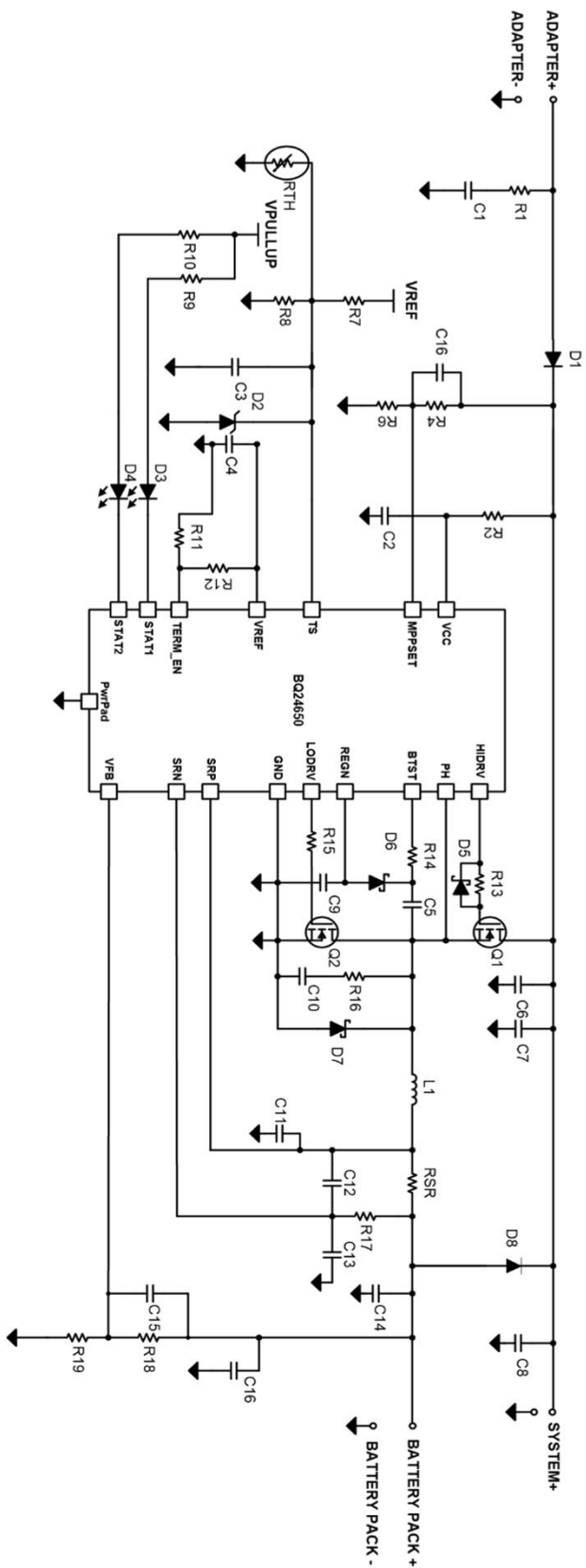
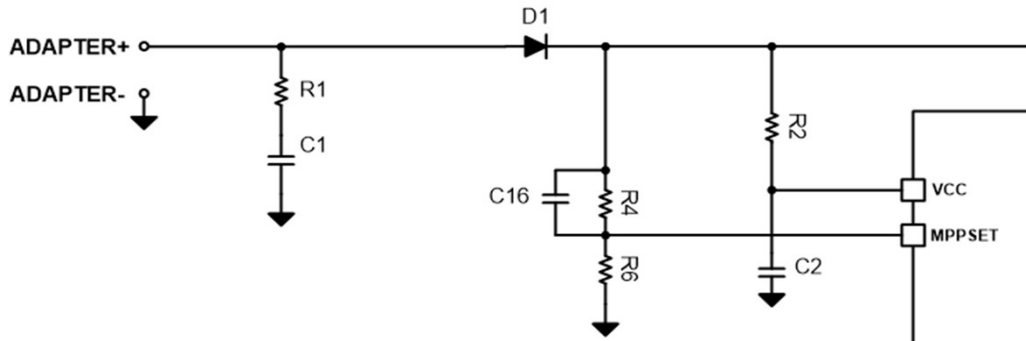


# BQ24650 Schematic

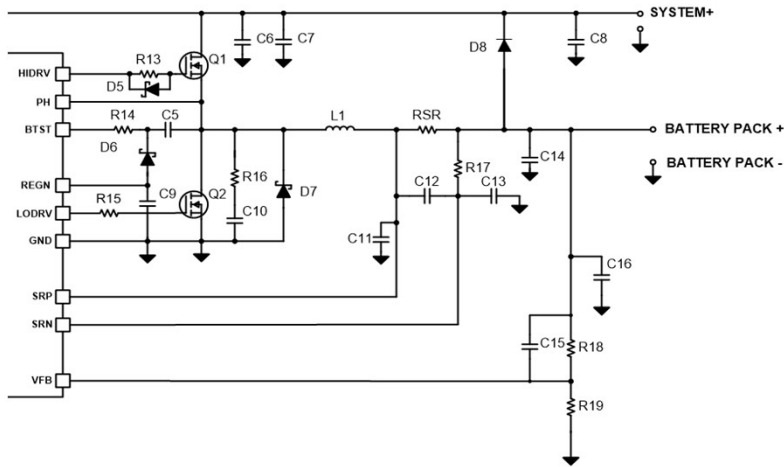


BQ24650 - Input Power Design



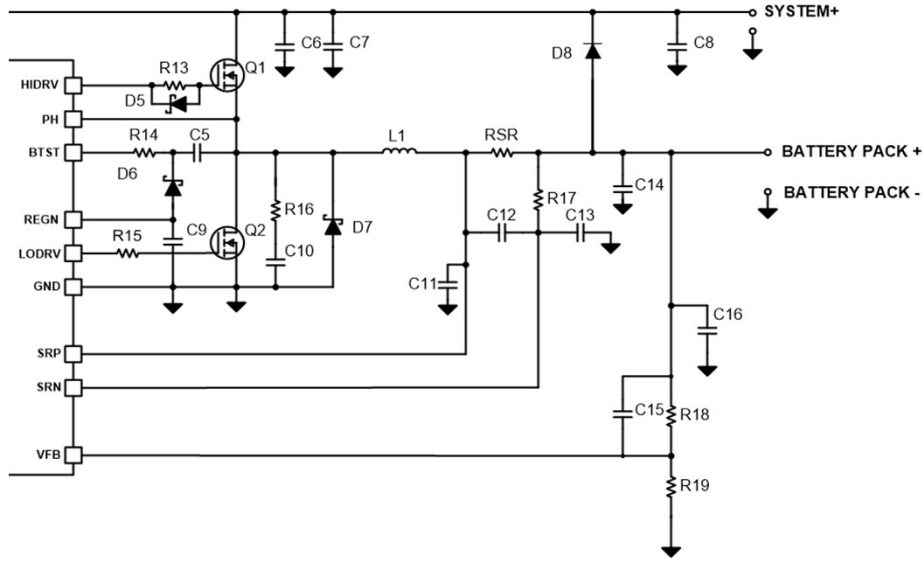
INPUT POWER - DESIGN CHECKLIST							
PIN NAME	REQUIREMENT	COMPONENT	MIN	TYP	MAX	DESCRIPTION	COMMENTS AND RELEVANT EQUATIONS
ADAPTER+ / ADAPTER-						<b>Input source to the charger</b>	
	Required	D1		-		Reverse-blocking diode	Blocks reverse current from the battery back to the input, and provides reverse voltage protection for the VCC pin
	Recommended	R1 C1		2 Ω 2.2 uF		Input hot-plug snubber circuit	Used to dampen ringing due to input inrush current
VCC						<b>IC power positive supply</b>	
	Required	R2		10 Ω		VCC inrush current limiting	
	Required	C2		1.0 uF		VCC decoupling capacitor	
MPPSET						<b>Input Regulation (DPM)</b>	
	Required	R4		* Ω		Input Voltage Regulation setpoint	$V_{mpp} = \left(1 + \frac{R4}{R6}\right) \times 1.2$
	Required	R6		* Ω			
	Optional	C2		22 pF			

BQ24650 - Output Power Design



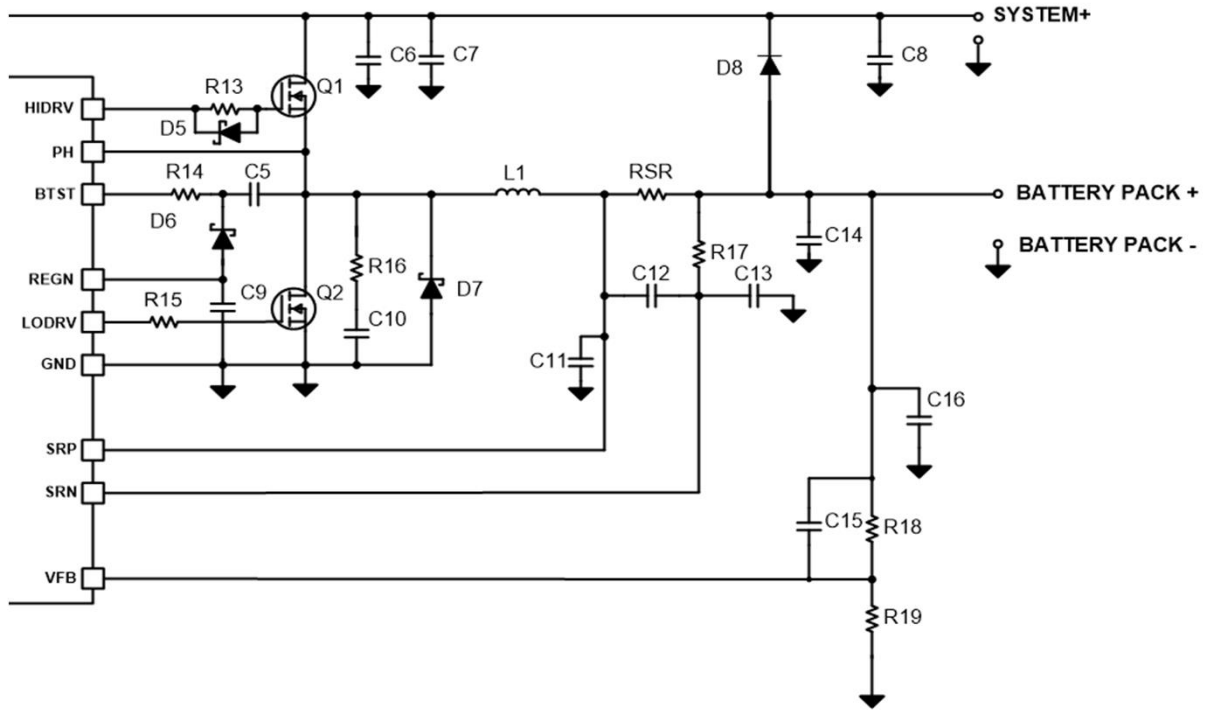
OUTPUT POWER - DESIGN CHECKLIST																										
PIN NAME	REQUIREMENT	COMPONENT	MIN	TYP	MAX	DESCRIPTION	COMMENTS AND RELEVANT EQUATIONS																			
SYSTEM+						<b>System output either from input source or battery</b>																				
	Required	C6/C7		10 uF		High frequency converter input capacitor(s)																				
	Required	C8		10 uF		System output noise filtering capacitor(s)																				
	Required	D8				Power-path Diode	Remove if powerpath is not required. Provides battery voltage to system when adapter is absent																			
BATTERY PACK+ / BATTERY PACK-						<b>Battery or battery pack connection to the charger</b>																				
	Required	C14		* uF		Converter output filtering capacitor(s)	<table border="1"> <tr> <td>Charge Current</td> <td>1A</td> <td>2A</td> <td>4A</td> <td>8A</td> </tr> <tr> <td>Output Inductor L<sub>o</sub></td> <td>15 μH</td> <td>10 μH</td> <td>6.8 μH</td> <td>3.3 μH</td> </tr> <tr> <td>Output Capacitor C<sub>o</sub></td> <td>10 μF</td> <td>15 μF</td> <td>20 μF</td> <td>40 μF</td> </tr> <tr> <td>Sense Resistor</td> <td>40 mΩ</td> <td>20 mΩ</td> <td>10 mΩ</td> <td>5 mΩ</td> </tr> </table> Recommended: 12 kHz < f <sub>o</sub> < 17 kHz $f_o = \frac{1}{2 \cdot \pi \cdot \sqrt{L_{out} \cdot C_{out}}}$	Charge Current	1A	2A	4A	8A	Output Inductor L <sub>o</sub>	15 μH	10 μH	6.8 μH	3.3 μH	Output Capacitor C <sub>o</sub>	10 μF	15 μF	20 μF	40 μF	Sense Resistor	40 mΩ	20 mΩ	10 mΩ
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OUTPUT POWER - DESIGN CHECKLIST



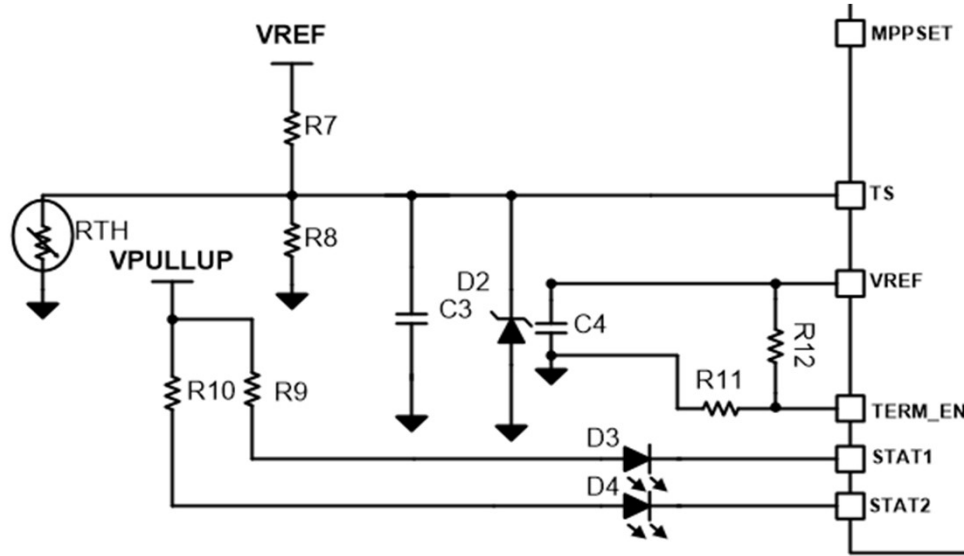
VFB	8	Battery regulation voltage feedback																								
		Required	R18	*kΩ	Resistor divider feedback for battery voltage regulation setting	$V_{batreg} = \left(1 + \frac{R18}{R19}\right) \times 2.1$ $V_{rechg} = \left(1 + \frac{R18}{R19}\right) \times 2.05$ $V_{batlowv} = \left(1 + \frac{R18}{R19}\right) \times 1.55$																				
			R19	*kΩ																						
		Optional	C16	100 nF	High frequency noise decoupling capacitor																					
		Optional	C15	22pF																						
SRP-SRN	9 10	Differential charge current sensing																								
		Required	R <sub>SR</sub>	* mΩ	Charge current sensing resistor	$I_{CHARGE} = \frac{40\text{ mV}}{R_{SR}}$ $I_{prechg} = I_{term} = I_{chg}/10$																				
		Recommended	C12	0.1 uF	Differential mode noise filtering	Filter differential-mode voltage to avoid amplification of high frequency signals, for more accurate current sensing																				
		Recommended	C11	0.1 uF	Common mode noise filtering	Filter common-mode voltage to avoid amplification of high frequency signals, for more accurate current sensing																				
		Optional	C13	0.1 uF																						
		Optional	R17	DNP																						
REGN	12	Internal LDO output																								
		Required	C9	1.0 uF	Internal LDO output stabilizing capacitor																					
		Required	D6		Bootstrap capacitor refresh and blocking Schottky diode	Schottky diodes reduce the risk associated with charge supplied back to the gate driver supply from the bootstrap capacitor and minimize leakage current. Fast reverse recovery minimizes losses																				
LODRV	13	Converter Low-Side N-Channel MOSFET gate driver																								
		Required	Q2	-	Converter synchronous Low-Side N-Channel MOSFET																					
PH & BTST	14 & 16	Required	L1	*uH	Converter output filtering inductor	<table border="1"> <thead> <tr> <th>Charge Current</th> <th>1A</th> <th>2A</th> <th>4A</th> <th>8A</th> </tr> </thead> <tbody> <tr> <td>Output Inductor L<sub>o</sub></td> <td>15μH</td> <td>10μH</td> <td>6.8μH</td> <td>3.3μH</td> </tr> <tr> <td>Output Capacitor C<sub>o</sub></td> <td>10μF</td> <td>15μF</td> <td>20μF</td> <td>40μF</td> </tr> <tr> <td>Sense Resistor</td> <td>40mΩ</td> <td>20mΩ</td> <td>10mΩ</td> <td>5mΩ</td> </tr> </tbody> </table> <b>Recommended: 12 kHz &lt; f<sub>o</sub> &lt; 17 kHz</b> $f_o = \frac{1}{2 \cdot \pi \cdot \sqrt{L_{out} \cdot C_{out}}}$	Charge Current	1A	2A	4A	8A	Output Inductor L <sub>o</sub>	15μH	10μH	6.8μH	3.3μH	Output Capacitor C <sub>o</sub>	10μF	15μF	20μF	40μF	Sense Resistor	40mΩ	20mΩ	10mΩ	5mΩ
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		Output Capacitor C <sub>o</sub>	10μF	15μF	20μF	40μF																				
		Sense Resistor	40mΩ	20mΩ	10mΩ	5mΩ																				
Required	C5	0.1 uF	Converter bootstrap capacitor for High-Side N-Channel MOSFET gate driver																							
Recommended	R14	10 Ω	Bootstrap capacitor discharge current limiting resistor	Limits peak current through bootstrap diode, and also reduces switch node ringing by slowing down turn-on of HSFET																						
Recommended	R16	DNP	Switching converter snubber resistor	Reduce switch node ringing on HSFET turn-on. Recommended to include footprint for evaluation, in case																						
Recommended	C10	DNP																								
		Recommended	D7		Fast recovery and asynchronous rectifier Schottky diode	Reduce reverse recovery loss as compared to internal body diode of LSFET, which helps reduce switch node ringing, as well as increase efficiency due to lower forward voltage drop of schottky as compared to forward voltage drop of internal body diode																				

OUTPUT POWER - DESIGN CHECKLIST



			<b>Converter High-Side N-Channel MOSFET gate driver</b>			
HIDRV	15	Required	Q1	-	Converter active High-Side N-Channel MOSFET	
		Recommended	R13		Converter active High-Side MOSFET gate drive strength limiting resistor	Increase turn-on time of HSFET to reduce ringing at PH node. Also increases turn-off time and reduces efficiency
		Optional	D5		Diode for fast High-Side MOSFET turn-off	Adding gate resistor limits turn-on and turn-off of HSFET resulting in lower efficiency. Diode allows faster turn-off and slower turn-on, reducing ringing on HSFET turn-on, and also reducing effects on efficiency by turning off faster.
GND	11				<b>IC Ground return</b>	

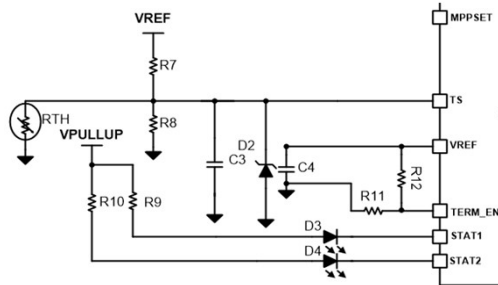
BQ24650 - Hardware Programmed Input Design



HARDWARE PROGRAMMED INPUT - DESIGN CHECKLIST

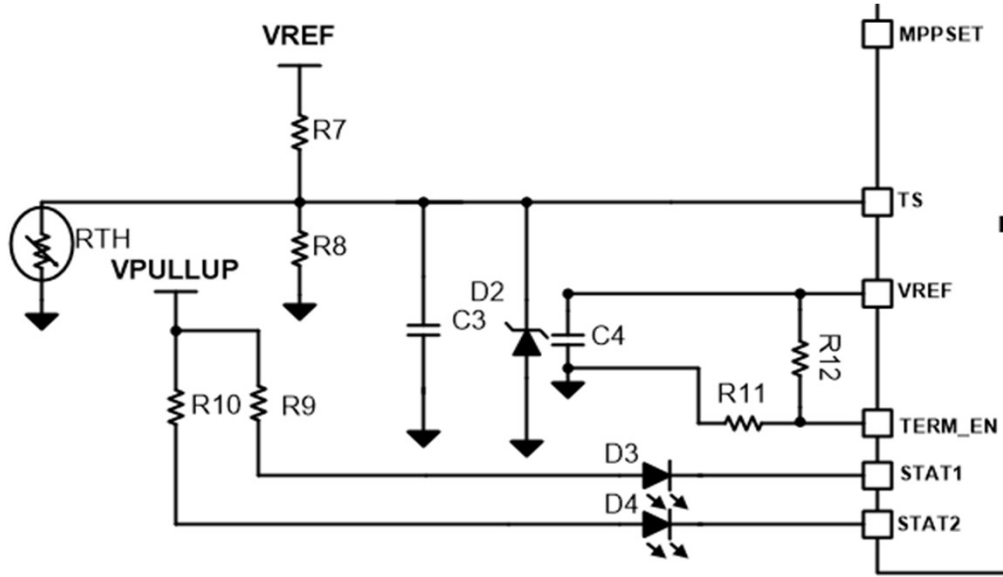
PIN	REQUIREMENT	COMPONENT	MIN	TYP	MAX	DESCRIPTION	COMMENTS AND RELEVANT EQUATIONS
TS						<b>Battery thermistor temperature qualification window setting resistor network</b>	
	Required	R7		*Ω		Resistor network to set window for thermistor	
	Required	R8		*Ω		temperature-based battery charging profile	
	Recommended	RTH		*Ω		External battery thermistor	
	Recommended	C3		0.1 uF		High frequency noise decoupling and/or thermistor detach delay capacitor	
	Recommended	D2				Zener clamp protection for TS pin	

BQ24650 - Hardware Programmed Input Design



COMMUNICATION AND MISC INPUT/OUTPUT SIGNAL - DESIGN CHECKLIST

PIN NAME	REQUIREMENT	COMPONENT	MIN	TYP	MAX	DESCRIPTION	COMMENTS AND RELEVANT EQUATIONS
STAT1						<b>Open-drain output signal for charging status</b>	Refer to Datasheet Table 2 for description
	Recommended	R9		10 kΩ		Charging status indicating LED	
	Optional	D3				Charging status indicating LED	
STAT2						<b>Open-drain output signal for charging status</b>	Refer to Datasheet Table 2 for description
	Recommended	R10		10 kΩ		Charging status indicating LED	
	Optional	D4				Charging status indicating LED	



TERM_EN	7				<b>Charge termination enable</b>	
		Recommended	R11		Pull TERM_EN to GND	Disable Charge Termination. Must be terminated and cannot be left floating
		Optional	R12		Pull TERM_EN to VREF	Enable Charge Termination. Must be terminated and cannot be left floating
VREF	6				<b>Internal 3.3V LDO</b>	
		Required	C4		Internal 3.3V LDO output stabilizing capacitor	
PwrPad	-				<b>IC Thermal dissipation pad</b>	