![FAIRCHILD SEMICONDUCTOR™]

September 1996

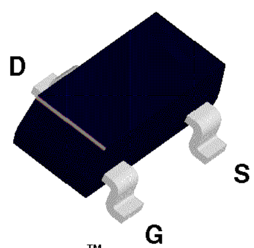
NDS356AP
P-Channel Logic Level Enhancement Mode Field Effect Transistor

General Description

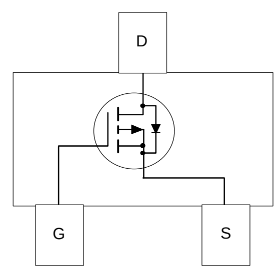
SuperSOT™-3 P-Channel logic level enhancement mode power field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance. These devices are particularly suited for low voltage applications such as notebook computer power management, portable electronics, and other battery powered circuits where fast high-side switching, and low in-line power loss are needed in a very small outline surface mount package.

Features

- -1.1 A, -30 V, $R_{DS(ON)}$ = 0.3 Ω @ V_{GS}=-4.5 V
  $R_{DS(ON)}$ = 0.2 Ω @ V_{GS}=-10 V.
- Industry standard outline SOT-23 surface mount package using proprietary SuperSOT™-3 design for superior thermal and electrical capabilities.
- High density cell design for extremely low $R_{DS(ON)}$.
- Exceptional on-resistance and maximum DC current capability.



SuperSOT™-3



Absolute Maximum Ratings T_A = 25°C unless otherwise noted

Symbol	Parameter	NDS356AP	Units
V_{DSS}	Drain-Source Voltage	-30	V
V_{GSS}	Gate-Source Voltage - Continuous	±20	V
I_D	Maximum Drain Current - Continuous (Note 1a)	±1.1	A
	- Pulsed	±10	
P_D	Maximum Power Dissipation (Note 1a)	0.5	W
	(Note 1b)	0.46	
T_J,T_{STG}	Operating and Storage Temperature Range	-55 to 150	°C
THERMAL CHARACTERISTICS			
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	250	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	75	°C/W

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

Symbol	Parameter	Conditions		Min	Typ	Max	Units
OFF CHARACTERISTICS							
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = -250 µA		-30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = -24 V, V_{GS} = 0 V				-1	µA
			T_J =55°C			-10	µA
I_{GSSF}	Gate - Body Leakage, Forward	V_{GS} = 20 V, V_{DS} = 0 V				100	nA
I_{GSSR}	Gate - Body Leakage, Reverse	V_{GS} = -20V, V_{DS} = 0 V				-100	nA
ON CHARACTERISTICS (Note 2)							
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = -250 µA		-0.8	-1.6	-2.5	V
			T_J =125°C	-0.5	-1.3	-2.2	
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS} = -4.5 V, I_D = -1.1 A			0.25	0.3	Ω
			T_J =125°C		0.35	0.4	
		V_{GS} = -10 V, I_D = -1.3 A			0.14	0.2	
$I_{D(ON)}$	On-State Drain Current	V_{GS} = -4.5 V, V_{DS} = -5 V		-3			A
g_{FS}	Forward Transconductance	V_{DS} = -5 V, I_D = -1.1 A			2		S
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	V_{DS} = -10 V, V_{GS} = 0 V, f = 1.0 MHz			280		pF
C_{oss}	Output Capacitance				170		pF
C_{rss}	Reverse Transfer Capacitance				65		pF
SWITCHING CHARACTERISTICS (Note 2)							
$t_{D(on)}$	Turn - On Delay Time	V_{DD} = -10 V, I_D = -1 A, V_{GS} = -10 V, R_{GEN} = 50 Ω			8	15	ns
t_r	Turn - On Rise Time				17	30	ns
$t_{D(off)}$	Turn - Off Delay Time				53	90	ns
t_f	Turn - Off Fall Time				38	80	ns
Q_g	Total Gate Charge	V_{DS} = -10 V, I_D = -1.1 A, V_{GS} = -5 V			3.4	4.4	nC
Q_{gs}	Gate-Source Charge				0.7		nC
Q_{gd}	Gate-Drain Charge				1.5		nC

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
I_S	Maximum Continuous Source Current				-0.42	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current				-10	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = -0.42 (Note 2)		-0.8	-1.2	V

Notes:

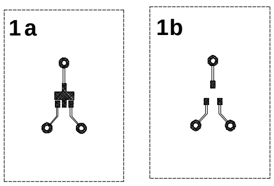
1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.

$$P_D(t) = \frac{T_J - T_A}{R_{\theta JA}(t)} = \frac{T_J - T_A}{R_{\theta JC} + R_{\theta CA}(t)} = I_D^2(t) \times R_{DS(ON)@T_J}$$

Typical $R_{\theta JA}$ using the board layouts shown below on 4.5"x5" FR-4 PCB in a still air environment:

a. 250°C/W when mounted on a 0.02 in^2 pad of 2oz copper.

b. 270°C/W when mounted on a 0.001 in^2 pad of 2oz copper.



Scale 1 : 1 on letter size paper

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

Typical Electrical Characteristics

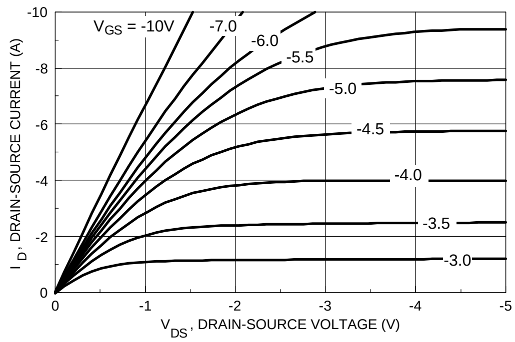


Figure 1. On-Region Characteristics.

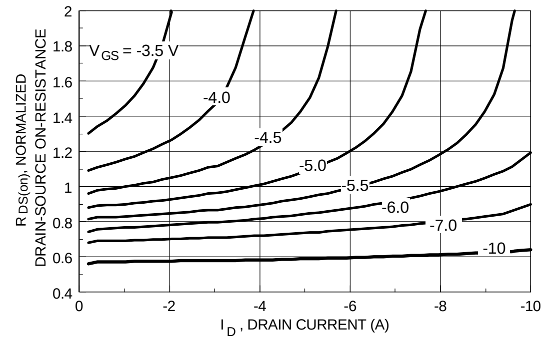


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

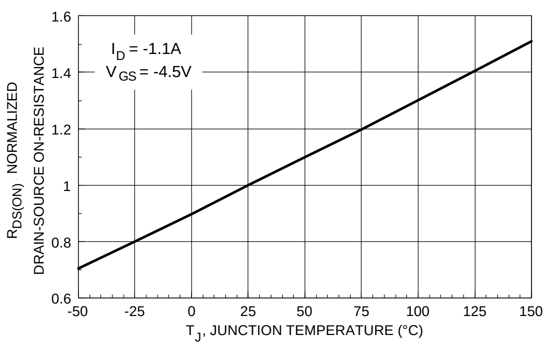


Figure 3. On-Resistance Variation with Temperature.

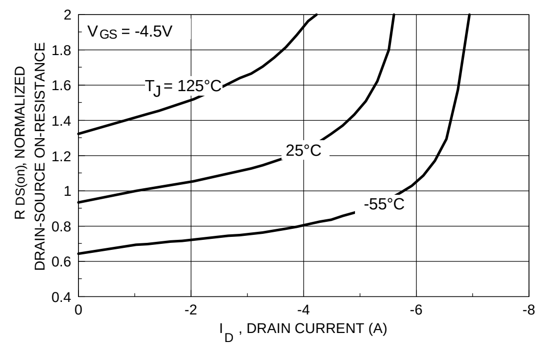


Figure 4. On-Resistance Variation with Drain Current and Temperature.

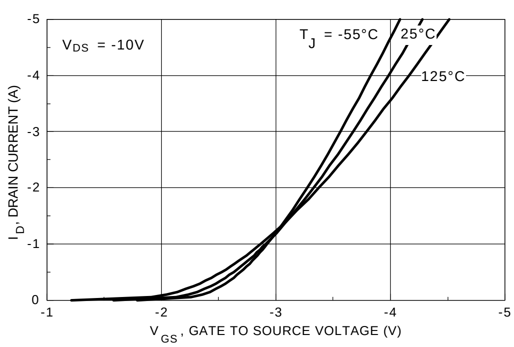


Figure 5. Transfer Characteristics.

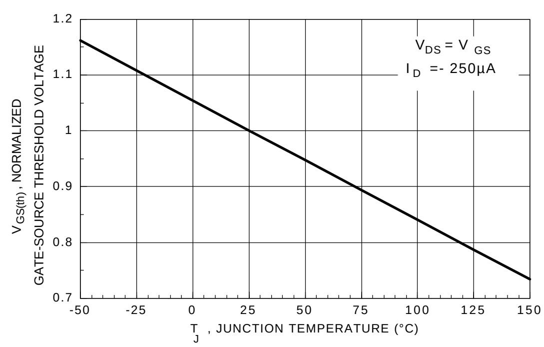


Figure 6. Gate Threshold Variation with Temperature.

Typical Electrical Characteristics (continued)

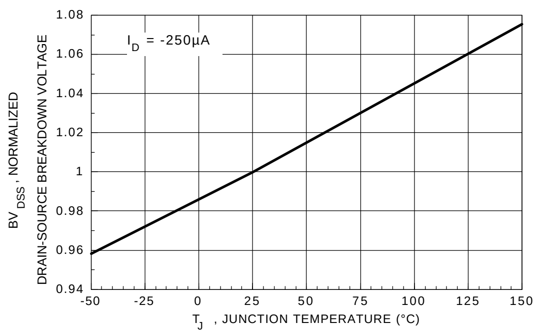


Figure 7. Breakdown Voltage Variation with Temperature.

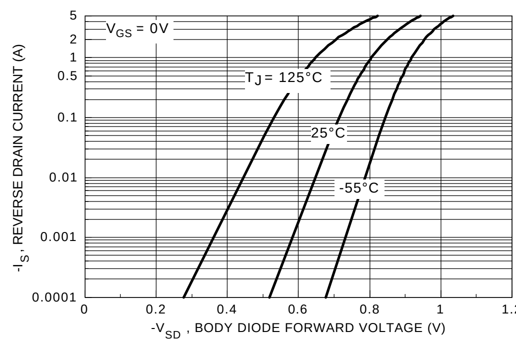


Figure 8. Body Diode Forward Voltage Variation with Source Current and Temperature.

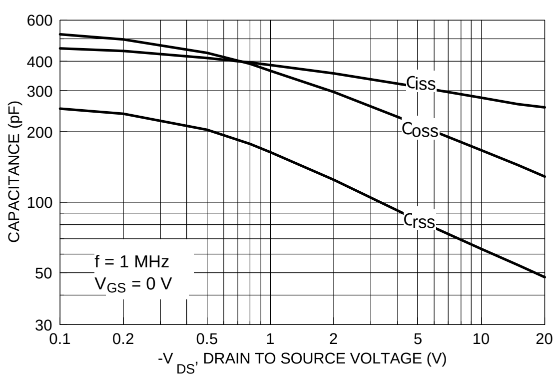


Figure 9. Capacitance Characteristics.

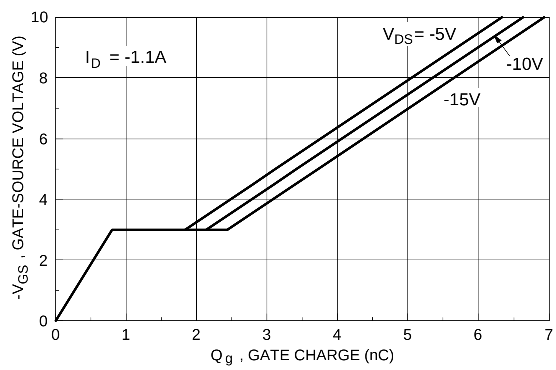


Figure 10. Gate Charge Characteristics.

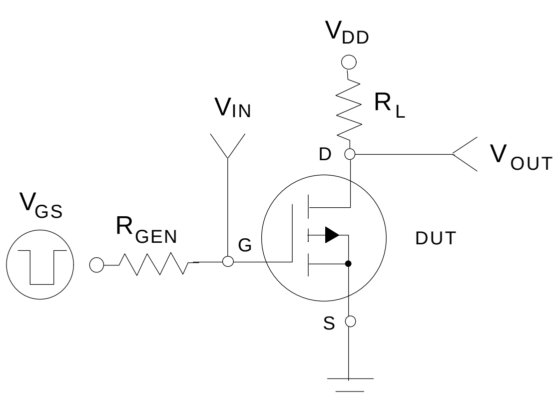


Figure 11. Switching Test Circuit.

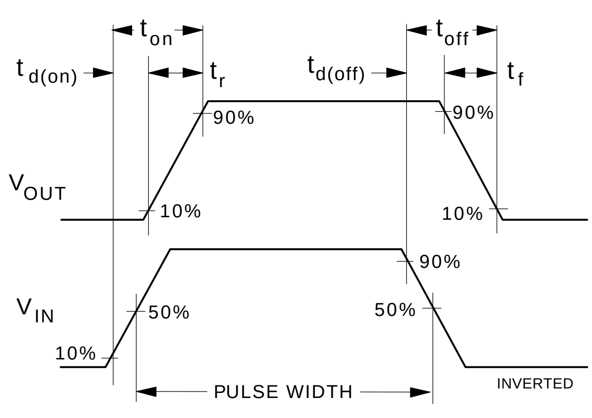


Figure 12. Switching Waveforms.

Typical Electrical Characteristics (continued)

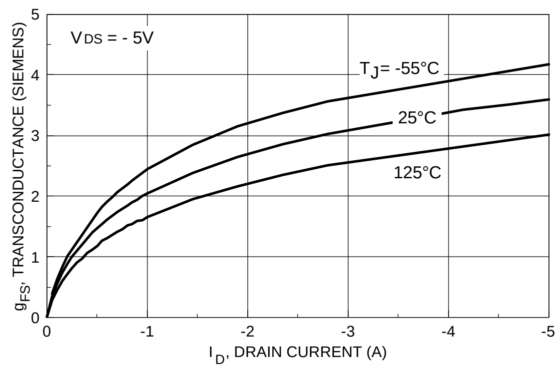


Figure 13. Transconductance Variation with Drain Current and Temperature.

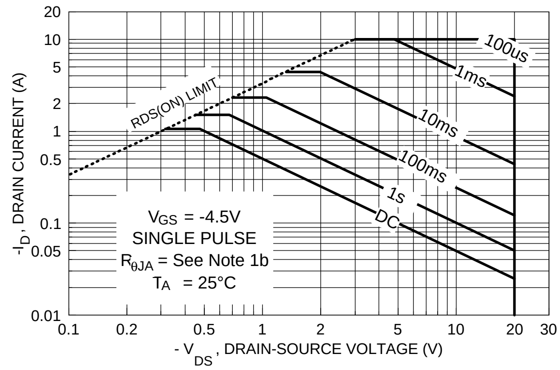
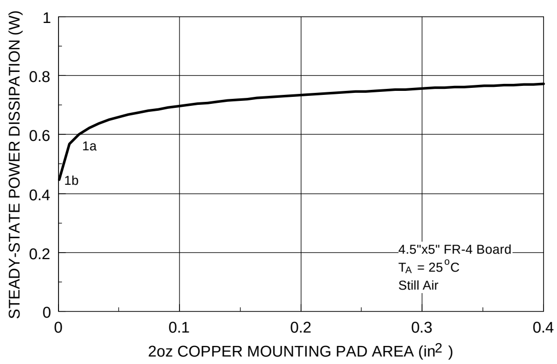


Figure 14. Maximum Safe Operating Area.



Figue 15. SuperSOT™ - 3 Maximum Steady-State Power Dissipation versus Copper Mounting Pad Area.

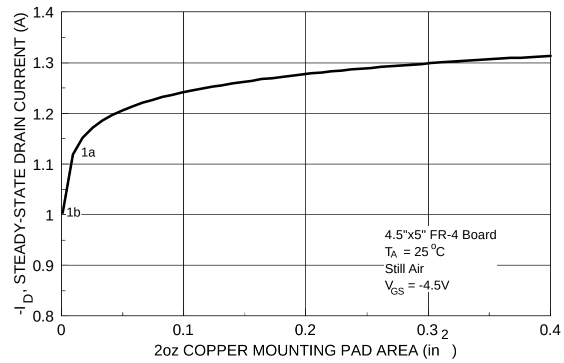


Figure 16. Maximum Steady-State Drain Current versus Copper Mounting Pad Area.

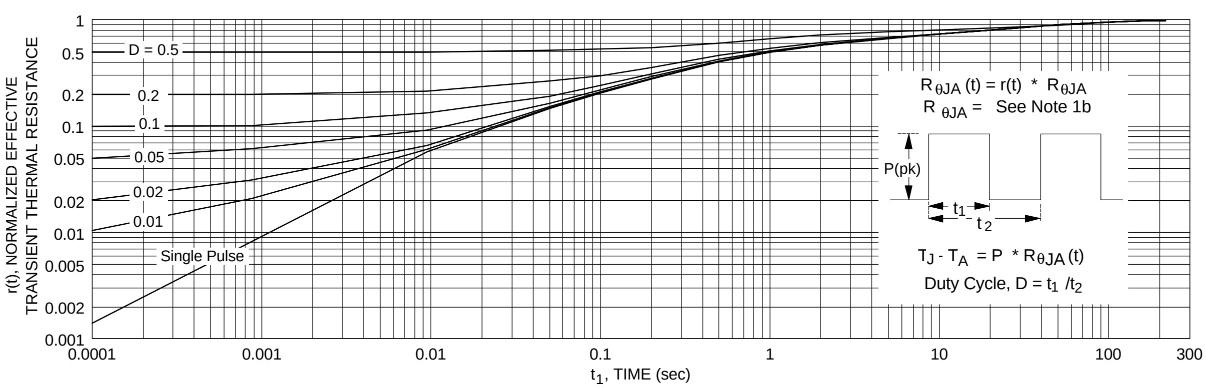


Figure 17. Transient Thermal Response Curve.

Note : Characterization performed using the conditions described in note 1b. Transient thermal response will change depending on the circuit board design.