The LVA amplifier
and its internal impedance
Special situation with capacitive load

The relating applications:
Onboard supply simulation for
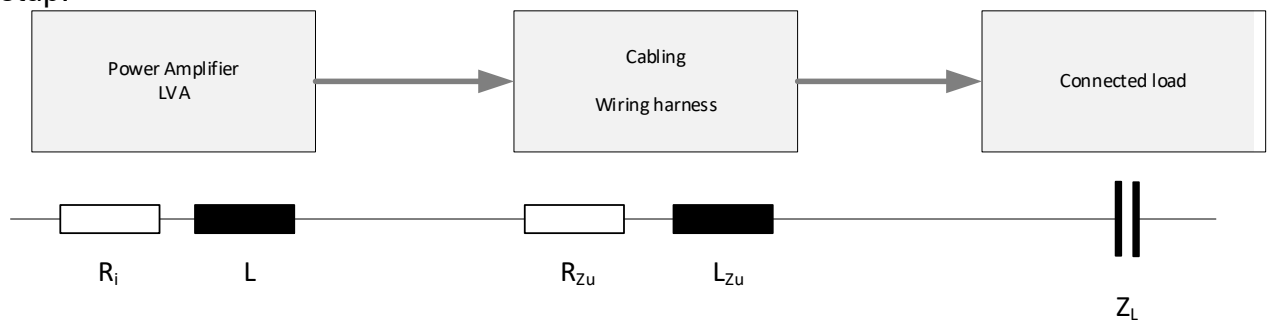*automotive and avionic testing*

The LVA amplifier has a programmable internal impedance as an optional feature.
The characteristic of the internal LVA impedance R_i is mainly real and can be adjusted between 0 and 200 mOhm.
A small additional inductive component Z can be measured additionally. This apparent impedance Z is caused due to the internal construction and wiring of the amplifier and its transfer function.

Typical values of Z of the different amplifier types are:

LVA 1000	4µH
LVA 2500	1.4µH
LVA 5000	0.85µH
LVA 7500	0.69µH

If a capacitive load is connected to the amplifiers output the test setup shows a circuit diagram displaying a complex resistance situation. The below circuit shows the test setup:

When supplying a complex resistance circuit with a voltage with varying frequency it is easily possible to reach resonance condition for the complex circuit.

To simulate and calculate resonance points the following formulas are used:

The internal impedance of the amplifier can be calculated with the following formula:

$$F_1: Z_i(f) := R_i + j * 2 * \pi * f * L$$

The impedance of the wiring between amplifier output and EUT can be calculated with the following formula:

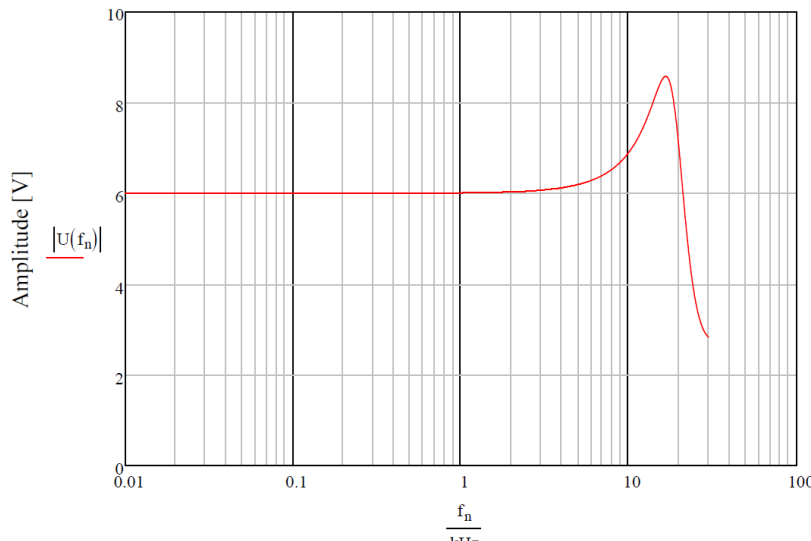$$F_2: Z_{Zu}(f) := R_{Zu} + j * (2 * \pi * f * L_{Zu})$$

The impedance of the load can be calculated with the following formula:

$$F_3: Z_L(f) := \frac{1}{2*\pi*f*C}$$

The transfer function of the amplifier can be calculated by:

$$U(f) := U_{Ampl} * \frac{Z_{Zu}(f) + Z_L(f)}{(Z_{Zu}(f) + Z_L(f) + Z_i(f))}$$

CALCULATION EXAMPLE AND DIAGRAM WITH A CAPACITIVE LOAD AT THE LVA 5000 OUTPUT	
Adjusted internal impedance value	$R_i := 0.01 \text{Ohm}$
Amplifiers inductance	$L := 0.85 \mu H$
Connected load at the LVA output (capacitive characteristic)	$C := 38 \mu F$
Real impedance of the connection wires between LVA and load	$R_{Zu} := 0.1 \text{Ohm}$
Inductance of the connection wires between LVA and load	$L_{Zu} := 1 \mu H$
Voltage setting at the LVA output	$U_{Ampl} := 6V$
The relating functional diagram resonance point between 10kHz and 20kHz	

Voltagecurve — Amplitude [V] vs Frequecy [kHz], $\left|U(f_n)\right|$, $\frac{f_n}{kHz}$

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