



BHW Technologies (博泓微科技有限公司)



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

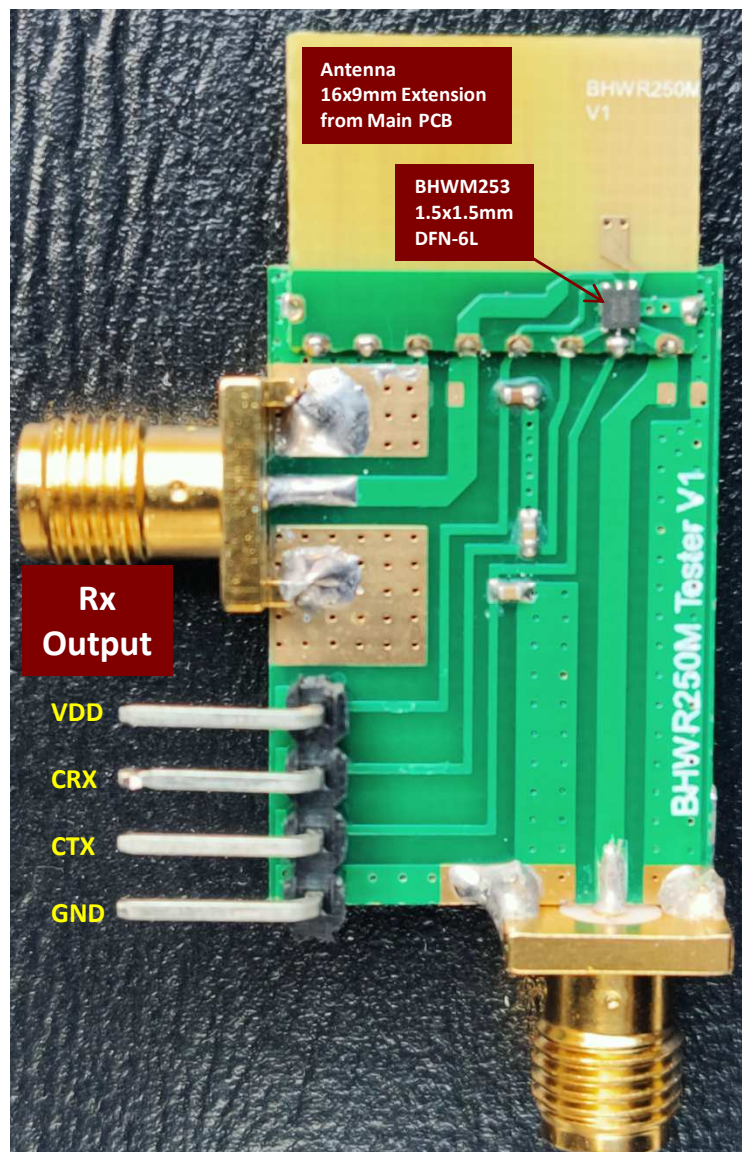
BHW AppNote #021

**Range Extension for 2.4GHz Systems with BHWA251 PA and
BHWR250M Active Integrated Antenna (AiA)**

Rev. 1.1, 1/10/2021

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BHWR250M AiA for 2.4GHz System Range Extension



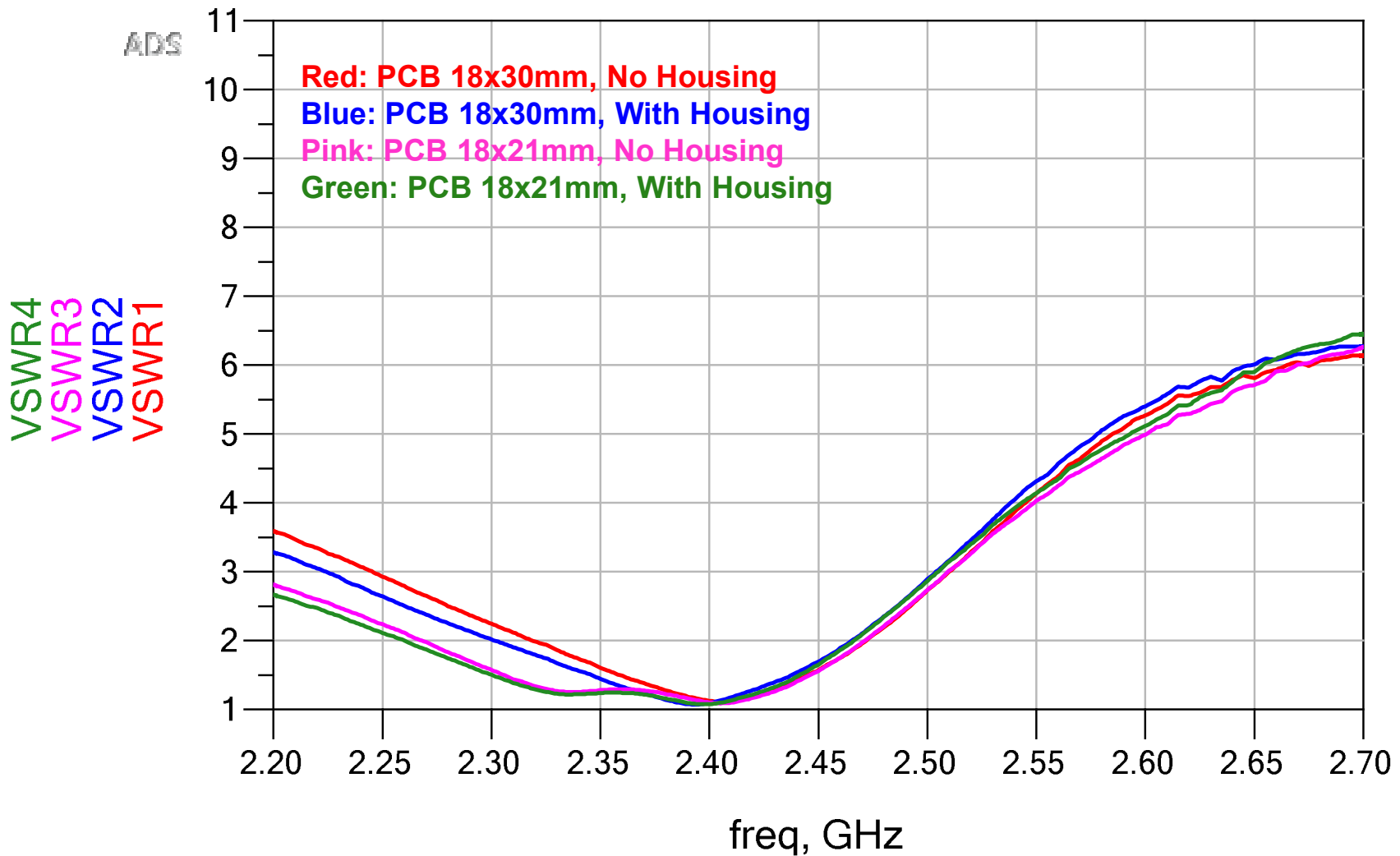
Features & Benefits:

- Innovative, Patented RF Active Integrated Antenna (RFAiA™) Architecture
- Compact Size: 16x12x0.7mm Total Size, Including Antenna and BHWM253 Front-End IC
- Simple Surface-Mount Interface to Main Product PCB
- 12x9mm Extension from Edge of Main PCB
- Minimum RF Design Requirement for Main PCB
- Comparable Antenna Efficiency to Much Larger Dipoles
- Industry-Leading Noise Figure: ~1.6dB at Antenna
- Low Insertion Loss for Tx Switch: ~0.7dB
- Significant Improvement in Rx Sensitivity (4~6dB)
- Option to Insert any 2.4GHz PA to Boost Transmit Power
- Close to 300 Meter Maximal Range Achieved with BHWA251 PA and BHWR250M AiA Implementation
- Up to 10x Range Extension Feasible by Utilizing BHW's Full Range of 2.4GHz AiA Solutions

BHWR250M VSWR for Rx Mode



Input VSWR vs PCB Size and Housing Effect

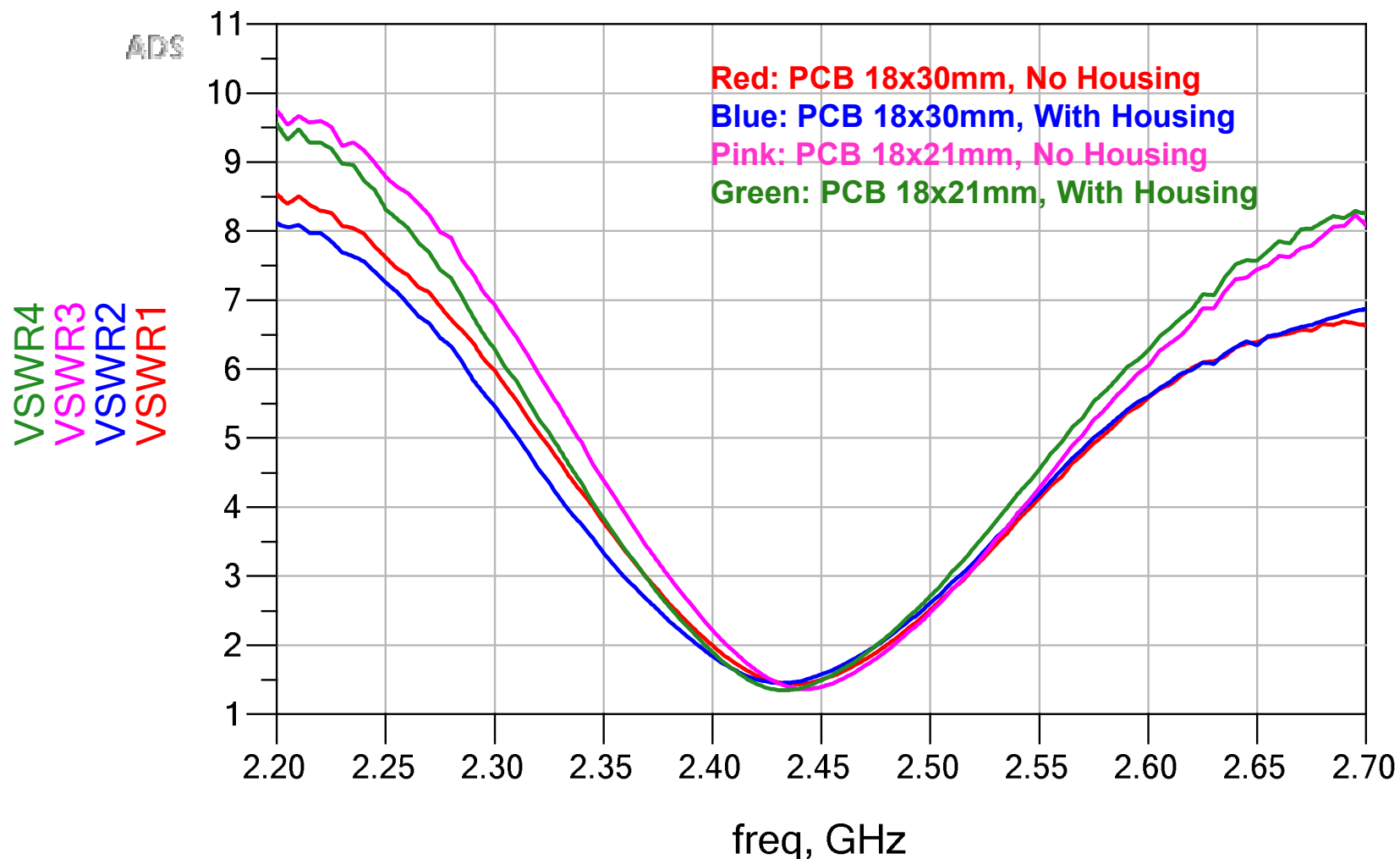


DC Bias: Vdd=CRX=3.3V, CTX=0, Idd~13mA; Vdd/Idd=1.2~4.2V/3~18mA Operational

BHWR250M VSWR for Tx Mode



Input VSWR vs PCB Size and Housing Effect



DC Bias: Vdd=CTX=3.3V, CRX=0; Vdd=1.2~4.2V Operational

Qualcomm QCC3021 BLE Range Test: Case #1



Source for Music Streaming:

Samsung Galaxy S7 Edge

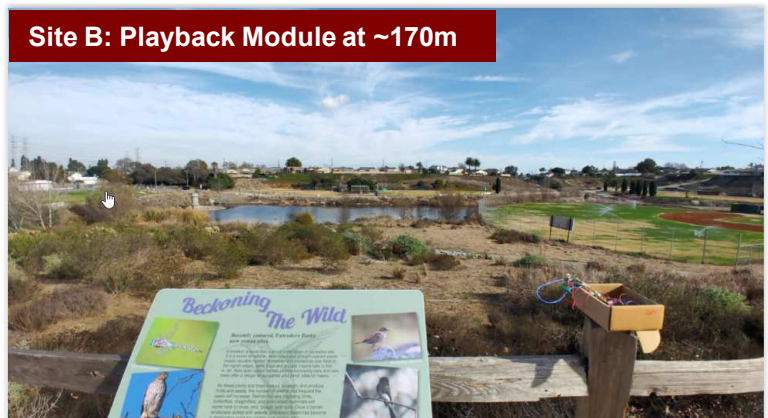
Placement: ~1m above Ground , Horizontal
(Site A)

Music Playback:

QCC3021 BLE Module with BHWR250M AiA and
BHWA251 EVB with FCC Compliance (~19dBm)

Range Test Result:

Site B: ~170m, Line-of-Sight, No Intermittency at
All Angles



Qualcomm QCC3021 BLE Range Test: Case #2



Source for Music Streaming:

Samsung Galaxy S7 Edge

Placement: ~1m above Ground , Near Vertical (Site A)

Music Playback:

QCC3021 BLE Module with BHWR250M AiA and BHWA251 EVB with FCC Compliance (~19dBm)

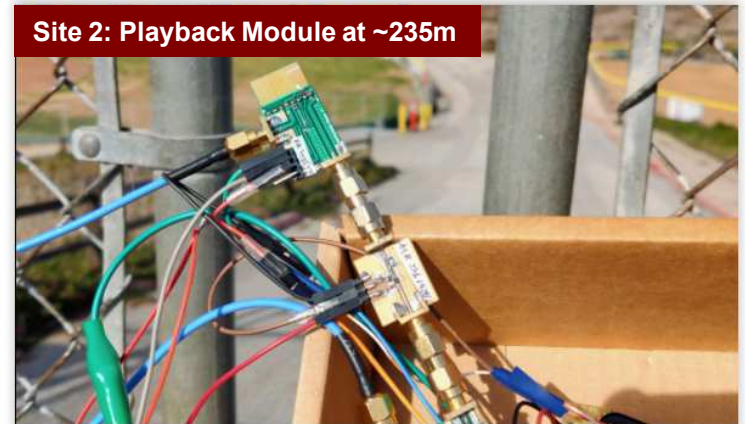
Range Test Result:

Site B: ~235m, Line-of-Sight, No Intermittency at All Angles

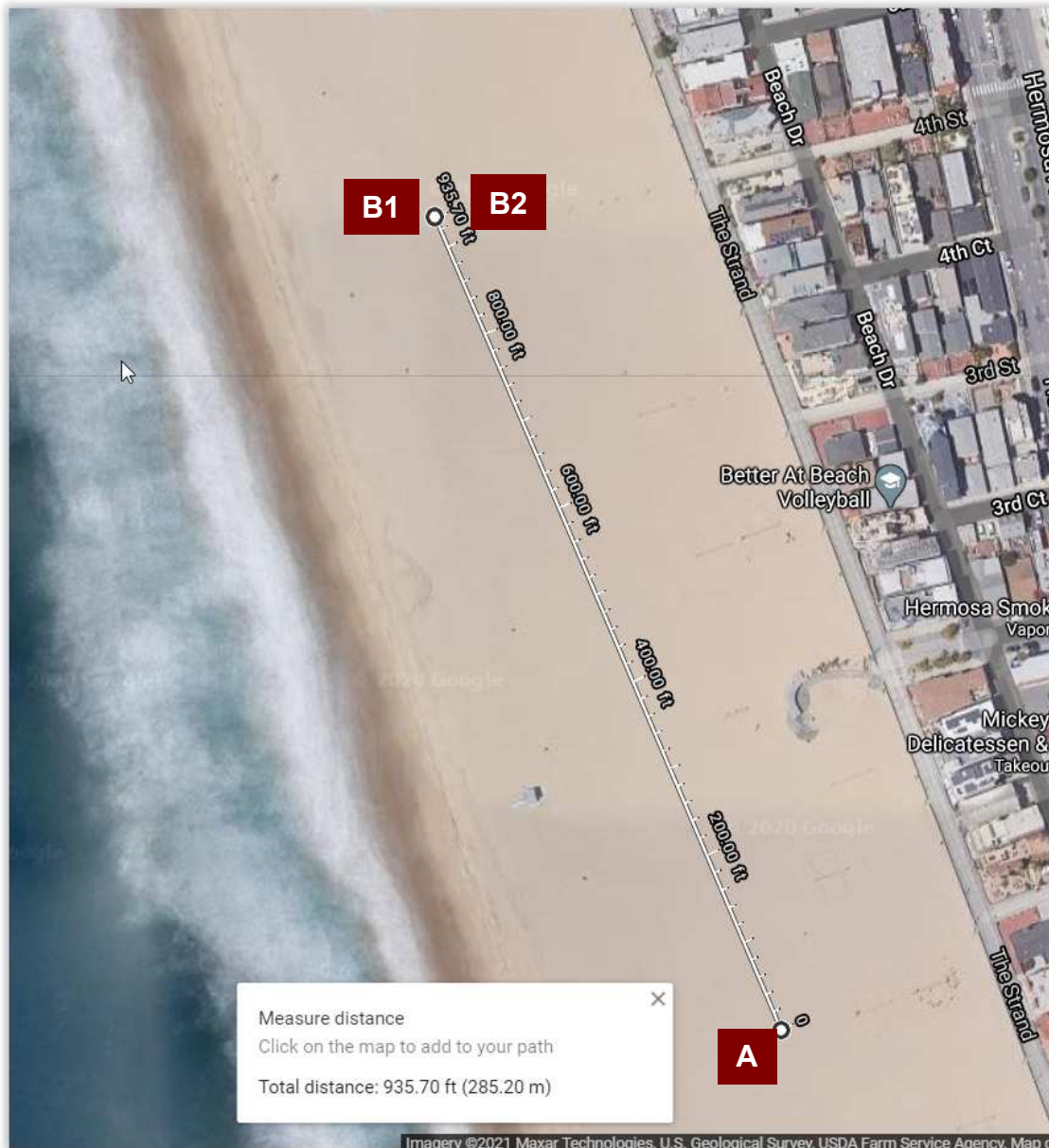
Site A: Audio Source



Site 2: Playback Module at ~235m



Qualcomm QCC3021 BLE Range Test: Case #3



Source for Music Streaming:

Samsung Galaxy S7 Edge

Placement: ~1.5m above Ground , Two Positions (Site A)

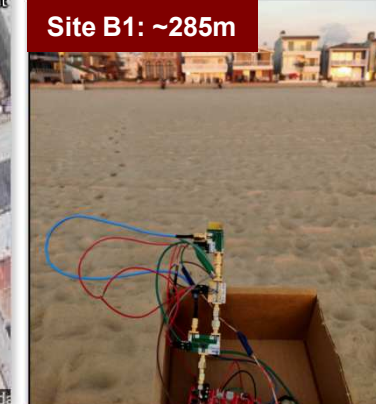
Music Playback:

QCC3021 BLE Module with BHWR250M AiA and BHWA251 EVB with FCC Compliance (~19dBm)

Range Test Result:

Site B1 (Phone Vertical): Max. Range ~285m

Site B2 (Phone 90 Deg. Turn): Max. Range ~280m



BHW RF Front-End AppNote Library



This is an abridged version of BHW AppNote #021. 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 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 BLE and 2.4GHz IoT
- 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 BLE, RC and IoT
- BHW AppNote #012 - Enabling Cost-Effective High-Precision GNSS Using BHWL160 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 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 - Multiplying the Range for BLE Music Streaming with BHWL250L Active Integrated Antenna (AiA)
- BHW AppNote #021 - Range Extension for 2.4GHz Systems with BHWA251 PA and BHWL250M Active Integrated Antenna (AiA)
- BHW AppNote #022 - Enabling Long-Range BLE AoA & AoD for High-Precision Indoor Positioning with BHWL250N RF AiA
- BHW AppNote #023 - Extend the Range for 5.8GHz Audio/Video Streaming with BHWL550M Active Integrated Antenna (AiA)
- BHW AppNote #024 - Improving 5.8GHz Radio Sensitivity with BHWL580L Active Integrated Antenna (AiA)
- BHW AppNote #025 - Improving Range and Throughput of 2.4GHz Wi-Fi with BHWL250 Array Antenna
- BHW AppNote #026 - Improving Range and Throughput of 5GHz Wi-Fi with BHWL550 Array Antenna

Contact support@bhwtechnologies.com or BHW distributor/representative for your copy of the above and new up-coming documents.