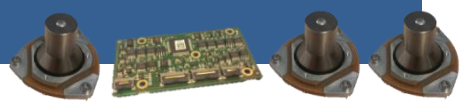
SAFRAN

ELECTRONICS & DEFENSE

Resonating Gyrometer Sensor

DATASHEET 10MS00-56 20MS00-56 30MS00-56

X0MS00-56 series are angular rate gyro (1,2 or 3 axis):
Resonating gyro delivered without its metallic housing allowing a compact integration in small available space. Each gyro is factory calibrated and compensated for temperature effects to provide high accuracy differential analogue output voltage.
The best compromise between MEMS and FOG gyros!



Key features

x0MS00-56	30°/s	60°/s	100°/s	120°/s	180°/s	250°/s	300°/s	Units
Measurement Range(1)	± 30	± 60	± 100	± 120	± 180	± 250	± 300	°/sec
Scale factor:								
Digital Output	16 Bits ADC RS422 output							
Analogue output (differential):	± 0,33	± 0,16	± 0,100	± 0,083	± 0,055	± 0,040	± 0,033	V/°/sec
Scale factor sensitivity (-45°C to +85°C)	±1							%, 1σ
Bias stability (Allan variance method) (2)	0,2							°/h, 2σ
Noise:								
Angular Random Walk ARW (2):	0,006							°/√h 2σ
Within 0,1 to 100Hz:	0,015							°/sec rms
Bandwidth	>100							Hz
Power supply	+/- 15 & +5							Vdc
Temperature (operating)	-45, +85							°C

(1) Any other value available on request from 30 to 300°/sec.

The x0MS00-56 series are an innovative, robust and solid-state resonating gyro unit used in numerous applications such as line of sight stabilization (sights and optical systems) turrets and line of fire stabilization, antenna and sonar's stabilization, ship anti-roll systems, artificial horizons, high-speed tilted trains and IMUs coupled to GPS. A standard and unique mechanical base resonator is coupled to an electronics which can be adapted to meet customer's specifications in terms of measurement range, bandwidth, noise, etc.

The SAFRAN Electronics & Defense 10MS00-56 Rate Gyro units, described in this present document is designed to deliver digital outputs as well as DC Voltage proportional to the angular rate seen by the sensitive axis of the gyro sensor.

Applications

Aircraft Flight Control
Fire control Systems
Tactical Training Simulators
Sights, optical and infrared line of sight
Gyro-stabilized gimbals

Naval and Land remote weapon systems
Antenna stabilization
Sonars stabilization
Ship anti-roll systems
Naval and Land weapon platforms

Unmanned Aerial vehicles (UAV's) control
Autonomous underwater vehicles (AUV's)
Automotive testing
Tilting trains
Robotics

PARAMETERS

All values are specified at ambient temperature (20°C) and nominal power supply voltage, unless otherwise stated.

Parameter	Comments	Min	Typ.	Max	Unit
Sensitivity					
Dynamic range	x0MS00-56	±0		300	°/s
Scale factor	Digital Output (RS422) 16Bits		6 E-04		V/LSB
	Analogue output (differential):	0,333		0,033	V/°/sec
Accuracy	Compensated -40°C to +80°C	-1	0.5	1	%
Sensitivity over T	-45°C to +85°C, 1σ		5000		ppm
Axis misalignment			10	20	Arc min
Non linearity	% of measurement range		0.02	0.1	%
Bias					
In run bias at 2σ	20°C (min of the Analog Allan Variance) (analog output)		0.1 0.000027	0.2 0.000055	°/h °/s
Accuracy over Temperature	-45°C to +85°C		200	<300	°/h rms
Linear acceleration effect	Negligible, within noise. Acceleration should be <30g			< 2	°/h/g
Random drift Bias instability	20°C, during 1h		20		°/h
Run to run	For OFF time < 2 hours	-40		+40	°/h
Noise					
Angular Random Walk ARW	Analogue output @ 22°C (slope of the linear part of the Allan Variance)		0.007		°/√h
Noise	in band 0-100Hz		0.008	0.015	°/s rms
Bandwidth					
Frequency response	-3dB / -90°	> 100			Hz
Temperature					
Operating		-45		+85	°C
Non-operating		-45		+85	°C
Power supply (V_{DD})					
Input voltage			+/-15V & +5V		V
consumption	Watts per axis		2	3	W
Startup time			2	3	s
Warm up time	Time before reaching the performances			15	min
Environment					
Vibration	See vibration & shocks note				
Shocks	See vibration & shocks note				
Angular accelerations				3000	°/s²
Altitude				30000	feet
EMC/EMI	See Handling precaution note				
MTBF	Operational MTBF sensor reaches 300 000 hours.				

Specifications

Absolute maximum ratings

Absolute maximum ratings are stress ratings. Stresses in excess of these ratings can cause permanent damage to the device. Exposure of the device to the absolute maximum ratings for an extended period may degrade the device and affect its reliability.

Parameter	Comments	Min	Typ	Max	Unit
Supply voltage +/-15V +5V		-16 4.75		+16 5.25	V
Operational temperature		-45		+85	°C
Altitude				30 000	feet
Maximum angular acceleration				3 000	°/s²
Maximum linear acceleration				30	g

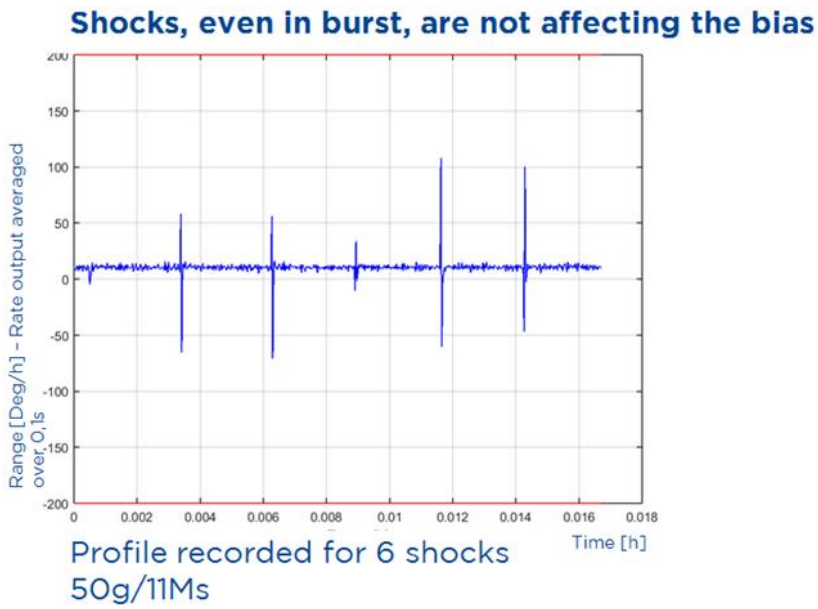
Absolute maximum ratings

Vibration & Shocks

Vibration (unit operational and non-operational) qualified according to Mil standard 810 issue G, Method 514-6, procedure 2. (0.3 g²/Hz)
Vibration frequency applied is 5 to 2000Hz.

Shock (unit operational and non-operational) qualified according to Mil standard 810 issue G, Method 516-6, procedure 1. Three Shocks applied on each axis. Shock form is ½ sinus.

Amplitude (g)	Duration (ms)
50	11
200	0.5
500	0.25



Handling precautions

The component is susceptible to damage due to electrostatic discharge (ESD). Therefore, suitable precautions shall be employed during all phases of manufacturing, testing, packaging, shipment and handling. Sensor will be supplied in antistatic bag with ESD warning label and they should be left in this packaging until use. The following guidelines are recommended:

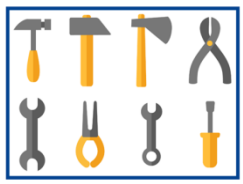
- Always manipulate the devices in an ESD-controlled environment
- Always store the devices in a shielded environment that protects against ESD damage (at minimum an ESD-safe tray and an antistatic bag)
- Always wear a wrist strap when handling the devices and use ESD-safe gloves

This product can be damaged by electrostatic discharge (ESD).
Handle with appropriate precautions.

Adjustable to your system the x0MS56 series is a modular solution:

The adjustable parameters are:

- Measurement range
- Scale factor
- Baud rate & RS422 Frame output
- Bandwidth & Phase lag



Definition

Measurement Range and outputs (analogue and digital)

The measurement range is the highest angular rate for which the user needs a very high accuracy (scale factor and linearity) without saturation.
When the applied rate on the gyro is equal to the measurement range, the differential analogue output of the unit is equal to 10 Volts.
The common measurement ranges are: 30, 60, 100,120, 180 and 300°/s.
Other values are possible upon specific customer request within 5°/s up to 400°/s.

Servo-loop Range

It is the highest angular rate for which the servo-loop is still working and is equal to 300°/s whatever the measurement range is. (The servo-loop range is always greater than the measurement range).

G insensitive drift / bias drift

It is the output voltage delivered by the unit, when no angular rate is applied on the gyro's sensitive axes.
The gyro typical drift value within the temperature range is 15°/h /°C from -45 to +85°C.

Caution: the reported value of the bias measurement is corrected from the projection of the earth rotation value.

Random drift/ Random walk

The Random drift values give the stability of the drift, during one hour, at constant temperature.
Typical value for a x0MS00-56 gyro is 10°/h
Typical value for an Angular Random Walk at 22°C for analog output: 0.005°/√h

G sensitive drift

Negligible, <2°/h/g

G^2 sensitive drift

No g^2 sensitive drift is identified on this gyro.

Input axes misalignment

The input axis misalignment is the angle between the mechanical references of the gyro measurement axis and the real sensitive axis of the gyroscope. Typical values for axis misalignment is 10 arc minute (20 arc minute max).

Start-up time

It is the time necessary for the Gyro unit to work correctly. Its typical value is 1.2 seconds (<2s).

Warm-up time

It is the time necessary for the Gyro unit to work into its performances. It is less than 15 minutes at ambient temperature.

Run to run

The run to run value is defined as the difference of the bias measured following a restart without warm-up phases. In stabilized temperature:

- For OFF time < 2 hours, run to run value is < 40°/h

Scale factor accuracy

The associated servo-loop electronics performs a thermal compensation of the scale factor.
The scale factor is given with a tolerance of ±1% from -45 to +85°C

Linearity error

For different rate applied at 20°C, the linearity error is given by the formula:

$$Linearity\ error\ (\%) = \frac{Rm - Ra}{100\ x\ Mm}$$

Where Rm = rate measured (°/s) (1axis)
Ra = rate applied (°/s)
Mm = Measurement Range (°/s)
The typical linearity error is 0.02% of the measurement range (0.1% max).

Bandwidth

The standard bandwidth is >100 Hz (amplitude -3db and phase lag at 90 degrees) and the overshoot is less than 2 dB.
See graphic in chapter “Bandwidth and phase”.

Noise (Analog & Digital output)

The noise value is <0,015°/s rms, in the 0.1-100 Hz frequency range (typically: 0.008°/s rms).
See graphic in chapter “Noise”.

Temperatures

Operating range: - 45°C, + 85°C
Maximum non-operating range: -45°C to +85°C

Angular accelerations

The sensor can accept up to 3000°/s².

Altitude

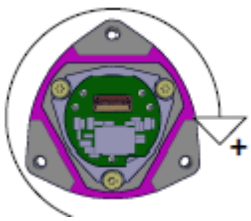
The gyro unit is operating up to 30 000 feet.

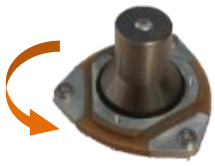
Rain

The product is not hermetic.

Sensitive axe

The vibrating gyroscope sensor is based on Coriolis’s effect. The rotation of the sensor involves a CORIOLIS’s effect on vibration which is measured. This corresponds to the angular rotation velocity.

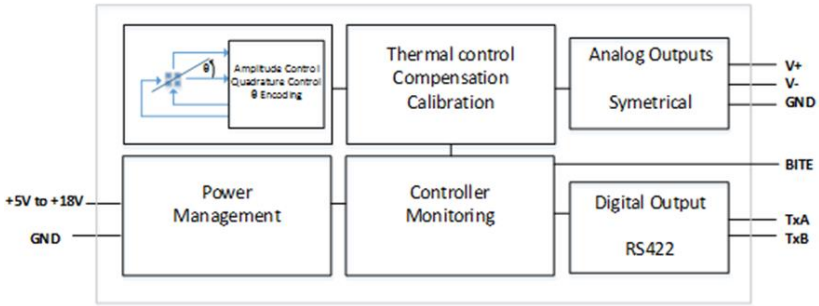




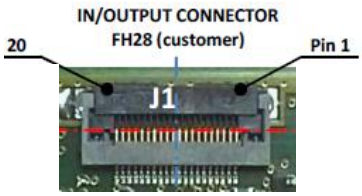
The rotation sense presented on this picture is the positive one

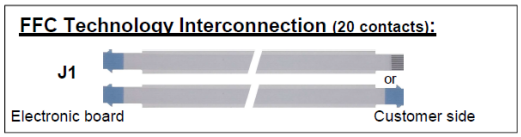
Electrical interface

Functional block diagram



Pin description x0MS00-56 serie :





Connector: Manufacturer is HIROSE FH28 D-20 () S -0.5.

Pin Out description

Pin Nb.	Pin name	Type	Description
1	Mechanical Ground	PWR	Connected to case ground. Usable for shielding.
2	Electrical Ground	GND	Ground
3	Analogue output (+)	AO	Differential analogue output [-10V to +10V]
4	Analogue output (-)	AO	
5	Electrical Ground	GND	Ground
6	Not to be used		Reserved. Do not use and connect any signal on this pin
7	Electrical Ground	GND	Ground
8	+15V	PWR	+15V +/-5% Positive power supply
9	-15V	PWR	-15V +/-5% Negative power supply
10	+5V	PWR	+5V +/-5% power supply
11	Not Connected		
12	Electrical GROUND	GND	Ground
13	Not to be used		Reserved. Do not use and connect any signal on this pin.
14	BITE	AO	Built in test, internal monitoring, referenced to GND. TTL output. Remains low in case of failure.
15	Not to be used		Reserved. Do not use and connect any signal on this pin.
16	RS422 RX(-)		RS422 input (Reserved)
17	RS422 RX(+)		RS422 input (Reserved)
18	RS422 TX(-)	DO	RS422 output (Gyro digital output)
19	RS422 TX(+)	DO	RS422 output (Gyro digital output)
20	Electrical GROUND	PWR	GROUND

PWR, power / AO, analog output / AI, analog input /
DO, digital output / PD, internal pull down / PU, internal pull up

Built-in self-Test function

A "Built In Test" TTL logic voltage output is also provided.
This self-test is a permanent monitoring of the gyroscope status. It tests the power supply and the sensor loops.
The built-in Self-Test generates a logic TTL signal on the device output BITE pin 14 and can be used for device failure detection. It can be used as a power on ready signal.

When the sensor is ready and functional, the signal level is 5V.

A Byte status word is also available through the RS422 (See below).

Digital output protocol

The typical frame of the message on the RS422 is as follow:

- Output frequency: 1 kHz
- Baud rate: 115200 bauds
- Frame of each word: asynchronous, 1 bit "start", 8 bits data, no parity, 1 bit "stop"
- Byte which are part of a 32 bits word are emitted LSB first

Content of the telegram message:

Name	Format	Size (Byte)	Byte number	LSB	Description
First Byte	UNIT8	1	0		First Byte emitted, fixed value: ASCII (H).
Frame counter	UNIT8	1	1	1	Increased by one each frame (0 to 255 decimal)
Omega X, LSB emitted first	UNIT32	4	2, 3 ,4,5	DM / 2^23	Value are signed 2's complement, +8388607 decimal for a speed of +DM °/s, -8388608 for a speed of -DM °/s
BITE	UNIT8	1	6		Built in test
Checksum	CHK8	1	7		Summation of the 7 first Bytes, taken unsigned, of the message

Description of word BITE:
D0, D1, D4 and D5: Status of internal alimentations
D2 and D3: Status of gyro loop parameters
D6 and D7: Spare

Electrical characteristics

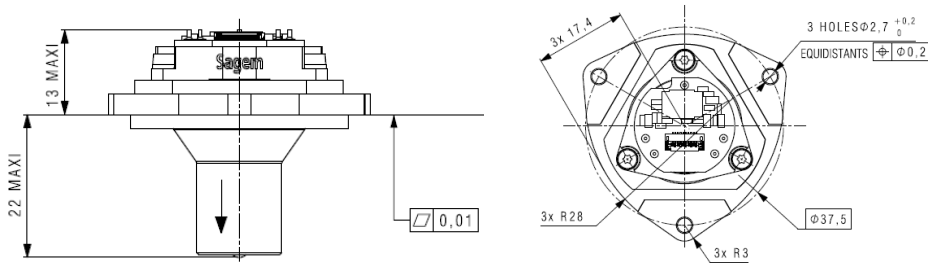
Electrical consumption

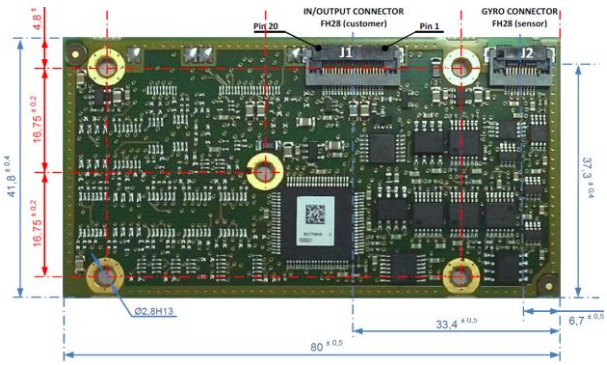
Electrical consumption is under 3W per axis.

Mechanical dimensions

Mechanical dimension are presented on figure below. All dimensions are in millimeter.
STP File available on request.

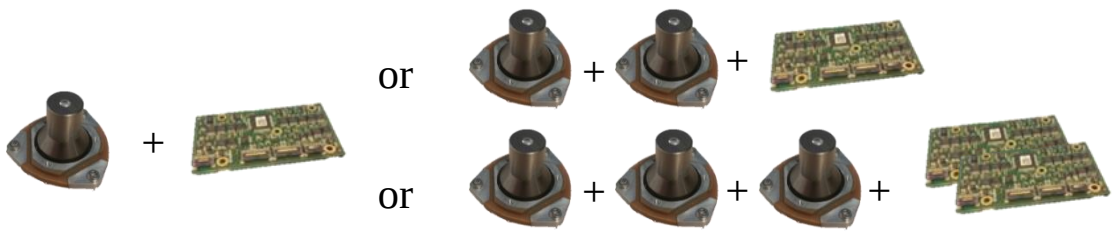
Dimensions





x0MS00-56 composition

The x0MS00-56 integrates the sensor and an electronic board, which can be sold separately for a better design integration in your system.

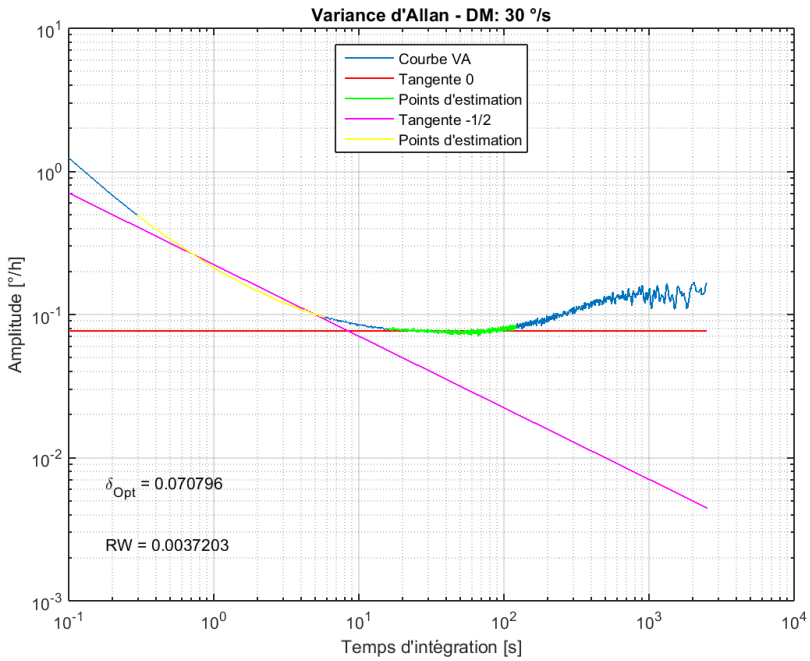


Typical characteristics

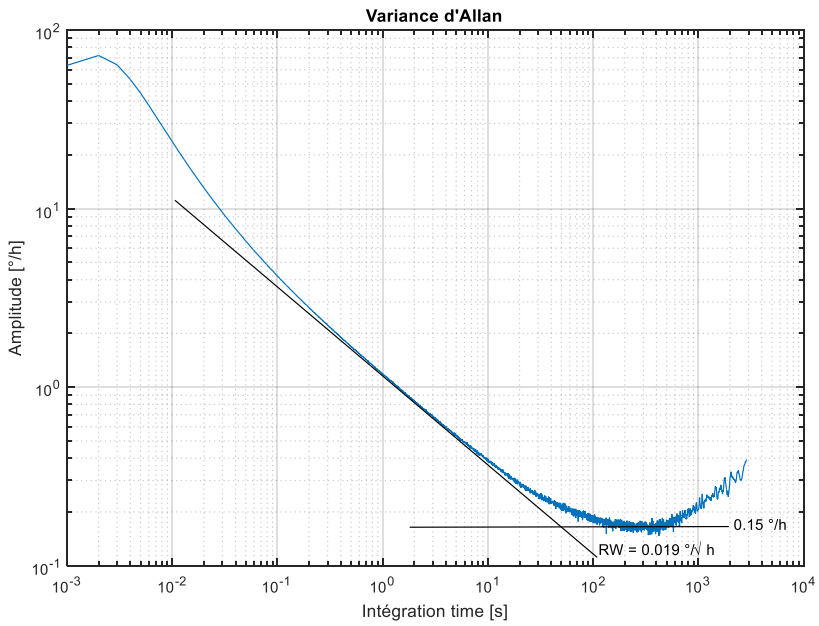
The new 10MS00 56 Vibrating Rate gyro represents Safran Electronics & Defense's breakthrough gyro technology enabling an ultra-low noise and exceptional Allan variance curve that has performance commensurable with much more expensive Fog gyros.

The Product is ideal when very low noise, excellent bias over temperature performance, low power consumption, light weight and rugged durability are desired.

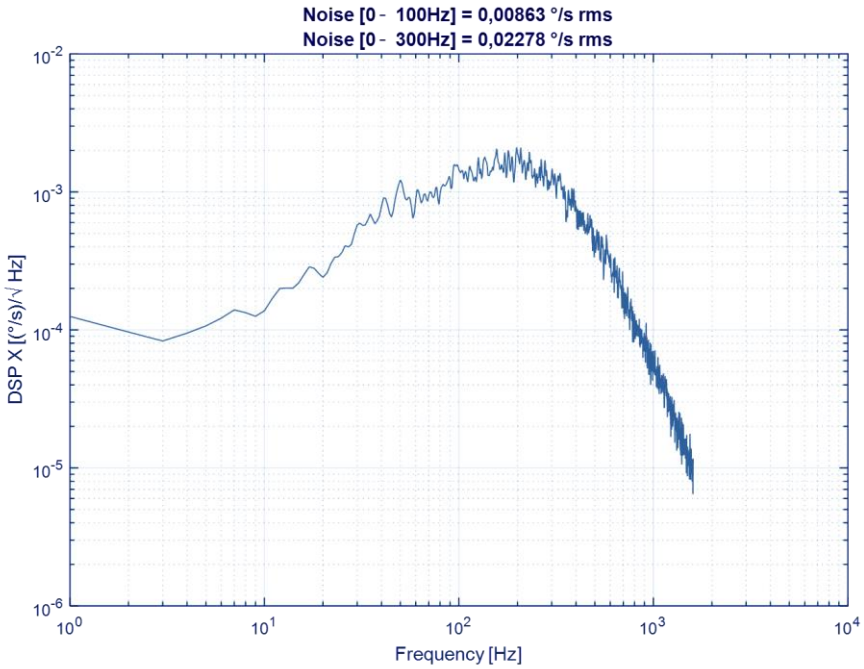
ALLAN VARIANCE CURVE ON ANANOG OUTPUT



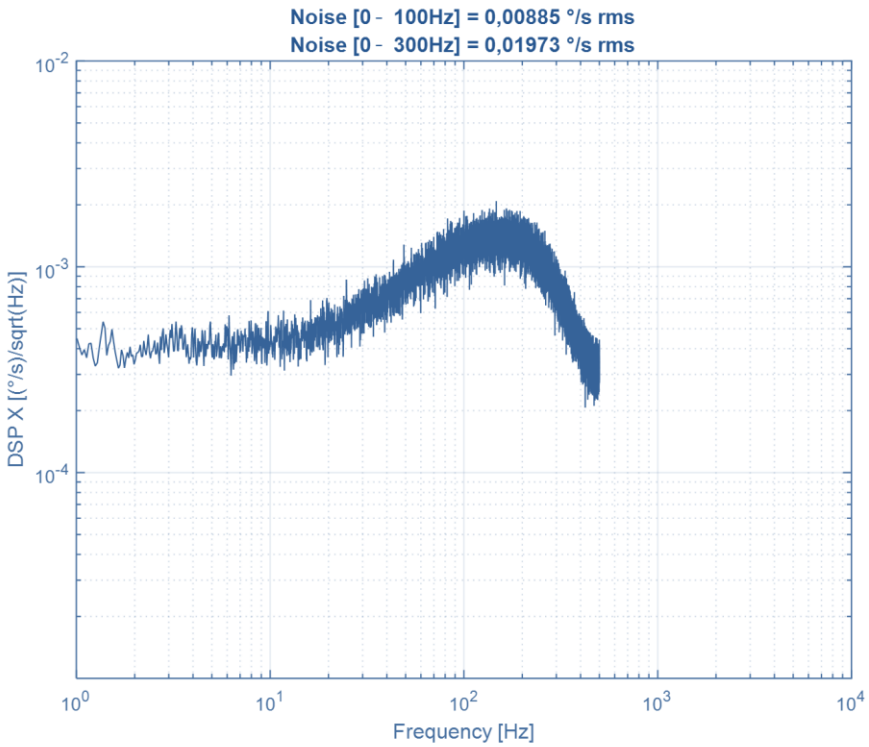
ALLAN VARIANCE CURVE ON DIGITAL OUTPUT



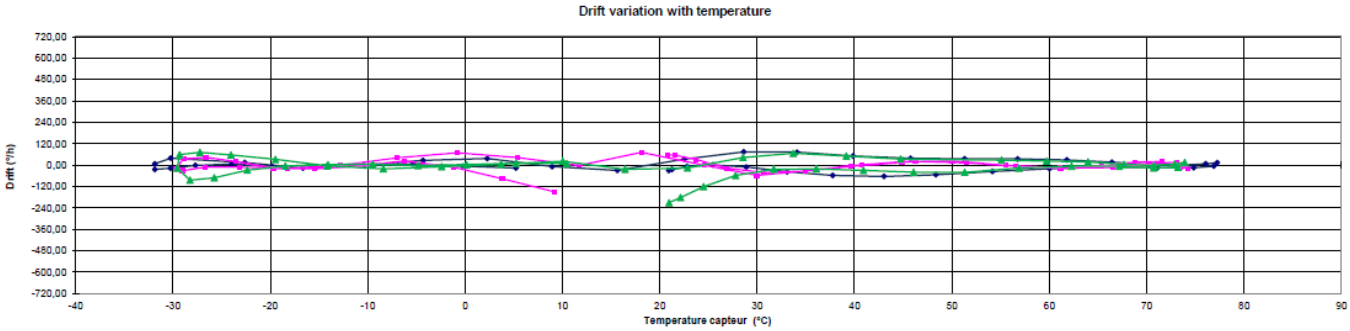
NOISE CURVE [0-100Hz] ON ANALOG OUTPUT



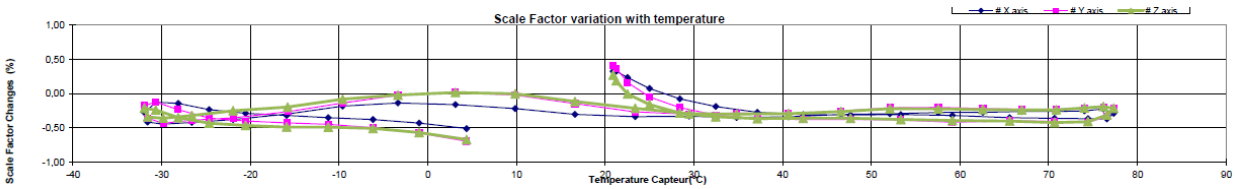
NOISE CURVE [0-100Hz] ON DIGITAL OUTPUT



BIAS IN TEMPERATURE



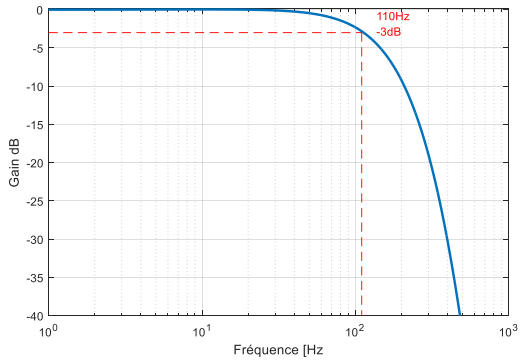
SCALE FACTOR IN TEMPERATURE



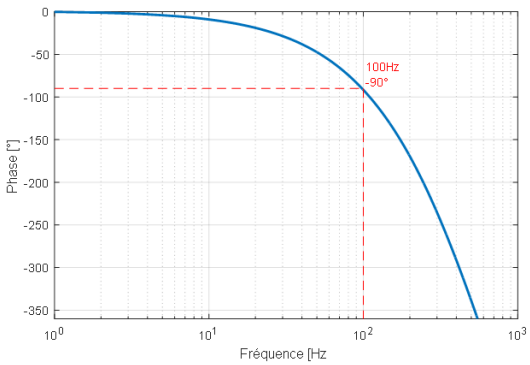
Bandwidth and phase:

The bandwidth is specified > 100Hz (-3dB) with a phase shift (-90°)

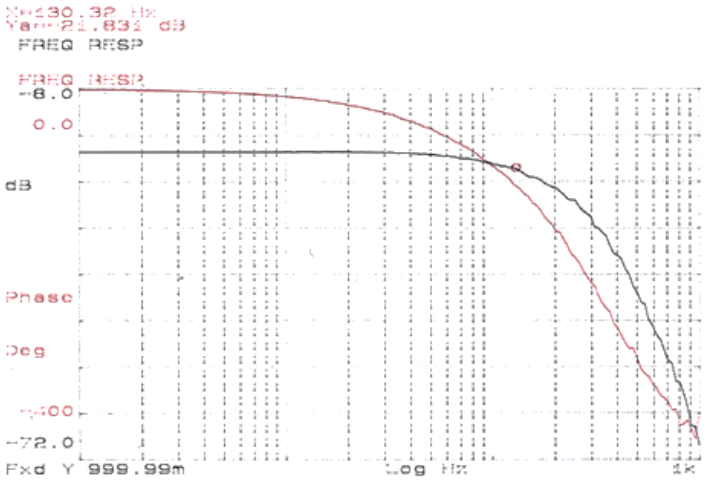
Gain :



Phase :



Measured Bandwidth:



Typical value is bandwidth 130 Hz @ -3dB
Typical phase shift is 108 Hz @ -90°

10MS00-56 20MS00-56 30MS00-56 Datasheet

POWERED BY TRUST

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