TI Technology Days 2010

Akkus laden, schützen und überwachen

Thomas Gulba

Agenda

Genereller Überblick über Akkus	10 min
Herausforderungen bei Ladeschaltungen	30 min
Überwachung und Messung des Ladezustands	35 min

Genereller Überblick über Akkus

Registrierte Teilnehmer

Bereiche:

- Industrie (Ströme von uA bis 250A)
- Forschungseinrichtungen
- Medizin
- Luftfahrt
- Automobil
- Kommunikation

Erfahrung:

- Noch nie mit Akkus gearbeitet
- Mit Akkus zu tun gehabt
- Experten

Häufig verwendete Akku Technologien

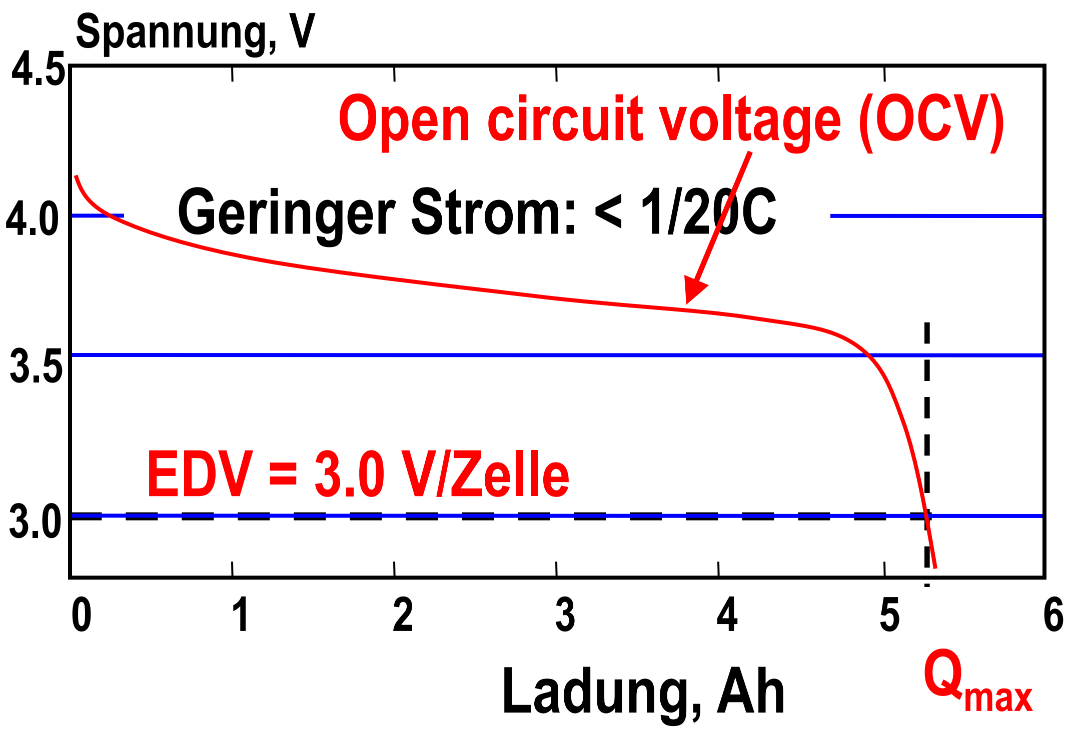
Blei
Nickel-Metallhydrid, Nickel-Cadmium
Lithium-Ionen, Lithium-Polymer, Lithium-Eisen-Phosphat

Eigenschaften verschiedener Technologien

	NiCd	NiMH	Li-Ion	Li-Polymer	Blei
Energiedichte (Wh/kg)	45-80	60-120	110-160	100-130	30-50
Lebensdauer (80% max. Ladung)	1500	300 to 500	500 to 1000	300 to 500	200 to 300
Ladezeit	1h typisch	2-4h	2-4h	2-4h	8-16h
Toleranz gegen Überladen	gemäßigt	niedrig	sehr niedrig	niedrig	hoch
Selbstentladung/pro Monat (20 C)	15-20%	20-30%	5-10%	~10%	5%
Zellenspannung (nominal)	1.2V	1.2V	3.6V	3.6V	2V
Laststrom - Spitze - Bestes Ergebnis	20C 1C	5C <=0.5C	>2C <=1C	>2C <=1C	5C 0.2C
Wartungsintervall	30-60 Tage	60-90 Tage	nicht benötigt	nicht benötigt.	3-6 Monate
Typische Kosten (US$, Beispiel)	\$50 (7.2V)	\$60 (7.2V)	\$100 (7.2V)	\$100 (7.2V)	\$25 (6V)
Kosten pro Zyklus (US$)	\$0.04	\$0.12	\$0.14	\$0.29	\$0.10
Industriell verfügbar	1950	1990	1991	1999	1970

Chemische Kapazität - Q_{max}

"Wie lange hält der Akku?"

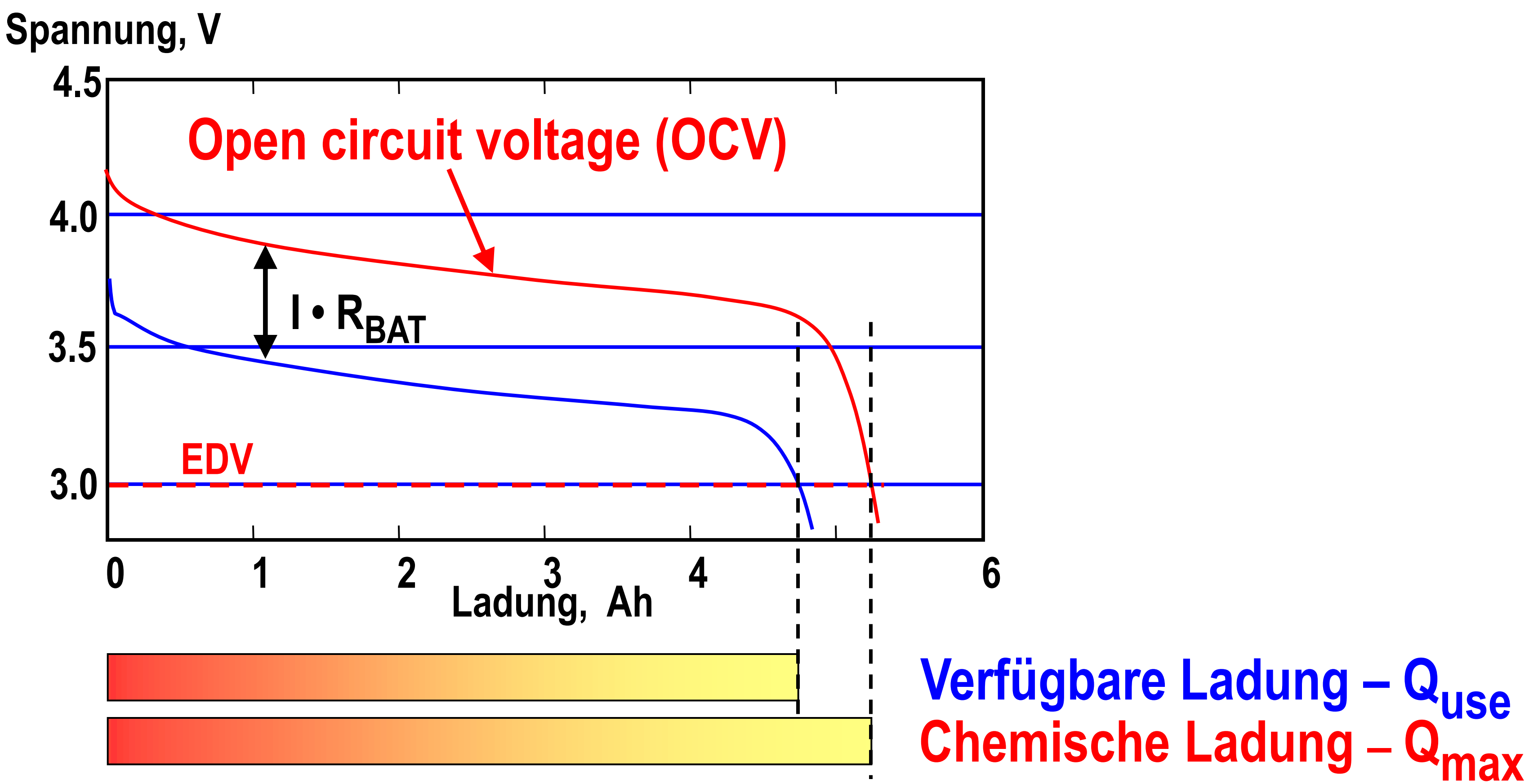


C-Koeffizient:
Strom um einen Akku innerhalb einer Stunde zu entladen

Beispiel:
2200-mAh Akku,
1C entspricht: 2200 mA,
0.5C entspricht: 1100 mA

-Die OCV Spannung tritt nur bei geringem Entladestrom auf
-Zellen dürfen nicht unterhalb der EDV (End of Discharge Voltage) Spannung betrieben werden

Wie viel Ladung ist wirklich verfügbar?

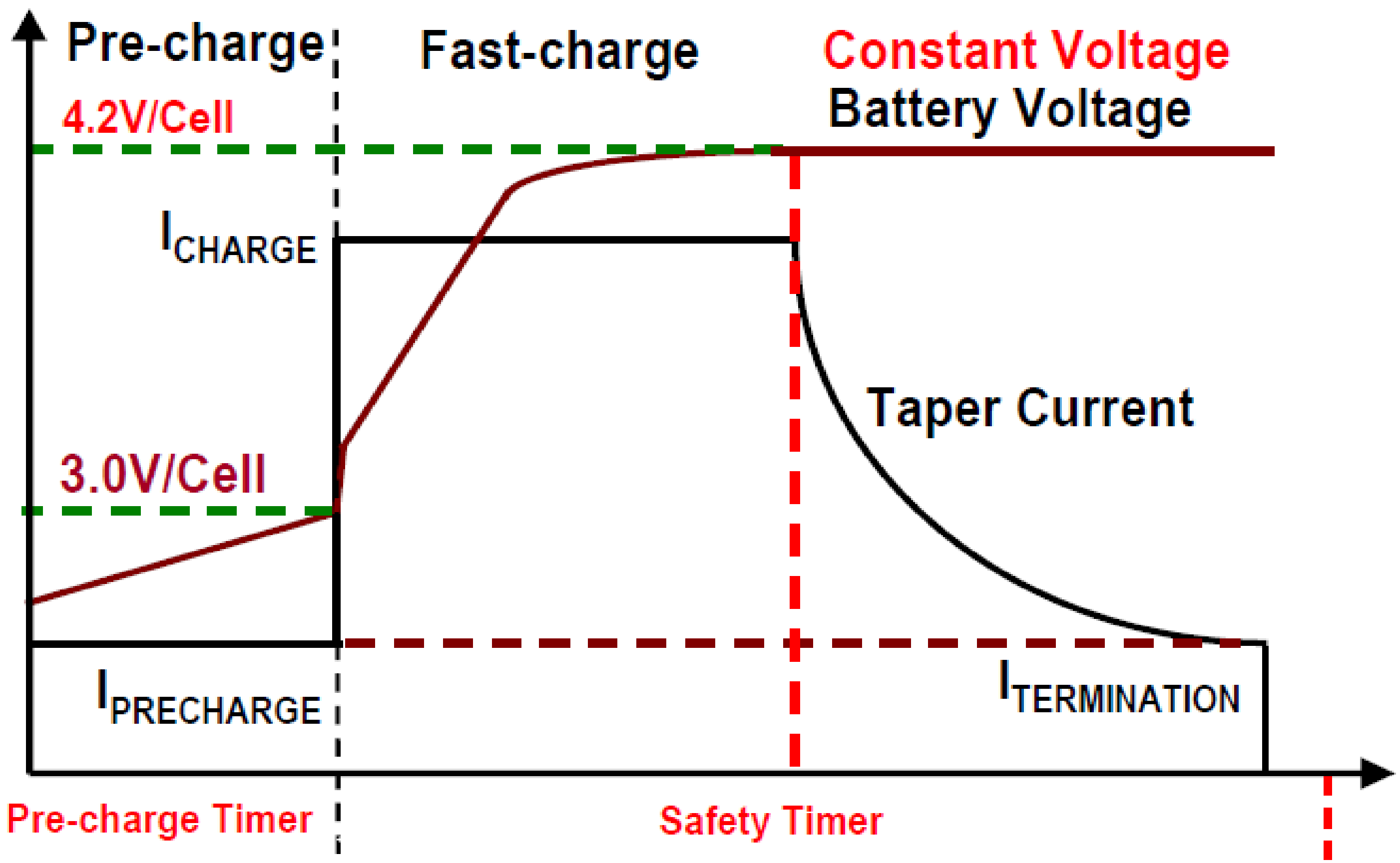


- Spannung an den Klemmen des Akkus (Blaue Kurve) $V = V_{OCV} - I \cdot R_{BAT}$
- Bei höheren Strömen wird die EDV früher erreicht

Ladeschaltungen

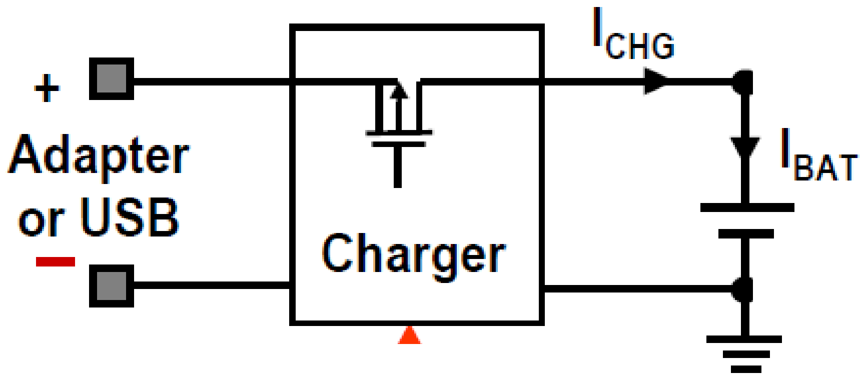
ICs zum Laden von Akkus mit Power Path Management

Ladeprofil von Li-Ion Akkus (CC-CV)



- Constant Current: 20-30% charging time, 70-80% capacity
- Constant Voltage: 70-80% charging time, 20-30% capacity

Laden mit einer aktiven Systemlast

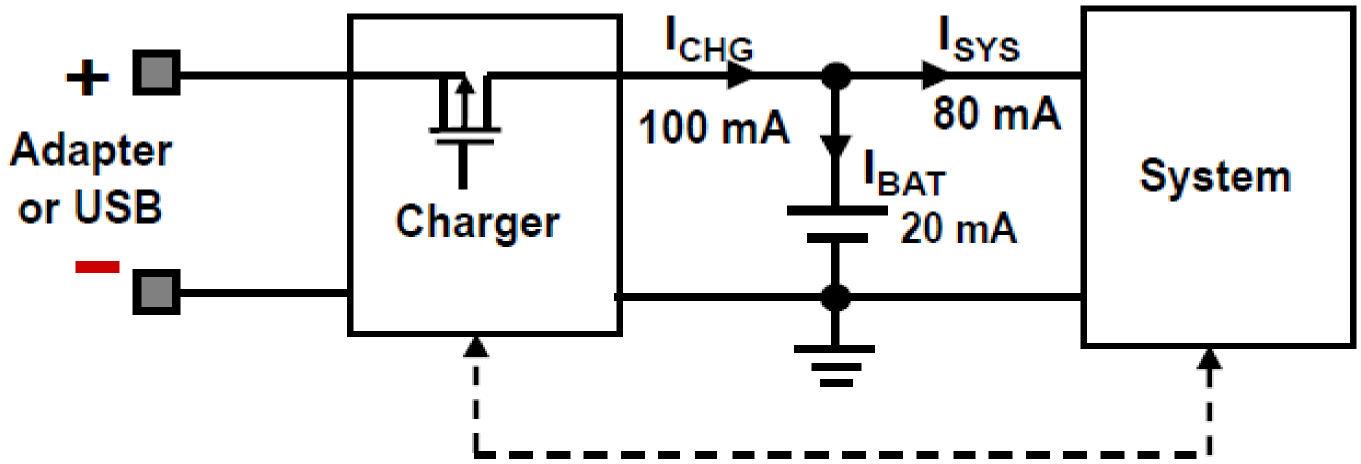


Der Strom aus dem Lade IC wird aufgeteilt

Probleme:

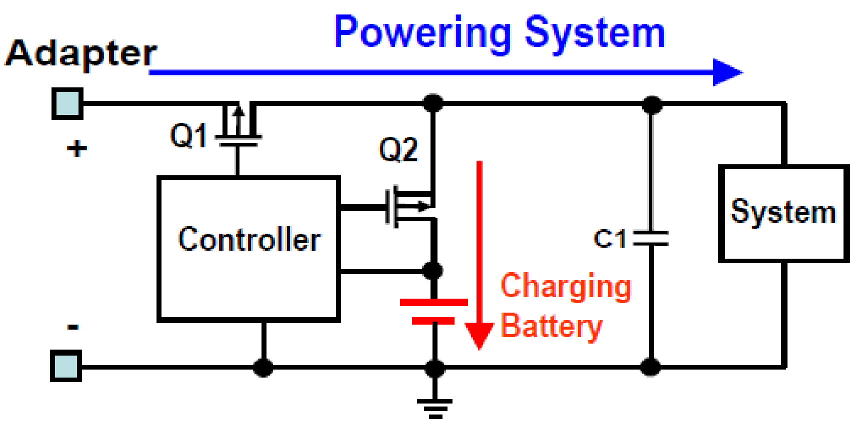
- **Falsch ablaufende Timer**
- **Abschaltungserkennung**

Systembetrieb im Pre-Charge Modus



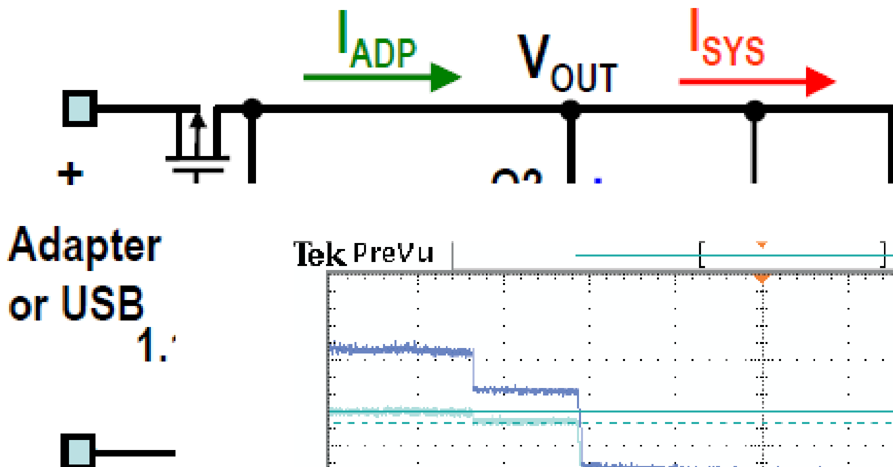
- Im Pre-Charge Modus kann die Systemlast einen enormen Einfluss auf den Ladestrom haben.
- System muss in diesem Modus abgeschaltet werden.

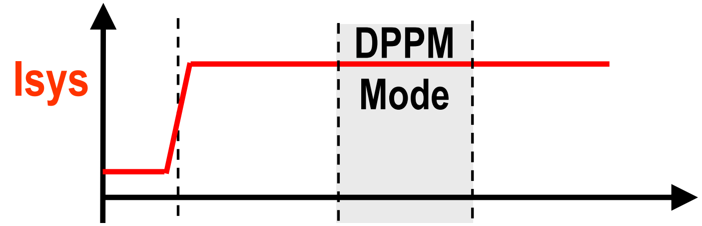
Laden mit Power Path Management

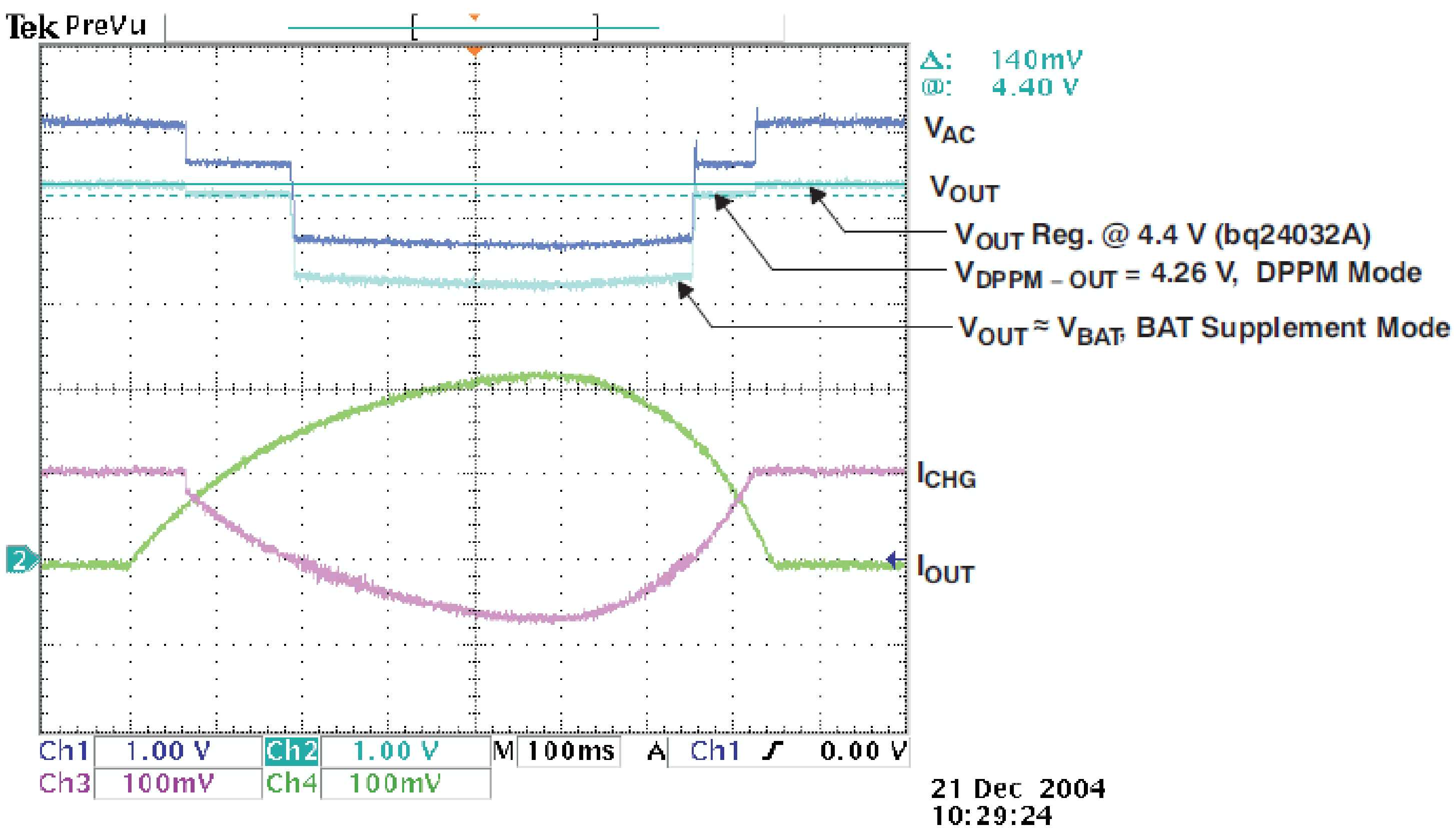


- System wird durch Q1 versorgt
- Ladestrom wird durch Q2 reguliert
- Ideal wenn Systembetrieb bei gleichzeitigem Laden gefordert ist

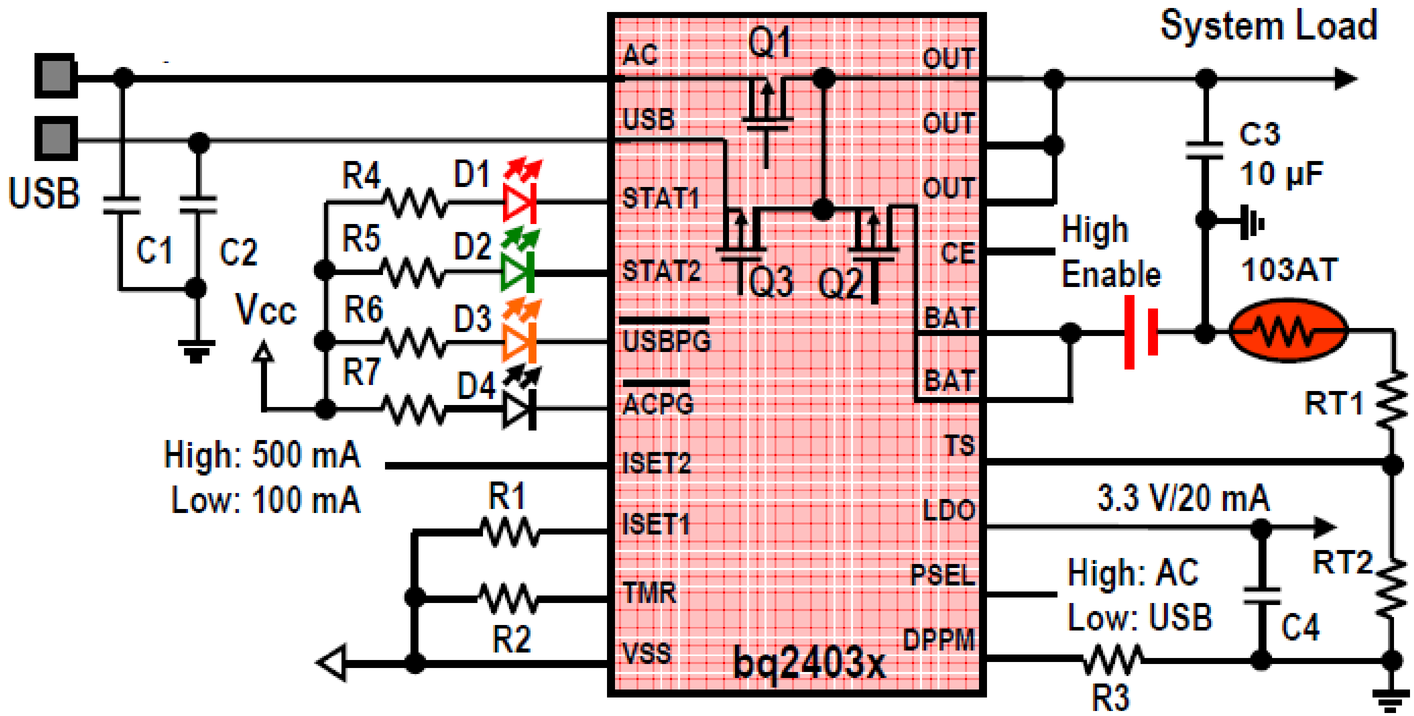
Voltage Based Dynamic Power Path Management (DPPM)







Details zum bq2403x



- USB oder Adapter als Eingangsspannung
- 100mA oder 500mA Strombegrenzung fuer USB
- Genaue Spannungs- und Stromregelung, Temperaturueberwachung, Timer, …

Übersicht: Spannungsbasierende DPPM ICs

	OUT	BAT	VIN-OVP	INPUTs
bq24030	6.0V	4.2V	NO	USB, AC
bq24031	6.0V	4.1V	NO	USB, AC
bq24032A	4.4V	4.2V	NO	USB, AC
bq24035	Cutoff for AC OV 6.4V	4.2V	Yes	USB, AC
bq24038	4.4V	4.2/4.36V	NO	USB, AC
bq24070	4.4V	4.2V	NO	MODE
bq24071	6.0V	4.2V	NO	MODE

Übersicht

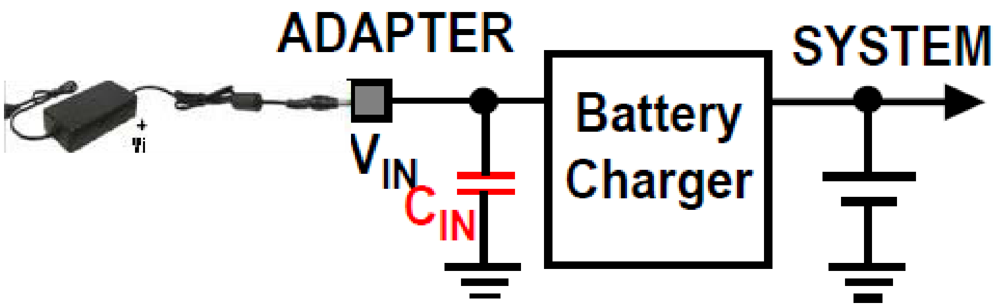
Device	Vin OVP	VOUT(REG)	VDPM	ITERM	Pin 15
bq24072	6.6V	V_{BAT}+225mV	VOUT $_{(REG)}$-100mV	10%	TD
bq24073	6.6V	4.4V	VOUT $_{(REG)}$-100mV	10%	TD
bq24074	10.5V	4.4V	VOUT $_{(REG)}$-100mV	ADJ (10% Internal)	ITERM
bq24075	6.6V	5.5V	4.3V	10%	SYSOFF
bq24230	6.6V	4.4V	VOUT $_{(REG)}$-100mV	10%	TD
bq24232	10.5V	4.4V	VOUT $_{(REG)}$-100mV	ADJ (10% Internal)	ITERM

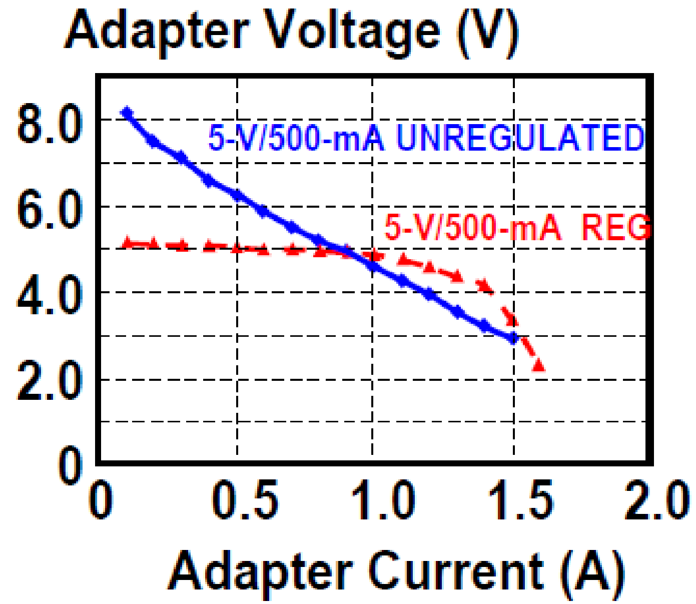
Systemanforderungen von Ladegeräten

Sicherheitsfunktionen

- **Hot Plug von externen Netzteilen**
- **Verpolungsschutz**
- **Strombegrenzung bei Kurzschluss**
- **Schutz gegen Überladen**

Fehlermöglichkeiten bei der Eingangsspannungsversorgung



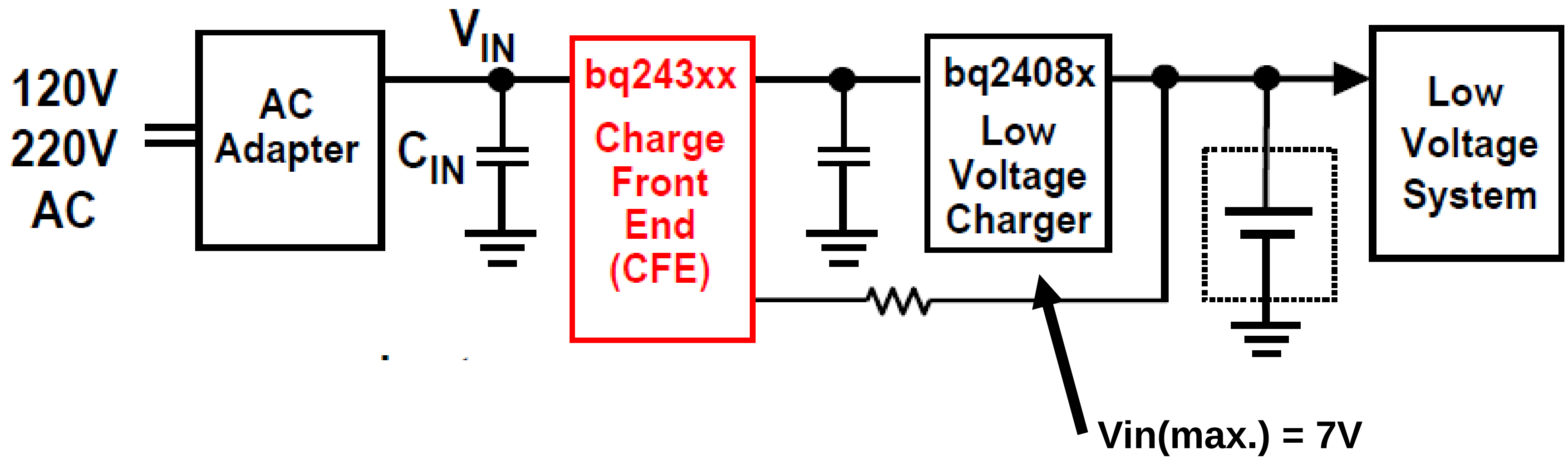


Input Over Voltage

Überspannung**:**

- **Falsches Netzteil oder billiges After-Market Produkt**
- **Ungeregeltes Netzteil**
- **Hot Plug**

Lösung mit verbessertem Schutz



Schutzfunktionen

- **Überspannung durch Transienten am Eingang**
- **Dauerhafte Überspannung**
- **Überstromschutz**
- **Verpolungsschutz**
- **Akku Überspannung**

Verfügbare CFE ICs

Device	OVP	OCP	Iq (max)	Batt OVP	PGATE	/Fault	/CE	LDO mode	Operation Temp Range	Package (SON)	Status
bq24300	Fixed 10.5V	Fixed 300mA	400µA	Fixed 4.35V	Yes	No	Yes	Yes, 5.5V	0-125°C	2x2-8	Released
bq24304	Fixed 10.5V	Fixed 300mA	500µA	Fixed 4.35V	Yes	No	Yes	Yes, 4.5V	0-125°C	2x2-8	Released
bq24305	Fixed 10.5V	Fixed 300mA	500µA	Fixed 4.35V	Yes	No	Yes	Yes, 5.0V	0-125°C	2x2-8	Released
bq24314	Fixed 5.85V	Prog. Up to 1.5A	600µA	Fixed 4.35V	No	Yes	Yes	No	0-125°C	2x2-8 4x3-12	Released
bq24314A	Fixed 5.85V	Prog. Up to 1.5A	600µA	Fixed 4.35V	No	Yes	Yes	No	-40-125°C	2x2-8	Released
Bq24313	Fixed 10.5V	Prog. Up to 1.5A	600µA	Fixed 4.35V	No	Yes	Yes	Yes, 5.85V	-40-125°C	2x2-8	Released
bq24315	Fixed 5.85V	Prog. Up to 1.5A	600µA	Fixed 4.35V	No	Yes	Yes	Yes, 5.5V	-40-125°C	2x2-8	Released
bq24316	Fixed 6.8V	Prog. Up to 1.5A	600µA	Fixed 4.35V	No	Yes	Yes	No	0-125°C	2x2-8 4x3-12	Released
bq24380	Fixed 6.3V	OCP @ startup	250µA	Fixed 4.35V	No	Yes	Yes	Yes, 5.5V	-40-125°C	2x2-8	Released
bq24381	Fixed 7.1V	OCP @ startup	300µA	Fixed 4.35V	No	Yes	Yes	Yes, 5.0V	-40-125°C	2x2-8	Released
bq24382	Fixed 10.5V	OCP @ startup	300µA	Fixed 4.35V	No	Yes	Yes	Yes, 5.0V	-40-125°C	2x2-8	Released

Li-Ion Linear Charger Portfolio

Dual Input Power Path →

bqTINY™-III
bq24030
$18V_{IN}$ – 1.5A
Power Path Mgt
Thermal Regulation
3.5x4.5 QFN

Dual Input AC/USB →

bqTINY™-II
bq24020
$7V_{IN}$ – 1A
3x3 QFN

bqHYBRID
bq25010
$7V_{IN}$ – 1A
Integrated DC/DC Converter (150mA)
3.5x4.5 QFN

Single Input Power Path →

USB Charger
bq24072
$28V_{IN}$ – 1.2A
Full USB Compliance
Power Path Mgt
3x3 QFN

Single Input →

Low Cost Solution
bq24085
$18V_{IN}$ – 750mA
OVP, Thermal Reg
3x3 QFN

USB Charger
bq25040
$30V_{IN}$ – 1.2A
100/500mA USB limit
Vin DPM
Integrated LDO
2x3 QFN

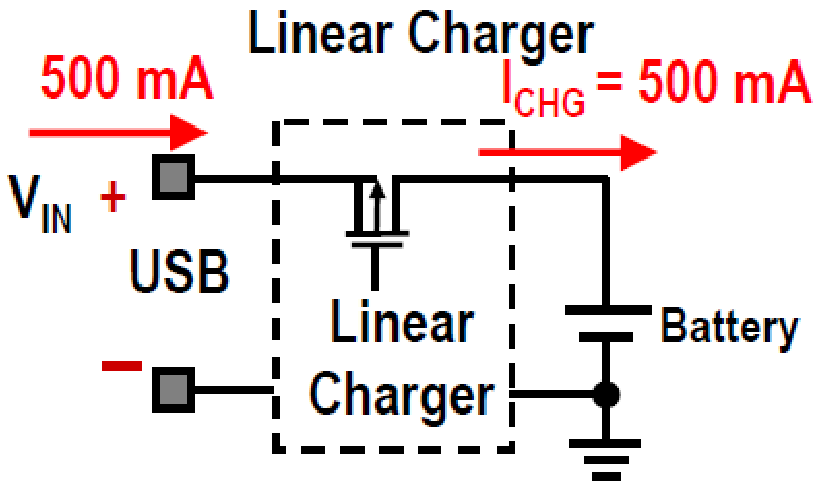
bq24010
$18V_{IN}$ – 1A
3x3 QFN
4.1/4.2/4.4 Vbat Options

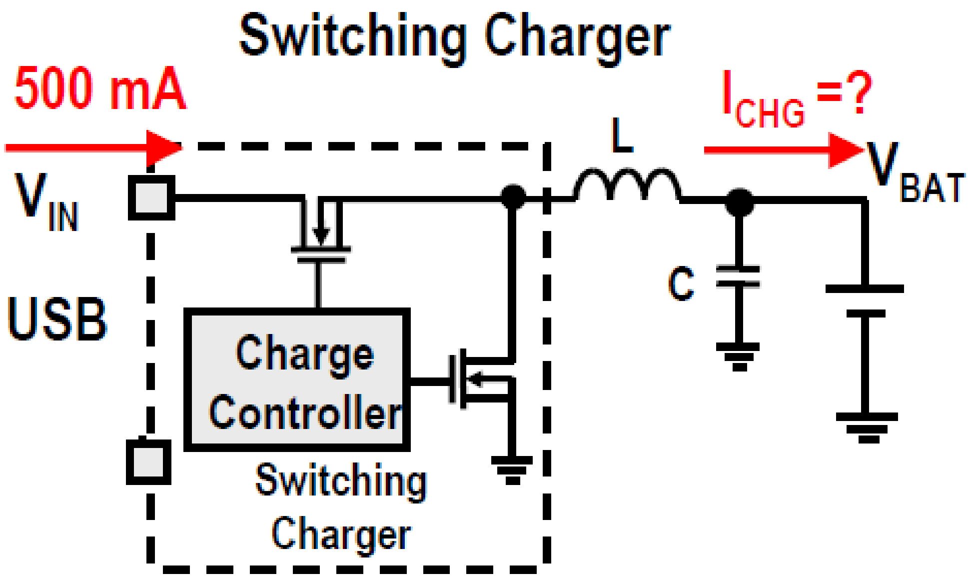
bq24060
$18V_{IN}$ – 1A
OVP, LDO Mode
Thermal Regulation
3x3 QFN

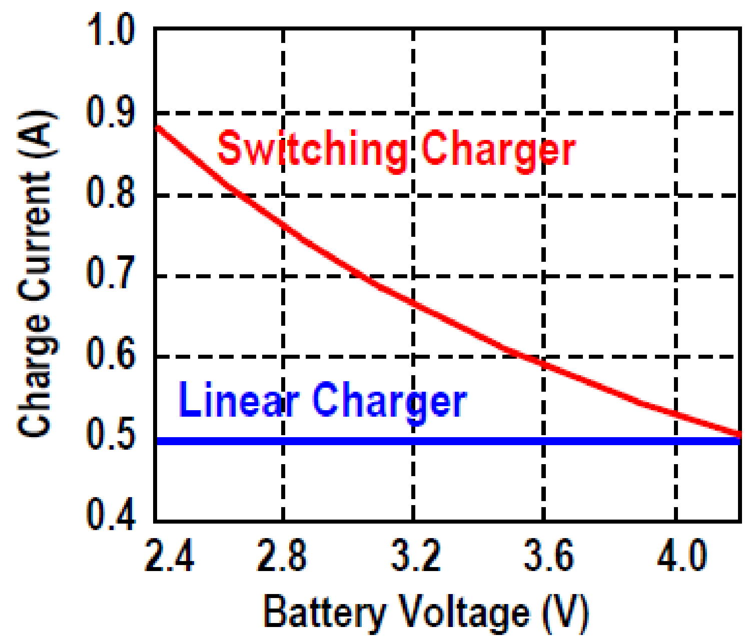
Cost →

Schnelles Laden von USB mit Schaltreglern

Vergleich: Schaltregler und Linearregler



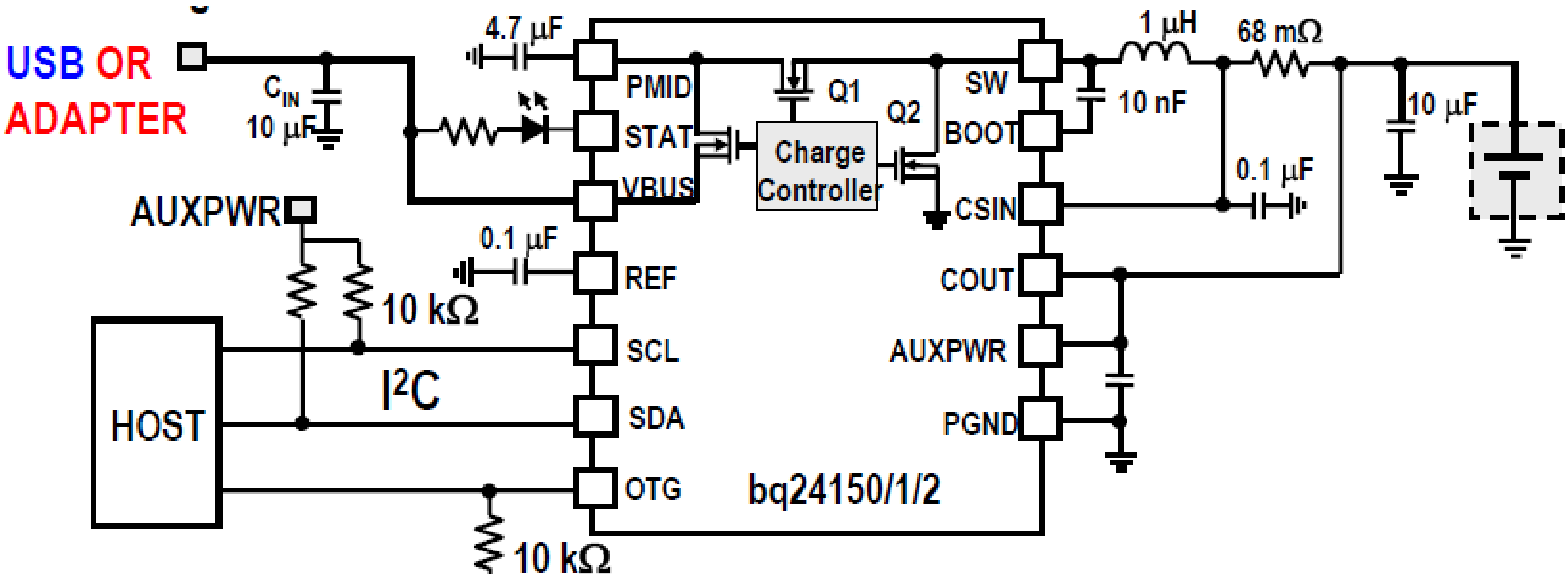




- 500-mA Current Limit
- 40% more charge current
- Full use of USB Power
- Reduce battery charging time

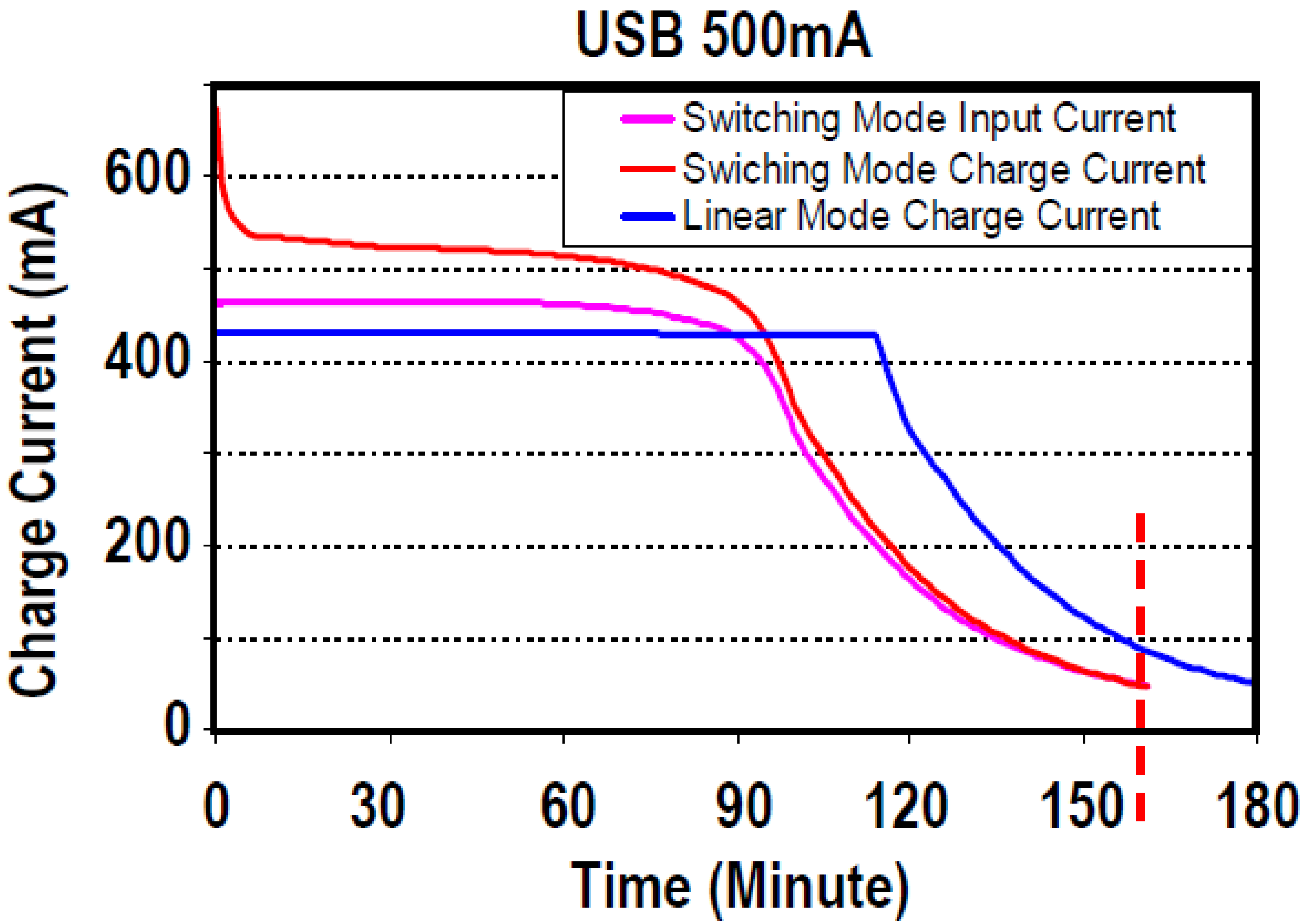
$$\boxed{I_{CHG} = \frac{V_{IN}}{V_{BAT}} \cdot \eta \cdot 500mA}$$

Typische Schaltung mit dem Bq24150

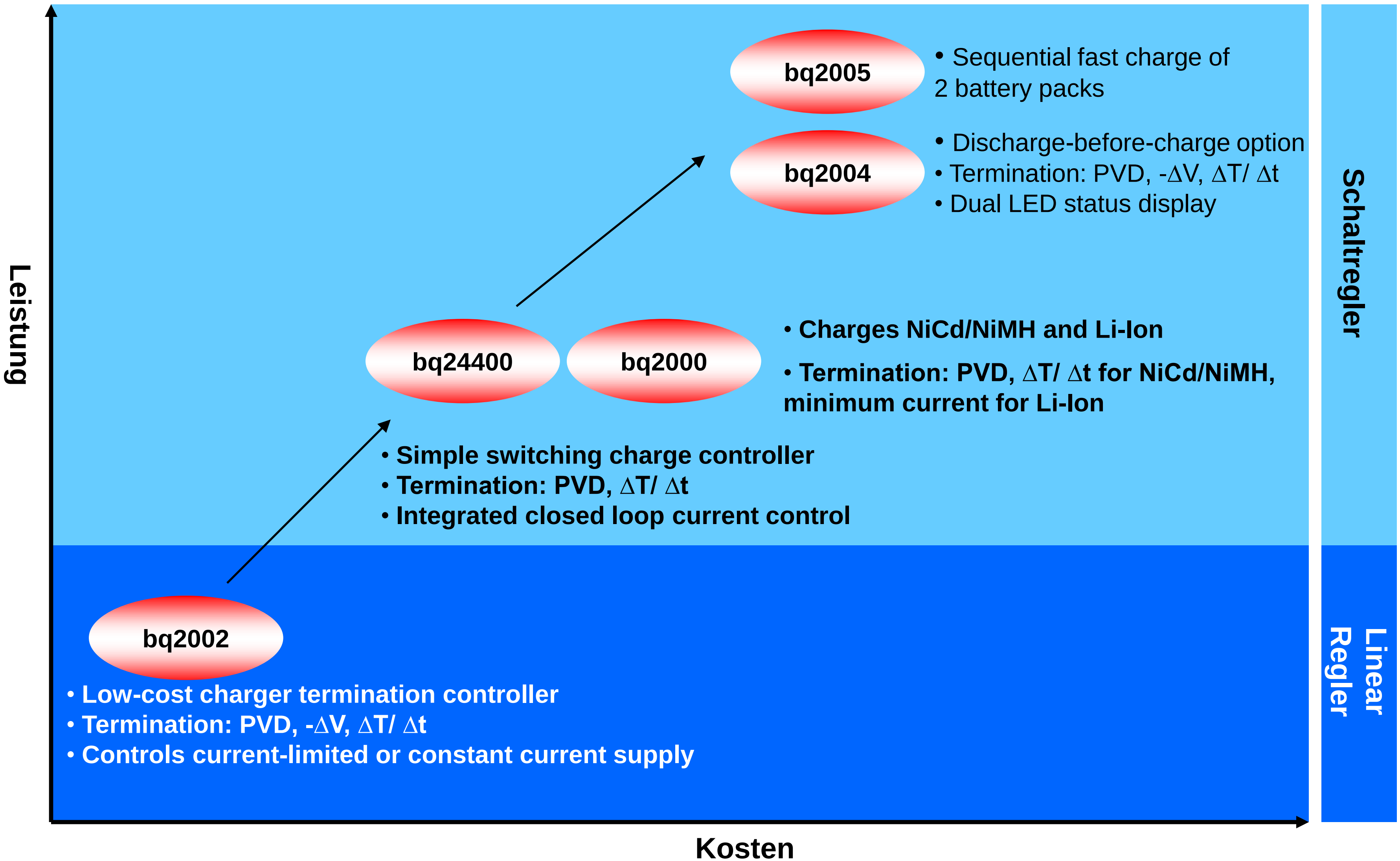


- Synchroner Schaltregler mit 3MHz
- Max. 20V Eingangsspannung
- Max. Ladestrom 1.25A
- Ladeparameter sind über I2C einstellbar
- Boost Mode für USB OTG

Vergleich der Ladezeiten



ICs zum Laden von NiMH/NiCd



Charge Management for NiCd/NiMH

- Discharge Before Charge **for the NiCd to eliminate battery memory**
- Soft start. **If the temperature is out of the LTF to HTF range, or if the battery voltage is out of the EDV to MCV rage, start with pulse trickle charge**
- Fast charge **when temperature and voltage are qualified**
- Fast Charge Termination
  - $\Delta T/\Delta t$. **Requires temperature sensor. Recommended for the NiMH, because**
    1) the voltage depression is smaller and harder to detect than NiCd
    2) a new NiMH battery has false peaks early in the charge cycle.
  - PVD, $-\Delta V$. **Work well with the NiCd. Cannot be used with active load.**
  - Safety backup: max voltage, max temperature, max time
- Top-off **at a reduced charge rate; usually used only with NiMH batteries, which tend to fill only 80 to 95% during fast charge**
- Maintenance Charge **keeps the battery full against the battery's self-discharge rate**

bq24450 – Sealed Lead Acid Battery Charge Controller

Features

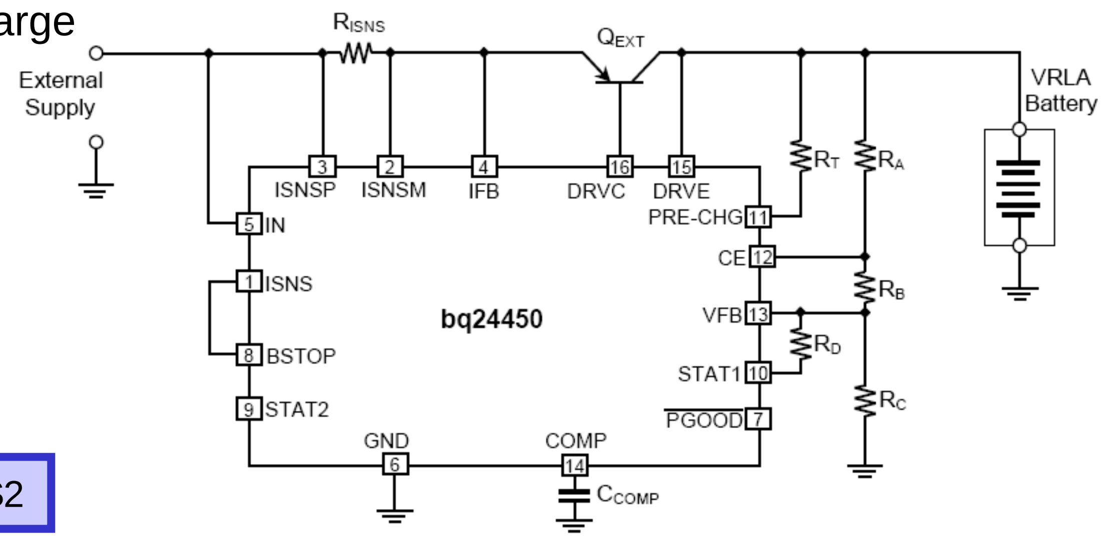
- 40V input rating
- Regulated both voltage and current during charging
- Precision temperature-compensated reference
- Configuration options:
  - Simple constant voltage float charge
  - Dual voltage float-cum-boost charge

Benefits

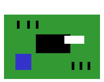
- Safe with high input voltage
- Integrated solution requires minimum external components
- Ensure safety and maximizes battery capacity over temperature
- Optimum control to maximize battery capacity and life

Applications

- Emergency lighting systems
- Security and alarm systems
- Telecom backup power
- Uninterruptible power supplies



EVM



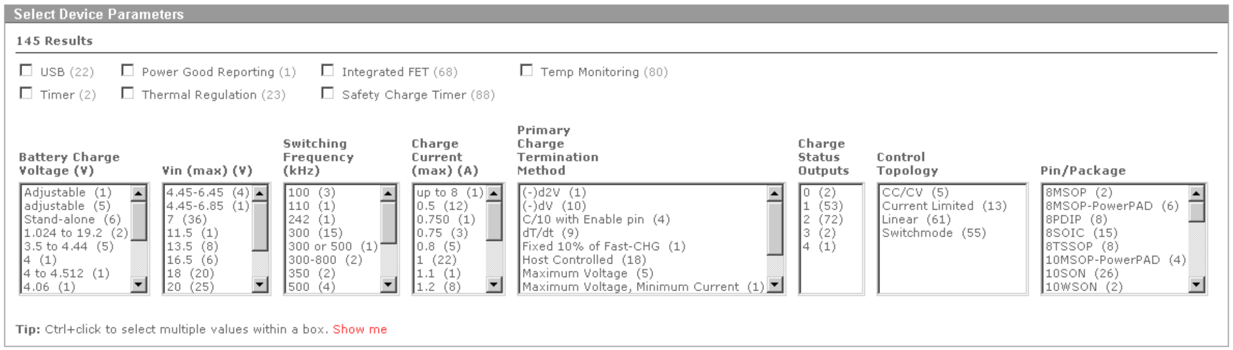
bq24450EVM

1ku pricing $2

Product Portfolio

Device	Control Topology	Max Vin	Status Outputs	Input Undervoltage Lockout	Package
Bq24450 (same as UC2906/ UC3906)	Linear	40V	Reports 3 charge states, PGOOD	Yes	16 pin PDIP or SOIC
bq2031	Switching	7V	Reports 19 charge states	No	16 pin PDIP or SOIC
UC2909/ UC3909	Switching	40V	Reports 4 charge states	Yes	20 pin PDIP or SOIC, 28 pin PLCC

Hilfsmittel von TI

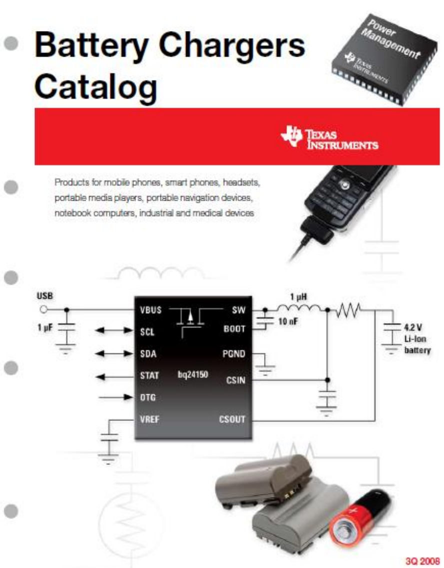


Application Notes

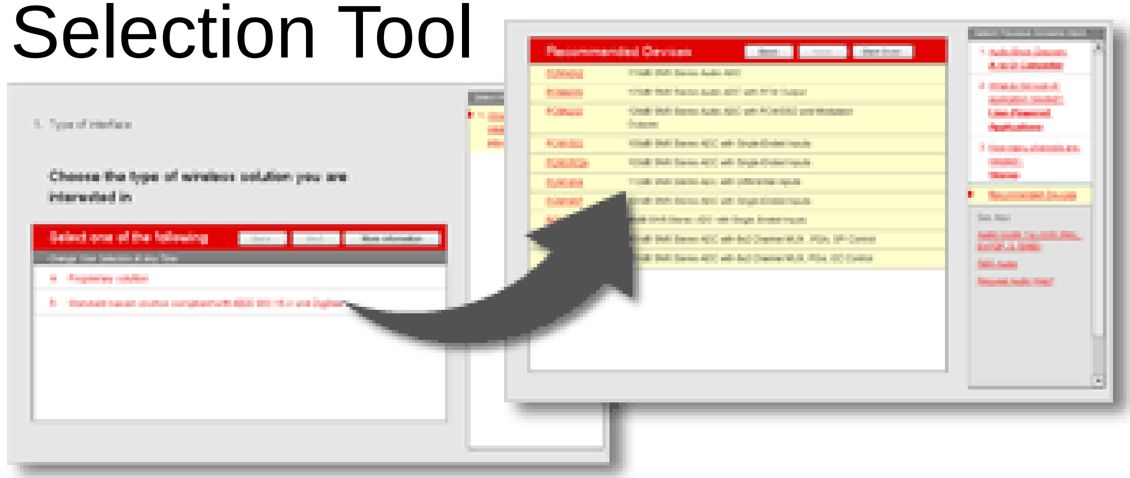
Most Useful | Most Recent | Most Viewed

Showing 100 of 248 results

Parameter Search

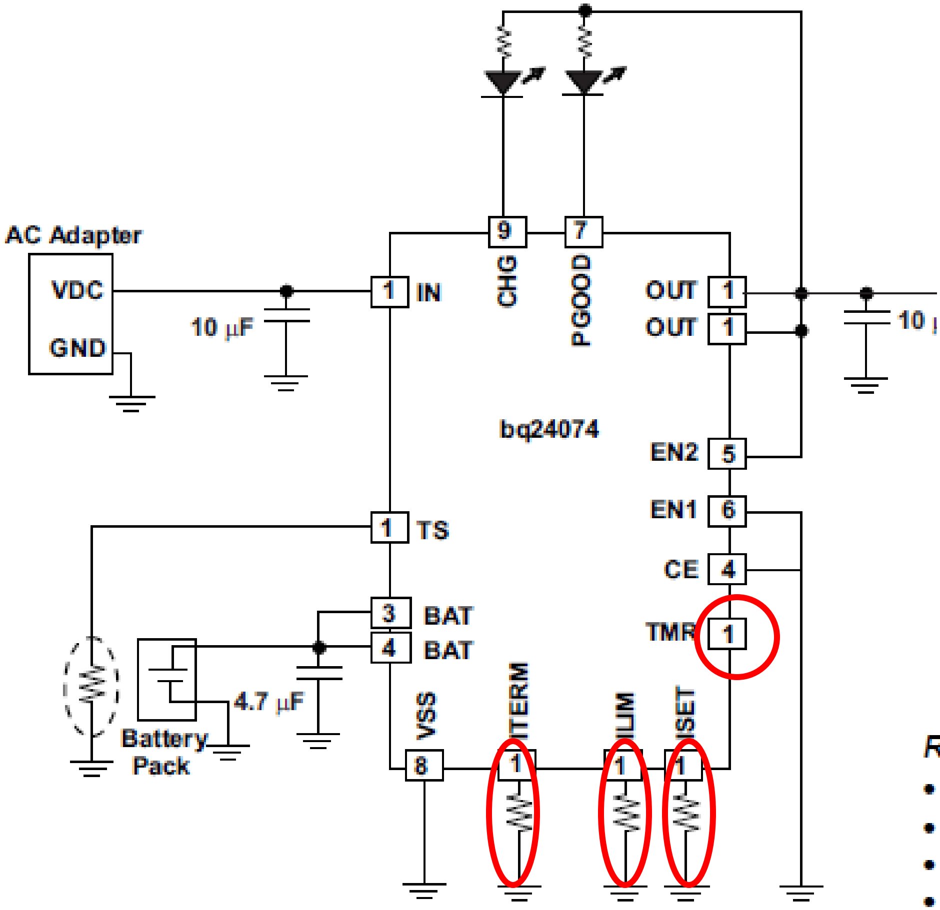


Selection Tool



Design Beispiele

bq24074 – 1 Cell Li-Ion



Program 6.25-hour Fast-Charge Safety Timer, TMR:

R(TMR) = [t(MAXCHG) / (10 * K(TMR))] from the electrical characteristics table. . .

K(TMR) = 48 s/kOhm

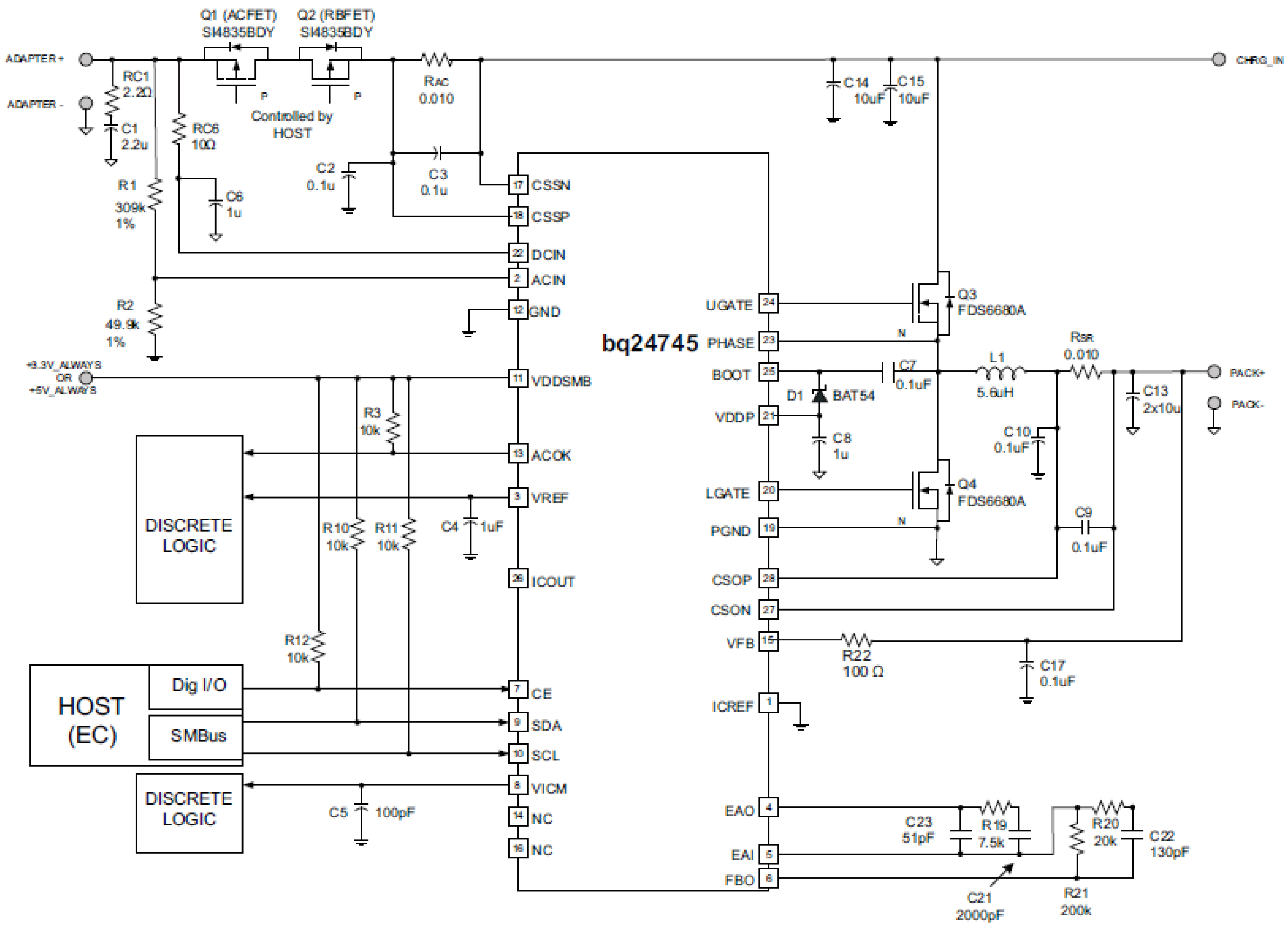
R(TMR) = [6.25 hr ´ 3600 s/hr / (10 (48 s/kW)] = 48.87 kOhm

Selecting the closest standard value, use a 46.4-kOhm resistor between TMR (pin 2) and Vss.

Requirements

- Supply voltage = 5 V
- Fast-charge current of approximately 900 mA; ISET – pin 16
- Input current limit = 2.2 A; ILIM – pin 12
- Termination current threshold = 120 mA; ITERM – pin 15
- Safety timer duration, fast-charge = 6.25 hours; TMR – pin 14
- TS – battery temperature sense = 10k NTC (103AT)

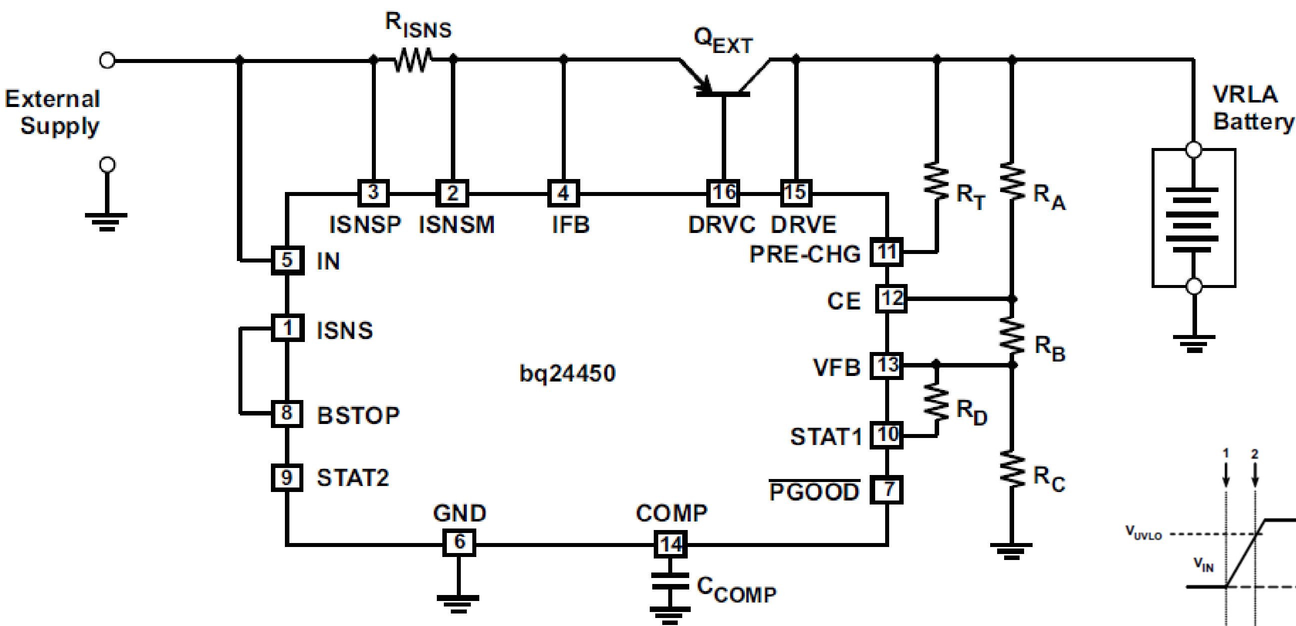
Bq24745 – 4 Cell Li-Ion

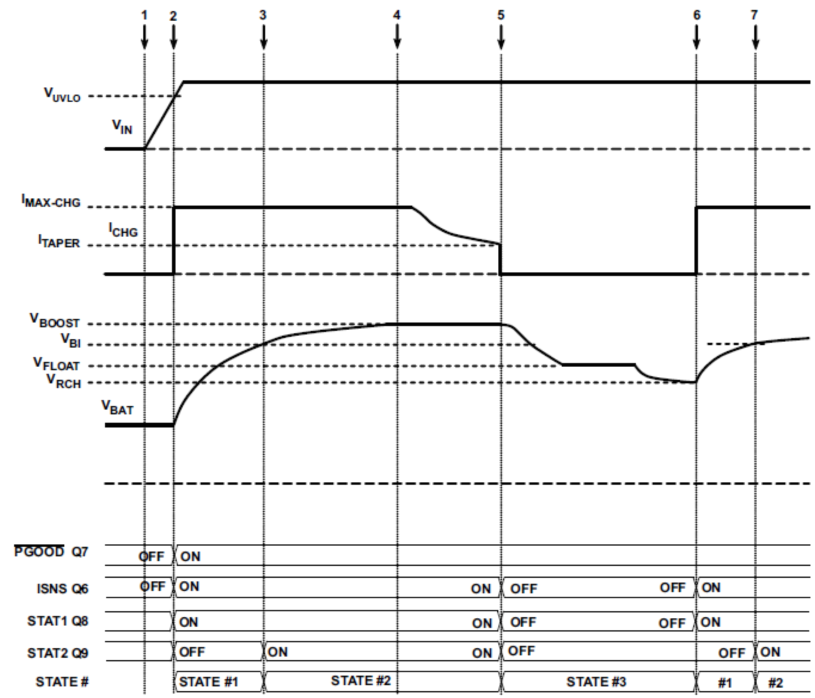


(1) Pull-up rail could be either VREF or other system rail.

Pull-up rail could be either VREF or other system rail.

Bq24450 – Blei Akku

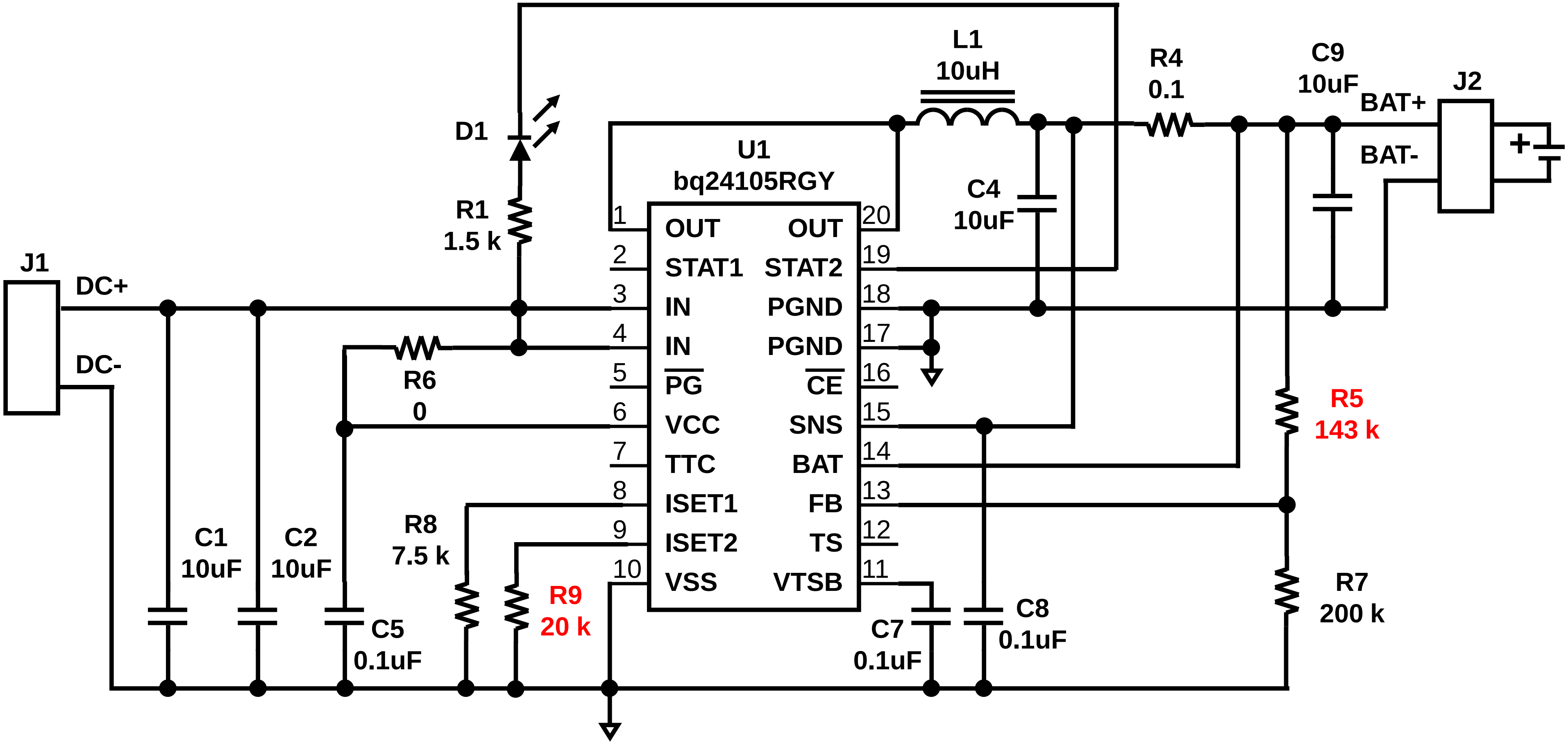




LiFePO4 Ladegerät

LiFePO4 Charger based on bq24105/125 EVM (changes in red)

up to 4 cell, <2A application

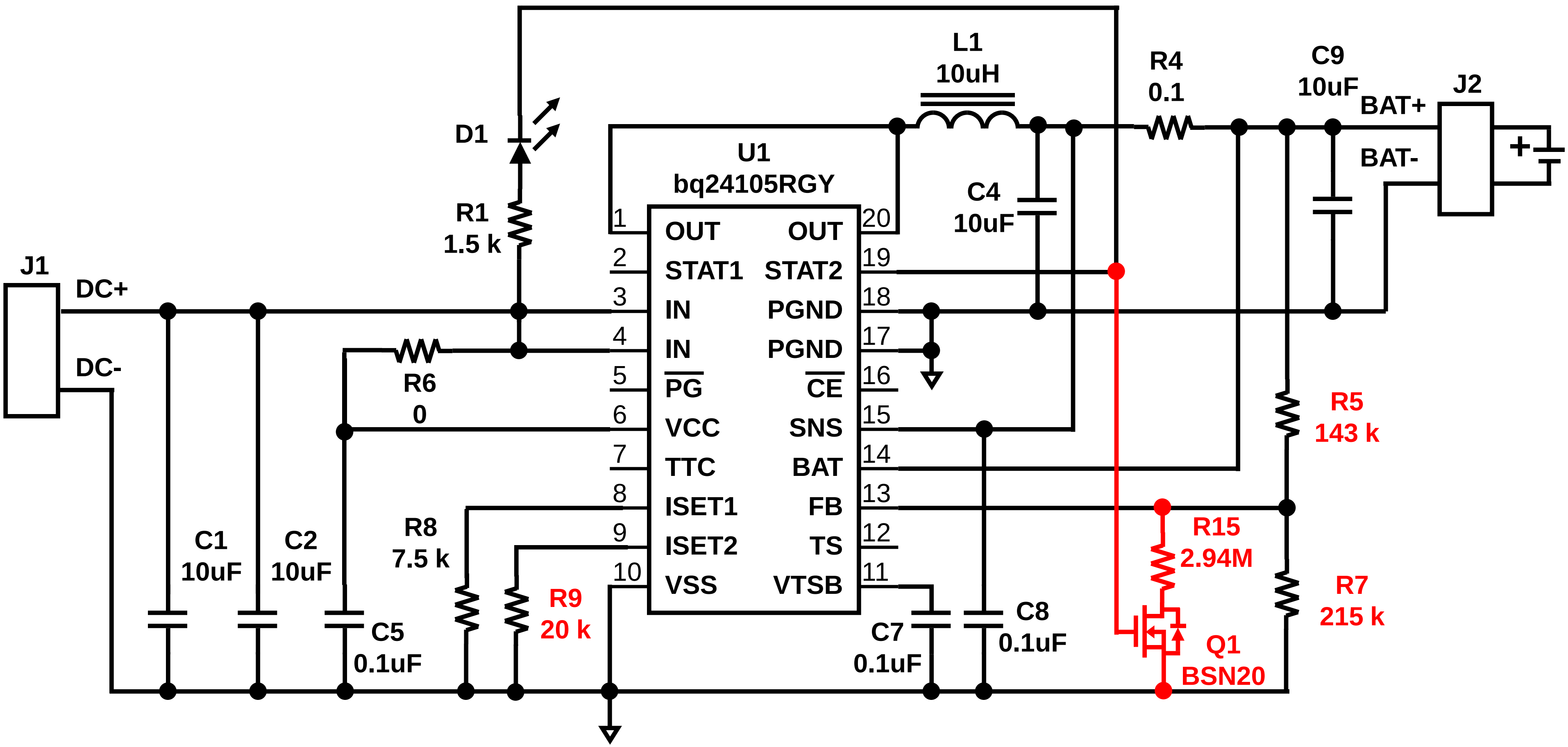


- Charge voltage change from 4.2V to **3.6V**
- Refresh voltage change from 4.1V to **3.516V**

- running frequently in refresh mode

LiFePO4 Charger based on bq24105/125 EVM (changes in red)

up to 4 cell, <2A application



- Charge voltage change from 4.2V to 3.6V
- Refresh voltage change from 4.1V to 3.4V

solved by lowering refresh voltage

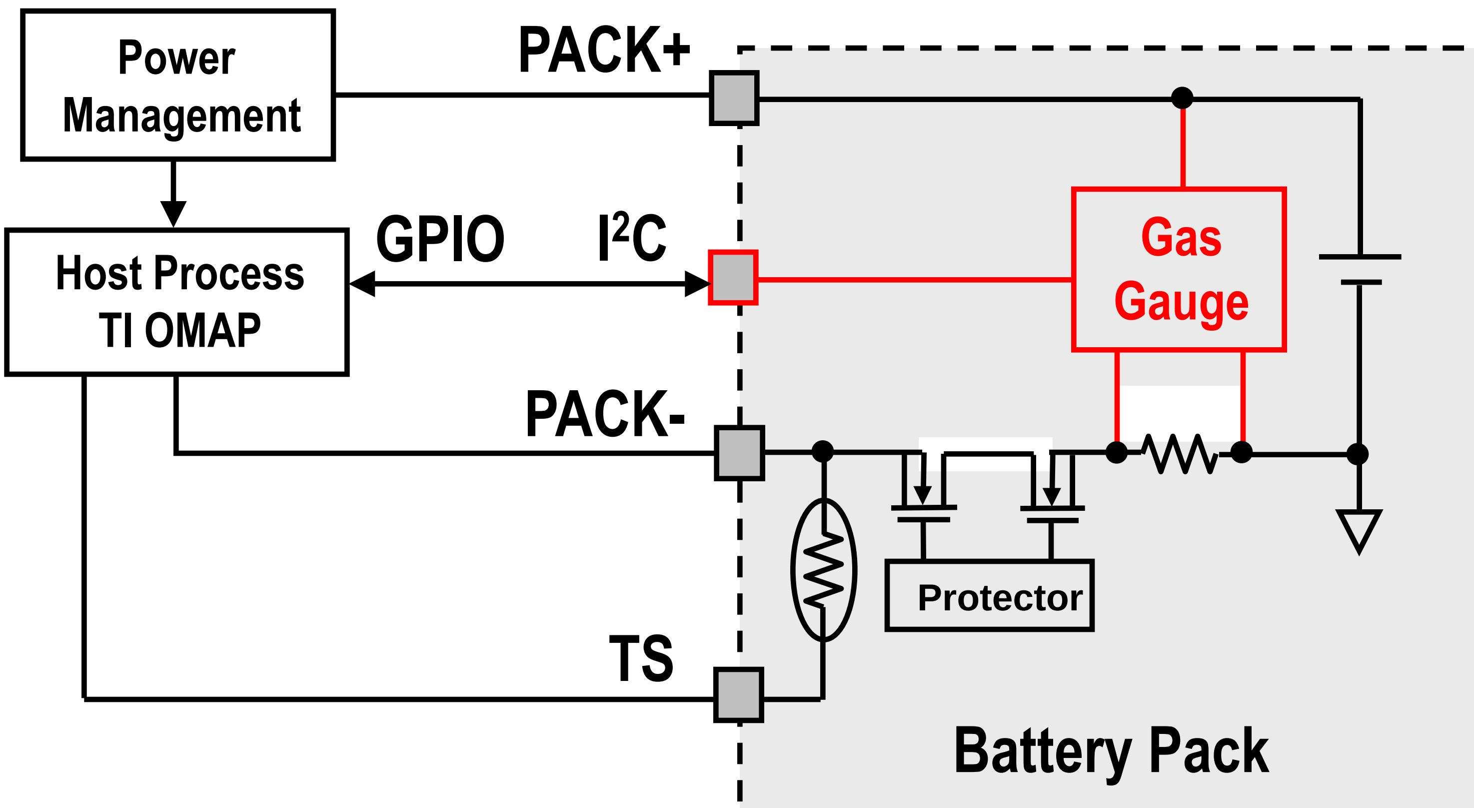
Texas Instruments

Ladezustand und Überwachung

Contents

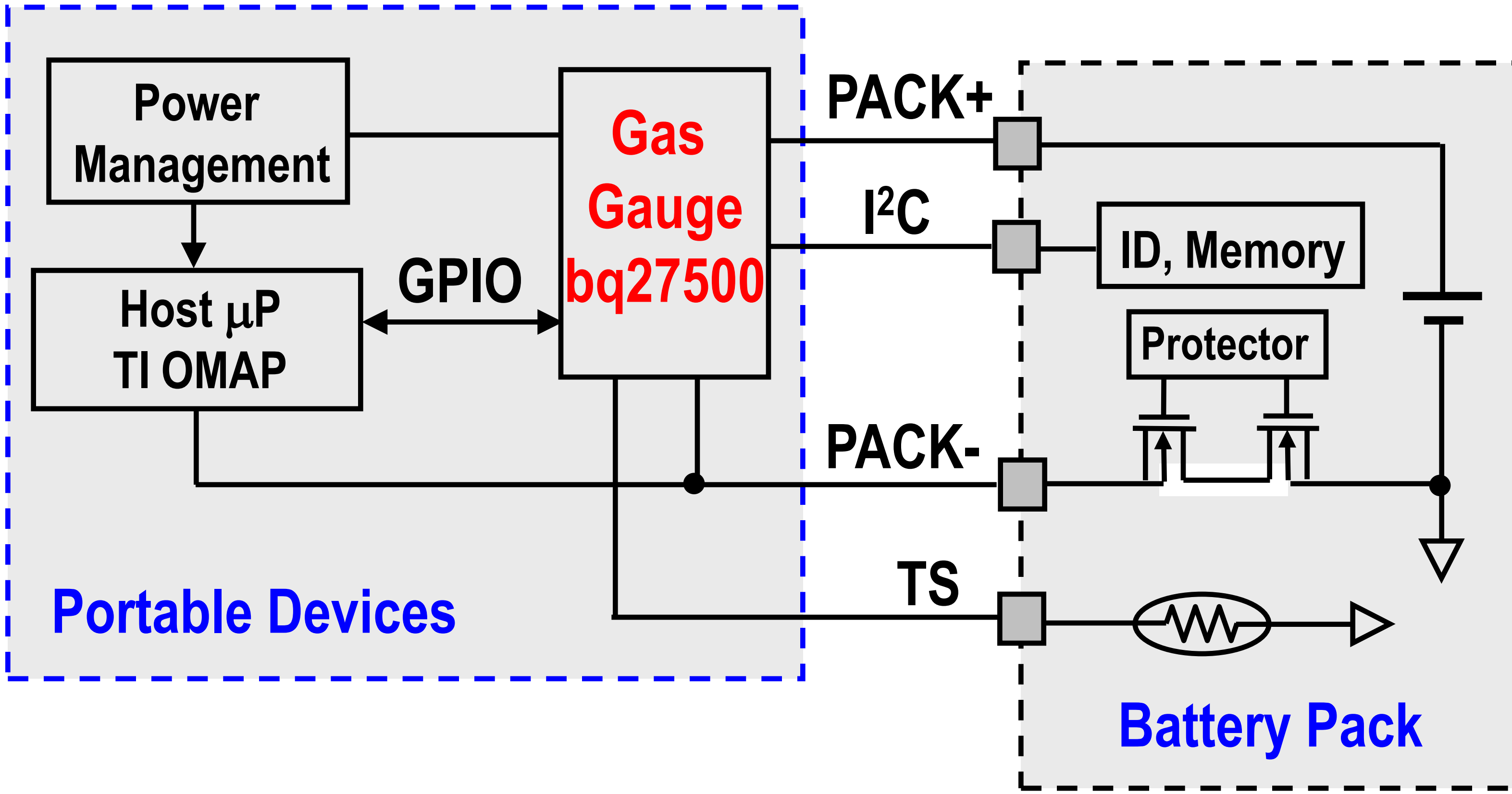
- System considerations – host side or pack side gauge?
- Applicability of different gauging methods to system-side gauging
- Special considerations in a host side gauge implementation
- State of health indication – cycle count vs. dynamic measure

Traditional Battery Pack-Side Gas Gauge



- Higher cost: Battery pack electronics
- Longer battery pack development time for different battery chemistries

System-Side Fuel Gauge



- Cheap battery pack for end users
- Standard battery pack
- Faster system design development cycle

Potential advantages of system-side gauge

- Low cost battery pack (only protection electronics)
- Many external packs can share just one gauge
- Battery replaced without replacing the electronics
- Fast development without battery pack maker

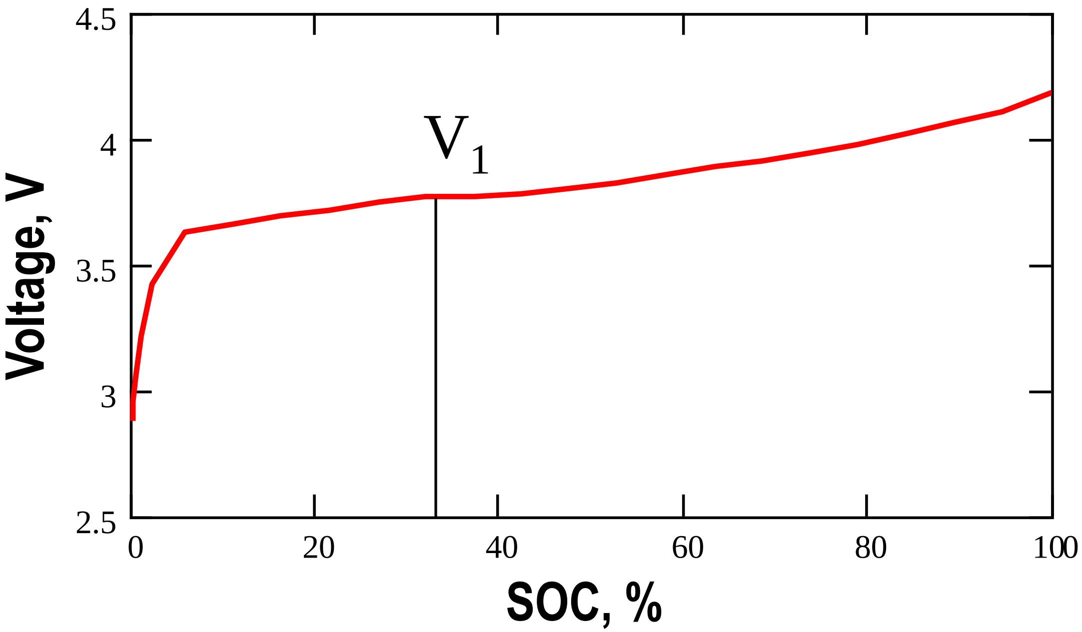
Challenges for system side gauging

- Multiple cells in series
- Industrial, interchangeably used packs pool
- Systems needs high accuracy
- System requires battery health indication
- Not sufficient resources in host processor
- No battery expertise by system maker
- Support of multiple cell types needed

Methods used for system-side gauging

- Voltage Correlation
- Resistance Compensated Voltage Correlation
- Current Integration with external initialization of state of charge (SOC)
- Impedance Track

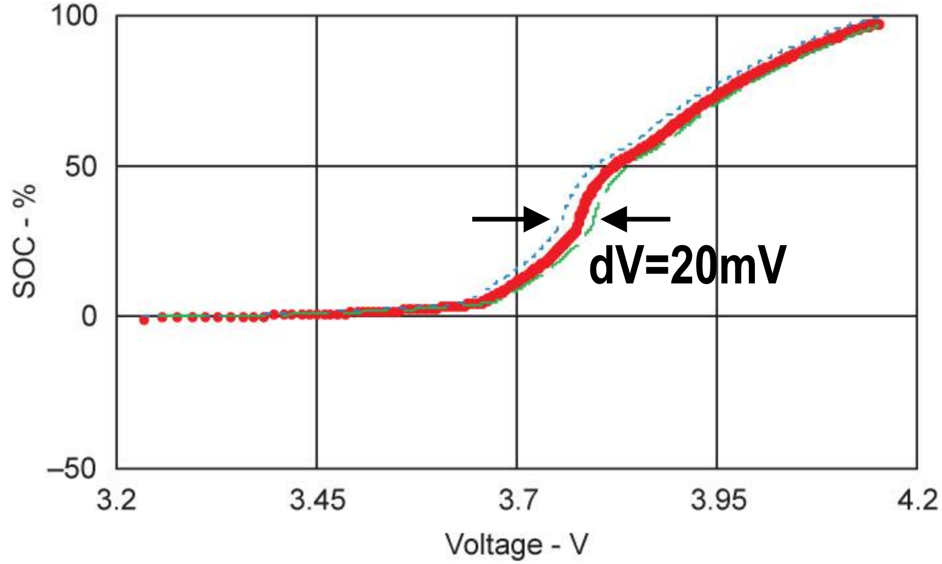
Voltage correlation based fuel gauging

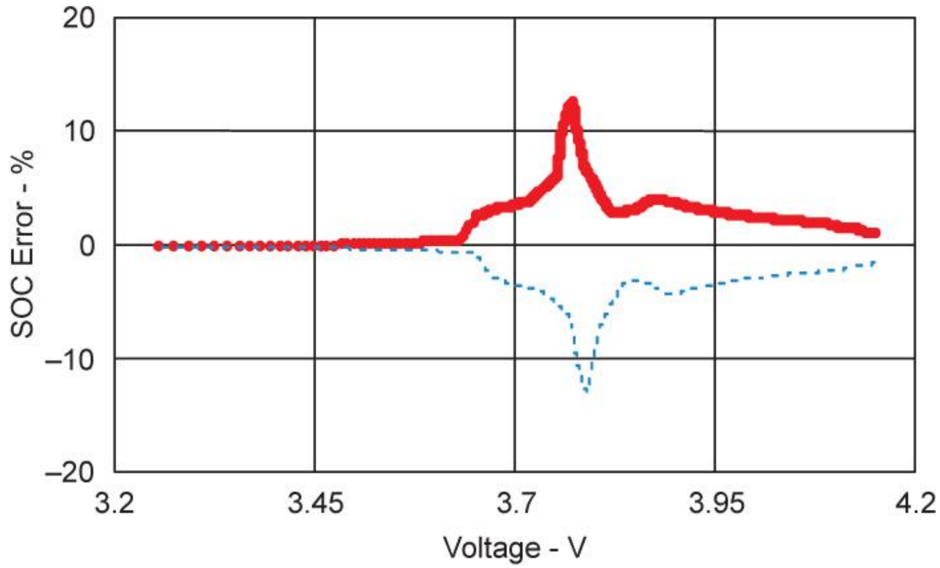


- Voltage is measured during discharge
- Characterized in pre-production Voltage / SOC curve is used for correlation to find SOC
- Because actual voltage depends on current, IR error distorts correlation

V = OCV – IR

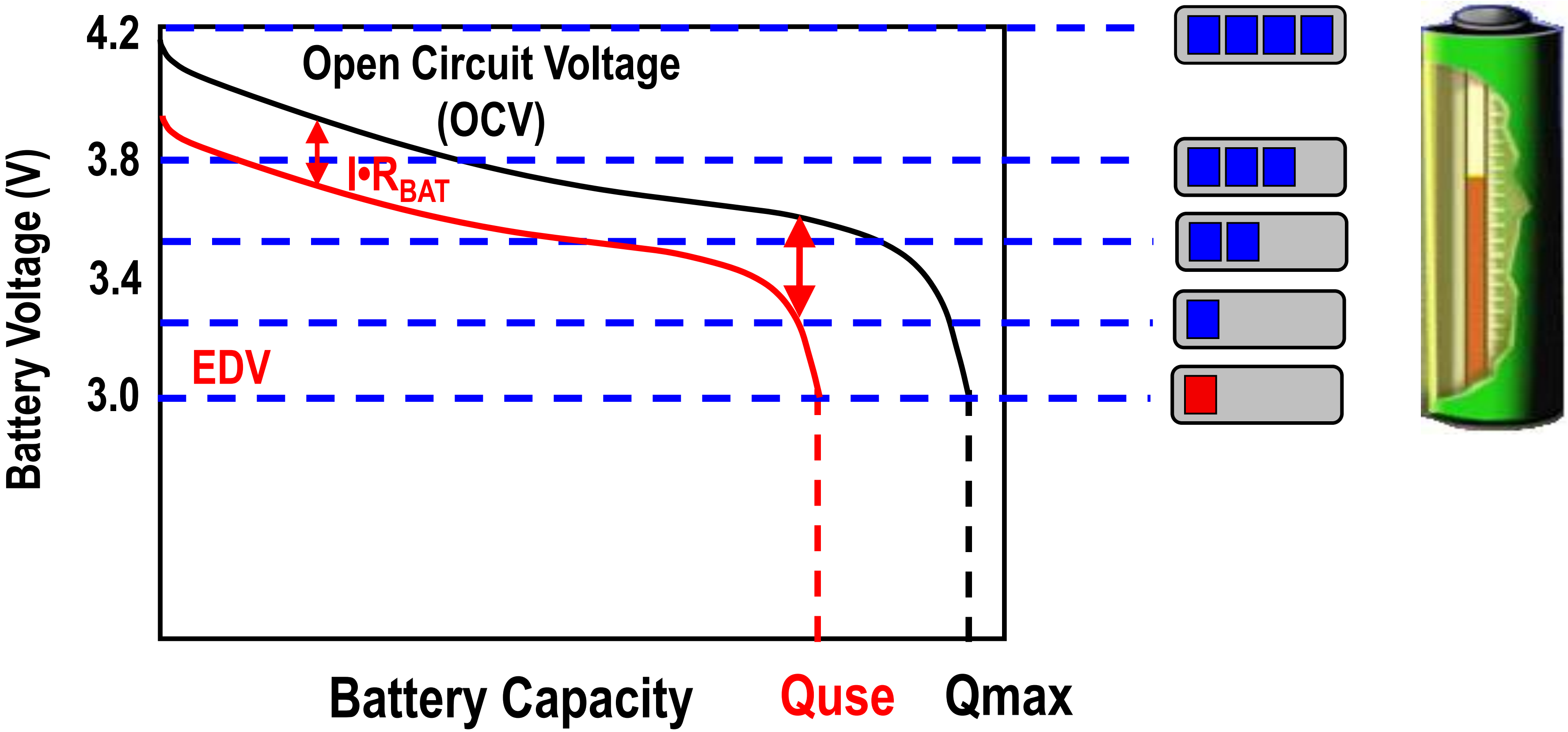
Base Voltage Correlation Error, no current





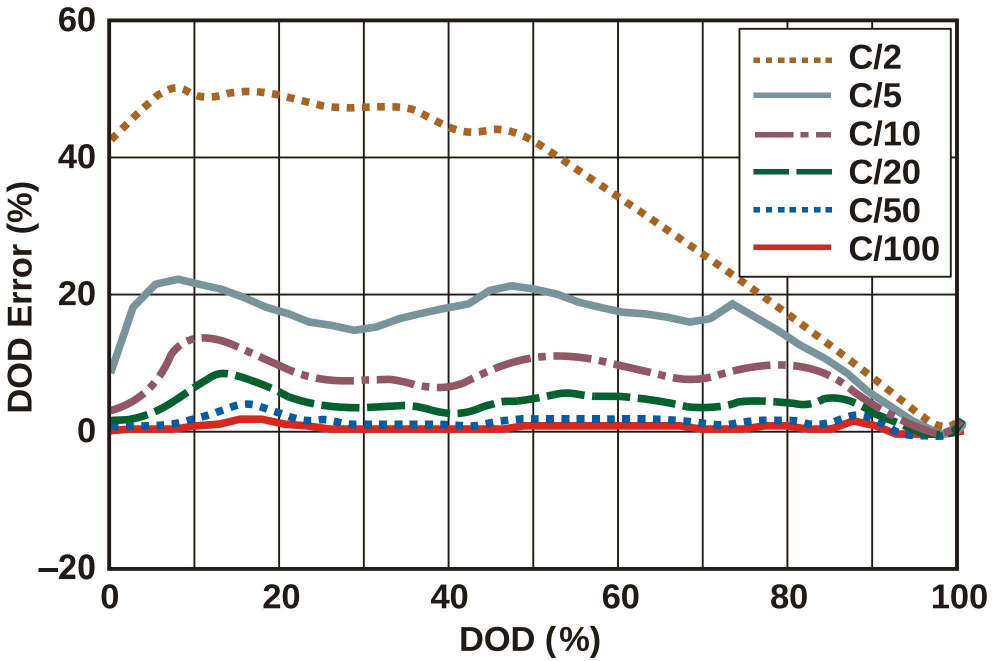
- Rule of thumb: 1mV voltage error gives 1% max. SOC error

IR drop effect on Voltage Correlation



- One bar represents over 50% capacity between 3.8V and 3.4V
- Pulsating load causes capacity bar up and down
- Accurate ONLY at very low current $V = V_{OCV} - \boxed{I \cdot R_{BAT}?}$

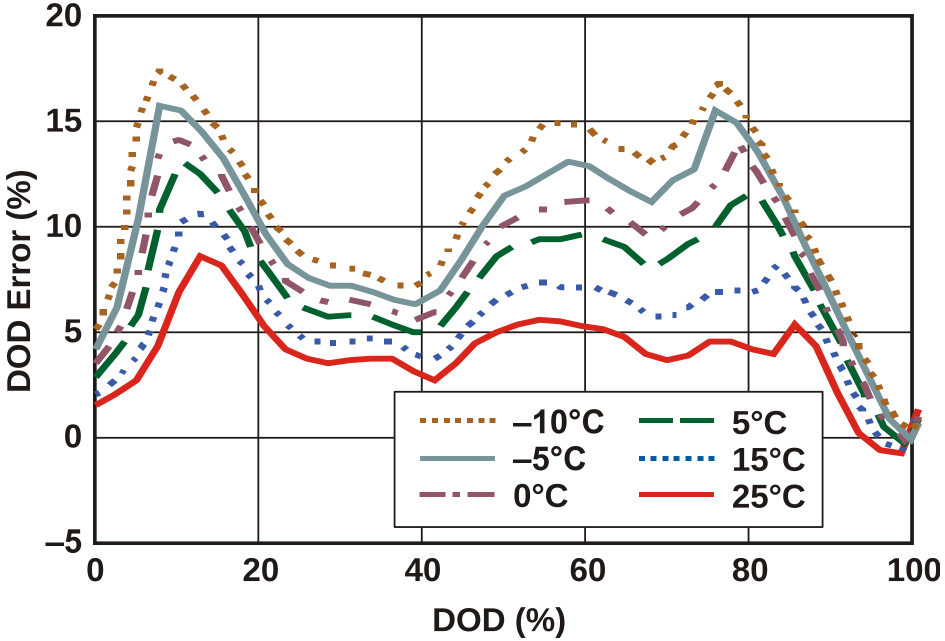
Discharge Rate vs Voltage Correlation Error



- Error increases with C-rate as $I*R_{bat}$ effects become more significant
- Error is higher in flat portions of voltage curve and lower in steep portions
- C/10 rate is the limit where voltage correlation can be used with reasonable accuracy

$$V = V_{OCV} - I \bullet R_{BAT}$$

C/20, Temperature effect on voltage Correlation Error

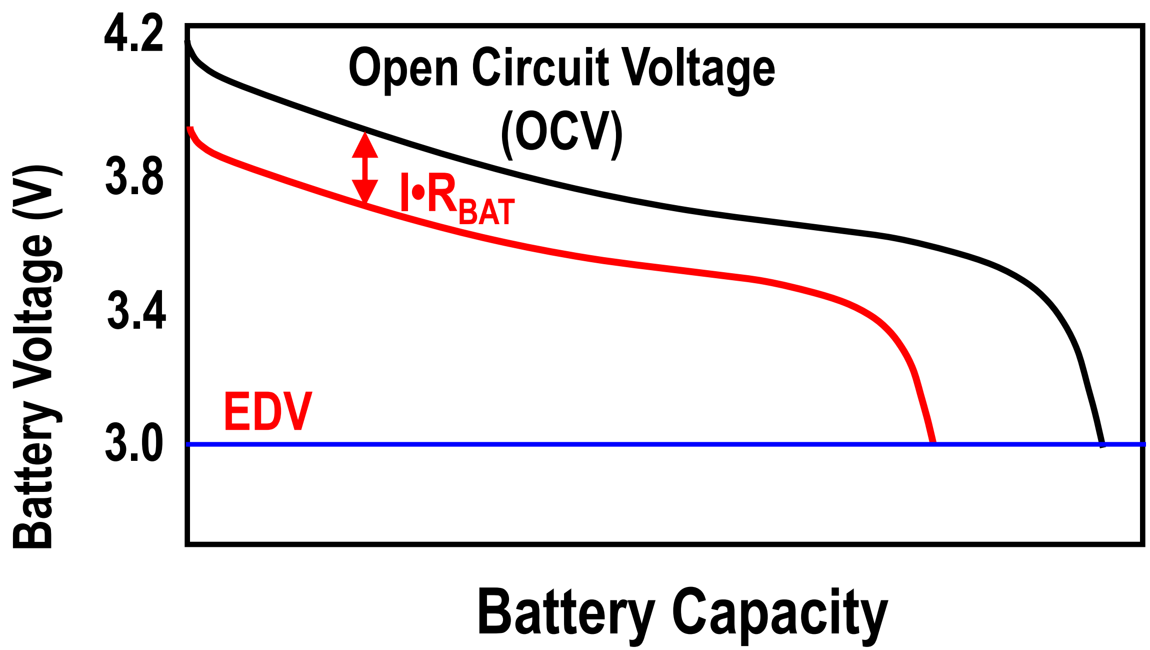


- Battery impedance increases as temperature decreases
- Correlation error increases as IR drops grow larger
- Error is higher in flat portions of voltage curve and lower in steep portions
- Even at C/20 rate, error approaches unacceptable values at -10C

Challenges for system side gauging

Requirement	Voltage Correlation	Voltage + IR correction	Coulomb counting	Impedance Track
Series cells	No			
Interchangeable batteries	Yes			
Max. error: New	50%			
300 cycles	100%			
Battery health	No			
Processing needs	Low			
Battery expertise	High			
Multiple chemistries support	No			

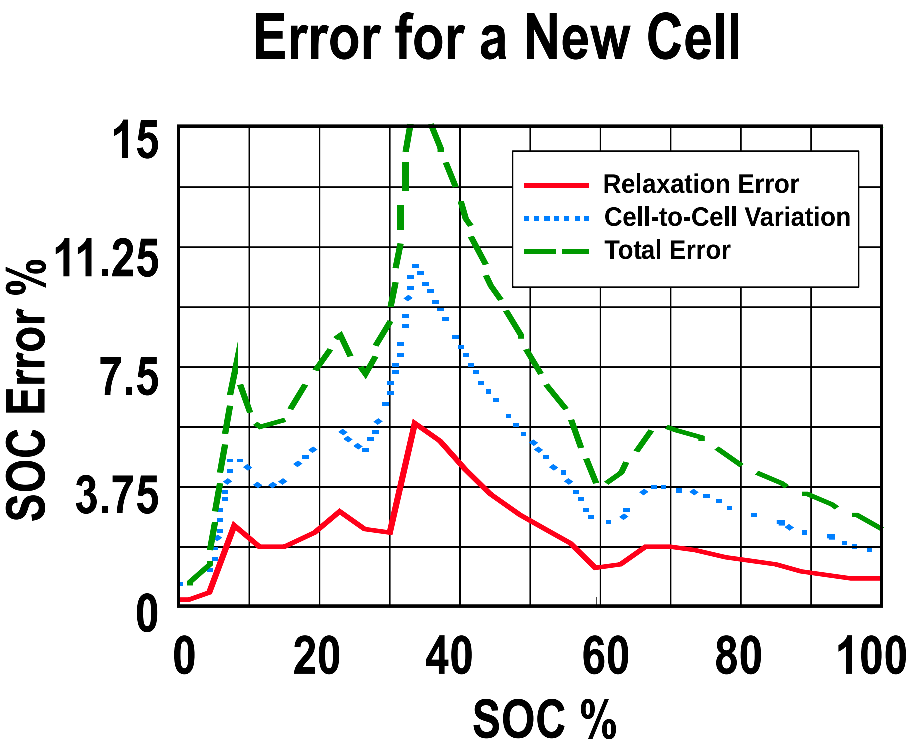
Voltage Correlation with IR correction

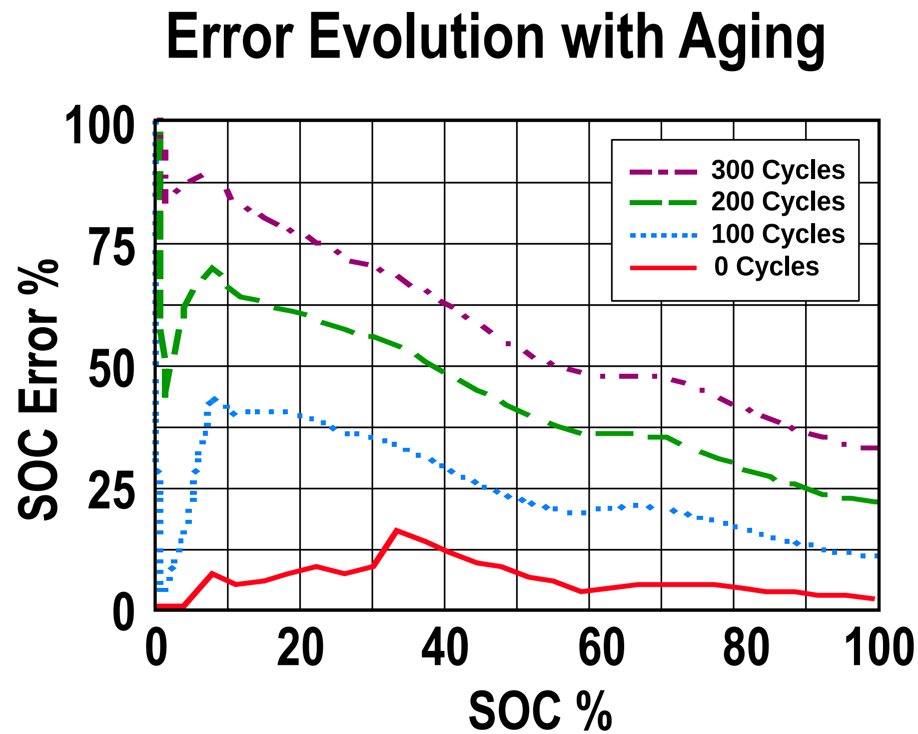


$$V = V_{OCV} - I \bullet R_{BAT}$$

- ❑ OCV has a good correlation with SOC without current flow
- ❑ IR can be applied during discharge
- ❑ Limited Accuracy: Relaxation, cell to cell variation, and aging

SOC Error of Voltage-based Gas Gauging





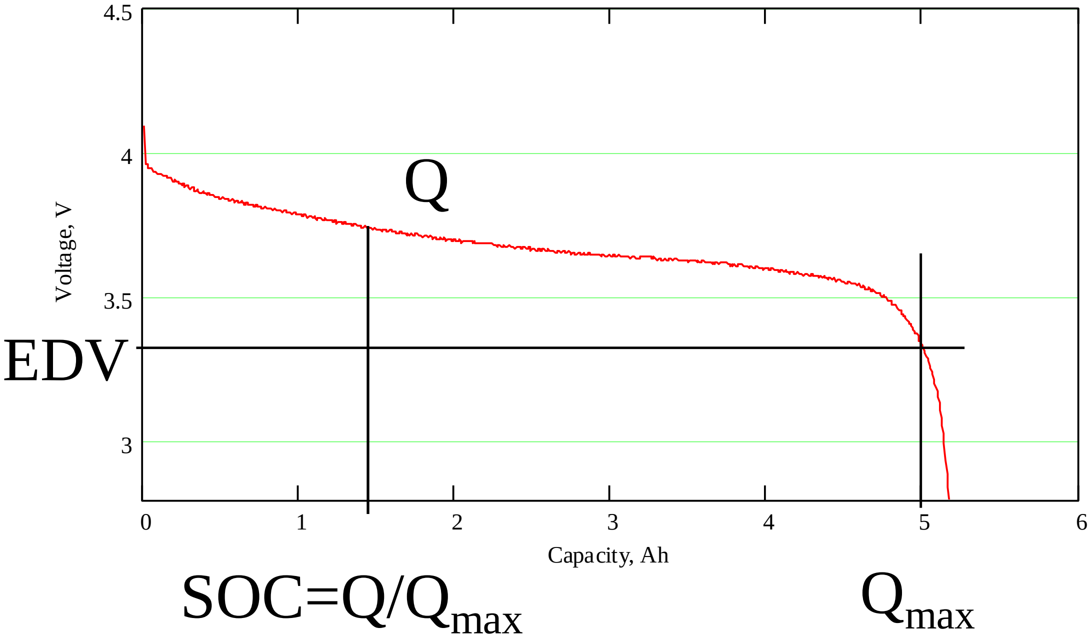
$$V = V_{OCV} - I \bullet \boxed{R_{BAT}\,?}$$

- 20mV voltage relaxation error
- ±15% cell to cell resistance variation
- Battery resistance doubles every 100 cycles

Challenges for system side gauging

Requirement	Voltage Correlation	Voltage + IR correction	Coulomb counting	Impedance Track
Series cells	No	No		
Interchangeable batteries	Yes	Yes		
Max. error: New	50%	15%		
300 cycles	100%	30%		
Battery health	No	No		
Processing needs	Low	High		
Battery expertise	High	High		
Multiple chemistries support	No	No		

Current integration based fuel-gauging



- Battery is fully charged
- During discharge capacity is integrated,

$Q = \int I(t)dt$

- State of charge (SOC) at each moment is Q/Q_{max}
- Q_{max} is updated every time full discharge occurs
- In case of battery insertion, voltage based initialization

Current Integration Capacity Learning

Remaining Capacity = Full Charge Capacity – Discharged Capacity.

- **synchronize near the top and bottom states of charge whenever possible**
- **Full Charge Capacity is determined by a coulomb measurement from the fully charged state (RSOC=100%) to a known near-empty condition**
- **Near the bottom, voltage is an excellent method of synchronization (EDV 2) since the discharge curve is sharp.**
  - **EDV2 = 7% (typical) This is configurable. Learning is based on this voltage threshold**
  - **EDV1 = 3.25%**
  - **EDV0 = 0%**
- **But, how do you reliably correlate remaining capacity with a measured voltage** under varying loads and temperatures?

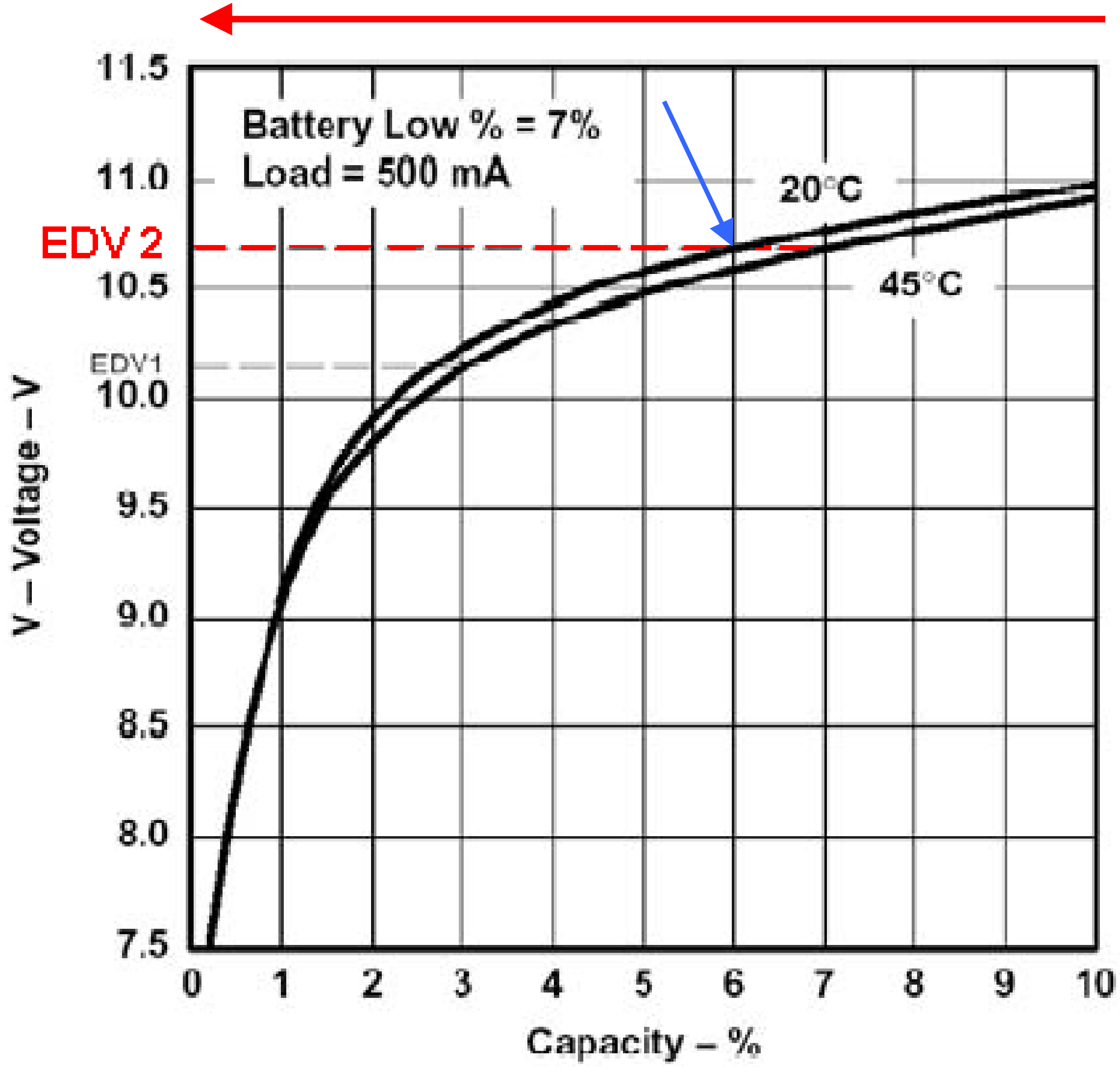
First problems with Fixed EDV

For example:

At 45 degrees, 7% SOC = 10.53 V

Now look at the 20 deg curve

We "End" at 6% SOC at cold temperature



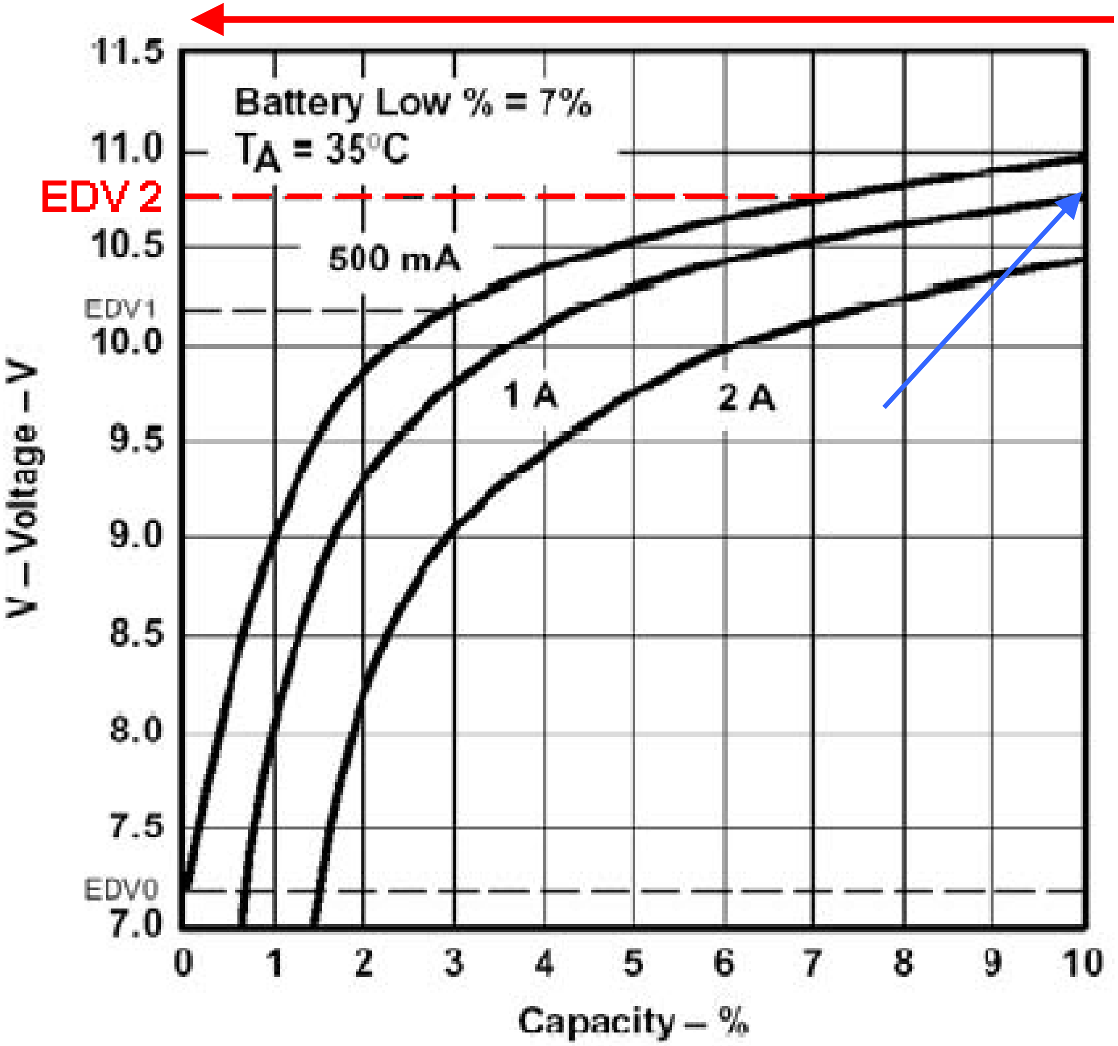
For accurate learning and capacity prediction - compensate for the battery's temperature

Second problem with Fixed EDV

7% SOC = 10.55V at 500 mA….

Now look at the 1A curve. We "end" at 10%

3% error !



For accurate learning and capacity prediction - compensate for the battery's impedance

Third problem with Fixed EDV

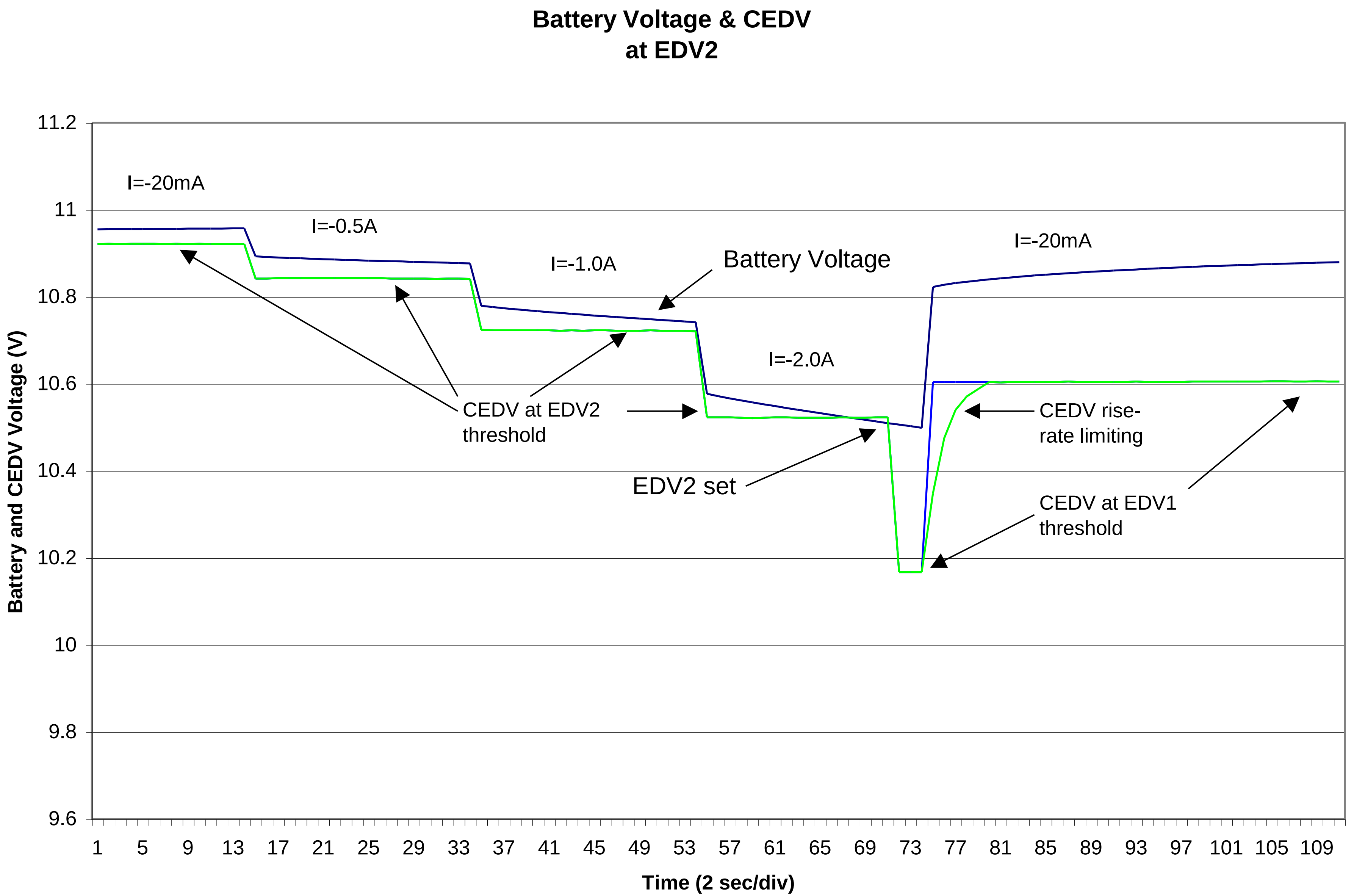
Surprise load increase near end of discharge could crash the system.

Therefore, EDV thresholds must be set higher than what is optimum for low current discharge

Benefits of CEDV

- "Compensated" end-of-discharge voltage (CEDV) is continuously re-calculated, during discharge, as a function of load current, temperature and remaining capacity.
- Remaining Capacity can be modified (downward only) when measured battery voltage falls below predicted voltage at three discrete levels.
- Uses battery chemistry model to predict the voltage that represents fixed levels of low capacity.

CEDV Real Time Performance



The CEDV Equation

$$\text{CEDV} = \text{CV} - I*[\text{EDVR0}/4096]*[1 + \text{EDVR1}*\text{Cact}/16384]*[1 - \text{EDVT0}*(10T - 10\text{Tadj})/(256*65536)]$$

Where.. (CV = Open Circuit Voltage based on temperature and state of charge)

CV = EMF*[1 – EDVC0*(10T)*log(Cact)/(256*65536)]

And…

Cact = 256/(2.56*RSOC + EDVC1) – 1 for (2.56*RSOC + EDVC1) > 0

Cact = 255 for (2.56*RSOC + EDVC1) = 0

EDVC1 = 2.56 * Residual Capacity (%) + “Curve Fit” factor

Tadj = EDVTC*(296-T) for T< 296^{o}K and Tadj < T

Tadj = 0 for T > 296 ^{o}K and Tadj max value = T

The CEDV Coefficients

Coefficient	Description	Typical Value
EMF	Battery voltage adjustment coefficient	4000mV/cell
EDVC0	No-load voltage vs RSOC curvature adjust	420
EDVC1	EDV0 residual capacity and curve flatness adjustment.	0
EDVT0	No-load voltage vs Temperature adjustment	3500
EDVTC	Cold temperature impedance adjustment below 296^{o}K	4
EDVR0	Battery impedance adjustment	4000
EDVR1	Battery impedance vs RSOC curvature	400

Challenges for system side gauging

Requirement	Voltage Correlation	Voltage + IR correction	Coulomb counting	Impedance Track
Series cells	No	No	Yes	
Interchangeable batteries	Yes	Yes	No	
Max. error: New	50%	15%	2%, full charge	
300 cycles	100%	30%	20%	
Battery health	No	No	No	
Processing needs	Low	High	Low	
Battery expertise	High	High	Low	
Multiple chemistries support	No	No	Yes	

Impedance Track™ Gas Gauge

- Voltage based gas gauge: Accurate gauging under no load

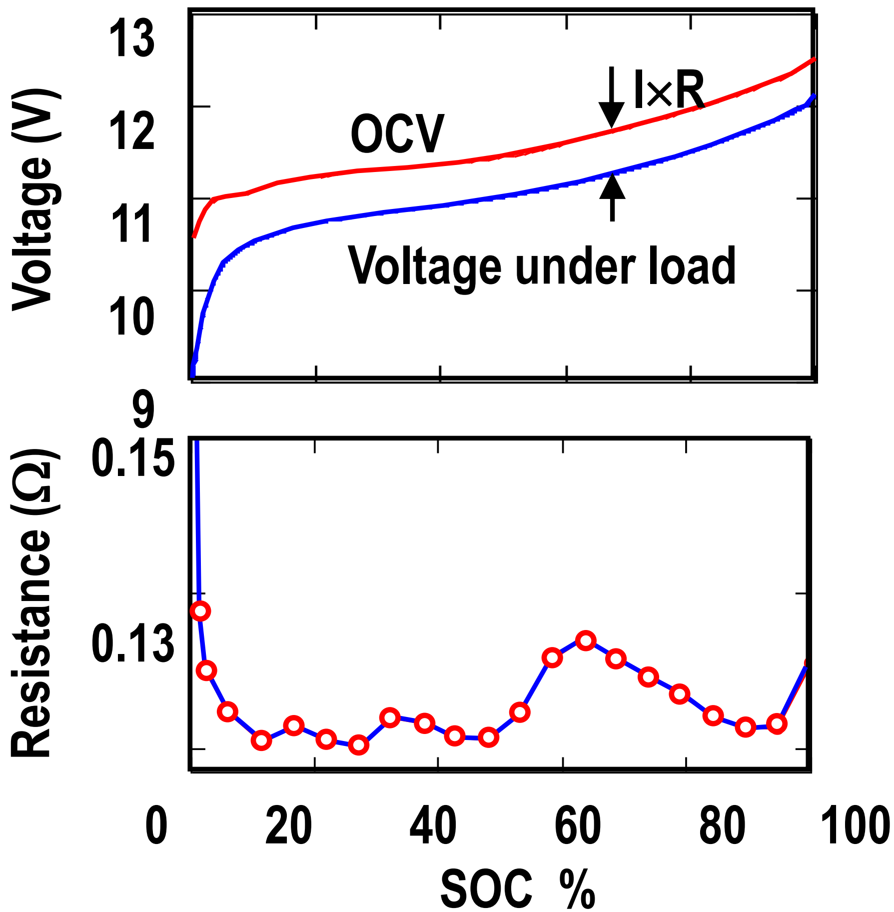
- Coulomb counting based gauging: Accurate gauging under load
- Combine advantages of voltage and current based methods

- Real time impedance update

- Remaining run-time calculation

$$V = OCV(T,SOC) - I*R(T,SOC)$$

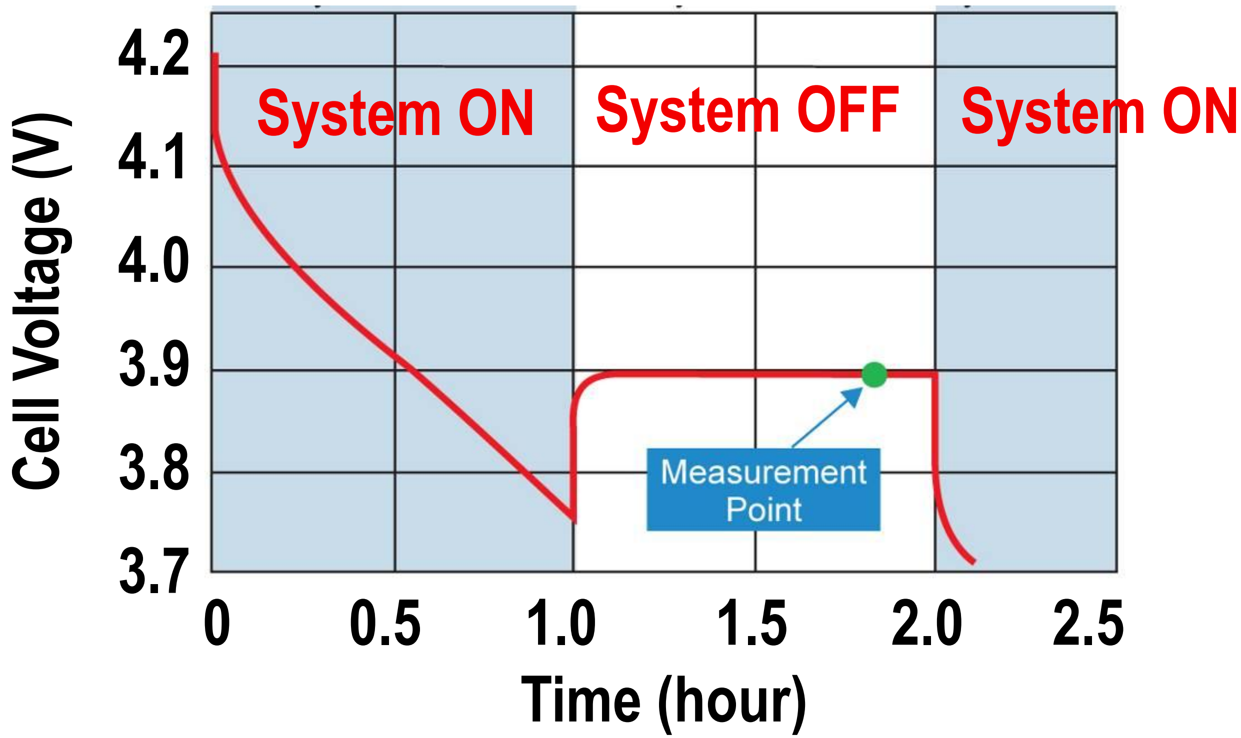
How To Measure the Impedance?



$$R_{BAT} = \frac{OCV - V_{BAT}}{I_{AVG}}$$

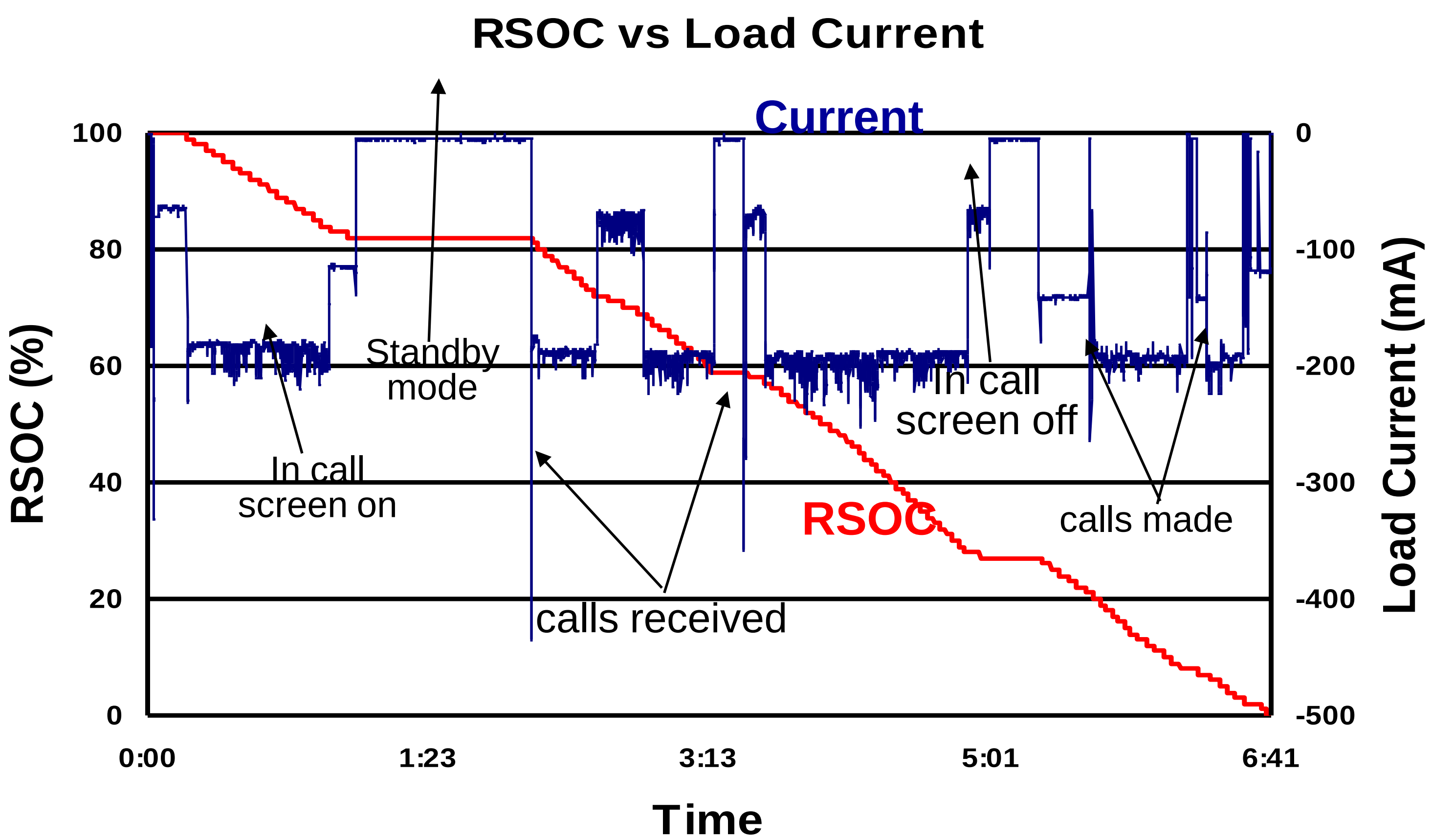
- Updates impedance at every cycle using voltage and current information
- Uses impedance, discharge rate and temperature information to calculate rate/temperature adjusted FCC.

How to Measure OCV ?



- OCV measurement allows SOC with 0.1% max error
- 1000 seconds is sufficient relaxation time for all tested batteries
- Self-discharge estimation is eliminated

GSM Phone test: RSOC vs Current



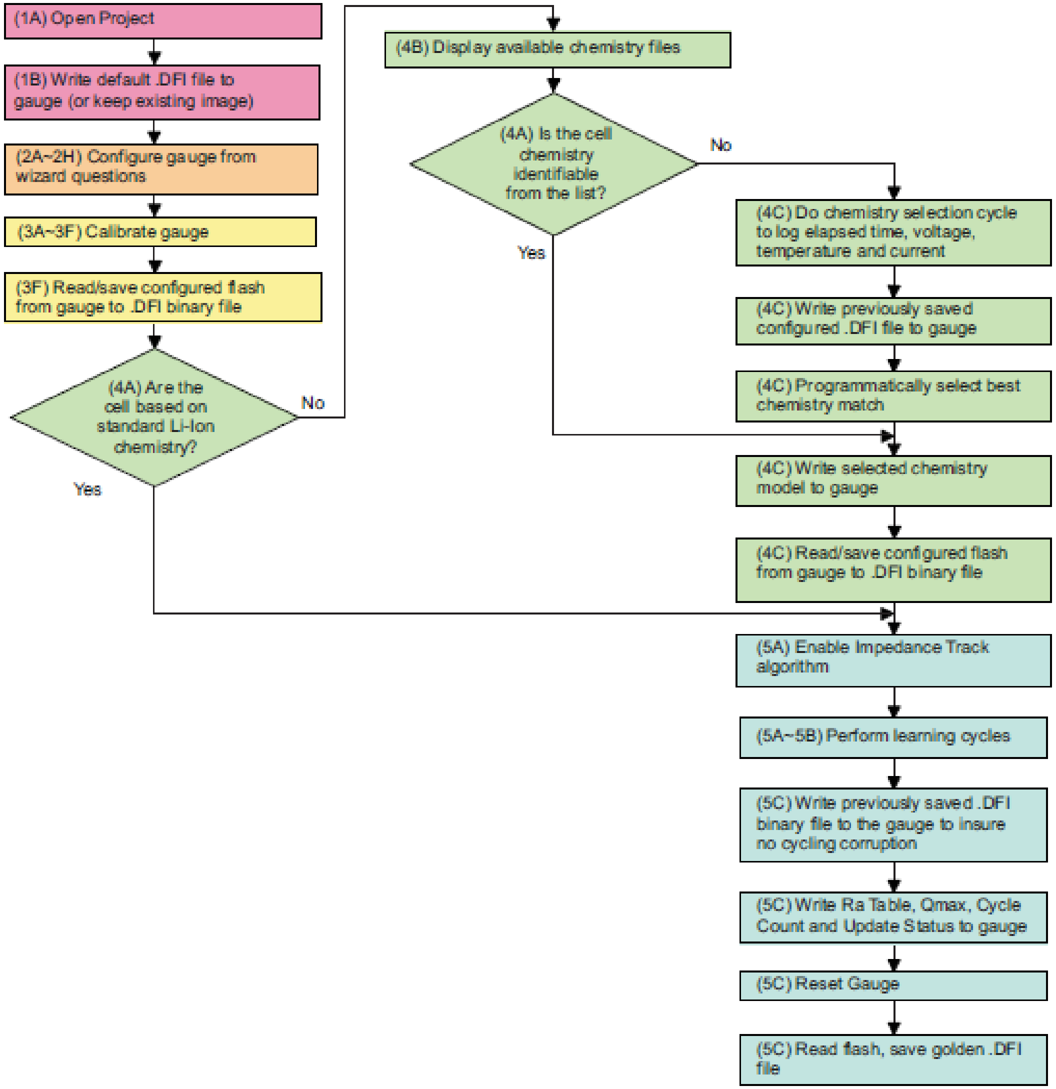
Challenges for system side gauging

Requirement	Voltage Correlation	Voltage + IR correction	Coulomb counting	Impedance Track
Series cells	No	No	Yes	No
Interchangeable batteries	Yes	Yes	No	Yes
Max. error: New	50%	15%	2%, full charge	1%
300 cycles	100%	30%	20%	3%
Battery health	No	No	No	Yes
Processing needs	Low	High	Low	High
Battery expertise	High	High	Low	High
Multiple chemistries support	No	No	Yes	Yes

System-side gauging on a dedicated IC

Requirement	Voltage Correlation	Voltage + IR correction	Coulomb counting	Impedance Track
Series cells	No	No	Yes	No
Interchangeable batteries	Yes	Yes	No	Yes
Max. error: New	50%	15%	2%, full charge	1%
300 cycles	100%	30%	20%	3%
Battery health	No	No	No	Yes
Processing needs	Low	Low	Low	Yes
Battery expertise	Low	Low	Low	Yes
Multiple chemistries support	Yes	Yes	Yes	Yes

BqEASY Software



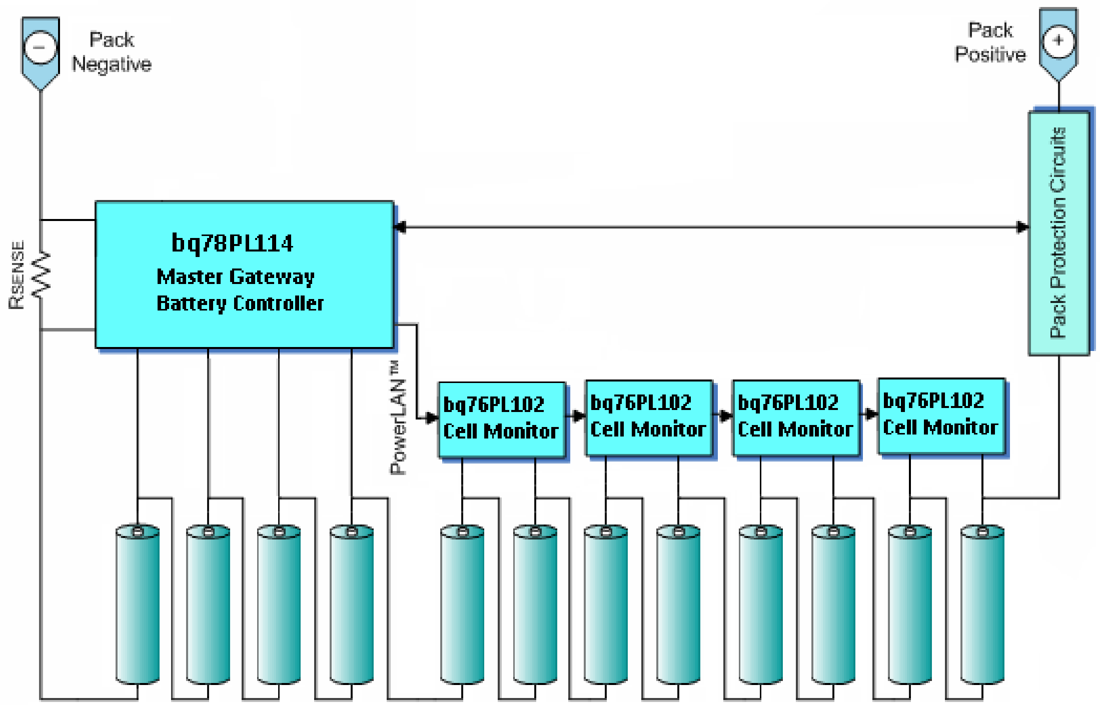
Summary

- Host side implementation offer cost saving and speeds up development
- Very inaccurate with most legacy methods except for very low rates of discharge
- Most of inaccuracy is inherent to the methods, not to measurement accuracy
- Impedance track eliminates most significant inherent errors due to IR, aging, relaxation and temperature.
- System maker battery expertise, computing power, accurate measurement requirements are eliminated if system-side gauge IC is used, such as bq2750x series
- Battery state of health indication is unique to Impedance Track gauging

bq78PL114 PowerLAN™ Master Battery Management Controller with PowerPump™ Cell Balancing Technology

Features

- Scaleable battery electronics design from 3 to 12 cell battery systems
- PowerPump™ cell balancing for longer run time and cell life
- High resolution 18-bit Integrating Delta-Sigma Coulomb Counter for precise charge-flow measurements and gas gauging
- Multiple independent Δ-Σ A/Ds: One-per-cell voltage, plus separate temperature, current & safety
- Fully programmable voltage, current, balance and temperature protection
- Remaining capacity indicators: LCD, LED, EPD
- Selectable sense resistor for appropriate discharge levels (10A, 35A, 100A)



Applications

- Electronic mobility devices (E-Bike)
- Portable medical instruments and test equipment
- Uninterruptible power supplies and hand-held tools

Multi-Cell Fuel Gauges

Protector
Fuel Gauge
Security

Product Key

released bq2060A
- Fixed EDV
- 28 pin SSOP
- 5 LEDs

released bq2083
- Compensated EDV
- 38 pin TSSOP
- 5 LEDs

released bq29311
- AFE for SAFETY
- Cell balancing
- 24 pin TSSOP

released bq20z80
- Impedance Track II
- 38 pin TSSOP
- 5 LEDs

released bq2084
- Compensated EDV
- 38 pin TSSOP
- 5 LEDs

released bq29312
- AFE for SAFETY
- Cell balancing
- 24 pin TSSOP

released bq20z90
- Impedance Track II
- 30 pin TSSOP
- 5 LEDs

released bq20z70
- Impedance Track II
- 20 pin TSSOP
- No LEDs

released bq29330
- AFE for SAFETY
- Call balancing
- 30 pin TSSOP

bq20z95
- Impedance Track II
- Single Chip Solution
- Integrated AFE protector

bq20z75
- Impedance Track II
- Single chip solution
- Integrated AFE protector

2H2006

Vielen Dank für Ihre Zeit!

Thomas Gulba

Field Application Engineer