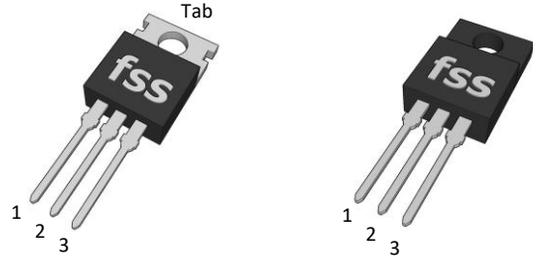
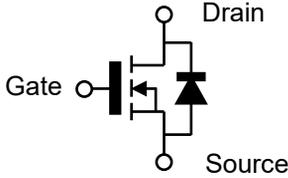


Silicon Carbide MOSFET

750V, 150mΩ SiC MOSFET – Falcon M2 Series



Product Information:



TO-220-3L

TO-220FP-3L

Features

- Optimized $R_{DS(on)}$ with Rapid Switching Behavior
- Compatible with Standard Gate Drivers
- High Avalanche Endurance Capability
- Optimized for High Power Density Applications
- Fully Packaged with Galvanic Isolation*^(optional)
- RoHS Compliant and Halogen Free

Terminal	Packaging Type	
	TO-220-3L	TO-220FP-3L
Gate	1	1
Drain	2, Tab	2
Source	3	3

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
- Motor Driver
- Renewable Energy
- Power Inverter & Motor Driver

Key Performance Parameters

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}@T_{j(max)}$	750	V
Recommended Gate-Source Turn-On Voltage	V_{GS}	15	
Drain-Source On-State Resistance	$R_{DS(on)}$	150	mΩ
Continuous Drain Current	TO-220-3L	22	A
	TO-220FP-3L	14	
Pulse Drain Current	$I_{D,pulse}$	40	
Power Dissipation	TO-220-3L	136	W
	TO-220FP-3L	51	
Avalanche Energy	E_{AS}	150	mJ
Gate Charge	Q_G	22.9	nC
Output Capacitive Charge	Q_{oss}	28	
Junction & Storage Temperature	T_j, T_{stg}	-55 to 175	°C

Part Number	Package	Marking
FF07150M2C	TO-220-3L	FF07150M2
FF07150M2D	TO-220-3L (Full-Pack)	FF07150M2

For further information about comparable products, please contact (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}	750	--	--	V	$V_{GS}=0\text{V}, I_D=100\mu\text{A}$
Continuous Drain Current	I_D	--	--	22	A	$V_{GS}=15\text{V}, T_c=25^\circ\text{C}$ $V_{GS}=15\text{V}, T_c=100^\circ\text{C}$ (TO-220-3L)
		--	--	14		
Pulse Drain Current	$I_{D,pulse}$	--	--	40		$V_{GS}=15\text{V}, T_c=25^\circ\text{C}$ $V_{GS}=15\text{V}, T_c=100^\circ\text{C}$ (TO-220FP-3L)
		--	--	10		
Continuous Body Diode Current	I_S	--	--	21	V	$V_{GS}=0\text{V}, T_c=25^\circ\text{C}$ (TO-220-3L)
		--	--	11		$V_{GS}=0\text{V}, T_c=25^\circ\text{C}$ (TO-220FP-3L)
Avalanche Energy, Single Pulse	E_{AS}	--	--	150	mJ	$L=25\text{mH}$
Operate Gate Source Voltage	$V_{GS,op}$	-8~0	--	12~15	V	Recommended operating values
Transient Gate Source Voltage	$V_{GS,tran.}$	-10	--	19		Transient operating limit (AC $f > 1\text{Hz}$, pulse width $< 100\text{ns}$)
Power Dissipation	P_{tot}	--	--	136	W	$T_c=25^\circ\text{C}$ (TO-220-3L)
		--	--	51		$T_c=25^\circ\text{C}$ (TO-220FP-3L)
Junction Temperature	T_j	-55	--	175	$^\circ\text{C}$	--
Storage Temperature	T_{stg}	-55	--	175		
Soldering Temperature	T_L	--	--	260		

Electrical Characteristics:

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	
DC Characteristics (at $T_j = 25^\circ\text{C}$, unless otherwise specified)							
Drain-source Breakdown Voltage	$V_{(BR)DSS}$	750	--	--	V	$V_{GS}=0\text{V}, I_D=100\mu\text{A}, T_j=25^\circ\text{C}$	
Drain-Source On-State Resistance	$R_{DS(on)}$	--	150	194	m Ω	$V_{GS}=15\text{V}, I_D=5\text{A}, T_j=25^\circ\text{C}$	
		--	161	--		$V_{GS}=15\text{V}, I_D=5\text{A}, T_j=100^\circ\text{C}$	
		--	200	--		$V_{GS}=12\text{V}, I_D=5\text{A}, T_j=25^\circ\text{C}$	
		--	193	--		$V_{GS}=12\text{V}, I_D=5\text{A}, T_j=100^\circ\text{C}$	
Gate-Source Threshold Voltage	V_{th}	--	2.5	--	V	$V_{GS}=V_{DS}, I_D=6\text{mA}$	
Zero Gate Voltage Drain Current	I_{DSS}	--	2	100	μA	$V_{DS}=750\text{V}, V_{GS}=0\text{V}, T_j=25^\circ\text{C}$	
Gate-Source Leakage Current	I_{GSS}	--	--	100	nA	$V_{GS}=15\text{V}, V_{DS}=0\text{V}$	
Body Diode Forward Voltage	V_{SD}	--	2.8	--	V	$V_{GS}=0\text{V}, I_S=3\text{A}, T_j=25^\circ\text{C}$	
		--	2.6	--		$V_{GS}=0\text{V}, I_S=3\text{A}, T_j=100^\circ\text{C}$	
AC Characteristics (at $T_j = 25^\circ\text{C}$, unless otherwise specified)							
Input Capacitance	C_{ISS}	--	688	--	pF	$V_{DS}=400\text{V}, V_{GS}=0\text{V},$ $f=250\text{kHz}, V_{AC}=25\text{mV}$	
Output Capacitance	C_{OSS}	--	35.5	--			
Reverse Capacitance	C_{RSS}	--	2.6	--			
Effective Output Capacitance, energy related	$C_{o(er)}^1$	--	40.8	--			
Effective Output Capacitance, time related	$C_{o(tr)}^2$	--	61.4	--			
C_{OSS} Stored Energy	E_{OSS}	--	3.2	--			μJ
Output Capacitive Charge	Q_{OSS}	--	24.1	--			nC
Internal Gate Resistance	$R_{G,int.}$	--	5.5	--	Ω	$f=1\text{MHz}, V_{AC}=25\text{mV}$	

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

² $C_{o(tr)}$ 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
Gate Characteristics						
Gate to Source Charge	Q_{GS}	--	5.4	--	nC	$V_{DS}=400V, V_{GS}=0V/15V, I_D=5A$
Gate to Drain Charge	Q_{GD}	--	7.5	--		
Total Gate Charge	Q_G	--	22.9	--		
Inductive Load						
Turn On Delay Time	$t_{d(on)}$	--	19.9	--	ns	$V_{DS}=500V,$ $I_D=5A,$ $V_{GS}=0/+15V,$ $R_{G(ext.)}=4.7\Omega$
Rise Time	t_r	--	19.1	--		
Turn Off Delay Time	$t_{d(off)}$	--	23.6	--		
Fall Time	t_f	--	15.6	--		
Turn On Switching Energy	E_{on}	--	104.4	--	μJ	
Turn Off Switching Energy	E_{off}	--	1.5	--		
Body Diode Characteristics						
Forward Recovery Charge	Q_{fr}	--	88.8	--	nC	$V_{DS}=500V, I_S=5A,$ $di/dt=2150A/\mu s$ * Q_{fr} herein included the Q_{oss} value.
Forward Recovery Time	T_{fr}	--	12	--	ns	
Peak Forward Recovery Current	I_{frm}	--	14.8	--	A	

¹ Test are based on TO-220-3L PKG

Thermal Characteristics:

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Thermal Impedance, junction-case	R_{th-jc}	--	1.1	--	K/W	TO-220-3L
		--	2.9	--		TO-220FP-3L
Thermal Impedance, junction-ambient	R_{th-ja}	--	40	--		Device on PCB, with 6 cm ² of cooling area

Electrical Characteristics Diagrams

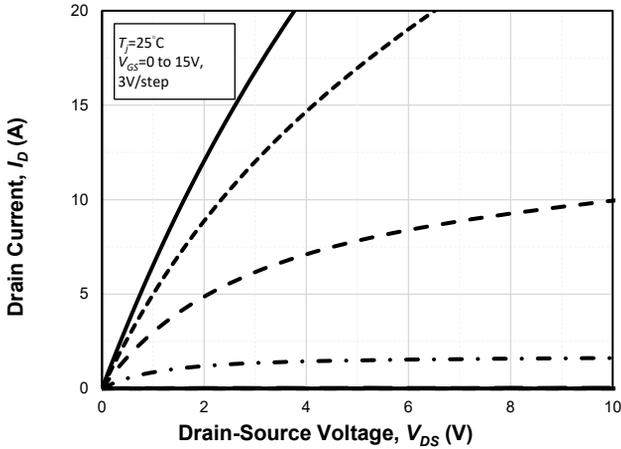


Fig. 1 Typical Output Characteristics at $T_j=25^\circ\text{C}$

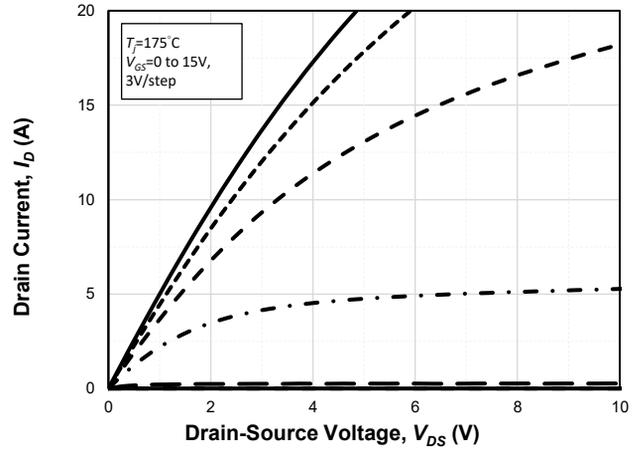


Fig. 2 Typical Output Characteristics at $T_j=175^\circ\text{C}$

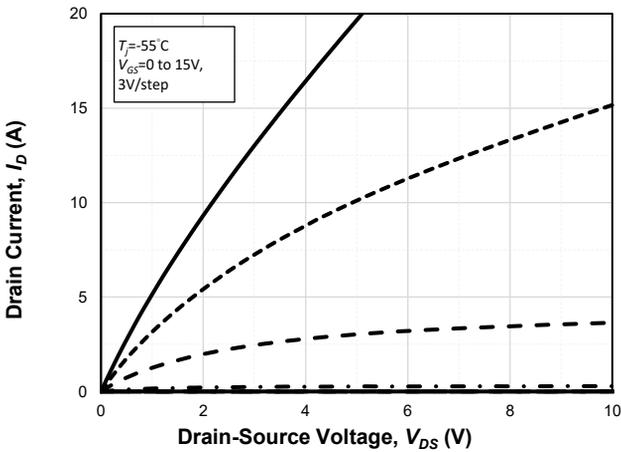


Fig. 3 Typical Output Characteristics at $T_j=-55^\circ\text{C}$

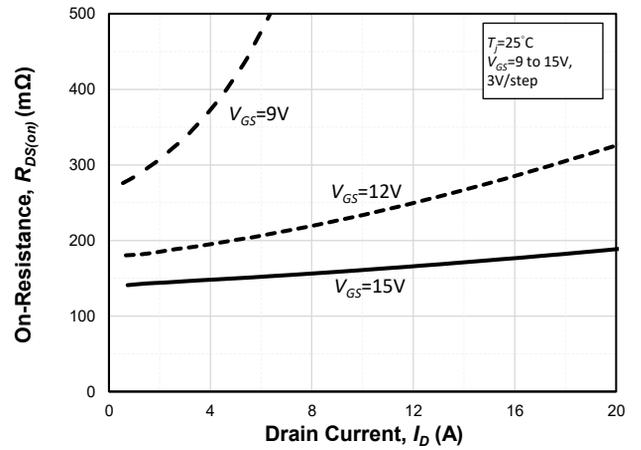


Fig. 4 Typ. $R_{DS(on)}$ vs. I_D with Various V_{GS}

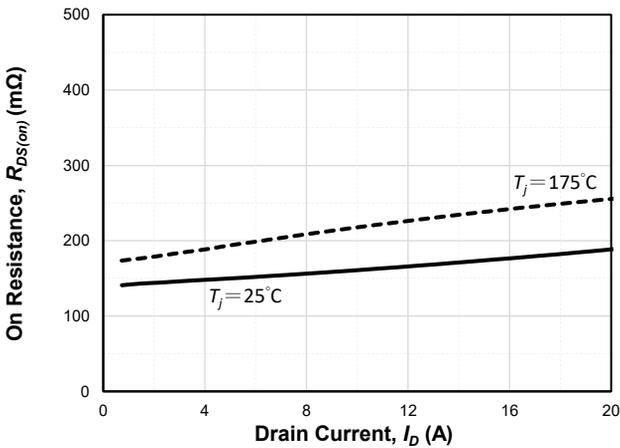


Fig. 5 Typ. $R_{DS(on)}$ vs. I_D with Various T_j , $V_{GS}=15\text{V}$

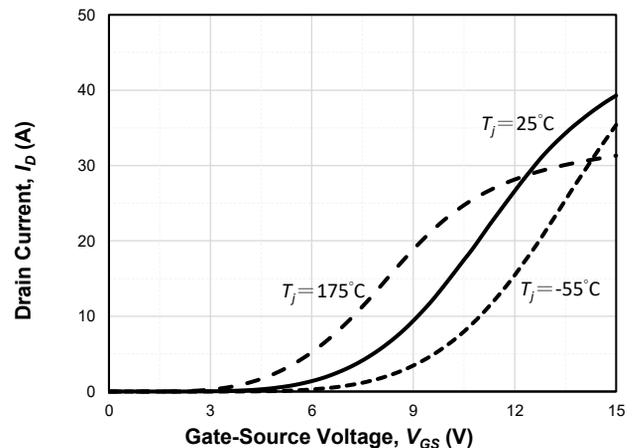


Fig. 6 Typ. I_D vs. V_{GS} with Various T_j , $V_{DS}=10\text{V}$

Electrical Characteristics Diagrams

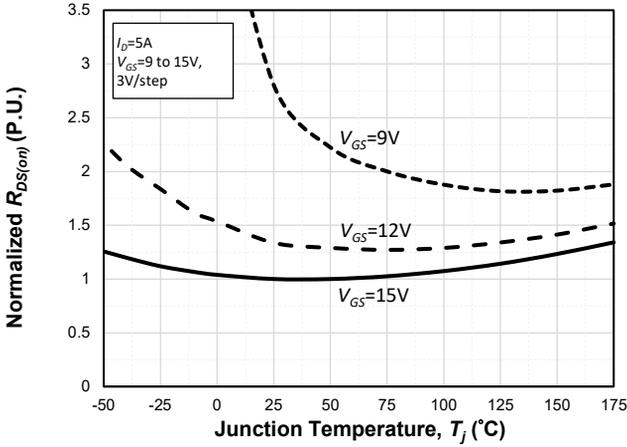


Fig. 7 Normalized $R_{DS(on)}$ vs. T_j with Various V_{GS}

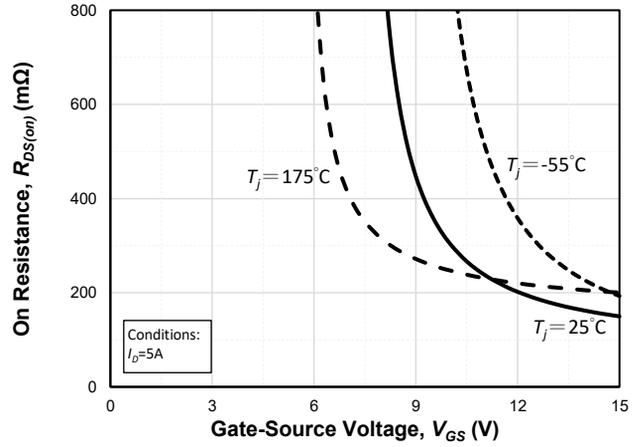


Fig. 8 Typ. $R_{DS(on)}$ vs. V_{GS} with Various T_j

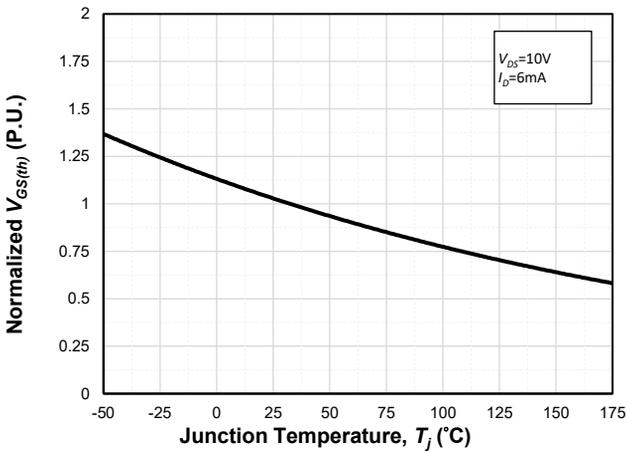


Fig. 9 Normalized V_{th} vs. T_j

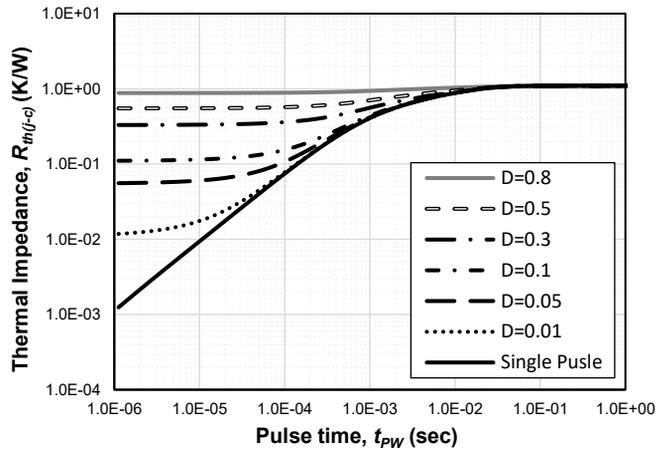


Fig. 10 Typ. Transient Thermal Impedance R_{th-jc} (TO-220-3L)

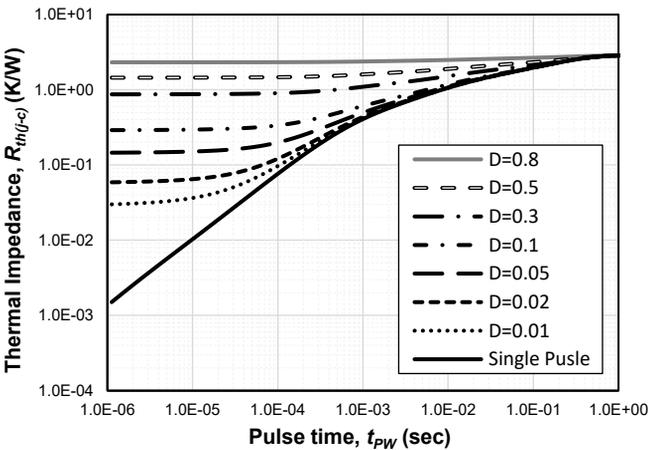


Fig. 11 Typ. Transient Thermal Impedance R_{th-jc} (TO-220-3L, Full-Pack)

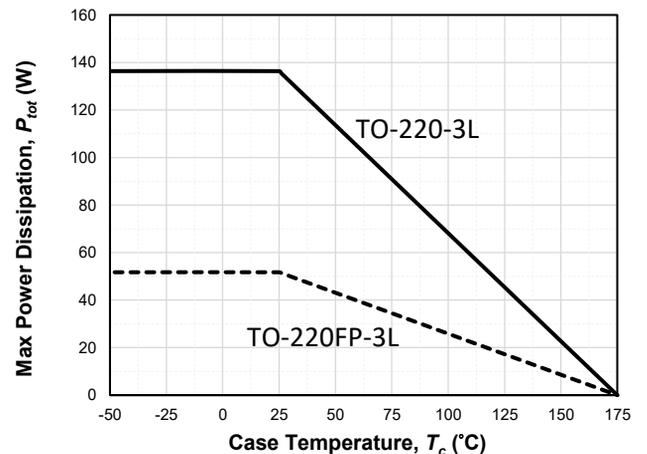


Fig. 12 Power Dissipation at $V_{GS}=15V$, $T_j \leq 175^\circ C$

Electrical Characteristics Diagrams

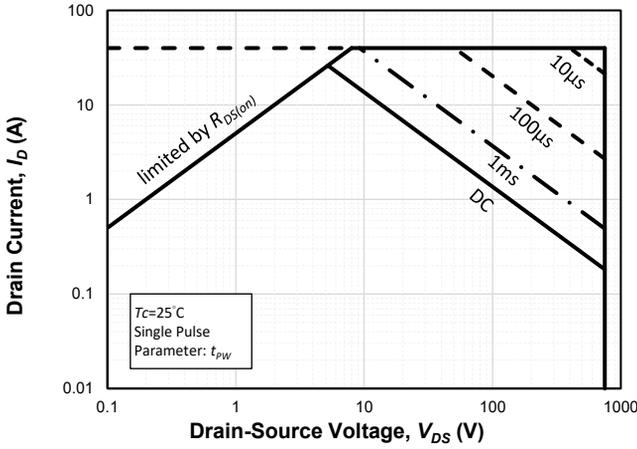


Fig. 13 Safe Operating Area at $T_c=25^\circ\text{C}$ (TO-220-3L)

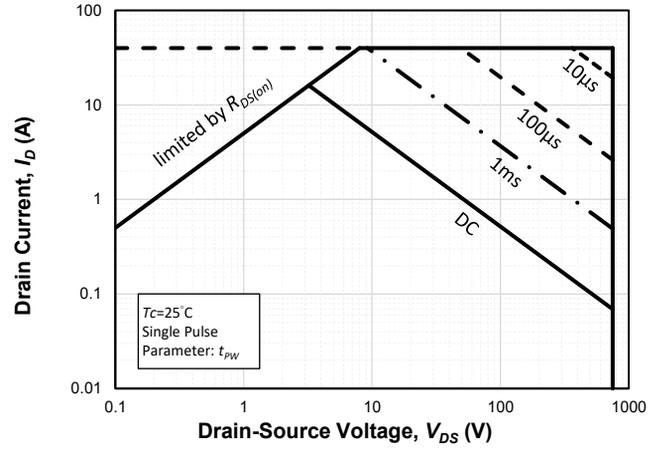


Fig. 14 Safe Operating Area at $T_c=25^\circ\text{C}$ (TO-220-3L, Full-Pack)

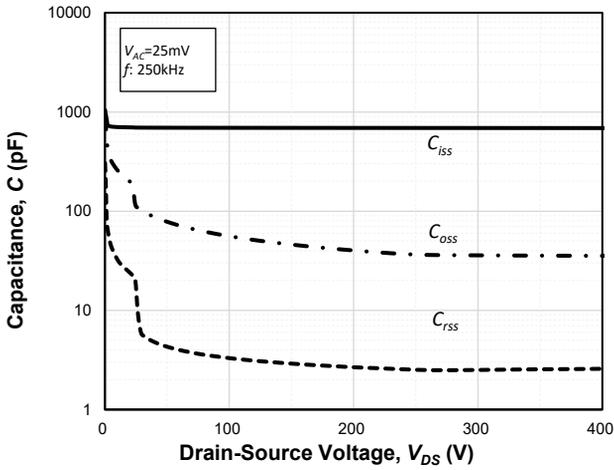


Fig. 15 Typ. Capacitance vs. V_{DS} at $f_{sw}=250\text{kHz}$

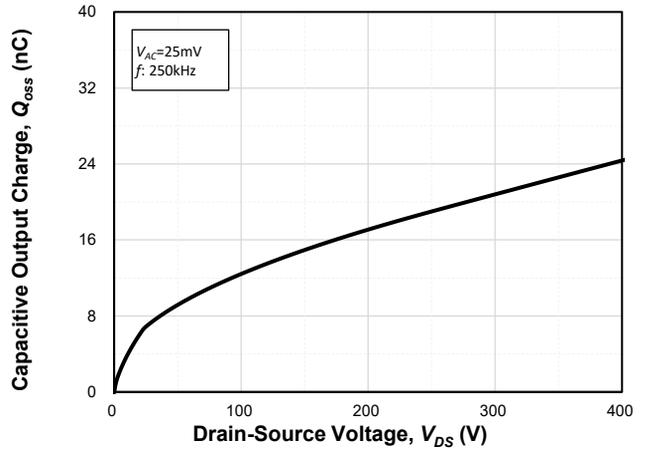


Fig. 16 Typ. Capacitive Output Charge at $f_{sw}=250\text{kHz}$

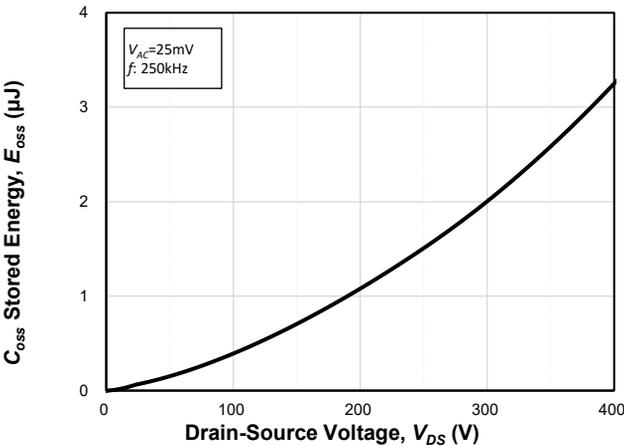


Fig. 17 Typ. C_{oss} Stored Energy at $f_{sw}=250\text{kHz}$

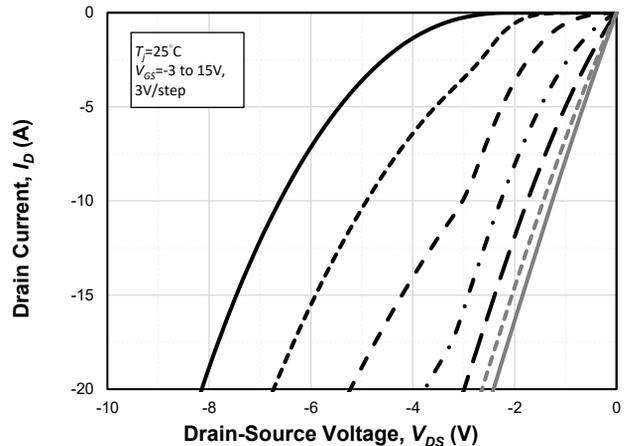


Fig. 18 Typical Forward Characteristics of Reverse Conduction at $T_f=25^\circ\text{C}$

Electrical Characteristics Diagrams

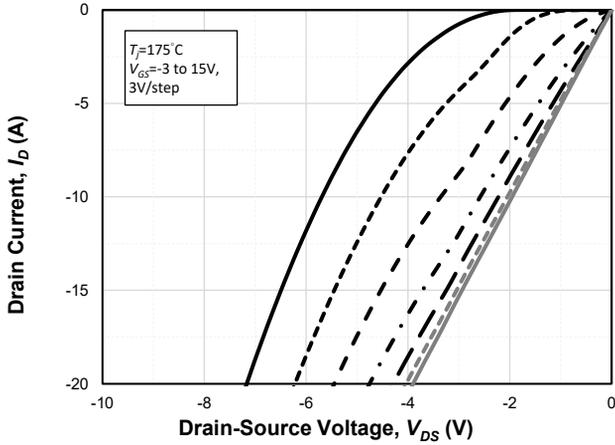


Fig. 19 Typical Forward Characteristics of Reverse Conduction at $T_j=175^\circ\text{C}$

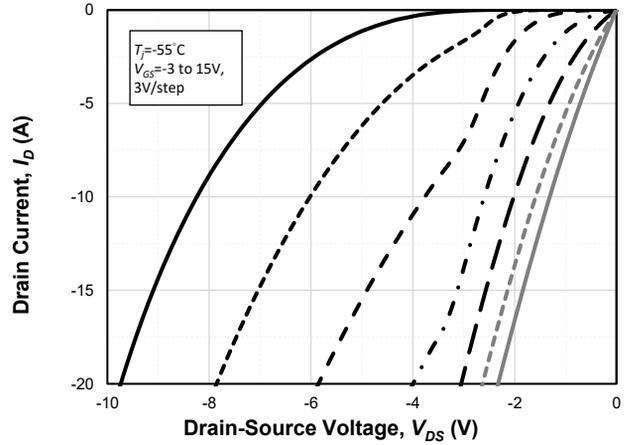


Fig. 20 Typical Forward Characteristics of Reverse Conduction at $T_j=-55^\circ\text{C}$

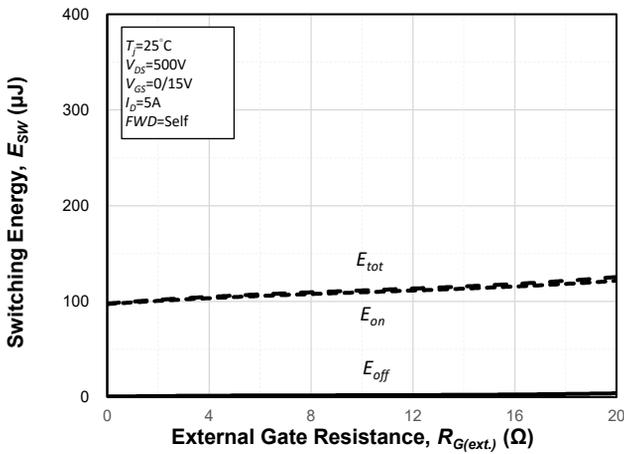


Fig. 21 Typ. Switching Energy vs. $R_{G(\text{ext.})}$

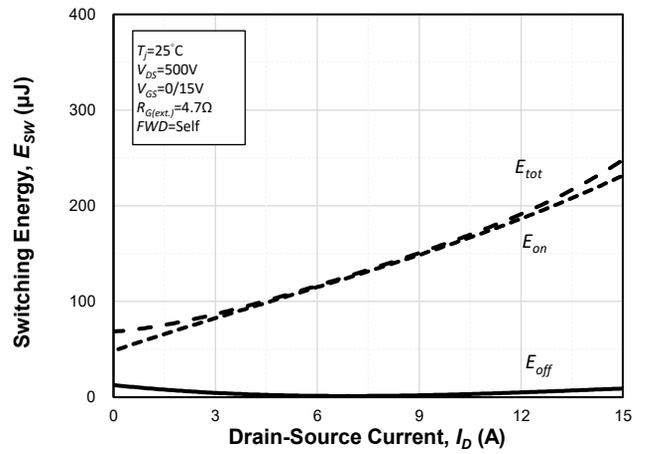


Fig. 22 Typ. Switching Energy vs. I_D

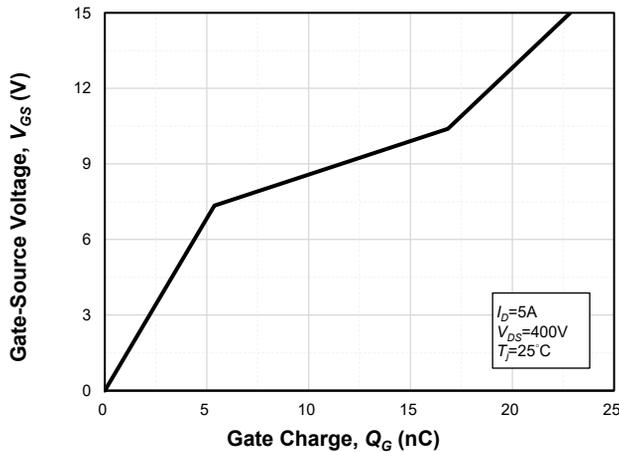
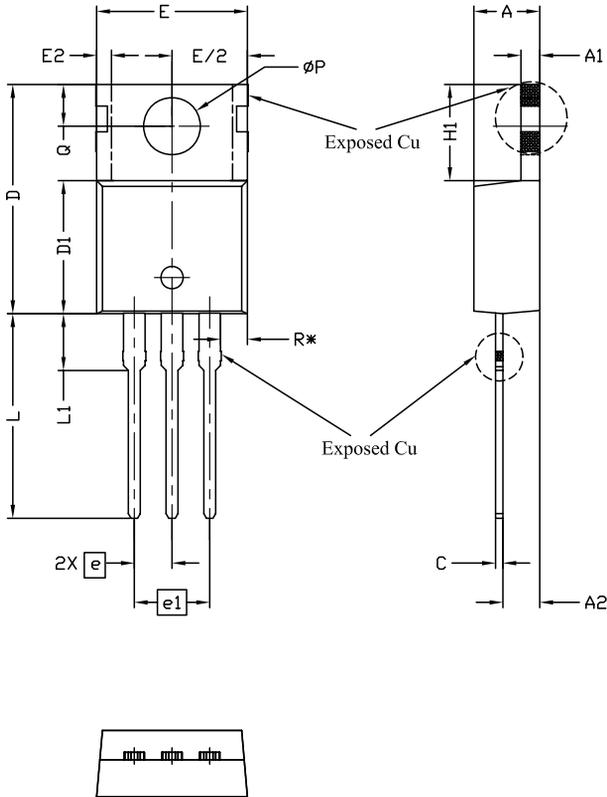


Fig. 23 Typ. Gate Charge at $V_{DS}=400\text{V}$, $I_D=5\text{A}$

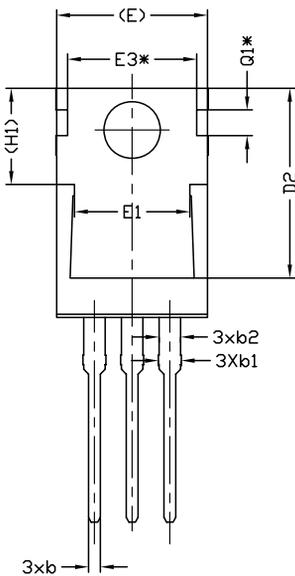
Package Outline (TO-220-3L)



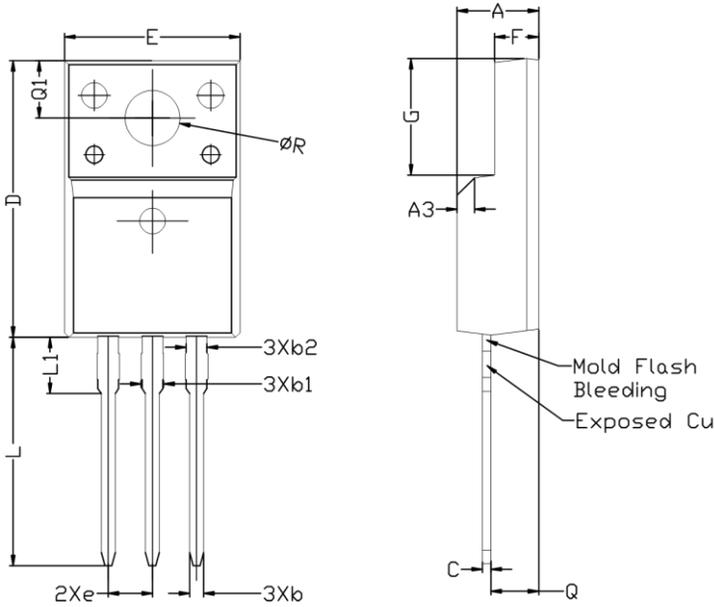
Symbol	Dimension (Millimeters)		
	Min.	Nom.	Max.
A	4.24	4.44	4.64
A1	1.15	1.27	1.40
A2	2.30	2.48	2.70
b	0.70	0.80	0.90
b1	1.20	1.55	1.75
b2	1.20	1.45	1.70
c	0.40	0.50	0.60
D ⁽²⁾	14.70	15.37	16.00
D1	8.82	8.92	9.02
D2 ⁽³⁾	12.43	12.73	12.83
E ^{(2), (3)}	9.96	10.16	10.36
E1 ⁽³⁾	6.86	7.77	8.89
E2 ⁽⁴⁾	--	--	0.76
E3*	8.70 REF.		
e	2.54 BSC.		
e1	5.08 BSC.		
H1 ^{(3), (4)}	6.30	6.45	6.60
L	13.47	13.72	13.97
L1	3.60	3.80	4.00
ØP	3.75	3.84	3.93
Q	2.60	2.80	3.00
Q1*	1.73 REF.		
R*	1.82 REF.		

Note:

1. Slot required; notch may be rounded.
2. Dimension D & E do not include mold flash. Mold flash shall not exceed 0.127mm pre side. These dimensions are measure at the outermost extreme of the plastic body.
3. Thermal pad contour optional within dimensions E, H1, D2 & E1.
4. Dimension E2 & H1 define a zone where stamping and singulation irregularities are allowed.
5. "*" is for reference.



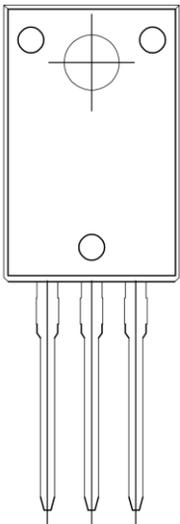
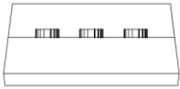
Package Outline (TO-220FP-3L)



Symbol	Dimension (Millimeters)		
	Min.	Nom.	Max.
A	4.60	4.70	4.80
b	0.70	0.80	0.91
b1	1.20	1.30	1.47
b2	1.10	1.20	1.30
C	0.45	0.50	0.63
D	15.80	15.87	15.97
e	2.54 BSC.		
E	10.0	10.10	10.30
F	2.44	2.54	2.64
G	6.50	6.70	6.90
L	12.90	13.10	13.30
L1	3.13	3.23	3.33
Q	2.65	2.75	2.85
Q1	3.20	3.30	3.40
ϕR	3.08	3.18	3.28

Note:

Package body sizes exclude mold flash and burrs. Mold flash should be less than 6 mil.



Revision History

Date	Revision	Changes
25.06	Tentative	1 st issue
25.07	Preliminary	1 st issue

Important Note (Disclaimer)

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This product is not designed or intended for use for applications in which the failure of the product could lead to personal injury, death or property damage, including but not limited to equipment used in medical systems, traffic communication or control systems, transportations (cars, ships, trains) and aerospace. FSS shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions provided herein.

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