BQ24133, BQ24170, BQ24172, BQ24172 Schematic Review

Typical applications: Charger for 2S+ LiIon batteries in tablet PCs, Mobile Computers, Portable Printers, Portable Data Terminals, Battery Backup Systems

DESIGN CHECKLIST									
PIN NAME		REQUIREMENT	COMPONENT	MIN	TYP	MAX	DESCRIPTION	COMMENTS AND RELEVANT EQUATIONS	PCB Placement
na	na	Recommended	RIN		2 Ω		Input hot plug filter		
na	na	Recommended	CIN		2.2 uF				Place close to input adapter port
na	na	Recommended	Q1		*		Soft start FET		
na	na	Recommended	Q2		*		Reverse blocking FET	If not used, a reverse blocking diode is recommended	
na	na	Optional	CGS		* uF		Soft start capacitor	To limit input surge current, external CGS at least 10 X FETs combined CGS can be added.	
na	na	Optional	RGS		499 kΩ		Pull down resistor	Required for 1S LiIon applications; recommended for all applications	
CMSRC	7	Required	R12		4.02 kΩ		Common source connection for input NFETs		
ACDRV	8	Required	R11		4.02 kΩ		Charge pump output for turning on input NETs		
AVCC	4	Required	C1		1 uF		IC input supply	C1 minimum voltage rating of 1.5 x maximum DC input voltage. R10 is 10 Ω unless input power is 5-V then reduce to 5 Ω.	Place capacitor close to IC pin and PGND, priority 1
			R1		10 Ω				
			D1 & D2		0.1 A		Schottky diode OR	Low current diode (BAT54) to allow charger to be powered from battery when no input power applied	
VREF	12	Required	C2		1 uF		3.3V reference voltage output for resistor bias		Place near to IC pin and AGND, priority 3
TTC	11	Required	C3		0.1 uF		Safety timer and termination control	Sets the fast charge safety timer (5.6 min/nF). Pull the TTC to LOW to disable the charge termination and safety timer. Pull the TTC to HIGH to disable the safety timer but allow the charge termination.	Place near to IC pin and AGND, priority 3
ACP	6	Optional	not shown		0.1 uF		Input current limit common mode filter capactior	If input current limit not used, do not install and short ACP=ACN.	Place from ACP pin to AGND. Kelvin connect to ACP pin.
ACN	5	Required	C12		0.1 uF		Input current limit common mode filter capactior	If input current limit not used, do not install and short ACP=ACN.	Place from ACN pin to AGND. Kelvin connect to ACN pin.
ACPtoACN	5 to 6	Required	RAC		*Ω		Input current sense resistor	IDPM = VACSET/(20xRAC) If input current limit not used, do not install and short ACP=ACN. Use current sense, low inductance resistor with appropriate current rating.	
		Required	C11		0.1 uF		Input current limit differential filter capacitor	If input current limit not used, do not install and short ACP=CAN. An optional 0.1 uF capacitor from ACN to AGND can be used for improved common mode filtering.	Place across RAC input current limit resistor. Kelvin connect to ACP pin.
TS	10	Required	R8 (RT1)		*Ω		Resistor divider to set window for thermistor temperature-based battery charging profile	$$RT1 = \frac{\left(\frac{1}{V_{T1}} - 1\right)}{\left(\frac{1}{RT2} + \frac{1}{R_{NTC,T1}}\right)}$$ If TS feature not used, use equations to set V(TS) to ~60% of VREF. $$RT2 = \frac{R_{NTC,T1} \times R_{NTC,T5} \times \left(\frac{1}{V_{T5}} - \frac{1}{V_{T1}}\right)}{R_{NTC,T1} \times \left(\frac{1}{V_{T1}} - 1\right) - R_{NTC,T5} \times \left(\frac{1}{V_{T5}} - 1\right)}$$ See design xls at http://www.ti.com/lit/zip/sluc244	Connect RT2 to AGND. Kelvin connect resistor divider midpoint to pin routed away from traces/pours/planes with switching noise.
		Required	R9 (RT2)		*Ω				
OVPSET	18	Required	R6		*Ω		Resistor divider to set input over voltage and under voltage thresholds	V_{ACOV} = 1.6V (R6/R7+1) V_{ACUV} = 0.5V (R6/R7+1) Recommended to set R7 = 402kΩ and solve for R6 See design xls at http://www.ti.com/lit/zip/sluc244	Connect R7 to AGND. Kelvin connect resistor midpoint pin routed away from traces/pours/planes with switching noise. Add an optional 330pF capacitor from OVPSET to ground if noisy supply or fast transients.
		Required	R7		*Ω				
ISET	13	Required	R2		*Ω		Resistor divider to set maximum charge current	V_{ISET} = VREF * R3/(R2+R3) I_{CHARGE} = V_{ISET}/(20xRSR) Recommended to set R2 = 100kΩ and solve for R3 See design xls at http://www.ti.com/lit/zip/sluc244	Connect R3 to AGND. Kelvin connect resistor divider midpoint to pin routed away from traces/pours/planes with switching noise.
		Required	R3		*Ω				

Pin	Pin #	Status	Designator				Description	Calculation / Notes	Placement
ACSET	17	Required	R4		*Ω		Resistor divider set maximum input (adapater) current	V_{ACSET} = VREF * R5/(R4+R5) I_{DPM} = V_{ACSET}/(20xRAC) Recommended to set R4 = 100kΩ and solve for R5 See design xls at http://www.ti.com/lit/zip/sluc244	Connect R5 to AGND. Kelvin connect resistor divider midpoint to pin routed away from traces/pours/planes with switching noise.
		Required	R5		*Ω				
STAT	10	Recommended	R10		*kΩ		LED pull up resistor		
		Optional	D3				Charging status indicating LED		
SW	1, 24	Required	L		3.3		Inductor connection	For BQ24133, refer to datasheet table 5 For BQ2417x, refer to datasheet table 3	
		Optional	D4				Low side Schottky diode	Increases efficiency by reducing the drop across the low side FET body diode. Sized for conduction only for duty < 10% * (1-D)	Place close to IC pin and PGND, priority 1. If placed on bottom layer, use multiple vias back to top.
		Optional	RSNUB, CSNUB				RC snubber to reduce EMI	603 footprint components, sized on working PCB using empirical measurements. Decreases efficiency by ~0.5% when properly sized	Place close to IC pin and PGND, priority 1. If placed on bottom layer, use multiple vias back to top.
BTST to SW	21 to 1,24	Required	C5		0.047 uF				Place close to IC pin and PGND, priority 2.
		Optional	RBTST	1 Ω		10 Ω		Slows down the FET turn on time which can reduce EMI. Sized empirical. Will reduce efficiency by up to 1%.	
SRP	16	Required	C7		0.1 uF		Input current limit common mode filter capacitor	If input current limit not used, do not install and short ACP=ACN.	Place capacitor from IC pin to AGND. Kelvin connect to IC pin and avoid traces/pours/planes with switching noise.
SRPtoSRN	15 to 16	Required	RSR		*Ω		Input current sense resistor	V_{ISET} = VREF * R3/(R2+R3) I_{CHARGE} = V_{ISET}/(20xRSR) Recommended to set R2 = 100kΩ and solve for R3 See design xls at http://www.ti.com/lit/zip/sluc244	
		Required	C8		0.1 uF		Input current limit differential filter capacitor	If input current limit not used, do not install and short ACP=CAN. An optional 0.1 uF capacitor from ACN to AGND can be used for improved common mode filtering.	Place across RAC input current limit resistor. Kelvin connect to ACP pin.
SRN	15	Optional	C_{DCP_BAT}	0.01 uF		0.1uF	Buck output decoupling capcaitor	Helpful in reducing output ripple and EMI	Place close to IC pin and PGND, priority 2.
		Required	C9 & C10	10 uF	20 uF		Buck output bulk capacitance near charger IC	Minimum recommended is 10 uF; typical is 20 uF For BQ24133, refer to datasheet table 5 For BQ2417x, refer to datasheet table 3	Place close to IC pin and PGND, priority 3. Kelvin connect to IC pin and avoid traces/pours/planes with switching noise.
PVCC	2, 3	Optional	C_{DCP_VCC}	0.01 uF		0.1uF	Buck input decoupling capacitance	Most important capacitor for minimizing EMI	Place close to IC pin and PGND, priority 1.
		Required	C4	10 uF			Buck input bulk capacitance		Place close to IC pin and PGND, priority 1.
REGN	20	Required	C6	1 uF			REGN linear regulation output capacitor		Place close to IC pin and PGND, priority 1.
CELL	14	Required	na		na		Sets CV regulation point for 133/170	Set CELL pin LOW for 1-cell, Float for 2-cell (0.8 V - 1.8 V), and HIGH for 3- cell with a fixed 4.2 V per cell.	
FB	14	Required	RTOP, RBOT		*		Sets CV regulation point for 171/172	VBATREG = 2.1 V * (1 + RTOP/RBOT) Recommended to set RBOT = 100kΩ and solve for RTOP See design xls at http://www.ti.com/lit/zip/sluc244	Place resistors close to IC pin and AGND.