**CMOS028 FDSOI MODEL FOR SYMMETRICAL HQ INDUCTORS
WITH PATTERNED GROUND SHIELD
(ind_hq_6U1x_2T8x_LB and inddif_hq_6U1x_2T8x_LB,
ind_hq_5U1x_2T8x_LB and inddif_hq_5U1x_2T8x_LB,
ind_hq_6U1x_2U2x_2T8x_LB and inddif_hq_6U1x_2U2x_2T8x_LB)**

Developer:
RF Team, April 2017

Maturity:

ind_hq_6U1x_2T8x_LB : Production data
inddif_hq_6U1x_2T8x_LB : Production data

ind_hq_5U1x_2T8x_LB : Tentative data
inddif_hq_5U1x_2T8x_LB : Tentative data

ind_hq_6U1x_2U2x_2T8x_LB : Tentative data
inddif_hq_6U1x_2U2x_2T8x_LB : Tentative data

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

8ML inductors are silicon based.
7ML and 10ML parameters are extrapolated from 8ML data

Test structure reference:
8ML : MPW C281608
7ML : Not applicable
10ML : Not applicable

Device Selection (8ML)
Lot: Q618020
Wafer: 08
Die: D68

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: Ls min, Rs max, Cox max.
      Max defined with: Ls max, Rs min, Cox 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:

<u>Layout & Model:</u>

- 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
- 6U1x_2U2x_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 IA
  The middle point access line is only modeled by its DC serial resistance

<u>Model Call:</u>
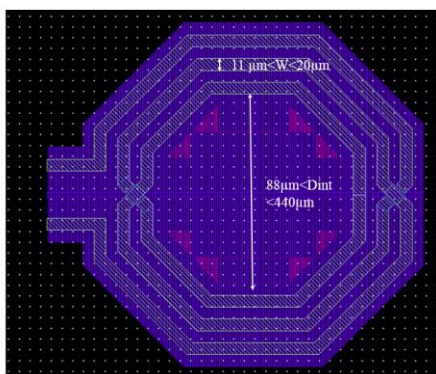
Single HQ inductor (nbturns=3)
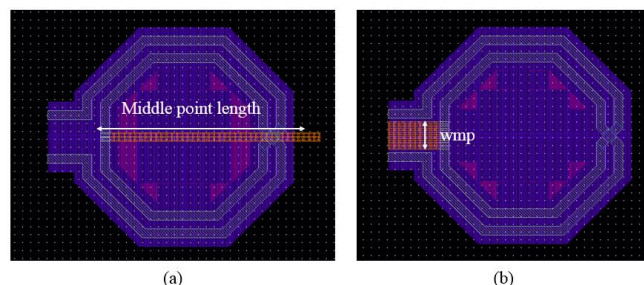
Diff HQ inductor with
(a) long middle point (b) short middle point

- Scalable inductor model
- Input parameters for **ind_hq_6U1x_2U2x_2T8x_LB, ind_hq_6U1x_2T8x_LB, ind_hq_5U1x_2T8x_LB** :

    d: internal diameter in um from 88 e-6 m to 440 e-6 m
      => the inductance value is computed

  or **ls:** inductance value in H from 0.549 e-9 to 7.794 e-9 H
      => the internal diameter is computed

    w: width of coils
        from 11 e-6 m to 32.99 e-6 m for nbturns=2
        is fixed to 11 e-6 m for nbturns=3

    nbturns: from 2 to 3

- Input parameters for **inddif_hq_6U1x_2U2x_2T8x_LB, inddif_hq_6U1x_2T8x_LB, inddif_hq_5U1x_2T8x_LB** :

    d: internal diameter in μm from 88 e-6 m to 440 e-6 m
      => the inductance value is computed

  or **ls:** inductance value in H from 0.549 e-9 to 7.794 e-9 H
      => the internal diameter is computed

    w: width of coils
        from 11 to 32.99 e-6 m for nbturns=2
        is fixed to 11 e-6 m for nbturns=3

    nbturns: from 2 to 3
    mpout: 1 : short middle point
         0 : long middle point
    wmp: - middle point width from 11 e-6 m to 35.2 e-6 m (multifinger

approach is used)

Frequency validity:

From DC to cut-off frequency Fmax of quality factor (Fmax 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.
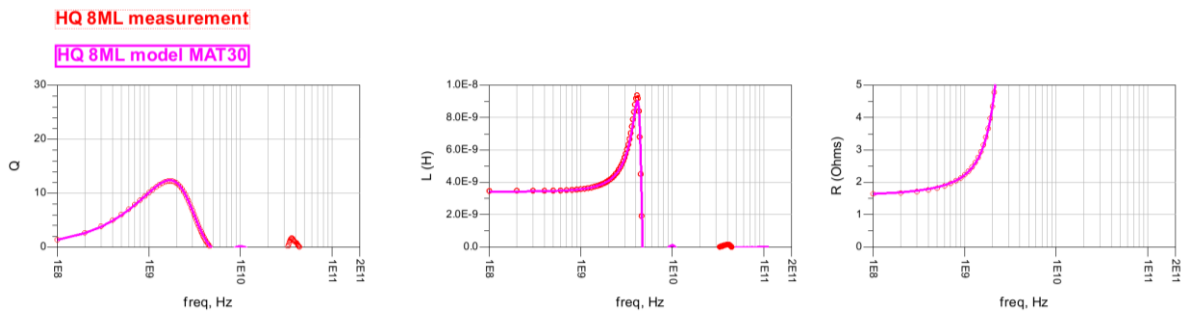
V. Model vs Measurements:

ind_hq_6U1x_2T8x_LB, configuration 1 : nbturns=2, w=11 µm, d=88 µm
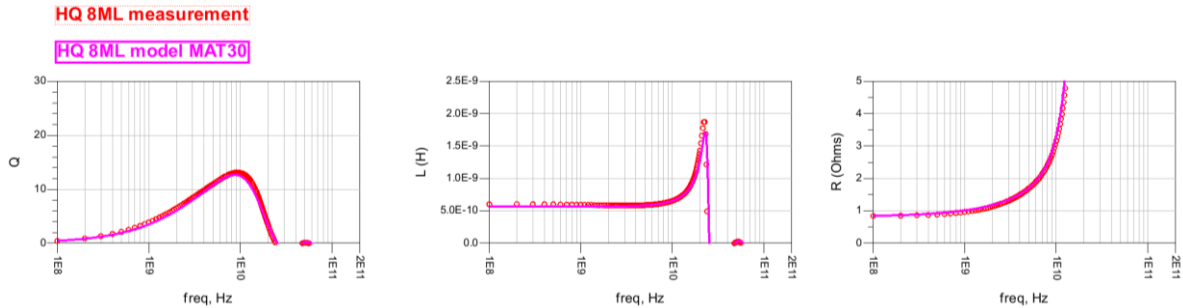
ind_hq_6U1x_2T8x_LB, configuration 2 : nbturns=2, w=15.5 µm, d=264 µm
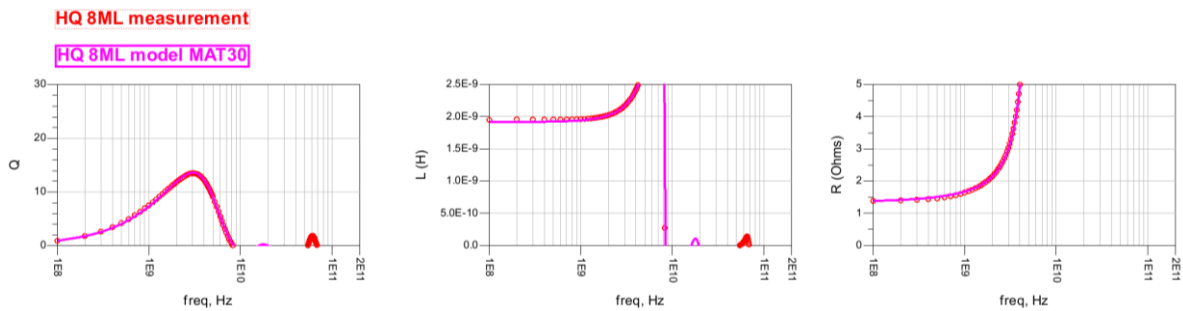
ind_hq_6U1x_2T8x_LB, configuration 3 : nbturns=2, w=20 µm, d=440 µm

ind_hq_6U1x_2T8x_LB, configuration 4 : nbturns=3, w=11 µm, d=264 µm