

Configuring an ALE station with the Icom IC-F8101 / Elecraft KPA-500 / Elecraft KAT-500



15 September 2018

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Revision History

DATE	DESCRIPTION
9 April 2019	Updated KAT-500 and KPA-500 issues section to indicate that all issues have been resolved by applying a firmware update to both the KAT-500 and KPA-500.
15 September 2018	Add link to Elecraft software download page.
17 April 2017	Add the ALE Station Behavior section.

Disclaimer

The author assumes no liability for anyone using this reference. You, the reader, must assume all liability should you apply the procedures, circuits and connections described within this document.

Overview

This article intends to provide information on how to configure an Automatic Link Establishment (ALE) station, using the Icom IC-F8101-3X, the Elecraft KPA-500 amplifier, and the Elecraft KAT-500 auto-tuner. It is possible to configure the IC-F8101-3X to properly drive the KPA-500, and it is also possible to configure the Elecraft equipment to emulate an Icom tuner, such that tuning will occur on a transition to a new channel within an ALE scan group when calling, sounding, or receiving an ALE link request.

Tasks required to configure an ALE station with this equipment will include:

- Accessing the Icom IC-F8101-3X service menu to reduce the **MID** power to an appropriate drive level for the Elecraft KPA-500 amplifier
- Installation of proper cabling between all three pieces of equipment
- Using the KAT-500 Utility to optimize the KAT-500 operation for the KPA-500 amplifier and applying other adjustments to avoid unnecessary automatic re-tuning

This station configuration can be made to work quite well with ALE. There are some compromises that need to be made during the configuration of the IC-F8101-3X in order to keep the power level at a reasonable setting for high duty cycle transmissions, such as ALE, which will also impact the output power levels for voice communications.

Service Menu Configuration of the IC-F8101-3X

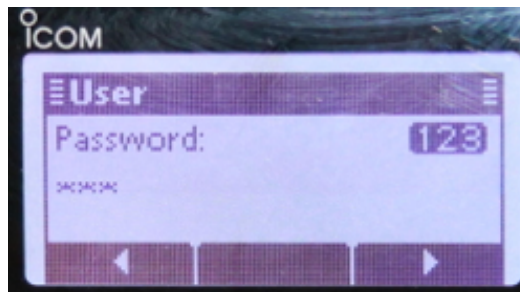
You will need to enter the IC-F8101-3X service menu in order to reduce the **MID** power level settings from the factory setting of 50-Watts, to approximately 27-Watts to drive the Elecraft KPA-500 amplifier.

Before making this adjustment, you should connect the IC-F8101-3X antenna connector, through a power meter, to a suitable 50 ω dummy-load, and configure the IC-F8101-3X for MID power operation.

It is also recommended that you record the value of the factory settings prior to changing any setting via the service menu so that you will be able to restore the original settings if needed at some point in the future.

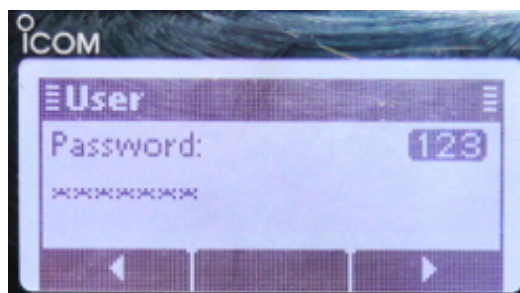
To enter the service menu on the Icom IC-F8101-3X, you will need to perform the following sequence:

1. Turn OFF the transceiver power, if the transceiver is powered ON.
2. While holding [#], [SCAN], [↶] and [⚠], hold the [⏻] button to power up the F8101.
3. Press the [MNGR] (lower right corner) repeatedly until **ABC** appears at upper right, and then enter **SX-**. This is done by pressing **7 PRS** [7PRS CLAR] key 3-times to enter **S**, the **9 WXY** [9WXY TUNE] button 2-times to enter **X**, and the *** &?** [MUTE] button 21-times to enter **-**.



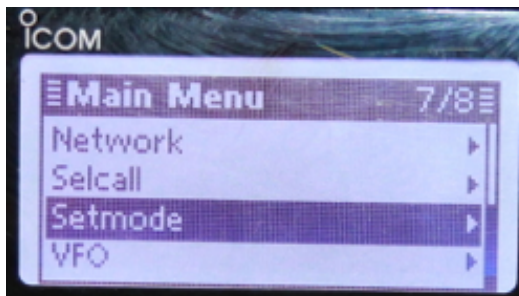
NOTE: The key sequence to enter the service menu on the IC-F8101-3X does not function 100 percent of the time. You may have to make multiple attempts to successfully enter the service menu. Persistence pays off.

4. Press the [MNGR] MGR twice (**ABC** changes to **123**), then press **3500** and the [CK MRK] key.

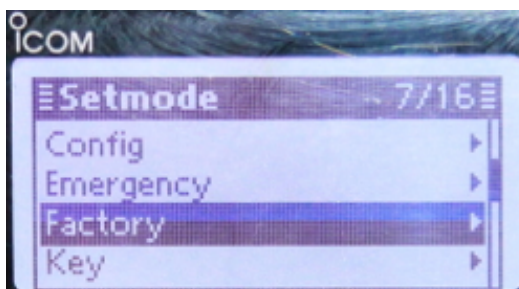


5. Press and hold **X** [X] key to change the display to the Main menu.

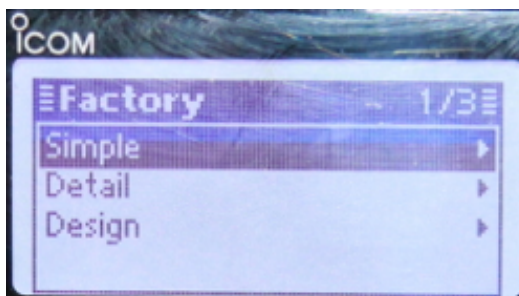
6. Scroll down to **Set Mode** (7/8) the CK MRK key.




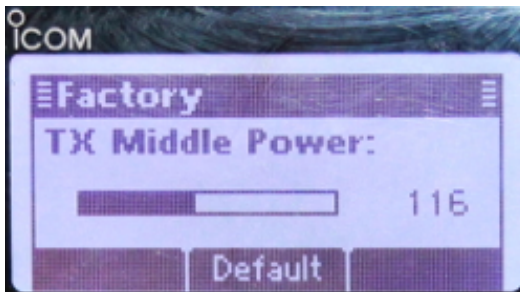
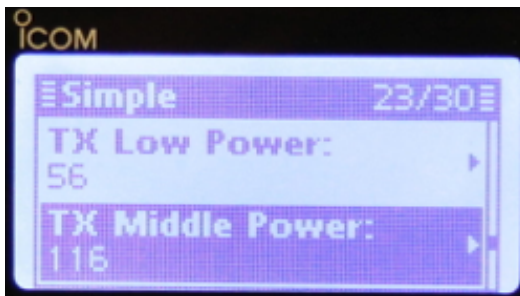
7. Scroll down to **Factory** (7/16) and press the CK MRK key.



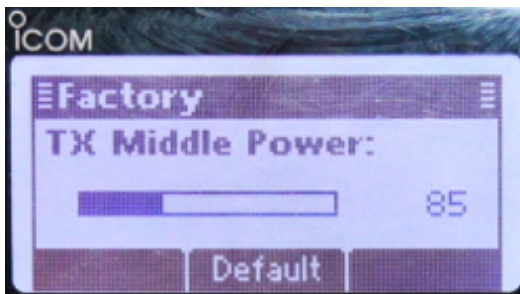
8. With **Simple** selected, press the CK MRK key.



9. Scroll down to **TX Middle Power** and press and hold the  CK MRK key to enter data-entry mode.

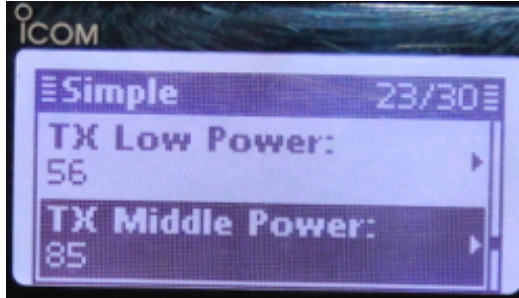



10. Use the down-arrow button to reduce the **TX Middle Power** value to a value that results in an acceptable drive level for the KPA-500 amplifier. I used a value of 85 to achieve a drive level of 25-Watts.

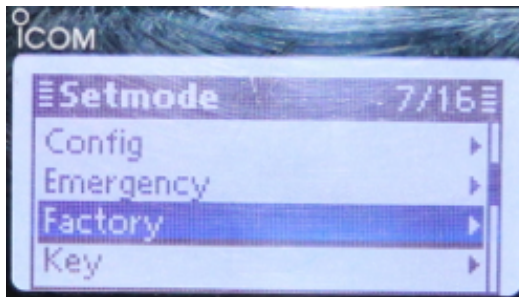


NOTE: A drive level of 25-Watts results in approximately 400-Watts output from the KPA-500 during ALE digital transmissions. This, in my opinion, is a bit on the high side. A more reasonable goal would be to achieve 250-Watts output from the KPA-500 during ALE digital transmissions while achieving 500-Watts output for voice transmissions. The IC-F8101-3X includes a **DATA Power Ratio** setting that is located within the **Detail** section of the **Factory** settings. It may be that the desirable output power levels can be achieved by adjusting this value, however, I was unable to obtain the results that I wanted to achieve and left this setting at the factory value. Caution is advised here. The Elecraft amplifier protects itself quite well, but there isn't anything to be gained by abusing the equipment.

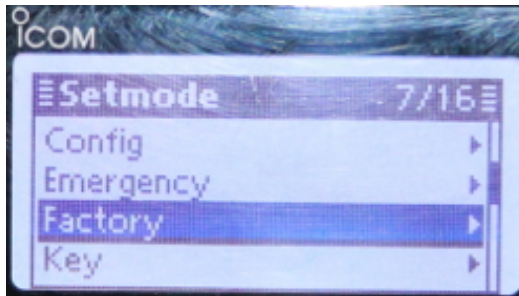
11. Press the **X**  key to exit data-entry mode.



12. Press the **X**  key to exit to the **Setmode** menu.



13. Press the **X**  key to exit the **Setmode** menu.



NOTE: If the key sequence used to enter the service menu does not work, power down the radio and try again. Experience shows that it may take more than one attempt to successfully enter the service menu.

The following table shows power settings applied to the **MID** value in the service menu and the measured output power (confirmed on two different radios):

VALUE	POWER OUT (WATTS)
60	10
75	18
85	25
90	27
111	45

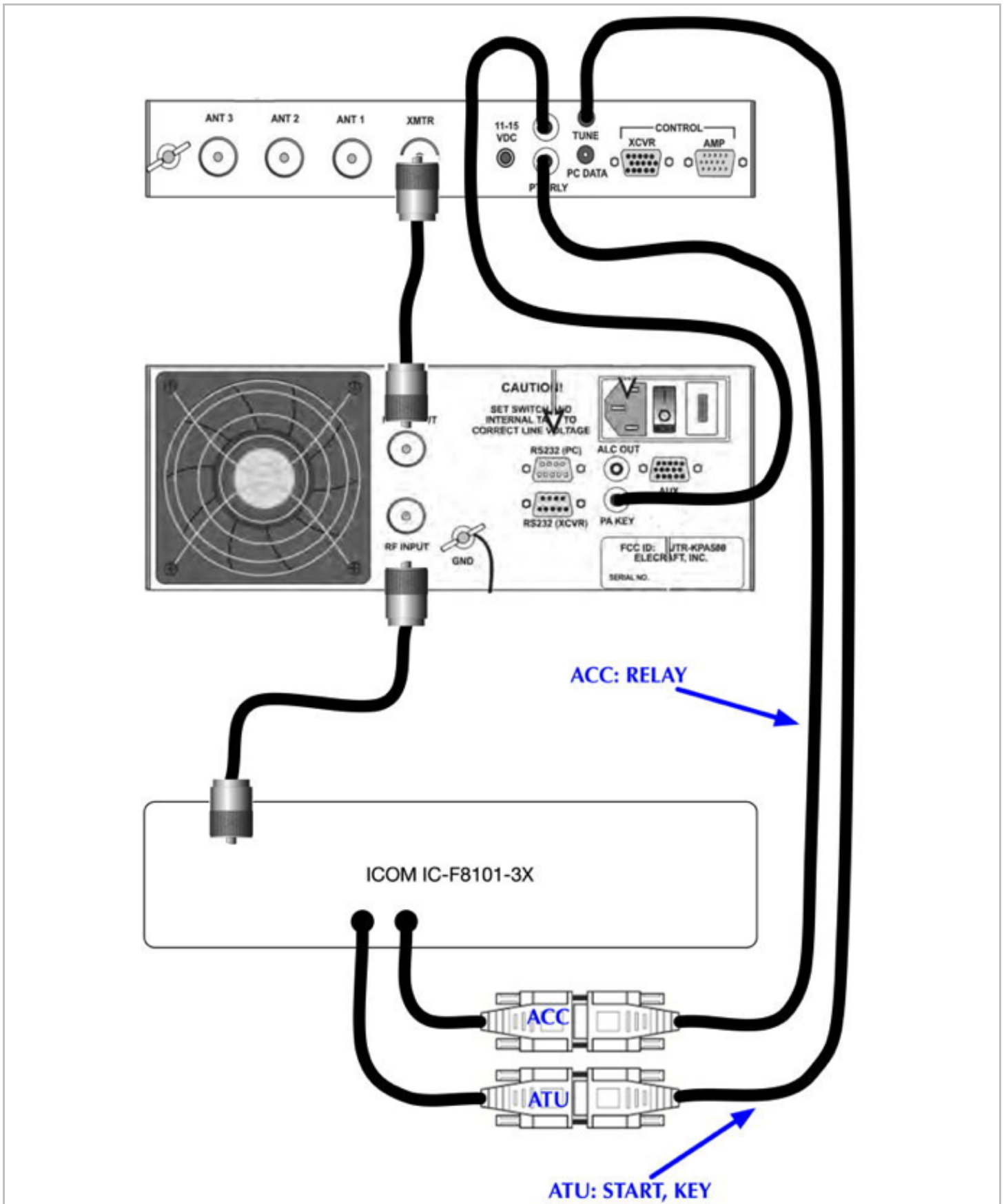
Anyone applying changes to the IC-F8101-3X should, of course, verify the settings on their radio with a power meter and dummy load.

Equipment Connections

The Elecraft KAT-500 Auto-Tuner is able to respond to Icom tuner control signal sequences. Further, when properly connected, the KAT-500 will block the keying signal from activating the KPA-500 amplifier in the presence of high VSWR. Combined, these two features make the KPA-500 and KAT-500 ideal candidates for increasing the power output of the IC-F8101-3X in support of ALE operations.

An overview of these connections has the IC-F8101-3X **RELAY** signal (i.e. push-to-talk output, grounded when keyed), taken from the 15-pin DSUB **ACC** connector, to drive the **KEY IN** signal at the KAT-500 auto-tuner. The KAT-500 auto-tuner includes an internal relay that will block the **KEY OUT** signal during tuning or when a high VSWR is present. The **KEY OUT** signal from the KAT-500 is routed to the **PA KEY** signal on the KPA-500 amplifier. The **START** and **KEY** lines, taken from the IC-F8101-3X 9-pin DSUB **ATU** connector, are routed to the KAT-500 auto-tuner's Icom compatible tuner control input signals at the 3.5mm jack at the back of the KAT-500.

A facsimile of figure 3 from the KAT500 Owners Manual - Rev C5, modified to depict the IC-F8101-3X, is shown below:

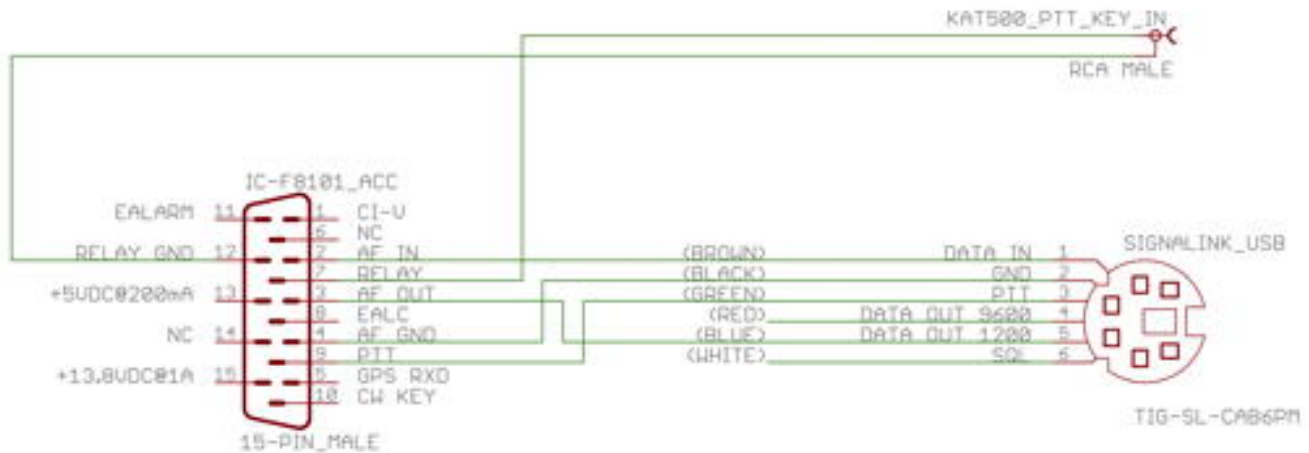


A schematic of the required connections, including the wiring of a female 6-pin Mini-DIN connector to interface a SignalLink USB, is shown below:

ICOM IC-F8101 SIGNALINK USB-6 INTERFACE CABLE, ELECRAFT KAT-500 AND ELECRAFT KPA-500 INTERFACE

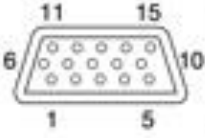
NOTES:

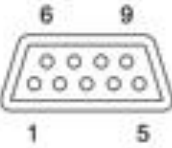
1. THE KAT500 TUNE JACK CAN IS A 3.5mm STEREO PLUG, WHICH IS CONNECTED TO THE 3.5mm TUNE JACK ON THE REAR OF THE ELECRAFT KAT500 AUTO-TUNER.
2. THE KAT500_PTT_KEY_IN IS AN RCA MALE PLUG, WHICH IS INSERTED IN THE BOTTOM PTT KEY RCA SOCKET AT THE REAR OF THE ELECRAFT KAT500 AUTO-TUNER. THIS CABLE REPLACES THE CABLE IN FIGURE 3 OF THE ELECRAFT KAT500 MANUAL, WHICH SHOWS A CONNECTION FROM THE ICOM ACC CONNECTOR TO THE KAT500 PTT KEY INPUT JACK.
3. THE KAT500_PTT_KEY_OUT IS THE TOP PTT KEY RCA SOCKET AT THE REAR OF THE KAT500 AUTO-TUNER.
4. THE SIGNALINK USB CONNECTOR IS A FEMALE 6-PIN MINI-DIN CONNECTOR, AND ROUTES SIGNALS IN A MANNER THAT IS COMPATIBLE WITH A LARGE NUMBER OF AMATEUR RADIO TRANSCEIVERS, ALLOWING INTERFACING TO A STANDARD SIGNALINK CONFIGURATION WHERE NO CUSTOM SIGNALINK CABLE IS REQUIRED.



NOTE: The above schematic includes interfacing of a SignalLink USB as Icom does not provide a Mac OS X compatible USB driver for the USB CI-V interface. Keying must be performed externally in such instances, and the SignalLink provides the required functionality.

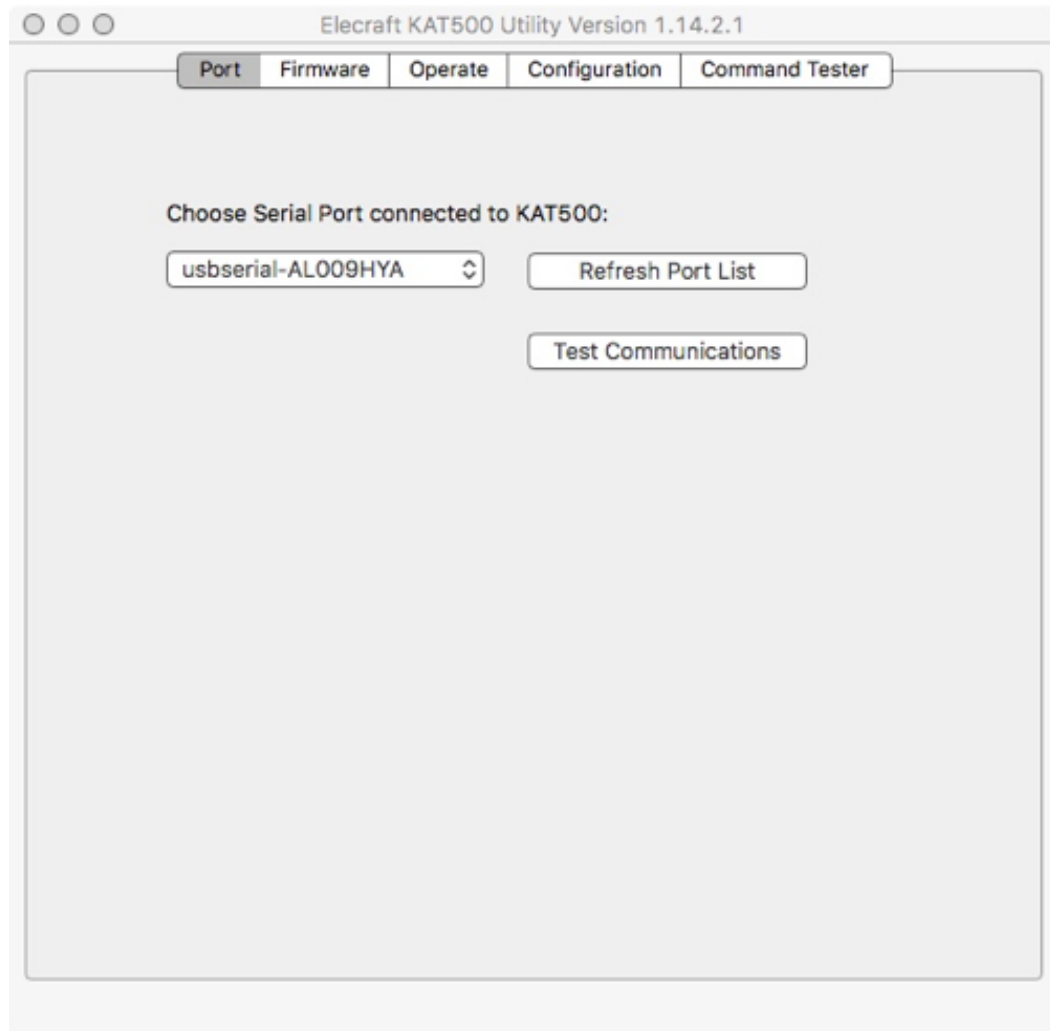
The following is a connector reference from the IC-F8101-3X manual:

ACC	Pin	Pin name	Description	Specification
	1	CI-V	—	—
	2	AF IN	Input terminal for the AF signal.	Input sensitivity (Data mode): More than 52.5 W at 100 mV
	3	AF OUT	Output terminal for the AF signal.	Output level: 200 to 400 mVrms when receiving Data mode
	4	AF GND	Ground line for the AF signal.	—
	5	GPS RXD	Input terminal for receive data from GPS unit.	NMEA0183
	6	NC	—	—
	7	RELAY	Goes to ground when transmitting.	Less than 100 mV
	8	EALC	ALC voltage input.	Control sensitivity (at -3 V input): More than 40 dB suppression
	9	MODPTT	PTT input terminal. When grounded, transmits.	Input voltage: Less than 0.8 V for transmit
	10	CW KEY	CW and FSK keying input.	CW: Less than 0.6 V for transmit RTTY: Open=Mark
	11	EALARM	Output terminal for the Alarm signal.	Output current: 12 mA±10% Open collector
	12	GND	Connect to ground.	—
	13	5V	5 V output for GPS unit.	5 V, maximum 200 mA
	14	NC	—	—
	15	13.8V	13.8 V output for external equipment.	13.8 V, maximum 1 A

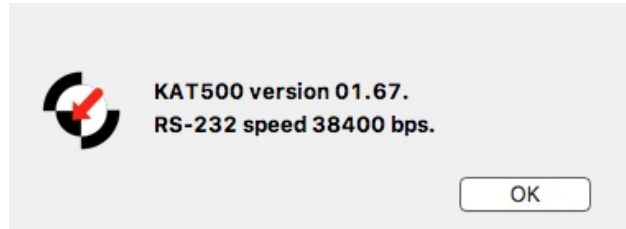
ATU	Pin	Pin name	Description	Specification
	1	KEY	Key signal input.	—
	2	START	Start/bypass signal output.	—
	3	13.8V	13.8 V output for Antenna tuner.	13.8 V, maximum 2 A
	4	13.8V	13.8 V output for Antenna tuner.	13.8 V, maximum 2 A
	5	GND	Connect to ground.	—
	6	GND	Connect to ground.	—
	7	NC	—	—
	8	NC	—	—
	9	NC	—	—

Elecraft software for configuring the KPA-500 Amplifier and the KAT-500 amplifier can be downloaded from the Elecraft site by visiting: www.elecraft.com/software/elecraft_software_page.htm

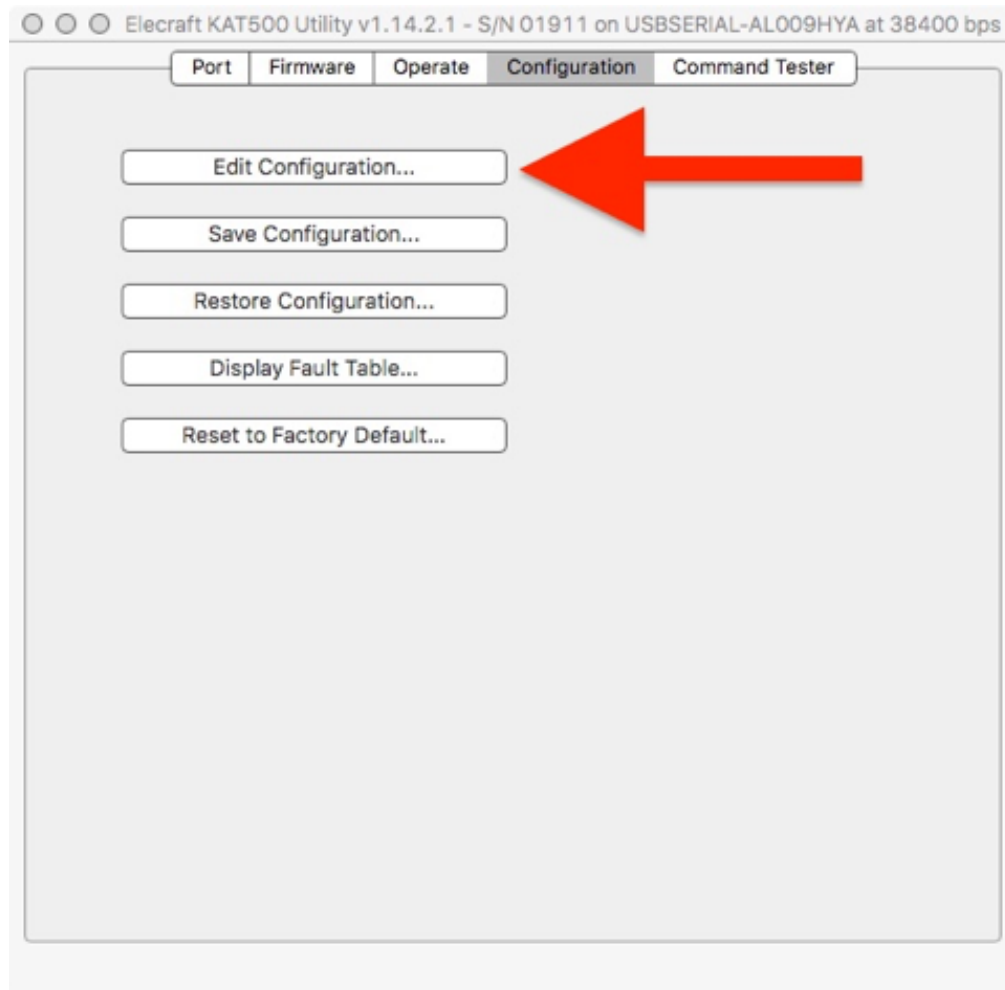
1. The KAT500 auto-tuner is shipped with a USB interface cable. This cable has a stereo 3.5mm plug on the end opposite of the USB connector. Install this cable on the computer and the **PC DATA** connector at the rear of the KAT-500 auto-tuner.
2. Power up the KAT-500 auto-tuner.
3. Launch the KAT500 Utility and select the proper target port to communicate with KAT-500 auto-tuner.



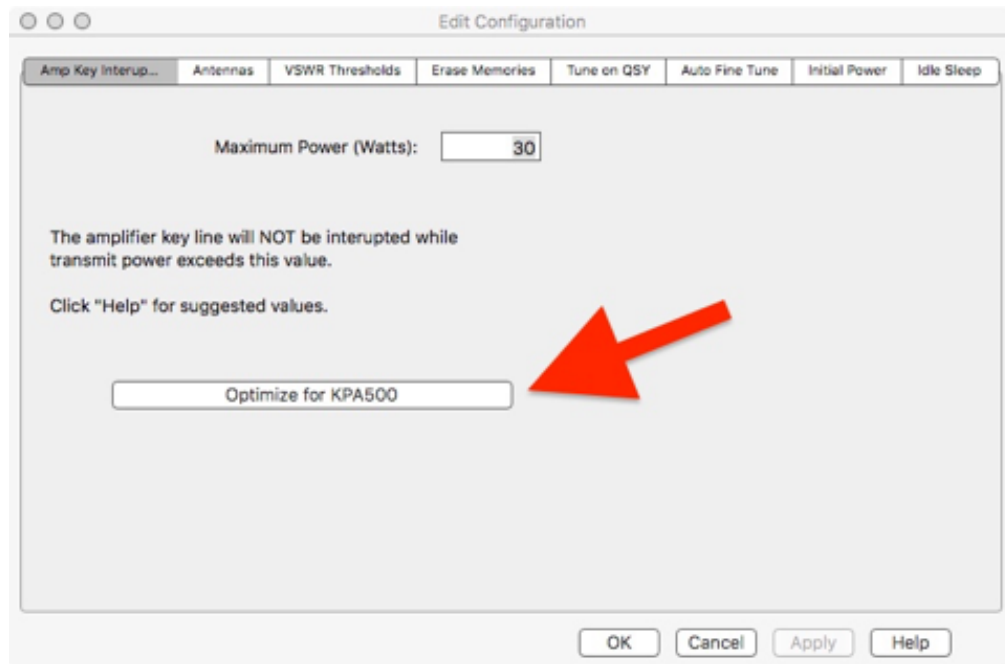
4. Click on the **Test Communications** button to verify that the cable and port selections are functional. Then dismiss the test status dialog box by clicking on the **OK** button.



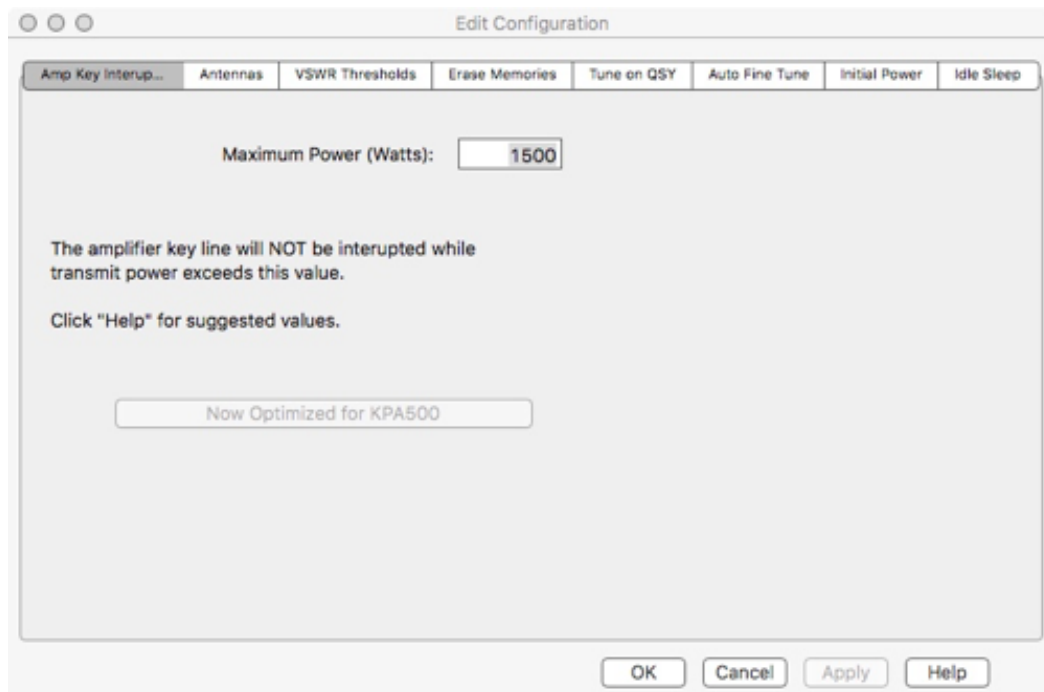
5. Select the **Configuration** tabbed window and then click on the **Edit Configuration...** button.



6. The default settings will show a configuration the following:



7. Click on the **Optimize for KPA500** button, and then click on the **Apply** button.



Tuner Memory

Select the ALE Network in the Icom IC-F8101-3X that you intend to use, and perform a sounding. This operation is performed to get the KAT-500 to perform an auto-tune sequence on each of the channels that are contained in the ALE Network so that the auto-tune settings can be pulled from memory during later use. Subsequent use of the ALE Network channels will then result in very fast tuning and will not adversely impact the ALE dwell time.

Note that if you are using another radio service, such as MARS or USCG Auxiliary, there may be restrictions on when you are allowed to perform a sounding. You can accomplish the same goal by simply iterating over each channel in the ALE Network and use the PTT-Tune (i.e. hold the microphone push-top-talk depressed until the auto-tune sequence completes) to accomplish the same goal without actually performing a sounding.

The auto-tuning sequence of memorizing the auto-tuner settings for each channel in the ALE Network, can be performed with the KPA-500 amplifier either on or off. If the KPA-500 amplifier is turned on, you should not observe any keying of the amplifier during the auto-tune sequence. Once the auto-tune sequence is completed, any subsequent transmission, if the auto-tuner tune sequence resolved to an acceptable VSWR, should result in keying of the KPA-500 amplifier.

Your station should now be ready for ALE operations. If the KPA-500 amplifier is not on, turn it on, and make a test link with another ALE station to assess operation. Again, during the auto-tune sequence you should not observe keying of the KPA-500 amplifier, but subsequent transmissions, including an ALE calling sequence, should key the KPA-500.

Firmware Updates for the Elecraft KAT-500 & KPA-500

Where issues regarding experiencing the KAT-500 initiating an auto-tune sequence or the KPA-500 amplifier jumping down one or two bands during digital transmission (i.e. ALE, MT63, etc.) had previously been reported in this article, those issues have been resolved by updating the firmware in both the KAT-500 and KPA-500.

It is highly recommended that users update the firmware in the Elecraft KAT-500 and KPA-500 devices.

- **ALE Linking and Un-linking**

Although the un-linking of two ALE stations, when invoked from the IC-F8101-3X, will result in the IC-F8101-3X resuming the ALE scanning process, the un-linking, when invoked from a remote station that unlinks from the IC-F8101-3X will not result in a resumption of ALE scanning on the IC-F8101-3X.

This may not be much of an issue for an attended station. But an unattended station, which may be a common occurrence outside of the Amateur Radio service, cannot function beyond the first unattended call with this behavior. Unattended access requires that the radio always resume ALE scanning, regardless which station has unlinked the ALE stations.

An attempt to use timers to restore ALE scanning after 5-minutes has not been successful.

Icom has been made aware of this issue, and attempts to resolve this critical behavior are in progress.

- **Truncated AMD Messages**

When an AMD message is received on the IC-F8101-3X, only the first 25-characters, of a message that may be as long as 90-characters, can be viewed.

Since AMD messages have to be pre-programmed, one might argue that their utility is limited. This issue is exposed because it may matter to you.

Icom has been made aware of this issue, and attempts to resolve this behavior are in progress.

- **Extraneous Tune on Unlink from ALE**

The IC-F8101-3X appears to invoke an auto-tune sequence when the **SCAN** button is pressed to unlink from another ALE station after having established a link. This tune operation is redundant in that tuning already occurred on the ALE network channel when establishing the link (either via a full auto-tune sequence, or by applying tuner settings from memory within the KAT-500 auto-tuner).

This behavior has not yet been reproduced on another radio.

This behavior is a minor annoyance and a resolution is not critical for normal station operations.

Icom has not been informed of this issue. Further fault isolation steps, and confirmation of the behavior on another radio would be required before informing Icom.

- **Automatic-Tuner Operation**

Despite having the configuration setting set to enable tuning (i.e. both **Tuner** and **PTT Tune** are set to **ON**), there are times when the IC-F8101 will not invoke an auto-tune sequence by pressing the **TUNE** button on the front panel, or by pressing the **PTT**. This has been observed with the VSWR in excess of 2.0:1. Further, the **TUN** icon is not displayed on the IC-F8101-3X display when this occurs. Sending a tone on transmit (using the **TUNE** button in FLDIGI) does result in tuning in this case. This is a new observation on the IC-F8101-3X (observed between 0230Z and 0315Z on 27 Mar 2017), and has not yet been confirmed on another radio.

The radio appears to not be transmitting a carrier when pressing the **TUNE** button or the **PTT**.

- **IC-F8101-3X Built-in USB Devices**

Although the Icom IC-F8101 provides a USB interface, with a USB Composite Device implementation, there are incomplete engineering issues with the USB Device Descriptors, and, depending on what other USB devices may be connected to your computer, may present additional difficulties.

The IC-F8101-3X Composite USB Device includes a USB Audio device, and is able to support using software based digital modems (i.e. FLDIG, WSJT-X, etc.), provided that keying of the transmitter is invoked using the CI-V interface. But because Icom choose not to have their own USB vendor ID, product ID, manufacturer string and product string encoded into the USB Audio device descriptor, the IC F8101-3X will report a USB Audio device descriptor that relies on the data provided by default by the Texas Instruments silicon, and will simply show up as **USB Audio CODEC** in your computer user interface.

Other manufacturers also take this short-cut, and the result is that you may have multiple USB audio devices attached to your computer that all identify themselves as **USB Audio Codec**. Other devices that are known to present themselves in this manner include the Behringer XENYX 1204 USB audio mixer, and the ubiquitous TigerTronics Signalink USB radio sound-card interface.

Because the USB Device Descriptors on these devices do not uniquely identify them, it can be difficult, if not impossible, to select the proper target USB audio device when more than one device is attached to your computer that presents this ambiguous device self identification. Software may simply bind to the first device found (which may change if you change the topology of your USB BUS). Menus that support device selection may suppress redundant entries, and may not provide the option to select the device that you wish to use. Even if the user interface does present multiple devices, the user would have to try to stream audio to/from that device to verify that the selection is correct.

This is all a gross violation of the **plug and play** intentions of USB. I, for one, would much rather pay an additional dollar to have a proper device descriptor that allows proper device identification and selection.

Oddly enough, Icom applied this engineering short-cut only to the USB Audio device built-in to the IC-F8101-3X. The USB Serial Device interfaces provide, at least, a serial number string that identify these interfaces as the **A** and **B** interfaces to the IC-F8101-3X, but even these are not properly implemented in that the vendor ID, product ID, manufacturer string and product string should have been implemented as unique to Icom and should not have relied on the silicon manufacturer default data.

If you have difficulty interfacing to the IC-F8101-3X USB Audio device, and if you have other USB Audio devices attached to your computer, you may need to disconnect the other devices to get the IC-F8101-3X USB Audio device to function properly.

Icom, and other manufacturers, need to know that this is a problem and unacceptable to the customer.

Icom IC-F8101-3X USB Device Descriptors

The following is a dump of the IC-F8101-3X USB Audio device descriptor (the interface descriptors have been omitted for brevity):

```
Device Descriptor
  Descriptor Version Number: 0x0110
  Device Class: 0 (Composite)
  Device Subclass: 0
  Device Protocol: 0
  Device MaxPacketSize: 8
  Device VendorID/ProductID: 0x08BB/0x2901 (Texas Instruments Japan)
  Device Version Number: 0x0100
  Number of Configurations: 1
  Manufacturer String: 1 "Burr-Brown from TI"
  Product String: 2 "USB Audio CODEC"
  Serial Number String: 0 (none)
  Number of Interfaces: 4
  Configuration Value: 1
  Attributes: 0xC0 (self-powered)
  MaxPower: 0 ma
```

The following is a dump of the IC-F8101-3X USB Serial A interface:

```
Device Descriptor
  Descriptor Version Number: 0x0110
  Device Class: 0 (Composite)
  Device Subclass: 0
  Device Protocol: 0
  Device MaxPacketSize: 64
  Device VendorID/ProductID: 0x10C4/0xEA60 (Silicon Laboratories, Inc.)
  Device Version Number: 0x0100
  Number of Configurations: 1
  Manufacturer String: 1 "Silicon Labs"
  Product String: 2 "CP2102 USB to UART Bridge Controller"
  Serial Number String: 3 "IC-F8101 33001005 A"
```

The following is a dump of the IC-F8101-3X USB Serial B interface:

```
Device Descriptor
  Descriptor Version Number: 0x0110
  Device Class: 0 (Composite)
  Device Subclass: 0
  Device Protocol: 0
  Device MaxPacketSize: 64
  Device VendorID/ProductID: 0x10C4/0xEA60 (Silicon Laboratories, Inc.)
  Device Version Number: 0x0100
  Number of Configurations: 1
  Manufacturer String: 1 "Silicon Labs"
  Product String: 2 "CP2102 USB to UART Bridge Controller"
  Serial Number String: 3 "IC-F8101 33001005 B"
```

ALE Station Behavior

During scanning, when no call is being received, no auto-tuning occurs.

Circumstances where auto-tuning will occur include:

- A. When the IC-F8101-3X issues an auto-tune sequence by sending a START signal via the ATU connector
- B. When the Elecraft KAT500 observes, during transmit, a frequency change of greater than 1%
- C. When the Elecraft KAT500 observes, during transmit, a high VSWR.

The expected behavior, in all cases, is that the IC-F8101-3X will issue a START signal, upon moving channels, to initiate an auto-tune cycle. The auto-tuner will, in response to receiving the START signal from the IC-F8101-3X, initiate an auto-tune cycle by asserting the KEY signal back to the IC-F8101-3X via the ATU connector. When the auto-tune cycle has completed, the auto-tuner will negate the KEY signal. The IC-F8101-3X will then re-key the transmitter to perform either an ALE transmission, voice transmission, or transmission of another appropriate mode to convey information for which the transmission was originally initiated.

If the IC-F8101-3X properly issues the START signal as indicated in **A** above, then items **B** and **C** should not need to occur. Items **B** and **C** will occur in the absence of **A**, and provide protection against high VSWR operation. However, if **A** does not occur, the ALE dwell time may be adversely impacted by the tune cycle as a tune cycle that is initiated by **B** or **C** is asynchronous to the normal sequence that should occur upon initiating transmission on a new channel.

When moving to a new channel and initiating an ALE digital transmission, the expected sequence is as follows:

1. Radio moves to new channel
2. Radio initiates auto-tune cycle by issuing START
3. Tuner asserts KEY on the ATU connector and performs auto-tune sequence
4. Radio keys transmitter, at reduced power, with a carrier to support auto-tune sequence
5. Tuner senses radio keying via the RELAY signal on the ACC connector, and inhibits the keying signal to the amplifier
6. Tuner negates KEY on the ATU connector upon completing auto-tune sequence
7. Radio un-keys
8. Radio re-keys
9. Tuner senses radio keying via the RELAY signal on the ACC connector, and forwards the keying signal to the amplifier
10. Radio transmits ALE digital transmission
11. Radio un-keys

When receiving an ALE call, I have observed instances where the radio does not issue an auto-tune prior to sending a digital transmission in response to the ALE call. When this occurs, the IC-F8101-3X has been observed to not issue a START to the auto-tuner. Further, when the digital transmission occurs that responds to the ALE call, the KAT500 will observe that a frequency change of greater than 1% has occurred, or that a high VSWR has occurred, and will initiate an auto-tune sequence on its own. This behavior does not always occur, as I have also observed instances where the IC-F8101-3X does issue a START to initiate auto-tuning prior to answering an ALE call. This issue is limited to receiving a call only and does not occur when issuing a call. This observation has been forwarded to Icom.

ALE Performance

The station configuration here includes a [184 foot balanced terminated folded dipole](#). This antenna is broadband, and exhibits a VSWR of less than 2.7:1 from 1.8 to 40 MHz. My use of the KAT-500 intends to optimize matching, but the tuner requirements, with this small mismatch, are fairly meager (and not strictly necessary above 3.5 MHz).

ALE operation will now need to have the IC-F8101-3X configured to the MID power setting so that an acceptable drive level is presented to the KPA-500 amplifier.

With the equipment connectiosn and configuration described above, I have been seeing very good performance using ALE. Received ALE calls will result in very fast memory tuning. The radio in this article has the IC-F8101-3X configured with a total of seven ALE networks, supporting both Amateur Radio and non-Amateur Radio services, and at present, none of those networks are exhibiting an issue.

I hope this information has been useful to other users of this equipment.