

Power MOSFET

TO-220AB


N-Channel MOSFET

FEATURES

- Low gate charge Q_g results in simple drive Requirement
- Improved gate, avalanche and dynamic dV/dt ruggedness
- Fully characterized capacitance and avalanche voltage and current
- Effective C_{OSS} specified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS*
Available

Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

APPLICATIONS

- Switch mode power supply (SMPS)
- Uninterruptible power supply
- High speed power switching

TYPICAL SMPS TOPOLOGIES

- Single transistor forward

PRODUCT SUMMARY

V_{DS} (V)	600	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10\text{ V}$	1.2
Q_g max. (nC)	42	
Q_{gs} (nC)	10	
Q_{gd} (nC)	20	
Configuration	Single	

ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free	IRFBC40APbF
Lead (Pb)-free and halogen-free	IRFBC40APbF-BE3


ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-source voltage	V_{DS}	600	V	
Gate-source voltage	V_{GS}	± 30		
Continuous drain current	V_{GS} at 10 V	$T_C = 25\text{ }^\circ\text{C}$	A	
		$T_C = 100\text{ }^\circ\text{C}$		
Pulsed drain current ^a	I_{DM}	25		
Linear derating factor		1.0	W/ $^\circ\text{C}$	
Single pulse avalanche energy ^b	E_{AS}	570	mJ	
Repetitive avalanche current ^a	I_{AR}	6.2	A	
Repetitive avalanche energy ^a	E_{AR}	13	mJ	
Maximum power dissipation	$T_C = 25\text{ }^\circ\text{C}$	P_D	125	W
Peak diode recovery dV/dt ^c	dV/dt	6.0	V/ns	
Operating junction and storage temperature range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$	
Soldering recommendations (peak temperature) ^d	For 10 s	300		
Mounting torque	6-32 or M3 screw	10	lbf · in	
		1.1	N · m	

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- Starting $T_J = 25\text{ }^\circ\text{C}$, $L = 29.6\text{ mH}$, $R_g = 25\text{ }^\circ\Omega$, $I_{AS} = 6.2\text{ A}$ (see fig. 12)
- $I_{SD} \leq 6.2\text{ A}$, $dI/dt \leq 80\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$
- 1.6 mm from case

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R_{thJA}	-	62	°C/W
Case-to-sink, flat, greased surface	R_{thCS}	0.50	-	
Maximum junction-to-case (drain)	R_{thJC}	-	1.0	

SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		600	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$		-	0.66	-	V/°C
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		2.0	-	4.0	V
Gate-source leakage	I_{GSS}	$V_{GS} = \pm 30\text{ V}$		-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$		-	-	25	μA
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 3.7\text{ A}^b$	-	-	1.2	Ω
Forward transconductance	g_{fs}	$V_{DS} = 50\text{ V}, I_D = 3.7\text{ A}$		3.4	-	-	S
Dynamic							
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V},$ $V_{DS} = 25\text{ V},$ $f = 1.0\text{ MHz},$ see fig. 5		-	1036	-	μF
Output capacitance	C_{oss}			-	136	-	
Reverse transfer capacitance	C_{rss}			-	7.0	-	
Output capacitance	C_{oss}	$V_{GS} = 0\text{ V}$	$V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$	-	1487	-	μF
Effective output capacitance	$C_{oss\text{ eff.}}$		$V_{DS} = 480\text{ V}, f = 1.0\text{ MHz}$	-	36	-	
Total gate charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 6.2\text{ A}, V_{DS} = 480\text{ V}$ see fig. 6 and 13 ^b	-	-	42	nC
Gate-source charge	Q_{gs}			-	-	10	
Gate-drain charge	Q_{gd}			-	-	20	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 300\text{ V}, I_D = 6.2\text{ A}$ $R_g = 9.1\text{ }\Omega, R_D = 47\text{ }\Omega,$ see fig. 10 ^b		-	13	-	ns
Rise time	t_r			-	23	-	
Turn-off delay time	$t_{d(off)}$			-	31	-	
Fall time	t_f			-	18	-	
Gate input resistance	R_g	$f = 1\text{ MHz},$ open drain		0.6	-	3.9	Ω
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	6.2	A
Pulsed diode forward current ^a	I_{SM}			-	-	25	
Body diode voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 6.2\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	1.5	V
Body diode reverse recovery time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = 6.2\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$		-	431	647	ns
Body diode reverse recovery charge	Q_{rr}			-	1.8	2.8	μC
Forward turn-on time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)					

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$
- $C_{oss\text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

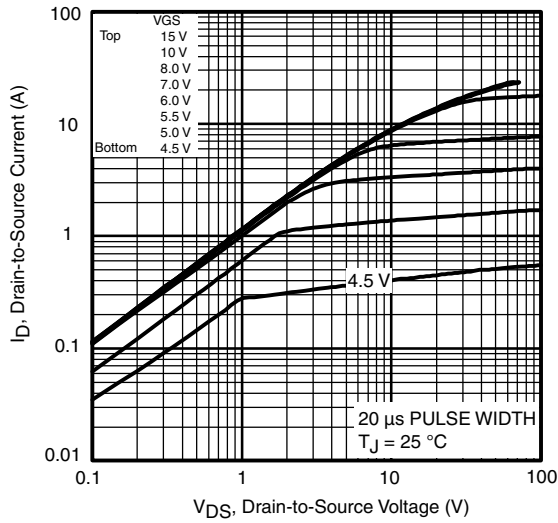


Fig. 1 - Typical Output Characteristics

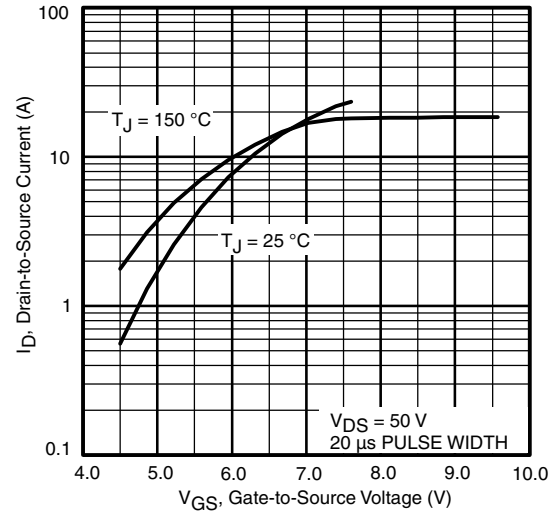


Fig. 3 - Typical Transfer Characteristics

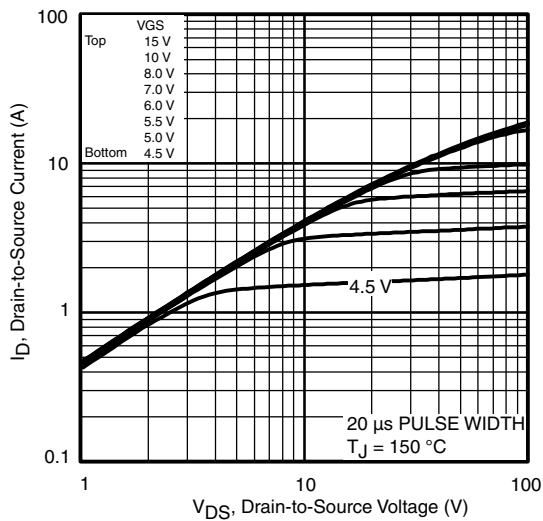


Fig. 2 - Typical Output Characteristics

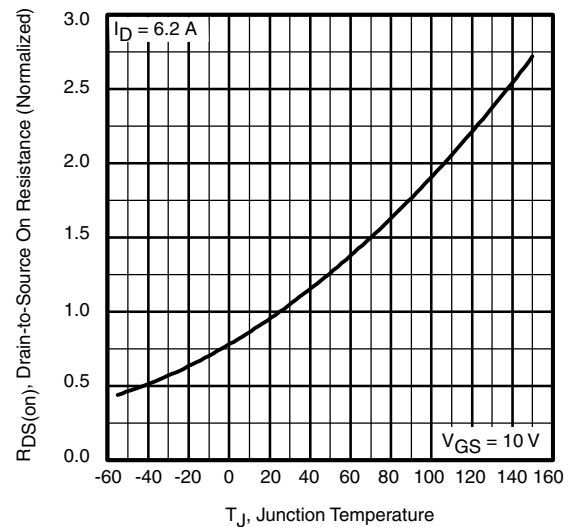


Fig. 4 - Normalized On-Resistance vs. Temperature

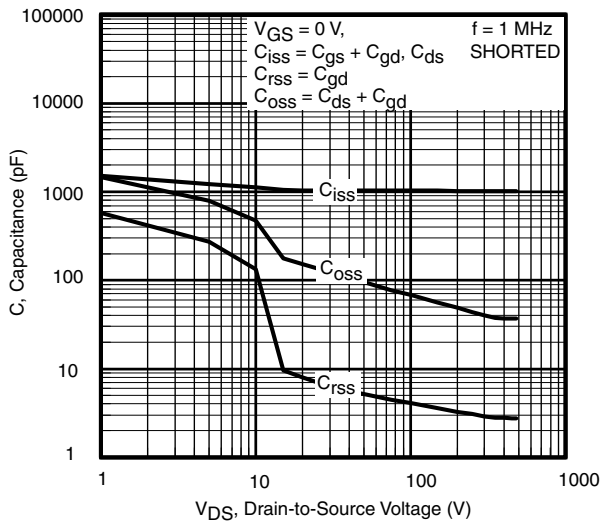


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

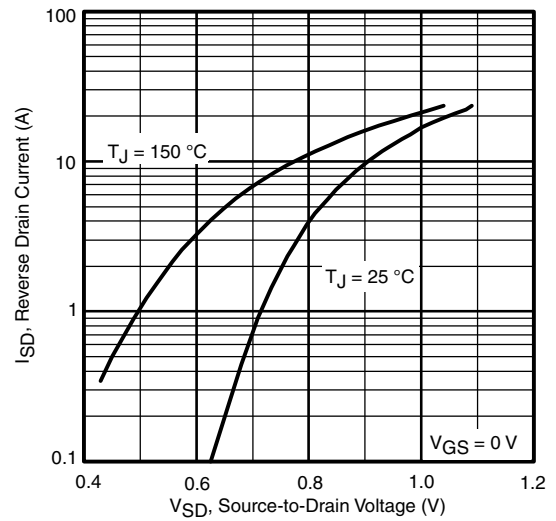


Fig. 7 - Typical Source-Drain Diode Forward Voltage

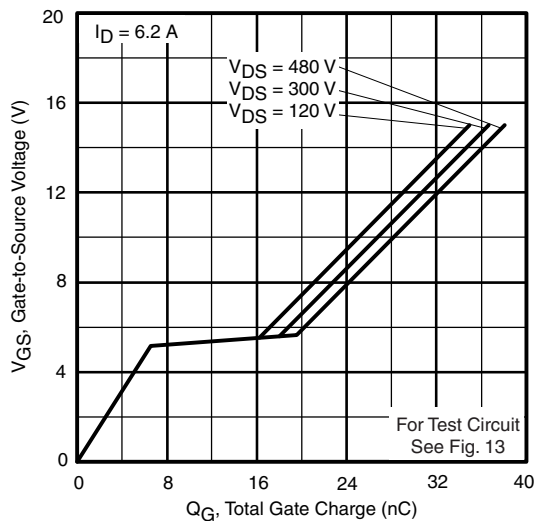


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

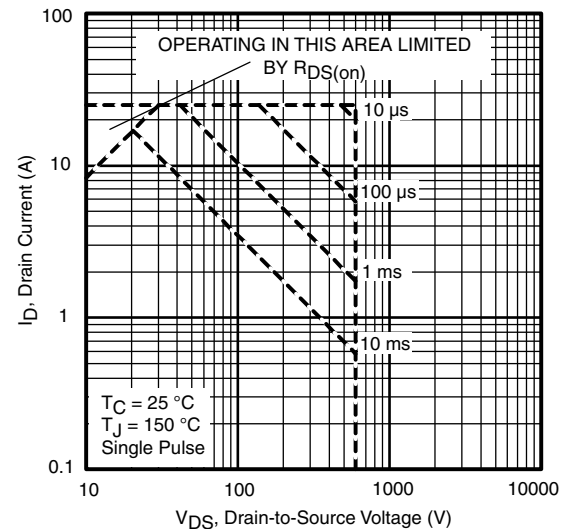


Fig. 8 - Maximum Safe Operating Area

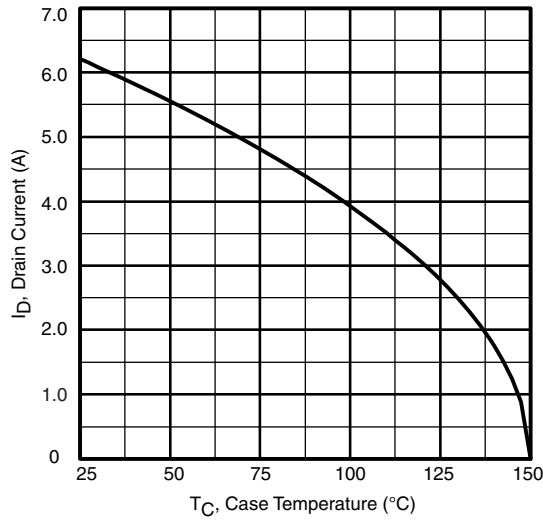


Fig. 9 - Maximum Drain Current vs. Case Temperature

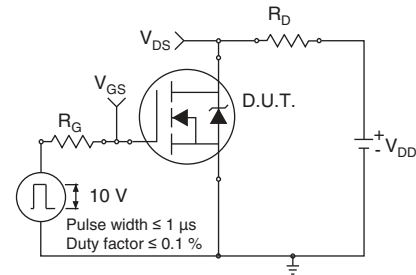


Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms

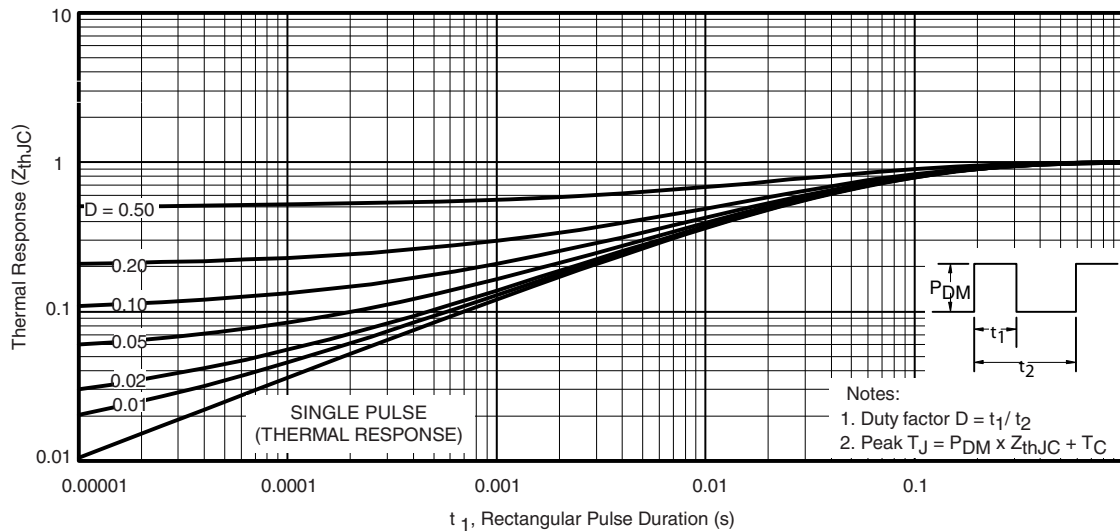


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

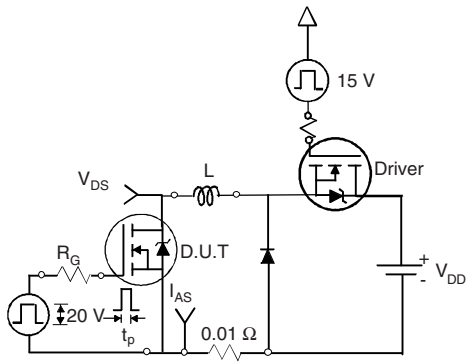


Fig. 12a - Unclamped Inductive Test Circuit

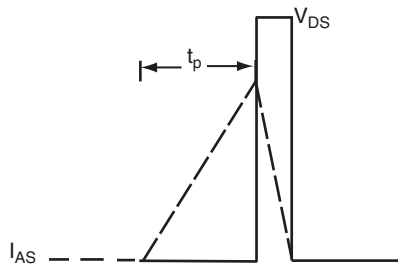


Fig. 12b - Unclamped Inductive Waveforms

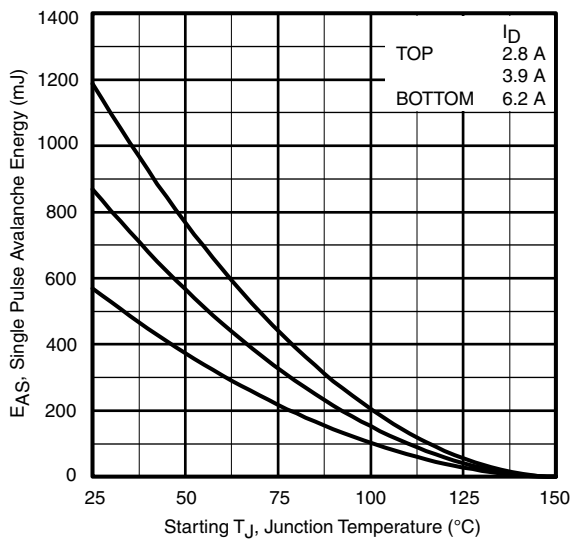


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

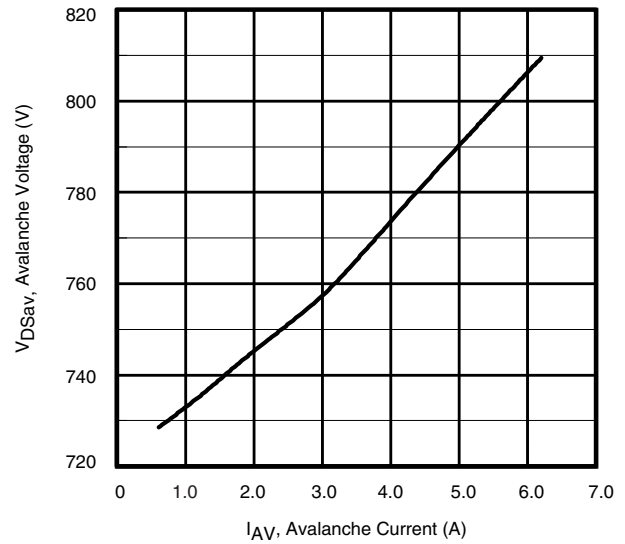


Fig. 12d - Typical Drain-to-Source Voltage vs. Avalanche Current

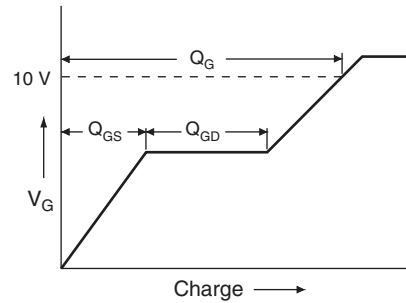


Fig. 13a - Basic Gate Charge Waveform

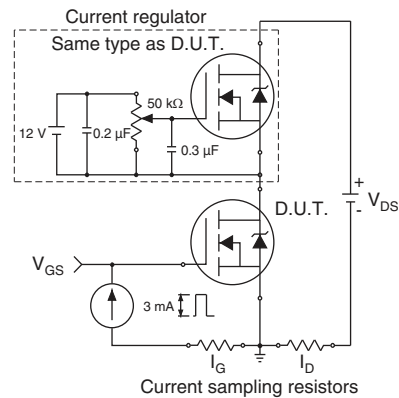
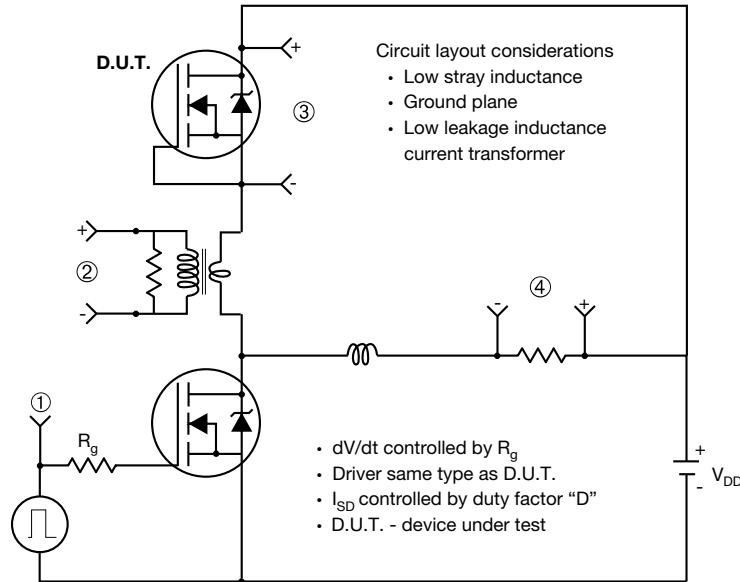


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note
a. $V_{GS} = 5\text{ V}$ for logic level devices

Fig. 14 - For N-Channel

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TO-220-1



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.24	4.65	0.167	0.183
b	0.69	1.02	0.027	0.040
b(1)	1.14	1.78	0.045	0.070
c	0.36	0.61	0.014	0.024
D	14.33	15.85	0.564	0.624
E	9.96	10.52	0.392	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	6.10	6.71	0.240	0.264
J(1)	2.41	2.92	0.095	0.115
L	13.36	14.40	0.526	0.567
L(1)	3.33	4.04	0.131	0.159
Ø P	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

ECN: X15-0364-Rev. C, 14-Dec-15
DWG: 6031

Note

- M* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM





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