SUPER-SEMI

SUPER-MOSFET

Super Junction Metal Oxide Semiconductor Field Effect Transistor

600V Super Junction Power MOSFET
SS*47N60S

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SJ-FET

SSW47N60S/SSA47N60S
600V N-Channel MOSFET

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
• 650V @T_J = 150 ℃
• Typ. RDS(on) = 60mΩ
• Ultra Low Gate Charge (typ. Qg = 64nC)
• 100% avalanche tested

SSW47N60S

TO-247

SSA47N60S

TO-3P
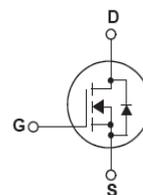
Absolute Maximum Ratings

Symbol	Parameter	SSW_A47N60S	Unit
V_{DSS}	Drain-Source Voltage	600	V
I_D	Drain Current -Continuous (TC = 25℃) -Continuous (TC = 100℃)	47* 29*	A
I_{DM}	Drain Current - Pulsed (Note 1)	140	A
V_{GSS}	Gate-Source voltage	±30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	1135	mJ
I_{AR}	Repetitive Avalanche Current (Note 1)	9.3	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	1.72	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℃)	391	W
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	℃
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300	℃

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

Thermal Characteristics

Symbol	Parameter	SSW_A47N60S	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.32	℃/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	℃/W

Electrical Characteristics TC = 25℃ unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV$_{DSS}$	Drain-Source Breakdown Voltage	V$_{GS}$ = 0V, I$_D$ = 250μA, T$_J$ = 25℃	600	-	-	V
		V$_{GS}$ = 0V, I$_D$ = 250μA, T$_J$ = 150℃	-	650	-	V
ΔBV$_{DSS}$/ΔT$_J$	Breakdown Voltage Temperature Coefficient	I$_D$ = 250μA, Referenced to 25℃	-	0.6	-	V/℃
I$_{DSS}$	Zero Gate Voltage Drain Current	V$_{DS}$ = 600V, V$_{GS}$ = 0V -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	2.5	-	4.5	V
R$_{DS(on)}$	Static Drain-Source On-Resistance	V$_{GS}$ = 10V, I$_D$ = 23A	-	60	70	mΩ
g$_{FS}$	Forward Transconductance	V$_{DS}$ = 40V, I$_D$ = 25A	-	35	-	S
Dynamic Characteristics						
C$_{iss}$	Input Capacitance	V$_{DS}$ = 25V, V$_{GS}$ = 0V, f = 1.0MHz	-	3250	-	pF
C$_{oss}$	Output Capacitance		-	910	-	pF
C$_{rss}$	Reverse Transfer Capacitance		-	27	-	pF
Switching Characteristics						
t$_{d(on)}$	Turn-On Delay Time	V$_{DD}$ = 480V, I$_D$ = 23A R$_G$ = 20Ω (Note 4)	-	16	-	ns
t$_r$	Turn-On Rise Time		-	12	-	ns
t$_{d(off)}$	Turn-Off Delay Time		-	83	-	ns
t$_f$	Turn-Off Fall Time		-	5	-	ns
Q$_g$	Total Gate Charge	V$_{DS}$ = 480V, I$_D$ = 23A V$_{GS}$ = 10V (Note 4)	-	64	-	nC
Q$_{gs}$	Gate-Source Charge		-	19	-	nC
Q$_{gd}$	Gate-Drain Charge		-	25.5	-	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I$_S$	Maximum Continuous Drain-Source Diode Forward Current		-	-	47	A
I$_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		-	-	140	A
V$_{SD}$	Drain-Source Diode Forward Voltage	V$_{GS}$ = 0V, I$_S$ = 23A	-	0.9	1.5	V
t$_{rr}$	Reverse Recovery Time	V$_{GS}$ = 0V, V$_R$ = 400V, I$_S$ = 20A, dI$_F$/dt =100A/μs	-	580	-	ns
Q$_{rr}$	Reverse Recovery Charge		-	10.7	-	μC
I$_{rrm}$	Peak Reverse Recovery Current		-	37	-	A

NOTES:
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I$_{AS}$=9.3A, VDD=50V, Starting TJ=25 ℃
3. I$_{SD}$≤ID, di/dt ≤ 200A/us, V$_{DD}$ ≤ BV$_{DSS}$, Starting TJ = 25 ℃
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Power dissipation
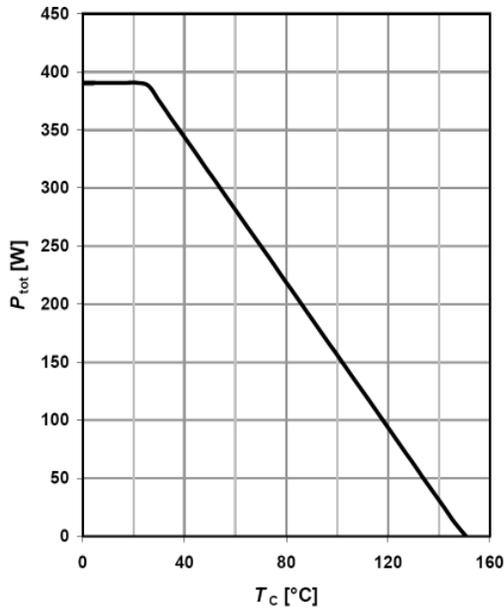

P_{tot}=f(T_C)

Safe operating area TC=25 ℃
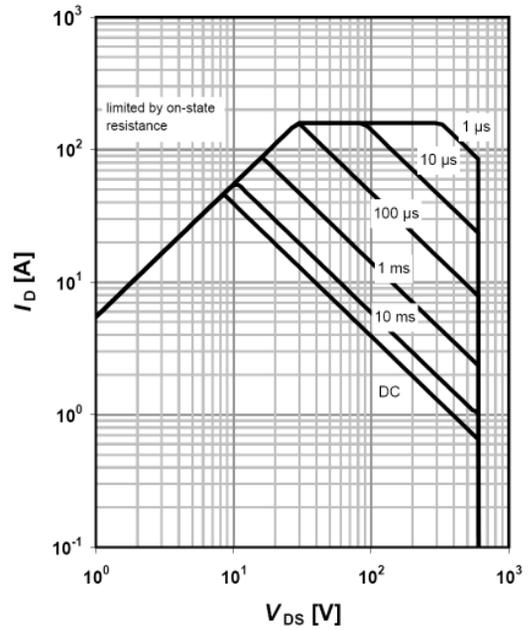
I_D=f(V_{DS}); T_C=25 ℃; D=0; parameter t_p

Max. transient thermal impedance
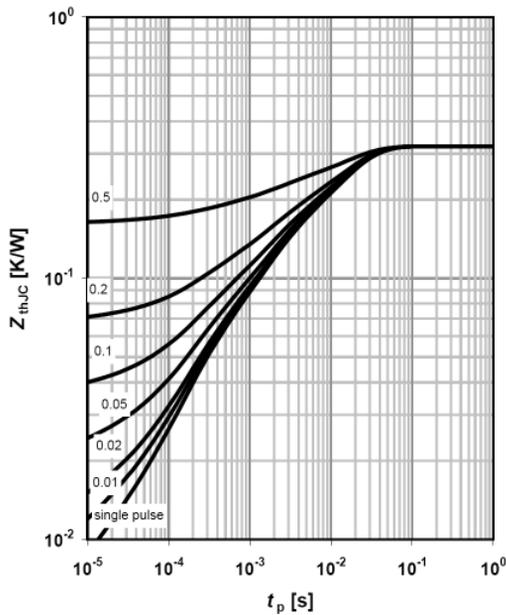

$Z_{(thJC)}$=f(tp); parameter D=tp/T

Typ. output characteristics T_j=25 ℃
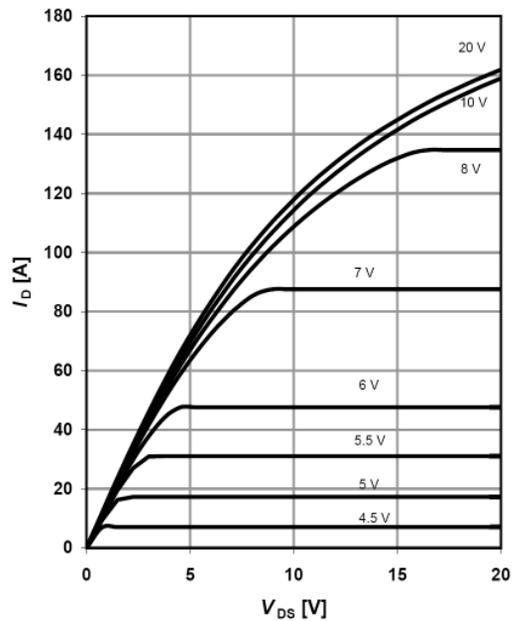
I_D=f(V_{DS}); T_j=25 ℃ ; parameter: V_{GS}

Typical Performance Characteristics

Typ. output characteristics $T_j=125\ ℃$
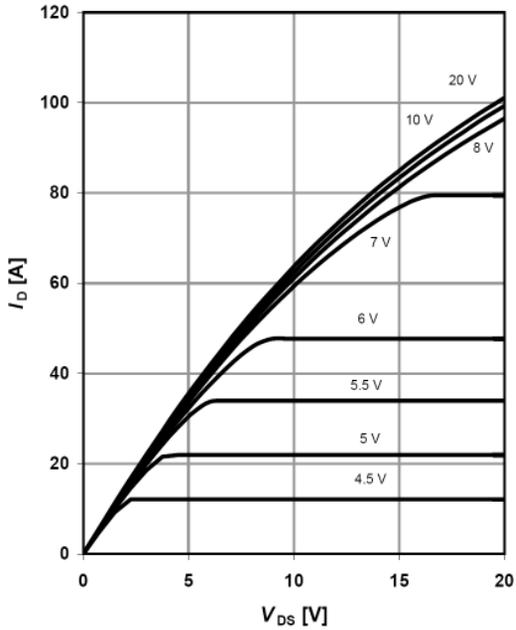
I_D=f(V_{DS}); T_j=125 ℃ ; parameter: V_{GS}

Typ. drain-source on-state resistance
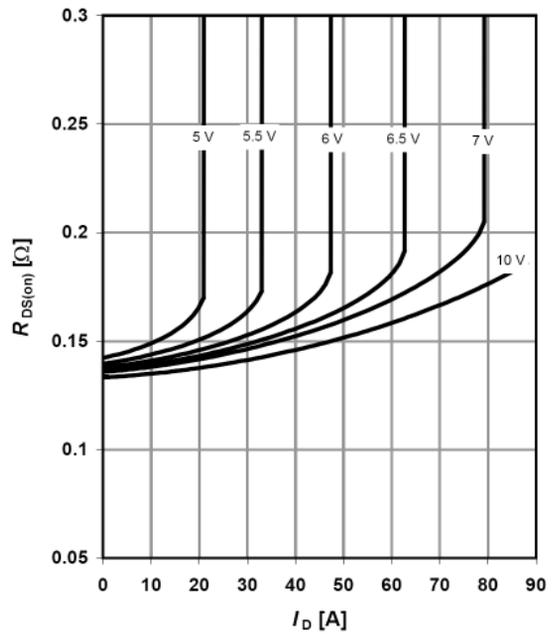
R_{DS}(on)=f(I_D); T_j=125 ℃ ; parameter:V_{GS}

Typ. drain-source on-state resistance
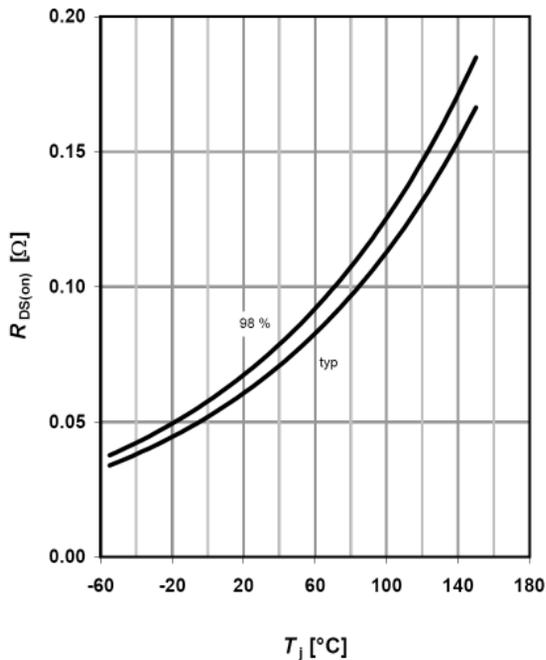
R_{DS}(on)=f(T_j); I_D=23 A; V_{GS}=10 V

Typ. transfer characteristics
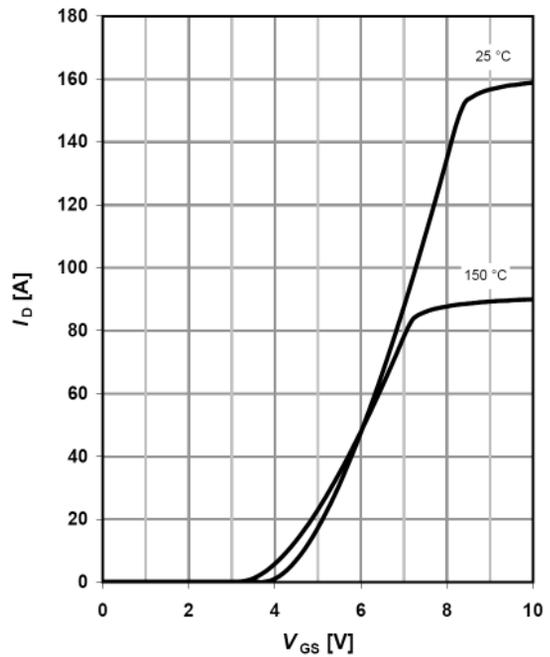
I_D=f(V_{GS}); V_{DS}=40V

Typical Performance Characteristics

Typ. gate charge

$V_{GS}=f(Q_g)$, I_D=23A pulsed

Avalanche energy

$E_{AS}=f(T_j)$; I_D=9.3A; V_{DD}=50 V
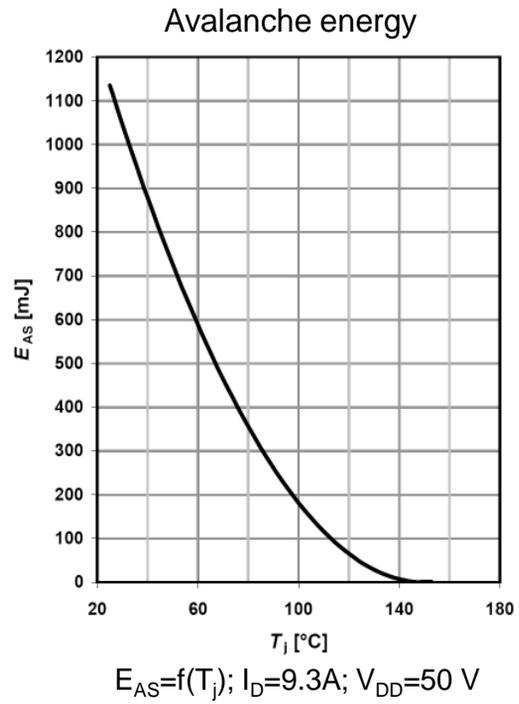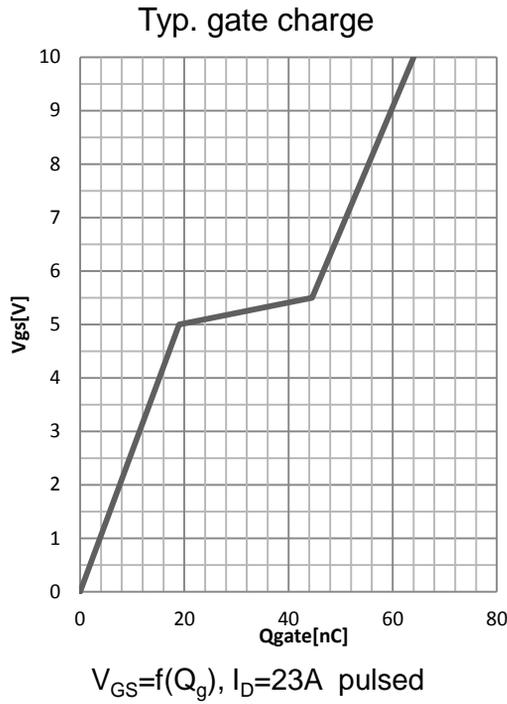
Forward characteristics of reverse diode

$I_F=f(V_{SD})$; parameter: T_j

Drain-source breakdown voltage

$V_{BR(DSS)}=f(T_j)$; I_D=0.25mA
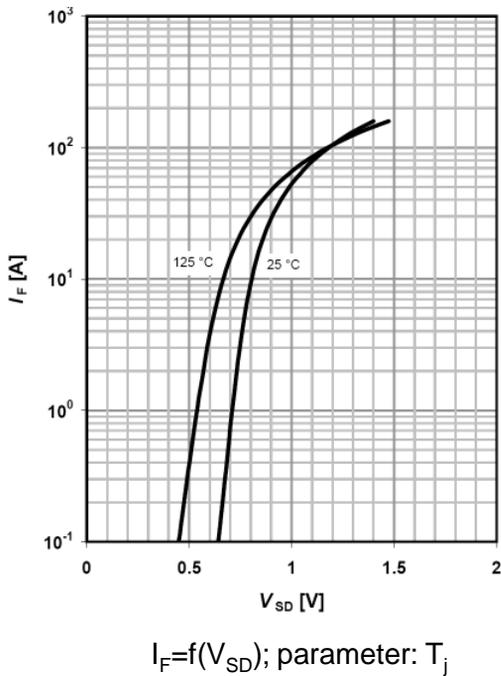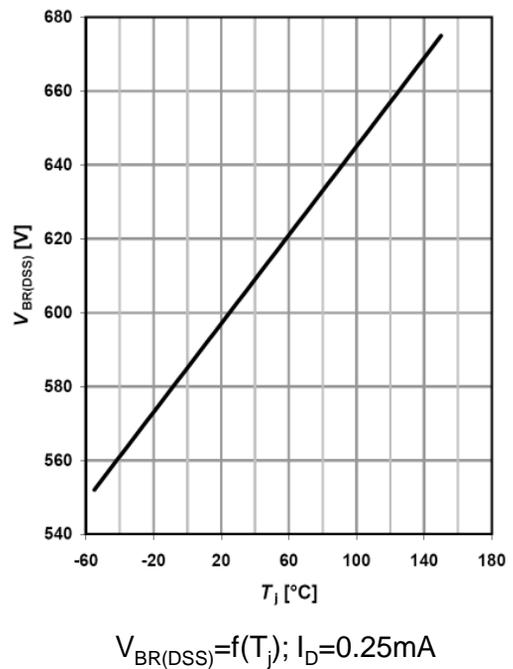
# Typical Performance Characteristics

Typ. capacitances
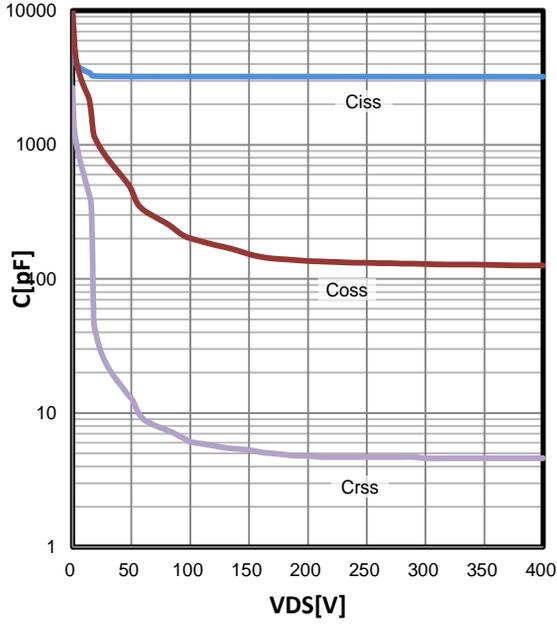
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Typ. Coss stored energy
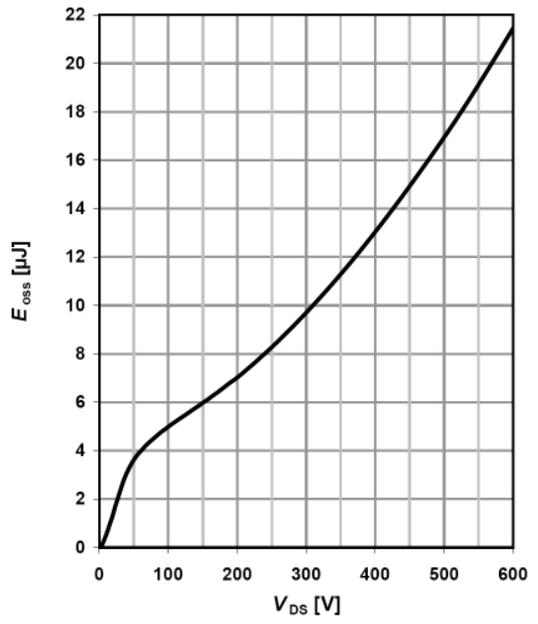
E_{OSS}=f(V_{DS})

Test circuits

Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load

V_{DS}
V_{GS}
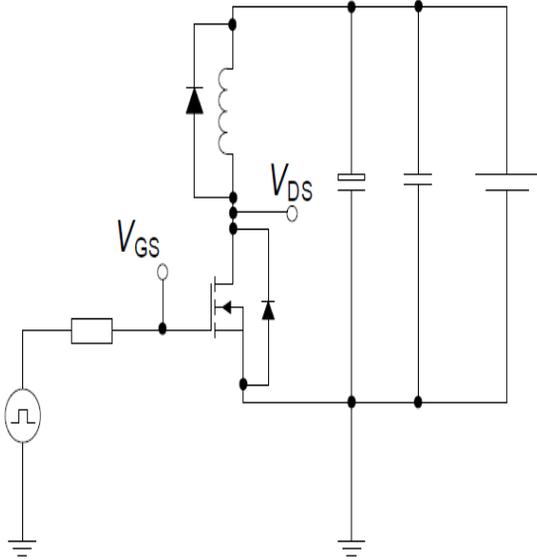
Switching time waveform

V_{DS}
90%
10%
V_{GS}

$t_{d(on)}$ t_r $t_{d(off)}$ t_f
t_{on} t_{off}
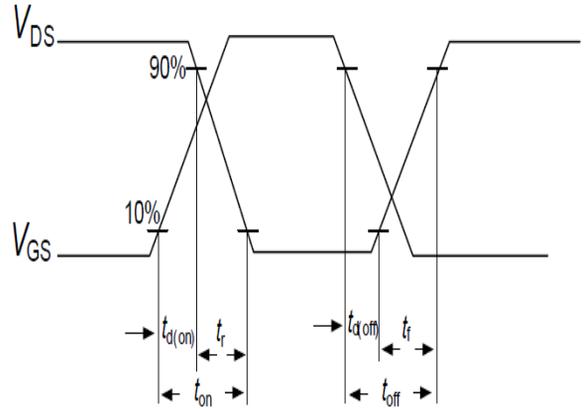
Unclamped inductive load test circuit and waveform

Unclamped inductive load test circuit

I_D V_{DS}
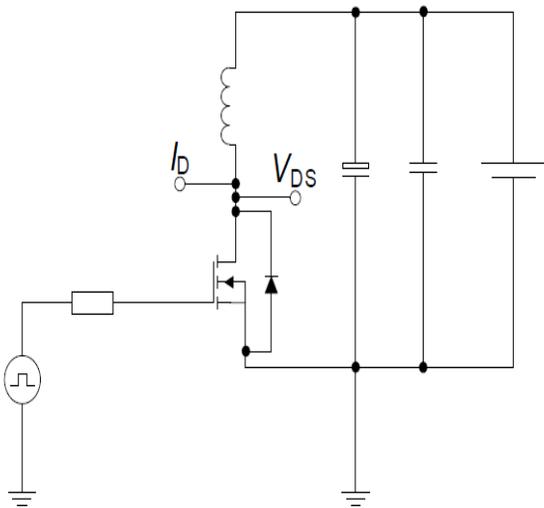
Unclamped inductive waveform

$V_{(BR)DS}$
$V_D \rightarrow$
V_{DS}
$I_D \rightarrow$
V_{DS}
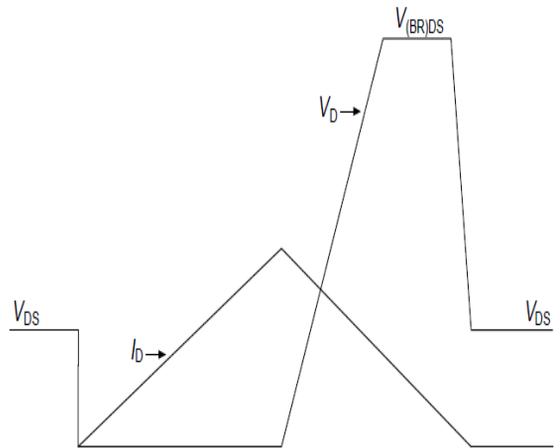
Test circuit and waveform for diode characteristics

Test circuit for diode characteristics

R_{G1}

I_D

R_{G2}

V_{DS}

$R_{G1} = R_{G2}$
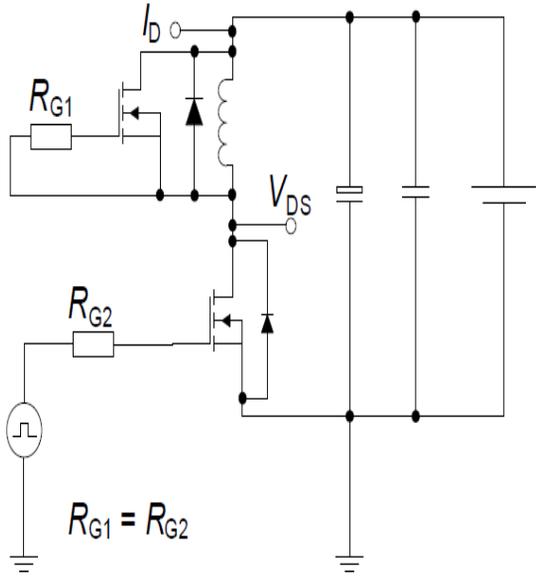
Diode recovery waveform

$\mathrm{d}i_F/\mathrm{d}t$

$t_{rr} = t_S + t_F$

$Q_{rr} = Q_S + Q_F$

t_{rr}

t_S t_F

I_F

I_{RRM}

Q_S Q_F

$\mathrm{d}i_{rr}/\mathrm{d}t$

$10\%\,I_{RRM}$

$90\%\,I_{RRM}$

V_{RRM}

V

t

Package Outline
TO-247
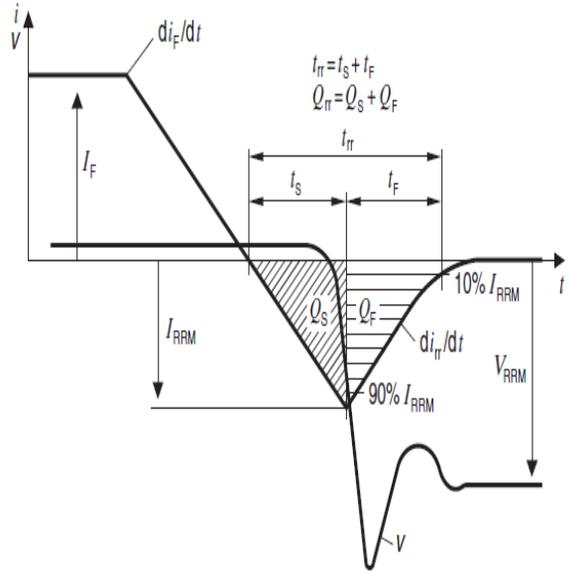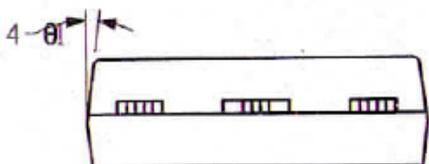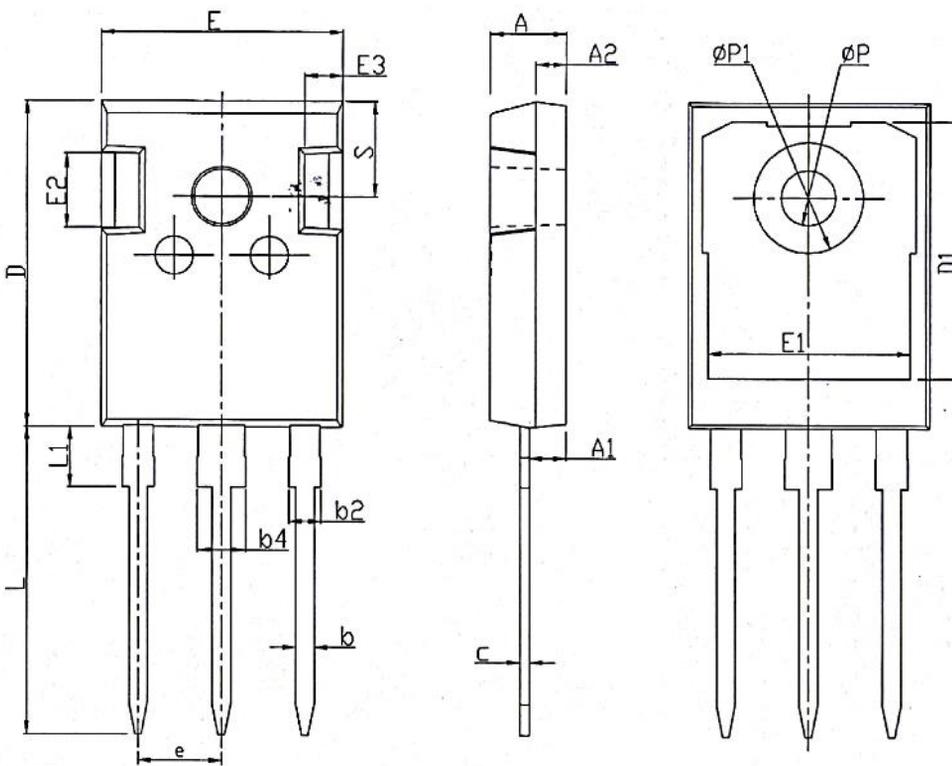
COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16	1.21	1.26
b2	1.96	2.01	2.06
b4	2.96	3.01	3.06
c	0.59	0.61	0.66
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.44BSC		
h	0.05	0.10	0.15
L	19.80	19.92	20.10
L1	-	-	4.30
ΦP	3.50	3.60	3.70
ΦP1	-	-	7.30
ΦP2	2.40	2.50	2.60
Q	5.60	5.80	6.00
S	6.15BSC		
R	0.50REF		
T	9.80	-	10.20
T1	1.65REF		
T2	8.00REF		
T3	12.80REF		
U	6.00	-	6.40
θ1	6°	7°	8°
θ2	4°	5°	6°
θ3	1°	-	1.5°
θ4	14°	15°	16°

SYMBOL	MM		
	MIN	NOM	MAX
A	4.60	4.80	5.00
A1	1.40	1.50	1.60
A2	1.33	1.38	1.43
b	0.80	1.00	1.20
b1	2.80	3.00	3.20
b2	1.80	2.00	2.20
c	0.50	0.60	0.70
D	19.75	19.90	20.05
D1	13.70	13.90	14.10
D2	12.90REF		
E	15.40	15.60	15.80
E1	13.40	13.60	13.80
E2	9.40	9.60	9.80
e	5.45 TYP		
G	4.60	4.80	5.00
H	40.30	40.50	40.70
H1	23.20	23.40	23.60
h	0.05	0.10	0.15
L	7.40 TYP		
L1	9.00 TYP		
L2	11.00 TYP		
L3	1.00 REF		
ΦP	6.90	7.00	7.10
ΦP1	3.20 REF		
ΦP2	3.50 REF		
ΦP3	1.40	1.50	1.60
R	0.50 REF		
Q	5.00 REF		
Q1	12.56	12.76	12.96
U	7.8	8	8.2
θ1	5°	7°	9°
θ2	1°	3°	5°
θ3	60° REF		

COMMON DIMENSIONS

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