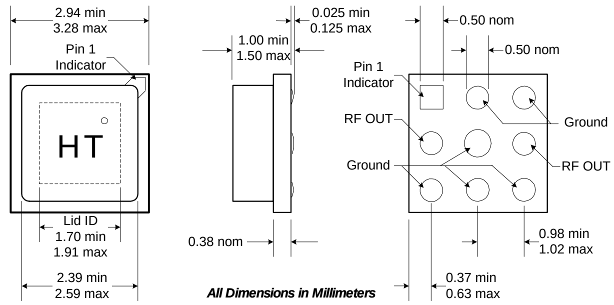
MICROWAVE GaInP/GaAs DISCRETE HBT
DC TO 12GHz

Typical Applications

- Active Amplifier in VCO Circuit
- Buffer Amplifier
- Gain Stage

Product Description

The NBT-168 discrete HBT is ideal for low-cost amplifier and oscillator applications up to 12GHz. Low noise figure, high gain, high current capability, and medium output give this device high dynamic range and excellent linearity for cascaded amplifier designs. This device is also ideally suited for VCO/buffer amplifier applications. The NBT-168 is packaged in a low-cost, surface-mount ceramic package, providing ease of assembly for high-volume tape-and-reel requirements. It is available in either packaged or chip (NBT-168-D) form, where its gold metallization is ideal for hybrid circuit designs.

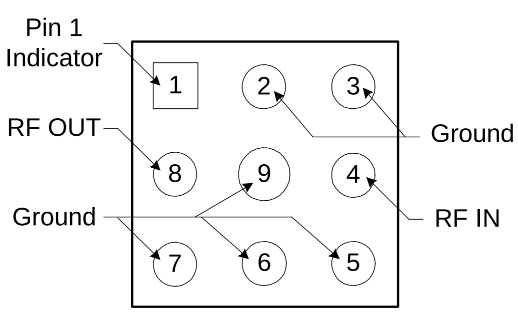


Notes:
1. Solder pads are coplanar to within ±0.025 mm.
2. Lid will be centered relative to frontside metallization with a tolerance of ±0.13 mm.
3. Mark to include two characters and dot to reference pin 1.

Optimum Technology Matching® Applied

- ☐ Si BJT
- ☐ Si Bi-CMOS
- ☑ GaInP/HBT
- ☐ GaAs HBT
- ☐ SiGe HBT
- ☐ GaN HEMT
- ☐ GaAs MESFET
- ☐ Si CMOS
- ☐ SiGe Bi-CMOS

Package Style: MPGA, Bowtie, 3x3, Ceramic



Functional Block Diagram

Features

- Reliable, Low-Cost HBT Design
- 26.0dB Gain@1.0GHz
- Positive Power Supply Operation
- 4-Finger Device for High-Current Capability
- Low Noise Figure, 1.7dB@2.0GHz

Ordering Information

NBT-168	Microwave GaInP/GaAs Discrete HBT DC to 12GHz
NBT-168-T1 or -T3	Tape & Reel, 1000 or 3000 Pieces (respectively)
NBT-168-D	NBT-168 Chip Form
NBT-168-E	Fully Assembled Evaluation Board

RF Micro Devices, Inc.
7628 Thorndike Road
Greensboro, NC 27409, USA
Tel (336) 664 1233
Fax (336) 664 0454
http://www.rfmd.com

NBT-168

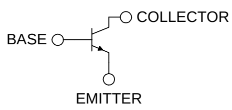
Absolute Maximum Ratings

Parameter	Rating	Unit
RF Input Power	+10	dBm
Power Dissipation	250	mW
V_{CBO}	8	
V_{CEO}	6	
V_{EBO}	1.5	V
Collector Current	42	mA
Junction Temperature	200	°C
Operating Temperature	-45 to +85	°C
Storage Temperature	-65 to +150	°C

Exceeding any one or a combination of these limits may cause permanent damage.

Caution! ESD sensitive device.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall					V_C=+3.9V, I_{CC}=25mA, Z_0=50Ω, T_A=+25°C
Collector Cutoff Current, I_{CBO}			0.1	µA	V_{CB}=5.0V, I_E=0
Emitter Cutoff Current, I_{EBO}			0.1	µA	V_{EB}=1.0V, I_C=0
DC Current Gain, h_{FE}	90	110	130		V_{CE}=4.0V, I_C=25mA
Current Gain, H21		20		dB	V_{CE}=4.0V, I_C=25mA, 2GHz
Small Signal Power Gain, S21	24	26		dB	f=1.0GHz
Noise Figure, NF		1.7		dB	f=2.0GHz
Reverse Isolation, S12	-30	-32		dB	f=1.0GHz
MTTF versus Temperature @ V_{CE}=3.9V, I_{CC}=25mA					
Case Temperature		85		°C	
Junction Temperature		112		°C	
MTTF		>1,000,000		hours	
Thermal Resistance					
θ_{JC}		277		°C/W	Thermal Resistance, at any temperature (in °C/Watt) can be estimated by the following equation: θ_{JC} (°C/Watt)=277[T_J(°C)/112]

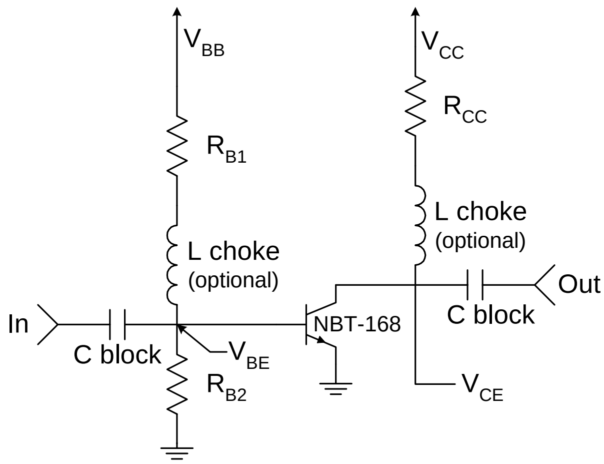
Pin	Function	Description	Interface Schematic
1	EMITTER	For best high frequency performance, this should be grounded. For best performance, keep traces physically short and connect immediately to ground plane.	
2	EMITTER	Same as pin 2.	
3	EMITTER	Same as pin 2.	
4	BASE	RF input pin. This pin is NOT internally DC blocked. A DC blocking capacitor, suitable for the frequency of operation, should be used in most applications. Base bias network should provide 1.3V to the base and be a current source sufficient to supply the correct base current for the collector current set.	
5	EMITTER	Same as pin 2.	
6	EMITTER	Same as pin 2.	
7	EMITTER	Same as pin 2.	
8	COLLECTOR	Collector bias. Must provide collector voltage and current. Biasing is accomplished with an external series resistor and choke inductor to V_{CC}. The resistor is selected to set the DC current into this pin at the desired level. The resistor value is determined by the following equation: $$R = \frac{(V_{CC} - V_C)}{I_{CC}}$$ Care should be taken to ensure the current through the devices never exceeds the maximum datasheet setting. Additionally, care should be taken to ensure the voltages between the collector and emitter (pins 3, 2 and 4), VCE is typically 3.5V to 4.0V. Because DC is present on this pin, a DC blocking capacitor, suitable for the frequency of operation, should be used in most applications. The supply side of the bias network should also be well bypassed.	
9	EMITTER	Same as pin 2.	

4

GENERAL PURPOSE AMPLIFIERS

Typical Bias Configuration

Application notes related to biasing circuit, device footprint, and thermal considerations are available on request.



Note: RF bypass circuitry omitted for simplicity.

Application Notes

Die Attach

The die attach process mechanically attaches the die to the circuit substrate. In addition, it electrically connects the ground to the trace on which the chip is mounted, and establishes the thermal path by which heat can leave the chip.

Wire Bonding

Electrical connections to the chip are made through wire bonds. Either wedge or ball bonding methods are acceptable practices for wire bonding.

Assembly Procedure

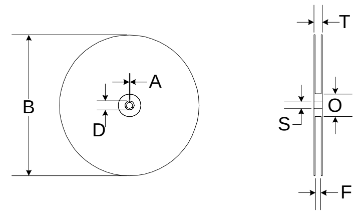
Epoxy or eutectic die attach are both acceptable attachment methods. Top and bottom metallization are gold. Conductive silver-filled epoxies are recommended. This procedure involves the use of epoxy to form a joint between the backside gold of the chip and the metallized area of the substrate. A 150°C cure for 1 hour is necessary. Recommended epoxy is Ablebond 84-1LMI from Ablestik.

Bonding Temperature (Wedge or Ball)

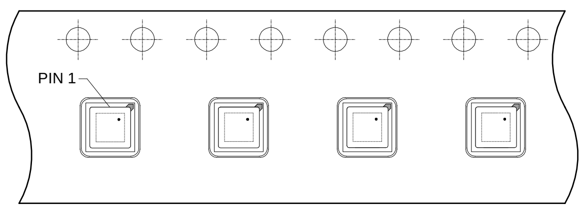
It is recommended that the heater block temperature be set to 160°C±10°C.

Tape and Reel Dimensions

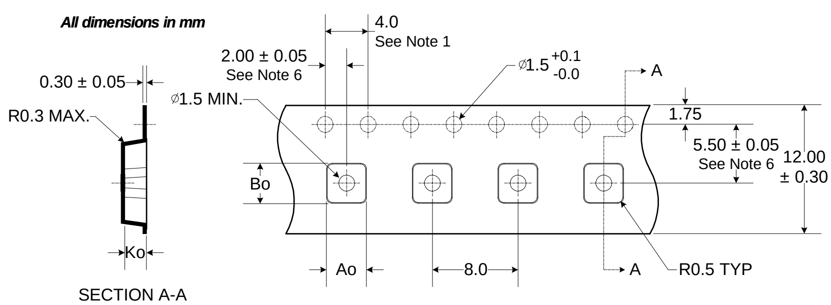
All Dimensions in Millimeters



330 mm (13") REEL			Micro-X, MPGA	
	ITEMS	SYMBOL	SIZE (mm)	SIZE (inches)
FLANGE	Diameter	B	330 +0.25/-4.0	13.0 +0.079/-0.158
	Thickness	T	18.4 MAX	0.724 MAX
	Space Between Flange	F	12.4 +2.0	0.488 +0.08
HUB	Outer Diameter	O	102.0 REF	4.0 REF
	Spindle Hole Diameter	S	13.0 +0.5/-0.2	0.512 +0.020/-0.008
	Key Slit Width	A	1.5 MIN	0.059 MIN
	Key Slit Diameter	D	20.2 MIN	0.795 MIN



User Direction of Feed

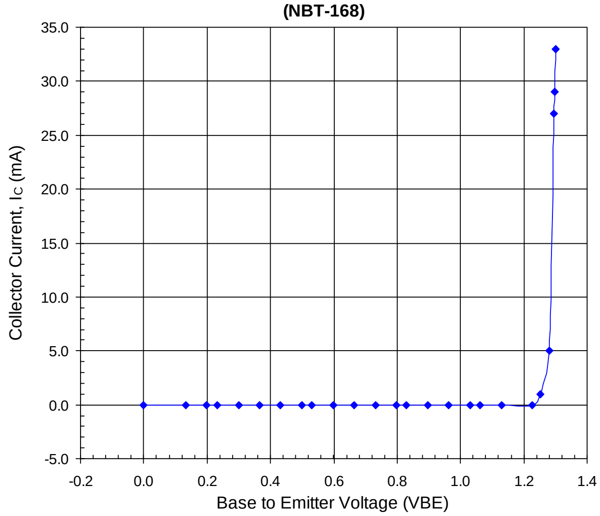


NOTES:
1. 10 sprocket hole pitch cumulative tolerance ±0.2.
2. Camber not to exceed 1 mm in 100 mm.
3. Material: PS+C
4. Ao and Bo measured on a plane 0.3 mm above the bottom of the pocket.
5. Ko measured from a plane on the inside bottom of the pocket to the surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

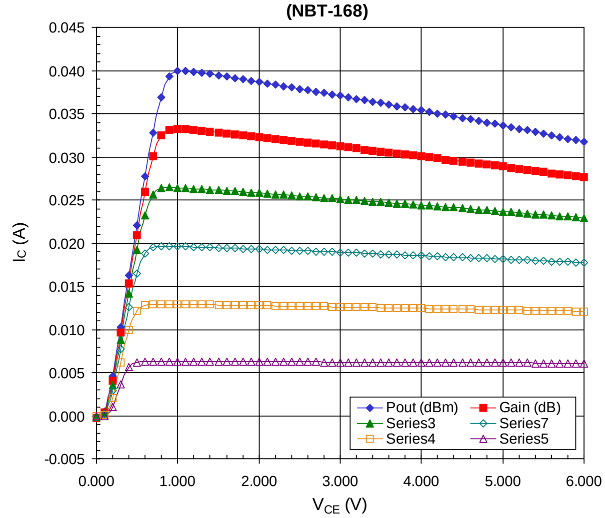
Ao = 3.6 MM
Bo = 3.6 MM
Ko = 1.7 MM

NBT-168

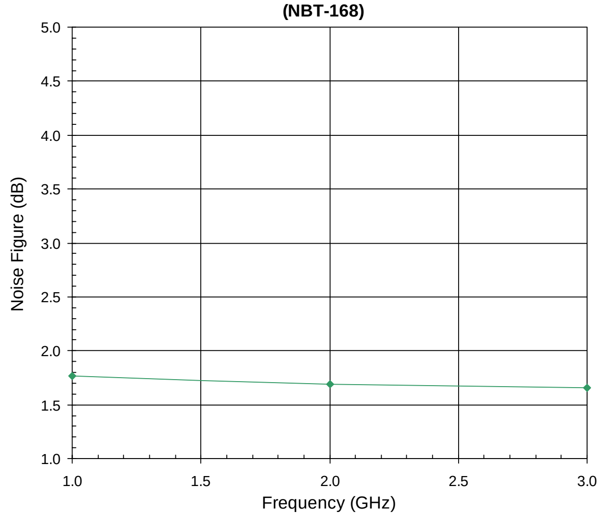
Collector Current versus Base to Emitter Voltage
(NBT-168)



Current Voltage Characteristics
(NBT-168)



Frequency versus Noise Figure
(NBT-168)



Insertion Power Gain versus Frequency
(NBT-168)