

# BG18D

## 5-4000 MHz Cascadable InGaP HBT Gain Block



### Device Features

- OIP3 = 32.0 dBm @ 1900 MHz
- Gain = 22.2 dB @ 1900 MHz
- Output P1 dB = 19.0 dBm @ 1900 MHz
- 50  $\Omega$  Cascadable
- Patented temperature compensation
- Patented Over Voltage Protection Circuit
- Lead-free/RoHS-compliant SOT-89 SMT package



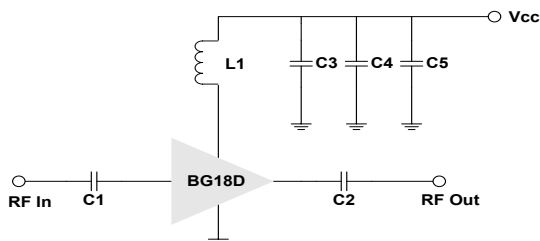
### Product Description

BeRex's BG18D is a high performance InGaP/GaAs HBT MMIC amplifier is internally matched to 50 Ohms and uses a patented **temperature compensation** circuit to provide stable current over the operating temperature range without the need for external components and a patented **over voltage protection** circuit to protect a internal device. The BG18D is designed for high linearity gain block applications that require excellent gain flatness. It is packaged in a RoHS-compliant with SOT-89 surface mount package.

### Applications

- Base station Infrastructure/RFID
- Commercial/Industrial/Military wireless system

### Applications Circuit



\*C1, C2, C3 =100 pF  $\pm$  5%; C4 = 1000 pF  $\pm$  5%; C5 = 10uF; L1 = 33nH

\*C1,C2 = 10nF; L1 = 2.7uH for IF Bandwidth

\*Optimum value of L1 may vary with board design.

### Typical Performance<sup>1</sup>

| Parameter         | Frequency |       |       |       |       | Unit |
|-------------------|-----------|-------|-------|-------|-------|------|
|                   | 500       | 900   | 1900  | 2140  | 2450  |      |
| Gain              | 24.3      | 24.1  | 22.2  | 21.7  | 20.8  | dB   |
| S11               | -13.0     | -21.0 | -22.0 | -20.0 | -26.0 | dB   |
| S22               | -15.0     | -22.0 | -20.0 | -22.0 | -26.0 | dB   |
| OIP3 <sup>2</sup> | 36.0      | 35.0  | 32.0  | 31.5  | 30.5  | dBm  |
| P1dB              | 19.5      | 19.5  | 19.0  | 18.8  | 17.3  | dBm  |
| Noise Figure      | 4.2       | 4.2   | 4.3   | 4.4   | 4.5   | dB   |

<sup>1</sup> Device performance \_ measured on a BeRex evaluation board at 25°C, 50  $\Omega$  system.

<sup>2</sup> OIP3 \_ measured with two tones at an output of 7 dBm per tone separated by 1 MHz.

|                                        | Min. | Typical | Max. | Unit  |
|----------------------------------------|------|---------|------|-------|
| Bandwidth                              | 5    |         | 4000 | MHz   |
| I <sub>C</sub> @ (V <sub>C</sub> = 5V) | 73   | 83      | 93   | mA    |
| V <sub>C</sub>                         |      | 5.0     |      | V     |
| dG/dT                                  |      | -0.004  |      | dB/°C |
| R <sub>TH</sub>                        |      | 50      |      | °C/W  |

### Absolute Maximum Ratings

| Parameter                  | Rating      | Unit |
|----------------------------|-------------|------|
| Operating Case Temperature | -40 to +85  | °C   |
| Storage Temperature        | -55 to +155 | °C   |
| Junction Temperature       | +220        | °C   |
| Operating Voltage          | +6.0        | V    |
| Supply Current             | 160         | mA   |
| Input RF Power             | 23          | dBm  |

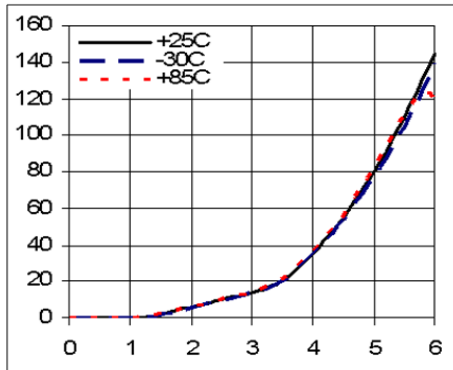
Operation of this device above any of these parameters may result in permanent damage.

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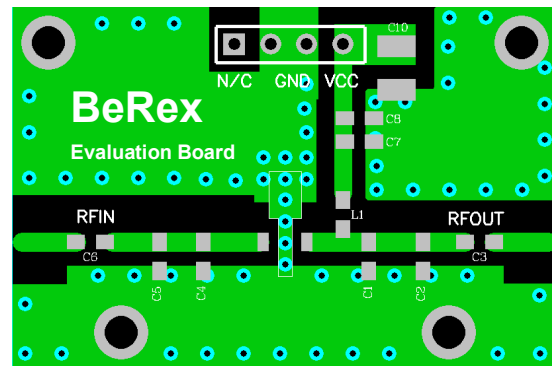
## 5-4000 MHz Cascadable InGaP HBT Gain Block



V-I Characteristics



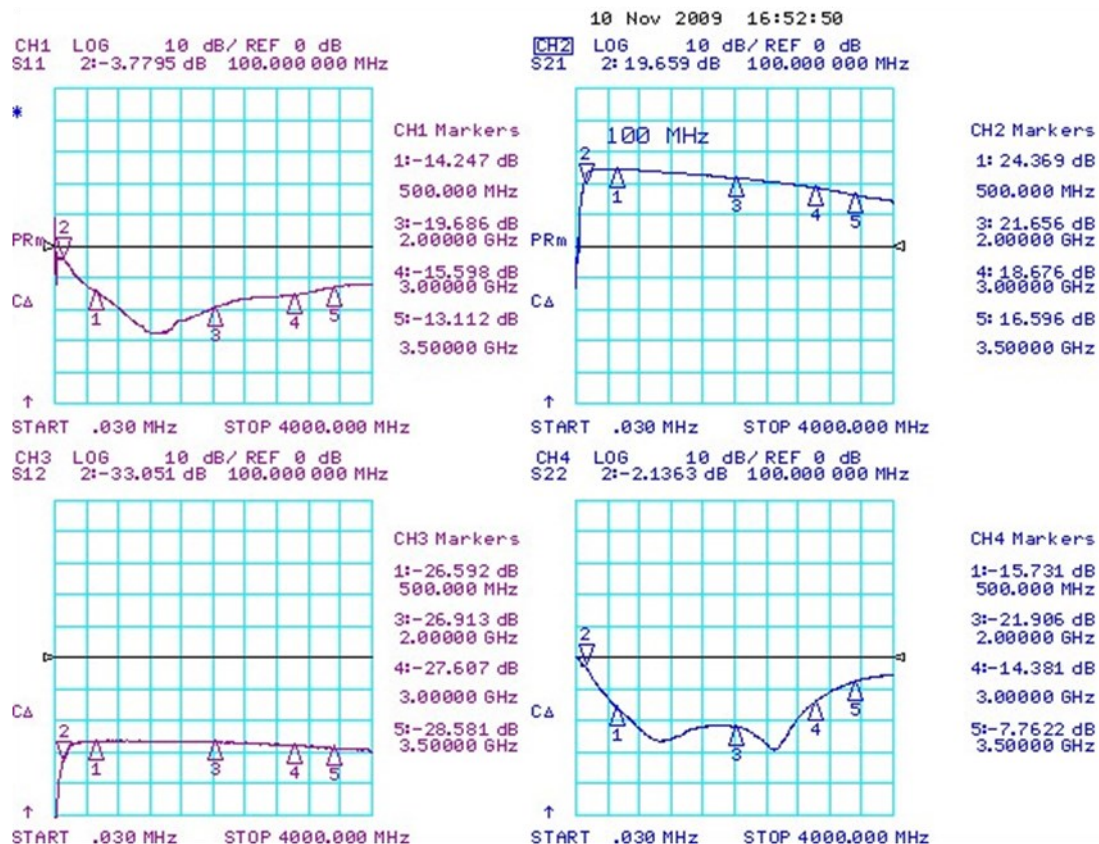
BeRex SOT89 Evaluation Board



\*Dielectric constant \_ 4.2 \*RF pattern width 52mil \*31mil thick FR4 PCB

## Typical Device Data

S-parameters (Vc=5V, Ic=83mA, T=25°C)



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## 5-4000 MHz Cascadable InGaP HBT Gain Block

### S-Parameter

(V<sub>device</sub> = 5.0V, I<sub>cc</sub> = 83mA, T = 25 °C, calibrated to device leads)

| Freq  | S11   | S11    | S21    | S21   | S12   | S12   | S22   | S22   |
|-------|-------|--------|--------|-------|-------|-------|-------|-------|
| [MHz] | [Mag] | [Ang]  | [Mag]  | [Ang] | [Mag] | [Ang] | [Mag] | [Ang] |
| 100   | 0.396 | -172.9 | 21.635 | 167.2 | 0.037 | 13.3  | 0.348 | -31.5 |
| 500   | 0.463 | 152.6  | 16.700 | 143.9 | 0.049 | 1.9   | 0.181 | -58.7 |
| 1000  | 0.409 | 123.5  | 15.718 | 118.7 | 0.046 | -3.2  | 0.105 | -97.0 |
| 1500  | 0.333 | 96.2   | 14.241 | 91.3  | 0.048 | -5.2  | 0.052 | 178.7 |
| 2000  | 0.206 | 68.2   | 12.533 | 65.3  | 0.047 | -11.8 | 0.099 | 90.5  |
| 2500  | 0.095 | 30.0   | 12.252 | 39.1  | 0.047 | -15.5 | 0.206 | 50.8  |
| 3000  | 0.034 | -168.1 | 10.439 | 2.7   | 0.044 | -18.6 | 0.309 | 25.6  |
| 3500  | 0.159 | 160.8  | 7.002  | -23.6 | 0.045 | -22.9 | 0.392 | -7.8  |
| 4000  | 0.233 | 126.3  | 5.014  | -41.4 | 0.043 | -26.8 | 0.048 | -33.6 |

Typical Performance (V<sub>d</sub> = 5V, I<sub>c</sub> = 80mA, T = 25°C)

| Freq | MHz | 70   | 150  | 250  | 500  | 900  | 1900 | 2140 | 2450 | 3500 |
|------|-----|------|------|------|------|------|------|------|------|------|
| S21  | dB  | 24.9 | 24.6 | 24.4 | 24.1 | 23.8 | 21.9 | 21.4 | 20.5 | 14.2 |
| S11  | dB  | 13.1 | 14.4 | 15.3 | 16.5 | 20.6 | 21.7 | 21.7 | 21.2 | 19.5 |
| S22  | dB  | 8.3  | 10.7 | 12.4 | 13.9 | 23.0 | 31.0 | 36.8 | 30.9 | 5.2  |
| P1   | dBm | 18.1 | 19.3 | 19.6 | 19.7 | 19.9 | 19.3 | 19.6 | 18.2 | 12.5 |
| OIP3 | dBm | 36.5 | 35.5 | 36.0 | 35.5 | 35.0 | 32.5 | 33.0 | 31.0 | 21.0 |
| P1   | dB  | 5.0  | 4.7  | 4.8  | 4.9  | 4.9  | 5.0  | 5.2  | 5.5  | 6.0  |

Typical Performance (V<sub>d</sub> = 4.7V, I<sub>c</sub> = 64mA, T = 25°C)

| Freq | MHz | 70   | 150  | 250  | 500  | 900  | 1900 | 2140 | 2450 | 3500 |
|------|-----|------|------|------|------|------|------|------|------|------|
| S21  | dB  | 24.5 | 24.3 | 24.1 | 23.8 | 23.7 | 21.8 | 21.3 | 20.6 | 14.2 |
| S11  | dB  | 12.2 | 13.3 | 14.1 | 15.3 | 18.7 | 22.8 | 22.5 | 21.5 | 19.0 |
| S22  | dB  | 7.8  | 10.1 | 11.7 | 13.0 | 20.8 | 27.0 | 30.0 | 34.7 | 5.3  |
| P1   | dBm | 17.2 | 17.9 | 17.9 | 17.9 | 18.2 | 18.3 | 18.6 | 17.4 | 11.9 |
| OIP3 | dBm | 32.0 | 31.5 | 32.5 | 32.0 | 32.0 | 31.5 | 32.0 | 30.0 | 20.0 |
| P1   | dB  | 4.7  | 4.4  | 4.6  | 4.6  | 4.6  | 4.7  | 4.8  | 5.1  | 5.5  |

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## 5-4000 MHz Cascadable InGaP HBT Gain Block

Typical Performance (Vd = 4.5V, Ic = 54mA, T = 25°C)

| Freq | MHz | 70   | 150  | 250  | 500  | 900  | 1900 | 2140 | 2450 | 3500 |
|------|-----|------|------|------|------|------|------|------|------|------|
| S21  | dB  | 24.3 | 24.0 | 23.9 | 23.6 | 23.5 | 21.8 | 21.3 | 20.6 | 14.3 |
| S11  | dB  | 11.6 | 12.5 | 13.2 | 14.2 | 17.2 | 22.6 | 22.0 | 20.8 | 19.3 |
| S22  | dB  | 7.5  | 9.7  | 11.2 | 12.4 | 19.0 | 24.5 | 26.8 | 36.1 | 5.3  |
| P1   | dBm | 15.6 | 16.0 | 16.5 | 16.7 | 16.7 | 17.6 | 17.9 | 16.7 | 11.5 |
| OIP3 | dBm | 29.0 | 29.0 | 29.5 | 29.5 | 29.5 | 29.5 | 30.0 | 28.0 | 19.5 |
| P1   | dB  | 4.4  | 4.0  | 4.2  | 4.3  | 4.1  | 4.2  | 4.3  | 4.5  | 4.7  |

Typical Performance (Vd = 4.0V, Ic = 34mA, T = 25°C)

| Freq | MHz | 70   | 150  | 250  | 500  | 900  | 1900 | 2140 | 2450 | 3500 |
|------|-----|------|------|------|------|------|------|------|------|------|
| S21  | dB  | 22.8 | 22.7 | 22.6 | 22.4 | 22.5 | 21.2 | 20.8 | 20.2 | 14.3 |
| S11  | dB  | 9.3  | 9.7  | 10.1 | 10.7 | 12.5 | 17.7 | 17.1 | 16.1 | 21.8 |
| S22  | dB  | 6.2  | 7.9  | 9.1  | 10.0 | 13.8 | 18.0 | 19.2 | 23.6 | 5.5  |
| P1   | dBm | 10.3 | 10.8 | 11.3 | 11.6 | 11.4 | 12.8 | 15.0 | 14.7 | 10.6 |
| OIP3 | dBm | 23.0 | 22.5 | 23.0 | 23.0 | 20.5 | 20.5 | 22.0 | 20.5 | 17.5 |
| P1   | dB  | 4.4  | 4.0  | 4.2  | 4.3  | 4.1  | 4.2  | 4.3  | 4.5  | 4.7  |

Typical Performance (Vd = 3.5V, Ic = 21mA, T = 25°C)

| Freq | MHz | 70   | 150  | 250  | 500  | 900  | 1900 | 2140 | 2450 | 3500 |
|------|-----|------|------|------|------|------|------|------|------|------|
| S21  | dB  | 18.0 | 18.0 | 17.9 | 17.9 | 18.6 | 18.5 | 18.5 | 18.4 | 14.3 |
| S11  | dB  | 5.2  | 5.1  | 5.1  | 5.3  | 5.8  | 7.3  | 7.2  | 6.8  | 16.2 |
| S22  | dB  | 3.6  | 4.6  | 5.1  | 5.5  | 6.7  | 8.7  | 9.1  | 10.3 | 7.2  |
| P1   | dBm | 4.4  | 5.0  | 5.4  | 5.3  | 4.2  | 4.9  | 10.4 | 12.9 | 10.0 |
| OIP3 | dBm | 17.5 | 17.5 | 17.0 | 17.5 | 18.0 | 19.5 | 20.0 | 21.0 | 16.0 |
| P1   | dB  | 4.2  | 3.9  | 4.2  | 4.2  | 4.1  | 4.1  | 4.1  | 4.3  | 4.4  |

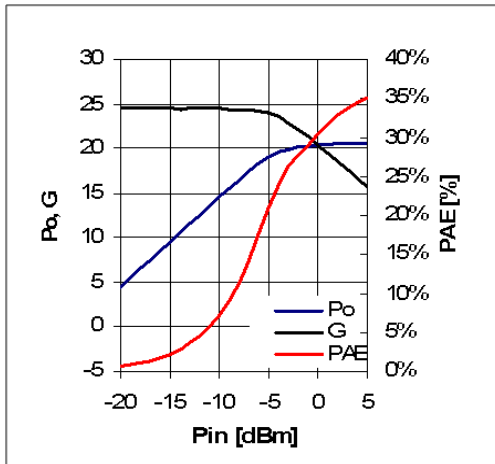
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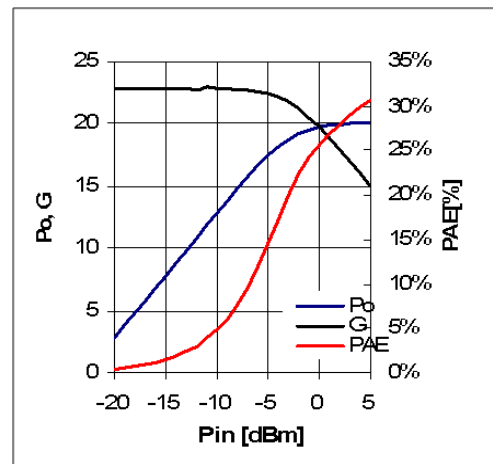


## Device Performance

Pin-Pout-Gain



900MHz, 5V/78mA



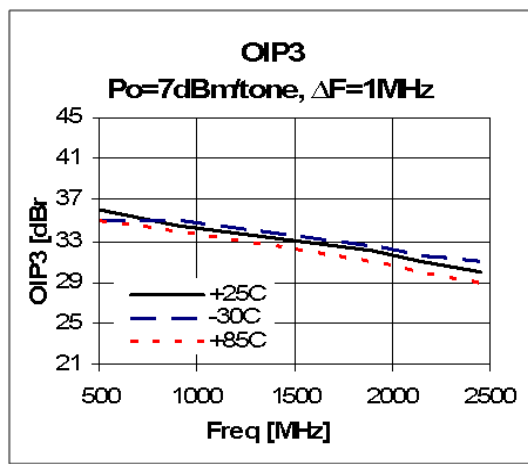
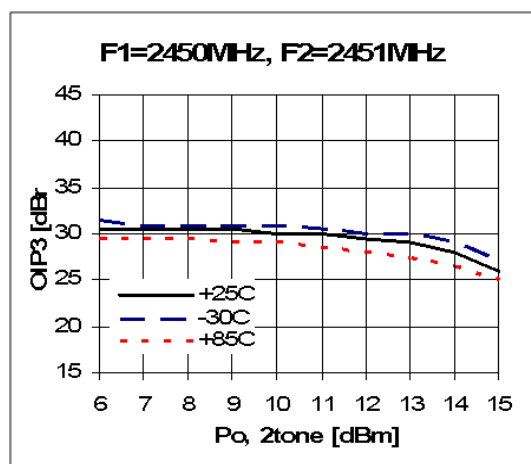
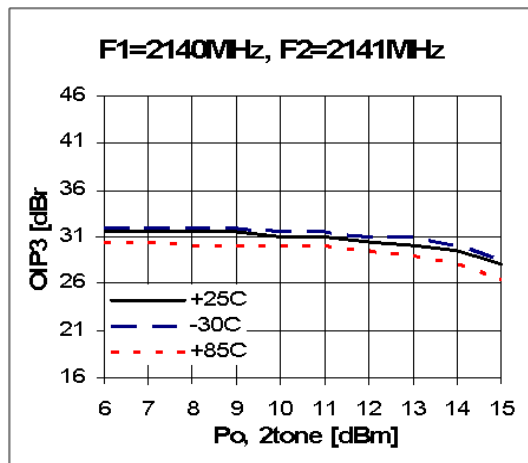
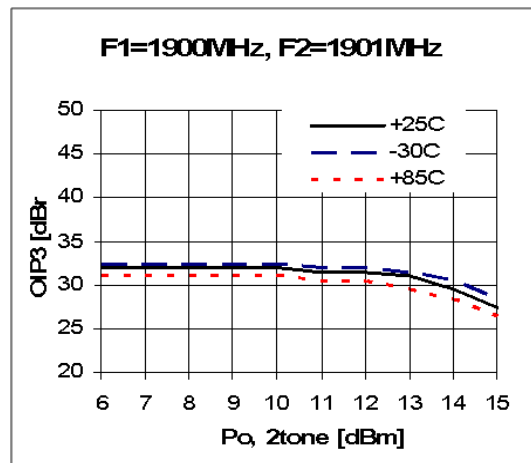
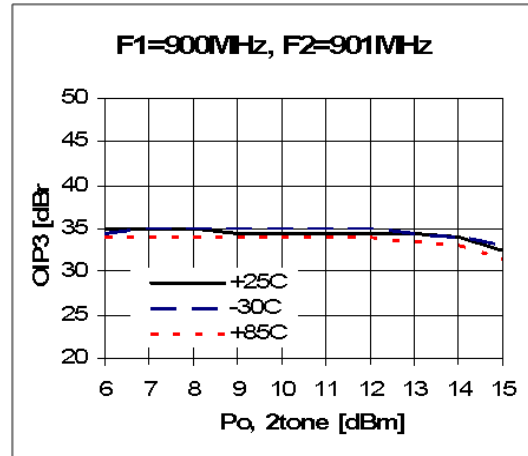
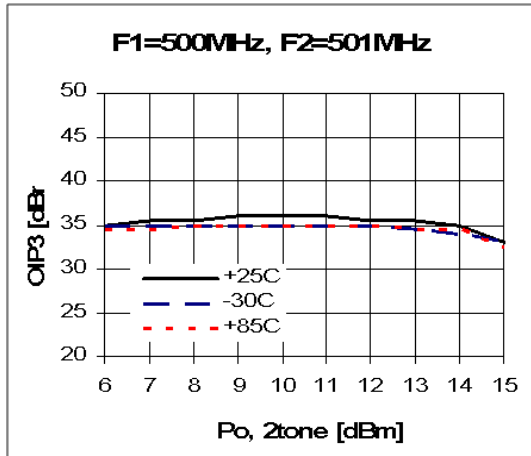
1900 MHz, 5V/78mA

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## OIP3

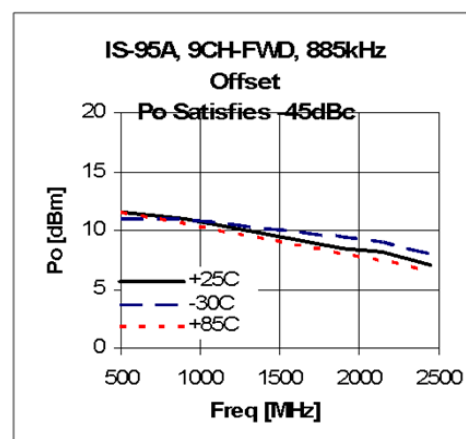
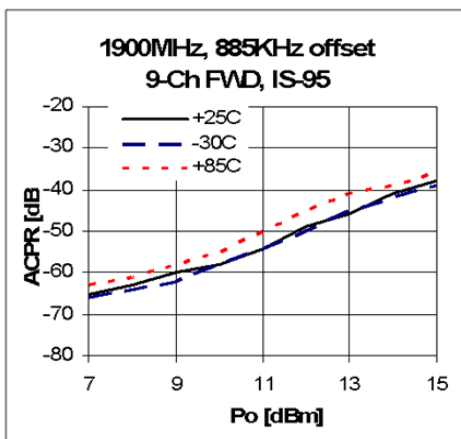
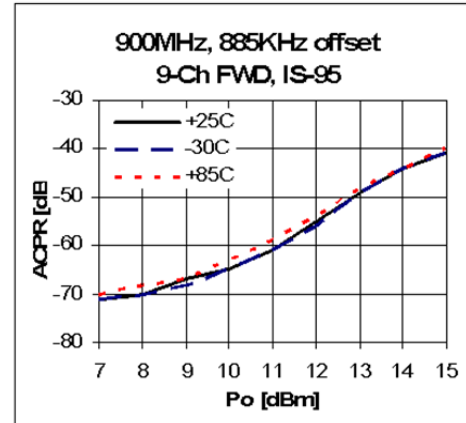
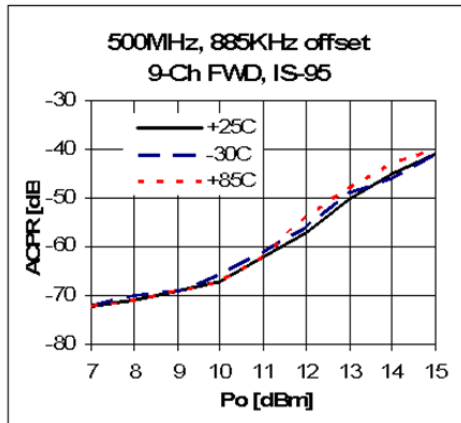


# BG18D

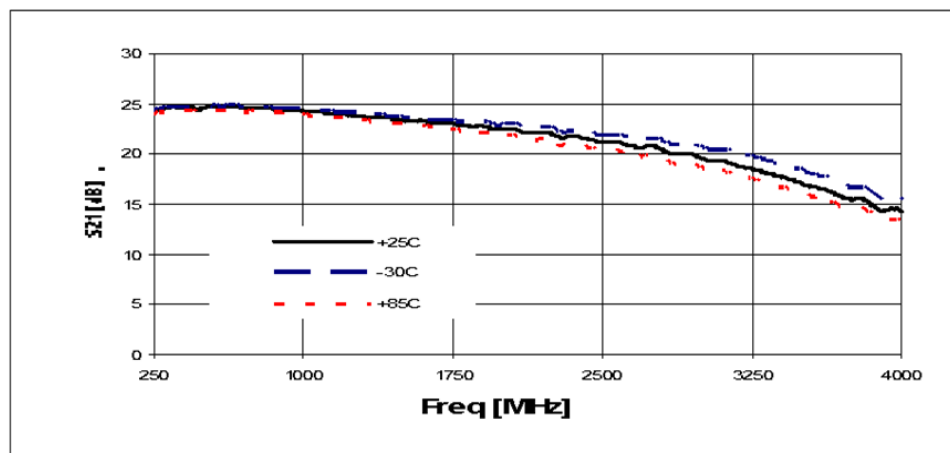
5-4000 MHz Cascadable InGaP HBT Gain Block



## ACPR



## Gain Flatness

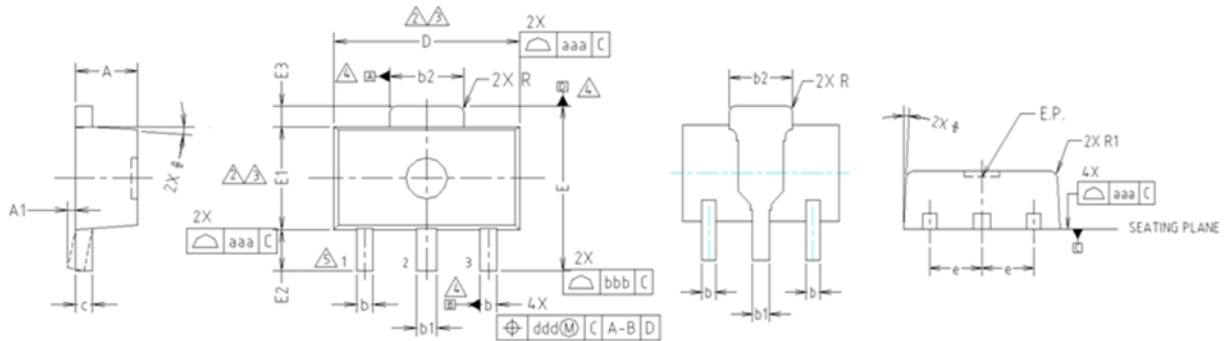


# BG18D

## 5-4000 MHz Cascadable InGaP HBT Gain Block



### Package Outline Dimension



**NOTE:**

1. DIMENSIONS IN MILLIMETERS.

⚠ DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.5mm PER END. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.5mm PER SIDE.

⚠ DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.

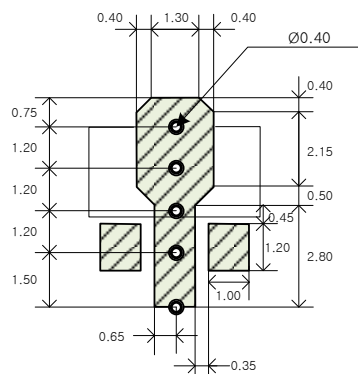
⚠ DATUMS A, B AND D TO BE DETERMINED 0.18mm FROM THE LEAD TIP.

⚠ TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.

| SYMBOL | MILLIMETERS                     |         |         | NOTE |
|--------|---------------------------------|---------|---------|------|
|        | MINIMUM                         | NOMINAL | MAXIMUM |      |
| A      | 1.40                            | 1.50    | 1.60    |      |
| A1     | 0.00                            | —       | 0.10    |      |
| b      | 0.38                            | 0.42    | 0.48    |      |
| b1     | 0.48                            | 0.52    | 0.58    |      |
| b2     | 1.79                            | 1.82    | 1.87    |      |
| c      | 0.40                            | 0.42    | 0.46    |      |
| D      | 4.40                            | 4.50    | 4.70    | 2,3  |
| E      | 3.70                            | 4.00    | 4.30    |      |
| E1     | 2.40                            | 2.50    | 2.70    | 2,3  |
| E2     | 0.80                            | 1.00    | 1.20    |      |
| E3     | 0.40                            | 0.50    | 0.60    |      |
| e      | 1.50 TYP.                       |         |         |      |
| φ      | 4° TYP.                         |         |         |      |
| R      | 0.15 TYP.                       |         |         |      |
| R1     | —                               | —       | 0.20    |      |
| SYMBOL | TOLERANCES OF FORM AND POSITION |         | NOTE    |      |
|        |                                 |         |         |      |
| aaa    | 0.15                            |         |         |      |
| bbb    | 0.20                            |         |         |      |
| ccc    | 0.10                            |         |         |      |
| ddd    | 0.10                            |         |         |      |

### Suggested PCB Land Pattern and PAD Layout

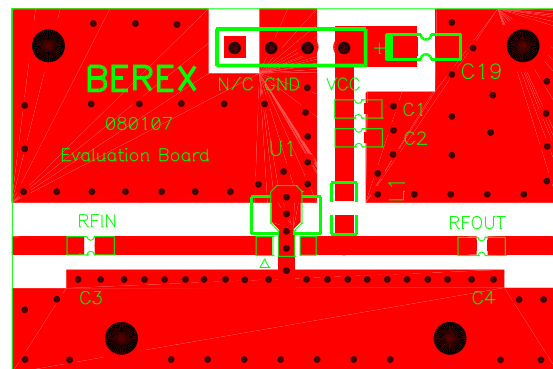
#### PCB Land Pattern



Note : All dimension \_ millimeters

PCB lay out \_ on BeRex website

#### PCB Mounting



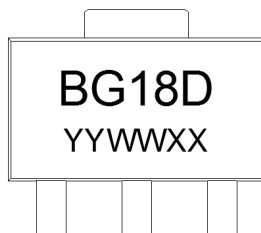


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## Package Marking

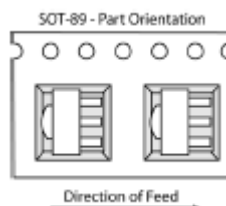


Pin 1

YY = Year, WW = Working Week,  
XX = Wafer No.

## Tape & Reel

SOT89



Packaging information:

Tape Width (mm): 12

Reel Size (inches): 7

Device Cavity Pitch (mm): 8

Devices Per Reel: 1000

## Lead plating finish

100% Tin Matte finish

(All BeRex products undergoes a 1 hour, 150 degree C, Anneal bake to eliminate thin whisker growth concerns.)

## MSL / ESD Rating

|                    |                                            |
|--------------------|--------------------------------------------|
| <b>ESD Rating:</b> | Class 1C                                   |
| <b>Value:</b>      | <b>Passes &lt;2000V</b>                    |
| <b>Test:</b>       | Human Body Model (HBM)                     |
| <b>Standard:</b>   | JEDEC Standard JESD22-A114B                |
| <b>MSL Rating:</b> | <b>Level 1 at +265°C convection reflow</b> |
| <b>Standard:</b>   | JEDEC Standard J-STD-020                   |

## NATO CAGE code:

|   |   |   |   |   |
|---|---|---|---|---|
| 2 | N | 9 | 6 | F |
|---|---|---|---|---|