

# MOSFET – Power, N-Channel, SUPERFET<sup>®</sup> III, Easy Drive 650 V, 12 A, 250 mΩ

## FCPF250N65S3L1-F154

### Description

SUPERFET III MOSFET is ON Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provides superior switching performance, and withstand extreme dv/dt rate.

Consequently, SUPERFET III MOSFET Easy drive series helps manage EMI issues and allows for easier design implementation.

### Features

- 700 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 210\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 24\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 248\text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

### Applications

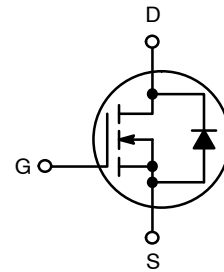
- Computing / Display Power Supplies
- Telecom / Server Power Supplies
- Industrial Power Supplies
- Lighting / Charger / Adapter



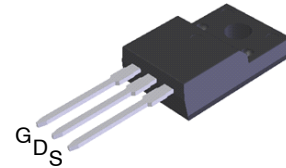
ON Semiconductor<sup>®</sup>

[www.onsemi.com](http://www.onsemi.com)

$V_{DSS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	250 mΩ @ 10 V	12 A

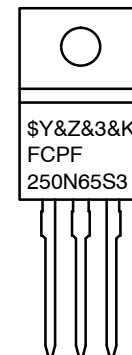


POWER MOSFET



TO-220F Ultra Narrow Lead  
CASE 221BN

### MARKING DIAGRAM



- |              |                           |
|--------------|---------------------------|
| \$Y          | = ON Semiconductor Logo   |
| &Z           | = Assembly Plant Code     |
| &3           | = Data Code (Year & Week) |
| &K           | = Lot                     |
| FCPF250N65S3 | = Specific Device Code    |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# FCPF250N65S3L1–F154

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, Unless otherwise noted)

Symbol	Parameter	Value	Unit
V <sub>DSS</sub>	Drain to Source Voltage	650	V
V <sub>GSS</sub>	Gate to Source Voltage	– DC	±30
		– AC (f > 1 Hz)	±30
I <sub>D</sub>	Drain Current	– Continuous (T <sub>C</sub> = 25°C)	12*
		– Continuous (T <sub>C</sub> = 100°C)	7.6*
I <sub>DM</sub>	Drain Current	– Pulsed (Note 1)	30*
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	57	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)	2.3	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	0.31	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt (Note 3)	20	
P <sub>D</sub>	Power Dissipation	(T <sub>C</sub> = 25°C)	31
		– Derate Above 25°C	0.25
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	–55 to +150	°C
T <sub>L</sub>	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 seconds	300	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

\*Drain current limited by maximum junction temperature.

1. Repetitive rating; pulse-width limited by maximum junction temperature.
2. I<sub>AS</sub> = 2.3 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> ≤ 6 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 400 V, starting T<sub>J</sub> = 25°C.

## THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case, Max.	4.07	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max.	62.5	

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
FCPF250N65S3L1	FCPF250N65S3	TO–220F	Tube	N/A	N/A	50 Units

# FCPF250N65S3L1–F154

## ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C	650			V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C	700			V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, Referenced to 25°C		0.67		V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V			1	μA
		V <sub>DS</sub> = 520 V, T <sub>C</sub> = 125°C		0.77		
I <sub>GSS</sub>	Gate to Source Leakage Current	V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V			±100	nA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 0.29 mA	2.5		4.5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6 A		210	250	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 6 A		7.4		S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 1 MHz		1010		pF
C <sub>oss</sub>	Output Capacitance			25		pF
C <sub>oss(eff.)</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V		248		pF
C <sub>oss(er.)</sub>	Energy Related Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V		33		pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10 V	V <sub>DS</sub> = 400 V, I <sub>D</sub> = 6 A, V <sub>GS</sub> = 10 V (Note 4)		24		nC
Q <sub>gs</sub>	Gate to Source Gate Charge			6.1		nC
Q <sub>gd</sub>	Gate to Drain "Miller" Charge			9.7		nC
ESR	Equivalent Series Resistance	f = 1 MHz		8.7		Ω

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400 V, I <sub>D</sub> = 6 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 4.7 Ω (Note 4)		18		ns
t <sub>r</sub>	Turn-On Rise Time			18		ns
t <sub>d(off)</sub>	Turn-Off Delay Time			49		ns
t <sub>f</sub>	Turn-Off Fall Time			12		ns

### SOURCE-DRAIN DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Source to Drain Diode Forward Current			12		A
I <sub>SM</sub>	Maximum Pulsed Source to Drain Diode Forward Current			30		A
V <sub>SD</sub>	Source to Drain Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 6 A		1.2		V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>DD</sub> = 400 V, I <sub>SD</sub> = 6 A, dI <sub>F</sub> /dt = 100 A/μs		251		ns
Q <sub>rr</sub>	Reverse Recovery Charge			3.4		μC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Essentially independent of operating temperature typical characteristics.

TYPICAL PERFORMANCE CHARACTERISTICS



Figure 1. On-Region Characteristics

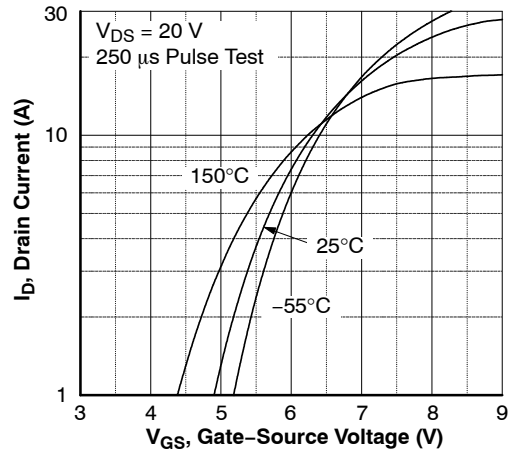


Figure 2. Transfer Characteristics



Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

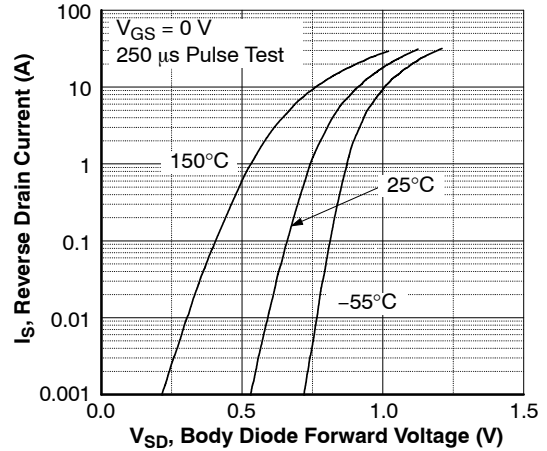


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature



Figure 5. Capacitance Characteristics

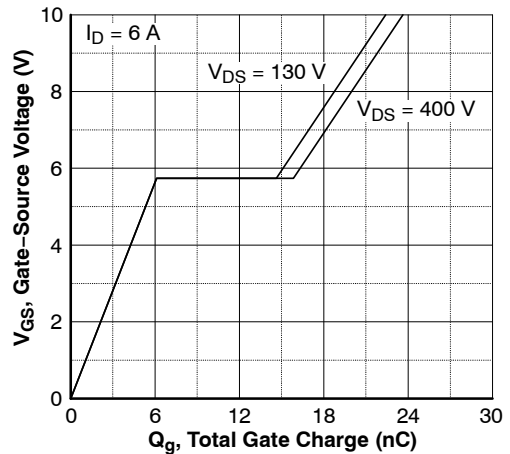


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

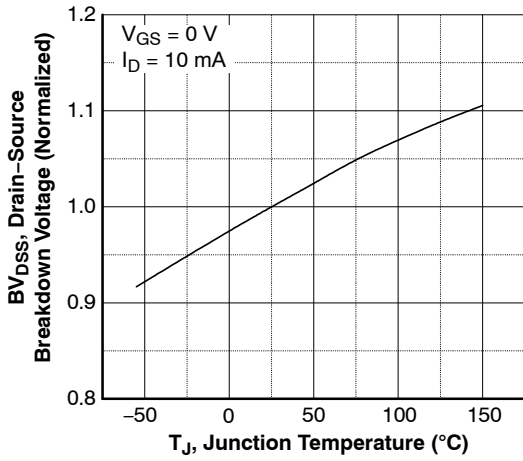


Figure 7. Breakdown Voltage Variation vs. Temperature

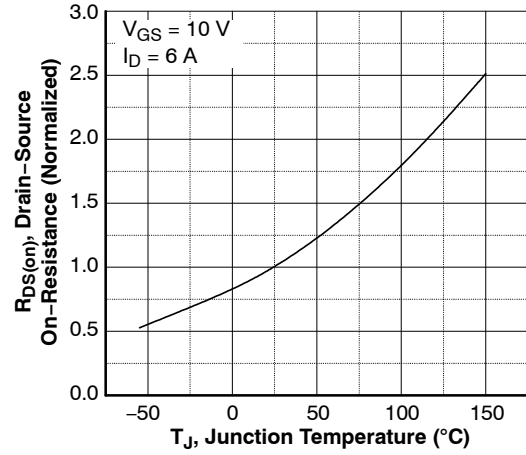


Figure 8. On-Resistance Variation vs. Temperature

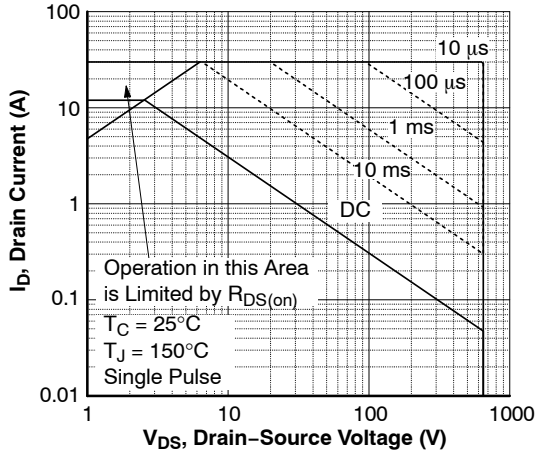


Figure 9. Maximum Safe Operating Area

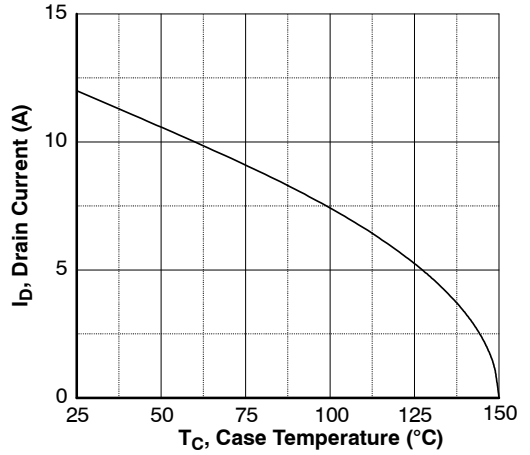


Figure 10. Maximum Drain Current vs. Case Temperature

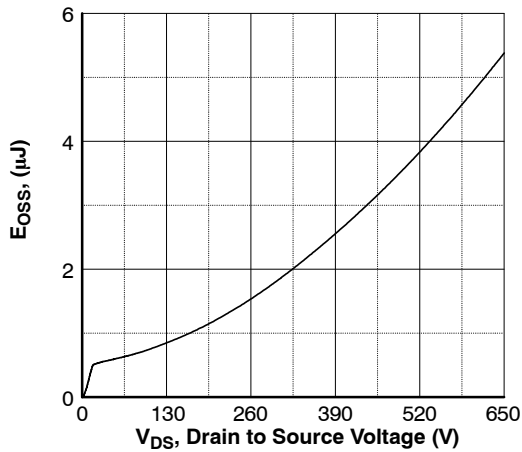


Figure 11. E<sub>OSS</sub> vs. Drain to Source Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

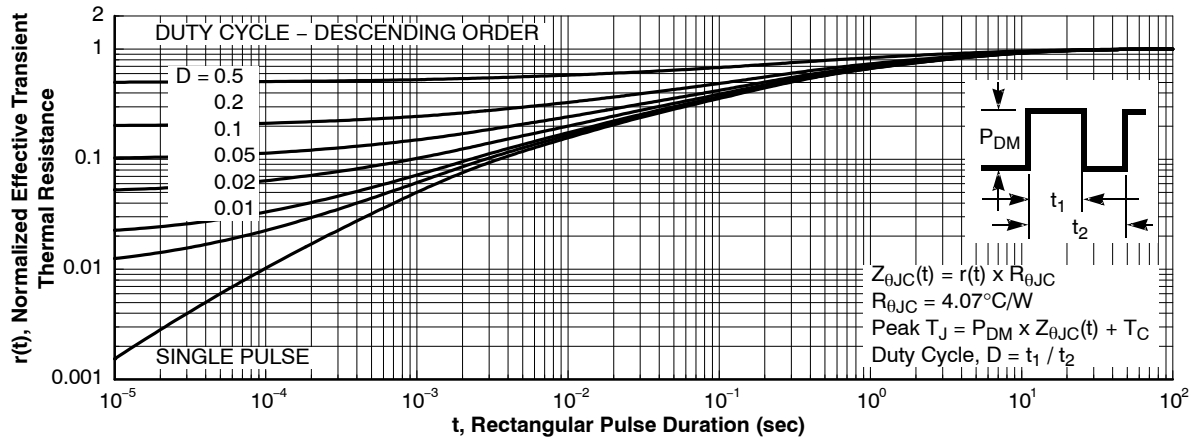


Figure 12. Transient Thermal Response Curve



Figure 13. Gate Charge Test Circuit & Waveform

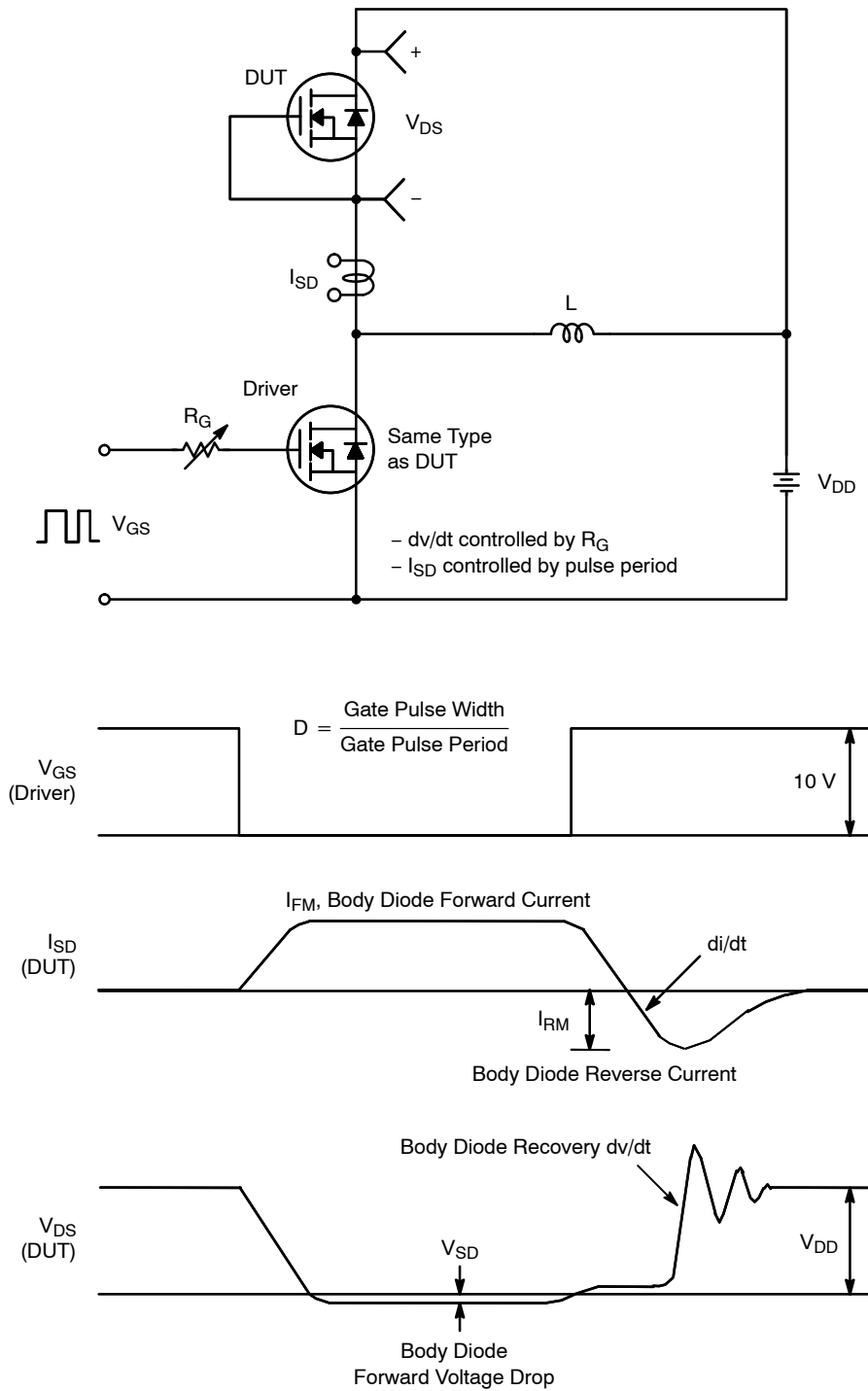


Figure 14. Resistive Switching Test Circuit & Waveforms



Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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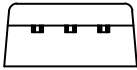
**Figure 16. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms**



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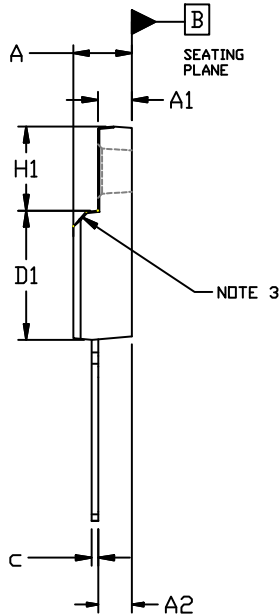
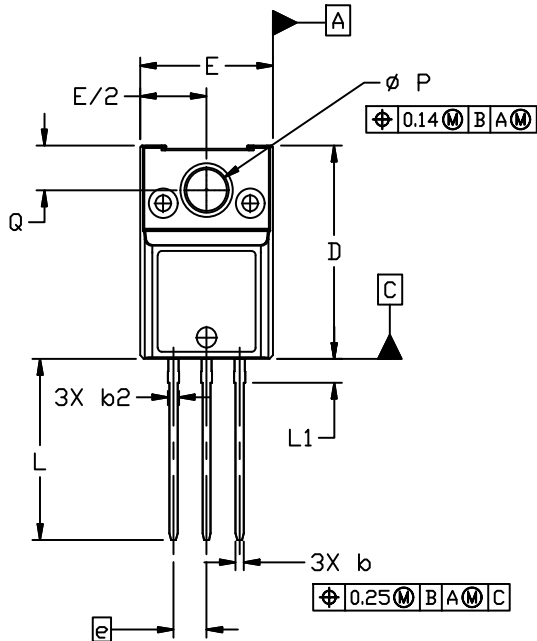
## PACKAGE DIMENSIONS

### TO-220 FULLPACK, 3-LEAD CASE 221BN ISSUE O



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. CONTOUR UNCONTROLLED IN THIS AREA.
4. DIMENSIONS EXCLUDE BURRS, MOLD FLASH, AND TIE BAR PROTRUSIONS.



DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.60	4.70	4.80
A1	2.50	2.60	2.70
A2	2.47	2.57	2.67
b	0.56	0.63	0.69
b2	---	---	0.90
c	0.46	0.53	0.59
D	15.80	16.00	16.20
D1	9.58	9.68	9.78
E	10.00	10.20	10.40
e	2.54 BSC		
H1	6.32 REF		
L	13.45	13.60	13.75
L1	1.70	1.80	1.90
P	3.00	3.10	3.20
Q	3.25	3.35	3.45

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