



# BHW Technologies (博泓微科技有限公司)



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

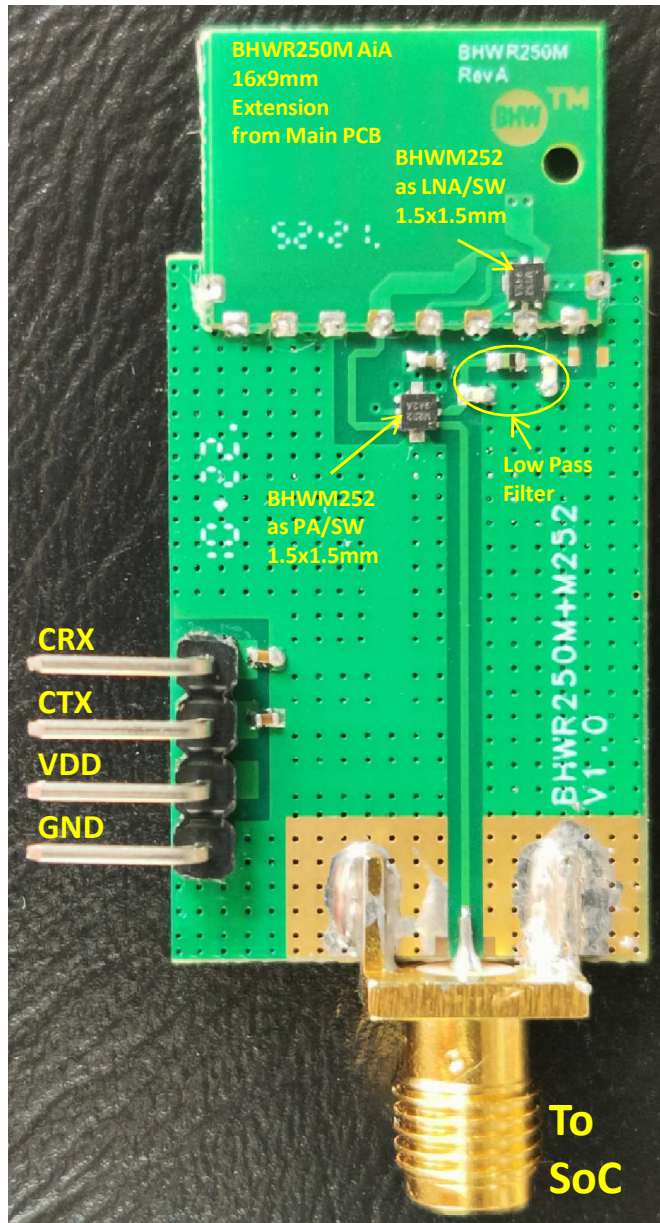
## BHW AppNote #030

Simultaneous Improvement in Range and Battery Life of  
2.4GHz Wireless Systems with BHW R250M AiA

Rev. 2.2

[www.bhw-tech.com](http://www.bhw-tech.com)

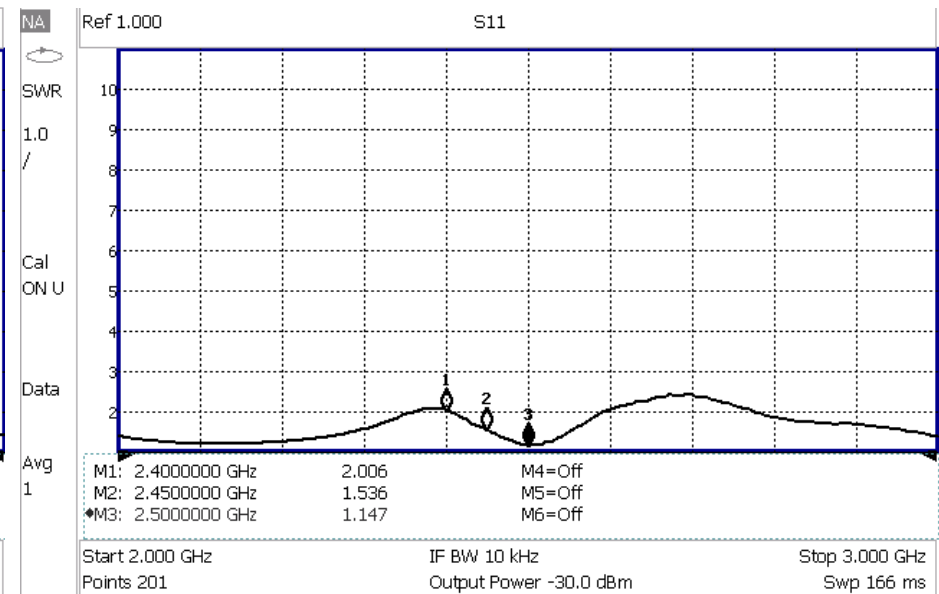
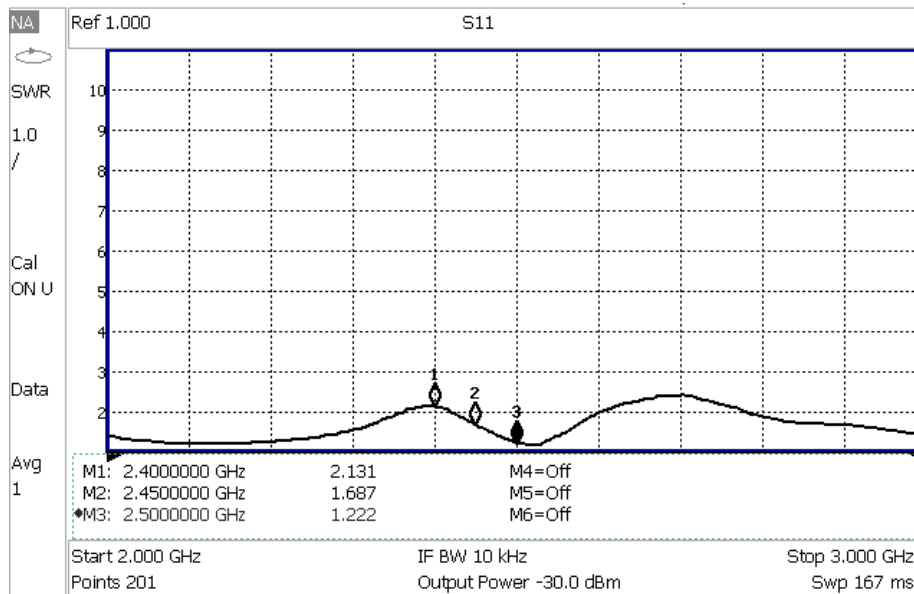
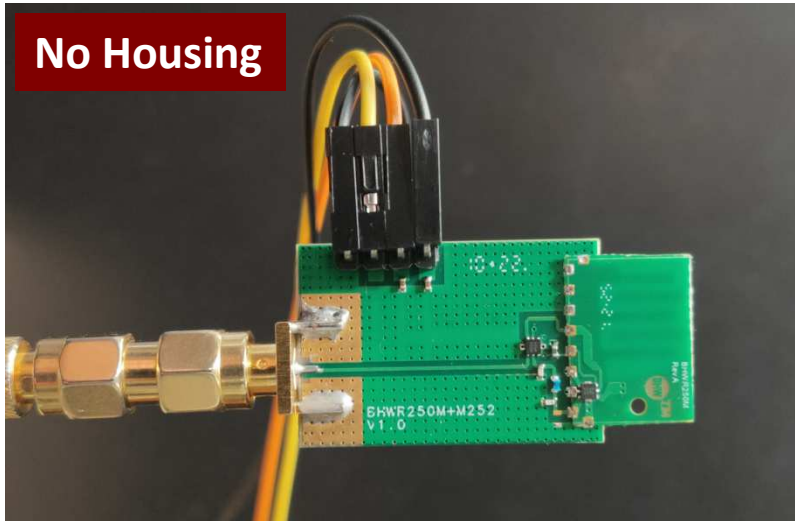
# BHWR250M AiA + BHWM252 for 2.4GHz PA/LNA/Antenna



## Features & Benefits:

- Industry's Lowest 2.4GHz System Noise Figure
- NF=1.7dB Including Antenna Switch, FCC Compliance
- Innovative, Patented RF Active Integrated Antenna (RFAiA™) Architecture
- Compact Size of BHWR250M AiA : 16x12x0.6mm
- Simple Surface-Mount Interface to Main Product PCB
- 12x9mm Extension from Edge of Main PCB
- Minimum and Relaxed RF Design for Main PCB
- Comparable Antenna Efficiency to Much Larger Dipoles
- Low Insertion Loss for Tx Switch: ~0.7dB
- Significant Improvement in Rx Sensitivity (4~6dB)
- Use a 2<sup>nd</sup> BHWM252 on Main PCB for Complete Tx/Rx FEM with PA/LNA for Single-Port SoCs
- Tx Power~13dBm with Total Idd~22mA at Vdd=3.3V
- Maximum Range of >500 Meters Achieved for Audio Streaming with BHWR250M & BHWM252 Combo
- Option for Adding External PA in Tx Path to Achieve Multi-Kilometer Long Range 2.4GHz Systems

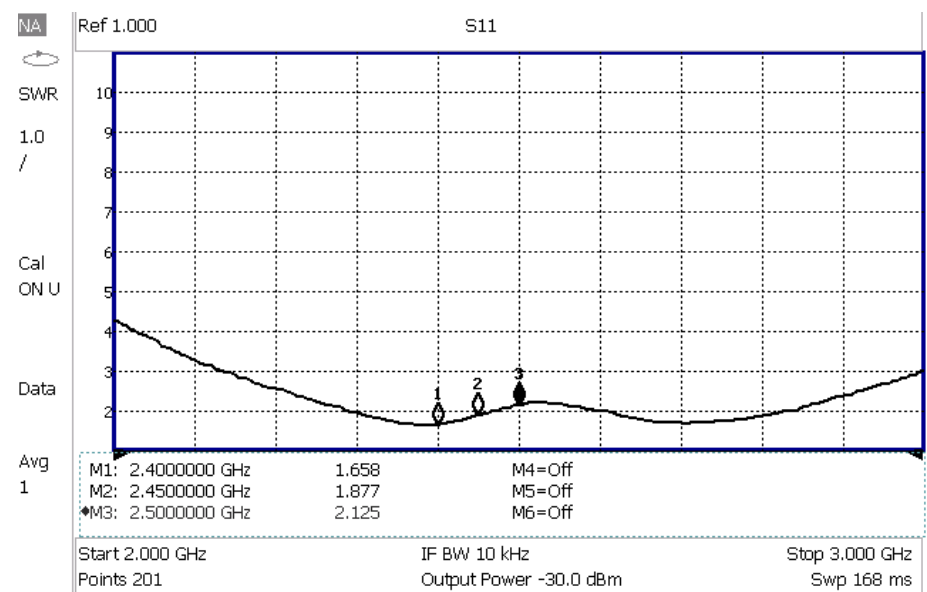
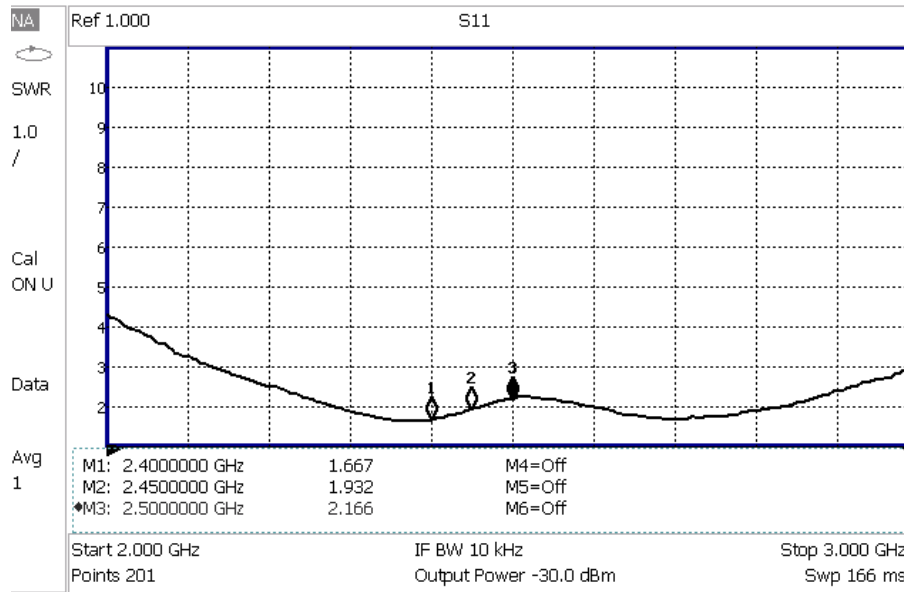
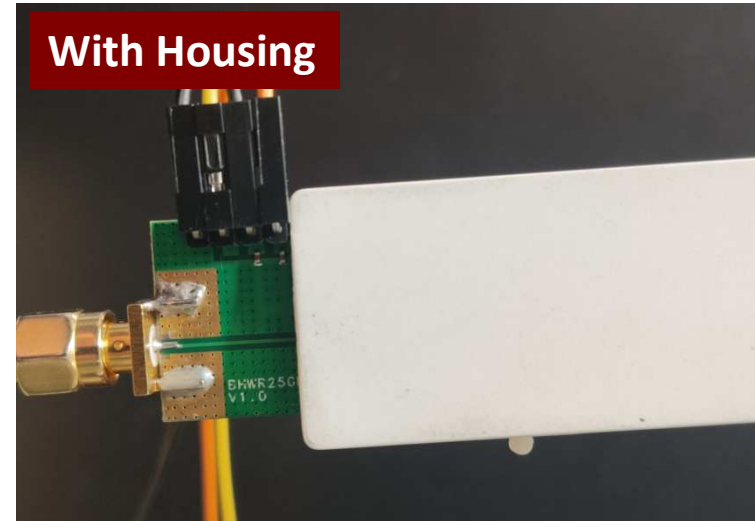
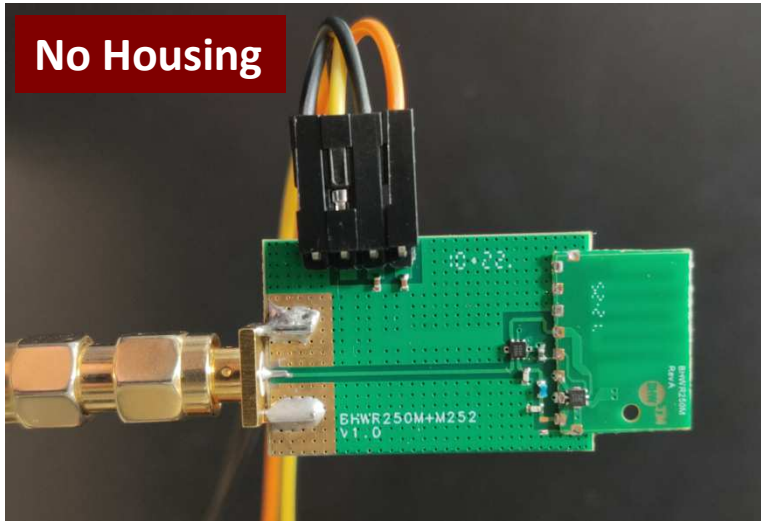
# BHWR250M+M252 Combo Input VSWR: Tx



DC bias: Vdd=CTX=3.3V, CRX=0V. VSWR may vary slightly for different main PCB thickness/material/size/shape and plastic housing designs, but should be significantly less sensitive than conventional small antennas.

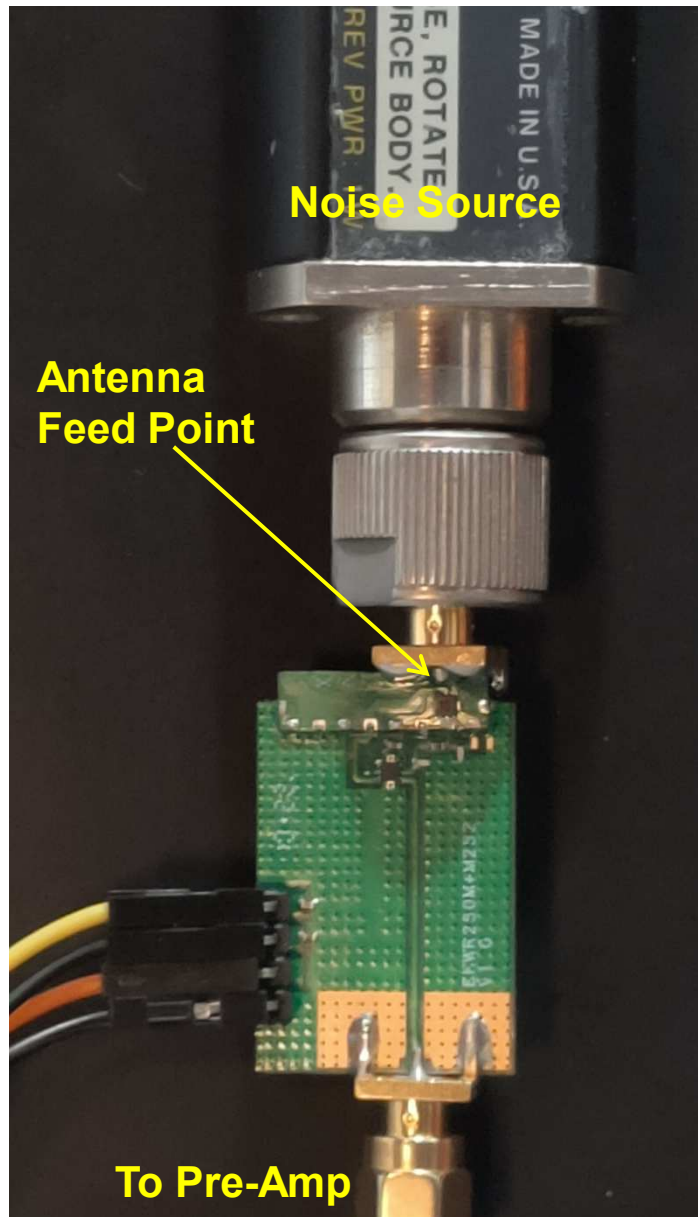


# BHWR250M+M252 Combo Input VSWR: Rx



DC bias: Vdd=CRX=3.3V, CTX=0V. VSWR may vary slightly for different main PCB thickness/material/size/shape and plastic housing designs, but should be significantly less sensitive than conventional small antennas.

# BHWR250M+M252 Combo Noise Figure Test



## Measured Noise Figure at 2485MHz Raw Data Including EVB/SMA Losses



### Notes:

-VDD=CRX=3.3V, CTX=0V.

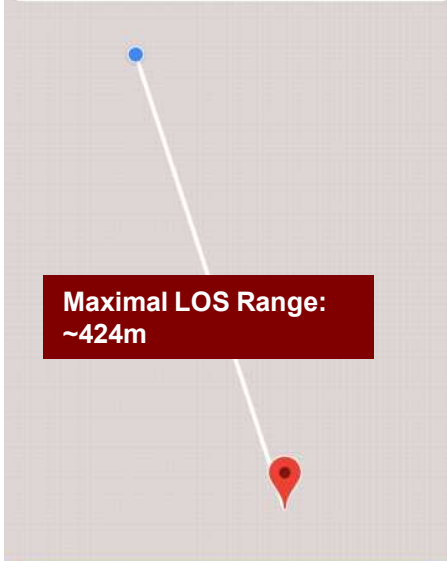
-Measured NF~1.7dB includes antenna switch, and harmonic filter for FCC compliance.

# BHWR250M+M252 for Wireless MIC: TX #1 (Original)



当前纬度: 33.8521407  
当前经度: -118.3997333  
基于 WGS84...

编辑



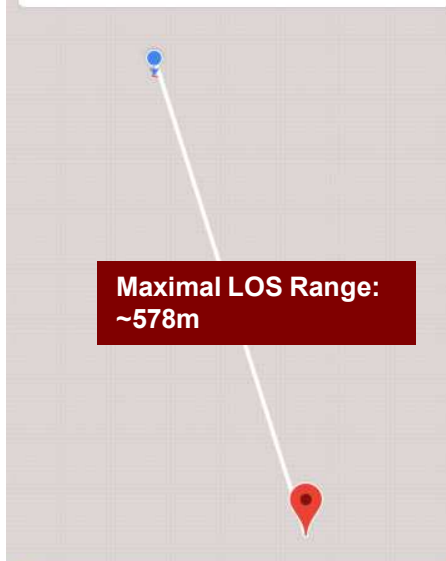
**Maximal LOS Range:  
~424m**

误差 平均 7 修正

**423.73 m 423.47**

当前纬度: 33.8521407  
当前经度: -118.3997333  
基于 WGS84...

编辑



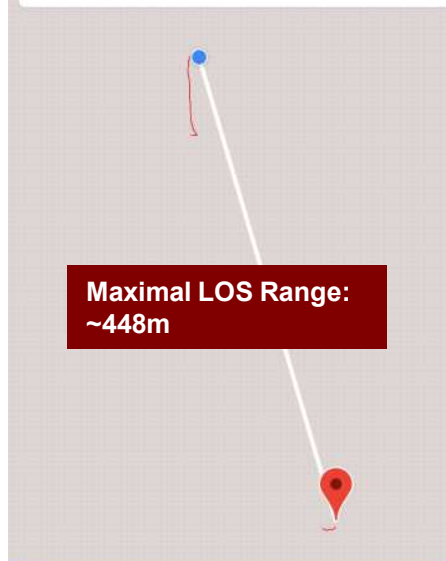
**Maximal LOS Range:  
~578m**

误差 平均 24 修正

**577.91 m 572.89**

当前纬度: 33.8521407  
当前经度: -118.3997333  
基于 WGS84...

编辑



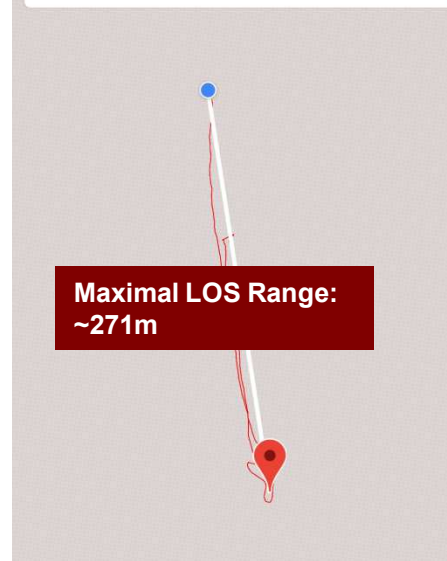
**Maximal LOS Range:  
~448m**

误差 平均 68 修正

**447.80 m 381.91**

当前纬度: 33.8521407  
当前经度: -118.3997333  
基于 WGS84...

编辑



**Maximal LOS Range:  
~271m**

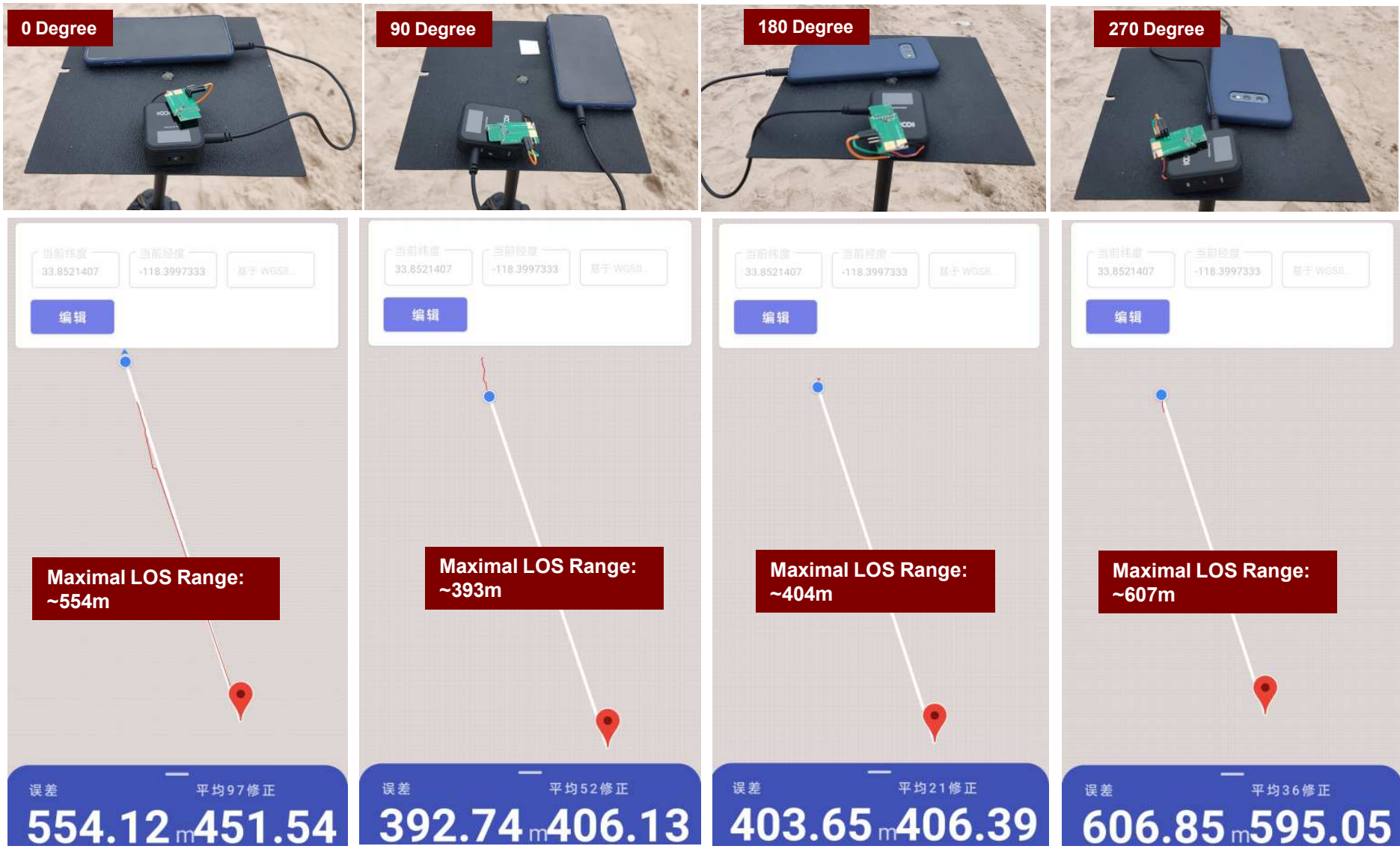
误差 平均 483 修正

**270.68 m 86.27 m**

RX unit was placed behind the neck to emulate LOS test condition when walking away from TX. Maximal range was recorded when music streaming started to break down. Average value for Max Range from 4 different Tx antenna angles was 430m.



# BHWR250M+M252 for Wireless MIC: TX #2 (Modified)



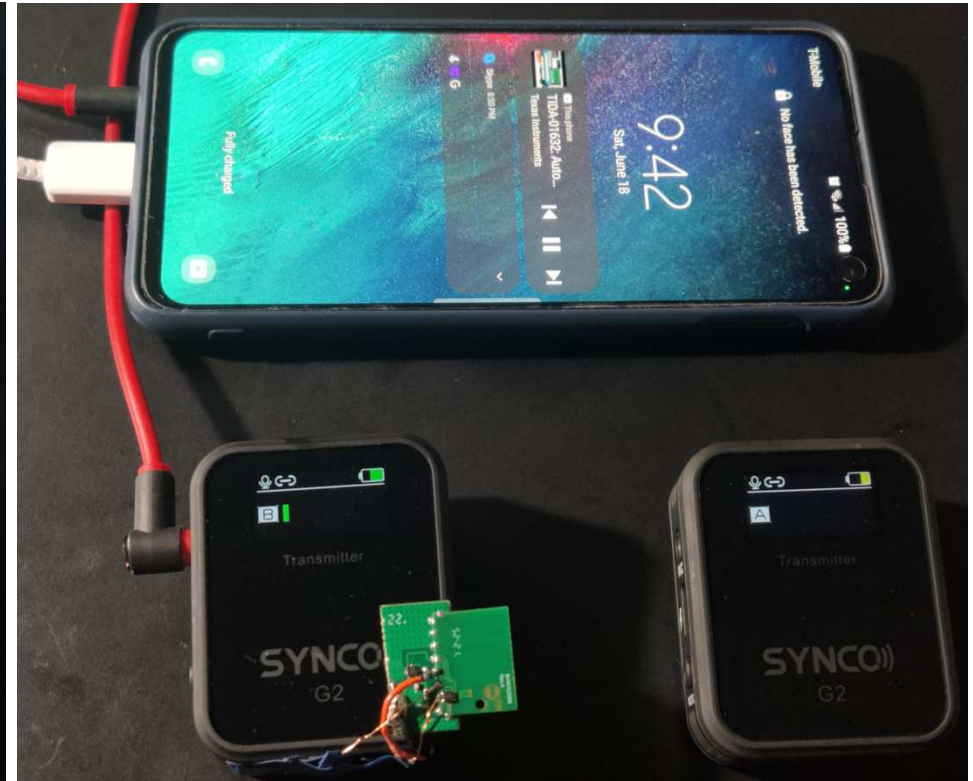
RX unit was placed behind the neck to emulate LOS test condition when walking away from TX. Maximal range was recorded when music streaming started to break down. Average value for Max Range from 4 different Tx antenna angles was 489m.

# BHWR250M AiA for Battery Life Extension



Starting Point

After 2 Hours



Left: Transmitter with BHW AiA (~90% Charged)  
Right: Transmitter with Original FEM (Fully Charged)

Left: Transmitter with BHW AiA (>>50% Remaining)  
Right: Transmitter with Original FEM (<<50% Remaining)

## Notes:

- Battery life comparison of two SYNCO G2 transmitters with original FEM and BHWR250M+BHWM252 Combo.
- Test was conducted by simultaneous music streaming to a common Receiver.
- Transmitter with BHW R250M+BHWM252 AiA solution has longer battery life even though it provides longer range.



# BHW RF Front-End AppNote Library



*This is an abridged version of BHW AppNote #030. 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@bhwtechnologies.com](mailto:support@bhwtechnologies.com) or BHW distributors/representatives for your copy of the above and new up-coming documents.