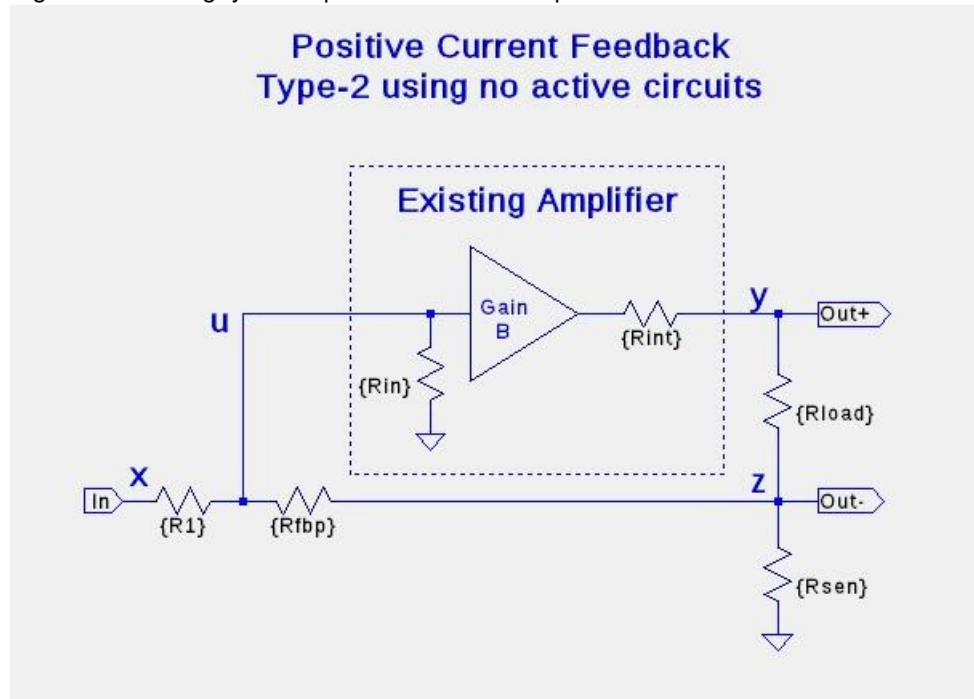# Positive Current Feedback (PCF) around existing Amplifier using no active circuits.

Figure 1: /m/m-rugby/rom1/quam/audio/circuits/spice/F7/DIYAudio-forum/PCF-T2-noFE-1.asc.jpg

Here is a Positive Current Feedback (PCF) circuit that can be used with
an existing power amplifier to obtain closed loop gain (CLG) and output resistance (Rout)
around the existing with no additional active circuitry.

Circuit Equations:
0 = (x-u)/R1 + (z-u)/Rfbp + (0-v)/Rin
Iload = (B*u-y)/Rint
Iload = (y-z)/Rload
Iload = z/Rsen
Zin=x/((x-u)/R1)

(Note: These circuit equations ignore the (minor) effects of
 currents through the feedback resistors on nodes y and z).

Parameters of the Existing Amplifier:
 Rin: input resistance to ground
 B: closed loop gain
 Rint: internal output resistance

Arbitrary parameters of the Circuit:
 Rsen

Parameters to obtain:
 CLG: closed loop gain of the resulting amplifier
 Rout: output resistance of the resulting amplifier

Circuit Unknowns to be determined:
 R1, Rfbp and Zin

Solving the circuit equations for R1 and Rfbp gives the following:

$$(\%o127) \quad R1 = \frac{Rin\left(-Rint + Rout + Rsen\left(-CLG + B - 1\right)\right)}{Rsen\,CLG}$$

(%o128) $\quad Rfbp = \dfrac{Rin\left(-Rint+Rout+Rsen\left(-CLG+B-1\right)\right)}{Rsen-Rout+Rint}$

(%o129) $\quad Zin = \dfrac{Rin\,B\left(-Rint+Rout+Rsen\left(-CLG+B-1\right)\right)}{Rsen\left(B-CLG\right)CLG}$

After some rearranging we get:

(%o111) $\quad \dfrac{R1}{Rin} = \dfrac{-1+\dfrac{Rout-Rint}{Rsen}+B}{CLG}-1$

(%o112) $\quad \dfrac{Rfbp}{Rin} = \dfrac{B-CLG}{\dfrac{Rint-Rout}{Rsen}+1}-1$

In order that R1 and Rfbp are non-negative, must have

CLG ≤ B-1-(Rint-Rout)/Rsen

Example:

FirstWatt F6
Rin = 100K
 B = 5.0
Rint = 0.5 Ohms

Choose
 CLG = 3.0
 Rsen = 0.5 Ohms
 Rout = 0.08 Ohms for DF=100

Get:
 R1 = 5333
Rfbp = 8696
 Zin = 13333

Figure 2: /m/m-rugby/rom1/quam/audio/circuits/spice/F7/DIYAudio-forum/PCF-T2-noFE-F6.asc.jpg

Positive Current Feedback
around FirstWatt F6

Zin = 13.33K
CLG = 3.0
Rout = 8/100 Ohms