National Semiconductor

August 1992

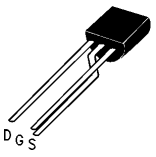
BS170/MMBF170
N-Channel Enhancement Mode Field Effect Transistor

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

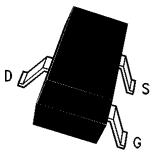
Features

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



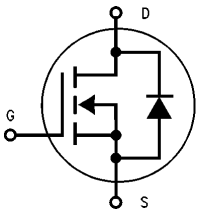
TL/G/11379–1

TO-92
BS170



TL/G/11379–2

TO-236AB
(SOT-23)
MMBF170



TL/G/11379–3

Absolute Maximum Ratings

Symbol	Parameter	BS170	MMBF170	Units
V_{DSS}	Drain-Source Voltage	60		V
V_{DGR}	Drain-Gate Voltage ($R_{GS} \leq 1$ MΩ)	60		V
V_{GSS}	Gate-Source Voltage	±20		V
I_D	Drain Current—Continuous	500	500	mA
	—Pulsed		800	mA
P_D	Total Power Dissipation	830	300	mW
	Derate above 25°C	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, 1/16″ from Case for 10 Seconds	300		°C

RRD-B30M115/Printed in U. S. A.

BS170

Electrical Characteristics (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
OFF CHARACTERISTICS						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 100 μA	60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 25V, V_{GS} = 0V			0.5	μA
I_{GSSF}	Gate-Body Leakage, Forward	V_{GS} = 15V, V_{DS} = 0V			10	nA
ON CHARACTERISTICS (Note 1)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 1 mA	0.8	2.1	3	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10V, I_D = 200 mA		1.2	5	Ω
g_{FS}	Forward Transconductance	V_{DS} = 10V, I_D = 200 mA		320		mS
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 10V, V_{GS} = 0V, f = 1.0 MHz		24	40	pF
C_{oss}	Output Capacitance			17	30	pF
C_{rss}	Reverse Transfer Capacitance			7	10	pF
SWITCHING CHARACTERISTICS (Note 1)						
t_{on}	Turn-On Time	V_{DD} = 25V, I_D = 200 mA, V_{GS} = 10V R_G = 25Ω			10	ns
t_{off}	Turn-Off Time				10	ns
THERMAL CHARACTERISTICS						
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient				150	°C/W

MMBF170

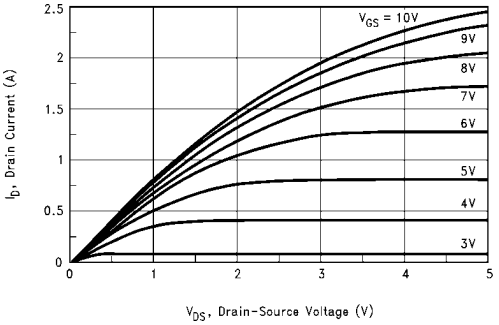
Electrical Characteristics (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
OFF CHARACTERISTICS						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 100 μA	60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 25V, V_{GS} = 0V			0.5	μA
I_{GSSF}	Gate-Body Leakage, Forward	V_{GS} = 15V, V_{DS} = 0V			10	nA
ON CHARACTERISTICS (Note 1)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 1.0 mA	0.8	2.1	3	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10V, I_D = 200 mA		1.2	5	Ω
g_{FS}	Forward Transconductance	$V_{DS} \geq 2\ V_{DS(on)}$, I_D = 200 mA		320		mS
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 10V, V_{GS} = 0V, f = 1.0 MHz		24	40	pF
C_{oss}	Output Capacitance			17	30	pF
C_{rss}	Reverse Transfer Capacitance			7	10	pF
SWITCHING CHARACTERISTICS (Note 1)						
t_{on}	Turn-On Time	V_{DD} = 25V, I_D = 500 mA, V_{GS} = 10V R_G = 50Ω			10	ns
t_{off}	Turn-Off Time				10	ns
THERMAL CHARACTERISTICS						
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient				417	°C/W

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

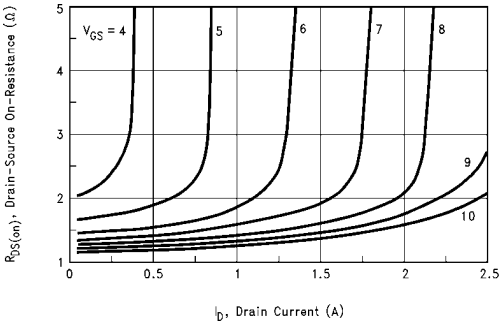
Typical Electrical Characteristics

BS170/MMBF170



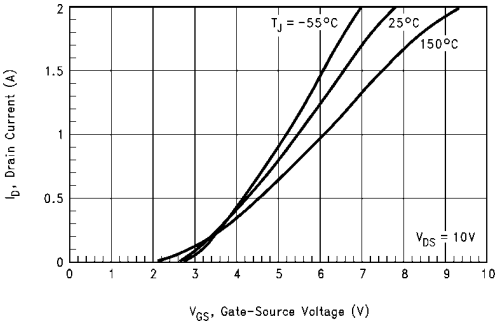
TL/G/11379–6

FIGURE 1. On-Region Characteristics



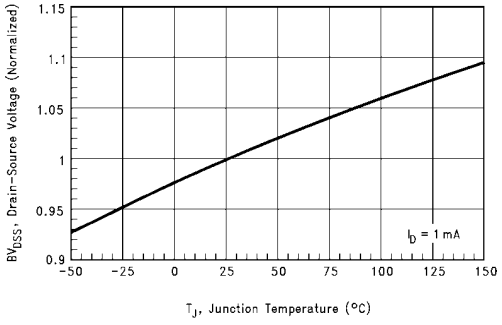
TL/G/11379–7

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



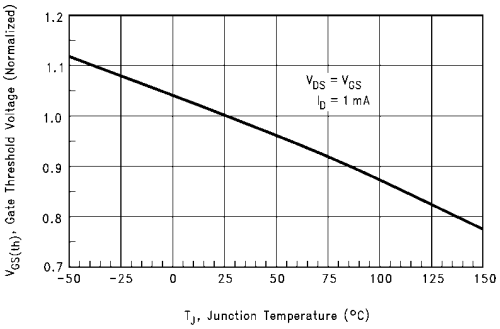
TL/G/11379–8

FIGURE 3. Transfer Characteristics



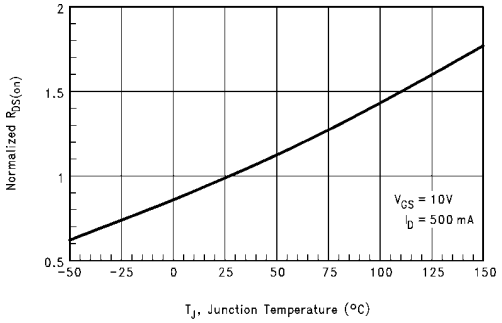
TL/G/11379–9

FIGURE 4. Breakdown Voltage Variation with Temperature



TL/G/11379–10

FIGURE 5. Gate Threshold Variation with Temperature

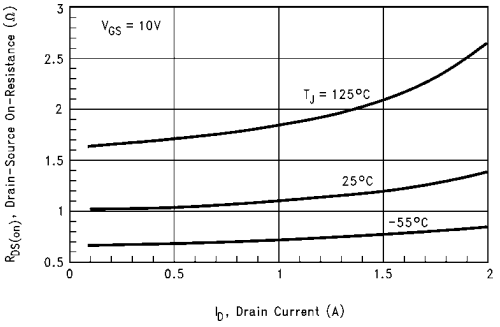


TL/G/11379–11

FIGURE 6. On-Resistance Variation with Temperature

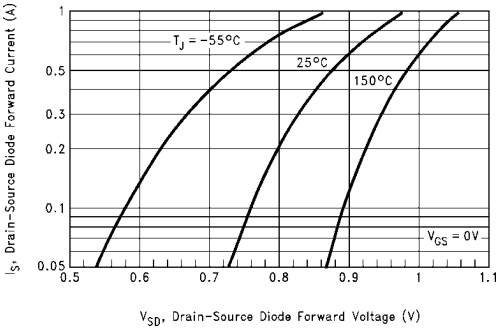
Typical Electrical Characteristics (Continued)

BS170/MMBF170



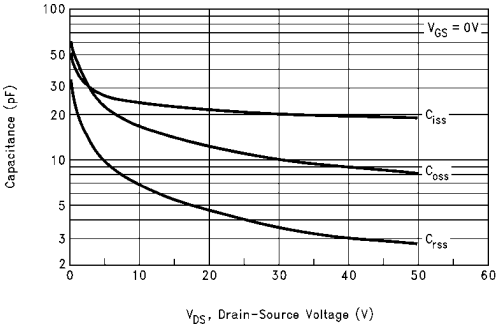
TL/G/11379–12

FIGURE 7. On-Resistance vs Drain Current



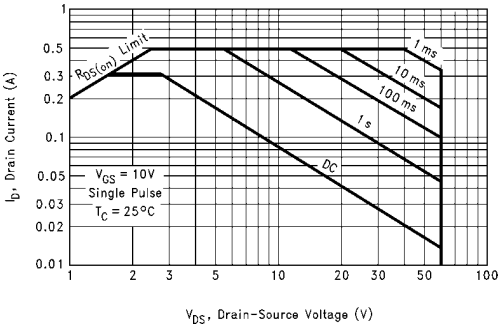
TL/G/11379–13

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



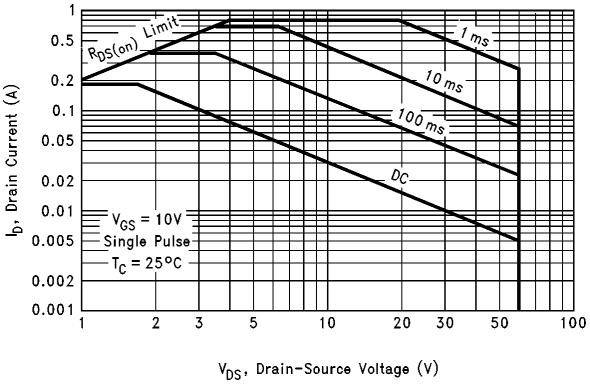
TL/G/11379–14

FIGURE 9. Capacitance vs Drain-Source Voltage



TL/G/11379–15

FIGURE 10. BS170 Safe Operating Area

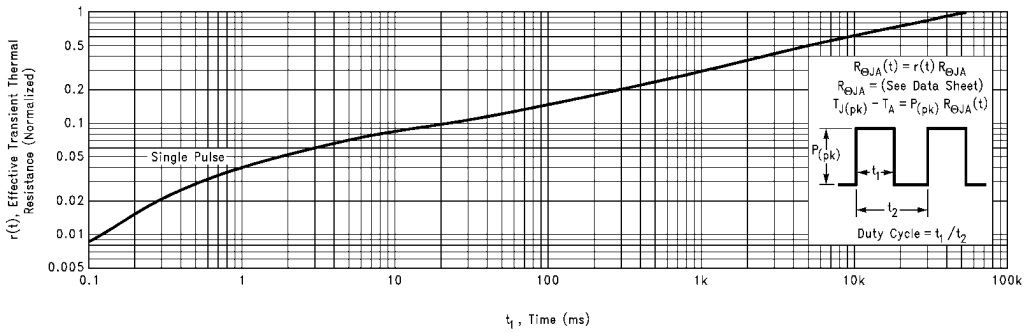


TL/G/11379–16

FIGURE 11. MMBF170 Safe Operating Area

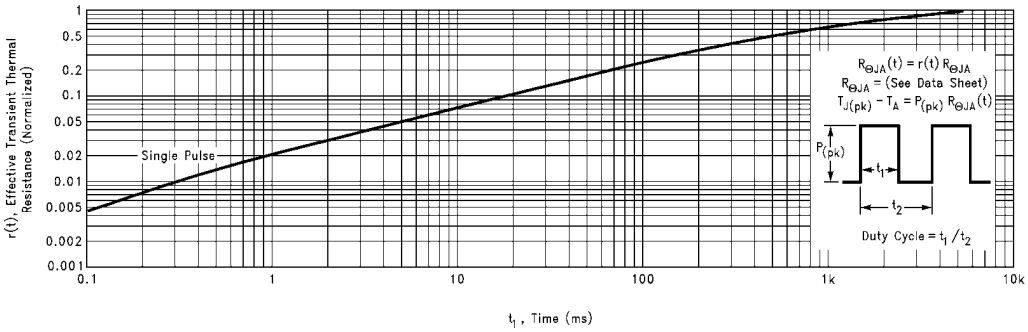
Typical Electrical Characteristics (Continued)

BS170/MMBF170



TL/G/11379–17

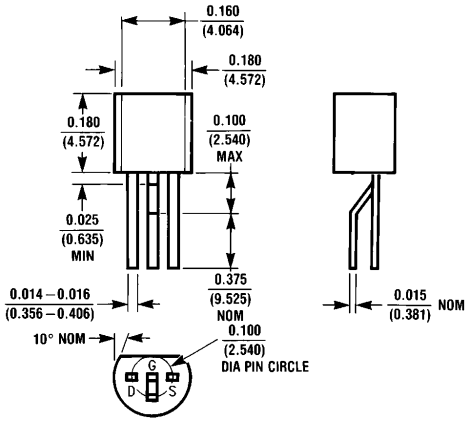
FIGURE 12. TO-92 Transient Thermal Response



TL/G/11379–18

FIGURE 13. SOT-23 Transient Thermal Response

Physical Dimensions inches (millimeters)

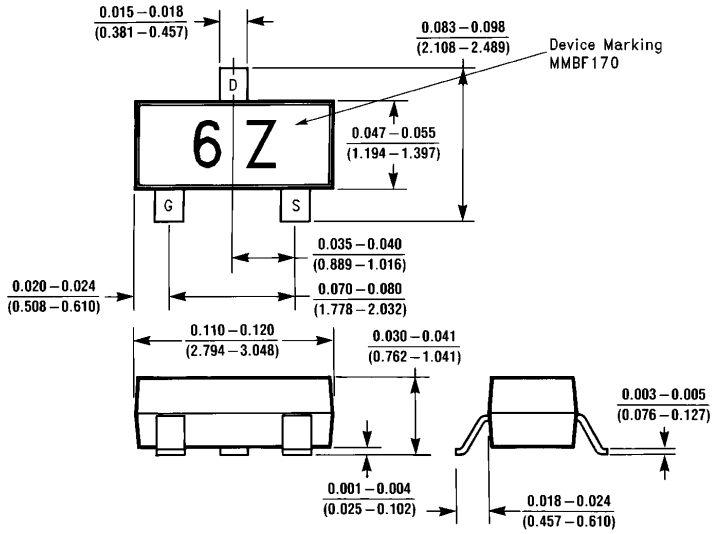


TL/G/11379–4

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)



TL/G/11379–5

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)

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor Corporation
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe
Fax: (+49) 0-180-530 85 86
Email: cnjwge@tevm2.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Français Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
Tel: 81-043-299-2309
Fax: 81-043-299-2408