

## N & P-Channel 60-V (D-S) MOSFET

### Key Features:

- Low  $r_{DS(on)}$  trench technology
- Low thermal impedance
- Fast switching speed

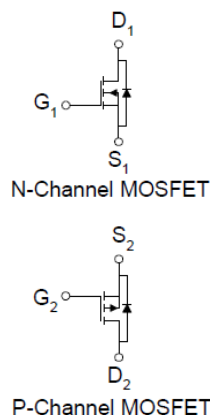
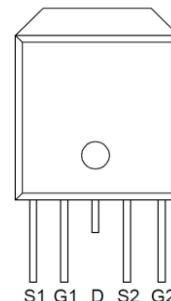
### Typical Applications:

- Automotive Systems
- DC/DC Conversion Circuits
- Battery Powered Power Tools

PRODUCT SUMMARY		
$V_{DS}$ (V)	$r_{DS(on)}$ (m $\Omega$ )	$I_D$ (A)
60	28 @ $V_{GS} = 10V$	35
	35 @ $V_{GS} = 4.5V$	31
-60	40 @ $V_{GS} = -10V$	-29
	52 @ $V_{GS} = -4.5V$	-25



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**



### ABSOLUTE MAXIMUM RATINGS (TA = 25°C UNLESS OTHERWISE NOTED)

Parameter	Symbol	Nch Limit	Pch Limit	Units
Drain-Source Voltage	$V_{DS}$	60	-60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	
Continuous Drain Current <sup>a</sup>	$I_D$	35	-29	A
Pulsed Drain Current <sup>b</sup>	$I_{DM}$	100	-100	
Continuous Source Current (Diode Conduction) <sup>a</sup>	$I_S$	37	-27	A
Power Dissipation <sup>a</sup>	$P_D$	50	50	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	$T_J, T_{stg}$	-55 to 175	$^{\circ}C$

### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Maximum	Units
Maximum Junction-to-Ambient <sup>c</sup>	$R_{\theta JA}$	50	$^{\circ}C/W$
Maximum Junction-to-Case	$R_{\theta JC}$	3	

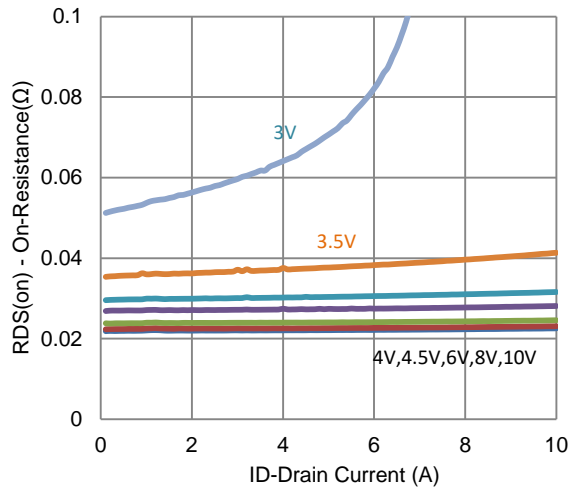
### Notes

- Package Limited
- Pulse width limited by maximum junction temperature
- Surface Mounted on 1" x 1" FR4 Board.

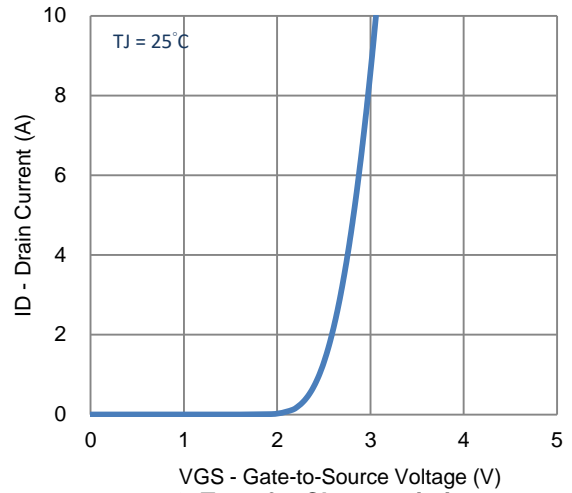
## Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Static</b>						
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250 \mu A$ <b>(Nch)</b>	1			V
		$V_{DS} = V_{GS}, I_D = -250 \mu A$ <b>(Pch)</b>	-1			V
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0 V, V_{GS} = \pm 20 V$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 48 V, V_{GS} = 0 V$ <b>(Nch)</b>			1	$\mu A$
		$V_{DS} = -48 V, V_{GS} = 0 V$ <b>(Pch)</b>			-1	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} = 5 V, V_{GS} = 10 V$ <b>(Nch)</b>	45			A
		$V_{DS} = -5 V, V_{GS} = -10 V$ <b>(Pch)</b>	-40			A
Drain-Source On-Resistance <sup>a</sup>	$r_{DS(on)}$	$V_{GS} = 10 V, I_D = 10 A$ <b>(Nch)</b>			28	$m\Omega$
		$V_{GS} = 4.5 V, I_D = 8 A$ <b>(Nch)</b>			35	
		$V_{GS} = -10 V, I_D = -10 A$ <b>(Pch)</b>			40	$m\Omega$
		$V_{GS} = -4.5 V, I_D = -8 A$ <b>(Pch)</b>			52	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 15 V, I_D = 10 A$ <b>(Nch)</b>		27		S
		$V_{DS} = -15 V, I_D = -10 A$ <b>(Pch)</b>		12		S
Diode Forward Voltage <sup>a</sup>	$V_{SD}$	$I_S = 18.5 A, V_{GS} = 0 V$ <b>(Nch)</b>		0.91		V
		$I_S = -13.5 A, V_{GS} = 0 V$ <b>(Pch)</b>		-1.1		V
<b>Dynamic <sup>b</sup></b>						
Total Gate Charge	$Q_g$	N - Channel $V_{DS} = 30 V, V_{GS} = 4.5 V,$ $I_D = 10 A$		9		nC
Gate-Source Charge	$Q_{gs}$			3.2		
Gate-Drain Charge	$Q_{gd}$			3.3		
Turn-On Delay Time	$t_{d(on)}$	N - Channel $V_{DS} = 30 V, R_L = 3 \Omega,$ $I_D = 10 A,$ $V_{GEN} = 10 V, R_{GEN} = 6 \Omega$		6		ns
Rise Time	$t_r$			6		
Turn-Off Delay Time	$t_{d(off)}$			32		
Fall Time	$t_f$			9		
Input Capacitance	$C_{iss}$	N - Channel $V_{DS} = 15 V, V_{GS} = 0 V, f = 1 Mhz$		1422		pF
Output Capacitance	$C_{oss}$			84		
Reverse Transfer Capacitance	$C_{rss}$			79		
Total Gate Charge	$Q_g$	P - Channel $V_{DS} = -30 V, V_{GS} = -4.5 V,$ $I_D = -10 A$		19		nC
Gate-Source Charge	$Q_{gs}$			9.3		
Gate-Drain Charge	$Q_{gd}$			5.9		
Turn-On Delay Time	$t_{d(on)}$	P - Channel $V_{DS} = -30 V, R_L = 3 \Omega,$ $I_D = -10 A,$ $V_{GEN} = -10 V, R_{GEN} = 6 \Omega$		12		ns
Rise Time	$t_r$			10		
Turn-Off Delay Time	$t_{d(off)}$			70		
Fall Time	$t_f$			26		
Input Capacitance	$C_{iss}$	P - Channel $V_{DS} = -15 V, V_{GS} = 0 V, f = 1 Mhz$		2057		pF
	$C_{oss}$			151		
Reverse Transfer Capacitance	$C_{rss}$			92		

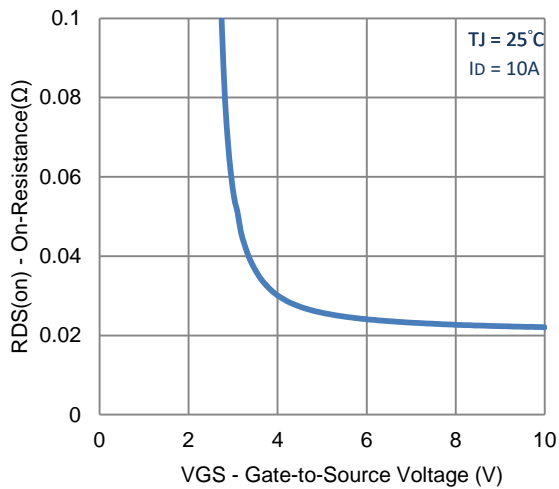
Typical Electrical Characteristics - N-channel



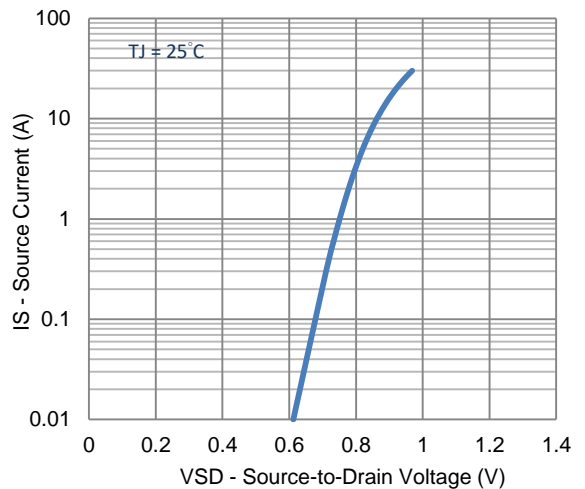
1. On-Resistance vs. Drain Current



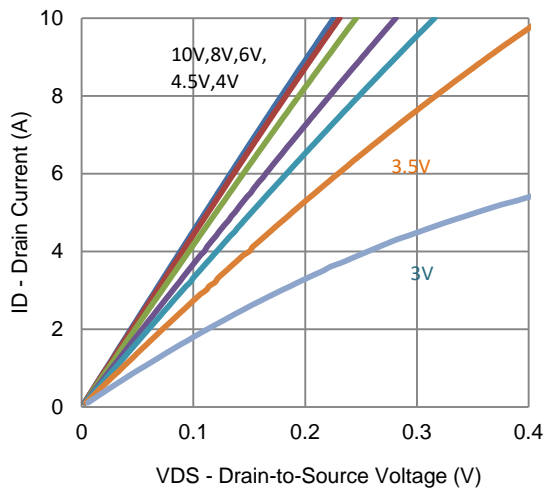
2. Transfer Characteristics



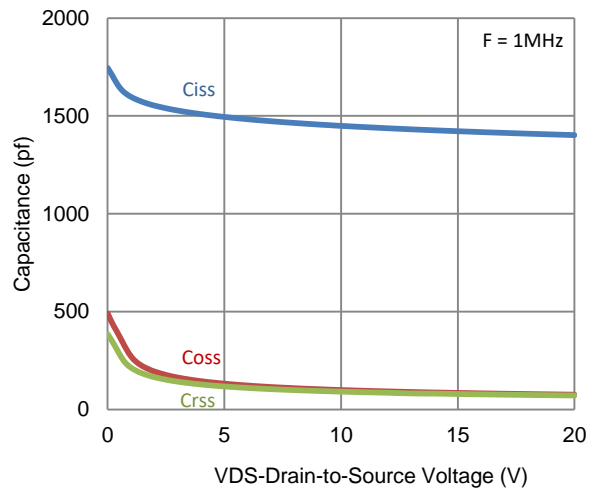
3. On-Resistance vs. Gate-to-Source Voltage



4. Drain-to-Source Forward Voltage

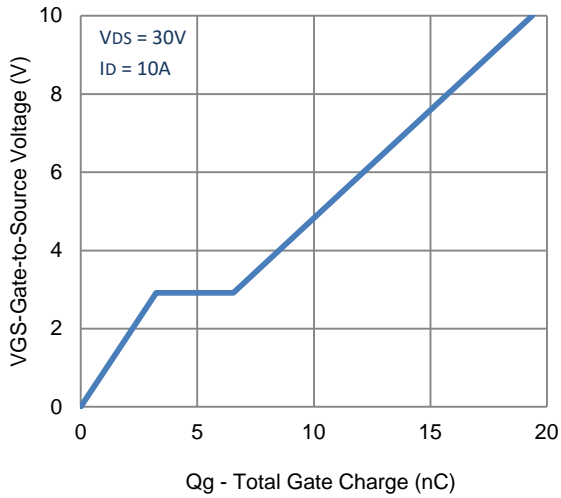


5. Output Characteristics

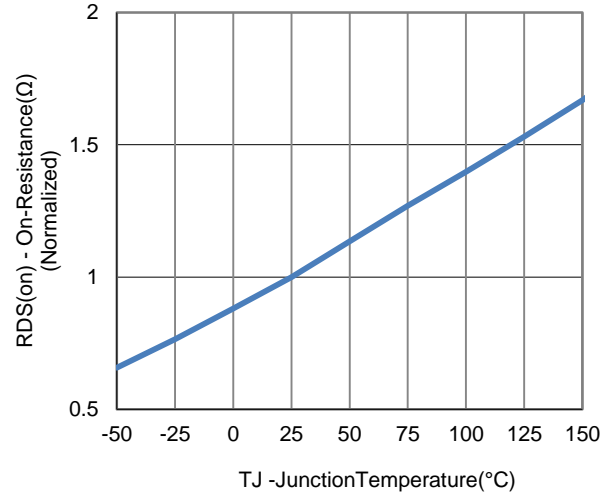


6. Capacitance

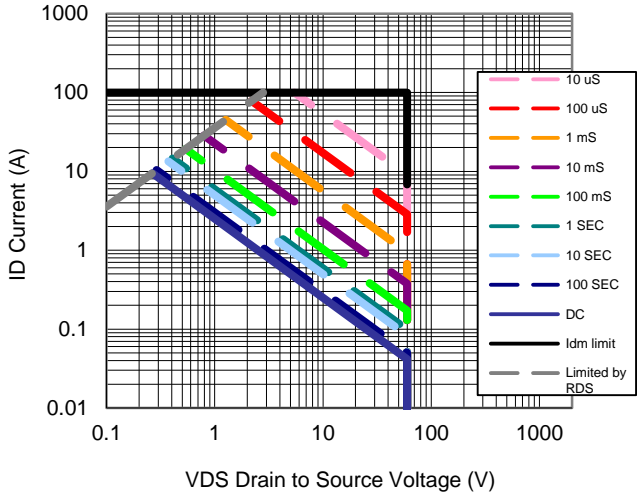
Typical Electrical Characteristics - N-channel



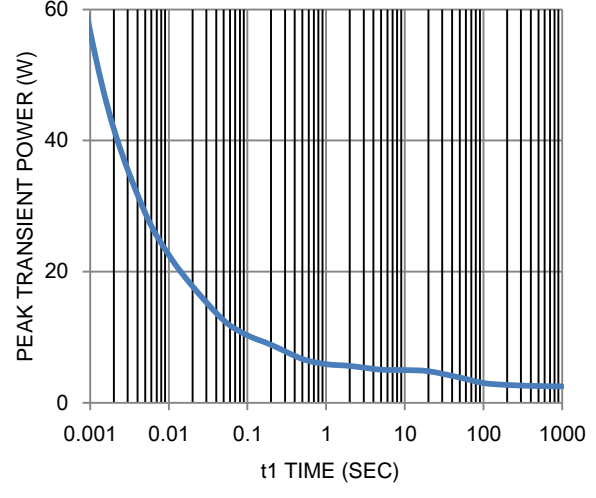
7. Gate Charge



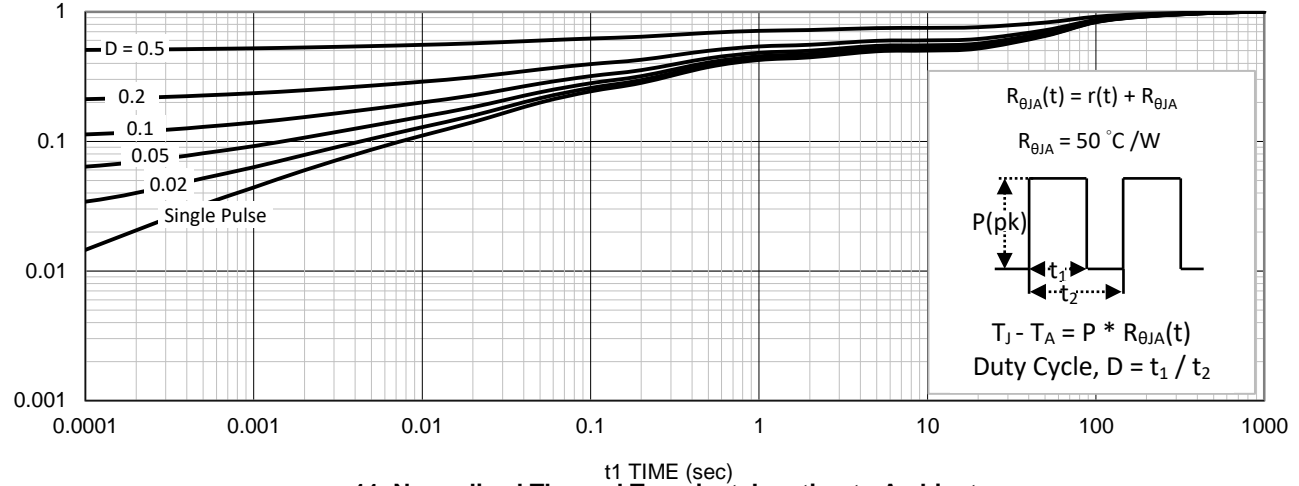
8. Normalized On-Resistance Vs Junction Temperature



9. Safe Operating Area

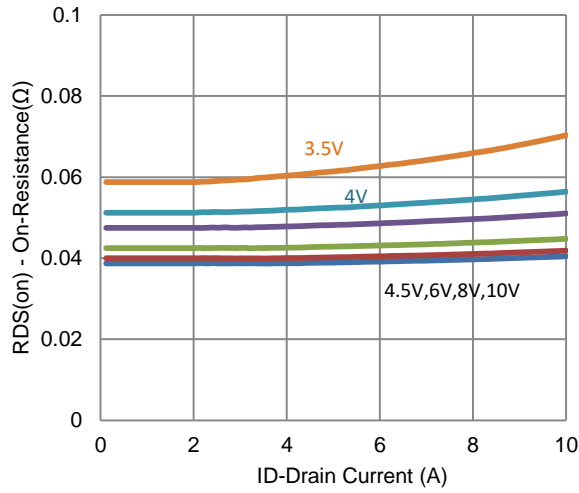


10. Single Pulse Maximum Power Dissipation

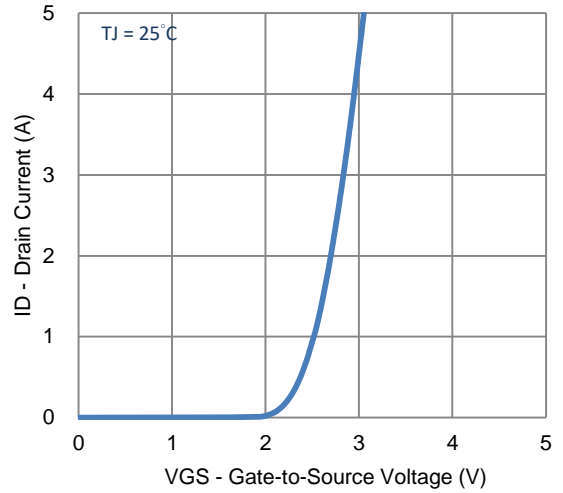


11. Normalized Thermal Transient Junction to Ambient

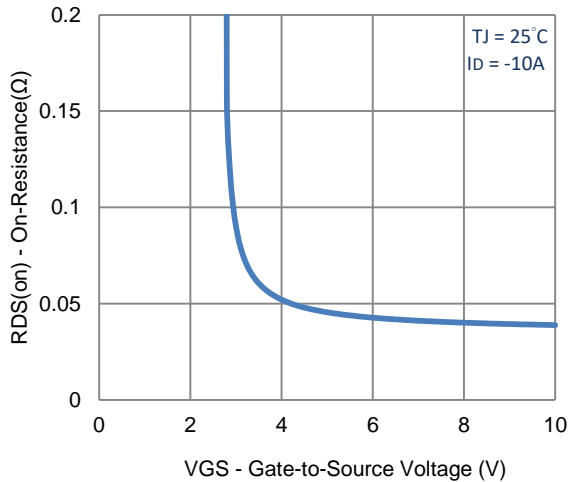
Typical Electrical Characteristics - P-channel



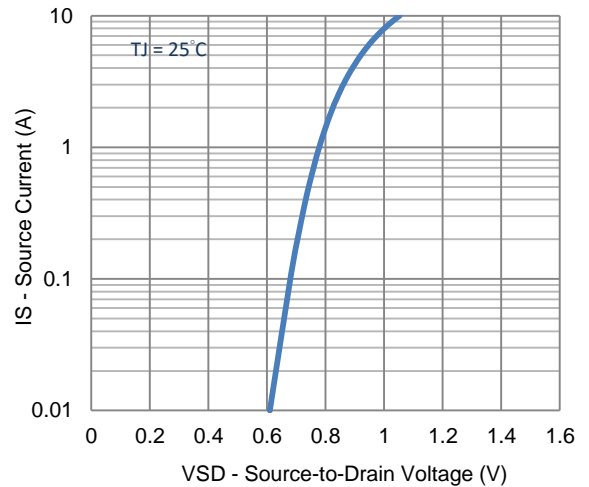
1. On-Resistance vs. Drain Current



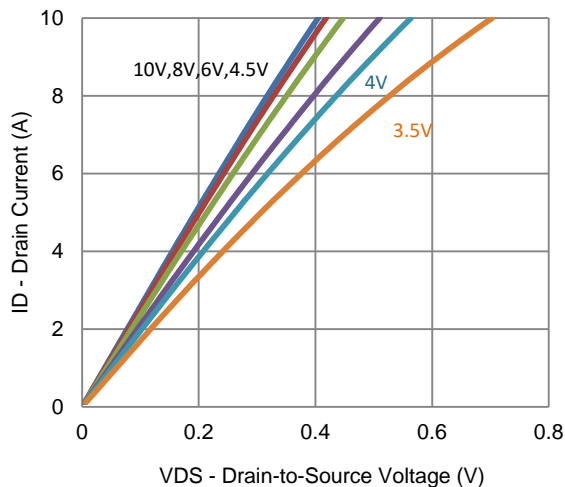
2. Transfer Characteristics



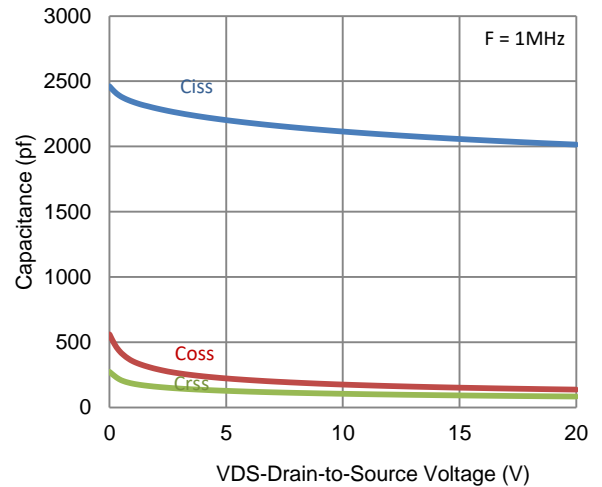
3. On-Resistance vs. Gate-to-Source Voltage



4. Drain-to-Source Forward Voltage

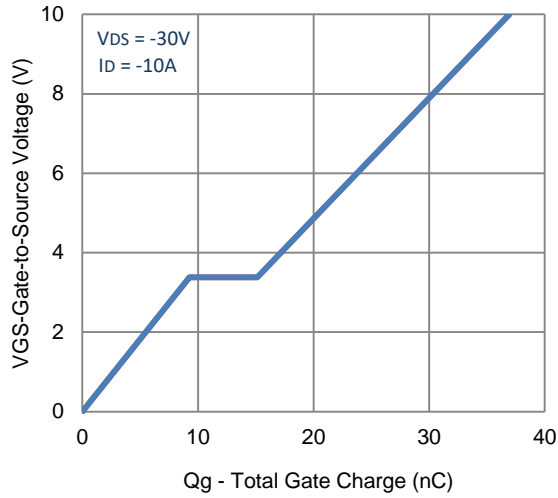


5. Output Characteristics

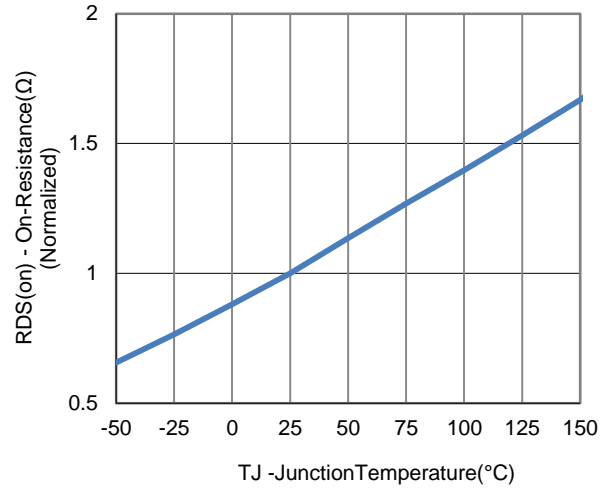


6. Capacitance

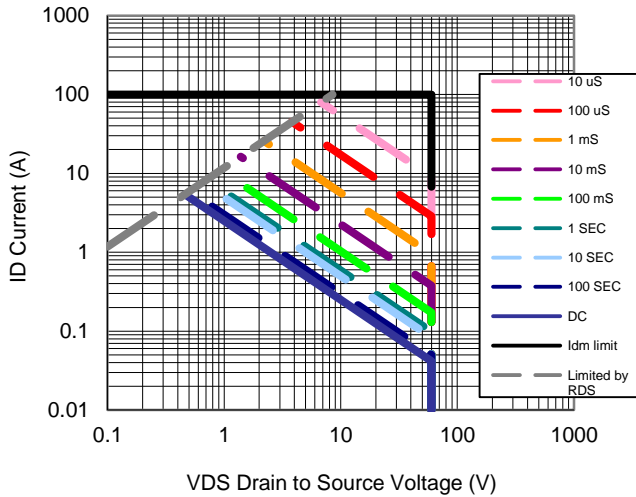
Typical Electrical Characteristics - P-channel



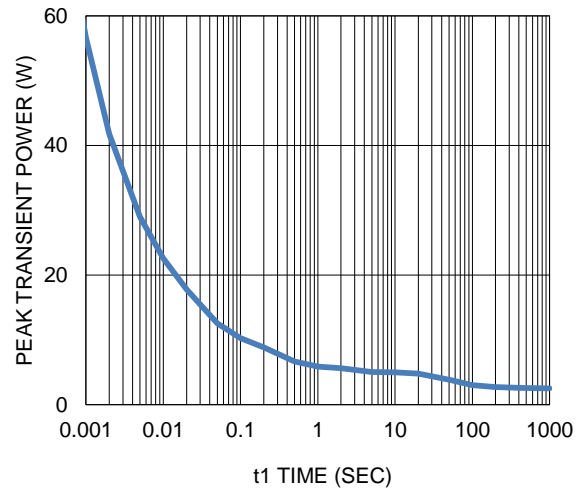
7. Gate Charge



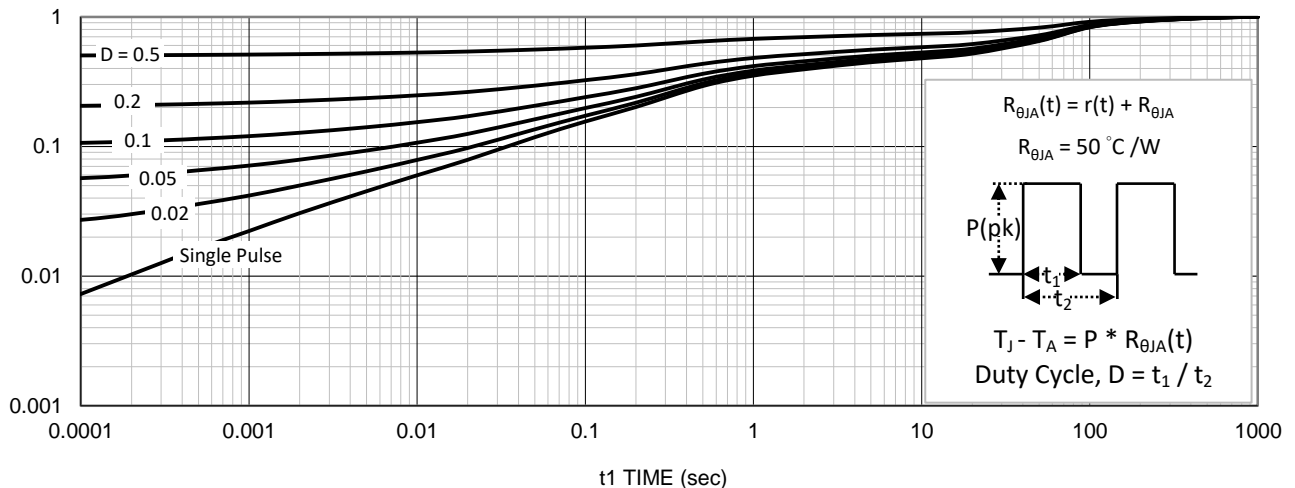
8. Normalized On-Resistance Vs Junction Temperature



9. Safe Operating Area

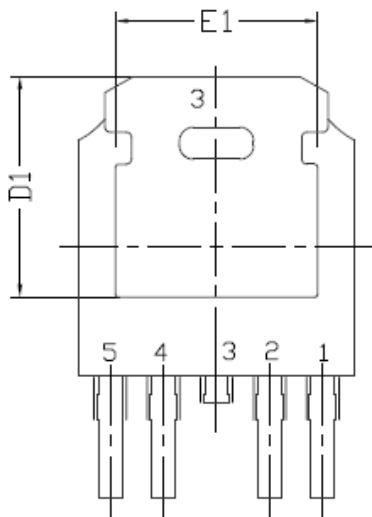
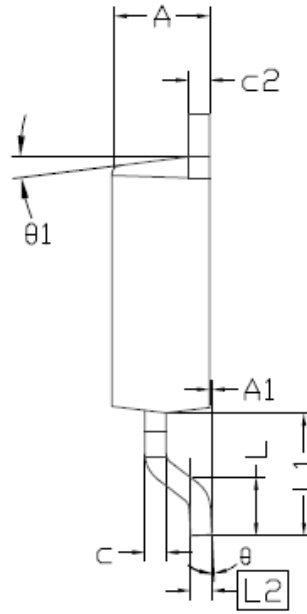
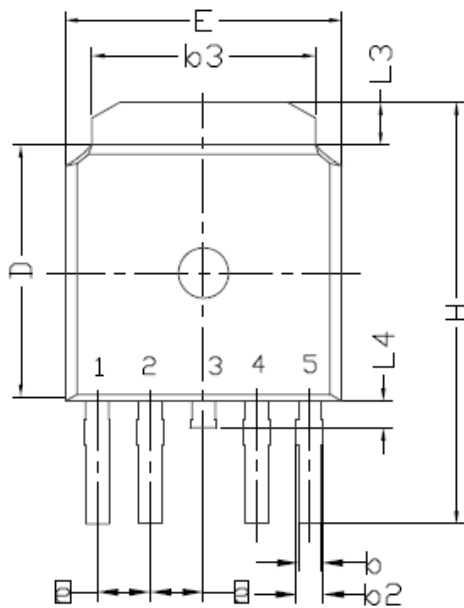


10. Single Pulse Maximum Power Dissipation



11. Normalized Thermal Transient Junction to Ambient

Package Information



SYMBOL	DIMENSIONAL REQMTS			INCHES REQMTS		
	MIN	NOM	MAX	MIN	NOM	MAX
E	6.35	6.60	6.73	0.250	0.260	0.265
L	1.40	1.52	1.77	0.055	0.060	0.070
L1	2.743 REF			0.108 REF		
L2	0.508 BSC			0.020 BSC		
L3	0.89	1.016	1.27	0.035	0.040	0.050
L4	0.64	--	1.01	0.025	--	0.040
D	6.00	6.10	6.20	0.236	0.240	0.244
H	9.40	10.00	10.40	0.370	0.394	0.409
b	0.508	0.56	0.711	0.020	0.022	0.028
b2	0.584	0.636	0.787	0.023	0.025	0.031
b3	5.21	5.34	5.46	0.205	0.210	0.215
e	1.27 BSC			0.050 BSC		
A	2.20	2.30	2.38	0.087	0.091	0.094
A1	0	--	0.127	0	--	0.005
c	0.457	0.50	0.60	0.018	0.020	0.024
c2	0.457	0.50	0.60	0.018	0.020	0.024
D1	5.21	--	--	0.205	--	--
E1	4.318	--	--	0.170	--	--
theta	0°	--	10°	0°	--	10°
theta1	0°	7°	15°	0°	7°	15°