



# CC-17-40-744L

## TO-247-4L

### SiC Power MOSFETs

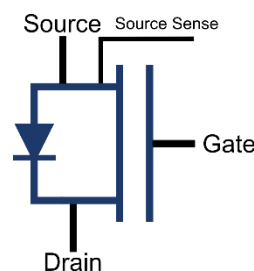
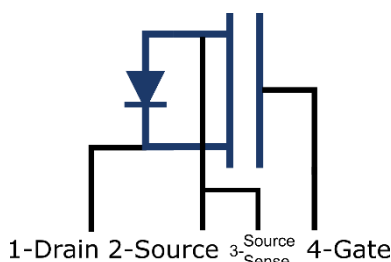
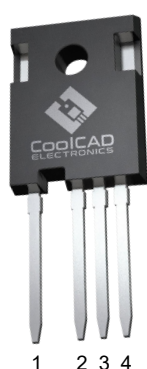
CoolCAD Power MOSFETs exceed power, efficiency and portability capabilities of standard silicon devices and are available in a variety of breakdown voltages (650V, 1200V, 1700V & 3300V) and current ratings. They have low on-resistance and low leakage in the blocking state. Fabricated on high-quality SiC epitaxial layers, our proprietary fabrication process includes carefully chosen annealing procedures to ensure a high-quality SiC-SiO<sub>2</sub> gate oxide dielectric layer. Doping profile, neck region, and edge termination ensure extremely low  $R_{on}$  and high breakdown voltage.

## BENEFITS

- ✓ Higher efficiency
- ✓ Reduced cooling
- ✓ Increased power
- ✓ Reduced system volume

## APPLICATIONS INCLUDE

Electromechanical power converters, DC to DC, AC to DC and DC to AC converters, switching power supplies, electric vehicles, hybrid vehicles, solar and wind energy power converters.



Part Number	Package	Marking
CC-17-40-744L	TO-247-4L	CoolCADElectronics

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Maximum Ratings						
*Characteristics	Symbol	Comments	Min	Typ	Max	Units
DC blocking voltage	$V_{DSmax}$	$T_J=25^{\circ}C$ to $175^{\circ}C$	1700			V
Gate input voltage range	$V_{GS}$	Recommended range Dynamic	-5 -7		20 22	V
Avalanche rating	$V_{AVA}$	$V_{GS}=0V$ ; $I_{DS}=1mA$ ; $T_J=25^{\circ}C$ $V_{GS}=0V$ ; $I_{DS}=1mA$ ; $T_J=175^{\circ}C$	1700	>2000		V
Pulsed drain current	$I_{Dpulsed}$	$V_{GS}=20V$ ; $T_J=25^{\circ}C$ $V_{GS}=20V$ ; $T_J=100^{\circ}C$ limited by $T_J$ , $tp=300\mu s$		120 100		A
Continuous drain current	$I_D$	$V_{GS}=20V$ ; $T_J=25^{\circ}C$ $V_{GS}=20V$ ; $T_J=100^{\circ}C$			50 40	A
Continuous drain power	P	$V_{GS}=20V$ ; $T_J=25^{\circ}C$			155	W
Maximum- junction temperature	$T_{Jmax}$	Recommended range During processing / soldering			195 250	$^{\circ}C$

Electrical and Thermal Characteristics						
*Characteristics	Symbol	Comments	Min	Typ	Max	Units
Gate threshold voltage	$V_{TH}$	$V_{DS}=1V$ ; $I_{DS}=20mA$ ; $T_J=25^{\circ}C$ $V_{DS}=1V$ ; $I_{DS}=20mA$ ; $T_J=175^{\circ}C$	2.63	2.78 1.44	2.93	V
Gate leakage	$I_{GSS}$	$V_{GS}=20V$ ; $V_{DS}=0$ ; $T_J=25^{\circ}C$ $V_{GS}=20V$ ; $V_{DS}=0$ ; $T_J=175^{\circ}C$		20 150		pA
Drain leakage	$I_{DSS}$	$V_{DS}=1000V$ ; $V_{GS}=0$ ; $T_J=25^{\circ}C$ $V_{DS}=1000V$ ; $V_{GS}=0$ ; $T_J=175^{\circ}C$		0.004 0.6		$\mu A$
Drain-source on-resistance	$R_{DS(on)}$	$V_{GS}=20V$ ; $I_{DS}=40A$ ; $T_J=25^{\circ}C$ $V_{GS}=20V$ ; $I_{DS}=40A$ ; $T_J=175^{\circ}C$ $V_{GS}=20V$ ; $I_{DS}=50A$ ; $T_J=25^{\circ}C$	35	40 145 43	45	m $\Omega$
Transconductance	$G_m$	$V_{DS}=10V$ ; $I_{DS}=30A$ ; $T_J=25^{\circ}C$ $V_{DS}=10V$ ; $I_{DS}=40A$ ; $T_J=25^{\circ}C$ $V_{DS}=10V$ ; $I_{DS}=30A$ ; $T_J=175^{\circ}C$		155 16.1 13.6 12.5		S
Input capacitance	$C_{ISS}$	$V_{GS}=0V$ ; $V_{DS}=200 / 1000V$		1800 / 1750		pF
Output capacitance	$C_{OSS}$	$f=1MHz$ ; $T_J=25^{\circ}C$		135 / 60		
Reverse transfer capacitance	$C_{RSS}$			19 / 11		
Stored energy at output	$E_{OSS}$	Double integral of $C_{OSS}$ (up to 1000V)		78		
Turn on switching energy (with body diode)	$E_{ON}$	$V_{GS}=-4/19V$ ; $V_{DD}=800V$ ; $R_{G(ext)}=0\Omega$ $I_{DS}=30A$ ; $L=180\mu H$ ; $T_J=25^{\circ}C$		520		$\mu J$
Turn off switching energy (with body diode)	$E_{OFF}$	Clamped inductive switching waveform test circuit. Figure 26.		230		
Rise time	$t_r$	$V_{GS}=-4/19V$ ; $V_{DD}=800V$ ; $R_{G(ext)}=0\Omega$ $I_{DS}=30A$ ; $L=180\mu H$ ; $T_J=25^{\circ}C$		65		
Fall time	$t_f$	Clamped inductive switching waveform test circuit. Figure 26.		20		ns
Turn off delay time	$t_{d(on)}$ $t_{d(off)}$	Relative to $V_{DS}$ inductive load. Figure 26.		1 50		
Gate Charge	$Q_G$	$V_{GS}=-4/18V$ ; $V_{DD}=800V$ ; $R_{G(ext)}=0\Omega$ $I_{DS}=16A$ ; $R_L=50\Omega$ ; $I_{GS}=38mA$ ; $T_J=25^{\circ}C$ Figure 27.		150		nC
Internal gate resistance	$R_G$	$f=1Mz$ ; $V_{AC}=25mV$ ; $T_J=25^{\circ}C$ Open drain		10		$\Omega$
Thermal resistance:Junction to Case	$R_{JC}$			0.6		$^{\circ}C/W$

2.3

Body diode characteristics						
*Characteristics	Symbol	Comments	Min	Typ	Max	Units
Diode forward voltage	$V_F$	$I_F=5A; V_{GS}=0V; T_J=25^{\circ}C$ $I_F=5A; V_{GS}=0V; T_J=175^{\circ}C$ $I_F=10A; V_{GS}=-4V; T_J=25^{\circ}C$ $I_F=10A; V_{GS}=-4V; T_J=175^{\circ}C$		2.57 2.28 3.76 3.09		V
Pulsed diode current	$I_{S(pulsed)}$	$V_{GS}=0V; V_{DS}=-3V; T_J=25^{\circ}C$ $V_{GS}=0V; V_{DS}=-3V; T_J=175^{\circ}C$		10.3 11		A
Reverse recovery time	$t_{rr}$	$V_{DD}=800V; V_{GS}=-4V; I_{DS}=50A$ $R_{G(ext)}=0\Omega; L=180\mu H; di/dt=840A/\mu s$ Clamped inductive switching waveform test circuit. Figure 26.		40		ns
Reverse recovery charge	$Q_{rr}$			350		nC
Peak reverse recovery current	$I_{RRM}$			13.5		A

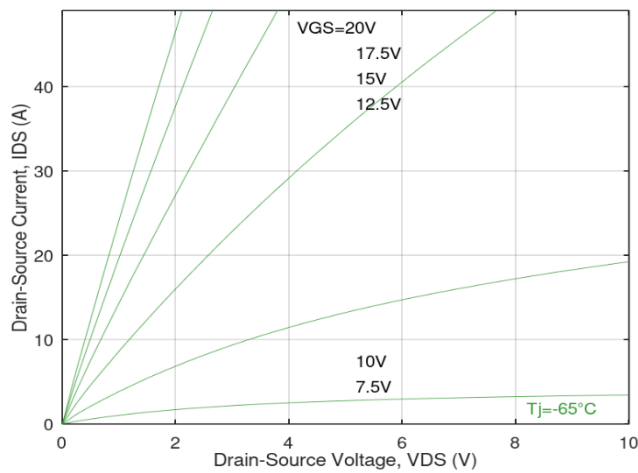


Figure 1: Low temperature output characteristics†.

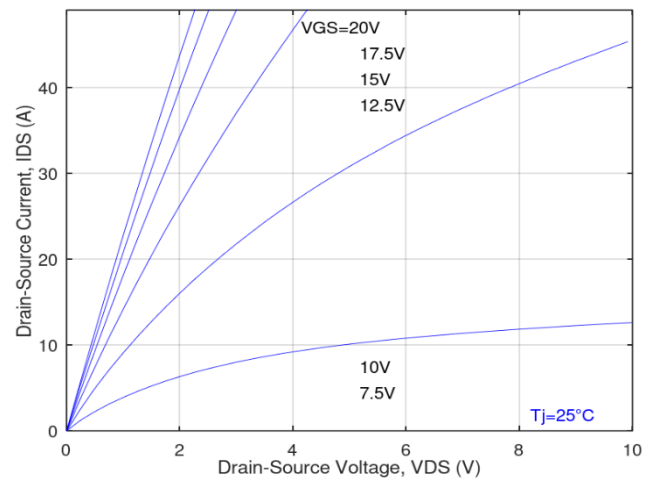


Figure 2: Room temperature output characteristics†.

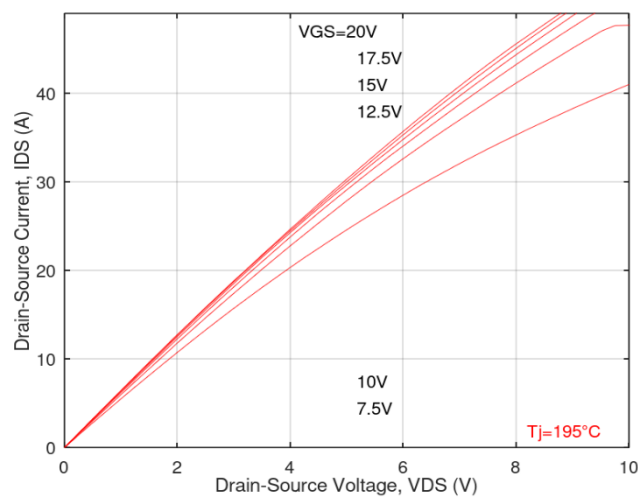


Figure 3: High temperature output characteristics†.

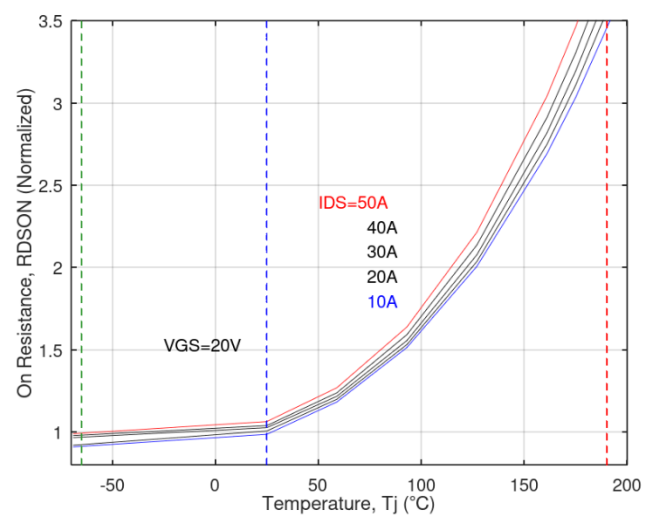
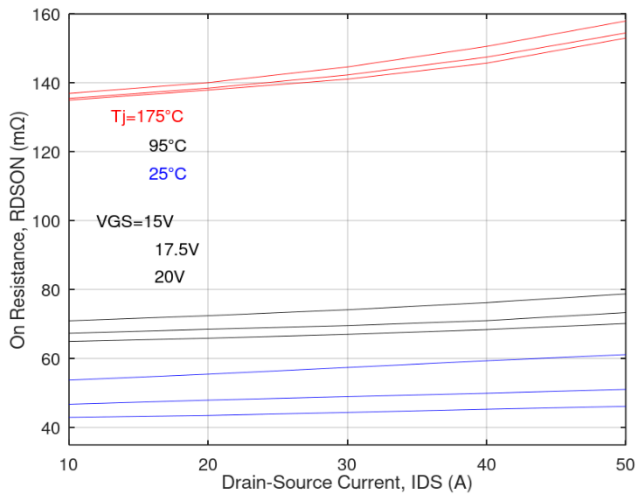


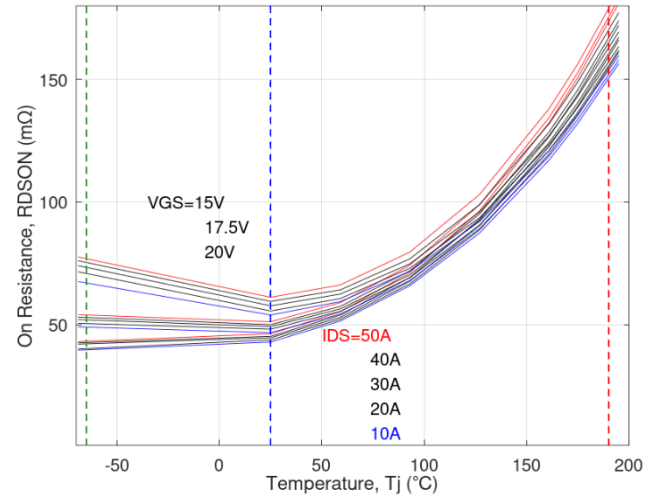
Figure 4: Normalized on-resistance vs. temperature. Dashed vertical lines indicate to room (25°C), high (190°C) and low (-65°C) temperatures.

†  $t_p=300\mu s$  in pulsed IV measurements.

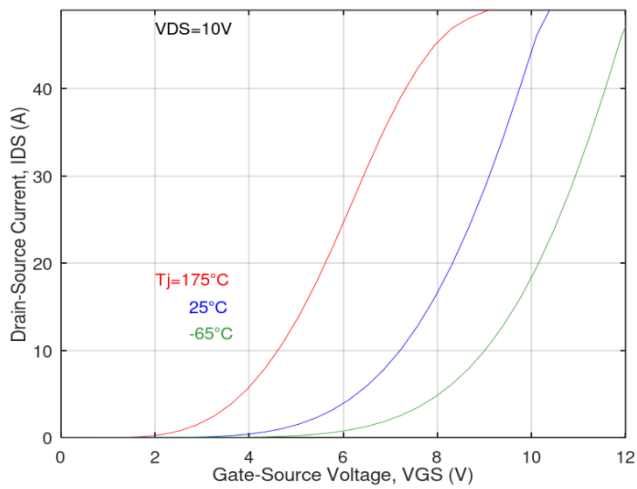
Unless stated otherwise, temperature corresponds to junction temperature.



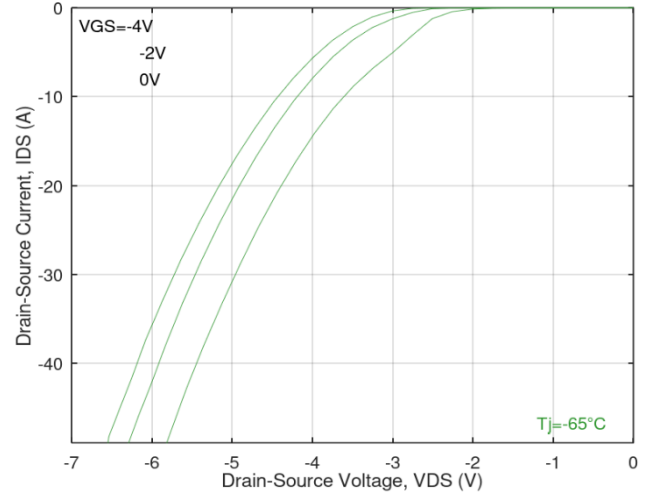
**Figure 5:** On-resistance vs. drain current.



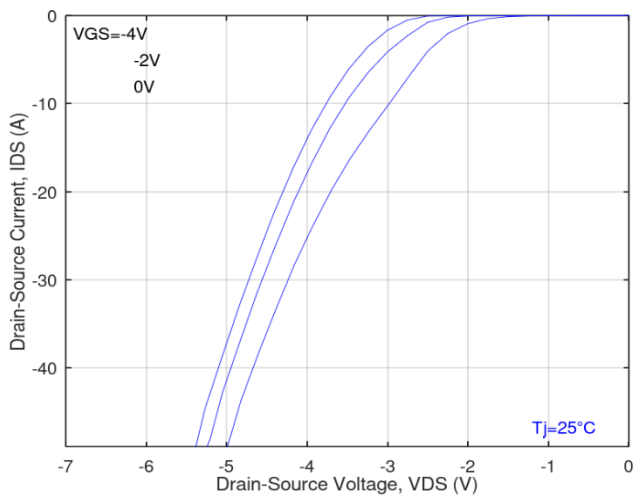
**Figure 6:** On-resistance vs. temperature. Dashed vertical lines indicate to room (25°C), high (190°C) and low (-65°C) temperatures.



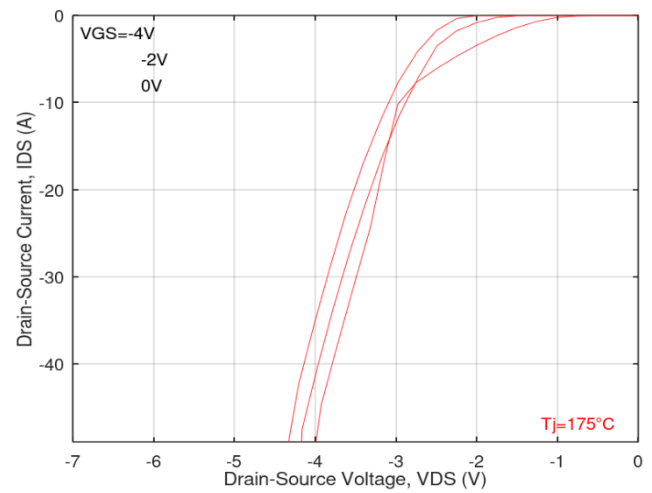
**Figure 7:** Transfer characteristics†.



**Figure 8:** Low temperature body diode characteristics†.



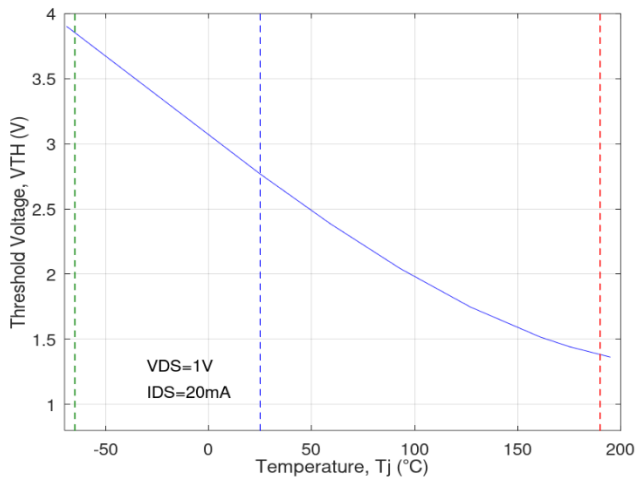
**Figure 9:** Room temperature body diode characteristics†.



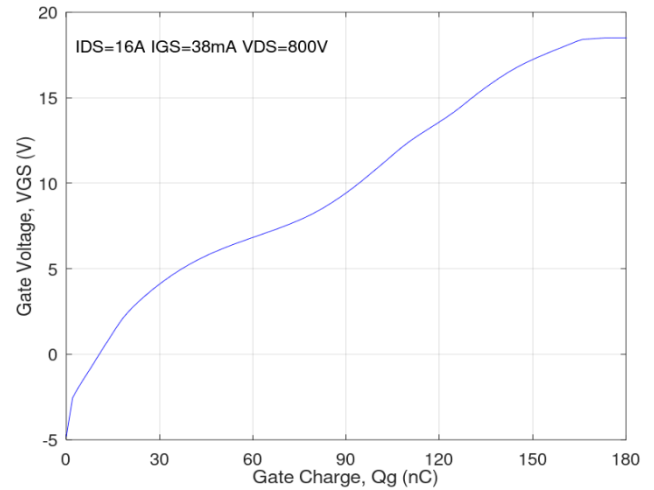
**Figure 10:** High temperature body diode characteristics†.

†  $t_p=300\mu s$  in pulsed IV measurements.

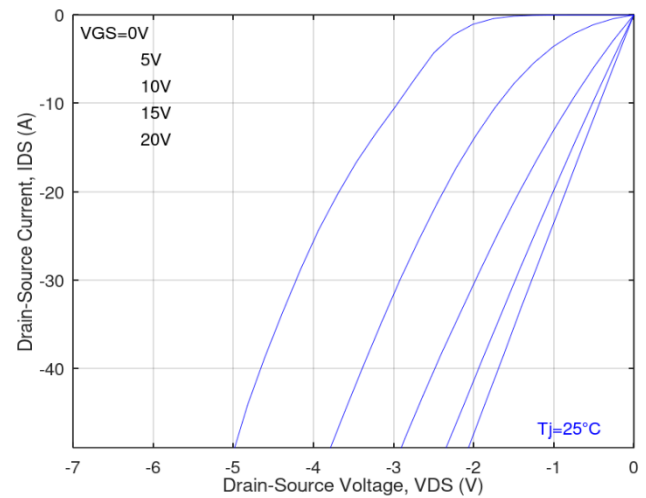
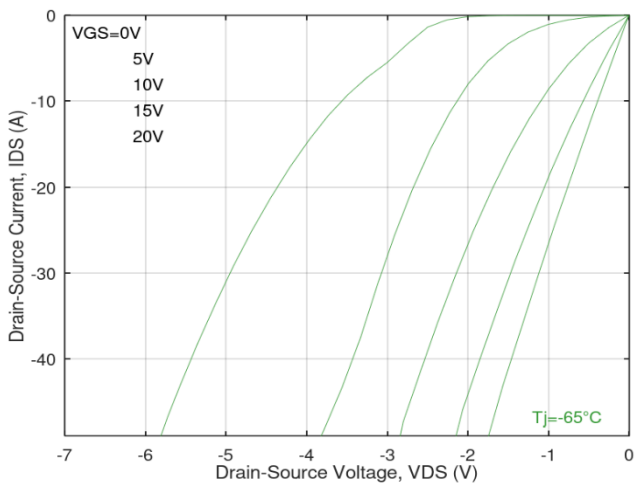
Unless stated otherwise, temperature corresponds to junction temperature.



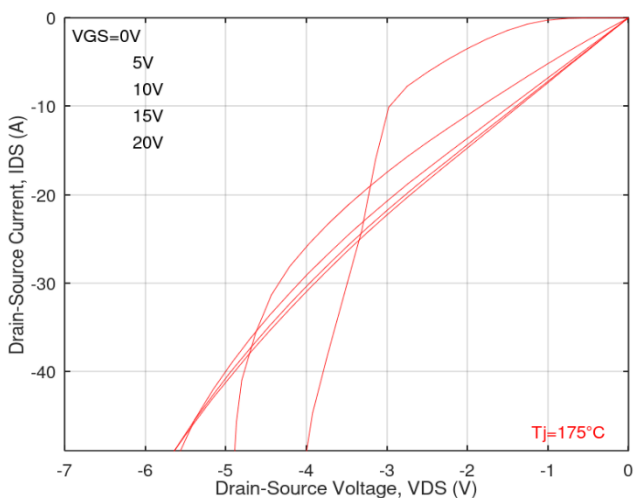
**Figure 11:** Threshold vs. temperature. Dashed vertical lines indicate to room (25°C), high (190°C) and low (-65°C) temperatures.



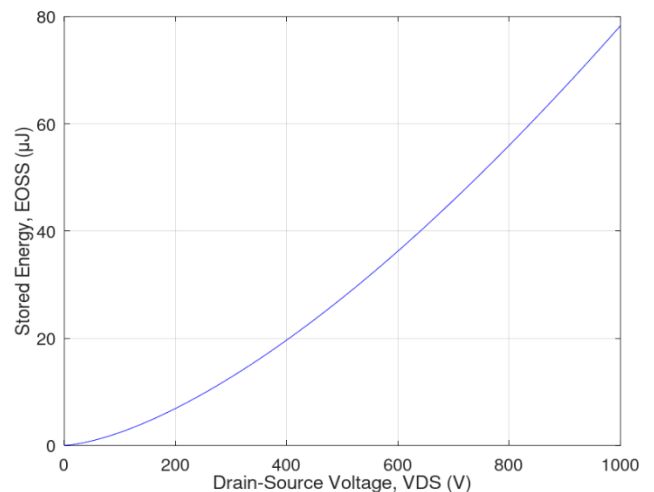
**Figure 12:** Gate charge characteristics.



**Figure 13:** Low temperature third quadrant characteristics†. **Figure 14:** Room temperature third quadrant characteristics†.



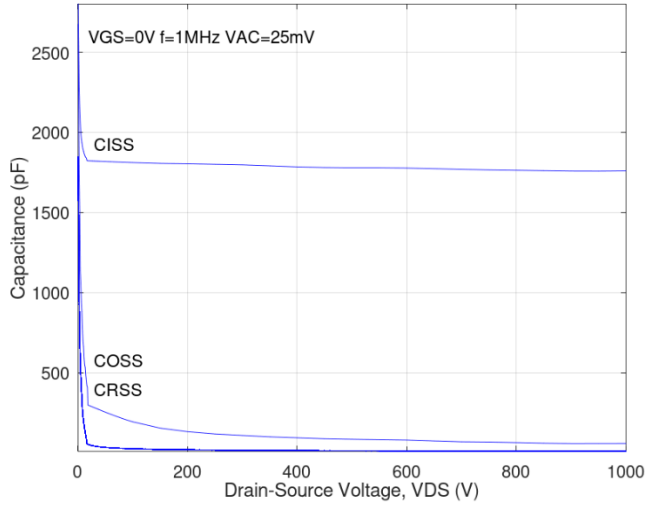
**Figure 15:** High temperature third quadrant characteristics†.



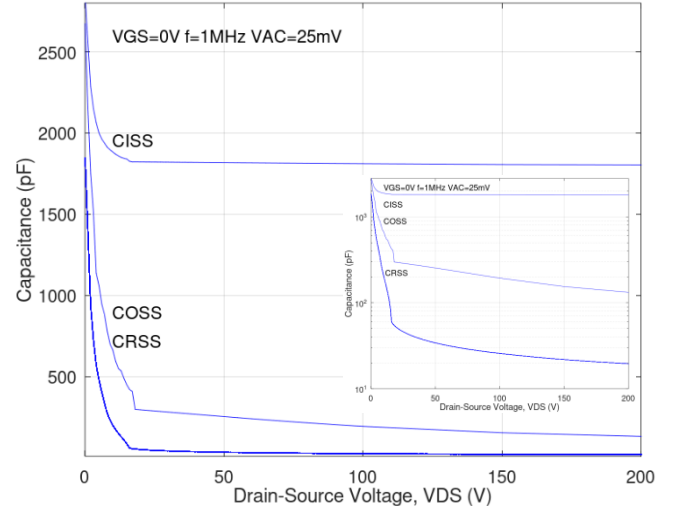
**Figure 16:** Output capacitor stored energy.

† tp=300μs in pulsed IV measurements.

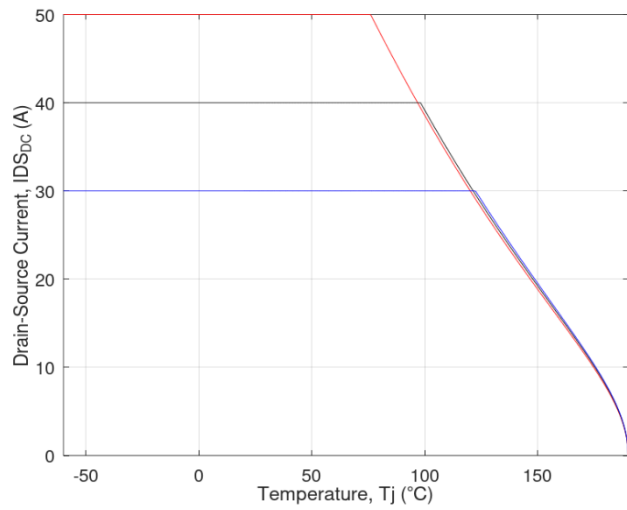
Unless stated otherwise, temperature corresponds to junction temperature.



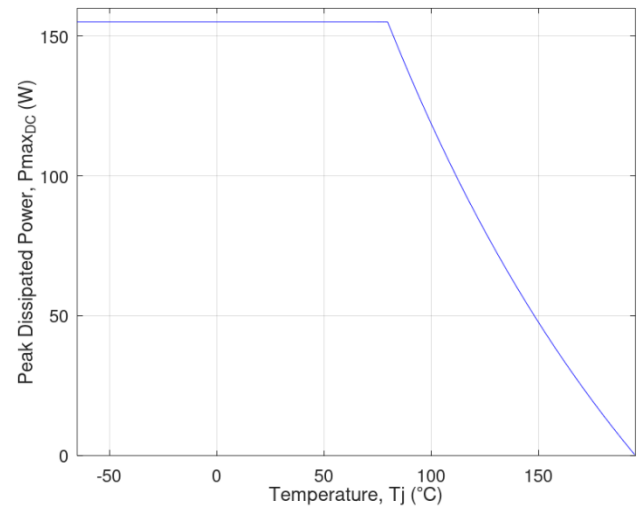
**Figure 17:** Capacitance vs. drain voltage.



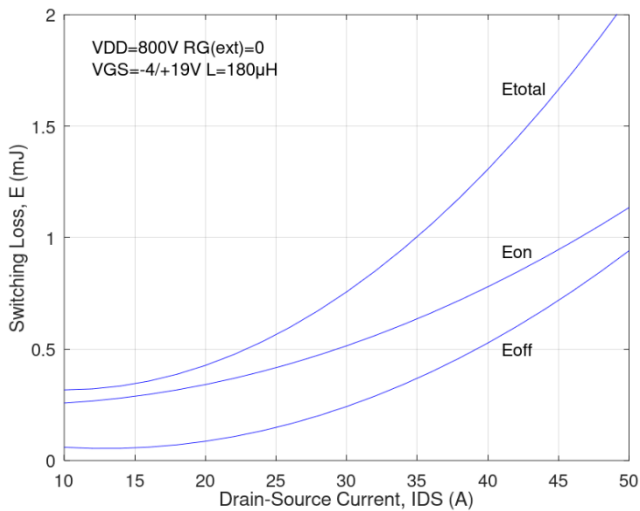
**Figure 18:** Capacitance vs. drain voltage.



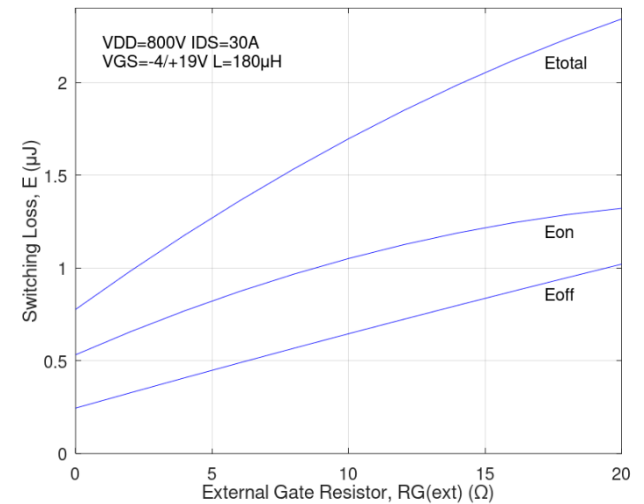
**Figure 19:** Continuous drain current vs. temperature.



**Figure 20:** Power dissipation derating vs. temperature.

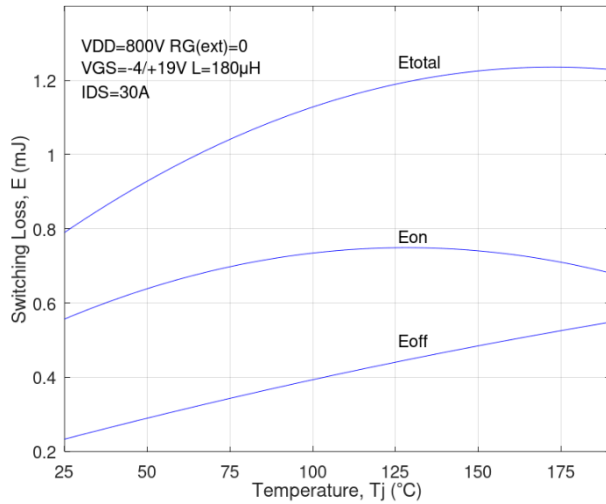


**Figure 21:** Clamped inductive switching energy vs. drain current at 800V VDD.

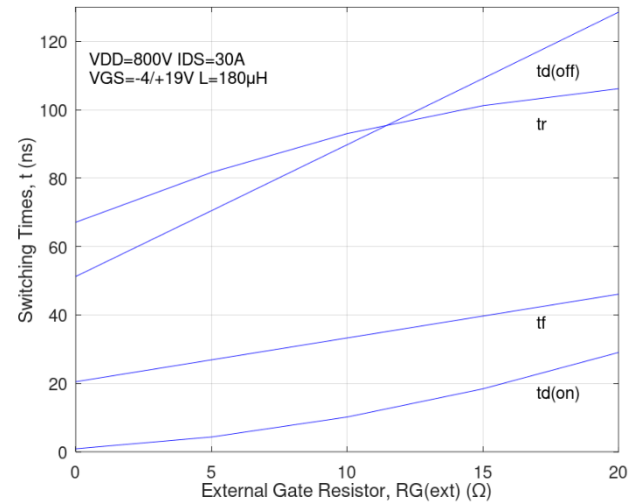


**Figure 22:** Clamped inductive switching energy vs. external gate resistance.

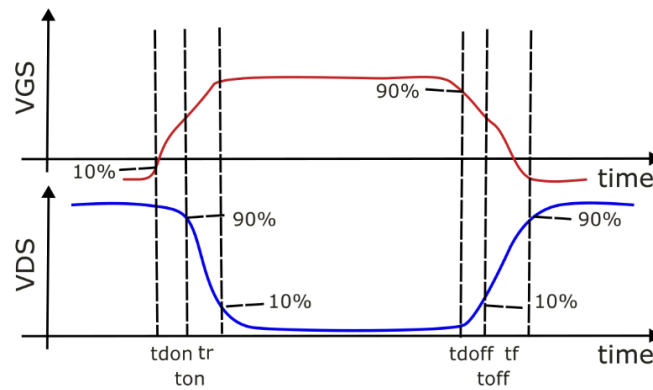
Unless stated otherwise, temperature corresponds to junction temperature.



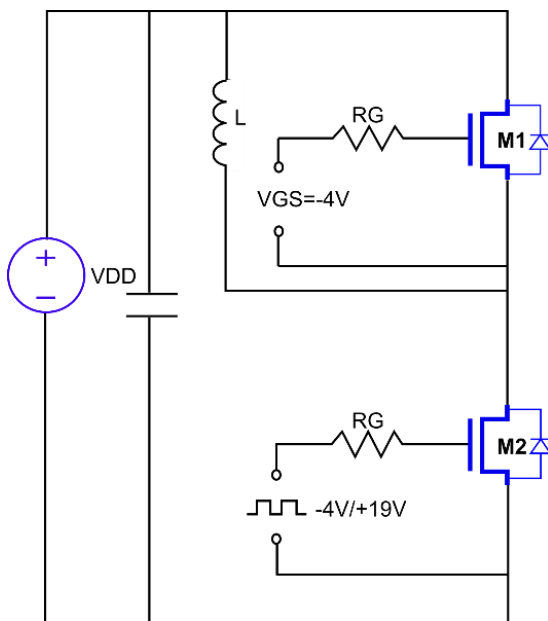
**Figure 23:** Clamped inductive switching energy vs. temperature.



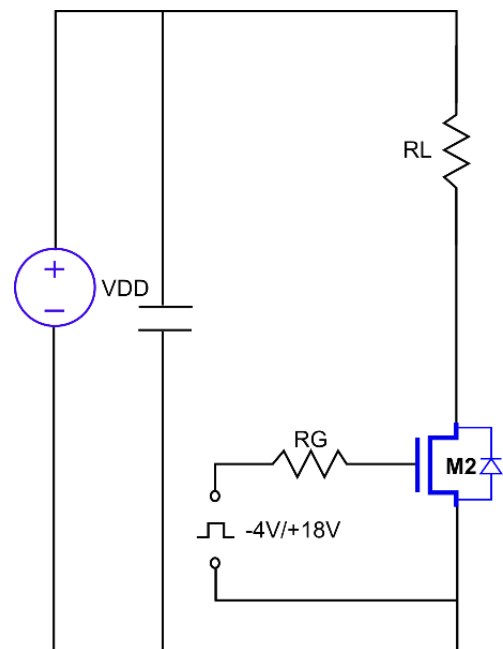
**Figure 24:** Switching times vs. external gate resistance.



**Figure 25:** Timing references.

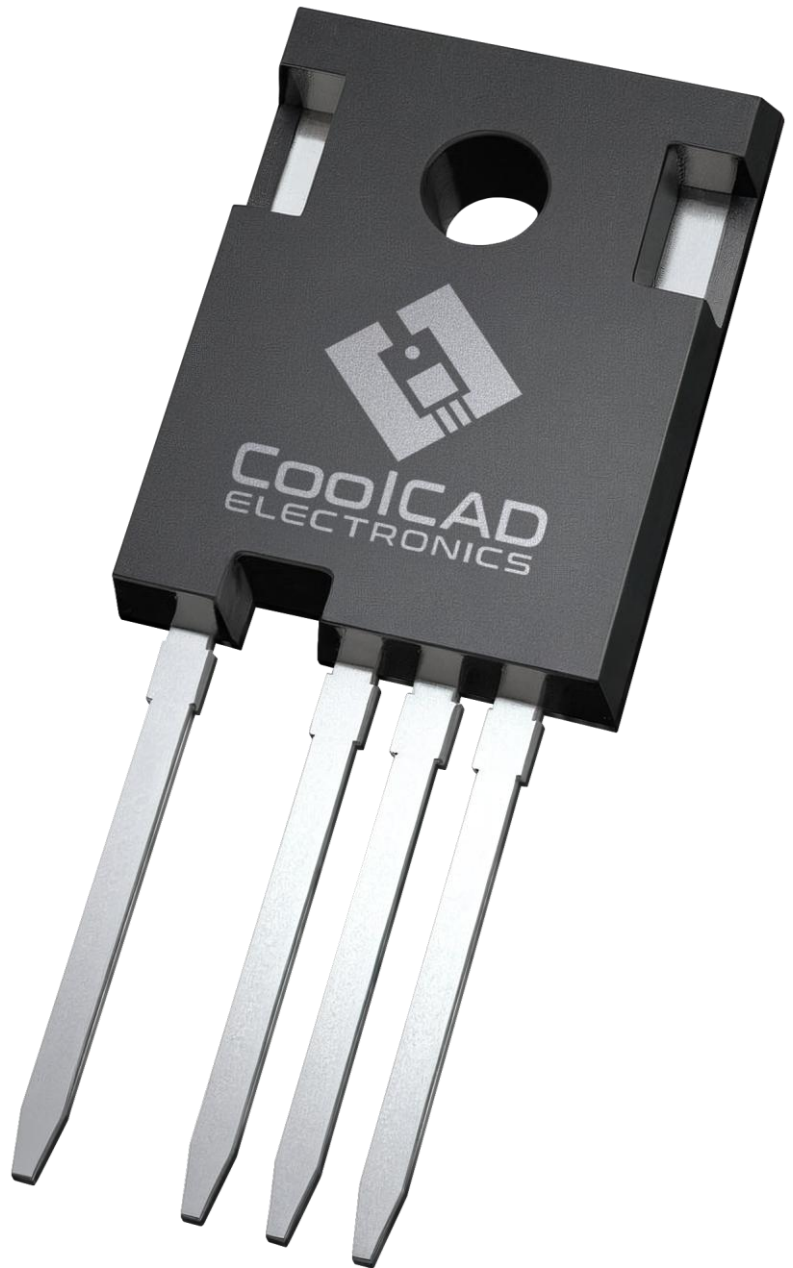
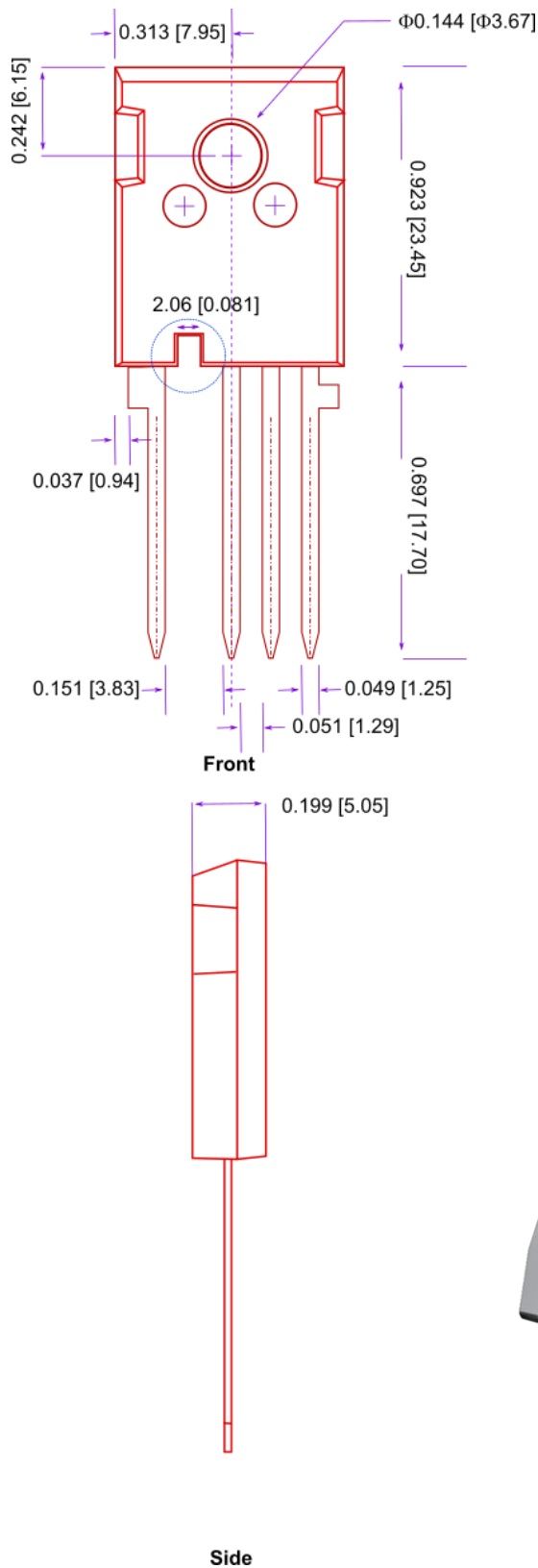


**Figure 26:** Clamped inductive switching waveform test circuit.



**Figure 27:** Gate charge test circuit.

Unless stated otherwise, temperature corresponds to junction temperature.



CAUTION: These devices are ESD sensitive. Use proper handling procedures.

**Disclaimer:** These specifications may not be considered as a guarantee of components characteristics. Components have to be tested depending on intended application as adjustments may be necessary. The use of CoolCAD Electronics components in life support appliances and systems are subject to written approval of CoolCAD Electronics.