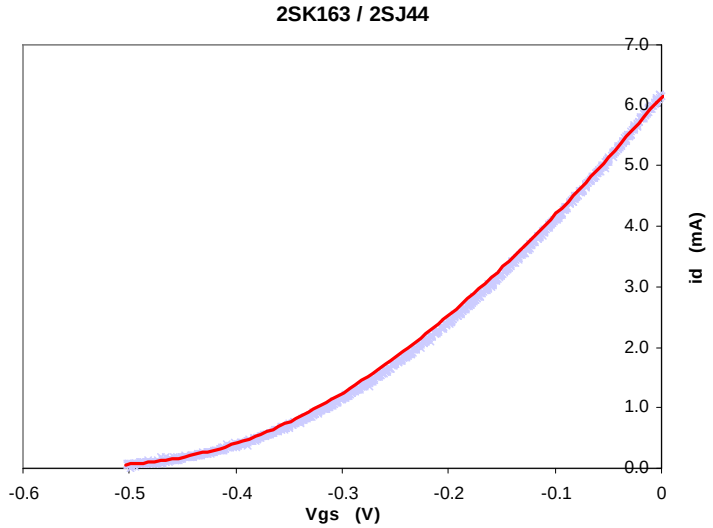
Complementary small signal JFETs for F5 input stage
EUVL
20 August 2010

Right at the beginning of the F5 thread, I have published characteristics curves of the Toshiba 2SK1530 / 2SJ201 Mosfets, and showed how good a complementary pair they are. In the X'ed balanced version of the circuit that I published, I also explained the use of a higher source resistor (15 ohm instead of 10 ohm) for the 2SJ74, the latter having a slightly higher I_{dss} than the 2SK170 (about 0.8mA). This is because the 2SJ74 has a higher transconductance than the 2SK170; i.e. they are not true complementary pair.

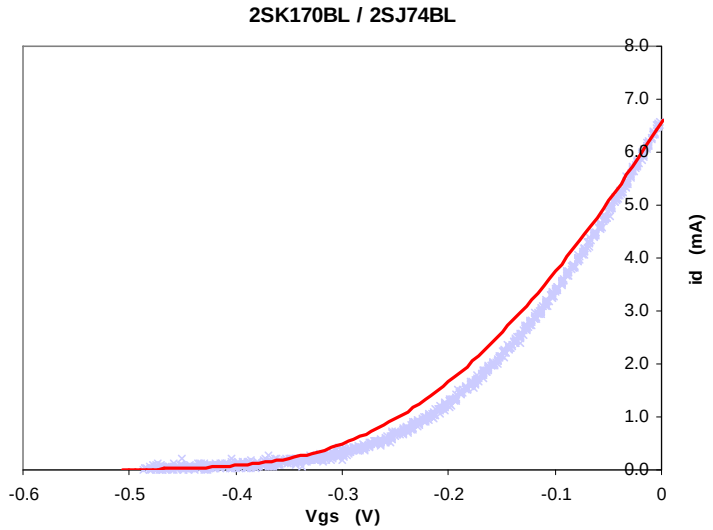
Finally I got round to making some graphs for "complementary" small signal JFETs. And here they are.

The first pair shown below is the now-unobtainium 2SK163 / 2SJ44 from NEC with matched I_{dss}. Red is N-JFET and light blue is P-JFET.

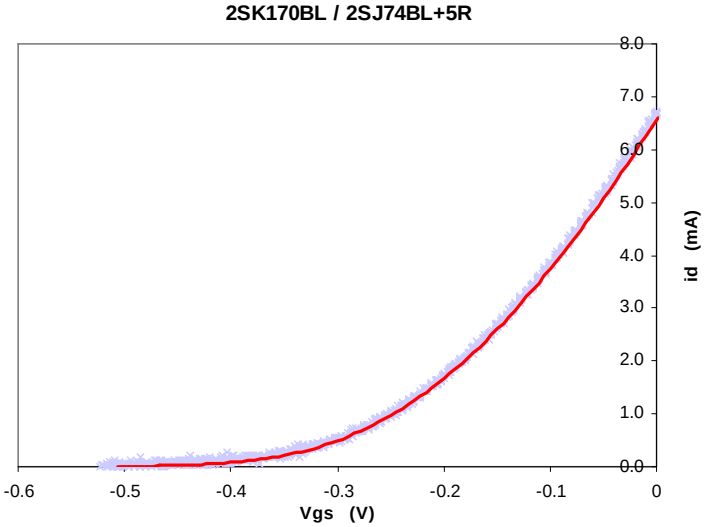


Hey, this is as complementary as it gets. Two problems still – you cannot get them anymore at a reasonable price, not to speak of matched pairs. And they have a low-ish transconductance (9mS).

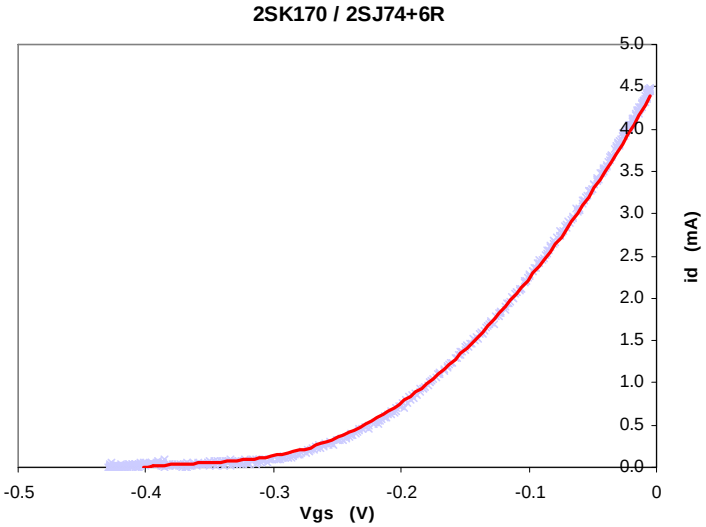
How about the beloved 2SK170 / 2SJ74 ? Show here is a pair of BL grades with matched I_{dss}. As you can see for yourself, they are not complementary at all.

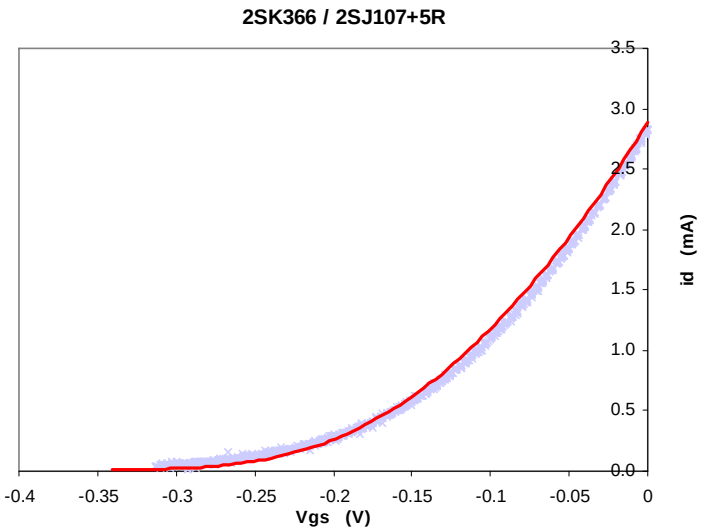


So how about following the EUVL-trick and add 5 ohms to the source of 2SJ74, now with a slightly higher I_{dss} (so that Id is matched again after degeneration) ?



Bingo !! We are back in business. To show you that this applies to other Grades and devices, here are a couple more :





I have, just out of curiosity, also tried the F5 with 2SK163/2SJ44 and 2SK2955/2SJ554. Both these pairs are truly complementary. But none of them is easily available, however good they sound. So I guess for now, degenerated 2SJ74 is the best available to the general public.

If you already have a working PCB for F5, and wish to add the degeneration trick, the easiest is to cut the copper track of the PCB at the J74 source, and solder a 5-ohm, SMD 0805 thin film resistor between the JFET and the feedback network. This way, the resistor only see the bias current of the JFET, and not the high current in the feedback loop, and you can easily get away with one at 0.1W. Don't forget that you need a new 2SJ74 with about 0.8mA higher I_{dss} than the 2SK170.