CMS3050

Highly Dynamic MagnetoResistive Current Sensor (I_{PN} = 50 A)

Preliminary data sheet

The CMS3000 current sensor family is designed for highly dynamic electronic measurement of DC, AC, pulsed and mixed currents with integrated galvanic isolation. The MagnetoResistive technology enables an excellent dynamic response without the hysteresis that is present in iron core based designs.

With a bandwidth of 2 MHz and a temperature range of –40°C to +105°C the CMS3000 enables new application fields for highly-dynamic and compact current measurement.

The CMS3000 product family offers PCB-mountable THT current sensors in the range of 5 A up to 100 A nominal current for industrial applications.

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Product overview CMS3050

Product description	Package	Delivery Type
CMS3050ABA	THT	Tray

Quick reference guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage	±12	±15	-	V
I_{PN}	Primary nominal current (RMS)	-	-	50	A
I_{PR}	Primary measuring range [1]	-150	-	+150	A
f_{co}	Upper cut-off frequency (-3 dB)	-	2	-	MHz
ε_{Σ}	Overall accuracy [2]	-	±1	±1.6	% of I_{PN}

1) For 3 s in a 60 s interval (RMS ≤ I_{PN}) and V_{CC} = ±15 V.

2) $\varepsilon_{\Sigma} = \varepsilon_G$ & ε_{off} & ε_{lin} with V_{CC} = ±15 V, $I_P = I_{PN}$, T_{amb} = 25 °C

Qualification overview

Standard	Name	Status
2002/95/EC	RoHS-conformity	Approval
EN 61010	CE-sign	Intended
EN 61800-5-1: 2007	Adjustable speed electrical power drive systems	Intended
DIN EN 50178	Electronic equipment for use in power installations	Intended
UL508	Industrial control equipment	Intended

Features

- Based on the Anisotropic MagnetoResistive (AMR) effect
- Measuring range up to 3 times nominal current
- Galvanic isolation between primary and measurement circuit
- Pin-compatible with CMS2000 family
- Bipolar 15 V power supply

Advantages

- Very high bandwidth of 2 MHz
- Highly dynamic step response
- Large temperature range –40°C to +105°C
- Excellent accuracy
- Negligible hysteresis
- Compact size

Applications

- Electrical motor control
- DC/DC converter
- IGBT gate driver
- Laser diode driver
- Audio amplifier
- Condition Monitoring
- Switched mode power supplies
- Sensorless BLDC motors

Absolute maximum ratings

In accordance with the absolute maximum rating system (IEC60134).

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Positive supply voltage	Tbd.	Tbd.	V
V_{SS}	Negative supply voltage	Tbd.	Tbd.	V
I_{PM}	Maximum primary current [1)]	-500	+500	A
T_{amb}	Ambient temperature	-40	+105	℃
T_{stg}	Storage temperature	-40	+125	℃
T_B	Busbar temperature	-40	+125	℃

1) For 20 ms in a 20 s interval (RMS ≤ I_{PN}).

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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Electrical data

T_{amb} = 25 °C; V_{CC} = ±15 V; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Positive supply voltage		+14.3	+15.0	+15.7	V
V_{EE}	Negative supply voltage		-14.3	-15.0	-15.7	V
I_{PN}	Primary nominal current (RMS)		-	-	50	A
I_{PR}	Measuring range [1)]		-150	-	+150	A
V_{outN}	Nominal output voltage (RMS)	$I_P = I_{PN}$, See Fig.1	-	2.5	-	V
R_M	Internal burden resistor for output signal		80	115	150	Ω
R_P	Resistance of primary conductor		-	-	0.15	mΩ
I_Q	Quiescent current	$I_P = 0$	-	27	30	mA
I_{CN}	Nominal current consumption	$I_P = I_{PN}$	-	50	60	mA
I_{CR}	Measuring range current consumption	$I_P \leq I_{PR}$	-	90	100	mA
I_{CM}	Maximum current consumption	$I_P > I_{PR}$	-	-	130	mA

T_{amb} = 25 °C; V_{CC} = ±12 V; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Positive supply voltage		+11.4	+12.0	+12.6	V
V_{EE}	Negative supply voltage		-11.4	-12.0	-12.6	V
I_{PN}	Primary nominal current (RMS)		-	-	50	A
I_{PR}	Measuring range [1)]		-100	-	+100	A
V_{outN}	Nominal output voltage (RMS)	$I_P = I_{PN}$, See Fig.1	-	2.5	-	V
R_M	Internal burden resistor for output signal		80	115	150	Ω
R_P	Resistance of primary conductor		-	-	0.15	mΩ
I_Q	Quiescent current	$I_P = 0$	-	27	30	mA
I_{CN}	Nominal current consumption	$I_P = I_{PN}$	-	50	60	mA
I_{CR}	Measuring range current consumption	$I_P \leq I_{PR}$	-	75	90	mA
I_{CM}	Maximum current consumption	$I_P > I_{PR}$	-	-	100	mA

1) For 3 s in a 60 s interval (RMS ≤ I_{PN}).

Accuracy

T_{amb} = 25 °C; V_{CC} = ±15 V; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
ε_{Σ}	Overall accuracy [1]	$I_P \le I_{PN}$	-	1.0	1.6	% of I_{PN}
ε_G	Gain error	$I_P \le I_{PN}$	-	-	0.7	% of I_{PN}
ε_{off}	Offset error	I_P = 0	-	-	0.8	% of I_{PN}
ε_{Lin}	Linearity error	$I_P \le I_{PN}$	-	Tbd.	-	% of I_{PN}
ε_{Hys}	Hysteresis [2]		-	-	Tbd.	% of I_{PN}
PSRR	Power supply rejection rate		-	-	Tbd.	dB
N	Noise level (RMS)		-	2.0	2.5	mV

T_{amb} = (-25…+85)°C; V_{CC} = ±15 V; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$T\varepsilon_G$	Maximum temperature induced gain error		-0.9	0	+0.9	% of I_{PN}
$T\varepsilon_{off}$	Maximum temperature induced offset error		-1.0	0	+1.0	% of I_{PN}
$T\varepsilon_{Lin}$	Maximum temperature induced linearity error		-	Tbd.	Tbd.	% of I_{PN}

T_{amb} = (-40…+105)°C; V_{CC} = ±15 V; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$T\varepsilon_G$	Maximum temperature induced gain error		-1.5	0	+1.5	% of I_{PN}
$T\varepsilon_{off}$	Maximum temperature induced offset error		-1.5	0	+1.5	% of I_{PN}
$T\varepsilon_{Lin}$	Maximum temperature induced linearity error		-	Tbd.	Tbd.	% of I_{PN}

Notes

[1] Overall accuracy contains ε_G, ε_{off} and ε_{Lin}.

[2] Residual voltage after 3 · I_{PN} DC.

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Highly Dynamic MagnetoResistive Current Sensor (I_{PN} = 50 A)

General data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
T_{amb}	Ambient temperature [1)]		-40	-	+105	°C
T_{stg}	Storage temperature		-40	-	+105	°C
T_B	Busbar temperature [1)]		-40	-	+125	°C
T_{THT}	Solder temperature	For 7 seconds.	-	-	250	°C
m	Mass		-	6.5	-	g

Dynamic data

T_{amb} = 25 °C; V_{CC} = ±15 V; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
t_{reac}	Reaction time [2)]	10 % I_{PN} to 10 % $I_{out,N}$	-	0.02	0.06	µs
t_{rise}	Rise time [2)]	10 % $I_{out,N}$ to 90 % $I_{out,N}$	-	0.15	0.40	µs
t_{resp}	Response time [2)]	90 % I_{PN} to 90 % $I_{out,N}$	-	0.01	0.02	µs
f_{co}	Upper cut-off frequency	-3 dB	-	2	-	MHz

Notes

1) Operating condition.

2) $I_P = I_{PN}$ with di/dt of 90 A/µs. See Fig. 2 and 3.

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Highly Dynamic MagnetoResistive Current Sensor (I_{PN} = 50 A)

Qualifications

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_I	Isolation test voltage (RMS)	50/60 Hz, 60 s	-	3.5	-	kV
V_{imp}	Impulse withstand voltage	1.2/50 µs	-	8	-	kV
d_{cp}	Creepage distance		5	-	-	mm
d_{cl}	Clearance distance		5	-	-	mm

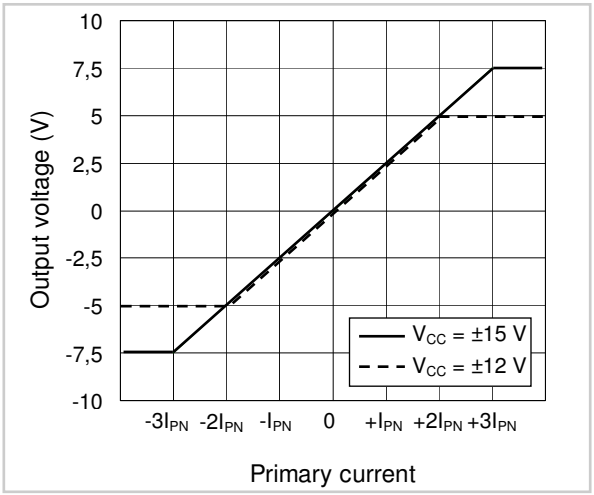

Fig. 1: Characteristic of primary current to output voltage according to supply voltage V_{cc}.

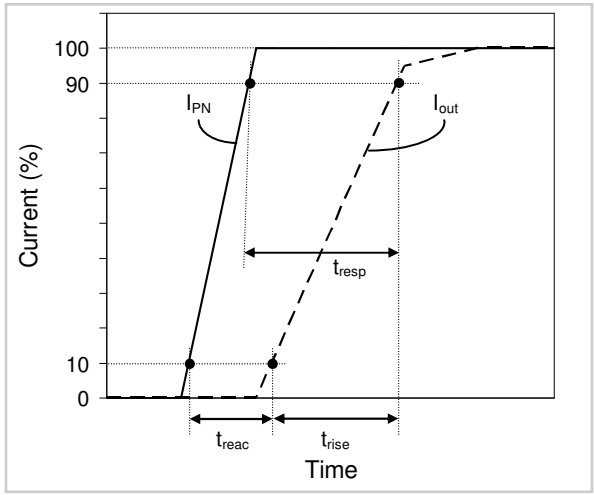

Fig. 2: Definition of reaction time (t_{reac}), rise time (t_{rise}) and response time (t_{resp}).

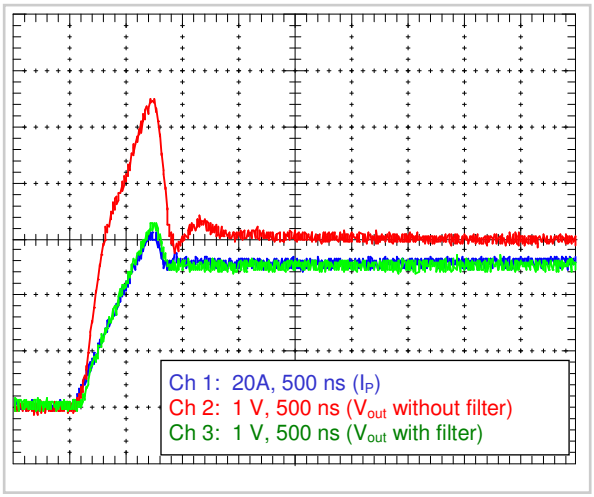

Fig.3: Typical output characteristic of the CMS3050ABA due to a primary current jump from 0 A to I_{PN} with di/dt ≈ 90 A/µs compared to a RC-filter configuration (green) with the parameters shown in Fig.6.

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Pinning

Pin	Symbol	Parameter
1	V_{CC}	Positive supply voltage
2	V_{SS}	Negative supply voltage
3	GND	Ground
4	SGND	Signal ground
5	V_{out}	Signal output
6	I_{in}	Primary current input
7	I_{out}	Primary current output

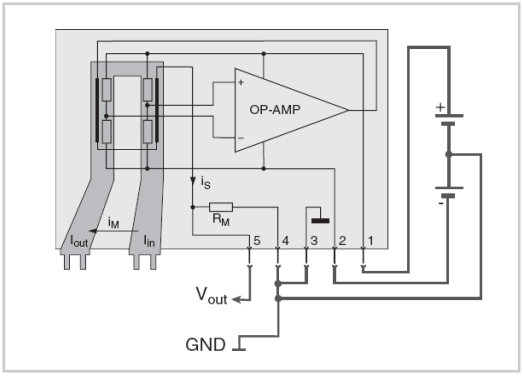


Fig. 4: Pinning of CMS3050.

Dimensions

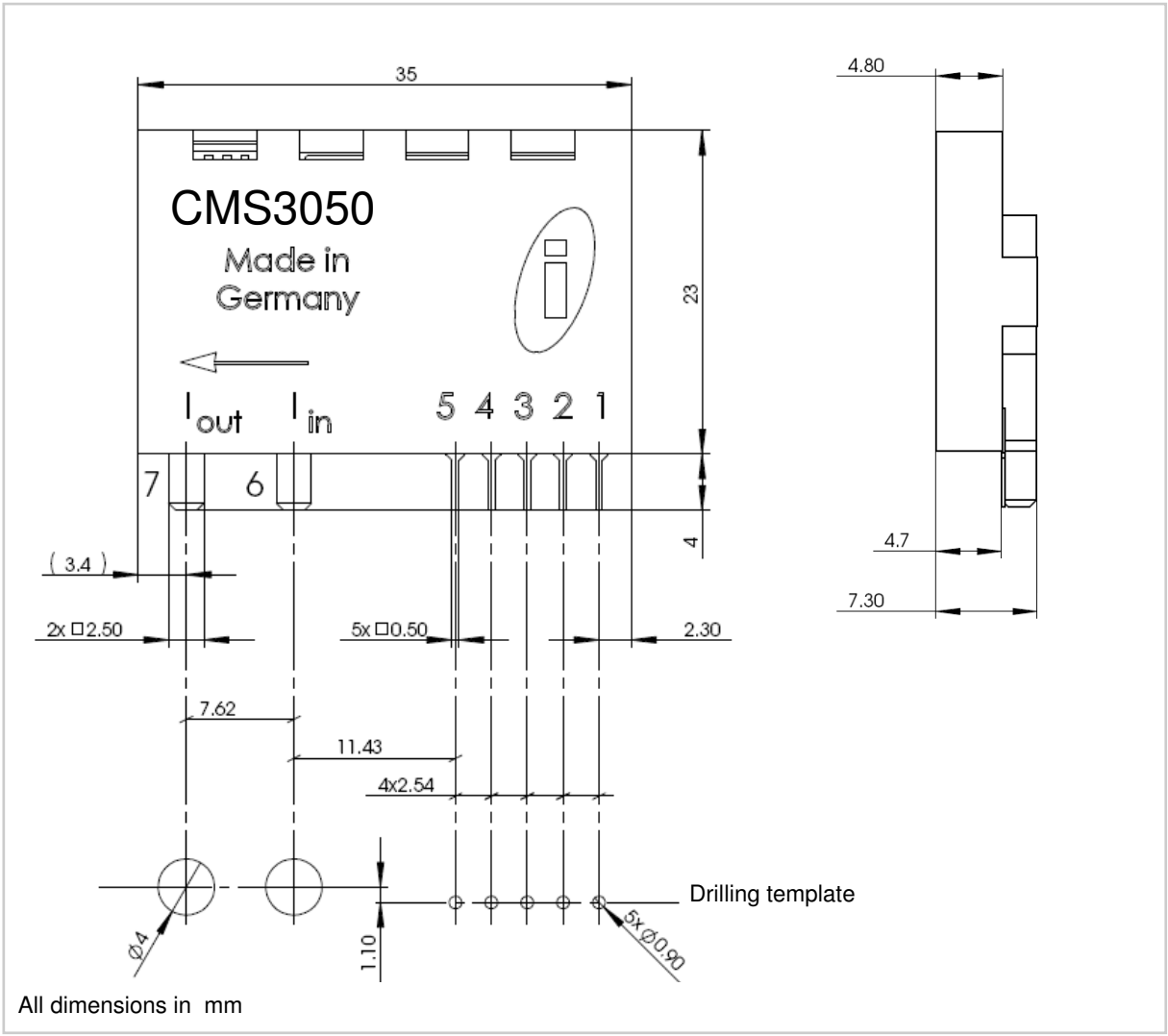


Fig. 5: Package outline with ± 0.2 mm tolerance and drilling plan with 0.05 mm tolerance.

Application circuit

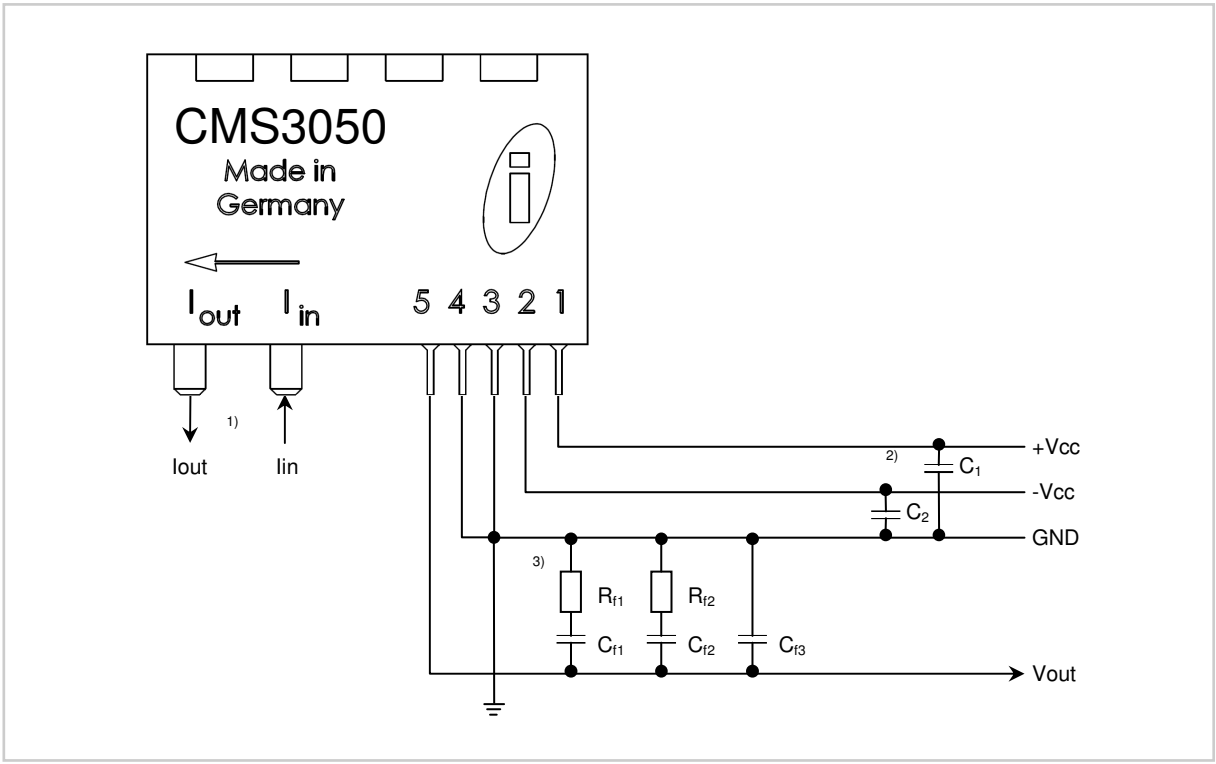


Fig. 6: Typical circuit to improve frequency response using a RC-filter network.

Notes

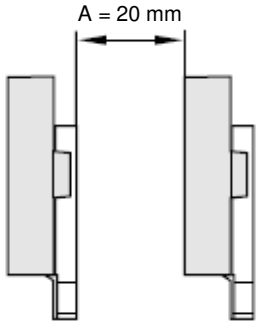
1) V_{out} is positive, if I_P flows from pin "I_{in}" to pin "I_{out}".

2) The power supply should always be buffered by 47 µF electrolytic capacitor C_1 and C_2.

3) To improve frequency response a RC-filter is recommended according to the followed parameters:

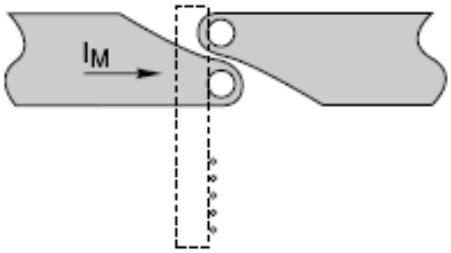
Type	Rf1	Cf1	Rf2	Cf2	Cf3
CMS3050ABA	470 Ω	47 nF	180 Ω	2.2 nF	2.2 nF

PCB Layout



Side View

Fig. 7: Recommended clearance A among each other.



Top View

Fig. 8: Recommended current path layout.

Additional notes for the designer

- The minimum clearance to other magnetic devices (for example: relay, current conductors and permanent magnets) depends on the strength of their magnetic field. Homogeneous fields should be below 1 kA/m and magnetic field gradients should be lower than 4 kA/m². A conductor carrying 1 A produces a magnetic field of 20 A/m and a magnetic field gradient of 2.5 kA/m² at a distance of 8 mm.
- The maximum operating temperature is primarily limited by the busbar temperature. Care must be taken to keep the busbar temperature below 125 °C.
- It is recommended to place multiple sensor arrangements with a clearance (A) of at least 20 mm as shown in Fig. 8. A smaller distance will cause cross-talk to adjacent sensors. The primary current paths in the PCB however may not be routed underneath a sensor. The ideal routing is sown in Fig. 9.

The CMS3000 product family

The CMS3025 is a member of the CMS3000 product family offering PCB-mountable THT current sensors from 5 A up to 100 A nominal current with a typical bandwidth of 2 MHz for various industrial applications.

	CMS3005ABA	CMS3015ABA	CMS3025ABA	CMS3050ABA	CMS3100ABA[1)]
					
I_{PN}	5 A	15 A	25 A	50 A	100 A
I_{PR}	15 A	45 A	75 A	150 A	300 A

[1)] Coming soon.

I_{PN} : Nominal primary current (RMS)

I_{PR} : Measurement range (for 1 s in a 60 s interval)

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General information

Product status
The product is under development, qualification is ongoing. Deliverables have a sample status. The datasheet is preliminary. **Note:** The status of the product may have changed since this data sheet was published. The latest information is available on the internet at www.sensitec.com.

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