X3 Series Battery Management System

ERX3-NMC20S30A, ERX3-NMC20S50A, ERX3-NMC20S70A, ERX3-NMC20S100A

1 Features

- Industrial grade BMS for 74.0V NMC battery
- Positive terminal (high side) switch
- AIS-156-A3 compliant
- Ultra-fast current response time: $8\mu S$
- High tolerance to transient voltages
- Typical cell voltage accuracy of $1mV$
- Supports 4 battery temperature sensors
- Onboard flash memory for up to 3 months of battery data storage
- Integrated audio alarm for fault indication
- Isolated CAN and RS-485 communication
- Dedicated peripheral attachment port with support for Display, GPRS, GPS and Bluetooth
- Parameter configuration through PC and mobile application

2 Applications

- Energy storage battery for inverters, UPS
- Low speed two-wheeler and three-wheeler electric vehicle
- Solar grade batteries up to 10kWhr

3 Description

ERX3 battery management system (BMS) is a robust, precise and extremely reliable industrial grade BMS device with best-in-class surge current handling and short circuit protection capability. An ultra-fast current response time along with an advanced short circuit detection mechanism enables the BMS to handle even direct shorting of battery terminals with thick conductor cables.

Unlike most other BMS solution where the protection switch is present on the negative terminal of the battery, ERX3 BMS implements positive terminal (high side) switch. In case of a fault, the positive terminal of the battery is disconnected.

During over load or short circuit conditions when the BMS protection switch turns – OFF, the BMS is subjected to large flyback voltage spike, especially if the load is inductive in nature. ERX3 BMS has an extremely high flyback current immunity and can successfully break over 600% rated current with inductive loads.

Other reliability features include isolated communication channels consisting of Iso-CAN, Iso-RS-485 and Iso-UART. This ensures that the BMS system can function safely even if the communication line is subjected to abnormal electrical conditions.

ERX3-NMC20S	
Cell Chemistry	$LiNiMnCoO_2$
Nominal Cell Voltage	3.7V
Series Cells	20
Nominal battery voltage	74.0V

4.1 General Specification

SN	PARAMETER	VALUE	UNIT	REMARKS	
1	Nominal battery voltage	74.0	V	20S cell configuration	
2	Operating current – active	8	mA	Battery voltage 72V	
3	Operating current – Sleep	500	µA	Battery voltage 72V	
4	Power MOSFET configuration	SPST	–	Positive terminal, High side	
5	Internal resistance (Terminal to terminal)	5.0 3.0 1.5 1.1	mΩ	ERX3-NMC20S30A ERX3-NMC20S50A ERX3-NMC20S70A ERX3-NMC20S100A	Max resistance $T_{BMS} = 50°C$
6	Battery temperature sensors	4	–		
7	Onboard data logging period	90	Days		
8	Communication			CAN, RS-485	
9	Communication isolation	YES	–	Isolated channels	

4.2 Absolute Maximum Rating

SN	PARAMETER	MIN	MAX	UNIT
1	Battery voltage	-1	95	V
2	Cell voltage $V_N - V_{N-1}$	-0.2	5	V
3	Operating ambient temperature	-20	70	°C
4	Maximum load inductance[#1]		100	µH

Operation beyond the absolute maximum rating may cause immediate damage to the device.

4.3 Measurement Accuracy

SN	PARAMETER	TYP	MAX	TEST CONDITION
1	Cell voltage accuracy	1mV	1.6mV	$-10°C$ to $60°C$, 0V to 4.5V
2	Battery voltage accuracy	0.05%	0.01%	$-10°C$ to $60°C$, 10V to 30V
3	Current accuracy (0A – 120%)	2% ± 0.1A	4% ± 0.2A	$25°C$ ambient, $T_{BMS} < 60°C$
4	Current accuracy (> 120%)	3%	5%	$25°C$ ambient, $T_{BMS} < 60°C$
5	Current thermal drift	–	0.03%/°C	T_{BMS} $25°C$ to $90°C$
6	Temperature accuracy	1°C	3°C	$-10°C$ to $60°C$
7	Measurement bandwidth[#2]	5Hz		
8	Data readout frequency	1Hz		

#1 Maximum load inductance is limited by the ability of the BMS to successfully interrupt currents as high as the short circuit limit without failure. If the nature of load is highly inductive, external TVS must be installed across the load. The clamping voltage of the TVS must not exceed the absolute maximum rated voltage of the BMS

#2 Measurement bandwidth refers to the bandwidth of current and voltage signal provided by the BMS to the external host after internal digital filtering. The actual acquisition and measurement bandwidth of the BMS is much higher. High bandwidth data is used only for internal functioning of the BMS.

4.4 Electrical Specification

SN	PARAMETER	VALUE	UNIT	REMARKS
	PACK VOLTAGE SPECIFICATION			
1	Over-charge entry threshold	84.6	V	Equivalent to 4.23V/Cell
2	Over-charge exit threshold	80.0	V	Equivalent to 4.0V/Cell
3	Over-discharge entry threshold	56.0	V	Equivalent to 2.80V/Cell
4	Over-discharge exit threshold	60.0	V	Equivalent to 3.00V/Cell
5	Sleep mode entry threshold	52.0	V	Equivalent to 2.60V/Cell
6	Sleep mode exit threshold	55.0	V	Equivalent to 2.75V/Cell
	CELL VOLTAGE SPECIFICATION			
7	High voltage entry threshold	4.25	V	
8	High voltage exit threshold	4.10	V	
9	Low voltage entry threshold	2.75	V	
10	Low voltage exit threshold	2.90	V	
	CURRENT SPECIFICATION			
11	Continuous current rating Discharge | Charge	30 | 15 50 | 25 70 | 35 100 | 50	A	ERX3-NMC20S30A ERX3-NMC20S50A ERX3-NMC20S70A ERX3-NMC20S100A
12	Over current capacity	120 150 300	%	Overload duration: 60s Overload duration: 20s Overload duration: 1s
13	Short circuit current threshold	550	%	% of continuous rating
14	Short circuit reaction time	8	µs	
15	Short circuit auto-restart time	3	s	Auto restart after short removal
16	Over load auto-restart time	10	s	
17	Max output load for successful hot—start after a fault trip	70	%	% of rated load current
	PRECHARGE SPECIFICATION			
18	Precharge resistance	30	Ω	
19	Maximum precharge duration	2	s	
20	Precharge repeat time	5	s	
	Maximum load capacitance for successful one shot precharge	2,000	µF	
	BALANCER SPECIFICATION			
21	Balancer type	Passive		
22	Typical balancing current	50	mA	
23	Balancer ON ΔV_{Cell} threshold	30 10	mV	Corse balancing Fine balancing
24	Balancer OFF ΔV_{Cell} threshold	5	mV	
25	Low V_Cell stop threshold	3.30	V	Balancing stops below this voltage
26	High V_Cell discharge threshold	3.65	V	Forced discharge is initiated on cells above this voltage regardless of cell voltage differential

4.5 Thermal Specification

SN	PARAMETER	VALUE	UNIT	REMARKS
1	Maximum heat dissipation at rated current	5 8 10 12	W	ERX3-NMC20S30A ERX3-NMC20S50A ERX3-NMC20S70A ERX3-NMC20S100A
2	Thermal resistance $R\theta_{CA}$ Case to ambient (vertical mounting)	3.0	℃/W	
3	ΔT max at rated current	< 40	℃	
4	Working temperature range (ambient temperature)	-20 to 60	℃	Derate maximum permissible current above 50℃

4.6 Mechanical Specification

SN	PARAMETER	VALUE	UNIT	REMARKS
1	Dimensions	144x78x17.5	mm	
2	Weight	250	g	
3	Waterproofing	IP51		Protected from limited dust and water droplets

X3 BMS Mechanical Drawing