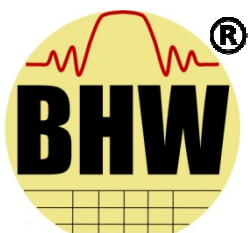




BHW Technologies (博泓微科技有限公司)



Advanced RF IC, Antenna, Filter, RF Front-End
and Wireless System Solutions

BHW Application Note #011

**BHWL161 Super-Compact Low-Power Low Noise Amplifier
for Range Extension of 2.4GHz BLE, RC and IoT**

Rev. 1.7, 11/17/2020

www.bhw-tech.com

Background: Improving Rx Sensitivity of 2.4GHz Systems



Background & Challenges:

- The 2.4GHz ISM Band is the Most Widely Used Spectrum Today, from Wi-Fi, Bluetooth, ZigBee and Other IoT Protocols, to Remote Controls, Game Consoles, Cordless Phones, Baby Monitors, as well as Microwave Ovens
- Most State-of-the-Art 2.4GHz SoCs/Transceivers Have Integrated LNAs with Good Rx Sensitivity up to $\sim -96\text{dBm}$
- For Certain Applications Especially those in Challenging RF Environments with Less-than-Perfect Antennas, it is Desirable to Improve Rx Sensitivity Further (Below -100dBm), if it can be Achieved Simply and Cost-Effectively

BHW Solutions & Benefits:

- Using Advanced GaAs HBT & ED-PHEMT Technologies, BHW has Developed a Broad Portfolio of High-Performance, Cost-Effect RF Front-End ICs for Various Wireless Applications Including the 2.4GHz ISM Band
- BHWM253 is a Common-Port Bi-Directional RF Front-End IC Integrating Amplifier and Switch into a 1.5x1.5mm DFN
- BHWA251 is a GaAs HBT PA with up to $+25\text{dBm}$ Output and Industry-Leading 50% Peak PAE in a 1.5x1.5mm DFN
- BHWM252 is a GaAs PHEMT LNA/SPDT Front-End IC with Industry-Leading 1.6dB NF in 1.5x1.5mm DFN
- Combination of BHWA251/M252 Enables up to 125dB Total Link Budget, Over 20dB Higher than that of a Standalone State-of-the-Art 2.4GHz SoC on the Market Today
- BHWL161 is a GaAs PHEMT LNA with Low NF of 1dB at Very Low-Voltage/Low-Current, in a Tiny 1x1mm DFN

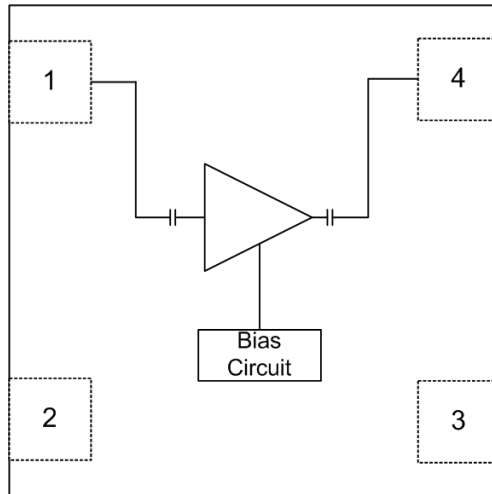
This AppNote Provides Detailed Information of BHWL161 at 2.4GHz, including Gain, Noise Figure, Input P1dB, as well as IIP3/OIP3/SFDR Analysis, as a Cost-Effective Alternative to Enhance Rx Sensitivity of 2.4GHz ISM Band Systems



BHWL161 Wideband GaAs Low Noise Amplifier

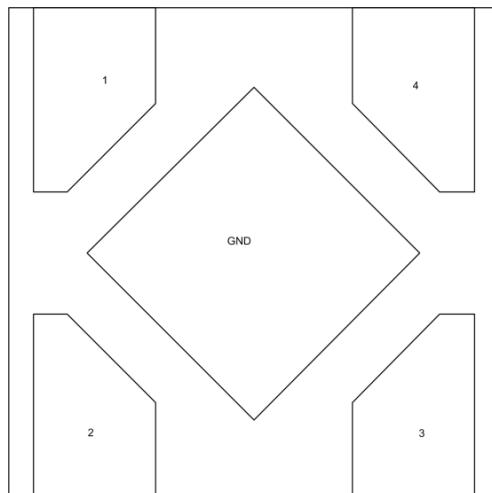


Functional Block Diagram



Package Pin-Out

(Top "See-Through" View)



DFN-4L 1.0x1.0x0.45mm



Product Overview:

- Advanced GaAs E/D-pHEMT Process
- Ultra-Wideband 700MHz~2.5GHz Operational
- Support Full-Band GNSS 1165~1610MHz
- Ultra-Low 0.45/0.4dB EVB/De-Embedded NF at L1
- NF <0.7dB at L1/L5; <0.8dB over Full GNSS Bands
- NF ~1dB when Tuned for 2.4GHz ISM Band
- Gain~12dB in 2.4GHz ISM Band
- Adjustable Current: 2~9mA at 1.2~3.6V
- ESD at All I/O Ports: 1kV HBM, >2KV CDM
- Ultra-Compact 1.0x1.0mm DFN-4L Package
- Relaxed Pin Pitch 0.65mm for Easy PCB Assembly

Applications:

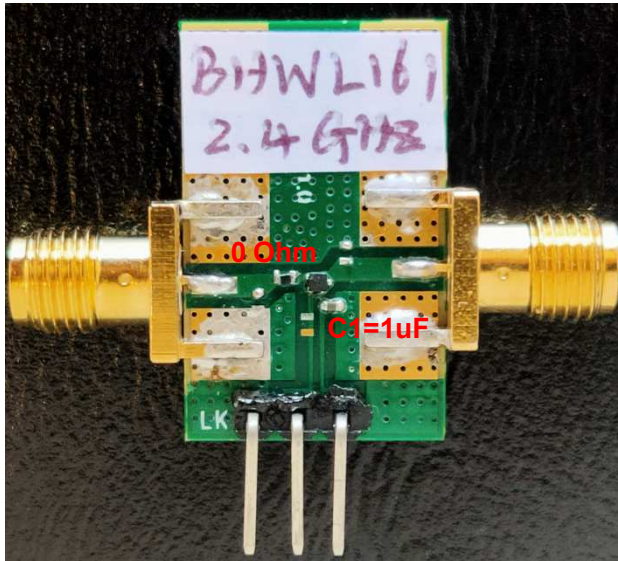
- GNSS for Smartphones, Smart Watches, Wearables
- GNSS for PNDs, UAVs and Drones
- GNSS for Vehicles, ADS Systems
- GNSS for Shared Rides, Asset Tracking
- Active GNSS Antennas & Modules
- UHF 700/868/915MHz Products
- 2.4GHz BLE AoA/AoD Systems
- 2.4GHz Remote Controls
- Other Generic Radios from Sub-GHz to 2.5GHz

BHWL161 EVB for 2.4GHz: Simplified eBOM

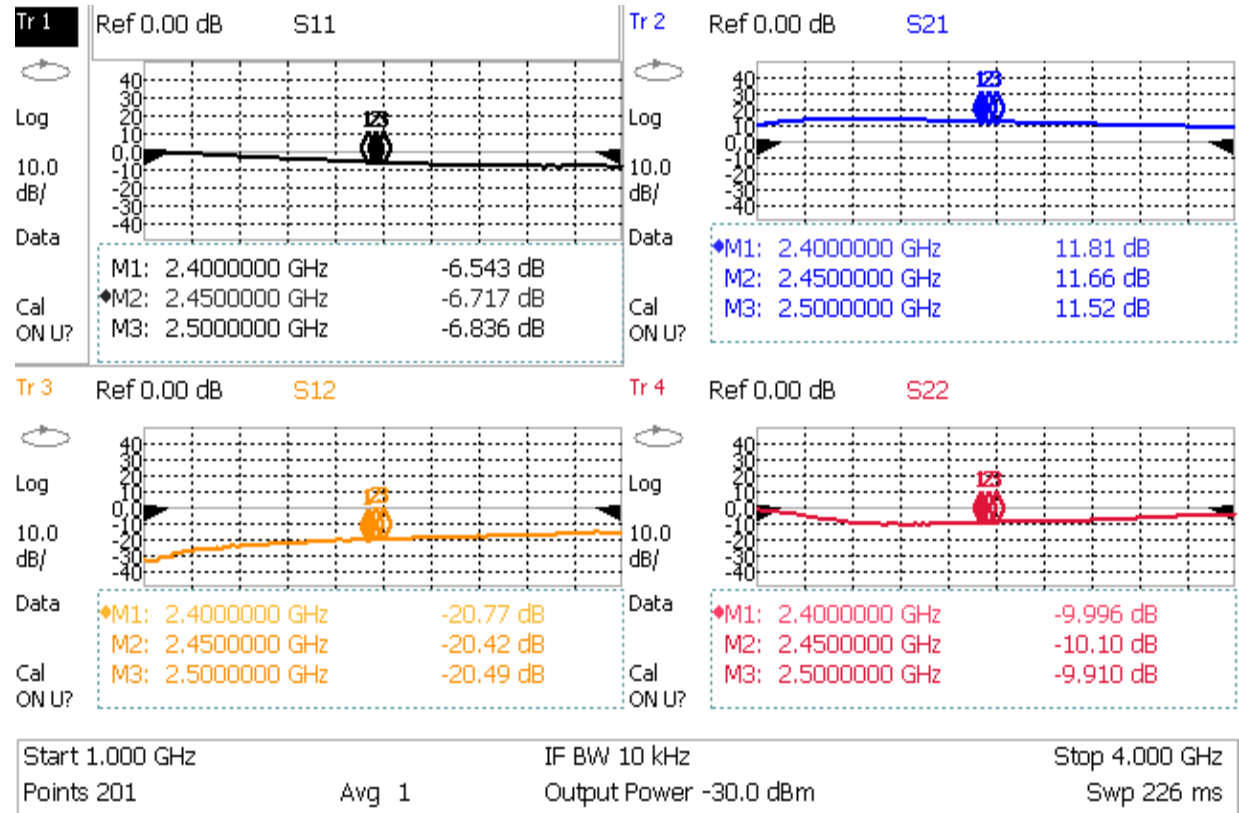


Simplified EVB with One Vdd Capacitor Only

Evaluation Board



Typical S-Parameters at Vdd=Ven=3.3V



Notes:

- No input inductor L1, C1=1uF only, Idq~7.5mA
- Only slight degradation in S11 and S21. No substantial impact on NF.
- Measured S21 included SMA connector and PCB feedline losses (~0.2dB)

BHW RF Front-End AppNote Library



For further information, please email to support@bhwtechnologies.com, or contact your local BHW Sales Rep or Distributor. We will send you the complete AppNote as well as additional related information.

In addition to standard datasheets and EVB/BOM info, BHW publishes an AppNote series that address various topics on RF front-end design and performance over a wide frequency range from 300MHz to 6GHz, as an effort to assist customers in developing cutting-edge, cost-competitive products:

- BHW AppNote #001 - Cross-Over Cascade of BHWM253 to Boost Tx Power and Rx Sensitivity of BLE and 2.4GHz IoT
- BHW AppNote #002 - Accurate Benchmark of GNSS CN0 Using the Power-Splitter Method
- BHW AppNote #003 - Boosting Wi-Fi Tx Power and Rx Sensitivity with BHWA251 and BHWM252
- BHW AppNote #004 - UHF 900MHz RF Front-End Solution Using BHWA251 Half-Watt PA and BHWL160 Sub-1dB-NF LNA
- BHW AppNote #005 - Sub-1GHz Applications of BHWA350 2-in-1 Wideband Fully Matched Amplifier
- BHW AppNote #006 - Low-Noise High-IIP3 LNB Architecture for Dual-Band High-Precision GNSS Using Cascade of BHWL160
- BHW AppNote #007 - UWB RF Front-End Solution Using BHWA350 and BHWM552
- BHW AppNote #008 - High-Power 5.8GHz RF Front-End Solution Using BHWA555 and BHWM552 for ETC, V2X and Wireless Video
- BHW AppNote #009 - 5.8GHz RF Front-End Using BHWA350 and BHWM552 for Wireless Audio
- BHW AppNote #010 - Multi-Constellation GNSS Active Antenna Using BHWL161 Cascade and Single-Fed Dual-Band Antenna
- BHW AppNote #011 - BHWL161 Super-Compact Low-Power Low Noise Amplifier for Range Extension of 2.4GHz BLE, RC and IoT
- BHW AppNote #012 - Enabling Cost-Effective High-Precision GNSS Using BHWL160 and Linear-Polarization PCB Antenna
- BHW AppNote #013 - Enabling Long-Range BLE AoA&AoD for High-Precision Indoor Positioning with BHW GaAs RF Front-End ICs
- BHW AppNote #014 - Designing Ultra Low-Power High-Performance GNSS Products Using BHWL160 GaAs PHEMT LNA
- BHW AppNote #015 - BHWL161 GNSS Full-Band High-Performance LNA in Super-Compact 1x1mm DFN with Relaxed Pin Pitch
- BHW AppNote #016 - Improving GNSS NF Measurement Accuracy Using Broadband LNA BHWL161 as Pre-Amp
- BHW AppNote #017 - High-Efficiency, Low-NF 2.4GHz Front-End Solution for BLE & IoT Using BHWA251 and BHWM252
- BHW AppNote #018 - Optimizing BHWA555 Wideband One-Watt PA for Long-Range 5.8GHz Transmitter Applications
- BHW AppNote #019 - Miniature 2.4GHz RF Front-End with Integrated Chip Antenna and BHWM253 for TWS and IoT
- BHW AppNote #020 - Doubling the Range for BLE Music Streaming with BHW250L Active Integrated Antenna (AIA)