

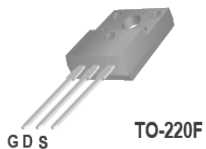
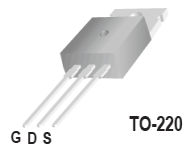
TSF65R190S2/TSP65R190S2/TSA65R190S2/TSK65R190S2 650V N-Channel Super-Junction MOSFET Gen-II

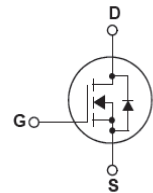
Description

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
- 700V @T_J = 150 °C
- Typ. RDS(on) = 0.16Ω
- Ultra Low Gate Charge (typ. Q_g = 36.5nC)
- 100% avalanche tested

TSF65R190S2

TSP65R190S2

TSA65R190S2

TSK65R190S2


Absolute Maximum Ratings

Symbol	Parameter	TSP_A_K65R190S2	TSF65R190S2	Unit
V _{DSS}	Drain-Source Voltage	650		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)	485		mJ
I _{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T _J max)	3.5		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

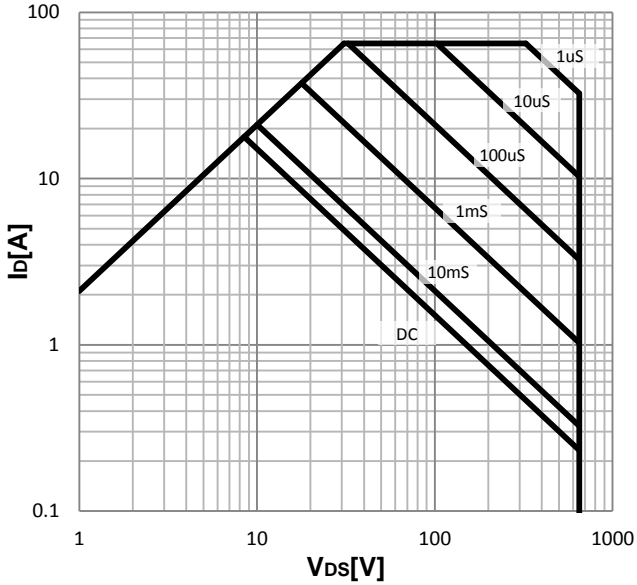
Symbol	Parameter	TSP_A_K65R190S2	TSF65R190S2	Unit
R _{θJC}	Thermal Resistance, Junction-to-Case	0.83	3.7	°C/W
R _{θCS}	Thermal Resistance, Case-to-Sink Typ.	0.5	-	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient	62	80	°C/W

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	650	-	-	V
		V _{GS} = 0V, I _D = 250μA, T _J = 150°C	-	700	-	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} = 650V, V _{GS} = 0V -T _C = 125°C	-	-	1 100	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	2.0	3.0	4.0	V
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10V, I _D = 10A	-	-	0.19	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 = 3.3Ω, V _{GS} = 10V (Note 4)	-	38	-	ns
t _r	Turn-On Rise Time		-	39	-	ns
t _{d(off)}	Turn-Off Delay Time		-	170	-	ns
t _f	Turn-Off Fall Time		-	47	-	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, dI _F /dt = 100A/μs	-	318	-	ns
Q _{rr}	Reverse Recovery Charge		-	5.5	-	μC
I _{rrm}	Peak Reverse Recovery Current		-	24.9	-	A

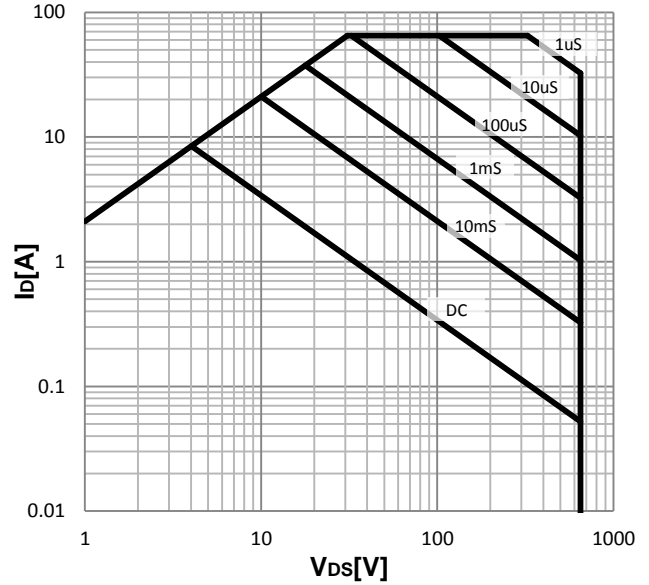
NOTES:

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_{DP} ≤ BV_{DSS}, Starting T_J = 25 °C
4. Essentially Independent of Operating Temperature Typical Characteristics

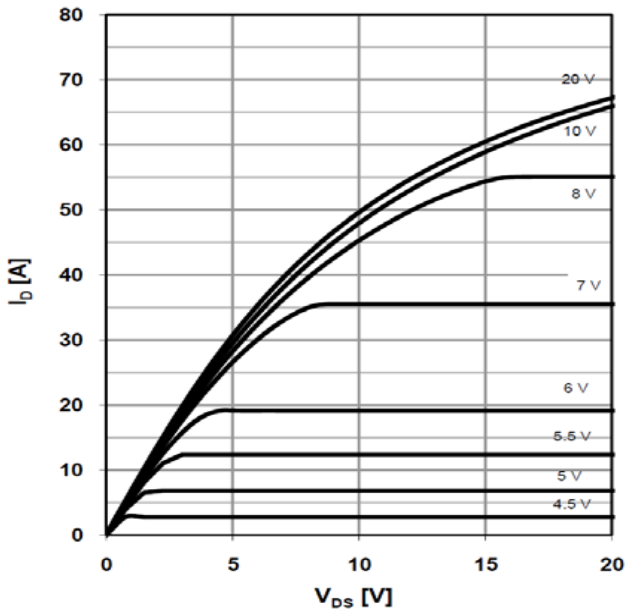
Safe operating area TC=25 °C
parameter: tp; TO-220, TO-247



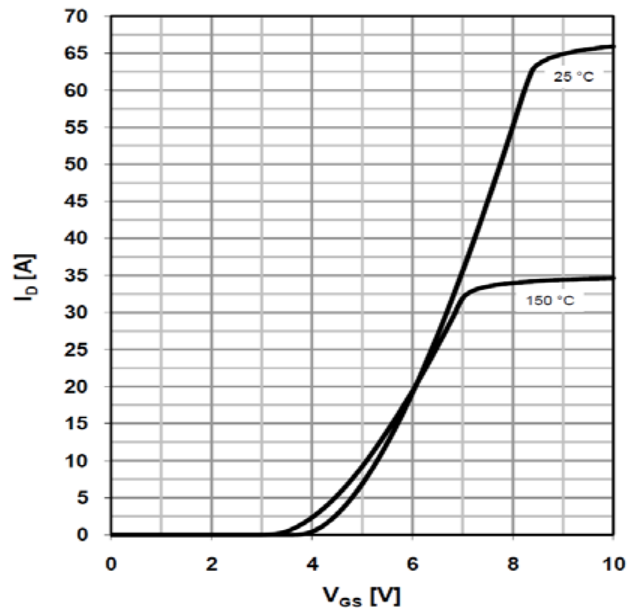
Safe operating area TC=25 °C
parameter: tp; TO-220FullPAK



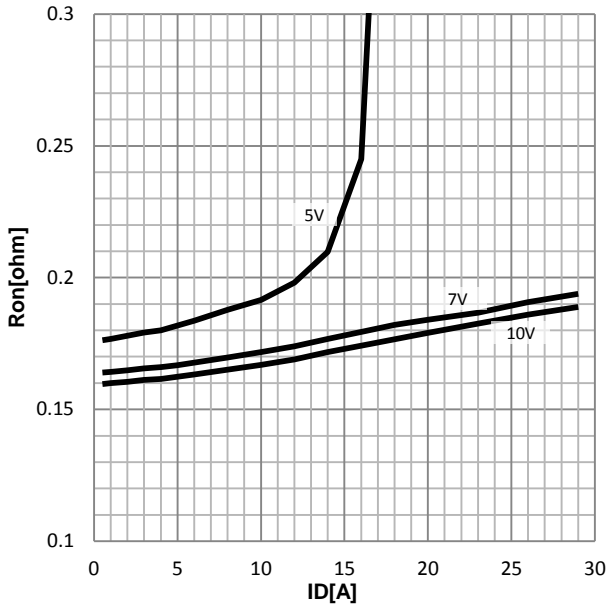
Typ. output characteristics $T_J=25\text{ }^\circ\text{C}$
parameter: V_{GS}



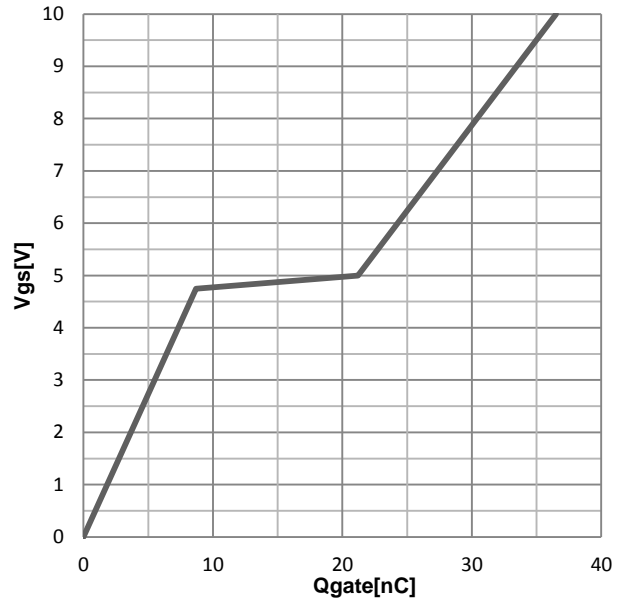
Typ. transfer characteristics



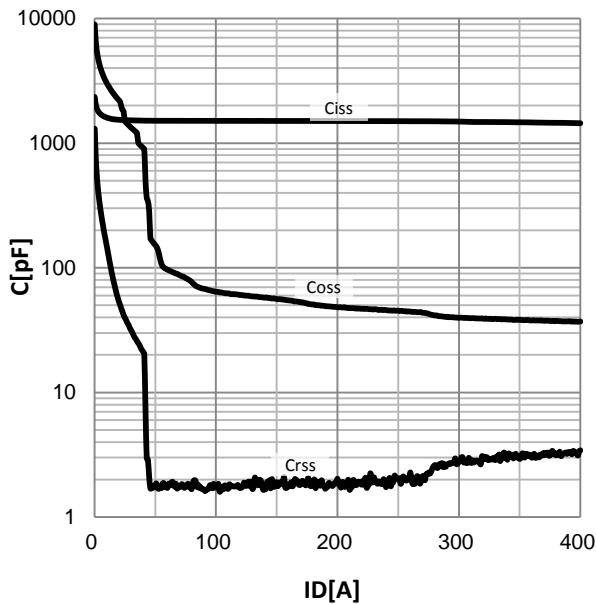
Typ. drain-source on-state resistance parameter : V_{GS}



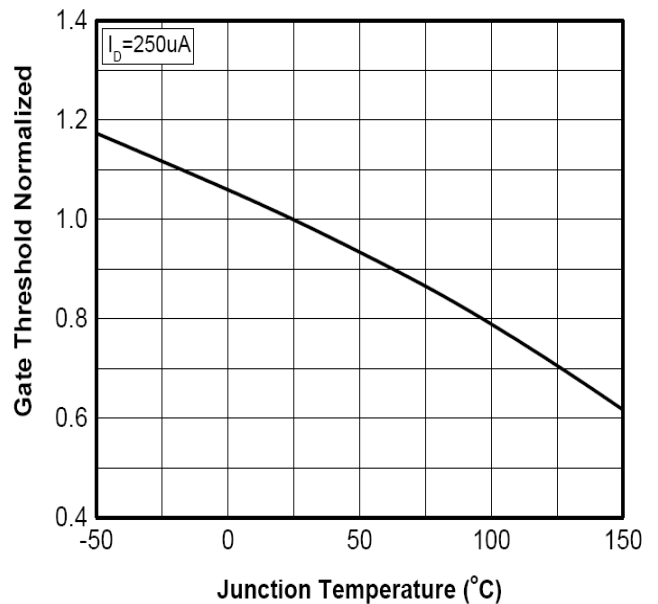
Typ. gate charge characteristics



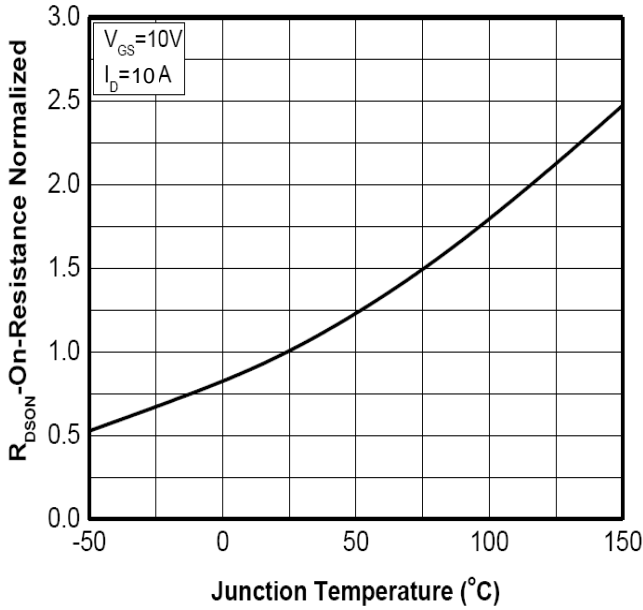
Typ. capacitances



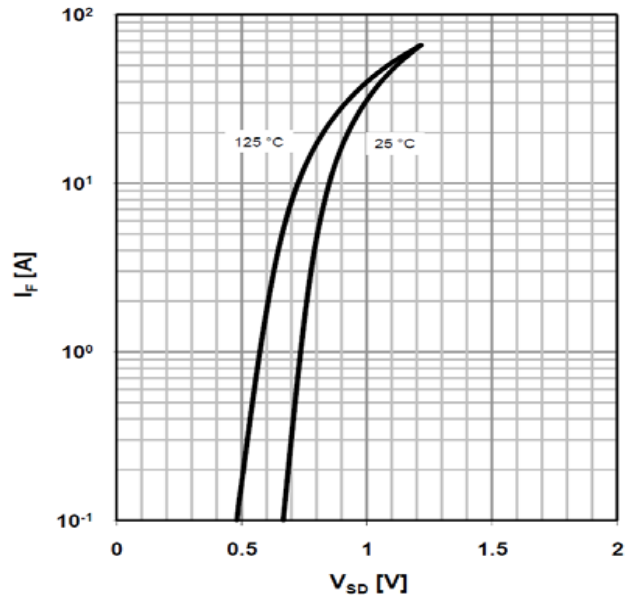
Normalized $V_{GS(th)}$ characteristics



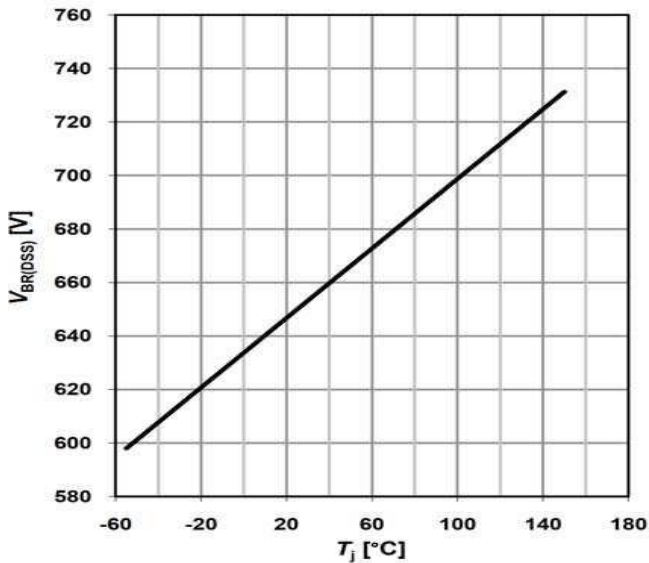
Normalized on-resistance vs temperature



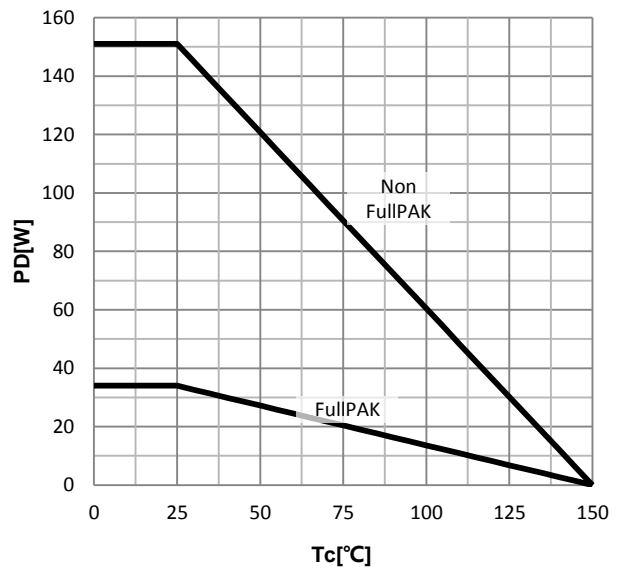
Forward characteristics of reverse diode



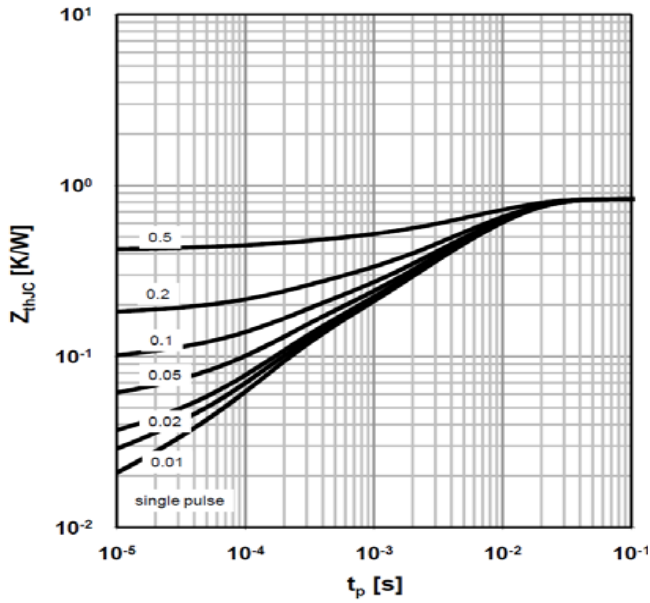
Drain-source breakdown voltage



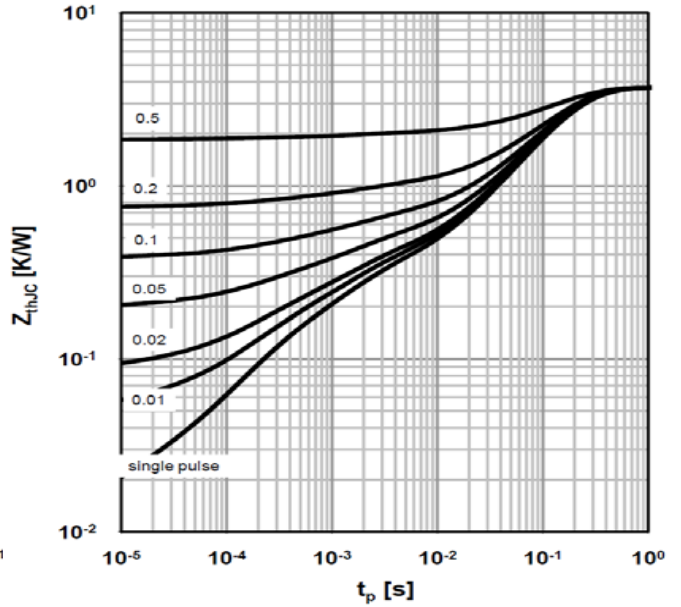
Power dissipation



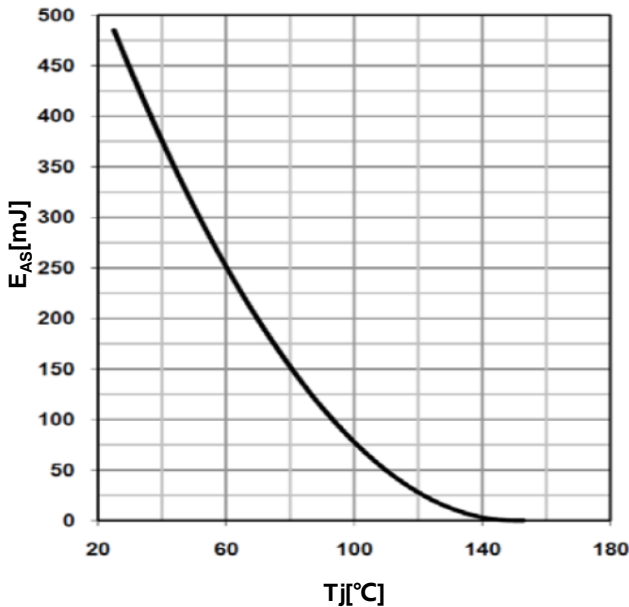
Max. transient thermal impedance
parameter: $D=t_p/T$; TO-220/3P/247

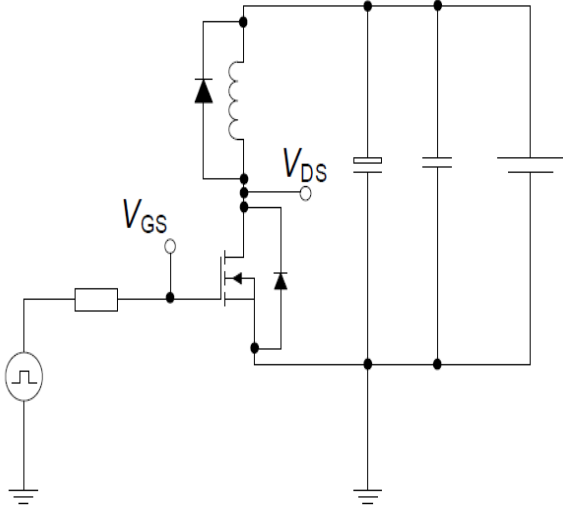
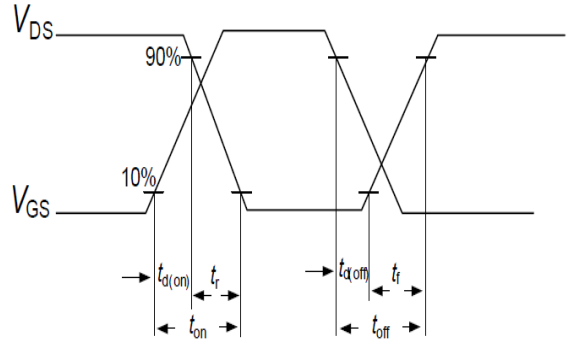
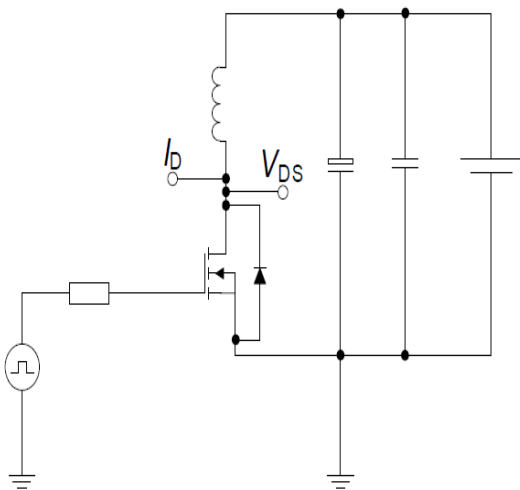
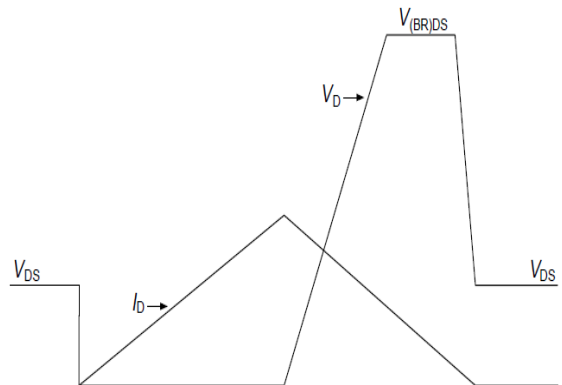


Max. transient thermal impedance
parameter: $D=t_p/T$; TO-220FullPAK



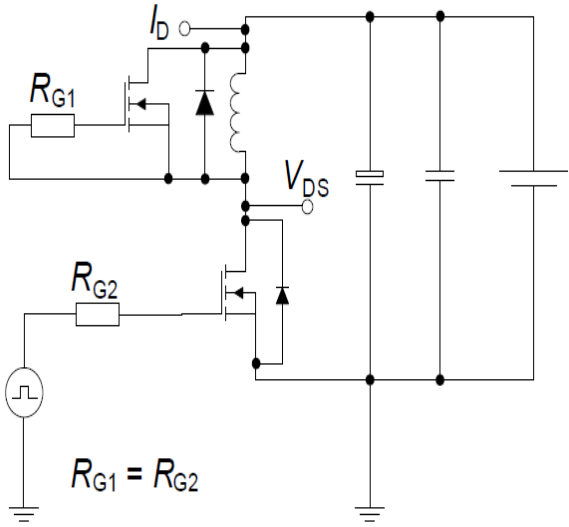
Avalanche energy



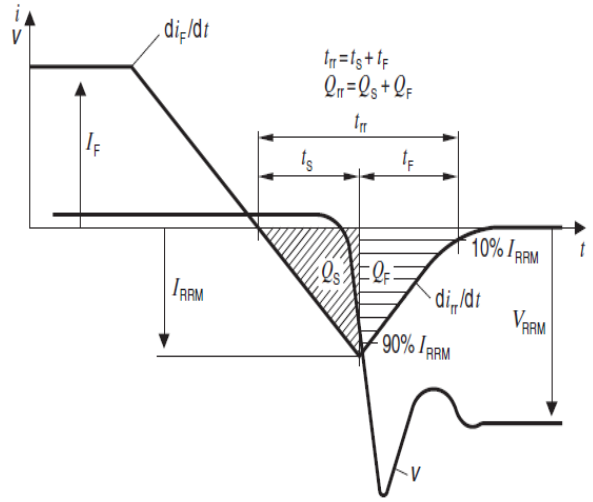
Switching times test circuit and waveform for inductive load
Switching times test circuit for inductive load

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





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