

N-CHANNEL ENHANCEMENT MODE FIELD EFFECT TRANSISTOR
Product Summary

BV _{DSS}	R _{DS(ON)} Max	I _D Max T _A = +25°C
60V	5Ω @ V _{GS} = 10V	210mA
	7.5Ω @ V _{GS} = 5V	170mA

Features and Benefits

- Low On-Resistance
- Low Gate Threshold Voltage
- Low Input Capacitance
- Fast Switching Speed
- Small Surface Mount Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Notes 3)**
- **For automotive applications requiring specific change control (i.e.: parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please refer to the related automotive grade (Q-suffix) part. A listing can be found at <https://www.diodes.com/products/automotive/automotive-products/>.**
- **This part is qualified to JEDEC standards (as references in AEC-Q) for High Reliability. <https://www.diodes.com/quality/product-definitions/>**
- **An Automotive-Compliant Part is Available Under Separate Datasheet ([2N7002Q](#))**

Description and Applications

This MOSFET has been designed to minimize the on-state resistance (R_{DS(on)}) and yet maintain superior switching performance, making it ideal for high-efficiency power management applications.

- Motor Control
- Power Management Functions

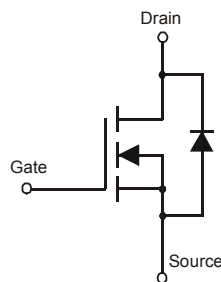
Mechanical Data

- Case: SOT23
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish — Matte Tin Plated Leads. Solderable per MIL-STD-202, Method 208
- Terminal Connections: See Diagram
- Weight: 0.009 grams (Approximate)

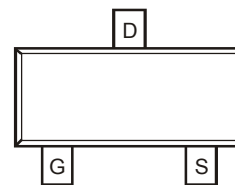
SOT23 (Standard)



Top View



Equivalent Circuit



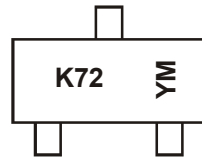
Top View

Ordering Information (Note 4)

Part Number	Case	Packaging
2N7002-7-F	SOT23 (Standard)	3,000/Tape & Reel
2N7002-13-F	SOT23 (Standard)	10,000/Tape & Reel

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
 2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
 4. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

Marking Information



K72 = Product Type Marking Code
 YM = Date Code Marking
 Y or Y = Year (ex: I = 2021)
 M or M = Month (ex: 9 = September)

Date Code Key

Year	2002	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Code	N	I	J	K	L	M	N	O	P	R	S
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D

Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	60	V
Drain-Gate Voltage R _{GS} ≤ 1.0MΩ	V _{DGR}	60	V
Gate-Source Voltage	V _{GSS}	Continuous ±20	V
		Pulsed (Note 8) ±40	
Continuous Drain Current (Note 5) V _{GS} = 10V	Steady State	T _A = +25°C	170
		T _A = +85°C	120
		T _A = +100°C	105
Continuous Drain Current (Note 6) V _{GS} = 10V	Steady State	T _A = +25°C	210
		T _A = +85°C	150
		T _A = +100°C	135
Maximum Continuous Body Diode Forward Current (Note 6)	Continuous Pulsed (Note 8)	I _S	0.2
			0.5
Pulsed Drain Current (10μs Pulse, Duty Cycle = 1%)	I _{DM}	800	mA

Thermal Characteristics (@ T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Total Power Dissipation	P _D	(Note 5) 370	mW
		(Note 6) 540	
Thermal Resistance, Junction to Ambient	R _{θJA}	(Note 5) 348	°C/W
		(Note 6) 241	
Thermal Resistance, Junction to Case	R _{θJC}	91	
Operating and Storage Temperature Range	T _J , T _{STG}	-55 to +150	°C

- Notes:
- Device mounted on FR-4 PCB, with minimum recommended pad layout.
 - Device mounted on 1" x 1" FR-4 PCB with high coverage 2oz. Copper, single sided.
 - Short duration pulse test used to minimize self-heating effect.
 - Guaranteed by design. Not subject to product testing.

Electrical Characteristics (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 7)						
Drain-Source Breakdown Voltage	BV_{DSS}	60	70	—	V	$V_{GS} = 0V, I_D = 10\mu A$
Zero Gate Voltage Drain Current	I_{DSS}	—	—	1.0 500	μA	@ $T_J = +25^\circ\text{C}$ @ $T_J = +125^\circ\text{C}$ $V_{DS} = 60V, V_{GS} = 0V$
Gate-Body Leakage	I_{GSS}	—	—	± 10	nA	$V_{GS} = \pm 20V, V_{DS} = 0V$
ON CHARACTERISTICS (Note 7)						
Gate Threshold Voltage	$V_{GS(th)}$	1.0	—	2.5	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
Static Drain-Source On-Resistance	$R_{DS(on)}$	—	3.2 2.4 4.4	7.5 5.0 13.5	Ω	@ $T_J = +25^\circ\text{C}$ @ $T_J = +25^\circ\text{C}$ @ $T_J = +125^\circ\text{C}$ $V_{GS} = 5.0V, I_D = 0.05A$ $V_{GS} = 10V, I_D = 0.5A$ $V_{GS} = 10V, I_D = 0.5A$
On-State Drain Current	$I_{D(on)}$	0.5	1.0	—	A	$V_{GS} = 10V, V_{DS} = 7.5V$
Forward Transconductance	g_{FS}	80	—	—	mS	$V_{DS} = 10V, I_D = 0.2A$
Diode Forward Voltage	V_{SD}	—	0.78	1.5	V	$V_{GS} = 0V, I_S = 115mA$
DYNAMIC CHARACTERISTICS (Note 8)						
Input Capacitance	C_{iss}	—	22	50	pF	$V_{DS} = 25V, V_{GS} = 0V$ $f = 1.0MHz$
Output Capacitance	C_{oss}	—	11	25	pF	
Reverse Transfer Capacitance	C_{rss}	—	2.0	5.0	pF	
Gate Resistance	R_g	—	120	—	Ω	$V_{DS} = 0V, V_{GS} = 0V,$ $f = 1.0MHz$
Total Gate Charge ($V_{GS} = 4.5V$)	Q_g	—	223	—	pC	$V_{DS} = 10V, I_D = 250mA$
Gate-Source Charge	Q_{gs}	—	82	—		
Gate-Drain Charge	Q_{gd}	—	178	—		
Turn-On Delay Time	$t_{D(on)}$	—	2.8	—	ns	$V_{DD} = 30V, I_D = 0.2A,$ $R_L = 150\Omega, V_{GEN} = 10V,$ $R_{GEN} = 25\Omega$
Turn-On Rise Time	t_R	—	3.0	—		
Turn-Off Delay Time	$t_{D(off)}$	—	7.6	—		
Turn-Off Fall Time	t_F	—	5.6	—		

Notes: 7. Short duration pulse test used to minimize self-heating effect.
8. Guaranteed by design. Not subject to product testing.

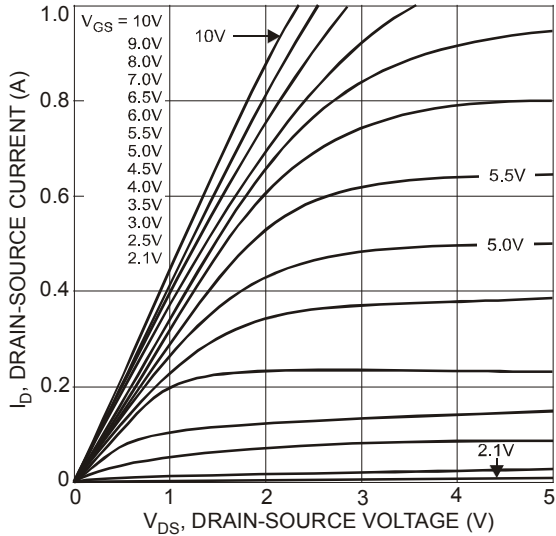


Fig. 1 On-Region Characteristics

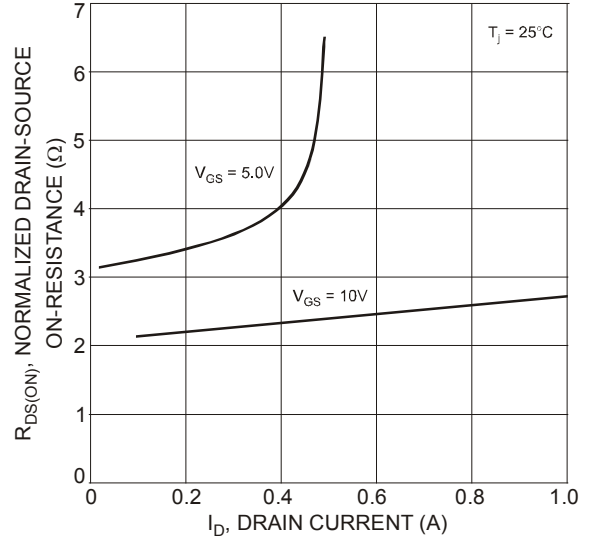


Fig. 2 On-Resistance vs. Drain Current

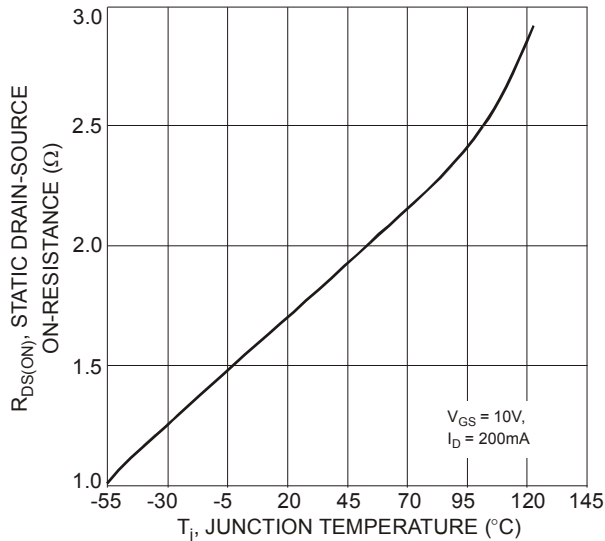


Fig. 3 On-Resistance vs. Junction Temperature

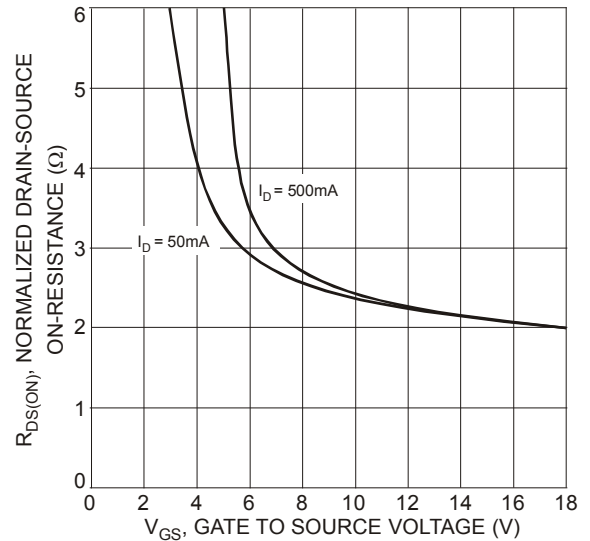


Fig. 4 On-Resistance vs. Gate-Source Voltage

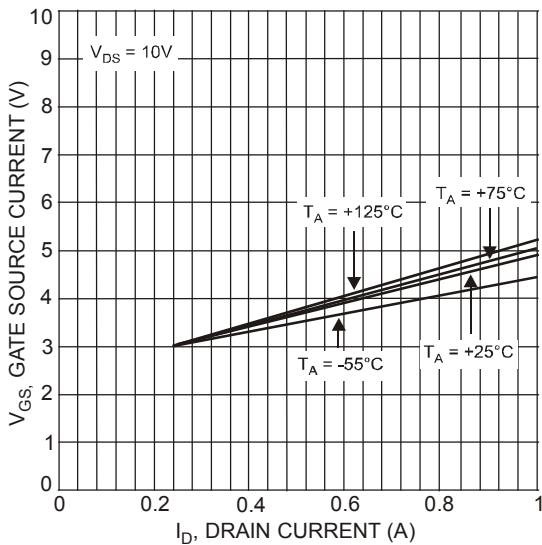


Fig. 5 Typical Transfer Characteristics

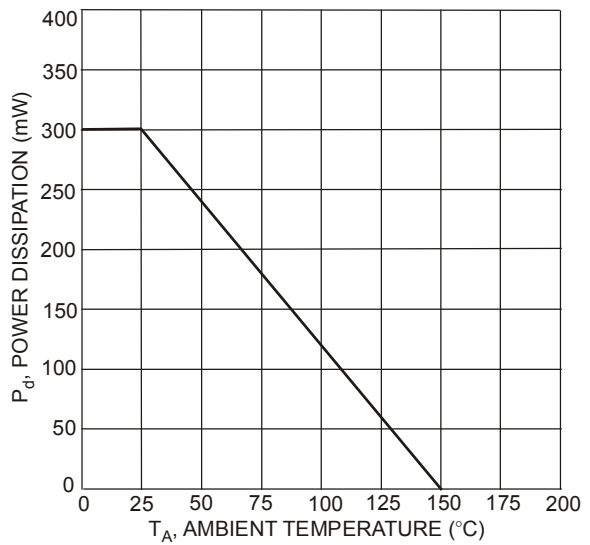
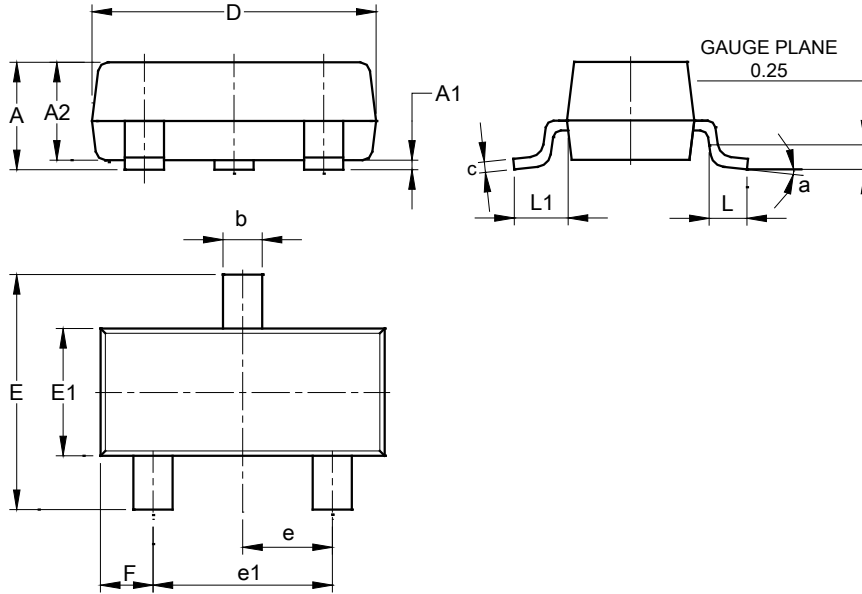


Fig. 6 Max Power Dissipation vs. Ambient Temperature

Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

SOT23 (Standard)

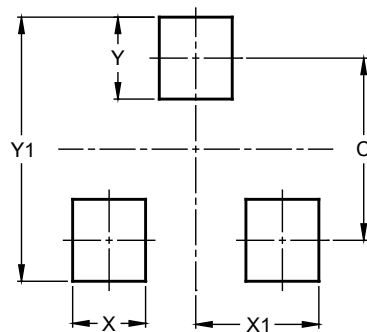


SOT23 (Standard)			
Dim	Min	Max	Typ
A	0.90	1.15	1.025
A1	0.00	0.10	0.05
A2	0.85	1.10	0.975
b	0.30	0.51	0.40
c	0.080	0.202	0.11
D	2.80	3.00	2.90
E	2.25	2.55	2.40
E1	1.20	1.40	1.30
e	0.89	1.03	0.915
e1	1.78	2.05	1.83
F	0.40	0.60	0.535
L1	0.45	0.61	0.55
L	0.25	0.55	0.40
a	0°	8°	--
All Dimensions in mm			

Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

SOT23 (Standard)



Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

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