Dual Enhancement Mode MOSFET (N-and P-Channel)

Features

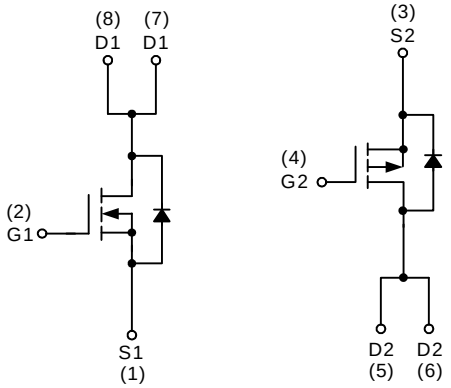
- N-Channel
  60V/5A,
  $R_{DS(ON)}$ = 38mΩ (typ.) @ V_{GS} = 10V
  $R_{DS(ON)}$ = 55mΩ (typ.) @ V_{GS} = 4.5V
- P-Channel
  -60V/-3.5A,
  $R_{DS(ON)}$ = 80mΩ (typ.) @ V_{GS} =-10V
  $R_{DS(ON)}$ = 100mΩ (typ.) @ V_{GS} =-4.5V
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free Available (RoHS Compliant)

Applications

- Power Management in FAN, LCD Inverter Systems

Pin Description

Top View of SOP – 8



N-Channel MOSFET P-Channel MOSFET

Ordering and Marking Information

APM4588 □□-□□ □

- Lead Free Code
- Handling Code
- Temp. Range
- Package Code

Package Code
K : SOP-8
Operating Junction Temp. Range
C : -55 to 150°C
Handling Code
TU : Tube TR : Tape & Reel
Lead Free Code
L : Lead Free Device Blank : Original Device

APM4588 K : APM4588 XXXXX

XXXXX - Date Code

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS and compatible with both SnPb and lead-free soldiering operations. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J STD-020C for MSL classification at lead-free peak reflow temperature.

Absolute Maximum Ratings (T_A = 25°C unless otherwise noted)

Symbol	Parameter		N Channel	P Channel	Unit
V_{DSS}	Drain-Source Voltage		60	-60	V
V_{GSS}	Gate-Source Voltage		±25	±25	
I_D*	Continuous Drain Current	V_{GS}=10V (N)	5	-3.5	A
I_{DM}*	Pulsed Drain Current	V_{GS}=-10V (P)	20	-14	
I_S*	Diode Continuous Forward Current		2.5	-2.5	A
T_J	Maximum Junction Temperature		150		°C
T_{STG}	Storage Temperature Range		-55 to 150		
P_D*	Power Dissipation	T_A=25°C	2		W
		T_A=100°C	0.8		
$R_{\theta JA}$*	Thermal Resistance-Junction to Ambient		62.5		°C/W

Note:

*Surface Mounted on 1in^2 pad area, t ≤ 10sec.

Electrical Characteristics (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition		APM4588K Min.	APM4588K Typ.	APM4588K Max.	Unit
Static Characteristics							
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_{DS}=250µA	N-Ch	60			V
		V_{GS}=0V, I_{DS}=-250µA	P-Ch	-60			
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=48V, V_{GS}=0V	N-Ch			1	µA
		T_J=85°C				30	
		V_{DS}=-48V, V_{GS}=0V	P-Ch			-1	
		T_J=85°C				-30	
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_{DS}=250µA	N-Ch	1	2	2.5	V
		V_{DS}=V_{GS}, I_{DS}=-250µA	P-Ch	-1	-2	-2.5	
I_{GSS}	Gate Leakage Current	V_{GS}=±25V, V_{DS}=0V	N-Ch			±100	nA
		V_{GS}=±25V, V_{DS}=0V	P-Ch			±100	
$R_{DS(ON)}$ [a]	Drain-Source On-State Resistance	V_{GS}=10V, I_{DS}=5A	N-Ch		38	52	mΩ
		V_{GS}=-10V, I_{DS}=-3.5A	P-Ch		80	100	
		V_{GS}=4.5V, I_{DS}=4A	N-Ch		55	75	
		V_{GS}=-4.5V, I_{DS}=-3.1A	P-Ch		100	135	

Electrical Characteristics (Cont.) (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition		APM4588K			Unit
				Min.	Typ.	Max.	
Diode Characteristics							
V_{SD} [a]	Diode Forward Voltage	I_{SD}=2.5A, V_{GS}=0V	N-Ch		0.8	1.1	V
		I_{SD}=-2.5A, V_{GS}=0V	P-Ch		-0.8	-1.1	
Dynamic Characteristics [b]							
R_G	Gate Resistance	V_{GS}=0V,V_{DS}=0V,F=1MHz	N-Ch		1.6		Ω
			P-Ch		8		
C_{iss}	Input Capacitance	N-Channel V_{GS}=0V, V_{DS}=30V, Frequency=1.0MHz	N-Ch		915		pF
			P-Ch		1050		
C_{oss}	Output Capacitance		N-Ch		70		
		P-Channel V_{GS}=0V, V_{DS}=-30V, Frequency=1.0MHz	P-Ch		70		
C_{rss}	Reverse Transfer Capacitance		N-Ch		45		
			P-Ch		50		
$t_{d(ON)}$	Turn-on Delay Time	N-Channel V_{DD}=30V, R_L=30Ω, I_{DS}=1A, V_{GEN}=10V, R_G=6Ω	N-Ch		9	17	ns
			P-Ch		7	14	
T_r	Turn-on Rise Time		N-Ch		6	12	
			P-Ch		8	15	
$t_{d(OFF)}$	Turn-off Delay Time	P-Channel V_{DD}=-30V, R_L=30Ω, I_{DS}=-1A, V_{GEN}=-10V, R_G=6Ω	N-Ch		25	46	
			P-Ch		47	86	
T_f	Turn-off Fall Time		N-Ch		5	10	
			P-Ch		17	32	
t_{rr}	Reverse Recovery Time	N-Channel I_{SD}=5A, dI_{SD}/dt =100A/µs	N-Ch		27		ns
			P-Ch		27		
Q_{rr}	Reverse Recovery Charge	P-Channel I_{SD}=-3.5A, dI_{SD}/dt =100A/µs	N-Ch		30		nC
			P-Ch		30		
Gate Charge Characteristics [b]							
Q_g	Total Gate Charge	N-Channel V_{DS}=30V, V_{GS}=10V, I_{DS}=5A	N-Ch		19	27	nC
			P-Ch		22	31	
Q_{gs}	Gate-Source Charge		N-Ch		4.4		
		P-Channel V_{DS}=-30V, V_{GS}=-10V, I_{DS}=-3.5A	P-Ch		2.8		
Q_{gd}	Gate-Drain Charge		N-Ch		4.4		
			P-Ch		5		

Notes:

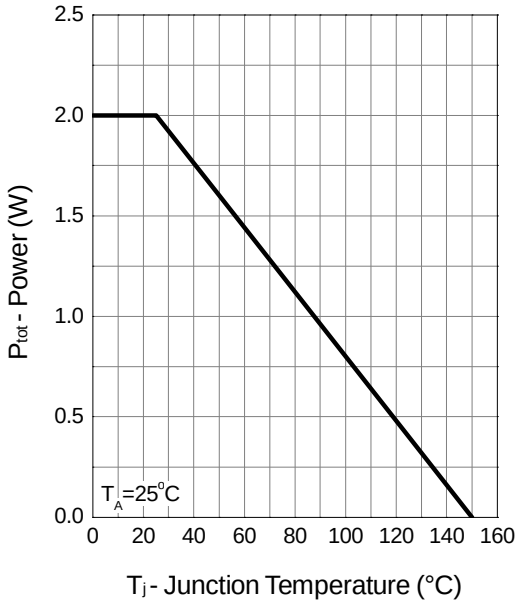
a : Pulse test ; pulse width≤300ms, duty cycle≤2%.

b : Guaranteed by design, not subject to production testing.

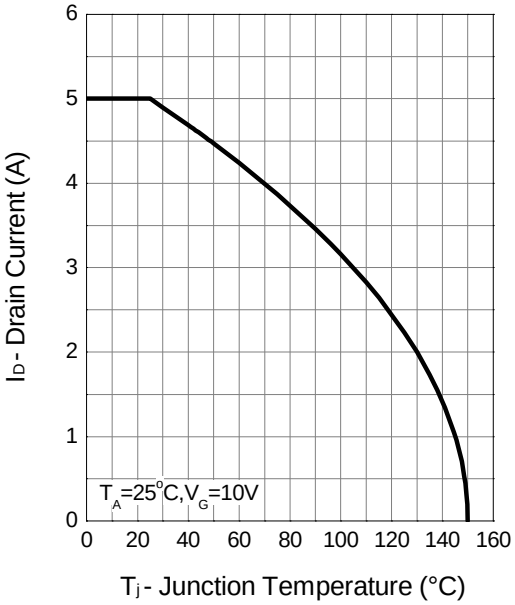
Typical Characteristics

N-Channel

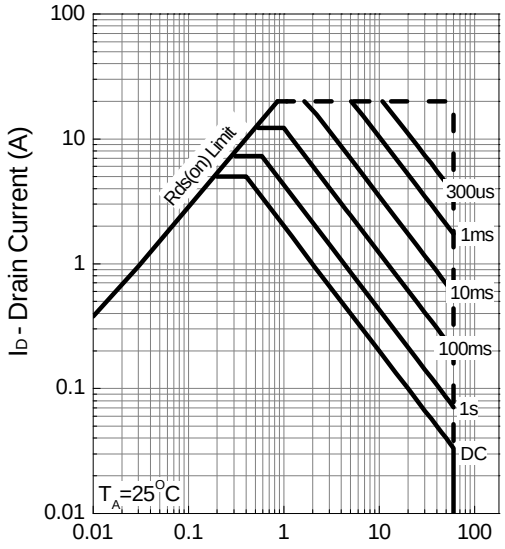
Power Dissipation



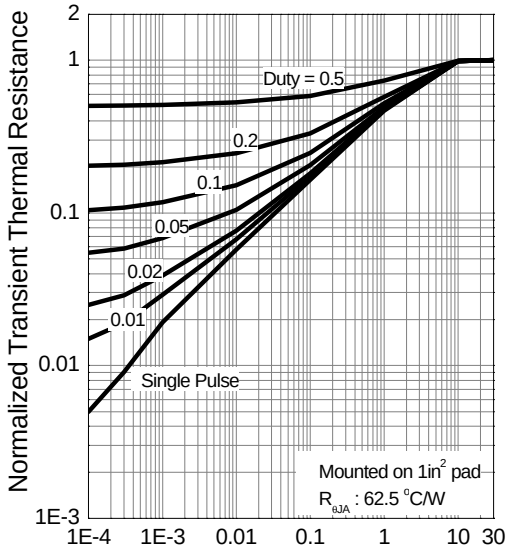
Drain Current



Safe Operation Area



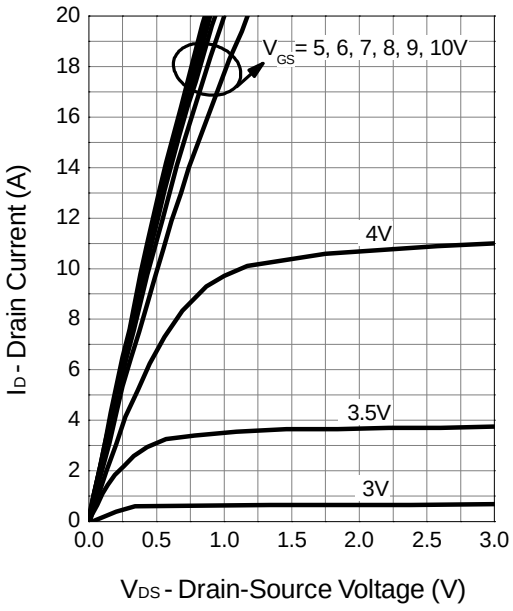
Thermal Transient Impedance



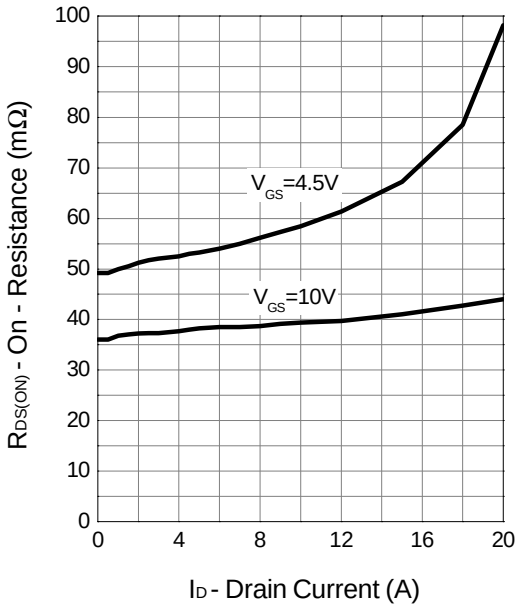
Typical Characteristics (Cont.)

N-Channel

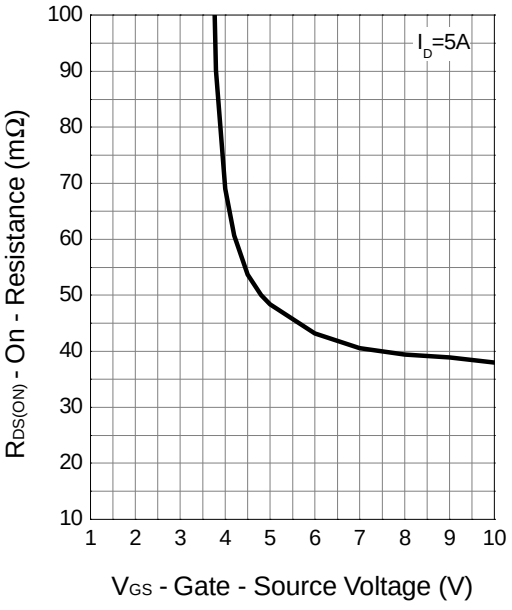
Output Characteristics



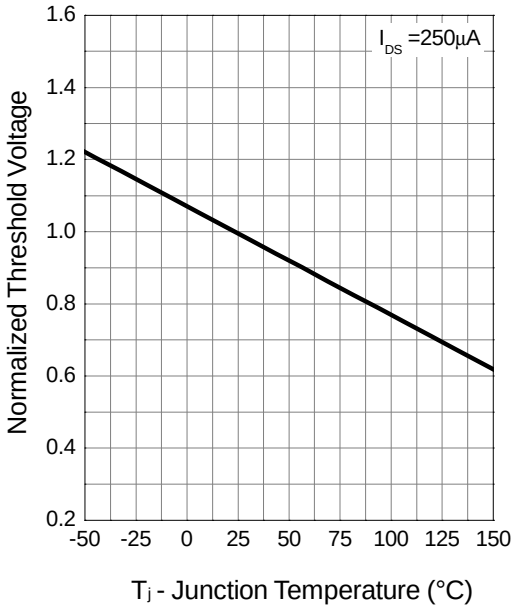
Drain-Source On Resistance



Drain-Source On Resistance



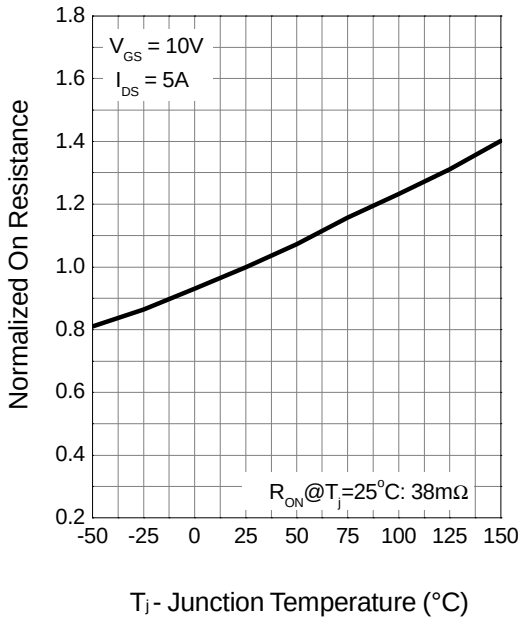
Gate Threshold Voltage



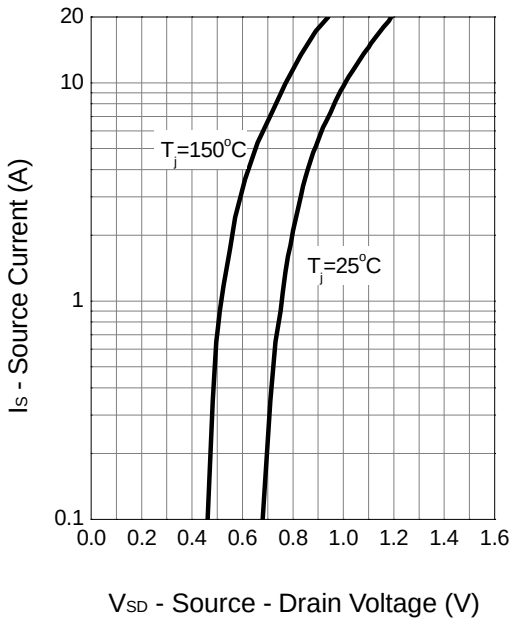
Typical Characteristics (Cont.)

N-Channel

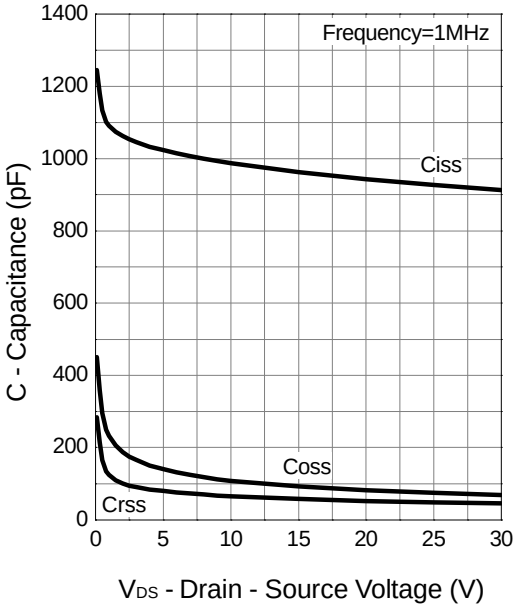
Drain-Source On Resistance



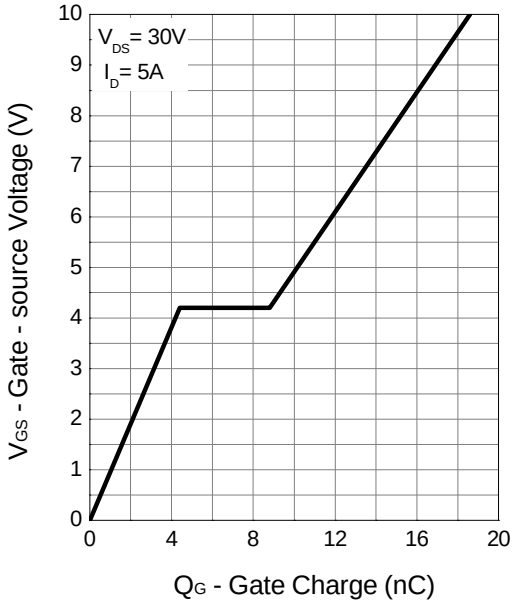
Source-Drain Diode Forward



Capacitance



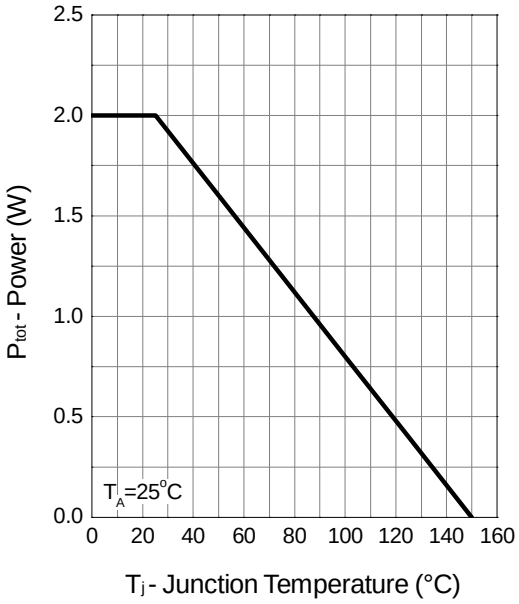
Gate Charge



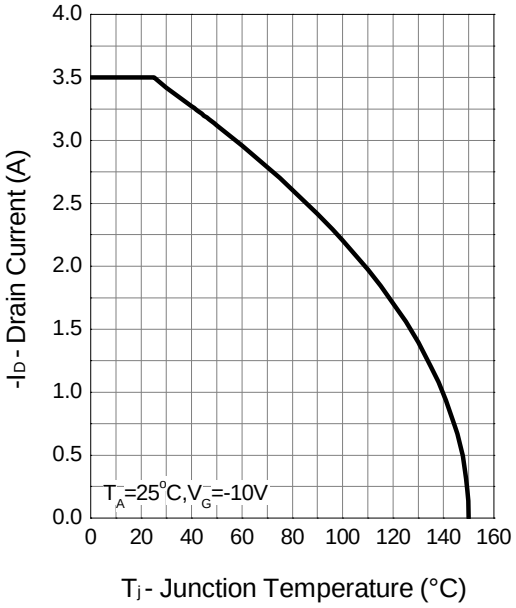
Typical Characteristics (Cont.)

P-Channel

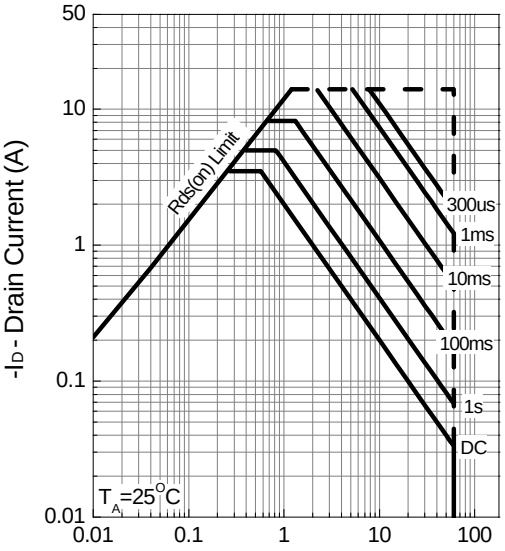
Power Dissipation



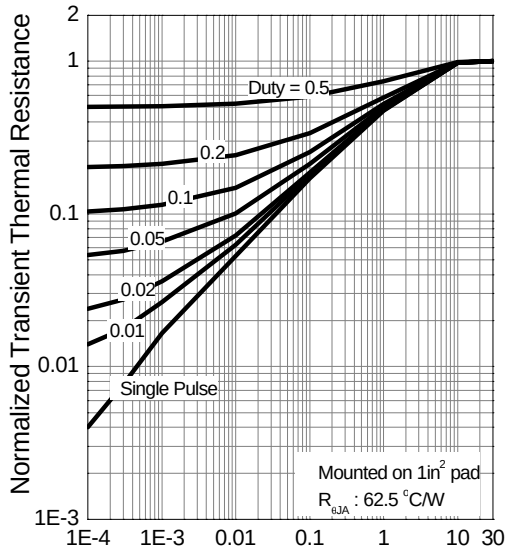
Drain Current



Safe Operation Area



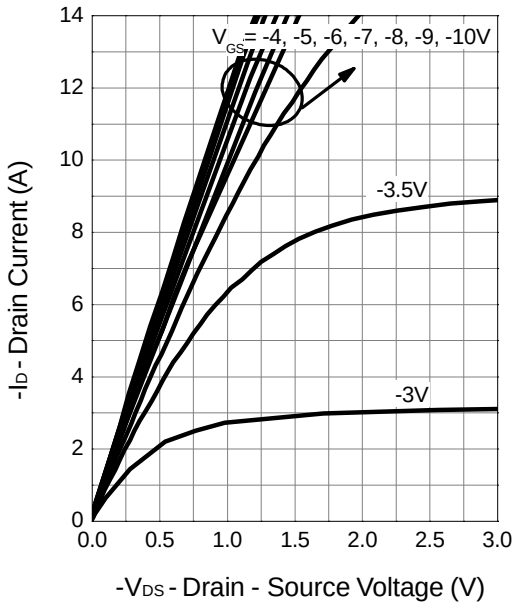
Thermal Transient Impedance



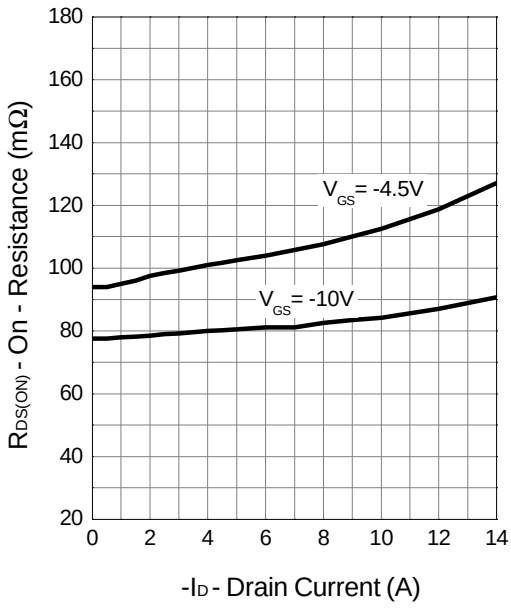
Typical Characteristics (Cont.)

P-Channel

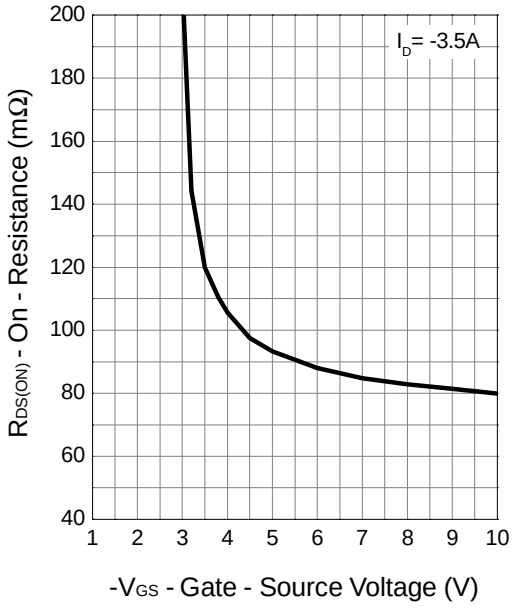
Output Characteristics



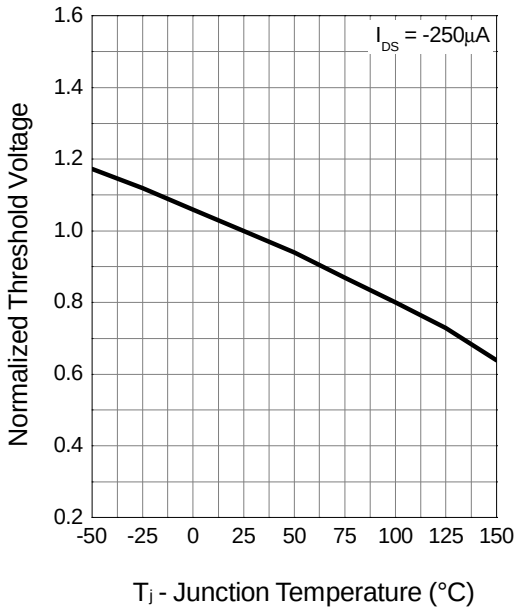
Drain-Source On Resistance



Drain-Source On Resistance



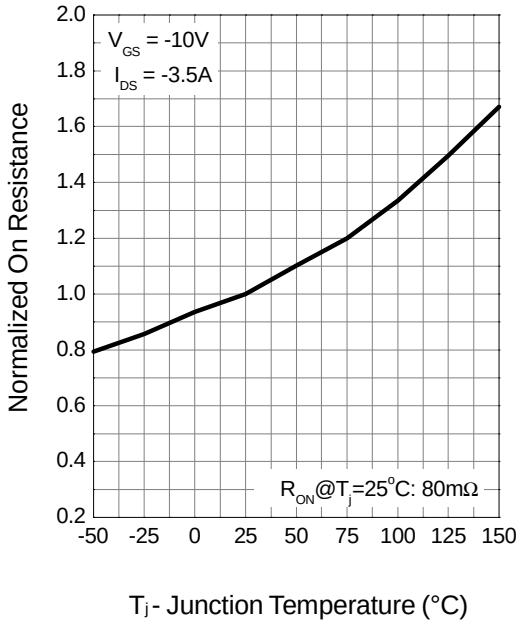
Gate Threshold Voltage



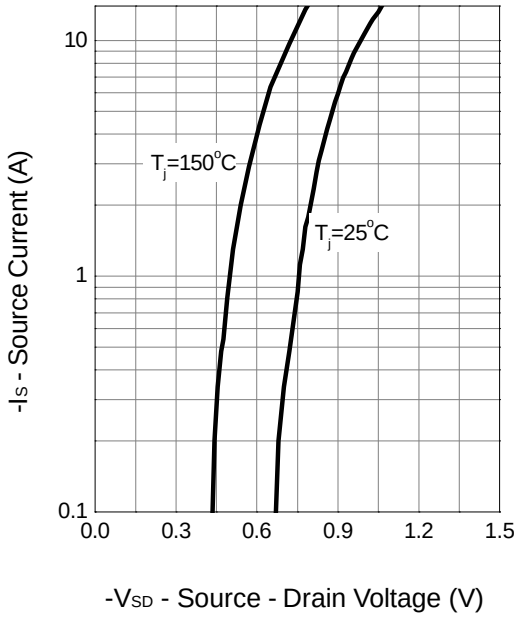
Typical Characteristics (Cont.)

P-Channel

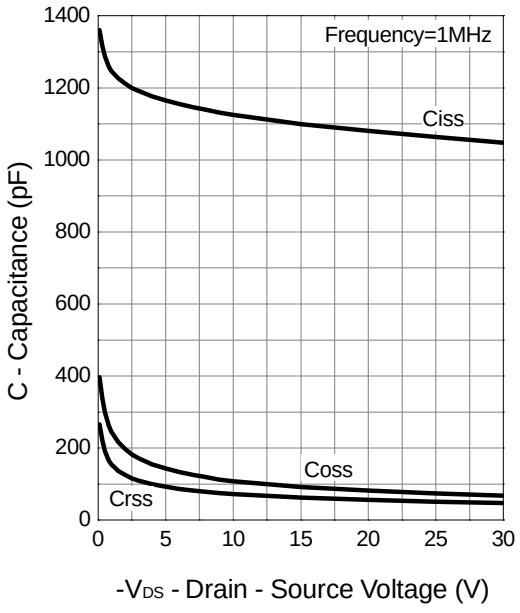
Drain-Source On Resistance



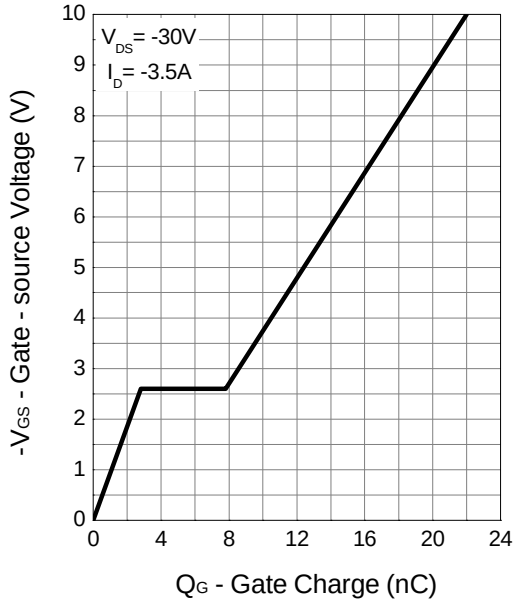
Source-Drain Diode Forward



Capacitance

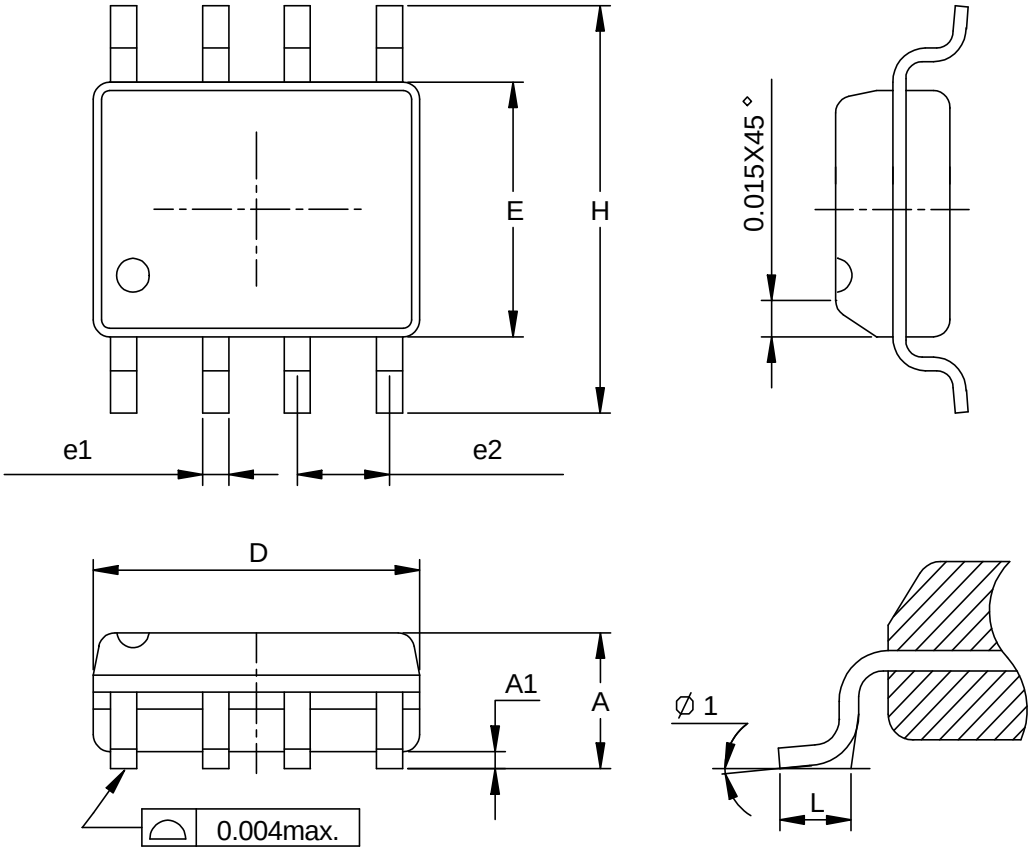


Gate Charge



Packaging Information

SOP-8 pin (Reference JEDEC Registration MS-012)

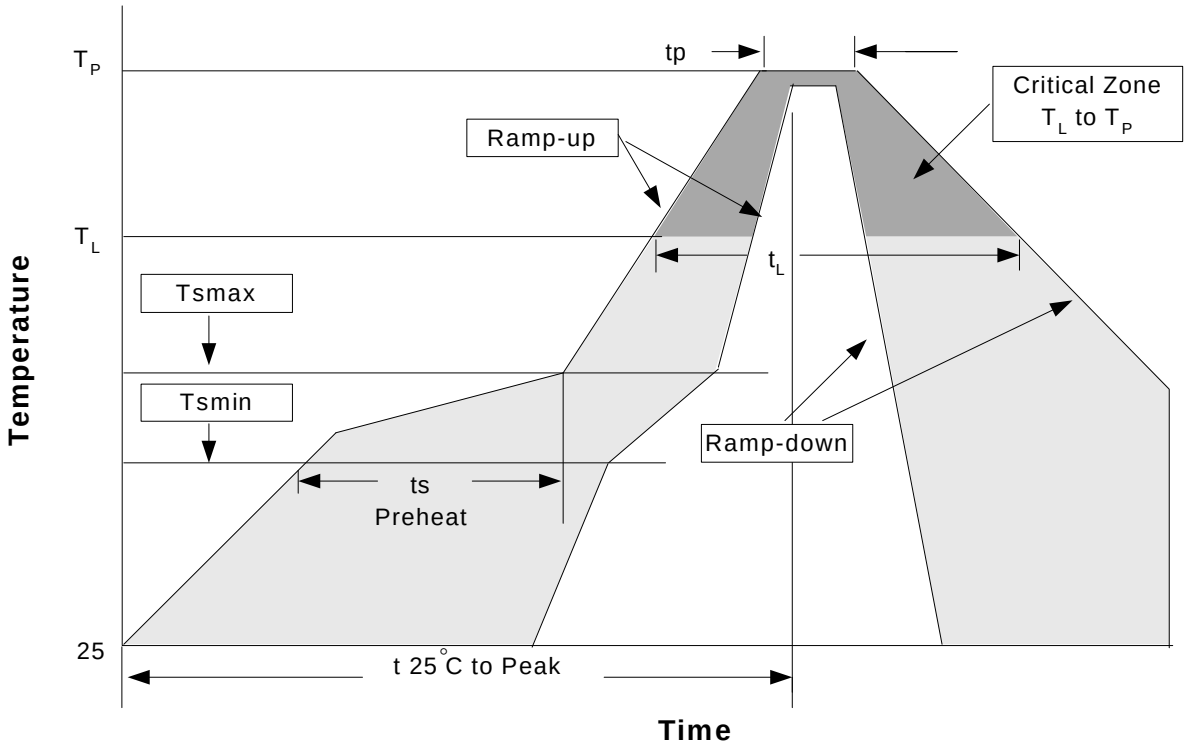


Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
D	4.80	5.00	0.189	0.197
E	3.80	4.00	0.150	0.157
H	5.80	6.20	0.228	0.244
L	0.40	1.27	0.016	0.050
e1	0.33	0.51	0.013	0.020
e2	1.27BSC		0.50BSC	
ϕ 1	0°	8°	0°	8°

Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb), 100%Sn
Lead Solderability	Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.

Reflow Condition (IR/Convection or VPR Reflow)



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	3°C/second max.	3°C/second max.
Preheat - Temperature Min (Tsmin) - Temperature Max (Tsmax) - Time (min to max) (ts)	100°C 150°C 60-120 seconds	150°C 200°C 60-180 seconds
Time maintained above: - Temperature (T_L) - Time (t_L)	183°C 60-150 seconds	217°C 60-150 seconds
Peak/Classificatioon Temperature (Tp)	See table 1	See table 2
Time within 5°C of actual Peak Temperature (tp)	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max.	6°C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

Notes: All temperatures refer to topside of the package .Measured on the body surface.

Classification Reflow Profiles(Cont.)

Table 1. SnPb Entectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 ³350
<2.5 mm	240 +0/-5°C	225 +0/-5°C
≥2.5 mm	225 +0/-5°C	225 +0/-5°C

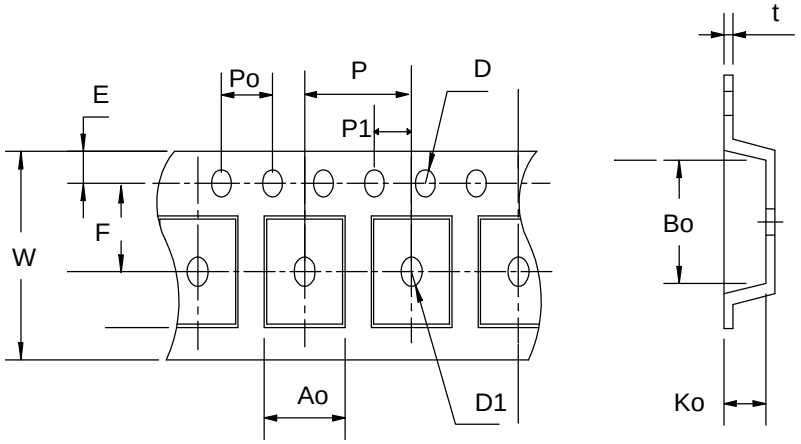
Table 2. Pb-free Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 350-2000	Volume mm^3 >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*
*Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0°C. For example 260°C+0°C) at the rated MSL level.			

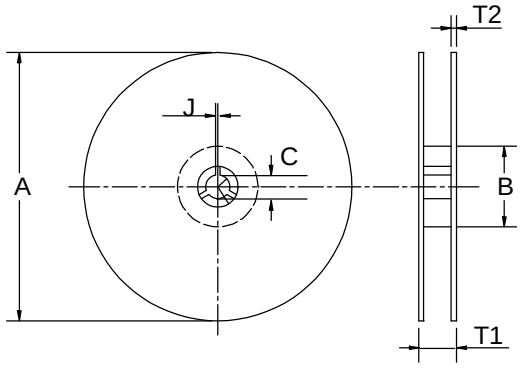
Reliability Test Program

Test item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245°C,5 SEC
HOLT	MIL-STD 883D-1005.7	1000 Hrs Bias @ 125°C
PCT	JESD-22-B, A102	168 Hrs, 100% RH, 121°C
TST	MIL-STD 883D-1011.9	-65°C ~ 150°C, 200 Cycles

Carrier Tape & Reel Dimensions



Carrier Tape & Reel Dimensions(Cont.)



Application	A	B	C	J	T1	T2	W	P	E
SOP-8	330±1	62 ± 1.5	12.75 + 0.1 5	2 + 0.5	12.4 +0.2	2± 0.2	12 + 0.3 - 0.1	8± 0.1	1.75± 0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	5.5 ± 0.1	1.55±0.1	1.55+ 0.25	4.0 ± 0.1	2.0 ± 0.1	6.4 ± 0.1	5.2± 0.1	2.1± 0.1	0.3±0.013

(mm)

Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOP- 8	12	9.3	2500

Customer Service

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Fax : 886-2-89191369