

1200V, 158A, N-channel SiC power MOSFET
General Description:

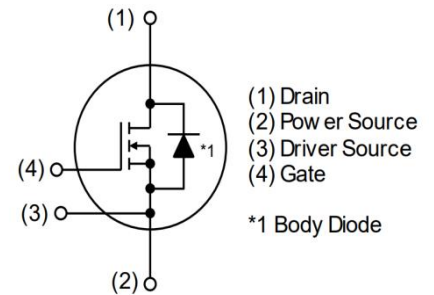
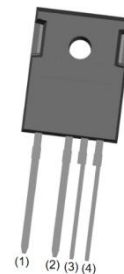
NCES120P013T4N is a SiC MOSFET that contributes to miniaturization and low power consumption of applications. This product achieves industry-leading low on-resistance without sacrificing short-circuit withstand time. This is a 4-pin package type with a driver source terminal that can maximize the high-speed 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-247-4LP
Package Marking and Ordering Information

Device	Device Package	Device Marking
NCES120P013T4N	TO-247-4LP	NCES120P013T4N

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	158	A
Drain Current-Continuous(T _C =100°C)	I _D (100°C)	112	A
Pulsed Drain Current (Note 3)	I _{DM}	396	A
Maximum Power Dissipation	P _D	T _{vj} = 25°C	652
		T _{vj} = 100°C	326
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	0.23	°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}	$V_{GS}=0V, I_D=100\mu A$	1200			V	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=1200V, V_{GS}=0V$	$T_{vj}=25^\circ\text{C}$	1	80	μA	
			$T_{vj}=175^\circ\text{C}$	2			
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=-10V / +24V, V_{DS}=0V$			± 100	nA	
On Characteristics (Note 4)							
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=20mA$	$T_{vj}=25^\circ\text{C}$	1.9	3.0	4.8	V
			$T_{vj}=175^\circ\text{C}$		2.1		
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=18V, I_D=60A$	$T_{vj}=25^\circ\text{C}$		13	17	m Ω
			$T_{vj}=175^\circ\text{C}$		19		
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=15V, I_D=60A$	$T_{vj}=25^\circ\text{C}$		16	21	
			$T_{vj}=175^\circ\text{C}$		24		
Gate input resistance	R_G	$f=1MHz, \text{open drain}$		0.5		Ω	
Forward Transconductance	g_{FS}	$V_{DS}=20V, I_D=60A$		14		S	
Dynamic Characteristics (Note 5)							
Input Capacitance	C_{iss}	$V_{DS}=800V, V_{GS}=0V, f=1MHz$		6300		pF	
Output Capacitance	C_{oss}			270		pF	
Reverse Transfer Capacitance	C_{rss}			6		pF	
C_{oss} stored energy	E_{oss}			105		μJ	
Output charge	Q_{oss}	Calculated by $C_{oss}(f)V_{DS}@1MHz$		395		nC	
Effective output capacitance, energy related	$C_{o(er)}$	$V_{DS}=0-800V, V_{GS}=0V$		329		pF	
Effective output capacitance, time related	$C_{o(tr)}$	$I_C=\text{constant}, V_{DS}=0-800V, V_{GS}=0V$		494		pF	
Switching Characteristics (Note 5)							
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=800V, I_D=60A, V_{GS}=+18V / -3V, R_G=2.7\Omega, L=200\mu H$		20.2		ns	
Turn-on Rise Time	t_r			33.5		ns	
Turn-Off Delay Time	$t_{d(off)}$			50.3		ns	
Turn-Off Fall Time	t_f			15		ns	
Turn-on energy	E_{on}	$V_{DD}=800V, I_D=60A, V_{GS}=+18V / -3V, R_G=2.7\Omega, L=200\mu H$	$T_{vj}=25^\circ\text{C}$	888		μJ	
			$T_{vj}=175^\circ\text{C}$	1128		μJ	
Turn-off energy	E_{off}	$R_G=2.7\Omega, L=200\mu H$	$T_{vj}=25^\circ\text{C}$	343		μJ	
			$T_{vj}=175^\circ\text{C}$	483		μJ	
Total Gate Charge	Q_g	$V_{DS}=800V, I_D=60A, V_{GS}=-3/18V$		236		nC	
Gate-Source Charge	Q_{gs}			73		nC	
Gate-Drain Charge	Q_{gd}			74		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 =60A	T _{vj} = 25°C		3.5	V
			T _{vj} = 175°C		3.2	
Reverse Recovery Time	t _{rr}	T _J = 25°C, I _F =60A, V _R =800V, di/dt = 4160A/μs (Note3)		20.2		ns
Reverse Recovery Charge	Q _{rr}			566		nC
Peak reverse recovery current	I _{rrm}			49.5		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

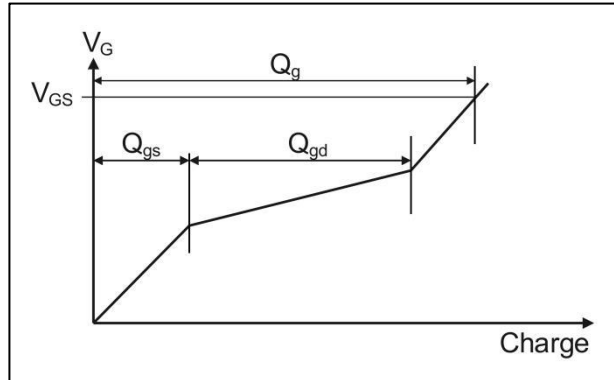


Fig.2-1 Switching Characteristics Measurement Circuit

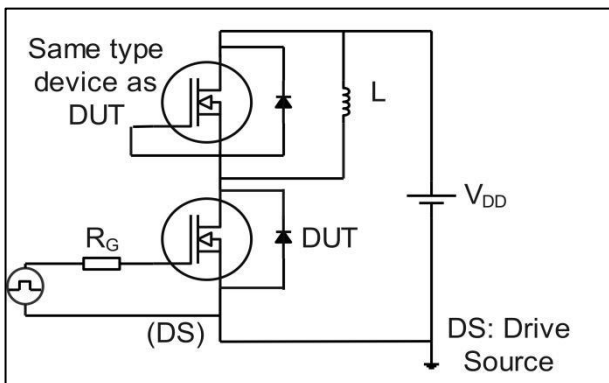
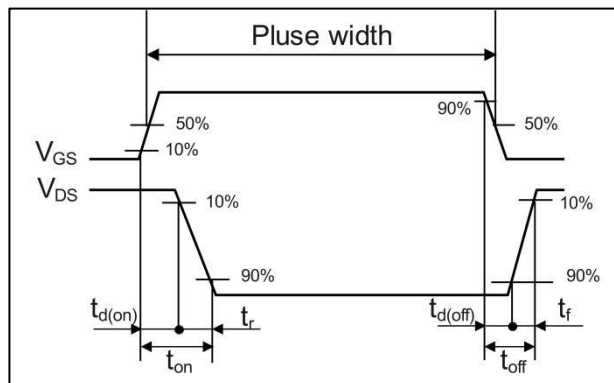


Fig.2-2 Waveforms for Switching Time



Typical Electrical and Thermal Characteristics

Fig.1 Power Dissipation Derating Curve

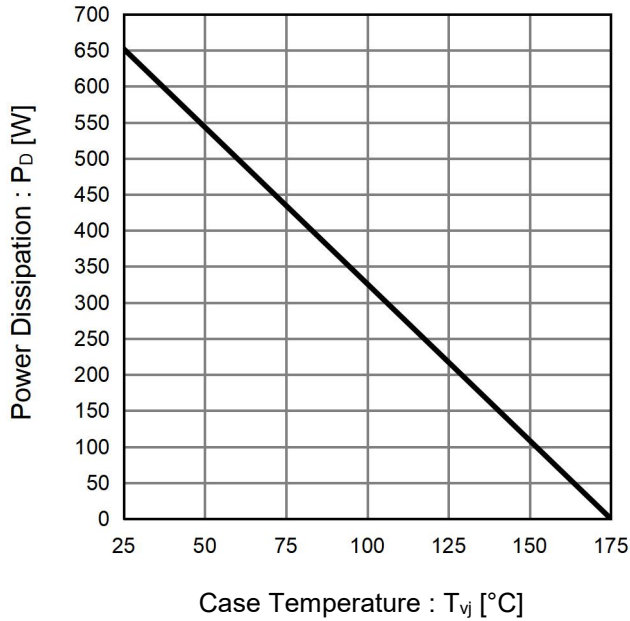


Fig.2 Maximum Safe Operating Area

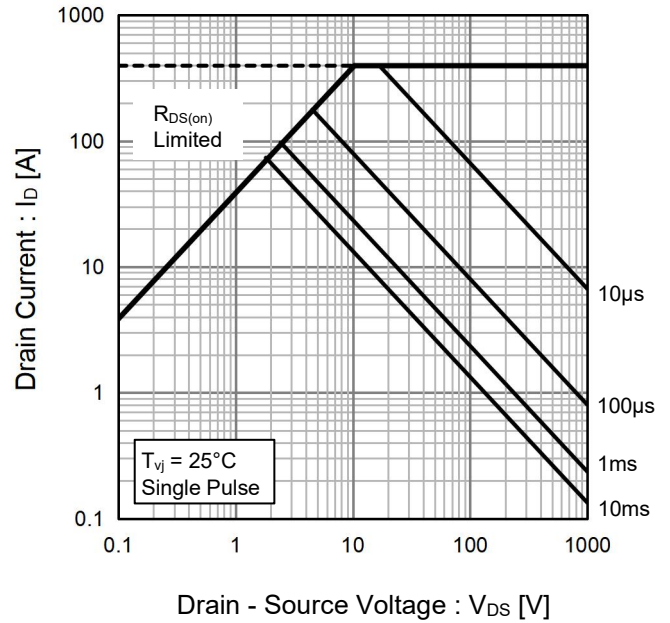


Fig.3 Typical Transient Thermal Impedance vs. Pulse Width

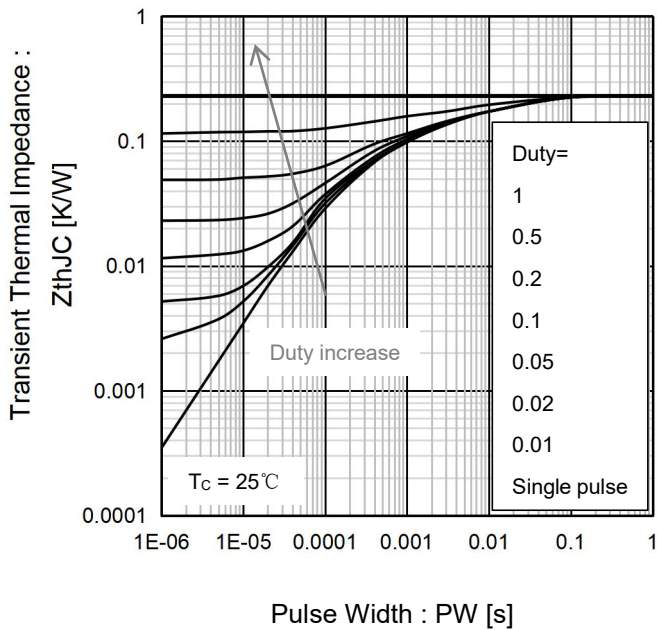


Fig.4 $T_{vj} = 25^{\circ}\text{C}$ Typical Output Characteristics

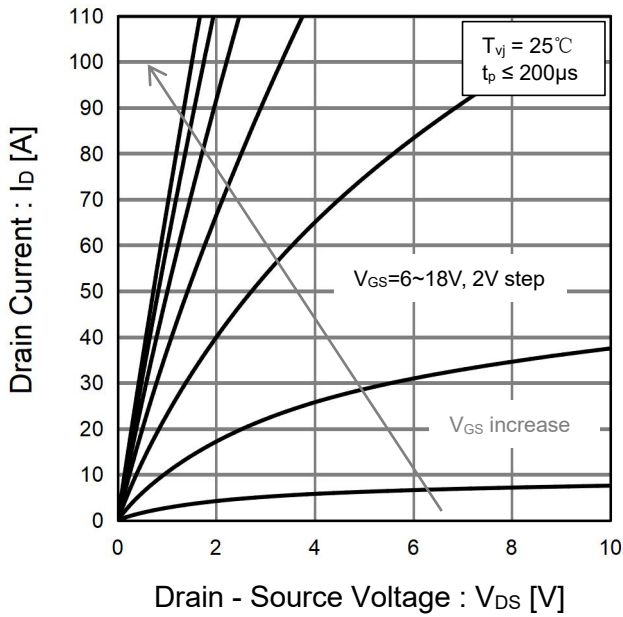


Fig.5 $T_{vj} = 25^{\circ}\text{C}$ 3rd Quadrant Characteristics

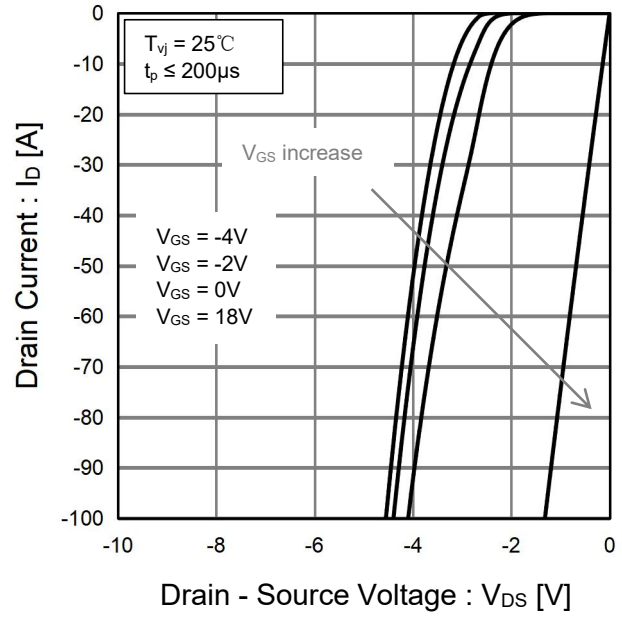


Fig.6 $T_{vj} = 175^{\circ}\text{C}$ Typical Output Characteristics

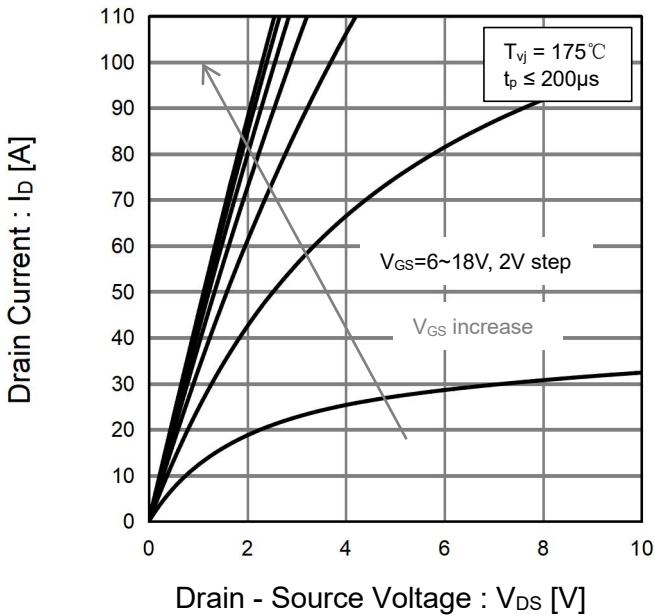


Fig.7 $T_{vj} = 175^{\circ}\text{C}$ 3rd Quadrant Characteristics

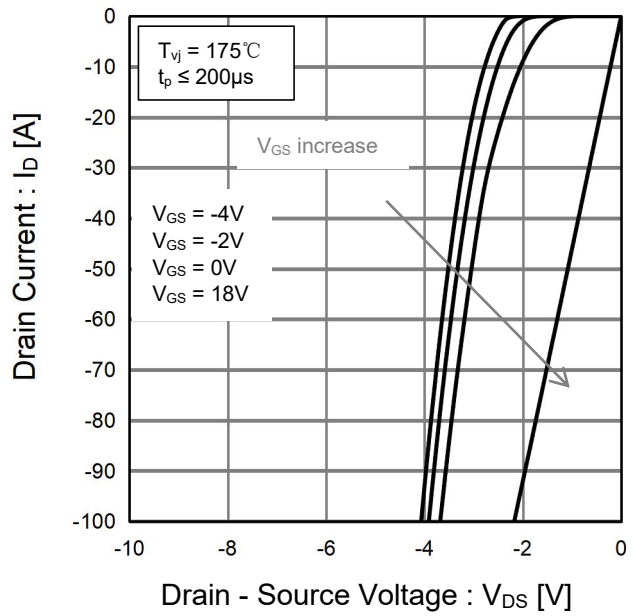


Fig.8 Typical Transfer Characteristics

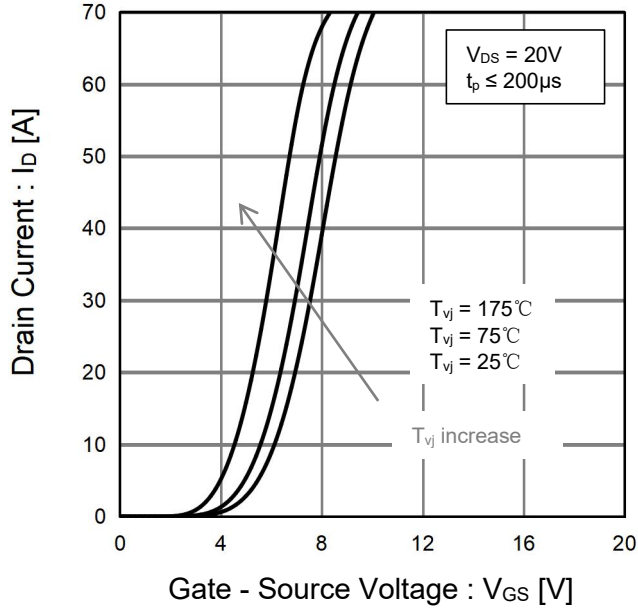


Fig.9 Static Drain - Source On - State Resistance vs. Gate - Source Voltage

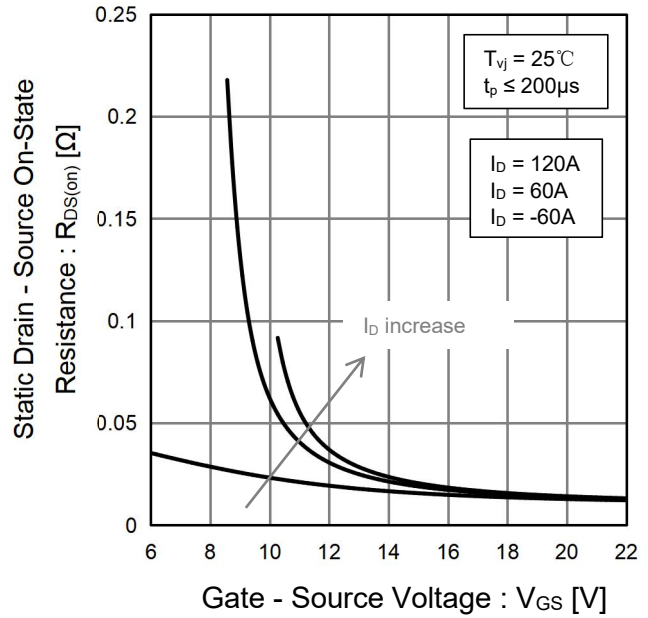


Fig.10 Static Drain - Source On - State Resistance vs. Drain Current

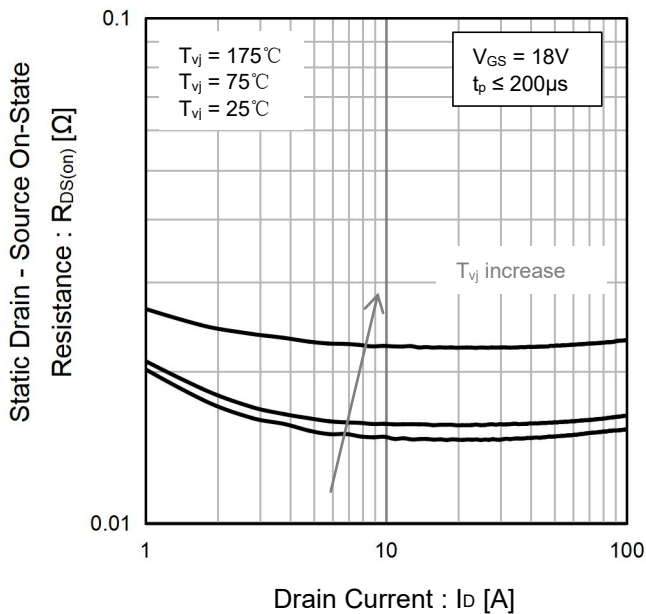


Fig.11 Static Drain - Source On - State Resistance vs. Virtual Junction Temperature

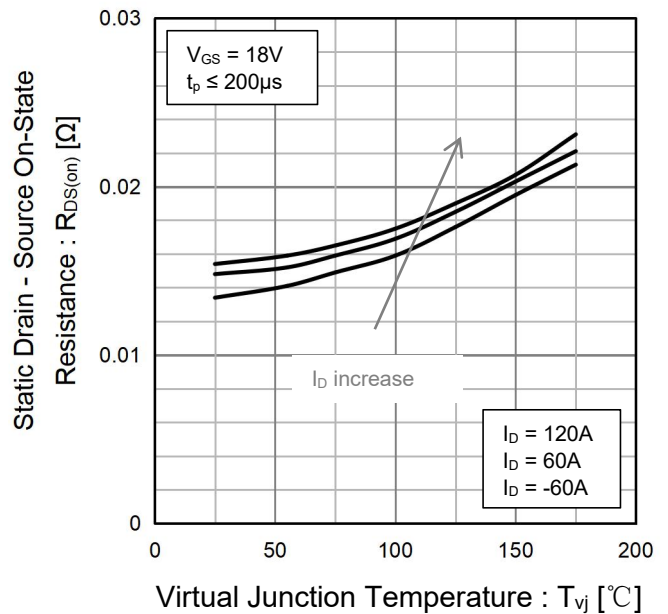


Fig.12 Body Diode Forward Voltage vs. Gate - Source Voltage

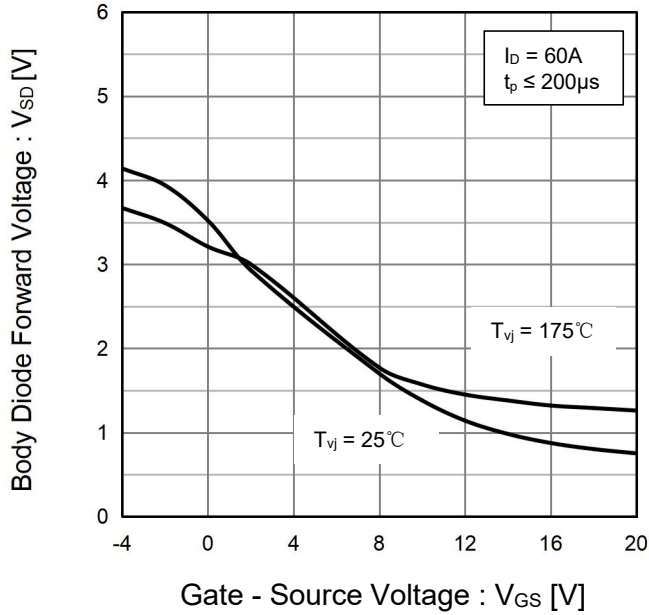


Fig.13 Gate Threshold Voltage vs. Virtual Junction Temperature

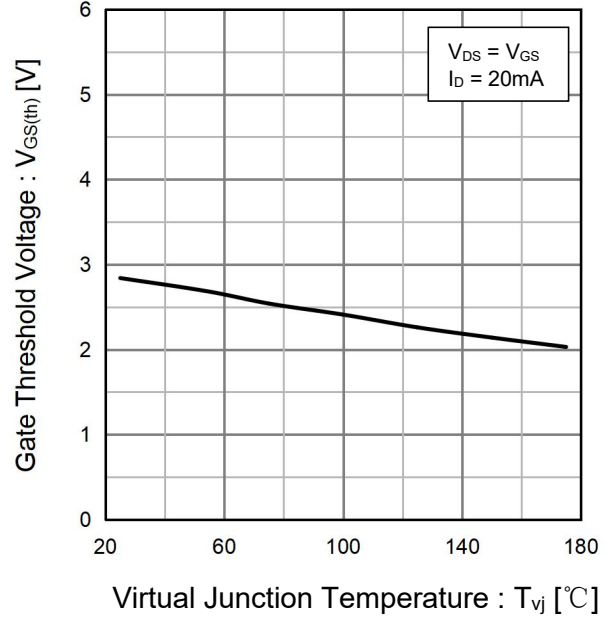


Fig.14 Typical Capacitance vs. Drain - Source Voltage

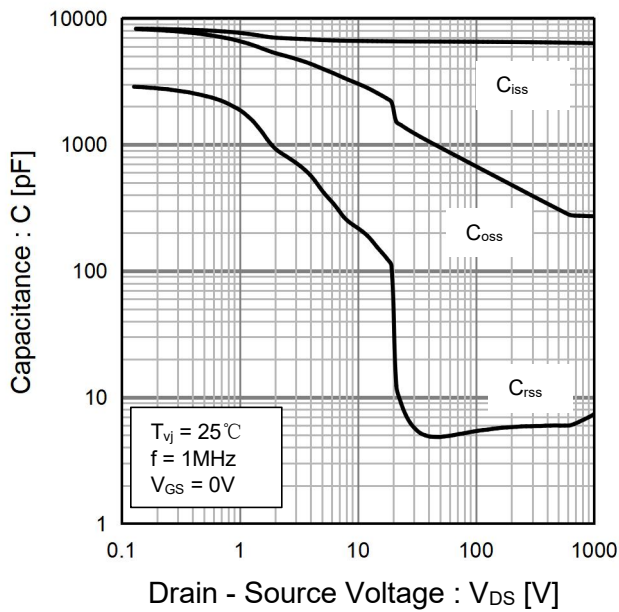


Fig.15 Coss Stored Energy

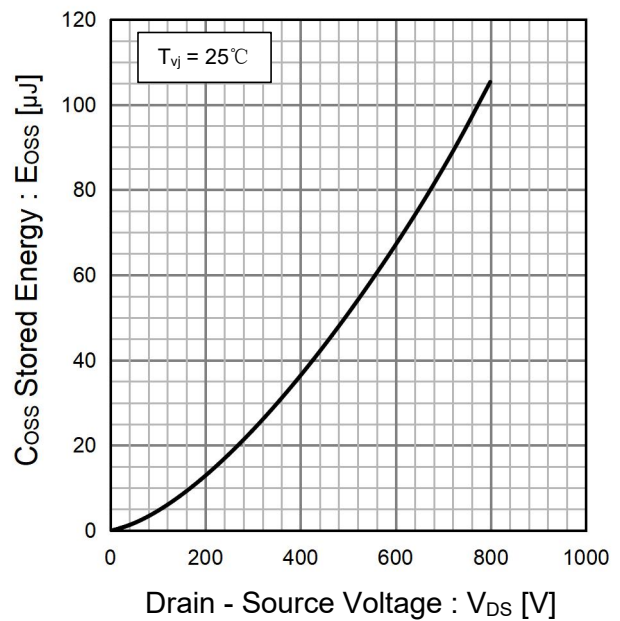


Fig.16 Dynamic Input Characteristics

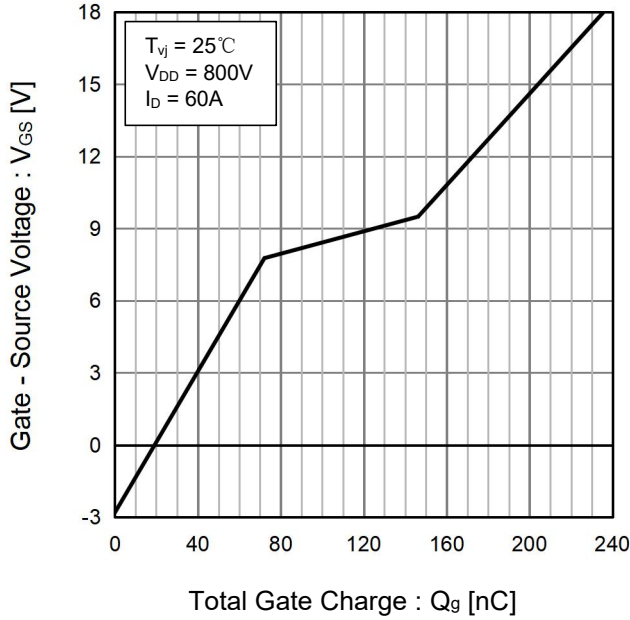


Fig.17 Typical Switching Time vs. External Gate Resistance

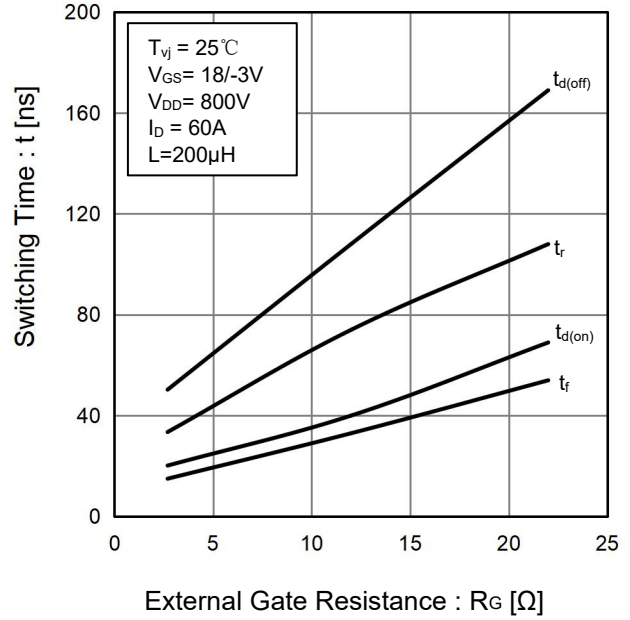


Fig.18 Typical Switching Energy vs. External Gate Resistance

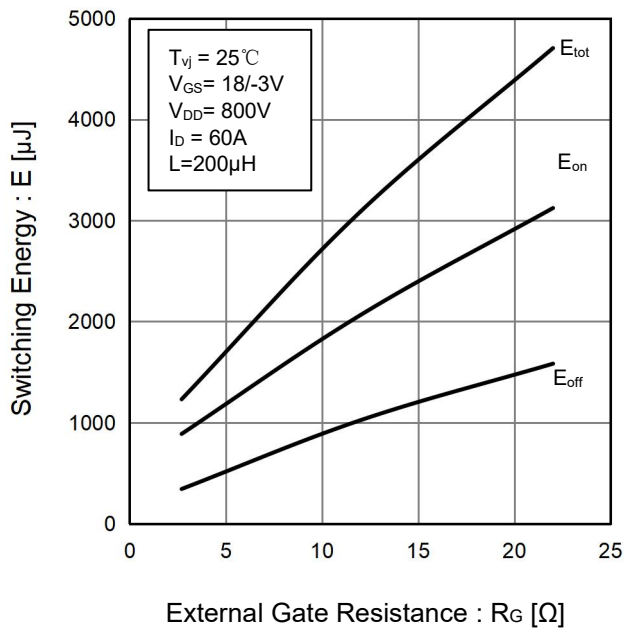


Fig.19 Typical Switching Energy vs. Drain Current

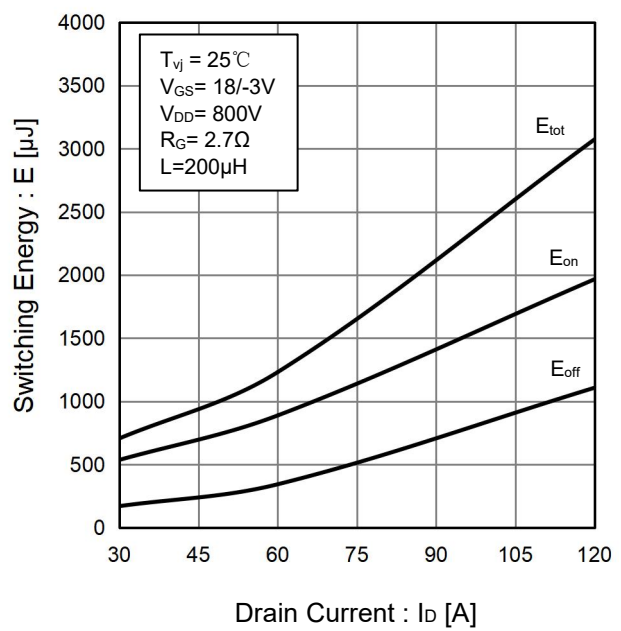
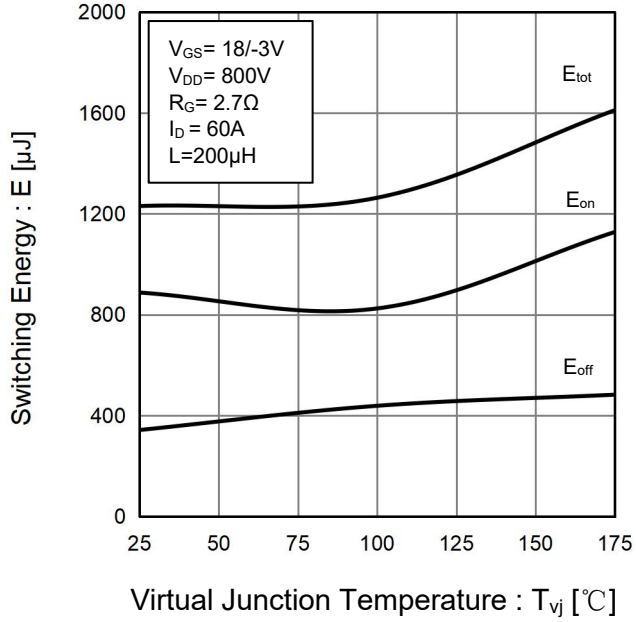
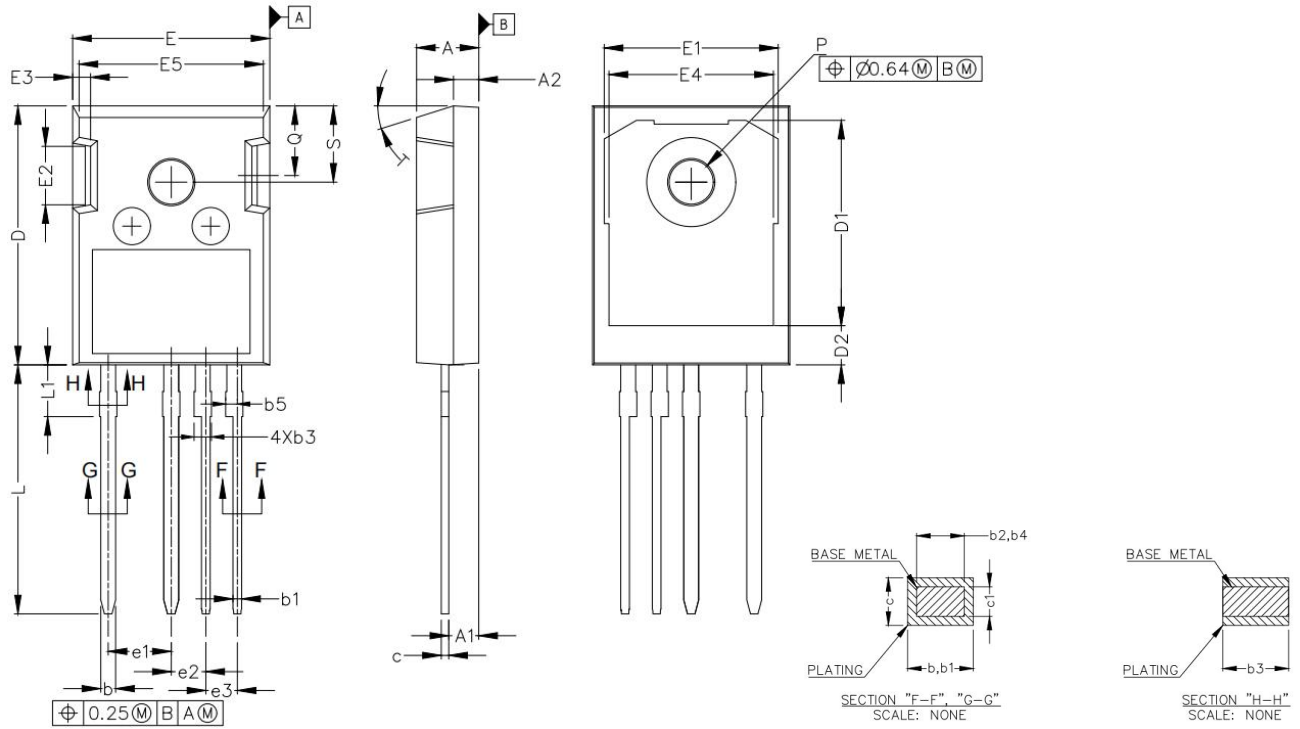


Fig.20 Typical Switching Energy vs. Virtual Junction Temperature



TO-247-4LP Package Information



SYM	MILLIMETERS	
	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b	1.10	1.30
b1	0.65	0.79
b2	1.10	1.25
b3	1.34	1.44
b4	0.65	0.74
b5	0.74	1.14
c	0.55	0.68
c1	0.55	0.65
D	20.80	21.10
D1	16.25	17.65
D2	2.95	3.35
E	15.75	16.13
E1	13.10	14.15
E2	4.32	5.10
E3	1.00	1.90
E4	12.38	13.43
E5	14.65	15.05
e1	5.08 BSC	
e2	2.79 BSC	
e3	2.54 BSC	
L	19.72	20.32
L1	3.97	4.37
$\varnothing P$	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° REF.	

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