

## MSC060SMA070B4N-VB Datasheet

### N-Channel 650V (D-S) SiC Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	650	
$R_{DS(on)}$ at 25 °C ( $\Omega$ )	$V_{GS} = 18$ V	0.05
$Q_g$ (nC)	90	

#### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)



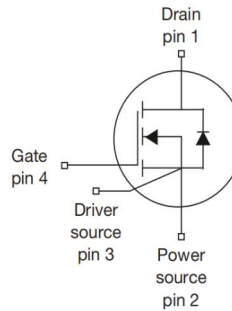
#### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- DC/DC converter

TO-247-4L



- Pin1 D - Drain
- Pin2 S - Source(Power)
- Pin3 S - Source(Driver)
- Pin4 G - Gate



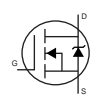
N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)					
PARAMETER		SYMBOL	LIMIT	UNIT	
Drain-Source Voltage		$V_{DS}$	650	V	
Gate-Source Voltage		$V_{GS}$	-10 / +22		
Continuous Drain Current ( $T_J = 150$ °C)	$V_{GS}$ at 18 V	$I_D$	$T_C = 25$ °C	40	A
			$T_C = 100$ °C	32	
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	120		
Linear Derating Factor			2.1	W/°C	
Single Pulse Avalanche Energy <sup>b</sup>		$E_{AS}$	225	mJ	
Maximum Power Dissipation		$P_D$	187	W	
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55 to +175	°C	
Drain-Source Voltage Slope	$T_J = 125$ °C	$dV/dt$	50	V/ns	
Reverse Diode $dV/dt$ <sup>d</sup>			15		
Soldering Recommendations (Peak Temperature) <sup>c</sup>	for 10 s		260	°C	

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 100$  V, starting  $T_J = 25$  °C,  $L = 0.5$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 30$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.8	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$		650	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.70	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 10\text{ mA}$		2	-	5	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = +22\text{ V}$		-	-	100	nA
		$V_{GS} = -10\text{ V}$		-	-	100	$\mu\text{A}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$		-	10	-	$\mu\text{A}$
		$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	100	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}$	$I_D = 20\text{ A}$	-	0.05	-	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 0\text{ V}, I_D = 30\text{ A}$		-	12	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V},$ $V_{DS} = 600\text{ V},$ $f = 1\text{ MHz}$		-	2000	-	pF
Output Capacitance	$C_{oss}$			-	175	-	
Reverse Transfer Capacitance	$C_{rss}$			-	9	-	
Effective Output Capacitance, Energy Related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		-	156	-	
Effective Output Capacitance, Time Related <sup>b</sup>	$C_{o(tr)}$			-	268	-	
Total Gate Charge	$Q_g$	$V_{GS} = -5/18\text{ V}$	$I_D = 20\text{ A}, V_{DS} = 400\text{ V}$	-	70	-	nC
Gate-Source Charge	$Q_{gs}$			-	20	-	
Gate-Drain Charge	$Q_{gd}$			-	23	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 400\text{ V}, I_D = 20\text{ A},$ $V_{GS} = -5/18\text{ V}, R_g = 2\text{ }\Omega$		-	12	15	ns
Rise Time	$t_r$			-	10	13	
Turn-Off Delay Time	$t_{d(off)}$			-	20	-	
Fall Time	$t_f$			-	10	-	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}, \text{ open drain}$		-	2.2	-	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	40	A
Pulsed Diode Forward Current	$I_{SM}$			-	-	120	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 20\text{ A}, V_{GS} = 0$		-	-	4.1	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 20\text{ A},$ $di/dt = 1000\text{ A}/\mu\text{s}, V_R = 400\text{ V}$		-	20	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	60	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	10	-	A

**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 60 %  $V_{DSS}$ .
- b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 60 %  $V_{DSS}$ .

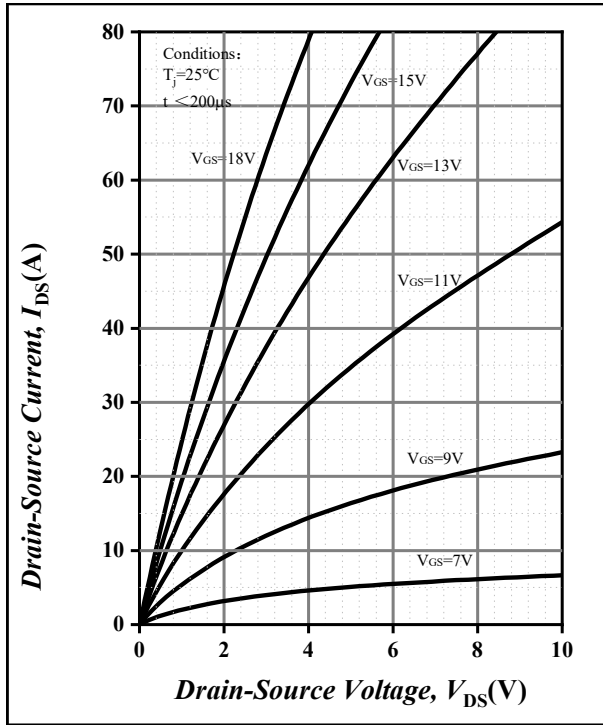


Fig.1 Output characteristics  $T_j=25^\circ\text{C}$

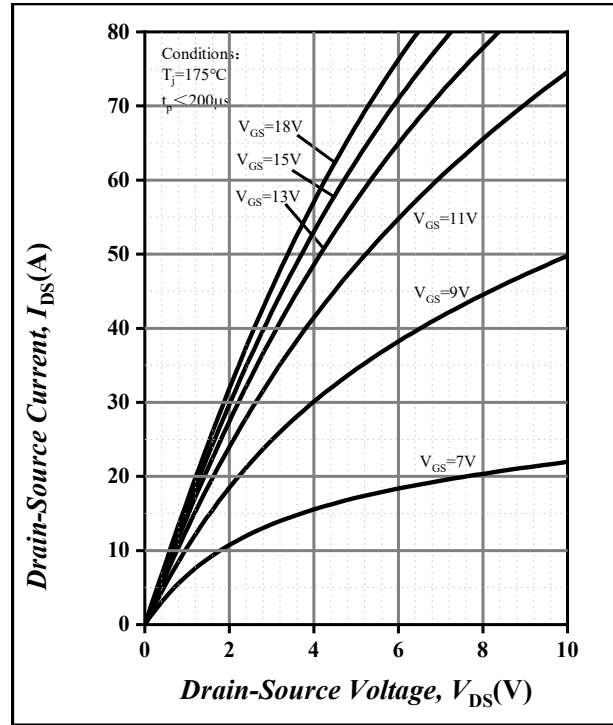


Fig.2 Output characteristics  $T_j=175^\circ\text{C}$

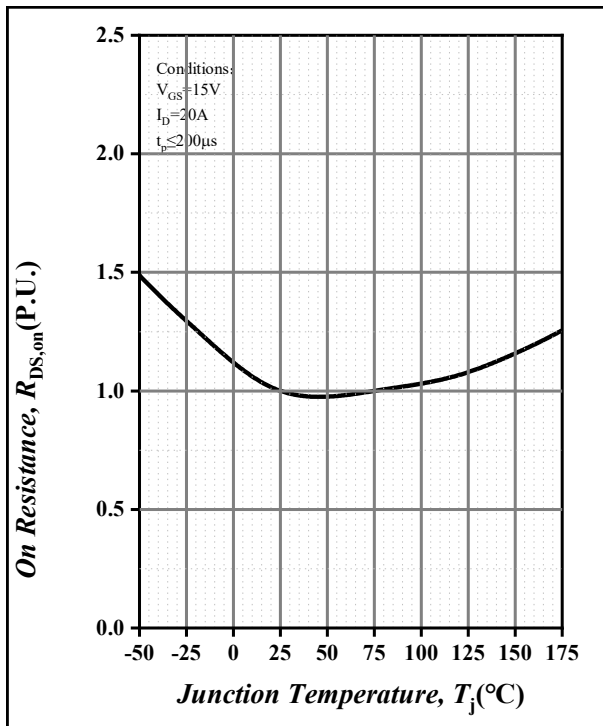


Fig.3 Normalized On-Resistance vs. Temperature

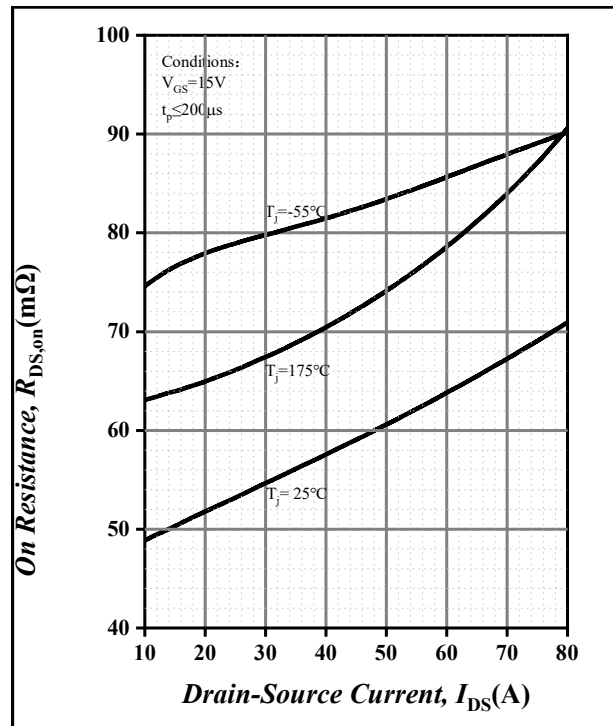


Fig.4 On-Resistance vs. Drain Current For Various Temperatures

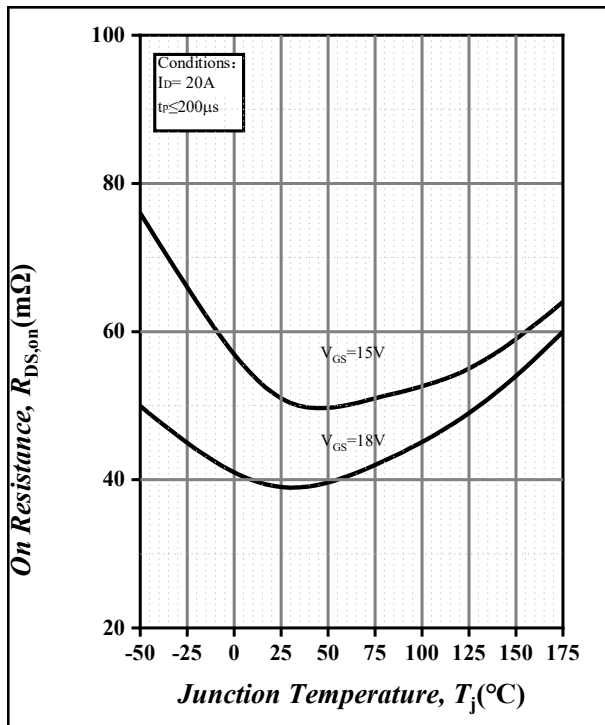


Fig.5 On-Resistance vs. Temperature For Various Gate Voltage

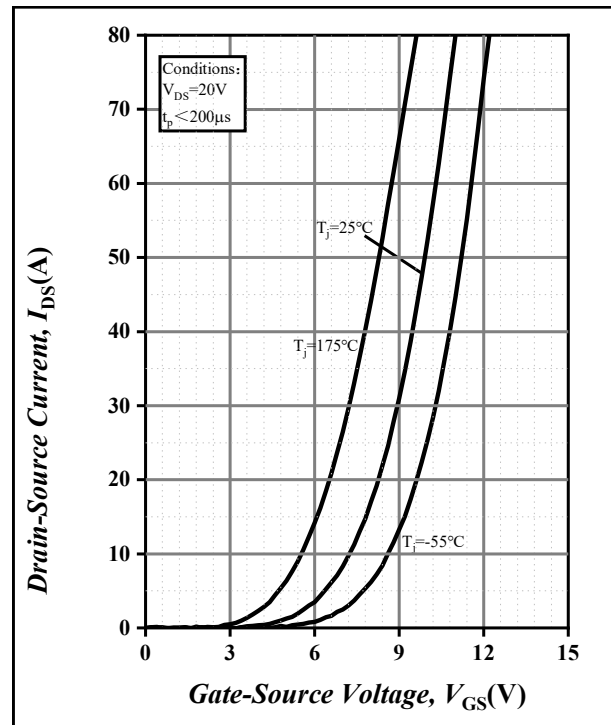


Fig.6 Transfer Characteristic For Various Junction Temperatures

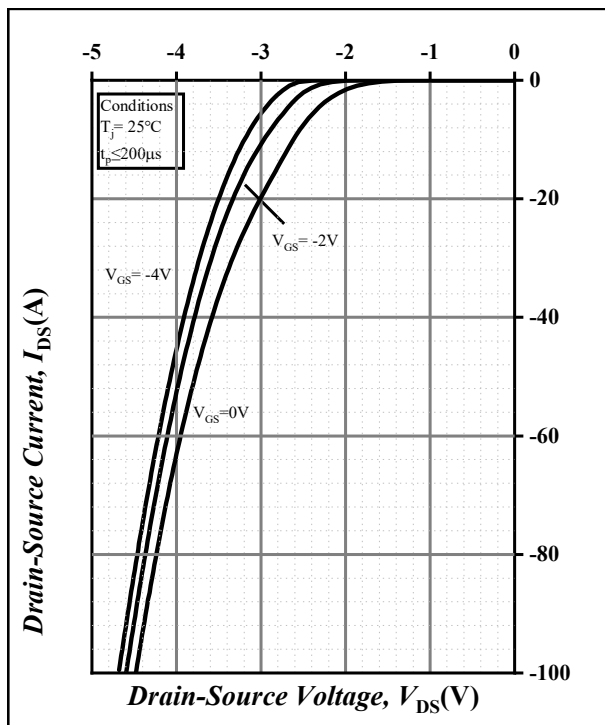


Fig.7 Body Diode Characteristic at 25 $^{\circ}$ C

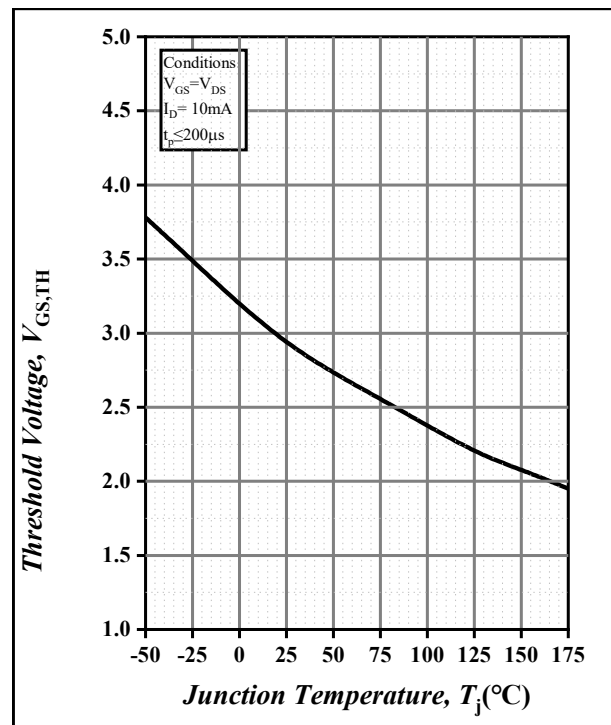


Fig.8 Threshold Voltage vs. Temperature



Fig.9 Gate Charge Characteristics

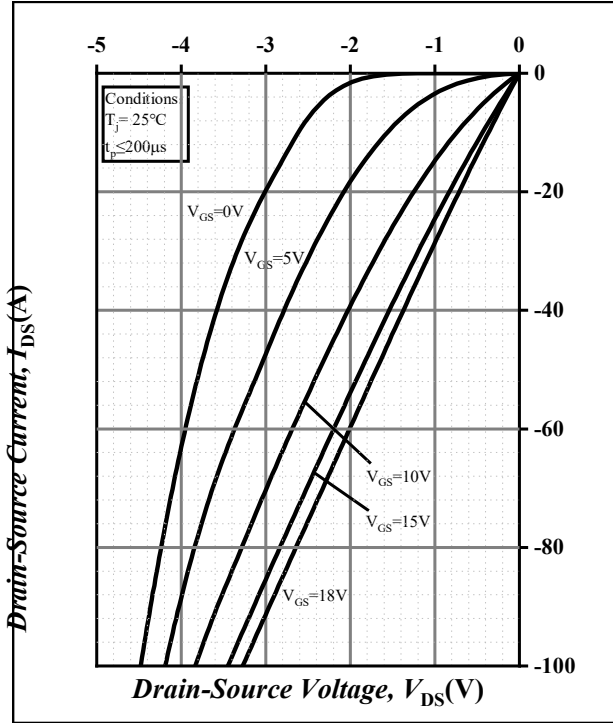


Fig.10 3<sup>rd</sup> Quadrant Characteristic at 25°C

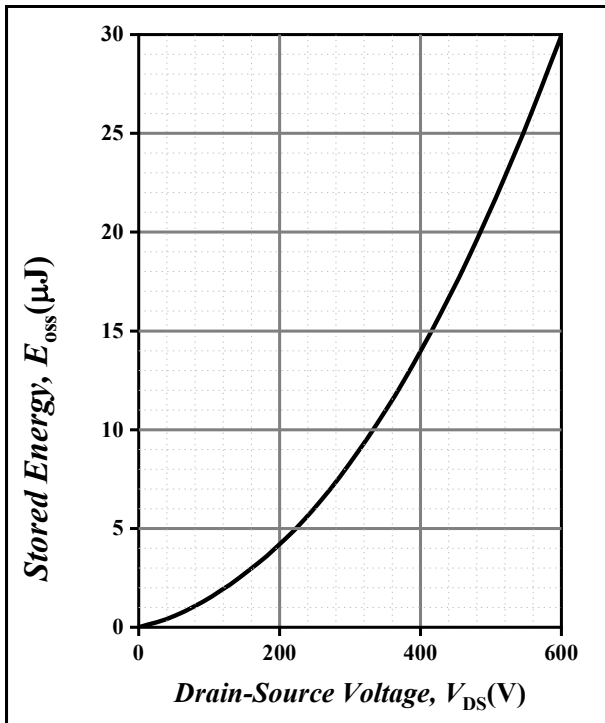


Figure 11. Output Capacitor Stored Energy

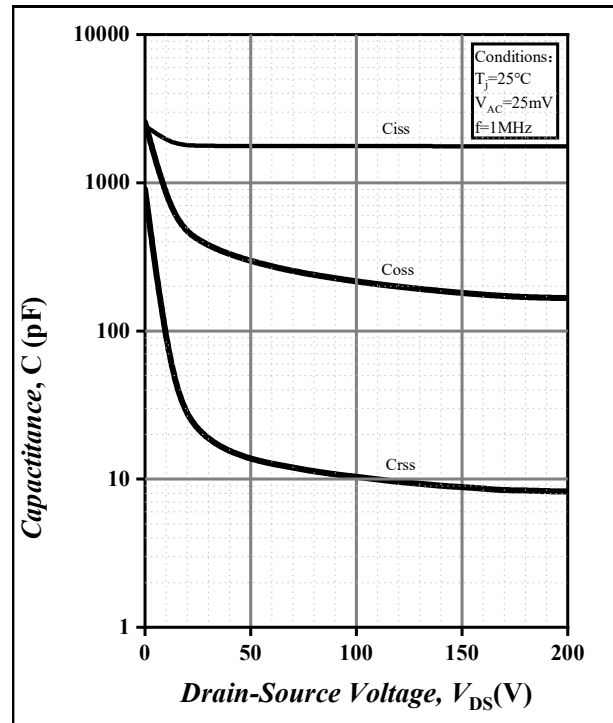


Fig.12 Capacitances vs. Drain-Source Voltage(0-200V)

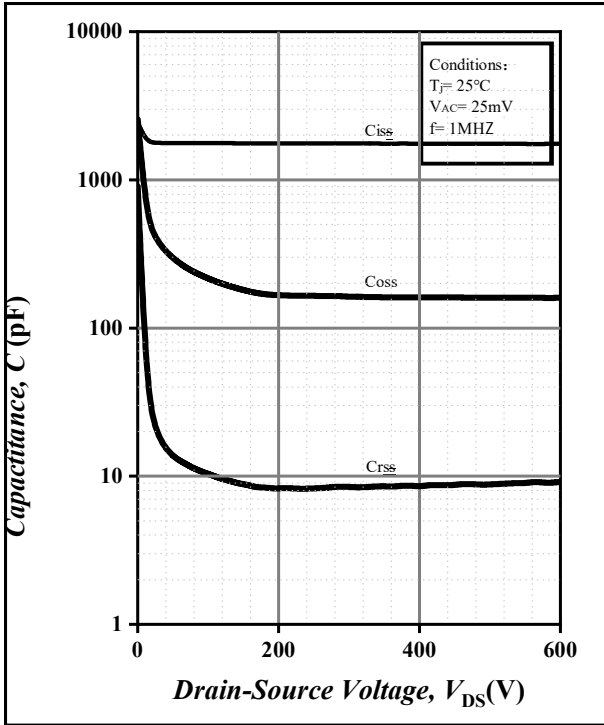


Fig.13 Capacitances vs. Drain-Source Voltage(0-600V)

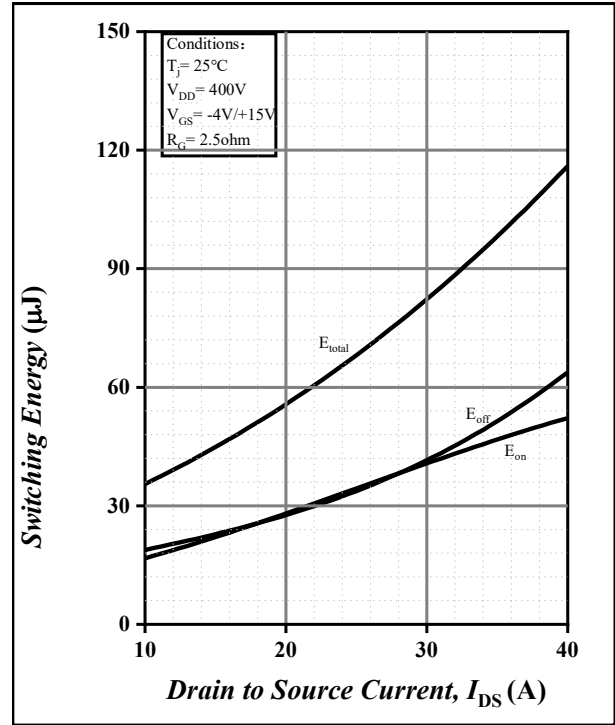


Figure 14. Clamped Inductive Switching Energy vs. Drain Current( $V_{DD}=400V$ )

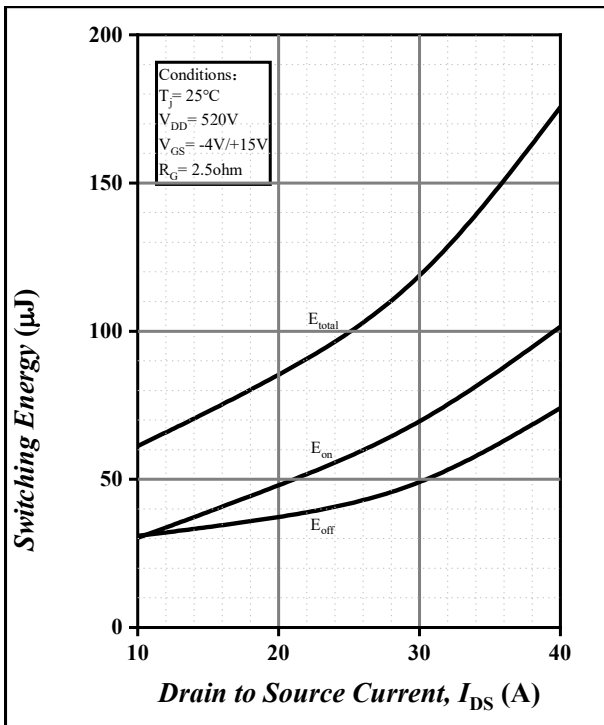


Figure 15. Clamped Inductive Switching Energy vs. Drain Current( $V_{DD}=520V$ )

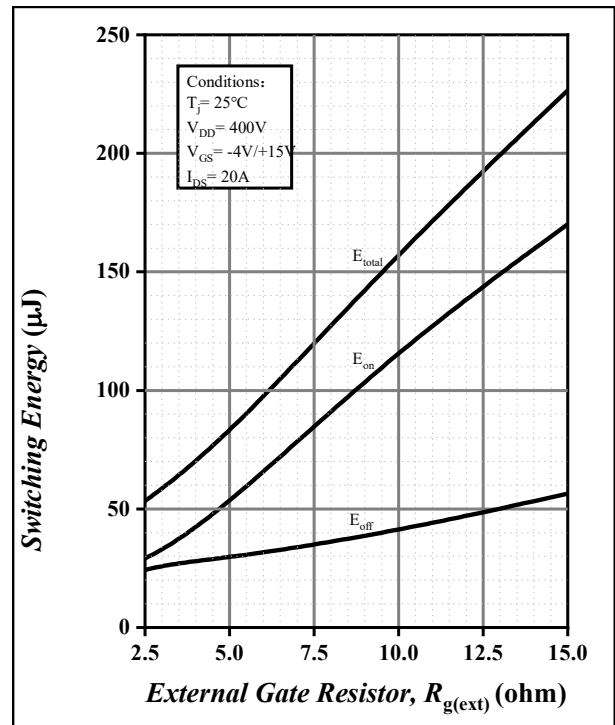


Figure 16. Clamped Inductive Switching Energy vs.  $R_{g(ext)}$

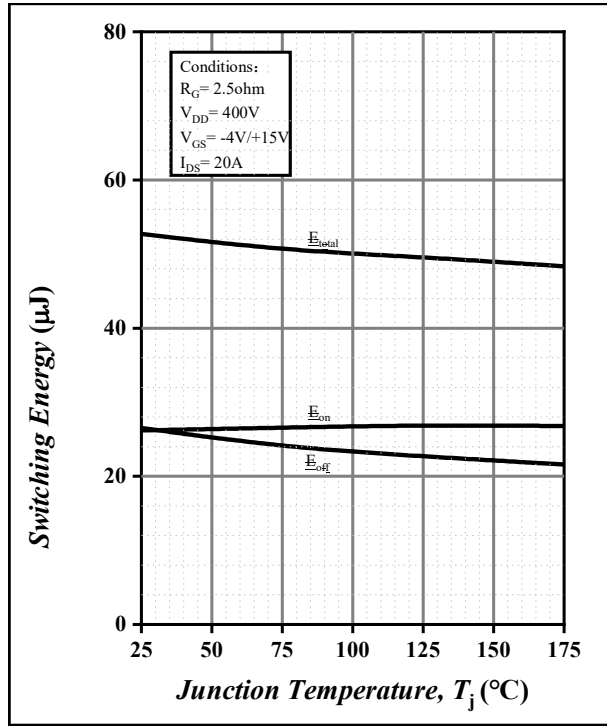


Figure 17. Clamped Inductive Switching Energy vs. Temperature

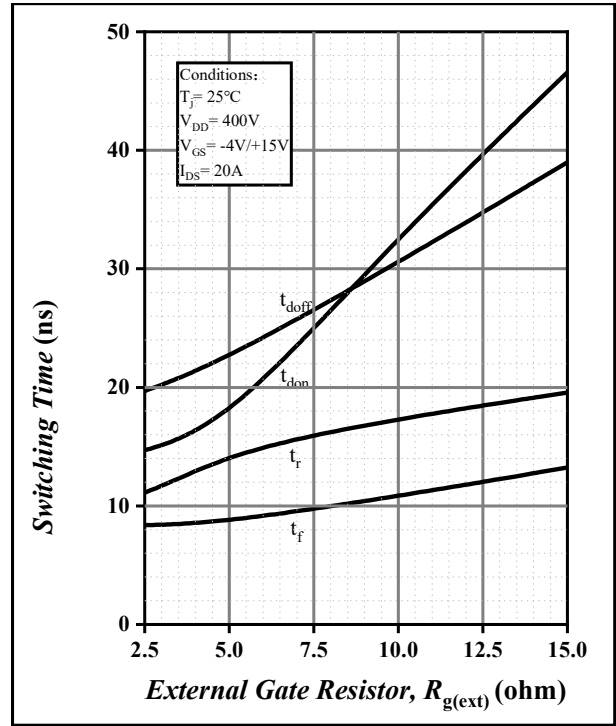
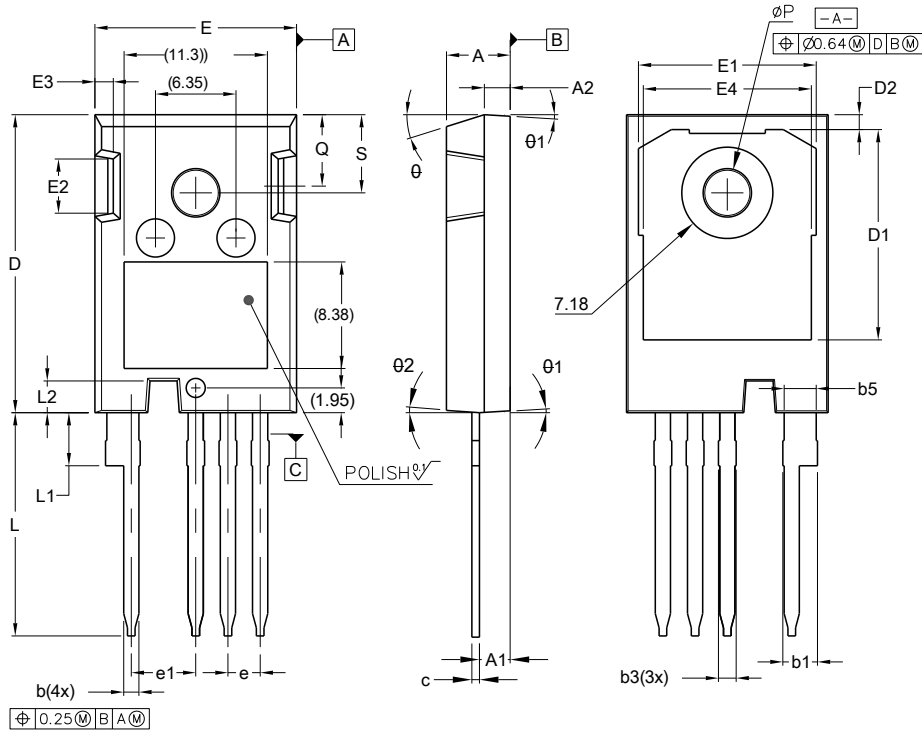


Figure 18. Switching Times vs.  $R_{g(ext)}$

TO247-4L Package Outline Dimensions



TO247-4 Standard		
Dim	Min	Max
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b	1.07	1.33
b1	2.39	2.94
b3	1.07	1.60
b5	2.39	2.69
c	0.55	0.68
D	23.30	23.60
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.30
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	2.54 BSC	
e1	5.08 BSC	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
$\varnothing P$	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
$\theta$	17.5° - 20° REF	
$\theta_1$	3.5° - 5° REF	
$\theta_2$	4° - 5° REF	
All Dimensions in mm		

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