PFB – Passive filters box

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The PFB block is a simulation model included in the Imperix Power library. It models one symmetrical half of the imperix passive filters box in Simulink and PLECS simulation.

For more information regarding the Imperix Power library, please read Getting started with Imperix Power library.

Imperix Power library is available starting from ACG SDK 2024.2. Simulink Simscape Electrical or PLECS is also required. The Simulink version is only compatible with Specialized Power Systems. The supported versions are:
• Simulink R2016a or newer.
• Plexim PLECS 4.5 or newer.

Modeling of PFB

The PFB model has two modeling levels:

- **(A) Simple**
- **(B) Detailed**

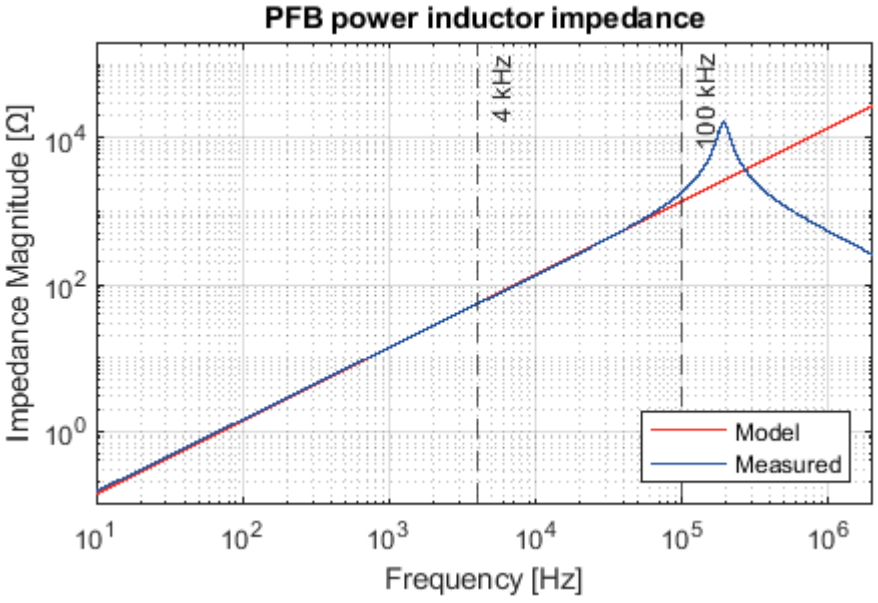
As introduced in the datasheet, the passive filter box consists of 3-phase power inductors, feedback capacitors, and an EMC filter. The power circuits can be wired differently for flexible use in power applications. According to all the possible wiring situations, the PFB model offers 3 wiring configurations:

- **Inductors**: only the power inductors are used.
- **Inductors, Cf/Rf, EMC filter**: refer to the "transformer-less connection to the grid" example in the datasheet. This option is named "config 1" in the later analysis.
- **Inductors, EMC filter, Cf/Rf**: refer to the "connection to the grid with an isolation transformer" example in the datasheet. This option is named "config 2" in the later analysis.

For more detailed model parameters and measurement results, please contact .

Power inductors

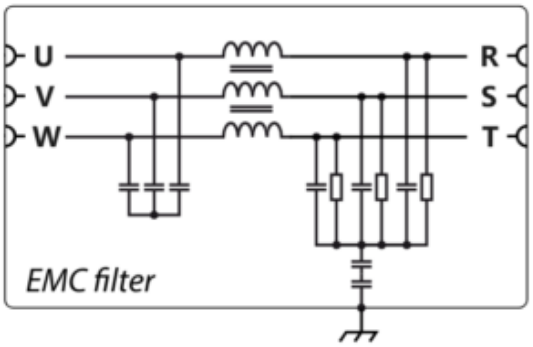
The power inductors are modeled by the inductance L_m and equivalent series resistance (ESR)R_m, which is the same for all the modeling levels. The impedance of the main inductors versus measured results is shown below.



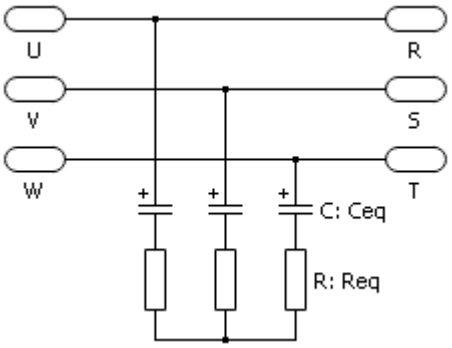
Lm [mH]	2.2
Rm [mΩ]	29

EMC filter

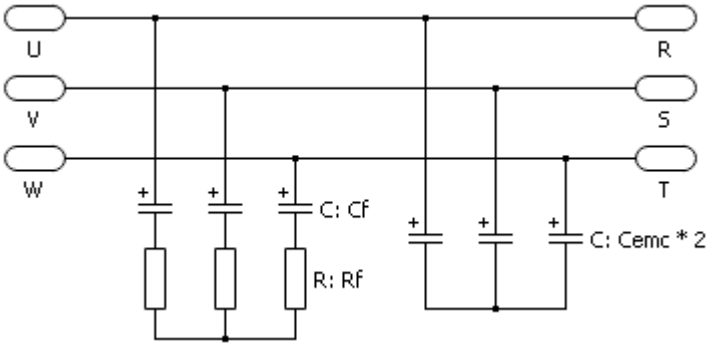
The figure below shows the schematic of the EMC filter. It has one common mode inductor and 2 three-phase capacitors on both sides of the inductor.



Since the common-mode characteristics mostly lie in the high-frequency range of up to hundreds of kilohertz to megahertz, only the differential mode is considered in the PFB model. The common mode path to GND is removed from the model. Furthermore, the leakage inductance of the common mode inductor can be neglected, and the capacitors can be lumped into one 3-phase capacitor. The schematic of the EMC filter model is shown below.

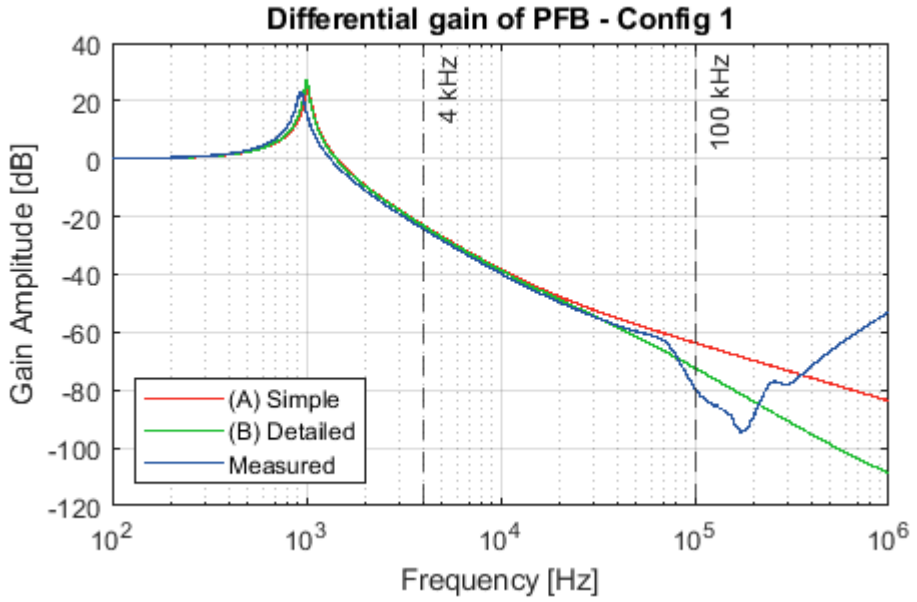


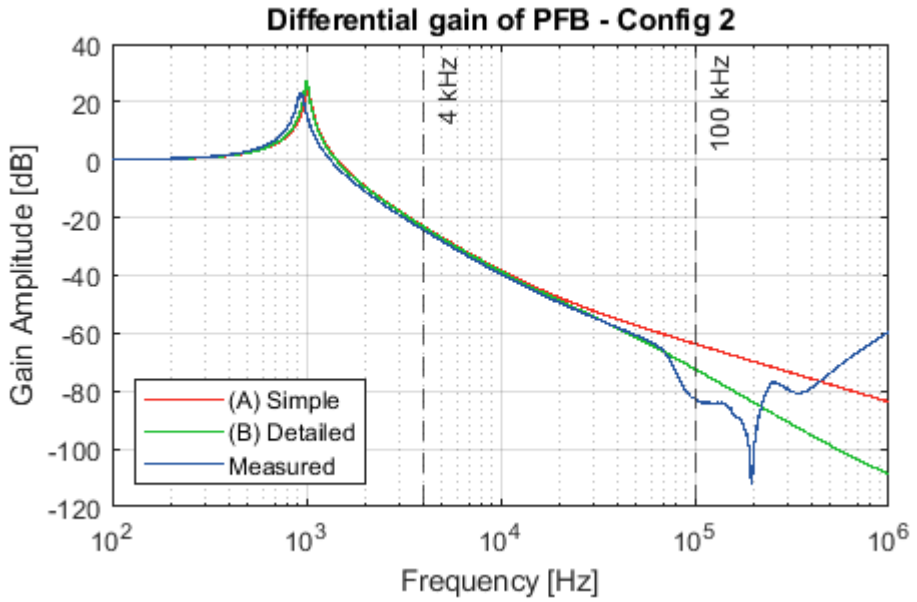
(A) Simple



(B) Detailed

In the differential mode, the combination of the EMC filter and the power inductors forms an LC circuit between phases. The model's accuracy can be validated by comparing the transfer function of the LC circuit with the measurement results. The comparison and parameters are displayed below.





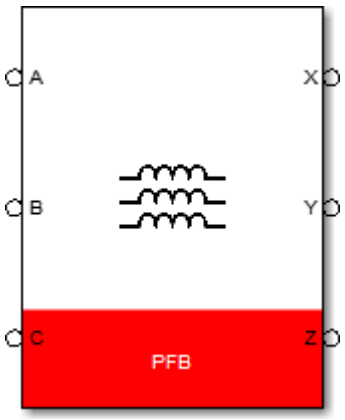
Req [Ω]	0.6
Ceq [μF]	16.6
Rf [Ω]	1
Cf [μF]	10
Cemc [μF]	3.3

Model parameters of PFB EMC filter

Simulink PFB block

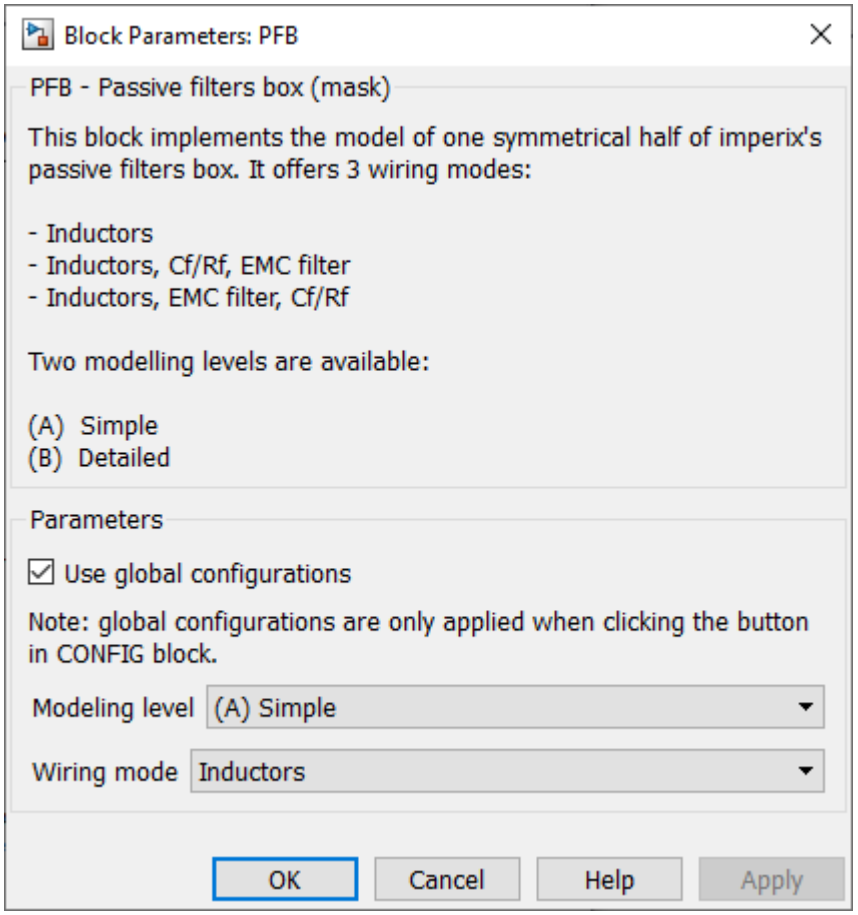
Port specification

- The connection ports `A,B,C` are the electrical ports connected to the physical ports `A,B,C` on the box.
- The connection ports `X,Y,Z` are the electrical ports connected to the physical ports `X,Y,Z` on the box.
- The connection ports `R,S,T` are the electrical ports connected to the physical ports `R,S,T` on the box.
- The connection ports `U,V,W` are the electrical ports connected to the physical ports `U,V,W` on the box.



Parameters

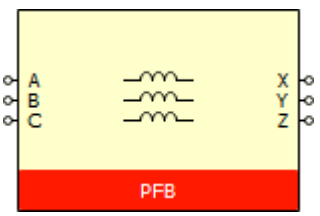
- `Use global configurations` is ticked when the block receives global configurations from the `Config` block.
- `Modeling level` selects the modeling level.
- `Wiring configuration` selects the wiring configuration.



PLECS PFB block

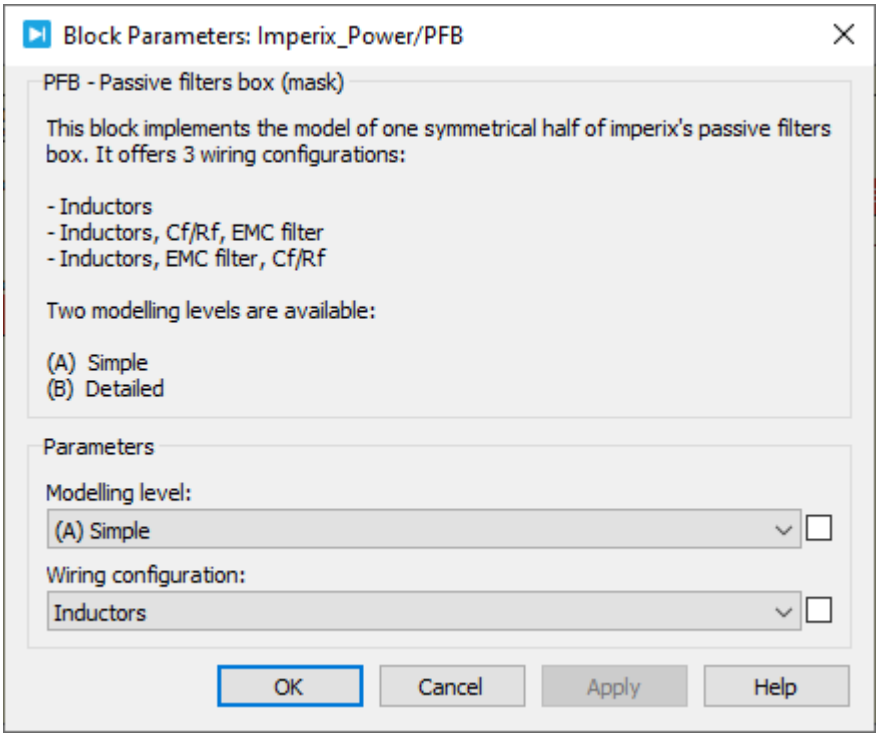
Port specification

- The connection ports `A,B,C` are the electrical ports connected to the physical ports `A,B,C` on the box.
- The connection ports `X,Y,Z` are the electrical ports connected to the physical ports `X,Y,Z` on the box.
- The connection ports `R,S,T` are the electrical ports connected to the physical ports `R,S,T` on the box.
- The connection ports `U,V,W` are the electrical ports connected to the physical ports `U,V,W` on the box.



Parameters

- Modeling level selects the modeling level.
- Wiring configuration selects the wiring configuration.



Probe signals

This block has no signals to be monitored.