

Small Signal MOSFET

60 V, 310 mA, Single, N-Channel, SOT-23

2N7002E

Features

- Low R_{DS(on)}
- Small Footprint Surface Mount Package
- Trench Technology
- S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Low Side Load Switch
- Level Shift Circuits
- DC-DC Converter
- Portable Applications i.e. DSC, PDA, Cell Phone, etc.

MAXIMUM RATINGS ($T_J = 25^{\circ}C$ unless otherwise stated)

Rating		Symbol	Value	Unit
Drain-to-Source Voltage		V _{DSS}	60	V
Gate-to-Source Voltage		V _{GS}	±20	V
Drain Current (Note 1) Steady State t < 5 s	T _A = 25°C T _A = 85°C T _A = 25°C T _A = 85°C	I _D	260 190 310 220	mA
Power Dissipation (Note 1) Steady State t < 5 s		P _D	300 420	mW
Pulsed Drain Current (t _p = 10 μ	s)	I _{DM}	1.2	Α
Operating Junction and Storage Temperature Range)	T _J , T _{STG}	-55 to +150	°C
Source Current (Body Diode)		Is	300	mA
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		TL	260	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

THERMAL CHARACTERISTICS

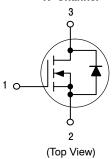
Characteristic	Symbol	Max	Unit
Junction-to-Ambient - Steady State (Note 1)	$R_{\theta JA}$	417	°C/W
Junction-to-Ambient - t ≤ 5 s (Note 1)	$R_{\theta JA}$	300	

Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces)

V _{(BR)DSS}	R _{DS(on)} MAX	I _D MAX (Note 1)
60 V	3.0 Ω @ 4.5 V	310 mA
	2.5 Ω @ 10 V	

Simplified Schematic

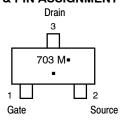
N-Channel



MARKING DIAGRAM & PIN ASSIGNMENT



SOT-23 CASE 318 STYLE 21



703 = Device Code M = Date Code ■ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping [†]
2N7002ET1G, S2N7002ET1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
2N7002ET7G, S2N7002ET7G	SOT-23 (Pb-Free)	3500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

ELECTRICAL CHARACTERISTICS (T_{.1} = 25°C unless otherwise specified)

Parameter	Symbol	Test Co	ndition	Min	Тур	Max	Units
OFF CHARACTERISTICS							
Drain-to-Source Breakdown Voltage	V _{(BR)DSS}	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$		60			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V _{(BR)DSS} /T _J				75		mV/°C
Zero Gate Voltage Drain Current	I _{DSS} V _{GS} = 0 V, V _{DS} = 60 V	T _J = 25°C			1	μΑ	
			T _J = 125°C			500	1
Gate-to-Source Leakage Current	I _{GSS}	V _{DS} = 0 V, V _{GS} = ±20 V				±100	nA
ON CHARACTERISTICS (Note 2)				•			
Gate Threshold Voltage	V _{GS(TH)}	$V_{GS} = V_{DS}$	I _D = 250 μA	1.0		2.5	V
Negative Threshold Temperature Coefficient	V _{GS(TH)} /T _J				4.4		mV/°C
Drain-to-Source On Resistance	R _{DS(on)}	V _{GS} = 10 V,	I _D = 240 mA		0.86	2.5	Ω
		$V_{GS} = 4.5 \text{ V}, I_D = 50 \text{ mA}$			1.1	3.0	•
Forward Transconductance	9FS	V _{DS} = 5 V, I _D = 200 mA			530		mS
CHARGES AND CAPACITANCES				•			
Input Capacitance	C _{ISS}	$V_{GS} = 0 \text{ V, f} = 1 \text{ MHz,}$ $V_{DS} = 25 \text{ V}$			26.7	40	pF
Output Capacitance	C _{OSS}				4.6		1
Reverse Transfer Capacitance	C _{RSS}				2.9		
Total Gate Charge	Q _{G(TOT)}				0.81		nC
Threshold Gate Charge	Q _{G(TH)}	V _{GS} = 5 V,	V _{DS} = 10 V;		0.31		
Gate-to-Source Charge	Q_{GS}		40 mA		0.48		
Gate-to-Drain Charge	Q_{GD}	1			0.08		
SWITCHING CHARACTERISTICS, V _{GS}	= V (Note 3)						
Turn-On Delay Time	t _{d(ON)}				1.7		ns
Rise Time	t _r	V_{GS} = 10 V, V_{DD} = 30 V, I_{D} = 200 mA, R_{G} = 10 Ω			1.2		
Turn-Off Delay Time	t _{d(OFF)}				4.8		
Fall Time	t _f			3.6			
DRAIN-SOURCE DIODE CHARACTER	ISTICS						
Forward Diode Voltage	V _{SD}	V _{GS} = 0 V,	T _J = 25°C		0.79	1.2	V
		I _S = 200 mA	T _J = 85°C		0.7		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

- Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%
 Switching characteristics are independent of operating junction temperatures

TYPICAL CHARACTERISTICS

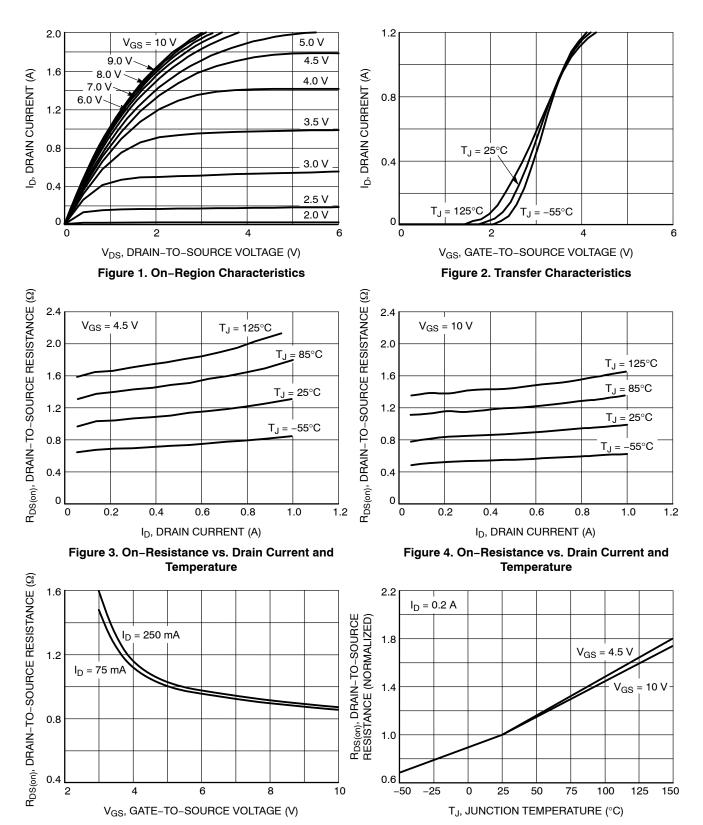


Figure 5. On-Resistance vs. Gate-to-Source Voltage

Figure 6. On-Resistance Variation with Temperature

TYPICAL CHARACTERISTICS

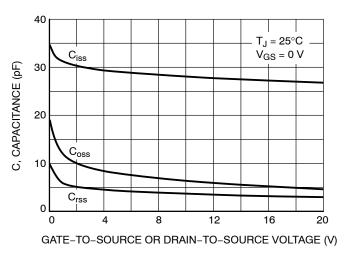


Figure 7. Capacitance Variation

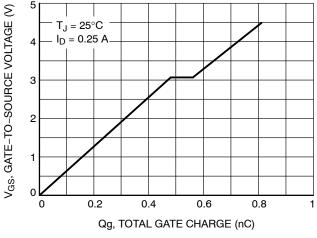


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

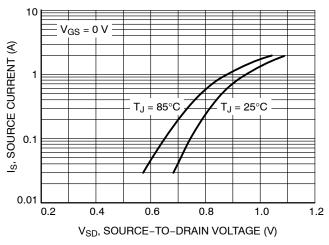


Figure 9. Diode Forward Voltage vs. Current

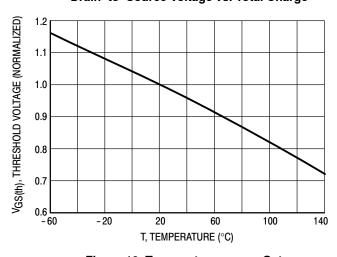


Figure 10. Temperature versus Gate Threshold Voltage

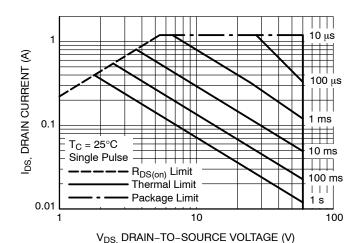


Figure 11. Safe Operating Area

TYPICAL CHARACTERISTICS

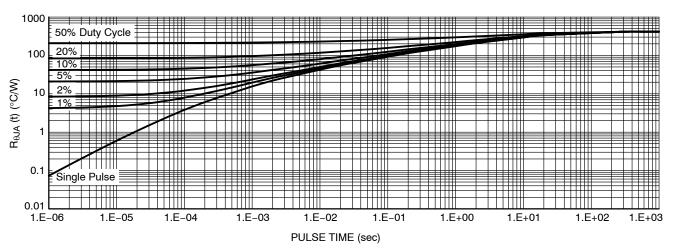


Figure 12. Thermal Impedance

MILLIMETERS

MIN

0.89

0.01

0.37

0.08

2.80

1.20

1.78

0.30

0.35

2.10

O°

NOM

1.00

0.06

0.44

0.14

2.90

1.30

1.90

0.43

0.54

2.40





SOT-23 (TO-236) 2.90x1.30x1.00 1.90P **CASE 318 ISSUE AU**

DATE 14 AUG 2024

MAX

1.11

0.10

0.50

0.20

3.04

1.40

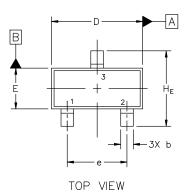
2.04

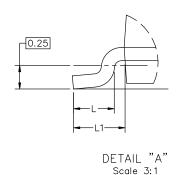
0.55

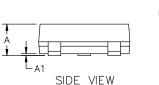
0.69

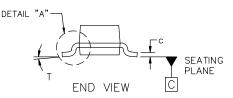
2.64

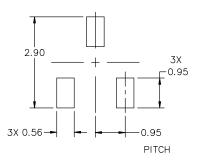
10°











NOTES:

DIM

Α

Α1

b

С

D

Ε

е L

L1

HE

Τ

- DIMENSIONING AND TOLERANCING 1. PER ASME Y14.5M, 2018. CONTROLLING DIMENSIONS:
- MILLIMETERS.
- MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE
- BASE MATERIAL.
 DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code

= Date Code

= Pb-Free Package



* For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

STYLES ON PAGE 2

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^{*}This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "=", may or may not be present. Some products may not follow the Generic Marking.

SOT-23 (TO-236) 2.90x1.30x1.00 1.90P CASE 318 ISSUE AU

DATE 14 AUG 2024

STYLE 1 THRU 5: CANCELLED	STYLE 6: PIN 1. BASE 2. EMITTER 3. COLLECTOR	STYLE 7: PIN 1. EMITTER 2. BASE 3. COLLECTOR	STYLE 8: PIN 1. ANODE 2. NO CONNECTION 3. CATHODE	1	
STYLE 9:	STYLE 10:	STYLE 11:	STYLE 12: PIN 1. CATHODE 2. CATHODE 3. ANODE	STYLE 13:	STYLE 14:
PIN 1. ANODE	PIN 1. DRAIN	PIN 1. ANODE		PIN 1. SOURCE	PIN 1. CATHODE
2. ANODE	2. SOURCE	2. CATHODE		2. DRAIN	2. GATE
3. CATHODE	3. GATE	3. CATHODE-ANODE		3. GATE	3. ANODE
STYLE 15:	STYLE 16:	STYLE 17:	STYLE 18:	STYLE 19:	STYLE 20: PIN 1. CATHODE 2. ANODE 3. GATE
PIN 1. GATE	PIN 1. ANODE	PIN 1. NO CONNECTION	PIN 1. NO CONNECTION	N PIN 1. CATHODE	
2. CATHODE	2. CATHODE	2. ANODE	2. CATHODE	2. ANODE	
3. ANODE	3. CATHODE	3. CATHODE	3. ANODE	3. CATHODE-ANODI	
STYLE 21:	STYLE 22:	STYLE 23:	STYLE 24:	STYLE 25:	STYLE 26:
PIN 1. GATE	PIN 1. RETURN	PIN 1. ANODE	PIN 1. GATE	PIN 1. ANODE	PIN 1. CATHODE
2. SOURCE	2. OUTPUT	2. ANODE	2. DRAIN	2. CATHODE	2. ANODE
3. DRAIN	3. INPUT	3. CATHODE	3. SOURCE	3. GATE	3. NO CONNECTION
STYLE 27: PIN 1. CATHODE 2. CATHODE 3. CATHODE	STYLE 28: PIN 1. ANODE 2. ANODE 3. ANODE				

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