gSKIN® -XU

OEM heat flux sensor

Datasheet v7.4 - 20220103

Features

- Ultra-Compact Heat Flux Sensor
- Compatible with Standard SMT Manufacturing
- Zero Current Consumption
- Minimal Thermal Invasiveness
- Low Impedance
- Low Noise
- Attractive OEM Pricing

Typical Applications

- Fitness and Health Wearables
- Non-Invasive Core Body Temperature Monitoring
- Energy Expenditure Estimation
- Miniaturized Calorimetric Solutions

Description

The gSKIN-XU is an ultra-compact, low-noise thermoelectric heat flux sensor. The sensing technique relies on highly integrated Bi_2Te_3 thermopiles enclosed in a reflow-solderable SMD package.

The XU sensor does not require any power source or bias current for its operation and does therefore not suffer from self-heating effects. The sensor output is a low-impedance bipolar analog voltage signal, comparable to a thermocouple output. Digitalization can be performed directly with a high-resolution ADC.

ADCs with lower precision (e.g. ADC included in MCUs) can also be used if combined with a low-offset pre-amplification stage (Fig. 1).

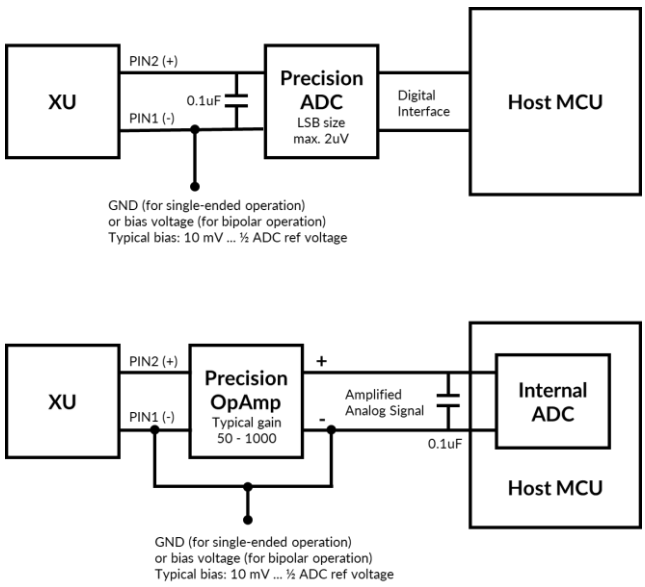


Fig. 1: Typical application circuit

greenTEG AG
Hofwisenstrasse 50A
8153 Rümlang, Switzerland
T: +41 44 515 09 15
info@greenTEG.com
greenTEG.com

Sensor Characteristics

Parameter	gSKIN® XU 22 9C	Unit
Detector Type	Thermoelectric – passive	-
Surface Material (Sensing Area)	Copper and polyimide	-
Sensing Area	2 x 2	mm
Sensor Thickness	0.4	mm
Absolute Thermal Resistance	~198	K/W
Electrical Connection	Bottom side SMD solder pads	-

Electrical Characteristics

Parameter	Min	Max	Unit
Sensitivity (Factory) @ 25°C	0.7	2.0	µV/(W/m^2)
Calibration Error	-5	+5	%
Sensitivity Drift	-	0.25	%/°C
Heat Flux Resolution [a)]	1.0	1.6	W/m^2
Electrical Resistance	1	10	Ohm

[a)] Assuming ADC LSB resolution of 2 µV

Absolute Maximum Ratings

Parameter	Min	Max	Unit
Current at Any Pin	-10	10	mA
Storage Temperature Range	-50	80	°C
Operating Temperature Range	-50	150	°C
Heat Flux Range (Thermal Destruction Limit)	-150	150	kW/m^2
Compressive Clamping Force	-	0.5	Kgf

ESD Considerations

Due to its electrical, geometric, and physical properties, XU sensors are not sensitive to ESD surges.

Sensitivity Bin

Due to variations in the production process, each sensor has a different sensitivity. Every sensor is characterized at the factory and assigned to a bin according to its “raw” sensitivity value (factory sensitivity).

The sensitivity bin is part of the product name:

XU-070501-**X**-CT where “X” stands for the sensitivity bin designation.

The sensitivity bin letter is an important input for the algorithm. Therefore, it is important to track the letter in accordance with the PCB and final device. For strategies of how to do that, please contact greenTEG

IMPORTANT NOTE:

There is no possibility of producing a specific bin on demand. All orders over 1000pcs (=1 reel) will always consist of several reels of different sensitivity bins. One reel only consist of sensor of only one sensitivity bin

Thermal Integration

The factory sensitivity value is only applicable to a “free-standing” sensor. The sensitivity observed in the application is strongly dependent on geometry and materials used for thermal integration into the final device or setup.

The causes are “thermal funnelling” or “thermal short-circuit” effects due to thermal properties of the PCBA as well as of the embedding and encapsulation compounds used.

These integration effects are linear and can be accounted for by introducing a so-called integration factor:

(Device Sensitivity) = (Factory Sensitivity) * (Integration Factor)

Typical integration factor lies between 0.250 to 4.000 and must be derived by a thermal characterization of the final device in a reference setup at greenTEG.

If a reproducible thermal integration is achieved during device assembly, the integration factor must only be derived once on a few representative samples and can thereafter be extrapolated to the entire production lot.

Please contact greenTEG for advice on thermal integration and thermal characterization.

Reel Labelling

Each reel is shipped in a DryLock bag meeting the requirement EIA 541. Each reel is provided with a label on both the external packaging as well as on the reel itself.

The QR-code encodes Article Number, Sensor Lot Number, Sensitivity Bin, and Quantity on reel, separated by semicolons.

Example: **A-044802;LN012605;J;282**

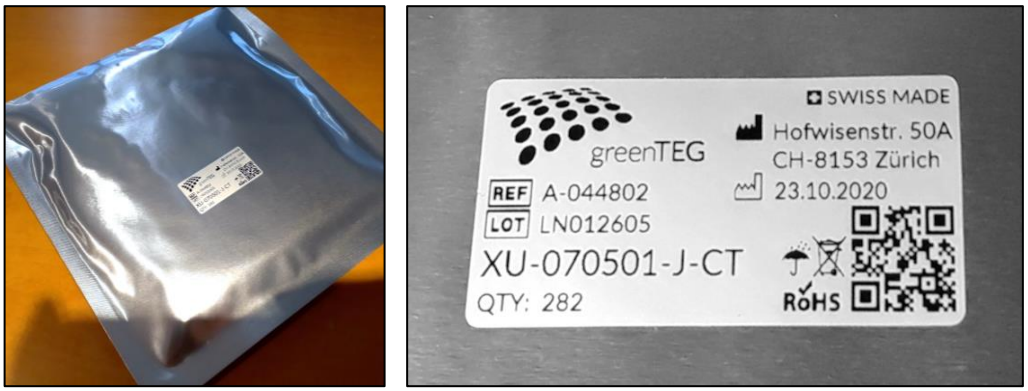


Fig. 2: Reel labelling

Sensor laser marking

Each individual sensor module is laser marked with an unique alphanumeric sensor ID.
The sensor ID is unique and has the following format:

Upper line:	1 or 2 letters followed by 2 digits	e.g.	“R24” or “AB05”
Lower line:	6 digits	e.g.	“002263” or “010029”

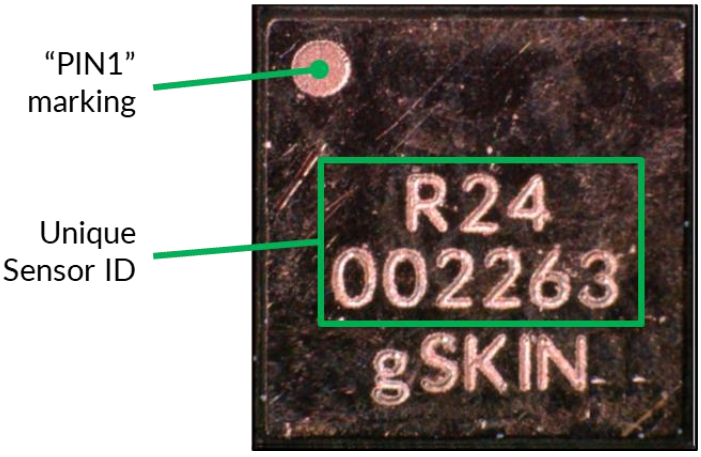
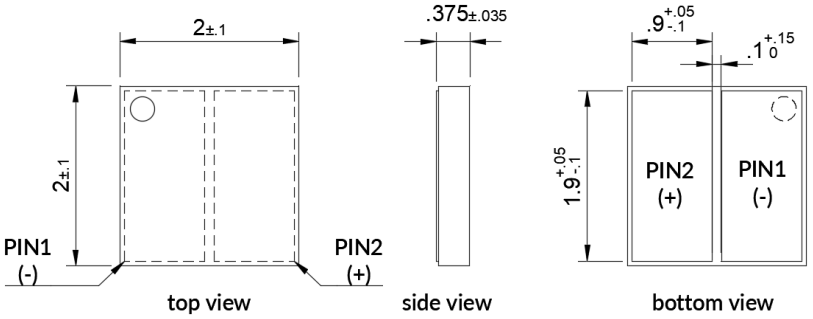


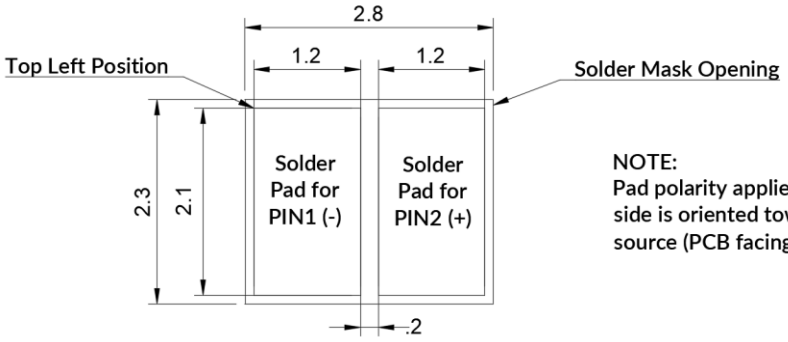
Fig. 3: Sensor top laser marking

Mechanical Information



NOTE:
Pad polarity applies if sensor top side is oriented towards heat source (PCB facing cold side)

Recommended Footprint



NOTE:
Pad polarity applies if sensor top side is oriented towards heat source (PCB facing cold side)

Layout Considerations

Layout requirements strongly depend on intended use and mechanical constraints of the final device.

Please contact greenTEG for advice on thermal integration guidelines best fit to your project.

Reflow and Assembly Guidelines

Pre-bake

The sensor is classified as **MSL 6** (mandatory bake before use). Prebake of the reel prior to soldering reduces risk of thermomechanical stress and sensor damage, especially if there is uncertainty regarding prior storage conditions.

Recommended prebake process is 2-4h vacuum bake at 60°C right before reflow. If vacuum is not available, increase baking temperature to 65-70°C and increase duration to 4-6h.

NOTE: Reel is only resistant to temperatures up to 70°C (warping temperature: 77°C)

Solder Paste

The sensors can be soldered with standard lead-free SAC solder paste. No-clean and halide activated /water soluble solder paste has both been successfully used.

Reflow Profile

Recommended peak reflow temperature is 240°C or less, but temperatures up to 250°C can be tolerated if time at peak temperature is limited to 10 seconds. Recommended time above liquidus is 30-60 seconds.

Cleaning

Board cleaning after reflow is recommended to remove potentially corrosive flux residues. The sensor withstands mild aqueous flux cleaners (neutral to mildly alkaline pH). Alcohol based cleaners are compatible as well. Strongly alkaline cleaners must be avoided as polyimide components of the sensor might be attacked.