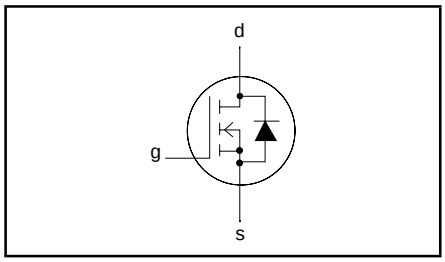
TrenchMOS™ transistor Logic level FET

PHP45N03LT, PHB45N03LT, PHD45N03LT

FEATURES

- **'Trench'** technology
- Very low on-state resistance
- Fast switching
- Stable off-state characteristics
- High thermal cycling performance
- Low thermal resistance

SYMBOL



QUICK REFERENCE DATA

V_{DSS} = 30 V

I_D = 45 A

$R_{DS(ON)} \leq 24\ m\Omega$ (V_{GS} = 5 V)

$R_{DS(ON)} \leq 21\ m\Omega$ (V_{GS} = 10 V)

GENERAL DESCRIPTION

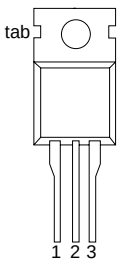
N-channel enhancement mode logic level field-effect power transistor in a plastic envelope using '**trench**' technology. The device has very low on-state resistance. It is intended for use in dc to dc converters and general purpose switching applications.

The PHP45N03LT is supplied in the SOT78 (TO220AB) conventional leaded package.
The PHB45N03LT is supplied in the SOT404 surface mounting package.
The PHD45N03LT is supplied in the SOT428 surface mounting package.

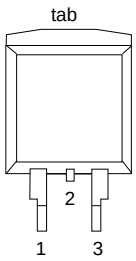
PINNING

PIN	DESCRIPTION
1	gate
2	drain[1]
3	source
tab	drain

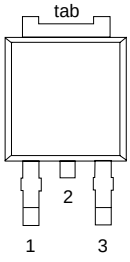
SOT78 (TO220AB)



SOT404



SOT428



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 ˚C to 175˚C	-	30	V
V_{DGR}	Drain-gate voltage	T_j = 25 ˚C to 175˚C; R_{GS} = 20 kΩ	-	30	V
V_{GS}	Gate-source voltage		-	± 15	V
I_D	Continuous drain current	T_{mb} = 25 ˚C; V_{GS} = 10 V	-	45	A
		T_{mb} = 100 ˚C; V_{GS} = 10 V	-	33	A
I_{DM}	Pulsed drain current	T_{mb} = 25 ˚C	-	180	A
P_D	Total power dissipation	T_{mb} = 25 ˚C	-	86	W
T_j, T_{stg}	Operating junction and storage temperature		- 55	175	˚C

1 It is not possible to make connection to pin 2 of the SOT428 or SOT404 packages.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Thermal resistance junction to mounting base		-	-	1.75	K/W
$R_{th\ j\text{-}a}$	Thermal resistance junction to ambient	SOT78 package, in free air	-	60	-	K/W
		SOT404 and SOT428 packages, pcb mounted, minimum footprint	-	50	-	K/W

ELECTRICAL CHARACTERISTICS

T_j= 25˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0.25 mA;	30	-	-	V
		T_j = -55˚C	27	-	-	V
$V_{GS(TO)}$	Gate threshold voltage	V_{DS} = V_{GS}; I_D = 1 mA	1	1.5	2	V
		T_j = 175˚C	0.5	-	-	V
		T_j = -55˚C	-	-	2.3	V
$R_{DS(ON)}$	Drain-source on-state resistance	V_{GS} = 5 V; I_D = 25 A	-	20	24	mΩ
		V_{GS} = 10 V; I_D = 25 A	-	16	21	mΩ
		V_{GS} = 5 V; I_D = 25 A; T_j = 175˚C	-	-	45	mΩ
g_{fs}	Forward transconductance	V_{DS} = 25 V; I_D = 25 A	8	27	-	S
I_{DSS}	Zero gate voltage drain current	V_{DS} = 30 V; V_{GS} = 0 V;	-	0.05	10	μA
		T_j = 175˚C	-	-	500	μA
I_{GSS}	Gate source leakage current	V_{GS} = ±5 V; V_{DS} = 0 V	-	10	100	nA
$Q_{g(tot)}$	Total gate charge	I_D = 40 A; V_{DD} = 24 V; V_{GS} = 5 V	-	23	-	nC
Q_{gs}	Gate-source charge		-	7	-	nC
Q_{gd}	Gate-drain (Miller) charge		-	10	-	nC
$t_{d\ on}$	Turn-on delay time	V_{DD} = 15 V; I_D = 25 A;	-	12	20	ns
t_r	Turn-on rise time	V_{GS} = 5 V; R_G = 5 Ω	-	80	130	ns
$t_{d\ off}$	Turn-off delay time	Resistive load	-	35	60	ns
t_f	Turn-off fall time		-	31	45	ns
L_d	Internal drain inductance	Measured tab to centre of die	-	3.5	-	nH
L_d	Internal drain inductance	Measured from drain lead to centre of die (SOT78 package only)	-	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 V; V_{DS} = 25 V; f = 1 MHz	-	1050	-	pF
C_{oss}	Output capacitance		-	270	-	pF
C_{rss}	Feedback capacitance		-	140	-	pF

REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS

T_j = 25˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	Continuous source current (body diode)		-	-	45	A
I_{SM}	Pulsed source current (body diode)		-	-	180	A
V_{SD}	Diode forward voltage	I_F = 25 A; V_{GS} = 0 V I_F = 40 A; V_{GS} = 0 V	- -	0.95 1.0	1.2 -	V
t_{rr} Q_{rr}	Reverse recovery time Reverse recovery charge	I_F = 40 A; -dI_F/dt = 100 A/µs; V_{GS} = -10 V; V_R = 25 V	- -	52 0.08	- -	ns µC

AVALANCHE LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
W_{DSS}	Drain-source non-repetitive unclamped inductive turn-off energy	I_D = 25 A; $V_{DD} \leq$ 15 V; V_{GS} = 10 V; R_{GS} = 50 Ω; T_{mb} = 25 ˚C	-	60	mJ

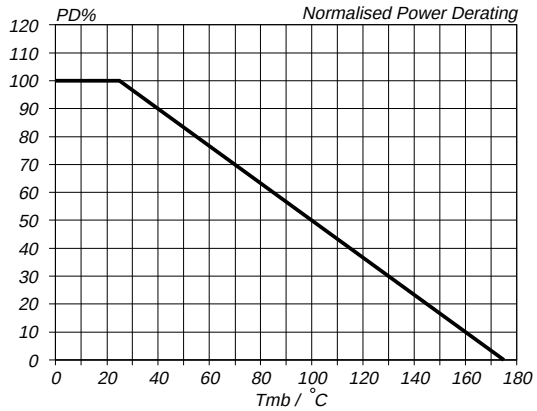


Fig.1. Normalised power dissipation.
PD% = 100·P_D/$P_{D\ 25\ ˚C}$ = f(T_{mb})

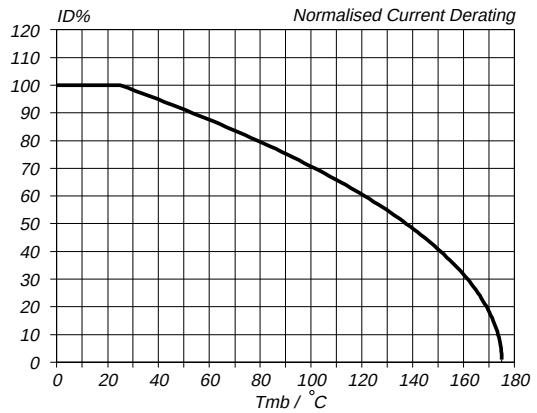


Fig.2. Normalised continuous drain current.
ID% = 100·I_D/$I_{D\ 25\ ˚C}$ = f(T_{mb}); conditions: $V_{GS} \geq$ 5 V

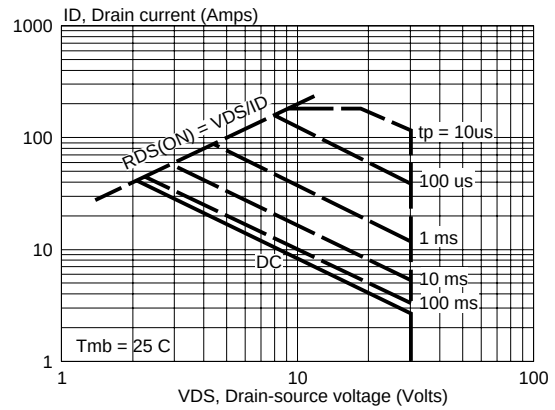


Fig.3. Safe operating area
I_D & I_{DM} = f(V_{DS}); I_{DM} single pulse; parameter t_p

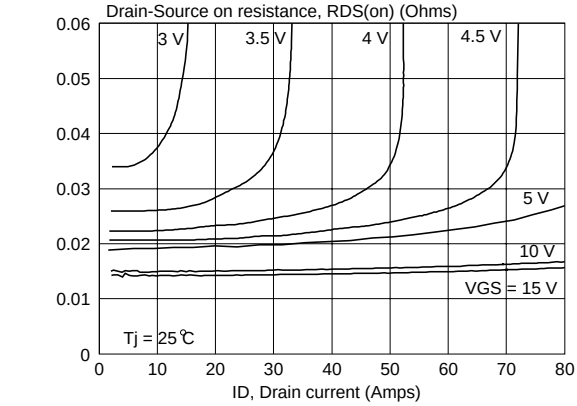


Fig.6. Typical on-state resistance
$R_{DS(ON)}$ = f(I_D); parameter V_{GS}

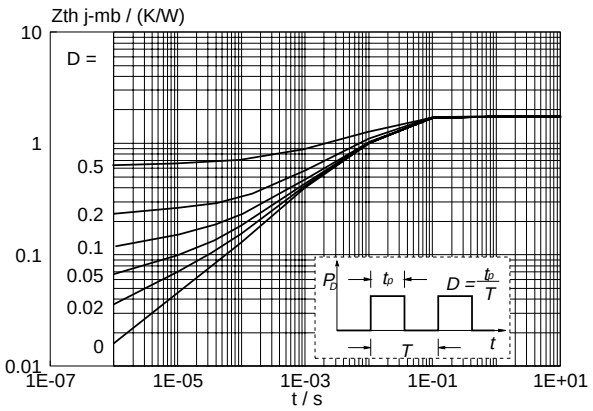


Fig.4. Transient thermal impedance.
$Z_{th\ j\text{-}mb}$ = f(t); parameter D = t_p/T

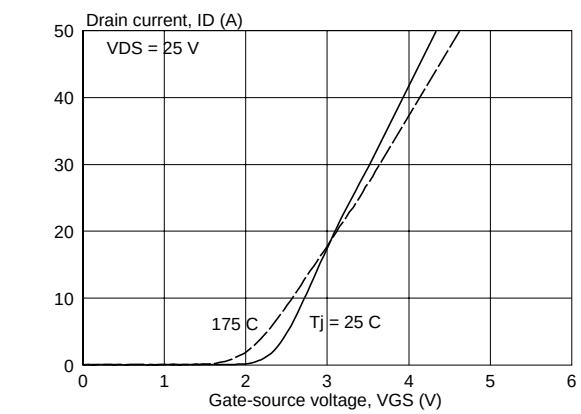


Fig.7. Typical transfer characteristics.
I_D = f(V_{GS})

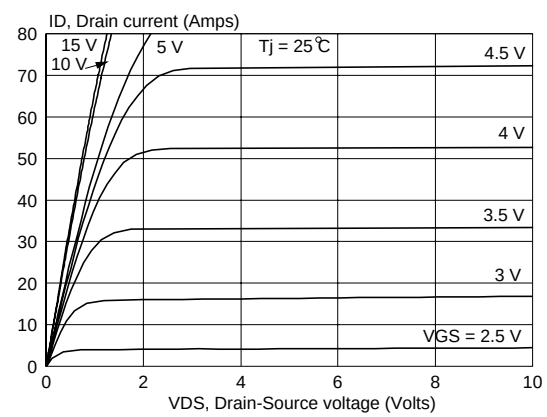


Fig.5. Typical output characteristics
I_D = f(V_{DS}); parameter V_{GS}

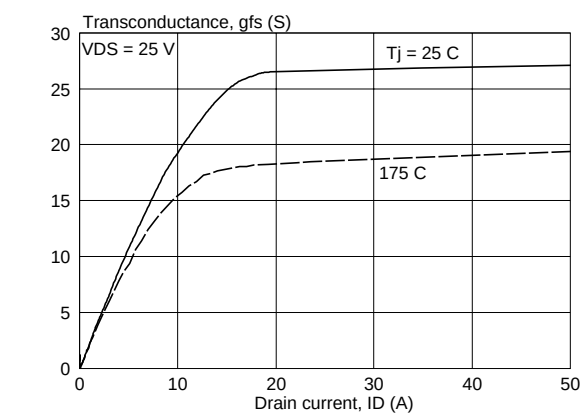


Fig.8. Typical transconductance
g_{fs} = f(I_D)

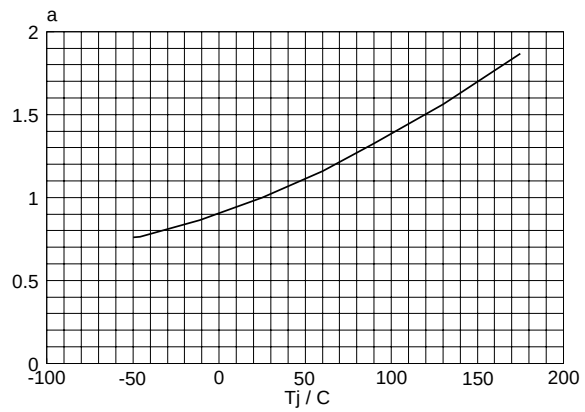


Fig.9. Normalised drain-source on-state resistance. $a = R_{DS(ON)}/R_{DS(ON)25\,^{\circ}C} = f(T_j)$; I_D = 25 A; V_{GS} = 5 V

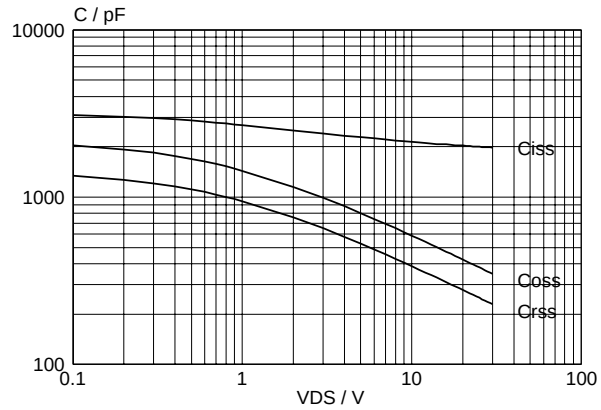


Fig.12. Typical capacitances, C_{iss}, C_{oss}, C_{rss}. $C = f(V_{DS})$; V_{GS} = 0 V; f = 1 MHz

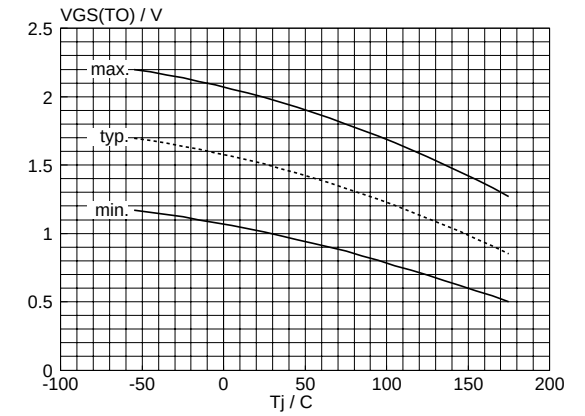


Fig.10. Gate threshold voltage. $V_{GS(TO)} = f(T_j)$; conditions: I_D = 1 mA; $V_{DS} = V_{GS}$

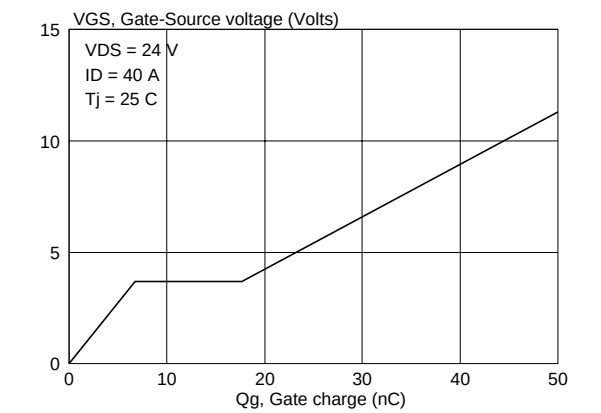


Fig.13. Typical turn-on gate-charge characteristics. $V_{GS} = f(Q_G)$

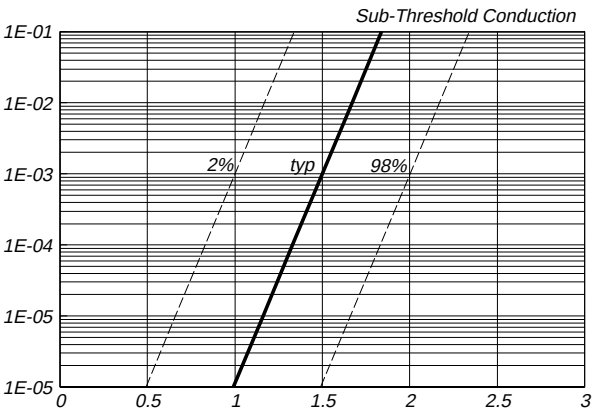


Fig.11. Sub-threshold drain current. $I_D = f(V_{GS})$; $V_{DS} = V_{GS}$

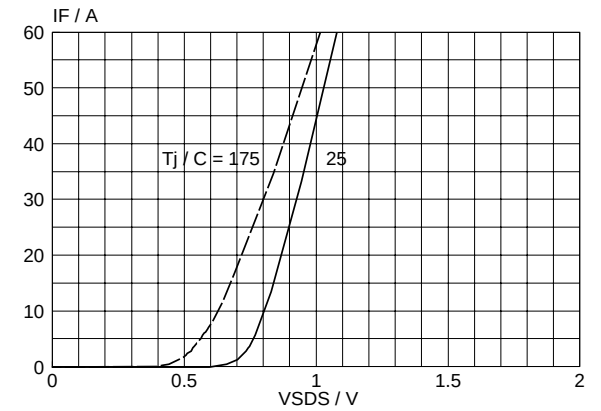


Fig.14. Typical reverse diode current. $I_F = f(V_{SDS})$

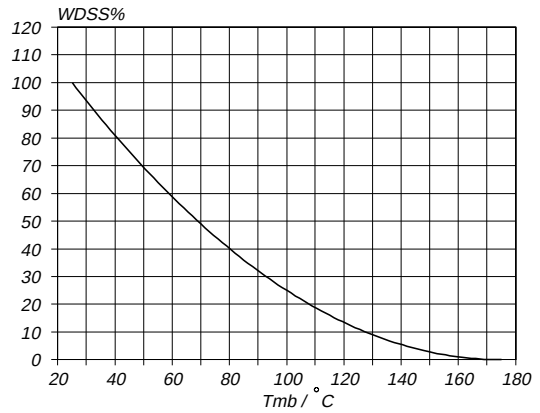


Fig.15. Normalised avalanche energy rating.
W_{DSS}% = f(T_{mb}); I_D = 25 A

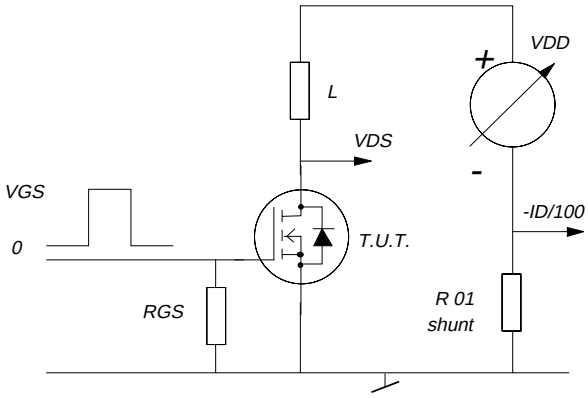


Fig.16. Avalanche energy test circuit.
$W_{DSS} = 0.5 \cdot L I_D^2 \cdot BV_{DSS}/(BV_{DSS} - V_{DD})$