

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

PRODUCT SUMMARY

Part Number	$V_{(BR)DSS}$ Min (V)	$r_{DS(on)}$ Max (Ω)	$V_{GS(th)}$ (V)	I_D (A)
2N7000	60	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		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

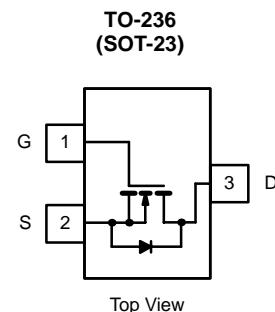
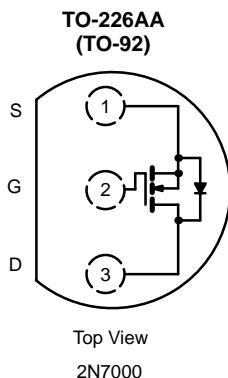
FEATURES

- Low On-Resistance: 2.5Ω
- Low Threshold: 2.1 V
- Low Input Capacitance: 22 pF
- Fast Switching Speed: 7 ns
- Low Input and Output Leakage
- Low Offset Voltage
- Low-Voltage Operation
- Easily Driven Without Buffer
- High-Speed Circuits
- Low Error Voltage

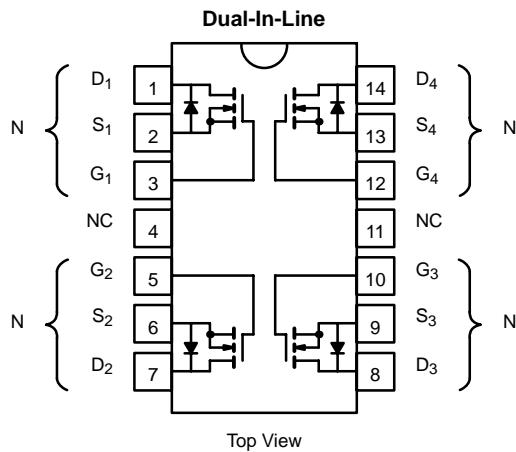
BENEFITS

APPLICATIONS

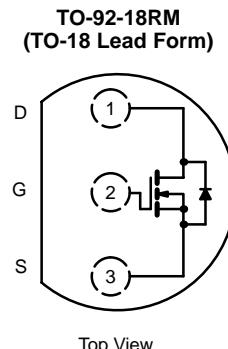
- Direct Logic-Level Interface: TTL/CMOS
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relays



Marking Code: 72wll
72 = Part Number Code for 2N7002
w = Week Code
ll = Lot Traceability



Plastic: VQ1000J
Sidebrazed: VQ1000P



BS170

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

Parameter	Symbol	2N7000	2N7002	Single		Total Quad	BS170	Unit	
				VQ1000J	VQ1000P	VQ1000J/P			
Drain-Source Voltage	V_{DS}	60	60	60	60		60	V	
Gate-Source Voltage—Non-Repetitive	V_{GSM}	± 40	± 40	± 30					± 25
Gate-Source Voltage—Continuous	V_{GS}	± 20	± 20	± 20	± 20				± 20
Continuous Drain Current ($T_J = 150^\circ\text{C}$)	I_D	0.2	0.115	0.225	0.225		0.5	A	
		0.13	0.073	0.14	0.14		0.175		
Pulsed Drain Current ^a	I_{DM}	0.5	0.8	1	1				
Power Dissipation	P_D	0.4	0.2	1.3	1.3	2	0.83	W	
		0.16	0.08	0.52	0.52	0.8			
Thermal Resistance, Junction-to-Ambient	R_{thJA}	312.5	625	96	96	62.5	156	$^\circ\text{C}/\text{W}$	
Operating Junction and Storage Temperature Range	T_J, T_{stg}			−55 to 150				$^\circ\text{C}$	

Notes

- a. Pulse width limited by maximum junction temperature.
b. $t_p \leq 50 \mu\text{s}$.

SPECIFICATIONS—2N7000 AND 2N7002 ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

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



2N7000/2N7002, VQ1000J/P, BS170

Vishay Siliconix

SPECIFICATIONS—2N7000 AND 2N7002 ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

Parameter	Symbol	Test Conditions	Typ ^a	Limits				Unit	
				2N7000		2N7002			
				Min	Max	Min	Max		
Switching^d									
Turn-On Time	t_{ON}	$V_{DD} = 15 \text{ V}, R_L = 25 \Omega$	7		10			ns	
Turn-Off Time	t_{OFF}	$I_D \approx 0.5 \text{ A}, V_{GEN} = 10 \text{ V}, R_G = 25 \Omega$	7		10				
Turn-On Time	t_{ON}	$V_{DD} = 30 \text{ V}, R_L = 150 \Omega$	7				20		
Turn-Off Time	t_{OFF}	$I_D \approx 0.2 \text{ A}, V_{GEN} = 10 \text{ V}, R_G = 25 \Omega$	11				20		

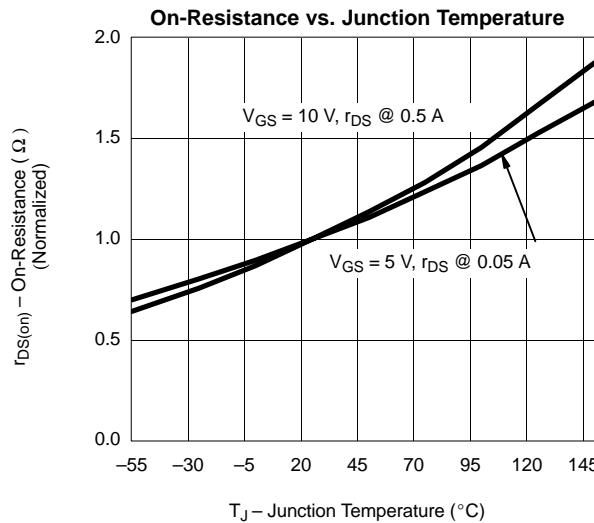
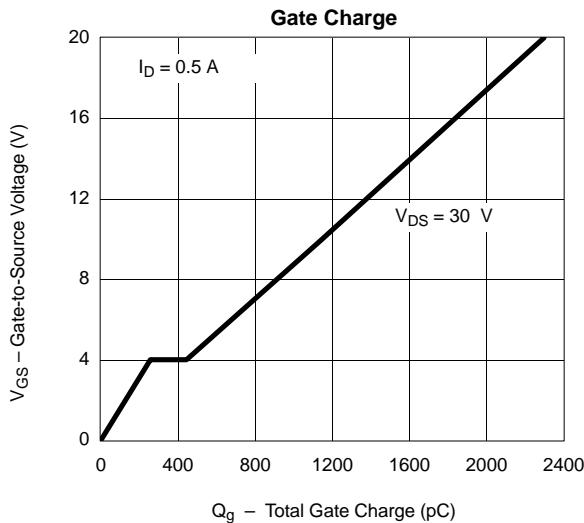
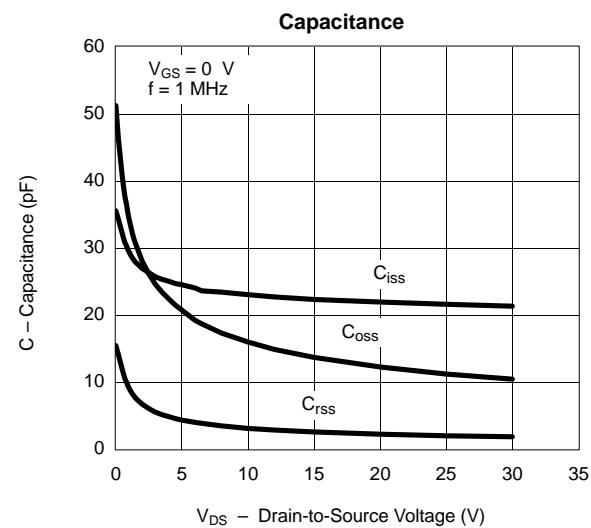
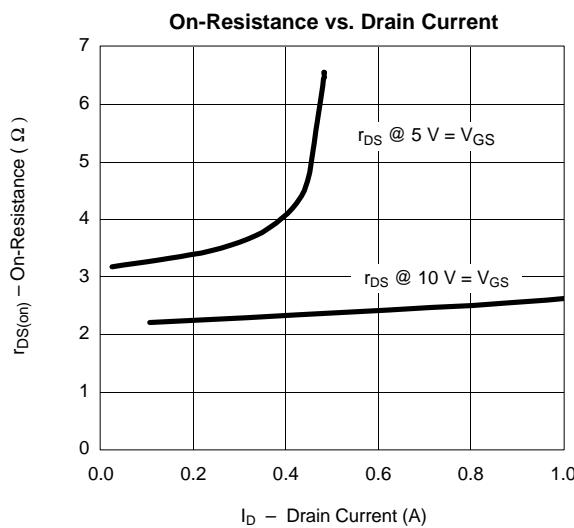
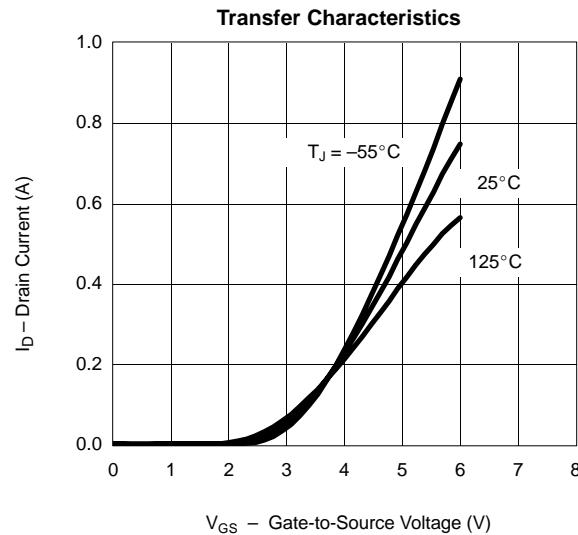
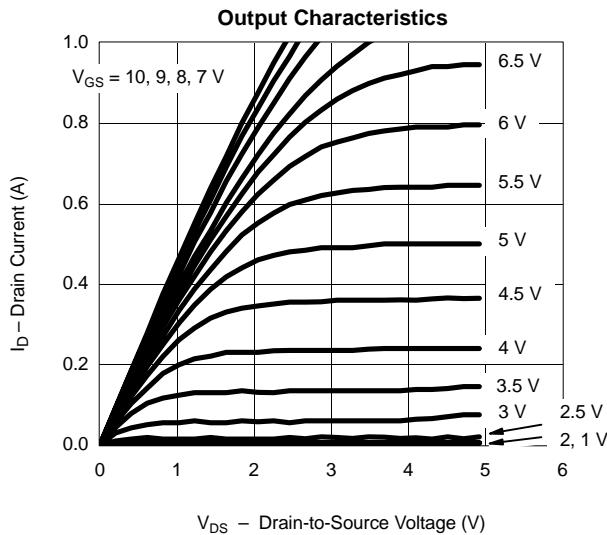
SPECIFICATIONS—VQ1000J/P AND BS170 ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

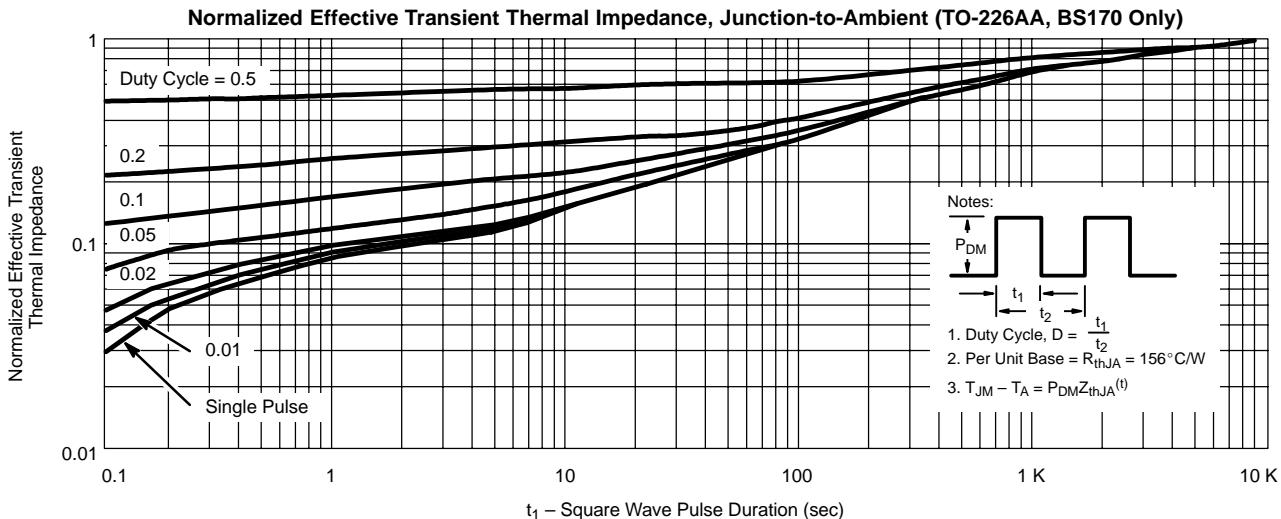
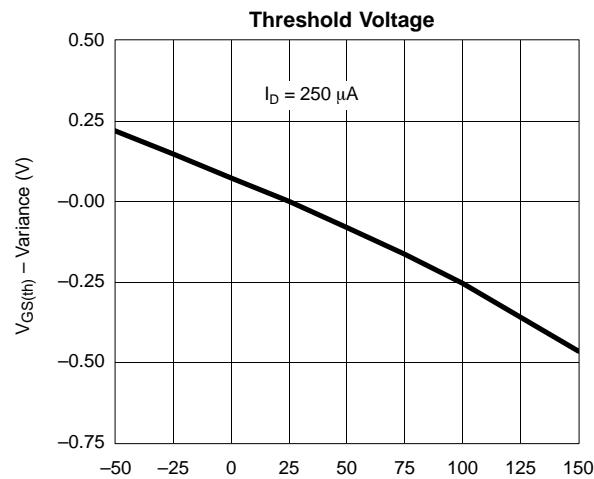
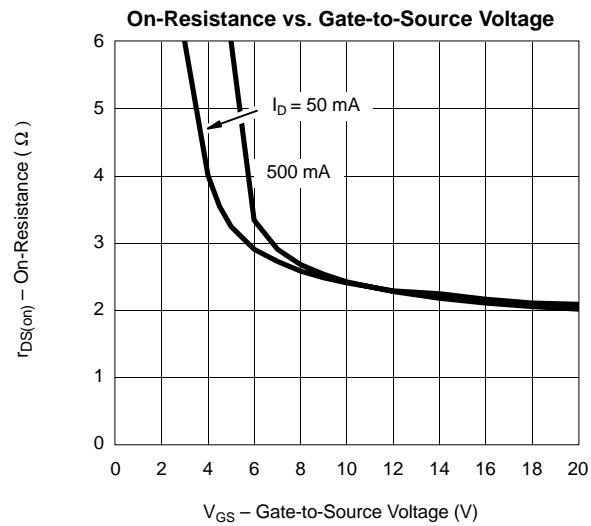
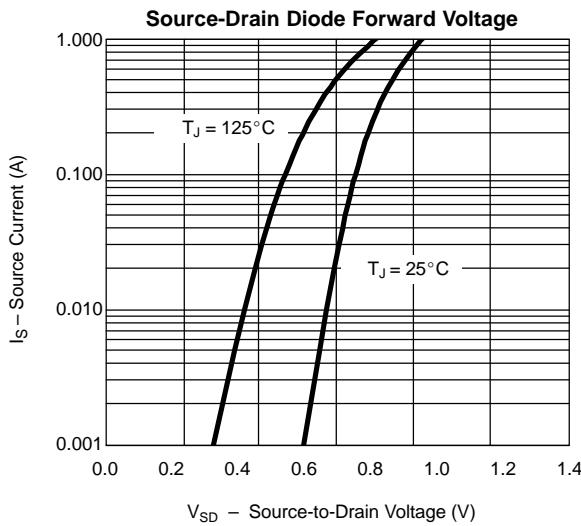
Parameter	Symbol	Test Conditions	Typ ^a	Limits				Unit	
				VQ1000J/P		BS170			
				Min	Max	Min	Max		
Static									
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0 \text{ V}, I_D = 100 \mu\text{A}$	70	60		60		V	
Gate-Threshold Voltage	$V_{GS(\text{th})}$	$V_{DS} = V_{GS}, I_D = 1 \text{ mA}$	2.1	0.8	2.5	0.8	3		
Gate-Body Leakage	I_{GSS}	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 10 \text{ V}$			± 100				
		$T_J = 125^\circ\text{C}$			± 500				
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 15 \text{ V}$					± 10	μA	
		$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}$					0.5		
		$V_{DS} = 48 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 125^\circ\text{C}$			500				
On-State Drain Current ^b	$I_{D(on)}$	$V_{DS} = 60 \text{ V}, V_{GS} = 0 \text{ V}$			10			A	
		$V_{DS} = 10 \text{ V}, V_{GS} = 10 \text{ V}$	1	0.5					
Drain-Source On-Resistance ^b	$r_{DS(on)}$	$V_{GS} = 5 \text{ V}, I_D = 0.2 \text{ A}$	4		7.5			Ω	
		$V_{GS} = 10 \text{ V}, I_D = 0.2 \text{ A}$	2.3				5		
		$V_{GS} = 10 \text{ V}, I_D = 0.3 \text{ A}$	2.3		5.5				
		$T_J = 125^\circ\text{C}$	4.2		7.6				
Forward Transconductance ^b	g_{fs}	$V_{DS} = 10 \text{ V}, I_D = 0.2 \text{ A}$				100		mS	
		$V_{DS} = 10 \text{ V}, I_D = 0.5 \text{ A}$		100					
Common Source Output Conductance ^b	g_{os}	$V_{DS} = 5 \text{ V}, I_D = 0.05 \text{ A}$	0.5						
Dynamic									
Input Capacitance	C_{iss}	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}$ $f = 1 \text{ MHz}$	22		60		60	pF	
Output Capacitance	C_{oss}		11		25				
Reverse Transfer Capacitance	C_{rss}		2		5				
Switching^d									
Turn-On Time	t_{ON}	$V_{DD} = 15 \text{ V}, R_L = 23 \Omega$ $I_D \approx 0.6 \text{ A}, V_{GEN} = 10 \text{ V}, R_G = 25 \Omega$	7		10			ns	
Turn-Off Time	t_{OFF}		7		10				
Turn-On Time	t_{ON}	$V_{DD} = 25 \text{ V}, R_L = 125 \Omega$ $I_D \approx 0.2 \text{ A}, V_{GEN} = 10 \text{ V}, R_G = 25 \Omega$	7				10		
Turn-Off Time	t_{OFF}		7				10		

Notes

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

VNBF06

TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

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