MEASURAND


# SAAF

Model 003

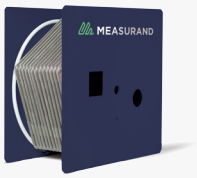
The ShapeAccelArray Field (SAAF) is a type of SAA that is most commonly used. All SAA types have rigid segments separated by flexible joints. Triaxial MEMS gravity sensors measure tilt in each individual segment. SAAFs produce data equivalent to inclinometer data. Each SAA is a fully-calibrated measuring instrument delivered on a reel, and installable in a very small ungrooved casing. As a result, installation is rapid and lower in cost, and much larger deformations can be monitored.

An SAAF may be installed near vertical to track the magnitude and direction of lateral deformation, or near horizontal to track vertical deformation. It can also be installed along the cross-section of tunnels and used in “mixed H/V” mode to measure convergence. Due to the bandwidth of the MEMS sensors and communication protocol, it is possible to use the SAAF to monitor 3D vibration data at up to three selected locations along the instrument. The SAAF model 003 has a non-multiplexed structure where every segment has a microprocessor unit and a temperature sensor.

SAAF installations are designed for either manual or automated measurements with a PC or Data Logger and can be powered with either mains or solar power. Other custom solutions are also available, contact Measurand for more details. All communications in the SAA are digital and carried along a cable to the reading device. Standard software required to collect, process, and view SAAF data is available free of charge from the Measurand website within the SAASuite software package. A Measurand interface is required between an SAAF and logger or computer. Interface functions include protocol conversion, power control, and surge protection. Interfaces include SAA232, SAA Field Unit, and SAAUSB.

Related products: SAA232, SAA232-5, SAA Field Power Unit, SAAUSB

# SPECIFICATIONS




## PHYSICAL PROPERTIES

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|---|---|
| SEGMENT LENGTH[1] | 305 mm or 500 mm (joint center to joint center) |
| MAXIMUM STANDARD LENGTH OF SAAF | Up to 100 m (500 mm segments) or 60.96 m (305 mm segments) |
| MAXIMUM CUSTOM LENGTH OF SAAF | Over 100 m (Contact Measurand for details) |
| LENGTH OF FAR TIP END | 60 mm |
| LENGTH OF UNSENSORIZED NEAR CABLE END | 340 mm (includes: Cable Terminator Segment underneath PEX, see diagram) |
| LENGTH OF HARDENED CABLE (INSIDE PEX) | 175 mm |
| LENGTH OF PEX TUBING | 1.5 m standard |
| LENGTH OF COMMUNICATION CABLE | Standard 15 m, (13.5 m extending past the PEX tubing) |
| WEIGHT | 0.6 kg/m |
| JOINT DIAMETER IN EXTENSION | 25 mm |
| JOINT DIAMETER IN COMPRESSION | 27 mm |
| MAXIMUM TENSILE RESISTANCE | 320 kgf |
| MAXIMUM AXIAL COMPRESSION | 45 kgf (in casing), 22 kgf (no casing) |
| MINIMUM AXIAL COMPRESSION TO PROVIDE SNUG FIT IN CASING | 10 kgf |
| MAXIMUM JOINT BEND ANGLES | 45° (larger angles permitted when stored on factory reel in factory orientation) |
| SMALLEST BEND RADIUS FOR 27 MM ID CONDUIT WHICH ALLOWS FOR EXTRACTION | 3.5 m for SAAF500<br>2.0 m for SAAF305 |
| STORAGE TEMPERATURE | -40°C to 60°C |
| INSTALLATION TEMPERATURE[2] | -5°C to 60°C |

| | |
|---|---|
| OPERATING TEMPERATURE | -35°C to 60°C polynomial temperature algorithm corrected |
| WATERPROOF TO | 2000 kPa (200m Water) |
| POWER REQUIREMENTS | 12 VDC at 4.2 mA/segment |

## DYNAMIC ACCELERATION MEASUREMENTS3

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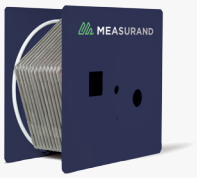
|---|---|
| RANGE | ± 1.7 G |
| 3DB BANDWIDTH | 50 Hz |
| NOISE FLOOR OF MEMS | 110 µG/Hz0.5 |
| DATA RATE | SAA232: 38.4 kbps to 230.4 kbps |

## STATIC SHAPE MEASUREMENTS

| | |
|---|---|
| ANGULAR RANGE OF MEMS SENSORS | ± 360° (software selection required for 2D/3D modes) |
| RANGE OF 3D MODE (VERTICAL) | ± 60° with respect to vertical (SAARecorder alert at ±70° w.r.t. vertical) |
| RANGE OF 2D MODE (HORIZONTAL) | ± 60° with respect to horizontal |
| RANGE OF 2D MODE (MIXED H/V) | ± 180° with respect to horizontal |
| LONG-TERM ACCURACY RELATIVE TO STARTING SHAPE[4,6,7] | ± 1.5 mm for 32 m SAA |
| SHORT-TERM RESOLUTION RELATIVE TO STARTING SHAPE[5,6,7] | ± 0.5 mm for 32 m SAA |
| LONG-TERM ACCURACY OF TILT/SEGMENT WITHIN 20° OF VERTICAL[4, 6, 7] | ± 0.0005 rad = 0.029° |
| RESOLUTION OF SINGLE SEGMENT: | +/- 2 arcseconds[8] |
| AZIMUTH ERROR IN JOINTS | < ±0.25° |
| ORTHOGONALITY WITHIN SEGMENTS | ± 0.1° |
| LONG-TERM RELIABILITY MTBF[9] | 38 years for 32 m SAA |

# NOTES




[1] Custom segment lengths between 200 mm and 305 mm are available at extra cost, contact Measurand for more information.

[2] Note that most PVC cement for the 27 mm ID PVC conduit is limited to working temperature of 0°C, though special low temperature PVC cement which will work to -20°C is available. Also, flexible SAA joints may be damaged by abrupt bending at low temperatures. As such installation below -5°C ambient must be accompanied by a means of warming the SAA joints and any cemented PVC couplings.

[3] Dynamic measurements require use of Vibration mode in SAARecorder software in a PC. In Vibration mode measurements at the speeds noted here are possible for two to three selected segments only. In Vibration mode it is not possible to simultaneously measure static shape.

[4] Value based on field measurements of vertical SAAs for 1.5 years of operation.

[5] Short-term ≤ 24 h.

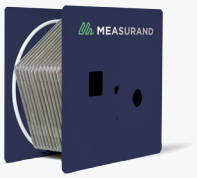
[6] Value based on averaging 200 – 1000 frames per reading.

[7] Specification is for 3D mode within ± 20° of vertical. Vertical accuracy degrades with angular deviation from the vertical.

[8] RMS, calculated from published noise figure of sensor (verified by Measurand Inc.), and bandwidth of system using highest AIA setting of 25,600 samples.

[9] Conservatively based on longevity data for electronic components used in SAA, a) assuming total system failure if any single component fails, b) system powered on 100% of the time, c) ambient 6 deg C, d) internal temperature rise of 8 deg C above ambient due to 100% powered-on duty, and e) a benign ambient environment typical of geotechnical instrumentation. MTBF will increase for more typical duty cycles (not powered on 100% of the time). At higher temperatures, MTBF will decrease (e.g. by ~half at 52 deg C). MTBF is based on “MIL-HDBK-217F Notice 2” performed by, ALD/SoHaR.

# NOTES




Minimum Capped SAA Length (A to B) = Min Cable Bend Radius + Unsensorized Length + Sensorized Length + TIP End – Compression

Sensorized Length = Near Cable End Sensorized Segment through Far Tip End Sensorized Segment

Compression = 1.9 mm per joint at 22 kg-force in vertical 27 mm PVC conduit

PVC conduit End Cap and Install Kit Top Stack require additional depth

Standard PEX Length 1500 mm

PEX is field-extendable using Measurand PEX Extension Kit, PEX must be at least 300 mm to accommodate the PEX coupler

PEX can be cut shorter, 200 mm minimum

Standard tolerance on measurements +/- 2 mm unless stated