

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

PRODUCT SUMMARY								
Part Number	V _{(BR)DSS} Min (V)	$r_{DS(on)}$ Max (Ω)	$Max\left(\Omega\right) \qquad V_{GS(th)}\left(V\right) \qquad I_{D}$					
2N7000		5 @ V _{GS} = 10 V	0.8 to 3	0.2				
2N7002		7.5 @ V _{GS} = 10 V	1 to 2.5	0.115				
VQ1000J	60	5.5 @ V _{GS} = 10 V	0.8 to 2.5	0.225				
VQ1000P		5.5 @ V _{GS} = 10 V	0.8 to 2.5	0.225				
BS170		5 @ V _{GS} = 10 V	0.8 to 3	0.5				

FEATURES

Low On-Resistance: 2.5 Ω
Low Threshold: 2.1 V

Low Input Capacitance: 22 pFFast Switching Speed: 7 ns

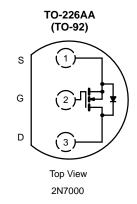
Low Input and Output Leakage

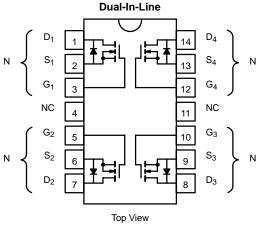
BENEFITS

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

APPLICATIONS

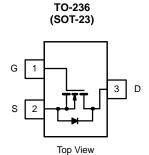
- Direct Logic-Level Interface: TTL/CMOS
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relays





Top View

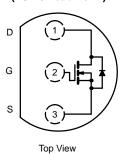
Plastic: VQ1000J
Sidebraze: VQ1000P



Marking Code: 72wll

72 = Part Number Code for 2N7002 w = Week Code l = Lot Traceability

TO-92-18RM (TO-18 Lead Form)



BS170

2N7000/2N7002, VQ1000J/P, BS170

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			_	T	S OTHERWISE NOT Single		Total Quad	BS170	T
Parameter		Symbol	2N7000	2N7002	VQ1000J	VQ1000P	VQ1000J/P		Unit
Drain-Source Voltage		V_{DS}	60	60	60	60		60	
Gate-Source Voltage—Non-Repetitive		V_{GSM}	±40	±40	±30			±25	٧
Gate-Source Voltage—Continuous		V_{GS}	±20	±20	±20	±20		±20	1
Continuous Drain Current (T _J = 150°C)	T _A = 25°C	I _D	0.2	0.115	0.225	0.225		0.5	
	T _A = 100°C		0.13	0.073	0.14	0.14		0.175	Α
Pulsed Drain Current ^a		I _{DM}	0.5	0.8	1	1			1
D 01 1 11	T _A = 25°C		0.4	0.2	1.3	1.3	2	0.83	
Power Dissipation	T _A = 100°C	P _D	0.16	0.08	0.52	0.52	0.8		W
Thermal Resistance, Junction-to-Ambient		R _{thJA}	312.5	625	96	96	62.5	156	°C/W
Operating Junction and Storage Temperature Range		T _J , T _{stg}	-55 to 150						°C

					Lin	nits			
				2N7000		2N7002		1	
Parameter	Symbol	Test Conditions	Typ ^a	Min	Max	Min	Max	Unit	
Static			•						
Drain-Source Breakdown Voltage	V _{(BR)DSS}	$V_{GS} = 0 \text{ V}, I_D = 10 \mu A$	70	60		60			
	.,	$V_{DS} = V_{GS}$, $I_D = 1 \text{ mA}$	2.1	0.8	3			V	
Gate-Threshold Voltage	V _{GS(th)}	$V_{DS} = V_{GS}, I_D = 0.25 \text{ mA}$	2.0			1	2.5	1	
Gate-Body Leakage		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 15 \text{ V}$			±10				
	I _{GSS}	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 20 \text{ V}$					±100	nA	
Zero Gate Voltage Drain Current		$V_{DS} = 48 \text{ V}, V_{GS} = 0 \text{ V}$			1				
	I _{DSS}	T _C = 125°C	;		1000			1 .	
		V _{DS} = 60 V, V _{GS} = 0 V					1	μΑ	
		T _C = 125°C	;				500	1	
0.00.00.00.00	I _{D(on)}	V _{DS} = 10 V, V _{GS} = 4.5 V	0.35	0.075					
On-State Drain Current ^b		$V_{DS} = 7.5 \text{ V}, V_{GS} = 10 \text{ V}$	1			0.5		A	
		$V_{GS} = 4.5 \text{ V}, I_D = 0.075 \text{ A}$	4.5		5.3				
		$V_{GS} = 5 \text{ V}, I_D = 0.05 \text{ A}$	3.2				7.5	1	
Drain-Source On-Resistance ^b	r _{DS(on)}	T _C = 125°C	5.8				13.5	Ω	
		$V_{GS} = 10 \text{ V}, I_D = 0.5 \text{ A}$	2.4		5		7.5	1	
		T _J = 125°C	4.4		9		13.5	1	
Forward Transconductance ^b	9 _{fs}	$V_{DS} = 10 \text{ V}, I_D = 0.2 \text{ A}$		100		80			
Common Source Output Conductance ^b	9 _{os}	$V_{DS} = 5 \text{ V}, I_D = 0.05 \text{ A}$	0.5					mS	
Dynamic			•						
Input Capacitance	C _{iss}		22		60		50		
Output Capacitance	Coss	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}$ f = 1 MHz	11		25		25	pF	
Reverse Transfer Capacitance	C _{rss}	1 - 1 1911 12	2		5		5	1	

Notes a. Pulse width limited by maximum junction temperature. b. $t_p \leq 50~\mu s.$



2N7000/2N7002, VQ1000J/P, BS170

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SPECIFICATIONS—2N7000 AND 2N7002 (T _A = 25°C UNLESS OTHERWISE NOTED)											
				Limits							
				2N7000 2N7002							
Parameter	Symbol	Test Conditions	Typa	Min	Max	Min	Max	Unit			
Switching ^d											
Turn-On Time	t _{ON}	$V_{DD} = 15 \text{ V}, R_{L} = 25 \Omega$	7		10						
Turn-Off Time	t _{OFF}	$I_D \approx 0.5 \text{ A}, V_{GEN} = 10 \text{ V}, R_G = 25 \Omega$	7		10			ns			
Turn-On Time	t _{ON}	$V_{DD} = 30 \text{ V}, R_{L} = 150 \Omega$	7				20	115			
Turn-Off Time	t _{OFF}	$I_D \cong 0.2 \text{ A}, V_{GEN} = 10 \text{ V}, R_G = 25 \Omega$	11				20				

					Lin	nits			
				VQ1000J/P		BS170		1	
Parameter	Symbol	Test Conditions	Typa	Min	Max	Min	Max	Unit	
Static	•		•	•		•			
Drain-Source Breakdown Voltage	V _{(BR)DSS}	$V_{GS} = 0 \text{ V}, I_D = 100 \mu\text{A}$	70	60		60		Ι.,	
Gate-Threshold Voltage	V _{GS(th)}	$V_{DS} = V_{GS}$, $I_D = 1$ mA	2.1	8.0	2.5	0.8	3	V	
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 10 \text{ V}$			±100				
Gate-Body Leakage	I _{GSS}	T _J = 125°C			±500			nA	
•	T	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 15 \text{ V}$					±10	1	
Zero Gate Voltage Drain Current		V _{DS} = 25 V, V _{GS} = 0 V					0.5	μА	
	I _{DSS}	V _{DS} = 48 V, V _{GS} = 0 V, T _J = 125°C			500				
		V _{DS} = 60 V, V _{GS} = 0 V			10				
On-State Drain Current ^b	I _{D(on)}	$V_{DS} = 10 \ V, V_{GS} = 10 \ V$	1	0.5				Α	
Drain-Source On-Resistance ^b	r _{DS(on)}	$V_{GS} = 5 \text{ V}, I_D = 0.2 \text{ A}$	4		7.5				
		$V_{GS} = 10 \text{ V}, I_D = 0.2 \text{ A}$	2.3				5	1	
		$V_{GS} = 10 \text{ V}, I_D = 0.3 \text{ A}$	2.3		5.5			Ω	
		T _J = 125°C	4.2		7.6			1	
Forward Transconductance ^b	9fs -	$V_{DS} = 10 \text{ V}, I_D = 0.2 \text{ A}$				100			
Forward Transconductance		$V_{DS} = 10 \ V, I_{D} = 0.5 \ A$		100				mS	
Common Source Output Conductance ^b	9 _{os}	$V_{DS} = 5 \text{ V}, I_D = 0.05 \text{ A}$	0.5					1	
Dynamic				-					
Input Capacitance	C _{iss}		22		60		60		
Output Capacitance	C _{oss}	V _{DS} =25 V, V _{GS} = 0 V f = 1 MHz	11		25			pF	
Reverse Transfer Capacitance	C _{rss}	1 - 1 1911 12			5				
Switching ^d	•		•	•		•			
Turn-On Time	t _{ON}	$V_{DD} = 15 \text{ V, R}_{I} = 23 \Omega$	7		10				
Turn-Off Time	t _{OFF}	$I_D \approx 0.6 \text{ A}, V_{GEN} = 10 \text{ V}, R_G = 25 \Omega$	7		10			1	
Turn-On Time	t _{ON}	$V_{DD} = 25 \text{ V}, R_{L} = 125 \Omega$	7				10	ns	
Turn-Off Time	toff	$I_D \cong 0.2 \text{ A}, V_{GEN} = 10 \text{ V}, R_G = 25 \Omega$					10	1	

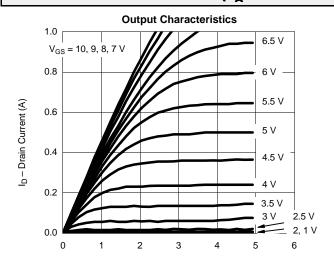
VNBF06

Notes a. For DESIGN AID ONLY, not subject to production testing. b. Pulse test: PW $\leq 80~\mu s$ duty cycle $\leq 1\%$. c. This parameter not registered with JEDEC. d. Switching time is essentially independent of operating temperature.

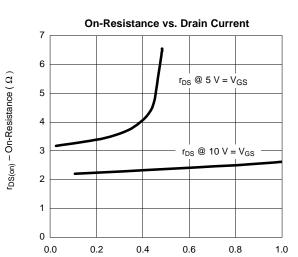
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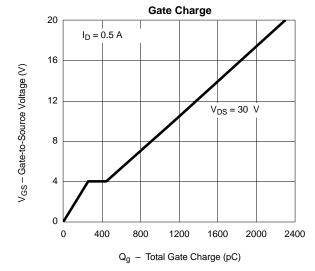
TYPICAL CHARACTERISTICS (TA = 25°C UNLESS OTHERWISE NOTED)

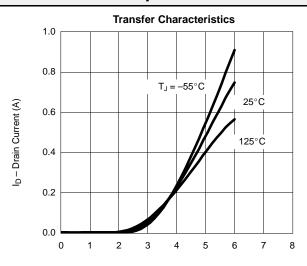


V_{DS} - Drain-to-Source Voltage (V)

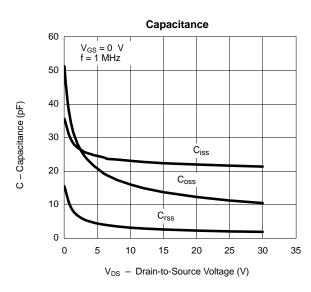


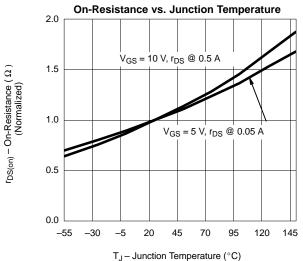
I_D - Drain Current (A)





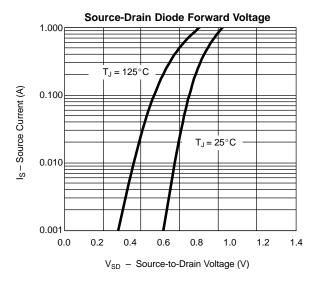
V_{GS} - Gate-to-Source Voltage (V)

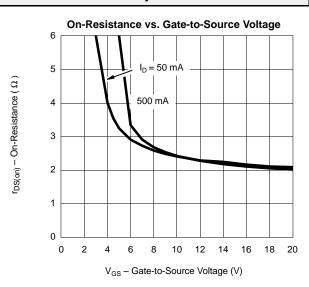


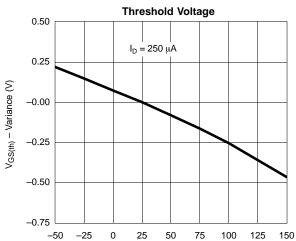


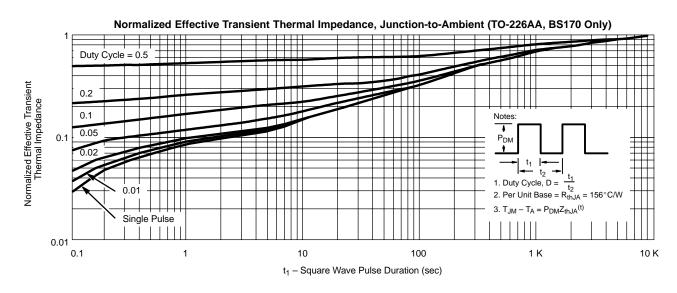
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TYPICAL CHARACTERISTICS (TA = 25°C UNLESS OTHERWISE NOTED)











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