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ON Semiconductor®

FDS6612A

Single N-Channel, Logic-Level, PowerTrench® MOSFET

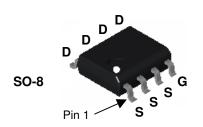
General Description

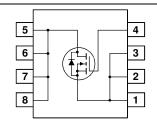
This N-Channel Logic Level MOSFET is produced using ON Semiconductor's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain superior switching performance.

These devices are well suited for low voltage and battery powered applications where low in-line power loss and fast switching are required.

Features

- 8.4 A, 30 V. $R_{DS(ON)} = 22 \ m\Omega \ @ \ V_{GS} = 10 \ V$ $R_{DS(ON)} = 30 \ m\Omega \ @ \ V_{GS} = 4.5 \ V$
- · Fast switching speed
- Low gate charge
- High performance trench technology for extremely low $R_{\text{DS}(\text{ON})}$
- High power and current handling capability





Absolute Maximum Ratings TA=25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V _{DSS}	Drain-Source Voltage		30	V
V_{GSS}	Gate-Source Voltage		±20	V
I_D	Drain Current - Continuous	(Note 1a)	8.4	А
	- Pulsed		40	
P _D	Power Dissipation for Single Operation	(Note 1a)	2.5	W
		(Note 1b)	1.0	
E _{AS}	Single Pulse Avalanche Energy	(Note 3)	24	mJ
T_J, T_{STG}	Operating and Storage Junction Tempera	ture Range	-55 to +150	°C

Thermal Characteristics

R _{eJA}	Thermal Resistance, Junction-to-Ambient	(Note 1a)	50	°C/W
R _{eJA}	Thermal Resistance, Junction-to-Ambient	(Note 1b)	125	
R _{eJC}	Thermal Resistance, Junction-to-Case	(Note 1)	25	

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS6612A	FDS6612A	13"	12mm	2500 units

Symbol	Parameter	Test Conditions	Min	Тур	Max	Units
Off Char	acteristics				I	
BV _{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, \qquad I_{D} = 250 \mu\text{A}$	30			V
<u>ΔBV_{DSS}</u> ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 250 μA, Referenced to 25°C		26		mV/°C
I _{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24 \text{ V}, \qquad V_{GS} = 0 \text{ V}$			1	μΑ
		$V_{DS} = 24 \text{ V}, V_{GS} = 0 \text{ V}, T_{J} = 55^{\circ}\text{C}$			10	μΑ
I _{GSS}	Gate-Body Leakage	$V_{GS} = \pm 20 \text{ V}, V_{DS} = 0 \text{ V}$			±100	nA
On Char	acteristics (Note 2)					
V _{GS(th)}	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250 \mu A$	1	1.9	3	V
$\Delta V_{GS(th)} \over \Delta T_J$	Gate Threshold Voltage Temperature Coefficient	I_D = 250 μ A, Referenced to 25°C		-4.4		mV/°C
R _{DS(on)}	Static Drain–Source On–Resistance	$\begin{split} &V_{GS} = 10 \text{ V}, &I_{D} = 8.4 \text{ A} \\ &V_{GS} = 4.5 \text{ V}, &I_{D} = 7.2 \text{ A} \\ &V_{GS} = 10 \text{ V}, I_{D} = 8.4 \text{ A}, T_{J} = 125 ^{\circ}\text{C} \end{split}$		19 24 25	22 30 37	mΩ
I _{D(on)}	On-State Drain Current	$V_{GS} = 10 \text{ V}, \qquad V_{DS} = 5 \text{ V}$	20			Α
g FS	Forward Transconductance	$V_{DS} = 15 \text{ V}, \qquad I_{D} = 8.4 \text{ A}$		30		S
Dynamic	Characteristics				•	
C _{iss}	Input Capacitance	$V_{DS} = 15 \text{ V}, \qquad V_{GS} = 0 \text{ V},$		560		pF
Coss	Output Capacitance	f = 1.0 MHz		140		pF
C _{rss}	Reverse Transfer Capacitance			55		pF
R _G	Gate Resistance	V _{GS} = 15 mV, f = 1.0 MHz		2.5		Ω
Switchin	g Characteristics (Note 2)					
t _{d(on)}	Turn-On Delay Time	$V_{DD} = 15 \text{ V}, \qquad I_D = 1 \text{ A},$		7	14	ns
t _r	Turn-On Rise Time	$V_{GS} = 10 \text{ V}, \qquad R_{GEN} = 6 \Omega$		5	10	ns
t _{d(off)}	Turn-Off Delay Time			22	35	ns
t _f	Turn-Off Fall Time			3	6	ns
Q_g	Total Gate Charge	$V_{DS} = 15 \text{ V}, \qquad I_{D} = 8.4 \text{ A},$		5.4	7.6	nC
Q_{gs}	Gate-Source Charge	$V_{GS} = 5 \text{ V}$		1.7		nC
Q_{gd}	Gate-Drain Charge			1.9		nC
Drain-So	ource Diode Characteristics	and Maximum Ratings				
Is	Maximum Continuous Drain-Source	e Diode Forward Current			2.1	Α
V _{SD}	Drain–Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, \qquad I_{S} = 2.1 \text{ A (Note 2)}$		0.77	1.2	٧
t _{rr}	Diode Reverse Recovery Time	1 - 9 4 A d /d - 100 A/va		19		nS
Q _{rr}	Diode Reverse Recovery Charge	$I_F = 8.4 \text{ A}, d_{iF}/d_t = 100 \text{ A/}\mu\text{s}$		9		nC

Notes:

R_{8JA} 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_{8JC} is guaranteed by design while R_{8CA} is determined by the user's board design.



a) 50 °C/W when mounted on a 1in² pad of 2 oz copper



b) 125°C/W when mounted on a minimum pad.

Scale 1:1 on letter size paper

² Test: Pulse Width < 300µs, Duty Cycle < 2.0% 3 Starting TJ = 25°C, L = 1mH, I_{AS} = 7A, V_{DD} = 27V, V_{GS} = 10V

Typical Characteristics

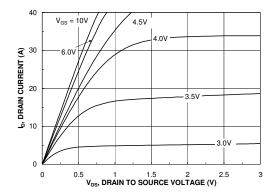


Figure 1. On-Region Characteristics.

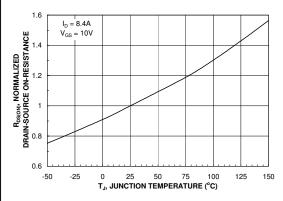


Figure 3. On-Resistance Variation with Temperature.

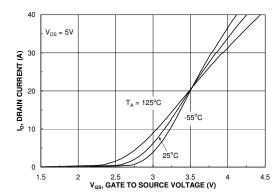


Figure 5. Transfer Characteristics.

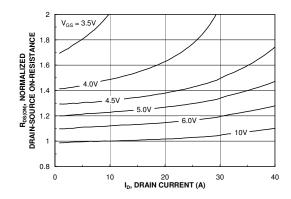


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

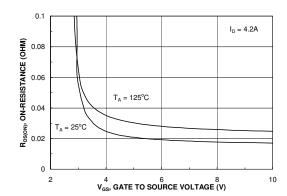


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

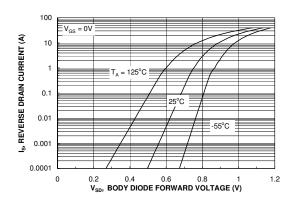
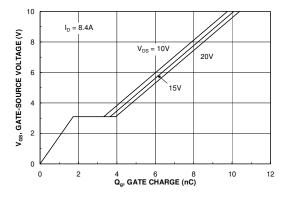


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics



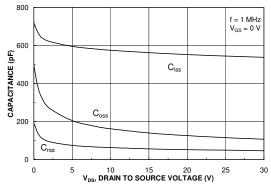
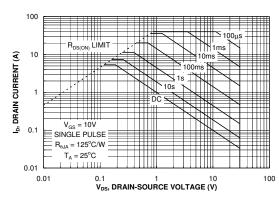


Figure 7. Gate Charge Characteristics.





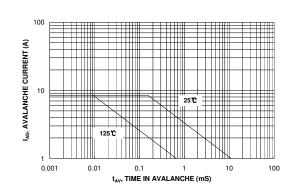


Figure 9. Maximum Safe Operating Area.

Figure 10. Unclamped Inductive Switching Capability

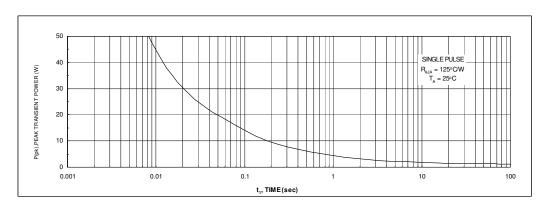


Figure 11. Single Pulse Maximum Power Dissipation.

Typical Characteristics

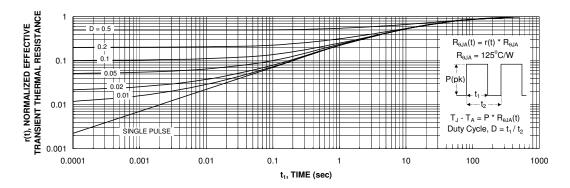


Figure 12. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1c. Transient thermal response will change depending on the circuit board design.

PSPICE Electrical Model N-Channel .SUBCKT FDS6612A 2 1 3 *NOM TEMP=25 DEG C *REV A - JULY 2003 CA 12 8 1E-9 CB 15 14 4.0E-10 CIN 6 8 5.1E-10 LDRAIN DPLC AP DRAIN **DBODY 7 5 DBODYMOD** DBREAK 5 11 DBREAKMOD 10 RLDRAIN DPLCAP 10 5 DPLCAPMOD RSLC1 DBREAK EBREAK 11 7 17 18 34.2 RSLC2 ₹ EDS 148581 ESLC 11 FGS 13 8 6 8 1 ESG 6 10 6 8 1 50 EVTHRES 6 21 19 8 1 (17 [18] **DBODY** RDRAIN EBREAK ESG EVTEMP 20 6 18 22 1 EVTHRES 21 IT 8 17 1 MWEAK **EVTEMP** RGATE GATE LGATE 1 9 3.84E-9 $\frac{18}{22}$ IMED 20 牾 LDRAIN 2 5 1.00E-9 LSOURCE 3 7 4E-9 RLGATE LSOURCE CIN SOURCE **RLGATE 1 9 38.4** RLDRAIN 25 10 RSOUR CE RLSOURCE 3 7 40 RLSOU RCE RBR EAK MMED 16 6 8 8 MMEDMOD 13 8 14 13 17 MSTRO 16 6 8 8 MSTROMOD MWEAK 16 21 8 8 MWEAKMOD **≨**RVTEMP СВ 19 RBREAK 17 18 RBREAKMOD 1 CA п RDRAIN 50 16 RDRAINMOD 8E-3 VBAT RGATE 9 20 4.2 EGS EDS RSLC1 5 51 RSLCMOD 1E-6 RSLC2 5 50 1E3 RVTHRES RSOURCE 8 7 RSOURCEMOD 7.5E-3 **RVTHRES 22 8 RVTHRESMOD 1** RVTEMP 18 19 RVTEMPMOD 1 S1A 6 12 13 8 S1AMOD S1B 13 12 13 8 S1BMOD S2A 6 15 14 13 S2AMOD S2B 13 15 14 13 S2BMOD VBAT 22 19 DC 1 ESLC 51 50 VALUE={(V(5,51)/ABS(V(5,51)))*(PWR(V(5,51)/(1E-6*105),3))} .MODEL DBODYMOD D (IS=7E-15 RS=6.1E-3 N=0.84 TRS1=1.7E-3 TRS2=1.0E-6 + CJO=3.2E-10 TT=10E-9 M=0.5 IKF=0.3 XTI=3.0) .MODEL DBREAKMOD D (RS=1E-1 TRS1=1.12E-3 TRS2=1.25E-6) .MODEL DPLCAPMOD D (CJO=14E-11 IS=1E-30 N=10 M=0.34) .MODEL MWEAKMOD NMOS (VTO=1.82 KP=0.05 IS=1E-30 N=10 TOX=1 L=1U W=1U RG=42 RS=.1) .MODEL MMEDMOD NMOS (VTO=2.1 KP=6 IS=1E-30 N=10 TOX=1 L=1U W=1U RG=4.2) .MODEL MSTROMOD NMOS (VTO=2.55 KP=50 IS=1E-30 N=10 TOX=1 L=1U W=1U) .MODEL RBREAKMOD RES (TC1=0.83E-3 TC2=1E-7) .MODEL RDRAINMOD RES (TC1=6E-3 TC2=5E-6) .MODEL RSLCMOD RES (TC1=2.5E-3 TC2=4.5E-6) .MODEL RSOURCEMOD RES (TC1=1.0E-3 TC2=1E-6) .MODEL RVTHRESMOD RES (TC1=-2.013E-3 TC2=-7E-6) .MODEL RVTEMPMOD RES (TC1=-1.5E-3 TC2=1E-6) .MODEL S1AMOD VSWITCH (RON=1E-5 ROFF=0.1 VON=-4 VOFF=-3) .MODEL S1BMOD VSWITCH (RON=1E-5 ROFF=0.1 VON=-3 VOFF=-4) .MODEL S2AMOD VSWITCH (RON=1E-5 ROFF=0.1 VON=-1.3 VOFF=-0.5) .MODEL S2BMOD VSWITCH (RON=1E-5 ROFF=0.1 VON=-0.5 VOFF=-1.3) **FNDS** Note: For further discussion of the PSPICE model, consult A New PSPICE Sub-Circuit for the Power MOSFET Featuring Global

Temperature Options; IEEE Power Electronics Specialist Conference Records, 1991, written by William J. Hepp and C. Frank Wheatley.

SPICE Thermal Model

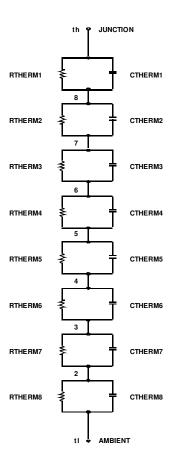
.SUBCKT FDS6612A_THERM TH TL *THERMAL MODEL SUBCIRCUIT

^{*}REV A - JULY 2003

*MIN	PAD	RJ/

CTHERM1	TH	8	0.005
CTHERM2	8	7	0.05
CTHERM3	7	6	0.10
CTHERM4	6	5	0.35
CTHERM5	5	4	0.45
CTHERM6	4	3	0.50
CTHERM7	3	2	0.55
CTHERM8	2	TL	3.00
RTHERM1	TH	8	5.000
RTHERM1 RTHERM2	TH 8	8 7	5.000 6.250
		-	
RTHERM2	8	7	6.250
RTHERM2 RTHERM3	8 7	7 6	6.250 7.500
RTHERM2 RTHERM3 RTHERM4	8 7 6	7 6 5	6.250 7.500 8.750
RTHERM2 RTHERM3 RTHERM4 RTHERM5	8 7 6 5	7 6 5 4	6.250 7.500 8.750 10.625
RTHERM2 RTHERM3 RTHERM4 RTHERM5 RTHERM6	8 7 6 5 4	7 6 5 4 3	6.250 7.500 8.750 10.625 11.875

.ENDS



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