Product Review Column from *QST* Magazine

March 1993

SSB Electronic SP-70 Mast-Mount Preamplifier

Down East Microwave DEM432 No-Tune 432-MHz Transverter

Down East Microwave 432PA 432-MHz Amplifier Kit

Conducted By James W. Healy, NJ2L
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SSB Electronic SP-70 Mast-Mount Preamplifier

Reviewed by Dick Jansson, WD4FAB,
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The latest and greatest low-noise preamplifiers are often discussed on the Amateur Radio VHF and UHF bands. The subject certainly is worthy of consideration, as satellite and terrestrial SSB and CW operators, especially, need the ability to hear very weak signals. Operators on these bands have been the beneficiaries of modern solid-state technology. Easily within recent memory, low-noise preamplifiers were a strange new breed using some esoteric and very expensive semiconductors. Seemingly, these units were outside the grasp of most hams.

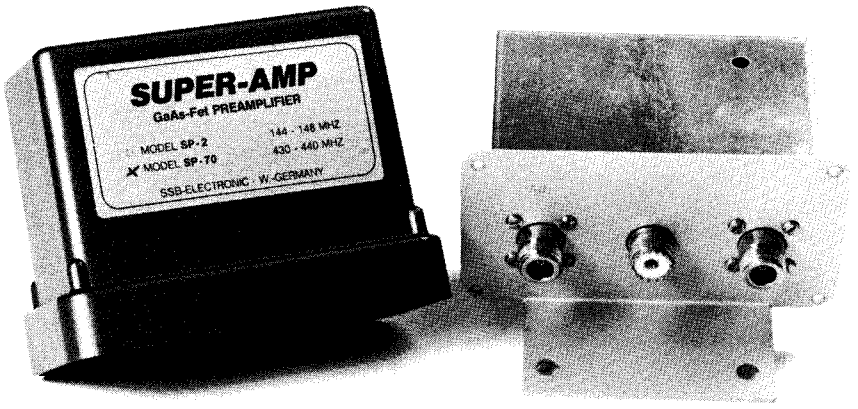
In the old days, the VHF/UHF amateur needed to assemble a good set of coaxial relays, the preamplifier (often home-brewed) and a switching controller (sequencer) needed to prevent switching transmitter power into the output end of the preamplifier. A number of commercial preamplifiers now offer all of these pieces in a single, weatherproof box designed to be mounted at the VHF/UHF antenna. The SSB Electronic SP-70 is such a unit.

Not long ago, obtaining a UHF noise figure (NF) of less than 2 dB from a preamplifier was a marvel. These days, preamplifiers with NFs of less than 0.5 dB are commonplace through at least 1296 MHz.

To the uninitiated, this noise-figure stuff may seem to be so much meaningless techtalk. Let's take a look at what NF can mean to you.

No matter how noise figures are derived, NF is fundamentally an expression of the level of minimum discernible signal (MDS)—the weakest signal your receiving system lets you hear. The lower the NF, the lower (better) the MDS.

Recent editions of *The ARRL Handbook* contain an excellent discussion of noise temperature, noise factor and noise figure—three ways to characterize receive-system sensitivity. This is recommended reading for anyone interested in UHF receiver performance. In the UHF-and-above range, galactic and terrestrial noise are so low that receivers are limited in their performance by their *internally generated noise.* This is the reason for the wide interest in low-noise preamplifiers.



The Bottom Line

The well-constructed, easy-to-use SP-70, with reliable performance and variable gain, is a good investment in a low-noise 70-cm preamplifier for most uses.

The first stage of the receiving system after the antenna, usually a preamplifier, is the stage that sets the noise figure for the entire receiver. As such, it should have the lowest possible noise figure. Note that the difference in minimum discernible signal *is not* merely the difference in the noise figures of two different preamplifiers. The 1993 *ARRL Handbook*, pages 12-2 and 12-3, and *The ARRL UHF/Microwave Experimenter's Manual*, pages 7-5 to 7-7, explain this.

Construction, Documentation and Performance

Over a number of years, German-based SSB Electronic has built a solid reputation among the VHF/UHF/microwave fraternity. SSB Electronic manufactures well-made gear over a wider spectrum than probably any other single manufacturer of such equipment. The SSB SP-70 "Super Amp" is literally a black box (well, *blue* in this case) intended for connect-and-forget operation. It's well protected from weather to permit mast-mounting close to the receiving antenna. This is a requirement for really low-noise system performance, since feed-line loss ahead of the preamplifier adds directly to the system noise figure. The SP-70 uses stainless-steel hardware and a zinc-plated mast clamp.

The SP-70 is designed for RF-actuated switching at power levels under 100 W, and for "hard" switching up to its maximum rated power—500 W on SSB and CW, and 300 W on FM. It uses N connectors for the feed line and antenna, and a female UHF connector (SO-239) for its power and control circuitry. The preamplifier can be powered via the coaxial RF-input connector or the SO-239. When the preamp is unpowered, it operates in its transmit mode (the preamp is bypassed by its relays). Applying power to the SP-70 switches it into the receive mode until it senses RF at the **TRX** (transceiver) connector.

The preamp's gain is variable from about 11 dB to about 22 dB (with a 13.8-V dc supply) to compensate for varying amounts of feed-line loss. The documentation recommends gain-control settings based on the length and type of feed line. See Table 1 for the ARRL Lab's test results.

Inside the SP-70's outer cover, the preamplifier and its control circuitry are contained by a well-shielded, tin-plated enclosure with connectors and a hole to access the gain control. I didn't open the shielded box to evaluate the circuit construction because it's sealed shut.

The instructions are clear and well written, both in German and English. This unit is simple to install and use. In more than a month of satellite UHF transmissions (Mode B) and a serious terrestrial contest effort, I had no problem with the RF-sensed switching for power levels up to 100 W. SSB Electronic notes that, for power levels between 100 W and 500 W, an external sequencer should be used to protect the preamplifier. (Sequencers are available from SSB Electronic and other manufacturers, and *The ARRL Handbook,* Chapter 31, contains a circuit for one you can build.) The manual includes a good discussion about setting the preamplifier gain appropriately for the feed-line loss—a useful discourse.

I lacked the switching capability to do a side-by-side comparison with a home-brew preamplifier (NF ≈ 0.5 dB), so I can present only my operating impressions. Most significantly, the receiver's S-meter level with no signal is about 3 to 4 dB higher for the SSB unit than for the home-brew preamplifier. The observed noise increase with the SSB unit is probably attributable to the gain variation, not its higher noise figure. From a purely technical standpoint, the NF observed and measured in the SP-70 can be considered disappointing, especially considering that

SSB Electronic offers other preamplifiers (without built-in switching) in the 0.3-0.4 dB range.

Despite this, the SP-70 works, and works well. For most terrestrial and satellite uses, the SP-70's higher NF is probably not significant. For EME (moonbounce), however, you'll want the lowest-noise preamp you can get, such as the SSB Electronic LNA 435, with external low-loss relays.

The noise figure of any preamplifier is set not just by the semiconductors used, but also by the losses in any switching devices, connectors and cabling ahead of the first amplifier stage. I suspect that the RF sensing and protection circuitry in the SP-70 are responsible for the poorer noise figure than the preamplifier alone would provide. The ARRL Lab's measured insertion loss (Table 1) supports this conclusion. In other words, you pay a noise-figure price of a few tenths of a decibel for the convenience of a single box over the separate preamplifier, low-loss relay and sequencer combination.

Table 1
SSB Electronic SP-70 70-Cm Mast-Mount Preamplifier

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency range: 430-440 MHz.	As specified.
Supply voltage: 13.8.	As specified.
Current drain: 350 mA.	At 13.8 V dc: transmit, 8 mA; receive, 270 mA.
Noise figure: 0.9 dB.	At minimum gain, 1.6 dB; at maximum gain, 1.35 dB.
Gain: 10-20 dB.	10.5-22 dB at 13.8 V dc.
Insertion loss: 0.2 dB.	432 MHz, 0.26 dB; 435 MHz, 0.32 dB.
Minimum operating voltage: Not specified.	8.5 V dc.
Power-handling capability: RF switched, 1-100 W; manually switched, 0-500 W (SSB, CW) and 0-300 W (FM).	As specified.

Is this a trade that's worth making? In most cases, yes. The SP-70 really "turns on the band" for multimode transceiver users. Consider the SP-70's advantages, flexibility and SSB Electronic's reputation when you're deciding which mast-mounted preamplifier is right for you.

Manufacturer's suggested price: SP-70, $209.95. SP-2 (144-148 MHz), $209.95. Distributor: SSB Electronic USA, 124 Cherrywood Dr, Mountaintop, PA 18707, tel 717-868-5643.

Down East Microwave DEM432 No-Tune 432-MHz Transverter

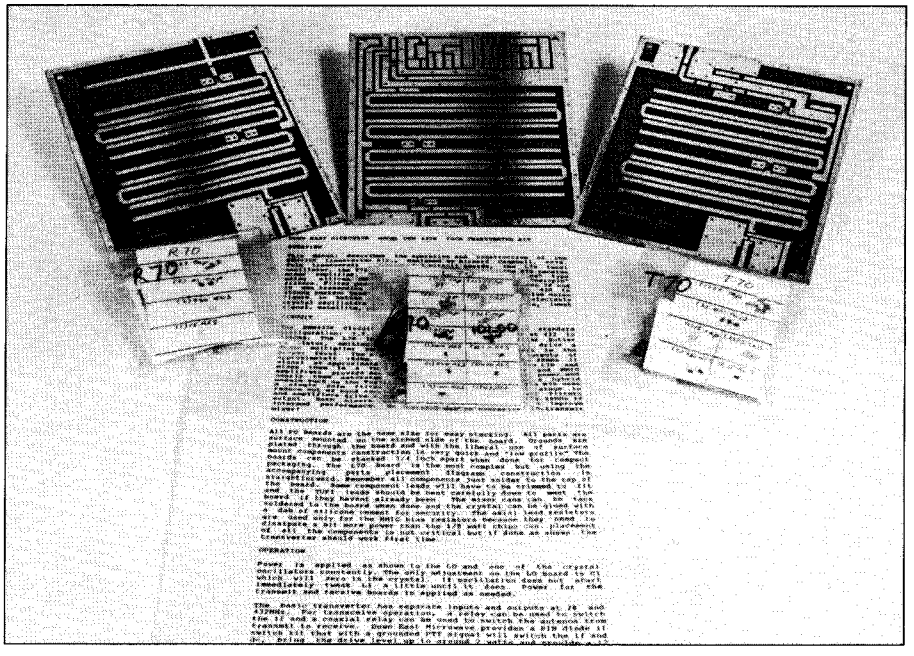
Reviewed by Rus Healy, NJ2L

Exploring the VHF and UHF bands, beyond the FM segments, is something many hams find intriguing. Many put off getting into this exciting aspect of ham radio when they discover how expensive it *can* be to equip a station for even one band. In truth, *it doesn't have to be expensive to put a 432-MHz station on the air* if you already have a transceiver that covers the 10- or 6-meter band. Just how easy and inexpensive can it be? Enter the Down East Microwave 432-MHz transverter.

A *transverter* consists of a *transmit converter, receive converter* and *local oscillator* working together to allow a transceiver operating at one frequency to work at another. The nuts and bolts are pretty simple: You provide low-level drive from your transceiver to the transverter, and connect the transverter's receive converter to your transceiver. At the transverter's output end (432 MHz in this case), you install a means of switching (usually a relay) the antenna between the transmit and receive converters. Accessories such as power amplifiers and preamplifiers usually go between the transverter and that relay.

How can a transverter serve you? It can let you use your 10-meter transceiver to operate on SSB and CW at 432 MHz. Or it can give you the ability to operate through the many satellites that use the 435- to 438-MHz range. How about 440 FM? If you already have a 10- or 6-meter rig with FM capability, you can add a transverter to it. In each of these cases, the Down East Microwave DEM432 transverter is far more economical than a new, dedicated 70-cm transceiver.

The DEM432 transverts either 28- or 50-MHz RF (your choice) to any part of the 420- to 450-MHz ham band. Suitable for CW, SSB, FM voice and packet, ATV, etc, the DEM432 is a good match for 10- or 6-meter single-band radios, or high-performance multiband transceivers.



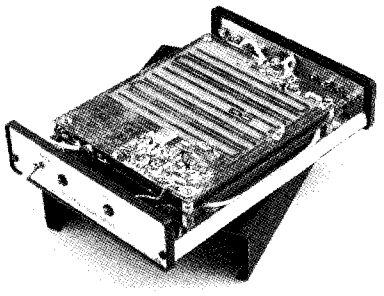
The Bottom Line

Ideal for portable or home-station use, the DEM432 gives top-notch performance at a bargain price. The kit version is an easy and practical way to learn about building modern UHF equipment. Interfacing the transverter to your transceiver is the most challenging part of the project.

Table 2
Down East Microwave 432-MHz Transverter

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency range: 420 to 450 MHz, with appropriate LO crystal and IF.	As specified.
Intermediate frequency (IF): 28 or 50 MHz, depending on LO crystal.	As specified. Tested at 28 MHz.
Supply voltage: 13.	As specified.
Current drain: Not specified.	At 13 V dc: LO, 125 mA; transmit converter, 125 mA; receive converter, 50 mA.
Noise figure: Less than 4 dB.	3.9 dB at 432 MHz.
Conversion gain: 16 dB.	16.1 dB at 432 MHz.
Transmit-converter characteristics: Input, 0 dBm (1 mW) typ; output, 50 mW linear, 80 mW saturated.	*Input (28 MHz)* / *Output (432 MHz)* −3 dBm (0.5 mW) / 17.6 dBm (59 mW)* 0 dBm (1 mW) / 19.0 dBm (79 mW) 11 dBm (12 mW) / 19.4 dBm (87 mW)†
Transmit-converter spectral purity: Not specified.	Meets FCC specifications.
IF rejection: Not specified.	More than 55 dB.
LO rejection: Not specified.	More than 30 dB.
Image rejection: Not specified.	More than 30 dB.

*1-dB compression point.
†Saturation point.



Design

Rick Campbell, KK7B, noted designer of no-tune transverters and high-performance receivers, designed the DEM432 for Down East Microwave as a follow-on to his 1296- and 903-MHz designs.[1] Although the 432-MHz transverter consists of three 4.75 × 5.5-inch etched boards (the LO, receive converter and transmit converter), the theme is the same as the single-board transverters: good performance, low cost and as few adjustments as possible. The 432-MHz version uses etched bandpass filters like those in the higher-frequency transverters. Etched filters eliminate adjustments, bulky components and a need for careful shielding of each assembly. The circuit also uses surface-mount chip components and no-tune MMIC amplifiers, along with a few leaded components. The three boards are drilled in each corner for mounting and can be stacked as little as ¼ inch apart, making for a very compact finished product.

With a 101-MHz crystal, the LO board produces a 404-MHz signal that's split and routed to the other boards at 8 dBm, where it's mixed with the 28-MHz IF signal (404 + 28 = 432). You can build two oscillators on the LO board, switching them with a dc signal. (A PIN-diode switch on the board handles the RF steering.) This gives the transverter the flexibility to be used with one IF in two parts of the band, such as 432-434 MHz (the weak-signal and beacon segment) and 435-437 MHz (part of the satellite subband), and for FM repeater operation (70-cm repeaters usually use 5-MHz splits).

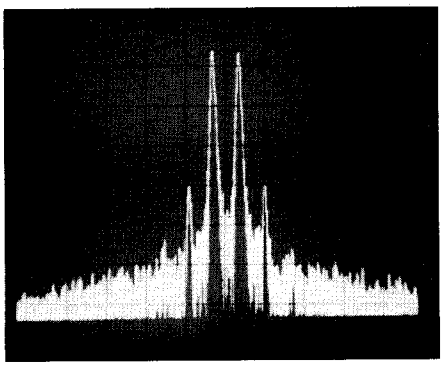


Fig 1—Spectral display of the Down East Microwave 432-MHz transmitter during two-tone intermodulation distortion (IMD) testing. Third-order products are approximately 40 dB below PEP output, and fifth-order products are approximately 54 dB down. Vertical divisions are 10 dB; horizontal divisions are 2 kHz. The transverter was being operated at 58 mW PEP output at 432 MHz.

The receive-converter board uses a single-pole, etched bandpass input filter to limit out-of-band signals, decreasing the chance of overload. The filter is followed by a low-noise MMIC amplifier, additional filtering, another MMIC gain stage and a diode-ring, double-balanced mixer for good intermodulation characteristics. The receive-converter noise figure, under 4 dB, is adequate for routine operation. Conversion gain is about 16 dB, which is also appropriate. If you use an external preamplifier for lower noise figure, keep the net conversion gain down to 20 dB or so by placing an attenuator between the preamplifier and receive-converter input or bypassing its first gain stage. This preserves receive-system dynamic range.

The transmit converter uses three MMIC gain stages and two bandpass filters to get from the mixer level to about 50 mW output. This board nominally requires 1 mW of drive at 28 MHz for this output level. Its linearity is quite good, as our two-tone IMD test (Fig 1) shows. Although the transverter produces almost 100 mW of power at its saturation point, the signal is not clean enough for SSB use at power levels above 50 to 60 mW.

Building the Kit

Although the DEM432 is available in assembled and tested form, I chose the kit (p/n DEM432K). *QST* has covered building no-tune transverters several times, most recently in Jim (WA8NLC) Davey's December 1992 article on his latest 2304-MHz transverter. Essentially, you need a pair of tweezers, small pliers and wire cutters, a low-wattage soldering iron, a couple of drill bits (to use as temporary coil forms), a steady hand, and good close-in vision (or a magnifier).

Down East Microwave supplies all the chip components for each board taped onto white card stock with easy-to-read labels. The other parts are supplied in small plastic bags. Building the LO board takes the most time (an hour or two), as it has more parts than the other two boards—including lots of chip resistors and capacitors. The receive and transmit converters take considerably less—no more than 30 minutes each. Once the LO board is finished, you can determine whether the oscillator is running by tuning a nearby FM-broadcast receiver to the fundamental crystal frequency (101 MHz in my case) and listening for quieting. The signal should be strong enough to fully quiet a broadcast receiver within 20 feet or more. If you don't hear the LO at the correct frequency, adjust the trimmer near the LO crystal and/or the coil adjacent to it (L1) until you do.

I built one of the first DEM432Ks. Although all three boards worked the first time I powered them up, I initially had some trouble getting the proper LO output from the board. Down East Microwave changed the specifications for two coils on the LO board; updating them brought the output up to spec. I also found the receive converter's noise figure to be rather high (4.7 dB or so), but increasing its spacing from the board

[1]These, as well as versions for 2304, 3456 and 5760 MHz, are also available from Down East Microwave. Zack Lau, KH6CP, reviewed the 1296-MHz version in Product Review, February 1990 *QST*, pp 33-34. The 903-MHz version appeared in July 1991 *QST*, pp 25-29.

above it (to ⅜ inch) brought that into spec also.

The DEM432 is probably as close as you can come to a true no-tune design, but you can make some useful adjustments on the LO board and the transmit converter. This process requires at least an RF probe (described in Chapter 25 of the 1993 *ARRL Handbook*) and a voltmeter, but preferably a relative power meter that reads about 100 mW full scale. Built as specified, the transverter meets its specifications, but adjusting the spacing of coil turns in L4, L5, L7 and L8 on the LO board, and L3 and L4 on the transmit-converter board, may net you 1-2 dB more linear output power or more overall transmit-converter gain (less drive for full output).

The Transverter as the Heart of a System

Once you have a completed transverter in hand, you'll need to interface it to your radio, antenna and, if used, amplifier, preamplifier or other accessories. The transverter documentation includes a block diagram showing how all these components interconnect. Down East Microwave and *The ARRL Handbook* can provide further help along these lines. An IF switch[2] makes the transceiver-side connections easy.

Many commercial and home-brew antenna designs are available for the 70-cm band, from verticals to long Yagis. Preamplifiers, such as the SSB Electronic SP-70 also reviewed this month, are widely available. Check the ads in *QST* for details. Since the basic transverter produces only about 50 milliwatts of linear output, you'll find an external power amplifier a practical necessity. The most convenient route to more power is the Down East Microwave 432PA 15-watt amplifier, reviewed later.

To make getting on 432 even easier, Down East Microwave has integrated the assembled and tested transverter with the 15-W power amplifier and a coaxial relay in the DEM432-15S.

Operation

The difference between transverters that let a good IF receiver do its job and those that limit system performance often lies in the receive-converter's mixer and amplifier stages. In addition to an unusually good noise figure for a transverter without a low-noise FET preamplifier, the DEM432's robust MMIC amplifiers and rugged passive mixer offer a performance advantage over most other commercial 70-cm transceivers and transverters. The local oscillator is stable and clean, contributing to nearly spur-free performance.

Because of its small size, low current drain and excellent RF performance, the DEM432 is well suited to both home-station and portable use. Designed for a nominal 13-V supply, it functions well down to 12 V dc, where its linear output drops by only 10 mW.

One useful modification is to strengthen the receiver section by amplifying the receive-side LO, using a higher-level receive mixer and replacing receive-converter gain stages with properly biased MSA-1104 (or MAV-11) MMICs for maximal strong-signal capability. Down East Microwave may make this configuration optional for a slightly higher cost than the stock version.

Documentation

The DEM432K comes with a 12-page manual containing a circuit description, clearly drawn schematics and larger-than-life photos of each board to help you with part placement, and an interconnection diagram. The documentation is a bit sparse and doesn't contain any troubleshooting information. Still, the part count is so low and the circuit so reliable that even if you have little building experience, you should be able to get this transverter going in no more than a couple of evenings. If you have any trouble, a call to Down East Microwave should set you on the right path.

Prices: DEM432 assembled and tested transverter in low-profile case, 28 to 432 or 435 MHz, $275; DEM432-15S assembled and tested transverter with integral 15-W amplifier and coaxial relay, 28 to 432 and 435 MHz, $395; DEM432K basic kit with crystal for 28 to 432 or 435 MHz (no enclosure or connectors), $155; low-profile enclosure, $20; 2.125 × 8.75 × 5.75-inch die-cast enclosure (suitable for DEM432K and 432PA power amplifier), $25; PC board set, $30; second LO kit (no crystal), $8; crystals (frequencies: 101, 101.75, 102, 100.5 MHz), $16 each. Manufacturer: Down East Microwave, RR 1 Box 2310, Troy, ME 04987, tel 207-948-3741, fax 207-948-5157.

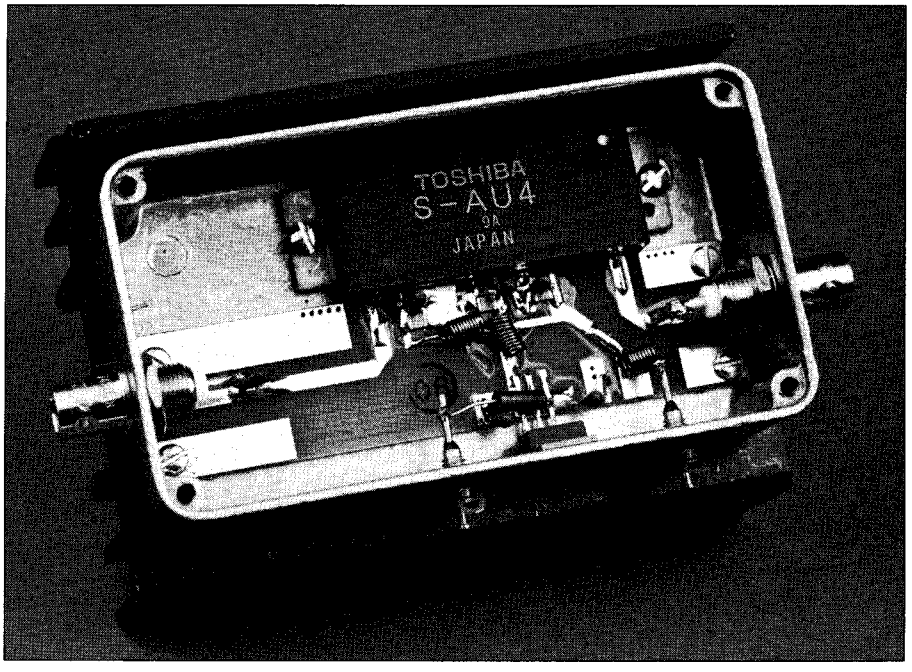
Down East Microwave 432PA 432-MHz Amplifier Kit

Reviewed by Rus Healy, NJ2L

Designed as a companion 15-watt amplifier for the DEM432 transverter, the 432PA requires 50 to 100 mW of drive to produce full linear output. Using a single active device, a Toshiba S-AU4 monolithic hybrid amplifier module (a fancy term for an integrated-circuit, multistage power amplifier), the kit requires little time and effort to build and requires no tuning.

The kit comes with the S-AU4, an etched PC board sized to fit popular die-cast enclosures, a handful of capacitors, a voltage regulator and some wire for winding RF chokes. With the basic kit, you supply the case, heat sink, connectors and feed-through capacitors. The complete kit comes with these items.

You first drill the case for connectors and mounting hardware, then screw the amplifier module and PC board to the enclosure and heat sink. Solder in the capacitors, amplifier-module leads and other connections, mount the connectors, and put the cover on the box. It's that simple! I built the amplifier into a 1.25 × 2.25 × 4.5-inch Hammond 1590B aluminum box and mounted it on a recycled heat sink. Construction takes about 30 minutes, not including case and heat-sink preparation.



[2]For a review of the Down East Microwave SHF-PIN IF-switch kit, see Product Review, June 1992 *QST*.

Table 3
Down East Microwave 432PA 432-MHz Linear Amplifier

Manufacturer's Specifications	*Measured in the ARRL Lab*
Frequency range: 420 to 450 MHz.	As specified. Tested at 432 MHz.
Supply voltage: 12-14.	Tested at 13.8 V.
Current drain: 3 A peak.	2.9 A maximum.
Power input/output: Less than 100 mW drive, more than 16 W linear output, 20 W saturated output.	*Drive* / *Output*: 10 mW / 2.9 W; 50 mW / 10.6 W; 100 mW / 18.0 W; 123 mW / 20.7 W*
Spectral purity: Not specified.	Meets FCC specifications.

*1-dB compression point.

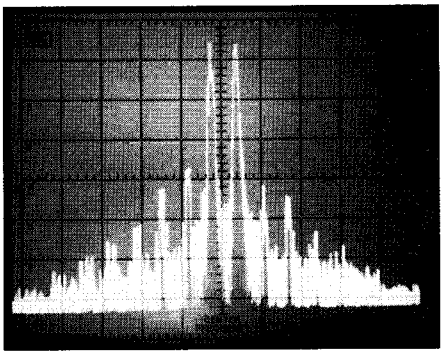


Fig 2—Spectral display of the Down East Microwave 432-MHz amplifier during two-tone intermodulation distortion (IMD) testing. Third-order products are approximately 37 dB below PEP output, and fifth-order products are approximately 42 dB down. Vertical divisions are 10 dB; horizontal divisions are 2 kHz. The amplifier was being operated at 15 W PEP output at 432 MHz.

The S-AU4 requires 12 to 14 V dc at less than 3 A. You supply power to two terminals: one that powers the final stages, and one that biases the amplifier into operation. Normally, 13.8 V is applied to the V_{CC} terminal continuously, and the bias terminal is powered only during transmitting.

The 432PA is the perfect mate for the DEM432 transverter. Though the S-AU4 is rated at 10 W, it easily puts out almost 20 W. With the DEM432 transverter's 50 mW of linear output, you can expect over 10 W of linear output from the 432PA. The amplifier's IMD characteristics are very impressive at the 15-W level, as Fig 2 shows. Table 3 gives other measured performance specifications.

The 432PA produces enough output for most uses, and can drive many popular solid-state and tube amplifiers to their rated output. Never has getting 23 dB of 70-cm gain been so easy and inexpensive.

Prices: 432PA, assembled and tested, $180; 432PAK basic kit (no case, connectors or heat sink), $75; 432PACK complete kit with enclosure, heat sink, feed-through capacitors and connectors, $135. Manufacturer: Down East Microwave. QST

New Books

THE ART OF ELECTRONICS

By Paul Horowitz and Winfield Hill

Second edition, 1991. Cambridge University Press, 110 Midland Ave, Port Chester, NY 10573; tel 914-937-9600. Hardcover, 7×11 inches, 1125 pp. B&W illus. $54.50. The accompanying Student Manual *is $39.50.*

Reviewed By William Sabin, WØIYH
1400 Harold Dr SE
Cedar Rapids, IA 52403

For six years I was an electronics specialist in an experimental nuclear physics laboratory. My job was to design and build a variety of electronic instruments for projects connected with experimental physics. I noticed that the physicists saved their main mathematical and theoretical horsepower for "doing physics." Nevertheless, most of them possessed a solid, practical and intuitive understanding of electronic circuits and design principles.

The Art of Electronics originally had the purpose of imparting this kind of pragmatic overview of the diverse field of circuit design to students of physics at Harvard University. By almost completely passing over the mathematical and theoretical aspects of electronics engineering pedagogy that the authors believe are irrelevant to an intuitive, "hands-on" capability, by presenting each topic in just enough depth to make the student conversant, by providing a jumping off point for further learning, by teaching the art of evaluating alternative methods and components in the face of bewildering options, the authors accomplish their teaching goal in an elegant fashion. It tries—successfully—to minimize the amount of tedious, time-consuming searches through books, catalogs and data manuals for the information a person needs to get started on an instrument-design project.

By giving the student highly distilled information, he's free to put the main emphasis on learning the mathematical and theoretical main business, which is physics. For these people, electronics is a tool, not the main thing. The enormous popularity of this book and its companion *Student Manual*, by Hayes and Horowitz, is because the teaching goals of the authors also satisfy the needs and desires of many others in the electronics arena. Most electronics engineers tend to be somewhat "focused" along narrow pathways (and, I might add, deeply focused—that's how we make a living!). The broad and insightful perspective the book presents gives us a chance to know the "bigger picture" a little better. The well-done index is a good place to begin the search for knowledge on the subjects covered. A careful, cover-to-cover reading is quite a task, but highly recommended: The light-handed and humorous approach is quickly appreciated.

The *caveat emptor* in a book of this kind is that if you start to do serious work on any given topic, and all you know is what you've read in this book, you'll run out of steam in a hurry. The large and respectable body of science and precedent that underlies any one topic in electronics engineering can't be easily dismissed, and the authors know this as well as anyone. But if you want a quick overview of, and an introduction to, a particular subject, this is an excellent place to begin.

For the radio amateur, this book provides information in certain areas at a depth not found in the present bookshelf of amateur publications or in conventional introductory textbooks. For the technically inclined ham, it will greatly expand the available reference material in a variety of subjects of interest to modern amateurs. [Paul Horowitz is W1HFA —*Ed.*]

The reviewer is a retired RF design engineer for Rockwell-Collins, where he worked from 1964-90. He coedited Single Sideband Systems and Circuits, *published by McGraw-Hill in 1987.* QST

New Products

HAM HORSESHOES

◊ A hand-crafted horseshoe with custom engraving makes a unique decorative gift for a ham's shack or office. These aren't replicas: The manufacturer—a ham and a blacksmith for 21 years (an increasingly rare skill)—creates the plaques from genuine hot-forged pony horseshoes. It's polished and hand-stamped on an anvil, mounted with authentic horseshoe nails, detailed in gold and mounted on a 3.5×5-inch plaque of ¾-inch finished red oak. The completed plaque is finished with natural oak stain and two coats of clear, high-gloss polyurethane sealant. The back has a recessed notch for wall hanging. Retail price $10 and League Members may add a gold ARRL logo in the center for $4 extra. Delivery time is just 1-2 weeks. Jeff Brown, WX2Z, "Blacksmith Brownie," PO Box 382, Dept 12, Hamburg, NJ 07419; tel 201-827-5414. QST