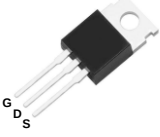
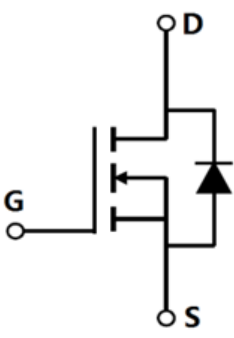


N-channel 250V, 22mΩ max., 95A
SGT MOSFET S2 in TO-220、TO-263 and TO247

Datasheet - production data

1. Descriptions

TO-220	TO-263	TO-247
		
Schematic Diagram 		

Key Performance Parameters

Parameters	Value	Unit
BV_{DSS}	250	V
$R_{DS(on),max}$	22	mΩ
$Q_{g,typ}$	71	nC
$I_{D,pulse}$	332	A
E_{AS}	400	mJ

Features

- Extremely low losses due to very low FOM $R_{ds(on)} \cdot Q_g$.
- High-speed switching.
- Qualified for industrial grade applications according to JEDEC.
- 100% UIS Tested.

Applications

High-Efficiency DC-DC Converters, Switching Voltage Regulators and Motor Drivers.

Type/Ordering Code	Package	Marking	Related Links
CSP220N25S2	TO-220	220N25S2	See Appendix A
CSB220N25S2	TO-263		
CSW220N25S2	TO-247		

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2. Maximum Ratings

at $T_j = 25^\circ\text{C}$, unless otherwise specified

Table 1. Absolute Maximum Ratings

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
V_{DS}	Drain-source voltage ¹⁾	-	-	250	V	$V_{GS}=0V$, $I_D=250\mu A$
I_D	Continuous drain current	-	-	95 66.5	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
$I_{D,pulse}$	Pulsed drain current	-	-	332	A	$T_C=25^\circ\text{C}$
E_{AS}	Avalanche energy, single pulse ²⁾	-	-	400	mJ	$I_D=40A$; $V_{DD}=50V$
I_{AS}	Avalanche current	-	-	40	A	-
V_{GS}	Gate source voltage	-20	-	20	V	static; AC ($f>1\text{ Hz}$)
P_{tot}	Power dissipation	-	-	428	W	$T_C=25^\circ\text{C}$
T_j, T_{stg}	Operating and storage temperature	-55	-	175	$^\circ\text{C}$	-
I_S	Continuous diode forward current	-	-	95	A	$T_C=25^\circ\text{C}$
$I_{S,pulse}$	Diode pulse current ²⁾	-	-	332	A	$T_C=25^\circ\text{C}$

1) Limited by T_j max. Maximum duty cycle $D=0.75$.

2) $V_{DD}=50V$, $L=0.5mH$, $R_G=25\Omega$, Starting $T_j=25^\circ\text{C}$.

3. Thermal Characteristics

Table 2. Thermal Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
R_{thJC}	Thermal resistance, junction - case	-	-	0.35	°C/W	$T_C = 25^{\circ}\text{C}$
R_{thJA}	Thermal resistance, junction - ambient	-	-	50	°C/W	$T_C = 25^{\circ}\text{C}$
T_{sold}	Soldering temperature, wavesoldering only allowed at leads	-	-	260	°C	Lead Temperature (Soldering, 10 sec)

4. Electrical Characteristics

at $T_j = 25^\circ\text{C}$, unless otherwise specified

Table 3. Static Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
$V_{(BR)DSS}$	Drain-source breakdown voltage	250	-	-	V	$V_{GS}=0V, I_D=250\mu A$
$V_{(GS)th}$	Gate threshold voltage	2	3.0	4	V	$V_{DS}=V_{GS}, I_D=250\mu A$
I_{DSS}	Zero gate voltage drain current	-	-	1	μA	$V_{DS}=250V, V_{GS}=0V, T_j=25^\circ C$
I_{GSS}	Gate-source leakage current	-	-	± 100	nA	$V_{GS}=\pm 20V, V_{DS}=0V$
$R_{DS(on)}$	Drain-source on-state resistance (TO-263)	-	15.7	22	m Ω	$V_{GS}=10V, I_D=20A, T_j=25^\circ C$
$R_{DS(on)}$	Drain-source on-state resistance (TO-220)	-	15.9	22	m Ω	$V_{GS}=10V, I_D=20A, T_j=25^\circ C$
$R_{DS(on)}$	Drain-source on-state resistance (TO-247)	-	15.7	22	m Ω	$V_{GS}=10V, I_D=20A, T_j=25^\circ C$
R_G	Gate resistance	-	3.7	-	Ω	$V_{DD}=0V, V_{GS}=0V, F=1MHz$
g_{fs}	Transconductance		44		S	$V_{DS}=5V, I_D=20A$

Table 4. Dynamic Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
C_{iss}	Input capacitance	-	5660	-	pF	$V_{GS}=0V, V_{DS}=100V, f=250kHz$
C_{oss}	Output capacitance	-	358	-	pF	$V_{GS}=0V, V_{DS}=100V, f=250kHz$
C_{rss}	Reverse transfer capacitance	-	6.8	-	pF	$V_{GS}=0V, V_{DS}=100V, f=250kHz$
$t_{d(on)}$	Turn-on delay time	-	18	-	ns	$V_{DD}=125V, V_{GS}=10V, I_D=20A, R_G=10\Omega$
t_r	Rise time	-	23	-	ns	$V_{DD}=125V, V_{GS}=10V, I_D=20A, R_G=10\Omega$
$t_{d(off)}$	Turn-off delay time	-	36	-	ns	$V_{DD}=125V, V_{GS}=10V, I_D=20A, R_G=10\Omega$
t_f	Fall time	-	13	-	ns	$V_{DD}=125V, V_{GS}=10V, I_D=20A, R_G=10\Omega$

Table 5. Gate Charge Characteristics

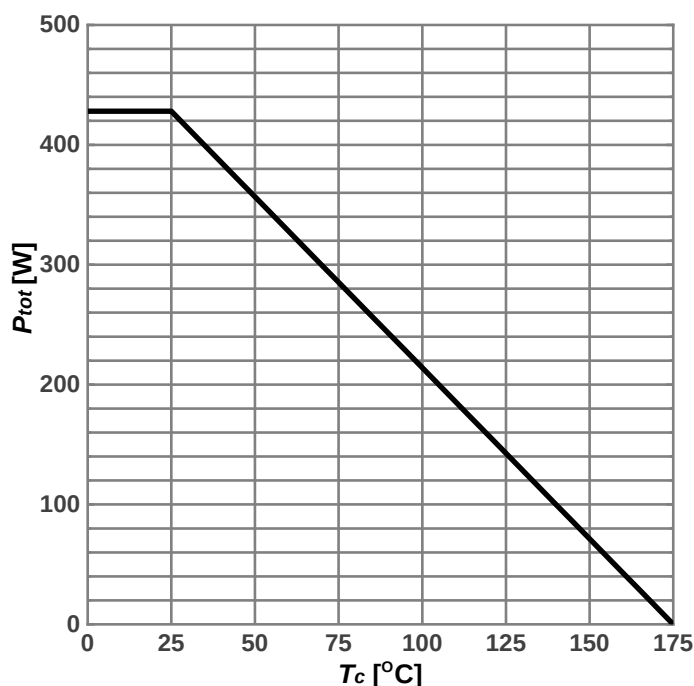
Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
Q_{gs}	Gate to source charge	-	23	-	nC	$V_{DD}=125V, I_D=20A, V_{GS}=0 \text{ to } 10V$
Q_{gd}	Gate to drain charge	-	9.5	-	nC	$V_{DD}=125V, I_D=20A, V_{GS}=0 \text{ to } 10V$
Q_g	Gate charge total	-	71	-	nC	$V_{DD}=125V, I_D=20A, V_{GS}=0 \text{ to } 10V$
$V_{plateau}$	Gate plateau voltage	-	4.45	-	V	$V_{DD}=125V, I_D=20A, V_{GS}=0 \text{ to } 10V$

Table 6. Reverse Diode Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
V_{SD}	Diode forward voltage	-	-	1.2	V	$V_{GS}=0V, I_F=20A, T_j=25^\circ C$
t_{rr}	Reverse recovery time	-	152	-	ns	$V_R=125V, I_F=20A, di_F/dt=100A/\mu s$
Q_{rr}	Reverse recovery charge	-	850	-	nC	$V_R=125V, I_F=20A, di_F/dt=100A/\mu s$

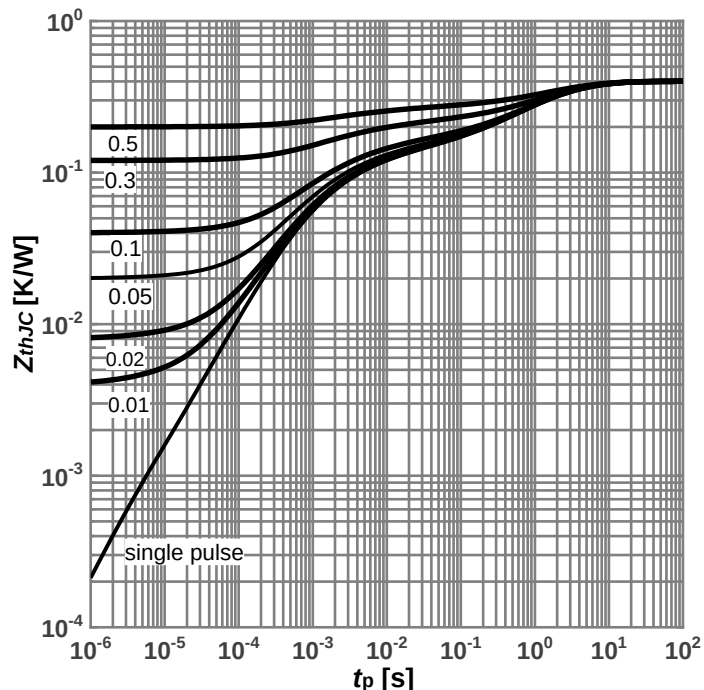
5. Electrical Characteristics Diagrams

Diagram 1: Power dissipation



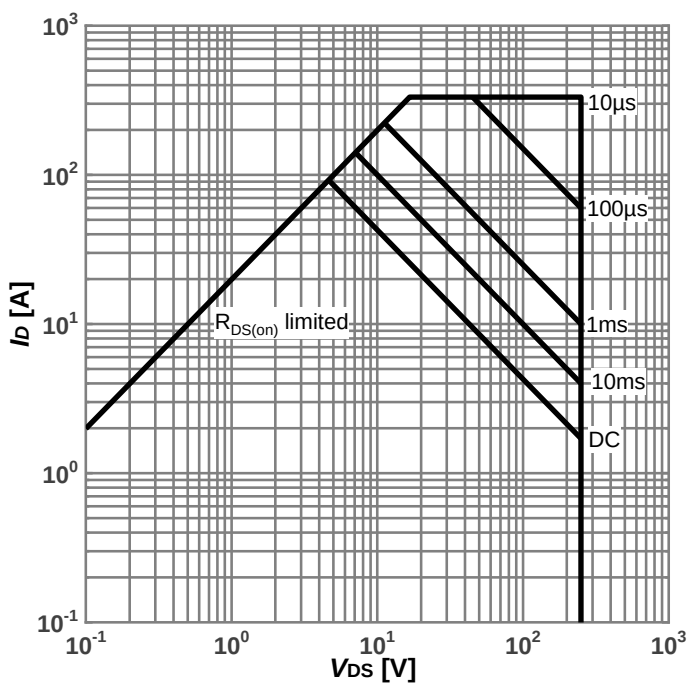
$$P_{tot}=f(T_c)$$

Diagram 2: Max. transient thermal impedance



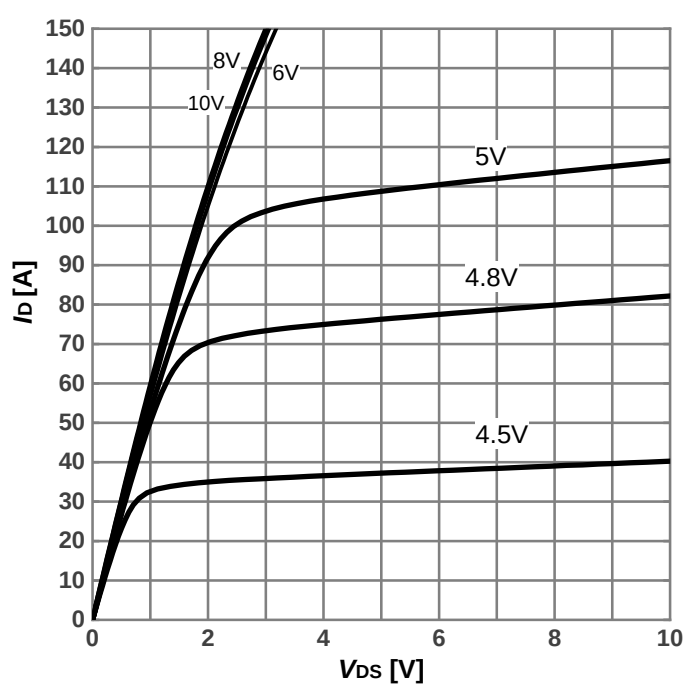
$$Z_{thJC}=f(t_p); \text{ parameter: } D= t_p/T$$

Diagram 3: Safe operating area



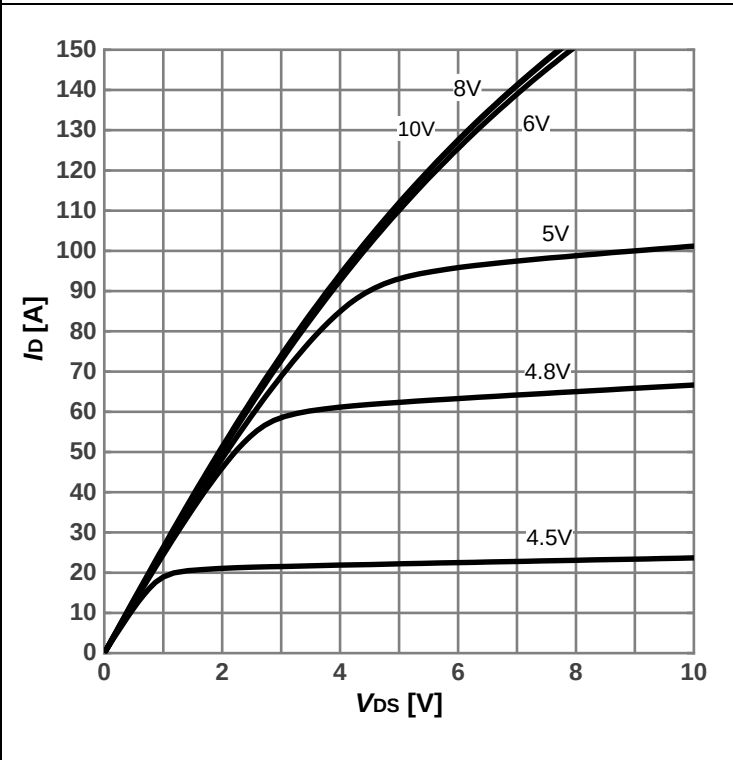
$$I_D=f(V_{DS}); T_J=25^\circ\text{C}; D=0; \text{ parameter: } t_p$$

Diagram 4: Typ. output characteristics



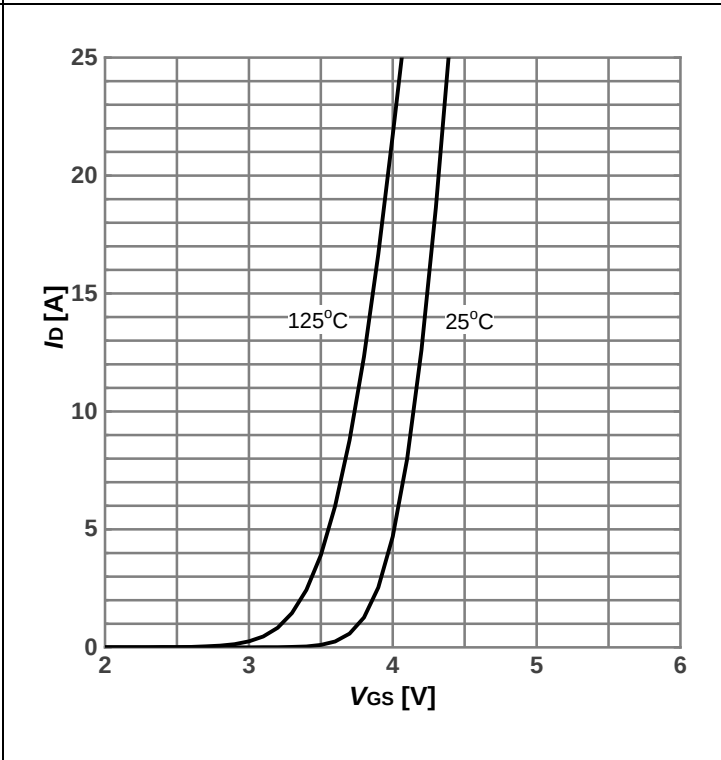
$$I_D=f(V_{DS}); T_J=25^\circ\text{C}; \text{ parameter: } V_{GS}$$

Diagram 5: Typ. output characteristics



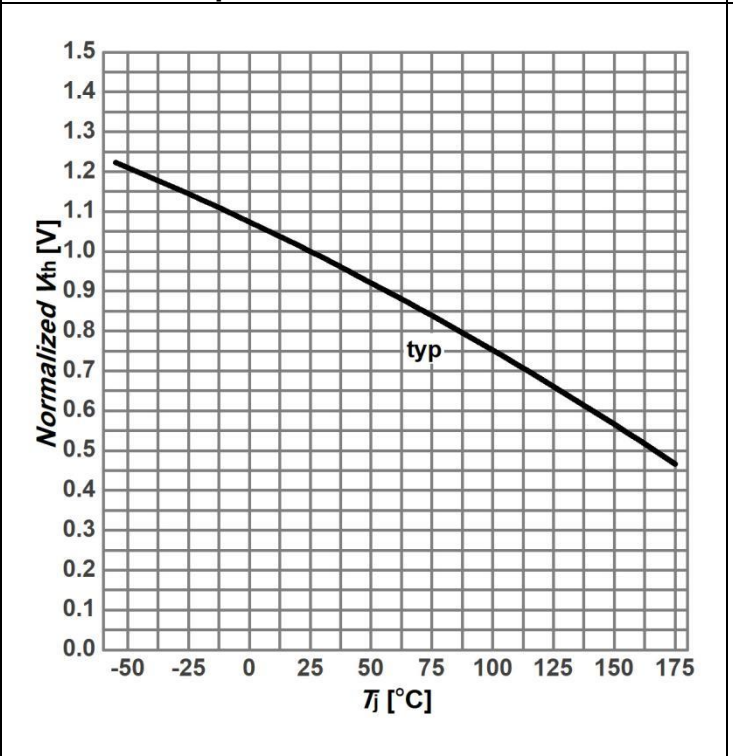
$I_D=f(V_{DS})$; $T_j=125^{\circ}\text{C}$; parameter: V_{GS}

Diagram 6: Typ. transfer characteristics



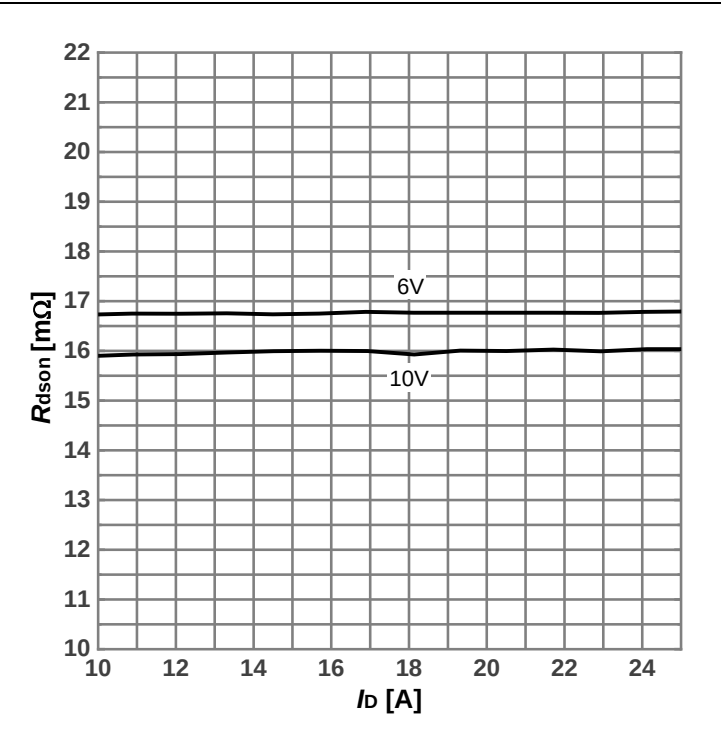
$I_D=f(V_{GS})$; $V_{DS}=5\text{V}$; parameter: T_j

Diagram 7: Gate threshold voltage vs. Junction temperature



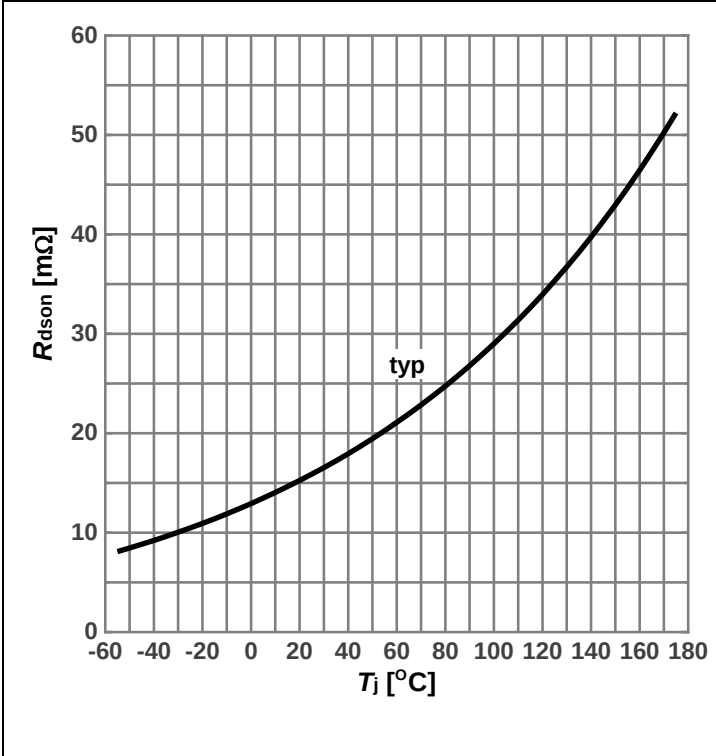
$V_{th}=f(T_j)$; $I_D=250\mu\text{A}$

Diagram 8: On-state resistance vs. Drain current



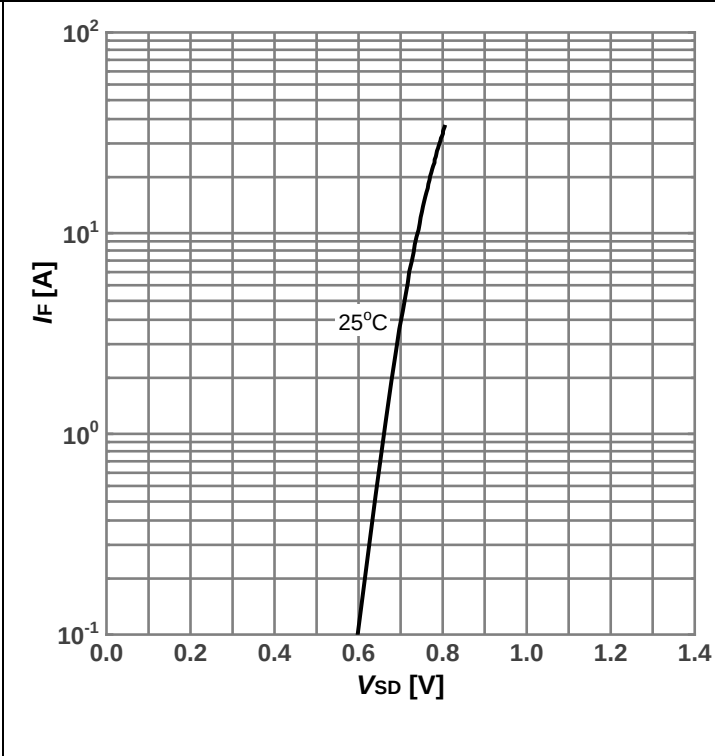
$R_{DS(on)}=f(I_D)$; $T_j=25^{\circ}\text{C}$; parameter: V_{GS}

Diagram 9: On-state resistance vs. Junction temperature



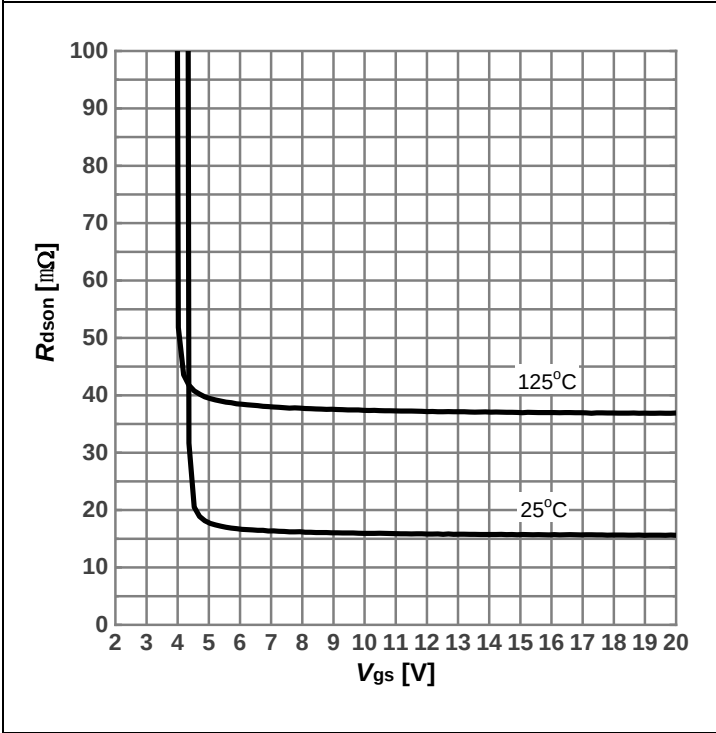
$R_{DS(on)}=f(T_j)$; $I_D=20A$; $V_{GS}=10V$

Diagram 10: Forward characteristics of reverse diode



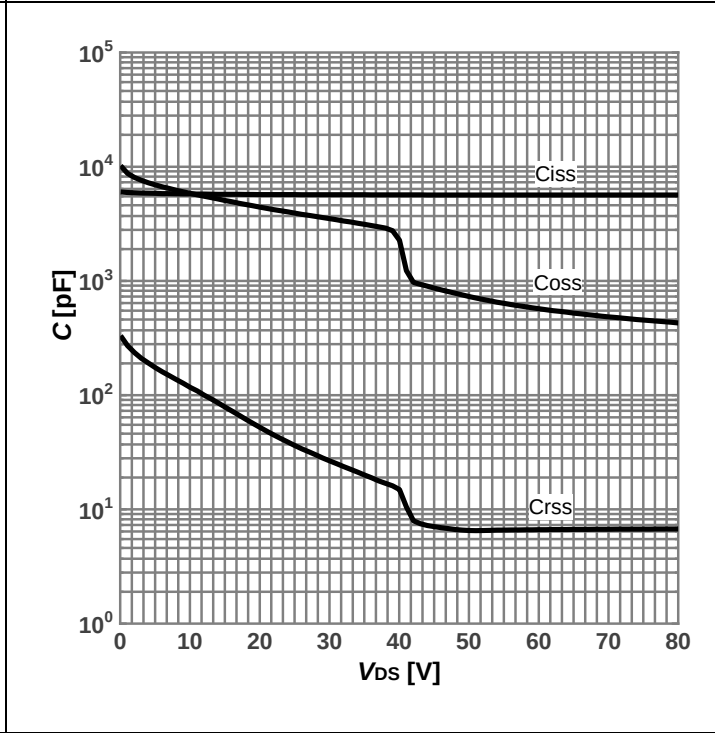
$I_F=f(V_{SD})$; $T_J=25^{\circ}C$

Diagram 11: On-state resistance vs. Vgs characteristics

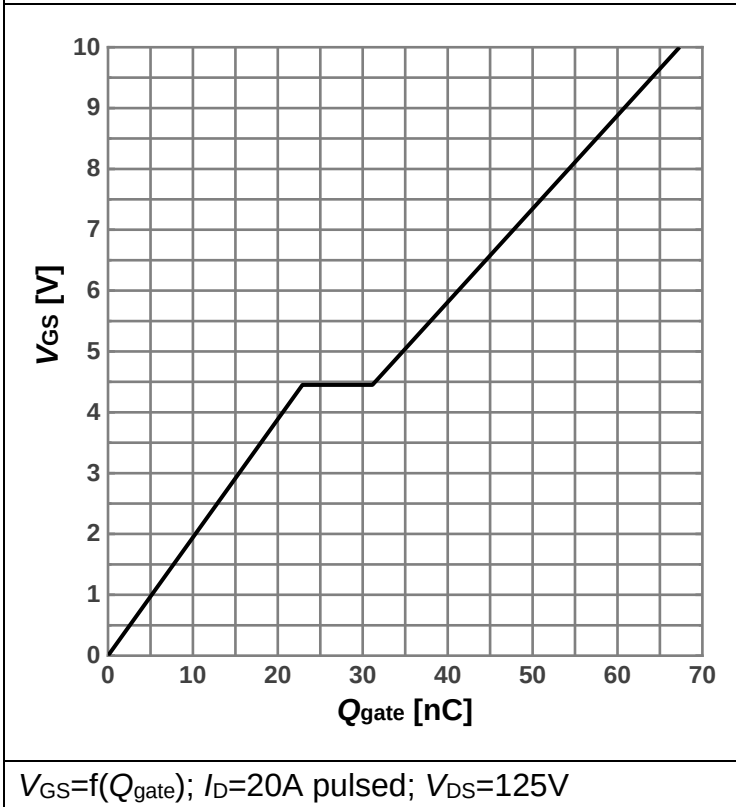


$R_{DS(on)}=f(V_{gs})$; $I_D=20A$;parameter: T_j

Diagram 12: Typ. capacitances



$C=f(V_{DS})$; $V_{GS}=0V$; $f=250KHz$

Diagram 13: Typ. gate charge

6. Test Circuits

Table 7. Diode Characteristics

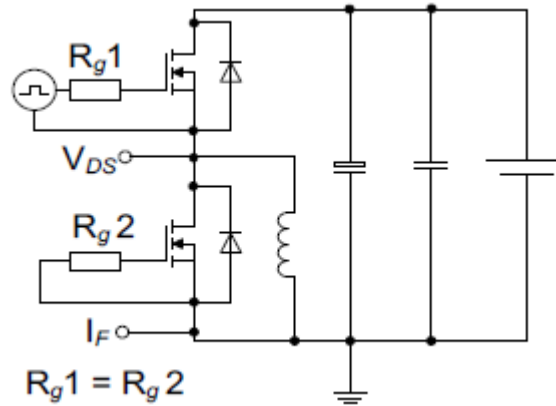
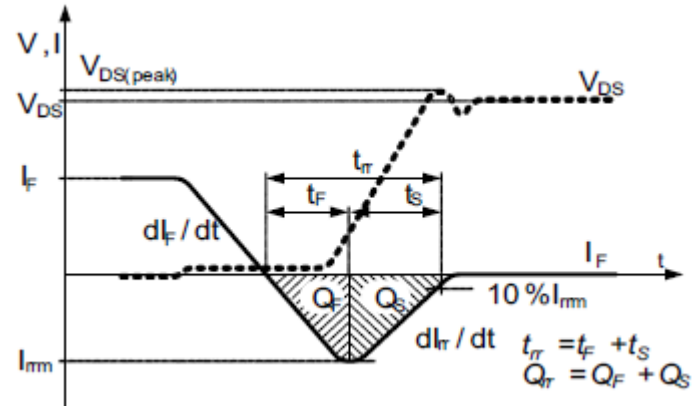
Test circuit for diode characteristics	Diode recovery waveform
	

Table 8. Switching Times

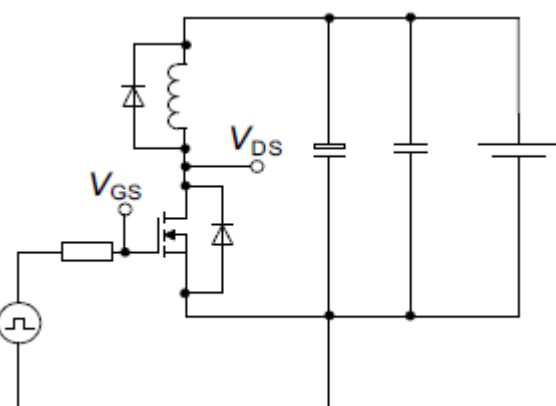
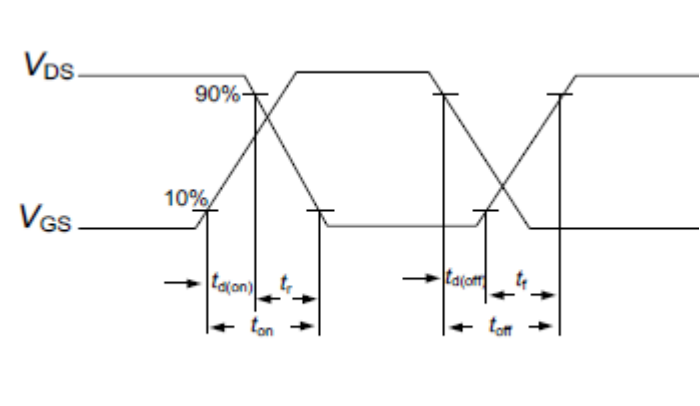
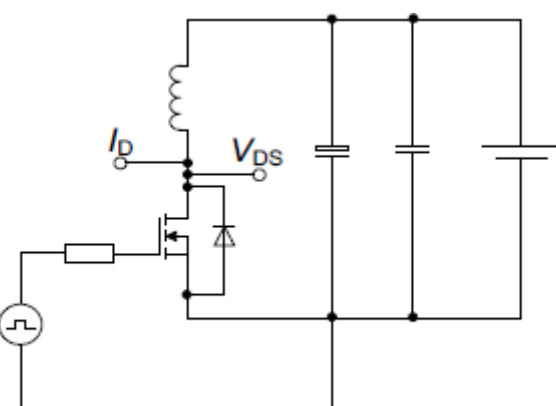
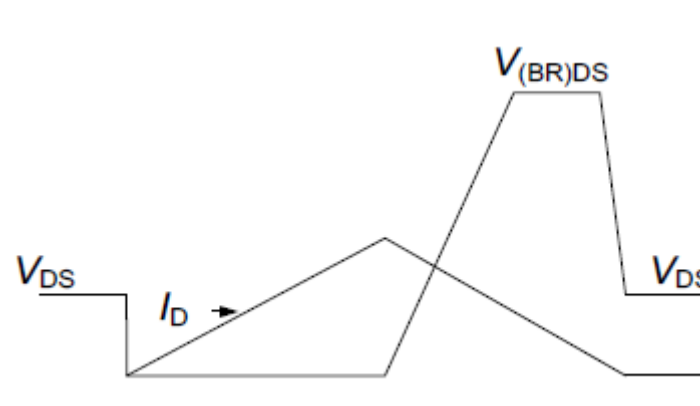
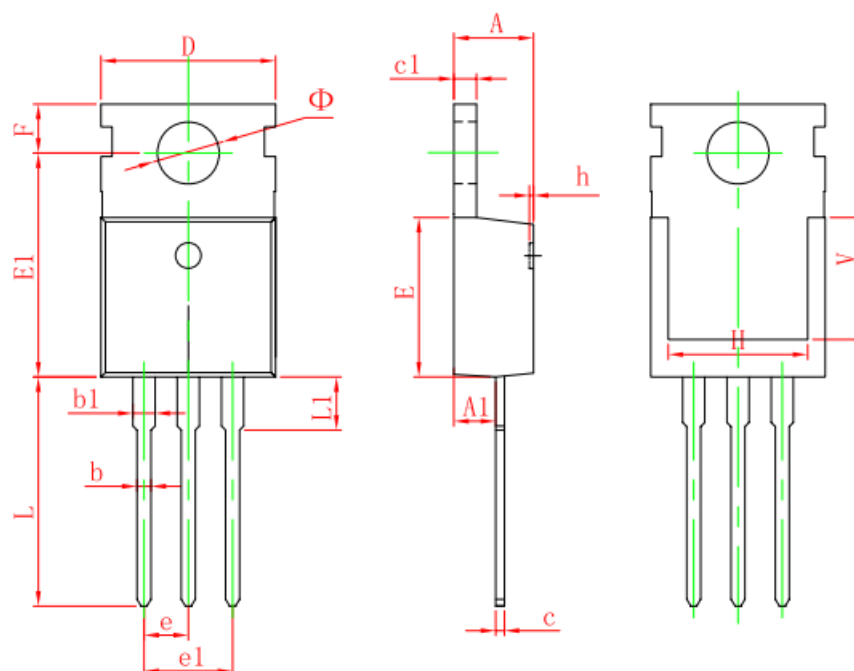
Switching times test circuit for inductive load	Switching times waveform
	

Table 9. Unclamped Inductive Load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7. Package Outlines

Figure 1 Outline TO-220 Dimensions in mm

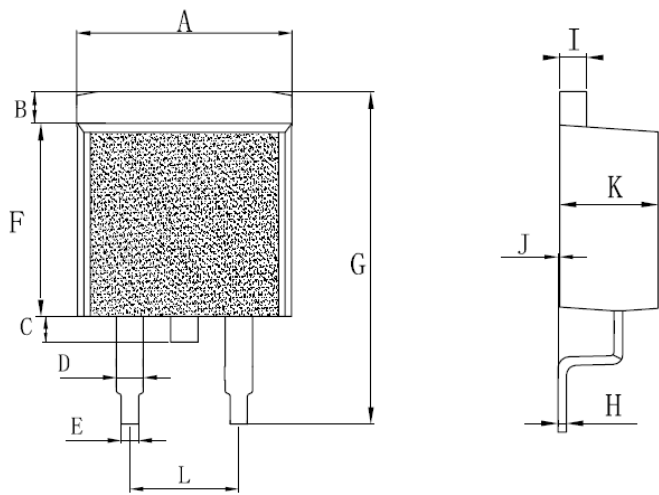


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.950	9.750	0.352	0.384
E1	12.650	13.050	0.498	0.514
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.750	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	6.900 REF.		0.276 REF.	
Φ	3.400	3.800	0.134	0.150

Figure 2 Outline TO-263 Dimensions in mm

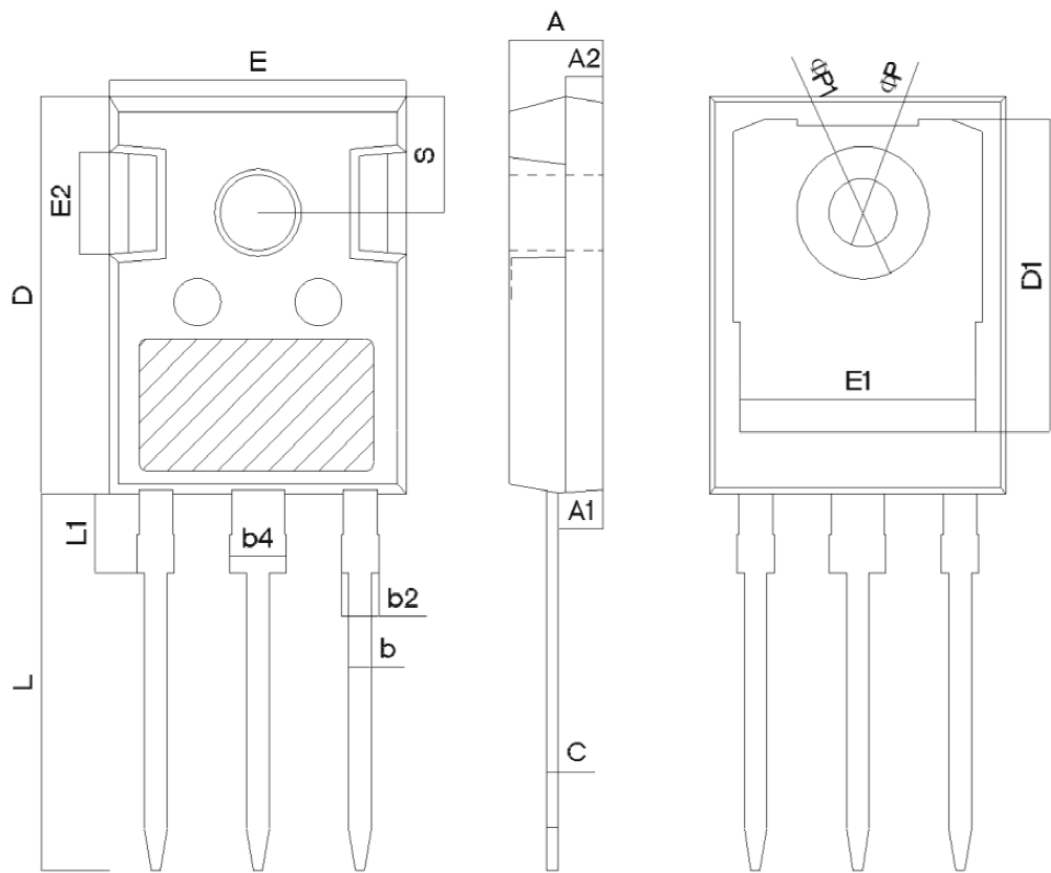
PACKAGE OUTLINE DIMENSIONS

TO-263



DIM.	Unit(mm)		Unit(inch)	
	Min	Max	Min	Max
A	9.7	10.4	0.381	0.409
B	1.31	1.62	0.051	0.063
C	0.65	1.22	0.025	0.048
D	1.15	1.36	0.045	0.053
E	0.62	0.95	0.024	0.037
F	8.75	9.32	0.344	0.366
G	14.75	15.8	0.580	0.622
H	0.32	0.48	0.012	0.018
I	1.18	1.36	0.046	0.053
J	0	0.15	0	0.005
K	4.38	4.86	0.172	0.191
L	4.85	5.23	0.190	0.205

Figure 3 Outline TO-247 Dimensions in mm



SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S	6.15BSC		

8. Appendix

CoolSemi Webpage: www.coolsemi.com.