



## Description

The SM3012T9RL uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.

## General Features

$V_{DS} = 30V$   $I_D = 20A$

$R_{DS(ON)} < 22m\Omega$  @  $V_{GS}=10V$

$V_{DS} = -30V$   $I_D = -23A$

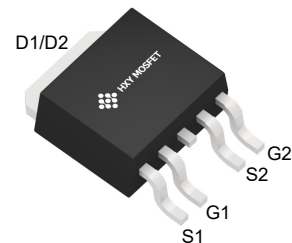
$R_{DS(ON)} < 30m\Omega$  @  $V_{GS}=-10V$

## Application

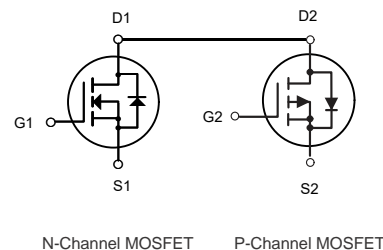
Wireless charging

Boost driver

Brushless motor



TO-252-4L



N-Channel MOSFET

P-Channel MOSFET

## Package Marking and Ordering Information

Product ID	Pack	Brand	Qty(PCS)
SM3012T9RL	TO-252-4L	HXY MOSFET	2500

## Absolute Maximum Ratings ( $T_c=25^{\circ}C$ unless otherwise noted)

Symbol	Parameter	Rating		Units
		N-Channel	P-Channel	
$V_{DS}$	Drain-Source Voltage	30	-30	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	$\pm 20$	V
$I_D@T_c=25^{\circ}C$	Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup>	20	-23	A
$I_D@T_c=70^{\circ}C$	Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup>	15	-14	A
$I_{DM}$	Pulsed Drain Current <sup>2</sup>	60	-60	A
$E_{AS}$	Single Pulse Avalanche Energy <sup>3</sup>	26.6	38	mJ
$P_D@T_A=25^{\circ}C$	Total Power Dissipation <sup>4</sup>	20.8	20.8	W
TSTG	Storage Temperature Range	-55 to 150	-55 to 150	$^{\circ}C$
$T_J$	Operating Junction Temperature Range	-55 to 150	-55 to 150	$^{\circ}C$
$R_{\theta JA}$	Thermal Resistance Junction-Ambient <sup>1</sup>	62		$^{\circ}C/W$
$R_{\theta JC}$	Thermal Resistance Junction-Case <sup>1</sup>	6		$^{\circ}C/W$



**N-Channel Electrical Characteristics ( $T_J=25^\circ\text{C}$ , unless otherwise noted)**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V$ , $I_D=250\mu A$	30	---	---	V
$\Delta BV_{DSS}/\Delta T$	BVDSS Temperature Coefficient	Reference to $25^\circ\text{C}$ , $I_D=1mA$	---	0.023	---	$V/^\circ\text{C}$
$R_{DS(ON)}$	Static Drain-Source On-Resistance <sup>2</sup>	$V_{GS}=10V$ , $I_D=10A$	---	18	22	$m\Omega$
		$V_{GS}=4.5V$ , $I_D=6A$	---	20	25	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS}=V_{DS}$ , $I_D=250\mu A$	1.0	---	2.5	V
$\Delta V_{GS(th)}$	$V_{GS(th)}$ Temperature Coefficient		---	-4.2	---	$mV/^\circ\text{C}$
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS}=24V$ , $V_{GS}=0V$ , $T_J=25^\circ\text{C}$	---	---	1	$\mu A$
		$V_{DS}=24V$ , $V_{GS}=0V$ , $T_J=55^\circ\text{C}$	---	---	5	
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=\pm 20V$ , $V_{DS}=0V$	---	---	$\pm 100$	nA
$g_{fs}$	Forward Transconductance	$V_{DS}=5V$ , $I_D=10A$	---	14	---	S
$R_g$	Gate Resistance	$V_{DS}=0V$ , $V_{GS}=0V$ , $f=1MHz$	---	2.3	---	$\Omega$
$Q_g$	Total Gate Charge (4.5V)	$V_{DS}=20V$ , $V_{GS}=4.5V$ , $I_D=10A$	---	5	---	nC
$Q_{gs}$	Gate-Source Charge		---	1.11	---	
$Q_{gd}$	Gate-Drain Charge		---	2.61	---	
$T_{d(on)}$	Turn-On Delay Time	$V_{DD}=12V$ , $V_{GS}=10V$ , $R_G=3.3\Omega$ $I_D=6A$	---	7.7	---	ns
$T_r$	Rise Time		---	46	---	
$T_{d(off)}$	Turn-Off Delay Time		---	11	---	
$T_f$	Fall Time		---	3.6	---	
$C_{iss}$	Input Capacitance	$V_{DS}=15V$ , $V_{GS}=0V$ , $f=1MHz$	---	416	---	pF
$C_{oss}$	Output Capacitance		---	62	---	
$C_{rss}$	Reverse Transfer Capacitance		---	51	---	
$I_S$	Continuous Source Current <sup>1,5</sup>	$V_G=V_D=0V$ , Force Current	---	---	20	A
$I_{SM}$	Pulsed Source Current <sup>2,5</sup>		---	---	40	A
$V_{SD}$	Diode Forward Voltage <sup>2</sup>	$V_{GS}=0V$ , $I_S=1A$ , $T_J=25^\circ\text{C}$	---	---	1.2	V

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
- 2.The data tested by pulsed , pulse width  $\leq 300\mu s$  , duty cycle  $\leq 2\%$
3. The EAS data shows Max. rating . The test condition is  $V_{DD}=25V$ ,  $V_{GS}=10V$ ,  $L=0.1mH$ ,  $I_{AS}=12.7A$
4. The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
5. The data is theoretically the same as  $I_D$  and  $I_{DM}$  , in real applications , should be limited by total power dissipation.



**P-Channel Electrical Characteristics ( $T_J=25^\circ\text{C}$ , unless otherwise noted)**

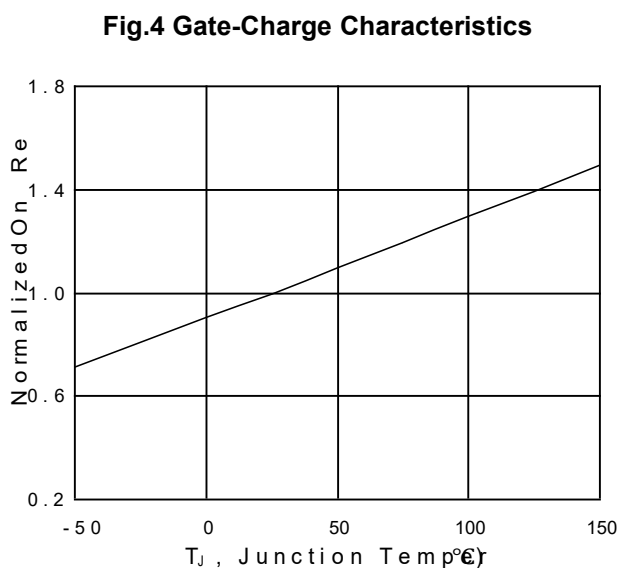
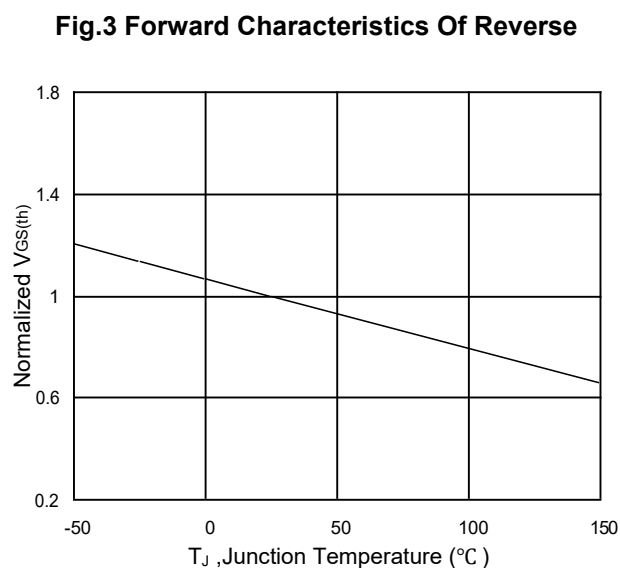
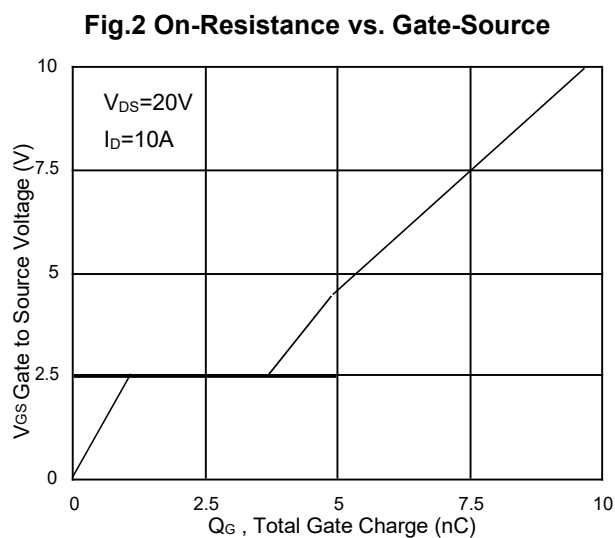
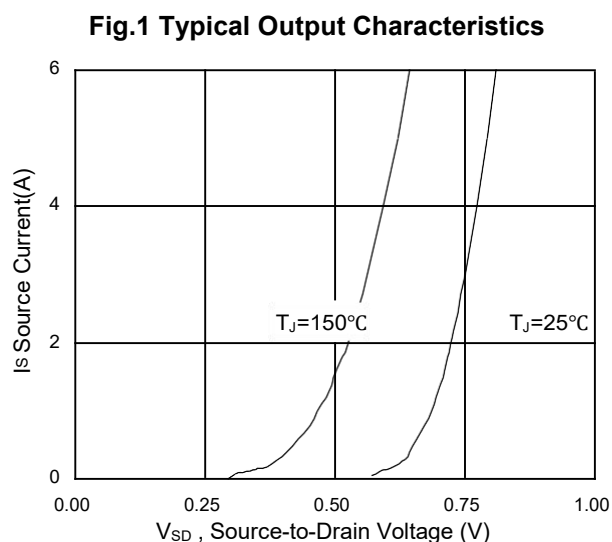
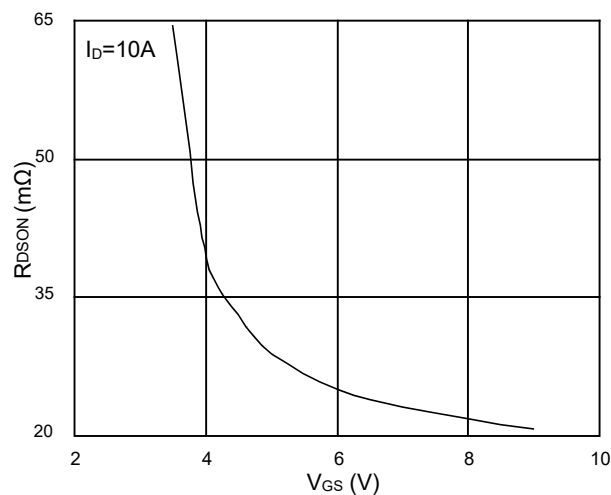
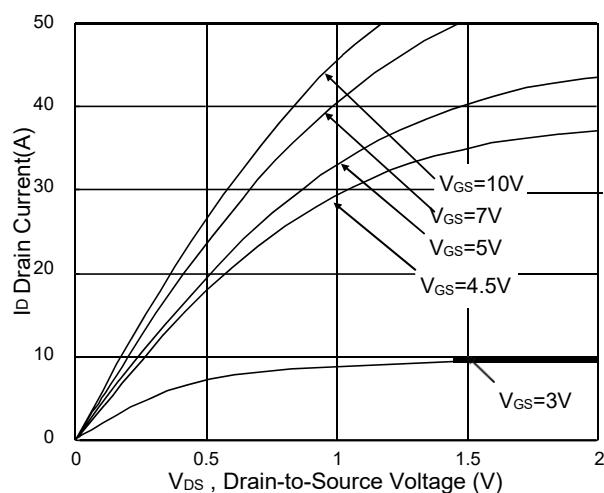
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V$ , $I_D=-250\mu A$	-30	---	---	V
$\Delta BV_{DSS}/\Delta T$	$BV_{DSS}$ Temperature Coefficient	Reference to $25^\circ\text{C}$ , $I_D=-1mA$	---	-0.021	---	V/ $^\circ\text{C}$
$R_{DS(ON)}$	Static Drain-Source On-Resistance <sup>2</sup>	$V_{GS}=-10V$ , $I_D=-8A$	---	25	30	$m\Omega$
		$V_{GS}=-4.5V$ , $I_D=-6A$	---	30	35	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS}=V_{DS}$ , $I_D=-250\mu A$	-1.0	---	-2.5	V
$\Delta V_{GS(th)}$	$V_{GS(th)}$ Temperature Coefficient		---	-4.2	---	mV/ $^\circ\text{C}$
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS}=-24V$ , $V_{GS}=0V$ , $T_J=25^\circ\text{C}$	---	---	1	$\mu A$
		$V_{DS}=-24V$ , $V_{GS}=0V$ , $T_J=55^\circ\text{C}$	---	---	5	
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=\pm 20V$ , $V_{DS}=0V$	---	---	$\pm 100$	nA
$g_{fs}$	Forward Transconductance	$V_{DS}=-5V$ , $I_D=-8A$	---	12.6	---	S
$R_g$	Gate Resistance	$V_{DS}=0V$ , $V_{GS}=0V$ , $f=1MHz$		15	---	$\Omega$
$Q_g$	Total Gate Charge (-4.5V)	$V_{DS}=-20V$ , $V_{GS}=-4.5V$ , $I_D=-6A$	---	9.8	---	nC
$Q_{gs}$	Gate-Source Charge		---	2.2	---	
$Q_{gd}$	Gate-Drain Charge		---	3.4	---	
$T_{d(on)}$	Turn-On Delay Time	$V_{DD}=-24V$ , $V_{GS}=-10V$ , $R_G=3.3\Omega$ , $I_D=-1A$	---	16.4	---	ns
$T_r$	Rise Time		---	20.2	---	
$T_{d(off)}$	Turn-Off Delay Time		---	55	---	
$T_f$	Fall Time		---	10	---	
$C_{iss}$	Input Capacitance	$V_{DS}=-15V$ , $V_{GS}=0V$ , $f=1MHz$	---	930	---	pF
$C_{oss}$	Output Capacitance		---	148	---	
$C_{rss}$	Reverse Transfer Capacitance		---	115	---	
$I_S$	Continuous Source Current <sup>1,5</sup>	$V_G=V_D=0V$ , Force Current	---	---	-23	A
$I_{SM}$	Pulsed Source Current <sup>2,5</sup>		---	---	-35	A
$V_{SD}$	Diode Forward Voltage <sup>2</sup>	$V_{GS}=0V$ , $I_S=-1A$ , $T_J=25^\circ\text{C}$	---	---	-1.2	V

Note :

1. The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
2. The data tested by pulsed, pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
3. The EAS data shows Max. rating. The test condition is  $V_{DD}=-25V$ ,  $V_{GS}=-10V$ ,  $L=0.1mH$ ,  $I_{AS}=-30A$
4. The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
5. The data is theoretically the same as  $I_D$  and  $I_{DM}$ , in real applications, should be limited by total power dissipation.



## N-Channel Typical Characteristics



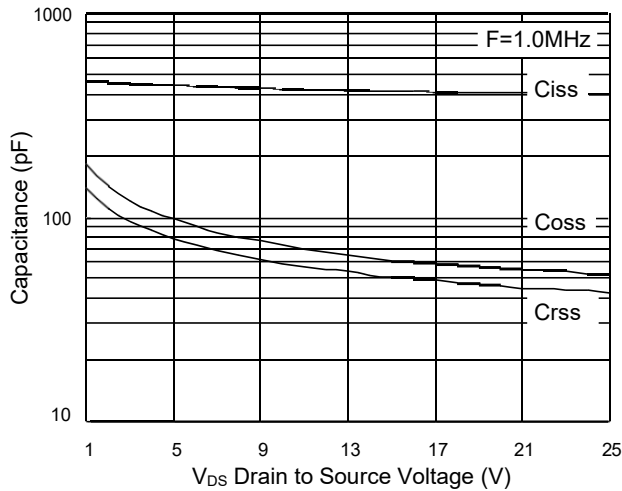


Fig.7 Capacitance

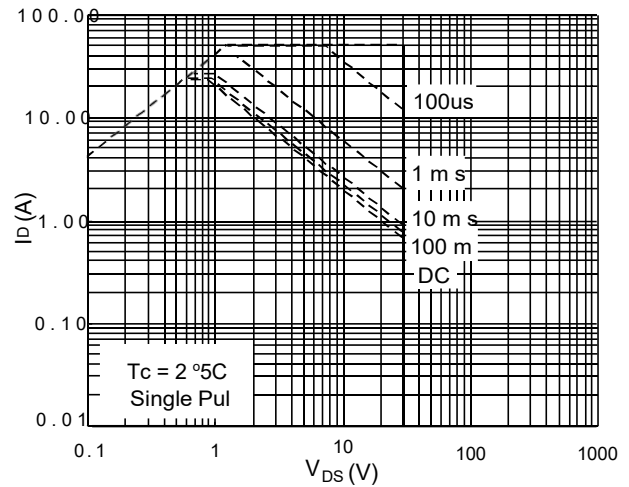


Fig.8 Safe Operating Area

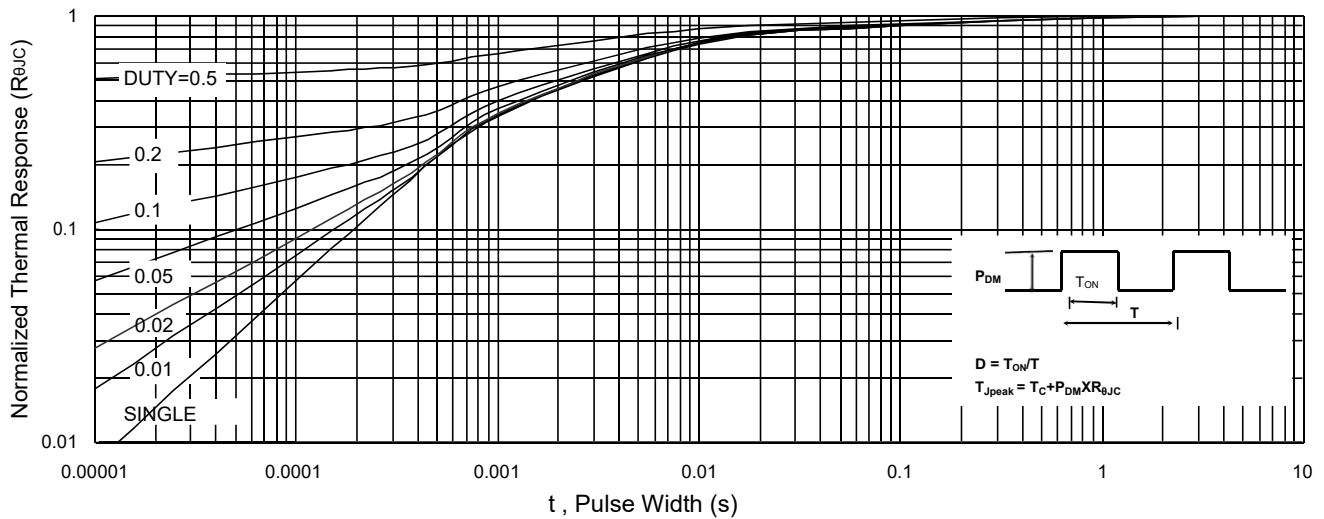
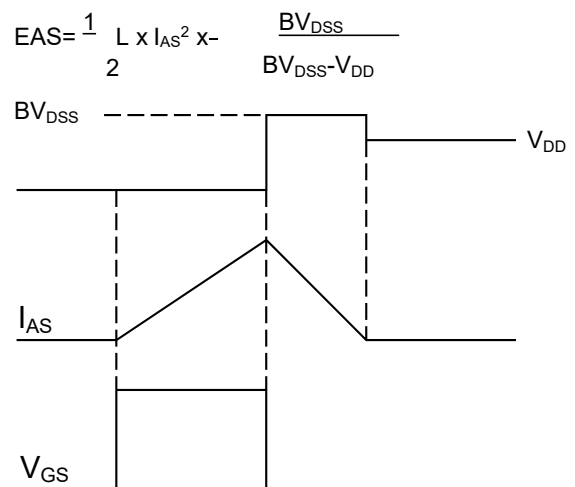
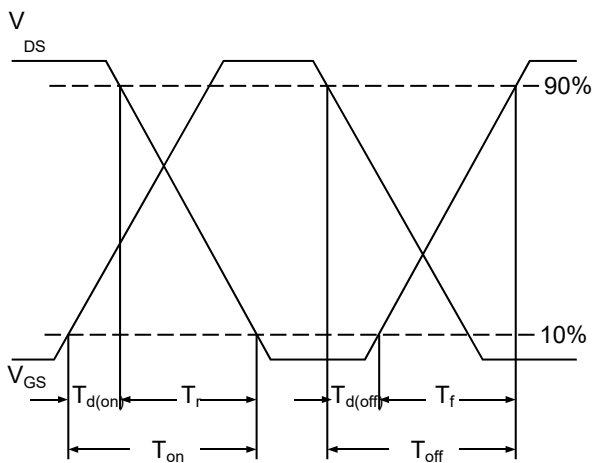


Fig.9 Normalized Maximum Transient Thermal Impedance





## P-Channel Typical Characteristics

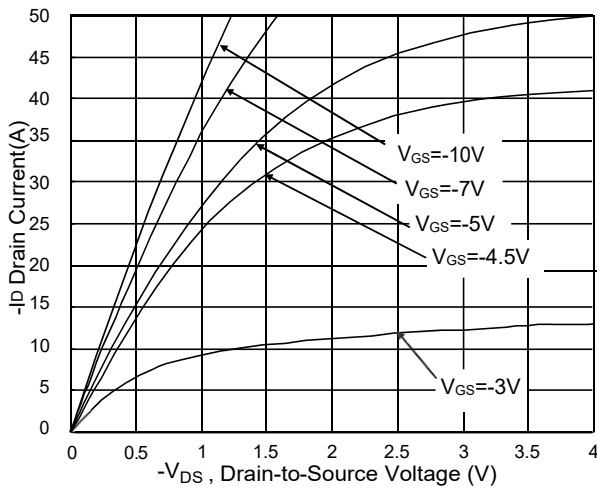


Fig.1 Typical Output Characteristics

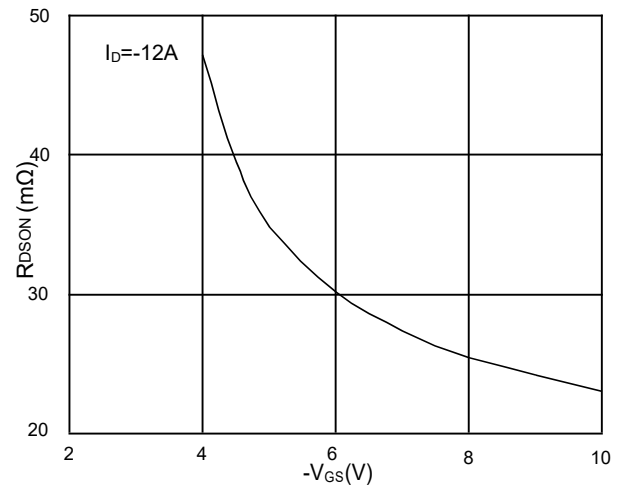


Fig.2 On-Resistance v.s Gate-Source

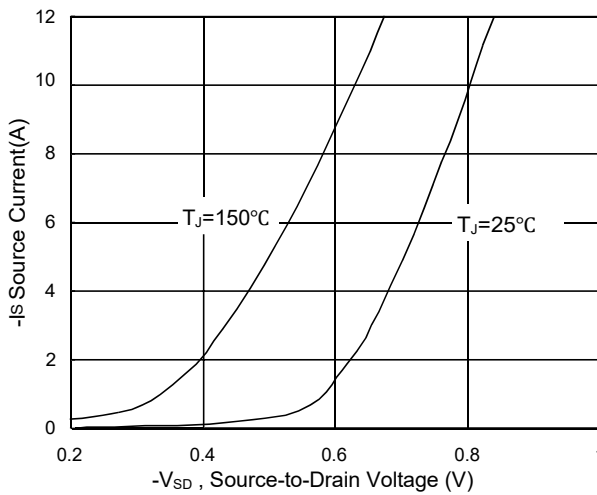


Fig.3 Forward Characteristics Of Reverse

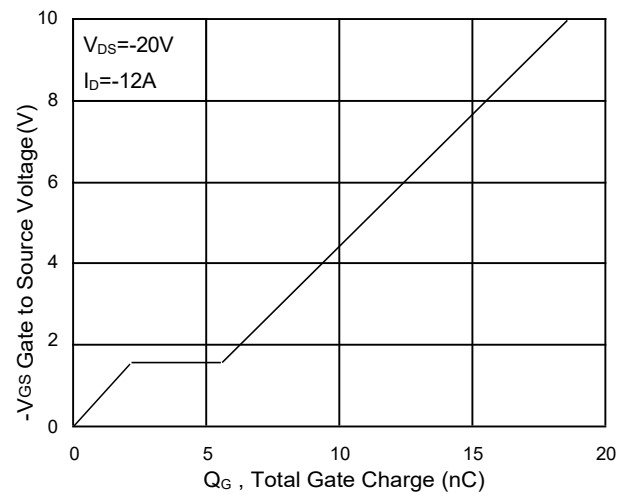


Fig.4 Gate-Charge Characteristics

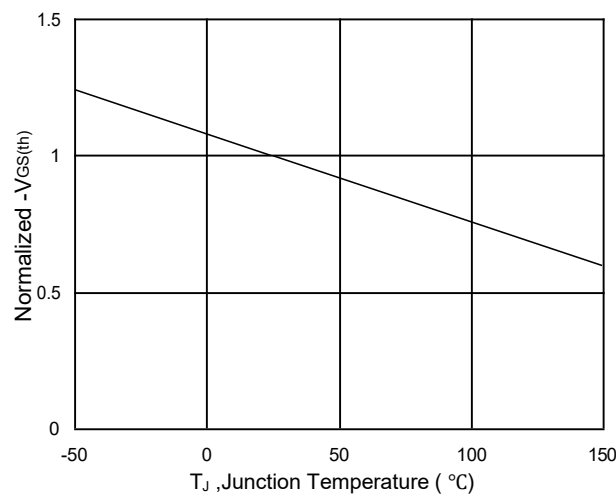


Fig.5 Normalized  $V_{GS(th)}$  v.s  $T_J$

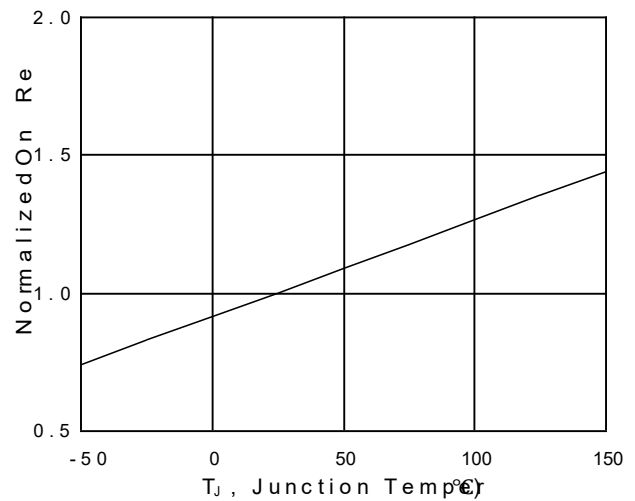


Fig.6 Normalized  $R_{DSON}$  v.s  $T_J$

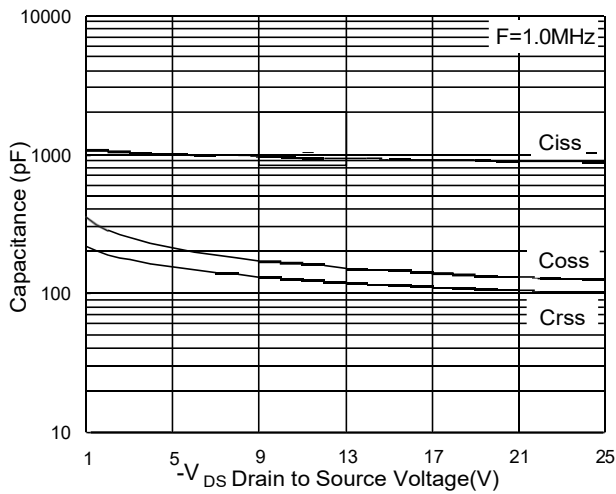


Fig.7 Capacitance

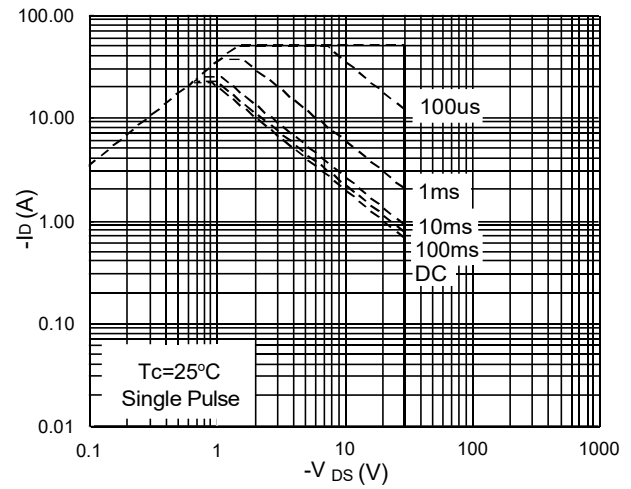


Fig.8 Safe Operating Area

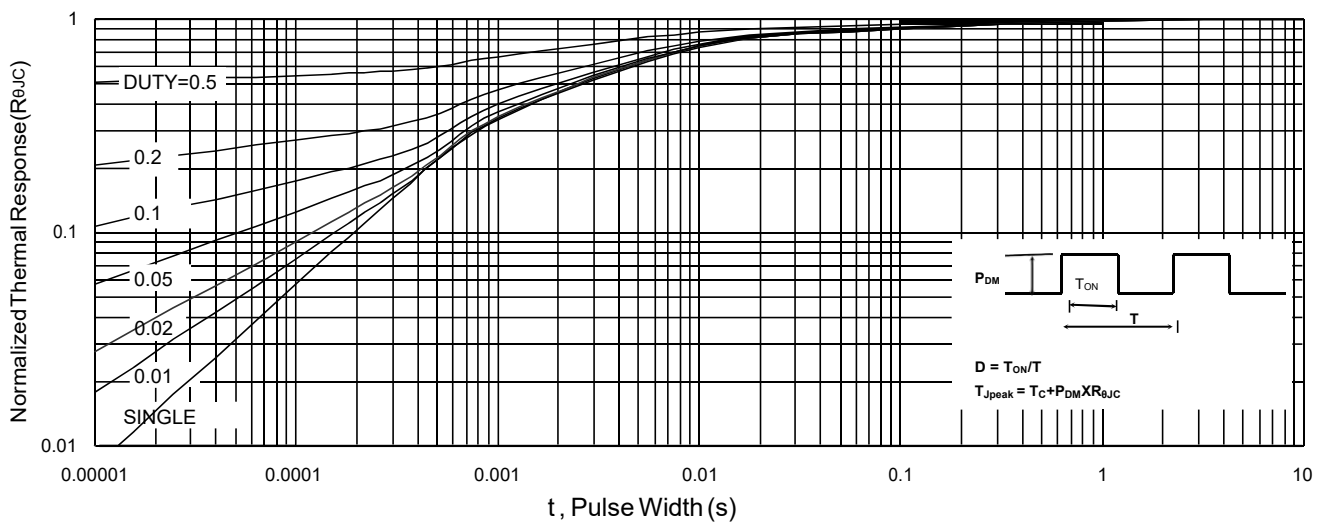


Fig.9 Normalized Maximum Transient Thermal Impedance

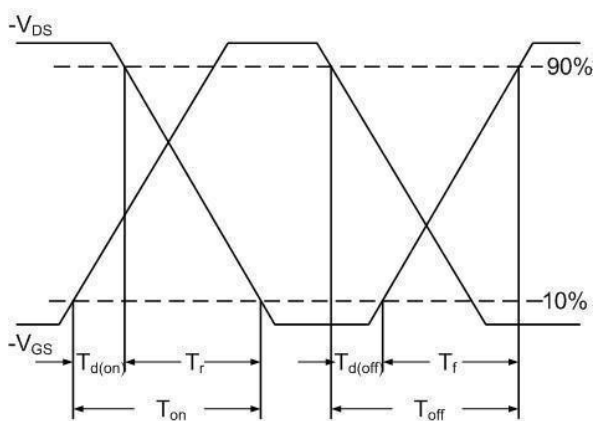


Fig.10 Switching Time Waveform

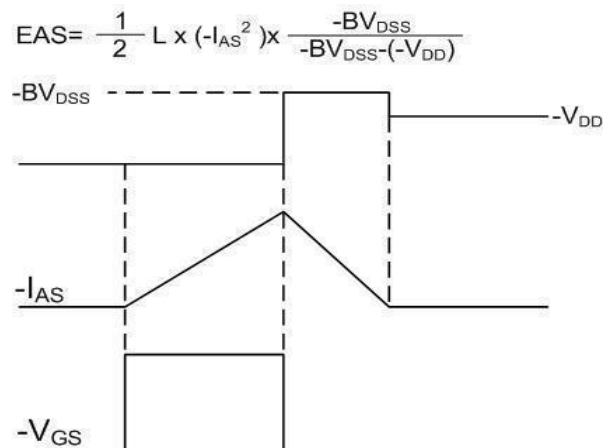
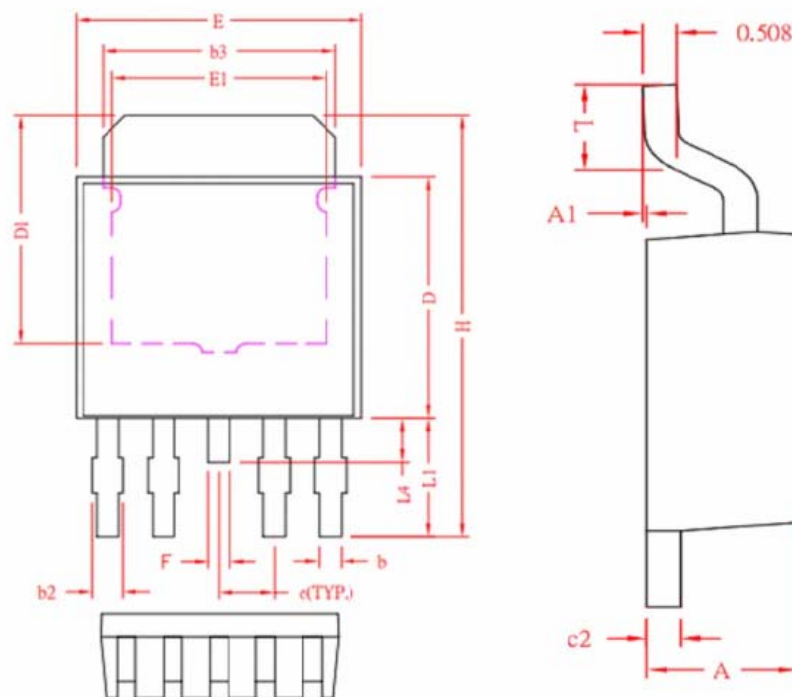


Fig.11 Unclamped Inductive Switching Waveform



## TO-252-4L Package Information



COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	2.20	2.30	2.40
A1	0	0.08	0.15
b	0.45	0.53	0.60
b2	0.50	0.65	0.80
b3	5.20	5.35	5.50
c2	0.45	0.50	0.55
D	5.40	5.60	5.80
D1	4.57	-	-
E	6.40	6.60	6.80
E1	3.81	-	-
e	1.27 REF.		
F	0.40	0.50	0.60
H	9.40	9.80	10.20
L	1.40	1.59	1.77
L1	2.40	2.70	3.00
L4	0.80	1.00	1.20





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