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Heathkit HD-3030 Computer Interface

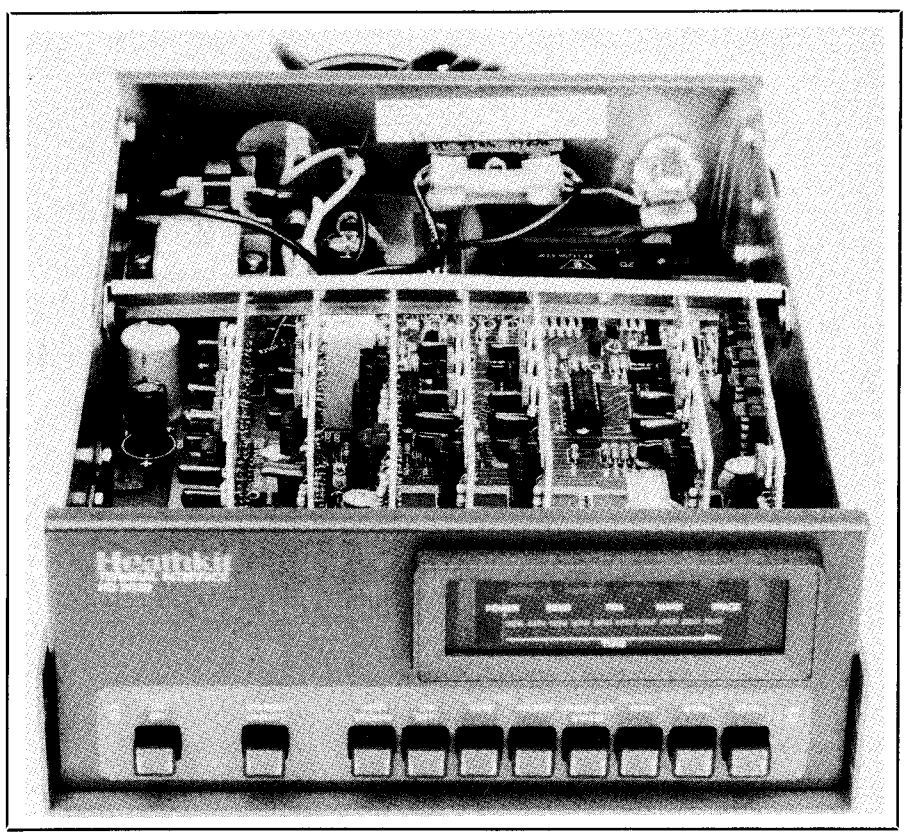
KLM 144-148-13LBA 2-M Yagi

Mirage Communications B215 2-Meter Amplifier

Product Review

Conducted By Paul K. Pagel,* N1FB

Heathkit HD-3030 Computer Interface



Heathkit's HD-3030 is a versatile interface that can match most any computer or teletypewriter (TTY) machine to any radio. Audio from the radio is converted to sequential signals in RS-232-C, TTL and 20- or 60-mA loop levels. Computer signals are translated into FSK or AFSK for transmission.

RTTY software can be purchased from Heath for their H-8 and H-89 computers. Those of us who own other computers can purchase software of our preference (from other suppliers) and make up the interface cables as required. I own a Commodore 64™, and used the Kantronics Hamtext™ software during the test period.

The HD-3030 circuit design comes from the Flesher TU-470 (Product Review, June 1983 *QST;* Heath markets the kit through an agreement with Flesher), and provides a multitude of features at data rates of up to 300 bauds.

- Space and mark frequencies are detected during RTTY operation. Front-panel switches allow you to reverse the frequency shift for incoming signals or outgoing signals, or both. Rear-panel connections are provided for use of an oscilloscope as a tuning aid.
- The interface provides TTL, RS-232-C and 20- or 60-mA current-loop connections. You enable (and set the level) or disable the current loop during construction.
- Autostart is accomplished with a Received Data Available (RDA) signal on the TTL and RS-232-C lines. A 117-V, 3-A relay-controlled outlet on the rear panel is keyed (by RDA) for activation of a mechanical TTY or computer power supply.
- FSK-control and AFSK (crystal-controlled) signals are provided.
- The HD-3030 comes with a 2125-Hz mark filter and a 2295-Hz space filter for 170-Hz operation. The main circuit board has connectors for 2250-Hz (450-Hz shift) and 2975-Hz (850-Hz shift) optional space filters.
- An optional 170-Hz preselector adds four 2-pole active filters to aid reception under crowded band conditions.
- The RTTY demodulator circuit includes a discriminator, low-pass filter, signal-balance restorer, slicer and mark-hold circuit.
- CW is demodulated by a separate circuit board with a dedicated three-stage filter.

Construction

Heath uses high-quality components throughout the HD-3030. The circuit boards are double-sided with plated-through holes. A heavy-gauge steel chassis and cabinet provide strength and RF shielding. A 117-V power supply and a 20- or 60-mA loop supply (portable operation with a single 12-V supply is not possible) are part of the circuit. The complete interface (3 × 7.5 × 10 inches, HWD) weighs nearly 17 pounds.[1] Red and white lettering over a subtle brown-tone cabinet finish allows the '3030 to fit into any station decor.

The assembly instructions are clear and easy to follow, consistent with Heathkit tradition. A 91-page instruction manual and a 24-page pictorial booklet are supplied with the kit. "X-ray" views of all circuit boards are included in the pictorials, and there are detailed explanations of circuit operation at the back of the manual. Construction takes a modular approach that makes it easy to work in a small area. (I built the kit on a folding tray in about 21 hours in my living room!) Each circuit board and the parts for that board are packed separately. There are few parts involved in any one stage of the operation. Also, most small parts are packed, in order of assembly, on tape strips.

Parts placement is clearly indicated on the circuit boards and in the instructions. Some of the components are placed close together, though, so I recommend use of a soldering iron with a small, conical tip. Alignment requires only a radio and an ac voltmeter with 1.5- and 10-V scales.

Cable preparation and connection of the interface to the station are the most difficult construction tasks. Since the '3030 can work with virtually any combination of radio and computer, there is a myriad of possible connection schemes.

Heath has answered this problem with an interconnection chart. The chart has two columns, each listing the pin numbers for a DB25 connector. One side of the chart lists the connections at the '3030. The builder completes the second column by listing the signals at the computer connector next to the corresponding pin numbers. Lines are then drawn from each signal in the first column to the corresponding signal in the second column. When the process is complete, the builder has drawn a schematic of the interconnection cable (provided that the computer uses a DB25 connector).

At this point, I faced some decisions about interface arrangements. The HD-3030 uses XMIT

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[1]mm = in × 25.4; kg = lb × 0.454.

(N and P) to control the PTT and CW-keying lines to the transmitter. I checked two transceivers (Kenwood and Yaesu) and found that the CW line of each is effective in the CW mode only (although voltage is present at all times in the Kenwood). The PTT line, however, is active at all times in both radios. Neither transceiver is meant to operate QSK. Also, heavy switching duty can quickly age a relay. Therefore, I decided to use the XMIT output for CW keying only, and VOX or manual transmitter switching. This probably is the most common station-control arrangement. (Heath describes this setup under "Sending CW" on page 71 of their manual.)

The second decision concerns software/hardware compatibility. TR, CW and RTTY CW-ID operation of the HD-3030 require one line each for TR (SEND), tone-shift control (KEY-N) and AFSK (AFSKIN), with CW keying signals on the TR line and RTTY CW-ID keying on the AFSK line. To accomplish RTTY CW-ID, TR must be in the transmit state, the tone-shift line must be "pulled" low and CW-keying signals must be applied to the AFSKIN line. Kantronics Hamtext provides separate TR and CW keying lines with the TR line keyed for RTTY identification. No line is provided for tone-shift on ID. This situation makes it impossible to use the full features of the hardware and software together. Happily, the FCC has eliminated the CW-ID requirement on RTTY/ASCII transmissions. My solution is to wire the Kantronics TR and CW-key lines together (with isolation diodes; see Fig. 5) and do without the RTTY CW-ID function. Complex logic or manual switching would be required to recover the feature when using this hardware/software combination.

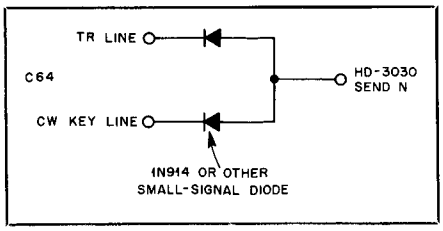


Fig. 1 — C 64/Hamtext to Heath HD-3030 control connection for TR and CW keying.

Circuit Operation

In the receive mode, audio (100 mV) from the receiver enters the '3030 through pin 13 of the DB25 connector. The signal is routed to the preselector or directly to the audio amplifier as determined by the PRESELECT/BYPASS switch position. Preselect is active only for 170-Hz shift and when the optional preselector board is installed. Two transistors amplify and two diodes clip the audio signal.

The signal is then supplied to the inputs of all filter boards. Each board contains three 2-pole, low-gain, low-Q stages that are cascaded to provide a very sharp and stable filter. Diodes on each board select the proper AFSK signals for transmission. The 2295-Hz space filter includes a phase-shift network to ensure the proper space/mark shift for the scope outputs (pins 7 and 8, DB25). Filter output is placed on the main-board bus for use by the decoder boards.

An RTTY decoder board is the heart of the HD-3030. A discriminator, low-pass filter and signal-balance restorer "clean up" and balance the space and mark signals. The slicer hysteresis (positive feedback) level prevents slight signal fluctuations from producing erroneous output signals. The mark-hold circuit returns the demodulator output to the mark state whenever a space signal exceeds 150 ms in length. More on this later.

The CW demodulator contains a separate filter, as opposed to using the RTTY filter as with some other modems. The filter center frequency is set to the sidetone frequency of your radio during alignment of the '3030. Thus, as long as the sidetone matches the receive offset of the transceiver, tuning is near zero beat when the incoming signal is in the filter passband. Unfortunately, the signal processing "magic" performed by the RTTY demodulator is not possible when working with one signal only.

The demodulator output goes to the RDA threshold circuit, display, RS-232-C output, and level-shift circuits for TTL output and loop control. If the mark level exceeds the setting of the RDA-threshold control (the control is inside the case and adjusted only during alignment), an RDA signal is placed on pin 1 of the DB25 connector and the autostart relay is closed. Mark and space signals are displayed by separate LEDs and the bar-graph display. Once through the filters, all signals in the '3030 are −10 V (mark) or +10 V (space). These levels are supplied as RS-232-C out (pin 4 — this and all subsequent pin numbers refer to the DB25 connector). A single transistor is keyed to provide TTL out, and a combination of three transistors keys the current-loop supply. (Do not leave the loop circuit open during operation with the loop supply enabled. Damage to the supply may result.)

The interface is placed in the transmit mode by pressing the SEND button on the front panel, supplying an RS-232-C (+3 V send, −3 V receive, to pin 25) or a TTL signal (low = send, pin 9). All send signals also switch the positive (pin 10) and negative (pin 11) outputs, which are used for PTT and CW keying. Loop keying is changed to TTL by a transistor, and supplied to the TTL input (pin 5), which keys CMOS logic circuits through another transistor.

Once in the CMOS logic circuits, signals from TTL follow the same path as RS-232-C signals, which enter the CMOS circuitry directly at pin 6. AFSK keying signals (±10-V) are then fed to the divider-program diodes of the selected filter to key the appropriate frequencies. AFSK output (pin 12) is adjustable (from inside the cabinet) from 0- to 2-V RMS (600 Ω). FSK control (−6 V mark, +6 V space, 3-kΩ load: pin 14) is achieved by a comparator driven by the mark/space switching circuits.

The AFSK board contains a 5.08-MHz crystal oscillator, two programmable-divider ICs (together they divide the oscillator frequency by any integer from 2 to 256) and one divide-by-16 IC. The oscillator is effectively switched on or off by enabling or disabling the final divider. This system can provide frequencies from 1240 Hz to 158,750 Hz. Worst-case resolution for AFSK is 28 Hz at 2995 Hz. Any frequency change because of temperature is divided by at least 212 to reach AFSK frequencies. AFSK tones from the '3030 should be very stable.

A TTL CW-ID signal (pin 2) selects the CW frequency from the AFSK board and disables the mark/space switching circuits. This input is used with AFSKIN for CW identification on RTTY only. Normal CW keying is applied to the SEND lines (pin 9 TTL, pin 25 RS-232-C).

Controls and Connections

Control functions on the HD-3030 are clearly labeled, and operating instructions are almost unnecessary. The display is comprised of an LED bar graph to show signal strength, and separate LEDs to indicate POWER (on), SEND, RDA, MARK and SPACE. Incoming signals are tuned by adjusting the receiver frequency for a maximum bar-graph display with the MARK and SPACE LEDs flashing alternately. The SEND indicator lights when the modem is in the transmit mode. Autostart activity is indicated by the RDA light. (RDA level is adjustable, but Heath recommends that it be set for about half scale on the bar graph.)

An assembly of flag-type, push-button switches provides all front-panel control. These switches have small color plates in the buttons that appear when the switch is active. It is easy to tell which functions are selected with a single glance. From left to right, the functions available are POWER, STANDBY/OPERATE, SEND/RECEIVE (can be software controlled), CW/RTTY, REVERSE SHIFT (one button for SEND, one for RECEIVE), PRESELECT/BYPASS and AUDIO FREQUENCY SHIFT (one button each for 170 Hz, 425 Hz and 850 Hz).

Rear-panel connections are provided for LOOP — ¼-inch phone jack for connection to current-loop controlled equipment; AUX POWER — 117-V ac connector (with ground) keyed by the autostart circuit, for control of computer or mechanical TTY; GROUND — RF ground; I/O INTERCONNECT — DB25 female receptacle for connection of TTL, RS-232-C and audio signals.

Operation

Once the connections are made, operation is simple and straightforward. Tuning is easy with the indicators provided; for those who want more indicators, 'scope outputs are provided at the DB25 connector.

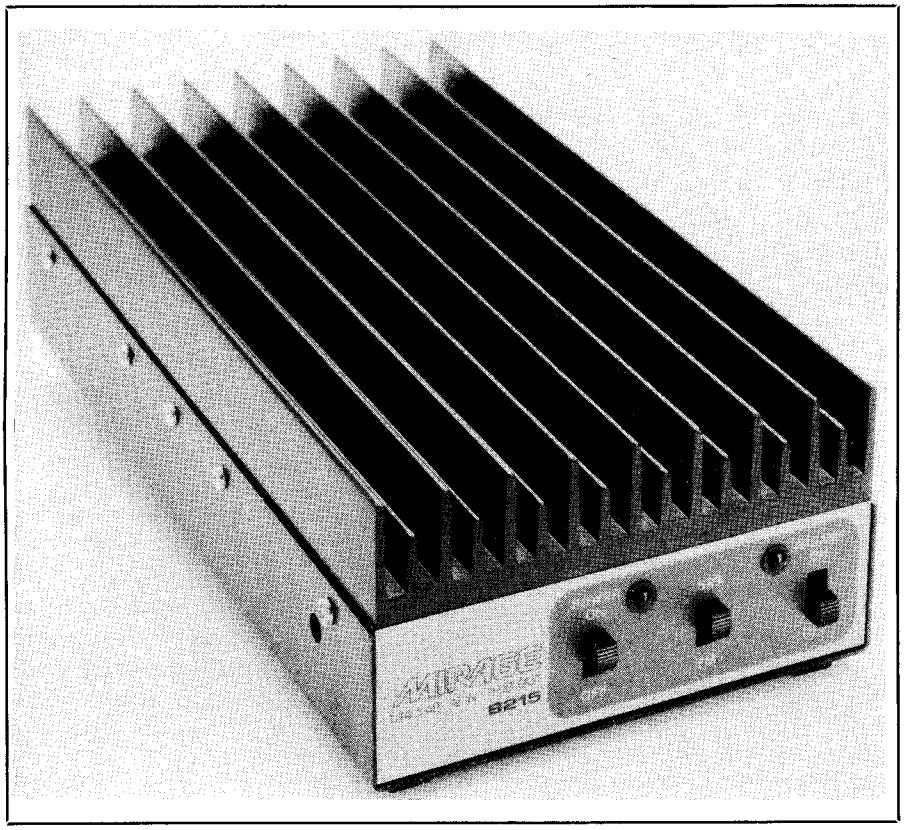
Upon completion of the interface, I wired some cables and proceeded to perform some output-voltage checks before connecting it to my computer. The voltage levels were correct, but there seemed to be a problem. Although the DMOUT-TTL line was (logic) high (+5 V) for mark, it was also high for space. I puzzled over the problem for quite some time before I read the manual again and understood the mark-hold feature. Each time I keyed the space frequency, DMOUT-TTL went low for 150 ms (not long enough for my analog voltmeter to react), then returned to 5 V.

After my misguided testing, I connected the HD-3030 to my radio and tuned to the W1AW RTTY bulletin. It only took about half a second to tune for perfect copy and to have the bulletin begin printing. After about five minutes, the text became unintelligible. Upon switching the software to the ASCII mode, a second perfect copy of the bulletin slid by.

Heath supplied the test unit with an optional 170-Hz preselector and one optional filter board. I was so happy with the performance of the completed interface that I immediately ordered the remaining filter board to fill the one empty slot. All functions and options work well, and excellent performance is achieved.

The HD-3030 performs well under noisy conditions. Tests show the Heath to have a low bit-error rate with lab-generated noise. I recommend the HD-3030 highly.

The HD-3030 is available from Heath Company, Benton Harbor, MI 49022. Price class for the HD-3030 is $249. Prices for the options are: HDA-3030-2 (optional filter board), $15; HDA-3030-4 (170-Hz preselector), $20. — *Bob Schetgen, KU7G*



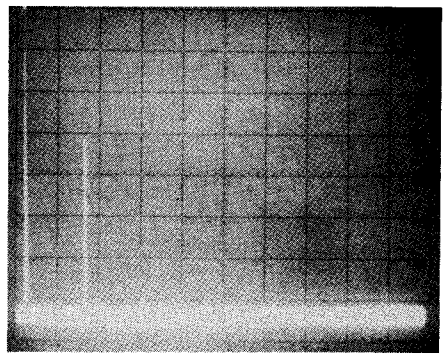


Fig. 2 — Worst-case spectral display of the Mirage B215 amplifier. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. Output power is approximately 150 W at 144.2 MHz. The fundamental (pip at the left of the photo) has been reduced in amplitude approximately 32 dB by means of a notch filter to prevent spectrum-analyzer overload. All harmonics and spurious emissions are at least 68 dB below peak fundamental output. The B215 complies with current FCC specifications for spectral purity.

Mirage Communications B215 2-Meter Amplifier, Serial No. 280-684

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency range: 144 to 148 MHz.	As specified.
Power output: 150 W or more for 2-W input. Input power 0.1 to 5 W.	10 W for 0.1-W drive: 110 W for 1-W drive; 145 W for 2-W drive; 150 W for 3-W drive; 155 W for 5-W drive.
Receive preamp: 10-dB gain with 2.5-dB (±0.5-dB) noise figure.	10 dB gain. NF not measured.
Power requirements: 13.6-V dc at 20-23 A nominal.	13.6-V dc at 23 A at 150-W output.
Input SWR: Not specified.	1.42 to 1 (145 MHz)
Size (HWD): 3 × 5.5 × 12 in†	
Weight: 5 lb	

†mm = in × 25.4; kg = lb × 0.454.

MIRAGE COMMUNICATIONS B215 2-METER AMPLIFIER

☐ The Mirage B215 is the perfect companion for a 2-meter FM hand-held or a low-power multimode rig. This amplifier features 150-W output for 2-W drive, along with a receive preamp. TR switching with a variable delay for SSB is a standard feature. An optional remote-control head (model RC-1), which duplicates the front-panel controls, is available if the user wants to mount the amplifier away from the operating position. This option is handy for mobile operation or for mounting the amplifier near the antenna in a base station if feed-line loss is a problem.

The B215 is a linear amplifier. It is always biased for linear operation, whether the front-panel switch is set to SSB or FM. The only difference between these two switch settings is the TR relay drop-out time delay. In the FM mode, the relay drops out instantaneously. For VOX SSB operation, the drop-out time may be adjusted with a screwdriver through a hole in the side panel. Drop-out time may be set anywhere between a few milliseconds and approximately 1.5 seconds.

RF-sensed switching is standard. Whenever approximately 0.1 W or more of RF drive is applied to the RADIO (input) jack on the rear panel, the amplifier automatically switches into transmit. A phono jack is provided on the rear panel for "hard wiring" the antenna relay to control it from the transceiver. Grounding the center pin of this phono jack places the amplifier in transmit.

Three switches and two pilot lights comprise the front panel. The POWER ON/OFF switch controls the power amplifier. As described earlier, the SSB/FM switch changes the time delay. The PREAMP ON/OFF switch controls the preamplifier. The power amplifier and preamplifier may be used separately or simultaneously, as operating conditions dictate.

The rear panel is equally straightforward. There are two SO-239 connectors for input and output, a phono jack for TR control, a six-pin Molex connector for the RC-1 and two heavy wires for dc power.

Two stages of power amplification are necessary to get from the 2-W level up to 150-W output. The first stage employs an MRF240A, while the second stage uses a pair of SRF3417 transistors. The preamp uses a U309. All components are mounted on a PC board that is bolted to the hefty heat sink that forms the top of the amplifier. A built-in thermostat shuts off the B215 if the heat-sink temperature reaches 170° F; it will not come back on until the heat-sink temperature drops below 140° F.[2] The amplifier features SWR protection. A 35-A fuse in the dc power line is located on the PC board. The cover must be removed to replace this fuse.

The B215 requires approximately 23 A at 13.8-V dc, so Mirage recommends using no. 8 wire between the amplifier and power source. If possible, the wires coming out the back of the brick should be connected directly to the battery or ac-operated power supply. At 23 A, there is substantial voltage drop in any length of wire.

I had the opportunity to use the B215 with a variety of rigs, including an IC-2AT FM hand-held transceiver, a Microwave Modules MMT144/28 linear transverter and an FT-726R multimode transceiver. Although the B215 is designed for use with hand-held rigs, using it with higher-power equipment proved to be no problem. With the MMT144/28 transverter, I simply adjusted the internal input attenuator for about 3-W output. With the FT-726R, I adjusted the front-panel DRIVE control for the right output.

It is important to note that the B215 manual cautions that input power must not exceed 5 W. Higher power may damage the driver transistor and will void the warranty. If your rig has more than 5-W output and no reliable means of controlling the power output, you should choose another power amplifier with higher drive requirements.

[2] $°C = \frac{5}{9}(°F - 32)$

I used the B215 for many SSB, CW and FM contacts during the review period in July and August 1984. The prime use was with a low-power FM rig and an AEA PKT-1 terminal node controller on packet radio. Local packet activity is concentrated on 145.01 MHz, and my station was the primary link between packeteers in the Hartford area and WØRLI near Boston. The B215 was left on almost continuously during this period. It functioned perfectly. The power was more than enough for a reliable link to WØRLI and others in the Boston area. The receive preamp often brought marginal signals up to a level that the TNC could copy with few tries. The highlight of this packet operation was working K1HTV near Washington, DC direct one evening when we had enhanced conditions.

On SSB and CW, the 150 W that the B215 provides was more than enough for solid QSOs around New England and into the New York, New Jersey and Pennsylvania area. Because of the convenience and ease of operation afforded by the B215, I rarely had the desire to turn on my tube-type amplifier.

ARRL staffer W1XX uses a B215 for VHF mountaintopping expeditions, especially during VHF/UHF contests. His 2-meter portable station is battery operated, so he uses an ICOM IC-202 SSB/CW hand-held 3-W transceiver for most of the operation. For contacts when the 3 W just won't get through, he switches in the B215. This combination is a real success because it conserves battery power, yet allows occasional high-power operation as necessary.

Mirage offers a five-year warranty on the B215 (except for the power transistors, which are warranted for one year). It is a solid piece of equipment that deserves consideration if you have a QRP 2-meter signal that occasionally needs a boost.

Price class: $290. Manufacturer: Mirage Communications Equipment, Inc., P.O. Box 1393, Gilroy, CA 95020. — *Mark Wilson, AA2Z*

KLM 144-148-13LBA 2-M YAGI

☐ There are many reasons for the universal popularity of the 2-meter band with radio amateurs. Band occupancy is high and there is a variety of interesting activities in which to participate. Propagation modes, repeaters and satellites allow excellent DX possibilities. Commercially built FM and multimode transceivers, transverters, amplifiers and antennas have helped populate the band.

New antenna designs have done much to improve VHF station performance in recent years. A few years ago, KLM announced the 144-148-13LB long boom, 2-meter Yagi.[3] The KLM 'LBA is an improved version of that antenna. A physical lightweight at 9 pounds, the 'LBA is a heavyweight performer.[4]

Assembly

Antenna assembly is straightforward and easy. After unpacking the antenna, I took the time to read the instructions completely — a habit well worth developing. Everything that one needs to know can be found in the eight-page documentation package. Large diagrams clearly illustrate proper assembly of the 'LBA. The next step was to sort the pieces and check them against the parts list. I used an old muffin tin to hold the hardware during assembly.

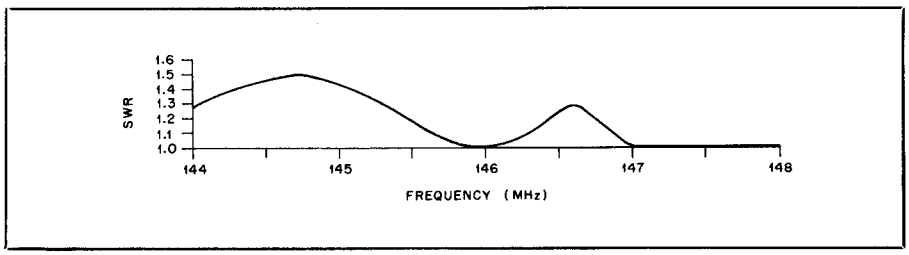


Fig. 3 — SWR curve of the KLM 144-148-13-LBA.

The five-section 'LBA boom is 1½ inches in diameter and about 21½ ft long. Each boom joint is secured with a pair of no. 8-32 screws and hardware. Insulators for the reflector and 10 directors are molded directly on the 3/16-in aluminum-rod elements. Parasitic elements mount in the boom rapidly. Elements are inserted in their predrilled holes and secured with stainless-steel keeper rings.

Multiple driven elements can be found on many KLM antennas — the 'LBA is no exception. It sports two driven elements, each made from 3/8-in tubing and mounted to the boom with sturdy plastic insulators. Dual-driven elements give two desirable characteristics to the 'LBA. The first is broad bandwidth (see Fig. 3). The second is a 200-ohm balanced feed-point impedance. An assembled 4:1 coaxial-line balun is included with the antenna. The 50-ohm coaxial feed line connects to the antenna by means of solder lugs that are also provided by KLM.

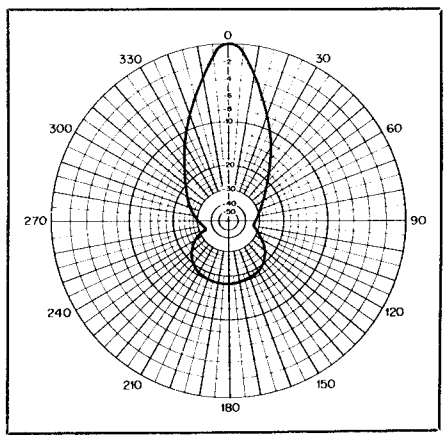


Fig. 4 — Measured radiation pattern of the KLM 144-148-13-LBA. Measurements were made between AA2Z and K8CH, a distance of about 20 miles.

Installation and Results

Installation of the 'LBA is easy. Attach the mounting plate to the boom at the balance point of the assembled antenna. I use a tower leg as a temporary "antenna mast" to ensure proper alignment while securing the plate to boom U bolts. That leaves only the plate-to-mast U bolts to tighten when the antenna is at the top of the tower.

Vertical mounting of the 'LBA is possible. KLM recommends a nonconducting mast that extends at least 6 inches either side of element tips. If you choose vertical mounting, the feed line must be brought off the antenna from the reflector end of the boom. That feed-line routing is important to prevent pattern distortion. Detailed instructions are included with the antenna. I chose horizontal polarization and so can't speak from experience about vertical polarization results — they should be good.

Of course, multiple 'LBAs can be used to form larger arrays. Instructions are given for assembly of two- and four-bay arrays. Stacking frames, power divider/couplers and phasing-harness cables are available from KLM. Spacing in those arrays is 12 to 14 feet vertically and 13 to 15 feet horizontally (horizontal polarization).

Results

During the review period, I raised my transmitted power output from 10 to 80 W. Even with 10 W, I was able to enjoy many CW and SSB QSOs with stations from Maine to southern New Jersey. With more power, I was able to work almost everything I could hear. The radiation pattern of the 'LBA shown in Fig. 4 was measured with the help of Mark Wilson, AA2Z, and a calibrated attenuator from the ARRL lab.

The 'LBA has weathered a hard New England winter; a couple of times it took wind gusts of up to 60 mi/h. During that storm, my tower and antenna system was doing a dance that would rival Antira. Mechanically, the antenna seems just as sound as the day it went up — and it is working just as well electrically, too.

The KLM-13LBA is available from KLM Electronics, Inc., 17025 Laurel Rd., Morgan Hill, CA 95037, tel. 408-779-7363. Price class: $100. — *Chuck Hutchinson, K8CH* QST

[3]B. Glassmeyer, "KLM 144-148-13 LB Antenna," Product Review, *QST*, October 1981, p. 48.
[4]mm = in × 25.4; m = ft × 0.3048; kg = lb × 0.454; km = mi × 1.609; km/h = mi/h × 1.609.

New Products

SUBLIMINAL CODE LEARNING

☐ Vince Luciani, K2VJ, is offering a different approach to learning Morse code: subconscious or subliminal learning. Said to be prepared by experts in the field of subliminal learning, Subliminal Code Learning is aimed at those who have difficulty initially learning the code or attempting to increase their recognition speed.

On one side of the tape, author Luciani announces the entire code alphabet, complete with the dots and dashes for each letter. But you won't hear any of it. Instead, you hear relaxing music. The code is presented subliminally for only your subconscious mind to hear and learn. The other side of the tape contains the vital affirmations that are meant to help you appreciate the code as fun, and the learning of it as a pleasure. The tape is available from Vince Luciani, K2VJ, P.O. Box 682, Cologne, NJ 08213. Price: $10.95, plus $1.50 for shipping and handling. A money-back guarantee is offered. — *Paul K. Pagel, N1FB*