GSX20N65EF

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

Super Junction MOSFET

650V Super Junction Power Transistor

GSX20N65EF

Data Sheet

Ver 1.1

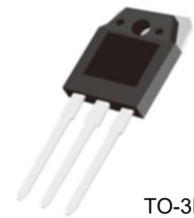
2023-4-7

650V 20A Power MOSFET

■Description

Group Semiconductor(GS) has series Multi-EPI Super-Junction power MOSFET platforms for voltage up 500V to 1000 volts, both with design service and manufacturing capability, including cell, termination design and simulation.
The GS 650V 20A power MOSFET is a Low voltage N channel Multi-EPI Super-Junction power MOSFET sample with advanced technology to have better characteristics, such as fast switching time, low Ciss and Crss, low on resistance and excellent avalanche characteristics, making it especially suitable for applications which require superior power density and outstanding efficiency.


TO-247


TO-3P


TO-220


TO-220FullPAK

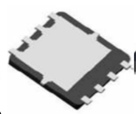

TO-263

■ Features

RDS(ON)=0.19Ω @VGS = 10V
VDS = 650V
ID (@ VGS=10V) = 11A
Intrinsic fast recovery diode.


TO-251


TO-252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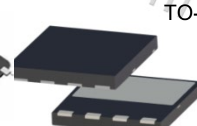
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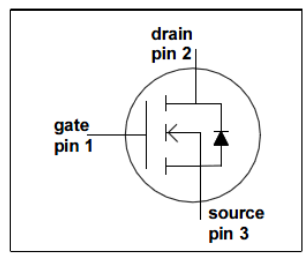

■ PKG

GSA20N65EF	GSP20N65EF	GSB20N65EF	GSD20N65EF	GSS20N65EF
TO-220Fullpak	TO-220	TO-263	TO-252	TO-251
GSW20N65EF	GSJ20N65EF	GSN20N65EF	GSM20N65EF	
TO-247	TO-3P	DFN5*6	DFN8*8	

■Absolute Maximum Ratings (TC = 25° C, unless otherwise specified)

Symbol	Parameter	GSP20N65EF	GSA20N65EF	Unit
V_{DSS}	Drain-Source Voltage	650		V
I_D	Drain Current -Continuous (TC = 25℃) -Continuous (TC = 100℃)	20* 12*		A
I_{DM}	Drain Current - Pulsed (Note 1)	45		A
V_{GSS}	Gate-Source voltage	±30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	485		mJ
I_{AR}	Avalanche Current (Note 1)	3.5		A
E_{AR}	Repetitive Avalanche Energy (Note 1)	1		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15		V/ns
dVds/dt	Drain Source voltage slope (Vds=480V)	50		V/ns
P_D	Power Dissipation (TC = 25℃)	151	35	W
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150		℃
T_L	Max. Lead Temperature for Soldering Purpose, 1/8” from Case for 5 Seconds	300		℃

650V 20A Power Transistor

■ Electrical Characteristics (TJ=25° C unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250μA, T_J = 25℃	650	--	--	V
		V_{GS} = 0V, I_D = 250μA, T_J = 150℃	--	700	--	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 250μA, Referenced to 25℃	--	0.6	--	V/℃
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 500V, V_{GS} = 650V -Tj=25 ℃ -T_J = 150℃	--	-- 10	1 -	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	--	5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10V, I_D = 10A	--	0.17	0.19	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40V, I_D = 10A	--	16	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz	--	1510	-	pF
C_{oss}	Output Capacitance		--	75	-	pF
C_{rss}	Reverse Transfer Capacitance		--	6	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 520Ω (Note 4)	--	25	--	ns
t_r	Turn-On Rise Time		--	17	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	130	--	ns
t_f	Turn-Off Fall Time		--	11	--	ns
Q_g	Total Gate Charge	V_{DS} = 520V, I_D = 10A V_{GS} = 10V (Note 4)	--	90	120	nC
Q_{gs}	Gate-Source Charge		--	8.5	--	nC
Q_{gd}	Gate-Drain Charge		--	13	--	nC
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		--	--	60	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0V, I_S = 10A	--	0.9	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0V, I_S = 10A dI_F/dt =100A/μs	--	170	--	ns
Q_{rr}	Reverse Recovery Charge		--	5.8	--	μC

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L=60mH, I_{AS}=3A, VDD=150V, Starting TJ=25 ℃
3. I_{SD}≤4.5A, di/dt ≤ 200A/us, V_{DD} ≤ BV_{DSS}, Starting TJ = 25 ℃
4. Pulse Test: Pulse width ≤ 300us, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

GROUP SEMICONDUCTOR

650V 20A Power Transistor

■Thermal Characteristics

Symbol	Parameter	GSA20N65EF	GSP20N65EF	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.2	1.2	℃/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	0.5	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	62	℃/W

Symbol	Parameter	Value (TO220)	Unit
$R_{\theta JA}$ (6)	Maximum Junction-to-Ambient	82	℃/W
$R_{\theta CS}$ (6)	Maximum Case-to-sink	0.6	℃/W
$R_{\theta JC}$ (7),(8)	Maximum Junction-to-Case θ	4.1	℃/W

1. The power dissipation PD is based on TJ(MAX)=150° C in a TO251 package, using junction-to-case thermal resistance.
2. Repetitive rating, pulse width limited by junction temperature TJ(MAX)=150° C.
3. L=1mH, Starting TJ=25° C.
4. L = 10mH, starting TJ = 25° C.
5. L=60mH, starting TJ = 25° C.
6. The tests are performed with the device with T A =25° C.
7. The R JA is the sum of the thermal impedance from junction to case R JC and case to ambient.
8. These curves are based on the junction-to-case thermal impedance, assuming a maximum junction temperature of TJ(MAX)=150° C.

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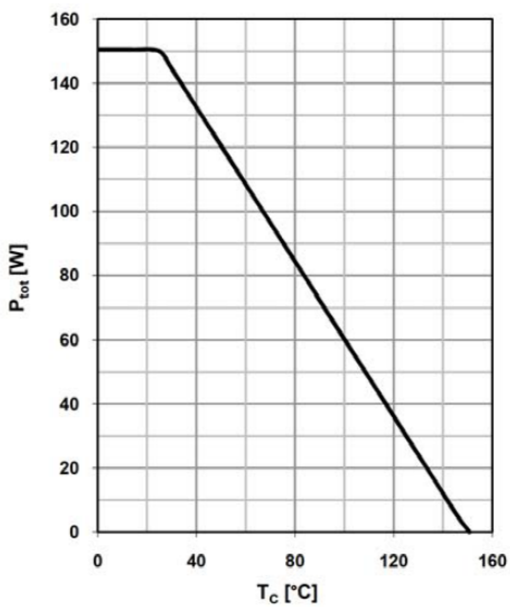
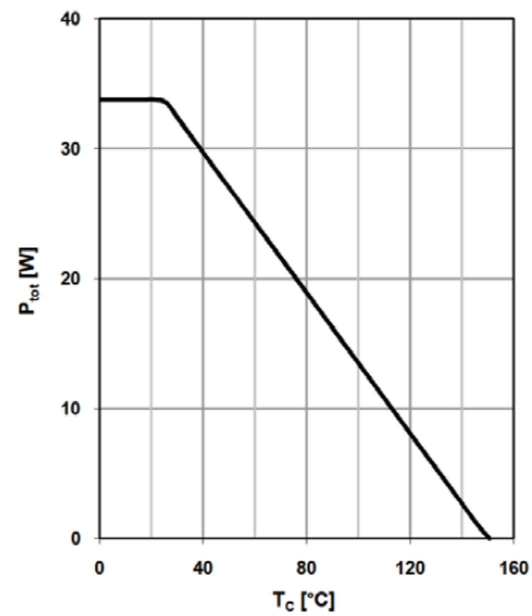
Typical Performance Characteristics

Power dissipation
Non FullPAK



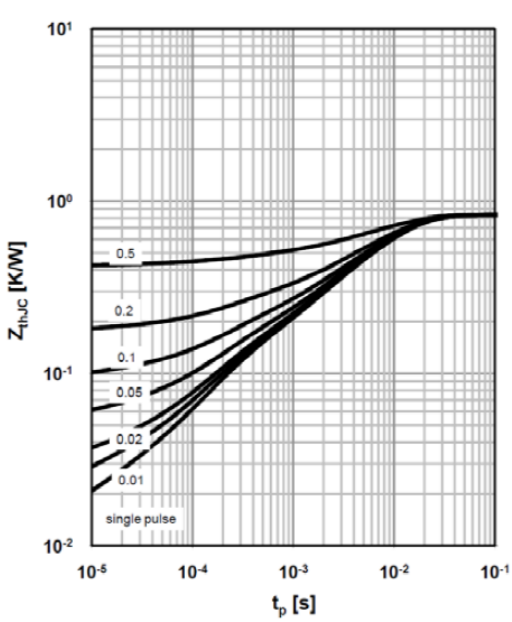
$P_{tot} = f(T_C)$

Power dissipation
FullPAK



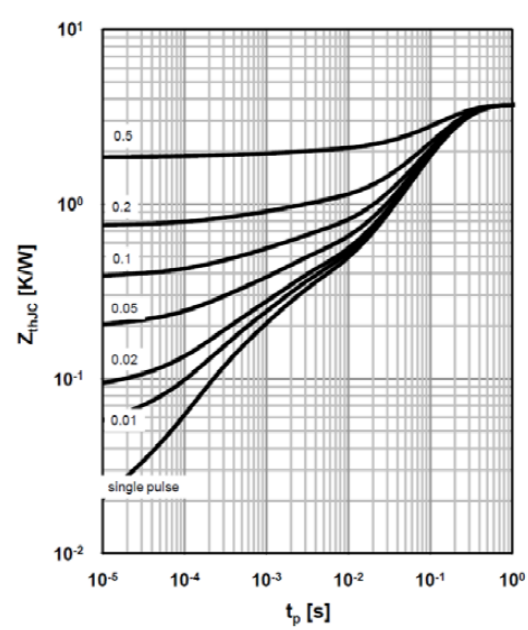
$P_{tot} = f(T_C)$

Max. transient thermal impedance
Non FullPAK



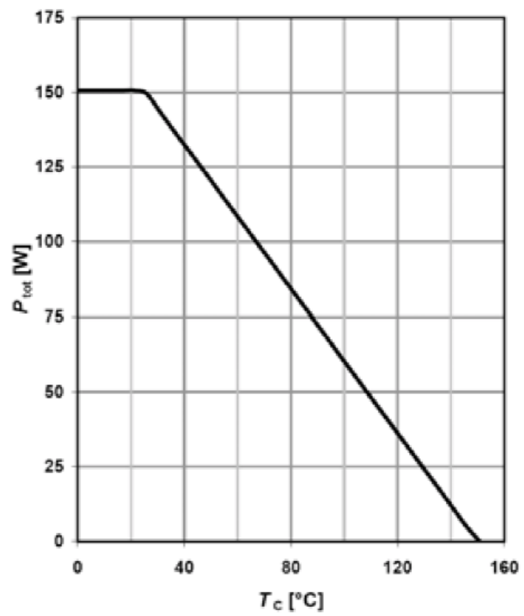
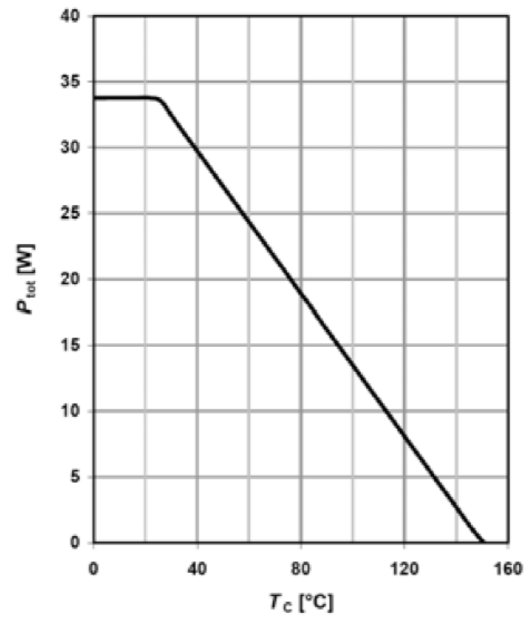
$Z_{(thJC)}$=f(tp); parameter: D=t_p/T

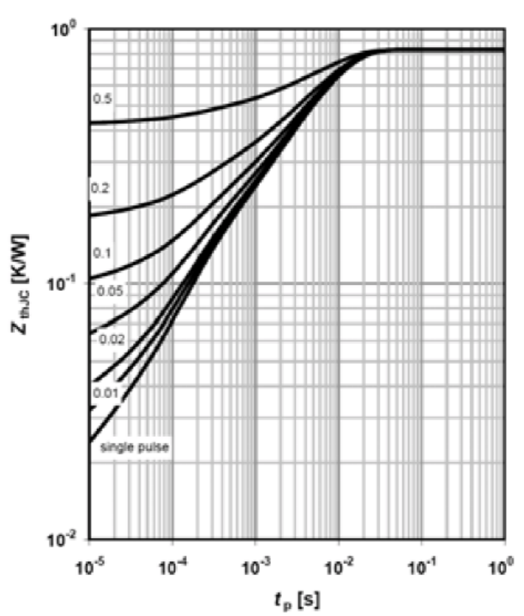
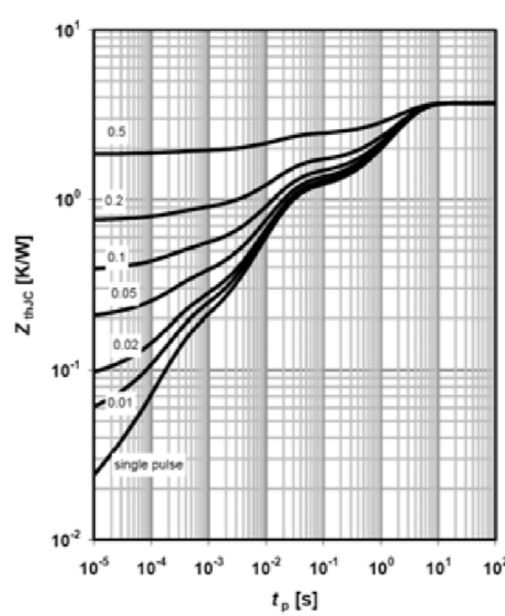
Max. transient thermal impedance
FullPAK



$Z_{(thJC)}$=f(tp); parameter: D=t_p/T

Typical Performance Characteristics

Power dissipation TO-220, TO-247, TO-262, TO-263	Power dissipation TO-220 FullPAK
	
P_{tot} = f(T_C)	P_{tot} = f(T_C)

Max. transient thermal impedance TO-220, TO-247, TO-262, TO-263	Max. transient thermal impedance TO-220 FullPAK
	
$Z_{(thJC)}$=f(tp); parameter: D=t_p/T	$Z_{(thJC)}$=f(tp); parameter: D=t_p/T

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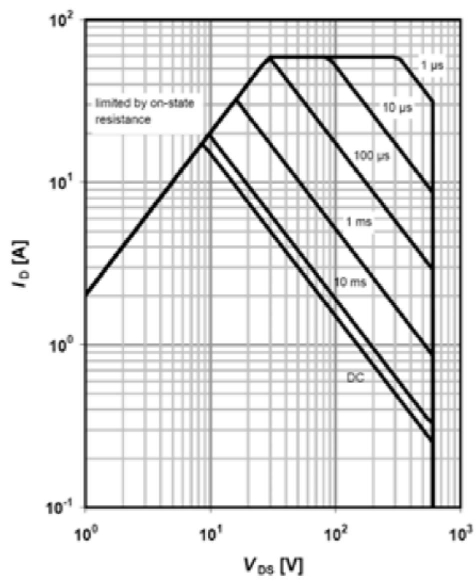
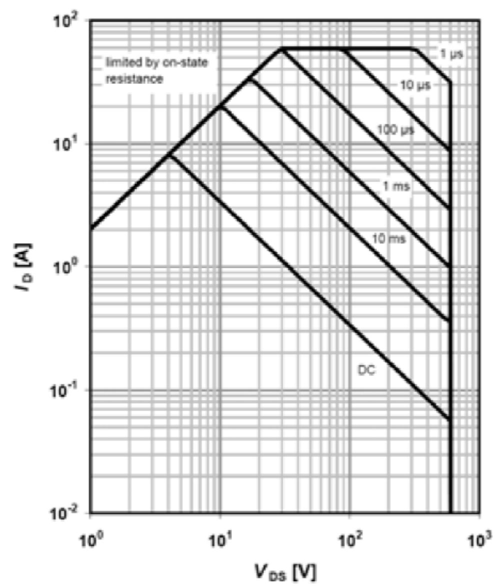
Typical Performance Characteristics

Safe operating area T_C=25 °C
TO-220, TO-247, TO-262, TO-263



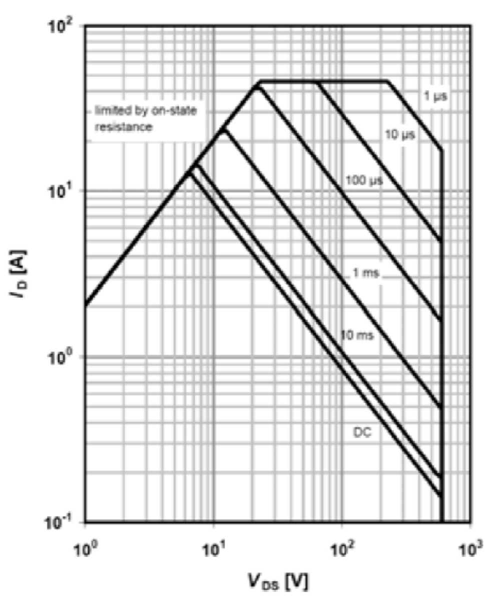
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p

Safe operating area T_C=25 °C
TO-220 FullPAK



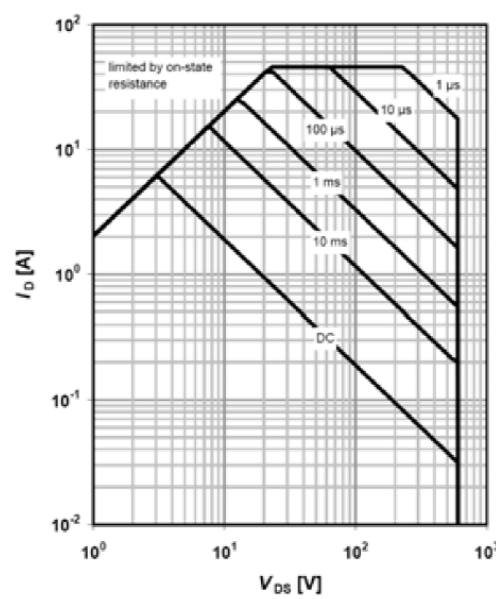
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p

Safe operating area T_C=80 °C
TO-220, TO-247, TO-262, TO-263



I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

Safe operating area T_C=80 °C
TO-220 FullPAK



I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

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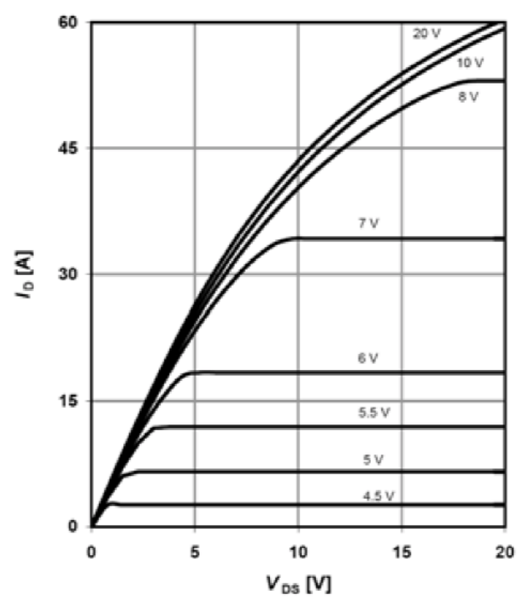
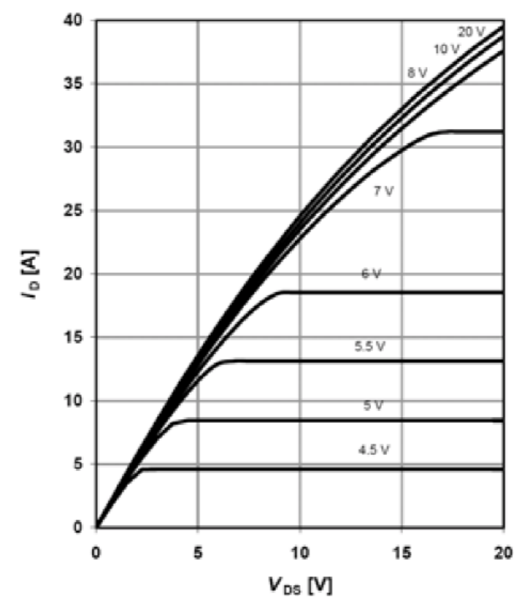
Typical Performance Characteristics

Typ. output characteristics T_C=25 °C



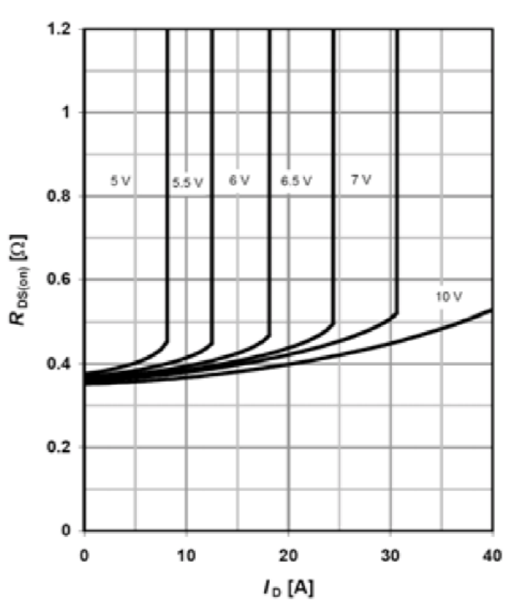
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Typ. output characteristics T_j=125 °C



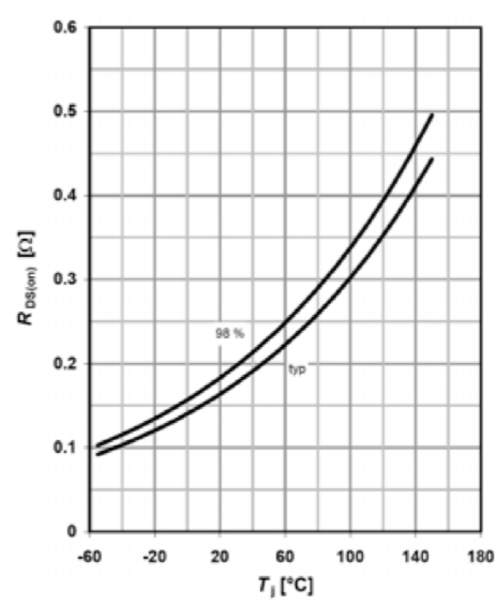
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

Typ. drain-source on-state resistance



$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

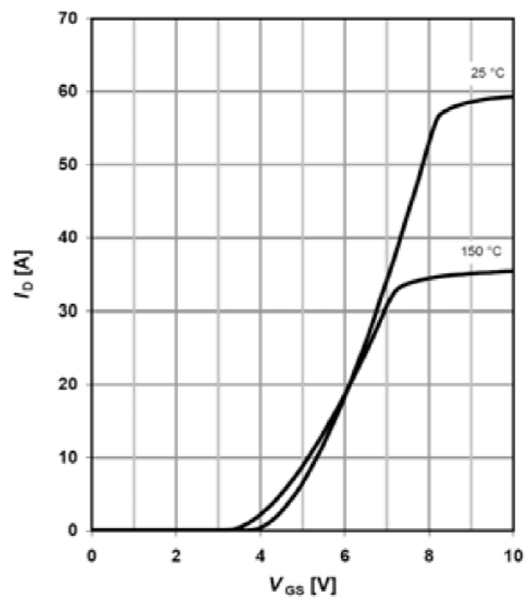
Drain-source on-state resistance



$R_{DS(on)}$=f(T_j); I_D=9.5 A; V_{GS}=10 V

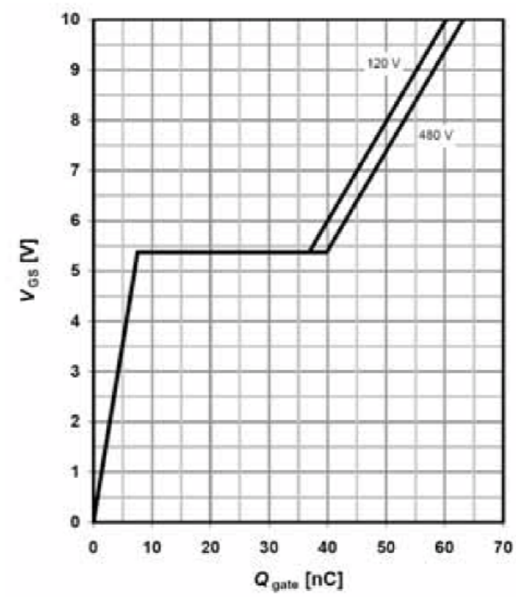
Typical Performance Characteristics

Typ. transfer characteristics



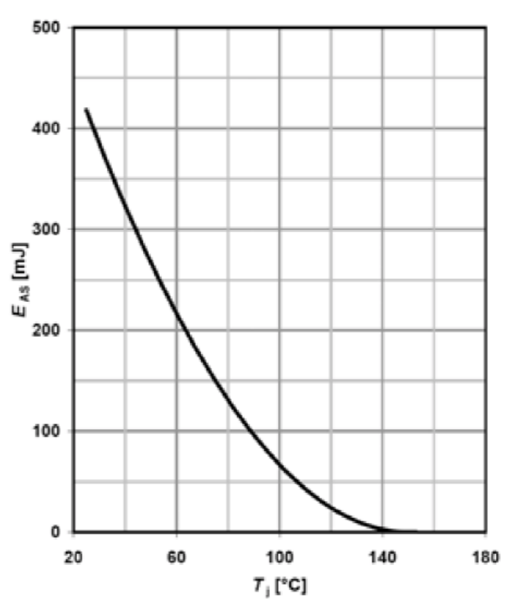
I_D=f(V_{GS}); V_{DS}=20V

Typ. gate charge



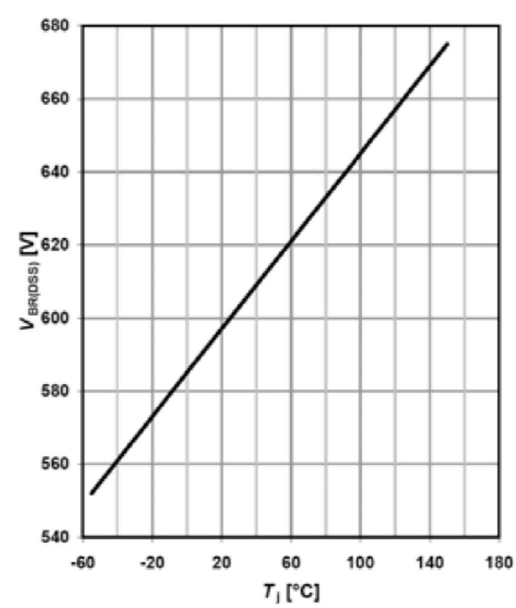
V_{GS}=f(Q_{gate}), I_D=9.5A pulsed

Avalanche energy



E_{AS}=f(T_j); I_D=3.4 A; V_{DD}=50 V

Drain-source breakdown voltage



$V_{BR(DSS)}$=f(T_j); I_D=0.25 mA

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Table 20 Switching times test circuit and waveform for inductive load

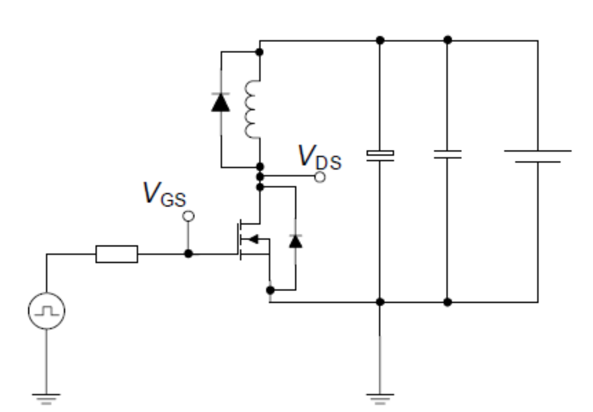
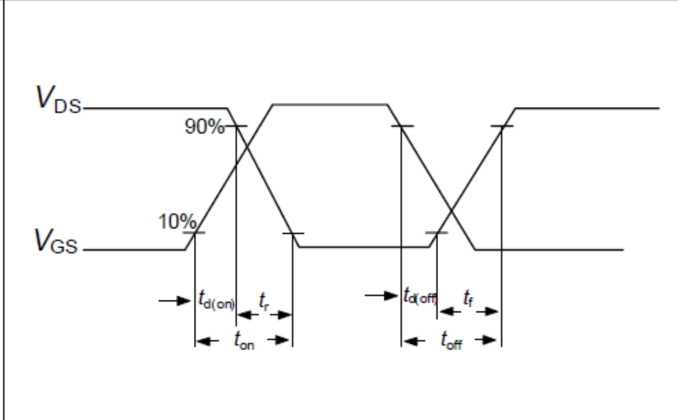
Switching times test circuit for inductive load	Switching time waveform
	

Table 21 Unclamped inductive load test circuit and waveform

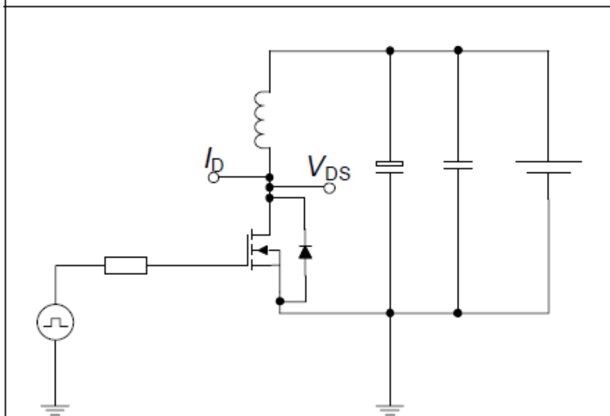
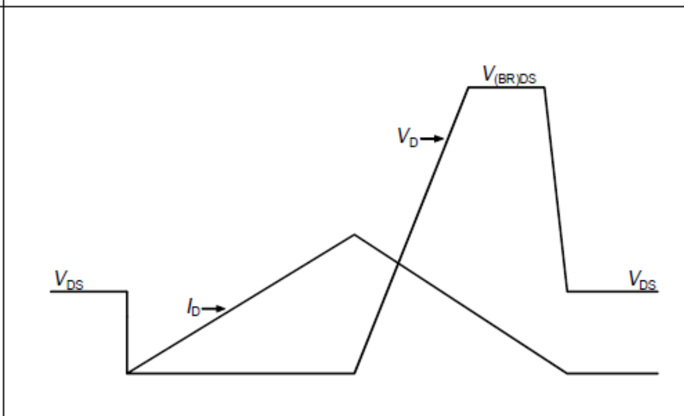
Unclamped inductive load test circuit	Unclamped inductive waveform
	

Table 22 Test circuit and waveform for diode characteristics

Test circuit for diode characteristics	Diode recovery waveform