

N-Channel 650 V (D-S) 175 °C MOSFET



RoHS
COMPLIANT
HALOGEN
FREE

PRODUCT SUMMARY		
V _{DS} (V) at T _J max.	650	
R _{DS(on)} max. at 25 °C (Ω)	V _{GS} = 10 V	0.106
Q _g max. (nC)	273	
Q _{gs} (nC)	46	
Q _{gd} (nC)	79	
Configuration	Single	

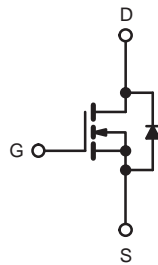
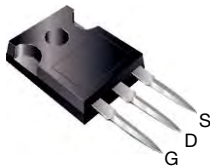
FEATURES

- Low Figure-of-Merit (FOM) R_{on} x Q_g
- Low Input Capacitance (C_{iss})
- Reduced Switching and Conduction Losses
- Ultra Low Gate Charge (Q_g)
- Avalanche Energy Rated (UIS)

APPLICATIONS

- Server and Telecom Power Supplies
- Switch Mode Power Supplies (SMPS)
- Power Factor Correction Power Supplies (PFC)
- Lighting
 - High-Intensity Discharge (HID)
 - Fluorescent Ballast Lighting
- Industrial
 - Welding
 - Induction Heating
 - Motor Drives
 - Battery Chargers
 - Renewable Energy
 - Solar (PV Inverters)

TO-247AC




N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V _{DS}	650	V
Gate-Source Voltage	V _{GS}	± 20	
Gate-Source Voltage AC (f > 1 Hz)		30	
Continuous Drain Current (T _J = 150 °C)	V _{GS} at 10 V	T _C = 25 °C	A
		T _C = 100 °C	
Pulsed Drain Current ^a	I _{DM}	139	
Linear Derating Factor		3.3	W/°C
Single Pulse Avalanche Energy ^b	E _{AS}	1410	mJ
Maximum Power Dissipation	P _D	417	W
Operating Junction and Storage Temperature Range	T _J , T _{stg}	- 55 to + 150	°C
Drain-Source Voltage Slope	dV/dt	T _J = 125 °C	V/ns
Reverse Diode dV/dt ^d		9	
Soldering Recommendations (Peak Temperature) ^c	for 10 s	300	°C

Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- V_{DD} = 50 V, starting T_J = 25 °C, L = 28.2 mH, R_g = 25 Ω, I_{AS} = 10 A.
- 1.6 mm from case.
- I_{SD} ≤ I_D, dI/dt = 100 A/μs, starting T_J = 25 °C.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	40	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.3	

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}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		650	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$		-	0.70	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		2	-	4	V
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$		-	-	1	μA
		$V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	25	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 24\text{ A}$	-	0.100	0.106	Ω
Forward Transconductance	g_{fs}	$V_{DS} = 30\text{ V}, I_D = 24\text{ A}$		-	16.7	-	S
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$		-	5682	-	μF
Output Capacitance	C_{oss}			-	251	-	
Reverse Transfer Capacitance	C_{rss}			-	1	-	
Effective Output Capacitance, Energy Related ^a	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 520\text{ V}, V_{GS} = 0\text{ V}$		-	192	-	μF
Effective Output Capacitance, Time Related ^b	$C_{o(tr)}$			-	665	-	
Total Gate Charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 24\text{ A}, V_{DS} = 520\text{ V}$	-	182	273	nC
Gate-Source Charge	Q_{gs}			-	46	-	
Gate-Drain Charge	Q_{gd}			-	79	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 520\text{ V}, I_D = 6\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$		-	47	94	ns
Rise Time	t_r			-	87	131	
Turn-Off Delay Time	$t_{d(off)}$			-	156	234	
Fall Time	t_f			-	103	206	
Gate Input Resistance	R_g	$f = 1\text{ MHz}, \text{open drain}$		-	0.64	-	Ω
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	38	A
Pulsed Diode Forward Current	I_{SM}			-	-	139	
Diode Forward Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 24\text{ A}, V_{GS} = 0\text{ V}$		-	0.9	1.2	V
Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 24\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}, V_R = 25\text{ V}$		-	753	1506	ns
Reverse Recovery Charge	Q_{rr}			-	14	28	μC
Reverse Recovery Current	I_{RRM}			-	28	-	A

Notes

- a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS} .
- b. $C_{oss(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS} .

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

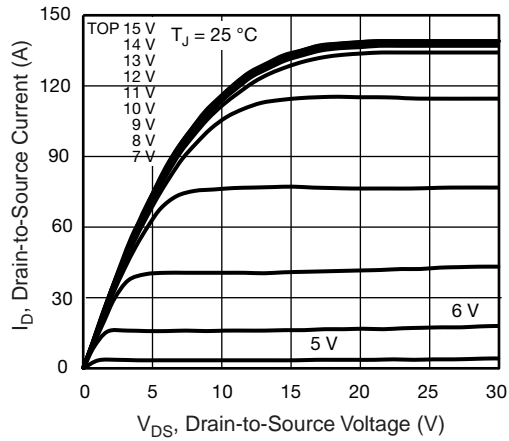


Fig. 1 - Typical Output Characteristics

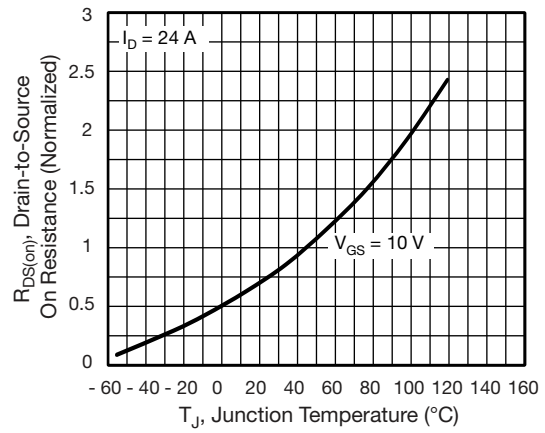


Fig. 4 - Normalized On-Resistance vs. Temperature

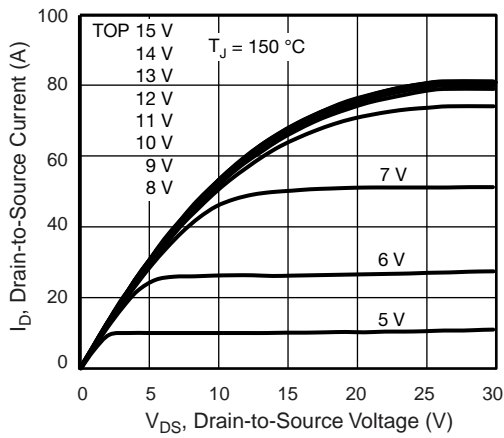


Fig. 2 - Typical Output Characteristics

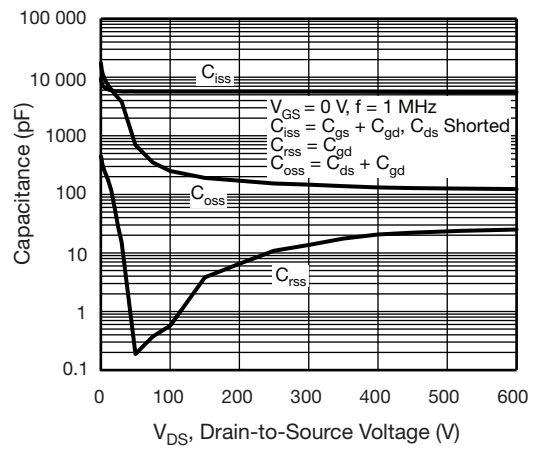


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

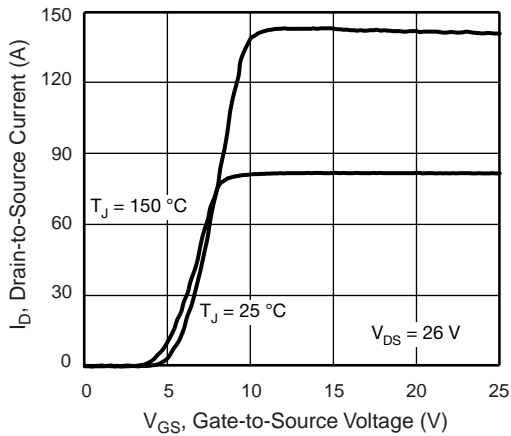


Fig. 3 - Typical Transfer Characteristics

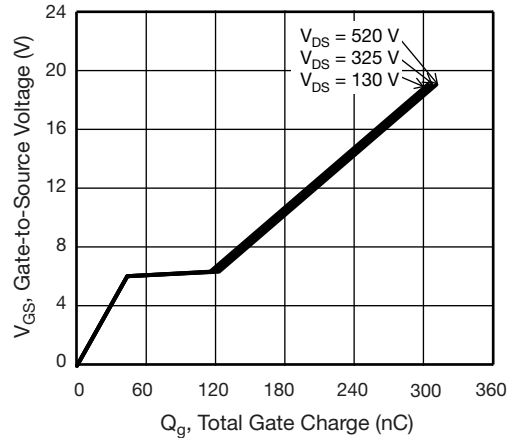


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

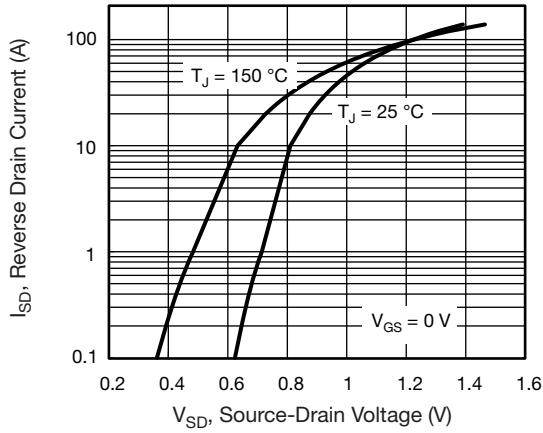


Fig. 7 - Typical Source-Drain Diode Forward Voltage

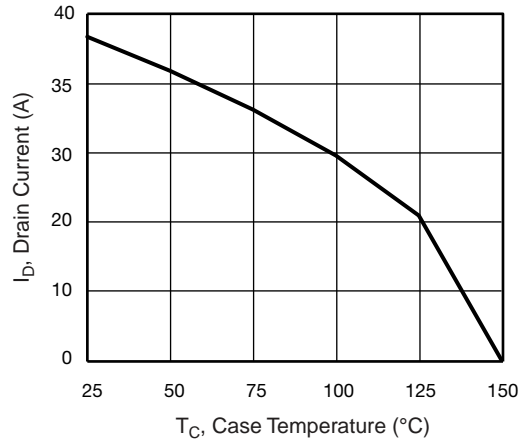


Fig. 9 - Maximum Drain Current vs. Case Temperature

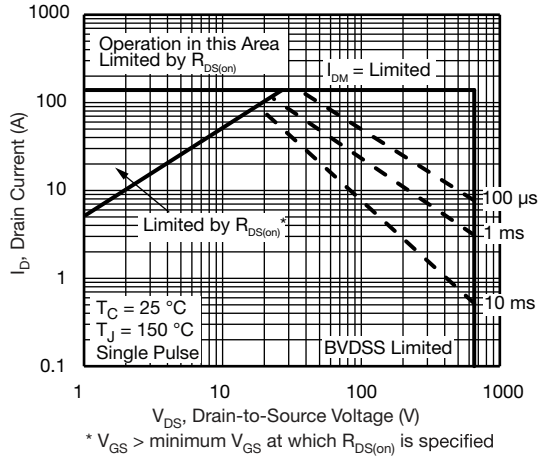


Fig. 8 - Maximum Safe Operating Area

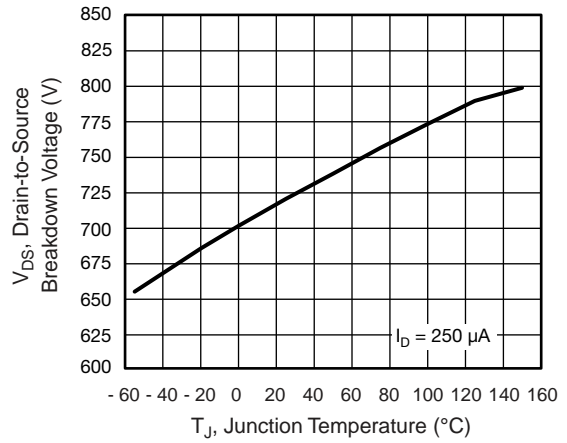


Fig. 10 - Temperature vs. Drain-to-Source Voltage

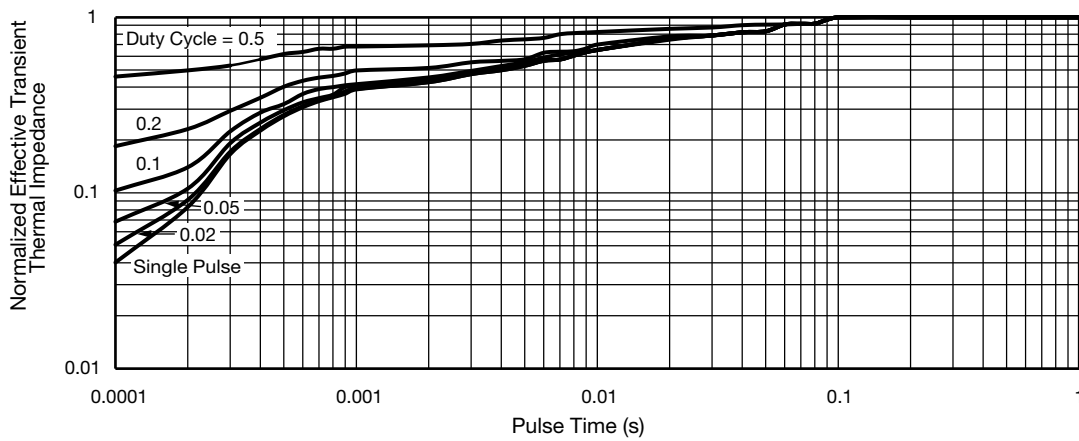


Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case

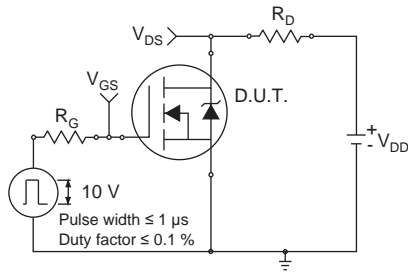


Fig. 12 - Switching Time Test Circuit

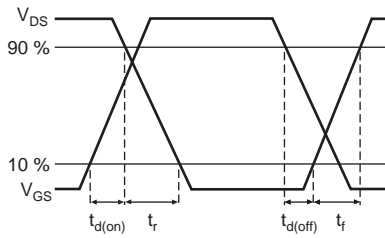


Fig. 13 - Switching Time Waveforms

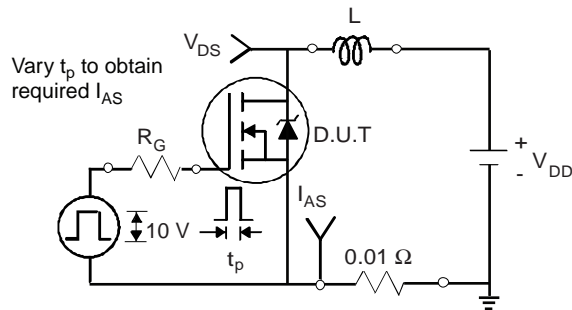


Fig. 14 - Unclamped Inductive Test Circuit

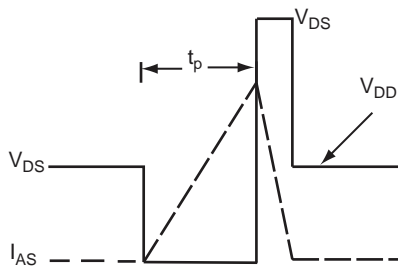


Fig. 15 - Unclamped Inductive Waveforms

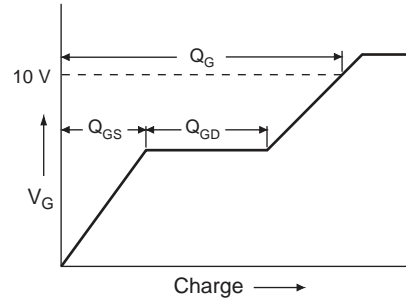


Fig. 16 - Basic Gate Charge Waveform

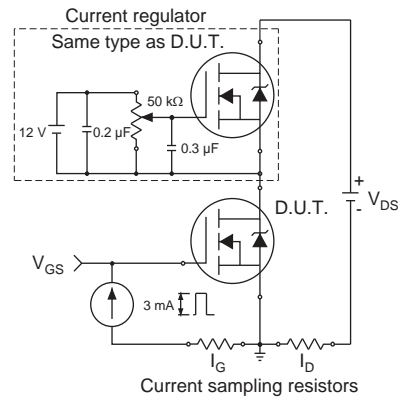
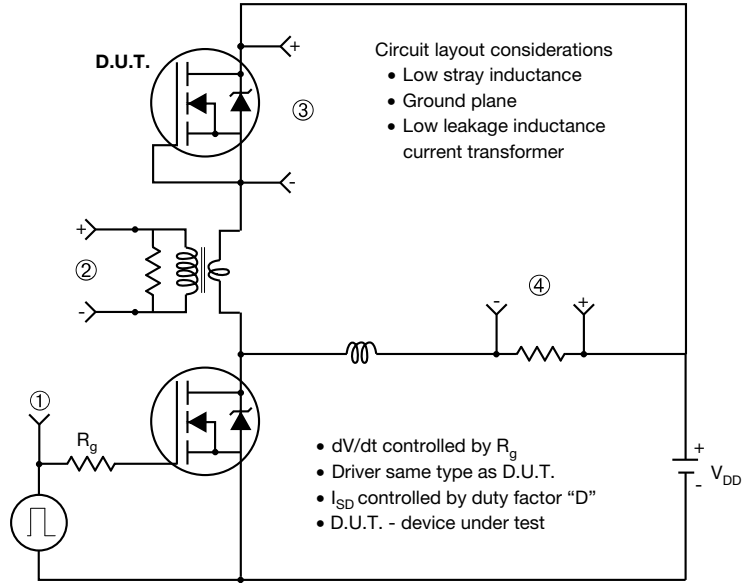


Fig. 17 - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

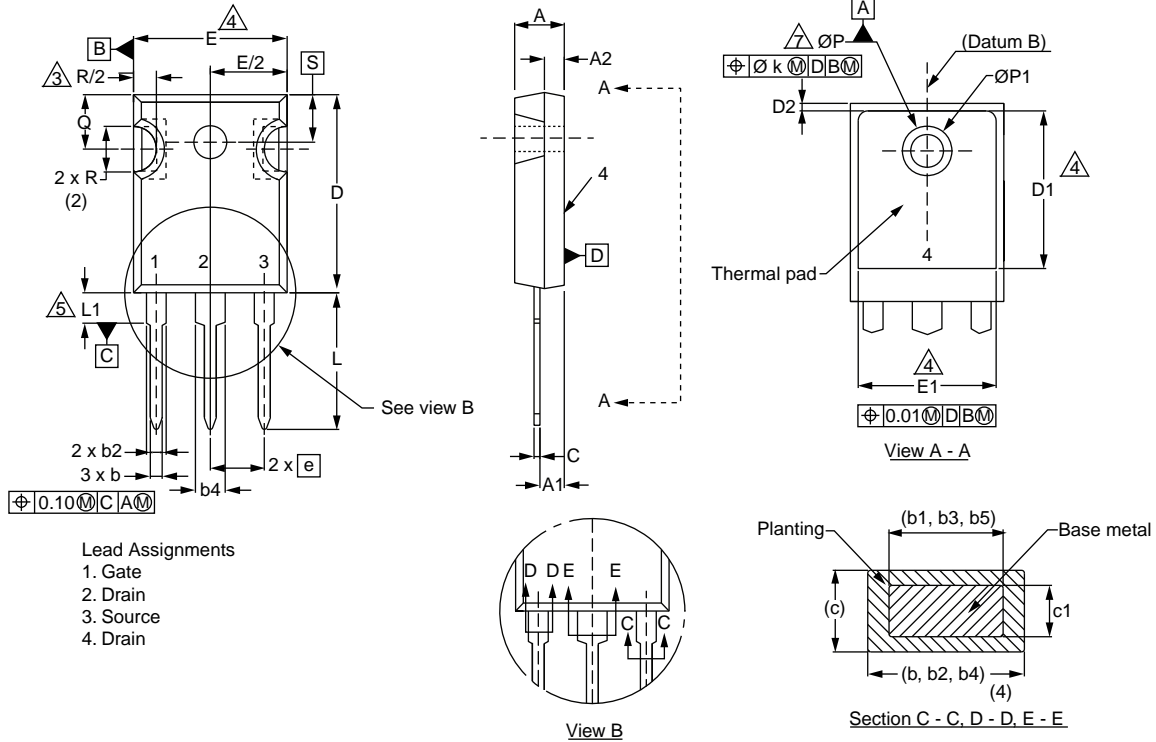


Note

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

Fig. 18 - For N-Channel

TO-247AC (High Voltage)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.58	5.31	0.180	0.209
A1	2.21	2.59	0.087	0.102
A2	1.17	2.49	0.046	0.098
b	0.99	1.40	0.039	0.055
b1	0.99	1.35	0.039	0.053
b2	1.53	2.39	0.060	0.094
b3	1.65	2.37	0.065	0.093
b4	2.42	3.43	0.095	0.135
b5	2.59	3.38	0.102	0.133
c	0.38	0.86	0.015	0.034
c1	0.38	0.76	0.015	0.030
D	19.71	20.82	0.776	0.820
D1	13.08	-	0.515	-

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D2	0.51	1.30	0.020	0.051
E	15.29	15.87	0.602	0.625
E1	13.72	-	0.540	-
e	5.46 BSC		0.215 BSC	
Ø k	0.254		0.010	
L	14.20	16.25	0.559	0.640
L1	3.71	4.29	0.146	0.169
N	7.62 BSC		0.300 BSC	
Ø P	3.51	3.66	0.138	0.144
Ø P1	-	7.39	-	0.291
Q	5.31	5.69	0.209	0.224
R	4.52	5.49	0.178	0.216
S	5.51 BSC		0.217 BSC	

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