
**CMOS028 FDSOI MODEL FOR SYMMETRICAL LOW HQ INDUCTORS
WITH PATTERNED GROUND SHIELD**

**(ind_lohq_5U1x_2T8x_LB and inddif_lohq_5U1x_2T8x_LB,
ind_lohq_6U1x_2T8x_LB and inddif_lohq_6U1x_2T8x_LB,
ind_lohq_6U1x_2U2x_2T8x_LB and inddif_lohq_6U1x_2U2x_2T8x_LB)**

Developer:

RF Team, April 2017

Maturity:

ind_lohq_6U1x_2T8x_LB : Production data

inddif_lohq_6U1x_2T8x_LB : Production data

ind_lohq_5U1x_2T8x_LB : Tentative data

inddif_lohq_5U1x_2T8x_LB : Tentative data

ind_lohq_6U1x_2U2x_2T8x_LB : Production data

inddif_lohq_6U1x_2U2x_2T8x_LB : Production data

I Measurement and Parameter **Extraction/Estimation of Typical Model Parameters:**

8ML and 10ML inductors are silicon based.

7ML parameters are extrapolated from 8ML data

Test structure reference:

8ML : MPW C281527

7ML : Not applicable

10ML : MPW C281527

Device Selection (8ML)

Lot: Q539039

Wafer: 10

Die : D110

Device Selection (10ML)

Lot: Q544151

Wafer: 23

Die : D45

Characterization domain:

High frequency measurements from 100 MHz to 110 GHz

II. Best/Worst Case:

Statistical and Best/Worst case simulations available.

The criteria is the quality factor.

Some approximations have been made for the definition of Min and Max:

Min defined with: L_s min, R_s max, C_{ox} max.

Max defined with: L_s max, R_s min, C_{ox} min.

FOR ANY FREQUENCY (approximation).

User corners are also available.

III. Simulation with temperature:

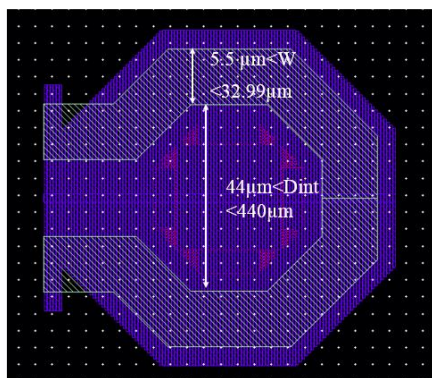
Available from -35 to 125 Celsius Degree.

IV. Model Application guidelines:

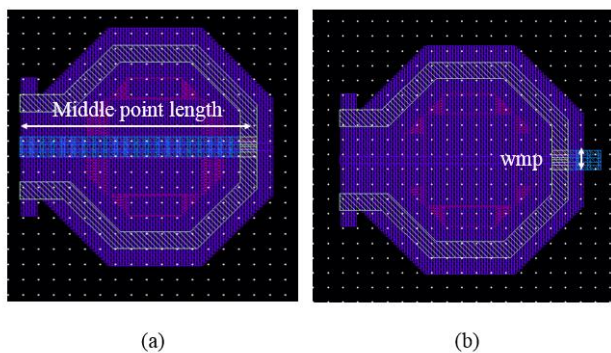
Layout & Model:

- Octagonal shape
- 6U1x_2U2x_2T8x_LB option: Coil in Alucap + last metal layer
- 5U1x_2T8x_LB option : Coil in Alucap + last metal layer
- 6U1x_2T8x_LB option : Coil in Alucap + last metal layer
- Patterned ground shield: Metal 1
- 2 Pi-cell model
- The model takes into account the proximity effects by the use of frequency dependent resistances
- Access to the middle point of the differential inductor : stack M2 to IB
The middle point access line is only modeled by its DC serial resistance

Model Call:



Single LoHQ inductor



(a)

(b)

Diff LoHQ inductor with
(a) long middle point (b) short middle point

- Scalable inductor model
- Input parameters for **ind_lohq_6U1x_2U2x_2T8x_LB**, **ind_lohq_6U1x_2T8x_LB**, **ind_lohq_5U1x_2T8x_LB** :
 - d**: internal diameter in μm from 44E-6 m to 440 E-6 m
=> the inductance value is computed
 - or **ls**: inductance value in H from 0.062E-9 to 1.112E-9
=> the internal diameter is computed
 - w**: width of coils
from 5.5E-6 m to 32.99E-6 m
- Input parameters for **inddif_lohq_6U1x_2U2x_2T8x_LB**, **inddif_lohq_6U1x_2T8x_LB**, **inddif_lohq_5U1x_2T8x_LB**:
 - d**: internal diameter in μm from 44E-6 m to 440 E-6 m
=> the inductance value is computed
 - or **ls**: inductance value in H from 0.062E-9 to 1.112E-9
=> the internal diameter is computed
 - w**: width of coils
from 5.5E-6 m to 32.99E-6 m
 - mpout**: 1 : short middle point
0 : long middle point
 - wmp**: - middle point width from 5.5E-6m to $d \cdot (\sqrt{2}-1) - 4.4\text{e-}6\text{ m}$
(multifinger approach is used)

Frequency validity:

From DC to cut-off frequency F_{max} of quality factor (F_{max} is the frequency where the quality factor reaches a null value).

Warning:

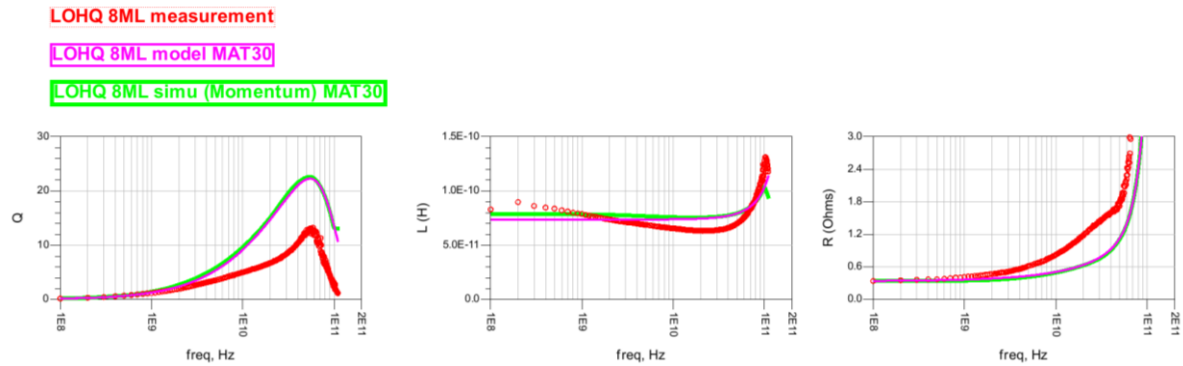
The differential inductor model is only valid if the inductor is used in differential configuration (no RF signal is driving by the middle point access). The middle point access port is a ground (or a virtual ground) in the RF point of view.

V. Model vs Measurements:

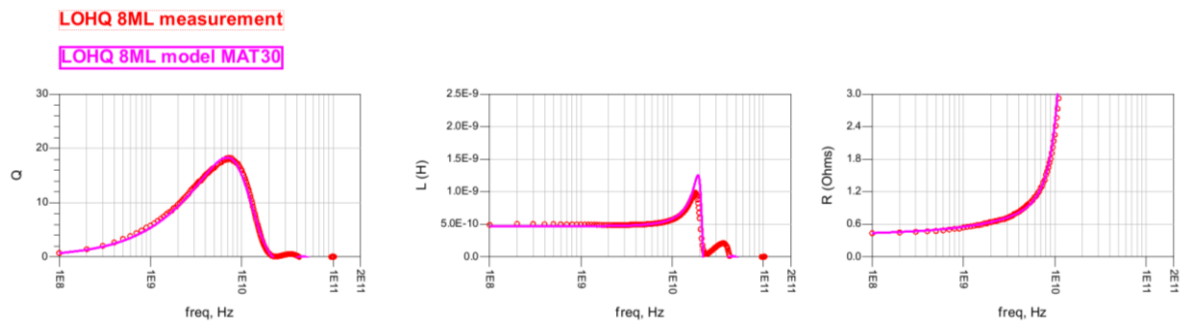
NB :

For the configurations below 150 pH, the model has been extracted considering both the measurements and the Momentum simulations. For such low value inductors, parasitics due to test structures are higher than device parameters to be extracted, leading to inaccurate model extraction. Momentum helps to deal with this issue by providing a more realistic Q factor. Above 150 pH, test structures are accurate enough to enable full model extraction based on measurement.

ind_lohq_6U1x_2T8x_LB, configuration 1: nbturns=1, w=5.5 μ m, d=44 μ m



ind_lohq_6U1x_2T8x_LB, configuration 2: nbturns=1, w=19.25 μ m, d=242 μ m



ind_lohq_6U1x_2T8x_LB, configuration 3: nbturns=1, w=32.99 μ m, d=440 μ m

