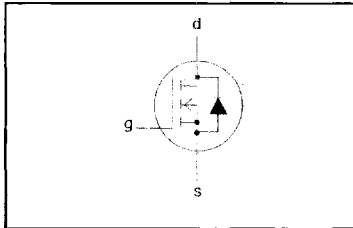


PowerMOS transistors FREDFET, Avalanche energy rated

PHX4ND40E**FEATURES**

- Repetitive Avalanche Rated
- Fast switching
- Stable off-state characteristics
- High thermal cycling performance
- Isolated package
- Fast reverse recovery diode

SYMBOL**QUICK REFERENCE DATA**

$$V_{DSS} = 400 \text{ V}$$

$$I_D = 2.7 \text{ A}$$

$$R_{DS(ON)} \leq 1.8 \Omega$$

$$t_{rr} = 180 \text{ ns}$$

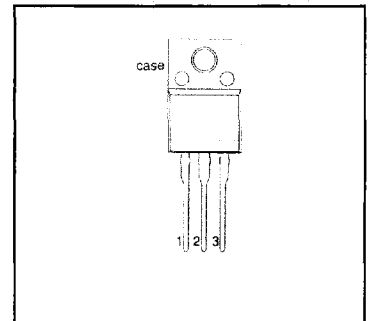
GENERAL DESCRIPTION

N-channel, enhancement mode field-effect power transistor, incorporating a Fast Recovery Epitaxial Diode (FRED). This gives improved switching performance in half bridge and full bridge converters making this device particularly suitable for inverters, lighting ballasts and motor control circuits.

The PHX4ND40E is supplied in the SOT186A full pack isolated package.

PINNING

PIN	DESCRIPTION
1	gate
2	drain
3	source
case	isolated

SOT186A**LIMITING VALUES**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DSS}	Drain-source voltage	$T_j = 25^\circ\text{C}$ to 150°C	-	400	V
V_{DGR}	Drain-gate voltage	$T_j = 25^\circ\text{C}$ to 150°C ; $R_{GS} = 20 \text{ k}\Omega$	-	400	V
V_{GS}	Gate-source voltage		-	± 30	V
I_D	Continuous drain current	$T_{hs} = 25^\circ\text{C}$; $V_{GS} = 10 \text{ V}$	-	2.7	A
		$T_{hs} = 100^\circ\text{C}$; $V_{GS} = 10 \text{ V}$	-	1.7	A
I_{DM}	Pulsed drain current ¹	$T_{hs} = 25^\circ\text{C}$	-	18	A
P_D	Total dissipation	$T_{hs} = 25^\circ\text{C}$	-	30	W
T_j, T_{stg}	Operating junction and storage temperature range		- 55	150	$^\circ\text{C}$

AVALANCHE ENERGY LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
E_{AS}	Non-repetitive avalanche energy	Unclamped inductive load, $I_D = 3.3 \text{ A}$; $V_{DD} \leq 50 \text{ V}$; starting $T_j = 25^\circ\text{C}$; $R_{GS} = 50 \Omega$; $V_{GS} = 10 \text{ V}$	-	190	mJ
E_{AR}	Repetitive avalanche energy ¹		-	5	mJ
I_{AS}, I_{AR}	Repetitive and non-repetitive avalanche current		-	3.3	A

¹ pulse width and repetition rate limited by T_j max.

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ISOLATION LIMITING VALUE & CHARACTERISTIC

 $T_{hs} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{isol}	R.M.S. isolation voltage from all three terminals to external heatsink	$f = 50\text{--}60\text{ Hz}$; sinusoidal waveform; $R.H. \leq 65\%$; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	$f = 1\text{ MHz}$	-	10	-	pF

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$R_{th\ j-ts}$	Thermal resistance junction to heatsink	with heatsink compound	-	-	4.1	K/W
$R_{th\ j-a}$	Thermal resistance junction to ambient		-	60	-	K/W

ELECTRICAL CHARACTERISTICS

 $T_j = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$; $I_D = 0.25\text{ mA}$	400	-	-	V
$\Delta V_{(BR)DSS} / \Delta T_j$	Drain-source breakdown voltage temperature coefficient	$V_{DS} = V_{GS}$; $I_D = 0.25\text{ mA}$	-	0.1	-	%/K
$R_{DS(ON)}$	Drain-source on resistance	$V_{GS} = 10\text{ V}$; $I_D = 2.2\text{ A}$	-	1.3	1.8	Ω
$V_{GS(TO)}$	Gate threshold voltage	$V_{DS} = V_{GS}$; $I_D = 0.25\text{ mA}$	2.0	3.0	4.0	V
g_{fs}	Forward transconductance	$V_{DS} = 30\text{ V}$; $I_D = 2.2\text{ A}$	1.3	2.2	-	S
I_{DSS}	Drain-source leakage current	$V_{DS} = 400\text{ V}$; $V_{GS} = 0\text{ V}$	-	1	25	μA
		$V_{DS} = 320\text{ V}$; $V_{GS} = 0\text{ V}$; $T_j = 125\text{ }^{\circ}\text{C}$	-	30	250	μA
I_{GSS}	Gate-source leakage current	$V_{GS} = \pm 30\text{ V}$; $V_{DS} = 0\text{ V}$	-	10	200	nA
$Q_{g(tot)}$	Total gate charge	$I_D = 4.4\text{ A}$; $V_{DD} = 320\text{ V}$; $V_{GS} = 10\text{ V}$	-	26	30	nC
Q_{gs}	Gate-source charge		-	2	4	nC
Q_{gd}	Gate-drain (Miller) charge		-	14	17	nC
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 200\text{ V}$; $R_D = 47\text{ }\Omega$; $R_G = 18\text{ }\Omega$	-	10	-	ns
t_r	Turn-on rise time		-	30	-	ns
$t_{d(off)}$	Turn-off delay time		-	55	-	ns
t_f	Turn-off fall time		-	38	-	ns
L_d	Internal drain inductance	Measured from drain lead to centre of die	-	4.5	-	nH
L_s	Internal source inductance	Measured from source lead to source bond pad	-	7.5	-	nH
C_{iss}	Input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$; $f = 1\text{ MHz}$	-	310	-	pF
C_{oss}	Output capacitance		-	60	-	pF
C_{rss}	Feedback capacitance		-	36	-	pF

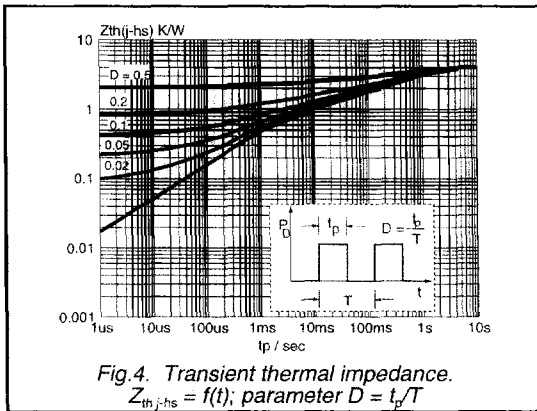
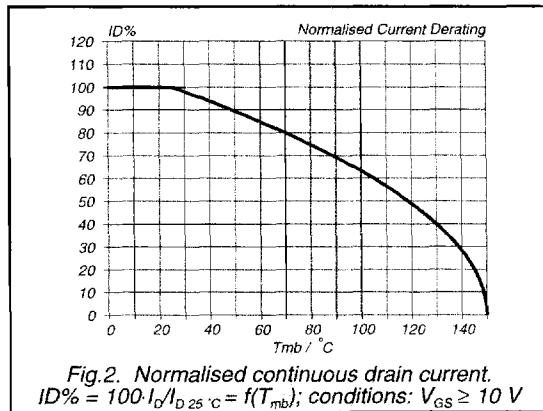
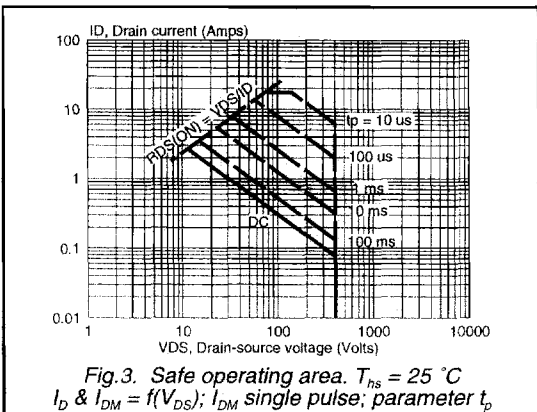
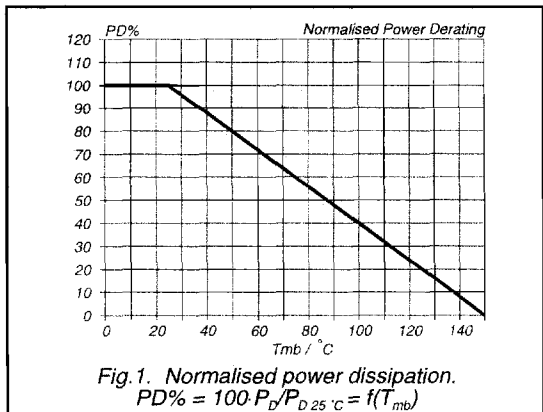
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SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

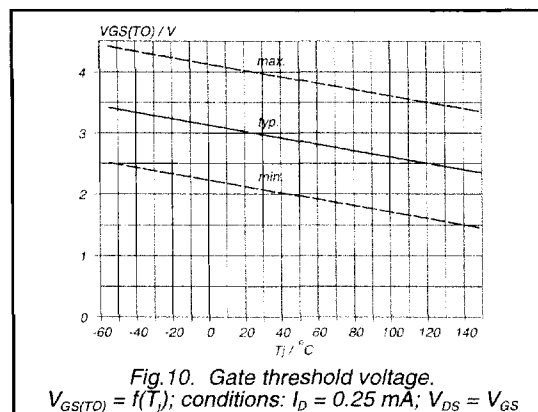
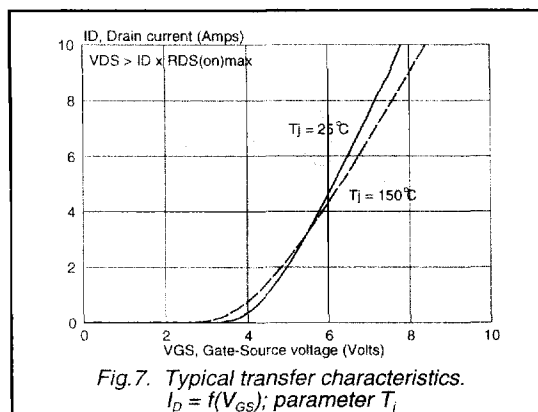
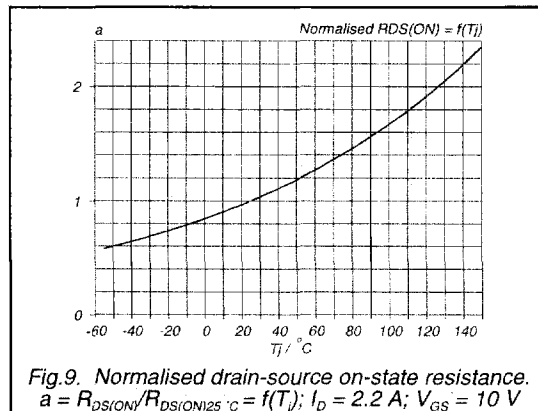
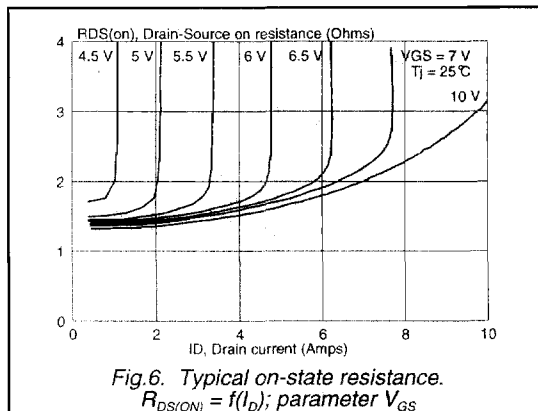
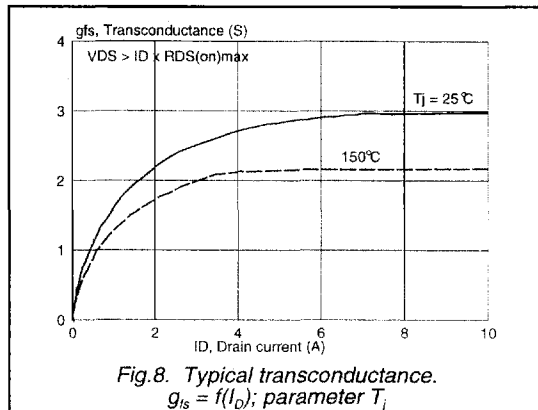
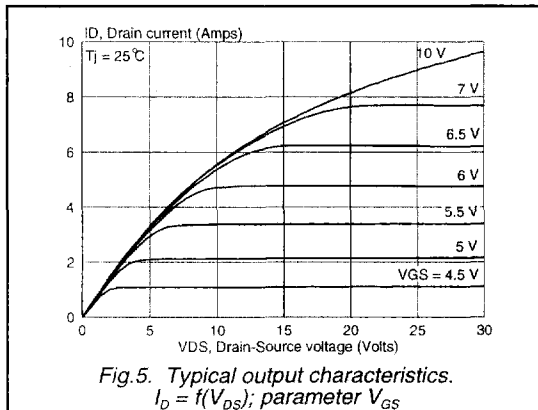
$T_j = 25^\circ\text{C}$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	Continuous source current (body diode)	$T_{hs} = 25^\circ\text{C}$	-	-	4.4	A
I_{SM}	Pulsed source current (body diode)	$T_{hs} = 25^\circ\text{C}$	-	-	18	A
V_{SD}	Diode forward voltage	$I_S = 4.4\text{ A}; V_{GS} = 0\text{ V}$	-	-	1.5	V
t_{rr}	Reverse recovery time	$I_S = 4.4\text{ A}; V_{GS} = 0\text{ V}; dI/dt = 100\text{ A}/\mu\text{s}$ $I_S = 4.4\text{ A}; V_{GS} = 0\text{ V}; dI/dt = 100\text{ A}/\mu\text{s}; 125^\circ\text{C}$	-	180 220	-	ns ns
Q_{rr}	Reverse recovery charge	$I_S = 4.4\text{ A}; V_{GS} = 0\text{ V}; dI/dt = 100\text{ A}/\mu\text{s}$ $I_S = 4.4\text{ A}; V_{GS} = 0\text{ V}; dI/dt = 100\text{ A}/\mu\text{s}; 125^\circ\text{C}$	-	0.65 2.6	-	μC μC
I_{rm}	Peak reverse recovery current	$I_S = 4.4\text{ A}; V_{GS} = 0\text{ V}; dI/dt = 100\text{ A}/\mu\text{s}; 125^\circ\text{C}$	-	15	-	A



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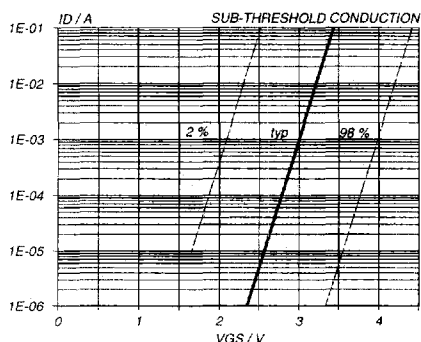


Fig. 11. Sub-threshold drain current.
 $I_D = f(V_{GS})$; conditions: $T_J = 25^\circ\text{C}$; $V_{DS} = V_{GS}$

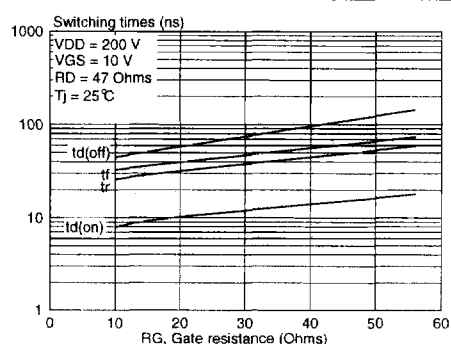


Fig. 14. Typical switching times.
 $t_{d(on)}$, t_r , $t_{d(off)}$, $t_f = f(R_G)$

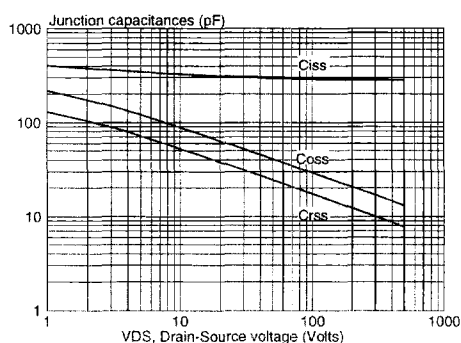


Fig. 12. Typical capacitances, C_{iss} , C_{oss} , C_{rss} .
 $C = f(V_{DS})$; conditions: $V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$

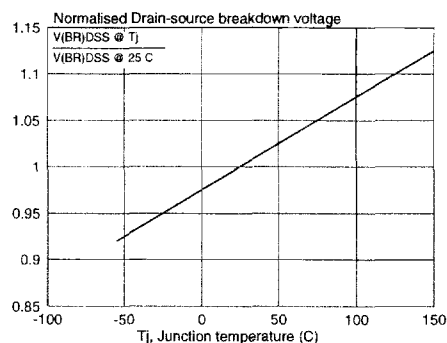


Fig. 15. Normalised drain-source breakdown voltage.
 $V_{(BR)DSS} / V_{(BR)DSS\ 25^\circ\text{C}} = f(T_J)$

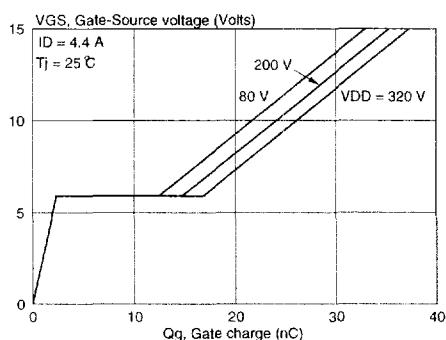


Fig. 13. Typical turn-on gate-charge characteristics.
 $V_{GS} = f(Q_G)$; parameter V_{DS}

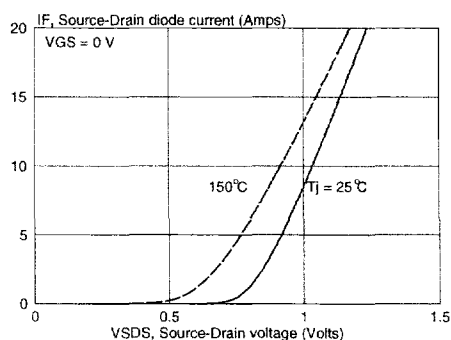


Fig. 16. Source-Drain diode characteristic.
 $I_F = f(V_{SDS})$; parameter T_J

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