Plug $dP_1/dI_{c1} = 0$ to get $I_{c1} = V_{CC}/(2R_L)$

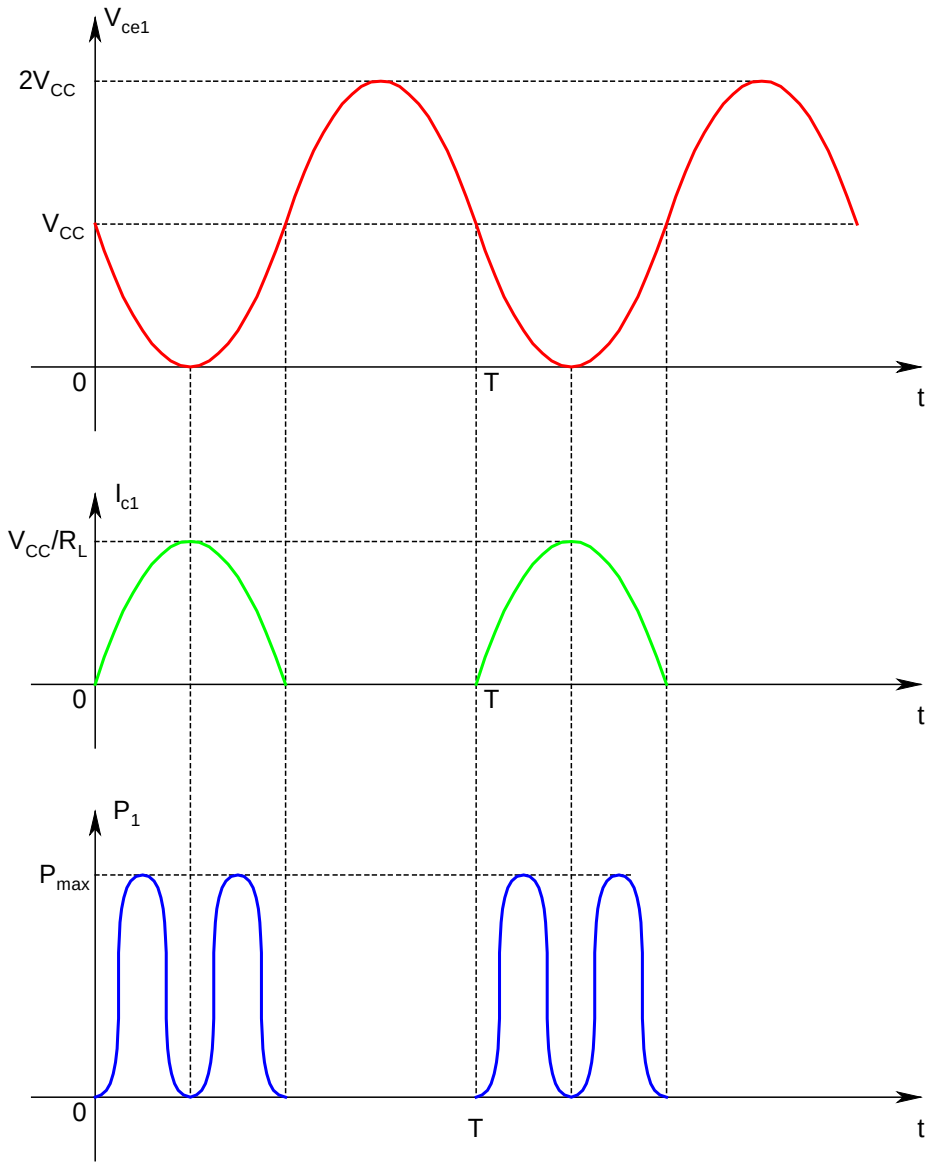
This is the ***mid-point of the load line***, with ***coordinates*** $[V_{CC}/2, V_{CC}/(2R_L)]$

$$\Rightarrow P_{max} = \frac{V_{CC}^2}{2R_L} \quad (\textbf{\textit{using a Safety Factor of 2}})$$

- There is also ***standby power***:

  $P_{Standby} = V_{CC} \times I_{Standby}$

- In general, $P_{max} >> P_{Standby}$
- Refer to the figure in the next slide
  - V_{ce1} ***oscillates between 0 and*** $2V_{CC}$
  - I_{c1} ***appears only during the positive half cycle***, ***with peak value of*** V_{CC}/R_L (***when*** $V_{ce1} = 0$)
  - P_1 $(= V_{ce1} \times I_{c1})$ ***oscillates*** between 0 and $V_{CC}^2/(4R_L)$ at ***twice the frequency*** only during the ***positive half cycle***


V_{ce1}
$2V_{CC}$
V_{CC}
0
T
t
I_{c1}
V_{CC}/R_L
0
T
t
P_1
P_{max}
0
T
t

- ***Two Special Cases***:
  - $R_L \rightarrow \infty$ (***open-circuit***):

    Load line becomes horizontal with $I_{c1} = 0$

    $\Rightarrow P_1 = 0 \Rightarrow$ ***no issue***
  - $R_L = 0$ (***short-circuit***):

    Load line becomes vertical with $I_{c1} \rightarrow \infty$

    Potentially dangerous situation

    Resulting power dissipation and consequent heat generation can completely damage the device
- ***In actual situation***, I_{c1} ***won't reach infinite value due to***:
  - ***Limited current driving capability of the driver stage***
  - ***Fall of*** β ***at high current levels*** due to ***High-Level Injection*** or ***Kirk Effect***
- These two are ***in-built self-protection mechanisms***
- Nevertheless, ***practical output stages need short-circuit protection***

➢ *Linearity and Output Resistance*:

- *While supplying/sinking current to/from load*, Q_1/Q_2 *operate in CC mode*

  $\Rightarrow A_v = R_L/(R_L + r_{Ei})$ $(i = 1,2)$ $(r_{Ei} = V_T/I_{ci})$

- Thus, if $R_L >> r_{Ei}$, then $A_v \rightarrow 1$, and *very high linearity in the VTC can be achieved*
- However, r_{Ei} *is not constant* - rather *it changes with the load current*
- Thus, A_v *can depart significantly from unity*, when the *load current is very small* (*large* r_{Ei})
- Referring to the *VTC*, the *slope of the characteristic near* $\pm V_\gamma$ will be *significantly less than unity* (*Class B*)

- However, ***as $V_o \uparrow$, load current $\uparrow$, $r_{Ei} \downarrow$***, and the ***VTC starts to attain its maximum slope of unity***
- Thus, ***for major part***, the ***VTC is highly linear*** and ***produces an almost distortionless output***
- ***Output Resistance***:
  - ***Open R_L*** and ***look back from the output***
  - ***$R_0 = r_{Ei}$*** (***by inpsection***), since ***bases of Q_1-Q_2*** can be considered to be at ***ac ground***
  - ***R_0 is variable***, but ***for major part***, ***extremely small***
- Generally, the ***linearity and output resistance*** are ***calculated*** at the ***region of maximum slope*** of the ***VTC***