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

Key Features:

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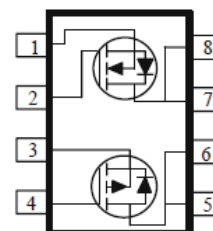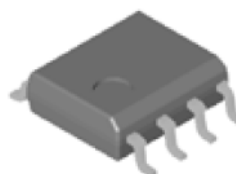
Typical Applications:

- White LED boost converters
- Automotive Systems
- Industrial DC/DC Conversion Circuits

PRODUCT SUMMARY		
V_{DS} (V)	$r_{DS(on)}$ (mΩ)	I_D(A)
60	35 @ V_{GS} = 10V	7.7
	50 @ V_{GS} = 4.5V	6.5
-60	57 @ V_{GS} = -10V	-5.0
	77 @ V_{GS} = -4.5V	-4.3

Pb-free

RoHS COMPLIANT

HALOGEN FREE

ABSOLUTE MAXIMUM RATINGS (T_A = 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}	±20	±20	
Continuous Drain Current [a]	T_A=25°C	I_D	7.7	-4.3	A
	T_A=70°C		6.5	-3.9	
Pulsed Drain Current [b]		I_{DM}	60	-60	
Continuous Source Current (Diode Conduction) [a]		I_S	3	-2.9	A
Power Dissipation [a]	T_A=25°C	P_D	2.1	2.1	W
	T_A=70°C		1.3	1.3	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to 150		°C

THERMAL RESISTANCE RATINGS				
Parameter		Symbol	Maximum	Units
Maximum Junction-to-Ambient [a]	t <= 10 sec	$R_{\theta JA}$	62.5	°C/W
	Steady State		110	

Notes

a.   Surface Mounted on 1" x 1" FR4 Board.
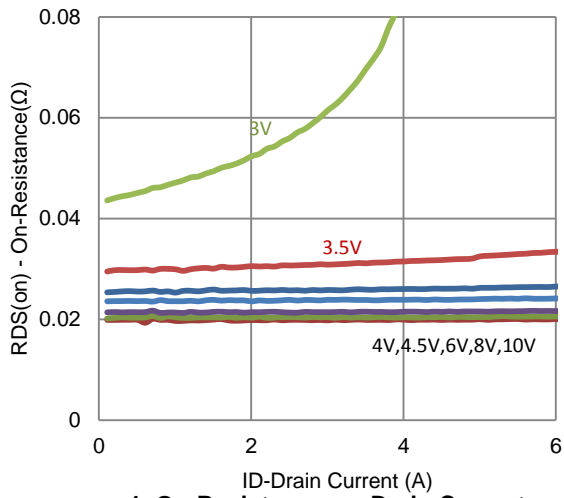
b.   Pulse width limited by maximum junction temperature

Electrical Characteristics

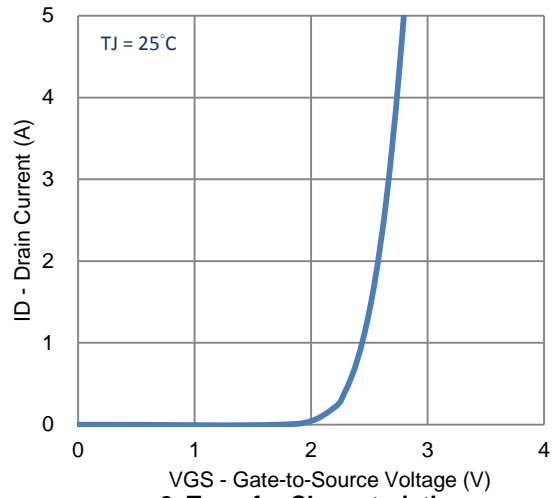| Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Static						
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = 250$ uA **(N-ch)**	1			V
		$V_{DS} = V_{GS}$, $I_D = -250$ uA **(P-ch)**	-1			V
Gate-Body Leakage	I_{GSS}	$V_{DS} = 0$ V, $V_{GS} = \pm20$ V			±100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 20$ V, $V_{GS} = 0$ V **(N-ch)**			1	uA
		$V_{DS} = -20$ V, $V_{GS} = 0$ V **(P-ch)**			-1	
On-State Drain Current [a]	$I_{D(on)}$	$V_{DS} = 5$ V, $V_{GS} = 10$ V **(N-ch)**	10			A
		$V_{DS} = -5$ V, $V_{GS} = -10$ V **(P-ch)**	-10			A
Drain-Source On-Resistance [a]	$r_{DS(on)}$	$V_{GS} = 10$ V, $I_D = 5.4$ A **(N-ch)**			33	mΩ
		$V_{GS} = 4.5$ V, $I_D = 4.4$ A **(N-ch)**			50	
		$V_{GS} = -10$ V, $I_D = -5.2$ A **(P-ch)**			57	mΩ
		$V_{GS} = -4.5$ V, $I_D = -4.2$ A **(P-ch)**			77	
Forward Transconductance [a]	g_{fs}	$V_{DS} = 15$ V, $I_D = 5.4$ A **(N-ch)**		22		S
		$V_{DS} = -15$ V, $I_D = -5.2$ A **(P-ch)**		25		S
Diode Forward Voltage [a]	V_{SD}	$I_S = 1.5$ A, $V_{GS} = 0$ V **(N-ch)**		0.72		V
		$I_S = -1$ A, $V_{GS} = 0$ V **(P-ch)**		-0.77		V
Dynamic [b]						
Total Gate Charge	Q_g	N - Channel		5		nC
Gate-Source Charge	Q_{gs}	$V_{DS} = 30$ V, $V_{GS} = 4.5$ V,		3.9		
Gate-Drain Charge	Q_{gd}	$I_D = 5.4$ A		8.2		
Turn-On Delay Time	$t_{d(on)}$	N - Channel		8		ns
Rise Time	t_r	$V_{DD} = 30$ V, $R_L = 5.6$ Ω, $I_D = 5.4$ A,		9		
Turn-Off Delay Time	$t_{d(off)}$	$V_{GEN} = 10$ V, $R_{GEN} = 6$ Ω		49		
Fall Time	t_f			14		
Input Capacitance	C_{iss}	N - Channel		1465		pF
Output Capacitance	C_{oss}	$V_{DS} = 15$ V, $V_{GS} = 0$ V, f = 1 MHz		126		
Reverse Transfer Capacitance	C_{rss}			114		
Total Gate Charge	Q_g	P - Channel		20		nC
Gate-Source Charge	Q_{gs}	$V_{DS} = -30$ V, $V_{GS} = -4.5$ V,		5.6		
Gate-Drain Charge	Q_{gd}	$I_D = -5.2$ A		7.9		
Turn-On Delay Time	$t_{d(on)}$	P - Channel		6		ns
Rise Time	t_r	$V_{DD} = -30$ V, $R_L = 5.8$ Ω,		13		
Turn-Off Delay Time	$t_{d(off)}$	$I_D = -5.2$ A,		71		
Fall Time	t_f	$V_{GEN} = -10$ V, $R_{GEN} = 6$ Ω		27		
Input Capacitance	C_{iss}	P - Channel		1817		pF
Output Capacitance	C_{oss}	$V_{DS} = -15$ V, $V_{GS} = 0$ V, f = 1 MHz		129		
Reverse Transfer Capacitance	C_{rss}			111		

Notes

a. Pulse test: PW <= 300us duty cycle <= 2%.

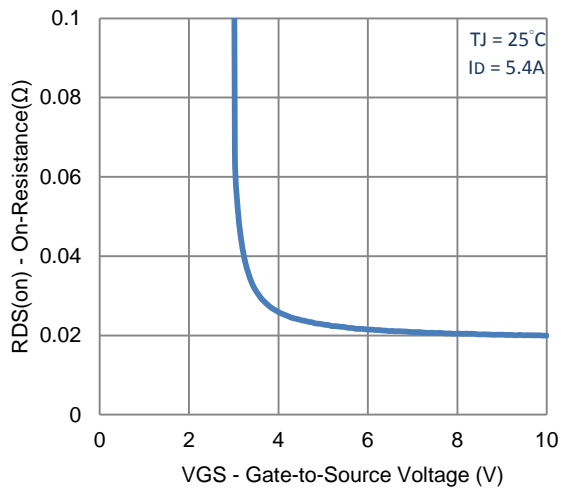b. Guaranteed by design, not subject to production testing.
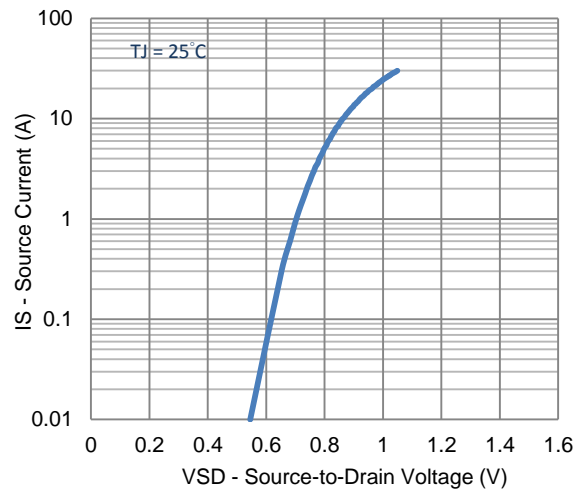
Typical Electrical Characteristics - N-channel

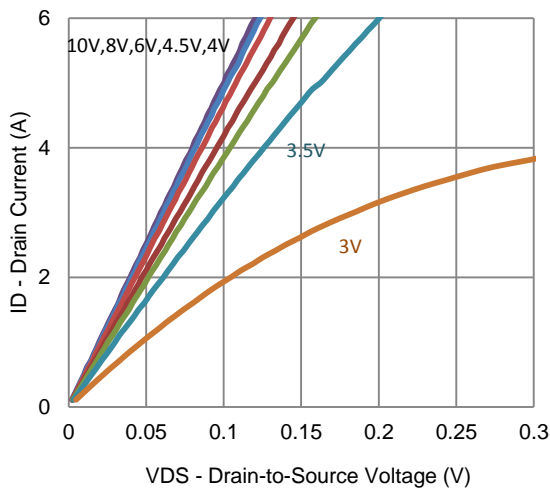**1. On-Resistance vs. Drain Current**
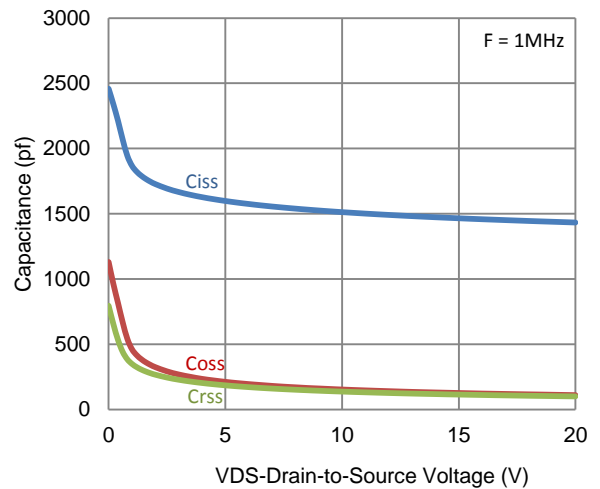

2. Transfer Characteristics

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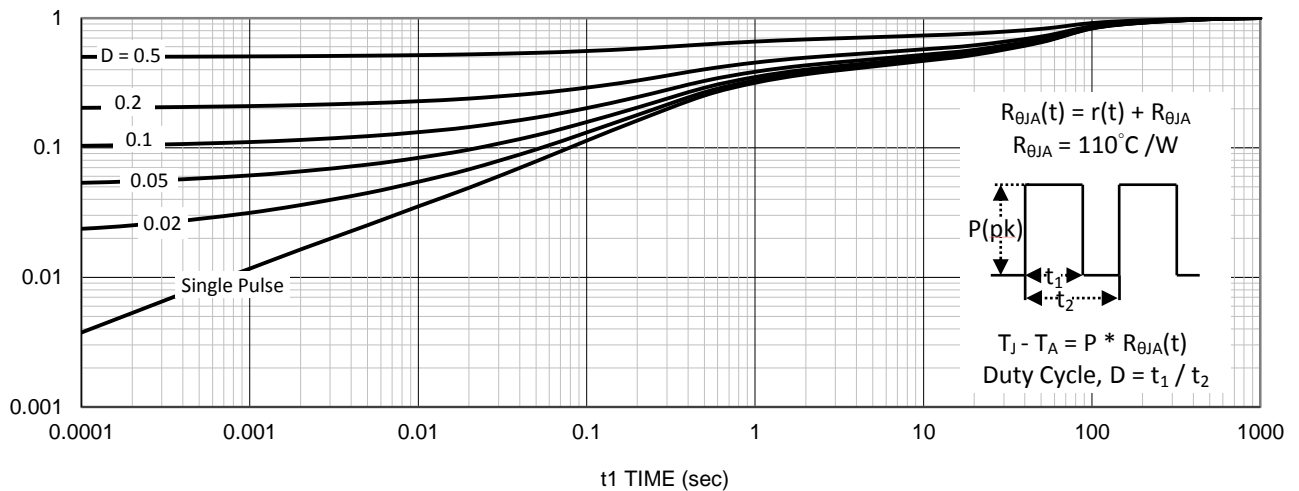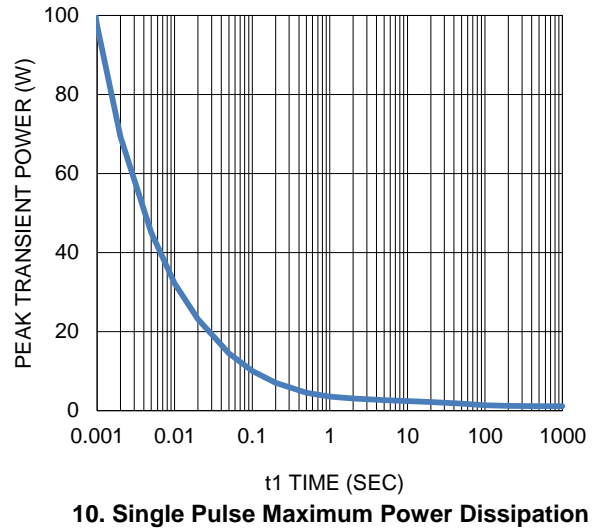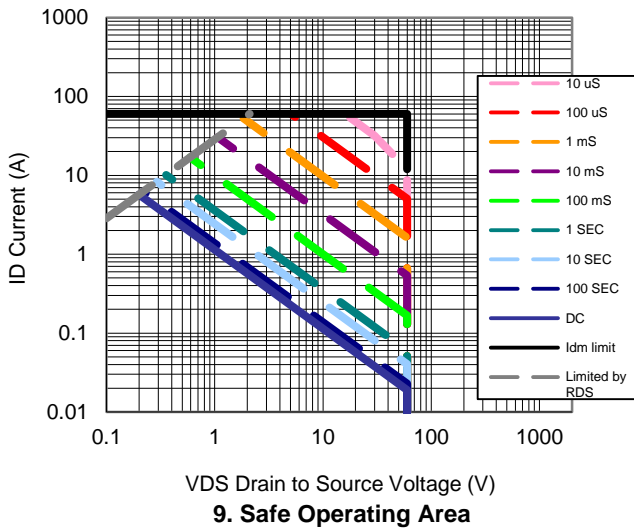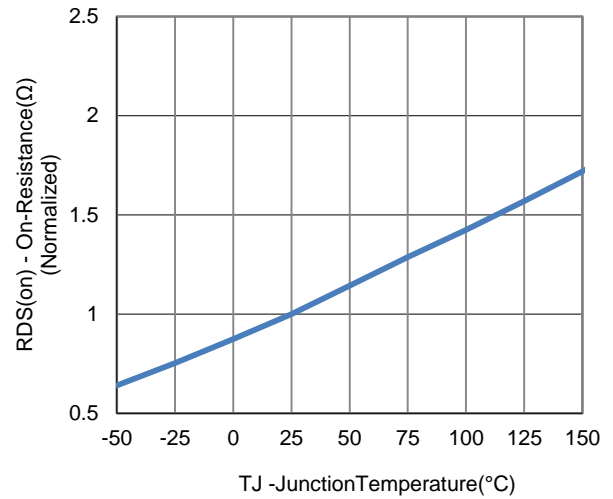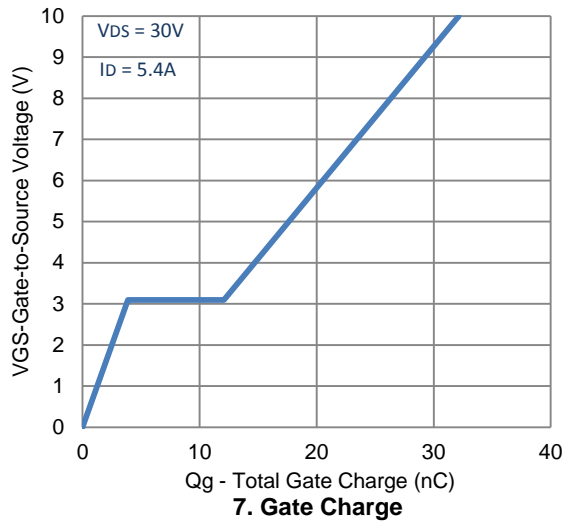

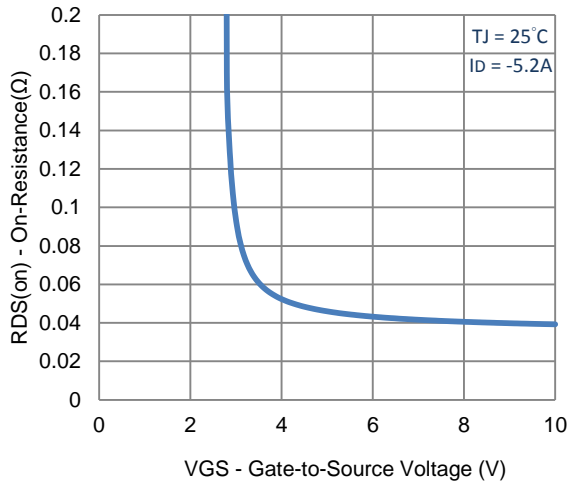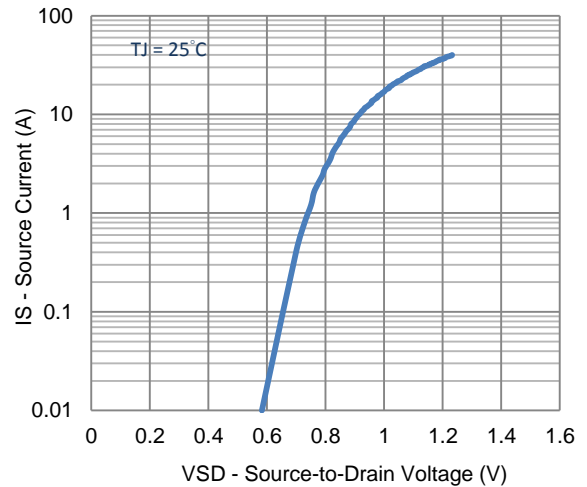**4. Drain-to-Source Forward Voltage**

5. Output Characteristics

6. Capacitance

Typical Electrical Characteristics - N-channel

VDS = 30V

ID = 5.4A

7. Gate Charge

VGS-Gate-to-Source Voltage (V) vs Qg - Total Gate Charge (nC)

8. Normalized On-Resistance Vs Junction Temperature

RDS(on) - On-Resistance(Ω) (Normalized) vs TJ -JunctionTemperature(°C)

9. Safe Operating Area

ID Current (A) vs VDS Drain to Source Voltage (V)

- 10 uS
- 100 uS
- 1 mS
- 10 mS
- 100 mS
- 1 SEC
- 10 SEC
- 100 SEC
- DC
- Idm limit
- Limited by RDS

10. Single Pulse Maximum Power Dissipation

PEAK TRANSIENT POWER (W) vs t1 TIME (SEC)

$R_{\theta JA}(t) = r(t) + R_{\theta JA}$

$R_{\theta JA} = 110^{\circ}C/W$

D = 0.5
0.2
0.1
0.05
0.02
Single Pulse

P(pk)

t_1
t_2

$T_J - T_A = P * R_{\theta JA}(t)$

Duty Cycle, D = t_1 / t_2

t1 TIME (sec)
11. Normalized Thermal Transient Junction to Ambient

Typical Electrical Characteristics - P-channel

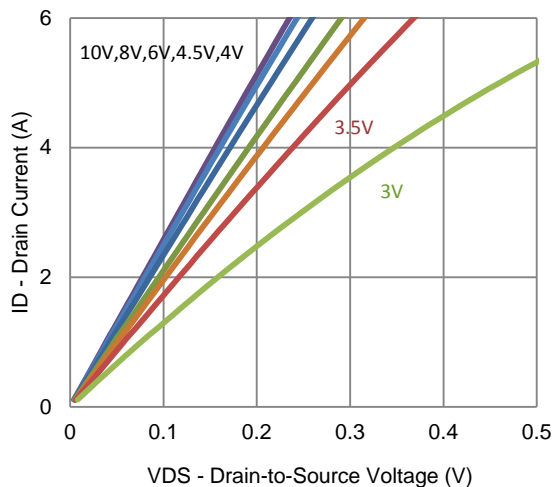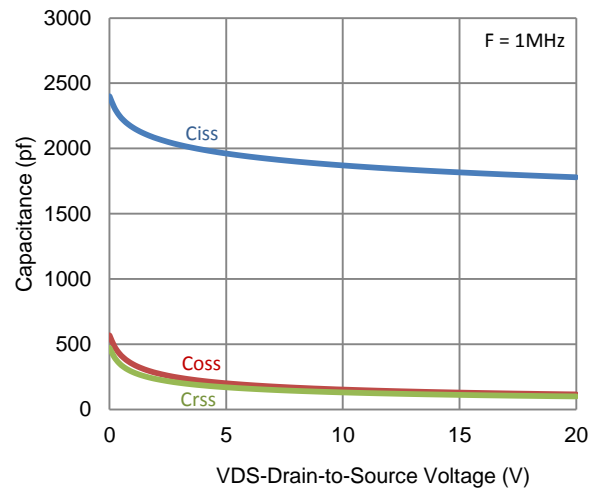**1. On-Resistance vs. Drain Current**

2. Transfer Characteristics

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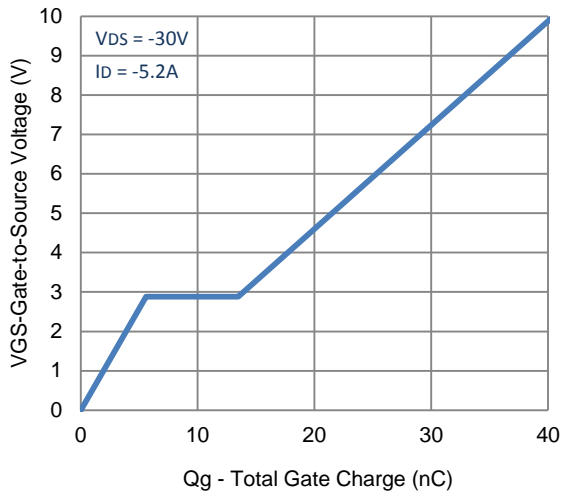

4. Drain-to-Source Forward Voltage
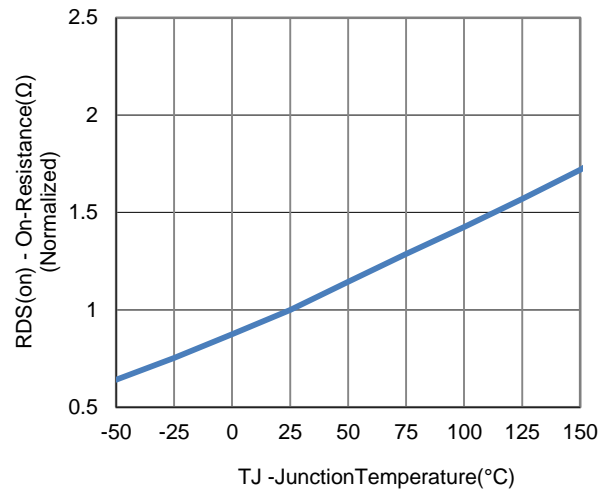

5. Output Characteristics

6. Capacitance

Typical Electrical Characteristics - P-channel
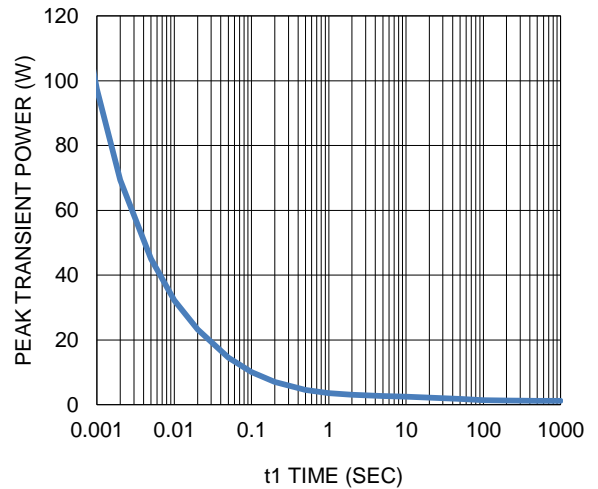

7. Gate Charge

VDS = -30V
ID = -5.2A

8. Normalized On-Resistance Vs Junction Temperature

9. Safe Operating Area

Legend:
- 10 uS
- 100 uS
- 1 mS
- 10 mS
- 100 mS
- 1 SEC
- 10 SEC
- 100 SEC
- DC
- Idm limit
- Limited by RDS

10. Single Pulse Maximum Power Dissipation

$R_{\theta JA}(t) = r(t) + R_{\theta JA}$
$R_{\theta JA} = 110^{\circ}C /W$

$T_J - T_A = P * R_{\theta JA}(t)$
Duty Cycle, $D = t_1 / t_2$
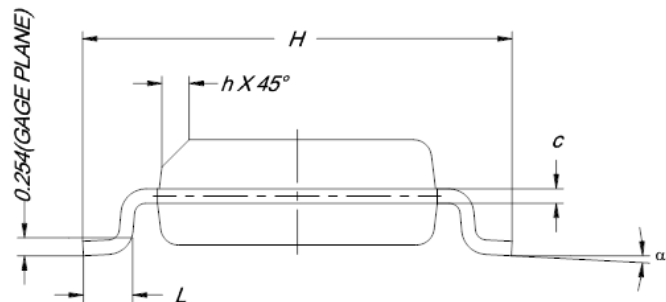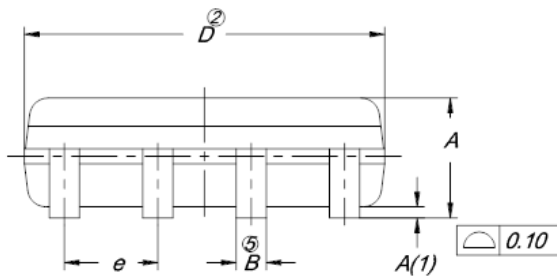
11. Normalized Thermal Transient Junction to Ambient

Package Information

Land Pattern
(Only for Reference)

DIM.	MILLIMETERS		
	MIN.	NOM.	MAX.
A	1.35	1.55	1.75
A(1)	0.10	0.18	0.25
B	0.38	0.45	0.51
C	0.19	0.22	0.25
D	4.80	4.90	5.00
E	3.80	3.90	4.00
e	1.27 BSC		
H	5.80	6.00	6.20
L	0.50	0.72	0.93
α	0°	4°	8°
h	0.25	0.38	0.50

Note:
1. All Dimension Are In mm.
2. Package Body Sizes Exclude Mold Flash, Protrusion Or Gate Burrs. Mold Flash, Protrusion Or Gate Burrs Shall Not Exceed 0.10 mm Per Side.
3. Package Body Sizes Determined At The Outermost Extremes Of The Plastic Body Exclusive Of Mold Flash, Tie Bar Burrs, Gate Burrs And Interlead Flash, But Including Any Mismatch Between The Top And Bottom Of The Plastic Body.
4. The Package Top May Be Smaller Than The Package Bottom.
5. Dimension "B" Does Not Include Dambar Protrusion. Allowable Dambar Protrusion Shall Be 0.08 mm Total In Excess Of "B" Dimension At Maximum Material Condition. The Dambar Cannot Be Located On The Lower Radius Of The Foot.