. And you can install a 250- or 500-Hz filter for CW. The FT-890's FM and 6-kHz AM filters are standard.

Along with the review FT-890, we tested its internal antenna tuner, FP-800 power supply/speaker and 500-Hz and 2.4-kHz IF filters.

Agility

The FT-890 gets around in the spectrum via tuning knob, UP and DOWN BAND/MEM,

and FAST and HAM/GEN buttons, a CLARIFIER (receiver incremental tuning, or RIT— ± 9.99 kHz), and its memory system. Dedicated buttons select modes and (for AM and CW) toggle selectivity options. Band memories (one per band, except for 10 meters, which has two) remember the tuning information last used on a given band. The radio's VFO/memory controls are pretty standard and can be quickly learned.

The '890's memory system supports frequency and memory scanning. Two memories (P1 and P2) can be used to set scanning and even manual-tuning limits. Each memory can store a pair of frequencies; A/B toggles them, effectively doubling the '890's memory capacity.

Connections to the Outer World

Four of the FT-890's back-panel jacks (DVS-2, TUNER, CAT, and BAND DATA are primarily intended to connect proprietary Yaesu gadgets. Others (KEY, PTT, +13.5V, GND, PATCH IN, EXT ALC and EXT SPKR) are self-explanatory. DATA IN/OUT handles fixed-level audio I/O from modems and can also be used to feed a tape recorder.

TX GND handles amplifier control. Connected to relay contacts, TX GND "can support non-QSK linear t/r switching voltage up to 125 VAC @ 200 mA [with chassis common, though—WJ1Z] or DC voltage up to 220 V @ 300 mA, or closed-circuit current up to 2 A with DC voltage up to 30 V," according to the FT-890 manual. (From the factory, this relay is disabled by default. Unless you're using it to

The Bottom Line

Few and minor shortcomings don't mask the FT-890's promising upward redefinition of radio performance in its class. Truly a "station in a box," the FT-890 has much to offer stay-at-homers, world travelers, Field Day excursionists and mobile operators alike.

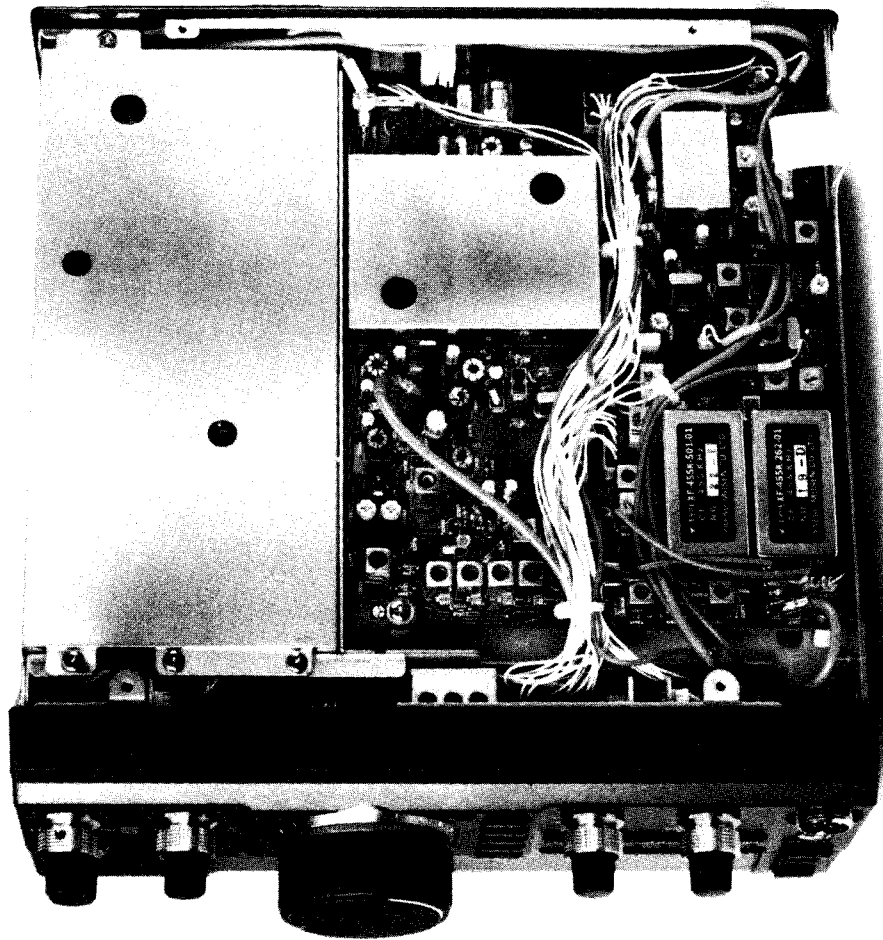


Fig 1—The FT-890, here with its bottom cover removed, is fairly typical of modern radios: Most of its circuitry resides on two main chassis-mounted PC boards, inside the final-amplifier compartment, and on another board behind the front panel. The two optional 455-kHz IF filters, at lower right in this photo, are soldered in place. Of the two, the SSB filter (at right) is difficult to install because you must first remove an existing filter.

control an external amplifier, you won't want to enable it. It's loud.) Lines accessible at the **BAND DATA** jack can control amplifiers capable of QSK. The switching transistor involved can handle up to 100 mA (closed circuit) and 15 V (open circuit).

The Limits of Power

In the FT-890's specifications, Yaesu rates the radio's transmitter duty cycle as 100% at 100 watts PEP SSB and 25 watts AM carrier. (That AM power level isn't wimpy or fudging: 100% amplitude-modulating a 25-watt carrier to produce two identical sidebands results in 100 W PEP.) Elsewhere in the manual, we read that, "Although the FT-890 cooling system is designed to handle continuous-duty transmission at 100 watts output, full key-down periods for long periods is not recommended. . . the safest approach is to keep power output at 50 watts during long transmissions." Elsewhere (under *FM Transmission*): "To avoid overheating, if you need full power, keep your transmissions to *three minutes or less*, with the same time for reception." The radio's energetic cooling fan comes on when the final amplifier

heats up beyond a certain point. The FP-800 contains another, quieter fan.

User Definable Features

The FT-890 continues the welcome trend toward increasing user-definability via firmware switches. At power-up, you can select the radio's FM repeater offset (± 0 to 200 kHz) and whether the radio's frequency display shifts by its CW offset (700 Hz) when switching between SSB and CW. Features adjustable during operation (by pressing **FAST** and another button) include display brightness, tuning rate, speech-processor IF offset and CTCSS tone frequency.

Lab Tests

Table 1 and Figs 2 through 5 show the results of our FT-890 lab testing. I'm particularly pleased with its receiver's third-order intermodulation distortion (IMD) dynamic range—generally between 90 and 100 dB in the lower part of the HF range. That's 1992 receiver performance! Purists may sniff that the radio's blocking performance could be better. In my opinion, receiver third-order IMD dynamic range is

more important because the fake signals a receiver manufactures through IMD harm reception long before the onset of blocking. Especially at 40, 30 and 17 meters, the proximity of superpower shortwave broadcasters makes strong receiver IMD performance a must. In common with other new-generation Japanese ham transceivers, the FT-890 receiver achieves this performance with an active four-JFET mixer.

The FT-890 on SSB and AM

I rate the FT-890 as a very good SSB performer in its class. Its selectivity is quite respectable even before you replace its stock ceramic filter (2.2 kHz wide, 60 dB or so of ultimate attenuation) with its optional crystal counterpart (2.4 kHz, ultimate attenuation around 75 dB). Its receiver AGC dynamics and control range sound fine on SSB—even on 75 meters, as NJ2L and I discovered while A/B comparing it with a TS-930S.

The FT-890's VOX works well. You have to reach around to the rear panel to adjust its **VOX**, **ANTI-TRIP** and **DELAY** controls, though. The FT-890's IF notch filter is smooth to adjust and works very well, as Table 1 reflects.

The FT-890 combines AF speech processing with transmit IF shift in a way that adds solid, tailorable punch to the radio's SSB signal. The rig's compression level is adjustable from zero to too much—as it should be. Like the FT-990, the FT-890 contains what Yaesu calls *frequency shifted processing* (FSP), which allows you to shift the transmit audio's tonal balance by anywhere from -0.3 to $+0.5$ kHz of nominal. Positive shifts make the audio brighter (more treble); negative shifts cut highs and add bass. Adjusted with care, this system should let FT-890 owners maximize communications punch for their voice using the mike of their choice. The radio's USB, LSB and AM (-3 to $+3$ kHz) FSP shifts can be set separately. The FT-890 remembers the FSP offset last selected for each mode.

Speaking of AM, the FT-890 receives it well. I've bleated in the past about how some MF/HF rigs sleaze out on AM reception by combining inappropriately wide IF filtering with ruthless high-end audio rolloff. (See my Yaesu FT-747GX review,¹ for instance.) The FT-890's AM filter is 6 kHz wide at -6 dB and 18 kHz wide at -60 dB—6 kHz wider at -60 than I think it should be, but quite acceptable if backed with thoughtful AF filtering. And the FT-890 has thoughtful AF filtering. So it sounds quite respectable during ham and broadcast AM reception—if you listen to it on something better than the radio's token, tiny top-firing speaker.

One thing that tells me how well Yaesu

¹D. Newkirk, "Yaesu FT-747GX MF/HF Transceiver," *QST*, Aug 1989, pp 33-36, 52; also see Feedback, *QST*, Dec 1989, p 32.

Table 1

Yaesu FT-890 160-10 Meter Transceiver, Serial no. 2C030061

Manufacturer's Claimed Specifications

Frequency coverage: Receive, 0.1-30 MHz; transmit, 1.8-2, 3.5-4, 7-7.5, 10.1-10.5, 14-14.5, 18-18.5, 21-21.5, 24.5-25, and 28-29.7 MHz.

Modes of operation: AM, CW, FM, LSB, USB.

Power requirement: 13.8 V dc (± 1.4 V) at 1.5 A on receive (no signal) and 20 A on transmit (100 W).

Receiver

Receiver sensitivity (2.4 kHz bandwidth, IPO off unless specified otherwise). SSB and CW (10 dB S+N/N): 150-250 kHz, IPO on, 5 μ V (-93 dBm); 250-500 kHz, 2 μ V (-101 dBm); 0.5-1.8 MHz, 1 μ V (-107 dBm); 1.8-30 MHz, 0.25 μ V (-119 dBm).

AM (10 dB S/N, 6 kHz bandwidth, IPO off unless specified otherwise): 150-250 kHz, IPO on, 40 μ V (-75 dBm); 250-500 kHz, 16 μ V (-83 dBm); 0.5-1.8 MHz, 8 μ V (-89 dBm); 1.8-30 MHz, 1 μ V (-107 dBm).

FM (12 dB SINAD, IPO off): 1.8-30 MHz, 0.5 μ V (-113 dBm).

Receiver dynamic range: Not specified.

Third-order input intercept:** Not specified.

S-meter sensitivity (for S9 reading): Not specified.

CW/SSB squelch sensitivity (1.8-30 MHz): Less than 2 μ V.

FM squelch sensitivity: Less than 0.32 μ V.

IF notch filter attenuation: 30 dB or better.

Receiver audio output: More than 1.5 W at 10% total harmonic distortion into a 4- Ω load.

Receiver IF/audio response: Not specified.

Transmitter

Transmitter power output: Adjustable up to 100 W on CW, SSB and FM; 25 W max on AM.

Spurious-signal suppression: 40 dB below peak power output. Harmonic suppression: 50 dB.

Third-order intermodulation distortion products: Typically -31 dBc at 100 W PEP output at 14.2 MHz.

CW keying characteristics: Not specified.

Transmit-receive turnaround time (PTT release to 90% audio output): Not specified.

Composite transmitted noise: Not specified.

Size (height, width, depth): 3.66 x 9.4 x 9.6 inches; weight, 12.3 lb.

Measured in the ARRL Lab

As specified.

As specified.

At 13.7 V: Receive (no signal), 1.6 A; transmit (100 W), 14.9 A.

Receiver Dynamic Testing

Minimum discernible signal (noise floor) with 500-Hz IF filter:

	IPO off	IPO On
1.0 MHz	-131 dBm	-121 dBm
3.5 MHz	-138 dBm	-128 dBm
14.0 MHz	-137 dBm	-127 dBm
28.0 MHz	-137 dBm	-126 dBm

Signal 30% modulated with a 1-kHz tone:

	IPO off	IPO On
1.0 MHz	-118 dBm	-109 dBm
3.8 MHz	-124 dBm	-116 dBm

29 MHz: -120 dBm (IPO off); -114 dBm (IPO on).

Blocking dynamic range (500-Hz IF filter):*

	IPO off	IPO On
1.0 MHz	121 dB†	122 dB†
3.5 MHz	127 dB†	128 dB†
14.0 MHz	127 dB†	129 dB†
28.0 MHz	129 dB†	130 dB†

Two-tone, third-order intermodulation distortion dynamic range (500-Hz IF filter):*

	IPO off	IPO On
1.0 MHz	84 dB	86 dB
3.5 MHz	93 dB	96 dB
14.0 MHz	96 dB	98 dB
28.0 MHz	92 dB	88 dB

	IPO off	IPO on
1.0 MHz	-5 dBm	8 dBm
3.5 MHz	1.5 dBm	16 dBm
14.0 MHz	7 dBm	20 dBm
28.0 MHz	1 dBm	6 dBm

At 14 MHz: IPO off, 71 μ V; IPO on, 316 μ V.

As specified.

As specified.

More than 50 dB.

2.8 W at 10% total harmonic distortion (THD) into a 4- Ω load.

At -6 dB: SSB (2.4-kHz IF filter), 142-2669 Hz (2527 Hz); CW (500-Hz IF filter), 357-930 Hz (573 Hz).

Transmitter Dynamic Testing

Adjustable from 1.5 to 120 W (CW, SSB, FM—output varies slightly from band to band). AM, as specified.

Meets FCC specifications. See Fig 2.

See Fig 3.

See Fig 4.

S1 signal, 20 ms; S9 signal, 20 ms.

See Fig 5.

pays attention to detail nowadays is the FT-890 *Operating Manual* section on receiving AM as LSB or USB. I've seen no other manufacturer discuss temporarily detuning IF shift to make zero beat more audible. The manual was written by people who *know their stuff*.

The FT-890 on FM

The '890's speech processor and transmit-IF-shift response tailoring aren't available in FM. The mike input level is factory-preset. But the '890's FM features get the job done. The radio's memories can store the CTCSS tone selection you set, in addition to frequency, offset and clarifier data.

The FT-890 on CW

I like how the FT-890 works on CW—even though its CW offset and sidetone

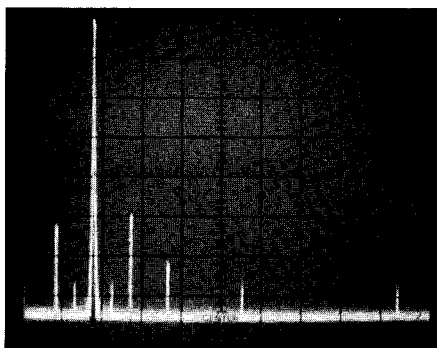


Fig 2—Yaesu FT-890 worst-case spectral display. Horizontal divisions are 10 MHz; vertical divisions are 10 dB. Output power is approximately 117 W at 18 MHz. All harmonics and spurious emissions are at least 50 dB below peak fundamental output. The FT-890 complies with current FCC specifications for spectral purity for equipment in this power-output class and frequency range.

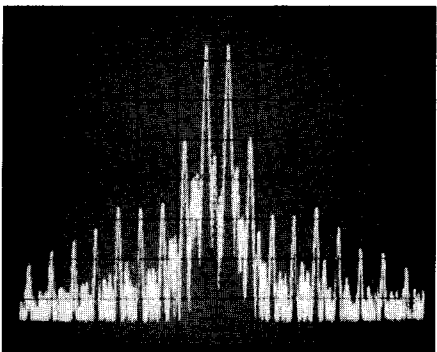
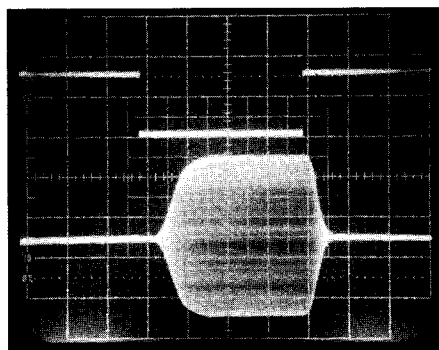


Fig 3—Worst-case spectral display of the FT-890 transmitter during two-tone intermodulation distortion (IMD) testing. Third-order products are approximately 30 dB below PEP output, and fifth-order products are approximately 46 dB down. Vertical divisions are 10 dB; horizontal divisions are 2 kHz. The transceiver was being operated at 100 W PEP output at 14.25 MHz.

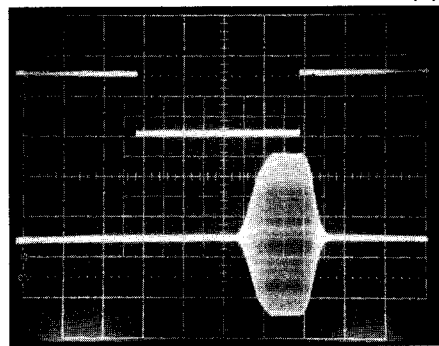
*Unless noted otherwise, blocking dynamic range and third-order IMD dynamic range measurements were made at the ARRL Lab standard signal spacing of 20 kHz.

†Noise limited at given value.

**Third-order input intercept (dBm) = MDS (dBm) [+ 1.5 x third-order IMD dynamic range (dB)].



(A)



(B)

Fig 4—CW-keying waveforms for the Yaesu FT-890 in the semi-break-in mode (A) and the full-QSK mode (B). The upper traces are the actual key closures; the lower traces are the RF envelopes. Horizontal divisions are 5 ms. The transceiver was being operated at 100 W output at 14 MHz.

pitch are not user adjustable. You're locked into its 700-Hz offset and CW sidetone unless you offset the RIT and recenter the IF shift for the new offset, but then the frequency display is correct only in transmit. Its keying sounds very good with manual TR switching, quite good with keyed VOX (there's just a bit of "first dit" shortening) and acceptable, although somewhat weight-lightened, during full-break-in operation (QSK). The radio's QSK keying is lightest during crossband split operation; within a band, it's noticeable but not too objectionable.

The FT-890's keyer and CW TR mode options are well integrated through top-cover **BREAK-IN**, **KEYER** and **SPEED** controls. You can use your keyer paddle as a straight key or make the radio transmit key-down in the CW mode just by throwing the right switches. One thing that strikes me as funny about the FT-890's **KEYER** switching, though, is what happens in its **WT** (weight) position. Maybe I'm Rip Van Winkle, but I thought increasing keying weight meant decreasing the length of your interelement spaces. Not with the FT-890: **WT** just changes the keyer's dot-to-dash ratio from the standard 1:3 to 1:4.5. Throwing **KEYER** to **WT**, then, makes you sound like one of those bug operators who send their dashes at 20 WPM and their dots

at 30! So **WT** can't do anything to "heavy up" the radio's light keying during QSK. (Darn!) But the FT-890's QSK is nonetheless the real thing—and generally useful.

The optional 500-Hz filter's 3.6:1 shape factor is a bit high, but pretty standard for monolithic crystal filters in this class. What impresses me about the FT-890 is that its IF filtering is more than reasonably free of blowby, even though the radio doesn't use dual (series) filtering. Yes, signals can blow by the FT-890's CW filter, but only stupendously strong signals. The FT-890 does single-filter filtering quite well.

I rate the FT-890's fast-AGC response as good; its slow AGC is very good. In fast mode, the AGC overshoots a bit, then overcompensates (lowering gain a bit too much), then hits the proper level—all very rapidly. This gives Morse code elements a distinctly modified, but not objectionable, sound.

Smooth audio filtering backs the FT-890's IF filtering, keeping wideband IF hiss down while helping the FT-890 to pretty much avoid the "narrow-CW graininess" common in the previous generation of mid- to low-end MF/HF radios. There's room for improvement, though: I can hear some audio IMD with two or more signals present in the IF passband during narrow CW reception.

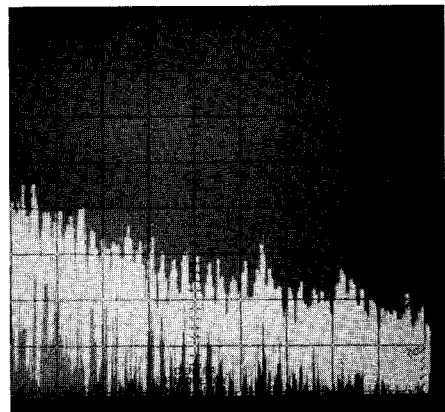
Antenna Tuner

One word describes the AT-2's operation: *smooth*. The AT-2 is specified as being capable of matching loads that present the FT-890's transmitter with an SWR of up to 3 to 1. Operating with a given antenna system for the first time, you first press the radio's **TUNER** button and then press **START** (pressing just **START** will do it, too). A **WAIT** indicator comes on and the FT-890 goes into transmit at reduced power to tune for minimum reflected power. Then **WAIT** goes out and the radio returns to receive. The tuner has 31 memories of its own and stores its findings for later use when you band-hop. Yaesu conservatively rates the tuner as taking up to 30 seconds to find a match (or to let you know it can't by illuminating the **HI SWR** indicator). The review FT-890AT didn't take longer than 15 seconds in the situations I encountered. The radio does put out some RF with the **HI SWR** indicator lit; I used it to make a local 80-meter contest QSO with my 40-meter dipole.

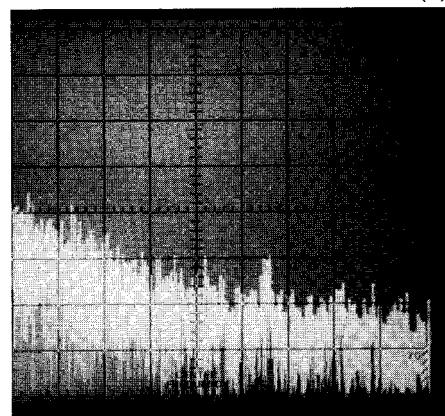
Documentation

The FT-890's *Operating Manual* is first-rate. I don't know who wrote it, but whoever he or she is (they are?) knows the radio, knows hams and shares my (our/their) appreciation of no-nonsense writing. Example:

The FT-890 offers a few special features for digital modes, such as the **DATA IN/OUT** jack on the rear panel, and a very fast transmit-to-receive turnaround time. This provides good



(A)



(B)

Fig 5—Spectral display of the FT-890 transmitter output during composite-noise testing. Power output is 101 W at 3.52 MHz (A) and 100 W at 14.02 MHz (B). Vertical divisions are 10 dB; horizontal divisions are 2 kHz. The scale on the spectrum analyzer on which these photos were taken is calibrated so that the log reference level (the top horizontal line on the scale) represents -60 dBc/Hz and the baseline is -140 dBc/Hz. Composite-noise levels between -60 and -140 dBc/Hz may be read directly from the photographs. The carrier, off the left edge of the photographs, is not shown. These photographs show composite transmitted noise at frequencies 2 to 20 kHz offset from the carrier.

performance on 1200-baud packet above 29 MHz. Unfortunately, optimum AMTOR, RTTY and 300-baud packet operation is difficult, because the optional 500-Hz narrow CW filter is not available in the SSB modes needed for AFSK transmission. You can keep operation simple (and avoid the need for the 500-Hz CW filter option) by using the LSB mode with its 2.4 kHz bandwidth for both transmission and reception, but the broad receiver IF bandwidth is not optimum for receiving narrow-shift AFSK. Alternatively, if you have the 500-Hz CW filter installed, you can try using it for reception in CW mode and transmitting in an SSB mode; but this requires offsetting your transmit and receive frequencies, along with a few other niggles.

Even a folksy manual needs to "talk schematic" where words and photos fail.

The FT-890 *Manual* uses partial schematics to round out its coverage of optional microphones, connecting a linear amplifier and explaining the relationship between the radio's **MIC** and rear-panel **PATCH IN** and **DATA IN/OUT** audio connections. The book also includes full schematics and a block diagram on separate sheets.

Rough Edges

Generally speaking, the FT-890 tunes smoothly and is free of synthesizer glitches, pops, clunks, etc. It does have several weak spurious responses (*spurs*), however, and three strong ones. The strong ones are all outside the ham bands (at 8.67, 17.34 and 26.01 MHz). Some of the FT-890's spurs are independent of the selected IF bandwidth. Most of the in-ham-band spurs are masked by band noise when the rig is connected to an antenna, save the very weak spurs around 7.097, 14.19, 29.02 and 29.477 MHz.

Tuning around within hours of taking the FT-890 out of its box, we noticed backward-tuning second-IF *images*² of signals 910 kHz higher than the frequency indicated on the FT-890 display. They were particularly troublesome at 20 meters because the 19-meter shortwave broadcast band, populated with many 100+ -kilowatt signals night and day, lies in that 910-kHz image range above much of the 20-meter ham band! After confirming and measuring this phenomenon in the ARRL Lab, we began a dialogue with Yaesu that quickly resulted in their finding the images' cause and cure. The cause: Misalignment of four transformers on the radio's RF Unit circuit board. The cure: Realign per Yaesu instruction. The result: Second-IF images in the review FT-890 dropped almost 25 dB—from about 50 down to nearly 75 dB down relative to the desired signal. This degree of image rejection should pose no problem.

Authorized Yaesu service facilities will readjust affected in-warranty FT-890s. Contact the dealer from which you purchased the FT-890 first; if they can make the adjustments, they can probably turn the radio around faster than Yaesu's California service facility can. If not, contact Yaesu's customer service department, tel 310-404-2700. According to Yaesu, they can typically adjust and ship radios within five days of receipt.

Users with access to an HF signal generator and some experience working on modern equipment can make the required adjustments themselves. Yaesu's customer service department can provide you with written instructions on how to do this. Request technical bulletin TB-9227.

Installing the FT-890's optional IF filters requires PC-board dismounting and

soldering—an anachronism, considering that the competition has been successfully using plug-in filters for years. Installing an FT-890 CW filter is straightforward compared to the nightmare of installing the optional YF-101 SSB filter, though. To put in the YF-101, you must first desolder and *take out* the existing ceramic SSB filter. The snag with this is that the existing filter is soldered into plated-through holes, and mere “solder suckers” and desoldering braid can't pull enough solder out of the holes to free the filter. I wanted to do the job myself so I could write about it better, but I chickened out when I saw what was necessary: Product Review editor Healy had to alternately heat each connection, slip a screwdriver under the ceramic filter and use much more force than either of us would like to apply to the main PC board in any modern radio. *Hams unfamiliar with invasive equipment modification and repair should not attempt this procedure!* Since a professional vacuum desoldering station looks like the only safe way of desoldering that filter, I think Yaesu dealers should handle YF-101 installation as a matter of policy.

The FT-890 includes no “clarifier clear” feature. It needs one. I used to think this complaint was merely quaint until I operated Field Day with the FT-890. A radio that lets you user-select its button-beep pitch but not clear its clarifier with a button press? C'mon!

The FT-890 includes no low-level RF output and receive-antenna-line taps suitable for use with transverters or separate receiving antennas.

The FT-890 comes with phone and phono plugs for its garden-variety I/O jacks, but *not* with plugs to match its three miniature DIN jacks (**BAND DATA**, **CAT** and **TUNER**). I just about went nuts trying to shove wires into the FT-890's mini DIN **CAT** jack to test the radio under computer control. (The ARRL FIF-232C predates Yaesu's mini-DIN CAT connector standard, and the FT-890 does not include a standard-to-mini 6-pin-DIN adapter.) Yaesu currently ships FIF-232C interfaces with the appropriate cable, and will supply (at no charge) owners of older FIF-232Cs with the appropriate cable.

So, What's the Bottom Line?

I like this radio. Despite its few rough edges, the FT-890 offers good value for money and more than delivers what its controls and specifications promise. Along with the Kenwood TS-450S/690S, the FT-890 redefines *upward* the basic radio performance expected of and acceptable in its class. To my mind, like the FT-1000D, the FT-890 is also another step in positively redefining Yaesu's reputation for making high-quality MF/HF equipment.

Some FT-890 ads call it a “mobile.” That's unnecessarily limiting. It's a trustworthy general-purpose conversation and

casual-contesting radio well-tailored to its target market. With its built-in keyer and optional in-board antenna tuner, it's now the most compact “station in a box” you can buy. Amateurs needing keypad tuning, CW pitch control, 6 meters, FSK-specific features or mode-unspecific dual filtering may go with the competition, but I can see a solid body of satisfied hams making the FT-890 their workhorse for years to come.

I thank Rus Healy, NJ2L, and Dave Sumner, K1ZZ, for participating in this review.

Manufacturer: Yaesu USA, Inc, 17210 Edwards Rd, Cerritos, CA 90701, tel 310-404-2700. Suggested retail prices: FT-890, \$1529 with ATU-2 internal tuner, \$1339 without; ATU-2, \$209; FP-800 power supply/speaker, \$299; MMB-20 mobile mount, \$26; DVS-2 voice recorder/player, \$299; FC-800 external automatic antenna tuner, \$469; FIF-232C RS-232-C interface, \$95; YF-100 500-Hz CW filter, \$159; YF-101 2.6-kHz SSB filter, \$159; XF-455K-251-01 250-Hz CW filter, \$159; MD-1C8 desk microphone, \$115.

COMMAND TECHNOLOGIES COMMANDER II 2-METER LINEAR AMPLIFIER

Reviewed by Rus Healy, NJ2L

Your forays into aurora, meteor scatter, moonbounce and other forms of serious weak-signal work on the VHF bands meet with the most success when you have serious power on tap. The trouble is, most VHF linear power amplifiers in the kilowatt range aren't inexpensive or as reliable as we'd like (not to mention portable!). For example, the legal-limit Henry 3002A (reviewed in November 1989 *QST*) costs \$2895, and at 190 pounds, it's not exactly portable.

Ohio-based Command Technologies, better known for its HF-1250 and HF-2500 MF/HF amplifiers, has gathered a loyal following with the Commander II. Using a single Eimac 3CX800A7 ceramic-metal triode in grounded-grid, the Commander II is a solid, lightweight powerhouse. Its 56-pound weight, relatively small package and fair price bring high-power portable operation to almost anyone who wants to do it.

Since its 1985 debut, Commander IIs

The Bottom Line

Unless you're into bending your own cabinets and building high-voltage power supplies, you won't find a better value in a kilowatt 2-meter amplifier than the Commander II.

²See D. Kazdan, “What's a Mixer?,” *QST*, Aug 1992, pp 39-42.

Table 2

Command Technologies Commander II 2-Meter Linear Amplifier

Manufacturer's Claimed Specifications

Frequency range: 144-148 MHz.
 Continuous power output: SSB, 1 kW
 PEP; CW, 650 W; FM and RTTY, 450 W.
 Drive requirements: 10-15 W nominal,
 25 W max (15 W max for FM and RTTY).
 Power gain: At least 15 dB.
 Spurious signal and harmonic
 suppression: At least 60 dB.
 Intermodulation products: At least 30 dB
 below PEP output.
 Power requirements: 120 V ac at 20 A
 or 240 V ac at 10 A; 240 V recommended.
 Input and output impedance: 50 Ω .
 Input SWR: Not specified.

Maximum load SWR: 2:1.

Size: 6 x 14.75 x 14.75 inches.

Weight: 56 pounds.

Measured in the ARRL Lab

As specified.

See Table 3.

See Table 3.

See Table 3.

Meets FCC requirements.

See Fig 7.

Not measured.

As specified.

Not measured.

1:1 from 144-148 MHz when
 properly tuned.

Not measured.

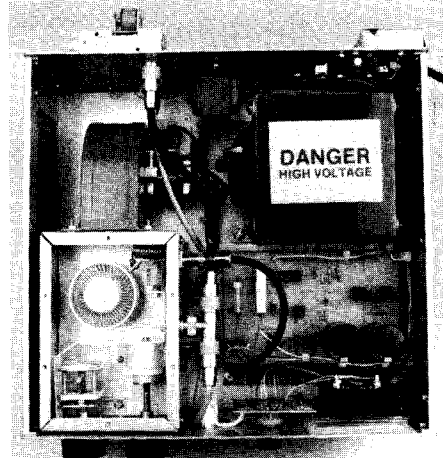


Fig 6—Inside the Commander II 2-meter amplifier. Clockwise from lower left: the RF deck with its top shield and tube chimney removed, centrifugal blower, TR relay (outside the back panel), low- and high-voltage transformers, a PC board containing control and bias circuitry, and the multifunction meter.

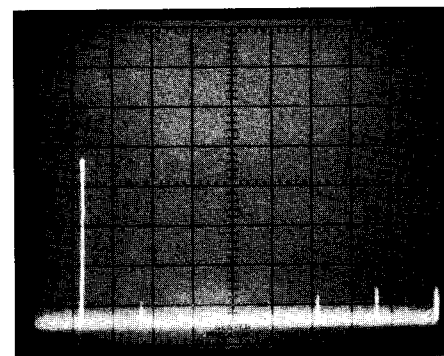
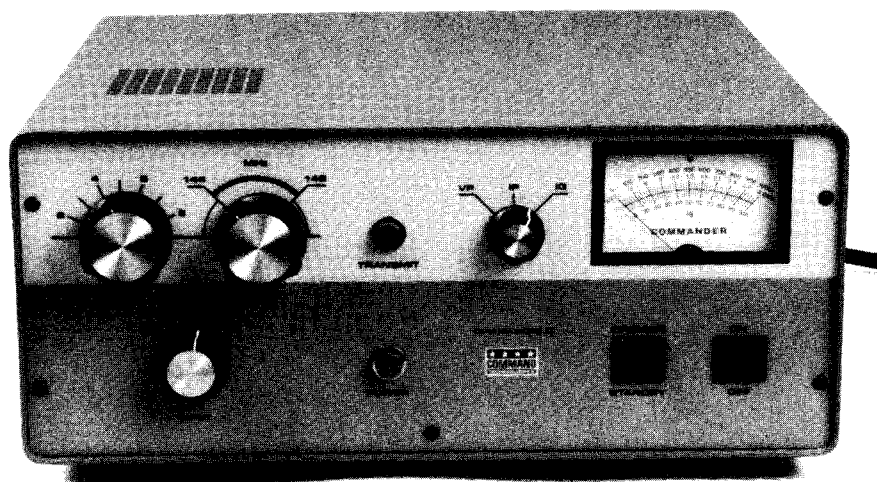


Fig 7—Worst-case spectral display of the Command Technologies Commander II 2-meter amplifier. Horizontal divisions are 100 MHz; vertical divisions are 10 dB. Output power is approximately 650 W at 144 MHz. For this photo, the fundamental was notched by approximately 33 dB to prevent spectrum-analyzer overload. All harmonics and spurious emissions are at least 65 dB below peak fundamental output. The Commander II complies with current FCC specifications for spectral purity for equipment in this power-output class and frequency range.

Table 3

Commander II Linear Amplifier Performance

Frequency (MHz)	Drive Power (W)	Output Power (W)	Anode Current (mA)	Grid Current (mA)	Anode Voltage (kV)
CW					
144	24	650	510	15	2.22
145	24	650	500	16	2.22
146	24	650	510	15	2.22
147	23	650	500	14	2.22
148	24	650	500	18	2.22
SSB					
144	39*	960*	400	10	2.22

*PEP.

have found their way into more than 500 ham stations worldwide, and have gained a reputation for reliability.

Construction

Inside, the Commander II is a sight to behold (see Fig 6). Although its cabinet resembles the HF-1250's, this amplifier is built considerably differently inside. A shielded enclosure surrounds the tube and

output network, keeping 2-meter RF from getting out of the cabinet by any path other than the TR relay. This enclosure also provides a convenient way to pressurize the RF deck with cooling air supplied by a physically small but fairly high-volume centrifugal blower that's reasonably quiet.

The Commander II uses a high-Q tuned input and a stripline output network with a well made, piston output-tuning capaci-

tor comprised of silver-plated copper and a Teflon bushing. A coaxial-stub output filter knocks down the second harmonic. The amplifier also features a built-in 2-minute warmup delay (see Operation). Fuse resistors in the high-voltage power supply circuit help protect the tube in case of an arc.

Command Technologies recently replaced the **INPUT** tuning capacitor with a higher-Q piston version using a multiturn reduction drive. This control tunes very smoothly and improves the amplifier's ruggedness (it

can now handle higher output SWRs without arcing or damage). A small quirk remains, however: The front panel is labeled for a partial-turn control. So, if the input network is far from resonance and you tweak the control over a small range, you won't see an output peak. The manual clearly explains this (which is one of the many good reasons to *read the manual* before you try to operate *any* new piece of gear—especially a high-power amplifier).

Functions you can monitor on the amplifier's single panel meter include anode current, grid current and high voltage. Power and SWR metering aren't included.

A Dow-Key DK-260 transfer relay mounted *outside* the amplifier's back panel handles TR switching. Antenna and transmitter connections are made directly to the relay's female UHF connectors. This is the Commander II's one mechanical shortcoming: The relay and its solenoid (including the bare connections to it) are unprotected. You must be careful to avoid shorting the coil or mechanically fouling the relay armature. A protective cover of some sort, or mounting the relay inside the amplifier, seems like a good idea.

For keying, the amplifier requires a closure across its **KEY** jack (12 V open circuit, 150 mA closed circuit). Almost any modern radio will key the Commander II without damage, except for some early, unmodified FT-736Rs (see Product Review, May 1990 *QST*). Even so, "crash keying" a power amplifier isn't a good idea. If you're going to use an external preamplifier, particularly a mast-mounted unit, you should key the amplifier, preamp and radio via a TR sequencer such as the one on pages 31-9 through 31-12 of *The 1992 ARRL Handbook* or those available from several *QST* advertisers. A sequencer minimizes the chance of damaging the preamplifier by sending a kilowatt of RF up the feed line before the preamp's switching-relay contacts have settled. It also avoids hot-switching the amplifier's \$200+ TR relay!

Although the Commander II is wired for 120 V at the factory and supplied with a 120-V power connector, Command Technologies recommends that you operate the amplifier from a 240-V line. Rewiring the amplifier for 240-V operation is a simple matter of moving two jumpers on a terminal strip under a small access cover on the amplifier's back panel.

The Commander II's documentation is fairly complete, if brief. It includes several warnings about the dangers of high voltage and using high-power RF amplifiers, and contains a detailed tuning procedure designed to protect you and the amplifier. A schematic of the high-voltage power supply and its control circuitry is included, as is a separate one showing the RF section and the attendant switching, biasing and metering circuitry. The only serious omis-

sions from the Commander II's documentation are the 3CX800A7's maximum anode and grid currents. According to Command Technologies, in CW operation, you should never allow the amplifier to exceed 60 mA of grid current or 600 mA of key-down anode current. SSB operation yields considerably lower peak meter readings, but the tube can safely handle somewhat higher peak currents.

Command Technologies has revised the Commander II manual substantially and expects to be shipping it with new amplifiers in the near future. Anyone who's bought a Commander II during 1992 will also receive an updated manual as soon as it's ready.

Operation

When you power up the Commander II, 2 minutes pass before the 3CX800A7's indirectly heated cathode is ready for operation. Therefore, the amplifier imposes a 2-minute delay before enabling the TR circuitry. When the delay passes, a green lamp on the front panel illuminates, indicating that the Commander II is ready to operate.

Tuning the Commander is smooth as silk, thanks to its 6:1 reduction output **TUNE** and **LOAD** controls and its multiturn **INPUT**-tuning control. You can tune the amplifier to several hundred watts output with less than 10 W of drive, which gets you quite close to the final tuning settings. Tables 2 and 3 show what you can expect from the Commander II.

The amplifier got quite a workout during the review period. It saw service in this year's January VHF Sweepstakes from a Connecticut home station, from a New Hampshire home station in the Spring Sprint, and in the June VHF QSO Party from an Eastern Pennsylvania hilltop. It performed flawlessly. During the January event, the amplifier's first use, the TR relay required some coercion (manual cycling) to actuate properly, but after that it operated reliably. Otherwise, the Commander II was a no-fuss kilowatt maker from the word go. In 900+ QSOs, the amplifier seemed to loaf at 1000 W PEP output on SSB (according to a Bird 43P peak-reading wattmeter) and *really* loaf at its rated 650 W output on CW. Even during lengthy moonbounce schedules, the amplifier behaved well, though it did get rather warm. Even so, tuning is rock stable over time and temperature. Unless you make wide frequency deviations or change antennas often, you can practically set and forget the Commander II's controls.

Signal cleanliness on SSB is very important in contest work, especially when you're operating in the center of the Northeast Corridor near the calling frequencies, because others near you are listening for very weak signals close to your loud signal.

If your signal is wide, your IMD products will mask those weak signals and annoy the other operators on the band, who will surely let you know about it. Command Technologies specifies the Commander II's IMD products on SSB to be down at least 30 dB from PEP. The ARRL Lab doesn't yet have the equipment to measure this accurately (without taking the driver signal's IMD into account). My experiences indicate that the amplifier is indeed very clean—probably much cleaner than its specifications guarantee.

Summary

A serious competitor in this market for a robust, non-backbreaking 2-meter amplifier, the Commander II is worthy of your consideration if you're looking for an amplifier that gets you in range of serious contest, moonbounce, aurora or meteor-scatter operation.

Thanks to Chet Slabinski, N8RA, Ed Parsons, K1TR, and Andy Zwirko, KA1GD (and the rest of the K1TR/3 June VHF contest group), for their help evaluating the Commander II.

Manufacturer's suggested retail price: \$1595. Warranty: 5 years (first year, 100% parts and labor; second year, 50% parts and labor; third through fifth years, 25% parts and labor), except for the 3CX800A7 tube, which is warranted by Eimac through Command Technologies. Manufacturer: Command Technologies, 1117 W High St, Bryan, OH 43506, tel 800-736-0443 or 419-636-0443, fax 419-636-2269. QST

Strays



AFRICAN 10-METER BEACON

□ Beacons strategically placed around the world help amateurs assess propagation conditions HF and VHF bands. The *ARRL Repeater Directory*, *ARRL Operating Manual* and the *Radio Amateur Callbook* list many known beacons. Z21ANB on 28.250 MHz in Bulawayo, Zimbabwe (grid square KG49) puts out 8 watts from a ground plane antenna on the roof of an office building 34 feet above the ground. The beacon is sponsored by the Zimbabwe Amateur Radio Society (ZARS), and its old equipment is lovingly tended by Eric Cohen, Z21BC/R, and Peter van Ek, Z21HC/R. Send reception reports and comments to Molly Henderson, Z21JE, Secretary of Council, ZARS, PO Box 2377, Harare, Zimbabwe.

The Z21ANB operators remind amateurs that the serious drought in Africa has necessitated electrical power load-shedding. This means that if the beacon is not heard at times, it may not be caused by poor band conditions, but the station may be temporarily off the air.