# MC33777B

## Battery junction box monitor integrated circuit

Rev. 1.0 — 23 January 2026 Product brief

## 1 General description

The MC33777B is a battery junction box controller integrated circuit (IC) designed for automotive applications, such as hybrid electric vehicles (HEV) and electric vehicles (EV), and industrial applications, such as energy storage systems (ESS).

The device performs multiple redundant current, voltage and temperature measurements. It includes a configurable event manager and integrates pyrotechnic switch drivers.

It locally processes the measurement results and autonomously detects application fault events (for example, short circuit, crash signals), to trigger fast reactions without a microcontroller intervention (GPIOs, pyrotechnic switch).

The current measurement interfaces support both shunt and Hall sensor measurements.

The two unique integrated pyrotechnic switch drivers operate independently and include a large set of diagnostic capabilities.

The supported interface options include an isolated daisy chain (TPL3) or a serial peripheral interface (SPI) for communication with the microcontroller.

The MC33777B supports the highest automotive safety integrity level (ASIL D) for all its features.

## 2 Features and benefits

- Current measurement
  - Four current measurement inputs (supporting two ASIL D current measurements)
    - One precise ADC per input (27 bit, 2 kHz)
    - One fast ADC per input (16 bit, 125 kHz, 8 µs data rate)
    - Supports Hall sensor measurement (5 V range)
  - Measurement compliant with stringent EMC requirements (for example, portable transmitter immunity)
  - Shunt temperature drift compensation with external temperature sensor
  - One coulomb counter per channel
  - Overcurrent detection (threshold, di/dt calculation, melting fuse emulation)
  - Switchable architecture support (2 x 400 V/800 V) with real-time calculation of current between packs
- General-purpose measurement
  - 16 measurement inputs, supporting up to eight redundant measurements (16 bit, 1 kHz)
  - Overvoltage and undervoltage detection
  - Multiplexed with 2 x 8 GPIOs
- Event manager
  - Set of input events from other modules (for example, overcurrent detection, fuse emulation, overvoltage detection, digital input for crash signal monitoring, and so on)
  - Configurable logical processing of the events (for example, debouncing, OR, custom logic functions, and so on)
  - Triggering reactions (for example, pyrotechnic switch controller, MCU wake-up, GPIOs, and so on)
  - Fastest overcurrent protection method (less than 30 µs from overcurrent event to detection and reaction triggering)
- Pyrotechnic switch controller (PSC)
  - Two independent controllers including driver stage
  - AK-LV16 and USCAR28 compliant
  - 1.2 A/2 ms or 1.75 A/0.5 ms driving capability per controller
  - Seemingly instantaneous triggering by the event manager without MCU processing
  - Extensive set of diagnostics (capacitor measurement, ESR measurement, igniter measurement, and so on)
- SPI controller interface and $I^2C$ controller interface to control peripherals
- MCU interface supporting SPI or isolated daisy-chain protocol TPL3
  - SPI (up to 4 Mbit/s)
  - TPL3 (2 Mbit/s, 62 nodes, transformer, or capacitive isolation)
- Power management
  - Direct supply from the pyrotechnic switch supply voltage
  - Redundant analog supplies
- Wake-up support (by communication, GPIO, or internal events)
- Supports ASIL D safety goals with redundant measurements, redundant signal processing, redundant pyrotechnic switch controller
- Unique device ID
- Thermally enhanced LQFP64-EP package with 0.5 mm pitch
- AEC-Q100 grade 1 qualification: Ta = -40 °C to 125 °C

## 3 Applications

Automotive:

- (Plug in) HEV battery management systems
- EV battery management systems

Industrial:

- Stationary energy storage system (ESS)
- Other current or voltage sense applications

## 4 Ordering information

This section describes the available part numbers.

**Table 1. Part numbers**

| Part number | Communication | 2 x 8 IOs | 2 x ISENSE inputs | 2 x VISENSE inputs | 2 x pyrotechnic switch controllers |
|---|---|---|---|---|---|
| Full feature set | | | | | |
| MC33777BTA1AE | TPL | Yes | Yes | Yes | Yes |
| MC33777BSA1AE | SPI | Yes | Yes | Yes | Yes |
| Optimized feature set | | | | | |
| MC33779BTA1AE | TPL | Yes | Yes | No | Yes |
| MC33779BSA1AE | SPI | Yes | Yes | No | Yes |
| MC33778BTA1AE | TPL | Yes | Yes | No | PRM_PSC only |
| MC33778BSA1AE | SPI | Yes | Yes | No | PRM_PSC only |
| MC33776BTA1AE | TPL | Yes | Yes | No | No |
| MC33776BSA1AE | SPI | Yes | Yes | No | No |

# 5 Block diagram

Figure 1 shows the general architecture of the MC33777B.

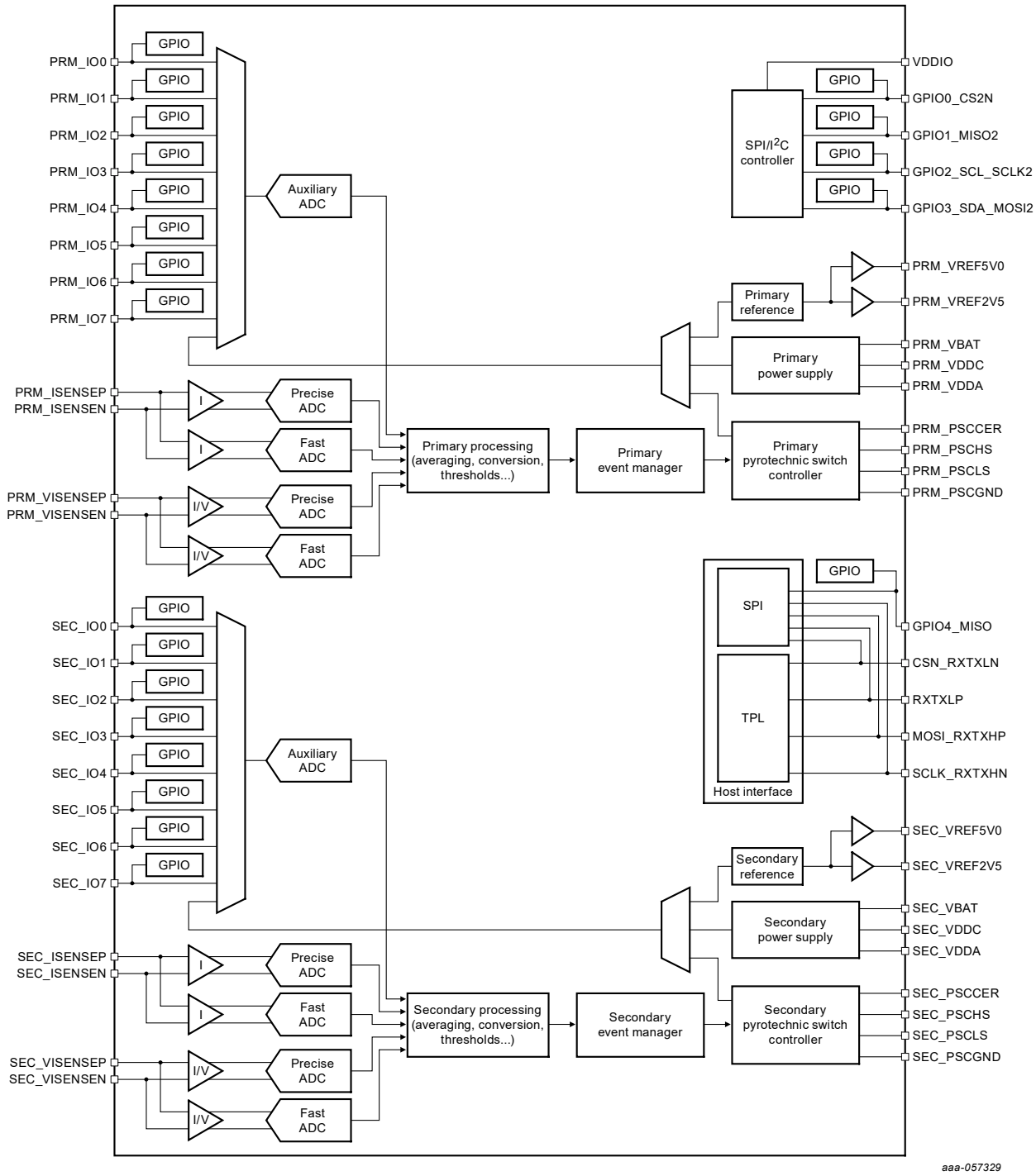


**Figure 1. Block diagram**

# 6 Pinning information

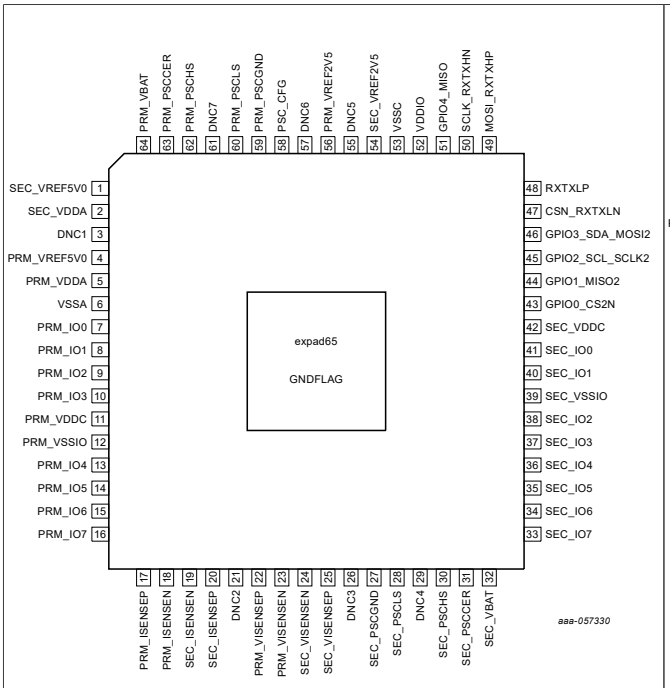


**Figure 2. MC33777 pinout**

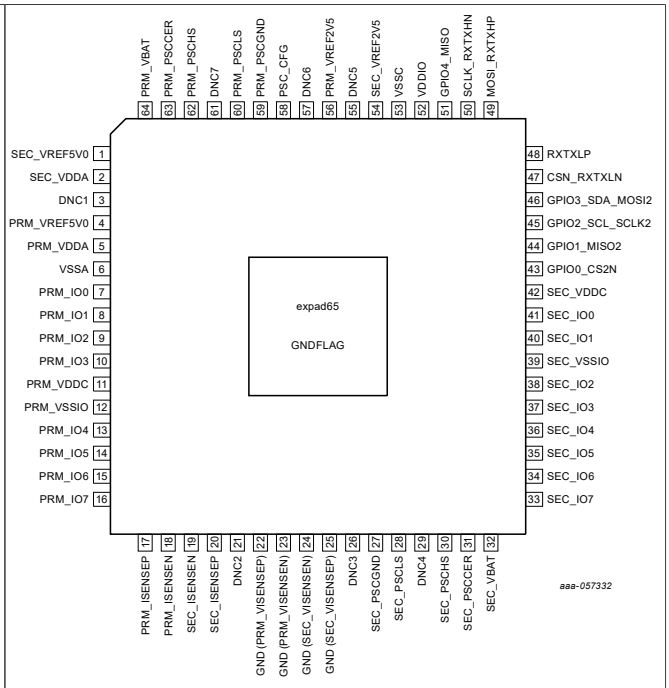


**Figure 3. MC33779 pinout**

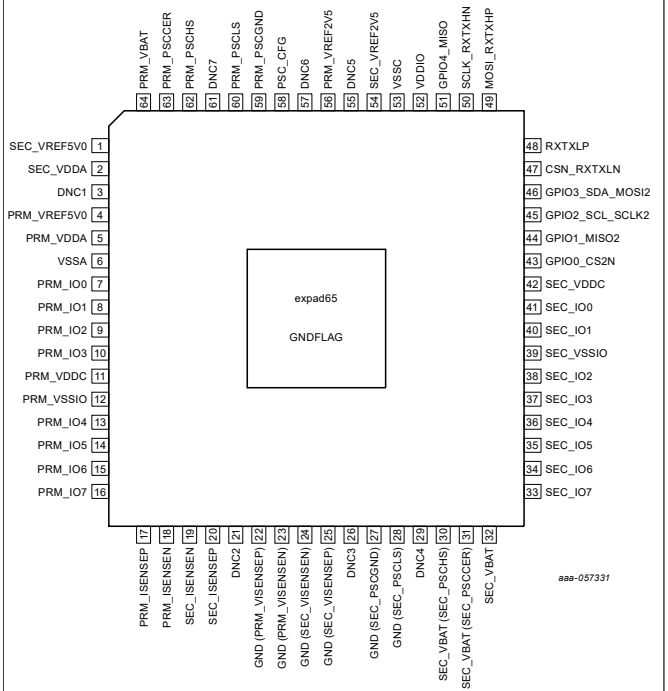


**Figure 4. MC33778 pinout**

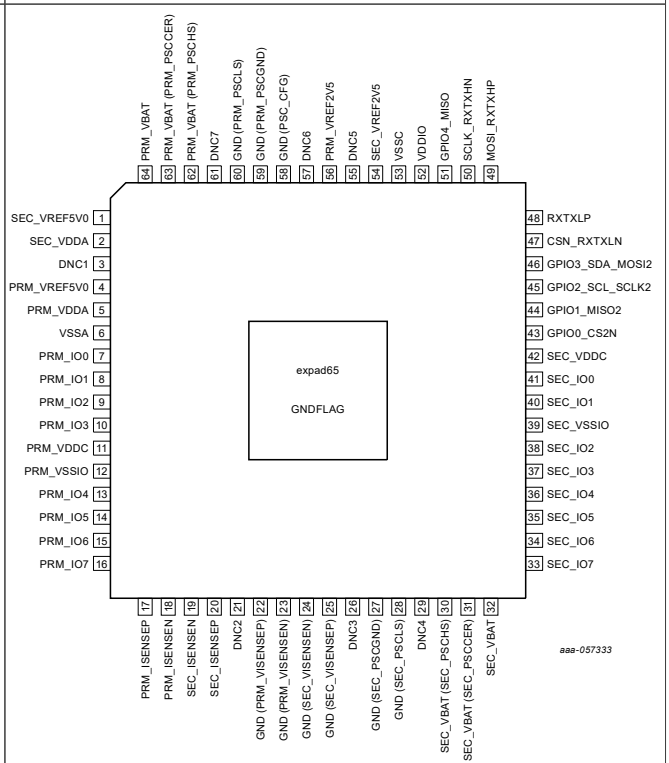


**Figure 5. MC33776 pinout**

**Table 2. Pinout LQFP64_EP**

*Ordered lists describe alternative functions.*

| Symbol | Pin | Description |
|---|---|---|
| SEC_VREF5V0 | 1 | Secondary 5 V reference voltage. |
| SEC_VDDA | 2 | Secondary internal analog supply. |
| DNC1 | 3 | Do not connect. Keep floating in the application. |
| PRM_VREF5V0 | 4 | Primary 5 V reference voltage. |
| PRM_VDDA | 5 | Primary internal analog supply. |
| VSSA | 6 | Internal analog ground reference. |
| PRM_IO0 | 7 | • Primary digital input/output 0.<br>• Primary analog measurement input 0. |
| PRM_IO1 | 8 | • Primary digital input/output 1.<br>• Primary analog measurement input 1. |
| PRM_IO2 | 9 | • Primary digital input/output 2.<br>• Primary analog measurement input 2. |
| PRM_IO3 | 10 | • Primary digital input/output 3.<br>• Primary analog measurement input 3. |
| PRM_VDDC | 11 | Primary VDDC supply output. |
| PRM_VSSIO | 12 | Primary IO ground reference and VDDD ground reference. |
| PRM_IO4 | 13 | • Primary digital input/output 4.<br>• Primary analog measurement input 4. |
| PRM_IO5 | 14 | • Primary digital input/output 5.<br>• Primary analog measurement input 5. |
| PRM_IO6 | 15 | • Primary digital input/output 6.<br>• Primary analog measurement input 6. |
| PRM_IO7 | 16 | • Primary digital input/output 7.<br>• Primary analog measurement input 7. |
| PRM_ISENSEP | 17 | Primary positive analog input for current measurement. |
| PRM_ISENSEN | 18 | Primary negative analog input for current measurement. |
| SEC_ISENSEN | 19 | Secondary negative analog input for current measurement. |
| SEC_ISENSEP | 20 | Secondary positive analog input for current measurement. |
| DNC2 | 21 | Do not connect. Keep floating in the application. |
| PRM_VISENSEP | 22 | • Primary positive analog input for current/voltage measurement.<br>• For MC33776, MC33778, and MC33779 connect to GND. |
| PRM_VISENSEN | 23 | • Primary negative analog input for current/voltage measurement.<br>• For MC33776, MC33778, and MC33779 connect to GND. |
| SEC_VISENSEN | 24 | • Secondary negative analog input for current/voltage measurement.<br>• For MC33776, MC33778, and MC33779 connect to GND. |
| SEC_VISENSEP | 25 | • Secondary positive analog input for current/voltage measurement.<br>• For MC33776, MC33778, and MC33779 connect to GND. |
| DNC3 | 26 | Do not connect. Keep floating in the application. |
| SEC_PSCGND | 27 | • Secondary pyrotechnic switch controller ground.<br>• For MC33776 and MC33778 connect to GND. |
| SEC_PSCLS | 28 | • Secondary pyrotechnic switch controller low-side switch input.<br>• For MC33776 and MC33778 connect to GND. |
| DNC4 | 29 | Do not connect. Keep floating in the application. |

**Table 2. Pinout LQFP64_EP*...continued***

*Ordered lists describe alternative functions.*

| Symbol | Pin | Description |
|---|---|---|
| SEC_PSCHS | 30 | • Secondary pyrotechnic switch controller high-side switch output.<br>• For MC33776 and MC33778 connect to SEC_VBAT |
| SEC_PSCCER | 31 | • Secondary pyrotechnic switch controller capacitor.<br>• For MC33776 and MC33778 connect to SEC_VBAT |
| SEC_VBAT | 32 | Device supply voltage and secondary pyrotechnic switch controller charge input. |
| SEC_IO7 | 33 | • Secondary digital input/output 7.<br>• Secondar analog measurement input 7. |
| SEC_IO6 | 34 | • Secondary digital input/output 6.<br>• Secondar analog measurement input 6. |
| SEC_IO5 | 35 | • Secondary digital input/output 5.<br>• Secondar analog measurement input 5. |
| SEC_IO4 | 36 | • Secondary digital input/output 4.<br>• Secondar analog measurement input 4. |
| SEC_IO3 | 37 | • Secondary digital input/output 3.<br>• Secondar analog measurement input 3. |
| SEC_IO2 | 38 | • Secondary digital input/output 2.<br>• Secondar analog measurement input 2. |
| SEC_VSSIO | 39 | Secondary I/O ground reference. |
| SEC_IO1 | 40 | • Secondary digital input/output 1.<br>• Secondar analog measurement input 1. |
| SEC_IO0 | 41 | • Secondary digital input/output 0.<br>• Secondar analog measurement input 0. |
| SEC_VDDC | 42 | Secondary VDDC supply output. |
| GPIO0_CS2N | 43 | • General-purpose logic input/output 0.<br>• SPI controller chip select output (CS2N). |
| GPIO1_MISO2 | 44 | • General-purpose logic input/output 1.<br>• SPI controller data input (MISO2). |
| GPIO2_SCL_SCLK2 | 45 | • General-purpose logic input/output 2.<br>• I²C controller clock input or output (SCL).<br>• SPI controller clock output (SCLK2). |
| GPIO3_SDA_MOSI2 | 46 | • General-purpose logic input/output 3.<br>• I²C controller data input or output (SDA).<br>• SPI controller data output (MOSI2). |
| CSN_RXTXLN | 47 | • SPI target chip select input (CSN).<br>• TPL RX negative input from lower node.<br>• TPL TX negative output to lower node. |
| RXTXLP | 48 | • TPL RX positive input from lower node.<br>• TPL TX positive output to lower node. |
| MOSI_RXTXHP | 49 | • SPI target data input (MOSI).<br>• TPL RX positive input from upper node.<br>• TPL TX positive output to upper node. |
| SCLK_RXTXHN | 50 | • SPI target clock input (SCLK).<br>• TPL RX negative input from upper node.<br>• TPL TX negative output to upper node. |
| GPIO4_MISO | 51 | • SPI target data output (MISO).<br>• General-purpose logic input/output 4. |

**Table 2. Pinout LQFP64_EP***...continued*

*Ordered lists describe alternative functions.*

| Symbol | Pin | Description |
|---|---|---|
| VDDIO | 52 | External VDDIO supply input. |
| VSSC | 53 | VDDC ground reference. |
| SEC_VREF2V5 | 54 | Secondary 2.5 V reference voltage. |
| DNC5 | 55 | Do not connect. Keep floating in the application. |
| PRM_VREF2V5 | 56 | Primary 2.5 V reference voltage. |
| DNC6 | 57 | Do not connect. Keep floating in the application. |
| PSC_CFG | 58 | • Pyrotechnic switch controllers capacitor charging configuration pin.<br>• For MC33776 connect to GND. |
| PRM_PSCGND | 59 | • Primary pyrotechnic switch controller ground.<br>• For MC33776 connect to GND. |
| PRM_PSCLS | 60 | • Primary pyrotechnic switch controller low-side switch input.<br>• For MC33776 connect to GND. |
| DNC7 | 61 | Do not connect. Keep floating in the application. |
| PRM_PSCHS | 62 | • Primary pyrotechnic switch controller high-side switch output.<br>• For MC33776 connect to PRM_VBAT. |
| PRM_PSCCER | 63 | • Primary pyrotechnic switch controller capacitor.<br>• For MC33776 connect to PRM_VBAT. |
| PRM_VBAT | 64 | • Device supply voltage and primary pyrotechnic switch controller charge input. |
| GNDFLAG | GNDFLAG | Grounded exposed pad. |

# 7 Limiting values

**Table 3. Limiting values**

*All voltages are defined relatively to the ground.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Voltage and current ratings** | | | | | | |
| $V_{BAT}$ | PRM_VBAT and SEC_VBAT input voltage | — | -0.3 | — | 35 | V |
| $V_{DDA}$ | PRM_VDDA and SEC_VDDA voltage | — | -0.3 | — | 1.65 | V |
| $V_{DDC}$ | PRM_VDDC and SEC_VDDC voltage | — | -0.3 | — | 5.5 | V |
| $V_{REF5V0}$ | PRM_VREF5V0 and SEC_VREF5V0 voltage | — | -0.3 | — | 5.5 | V |
| $V_{REF2V5}$ | PRM_VREF2V5 and SEC_VREF2V5 voltage | — | -0.3 | — | 3 | V |
| $V_{i(IO)}$ | General-purpose voltage measurement input voltage (PRM_IOx and SEC_IOx) (x = 0 to 7) | — | -0.3 | — | 5.5 | V |
| $V_{i(GPIO)}$ | Digital general-purpose input output (GPIO0_ CS2N, GPIO1_MISO2, GPIO2_SCL_SCLK2, GPIO3_SDA_MOSI2, GPIO4_MISO) | — | -0.3 | — | 5.5 | V |
| $V_{i(ISENSE)}$ | PRM_ISENSEP, PRM_ISENSEN, SEC_ ISENSEP, SEC_ISENSEN precision current measurement input voltage | — | -0.4 | — | 5.5 | V |
| $V_{i(VISENSE)}$ | PRM_VISENSEP, PRM_VISENSEN, SEC_ VISENSEP, SEC_VISENSEN precision voltage and current measurement input voltage | — | -0.4 | — | 5.5 | V |
| $V_{i(PSC)}$ | PRM_PSCHS, PRM_PSCLS, SEC_PSCHS, and SEC_PSCLS voltage | — | -0.3 | — | 25 | V |
| $V_{i(CER)}$ | PRM_PSCCER and SEC_PSCCER voltage | — | -0.3 | — | 25 | V |
| $V_{i(CFG)}$ | PSC_CFG input voltage | — | -0.3 | — | 5.5 | V |
| $I_{reverse(ccl)}$ | Current from PRM_PSCCER to PRM_VBAT or from SEC_PSCCER to SEC_VBAT | Reverse current through the PSC charge current limiter diode in case of power loss | — | — | 100 | mA |
| $V_{i(DDIO)}$ | VDDIO voltage | — | -0.3 | — | 5.5 | V |
| $V_{bus(TPL)}$ | Voltage on TPL communication bus pins (RXTXHP, RXTXHN, RXTXLP, RXTXLN) | — | -27 | — | 40 | V |
| **ESD ratings** | | | | | | |
| $V_{ESD1}$ | Electrostatic discharge voltage | At any pin; human body model (HBM): according to AEC-Q100-002 (100 pF, 1.5 kΩ) | -2 | — | 2 | kV |
| $V_{ESD2}$ | Electrostatic discharge voltage | CSN_RXTXLN, RXTXLP, MOSI_RXTXHP, SCLK_RXTXHN | -4 | — | 4 | kV |
| $V_{ESD3-2}$ | Electrostatic discharge voltage | At all pins; charged device model (CDM): according to JEDEC JS-002-2018 | -500 | — | 500 | V |
| $V_{ESD4-2}$ | Electrostatic discharge voltage | At corner pins; CDM: according to JEDEC JS-002-2018 | -750 | — | 750 | V |
| **Termal ratings** | | | | | | |
| $T_j$ | Junction temperature | — | -40 | — | 150 | °C |
| $T_{reflow(peak)}$ | Peak reflow temperature | Pin soldering temperature limit is for 30 seconds maximum duration. Not designed for immersion soldering. Exceeding these limits may cause a malfunction or permanent damage to the device. | — | — | 260 | °C |
| $T_{stg}$ | Storage temperature | — | -55 | — | 150 | °C |

# 8 Revision history

**Table 4. Revision history**

| Document ID | Release date | Description |
|---|---|---|
| MC3377B_PB | 23 January 2026 | Initial version |

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## Tables



## Figures

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