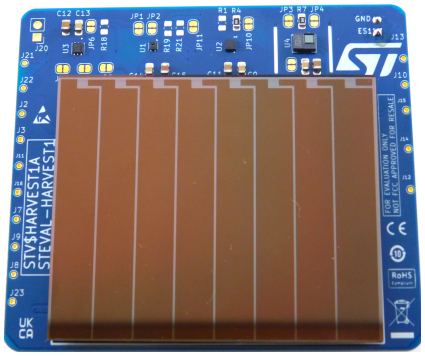
STEVAL-HARVEST1

Data brief

Energy harvesting expansion board for NUCLEO-WL55 LoRaWAN Nucleo board



Product summary	
Solar based energy harvesting expansion board for NUCLEO-WL55	STEVAL-HARVEST1
LPWAN dual-core 32-bit MCU based NUCLEO board	NUCLEO-WL55JC1
Temperature sensor with 0.5°C accuracy	STTS22HTR
3-Axis accelerometer	LIS2DU12TR
Infrared motion and presence detection sensor	STHS34PF80TR
Digital humidity and temperature sensor	SHT40-AD1B
Applications	Energy harvesting

Features

- Energy harvesting board, based on a solar panel and sensors
- STTS22H, LIS2DU12, STHS34PF80, and SHT40 mounted on the board:
  - STTS22H sensor to measure temperature with accuracy ± 0.5°C
  - LIS2DU12 sensor to measure acceleration with selectable full scales of ±2 g, ±4 g, ±8 g, ±16 g
  - STHS34PF80 sensor to detect the presence and motion of an object
  - SHT40 sensor to measure relative humidity and temperature from Sensiron
- The board, connected to NUCLEO-WL55JC1, can send the LoRa packet using only energy harvested from a solar panel mounted on the board. It is a battery free solution
- Besides running the user application, the STM32WL manages energy through a ceramic capacitor charged by solar power, without requiring an external PMIC, while also handling radio connectivity
- The packet consists of data from sensors (STTS22H, LIS2DU12, STHS34PF80, SHT40) mounted on the STEVAL-HARVEST1
- Compatible with STM32 NUCLEO-WL55 board
- Equipped with Morpho connector
- RoHS compliant

Description

The STEVAL-HARVEST1 energy harvesting expansion board is a shield to be used with NUCLEO-WL55JC1, based on STM32WL for LoRa connectivity, with a capability of measuring temperature through the STTS22H sensor, acceleration through the LIS2DU12 sensor, and temperature and relative humidity through the SHT40 sensor (from Sensirion). Moreover, It can detect the presence of stationary and moving human bodies through the STHS34PF80 sensor. The board is self-powered due to the energy harvested using the solar panel mounted on it. The storage capacitor is available for storing energy harvested from the solar panel.

The STEVAL-HARVEST1 expansion board is compatible with the Morpho connector pin assignment, and it can easily be plugged onto a STM32 NUCLEO-WL55 development board.

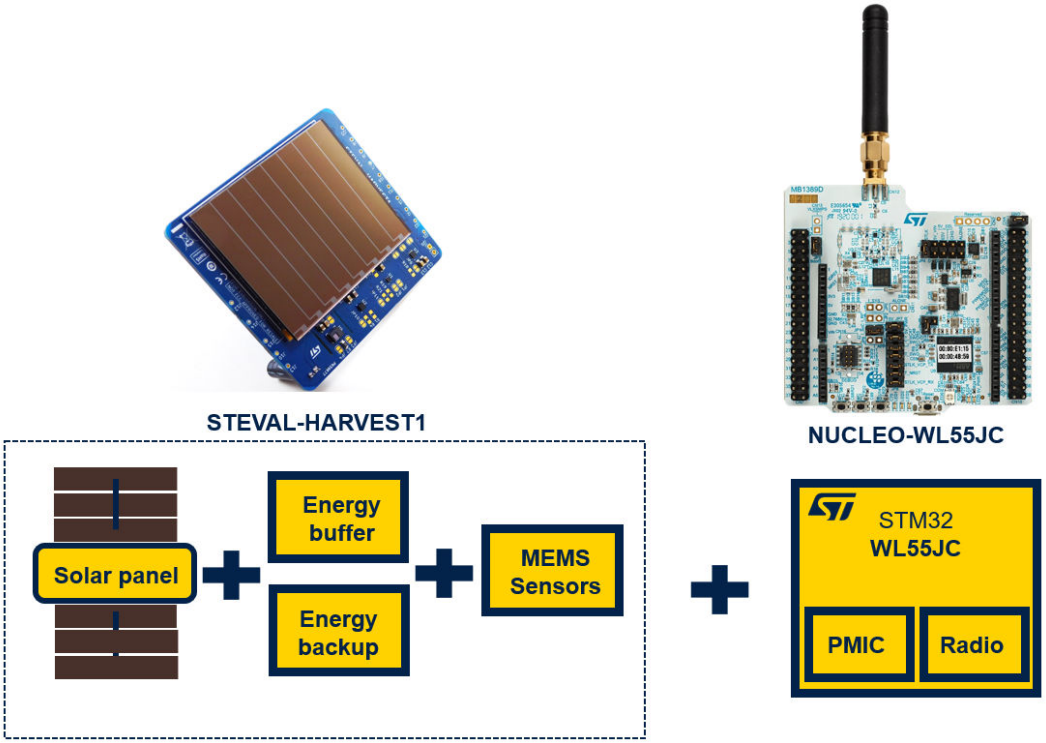
In this application, the STM32WL55 reads sensors and stores data in an internal memory. It manages energy by buffering it on a dedicated ceramic capacitor located at the bottom of the board, using solar power from both indoor and outdoor environments, without requiring an external PMIC. Additionally, it handles radio connectivity, specifically using the LoRaWAN protocol.

The board includes ceramic capacitors to store energy, which is used to run the application (sensor reading and LoRaWAN message transmission) during the day, as well as a SuperCAP to store energy for nighttime use.

1 Detailed description

The STEVAL-HARVEST1 is a shield powered by a solar panel and sensors to be used in combination with STM32 NUCLEO-WL55 board with LoRaWAN connectivity. It measures the temperature through STTS22H sensor, acceleration through LIS2DU12 sensor, and humidity through SHT40 sensor. A STHS34PF80 sensor detects the presence and motion of an object. Solar energy is stored in the capacitor. Periodically, the system wakes up, reads the sensors, and sends the data via a LoRaWAN message. The LoRA packet consisting of these sensor's data is sent by STM32WL55. For this solution, a dedicated PMIC isn't required because the STM32WL55 itself can manage energy harvesting. Both NUCLEO and STEVAL-HARVEST1 are driven by voltage buildup across storage capacitor charged by solar panel. No external power is required.

Figure 1. Functional block diagram



NUCLEO-WL55 boards are based on STM32WL55, which are long-range wireless and ultra-low-power devices. They embed a powerful and ultra-low-power LPWAN-compliant radio solution, supporting the following modulations: LoRa®, (G)FSK, (G)MSK, and BPSK. In this application's use case, we provide a LoRaWAN communication protocol example.

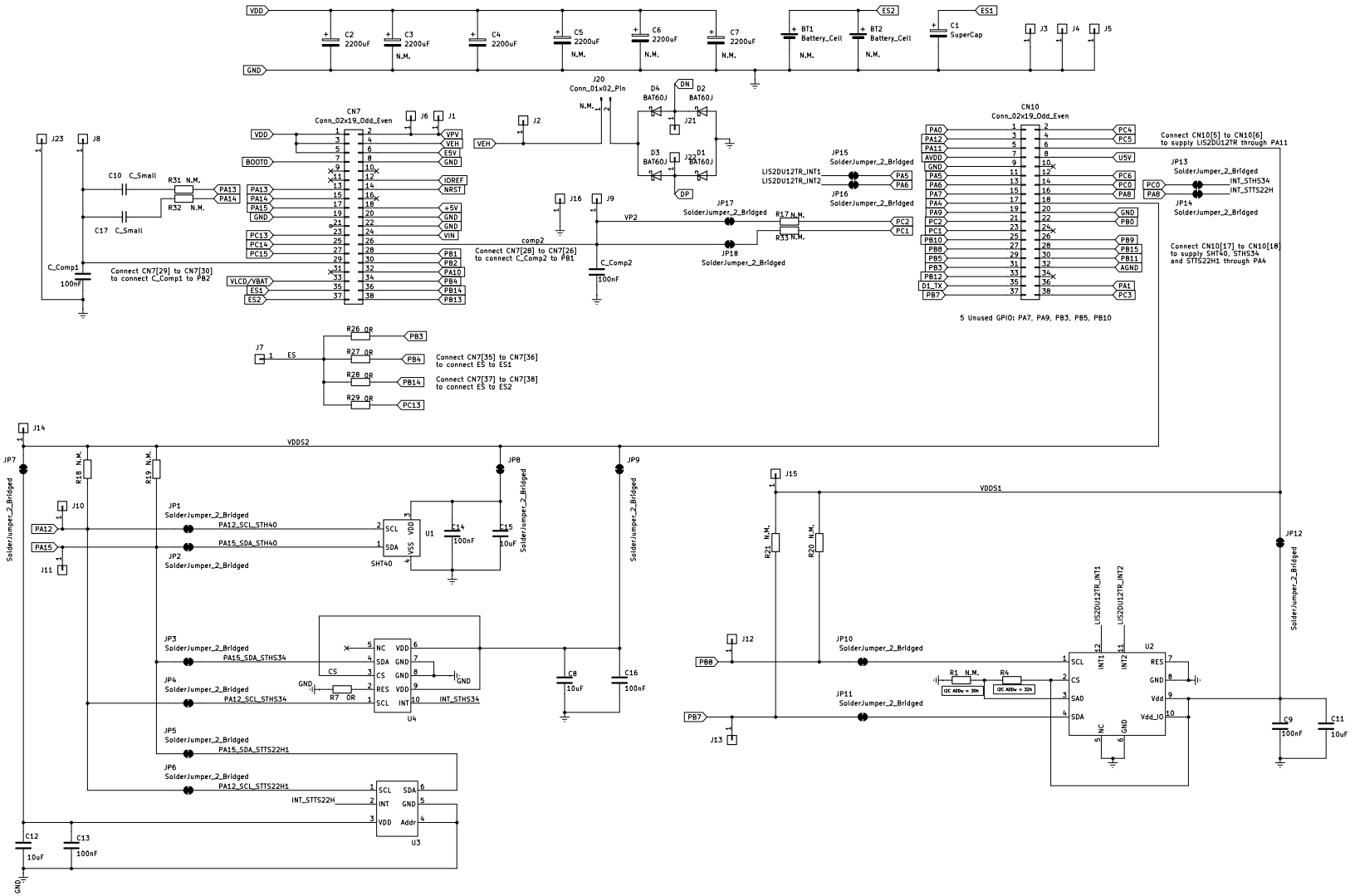
The sub-GHz radio is an ultra-low-power radio operating in the 150 ~ 960 MHz ISM band. LoRa and (G)FSK modulations are in transmit and receive, and BPSK and (G)MSK are in transmit only. They allow an optimal trade-off between range, data rate and power consumption. This sub-GHz radio is compliant with the LoRaWAN® specification v1.0 and radio regulations, such as ETSI EN 300 220, EN 300 113, EN 301 166, FCC CFR 47 part 15, 24, 90, 101, and the ARIB STD-T30, T-67, and T-108.

The LoRa® modulation is available in STM32WLx5xx only. These devices are designed to be extremely low-power and they are based on the high-performance Arm Cortex®-M4 32-bit RISC core, operating at a frequency up to 48 MHz.

The STM32WL55 wakes up using the power voltage detector (PVD) feature, embedded on the MCU. It harvests the energy through the solar panel and, once there is voltage buildup across the storage capacitor, it crosses the threshold voltage and the MCU wakes up. Then the MCU initializes all the ICs (STTS22H, LIS2DU12, STHS34PF80, SHT40) and it takes the reading. The LoRA packet consisting of all the sensors data is sent. Finally, the MCU enters in STOP Mode. This step keeps repeating.

2 Schematic diagrams

Figure 2. **STEVAL-HARVEST1 circuit schematic**



Revision history

Table 1. **Document revision history**

Date	Revision	Changes
23-Jul-2025	1	Initial release.

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