NEOCRUX SYSTEMS

Battery Safety First: A Practical Insight into Lithium Cell Protection Using the BQ77915

NEOCRUX SYSTEMS

🔋 The Rise of Lithium Power

- Lithium-ion batteries power our phones, laptops, EVs, and solar systems
- High energy density, lightweight, and efficiency
- But with power comes risk — safety is not optional
- Need for protection and monitoring systems

The Risks Behind the Power

- Overcharge → thermal runaway
- Overdischarge → battery degradation
- Short circuit → fire or explosion
- High temperature → breakdown of internal chemistry

The Brain Behind the Battery

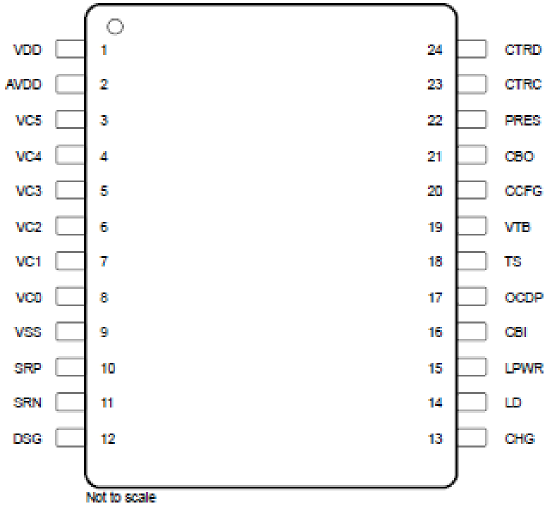
- Monitors: voltage, temperature, current
- Protects: detects and responds to faults
- Balances: equalizes charge across cells
- Communicates: (if advanced) sends data to controller or host system

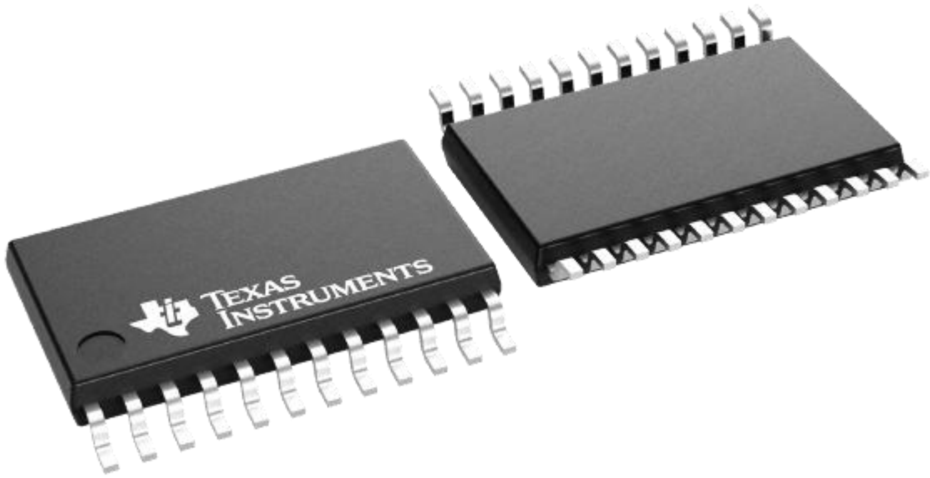
Layers of Defense

- Overvoltage protection (OVP) – Prevents overcharging
- Undervoltage protection (UVP) – Prevents deep discharge
- Overcurrent protection (OCP) – Avoids overheating from high loads
- Short Circuit Detection (SCD) – Cuts off instantly
- Temperature protection – Ensures operation within safe limits

Meet the BQ77915

- Designed by Texas Instruments
- Ideal for 3 to 5 series lithium cells (Li-ion, $LiFePO_4$)
- Offers standalone protection — no microcontroller needed
- Integrates: OV, UV, SCD, OCD, temperature, permanent fault detection

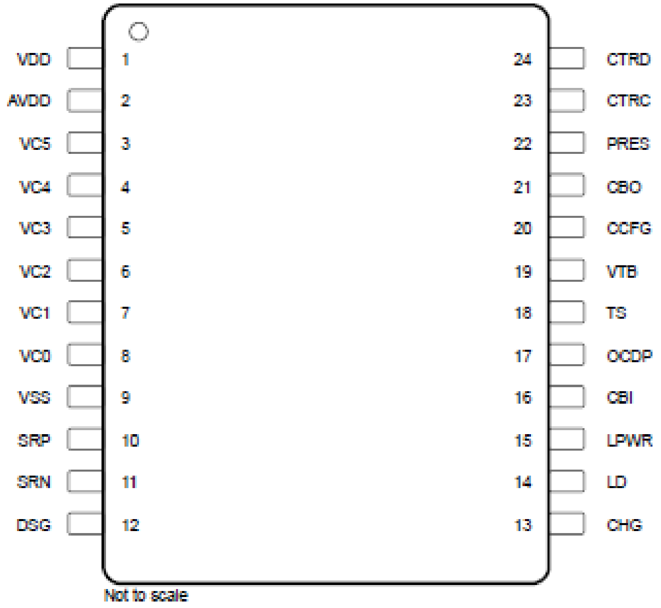




Meet the BQ77915

Pinouts

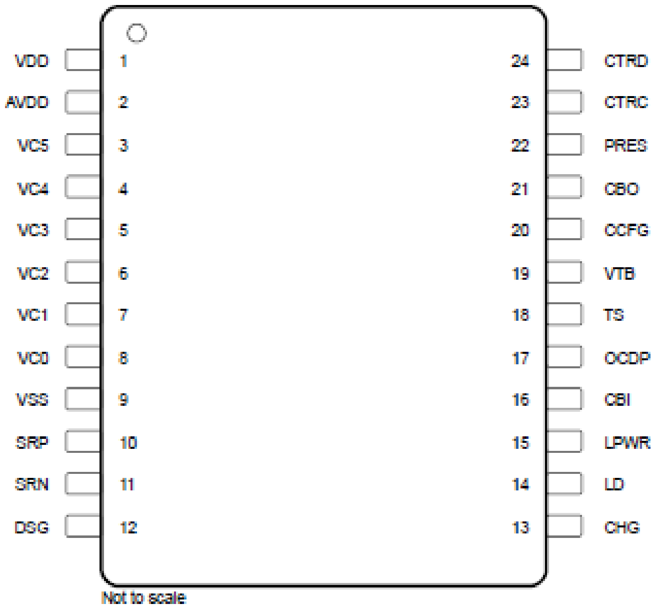
Pin	Name	Type	Description
1	VDD	P	Supply voltage
2	AVDD	O	Analog supply (only connect to a capacitor)
3	VC5	I	Cell voltage sense input
4	VC4	I	Cell voltage sense input
5	VC3	I	Cell voltage sense input
6	VC2	I	Cell voltage sense input
7	VC1	I	Cell voltage sense input
8	VC0	I	Cell voltage sense input
9	VSS	P	Analog ground
10	SRP	I	Current sense input (battery side of the sense resistor)



Meet the BQ77915

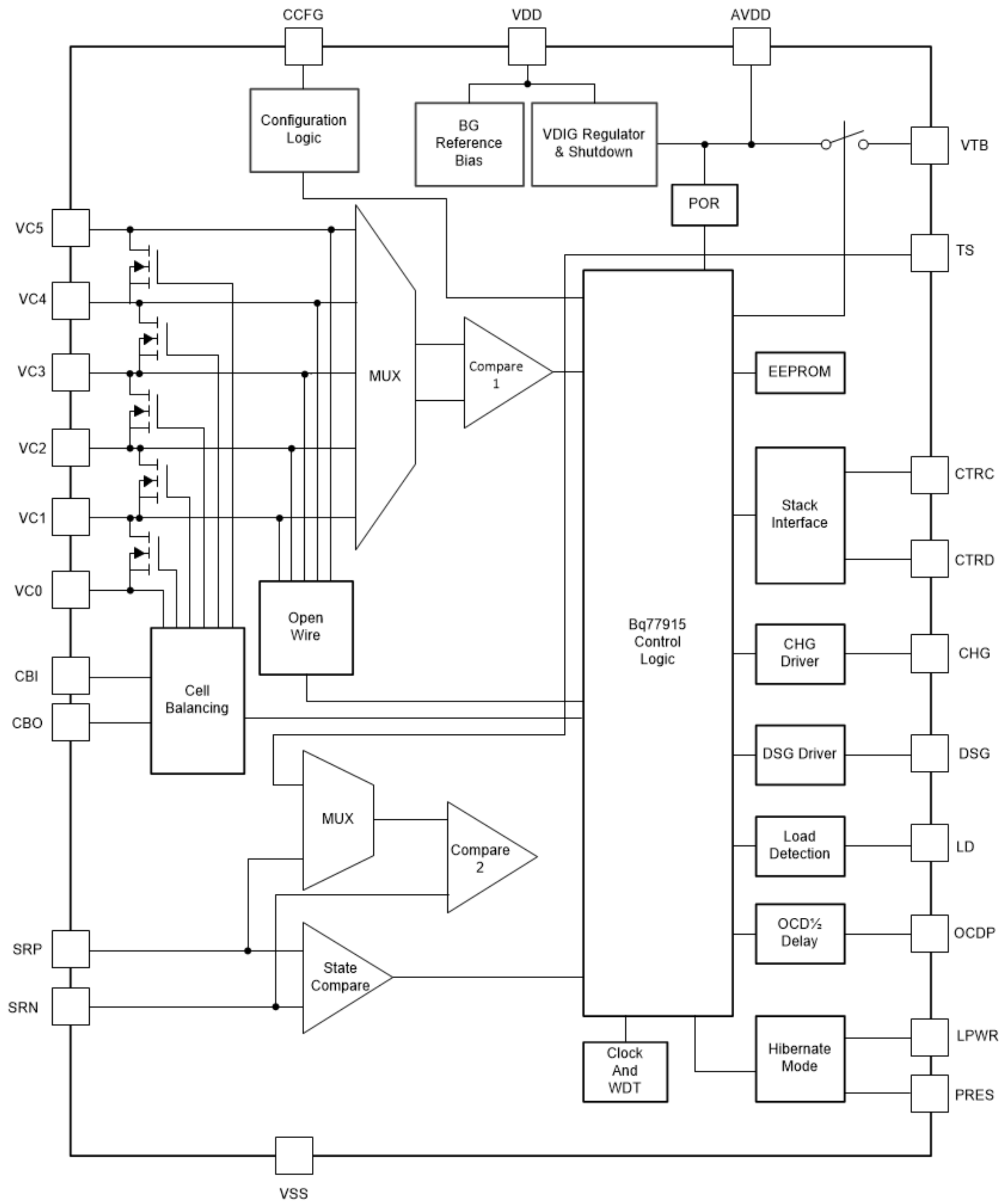
Pinouts

11	SRN	I	Current sense input (pack side of the sense resistor)
12	DSG	O	Discharge FET driver output
13	CHG	O	Charge FET driver output
14	LD	I	Load removal detection (PACK–)
15	LPWR	O	HIBERNATE mode communication pin (float if single device)
16	CBI	I	Cell balancing input (drive low to enable, float to disable)
17	OCDP	I	Overcurrent fault delay setting (connect resistor to VSS)
18	TS	I	Thermistor input (connect 10 kΩ to VSS if unused)
19	VTB	O	Thermistor bias output
20	CCFG	I	Cell in-series configuration input
21	CBO	O	Cell balancing output (float if single device)
22	PRES	I	HIBERNATE mode input (high for NORMAL, float for HIBERNATE)
23	CTRC	I	CHG/DSG override input
24	CTRD	I	CHG/DSG override input



Inside the Chip

- Protection comparator logic
- Charge/discharge FET drivers
- Thermistor interface
- Permanent fault memory

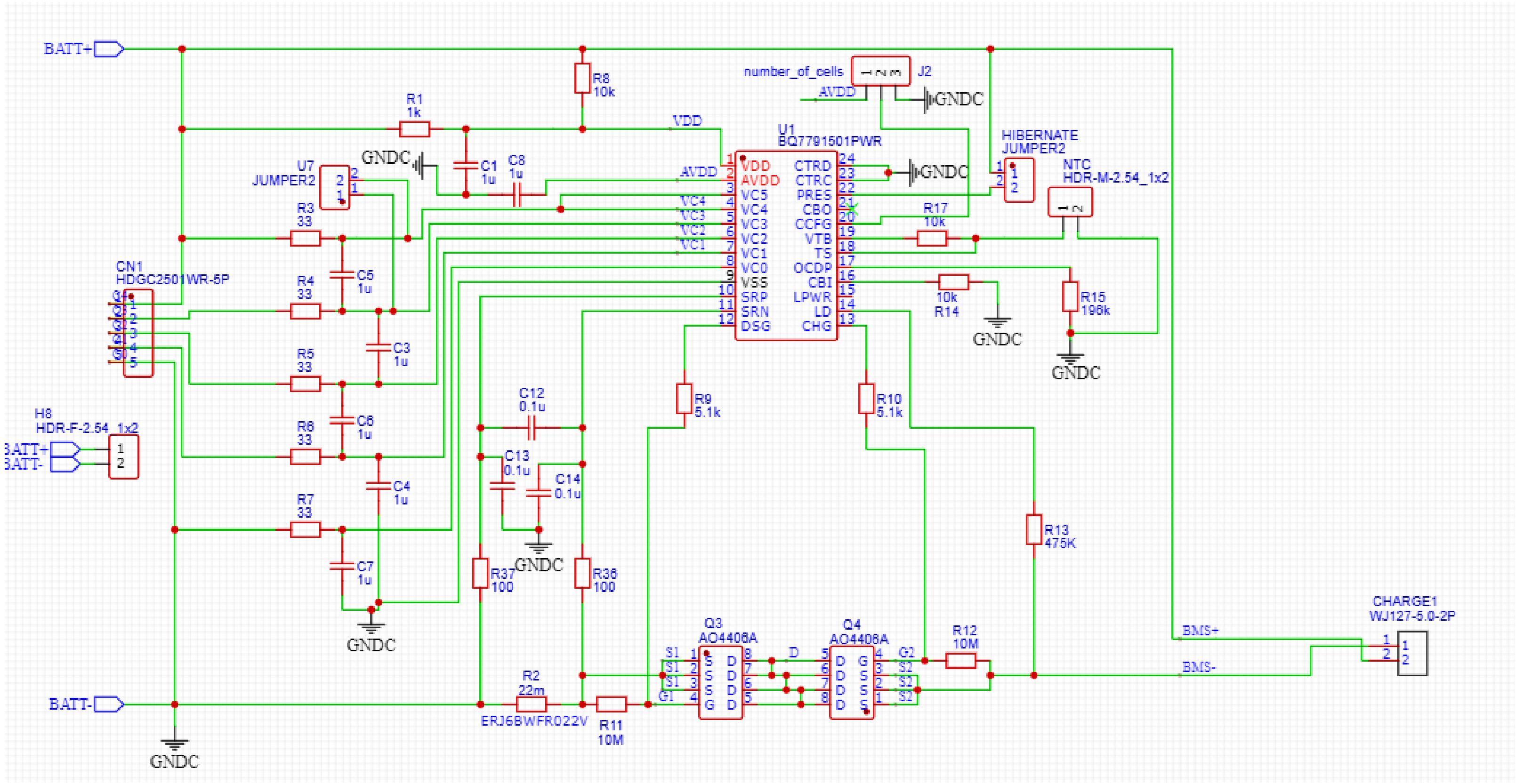


Robust Features, Compact Design

- Cell protection for up to 5 cells
- Multiple fault protections: OVP, UVP, SCD, OCD
- Balancing support (via external circuitry)
- Low power consumption in standby
- Permanent fault latch – ensures no unsafe reuse

Real-World Application

- Application: 4S (4-cell series) lithium battery pack



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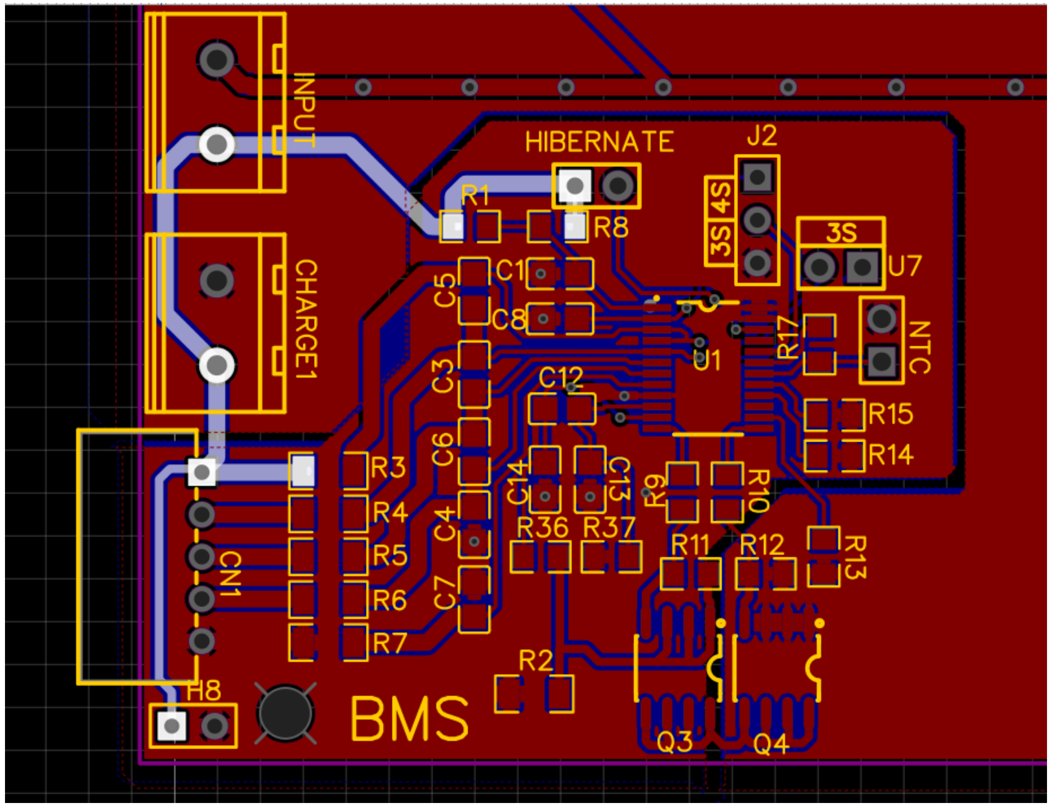

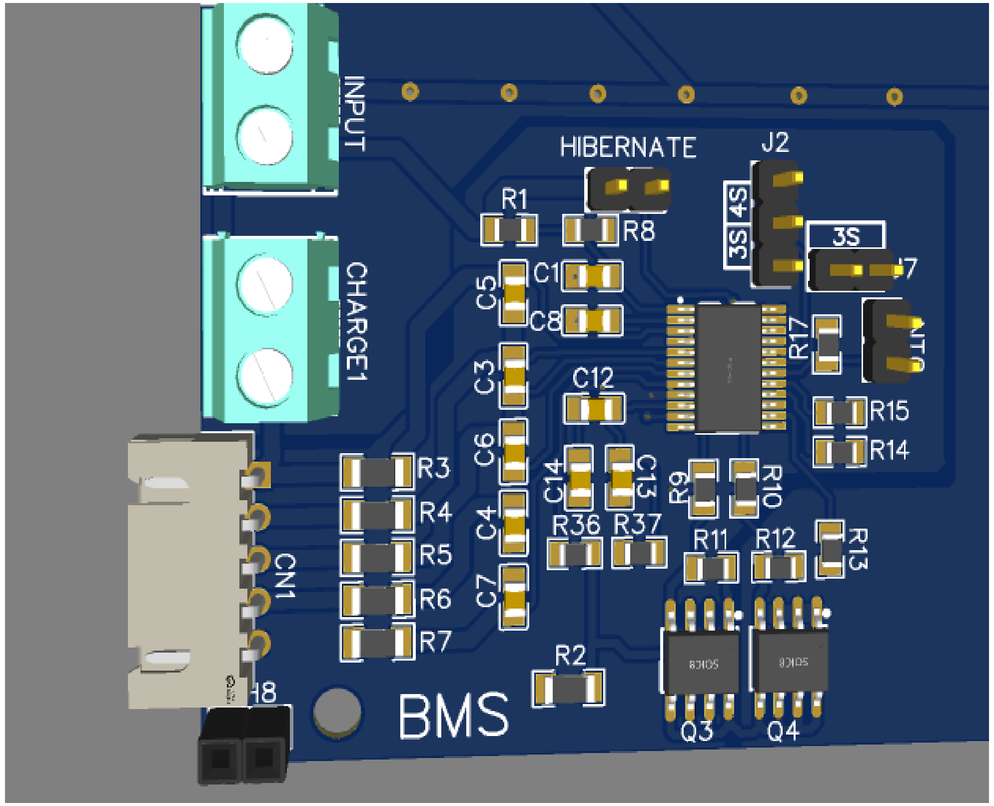

🔋 Strengths and Gaps

✅ **Advantages**:

- Standalone operation
- Reliable fault detection
- Permanent safety memory
- Compact and cost-efficient

❌ Limitations:

- No data communication
- No internal balancing
- Not a full BMS (no SOC/SOH estimation)

Future of Battery Management

- Smart BMS: wireless connectivity, CAN/I2C communication
- AI prediction: fault prediction before failure
- Modular systems for large-scale packs
- Solid-state batteries will need new protection strategies

Power with Protection

- Lithium batteries are powerful but sensitive
- Protection circuits like BQ77915 offer essential safety
- For advanced systems, full BMS is required
- Smart energy needs smart safety