

1200V, 65A, N-channel SiC power MOSFET
General Description:

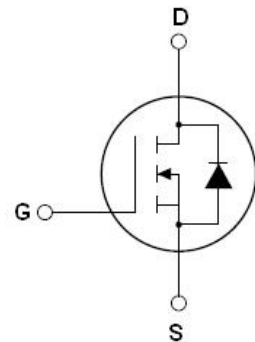
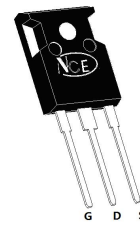
NCES120P040T is a SiC MOSFET that contributes to miniaturization and low power consumption of applications. This product achieves industry-leading low on-resistance without sacrificing short-circuit withstand time.

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-247-3L
Package Marking and Ordering Information

Device	Device Package	Device Marking
NCES120P040T	TO-247-3L	NCES120P040T

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	65	A
Drain Current-Continuous(T _C =100°C)	I _D (100°C)	46	A
Pulsed Drain Current (Note 3)	I _{DM}	163	A
Maximum Power Dissipation	P _D	T _{vj} = 25°C	326
		T _{vj} = 100°C	163
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	0.46	°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	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=6mA$	$T_{vj} = 25^\circ\text{C}$	1.9	3.2	4.8	V
			$T_{vj} = 175^\circ\text{C}$		2.4		
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=18V, I_D=20A$	$T_{vj} = 25^\circ\text{C}$	40	52	m Ω	
			$T_{vj} = 175^\circ\text{C}$	65			
Gate input resistance	R_G	$f=1MHz, \text{open drain}$		3.0		Ω	
Forward Transconductance	g_{FS}	$V_{DS}=20V, I_D=20A$		12		S	
Dynamic Characteristics (Note 5)							
Input Capacitance	C_{iss}	$V_{DS}=800V, V_{GS}=0V,$ $f=1MHz$		2210		pF	
Output Capacitance	C_{oss}			86		pF	
Reverse Transfer Capacitance	C_{rss}			4.3		pF	
C_{oss} stored energy	E_{oss}			37		μJ	
Output charge	Q_{oss}	Calculated by $C_{oss}(f)V_{DS}@1MHz$		130		nC	
Effective output capacitance, energy related	$C_{o(er)}$	$V_{DS}=0-500V, V_{GS}=0V$		104		pF	
Effective output capacitance, time related	$C_{o(tr)}$	$I_C=\text{constant}, V_{DS}=0-500V, V_{GS}=0V$		261		pF	
Switching Characteristics (Note 5)							
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=800V, I_D=20A, V_{GS}=+18V /$ $-3V, R_G=2.7\Omega, L=200\mu H$		14.2		ns	
Turn-on Rise Time	t_r			17.3		ns	
Turn-Off Delay Time	$t_{d(off)}$			35		ns	
Turn-Off Fall Time	t_f			12.8		ns	
Turn-on energy	E_{on}	$V_{DD}=800V, I_D=20A,$ $V_{GS}=+18V / -3V,$ $R_G=2.7\Omega, L=200\mu H$	$T_{vj} = 25^\circ\text{C}$	268		μJ	
			$T_{vj} = 175^\circ\text{C}$	412		μJ	
Turn-off energy	E_{off}		$T_{vj} = 25^\circ\text{C}$	55		μJ	
			$T_{vj} = 175^\circ\text{C}$	66		μJ	
Total Gate Charge	Q_g	$V_{DS}=800V, I_D=20A, V_{GS}=-3/18V$		107		nC	
Gate-Source Charge	Q_{gs}			27		nC	
Gate-Drain Charge	Q_{gd}			46		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 =20A	T _{vj} = 25°C		3.5	V
			T _{vj} = 175°C		3.2	
Reverse Recovery Time	t _{rr}	T _J = 25°C, I _F =20A, V _R =800V, di/dt = 2800A/μs (Note3)		15		ns
Reverse Recovery Charge	Q _{rr}			250		nC
Peak reverse recovery current	I _{rrm}			25		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

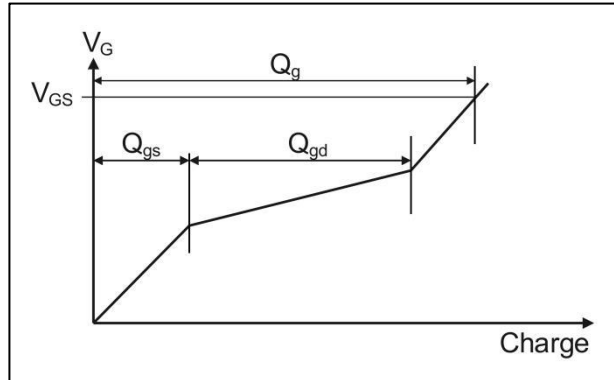


Fig.2-1 Switching Characteristics Measurement Circuit

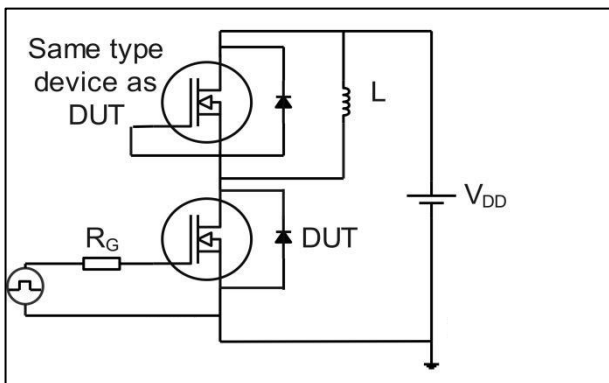
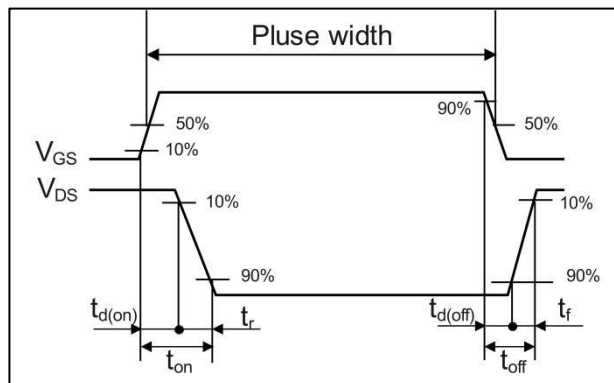


Fig.2-2 Waveforms for Switching Time



Typical Electrical and Thermal Characteristics

Fig.1 Power Dissipation Derating Curve

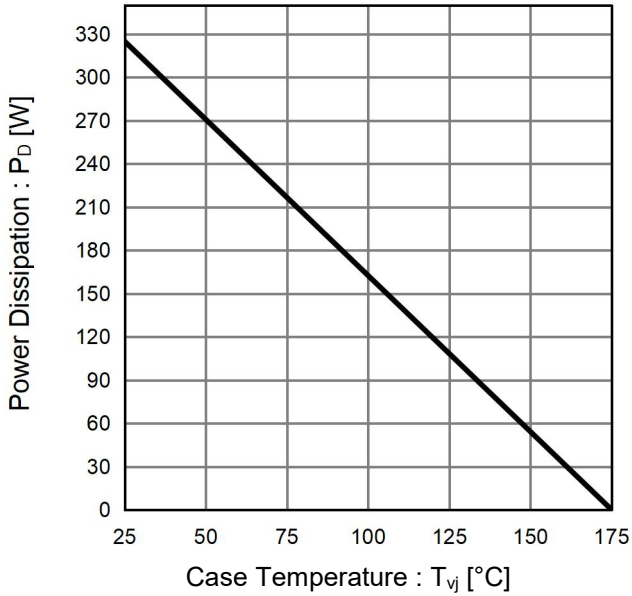


Fig.2 Maximum Safe Operating Area

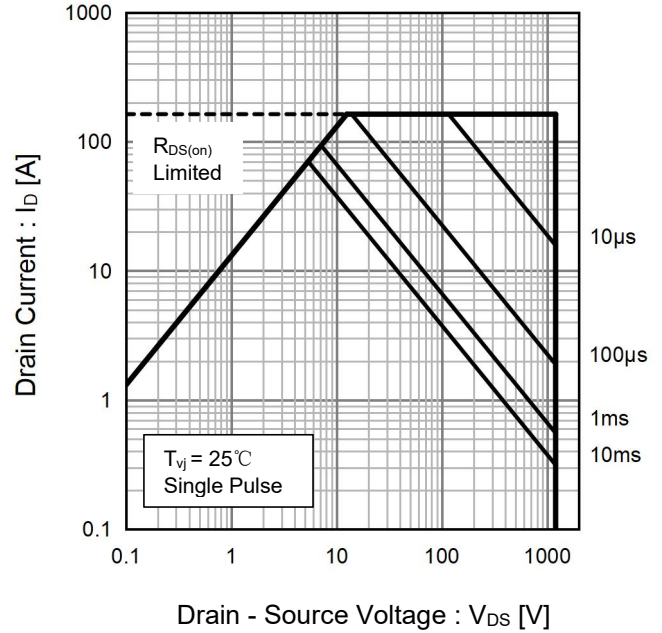


Fig.3 Typical Transient Thermal Impedance vs. Pulse Width

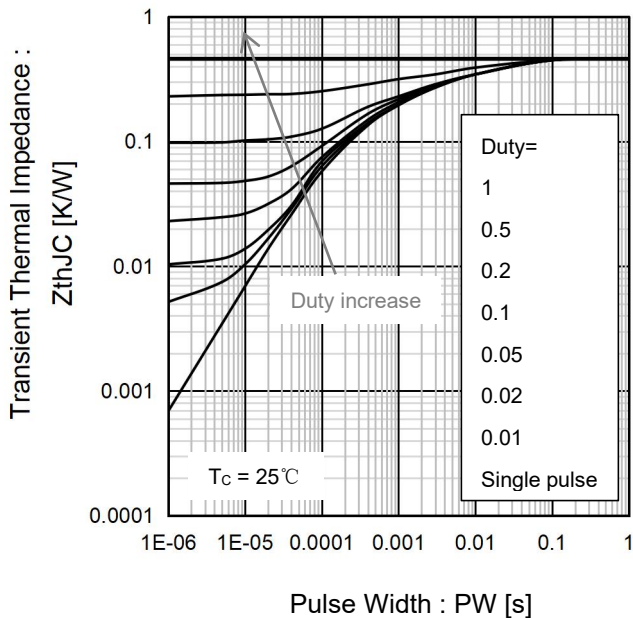


Fig.4 $T_{vj} = 25^{\circ}\text{C}$ Typical Output Characteristics

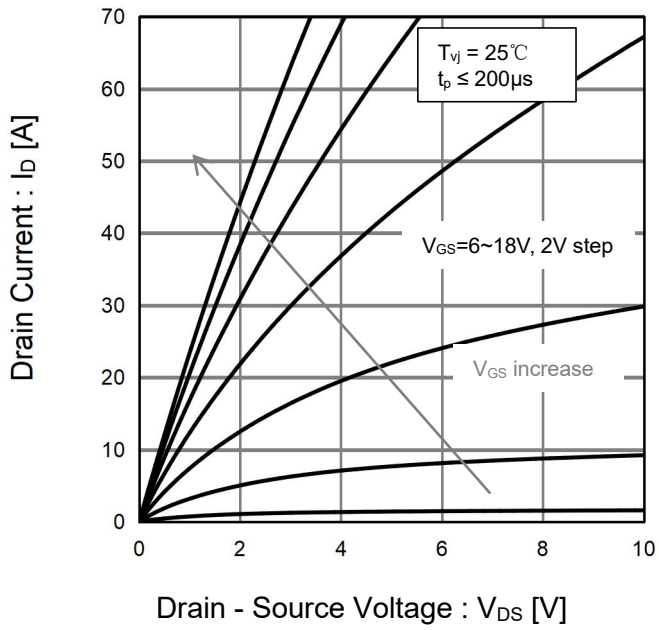


Fig.5 $T_{vj} = 25^{\circ}\text{C}$ 3rd Quadrant Characteristics

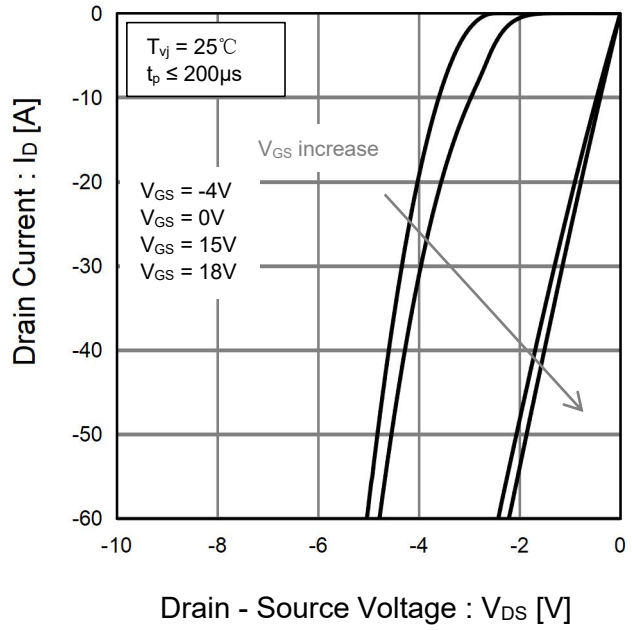


Fig.6 $T_{vj} = 175^{\circ}\text{C}$ Typical Output Characteristics

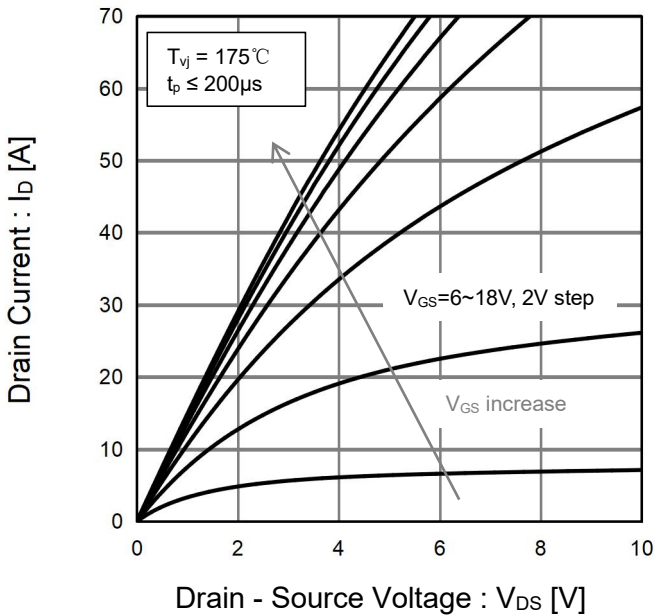


Fig.7 $T_{vj} = 175^{\circ}\text{C}$ 3rd Quadrant Characteristics

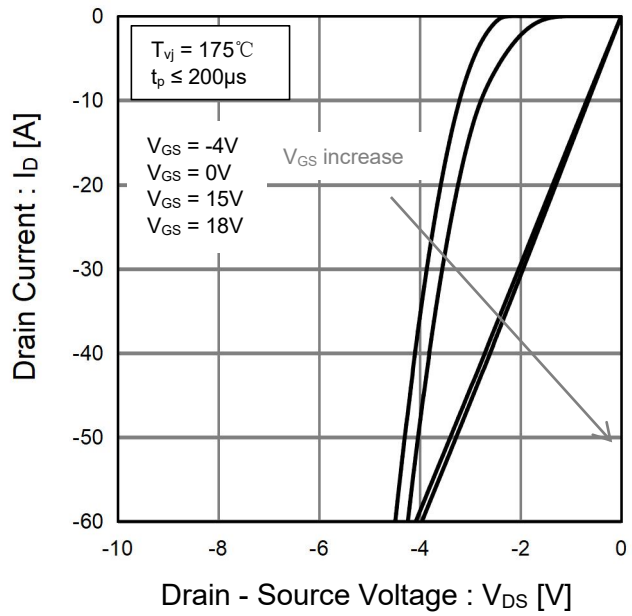


Fig.8 Typical Transfer Characteristics

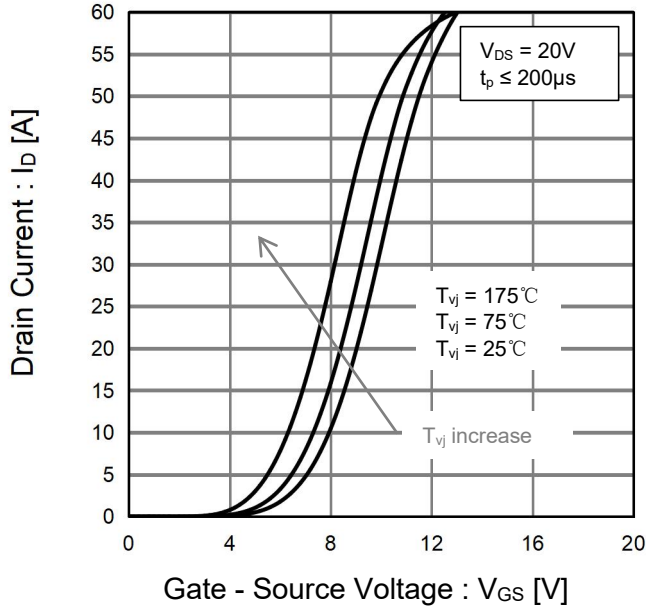


Fig.9 Static Drain - Source On - State Resistance vs. Gate - Source Voltage

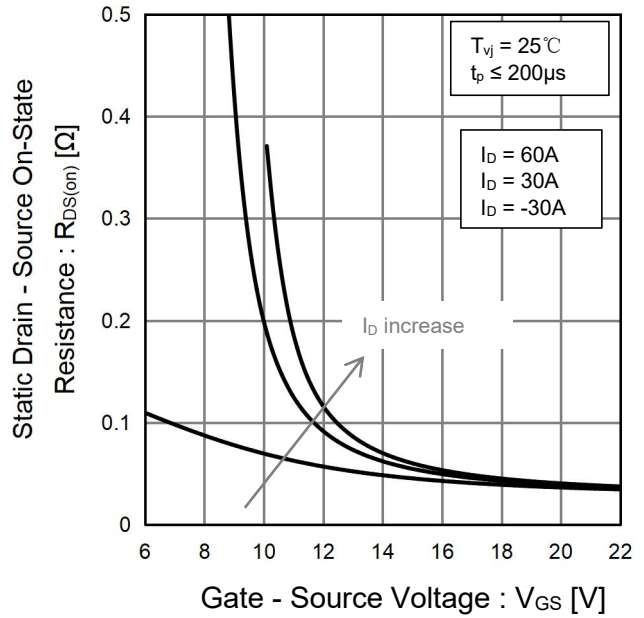


Fig.10 Static Drain - Source On - State Resistance vs. Drain Current

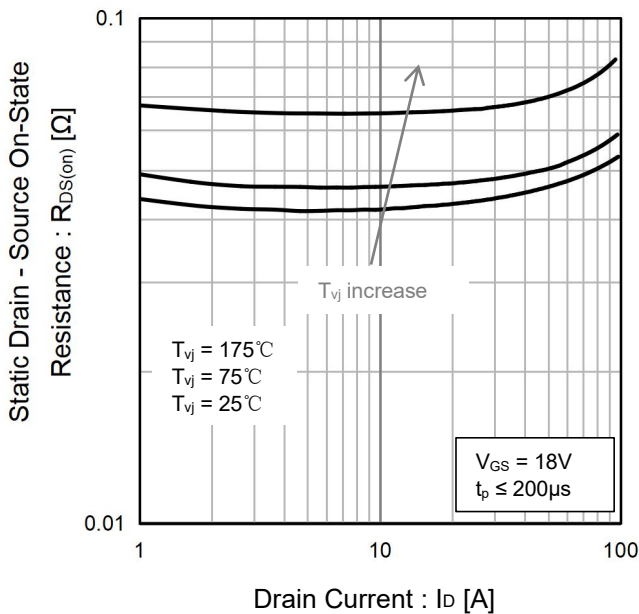


Fig.11 Static Drain - Source On - State Resistance vs. Virtual Junction Temperature

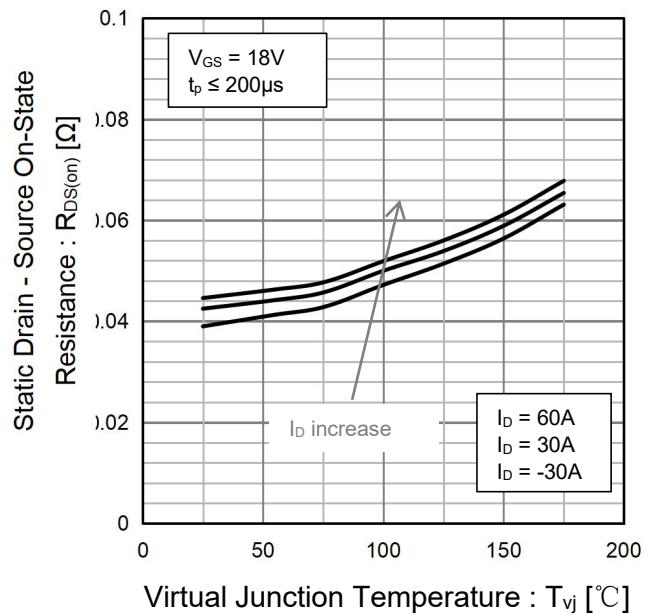


Fig.12 Body Diode Forward Voltage vs. Gate - Source Voltage

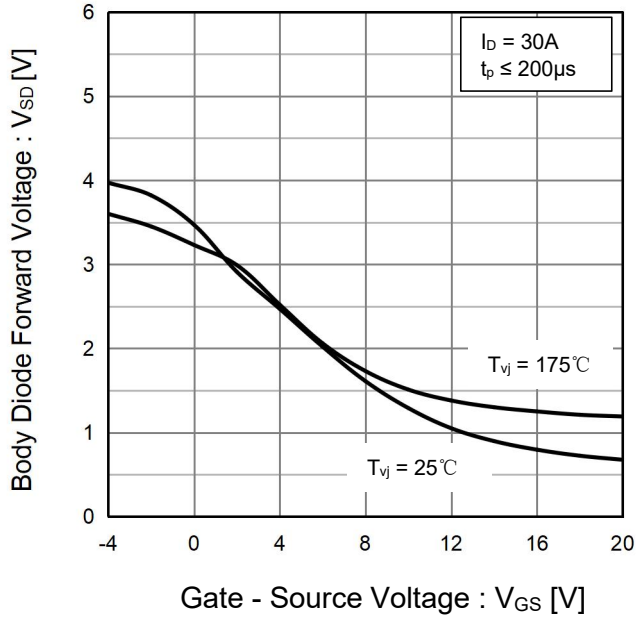


Fig.13 Gate Threshold Voltage vs. Virtual Junction Temperature

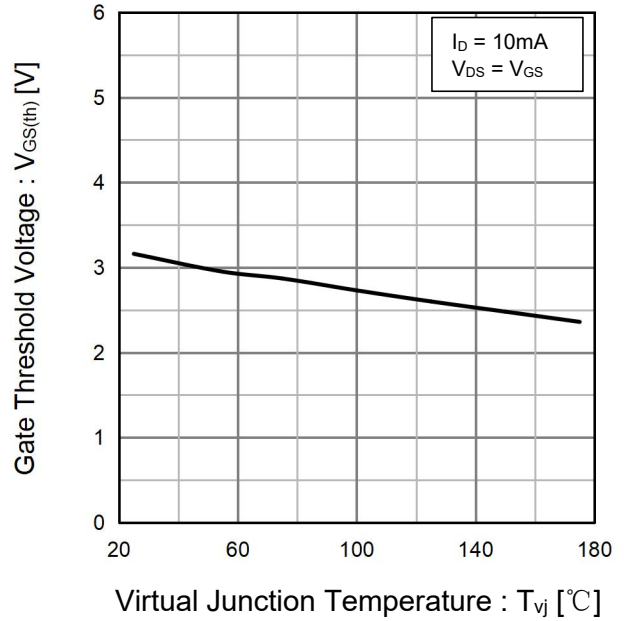


Fig.14 Typical Capacitance vs. Drain - Source Voltage

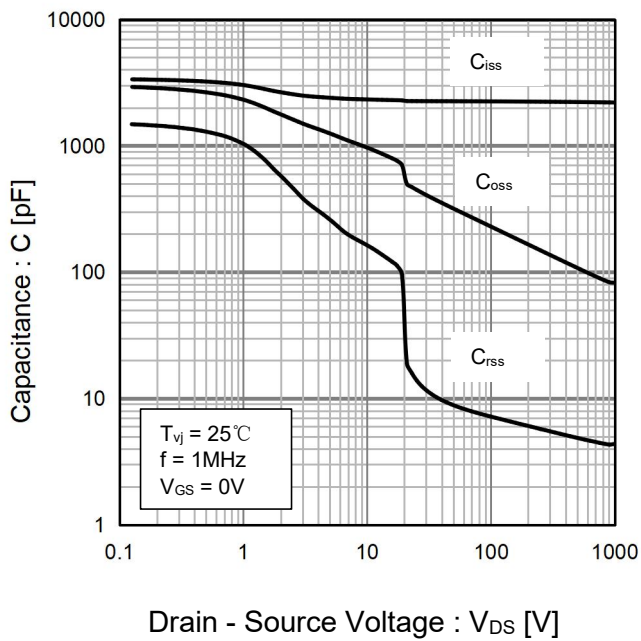


Fig.15 Coss Stored Energy

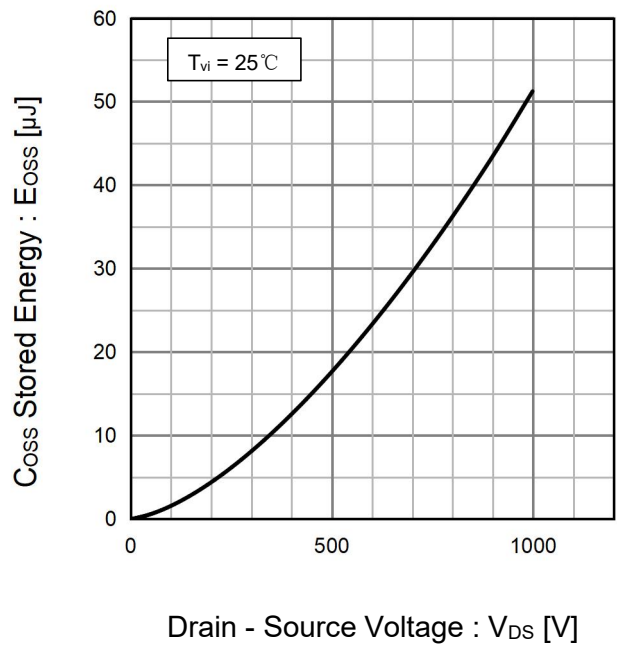


Fig.16 Dynamic Input Characteristics

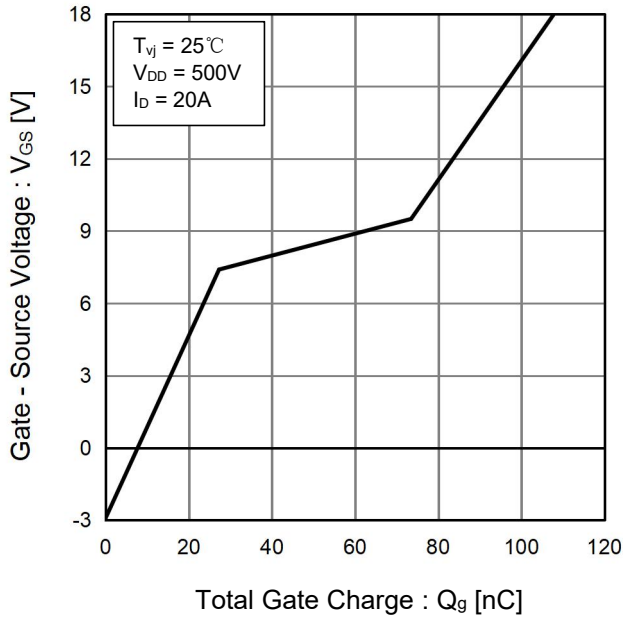


Fig.17 Typical Switching Time vs. External Gate Resistance

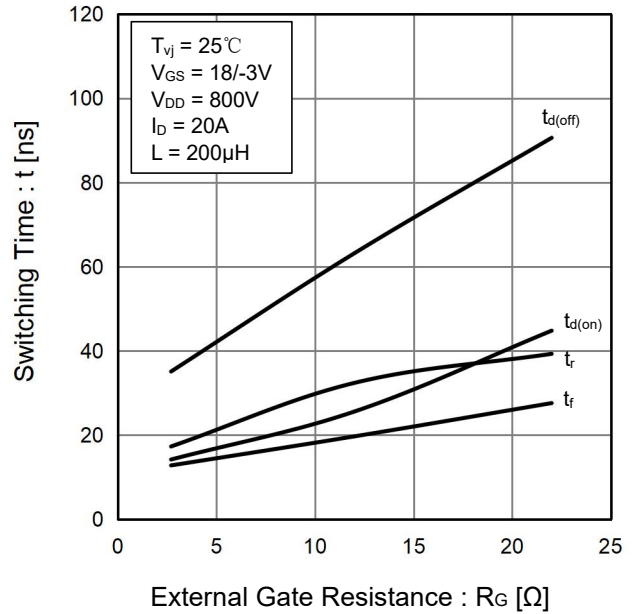


Fig.18 Typical Switching Energy vs. External Gate Resistance

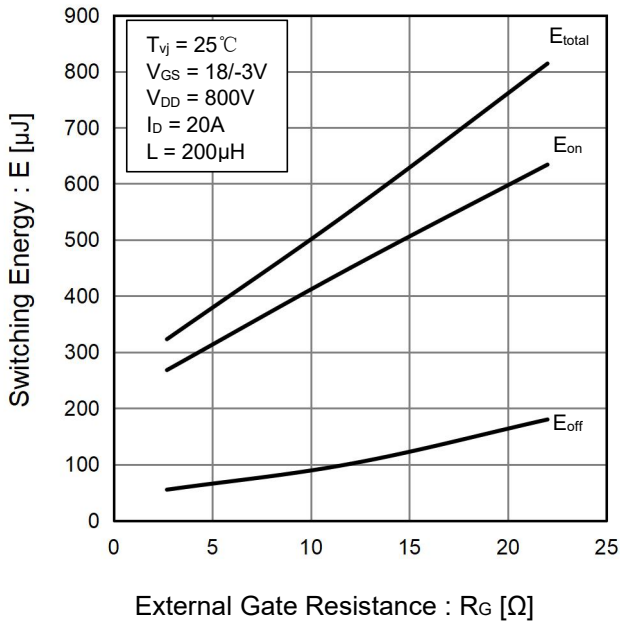


Fig.19 Typical Switching Energy vs. Drain Current

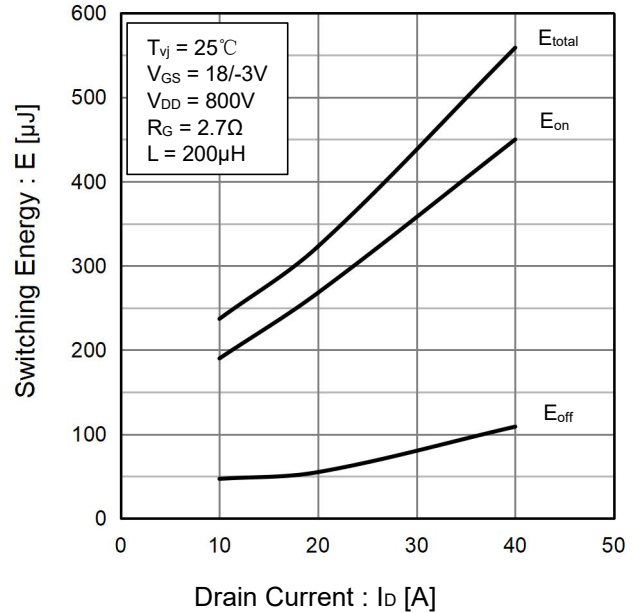
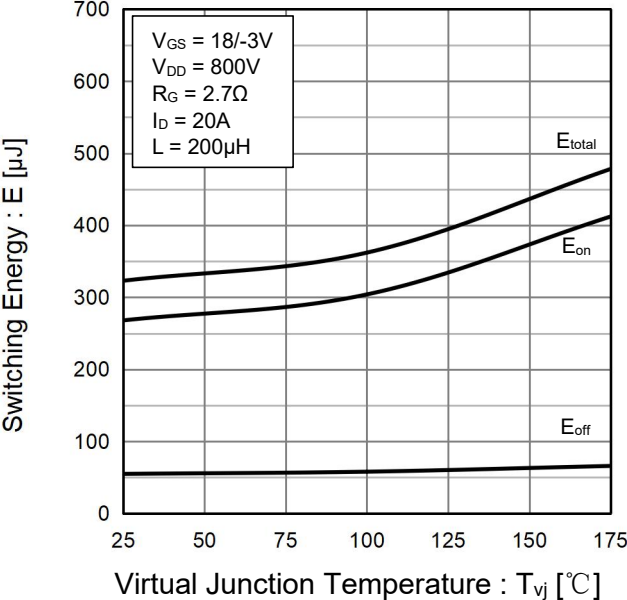
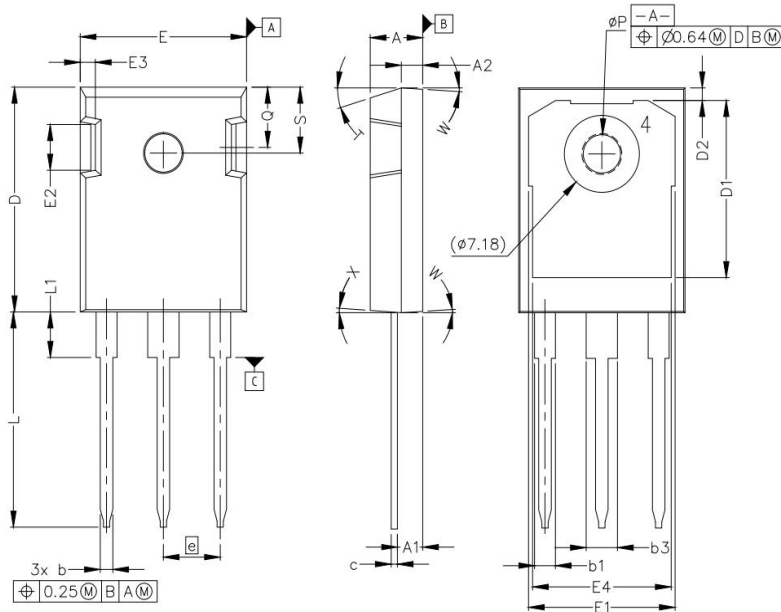


Fig.20 Typical Switching Energy vs. Virtual Junction Temperature



TO-247-3L 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
b	1.07	1.33	0.04	0.05
b1	1.91	2.41	0.08	0.10
b3	2.87	3.38	0.11	0.13
c	0.55	0.68	0.02	0.03
D	20.80	21.10	0.82	0.83
D1	16.25	17.65	0.64	0.70
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	0.15	0.20
E3	1.00	1.90	0.04	0.08
E4	12.38	13.43	0.49	0.53
e	5.44 BSC		0.21 BSC	
L	19.81	20.32	0.78	0.80
L1	4.10	4.40	0.16	0.17
ØP	3.51	3.65	0.14	0.15
Q	5.49	6.00	0.22	0.24
S	6.04	6.30	0.24	0.25
T	17.5° REF			
W	3.5° REF			
X	4° REF			

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