

Aircraft-Integrated Meteorological Measurement System (AIMMS) Instrument Handbook

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Acronyms and Abbreviations

AAF	ARM Aerial Facility
AIMMS	aircraft-integrated meteorological measurement system
ARM	Atmospheric Radiation Measurement
G-1	Gulfstream-159
GPS	Global Positioning System
NAVMET-AIR	Navigation and Meteorological Data from Multiple Sensors on Airborne Platform
ODMS	onboard data management system
RH	relative humidity
TAS	true air speed
UTC	Coordinated Universal Time
VAP	value-added product

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1.0 Instrument Title

Aircraft-integrated meteorological measurement system, or AIMMS-20



Figure 1. AIMMS probe installed on the U.S. Department of Energy’s Atmospheric Radiation Measurement (ARM) former Gulfstream-159 (G-1) aircraft.

2.0 Mentor Contact Information

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3.0 Vendor/Developer Contact Information

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4.0 Instrument Description

The AIMMS-20 probe is manufactured by Aventech Research Inc. (<http://www.aventech.com>) and measures platform position, velocity, attitude, ambient temperature, static pressure, and the differential pressures from a 5-port hemispheric gust probe, and combines all these measured data into a calculation of the ambient winds. A detailed description of the AIMMS-20 specifications is available [here](#).

Note: The Aventech engineers use the aircraft-centric frame of reference common to aeronautical engineering, which defines z as down.



Figure 2. AIMMS probe canister housing mounted on the ARM G-1 aircraft.

5.0 Measurements Taken

Table 1. Measurements taken by AIMMS-20 probe.

Column number	Variable description	Units
1	UTC time	Seconds
2	Temperature	Celsius
3	Humidity	%RH/100
4	Barometric pressure	Pa
5	u_w – North wind component	m/s [+’ve North]
6	v_w – East wind component	m/s [+’ve East]
7	GPS latitude	decimal degrees
8	GPS longitude	decimal degrees
9	GPS altitude	M
10	u_i – Aircraft longitudinal inertial velocity	m/s [+’ve forward]
11	v_i – Aircraft lateral inertial velocity	m/s [+’ve to starboard]
12	w_i – Aircraft vertical velocity	m/s [+’ve down]
13	Roll	degrees
14	Pitch	degrees
15	Yaw or heading	degrees
16	True air speed (TAS)	m/s
17	w_w – Vertical wind component	m/s
18	Dimensional sideslip angle	degrees
19	Non-dimensional angle-of-attack	
20	Non-dimensional sideslip angle	
21	Wind status flag	0 – Invalid; 1 – Valid; -9999 missing

6.0 Links to Definitions and Relevant Information

More information on this instrument can be found at the [vendor site](#).

See also Mei et al. 2020, Beswick et al. 2008.

6.1 Data Object Description

The data are originally communicated as raw measurements over the CAN bus to the onboard data management system (ODMS) data module and stored in flight in binary .rXX files. These files are combined in post-processing using the Aventech program asmb1.exe into .raw files, one for each flight. The .raw files are subsequently processed using the Aventech program ekf553_oemv.exe, which regenerates the wind estimates, in this case at an output rate of 20 Hz. The data is ingested and available at arm.gov in icartt format at 20 Hz. Another data set that contains AIMMS-20 data merged with other navigational and meteorological variables is [‘aafiwgnavair’](#).

6.2 Data Ordering

The data may be ordered from the ARM Data Center at archive.arm.gov. Data are organized by measurement location/campaign.

6.3 Data Plots

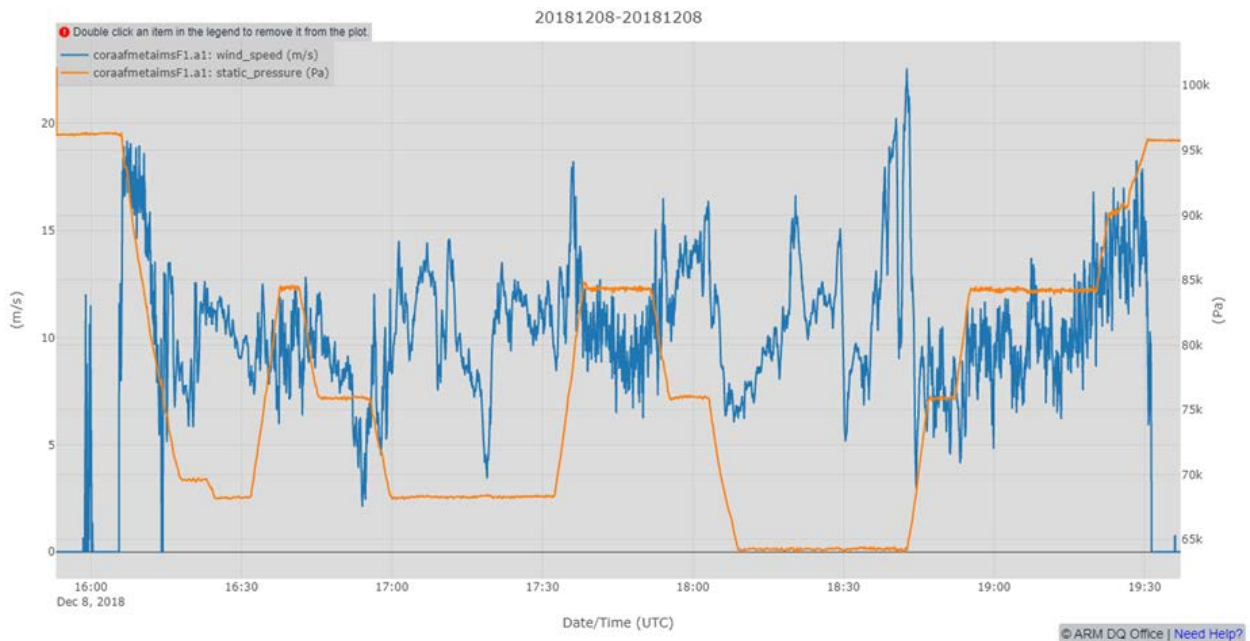


Figure 3. Wind speed and static pressure time series from AIMMS-20 probe generated by the ARM Data Quality Plot Browser.

6.4 Data Quality

The AIMMS-20 five-port gust probe requires purging with dry air delivered via canistered air after flying through clouds to prevent clogging. This is done at the flight scientists' digression. Measurements of position, winds, temperature, and RH are validated with redundant measurements from other instrumentation on board. For a merged data set containing navigational and meteorological data at 1 Hz, please refer to the ARM value-added product NAVMET-AIR (Navigation and Meteorological Data from Multiple Sensors on Airborne Platform).

7.0 Technical Specification

The technical specifications may be found [here](#).

7.1 Accuracy

- WIND SPEED ACCURACY
 - Horizontal North and East Components: 0.50 m/s (1.0 knot) @ 150 knot
 - TAS Vertical: 0.75 m/s (1.5 knot) @ 150 knot TAS
- TEMPERATURE
 - Accuracy: 0.30 C
 - Resolution: 0.01 C
- RELATIVE HUMIDITY
 - Accuracy: 2.0%RH
 - Resolution: 0.1%RH
- Broadcast / Log Update Rate:
 - 1 - 10 Hz
- Log Capacity:
 - 45000 Records
 - 12.5 hours @ 1 Hz

8.0 Instrument System Functional Diagram

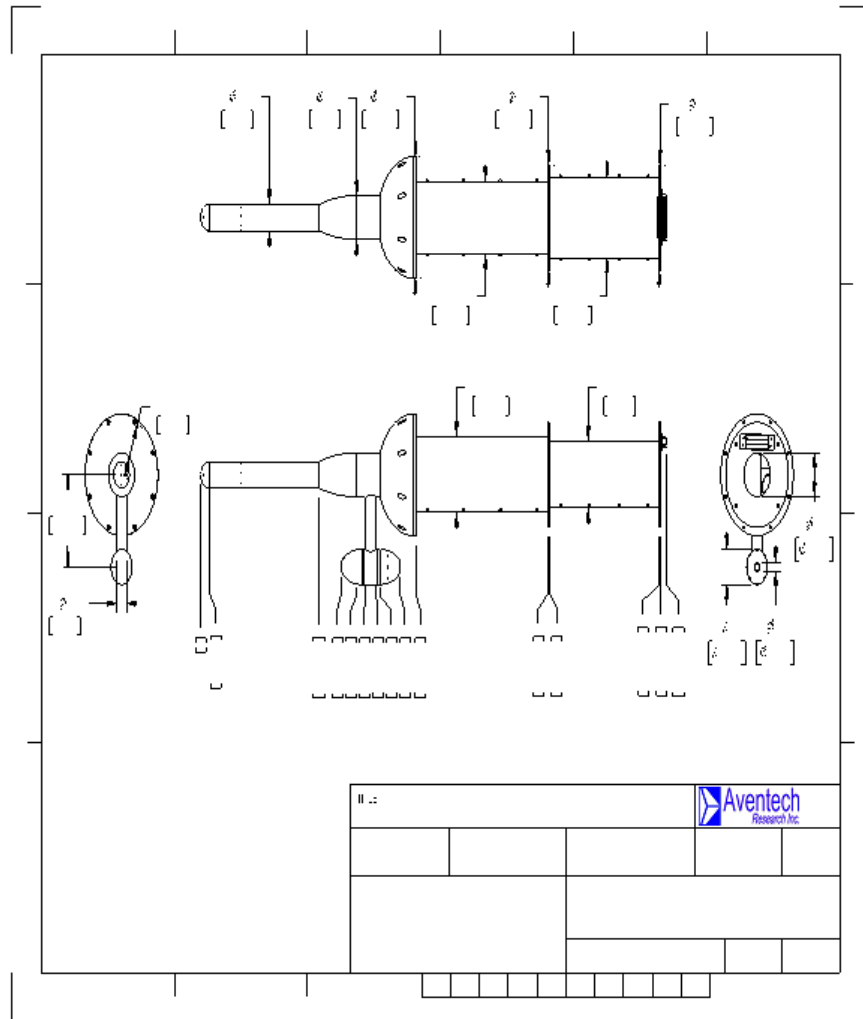


Figure 4. AIMMS-20 functional diagram (from the manufacturer’s website).

9.0 Software

The data are collected primarily using an ODMS, as well as a secondary collection using another data acquisition system, [M300](#).

10.0 Calibration

We recommend that the instrument be calibrated prior to each campaign. This requires clear air flights in smooth air at increasing and decreasing true air speeds and yaws of 5-10 degrees, heading true north followed by true south. This data may then be sent to the vendor who will provide the calibration files necessary.

11.0 Maintenance

The instrument should be purged in flight after particularly moist or cloudy levels to remove moisture from the canister and bulb. The bulb should also be checked occasionally for water.

12.0 Citable References

Aventech website: <https://aventech.com/products/aimms20.html>

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