

1200V, 17A, N-channel SiC power MOSFET

General Description:

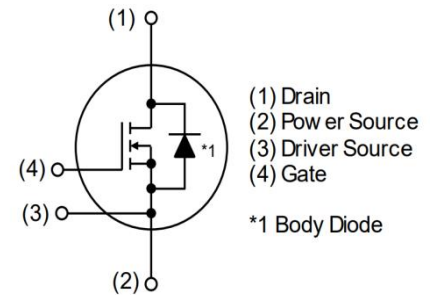
NCES120P160T4 is a SiC MOSFET that contributes to miniaturization and low power consumption of applications. This product achieves industry-leading low on-resistance without sacrificing short-circuit withstand time. This is a 4-pin package type with a driver source terminal that can maximize the high-speed switching performance that is a feature of SiC MOSFETs.

Features

- Low on-resistance
- Fast switching speed
- Fast reverse recovery
- Easy to parallel
- Simple to drive
- Pb-free lead plating ; RoHS compliant

Application

- Solar inverters
- DC/DC converters
- Switch mode power supplies
- Induction heating
- Motor drives



Schematic diagram



TO-247-4L

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCES120P160T4	TO-247-4L	NCES120P160T4

Absolute Maximum Ratings (T_c=25°C unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V _{DS}	1200	V
Gate-Source Voltage,max static voltage	V _{GS}	-10 to +24	V
Gate-Source Voltage,max transient voltage (Note 1)	V _{GS}	-11 to +26	V
Drain Current-Continuous (Note 2)	I _D	17	A
Drain Current-Continuous(T _c =100°C)	I _D (100°C)	12	A
Pulsed Drain Current (Note 3)	I _{DM}	43	A
Maximum Power Dissipation	P _D	88	W
		44	
Recommended turn-on gate - source drive voltage	V _{GS_on}	+15 to +18	V
Recommended turn-off gate - source drive voltage	V _{GS_off}	-4 to 0	V
Virtual junction temperature	T _{vj}	175	°C
Operating Junction and Storage Temperature Range	T _J , T _{STG}	-55 To 175	°C

Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case	1.7	$^{\circ}\text{C/W}$

Electrical Characteristics ($T_c=25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Off Characteristics							
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V, I _D =100μA		1200			V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =1200V, V _{GS} =0V	T _{vj} = 25℃		1	80	μA
			T _{vj} = 175℃		2		
Gate-Body Leakage Current	I _{GSS}	V _{GS} =-10V / +24V, V _{DS} =0V				±100	nA
On Characteristics (Note 4)							
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =2mA	T _{vj} = 25℃	1.9	3.0	4.8	V
			T _{vj} = 175℃		2.1		
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =18V, I _D =5A	T _{vj} = 25℃		160	208	mΩ
			T _{vj} = 175℃		250		
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =15V, I _D =5A	T _{vj} = 25℃		209	272	
			T _{vj} = 175℃		326		
Gate input resistance	R _G	f=1MHZ, open drain			2		Ω
Forward Transconductance	g _{FS}	V _{DS} =20V, I _D =5A			3.1		S
Dynamic Characteristics (Note 5)							
Input Capacitance	C _{iss}	V _{DS} =800V, V _{GS} =0V, f=1MHz			618		pF
Output Capacitance	C _{Oss}				66		pF
Reverse Transfer Capacitance	C _{rss}				16		pF
C _{Oss} stored energy	E _{Oss}				25.1		μJ
Output charge	Q _{Oss}	Calculated by C _{Oss} (f)V _{DS} @1MHz			74.4		nC
Effective output capacitance, energy related	C _{o(er)}	V _{DS} =0-800V, V _{GS} =0V			78.5		pF
Effective output capacitance, time related	C _{o(tr)}	I _C =constant, V _{DS} =0-800V, V _{GS} =0V			93		pF
Switching Characteristics (Note 5)							
Turn-on Delay Time	t _{d(on)}	V _{DD} =800V, I _D =5A, V _{GS} =+18V / -3V, R _G =2.7Ω, L=200μH			6.2		ns
Turn-on Rise Time	t _r				15.2		ns
Turn-Off Delay Time	t _{d(off)}				16.2		ns
Turn-Off Fall Time	t _f				38.1		ns
Turn-on energy	E _{on}	V _{DD} =800V, I _D =5A, V _{GS} =+18V / -3V, R _G =2.7Ω, L=200μH	T _{vj} = 25℃		97		μJ
			T _{vj} = 175℃		135		μJ
Turn-off energy	E _{off}		T _{vj} = 25℃		27.1		μJ
			T _{vj} = 175℃		37		μJ
Total Gate Charge	Q _g	V _{DS} =800V, I _D =5A, V _{GS} =-3/18V			26.5		nC
Gate-Source Charge	Q _{gs}				5.7		nC
Gate-Drain Charge	Q _{gd}				10.7		nC

Electrical Characteristics (T_C=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 4)	V _{SD}	V _{GS} =0V, I _D =5A	T _{vj} = 25°C	2.9		V
			T _{vj} = 175°C	2.7		
Reverse Recovery Time	t _{rr}	T _J = 25°C, I _F =5A, V _R =800V, di/dt = 1190A/μs (Note3)		9.8		ns
Reverse Recovery Charge	Q _{rr}			25.3		nC
Peak reverse recovery current	I _{rrm}			12.1		A

Notes:

1. t_p < 500ns, D < 0.01
2. Repetitive Rating: Pulse width limited by maximum junction temperature.
3. PW ≤ 10μs, Duty cycle ≤ 1%
4. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
5. Guaranteed by design, not subject to production

Test Circuit

Fig.1-1 Gate Charge Measurement Circuit

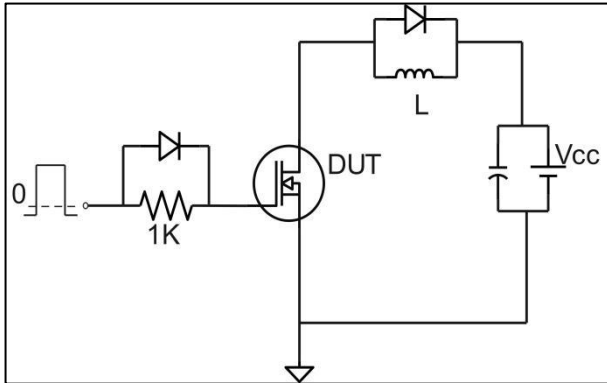


Fig.1-2 Gate Charge Waveform

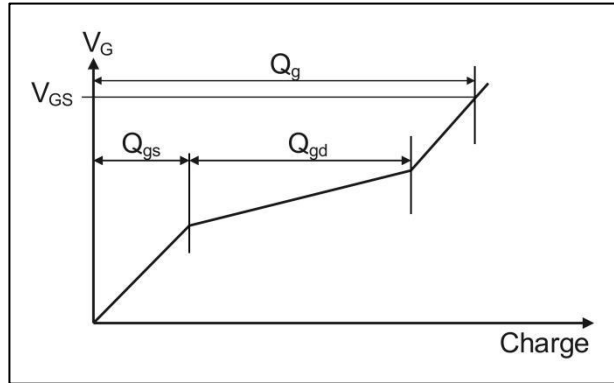


Fig.2-1 Switching Characteristics Measurement Circuit

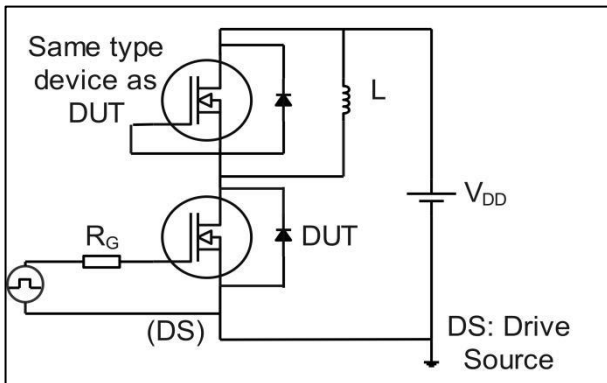
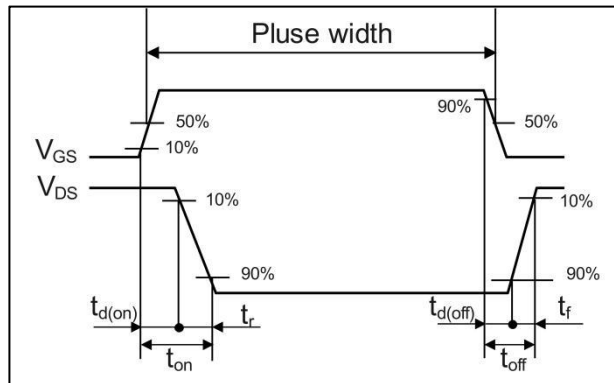


Fig.2-2 Waveforms for Switching Time



Typical Electrical and Thermal Characteristics

Fig.1 Power Dissipation Derating Curve

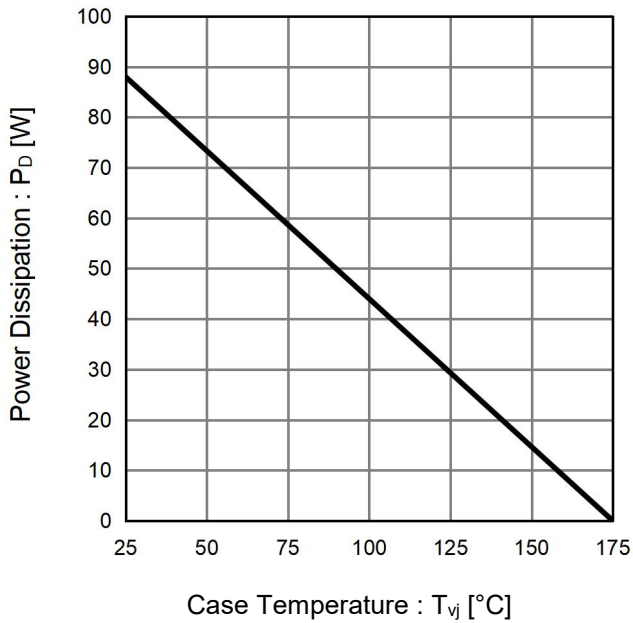


Fig.2 Maximum Safe Operating Area

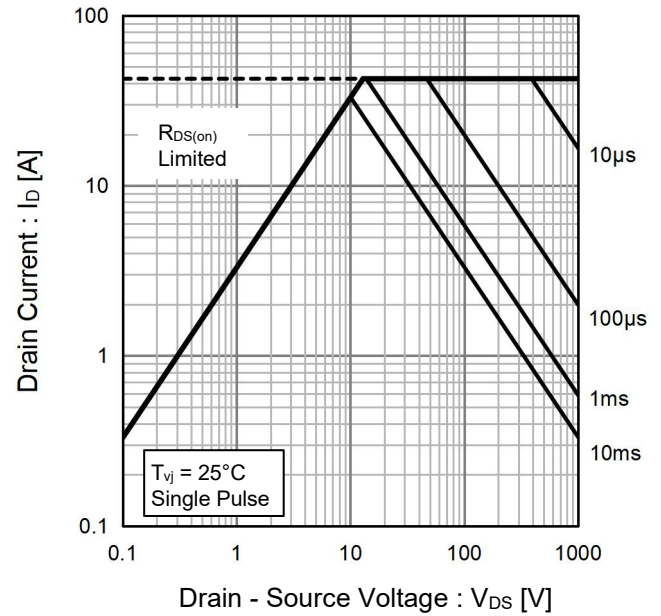


Fig.3 Typical Transient Thermal Impedance vs. Pulse Width

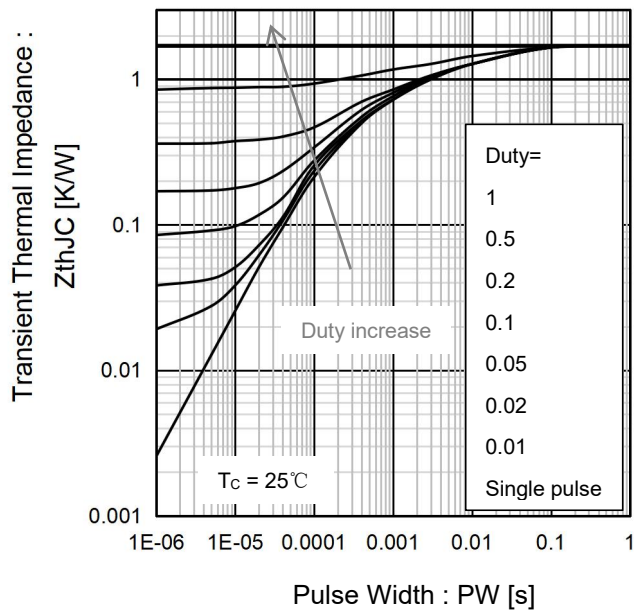


Fig.4 $T_{vj} = 25^{\circ}\text{C}$ Typical Output Characteristics

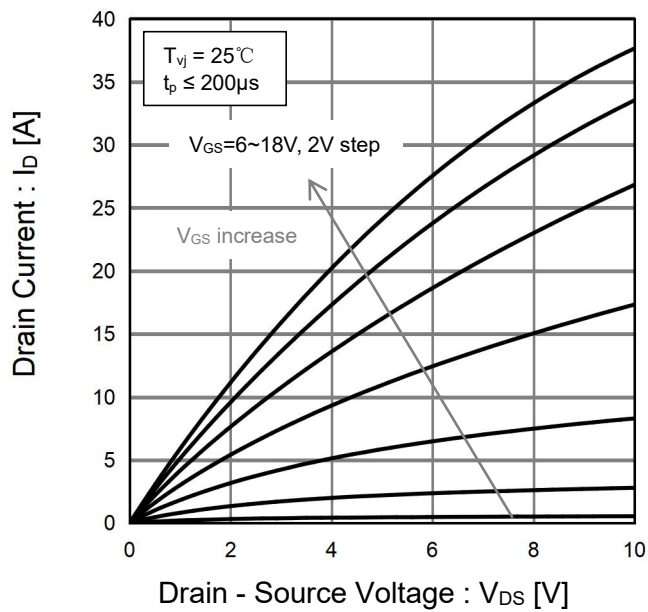


Fig.5 $T_{vj} = 25^{\circ}\text{C}$ 3rd Quadrant Characteristics

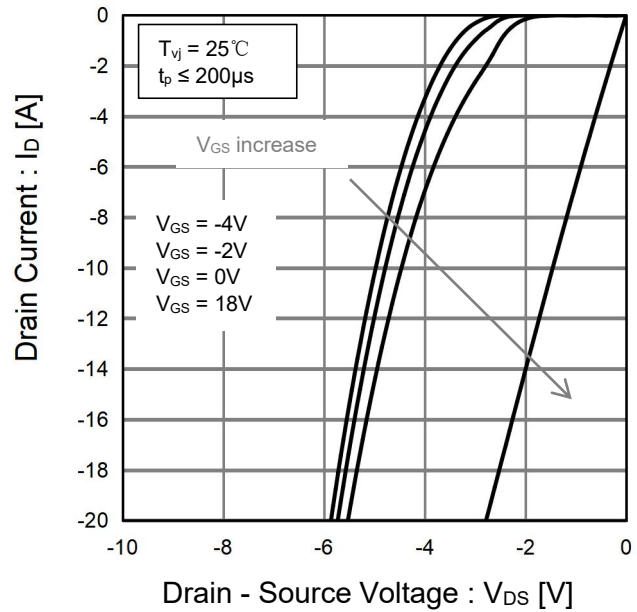


Fig.6 $T_{vj} = 175^{\circ}\text{C}$ Typical Output Characteristics

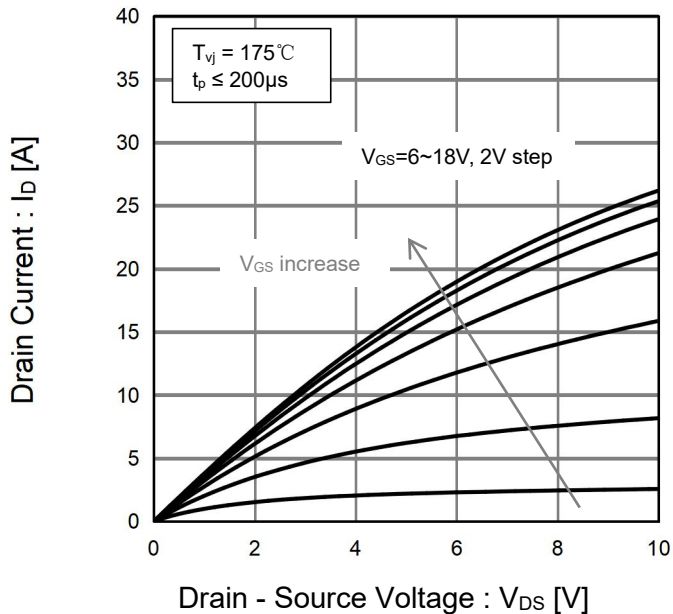


Fig.7 $T_{vj} = 175^{\circ}\text{C}$ 3rd Quadrant Characteristics

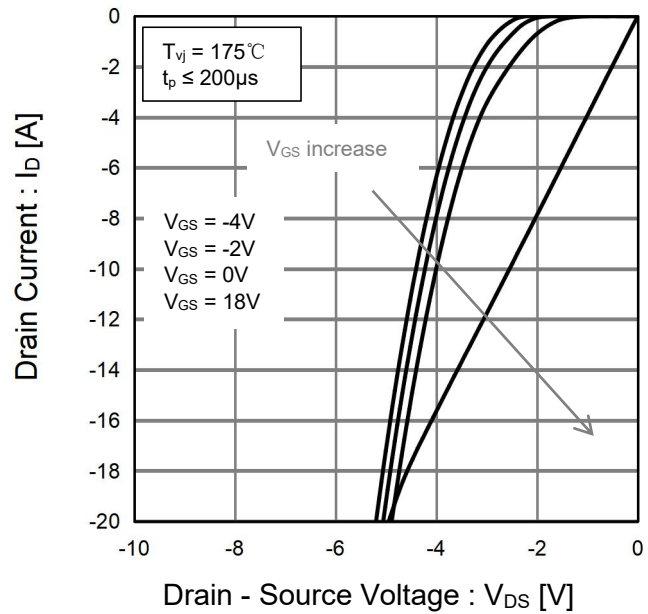


Fig.8 Typical Transfer Characteristics

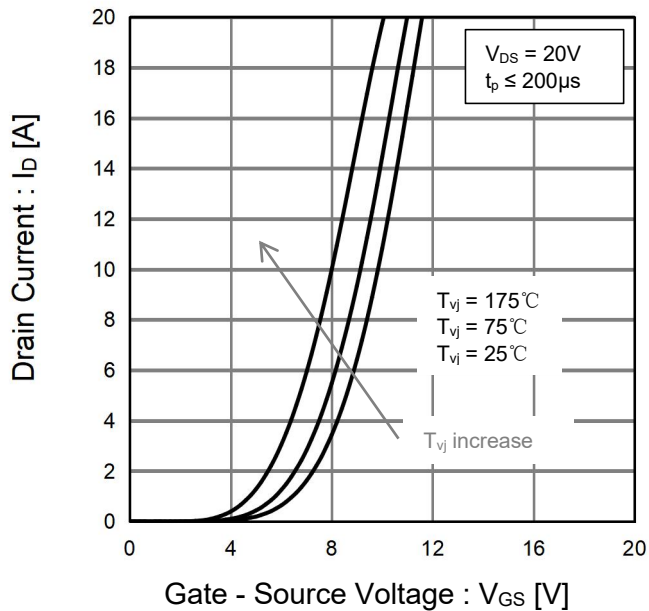


Fig.9 Static Drain - Source On - State Resistance vs. Gate - Source Voltage

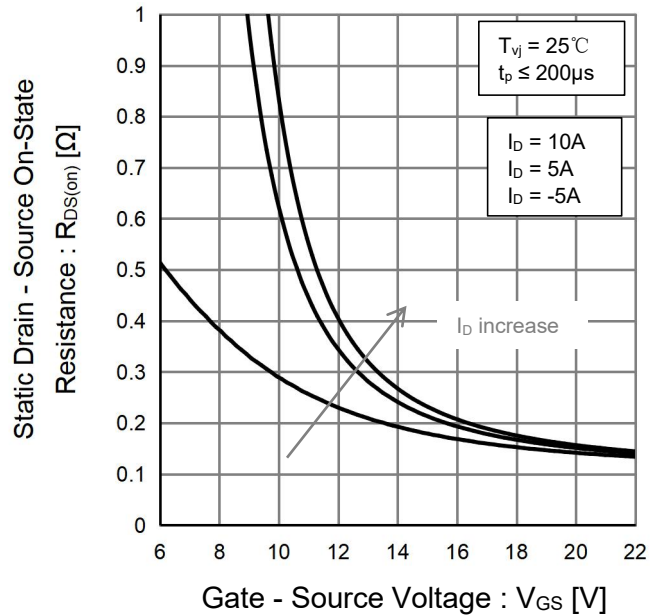


Fig.10 Static Drain - Source On - State Resistance vs. Drain Current

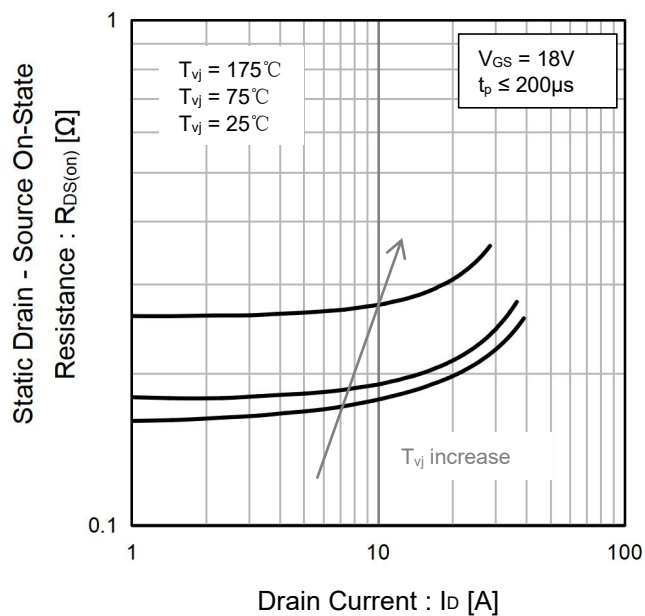


Fig.11 Static Drain - Source On - State Resistance vs. Virtual Junction Temperature

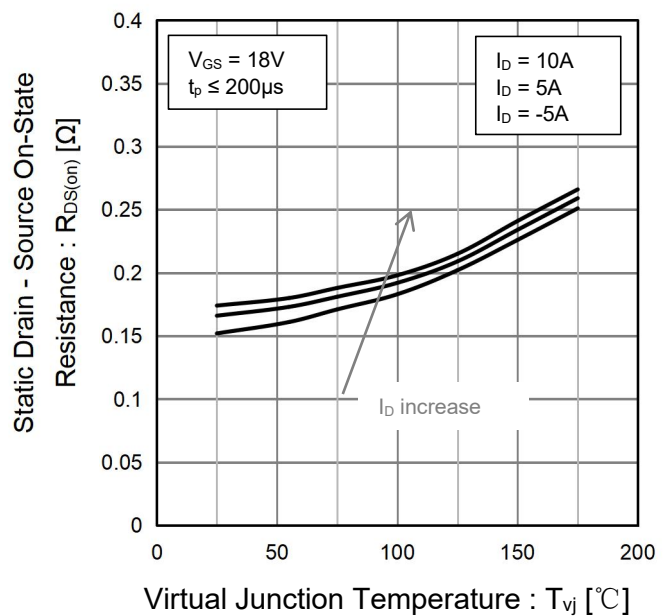


Fig.12 Body Diode Forward Voltage
vs. Gate - Source Voltage

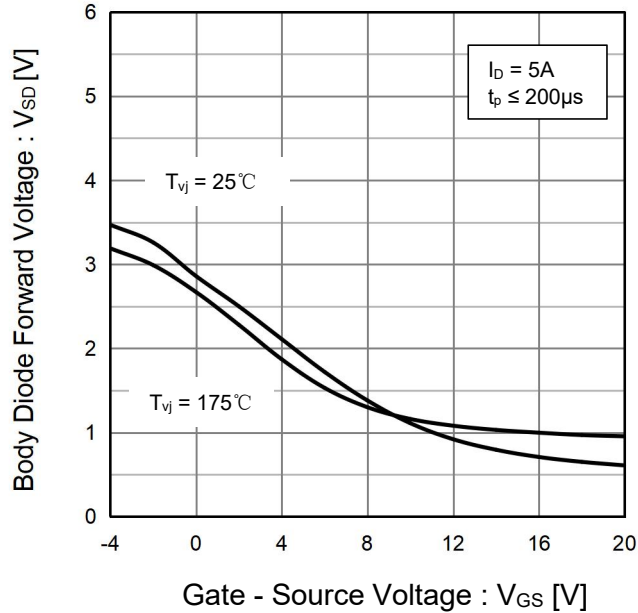


Fig.13 Gate Threshold Voltage
vs. Virtual Junction Temperature

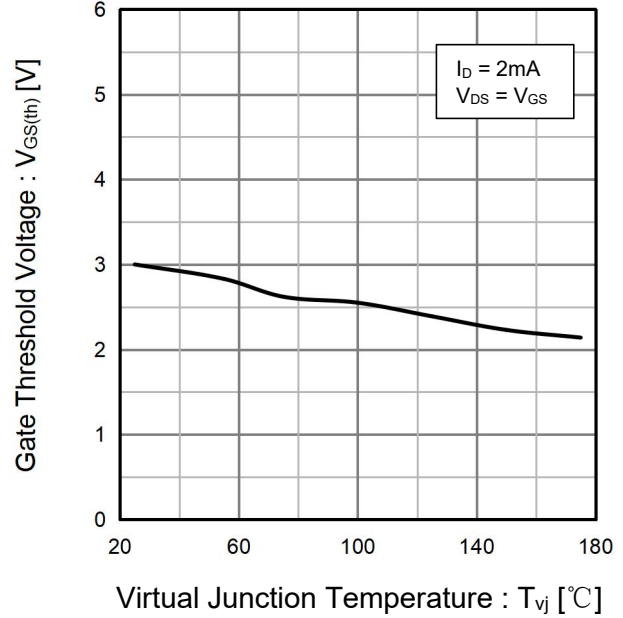


Fig.14 Typical Capacitance
vs. Drain - Source Voltage

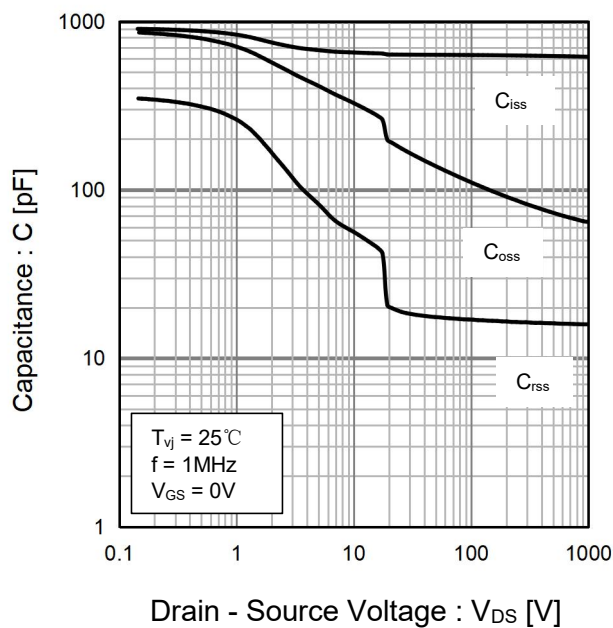


Fig.15 C_{oss} Stored Energy

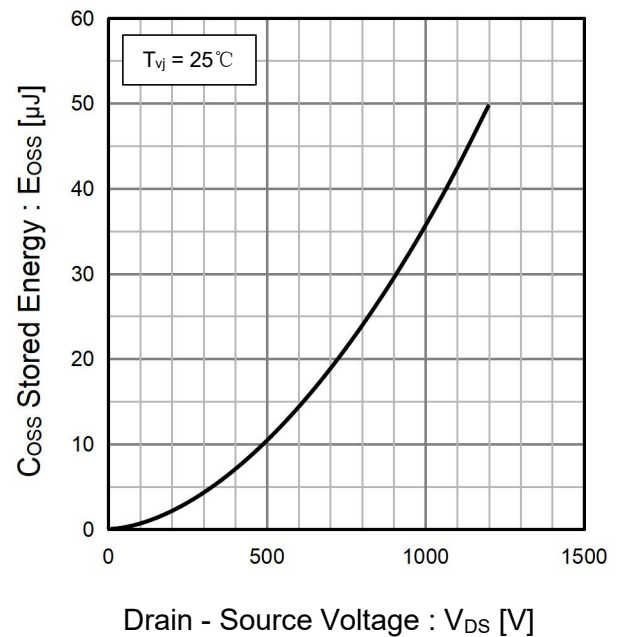


Fig.16 Dynamic Input Characteristics

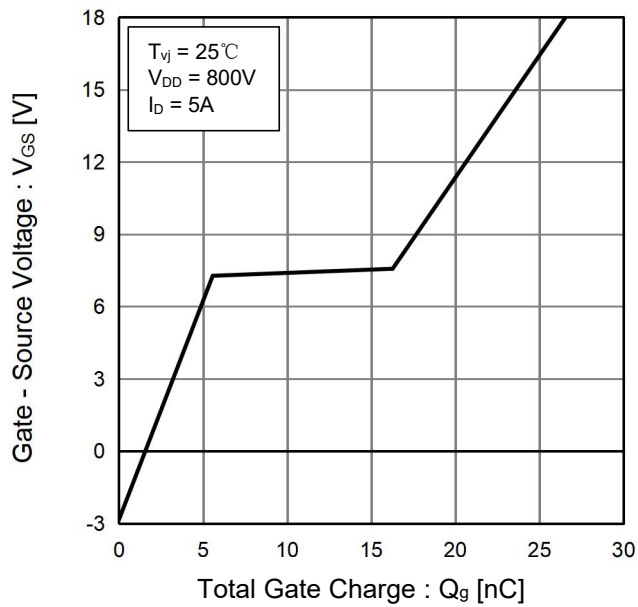


Fig.17 Typical Switching Time vs. External Gate Resistance

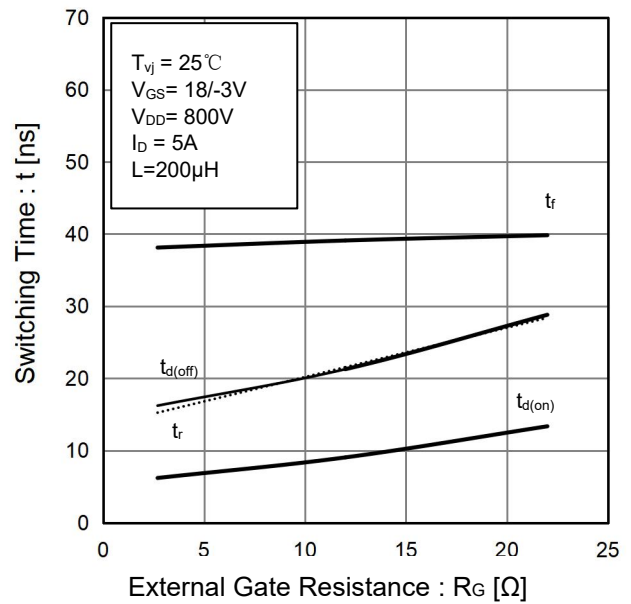


Fig.18 Typical Switching Energy vs. External Gate Resistance

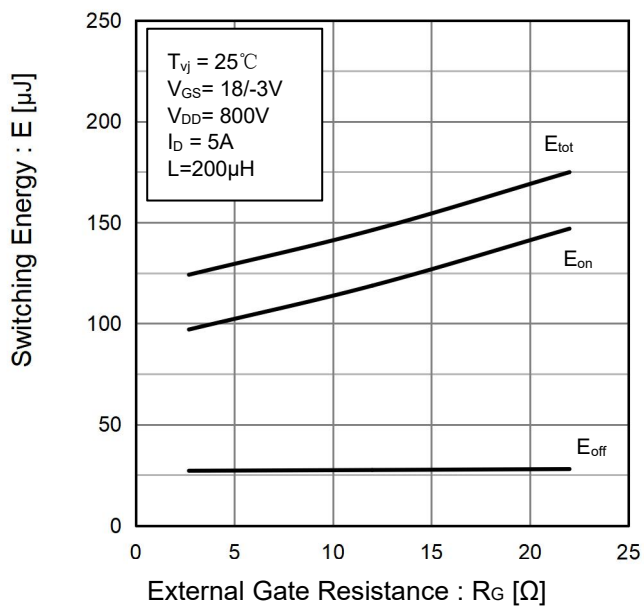


Fig.19 Typical Switching Energy vs. Drain Current

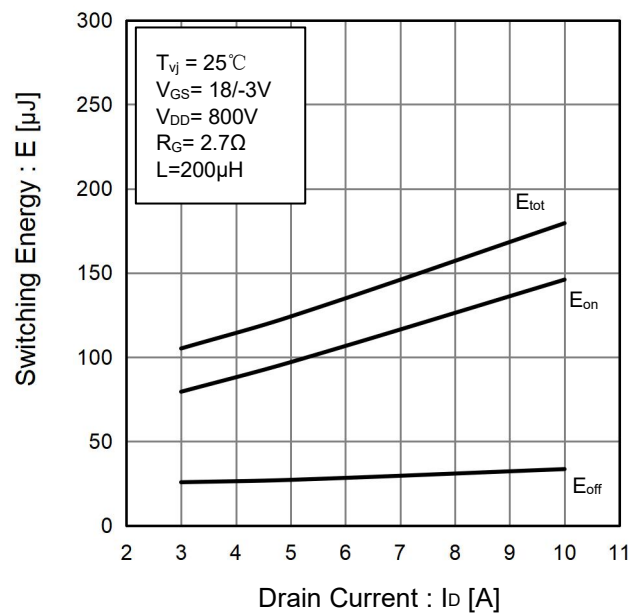
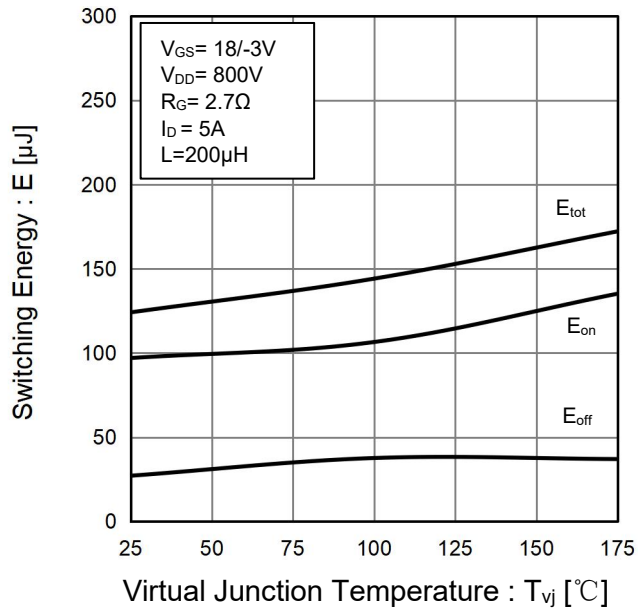
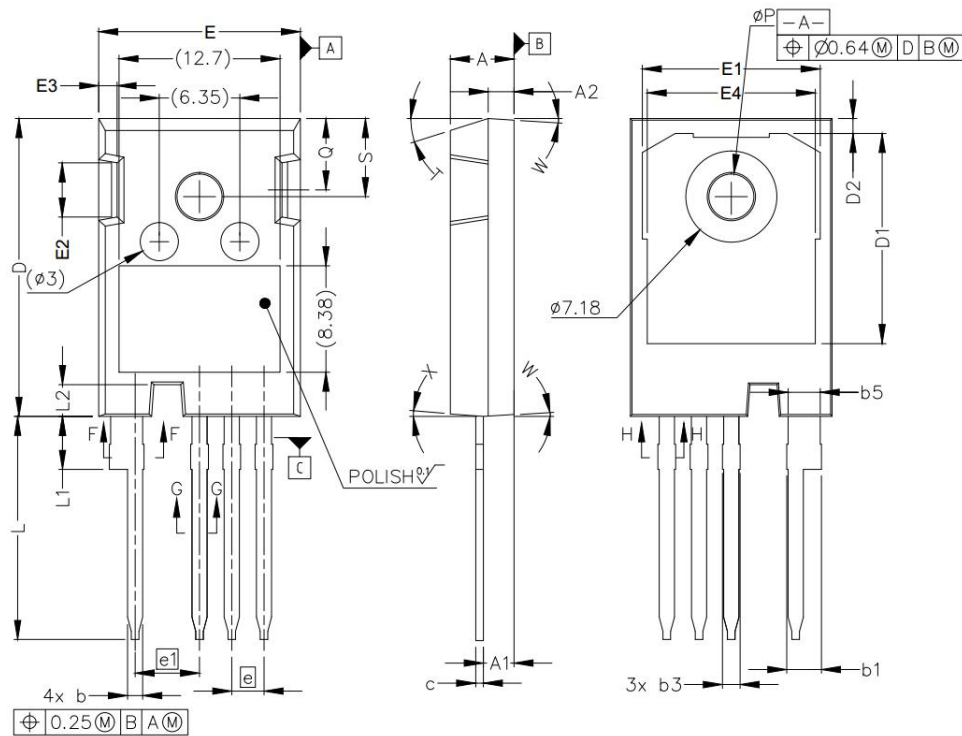


Fig.20 Typical Switching Energy
vs. Virtual Junction Temperature



TO-247-4L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	0.19	0.21
A1	2.29	2.54	0.09	0.10
A2	1.91	2.16	0.08	0.09
b1	2.39	2.94	0.09	0.12
b3	1.07	1.60	0.04	0.06
b5	2.39	2.69	0.09	0.11
c	0.55	0.68	0.02	0.03
D	23.30	23.60	0.92	0.93
D1	16.25	17.65	0.64	0.69
D2	0.95	1.25	0.04	0.05
E	15.75	16.13	0.62	0.64
E1	13.10	14.15	0.52	0.56
E2	3.68	5.10	0.14	0.20
E3	1.00	1.90	0.04	0.07
E4	12.38	13.43	0.49	0.53
e	2.54 BSC		0.1 BSC	
e1	5.08 BSC		0.2 BSC	
L	17.31	17.82	0.68	0.70
L1	3.97	4.37	0.16	0.17
L2	2.35	2.65	0.09	0.10
φP	3.51	3.65	0.14	0.14
Q	5.49	6.00	0.22	0.24
S	6.04	6.30	0.24	0.25
T	17.5° REF.		0.69° REF.	
W	3.5° REF.		0.14° REF.	
X	4.0° REF.		0.16° REF.	

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