HzBeat

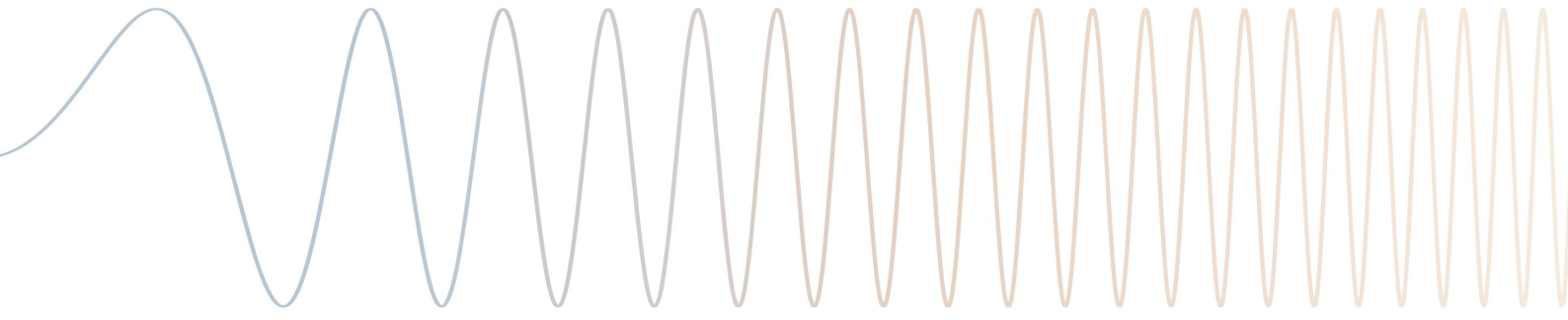
Product Manual

Microstrip | Drop-in | Coaxial | Waveguide
Circulator and Isolator

hzbeat.com

“Power in Every Small Beat”

In the world of wireless communication, every signal, every connection, every breakthrough has a rhythm—a fundamental, essential beat. We ensure there is power in every beat—power to connect, to protect, to discover, and to advance.
We are Hzbeat. We power the signal of tomorrow.



About HzBeat

Shaping the Future of RF Technology: Chengdu Hzbeat Electronic Technology Co., Ltd. (Hzbeat)

At Hzbeat, we engineer the RF solutions that power tomorrow's technologies. As a specialized high-tech manufacturer, we develop groundbreaking RF products from 20MHz to 200GHz, enabling innovation across global industries.

Our Impact:

From 5G base stations and radar systems to satellite communications and critical disaster control units, our components are at the heart of advanced applications. We are a preferred supplier for leading communication giants and vital national projects.

Our Promise:

We don't just sell products; we deliver partnerships. Our focus is on providing high-performance, cost-effective, and highly customized solutions that give our customers a competitive edge.Partner with Hzbeat to leverage our expertise and build the transformative technologies of tomorrow, together.

About HzBeat

2009
The factory was established.

2011
Obtained China's National Military Standard Quality Management System Certification.

2020
Served as one of the suppliers for more than 10 national key projects.

2021
HzBeat was established as an R&D center composed of senior microwave engineers.

2024
Began exploring international business.

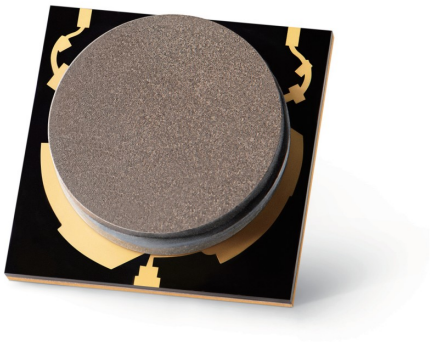
PRODUCTION FACTORY

Substrate Processing

PRODUCTION ENVIRONMENT

OUR SERVICE

RF Circulators & Isolators Solutions



R&D | Technology | Innovate | Cooperation

20MHz —— 200GHz

Product Advantages

- Small size
- Ultra-wide band
- Withstand high power

Customization process

1.Finalize the Plan

- Analyze and formulate a plan.
- Finalize the product specifications.
- Submit a specification and quotation, and signthe contract.

2.Design for Production

- Modeling and simulation, and then creating prototypes.
- Reliability Testing.
- Batch Production.

3.Inspection and Testing

- Extreme Temperature Electrical Performance Testing.
- Inspecting tolerances and appearance.
- Product Reliability Testing.

4.Packaging and Shipping

- Box/ Reel/ Customize
- DHL/ Fedex/ UPS

Product Grade Options

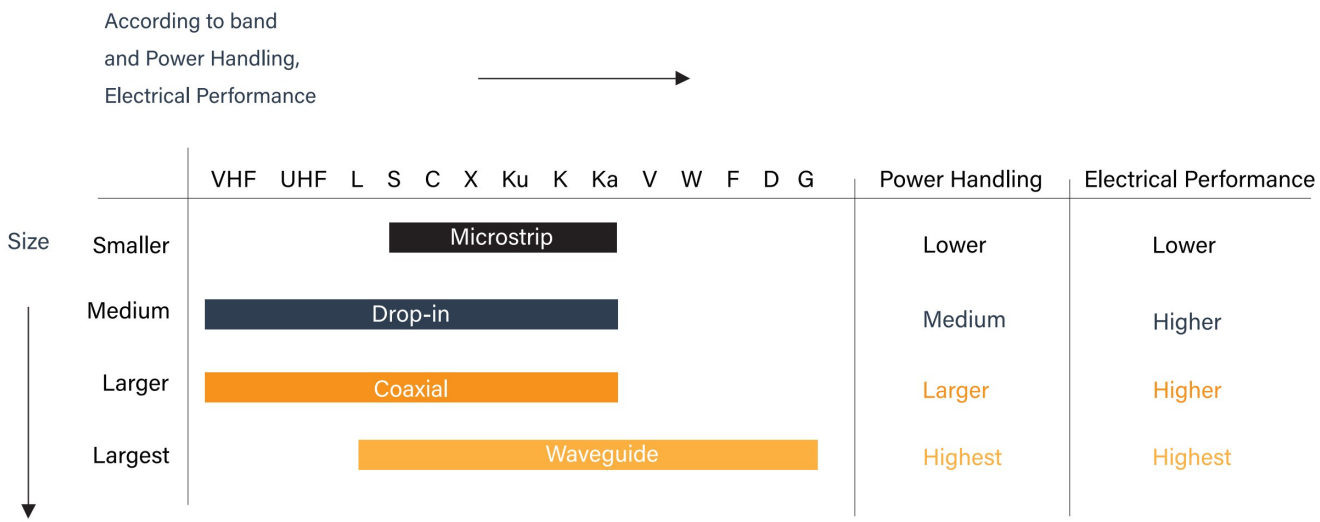
Industrial, Military & Space Grade RF Circulators and Isolators

HzBeat provides RF circulators and isolators in industrial-grade, military-grade, and space-grade configurations. Each grade is defined by application environment, electrical performance verification, environmental screening, traceability, and documentation requirements..

Item	Industrial Grade	Military Grade	Space Grade
Typical Application	5G/6G infrastructure, RF testing systems, industrial communication, etc.	Radar, military communication, electronic countermeasures, airborne/shipborne/ground-based platforms, etc.	Satellite communication, space payloads, space radio frequency links, etc.
Electrical Performance	(1) Insertion Loss (2) Reverse Loss (3) VSWR (4) Power handling / tolerance (design guaranteed) (5) Frequency range & operating bandwidth	(1) Insertion Loss (2) Reverse Loss (3) VSWR (4) Power handling / tolerance (design guaranteed) (5) Frequency range & operating bandwidth	(1) Insertion Loss (2) Reverse Loss / Isolation (3) VSWR (4) Power handling / tolerance (design guaranteed) (5) Frequency range & operating bandwidth (6) Full-band RF verification before / after screening
Environmental Adaptability	(1) High/low temperature operation: –55°C to +85°C (one unit sample test)	(1) High/low temperature operation: –55°C to +85°C (2) Acceleration test: 10 g (3) Temperature cycling: –55°C — +85°C (4) Constant damp heat (5) Salt spray (6) Fungus (on request) (7) Low pressure (high altitude / airborne)	(1) High/low temperature operation: -55°C to +85°C or mission-specific (2) Temperature cycling: -55°C to +85°C or mission-specific (3) Thermal vacuum test(upon request) (4) Low pressure / vacuum compatibility (5) Constant damp heat(ground storage / launch-site requirement) (6) Salt spray (upon request) (7) Fungus(upon request) (8) Low-outgassing material control
Mechanical & Physical	(1) Appearance, dimensions, weight (sample test)	(1) Appearance, dimensions, weight (2) Harmonic vibration (3) Mechanical shock (4) Acoustic noise (60 seconds continuous)	(1) Appearance, dimensions, weight (2) Harmonic vibration (3) Random vibration (4) Mechanical shock (5) Acoustic noise (upon launch-profile requirement) (6) Connector retention and mounting integrity
Additional Specifications	(1) Resource (MTBF equivalent): 11,000 hours (design guaranteed) (2) Service life: 5 years (design guaranteed) (3) Weight: <80 g	(1) Resource: 11,000 hours (2) Service life: 5 years (3) Weight: <80 g	(1) Resource / mission life: project-defined (2) MTBF equivalent: mission-specific (3) Weight: <80 g or project-specific (4) Full material / process / test traceability

PRODUCT DIFFERENTIATION

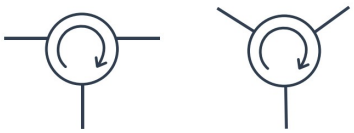
Through the two charts below, you can get a rough understanding of the differences in size, power, and Electrical performance of different product types. It also demonstrates the frequency range that different types of products are suitable to cover.



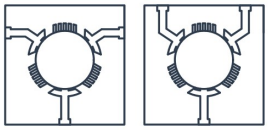
*Note: that the evaluations in the table are still based on general comparisons, and the specific circumstances and performance may vary depending on design requirements, materials used, and other factors.

Y-Junction and T-Junction Structures

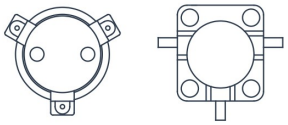
HzBeat microstrip and Drop-in circulators are designed using two proven junction topologies: Y-junction and T-junction structures.Each topology exhibits distinct electromagnetic characteristics, bandwidth capability, physical size, and design flexibility, making them suitable for different frequency bands and system requirements.



(Y-junction and T-junction structures)



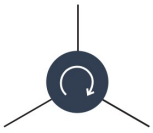
(Microstrip)



(Drop-in)

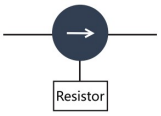
PRODUCT WORKING PRINCIPLE

Circulators and isolators are passive electronic components, and they are the only non-reciprocal products among all electronic components.



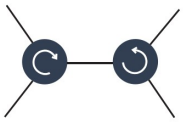
RF Circulator

A three-port device where signals transmit unidirectionally in the order T→ANT→R. Forward transmission (T→ANT, ANT→R) exhibits low loss, while reverse isolation is high. Direction (clockwise/counterclockwise) can be customized. Commonly used in T/R modules.



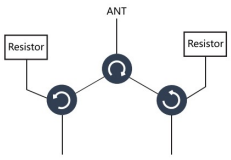
RF Isolator

Based on the circulator, with one port terminated into a matched resistor, forming a two-port device. Forward transmission (T→ANT) has low loss, while reflected signals from ANT are absorbed by the resistor, protecting the power amplifier. Suitable for transmit-only or receive-only components.



Dual-Junction Circulator

Integrates a circulator and an isolator. The signal path remains T→ANT→R. The key enhancement is that signals reflected from the R port are directed to an internal resistor for absorption, preventing them from returning to the T port. This combines unidirectional transmission with power amplifier protection.



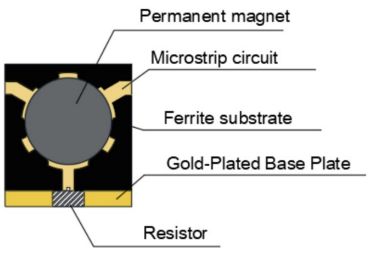
Triple-Junction Circulator

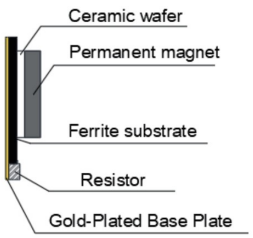
An enhanced version of the Dual-Junction Circulator. It corporates an isolator between T→ANT and adds high reverse loss plus an additional resistor between R→T. This design significantly improves power amplifier protection. It can be customized based on frequency range, power, and size requirements.

THE STRUCTURE AND MANUFACTURING PROCESS OF THE PRODUCT

structure diagram

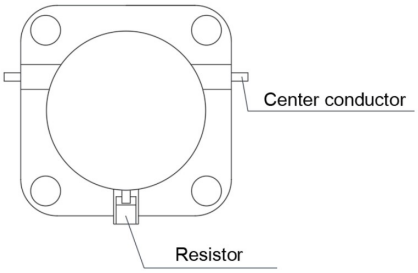
Microstrip circulators/isolators adopt a thin-film circuit fabrication process featuring high precision, high reliability, and high consistency. The product has a simple structure and adopts a surface-mount configuration.

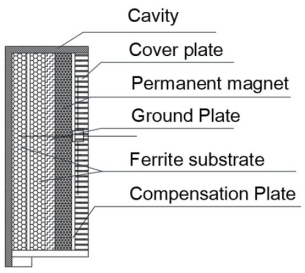




Structural representation

Drop-in isolators/circulators are typically designed using distributed parameters. Common structures include connectors (coaxial type) and chip resistors, resulting in a simple and reliable product structure.





Manufacturing process

Microstrip Components

The circuit substrate and backplane are soldered. The solder is solder paste, or solder lug.
The bonding processis adopted between the circuit substrate,support medium, compensation sheet, and permanent magnet

Drop-in/Coaxial Components

The Drop-in circuit is beryllium bronze plated with gold or copper and silver.There sistance andcavity adopt welding process, the solder is solder paste, and the welding temperature is 205 °C.
Thebondingprocessis adopted between the ferrite substrate, support medium, compensation sheet, permanent magnet and magnetic circuit, and the adhesive is X98-11 acetal drying glue,and the curing temperature is 150 °C.
The coating layer of the product shell is: industrial pure ironcopper plating nickel plating.
The coaxial producthas connectors added on top of the Drop-in product.

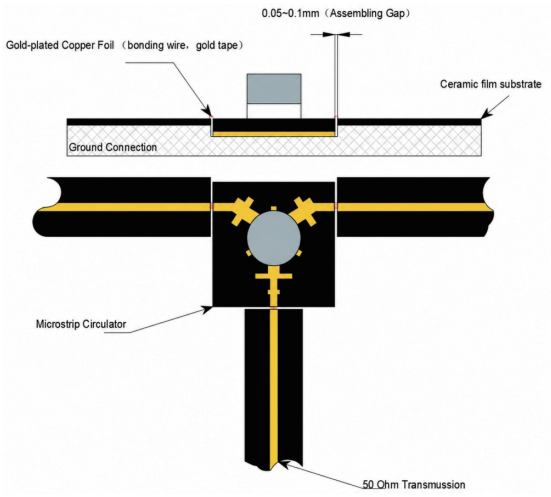
Waveguide Components

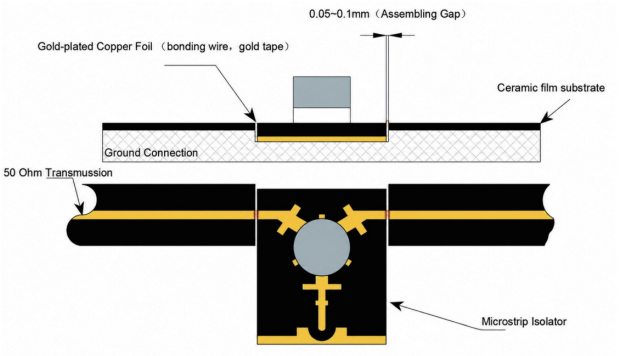
The cavity adopts duralumin conductive oxidation treatment.
The screw connection process is adopted between the cavities.
The bonding process is adopted between ferrite substrate, support medium, compensation sheet,permanent magnet and cavity.

Instructions for Use

Microstrip Components

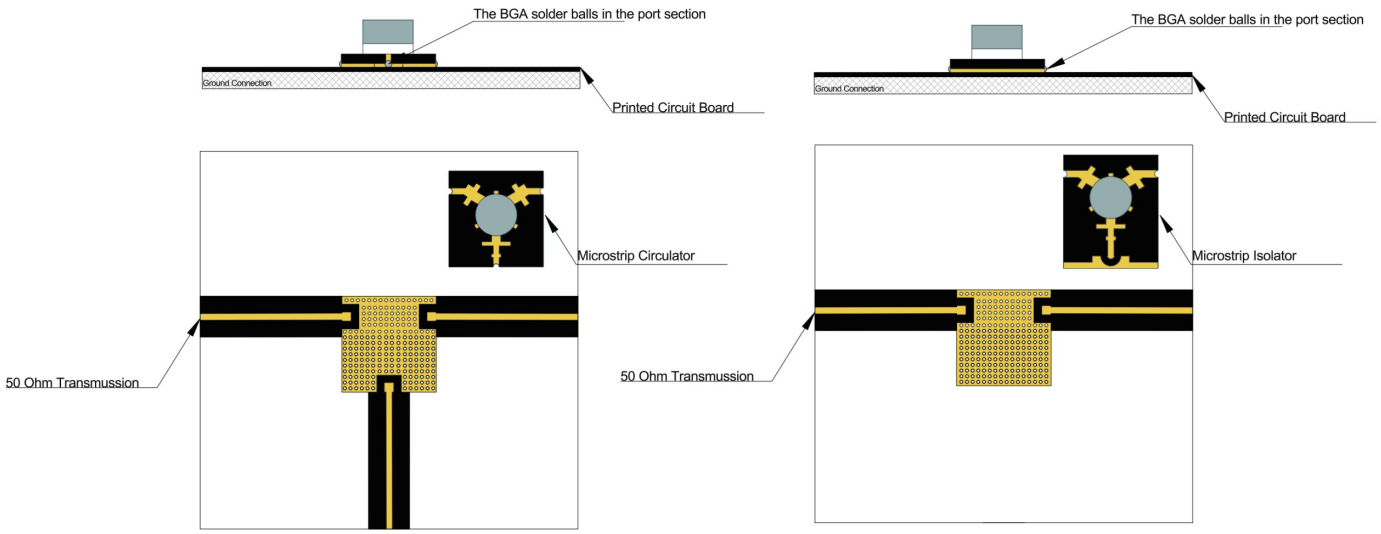
Use copper tape soldering or gold tape/wire bonding.Keep solder away from the Ω-shaped bridge section.Maintain ferrite surface temperature at 60–100°C before soldering.Gold tape width should be smaller than the microstrip line width.





Surface-Mounted Technology Circulator/Isolators

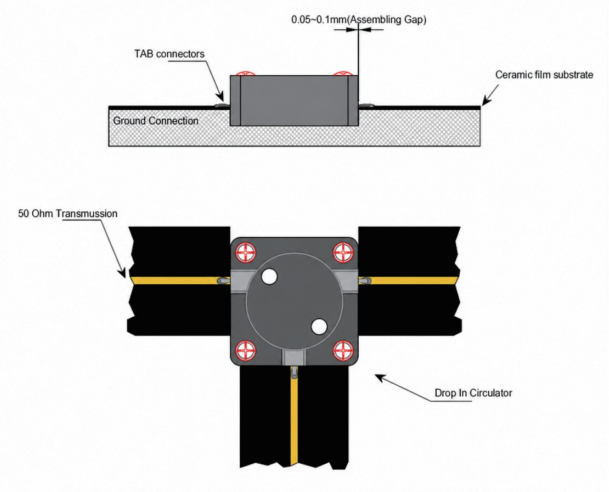
Surface-mount products use reflow soldering for batch assembly.

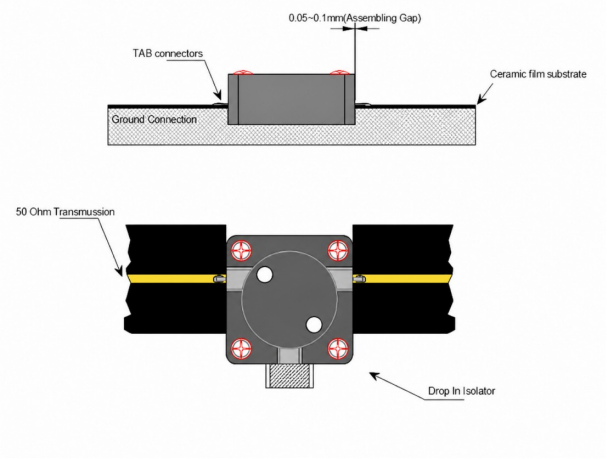


Instructions for Use

Drop-in Components

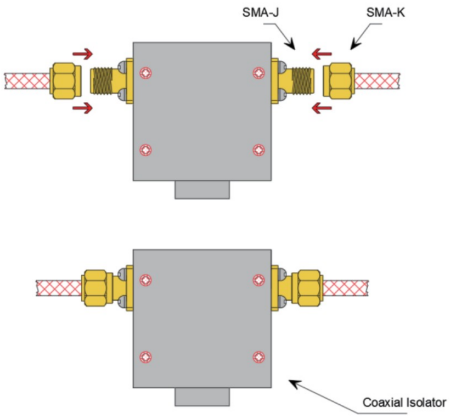
Install the drop-in circulator by placing it in the PCB cavity, aligning and soldering the ports, and ensuring solid ground contact. Then secure it with screws, keep the RF gap minimal, and verify matching with a VSWR check.

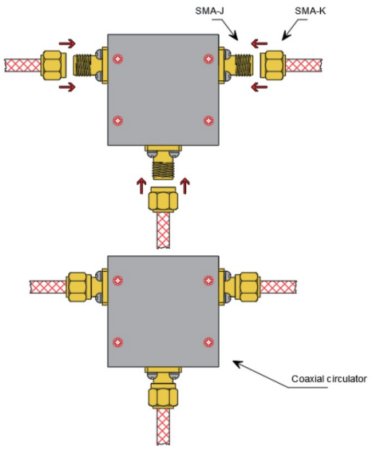




Coaxial Components

Coaxial products connect easily and mate directly with matching connector types, such as female to male.





Instructions for Use

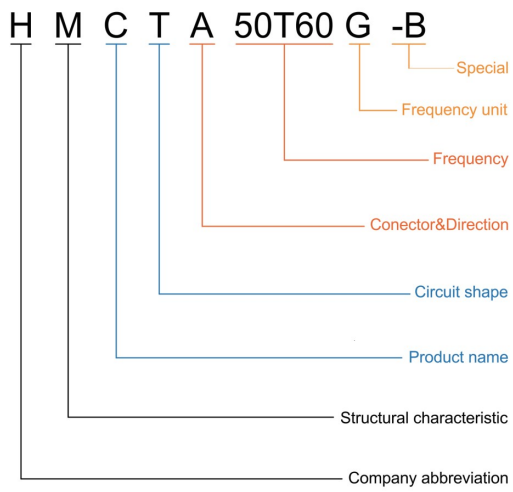
Waveguide Components

Waveguide circulators are typically installed using flange connections, with the three ports of the circulator securely connected to the system waveguides through standard waveguide flanges.

Surface-Mounted Technology Circulator/Isolators

Surface-mount products use reflow soldering for batch assembly.

Product model naming introduction



- Company abbreviation: **H**-HzBeat
- Structural characteristic: **M**-Microstrip / **D**-Drop-In / **C**-Coaxial / **W**-Waveguide
- Product name: **C**-Circulator/ **I**-Isolator / **D**-Dual-Junction Circulator/ **T**-Triple-Junction Circulator
- Circuit shape: **T**-T-shape / **Y**-Y-shape / **H**-H-shape / **U**-Unconventional shape
- Connector & Direction:
  (1)Microstrip:
  -Gold wire bonding: **A**-Clockwise / **B**-Counter Clockwise
  - Lap welding: **C**-Clockwise / **D**-Counter Clockwise
  (2).Drop-In: **C**-Clockwise / **D**-Counter Clockwise
  (3).Coaxial: **A**-Clockwise / **B**-Counter Clockwise
  (4).Waveguide: **A**-Clockwise / **B**-Counter Clockwise
  (5).Surface Mount Technology: **E**-Clockwise / **F**-Counter Clockwise
- Frequency: Start frequency point to end frequency point
- Frequency unit:**G**-GHz(10=1GHz,as shown in the figure:50=5GHz,60=6GHz); **M**-MHz.
- Special: **B**-Broadband; **M**-Miniaturized; **H**-High Power.

How to calculate relative bandwidth

Relative Bandwidth (%) = (Upper Frequency − Lower Frequency) ÷ Center Frequency × 100%
Example: For a frequency range of 2–4 GHz, the center frequency is 3 GHz, so the relative bandwidth is 66.7%.

Absolute Bandwidth

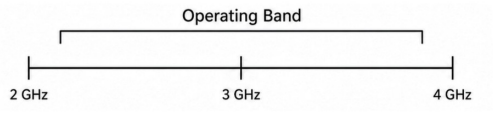
$$BW = f_H - f_L$$

$$BW = 4 - 2 = 2\ \text{GHz}$$

Center Frequency

$$f_C = \frac{f_H + f_L}{2}$$

$$f_C = \frac{4+2}{2} = 3\ \text{GHz}$$



Relative Bandwidth

$$Relative\ BW = \frac{f_H - f_L}{f_C} \times 100\%$$

$$Relative\ BW = \frac{4-2}{3} \times 100\% = 66.7\%$$

2–4 GHz
BW = 2 GHz
Relative BW = 66.7%

Tip: Use absolute bandwidth (GHz) to show the frequency range.
Use relative bandwidth (%) to show how wide the band is relative to the center frequency.