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# The EKV Charge-based MOSFET Model

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# A Long History – The Early Days

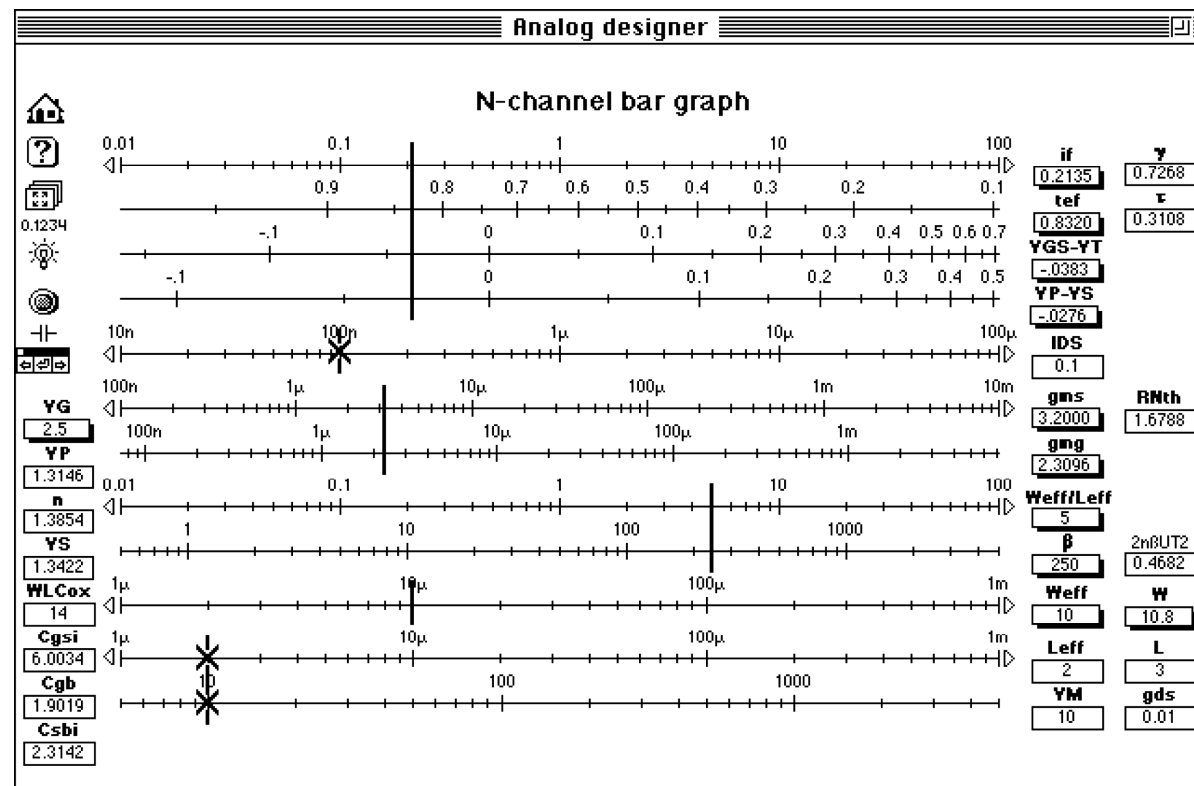
- Finds its roots in the first models presenting weak inversion published in the 70's
- First charge-based approach taken by Jespers and Memelink (1977)
- Bulk-referenced symmetrical model proposed by Châtelain, but only for strong inversion (1979)
- First model continuous from weak to strong inversion by Oguey and Cserveny (1982), simplified later on by Vittoz for analog design purpose
- Linearization of inversion charge versus surface potential originally proposed in by the pioneering work of Maher and Mead (1987)
- First EKV paper describing EKV2 by Enz, Krummenacher and Vittoz (1995)
- First EKV charge-based formulation by Bucher (1997)
- Similar approach by Cunha (1997)
- Inversion charge linearization rediscovered by Gummel and Singhal (2001)
- Rigorous derivation of inversion charge linearization of the EKV by Sallese (2003)

# A Long History – The Compact Modeling Stage

- Non-uniform doping was proposed by Lallement (1996)
- EKV compact model 2.6 released in 1997 by M. Bucher
- Implementation in most commercially available circuit simulator by M. Bucher
- Extension of EKV to RF CMOS by Enz (1999)
- Charge-based NQS model added by Sallese and Porret (2000)
- Quantum and polydepletion effects by Lallement (2003)
- Accurate thermal noise model developed by Roy (2005)
- Selection of EKV3 (Bazigos and Bucher) among 4 other CM by the CMC (2005)
- Accurate flicker noise model added by Enz (2006)
- Publication of the book “Charge-Based MOS Transistor Modeling - The EKV Model for Low-Power and RF IC Design,” by Enz and Vittoz (2006)
- Extension of EKV to ballistic/quasi-ballistic transport by Mangla (2011)

# The Link between Process and Designers

- EKV is not only a compact model but also a low-power analog-RF **design methodology** based on the **inversion coefficient**
- EKV establishes the link between process and designer



## What's Next? – BSIM-EKV team-up

BSIM and EKV groups have agreed to collaborate on the long-term development and support of BSIM6 as an open-source MOSFET SPICE model for worldwide use.

This is an exciting opportunity to leverage the long history and large user base of the BSIM model with the long experience and active role of EKV in furthering charge-based compact model.

**BSIM**



**EKV**