



SUPER-MOSFET

Super Junction Metal Oxide Semiconductor Field Effect Transistor

600V Super Junction Power MOSFET Gen-II With Fast-Recovery
SS*60R190SFD

Rev. 1.4

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SUPER

SSF60R190SFD/SSP60R190SFD/SSW60R190SFD 600V N-Channel Super-Junction MOSFET Gen-II With Fast-Recovery

Description

SJ-FET is new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance. This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. SJ-FET is suitable for various AC/DC power conversion in switching mode operation for higher efficiency.

Features

- Multi-Epi process SJ-FET
- Fast-Recovery body diode
- Extremely Low Reverse Recovery Charge
- 650V @T_J = 150 °C
- Typ. R_{DS(on)} = 0.175Ω
- Ultra Low Gate Charge (typ. Q_g = 36.5nC)
- 100% avalanche tested

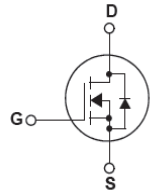
SSF60R190SFD



SSP60R190SFD



SSW60R190SFD



Absolute Maximum Ratings

Symbol	Parameter	SSP_W60R190SFD	SSF60R190SFD	Unit
V _{DSS}	Drain-Source Voltage	600		V
I _D	Drain Current -Continuous (TC = 25°C) -Continuous (TC = 100°C)	20* 12.6*		A
I _{DM}	Drain Current - Pulsed (Note 1)	65		A
V _{GSS}	Gate-Source voltage	±30		V
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	625		mJ
I _{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max)	5		A
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15		V/ns
dVds/dt	Drain Source voltage slope (V _{ds} =480V)	50		V/ns
P _D	Power Dissipation (TC = 25°C)	150	34	W
T _J , T _{STG}	Operating and Storage Temperature Range	-55 to +150		°C
T _L	Maximum Lead Temperature for Soldering Purpose, 1/16" from Case for 10 Seconds	260		°C

* Drain current limited by maximum junction temperature. Maximum duty cycle D=0.75.

Thermal Characteristics

Symbol	Parameter	SSP_W60R190SFD	SSF60R190SFD	Unit
R _{θJC}	Thermal Resistance, Junction-to-Case	0.83	3.7	°C/W
R _{θCS}	Thermal Resistance, Case-to-Sink Typ.	0.5	-	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient	62	80	°C/W

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Electrical Characteristics TC = 25°C unless otherwise noted

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0V, I _D = 250μA, T _J = 25°C	600	-	-	V
		V _{GS} = 0V, I _D = 250μA, T _J = 150°C	650	-	-	V
ΔBV _{DSS} /ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 250μA, Referenced to 25°C	-	0.6	-	V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 600V, V _{GS} = 0V -T _C = 125°C	-	1 300	4 -	μA μA
I _{GSSF}	Gate-Body Leakage Current, Forward	V _{GS} = 30V, V _{DS} = 0V	-	-	100	nA
I _{GSSR}	Gate-Body Leakage Current, Reverse	V _{GS} = -30V, V _{DS} = 0V	-	-	-100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250μA	3.0	4.0	5.0	V
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10V, I _D = 10A	-	0.175	0.21	Ω
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 100V, V _{GS} = 0V, f = 1.0MHz	-	1505	-	pF
C _{oss}	Output Capacitance		-	68	-	pF
C _{rss}	Reverse Transfer Capacitance		-	2.1	-	pF
Q _g	Total Gate Charge	V _{DS} = 480V, I _D = 10A, V _{GS} = 10V (Note 4)	-	36.5	-	nC
Q _{gs}	Gate-Source Charge		-	8.7	-	nC
Q _{gd}	Gate-Drain Charge		-	12.5	-	nC
R _g	Gate resistance	f=1 MHz, open drain	-	9.8	-	Ω
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time	V _{DS} = 400V, I _D = 10A R _G = 15Ω, V _{GS} = 12V (Note 4)	-	21	-	ns
t _r	Turn-On Rise Time		-	18	-	ns
t _{d(off)}	Turn-Off Delay Time		-	102	-	ns
t _f	Turn-Off Fall Time		-	22	-	ns
Drain-Source Diode Characteristics and Maximum Ratings						
I _S	Maximum Continuous Drain-Source Diode Forward Current		-	-	20	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		-	-	65	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0V, I _S = 20A	-	0.9	1.4	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, V _{DS} = 400V, I _S = 10A, diF/dt = 100A/μs	-	120	-	ns
Q _{rr}	Reverse Recovery Charge		-	0.6	-	μC
I _{rrm}	Peak Reverse Recovery Current		-	10	-	A

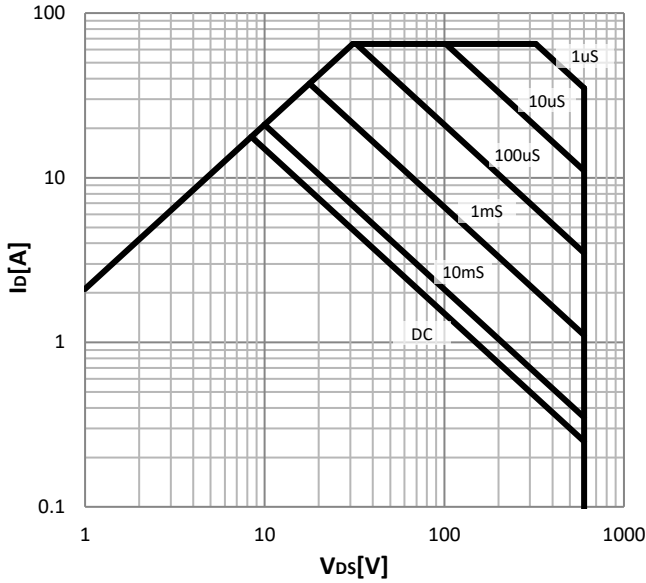
NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_D = I_{AS}, V_{DD} = 50V, Starting T_J = 25 °C
3. I_{SD} ≤ I_D, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25 °C
4. Essentially Independent of Operating Temperature Typical Characteristics

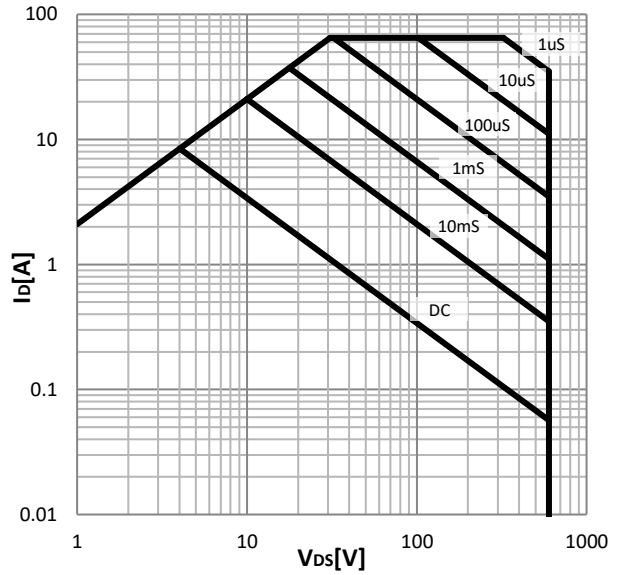


Typical Performance Characteristics

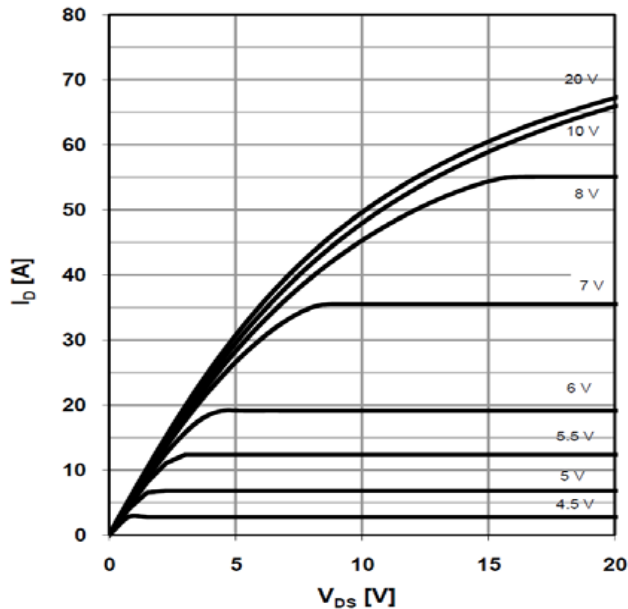
Safe operating area TC=25 °C
parameter: tp; TO-220,TO-247



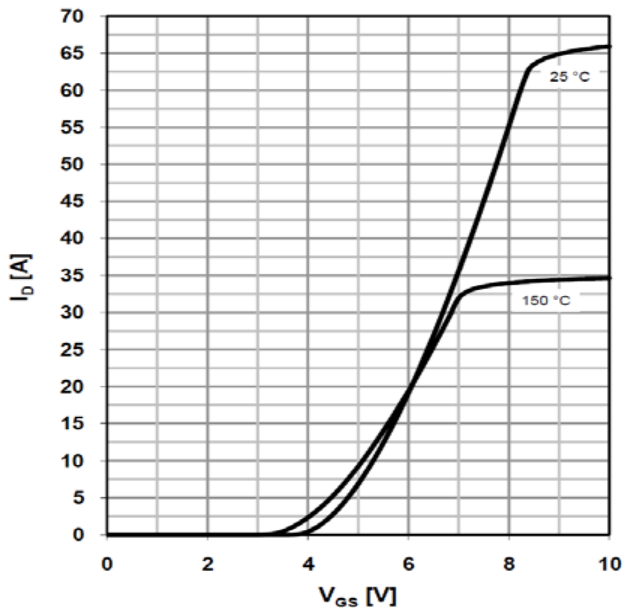
Safe operating area TC=25 °C
parameter: tp; TO-220FullPAK



Typ. output characteristics $T_j=25\text{ }^\circ\text{C}$
parameter: V_{GS}



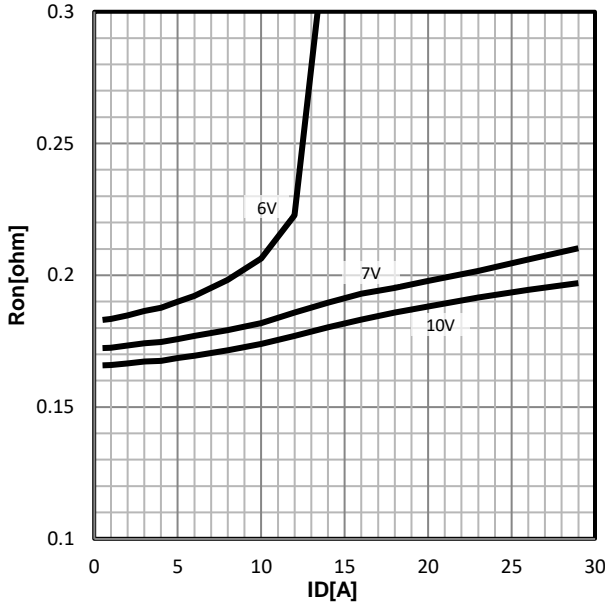
Typ. transfer characteristics



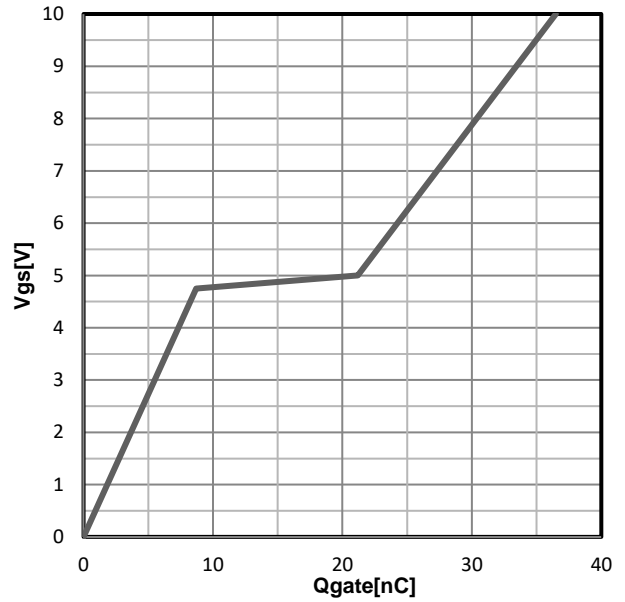


Typical Performance Characteristics

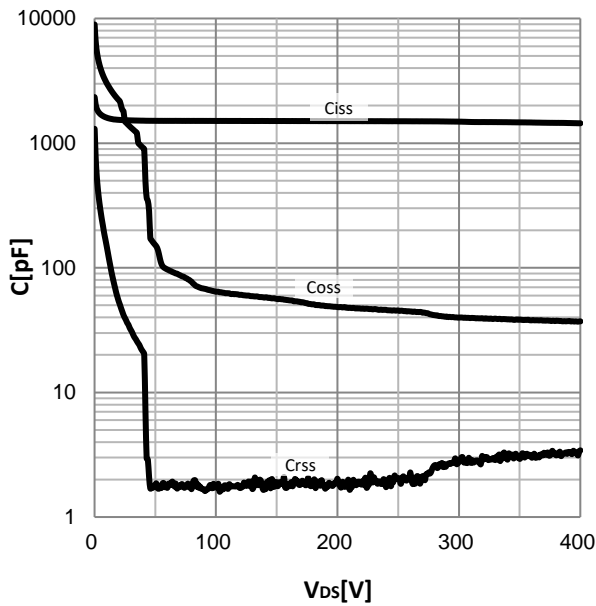
Typ. drain-source on-state resistance parameter: V_{GS}



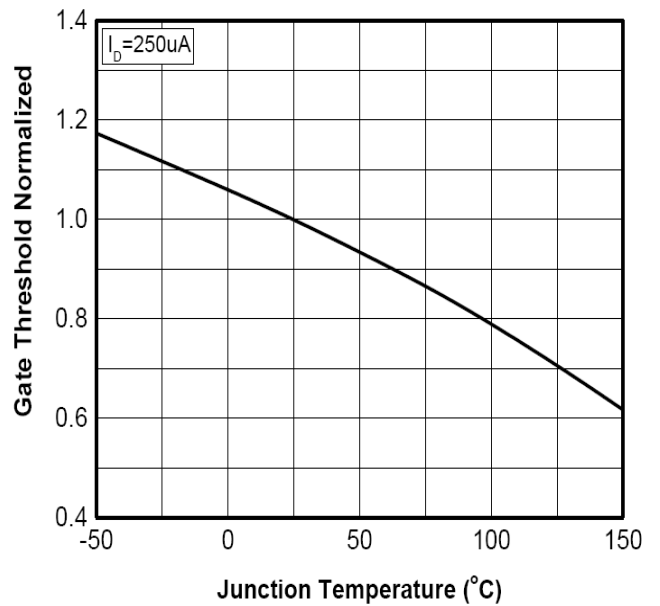
Typ. gate charge characteristics



Typ. capacitances



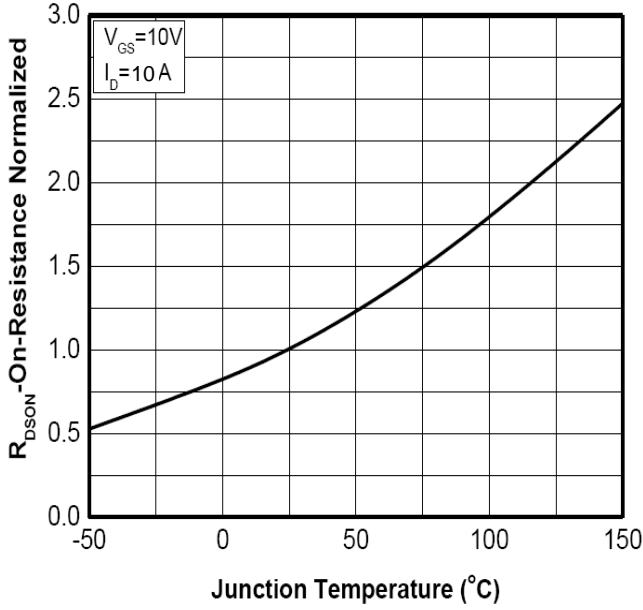
Normalized $V_{GS(th)}$ characteristics



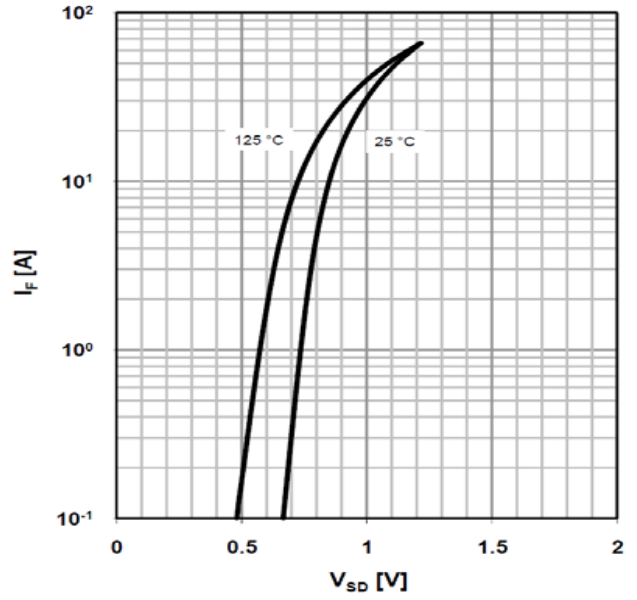


Typical Performance Characteristics

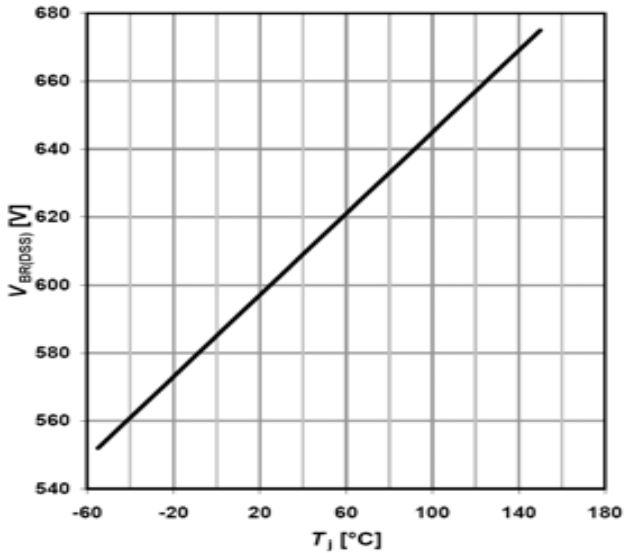
Normalized on-resistance vs temperature



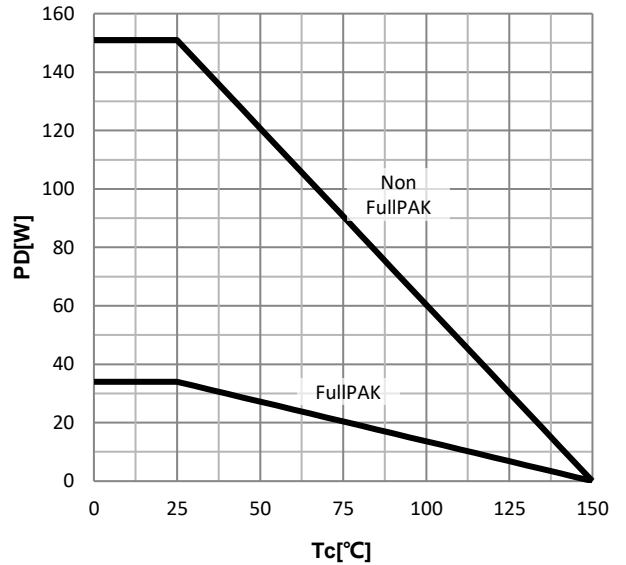
Forward characteristics of reverse diode



Drain-source breakdown voltage



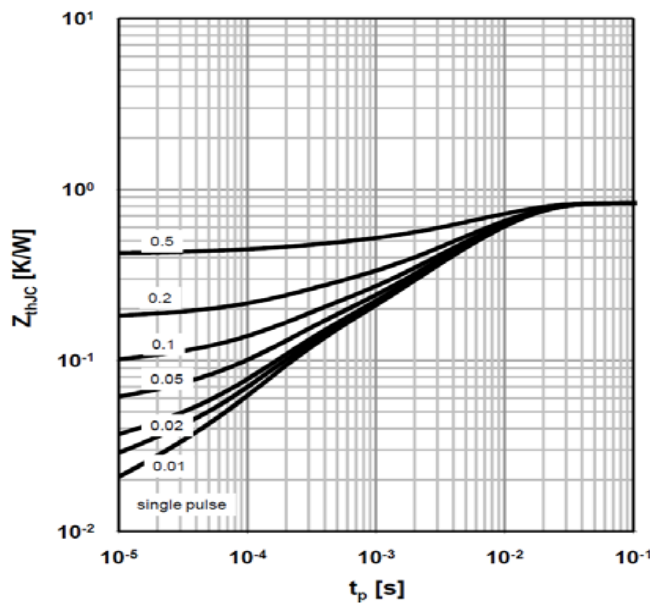
Power dissipation



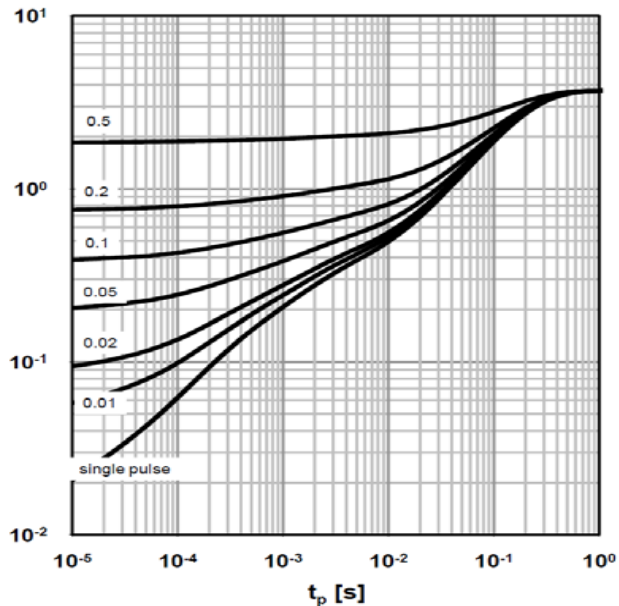


Typical Performance Characteristics

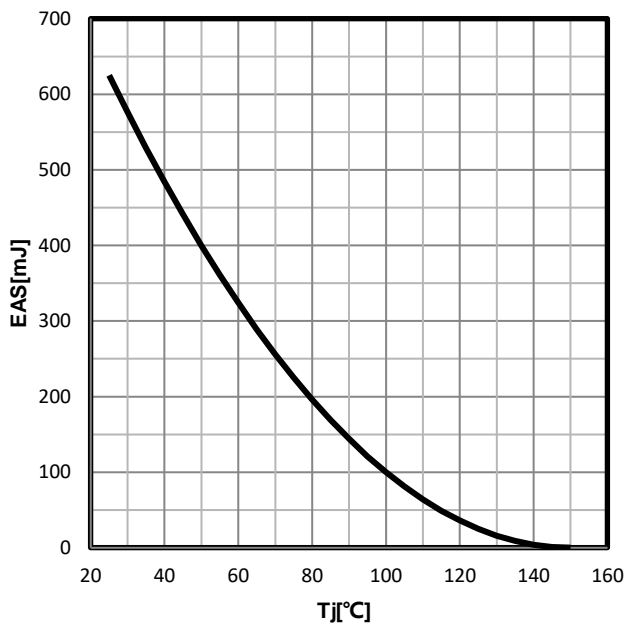
Max. transient thermal impedance parameter: $D=tp/T$; TO-220,TO-247



Max. transient thermal impedance parameter: $D=tp/T$; TO-220FullPAK



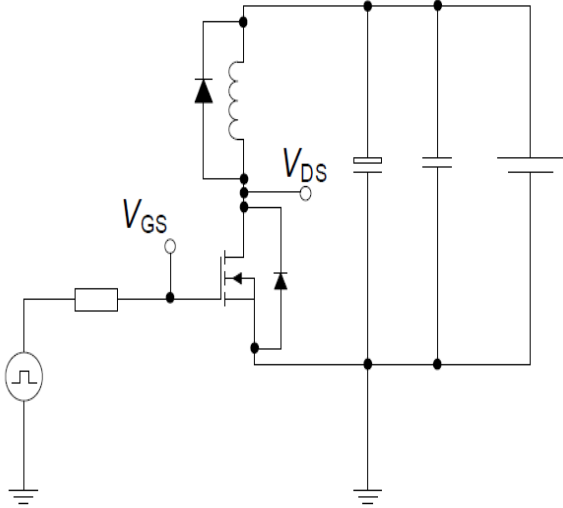
Avalanche energy



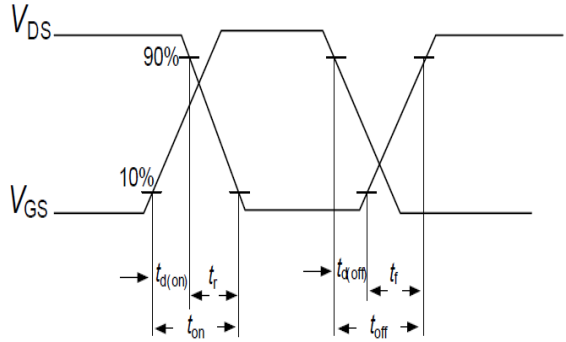
SSF60R190SFD/SSP60R190SFD/SSW60R190SFD 600V N-Channel Super-Junction MOSFET Gen-II With Fast-Recovery

Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load

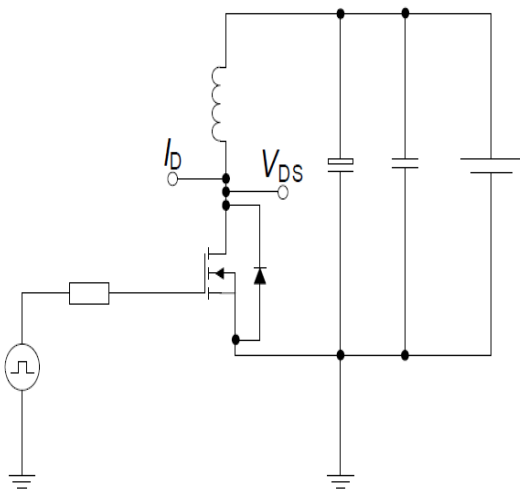


Switching time waveform

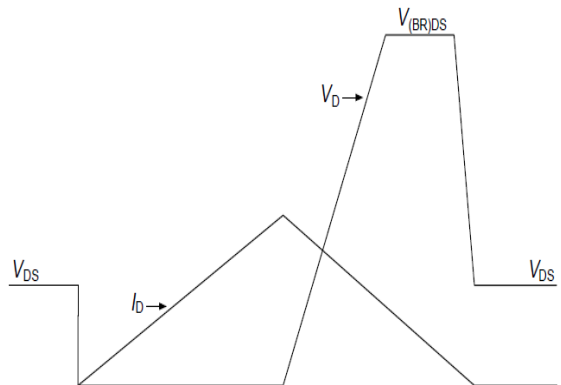


Unclamped inductive load test circuit and waveform

Unclamped inductive load test circuit

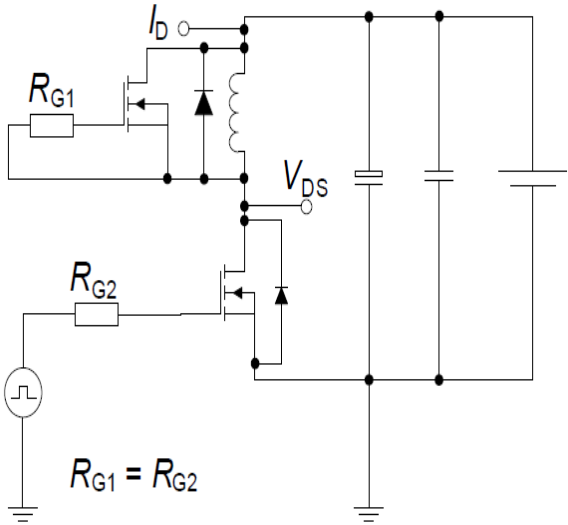


Unclamped inductive waveform

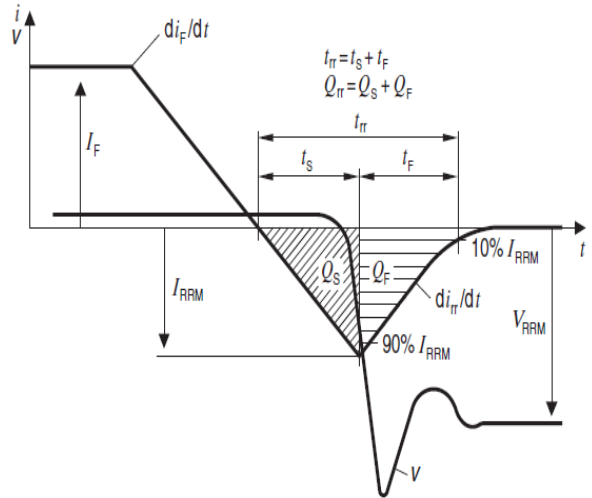


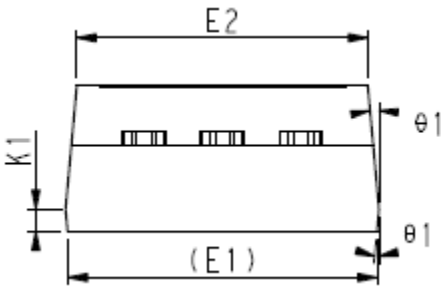
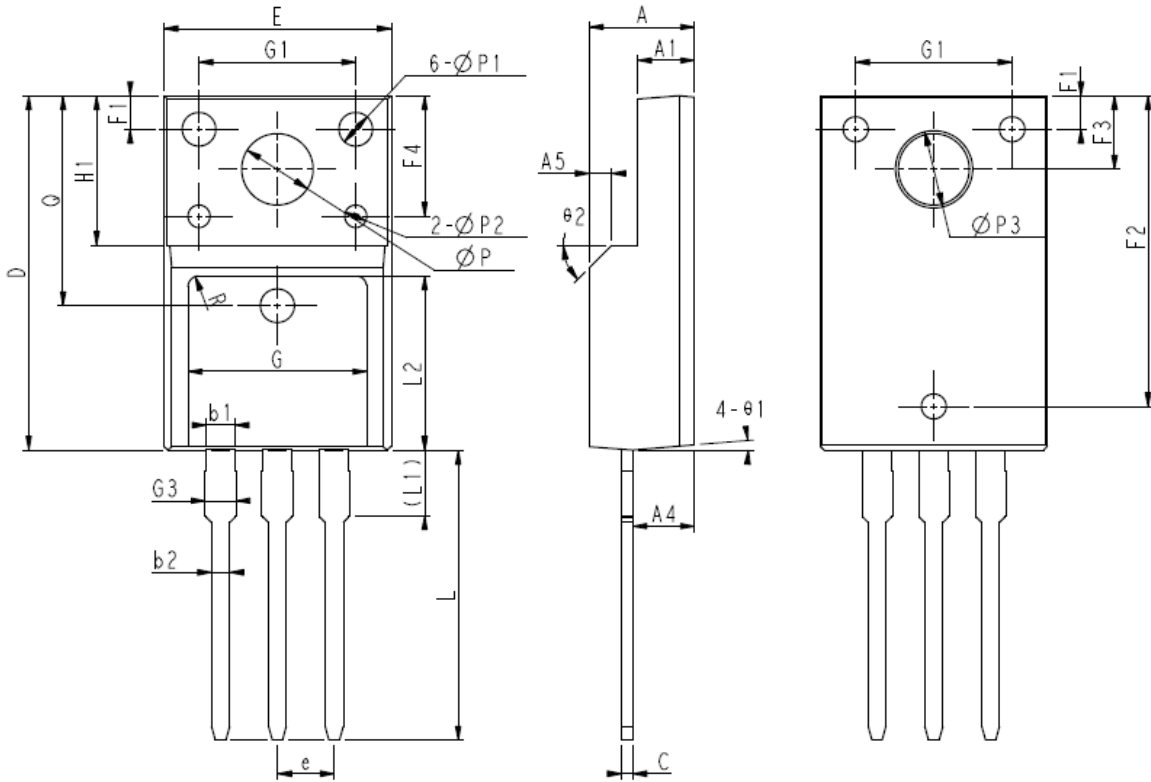
Test circuit and waveform for diode characteristics

Test circuit for diode characteristics



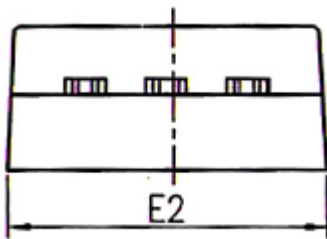
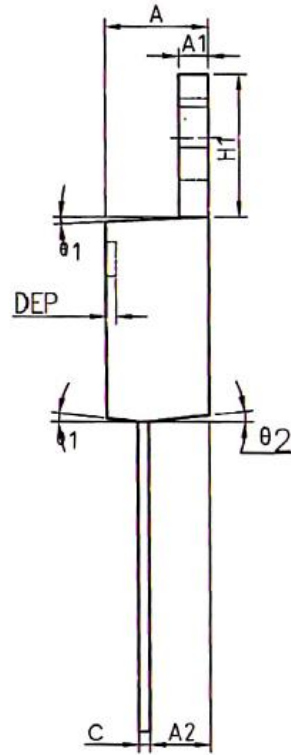
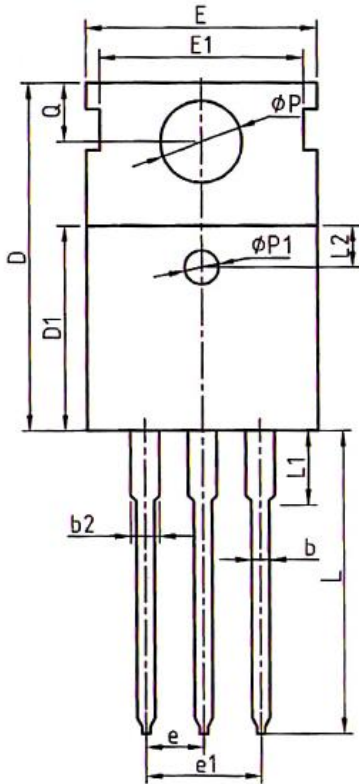
Diode recovery waveform





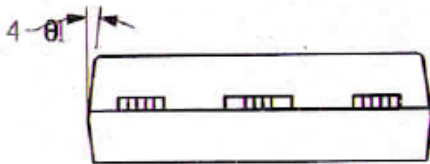
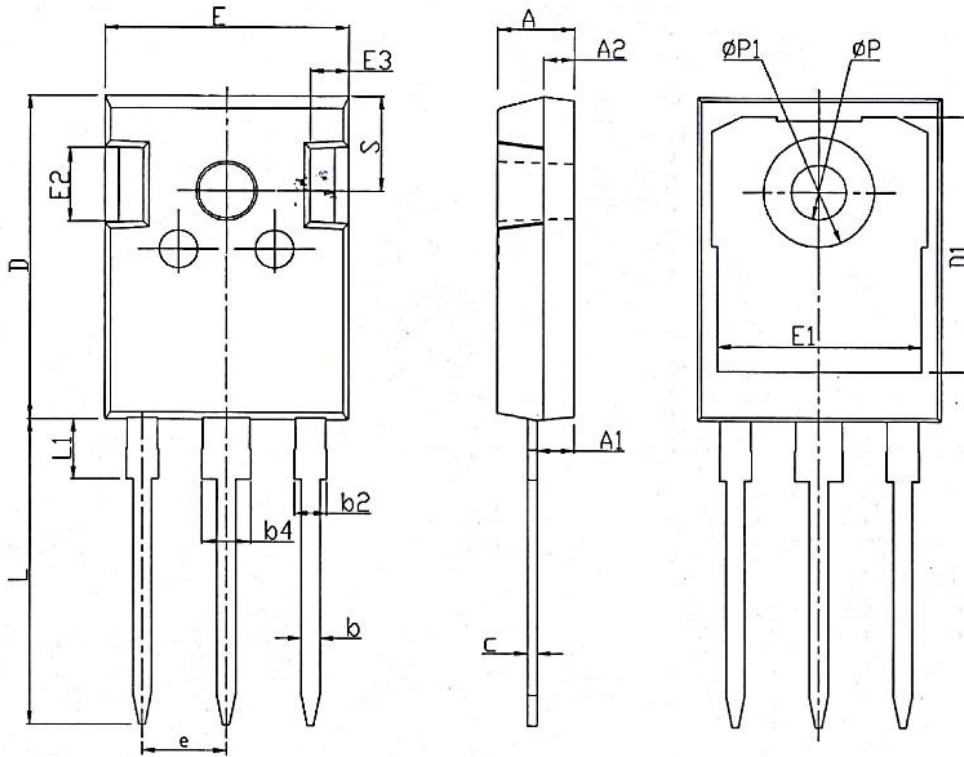
COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NOM	MAX
E	10.00	10.16	10.32
E1	9.94	10.04	10.14
E2	9.36	9.46	9.56
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A4	2.66	2.76	2.86
A5		1.00REF	
c	0.45	0.50	0.60
D	15.67	15.87	16.07
Q		9.40REF	
H1		6.70REF	
e		2.54BSC	
Φ P		3.18REF	
L	12.78	12.98	13.18
L1	2.83	2.93	3.03
L2	7.70	7.80	7.90
Φ P1	1.40	1.50	1.60
Φ P2	0.95	1.00	1.05
Φ P3		3.45REF	
θ 1	3°	5°	7°
θ 2	-	45°	-
F1	1.00	1.50	2.00
F2	13.80	13.90	14.00
F3	3.20	3.30	3.40
F4	5.30	5.40	5.50
G	7.80	8.00	8.20
G1	6.90	7.00	7.10
G3	1.25	1.35	1.45
b1	1.23	1.28	1.38
b2	0.75	0.80	0.90
K1	0.65	0.70	0.75
R		0.50REF	



COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NDM	MAX
A	4.40	4.57	4.70
A1	1.27	1.30	1.37
A2	2.35	2.40	2.50
b	0.77	0.80	0.90
b2	1.17	1.27	1.36
c	0.48	0.50	0.56
D	15.40	15.60	15.80
D1	9.00	9.10	9.20
DEP	0.05	0.10	0.20
E	9.80	10.00	10.20
E1	-	8.70	-
E2	9.80	10.00	10.20
phi P1	1.40	1.50	1.60
e	2.54BSC		
e1	5.08BSC		
H1	6.40	6.50	6.60
L	12.75	13.50	13.65
L1	-	3.10	3.30
L2	2.50REF		
phi P	3.50	3.60	3.63
Q	2.73	2.80	2.87
theta 1	5°	7°	9°
theta 2	1°	3°	5°
theta 3	1°	3°	5°



COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S	6.15BSC		



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