BU323Z

NPN Silicon Power Darlington

High Voltage Autoprotected

The BU323Z 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, and exhibit the following main features:

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
- Offered in Plastic SOT−93/TO−218 Type or TO−220 Packages
- Pb−Free Packages are Available*

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Collector−Emitter Sustaining Voltage	V_{CEO}	350	Vdc
Collector−Emitter Voltage	V_{EBO}	6.0	Vdc
Collector Current − Continuous − Peak	I_C I_{CM}	10 20	Adc
Base Current − Continuous − Peak	I_B I_{BM}	3.0 6.0	Adc
Total Power Dissipation @ T_C = 25°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
Maximum Lead Temperature for Soldering Purposes: 1/8″ from Case for 5 Seconds	T_L	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

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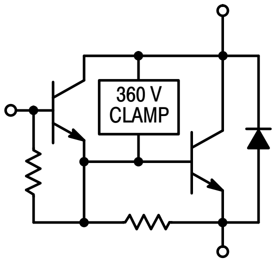
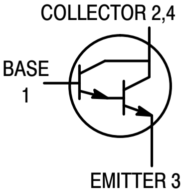
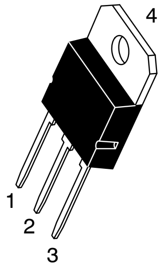
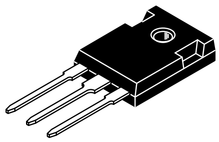
10 AMPERE DARLINGTON AUTOPROTECTED 360 − 450 VOLTS CLAMP, 150 WATTS







SOT−93
CASE 340D
STYLE 1



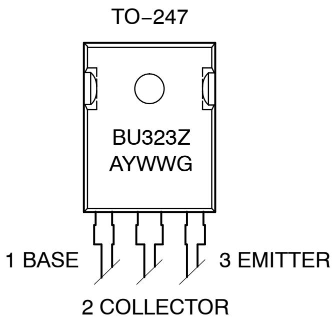
TO−247
CASE 340L
STYLE 3

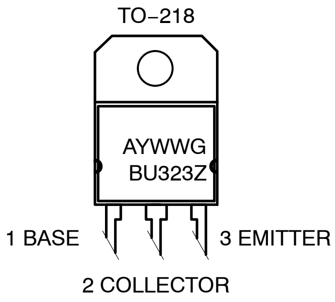
NOTE: Effective June 2012 this device will be available only in the TO−247 package. Reference FPCN# 16827.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

MARKING DIAGRAMS





BU323Z = Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

ORDERING INFORMATION

Device Order Number	Package Type	Shipping
BU323ZG	TO−218 (Pb−Free)	30 Units / Rail
BU323ZG	TO−247 (Pb−Free)	30 Units / Rail

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (1)					
Collector−Emitter Clamping Voltage (I_C = 7.0 A) (T_C = −40°C to +125°C)	V_{CLAMP}	350	–	450	Vdc
Collector−Emitter Cutoff Current (V_{CE} = 200 V, I_B = 0)	I_{CEO}	–	–	100	μAdc
Emitter−Base Leakage Current (V_{EB} = 6.0 Vdc, I_C = 0)	I_{EBO}	–	–	50	mAdc
ON CHARACTERISTICS (1)					
Base−Emitter Saturation Voltage	$V_{BE(sat)}$				Vdc
(I_C = 8.0 Adc, I_B = 100 mAdc)		–	–	2.2	
(I_C = 10 Adc, I_B = 0.25 Adc)		–	–	2.5	
Collector−Emitter Saturation Voltage	$V_{CE(sat)}$				Vdc
(I_C = 7.0 Adc, I_B = 70 mAdc)		–	–	1.6	
(T_C = 125°C)		–	–	1.8	
(I_C = 8.0 Adc, I_B = 0.1 Adc)		–	–	1.8	
(T_C = 125°C)		–	–	2.1	
(I_C = 10 Adc, I_B = 0.25 Adc)		–	–	1.7	
Base−Emitter On Voltage	$V_{BE(on)}$				Vdc
(I_C = 5.0 Adc, V_{CE} = 2.0 Vdc) (T_C = −40°C to +125°C)		1.1	–	2.1	
(I_C = 8.0 Adc, V_{CE} = 2.0 Vdc)		1.3	–	2.3	
Diode Forward Voltage Drop (I_F = 10 Adc)	V_F	–	–	2.5	Vdc
DC Current Gain	h_{FE}				–
(I_C = 6.5 Adc, V_{CE} = 1.5 Vdc) (T_C = −40°C to +125°C)		150	–	–	
(I_C = 5.0 Adc, V_{CE} = 4.6 Vdc)		500	–	3400	
DYNAMIC CHARACTERISTICS					
Current Gain Bandwidth (I_C = 0.2 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)	f_T	–	–	2.0	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	–	200	pF
Input Capacitance (V_{EB} = 6.0 V)	C_{ib}	–	–	550	pF
CLAMPING ENERGY (see notes)					
Repetitive Non−Destructive Energy Dissipated at turn−off: (I_C = 7.0 A, L = 8.0 mH, R_{BE} = 100 Ω) (see Figures 2 and 4)	W_{CLAMP}	200	–	–	mJ

SWITCHING CHARACTERISTICS: Inductive Load (L = 10 mH)

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

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle = 2.0%.

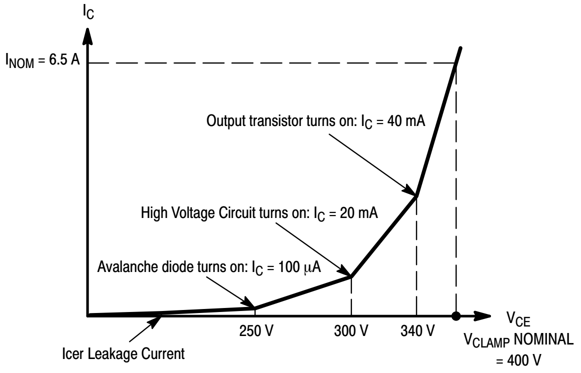


Figure 1. $I_C = f(V_{CE})$ Curve Shape

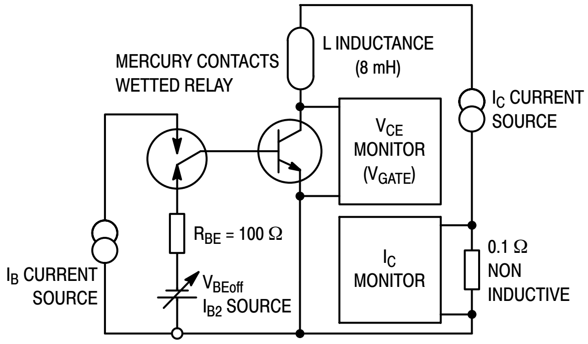


Figure 2. Basic Energy Test Circuit

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.

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, $R_{BE} = 100\ \Omega$, $V_{gate} = 280$ V, L = 8.0 mH

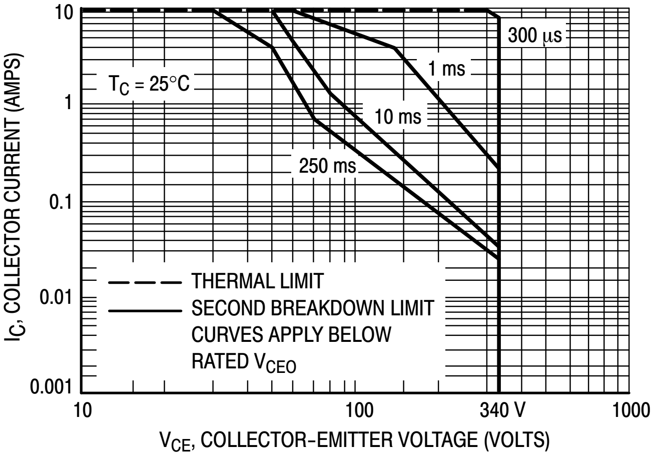
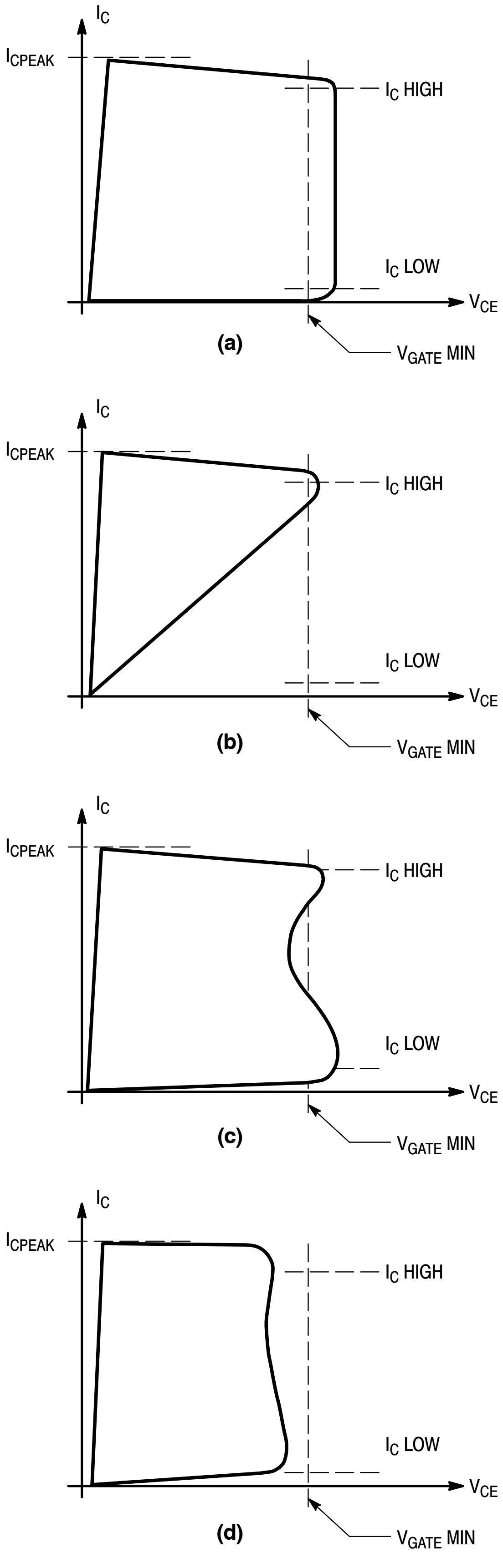


Figure 3. Forward Bias Safe Operating Area



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

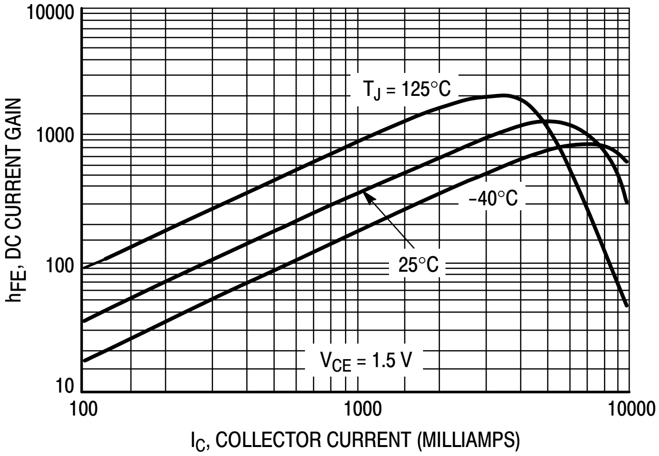


Figure 5. DC Current Gain

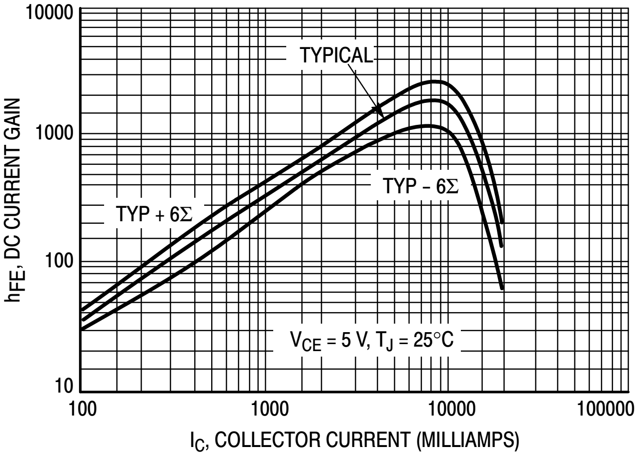


Figure 6. DC Current Gain

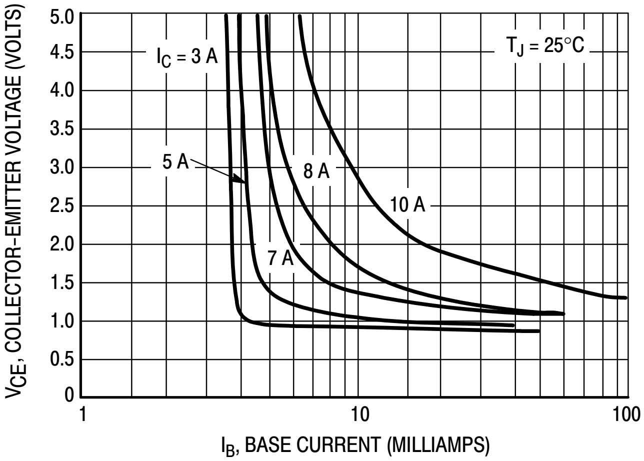


Figure 7. Collector Saturation Region

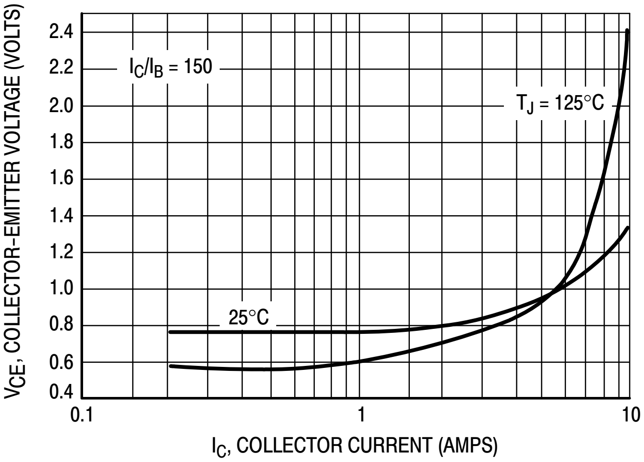


Figure 8. Collector−Emitter Saturation Voltage

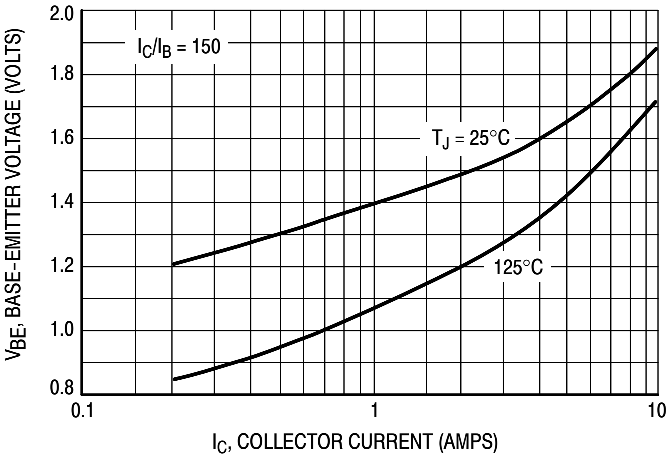


Figure 9. Base−Emitter Saturation Voltage

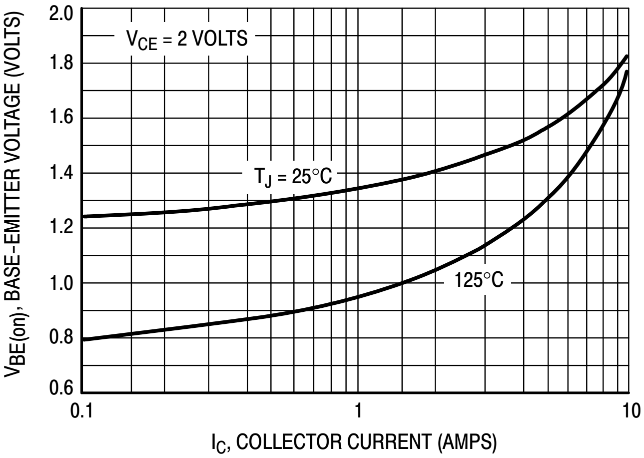
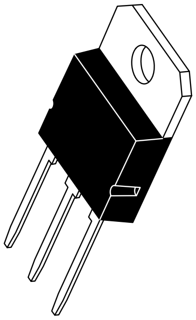


Figure 10. Base−Emitter “ON” Voltages

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

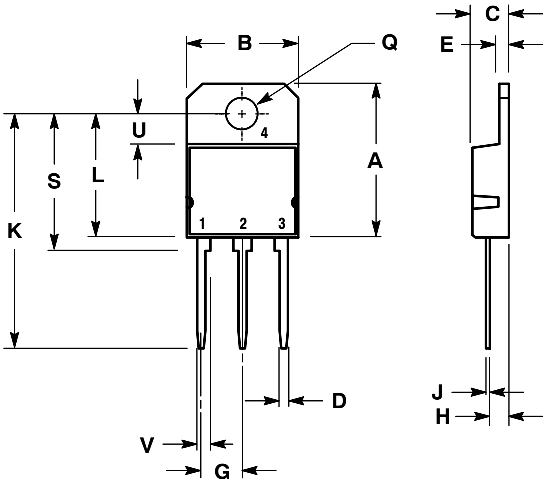
ON Semiconductor®



SOT−93 (TO−218)
CASE 340D−02
ISSUE E

DATE 01/03/2002

SCALE 1:1



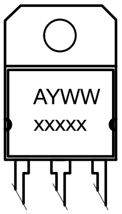
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

	MILLIMETERS		INCHES	
DIM	**MIN**	**MAX**	**MIN**	**MAX**
A	---	20.35	---	0.801
B	14.70	15.20	0.579	0.598
C	4.70	4.90	0.185	0.193
D	1.10	1.30	0.043	0.051
E	1.17	1.37	0.046	0.054
G	5.40	5.55	0.213	0.219
H	2.00	3.00	0.079	0.118
J	0.50	0.78	0.020	0.031
K	31.00 REF		1.220 REF	
L	---	16.20	---	0.638
Q	4.00	4.10	0.158	0.161
S	17.80	18.20	0.701	0.717
U	4.00 REF		0.157 REF	
V	1.75 REF		0.069	

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
xxxxx = Device Code

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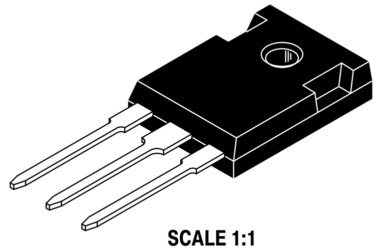
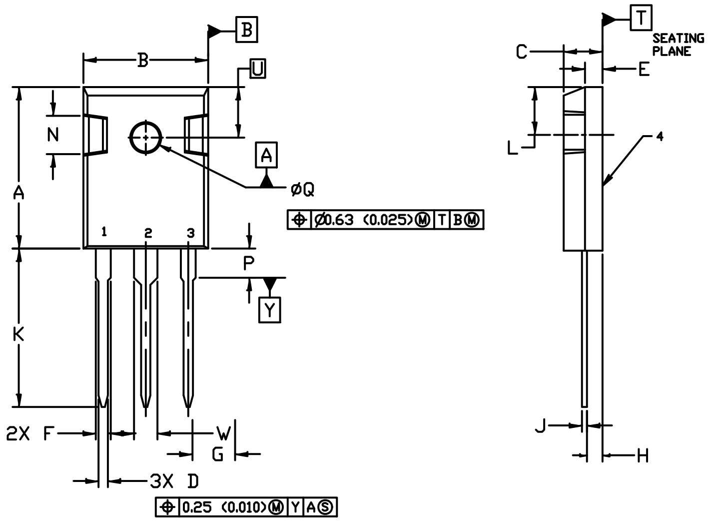


SCALE 1:1

TO−247
CASE 340L
ISSUE G

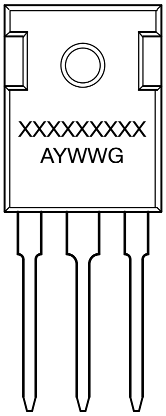
DATE 06 OCT 2021



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER

	MILLIMETERS		INCHES	
DIM	MIN.	MAX.	MIN.	MAX.
A	20.32	21.08	0.800	0.830
B	15.75	16.26	0.620	0.640
C	4.70	5.30	0.185	0.209
D	1.00	1.40	0.040	0.055
E	1.90	2.60	0.075	0.102
F	1.65	2.13	0.065	0.084
G	5.45 BSC		0.215 BSC	
H	1.50	2.49	0.059	0.098
J	0.40	0.80	0.016	0.031
K	19.81	20.83	0.780	0.820
L	5.40	6.20	0.212	0.244
N	4.32	5.49	0.170	0.216
P	----	4.50	----	0.177
Q	3.55	3.65	0.140	0.144
U	6.15 BSC		0.242 BSC	
W	2.87	3.12	0.113	0.123

GENERIC MARKING DIAGRAM*



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

*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.

STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 2:
PIN 1. ANODE
2. CATHODE (S)
3. ANODE 2
4. CATHODES (S)

STYLE 3:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 4:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 5:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 6:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

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