

Power MOSFET



N-Channel MOSFET

FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- Ultra low on-resistance
- Very low thermal resistance
- 175 °C operating temperature
- Fast switching
- Ease of paralleling
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



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

DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-220AB package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

PRODUCT SUMMARY	
V _{DS} (V)	60
R _{DS(on)} (Ω)	V _{GS} = 10 V 0.018
Q _g (Max.) (nC)	110
Q _{gs} (nC)	29
Q _{gd} (nC)	36
Configuration	Single

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	IRFZ48PbF

ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted)				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-source voltage	V _{DS}	60	V	
Gate-source voltage	V _{GS}	± 20		
Continuous drain current	V _{GS} at 10 V	T _C = 25 °C	A	
		T _C = 100 °C		
Pulsed drain current ^a	I _{DM}	290		
Linear derating factor		1.3	W/°C	
Single pulse avalanche energy ^b	E _{AS}	100	mJ	
Repetitive avalanche current ^a	I _{AR}	50	A	
Repetitive avalanche energy ^a	E _{AR}		19	mJ
		T _C = 25 °C	190	W
Maximum power dissipation	P _D	190	W	
Peak diode recovery dV/dt ^c	dV/dt	4.5	V/ns	
Operating junction and storage temperature range	T _J , T _{stg}	- 55 to + 175	°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)
- V_{DD} = 25 V, starting T_J = 25 °C, L = 22 μH, R_g = 25 Ω I_{AS} = 72 A (see fig. 12)
- I_{SD} ≤ 72 A, dI/dt ≤ 200 A/μs, V_{DD} ≤ V_{DS}, T_J ≤ 175 °C
- 1.6 mm from case
- Current limited by the package, (die current = 72 A)

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}	-	0.80	

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}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		60	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$		-	0.060	-	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}	$V_{GS} = \pm 20$		-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$		-	-	25	μA
		$V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 43\text{ A}^b$	-	-	0.018	Ω
Forward transconductance	g_{fs}	$V_{DS} = 25\text{ V}, I_D = 43\text{ A}^b$		27	-	-	S
Dynamic							
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V},$ $V_{DS} = 25\text{ V},$ $f = 1.0\text{ MHz}$, see fig. 5		-	2400	-	pF
Output capacitance	C_{oss}			-	1300	-	
Reverse transfer capacitance	C_{rss}			-	190	-	
Total gate charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 72\text{ A}, V_{DS} = 48\text{ V},$ see fig. 6 and 13 ^b	-	-	110	nC
Gate-source charge	Q_{gs}			-	-	29	
Gate-drain charge	Q_{gd}			-	-	36	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 30\text{ V}, I_D = 72\text{ A},$ $R_g = 9.1\text{ }\Omega, R_D = 0.34\text{ }\Omega$, see fig. 10 ^b		-	8.1	-	ns
Rise time	t_r			-	250	-	
Turn-off delay time	$t_{d(off)}$			-	210	-	
Fall time	t_f			-	250	-	
Internal drain inductance	L_D	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH
Internal source inductance	L_S			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	50 ^c	A
Pulsed diode forward current ^a	I_{SM}			-	-	290	
Body diode voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 72\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	2.0	V
Body diode reverse recovery time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = 72\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$		-	120	180	ns
Body diode reverse recovery charge	Q_{rr}			-	0.50	0.80	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 $\leq 2\%$
- Current limited by the package, (die current = 72 A)

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

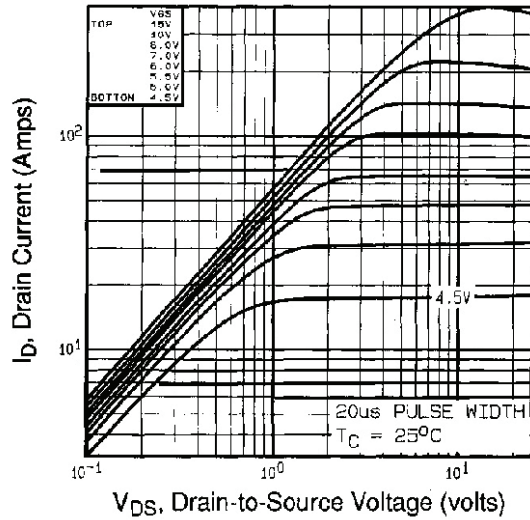


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

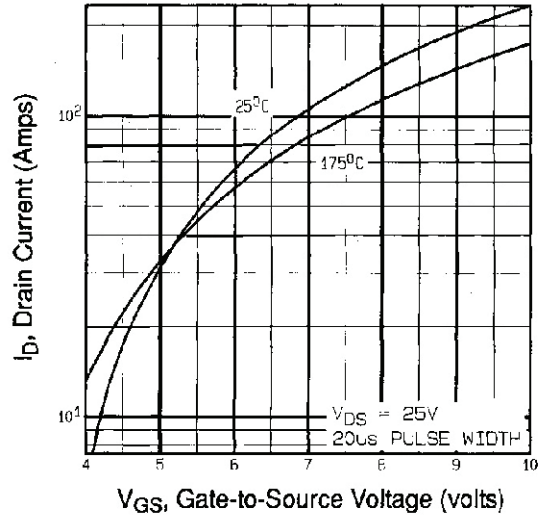


Fig. 3 - Typical Transfer Characteristics

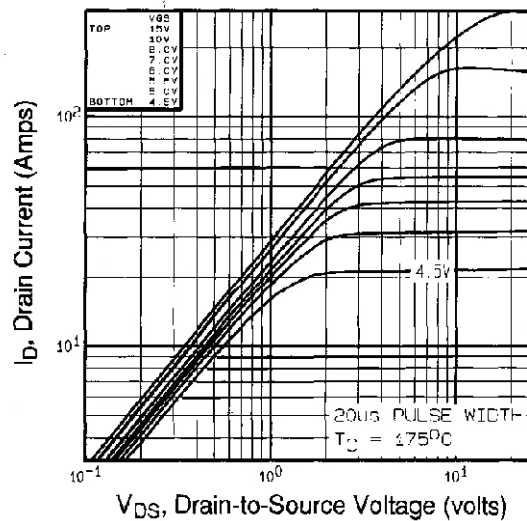


Fig. 2 - Typical Output Characteristics, $T_C = 175^\circ\text{C}$

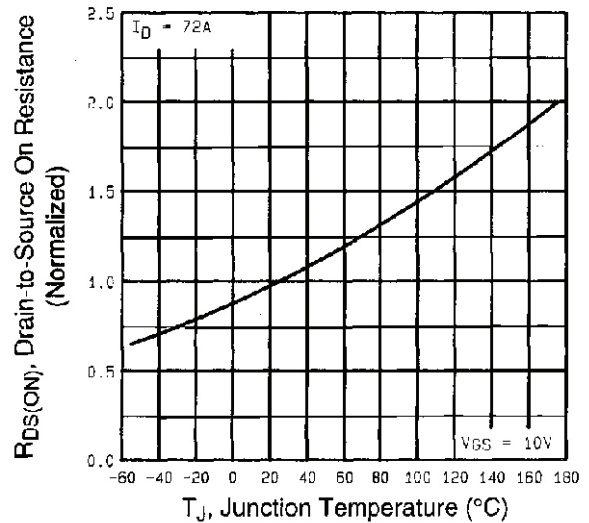


Fig. 4 - Normalized On-Resistance vs. Temperature

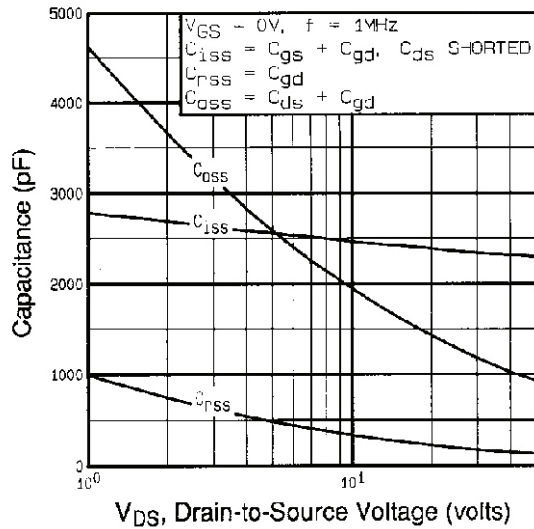


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

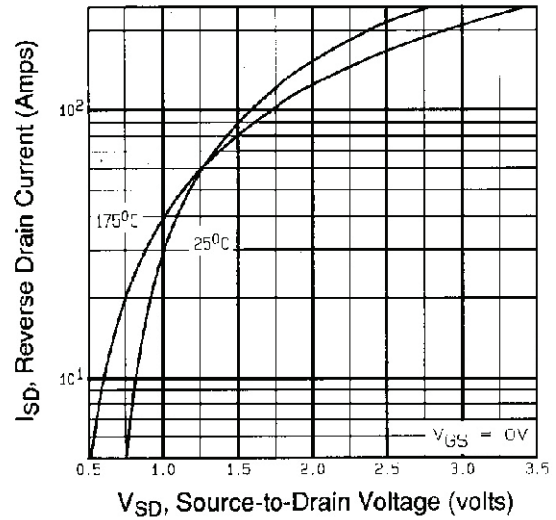


Fig. 7 - Typical Source-Drain Diode Forward Voltage

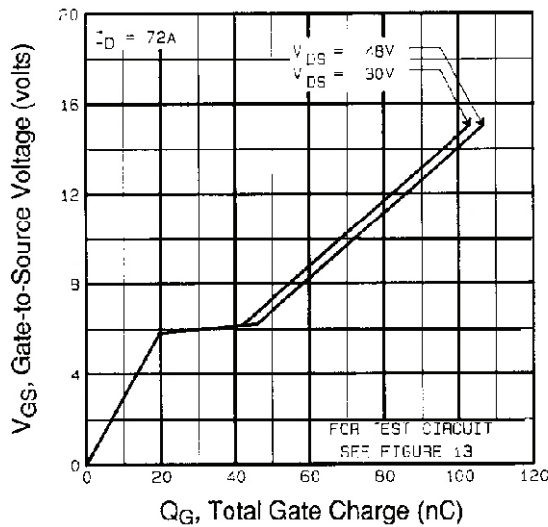


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

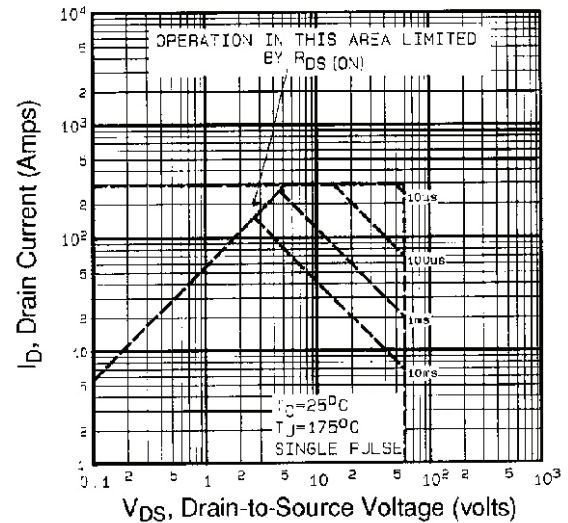


Fig. 8 - Maximum Safe Operating Area

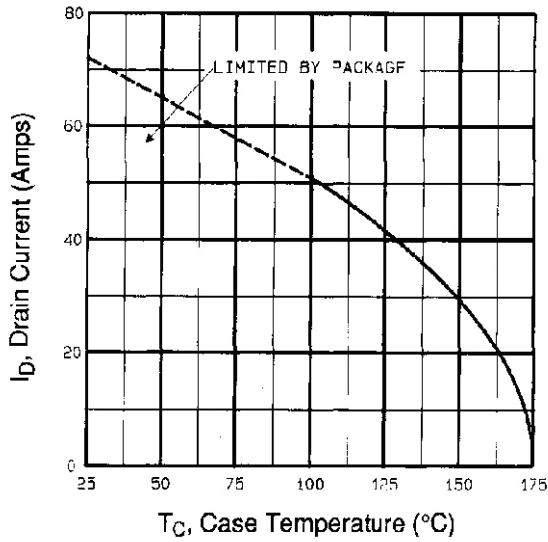


Fig. 9 - Maximum Drain Current vs. Case Temperature

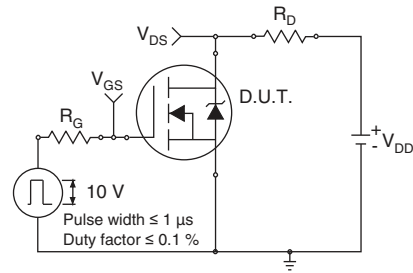


Fig. 10a - Switching Time Test Circuit

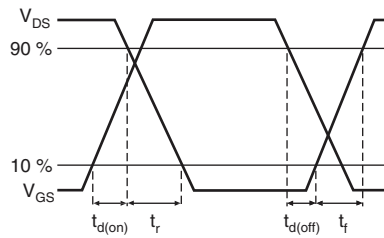


Fig. 10b - Switching Time Waveforms

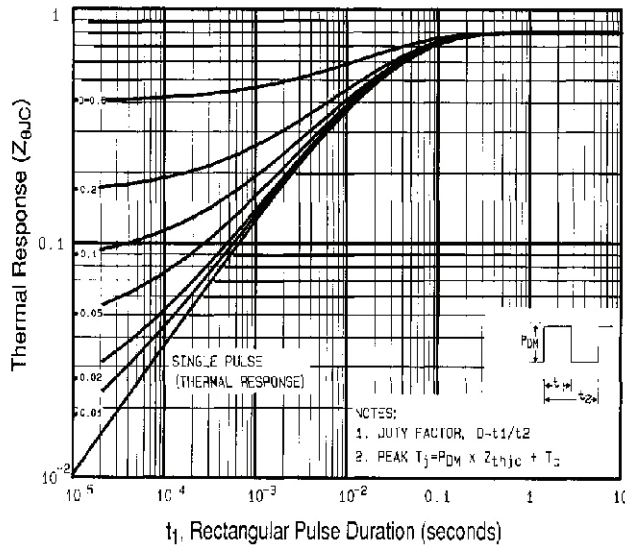


Fig. 10 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

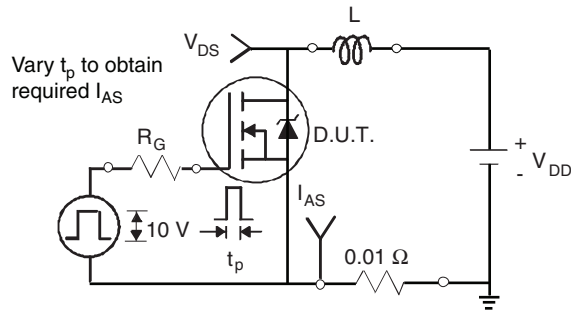


Fig. 12a - Unclamped Inductive Test Circuit

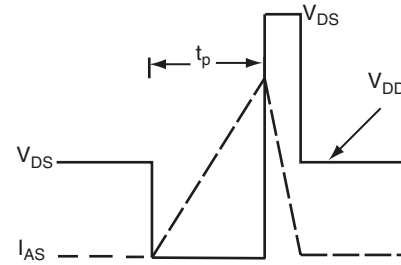


Fig. 12b - Unclamped Inductive Waveforms

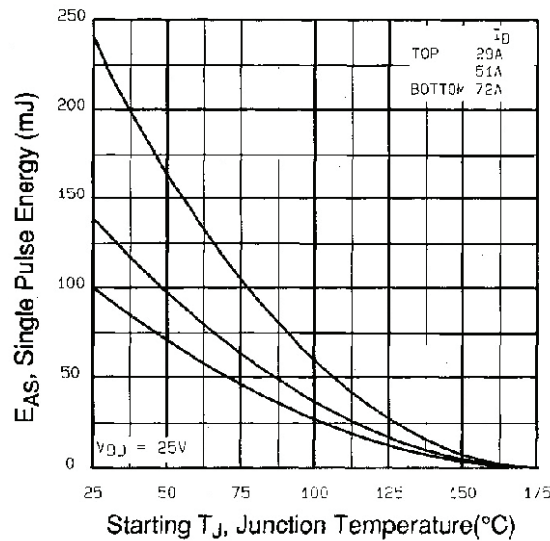


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

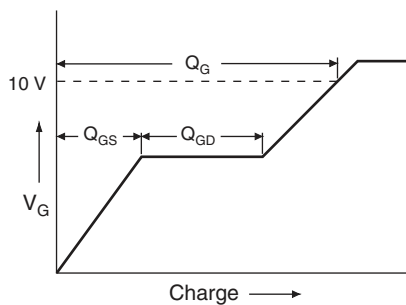


Fig. 13a - Basic Gate Charge Waveform

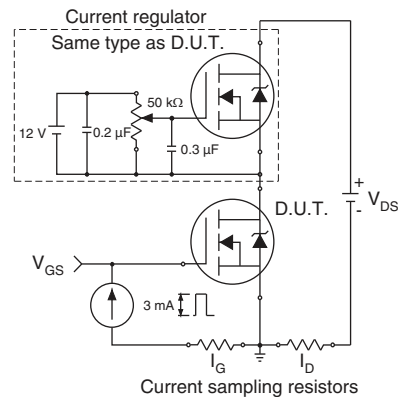
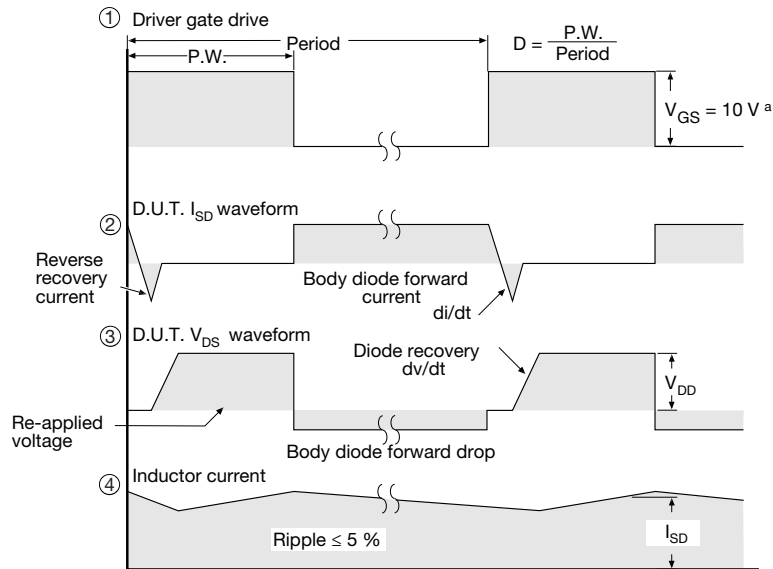
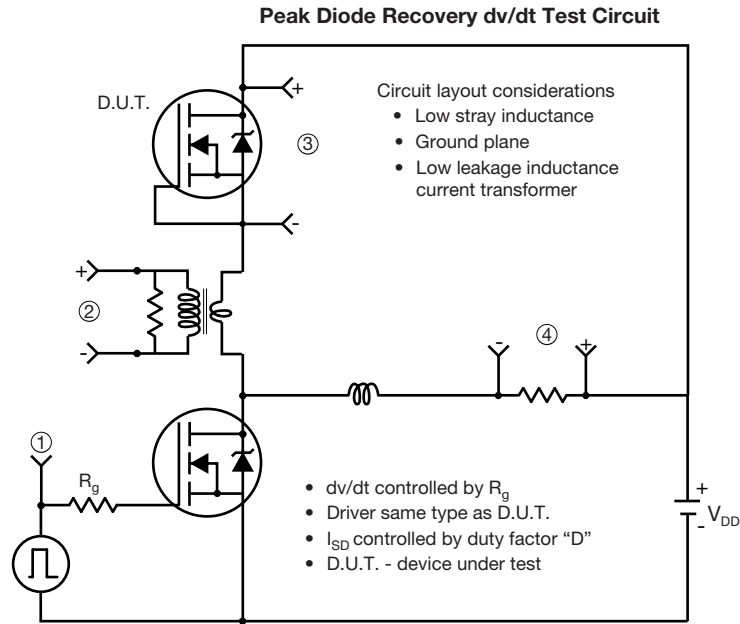


Fig. 13b - Gate Charge Test Circuit



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
$\varnothing P$	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

ECN: E21-0621-Rev. D, 04-Nov-2021
DWG: 6031

Note

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



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