

## N-Channel and P-Channel 40V(D-S) MOSFET

Product summary			
$V_{DS}$	40	-40	V
$R_{DS(ON)}$ (at $V_{GS}=10V$ ) Max.	28	40	m $\Omega$
$R_{DS(ON)}$ (at $V_{GS}=4.5V$ ) Max.	42	65	m $\Omega$
$I_D(T_C=25^{\circ}C)$	23	-20	A

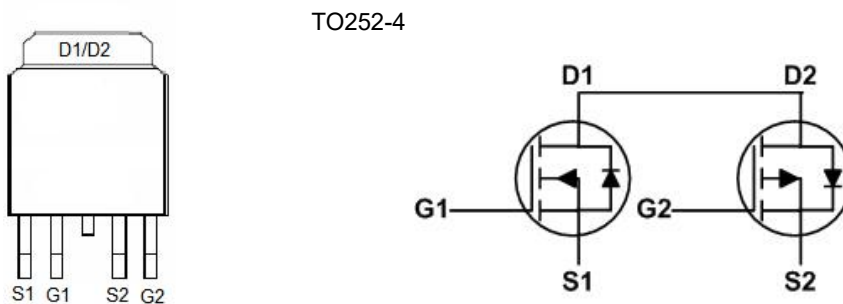
### Features

- Super Low Gate Charge
- Trench Power LV MOSFET technology

### Applications

- Power management functions
- Load switch

### Pin Configuration



### Packing Information

Device	Package	Reel Size	Quantity(Min. Package)
ECFD20C04C	TO252-4	13"	2500pcs

### Absolute Maximum Ratings (at $T_A=25^{\circ}C$ Unless Otherwise Noted)

Symbol	Parameter		N-Rating	P-Rating	Units
V <sub>DS</sub>	Drain-Source Voltage		40	-40	V
V <sub>GS</sub>	Gate-Source Voltage		±20	±20	V
I <sub>D</sub>	Continuous Drain Current <sup>A</sup>	T <sub>C</sub> =25°C	23	-20	A
		T <sub>C</sub> =100°C	18	-16	A
I <sub>DM</sub>	Pulse Drain Current Tested <sup>B</sup>		46	-40	A
E <sub>AS</sub>	Single Pulse Avalanche Energy <sup>C</sup>		28	66	mJ
P <sub>D</sub>	Power Dissipation <sup>D</sup>	T <sub>C</sub> =25°C	25	31	W
T <sub>J</sub> ,T <sub>STG</sub>	Junciton and Storage Temperature Range		-55 to +150	-55 to +150	°C

### Thermal Characteristics

Symbol	Parameter	Typical	Units
$R_{\theta JA}$	Thermal Resistance-Junction to ambient <sup>A</sup>	62	$^{\circ}C/W$
$R_{\theta JC}$	Thermal Resistance Junction-Case <sup>A</sup>	5	$^{\circ}C/W$

**N-Channel Electrical Characteristics (at  $T_J = 25^\circ\text{C}$  Unless Otherwise Noted)**

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
<b>Static Parameters</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	40	--	--	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=32V, V_{GS}=0V$	--	--	1	$\mu A$
$I_{GSS}$	Gate-Body Leakage Current	$V_{DS}=0V, V_{GS}=\pm 20V$	--	--	$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	1.0	1.5	2.5	V
$R_{DS(on)}$	Drain-Source On-State Resistance <sup>B</sup>	$V_{GS}=10V, I_D=12A$	--	--	28	m $\Omega$
		$V_{GS}=4.5V, I_D=10A$	--	--	42	m $\Omega$
$V_{SD}$	Diode Forward Voltage	$I_S=1A, V_{GS}=0V$	--	--	1.2	V
$I_S$	Maximum Body-Diode Continuous Current		--	--	23	A
<b>Dynamic Parameters <sup>E</sup></b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0V, V_{DS}=15V$ $f=1MHz$	--	593	--	pF
$C_{oss}$	Output Capacitance		--	76	--	pF
$C_{rss}$	Reverse Transfer Capacitance		--	56	--	pF
$Q_g$	Total Gate Charge	$V_{DS}=20V, I_D=12A$ $V_{GS}=4.5V$	--	5.5	--	nC
$Q_{gs}$	Gate-Source Charge		--	1.25	--	nC
$Q_{gd}$	Gate-Drain Charge		--	2.5	--	nC
$t_{D(on)}$	Turn-on Delay Time	$V_{DD}=20V$ $I_D=1A, R_G=3.3\Omega,$ $V_{GS}=10V$	--	8.9	--	ns
$t_r$	Turn-on Rise Time		--	2.2	--	ns
$t_{D(off)}$	Turn-off Delay Time		--	41	--	ns
$t_f$	Turn-off Fall Time		--	2.7	--	ns

A. The data tested by surface mounted on a 1 inch x 1 inch FR-4 board with 20Z copper.

B. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .

C. The  $E_{AS}$  data shows Max. rating . The test condition is  $V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=17.8A$ .

D. The power dissipation is limited by  $150^\circ\text{C}$  junction temperature.

E. Guaranteed by design, not subject to production testing.

**P-Channel Electrical Characteristics (at  $T_J = 25^\circ\text{C}$  Unless Otherwise Noted)**

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
<b>Static Parameters</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=-250\mu A$	-40	--	--	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=-32V, V_{GS}=0V$	--	--	-1	$\mu A$
$I_{GSS}$	Gate-Body Leakage Current	$V_{DS}=0V, V_{GS}=\pm 20V$	--	--	$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=-250\mu A$	-1.0	-1.6	-2.5	V
$R_{DS(on)}$	Drain-Source On-State Resistance <sup>B</sup>	$V_{GS}=-10V, I_D=-8A$	--	--	40	m $\Omega$
		$V_{GS}=-4.5V, I_D=-4A$	--	--	65	m $\Omega$
$V_{SD}$	Diode Forward Voltage	$I_S=-1A, V_{GS}=0V$	--	--	-1.0	V
$I_S$	Maximum Body-Diode Continuous Current		--	--	-20	A
<b>Dynamic Parameters <sup>E</sup></b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0V, V_{DS}=-15V$ $f=1MHz$	--	1004	--	pF
$C_{oss}$	Output Capacitance		--	108	--	pF
$C_{rss}$	Reverse Transfer Capacitance		--	80	--	pF
$Q_g$	Total Gate Charge	$V_{DS}=-20V, I_D=-12A$ $V_{GS}=-4.5V$	--	9	--	nC
$Q_{gs}$	Gate-Source Charge		--	2.54	--	nC
$Q_{gd}$	Gate-Drain Charge		--	3.1	--	nC
$t_{D(on)}$	Turn-on Delay Time	$V_{DD}=-15V$ $I_D=-1A, R_G=3.3\Omega,$ $V_{GS}=-10V$	--	19.2	--	ns
$t_r$	Turn-on Rise Time		--	12.8	--	ns
$t_{D(off)}$	Turn-off Delay Time		--	48.6	--	ns
$t_f$	Turn-off Fall Time		--	4.6	--	ns

A. The data tested by surface mounted on a 1 inch x 1 inch FR-4 board with 20Z copper.

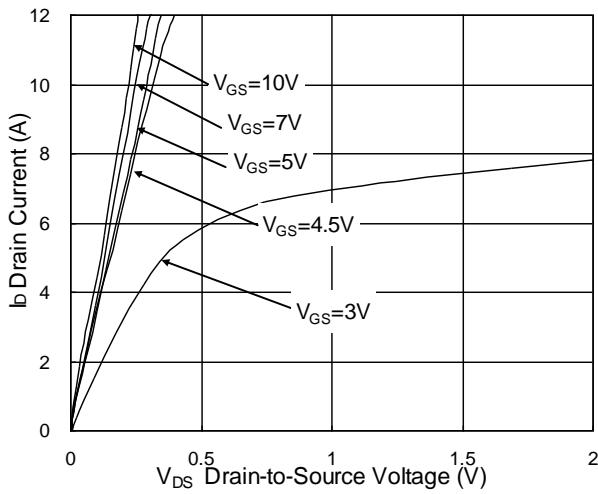
B. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .

C. The  $E_{AS}$  data shows Max. rating . The test condition is  $V_{DD}=-25V, V_{GS}=-10V, L=0.1mH, I_{AS}=-27.2A$ .

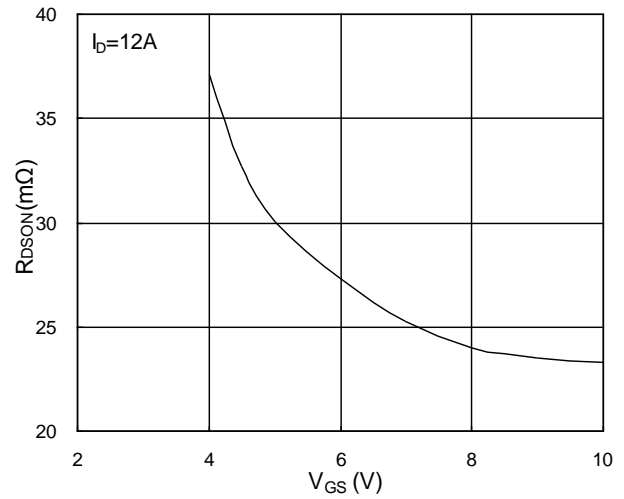
D. The power dissipation is limited by  $150^\circ\text{C}$  junction temperature.

E. Guaranteed by design, not subject to production testing.

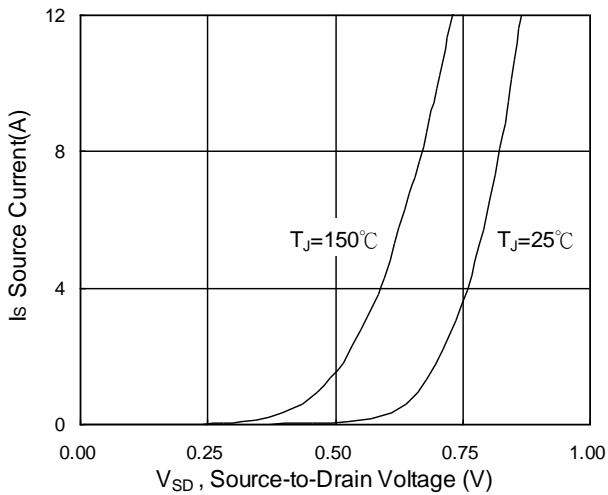
## N-Channel Typical Characteristics



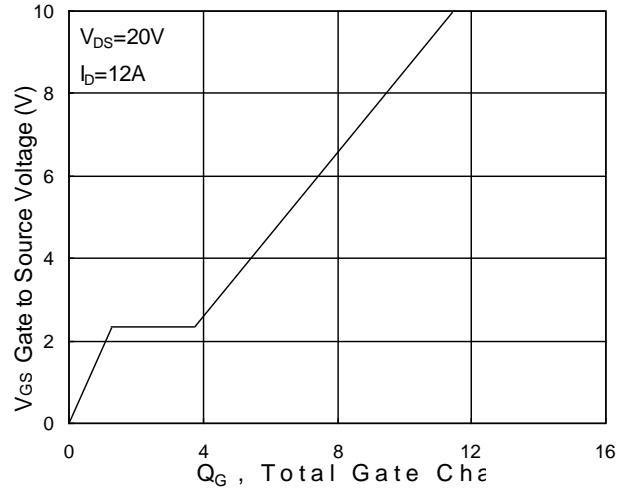
**Fig.1 Typical Output Characteristics**



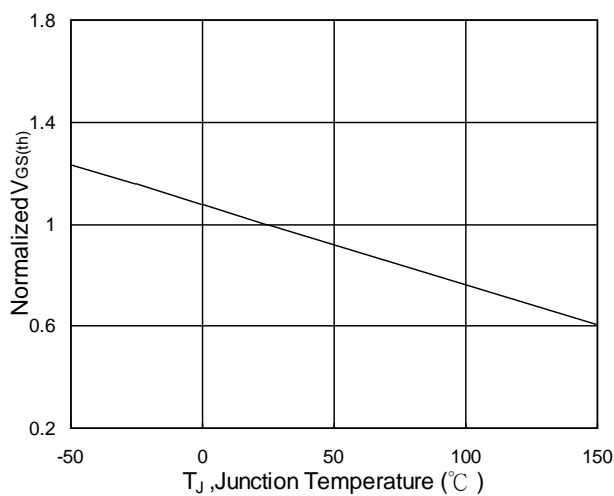
**Fig.2 On-Resistance vs. G-S Voltage**



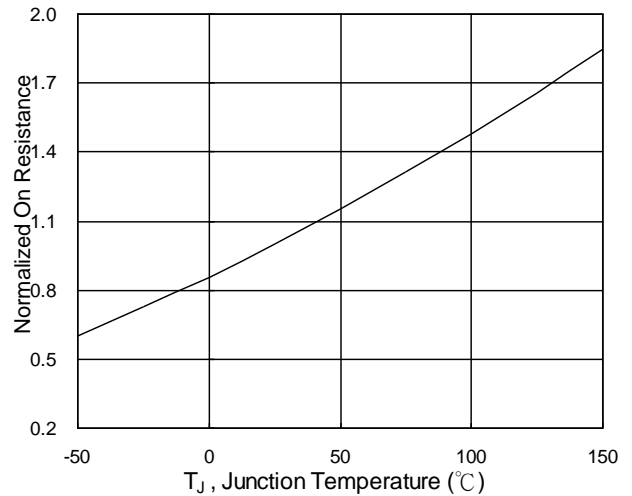
**Fig.3 Forward Characteristics of Reverse**



**Fig.4 Gate-Charge Characteristics**

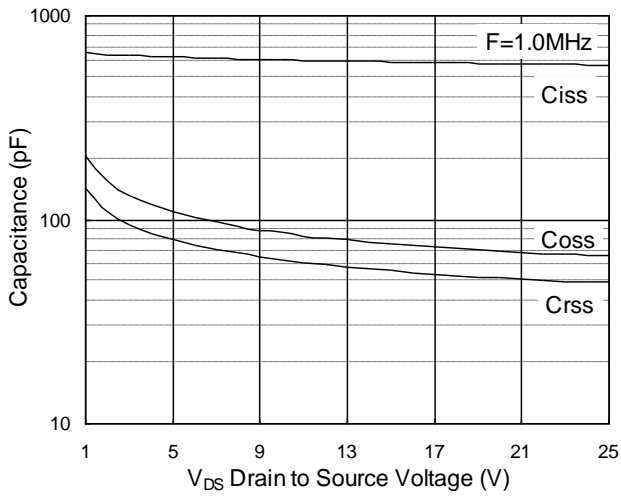


**Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$**

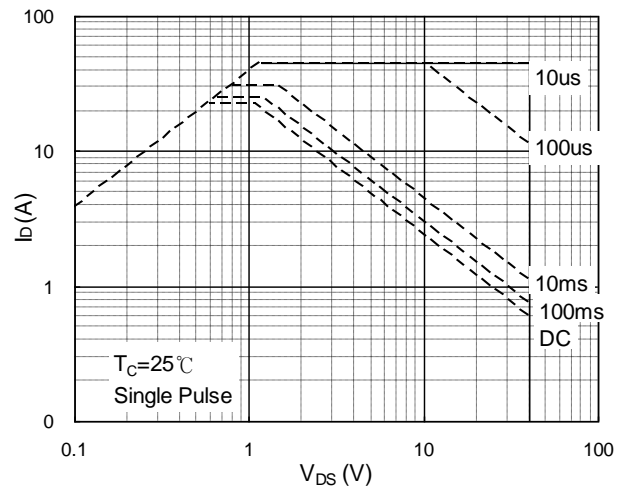


**Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$**

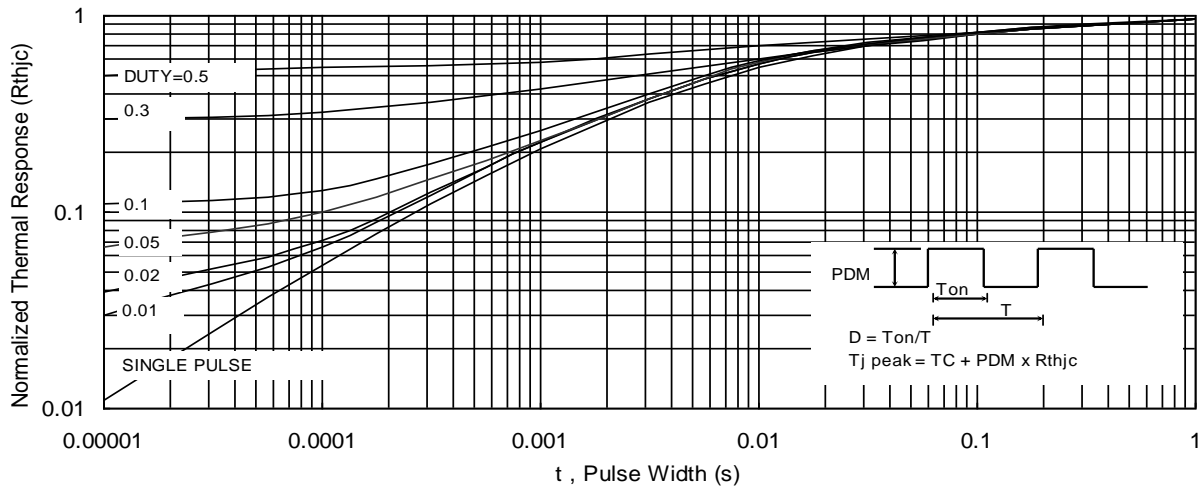
## N-Channel Typical Characteristics



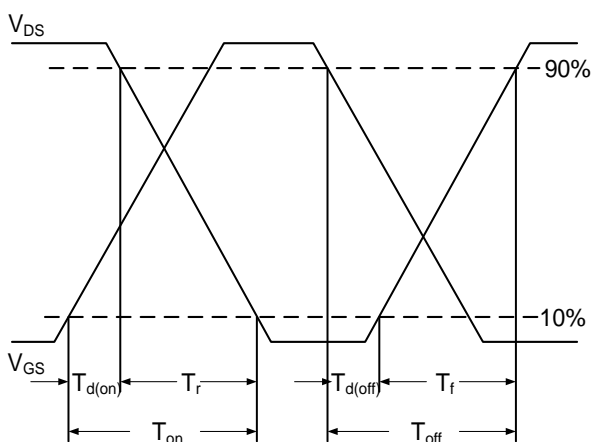
**Fig.7 Capacitance**



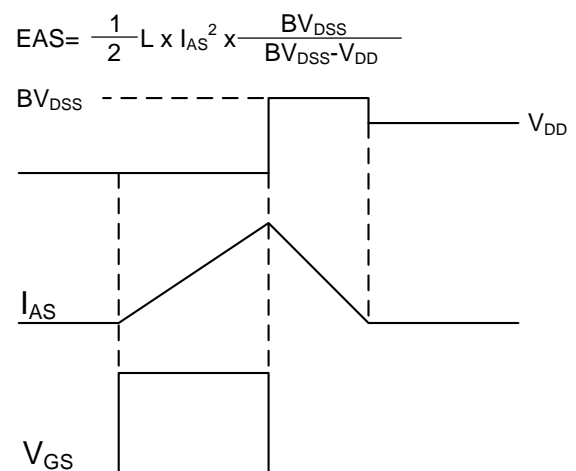
**Fig.8 Safe Operating Area**



**Fig.9 Normalized Maximum Transient Thermal Impedance**

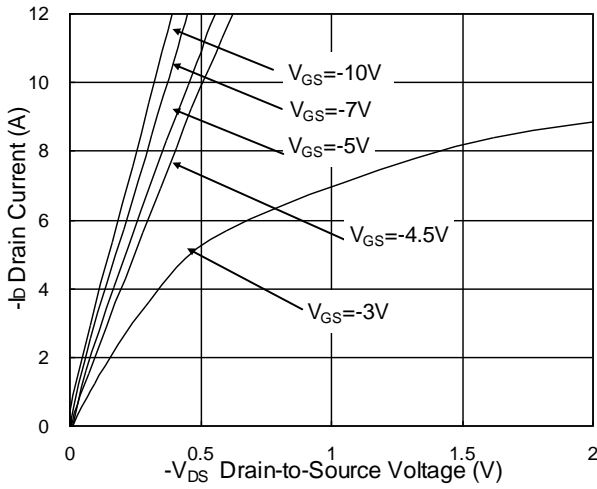


**Fig.10 Switching Time Waveform**

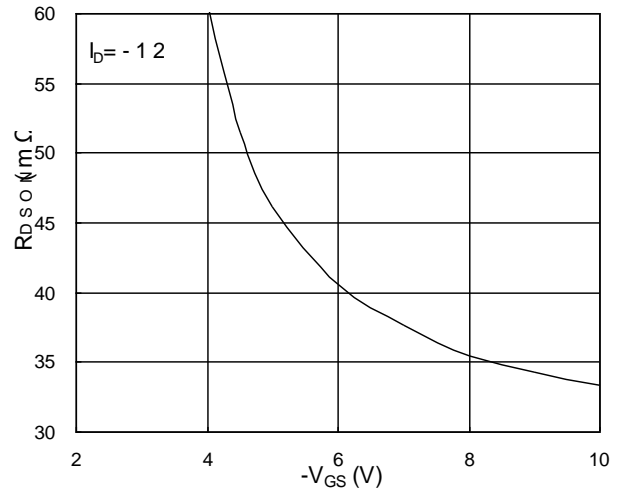


**Fig.11 Unclamped Inductive Switching Wave**

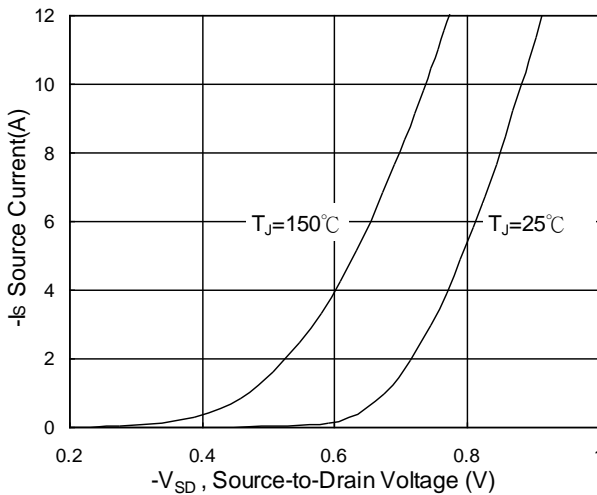
## P-Channel Typical Characteristics



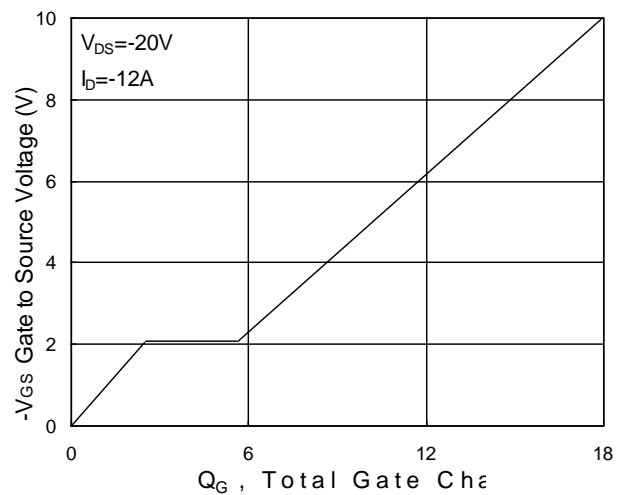
**Fig.1 Typical Output Characteristics**



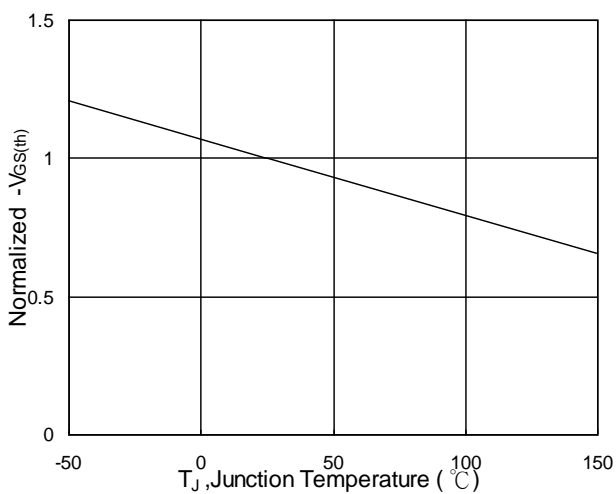
**Fig.2 On-Resistance v.s Gate-Source**



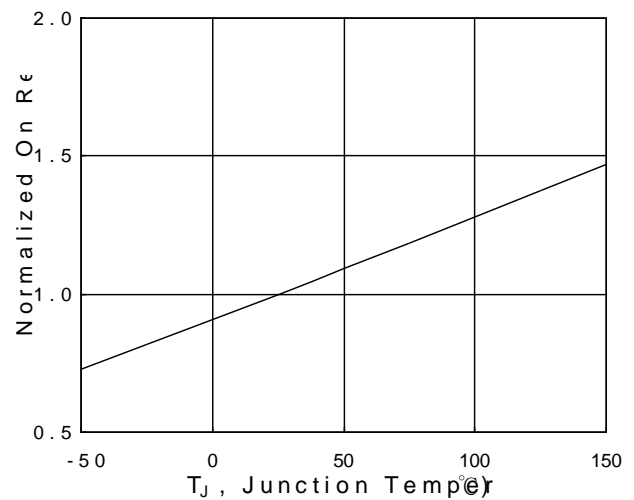
**Fig.3 Forward Characteristics of Reverse**



**Fig.4 Gate-Charge Characteristics**

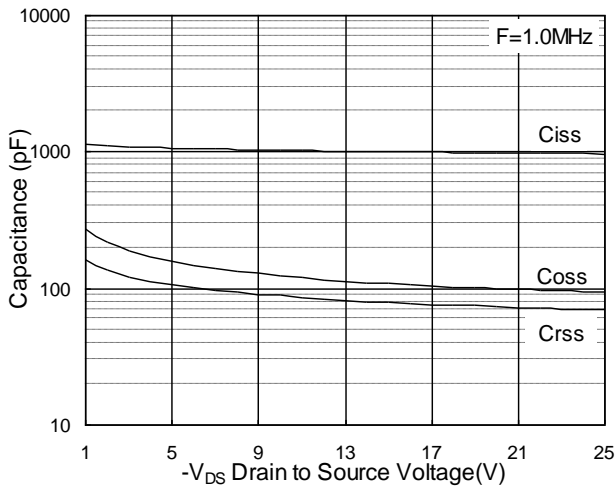


**Fig.5 Normalized  $V_{GS(th)}$  v.s  $T_J$**

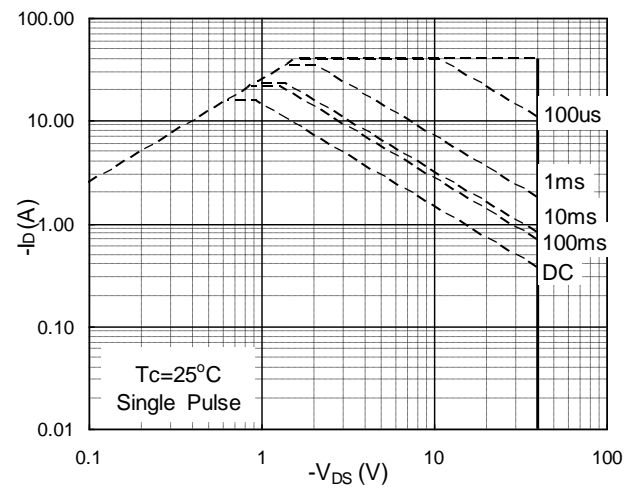


**Fig.6 Normalized  $R_{DS(on)}$  v.s  $T_J$**

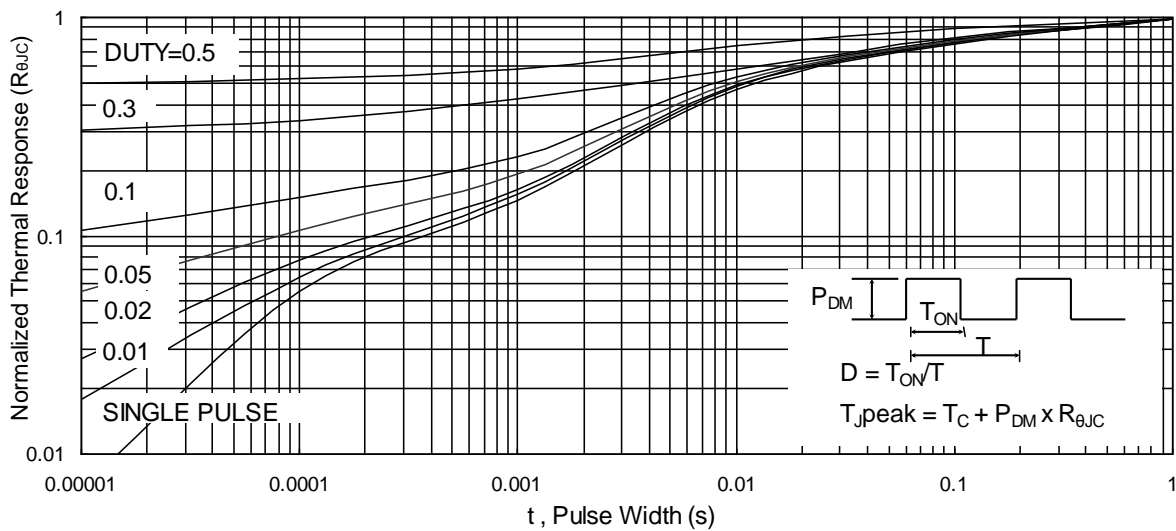
## P-Channel Typical Characteristics



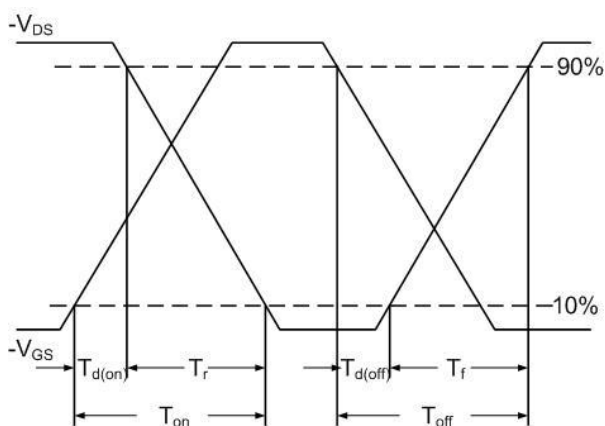
**Fig.7 Capacitance**



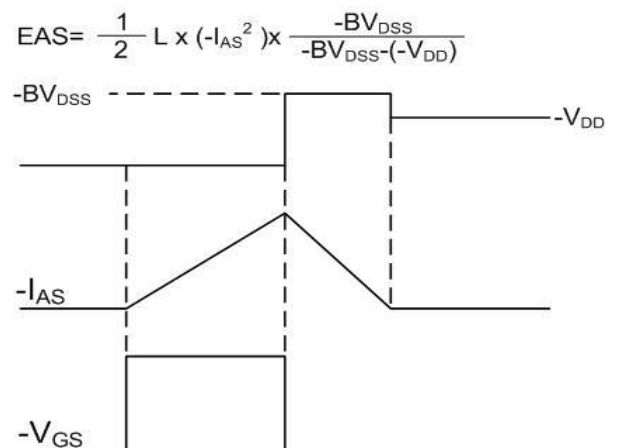
**Fig.8 Safe Operating Area**



**Fig.9 Normalized Maximum Transient Thermal Impedance**

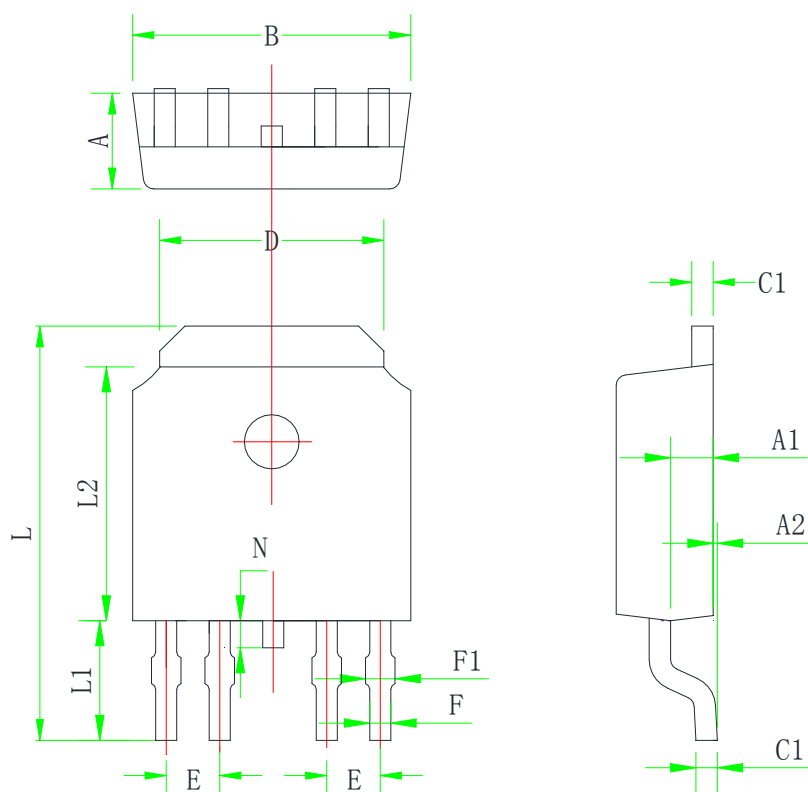


**Fig.10 Switching Time Waveform**



**Fig.11 Unclamped Inductive Waveform**

## TO252-4L Package Information(mm)



Symbol	Min	Typ	Max
A	2.20	2.30	2.40
A1	0.91	1.01	1.11
A2	0.05	0.15	0.25
B	6.45	6.60	6.75
C	0.45	0.50	0.58
C1	0.45	0.50	0.58
D	5.12	5.32	5.52
E	1.27 TYP		
F	0.45	0.60	0.75
F1	0.40	0.50	0.60
L	9.70	10.00	10.20
L1	2.6	2.8	3.0
L2	5.95	6.10	6.25
N	0.45	0.65	0.85