March, 2016

SJ-FET

RTW47N60SFD/RTA47N60SFD
600V N-Channel MOSFET 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.

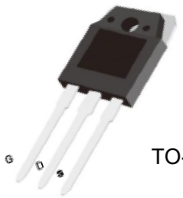
Features

- Multi-Epi process SJ-FET
- Fast-Recovery body diode
- Extremely Low Reverse Recovery Charge
- 650V @TJ = 150℃
- Typ. RDS(on) = 65mΩ
- Ultra Low Gate Charge (typ. Qg = 64nC)
- 100% avalanche tested

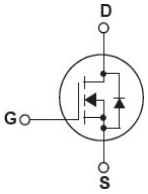
RTW47N60SFD

TO-247

RTA47N60SFD



TO-3P



Absolute Maximum Ratings

Symbol	Parameter	RTW_A47N60SFD	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)	40	V/ns
dVds/dt	Drain Source voltage slope (Vds=480V)	80	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	RTW_A47N60SFD	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°C unless otherwise noted

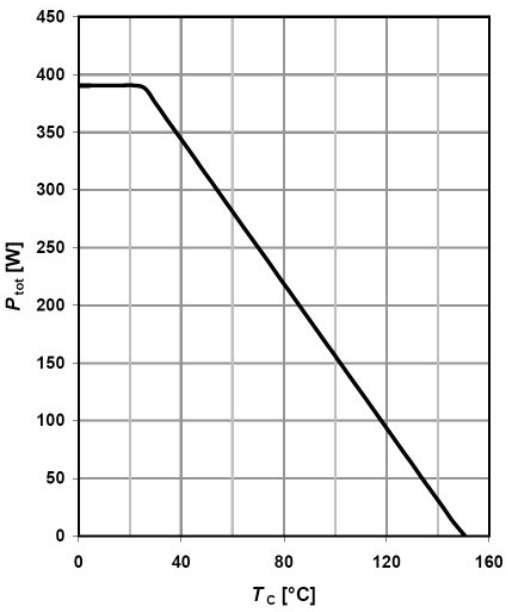
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250μA, T_J = 25℃	600	-	-	V
		V_{GS} = 0V, I_D = 250μA, T_J = 150℃	-	650	-	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 250μA, Referenced to 25℃	-	0.6	-	V/℃
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600V, V_{GS} = 0V -T_J = 150℃	-	1 300	5 -	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	-	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10V, I_D = 23A	-	65	75	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 = 480V, I_S = 23A, dI_F/dt =100A/μs	-	230	-	ns
Q_{rr}	Reverse Recovery Charge		-	3	-	μC
Irrm	Peak Reverse Recovery Current		-	23	-	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

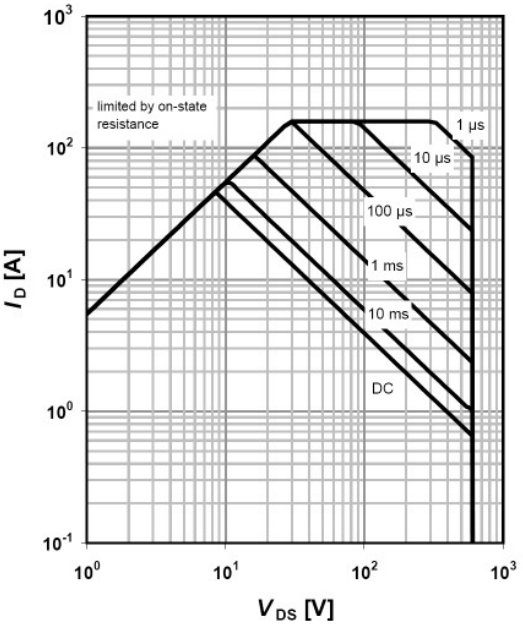
Typical Performance Characteristics

Power dissipation



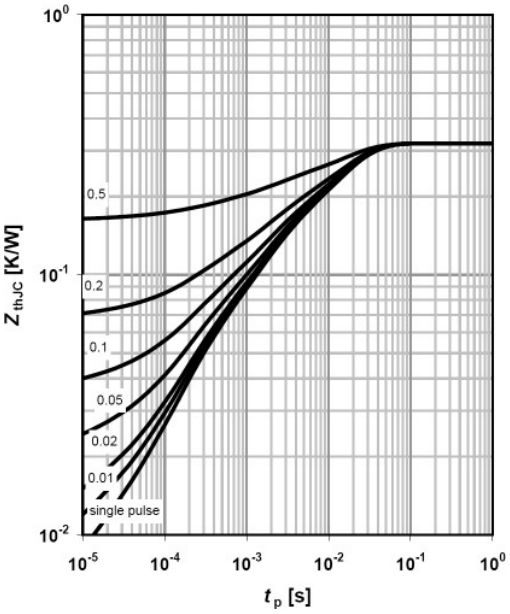
$P_{□}$ =f(T_C)

Safe operating area TC=25 ℃



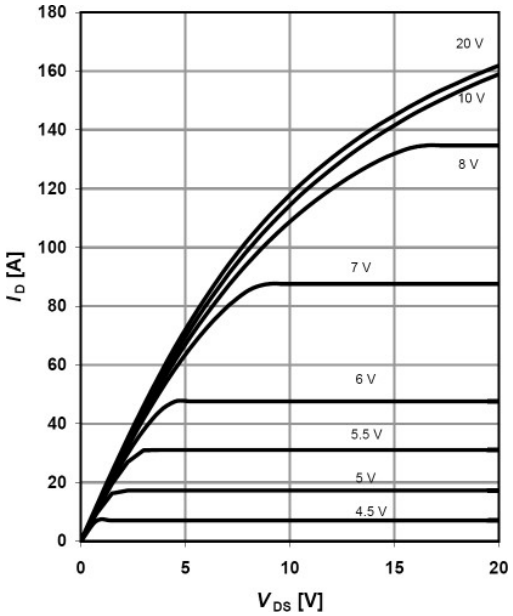
I_D=f(V_{DS}); T_C=25 ℃; D=0; parameter t_p

Max. transient thermal impedance



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

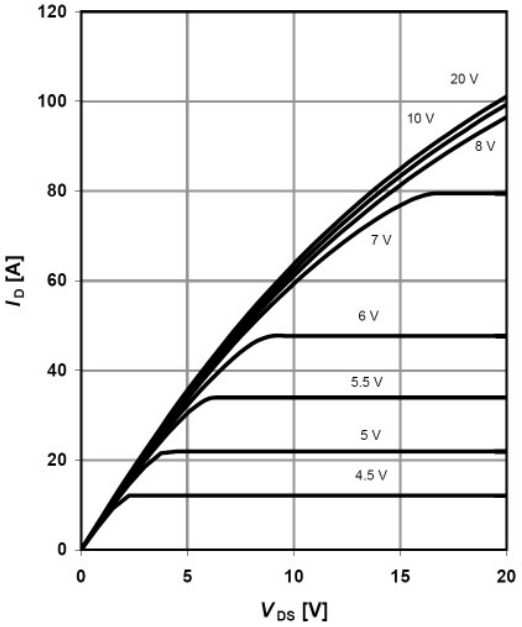
Typ. output characteristics T_j=25 ℃



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

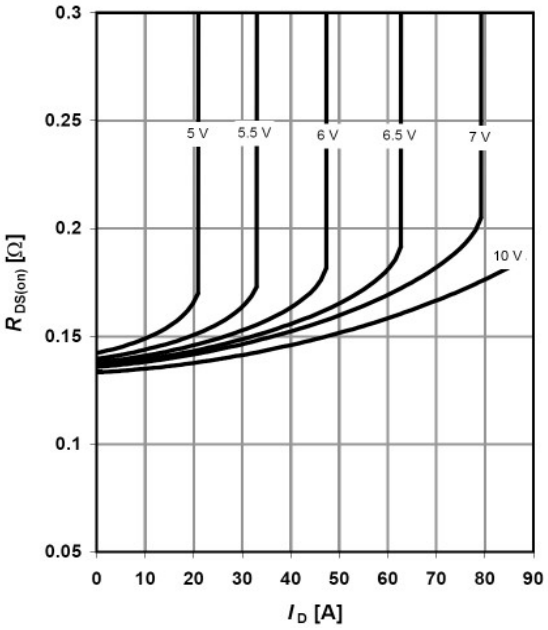
Typical Performance Characteristics

Typ. output characteristics T_j=125 ℃



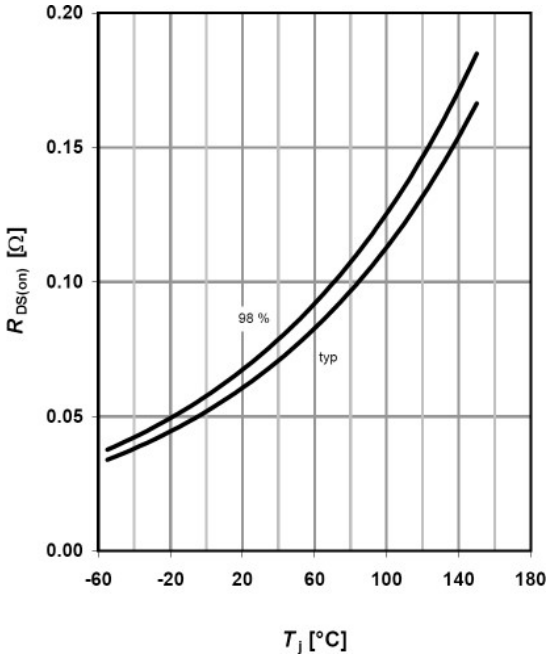
I_D=f(V_{DS}); T_j=125 ℃ ; parameter: V_{GS}

Typ. drain-source on-state resistance



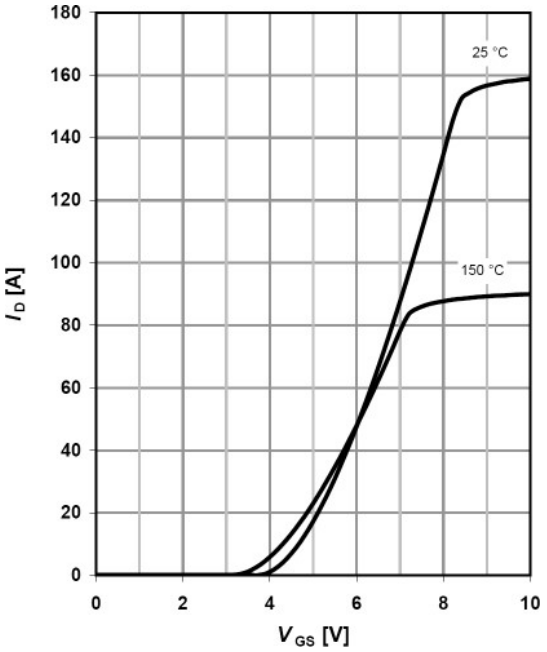
R_{DS}(on)=f(I_D); T_j=125 ℃ ; parameter:V_{GS}

Typ. drain-source on-state resistance



R_{DS}(on)=f(T_j); I_D=23 A; V_{GS}=10 V

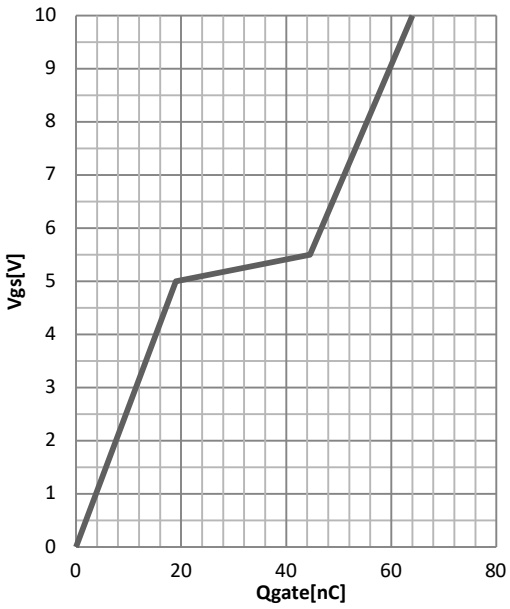
Typ. transfer characteristics



I_D=f(V_{GS}); V_{DS}=40V

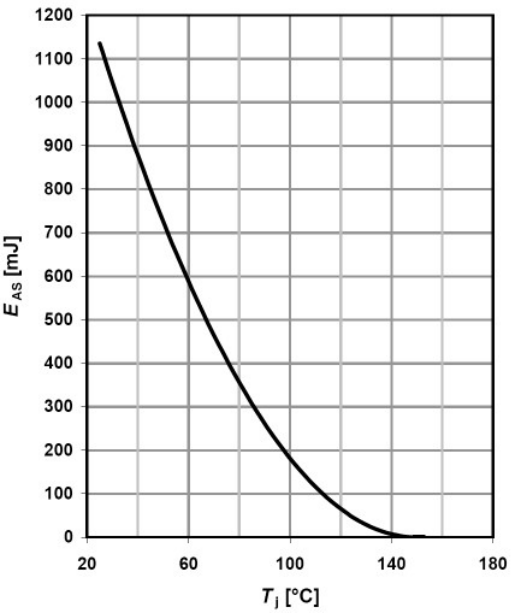
Typical Performance Characteristics

Typ. gate charge



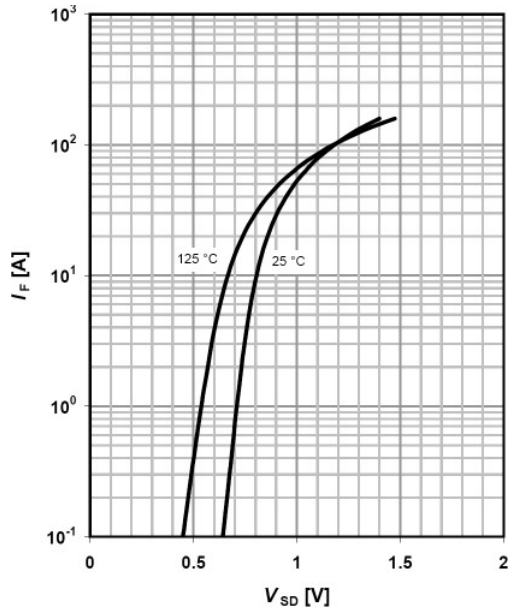
V_{GS}=f(Q_g), I_D=23A pulsed

Avalanche energy



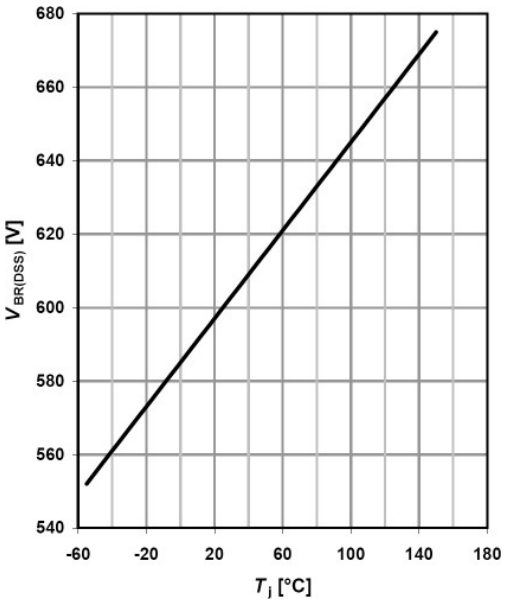
E_{AS}=f(T_j); I_D=9.3A; V_{DD}=50 V

Forward characteristics of reverse diode



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

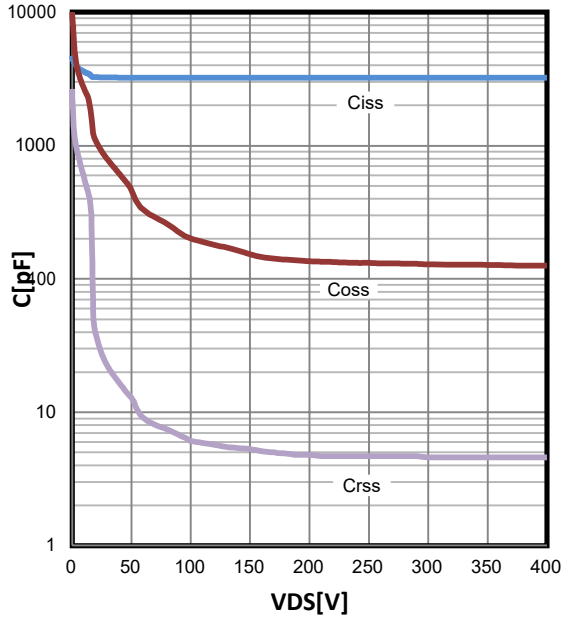
Drain-source breakdown voltage



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

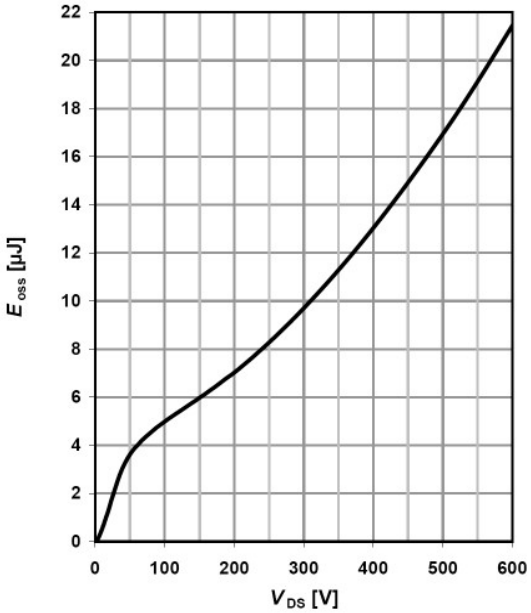
Typical Performance Characteristics

Typ. capacitances



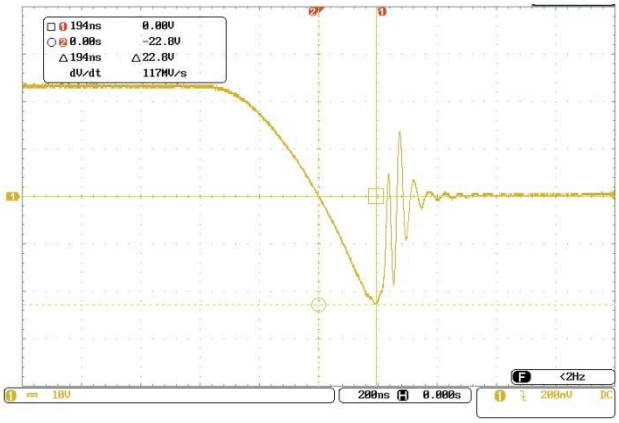
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Typ. Coss stored energy



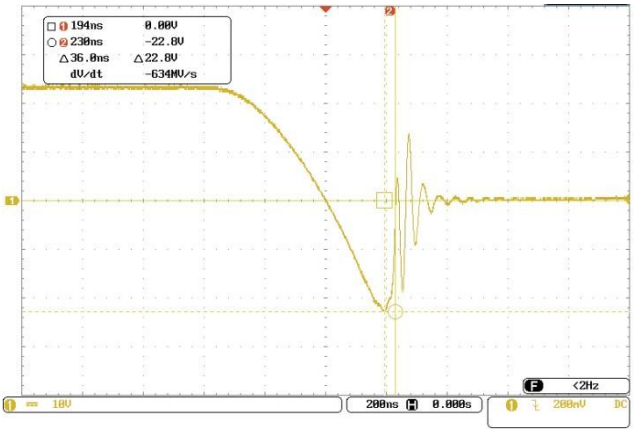
E_{OSS}=f(V_{DS})

Typ. Recovery Time(Ts)



VR=480V, Is = 23A, dIF/dt =100A/μs

Typ. Recovery Time(Tf)

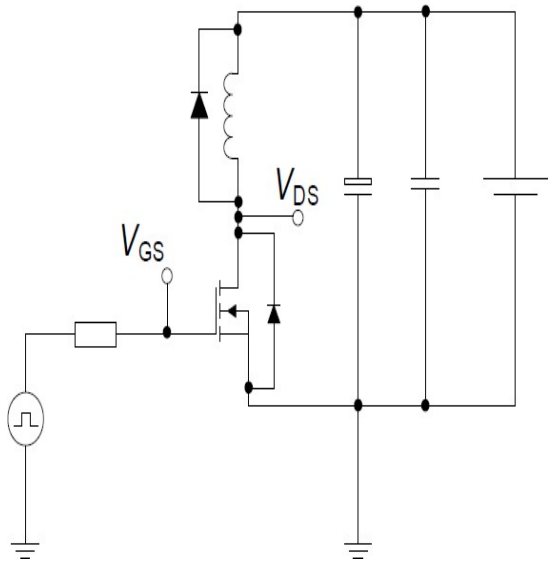


VR=480V, Is = 23A, dIF/dt =100A/μs

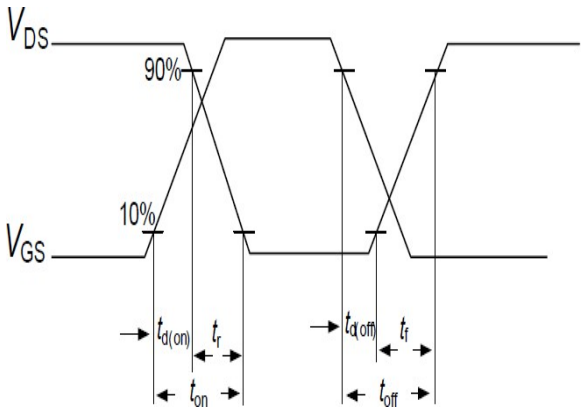
Test circuits

Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load

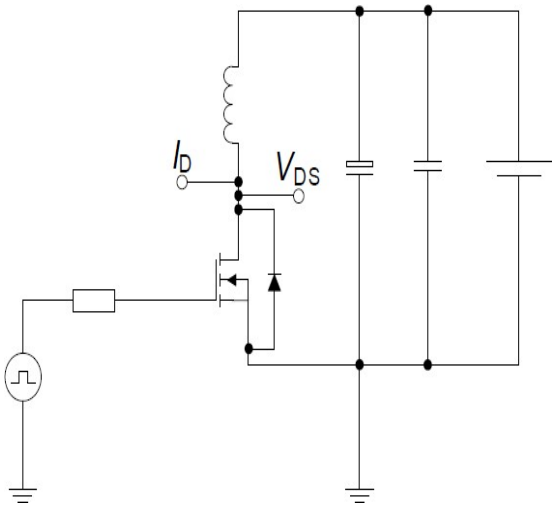


Switching time waveform

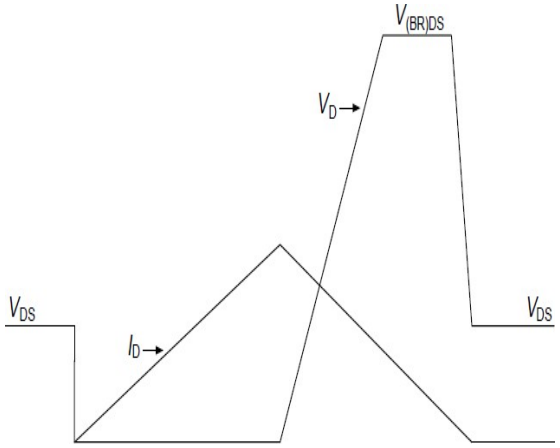


Unclamped inductive load test circuit and waveform

Unclamped inductive load test circuit



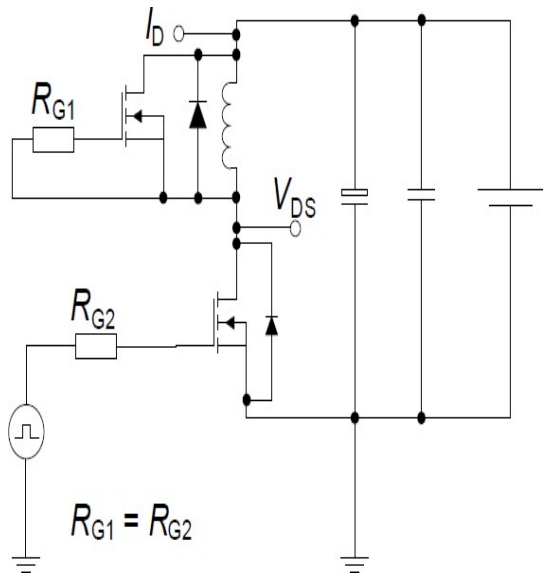
Unclamped inductive waveform



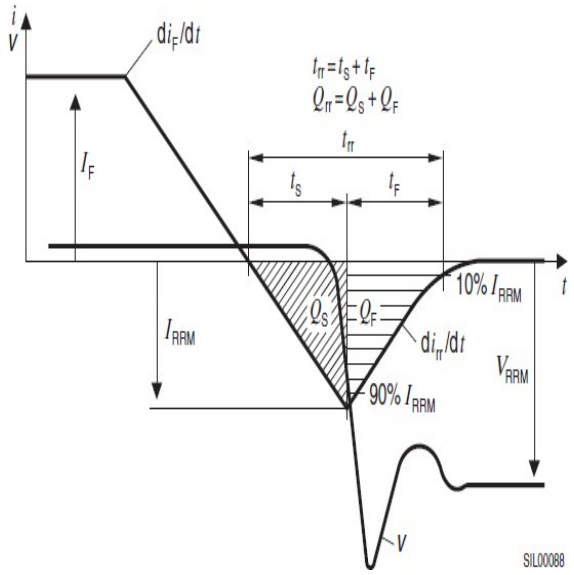
Test circuits

Test circuit and waveform for diode characteristics

Test circuit for diode characteristics



Diode recovery waveform



Package Outline

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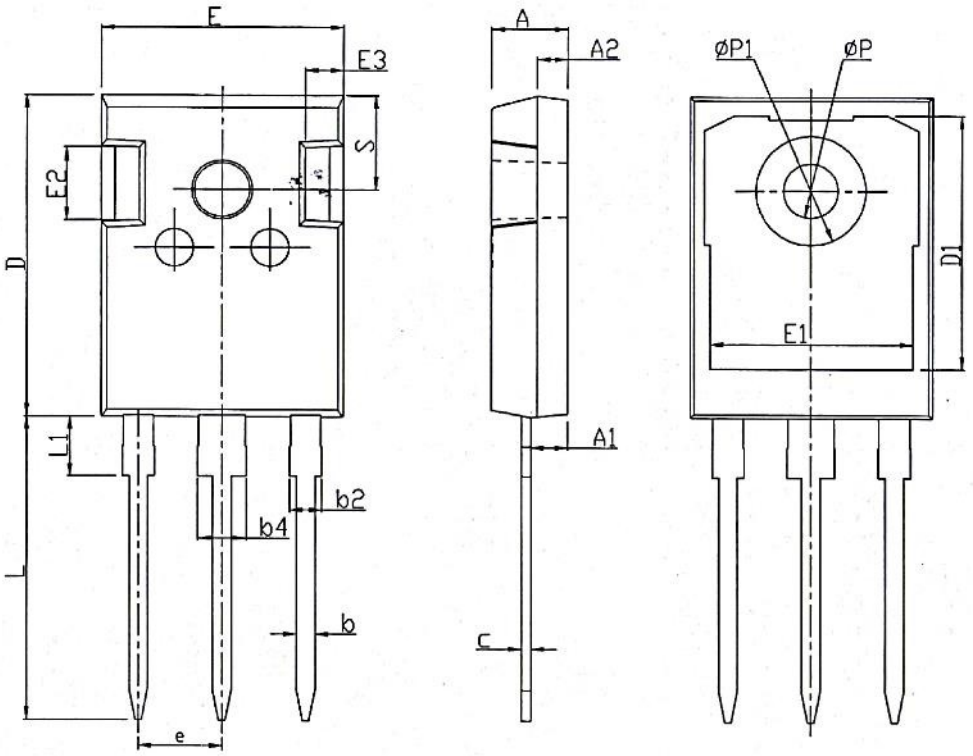
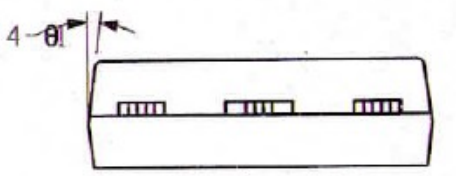


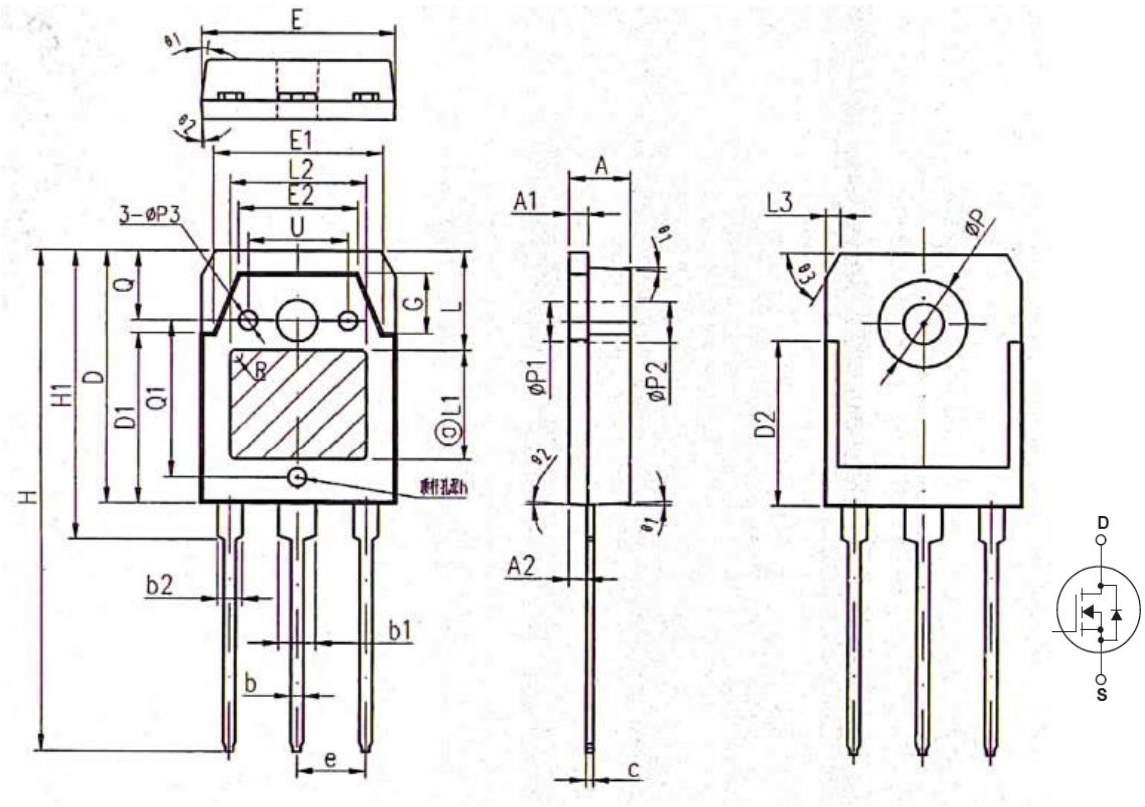


COMMON DIMENSIONS

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°

Package Outline

TO-3P



COMMON DIMENSIONS

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	