In order to compare the properties of the 6SG7 vacuum tube and MOSFETs we must look primarily at the transfer functions that characterize their behavior. It is this examination that ultimately determines weather or not FETs are qualified to be used in the place of tubes for applications of amplification and or logical circuitry. The logical procedure to make this determination is to implement vacuum tubes in place of JFETs in the original design to see of the behavior at output was desirable. In the simulations, a portion of the RCA AR88 Receiver RF Amplifier was molded in Pspice. The simulation profile evaluated the schematic’s response to a frequency sweep from 100kHz to 5000kHz. As expected, the simulations had similar responses throughout the whole range of frequencies. The most notable discrepancy was the difference in the magnitude of output voltage. The JFET had larger output amplitude but nonetheless the substitution was proved valuable. Ultimately FETS were found to be superior to the vacuum tube in most applications not for their transfer characteristics but instead for practical considerations such as the fact that FETs do not require a cathode heater reducing power consumption, eliminating delay as tube heaters warm up. Furthermore, FET transistors are very small and have significantly more desirable size and weight. Perhaps most importantly, large numbers of extremely small transistors can be manufactured as a single circuit. They also possess inherent reliability and very long life span, whereas, tubes invariably degrade and fail over time. In rare cases, some transistorized devices have been in service in excess of 50 years. These transistors exhibit very low sensitivity to mechanical shock and vibration, providing physical ruggedness and virtually eliminating shock-induced spontaneous signals and are not susceptible to breakage of a glass envelope, leakage, outgassing, and other physical damage.

At first, upon examination, the JFET and MOSFET appear to be perfectly comparable at standard operating temperatures. The majority of small signal transistors are perfect substitutes for each other with only imperceptible discrepancies in output. That being said, the most notable difference between the two particular transistors we studied is that the BS170 (a MOSFET) works in enhancement mode where as the 2N5458 being a JFET operates in depletion mode. The main advantage of a MOSFET transistor over a JFET is that a very small current input is capable of operating the MOSFET while simultaneously producing an output current, potentially orders of magnitude greater, to the load. Both devices have high input impedance allowing them to generate large charges however MOSFETS as a rule of thumb have higher input impedance. Each respective FET behaves like a voltage-controlled resistor in which the current through the channel (S-D terminals) is proportional to the input voltage. For all intensive purposes the MOSFET as 3 terminals (source, drain, gate). There is also a 4th pin called the substrate however for our purpose it serves as a ground. FETS and their predecessor the vacuum tube are commonly used for the amplification of signals with the goal of a high current transfer ratio to supply power to a load. For these devices the operating principle is that the V-I relationship between two terminals is deliberately manipulated by changing the voltage at the 3rd terminal. This principle suggests in theory that there is an infinite family of IV relationships for an infinite # of possible voltages at the manipulating terminal. Although from an objective or engineering standpoint, FET transistors are the clear choice for any application including amplification, in the world of musical audio amplification the reality is quite puzzling. The controversy stems from the fact that music is supposed to be heard and enjoyed by human beings. This is where the caveat lies; a human’s nonlinear ear-brain processing system is not fully understood. Because we do not know how to model the human auditory system, we cannot gauge what electrical parameters are pertinent to evaluating the performance of audio equipment. As of the current state of technology and human knowledge, the only way to judge audio equipment is qualitative and hence subjective. [IEEE The Cool Sound of Tubes]