

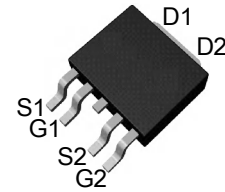
Features

- N Channel : 60V/20A,
 $R_{DS(ON)}=19m\Omega(\text{typ.})@V_{GS}=10V$
 $R_{DS(ON)}=23m\Omega(\text{typ.})@V_{GS}=4.5V$
- P Channel : -60V/-15A,
 $R_{DS(ON)}=57m\Omega(\text{typ.})@V_{GS}=-10V$
 $R_{DS(ON)}=83m\Omega(\text{typ.})@V_{GS}=-4.5V$
- 100% UIS + R_g Tested
- Reliable and Rugged
- Lead Free and Green Devices Available
(RoHS Compliant)
- Moisture Sensitivity Level MSL1
(per JEDEC J-STD-020D)

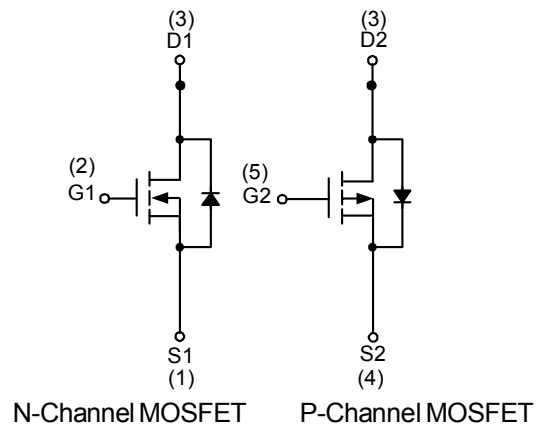
Applications

- Power Management in Notebook Computer,
Portable Equipment and Battery Powered
Systems.

Pin Description



Top View of TO-252-4



Absolute Maximum Ratings ($T_A=25^{\circ}\text{C}$ Unless Otherwise Noted)

Symbol	Parameter		N Channel	P Channel	Unit
Common Ratings					
V _{DSS}	Drain-Source Voltage		60	-60	V
V _{GSS}	Gate-Source Voltage		±20	±20	
T _J	Maximum Junction Temperature		150		°C
T _{STG}	Storage Temperature Range		-55 to 150		
I _S	Diode Continuous Forward Current	T _C =25°C	20	-15	A
I _D	Continuous Drain Current	T _C =25°C	20	-15	A
		T _C =100°C	12	-9	
I _{DM} ^a	Pulse Drain Current Tested	T _C =25°C	60	-45	A
P _D	Maximum Power Dissipation	T _C =25°C	20.8		W
		T _C =100°C	8.3		
R _{θJC}	Thermal Resistance-Junction to Case	Steady State	6		°C/W
R _{θJA} ^b	Thermal Resistance-Junction to Ambient	Steady State	80		°C/W
I _{AS} ^c	Avalanche Current, Single pulse	L=0.5mH	8	10	A
E _{AS} ^c	Avalanche Energy, Single pulse	L=0.5mH	16	25	mJ

Note a : Pulse width limited by maximum junction temperature.

Note b : Surface Mounted on 1in^2 pad area.

Note c : UIS tested and pulse width limited by maximum junction temperature (initial temperature $T_J=25^{\circ}\text{C}$).

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

Symbol	Parameter	Test Conditions	N Channel			Unit
			Min.	Typ.	Max.	
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =250μA	60	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =48V, V _{GS} =0V	-	-	1	μA
		T _J =85°C	-	-	30	
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250μA	1	2	3	V
I _{GSS}	Gate Leakage Current	V _{GS} =±20V, V _{DS} =0V	-	-	±10	μA
R _{DS(ON)} ^d	Drain-Source On-state Resistance	V _{GS} =10V, I _{DS} =7.5A	-	19	22	mΩ
		V _{GS} =4.5V, I _{DS} =4.5A	-	23	26	
Diode Characteristics						
V _{SD} ^d	Diode Forward Voltage	I _{SD} =3.7A, V _{GS} =0V	-	0.8	1.3	V
t _{rr}	Reverse Recovery Time	I _{SD} =7.5A, dI _{SD} /dt=100A/μs	-	21	-	ns
Q _{rr}	Reverse Recovery Charge		-	21	-	nC
Dynamic Characteristics ^e						
R _G	Gate Resistance	V _{GS} =0V, V _{DS} =0V, f=1MHz	-	2		Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =30V, Frequency=1.0MHz	-	550	715	pF
C _{oss}	Output Capacitance		-	60	-	
C _{rss}	Reverse Transfer Capacitance		-	31	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =30V, R _L =30Ω, I _{DS} =1A, V _{GEN} =10V, R _G =6Ω	-	10	18	ns
t _r	Turn-on Rise Time		-	6	11	
t _{d(OFF)}	Turn-off Delay Time		-	21	38	
t _f	Turn-off Fall Time		-	5	9	
Gate Charge Characteristics ^e						
Q _g	Total Gate Charge	V _{DS} =30V, V _{GS} =4.5V, I _{DS} =7.5A	-	5.4	-	nC
Q _g	Total Gate Charge	V _{DS} =30V, V _{GS} =10V, I _{DS} =7.5A	-	11.2	15.7	
Q _{gs}	Gate-Source Charge		-	2.2	-	
Q _{gd}	Gate-Drain Charge		-	2	-	

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

Note e : Guaranteed by design, not subject to production testing.

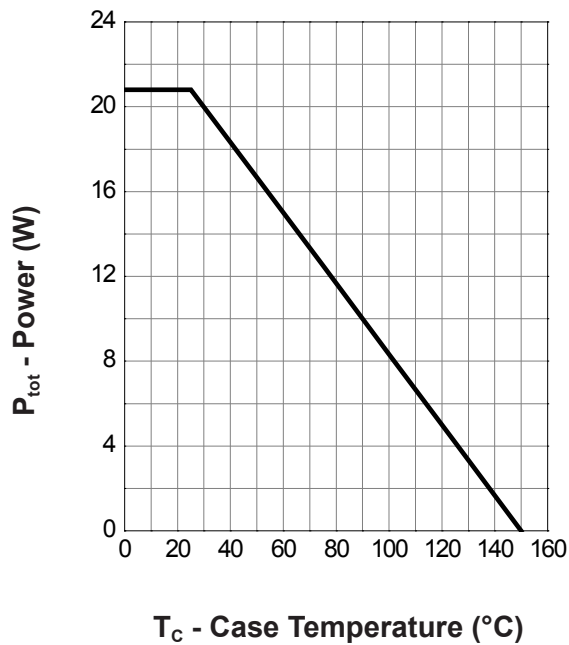
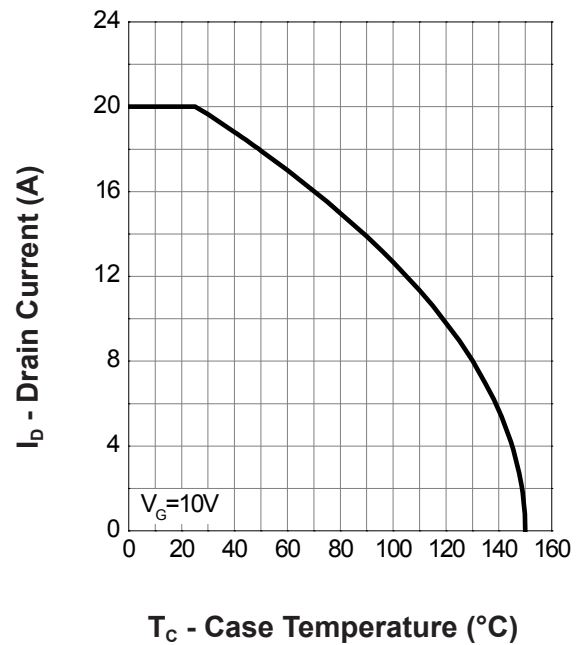
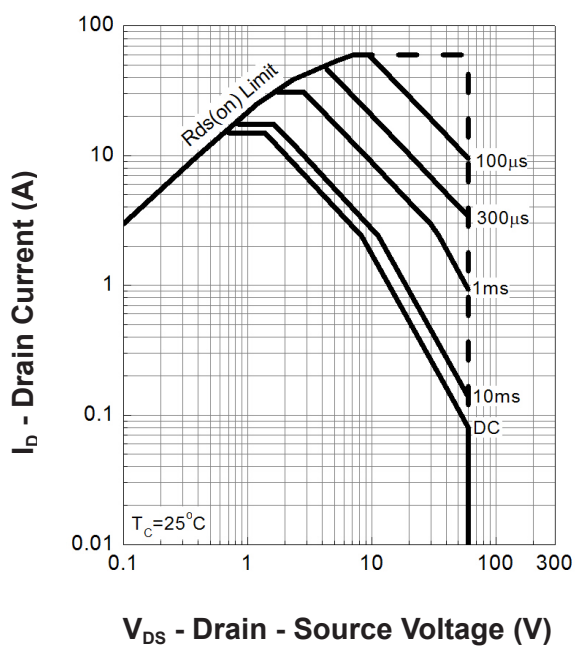
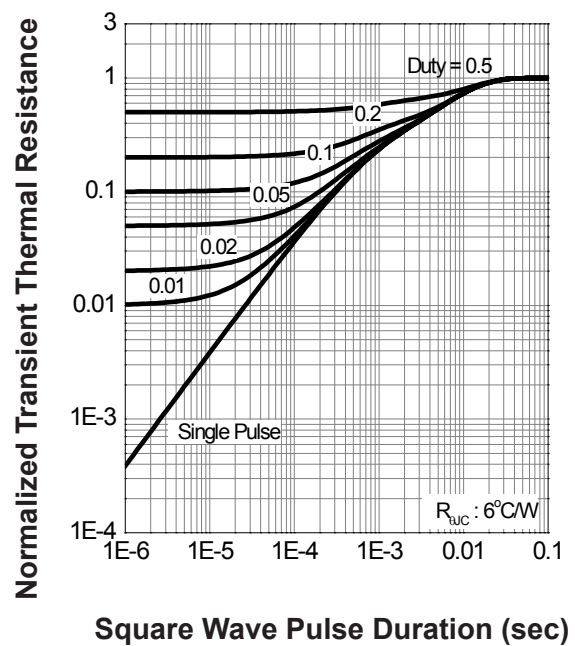
P Channel Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	P Channel			Unit
			Min.	Typ.	Max.	
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =-250μA	-60	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =-48V, V _{GS} =0V	-	-	-1	μA
		T _J =85°C	-	-	-30	
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250μA	-1	-2	-3	V
I _{GSS}	Gate Leakage Current	V _{GS} =±20V, V _{DS} =0V	-	-	±10	μA
R _{DS(ON)} ^d	Drain-Source On-state Resistance	V _{GS} =-10V, I _{DS} =-5.4A	-	57	61	mΩ
		V _{GS} =-4.5V, I _{DS} =-3.2A	-	83	88	
Diode Characteristics						
V _{SD} ^d	Diode Forward Voltage	I _{SD} =-2.7A, V _{GS} =0V	-	-0.8	-1.3	V
t _{rr}	Reverse Recovery Time	I _{SD} =-5.4A, dI _{SD} /dt=100A/μs	-	22	-	ns
Q _{rr}	Reverse Recovery Charge		-	23	-	nC
Dynamic Characteristics ^e						
R _G	Gate Resistance	V _{GS} =0V,V _{DS} =0V,f=1MHz	-	10	-	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =-30V, Frequency=1.0MHz	-	535	695	pF
C _{oss}	Output Capacitance		-	70	-	
C _{rss}	Reverse Transfer Capacitance		-	40	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =-30V, R _L =-30Ω, I _{DS} =-1A, V _{GEN} =-10V, R _G =6Ω	-	9	16	ns
t _r	Turn-on Rise Time		-	5	9	
t _{d(OFF)}	Turn-off Delay Time		-	40	72	
t _f	Turn-off Fall Time		-	27	49	
Gate Charge Characteristics ^e						
Q _g	Total Gate Charge	V _{DS} =-30V, V _{GS} =-4.5V, I _{DS} =-5.4A	-	5.5	-	nC
Q _g	Total Gate Charge	V _{DS} =-30V, V _{GS} =-10V, I _{DS} =-5.4A	-	11.3	15.8	
Q _{gs}	Gate-Source Charge		-	2.3	-	
Q _{gd}	Gate-Drain Charge		-	2.3	-	

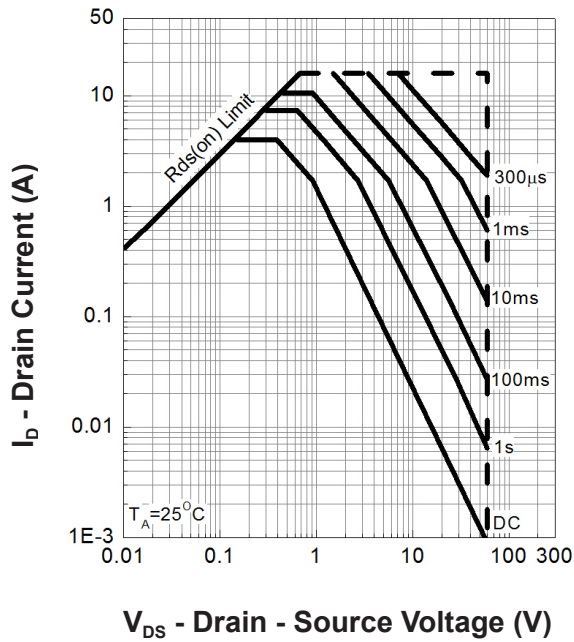
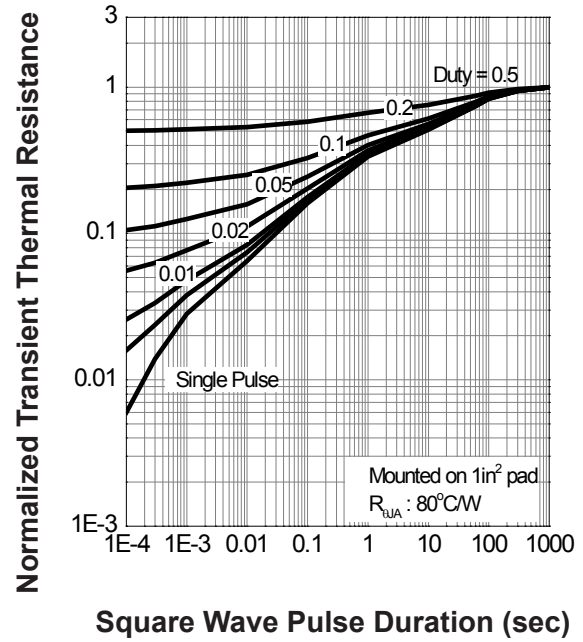
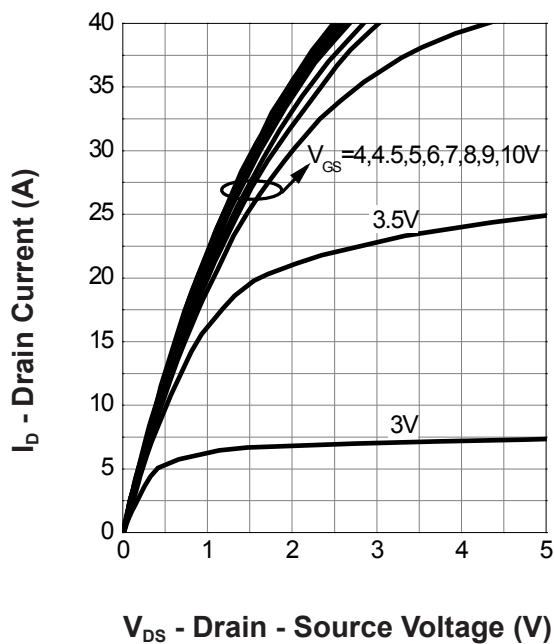
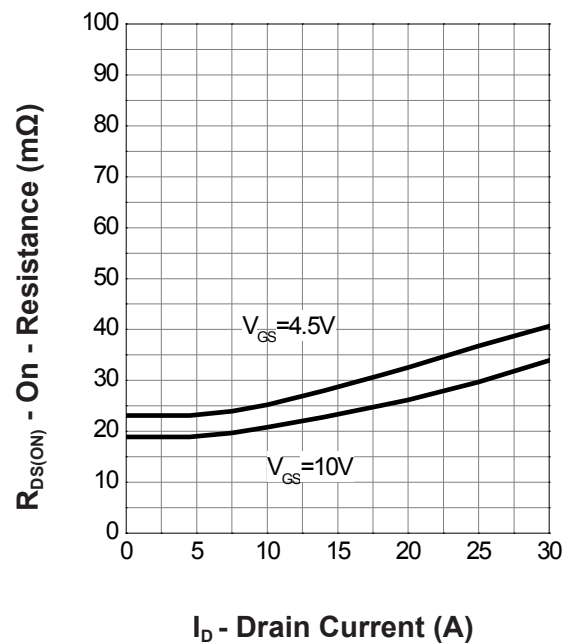
Note d : Pulse test ; pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.

Note e : Guaranteed by design, not subject to production testing.

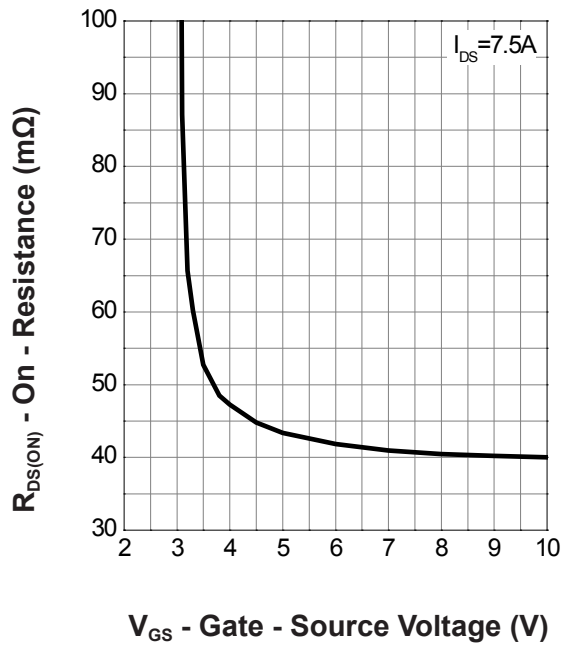
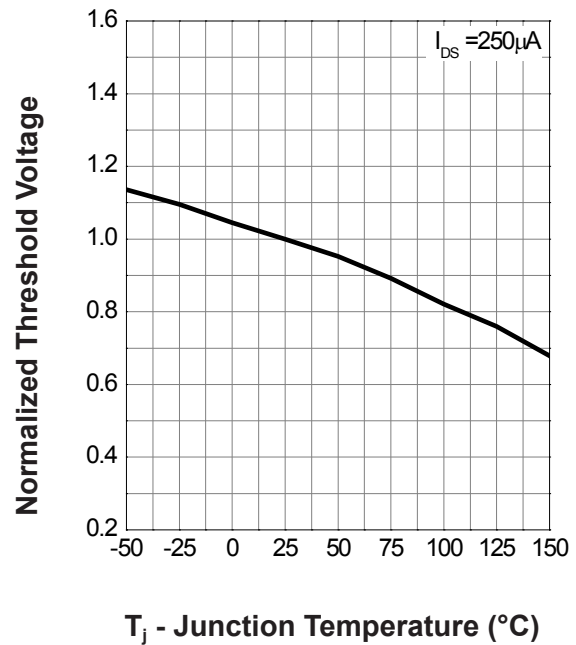
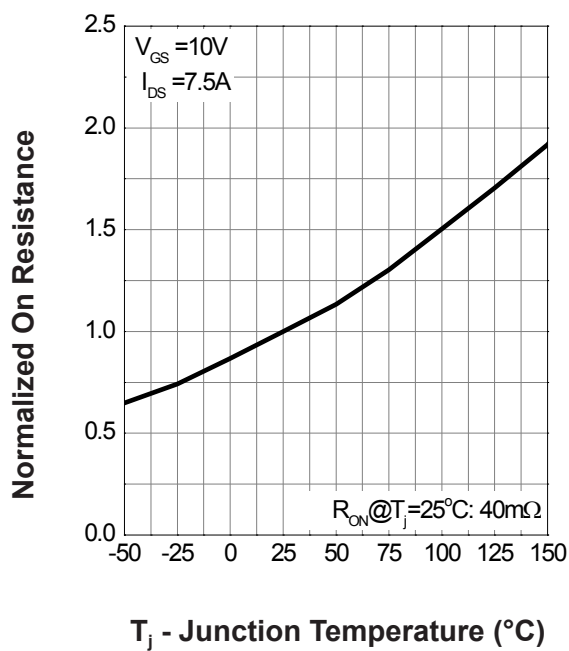
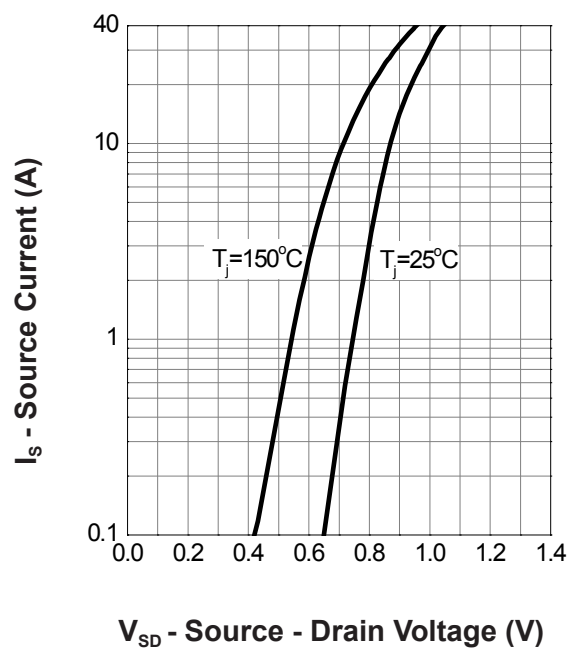
N Channel Typical Operating Characteristics

Power Dissipation

Drain Current

Safe Operation Area

Thermal Transient Impedance


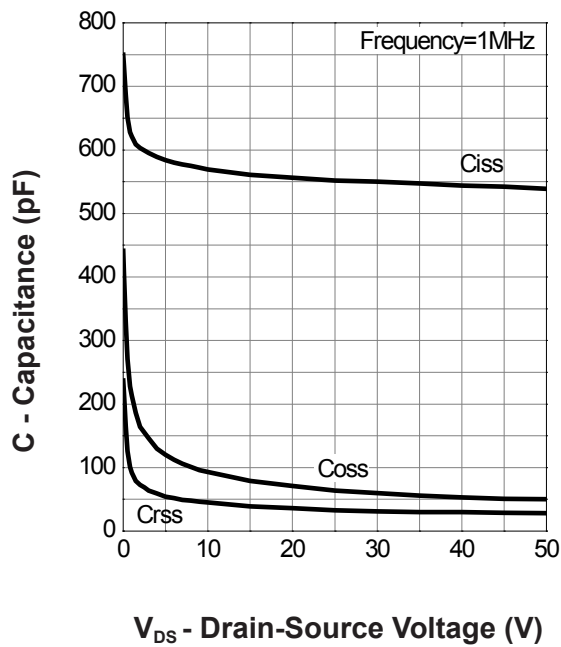
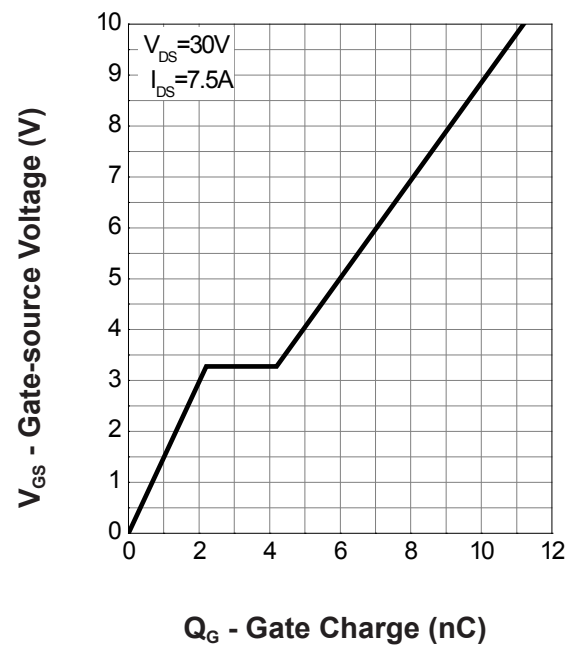
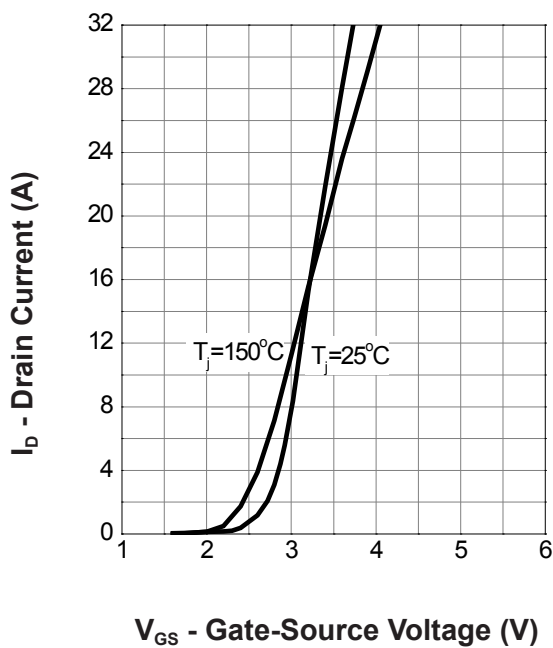
N Channel Typical Operating Characteristics(Cont.)

Safe Operation Area

Thermal Transient Impedance

Output Characteristics

Drain-Source On Resistance


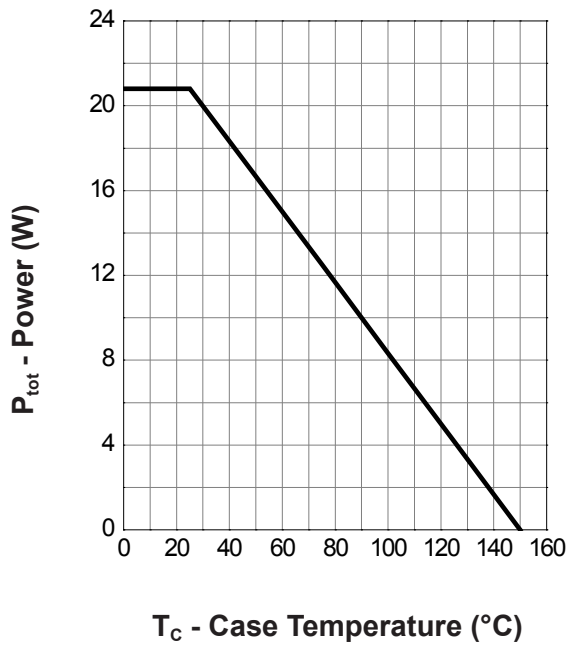
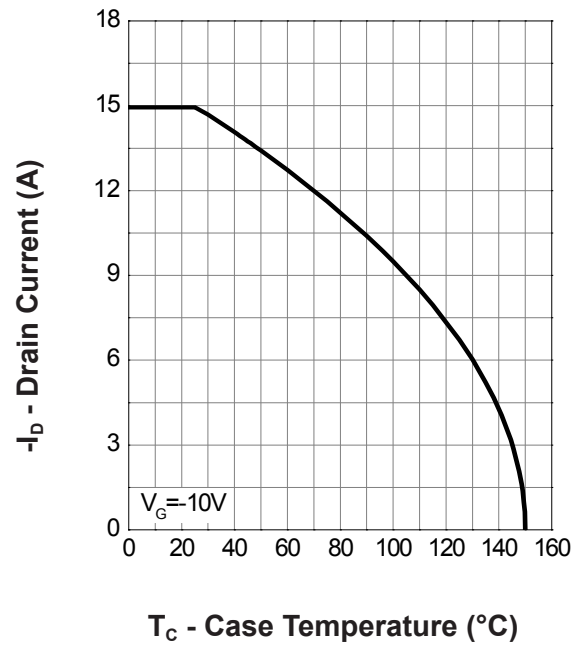
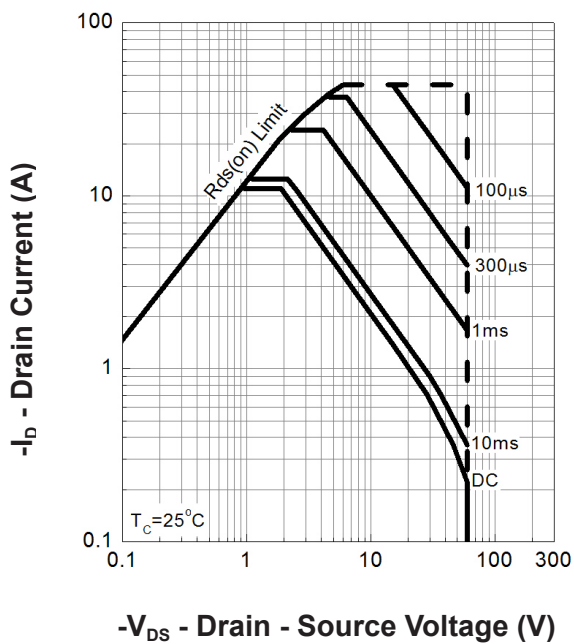
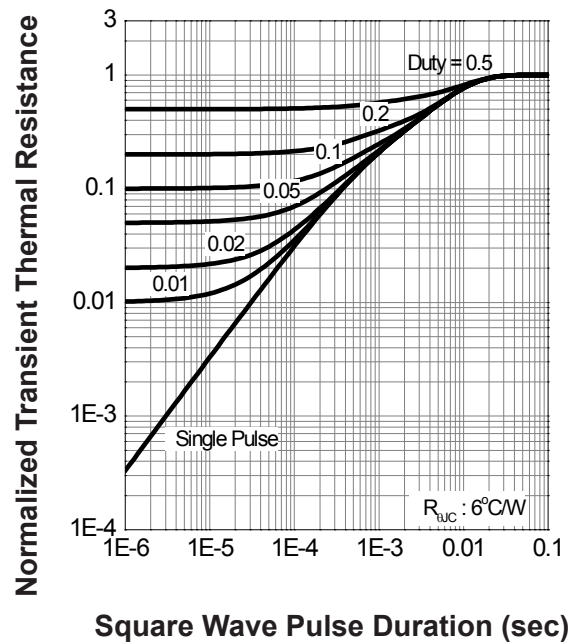
N Channel Typical Operating Characteristics(Cont.)

Gate-Source On Resistance

Gate Threshold Voltage

Drain-Source On Resistance

Source-Drain Diode Forward


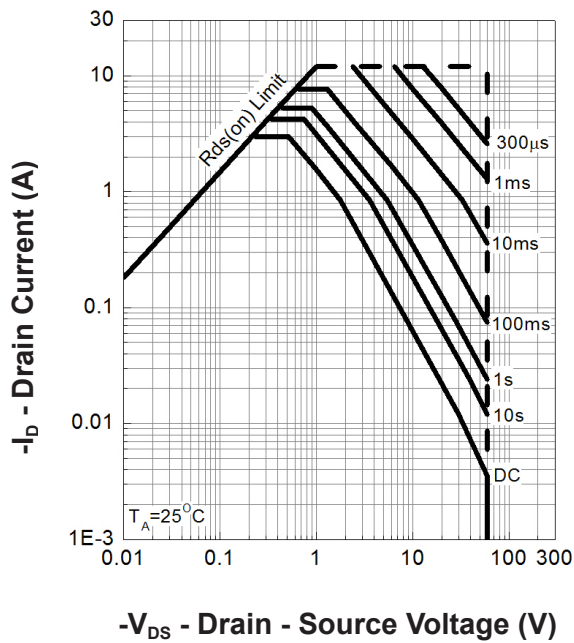
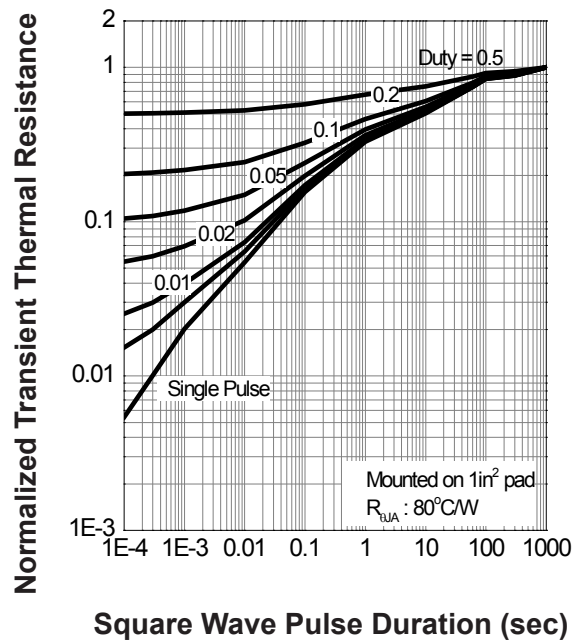
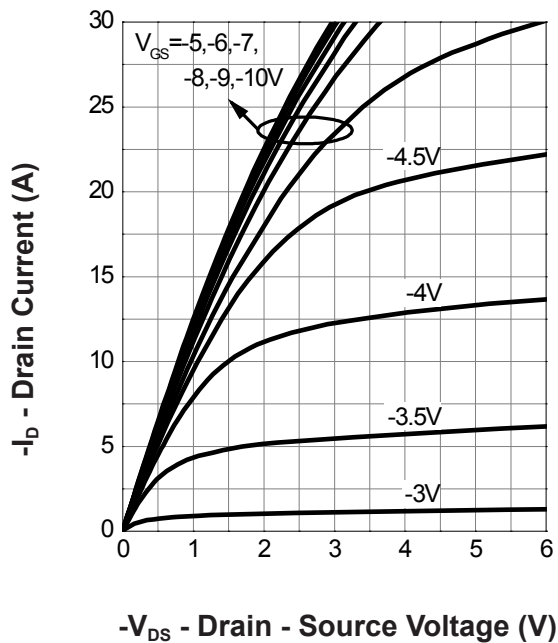
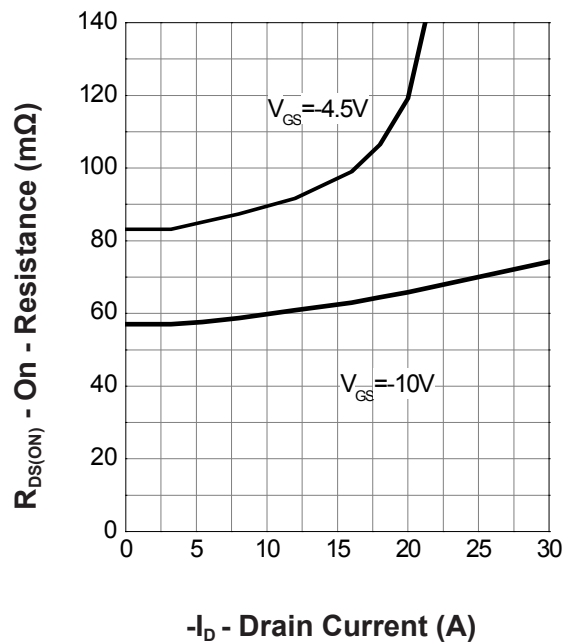
N Channel Typical Operating Characteristics(Cont.)

Capacitance

Gate Charge

Transfer Characteristics


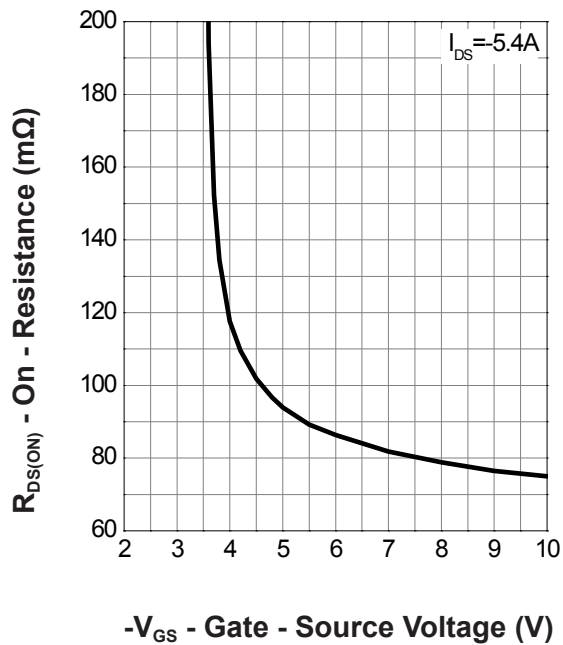
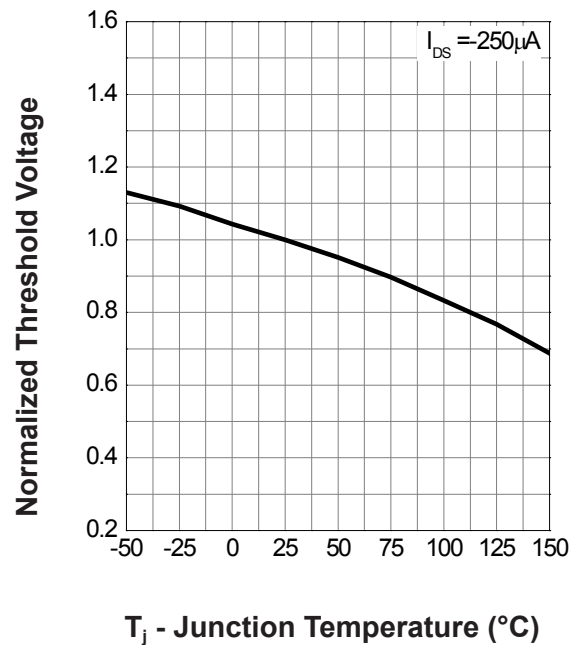
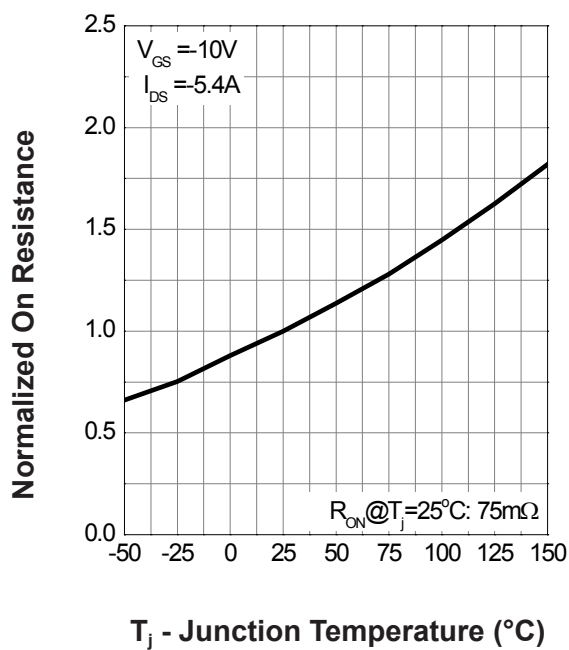
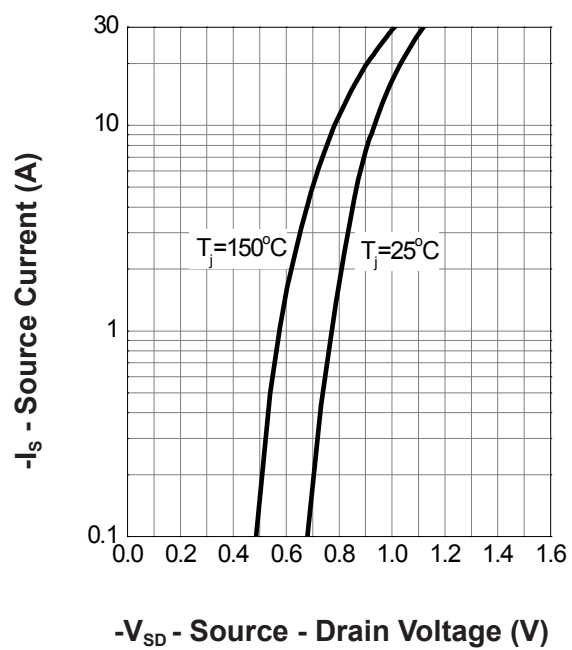
P Channel Typical Operating Characteristics

Power Dissipation

Drain Current

Safe Operation Area

Thermal Transient Impedance


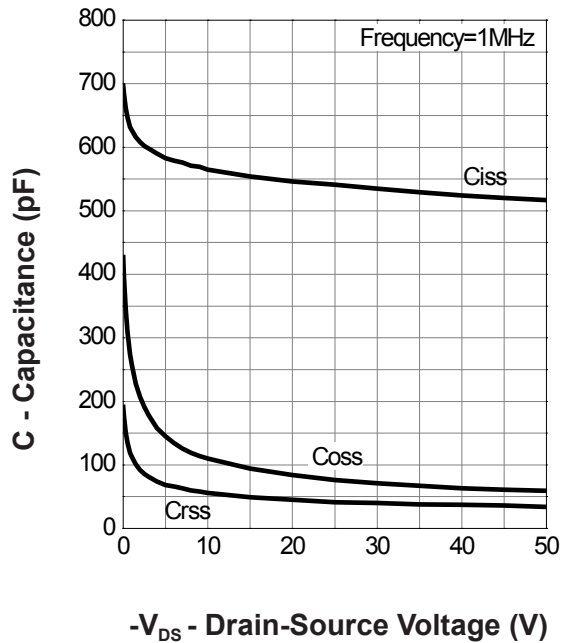
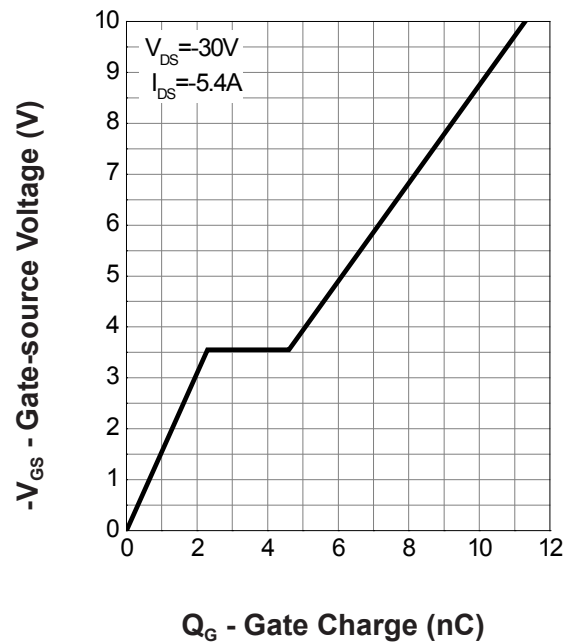
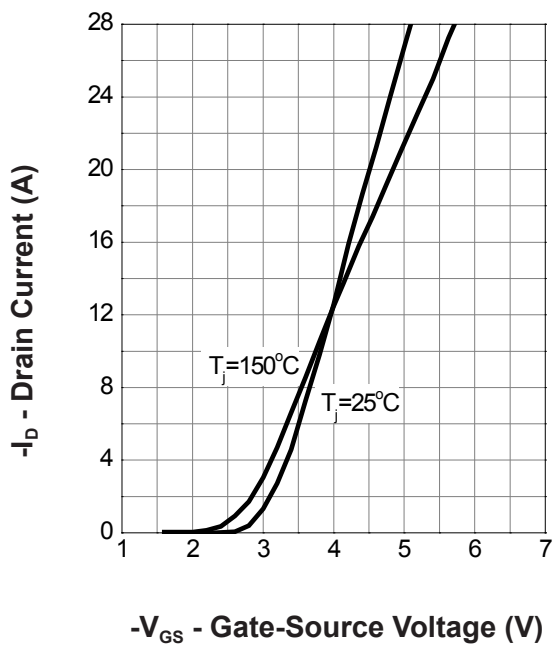
P Channel Typical Operating Characteristics(Cont.)

Safe Operation Area

Thermal Transient Impedance

Output Characteristics

Drain-Source On Resistance


P Channel Typical Operating Characteristics(Cont.)

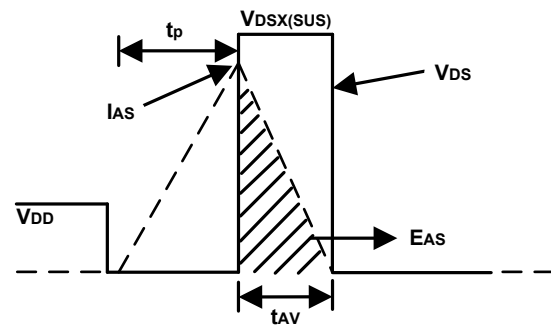
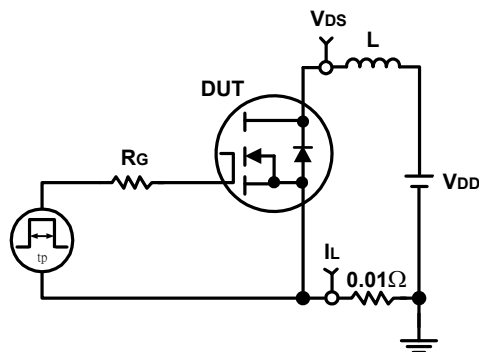
Gate-Source On Resistance

Gate Threshold Voltage

Drain-Source On Resistance

Source-Drain Diode Forward


P Channel Typical Operating Characteristics(Cont.)

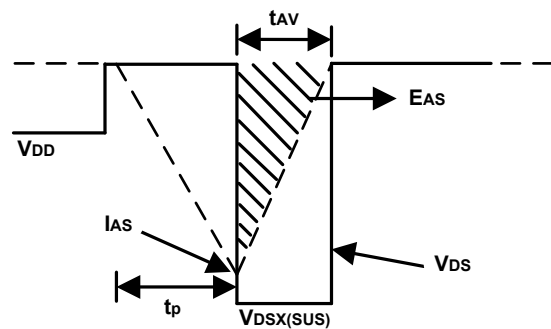
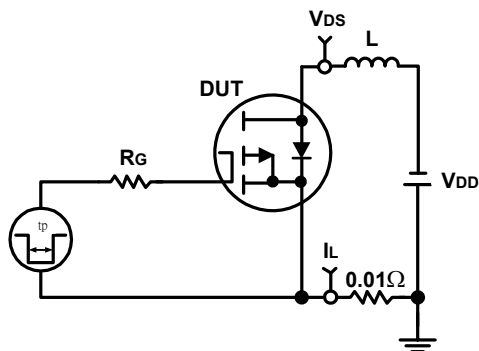
Capacitance

Gate Charge

Transfer Characteristics


Avalanche Test Circuit and Waveforms

N Channel

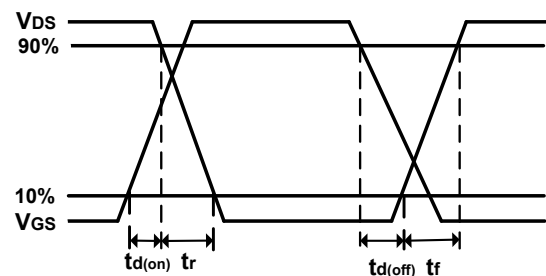
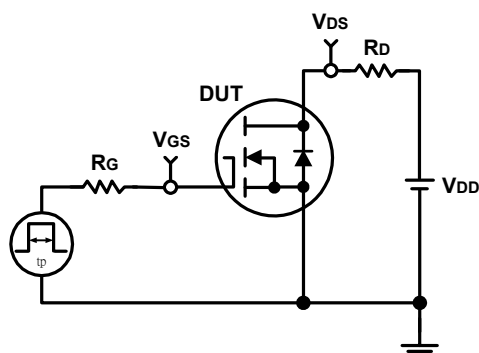


P Channel

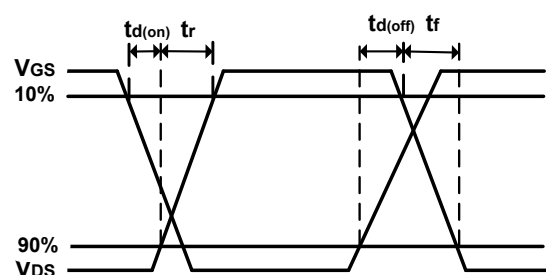
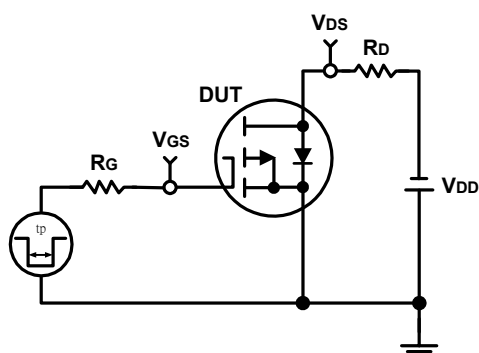


Switching Time Test Circuit and Waveforms

N Channel

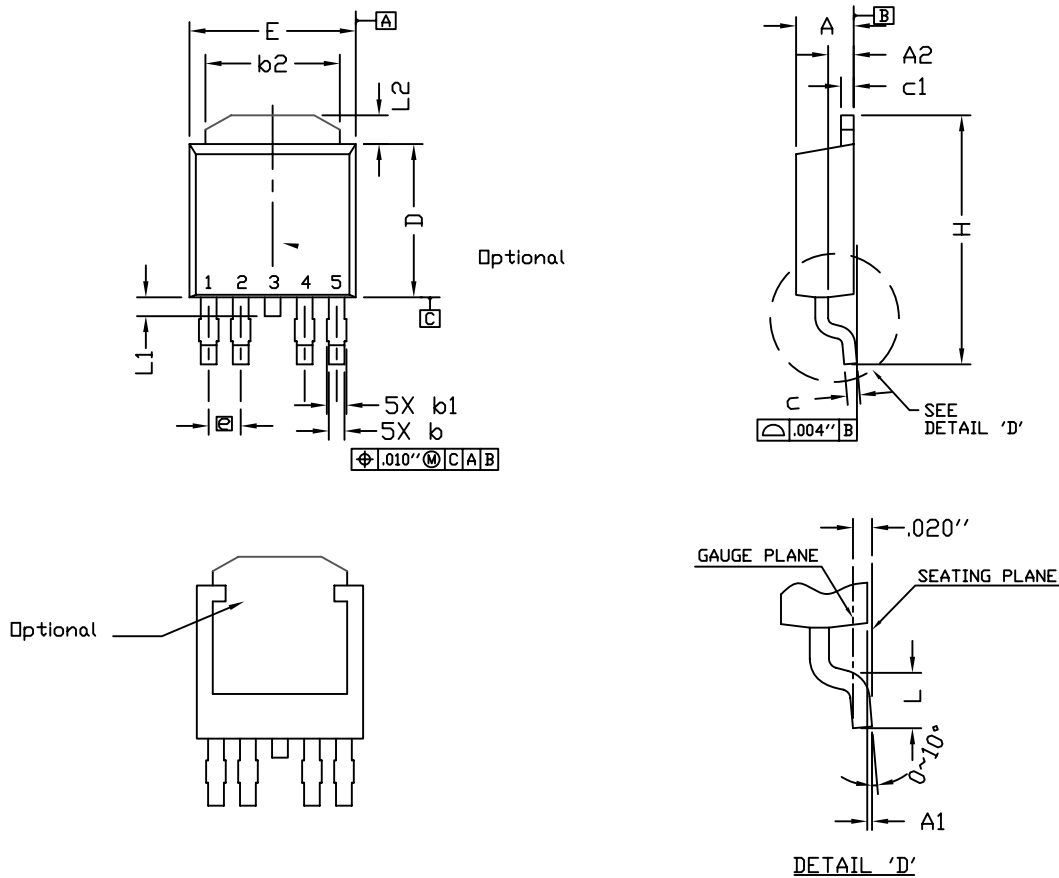


P Channel

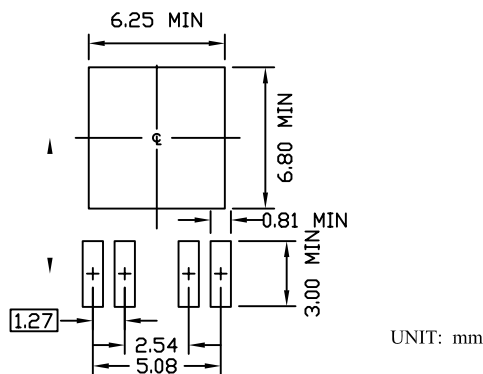


Package Information

TO-252-4



RECOMMENDED LAND PATTERN



NOTE

1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS. MOLD FLASH SHOULD BE LESS THAN 6 MIL.
2. DIMENSION L IS MEASURED IN GAUGE PLANE.
3. TOLERANCE 0.10 mm UNLESS OTHERWISE SPECIFIED.
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. REFER TO JEDEC TO-252 (AD).

SYMBOL	DIMENSION IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	2.184	2.286	2.388	0.086	0.090	0.094
A1	0.000	----	0.127	0.000	----	0.005
A2	0.889	----	1.143	0.035	----	0.045
b	0.508	----	0.711	0.020	----	0.028
b1	0.584	----	0.787	0.023	----	0.031
b2	4.953	----	5.461	0.195	----	0.215
c	0.457	0.508	0.610	0.018	0.020	0.024
c1	0.457	----	0.610	0.018	----	0.024
D	5.969	6.096	6.223	0.235	0.240	0.245
E	6.350	6.604	6.731	0.250	0.260	0.265
e	1.270 BSC.			0.050 BSC.		
H	9.398	----	10.414	0.370	----	0.410
L	1.270	----	2.032	0.050	----	0.080
L1	----	----	1.016	----	----	0.040
L2	0.889	----	1.270	0.035	----	0.050