N-Channel 60 V (D-S), MOSFET

PRODUCT SUMMARY			
V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)[a]	Q_g (Typ.)
60	0.031 at V_{GS} = 10 V	9.1	6.5 nC
	0.045 at V_{GS} = 4.5 V	7.6	

FEATURES

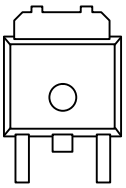
- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- 100 % R_g and UIS Tested
- Compliant to RoHS Directive 2002/95/EC

RoHS COMPLIANT
HALOGEN FREE

APPLICATIONS

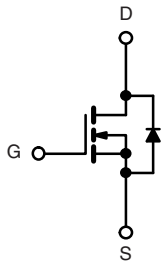
- DC/DC Converters

TO-252



Drain Connected to Tab

Top View



N-Channel MOSFET

Ordering Information: SUD23N06-31-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS (T_A = 25 °C, unless otherwise noted)				
Parameter		**Symbol**	**Limit**	**Unit**
Drain-Source Voltage		V_{DS}	60	V
Gate-Source Voltage		V_{GS}	± 20	
Continuous Drain Current (T_J = 150 °C)	T_C = 25 °C	I_D	21.4	A
	T_C = 70 °C		17.1	
	T_A = 25 °C		9.1[a]	
	T_A = 70 °C		7.6[a]	
Pulsed Drain Current		I_{DM}	50	
Continuous Source-Drain Diode Current	T_C = 25 °C	I_S	20.8	
	T_A = 25 °C		3.8[a]	
Single Pulse Avalanche Current	L = 0.1 mH	I_{AS}	20	
Avalanche Energy		E_{AS}	20	mJ
Maximum Power Dissipation	T_C = 25 °C	P_D	31.25	W
	T_C = 70 °C		20	
	T_A = 25 °C		5.7[a]	
	T_A = 70 °C		3.6[a]	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	- 55 to 150	°C

THERMAL RESISTANCE RATINGS					
Parameter		**Symbol**	**Typical**	**Maximum**	**Unit**
Maximum Junction-to-Ambient[a]	t ≤ 10 s	R_{thJA}	18	22	°C/W
Maximum Junction-to-Case	Steady State	R_{thJC}	3.2	4.0	

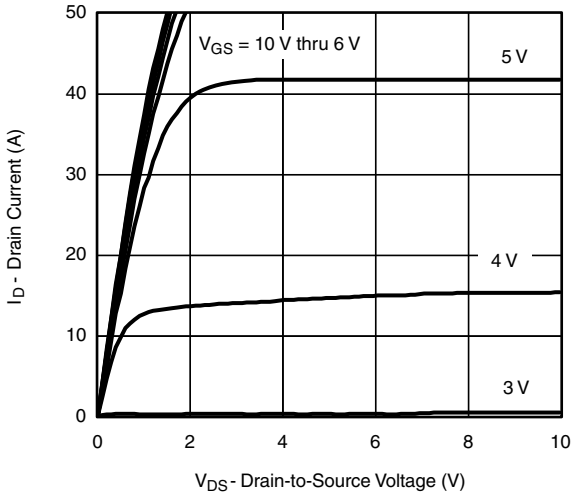
Notes:
a. Surface mounted on 1" x 1" FR4 board, t ≤ 10 s.

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)						
Parameter	**Symbol**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA	60			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	I_D = 250 µA		65		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			- 6.3		
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA	1.0		3.0	V
Gate-Source Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 20 V			± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 60 V, V_{GS} = 0 V			1	µA
		V_{DS} = 60 V, V_{GS} = 0 V, T_J = 70 °C			20	
On-State Drain Current[a]	$I_{D(on)}$	$V_{DS} \geq$ 5 V, V_{GS} = 10 V	50			A
Drain-Source On-State Resistance[a]	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 15 A		0.025	0.031	Ω
		V_{GS} = 4.5 V, I_D = 10 A		0.037	0.045	
Forward Transconductance[a]	g_{fs}	V_{DS} = 15 V, I_D = 15 A		20		S
Dynamic[b]						
Input Capacitance	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V, f = 1 MHz		670		pF
Output Capacitance	C_{oss}			140		
Reverse Transfer Capacitance	C_{rss}			60		
Total Gate Charge	Q_g	V_{DS} = 30 V, V_{GS} = 10 V, I_D = 23 A		11	17	nC
		V_{DS} = 30 V, V_{GS} = 4.5 V, I_D = 23 A		6.5	13	
Gate-Source Charge	Q_{gs}			3.0		
Gate-Drain Charge	Q_{gd}			3.0		
Gate Resistance	R_g	f = 1 MHz		1.6	3.2	Ω
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 30 V, R_L = 1.3 Ω $I_D \cong$ 23 A, V_{GEN} = 4.5 V, R_g = 1 Ω		18	30	ns
Rise Time	t_r			250	400	
Turn-Off Delay Time	$t_{d(off)}$			35	55	
Fall Time	t_f			68	110	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 30 V, R_L = 1.3 Ω $I_D \cong$ 23 A, V_{GEN} = 10 V, R_g = 1 Ω		8	15	
Rise Time	t_r			15	25	
Turn-Off Delay Time	$t_{d(off)}$			30	45	
Fall Time	t_f			25	40	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	T_C = 25 °C			20.8	A
Pulse Diode Forward Current[a]	I_{SM}				50	
Body Diode Voltage	V_{SD}	I_S = 15 A		1.0	1.5	V
Body Diode Reverse Recovery Time	t_{rr}	I_F = 15 A, dI/dt = 100 A/µs, T_J = 25 °C		30	60	ns
Body Diode Reverse Recovery Charge	Q_{rr}			35	70	nC
Reverse Recovery Fall Time	t_a			20		ns
Reverse Recovery Rise Time	t_b			10		

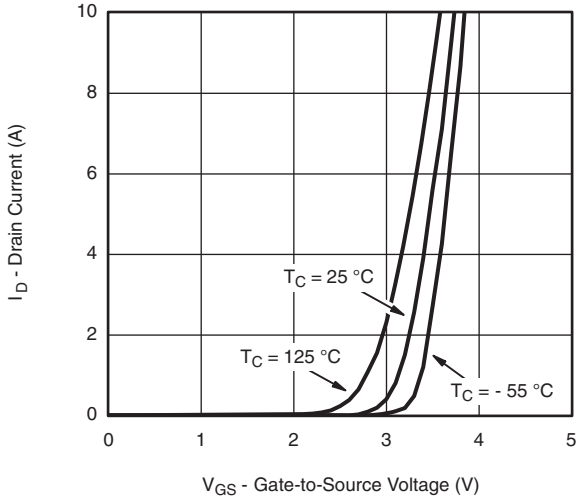
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

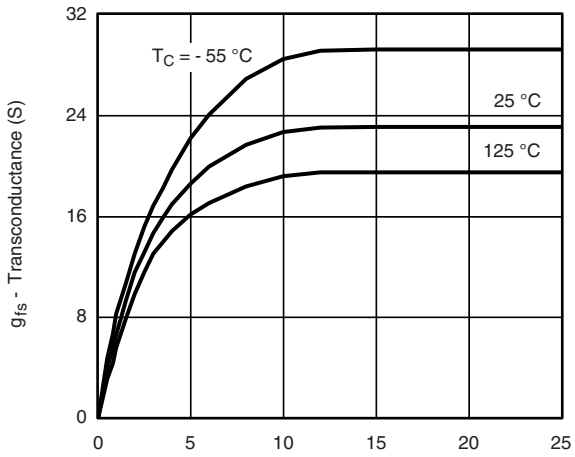
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



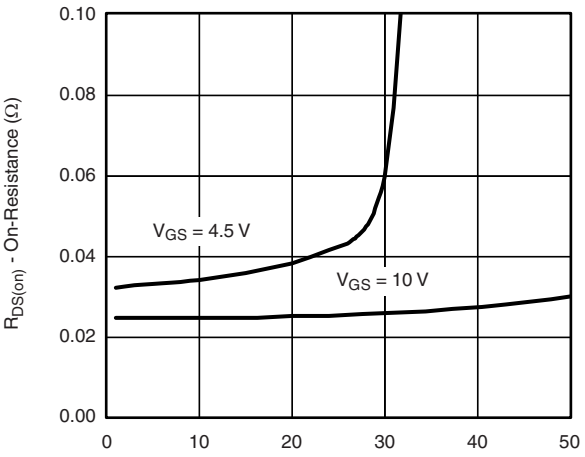
Output Characteristics



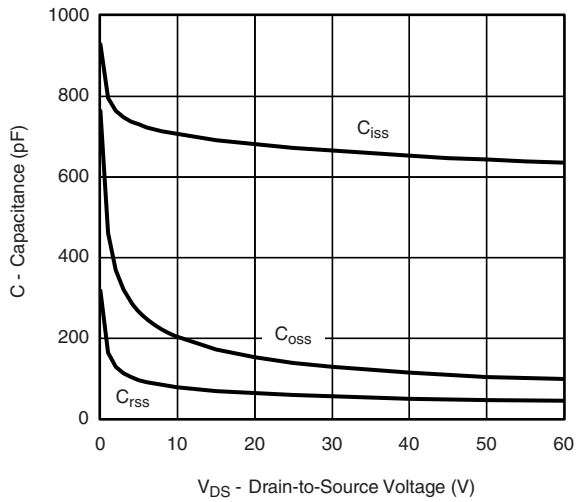
Transfer Characteristics



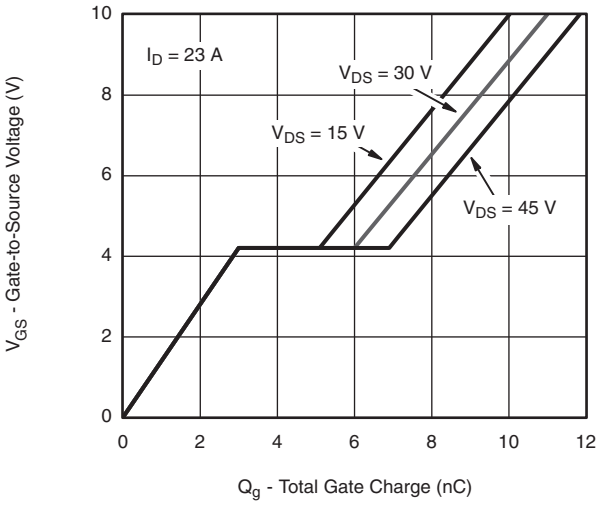
Transconductance



On-Resistance vs. Drain Current

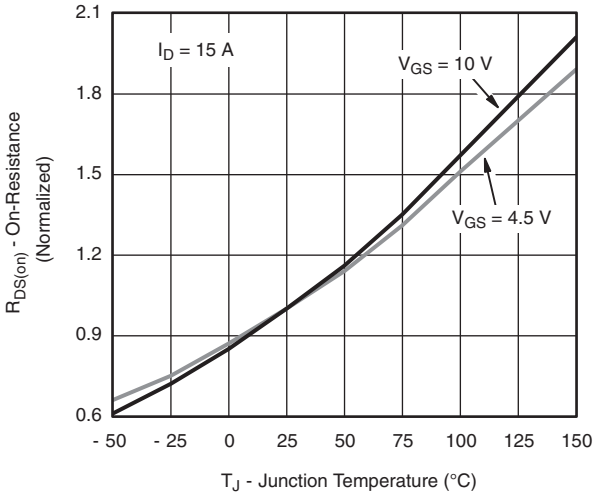


Capacitance

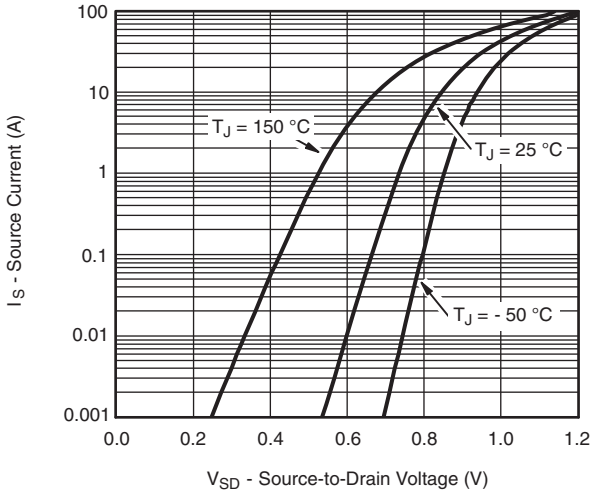


Gate Charge

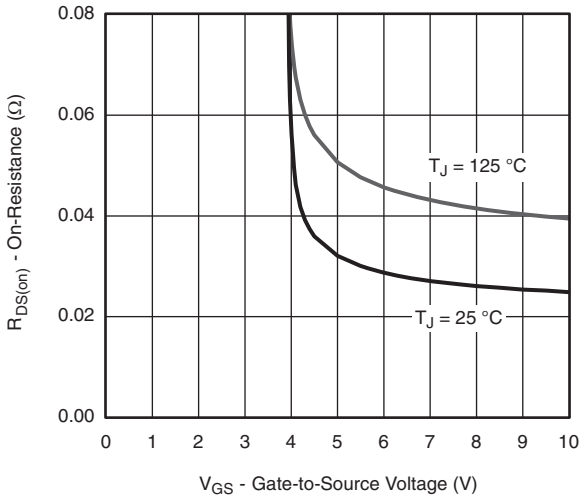
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



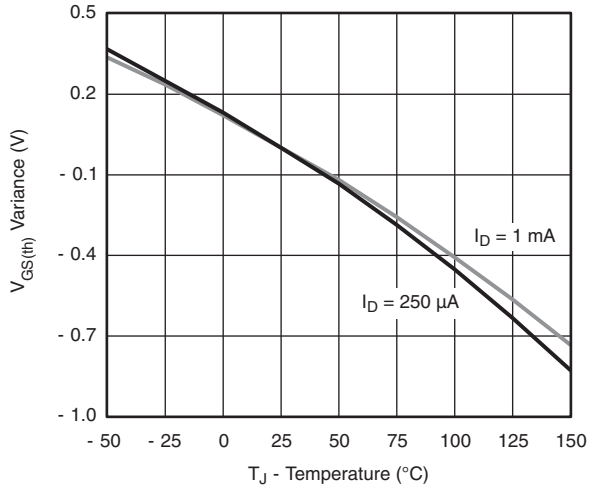
On-Resistance vs. Junction Temperature



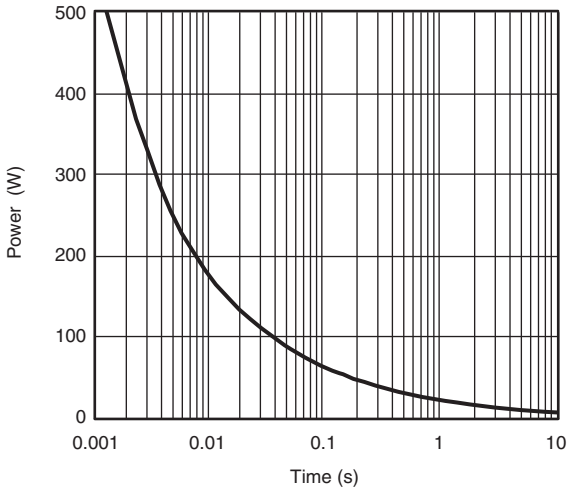
Source-Drain Diode Forward Voltage



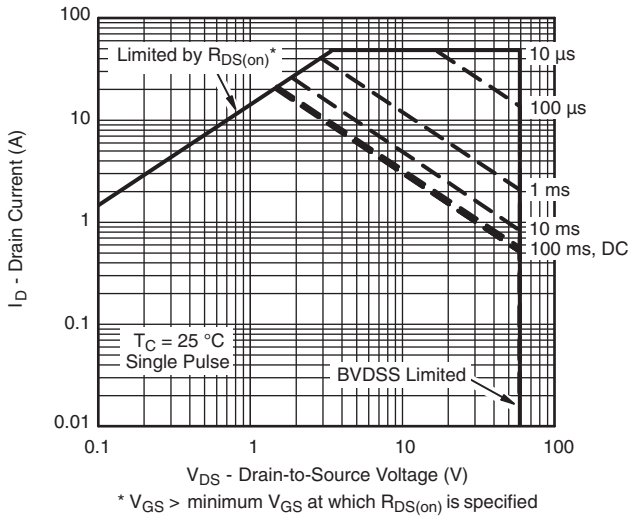
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



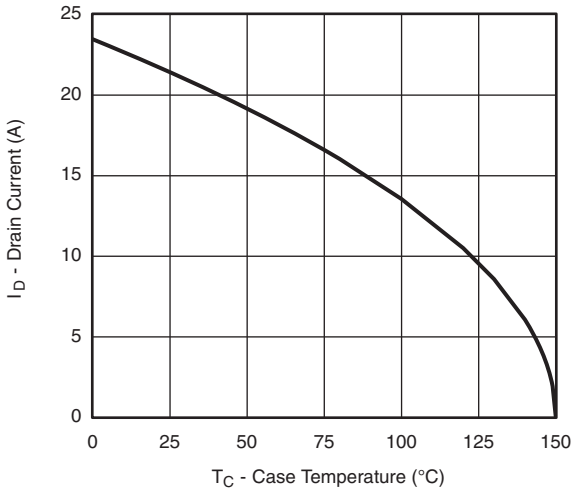
Single Pulse Power, Junction-to-Ambient



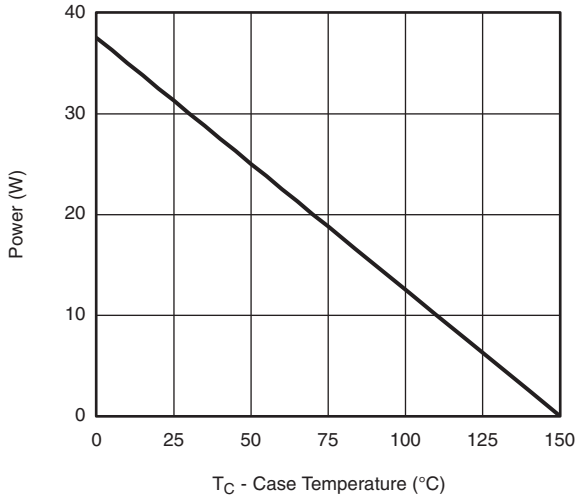
* V_{GS} > minimum V_{GS} at which $R_{DS(on)}$ is specified

Single Pulse Power, Junction-to-Case

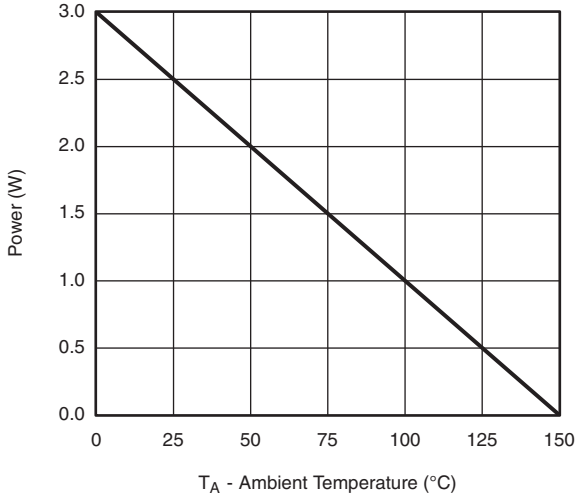
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*, Junction-to-Case



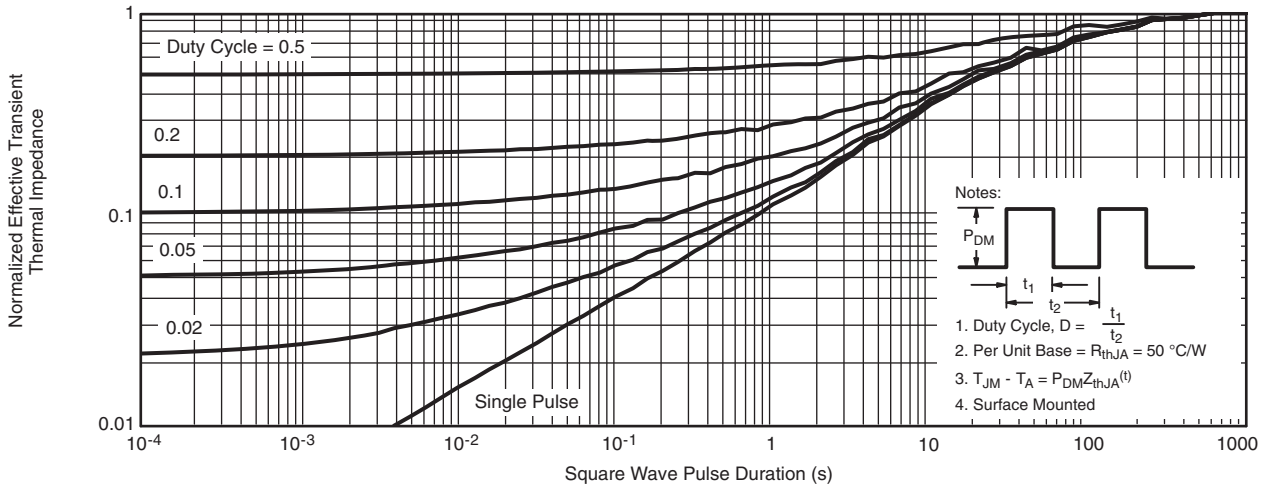
Power, Junction-to-Case



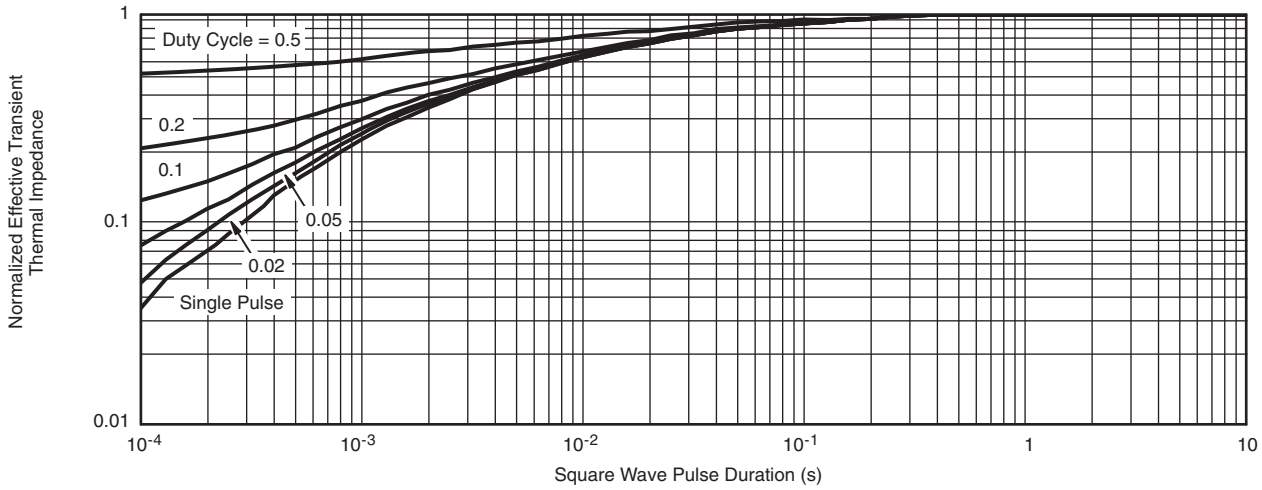
Power, Junction-to-Ambient

* The power dissipation P_D is based on $T_{J(max)}$ = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Ambient

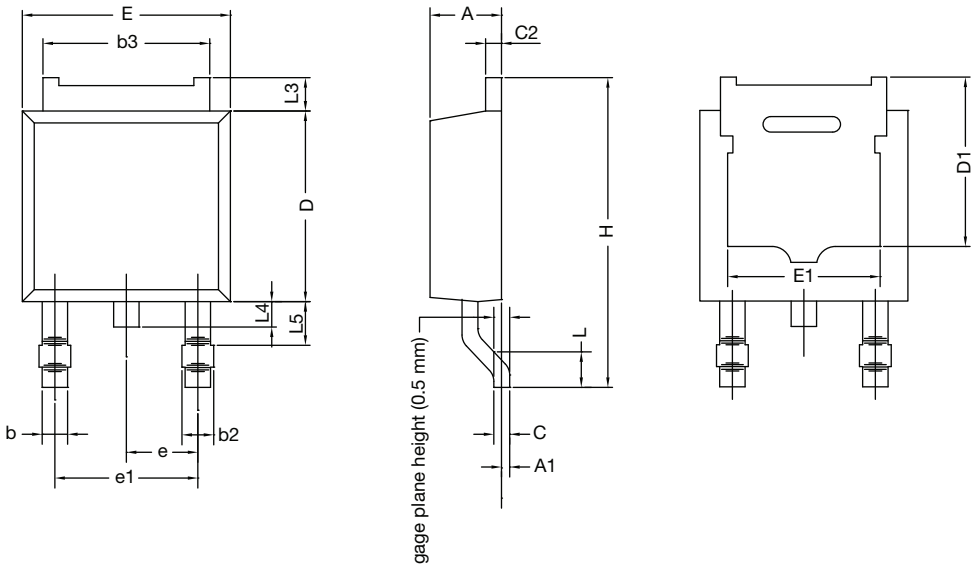


Normalized Thermal Transient Impedance, Junction-to-Case

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TO-252AA Case Outline

VERSION 1: FACILITY CODE = Y



	MILLIMETERS	
DIM.	MIN.	MAX.
A	2.18	2.38
A1	-	0.127
b	0.64	0.88
b2	0.76	1.14
b3	4.95	5.46
C	0.46	0.61
C2	0.46	0.89
D	5.97	6.22
D1	4.10	-
E	6.35	6.73
E1	4.32	-
H	9.40	10.41
e	2.28 BSC	
e1	4.56 BSC	
L	1.40	1.78
L3	0.89	1.27
L4	-	1.02
L5	1.01	1.52

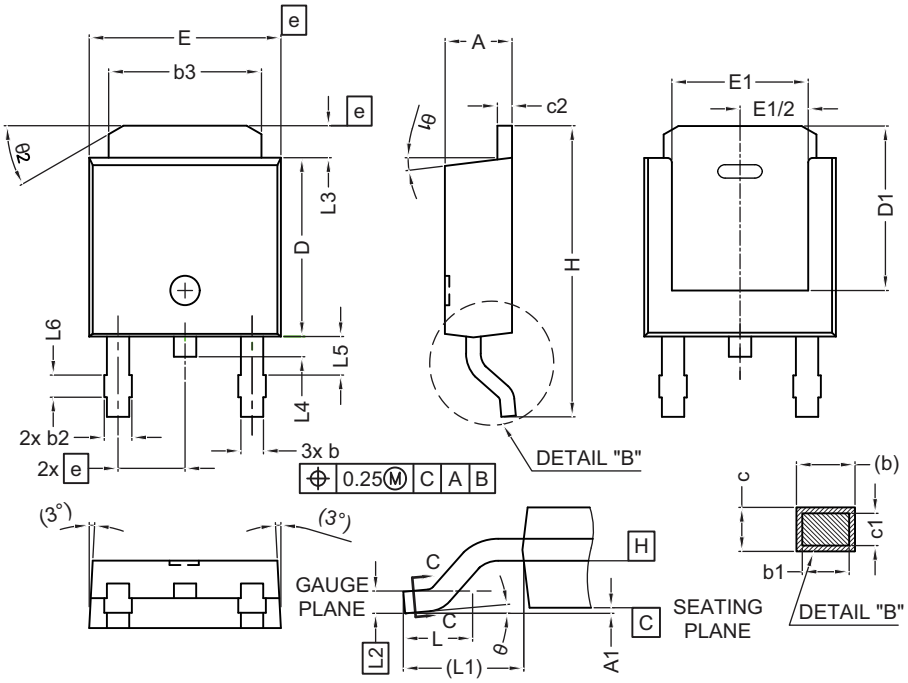
Note

- Dimension L3 is for reference only

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VERSION 2: FACILITY CODE = N



	MILLIMETERS	
DIM.	MIN.	MAX.
A	2.18	2.39
A1	-	0.13
b	0.65	0.89
b1	0.64	0.79
b2	0.76	1.13
b3	4.95	5.46
c	0.46	0.61
c1	0.41	0.56
c2	0.46	0.60
D	5.97	6.22
D1	5.21	-
E	6.35	6.73
E1	4.32	-
e	2.29 BSC	
H	9.94	10.34

	MILLIMETERS	
DIM.	MIN.	MAX.
L	1.50	1.78
L1	2.74 ref.	
L2	0.51 BSC	
L3	0.89	1.27
L4	-	1.02
L5	1.14	1.49
L6	0.65	0.85
θ	0°	10°
θ1	0°	15°
θ2	25°	35°

Notes

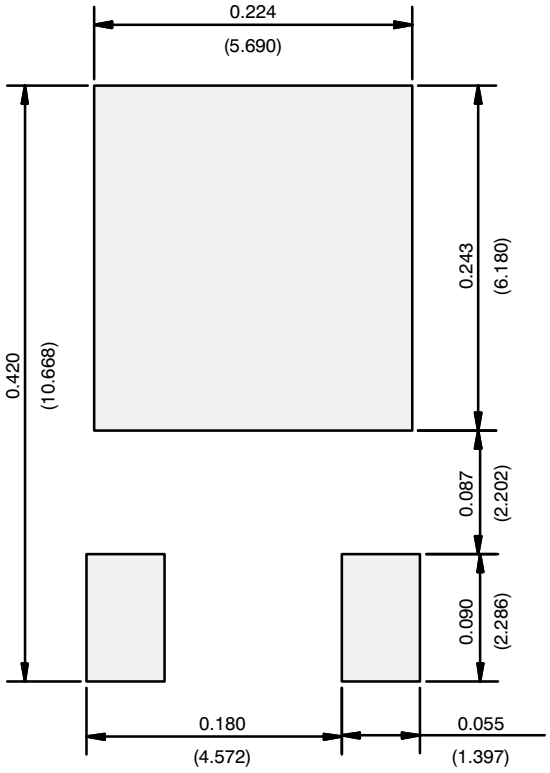
- Dimensioning and tolerance confirm to ASME Y14.5M-1994
- All dimensions are in millimeters. Angles are in degrees
- Heat sink side flash is max. 0.8 mm
- Radius on terminal is optional

ECN: E22-0399-Rev. R, 03-Oct-2022
DWG: 5347

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RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads
Dimensions in Inches/(mm)

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APPLICATION NOTE

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