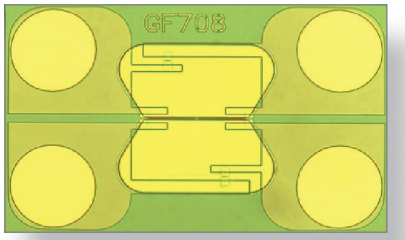
SENSITEC
MAGNETORESISTIVE SENSORS

DATA SHEET

GF708

MagnetoResistive Magnetic Field Sensor



The GF708 is a magnetic field sensor based on the GiantMagnetoResistive (GMR) effect. Its functional magnetic layer is pinned within a synthetic spin-valve connected as a Wheatstone bridge. With its on-chip flux concentrators an extremely large sensitivity can be achieved, resulting in an almost step-like bipolar transfer curve. This way the sensor is suitable for two key application fields: On one hand a highly sensitive magnetic field sensor with a sensitivity of 130 mV/V/mT - on the other hand, the sensor can be used as an index sensor for encoders. Here a single magnetic reference pole can be detected with high spatial resolution.

The product is available as bare die with gold terminals. As flipchip or integrated in a SIL6 or LGA-package the device is suitable for SMD assembly.

Product Overview GF708

Article Description	Package	Delivery Type
GF708APA-AE	Flip-chip	Tape on reel (2500)
GF708ACA-AB	Die on wafer [1]	Waferbox
GF708AKA-AC	SIL6	Waffle pack (90)
GF708AMA-AE	LGA6S	Tape on reel (2500)

[1] Minimum order quantities apply.

Quick Reference Guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
General					
V_{CC}	Supply voltage	-	5.0	-	V
R_B	Bridge resistance	13	16	19	kΩ
T_{amb}	Ambient temperature	-40	-	+125	°C
Switching Applications					
B_{op}	Magnetic operation range [1]	-18	-	+18	mT
B_{switch}	Magnetic switching range	-1.0	-	+1.0	mT
V_{range}	Electrical output range	30	56	70	mV/V
Magnetic Field Applications					
S	Sensitivity	80	130	180	mV/V/mT
V_{lin}	Linear range of output voltage	30	40	50	mV/V

[1] Magnetically unambiguous range.

Features

- Very high magnetic sensitivity
- Extremely low hysteresis
- Step-like bipolar transfer curve
- Simplified mechanical design, due to in-plane sensitivity
- Available in flip-chip design, SIL6 and LGA housing

Advantages for Magnetic Switching Applications

- Large air gap
- Large air gap tolerances
- High switching accuracy
- Easy identification of field direction
- Simple integration
- Allows use of small magnets

Advantages for Magnetic Field Measurement Applications

- Allows detection of smaller particles or material defects (NDT)
- Large distance to target
- High resolution for magnetic imaging

ESD

RoHS-Compliant www.sensitec.com

Absolute Maximum Ratings

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

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply voltage	-9.0	+9.0	V
T_{amb}	Ambient temperature	-40	+125	°C
T_{stg}	Storage temperature (bare die)	-65	+150	°C
V_{ESD}	HBM [1] ESD classification level 1a	-	150	V

[1] Human Body Model ESD classification level according MIL-STD-883.

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. The device however cannot neither be damaged nor are the specified parametrical limits affected by strong magnetic fields within ambient temperature range.

General Electrical Data

T_{amb} = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage		-	5.0	-	V
R_B	Bridge resistance [2]		13	16	19	kΩ
TC_{RB}	Temperature coefficient of RB [3]	T_1 = 30°C, T_2 = 85°C	0.08	0.12	0.14	%/K

[2] Bridge resistance between pads 1 and 3 or 2 and 4. See Fig.1.

[3] $TC_{RB} = 100 \cdot \frac{R_{B(T2)} - R_{B(T1)}}{R_{B(T1)} \cdot (T_2 - T_1)}$ with T1 = +30 °C; T2 = +85 °C.

General Electrical Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
f	Frequency range		1 [4]	-	-	MHz

[4] No significant amplitude attenuation.

In Fig. 1 the resistors R_{23} and R_{41} are covered by two flux concentrators (shields) to prevent an applied magnetic field from influencing them. Therefore, when a field is applied, the resistors R_{12} and R_{34} decrease in resistance, while the other two resistors under the flux concentrator do not. This imbalance leads to the bridge output.

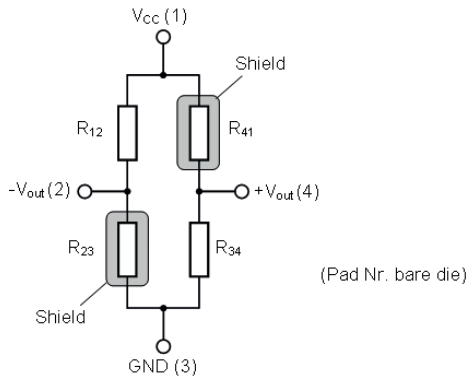


Fig. 1: Simplified circuit diagram.

Characteristic Transfer Curve Parameters for Switching Applications

GF708 can ideally be employed as reference sensor or in end-point detection applications. Here, the quasi step-like transfer curve of the incorporated spin-valve is unique within the wide operating range B_{op} of ±18 mT and provides a comfortable electrical operating window V_{range} of 40 mV/V for the switching threshold.

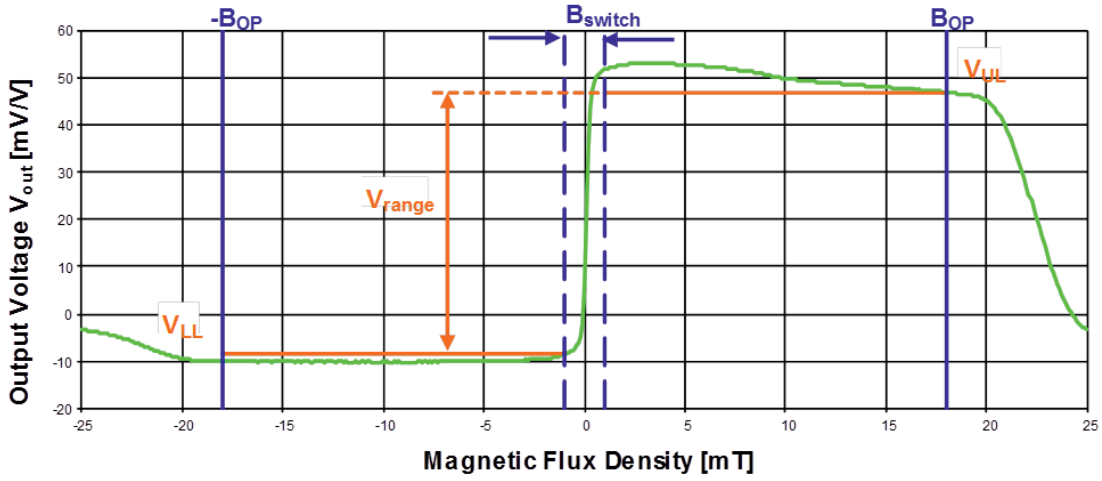


Fig. 2: Typical output voltage for magnetic flux density within ±25 mT.

Magnetic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
B_{switch}	Magnetic switching range	See Fig. 2	-1.0	-	+1.0	mT
B_{op}	Magnetic operation range [1]	See Fig. 2	-18	-	+18	mT

[1] Magnetically unambiguous range.

General Electrical Data

T_{amb} = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{UL}	Upper limit of electrical output range [2]	See Fig. 2	20	30	40	mV/V
V_{LL}	Lower limit of electrical output range [3])	See Fig. 2	-25	-12	-2	mV/V
V_{range}	Electrical output range	See Fig. 2	30	45	60	mV/V
TC_{Vrange}	Temperature coefficient of V_{range} [4]	T_1 = 25 °C, T_2 = 85 °C	-0.5	-0.35	-0.2	%/K
TC_{VLL}	Temperature coefficient of V_{LL} [5]	T_1 = 25 °C, T_2 = 85 °C	-20	15	50	µV/V/K

[2] The upper limit of the electrical output range is defined as the minimum output voltage in the range (1mT, 18mT).

[3] The lower limit of the electrical output range is defined as the maximum output voltage in the range (-1mT, -18mT).

[4] $TC_{Vrange} = 100 \cdot \frac{V_{range(T2)} - V_{range(T1)}}{V_{range(T1)} \cdot (T_2 - T_1)}$ with T1 = +25 °C; T2 = +85 °C.

[5] $TC_{VLL} = 100 \cdot \frac{V_{LL(T2)} - V_{LL(T1)}}{T_2 - T_1}$ with T1 = +25 °C; T2 = +85 °C.

V_{LL} is always negative within the specified ambient temperature range.

Characteristic Transfer Curve Parameters for Highly Sensitive Magnetic Field Measurement

GF708 also serves as a highly sensitive magnetic field sensor. Due to the spin-valve technology the transfer curve within ±1 mT features an extremely high sensitivity of 130 mV/V/mT with very low coercitivity at the same time. Thus the sensor is ideally suited for e. g. magnetic particle detection, non-destructive testing applications or vehicle detection. Furhtermore, the sensor can also be used as an index sensor on encoders.

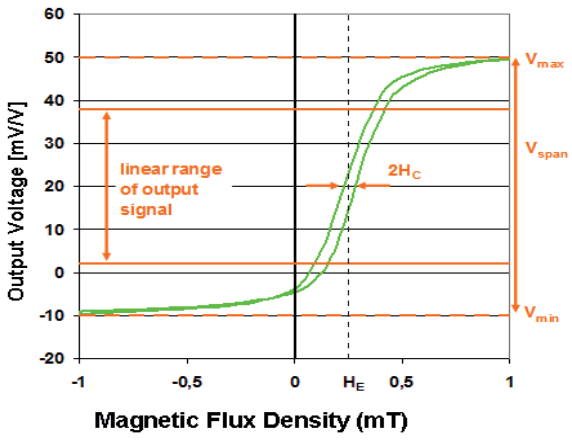


Fig. 3: Typical output voltage for magnetic flux density. within ±1 mT.

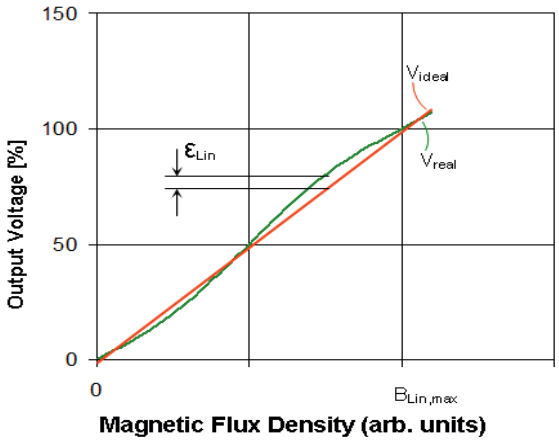


Fig. 4: Definition of linearity error ε_{Lin} [1] (schematic).

[1] Linearity error is normalized to the output voltage span $V_{span} = V_{max} - V_{min}$.

Magnetic Data

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
H_E	Exchange coupling [2]	See Fig. 3	0	0.11	0.2	mT

[2] H_E is the exchange coupling field for the GMR spin valve.

General Electrical Data

T_{amb} = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{lin}	Linear range of output voltage [3]	See Fig. 3	25	35	45	mV/V
S	Sensitivity	for B = -5 to +5 mT	80	130	180	mV/V/mT
TC_S	Temperature coefficient of sensitivity [4]	T_1 = 25 °C, T_2 = 85 °C	-0.5	-0.24	-0.00	%/K

[3] The linear range of the out signal is defined as the interval $[V_{min} + 0.2 * V_{span}; V_{max} - 0.2 * V_{span}]$.

[4] $TCS = 100 \cdot \frac{S_{(T2)} - S_{(T1)}}{S_{(T1)} \cdot (T_2 - T_1)}$ with T1 = +25 °C; T2 = +85 °C.

Accuracy

T_{amb} = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
H_C	Hysteresis (Coercitivity)	For B = -5 to +5 mT (see Fig. 3)	-	0.05	0.1	mT
ε_{Lin}	Linearity error [5]	See Fig. 4	0	6	10	%

[5] Linearity error is normalized to the output voltage span $V_{span} = V_{max} - V_{min}$.

GF708 as Bare Die and Flip-Chip

Pinning

Pad	Symbol	Parameter
1	V_{CC}	Supply voltage
2	$-V_{out}$	Negative output voltage
3	GND	Ground
4	$+V_{out}$	Positive output voltage

Note:
The orientation for the pinout of the bare die is given by product label.

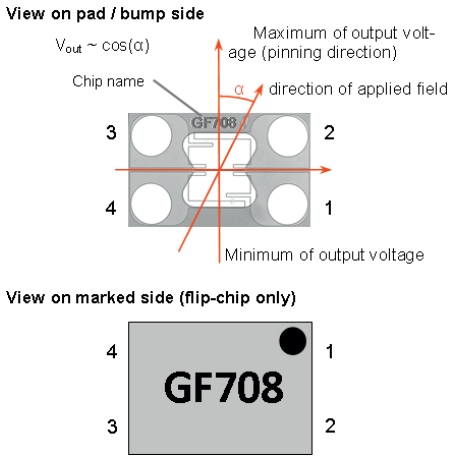


Fig. 5: Sensitivity of GF708.

Fig. 5:
Bottom: Backside view on laser mark with pin1 indication.

Dimensions

Symbol	Parameter		Min.	Typ.	Max.	Unit
A	Bare die	Length	1420	1460	1500	µm
B		Width	920	960	1000	µm
C		Height	240	250	260	µm
d		Diameter	-	230	-	µm
A	Flip-chip	Length	1350	1400	1450	µm
B		Width	850	900	950	µm
C		Height	400	410	420	µm
d		Diameter [1]	-	300	-	µm
S		Standoff [2]	-	240	-	µm
a		Pitch a	-	1000	-	µm
b		Pitch b	-	500	-	µm
e		Margin	-	200	-	µm

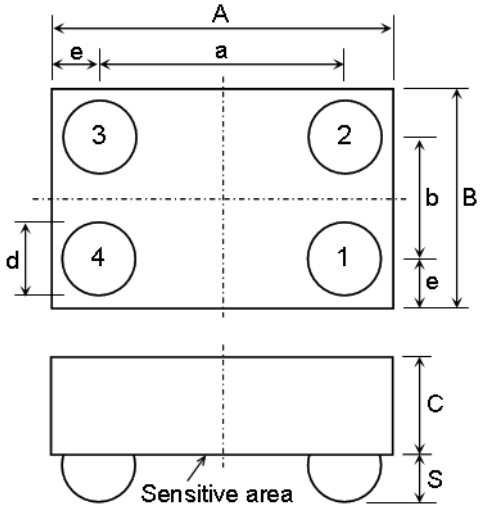


Fig. 6: Chip outline of GF708.

[1] Solder ball diameter before reflow.

[2] After reflow.

Data for Packaging and Interconnection Technologies

Symbol	Parameter	Conditions	Value	Unit
Bare die	Pad material		Au	-
	Pad thickness		0.4	µm
Flip-chip	Solder ball material		SnAg2.6Cu0.6	-
	Maximum solder temperature	For 6 s	260	°C

GF708AKA SIL6 Package

Pinning

Pad	Symbol	Parameter
1	GND	Ground
2	nc	Not connected
3	$+V_{out}$	Positive output voltage
4	V_{CC}	Supply voltage
5	nc	Not connected
6	$-V_{out}$	Negative output voltage

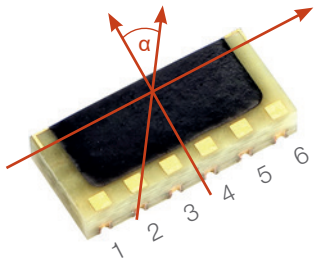


Fig. 7: GF708AKA.

Dimensions

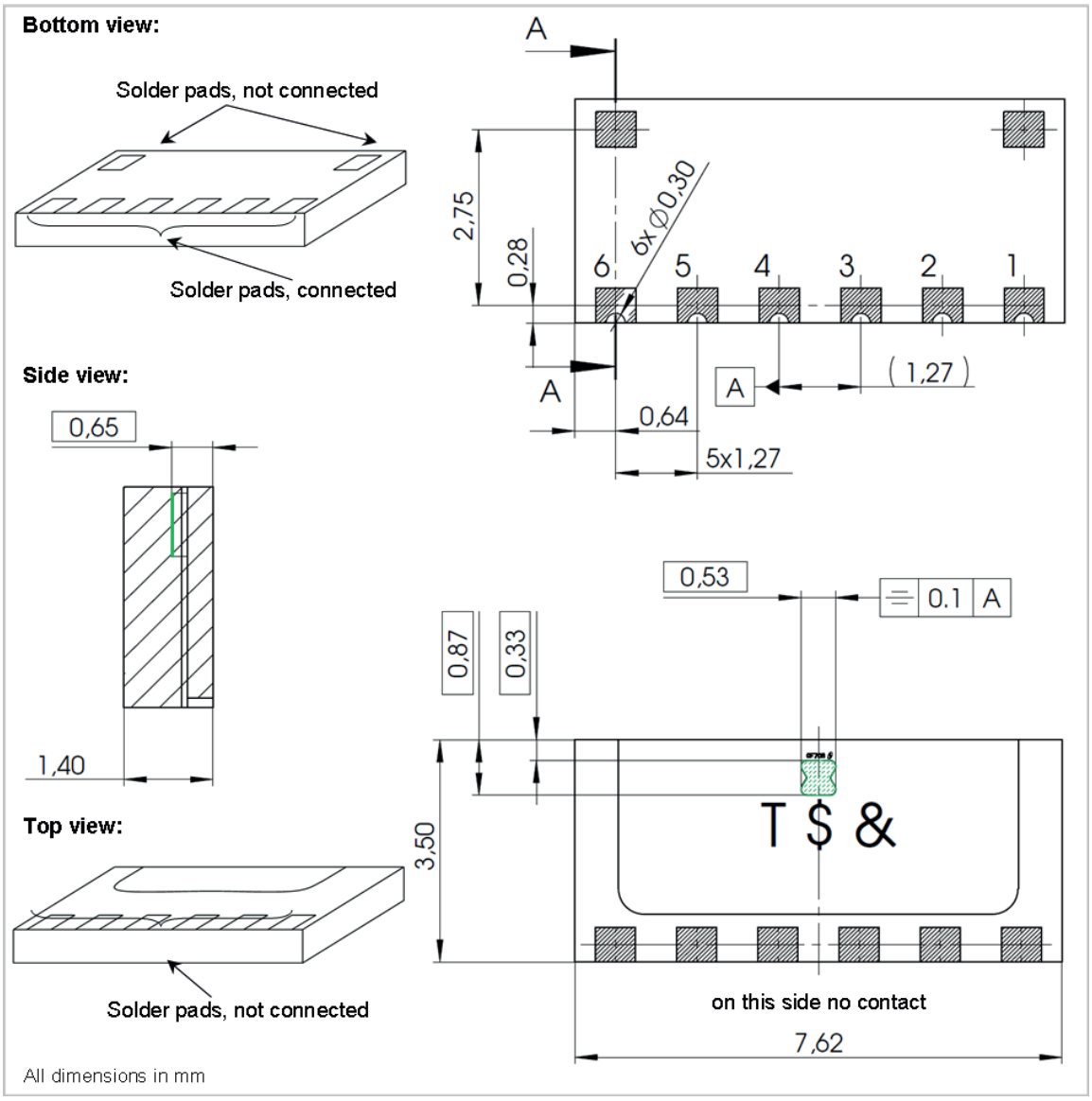


Fig. 8: Package outline of SIL6-housing.

GF708AMA LGA6S

Pinning

Pad	Symbol	Parameter
1	$+V_{01}$	Positive output voltage bridge 1
2	NC	Not connected
3	GND	Ground
4	V_{CC}	Supply voltage
5	$-V_{01}$	Negative output voltage bridge 1
6-8	NC	Not connected

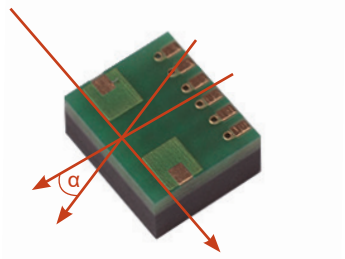
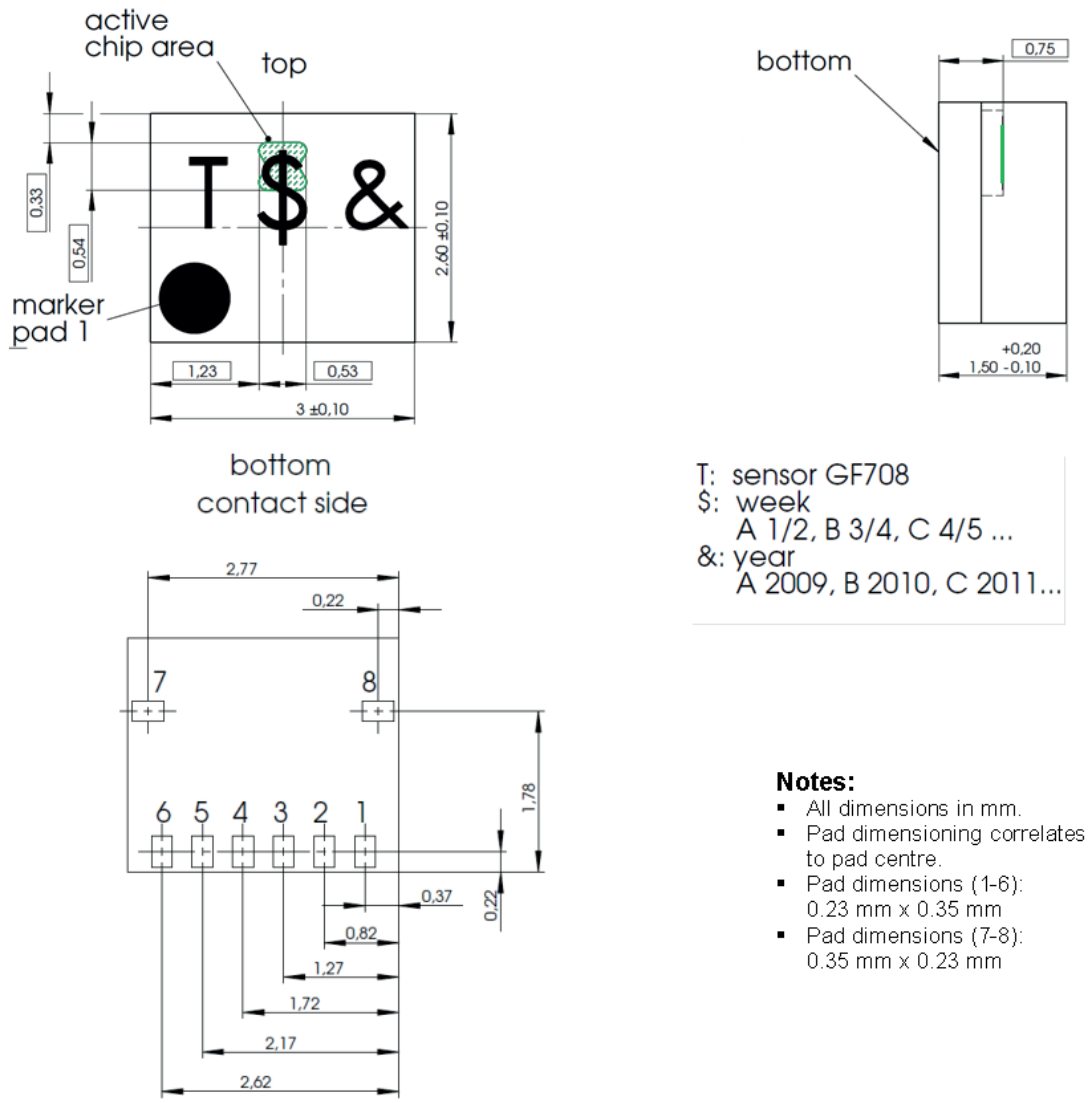


Fig. 9: GF708AMA.

Dimensions



Notes:

- All dimensions in mm.
- Pad dimensioning correlates to pad centre.
- Pad dimensions (1-6): 0.23 mm x 0.35 mm
- Pad dimensions (7-8): 0.35 mm x 0.23 mm

Fig. 10: LGA6S for GF708AMA.

General Information

Product Status

Article	Status
GF708APA-AE	The product is undergoing qualification tests. Deliverables have a sample status. The datasheet is preliminary.
GF708ACA-AB	The product is undergoing qualification tests. Deliverables have a sample status. The datasheet is preliminary.
GF708AKA-AC	The product is undergoing qualification tests. Deliverables have a sample status. The datasheet is preliminary.
GF708AMA-AE	The product is undergoing qualification tests. 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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Changelist

Version	Description of the Change	Date
GF708.DSE.07	Logo and adress updated (pp. 1-9)	03/2024
GF708.DSE.00	Original (pp. 1-9)	03/2011

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