

**VCRR N-Channel Enhancement Mode Power MOSFET**

**Description**

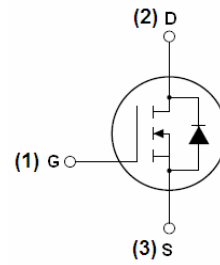
The VCRR85H21 uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in automotive applications and a wide variety of other applications.

**General Features**

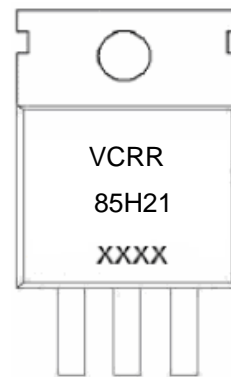
- $V_{DSS} = 85V, I_D = 210A$  (Note5)
- $R_{DS(ON)} < 3.8m\Omega @ V_{GS} = 10V$
- Good stability and uniformity with high  $E_{AS}$
- Special process technology for high ESD capability
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Excellent package for good heat dissipation

**Application**

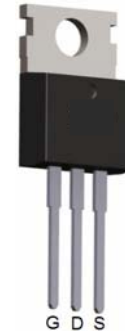
- Automotive applications
- Hard switched and high frequency circuits
- Uninterruptible power supply



**Schematic diagram**



**Marking and pin assignment**



**TO-220-3L top view**

**Package Marking and Ordering Information**

Device Marking	Device	Device Package
VCRR85H21		TO-220-3L

**Absolute Maximum Ratings ( $T_C = 25^\circ C$  unless otherwise noted)**

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DSS}$	85	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	210 (Note5)	A
Drain Current-Continuous( $T_C = 100^\circ C$ )	$I_D(100^\circ C)$	150	A
Pulsed Drain Current	$I_{DM}$	850	A
Maximum Power Dissipation	$P_D$	310	W
Derating factor		2.07	W/ $^\circ C$

Single pulse avalanche energy <sup>(Note 3)</sup>	$E_{AS}$	2200	mJ
Peak Diode Recovery $dv/dt$ <sup>(Note 4)</sup>	$dv/dt$	5	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 175	°C

## Thermal Characteristic

Thermal Resistance, Junction-to-Case <sup>(Note 1)</sup>	$R_{\theta JC}$	0.48	°C/W
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## Electrical Characteristics ( $T_C=25^\circ\text{C}$ unless otherwise noted)

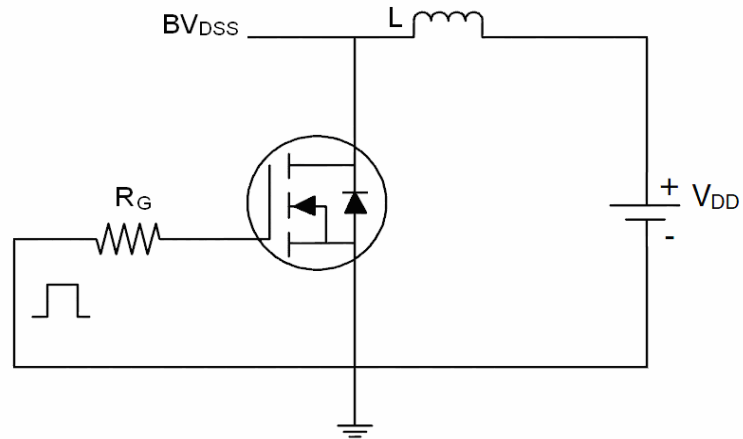
Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	85	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=85V, V_{GS}=0V$	-	-	1	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	$\pm 200$	nA
<b>On Characteristics</b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2	3	4	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=40A$	-	3.2	3.8	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS}=10V, I_D=20A$	35	-	-	S
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{DS}=25V, V_{GS}=0V,$ $F=1.0\text{MHz}$	-	11000	-	PF
Output Capacitance	$C_{oss}$		-	914	-	PF
Reverse Transfer Capacitance	$C_{riss}$		-	695	-	PF
<b>Switching Characteristics</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=38V, I_D=40A$ $V_{GS}=10V, R_{GEN}=1.2\Omega$ <sup>(Note2)</sup>	-	23	-	nS
Turn-on Rise Time	$t_r$		-	190	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	130	-	nS
Turn-Off Fall Time	$t_f$		-	120	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=60V, I_D=40A,$ $V_{GS}=10V$ <sup>(Note2)</sup>	-	250	-	nC
Gate-Source Charge	$Q_{gs}$		-	48	-	nC
Gate-Drain Charge	$Q_{gd}$		-	98	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_S=40A$	-	-	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25^\circ\text{C}, I_F = 40A$ $di/dt = 100A/\mu s$ <sup>(Note2)</sup>	-	63	-	nS
Reverse Recovery Charge	$Q_{rr}$		-	98	-	nC
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

## Notes:

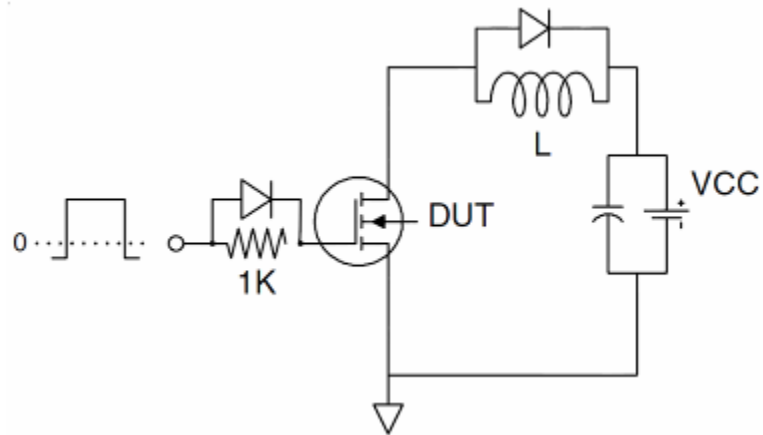
1. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
2. Pulse Test: Pulse Width  $\leq 400\mu s$ , Duty Cycle  $\leq 2\%$ .
3. EAS condition:  $T_J=25^\circ\text{C}, V_{DD}=42.5V, V_G=10V, L=0.5\text{mH}, R_g=25\Omega, I_{AS}=37A$
4.  $ISD \leq 125A, di/dt \leq 260A/\mu s, V_{DD} \leq V(BR)_{DSS}, T_J \leq 175^\circ\text{C}$
5. Package limitation current is 190A.

## Test Circuit

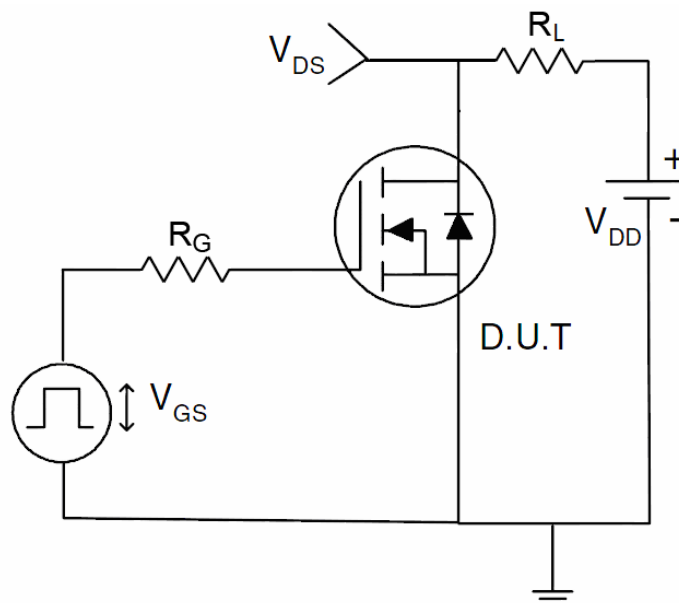
### 1) $E_{AS}$ test Circuit



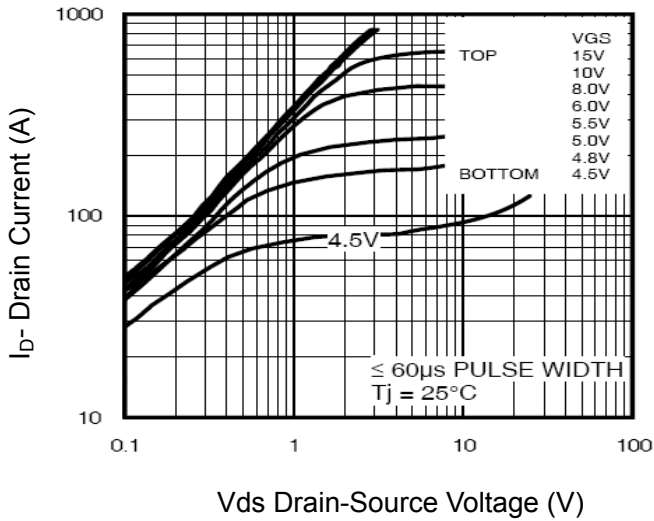
### 2) Gate charge test Circuit



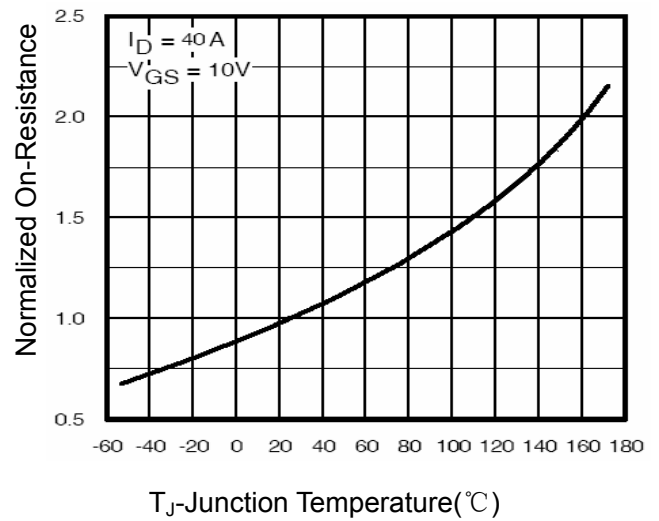
### 3) Switch Time Test Circuit



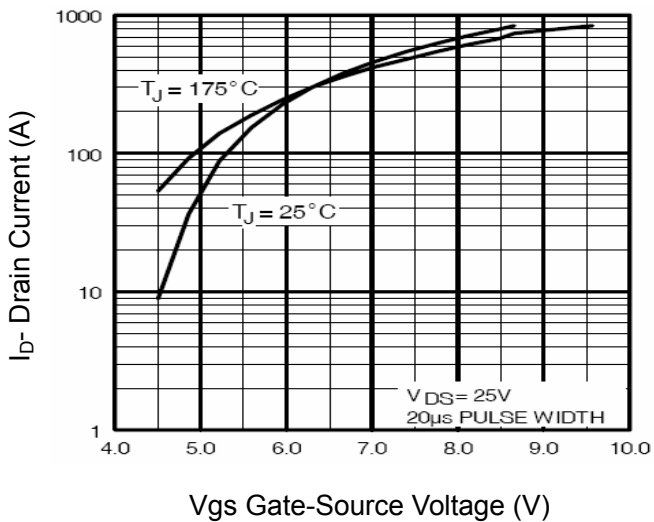
## Typical Electrical and Thermal Characteristics



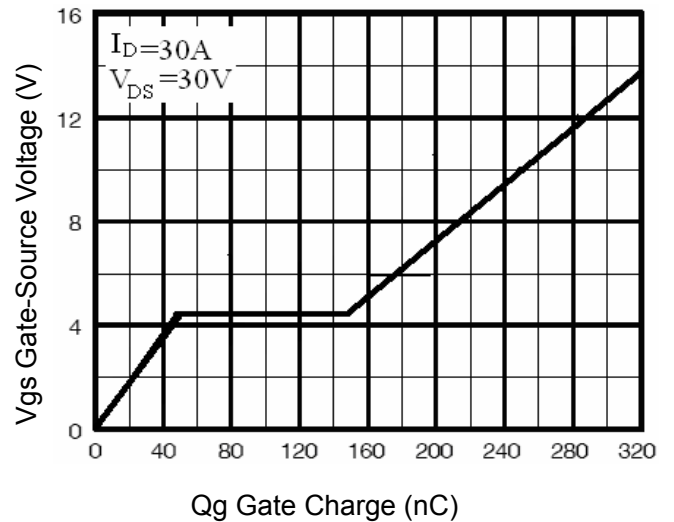
Vds Drain-Source Voltage (V)  
**Figure 1 Output Characteristics**



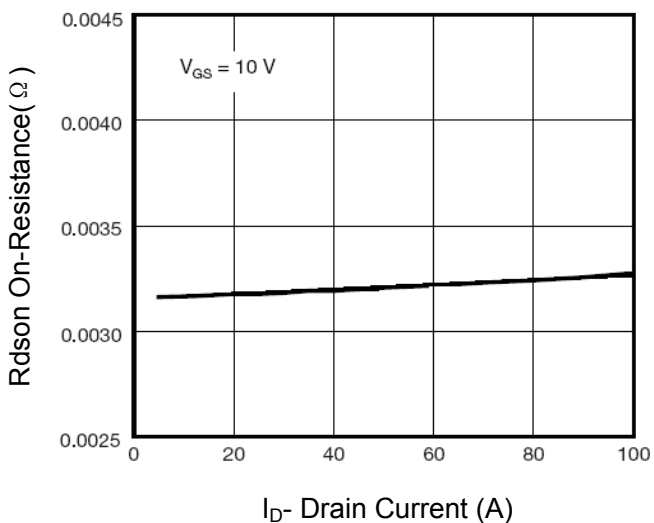
T<sub>J</sub>-Junction Temperature(°C)  
**Figure 4 Rdson-Junction Temperature**



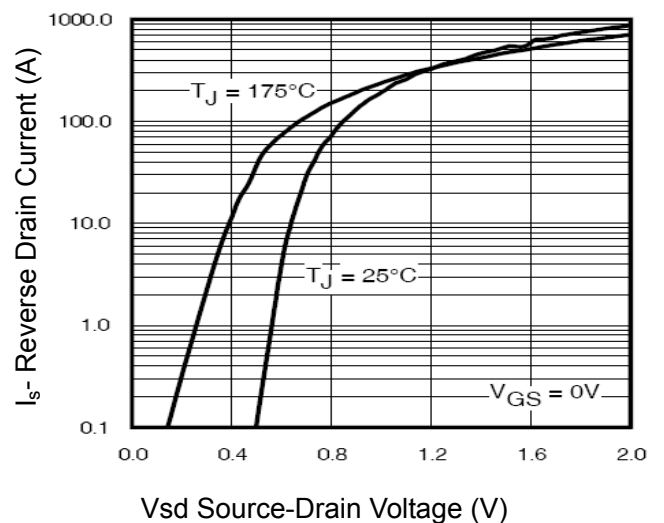
Vgs Gate-Source Voltage (V)  
**Figure 2 Transfer Characteristics**



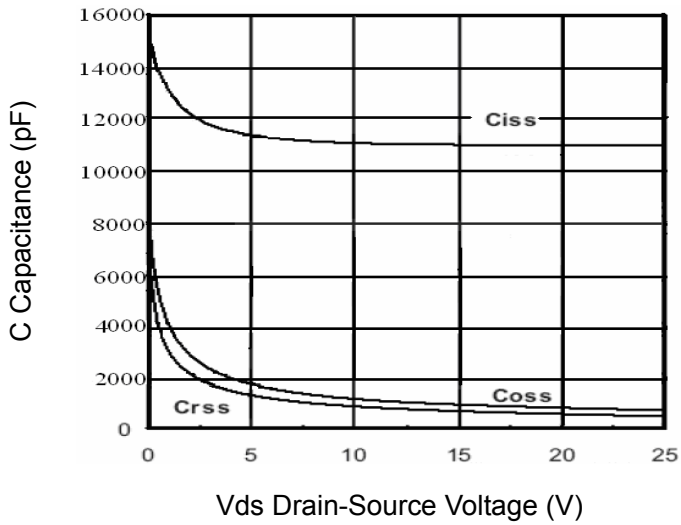
Qg Gate Charge (nC)  
**Figure 5 Gate Charge**



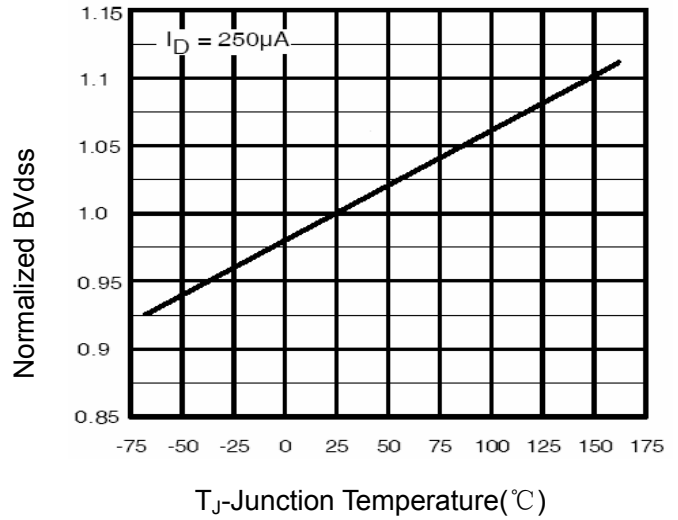
$I_D$ - Drain Current (A)  
**Figure 3 Rdson- Drain Current**



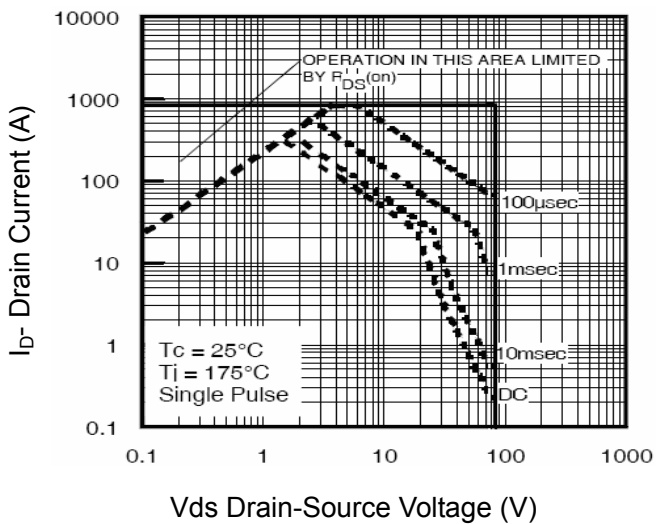
Vsd Source-Drain Voltage (V)  
**Figure 6 Source- Drain Diode Forward**



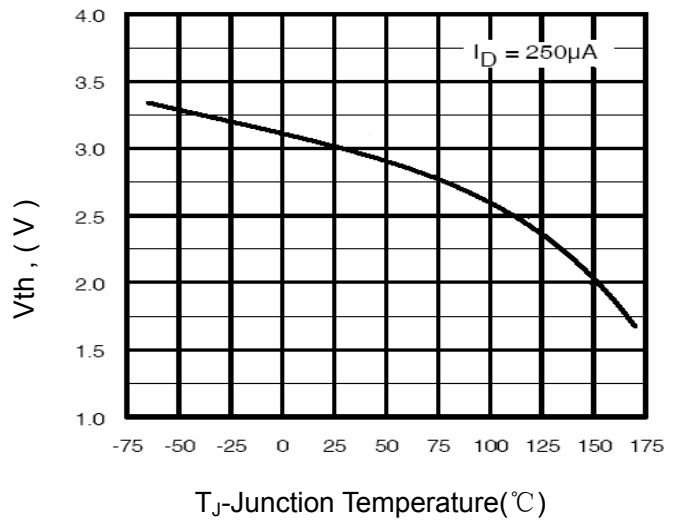
**Figure 7 Capacitance vs Vds**



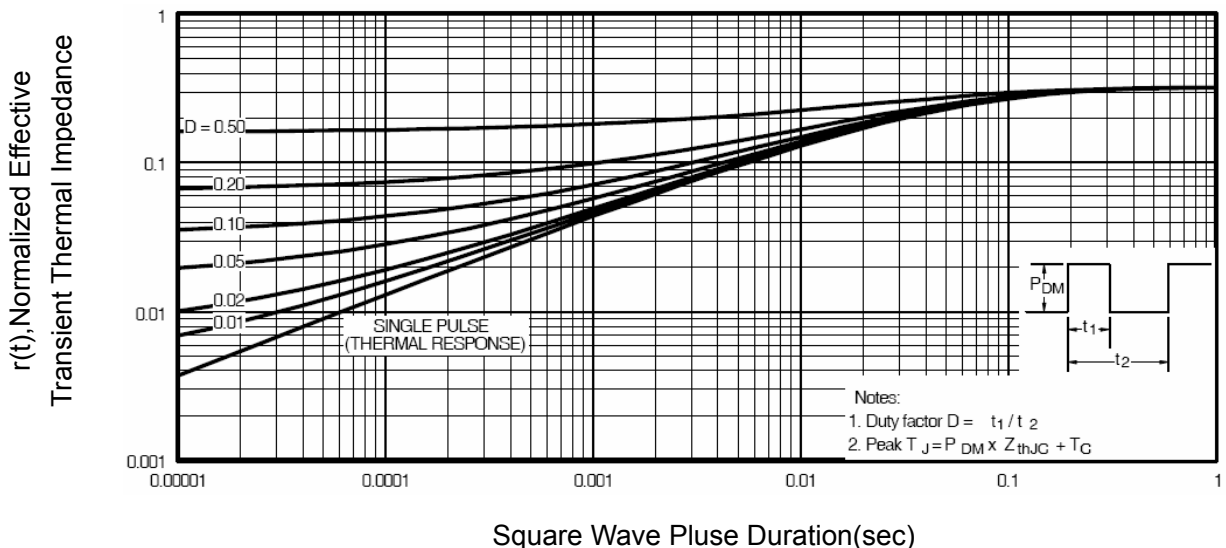
**Figure 9 BV<sub>DSS</sub> vs Junction Temperature**



**Figure 8 Safe Operation Area**

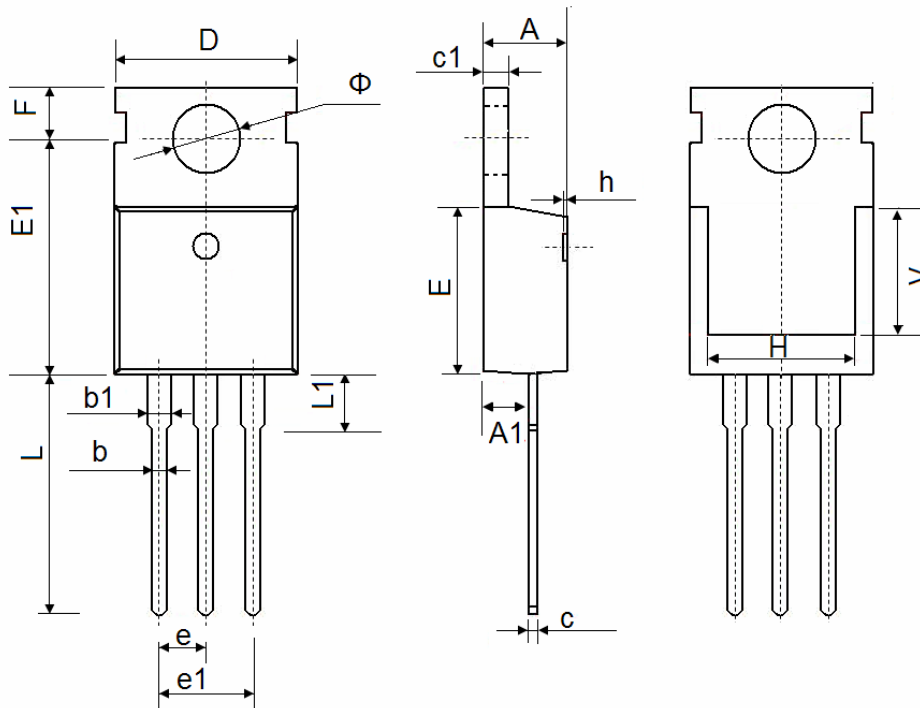


**Figure 10 V<sub>GS(th)</sub> vs Junction Temperature**



**Figure 11 Normalized Maximum Transient Thermal Impedance**

**TO-220-3L Package Information**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.900	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	7.500 REF.		0.295 REF.	
$\Phi$	3.400	3.800	0.134	0.150

## Attention

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