

# Application Notes

Technical application notes for hardware and software designs and best-practices are stored in the [app-notes Github repository](#):

<https://github.com/particle-iot/app-notes/>

## HARDWARE DESIGNS

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- [AN001 Basic SoM Design](#) is a simple SoM base board. Like a Boron it can be powered by LiPo battery, USB, or an external DC supply. It includes: RGB LED, bq24195 PMIC, MAX17043 Fuel Gauge, USB Connector, LiPo Connector (JST-PH), and M.2 SoM Connector.
- [AN006 Vehicle Power](#) provides sample designs for powering Particle devices in vehicles.
- [AN012 Tracker 1-Wire](#) shows how you can add DS18B20 temperature sensors to your Tracker One and interface with 5V I2C devices.
- [AN013 Tracker GPIO](#) shows how you can add additional GPIO to your Tracker One using the external M8 connector. It includes both 3.3V and 5V design options, as well.
- [AN015 Tracker Breakout](#) is a simple breakout board to help prototype using the Tracker One M8 connector.
- [AN016 Tracker Keypad LCD](#) demonstrates adding a keypad, LCD character display, DAC, and cloud configuration to the Tracker One using the M8 connector.
- [AN018 Tracker Tank Level Sensor](#) shows how to expand the Tracker One via the M8 connector including additional GPIO, ADC, a 240-33 ohm tank level sensor input, and a 12 VDC boost converter.
- [AN019 Tracker Prototype to Board](#) shows how start prototyping with off-the-shelf I2C sensors and the Tracker SoM Evaluation and migrate to using a custom board for the Tracker One M8 Connector.
- [AN020 Tracker 4-20mA Sensor Single](#) shows how connect 4-20mA sensors to the Tracker One. Includes a 24V boost converter that can power from the LiPo battery and overcurrent protection.
- [AN021 Tracker 4-20mA Sensor Quad](#) shows how connect up to four 4-20mA sensors to the Tracker One. Requires an external 12VDC power supply, but includes a boost converter to 24V and an I2C ADC (ADC1015).
- [AN022 Tracker SHT3x Temperature/Humidity](#) shows how to connect 5V I2C devices including the SHT30 and SHT31 temperature and humidity sensors to the Tracker One M8 connector and add data to location publishes.
- [AN023 Watchdog Timers](#) has information about watchdog timers, and hardware and software designs for the TPL5010 and AB1805.
- [AN024 Tracker Relay](#) shows how to connect two different types of relays to the Tracker One using the M8 connector.
- [AN025 Tracker SoM First Board](#) contains the Eagle CAD files for creating your first Tracker SoM base board design.

## SOLUTIONS ACCELERATOR PROJECTS

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- [AN026 Tracker Current Solutions Accelerator](#) shows how to measure AC current using the Tracker One via the M8 connector.

## PROGRAMMING TECHNIQUES

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- [AN002-Device-Powerdown](#) shows how to have an Electron, E Series, or Boron gracefully power down under battery power when the power supply is disconnected then automatically power up when restored. This can be useful in automotive applications or devices powered by a switch

in mains power applications.

- [AN005 Threading Explainer](#) provides detailed information on using execution threads on Particle devices.
- [AN008 Using a Xenon with the Nordic SDK](#)
- [AN009 Firmware Examples](#) provides some annotated code examples, including how to effectively use sleep modes.
- [AN010 Finite State Machines](#) shows some of the ways to effectively structure your code using finite state machines.
- [AN011 Publish to Google Sheets](#) shows how you can publish directly to Google G Suite spreadsheets using webhooks.
- [AN017 Tracker CAN](#) shows how to use the CAN bus for OBD-II to retrieve engine RPM and other useful techniques you may want to use in your own projects.
- [AN023 Watchdog Timers](#) has information about watchdog timers, and hardware and software designs for the TPL5010 and AB1805.

## TROUBLESHOOTING

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- [AN003 Interpreting Cloud Debug](#) shows how to interpret cloud debugging logs to troubleshoot various common issues.
- [AN004 Interpreting Cloud Debug-2](#) is a deep dive into interpreting cloud debug logs and cross-referencing the AT command guide for the u-blox modem.
- [AN007 Tower Info](#) is a tool for location nearby cellular towers.
- [AN014 Tracker I2C Scanner](#) is a version of the I2C scanner application for scanning the I2C bus looking for devices designed to work with the Tracker One M8 connector I2C.

## ASSET TRACKING

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