Complementary 20-V (D-S) MOSFET

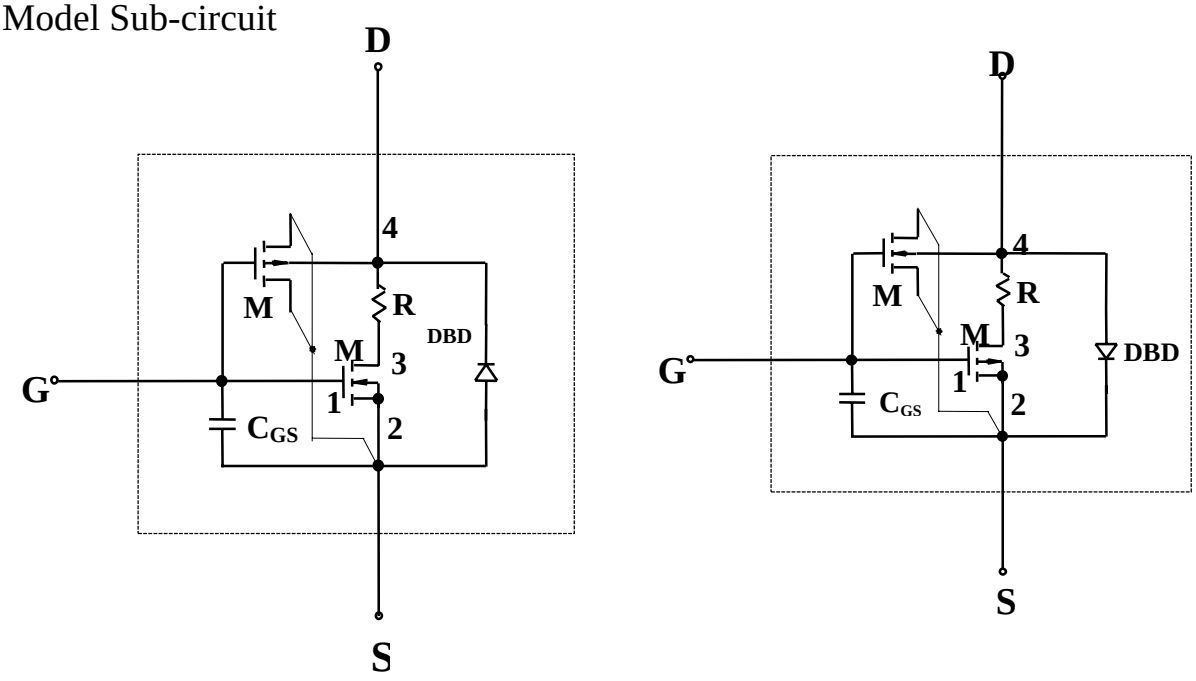
Characteristics

- N- and P- channel Vertical DMOS
- Macro-Model (Sub-circuit)
- Level 3 MOS
- Applicable for Both Linear and Switch Mode
- Applicable Over a -55 to 125°C Temperature Range
- Models Gate Charge, Transient, and Diode Reverse Recovery Characteristics

Description

The attached SPICE Model describes typical electrical characteristics of the n- and p- channel vertical DMOS. The sub-circuit model was extracted and optimized over a 25°C to 125°C temperature range under pulse conditions for 0 to -4.5 volts gate drives. Saturated output impedance model accuracy has been maximized for gate biases near threshold. A novel gate-to-drain feedback capacitance network is used to model gate charge characteristics while avoiding convergence problems of switched C_{gd} model. Model parameter values are optimized to provide a best fit to measure electrical data and are not intended as an exact physical description of a device.

Model Sub-circuit



This document is intended as a SPICE modeling guideline and does not constitute a commercial product data sheet. Designers should refer to the appropriate data sheet of the same number for guaranteed specification limits.

Model Evaluation

N- and P- Channel Device (T_J=25°C Unless Otherwise Noted)

Parameter	Symbol	Test Conditions		Typical	Unit
Static					
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250µA	**N-Ch**	**1.1**	V
		V_{DS} = V_{GS}, I_D = -250µA	**P-Ch**	**1.1**	
On-State Drain Current [a]	$I_{D(on)}$	V_{DS} = **5**V, V_{GS} = **4.5**V	**N-Ch**	**1.1**	A
		V_{DS} = **-5**V, V_{GS} = **-4.5**V	**P-Ch**	**3.1**	
Drain-Source On-State Resistance [a]	$r_{DS(on)}$	V_{GS} = **4.5**V, I_D = **0.29**A	**N-Ch**	**1.64**	Ω
		V_{GS} = **-4.5**V, I_D = **- 0.41**A	**P-Ch**	**0.85**	
		V_{GS} = **2.7**V, I_D = **0.1**A	**N-Ch**	**2.34**	
		V_{GS} = **-2.7**V, I_D = **- 0.25**A	**P-Ch**	**1.2**	
		V_{GS} = **2.5**V, I_D = **0.1**A	**N-Ch**	**2.58**	
		V_{GS} = **-2.5**V, I_D = **- 0.25**A	**P-Ch**	**1.33**	
Forward Transconductance [a]	g_{fs}	V_{DS} = **10**V, I_D = **0.29**A	**N-Ch**	**0.33**	S
		V_{DS} = **-10**V, I_D = **-0.41**A	**P-Ch**	**0.80**	
Diode Forward Voltage [a]	V_{SD}	I_S = **0.23**A, V_{GS} = 0V	**N-Ch**	**0.67**	V
		I_S = **-0.23**A, V_{GS} = 0V	**P-Ch**	**-0.76**	
Dynamic [b]					
Total Gate Charge	Q_g	N-Channel V_{DS} = **10**V, V_{GS} = **4.5**V, I_D = **0.29**A P-Channel V_{DS} = **-10**V, V_{GS} = **-4.5**V, I_D = **-0.41**A	**N-Ch**	**0.55**	nC
			P-Ch	**0.54**	
Gate-Source Charge	Q_{gs}		**N-Ch**	**0.22**	
			P-Ch	**0.11**	
Gate-Drain Charge	Q_{gd}		**N-Ch**	**0.13**	
			P-Ch	**0.14**	
Turn-On Delay Time	$t_{d(on)}$	N-Channel V_{DD} = **10**V, R_L = **20**Ω $I_D \cong$ **0.5**A, V_{GEN} = **4.5**V, R_G = 6Ω P-Channel V_{DD} = **-10**V, R_L = **20**Ω $I_D \cong$ **-0.5**A, V_{GEN} = **-4.5**V, R_G = 6Ω	**N-Ch**	**18**	ns
			P-Ch	**8.8**	
Rise Time	t_r		**N-Ch**	**21**	
			P-Ch	**11**	
Turn-Off Delay Time	$t_{d(off)}$		**N-Ch**	**21**	
			P-Ch	**11**	
Fall Time	t_f		**N-Ch**	**22**	
			P-Ch	**12**	
Source-Drain Reverse Recovery Time	t_r	I_F = **0.23**A, di/dt = 100A/µs	**N-Ch**	**20**	
		I_F = **- 0.23**A, di/dt =100A/µs	**P-Ch**	**25**	

Notes:

a) Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2%

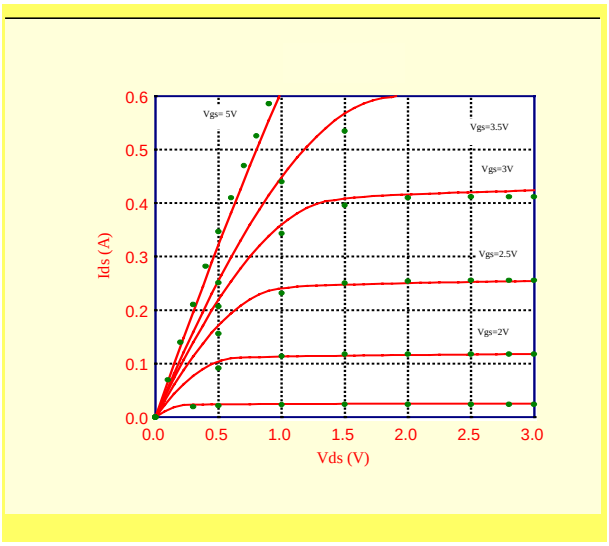
b) Guaranteed by design, not subject to production testing

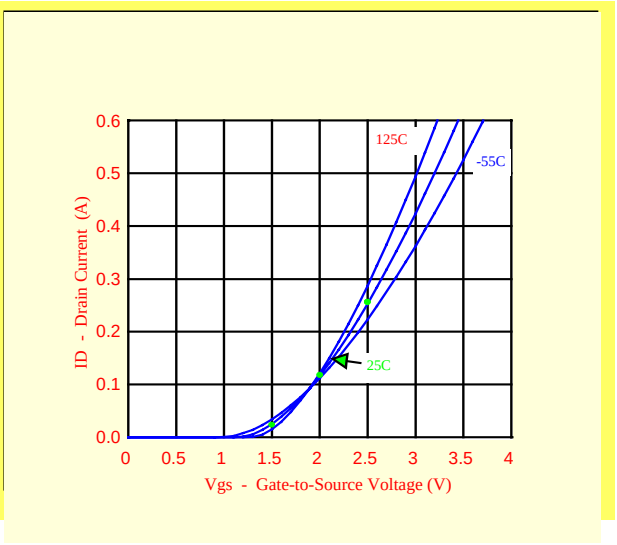
SPICE Device Model Si1551DL

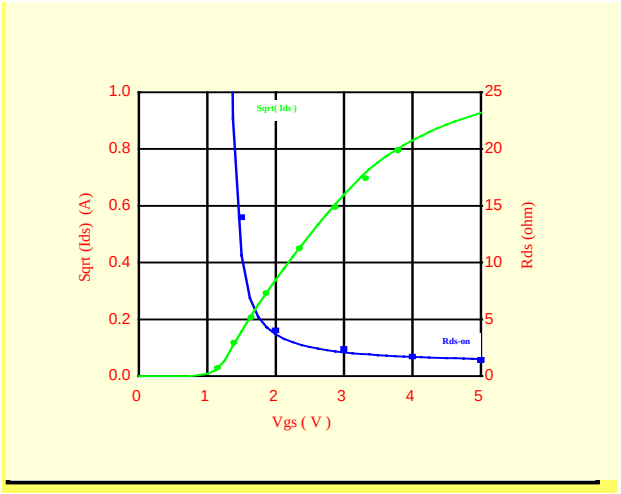
Comparison of Model with Measured Data

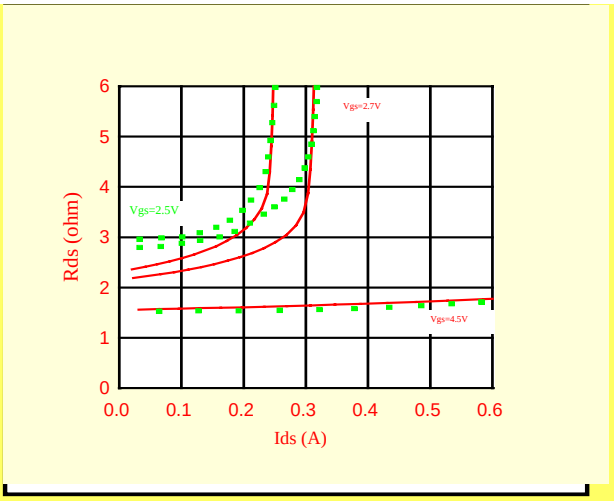
N-Channel MOSFET

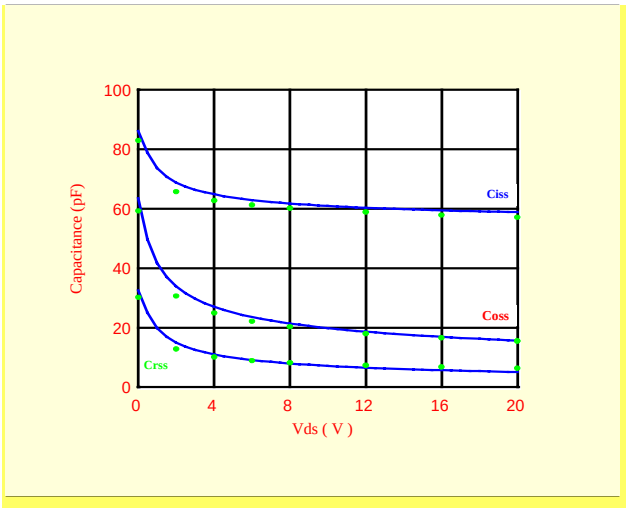
(T_J=25°C Unless Otherwise Noted)

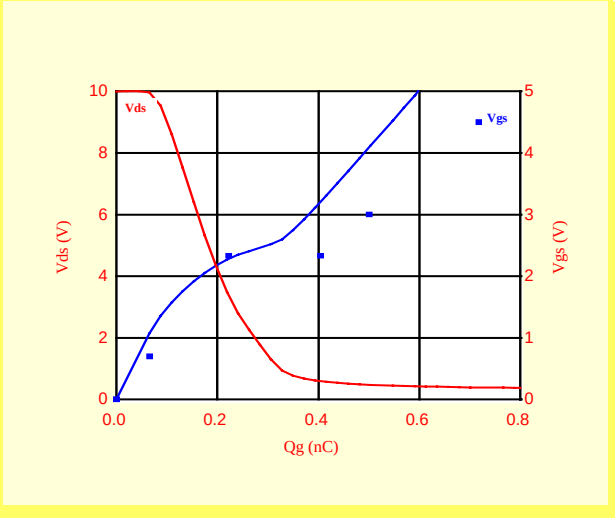


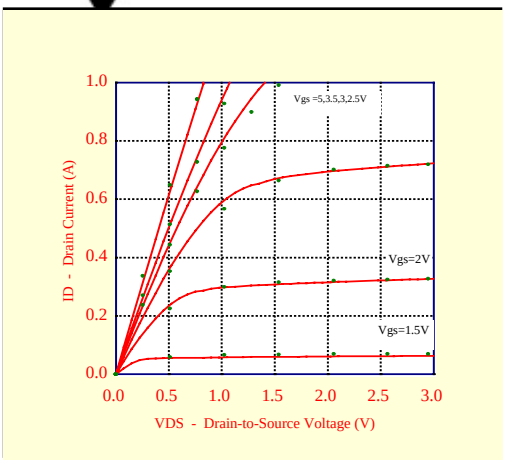


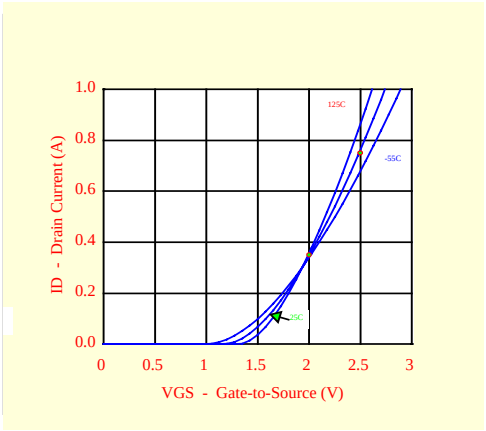


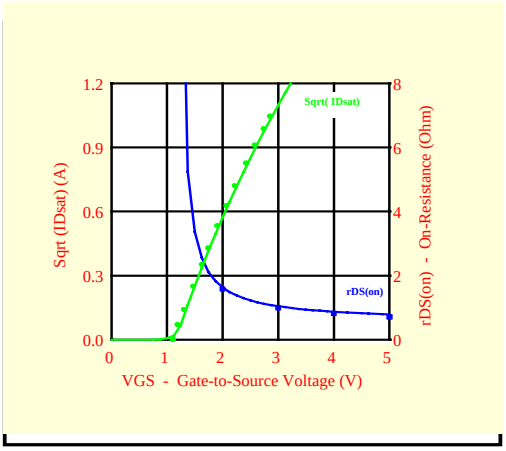


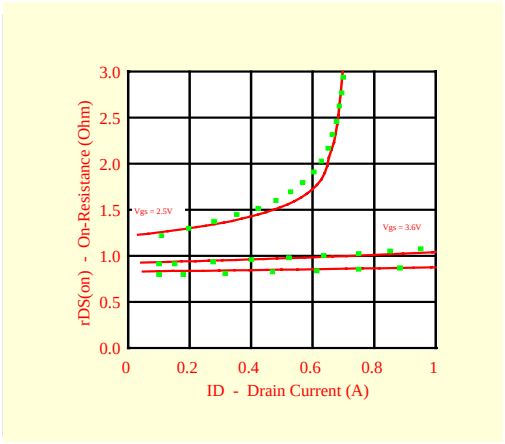


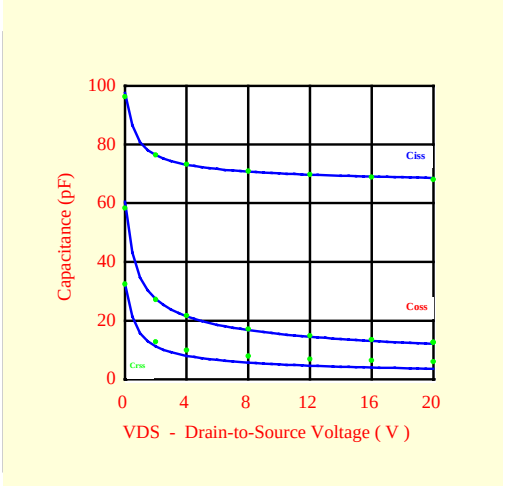


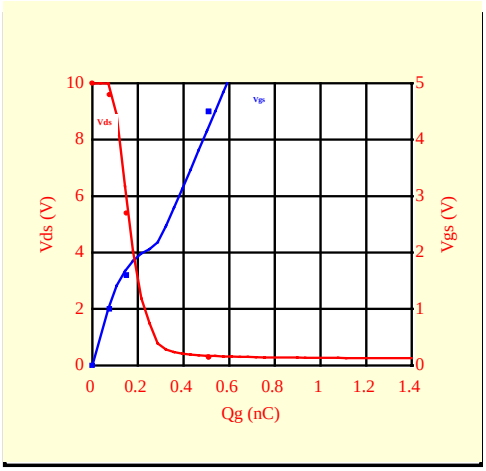

Vgs =5,3.5,3.2.5V
Vgs=2V
Vgs=1.5V
ID - Drain Current (A)
VDS - Drain-to-Source Voltage (V)


125C
-55C
25C
ID - Drain Current (A)
VGS - Gate-to-Source (V)


Sqrt(IDsat)
rDS(on)
Sqrt (IDsat) (A)
rDS(on) - On-Resistance (Ohm)
VGS - Gate-to-Source Voltage (V)


Vgs = 2.5V
Vgs = 3.6V
rDS(on) - On-Resistance (Ohm)
ID - Drain Current (A)


Ciss
Coss
Crss
Capacitance (pF)
VDS - Drain-to-Source Voltage (V)


Vds
Vgs
Vds (V)
Vgs (V)
Qg (nC)