Getting started with the STEVAL-GPT001V1 SensorTile add-on development kit powered by thin-film solar modules

Introduction

The STEVAL-GPT001V1 is an add-on development kit for the STEVAL-STLCS01V1 SensorTile module.

The kit and the module create a whole system which represents a multi-sensor IoT node with increased energy autonomy thanks to the power harvested from thin-film solar modules (under indoor or outdoor lighting conditions) and conditioned to recharge the battery through the SPV1050TTR energy harvester and battery charger.

The STEVAL-GPT001V1 kit consists of a watch-shaped silicon strap embedding three PV panels, a cradle board (which is an evolution of the STLCR01V1 SensorTile Cradle board) whose core product is the SPV1050TTR and the power management section to recharge a 100 mAh Li-Po battery.

The SPV1050TTR optimizes the energy harvested from the PV panels, thanks to the embedded MPPT algorithm, and recharges the battery while guaranteeing over-voltage and under-voltage protection; the harvested energy allows a longer system autonomy and makes available a 3.3 V LDO output to supply the STEVAL-STLCS01V1 SensorTile module.

The customized STSW-GPT001V1 software offers a complete framework to build a typical multi-sensor node application and to monitor battery charge, system autonomy, recharge time and the energy stored.

The firmware can be uploaded onto the STEVAL-STLCS01V1 SensorTile module via the STEVAL-GPT001V1 cradle board SWD connector.

Figure 1. STEVAL-GPT001V1 development kit

1 Getting started

1.1 Hardware description

1.1.1 Kit overview

The STEVAL-GPT001V1 kit is an add-on to the SensorTile cradle board with on-board charger for Li-Ion and Li-Po batteries, a fuel gauge and a humidity and temperature sensor, housed in a watch-shaped silicon strap with embedded PV solar panels.

The user can plug the STEVAL-STLCS01V1 SensorTile module to the STEVAL-GPT001V1 via a dedicated connector (CN2).

The kit has been designed for evaluation purpose and to support the development and prototyping phase of new projects.

A complete hardware and software file package is available at www.st.com containing:

- Hardware files (schematics, Gerber, BoM)
- Software files:
  - Basic firmware (.hex), running on STEVAL-STLCS01V1 SensorTile module
  - Complete software app. (.apk) to monitor and run the whole system features via smartphone and tablet

The kit features:

- Sensor Tile Cradle with SPV1050TTR energy harvester and battery charger, humidity and temperature sensor, gas gauge, lithium battery charger, micro-USB port, ON/OFF switch and breakaway SWD connector
- 3.7 V / 100 mAh Li-Po battery
- SWD programming cable
- Silicon strap embedding the thin-film flexible solar modules and housing the SensorTile Cradle and the battery
- Software libraries and tools:
  - STSW-GPT001V1: dedicated SensorTile firmware package supporting different algorithms tailored to the on-board sensors and computation of system autonomy and charge stored in the battery
  - FP-SNS-ALLMEMS1: STM32 ODE function pack
  - FP-SNS-MOTENV1: STM32Cube function pack
  - STBLESensor: iOS and Android demo apps
  - BlueST-SDK: iOS and Android software development kit
  - Compatible with STM32 ecosystem through STM32Cube support
- STEVAL-STLCS01V1 SensorTile module (not included in the kit)
- Firmware debug/upload through the SWD connector and cable
- RoHS and WEEE compliant

1.1.1.1 *Watch-shaped silicon strap*

The watch-shaped silicon strap has been designed to embed high efficiency flexible PV panels and to host both the STEVAL-GPT001V1 cradle board and the 100mAh battery provided in the STEVAL-GPT001V1 development kit.

The PV panels are connected to the input stage of the STEVAL-GPT001V1 cradle board.

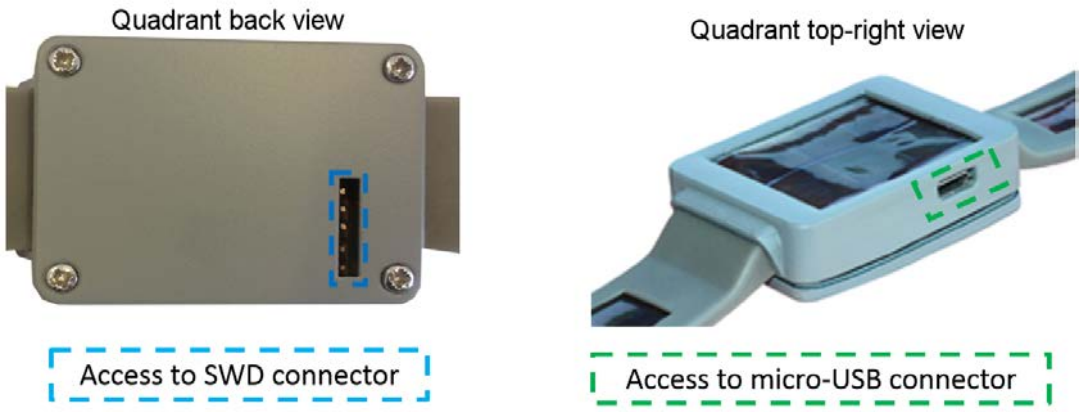
As shown in Figure 1. STEVAL-GPT001V1 development kit:

- A PV panel is embedded in the front quadrant and can reach up to about 4 mW;
- Two PV panels are embedded in the lateral straps and each of them can provide up to about 2 mW each at 1 Sun.

The four PV panels embedded in the strap are connected in parallel, so that, in total, they can supply up to 8 mW at 1 Sun.

Three dedicated slots are available on the back and right side of the quadrant for direct access to the SWD, to the micro-USB connector and to the ON/OFF switch (SW1).

Figure 2. **STEVAL-GPT001V1 kit: smart watch direct access points**



The back cover can be removed to access the battery and the STEVAL-GPT001V1 cradle board.

1.1.1.2 *STEVAL-GPT001V1 cradle board*

The STEVAL-GPT001V1 cradle board hosts and supplies the STEVAL-STLCS01V1 SensorTile module; it increases the autonomy of the SensorTile module when the 5 V USB supply source is not available, thanks to the harvested energy provided by the PV panels.

The cradle board features:

- A pluggable or solderable interface (CN2) for the STEVAL-STLCS01V1 SensorTile module
- SPV1050TTR – high efficiency harvester, battery charger and power manager
- SW1 - ON/OFF switch to enable/disable the LDO supplying the SensorTile module
- STBC08PMR – 800 mA standalone linear Li-Ion battery charger
- HTS221 – capacitive digital sensor for relative humidity and temperature
- STC3115 – fuel gauge IC
- USBLC6-2P6 – very low capacitance ESD protection
- USB type A to micro-B USB connector for power supply and communication
- SWD connector for programming and debugging

1.1.1.3 *Battery*

The battery included in the kit is a one cell (3.7 V) lithium polymer battery able to supply up to 100 mAh (refer to Section 1.4.5 STEVAL-GPT001V1 programming interface for instructions on how to connect the battery to the STEVAL-GPT001V1 cradle board).

1.1.1.4 *SWD cable*

The five-way SWD cable easily allows the STEVAL-GPT001V1 cradle board to be connected to a programmer/debugger system such as ST-LINK V2.1 (refer to Section 1.4.5 STEVAL-GPT001V1 programming interface for further details on the programming interface).

1.2 Software description

The STSW-GPT001V1 software available with the STEVAL-GPT001V1 development kit is based on the STSW-STLKT01 SensorTile kit software, with the addition of the following functions:

- **Running mode**, which calculates the system autonomy on the basis of the battery current sensed by STC3115 through resistor R9. This computation is based on the STEVAL-STLCS01V1 module average current consumption when the PV modules constitute the available energy source. The software returns the battery charge level, the average current consumption and the estimated overall system autonomy.
- **Sleep mode**: the interrupt to wake up the microcontroller is provided by the accelerometer output being inactive for a time period longer than 1 minute by default. It can be changed and set up according to the specific firmware needs. In this condition, the RTC of the microcontroller remains active to count the time elapsed during the low power consumption mode. Battery charge measurement just before and after the sleep mode allows calculating the amount of charge stored during this time frame.

1.3 STBLESensor app description

1.3.1 SensorTile module activation and transmission

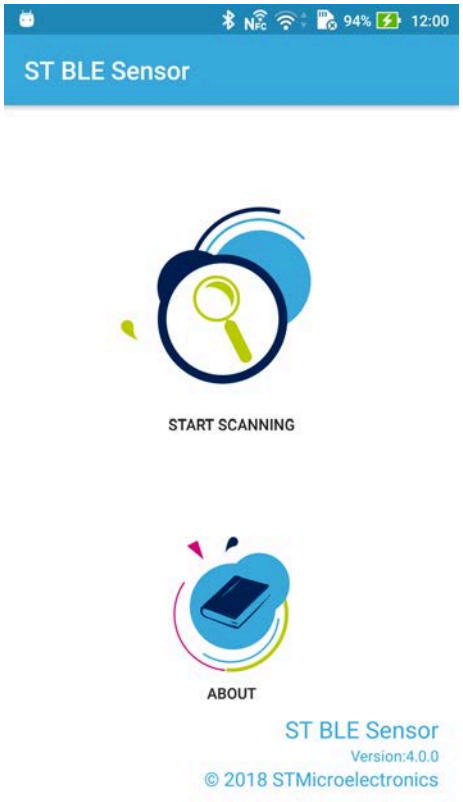
When active (see Section 1.4.1 Startup), the SensorTile module can transmit the environmental data to STBLESensor app for smartphones and tablets.

To start transmitting data, the SensorTile module has to be virtually connected to the app by the scan procedure described below.

Step 1. Launch the STBLESensor app

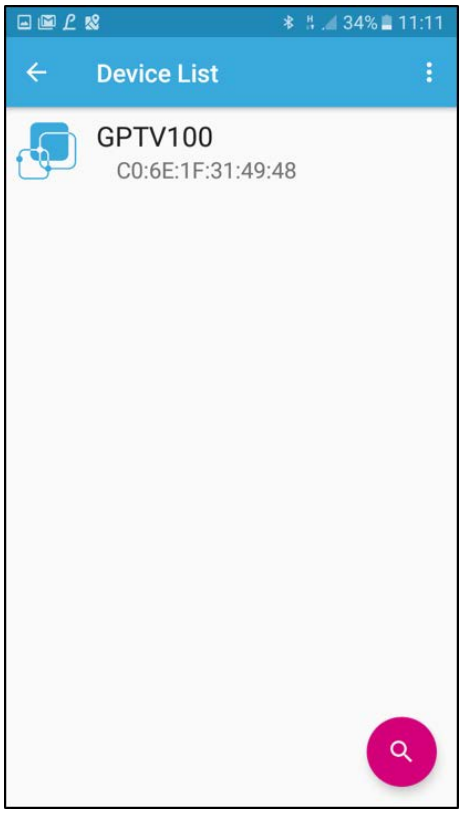
Step 2. Click on the **Start Scanning** icon

Figure 3. STBLESensor app - Start Scanning tab



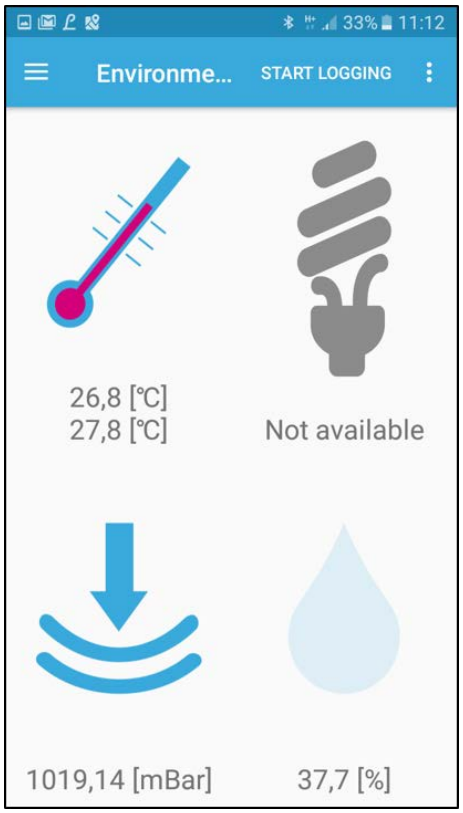
Step 3. After a few seconds the app will show the SensorTile module device list identified by the scanning procedure.

Figure 4. **STBLESensor app - Device List tab**



Step 4. After having selected one among the available devices, the app will automatically move to the **Environmental** tab showing the ambient temperature [°C], pressure [mBar] and humidity [%] values:

Figure 5. **STBLESensor app - Environmental tab**



Step 5. Scroll the display to left/right to move over the different tabs available in the app (plots of environmental sensors, accelerometer, Rssi and battery information).

1.3.2 Rssi and Battery information tab

The Rssi and Battery information tab shows the transmission signal Rssi level and a fully detailed information list related to the battery when the system is powered by solar modules:

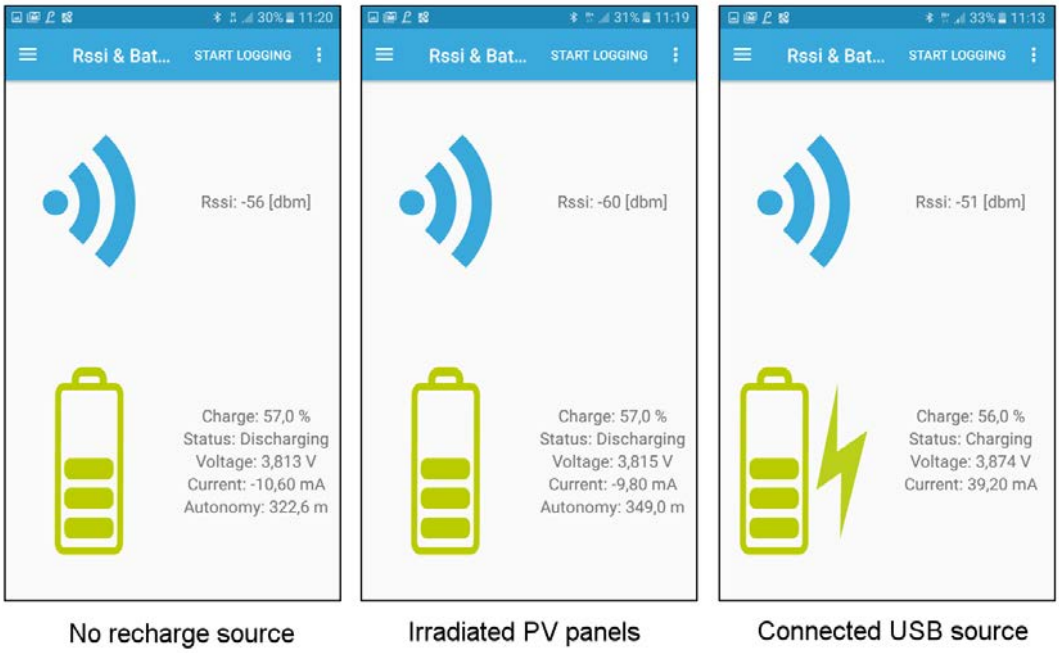
- Charging level [%]
- Status (Discharging/Charging)
- Voltage [V]
- Current [mA] (net current = charging current minus load current)
- Estimated system autonomy [minutes], according to the charge level and to the current drained by the load

The harvested current allows increasing the system autonomy significantly.

The figure below shows the Rssi and battery information tab in 3 different cases:

- without any external recharge source connected to the cradle board (neither USB nor PV panels)
- with PV panels
- with a USB source connected

Figure 6. **STBLESensor app - Rssi and Battery information tab**



The figures below show the increase of system autonomy in minutes thanks to the lighting energy from 6500 K fluorescent lamp (250 to 5 k Lux) and solar (from 0.06 and 1 W/m2) light conditions.

Figure 7. **System autonomy vs. irradiance (indoor)**

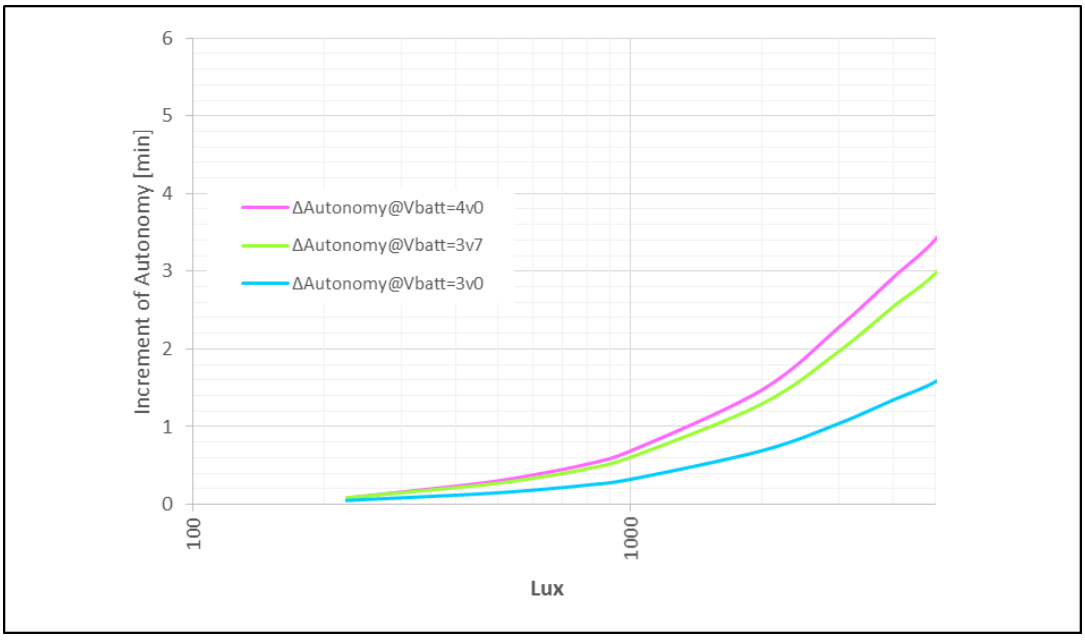
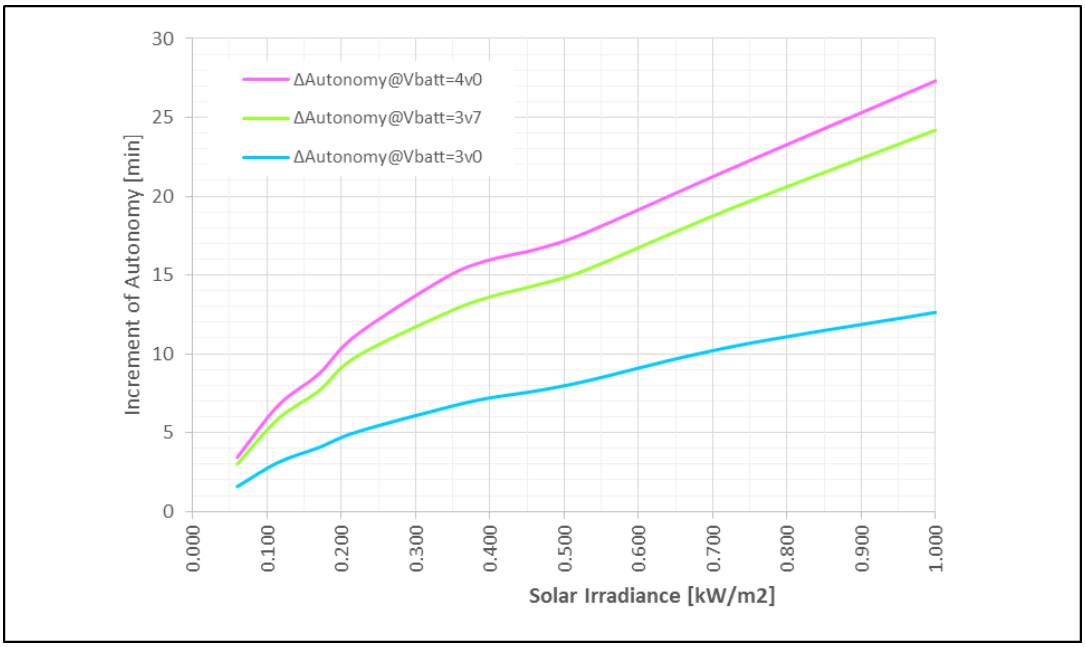


Figure 8. **System autonomy vs. irradiance (outdoor)**

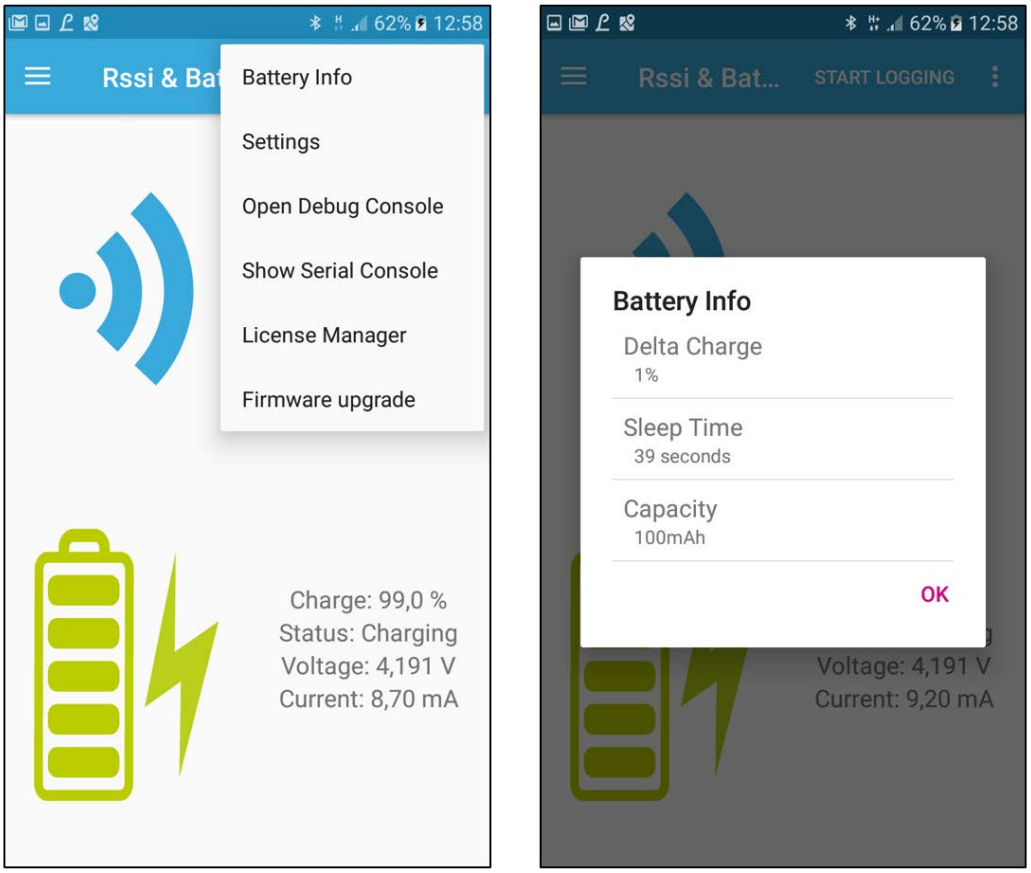


The STSW-GPT001V1 firmware is designed to automatically enter a low consumption mode (sleep mode) in case the app is closed (BLE network processor inactive) and after one minute of inactivity of the SensorTile module accelerometer.

The system automatically restarts working normally when the accelerometer detects a movement.

In the Rssi and Battery information tab, it is possible to monitor system sleep time duration and the amount of charge accumulated at the same time (Delta Charge), as shown in the following picture.

Figure 9. **STBLESensor app - Rssi and Battery information tab after sleep mode**



1.4 System setup

1.4.1 Startup

To start the system up, the SensorTile module and the battery must be plugged into the cradle board; the battery has to be supplied by the PV panels or by a 5 V source otherwise it remains electrically isolated.

The STEVAL-GPT001V1 cradle board power management architecture electrically connects the battery when the voltage on the SPV1050TTR STORE pin triggers the 4.1 V EOC threshold (set by the resistor partitioning R14, R15 and R16) and the Q1 pass transistor is consequently activated (see Section 1.4.3.2 Protection).

The PV panels supply the system when irradiated by a light source: the battery electrical connection and the related recharge are fully managed by the SPV1050TTR (the energy harvesting system is described in Section 1.4.3.3 Recharge through PV modules).

Another option to start the system up is plugging a 5 V source (e.g. USB port) to the micro-USB connector: the battery electrical connection and Q1 activation are managed by SPV1050TTR while the charging profile is managed by the STBC08PMR (with a charge current limited to 50 mA by R5 = 20 kΩ) (see Section 1.4.3.4 Recharge via micro-USB connector).

The SensorTile module is supplied by the 3.3 V LDO integrated in the SPV1050TTR: to enable the LDO, slide the SW1 to ON position.

Note: Regardless of the SW1 status, the 3.3 V LDO is forced off by the SPV1050TTR until Q1 is OFF.

If the quadrant back case is open, you can check if the STEVAL-STLCS01V1 module is powered on through the red LED placed in the bottom right corner (blinking = power on).

If the back case is closed, you can check if the SensorTile module is working by launching the scan procedure on the dedicated app (see Section 1.3.1 SensorTile module activation and transmission).

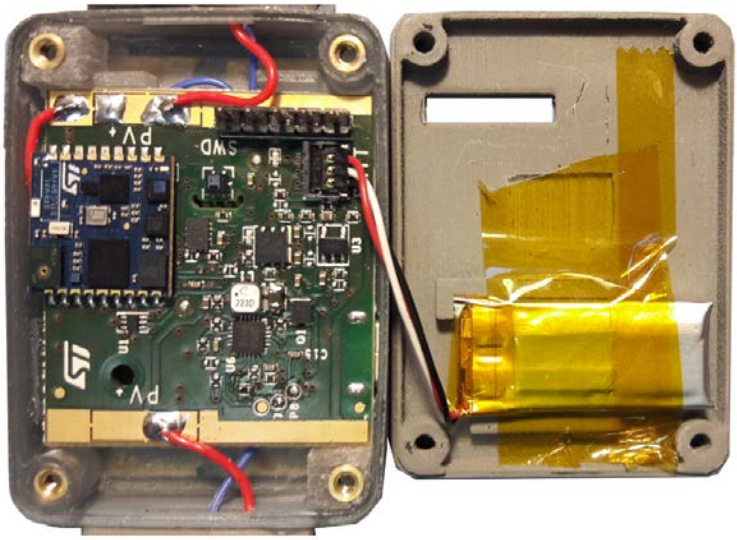
1.4.2 SensorTile module connection

The SensorTile (STEVAL-STLCS01V1) is a tiny, square-shaped IoT module built on an 80 MHz STM32L476JG microcontroller and a Bluetooth low energy connectivity based on BlueNRG network processor as well as a wide spectrum of motion and environmental MEMS sensors, including a digital microphone.

Figure 10. STEVAL-STLCS01V1 SensorTile module

The SensorTile module is not included in the STEVAL-GPT001V1 kit but can be purchased separately and easily plugged to the STEVAL-GPT001V1 cradle board via CN2 connector (as shown in the figure below).

Figure 11. SensorTile module connected to the STEVAL-GPT001V1 cradle board



1.4.3 Battery

1.4.3.1 *Connection*

The STEVAL-GPT001V1 development kit contains a battery disconnected from the board.

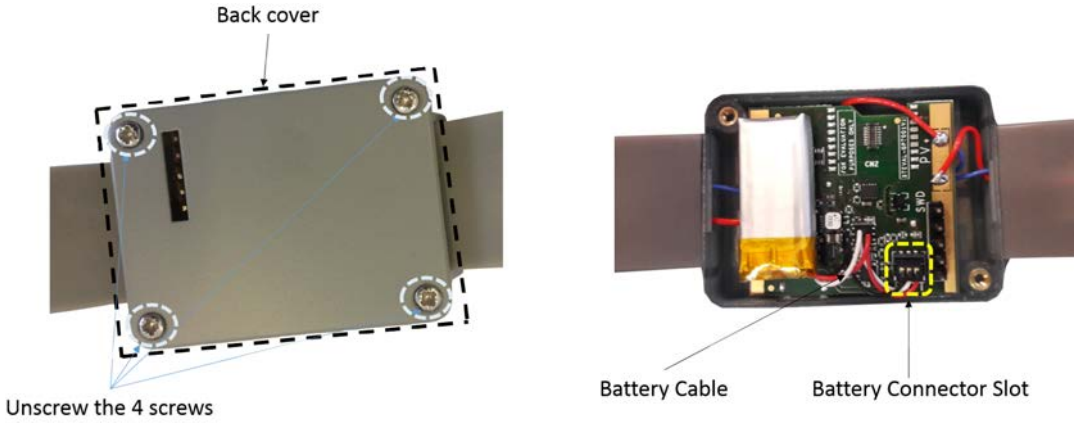
To connect the battery:

Step 1. Unscrew and remove the cover on the back of the quadrant.

Step 2. Plug the battery cable in the related BATT connector slot.

Step 3. Place the cover back, paying attention to the SWD connector position, and screw it in place.

Figure 12. STEVAL-GPT001V1 watch-shape silicon strap (external back view) and battery connection (internal view)



1.4.3.2 *Protection*

The high precision voltage monitoring on the SPV1050TTR STORE pin allows a reliable recharge or discharge of the battery avoiding over-voltage or under-voltage events that may shorten the battery lifetime or damage the battery itself. In fact,in both cases, the SPV1050TTR stops supplying or draining current when the concerned set threshold is triggered.

When the battery is connected, the pass transistor Q1 remains OFF until the system is supplied.

Q1 activation occurs when the STORE pin voltage triggers EOC threshold = 4.1 V.

When Q1 is not active the voltage on its body diode (V_{FW}) links the STORE pin voltage to the battery voltage ($V_{STORE} = V_{FW} + V_{BATT}$).

Thus, the V_{FW} defines the minimum battery voltage level for the system to connect the battery: Q1 is ON and the battery can start supplying the load only when $V_{BATT} = 4.1\ V\text{-}V_{FW}$.

The V_{FW} can vary according to the current flowing through Q1 body diode ($V_{FW} = 150\ mV_{@IFW=500nA}$; $V_{FW} = 500\ mV_{@IFW=50mA}$).

Vice versa, when the STORE pin voltage is below the UVP threshold (2.4 V according to R15, R16, R17 settings), the SPV1050TTR turns Q1 off to disconnect the battery from the load.

1.4.3.3 *Recharge through PV modules*

The SPV1050 controls the PV panel harvesting and conditioning of the extracted power to recharge the battery.

It integrates a high efficiency boost architecture which, combined with the high accuracy MPPT algorithm, ensures long SensorTile module autonomy and battery recharging in indoor and outdoor conditions(For further details, refer to the SPV1050 datasheet at www.st.com.).

The STEVAL-GPT001V1 cradle board embeds a sensing circuit automatically able to track the environmental irradiance and to optimize the system MPP working point. It is based on an operational amplifier (TSU111) in differential configuration that discriminates the PV panel current values above 1 mA or below 0.8 mA as per firmware value set-up.

By default, its companion Q2 MOSFET is OFF and the whole harvesting system is optimized for indoor irradiation conditions(i.e. The input current is below 0.8 mA (~6 k Lux or 50 mW/m2)).

On the contrary, if the input sensed current is higher than 1 mA (Corresponding to ~10 k Lux or 70 mW/m2.), then Q2 switches ON consequently modifying the resistor partitioning ratio on the SPV1050 MPP-SET pin. The MPP has to be changed due to the PV panels different specs below 0.8 and above 1 mA (Vmpp/Voc).

On the battery return path, the STC3115 implements a high performance gas gauge for current and voltage battery monitoring; related data are used by the firmware running on the SensorTile STM32L4 to check the battery charging status, calculate and show either the system autonomy increases in running mode or the battery charge gain after a micro sleep mode period.

The figures below show the energy harvester circuit performance in terms of MPPT accuracy and power conversion efficiency in case of light source from a fluorescent tube lamp 6’500 K (irradiation levels from 250 to 5 k Lux) and from the solar light (from 0.06 to 1 W/m2) irradiation conditions.

Figure 13. STEVAL-GPT001V1 cradle board battery energy harvesting: indoor irradiation

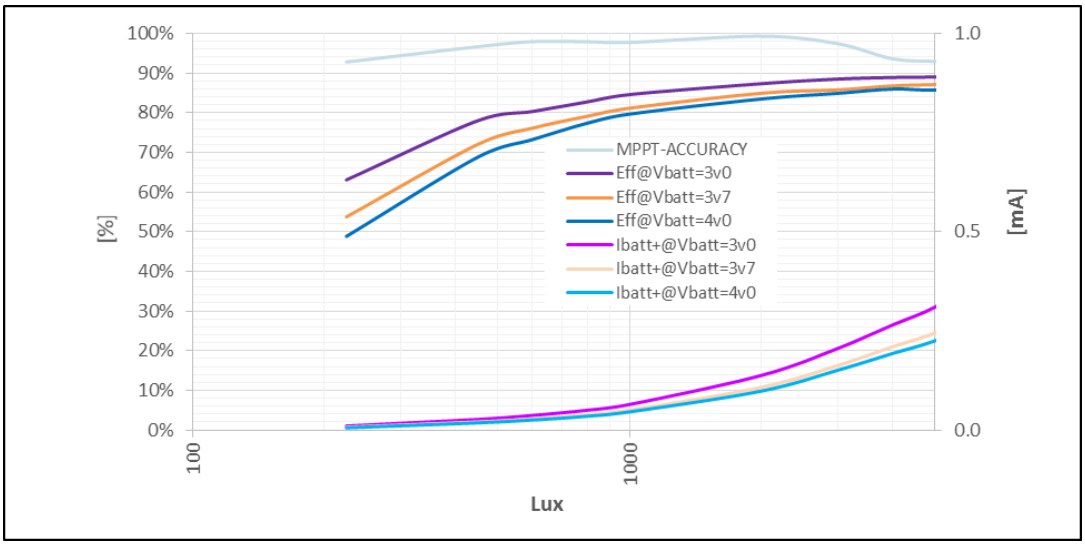
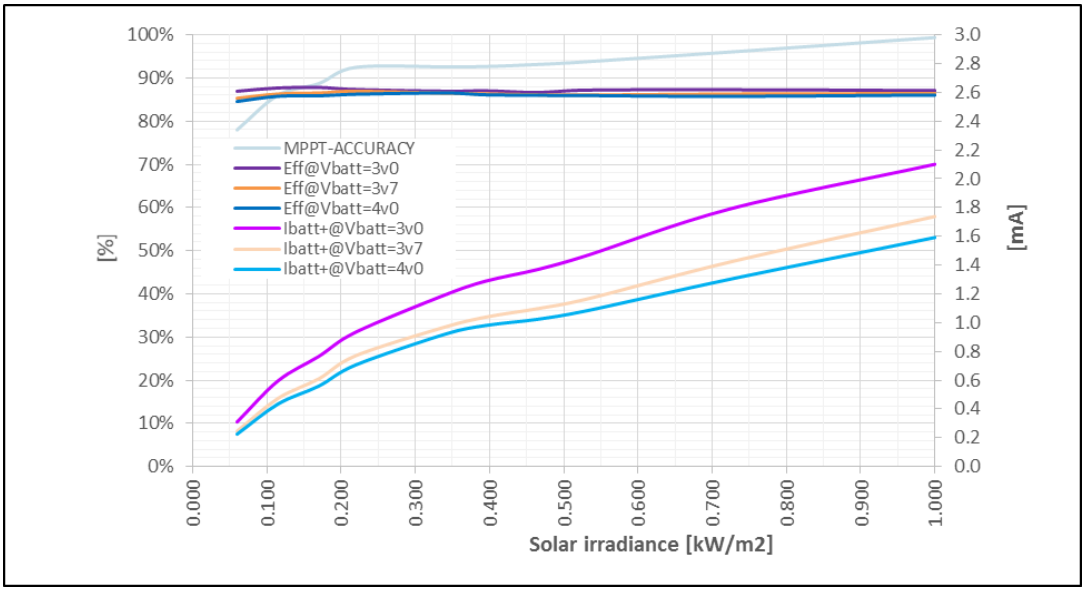


Figure 14. STEVAL-GPT001V1 cradle board battery energy harvesting: outdoor irradiation



1.4.3.4 *Recharge via micro-USB connector*

The STEVAL-GPT001V1 cradle board has an ESD protected micro-USB connector that can be plugged to a 5 V supply source (e.g., a USB port) to activate a fast battery recharge controlled by the STBC08PMR(For details on the device, refer to the related datasheet at www.st.com).

The ESD protection is featured by USBLC6-2P6, a monolithic application specific device dedicated to high speed interfaces. The very low line capacitance ensures a high level of signal integrity without compromising sensitive chip protection against the most stringently characterized ESD strikes.

The STBC08PMR is a constant current/constant voltage charger for single-cell Li-Ion batteries designed to work within USB power specifications.

The charge voltage is fixed at 4.2 V (typical value) and current limitation can be programmed via a single resistor connected between PROG pin and GND.

In the STEVAL-GPT001V1 cradle board current limitation is set at 50 mA by R5 = 20 kΩ.

The red LED (CHRG), mounted between 5 V supply rail and STBC08PMR CHGR pin, remains activated until full battery charge is achieved.

The STBC08PMR BAT output pin is connected to the battery through the SPV1050TTR STORE pin and the pass transistor Q1.(As aforementioned this architecture allows full battery protection by avoiding over-voltage and under-voltage events.)

1.4.4 Humidity and temperature sensor

The HTS221 is an ultra-compact sensor for relative humidity and temperature measurement.

It includes a sensing element (manufactured using a proprietary ST process) and a mixed signal ASIC to provide measurement data through digital serial interfaces.

The sensing element consists of a polymer dielectric planar capacitor structure capable of detecting relative humidity variations and temperature.

The HTS221 is fully monitored by the firmware running on the SensorTile module; thus, the sensed values are displayed by the app dedicated tab(For further details about HTS221, refer to the related datasheet freely downloadable from www. st.com.).

1.4.5 STEVAL-GPT001V1 programming interface

When the SensorTile module is supplied (see Section 1.4.3.1 Connection, Section 1.4.2 SensorTile module connection and Section 1.4.1 Startup) and connected to the STEVAL-GPT001V1 cradle board or to the STLCX01V1 SensorTile Cradle expansion board, the dedicated firmware STSW-GPT001V1 can be uploaded through the SWD cable and an ST-Link programmer.

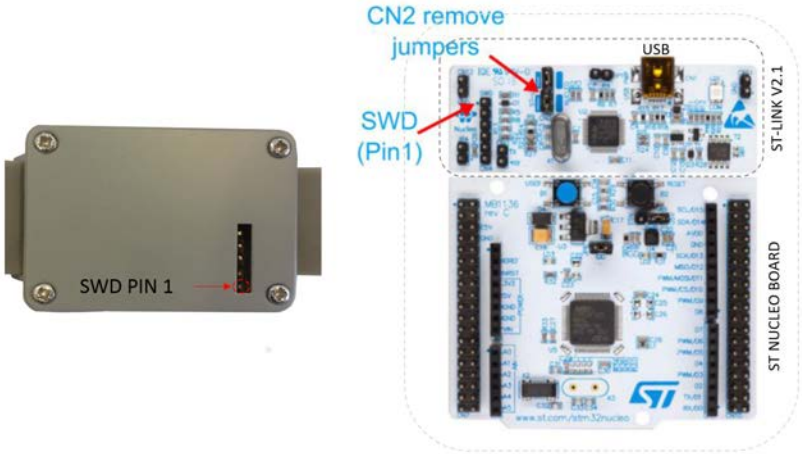
The easiest way is using an STM32 Nucleo board which bundles an ST-LINK V2.1 debugger and programmer.

Step 1. Ensure CN2 jumpers are OFF.

Step 2. Connect your STM32 Nucleo board to the cradle, paying attention to the position of pin 1 on both SWD connectors.

The STEVAL-GPT001V1 SWD connector is directly accessible from the cover back without opening the case.

Figure 15. STEVAL-GPT001V1 cradle board and STM32 Nucleo connection via SWD connectors



Step 3. Connect the ST-LINK V2.1 to a USB port of a PC/laptop where the STM32 ST-LINK Utility is installed.

Step 4. Launch the STM32 ST-LINK Utility and virtually connect it to the ST-LINK V2.1 ([**Target**]>[**Connect**]).

From [**File**]>[**Open**] you can browse your folder and select the file **STSW-GPT001V1.bin**.

Step 5. Upload the firmware **STSW-GPT001V1.bin** ([**Target**]>[**Program & Verify**]>[**Start address: 0x08004000**]).

Step 6. Virtually disconnect the ST-Link V2.1 [**Target Disconnect**].

Step 7. Disconnect the SWD cable from the cradle.

The uploaded firmware starts running automatically.

2 Schematic diagram

Figure 16. STEVAL-GPT001V1 circuit schematic: power and connectors

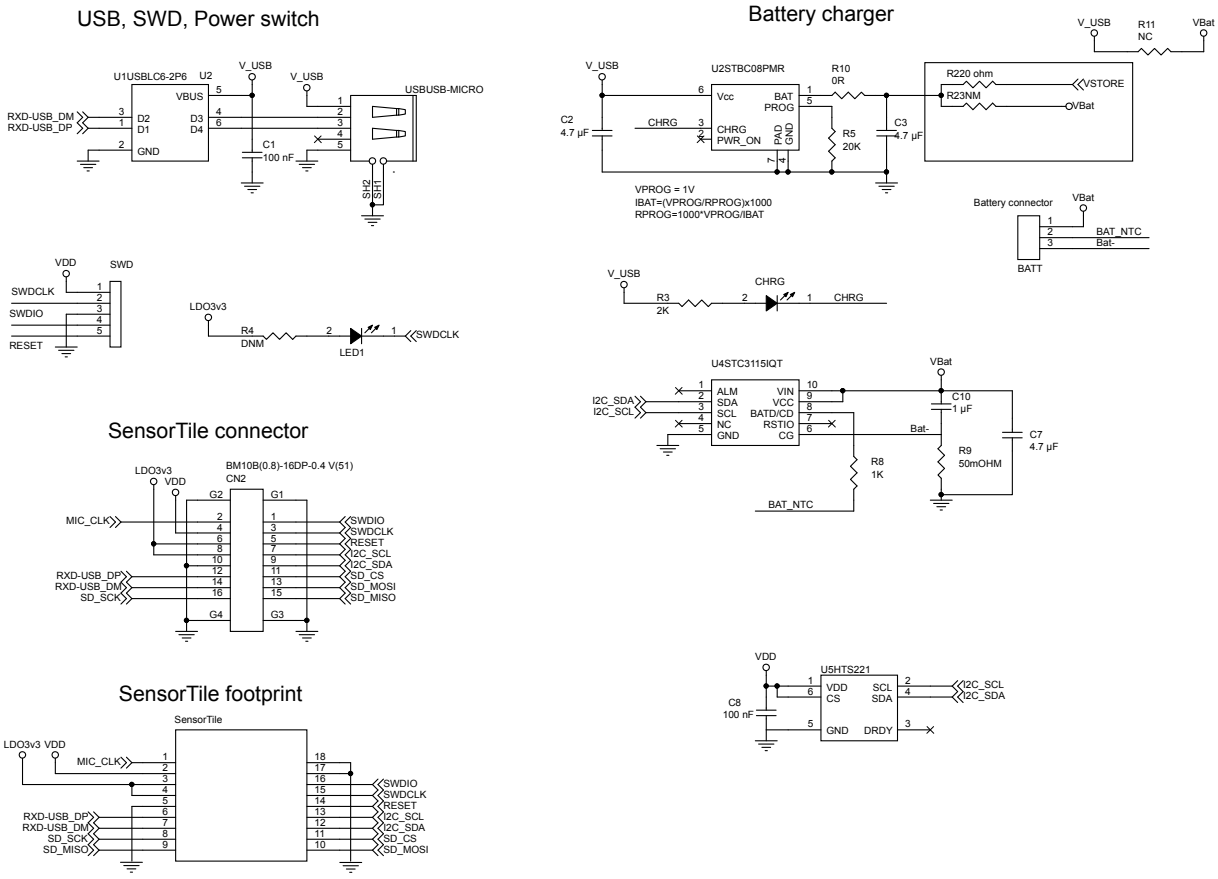
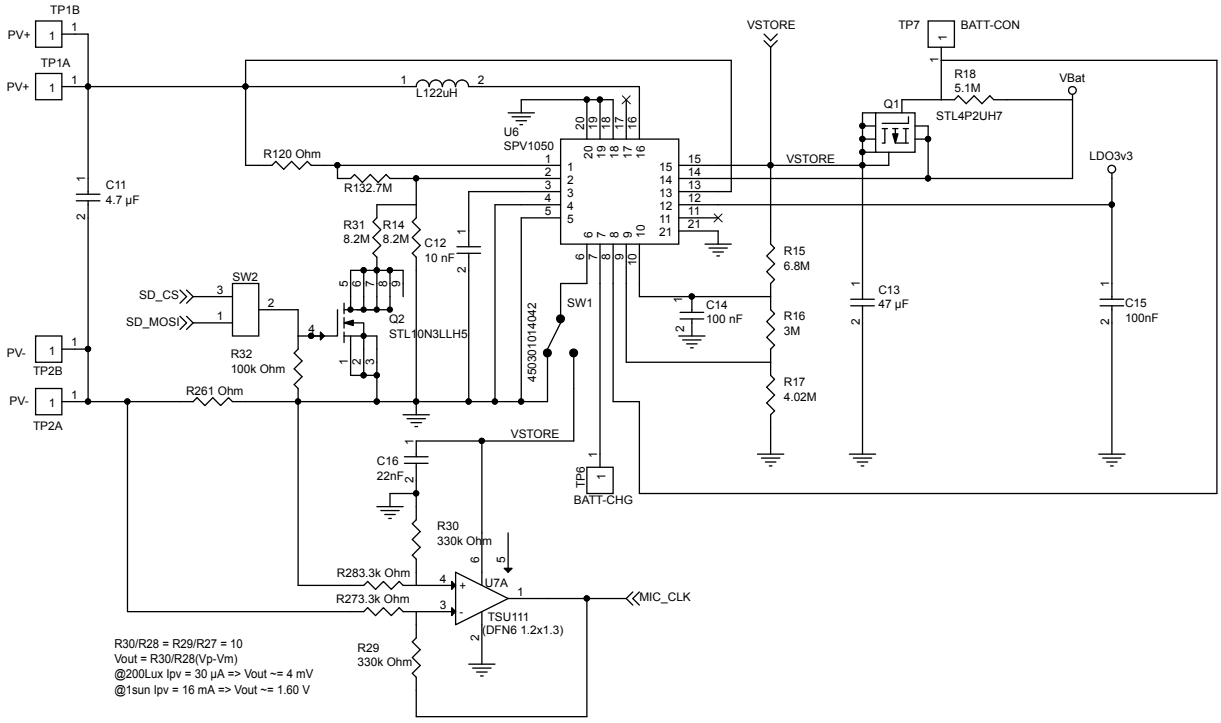


Figure 17. **STEVAL-GPT001V1 circuit schematic: harvesting**



3 Bill of materials

Table 1. **STEVAL-GPT001V1 bill of materials**

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	BATT		Battery connector	Molex	78171-0003
2	1	CHRG	0402	Red LED	Any	
3	4	C1, C8, C14, C15	100 nF 16 V ±10% 0402	Capacitors	Murata	GRM155R71C104KA88J
4	4	C2, C3 C7, C11	4.7 µF 10 V 0402 X5R	Capacitors	Murata	ZRB15XR61A475KE01D
5	1	C10	1 µF 10 V 0402 X5R	Capacitor	Any	
6	1	LED1	0402	Green LED	Any	
7	1	R3	2 kΩ 0402	Resistor	Any	
8	1	R8	1 kΩ 0402	Resistor	Any	
9	1	R5	20 kΩ ±1% 0402	Resistor	Any	
10	0	R4, R11, R23		Resistors (not mounted)	Any	
11	3	R10, R12, R22	0 Ω 63 mW 0402	Resistors	Vishay	CRCW04020000Z0ED
12	1	R9	50 mΩ ±1/16 W 0402	Resistor	Panasonic	ERJ-2BWFR050X
14	1	SWD	Pitch 2.54 mm	Circuit jumper plug	Omron	XJ8B-0511
15	1	SensorTile	SensorTile	SensorTile connectable sensor node	ST	STEVAL-STLCS01V1
16	1	USB		USB Micro-B	GCT	USB3075-30-A
17	1	U1	USBLC6-2P6 SOT666	Very low capacitance ESD protection	ST	USBLC6-2P6
18	1	U2	STBC08PMR DFN6	800 mA standalone linear Li-Ion battery charger with thermal regulation	ST	STBC08PMR
19	1	U4	STC3115IQT DFN10	Gas gauge IC with alarm output for handheld applications	ST	STC3115IQT
20	1	U5	HTS221 HLGA-6L (2 x 2 x 0.9 mm)	Capacitive digital sensor for relative humidity and temperature	ST	HTS221

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
21	1	U6	SPV1050 VFQFPN 3 mm x 3 mm	Ultra low power energy harvester and battery charger with embedded MPPT and LDOs	ST	SPV1050TTR
22	1	L1	22 µH 0.4 A ±20% 3.0x3.0x1.4 [mm3]	Fixed inductor	CoilCraft	LPS3015-223
23	1	C13	47 µF 10 V ±20% 0805	Multilayer ceramic capacitor	EPCOS/TDK	C2012X5R1A476M125AC
24	1	C12	10 nF 16 V ±10% 0402	Capacitor	Murata	GRM155B31H103KA88D
25	1	R13	2.7MΩ 63mW 0402	Resistor	Vishay	CRCW04022M72FKED
26	1	R18	5.1MΩ 63mW 0402	Resistor	Multicomp	MC00625W040215M10
27	1	R14	8.2MΩ 63mW 0402	Resistor	Multicomp	MC00625W040218M20
28	1	R31	5.6MΩ 63mW 0402	Resistor	Multicomp	MC00625W040215M60
29	1	R15	6.8MΩ 63mW 0402	Resistor	Multicomp	MC00625W040216M80
30	1	R16	3.0MΩ 63mW 0402	Resistor	Multicomp	MC00625W040213M00
31	1	R17	4.22MΩ 63mW 0402	Resistor	Vishay	CRCW04024M22FKED
32	1	Q1	STL4P2UH7 PowerFlat 2mm x 2mm	Power MOSFET	ST	STL4P2UH7
33	1	Q2	STL10N3LLH5 PowerFLAT 3.3x3.3	N-channel 30 V, 0.015 Ohm, 9 A, PowerFLAT STripFET V Power MOSFET	ST	STL10N3LLH5
34	1	CN2	BM10B(0.8)-16 DP-0.4V(51) SMT	High contact reliability connector	Hirose Electric Co Ltd	BM10B(0.8)-16DP-0.4V(51)
35	2	TP6, TP7	SMT Ø = 1mm	Test points	Any	
36	1	SW1	3v3 1 row, 3 ways, PTH, 100mils	Switch	Wurth	4.50301E+11
37	1	R32	100 kΩ 100 mW 0402	Resistor	Vishay	CRCW0402100KFKEDHP
38	2	R27, R28	3.3 kΩ 63 mW 0402	Resistors	Rohm	MCR01MZPF3301
39	2	R29, R30	330 kΩ 63 mW 0402	Resistors	Vishay	CRCW0402330KFKED

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
40	1	R26	1 Ω 200 mW 0402	Resistor	Vishay	CRCW04021R00FKEDHP
41	1	C16	22 nF 16 V 0402	Capacitor	AVX	0402YC223KAT2A
42	1	U7A	TSU111 DFN6 1.2x1.3	Nanopower high accuracy CMOS Op-Amp	ST	TSU111IQ1T
43	1	SW2	2 way, JMP-0402-3	Jumper	Any	
44	1	Battery	3.7 V 100 mAh	LiPO-501225 3pin connector	Himax electronics	LiPO-501225
45	1	SWD Cable	2.54 mm, L = 15cm	SWD cable	Any	
46	1	Bracelet		Bracelet	Skorpion	
47	1	PV panel (FRONT)	FlexRB-15-4030 Vmp = 1.5V, Imp = 80µA @1kLUX	PV panel	Ribes Tech	FlexRB-15-4030
48	2	PV panel (LATERAL)	FlexRB-15-4015 Vmp = 1.5V, Imp = 40µA @1kLUX	PV panel	Ribes Tech	FlexRB-15-4015

4 Board layout

Figure 18. STEVAL-GPT001V1: top layer

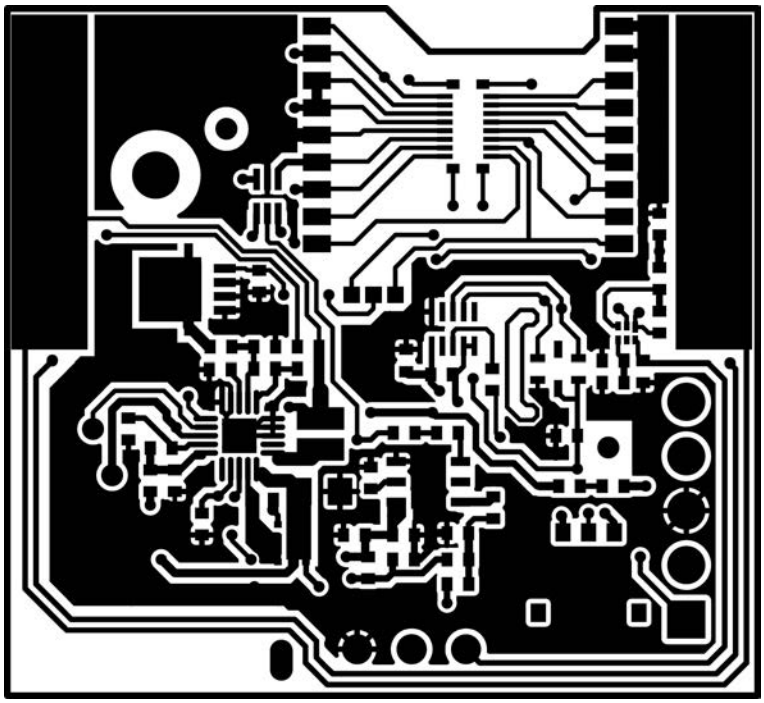


Figure 19. STEVAL-GPT001V1: bottom layer

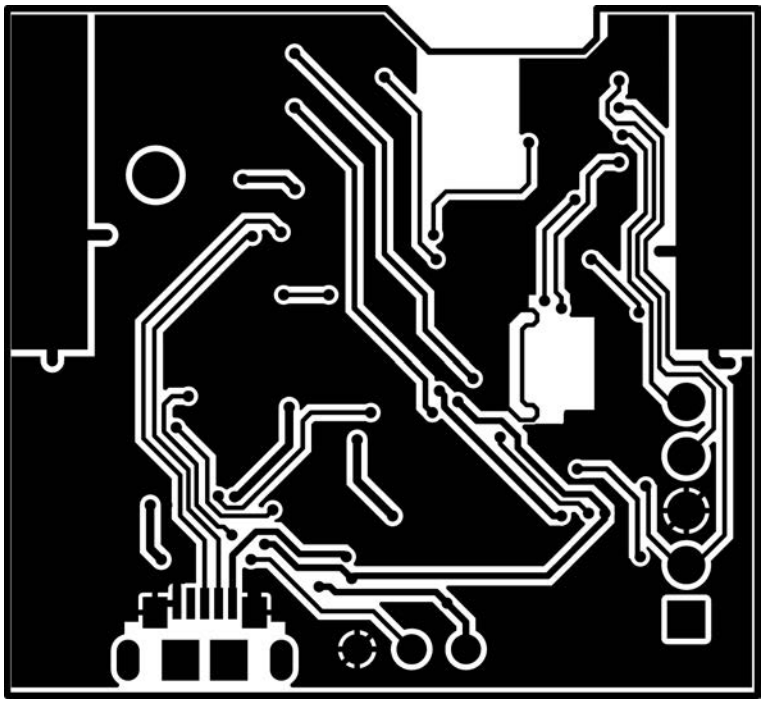
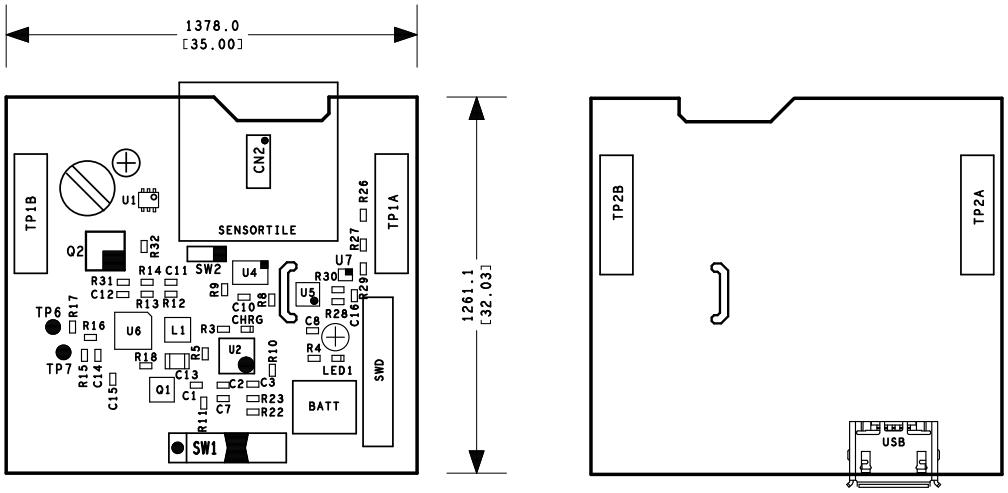


Figure 20. **STEVAL-GPT001V1 component placement (top and bottom layers)**



Revision history

Table 2. **Document revision history**

Date	Version	Changes
25-Sep-2017	1	Initial release.
09-Nov-2018	2	Updated Figure 1. STEVAL-GPT001V1 development kit. Minor text changes.

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