Simplifying Design of Wireless Chargers

Silvan Ho
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AGENDA

• Qi Wireless Transmitter Diversity Advantage
• What a Transmitter is Made of
• RT3181A as Universal Transmitter Building Block
• Simple Design Examples
  • A11
  • A6, A19
  • MP-A5
• Wireless Power Receivers
• Summary
Qi Wireless Transmitter Diversity

- WPC transmitter portfolio accounts several dozen of transmitter types
- System integrators have great level of flexibility addressing practical wireless power implementations
- Two major transmitter groups
  - Single coil, Like A10, A11, MP-A5, etc.
  - Multi coil, A6, A19, etc.
- Addressing TX variety presents technical and economical problems
What Wireless Power Transmitter is Made Of

- **Typical WPTX takes DC input**
  - Regulates it down to power control circuitry
  - The MCU controls all TX functions
  - Interface chips demodulate RX feedback signals
  - The Power Amplifier converts DC voltage to square wave AC that energizes the resonant network
  - The resonant network drives sine wave current through TX coil
  - All these functions in many cases are done by the individual discrete components making TX design complex and expensive
RT3181A – Universal Single Chip WPTX Inverter

• **RT3181A Does:**
  - Regulates DC input down to power control circuitry and PA
  - Incorporates MCU that controls all TX functions and digitally processes RX feedback signals
  - Incorporates Power Amplifier that converts DC voltage to the square-wave AC voltage that energizes the resonant network
  - Supports two FOD methods – before power transfer and during power transfer
  - Controls LED indicators and buzzers
  - Reduces TX BOM by more than 50%

Integrating Most of WPTX Functions into a Single IC Provides Highly Functional and Economical WPTX Solution
RT3181A – WPC Transmitter Examples

• RT3181A
  • Support WPC BPP & EPP
  • Configurable Internal PA or External PA
  • Package, 6x6 QFN48

LP-A11 (BPP) Single Chip

LP-A11 (BPP) Efficiency Enhanced

MP-A5 (EPP)
BPP - A6/A19

- **A6 (3 coil)**
  - External selection FET
  - High efficiency by 2 HB parallel operation.
  - Optional Boost controller for 5V input

- **A19 (2 coil)**
  - Simple BOM
  - Trade off of BOM cost and charging area
  - Optional Boost controller for 5V input
RT3181A Based A11 TX Module

- **Module Design**
- WPC Registered Product
  https://www.wirelesspowerconsortium.com/products/details/1853/rt3181-lp-charger
- Commercial production ready
- Optional external DrMOS (RT9682A) for efficiency enhancement
- Module Supplier, Kupiin
RT3181A LP-A11 C/P Trade-Off

- **Cost/Performance Trade-off**
  - PCB, 2L vs 4L
    - IC Temp 72°C vs 62°C @5W RX
    - Similar Eff, 50% PCB cost down
  - Internal PA vs External PA (RT9682A DrMOS)
  - Tuning Capacitor, X7R vs C0G
  - Coil

<table>
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<tr>
<th>Configuration</th>
<th>Efficiency</th>
<th>Cost</th>
<th>Remark</th>
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<td>Basic Configuration</td>
<td>η</td>
<td>$</td>
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<tr>
<td>2L PCB Int. PA, C0Gx1 + X7Rx3, Gotrend 2L Coil</td>
<td>η+5%</td>
<td>$ + 0.6</td>
<td>(RT9682A+Cap)x2</td>
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<td>X7Rx3 → C0Gx3</td>
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<tr>
<td>Coil Improvement</td>
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For Very Thin TX Design

- **Conventional Design**
  - AC/DC
  - RX

- **Coil Wire Extension**
  - AC/DC
  - RT3181A
  - PS
  - RX

- **Remote Drive**
  - AC/DC
  - RT3181A
  - PS
  - RX
Remote Drive™ TX

Why Remote Drive™
- For very thin TX Pad design (~2mm), TX Attached on the table edge, no need to drill the hole
- Separate the heat in TX, versus the conventional design, TX PCB underneath the coil.
- Prototype base on A11, can also apply to MP-A5 and other TX type
- Module Supplier: Kupiin

![Diagram of Remote Drive™ TX components](image)}
RT3181A Based A19 TX Module
RT3181A based Wearable Solution

- **WPC base Wearable Solution**
  - Coil and PCB minimized for low power application
  - TX : RT3181A with mini-A11 coil
  - RX : RT1652, Voltage source or Direct Charge to battery

- **Module Supplier**
  - Luxshare/ICT
  - Contact : Jefferson Lin, Email : Jefferson.Lin@luxshare-ict.com

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**Voltage Source**
- Matching
  - 100mW ~150mW
- Rect.
  - 150mW
- LDO
  - 50mW
- Charger
  - 150mW ~200mW

**Direct Charge**
- Matching
  - 100mW ~150mW
- Rect.
  - 150mW
- LDO
  - 50mW

Vrect = Vbat + 0.1V
Pre-chg/CC/CV mode
RT3181A Based MP-A5 TX Module

• MPA5 Module Design
  • In Certification process
  • 4L PCB Ref design

**Diagram:**
- **MP-A5 (EPP)**
- 12V IN
- Buck Ctrl
- RT3181A
- HB
- DrMOS RT9682A
- HB
- DrMOS RT9682A
MPA5 w/ RT1653 & RT3180W

MPA5+RT1653

MPA5 + RT3180W

Efficiency (%) vs. Output current (A)

Efficiency (%) vs. Power (W)

- Output 9V Vishay coil
- Output 12V Vishay coil
- Output 9V AKS coil
- Output 12V AKS coil

- 5V (Buck 11.5V) 10W
- 9V (Buck 11.5V) 15W
- 11.5V (Bypass) 15W
SUMMARY

- Simplify your next wireless power product design
- Choose Qi SOC transmitters for reduced system BOM
- Look for these part numbers

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<th>RX</th>
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<td>RT3181A</td>
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http://www.richtek.com/
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thank you.