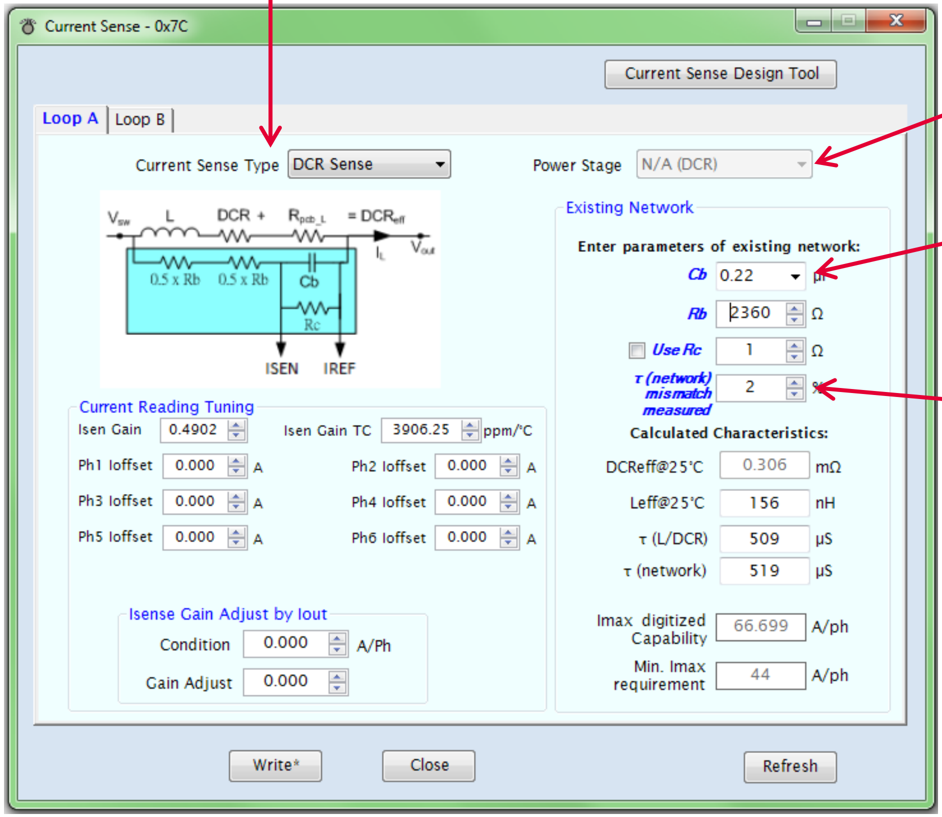
Current sense... DCRsense

Current Sense Type: can be selected between DCR sense (as shown), DCR Shunt or Non-DCR (i.e. Powerstage with internal current sense).

The grapichal figure will change to match selection made. Here DCR sense is shown.



Power stage. When Current sense Type is selected to be Non-DCR then the family of powerstage used can be selected here. In this example grayed out and not selectable as DCRsense is selected.

Cb and **Rb:** Enter the real values used on the PCB for capacitor and resistor

T (Network) mismatch measured: This is the mismatch in the two timeconstants Rb*Cb and L/DCR for the real components. Explanation follows on next 2 pages

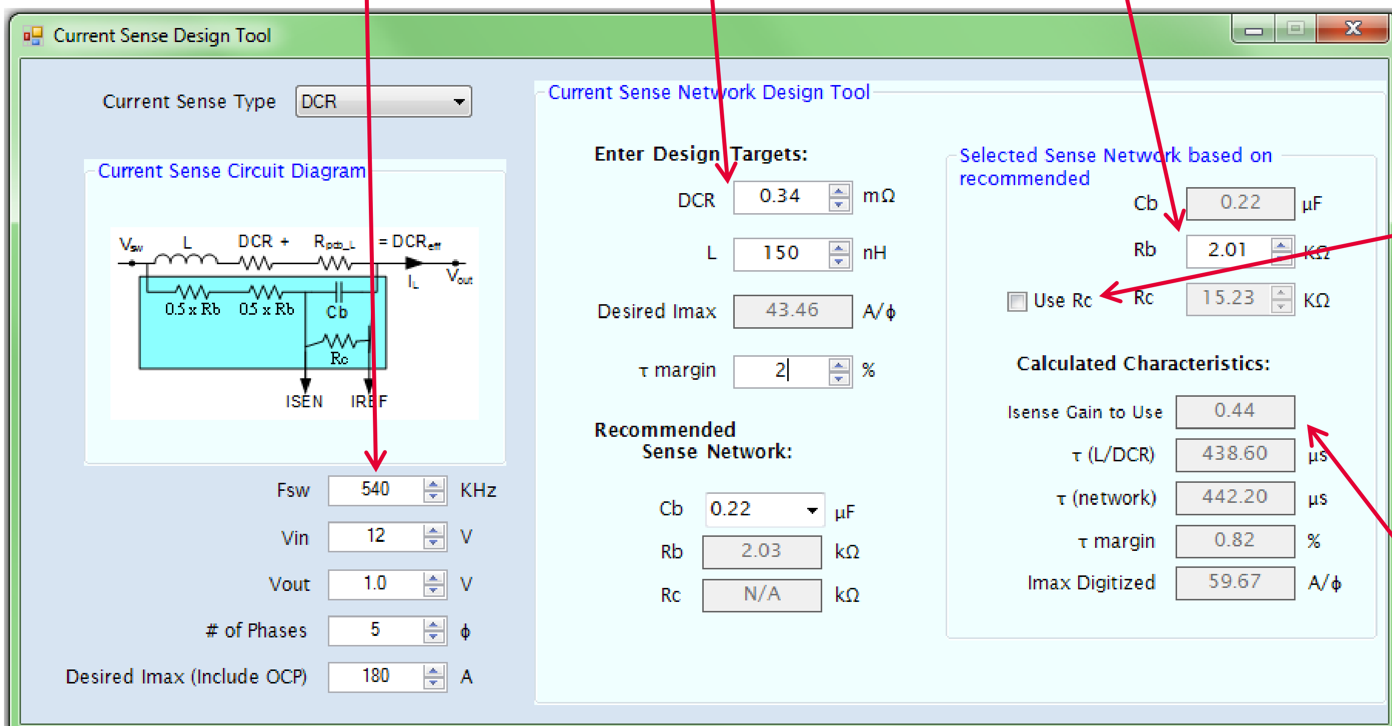
Current sense... Current sense design tool

A tool to help calculate current sense parameters. Use knowledge from the 3 following theory slides to find suitable numbers to enter.

First enter some basic numbers for the design

2nd step. Enter Data for inductor used
And the Cb capacitor 0.22uF recomended. T marging typical 2%

3rd step. Enter Data for Rb resistor

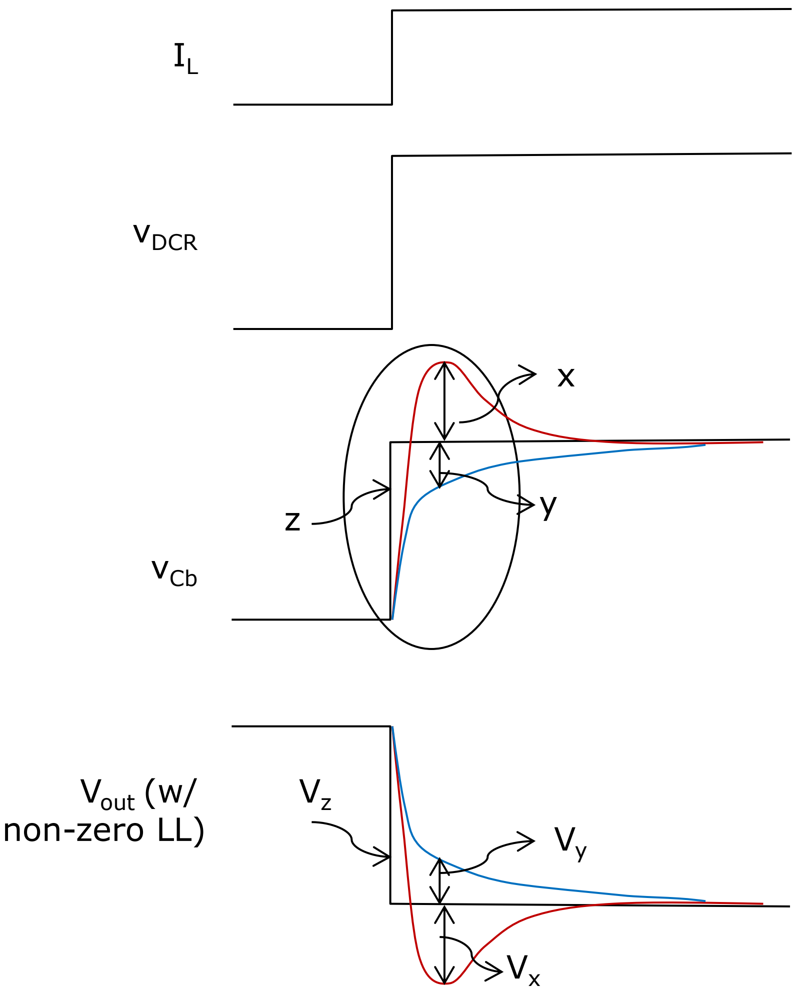


Use Rc. If there is a high DCR value the sense voltage may be needed to be divided down by using resistor Rc. If this is used mark the box and enter a number in the **Rc** field

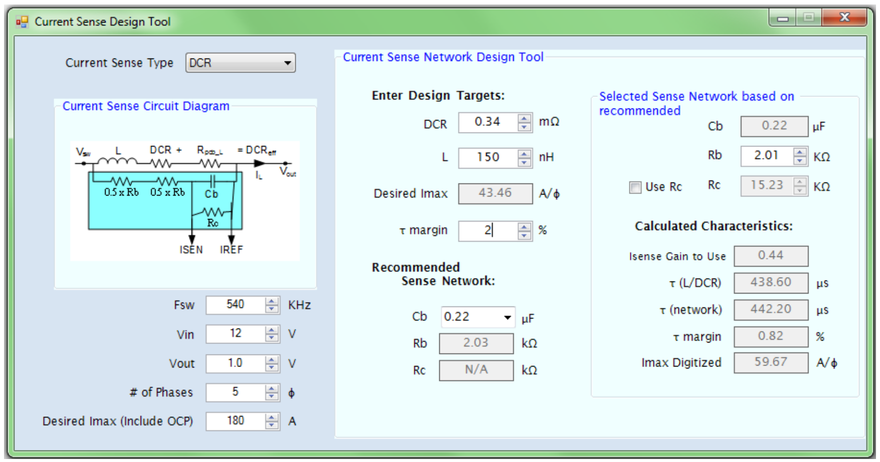
Isense gain. Calculated value that can be used as Isense gain in the current sense window.
It is to be used as starting point as final gain is determined by testing.

Current sense... dynamic response: Rb*Cb time constant

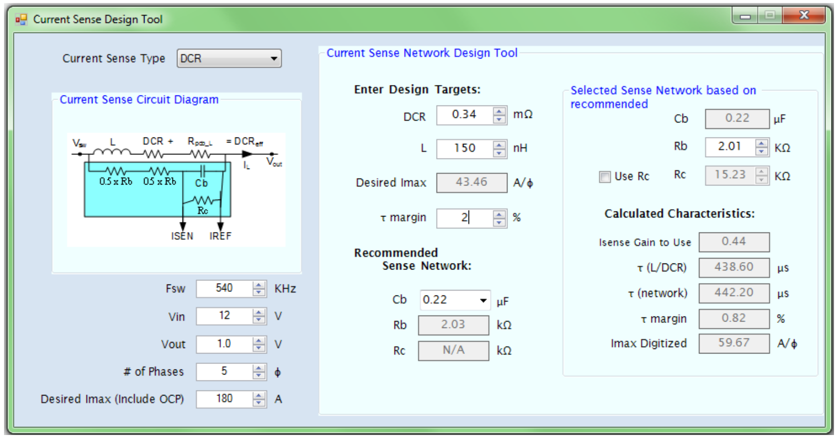
$$v_{Cbx} = v_{DCRx} * \frac{L/DCR}{R_b * C_b}, \quad s \to \infty$$



› Impact of how Rb*Cb compared to L/DCReff:
  - If R_b*C_b = L/DCReff, v_{Cb} will be the same v_{DCR} at any frequency
  - If R_b*C_b < L/DCReff, v_{Cb} will underdamp v_{DCR} which leads to overshoot/undershoot during transient when LL is non-zero. To adjust time constant:
    - $(R_b*C_b)_{new} = (R_b*C_b)_{orig}*(1+x/z)$
  - If R_b*C_b > L/DCR, v_{Cb} will overdamp v_{DCR}. To adjust time constant:
    - $(R_b*C_b)_{new} = (R_b*C_b)_{orig}*(1-y/z)$



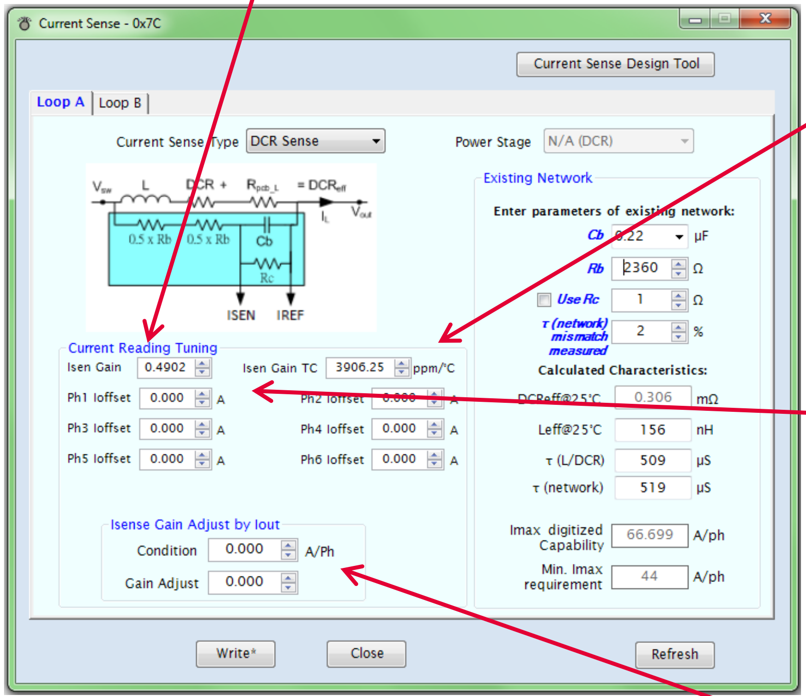
- The DC current sense gain must be tuned before adjusting time constant → actual DCR on board $DCR_{eff@25degC} = DCR_L + DCR_{trace}$ can be calculated
- Step 1: enter C_b and R_b values used on the board
- Step 2: set up transient load from 5% TDC to 55% TDC and measure z and x or y in previous page
- Step 3: if V_{Cb} overshoots V_{DCR}, enter x/z to "τ mismatch measured"; otherwise, enter −y/z to "τ mismatch measured" → actual L can be calculated



- Step 5: Select the desired C_b value and then R_b will be calculated automatically
  - Tip: recommend to keep the same C_b value and only adjust R_b value to minimize modifications on board
- Step 7: change the R_b or C_b to the new values on the board and verify DC current reading and time constants matching again
  - Iteration of DC current reading and time constant adjustments might be necessary

Current sense… DCRsense

Isen Gain. The gain factor for the measured voltage across Cb that represent the current through the Inductor. Tuning this value such that the current reading gain is accurate from 0A to 2/3 of TDC with Isen gain TC set at 3906.25ppm/degC when temp change in inductor is small.
To get a starting value set the gain=0.15mV/DCR



Isen Gain TC (Temperature Coefficient) This setting value is between 2000 ~ 4000 ppm/degC typically. Use the idea copper TC=3906.25 first and then based on temperature compensation result of inductor DCR to trim this value. This value could be different by layout.

Ph1 (Phase1) Ioffset. Additional offset for reported value. Behavior does depend on if current sharing is active or not. When no current sharing each phase get the individual offset. When current sharing active then any offset entered is shared equal between all active phases even of offset is only entered for one phase.

Isense Gain Adjust by Iout

–Applies an optional gain adjustment to the current sense based on Iout

–For load currents greater than the specified A/ph Condition, the specified **Gain Adjust** value will be applied

–Recommended setting for *Integrated* **Current Sense Type** (**A**) is 16A/ph

$$Isen\ Gain\ @\ I_x\ per\ phase = Isen\ Gain * (I_x - I_{condition}) * (1 + GainAdjust)$$