

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

Symbol	Parameter	N Channel	P Channel	Unit	
V_{DSS}	Drain-Source Voltage	40	-40	V	
V_{GSS}	Gate-Source Voltage	± 20	± 20		
I_D^a	Continuous Drain Current	$T_C=25^\circ\text{C}$	20	-18	A
I_{DM}^a	Pulsed Drain Current	$T_C=25^\circ\text{C}$	40	-40	
I_S^a	Diode Continuous Forward Current	$T_C=25^\circ\text{C}$	20	-18	A
T_J	Maximum Junction Temperature	150		$^\circ\text{C}$	
T_{STG}	Storage Temperature Range	-55 to 150			
P_D	Power Dissipation	$T_C=25^\circ\text{C}$	25		W
		$T_C=100^\circ\text{C}$	10		
$R_{\theta JC}$	Thermal Resistance-Junction to Case	5		$^\circ\text{C/W}$	
$R_{\theta JA}^a$	Thermal Resistance-Junction to Ambient	50			

Notes:

a : Surface Mounted on 1in^2 pad area, $t \leq 10\text{sec}$.

Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Condition	APM4052DU			Unit	
			Min.	Typ.	Max.		
Static Characteristics							
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0\text{V}, I_{DS}=250\mu\text{A}$	N-Ch	40		V	
		$V_{GS}=0\text{V}, I_{DS}=-250\mu\text{A}$	P-Ch	-40			
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=32\text{V}, V_{GS}=0\text{V}$ $T_J=85^\circ\text{C}$	N-Ch		1	μA	
					30		
		$V_{DS}=-32\text{V}, V_{GS}=0\text{V}$ $T_J=85^\circ\text{C}$	P-Ch		-1		
					-30		
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$	N-Ch	1.3	2	2.5	V
		$V_{DS}=V_{GS}, I_{DS}=-250\mu\text{A}$	P-Ch	-1.3	-2	-2.5	
I_{GSS}	Gate Leakage Current	$V_{GS}=\pm 20\text{V}, V_{DS}=0\text{V}$	N-Ch			± 100	nA
		$V_{GS}=\pm 20\text{V}, V_{DS}=0\text{V}$	P-Ch			± 100	
$R_{DS(ON)}^a$	Drain-Source On-State Resistance	$V_{GS}=10\text{V}, I_{DS}=7.5\text{A}$	N-Ch		30	38	m Ω
		$V_{GS}=-10\text{V}, I_{DS}=-6\text{A}$	P-Ch		40	50	
		$V_{GS}=5\text{V}, I_{DS}=5\text{A}$	N-Ch		46	62	
		$V_{GS}=-5\text{V}, I_{DS}=-3.5\text{A}$	P-Ch		52	73	

Electrical Characteristics (Cont.) ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Condition	APM4052DU			Unit	
			Min.	Typ.	Max.		
Diode Characteristics							
V_{SD}^a	Diode Forward Voltage	$I_{SD}=2A, V_{GS}=0V$	N-Ch		0.8	1.1	V
		$I_{SD}=-2A, V_{GS}=0V$	P-Ch		-0.8	-1.1	
t_{rr}	Reverse Recovery Time	N-Channel $I_{DS}=7.5A, dI_{SD}/dt=100A/\mu s$	N-Ch		21		ns
			P-Ch		17		
Q_{rr}	Reverse Recovery Charge	P-Channel $I_{DS}=-6A, dI_{SD}/dt=100A/\mu s$	N-Ch		16		nC
			P-Ch		10		
Gate Charge Characteristics^b							
Q_g	Total Gate Charge	N-Channel $V_{DS}=20V, V_{GS}=10V,$ $I_{DS}=7.5A$	N-Ch		10	14	nC
			P-Ch		17	24	
Q_{gs}	Gate-Source Charge	P-Channel $V_{DS}=-20V, V_{GS}=-10V,$ $I_{DS}=-6A$	N-Ch		1.7		
			P-Ch		2.2		
Q_{gd}	Gate-Drain Charge		N-Ch		3.2		
			P-Ch		4		
Dynamic Characteristics^b							
R_G	Gate Resistance	$V_{GS}=0V, V_{DS}=0V, F=1MHz$	N-Ch		2.2		Ω
			P-Ch		8		
C_{iss}	Input Capacitance	N-Channel $V_{GS}=0V,$ $V_{DS}=20V,$ Frequency=1.0MHz	N-Ch		480		pF
			P-Ch		970		
C_{oss}	Output Capacitance	P-Channel	N-Ch		70		
			P-Ch		100		
C_{rss}	Reverse Transfer Capacitance	$V_{GS}=0V,$ $V_{DS}=-20V,$ Frequency=1.0MHz	N-Ch		50		
			P-Ch		70		
$t_{d(ON)}$	Turn-on Delay Time	N-Channel $V_{DD}=20V, R_L=20\Omega,$ $I_{DS}=1A, V_{GEN}=10V,$ $R_G=6\Omega$	N-Ch		7	14	ns
			P-Ch		5	10	
t_r	Turn-on Rise Time		N-Ch		10	19	
			P-Ch		11	21	
$t_{d(OFF)}$	Turn-off Delay Time	P-Channel $V_{DD}=-20V, R_L=20\Omega,$ $I_{DS}=-1A, V_{GEN}=-10V,$ $R_G=6\Omega$	N-Ch		17	32	
			P-Ch		37	68	
t_f	Turn-off Fall Time		N-Ch		3	6	
			P-Ch		12	23	

Notes:

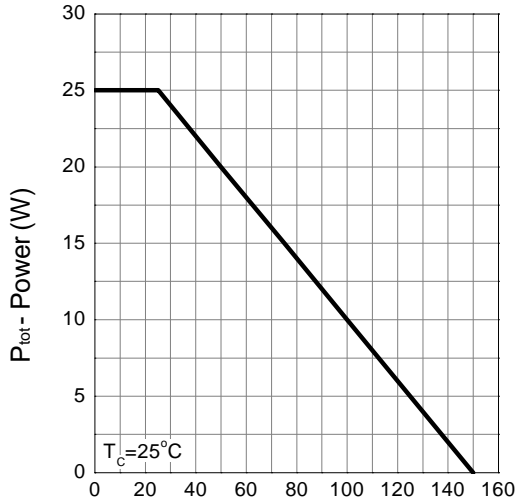
a : Pulse test ; pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.

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

Typical Characteristics

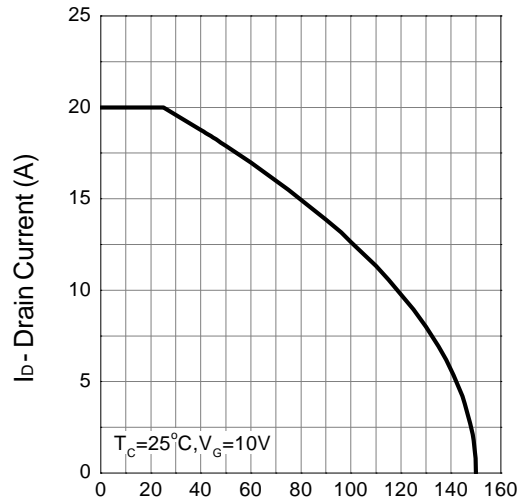
N-Channel

Power Dissipation



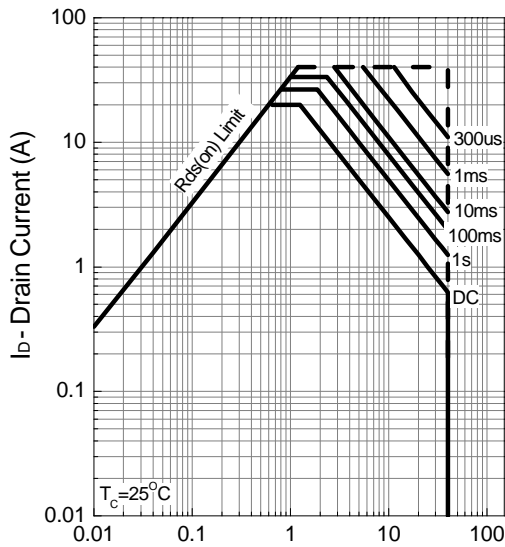
T_j - Junction Temperature (°C)

Drain Current



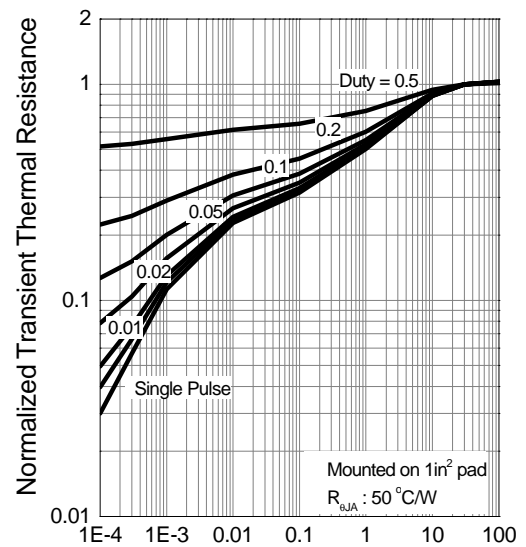
T_j - Junction Temperature (°C)

Safe Operation Area



V_{DS} - Drain - Source Voltage (V)

Thermal Transient Impedance

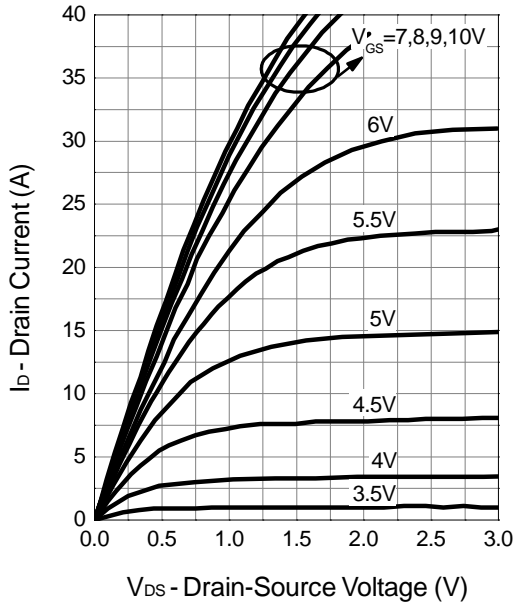


Square Wave Pulse Duration (sec)

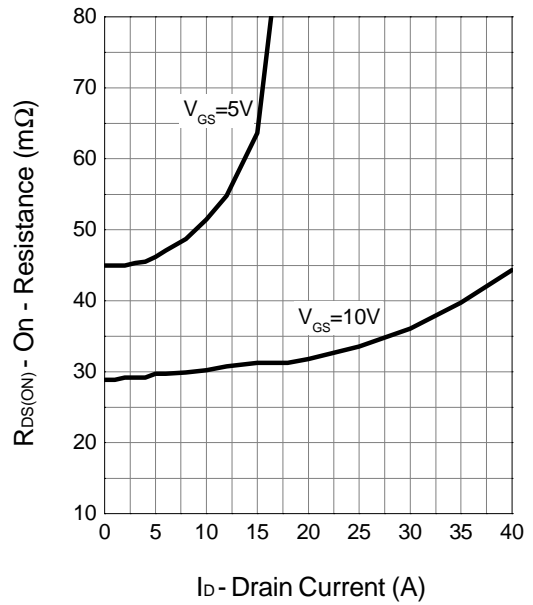
Typical Characteristics (Cont.)

N-Channel

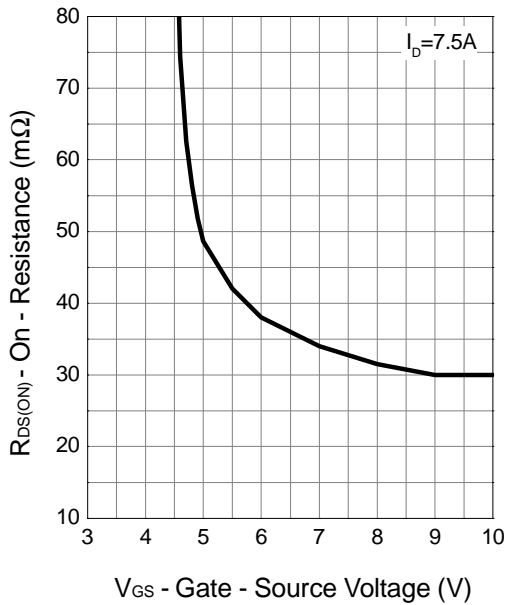
Output Characteristics



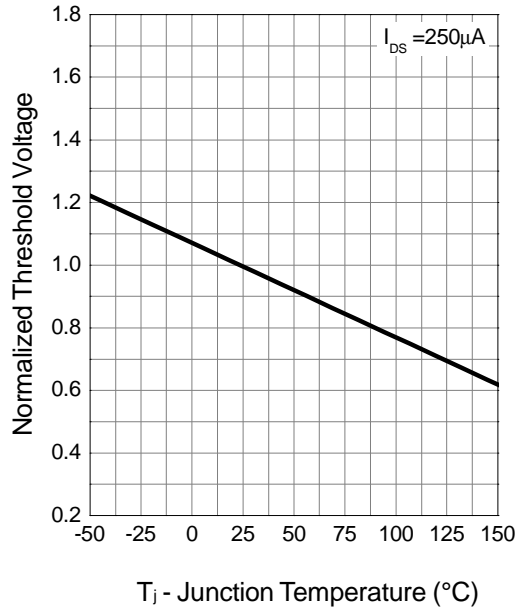
Drain-Source On Resistance



Drain-Source On Resistance



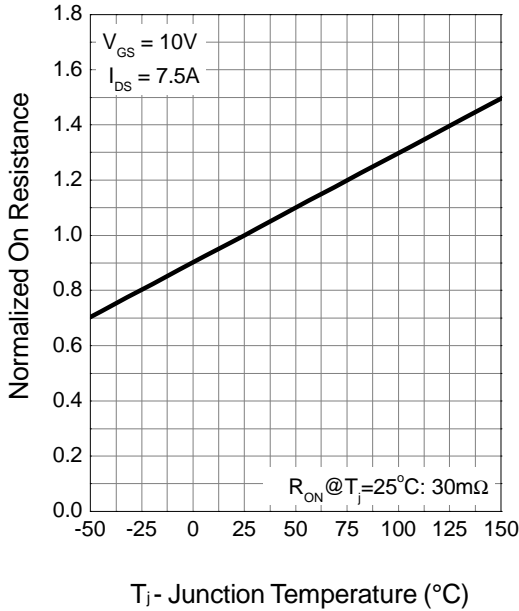
Gate Threshold Voltage



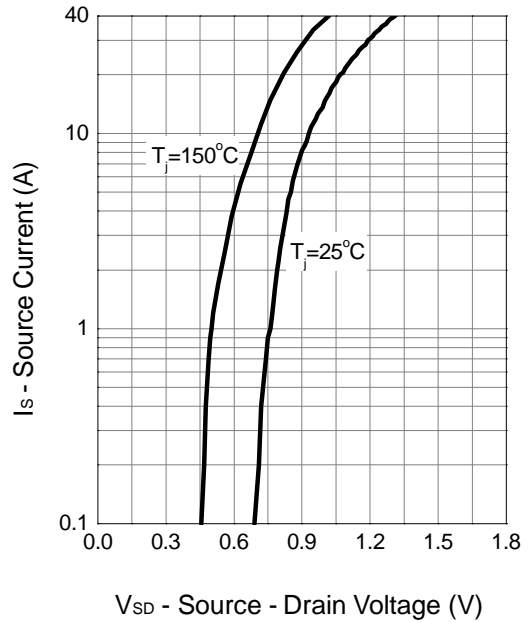
Typical Characteristics (Cont.)

N-Channel

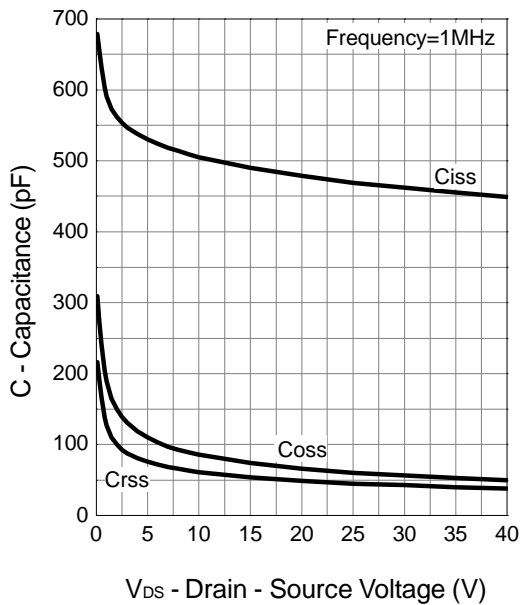
Drain-Source On Resistance



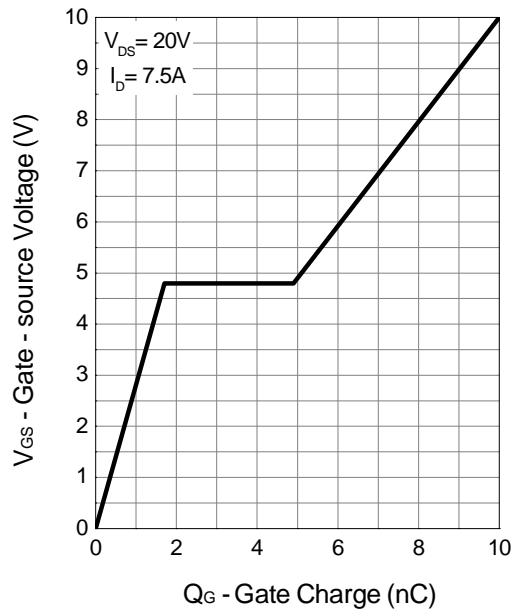
Source-Drain Diode Forward



Capacitance



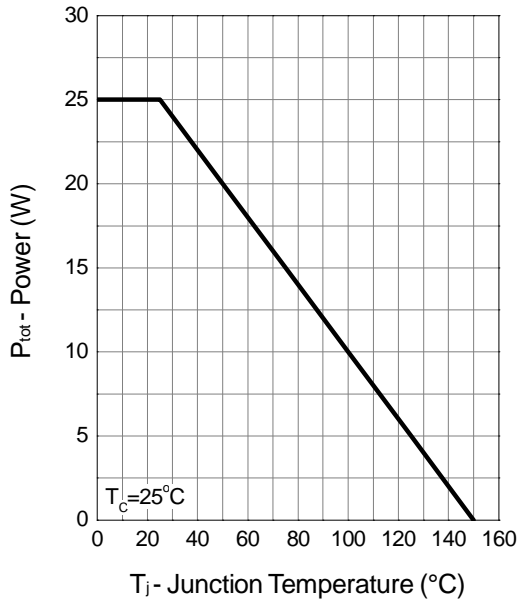
Gate Charge



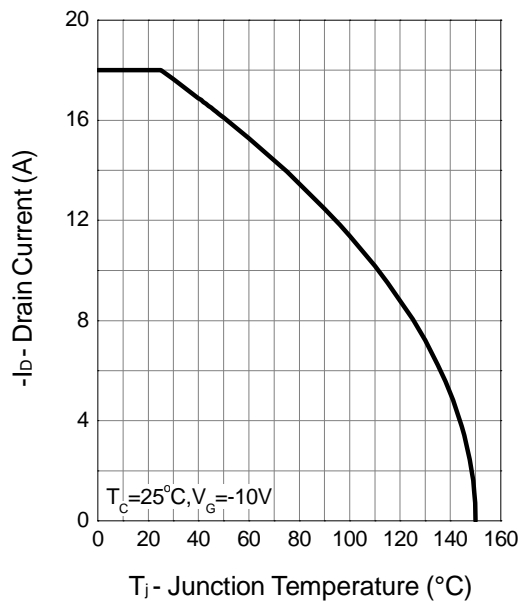
Typical Characteristics (Cont.)

P-Channel

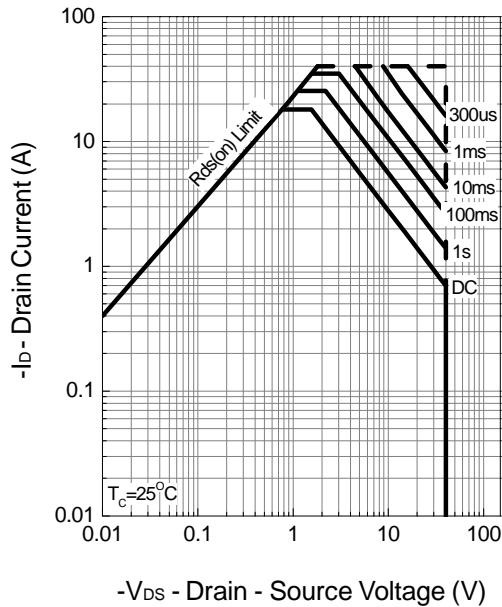
Power Dissipation



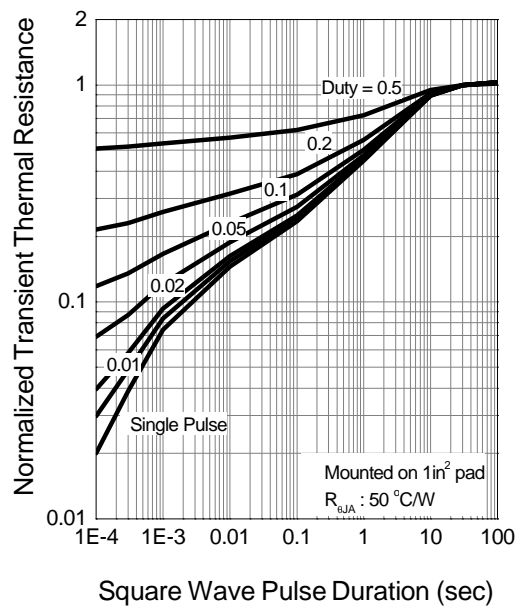
Drain Current



Safe Operation Area



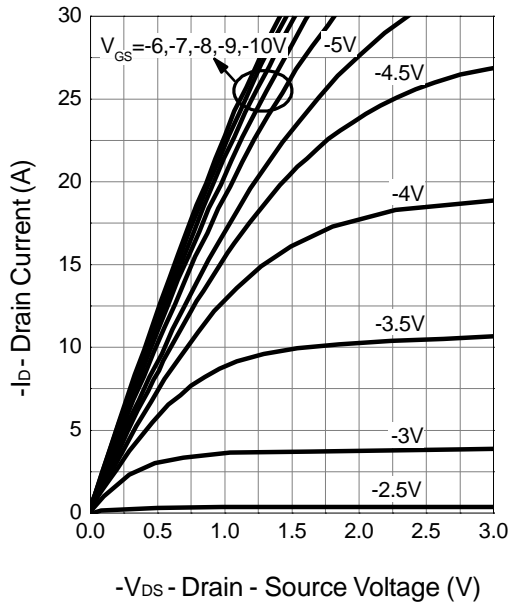
Thermal Transient Impedance



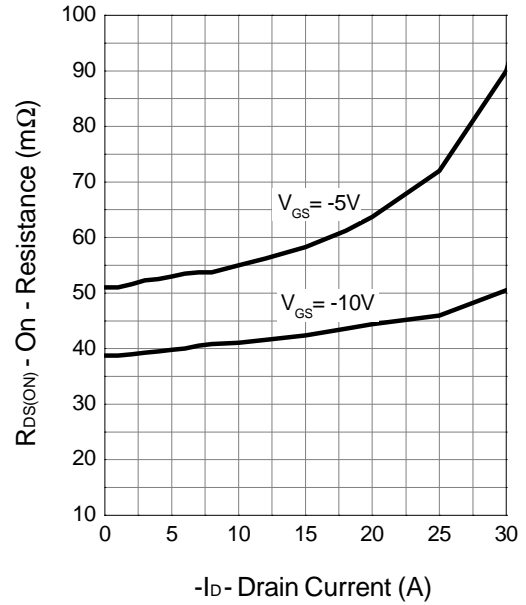
Typical Characteristics (Cont.)

P-Channel

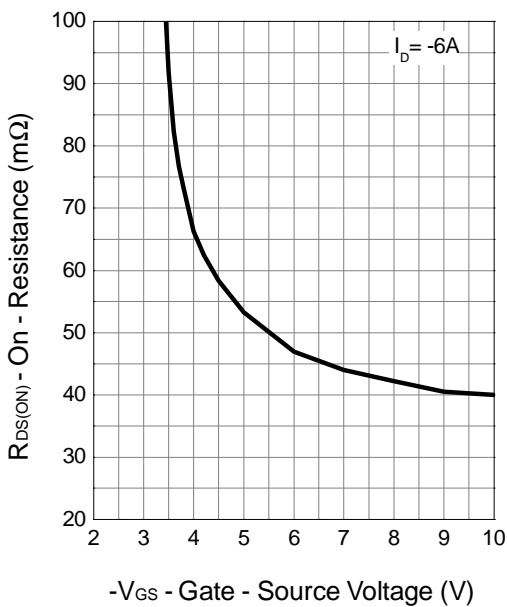
Output Characteristics



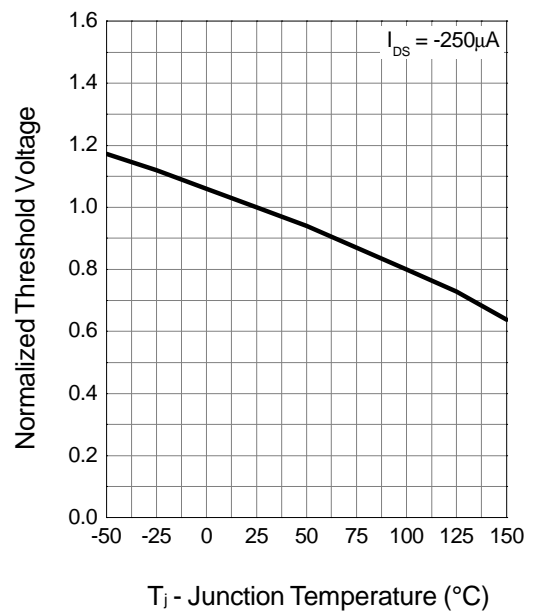
Drain-Source On Resistance



Drain-Source On Resistance



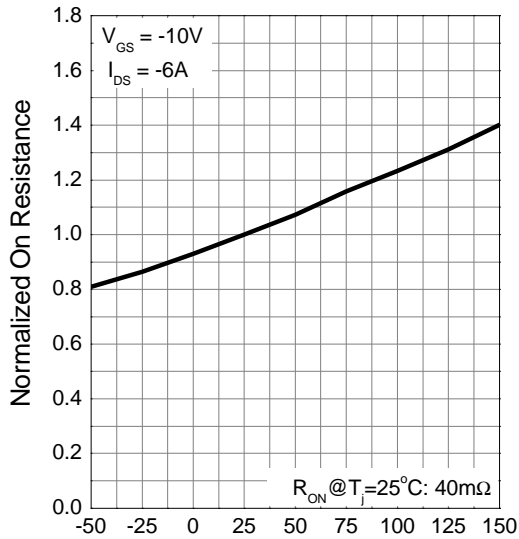
Gate Threshold Voltage



Typical Characteristics (Cont.)

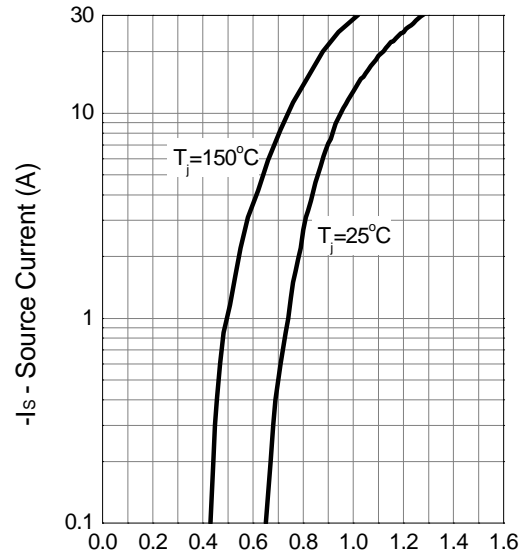
P-Channel

Drain-Source On Resistance



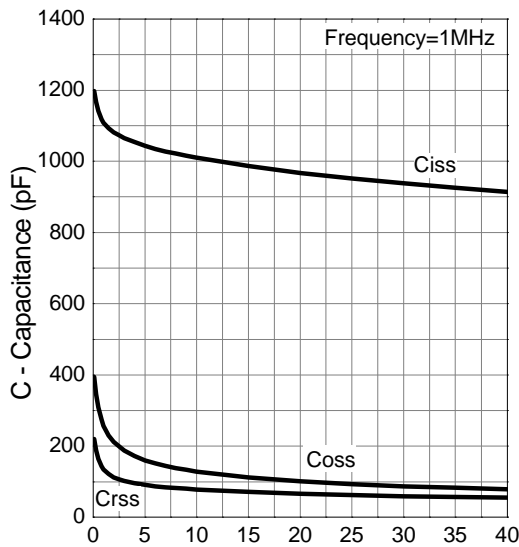
T_j- Junction Temperature (°C)

Source-Drain Diode Forward



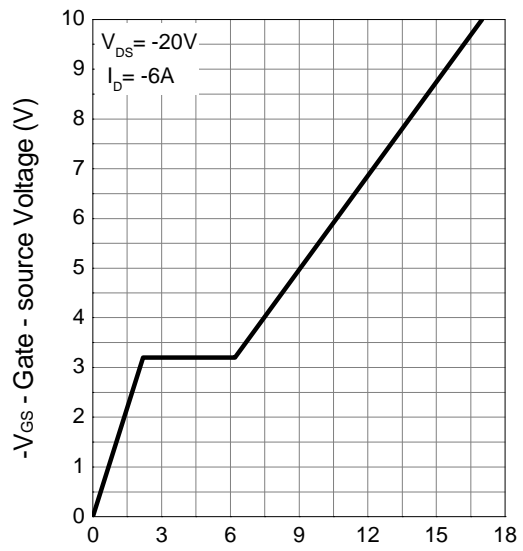
-V_{SD} - Source - Drain Voltage (V)

Capacitance



-V_{DS} - Drain - Source Voltage (V)

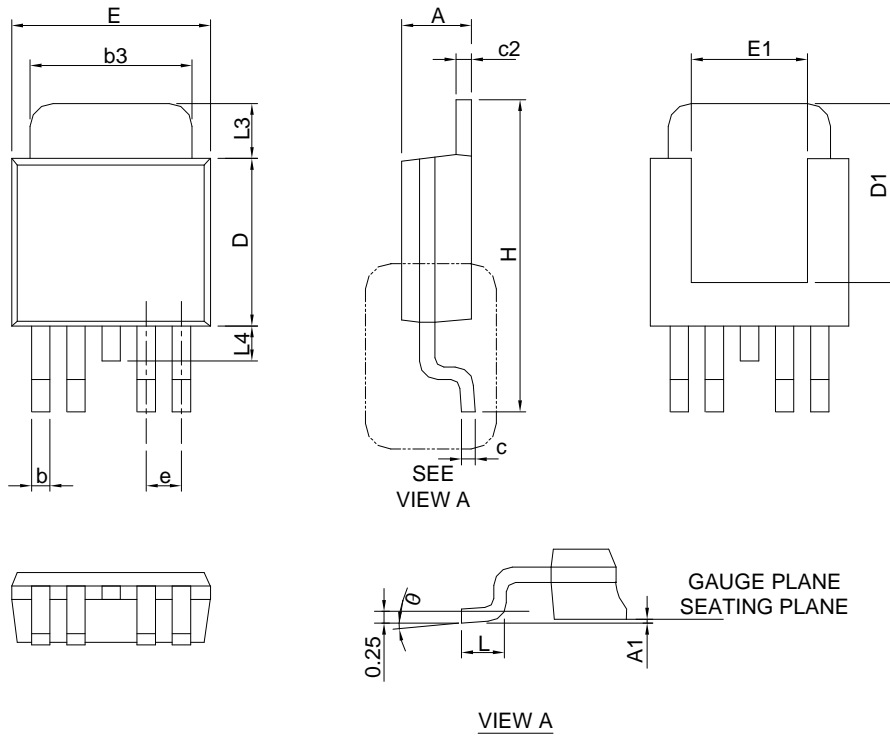
Gate Charge



Q_G - Gate Charge (nC)

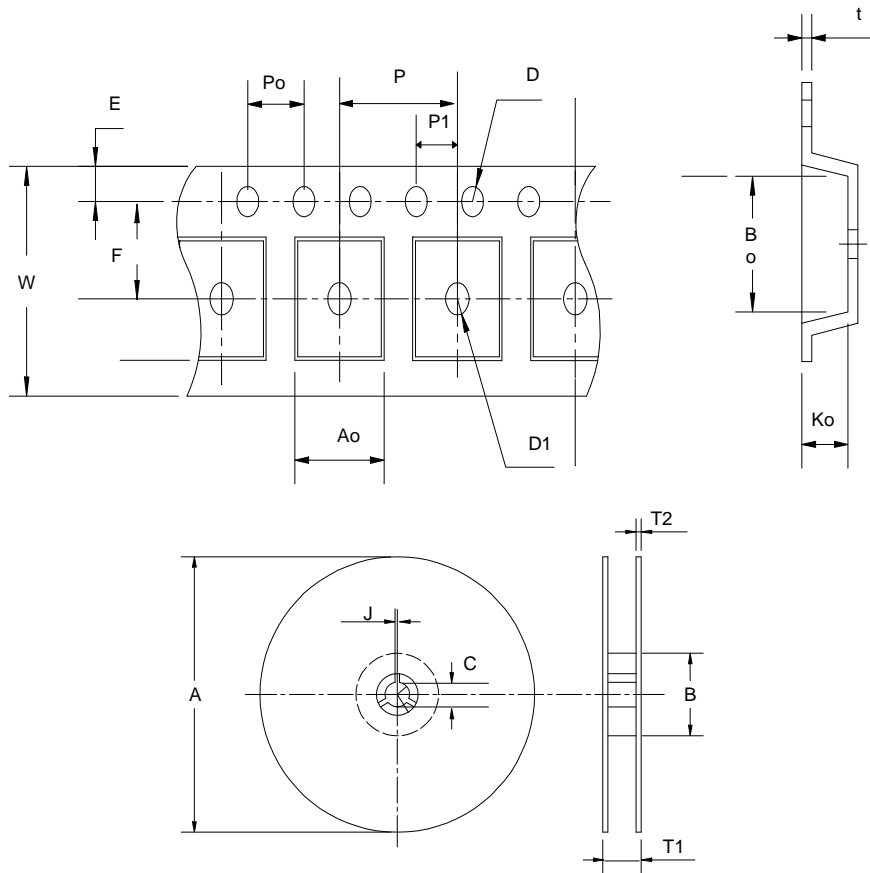
Package Information

TO252-4



SYMBOL	TO252-4			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.39	0.086	0.094
A1		0.13		0.005
b	0.50	0.71	0.020	0.028
b3	4.32	5.46	0.170	0.215
c	0.46	0.61	0.018	0.024
c2	0.46	0.89	0.018	0.035
D	5.33	6.22	0.210	0.245
D1	4.57		0.180	
E	6.35	6.73	0.250	0.265
E1	3.81		0.150	
e	1.27 BSC		0.050 BSC	
H	9.40	10.41	0.370	0.410
L	1.40	1.78	0.055	0.070
L3	0.89	2.03	0.035	0.080
L4		1.02		0.040
θ	0°	8°	0°	8°

Carrier Tape & Reel Dimensions



Application	A	B	C	J	T1	T2	W	P	E
TO-252	330 ±3	100 ± 2	13 ± 0.5	2 ± 0.5	16.4 +0.3 -0.2	2.5 ± 0.5	16 + 0.3 -0.1	8 ± 0.1	1.75 ± 0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	7.5 ± 0.1	1.5 + 0.1	1.5 ± 0.25	4.0 ± 0.1	2.0 ± 0.1	6.8 ± 0.1	10.4 ± 0.1	2.5 ± 0.1	0.3 ± 0.05

(mm)

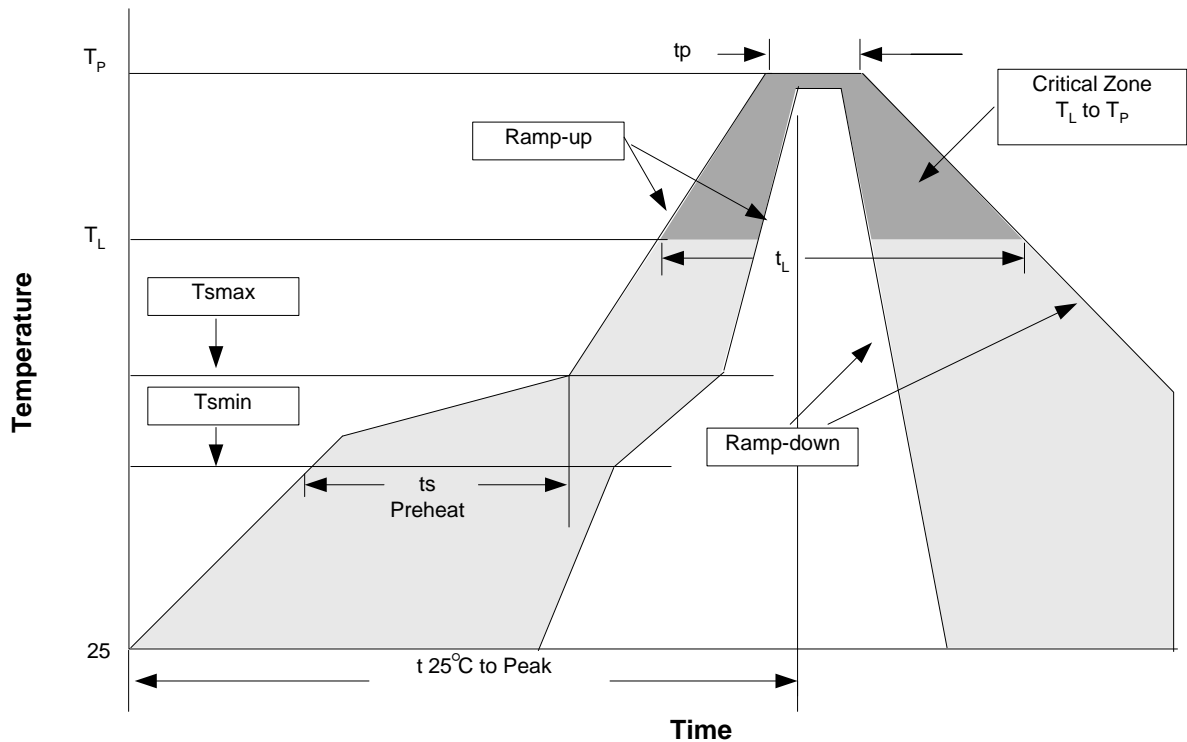
Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
TO- 252	16	13.3	2500

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 (T _{smmin})	100°C	150°C
- Temperature Max (T _{smmax})	150°C	200°C
- Time (min to max) (ts)	60-120 seconds	60-180 seconds
Time maintained above:		
- Temperature (T _L)	183°C	217°C
- Time (t _L)	60-150 seconds	60-150 seconds
Peak/Classification Temperature (T _p)	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 Eutectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<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
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms, 1 _{tr} > 100mA

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