



BHW Technologies (博泓微科技有限公司)



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

BHW AppNote #017

High-Efficiency, Low-NF 2.4GHz Front-End Solution for IoT
Using BHWA251 and BHWM252

Rev. 2.1

www.bhw-tech.com

Background: Improving Link Budget of 2.4GHz Systems



Background & Challenges:

- The 2.4GHz ISM Band is the Most Widely Used Spectrum Today, from Wi-Fi, ZigBee, Thread, and Other IoT Protocols, to Remote Controls, Game Consoles, Cordless Phones, Baby Monitors, as well as Microwave Ovens
- To Achieve Reasonably Long Range and Maintain Reliable Wireless Connection, RF Front-End with Sufficient Link Budget should be Considered at the Design Stage
- Most State-of-the-Art 2.4GHz SoCs Have Transmit Power below 8dBm due Partly to Low-Power Design Constraints
- Most State-of-the-Art 2.4GHz SoCs Have Receive Sensitivity that are Limited to the -90~-96dBm Range
- For Certain Applications Especially those in Challenging RF Environments with Less-than-Perfect Antennas, this 98~104dB Link Budget might be Insufficient to Deliver Product Performances with Satisfactory User Experience

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 +25dBm 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
- BHWL161 is a GaAs PHEMT LNA with Ultra-Low NF of 1dB at Very Low-Voltage/Low-Current, in a Tiny 1x1mm DFN
- Combination of BHWA251/M252 Enables up to 125dB Total Link Budget, Over 20dB Higher than that of some Standalone 2.4GHz SoC on the Market Today

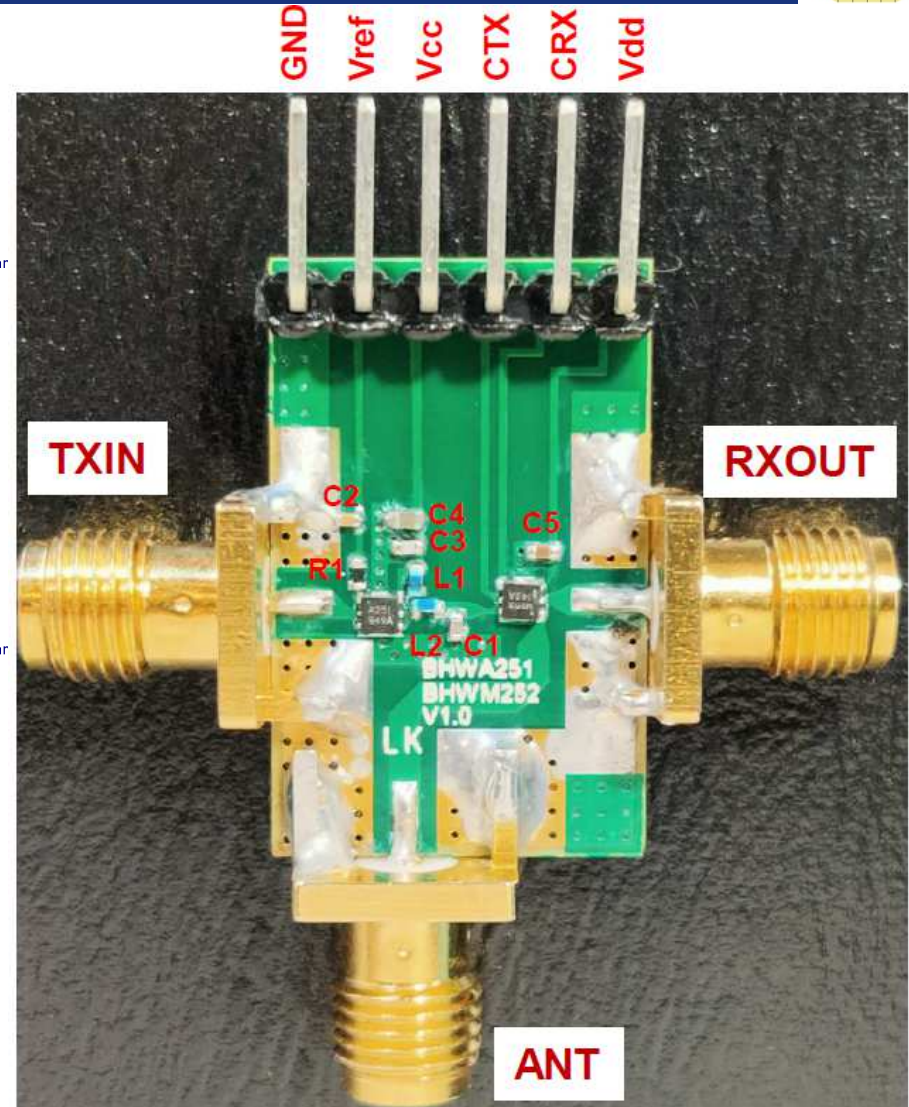
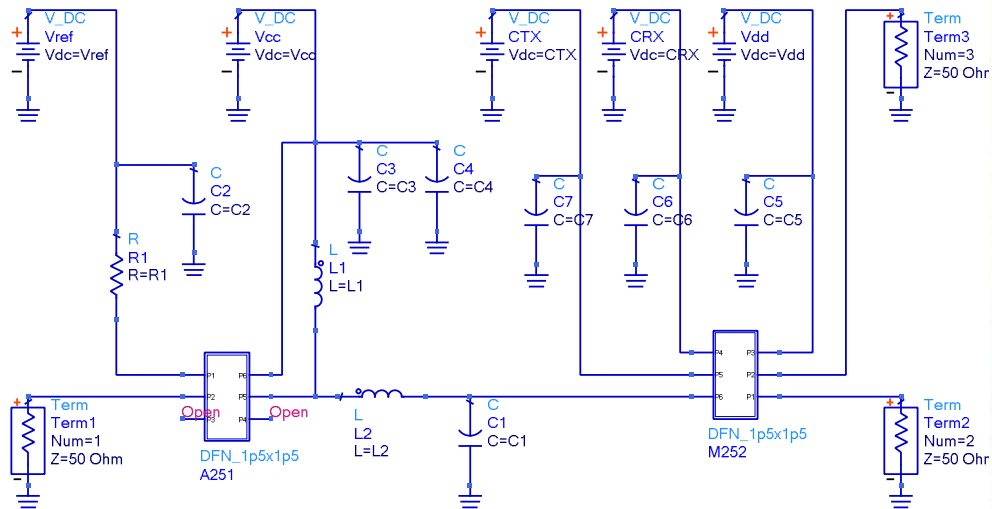
This AppNote Describes the Implementation and Test Results of a Complete 2.4GHz RF Front-End Using the BHWA251/M252 Combo, which Offers Several Advantages such as High Performance, Best-Class Power Efficiency, and Disruptive Cost Structure



BHWA251 PA & BHWM252 FEM Combo EVB



Application Schematic



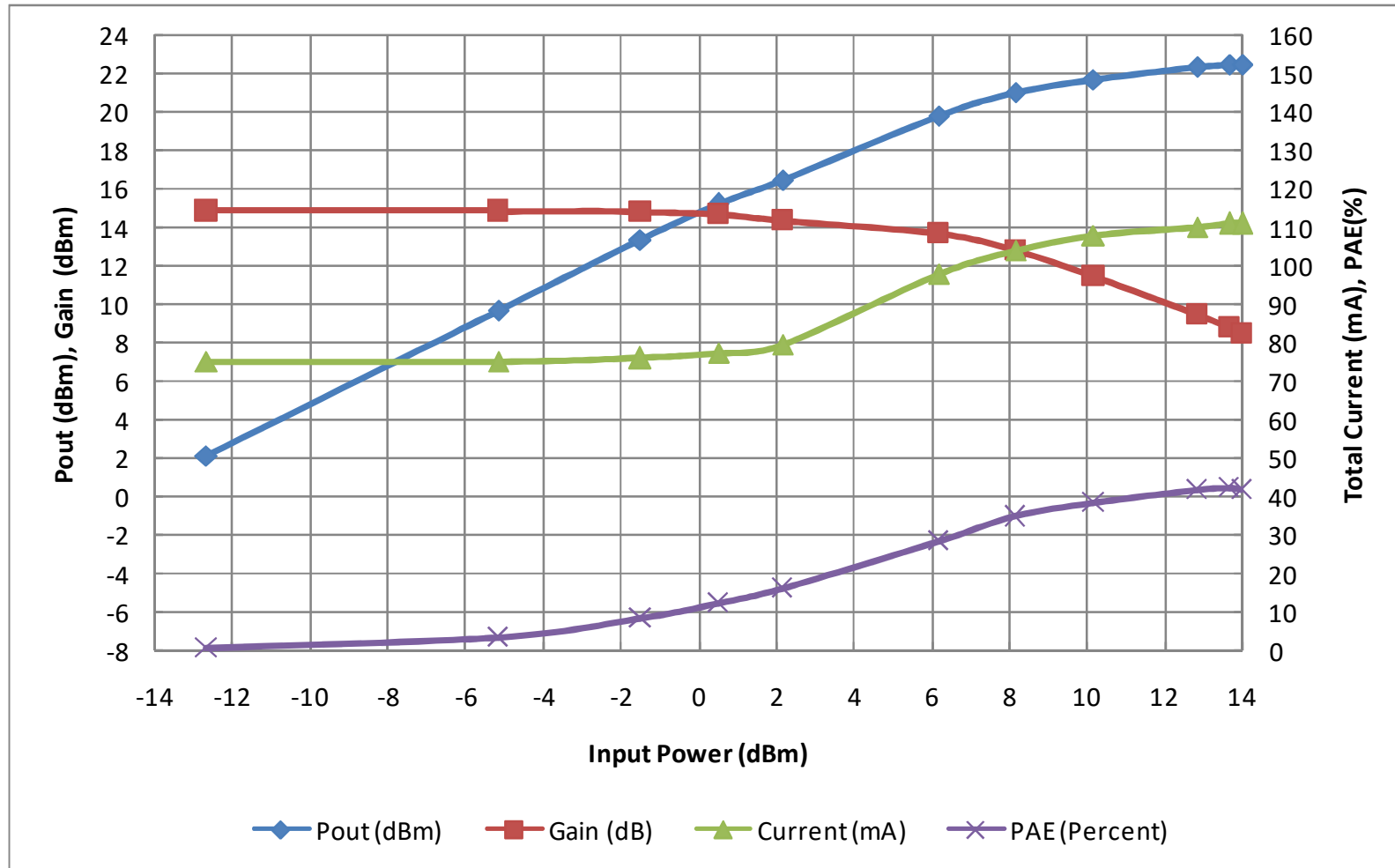
Nominal BOM for 2.4GHz High-Efficiency Operation:

- Capacitors: C1=1.2pF(0402), C2=470pF, C3=330pF, C4=10uF, C5=1uF, C6=C7=1nF
- Inductors: L1=10nH(0402), L2=1.5nH(0402, Murata LQW15A Series Recommended)
- Resistor: R1=200 Ohm for $I_{cq} \sim 75\text{mA}$ at $V_{cc}=V_{ref}=3.3\text{V}$. Other bias settings available upon request

BHWA251/M252 Combo CW Power Sweep



Output Power, Gain, Current & PAE vs Input Power at 2450MHz Using 0402 Components for BHWA251 Output Matching



Notes:

- Bias Setting: $V_{cc}=V_{ref}=V_{dd}=CTX=3.3V$, $I_{cq}\sim 75mA$; $CRX=0$
- Measured data include feedline and SMA connector losses of $\sim 0.2dB$

BHW RF Front-End AppNote Library



This is an abridged version of BHW AppNote #017. Please contact BHW Support or your local sales rep/distributor for a complete copy of the document and other related information.

BHW RF Front-End Solutions AppNote Library



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 2.4GHz Systems
- BHW AppNote #002 - Accurate Benchmark of GNSS CNO 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 RC and IoT
- BHW AppNote #012 - Enabling Cost-Effective High-Precision GNSS Using BHWL161 and Linear-Polarization PCB Antenna
- BHW AppNote #013 - GNSS Noise Floor vs Receiver Architecture
- 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 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 - Multiplying the Range for 2.4GHz Music Streaming with BHWR250L Active Integrated Antenna (AiA)
- BHW AppNote #021 - Range Extension for 2.4GHz Wireless Systems with BHWR250M Active Integrated Antenna (AiA)
- BHW AppNote #022 - Enabling Long-Range Angle-of-Arrival for High-Precision Indoor Positioning with BHWR250N RF AiA
- BHW AppNote #023 - Extend the Range for 5.8GHz Audio/Video Streaming with BHWR580M Active Integrated Antenna (AiA)
- BHW AppNote #024 - Improving 5.8GHz Radio Link Budget with BHWR580L Active Integrated Antenna (AiA)
- BHW AppNote #025 - Improving Range and Throughput of 2.4GHz Wi-Fi with BHWR250 Array Antenna
- BHW AppNote #026 - Improving Range and Throughput of 5GHz Wi-Fi with BHWR550 Array Antenna
- BHW AppNote #027 - Multi-Band High-Accuracy GNSS Solutions Using BHWP150 DFN1x1 Ultra-Compact Power Divider & Combiner
- BHW AppNote #028 - Use BHWM252 Cascade to Extend Range of 2.4GHz Wireless Systems with Single-Port SoCs
- BHW AppNote #029 - Improving Range of 2.4GHz Wireless Microphones and Audio Systems with BHWR250A Active Integrated Antenna (AiA)
- BHW AppNote #030 - Simultaneous Improvement in Range and Battery Life of 2.4GHz Wireless Systems with BHWR250M AiA

Contact support@bhwrtechnologies.com or BHW distributors/representatives for your copy of the above and new up-coming documents.