MP2662在TWS耳机中的应用

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主要内容

- 小型电池的充电要求
- TWS耳机充电方案
- MP26029, MP2661, MP2662充电方案
- MP2662应用

电池管理产品应用领域

Mobile Computing

- Tablets & 2-in-1
- Notebooks
- Chromebooks
- Smart Phones
- Hand-held Gaming

Portable Power

- USB PD Power Bank
- Micro USB Power Bank
- Smartphone Charging Case
- BT Earbud Charging Case

Wearable

- Fitness Band
- Smart Watch
- Bluetooth Headphones
- Bluetooth Neckband

Connected Devices

- BT Speakers
- Action Cameras
- Wi-Fi Cameras
- Drone Controllers
- Gaming Controllers

2-6 Cell non-USB

- POS Terminal
- Robot Vacuums
- Drones
- Portable Appliances

BMS

- Power Tools
- E-bike/E-scooter
- Battery Backup
- EV/HEV BMS

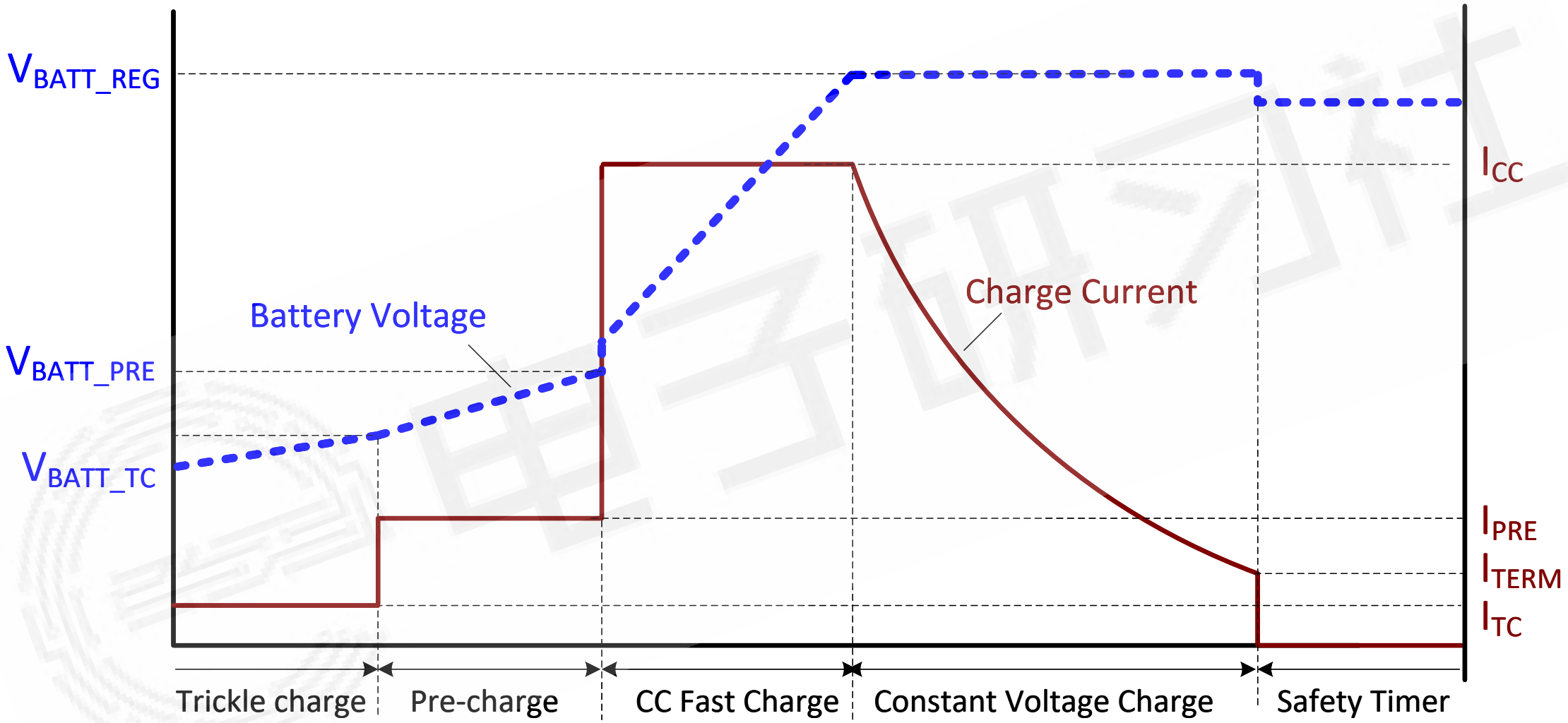
小型电池典型应用

Over-ear BT Headphones	Fitness Band and Smartwatch	In-ear BT earbuds and charging cases	Connected Glasses
			
• 300mAh-600mAh • Linear chargers for up to 1A charge current • Switching charger needed for faster charging > 1A • Power path for instant-on	• 100mAh-500mAh • Linear chargers for up to 1A • Very low Battery Iq and shipping mode • Ideally integrate battery protection FETs into charger	• Charging case 300mAh-400mAh • Earbud 30mAh-60mAh • Linear chargers for up to 200mA charge current • Linear charger or switching charger for up to 1A charge current • Very low battery-Iq charger	• Single or dual batteries to balance weight • Charge current in the range of 200-500mA • 1-2 linear chargers with power path and low Iq

小型电池的充电要求

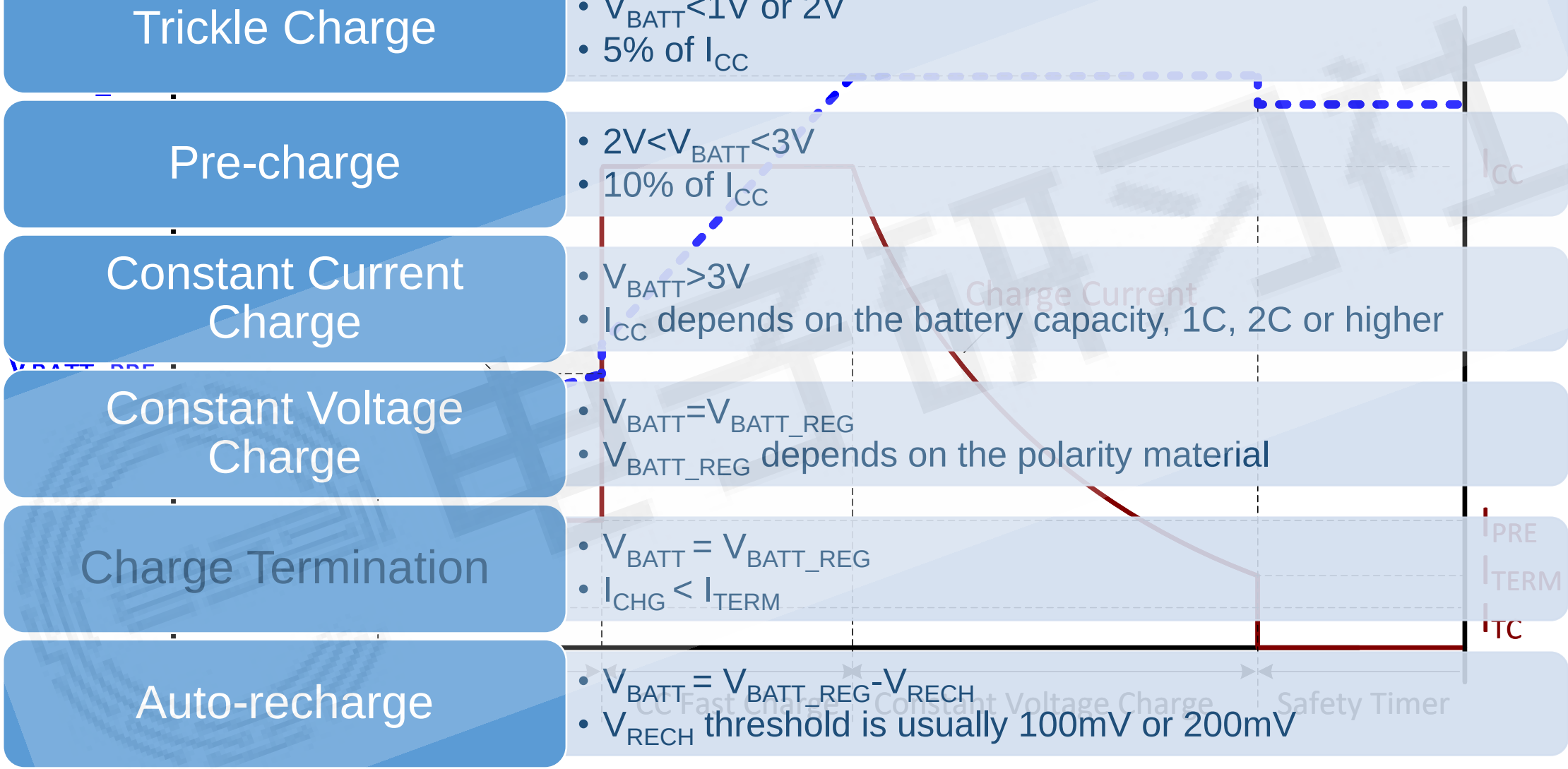
- **更高的充电电流**
  - ✓ 1C，2C，3C充电
  - ✓ 降低充电时间，提升用户体验
- **提高电池利用率**
  - ✓ 较低的截止充电电流，让电池充的更满
  - ✓ 较高的放电效率，提高电池利用率
- **降低充电方案功耗**
  - ✓ 降低充电IC静态耗电
  - ✓ 降低运输模式漏电
  - ✓ 延长电池使用时间
- **提高充电安全性**
  - ✓ 安全可靠的充电和放电保护
  - ✓ 电池温度监控与保护
- **减小充电方案尺寸**
  - ✓ 提高充电方案的集成度
  - ✓ 充电IC的封装

典型充电曲线

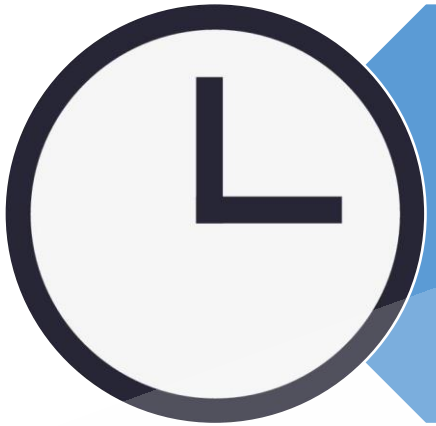

VBATT_REG
VBATT_PRE
VBATT_TC
ICC
IPRE
ITERM
ITC
Battery Voltage
Charge Current
Trickle charge
Pre-charge
CC Fast Charge
Constant Voltage Charge
Safety Timer

典型充电曲线

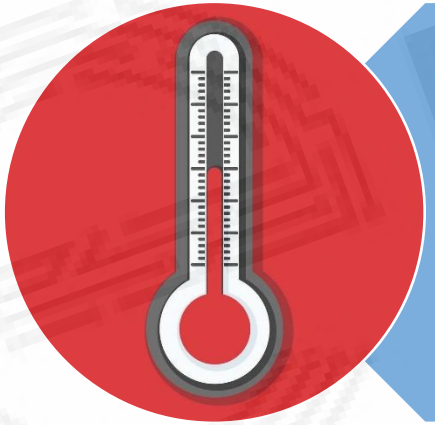
Trickle Charge	• V_{BATT}<1V or 2V • 5% of I_{CC}
Pre-charge	• 2V<V_{BATT}<3V • 10% of I_{CC}
Constant Current Charge	• V_{BATT}>3V • I_{CC} depends on the battery capacity, 1C, 2C or higher
Constant Voltage Charge	• V_{BATT}=V_{BATT_REG} • V_{BATT_REG} depends on the polarity material
Charge Termination	• V_{BATT} = V_{BATT_REG} • I_{CHG} < I_{TERM}
Auto-recharge	• V_{BATT} = V_{BATT_REG}-V_{RECH} • V_{RECH} threshold is usually 100mV or 200mV



充电安全性

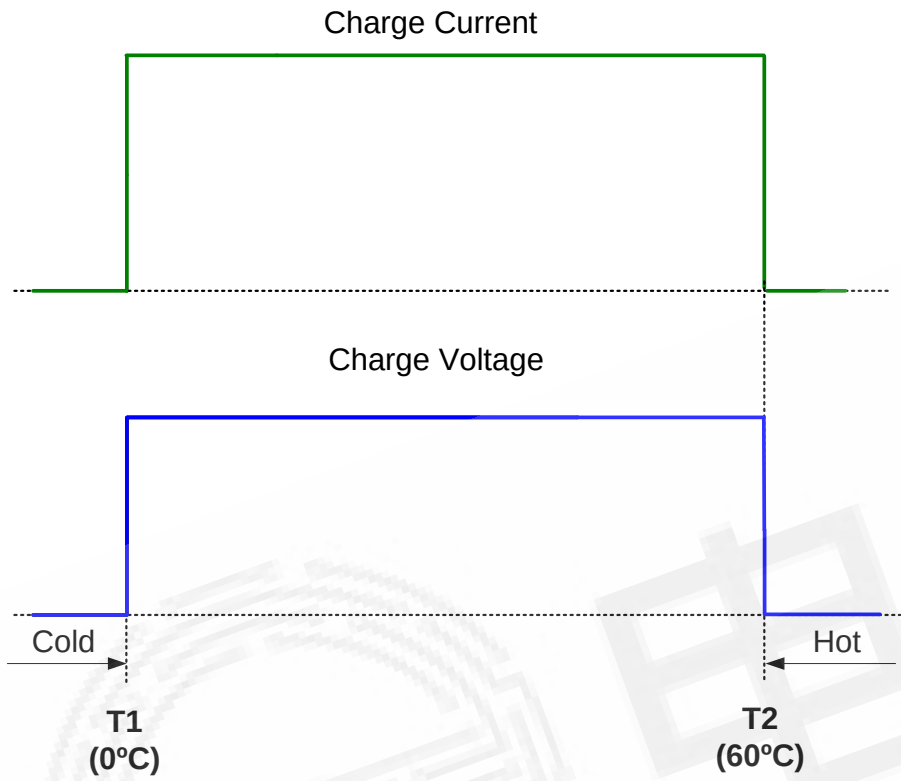


Charge Safety Timer to Stop Charging Mandatorily after Preset Time

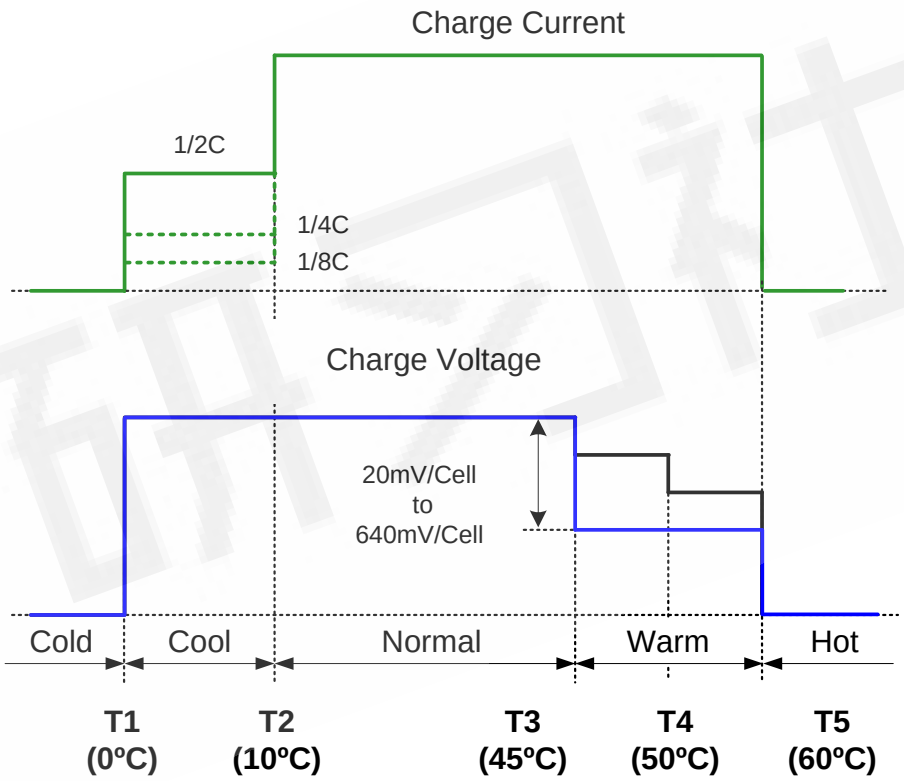


Battery Temperature Monitoring by NTC (Negative Temperature coefficient) Thermistor

电池温度保护



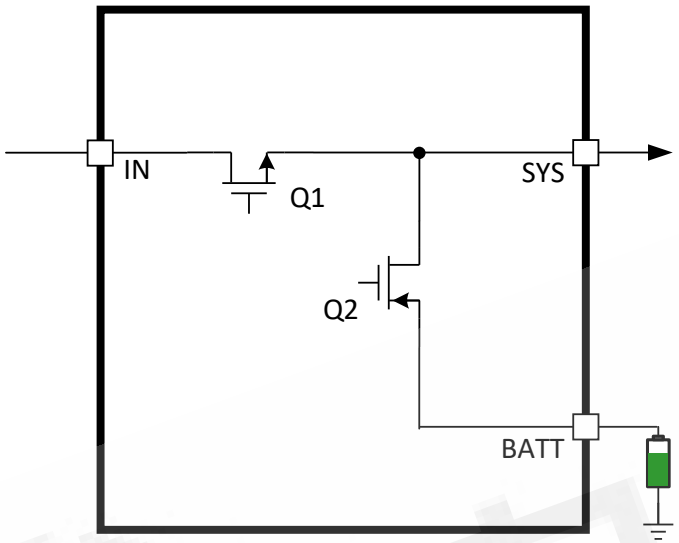
Standard NTC Protection Window

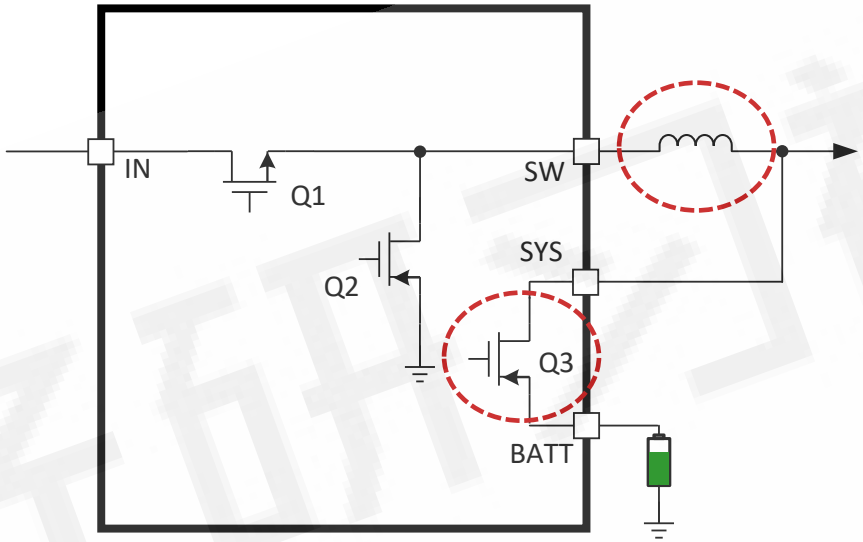


JEITA* Compliant NTC Protection Window

JEITA: Japan Electronics and Information Technology Industries Association
https://www.jeita.or.jp/english/

线性充电和开关充电

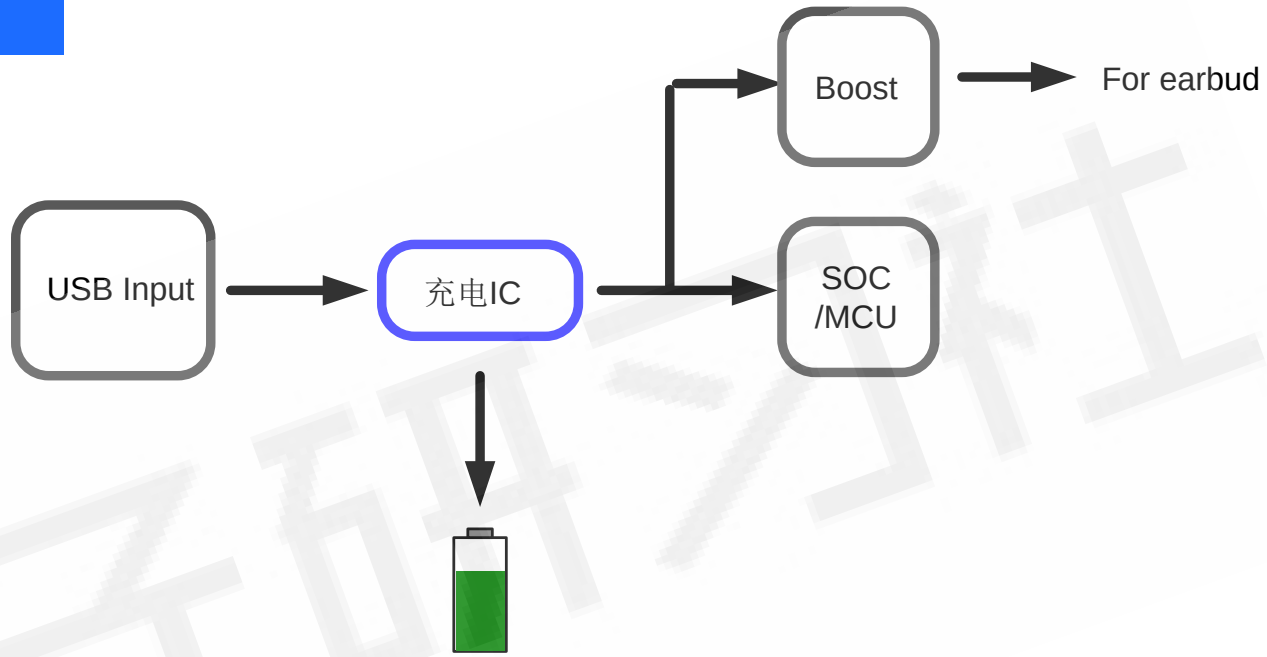


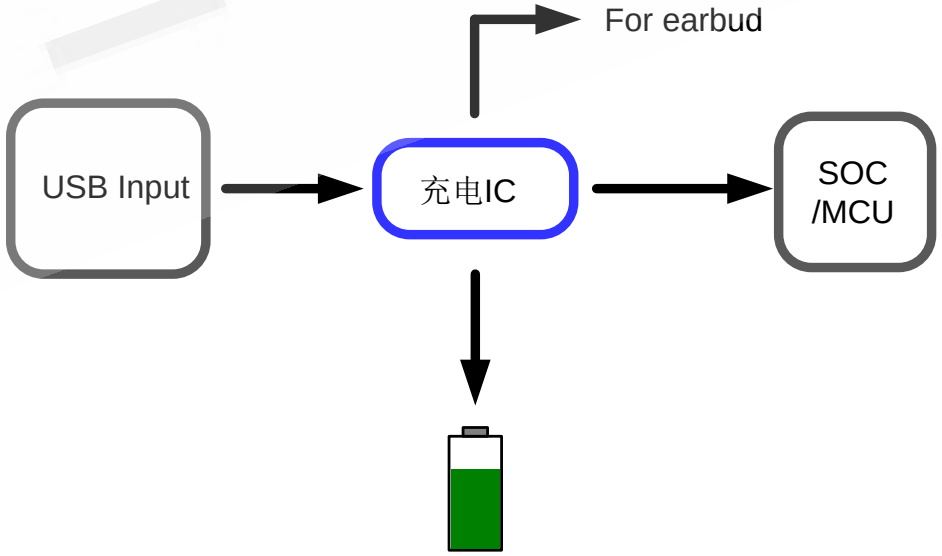


- 线性充电，简单易用，尺寸小，成本低
- 开关充电，大电流充电，效率高
- 线性充电VS开关充电
  - 充电电流<500mA: 线性充电
  - 500mA<充电电流<1000mA: 线性充电或开关充电
  - 充电电流>1000mA: 开关充电

TWS耳机的充电方案

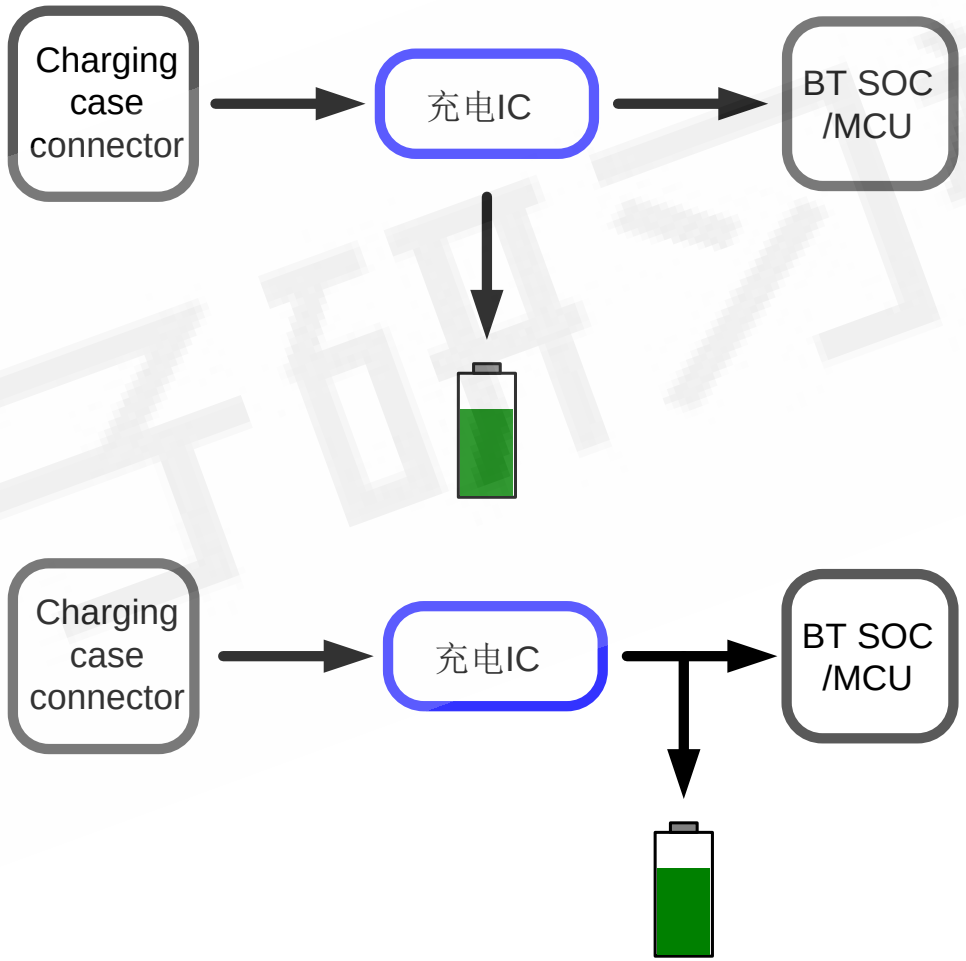
- 充电盒
  - 电池容量 300mAh-400mAh
  - 充电电流 <1000mA
  - 线性充电或开关充电
  - 带功率路径管理





TWS耳机的充电方案

- 耳机
  - 电池容量 30mAh-60mAh
  - 充电电流 <200mA
  - 线性充电
  - 带或不带功率路径管理

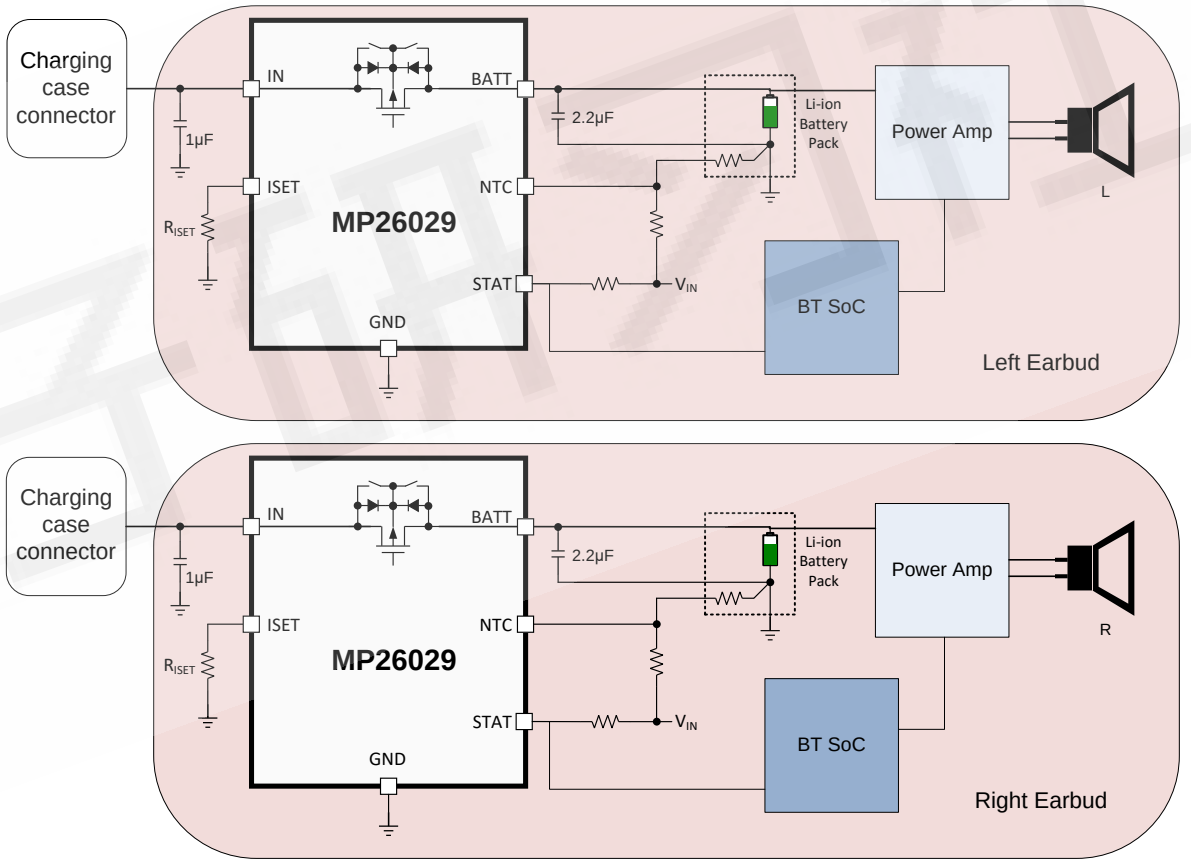


Linear Charger Solution

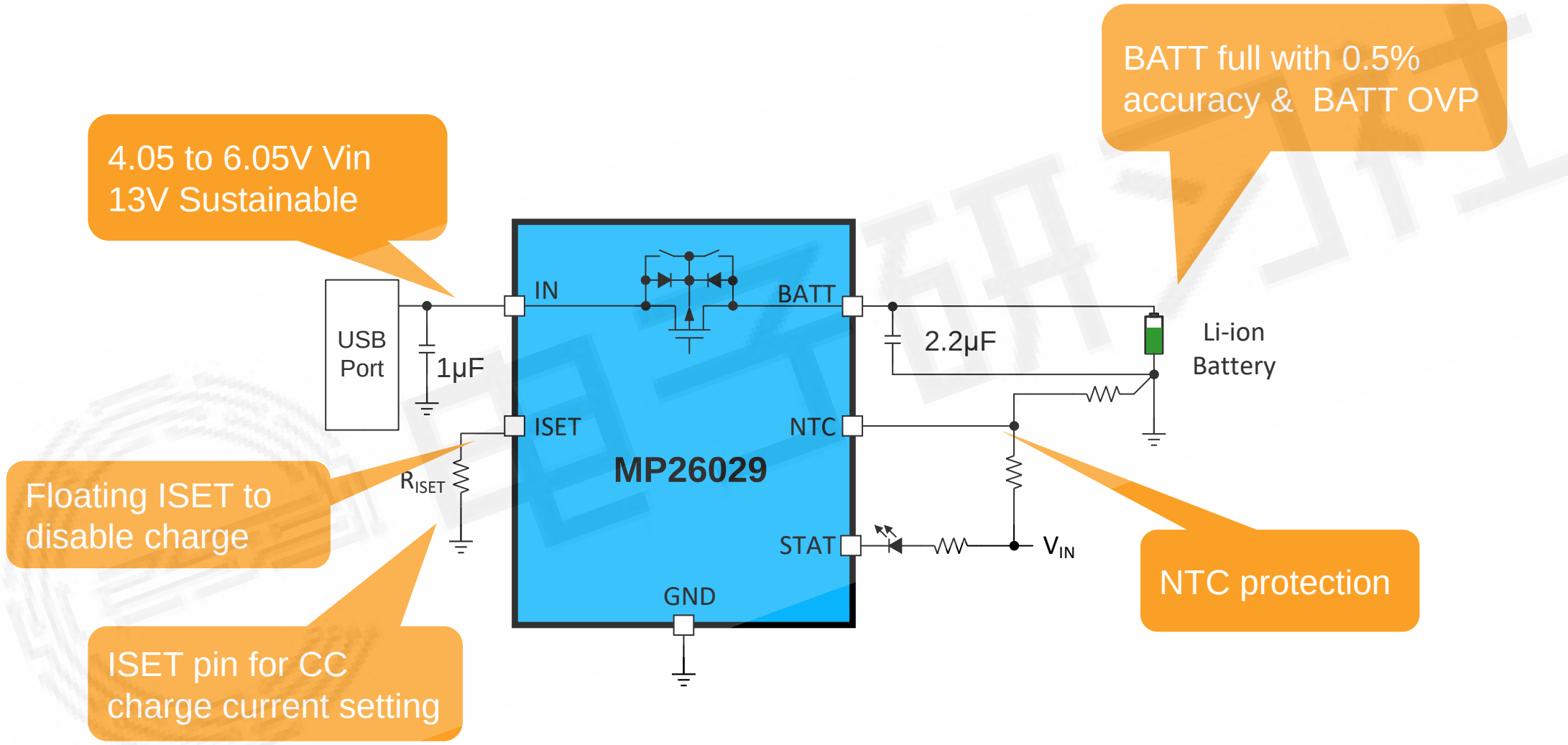
Part Number	Operating V_{IN} (V)	Charge Current (mA)	Termination Current (min) (mA)	Battery Charge Voltage (V)	Battery Iq (μA)	Power Path	Control Interface	Package (mm)	Status
MP2602	4.35 to 5.5	85 to 1000	8.5	4.2	1	N	Standalone	QFN-10 (3x3)	Released
MP26029	4.35 to 5.5	30 to 1000	3	3.6 to 4.4	0.1	N	Standalone + OTP	SOT563 (1.6x1.6); QFN-10 (3x3)	Released
MP2660	4.35 to 5.5	8 to 500	6	3.6 to 4.5	5.5	Y	I2C + OTP	WCSP-9 (1.55x1.55)	Released
MP2661	4.35 to 5.5	8 to 500	6	3.6 to 4.565	5.5	Y	I2C + OTP	WCSP-9 (1.55x1.55)	Released
MP2662	4.35 to 5.5	8 to 456	1	3.6 to 4.5	0.35	Y	I2C + OTP	WCSP-9 (1.75x1.75)	Released
MP2663	4.35 to 5.5	8 to 500	6	3.6 to 4.5	5.5	Y	I2C + OTP	WCSP-9 (1.55x1.55)	Released
MP2664	4.35 to 5.5	8 to 500	6	3.6 to 4.5	5.5	Y	I2C + OTP	QFN-10 (2x2)	Released
MP2665	4.35 to 5.5	16 to 900	2.5	3.6 to 4.5	0.35	Y	I2C + OTP	QFN-12 (2.5x3)	Sampled
MP2667	4.35 to 5.5	16 to 1000	6	3.6 to 4.5	5.5	Y	I2C + OTP	QFN-10 (2x2)	Released

TWS耳机充电方案—MP26029充电方案

- 低至30mA的充电电流和低至3mA的截止电流
- OTP配置充电参数
- <100nA 电池漏电流，延长电池使用时间
- 小封装SOT563（1.6mmx1.6mm）
- 整体方案简单，尺寸小
- 集成温度环
- 电池温度监控与保护

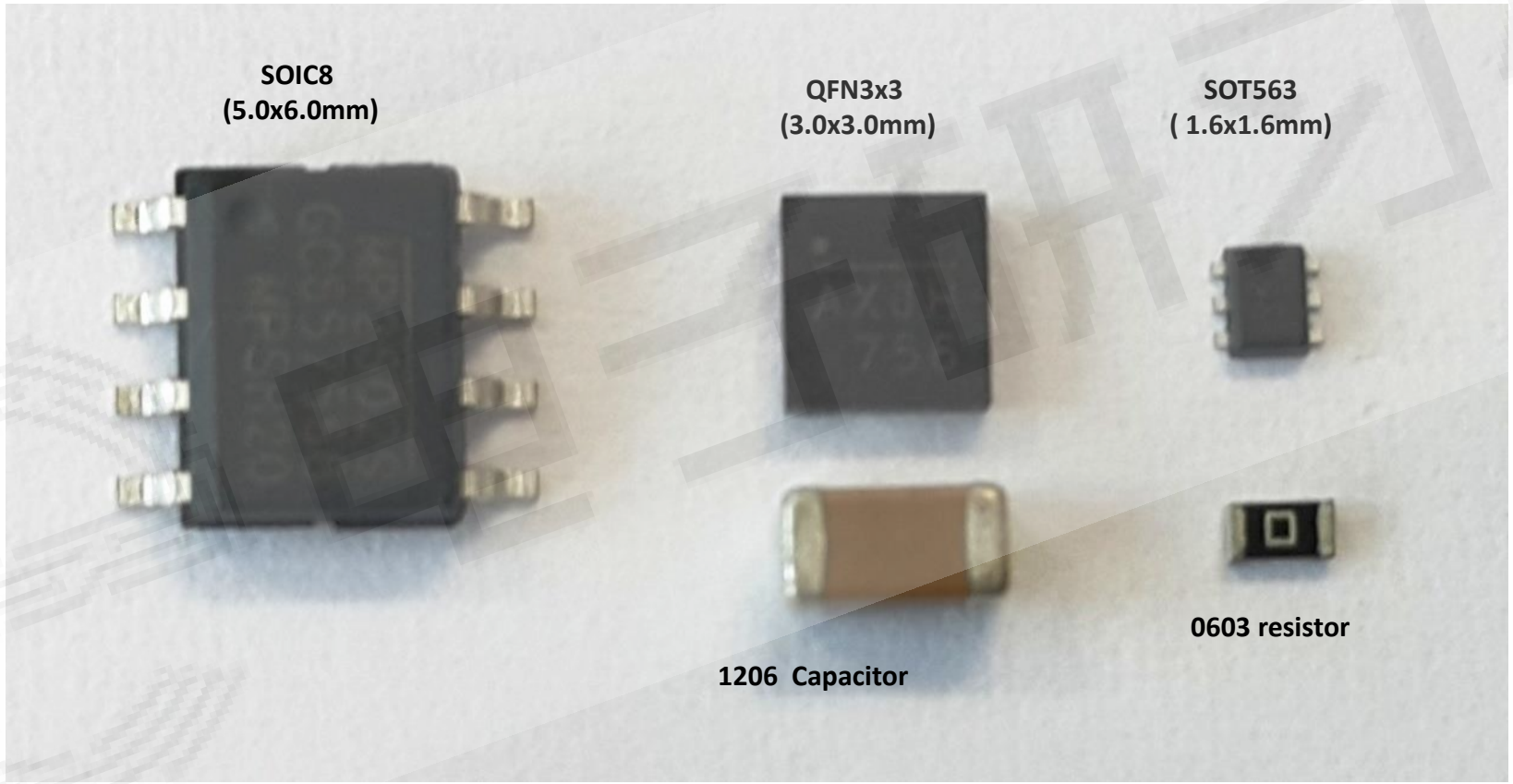


MP26029 介绍


4.05 to 6.05V Vin
13V Sustainable
BATT full with 0.5%
accuracy & BATT OVP
USB
Port
1µF
IN
BATT
2.2µF
Li-ion
Battery
ISET
NTC
MP26029
R_{ISET}
Floating ISET to
disable charge
STAT
V_{IN}
NTC protection
GND
ISET pin for CC
charge current setting

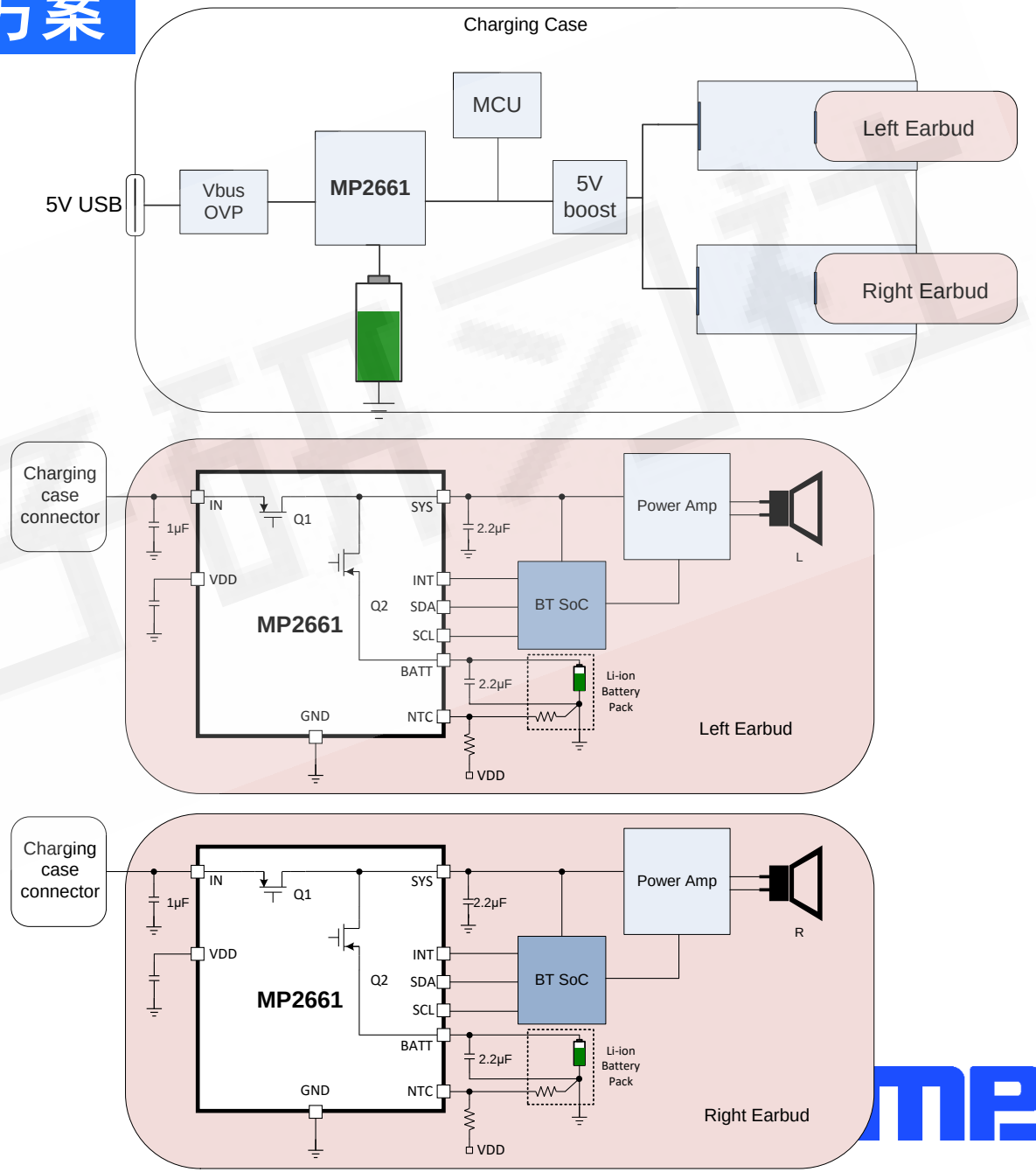
MP26029 封装

MP26029 is available in SOIC8-EP , QFN3x3-10pins and SOT563-6pins packages.



TWS耳机充电方案—MP2661充电方案

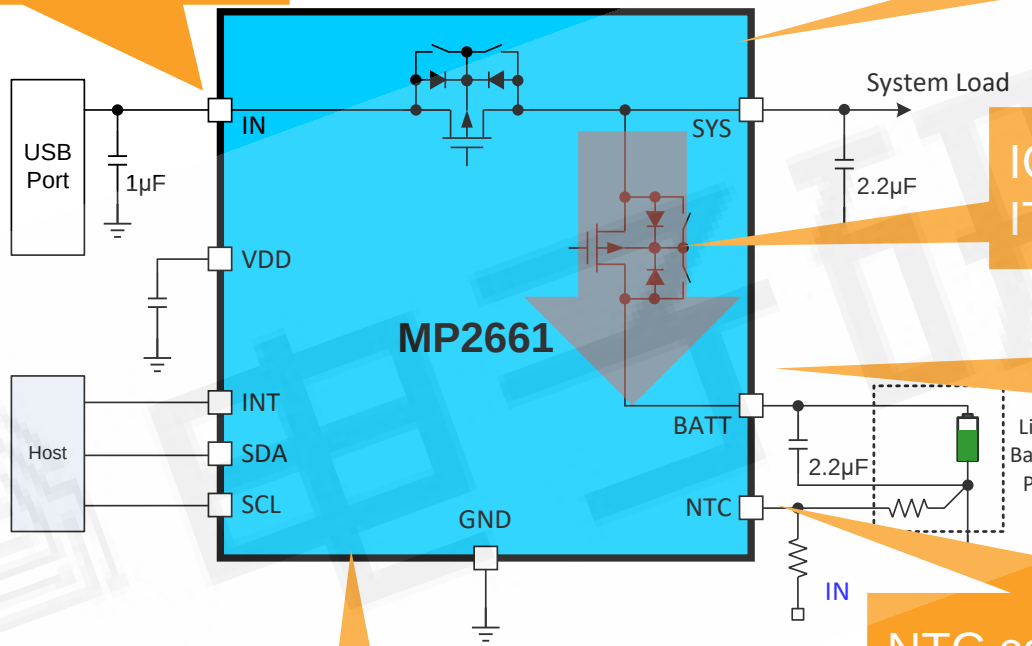
- 充电电流8mA-500mA
- 截止充电电流低至6mA
- I²C实时配置充电参数
- 待机模式<13μA leakage
- 运输模式<5.5μA leakage
- 小封装WCSP 1.55mmx1.55mm
- 带功率路径管理
- 保护功能
  - 过充保护
  - 过放保护UVLO，OCP
  - 集成温度环
  - 电池温度监控与保护



MP2661 介绍

4.35V to 5.5V VIN range,
Up to 13V Sustain Voltage

Power path, VSYS=4.65V fixed



ICC: 8mA to 456mA with 8mA/step
ITERM: 6 to 27mA with 7mA/step

<13uA battery quiescent current,
<5.5uA shipping mode current

NTC can be pull up to VDD if not used to save battery leakage

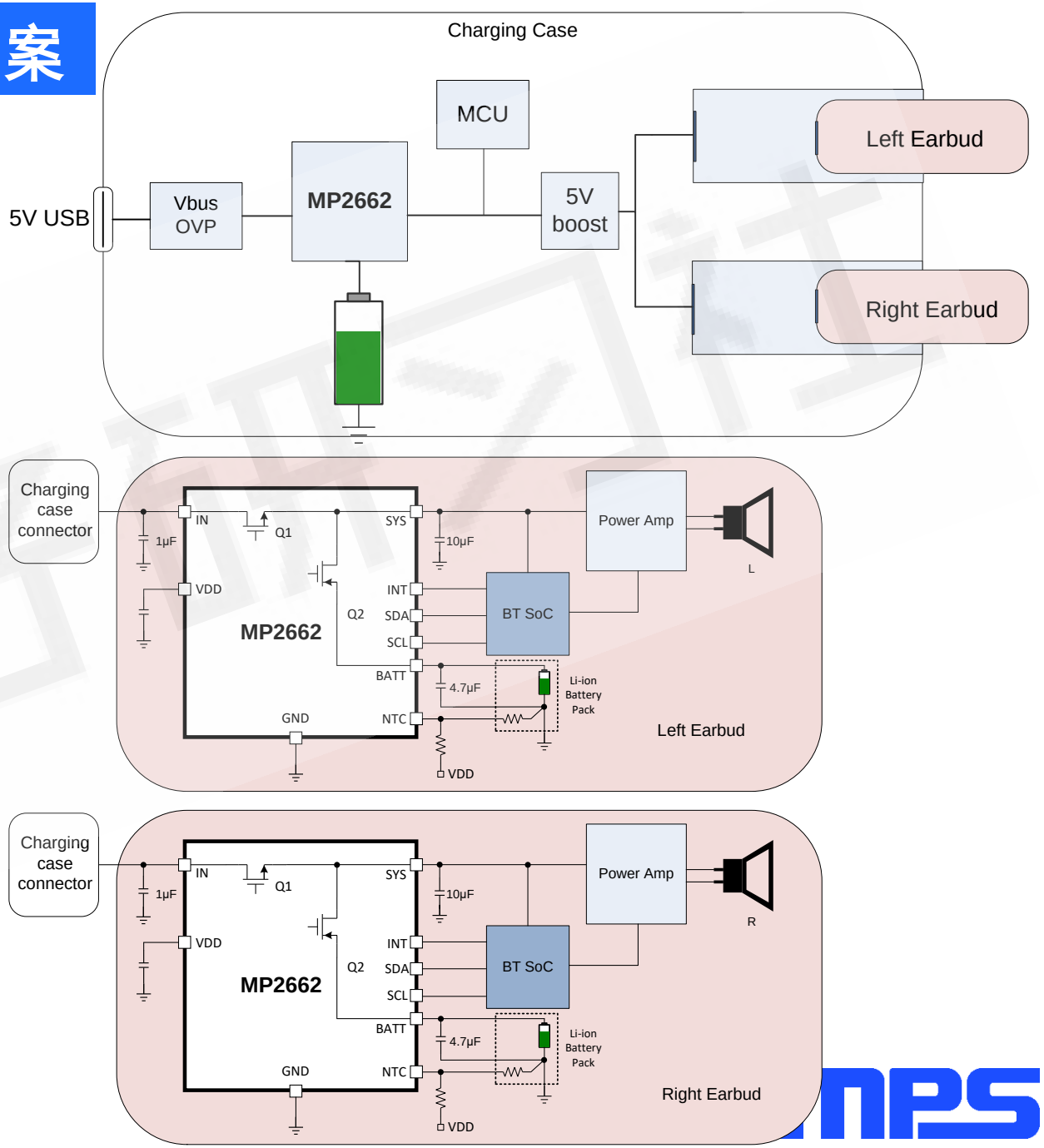
WLCSP-9

MP2661 封装

MP2661 is available in WLCSP-9 1.55mmx1.55mm package.

TWS耳机充电方案—MP2662充电方案

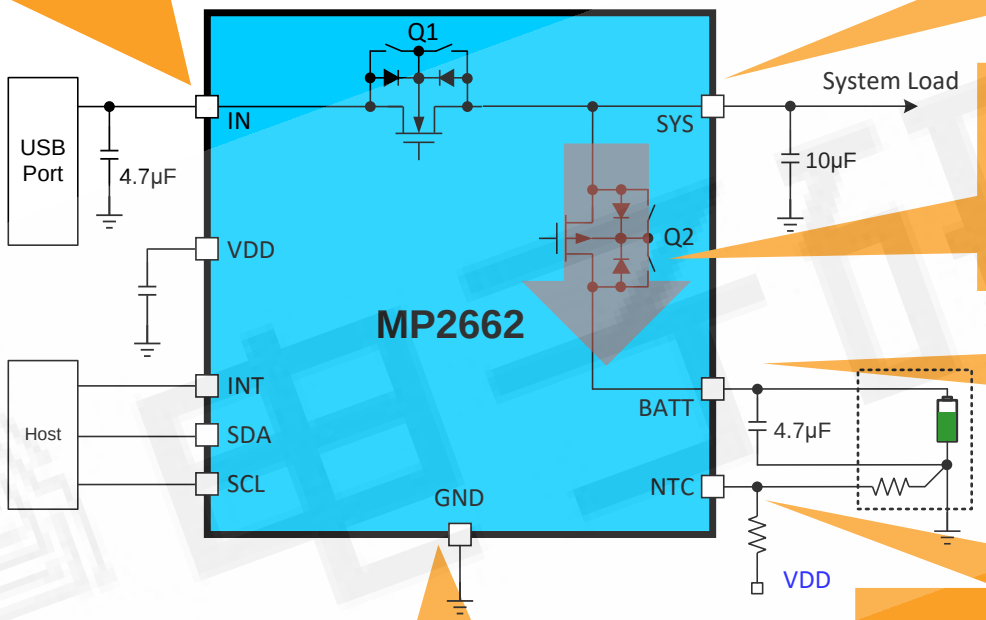
- 充电电流8mA-500mA
- 截止充电电流低至1mA+/-10%
- I²C实时配置充电参数
- 待机模式<6.5μA leakage
- 运输模式<350nA leakage
- 小封装WCSP 1.75mmx1.75mm
- 带功率路径管理
- 保护功能
  - 过充保护
  - 过放保护UVLO，OCP
  - 集成温度环
  - 电池温度监控与保护
  - 系统复位功能



MP2662 介绍

4.35V to 5.5V VIN range,
Up to 21V Sustain Voltage

Power path, VSYS_REG can be programmable (4.2V to 4.95V)



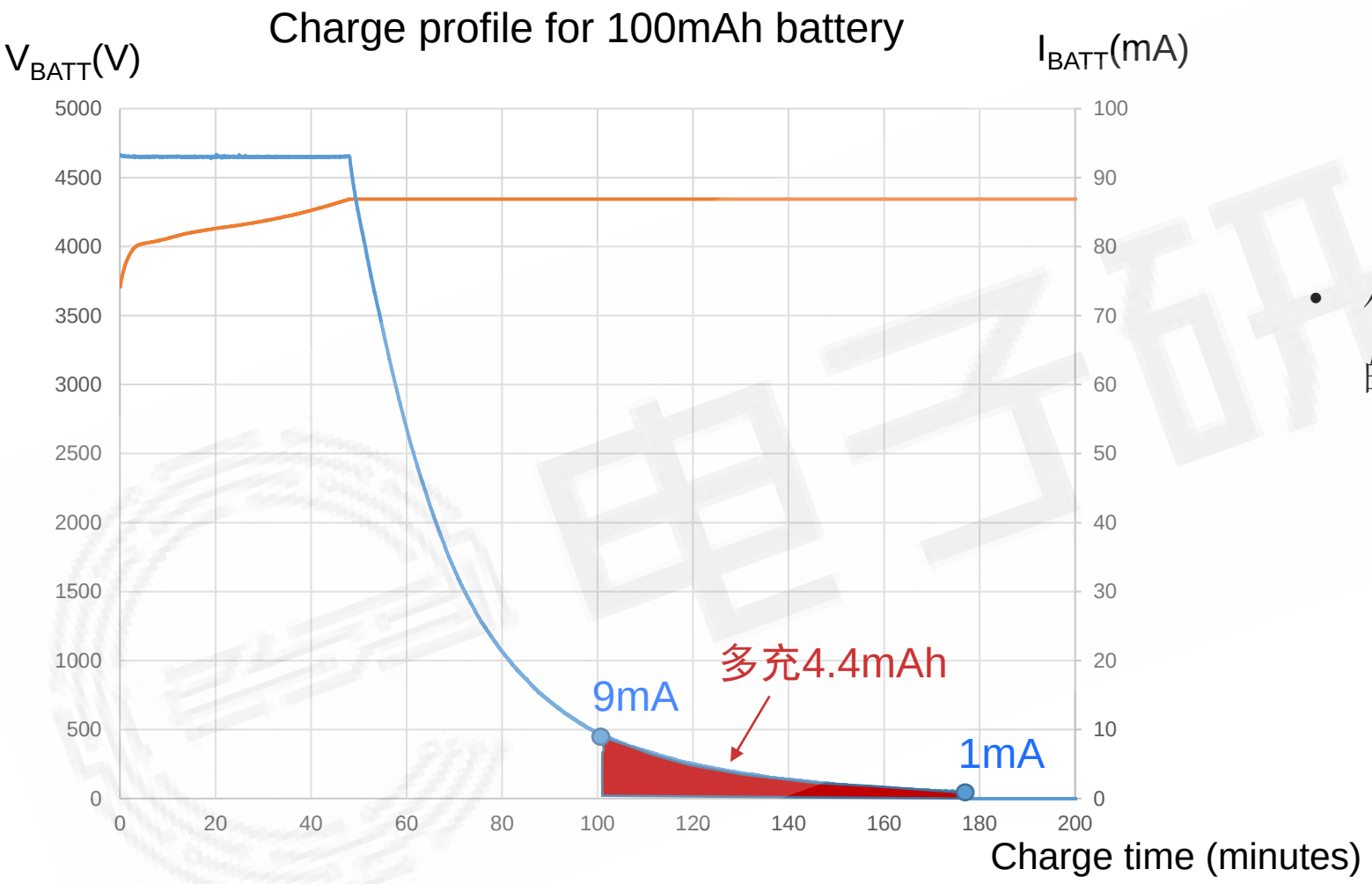
ICC: 8mA to 456mA with 8mA/step
ITERM: 1 to 31mA with 2mA/step,
10% accuracy at 1mA

6.5uA battery quiescent current,
<350nA shipping mode current

NTC can be pull up to VDD if not used to save battery leakage

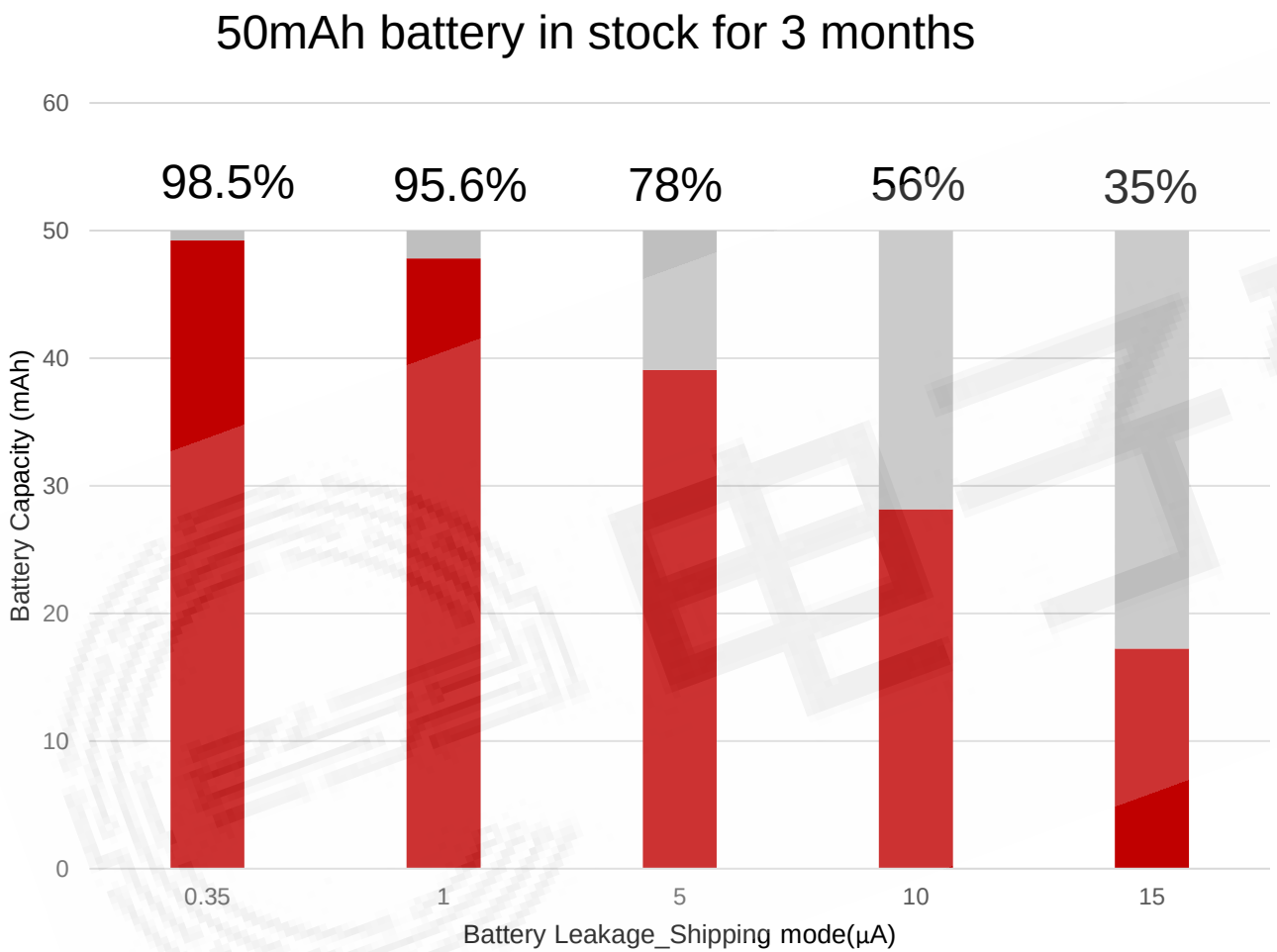
WLCSP-9, p2p with MP2661

MP2662低至1mA的截止电流



- 小的截止充电电流可以让电池充的更满，提升电池容量的利用率

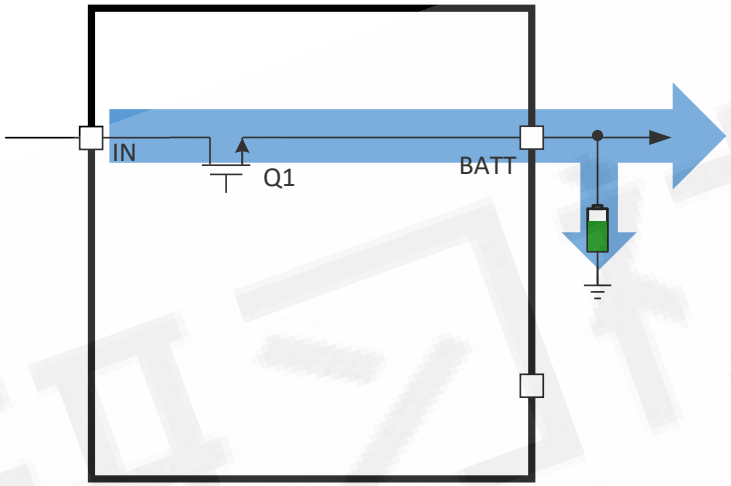
MP2662超低Battery Leakage

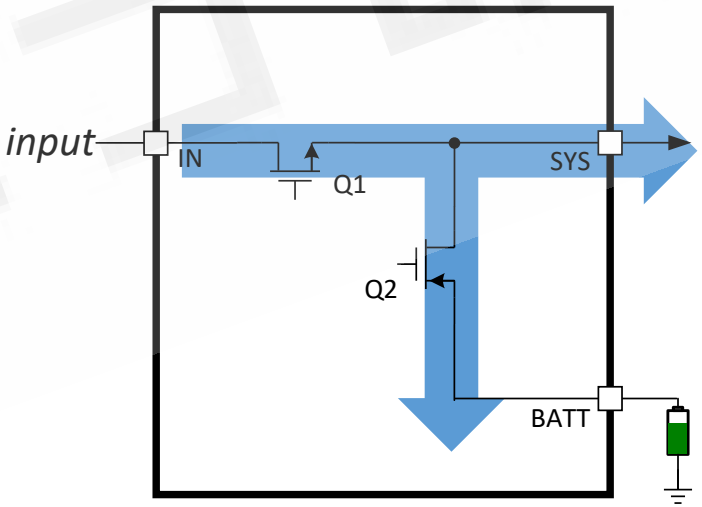


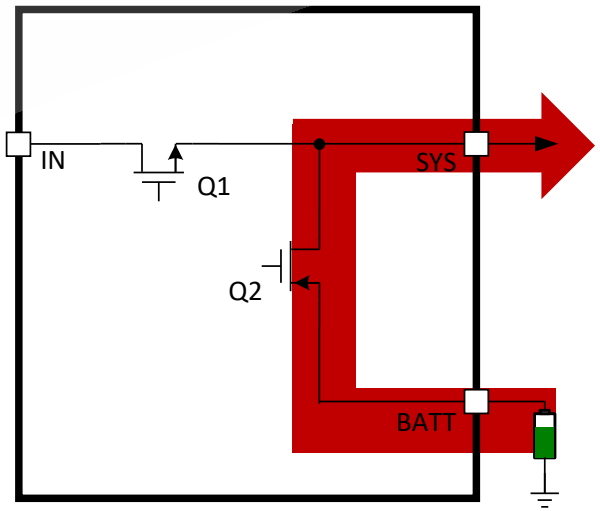
- 超低battery leakage可以延长电池使用时间

功率路径管理

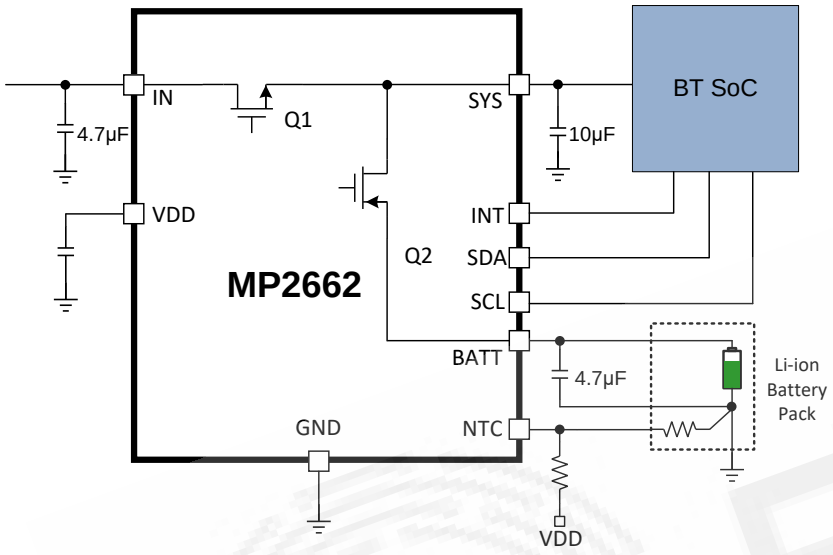
- 可以同时给系统负载供电和给电池充电
- 将充电路径和系统负载供电路径分开，实现精确的截止充电
- 在输入功率不够的情况下，系统负载有更高的供电优先级
- 即时开机
- 可以对电池放电进行监控和保护

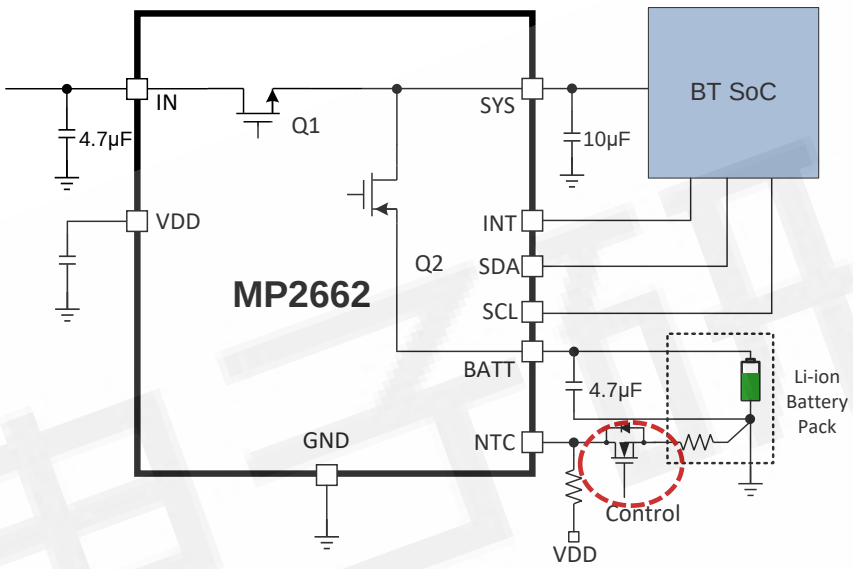


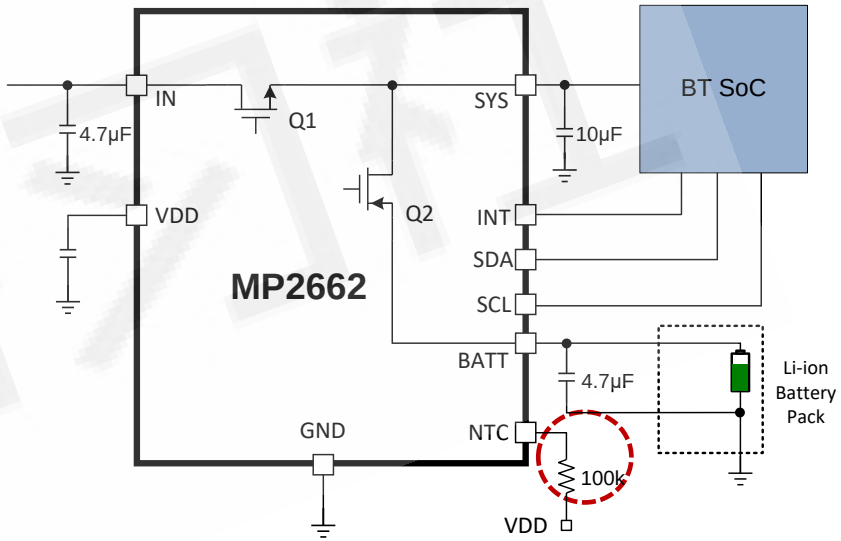




MP2662应用技巧_1

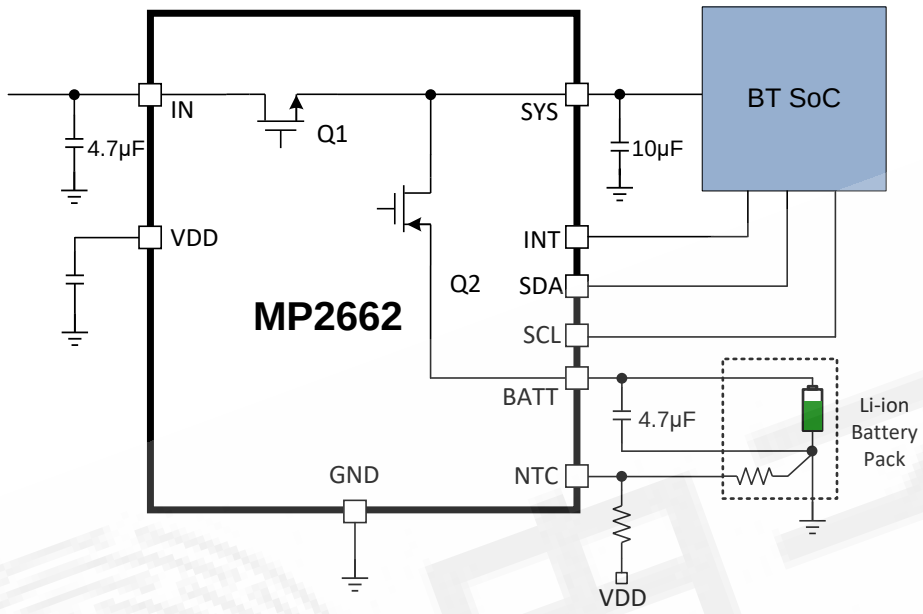


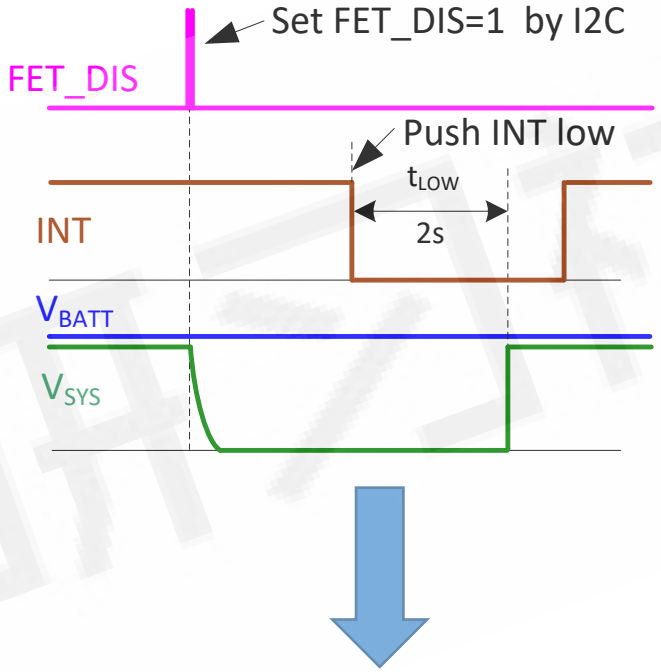


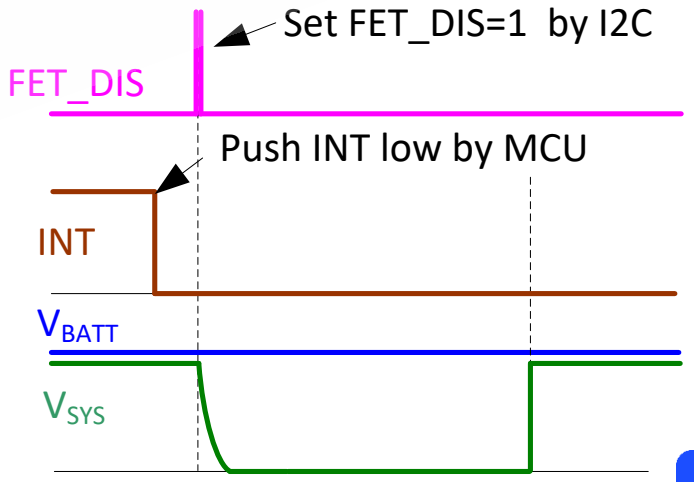


- 如果不用NTC功能，可以将NTC脚通过100k电阻上拉到VDD，以降低battery漏电
- 如果使用NTC功能，可以用NTC脚处电阻串中插入MOS以控制battery漏电

MP2662应用技巧_2



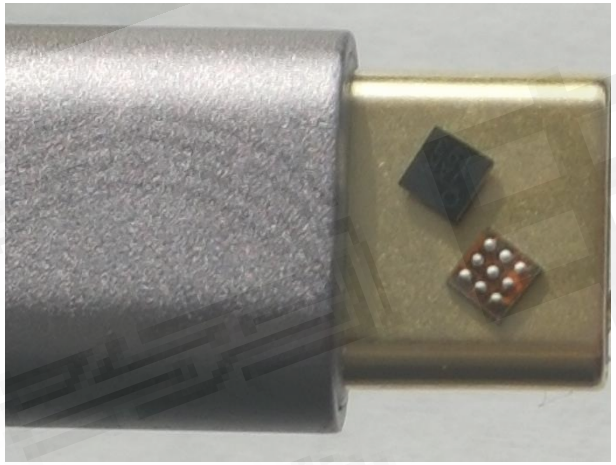




- 正常情况下，set FET_DIS为1，进入shipping mode
- 将INT脚拉低持续2s退出shipping mode
- MCU控制，先将INT拉低，然后再set FET_DIS为1，进入shipping mode，避免由于MCU下电拉低INT引起退出shipping mode

MP2662靓照

MP2662 won the 2019 IoT Technology Innovation Award at the 4th China IoT conference held by the global electronic technology professional media "electronic enthusiasts"



Thank you!

如有任何疑问，可发送问题至mpssupport@monolithicpower.com

更多资料https://www.monolithicpower.com/en/products/battery-management.html