

NPN Silicon Power Darlington

High Voltage Autoprotected
D²PAK for Surface Mount

BUB323Z

The BUB323Z is a planar, monolithic, high-voltage power Darlington with a built-in active zener clamping circuit. This device is specifically designed for unclamped, inductive applications such as Electronic Ignition, Switching Regulators and Motor Control.

Features

- Integrated High-Voltage Active Clamp
- Tight Clamping Voltage Window (350 V to 450 V) Guaranteed Over the -40°C to +125°C Temperature Range
- Clamping Energy Capability 100% Tested in a Live Ignition Circuit
- High DC Current Gain/Low Saturation Voltages Specified Over Full Temperature Range
- Design Guarantees Operation in SOA at All Times
- NJV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

MAXIMUM RATINGS

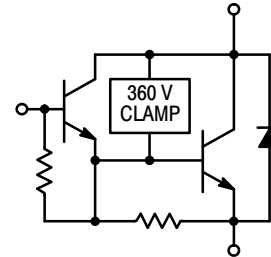
Rating	Symbol	Value	Unit
Collector-Emitter Sustaining Voltage	V_{CEO}	350	Vdc
Collector-Emitter Voltage	V_{EBO}	6.0	Vdc
Collector Current – Continuous	I_C	10	Adc
– Peak	I_{CM}	20	
Base Current – Continuous	I_B	3.0	Adc
– Peak	I_{BM}	6.0	
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	150 1.0	W W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +175	°C

THERMAL CHARACTERISTICS

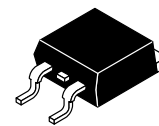
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.0	°C/W
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8 in from Case for 5 Seconds	T_L	260	°C

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.

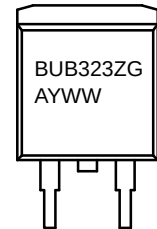
AUTOPROTECTED
DARLINGTON
10 AMPERES
360–450 VOLTS CLAMP
150 WATTS



MARKING DIAGRAM



D²PAK
CASE 418B
STYLE 1



BUB323Z = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 6.

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS (Note 1)

Collector-Emitter Clamping Voltage ($I_C = 7.0\text{ A}$) ($T_C = -40^\circ\text{C}$ to $+125^\circ\text{C}$)	V_{CLAMP}	350	–	450	Vdc
Collector-Emitter Cutoff Current ($V_{CE} = 200\text{ V}$, $I_B = 0$)	I_{CEO}	–	–	100	μAdc
Emitter-Base Leakage Current ($V_{EB} = 6.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	–	–	50	mAdc

ON CHARACTERISTICS (Note 1)

Base-Emitter Saturation Voltage ($I_C = 8.0\text{ Adc}$, $I_B = 100\text{ mAdc}$) ($I_C = 10\text{ Adc}$, $I_B = 0.25\text{ Adc}$)	$V_{BE(sat)}$	– –	– –	2.2 2.5	Vdc
Collector-Emitter Saturation Voltage ($I_C = 7.0\text{ Adc}$, $I_B = 70\text{ mAdc}$) ($I_C = 8.0\text{ Adc}$, $I_B = 0.1\text{ Adc}$) ($I_C = 10\text{ Adc}$, $I_B = 0.25\text{ Adc}$)	$V_{CE(sat)}$	– – – –	– – – –	1.6 1.8 1.8 2.1 1.7	Vdc
Base-Emitter On Voltage ($I_C = 5.0\text{ Adc}$, $V_{CE} = 2.0\text{ Vdc}$) ($I_C = 8.0\text{ Adc}$, $V_{CE} = 2.0\text{ Vdc}$)	$V_{BE(on)}$	1.1 1.3	– –	2.1 2.3	Vdc
Diode Forward Voltage Drop ($I_F = 10\text{ Adc}$)	V_F	–	–	2.5	Vdc
DC Current Gain ($I_C = 6.5\text{ Adc}$, $V_{CE} = 1.5\text{ Vdc}$) ($I_C = 5.0\text{ Adc}$, $V_{CE} = 4.6\text{ Vdc}$)	h_{FE}	150 500	– –	– 3400	–

DYNAMIC CHARACTERISTICS

Current Gain Bandwidth ($I_C = 0.2\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ MHz}$)	f_T	–	–	2.0	MHz
Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	C_{ob}	–	–	200	pF
Input Capacitance ($V_{EB} = 6.0\text{ V}$)	C_{ib}	–	–	550	pF

CLAMPING ENERGY (See Notes)

Repetitive Non-Destructive Energy Dissipated at turn-off: ($I_C = 7.0\text{ A}$, $L = 8.0\text{ mH}$, $R_{BE} = 100\ \Omega$) (see Figures 2 and 4)	W_{CLAMP}	200	–	–	mJ
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SWITCHING CHARACTERISTICS: Inductive Load ($L = 10\text{ mH}$)

Fall Time	$(I_C = 6.5\text{ A}$, $I_{B1} = 45\text{ mA}$, $V_{BE(off)} = 0$, $R_{BE(off)} = 0$, $V_{CC} = 14\text{ V}$, $V_Z = 300\text{ V}$)	t_{fi}	–	625	–	ns
Storage Time		t_{si}	–	10	30	μs
Cross-over Time		t_c	–	1.7	–	μs

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.

1. Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle = 2.0%.

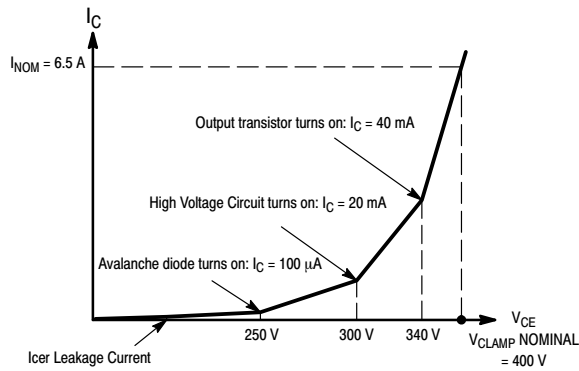


Figure 1. $I_C = f(V_{CE})$ Curve Shape

By design, the BU323Z has a built-in avalanche diode and a special high voltage driving circuit. During an auto-protect cycle, the transistor is turned on again as soon as a voltage, determined by the zener threshold and the network, is reached. This prevents the transistor from going into a Reverse Bias Operating limit condition. Therefore, the device will have an extended safe operating area and will always appear to be in "FBSOA." Because of the built-in zener and associated network, the $I_C = f(V_{CE})$ curve exhibits an unfamiliar shape compared to standard products as shown in Figure 1.

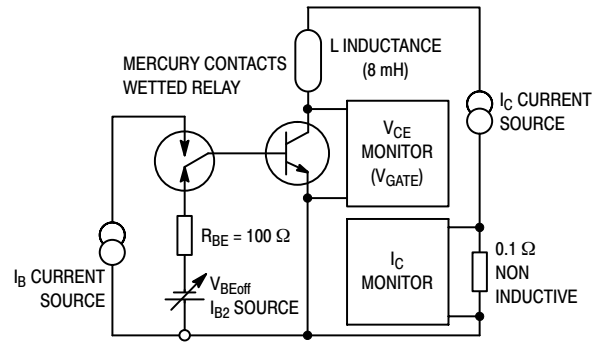


Figure 2. Basic Energy Test Circuit

The bias parameters, V_{CLAMP} , I_{B1} , $V_{BE(off)}$, I_{B2} , I_C , and the inductance, are applied according to the Device Under Test (DUT) specifications. V_{CE} and I_C are monitored by the test system while making sure the load line remains within the limits as described in Figure 4.

Note: All BU323Z ignition devices are 100% energy tested, per the test circuit and criteria described in Figures 2 and 4, to the minimum guaranteed repetitive energy, as specified in the device parameter section. The device can sustain this energy on a repetitive basis without degrading any of the specified electrical characteristics of the devices. The units under test are kept functional during the complete test sequence for the test conditions described:

$I_{C(peak)} = 7.0$ A, $I_{CH} = 5.0$ A, $I_{CL} = 100$ mA, $I_B = 100$ mA, $R_{BE} = 100$ Ω, $V_{gate} = 280$ V, $L = 8.0$ mH

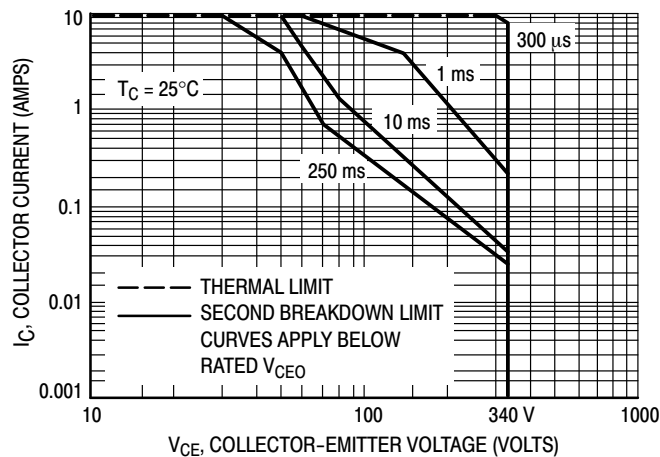
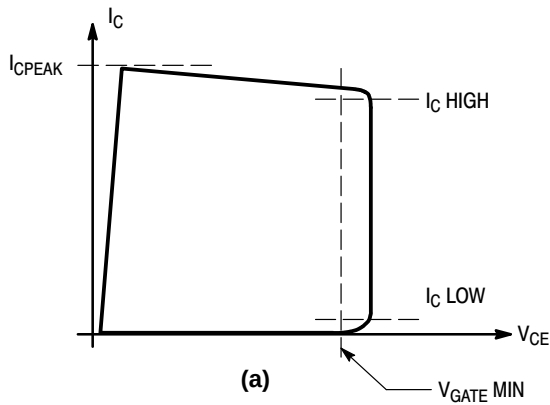
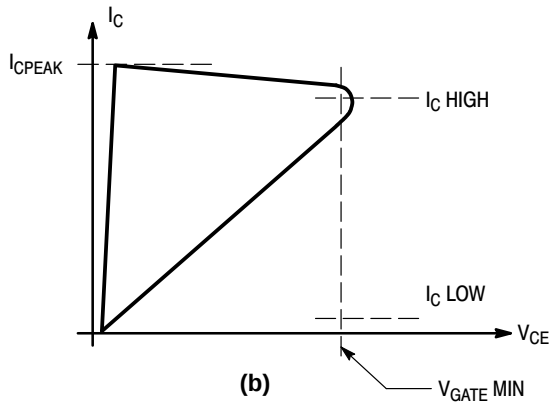


Figure 3. Forward Bias Safe Operating Area

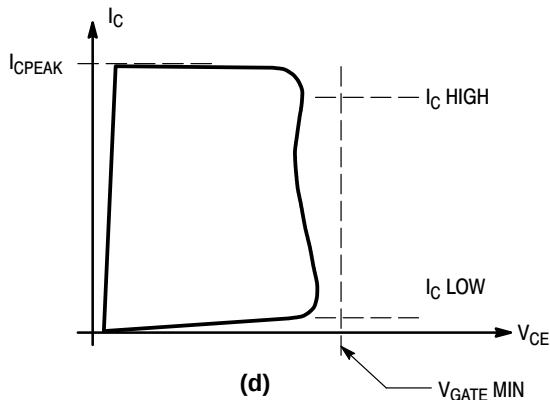
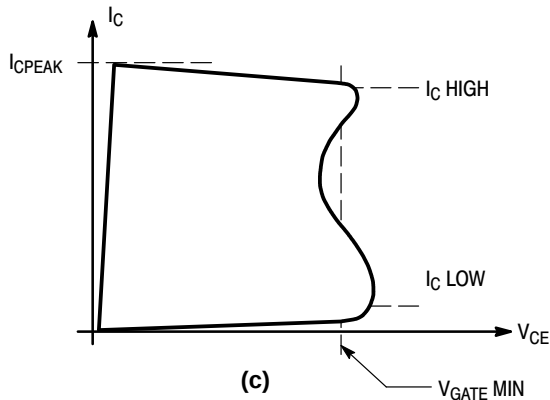


The shaded area represents the amount of energy the device can sustain, under given DC biases ($I_C/I_B/V_{BE(off)}/R_{BE}$), without an external clamp; see the test schematic diagram, Figure 2.

The transistor **PASSES** the Energy test if, for the inductive load and $I_{CPEAK}/I_B/V_{BE(off)}$ biases, the V_{CE} remains outside the shaded area and greater than the V_{GATE} minimum limit, Figure 4a.



The transistor **FAILS** if the V_{CE} is less than the V_{GATE} (minimum limit) at any point along the V_{CE}/I_C curve as shown on Figures 4b, and 4c. This assures that hot spots and uncontrolled avalanche are not being generated in the die, and the transistor is not damaged, thus enabling the sustained energy level required.



The transistor **FAILS** if its Collector/Emitter breakdown voltage is less than the V_{GATE} value, Figure 4d.

Figure 4. Energy Test Criteria for BU323Z

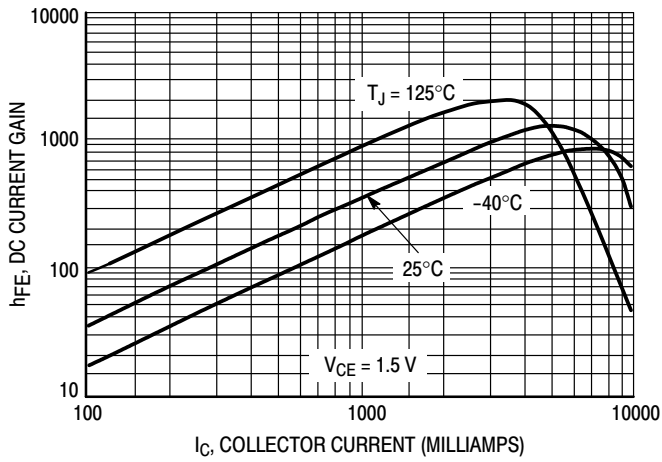


Figure 5. DC Current Gain

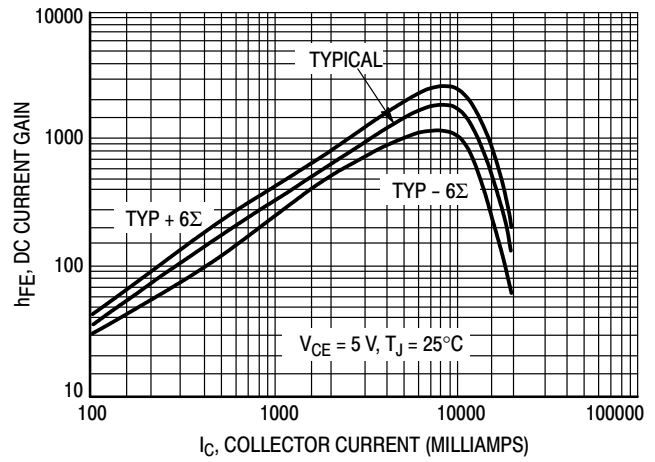


Figure 6. DC Current Gain

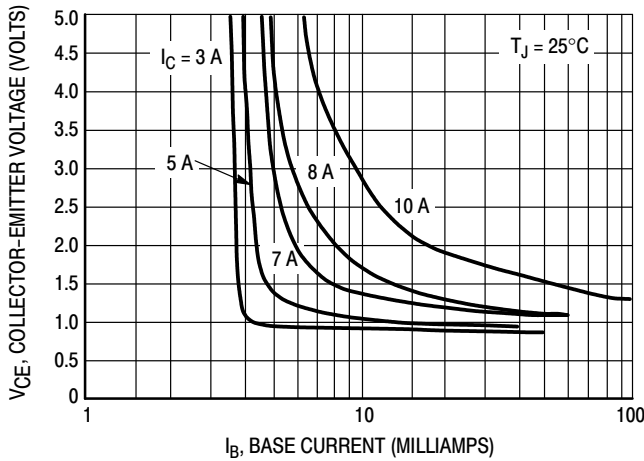


Figure 7. Collector Saturation Region

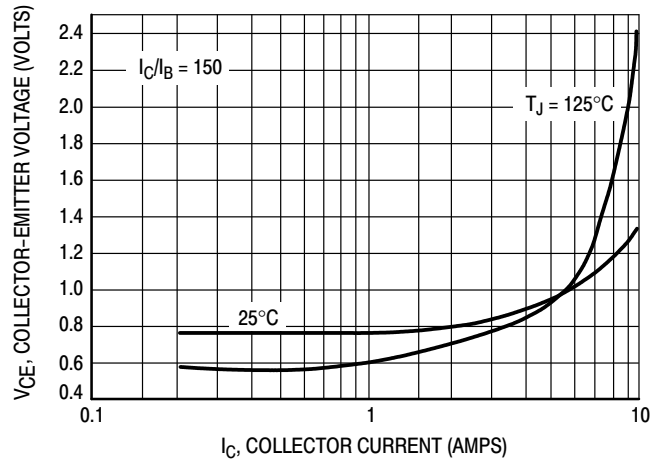


Figure 8. Collector-Emmitter Saturation Voltage

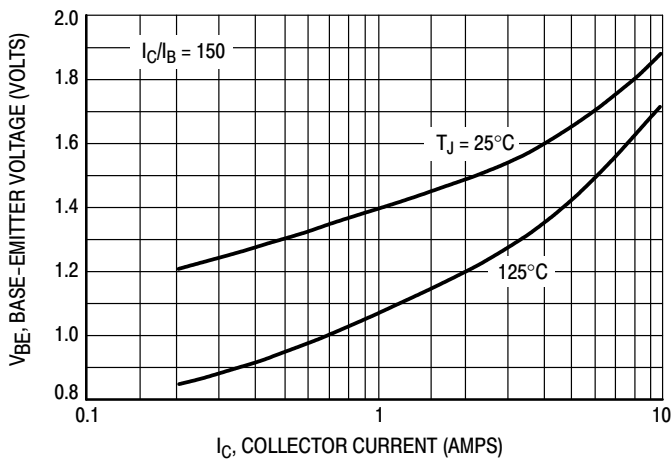


Figure 9. Base-Emmitter Saturation Voltage

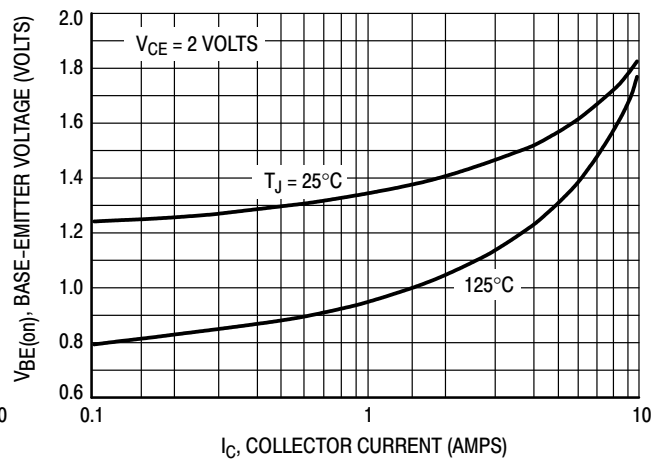


Figure 10. Base-Emmitter "ON" Voltages

BUB323Z

ORDERING INFORMATION

Device	Package	Shipping†
BUB323ZT4G	D ² PAK (Pb-Free)	800 Units / Tape & Reel

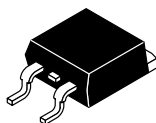
DISCONTINUED (Note 2)

BUB323ZG	D ² PAK (Pb-Free)	50 Units / Rail
NJVBUB323ZT4G*	D ² PAK (Pb-Free)	800 Units / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NJV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

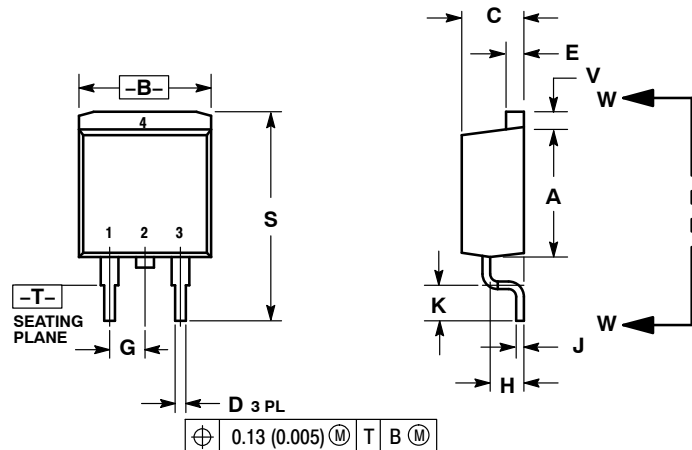
2. **DISCONTINUED:** These devices are not recommended for new design. Please contact your **onsemi** representative for information. The most current information on these devices may be available on www.onsemi.com.



D²PAK 3
CASE 418B-04
ISSUE L

DATE 17 FEB 2015

SCALE 1:1

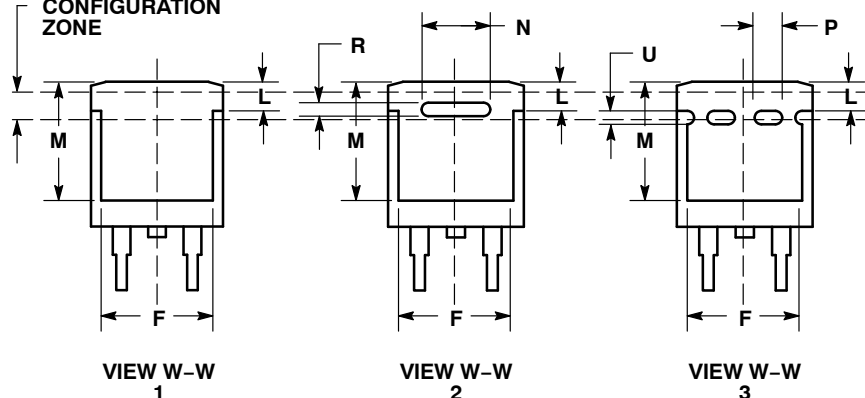


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.340	0.380	8.64	9.65
B	0.380	0.405	9.65	10.29
C	0.160	0.190	4.06	4.83
D	0.020	0.035	0.51	0.89
E	0.045	0.055	1.14	1.40
F	0.310	0.350	7.87	8.89
G	0.100	BSC	2.54	BSC
H	0.080	0.110	2.03	2.79
J	0.018	0.025	0.46	0.64
K	0.090	0.110	2.29	2.79
L	0.052	0.072	1.32	1.83
M	0.280	0.320	7.11	8.13
N	0.197	REF	5.00	REF
P	0.079	REF	2.00	REF
R	0.039	REF	0.99	REF
S	0.575	0.625	14.60	15.88
V	0.045	0.055	1.14	1.40

VARIABLE
CONFIGURATION
ZONE



STYLE 1:

- PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:

- PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 3:

- PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

STYLE 4:

- PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 5:

- PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE

STYLE 6:

- PIN 1. NO CONNECT
2. CATHODE
3. ANODE
4. CATHODE

MARKING INFORMATION AND FOOTPRINT ON PAGE 2

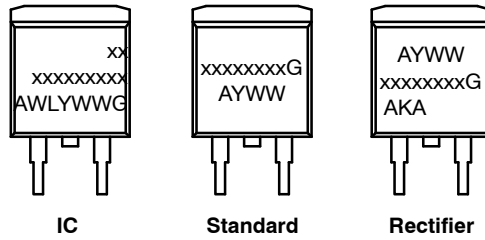
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D²PAK 3
CASE 418B-04
ISSUE L

DATE 17 FEB 2015

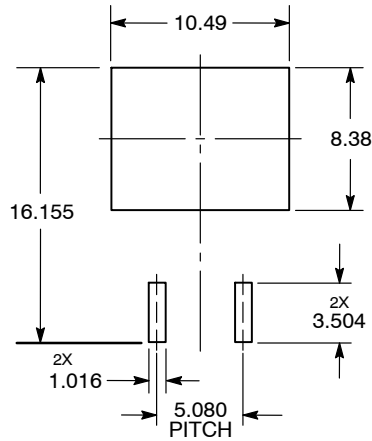
**GENERIC
MARKING DIAGRAM***



xx = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
G = Pb-Free Package
AKA = Polarity Indicator

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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