

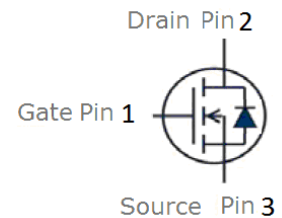
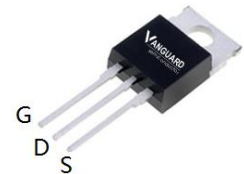
## Features

- N-Channel, 5V Logic Level Control
- Very low on-resistance  $R_{DS(on)}$  @  $V_{GS}=4.5V$
- 100% Avalanche Tested
- Pb-free lead plating; RoHS compliant



Part ID	Package Type	Marking	Tape and reel information
VS4604DT	TO-220AB	4604DT	50pcs/Tube

$V_{DS}$	40	V
$R_{DS(on),TYP} @ V_{GS}=10V$	1.7	m $\Omega$
$R_{DS(on),TYP} @ V_{GS}=4.5V$	2.3	m $\Omega$
$I_D$	285	A

**TO-220AB**


## Maximum ratings, at $T_j=25^\circ\text{C}$ , unless otherwise specified

Symbol	Parameter	Rating	Unit
$V_{(BR)DSS}$	Drain-Source breakdown voltage	40	V
$I_S$	Diode continuous forward current	$T_C=25^\circ\text{C}$ 285	A
$I_D$	Continuous drain current @ $V_{GS}=10V$	$T_C=25^\circ\text{C}$ 285	A
		$T_C=100^\circ\text{C}$ 202	A
$I_{DM}$	Pulse drain current tested ①	$T_C=25^\circ\text{C}$ 1140	A
EAS	Avalanche energy, single pulsed ②	156	mJ
$P_D$	Maximum power dissipation	$T_C=25^\circ\text{C}$ 214	W
$V_{GS}$	Gate-Source voltage	$\pm 20$	V
$T_{STG} T_J$	Storage and operating temperature range	-55 to 175	$^\circ\text{C}$

## Thermal Characteristics

Symbol	Parameter	Typical	Unit
$R_{\theta JC}$	Thermal Resistance-Junction to Case	0.7	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	62.5	$^\circ\text{C/W}$

**Typical Characteristics**

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
<b>Static Electrical Characteristics @ T<sub>j</sub> = 25°C (unless otherwise stated)</b>						
V <sub>(BR)DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	40	--	--	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =40V, V <sub>GS</sub> =0V	--	--	1	μA
	Zero Gate Voltage Drain Current(T <sub>j</sub> =125°C)	V <sub>DS</sub> =40V, V <sub>GS</sub> =0V	--	--	100	μA
I <sub>GSS</sub>	Gate-Body Leakage Current	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	--	--	±100	nA
V <sub>GS(TH)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	1.3	1.6	2.4	V
R <sub>DS(ON)</sub>	Drain-Source On-State Resistance <sup>③</sup>	V <sub>GS</sub> =10V, I <sub>D</sub> =60A	--	1.7	2.5	mΩ
R <sub>DS(ON)</sub>	Drain-Source On-State Resistance <sup>③</sup>	V <sub>GS</sub> =4.5V, I <sub>D</sub> =40A	--	2.3	3	mΩ
<b>Dynamic Electrical Characteristics @ T<sub>j</sub> = 25°C (unless otherwise stated)</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, f=1MHz	9500	10565	11500	pF
C <sub>oss</sub>	Output Capacitance		800	880	1000	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		680	740	850	pF
R <sub>g</sub>	Gate Resistance	f=1MHz		1.9		Ω
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =20V, I <sub>D</sub> =60A, V <sub>GS</sub> =10V	--	180	--	nC
Q <sub>gs</sub>	Gate-Source Charge		--	24	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	30	--	nC
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-on Delay Time	V <sub>DD</sub> =20V, I <sub>D</sub> =60A, R <sub>G</sub> =3Ω, V <sub>GS</sub> =10V	--	20	--	nS
t <sub>r</sub>	Turn-on Rise Time		--	22	--	nS
t <sub>d(off)</sub>	Turn-Off Delay Time		--	109	--	nS
t <sub>f</sub>	Turn-Off Fall Time		--	23	--	nS
<b>Source- Drain Diode Characteristics @ T<sub>j</sub> = 25°C (unless otherwise stated)</b>						
V <sub>SD</sub>	Forward on voltage	I <sub>SD</sub> =60A, V <sub>GS</sub> =0V	--	0.8	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	T <sub>j</sub> =25°C, I <sub>sd</sub> =60A, V <sub>GS</sub> =0V	--	21	--	nS
Q <sub>rr</sub>	Reverse Recovery Charge	di/dt=500A/μs		39		nC

**NOTE:**

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Limited by T<sub>Jmax</sub>, starting T<sub>J</sub> = 25°C, L = 0.5mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 25A, V<sub>GS</sub> = 10V. Part not recommended for use above this value
- ③ Pulse width ≤ 300μs; duty cycle ≤ 2%.



Typical Characteristics

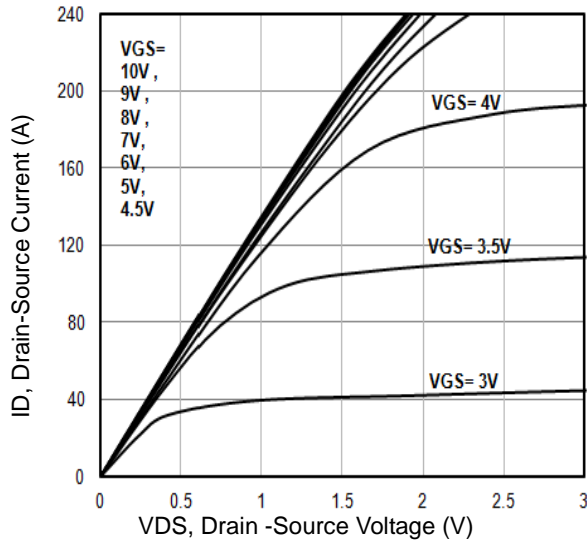


Fig1. Typical Output Characteristics

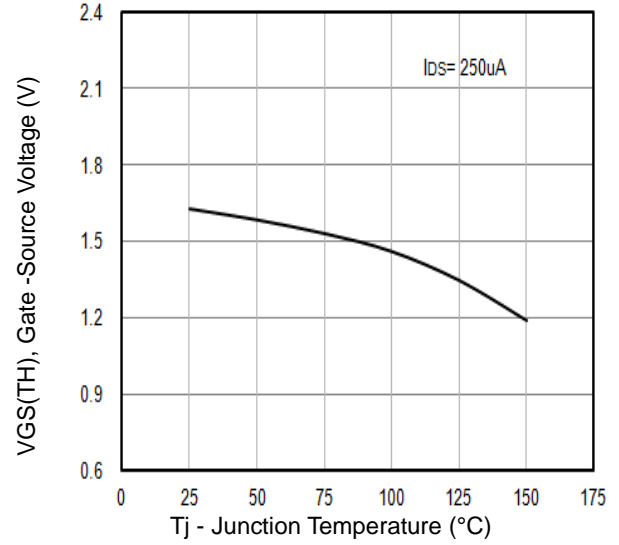


Fig2.  $V_{GS(TH)}$  Gate -Source Voltage Vs.  $T_j$

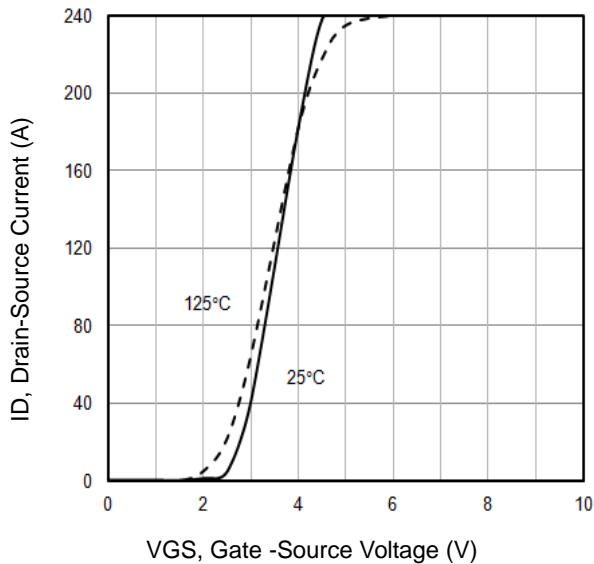


Fig3. Typical Transfer Characteristics

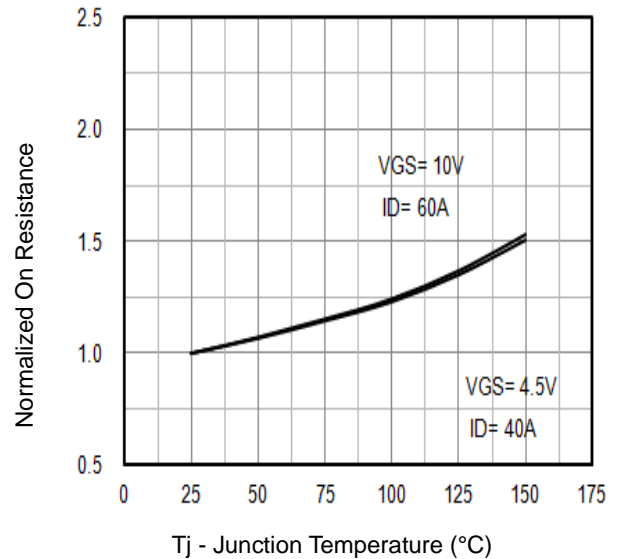


Fig4. Normalized On-Resistance Vs. Temperature

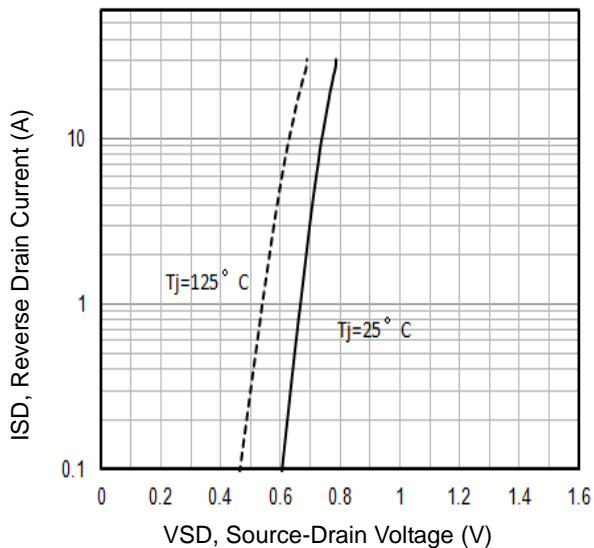


Fig5. Typical Source-Drain Diode Forward Voltage

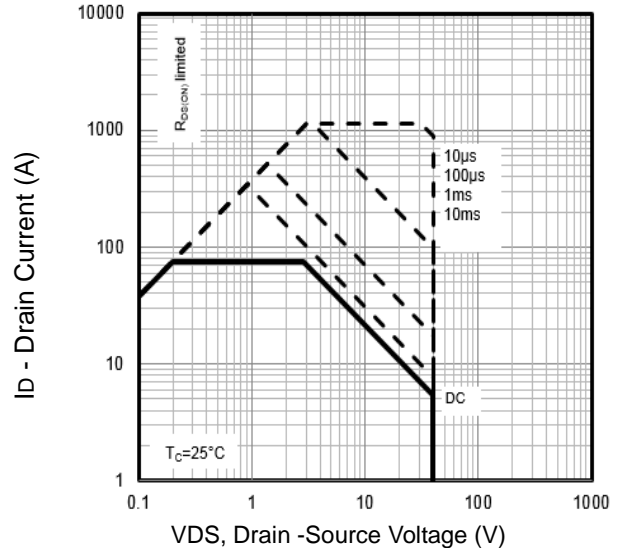


Fig6. Maximum Safe Operating Area

Typical Characteristics

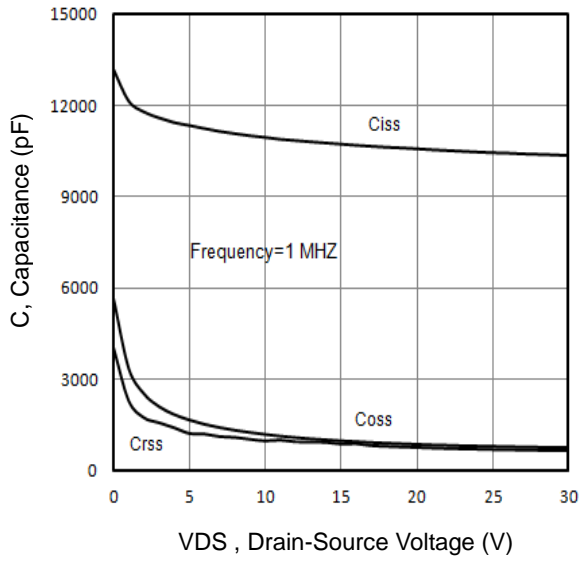


Fig7. Typical Capacitance Vs.Drain-Source Voltage

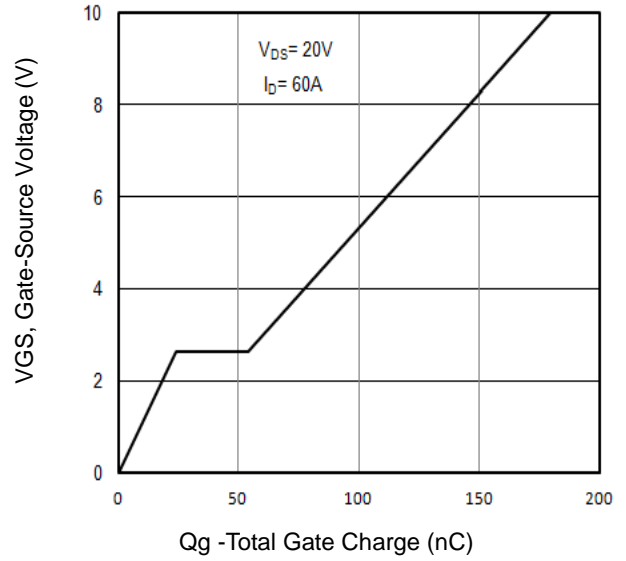


Fig8. Typical Gate Charge Vs.Gate-Source Voltage

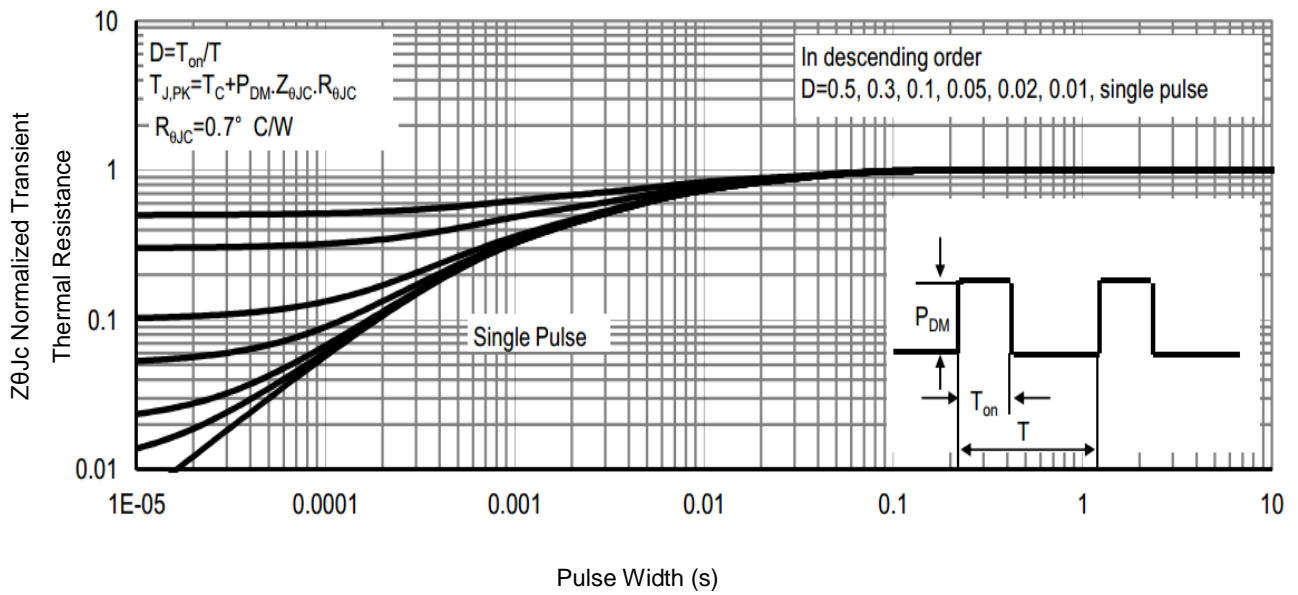


Fig9 . Normalized Maximum Transient Thermal Impedance

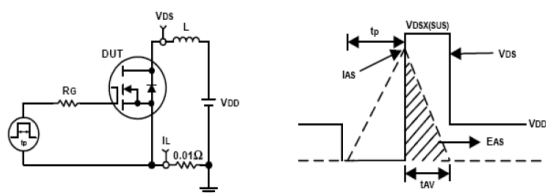


Fig10. Unclamped Inductive Test Circuit and waveforms

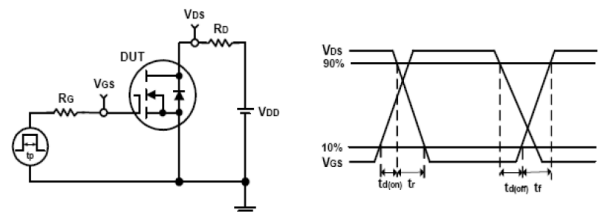
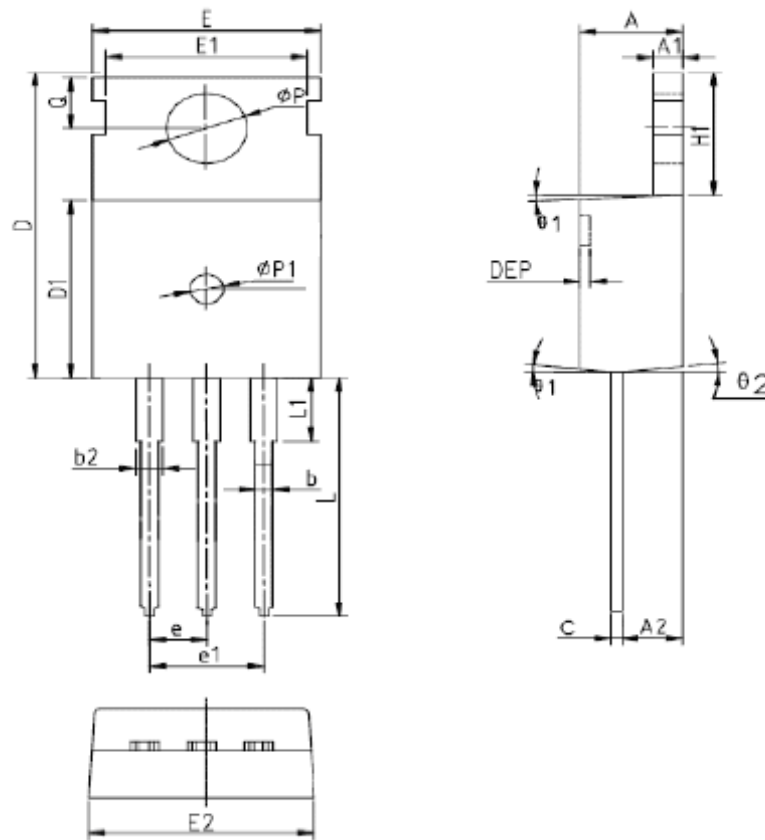


Fig11. Switching Time Test Circuit and waveforms



## TO-220AB Package Outline Data



SYMBOL	MM			INCH			SYMBOL	MM			INCH		
	MIN	NOM	MAX	MIN	NOM	MAX		MIN	NOM	MAX	MIN	NOM	MAX
A	4.40	4.57	4.70	0.173	0.180	0.185	phi p1	1.40	1.50	1.60	0.055	0.059	0.063
A1	1.27	1.30	1.33	0.050	0.051	0.052	e	2.54BSC			0.1BSC		
A2	2.35	2.40	2.50	0.093	0.094	0.098	e1	5.08BSC			0.2BSC		
b	0.77	-	0.90	0.030	-	0.035	H1	6.40	6.50	6.60	0.252	0.256	0.260
b2	1.23	-	1.36	0.048	-	0.054	L	12.75	-	13.17	0.502	-	0.519
C	0.48	0.50	0.52	0.019	0.020	0.021	L1	-	-	3.95	-	-	0.156
D	15.40	15.60	15.80	0.606	0.614	0.622	L2	2.50REF.			0.098REF.		
D1	9.00	9.10	9.20	0.354	0.358	0.362	phi p	3.57	3.60	3.63	0.141	0.142	0.143
DEP	0.05	0.10	0.20	0.002	0.004	0.008	Q	2.73	2.80	2.87	0.107	0.110	0.113
E	9.70	9.90	10.10	0.382	0.389	0.398	theta 1	5°	7°	9°	5°	7°	9°
E1	-	8.70	-	-	0.343	-	theta 2	1°	3°	5°	1°	3°	5°
E2	9.80	10.00	10.20	0.386	0.394	0.401							

## Customer Service

Sales and Service:

[sales@vgsemi.com](mailto:sales@vgsemi.com)

Vanguard Semiconductor CO., LTD

TEL: (86-755) -26902410

FAX: (86-755) -26907027

WEB: [www.vgsemi.com](http://www.vgsemi.com)