

N-channel 40V, 1.2mΩ max., 200A
 SGT MOSFET S2 in TOLL

Datasheet - production data

1. Descriptions

Key Performance Parameters

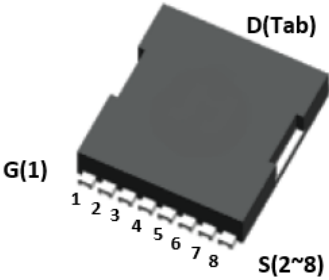
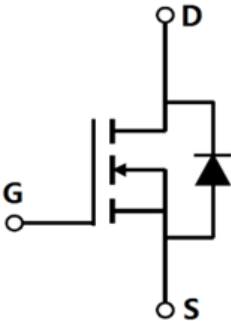
Parameters	Value	Unit
BV_{DSS}	40	V
$R_{DS(on),max}$	1.2	mΩ
$Q_{g,typ}$	41.7	nC
$I_{D,pulse}$	800	A
E_{AS}	1225	mJ

Features

- Extremely Low Losses Due to Very Low FOM $R_{dson} \cdot Q_g$.
- High-Speed Switching.
- Qualified for Industrial Grade Applications According to JEDEC.
- 100% UIS Tested.

Applications

High-Efficiency DC-DC Converters, High-Frequency Switching and Synchronous Rectification, Motor Drivers.

TOLL

Schematic Diagram


Type/Ordering Code	Package	Marking	Related Links
CST012N04S2	TOLL	012N04S2	see Appendix A

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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⁾	-	-	40	V	$V_{GS}=0\text{V}$, $I_D=250\mu\text{A}$
I_D	Continuous Drain Current (Silicon Limited)	-	-	200	A	$T_C=25^\circ\text{C}$
$I_{D,pulse}$	Pulsed Drain Current	-	-	800	A	$T_C=25^\circ\text{C}$
E_{AS}	Avalanche Energy, Single Pulse ²⁾	-	-	1225	mJ	$I_D=70\text{A}$; $V_{DD}=50\text{V}$
I_{AS}	Avalanche Current	-	-	70	A	-
V_{GS}	Gate Source Voltage	-20	-	20	V	Static; AC ($f > 1\text{ Hz}$)
P_{tot}	Power Dissipation	-	-	375	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	-	-	200	A	$T_C=25^\circ\text{C}$
$I_{S,pulse}$	Diode Pulse Current ²⁾	-	-	800	A	$T_C=25^\circ\text{C}$

1) Limited by T_j max. Maximum Duty Cycle $D=0.75$.

2) $V_{DD}=50\text{V}$, $L=0.5\text{mH}$, $R_G=25\Omega$, 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	-	-	0.4	°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	40	-	-	V	$V_{GS}=0V, I_D=250\mu A$
$V_{(GS)th}$	Gate Threshold Voltage	1.0	1.7	2.5	V	$V_{DS}=V_{GS}, I_D=250\mu A$
I_{DSS}	Zero Gate Voltage Drain Current	-	-	1	μA	$V_{DS}=40V, V_{GS}=0V, T_J=25^\circ C$
I_{GSS}	Gate-Source Leakage Current	-	-	± 100	nA	$V_{GS}=\pm 20V, V_{DS}=0V$
$R_{DS(on)}$	Drain-Source On-State Resistance	-	1.0	1.2	m Ω	$V_{GS}=10V, I_D=20A, T_J=25^\circ C$
R_G	Gate resistance	-	3.5	-	Ω	$V_{DD}=0V, V_{GS}=0V, F=1MHz$
g_{fs}	Transconductance	-	120	-	S	$V_{DS}=5V, I_D=20A$

Table 4. Dynamic Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
C_{iss}	Input Capacitance	-	7070	-	pF	$V_{GS}=0V, V_{DS}=20V, f=250kHz$
C_{oss}	Output Capacitance	-	1800	-	pF	$V_{GS}=0V, V_{DS}=20V, f=250kHz$
C_{rss}	Reverse Transfer Capacitance	-	128	-	pF	$V_{GS}=0V, V_{DS}=20V, f=250kHz$
$t_{d(on)}$	Turn-On Delay Time	-	18	-	ns	$V_{DD}=20V, V_{GS}=10V, I_D=20A, R_G=1.8\Omega$
t_r	Rise Time	-	40	-	ns	$V_{DD}=20V, V_{GS}=10V, I_D=20A, R_G=1.8\Omega$
$t_{d(off)}$	Turn-Off Delay Time	-	180	-	ns	$V_{DD}=20V, V_{GS}=10V, I_D=20A, R_G=1.8\Omega$
t_f	Fall Time	-	60	-	ns	$V_{DD}=20V, V_{GS}=10V, I_D=20A, R_G=1.8\Omega$

Table 5. Gate Charge Characteristics

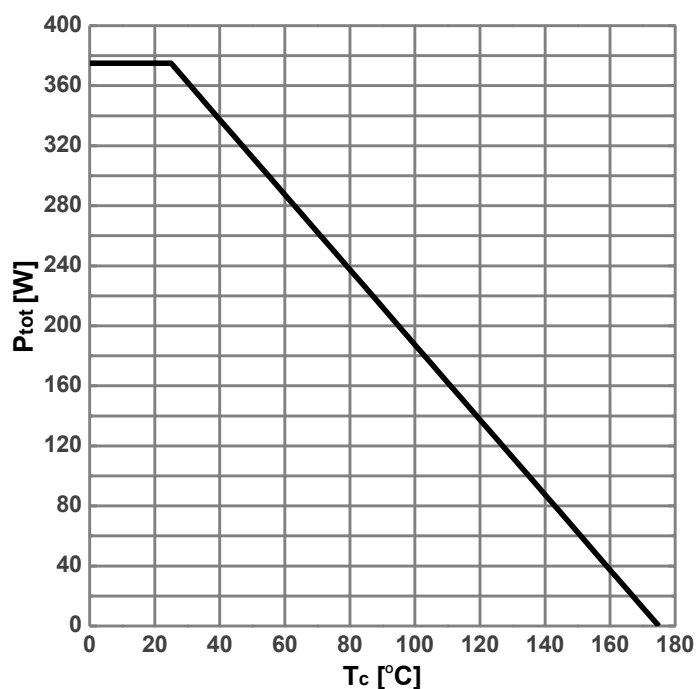
Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
Q_{gs}	Gate to Source Charge	-	5.4	-	nC	$V_{DD}=20V, I_D=20A, V_{GS}=0 \text{ to } 10V$
Q_{gd}	Gate to Drain Charge	-	4.3	-	nC	$V_{DD}=20V, I_D=20A, V_{GS}=0 \text{ to } 10V$
Q_g	Gate Charge Total	-	41.7	-	nC	$V_{DD}=20V, I_D=20A, V_{GS}=0 \text{ to } 10V$
$V_{plateau}$	Gate Plateau Voltage	-	2	-	V	$V_{DD}=20V, I_D=20A, V_{GS}=0 \text{ to } 10V$

Table 6. Reverse Diode Characteristics

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
V_{SD}	Diode Forward Voltage	-	0.8	-	V	$V_{GS}=0V, I_F=20A, T_J=25^\circ C$
t_{rr}	Reverse Recovery Time	-	57	-	ns	$V_R=20V, I_F=20A, dI_F/dt=100A/\mu s$
Q_{rr}	Reverse Recovery Charge	-	60	-	nC	$V_R=20V, I_F=20A, dI_F/dt=100A/\mu s$

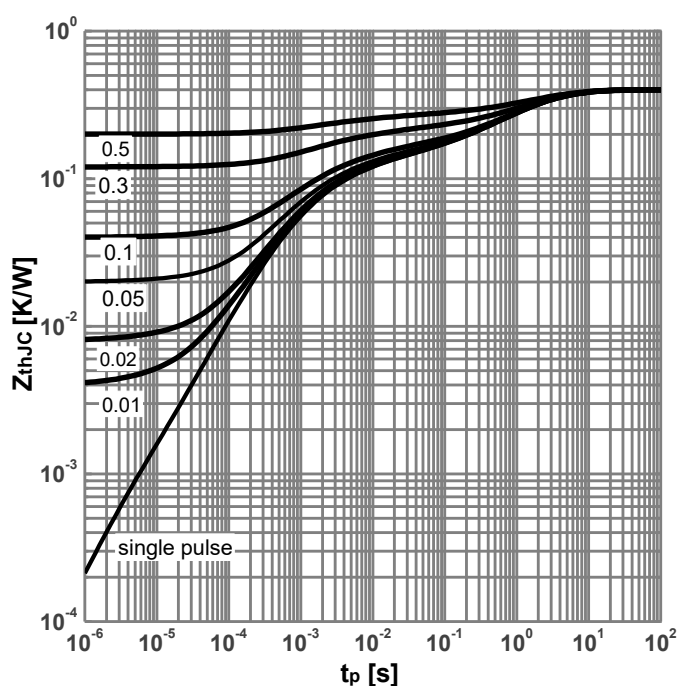
5. Electrical Characteristics Diagrams

Diagram 1: Power Dissipation



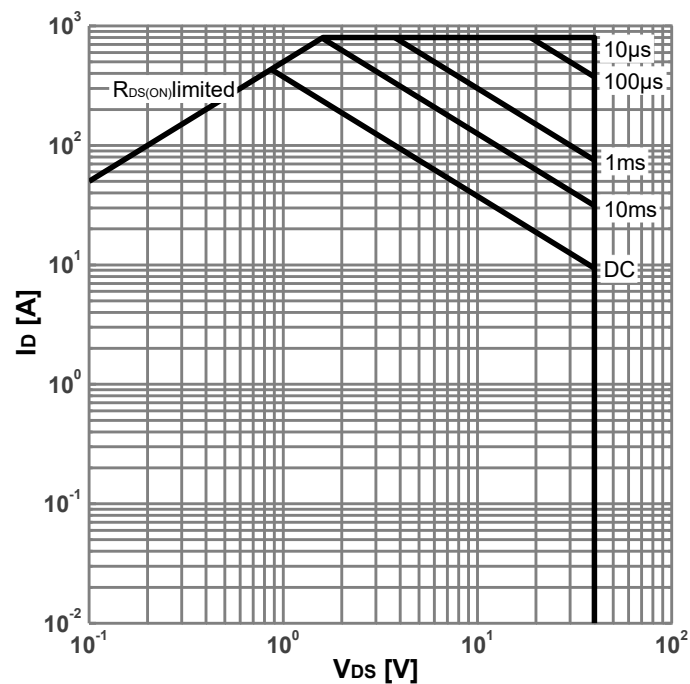
$$P_{tot}=f(T_c)$$

Diagram 2: Max. Transient Thermal Impedance



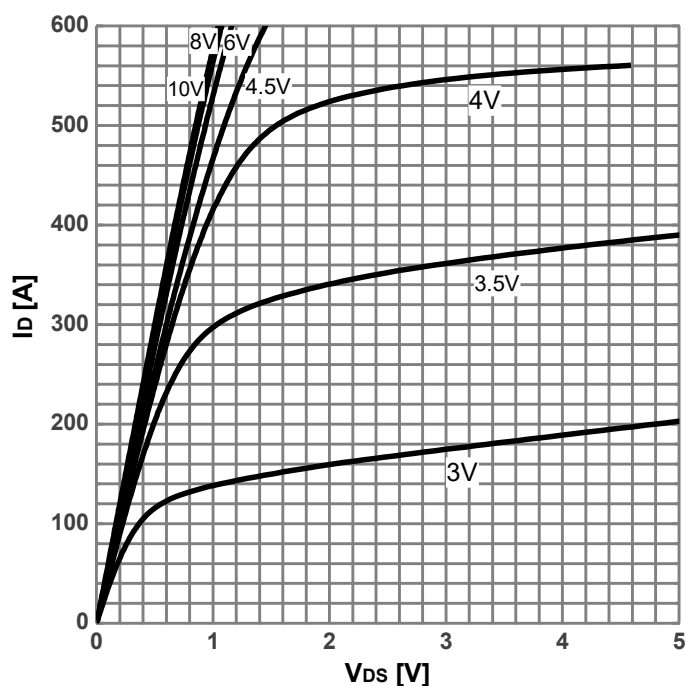
$$Z_{thJC}=f(t_p); \text{ parameter: } D=t_p/T$$

Diagram 3: Safe Operating Area



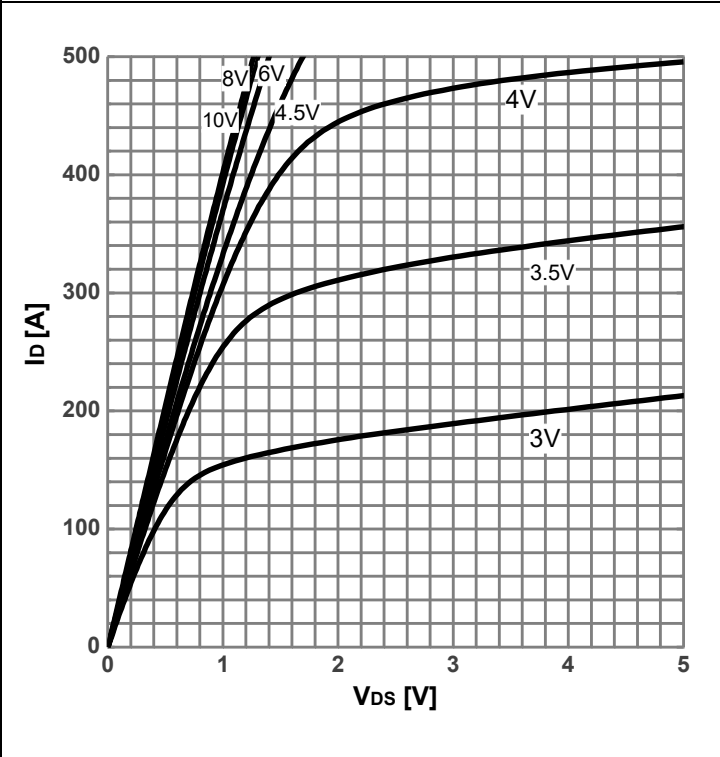
$$I_D=f(V_{DS}); T_J=25^{\circ}\text{C}; D=0; \text{ parameter: } t_p$$

Diagram 4: Typ. Output Characteristics



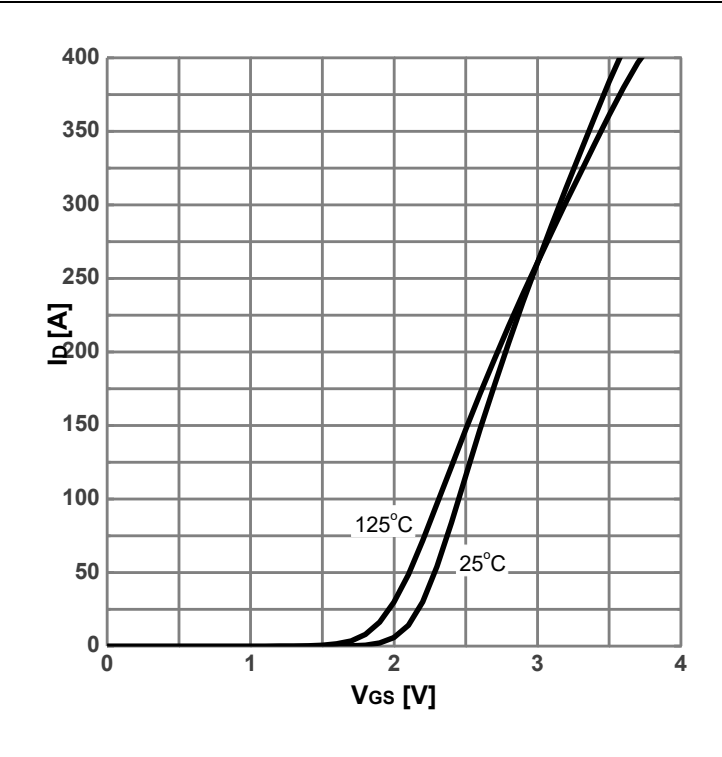
$$I_D=f(V_{DS}); T_J=25^{\circ}\text{C}; \text{ parameter: } V_{GS}$$

Diagram 5: Typ. Output Characteristics



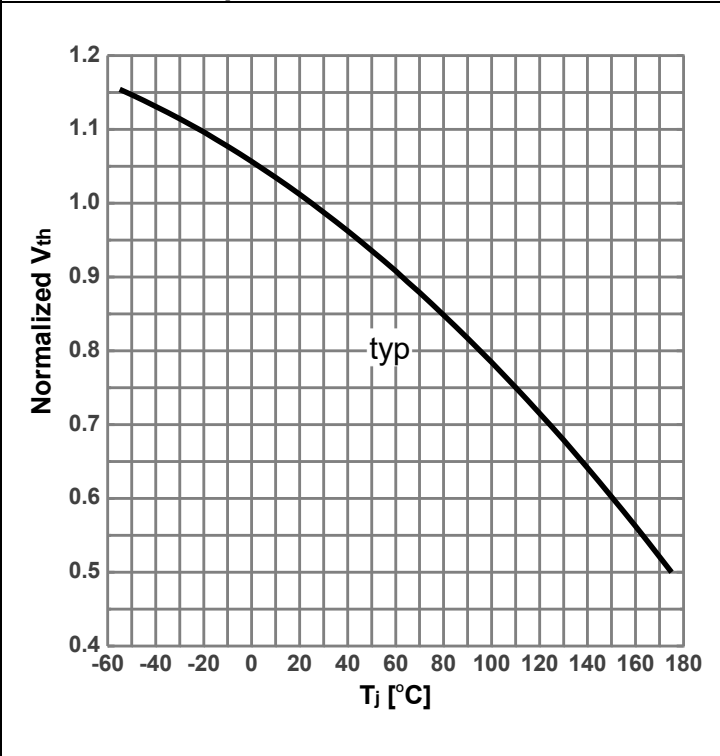
$I_D=f(V_{DS})$; $T_J=125^{\circ}\text{C}$; parameter: V_{GS}

Diagram 6: Typ. Transfer Characteristics



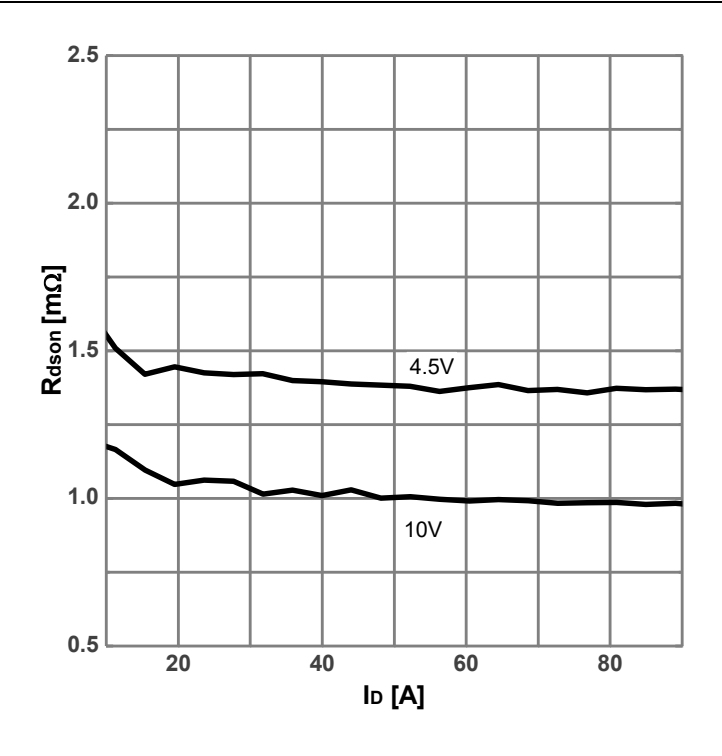
$I_D=f(V_{GS})$; $V_{DS}=20\text{V}$; parameter: T_J

Diagram 7: Gate Threshold Voltage vs. Junction Temperature



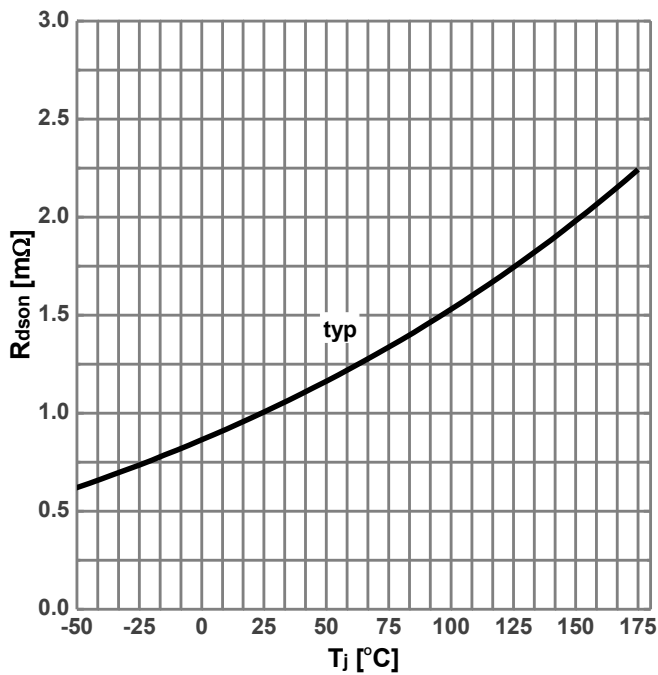
$V_{th}=f(T_J)$; $I_D=250\mu\text{A}$

Diagram 8: On-State Resistance vs. Drain Current



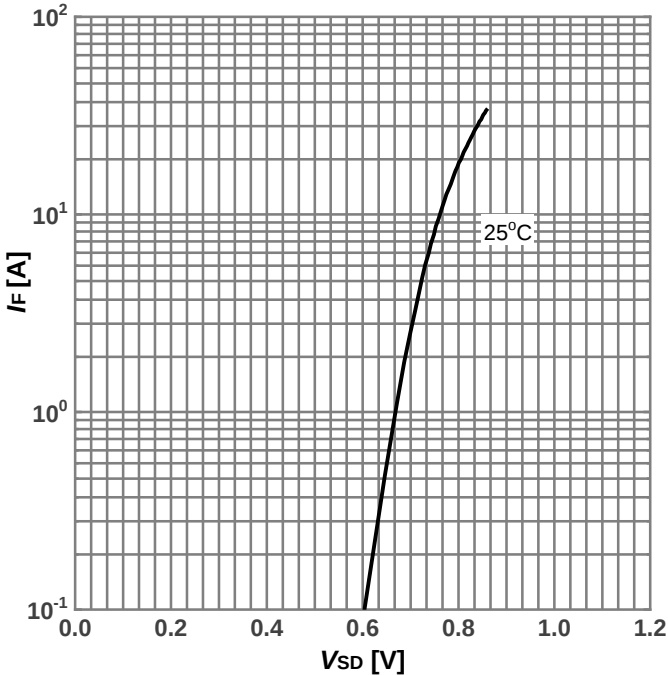
$R_{DS(on)}=f(I_D)$; $T_J=25^{\circ}\text{C}$; parameter: V_{GS}

Diagram 9: On-State Resistance vs. Junction Temperature



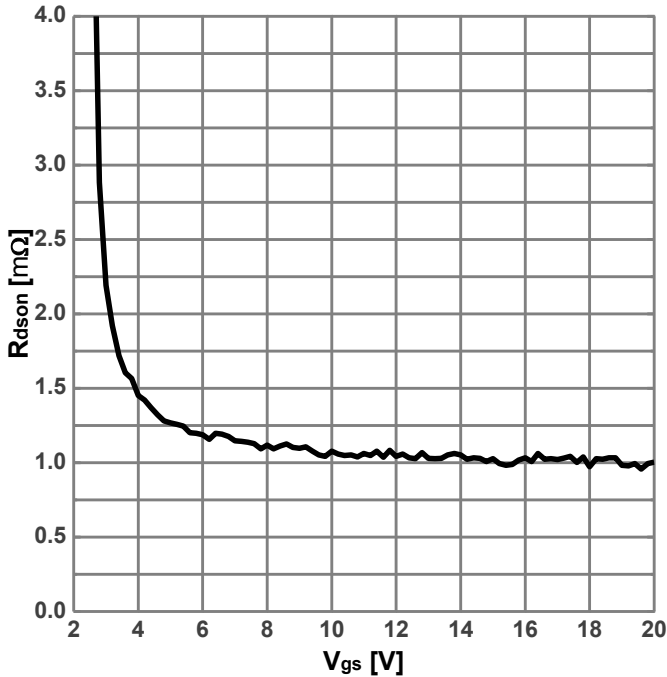
$R_{DS(on)}=f(T_J); I_D=20A; V_{GS}=10V$

Diagram 10: Forward Characteristics of Reverse Diode



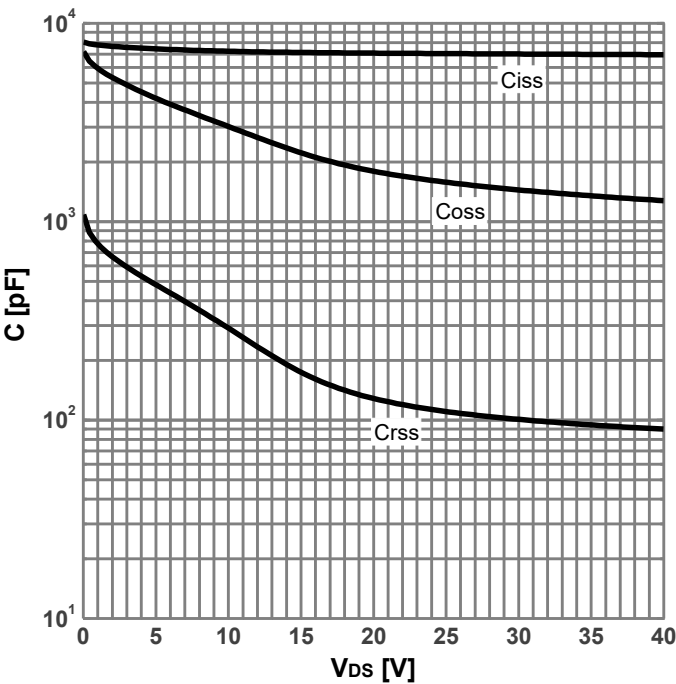
$I_F=f(V_{SD}); \text{parameter: } T_J$

Diagram 11: On-State Resistance vs. Vgs Characteristics

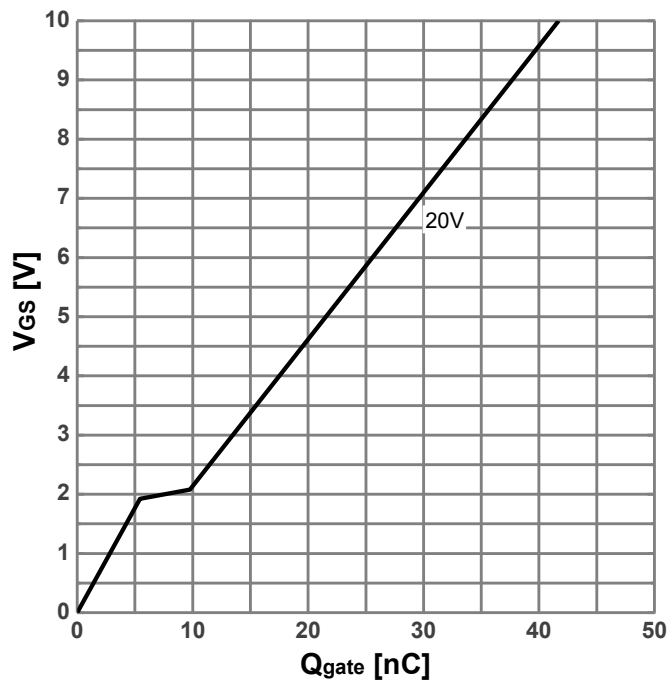


$R_{DS(on)}=f(V_{GS}); T_J=25^{\circ}C; I_D=20A$

Diagram 12: Typ. Capacitances



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

Diagram 13: Typ. Gate Charge

$V_{GS}=f(Q_{gate})$; $I_D=20A$ pulsed; $V_{DS}=20V$

6. Test Circuits

Table 7. Diode Characteristics

Test Circuit for Diode Characteristics $R_{g1} = R_{g2}$	Diode Recovery Waveform $t_{tr} = t_F + t_S$ $Q_{tr} = Q_F + Q_S$
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Table 8. Switching Times

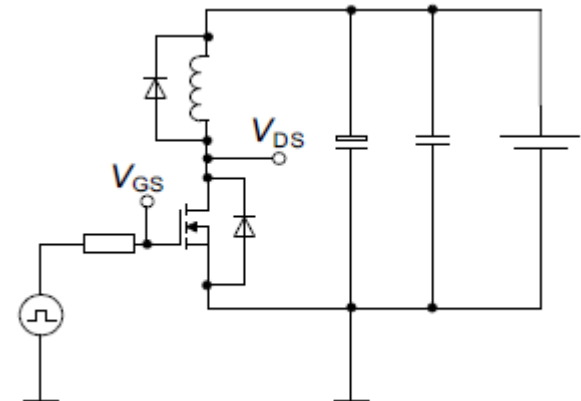
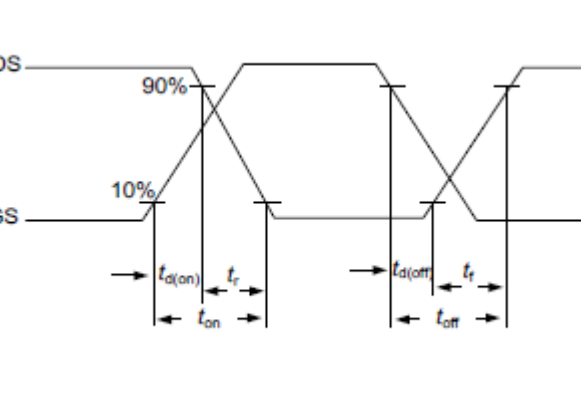
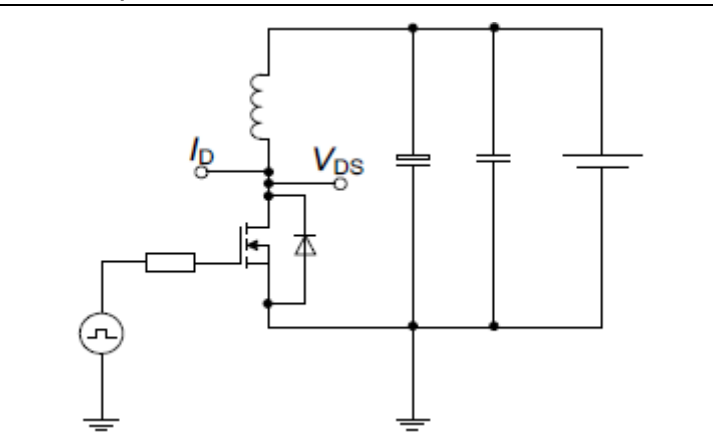
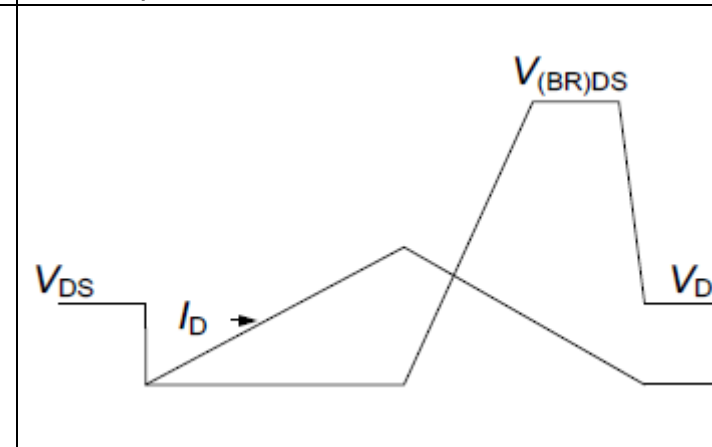
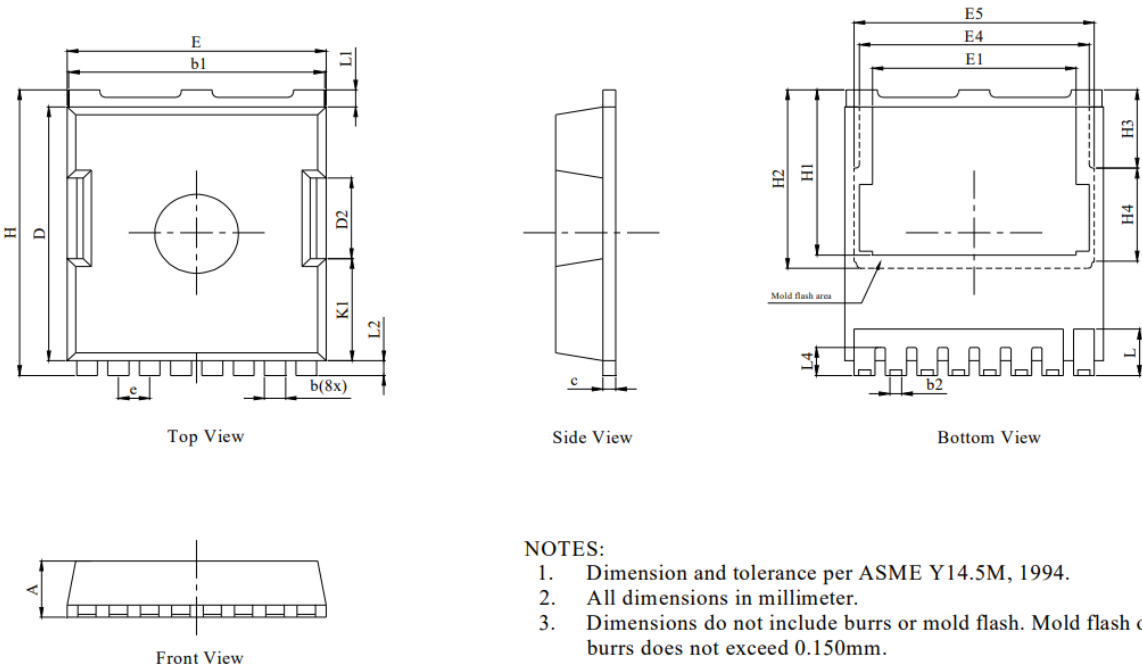
Switching Times Test Circuit for Inductive Load	Switching Times Waveform
	

Table 9. Unclamped Inductive Load

Unclamped Inductive Load Test Circuit	Unclamped Inductive Waveform
	

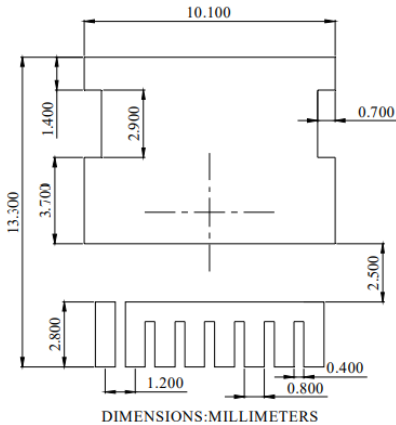
7. Package Outlines

Figure 1 Outline TOLL Dimensions in mm



DIM.	MILLIMETER		
	MIN.	NOM.	MAX.
A	2.20	2.30	2.40
b	0.70	0.80	0.90
b1	9.70	9.80	9.90
b2	0.42	0.46	0.50
c	0.40	0.50	0.60
D	10.28	10.38	10.58
D2		3.30	
E	9.70	9.90	10.10
E1		7.80	
E4		8.80	
E5		9.20	
e	1.20 (BSC)		
H	11.48	11.68	11.88
H1	6.55	6.75	6.85
H2		7.30	
H3		3.20	
H4		3.80	
K1		4.18	
L	1.70	1.90	2.10
L1		0.70	
L2		0.60	
L4	1.00	1.15	1.30

Recommended Soldering Footprint



8. Appendix

CoolSemi Webpage: www.coolsemi.com.