Product Review Column from *QST* Magazine

April 1989

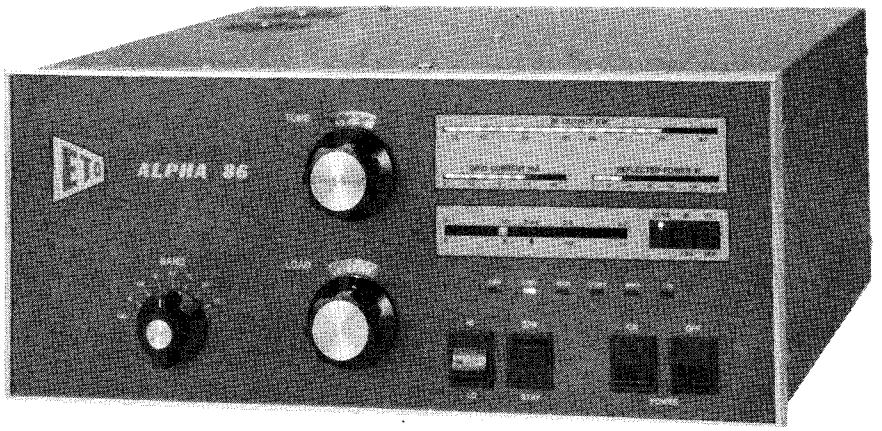
ETO Alpha 86 Linear Amplifier

RF Concepts RFC 8-RC Repeater Controller

Conducted By James W. Healy, NJ2L
Assistant Technical Editor

ETO Alpha 86 Linear Amplifier

Reviewed by David Sumner, K1ZZ



A few years ago, the FCC changed the standards for measurement of transmitter power in the Amateur Radio service and created a legitimate market for a new generation of higher-power linear amplifiers. Most amplifiers then available did not deliver the new maximum legal limit of 1.5 kW output; they hadn't been designed to, because the old power limit, defined in terms of input power, equated to something more like 1.3 kW peak output on SSB and 650 W output on CW and RTTY.

In developing a legal-limit amplifier today, designers not only have to design amplifiers able to deliver the watts; they have to do it on eight bands between 1.8 and 29.7 MHz. This isn't as easy as it seems, because critical components (such as anode RF chokes) have resonances that have to be placed outside all of the bands of interest. Designers have to make amplifier operation "idiot proof," because a device capable of generating 1.5 kW can do a lot of damage—to itself and to other things—if it's misused. Finally, it's nice if the designers can do all this around tubes that won't cost more than the gross national product of a small country when, inevitably, the time comes to replace them.

The ETO Alpha 86 is not inexpensive. For most hams who buy one, this amplifier will be the single most expensive item in their stations. But the Alpha 86 meets all the above criteria, and then some—and it's a pretty safe bet that an Alpha built today will still be in regular use well into the next century.

ETO now sells factory direct, and supports its products from its plant in Colorado. When shipped from the factory, the Alpha 86 is in two boxes: one for the power transformer, and one for the amplifier itself. It's done this way because the power transformer by itself is heavy; the rigors of shipment are much greater than anything you'll subject the amplifier to once it's safely inside your shack, and shipping the amplifier with the transformer installed could cause severe damage. So, the first thing you do when the two boxes arrive is to install the transformer—a one-screwdriver operation. You then have a 66-lb cabinet with everything inside; the power supply is built in.

For a self-contained amplifier running this much power, it's not a big box. But it's not a small one, either; check out the dimensions when planning where you're going to put it, and remember that unless your ham experience includes rigs like the Heathkit® DX-100, you're going to think it's heavy.

Hooking up the Alpha 86 is a breeze. Plan on running it from a 240-V ac line; 120-V household wiring generally won't handle the load. If you're going to use the Alpha 86 with a non-QSK exciter, there are just four connections to be made: RF in, RF out, the relay keying line and ALC. *Don't neglect the ALC hookup!* It takes only about 50 watts of RF drive to tickle the amplifier to full legal output, so the typical 100-W exciter run wide open will seriously overdrive this amplifier. If you're going to operate QSK, there's an additional keying line to be used; you'll actually be keying the amplifier's relay line, which in turn will key the exciter. The instruction manual explains how to switch between this mode and conventional VOX or PTT operation.

On the front panel, there are three knobs, four large switches and three small ones, six small indicator lights and four multicolored LED bar indicators. There are no meters; the bar indicators take the place of meters, and function quite well, but they do take some getting used to. The three knobs are the band switch, tuning and loading controls. The four large switches are POWER ON, POWER OFF, OPERate/STANDBY and HIGH/LOW POWER. The three small switches set one of the four bar indicators to indicate anode voltage, anode current, or a special TUNE function (described later). The other three bar indicators show power output, reflected power and grid current. The six indicator lights show various faults and conditions.

Once all the connections have been made, it's time to hit the POWER ON switch. With the multifunction indicator on HV and the HIGH/LOW POWER switch on HIGH, you'll see the anode voltage rise to 1750 or so, and then jump up to 2500 a second or so later. The next thing you have to do is wait—for about three minutes (2 minutes, 55 seconds on the review unit); the control circuitry keeps the amplifier in standby until the tubes (a pair of Eimac® 3CX800A7s) are warmed up to Eimac's specifications. For those of us who are used to "instant" warm-up amplifiers, this 3-minute warm-up may dictate a significant change in operating habits. I usually keep my trusty 2 × 3-500Z amplifier turned off until I need it, but the first time I missed a DX contact while waiting for the WAIT light on the Alpha 86 to go out cured me of that! ETO recommends that you minimize the number of times you turn the amplifier on and off during a day's operation, because temperature cycling shortens tube life.

Tune-up of the Alpha 86 is straightforward. An initial tuning chart customized for each amplifier is included in the instruction manual to give you a starting point. The special TUNE function mentioned earlier helps you tune for maximum linearity at the 1.5-kW output level; if you've ever used a Collins 30L-1 or 30S-1, this should be a familiar concept. On the review unit, this function worked fine on all bands except 10 meters, where it wasn't possible to tune for an indicated balanced condition at 1.5 kW output. Because the amp tuned up properly in all other respects on 10 meters, this didn't seem to be anything to worry about.

The tuning and loading controls are each marked from 0 to 100, and once you've tuned up into each antenna on each of your favorite operating frequencies, you'll be able just to set and forget them when you QSY. Then, when you begin transmitting, a glance at the LED bar indicators will show you if anything's amiss. If anything is *seriously*

Table 1

ETO Alpha 86 MF/HF Linear Amplifier, Serial no. 88340043

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 1.8 to 22 MHz (can be modified by licensed amateurs for 12- and 10-meter operation).	As specified.
Power output: 1.5 kW continuous carrier, CCS.	As specified.
Driving power required: 60 to 70 W, nominal, for rated output	40 to 55 W, nominal, for 1.5 kW output.
Spurious signal and harmonic suppression: better than 50 dB.	See Fig 1.
IMD: −35 dBc at 1 kW output, typ.	See Fig 2.
Maximum load SWR: 2.5:1.	As specified.
SWR trip-circuit threshold: 250 W reflected power at 1.5 kW output.	As specified.
Primary power requirements: 220-240 V, fused at 20 A.	
ALC: negative-going, grid-current derived.	
Equipment protection features: primary and step-start fuses; primary ac interlock; high-voltage interlock; anode over-current relay; high-SWR cut-out.	
Color: Gray.	
Size (H × W × D): 7½ × 17 × 15 inches.	
Weight: 66 lb.	

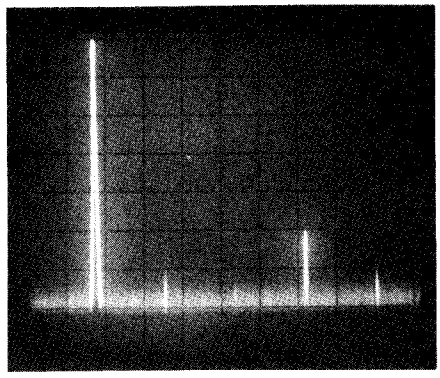


Fig 1—Worst-case spectral display of the ETO Alpha 86. Horizontal divisions are each 10 MHz; vertical divisions are each 10 dB. Output power is approximately 1.5 kW at 18.1 MHz. All harmonics and spurious emissions are at least 50 dB below peak fundamental output (−50 dBc). The Alpha 86 complies with current FCC specifications for spectral purity.

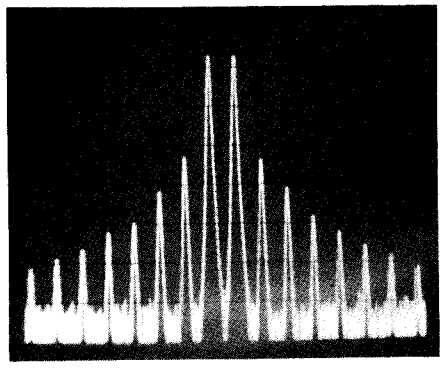


Fig 2—Spectral display of the ETO Alpha 86 during two-tone intermodulation distortion (IMD) testing. Third-order products are approximately 33 dB below PEP output, and fifth-order products are approximately 42 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. The amplifier was being operated at 1.5 kW PEP output on 14.2 MHz.

amiss, such as your antenna having shorted out or fallen down, the control circuitry senses this when you apply RF drive and puts the amplifier into standby—and those indicator lights mentioned earlier tell you what's wrong. This is one of the most impressive features of the Alpha 86, and is a great comfort in the wee hours of a contest weekend if you forget to switch antennas when changing bands.

A two-speed blower is used to cool the tubes. Even at the higher speed, the blower is quieter than the fans used in most other amplifiers.

As required by the FCC, the Alpha 86 does not work on 12 or 10 meters as shipped by ETO. If you buy one, send ETO the completed warranty card for the amplifier, along with a copy of your license, and they'll provide you with the information required to make the appropriate modification, as well as tuning settings for the 10- and 12-meter bands. ETO provides a three-year limited warranty for use of the Alpha 86 in the amateur service, except for the tubes, which are warranted by their manufacturer.

Unless you're into microprocessor control of band switching and tune-up functions, it's difficult to think of anything you might want in an amplifier that isn't delivered by the Alpha 86. Price: $3395, shipping to US and Canadian addresses included. Manufacturer: Ehrhorn Technological Operations, Inc, 4975 North 30th Street, Colorado Springs, CO 80919.

RF CONCEPTS RFC 8-RC REPEATER CONTROLLER

Reviewed by Tom Francis, NM1Q

Thanks to Eric Wagner, KB1RI, Pete Simpson, KA1AXY, and Jim Podsiadlo, AE1C, for providing a repeater and their help with this review.

Under normal circumstances, the first thing a ham does when a new piece of equipment arrives is open the box, pull out the gear and get on with the show—reading the documentation is for times when you run into trouble or can't figure out what a particular gizmo does. The RFC 8-RC is different—we received a stuffed PC board and a descriptive 43-page manual complete with schematic, hook-up diagrams, repeater commands and modes of operation. Maybe reading the manual first isn't such a bad idea...

The RFC 8-RC can control up to three transmitters (repeater, link and remote base) and four receivers (repeater, link, remote base and control). There are also provisions for a continuous tone-coded squelch system (CTCSS) input and an alarm-input signal. The CTCSS input is a logic-level input—you have to use an external CTCSS decoder to decode the tone. The alarm input can be used for just about anything; for instance, to indicate an open door in the repeater room or cabinet, a fire in the repeater room, and so on. The controller also has eight auxiliary control outputs. Other options for the RFC 8-RC include interfaces for packet radio, link and remote-base receivers, and other auxiliary inputs. An autopatch controller is also available.[1]

Installation

After mounting the controller in a card cage and providing a source of 5 V dc, installation was straightforward. The only modification we had to make to the repeater itself was to the controller interface. The controller audio input and output levels were specified at 0.25 V RMS (−10 dBm). Two logic signals are also required: one to indicate the presence of a signal at the receiver (COR) and another to activate the transmitter (PTT). RFC provides an open-collector output for the PTT output and a CMOS-gate input for the COR signal. (RFC recommends using an open-collector driver at the receiver to generate the COR signal.) Both the COR and PTT signals are active-low.

Our repeater receiver does not provide a squelch-open signal, but instead, a signal based on receiver quieting. This signal varies continuously. To solve this problem, we built a simple comparator circuit to provide a squelch-open (COR) signal and to control an audio-muting switch.

It is easy to configure the RFC 8-RC—all you need is a transceiver with a dual-tone

[1]The optional autopatch controller, the RFC 8-AP, was bench tested as part of this review. All functions worked as specified. The autopatch PC board is well constructed, and the documentation is detailed and complete. Connecting the autopatch controller to the repeater controller is simple and straightforward.

multifrequency (DTMF) pad. (One minor problem was the layout of the command set—there doesn't appear to be any pattern to the commands, which caused us to spend a lot of time looking up the pertinent information in the manual.) We decided to lengthen the transmitter hang time to from 1 to 3 seconds[2] and to set the time-out timer to 1.5 minutes. All together, configuring the controller took less than ten minutes.

Up to ten sets of configuration parameters can be stored in nonvolatile memory. The command codes can be changed by "unlocking" the controller's command memory with a multi-digit DTMF code. This DTMF code is different for each controller. When you've finished configuring the command set, you lock it. If you forget to lock the command set, the controller will do it for you after a short delay. We elected to use the default command set. The command-set-lock feature was deemed a good thing by everyone involved in the review, and the automatic relock feature is a bonus.

As you program the controller, it acknowledges command entry in CW. This is another handy feature.

Repeater Operation

Once the configuration was done, we turned the repeater on, used the controller for six weeks and collected observations from users. We had installed the RFC 8-RC in place of a home-brew repeater controller that had been in operation for several years, so there were some differences to get used to. We've tried to ignore the subjective aspects of these differences in this review.

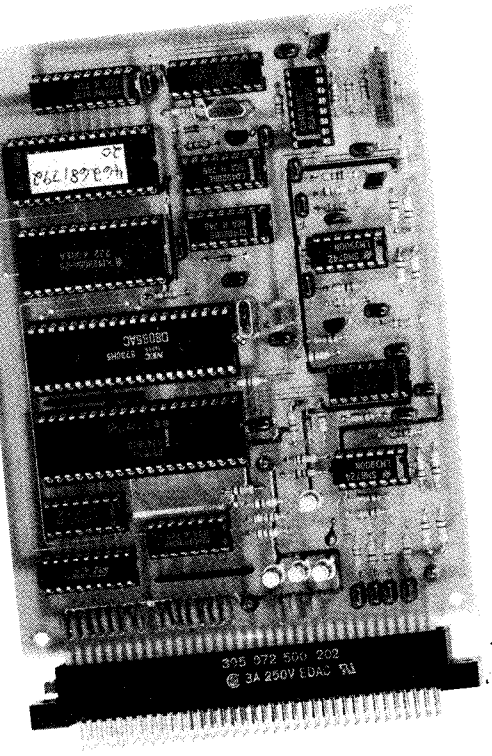
One glitch we noticed occurred—with somewhat unpredictable results—when the identification (ID) timer and time-out timer clashed. At one point, a user claimed that the repeater began to ID, then timed out during the transmission of the ID message. Another ID/timeout conflict occured when the machine sent an ID message, then timed out with no input carrier. This was the only bug that we found with the controller. [Ev Gracey, WA6CBA, of RF Concepts, says that this problem existed in preproduction units only, but that similar problems can be caused by improper repeater-controller-to-repeater connections. Anyone experiencing similar trouble can call or write RFC for assistance. If there is a problem with the controller itself, RFC will correct the problem.—*Ed.*]

The RFC 8-RC IDs the repeater at fixed (6-minute) intervals, and does not give a courtesy beep after the ID. This is a common feature among repeater controllers, but some feel that a courtesy beep after the ID is desirable. The RFC 8-RC turns on the repeater transmitter almost immediately when an input signal is present; a short delay is introduced to keep the transmitter from being keyed by noise transients. An anti-kerchunk feature takes over beyond this noise-protection delay: When someone kerchunks an RFC 8-RC-controlled repeater, a short transmission occurs, but neither a squelch tail nor a courtesy tone is generated. This feature can be defeated by transmitting beyond the anti-kerchunk time period, but it's a good idea nonetheless.

DTMF tones transmitted on the repeater-input frequency are muted and masked (the tones aren't retransmitted by the repeater) after the second tone is entered. This is done to keep unauthorized people from using the DTMF tones transmitted on the repeater for nefarious purposes (such as unauthorized changing of the repeater's control parameters). Unfortunately, this also inhibits the use of selective-calling systems using multi-digit DTMF addressing through the repeater. One solution to this problem might involve a program change in the controller that would mute only *commands*, perhaps by requiring that all commands be prefaced by a DTMF *. In the prevention of unauthorized command entry, however, the present system is almost airtight.

The RFC 8-RC performs well, and is a high-quality product. The PC board shows excellent workmanship and is built of good-quality components. If you're not into home-brewing repeater controllers, the RFC 8-RC is worth looking into. Manufacturer: RF Concepts, 1202 E 23rd St, Lawrence, KS 66046, tel 702-827-0133. Price class: RFC 8-RC repeater controller, $395; RFC 8-AP optional autopatch controller, $199. QST

[2]*Hang time* refers to the delay between cessation of the repeater RF-input signal and the termination of repeater-carrier transmission.



RF Concepts 8-RC Repeater Controller, Serial no. 0001

Manufacturer's Claimed Specifications

Audio input level: 0.25 V RMS.

Input impedance: at least 50 kΩ.

PTT output: open-collector, active low; maximum 24 V at 100 mA.

Hang-delay timer: programmable from 0.5 to 4 seconds.

Time-out timer: programmable from 30 seconds to 3 minutes.

Feedback-tone frequencies: programmable from 400 to 3000 Hz.

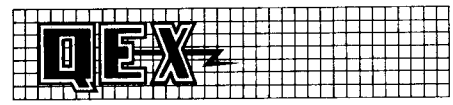
Identification timer interval: 6 minutes.

CW speed: programmable from 10 to 30 WPM.

Microprocessor: 8085A; 1.6-MHz clock.

Power requirements: 5 V dc (± 0.25 V) at less than 300 mA.

Size: 4½ × 6½ inches.



QEX: THE ARRL EXPERIMENTER'S EXCHANGE AND AMSAT SATELLITE JOURNAL

The March issue of *QEX* includes:

- "MMICs Mimic Mixer" by H. Paul Schuch, N6TX. Paul describes an active balanced mixer circuit that uses two inexpensive monolithic microwave integrated circuits (MMICs) to afford significant conversion gain and low noise figure, and requires extremely low LO drive levels.
- "The ACE Orbit: A New Communications Satellite Orbit," by Andrew E. Turner and Kent M. Price. Launch opportunities for geosynchronous-orbit spacecraft are becoming more expensive and less available. The newly developed ACE orbit is nongeosynchronous, but has many advantageous characteristics.
- In "Correspondence," Carl Gustaf Blom, SM6HYG, discusses tropospheric backscatter.
- ">50," by Bill Olson, W3HQT. This month, >50 wraps up a series on reflector antennas. The column concentrates on surface accuracy, surfacing materials and obtaining dishes and materials.
- "VHF+ Technology," by Geoff Krauss, WA2GFP. Reports have it that surplus 800-MHz cavities of potential use to hams are now scrapped by the cavity manufacturer(s) when decommissioned because of greed on the part of a few cavity-reselling "entrepreneurs." Can we mollify the cavity manufacturer(s) and redirect these cavities to honest hams?

QEX is edited by Paul Rinaldo, W4RI, and is published monthly. The special subscription rate for ARRL/AMSAT members is $10 for 12 issues; for nonmembers, $20. There are additional postage surcharges for mailing outside the US; write to HQ for details.