

# Thermally Enhanced GaN Amplifier

## 820 W, 48 V, 758 - 960 MHz

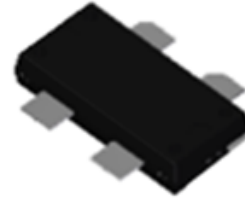


GTRB097152NCV1A

Rev. V1

### Features

- GaN on SiC HEMT Technology
- Pulsed CW Performance: 960 MHz, 48 V, 10  $\mu$ s pulse width, 10% Duty Cycle, Combined Outputs
- Output Power @ P5dB = 820 W
- Efficiency @ P5dB = 68%
- Thermally Enhanced Package
- RoHS\* Compliant



Package Type: PG-HB3SOF-4-1

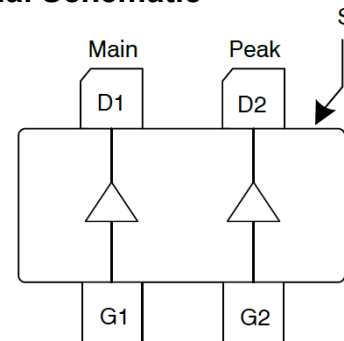
### Applications

- Cellular Power

### Description

The GTRB097152NC is a 820 W (P5dB) GaN on SiC HEMT amplifier for use in multi-standard cellular applications. It features high efficiency, and a thermally-enhanced package with earless flange.

### Functional Schematic



### Ordering Information

Part Number	Package
GTRB097152NCV1A-R0	50 piece reel
GTRB097152NCV1A-R2	250 piece reel

### Pin Configuration

Pin #	Function
D1	Drain Device 1 (main)
D2	Drain Device 2 (peak)
G1	Gate Device 1 (main)
G2	Gate Device 2 (peak)
S	Source (flange)

\* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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### RF Characteristics: Single-Carrier WCDMA Specifications<sup>1</sup>:

$V_{DD} = 48\text{ V}$ ,  $I_{DQ} = 1000\text{ mA}$ ,  $P_{OUT} = 115\text{ W avg.}$ ,  $V_{GS(PEAK)} = -4.8\text{ V}$ ,  $T_C = 25^\circ\text{C}$ , Channel Bandwidth = 3.84 MHz, Peak/Average = 10 dB @ 0.01% CCDF

Parameter	Frequency Test Conditions (MHz)	Units	Min.	Typ.	Max.
Output Power	925	dBm	—	50.6	—
	940				
	960				
Gain	925	dB	—	18.4	—
	940			18.2	
	960			17.8	
Efficiency	925	%	—	61.3	—
	940			60.5	
	960			60.0	
ACPR+	925	dBc	—	-29.0	—
	940			-30.8	
	960			-32.1	
ACPR-	925	dBc	—	-28.8	—
	940			-30.5	
	960			-32.1	
OPAR	925	dB	—	8.3	—
	940			8.1	
	960			8.1	

1. Measurements taken with the device soldered to a heatsink of the AB application test circuit.

### DC Characteristics

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain-Source Breakdown Voltage	$V_{GS} = -8\text{ V}$ , $I_D = 10\text{ mA}$ Main, Peak	V	150	—	—
Drain-Source Leakage Current	$V_{GS} = -8\text{ V}$ , $V_{DS} = 10\text{ V}$ Main Peak	mA	—	—	5.7 11.5
Gate-Source Leakage Current	$V_{GS} = -8\text{ V}$ , $V_{DD} = 150\text{ V}$ Main Peak	mA	—	—	11.3 22.6
Gate Threshold Voltage	$V_{DS} = 10\text{ V}$ , $I_D = 33\text{ mA}$ Main $V_{DS} = 10\text{ V}$ , $I_D = 66\text{ mA}$ Peak	V	-3.8	-3.1	-2.3

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### Recommended Operating Voltages

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain Operating Voltage	—	V	0	—	50
Gate Quiescent Voltage	$V_{DS} = 48\text{ V}, I_D = 1000\text{ mA}$	V	-3.8	-2.9	-2.3

### Absolute Maximum Ratings<sup>2,3,4</sup>

Parameter	Absolute Maximum
Drain Source Voltage	125 V
Gate Source Voltage	-10 V to +2 V
Operating Voltage	55 V
Gate Current main Peak	33 mA 66 mA
Drain Current main peak	12 A 24 A
Junction Temperature	+225°C
Storage Temperature	-65°C to +150°C

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. MACOM does not recommend sustained operation near these survivability limits.
4. Product's qualification were performed @ +225°C. Operation @  $T_J$  (+275°C) reduces median time to failure.

## Thermal Characteristics

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Thermal Resistance ( $R_{\theta JC}$ ) main peak	$T_C = +85^\circ\text{C}$ , $P_{DISS} = 97.7 \text{ W DC}$ $P_{DISS} = 168.5 \text{ W DC}$	$^\circ\text{C/W}$	—	1.24 0.71	—

## RF Functional Test: Single-Carrier WCDMA Specifications<sup>5</sup>:

Freq. = 960 MHz,  $V_{DD} = 48 \text{ V}$ ,  $I_{DQ} = 332 \text{ mA}$ ,  $P_{OUT} = 50.6$ ,  $V_{GS(PEAK)} = -4.8 \text{ V}$ ,  $T_C = 25^\circ\text{C}$ , 3GPP Signal, Channel Bandwidth = 3.84 MHz, Input PAR = 10 dB @ 0.01% CCDF

Parameter	Units	Min.	Typ.	Max.
Gain	dB	15.6	17.5	—
Efficiency	%	51	58	—
Adjacent Cannel Power Ratio	dBc	—	-26.4	-23.5
Output PAR @ 0.01% CCDF	dB	6.8	7.6	—

5. Measurements taken in the production fixture.

## Bias Sequencing

### Bias ON

1. Ensure RF is turned off
2. Apply pinch-off voltage of -5 V to the gate
3. Apply nominal drain voltage
4. Bias gate to desired quiescent drain current
5. Apply RF

### Bias OFF

1. Turn RF off
2. Apply pinch-off voltage to the gate
3. Turn-off drain voltage
4. Turn-off gate voltage

## Handling Procedures

Please observe the following precautions to avoid damage:

### Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1B devices.

Load Pull Performance: Pulsed CW Signal: 160  $\mu$ s, 10% Duty Cycle

Main Side:

Frequency (MHz)	$Z_{SOURCE}$ ( $\Omega$ )	Maximum Output Power				
		$V_{DS} = 48\text{ V}, I_{DQ} = 350\text{ mA}, T_C = 25^\circ\text{C}, P_{3dB}, \text{Class AB}$				
		$Z_{LOAD}$ ( $\Omega$ )	Gain (dB)	$P_{OUT}$ (dBm)	$P_{OUT}$ (W)	$\eta_D$ (%)
925	4.58 - j5.45	2.87 - j1.54	19.39	56.15	412.10	66.66
940	5.25 - j5.67	2.87 - j1.54	19.30	56.16	413.05	67.42
960	5.81 - j6.45	2.87 - j1.54	19.20	56.04	401.79	67.26

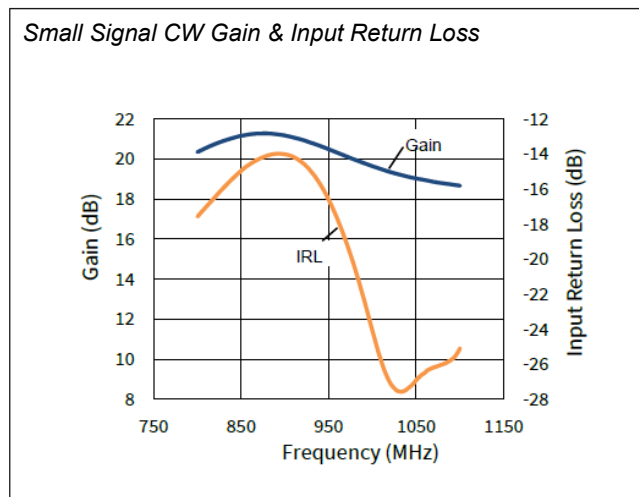
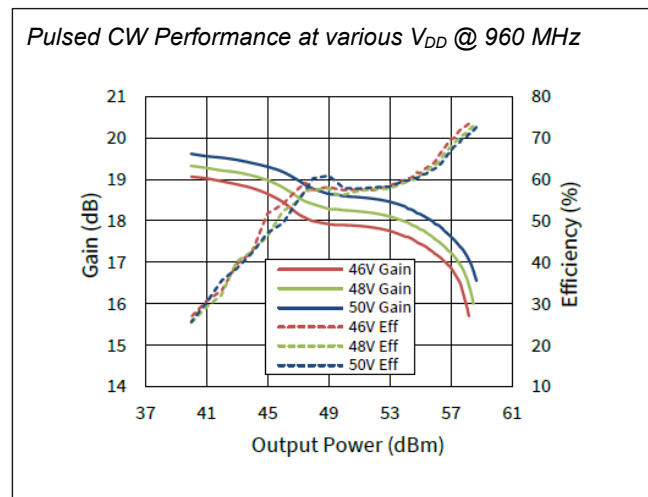
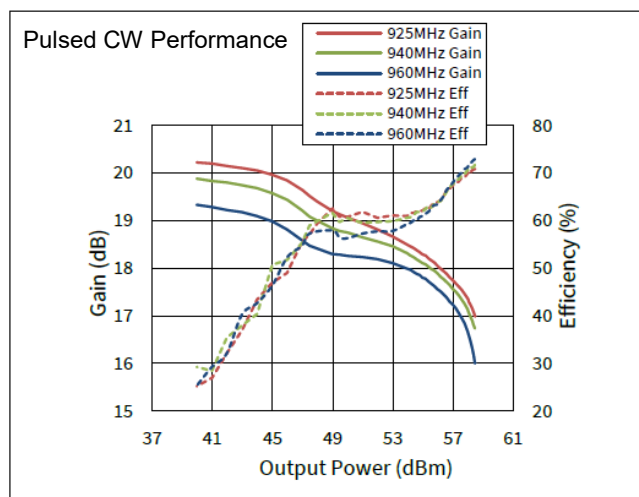
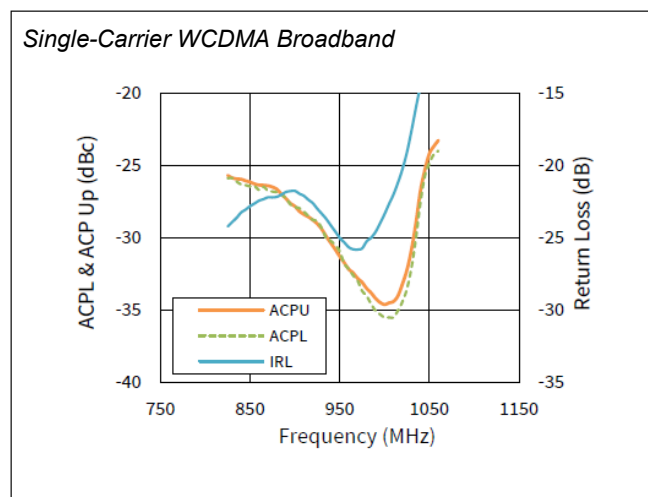
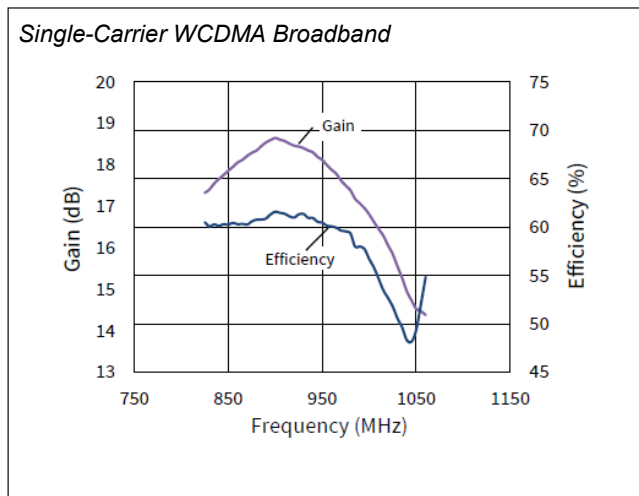
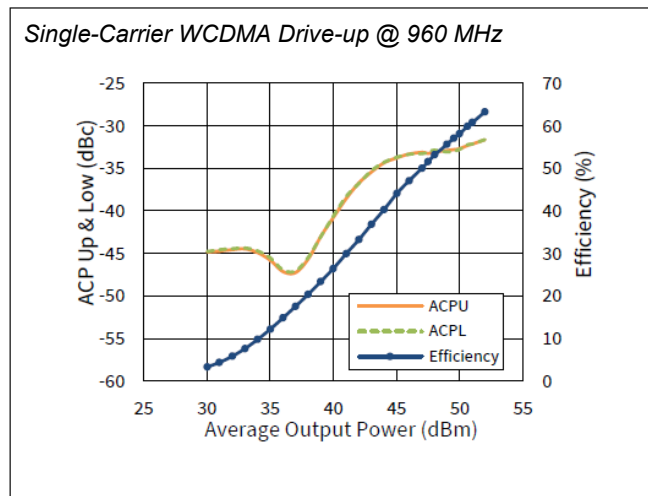
Frequency (MHz)	$Z_{SOURCE}$ ( $\Omega$ )	Maximum Drain Efficiency				
		$V_{DS} = 48\text{ V}, I_{DQ} = 350\text{ mA}, T_C = 25^\circ\text{C}, P_{3dB}, \text{Class AB}$				
		$Z_{LOAD}$ ( $\Omega$ )	Gain (dB)	$P_{OUT}$ (dBm)	$P_{OUT}$ (W)	$\eta_D$ (%)
925	4.58 - j5.45	3.22 + j2.41	21.45	53.07	202.77	81.46
940	5.25 - j5.67	3.22 + j2.41	21.37	53.08	203.24	83.13
960	5.81 - j6.45	3.22 + j2.42	21.34	52.97	198.15	83.60

Peak Side:

Frequency (MHz)	$Z_{SOURCE}$ ( $\Omega$ )	Maximum Output Power				
		$V_{DS} = 48\text{ V}, V_{GS} = -5\text{ V}, T_C = 25^\circ\text{C}, P_{3dB}, \text{Class C}$				
		$Z_{LOAD}$ ( $\Omega$ )	Gain (dB)	$P_{OUT}$ (dBm)	$P_{OUT}$ (W)	$\eta_D$ (%)
925	1.59 - j3.51	1.09 - j1.57	15.98	58.32	679.20	62.65
940	1.76 - j3.44	1.39 - j1.64	15.83	58.33	680.77	68.28
960	1.25 - j4.00	1.10 - j1.35	16.26	58.33	680.77	69.89

Frequency (MHz)	$Z_{SOURCE}$ ( $\Omega$ )	Maximum Drain Efficiency				
		$V_{DS} = 48\text{ V}, V_{GS} = -5\text{ V}, T_C = 25^\circ\text{C}, P_{3dB}, \text{Class C}$				
		$Z_{LOAD}$ ( $\Omega$ )	Gain (dB)	$P_{OUT}$ (dBm)	$P_{OUT}$ (W)	$\eta_D$ (%)
925	1.59 - j3.51	1.71 + j0.730	16.73	55.11	324.34	85.06
940	1.76 - j3.44	1.99 + j0.635	15.89	55.05	319.89	82.84
960	1.25 - j4.00	1.64 + j0.560	16.53	55.00	316.23	86.53

### Typical Performance Curves



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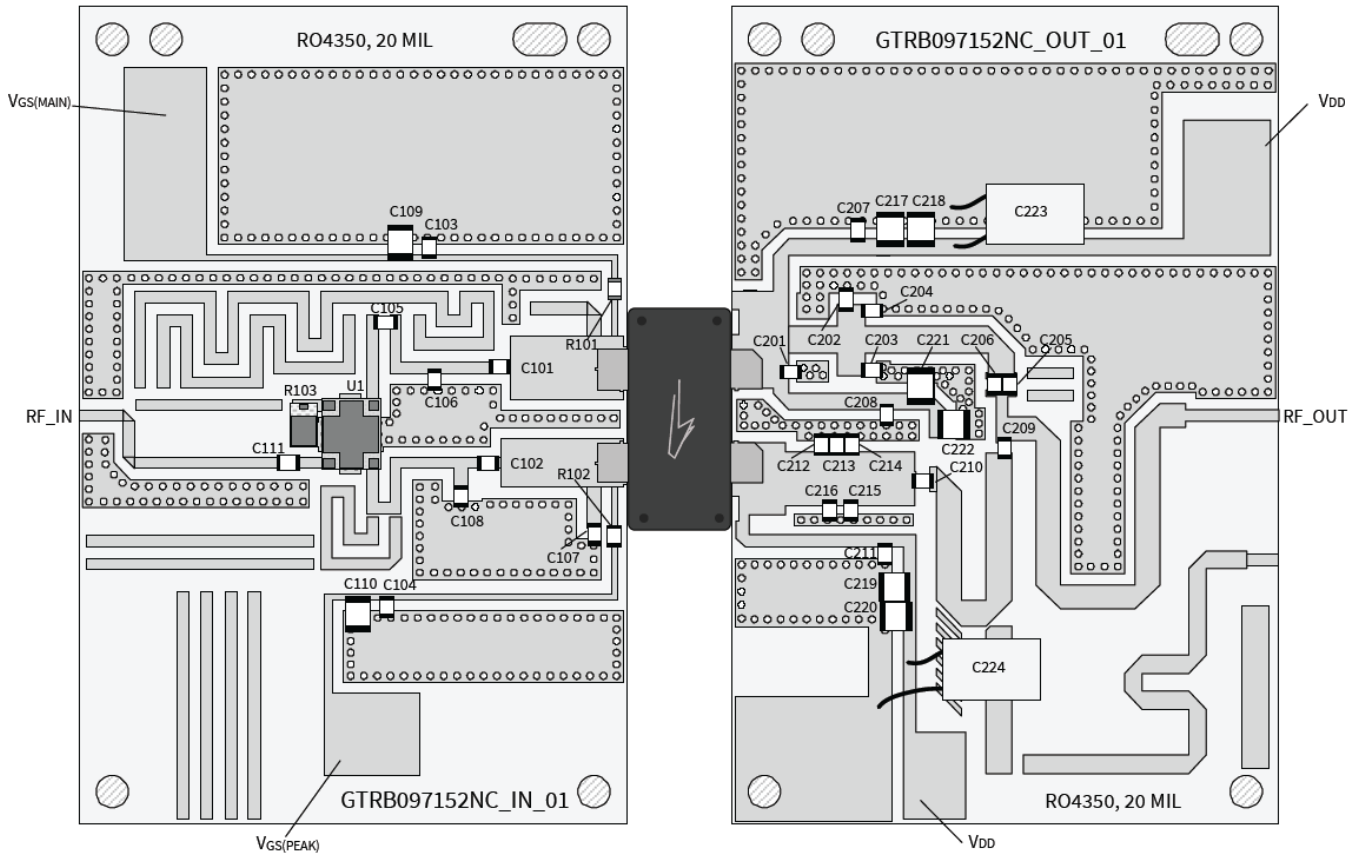
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### Evaluation Board: 925 - 960 MHz



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### Parts List for Evaluation Board: 925 - 960 MHz

Component	Description	Manufacturer	Manufacturer P/N
<b>Input</b>			
C101	Capacitor, 39 pF	ATC	ATC600F390JT250XT
C102, C103, C104, C105, C111	Capacitor, 100 pF	ATC	ATC600F101JT250XT
C106	Capacitor, 5.6 pF	ATC	ATC600F5R6BT250XT
C107	Capacitor, 8.2 pF	ATC	ATC600F8R2BT250XT
C108	Capacitor, 5.6 pF	ATC	ATC600F5R6BT250XT
C109, C110	Capacitor, 10 $\mu$ F, 100 V	Murata	GRM32EC72A106KE05L
R101	Resistor, 5.6 $\Omega$	Panasonic	ERJ-H3ED5601V
R102	Resistor, 18 $\Omega$	Panasonic	ERJ-PA3F18R0V
R103	Resistor, 50 $\Omega$	TTM Technologies	C8A50Z4B
U1	Hybrid Coupler	Anaren	X3C09P1-03S
<b>Output</b>			
C201, C203	Capacitor, 3.0 pF	ATC	ATC600F3R0BT250XT
C202	Capacitor, 3.6 pF	ATC	ATC600F3R6BT250XT
C204	Capacitor, 3.9 pF	ATC	ATC600F3R9BT250XT
C205, C206	Capacitor, 3.3 pF	ATC	ATC600F3R3BT250XT
C207, C208, C209	Capacitor, 100 pF	ATC	ATC600F101JT250XT
C210	Capacitor, 18 pF	ATC	ATC600F180JT250XT
C211	Capacitor, 51 pF	ATC	ATC600F510JT250XT
C212	Capacitor, 5.1 pF	ATC	ATC600F5R1BT250XT
C213, C216	Capacitor, 6.2 pF	ATC	ATC600F6R2BT250XT
C214	Capacitor, 0.7 pF	ATC	ATC600F0R7BT250XT
C215	Capacitor, 2.4 pF	ATC	ATC600F2R4BT250XT
C217, C218, C219, C220, C221, C222	Capacitor, 10 $\mu$ F, 100 V	Murata	GRM32EC72A106KE05L
C223, C224	Capacitor, 470 $\mu$ F, 100 V	Panasonic	ECA-2AHG471B



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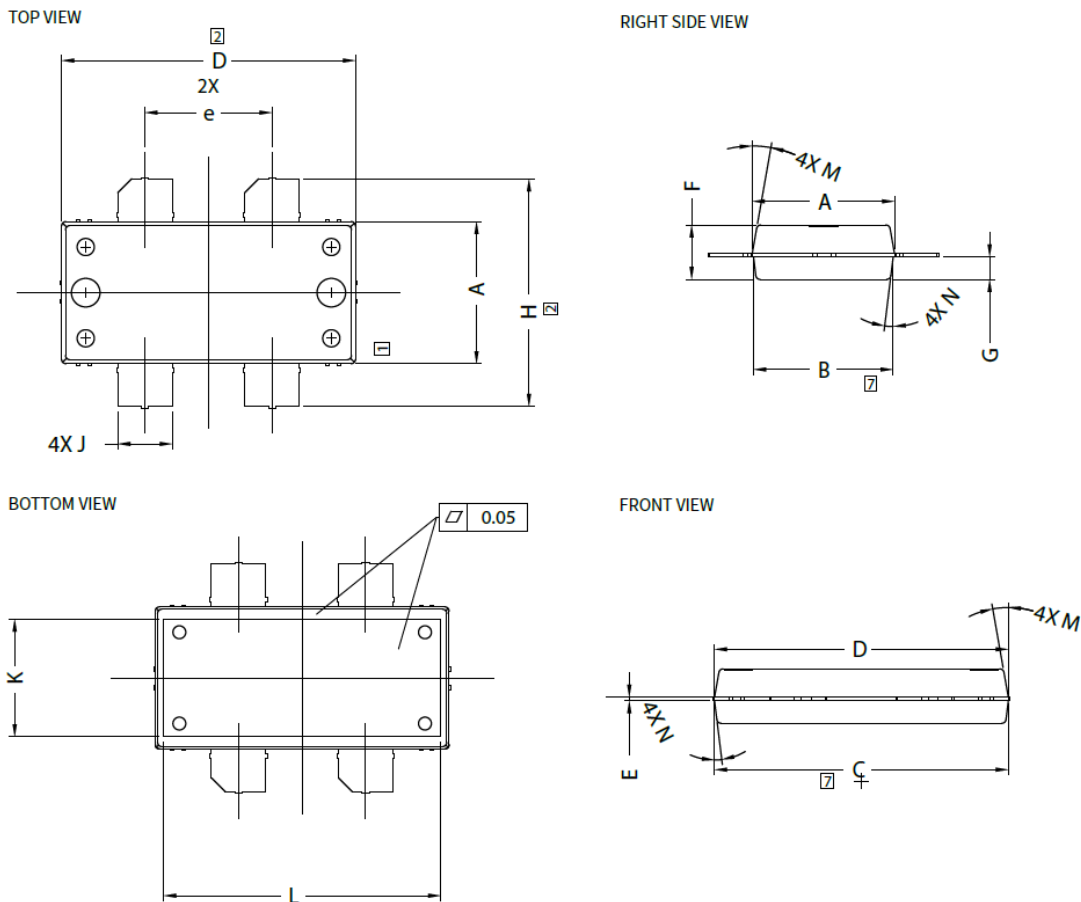
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### Lead-Free Outline Drawing PG-HB3SOF-4-1



1. Interpret dimensions and tolerances per ASME Y14.5M-1994.
2. Mold/Dam Bar/Metal protrusion of 0.30 mm max per side not included.
3. Metal protrusions are connected to source and shall not exceed 0.10 mm max.
4. Fillets and radii:- Unless otherwise noted all radii are 0.30 mm max.
5. Molded package Ra 1.2-1.6  $\mu\text{m}$ .
6. All metal surfaces are tin plated, except area of cut.
7. Does not include Mold/Dam Bar and Metal protrusion.

Dim.	Inches			Millimeters		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.390	0.392	0.394	9.91	9.96	10.01
B	0.383	0.385	0.387	9.73	9.78	9.83
C	0.808	0.810	0.812	20.52	20.57	20.62
D	0.808	0.810	0.812	20.52	20.57	20.62
E	0.007	0.010	0.013	0.17	0.25	0.33
F	0.148	0.150	0.152	3.76	3.81	3.86
G	0.060	0.062	0.064	1.52	1.57	1.62
H	0.624	0.628	0.632	15.86	15.96	16.06
J	0.148	0.150	0.152	3.76	3.81	3.86
K	-	0.325	-	-	8.25	-
L	-	0.764	-	-	19.40	-
M	-	10°±1°	-	-	10°±1°	-
N	-	7°±1°	-	-	7°±1°	-
e	-	0.350	-	-	8.89	-

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