BHW Technologies (博泓微科技有限公司)

RF Chips & Beyond

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

BHW AppNote #028

Use BHWM252 Cascade to Extend Range of 2.4GHz Wireless Systems with Single-Port SoCs

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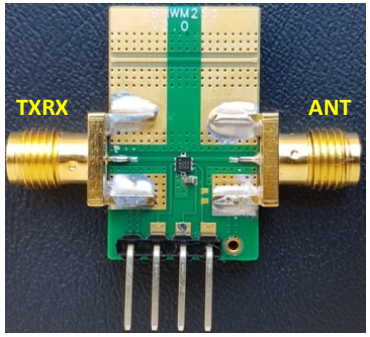
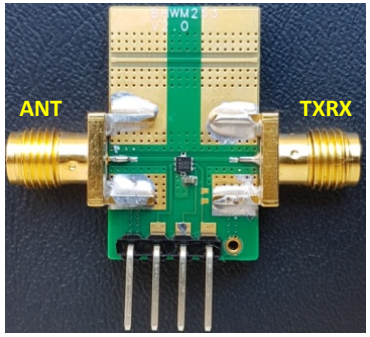
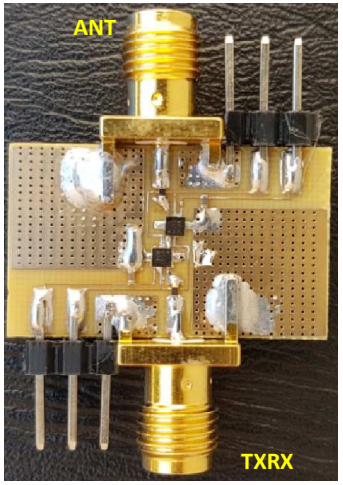
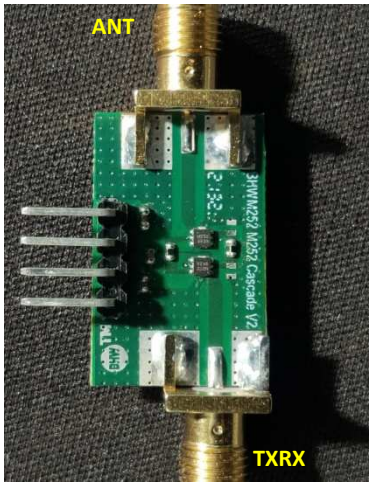
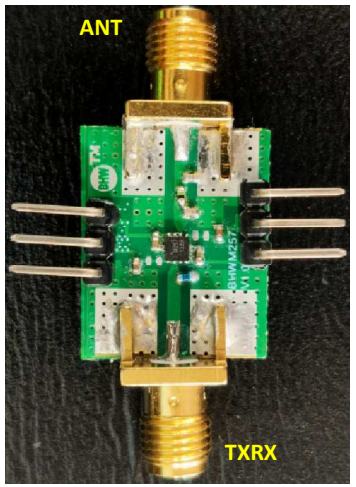
BHW Solutions for 2.4GHz Range Extension: RF IC Line-Up

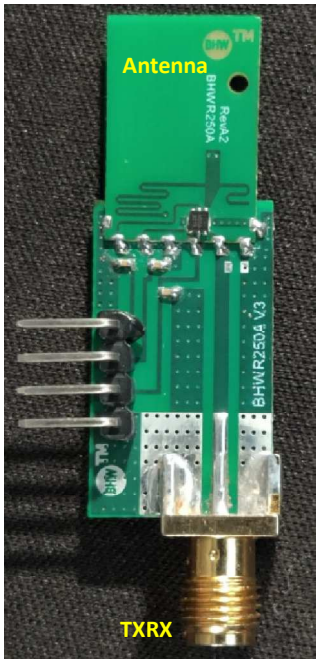
BHWM253 for Rx Sensitivity	BHWM253 for Tx Power	BHWM253 Cascade for Tx & Rx Improvement	BHWM252 Cascade for Tx & Rx Improvement	BHWM257 for Tx & Rx Improvement
				
Tiny DFN6-1.5x1.5	Tiny DFN6-1.5x1.5	Tiny DFN6-1.5x1.5	Tiny DFN6-1.5x1.5	Compact DFN8-2x2
				
Rx NF: 1.8dB Tx Pout: N/A Switch IL: 1.3dB Reference: BHWM253 AppNote	Tx Pout: 12~14dBm Vdd: 3.3~4.2V Rx: N/A Switch IL: 1.3dB Reference: BHWM253 AppNote	Tx Pout: 11~13dBm Vdd: 3.3~4.2V Rx NF: 1.8dB Reference: BHW AppNote #001	Tx Pout: 13~15dBm Vdd: 3.3~4.2V Rx NF: 1.7dB Reference: BHW AppNote #028	Tx Pout: 13~15dBm Vdd: 3.3~4.2V Rx NF: 1.8dB Reference: BHWM257 AppNote

Notes:

- All solutions provide direct interface with single-port 2.4GHz SoCs, without the need for additional switches
- The PA inside BHWM252 or M253 can use Vdd up to 4.2V to maximize output power
- Harmonic rejection filters for FCC compliance (if applicable) can be implemented before the antenna switch, resulting in lowest Rx NF and receive sensitivity

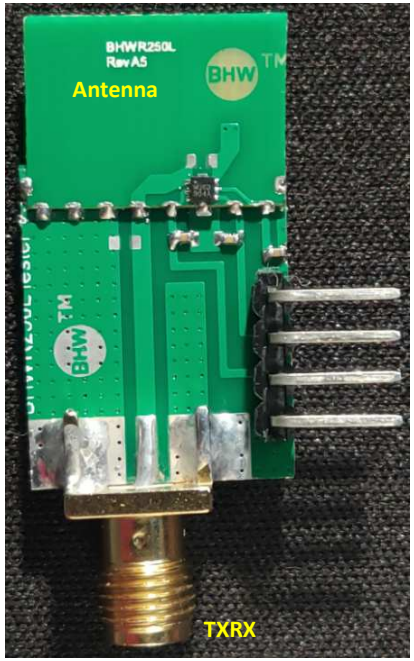
BHW Solutions for 2.4GHz Range Extension: RFAiA Line-Up

BHWR250A
for Increasing Tx Power



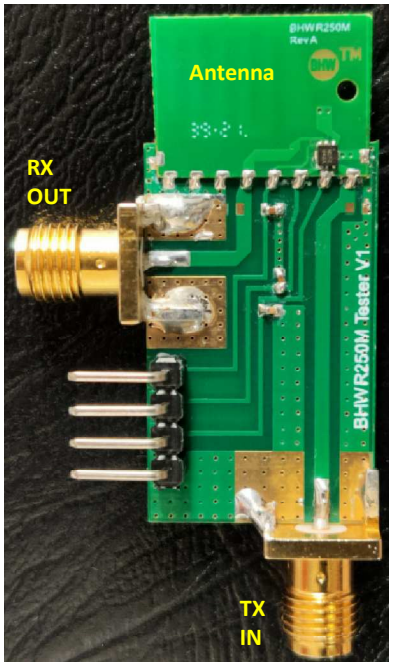
Size: 12x18x0.6mm
Tx Pout: 12~14dBm
Vdd: 3.3~4.2V
Rx: N/A
Switch IL: 1.3dB
Reference:
BHWR250A AppNote

BHWR250L
for Improving Rx Sensitivity



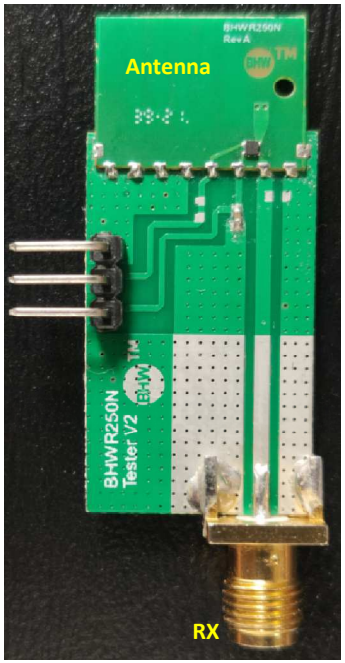
Size: 16x12x0.6mm
Rx NF: 1.8dB
Tx Pout: N/A
Switch IL: 1.3dB
Reference:
BHW AppNote #020

BHWR250M
for Improving both Tx & Rx



Size: 16x12x0.6mm
Rx NF: 1.7dB
Tx Pout: N/A (Port for Ext. PA or BHWM252)
Switch IL: 0.7dB
Reference:
BHW AppNote #021

BHWR250N
for AoA/AoD



Size: 16x12x0.6mm
Rx NF: 1.0dB
Low Current: ~7mA
Reference:
BHW AppNote #022

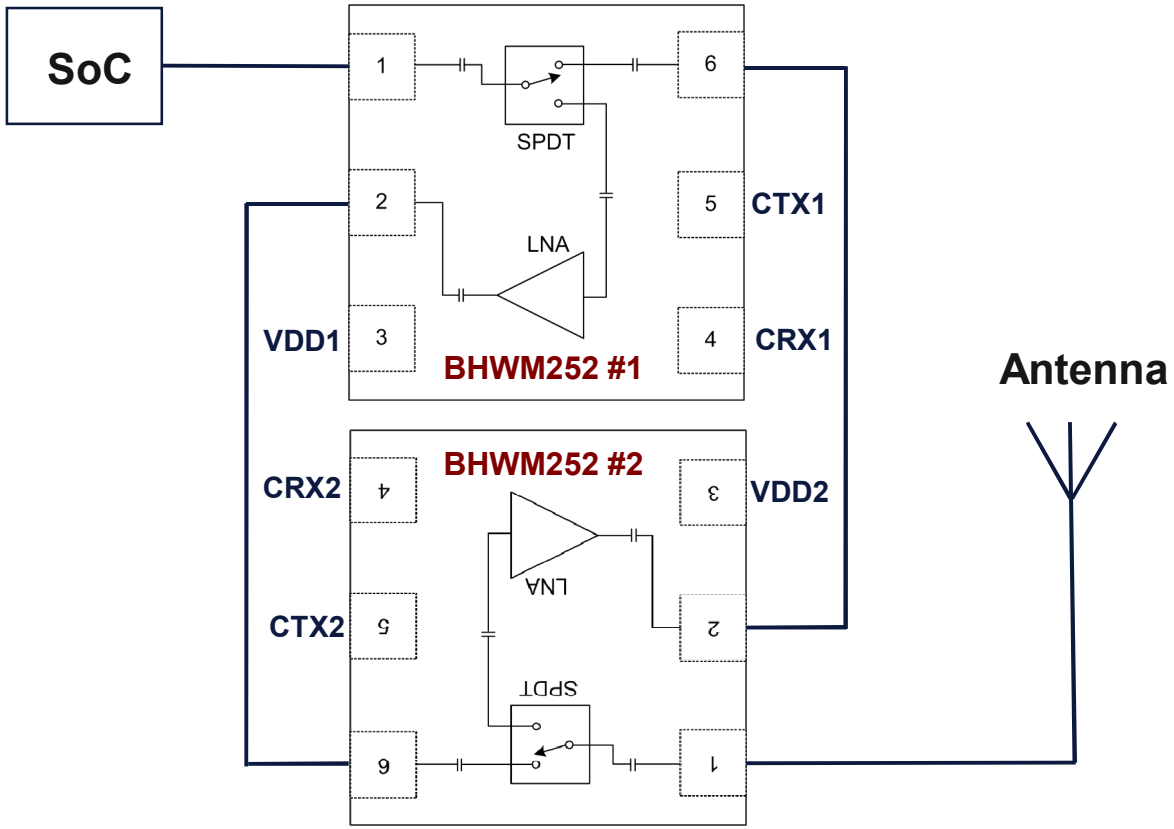
BHWR250
Slot Array Antenna

BHWR250:
12x57x0.6mm Slot Array
Reference:
BHW AppNote #025

Notes:
- **The antennas for BHW RFAiA are based on patented slot antenna architecture and less sensitive to PCB and plastic cover effects**
- **BHWR250 can be used as FPC antenna replacement and attached to the inner wall of the product cover for cost saving and better ID aesthetics**

BHWM252 Cascade for Single-Port Application

BHWM252 Cascade Topology & Advantages



-BHWM252 1.5x1.5mm DFN内部集成了放大器和开关。放大器可以用作LNA提升接收灵敏度，或者用作PA提升发射功率

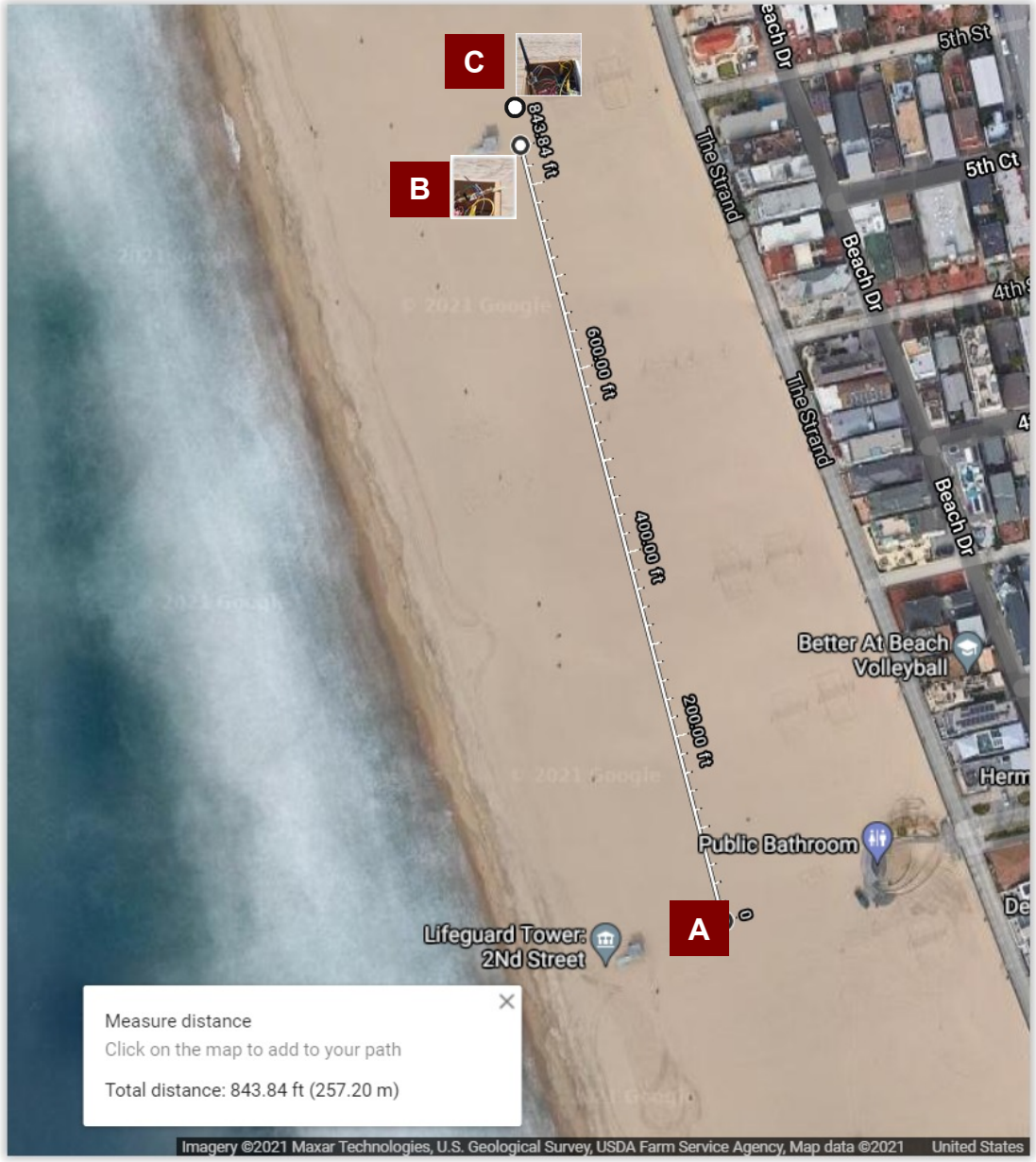
-如果需要同时提升收发性能，可以如上图所示级联两颗M252, 推荐电压VDD1=3.3~4.2V, VDD2=1.8~3.3V

-接收: CTX1=CRX2=1.8~3.3V, CRX1=CTX2=0, 电流约6~12mA，NF约1.7dB，可实现几个dB的灵敏度提升
（SoC不同稍有差异）。由于开关损耗在LNA后级，接收灵敏度跟单独使用一颗M252几乎不变。

-发射: CRX1=CTX2=1.8~3.3V, CTX1=CRX2=0, 天线端发射功率约13dBm时电流约25mA(3.3V)。虽然跟单独使用一颗M252相比，发射功率因后级开关损耗约0.7dB，总体可实现5~10dB的发射功率提升 （SoC不同稍有差异）。

-谐波抑制：可以按传统方式在天线端设置Pi型低通滤波器（接收灵敏度稍有降低）；也可以在第1/第2个M252之间实现谐波抑制，满足发射模式时FCC等验证要求，保持接收NF~1.7dB不变

Qualcomm QCC3021 Rx Range Improvement Test #1



Source for Music Streaming:
Samsung Galaxy S10e
Placement: ~1.5m Tripod above Ground, Horizontal
Music Playback:
QCC3021 BLE Module with BHWM252 Cascade, Vdd=3.2V, BHWR250 57mm Slot & 100mm Dipole
Range Test Result:
Site B (57mm Antenna): Maximum Range for Music Playback ~257m, Open Space, Line-of-Sight
Site C (100mm Dipole Antenna): Maximum Range ~275m (Larger Antenna Has Higher Gain)

Qualcomm CSR8675 Tx Range Improvement Test

Source for Music Streaming:
Samsung Galaxy Connected to Vikefon in Tx Mode
Placement: Site A, ~1.5m above Ground, BHWR250 Antenna Oriented Vertically

Music Playback:
Boltune BT-BH010 Headphone Paired with Vikefon

Range Test Result:
Site B: ~185m, Max. Range for Music Playback
Site C: ~80m, Almost no Intermittency with Headphone on Ears and 360 Degree Rotation
Max. Range is Shorter than Rx Improvement, as Expected, due mainly to Blocking Effect with Headphone Test.


Site A: Audio Source & Tx, ~1.5m above Ground


Headphone for Receive, On Both Ears during Test

BHW RF Front-End AppNote Library

This is an abridged version of BHW AppNote #028. 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 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 - 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 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 BLE AoA & AoD 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 LE Audio Systems with BHWR250A Active Integrated Antenna (AiA)

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