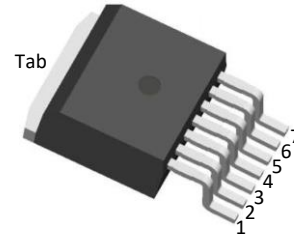
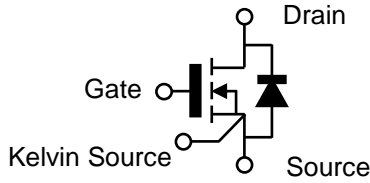


## Silicon Carbide MOSFET

650V, 30mΩ SiC MOSFET – Falcon Series



### Product Information:



**TO-263-7L**

### Features

- Optimized  $R_{DS(on)}$  with Rapid Switching Behavior
- Compatible with Standard Gate Drivers
- Clean Kelvin-Source Switching Pin-out (7L type)
- High Avalanche Endurance Capability
- Optimized for High Power Density Applications
- RoHS Compliant and Halogen Free

Terminal	Pin Arrangement
Gate	1
Drain	Tab
Source	3, 4, 5, 6, 7
Kelvin Source	2

### Benefits

- Higher System Efficiency
- Increase Parallel Device Convenience
- Enable High Temperature Application
- Allow High Frequency Operation
- Realize Compact and Lightweight Systems
- High Reliability

### Potential Applications

- Switching Mode Power Supply
- PFC & DC/DC Converter
- EV Charging Station
- UPS
- Renewable Energy
- Power Inverter & Motor Driver

### Key Performance Parameters

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS @ T_{j(max)}}$	650	V
Recommended Gate-Source Turn-On Voltage	$V_{GS}$	15~18	
Drain-Source On-State Resistance	$R_{DS(on)}$	30	mΩ
Continuous Drain Current	$I_D$	62*	A
Pulse Drain Current	$I_{D, pulse}$	183*	
Power Dissipation	$P_{tot}$	187*	W
Avalanche Energy	$E_{AS}$	1100	mJ
Gate Charge	$Q_G$	125	nC
Output Capacitive Charge	$Q_{oss}$	102	
Junction & Storage Temperature	$T_j, T_{stg}$	-55 to 175	°C

Part Number	Package	Marking
FF06030J-7	TO-263-7L	FF06030

For further information about comparable products, please contact ([www.fastsic.com](http://www.fastsic.com)).

**Maximum Ratings: ( $T_j = 25^\circ\text{C}$ , unless otherwise specified)**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Drain-Source Voltage	$V_{DSS}$	650	--	--	V	$V_{GS}=0\text{V}, I_D=100\mu\text{A}$
Continuous Drain Current	$I_D$	--	--	62* 45*	A	$V_{GS}=18\text{V}, T_C=25^\circ\text{C}$ $V_{GS}=18\text{V}, T_C=100^\circ\text{C}$
Pulse Drain Current	$I_{D,pulse}$	--	--	183*		Per Fig. 12
Continuous Body Diode Current	$I_S$	--	--	39*		$V_{GS}=0\text{V}, T_C=25^\circ\text{C}$
Avalanche Energy, Single Pulse	$E_{AS}$	--	--	1100	mJ	$L=25\text{mH}$
Operate Gate Source Voltage	$V_{GS,op}$	-8~0	--	15~18	V	Recommended operating values
Transient Gate Source Voltage	$V_{GS,tran.}$	-10	--	22		Transient operating limit (AC $f > 1\text{Hz}$ , pulse width $< 100\text{ns}$ )
Power Dissipation	$P_{tot}$	--	--	187*	W	$T_C=25^\circ\text{C}$
Junction Temperature	$T_j$	-55	--	175	°C	--
Storage Temperature	$T_{stg}$	-55	--	175		
Soldering Temperature	$T_L$	--	--	260		

**Electrical Characteristics:**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
<b>DC Characteristics (at <math>T_j = 25^\circ\text{C}</math>, unless otherwise specified)</b>						
Drain-source Breakdown Voltage	$V_{(BR)DSS}$	650	--	--	V	$V_{GS}=0\text{V}, I_D=100\mu\text{A}, T_j=25^\circ\text{C}$ $V_{GS}=0\text{V}, I_D=100\mu\text{A}, T_j=175^\circ\text{C}$
Drain-Source On-State Resistance	$R_{DS(on)}$	--	30 43	45	mΩ	$V_{GS}=18\text{V}, I_D=30\text{A}, T_j=25^\circ\text{C}$ $V_{GS}=18\text{V}, I_D=30\text{A}, T_j=175^\circ\text{C}$
Gate-Source Threshold Voltage	$V_{th}$	--	2.2	--	V	$V_{GS}=V_{DS}, I_D=40\text{mA}$
Zero Gate Voltage Drain Current	$I_{DSS}$	--	2	60	μA	$V_{DS}=650\text{V}, V_{GS}=0\text{V}, T_j=25^\circ\text{C}$
Gate-Source Leakage Current	$I_{GSS}$	--	--	100	nA	$V_{GS}=18\text{V}, V_{DS}=0\text{V}$
Body Diode Forward Voltage	$V_{SD}$	--	3.3 2.9	--	V	$V_{GS}=0\text{V}, I_S=20\text{A}, T_j=25^\circ\text{C}$ $V_{GS}=0\text{V}, I_S=20\text{A}, T_j=175^\circ\text{C}$
<b>AC Characteristics (at <math>T_j = 25^\circ\text{C}</math>, unless otherwise specified)</b>						
Input Capacitance	$C_{iss}$	--	3015	--	pF	$V_{DS}=400\text{V}, V_{GS}=0\text{V},$ $f=250\text{kHz}, V_{AC}=25\text{mV}$
Output Capacitance	$C_{oss}$	--	199	--		
Reverse Capacitance	$C_{rss}$	--	26	--		
Effective Output Capacitance, energy related	$C_{o(er)}^1$	--	222	--		
Effective Output Capacitance, time related	$C_{o(tr)}^2$	--	279	--		
$C_{oss}$ Stored Energy	$E_{oss}$	--	15	--		
Output Capacitive Charge	$Q_{oss}$	--	102	--	nC	
Internal Gate Resistance	$R_{G,int.}$	--	2.4	--	Ω	$f=1\text{MHz}, V_{AC}=25\text{mV}$

<sup>1</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 400V.

<sup>2</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 400V.

### Switching Characteristics:

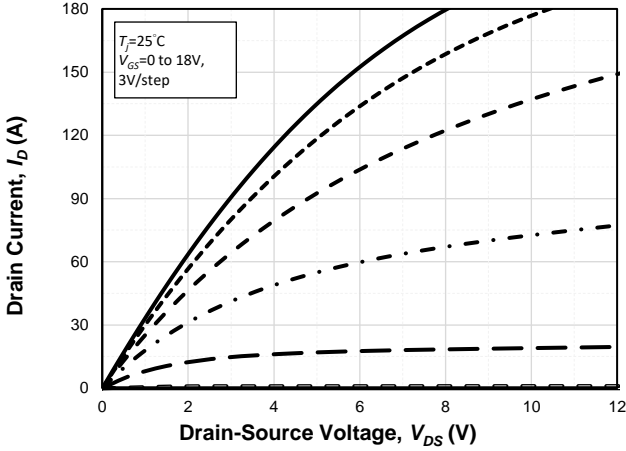
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
<b>Gate Characteristics</b>						
Gate to Source Charge	$Q_{GS}$	--	15	--	nC	$V_{DS}=400V, V_{GS}=0V/15V, I_D=40A$
Gate to Drain Charge	$Q_{GD}$	--	72	--		
Total Gate Charge	$Q_G$	--	125	--		
<b>Inductive Load</b>						
Turn On Delay Time	$t_{d(on)}$	--	57	--	ns	$V_{DS}=400V,$ $I_D=28.5A,$ $V_{GS}=-3/+15V,$ $R_{G(ext.)}=2.7\Omega$ External SiC Diode as an FWD
Rise Time	$t_r$	--	47	--		
Turn Off Delay Time	$t_{d(off)}$	--	14	--		
Fall Time	$t_f$	--	35	--		
Turn On Switching Energy	$E_{on}$	--	324	--	$\mu J$	External SiC Diode as an FWD
Turn Off Switching Energy	$E_{off}$	--	54	--		
<b>Resistive Load</b>						
Turn On Delay Time	$t_{d(on)}$	--	18	--	ns	$V_{DS}=400V,$ $I_D=26.7A, V_{GS}=-3/+15V,$ $R_{G_{on, ext.}}=2.7\Omega, R_{G_{off, ext.}}=1\Omega$ $R_L=15\Omega$
Rise Time	$t_r$	--	25	--		
Turn Off Delay Time	$t_{d(off)}$	--	38	--		
Fall Time	$t_f$	--	14	--		
<b>Body Diode Characteristics</b>						
Reverse Recovery Charge	$Q_{rr}$	--	68	--	nC	$V_{GS}=0V,$ $I_S=40A, V_{DS}=400V,$ $di/dt=300A/\mu s$ * $Q_{rr}$ herein excluded the $Q_{oss}$ value.
Reverse Recovery Time	$t_{rr}$	--	<100	--	ns	
Peak Reverse Recovery Current	$I_{rrm}$	--	3.5	--	A	

### Thermal Characteristics:

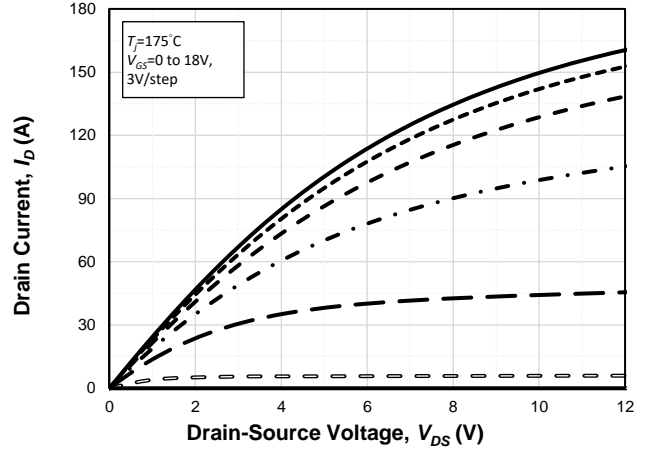
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Thermal Impedance, junction-case	$R_{th-jc}$	--	0.8*	--	K/W	--
Thermal Impedance, junction-ambient	$R_{th-ja}$	--	--	--		Device on PCB, with 6 cm <sup>2</sup> of cooling area

\* By estimation

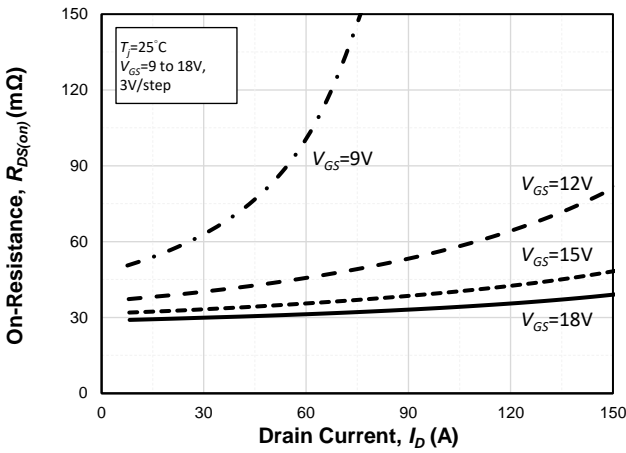
**Electrical Characteristics Diagrams**



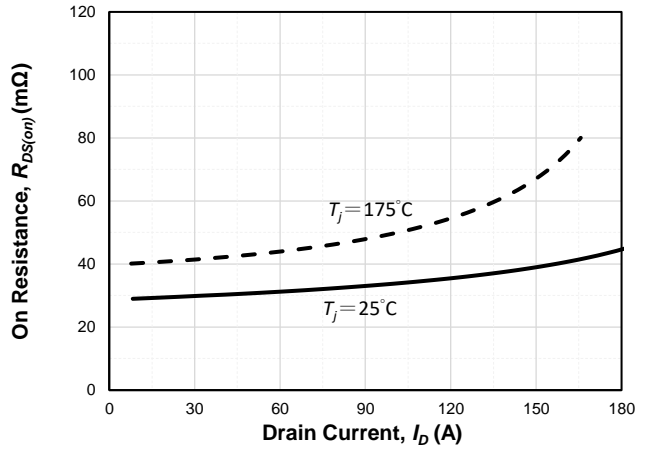
**Fig. 1 Typical Output Characteristics at  $T_j=25^\circ\text{C}$**



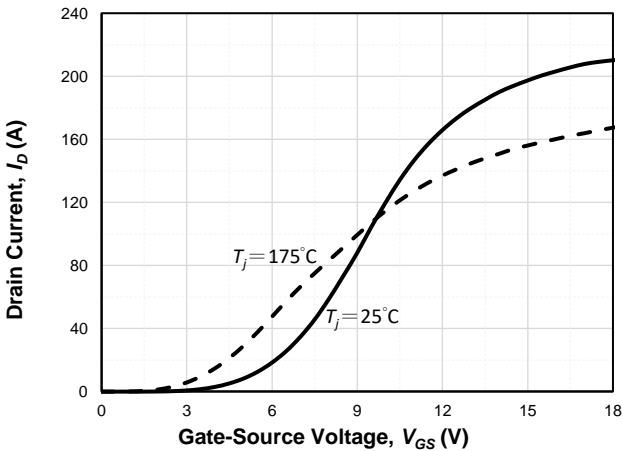
**Fig. 2 Typical Output Characteristics at  $T_j=175^\circ\text{C}$**



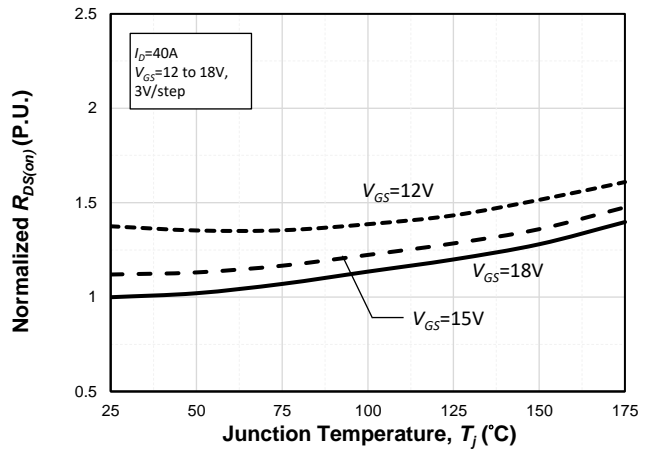
**Fig. 3 Typ.  $R_{DS(on)}$  vs.  $I_D$  with Various  $V_{GS}$**



**Fig. 4 Typ.  $R_{DS(on)}$  vs.  $I_D$  with Various  $T_j$ ,  $V_{GS}=18\text{V}$**



**Fig. 5 Typ.  $I_D$  vs.  $V_{GS}$  with Various  $T_j$ ,  $V_{DS}=20\text{V}$**



**Fig. 6 Normalized  $R_{DS(on)}$  vs.  $T_j$  with Various  $V_{GS}$**

**Electrical Characteristics Diagrams**

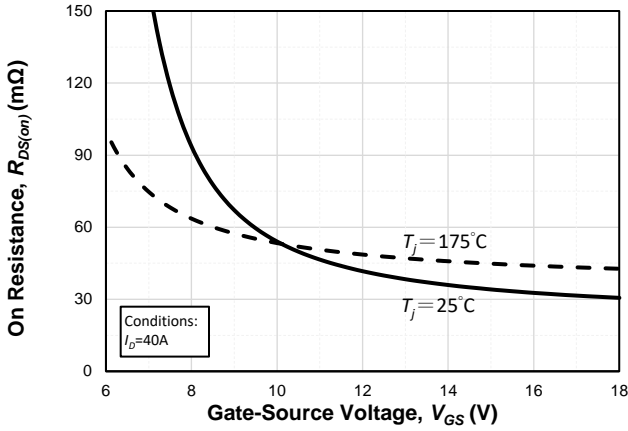


Fig. 7 Typ.  $R_{DS(on)}$  vs.  $V_{GS}$  with Various  $T_j$

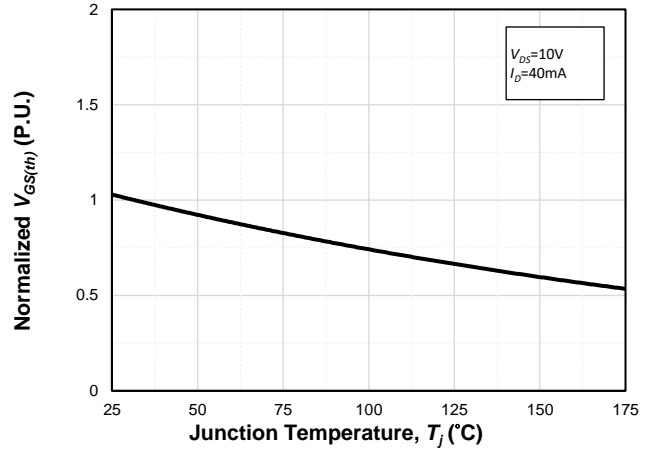


Fig. 8 Normalized  $V_{th}$  vs.  $T_j$

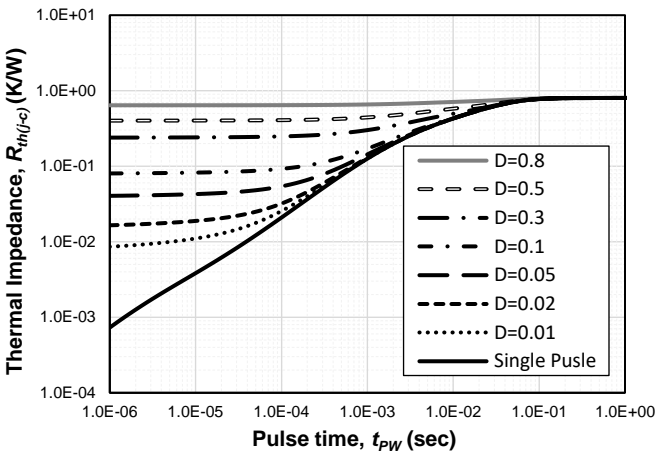


Fig. 9 Typ. Transient Thermal Impedance  $R_{th-jc}$

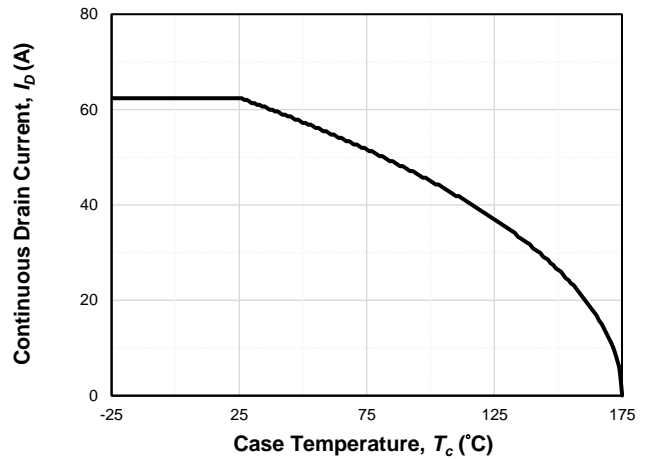


Fig. 10 Continuous  $I_D$  De-rating at  $V_{GS}=18V$ ,  $T_j \leq 175^\circ C$

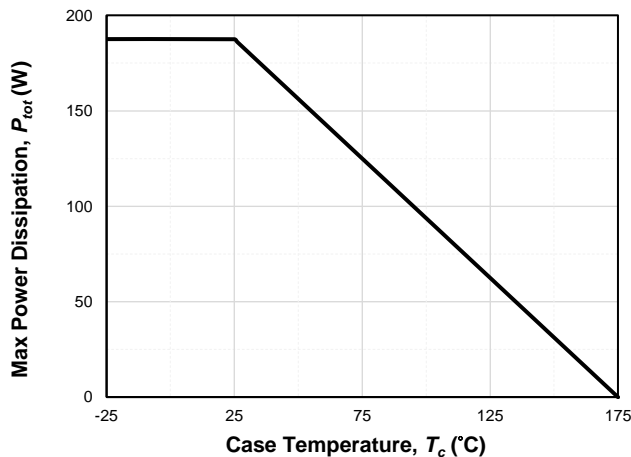


Fig. 11 Power Dissipation at  $V_{GS}=18V$ ,  $T_j \leq 175^\circ C$

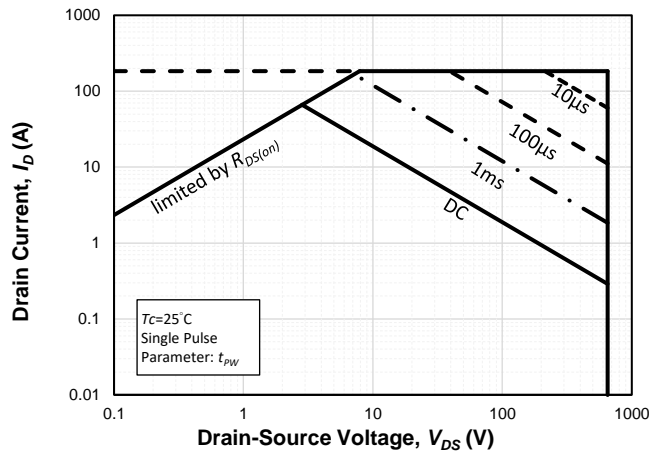
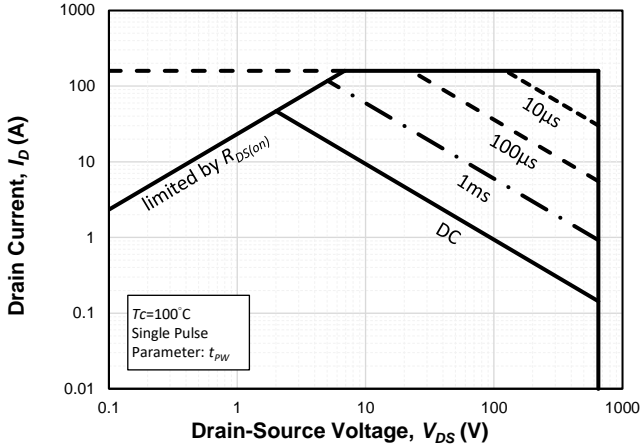
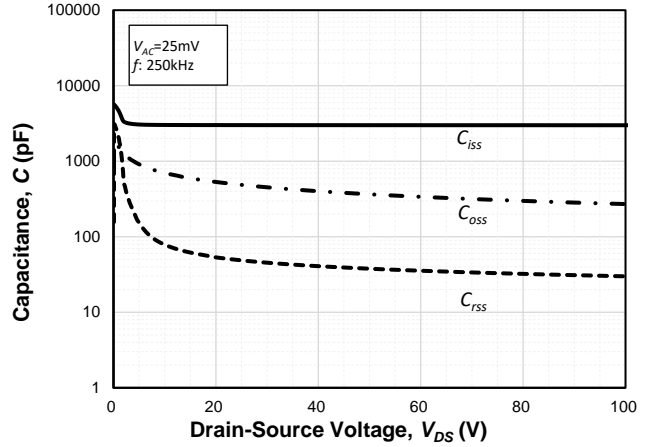


Fig. 12 Safe Operating Area at  $T_c=25^\circ C$

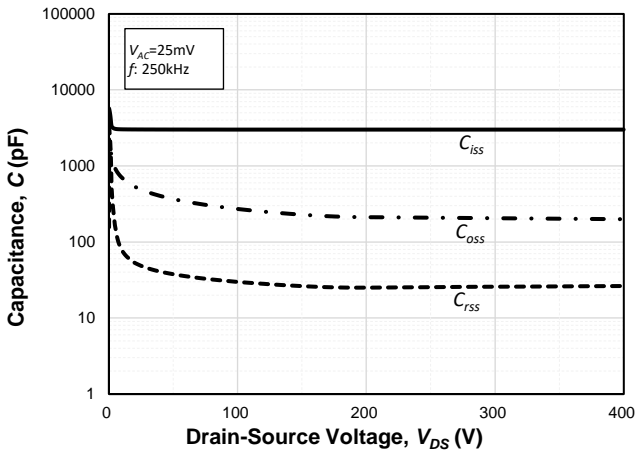
**Electrical Characteristics Diagrams**



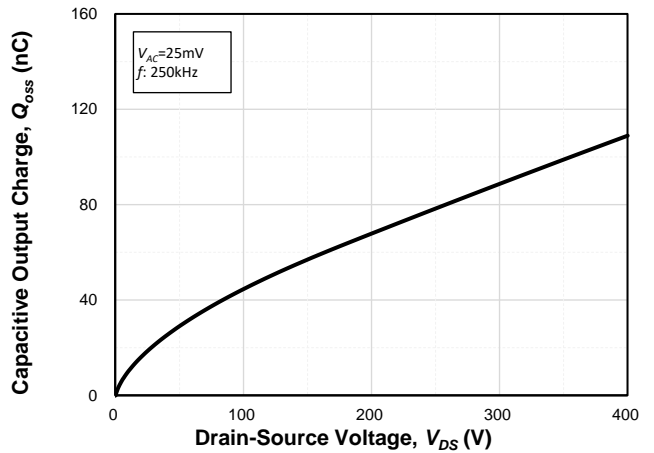
**Fig. 13 Safe Operating Area at  $T_c=100^\circ\text{C}$**



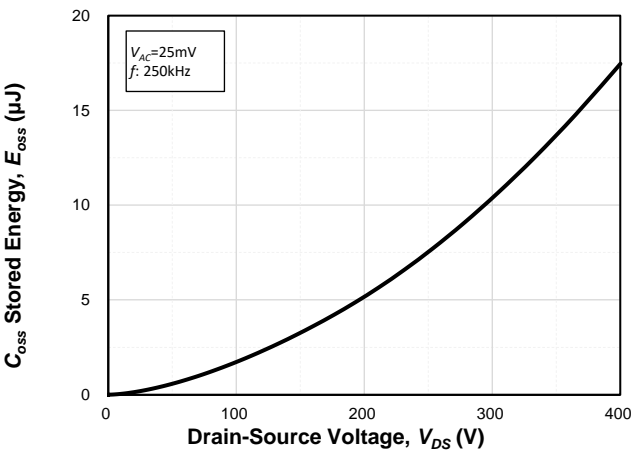
**Fig. 14 Typ. Capacitance vs.  $V_{DS}$  at  $f_{sw}=250\text{kHz}$ ,  $V_{DS}\leq 100\text{V}$**



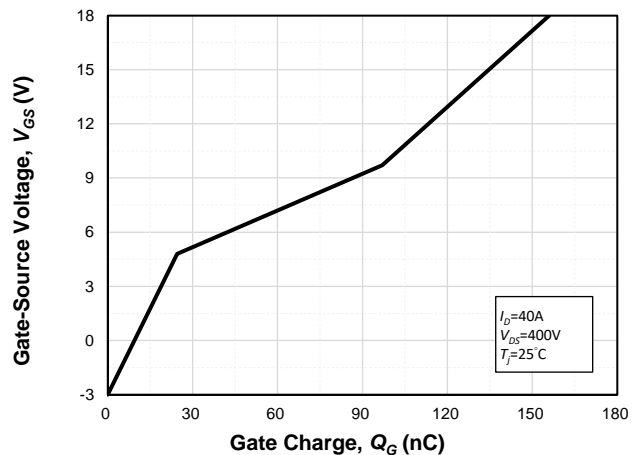
**Fig. 15 Typ. Capacitance vs.  $V_{DS}$  at  $f_{sw}=250\text{kHz}$ ,  $V_{DS}\leq 400\text{V}$**



**Fig. 16 Typ. Capacitive Output Charge at  $f_{sw}=250\text{kHz}$**

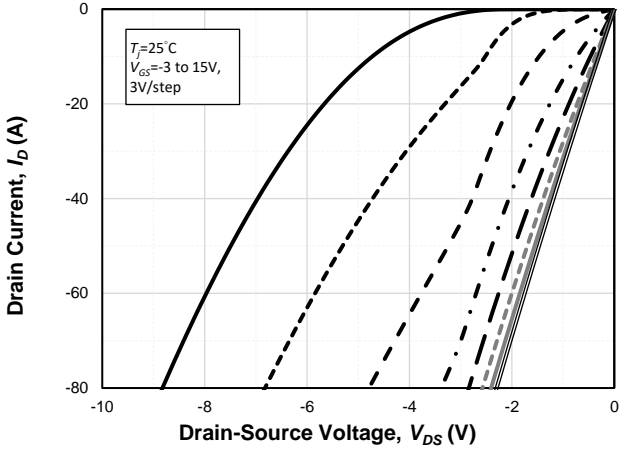


**Fig. 17 Typ.  $C_{oss}$  Stored Energy at  $f_{sw}=250\text{kHz}$**

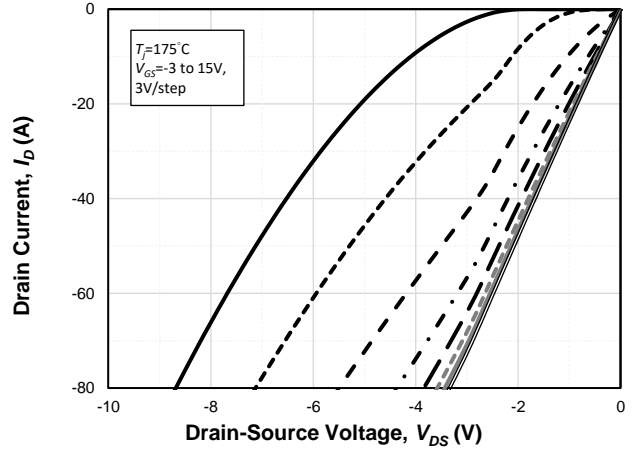


**Fig. 18 Typ. Gate Charge at  $V_{DS}=400\text{V}$ ,  $I_D=40\text{A}$**

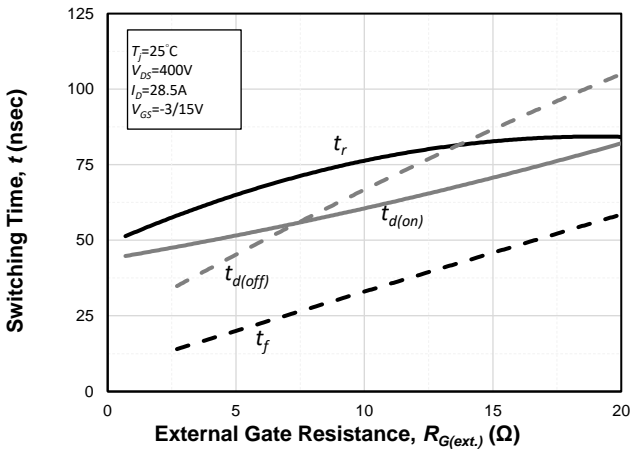
**Electrical Characteristics Diagrams**



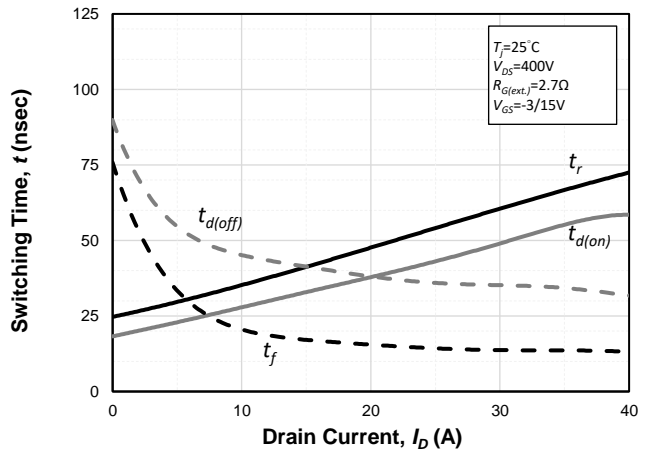
**Fig. 19 Typical Forward Characteristics of Reverse Conduction at  $T_j=25^\circ\text{C}$**



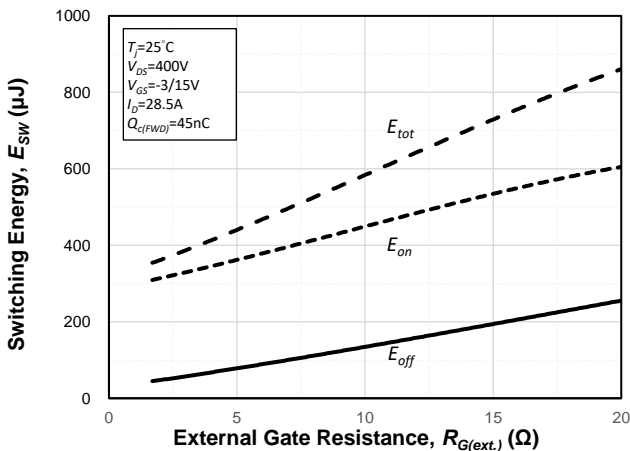
**Fig. 20 Typical Forward Characteristics of Reverse Conduction at  $T_j=175^\circ\text{C}$**



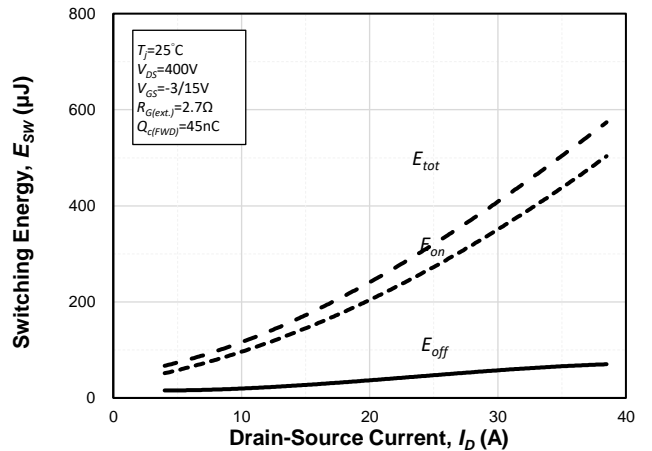
**Fig. 21 Typ. Switching Time vs.  $R_{G(ext.)}$**



**Fig. 22 Typ. Switching Time vs.  $I_D$**

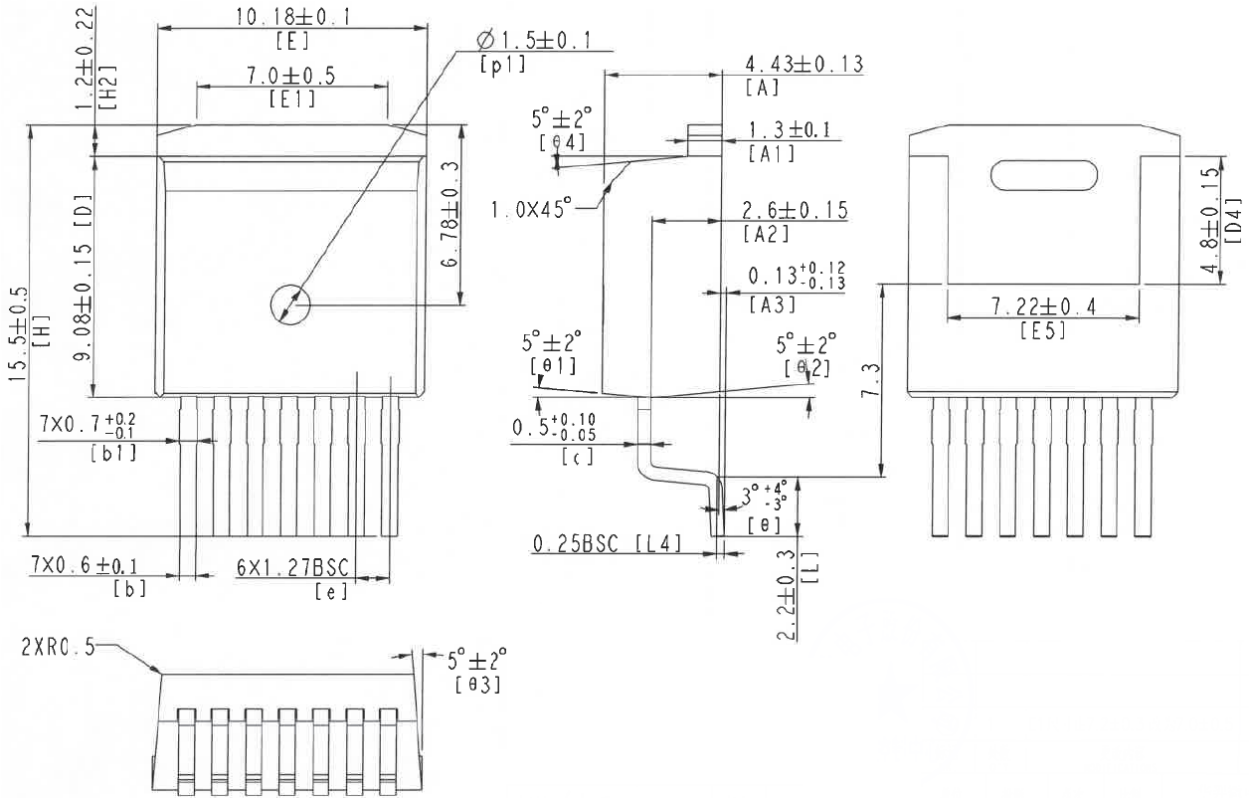


**Fig. 23 Typ. Switching Energy vs.  $R_{G(ext.)}$**



**Fig. 24 Typ. Switching Energy vs.  $I_D$**

**Package Outline (TO-263-7L)**





**Revision History**

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Date	Revision	Changes
22.11	Tentative	1 <sup>st</sup> issue

**Important Note (Disclaimer)**

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Hsinchu, Taiwan  
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