DATA SHEET

PAM7951F

Dual axial 360 degree absolute Encoder

The axial encoder system PAM7951F consists of two individual axial encoder systems. One for input (motor encoder) and one for output side (after gearbox). The encoder system consists of two 360 degree absolute encoder and two two-track axial magnetic discs. Both encoder systems are stacked.
This system offers a true-power-on position measurement system with an resolution up to 24 bit.

Due to it's axial magnetic disc and the compact sensor module the system is ideally suited for use in robot joints or motors.
With the proven MR-sensor technology and integrated correction algorithms the PAM7951F is a very robust and reliable solution with a high accuracy and repeatability.

Features

- Singleturn absolute
- Up to 24 bit resolution
- Calibration algorithms
- True-power-on
- Wide temperature range from –40°C up to +85°C
- BISS protocol interfaces

Advantages

- Compact design (axial)
- High accuracy
- Robust and reliable

Applications

- Off-axis applications
- Robotic joints
- Automated Guided Vehicles
- Flat electro motors

Product Overview

Article Name	Description
PAM7951-FGA-EG	Axial 360 degree absolute encoder, Geometry A
PAM7951-FGB-EG	Axial 360 degree absolute encoder, Geometry B

Quick Overview

Symbol	Parameter	min.	typ.	max.	Unit
V_{CC}	Supply voltage	4.75	5.0	5.25	V
$I_{C, A}$	Current consumption A[1)]	100	125	150	mA
$I_{C, B}$	Current consumption B[2)]	100	115	130	mA
Res	Resolution Singleturn	-	24	-	bit
Acc	Accuracy	±12.0	-	±15.0	arcsec
T_{amb}	Operating temperature	-40	-	+85	°C

[1)] PAM7951-FGA-EG

[2)] PAM7951-FGB-EG

ESD

Electrical Data

T_{amb} = 25°C, V_{CC} = 5.0 V; unless otherwise specified

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
V_{cc}	Supply voltage		4.75	5.0	5.25	V
F_{Pos}	Position Refresh Rate		-	18.0	-	kHz
I_A	Current [1]	V_{CC} = 5.0 V	100.0	125.0	150.0	mA
I_B	Current [2]	V_{CC} = 5.0 V	100.0	115.0	130.0	mA
t_{Start}	Start time		-	100.0	-	ms
T_{op}	Operating temperature		-40	-	+85	°C
$T_{storage}$	Storage temperature		-40	-	+105	°C

[1] PAM7951-FGA-EG

[2] PAM7951-FGB-EG

Mechanical Data [3]

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

Symbol	Parameter	Conditions	min.	typ.	max.	Unit
D_{out}	Outer diameter of the module		58.0	-	69.0	mm
D_{in}	Inner diameter of the module		19.5	-	23.5	mm
H	Height of the module		10.4	-	16.7	mm

[3] more details in Fig. 2 and Fig. 4

Performance Data

T_{amb} = +25°C, V_{CC} = 5.0 V, unless otherwise specified

Symbol	Parameter	Comment	Min.	Typ.	Max.	Unit
Acc_A	Accuracy[4]		-	±15.0	-	arcsec
Acc_B	Accuracy[5]		-	±12.0	-	arcsec
Rep_A	Repeatability[4]		-	±7.0	-	arcsec
Rep_B	Repeatability[5]		-	±6.0	-	arcsec
Res_{Single}	Resolution		-	24	-	bit
$Speed_A$	Maximum speed[4]		-	10000	-	RPM
$Speed_B$	Maximum speed[5]		-	2000	-	RPM
N	Noise		-	±0.0005	-	°

[4] PAM7951-FGA-EG

[5] PAM7951-FGB-EG

Environmental Data

Symbol	Conditions	min.	typ.	max.	Unit
Vibration resistance		-	-	785	m/s^2
Shock resistance		-	-	980	m/s^2
External magnetic field		-	-	±100	mT
Humidity		-	-	70	%

Pinout of the sensor module

Pad	Symbol	Parameter
1	NC	Not connected
2	Dat-	Inverted data signal
3	Dat+	Data signal
4	Clk-	Inverted clock signal
5	Clk+	Clock signal
6	GND	Ground
7	V_{CC}	Supply Voltage

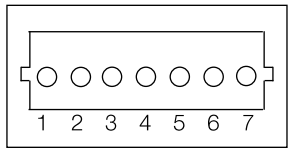


Fig. 1: Pinout of the PAM7951-FGA-EG connector

Dimensions

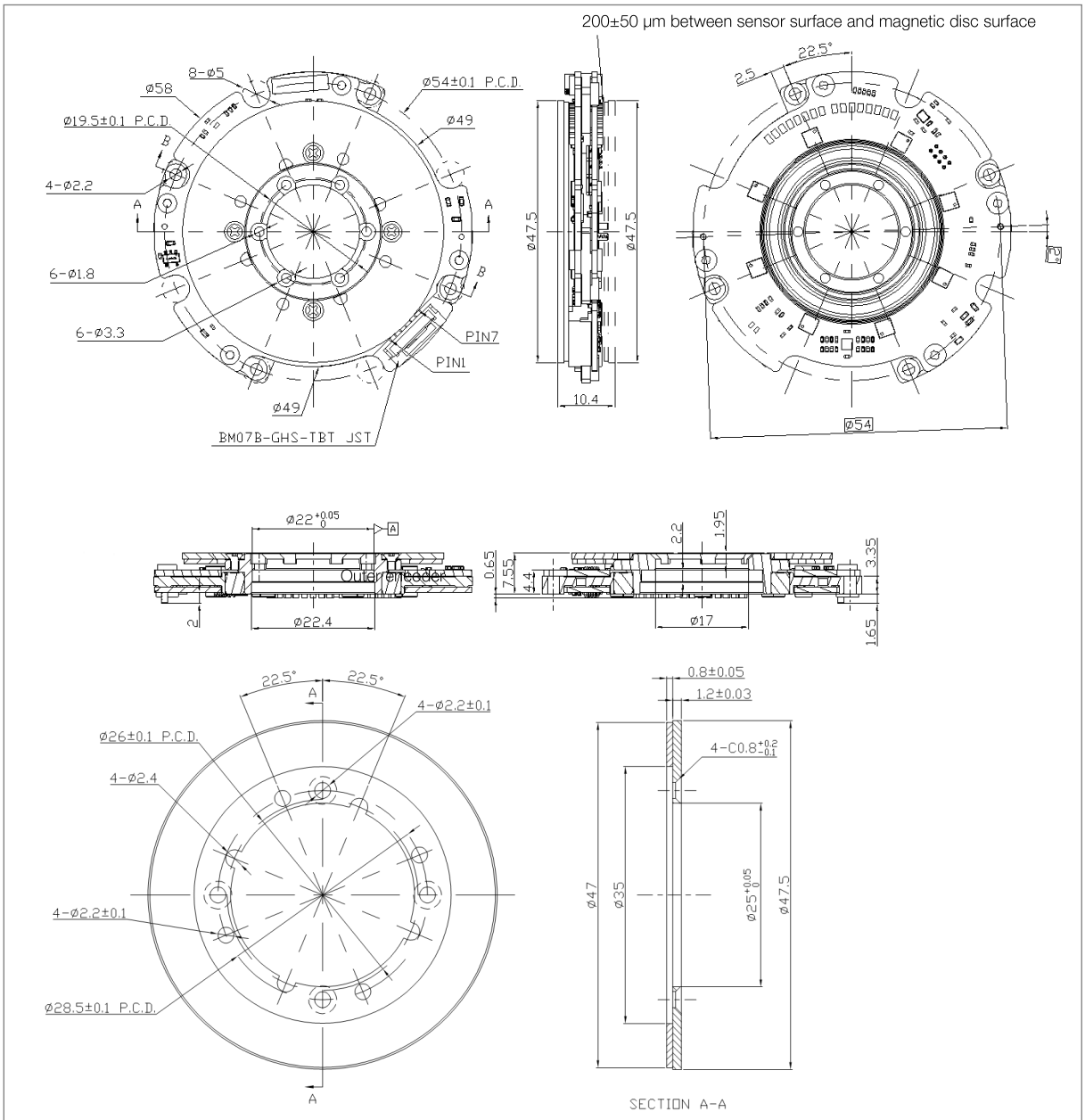


Fig. 2: Dimensions of PAM7951-FGA-EG.

Pinout of the sensor module

Pad	Symbol	Parameter
1	V_{CC}	Supply Voltage
2	GND	Ground
3	Clk+	Clock signal
4	Clk-	Inverted clock signal
5	Dat+	Data signal
6	Dat-	Inverted data signal

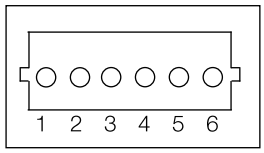


Fig. 1: Pinout of the PAM7951-FGB-EG connector

Dimensions

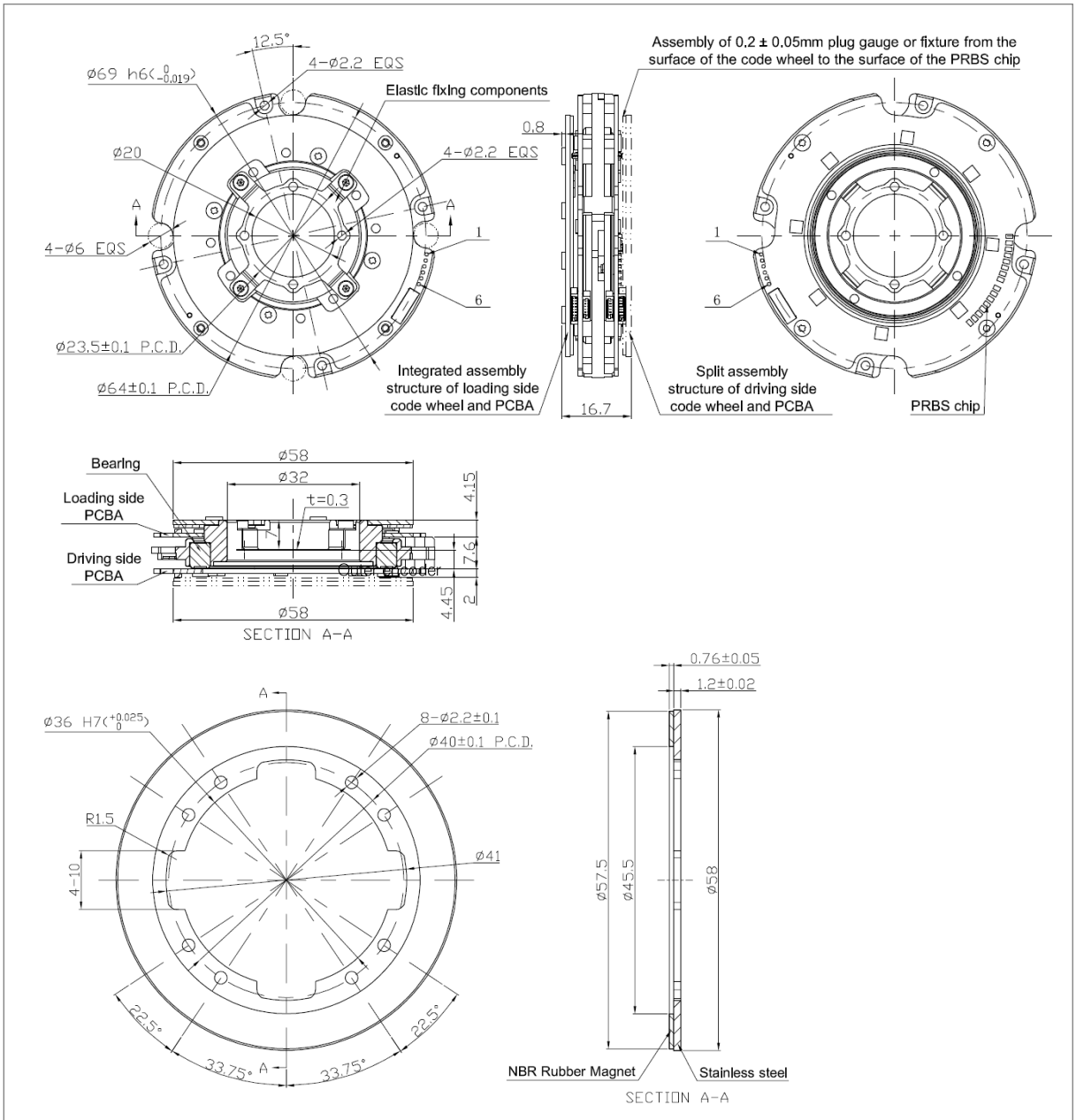
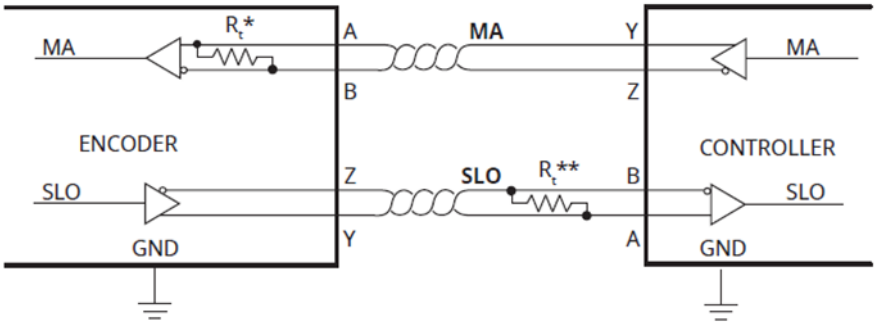


Fig. 2: Dimensions of PAM7951-FGB-EG.

BISS interface

The encoder position is encoded in a 24-bit natural binary format, with data aligned to the left. Status information is provided via the BiSS C protocol. Two active-low status bits follow the position data, succeeded by an inverted CRC for data integrity.

Electrical connection



*) The MA and SLO lines are 5V RS422 compatible differential pairs. The termination resistor on the MA line is integrated inside the encoder.

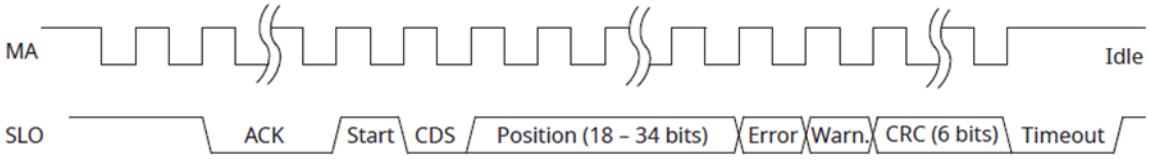
**) If the total cable length is more than 5 meters, it needs to be terminated at the controller. The cable has a nominal impedance of 120Ω.

Signal	
MA	Master clock, the maximum clock frequency is 2.5Mhz
SLO	The data is output on the rising edge of the MA

Output protection

Two mechanisms prevent excessive output current and power loss due to errors or bus collisions. Reverse current limiting on the output stage provides immediate protection against short circuits. In addition, if the chip temperature is too high, the thermal shutdown circuit forces the driver output into a high-impedance state.

Timing diagram



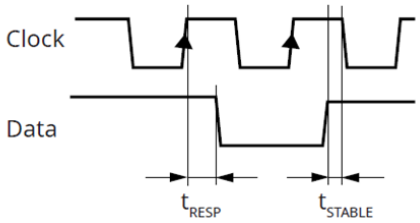
The MA is in a high state and communication starts at the first falling edge.
The encoder sets the SLO low at the second rising edge of the MA, and the ACK length is 1~30 bits.
When the encoder is ready for the next request cycle, it indicates this to the host by setting the SLO to high.
Absolute position and CRC data are provided in binary format and are first sent in MSB format.

Cable length compensation

The read head takes 170 ns to respond to the incoming clock (tRESP). The change in the data signal is delayed by 170 ns after the rising edge of the clock line. The additional delay is caused by the time it takes for the signal to propagate through the cable to the read head and back (tPROP). This delay is typically 14ns per 14 meters of cable. The total cable length from the encoder to the receiver must be considered.

Before a value can be latched, the data signal must be stable. Therefore, if the cable length is more than 1 meter and the clock frequency is higher than 1MHz, this delay must be compensated in the receiver (controller) to which the encoder is connected.

$$t_{DELAY} = t_{RESP} + t_{PROP} \times \text{cable length}$$



Status bits

Type	Value0	Value1	Description
Error	Location data is invalid	OK	Error bit activation is low. If it is low, the bit is invalid.
Warning	Location data is valid	OK	The warning bit is active low. If it is low, the encoder operation is close to its limit. The location is still valid, but the resolution and/or accuracy may be out of specification.

Communication parameters

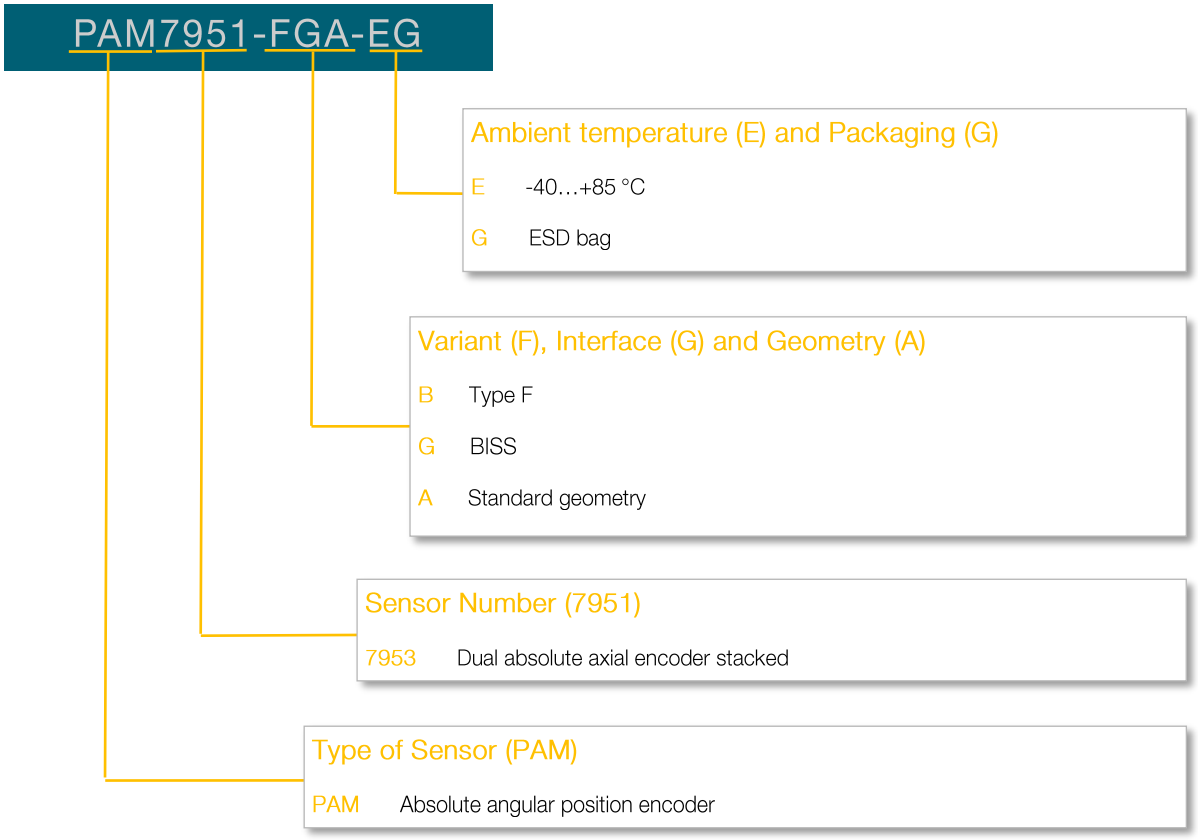
Parameter	Value
MA frequency	Max. 2.5 MHz
ACK length	1-30 bit
Register access	No

The "Bandwidth" parameter is the mechanical bandwidth. AksIM samples at 18 kHz, so the mechanical change occurs faster than 9 kHz and the output cannot be detected (Nyquist's theorem). If the position request is faster than the sampling frequency, the AksIM encoder recalculates the position at the time of the request based on the current ring velocity.

Packet description

24-bit position + 2-bit status + 6-bit CRC = 32-bit long packets.
The CRC calculation polynomial for position, error, and warning data is: x6 + x1 + 1. It is also denoted as 0x43. It is inverted and transmits the MSB first.

Additional Information on Ordering Code



General Information

Product Status

Article	Status
PAM7951-FGA-EG	The product is under development.
PAM7951-FGB-EG	The product is under development.
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
PAM7951F.DSE.00	Original (pp. 1-9)	04/2025

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