



## P3100 Horizontal Axis Wind Generator Module

### INTRODUCTION

The P3100 Horizontal Axis Wind Generator Module is able to measure torque and thrust generated from a 600mm diameter wind turbine. The module comprises of a small variable speed motor configured to act as a power generator, mounted on a shaft free to slide axially within ball bearings. The blades are mounted on a hub and allow the angle of attack to be adjusted and set with reasonable accuracy. The unit is provided with a control box that displays current, voltage and wind generator speed. The P3100 reads torque and thrust by weights, whilst the P3100e uses load cells. Speed is measured with a tacho generator.

### DESCRIPTION

The Generator Module is designed to allow a variety of wind turbine blades to be mounted on a hub and placed within the airflow. The hub allows the angle of attack of each blade to be changed. A variable field motor allows some control over the speed of the generator whilst current and voltage outputs are displayed. Thrust and torque created by the wind generator are also measured.

### EXPERIMENTAL CAPABILITY

The following experiments can be conducted

- ◆ Determination of the energy available from an air stream,
- ◆ The effect of relative wind velocities and blade angles
- ◆ Performance differences between straight and twisted blades
- ◆ The use of aerofoil lift and drag
- ◆ The effect of stall on wind generator performance
- ◆ The use of lift to generate torque

The experiments are intended to provide a realistic understanding of the way that aerofoil blades work and this is covered fully in the theory. However the relatively low Reynolds numbers that can be achieved, and the shape of the blades means that the effects of change of momentum of the air flow are more significant in creating torque and thrust than the aerofoil lift.

The rotor is designed to operate in wind speeds of 0 to 15 m/s and at rotational speeds of 100 to 1500 r.p.m.

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## CONSTRUCTION

The P3100 Horizontal Wind Generator Module comprises of a small bearing housing located within, either the centre of its wind channel or in free wind, by two support struts. The bearing housing can be clamped in position either directly into the wind, or at an angle to the wind. The bearing housing provides a location for the main horizontal axis turbine shaft. The shaft is free to slide axially within the bearings, and is constrained axially by the turbine thrust measurement device.

The leading end of the shaft is provided with a screw thread on which the blade hub and nose cone can be mounted. An aluminium hub is provided with ports for 12 blades to be fitted. Each port has a grub screw able to lock the blade into a set angle of attack. A simple angle-setting gauge is provided with the generator, which is bolted to the edge of the P3106 Wind Fan and Bench if ordered.

A wooden nose cone is provided, which screws onto the leading end of the shaft. This improves the airflow and locks the hub in place.

The trailing end of the shaft is directly coupled to a DC variable field motor. The output of the motor is taken to a control box with a variable rheostat, to provide a load bank. Variation of the field voltage provides a degree of ability to control the speed of the wind generator. The speed of rotation, whilst proportional to the field voltage, is also measured directly by a small tacho-generator.

Thrust and Torque can be measured either mechanically (P3100) or by load cells (P3100e). Mechanical readings of torque are taken by adding weights (outside the wind channel) to a torque arm taken from the motor stator, whilst thrust is measured by adding weights to a constraining strap pulling axially on the motor casing. Load cells are applied in a similar manner.

## TENDER SPECIFICATION

The P3100 Horizontal Axis Wind Generator Module is to provide the means to measure torque and thrust generated from a 600mm diameter wind turbine. The module comprises of a small variable speed motor configured to act as a power generator, mounted on a shaft free to slide axially within ball bearings. The module is to include the supply of a hub that allows the angle of attack to be adjusted and set with reasonable accuracy. The unit is to be provided with a control box that displays current, voltage and wind generator speed. The P3100 is to read torque and thrust by weights, whilst the P3100e is to use load cells. Speed is to be measured with a tacho generator.

## DATA ACQUISITION

Product P3100e provides a range of signals suitable for acceptance by most data acquisition systems. Cussons recommends the use of its P7141 Data Acquisition Module for use with the P3100e system. P7141 provides a plug in data acquisition module connected to a PC, supplied as a current production specification at the time of order.

## PACKING DIMS / POWER REQUIRED

Length 1.4m Width 1.0m Depth 0.8m

No Power Supply is required

## REQUIRED ACCESSORIES

Mounting. The user must acquire either P3106 Wind Channel or P3107/8 External Mounting or provide their own mounting

Blades. The user should acquire either one or more of Cussons blade sets P3102, P3103, P4104 or provide their own blades.