Current Sources
&
Active Loads

INEL 4202 - Electronics II - Spring 2010
Basic C.S.  

Basic C.S. with PNP BJTs
Mirror with base-current compensation
Basic Source with Emitter Resistors
Output Resistance

Mirror with emitter resistors

small-signal equivalent circuit
Mirror’s Output Resistance

\[ R_{TH} = R_1 + \frac{1}{g_{m1}} \]

\[ R_{OUT} = r_o (1 + g_{m2} R_2) \]
Wilson C.S.
Widlar C.S.
MOSFET CSs

\[ \text{REF} \]
\[ \text{M}_1 \quad \text{M}_2 \]

\[ \text{V}^+ \quad \text{I}_O \quad \text{V}^- \]

\[ \text{V}^+ \quad \text{I}_O \quad \text{V}^- \]
Active Loads
**Active Loads**

NOTE:

$Q_3$ and $Q_4$ are PNP BJT's

\[ v_{OUT} = i_{OUT} R_O \]

\[ R_O = R_{LOAD} || r_{O2} || r_{O4} \]

\[ i_{OUT} = g_m v_d \]

\[ v_{OUT} = i_{OUT} R_O \]
\[ V_{CC} \]

\[ +v^+ \]

\[ R_C \]

\[ R_C \]

\[ v_{od} \]

\[ \frac{g_m v_d}{2} \]

\[ Q_3 \]

\[ Q_4 \]

\[ v_{b1} \]

\[ V_{BIAS} \]

\[ Q_1 \]

\[ Q_2 \]

\[ v_{b2} \]

\[ V_{CC} \]

\[ V_{BIAS} \]

\[ R_{TAIL} \]

\[ I \]

\[ -V_{EE} \]

\[ R_O = (1 + g_{m4} R_P) r_{O4} \]

\[ R_P = r_{O2} \| r_{\pi 4} \]

\[ R_O = (1 + \beta) r_{O4} \]
\[ i_{OUT} = g_m v_d \]
\[ v_{OUT} = i_{OUT} R_O \]
\[ R_O = R_{LOAD} \parallel r_{O6} \parallel (1+\beta)r_O. \]
\[ i_{\text{OUT}} = g_m V_d \]

\[ V_{\text{OUT}} = i_{\text{OUT}} R_O \]