



Solar MEMS is a company specialized on the design and development of Fine and Coarse Sun Sensors for High Technology Applications

**RENEWABLE ENERGY
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www.solar-mems.com

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SOLAR MEMS TECHNOLOGIES

Solar MEMS Technologies S.L. is a company of technological-based established on 2009 as a Spin-Off from the School of Engineering of the University of Seville, was founded by a group of engineers led by Professor Jose Manuel Quero Reboul (PhD), and thanks to the achievement of the CAMPUS project and the support of the "Consejería de Innovación, Ciencia y Empresa de la Junta de Andalucía".

Based on its high technological capacity, its long experience on MEMS technology (Micro-electro-mechanical-systems) and the design and manufacture of electronic systems, Solar MEMS has designed its business model developing light-radiation sensors and control systems on different fields: Space, Aeronautics, Renewable Energy and Lighting; at the national and international markets.

Thanks to this technology the efficiency is improved, because these high accurate sensors have better characteristics, are smaller and have lower consumption than other products of the market.

Moreover, Solar MEMS offers consultancy and advising services, including the design, the development, the manufacture and the implementation of customized devices.

Mission

The mission of Solar MEMS Technologies is to introduce the MEMS technology, applied on sun sensors, to Aerospace field, Aeronautics, Renewable Energy and Lighting, to get improved the current systems, to reduce costs and to increase features.

Vision

The vision of Solar MEMS Technologies is to become a reference in the application of this MEMS technology to sun sensors at international level.

Team

Solar MEMS is composed of a team compromised on the project and it works according to these values every day.

Quality

A fundamental pillar of our work is the quality of the products that we make, since start to the end of it, considering all de development and manufacture processes.

Professionalism

We are a high qualified team, with an extensive experience in MEMS technology and capacity to develop new products.

Commitment, transparency and honesty

Our every day work is based on the transparency and the honesty of the team, as well as the compromise with the project.

Innovation

Other fundamental pillar of Solar MEMS is to look for innovation every time, working either products, applications or projects.

Commitment to the Youth

The team of Solar MEMS has young professionals with a great experience and capacity.

Industrial Sun Sensor ISS

Comparative Table

Solar MEMS offers a wide range of sun sensors, called **Industrial Sun Sensors (ISS)**, to measure the incident angle of a sunlight source and its radiation level. They are for different applications: solar tracking, light-source tracking, pointing systems, attitude control, sun radiation measurements, heliostat controllers, etc.

Solar MEMS offers a special sensor called **MASS** that includes three sensors in one: magnetometer + accelerometer + sun sensor. This one provides all the information you need to control your system.

They have been designed with a unique and a novel own technology based on MEMS fabrication processes to achieve high integrated sensing structures at low cost.



ISS Sun Sensors:

| Model | Type | Field of View | Axes | Accuracy | Precision | Comments |
|------------|---------|---------------|------|----------|-----------|---|
| ISS-D60 | Digital | 120 | 2 | < 0.4 ° | < 0.06 ° | Fully calibrated More accurate sensors MODbus RTU comm Consumption 33 mA |
| ISS-D25 | Digital | 50 | 2 | < 0.3 ° | < 0.04 ° | |
| ISS-D15 | Digital | 30 | 2 | < 0.2 ° | < 0.02 ° | |
| ISS-D5 | Digital | 10 | 2 | < 0.1 ° | < 0.005 ° | |
| ISS-T60 | Digital | 120 | 2 | < 10 % | < 0.06 ° | For Tracking Systems Reduced calibration High production capacity MODbus RTU comm Consumption 33 mA |
| ISS-T25 | Digital | 50 | 2 | < 10 % | < 0.04 ° | |
| ISS-T15 | Digital | 30 | 2 | < 10 % | < 0.02 ° | |
| ISS-T5 | Digital | 10 | 2 | < 10 % | < 0.005 ° | |
| ISS-A60 | Analog | 120 | 2 | < 10 % | < 0.06 ° | No calibrated High production capacity 4 voltage signals Consumption 9 mA |
| ISS-A25 | Analog | 50 | 2 | < 10 % | < 0.04 ° | |
| ISS-A15 | Analog | 30 | 2 | < 10 % | < 0.02 ° | |
| ISS-A5 | Analog | 10 | 2 | < 10 % | < 0.01 ° | |
| NANO-ISS60 | Analog | 120 | 2 | - | - | For hardware integration No calibrated 4 voltage signals High production capacity Consumption 5 mW |
| NANO-ISS25 | Analog | 50 | 2 | - | - | |
| NANO-ISS15 | Analog | 30 | 2 | - | - | |
| NANO-ISS5 | Analog | 10 | 2 | - | - | |



MASS sensor: see page 8

Solar MEMS Technologies S.L. has a system of quality and environment according to the ISO 9001 and ISO 14001 standards, provided by the certification company Applus CTC.



SUN SENSOR ISS-DX

Digital model, fully calibrated

Solar MEMS ISS-DX Sun Sensor provides the position of the sun with a high accuracy.

It has been designed with a unique and novel own technology based on MEMS fabrication processes to achieve high integrated sensing structures at low cost.

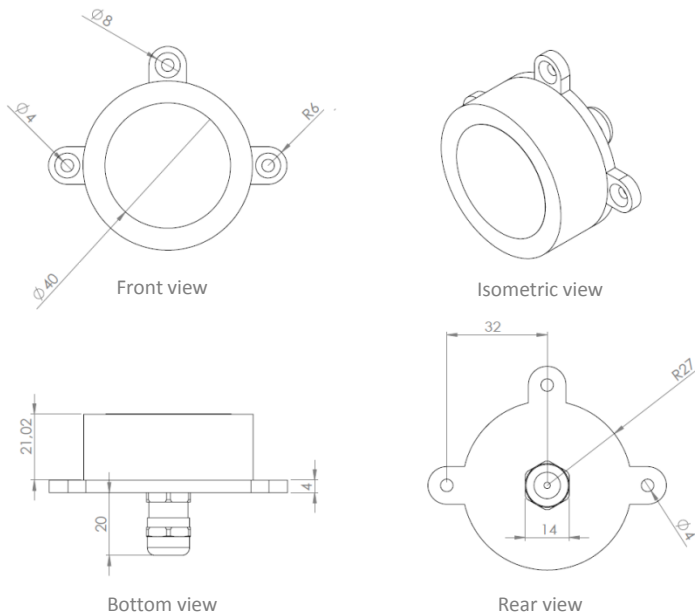
ISS-DX device provides the incident angle of a sun ray in two axes and the direct solar radiation via a communication interface. The high sensitivity is based on geometrical dimensions of the design and calibration processes during production.

Its characteristics make it a suitable tool for high accurate sun-tracking and positioning systems, with low power consumption and high reliability.



ISS-DX Models:

| Characteristics | D60 | D25 | D15 | D5 | Unit | Comments |
|---------------------|--------|--------|--------|---------|------|---------------------------------------|
| Field of view (FOV) | 120 | 50 | 30 | 10 | ° | Aperture of the cone of view |
| Accuracy | < 0,4 | < 0,3 | < 0,2 | < 0,1 | ° | 3σ |
| Precision | < 0,06 | < 0,04 | < 0,02 | < 0,005 | ° | Sensitivity |
| Solar Radiation | < 10 | < 10 | < 10 | < 10 | % | As accurate as close to normal vector |



Technical Specifications

| | |
|--------------|--|
| Sensor type | two orthogonal axes |
| Power supply | 5÷12 V |
| Consumption | 33 mA |
| Interface | MODbus RTU over RS485 0.01s response time |
| Data output | Angles X & Y (filtering stage included) Solar Radiation (DNI) |
| Temperature | -40° to 85°C |
| Protection | Reverse polarity IP65 |
| Cable | 2 meters without connector |
| Optional | ECO mode for low consumption when measuring is not needed. |

Applications

Sun tracking/pointing systems
Heliostats
Attitude control using light sources
Aircraft attitude control
Determination of sun radiation

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SUN SENSOR ISS-TX

Digital model for Tracking systems

Solar MEMS ISS-TX Sun Sensor provides the position of the sun with a high accuracy.

It has been designed with a unique and novel own technology based on MEMS fabrication processes to achieve high integrated sensing structures at low cost.

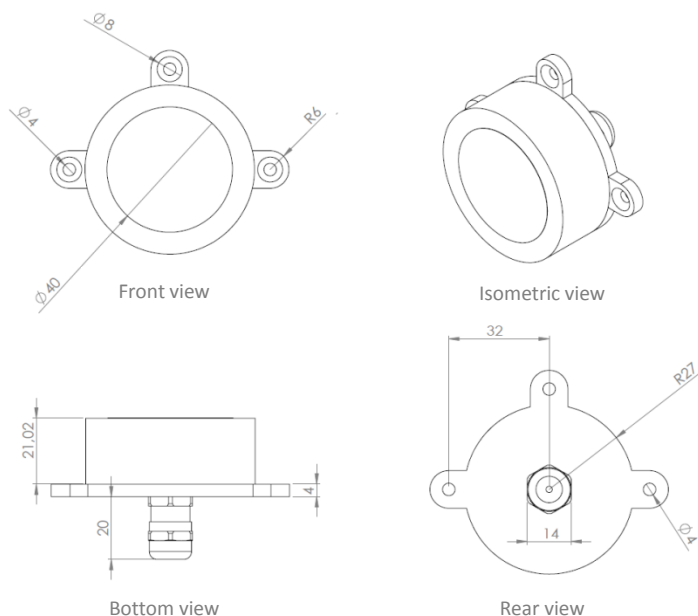
ISS-TX device provides the incident angle of a sun ray in two axes and the direct solar radiation via a communication interface. The high sensitivity is based on geometrical dimensions of the design.

Based on the ISS-DX models, ISS-TX has a reduced calibration procedure to get high production capacity with the same accuracy characteristics, so it is a suitable tool for solar tracking systems.



ISS-TX Models:

| Characteristics | T60 | T25 | T15 | T5 | Unit | Comments |
|---------------------|--------|--------|--------|---------|------|---------------------------------------|
| Field of view (FOV) | 120 | 50 | 30 | 10 | ° | Aperture of the cone of view |
| Accuracy | < 10 | < 10 | < 10 | < 10 | % | 3σ |
| Precision | < 0,06 | < 0,04 | < 0,02 | < 0,005 | ° | Sensitivity |
| Solar Radiation | < 10 | < 10 | < 10 | < 10 | % | As accurate as close to normal vector |



Technical Specifications

| | |
|--------------|---|
| Sensor type | two orthogonal axes |
| Power supply | 5÷12 V |
| Consumption | 33 mA |
| Interface | MODbus RTU over RS485 |
| | 0.01s response time |
| Data output | Angles X & Y (filtering stage included) |
| | Solar Radiation (DNI) |
| Temperature | -40° to 85°C |
| Protection | Reverse polarity |
| | IP65 |
| Cable | 2 meters without connector |

Applications

Sun tracking/pointing systems
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SUN SENSOR ISS-AX

Analog model

Solar MEMS ISS-AX Sun Sensor provides the measurement of the sun ray incident vector.

It has been designed with a unique and novel own technology based on MEMS fabrication processes to achieve high integrated sensing structures at low cost.

ISS-AX device allows the measurement of the incident angle of a sun ray by providing 4 analog outputs and by means of a simple calculation procedure. The high sensitivity reached is based on the geometrical dimensions of the design.

Its characteristics make it a suitable tool for high accurate sun-tracking and positioning systems, with low power consumption and high reliability.



ISS-AX Models:

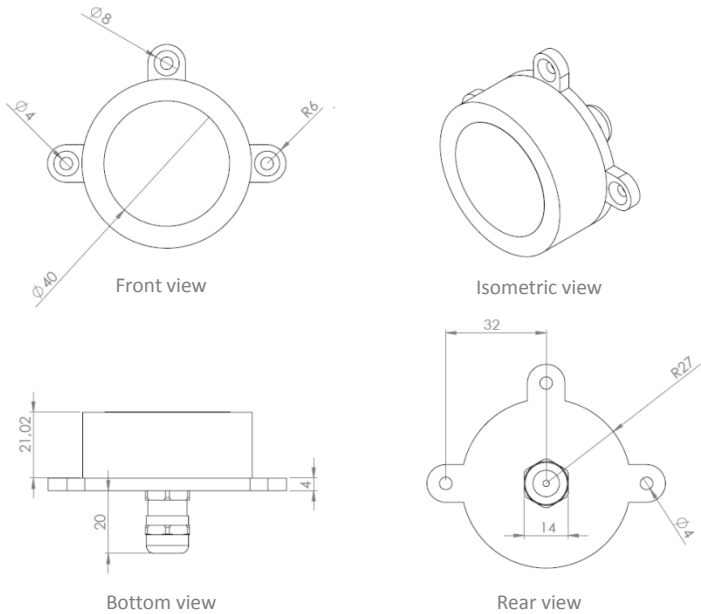
| Characteristics | A60 | A25 | A15 | A5 | Unit | Comments |
|---------------------|--------|--------|--------|--------|------|------------------------------|
| Field of view (FOV) | 120 | 50 | 30 | 10 | ° | Aperture of the cone of view |
| Accuracy | < 10 | < 10 | < 10 | < 10 | % | 3σ |
| Precision | < 0,06 | < 0,04 | < 0,02 | < 0,01 | ° | Sensitivity |

Technical Specifications

| | |
|----------------|--|
| Sensor type | <i>two orthogonal axes</i> |
| Power supply | <i>5÷12 V</i> |
| Consumption | <i>9 mA</i> |
| Analog Outputs | <i>4 signals 0-4.5 V</i> <i>Voltage of each quadrant</i> <i>4-quadrant microsensor</i> |
| Temperature | <i>-40° to 85°C</i> |
| Protection | <i>Reverse polarity</i> <i>IP65</i> |
| Cable | <i>2 meters without connector</i> |

Applications

Sun tracking/pointing systems
Heliostats
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Aircraft attitude control
Determination of sun radiation



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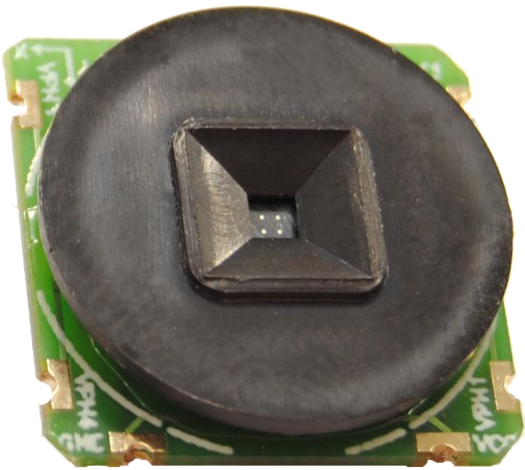
SUN SENSOR NANO-ISSX

Sensor for hardware integration

Solar MEMS NANO-ISSX Sun Sensor allows the measurement of the sun ray incident vector by providing its projection angles in two orthogonal reference axes by means of a simple calculation procedure.

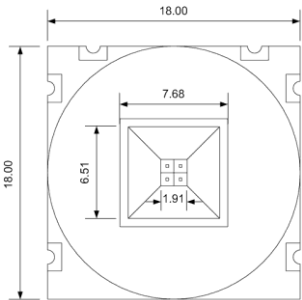
The wide field of view is achieved by the geometrical dimensions of the design. Its compact design, easy integration and low power consumption, makes it a suitable tool for renewable energies or low cost intelligent sensing applications.

NANO-ISSX is available in two formats: one designed for PCB surface mounting and other with a wire-to-board crimp style connector (NANO-ISSX-c).



NANO-ISSX Models:

| Characteristics | 60 | 25 | 15 | 5 | Units | Comments |
|---------------------|-------|-------|-------|-------|-------|------------------------------|
| Field of view (FOV) | 120 | 50 | 30 | 10 | ° | Aperture of the cone of view |
| Dimensions (LxW) | 18x18 | 18x18 | 18x18 | 18x18 | mm | |
| Height | 3,85 | 5,15 | 6,35 | 10,15 | mm | |



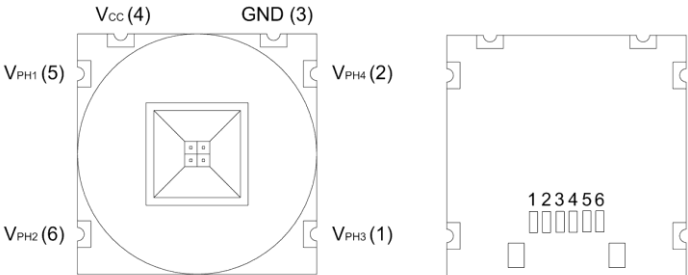
Front view

Technical Specifications

| | |
|----------------|---|
| Sensor type | two orthogonal axes |
| Power supply | 3,3÷12 V |
| Consumption | 5 mW (average) |
| Analog Outputs | 4 signals Voltage of each quadrant 4-quadrant microsensor |
| Temperature | -40° to 85°C |

Applications

Sun tracking/pointing systems
Heliostats
Attitude control using light sources
Aircraft attitude control
Determination of sun radiation



Front view

Bottom view

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MASS SENSOR

Magnetometer + Accelerometer + Sun Sensor

Solar MEMS MASS Sensor provides all the information you need to control your system.

MASS sensor includes one accelerometer, one magnetometer, and one sun sensor to measure position, angle of sun-ray and DNI solar radiation. The high sensitivity reached is based on the geometrical dimensions of the design.

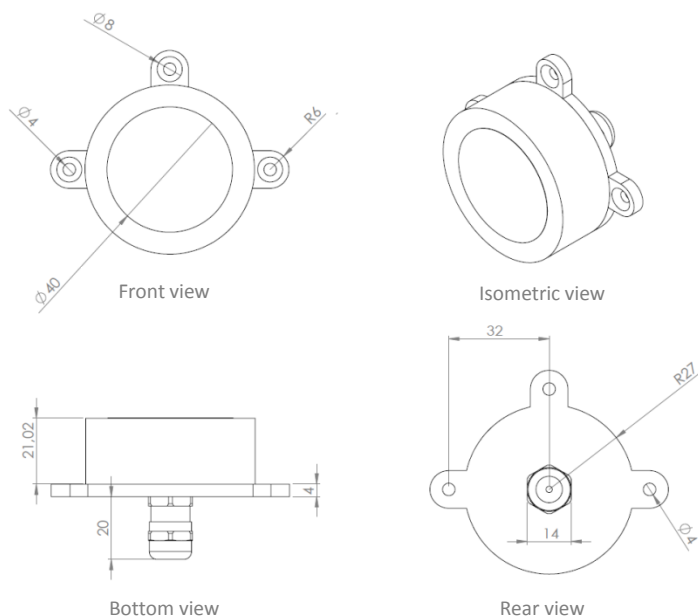
Its characteristics make it a suitable tool for high accurate sun-tracking and positioning systems, with low power consumption and high reliability.

MASS sensor has been designed with a unique and novel own technology based on MEMS fabrication processes to achieve high integrated sensing structures at low cost.



MASS Models:

| Characteristics | 60 | 25 | 15 | 5 | Unit | Comments |
|-----------------|--------|--------|--------|-------|------|-----------------------------|
| Sun Sensor | ISST60 | ISST25 | ISST15 | ISST5 | - | Type of sun sensor included |
| Accelerometer | 0.1 | 0.1 | 0.1 | 0.1 | ° | 3-axis |
| Magnetometer | 0.5 | 0.5 | 0.5 | 0.5 | ° | 3-axis |



Technical Specifications

| | |
|--------------|---|
| Sensor type | 3 sensors included |
| Power supply | 5÷12 V |
| Consumption | 33 mA |
| Interface | MODbus RTU over RS485 |
| | 0.01s response time |
| Data output | Angles from MAG and ACC (filter Filtering stage included Other data as ISSTX included |
| Temperature | -40° to 85°C |
| Protection | Reverse polarity |
| | IP65 |
| Cable | 2 meters without connector |

Applications

Sun tracking/pointing systems
Heliostats
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RECOMMENDATIONS

What kind of sun sensor do I need for my application?

It depends on your requirements and expected costs.

If the accuracy requirements are high, you will need the 5 FOV models (ISSD5, ISST5 or ISSA5), because a sun sensor has more accuracy with a narrow field of view.

Furthermore all our sun sensors are very accurate, but environmental conditions affects their accuracy: clouds effect or seeing the ground introduce albedo effects. So, if you need high accuracy, choose a narrow field of view.

On the other hand, if your accuracy requirements are less demanding you will need a higher FOV, i.e. 60 or 25 models. This lets you see more field of view, so this reduces the requirements to the controller.

Examples:

Solar Tracker PV: ISS-D25, ISS-D60, ISS-T25, ISS-T60, ISS-A25, or ISS-A60.

Solar Tracker CPV: ISS-A5, ISS-T5 or ISS-D5.

Analog or digital sun sensor?

Analog Sun Sensor (ISS-AX) has an easy interface with only 4 analog signals and it needs a simple calibration process after installation to set zero degrees position.

Digital Sun Sensor (ISS-DX) doesn't need calibration because it's calibrated in accurate production processes, and provides directly radiation data and measured angles via a communication interface. Furthermore, you can communicate for long distance.

Why ISS-TX?

The Sun Sensors for Tracking (ISS-TX) will be the perfect choice if you need a digital communication, DNI measurements, and high production capacity for Solar Trackers. This model has the same features than ISS-DX but a reduced calibration procedure.

Why NANO-ISSX?

It's the cheapest and the smallest, and is designed for applications that require highly integrated and compact solution. It's a perfect choice for hardware integration and making your own sensor.

Why MASS?

The full sensor to control your system, it lets you to save money because you include all in one.

Contact us if you need technical assistance to choose your sun sensor.

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