A 19dB BI-LATERAL AMPLIFIER WITH 37dB GAIN CONTROL RANGE

Ron Taylor G4GXO, The Steading, Stainton, PENRITH, Cumbria CA11 0ES
ron@cumbriadesigns.co.uk

Here is a variation of a familiar and useful circuit popularised in the late 1970's in the G4CLF Plessey SSB module. In common with conventional amplifiers, the bi-lateral amplifier has two ports. But whereas in a conventional amplifier one port is always an input and the other the output, with a bi-lateral amplifier the direction of amplification and hence the port functions, are set by the supply conditions. The ability to set the direction of gain is useful in transceiver circuits where a bi-lateral stage can be used on both receive and transmit.

In this design a second FET has been added to produce a Cascode configuration. This increases the gain of the stage by about 6dB and provides a second gate which is used to set the gain. Note that this Cascode form is similar to a dual gate mosfet, in fact it should be possible to directly substitute a dual gate mosfet for both FETs in this circuit to obtain a higher stage gain – although care will be needed to ensure stability.

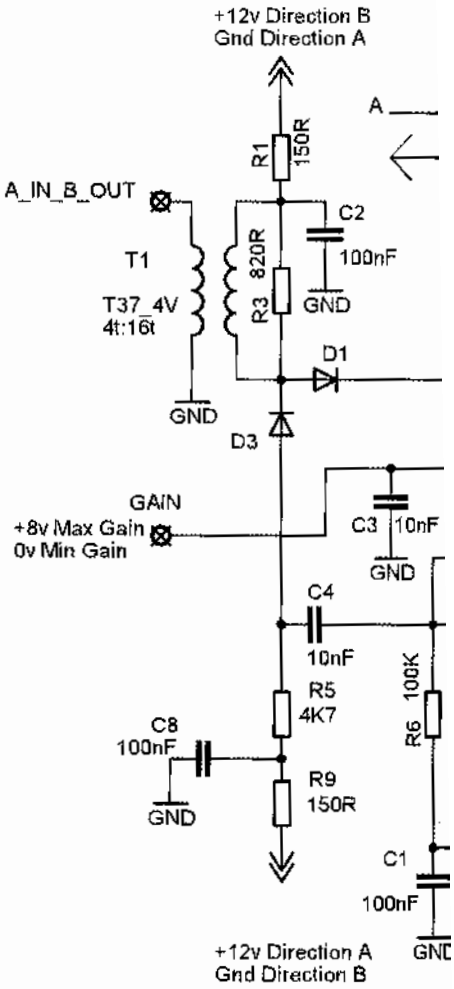
Two LED's are used to lift the amplifier's common point to about 3v above the zero volt rail. (Four or five diodes could be used instead of LED's). This allows the gain control voltage applied to Q2 to go negative with respect to the amplifier's common point significantly increasing the gain control range.

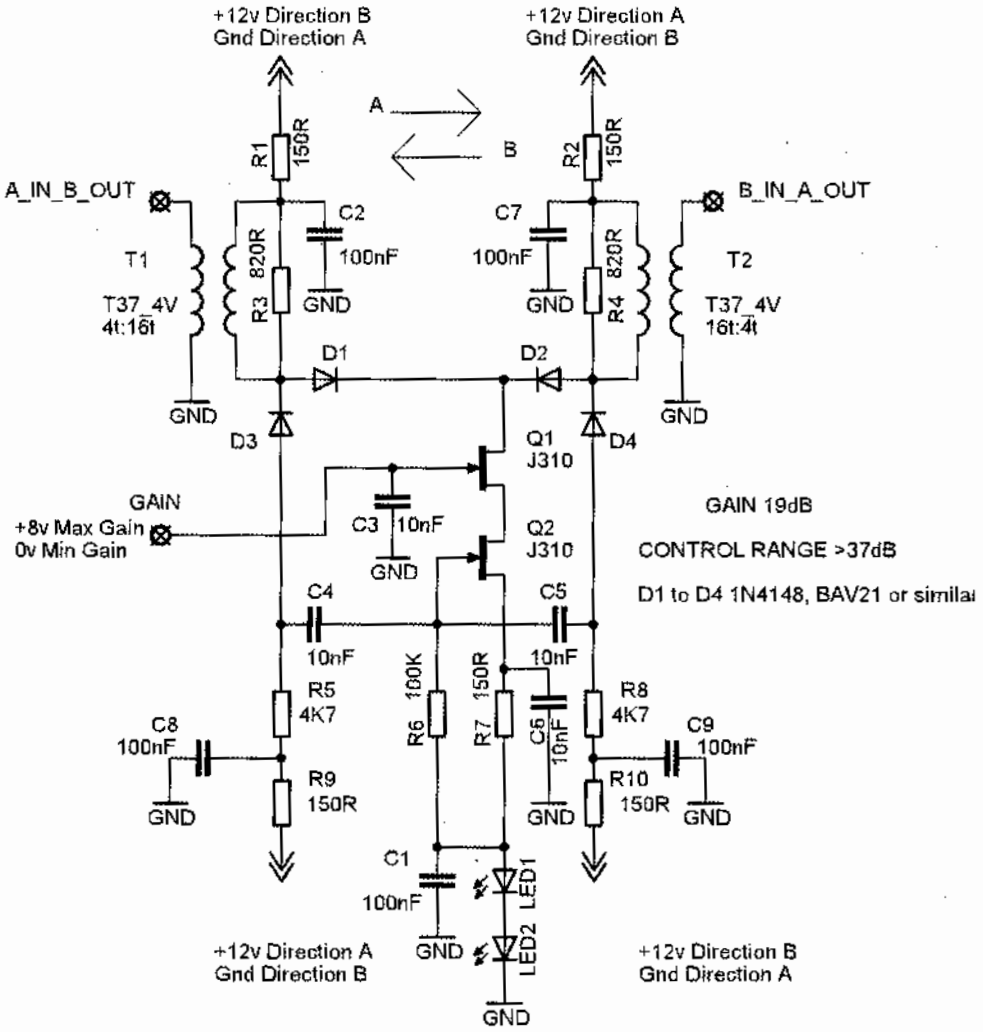
With the components shown, the control range is around 37dB. To operate the amplifier at fixed gain the Q2 gate voltage can be set by a resistive divider, about 6v will produce maximum gain. Alternatively, the gain could be made adjustable by using with a small 10K pot to set the gate voltage or in a receiver application the gate voltage could be set by an AGC system. Always ensure that the gate is tied to a control voltage and is not allowed to float.

The input/output transformers are wound on FT37-43 toroids, small binocular cores or improvised binocular cores made from ferrite beads could also be used. Resistors R3 and R4 together with the turns ratios of the transformers set the input impedance and are the dominant factor for defining the output impedance.

With the values and winding ratios shown the input/output impedances will be about 50 Ohms. Other values are easily accommodated by scaling the R3/R4 and T1/T2 turns ratios. Note that if R3/R4 are set higher than about 1K then the steering diode resistors R5 and R8 will start to influence the input impedance.

For circuit clarity, the four supply connections used to set amplifier direction are shown separately. The A and B arrows illustrate the gain directions for the two supply conditions shown against each supply connection.




+12v Direction B
Gnd Direction A
+12v Direction A
Gnd Direction B
A
B
R1 150R
R2 150R
A_IN_B_OUT
B_IN_A_OUT
C2 100nF
C7 100nF
T1
T37_4V
4t:16t
R3 820R
R4 820R
T2
T37_4V
16t:4t
GND
D1
D2
D3
D4
Q1
J310
Q2
J310
GAIN
+8v Max Gain
0v Min Gain
C3 10nF
GAIN 19dB
CONTROL RANGE >37dB
D1 to D4 1N4148, BAV21 or similar
C4 10nF
C5 10nF
R5 4K7
R6 100K
R7 150R
C6 10nF
R8 4K7
C8 100nF
C9 100nF
R9 150R
R10 150R
C1 100nF
LED1
LED2
+12v Direction A
Gnd Direction B
+12v Direction B
Gnd Direction A