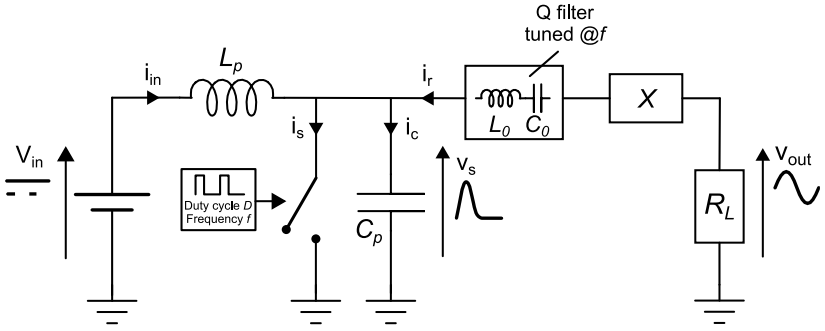
Class E inverter design

For an arbitrary duty cycle and a finite input inductance [REF]

I – Circuit diagram

$$q = \frac{1}{\omega\sqrt{L_p C_p}}$$

$$R_{DC} = \frac{V_{in}}{< i_{in} >}$$



II – Design assumptions

- Transistor is ideal (no power losses and instantaneous switching)
- Passive components are ideal (no power losses)
- Capacitance C_p is linear (constant)
- Current i_r is sinusoidal at the switching frequency f (Q high enough)

III – Structure of the MATLAB script

*To be downloaded at **https://github.com/matthieubeley/class-E-design***

1) Inputs

Inputs are the duty cycle D and the q ratio. They are either scalars (for investigating a single point) or vectors (for the complete exploration of the design space). Default vector boundaries are [0.1-0.9] for D and [0-4] for q.

*2) Parameters calculation (for the **normalized** circuit)*

Analytical calculations only. All normalized parameters are obtained.

3) De-normalization

Following class E parameters are obtained, considering the actual operating point (input voltage V_{in}, switching frequency f and load resistance R_L).

Circuit parameters	**Voltages**	**Currents**
Input inductance L_p	Output voltage V_{out}	Input current DC I_{in}
Shunt capacitance C_p	Switch voltage fund. $V_{s_{fund}}$	Input current RMS $I_{in_{RMS}}$
Residual reactance X	Switch peak voltage V_{sp}	Input current spectrum $I_{in_{spectr}}$
Output power P		Output current magnitude I_r
Equivalent DC input resistance R_{DC}		Switch peak current I_{sp}
		Switch RMS current $I_{s_{RMS}}$
		Shunt capacitor current $I_{C_{RMS}}$

Contour plots for parameter ***x*** (isolines ***x***=a, ***x***=b, etc.) can be displayed using function *contour3(q,D,**x**,[a,b,…])*. This is how the different charts in the shared folder have been obtained.

4) Waveforms

ONLY ONCE q AND D ARE SET SCALARS!

Main circuit voltages and currents temporal waveforms can be plotted.

Voltages	**Currents**
Drive voltage v_{drive}	Output current i_r
Switch voltage v_s	Input current i_{in}
Switch voltage fundamental $v_{s_{fund}}$	Switch current i_s
Output voltage v_{out}	Shunt capacitor current i_c

[REF] M. Beley, L. Pace and A. Bréard, "Performances Assessment of Very High-Frequency Class E Inverters Based on a Load-Oriented Generic Design Method," in *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 13, no. 4, pp. 4721-4733, Aug. 2025, doi: 10.1109/JESTPE.2025.3565020.