

**N-CHANNEL ENHANCEMENT MODE FIELD EFFECT TRANSISTOR**
**Product Summary**

$BV_{DSS}$	$R_{DS(ON)}$ Max	$I_D$ Max $T_A = +25^\circ C$
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

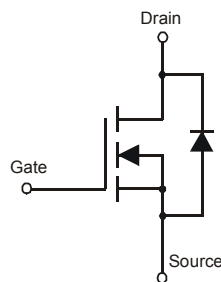
**Mechanical Data**

- 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 <sup>e3</sup>
- Terminal Connections: See Diagram
- Weight: 0.009 grams (Approximate)

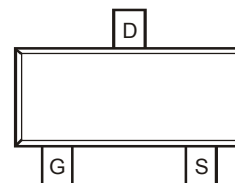
SOT23 (Standard)



Top View



Equivalent Circuit



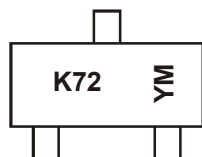
Top View

**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

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

## Maximum Ratings (@T<sub>A</sub> = +25°C, unless otherwise specified.)

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

## Thermal Characteristics (@ T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic		Symbol	Value	Unit
Total Power Dissipation	(Note 5)	P <sub>D</sub>	370	mW
	(Note 6)		540	
Thermal Resistance, Junction to Ambient	(Note 5)	R <sub>θJA</sub>	348	°C/W
	(Note 6)		241	
Thermal Resistance, Junction to Case	(Note 6)	R <sub>θJC</sub>	91	
Operating and Storage Temperature Range		T <sub>J</sub> , T <sub>STG</sub>	-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
<b>OFF CHARACTERISTICS (Note 7)</b>						
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	$\mu A$	$V_{DS} = 60V, V_{GS} = 0V$ $@ T_J = +125^\circ\text{C}$
Gate-Body Leakage	$I_{GSS}$	—	—	$\pm 10$	nA	$V_{GS} = \pm 20V, V_{DS} = 0V$
<b>ON CHARACTERISTICS (Note 7)</b>						
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	$\Omega$	$V_{GS} = 5.0V, I_D = 0.05A$ $V_{GS} = 10V, I_D = 0.5A$ $V_{GS} = 10V, I_D = 0.5A$ $@ T_J = +125^\circ\text{C}$
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	$V_{GS} = 0V, I_S = 115mA$
<b>DYNAMIC CHARACTERISTICS (Note 8)</b>						
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	$C_{riss}$	—	2.0	5.0	pF	
Gate Resistance	$R_g$	—	120	—	$\Omega$	$V_{DS} = 0V, V_{GS} = 0V,$ $f = 1.0MHz$
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.

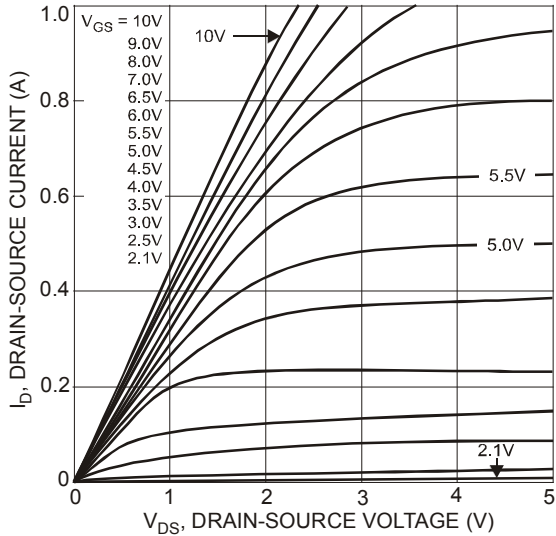


Fig. 1 On-Region Characteristics

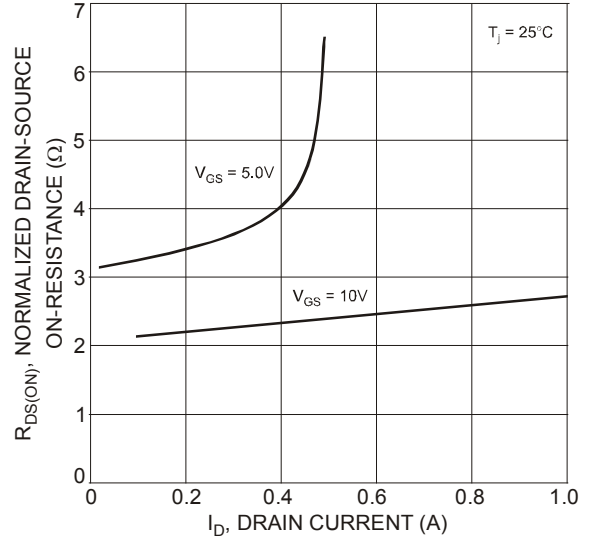


Fig. 2 On-Resistance vs. Drain Current

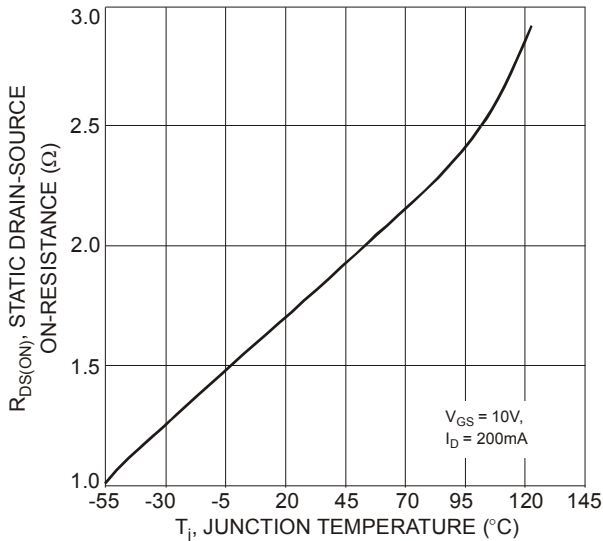


Fig. 3 On-Resistance vs. Junction Temperature

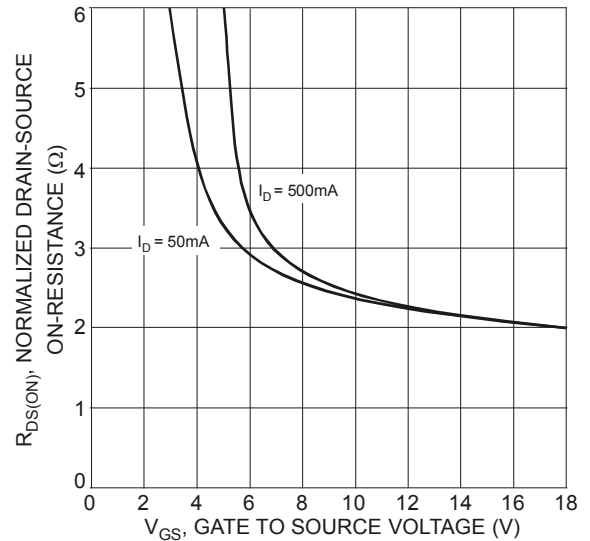


Fig. 4 On-Resistance vs. Gate-Source Voltage

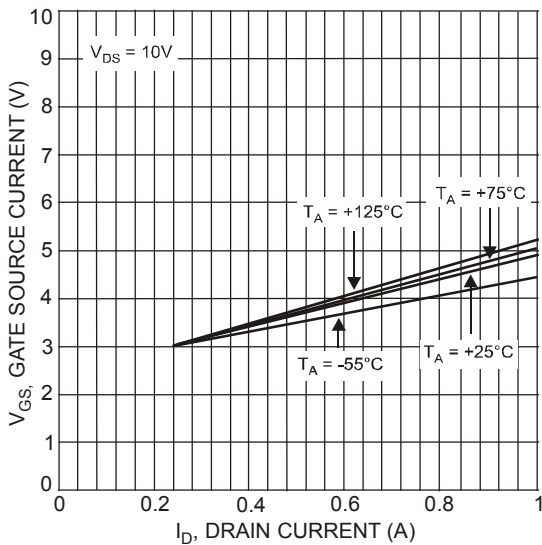


Fig. 5 Typical Transfer Characteristics

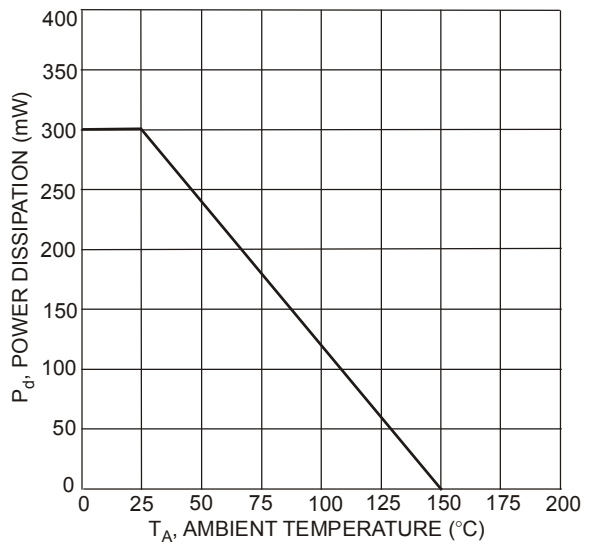
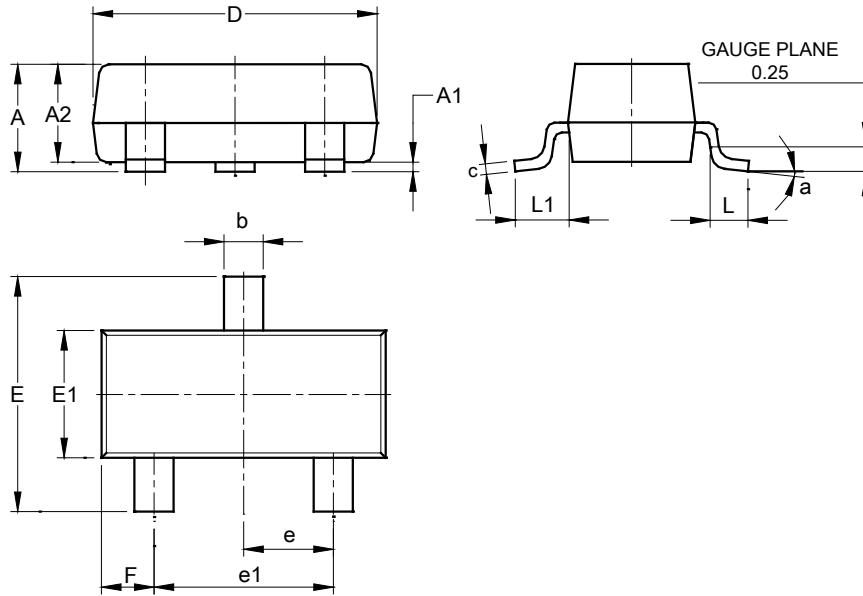


Fig. 6 Max Power Dissipation vs. Ambient Temperature

## Package Outline Dimensions

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

### SOT23 (Standard)

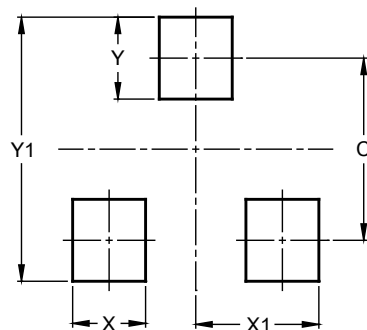


SOT23 (Standard)			
Dim	Min	Max	Typ
A	0.90	1.15	1.025
A1	0.00	0.10	0.05
A2	0.85	1.10	0.975
b	0.30	0.51	0.40
c	0.080	0.202	0.11
D	2.80	3.00	2.90
E	2.25	2.55	2.40
E1	1.20	1.40	1.30
e	0.89	1.03	0.915
e1	1.78	2.05	1.83
F	0.40	0.60	0.535
L1	0.45	0.61	0.55
L	0.25	0.55	0.40
a	0°	8°	--
All Dimensions in mm			

## 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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