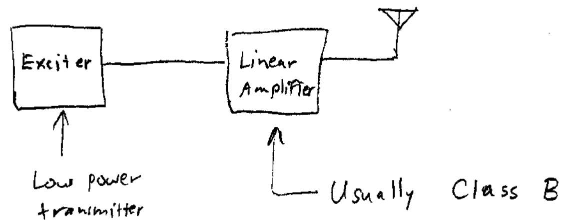
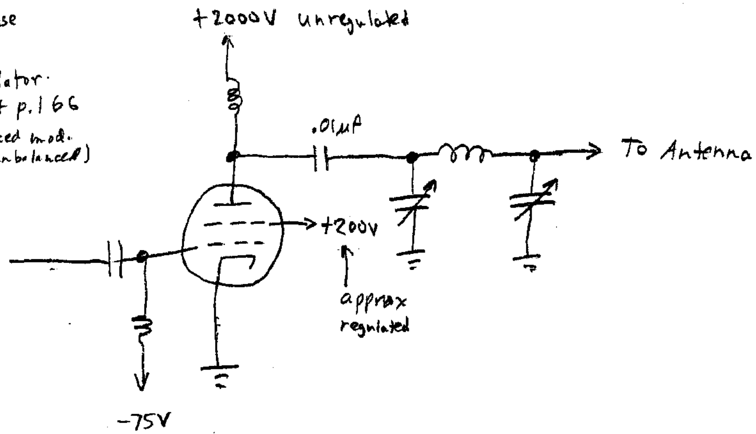
Other ways to transmit AM



could use diode modulator. See text p. 166 or balanced mod. (unbalanced)



Class B differs from class C only in bias and usage

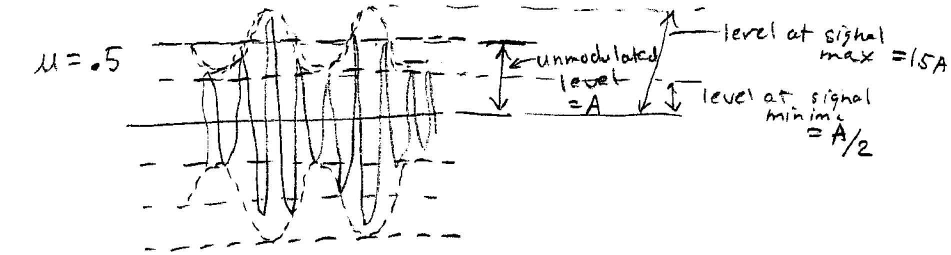
	B	C
bias:	a little idle current	cut off
signal level:	not overdriven	driven to hard clipping
signal quality:	half-wave rectified, linear otherwise	very distorted
filtering:	harmonics filtered out	harmonics filtered out

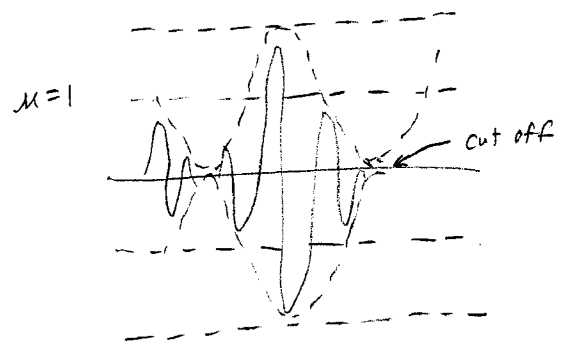
Math - analysis

Definitions: μ = modulation index $0 \le \mu \le 1$

0 = no modulation

1 = modulation sufficient to cut off carrier.





You may also hear/read "% modulation"

100% $\Leftrightarrow \mu = 1$

50% $\Leftrightarrow \mu = .5$

when $\mu > 1$, positive peak is higher, (OK)

negative peak is clipped — carrier cut off (bad)

Sideband and carrier power

$$\phi_{AM}(t) = \underbrace{A\cos\omega_c t}_{\text{carrier}} + \underbrace{m(t)\cos(\omega_c t)}_{\text{sidebands}}$$

($\phi_{AM}(t)$ = transmitted signal; $m(t)$ = modulating signal)

Carrier power: P_c = mean square value of $A\cos\omega_c t$

$$= \frac{A^2}{2}$$ — carries no information. (wasted?)

Sideband power: depends on modulation (useful?)

$$P_s = \frac{1}{2}\overline{m^2(t)}$$

$$\overline{m^2(t)} = \frac{(\mu A)^2}{2}$$ with tone modulation

$$P_s = \frac{(\mu A)^2}{4}$$

Efficiency: η = $\frac{\text{useful power}}{\text{total power}}$

$$= \frac{P_s}{P_c + P_s}$$

$$= \frac{m^2(t)}{A^2 + m^2(t)}$$

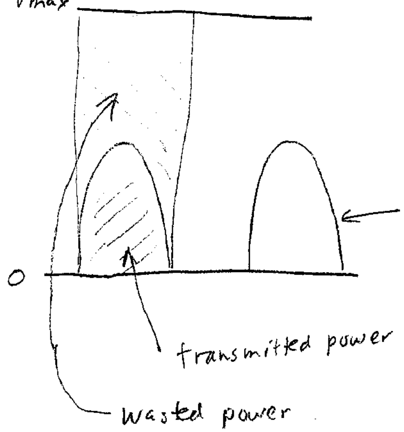
$$= \frac{\frac{(\mu A)^2}{4}}{\frac{A^2}{2} + \frac{(\mu A)^2}{4}}$$

$$\eta = \frac{\mu^2}{2+\mu^2}$$

For $\mu = 1$, $\eta = \frac{1}{3} = .33 \rightarrow 33\%$ best possible efficiency

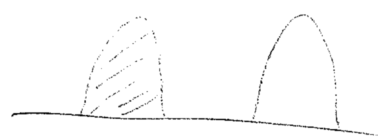
$\mu = .5$ $\eta = \frac{.25}{2.25} = .11 \rightarrow 11\%$

Linear Amplifier efficiency



With no modulation — The voltage is half of what the amplifier is capable of.

Current: - - - I_{max}



$$P_{in} = \int_0^{\pi/\omega} A \sin\omega_c t \, dt$$

(A ↑ volts, $\sin\omega_c t$ ↑ amps)

($\omega_c = 1$, $A = 1$)

$$= \int_0^{\pi} \sin t \, dt$$

$$= -\cos t \Big|_0^{\pi}$$

$$P_{in} = 2$$

Output power:

$$P_{out} = \int_0^{\pi/\omega} \left(\frac{A}{2}\sin\omega_c t\right)(\sin\omega_c t)\, dt$$

($\frac{A}{2}\sin\omega_c t$ ↑ volts, $\sin\omega_c t$ ↑ amps)

($\omega_c = 1$, $A = 1$)

$$= .5\int_0^{\pi} \sin^2 t \, dt$$

$$= .5\left(\frac{t}{2} - \frac{\sin 2t}{4}\right)\Big|_0^{\pi}$$

$$P_{out} = \frac{\pi}{4}$$

$$\text{Efficiency} = \frac{P_{out}}{P_{in}} = \frac{\frac{\pi}{4}}{2} = \frac{\pi}{8}$$

$= .392$ → **39%**