

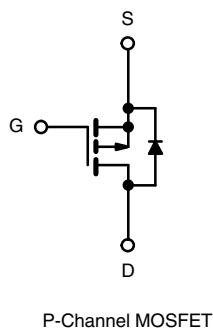
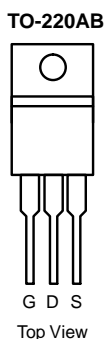
## 4P04L06-VB TO220 Datasheet

### P-Channel 40-V (D-S) MOSFET

PRODUCT SUMMARY			
$V_{DS}$ (V)	$r_{DS(on)}$ ( $\Omega$ )	$I_D$ (A) <sup>a</sup>	$Q_g$ (Typ.)
- 40	0.0041 at $V_{GS} = - 10$ V	- 110	185 nC

#### FEATURES

- TrenchFET<sup>®</sup> Power MOSFET



ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted				
Parameter	Symbol	Limit	Unit	
Drain-Source Voltage	$V_{DS}$	- 40	V	
Gate-Source Voltage	$V_{GS}$	$\pm 20$		
Continuous Drain Current ( $T_J = 175$ °C)	$I_D$	$T_C = 25$ °C	- 110 <sup>a</sup>	A
		$T_C = 70$ °C	- 110 <sup>a</sup>	
		$T_A = 25$ °C	39 <sup>b, c</sup>	
		$T_A = 70$ °C	33 <sup>b, c</sup>	
Pulsed Drain Current	$I_{DM}$	240		
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25$ °C	110	
		$T_A = 25$ °C	10 <sup>b, c</sup>	
Avalanche Current	$I_{AS}$	L = 0.1 mH	75	
Single-Pulse Avalanche Energy			$E_{AS}$	
Maximum Power Dissipation	$P_D$	$T_C = 25$ °C	375	W
		$T_C = 70$ °C	262	
		$T_A = 25$ °C	15 <sup>b, c</sup>	
		$T_A = 70$ °C	10.5 <sup>b, c</sup>	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 175	°C	
Soldering Recommendations (Peak Temperature) <sup>d, e</sup>		260		

THERMAL RESISTANCE RATINGS					
Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>b, d</sup>	$t \leq 10$ s	$R_{thJA}$	8	10	°C/W
Maximum Junction-to-Case (Drain)	Steady State	$R_{thJC}$	0.33	0.4	

Notes:

- Package limited.
- Surface Mounted on 1" x 1" FR4 board.
- $t = 10$  s.
- Maximum under Steady State conditions is 40 °C/W.

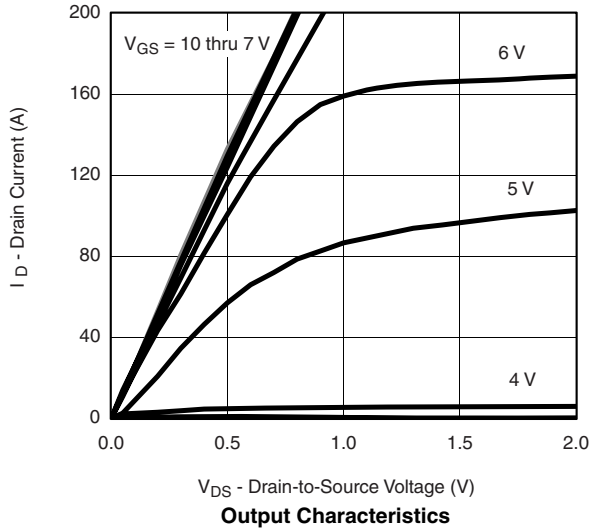
SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	- 40			V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		- 40		mV/ $^\circ\text{C}$
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			- 5.5		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	- 2	- 3	- 4	V
Gate-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}$			- 1	$\mu\text{A}$
		$V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			- 10	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \geq 5\text{ V}, V_{GS} = -10\text{ V}$	- 120			A
Drain-Source On-State Resistance <sup>a</sup>	$r_{DS(on)}$	$V_{GS} = -10\text{ V}, I_D = -20\text{ A}$		0.0041		$\Omega$
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -15\text{ V}, I_D = -20\text{ A}$		75		S
<b>Dynamic<sup>b</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		11300		pF
Output Capacitance	$C_{oss}$			1510		
Reverse Transfer Capacitance	$C_{rss}$			1000		
Total Gate Charge	$Q_g$	$V_{DS} = -20\text{ V}, V_{GS} = -10\text{ V}, I_D = -110\text{ A}$		185	280	nC
Gate-Source Charge	$Q_{gs}$			48		
Gate-Drain Charge	$Q_{gd}$			42		
Gate Resistance	$R_g$	$f = 1\text{ MHz}$		4.0		$\Omega$
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -20\text{ V}, R_L = 0.18\text{ }\Omega$ $I_D \cong -110\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$		25	40	ns
Rise Time	$t_r$			290	440	
Turn-Off Delay Time	$t_{d(off)}$			110	165	
Fall Time	$t_f$			35	55	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			- 110	A
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$				- 240	
Body Diode Voltage	$V_{SD}$	$I_S = -20\text{ A}$		- 0.8	- 1.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = -20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		70	105	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			130	200	nC
Reverse Recovery Fall Time	$t_a$			37		ns
Reverse Recovery Rise Time	$t_b$			33		

Notes:

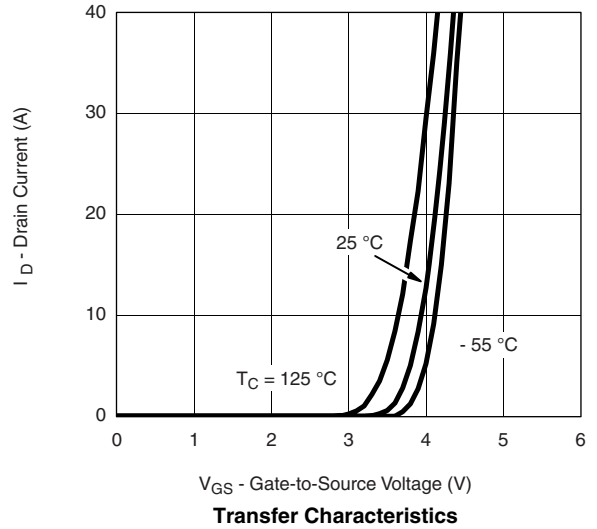
- Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

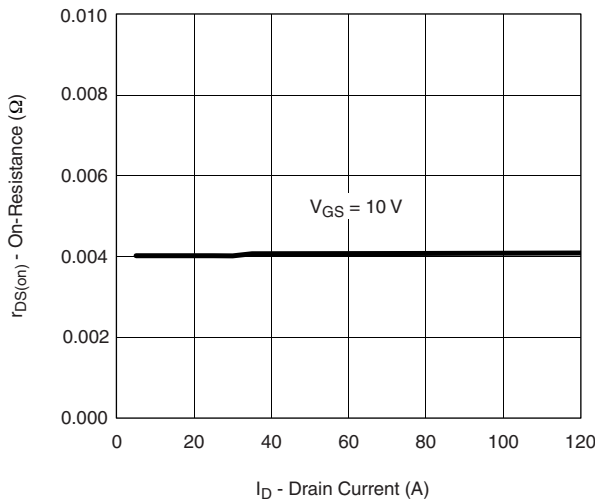
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



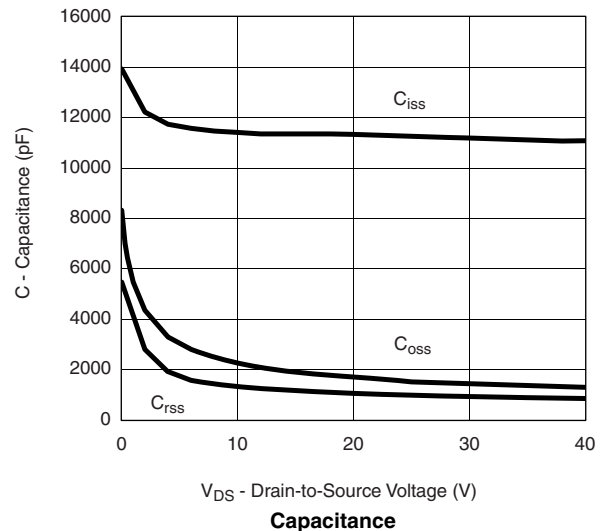
**Output Characteristics**



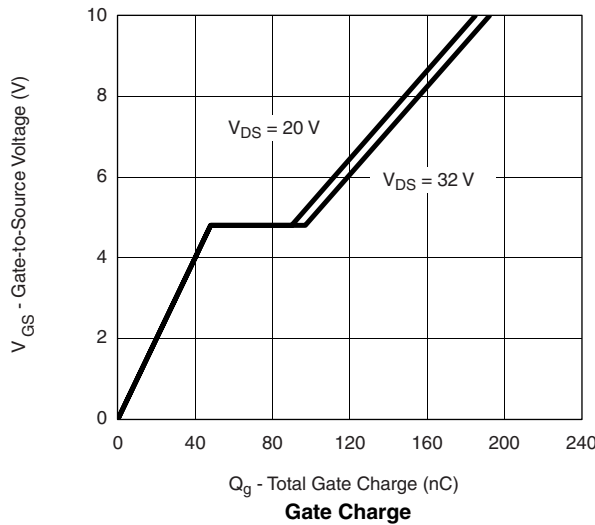
**Transfer Characteristics**



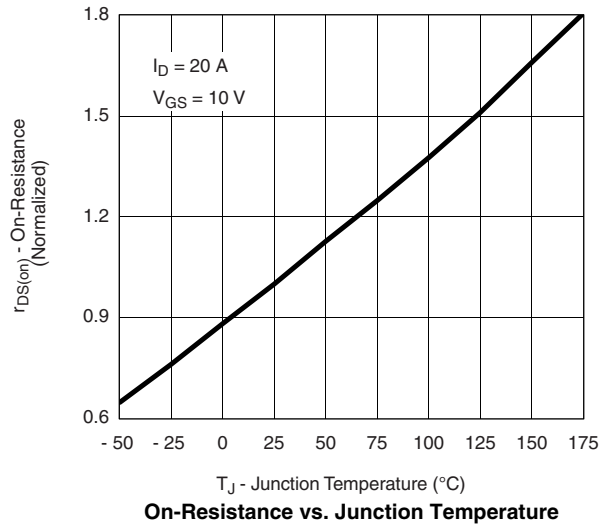
**On-Resistance vs. Drain Current**



**Capacitance**

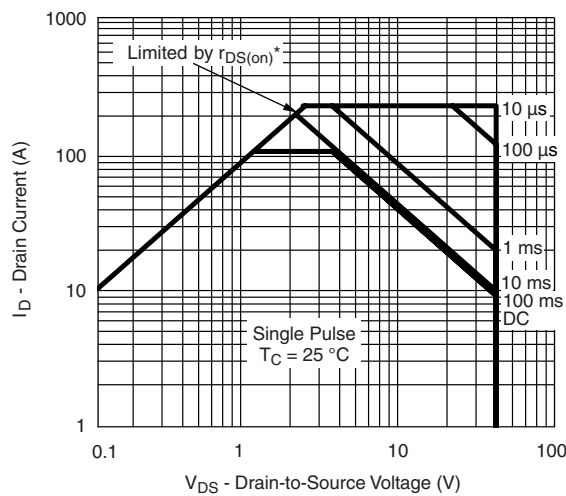
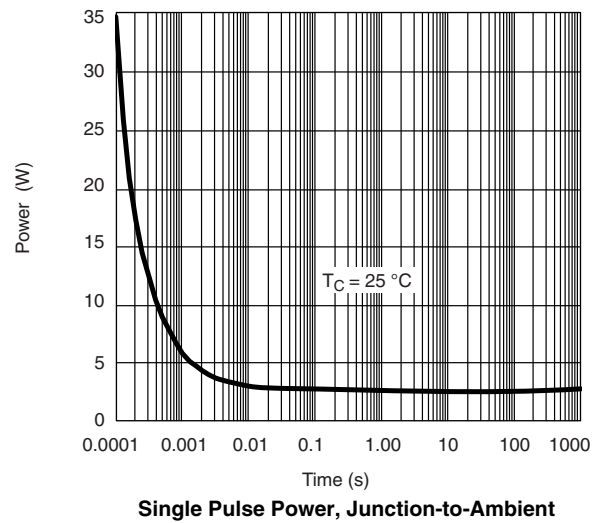
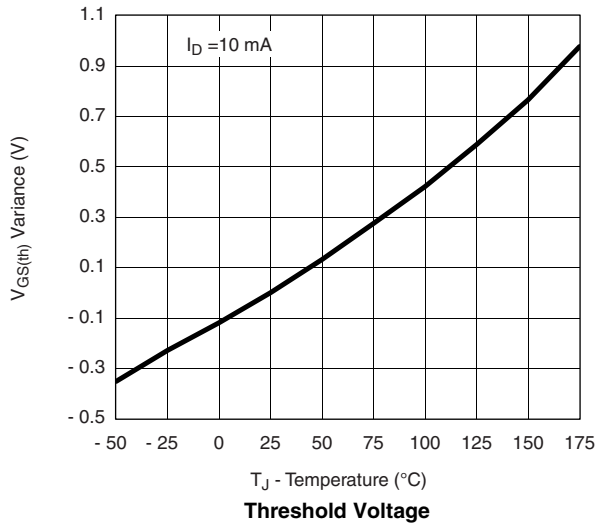
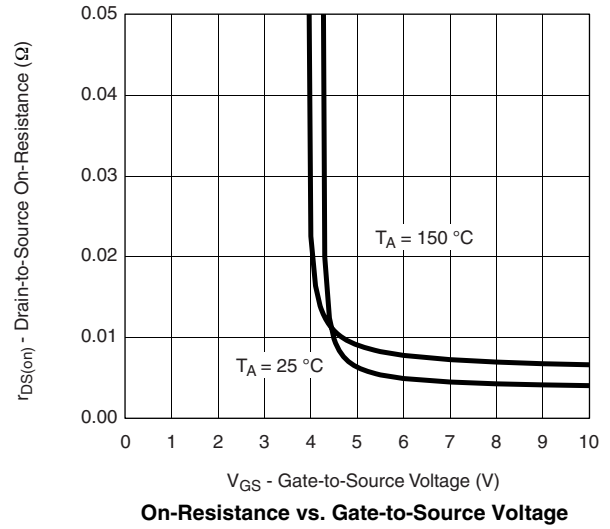
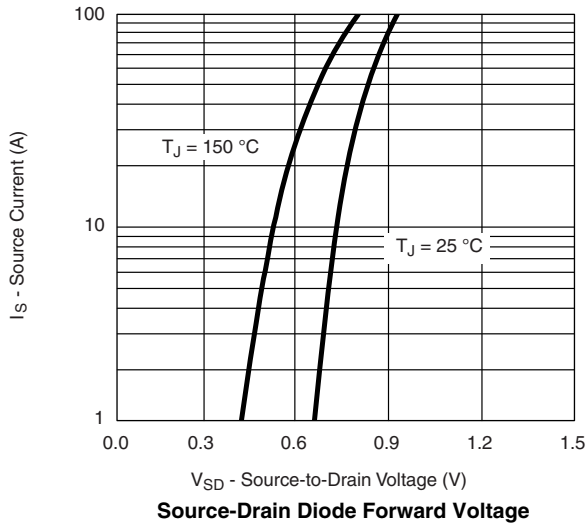


**Gate Charge**



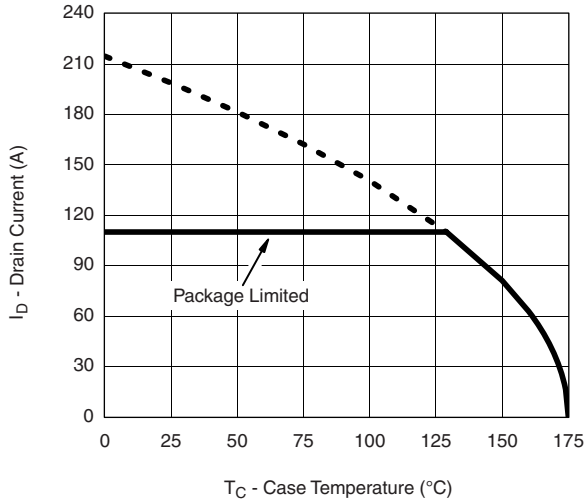
**On-Resistance vs. Junction Temperature**

**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted

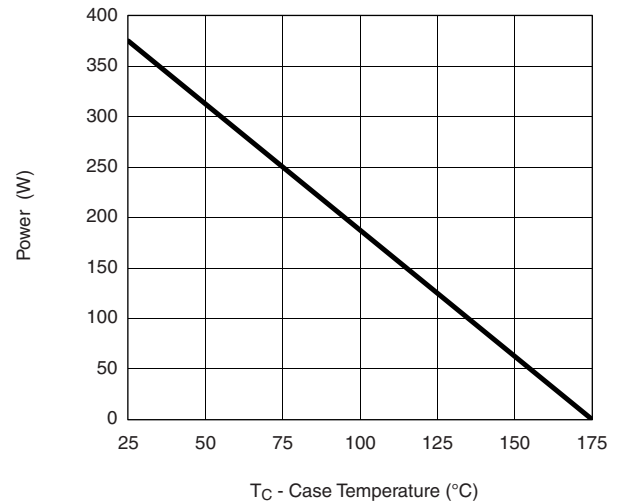


\* $V_{GS} >$  minimum  $V_{GS}$  at which  $r_{DS(on)}$  is specified

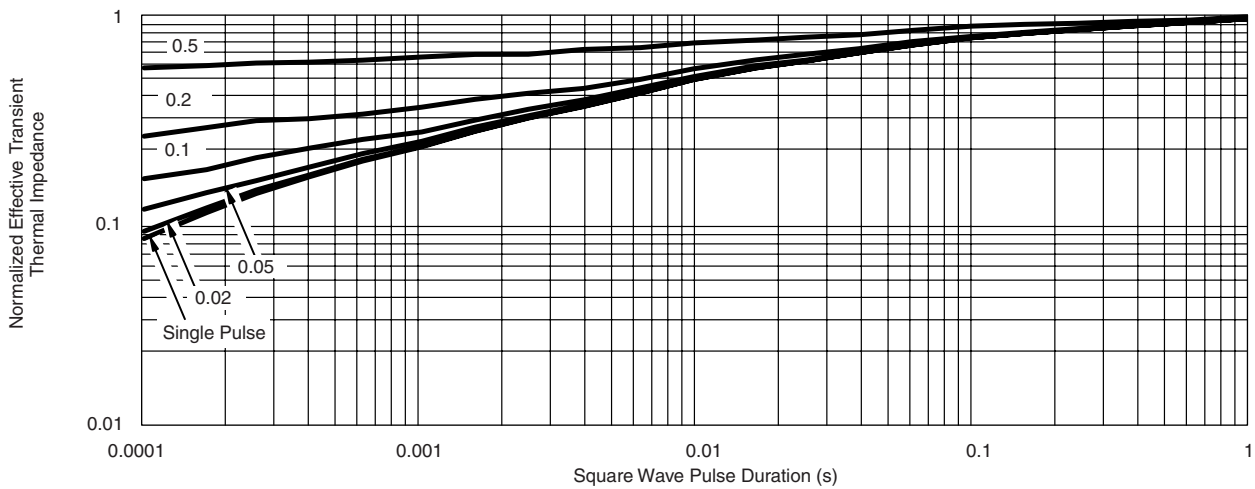
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



**Max. Avalanche and Drain Current vs. Case Temperature\***



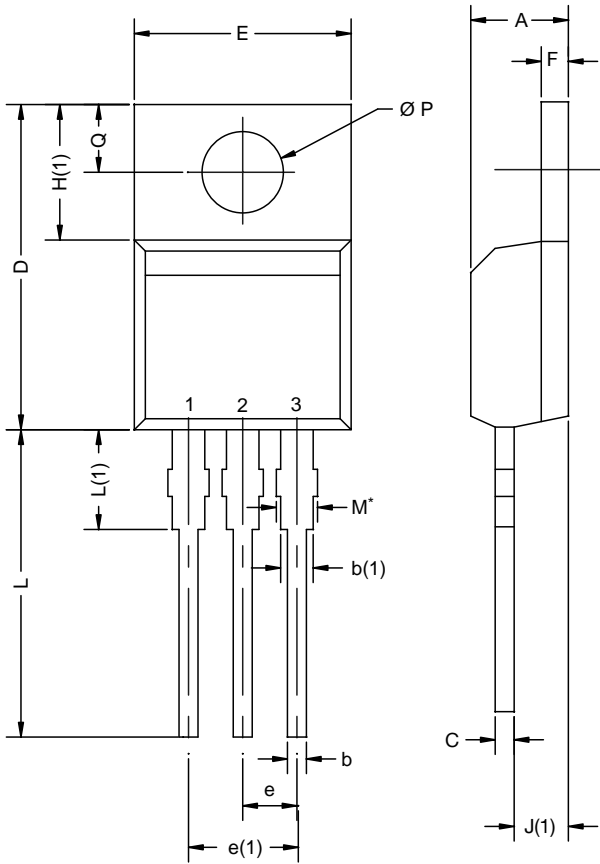
**Power Derating, Junction-to-Case**



**Normalized Thermal Transient Impedance, Junction-to-Case**

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 175\text{ °C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

### TO-220AB



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.25	4.65	0.167	0.183
b	0.69	1.01	0.027	0.040
b(1)	1.20	1.73	0.047	0.068
c	0.36	0.61	0.014	0.024
D	14.85	15.49	0.585	0.610
E	10.04	10.51	0.395	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)	6.09	6.48	0.240	0.255
J(1)	2.41	2.92	0.095	0.115
L	13.35	14.02	0.526	0.552
L(1)	3.32	3.82	0.131	0.150
Ø P	3.54	3.94	0.139	0.155
Q	2.60	3.00	0.102	0.118

ECN: X12-0208-Rev. N, 08-Oct-12  
DWG: 5471

**Notes**

\* M = 1.32 mm to 1.62 mm (dimension including protrusion)  
Heatsink hole for HVM

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