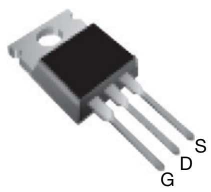
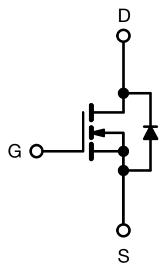
Power MOSFET

TO-220AB





N-Channel MOSFET

FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- 175 °C operating temperature
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Available

RoHS*
Available

HALOGEN FREE
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

PRODUCT SUMMARY		
V_{DS} (V)	100	
$R_{DS(on)}$ (Ω)	V_{GS} = 10 V	0.077
Q_g max. (nC)	72	
Q_{gs} (nC)	11	
Q_{gd} (nC)	32	
Configuration	Single	

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.

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	IRF540PbF
Lead (Pb)-free and halogen-free	IRF540PbF-BE3

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-source voltage			V_{DS}	100	V
Gate-source voltage			V_{GS}	± 20	
Continuous drain current	V_{GS} at 10 V	T_C = 25 °C	I_D	28	A
		T_C = 100 °C		20	
Pulsed drain current [a]			I_{DM}	110	
Linear derating factor				1.0	W/°C
Single pulse avalanche energy [b]			E_{AS}	230	mJ
Repetitive avalanche current [a]			I_{AR}	28	A
Repetitive avalanche energy [a]			E_{AR}	15	mJ
Maximum power dissipation	T_C = 25 °C		P_D	150	W
Peak diode recovery dV/dt [c]			dV/dt	5.5	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

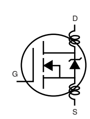
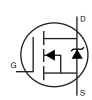
a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)

b. V_{DD} = 25 V, starting T_J = 25 °C, L = 440 μH, R_g = 25 Ω, I_{AS} = 28 A (see fig. 12)

c. $I_{SD} \leq$ 28 A, dI/dt $\leq$ 170 A/μs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 175 °C

d. 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 °C, unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static						
Drain-source breakdown voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 μA	100	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA	-	0.13	-	V/°C
Gate-source threshold voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 μA	2.0	-	4.0	V
Gate-source leakage	I_{GSS}	V_{GS} = ± 20 V	-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	V_{DS} = 100 V, V_{GS} = 0 V	-	-	25	μA
		V_{DS} = 80 V, V_{GS} = 0 V, T_J = 150 °C	-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS} = 10 V; I_D = 17 A [b]	-	-	0.077	Ω
Forward transconductance	g_{fs}	V_{DS} = 50 V, I_D = 17 A [b]	8.7	-	-	S
Dynamic						
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 25 V, f = 1.0 MHz, see fig. 5	-	1700	-	pF
Output capacitance	C_{oss}		-	560	-	
Reverse transfer capacitance	C_{rss}		-	120	-	
Total gate charge	Q_g	V_{GS} = 10 V; I_D = 17 A, V_{DS} = 80 V, see fig. 6 and 13 [b]	-	-	72	nC
Gate-source charge	Q_{gs}		-	-	11	
Gate-drain charge	Q_{gd}		-	-	32	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 50 V, I_D = 17 A, R_g = 9.1 Ω, R_D = 2.9 Ω, see fig. 10 [b]	-	11	-	ns
Rise time	t_r		-	44	-	
Turn-off delay time	$t_{d(off)}$		-	53	-	
Fall time	t_f		-	43	-	
Gate input resistance	R_g	f = 1 MHz, open drain	0.5	-	3.6	Ω
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 	-	-	28	A
Pulsed diode forward current [a]	I_{SM}		-	-	110	
Body diode voltage	V_{SD}	T_J = 25 °C, I_S = 28 A, V_{GS} = 0 V [b]	-	-	2.5	V
Body diode reverse recovery time	t_{rr}	T_J = 25 °C, I_F = 17 A, dI/dt = 100 A/μs [b]	-	180	360	ns
Body diode reverse recovery charge	Q_{rr}		-	1.3	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

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
b. Pulse width ≤ 300 μs; duty cycle ≤ 2 %

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

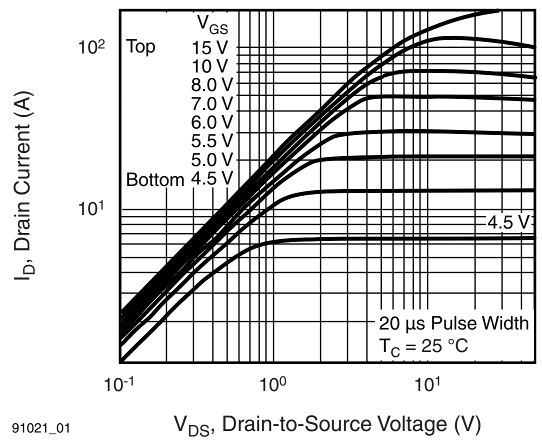


Fig. 1 - Typical Output Characteristics, T_C = 25 °C

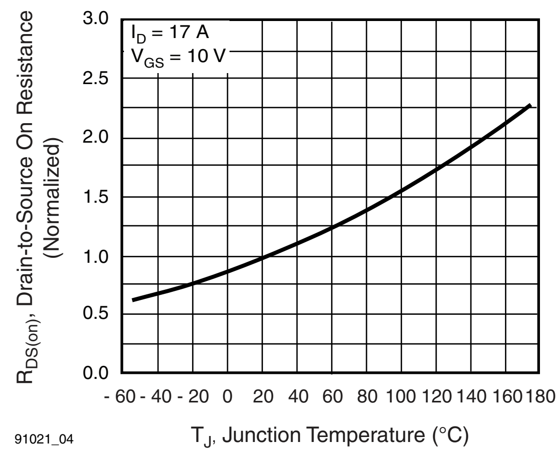


Fig. 4 - Normalized On-Resistance vs. Temperature

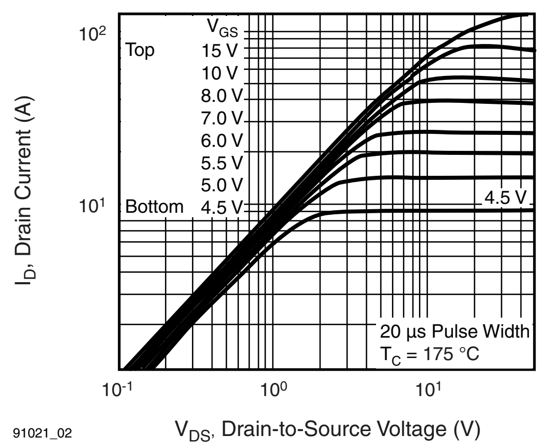


Fig. 2 - Typical Output Characteristics, T_C = 175 °C

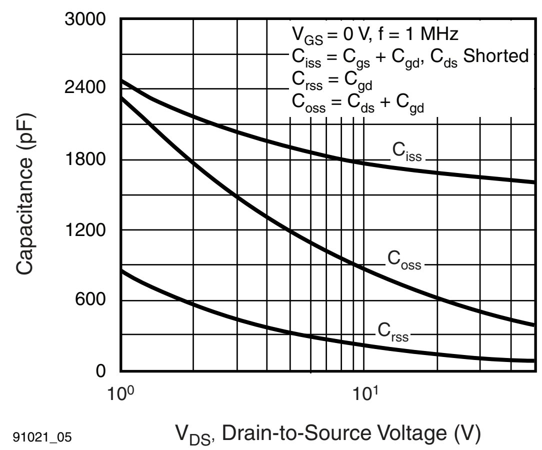


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

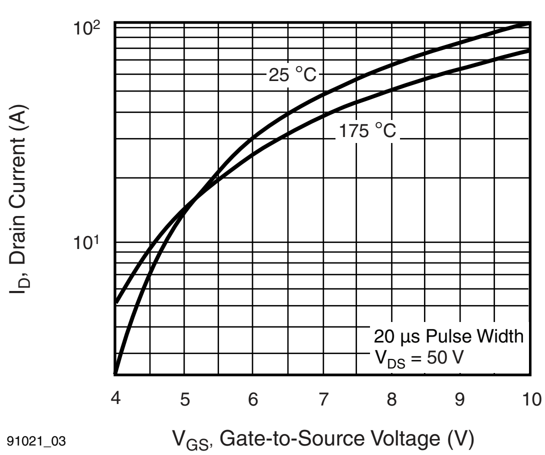


Fig. 3 - Typical Transfer Characteristics

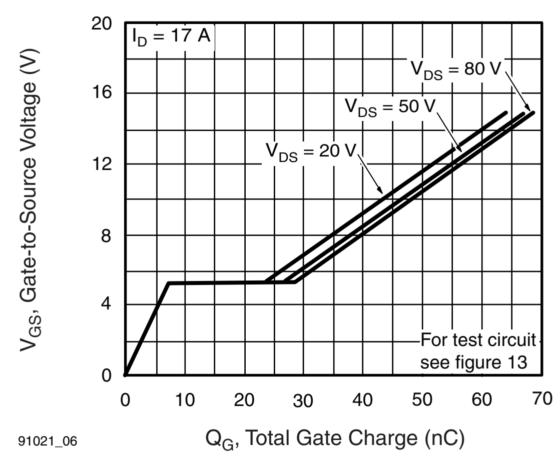


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

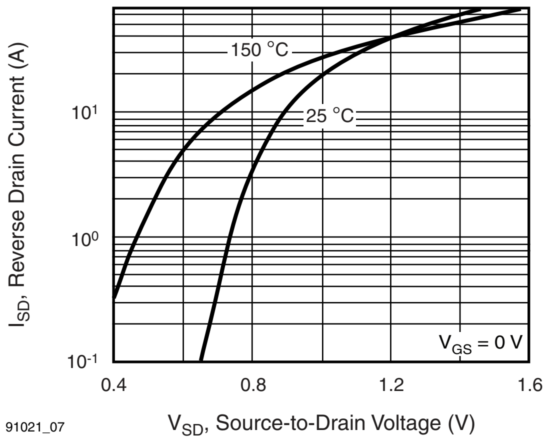


Fig. 7 - Typical Source-Drain Diode Forward Voltage

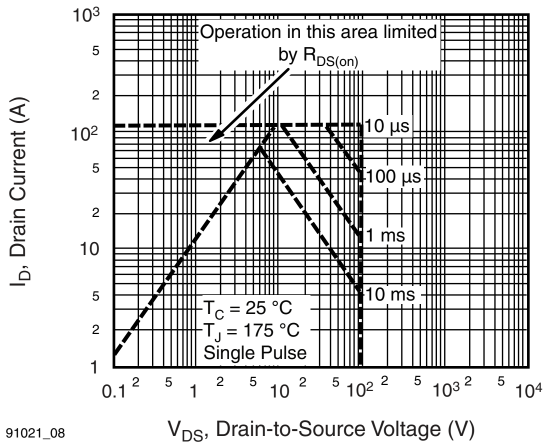


Fig. 8 - Maximum Safe Operating Area

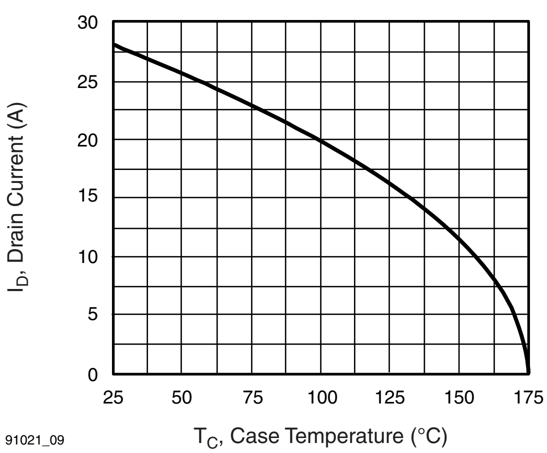


Fig. 9 - Maximum Drain Current vs. Case Temperature

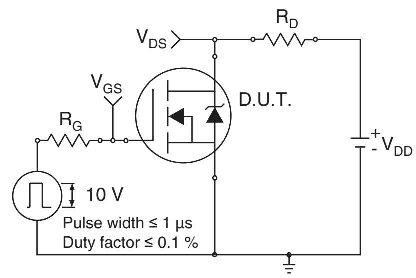


Fig. 10a - Switching Time Test Circuit

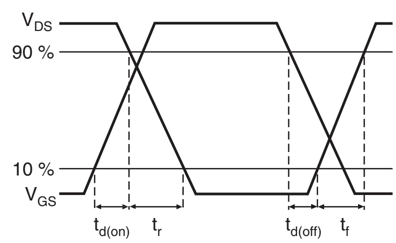


Fig. 10b - Switching Time Waveforms

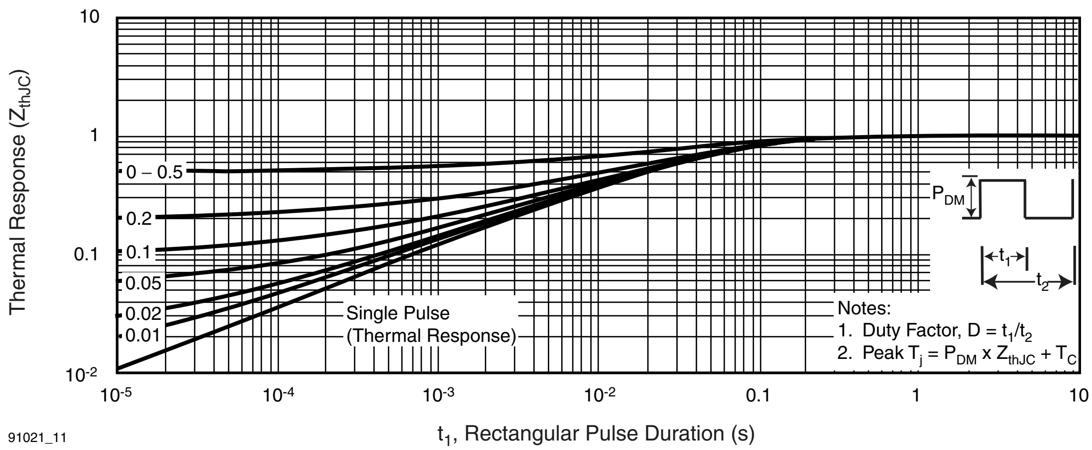


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

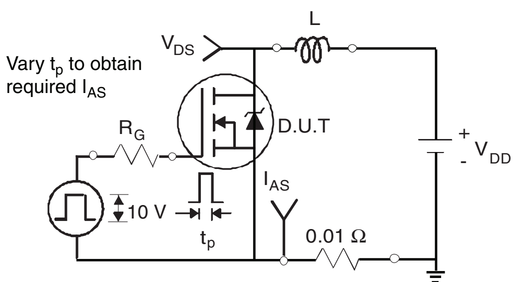


Fig. 12a - Unclamped Inductive Test Circuit

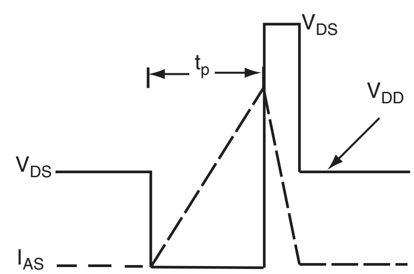


Fig. 12b - Unclamped Inductive Waveforms

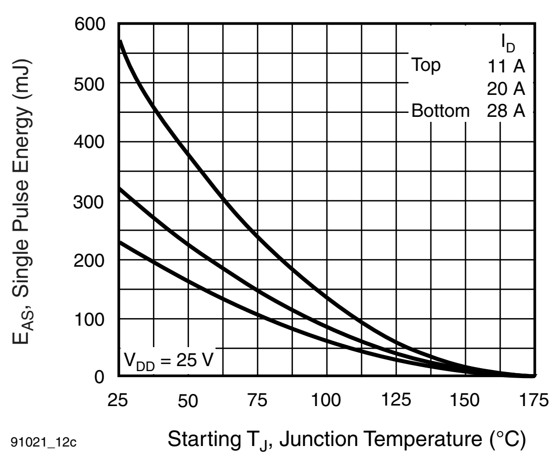


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

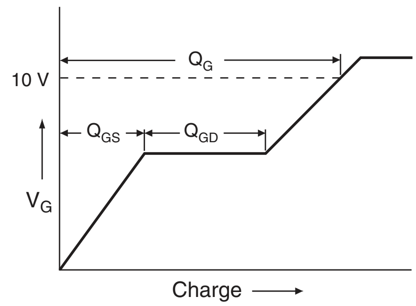


Fig. 13a - Basic Gate Charge Waveform

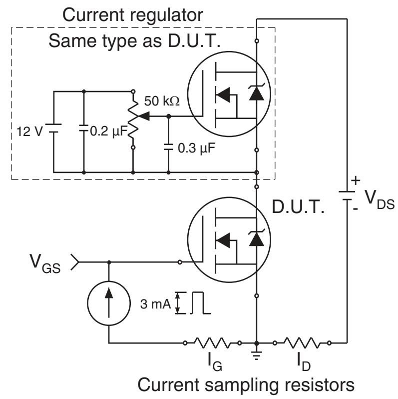
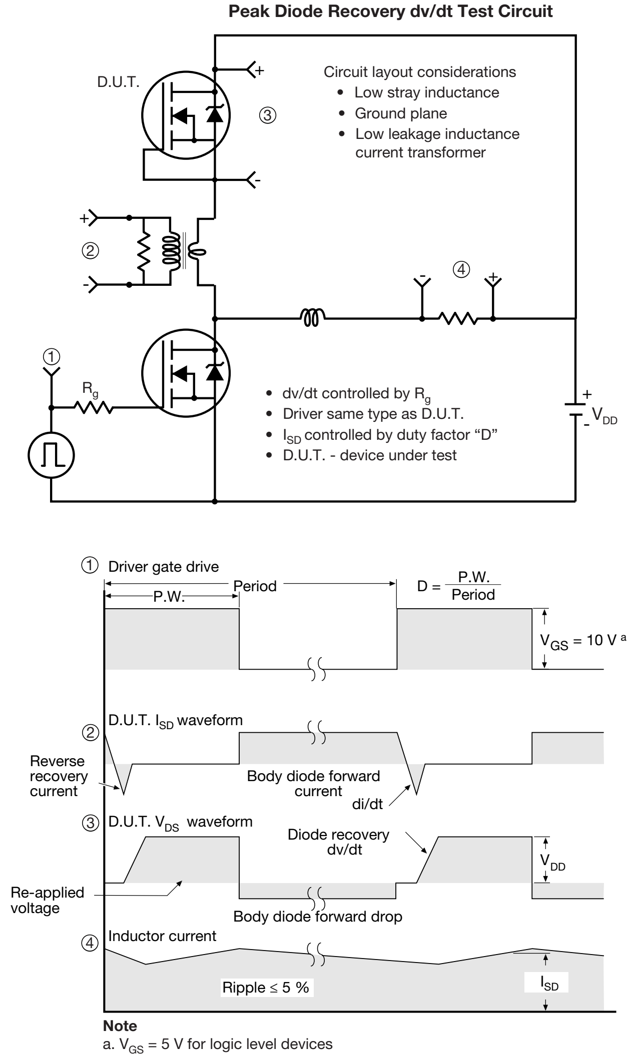


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



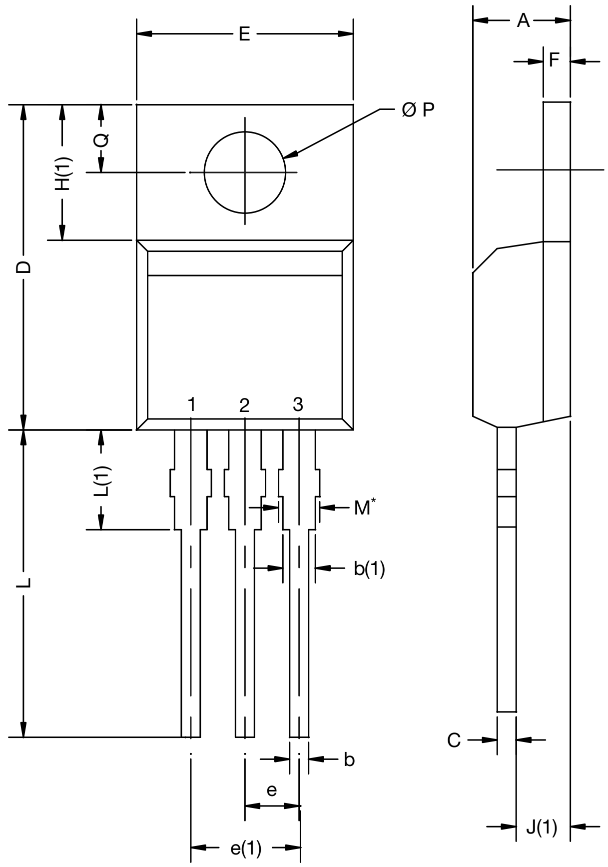
Note

a. V_{GS} = 5 V for logic level devices

Fig. 14 - For N-Channel

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see http://www.vishay.com/ppg?91021.

TO-220-1



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<tr><th rowspan="2">DIM.</th><th colspan="2">MILLIMETERS</th><th colspan="2">INCHES</th></tr>
<tr><th>MIN.</th><th>MAX.</th><th>MIN.</th><th>MAX.</th></tr>
<tr><td>A</td><td>4.24</td><td>4.65</td><td>0.167</td><td>0.183</td></tr>
<tr><td>b</td><td>0.69</td><td>1.02</td><td>0.027</td><td>0.040</td></tr>
<tr><td>b(1)</td><td>1.14</td><td>1.78</td><td>0.045</td><td>0.070</td></tr>
<tr><td>c</td><td>0.36</td><td>0.61</td><td>0.014</td><td>0.024</td></tr>
<tr><td>D</td><td>14.33</td><td>15.85</td><td>0.564</td><td>0.624</td></tr>
<tr><td>E</td><td>9.96</td><td>10.52</td><td>0.392</td><td>0.414</td></tr>
<tr><td>e</td><td>2.41</td><td>2.67</td><td>0.095</td><td>0.105</td></tr>
<tr><td>e(1)</td><td>4.88</td><td>5.28</td><td>0.192</td><td>0.208</td></tr>
<tr><td>F</td><td>1.14</td><td>1.40</td><td>0.045</td><td>0.055</td></tr>
<tr><td>H(1)</td><td>6.10</td><td>6.71</td><td>0.240</td><td>0.264</td></tr>
<tr><td>J(1)</td><td>2.41</td><td>2.92</td><td>0.095</td><td>0.115</td></tr>
<tr><td>L</td><td>13.36</td><td>14.40</td><td>0.526</td><td>0.567</td></tr>
<tr><td>L(1)</td><td>3.33</td><td>4.04</td><td>0.131</td><td>0.159</td></tr>
<tr><td>Ø P</td><td>3.53</td><td>3.94</td><td>0.139</td><td>0.155</td></tr>
<tr><td>Q</td><td>2.54</td><td>3.00</td><td>0.100</td><td>0.118</td></tr>
<tr><td colspan="5">ECN: E21-0621-Rev. D, 04-Nov-2021
DWG: 6031</td></tr>
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Note

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

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