Jackson 658 – Rebuild and Calibration Instructions by Erik Knutson
Version 2 – June 2005

These instructions apply to all Jackson 658 models. "658," as used below, refers to models 658, 658A, and 658-1. Any procedural differences between models will be noted. Standard caveats apply: don't shock yourself or do anything that wrecks your tester, and don't blame me if you do. This document may only be reproduced in its entirety, and only on web sites, forums, bulletin boards, etc., or otherwise on or in any printed media or electronic media that cost nothing, either for use, viewing, or access, without the author's permission. It can be freely copied by individuals if solely for their own use, including individuals who fix testers for money.

Background and Circuit Explanations:

This section is not necessary for restoration or calibration, it's solely informational.

The numbered rows of buttons do not match socket numbers, they're Jackson's internal channel numbers. There's a chart on the schematic of how they connect to actual tube sockets. Jackson used a bus line wiring scheme. For example, connecting to the shorts switch (S5) are lines that are always (once a tube test is set up) connected to the cathode, plate, filament etc. Jackson had a specific order in which the channels intersect with the bus lines. On the top row, this is filament common, followed by filament high, and then cathode. On the bottom row, it's plate, then G2, then G1. The lettered buttons reverse and alter this order if needed for a particular tube's pinout. The functions of the panel controls (skipping the obvious ones) are as follows (presented along with some other random facts):

- *center knob on filament voltage control*: this changes the power flowing to the primary of the filament transformer (as opposed to the larger knob, which selects a secondary winding) to better match filament power to the current draw of the tube under test. The effect of this is to provide over 200 permutations, so that basically any tube put under test will have appropriate filament current available to it, and filament voltage will be within 3% of spec.
- *plate voltage (small) knob:* this selects the plate (B+) and screen grid voltage to be used in the quality test, and plate voltage range for voltage regulator tests. The highest Gm B+ is on setting "Q," and the highest for voltage regulators is on setting "VR1."
- *plate knob (large):* this does not change any input to the tube under test, it is one leg of the low impedance meter bridge, used to set the meter bridge such that whatever tube is currently under test will move the meter the appropriate amount of deflection during the quality test. This knob has no effect on anything but the quality test and the meter voltage reading during voltage regulator tests.
- *grid knob:* this controls grid bias and a.c. signal levels (top pot in the dual set, R15), and plate voltage (bottom pot, R22) for voltage regulator tests. The two halves of this pot are not used simultaneously for any test, which means that no difficult alignment of them need ever be made (unlike certain other types of testers). The top section, R15, controls a.c. control grid signal and control

grid bias simultaneously, so the two components of what is placed on the control grid during tests will never be out of sync with each other (if the machine is properly calibrated).

- *tube inputs, in general:* no test signals are applied to the tube under test when the filament test knob is the in "filament" position, except for a very low current to the filament itself to establish if there's continuity. In the knob's "test" position, control grid bias and a.c. signal are always on, with B+ and screen grid voltage applied only when one or more of the lettered test buttons are pressed.
- *"grid" button:* this test is the only use the 658's 6AV6 tube gets, and makes for an excellent grid leakage test. Grid leakage tends to increase with heat, so make sure what you're testing is good and warmed up for the most meaningful results, and hold the button down for at least five seconds. The sensitivity of the 658's grid leakage test, by the way, is second only to Heathkit's TT-1 machines (albeit a fairly distant second).
- *the meter:* 155 ohm, 200uA full scale, and VERY sensitive to static. These often require a gentle tap to the left of the meter (on the tester's panel, not on the meter itself) to get the meter to settle into it's proper reading when it's up the scale. This should only be necessary once, when you first turn it on. If you install meter protection diodes, it will alter your test readings (they will increase, believe it or not), but only by a small amount, typically 2% on the quality scale if you use standard silicon diodes.
- *the transformers:* T1 is for the filaments, T2 is everything else. The uppermost section of T2 (on the schematic, not physically) functions solely to the provide a.c. control grid signal. The capacitor attached to it via the wiper of R19, C3, is there solely to block the d.c. portion of the grid signal that is pasted onto the same line, it is not there to do d.c. filtering, even though it's the value of a typical filter cap. The next section down on T2 provides control grid bias (via D7 and D8 – full-wave rectified), shorts and filament continuity test power, and B+, if you want to call it that (since it's a.c.) for diode tube tests. The third section down provides B+ and screen grid bias (which also goes through a full-wave rectifier), and the bottom section is to light the filament of the internal 6AV6. The bottom section doubles as reference voltage for setting the line input voltage knob with the meter.

Restoration:

If your 658 has never been restored, you'll need to do a few things before you calibrate it:

1. Replace the power cord with a three-wire one. Put a round terminal on the ground wire, remove one of the transformer mounting screws, and attach the terminal there. Hook the hot line to the wire that leads to the power switch.
2. Replace all nine diodes with new silicon ones (even the germanium D9), no matter how normal your DMM says they are. The same type diode can be used in all nine spots. I recommend 1N4007's. D1-6 must have at least a 750 PIV

rating at 750+ mA. If you have something even bigger around, like 1N5408's, use those instead for D1-6, as they take a lot of stress. The other three don't. Make a drawing of the layout of the old diodes before removing them. If you reverse any of D1-D6, get your marshmallows out.

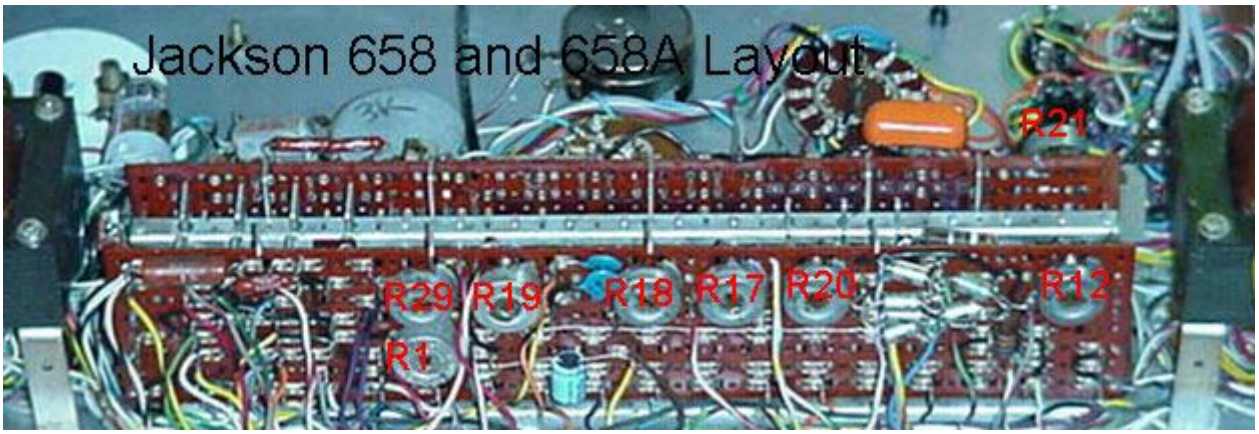
3. Replace the three electrolytic capacitors and the 0.1uF tubular. The disc capacitor shouldn't need replacing unless it looks damaged.
4. Check the values of all your resistors (including the pot's), and replace anything out of tolerance or damaged looking. You may have to press the lettered test buttons or turn the function knobs to be able to read the values of some of the resistors, depending what they're connected to. Pay special attention to R19 (a pot), as those love to burn out. You won't know it if has unless you remove it and look underneath. It's worth your time to do so, since this controls the test signal applied to the control grid (and hence dramatically affects quality readings). Before you check your pot's for smooth operation, mark their starting positions with a magic marker, for reference. Pay special attention to R9 and R10 too, as they have a very important role. If you replace any resistors, go up in wattage rating to be on the safe side. All the resistor failures I've seen in 658's have been burn-out's. Use something wirewound if you replace a pot.
5. Check the 6AV6. You can use the 658 itself to do this, as the 6AV6 is only used for grid leakage testing, not in the quality test. The diode sections aren't even used, so don't worry about the quality of those. Replace the tube if needed before you calibrate the tester. By the way, the 6AV6 is in the line adjust circuit, so if you replace it later, you'll need to recalibrate R20 (but nothing else will be affected).
6. Clean the slide and rotary switches with DeOxIt or something equally good. Mechanically zero the meter, and check the B+ fuse if you have a 658-1.
7. Because Jackson 658's operate tubes under test at a healthy current flow, oscillation can occur with higher gain tubes. I recommend putting a ferrite bead on each lead of the last tube socket in the wiring chain to prevent oscillation. Putting them on every socket is not necessary.

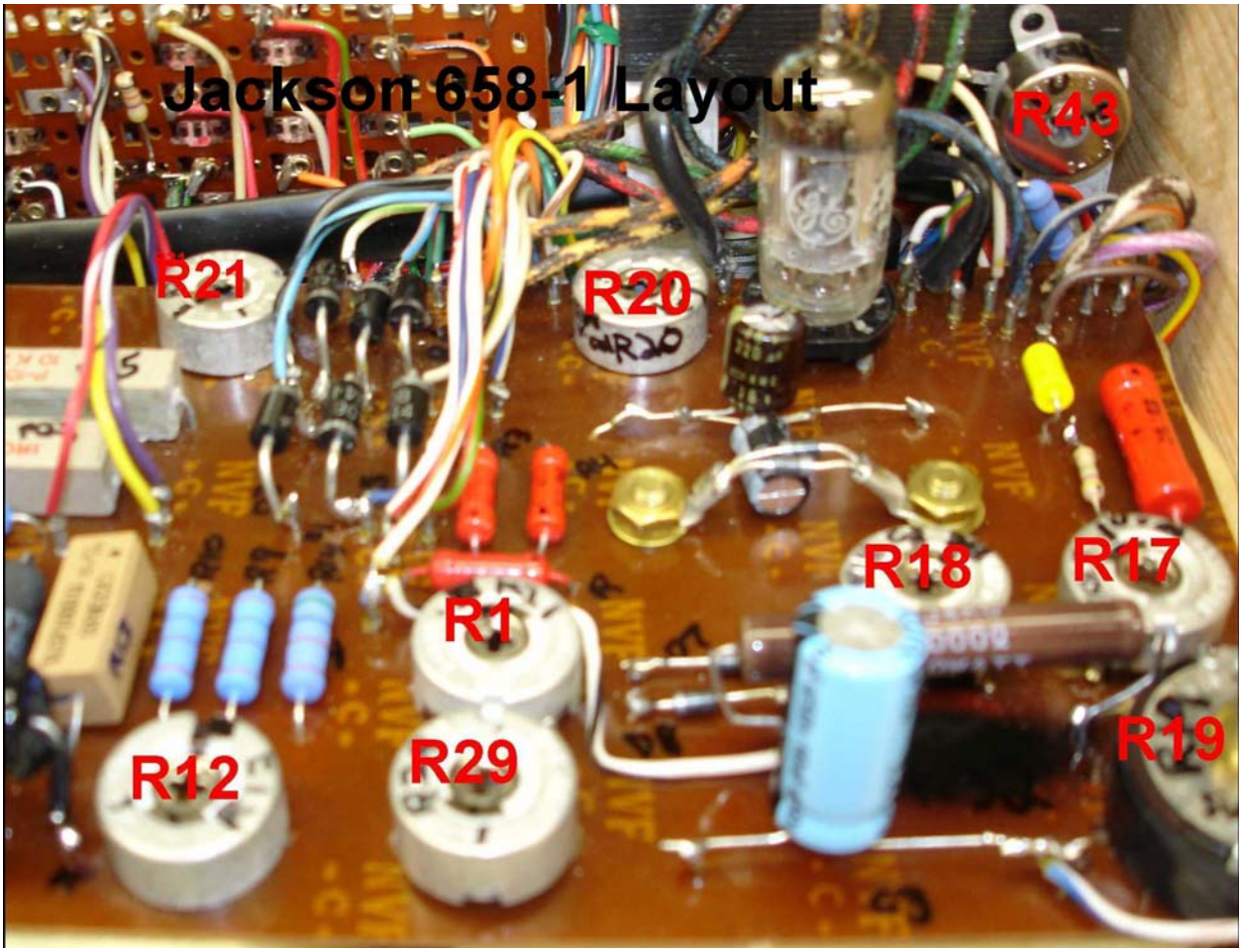
Calibration:

What you'll need: a variac and a modern (high impedance) DMM, along with some sort of non-miniature 6 volt tube (something that draws half an amp or so of filament current, preferably). A 6L6 or 6V6 will work well, if you have either of those. Optional items: a line voltage smoother, like a Sola, will help during voltage settings, and a tube socket extender will make life easier for pin hookups and measurements, but you can get by without these items.

The eight cal pots in the 658 function as follows: R20 - line voltage reading; R21 – filament current reading; R12 – B+ rectifier balancing (to sink the d.c. out of the Gm reading so only a.c. plate current is measured); R29 – overall meter sensitivity fine adj.; R1 – voltage regulator voltage reading; R19 – a.c. control grid signal level; R18 – d.c. control grid level; R17 – grid leakage sensitivity; and you might have a ninth, which is not even on the schematic. It's mounted on T2, if it's there at all, and I'll call it R43. It's to zero the a.c. and d.c. control grid signals (2.5k). The pictures below show common

locations for all the models (658 and 658A are the same, while the 658-1 has a meter-mounted circuit board). If your cal pots don't look exactly like what's pictured, DON'T MAKE ASSUMPTIONS ABOUT WHAT THEY ARE. If you can trace the wiring to determine what they are on the schematic, the procedure below will work (referencing the R number) no matter what the physical layout of the pots is.





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In all the procedures below, except as noted, set up the Jackson as if you're testing a 6L6 – 6.4L 123 top row 456 bottom row, 30Q, 45 for the grid control, and the rotary function switch set to "test." This setup will be used for all the following steps, which reference pins of the octal socket.

1. Set up for a 6L6 (but don't put a tube in), with one exception: turn the "Plate" knob to exactly 52. **Turn off the tester and unplug it for the entirety of this step!** Attach the positive lead of a d.c. power supply to a 1Kohm resistor and the other end of the resistor to the octal socket's pin 8. Attach your DMM, on the d.c. ammeter function (with the appropriate lead hookup changes) to pin 3 of the octal socket, and the other DMM lead to the negative terminal of the power supply. Turn on the power supply, and start it at zero volts. Hold down the "V" button, and increase the power supply's voltage output until you read 25mA on the DMM. At this point, your 658's meter needle should be pointing to exactly half scale. If it isn't, adjust R29 until it is, monitoring the DMM for 25mA, as the current drawn through the tester will change as you adjust R29. Note that it will take about 70 volts from the power supply to achieve a 25mA current flow in this setup.
2. Set up for a 6L6, but don't plug a tube into the tester. Set your variac to exactly 120 volts, turn the “Line Input” selector to 120, plug the 658 into the variac, and turn it on. Adjust R20 for an exact mid-scale reading. Check the positioning of your “Line Input” selector knob by rotating it through all its positions with the 658 on. The highest meter reading should be when the knob points at the dot above “100,” although it will be very close to the reading right at “100.” At this point it's a good idea to set up the 658 (per the roll chart) for a few tubes of different filament voltages, and measure the voltages being applied to the filament with the tester on, function switch on "test," to see if your filament voltages are what they should be. All should be within 3%. Turn the tester off.
3. Set up for a 6L6, and set your DMM to measure a.c. current, one amp scale. Connect a test lead from tester socket pin 2 to pin 2 of your tube (assuming it's a 6L6 or 6V6), pin 7 of your tube to one DMM lead, and the other DMM lead to tester socket pin 7. Press the "A" button on the top row (VERY IMPORTANT STEP), and turn the 658 on. Press test button "Z," and adjust R21 until the meter's current reading on the bottom scale matches what your DMM says. Increase the filament voltage to 8.5 and 10.6 then down to 4.0 (higher filament voltages are standard procedure during filament current tests, and will not apply that much voltage to your tube or hurt it), comparing your DMM's reading with the 658's at a couple different points on the scale. Turn off the tester
4. Disconnect and set aside your tube, you're done with it, and UNPLUG the 658. Release the top row of buttons, and repress 1, 2, and 3. Connect an ohmmeter to the wiper of R12, and measure to the non-R12 ends of R9 and R10. You will see about 360 ohms if you're in the right place. Adjust R12 to get as nearly equal a resistance reading from R12's wiper to the other end of each resistor as you can. Doing this well will make a big difference in the accuracy of your Gm readings.
5. Using a 330kohm resistor, check the shorts test as follows: connect an insulated test lead to tube socket pin 8 and to one end of the resistor. Connect another insulated lead to the other end of the resistor, and turn the tester on. The shorts

test uses 110 volts, so make sure you don't touch any metal. Set the Selector knob to "K" and touch the other end of the second test lead to all other tube socket pins. The shorts neon should glow on all pins except 1 and 6. It won't glow much, as 330k is the sensitivity limit of the test, but it should glow a little. Repeat the above for Selector positions "P," "G2," and "G1," noting neon indications at all pins except 1 and 6 when the other end of the resistor is connected to pins 3, 4, and 5, respectively. Make sure to do all of these, because it's the only way to verify proper connection of the Jackson's channel busses. Turn the tester off and remove the resistor.

6. Set the plate voltage control to "VR1," and connect your DMM's negative lead to socket pin 8 and the positive lead to 3. Turn the plate knob to exactly 52, and turn the grid knob all the way to 100. Turn the tester on and press both "Y" and "Z." You should get 225 volts d.c. or higher on the DMM if your transformer, C4, and diodes are good. Adjust R1 so that the 658's meter voltage reading matches what's showing on your DMM.
7. Set up for a 6L6 again by turning the plate voltage knob back to "Q", then connect the negative lead of your DMM to socket pin 8, and the positive lead to 3. Turn the tester on and note the a.c. and d.c. readings. Both should be close to zero. AC will typically be about 2.5 Vrms, and d.c. should be under seven. If this is the case, move the DMM's positive lead to pin 5. Turn the grid knob to zero and read d.c. and a.c. on your DMM. Both should be zero. If not, adjust R43 (if you have it), mounted on the side of T2 until both a.c. and d.c. are zeroed. Then turn the grid knob all the way up. Start by measuring d.c., and adjust R18 for exactly –26 volts. Switch to a.c., and adjust R19 for 18.38 Vrms if you totally trust your DMM's accuracy, 18.3 Vrms if you don't. Recheck d.c. zero and full scale after this step and readjust if necessary. Do the same for a.c. if you make any d.c. adjustments. Set the grid knob to 50. You should read -13 V d.c. and 9.1x Vrms a.c. If you don't see values close to that, check a few other points on the knob, using the knob pointer indication as the percent of full scale that you should see. If it's off consistently, loosen the grid knob and adjust it. Turn the tester off.
8. Remove the DMM leads and insert a 15 megohm resistor between pins 8 and 5. Turn the tester on and press the "grid" button. Set R17 so that the meter is just into the red on the grid leakage scale near the bottom. Theoretically, you could make this test much more sensitive if you wanted to, but the test will get flaky if you do. That's the last step.

If you were diligent in your restoration and the calibration steps above all produced the correct results, your 658 is now as accurate as when it left the factory, possibly more so.

K4XL's  BAMA

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