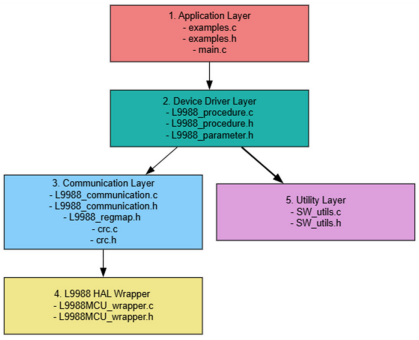
STSW-L9988FW

Data brief

L9988 firmware device driver



Product status link
STSW-L9988FW

Features

- **Complete FW driver for L9988 battery management IC:**
  - configuration and read-out of cells, VBS, VPP, SUM, NTC, CS, CC, SC, OVC
  - cell balancing management (modes, timer, cooldown, OVC during balancing)
- **Modular and portable architecture:**
  - high-level driver module
  - L9988 SPI communication module with 40-bit frame and CRC handling
  - MCU wrapper for SPI, GPIO, PWM, FCCU, delay
  - utility module for bitfield handling and numeric conversions
- **BMS integration and functional safety support:**
  - UV/OV/DEEP-UV thresholds for cell and pack sum
  - VBS/VPP, VBS-SUM, VBS-VPP thresholds and supply diagnostics
  - current protections: OVC, SC in charge/discharge, CC-based wake-up
  - configurable and monitored QeA/PRN watchdog
  - FCCU interface supporting multiple modes (dual-rail, time-switch, bistable)
  - CS/CC and temperature cross-check functions
- **Integrated NVM management:**
  - functions for NVM upload/download
  - NVM upload counter and power-down upload information
- **Power state and FSM control:**
  - power-up sequences through IGN/WAKE pins
  - special commands SW_RST, GO2STBY, GO2SLEEP, watchdog counter reset
- **Easy portability to other MCUs:**
  - porting limited to the L9988MCU_wrapper module (SPI/GPIO/PWM/FCCU/delay)
  - usage examples for cell configuration and measurement readout

Description

The STSW-L9988-DRV package provides the firmware device driver for the L9988 battery management IC, including:

- **High-level configuration and measurement APIs covering all main BMS features:** cell monitoring, current sensing, Coulomb counter, balancing, safety thresholds, diagnostics and watchdog.
  - A **SPI communication layer** implementing the L9988-specific 40-bit protocol (operation, address, frame counter, data, CRC) with error handling and unified error codes.
  - An **MCU wrapper** abstracting hardware resources (SPI, GPIO, PWM, FCCU, delay), enabling easy migration to different microcontroller platforms while keeping the high-level logic unchanged.
  - A **SW_utils module** with macros and helper functions for bitfield manipulation, sign extension and measurement code interpretation, reused across the whole stack.

The driver has been developed using the **SPC582B50E1 MCU** as reference platform, but the separate module architecture makes the software portable to other architectures, preserving:

- A coherent configuration interface (thresholds in mV, currents in µV, temperatures in °C).
- Fine-grained fault, masking and diagnostics control, suitable for automotive BMS applications.

1 Main software modules

Table 1. **Software modules**

Module	Description
L9988 Driver	High-level API to configure and read the device: cells, NTC, GPIO, CS/CC/SC/OVC, balancing, FCCU, watchdog, conversions (SoC, cyclic), thresholds and filters. Also manages special commands, power-up sequences and NVM operations.
L9988 Communication	Implements the L9988 SPI protocol: 40-bit frame packing/unpacking, CRC, frame counter, single and multiple read/write, communication error handling.
L9988 Wrapper	MCU abstraction layer for SPI, GPIO, PWM, FCCU and delay services. It is the only module that needs to be adapted when porting to new MCUs/platforms.
SW Utility	Utility macros and functions to create masks, set/extract bitfields in 32-bit registers and convert two's-complement values with proper sign extension.

2 Key functionalities

Device configuration:

- Enable/disable measurements for cells, VBS, VPP, SUM.
- Configure NTC channels and GPIOs (analog/digital in/out, pull-up/pull-down).
- Set UV/OV/DEEP-UV, open-cell, VBS/VPP/SUM, VBS-SUM, VBS-VPP thresholds.
- Configure CS, CC, SC and OVC/SC thresholds in µV.
- Configure HS-driver (timeout, diagnostics, BIST, IN1/IN2 commands).
- Watchdog QeA/PRN: mode selection, wrong-command reactions, overflow, counters.
- FCCU: protection mode, timing and reaction configuration.
- Conversions: ADCV/CS/CC filters, SoC trigger (SPI/internal timer), cyclic activation in standby.

Power-up sequences and FSM:

- Initialization of MCU GPIOs connected to L9988.
- HW reset handling, wake-up via WAKE, power-up via IGN.
- Special commands for software reset, transition to standby/sleep, watchdog counter reset.

NVM and configuration maintenance:

- NVM uploads and downloads.
- NVM upload counter read-out and power-down NVM upload registers.

Measurement and diagnostics:

- Read cells, VBS, VPP, SUM in mV with data-ready flags.
- Read CS and CC in µV and sample counters.
- Read NTC voltages in mV and die temperature sensors in °C.
- Diagnostics for cell UV/OV/DEEP-UV/BAL_UV, cell-open, NTC OT/UT/FastCharge/Open, VBS/VPP faults, HS-driver status and watchdog.

Fault/event mask management:

- Centralized API to set/get masks to select which faults/events generate reporting.

Revision history

Table 2. **Document revision history**

Date	Version	Changes
16-Jun-2026	1	Initial release.

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