

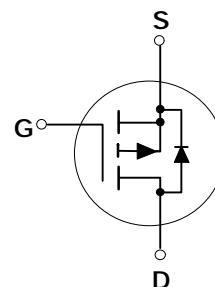
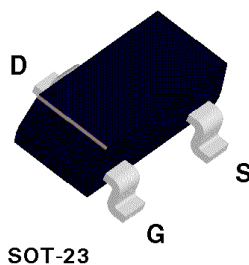
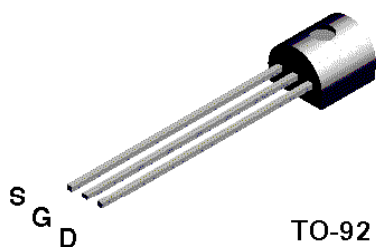
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NDF0610 / NDS0610**P-Channel Enhancement Mode Field Effect Transistor****General Description**

These P-Channel enhancement mode power field effect transistors are produced using National's proprietary, high cell density, DMOS technology. This very high density process has 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 0.18A DC and can deliver pulsed currents up to 1A. This product is particularly suited to low voltage applications requiring a low current high side switch.

Features

- -0.18 and -0.12A, -60V. $R_{DS(ON)} = 10\Omega$
- Voltage controlled p-channel small signal switch
- High density cell design for low $R_{DS(ON)}$
- TO-92 and SOT-23 packages for both through hole and surface mount applications
- High saturation current

**Absolute Maximum Ratings** $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	NDF0610	NDS0610	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 - Continuous	± 20		V
	- Nonrepetitive ($t_p < 50\ \mu\text{s}$)	± 30		V
I_D	Drain Current - Continuous	-0.18	-0.12	A
	- Pulsed		-1	
P_D	Maximum Power Dissipation $T_A = 25^\circ\text{C}$	0.8	0.36	W
	Derate above 25°C	5	2.9	mW/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to 150		$^\circ\text{C}$
T_L	Maximum lead temperature for soldering purposes, 1/16" from case for 10 seconds	300		$^\circ\text{C}$

THERMAL CHARACTERISTICS

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	200	350	$^\circ\text{C}/\text{W}$
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ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
OFF CHARACTERISTICS						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = -10\ \mu\text{A}$	-60			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}$ $T_J = 125^\circ\text{C}$			-1	μA
					-200	μA
I_{GSSF}	Gate - Body Leakage, Forward	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$			10	nA
I_{GSSR}	Gate - Body Leakage, Reverse	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$			-10	nA
ON CHARACTERISTICS (Note 1)						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -1\text{ mA}$ $T_J = 125^\circ\text{C}$	-1	-2.4	-3.5	V
			-0.6	-2.1	-3.2	
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -10\text{ V}, I_D = -0.5\text{ A}$ $T_J = 125^\circ\text{C}$ $V_{GS} = -4.5\text{ V}, I_D = -0.25\text{ A}$ $T_J = 125^\circ\text{C}$		3.6	10	Ω
				5.9	16	
				5.2	20	
$I_{D(on)}$	On-State Drain Current	$V_{GS} = -10\text{ V}, V_{DS} = -10\text{ V}$ $V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}$	-0.6	-1.6		A
				-0.35		
g_{FS}	Forward Transconductance	$V_{DS} = -10\text{ V}, I_D = -0.1\text{ A}$	0.07	0.17		S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	$V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		40	60	pF
C_{oss}	Output Capacitance			11	25	pF
C_{rss}	Reverse Transfer Capacitance			3.2	5	pF
SWITCHING CHARACTERISTICS (Note 1)						
$t_{D(on)}$	Turn - On Delay Time	$V_{DD} = -25\text{ V}, I_D = -0.18\text{ A},$ $V_{GS} = -10\text{ V}, R_{GEN} = 25\ \Omega$		7	10	nS
t_T	Turn - On Rise Time			5	15	nS
$t_{D(off)}$	Turn - Off Delay Time			13	15	nS
t_f	Turn - Off Fall Time			10	20	nS
Q_g	Total Gate Charge	$V_{DS} = -48\text{ V},$ $I_D = -0.5\text{ A}, V_{GS} = -10\text{ V}$		1.43		nC
Q_{gs}	Gate-Source Charge			0.6		nC
Q_{gd}	Gate-Drain Charge			0.25		nC
DRAIN-SOURCE DIODE CHARACTERISTICS						
I_S	Maximum Continuous Source Current				-0.18	A
I_{SM}	Maximum Pulse Source Current (Note 1)				-1	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -0.5\text{ A}$ (Note 1) $T_J = 125^\circ\text{C}$		-1.2	-1.5	V
				-0.98	-1.3	
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = -0.5\text{ A},$ $di_f/dt = 100\text{ A}/\mu\text{s}$		40		ns
I_{rr}	Reverse Recovery Current			2.8		A

Note:

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

Typical Electrical Characteristics

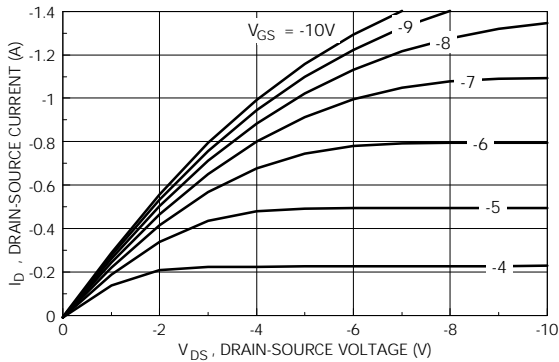


Figure 1. On-Region Characteristics

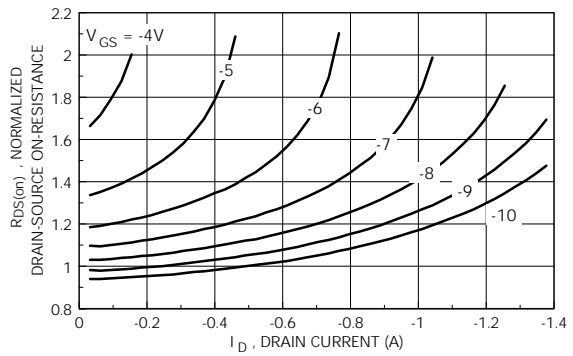


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

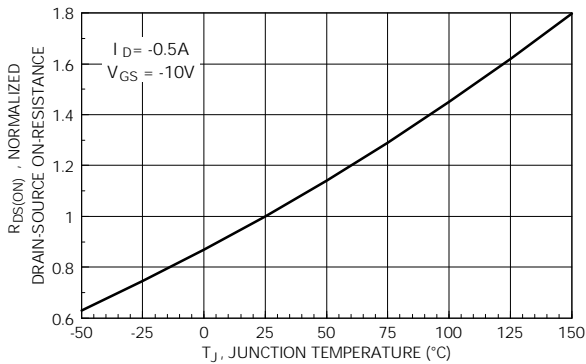


Figure 3. On-Resistance Variation with Temperature

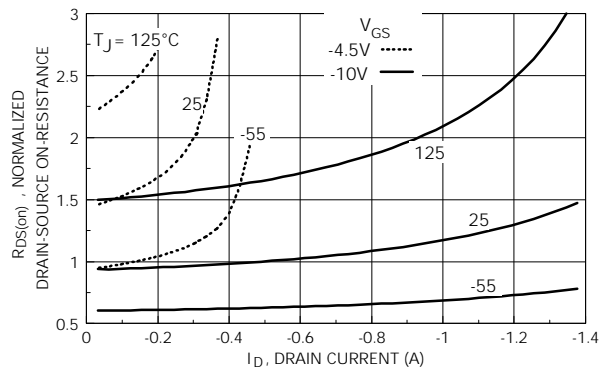


Figure 4. On-Resistance Variation with Drain Current and Temperature

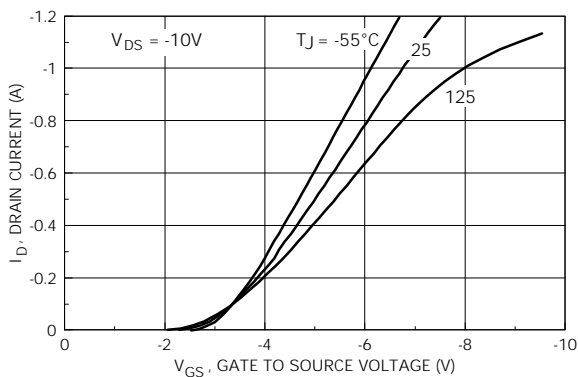


Figure 5. Transfer Characteristics

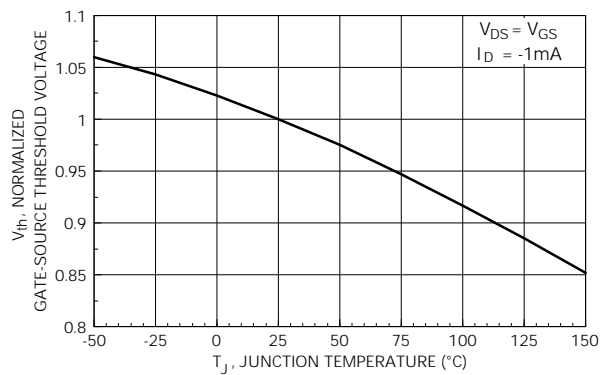


Figure 6. Gate Threshold Variation with Temperature

Typical Electrical Characteristics (continued)

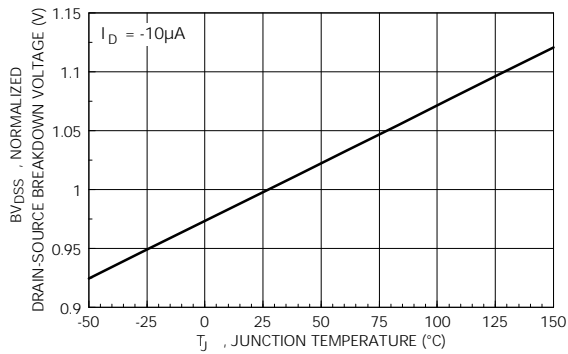


Figure 7. Breakdown Voltage Variation with Temperature

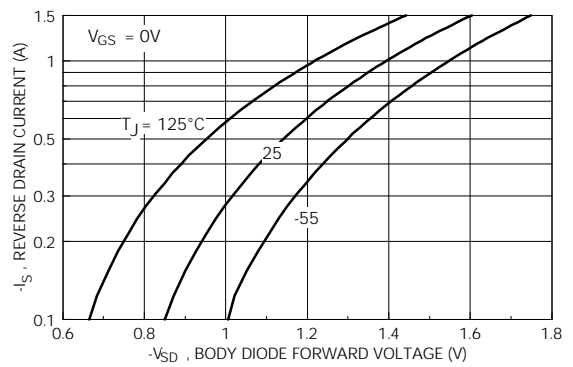


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature

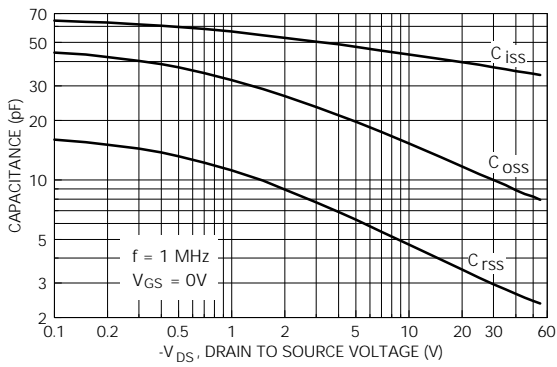


Figure 9. Capacitance Characteristics

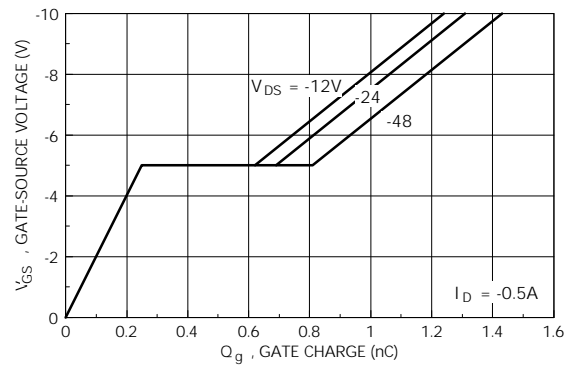


Figure 10. Gate Charge Characteristics

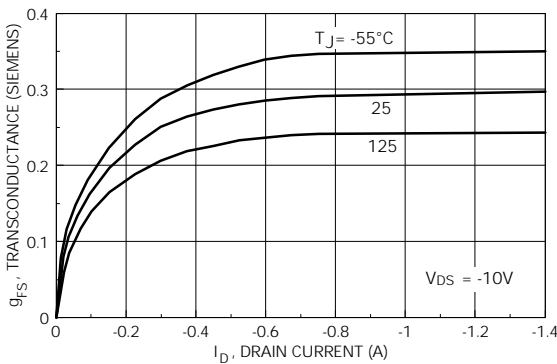


Figure 11. Transconductance Variation with Drain Current and Temperature

Typical Electrical Characteristics (continued)

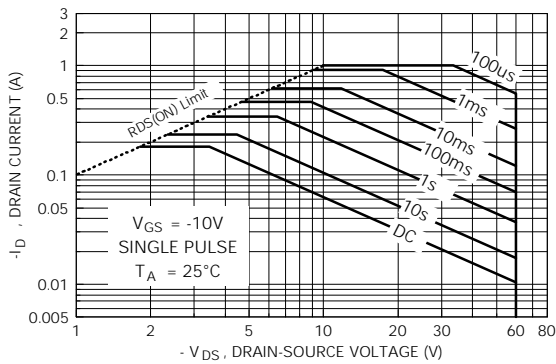


Figure 12. NDF0610 (TO-92)
Maximum Safe Operating Area

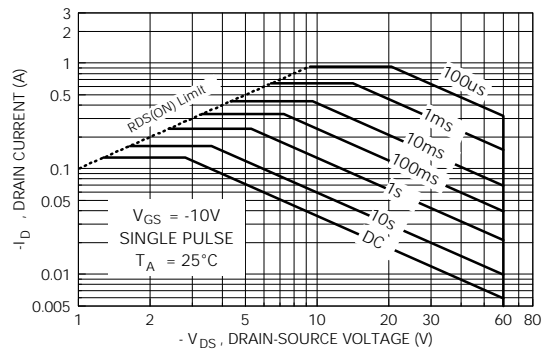


Figure 13. NDS0610 (SOT-23)
Maximum Safe Operating Area

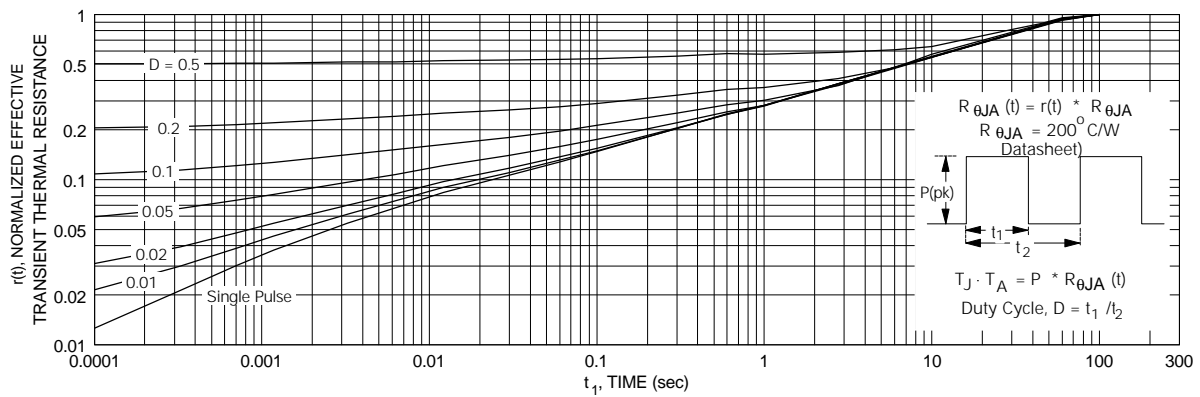


Figure 14. NDF0610 (TO-92) Transient
Thermal Response Curve.

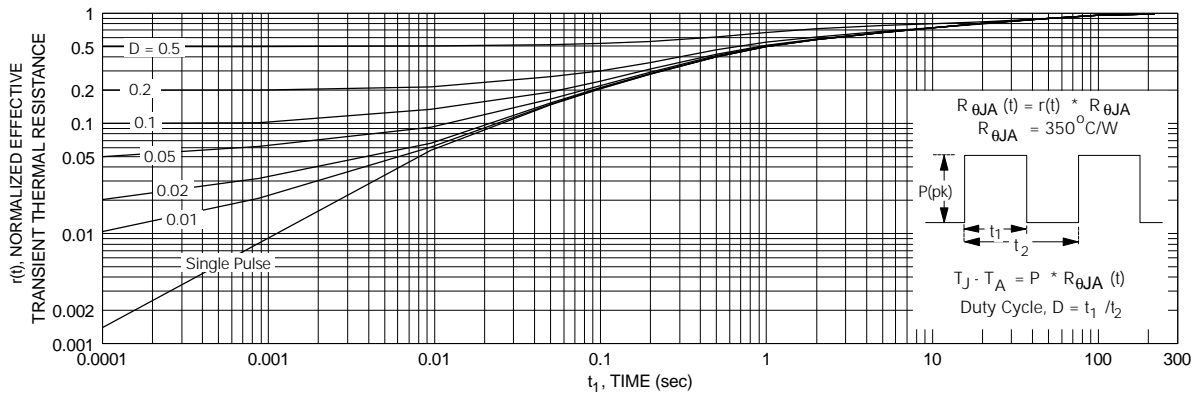


Figure 15. NDS0610 (SOT-23) Transient
Thermal Response Curve.