N-Channel 60 V (D-S) MOSFET

PRODUCT SUMMARY		
V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (mA)
60	3 at V_{GS} = 10 V	240

FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- Low On-Resistance: 3 Ω
- Low Threshold: 2 V (typ.)
- Low Input Capacitance: 25 pF
- Fast Switching Speed: 7.5 ns
- Low Input and Output Leakage
- Compliant to RoHS Directive 2002/95/EC

Pb-free
RoHS COMPLIANT
HALOGEN FREE Available

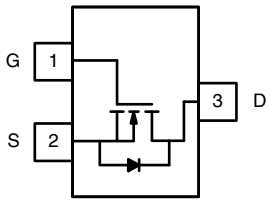
BENEFITS

- Low Offset Voltage
- Low-Voltage Operation
- Easily Driven Without Buffer
- High-Speed Circuits
- Low Error Voltage

APPLICATIONS

- Direct Logic-Level Interface: TTL/CMOS
- Drivers: Relays, Solenoids, Lamps, Hammers, Display, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relays

TO-236
(SOT-23)



Top View

Marking Code: 7E

Ordering Information: 2N7002E-T1-E3 (Lead (Pb)-free)
2N7002E-T1-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_A = 25 °C	I_D	240	mA
	T_A = 70 °C		190	
Pulsed Drain Current[a]		I_{DM}	1300	
Power Dissipation	T_A = 25 °C	P_D	0.35	W
	T_A = 70 °C		0.22	
Thermal Resistance, Junction-to-Ambient		R_{thJA}	357	°C/W
Operating Junction and Storage Temperature Range		T_J, T_{stg}	- 55 to 150	°C

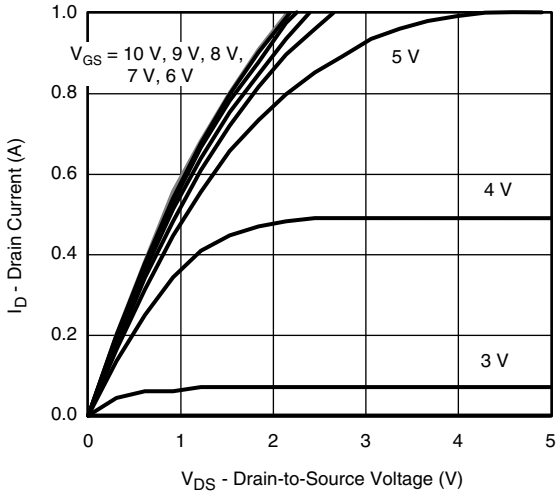
Notes:
a. Pulse width limited by maximum junction temperature.

SPECIFICATIONS (T_A = 25 °C, unless otherwise noted)						
			Limits			
Parameter	**Symbol**	**Test Conditions**	**Min.**	**Typ.[a]**	**Max.**	**Unit**
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 10 µA	60	68		V
Gate-Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA	1	2	2.5	
Gate-Body Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 15 V			± 10	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 = 125 °C			500	
On-State Drain Current[b]	$I_{D(on)}$	V_{GS} = 10 V, V_{DS} = 7.5 V	800	1300		mA
		V_{GS} = 4.5 V, V_{DS} = 10 V	500	700		
Drain-Source On-Resistance[b]	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 250 mA		1.2	3	Ω
		V_{GS} = 4.5 V, I_D = 200 mA		1.8	4	
Forward Transconductance[b]	g_{fs}	V_{DS} = 15 V, I_D = 200 mA		600		mS
Diode Forward Voltage	V_{SD}	I_S = 200 mA, V_{GS} = 0 V		0.85	1.2	V
Dynamic[a]						
Total Gate Charge	Q_g	V_{DS} = 10 V, V_{GS} = 4.5 V $I_D \cong$ 250 mA		0.4	0.6	nC
Gate-Source Charge	Q_{gs}			0.06		
Gate-Drain Charge	Q_{gd}			0.06		
Input Capacitance	C_{iss}	V_{DS} = 5 V, V_{GS} = 0 V, f = 1 MHz		21		pF
Output Capacitance	C_{oss}			7		
Reverse Transfer Capacitance	C_{rss}			2.5		
Switching[a, c]						
Turn-On Time	$t_{d(on)}$	V_{DD} = 10 V, R_L = 40 Ω $I_D \cong$ 250 mA, V_{GEN} = 10 V, R_g = 10 Ω		13	20	ns
Turn-Off Time	$t_{d(off)}$			18	25	

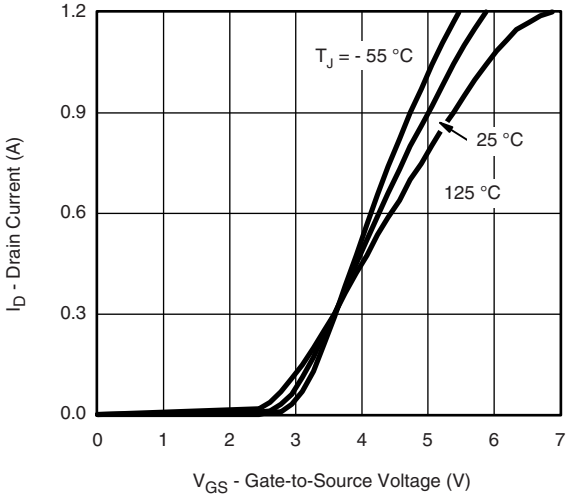
Notes:
a. For DESIGN AID ONLY, not subject to production testing.
b. Pulse test: pulse width ≤ 300 µs duty cycle ≤ 2 %.
c. Switching time is essentially independent of operating temperature.

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.

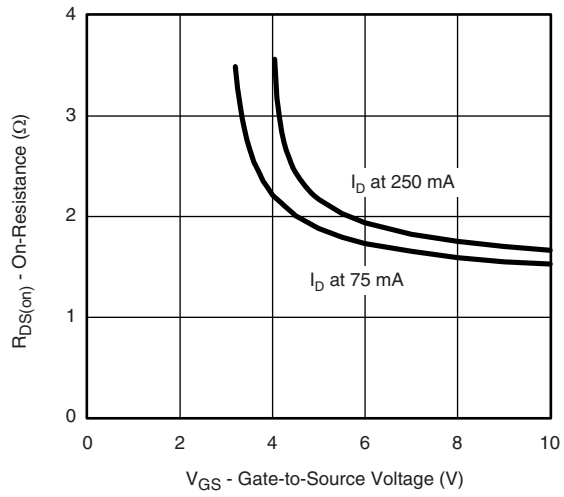
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



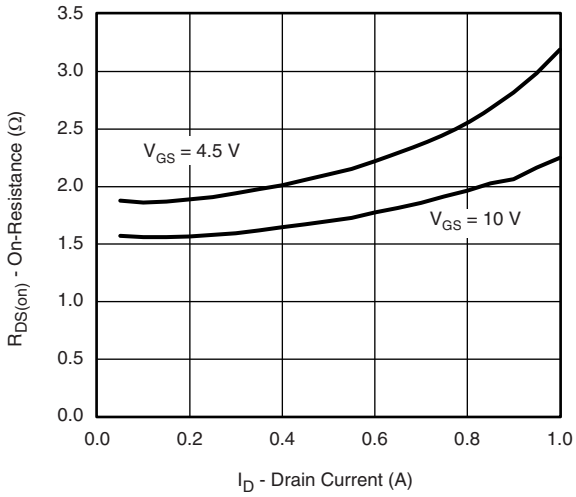
Output Characteristics



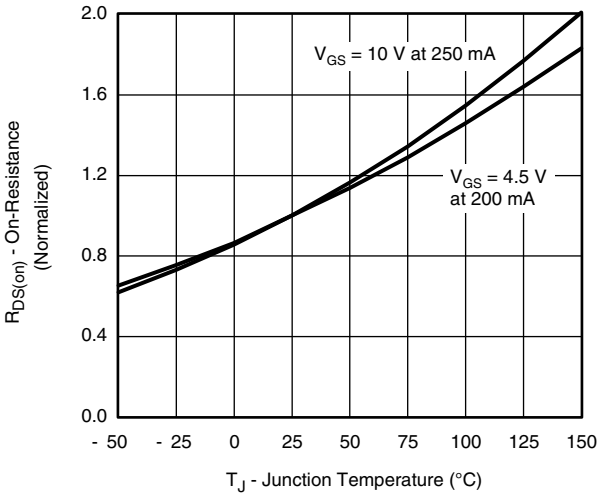
Transfer Characteristics



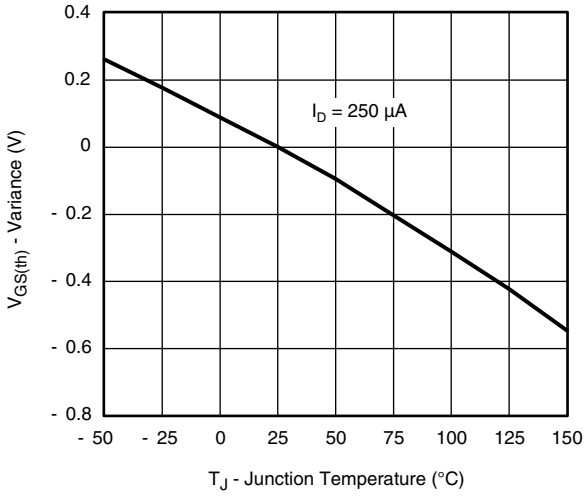
On-Resistance vs. Gate-Source Voltage



On-Resistance vs. Drain Current

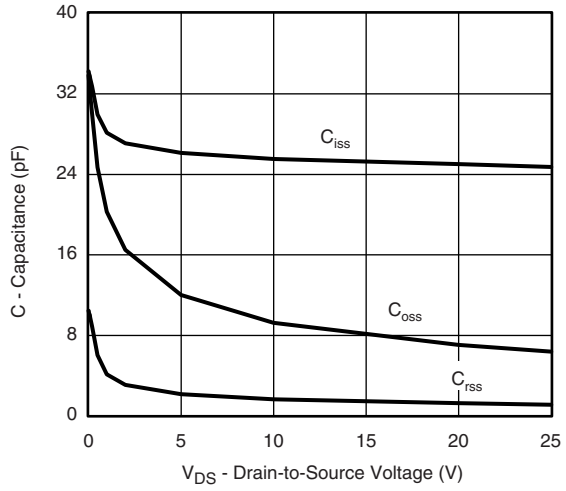


On-Resistance vs. Junction Temperature

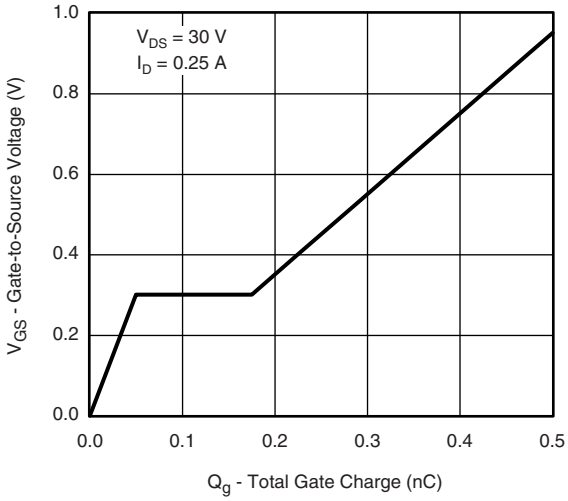


Threshold Voltage Variance Over Temperature

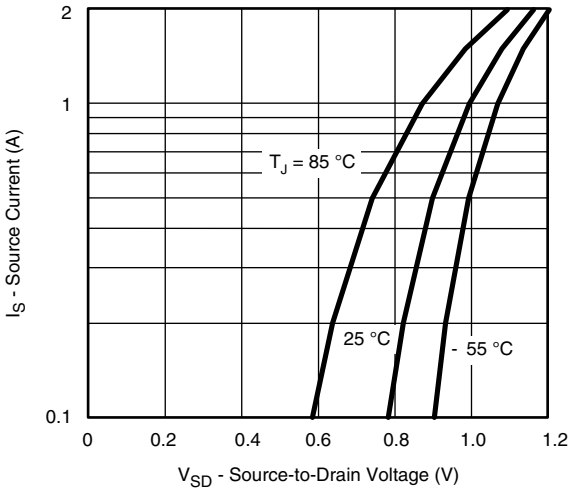
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Capacitance



Gate Charge



Source-Drain Diode Forward Voltage

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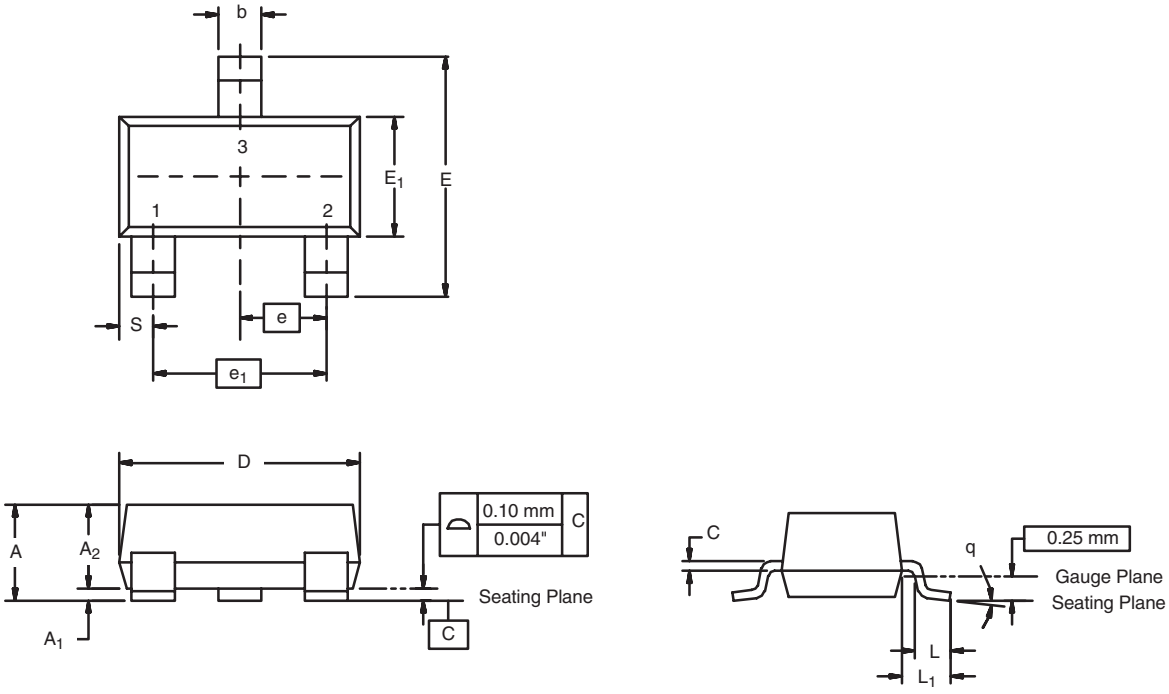
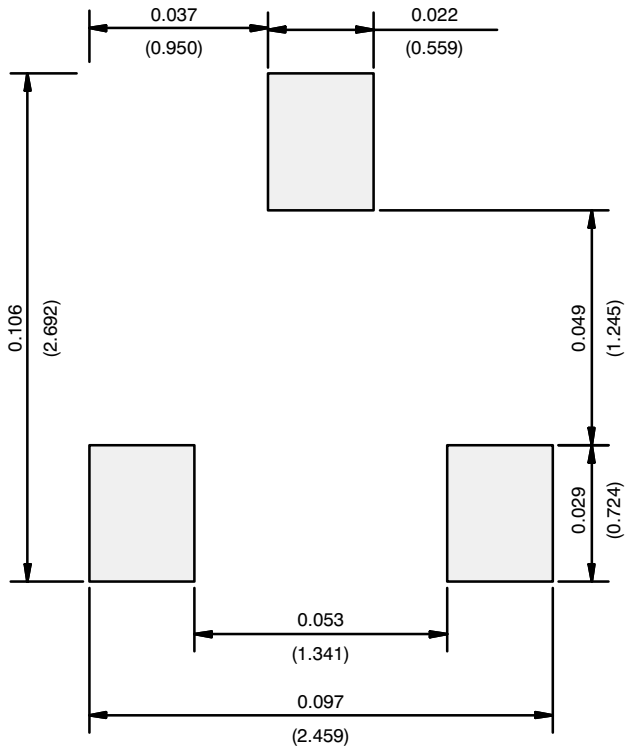
SOT-23 (TO-236): 3-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	0.89	1.12	0.035	0.044
A_1	0.01	0.10	0.0004	0.004
A_2	0.88	1.02	0.0346	0.040
b	0.35	0.50	0.014	0.020
c	0.085	0.18	0.003	0.007
D	2.80	3.04	0.110	0.120
E	2.10	2.64	0.083	0.104
E_1	1.20	1.40	0.047	0.055
e	0.95 BSC		0.0374 Ref	
e_1	1.90 BSC		0.0748 Ref	
L	0.40	0.60	0.016	0.024
L_1	0.64 Ref		0.025 Ref	
S	0.50 Ref		0.020 Ref	
q	3°	8°	3°	8°
ECN: S-03946-Rev. K, 09-Jul-01 DWG: 5479				

RECOMMENDED MINIMUM PADS FOR SOT-23



Recommended Minimum Pads
Dimensions in Inches/(mm)

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