

## N&P-Channel V Complementary MOSFET

### Description

The PT1€S uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.

### General Features

#### N channel

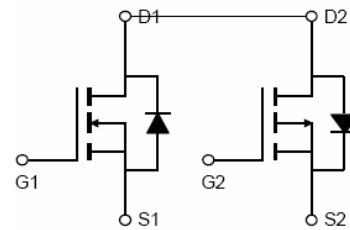
- $V_{DS} = 30V, I_D = 15A$   
 $R_{DS(ON)} < 7m\Omega @ V_{GS} = 10V$   
 $R_{DS(ON)} < 12m\Omega @ V_{GS} = 4.5V$

#### p channel

- $V_{DS} = -30V, I_D = -25A$   
 $R_{DS(ON)} < 11m\Omega @ V_{GS} = -10V$   
 $R_{DS(ON)} < 6m\Omega @ V_{GS} = -4.5V$
- High density cell design for ultra low  $R_{ds(on)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

### Application

- H-bridge
- Inverters



Schematic diagram



Marking and pin assignment

**100% UIS TESTED!**

**100%  $\Delta V_{ds}$  TESTED!**

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
PT1€S	PT1€S	TO-252-4L	-	-	-

### Absolute Maximum Ratings ( $T_C = 25^\circ C$ unless otherwise noted)

Parameter	Symbol	N-Channel	P-Channel	Unit
Drain-Source Voltage	$V_{DS}$	30	-30	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V
Continuous Drain Current	$I_D$	15	-25	A
		24.5	-17.5	
Pulsed Drain Current (Note 1)	$I_{DM}$	105	-75	A
Maximum Power Dissipation	$P_D$	21		W
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 175		$^\circ C$

### Thermal Characteristic

Thermal Resistance, Junction-to-Case (Note 2)	$R_{\theta JC}$	7	$^\circ C/W$
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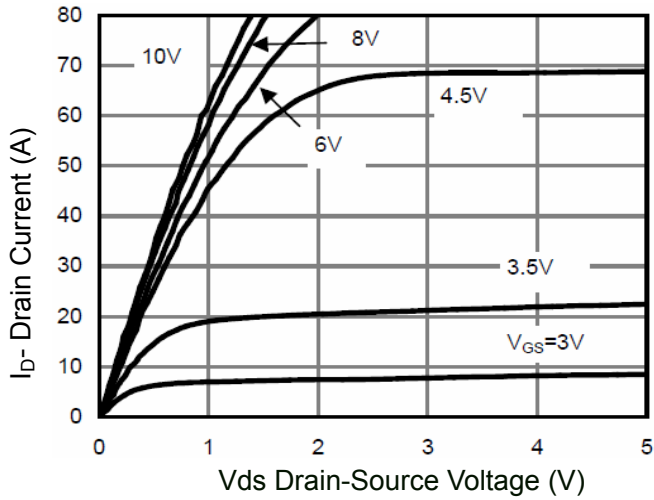
**N-Channel Electrical Characteristics (T<sub>C</sub>=25°C unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	30	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =30V,V <sub>GS</sub> =0V	-	-	1	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V,V <sub>DS</sub> =0V	-	-	±100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =250μA	1.0	1.5	2.5	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =7A	-	5.5	7	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =6A	-	7.8	12	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =10V,I <sub>D</sub> =7A	-	29	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =15V,V <sub>GS</sub> =0V, F=1.0MHz	-	450	-	PF
Output Capacitance	C <sub>OSS</sub>		-	150	-	PF
Reverse Transfer Capacitance	C <sub>RSS</sub>		-	90	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =15V ,R <sub>L</sub> =2.5Ω V <sub>GS</sub> =10V,R <sub>G</sub> =3Ω	-	5	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	12	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	19	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	6	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =15V,I <sub>D</sub> =6A, V <sub>GS</sub> =10V	-	9.5		nC
Gate-Source Charge	Q <sub>gs</sub>		-	2.0		nC
Gate-Drain Charge	Q <sub>gd</sub>		-	1.9		nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V <sub>SD</sub>	V <sub>GS</sub> =0V,I <sub>S</sub> =35A	-		1.2	V
Diode Forward Current (Note 2)	I <sub>S</sub>		-	-	35	A

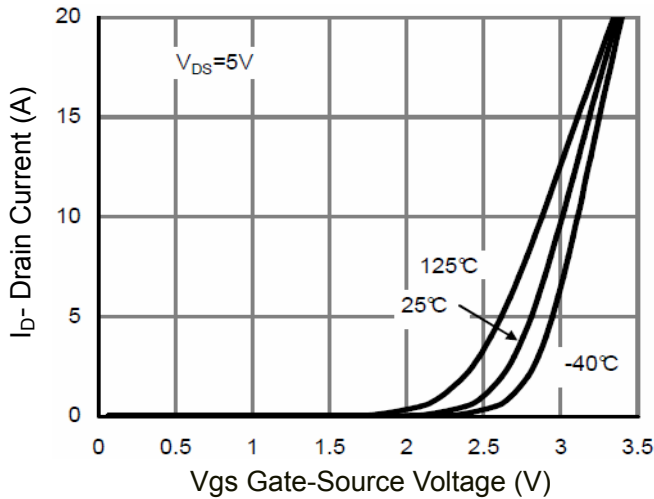
**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production
5. EAS condition: T<sub>J</sub>=25°C, V<sub>DD</sub>=30V, V<sub>G</sub>=10V, L=0.5mH, R<sub>G</sub>=25Ω

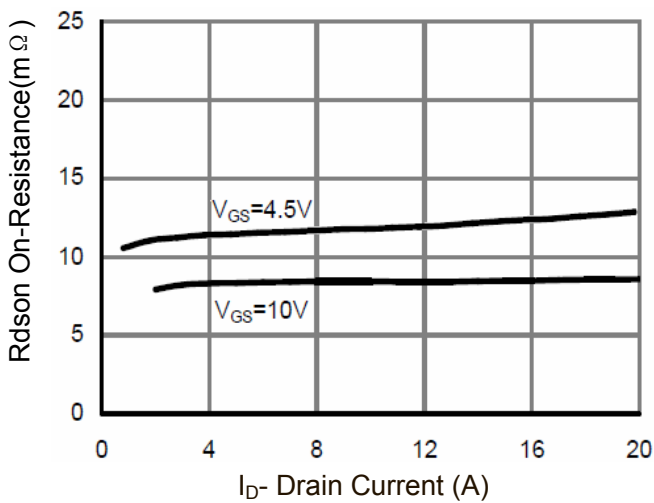
### N-Channel Typical Electrical and Thermal Characteristics (Curves)



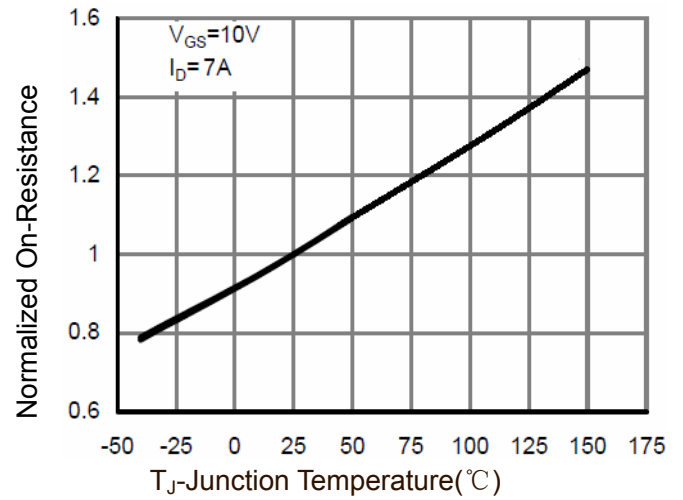
**Figure 1 Output Characteristics**



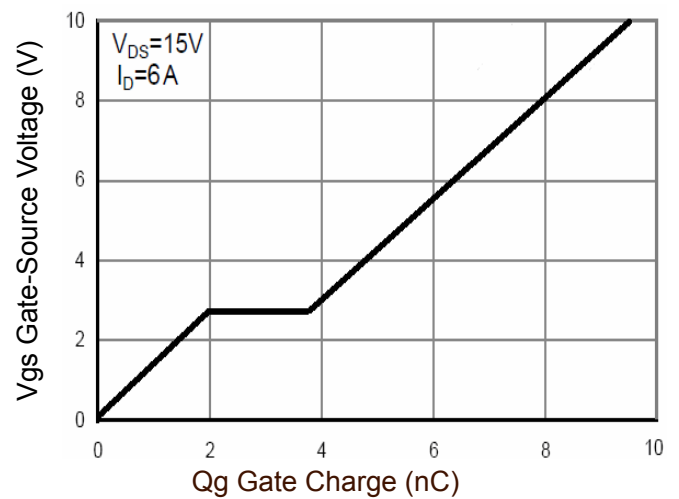
**Figure 2 Transfer Characteristics**



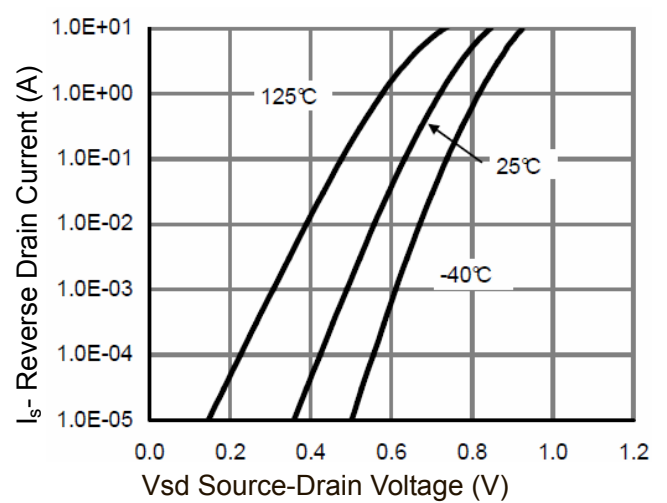
**Figure 3 Rdson- Drain Current**



**Figure 4 Rdson-Junction Temperature**



**Figure 5 Gate Charge**



**Figure 6 Source- Drain Diode Forward**

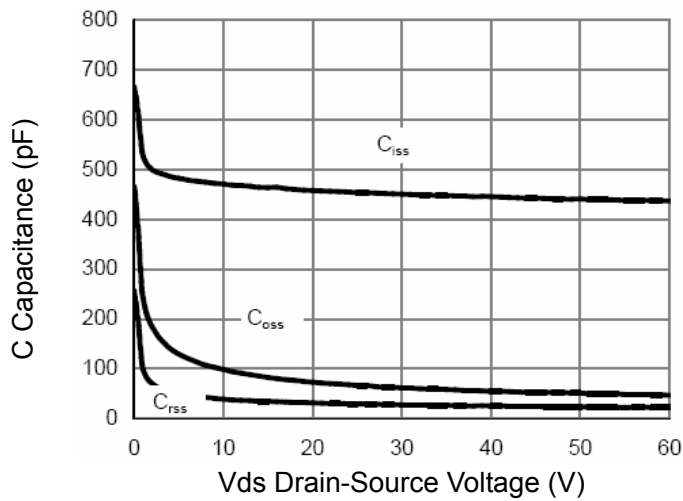


Figure 7 Capacitance vs Vds

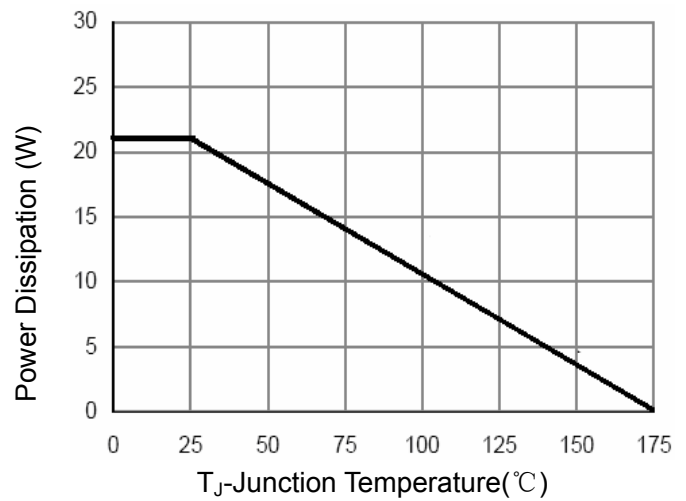


Figure 9 Power De-rating

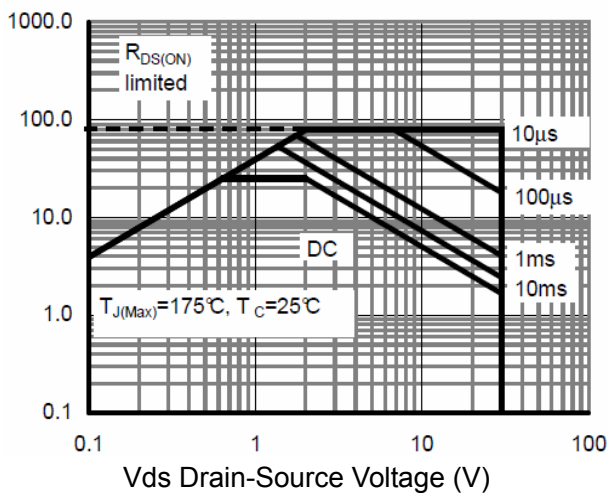


Figure 8 Safe Operation Area

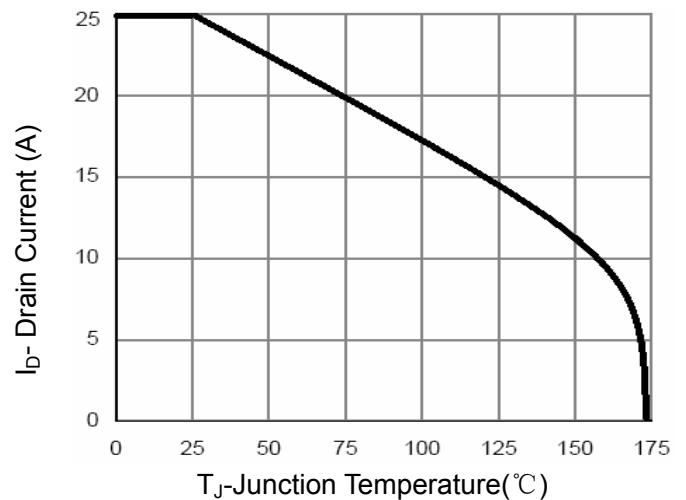


Figure 10 Current De-rating

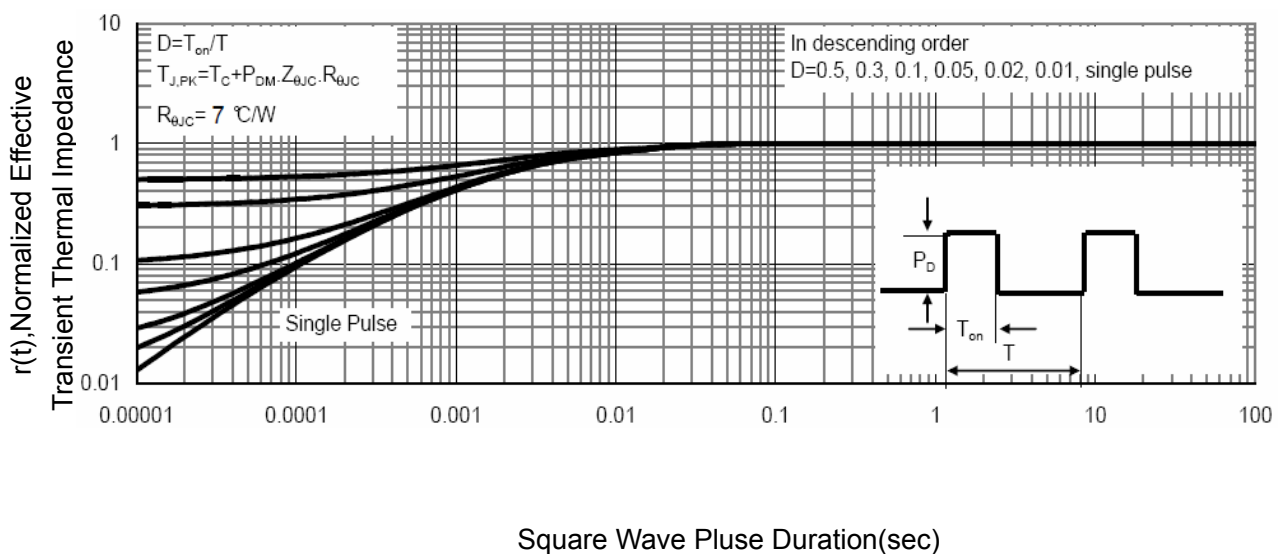
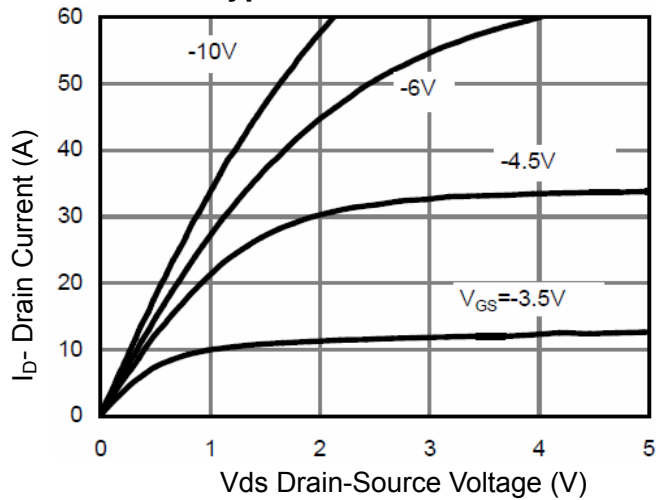


Figure 11 Normalized Maximum Transient Thermal Impedance

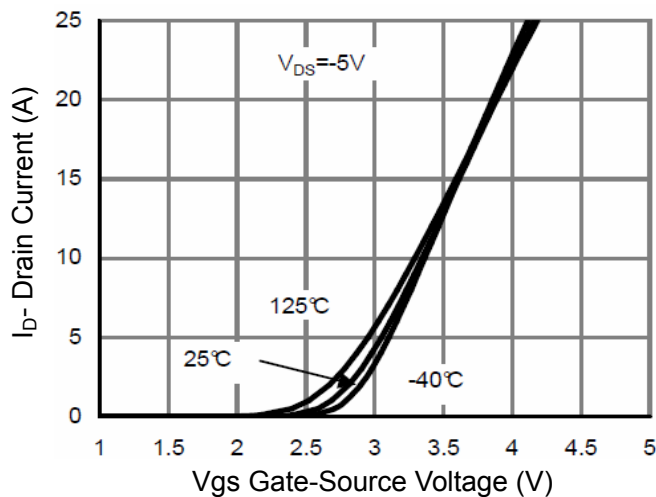
**P-Channel Electrical Characteristics (T<sub>C</sub>=25°C unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =-250μA	-30	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V	-	-	-1	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA
On Characteristics <sup>(Note 3)</sup>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA	-1.0	-1.5	-2.4	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =-10V, I <sub>D</sub> =-6A	-	15	18	mΩ
		V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-5A		20	25	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =-5V, I <sub>D</sub> =-6A	-	15	-	S
Dynamic Characteristics <sup>(Note4)</sup>						
Input Capacitance	C <sub>Iss</sub>	V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V, F=1.0MHz	-	920	-	PF
Output Capacitance	C <sub>Oss</sub>		-	140	-	PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	90	-	PF
Switching Characteristics <sup>(Note 4)</sup>						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =-15V ,R <sub>L</sub> =2.5Ω V <sub>GS</sub> =-10V, R <sub>G</sub> =3Ω	-	8	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	30	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	22	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	26	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =-15V, I <sub>D</sub> =-6A, V <sub>GS</sub> =-10V	-	16.2		nC
Gate-Source Charge	Q <sub>gs</sub>		-	2.9		nC
Gate-Drain Charge	Q <sub>gd</sub>		-	3.6		nC
Drain-Source Diode Characteristics						
Diode Forward Voltage <sup>(Note 3)</sup>	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =-6A	-		-1.2	V
Diode Forward Current <sup>(Note 2)</sup>	I <sub>S</sub>		-	-	-25	A
Reverse Recovery Time	t <sub>rr</sub>	TJ = 25°C, IF =-6A	-	23	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100A/μs <sup>(Note3)</sup>	-	14	-	nC

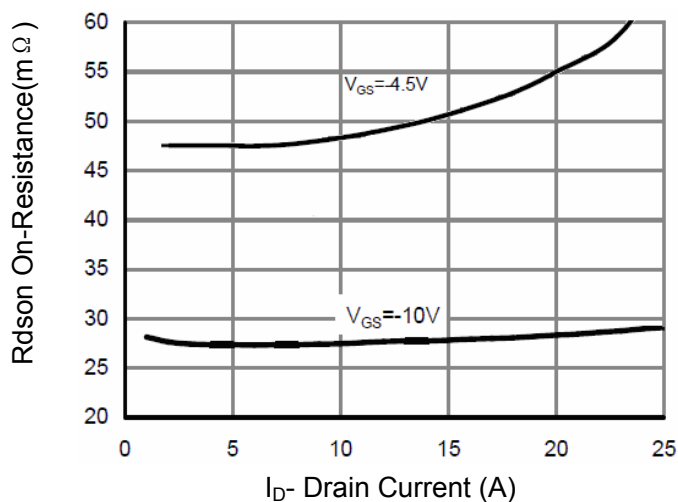
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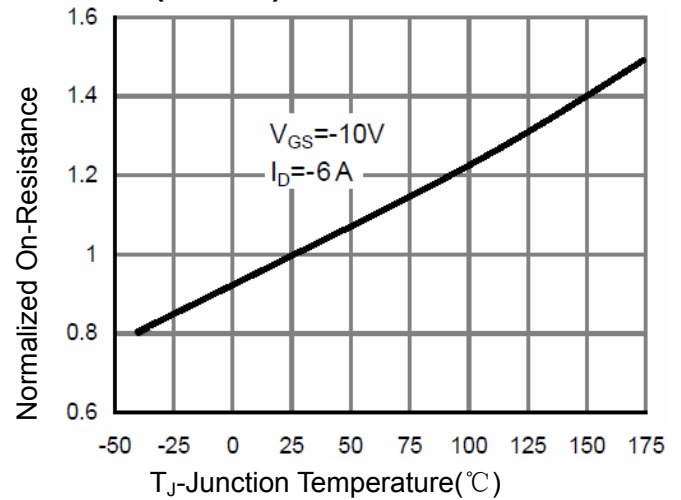
**Figure 1 Output Characteristics**



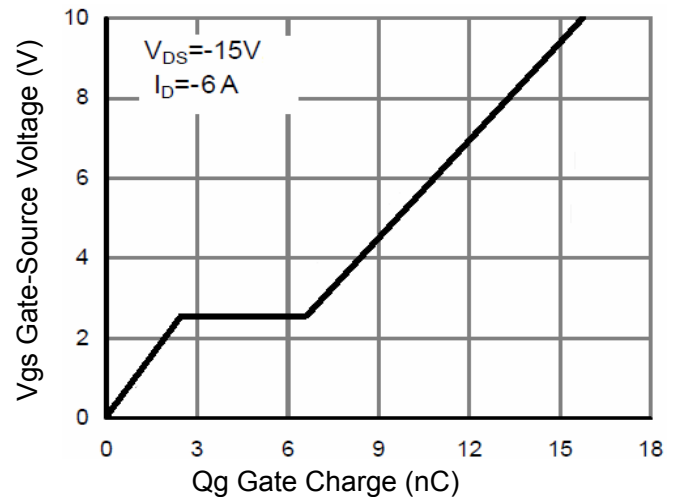
**Figure 2 Transfer Characteristics**



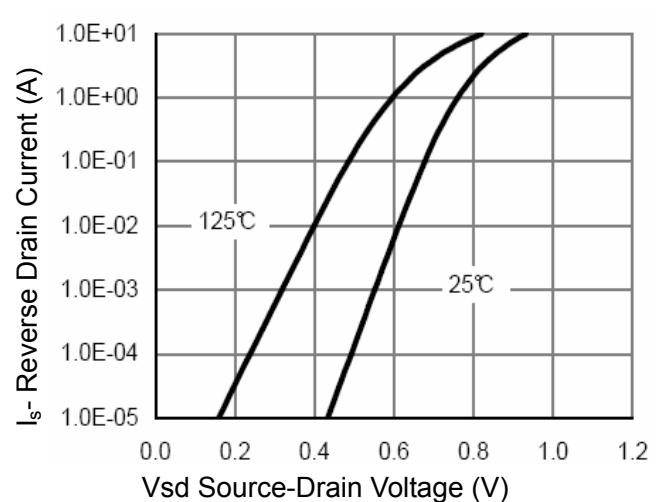
**Figure 3  $R_{DS(on)}$ - Drain Current**



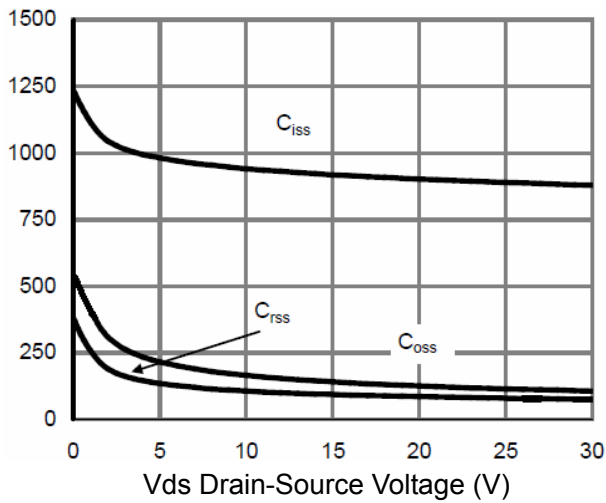
**Figure 4  $R_{DS(on)}$ -Junction Temperature**



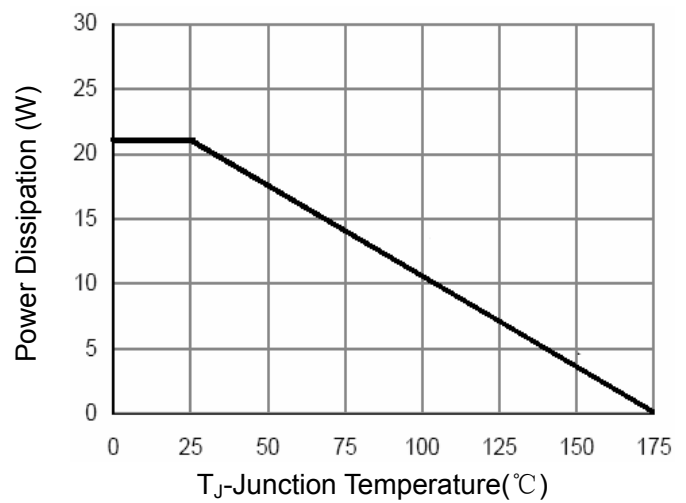
**Figure 5 Gate Charge**



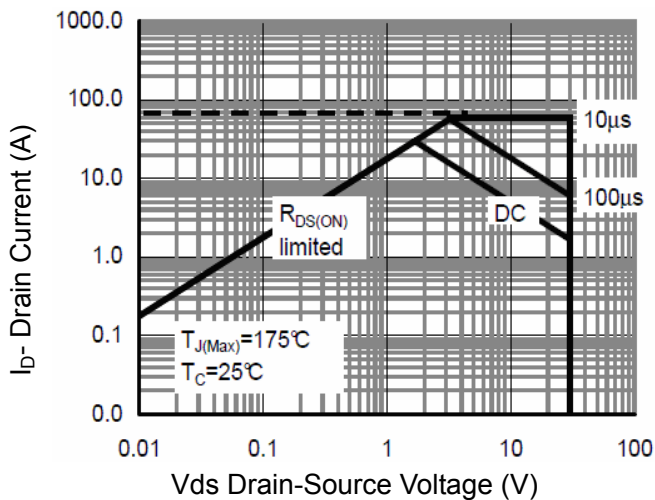
**Figure 6 Source- Drain Diode Forward**



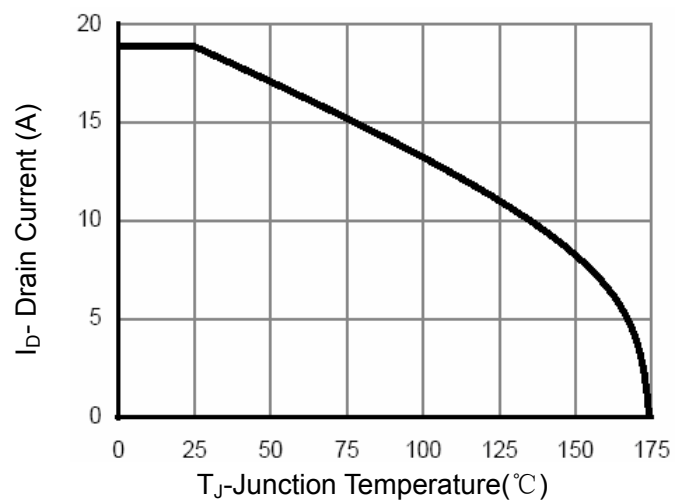
**Figure 7 Capacitance vs Vds**



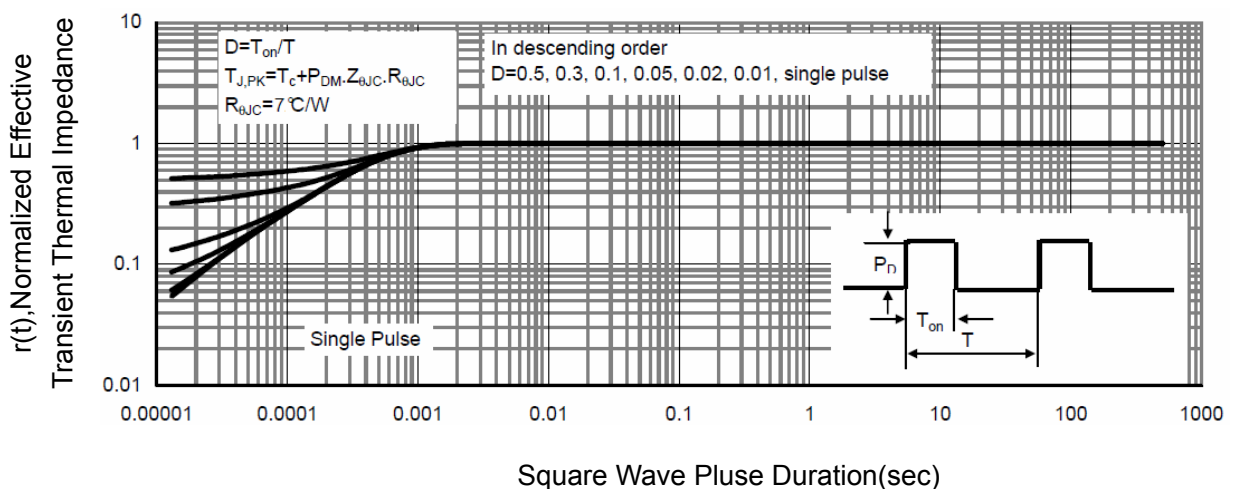
**Figure 9 Power De-rating**



**Figure 8 Safe Operation Area**

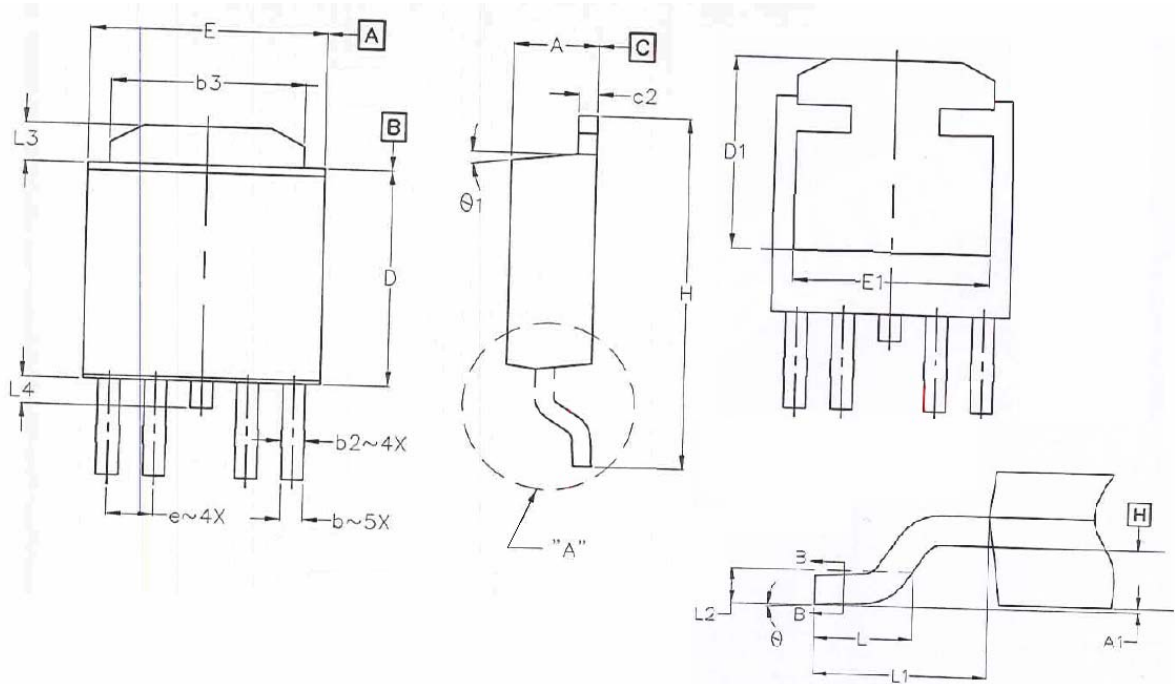


**Figure 10 Current De-rating**



**Figure 11 Normalized Maximum Transient Thermal Impedance**

## TO-252-4L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.184	2.387	0.086	0.094
A1	-	0.127	-	0.094
b	0.508	0.711	0.020	0.028
b1	0.508	0.660	0.020	0.026
b2	0.610	0.787	0.024	0.031
b3	4.953	5.461	0.195	0.215
c	0.460	0.610	0.018	0.024
c1	0.410	0.559	0.016	0.022
C2	0.460	12.950	0.498	0.510
D	4.980	5.180	0.196	0.204
D1	2.650	2.950	0.104	0.116
E	7.900	8.100	0.311	0.319
E1	0.000	0.300	0.000	0.012
e	12.900	13.400	0.508	0.528
H	2.850	3.250	0.112	0.128
L	1.397	1.778	0.055	0.070
L1	2.743	BSC	0.108	BSC
L2	0.508	BSC	0.020	BSC
L3	0.889	1.270	0.035	0.050
L4	-	1.015	-	0.040
$\theta$	0°	10°	0°	10°
$\theta_1$	0°	15°	0°	15°