

TI Battery Chargers

Key Products for Battery Chargers and Front-End Charging Protection

2011

Major TI Battery Chargers & Applications

Linear Single Cell Chargers

bq2404x/bq2409x

- 1A and lower charging current
- Lowest solution cost chargers
- USB Friendly Input
- bq2404x only 2x2mm QFN



bq2407xT

- Instantly power the system even with a depleted battery w/ Power Path
- Up to 1.5A charging current
- USB Friendly Input



Switch-mode Multi-Cell Chargers w/ Power Path

bq24133/bq24170

- Up to 4A charging current for 1 to 3 cells
- Optimized for size & efficiency w/ Integrated FETs & switch-mode operation



bq24610

- Up to 10A charging current for 1 to 6 cells
- Drives external Power MOSFETs for maximum flexibility



bq24040/50 – 800mA Linear Charger in 2x2 QFN with USB D+ D- Detection



Features

- 30V input rating with input OVP
- Input voltage dynamic power management
- Selectable 100mA or 500mA USB current limit
- Adjustable precharge and termination current
- TS pin to monitor pack temperature
- USB D+ D- Detection (bq2405x)

Benefits

- • Supports unregulated adapters
- • Protection against poor USB sources
- • USB compliance
- • Flexibility
- • Meets new safety standard
- • Fast charging from adapter before host takes any action

Applications

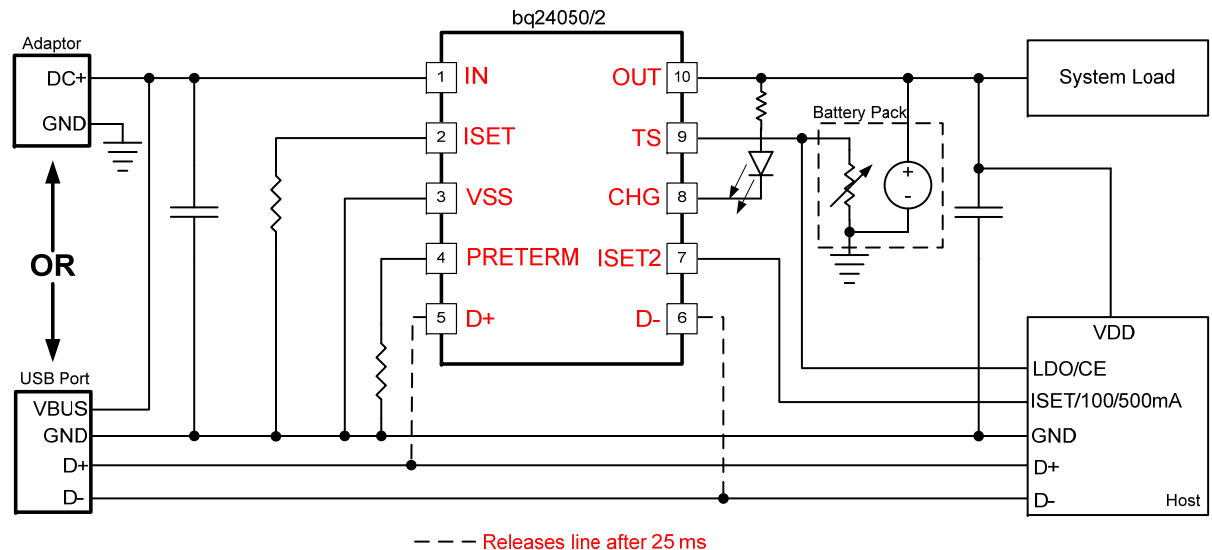
- Mobile Phones
- MP3 Players
- Low Power Handheld

bq24040: \$0.90

bq24050: \$0.99

**Also see
bq24090: \$0.70**

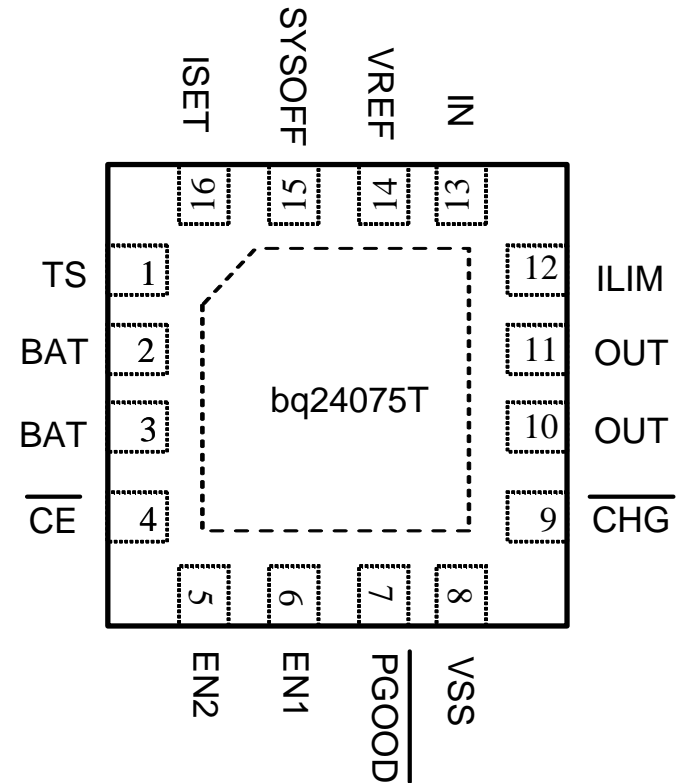
EVM



bq2407x/7xT – USB-Friendly Li-Ion Battery Charger with NTC Monitoring and Dynamic Power-Path Management

Features

- Fully Compliant USB Charger
 - Selectable 100-mA and 500-mA Maximum Input Current
 - 100-mA Maximum Current Limit Ensures Compliance to USB-IF Standard
 - Input-based Dynamic Power Management (V_{IN} -DPM) for Protection Against Poor USB Sources
- Input voltage ABS Max 28V, 3.5V - 10.5V operating range
- +/-1% Accurate Battery Charge Voltage
- Dynamic Power Path Management (DPPM)
 - Support System Load without Extending Charge Time
 - Accurate Termination
- Programmable Charge Current with Current Monitoring Output (ISET)
 - Input Current: 100mA, 500mA, and User Programmable
 - Charge Current from up to 1.5A
- Battery Disconnect Input (SYSOFF)
- Complete System Protection
 - Voltage: UVLO, OVP, Sleep Mode, Battery OVP, V_{IN} -DPM
 - Current Limit: Input Source and Charge Current Limit
 - Thermal: Regulation 125°C, Shutdown 155°C
 - Battery Pack NTC Monitoring
 - Simple current-based (bq2407x)
 - Flexible voltage-based (bq2407xT)
 - Dynamic Safety Timers: Programmable Pre-charge and Fast-charge Timer



bq24153A / 56A

3MHz switch-mode charger w/ Integrated FETs & Host I2C Control

Features

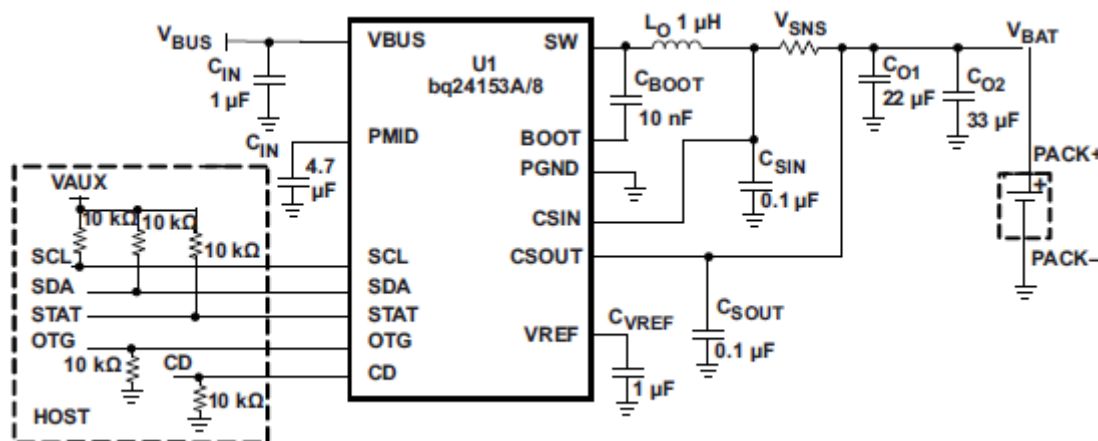
- Built-in input current sensing and limiting
- Synchronous 3MHz PWM controller
- Integrated FETs for up to 1.25A or 1.5A charge rate
- 20V max input voltage with 6V or 9V OVP
- 0.8A max charge current from USB
- High-Speed (3.4MHz) I2C interface
- 3.5 mm x 3.5 mm 14-Pin QFN Package

Benefits

- USB compliance, can use cheaper adapter
- High efficiency, small inductor (1uH)
- Small solution size
- Protects against transient and faulty inputs
- Faster charging from USB
- High level of programmability
- Small solution size

Applications

- Mobile Phones
- Portable Media Players
- Portable Navigation Devices
- Handheld Devices



bq24153A/56A Portfolio Position

Part Number	bq24150A/51A/52/53A/56A	bq24180	bq24185
V_{OVP} (V)	6.5V 9.8V ('156A)	16.5V with linear charge above 9.8V	
Maximum Charge Current (A)	1.25A 1.55A ('156A)	1.55A	
Input Current Limit with no Host Control	100mA (OTG=LOW); 500mA (OTG=High)	100mA (PSEL=LOW); None (PSEL=High)	
Auto-Start Charging with no Host Control	Yes No ('151A)	Yes	
Boost Function (USB OTG Support)	Yes No ('156A)	No	Yes
Current Limited Switch for Powering External Accessories from Battery	No	Yes	
Input Voltage Based DPM	Yes No ('150A, '151A, '152)	Yes	
Safety Limit Register	Yes No ('150A, '151A, '152)		
Hardware Disable Function (CD)	Yes No ('150A, '151A, '152)		
TS Pin	No		
Package	20-Pin WCSP	25-Pin WCSP	

Multi-Cell Charger Roadmap

 Production

↑ Integrated MOSFETs

bqSWITCHER I [1-, 2- or 3-Cell]
(3.5x4.5 QFN-20)

bq2410x/1x/2x

- 1.1MHz sync charger
- 0.8A-2A
- Standalone(0x/2x)/Host (1x)
- Lower EMI
- 80-90% Efficiency
- No Selector or DPM

bqSWITCHER II [1-3 Cell]
(3.5x5.5 QFN-24)

bq2417x/3x

- 1.6 MHz
- 4A
- Improved efficiency
- Thermal regulation loop
- 90-95% Efficiency
- Standalone
- Selector, DPM

SMBus
(3.5x7 QFN-34)

bq24765

- 700kHz
- 6A
- Thermal Regulation Loop
- No system power selector

↑ Controller w/
External MOSFETs

↑ Higher Integration

bqStroller [1-6 (7) Cell]
(3.5x3.5 QFN-16 & 4x4 QFN-24)

bq24600/1x/20/30

- 300k-1.2MHz
- 5-28V input; 1-10A
- Safety timer; Temp monitor

- Li-Ion
bq24600: No DPM
bq24610: DPM, Selector
bq24616: JEITA, DPM, Selector
bq24617: '610 w/ 5-24V input
bq24618: '610 w/ 4.7-28V input

- LiFePO4
bq24620: No DPM
bq24630: DPM, Selector

bqSuperCap
(3.5x3.5 QFN-16)

bq24640

- 600kHz
- 5-28V input
- Up to 26V output

bqSolar [1-6 (7) Cell]
(3.5x3.5 QFN-16)

bq24650

- 600kHz
- MPPT for Solar Panel Input
- Li-Ion, Lead-Acid, LiFePO4

bqHighVoltage
[> 7 Cells]

**bq24610EVM
-HV**

- High Voltage EVM/Reference Design
- Allows 7+ Cell Charging

SMBus [1-4 Cells]
(3.5x3.5 QFN-20)

bq24725/707

- 750kHz
- SMBus
- Li-Ion and others

Stand-Alone

Host Controlled

bq24170/171/172

Synchronous Switch-Mode Li-Ion/Li-Polymer Stand-Alone Battery Charger with Integrated MOSFETs and Power Path Selector

Features

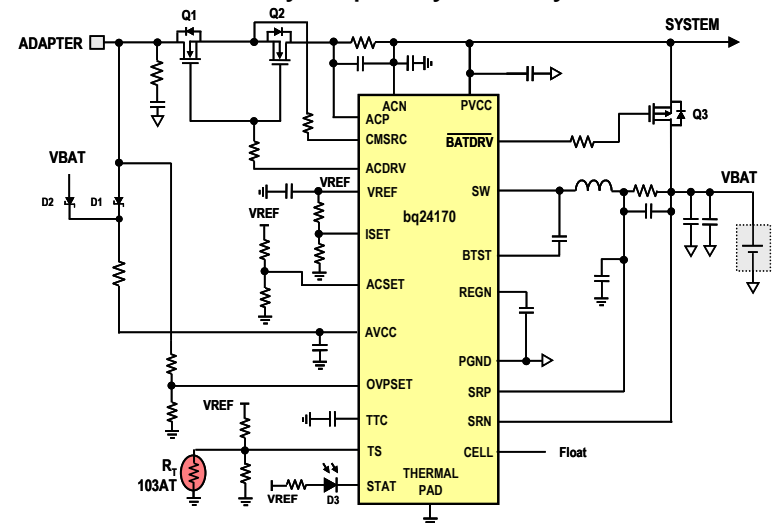
- 1.6MHz Synchronous Switch-Mode Charger with 4A Integrated N-MOSFETs
- 1 to 3 Li-Ion Cells in Series
- Up to 94% Efficiency
- Dynamic Power Management with Integrated Power Path Selector
- 4.5V-17V Input Operating Range with Prog. OVP
- $\pm 0.5\%$ voltage regulation and $\pm 4\%$ input & charge current regulation
- 3.5 x 5.5 mm QFN-24 Package

Applications

- Tablet PC
- Netbook and Ultra-Mobile Computers
- Portable Data Capture Terminals
- Portable Printers
- Medical Diagnostics Equipment
- Battery Bay Chargers
- Battery Back-Up Systems

Benefits

- Double the charge current capability vs. previous generation plus save over 25% area with integrated FETs and small inductor
- Easily set at 4.2V increments ('170) or set your own charge voltage ('172 or '171 (JEITA))
- Enjoy a lower thermal impact to your system
- Maximize adapter current capability
- Supports 5V, 9V, 12V and 15V adapters
- Maximize battery capacity and cycle life



bq2417x Product Positioning

Device	Battery Chemistry	Input Voltage	Fast Charge Current	Charge Voltage	Power Path (DPM)	Switching MOSFET	Temperature Qualification Profile	Package
bq24170	Li-Ion or Li-Polymer	4.5-17V	Max 4A	1-3 cell 4.2V/cell	ACFET NMOS BATFET PMOS	Internal	5-40C or Wider	3.5x5.5 QFN-24
bq24171	Li-Ion or Li-Polymer	4.5-17V	Max 4A	1-3 cell Adjustable	ACFET NMOS BATFET PMOS	Internal	JEITA	3.5x5.5 QFN-24
bq24172	Li-Ion or Li-Polymer	4.5-17V	Max 4A	1-3 cell Adjustable	ACFET NMOS BATFET PMOS	Internal	5-40C or Wider	3.5x5.5 QFN-24
bq24133	Li-Ion or Li-Polymer	4.5-17V	Max 2.5A	1-3 cell 4.2V/cell	ACFET NMOS BATFET PMOS	Internal	5-40C or Wider	3.5x5.5 QFN-24
bq24616	Li-Ion or Li-Polymer	5-28V	Max 10A	1-6 cell Adjustable	ACFET PMOS BATFET PMOS	External	JEITA	4x4 QFN-24
bq24618	Li-Ion or Li-Polymer	4.7-28V	Max 10A	1-6 cell Adjustable	ACFET PMOS BATFET PMOS	External	5-40C or Wider	4x4 QFN-24

bq2461x/3x: 28-Vin Charge Controller With Integrated Power Path Selector

Features

- High voltage, high frequency, high integration
 - 32V absolute maximum rating
 - 5-28V input operating range
 - internal loop compensation
 - 300kHz to 1.2MHz frequency
 - Multi-level safety protection, thermal shutdown
 - Integrated power path selector
 - DPM regulation loop
- Charge Management
 - 1 to 6 Li-Ion or 1 to 7 LiFePO4 cells in series
 - ± 0.5% voltage regulation, charge conditioning, charge status, charge termination, safety timer, battery detection, battery temperature monitoring

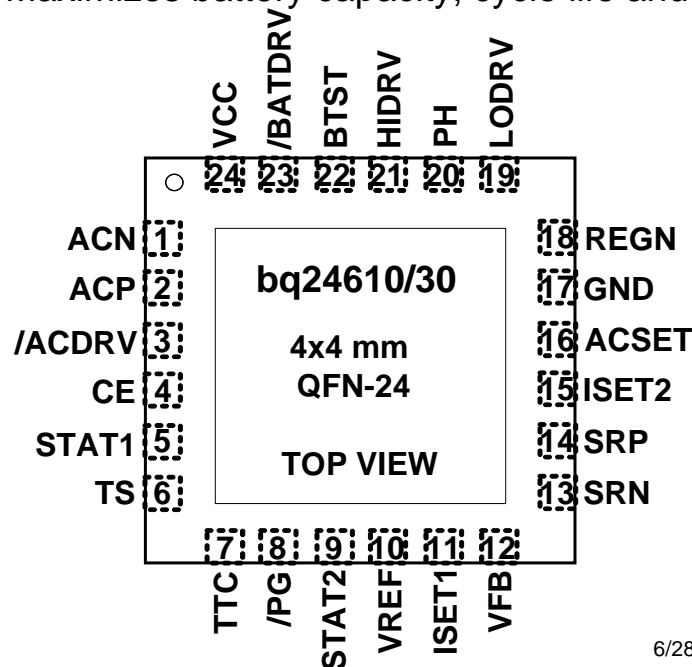
Benefits

- Improved Safety
- Wide adapter input voltage range
- Minimize external component number
- Small size inductor
- Reliable operation
- Save board space and cost
- Maximize adapter current capability
- Suitable for a wide range of applications
- Maximizes battery capacity, cycle life and safety

Applications

- Portable Notebook, Netbook, UMPC or MID
- Personal Digital Assistants, Handheld Terminals
- Industrial and Medical Equipments
- Portable Equipments with up to 6 cell Li-Ion Batteries or 7 cell LiFePO4 Batteries

Options	Chemistry	Frequency	VFB
bq24610	Li-Ion	600kHz	2.1V (4.2V/cell)
bq24617	Li-Ion	600kHz	2.1V (4.2V/cell)
bq24630	LiFePO4	300kHz	1.8V (3.6V/cell)

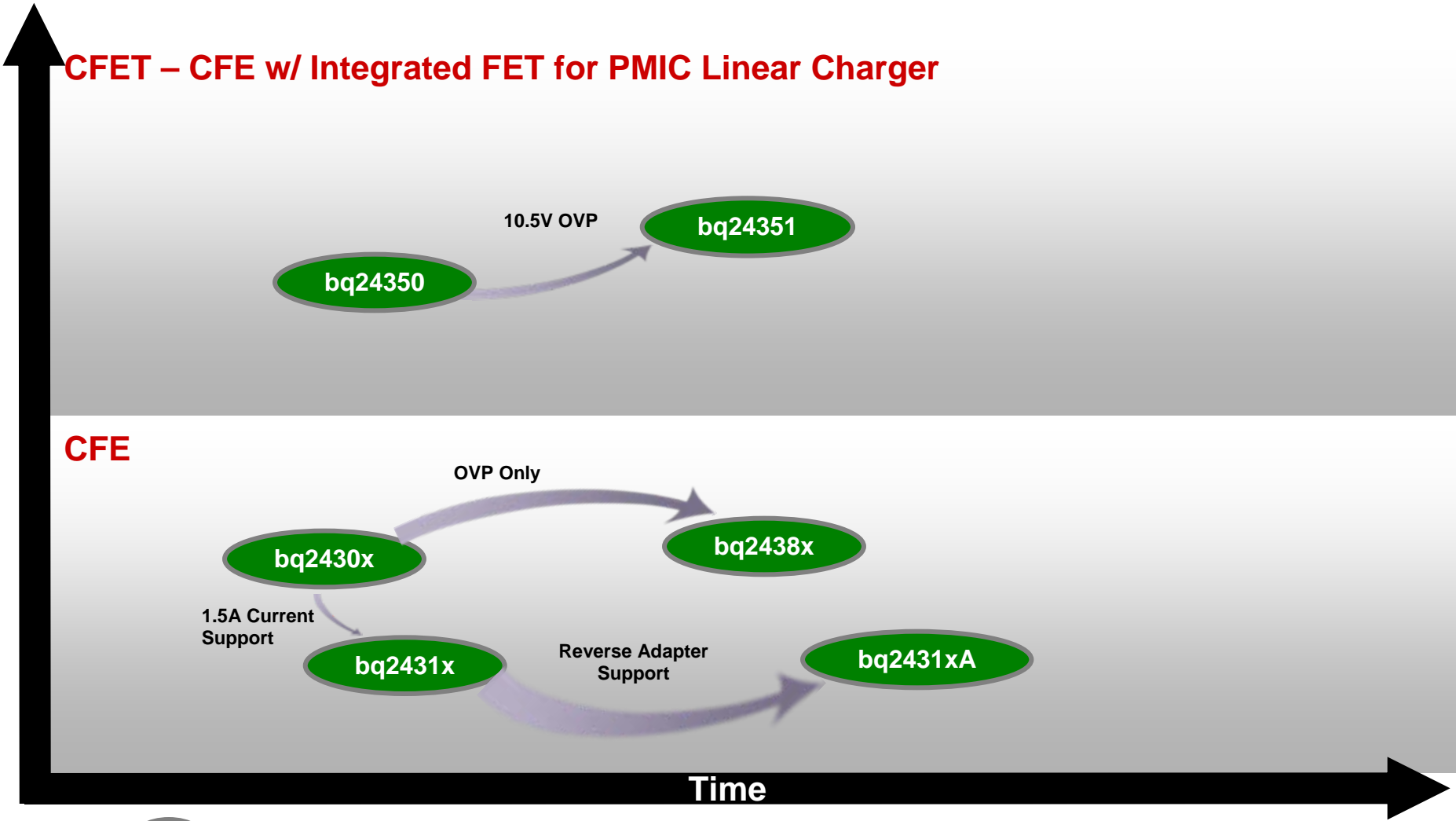


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bq246xx Product Family

Device	Battery Chemistry	Switching Frequency	Input Voltage (ACOV)	Precharge Current	Precharge Threshold	Charge Voltage	Recharge Threshold	Power Path (DPM)	Temperature Qualification Profile	Package
bq24600	Li-Ion or Li-Pol	1200kHz	5V-28V (32V)	C/10	VFB=1.55V	2.1-26V	VFB-50mV	No	Li-Ion 0-45C	3.5x3.5 QFN-16
bq24610	Li-Ion or Li-Pol	600kHz	5V-28V (32V)	R PROG (125mA min)	VFB=1.55V	2.1-26V	VFB-50mV	Input Current Regulation	Li-Ion 0-45C	4x4 QFN-24
bq24616	Li-Ion or Li-Pol	600kHz	5V-28V (32V)	R PROG (125mA min)	VFB=1.55V	2.1-26V	VFB-50mV	Input Current Regulation	Li-Ion JEITA	4x4 QFN-24
bq24617	Li-Ion or Li-Pol	600kHz	5V-24V (26V)	R PROG (125mA min)	VFB=1.55V	2.1-22V	VFB-50mV	Input Current Regulation	Li-Ion 0-45C	4x4 QFN-24
bq24618	Li-Ion or Li-Pol	600kHz	4.7V-28V (32V)	R PROG (125mA min)	VFB=1.55V	2.1-26V	VFB-50mV	Yes	Li-Ion 0-45C	4x4 QFN-24
bq24620	LiFePO4	300KHz	5V-28V (32V)	125mA	VFB=0.35V	1.8V-26V	VFB-125mV	No	LiFePO4	3.5x3.5 QFN-16
bq24630	LiFePO4	300KHz	5V-28V (32V)	125mA	VFB=0.35V	1.8V-26V	VFB-125mV	Input Current Regulation	LiFePO4	4x4 QFN-24
bq24640	Super Capacitor	600kHz	5V-28V (32V)	Same as Fast Charge Current	VFB=1.55V	2.1V-26V	VFB-50mV	No	0-45C	3.5x3.5 QFN-16
bq24650	Li-Ion or Li-Pol Lead Acid LiFePO4	600kHz	5V-28V (32V)	R PROG (125mA min)	VFB=1.55V	2.1V-26V	VFB-50mV	Input Voltage Regulation	5-40C	3.5x3.5 QFN-16

Charger Front End Protection Roadmap



 Production

Charger Front End Protection IC Portfolio

Device	Vin Max (V)	OVP (V)	OCP	Batt OVP (V)	LDO Out (V)	Max Operating Current	Operating Temp. Range (°C)	Package	Features
bq24300	30	10.5	Fixed 300mA	4.35	5.5	500 uA	0 to 125	8-QFN	Reverse polarity protection
bq24304	30	10.5	Fixed 300mA	4.35	4.5	500 uA	0 to 125	8-QFN	
bq24305	30	10.5	Fixed 300mA	4.35	5	500 uA	0 to 125	8-QFN	
bq24308	30	6.3	Prog. <1.5A	4.35	5	500uA	-40 to 125	8-QFN	
bq24312	30	5.85	Prog. <1.5A	4.35	-	600 uA	-40 to 125	8-QFN	Fault indication
bq24313	30	10.5	Prog. <1.5A	4.35	5.85	600 uA	-40 to 125	8-QFN	
bq24314	30	5.85	Prog. <1.5A	4.35	-	600 uA	0 to 125	8/12-QFN	
bq24314A	30	5.85	Prog. <1.5A	4.35	-	600 uA	-40 to 125	8-QFN	
bq24315	30	5.85	Prog. <1.5A	4.35	5.5	600 uA	-40 to 125	8-QFN	
bq24316	30	6.5	Prog. <1.5A	4.35	-	600 uA	0 to 125	8/12-QFN	
bq24380	30	6.3	No OCP	4.35	5.5	250 uA	-40 to 125	8-QFN	
bq24381	30	7.1	No OCP	4.35	5	250 uA	-40 to 125	8-QFN	
bq24382	30	10.5	No OCP	4.35	5	250 uA	-40 to 125	8-QFN	