

COBRA PROBE

The Cobra Probe is a 4-hole pressure probe that provides dynamic, 3-component velocity and local pressure measurements in real-time.

The Cobra Probe features a linear frequency-response from 0 Hz (mean flow) to more than 2000 Hz and is available in various ranges for use between 2 m/s and 100 m/s. The Probe can be used in a wide variety of applications due to its compact size and robust construction. The Cobra Probe is supplied fully calibrated and ready to use.



Series 100 Cobra Probe

TFI's Windows-based *Device Control* software provides a powerful, easy-to-use interface for controlling and operating the *Cobra Probe*.



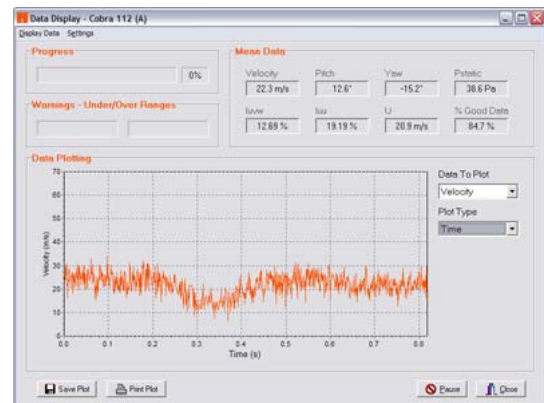
How it works

The Cobra Probe incorporates four 0.5 mm pressure taps in a multi-faceted head, with the pressure taps connected via tubing to pressure transducers in the body of the Probe. The frequency response of the Probe is linearised to provide dynamic capabilities from the mean velocity component (0 Hz) to more than 2000 Hz. The ratios of the tap pressures are then related to the instantaneous velocity vector and static pressure at the Probe head via calibration tables. Data processing is performed by the included *Device Control* software.

Capabilities

The Cobra Probe's precision construction along with the powerful *Device Control* software allow it to perform the following functions:

- 3-component velocity and static pressure measurement within a $\pm 45^\circ$ acceptance cone
- Frequency response from 0 Hz (mean flow component) to more than 2000 Hz
- Measurement of all six Reynolds stresses
- Calculation of any other higher order terms
- Real-time data processing and display
- Real-time frequency analysis
- Simultaneous use of multiple Probes



Data Display screen of the TFI Device Control software

Foundations for the Cobra Probe

The principals of measuring flow direction via pressure measurement have been around in many forms for over 50 years. These have included 2- to 7-hole flow speed and angle meters of various designs such as claw, cobra and conical probes, as well as Conrad probes and cantilever cylinders. However, all of these methods are based on time-averaged pressure measurements and do not supply the fluctuating flow properties.

In the late 1980's a co-founder of TFI applied the concept of linearisation of pressure tubing response functions to produce multi-hole pressure probes that could measure time-varying 3-component velocity and local static pressure. This concept became the 4-hole pressure probe named the Cobra Probe.

This was the original TFI Cobra Probe and since then TFI has improved both the software and hardware to produce the next generation Series 100 Cobra Probe that is sold today. A list of publications detailing some of this development work and early use of these probes is on the TFI website (www.turbulentflow.com.au).

Uses and Applications

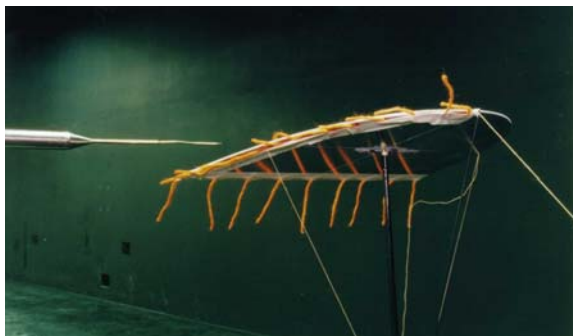
The Cobra Probe can be used to take time-averaged (mean) flow measurements as well as time-varying (turbulent) flow measurements in real time. It can be used in relatively 'dirty', contaminated flows, to replace hot-wire and other anemometers, and can be hand-held or traverse mounted. With its robustness, high-frequency response and ease-of-use, there are a large number of applications for the Cobra Probe as indicated below.



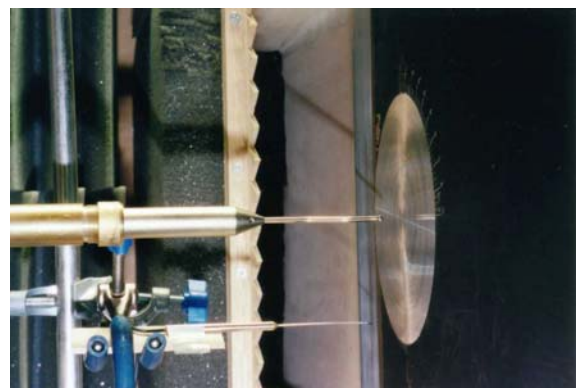
Miniature (1.3 mm) head in front of a car radiator

Table 1: Uses and applications of the TFI Cobra Probe

General uses in all applications	<ul style="list-style-type: none"> - Flow mapping - Rapid point (hand-held) measurements - Simultaneous multi-probe measurements - Turbulent wake measurement and mapping
CFD boundary & initial conditions determination	<ul style="list-style-type: none"> - Vehicle HVAC (air-conditioning) systems
Industrial/environmental aerodynamics	<ul style="list-style-type: none"> - Boundary-layer profiles for industrial and building aerodynamics - Pedestrian level flow-field studies - On-site measurements in commercial or industrial facilities
Vehicle aerodynamics	<ul style="list-style-type: none"> - Measurement of atmospheric winds during on-road, on-vehicle testing - Measurement of vehicle under-body flow - Measurements on-road, at test tracks or in wind tunnel facilities
Aircraft aerodynamics	<ul style="list-style-type: none"> - Flow mapping around scale models - Atmospheric turbulence characterisation on light aircraft
Wind-tunnel measurements	<ul style="list-style-type: none"> - Wind tunnel flow characterisation - Flow mapping around model-scale vehicles, ships and aircraft



Series 0 Cobra Probe taking measurements behind a delta wing in the RMIT Industrial Wind Tunnel



Series 100 Cobra Probe next to a flat plate model in an open jet aeroacoustic wind tunnel

Operating Requirements

The following components are supplied when you order a Cobra Probe system: Series 100 Cobra Probe, cabling, *TFI Device Control* software and technical support. You will need to supplement these components with the following:

- Windows-based computer – desktop or laptop (200 MHz processor minimum)
- Supported A/D card or other suitable data acquisition system (16 bit, 50 kHz preferred). Supported cards include:
 - IOtech DaqBoard/2000 series for desktop computers
 - National Instruments M-series and E-series for desktop and laptop computers
 - Quatech DAQP-16 for laptop computers
 - SuperLogics PCM16 for laptop computers

(TFI can supply data acquisition equipment if required.)

Calibration Requirements

Cobra Probes are supplied fully calibrated and ready to use - full calibration of the Probes is performed by TFI before delivery to customers. Occasional (6-monthly) transducer re-calibration is recommended however (these checks are quickly and easily performed by the user).

Cobra Probe Configurations

The Cobra Probe outputs raw voltage data which is transferred to computer using one of the TFI supported A/D cards (see above) or another suitable data acquisition system. The raw voltage information is then processed into three-component velocity data by the *TFI Device Control* software, via calibration surfaces and other signal processing. There are several different Probe configurations available, depending on the number of Cobra Probes purchased and your preferred data acquisition system.

Stand-alone configurations

The stand-alone configurations supported for the Series 100 Cobra Probe use the TFI supported A/D cards and are illustrated below in Figure 1. A single Cobra Probe can be directly connected to an A/D card installed in a computer via a single cable. Up to 4 Cobra Probe units can also be accommodated in a similar manner via a single split cable, while higher numbers of Probes require an interface box between the Probe units and the computer. Cobra Probes can also be used with laptop computers, enabling a portable system that you can take wherever you take a laptop computer. Each of the stand-alone configurations can support optional additional inputs, such as temperature information, external triggers or other data inputs as required.



Items supplied with the Series 100 Cobra Probe: Probe and cable showing connectors (top); Probe box for storage (above).

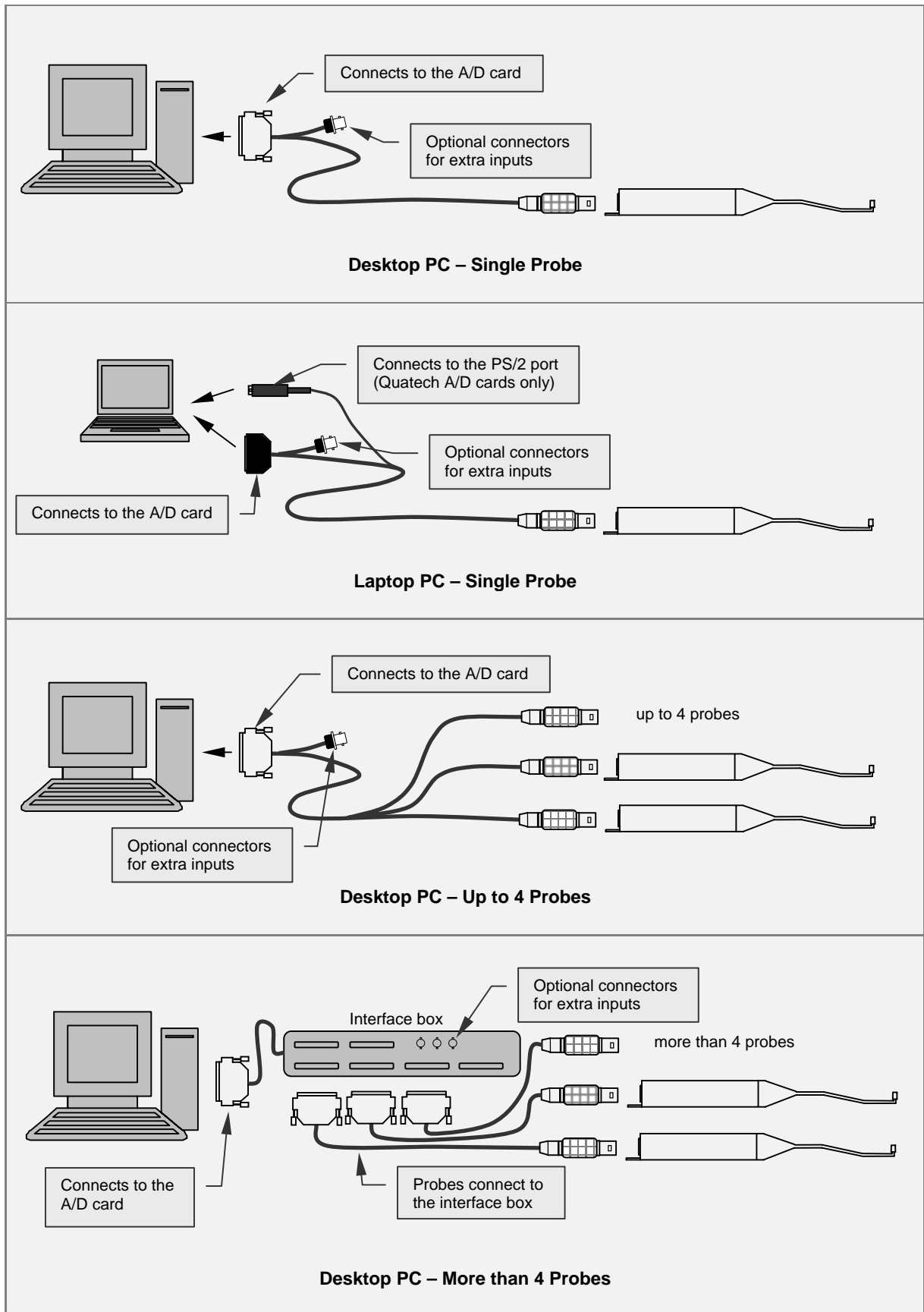


Figure 1: Stand-alone operating configurations for the Series 100 Cobra Probe

Interfacing with existing systems

As well as the stand-alone configurations, TFI can provide a configuration that will interface with a customer's existing data acquisition system (Figure 2). The Cobra Probe is connected to the existing data acquisition system using compatible connectors, and can include connecting the Probe channels via a separate cable for each input (e.g. using BNC connectors). Specialised software interface routines supplied by TFI can then be called by the customer's existing data acquisition software in order to produce the 3-component velocity and static pressure information. The software routines are compatible with C++, LabVIEW® and other programming languages.

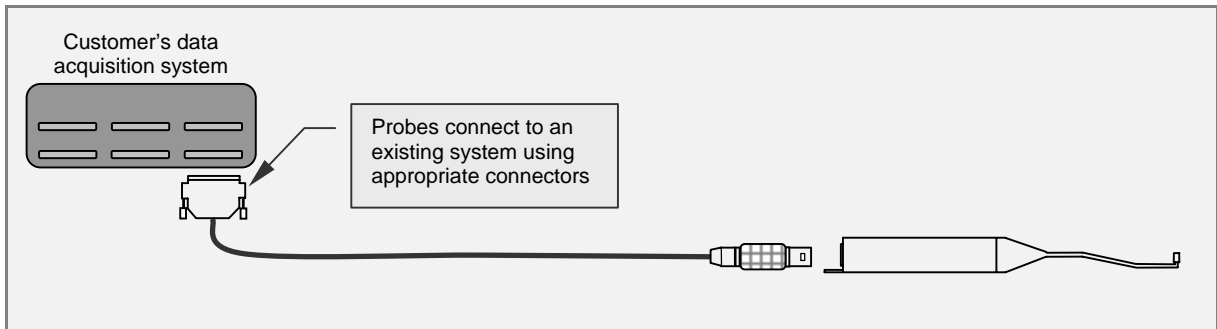


Figure 2: Interfacing a Series 100 Cobra Probe with an existing data acquisition system

Specifications

Dimensions

Table 2: Series 100 Cobra Probe Dimensions

Overall length	Body diameter	Head width
155 mm + 30 mm for connector & cable	14 mm	2.6 mm (1.4 and 5 mm versions available)

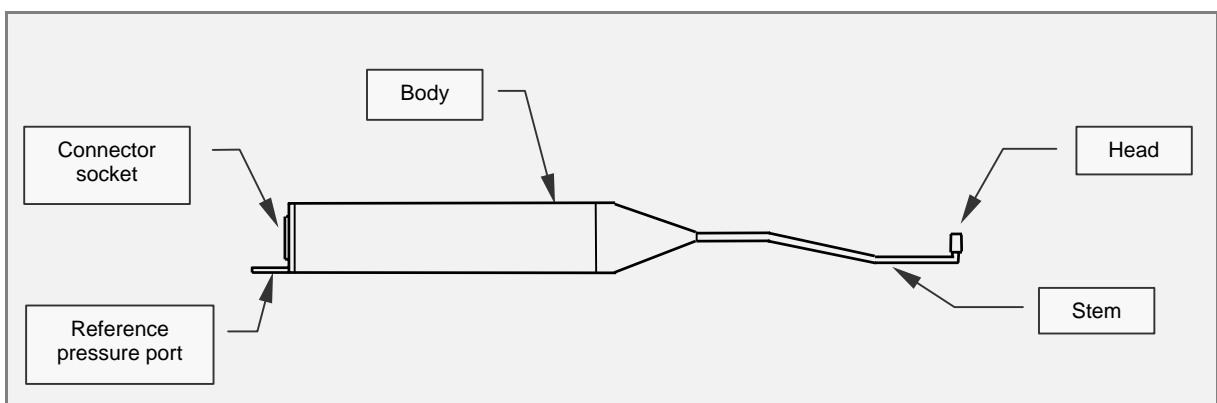


Figure 3: Schematic diagram of the Series 100 Cobra Probe

Performance

Table 3: Series 100 Cobra Probe Performance

Flow velocity	Flow angles	Accuracy (typical at most flow angles)	
		Velocity	Flow angles
2 – 100 m/s (in various ranges)	± 45° cone	± 0.3 m/s	±1.0°

Cobra Probe

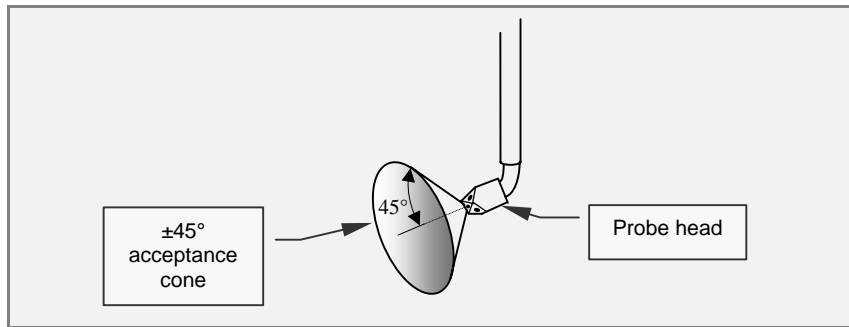


Figure 4: In order for the Cobra Probe to take accurate flow measurements, the flow direction must reside within ±45° of the probe x-axis.

Customisation

TFI can customise the Cobra Probe to suit your particular requirements. Common items customised include the stem length, head size and operating range, as well as integrating the Cobra Probe system into existing equipment or data acquisition systems.



Standard head size: 2.6 mm



Customisation can include the head size, stem length and the transducer operating range