

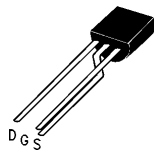
## BS170/MMBF170 N-Channel Enhancement Mode Field Effect Transistor

### General Description

These N-channel enhancement mode field effect transistors are produced using National's very high cell density third generation DMOS technology. These products have been designed to minimize on-state resistance, provide rugged and reliable performance and fast switching. They can be used, with a minimum of effort, in most applications requiring up to 500 mA DC. This product is particularly suited to low voltage, low current applications, such as small servo motor controls, power MOSFET gate drivers, and other switching applications

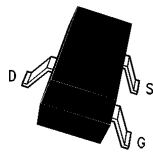
### Features

- Efficient high density cell design approaching (3 million/in<sup>2</sup>)
- Voltage controlled small signal switch
- Rugged
- High saturation current
- Low  $R_{DS(on)}$



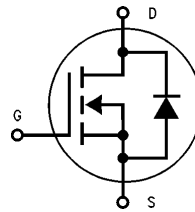
**TO-92  
BS170**

TL/G/11379-1



**TO-236AB  
(SOT-23)  
MMBF170**

TL/G/11379-2



TL/G/11379-3

### Absolute Maximum Ratings

Symbol	Parameter	BS170	MMBF170	Units
$V_{DSS}$	Drain-Source Voltage		60	V
$V_{DGR}$	Drain-Gate Voltage ( $R_{GS} \leq 1 \text{ M}\Omega$ )		60	V
$V_{GSS}$	Gate-Source Voltage		$\pm 20$	V
$I_D$	Drain Current—Continuous —Pulsed	500	500	mA
			800	mA
$P_D$	Total Power Dissipation Derate above 25°C	830	300	mW
		6.6	2.4	mW/°C
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to 150		°C
$T_L$	Maximum Lead Temperature for Soldering Purposes, $\frac{1}{16}$ " from Case for 10 Seconds	300		°C

## BS170

### Electrical Characteristics (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
B <sub>V</sub> D <sub>SS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 100 μA	60			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V			0.5	μA
I <sub>GSSF</sub>	Gate-Body Leakage, Forward	V <sub>GS</sub> = 15V, V <sub>DS</sub> = 0V			10	nA
<b>ON CHARACTERISTICS</b> (Note 1)						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1 mA	0.8	2.1	3	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 200 mA		1.2	5	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 10V, I <sub>D</sub> = 200 mA		320		mS
<b>DYNAMIC CHARACTERISTICS</b>						
C <sub>iSS</sub>	Input Capacitance	V <sub>DS</sub> = 10V, V <sub>GS</sub> = 0V, f = 1.0 MHz		24	40	pF
C <sub>oSS</sub>	Output Capacitance			17	30	pF
C <sub>rSS</sub>	Reverse Transfer Capacitance			7	10	pF
<b>SWITCHING CHARACTERISTICS</b> (Note 1)						
t <sub>on</sub>	Turn-On Time	V <sub>DD</sub> = 25V, I <sub>D</sub> = 200 mA, V <sub>GS</sub> = 10V R <sub>G</sub> = 25Ω			10	ns
t <sub>off</sub>	Turn-Off Time				10	ns
<b>THERMAL CHARACTERISTICS</b>						
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient				150	°C/W

## MMBF170

### Electrical Characteristics (T<sub>C</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
B <sub>V</sub> D <sub>SS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 100 μA	60			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V			0.5	μA
I <sub>GSSF</sub>	Gate-Body Leakage, Forward	V <sub>GS</sub> = 15V, V <sub>DS</sub> = 0V			10	nA
<b>ON CHARACTERISTICS</b> (Note 1)						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.0 mA	0.8	2.1	3	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 200 mA		1.2	5	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> ≥ 2 V <sub>DS(on)</sub> , I <sub>D</sub> = 200 mA		320		mS
<b>DYNAMIC CHARACTERISTICS</b>						
C <sub>iSS</sub>	Input Capacitance	V <sub>DS</sub> = 10V, V <sub>GS</sub> = 0V, f = 1.0 MHz		24	40	pF
C <sub>oSS</sub>	Output Capacitance			17	30	pF
C <sub>rSS</sub>	Reverse Transfer Capacitance			7	10	pF
<b>SWITCHING CHARACTERISTICS</b> (Note 1)						
t <sub>on</sub>	Turn-On Time	V <sub>DD</sub> = 25V, I <sub>D</sub> = 500 mA, V <sub>GS</sub> = 10V R <sub>G</sub> = 50Ω			10	ns
t <sub>off</sub>	Turn-Off Time				10	ns
<b>THERMAL CHARACTERISTICS</b>						
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient				417	°C/W

**Note 1:** Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

# Typical Electrical Characteristics

## BS170/MMBF170

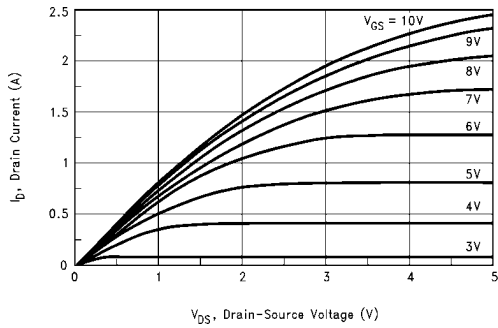


FIGURE 1. On-Region Characteristics

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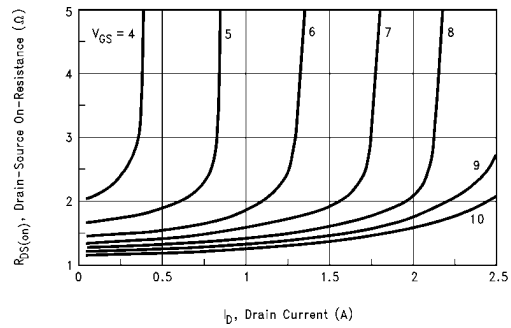


FIGURE 2.  $R_{DS(on)}$  Variation with Drain Current and Gate Voltage

TL/G/11379-7

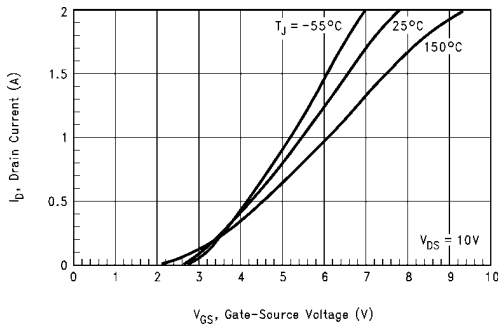


FIGURE 3. Transfer Characteristics

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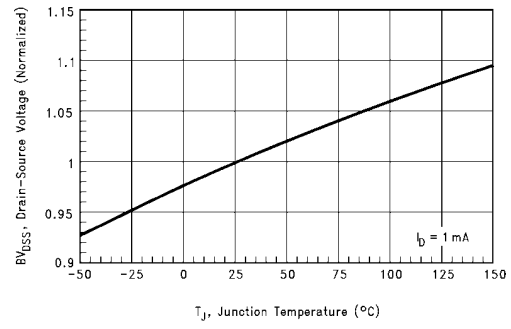


FIGURE 4. Breakdown Voltage Variation with Temperature

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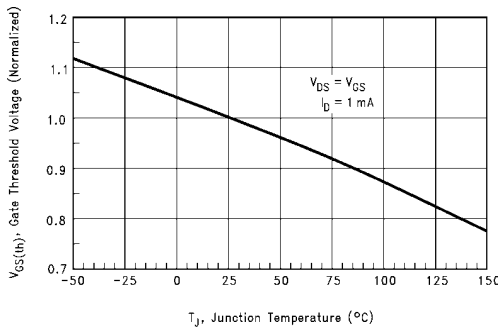


FIGURE 5. Gate Threshold Variation with Temperature

TL/G/11379-10

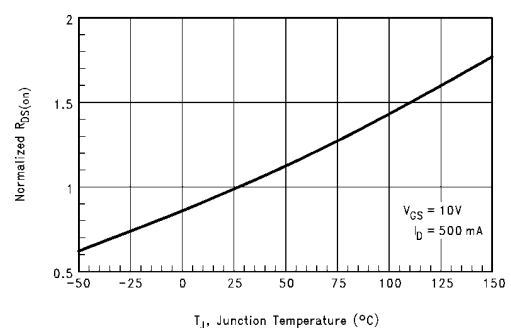
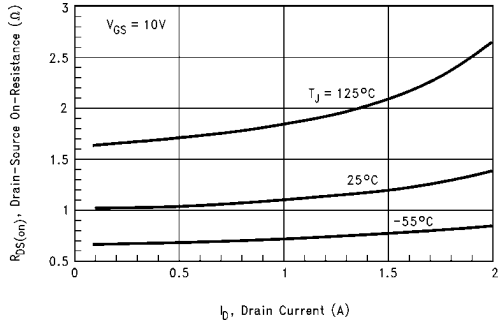


FIGURE 6. On-Resistance Variation with Temperature

TL/G/11379-11

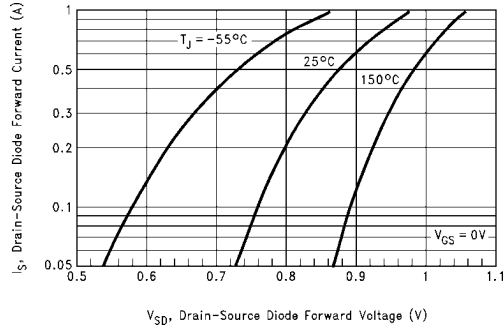
**Typical Electrical Characteristics (Continued)**

**BS170/MMBF170**



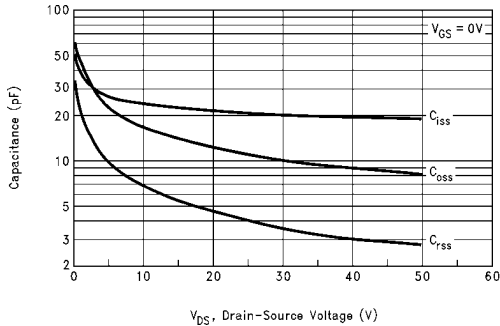
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**FIGURE 7. On-Resistance vs Drain Current**



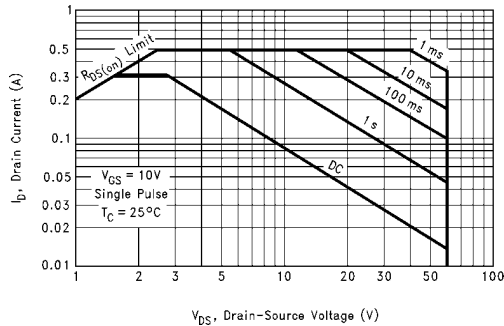
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**FIGURE 8. Body Diode Forward Voltage Variation with Current and Temperature**



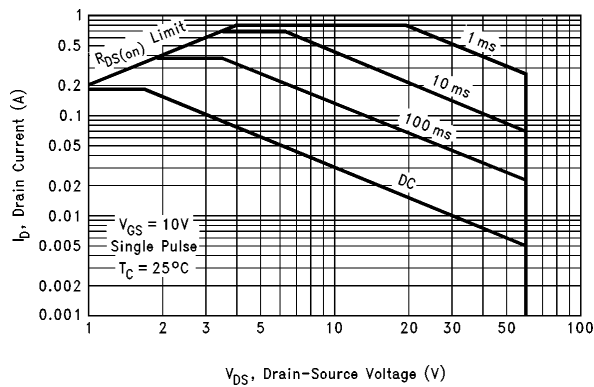
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**FIGURE 9. Capacitance vs Drain-Source Voltage**



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**FIGURE 10. BS170 Safe Operating Area**

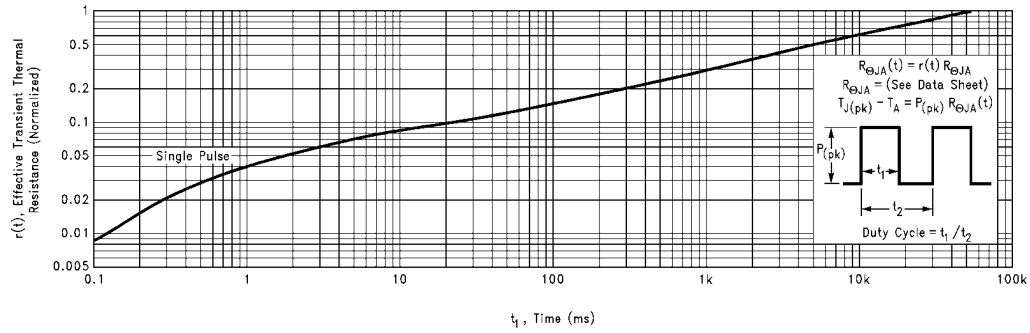


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**FIGURE 11. MMBF170 Safe Operating Area**

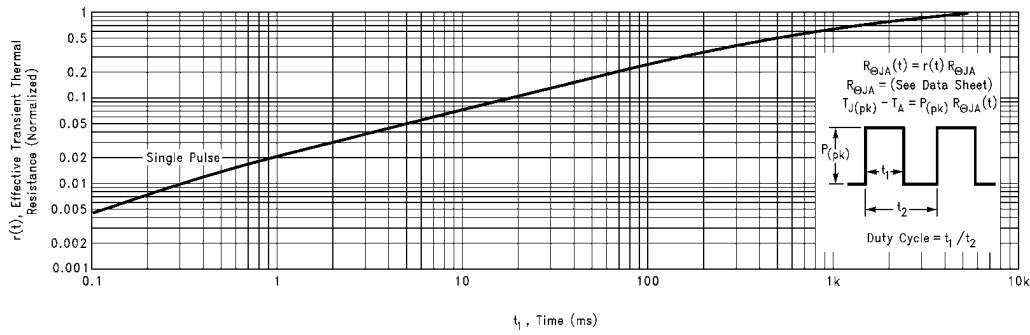
**Typical Electrical Characteristics** (Continued)

**BS170/MMBF170**



**FIGURE 12. TO-92 Transient Thermal Response**

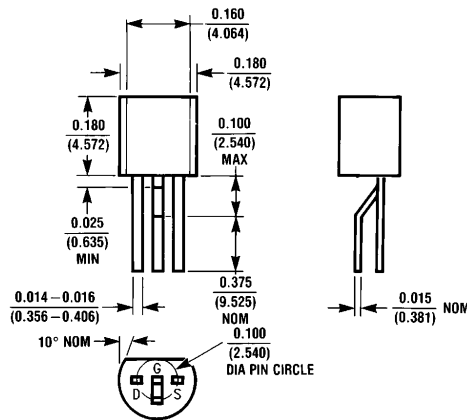
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**FIGURE 13. SOT-23 Transient Thermal Response**

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**Physical Dimensions** inches (millimeters)

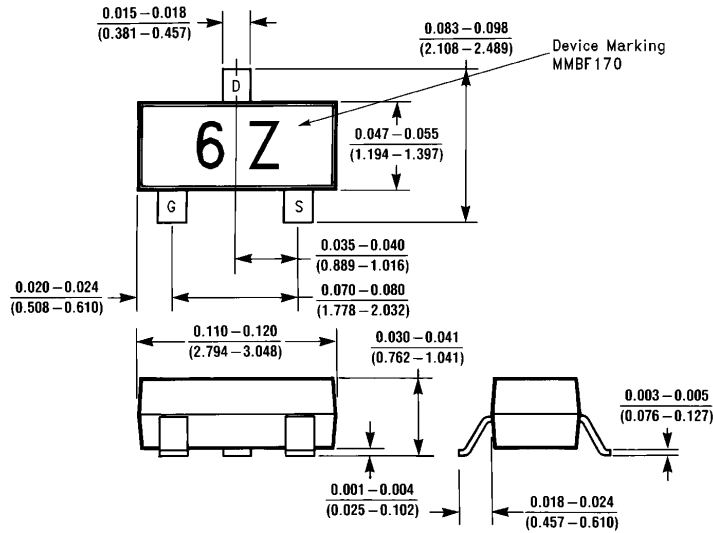


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**Note:** All 1 transistors are load formed to this configuration prior to bulk shipment.

**TO-92  
TO-18 Lead Form STD\***

**Physical Dimensions** inches (millimeters) (Continued)



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**Note 1:** Meets all JEDEC dimensional requirements for TO-236AB.

**Note 2:** Controlling dimension: millimeters.

**Note 3:** Available also in TO-236AA. Contact your local National Semiconductor representative for delivery and ordering information.

**Note 4:** Tape and reel is the standard packing method for TO-236.

**TO-236AB  
(SOT-23) (Notes 3,4)**

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