



# 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 #001

### Cross-Over Cascade of BHWM253 to Boost Tx Power and Rx Sensitivity of BLE and 2.4GHz IoT

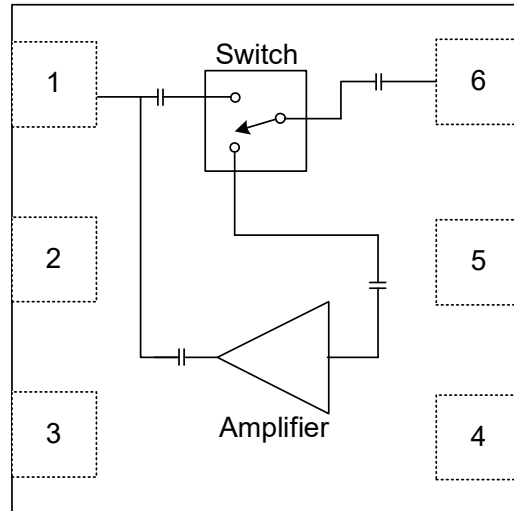
Rev. 2.8, 11/17/2020

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

# BHWM253 2.4GHz RF-FE with Common TRX Port

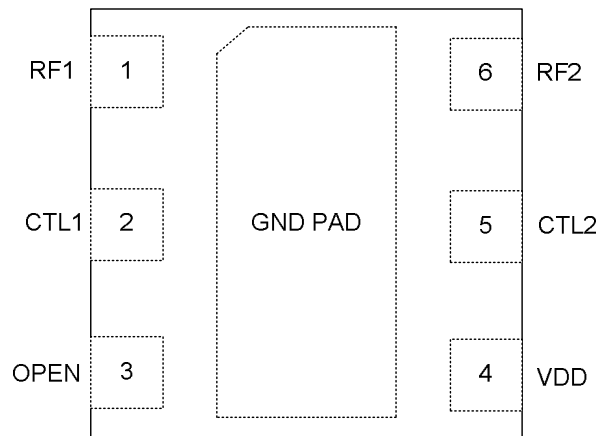


## Functional Block Diagram



## Package Pin-Out

(Top "See-Through" View)



DFN-6L 1.5x1.5x0.55mm

## Product Overview:

- Advanced GaAs E/D-pHEMT Process
- 2.4-2.5GHz Operation
- Operation Voltage: 1.2~4.2V
- Bias Current: 3~18mA over 1.2~3.6V Control Voltage
- Rx Noise Figure: 1.8~2dB; Rx Gain: 10~13dB
- IIP3: ~+5.5dBm at VDD=3.3V
- Switch Insertion Loss: ~1.3dB
- Amplifier Can Be Used as either LNA or PA
- Amplifier Output P1dB: ~12dBm at 3.3V/25mA
- Amplifier Output P1dB: ~14dBm at 4.2V/30mA
- Common Tx/Rx Port Fully Matched to 50 Ohm
- Simplest BOM: Needs Only 1 Capacitor
- ESD on All I/O Pins: 600V HBM RF; 1KV Non-RF
- Ultra-Small 1.5x1.5mm DFN Package

## Applications:

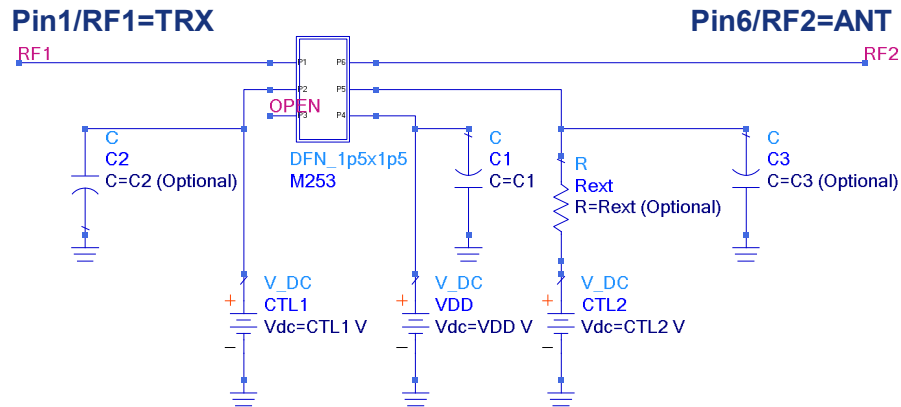
- Bluetooth/ZigBee/Wi-Fi IoT Solutions
- Bluetooth/BLE Audio & Video
- Smart Watches and Wearables
- BLE AoA/AoD Direction Finding & Indoor Location
- Remote Control for Gaming, Toys, Drones
- Home Automation
- Electronic Labeling, Asset Tracking
- Other Generic 2.4GHz Radio Designs

# BHWM253 EVB for LNA Application



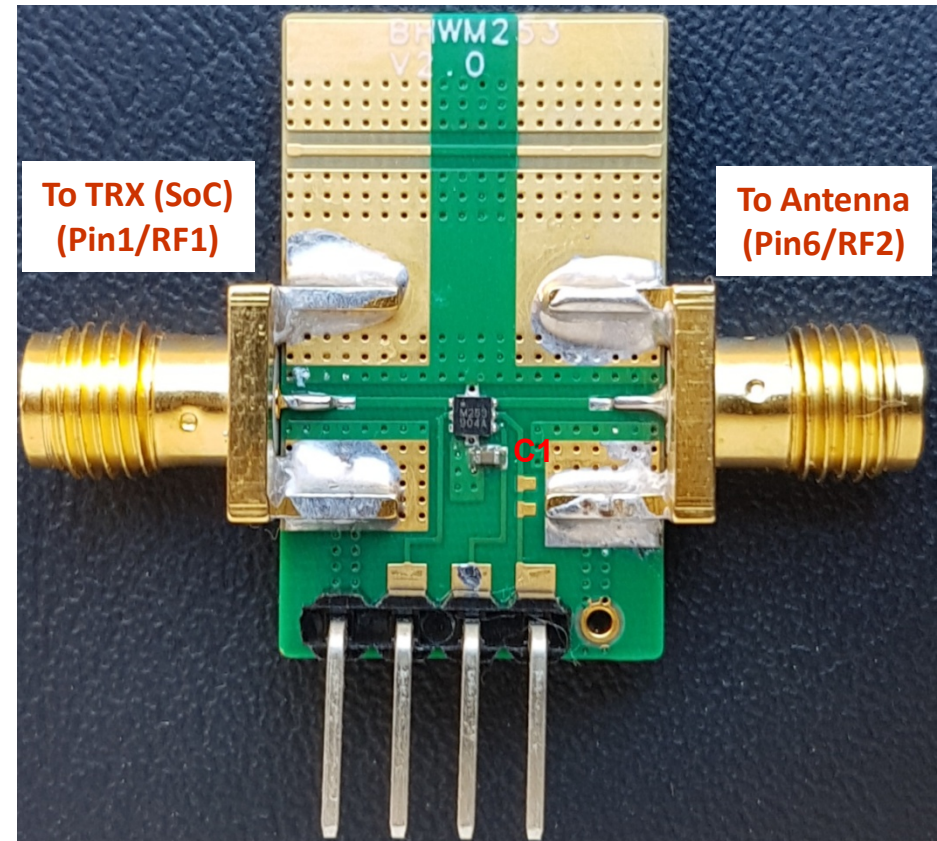
## Connection for Using BHWM253 as LNA with By-Pass for Transmit

### Application Schematic



### Logic Control (For LNA Application)

CTL1 (Pin 2)	CTL2 (Pin 5)	Mode of Operation
0	0	All Off
1	0	Transmit (By-Pass)
0	1	Receive (LNA On)



**GND**  
**CTL1**  
**VDD**  
**CTL2**

### Notes:

- BOM: C1=1uF (on VDD Pin 4)
- Recommended VDD: 1.2~3.3V
- Bypass capacitors on CTL1, CTL2 can be omitted for small foot-print PCB designs without long traces

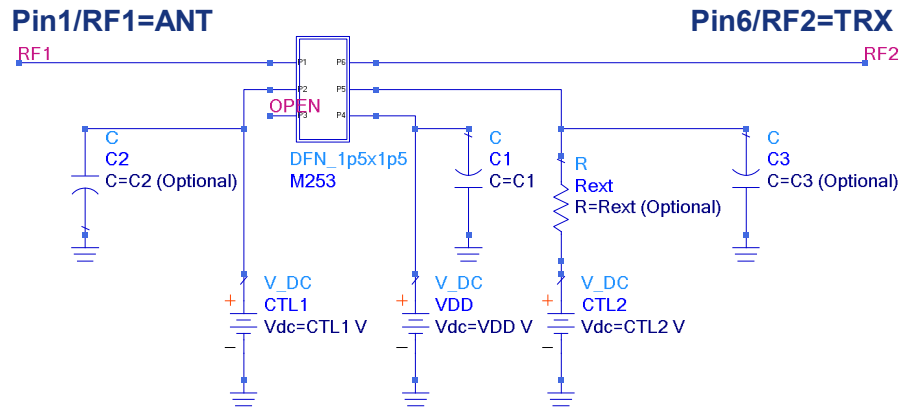


# BHWM253 EVB for PA Application



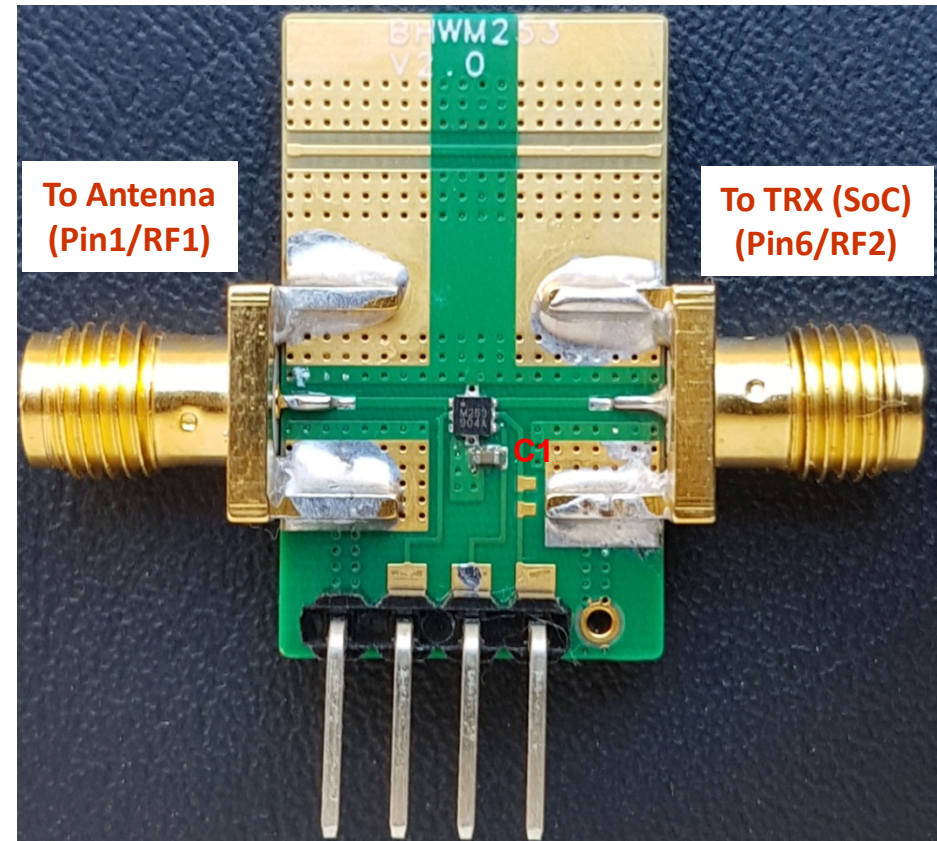
## Connection for Using BHWM253 as PA with By-Pass for Receive

### Application Schematic



### Logic Control (For PA Application)

CTL1 (Pin 2)	CTL2 (Pin 5)	Mode of Operation
0	0	All Off
0	1	Transmit (PA On)
1	0	Receive (By-Pass)



**GND**  
**CTL1**  
**VDD**  
**CTL2**

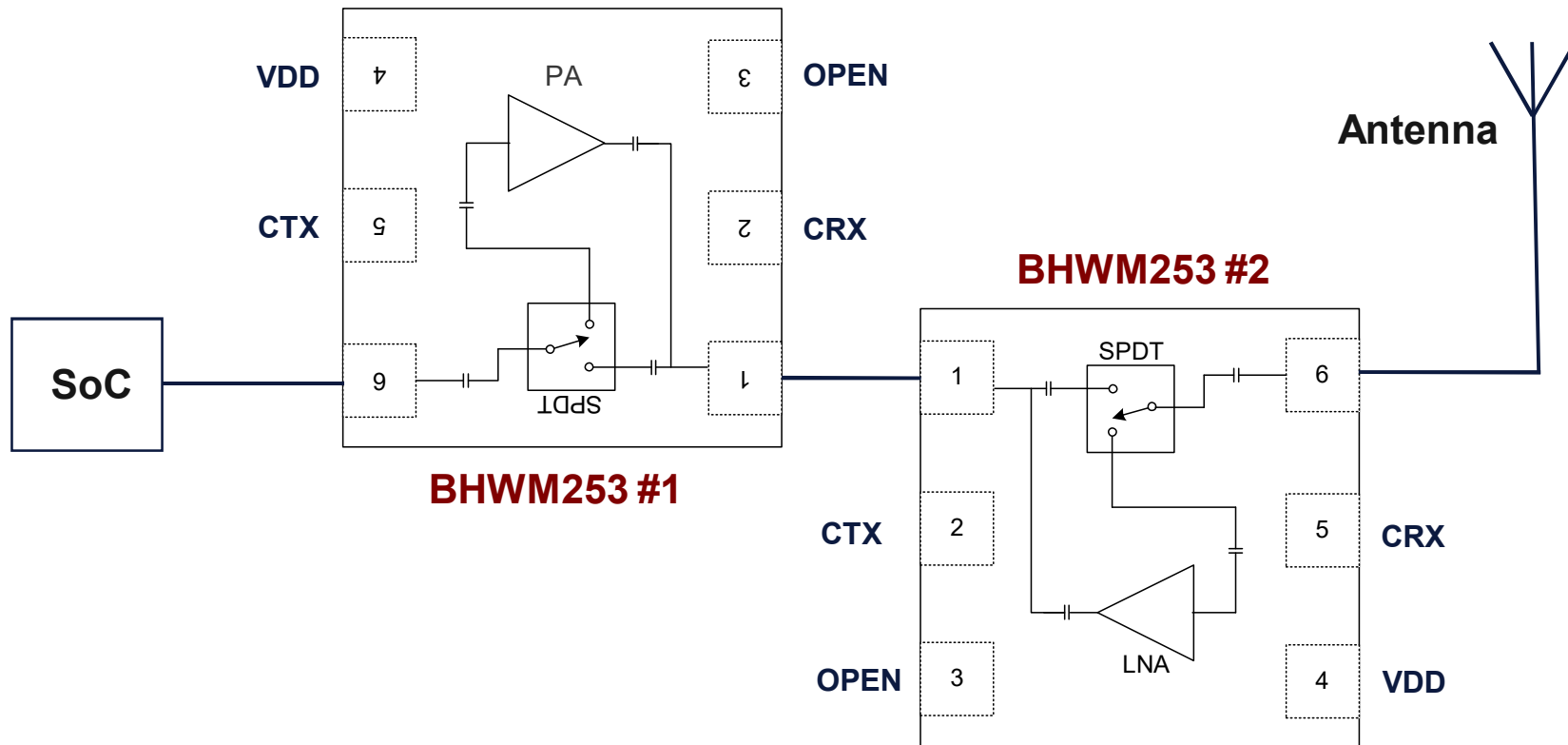
### Notes:

- BOM: C1=1uF (on VDD Pin 4)
- Recommended VDD: 1.8~4.2V
- Bypass capacitors on CTL1, CTL2 can be omitted for small foot-print PCB designs without long traces

# BHWM253 Crossover Cascade Topology



To Improve both Tx Power and Rx Sensitivity



- The amplifier inside BHWM253 can be used either as an LNA to improve receive sensitivity, or as a PA to boost transmit power, depending on system link budget requirements.
- For applications that require improvement of both Tx power and Rx sensitivity, the crossover cascade is recommended. Nominal supply voltage is VDD=3.3V, although VDD up to 4.2V can be used for further increase in Tx power.
- For Tx Mode, set CTX=High (3.3V Typical), CRX=0. The circuit is ready for transmission. Tx power at the antenna could reach ~12/13dBm (at VDD=3.3/4.2V), with ~30mA current, depending RF driving levels from the SoC.
- For Rx Mode, set CRX=High(3.3V Typical), CTX=0. The entire circuit takes ~14mA at VDD=3.3V. Noise Figure is ~1.8dB including switch loss, resulting in 4~6dB better Rx sensitivity typically (depending on specific SoCs).



# BHWM253 Crossover Cascade: Case Study



## 音乐播放源:

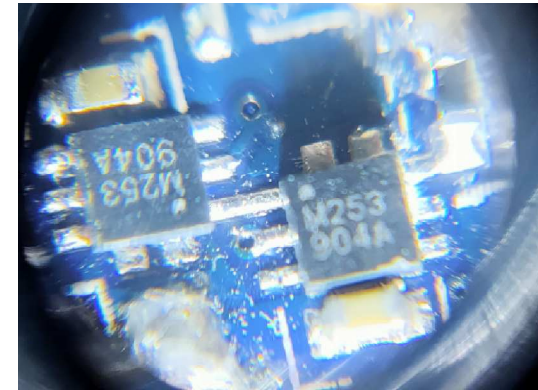
Samsung Galaxy S7 Edge (地点1)

接近垂直倾斜靠放塑料栏杆/金属柱, 离地约1米

## 音乐接收:

Qualcomm QCC3021模组+BHWM253

Crossover Cascade (Partial Circuit Below)



## 测试结果:

地点2: 约60米, 垂直/水平360度完全无卡顿

地点3: 约50米, 垂直/水平360度完全无卡顿

地点4: 约150米, 稍有卡顿

地点5: 绕球场一圈, 无卡顿

地点6: 267米, 隔球场铁丝网, 能够勉强放音



# 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)