

ES4L-4B SOFT-START/SOFT-KEY/BIAS MODULE v1.0 INSTALLATION INSTRUCTIONS

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PARTS SUPPLIED WITH THIS UPGRADE KIT

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|--|------------------------------------|
| (1) ES4L-4B Soft-Start/Soft-Key/Bias Module v1.0 | (1) 100K Ω 5-Watt Resistor |
| (6) #4-40 x 1/4" Pan Head Machine Screw | (2) #4-40 Hex Nut |
| (2) #4-40 x 1/2" Threaded Standoff | (2) #8-32 x 1/2" Threaded Standoff |
| (2) #8-32 x 1/4" Pan Head Machine Screw | (1) 1-1/2" 3/16" HST Tubing |
| (1) 14" #20 Blue Wire | (1) 4" #20 White/Orange Wire |
| (1) 4" #20 Black Wire | (1) 10" #20 Yellow Wire |
| (1) 10" #12 Black Wire with #4 Lug | (1) #4 Lug |
| (1) 2" #20 PTFE Tubing | |

WARNING: Voltages inside the amplifier CAN & WILL KILL YOU! You MUST also know how to work around HIGH VOLTAGE safely. If you do not, get assistance from someone who does.

PRELIMINARY INFORMATION

Determine the operating status of the amplifier and power supply before beginning this upgrade. Is the amplifier working now? Is the power supply working now? You need to know where you are starting from or you may have difficulty finding your way home again.

This module was specifically designed for an easy retrofit into the Drake L-4 or L-4B amplifier.

The instructions are step-by-step. It is strongly recommended you read the entire document before you begin and read each step completely before starting the step. There may be a bit of information gleaned at the end of the step that you wished you had just a minute earlier. The process of labeling or tagging wires is strongly recommended on any repair or rebuild project. Wires are color coded but it is a good idea to label them anyway as referenced in the instructions. Masking tape and a ball point works fine.

- () **Read, re-read and fully understand these instructions prior to beginning this upgrade.** Make sure to perform the steps in the order they are listed. Also, be sure to label wires as they are disconnected from various points inside the amplifier. This will help when the time comes to re-attach the wires that will be disconnected during installation of the kit.

TOOLS THAT YOU WILL NEED TO PERFORM THIS UPGRADE

Phillips screwdriver, Size 1 preferred
Long nose pliers
Side cutters, flush cutters, or lead trimmers
Soldering iron and a bit of 60/40 electronic solder (NO lead core solder)
Schematic of the L-4 or L-4B amplifier

TOOLS THAT WILL BE HELPFUL IN PERFORMING THIS UPGRADE

#32 drill bit

Wire strippers

Forceps or hemostat clamp

Paper and pencil or digital camera for taking notes and documentation

Masking tape to label wires during disassembly

ES4L-4B SOFT-START/SOFT-KEY/BIAS MODULE INSTALLATION INSTRUCTIONS

- () Use the multimeter of the amplifier to read PLATE VOLTAGE. Unplug the AC power cord from the mains outlet and allow time for the high voltage to discharge to 0 VDC. Verify that the HV has bled down to 0 VDC on the multimeter.
- () Disconnect the remote power supply cable and HIGH VOLTAGE cable from the rear of the RF deck. Disconnect the input and output coax cables and any keying and ALC cables from the RF deck.
- () Do not plug in the AC power cord or re-apply AC mains power until you have completed your work & inspected it and removed any accidental short circuits and stray wire clippings.
- () Place a towel or protective covering on the work surface and place the RF deck on the surface top side down. Remove the bottom cover of the RF deck and place it and the screws aside. The top cover will be removed in a later step.

Before beginning the installation please take whatever time is necessary to familiarize yourself with the amplifier as built. The connections and wire colors on the new kit have been chosen to agree with the original Drake nomenclature in an attempt to eliminate any confusion during installation. Look the schematic copy and take the time to trace out the wiring. Make certain that the unit you are going to work on is in agreement with the documentation provided prior to starting the installation. Make the information presented there “your own”. Do not assume or get in a hurry. There is no prize for being fast, only for being right. If something doesn’t look right, contact Electronic Specialties before proceeding. It is much easier to provide assistance before it becomes a pile of loose parts. Manufacturers have been known to deviate from what is generally accepted as “gospel” in the midst of a production run and that can cause problems during installation.

With the RF deck resting on its top and the front panel forward (away from you), the following terms will be used: FRONT refers to the front panel; REAR refers to the rear panel; INSIDE is toward the center of chassis; and OUTSIDE refers to the edge of the chassis or right side if oriented as described above.

- () There are two blue wires coming from the center side of the filament transformer T1. These are low voltage wires that originally powered the relay. Unsolder both wires from their original locations. The shorter wire landed at a ground lug on the watt meter board and the longer one to a terminal strip near the front. DO NOT just clip the wires. Try to keep them original and clean the ends. The shorter one barely has enough length to reach the new module so try to keep it intact or you will need to splice in extra wire.
- () Remove the 1-lug terminal strip near the front and the RF deck along with diode D2, capacitor C33, and resistor R5. These parts will no longer be needed.

- () Inspect the longer terminal strip near the front of the RF deck where the pilot lamp leads are attached. Clean up any sloppy soldering and tighten up the leads if required. This is important because the new module will mount close to the back side of the terminal strip.
- () In this step you will reroute the WHITE-BLUE wire from the relay coil to the VOX connector. Unsolder the WHITE-BLUE wire from the anode of D5 at the VOX connector on the rear panel of the RF deck. Clean the solder from the end of the wire and straighten it (make it smooth) and "fish" it out of the corner of the chassis and rear panel. Behind the relay the wire is held in a bundle with other wires with a short twisted solid wire (possibly light green in color). You will need to untwist this wire tie enough to be able to fish the WHITE-BLUE wire through it. Near the relay and next to the watt meter circuit board you will find another wire tie. Loosen it as well and continue fishing the WHITE-BLUE wire out of its location so that it can be re-routed toward the front of the RF deck where it will connect to the new module. DO NOT disconnect the WHITE-BLUE wire from the relay.
- () Strip ¼" of insulation from the new #20 BLUE wire supplied in the kit and solder it to the anode connection of D5 (where the WHITE-BLUE wire was removed) and dress it along the chassis and route it along the same path as the WHITE-BLUE wire toward the front of the RF deck.
- () In this step you will disconnect wires at the relay and re-route them to their new location. Disconnect the WHITE-GREEN wire from the NORMALLY CLOSED solder lug of the center pole of the relay. Fold the now free end of the WHITE-GREEN wire over on itself and place a ¾" length of heat shrink tubing over it and shrink it tight. The wire just removed is the 120 VDC cutoff bias that is no longer required. Since there will still be voltage present on this wire, it needs to be insulated and tucked out of the way. There will be NO connection to the relay where the WHITE-GREEN wire was removed.
- () Identify the YELLOW wire coming from the transformer that connects to the COMMON solder lug of the center pole of the relay. This is the filament center tap lead which is also the cathode connection for the tubes. Disconnect the YELLOW wire from the relay and clean the solder from the lug.
- () Place a 1" length of #20 clear PTFE tubing (supplied in the kit) on each of the two leads of the 100KΩ 5W resistor (supplied in the kit). Strip ¼" of insulation from one end of the #20 YELLOW wire (supplied in the kit) and tin the wire lightly. Insert the tinned end of the new YELLOW wire and one lead of the 100KΩ 5W resistor through the COMMON solder lug of the center pole of the relay and solder. It is a snug fit, which is why the lug needs to be clean to start with. BE CAREFUL, there is NOT an abundance of room in there to work and you do not want to melt something with a careless soldering iron!
- () Clean the solder from the NORMALLY OPEN solder lug of the center pole of the relay. This lug has a WHITE-YELLOW or ORANGE wire connected to it. DO NOT remove the wire but add the remaining end of the 100KΩ 5W resistor to the lug and solder the connection. The procedure just completed places the 100KΩ 5W resistor across the open set of keying contacts of the relay. With the relay open (receive), the resistor is in the cathode circuit of the tubes and they are biased off. When the relay closes (transmit), the resistor is shorted out by the relay contact and the tubes are biased for operation by the diode string on the new module.
- () At the terminal strip near the front of the RF deck (the one with all the pilot light connections---right behind the power switches), remove the two (2) #4 sheet metal screws which attach the terminal strip to the chassis. CAREFULLY enlarge the two screw holes using a #32 drill bit.

- () Inspect your work thus far and turn the RF deck over so that the top is facing up and remove the cover. Place the cover and screws aside.
- () This would be a good time to inspect top of chassis items and take care of any needed steps or remember to come back to them later. Check the blower wheel to see that it turns freely. If you have never lubricated the motor this would be a great time to do that. There are two small holes in the ends of the motor case for that. No need to flood it, just a couple drops of a fine grade oil are adequate.
- () Are the tubes and chimneys clean? Baked on dust is of no help for cooling the tubes. The procedure for inserting and removing chimneys and tubes is covered in the manual. If removing tubes seems too easy (as in loose) then it likely indicates the springs on the sockets are loose and must be attended to for maximum performance and longevity of the amplifier and tubes.

Loose socket contacts on tubes like the 3-500Z are a frequent cause of problems like “one of my tubes won’t light” or “my amplifier is acting strange and intermittent“. Sockets like those used in the amplifier have a bent U shaped spring around the contacts which holds the contacts tight on the tube pins. The two filament pins are the worst. The high filament current coupled with poor contact weakens the springs and causes undue heating of the pins which can melt the solder in the pins. It is relatively easy to carefully remove the clips when the tubes are removed, clean the socket contact surface with contact cleaner on a Q-tip, bend the clips back to where the open ends touch each other and re-install them on the contacts. If you have done a good job bending the clips and they still have the original spring tension the tubes will be a bit difficult to snap back in place but that is a good thing. If the spring have lost their temper, they need to be replaced with better clips from a donor socket.

- () From the top of the RF deck place one (1) of the supplied #4 x ¼” pan head machine screw into each of the two (2) holes that were enlarged in a previous step. Pass the screws through the terminal strip mounting feet and secure each screw using one (1) of the supplied #4-40 x ½” threaded standoffs on the underside of the chassis. Before tightening, slide the terminal strip forward toward the front of the RF deck as far as it will go and then tighten the two screws.
- () That completes work on the top side of the RF deck. Flip the RF deck back over so that the bottom is now facing up.
- () CAREFULLY remove the two (2) #8-32 screws that are two of three mounting screws for the large ceramic coil form. These are the two screws that are located directly forward of the barrier terminal strip for AC line voltage selection. They are threaded into the ceramic form. Be cautious not to stress or break the ceramic form!
- () VERY CAREFULLY insert the threaded end (male end) of one (1) of the supplied #8-32 x ½” male/female standoffs into each of the tapped holes in the ceramic coil form where the two (2) screws were just removed. Resist any temptation to just run these in with the nut driver! Thread them in by hand to ensure that they are NOT cross threading. When they have been threaded in all the way finger tight give each one a slight tweak with the nut driver to seat it but not so much that you risk damaging the ceramic coil form.
- () Take the assembled soft-start/soft-key/bias module supplied with the kit and observe the various connection points are labeled on the component side of the printed circuit board. The correct mounting position for the module will be over the four (4) standoffs that were just installed with the large power resistor nearest to the outside of the RF deck and the diode string nearest to the inside of the RF deck. The mounting will be completed in a later step after wiring has been attached.

- () Strip ¼" insulation from the #20 WHITE-ORANGE wire supplied in the kit. Insert the wire from the foil (underneath) side of the board in hole labeled **+24V** and solder from the component (top) side of the printed circuit board.
- () In like fashion install the supplied 4" #20 BLACK wire into the hole labeled **GND**.
- () Place the module in position but DO NOT mount yet. Route the longer of the BLUE transformer wires under the module and insert the bare end into the hole labeled **X1** and solder from the top of the printed circuit board.
- () Route the YELLOW center tap transformer wire under the module and insert the bare end into the hole labeled **CT** and solder from the top side of the printed circuit board.
- () Route the WHITE-BLUE relay wire under the module and insert into the hole labeled **RLY** and solder from the top side of the printed circuit board.
- () Strip ¼" insulation from the new #20 BLUE wire, route it under the module and insert into the hole labeled **KEY** and solder from the top side of the printed circuit board.
- () Route the remaining BLUE transformer lead under the module and insert into the hole labeled **X0** and solder from the top side of the printed circuit board.
- () Strip ¼" insulation from the new #20 YELLOW wire connected to the COMMON solder lug of the center pole of the relay. Tin the end of the wire and choose one of five possible connections labeled **1, 2, 3, 4, 5** corresponding to approximate operating bias voltage for the tubes. It is not necessary to insert the wire through the hole in the board but merely solder to the pad on the top of the printed circuit board to allow easy re-positioning if required.

Observations thus far are that older EIMAC tubes are operating at 3VDC bias and newer import tubes or those with graphite plates like AMPEREX do well at 4VDC bias. The final determination is made with the amplifier operating. Observe the resting plate current for SSB operation and select a bias voltage that results in current between 120mA minimum and 180mA maximum. Remember that higher the bias voltage results in lower resting plate current. Weak tubes require a lower setting to obtain adequate resting plate current.

- () Unsolder the #12 BLACK wire from the end terminal of the front panel ON/OFF rocker switch. Trim the excess tinned end to ¼". Pull the lead back through the wire tie closest to the switch. Place ¾" of the supplied heat shrink tubing over the lead and push it well back on the lead far from the bare end. Place the large supplied solder lug on the end of the wire and solder securely. When the connection has cooled a bit, slide the heat shrink tubing forward over the barrel of the lug. Shrink the tubing in place and bend the lead back toward the rear of the chassis to permit attachment to the new module.

Routing for the two wires in the following steps is best if the wire from AC2 exits the module to the front and the wire from AC1 exit's the module to the rear. Each wire then makes a reverse loop along the chassis edge to its destination. That method leaves a bit of slack for subsequent service should it be required and the wires positioned AWAY from the large power resistor.

- () Insert one (1) supplied #4-40 x ¼" pan head machine screw through the board at **AC2**, place the lug of the wire just completed over the screw and secure with a supplied #4-40 nut. **TIGHTEN THIS CONNECTION SECURELY,**

- () In similar fashion secure the supplied #12 BLACK wire with lug already attached to the connection labeled **AC1**. TIGHTEN THIS CONNECTION SECURELY.
- () Strip the free end of the #12 BLACK wire just installed and solder it to the end lug of the ON/OFF rocker switch which was previously vacated.
- () OPTIONAL STEP: There is an unused output on the board labeled **RDY** for READY. This is a pull-down output that along with R11 (user supplied current limiting resistor) provides a pull down which can be used to illuminate a small LED or lamp sourced from +24VDC to indicate the startup status as the soft start is complete. The value of R11 is dependent on the electrical characteristics of the LED or lamp used. For example, R11 would need to be approximately 1.2K Ω ½-watt if you used a standard 5mm red LED with a 2VDC voltage drop and operating current of 20mA. See equation below for calculation of resistor value:

$$(24\text{VDC} - 2\text{VDC})/0.020\text{A} = 1100\Omega$$
 (next standard value is 1.2K Ω)
- () Mount the new module in place over the four threaded standoffs using two (2) supplied #4-40 x ¼" pan head machine screws and two (2) supplied #8-32 x ¼" pan head machine screws
- () Strip ¼" of insulation from the free end of the #20 BLACK wire connected to the module GND pad and solder it to the grounded lug on the inside end of the terminal strip near the front of chassis.
- () In a similar fashion, prepare the free end of the #20 WHITE-ORANGE wire connected to the module +24V pad and solder it to the second terminal from the inside end of the terminal strip near the front of the RF deck. This terminal has an ORANGE wire on it and is the +24VDC source to the STANDBY switch (L-4B only) and then to the inside terminal of the coil on the relay.
- () This completes installation of the ES4L-4B module. Take a moment to inspect everything for solder splashes and any loose wire clippings. Dress the two (2) #12 BLACK power leads against the outer edge of the chassis and away from the large power resistor. Dress the smaller low voltage wiring to the module into the trough near center of the chassis. Wire ties are optional but always make things neater.
- () Inspect the foam weather stripping on the inside of the bottom cover. If it is deteriorated this is the time to replace it. Replacement will require 16" of ¾" wide x 3/16" thick high density foam weather stripping. This keeps the air from leaking out and makes sure it all goes up through the tube chimneys to cool the tubes.
- () Replace the top and bottom covers on the RF deck and secure them in place with just a couple screws until the installation has been checked and you are satisfied with the bias setting selected.

EXERCISE EXTREME CAUTION IN THE FOLLOWING STEPS

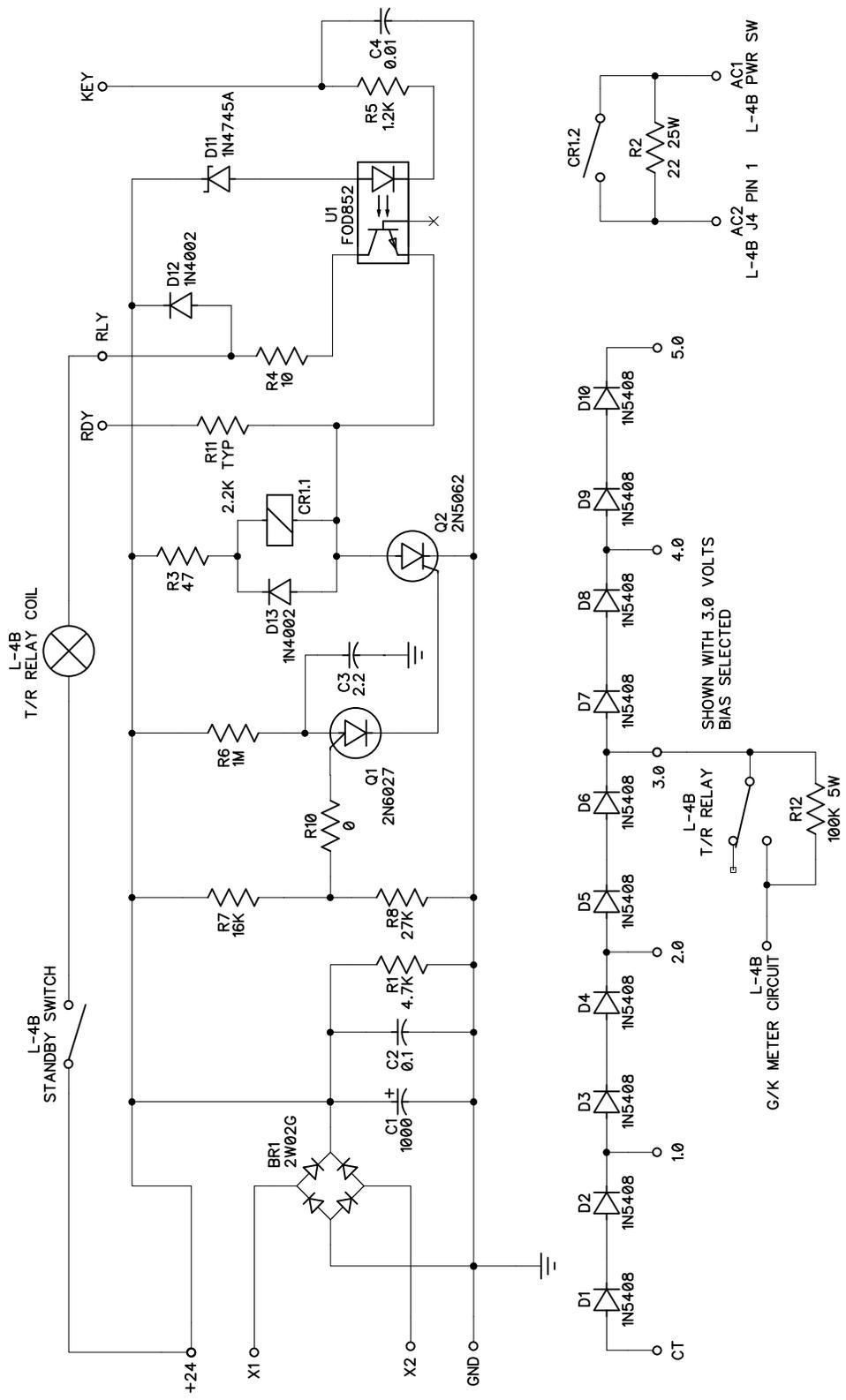
- () Place the RF deck right side up with the covers temporarily in place. Make sure the power switch is in the OFF position. Connect the remote power supply cable from the power supply to the large Jones connector on the rear panel of the RF deck. Connect the HIGH VOLTAGE cable from power supply to the HV connector on rear of the RF deck. Connect the RF OUTPUT to a dummy load capable of handling 1KW of RF. The dummy load connection is not essential to the testing but always a good idea when working on ANY linear amplifier to ALWAYS have the RF OUTPUT terminated in a load.
- () Plug in the AC power cord from the L4-PS to the mains outlet.

- () Set the multimeter switch to PLATE VOLTAGE, the CW/SSB switch to either position, and power switch to ON. The plate voltage should rise to about 1500VDC (CW) or 2000VDC (SSB) and the tube filaments should gradually come to near full brilliance over the 2 ½ second soft-start time. When the time delay has elapsed, there will be a faint click as the soft-start relay closes and shorts out the load resistor. The high voltage should increase to its final value of 1900VDC (CW) or 2600VDC (SSB) and the tube filament and dial lights will increase to full brilliance.
- () If the startup is not as described above, IMMEDIATELY turn the amplifier OFF and determine the cause of problem before proceeding. When removing the top cover of the amplifier ALWAYS check the PLATE VOLTAGE on the meter to ensure that the power supply has completely discharged to 0VDC plate volts.
- () After you are satisfied that the installation is correct and the amplifier is operational you may proceed to check the resting current of the tubes and the soft-key interface.
- () With the amplifier on and the keyed and no drive signal applied to the amplifier, the resting current will be displayed on the PLATE AMPERES meter. Remember, we are looking for a value of 120mA to 180mA.
- () Set a VOM to measure DC voltage and check that the open circuit voltage at the VOX RELAY connector is less than +12VDC. With the VOM set to measure DC current (mA), check that the current from VOX RELAY connector to ground should be less than 10mA DC when the amplifier is keyed.
- () Replace the remaining screws to secure the covers and the installation is complete.

Enjoy your enhanced L-4 or L-4B which should continue to provide many additional years of service. Please don't hesitate to call or write if you have questions or comments.

Thank you!
Paul Kraemer K0UYA

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ALL RESISTORS IN OHMS, 1/4W UNLESS NOTED
 ALL CAPACITORS IN MICROFARAD
 ALL ELECTROLYTIC CAPACITORS ARE 35WVDC
 ALL CERAMIC CAPACITORS ARE 100WVDC

ELECTRONIC SPECIALTIES 53 N. 16TH STREET, FAIRFIELD, IA 52556	
ES4L-4B SOFT-START/SOFT-KEY/BIAS	
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