

47A 650V N-Channel Super Junction MOSFET

Features :

- $R_{DS(ON)} < 70m\Omega @ V_{GS}=10V$
- 100% avalanche tested
- RoHS compliant

Mechanical Data :

- Case: TO-247 Package

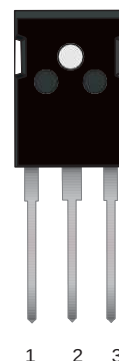
Application :

- Consumer
- EV Charger
- PFC stages for server & telecom

Ordering Information

Part No.	Package Type	Package	Quality(box)
KWSJ47N65P	TO-247	Tube	600

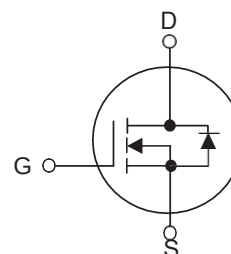
TO-247



Block Diagram

Pin Definition:

1. Gate
2. Drain
3. Source



V_{DS}	$R_{DS(on)}$ (m Ω) Typ	I_D (A)	Q_g (Typ)
650V	60@ 10V	47	190nc

Table1 Absolute Maximum Ratings ($T_C=25^\circ C$, unless otherwise specified)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	660	V
Gate-Source Voltage	V_{GS}	± 30	V
Continuous Drain Current	I_D	$T_C=25^\circ C$	A
		$T_C=100^\circ C$	
Pulsed Drain Current (Note 1)	I_{DM}	140	A
Single Pulse Avalanche Energy(Note 2)	E_{AS}	1160	mJ
Avalanche Current(Note 1)	I_{AR}	10	A
Repetitive Avalanche Energy	E_{AR}	1.72	mJ
Power Dissipation $T_C=25^\circ C$	P_D	391	W
Operating Junction and Storage Temperature	T_J/T_{STG}	-55 ~ +150	$^\circ C$
Maximum Temperature for soldering	T_L	300	$^\circ C$

Table 2. Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal resistance Junction to Ambient	$R_{\theta JA}$	62	$^{\circ}\text{C/W}$
Thermal resistance Junction to Case	$R_{\theta JC}$	0.32	$^{\circ}\text{C/W}$

Table 3. Electrical Characteristics ($T_J=25^{\circ}\text{C}$, unless otherwise specified)

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Off Characteristics							
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} =0V,I _D =250μA	650	--	--	V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =650V,V _{GS} =0V	--	--	1	μA
Gate- Source Leakage Current	Forward	I _{GSS}	V _{GS} =30V,V _{DS} =0V	--	--	100	nA
	Reverse		V _{GS} =-30V,V _{DS} =0V	--	--	-100	nA
On Characteristics(Note 4)							
Gate Threshold Voltage		V _{GS(TH)}	V _{DS} =V _{GS} ,I _D =250μA	2.5	--	4.5	V
Static Drain-Source On-State Resistance		R _{DS(ON)}	V _{GS} =10V,I _D =23A	--	60	70	mΩ
Dynamic Characteristics(Note 5)							
Input Capacitance		C _{ISS}	V _{DS} =25V,V _{GS} =0V,f=1MHz	--	3100	--	pF
Output Capacitance		C _{OSS}		--	148	--	pF
Reverse Transfer Capacitance		C _{RSS}		--	5	--	pF
Switching Characteristics (Note 5)							
Turn-On Delay Time		t _d (on)	V _{DD} =480V,I _D =23A, R _G =20Ω	--	19	--	ns
Turn-On Rise Time		t _R		--	10	--	ns
Turn-Off Delay Time		t _d (off)		--	87	--	ns
Turn-Off Fall Time		t _f		--	5	--	ns
Total Gate Charge		Q _G	V _{DS} =480V,I _D =23A, V _{GS} =10V	--	190	--	nC
Gate-Source Charge		Q _{GS}		--	30	--	nC
Gate-Drain Charge		Q _{GD}		--	95	--	nC
Drain-Source Diode Characteristics and Maximum Ratings							
Drain-Source Diode Forward Voltage		V _{SD}	V _{GS} =0V, I _S =23A	--	0.9	1.5	V
Maximum Continuous Drain-Source Diode Forward Current		I _S		--	--	47	A
Reverse Recovery Time		trr	V _{GS} =0V, I _F =23A	--	710	--	ns
Reverse Recovery Charge		Q _{RR}	dI _F /dt=100A/μs (Note 1)	--	19	--	nC

Notes : 1 Repetitive Rating:Pulse width limited by maximum junction temperature 2

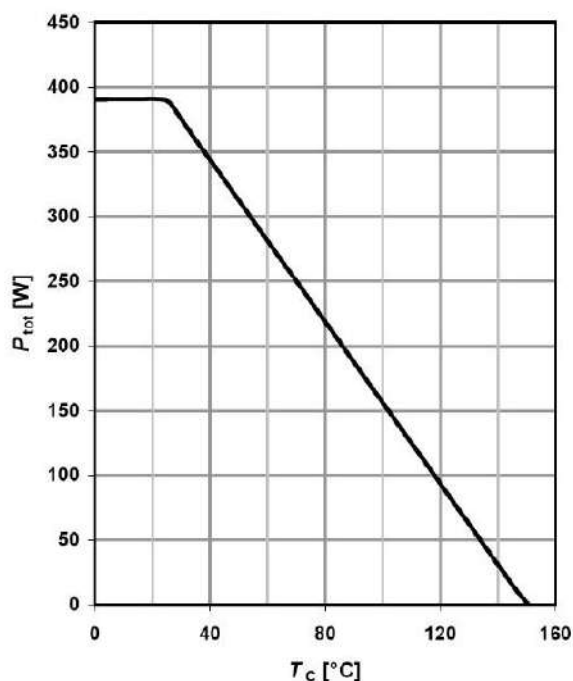
Starting $T_J=25^{\circ}\text{C}$

4 Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$

5 Guaranteed by design, not subject to production

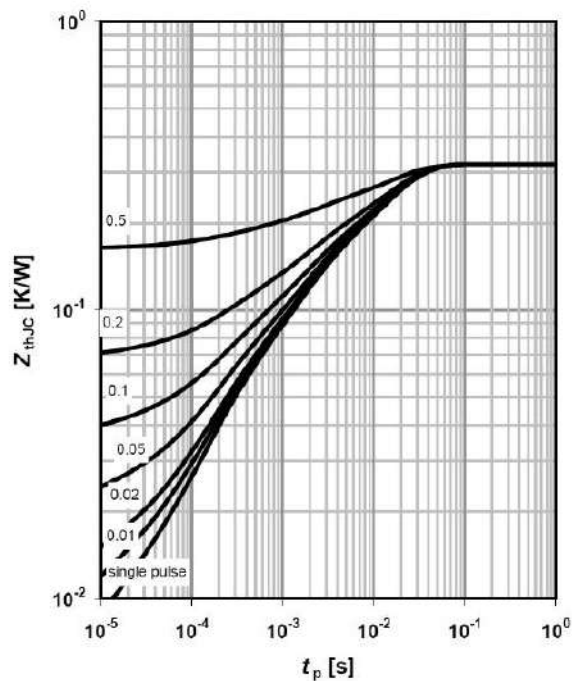
Typical characteristics Diagrams

Power dissipation



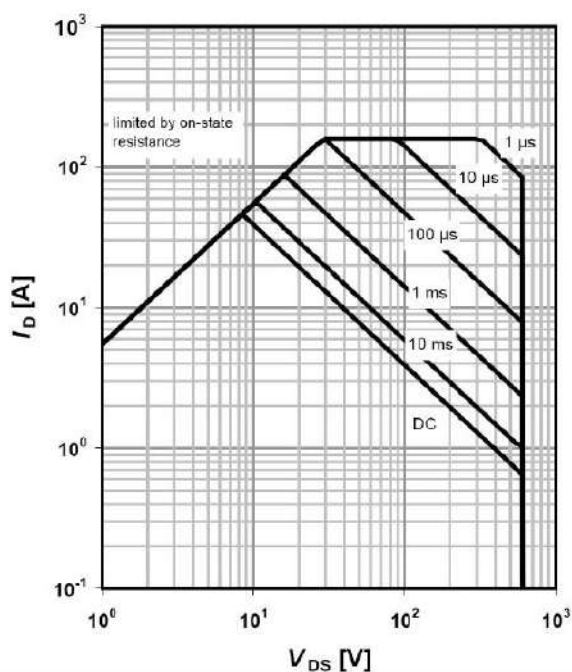
$$P_{tot} = f(T_c)$$

Max. transient thermal impedance



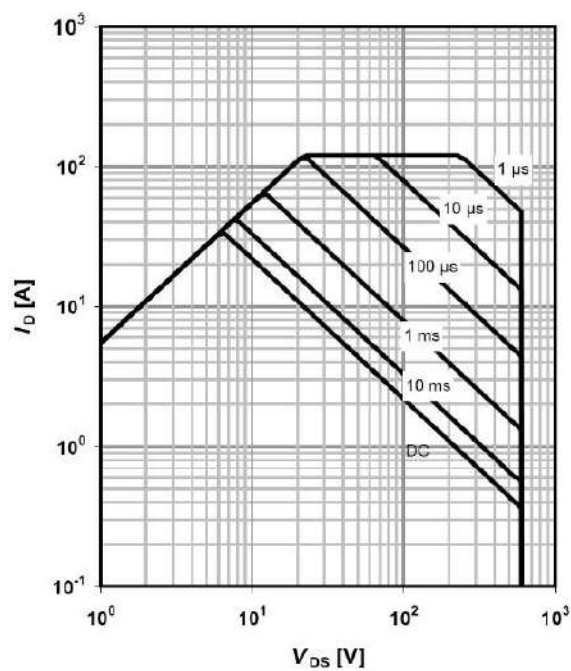
$$Z_{thJC} = f(t_p); \text{ parameter: } D = t_p / T$$

Safe operating area $T_c = 25^\circ\text{C}$



$$I_D = f(V_{DS}); T_c = 25^\circ\text{C}; V_{GS} > 7\text{V}; D = 0; \text{ parameter } t_p$$

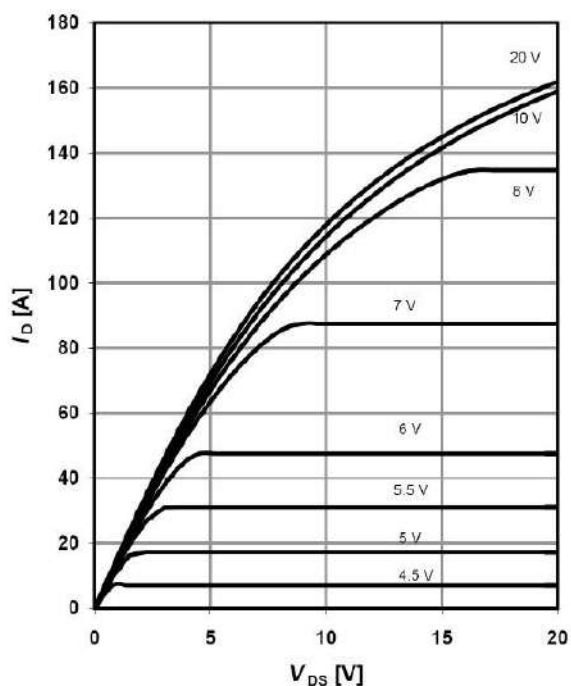
Safe operating area $T_c = 80^\circ\text{C}$



$$I_D = f(V_{DS}); T_c = 80^\circ\text{C}; V_{GS} > 7\text{V}; D = 0; \text{ parameter } t_p$$

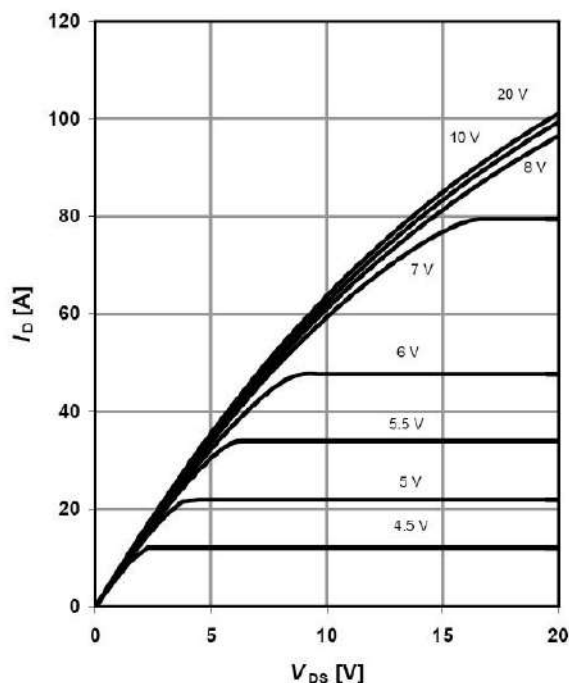
Typical characteristics Diagrams

Typ. output characteristics $T_j=25\text{ }^{\circ}\text{C}$



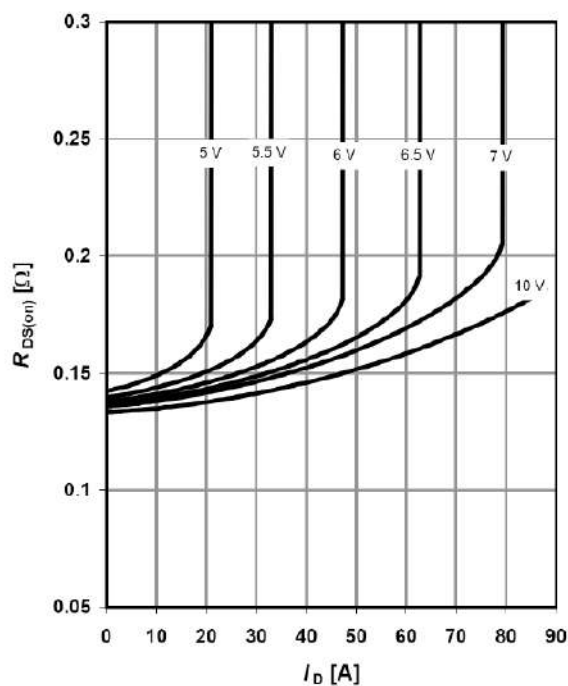
$I_D=f(V_{DS}); T_j=25\text{ }^{\circ}\text{C}; \text{parameter: } V_{GS}$

Typ. output characteristics $T_j=125\text{ }^{\circ}\text{C}$



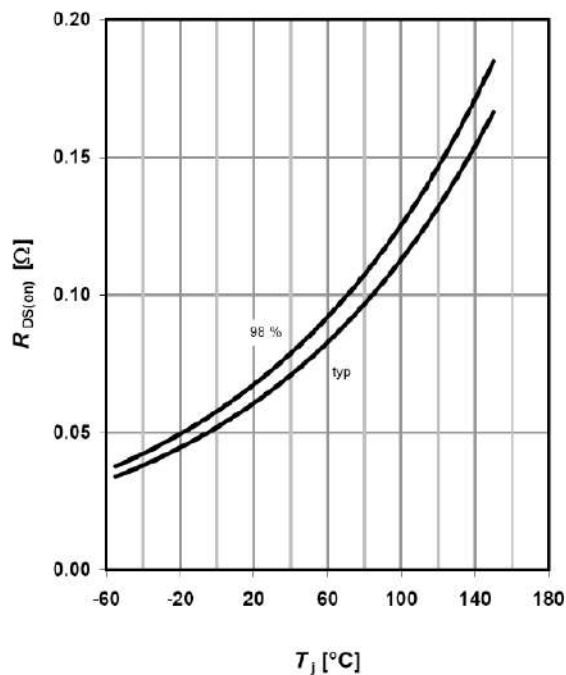
$I_D=f(V_{DS}); T_j=125\text{ }^{\circ}\text{C}; \text{parameter: } V_{GS}$

Typ. drain-source on-state resistance



$R_{DS(on)}=f(I_D); T_j=125\text{ }^{\circ}\text{C}; \text{parameter: } V_{GS}$

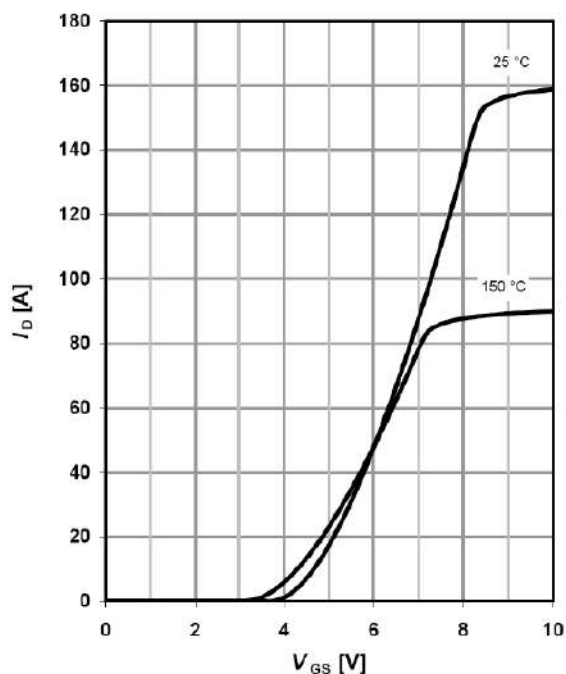
Drain-source on-state resistance



$R_{DS(on)}=f(T_j); I_D=17.6\text{ A}; V_{GS}=10\text{ V}$

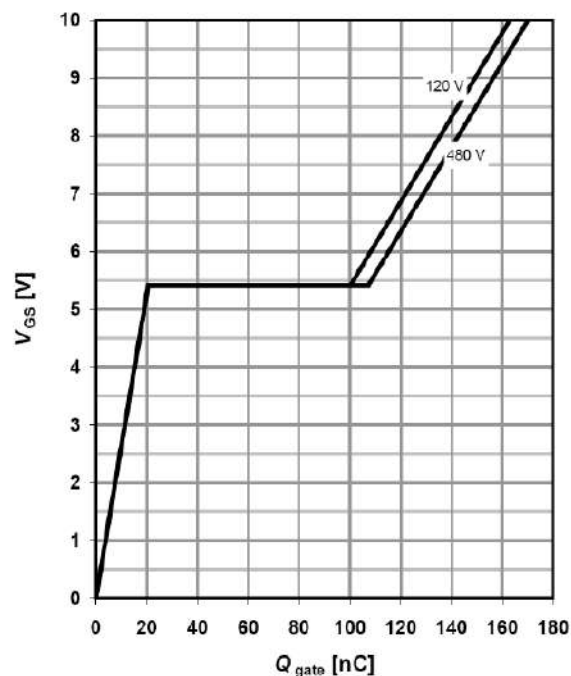
Typical characteristics Diagrams

Typ. transfer characteristics



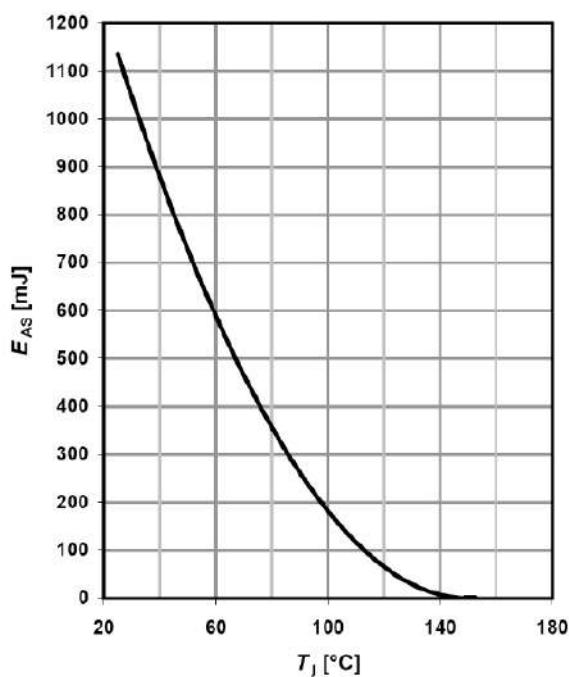
$$I_D = f(V_{GS}); V_{DS} = 20V$$

Typ. gate charge



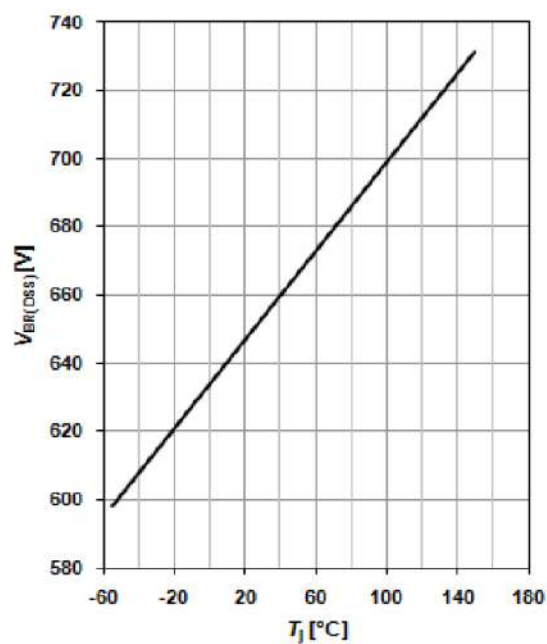
$$V_{GS} = f(Q_{gate}), I_D = 26.3 \text{ A pulsed}$$

Avalanche energy



$$E_{AS} = f(T_J); I_D = 9.3 \text{ A}; V_{DD} = 50 \text{ V}$$

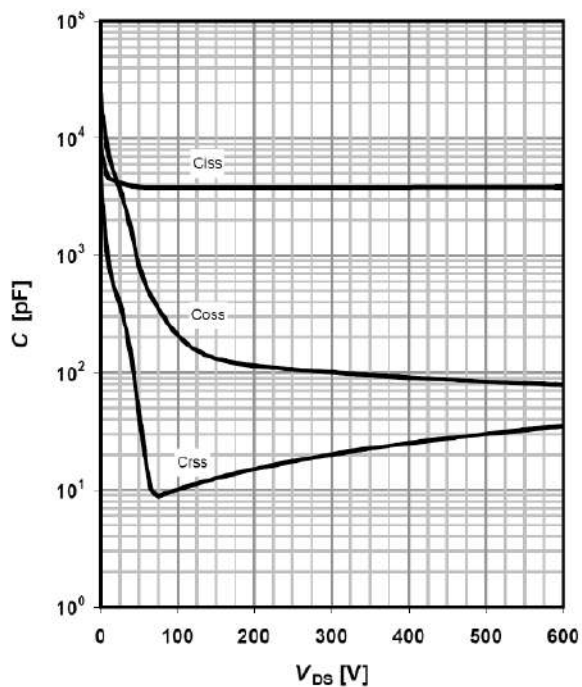
Drain-source breakdown voltage



$$V_{BR(DSS)} = f(T_J); I_D = 1.0 \text{ mA}$$

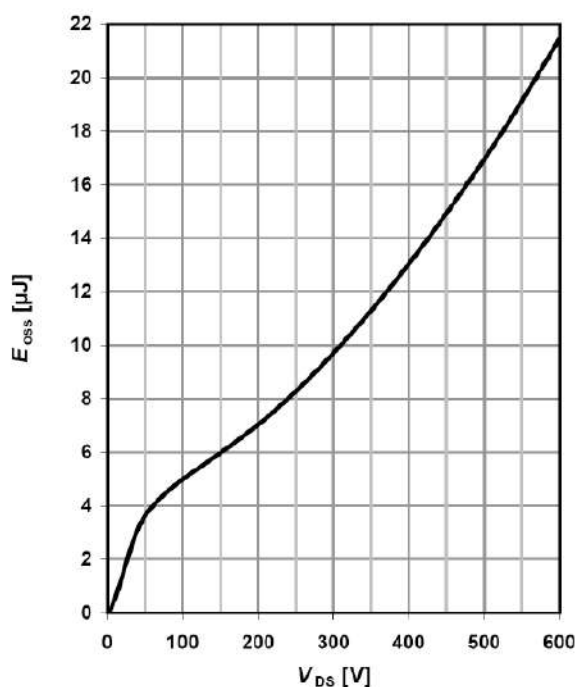
Typical characteristics Diagrams

Typ. capacitances



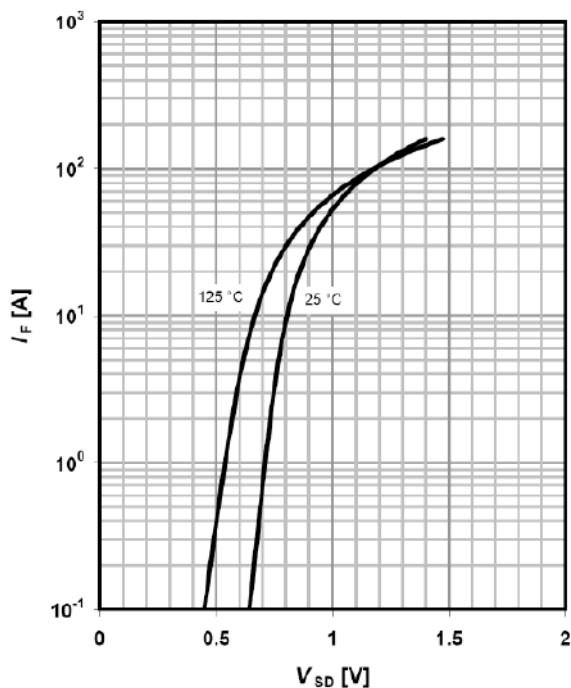
$$C=f(V_{DS}); V_{GS}=0 \text{ V}; f=1 \text{ MHz}$$

Typ. C_{oss} stored energy



$$E_{oss}=f(V_{DS})$$

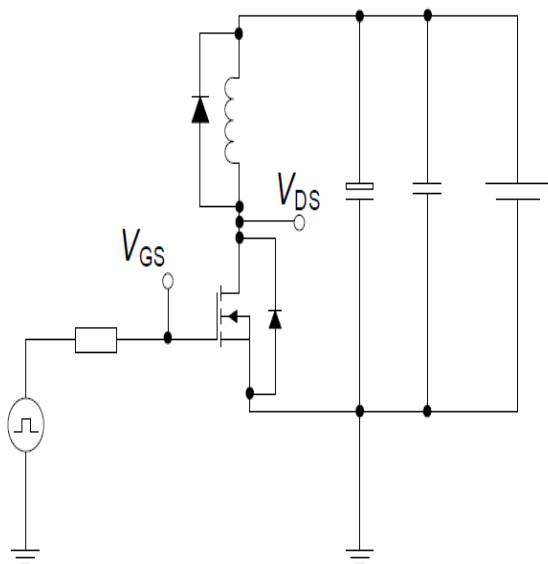
Forward characteristics of reverse diode



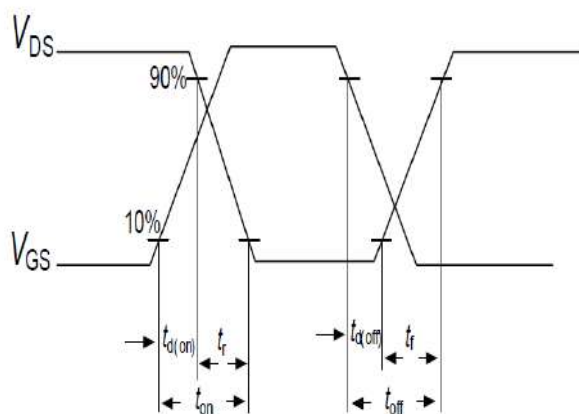
$$I_F=f(V_{SD}); \text{parameter: } T_j$$

Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load

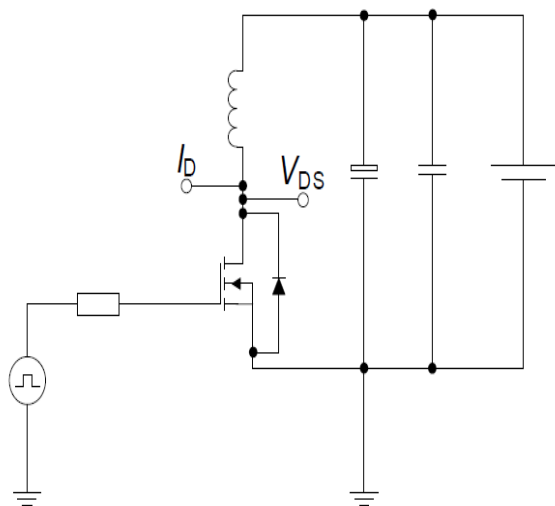


Switching time waveform

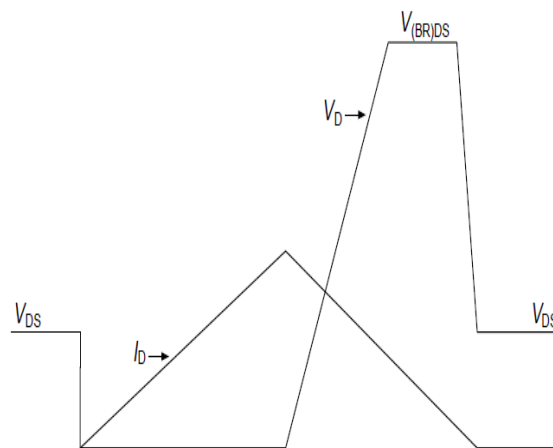


Unclamped inductive load test circuit and waveform

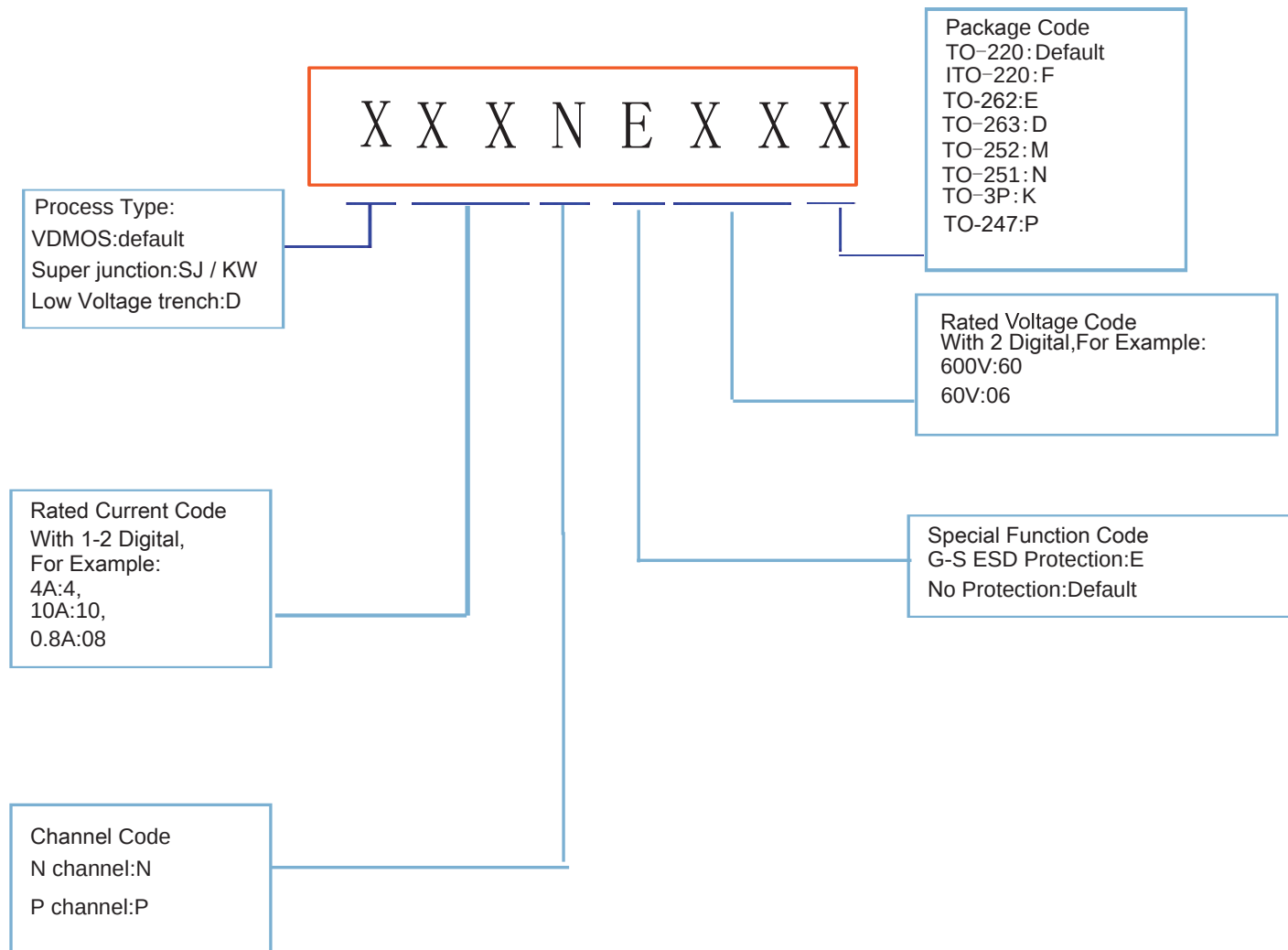
Unclamped inductive load test circuit



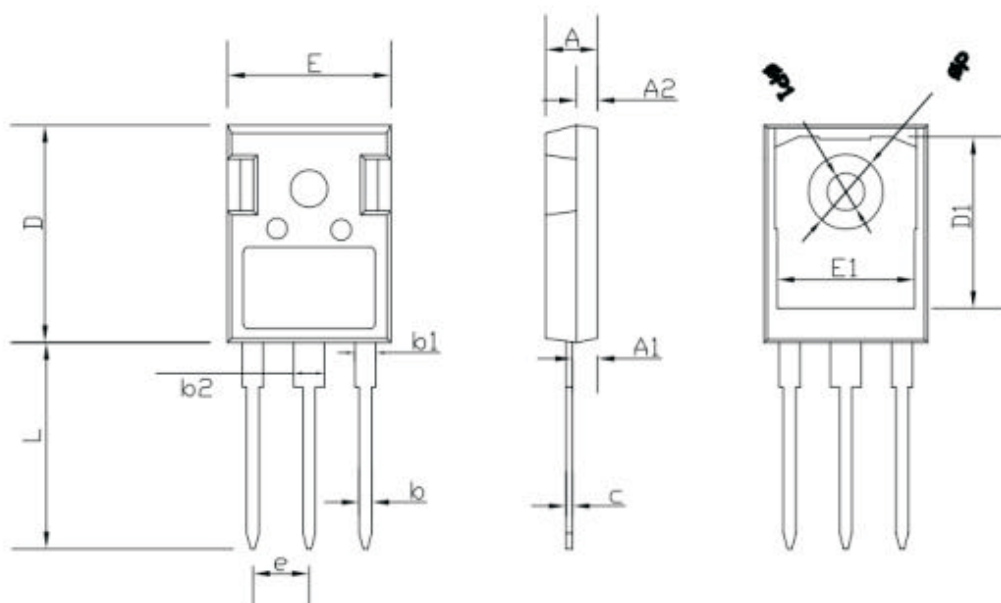
Unclamped inductive waveform



Product Names Rules



TO-247 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.06	0.0772	0.0812
b2	2.96	3.06	0.117	0.121
c	0.59	0.66	0.0232	0.0260
D	20.90	21.10	0.8235	0.8313
D1	16.25	16.85	0.6403	0.6639
E	15.70	15.90	0.6186	0.6265
E1	13.10	13.50	0.5161	0.5319
e	5.44		0.2143	
L	19.80	20.10	0.7801	0.7919
ΦP	3.50	3.70	0.1379	0.1458
ΦP1	0	7.30	0	0.2876