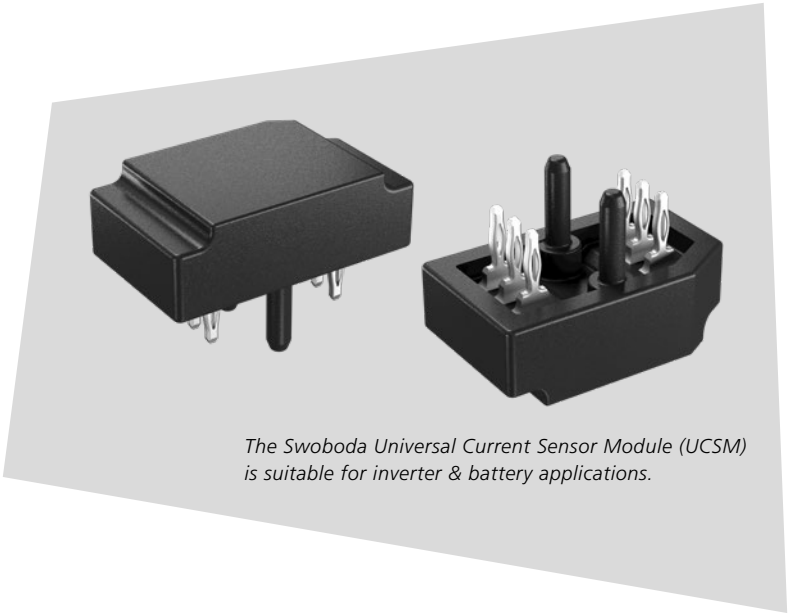
swoboda
technologies

SWOBODA UNIVERSAL CURRENT SENSOR MODULE
FOR AUTOMOTIVE APPLICATIONS



The Swoboda Universal Current Sensor Module (UCSM) is suitable for inverter & battery applications.

INTRODUCTION

Current sensors are used in a wide variety of commercial, industrial and automotive applications.
The Swoboda Universal Current Sensor Module (UCSM) is a galvanically isolated ultra-compact current sensor that can measure high currents (AC & DC) at high voltages. The current sensor is optimized for automotive inverter and high voltage battery applications and compatible with the common busbar designs. It is fully automotive qualified and complies with functional safety level up to ASIL-B.
For best possible system integration of the sensor module Swoboda is able to offer dedicated overmolded busbar assemblies, tailored to the customer engineering space.

ADVANTAGES

- High accuracy measurement of both alternating and direct currents (AC/DC)
- Significantly smaller footprint and 30% less weight than conventional core-based current sensors
- Extremely low drift over temperature and lifetime
- High linearity due to coreless measurement principle
- Bandwidth of more than 120 kHz

FEATURES & BENEFITS

- Able to operate in different output configurations (single-ended, semi-differential, fully-differential)
- Optimized for busbars with 1 to 3 mm thickness
- Available in EloPin (press fit) or solder pin configurations
- Embedded Infineon XENSIVTM TLE4973 chipset including direct pass-through of all input/output signals
- Measurements of peak currents up to ±1600 A
- Single supply voltage of 5 V
- Functional safety (ISO26262): ASIL-B (SEooC)
- Inherent immunity to external / stray magnetic fields due to differential measurement principle
- High bandwidth / fast response time
- Dedicated over current detection output with a detection time of less than 1.7 µs
- Built-in programming interface (via dedicated pin) for EOL calibration
- Fully automotive qualified

APPLICATION AREAS

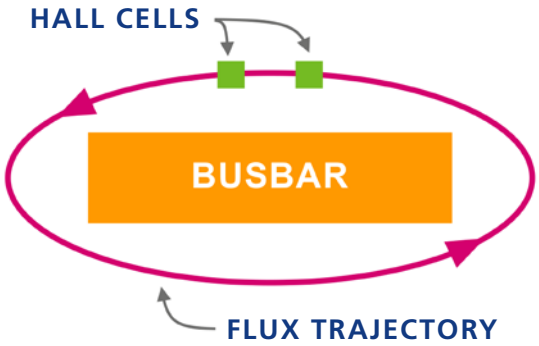
- Automotive main inverter
- Battery management / protection
- Electric motor drives
- General current monitoring

Any questions about this product?
Please contact us:
Sales Department
Swoboda Schorndorf KG
Telephone: **+49 (0) 7181 7003-0**
sales.schorndorf@swoboda.com

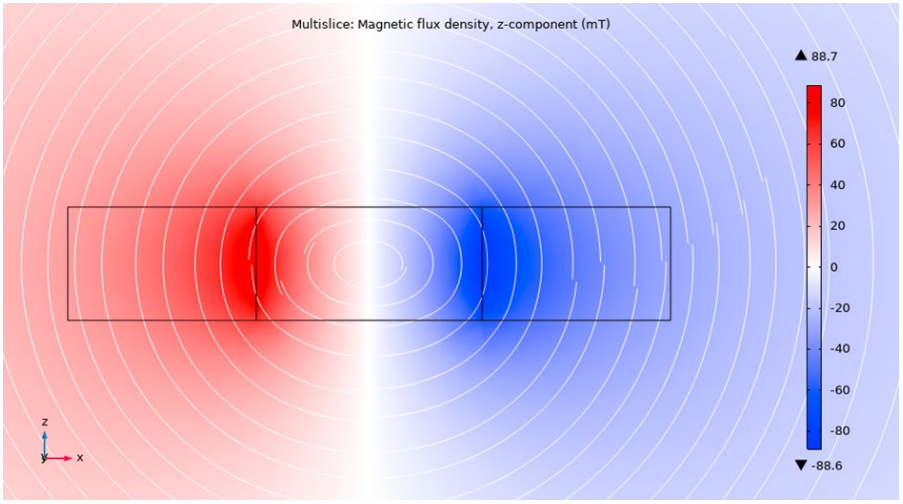
PRINCIPLE OF OPERATION

All current carrying conductors generate a magnetic field around them. Therefore, by measuring this flux density, the current flowing can be measured. The Swoboda Universal Current Sensor Module contains two Hall cells separated by a gap of approximately 2.3 mm, as shown below. The difference between the flux densities measured by the two sensitive elements is filtered and amplified. Subsequently, an analog output voltage that is proportional to the measured flux density is given out. As this flux density is proportional to the current flowing, the chip measures the current flowing in the busbar. This system by inherent design offers the following advantages over traditional core based single ended sensors:

- Inherent immunity to uniform stray magnetic flux densities because of the differential measurement principle.
- High linearity and negligible hysteresis due to the absence of a ferromagnetic core.

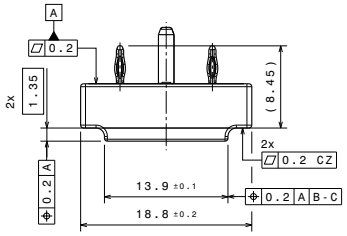


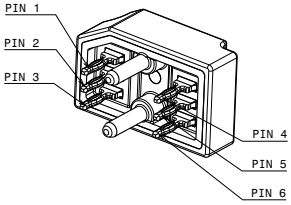
Hall cells in differential configuration, marked in green,along with thebusbar



Flux lines based on finite element analysis.

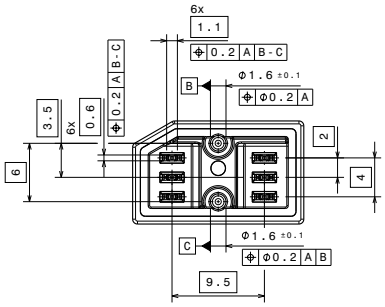
DRAWING

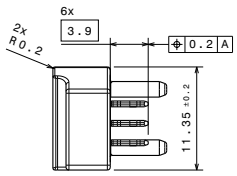




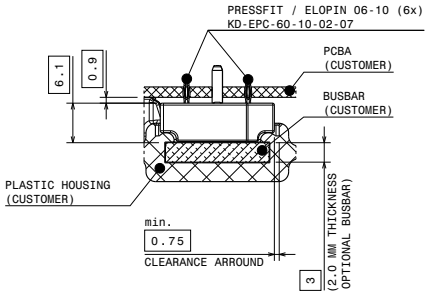
PIN	PIN ASSIGN	DESCRIPTION
1	V_{DD}	SUPPLY VOLTAGE
2	A_{out}	ANALOG SIGNAL OUTPUT
3	DCDI	PROGRAMMING
4	GND	GROUND
5	V_{ref}	VOLTAGE REFERENCE
6	OCD	OVER CURRENT DETECTION

PARTNAME	MATERIAL	PLATING
PLASTICS	>Epoxidur<	
PREMOLD	>PPA-GF30<	
PINS	>CuNi3Si1Mg<	Sn matte over Ni ductile

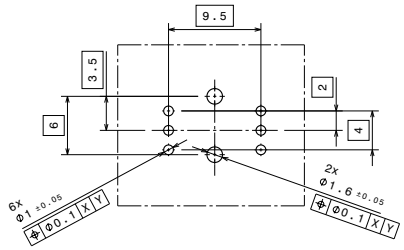




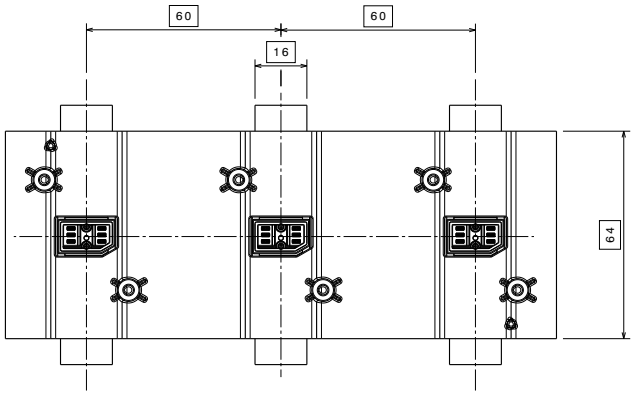
INTERFACE DEFINITION

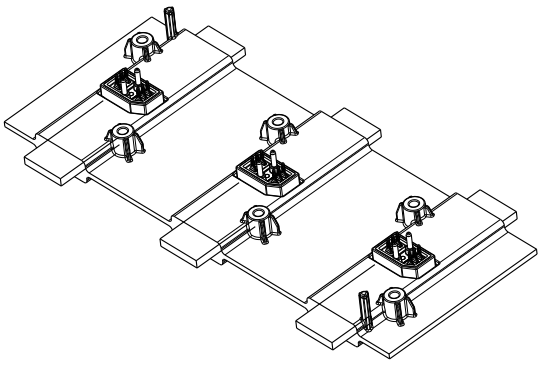


PCB DRILLING



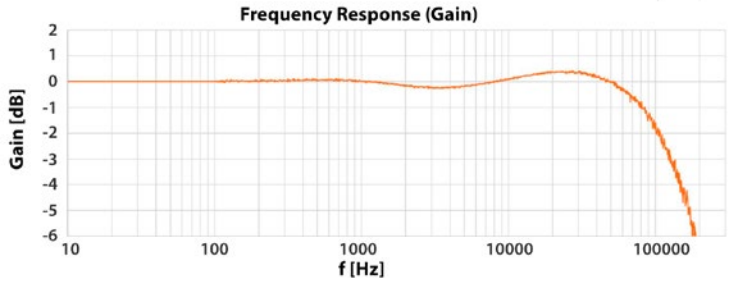
PCB THICKNESS MIN. 1.0mm
DIAMETER OF FINISHED
PLATED THROUGH HOLE
- Cu THICKNESS > 25 µm
- Sn THICKNESS = 1-2 µm
FOR PADS DIMENSION REFER TO
IEC 60352-5 STANDARD

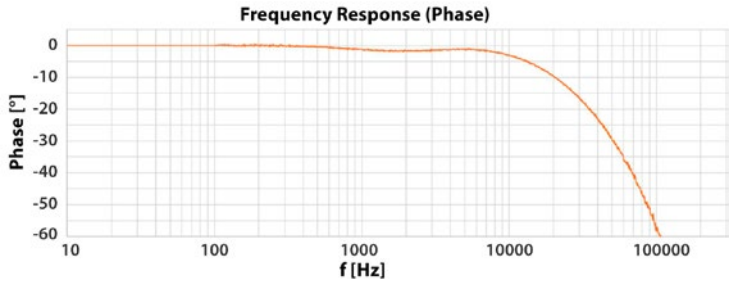




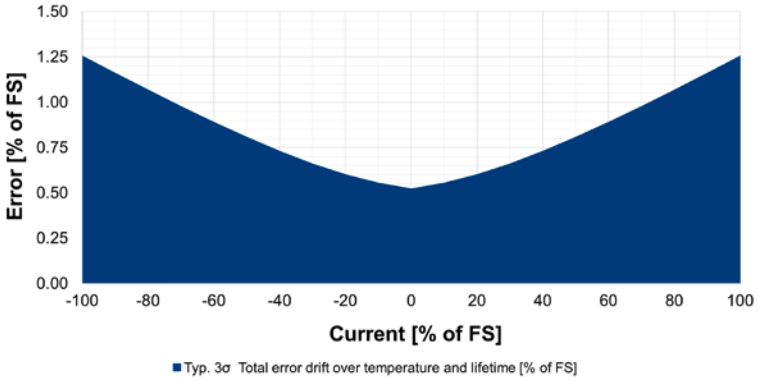
NOMINAL OPERATING CHARACTERISTICS

SIGNAL DESCRIPTION	UNITS	MIN.	NOM.	MAX.	REMARKS
Primary current, peak value	[A]	-1600	-	+1600	Lower range configurable. Max current is however limited by bus bar design and thermal conditions.
Ambient temperature	[°C]	-40	-	150	
V_{DD}	[V]	4.5	5.0	5.5	Supply voltage
A_{OUT}	[V]	-0.3	-	V_{DD}	Analog signal output
V_{REF}	[V]	-	-	-	Not used, should be kept open in single ended mode
		-0.3	-	V_{DD}	Inverted analog signal output in fully differential mode
OCD	[V]	-0.3	-	V_{DD}	Overcurrent detection output: open drain out
DCDI	[V]	-0.3	-	V_{DD}	DCDI communication interface: open drain I/O
I_{DD}	[mA]	-	21	25	Current consumption, I_{Aout} = 0 mA
Load current	[mA]	-6.5	-	6.5	DC current
Output capacitance	[nF]	6	6.8	8	
Step response time	[µs]	-	-	1.7	
Bandwidth	[kHz]	60	-	-	-3 dB, C_{Aout} = 6.8 nF
Phase shift	[°]		3.4		@ 2 kHz
External magnetic field suppression	[dB]	34	40		When a 4 kHz, 20 mT homogenous external magnetic field is applied.





Estimated frequency plots of the current sensor module with 3 mm thick busbar.



Estimated 3σ error of the current sensor module after calibration, for a measurement range of ± 1600 A.