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Fox-Tango YF-90H1.8 Crystal Filter

Robot 800 Specialty Mode Terminal

Wilson Systems, Inc System 40 Tribander

Product Review

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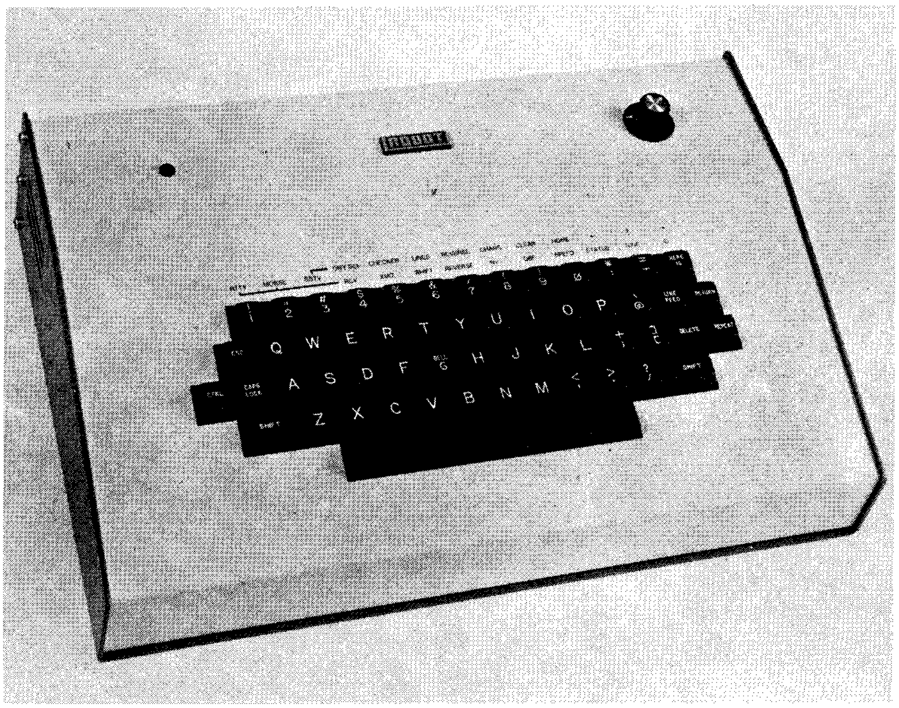
Robot 800 Specialty Mode Terminal



"Silent RTTY" is well entrenched and growing every day. If you've never experienced this exciting mode of communication, you're missing a lot of fun. With a unit such as the Robot 800 and a video monitor, you can open a new range of communications experiences to yourself. RTTY (Baudot), ASCII, cw and SSTV character generation are at your fingertips.

The Robot 800 is designed to send and receive 850- and 170-Hz shift RTTY at speeds of 60, 66, 75, 100 and 132 wpm, Morse at 1 to 99 wpm, and ASCII at 110 baud. It also acts as a character generator for SSTV, but a unit such as the Robot 400 is required for complete SSTV operation. A video monitor (not available from Robot) is required to complete the system.

Physical Sketch

The 4 × 15.5 × 10.25-inch[1] (HWD) unit weighs 10 pounds. A rugged, two-piece, two-toned (dark gray and white) sloping keyboard cabinet houses the Robot 800 electronics, which are mounted on a neatly arranged, double-sided, glass-epoxy circuit board. The unit certainly appears to have been built to last, providing years of trouble-free service.

Interface between man and machine is by means of a rear-panel mounted ON/OFF switch, SIDETONE and afsk OUTPUT level controls, a top-mounted input level control, and the 55-key keyboard. All control functions, alphanumeric and special character generation are implemented from the keyboard, which has a touch I found quite comfortable.

Machine-to-machine connections are made from the rear panel. Each Robot 800 is supplied with four cable assemblies to permit quick and easy equipment interconnection. Two three-circuit jacks provide CW KEYing and TO XMTR (afsk) outputs to the transmitter. Phono jacks are used for fsk output keying (TTY LOOP), receiver audio input (FROM RCVR), and SCOPE MARK and SPACE outputs that may be connected to a scope used as a tuning indicator. A female BNC (TO MONITOR) connector links a video monitor to the '800. The AUX OUT jack is used with the Robot 400 SSTV scan converter. A ground terminal, ac line cord and fuse holder are also located at the rear of the unit.

Electronics

The Robot 800 is a "dedicated computer"; a microcomputer that is designed for a specific application. For those "into computers," the '800 uses an 8085A μP, supported by 6144 bytes of ROM and 2560 bytes of RAM. An 8251 USART is used for serial I/O and 8155s for parallel I/O and keyboard interfacing.

The built-in TU (terminal unit) employs active filters. These are constructed using low-cost 1458 dual op amps. Following the input level control is a high-pass/low-pass filter combination. Only the high-pass filter section is used during 850-Hz shift RTTY reception. A limiter, separate mark/space discriminators for 850- and 170-Hz shift, full-wave rectifiers, tuning indicator, low-pass filter, ATC (Automatic Threshold Computer) and slicer sections follow. A sidetone oscillator for monitoring and certain signaling applications and a sine-wave synthesizer for afsk generation are also included.

In Operation

As is typical of many Amateur Radio stations today, a transceiver is used at N1FB. Baudot (using afsk and fsk), cw and ASCII were employed, Baudot quickly becoming a favorite mode.

CW

I haven't used a machine yet that could match the human ear/brain combination for copying cw under all operating conditions. The Robot 800 was no exception. When copying machine-sent cw with good reception conditions, the '800 performed well, but for the most part, I relied on "head copy" while using the keyboard for transmitting.

The RTTY mark channel filter (1275 Hz) is used by the Robot 800 when copying cw, and though the passband is narrow (about 70 Hz), the transceiver must be operated with the MODE switch in the LSB or USB position. Because the ssb filter must be in the i-f chain in order to pass the 1275-Hz tone required by the '800, it compromises the station operation in a couple of ways. First, while the narrow passband of the mark channel audio filter can protect the '800 from unwanted audio frequencies, the bandwidth of the ssb filter is about four times as great as that of the cw filter (500-Hz cw filter being used). This allows unwanted signals to get to the i-f stages of the receiver section and degrade overall receiver performance. Second, some transceivers automatically insert the cw filter when the transceiver MODE switch is in the CW position; there is no narrow/wide selection switch. This means that the operator must continually switch between the CW and USB MODE switch positions when going between transmit and receive because the transmitter cw keying circuit is deactivated in the SSB mode.

Another anomaly noted was the extended word spacing that occurs when an end of line is reached. A carriage return/line feed is automatically generated by the microcomputer, and this causes a slightly exaggerated word space at that point. But the CR/LF is a necessity for machine-to-machine copy and shouldn't unduly upset an operator copying by ear.

ASCII

Few ASCII stations were noted on the air. Some that were heard couldn't be copied because their transmission speed exceeded the 110 baud rate of the '800. Copying ASCII is fun — the characters stream from left to right

[1]mm = in. × 25.4; kg = lb × 0.454
*Assistant Technical Editor

across the screen quickly and smoothly. It's another story when it comes to transmitting, however! Unless you're a terrific typist, the 511-character transmit buffer will empty before you know it and you're back to transmitting at whatever speed your typing skill permits. For me, that's about 50 wpm. And since I had no specific reason to use ASCII, I "QSYd" to RTTY, where the predominantly used speed of 60 wpm more closely matched my typing speed.

RTTY

Some transceiver models permit switching between fsk and afsk transmission with a flick of the mode switch. I set my unit up that way, preferring to use afsk because of the MONITOR feature my transceiver employs. This enables me to keep a constant check of the output tone quality while monitoring the transmitted waveform on an SB-610 scope. The FSK position of the transceiver was used only when QRM was rough and the narrower passband of the cw filter was desired.

I felt (as did some other Robot owners to whom I spoke) that a transmit buffer capacity of double that available (511 characters) would be most welcome. However, there is also a tie-in with the video display, which will show only 11 lines of transmit text, no matter how full the buffer is. The same memory is used for the screen display and transmit buffer. If the screen is called to present all received text, any information that may have been stored in the transmit buffer is erased.

Another instance in which the buffer is erased is when any transition is made from receive to transmit and back to receive again *without transmitting the text* (two ESCape key depressions). The '800 is fooled into thinking that the transmit buffer has been called to empty, when in actuality nothing has been transmitted.

Tuning in an RTTY signal is simple. You merely adjust the receiver/transceiver tuning control for maximum deflection of a bar in the upper left-hand corner of the screen. No external tuning scope is required although mark and space channel outputs are provided for that purpose on the rear panel.

I never ceased to be amazed at the ability of the Robot TU to copy RTTY signals that I could hardly discern by ear! Rapid QSB was the greatest enemy of perfect reception, otherwise it appeared as though little could deter the Robot from the assigned task of copying a desired incoming signal. On many occasions, very strong adjacent signals would literally "bury" the desired signal, but the Robot kept on printing to the screen as if nothing had changed.

Two 64-character message memories make a convenient place to store short, oft-repeated messages such as your call sign, name and location for inclusion in a CQ. A separate i-d message memory can be called to identify the station, but the transmission speed of the cw i-d during RTTY operation cannot be altered; it is fixed at about 16 wpm.

General

The instruction manual that accompanies the Robot 800 is a vinyl-clad loose-leaf three-ring binder. It is well written and includes schematic diagrams of the unit. Some resistor values used in the TU were not noted on the diagram, perhaps because they are used for trimming the discriminators. Parts lists, a quick reference guide for the keystrokes required to make the '800 perform (too many to list here), and an addendum that notes the parts value differences between the low-tone model 800 and high-tone model 800H are included. Block diagrams and a complete technical description of the terminal unit aid the owner in understanding the operation of the Robot 800.

The low-tone model 800 uses 1275-Hz mark and 1445-Hz space tones for 170-Hz shift, and a 2125-Hz space tone for 850-Hz shift on RTTY. An 800H high-tone pair model is available that uses tone frequencies of 2125 Hz for mark and 2295 Hz for space with 170-Hz shift, with a 2975-Hz space frequency for 850-Hz shift.

There are more features to list than space allows, but some of these are: A Morse trainer that sends random 5-letter groups at selected speeds from 1 to 99 wpm, keyboard-operated transmitter control (KOX), on-screen status and tuning indicators, unshift on space, automatic carriage return/line feed, "RY" and "Quick Brown Fox" test messages, and 8-character programmable WRU (Who aRe yoU) and SELCAL (SELective CALling) codes. Using the continuous line or word transmit modes and the editing feature can make your transmissions smooth and errorless.

Each display line contains 72 characters, with 11 lines devoted to received text and 11 lines to transmit text when using the split-screen mode. In the full-screen mode (deleting the status indicator and divider lines), 24 lines of text are presented. Word wrap-around prevents the awkward splitting of words at the end of a line.

Early models of the Robot 800 did not have the split-screen feature. If you own one of those units, you'll be pleased to know that it may be retrofitted at the factory for $40 plus shipping charges.

Summary

If you've never used a terminal like the Robot 800 or have never operated RTTY or ASCII, I'd recommend a little off-the-air practice beforehand — if not for your sake, for the other guy's! Try to eliminate as much of the "cockpit error" as you can before generating any rf energy. The quick-reference keystroke guide can be removed from the instruction manual and placed conveniently nearby to help you.

I thoroughly enjoyed using the '800. It provided me with hours of trouble-free enjoyment. Not once did it glitch, even when an unenclosed 1-kW amplifier was being used. If you want more information, contact Robot Research Inc., 7591 Convoy Ct., San Diego, CA 92111. Price class: $800. — *Paul K. Pagel, N1FB*

WILSON SYSTEMS, INC. SYSTEM 40 TRIBANDER

□Within the past few years, several antenna manufacturers have introduced large tribanders. The Wilson System 40, with 10 elements, the longest of which is 36 ft,[2] certainly ranks as one of the most imposing! The antenna arrived packed in two long, heavyweight shipping cartons, and ideas of "instant Yagi" were speedily revised! Twenty-three hours later, after following the instructions in Wilson's thorough assembly manual, the System 40 was ready to go aloft at AC1Y. It is worth noting that much of that time was spent in inventorying the hundreds of bolts, nuts and washers that hold the antenna clamps together. The extra effort was worthwhile, permitting smooth assembly.

Mechanical and Electrical Details

The System 40 is not a typical tribander. Rather it may be described as two antennas interlaced on a common boom. The first antenna is a full-sized, 4-element, 20-meter monobander; the second antenna is a 6-element trap duobander for 15 and 10 meters. There are four active elements on 15 and five on 10. The feed system is formed by a beta match driving the 20-meter and 15/10-meter driven elements in parallel. An rf choke, supplied by Wilson, is a coil of RG-8/X coaxial cable encased in a heavy plastic tube.

The antenna element sections have slots for ease of assembly, and sturdy compression clamps secure the telescoped sections. Polypropylene rope supplied in the kit is not for use with a gin pole! Appropriate lengths of the rope are cut for each untrapped element half and inserted therein during assembly. The rope within the elements serves to damp wind-induced vibration, and helps to prevent premature weakening and structural breakdown of the aluminum. A large plastic envelope containing conductive grease was supplied with the antenna to facilitate assembly and to ensure future electrical continuity. This compound is very often missing from antenna kits; it definitely prolongs the useful life of the antenna.

Wilson rates the System 40 at 12.1 sq. ft of surface area with a finished weight of approximately 75 lb. Power handling capability is 2 kW PEP input. A Yagi of this size requires both a secure tower installation and a hefty rotator. I have utilized a CDE Ham III and an Alliance HD-73 with excellent results. However, it is worth noting that I provided for adequate torque stress relief in the rotor system by mounting the rotor approximately 8 ft below the tower thrust bearing.

The System 40 did not, at first test, yield VSWR curves on 10 and 15 meters within the range suggested by the manufacturer. Two factors were found responsible: My tower installation included uninsulated guys as well as a number of wire antennas suspended within several feet of the System 40. In addition, during discussion of the VSWR problem with the factory, I learned that the design was prototyped atop a 60-ft freestanding tower with no adjustment provided for problems with resonant guy wires. Wilson agreed that their design parameters might not be electrically compatible with some individual installations. The manufacturer advised me that they were sending new traps to those System 40 owners experiencing VSWR problems. (These traps lower the resonant frequency of the antenna on 10 and 15 meters.) The new traps arrived soon afterward, at which time I proceeded to insert insulators in the top set of guys. The new traps were installed, and new VSWR curves were taken; these are shown in Fig. 1. They represent the broadband nature of the System 40 design, which should present a reasonable match for modern solid-state transceivers. Experience shows that VSWR curves are representative in an antenna manufacturer's literature, and will likely vary between individual installations.

In well over a year of operation at AC1Y, the System 40 has given good front-to-back and

[2] m = feet × 3.28; $m^2 = ft^2 \times 0.0929$; kg = lb × 0.454.

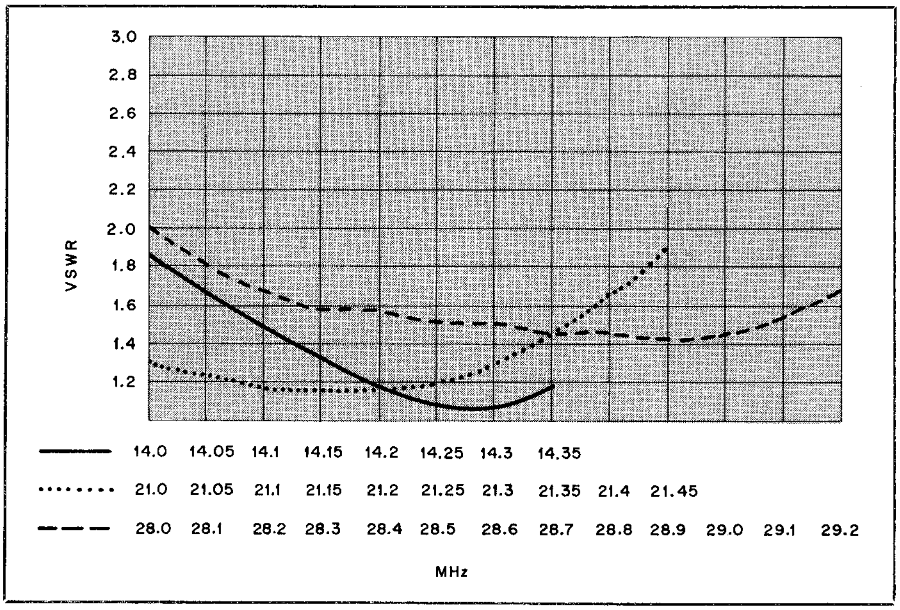


Fig. 1 — SWR curve of the Wilson SY-40 tribander.

front-to-side ratios; performance on all three bands yield consistent results in this category. Forward gain, too, appears to be excellent, judging from signal reports received. Overall, the System 40 has performed very well mechanically, having withstood some nasty Connecticut winter weather this past year, including two ice storms! Recent inspection of the antenna shows it to be in fine shape.

The System 40 is well designed. Although it has a great many small parts in the bolt and nut category, everything together makes for a sound Yagi. The amount of assembly time required is worthwhile, considering the durability the antenna provides. The aluminum and associated hardware is of excellent quality, and the instructions are thorough. The System 40 is manufactured by Wilson Systems, Inc., 4286 S. Polaris Ave., Las Vegas NV 89103. Price class is $395. — *Sandy Gerli, AC1Y*

FOX-TANGO YF-90H1.8 CRYSTAL FILTER

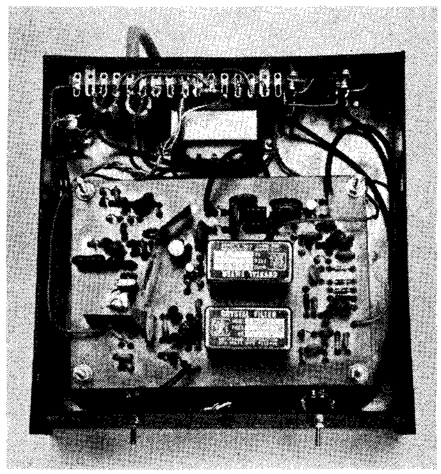
□ An essential trait of a communications receiver is good adjacent-channel selectivity. In a modern superheterodyne receiver, this quality is determined by the i-f filter and associated circuit. In a filter type ssb voice transmitter, the filter defines the audio fidelity and establishes adequate opposite sideband (and sometimes carrier) suppression. Transceive applications require filters having all of these characteristics; in short, the i-f filter is the heart of a superheterodyne communications transceiver.

When the i-f is in the hf range, quartz crystals are usually employed in the filter. *QST* has offered articles on home construction of crystal filters, but the process can be tedious, and the design is not easy. Today most builders design their radio circuits around commercially manufactured filters of known performance. I opted for this "systems engineering" approach when roughing out the design for the hybrid speech processor featured in the 1982 *Handbook*. Milt Lowens, N4ML of Fox-Tango Corporation, recommended the YF-90H1.8 crystal filter for my application and supplied a pair of these units for evaluation. The YF-90H1.8 is a 1.8-kHz bandwidth, eight-pole[3] filter designed for plug-in replacement service in the Yaesu FT-301 and FT-7B transceivers. The Fox-Tango literature gives complete specifications for the filter, but because they were destined for unusual service, some tests and measurements were necessary before I could finalize my design.

The specifications are summarized in the table, but as with most measurements, there's a story behind the numbers. A 2500-3000 Hz bandwidth is accepted as standard for a voice channel, so if you think a bandwidth of 1800 Hz is a bit sharp, you're right. The 3000-Hz requirement is for intelligibility and recognizability. With only 1800 Hz to work with, we have to be satisfied with intelligibility. But to get that intelligibility, we must select the *proper* 1800-Hz bandwidth. The optimum slice will vary from voice to voice, but it's safe to say that 0-1800 Hz is not optimum. Many voice devices have an upper frequency 3-dB rolloff of 2500 Hz. When the upper −3 dB response of the YF-90H1.8 is set at 2500 Hz, the specified −6 dB response is at 2950 Hz. The corresponding lower −3 dB and −6 dB responses fall at 1350 Hz and 1150 Hz, respectively. The half-power bandwidth of the YF-90H1.8, then, is 1600 Hz. For voice modulation or demodulation, the carrier oscillator should be set to 8.99795 MHz or 9.00205 MHz to center the filter passband on the 1350-2500 Hz range. This is the second formant of the speech spectrum. The articulation is contained in this formant.

In the *Handbook* speech processor, the second-formant signal is heterodyned up to 9 MHz, where it is filtered, clipped, filtered again and finally demodulated as recovered audio. A single carrier oscillator serves for both the modulation and demodulation processes, so the output frequency is the same as the input frequency. The carrier oscillator frequency is important, but only in selecting the proper audio passband. In a receiver or transmitter, however, the carrier oscillator frequency is critical, not only for passband selection, but also for accurate demodulation. With "normal" communications bandwidths of 2400 Hz, the receiver can be mistuned a couple of hundred hertz, and an experienced operator can still understand the "gravelly" or "Donald

[3]The term "pole" is often tossed about by amateurs without thorough understanding. When pressed for an explanation, most hams (including this one) are inclined to stutter. The concepts of "poles" and "zeros" are based on some fairly sophisticated mathematics, including root locus and complex variables. At the risk of oversimplification, a pole is a parallel-resonant circuit, and a zero is a series-resonant circuit. Unless it's necessary to discuss the fine details of filter design theory, perhaps it's safer (and more useful) to describe the product being reviewed as an "eight-crystal filter," "eight-resonator filter" or "eight-element filter."


Two Fox-Tango YF-90H1.8 crystal filters are used in the hybrid speech processor featured in the 1982 *Handbook.*

Fox-Tango YF-90H1.8 Crystal Filter

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Center frequency: 9.000 MHz.	As specified.
6-dB bandwidth: 1800 (± 100) Hz.	1700 Hz.
Insertion loss: 6 dB.	3 dB.
Terminating impedance: 500 ohms, resistive.	
Case dimensions: (HWD) 18 × 18 × 50 mm.	As specified.