

# AN-1003

## Hot Wire / Hot Film Anemometry System



## A.A. LAB SYSTEMS

Since 1983 A. A. Lab Systems has been specializing in electronic laboratory test equipment which we supply to aeronautics research laboratories, universities, hospitals, meteorological research institutes and the defense industry. We maintain constant contact with our customer base in order to include your vital feedback in the research and design process, thus ensuring that our products will meet future needs and address the requirements of real researchers as well as exploit the most recent advances in technology to provide maximum reliability and performance.

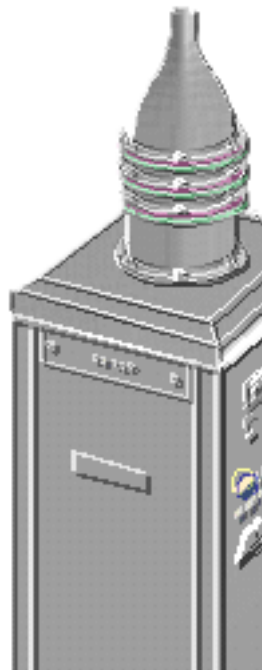
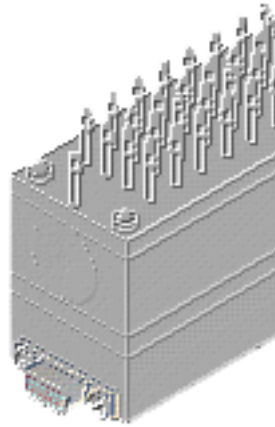
Our product line includes both general and specialized measurement instrumentation:

- Digital air-speed calibrators
- Analog Fiber-Optic Links
- Pressure, Force, Air speed transducers
- Remote data acquisition systems
- Computerized anemometry systems
- Very low noise instrumentation amplifiers
- PC-based data acquisition systems
- Stepping motor drivers and traverse systems

All of our products are backed by a full service warranty and a competent staff of systems engineers more than willing to give professional advice to customers concerning the installation, maintenance & use of our systems.

All of our products are supplied with extra channels (where appropriate) to provide an immediate solution to any problems that may arise during prolonged operation. This policy allows the researcher to continue work uninterrupted until a replacement channel arrives, which we send as soon as we receive the faulty unit.

Our full, one-year warranty covers all, labor and parts.

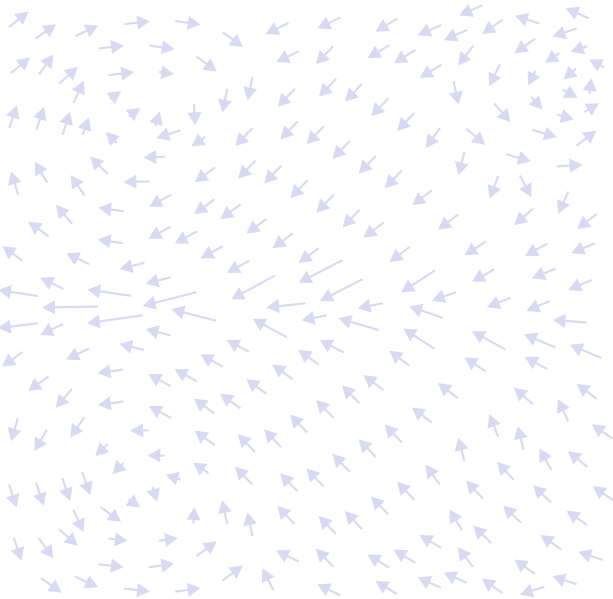
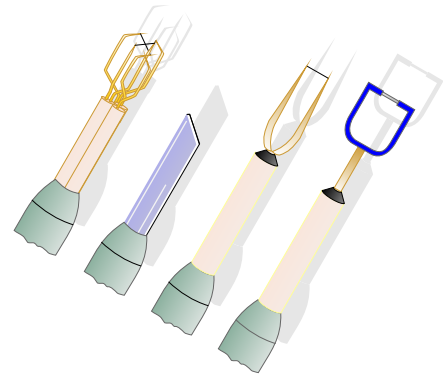


## THE BEST SOLUTION FOR YOUR ANEMOMETER REQUIREMENTS

An anemometer is an instrument for measuring fluid velocity, whether it be of gases or fluids, Hot wire, or hot film, anemometers measure fluid speed using a delicate probe made from a thin tungsten/platinum wire, or a thin metallic film, which is heated to a temperature higher than the average temperature of the fluid. Using sophisticated circuitry, the anemometer stabilizes and maintains the probe temperature at a constant level throughout the measurement. Since the fluid flowing past the probe has a lower temperature than the probe, the film/wire is constantly being cooled by the fluid flow - the higher the velocity, the faster the rate of cooling. Since the anemometer must maintain the probe temperature at a constant level, it is therefore sensitive to the rate at which it is being cooled, i.e., the fluid velocity. This velocity is then translated to a continuously changing voltage which has a nonlinear relationship with the fluid velocity. This voltage signal then undergoes signal conditioning to filter our noise and improve the Signal/Noise ratio. After proper calibration of the probe channels, it is possible to measure fluid velocities with an accuracy of 0.05% or greater, depending upon the measurement range and the quality of the calibration. The response time between measurement and instrument output is very short in comparison with other methods of fluid flow measurement and can reach a minimum of 1-2 microsecond. The AN-1003 Anemometer system will measure at this speed from up to 10 channels simultaneously!

Some of the more outstanding features of the AN-1003 are:

- Easy Operation
- Low Noise - less than  $2.2 \text{ nV}/\sqrt{\text{Hz}}$
- Ultra - Low Noise Option - less than  $400 \text{ pV}/\sqrt{\text{Hz}}$
- Intelligent Modular Design
- C.T.A & C.C.A in one channel (optional)
- Probe protection circuit
- Soft-start circuit for delicate probes
- High Frequency Response:  
DC-120kHz standard, optional DC-500KHz
- Flexible: For use with Hot-Film and Hot-wire Probes
- Built-In Signal Conditioner:  
Low Pass Filter: with 12 cut-off frequencies  
Gain and DC offset adjustable to any value
- Built-in Indicators aid user in balancing the Bridge
- Built-in Square Wave/ Pulse Generator
- Fail-safe switches
- Self-maintained; expensive servicing not required
- One year Parts & Labor warranty



The AN-1003 can measure fluid velocities ranging from 0 to 200 m/sec, as well as supersonic measurement. Besides these inherent qualities of the basic AN-1003 system, there are 14 extra options which can be added to any number of channels and which can expand the capabilities of the system, allowing it to make professional-standard measurements in different kinds of fluid. The AN-1003 is being used today at a number of leading research institutes and universities throughout the world, where, for a number of years, it has proved its value as a reliable and accurate instrument, and has become an invaluable research tool for scientists and engineers. Part of the AN-1003's success is due to its user-oriented design, making the system easy and straight forward to use by inexperienced students and professional researchers alike. Another advantage of the AN-1003 is its modularity; channels can be removed or interchanged without disturbing other channels already calibrated for different experiments. In the following pages you'll find a more technical description of the AN-1003 system's outstanding specifications and characteristics. As a result of technological advances in design and production, A. A. Lab systems can now offer you the AN-1003 anemometer system at a substantially lower price, making this highly reliable and accurate system highly affordable as well. Our professional staff will be happy to answer any technical questions you may have.

# CONSTANT TEMPERATURE ANEMOMETER & SIGNAL CONDITIONER MODULE



## C.T.A. BRIDGE.

CHANNEL UNDER TEST Indicator LED.

MODE SELECTOR, selects between the 3 channel modes: Adjust, Normal and Operate.

NULL for nulling out the cable resistance.

UP / DOWN INDICATORS helps the user with balancing the bridge.

PRECISION RESISTOR DECADE provides precise resistance measurements and Sensor Overheat set-up with 0.01 . increments

x1/x10 SELECTOR for probes over 10 . Provides 1:1 and 1:10 Bridge ratios or 1:2 and 1:20 Bridge ratios in high power mode.

FREQUENCY COMPENSATION (OPTION 04) for operation over 150Khz (or CCA current adjustment for OPTION 11).

DAMPING for adjusting the frequency response.

## SIGNAL CONDITIONER.

FILTER Bandwidth: a 3'rd order Low-Pass filter with 2 bands x 6 cut-off frequencies. Bands can be selected on module board.

FILTER ON/OFF switch for by-passing the Low-Pass filter.

AMPLIFIER OUTPUT socket.

T.O.B / ERR. switch selects the input signal to the signal conditioner.

GAIN adjustment trimpot for any gain on 1-20 range. Can be ordered with 1-50 or 1-100 range.

DC OFFSET for 0-10 Volt offset voltage adjustment.

PROBE input socket.

# DIGITALLY CONTROLLED TEST MODULE

## New features:

1. Probe protection circuit.
2. Fail-safe switches
3. Soft start circuit (for sensors under  $1.5 \mu$ )
4. DC offset reading - standard
5. Pulse or square - wave input selector.
6. Higher accuracy reference circuit.
7. New PCB layout.
8. Lower drift



DIGITAL VOLTMETER for reading the Bridge Voltage, Gain and Output Voltage.

CHANNEL UNDER TEST display.

CHANNEL SELECTORS (UP and DOWN).

OPERATE MODE for monitoring the channel's Output Voltage and DC offset.

REFERENCE MODE for calibrating the DC Gain.

N/ADJ MODE for the calibration procedure.

PULSE MODE for checking the frequency response.

PULSE OUTPUT for triggering a Scope and adjusting pulse amplitude.

ANEMOMETER OUTPUT - CTA output of the channel being selected.

REFERENCE VOLTAGE OUTPUT. Output for calibration and stability check.

AMPLIFIER OUTPUT of the channel being selected.

POWER ON switch.

## CHANNEL SPECIFICATIONS

### C.T.A BRIDGE

Non-linear, Constant-Temperature type.

Bridge ratio.....	1:10 and 1:1
High power mode.....	1:20 and 1:2
Sensor resistance range:	
1:1 Bridge.....	1.0-9.99 Ohm
1:10 Bridge.....	0.5-9.99 Ohm
Cable resistance compensation.....	0.2-1.2 Ohm
Maximum closed loop bandwidth:	
1:1 Bridge.....	DC-120 KHz
1:10 Bridge.....	DC-100 KHz
With option 04.....	DC-500 KHz
Maximum probe current:	
x1 Drive.....	300 mA max.
x2 Drive.....	600 mA max.
Equivalent input noise:	
1:1 Bridge.....	1.6 nV/ $\sqrt{\text{Hz}}$
1:10 Bridge.....	2.2 nV/ $\sqrt{\text{Hz}}$
With option 01.....	400 Picovolts/ $\sqrt{\text{Hz}}$
Typical hum induced in input.....	0.03 $\mu\text{Vrms}$
Typical output noise:	
5 $\mu\text{m}$ Tungsten probe:	
OHR=1.5, U=0, B.W.=10 KHz.....	135 $\mu\text{Vrms}$
The same with option 01.....	60 $\mu\text{Vrms}$
Stability: typical input drift:	
1:1 Bridge.....	0.5 $\mu\text{V}/^\circ\text{C}$
1:10 Bridge.....	0.3 $\mu\text{V}/^\circ\text{C}$
With option 01.....	Less than 0.1 $\mu\text{V}/^\circ\text{C}$
Probe cable.....	5m of RG174 or RG58A
Please consult the factory for a longer probe cable.	
Output.....	Top of bridge or amplifier output

### C.C.A BRIDGE

(Constant Current Anemometer, option 11):

Fixed currents.....	1,2,5,10,20 mA
	and any combination of these currents
Variable current source.....	0.3 - 30 mA
Selected current is displayed on Test-module	

### POWER SUPPLY:

Output Voltages.....	$\pm 15\text{V}$ , $\pm 5\text{V}$
Maximum current (@ $\pm 15\text{V}$ ).....	$\pm 4\text{A}$
Hum & Noise.....	100 $\mu\text{Vrms}$
Can drive 10 channels @ 1:10 bridge ratio or 5 channels @ 1:1 bridge ratio. Option 10 can drive all 10 channels in 1:1 or 1:10 modes simultaneously.	

### SIGNAL CONDITIONER:

Output voltage range.....	$\pm 12\text{V}$
Amplifier gain.....	1-20
presentable to any gain in range.	
(can be ordered with 1-50 or 1-100 ranges)	
Gain accuracy.....	0.5%
DC offset.....	0-10V
Output impedance.....	100 Ohm
Input impedance.....	10K Ohm
Typical input white noise.....	30nV/ $\sqrt{\text{Hz}}$
Frequency range.....	DC-100KHz
Typical equivalent input drift.....	160 $\mu\text{V}/^\circ\text{C}$

### LOW-PASS FILTER:

Triple pole Butterworth Type.	
12 Cut-off Frequencies in 2 bands:	
Lower band.....	300Hz - 5KHz (6 frequencies)
Upper band.....	7KHz - 16KHz (6 frequencies)
(Other frequency bands can be ordered)	

### TEST MODULE

#### PULSE GENERATOR:

Frequency.....	2KHz
Duty Cycle.....	50% or 0.2%
Rise Time.....	50nSec

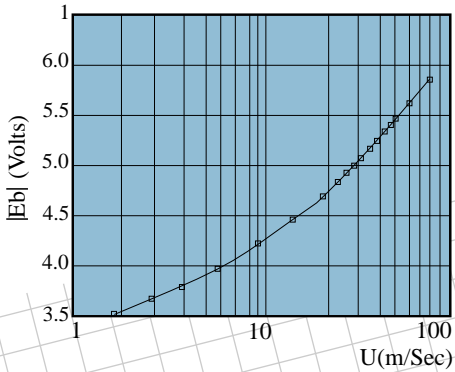
#### DC REFERENCE:

Output Voltages.....	0.1V
Accuracy.....	100 ppm/ $^\circ\text{C}$ , 0.1%
Function selects: Automatic input/output connection according to selected function.	
Channel Selector: Digitally controlled, gold plated contacts.	
In normal operation, all channels except one are disconnected from the Test Module in order to prevent additional noise.	

\* All specifications might change without a prior notice.

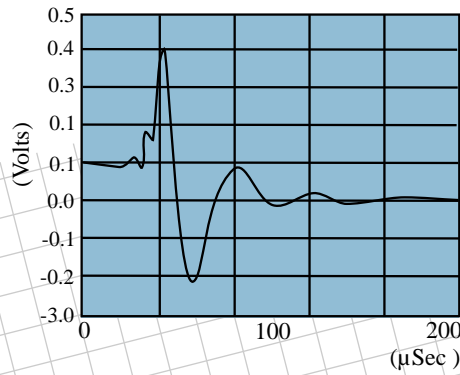
# CHANNEL CHARACTERISTICS - (OPTION 01)

## CALIBRATION CURVE



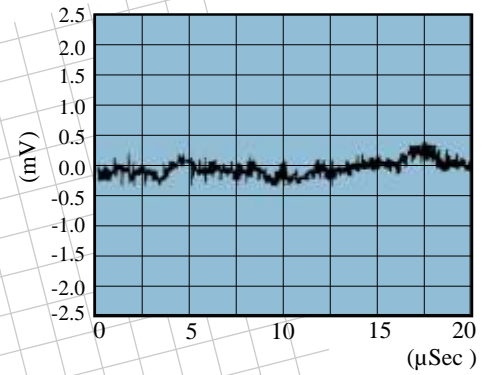
This graph is made for the "Top of the bridge" voltage with no signal conditioning.  
 Probe: P-11 O.H.R.:1.5 R:3Ω T:22-24°C

## PULSE RESPONSE



@ O.H.R. = 1.2  
 5 m. cable

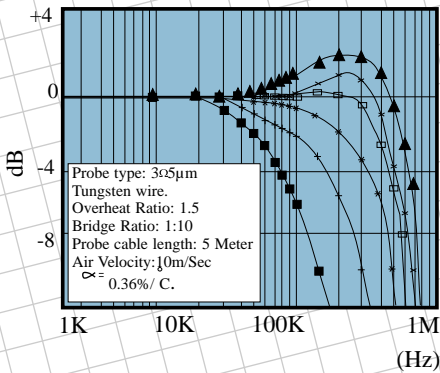
## OUTPUT NOISE (T.O.B)



1 mV P. T. P @  
 200KHz Bandwidth

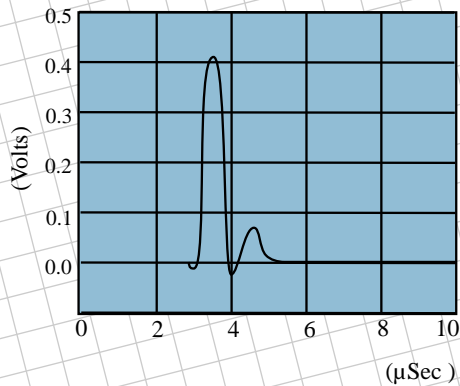
## HIGH FREQUENCY OPTION (OPTION 04)

### TYPICAL FREQUENCY RESPONSE (opt. 04)



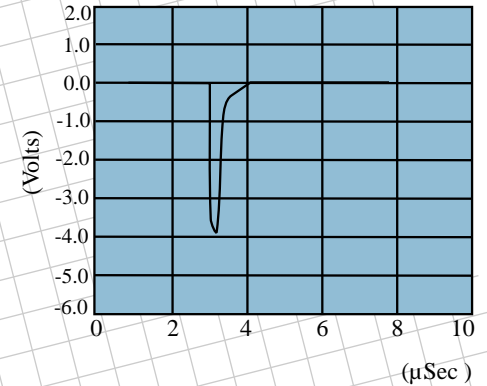
The typical frequency response graph was plotted according to data taken from AN-1003 Hot-Wire Anemometer with options 01 & 04. The amplitude is relative to the amplitude @ 1 KHz.

### PULSE RESPONSE (opt. 04)



Top of Bridge Output  
 @ O.H.R. = 1.5  
 Cable length: 5m

### PULSE INPUT (opt. 04)



Impulse input:  
 4 V amplitude,  
 400 nsec width

## OPTION 12

Option 12 was made to enhance the features of the built-in signal conditioner/amplifier. The Gain setup is mainly used for obtaining high gain in relatively low noise, and for fine calibration at low velocities.

The range switch selects between 4 gain ranges:  
 1 to 10 in the x1 range.      2 to 20 in the x2 range.  
 5 to 50 in the x5 range.      10 to 100 in the x10 range.  
 All gain values can be selected - no discrete values!

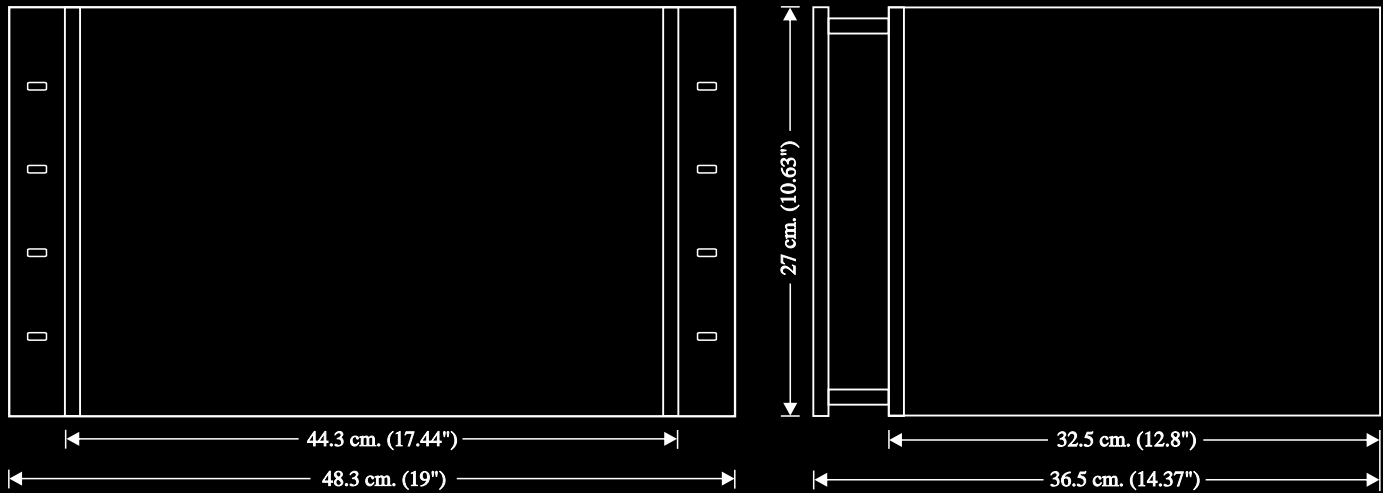
The DC offset unit is made from a highly stable voltage reference with a wide temperature range. With this offset, the user is able to zero DC level at a gain of up to 100 without any reduction in system performance.

The DC offset is adjusted by using 2 controls:  
 A fixed DC offset level of 0,2,4,6,8 Volts + DC off.  
 A variable DC offset level of 0 to 2V, using a multi-turn trimpot.  
 The variable control level is added to the fixed level for obtaining DC levels of 0-10V.

DC reference stability: better than 2 ppm/°C.  
 All other features are equivalent to the standard signal conditioner.  
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 All other features are equivalent to the standard signal conditioner.



## MAINFRAME DIMENSIONS:



SUITABLE FOR 19" RACK.

## ORDERING INFORMATION

The Hot Wire/Hot Film Anemometer System includes:  
1 Mainframe (including low noise power supplies).  
1 Digitally Controlled Test Module.  
10 C.T.A. channels (including Signal Conditioner).

**EXAMPLE:** AN-1003-C10-01-03-04

options ordered  
no. of channels

When ordering the system with 10 channels, 2 additional spare channels will be supplied at no extra charge. The spare channels do not include any options, but options may be specified upon request. The Anemometer System can be ordered with any number of channels.

## OPTIONS:

01-ULTRA LOW NOISE INPUT AMPLIFIER - 400 PICOVOLTS/ $\sqrt{\text{Hz}}$

(less than 0.1 mVrms output noise on 0-20 KHz bandwidth)

02-Discontinued.

03-TEMP. COMPENSATION - discontinued - Use opt. 11 instead.

04-FREQUENCY COMPENSATION - A tunable circuit for improving the frequency response up to 500 KHz.

05-BACKUP BATTERIES provide operation without mains current for more than 2 hours. Built-in charger included.

06-FILTER BANDS other than specified. Please specify upper and lower cut-off frequencies in each band.

07-GAIN OPTION other than 1-20. Please specify maximal gain.

08-VARIABLE GAIN AMPLIFIER with a variable gain of 1-10 and a gain multiplier of x1.x2.x5.x10, to provide any gain from 1-100 (1-200 optional). A highly stable DC offset is added to this option.

09-DC OFFSET MEASUREMENT on the test module with external BNC output.

10-HIGH CURRENT POWER SUPPLY able to drive up to 10 probes in 1:1 bridge ratio as well as in x2 mode (up to 600 mA per channel).

11-C.C.A. mode in addition to C.T.A. mode with 31 fixed current levels and a variable current of 0.3-30 mA.

12-HIGH PERFORMANCE SIGNAL CONDITIONER:

Gain of 1-100 (1-200 optional) with 1-10 variable control and x1.x2.x5.x10 gain multiplier. High accuracy DC offset (2 ppm/ $^{\circ}\text{C}$  stability) with a variable control of 0-2v + fixed steps of 0,2,4,6,8 Volts. DC-off function. Use for low speeds and low turbulence levels.

13-EXTERNAL POWER SUPPLY REMOVAL KIT.

For removing the power supply to an external rack for ultra high noise immunity. (Recommended for CCA channels)

14-AUTO-ZERO DC OFFSET -for automatic reduction of DC offset (use for Velocity profiles or near wall).

Control signals are TTL compatible (zero + read DC offset).

15-5m RG-58 COAXIAL PROBE CABLE.

Probe protection and soft start circuits are standard on all channels.

All mainframes are built for 115/220 Vac @ 50/60 Hz operation.



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