# HV MOS

## BSIM3-based High Voltage Compact Model

### Accurate SPICE Simulation of High Voltage Devices without using macro-models

Simucad Level 88 provides a high-voltage compact model and is an extension of the industry standard BSIM3v3 model.

This model is suitable to simulate Vertical Double-diffused (VDMOS) and any other high-voltage MOS devices.

### Features

- Asymmetric source and drain parasitics.
- Bias dependency of source and drain parasitics.
- Mobility reduction, including reduction due to drain voltage.
- Dependency of velocity saturation on both gate and drain voltages.
- Self-heating.
- Quasi-saturation.
- Velocity saturation.
- Drain-Induced Barrier Lowering (DIBL).
- Static feedback.
- Channel length modulation.
- Weak avalanche current.

Level 88 improves on the widely adopted BSIM3v3 model to correctly describe, in a single compact model, the behavior of high voltage MOS transistors. Being a compact model, Level 88 provides much better convergence properties as compared to using a macro-model based approach. Simulation speed is not hampered by increased circuit size as internal macro-model nodes are not required.

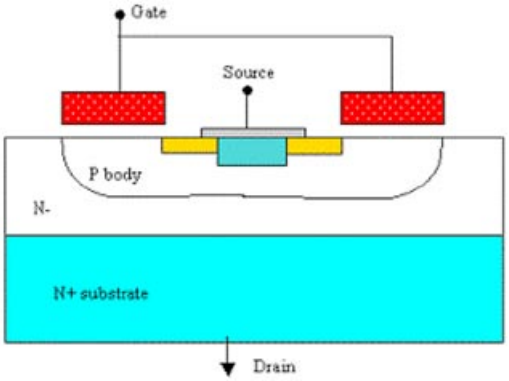


Fig.1 Schematic cross-section of a VDMOS device.

### Simucad Implementation

- Level 88 model is part of SmartLib product-independent models library. It can be accessed within SmartSpice as LEVEL 88.
- Level 88 is compatible with parallel architecture algorithms
- Level 88 is compatible with VZERO and BYPASS options in order to achieve greater speed performance.
- Internal warnings and diagnostics provide valuable information to help identify convergence issues.
- Usual MOS device variables like currents, conductances, charges and capacitances as well as MOS Level 88-specific internal variables can be saved, printed, plotted and/or measured.

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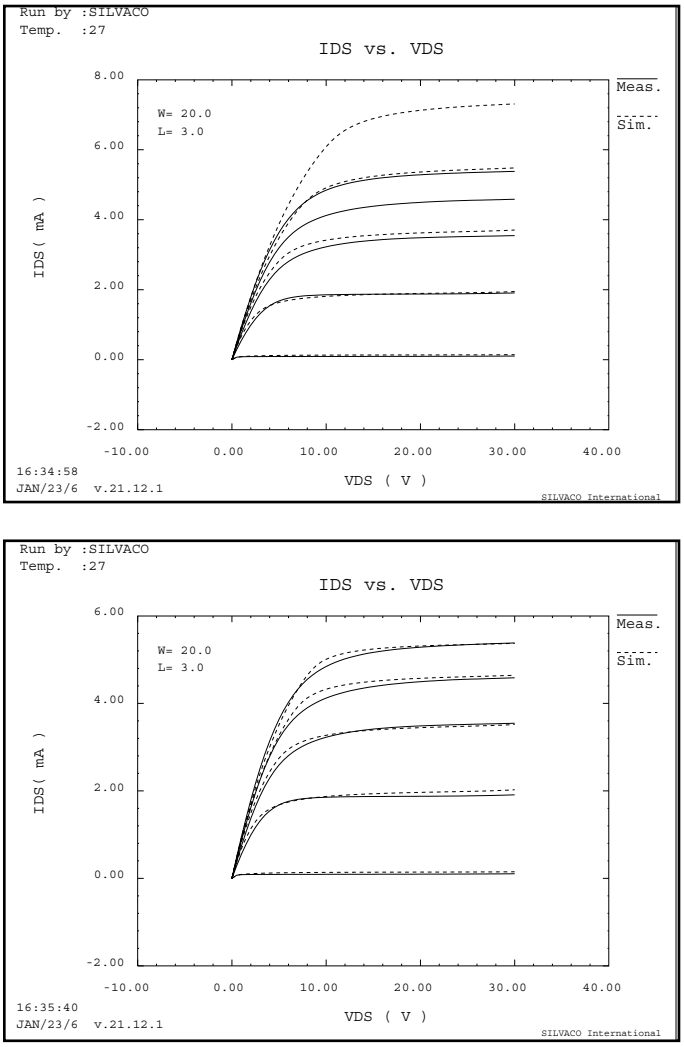
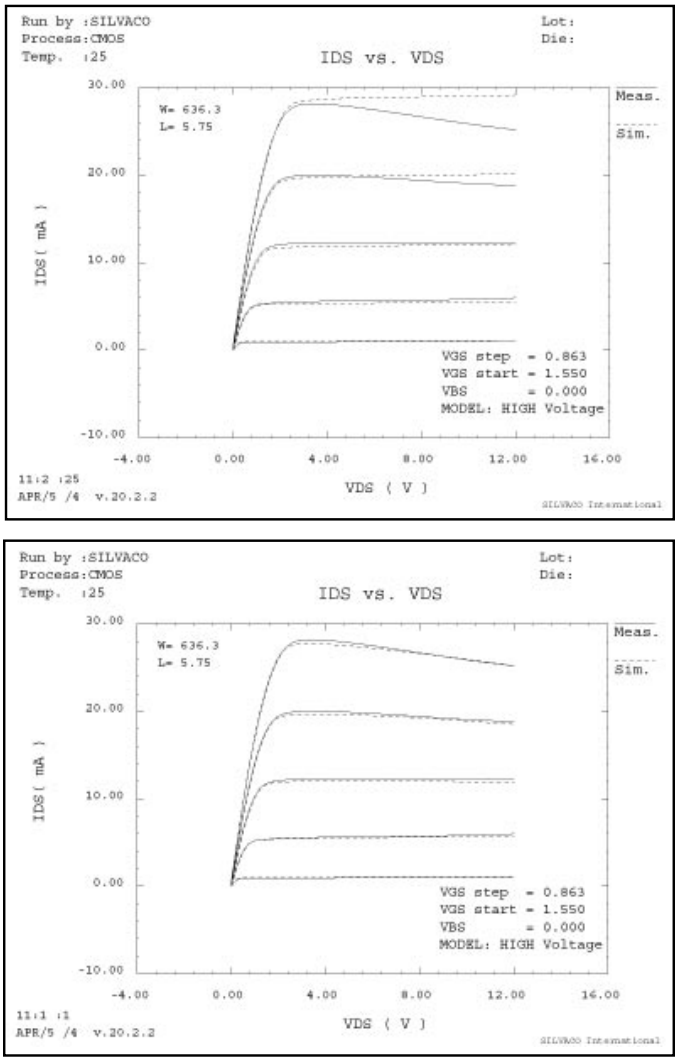
## Benefits From Simucad Model Improvements

- Core parameter set is based on a final version of BSIM3v3.2 and ensures good continuity in the drain current equation and stable convergence.
- Easy parameter extractions for modeling engineers who are familiar with BSIM3v3.2.




Typical best model fit using BSIM3v3 (top) and Level 88 (bottom) showing bias dependency of velocity saturation.




Typical best model fit using BSIM3v3 (top) and Level 88 (bottom) showing self-heating effects.

### Additional model parameters added to the core model

| Parameter | Description |
|---|---|
| PRWD1 | First order Vds dependence of external resistance Rds (Forward Mode) |
| PRWD2 | Second order Vds dependence of external resistance Rds (Forward Mode) |
| PRWS1 | First order Vds dependence of external resistance Rds (Reverse Mode) |
| PRWS2 | Second order Vds dependence of external resistance Rds (Reverse Mode) |
| UD | Vds dependence of mobility degradation |
| PCSE | Subthreshold slope and reverse short channel effect parameter |
| CCSE | Subthreshold slope and reverse short channel effect parameter |
| VSATG | Vgs dependence of VSAT |
| VSATB | Vbs dependence of VSAT |