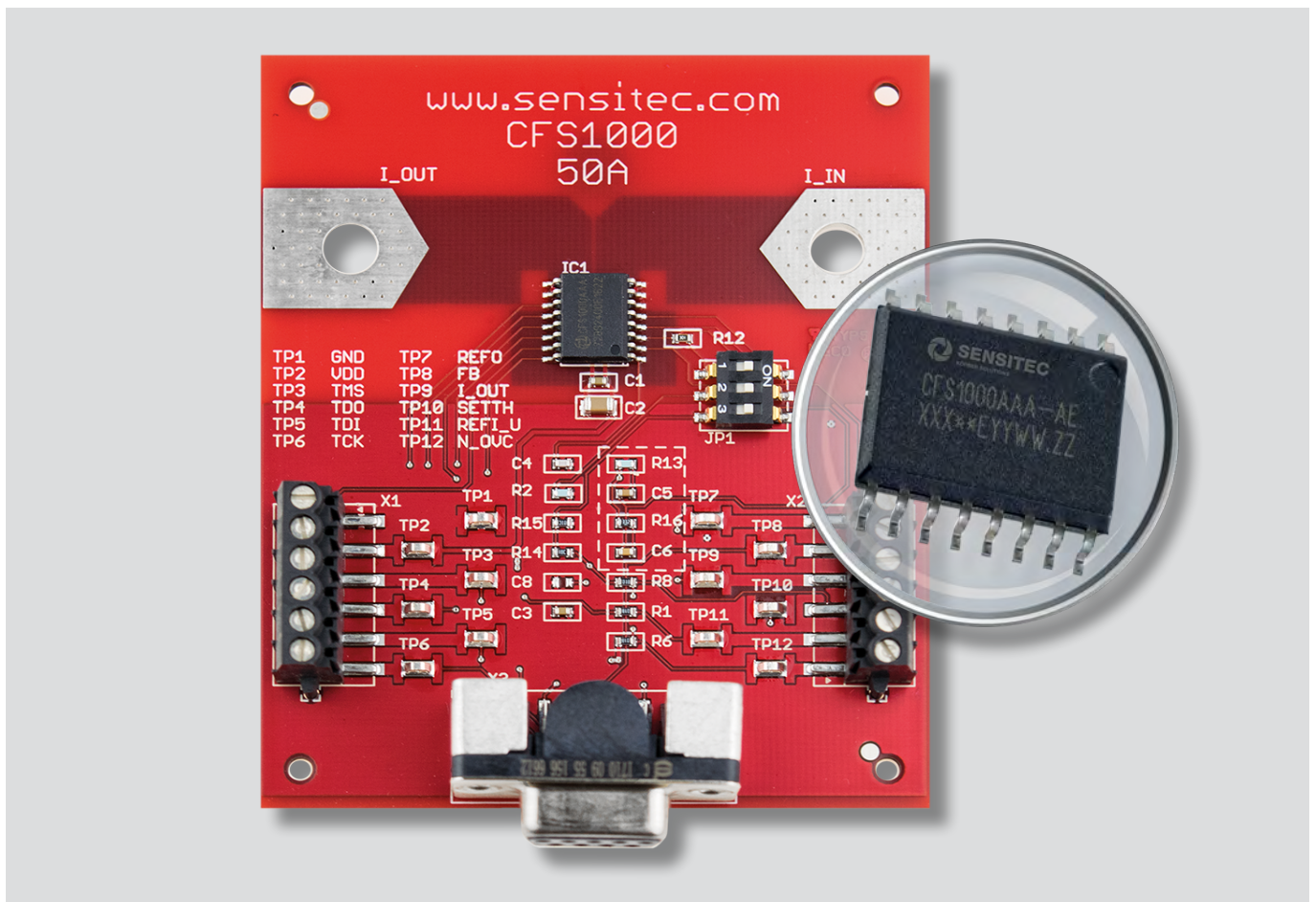


# CFS1000

MagnetoResistive Current Sensor



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## 1. Introduction

The following current sensor application note describes the concept, the key features and application fields of the CFS1000 current sensor. The operational principle is explained and the geometric dependencies and relations needed for tailoring the CFS1000 to a wide range of applications are discussed in detail. In addition to that, specific examples for different current ranges, including useful design tips, are provided to the user.

### 1.1 Sensor Concept

The programmable CFS1000 current sensor is designed for highly dynamic, magnetic measurements of DC, AC or pulsed currents. The CFS1000 is a closed-loop current transducer consisting of an Anisotropic Magneto Resistive (AMR) sensor chip, two bias magnets and a signal conditioning ASIC that are all packaged in a JEDEC compliant standard SMD SO16w package. This allows standard assembly techniques and low assembly costs (Fig. 1).

Contactless and in particular high bandwidth current measurements up to 500 kHz in the range of 10 A to 1000 A are possible. The measuring range of the current sensor is defined by the geometry of an external current conductor. Due to the differential field measurement principle, the CFS1000 also offers a high interference field suppression.

The high sensitivity of the used AMR effect enables excellent dynamic response without hysteresis or saturation effects, as present in current measurement systems using iron-cores. The large measuring range allows the customer a high degree of design flexibility, since a wide variety of measuring tasks can be handled with just one sensor type.

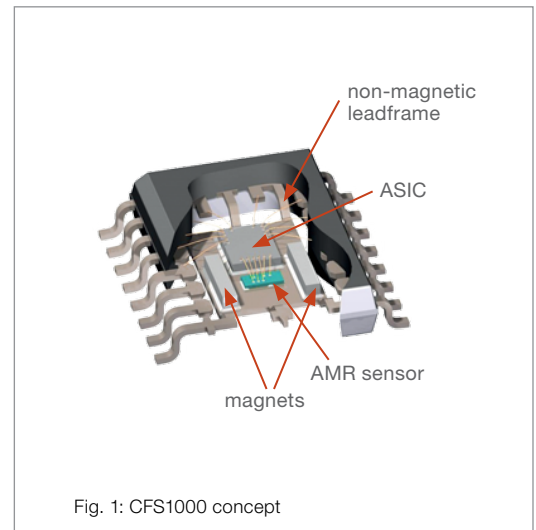
The CFS1000 is a compact, low-cost yet high-quality current sensor with automotive qualification according to AEC-Q100, Grade 1. The concept as a pre-qualified measuring cell enables fast adaptation, with low engineering effort, to customer-specific applications in modern power electronics. In addition, the integrated overcurrent detection is adjustable by the customer, and supersedes additional components for realizing protective functions.

The CFS1000 offers a unique combination of high bandwidth, small dimensions and robustness.

### 1.2 Application Fields

The development e.g. in the field of regenerative energy generation will bring a lot of new applications for current measurement. Power inverters for photovoltaic panels, or current monitoring in the field of electro mobility (motor control, battery charging and monitoring) are only the most obvious ones. Future applications will need to monitor currents in the range from several ten Amperes up to several hundred Amperes, at high bandwidth and good electric isolation. This requires a product with high accuracy and inherent high flexibility like the CFS1000. The CFS1000 in SMD housing and unipolar +5 V supply voltage is suitable e. g. for measurement tasks in the areas:

- » Electrical speed drives (industry, E-Mobility)
- » Power electronic inverters and converters
- » Photovoltaics (micro inverters)
- » Switched mode power supplies (SMPS)
- » Uninterruptible power supply (UPS)



### Key Features

- Galvanic isolation from primary current
- Coreless current measurement up to 1000 A
- Measurement range up to three times nominal current  $I_{PN}$  (Peak)
- Compensated differential field measurement (closed-loop-principle)
- High bandwidth current measurement: DC, AC (up to 500 kHz)
- Fast overcurrent detection with tunable threshold
- AEC-Q100 Grade 1 qualified

### Advantages

- High linearity
- Low temperature dependency
- No hysteresis and saturation effects
- Excellent accuracy
- Temperature range -40 °C to +125 °C
- Large signal-to-noise ratio
- Standard SMD SO16w package

### Applicable Documents

- CFS1000 datasheet
- Calc-U-Bar software manual
- CFK1000 application note



In addition, automotive, industrial and other applications in the area of power electronics, that require smaller size, lighter weight and more efficient operation, see an increased demand for silicon carbide (SiC) and gallium nitride (GaN) wide-bandgap semiconductor solutions. Wide-bandgap semiconductors enable

- » Higher switching frequencies
- » Lower switching losses
- » Higher efficiency
- » Increased power density

The CFS1000 enables high bandwidth current measurements and therefore, allows the full leverage of the benefits of wide-bandgap semiconductors. As a result of the higher switching frequencies, less and smaller filter components (LC) are required, which in turn reduces the total system costs. Therefore, the CFS1000 also contributes to the cost reduction, which is a major topic as well.

## 2. Operation Principle

The operation principle of the CFS1000 current sensor is based on a compensated differential field measurement. It has to be emphasized, that the AMR-based sensor exhibits no hysteresis as observed in iron core based Hall-sensor solutions. Due to the high sensitivity of AMR sensors, a flux concentrator is not necessary. It is designed for high resolution and very fast current measurement from DC up to 500 kHz AC.

The primary current  $I_{PN}$  to be measured is fed below the sensor, usually through a U-shaped current conductor, as for example a busbar (Fig. 2). In this way, a magnetic differential field (gradient) is generated between both sides of the conductor, which is measured by the sensor element. By measuring the field gradient at two measurement points being in close proximity, an excellent stray field immunity is achieved.

The modulation of the sensor element is compensated by a magnetic counter field  $H_{comp}$  on the AMR-sensor chip. The value for this required compensating current  $I_{comp}$  is the proportional measure for the primary current and represents the output signal of the sensor. The output current can easily be transformed to an output voltage via a burden resistor. Based on the compensation of the primary field (closed-loop principle), a high linearity is realized.

Fig. 3 details the closed-loop principle. The normal operating point of the MR-resistors is at (0,0), because the magnetic field  $H_{PN}$  (generated by  $I_{PN}$ ) is instantaneously compensated by  $H_{comp}$  (generated by  $I_{comp}$ ). As a result, the CFS1000 has a highly linear output, which makes it competitive to closed-loop measurement systems having an iron core, but without drawbacks like hysteresis or saturation effects.

Fig. 4 shows the transfer function of the CFS1000. At nominal primary current the nominal output current of the CFS1000 is 2 mA. The output current scales highly linear up to threefold primary current.

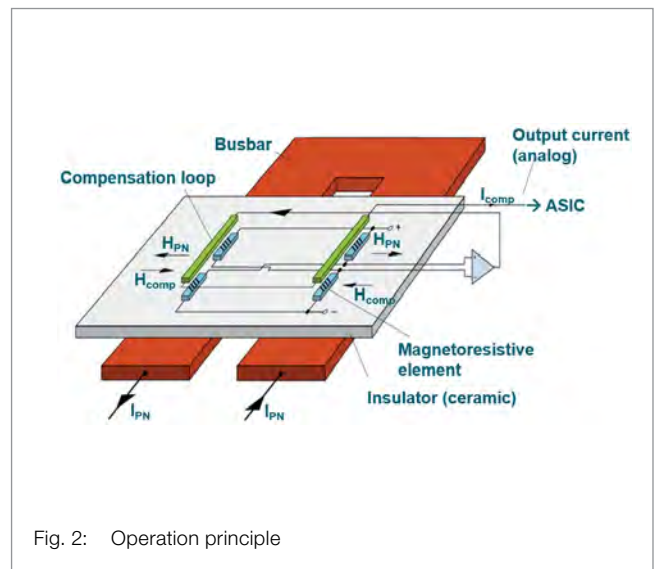


Fig. 2: Operation principle

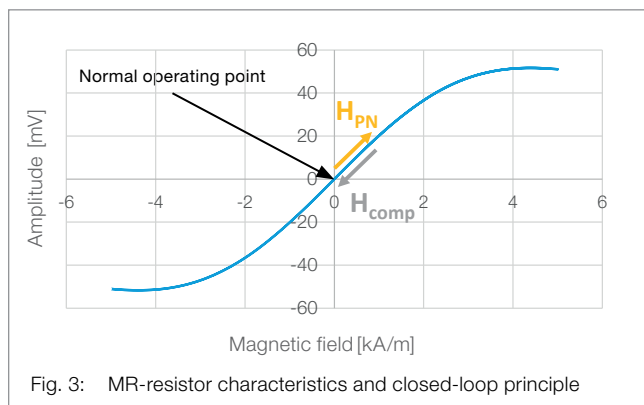


Fig. 3: MR-resistor characteristics and closed-loop principle

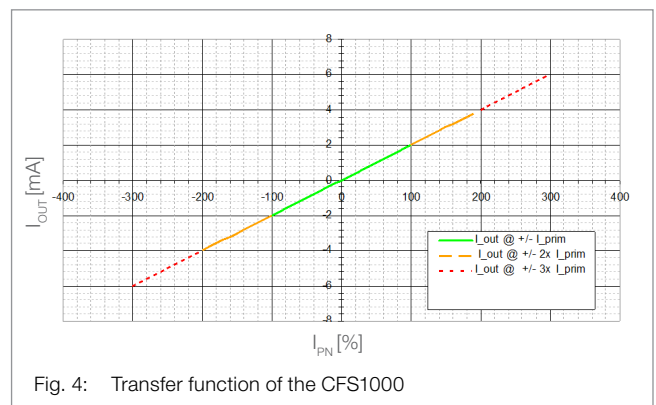


Fig. 4: Transfer function of the CFS1000

**2.1 MR-Resistor**

The AMR effect describes the variation of the specific resistivity of a material, depending on the angle ( $\alpha$ ) between an electrical current (I) through this material and the magnetic field vector of its internal magnetization M.

An external magnetic field  $H_{ext}$  acting on the material, which for example is generated by a current flowing through a busbar, rotates the internal magnetization M of the material in such a way that it orients itself with increasing magnetic field strength more and more on the external field  $H_{ext}$ . If the external field strength is strong enough, the orientation of the internal magnetization and the external field is the same.

When the internal magnetization M and the current through the material are aligned parallel to each other ( $\alpha = 0^\circ$ ), the resistivity reaches its maximum ( $R = R_{max}$ ). When oriented vertically ( $\alpha = 90^\circ$ ),  $R = R_{min}$ . In between, the resistance varies like a cosine (see Fig. 5). The typical variation of resistivity is in the range of 2 % to 3 %. Beyond the anisotropic field strength, there is no further decrease in resistance.

The sensor cell consists of four resistors of permalloy in a Wheatstone bridge configuration as shown in Fig. 6. The four resistors are split in two half bridges, R1 and R2, R3 and R4, with a certain distance in between. In the following explanations, the sensor substrate defines the xy-plane. The resistors are oriented along the y-axis, and also the current flow through them. With the primary current line in parallel to the resistors, a H-field component in x-direction will alter the resistivity. The average distance of the MR areas of the sensor element is 1.24 mm – also called base width.

A barber pole structure is deposited at  $45^\circ$  to the anisotropy axis of each MR-resistor. This increases the effective sensitivity and at the same time allows for the determination of the direction of the magnetic field.

**2.2 Differential Field (field in x-direction)**

The target value of the gradient field in x-direction is 1.6 kA/m/mm (2 mT/mm), leading to target value of 1920 A/m field difference over 1.2 mm base width of the MR-Sensor. The origin of the coordinate system is located in the center of the MR-sensor surface (in xy-plane). The busbar is always located in a parallel plane below the sensor position (shift in z-direction; see Fig. 7). The current flows into the busbar on the right side generating the magnetic field  $H_{x2}$  and flows back on the left side generating  $H_{x1}$ . The difference between both is the magnetic field gradient.

Such a magnetic differential field measurement has the benefit, that the influence of external magnetic stray fields is significantly reduced. Although field vectors of external magnetic fields alter the length of  $H_{x1}$  and  $H_{x2}$  unevenly, the resulting differential field vector  $H_{diff}$  still has the same total value. Due to that fact, a magnetic shielding is often not required. In addition, the CFS1000 is able to tolerate differential field tolerances about  $\pm 10\%$ .

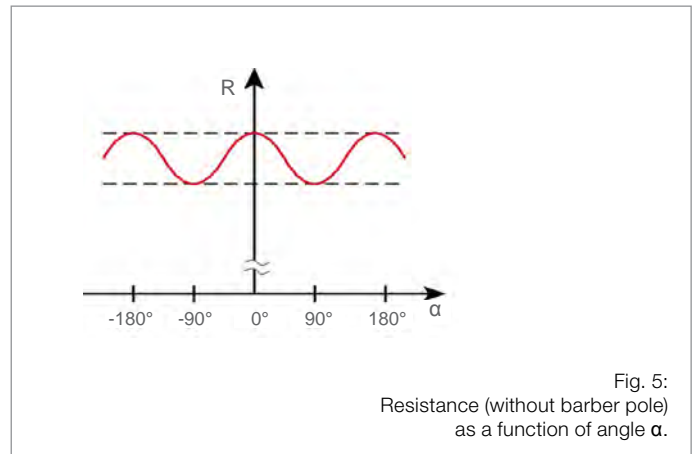


Fig. 5: Resistance (without barber pole) as a function of angle  $\alpha$ .

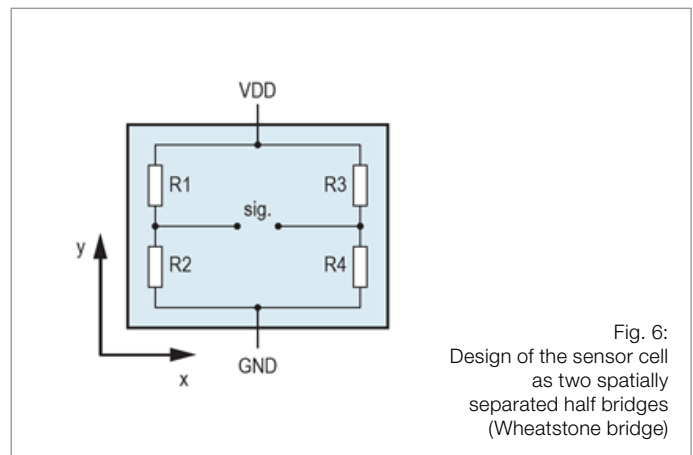


Fig. 6: Design of the sensor cell as two spatially separated half bridges (Wheatstone bridge)

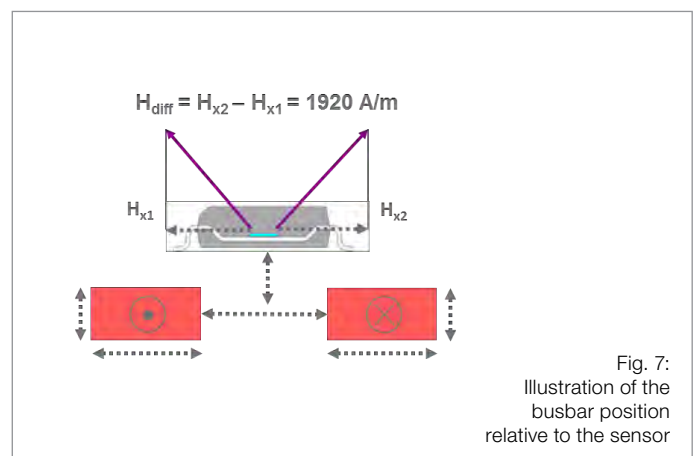


Fig. 7: Illustration of the busbar position relative to the sensor

### 2.3 Stabilization Field (field in y-direction)

MR resistances have an initial magnetization direction which can flip about 180°, if an external magnetic field, pointing in the opposite y-direction of the stabilization field (y-field) and being larger than this, is present. In closed-loop operation, this would lead to a positive feedback situation as the MR-characteristics curve is inverted, which would flip the output of the CFS1000 to the opposite voltage saturation rail. This operation error is a temporary effect, lasting as long as such field conditions are present – whereby permanent damage would require fields above 3 T.

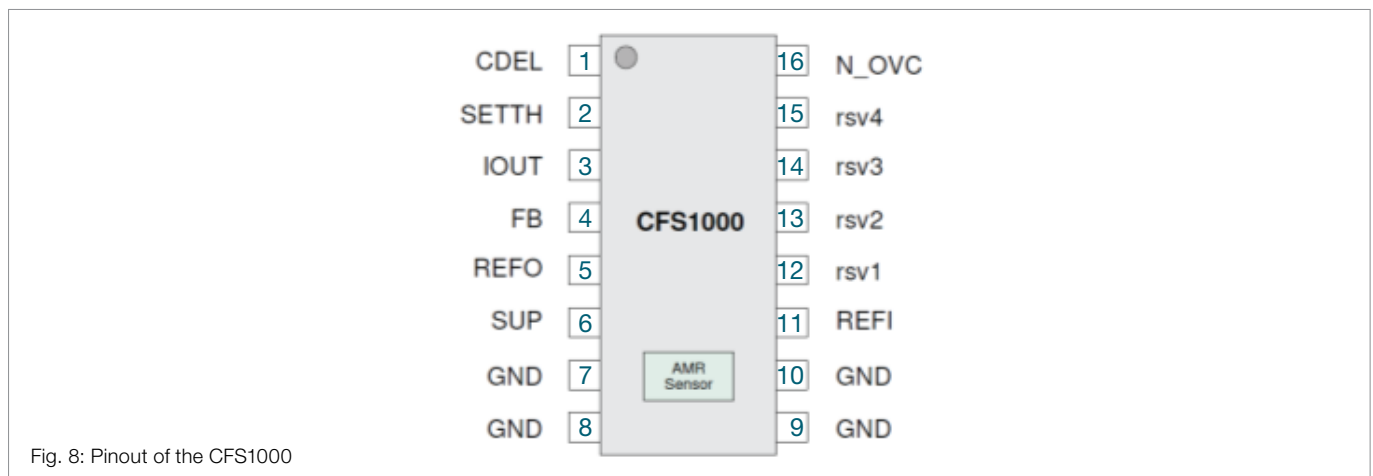
To avoid the flipping of the initial magnetization direction of the magnetoresistive resistors of the MR-Sensor, the MR resistances are biased by a stabilization field generated by two permanent magnets inside the package. At sensor position, their field is typically 3 kA/m in y-direction.

As mentioned before, the sensor can still flip as soon as an external field in y-direction becomes larger than the stabilization field. As the sensor can measure above 3 times the nominal field gradient and is supposed to operate stable for overcurrents up to 5 times the nominal current, the maximum allowed impact on the stabilization field should not exceed ±0.5 kA/m at nominal current.

Note: For applications where the maximum current is clearly limited to less than 5 times the nominal current, or stable measurement in overcurrent situations is not required, this limit (±0.5 kA/m) may be expanded. This will allow the construction of smaller busbars.

## 3. CFS1000 Sensor Device

### 3.1 Pinout and Description



#### Pin 1: CDEL

Defines the delay time for the overcurrent detection. The intrinsic delay time (minimum delay) of the overcurrent detection is valid for an open pin  $C_{DEL}$  and is  $\leq 500$  ns. The purpose is the suppression of false alarm caused by switching noise pulses. This delay time  $T_{ovc(D)}$  can be adjusted by a capacitor at  $C_{DEL}$  to ground according to the formula.

$$T_{ovc(D)} = 500 \text{ ns} + 20 \frac{\text{ns}}{\text{pF}} \cdot C_{DEL}$$

The maximum delay is typically 15  $\mu$ s by direct connection of pin 1 to ground or a capacitor of sufficient size according to the formula above ( $C_{DEL} \gg 25$  pF).

- » Example: A capacitance  $C_{DEL}$  of 100 pF between pin 1 and ground defines a total delay time of  $500 \text{ ns} + 100 \text{ pF} \times 20 \text{ ns/pF} = 2.5 \mu\text{s}$

#### Pin 2: SETTH

Is used to define the threshold for overcurrent detection (alarm output N\_OVC). It is defined by the resistor divider  $R_{S1}$  and  $R_{S2}$  in Fig. 9 as a fraction of the reference voltage at REFO (nominal 2.5 V), and can be set in the range 0.5 V to  $(V_{REFO} - 0.2)$  V. SETTH defines the absolute maximum output current  $I_{out,max}$  up to where no overcurrent alarm occurs.

- » Example:  $R_{S1} = 10 \text{ k}\Omega$ ,  $R_{S2} = 15 \text{ k}\Omega \rightarrow V_{SETTH} = 2.5 \text{ V} \times 10 \text{ k}\Omega / 15 \text{ k}\Omega = 1.67 \text{ V}$

**Pin 3: IOOUT**

Is the output signal of the device, which delivers an output current proportional to the measured primary current. This output current is bi-directional with target amplitude trimmed to  $\pm 2$  mA for full scale primary current.

**Pin 4: FB**

Is the input for the feedback loop. It is connected via  $R_M$  to  $I_{OUT}$ . Under nominal conditions ( $I_{OUT} = \pm 2$  mA),  $R_M$  is set to  $330 \Omega$  in order to achieve an output voltage drop of  $\pm 0.66$  V, which will be altered around the internal reference voltage of 2.5 V. A peak current of  $\pm 3$  times  $I_{PN}$  therefore results in an output voltage of  $2.5 \text{ V} \pm 2$  V. At  $I_{OUT} = 0$  mA the output voltage is 2.5 V. Keep in mind that the internal reference voltage can also be replaced by an external if desired.

**Pin 5: REFO**

Is the reference voltage output of typ. 2.5 V with REFI at 0 V.

**Pin 6: SUP**

Connected to  $V_{SUP}$  (5 V).

**Pin 7, 8, 9, 10: GND**

Internally connected. Only one Pin must be connected to ground.

**Pin 11: REFI**

Selects the use of the internal or an external reference. There are two options:

- »  $0 \text{ V} \leq V_{REFI} \leq 0.5 \text{ V}$  selects the internal reference voltage of typ. 2.5 V
- »  $1.2 \text{ V} \geq V_{REFI} \geq 2.6 \text{ V}$  feeds this voltage as an external reference over an internal buffer to REFO and FB. This is beneficial when using several current sensors in one application, as needed e.g. in 3-phase inverters: the internal reference of the first sensor can be used as an external reference for the other two, eliminating small differences between the three samples. This improves the overall accuracy of the whole system.

**Pin 12, 13, 14, 15: rsv1-4**

Reserved for factory use. Leave open, do not connect!

For more details, the reader is kindly asked to refer to the datasheet, available at [www.sensitec.com](http://www.sensitec.com)



**Pin 16: N\_OVC**

Is the active-low overcurrent alarm output. Depends on IOOUT (Pin 3), SETTH (Pin 2) and the burden resistor  $R_M$  according to the following relation:

$$|I_{OUT}| = I_{OUT,max} > \frac{V_{REFO}}{R_M} \cdot \left( 1 - \frac{V_{SETTH}}{V_{REFO}} \right)$$

For the above given values for  $V_{REFO} = 2.5 \text{ V}$ ,  $R_M = 330 \Omega$ , and  $V_{SETTH} = 1.67 \text{ V}$ , the output N\_OVC is put low at 2.5 mA on pin 3 (IOOUT), which is 1.25 times  $I_{OUT}$  of 2 mA.

### 3.2 Application Circuitry

The application circuitry for the CFS1000 allows defining certain characteristics by using only a few external components (Fig. 9). The magnetically sensitive area of the device is centered on the virtual connecting line between pins 7 and 10, 1 mm above PCB of the package (see Fig. 8). For more details and specified limiting conditions please refer to the latest version of the datasheet (available at [www.sensitec.com](http://www.sensitec.com)).

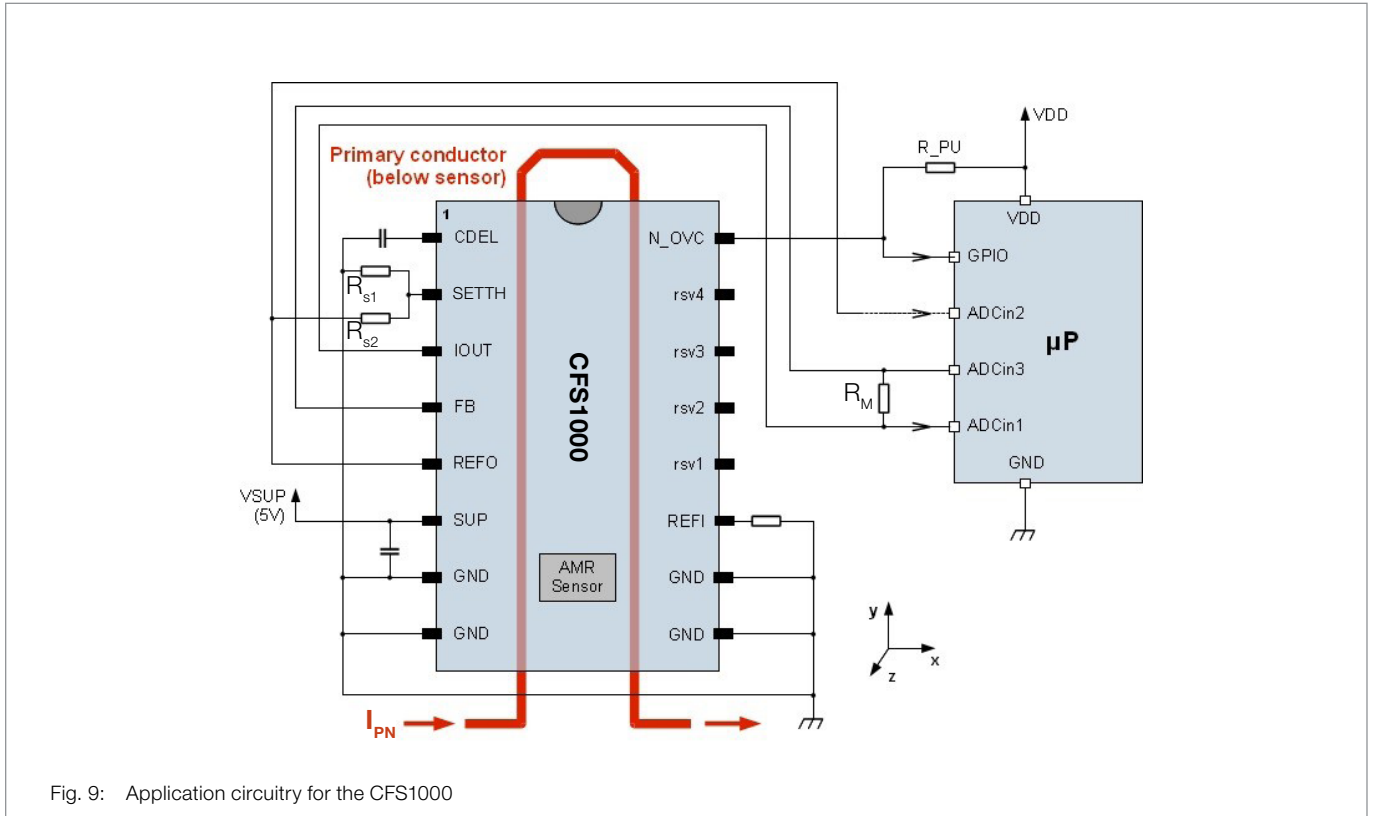
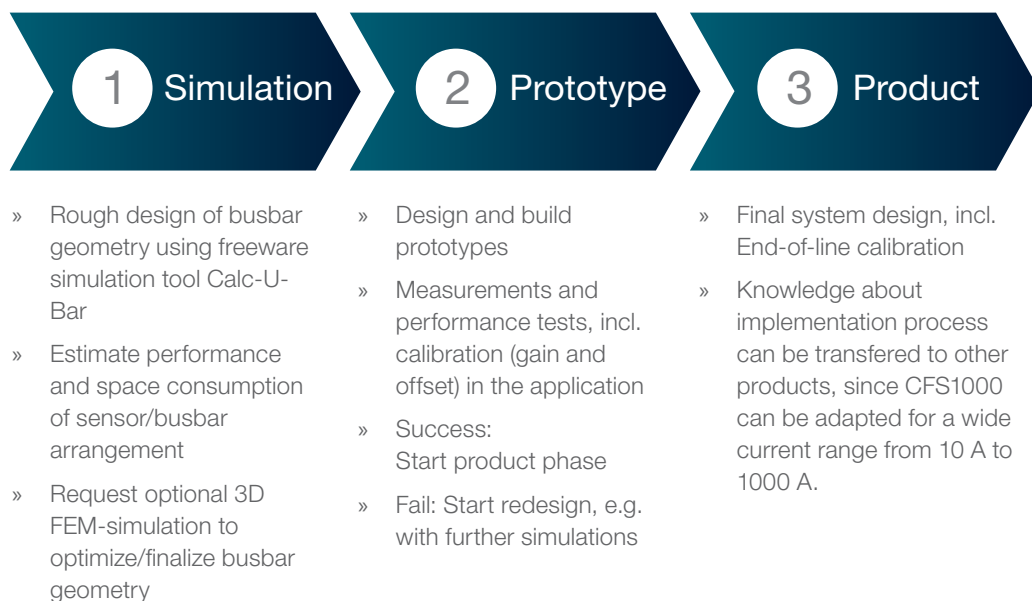


Fig. 9: Application circuitry for the CFS1000

## 4. Implementation Process

For the successful use of the CFS1000 in a user specific application the following design processflow is suggested.





## 5. Simulation

In general, it is highly recommended to run simulations in order to get the best sensor performance. This can be done using our analytical freeware simulation tool Calc-U-Bar or by numerical 3D FEM-simulations. A common way is to use the analytical tool first in order to get an impression about the sensor/busbar arrangement and design targets. After that, the numerical simulation can be used to optimize and finalize the busbar geometry to achieve the best sensor performance.

This application note is best used in combination with the Calc-U-Bar software and manual, both available at [www.sensitec.com](http://www.sensitec.com).

### 5.1 Analytical Simulation Tool Calc-U-Bar

Calc-U-Bar (Fig. 10) is a customer support tool, which allows first analytical design approaches to magnetic requirements of a customized current measurement solution with Sensitec CFS1000 current sensors. The tool operates using the National Instruments LabVIEW® runtime environment (Copyright © 2018 National Instruments Corporation. All rights reserved). Based on magnetic field calculations using Biot-Savart's Law, it can be used for first dimension estimations of the U-shaped busbar for operating the CFS1000. Additionally, the influence of different current feeds can be investigated without the need for excessive 3D FEM-simulations (three-axis angle variation for the current feed is possible). It also includes the possibility to estimate magnetic crosstalk or interference from adjacent current paths or field sources, which gives the possibility, to define specific spacing requirements for multiphase arrangements. At the same time, the influence of a varying sensor position relative to the busbar is calculated. This gives an idea towards process related positioning tolerances and their influence on the magnetic field components. For more details the reader is kindly asked to refer to the corresponding software manual. The manual contains multiple examples for various current ranges and additional design tips, which will reduce the design-in process a lot.

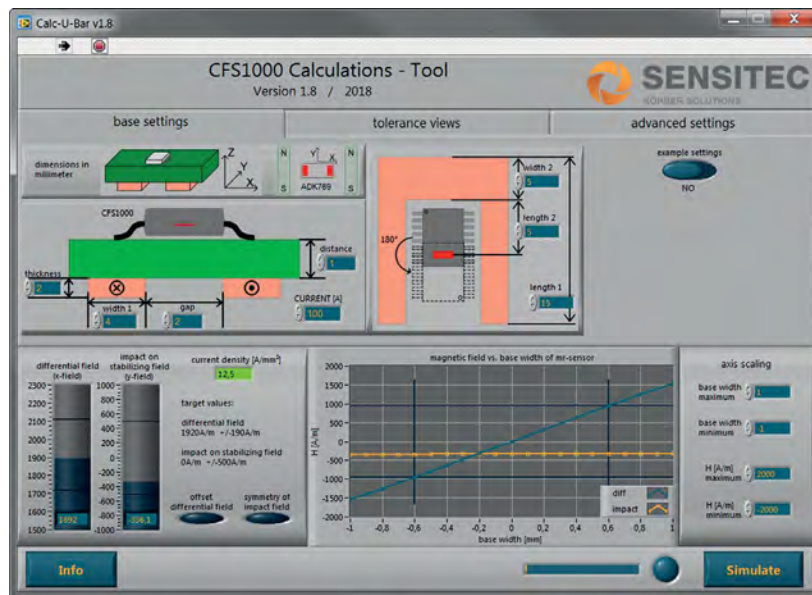


Fig. 10: Analytical simulation tool Calc-U-Bar

### 5.2 Numerical 3D FEM-Simulation

For more complex applications, in which for instance the mounting space is limited or in which the impact of adjacent magnetic materials or conductors needs to be taken into account, a 3D FEM-simulation is recommended. Reasons for a 3D FEM-simulations can be:

- » Isolation topics
- » Magnetic or electric shielding
- » Usage of ferrous materials close to the sensor
- » AC-effects or inhomogeneous current density distributions (field asymmetries)
- » Thermal issues due to power losses and local hot spots

Before integrating the CFS1000 sensor into a final applications/series products, it is recommended to contact the Sensitec sales department and request such a numerical simulation support.

## 6. Design Tips

In the following, some important design tips are presented, which should be considered when implementing the CFS1000 into an application.

### Field Symmetry

- » Symmetry of the magnetic field relative to the chip center is not mandatory, due to differential field principle, but nevertheless, will reduce non-linearity for high current arrangements. For busbar systems targeted above 100 A nominal current, the magnetic field of the current feed may also reach field strengths above 1 kA/m at sensor position, which may cause inhomogeneous field strengths at a single MR-resistor.

### Stray Fields

- » 1 kA/m stray field at sensor position is a general experienced limit for keeping its impact below 1%, as this is the nominal field for one active chip area. The stray field immunity can be improved by applying a ferrous or Mu-metal shield.

### Ferrous Materials

- » Ferrous materials in the environment of the CFS1000 may become a threat, due to their magnetic hysteresis, which may lead to a hysteresis in the characteristics of the current sensor. Therefore, the environment has to be investigated carefully in order to prevent operational failures. A 3D FEM-simulation can be performed if uncertainty still remains.

### Skin effect

- » May lead to field strength variations, generating a larger field gradient and thus affects the sensor. The result is an increasing gain over frequency (in frequency response) or peaking and overshooting in step response. Both can be compensated by the use of one or more RC-stages, damping higher frequency signals to the correct level.

### Temperature effects

- » Temperature has a certain effect on current measurements, even though drifts are factory calibrated. Thermal effects may influence the PCB thickness and therefore, will influence the differential field.

### Small currents $\leq 15$ A

- » For low nominal currents below 15 A and/or larger distances between the CFS1000 and the busbar, as may be required due to isolation layer constraints, it might not be possible to generate the target differential field using a single U-shaped busbar. A smaller nominal gradient is possible as long as the signal to noise ratio is still acceptable or if noise can be filtered out for the relevant frequency range. However, a better solution is a busbar consisting of several windings or a coil in order to achieve the nominal field gradient. Examples for such low current can be found in the CFK1000 evaluation board manual ([www.sensitec.com](http://www.sensitec.com)). Low voltage isolation requirement will improve low current measurement capability, since the current-track can be routed in the top-layer without isolation layer.

## 7. Calibration

The CFS1000 is already pre-calibrated regarding offset, temperature coefficient (TCO) of offset and sensitivity. Nevertheless, an additional calibration of offset and sensitivity should be performed after assembly to PCB and primary current line within the application. This end-of-line calibration compensates assembly deviations concerning the orientation CFS1000/PCB/current bar. The calibration data is stored in an EEPROM. Four bytes are programmable, two for customer specific data and two for the end-of-line calibration of offset and gain.

For EEPROM programming, an asynchronous serial interface (ASIF) is implemented, which uses the pin 4 (FB) as a bi-directional digital-I/O. The detailed description of this interface (connection, protocol, commands) is given in the CFS1000 calibration manual (available at [www.sensitec.com](http://www.sensitec.com)).

### 8. Adaption to Different Current Ranges

This chapter gives a short description on the background of the flexibility of the system and focuses on the importance and dependencies of certain geometric parameters.

As described above, a magnetic field difference between the spatially separated half bridges generates the bridge signal of the sensor cell. Fig. 11 shows a schematic cross section of a typical configuration of sensor, PCB and current bar.

The brown rectangles represent the primary current line, the green one the PCB and the grey the CFS1000 housing. The yellow squares indicate the positions of the two sensor half bridges. The sensing current through the resistors is flowing in y-direction. The primary current generates a magnetic field H around the conductor (Fig. 12).

The magnetic field strength for an infinite long and thin current line, at a certain spatial point, depends on the current I flowing through the wire and the distance r.

$$H = \frac{I}{2 \cdot \pi \cdot r}$$

Although this equation is strictly valid only for an infinite long straight wire, it clearly shows the influence of the parameters which are determining the performance of the CFS1000: the relation between the primary current I and the radius vector r. The resulting magnetic field vector H is oriented in parallel to this radius vector r. The effective component of the magnetic field vector H onto the resistors is the projection of it to the plane of the resistors, which is  $H_x$  in the chosen notation.

The required H-field difference results from the U-shaped primary current line, which leads to opposite current directions under each half bridge and with this to opposite magnetic field vectors. The sensor cell interprets the difference of both  $H_x$ -vectors. In Fig. 13 the trend of the magnetic field in x-direction for two current lines with 2 mm distance at 100 A is shown by the dark line. The two colored dots indicate the x-position of the sensor half bridges, the height h was chosen to be 2.0 mm. Each branch sees a field of the same magnitude, but opposite direction. In this configuration, the difference of  $H_x$  is 1600 A/m/mm at  $x = 0$ . The corresponding gradient of  $H_x$  is represented by the grey line.

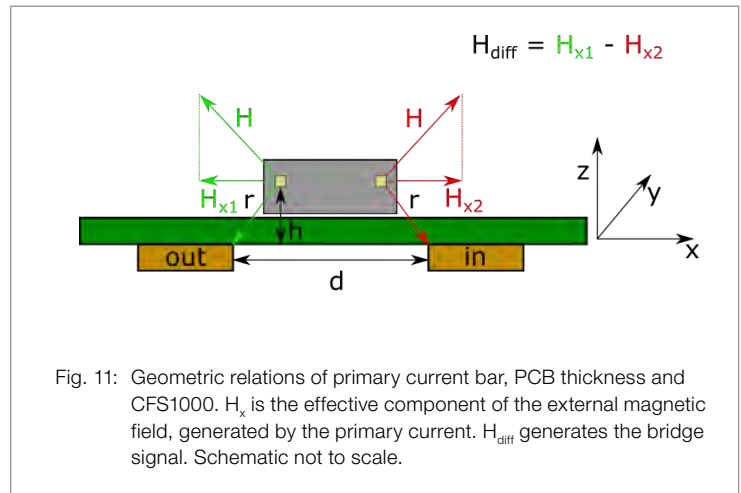


Fig. 11: Geometric relations of primary current bar, PCB thickness and CFS1000.  $H_x$  is the effective component of the external magnetic field, generated by the primary current.  $H_{diff}$  generates the bridge signal. Schematic not to scale.

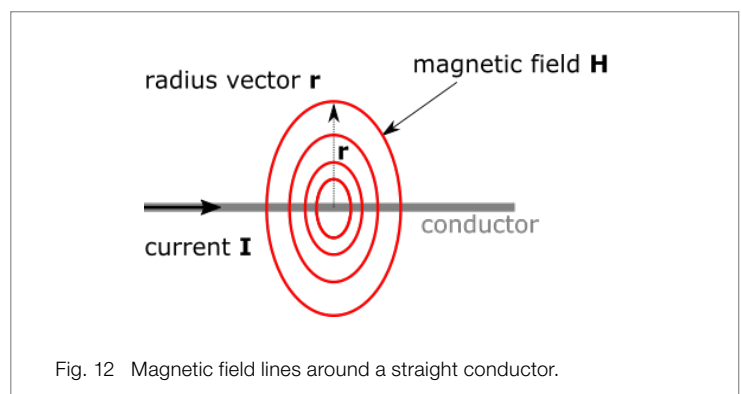


Fig. 12 Magnetic field lines around a straight conductor.

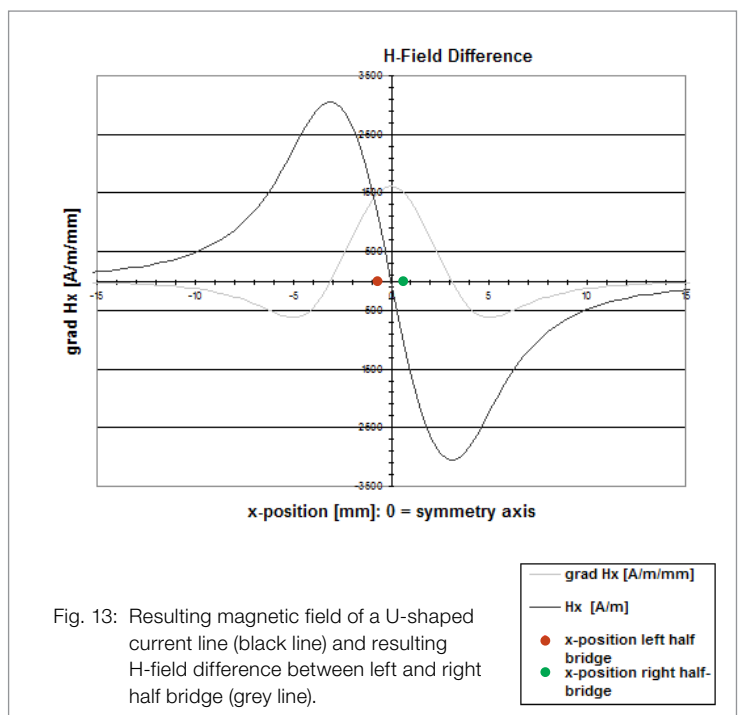


Fig. 13: Resulting magnetic field of a U-shaped current line (black line) and resulting H-field difference between left and right half bridge (grey line).

### 8.1 Radius Vector $r$

The length of  $r$  is determined by three parameters:

- » The width of the gap  $d$  between both straight parts of the U-shaped current line
- » The height  $h$  of the sensor element above the current line (e.g. PCB thickness)
- » The cross section of the primary current bar

These parameters might be constrained by the application.

### 8.2 Primary Current Bar Cross Section Influence

From Fig. 11 it becomes obvious, that the cross section of the primary current bar influences the resulting field component  $H_x$ . In this figure, only one vector  $r$  is drawn. Considering the cubic expansion of the current bar, each point of the cross section will have a different distance vector  $r$  to the sensor elements, and with this have a different contribution to the effective  $H_x$ -field. This is shown in Fig. 14 for the four corners of the cross section of the current bar. In fact, there are additional  $H_x$ -field contributions from the second, parallel part of the U, which have opposite directions, and are smaller due to the gap distance  $d$ . Nevertheless, they will weaken the  $H_x$ -field (these components are not shown in Fig. 14).

As a consequence, the dimensioning of the cross section will have an influence of the resulting sensor signal. For a certain height  $h$  and width  $d$  of the gap, the resulting  $H_x$ -vector will be different for a square or a very thin rectangular current bar cross section of the same area. This gives an additional degree of freedom for the optimization of the layout of the whole system.

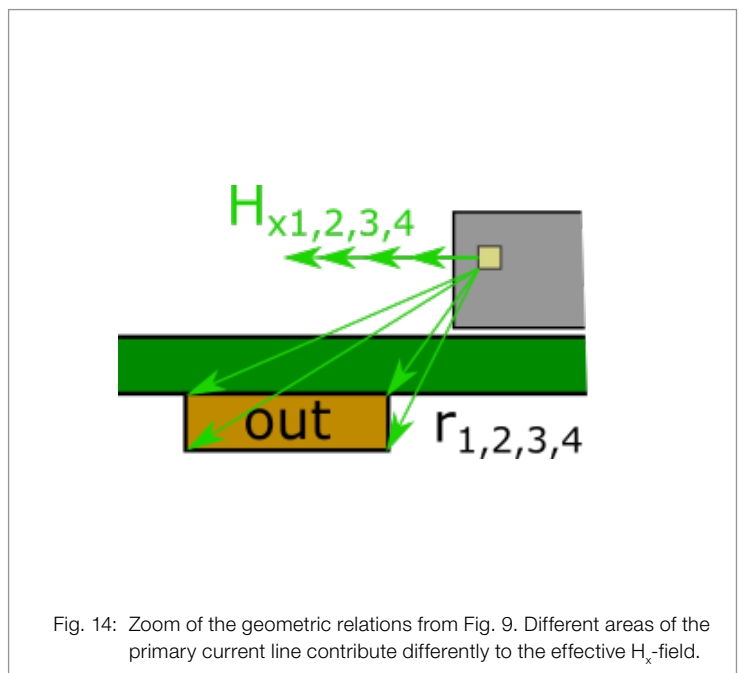


Fig. 14: Zoom of the geometric relations from Fig. 9. Different areas of the primary current line contribute differently to the effective  $H_x$ -field.

The adoption to different current ranges is achieved by determining the parameters  $d$ ,  $h$ , and the width and height of the primary current bar cross section (Fig. 11). Starting point is the nominal current to be measured, which determines the needed cross section area for the ampacity of the current bar to avoid overheating due to thermal losses. This cross section area strongly depends on the application and has to take into account constraints like active cooling, convection, embedded layers in multi-layer PCBs or ambient operating temperature.

The concept of an external primary current bar gives a certain degree of freedom to adapt the system to a wide range of applications. To get the best signal-to-noise ratio (SNR), the field gradient should be near 1920 A/m for the full scale range of the primary current. The target positioning is a symmetrical arrangement of primary current bar and sensor area.

The current bar can be integrated into the PCB for relatively small currents. For higher currents the current bar can be glued on the backside of the PCB below the sensor. Sensitec offers various ready-to-use evaluation boards which cover a current range from 15 A up to 400 A or even a 3-phase evaluation board designed for 3 times 200 A nominal current.

### 8.3 Currents up to 50 A

Sensitec offers three evaluation boards (CFK1015, CFK1025 and CFK1050) where the busbar is directly integrated into the PCB:

- » 15 A
- » 25 A
- » 50 A

The difference between the evaluation boards is the dimensioning of the current bar for different nominal currents (compare with Fig. 15). In all cases the magnetic field gradient is 1920 A/m at sensor position. For currents higher than 50 A it is still possible to integrate the busbar into the PCB. In such cases it is important to keep an eye on the maximum allowed thermal budget.

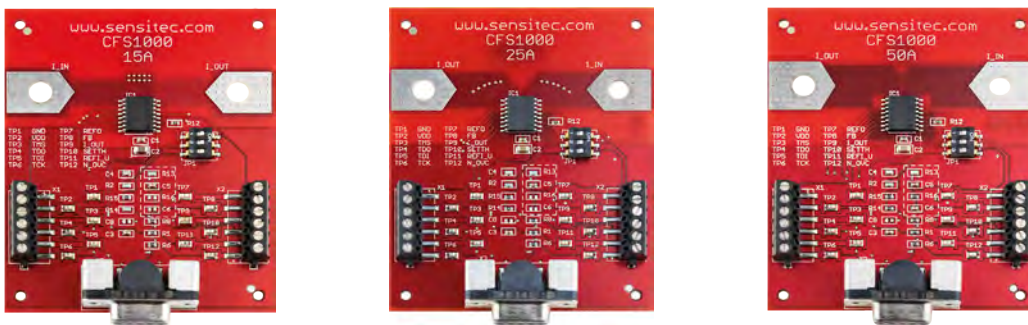


Fig. 15: CFK evaluation boards for 15 A (left), 25 A (middle) and 50 A (right).

The corresponding technical drawings and descriptions can be found in the CFK1000 application note.

### 8.4 Currents above 50 A

Sensitec offers four evaluation boards (CFK1100, CFK1200, CFK1250 and CFK1400) where the busbar is glued on the backside of the PCB:

- » 100 A
- » 3 x 200 A
- » 250 A
- » 400 A

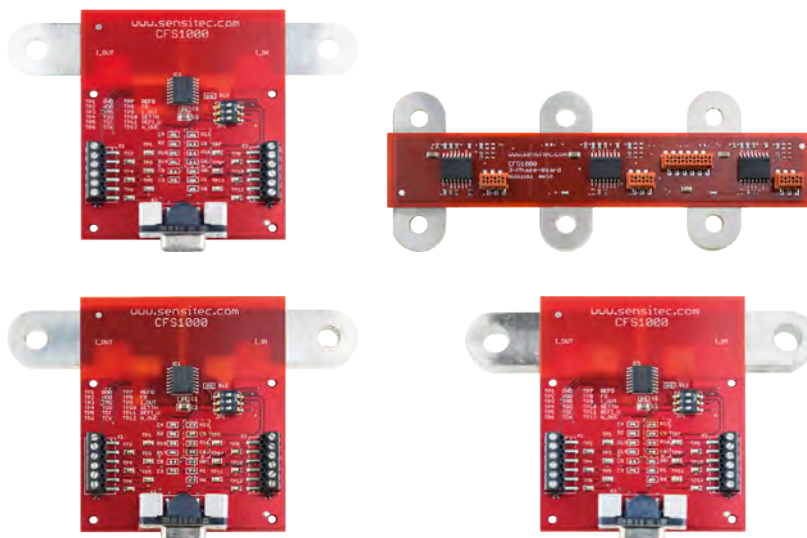


Fig. 16: CFK evaluation boards for 100 A (top left), 3 x 200 A, 250 A and 400 A (bottom right).

The corresponding technical drawings and descriptions can be found in the CFK1000 application note.

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