



# 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 #019

Miniature 2.4GHz RF Front-End with Integrated Chip Antenna and  
BHWM253 for TWS, Wireless Audio and IoT

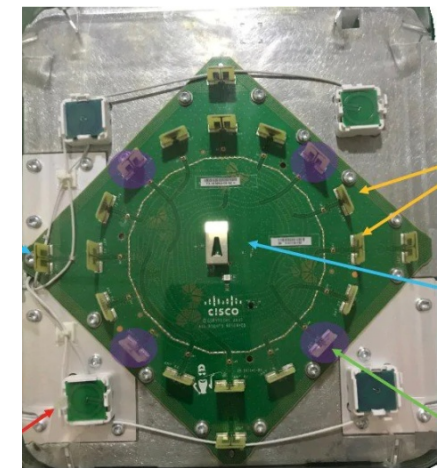
Rev. 1.6, 11/7/2020

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

# Active Integrated Antenna with BHWM253



**Motivation: Improving 2.4GHz RF Performance under Challenging Space Constraints**



## Advantages & Benefits:

- 10x or More Increase in Effective Antenna Radiation Efficiency
- Virtually No Increase in PCB Size by Taking Advantage of Unused Keep-Out Space for the Chip Antenna
- Easier, Stable and Broadband Impedance Matching
- Significant Improvement in RF Performance for TWS Earphone, Wireless Audio Streaming, and IoT Solutions

# Active Integrated Antenna with BHWM253

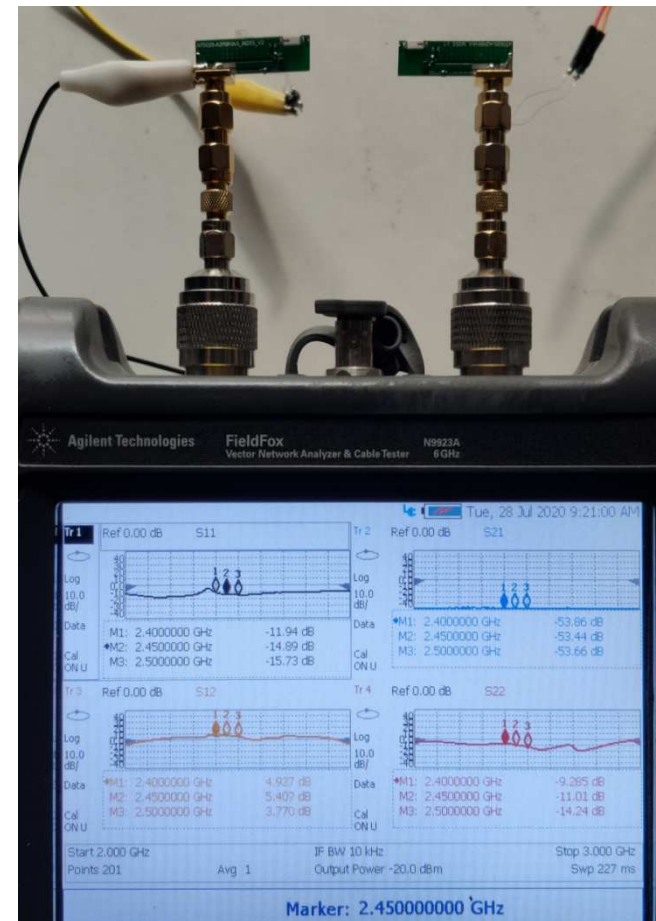
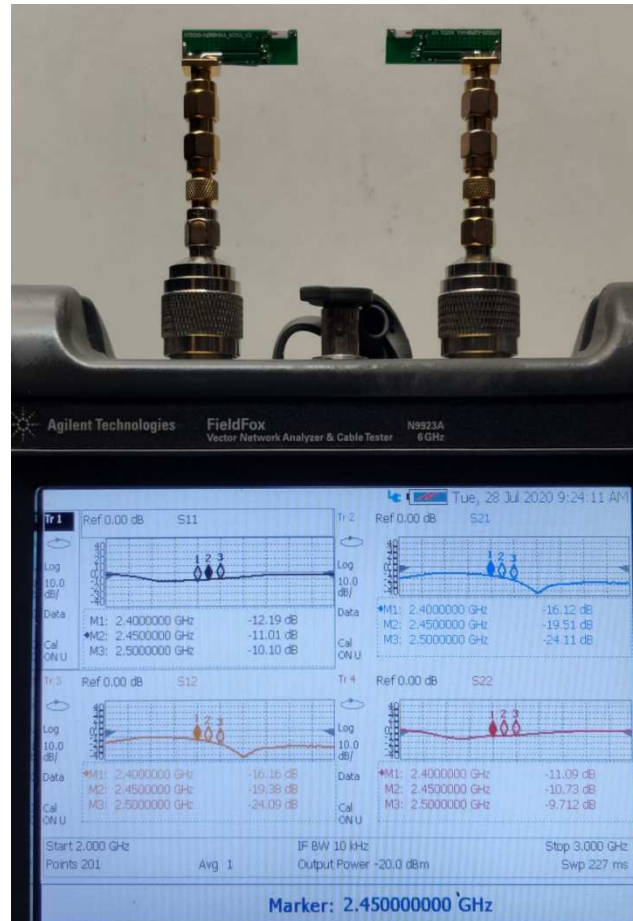
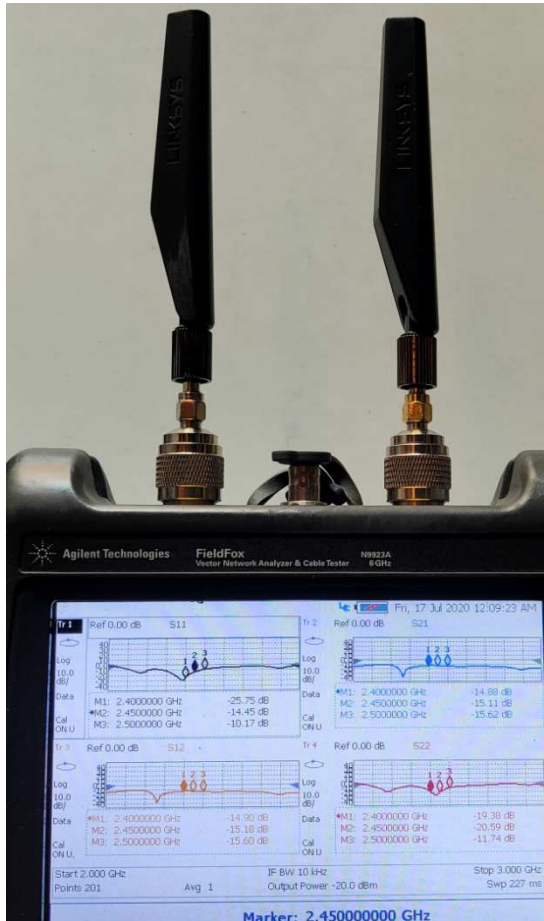


**Concept: "Embed" RF Front-End IC into Chip Antenna to Improve Wireless Link Quality**

Path Loss: Two 10cm Dipoles  
 $S_{21}=S_{12} \sim -15.1\text{dB}$  at 2.45GHz

Path Loss: Two Passive 5020 Monopoles  
 $S_{21}=S_{12} \sim -19.5\text{dB}$  at 2.45GHz

Path Loss: Two Active 5020 Antennas  
 Port1: M253 as LNA; Port2: M253 as PA  
 $S_{12} \sim +5.4\text{dB}$  at 2.45GHz



**Notes:**

- Depending on Tx power and Rx sensitivity of the SoC, an improvement of 10~20dB in total link budget is possible with the AIA approach.
- The above  $S_{21}$  measurement is intended as an approximate estimation of the radiation performance of the antenna. Detailed evaluation of antenna pattern, gain and efficiency in anechoic chamber is in progress.

# Active Integrated Antenna with BHW253



## Examples of Integrating Chip Antenna and BHW253 RF Front-End IC

3216 Monopole Antenna  
+ BHW253 as PA  
Keep-Out:  $\leq 6 \times 6 \text{mm}$



3216 Loop Antenna  
+ BHW253 as PA  
Keep-Out:  $\leq 4 \times 6 \text{mm}$



5020 Monopole Antenna  
+ BHW253 as LNA  
Keep-Out:  $\leq 8 \times 9.6 \text{mm}$



1608 Monopole Antenna  
+ BHW253 as LNA  
Keep-Out:  $\leq 4 \times 6 \text{mm}$



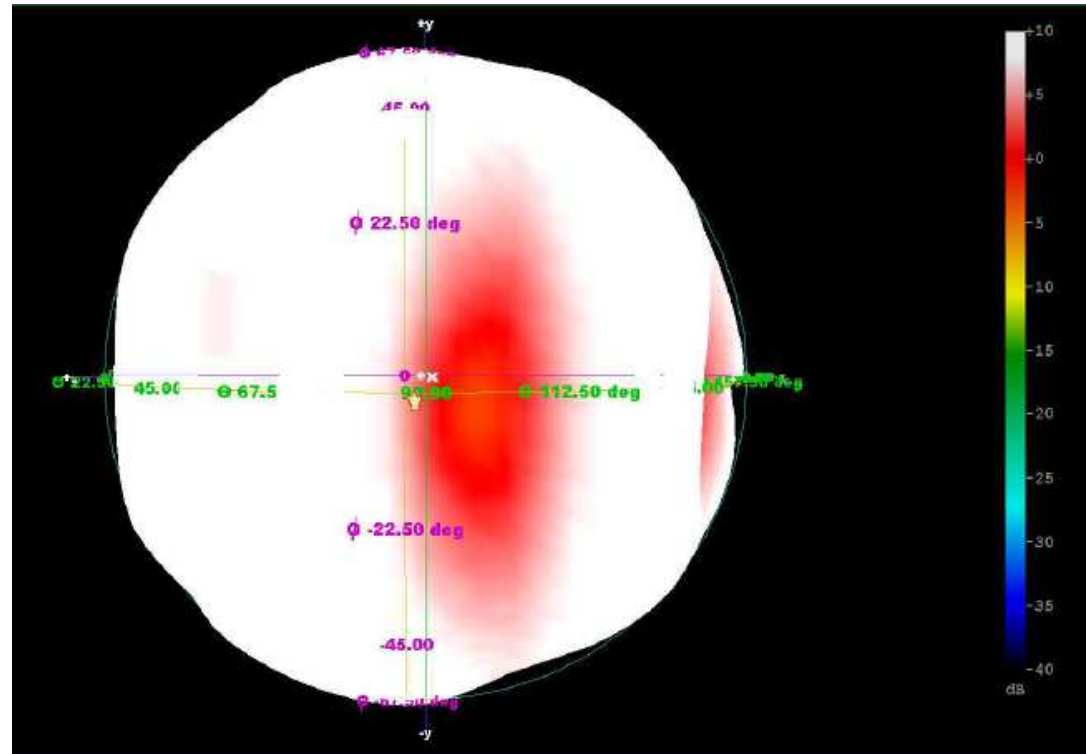
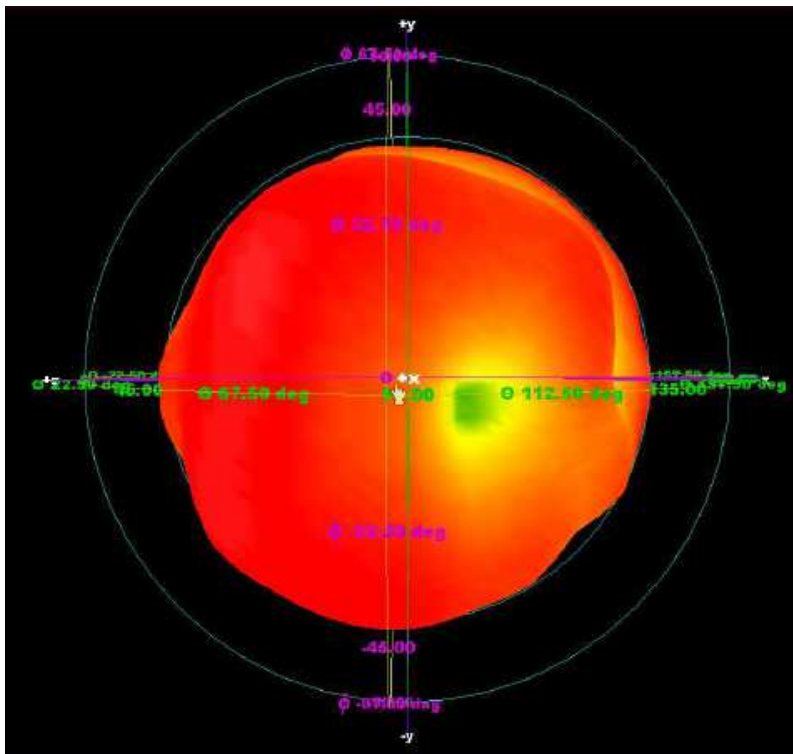
# 5020 Monopole Antenna + BHWM253 as LNA



## Comparison of 3D Radiation Pattern, Peak/Average Gain and Efficiency

Passive Antenna

Active Integrated Antenna



Unit in dBi@2440MHz	XY-plane		XZ-plane		YZ-plane		Efficiency
	Peak	Avg.	Peak	Avg.	Peak	Avg.	
AT5020-A2R8HAA Passive Antenna	2.4	-1.3	3.1	-2.6	-2.5	-5.2	67.0%
AT5020-A2R8HAA Active Integrated Antenna	10.3	6.1	11.5	6.4	11.0	8.4	639.0%

Courtesy: ACX Corp.

# BHW RF Front-End AppNote Library



***For further information, please email to [support@bhwtechnologies.com](mailto: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)