



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

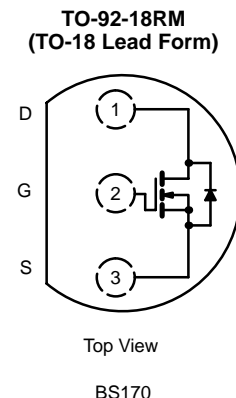
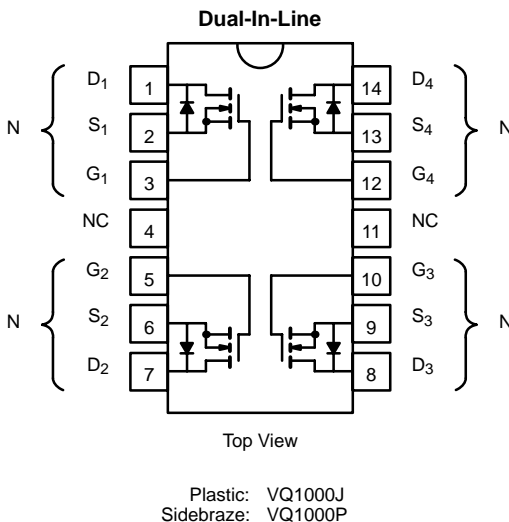
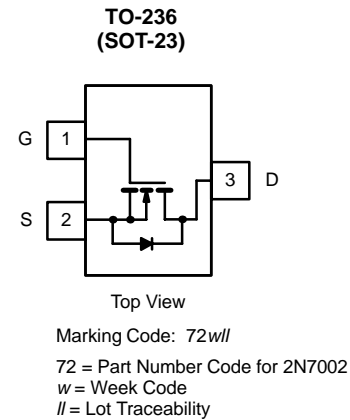
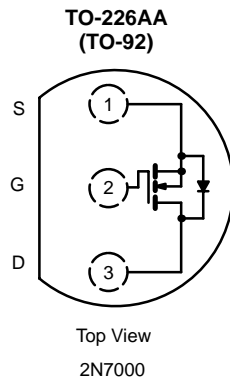
- Low On-Resistance: 2.5 Ω
- Low Threshold: 2.1 V
- Low Input Capacitance: 22 pF
- Fast Switching Speed: 7 ns
- Low Input and Output Leakage

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





ABSOLUTE MAXIMUM RATINGS (T _A = 25 °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 °C)	T _A = 25 °C	I _D	0.2	0.115	0.225	0.225		0.5	A
	T _A = 100 °C		0.13	0.073	0.14	0.14		0.175	
Pulsed Drain Current ^a	I _{DM}	0.5	0.8	1	1				
Power Dissipation	T _A = 25 °C	P _D	0.4	0.2	1.3	1.3	2	0.83	W
	T _A = 100 °C		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	°C/W	
Operating Junction and Storage Temperature Range	T _J , T _{stg}	-55 to 150							°C

Notes

- a. Pulse width limited by maximum junction temperature.
- b. t_p ≤ 50 μs.

SPECIFICATIONS—2N7000 AND 2N7002 (T _A = 25 °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 V, I _D = 10 μA	70	60		60		V
Gate-Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 1 mA	2.1	0.8	3			
		V _{DS} = V _{GS} , I _D = 0.25 mA	2.0			1	2.5	
Gate-Body Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 15 V			± 10			nA
		V _{DS} = 0 V, V _{GS} = ± 20 V					± 100	
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 48 V, V _{GS} = 0 V			1			μA
		T _C = 125 °C			1000			
		V _{DS} = 60 V, V _{GS} = 0 V					1	
On-State Drain Current ^b	I _{D(on)}	V _{DS} = 10 V, V _{GS} = 4.5 V	0.35	0.075				A
		V _{DS} = 7.5 V, V _{GS} = 10 V	1			0.5		
		V _{GS} = 4.5 V, I _D = 0.075 A	4.5		5.3			
Drain-Source On-Resistance ^b	r _{DS(on)}	V _{GS} = 5 V, I _D = 0.05 A	3.2				7.5	Ω
		T _C = 125 °C	5.8				13.5	
		V _{GS} = 10 V, I _D = 0.5 A	2.4		5		7.5	
		T _J = 125 °C	4.4		9		13.5	
Forward Transconductance ^b	g _{fs}	V _{DS} = 10 V, I _D = 0.2 A		100		80		mS
Common Source Output Conductance ^b	g _{os}	V _{DS} = 5 V, I _D = 0.05 A	0.5					
Dynamic								
Input Capacitance	C _{iss}	V _{DS} = 25 V, V _{GS} = 0 V f = 1 MHz	22		60		50	pF
Output Capacitance	C _{oss}		11		25		25	
Reverse Transfer Capacitance	C _{rss}		2		5		5	



SPECIFICATIONS—2N7000 AND 2N7002 (T _A = 25 °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 V, R _L = 25 Ω I _D ≅ 0.5 A, V _{GEN} = 10 V, R _G = 25 Ω	7		10			ns
Turn-Off Time	t _{OFF}		7		10			
Turn-On Time	t _{ON}	V _{DD} = 30 V, R _L = 150 Ω I _D ≅ 0.2 A, V _{GEN} = 10 V, R _G = 25 Ω	7				20	
Turn-Off Time	t _{OFF}		11				20	

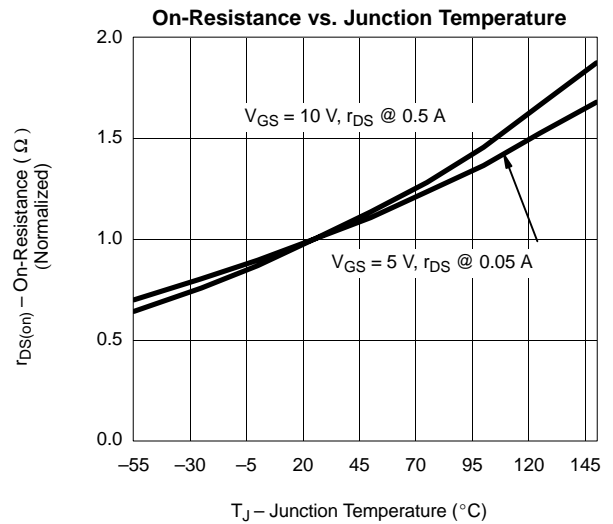
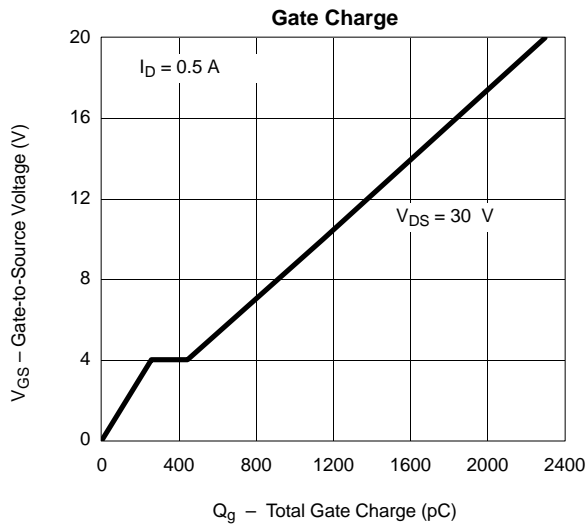
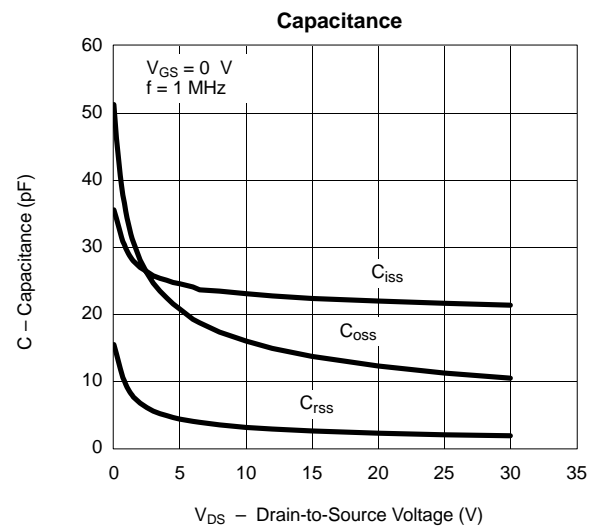
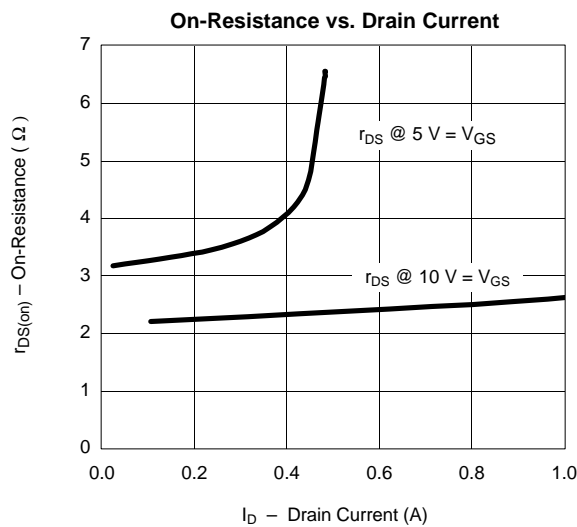
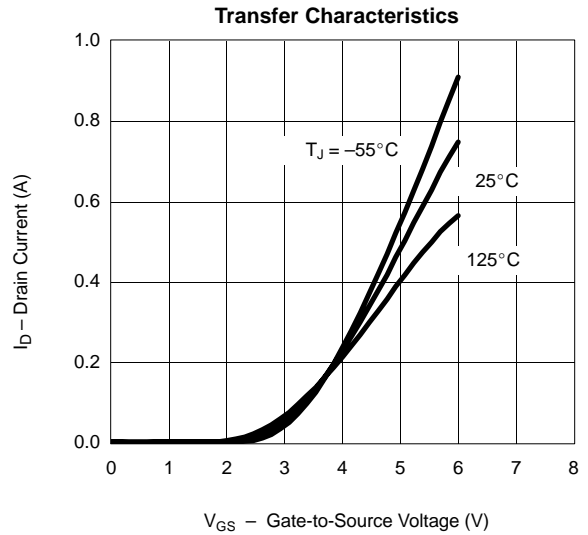
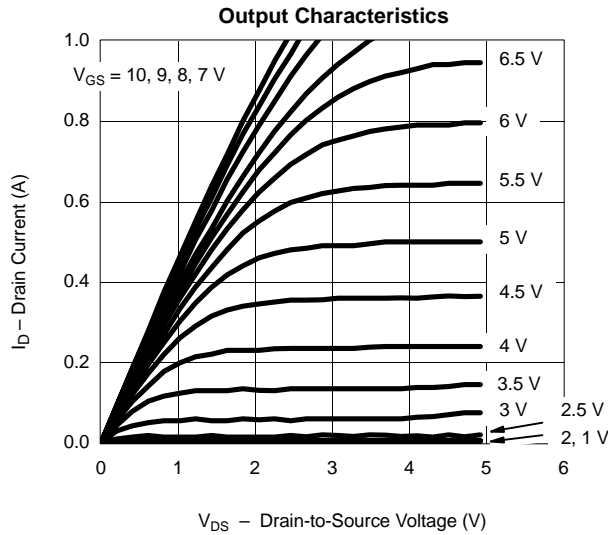
SPECIFICATIONS—VQ1000J/P AND BS170 (T _A = 25 °C UNLESS OTHERWISE NOTED)								
Parameter	Symbol	Test Conditions	Typ ^a	Limits				Unit
				VQ1000J/P		BS170		
				Min	Max	Min	Max	
Static								
Drain-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0 V, I _D = 100 μA	70	60		60		V
Gate-Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 1 mA	2.1	0.8	2.5	0.8	3	
Gate-Body Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ±10 V			±100			nA
		T _J = 125 °C			±500			
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 0 V, V _{GS} = ±15 V					±10	μA
		V _{DS} = 25 V, V _{GS} = 0 V					0.5	
		V _{DS} = 48 V, V _{GS} = 0 V, T _J = 125 °C			500			
On-State Drain Current ^b	I _{D(on)}	V _{DS} = 10 V, V _{GS} = 10 V	1	0.5				A
		V _{GS} = 5 V, I _D = 0.2 A	4		7.5			
Drain-Source On-Resistance ^b	r _{DS(on)}	V _{GS} = 10 V, I _D = 0.2 A	2.3				5	Ω
		V _{GS} = 10 V, I _D = 0.3 A	2.3		5.5			
		T _J = 125 °C	4.2		7.6			
		V _{DS} = 10 V, I _D = 0.2 A				100		
Forward Transconductance ^b	g _{fs}	V _{DS} = 10 V, I _D = 0.5 A		100				mS
Common Source Output Conductance ^b	g _{os}	V _{DS} = 5 V, I _D = 0.05 A	0.5					
Dynamic								
Input Capacitance	C _{iss}	V _{DS} = 25 V, V _{GS} = 0 V f = 1 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 V, R _L = 23 Ω I _D ≅ 0.6 A, V _{GEN} = 10 V, R _G = 25 Ω	7		10			ns
Turn-Off Time	t _{OFF}		7		10			
Turn-On Time	t _{ON}	V _{DD} = 25 V, R _L = 125 Ω I _D ≅ 0.2 A, V _{GEN} = 10 V, R _G = 25 Ω	7				10	
Turn-Off Time	t _{OFF}		7				10	

Notes

- a. For DESIGN AID ONLY, not subject to production testing.
- b. Pulse test: PW ≤ 80 μs duty cycle ≤ 1%.
- c. This parameter not registered with JEDEC.
- d. Switching time is essentially independent of operating temperature.

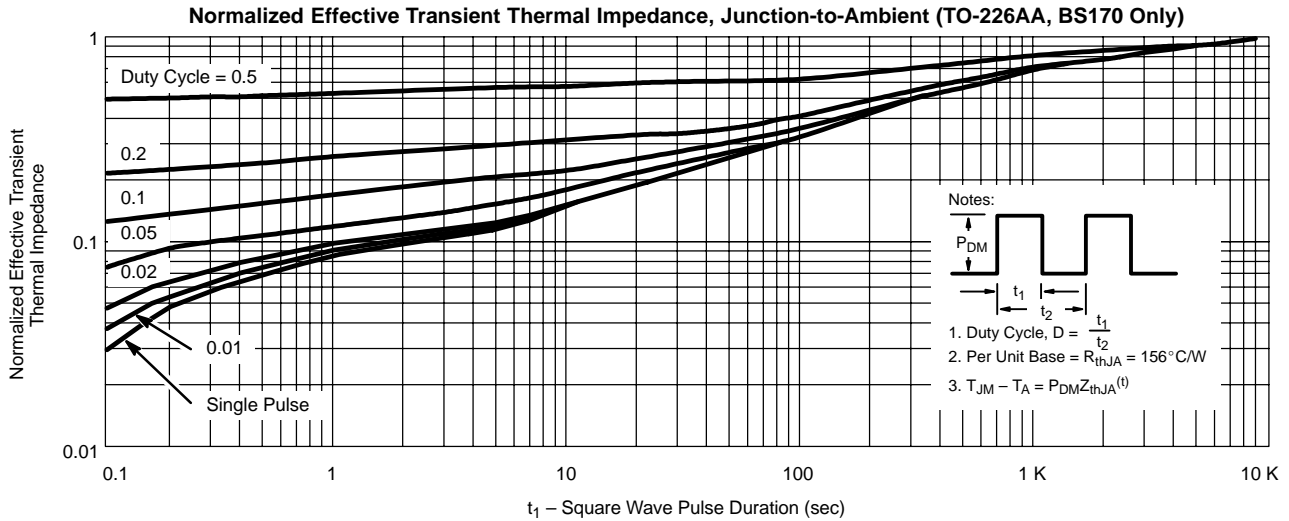
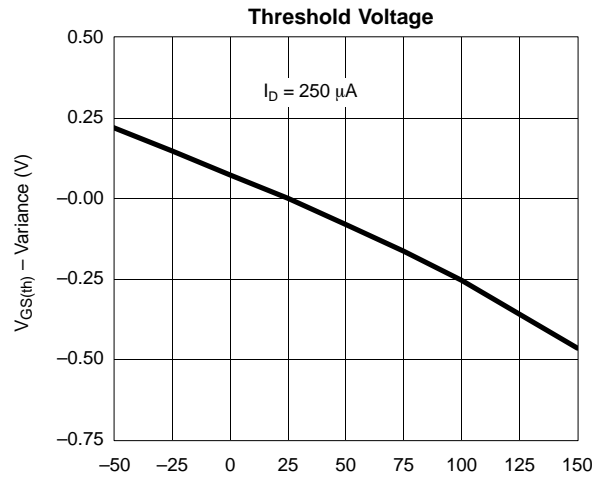
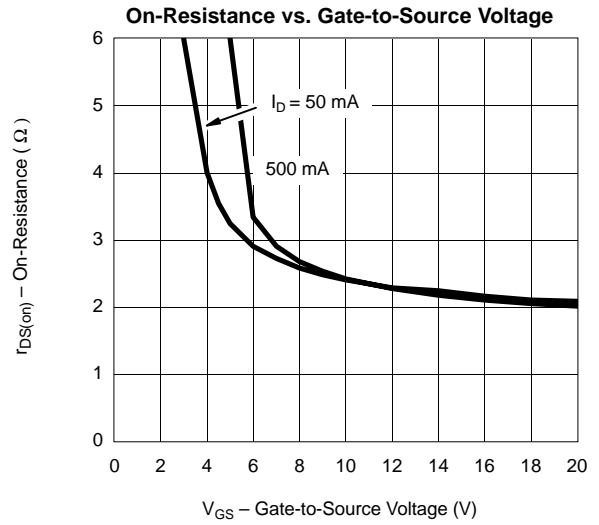
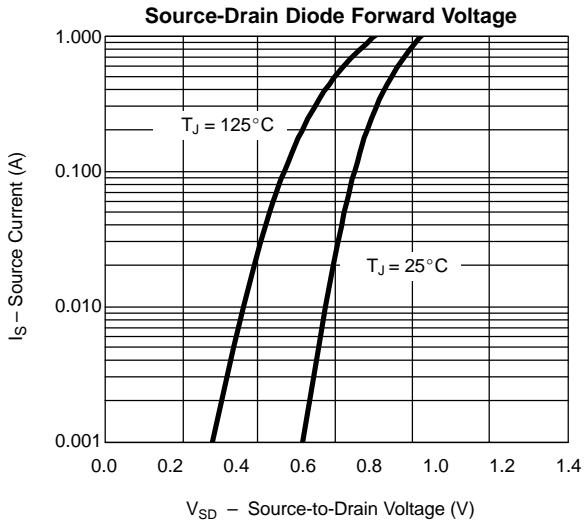
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TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)





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