

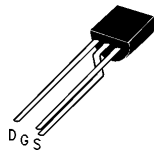
## BS270/NDS7002A N-Channel Enhancement Mode Field Effect Transistor

### 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 400 mA DC and can deliver pulsed currents up to 2A. 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.

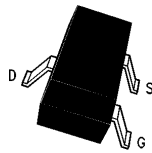
### Features

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



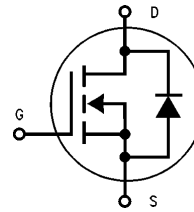
**TO-92**  
**BS270**

TL/G/11380-1



**TO-236AB**  
**(SOT-23)**  
**NDS7002A**

TL/G/11380-2



TL/G/11380-3

### Absolute Maximum Ratings

Symbol	Parameter	BS270	NDS7002A	Units
V <sub>DSS</sub>	Drain-Source Voltage	60		V
V <sub>DGR</sub>	Drain-Gate Voltage (R <sub>GS</sub> ≤ 1 MΩ)	60		V
V <sub>GSS</sub>	Gate-Source Voltage	± 40		V
I <sub>D</sub>	Drain Current—Continuous —Pulsed	400	280	mA
		2000	1500	mA
P <sub>D</sub>	Total Power Dissipation @ T <sub>A</sub> = 25°C Derate above 25°C	625	300	mW
		5	2.4	mW/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-65 to +150		°C
T <sub>L</sub>	Maximum Lead Temperature for Soldering Purposes, 1/16" from Case for 10 Seconds	300		°C

## BS270/NDS7002A

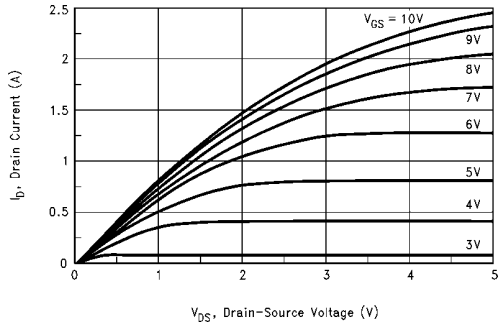
### Electrical Characteristics ( $T_c = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 10 \mu A$	60			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 60V, V_{GS} = 0V$			1	$\mu A$
					500	$\mu A$
$I_{GSSF}$	Gate-Body Leakage, Forward	$V_{GS} = 20V$			10	nA
$I_{GSSR}$	Gate-Body Leakage, Reverse	$V_{GS} = -20V$			-10	nA
<b>ON CHARACTERISTICS (Note 1)</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250 \mu A$	1	2.1	2.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 500 \text{ mA}$		1.2	2	$\Omega$
				2	3.5	$\Omega$
				1.8	3	$\Omega$
$V_{DS(on)}$	Drain-Source On-Voltage	$V_{GS} = 10V, I_D = 500 \text{ mA}$		0.6	1	V
				0.14	0.225	V
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 10V, V_{DS} \geq 2V_{DS(on)}$	2000	2700		mA
			400	600		mA
$g_{FS}$	Forward Transconductance	$V_{DS} \geq 2V_{DS(on)}, I_D = 200 \text{ mA}$	100	320		mS
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V, f = 1.0 \text{ MHz}$		20	50	pF
$C_{iss}$	Output Capacitance			11	25	pF
$C_{rss}$	Reverse Transfer Capacitance			4	5	pF
<b>SWITCHING CHARACTERISTICS (Note 1)</b>						
$t_{on}$	Turn-On Time	$V_{DD} = 30V, I_D = 500 \text{ mA}, V_{GS} = 10V, R_G = 25\Omega$			10	ns
$t_{off}$	Turn-Off Time				10	ns
<b>THERMAL CHARACTERISTICS</b>						
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	BS270			200	$^\circ\text{C/W}$
		NDS7002A			417	$^\circ\text{C/W}$
<b>BODY-DRAIN DIODE RATINGS</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current	BS270			400	mA
		NDS7002A			280	mA
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	BS270			2000	mA
		NDS7002A			1500	mA
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0V, I_S = 400 \text{ mA}$ (Note 1)		0.88	1.2	V

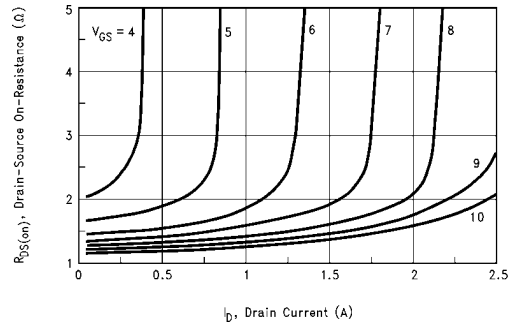
**Note 1:** Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

# Typical Electrical Characteristics

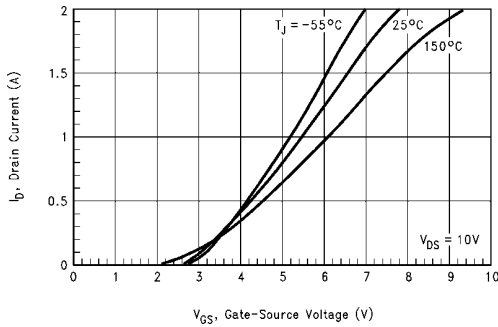
## BS270/NDS7002A



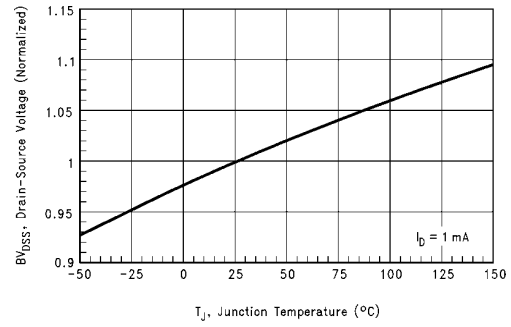
TL/G/11380-6  
**FIGURE 1. On-Region Characteristics**



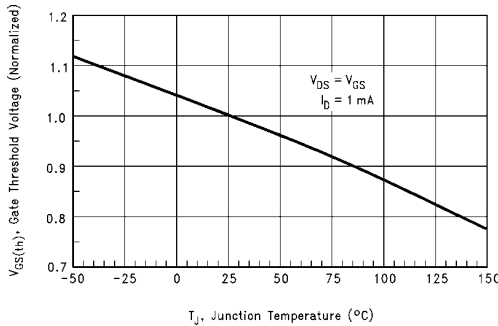
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**FIGURE 2.  $R_{DS(on)}$  Variation with Drain Current and Gate Voltage**



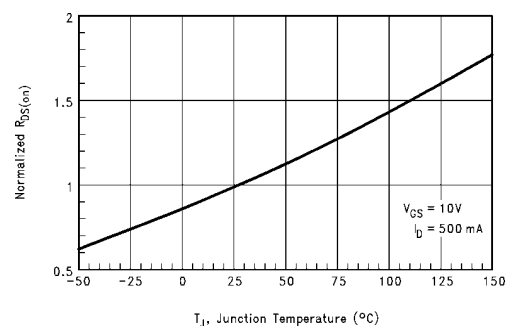
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**FIGURE 3. Transfer Characteristics**



TL/G/11380-9  
**FIGURE 4. Breakdown Voltage Variation with Temperature**



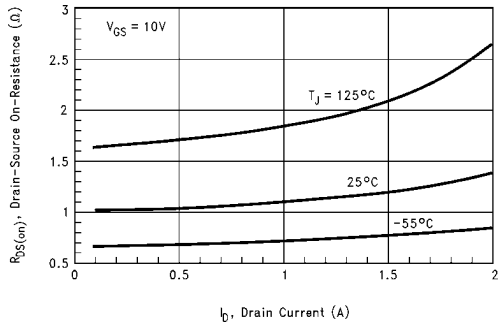
TL/G/11380-10  
**FIGURE 5. Gate Threshold Variation with Temperature**



TL/G/11380-11  
**FIGURE 6. On-Resistance Variation with Temperature**

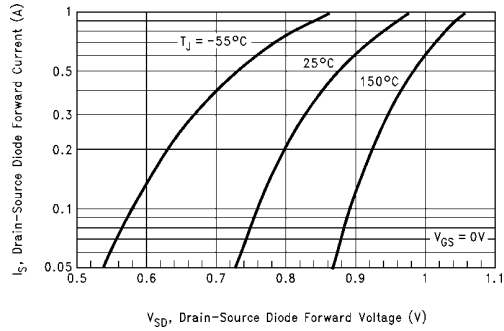
# Typical Electrical Characteristics (Continued)

## BS270/NDS7002A (Continued)



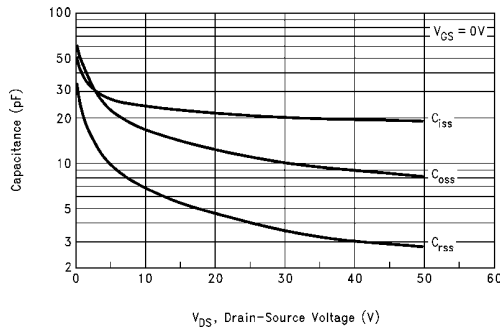
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FIGURE 7. On-Resistance vs Drain Current



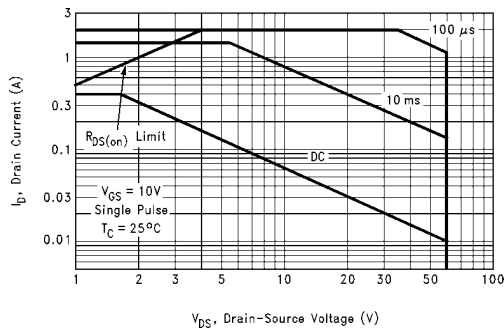
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FIGURE 8. Body Diode Forward Voltage Variation with Current and Temperature



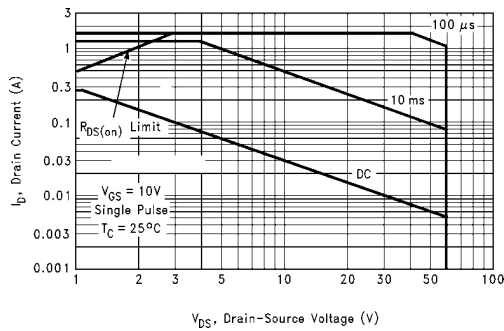
TL/G/11380-14

FIGURE 9. Capacitance vs Drain-Source Voltage



TL/G/11380-15

FIGURE 10. BS270 Safe Operating Area



TL/G/11380-16

FIGURE 11. NDS7002A Safe Operating Area

## Typical Electrical Characteristics (Continued)

### BS270/NDS7002A (Continued)

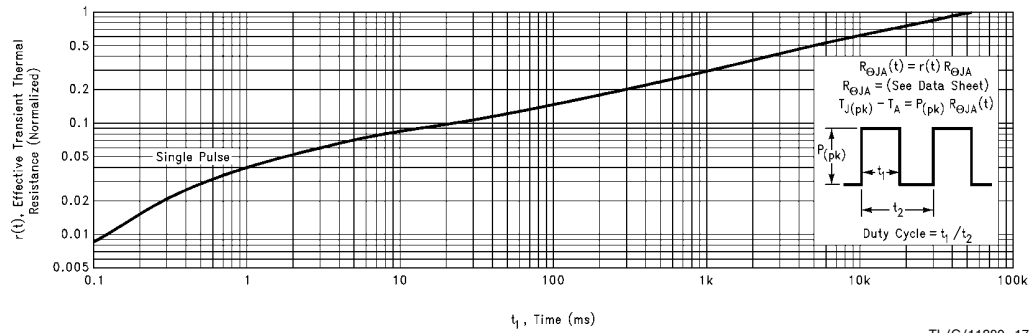


FIGURE 12. TO-92 Transient Thermal Response

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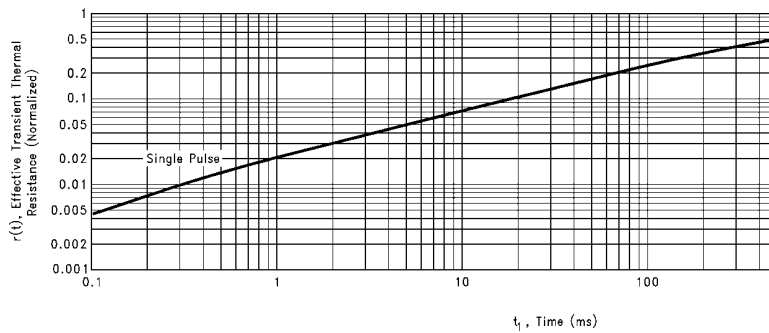
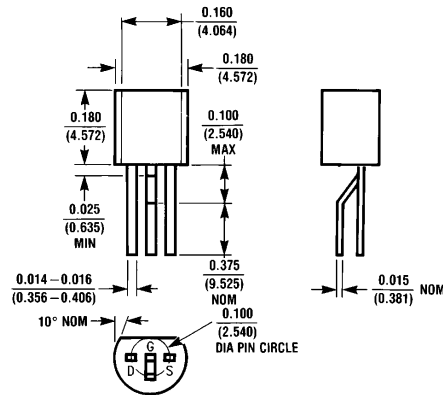


FIGURE 13. SOT-23 Transient Thermal Response

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## Physical Dimensions inches (millimeters)

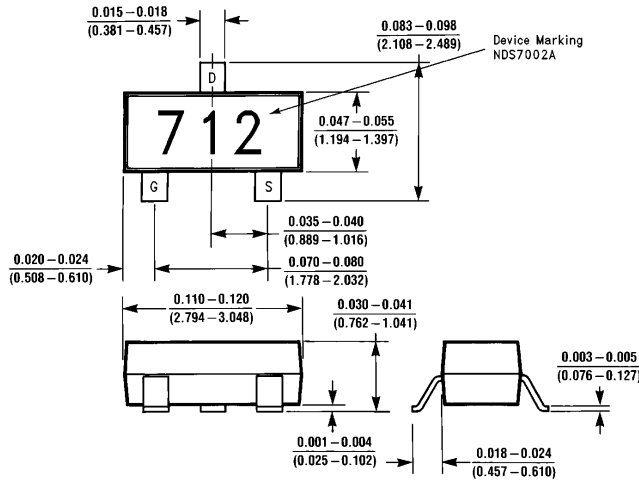


TL/G/11380-4

**Note:** All 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/11380-5

**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.

**TO236AB  
(SOT-23) (Notes 3,4)**

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