Texas Instruments

TI POWER

TI *Live!* BATTERY MANAGEMENT SYSTEMS SEMINAR

BILL JOHNS

A GUIDE TO BUILDING A LOW-POWER CHARGE SYSTEM OF COMMON BATTERY CHEMISTRIES

Low-power multichemistry charging | Outline

Overview of low-power battery chemistry

- Will focus on four types:
  - **Lithium-ion (Li-ion)** – most widely used battery chemistry. Light weight. Good fit for portable applications.
  - **Lithium-ion phosphate battery ($LiFePO_4$)** – relatively new technology, similar to Li-ion. Advantage is longer life and higher peak current, but lower energy density vs. weight volume.
  - **Nickel-metal hydride (NiMH)** – mature technology. Good in industrial applications with a wide temperature range, high peak current and fast charge options.
  - **Supercapacitor** – a new option for power storage. Fewer shipping or transport restrictions. Wider temperature range. Supports high peak currents. But low energy density and wide voltage variation.

Overview of charger solutions

- TI charging solutions; how we can help with your design:
  - The BQ2517x family of multichemistry non-power-path chargers.
  - The BQ25180 power-path charger.

Low-power multichemistry charging | Li-ion battery

Li-ion: Key features, pros/cons

- **Benefits:**
  - High energy density vs. volume and weight.
  - High voltage pre- and single-cell solutions.
  - Long lifetime; typically 500 charge cycles.
- **Limitations:**
  - Protection circuit required (PCN) and risk of thermal runaway.
  - Number of shipping restrictions.

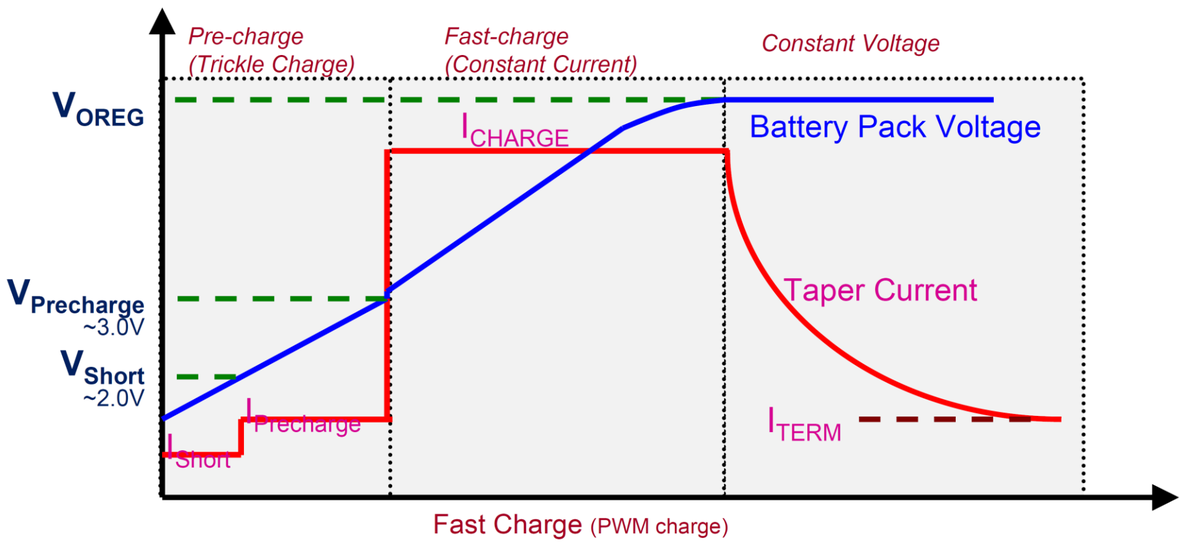
Differentiation

- Wide availability; easy to identify battery to fit application.
- Flat, pouch or cylindrical form factor with lithium-polymer version.
- Relatively low cost.

Charger considerations

- CC/CV – accurate current and voltage regulation.
- Termination – low current measurement accuracy.
- Fault condition detection – short, timer, hot battery detection.
- Charge temperature limits – battery NTC.
- Low I_Q – reduce battery drain after charge.

Charging profile



Typical battery specifications

- 4.2-V maximum charge voltage and usable voltage down to 3.0 V; nominal voltage: 3.7 V.
- Discharge current: 1 C; charge current 0.5 C.
- Discharge temperature range: –20°C to 60°C; charge 0°C to 45°C.
- Typical characteristics: Tenergy 18650 2,200 mAh.

Low-power multichemistry charging | Li-ion battery

Appliances

Medical

Building automation

TWS headsets

TI chargers

Applications:

- Lightweight/high energy – portable applications, cellphones.
- Small single cell – small solutions, TWS and watches.

Hero products

- BQ25170 | 800-mA stand-alone non-power-path linear charger, 8-pin 2-mm-by-2-mm QFN
- BQ25175 | 800-mA stand-alone non-power-path linear charger, 6-pin 0.8-mm-by-1.25-mm WCSP
- BQ25180 | 1-A I^2C power-path linear charger, 8-pin 1.6-mm-by-1.1-mm WCSP
- BQ25155 | 0.5-A I^2C power-path linear charger with integrated ADC and LDO, 20-pin 2-mm-by-1.6-mm WCSP

Low-power multichemistry charging | LiFePO4 battery

LiFePO4: Key features, pros/cons

- **Benefits:**
  - Good thermal stability, low risk of thermal runaway.
  - High discharge current rating, typically 3 times C.
  - Long cycle life; 2,000 charge cycles common.
- **Limitations:**
  - Lower cell voltage than Li-ion: 3.2 V vs. 3.6 V.
  - Lower energy density, weight vs. watt hours.

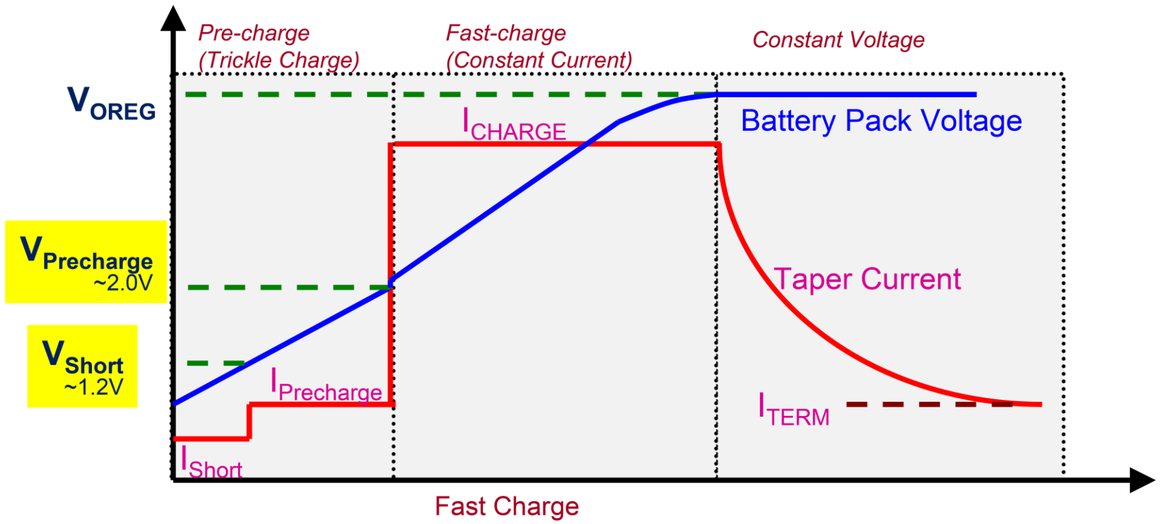
Differentiation

- Very good high-temperature application.
- Cells available but not common.
- Lower cell voltage may require a boost converter.

Charger considerations

- Similar to Li-ion, but voltages are lower.
- CC/CV – current and voltage regulation.
- Fault condition detection – short, timer, hot battery detection.
- Charge temperature limits – battery NTC.

Charging profile



Typical battery specifications

- 3.6-V maximum charge voltage and usable voltage down to 2.5 V; nominal voltage: 3.2 V.
- Discharge temperature range: –20°C to 60°C, charge 0°C to 45°C.
- Discharge current: **3C**, charge current 0.5C.
- Typical characteristics: Zeus PCIFR26650-3300.

Low-power multichemistry charging | LiFePO4 battery

Industrial transport

Surgical tools

Beauty and grooming

TI chargers

Applications:

- Portable power tools with high current demands.
- Electric shavers and toothbrushes.

Hero products

- BQ25170 | 800-mA stand-alone non-power-path linear charger with 1S LiFePO4 support
- BQ25180 | 1-A I^2C power-path linear charger with programmable battery voltage to support 1S $LiFePO_4$
- BQ25155 | 0.5-A I^2C power-path linear charger with 1S $LiFePO_4$ support
- BQ25171-Q1 | 800-mA stand-alone non-power-path linear charger with 1S to 2S $LiFePO_4$ support

Low-power multichemistry charging | NiMH battery

NiMH: Key features, pros/cons

- **Benefits:**
  - Reliable and durable.
  - Safe: overcharge and discharge do not create high temperatures.
  - Puncture-resistant water-based electrolyte.
  - Lowest cost solutions.
- **Limitations:**
  - Low cell voltage will require three cells in series to match Li-ion.
  - Self-discharge limits storage times.

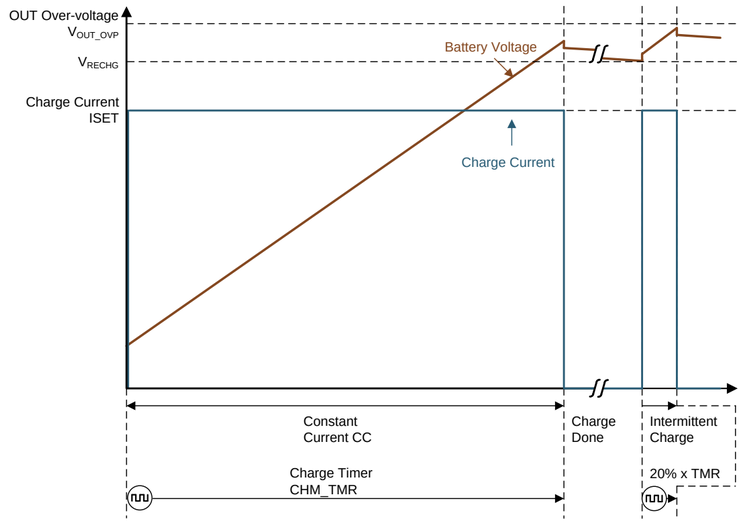
Differentiation

- Cells are common and readily available in multiple sizes.
- Cost is the lowest; no protection circuit required.
- Low cost but multiple cells required; larger solution.

Charger considerations

- Fast charge option requires large current source and voltage monitoring.
- Fault condition detection – short, timer, hot battery detection.
- Charge temperature limits – battery NTC.

Charging profile – timer-based



Typical battery specifications

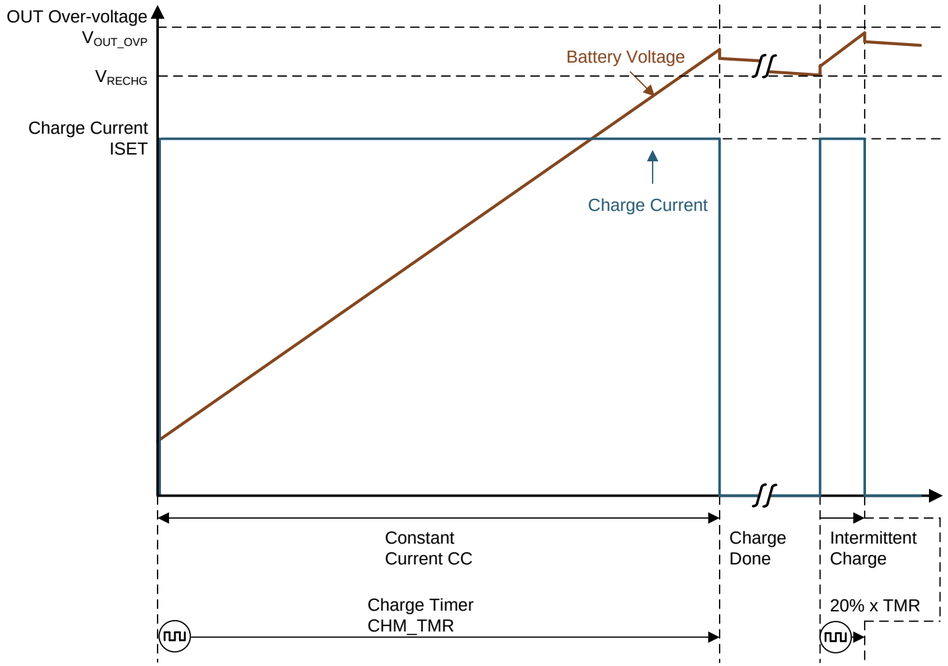
- FDK HR-AAUTEW AA cell for in-vehicle applications: 1100 mAh.
- Nominal voltage: 1.2 V per cell.
- Discharge current: 2C; temperature range: 0°C to 50°C.
- Charge current: 1C; temperature range: 0°C to 40°C.

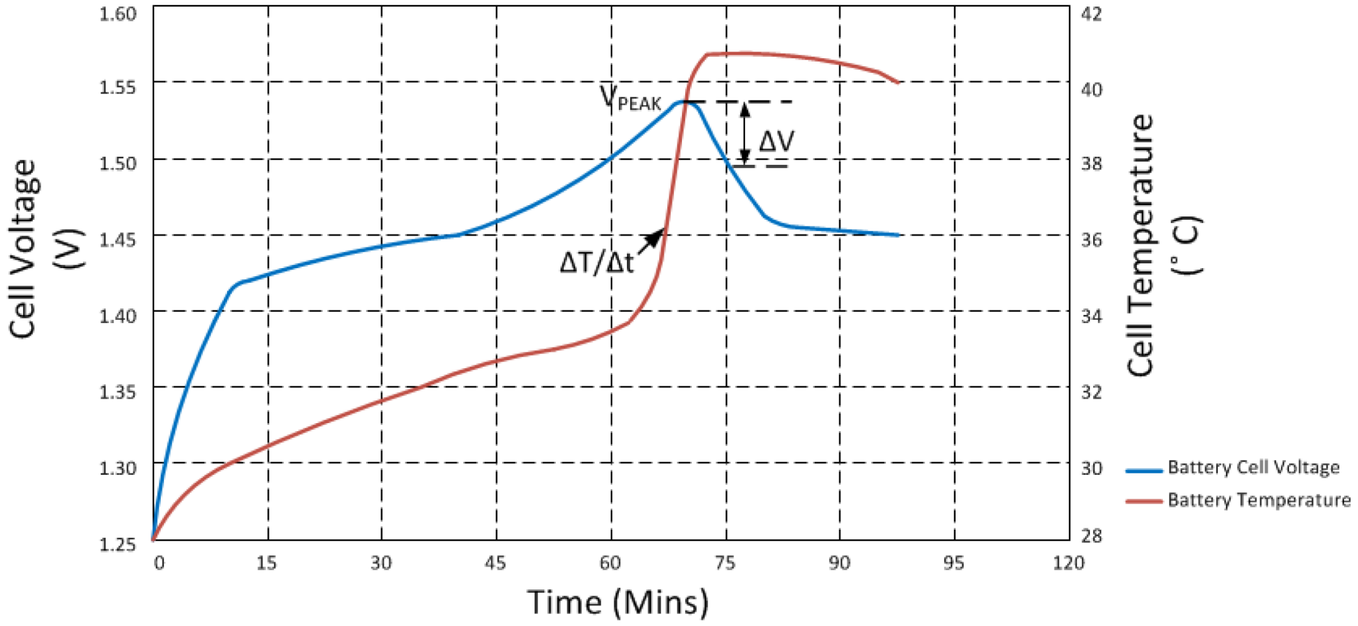
Hero products

- BQ25171-Q1 | 800-mA stand-alone non-power-path charger 1S to 6S NiMH

Low-power multichemistry charging | Fast vs. timer charging

- NiMH battery fast charging vs. timer-based charging:
  - During **fast charging** of an NiMH battery, the charger will supply a large current to the battery while monitoring the battery voltage or temperature. When the battery is full, the voltage will increase and then decrease by a small amount ; the battery temperature will increase. The fast charge current is battery capacity (C); milliampere hour and higher currents are possible. Charge time in this condition is typically about 1 hour.
  - During **timer-based charging,** the charge current is reduced to a lower amount, typically 25% of capacity, or C/4. Termination is based on time. For C/4, the charge current time will be 4 hours.
  - After charging is complete, some way to top off the cell is necessary. In this example, the output voltage is monitored and when it drops to recharge point, a short recharge cycle begins.





Low-power multichemistry charging | Supercapacitor

Supercapacitor: Key features, pros/cons

- **Benefits:**
  - No wear-out factor; long life.
  - No protection circuit required.
  - Can be discharged to 0 V.
- **Limitations:**
  - Cell balancing may be required.
  - Cell voltage limited to 2.7 V; series to increase voltage.
  - Output voltage change with SoC; steep discharge curve.

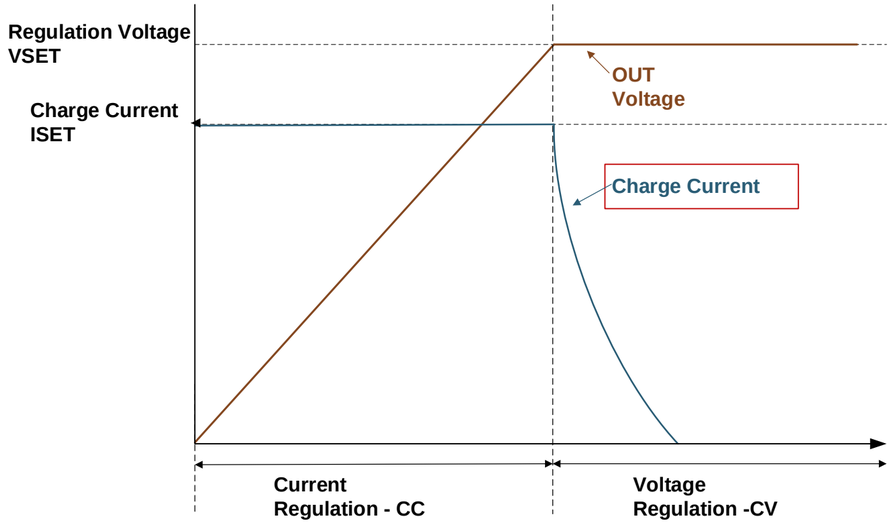
Differentiation

- Long life; 500,000 cycles.
- Large solution size.

Charger considerations

- CC/CV – current and voltage regulation.
- Fault condition detection – input and output OVP, output OCP.
- Thermal protection – die temperature regulation and shutdown.

Charging profile – placeholder



Typical battery specifications

- Nominal voltage: 2.7 V at 65°C.
- Operating temperature range: –40°C to 65°C.
- Discharge current: 11 A. Charge current: 5 A; DCR: 20 mΩ.
- Typical characteristics: Wurth 50F.

Low-power multichemistry charging | Supercapacitor

Smart meters

Barcode scanners

Dash cameras

TI chargers

Applications:

- Smart meters.
- Barcode scanners.
- Dash cameras.

Hero products

- BQ25173 | 800-mA stand-alone non-power-path linear charger with 1S to 4S supercapacitor support
- BQ24640 | 10-A stand-alone switching charger controller with 1S to 8S supercapacitor support

Low-power multichemistry charging | Trade-offs

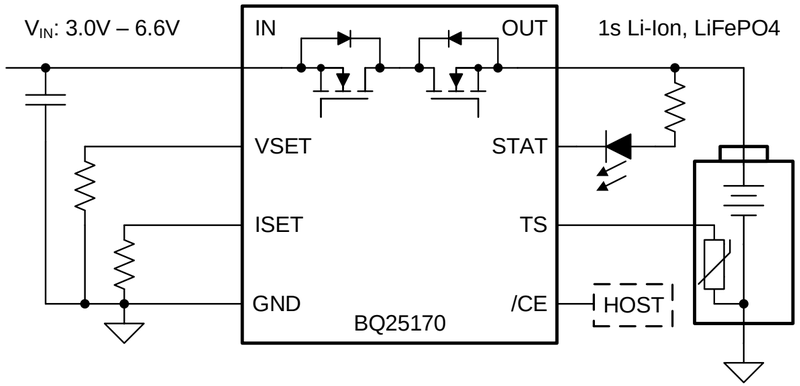
	Li-ion	$LiFePO_4$	NiMH	Supercapacitor
Energy density	High 150 to 180 Wh/kg	Medium 90 to 120 Wh/kg	Low 60 to 120 Wh/kg	Low 4.5 Wh/kg
V(nom)/cell	3.6 V	3.2 V	1.2 V	2.7 V
V(charging)	3.9 V to 4.2 V	3.5 V to 3.65 V	1.4 V to 1.6 V	2.7 V
Area	Low	Medium	High	High
Price	High	Medium	Low	Medium
Benefits	• High energy density. • High voltage/cell at 3.6 V can lead to single-cell use and space savings. • Long lifetime.	• High current rating. • Long cycle life. • Good thermal stability. • Safer Li-ions: enhanced safety/tolerance if abused. • Tolerant to full charge conditions.	• Reliable and durable. • Safe: Overcharge and discharge do not create high temperatures. • More cost-effective.	• Safe: No volatile chemicals; overcharge and discharge do not create high temperatures. • Long life, no wear-out mechanism.
Limitations	• Fragile: requires protection circuit for safe operation. • Peak voltage limited during charge. • Temperature needs to be monitored.	• Lower voltage of 3.2 V/cell. • Higher self-discharge, which can cause balancing issues with aging.	• Quick self-discharge; needs to be charged more frequently. • Lower voltage (1.2 V/cell) requires multiple cell packs and larger solutions.	• Voltage will have large change with discharge, SoC. • Low cell voltage will require series cell and possible balancing circuit.
Charge temperature	0°C to 45°C	0°C to 45°C	0°C to 40°C	–40°C to 65°C
Discharge temperature	–20°C to 60°C	–20°C to 60°C	0°C to 50°C –20°C to 85°C possible	–40°C to 65°C

Charging solutions

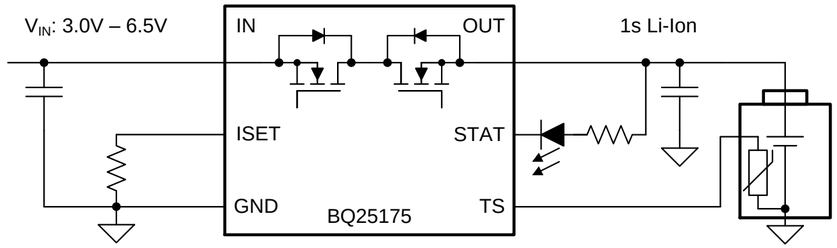
Low-power multichemistry charging | Charging solutions

	BQ25170	BQ25180	BQ25171-Q1	BQ25172	BQ25173	BQ25175
V_{IN} max rating	30 V	25 V	40 V	30 V	40 V	30 V
V_{IN} operating range	3.0 V to 6.65 V	3.0 V to 5.9 V	3.0 V-18 V	3.0 V-18 V	3.0 V to 18 V	3.0 V to 6.65 V
Battery configuration	1S Li-ion, $LiFePO_4$	1S Li-ion, $LiFePO_4$	1S to 2S Li-ion, $LiFePO_4$, 1S to 6S NiMH	1S to 6S NiMH	1S to 4S supercapacitor	1S Li-ion
Charge voltage	3.5 V to 4.4 V	3.5 V to 4.65 V	3.5 V to 8.4 V	1S to 6S NiMH	FB pin (2 V ~ 9 V)	Fixed (4.35 V)
Control interface	Stand-alone	I^2C	Stand-alone	Stand-alone	Stand-alone	Stand-alone
Integrated power path	No	Yes	No	No	No	No
Fast charge timer	Fixed	Programmable	Programmable	Programmable	Disabled	Fixed
TS	Yes	Yes	Yes	Yes	No	Yes
/CE pin	No	No	Yes	No	Yes	No
Package	2-mm × 2-mm QFN-8	1.6-mm × 1.1-mm WCSP-8	3-mm × 3-mm QFN-10	2-mm × 2-mm QFN-8	2-mm × 2-mm QFN-8	0.8-mm × 1.25-mm WCSP-6
Additional market applications	TWS, wearables, ePOS, cameras	TWS, wearables, medical, building and retail automation	TCU, eCall	Building automation, medical	Smart meters, Barcode scanner	TWS, wearables
Prior-generation linear charger reference	BQ2510x, BQ2404x/5x/6x/8x/9x, BQ21040, LM3658	BQ2106x, BQ2407x, BQ2423x, BQ2403x, BQ25050/60/70	BQ24081-Q1, BQ25071-Q1, BQ24079QW-Q1, BQ24075-Q1	BQ200x	New	BQ2510x, BQ2404x/5x/6x/8x/9x, BQ21040, LM3658

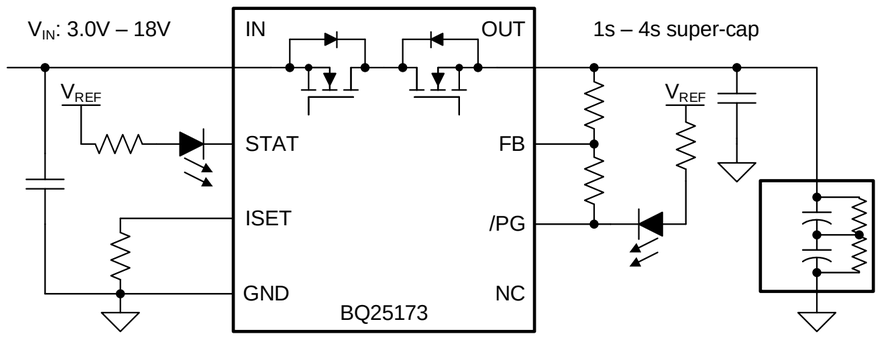
Low-power multichemistry charging | BQ2517x family



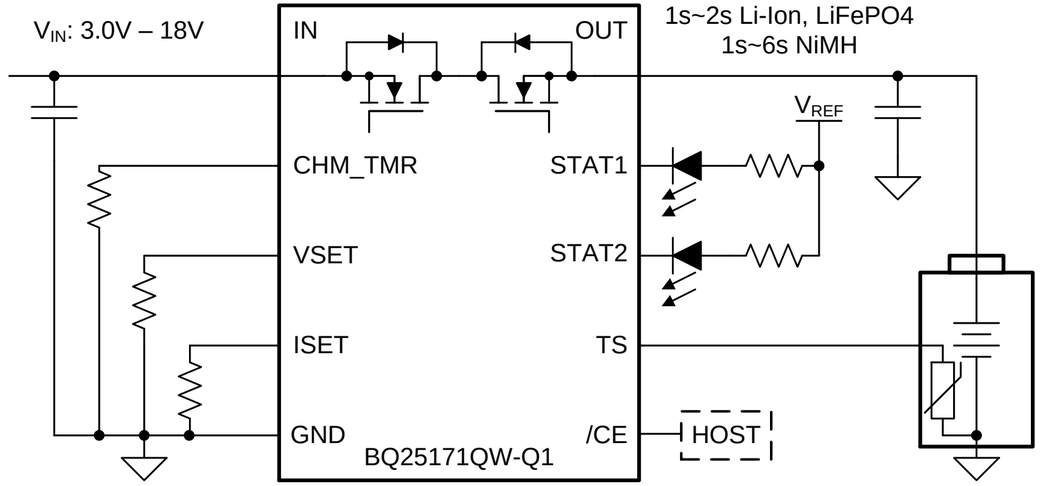
BQ25170 1S Li-ion/LiFePO$_4$



BQ25175 1S Li-ion (WCSP)



BQ25173 1S to 4S supercapacitor



BQ25171-Q1 1S to 2S Li-ion/LiFePO$_4$
1S to 6S NiMH

Low-power multichemistry charging | BQ25171-Q1

Wide input voltage range supports 1S or 2S charging with 18-V OVP
Abs max: 40 V

3.0-mm-by-3.0-mm^2 QFN-10 pin package

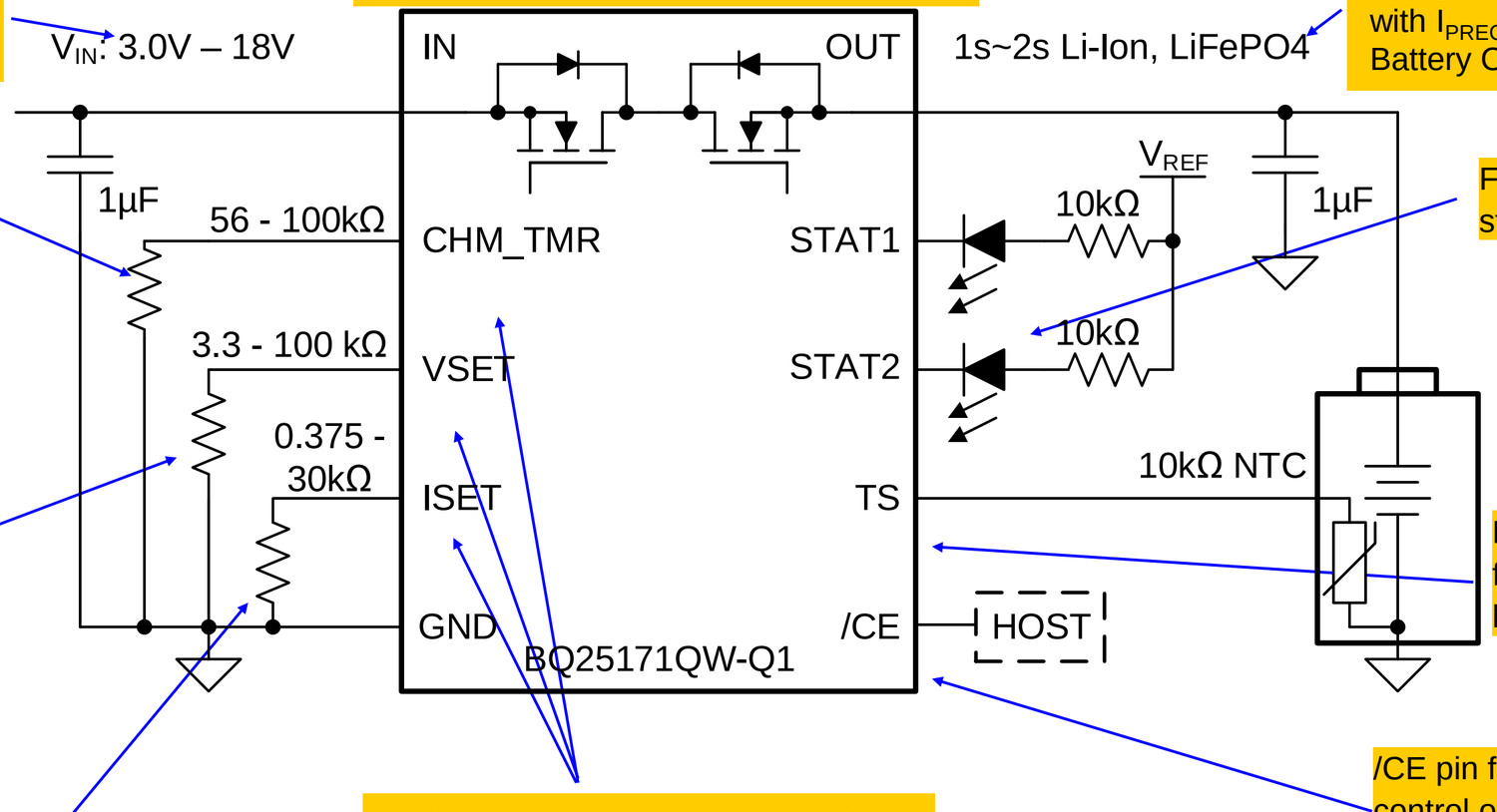
Automatic charge cycle control of pre-charge, fast charge and CV modes with I_{PRECHG} and I_{TERM}
Battery OVP and OCP

CHM_TMR programs chemistry and charge timer:
Safety timer disable
10 hours
5 hours

VSET programmable levels:

1S:	2S:
3.5 V	7.0 V
3.6 V	7.2 V
3.7 V	7.4 V
3.8 V	
3.9 V	
4.05 V	
4.1 V	8.2 V
4.2 V	8.4 V
4.35 V	

Continuously programmable charge-current pin from 10 mA to 800 mA



Four-state battery-charger status indicator

Battery temperature sensing for safe battery charging with hot/cold profile

Pin-short and pin-open protection

/CE pin for immediate host control of charger function

Low-power multichemistry charging | BQ25180

Input voltage:

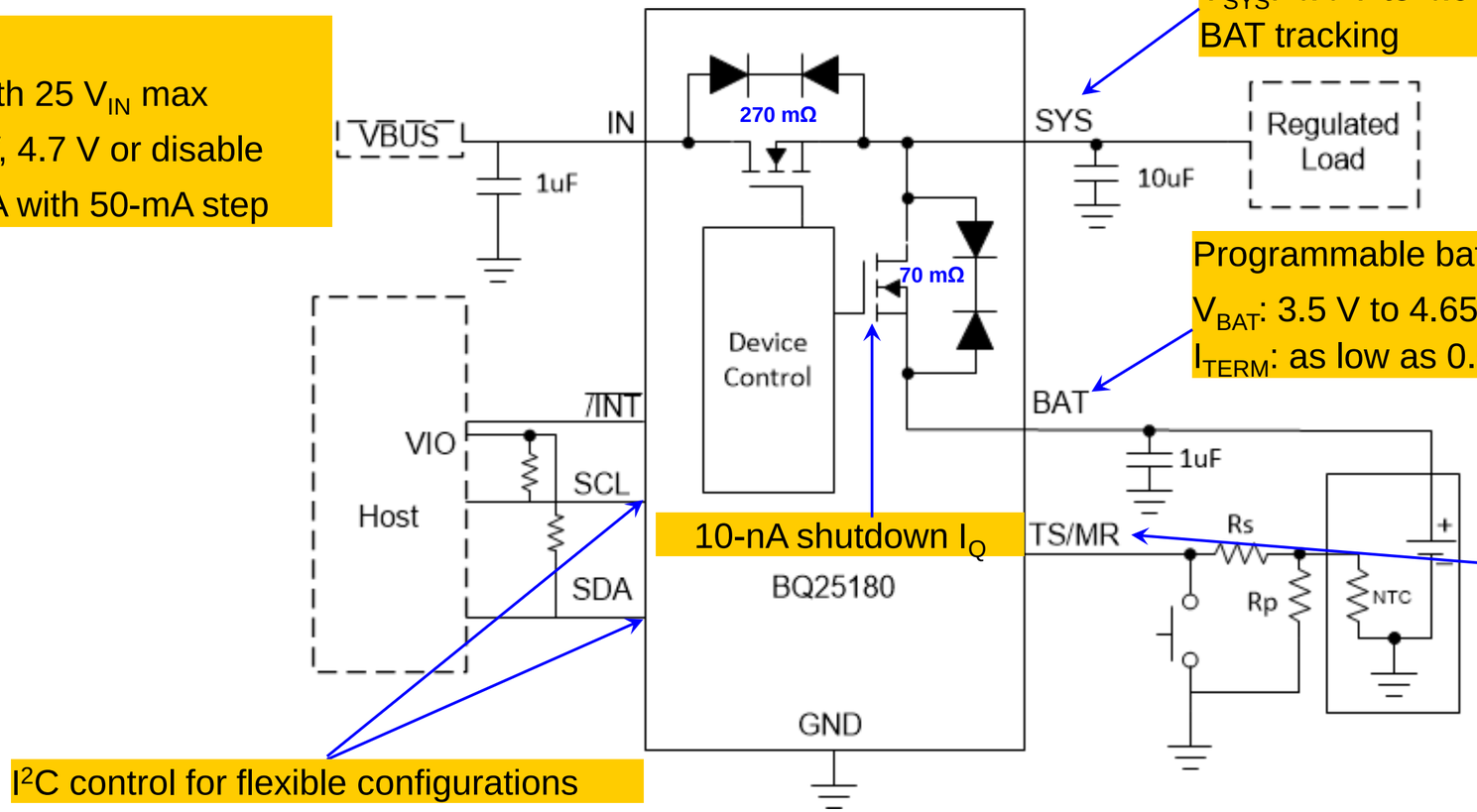
V_{IN}: 3 V to 5.9 V with 25 V_{IN} max

V_{INDPM}: 4.2 V, 4.5 V, 4.7 V or disable

I_{LIM}: up to 1,100 mA with 50-mA step

Programmable regulated system

V_{SYS}: 4.4 V to 4.9 V, passthrough or BAT tracking



Programmable battery voltage

V_{BAT}: 3.5 V to 4.65 V, I_{CHG}: 5 mA to 1 A, I_{TERM}: as low as 0.5 mA

TS: programmable JEITA for battery temperature monitoring

MR: push-button control for reset, wakeup, etc.

I^2C control for flexible configurations

WCSP I^2C
(1.6 mm by 1.1 mm)

1-A Li-ion I^2C programmable charger with regulated power path

Low-power multichemistry charging | Summary

- **Summary**
  - Applications for battery products have increased sharply, and designers have options on which device to use.
  - Charging requirements vary from battery to battery, driving another design decision for designers.
  - TI can support your battery-charger requirements with a number of devices.
  - For more resources and information:
    - Battery Management Solutions overview page.
    - BQ25171-Q1 battery chargers.
  - Find the right charger for your application.

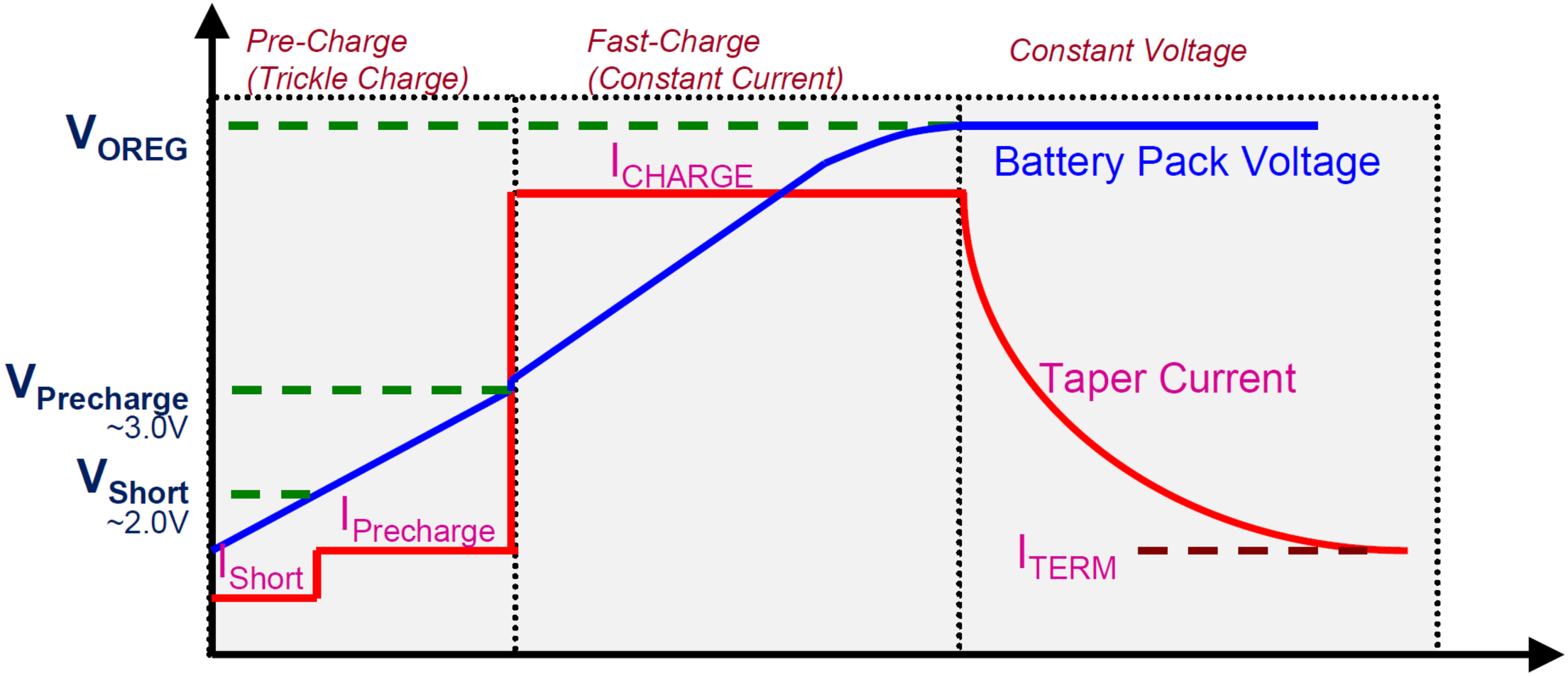
Questions?

Back-Up Slides

Guide to building a charger system | Li-Ion Battery

- Li-Ion and Li-Poly cell are the most popular re-chargeable battery for portable applications.
- Some typical characteristics (Tenergy 18650 2200mAh):
  - 18650 Cell, Cylindrical cell 18mm X 65mm (64.8mm X 18.2mm) weight 46 grams
  - 4.2V maximum charge voltage and usable voltage down to 3.0V, nominal voltage 3.7V
  - Cell are available in wide range of capacity from 100mAh to 5Ah.
  - Discharge temp range -20°C to 60°C, charge 0°C to 45°C.
  - Discharge current 1C, with C = capacity in mAh. A 1Ah battery would be a 1A discharge current.
  - Charge current 0.5C.
- The cell are available in cylindrical and pouch form factor
- Li-Ion / Li Poly
  - Li-Ion cylindrical cell with steel case
  - Li-Poly pouch on flat cell
- Circuit protector required to prevent Overcurrent, overvoltage, undervoltage and others.
  - This is a small circuit board with IC
- Li-Ion battery are subject to thermal runaway if damaged, overheated or overcharged. If this occurs the cell will overheat due to internal chemical reactions that generates heat. Temperatures are high enough to damage cases and adjacent batteries.
- Due to above strict shipping requirements are in place, considered hazardous cannot be carried on aircraft.

Typical Li-Ion Battery Charging Profile “CC-CV”



Guide to building a charger system | LiFePO4 Battery

- LiFePO4 is similar to the Li-Ion battery with **improved thermal runaway** performance and higher discharge current. The cells have a longer life with charge cycles of 2000 vs 500 Li-Ion.
- Typical max voltage will be lower, 3.6V
- Some typical characteristics (Zeus PCIFR26650-3300):
  - 26650 Cylindrical Cell, 26mm X 65mm (26.1mm X 65.5mm) weight 88 grams
  - 3.6V maximum charge voltage and usable voltage down to 2.5V, nominal voltage 3.2V
    - Why is this and is a boost required
  - Discharge temp range -20°C to 60°C, charge 0°C to 45°C.
  - Discharge current **3C**, with C = capacity in mAh. A 1Ah battery would be a 3A discharge current.
  - Charge current 0.5C.
- The cell are available in cylindrical form factor
- Same shipping restrictions as Li-Ion
- But safer than Li-Ion, thermal runaway temperature is much higher and very hard to enter this fail mode.

Guide to building a charger system | NiMH Battery

- NiMH cell are the most popular re-chargeable battery for portable applications. Lower power density vs weight and area.
- Also self discharge is higher
- Some typical characteristics (FDK HR-AAUTEW):
  - AA Size cell, Typical Capacity 1100mAH
  - Nominal voltage 1.2V per cell
  - Charge current 1C, charge 0°C to 40°C.
  - Discharge current 2C, temp range 0°C to 50°C
  - Possible Discharge current 0.2C, temp range -40°C to +85°C
- The cells are available in cylindrical and typically configured in multiple-cell packs.
- Fewer shipping requirements

NiMH vs Li-Ion

- NiMH has not specific safety requirements vs Li-ion batteries has multiple levels of protection
  - Battery Cell PTC Protection
  - Battery protector IC (cell temperature monitor, OVP, OCP, Short Circuit protection)
  - Charger IC (thermal, input and battery OVP & OCP, short circuit protection)
- Lower energy density: NiMH vs Li-ion
  - Gravimetric energy density (Wh/kg): ~100 vs ~130
  - Volumetric energy density (Wh/L): ~200 vs ~300
- Higher self-discharge rate:
  - First 24-hr: 10 to 15% vs 5%
  - Per month after the first 24 hours 10% to 15% vs 1 to 2%

Guide to building a charger system | Super Capacitor

- Super-Capacitor cell are a new option for some application
- Some typical characteristics (Wurth 50F):
  - Cylindrical case (typical capacitor body), 18mm X 40mm, weight 11 grams
  - Nominal voltage 2.7V
  - Operating temp range -40°C to 65°C.
  - Discharge current 33A.
  - Charge current 0.5C.
- The capacitors are available in cylindrical
- Circuit protector not required
- No shipping restrictions
- In multiple-cell configuration, cell balancing may be required.

Guide to building a charger system | Battery Chemistry

BQ25171QW-Q1: Multi-chemistry 800mA Battery Charger

Features

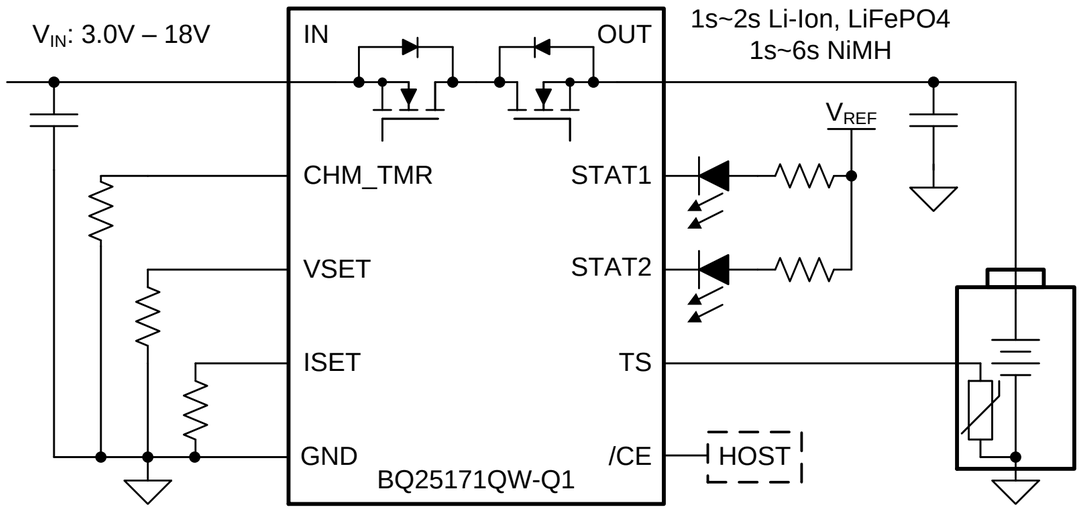
- Multi-chemistry: **1s – 2s Li-Ion, LiFePO4, & 1s – 6s NiMH**
  - Input voltage from 3.5V to 18V, with **40V abs. max**
- External resistor programmable charge current and voltage **with pin-short & open protection**
  - Adjustable charge voltage from **3.5V to 4.35V or 2x**
  - Adjustable charge current from **10mA to 800mA**
- Charge voltage accuracy: **±1%** for full capacity utilization
- Charge current accuracy: **±10%** for charge profile control
- Precharge and termination current limits
  - IPRECHG = 20% ISET
  - ITERM = 10% ISET
- Ultra-low quiescent current: **$I_{Q,BAT}$ < 0.5µA, $I_{SD,IN}$ < 5µA**
- Battery **temperature (TS) monitoring** for safe charging

Applications

- Emergency Call system
- Telematics
- Asset Tracking

Benefits

- Support multi-chemistry charging with single design
- Easily programmable charge voltage and current with pin-short protection
- Supports applications with different battery voltage needs
- Safe charging with integrated battery temp. sensing
- Maximize runtime with low battery quiescent current
- Package: 10-pin QFN 3 x 3 x 1mm^3 (wettable flank)



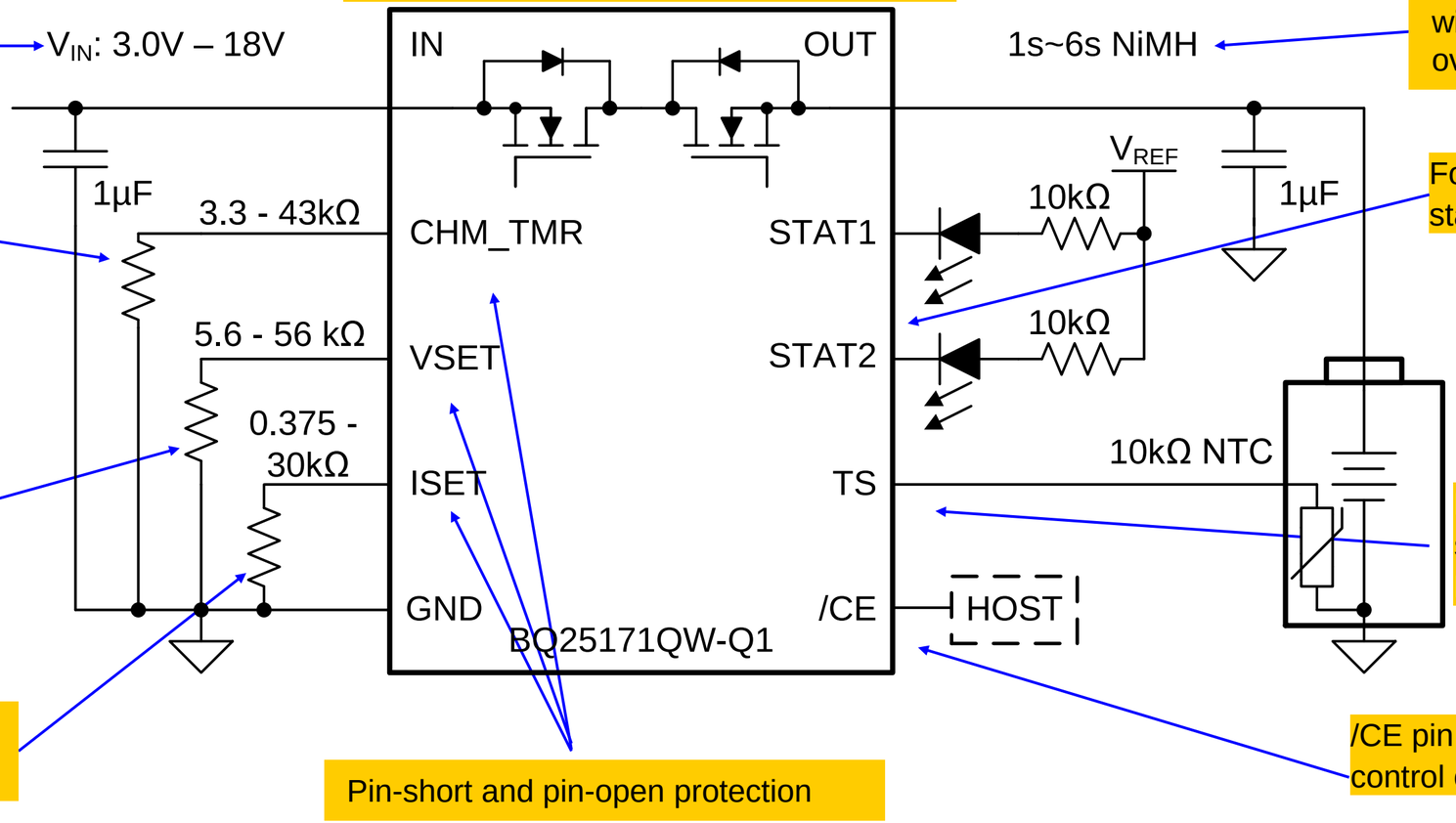
Guide to building a charger system | Battery Chemistry

BQ25171QW-Q1: Application Diagram for NiMH-based batteries

Wide input voltage range supports
1s to 6s charging with 18V OVP
Abs Max: 40V

3.0 x 3.0mm^2 QFN-10 pin Package

Automatic charge cycle control with battery over-voltage / over-current protection



CHM_TMR programs chemistry & charge timer:
4hr to 22hr in 2hr / step

Four-state Battery Charger status indicator

VSET programmable levels:

1s	1s + pulse charge
2s	2s + pulse charge
3s	3s + pulse charge
4s	4s + pulse charge
5s	5s + pulse charge
6s	6s + pulse charge

Battery Temperature sensing for safe battery charging with HOT/COLD profile

Continuously programmable charge current pin from 10mA – 800mA

Pin-short and pin-open protection

/CE pin for immediate host control of charger function

Guide to building a charger system | Battery Chemistry

BQ25170: 1 Cell Li-Ion, $LiFePO_4$ 800mA Battery Charger

Features

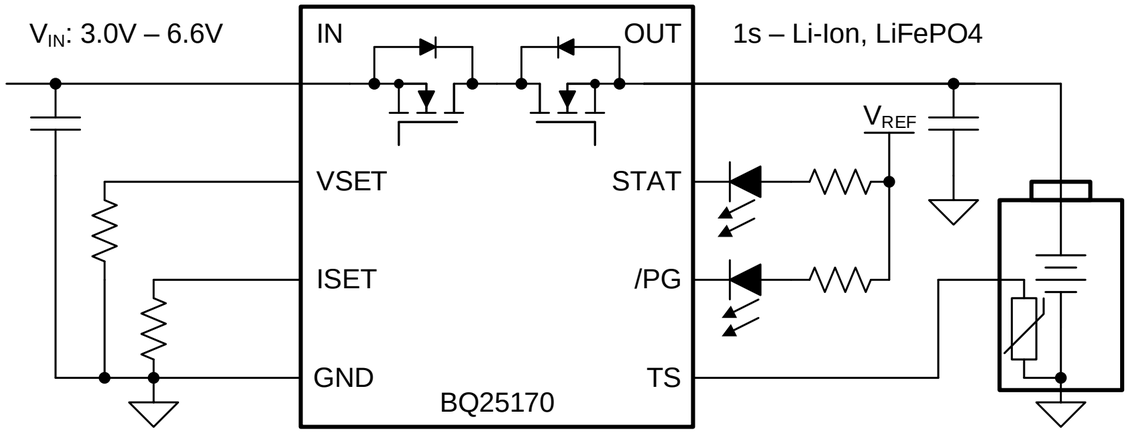
- Supports multi-cell: **1s Li-Ion, $LiFePO_4$**
  - Input voltage from 3.5V to 6.6V, **30V abs max**
- External resistor programmable charge current and voltage
  - Adjustable charge voltage from **3.5V to 4.4V**
  - Adjustable charge current from **10mA to 800mA**
- Charge voltage accuracy: **±1%** for full capacity utilization
- Charge current accuracy: **±10%** for charge profile control
- Precharge and termination current limits
  - IPRECHG = 20% ISET or **2mA minimum**
  - ITERM = 10% ISET
- Ultra-low battery quiescent current: **$I_{Q,BAT}$ < 0.5µA**
- Battery **temperature (TS) monitoring** for safe charging

Benefits

- Single-cell charging multi-voltage with single design
- Easily programmable charge voltage and current with pin- and -open short protection
- Supports applications with different battery voltage needs
- Maximize runtime with low battery quiescent current
- Package: 8-pin QFN 2.0 x 2.0 x 0.8mm^3

Applications

- Headset
- Wearable
- ePOS



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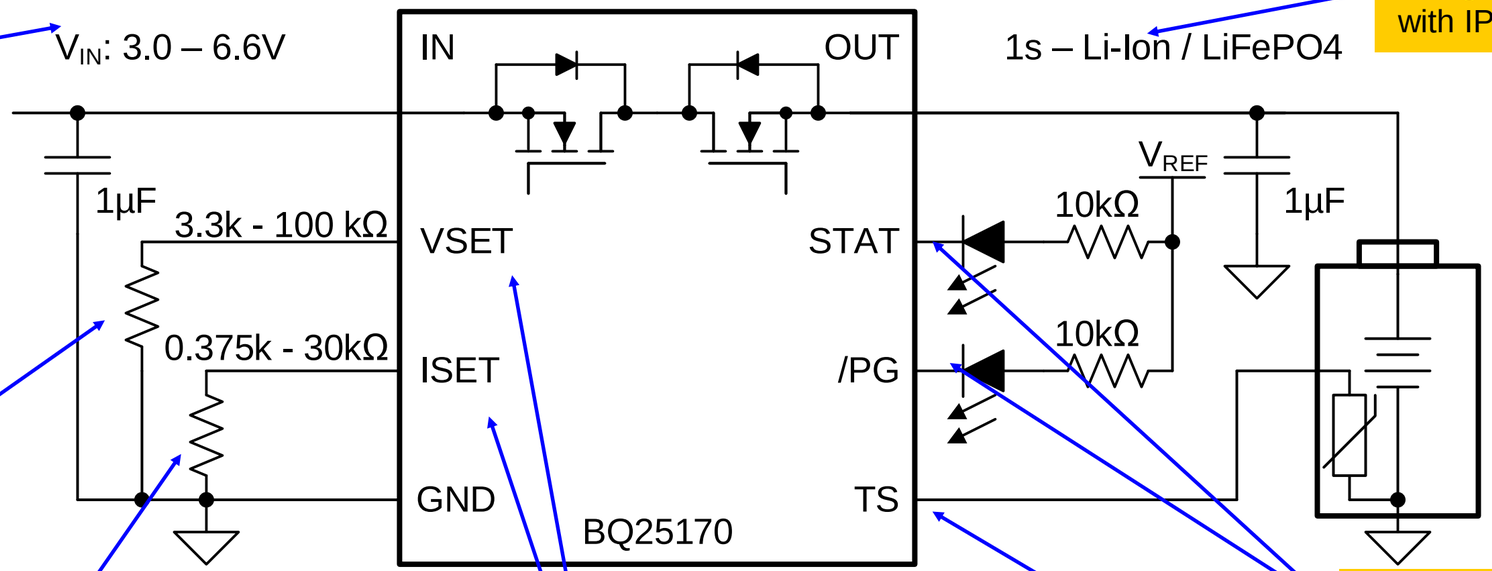
BQ25170: Li+ Application Diagram

Wide input voltage range supports
1s charging with 6.6V OVP
Abs Max: 30V

2.0 x 2.0mm^2 QFN-8 pin Package

Automatic charge cycle control of pre-charge, fast-charge and CV modes with IPRECHG and ITERM



VSET programmable levels:

1S:

3.5V
3.6V
3.7V
4.05V
4.1V
4.2V
4.35V
4.4V

Battery Charger status indicator

Power Good status indicator

Continuously programmable charge current pin from 10mA – 800mA

Pin-short and pin-open protection

Battery Temperature sensing for safe battery charging with HOT/COLD profile

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BQ25173: Super Cap 800mA Charger

Features

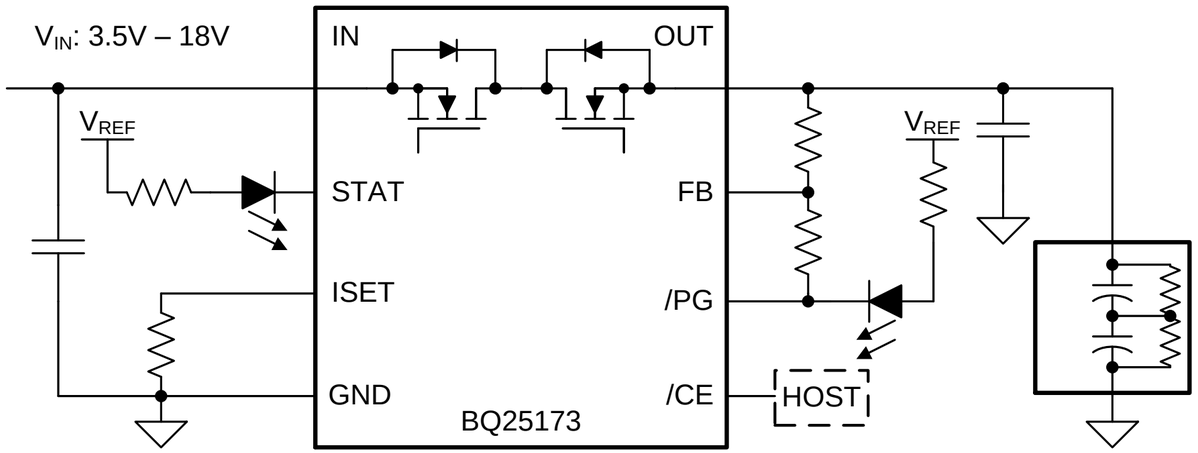
- Charge multiple super caps in series:
  - Input voltage from 3.5V to 18V, **40V abs max**
- External resistor programmable charge current and voltage
  - FB resistor adjustable charge voltage
  - Adjustable charge current from **10mA to 800mA**
- Charge voltage accuracy: **±1%** for full capacity utilization
- Charge current accuracy: **±10%** for charge profile control
- Ultra-low input quiescent current: **I_{SD_IN} < 5µA**
- Input **Power Good** /PG Indicator
- **Charge status** STAT Indicator

Applications

- Smart Meter

Benefits

- Single and Multi-cell charging with single design
- Easily programmable charge current with pin-open and short protection
- Supports applications with different supercapacitor voltages
- Maximize runtime with low output quiescent current
  - Disconnect FB network when input is removed
- Package: 8-pin QFN 2.0 x 2.0 x 0.8mm^3



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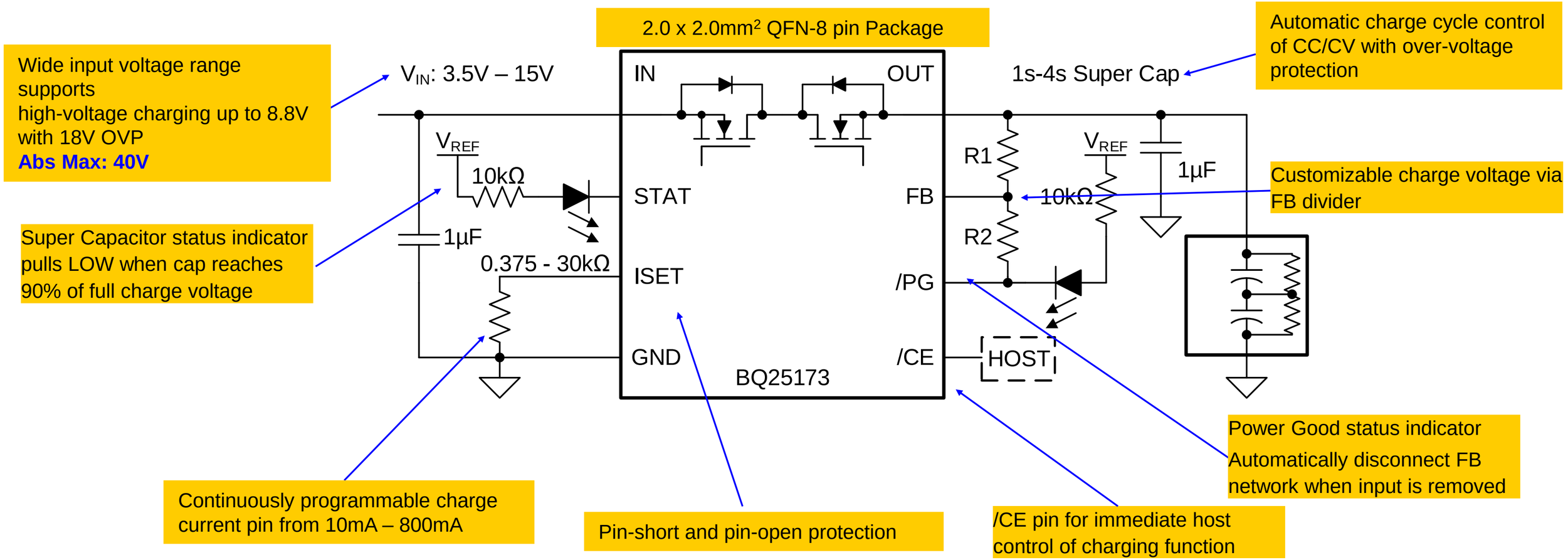
BQ25173: Super Cap Charger Application Diagram



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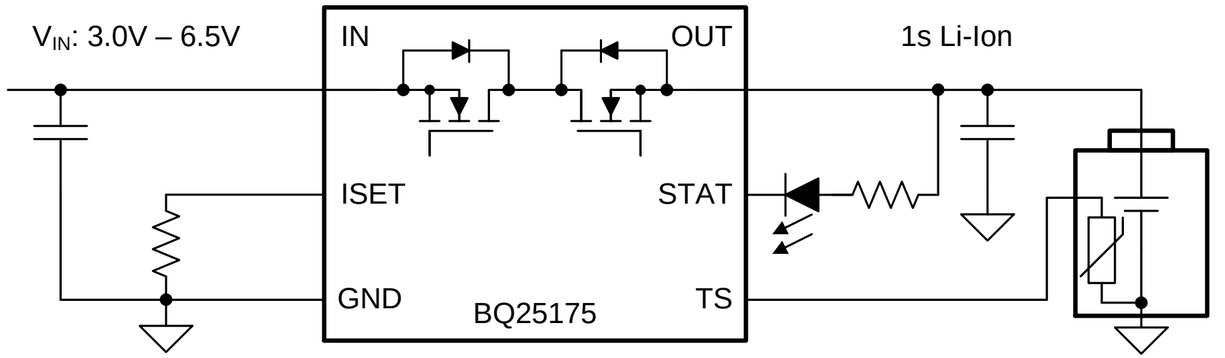
BQ25175: 1 Li-Ion, 800mA Battery Charger

Features

- Input voltage from 3.0V to 6.5V, 30V abs. max.
- External resistor programmable charge current
  - Adjustable charge current from **10mA to 800mA**
- Charge voltage accuracy: **4.2V ±0.5%** for full capacity utilization
- Charge current accuracy: **±10%** for charge profile control
- Precharge and termination current limits
  - IPRECHG = 20% ISET
  - ITERM = 10% ISET
- Ultra-low battery leakage current: **$I_{Q,BAT}$ < 0.35µA**
- Battery **temperature (TS) monitoring** for safe charging
- Charge **status (STAT)** indicator

Benefits

- Compact and simple linear-charging solution
- Easily programmable charge current with pin-open and short protection
- Maximize runtime with low battery quiescent current
- Charge disable with GPIO to pull-low on TS pin
- Package: tiny 6-ball WCSP 1.25 x 0.8 mm^2



Applications

- Headset
- Wearable
- TWS

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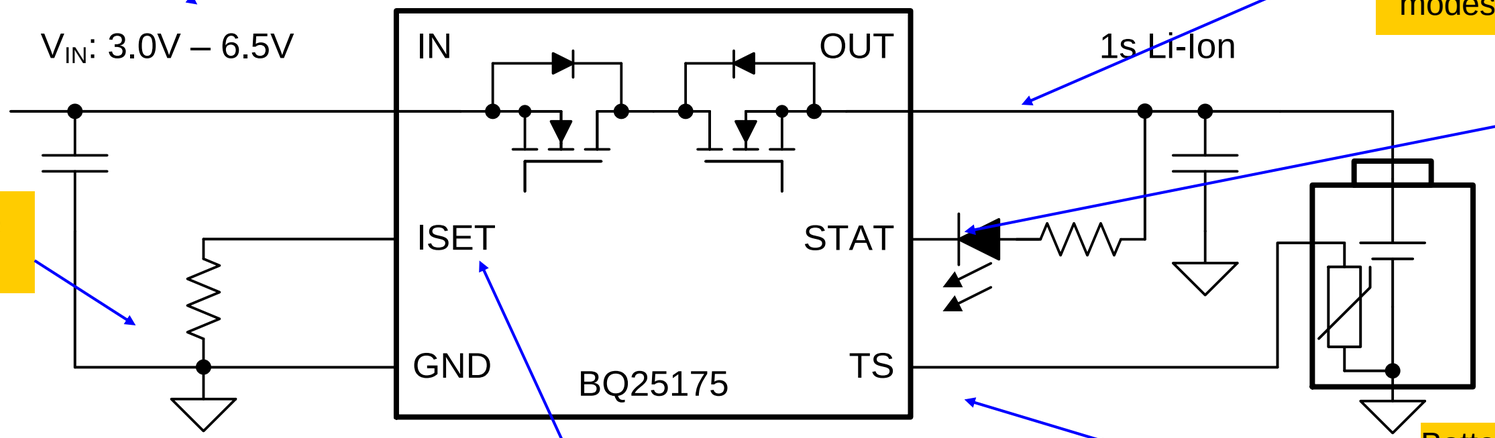
BQ25175: Application Diagram

Wide input voltage range supports safe 1s charging with 6.5V OVP
Abs Max: 30V

1.25 x 0.8 mm^2 6-ball WCSP

Automatic charge cycle control of pre-charge, fast-charge and CV (4.2V) modes with IPRECHG and ITERM.



Battery Charger status indicator

Continuously programmable charge current pin from 10mA – 800mA

Pin-short and pin-open protection

Battery Temperature sensing for safe battery charging with modified JEITA profile

Simple Charge Disable by pulling TS pin low through GPIO

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