

N-Channel 60 V (D-S) MOSFET

PRODUCT SUMMARY			
V _{DS} (V)	R _{DS(on)} (Ω)	I _D (A) ^{a, e}	Q _g (Max)
60	0.024 at V _{GS} = 10 V	50	66 nC
	0.028 at V _{GS} = 4.5 V	40	

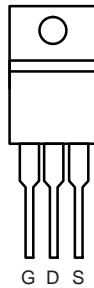
FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Surface Mount
- Available in Tape and Reel
- Dynamic dV/dt Rating
- Logic-Level Gate Drive
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC

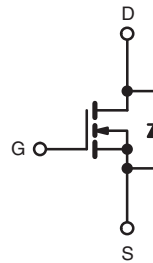


RoHS*
COMPLIANT

TO-220AB



Top View



N-Channel MOSFET

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 ^f	V _{GS} at 10 V	T _C = 25 °C	A
Continuous Drain Current		T _C = 100 °C	
Pulsed Drain Current ^a	I _{DM}	200	
Linear Derating Factor		1.0	W/°C
Linear Derating Factor (PCB Mount) ^e		0.025	
Single Pulse Avalanche Energy ^b	E _{AS}	400	mJ
Maximum Power Dissipation	P _D	T _C = 25 °C	W
Maximum Power Dissipation (PCB Mount) ^e		T _A = 25 °C	
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 ^d	

Notes

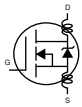
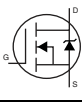
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- V_{DD} = 25 V, starting T_J = 25 °C, L = 179 μH, R_g = 25 Ω, I_{AS} = 51 A (see fig. 12).
- I_{SD} ≤ 51 A, di/dt ≤ 250 A/μs, V_{DD} ≤ V_{DS}, T_J ≤ 175 °C.
- 1.6 mm from case.
- When mounted on 1" square PCB (FR-4 or G-10 material).
- Current limited by the package, (die current = 51 A).

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	62	°C/W
Maximum Junction-to-Ambient (PCB Mount) ^a	R_{thJA}	-	40	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	1.0	

Note

a. When mounted on 1" square PCB (FR-4 or G-10 material).

SPECIFICATIONS ($T_J = 25\text{ °C}$, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0, I_D = 250\ \mu A$	60	-	-	V	
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, $I_D = 1\text{ mA}$	-	0.070	-	V/°C	
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\ \mu A$	1.0	-	2.5	V	
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 10\text{ V}$	-	-	± 100	nA	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$	-	-	25	μA	
		$V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ °C}$	-	-	250		
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	-	24	-	Ω	
		$V_{GS} = 4.5\text{ V}$	-	28	-		
Forward Transconductance	g_{fs}	$V_{DS} = 25\text{ V}, I_D = 21A^b$	23	-	-	S	
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$	-	1900	-	μF	
Output Capacitance	C_{oss}		-	920	-		
Reverse Transfer Capacitance	C_{rss}		-	170	-		
Total Gate Charge	Q_g	$V_{GS} = 5.0\text{ V}$	$I_D = 51\text{ A}, V_{DS} = 48\text{ V}, \text{ see fig. 6 and 13}^b$	-	-	66	nC
Gate-Source Charge	Q_{gs}			-	-	12	
Gate-Drain Charge	Q_{gd}			-	-	43	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 30\text{ V}, I_D = 51\text{ A}, R_g = 4.6\ \Omega, R_D = 0.56\ \Omega, \text{ see fig. 10}^b$	-	17	-	ns	
Rise Time	t_r		-	230	-		
Turn-Off Delay Time	$t_{d(off)}$		-	42	-		
Fall Time	t_f		-	110	-		
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}		-	-	200		
Body Diode Voltage	V_{SD}	$T_J = 25\text{ °C}, I_S = 51\text{ A}, V_{GS} = 0\text{ V}^b$	-	-	2.5	V	
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ °C}, I_F = 51\text{ A}, di/dt = 100\text{ A}/\mu s^b$	-	130	180	ns	
Body Diode Reverse Recovery Charge	Q_{rr}		-	0.84	1.3	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 $\leq 300\ \mu s$; duty cycle $\leq 2\%$.
- c. Current limited by the package, (Die Current = 51 A).

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

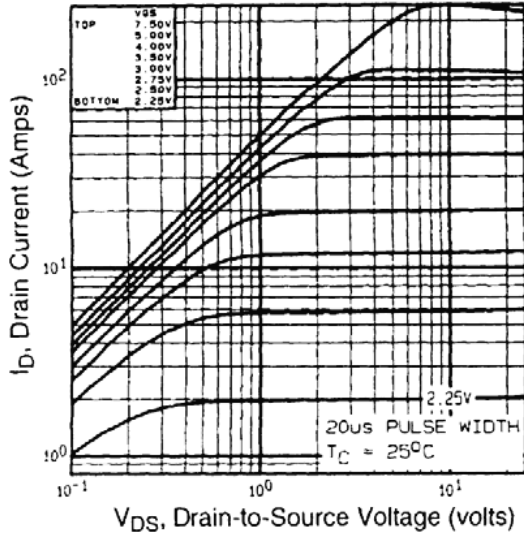


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

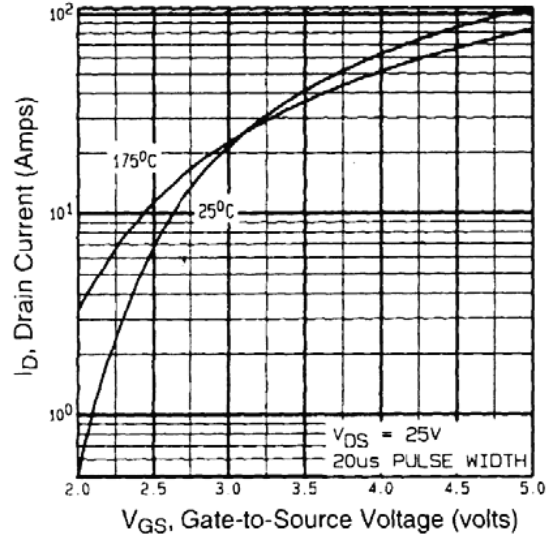


Fig. 3 - Typical Transfer Characteristics

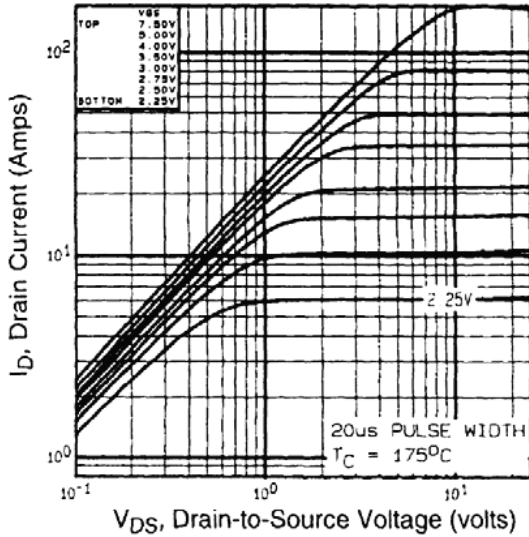


Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$

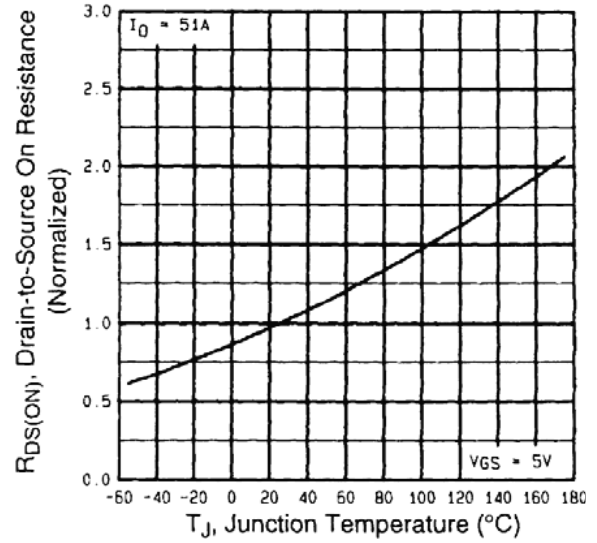


Fig. 4 - Normalized On-Resistance vs. Temperature

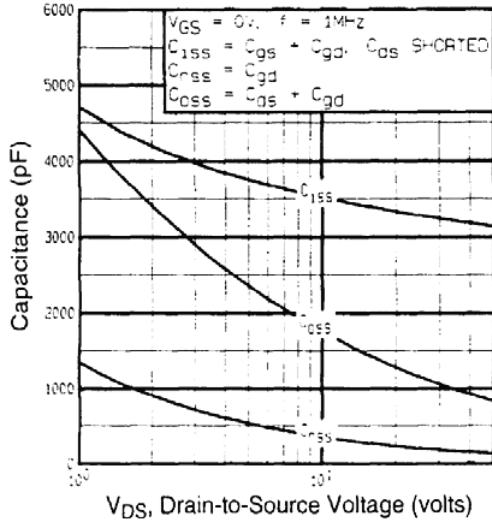


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage



Fig. 7 - Typical Source-Drain Diode Forward Voltage

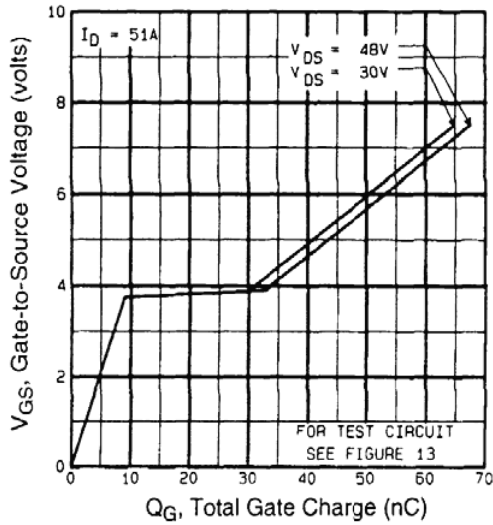


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

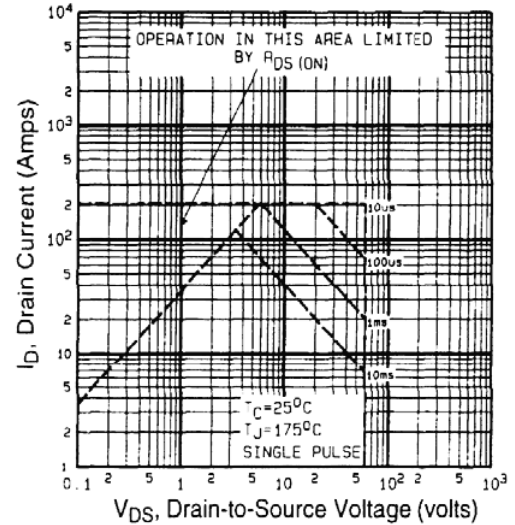


Fig. 8 - Maximum Safe Operating Area



Fig. 9 - Maximum Drain Current vs. Case Temperature

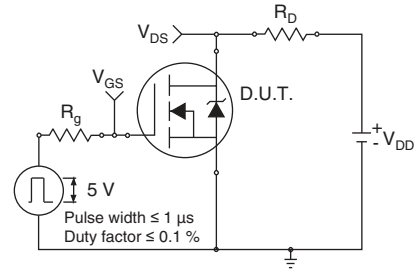


Fig. 10a - Switching Time Test Circuit

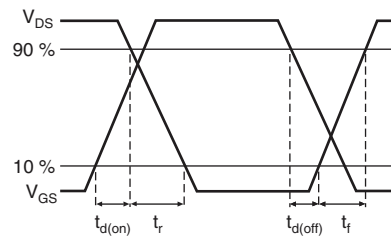


Fig. 10b - Switching Time Waveforms

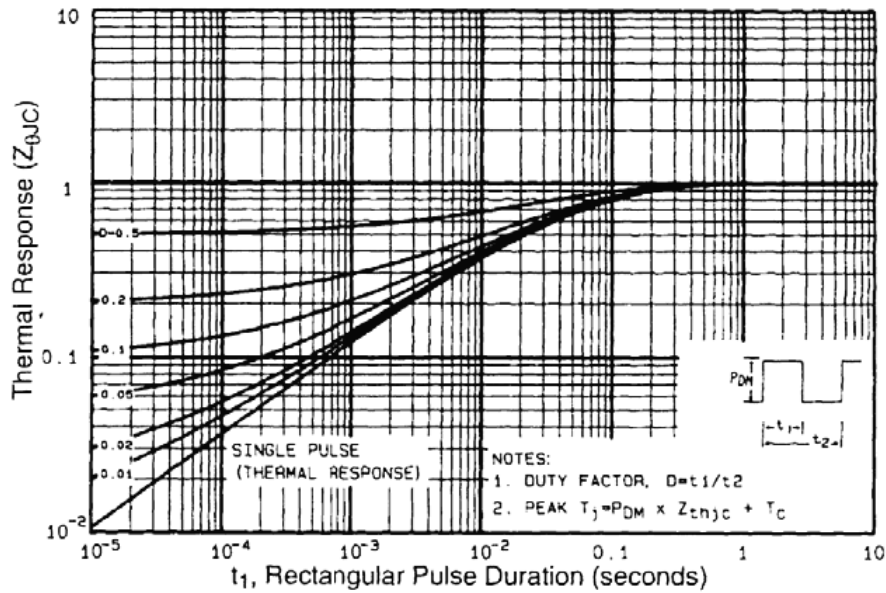


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

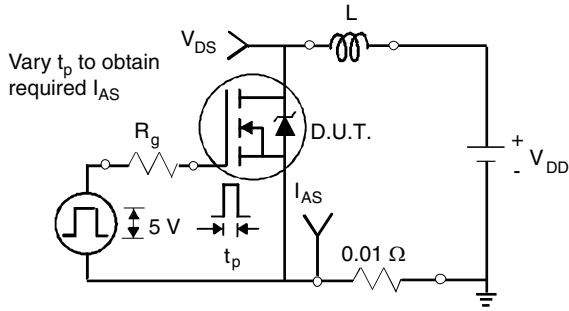


Fig. 12a - Unclamped Inductive Test Circuit

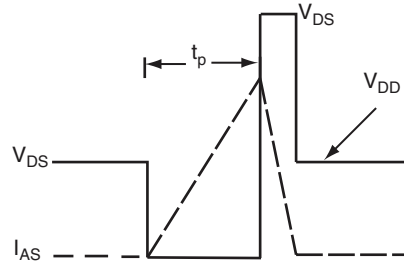


Fig. 12b - Unclamped Inductive Waveforms

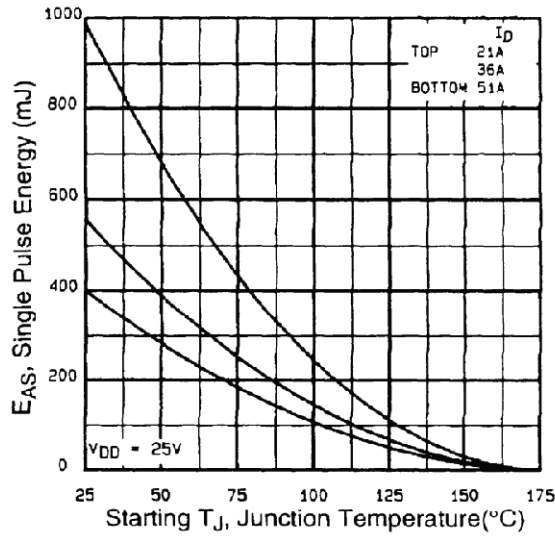


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

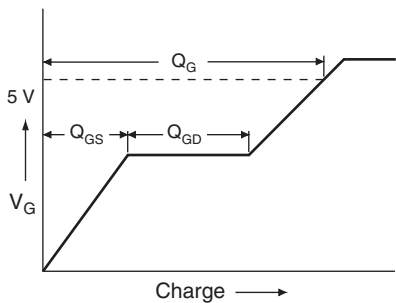


Fig. 13a - Basic Gate Charge Waveform

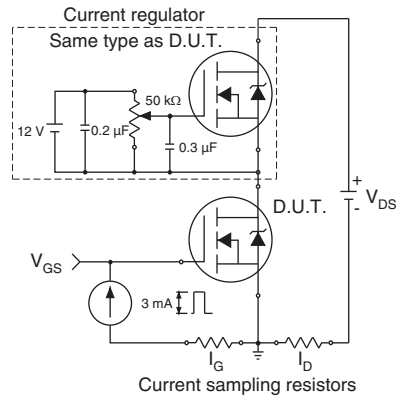
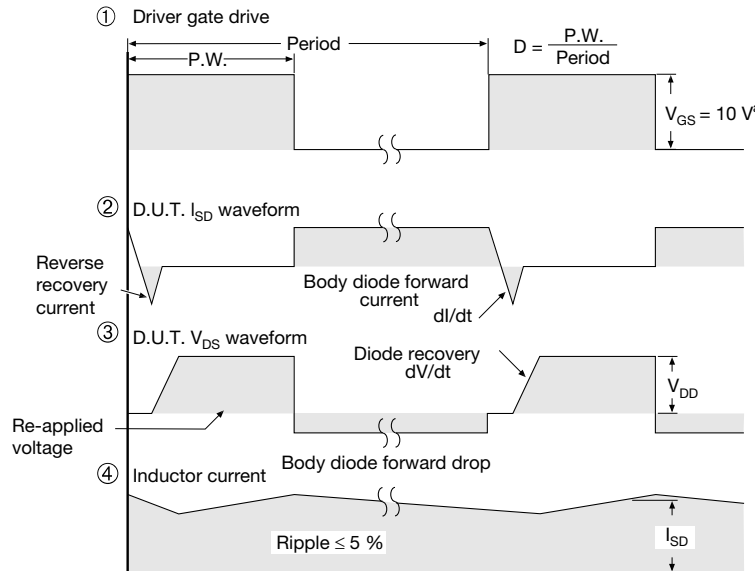
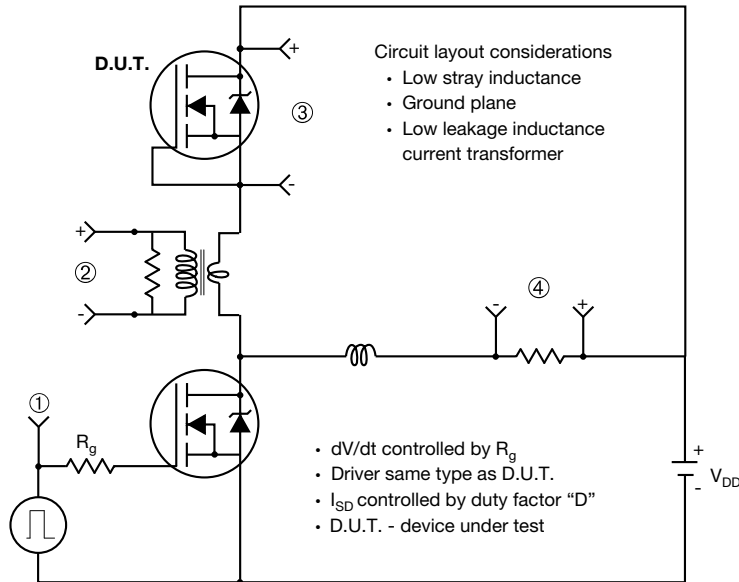


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

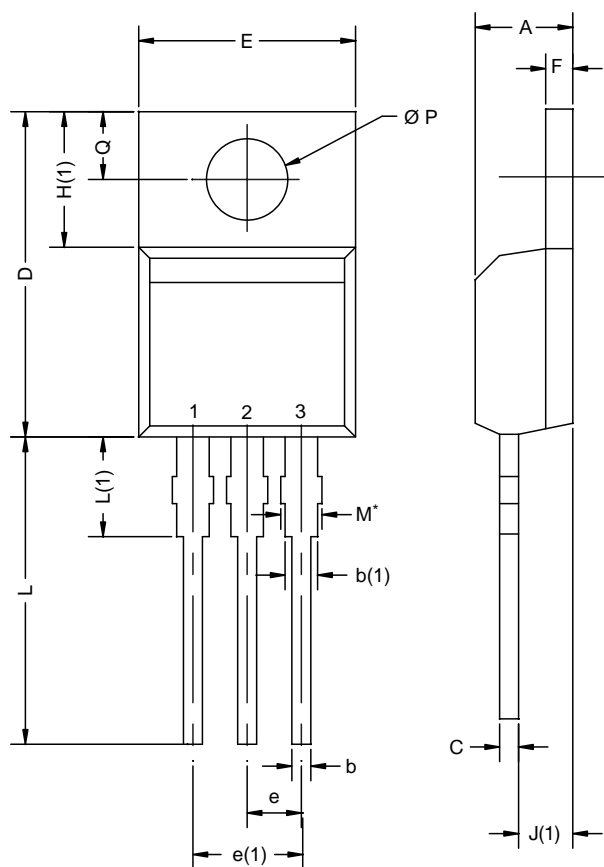


Note

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

Fig. 14 - For N-Channel

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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