



IRFZ40 IRFZ40FI

N-CHANNEL 50V - 0.022 Ω - 50A TO-220/ISOWATT220 POWER MOS TRANSISTORS

Table 1. General Features

Type	V _{DSS}	R _{DS(on)}	I _D
IRFZ40	50 V	< 0.028 Ω	50 A
IRFZ40FI	50 V	< 0.028 Ω	27 A

FEATURES SUMMARY

- TYPICAL R_{DS(on)} = 0.022 Ω
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- 175°C OPERATING TEMPERATURE

APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SOLENOID AND RELAY DRIVERS
- REGULATORS
- DC-DC & DC-AC CONVERTERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- AUTOMOTIVE ENVIRONMENT (INJECTION, ABS, AIR-BAG, LAMPDRIVERS, Etc.)

Figure 1. Package

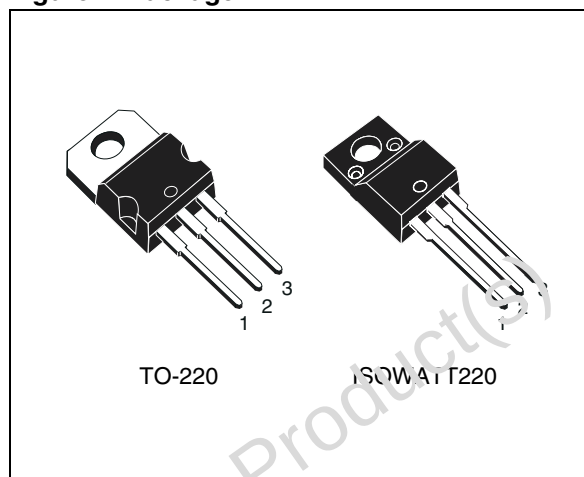


Figure 2. Internal Schematic Diagram

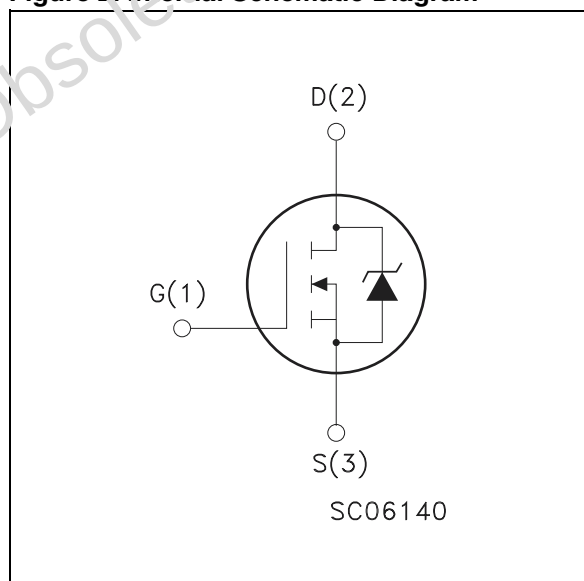


Table 2. Order Codes

Part Number	Marking	Package	Packaging
IRFZ40	IRFZ40	TO-220	TUBE
IRFZ40FI	IRFZ40FI	ISOWATT220	TUBE

Table 3. Absolute Maximum Ratings

Symbol	Parameter	Value		Unit
		IRFZ40	IRFZ40FI	
V_{DS}	Drain-source Voltage ($V_{GS} = 0$)	50	50	V
V_{DGR}	Drain- gate Voltage ($R_{GS} = 20\text{ k}\Omega$)	50	50	V
V_{GS}	Gate-source Voltage	± 20		V
I_D	Drain Current (cont.) at $T_C = 25\text{ }^\circ\text{C}$	50	27	A
I_D	Drain Current (cont.) at $T_C = 100\text{ }^\circ\text{C}$	35	19	A
$I_{DM}^{(1)}$	Drain Current (pulsed)	200	200	A
P_{tot}	Total Dissipation at $T_C = 25\text{ }^\circ\text{C}$	150	45	W
	Derating Factor	1	0.3	W/ $^\circ\text{C}$
V_{ISO}	Insulation Withstand Voltage (DC)	—	2000	V
T_{stg}	Storage Temperature	-65 to 175		$^\circ\text{C}$
T_j	Max. Operating Junction Temperature	175		$^\circ\text{C}$

Note: 1. Pulse width limited by safe operating area

Table 4. Thermal Data

Symbol	Parameter	Value		Unit
		TO-220	ISOWATT220	
$R_{thj-case}$	Thermal Resistance Junction-case Max	1	3.33	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal Resistance Junction-ambient Max	62.5		$^\circ\text{C}/\text{W}$
T_j	Maximum Lead Temperature For Soldering Purpose	300		$^\circ\text{C}$

Table 5. Avalanche Characteristics

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max, $\delta < 1\%$)	50	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25\text{ }^\circ\text{C}$; $I_D = I_{AR}$; $V_{DD} = 25\text{ V}$)	400	mJ
E_{AR}	Repetitive Avalanche Energy (pulse width limited by T_j max, $\delta < 1\%$)	100	mJ
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive ($T_C = 100\text{ }^\circ\text{C}$, pulse width limited by T_j max, $\delta < 1\%$)	35	A

ELECTRICAL CHARACTERISTICS ($T_{\text{case}} = 25^{\circ}\text{C}$ unless otherwise specified)**Table 6. Off**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source Breakdown Voltage	$I_D = 250 \text{ mA}; V_{\text{GS}} = 0$	50			V
I_{DSS}	Zero Gate Voltage	$V_{\text{DS}} = \text{Max Rating}$			250	μA
	Drain Current ($V_{\text{GS}} = 0$)	$V_{\text{DS}} = \text{Max Rating} \times 0.8; T_c = 125^{\circ}\text{C}$			1000	μA
I_{GSS}	Gate-body Leakage Current ($V_{\text{DS}} = 0$)	$V_{\text{GS}} = \pm 20 \text{ V}$			± 100	nA

Table 7. On ⁽¹⁾

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{\text{GS(th)}}$	Gate Threshold Voltage	$V_{\text{DS}} = V_{\text{GS}}; I_D = 250 \mu\text{A}$	2	2.9	4	V
$R_{\text{DS(on)}}$	Static Drain-source On Resistance	$V_{\text{GS}} = 10\text{V}; I_D = 29 \text{ A}$		0.022	0.028	Ω

Note: 1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %**Table 8. Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{\text{fs}}^{(1)}$	Forward Transconductance	$V_{\text{DS}} > I_{\text{D(on)}} \times R_{\text{DS(on)max}}; I_D = 29 \text{ A}$	17	22		S
C_{iss}	Input Capacitance	$V_{\text{DS}} = 25 \text{ V}; f = 1 \text{ MHz}; V_{\text{GS}} = 0$		1700	2200	pF
C_{oss}	Output Capacitance			630	850	pF
C_{rss}	Reverse Transfer Capacitance			200	260	pF

Note: 1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %**Table 9. Switching Resistive Load**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on Time	$V_{\text{DD}} = 25 \text{ V}; I_D = 29 \text{ A}; R_G = 4.7 \Omega;$ $V_{\text{GS}} = 10 \text{ V}$ (see test circuit)		50	70	ns
t_r	Rise Time			110	160	ns
$t_{\text{d(off)}}$	Turn-off Delay Time			60	90	ns
t_f	Fall Time			25	35	ns
Q_g	Total Gate Charge	$I_D = 64 \text{ A}; V_{\text{GS}} = 10 \text{ V};$		50	70	nC
Q_{gs}	Gate-Source Charge	$V_{\text{DD}} = \text{Max Rating} \times 0.8;$ (see test circuit)		15		nC
Q_{gd}	Gate-Drain Charge			27		nC

Table 10. Source Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				50	A
$I_{SDM}^{(1)}$	Source-drain Current (pulsed)				200	A
$V_{SD}^{(2)}$	Forward On Voltage	$V_{GS} = 0$; $I_{SD} = 50$ A			2	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 50$ A; $di/dt = 100$ A/ μ s $V_{DD} = 30$ V; $T_j = 150$ °C		150		ns
Q_{rr}	Reverse RecoveryCharge			0.45		μ C

Note: 1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300 μ s, duty cycle 1.5 %

Figure 3. Safe Operating Area for TO-220

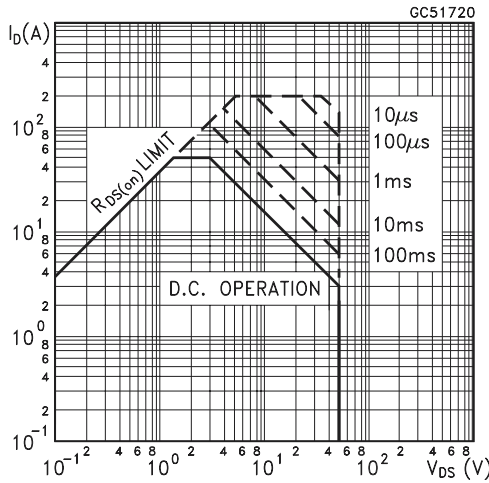


Figure 4. Safe Operating Area for ISOWATT220

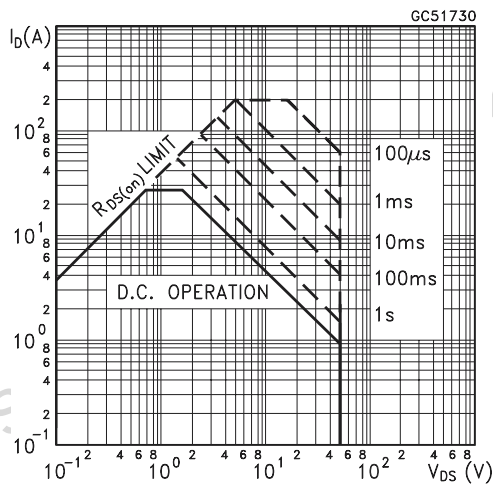


Figure 5. Thermal Impedance for TO-220

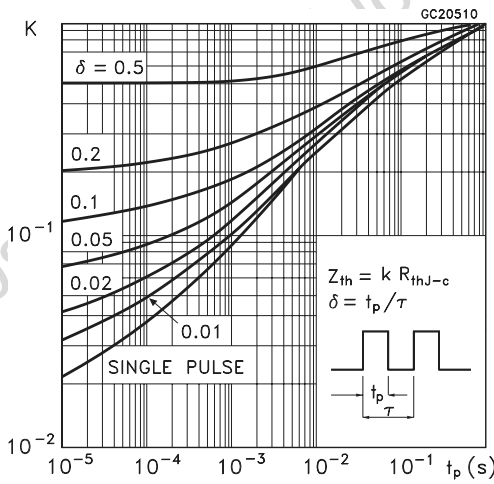


Figure 6. Thermal Impedance for ISOWATT220

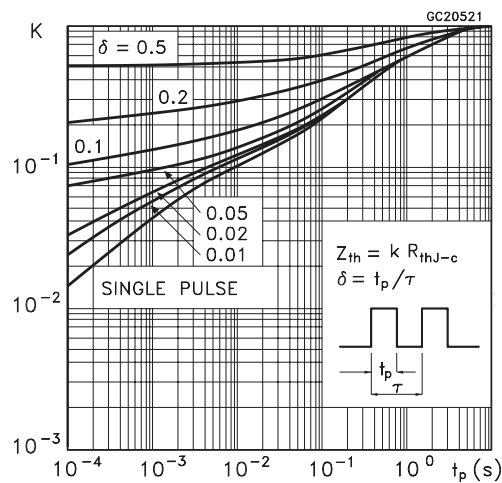


Figure 7. Derating Curve for TO-220

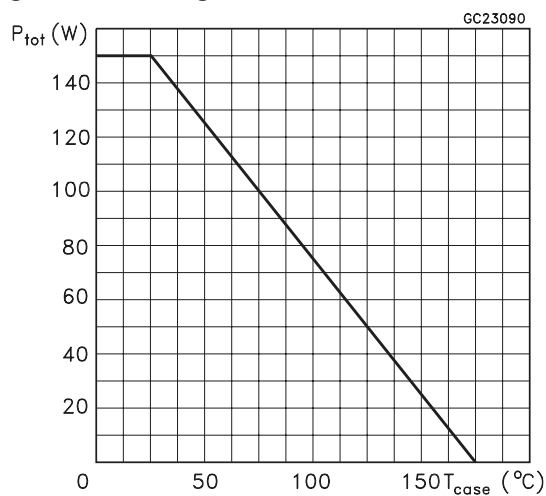


Figure 8. Derating Curve for ISOWATT220

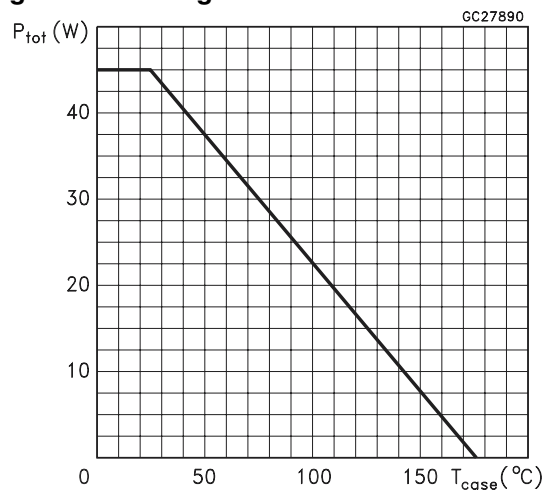


Figure 9. Output Characteristics

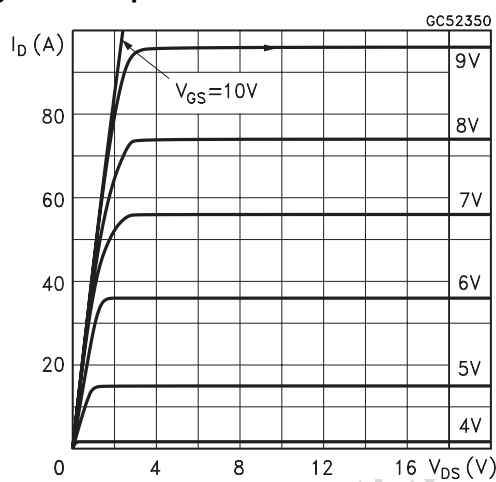


Figure 10. Transfer Characteristics

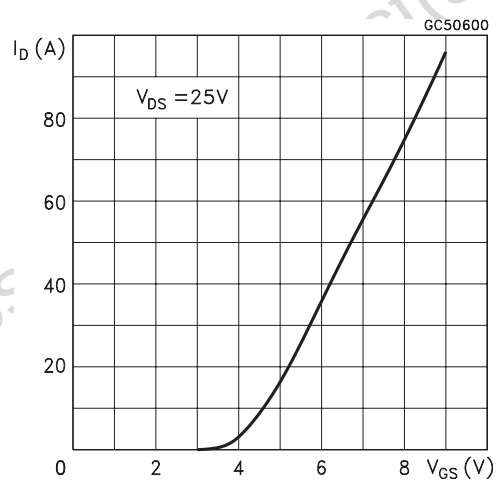


Figure 11. Transconductance

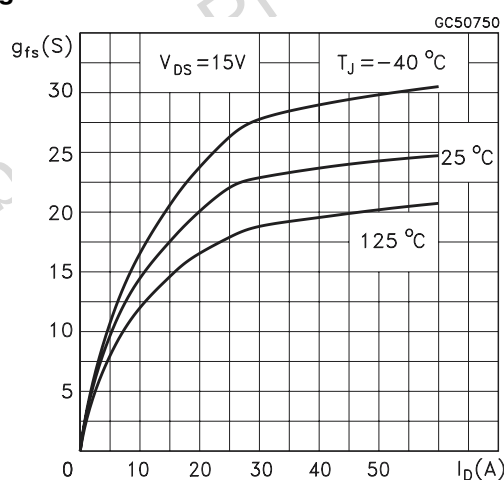


Figure 12. Static Drain-source On Resistance

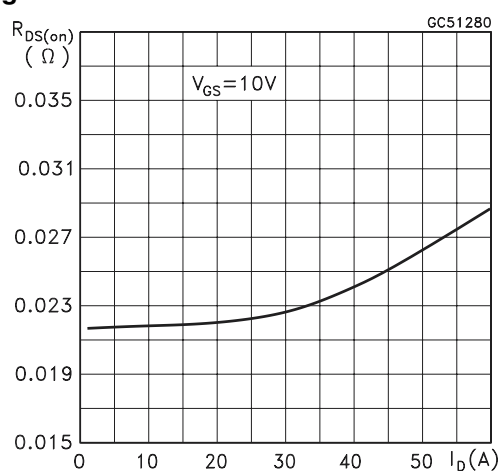


Figure 13. Gate Charge vs Gate-source Voltage

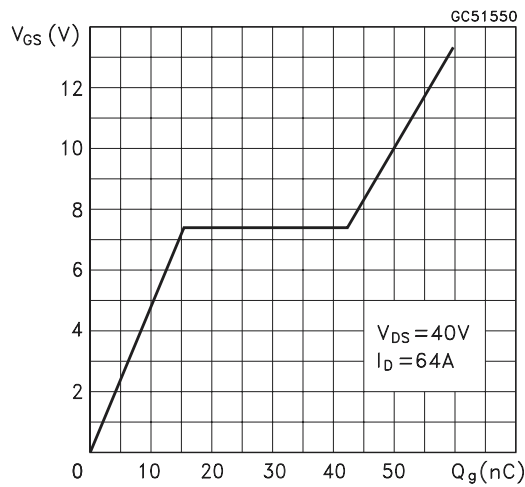


Figure 14. Capacitance Variations

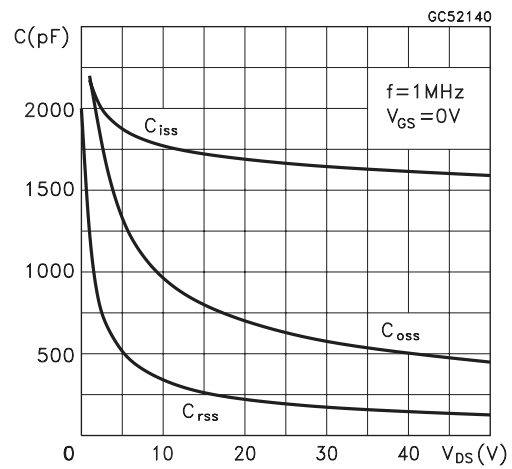


Figure 15. Normalized Gate Threshold Voltage vs Temperature

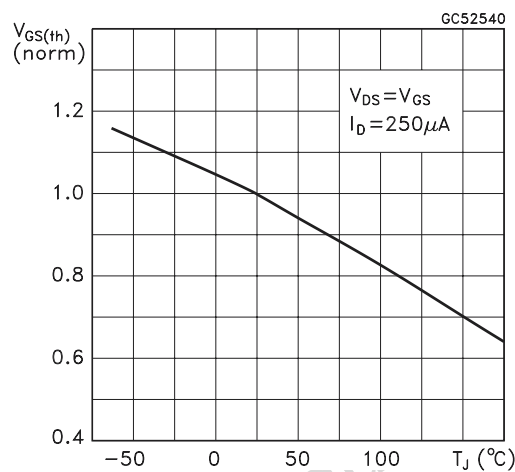


Figure 16. Normalized on Resistance vs Temperature

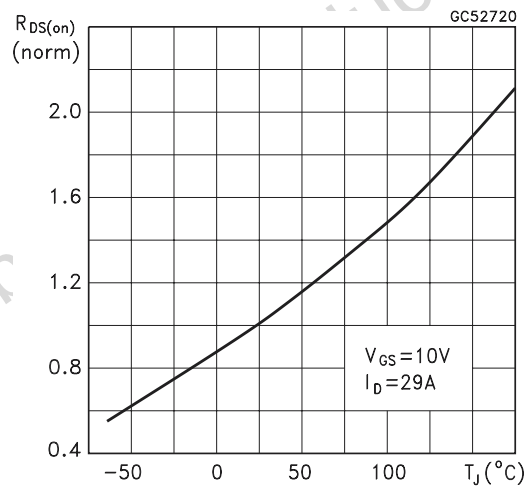


Figure 17. Source-drain Diode Forward Characteristics

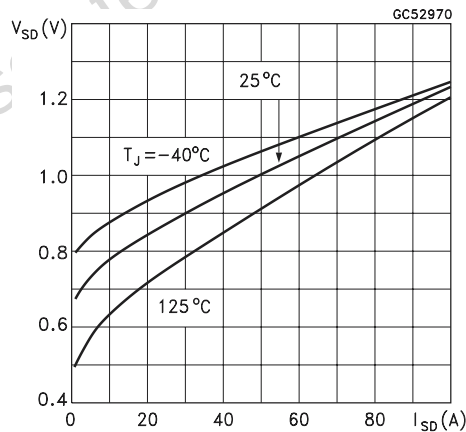


Figure 18. Unclamped Inductive Load Test Circuit

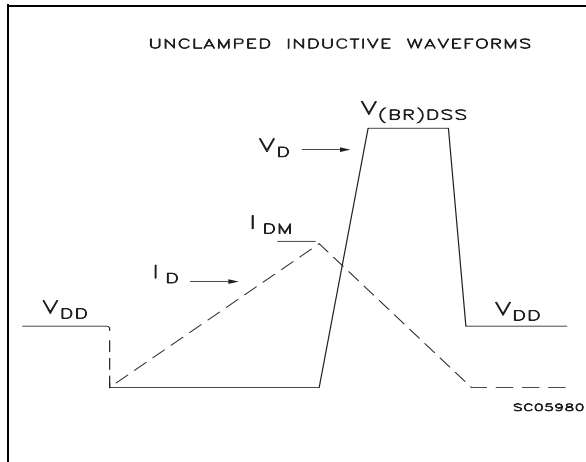


Figure 19. Unclamped Inductive Waveforms

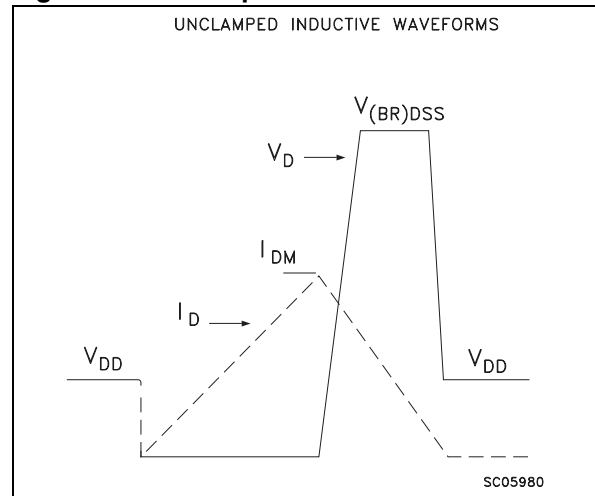


Figure 20. Switching Time Test Circuit For Resistive Load

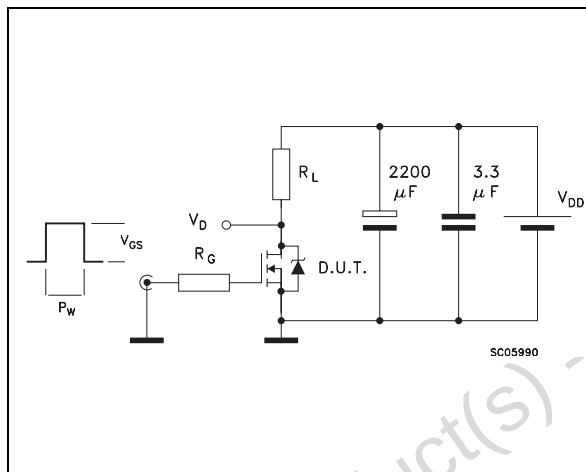
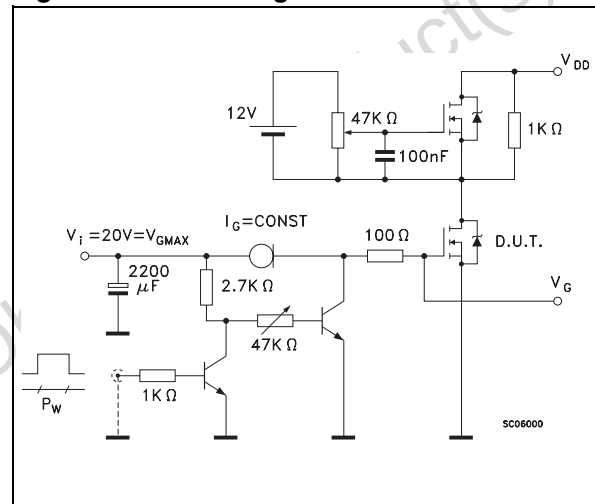


Figure 21. Gate Charge Test Circuit

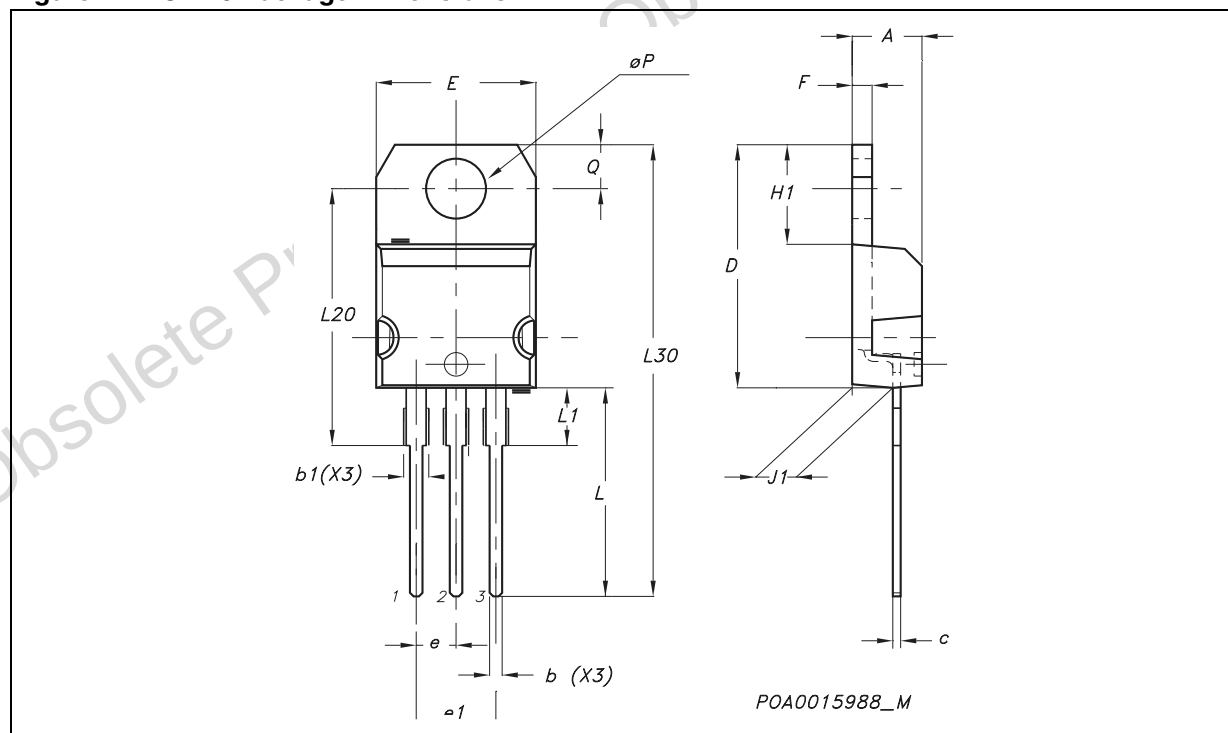


PACKAGE MECHANICAL

Table 11. TO-220 Mechanical Data

Symbol	millimeters			inches		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
ØP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116

Figure 22. TO-220 Package Dimensions

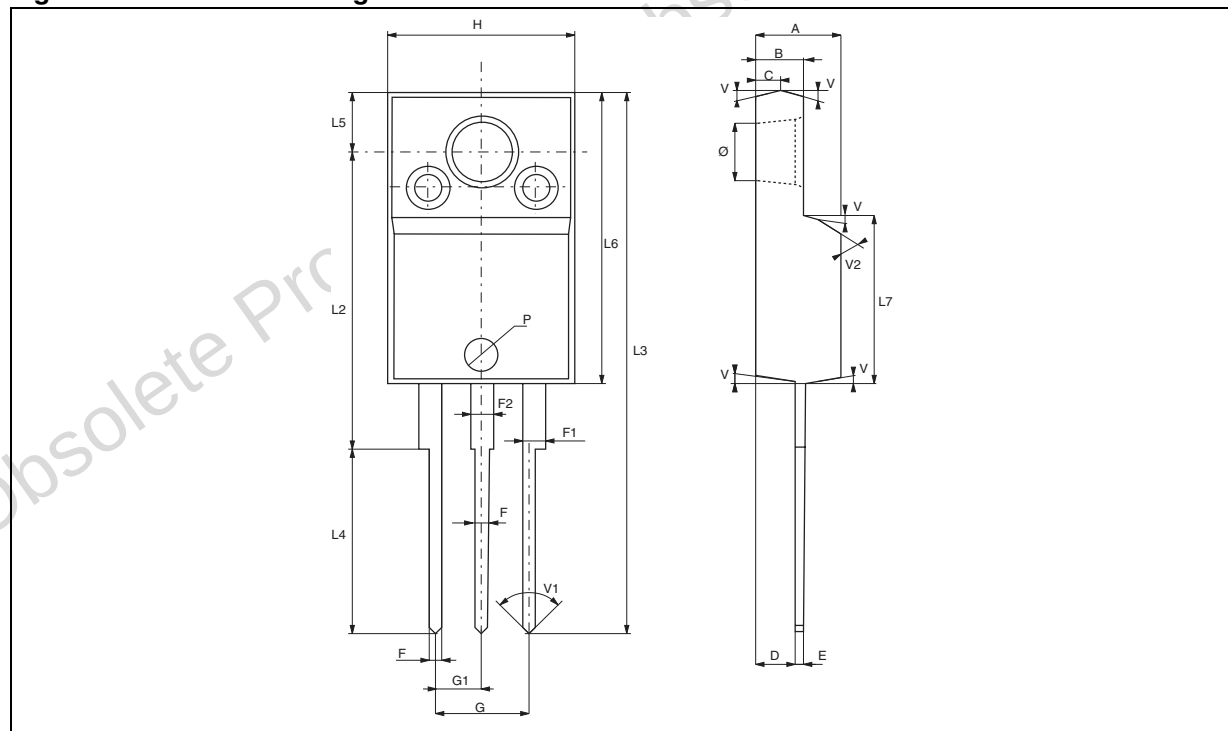


Note: Drawing is not to scale.

Table 12. TO-220FP Mechanical Data

Symbol	millimeters			inches		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
B	2.50		2.70	0.098		0.106
C	1.00		1.30	0.039		0.051
D	2.50		2.75	0.098		0.108
E	0.40		0.70	0.016		0.027
F	0.75		1.00	0.030		0.039
F1	1.15		1.70	0.045		0.066
F2	1.15		1.70	0.045		0.066
G	4.95		5.20	0.195		0.204
G1	2.40		2.70	0.094		0.106
H	10.00		10.40	0.393		0.409
L2		16.00			0.630	
L3	28.60		30.60	1.126		1.204
L4	9.80		10.60	0.385		0.417
L5	3.30		3.50	0.129		0.137
L6	15.90		16.40	0.626		0.645
L7	9.00		9.30	0.354		0.366
P			1.60			0.063
V		5°			5°	
V1	50°		100°	50°		100°
V2	44°		46°	44°		46°
Ø	3.00		3.20	0.118		0.126

Figure 23. TO-220FP Package Dimensions



Note: Drawing is not to scale.

REVISION HISTORY

Table 13. Revision History

Date	Revision	Description of Changes
July-1993	1	First Issue
16-Apr-2004	2	Stylesheet update. No content change.

Obsolete Product(s) - Obsolete Product(s)

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