

X3 Series Battery Management System

ERX3-NMC13S30A, ERX3-NMC13S50A, ERX3-NMC13S70A, ERX3-NMC13S100A

1 Features

- Industrial grade BMS for 48.1V NMC battery
- Positive terminal (high side) switch
- AIS-156-A3 compliant
- Ultra-fast current response time: 8μS
- 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-NMC13S | |
|-------------------------|------------------------|
| Cell Chemistry | LiNiMnCoO ₂ |
| Nominal Cell Voltage | 3.7V |
| Series Cells | 13 |
| Nominal battery voltage | 48.1V |

4.1 General Specification

| SN | PARAMETER | VALUE | UNIT | REMARKS |
|----|---|--------------------------|------|---|
| 1 | Nominal battery voltage | 48.1 | V | 13S cell configuration |
| 2 | Operating current – active | 8 | mA | Battery voltage 48V |
| 3 | Operating current – Sleep | 500 | μA | Battery voltage 48V |
| 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-NMC13S30A ERX3-NMC13S50A ERX3-NMC13S70A ERX3-NMC13S100A Max resistance $T_{BMS} = 50^{\circ}\text{C}$ |
| 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 | 75 | 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, $T_{BMS} < 60^{\circ}\text{C}$ |
| 4 | Current accuracy (> 120%) | 3% | 5% | 25°C ambient, $T_{BMS} < 60^{\circ}\text{C}$ |
| 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 | 55.0 | V | Equivalent to 4.23V/Cell |
| 2 | Over-charge exit threshold | 52.0 | V | Equivalent to 4.0V/Cell |
| 3 | Over-discharge entry threshold | 36.4 | V | Equivalent to 2.80V/Cell |
| 4 | Over-discharge exit threshold | 39.0 | V | Equivalent to 3.00V/Cell |
| 5 | Sleep mode entry threshold | 33.8 | V | Equivalent to 2.60V/Cell |
| 6 | Sleep mode exit threshold | 35.8 | 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 50 70 100 | 15 25 35 50 | A ERX3-NMC13S30A ERX3-NMC13S50A ERX3-NMC13S70A ERX3-NMC13S100A |
| 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 | 4,500 | μF | |
| BALANCER SPECIFICATION | | | | |
| 21 | Balancer type | Passive | | |
| 22 | Typical balancing current | 50 | mA | |
| 23 | Balancer ON ΔV_{Cell} threshold | 30 10 | mV | Coarse 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-NMC13S30A ERX3-NMC13S50A ERX3-NMC13S70A ERX3-NMC13S100A |
| 2 | Thermal resistance $R_{\theta_{CA}}$ Case to ambient (vertical mounting) | 3.0 | °C/W | |
| 3 | ΔT max at rated current | < 40 | °C | |
| 4 | Working temperature range (ambient temperature) | -20 to 60 | °C | Derate maximum permissible current above 50°C |

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

