Power Meter

4422

Operation Manual

Instruction Book Part Number 920-4422 Rev. A

Safety Precautions

The following are general safety precautions that are not necessarily related to any specific part or procedure, and do not necessarily appear elsewhere in this publication. These precautions must be thoroughly understood and apply to all phases of operation and maintenance.

WARNING
Keep Away From Live Circuits
Operating Personnel must at all times observe general safety precautions. Do not replace components or make adjustments to the inside of the test equipment with the high voltage supply turned on. To avoid casualties, always remove power.

WARNING
Do Not Service Or Adjust Alone
Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

WARNING
Safety Earth Ground
An uninterruptible earth safety ground must be supplied from the main power source to test instruments. Grounding one conductor of a two conductor power cable is not sufficient protection. Serious injury or death can occur if this grounding is not properly supplied.

WARNING
Resuscitation
Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

WARNING
Remove Power
Observe general safety precautions. Do not open the instrument with the power on.

Safety Symbols

WARNING
Warning notes call attention to a procedure, which if not correctly performed, could result in personal injury.

CAUTION
Caution notes call attention to a procedure, which if not correctly performed, could result in damage to the instrument.

Note: *Calls attention to supplemental information.*

Safety Symbols Used on the Equipment

Pinch Point

The 4422 Power Meter is designed to be opened for use. When closing for storage/transport there is a possibility of pinching fingers, hands, or cabling. Keep items clear of chassis when closing power meter.

Warning Statements

The following safety warnings appear in the text where there is danger to operating and maintenance personnel and are repeated here for emphasis.

WARNING
Pinch Point.
Hold the 4422 Power Meter chassis by the handle when lowering to the stowed position.
Keep hands, fingers, and electrical cords clear of the outside edge of the chassis.

See page 6

WARNING
Before connecting the power sensor to a transmission line, refer to the power sensor instruction book. Note the potential hazard when working with RF power.

See page 7

WARNING
To avoid personal injury, disconnect the power cord from the AC line before performing any maintenance.

See page 10

WARNING
The Bird 4422 contains no user-serviceable parts.
Do not remove its cover.

See page 10

Caution Statements

The following equipment cautions appear in the text and are repeated here for emphasis.

CAUTION
Do not block air flow. The vents on the unit are for air convection and must not be obstructed.

See page 4

CAUTION
If Wall Mounting the 4422 Power Meter, care should be taken to avoid any movement of the chassis that could separate the unit from the hardware used to hang the Power Meter. If the unit lifts off the hardware it may be damaged by falling.

See page 5

CAUTION
4421B540-2 must be disconnected from the power supply when connecting or disconnecting the power sensor.

See page 7

CAUTION
Do not store at temperatures below -20° C (-4° F) or above 60° C (140° F). Equipment damage may result.

See page 14

Safety Statements

USAGE

ANY USE OF THIS INSTRUMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE INSTRUMENT'S SAFETY PROTECTION.

USO

EL USO DE ESTE INSTRUMENTO DE MANERA NO ESPECIFICADA POR EL FABRICANTE, PUEDE ANULAR LA PROTECCIÓN DE SEGURIDAD DEL INSTRUMENTO.

BENUTZUNG

WIRD DAS GERÄT AUF ANDERE WEISE VERWENDET ALS VOM HERSTELLER BESCHRIEBEN, KANN DIE GERÄTESICHERHEIT BEEINTRÄCHTIGT WERDEN.

UTILISATION

TOUTE UTILISATION DE CET INSTRUMENT QUI N'EST PAS EXPLICITEMENT PRÉVUE PAR LE FABRICANT PEUT ENDOMMAGER LE DISPOSITIF DE PROTECTION DE L'INSTRUMENT.

IMPIEGO

QUALORA QUESTO STRUMENTO VENISSE UTILIZZATO IN MODO DIVERSO DA COME SPECIFICATO DAL PRODUTTORE LA PROZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.

SERVICE

SERVICING INSTRUCTIONS ARE FOR USE BY SERVICE - TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

SERVICIO

LAS INSTRUCCIONES DE SERVICIO SON PARA USO EXCLUSIVO DEL PERSONAL DE SERVICIO CAPACITADO. PARA EVITAR EL PELIGRO DE DESCARGAS ELÉCTRICAS, NO REALICE NINGÚN SERVICIO A MENOS QUE ESTÉ CAPACITADO PARA HACERIO.

WARTUNG

ANWEISUNGEN FÜR DIE WARTUNG DES GERÄTES GELTEN NUR FÜR GESCHULTES FACHPERSONAL.

ZUR VERMEIDUNG GEFÄHRLICHE, ELEKTRISCHE SCHOCKS, SIND WARTUNGSARBEITEN AUSSCHLIEßLICH VON QUALIFIZIERTEM SERVICEPERSONAL DURCHZUFÜHREN.

ENTRENTIEN

L'EMPLOI DES INSTRUCTIONS D'ENTRETIEN DOIT ÊTRE RÉSERVÉ AU PERSONNEL FORMÉ AUX OPÉRATIONS D'ENTRETIEN. POUR PRÉVENIR UN CHOC ÉLECTRIQUE DANGEREUX, NE PAS EFFECTUER D'ENTRETIEN SI L'ON N'A PAS ÉTÉ QUALIFIÉ POUR CE FAIRE.

ASSISTENZA TECNICA

LE ISTRUZIONI RELATIVE ALL'ASSISTENZA SONO PREVISTE ESCLUSIVAMENTE PER IL PERSONALE OPPORTUNAMENTE ADDESTRATO. PER EVITARE PERICOLOSE SCOSSE ELETTRICHE NON EFFETTUARRE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

About This Manual

This manual covers the operating & maintenance instructions for the following models:

4422

Changes to this Manual

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our Solon, Ohio factory. This manual may be periodically updated. When inquiring about updates to this manual refer to the part number and revision on the title page.

Chapter Layout

Introduction — Describes the features of the Power Meter.
Setup — Includes unpacking and equipment setup.
Operating Instructions — Identifies steps required to power on, use, and power off the Power Meter.
Troubleshooting — Provides limited troubleshooting instructions for commonly encountered problems.
Maintenance — Lists routine maintenance tasks as well as storage and shipping instructions.
Specifications — Provides the specifications for the Bird Power Meter.

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Chapter 1 Introduction

The Bird 4422 Power Meter is used with Bird power sensors to measure RF power. The 4422 Power Meter is a Panel PC running Bird's Virtual Power Meter (VPM) Software. For instructions regarding the VPM3 software, refer to the VPM3 Operation Manual (920-VPM3).

General Description

The 4422 Power Meter is designed to be used with Bird's full line of USB compatible Power Sensors. The 4422 is equipped with a touchscreen interface.

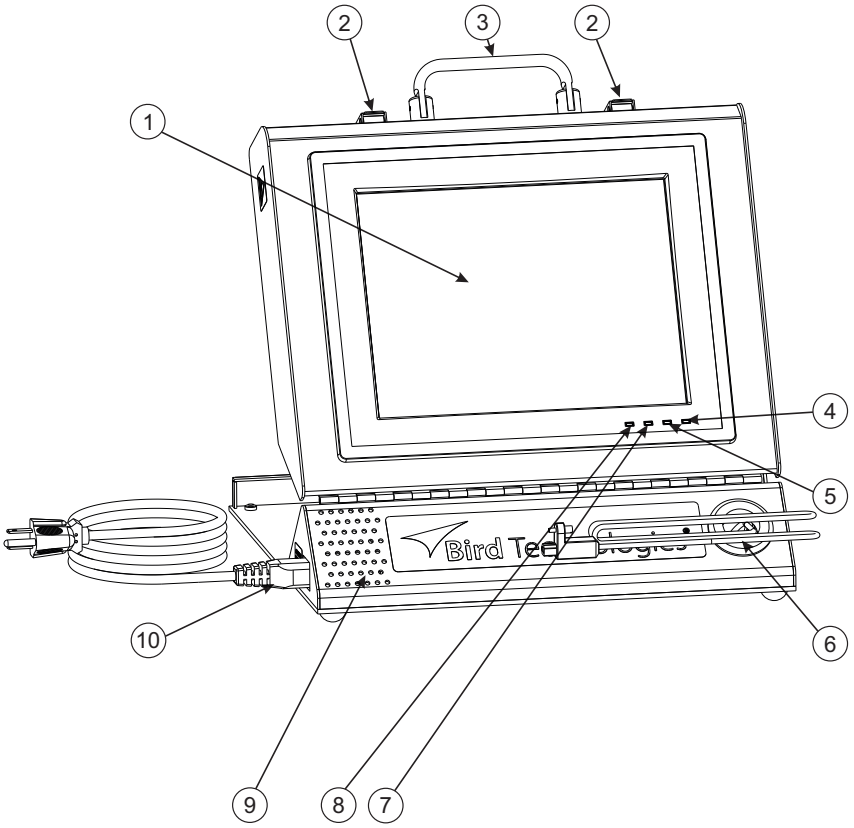
Figure 1 Bird 4422 Power Meter Assembly

Table 1 - Compatible Power Sensors

Sensor Type	Bird Model Number	CONNECTION
Wideband Power Sensors (WPS)	5012, 5016, 5017, 5018, 5019	USB
	7020	USB
Terminating Power Sensors	5015, 5015-EF	USB
Directional Power Sensors (DPS)	4021, 4022, 4023, 4024, 4025, 4027, 4028	Bird Sensor Interface Module 4421B540-2
	5014	USB
Statistical Power Sensors (STAT)	7022	USB
Pulse Power Sensor	7023	USB

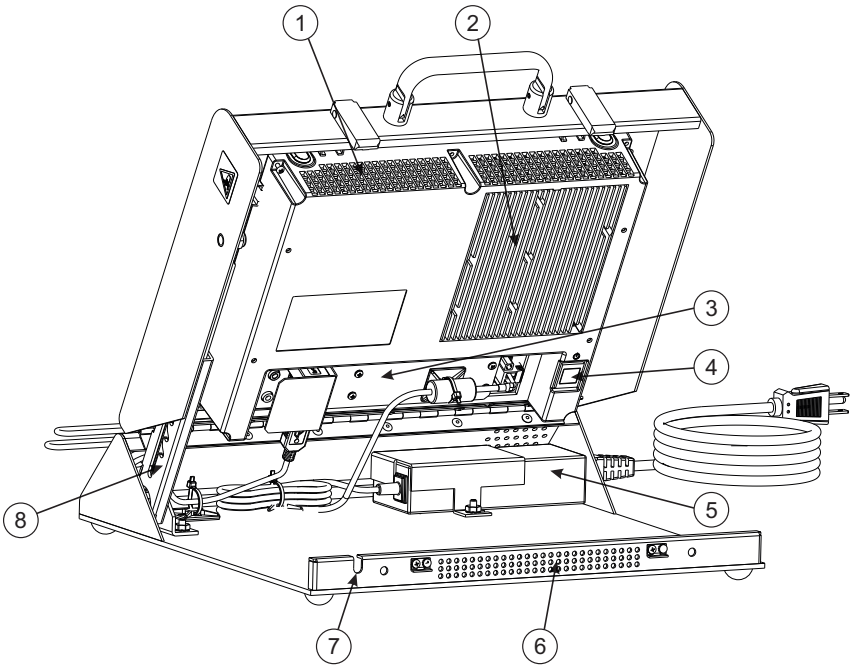
Controls and Indicators

Figure 2 Front Panel



Item	Indicator	Description
1	Display/Touch Screen	Displays Power Sensor information and acts as the user interface.
2	Latches	Secures the 4422 Power Meter when in the closed position.
3	Handle	Carry handle for transporting the 4422 Power Meter when in the closed position.
4	Power status (green)	Illuminates when power is applied to the unit.
5	HDD status (yellow)	Flashes to indicate hard drive activity.
6	USB Cable	Used to connect the 4422 Power Meter to power sensors.
7	Network status (green/ yellow)	Flashes to indicate network activity.
8	Light sense	Front panel light sense.
9	Air Vent	Allows ambient air to flow through the 4422 Power Meter.
10	AC Power Cord	Removable AC power supply cord.

Figure 3 Rear Panel



Item	Indicator	Description
1	Air Vent	Allows air flow though PC.
2	Heat Sink	Transfers heat away from internal PC components.
3	Interface Connector Cover	Tamper resistant cover to prevent unauthorized use of the unused interface connectors.
4	Power Switch	Used to apply and remove power from the unit.
5	AC Power Supply	Provides the AC to DC interface for power to the 4422 Power Meter.
6	Air Vent	Rear air vent.
7	Cable Exit	Cable opening for use when 4422 Power Meter is operated in the closed position.
8	Multi-position Latching Support	Locks the chassis in the open position, once open chassis must be opened to full extension to return to closed position.
Not Shown	Wall-Mount Slots	Keyhole Slots in the bottom section of the chassis provided for wall mounting the 4422 Power Meter. See “Wall Mounting” on page 5.

Chapter 2 Setup

This chapter provides information for unpacking, inspection, and preparing the Bird Power Meter for use.

Unpacking and Inspection

1. Carefully inspect shipping container for signs of damage.
2. Do one of the following:
   - If the shipping container is damaged, do not unpack the unit. Immediately notify the shipping carrier and Bird Electronic Corporation.
   - If the shipping container is not damaged, unpack the unit. Save shipping materials for repackaging.
3. Inspect unit for visual signs of damage.

Note: *If there is damage, immediately notify the shipping carrier and Bird Electronic Corporation.*

Setup

Setup consists of three basic steps: moving the unit into position, connecting AC power and attaching a Bird Power Sensor. The 4422 Power Meter may also be wall mounted and operated with the chassis closed.

> CAUTION
> Do not block air flow. The vents on the unit are for air convection and must not be obstructed.

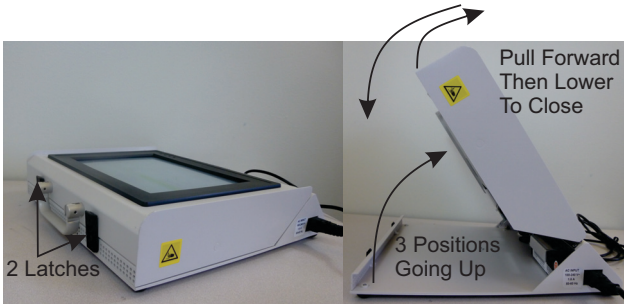
- Use the in a dry, dust-free environment.

  Note: *Do not use outdoors or in areas of condensing humidity.*

- Allow unobstructed air flow around the unit.
- The AC power supply required is 100 - 240 V @ 50 - 60 Hz, 1ϕ, 1.5 A.

1. Place the 4422 Power Meter on a stable work area.
2. Release latches and raise the Power Meter into viewing position.

Figure 4 Opening the Power Meter



3. Connect Power Cord to Power supply.
4. Feed USB Cable through Cable Access in Power Meter Front Panel.

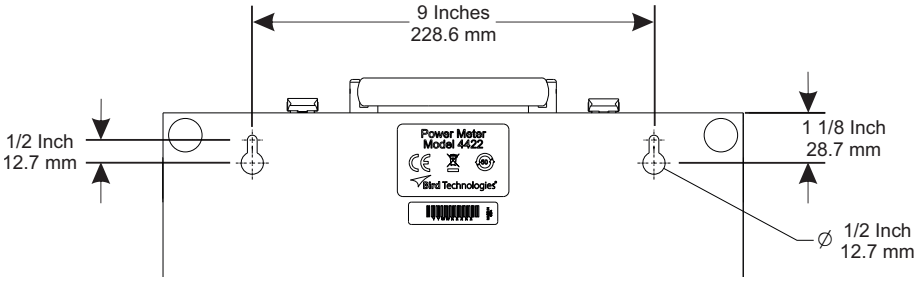
Wall Mounting

The 4422 Power Meter may be wall mounted if desired. There are two key holes located in the base of the 4422 Power Meter for use in wall mounting. See Figure 5 on page 5.

> CAUTION
> If Wall Mounting the 4422 Power Meter, care should be taken to avoid any movement of the chassis that could separate the unit from the hardware used to hang the Power Meter. If the unit lifts off the hardware it may be damaged by falling.

1. Identify location.
2. Install two screws capable of supporting the full weight (11.1 lbs (5035 g)) of the Power Meter. See Figure 5 for dimensions for locating the fasteners.
3. Remove the four rubber feet from the unit.
4. Install the 4422 Power on the screws.

Figure 5 Wall Mounting Dimensions



Normal Operation

Power On

1. Connect the Bird 4422 power meter to AC Power Supply.

   Note: *If the unit is wall mounted, release the latches and carefully lower the front panel to access the power button, close and latch the front panel after power is applied.*

2. Press Power button on the Bird 4422 power meter rear panel.
3. Wait for VPM3 software to display before continuing.

Power Off

1. Press Power button on the Bird 4422 power meter rear panel to power down the 4422 Power Meter.

   Note: *Wait for complete power down before continuing*

2. Disconnect the AC power supply.
3. Disconnect USB cable from Power Sensor.

> **WARNING**
> **Pinch Point.**
> Hold the 4422 Power Meter chassis by the handle when lowering to the stowed position.
> Keep hands, fingers, and electrical cords clear of the outside edge of the chassis.

4. Raise the Power Meter to the farthest forward position then slowly lower to the fully stowed position.
5. Close storage latches.

   Note: *Ensure latches are closed and locked before transporting the 4422 using the carry handle.*

Touch panel Operation

The 4422 has a touch screen and is designed to be used without a keyboard or mouse.

The following are gestures equivalent to the listed typical mouse operations:

Right click context menu — Press and hold your finger on the touch screen, a white circle will be drawn on the screen, remove your finger and the context menu options will appear.

Left click — Tap the screen at the position of the desired click.

Click and drag — Press and hold your finger at position of the desired click, maintain contact with the screen and drag your finger to desired location.

USB Power Sensor operation

WARNING
Before connecting the power sensor to a transmission line, refer to the power sensor instruction book. Note the potential hazard when working with RF power.

1. If required, connect Bird Power Sensor to RF Transmission Line, following instructions in the Power Sensor manual.
2. Connect the Power Meter USB cable to the Power Sensor.

   Note: *VPM will automatically detect the power sensor.*
3. Apply RF power to the Power Sensor.
4. Make measurements. Refer to the VPM Software Operation Manual (920-VPM3). The VPM3 manual is available on www.birdrf.com.

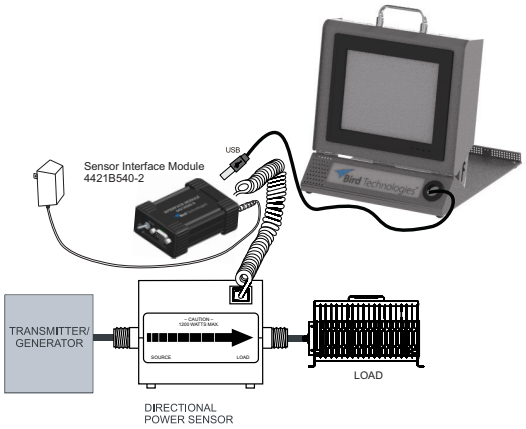
4421B540-2 Module Power Sensor operation (Bird 402X Power Sensors)

WARNING
Before connecting the power sensor to a transmission line, refer to the power sensor instruction book. Note the potential hazard when working with RF power.

CAUTION
4421B540-2 must be disconnected from the power supply when connecting or disconnecting the power sensor.

1. If required, connect Bird Power Sensor to RF Transmission Line, following instructions in the Power Sensor manual.
2. Connect a sensor cable (supplied with sensor) between the 4421B540-2 and the RF power sensor.
3. Connect the USB cable from the 4422 Power Meter to the 4421B540-2.
4. Connect AC power supply to the 4421B540-2 Interface Module.
5. Apply RF power to the Power Sensor.
6. Make measurements. Refer to the VPM Software Operation Manual (920-VPM3). The VPM3 manual is available on www.birdrf.com.

Figure 6 4421B540-2 Module Operational Setup



Optional Configurations

Multiple Sensor Operation

It is possible to connect up to four Power Sensors directly to the 4422 Power Meter simultaneously. The Bird 4422 has a total of four USB ports.

To attach additional Power Sensors to the 4422 Power Meter, perform the following:

1. Remove the Interface Connector Cover. See "Remove Interface Connector Cover" on page 13.
2. Obtain additional USB cables, Type A to Type B. See "Replacement Parts" on page 17.
3. Connect Power Sensors to the 4422 Power Meter as described in "USB Power Sensor operation" on page 7 or "4421B540-2 Module Power Sensor operation (Bird 402X Power Sensors)" on page 7.

Ethernet Connection

It is possible to connect the 4422 Power Meter to an Ethernet Network. To connect the 4422 Power Meter, perform the following:

1. Remove the Interface Connector Cover. See "Remove Interface Connector Cover" on page 13.
2. Obtain a standard “straight” Ethernet cable.
3. Plug one end of the Ethernet cable into to back of the 4422 Power Meter.
4. Plug the remaining end of the Ethernet cable into an available LAN connection.
5. Configure Windows 7 to enable the network connection.

Chapter 4 Troubleshooting

PROBLEM	POSSIBLE CAUSE	CORRECTION
Power meter has no power	Is the power meter's AC power supply connected to an AC outlet?	Connect the power cord.
	Is the DC supply cord connected to the Power Meters rear panel?	Connect the power cord.
	Is the power switch on the rear panel set to OFF?	Set the switch to ON.
The power sensor is not automatically detected by the VPM software.	VPM is not configured to auto detect power sensors.	Verify Preferences are set to automatically connect to sensors.
	Is the USB sensor cable connected to both the power meter and power sensor?	Connect sensor cable.
	Is the sensor cable defective?	Replace sensor cable.
Power meter does not accurately respond to screen gestures.	Touch screen is not calibrated.	Calibrate touch screen. See Touch Screen Calibration, page 10.

Chapter 5 Maintenance

This chapter describes routine maintenance for service beyond this level or that in Chapter 4, Troubleshooting, return the unit to a qualified service center.

> WARNING
> To avoid personal injury, disconnect the power cord from the AC line before performing any maintenance.

> WARNING
> The Bird 4422 contains no user-serviceable parts.
> Do not remove its cover.

Routine Maintenance

The Bird 4422 Power Meter requires only simple, routine maintenance.

- Wipe off dust and dirt regularly. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
- Check the connectors and cables for damage.

Annual Maintenance

Lubricate the following components using silicone lubricant:

- Support strut
- Hinges
- Carry handle

Touch Screen Calibration

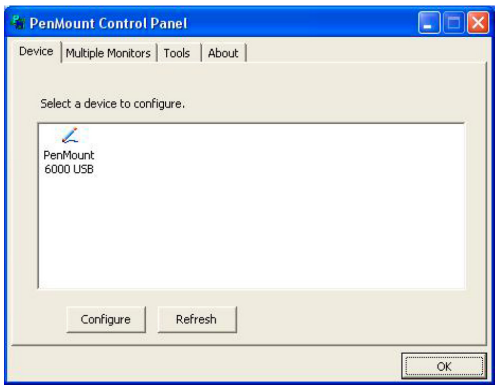
The Touch Screen has two levels of calibration available, Standard and Advanced. Standard calibration uses five points on the screen for calibration. In most cases standard calibration will provide sufficient touch screen accuracy for 4422 Power Meter operation. Advanced calibration uses 9, 16, or 25 points on the screen for calibration. This option should only be required if the standard calibration does not provide sufficient accuracy. It is recommend that a stylus be used when performing an advanced calibration.

Standard Touch Screen Calibration

In most cases standard touch screen calibration will provide sufficient accuracy for power meter operations.

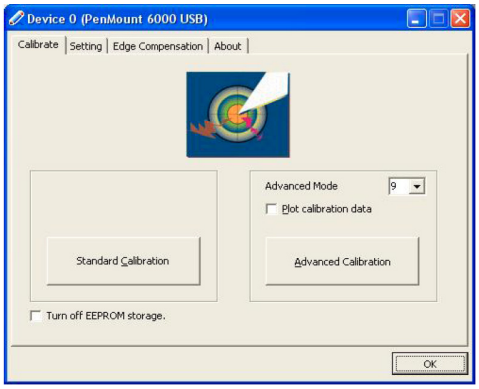
1. Close the VPM3 display application by selecting File-> Exit
2. On the desktop, double tap the "PenMount Control Panel" icon.
3. Tap PenMount6000 RS232 on the Device tab. See Figure 7 on page 11.
4. Tap Configure.

Figure 7 PenMount Control Panel



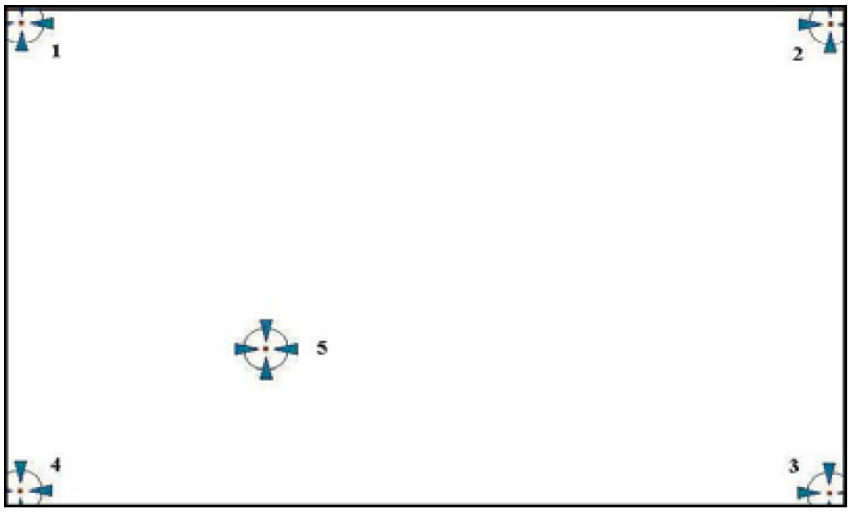
5. Tap Standard Calibration on the Device's Calibration Dialog Box. See Figure 8 on page 11.

Figure 8 Calibration Dialog Box



6. On the Calibration Screen, press and hold a finger on each calibration point as it is displayed. See Figure 9 on page 11.

Figure 9 Standard Calibration Screen

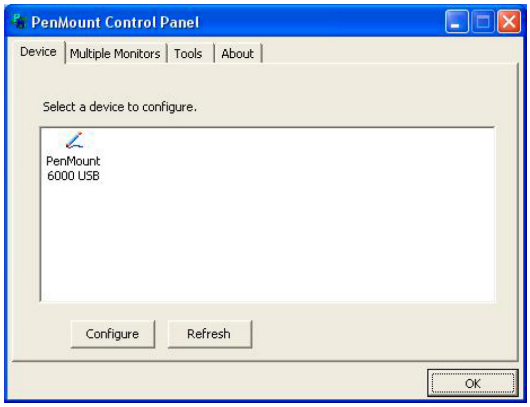


Advanced Touch Screen Calibration

The advanced calibration is only required if the standard calibration does not provide accurate touch screen operation. It is recommended a stylus be used when performing the advanced touch screen calibration.

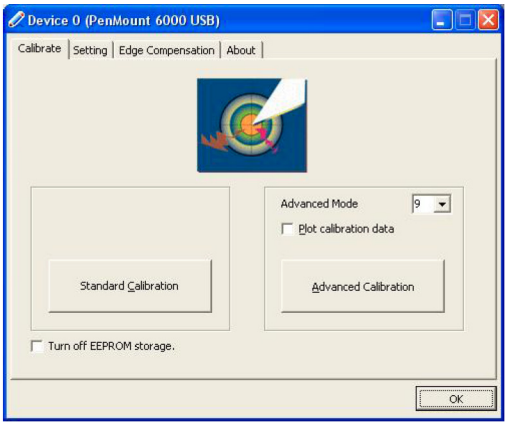
1. Close the VPM3 display application by selecting File-> Exit
2. On the desktop, double tap the "PenMount Control Panel" icon.
3. Tap PenMount6000 RS232 on the Device tab. See Figure 10 on page 12.
4. Tap Configure.

Figure 10 PenMount Control Panel



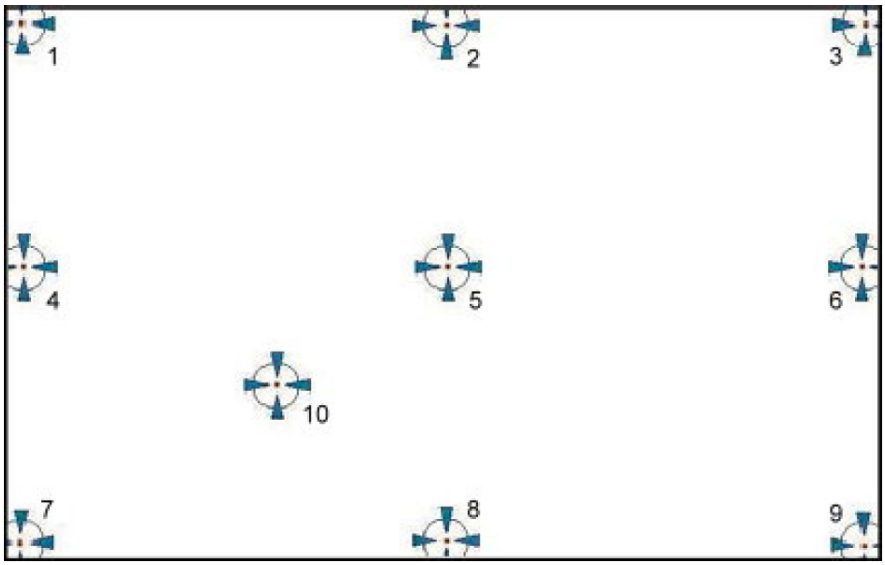
5. Tap Advanced Calibration on the Device's Calibration Dialog Box. See Figure 11 on page 12.

Figure 11 Calibration Dialog Box



6. On the Calibration Screen, press and hold a stylus on each calibration point as it is displayed. See Figure 12 on page 13.

Figure 12 Advanced Calibration Screen

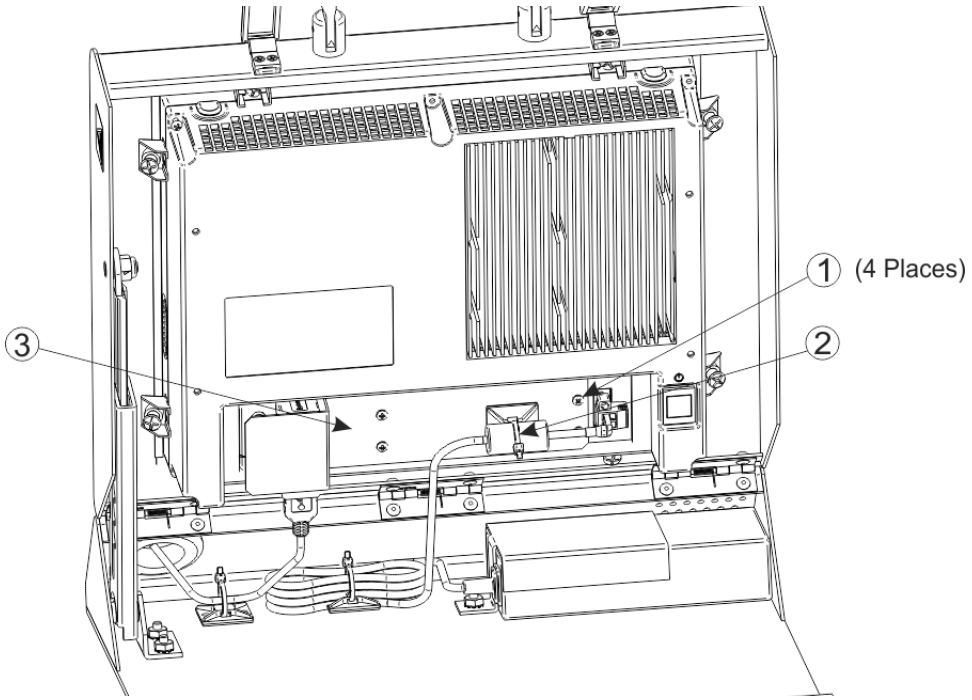


Remove Interface Connector Cover

A tamper guard is installed over the Interface connectors from the factory. This reduces risk of unauthorized data access to the 4422. If the cover is not necessary or connection of multiple sensors is desired, remove the cover as follows:

1. Power Off the 4422 Power Meter, but do not close. See "Power Off" on page 6.
2. Cut the cable tie (2) securing the power cord to the Interface Connector Cover (3). See Figure 13 on page 13.
3. Remove four #1 cross-tip screws (1) securing the Interface Connector Cover (3) to the Bird Power Meter.
4. Store cover and screws for re-installation.

Figure 13 Interface Connector Cover Removal



Storage and Shipment

Storage

CAUTION
Do not store at temperatures below -20° C (-4° F) or above 60° C (140° F). Equipment damage may result.

1. Cover Bird 4422 Power Meter before storing to keep out dust and dirt.
2. Store in a dry, dust-free environment where the ambient temperature will remain between –20 and +60 °C (–4 to +140 °F).
3. Disconnect Power Meter from the power source to avoid damage by transient over-voltage.

Shipment

Ensure unit is closed and latched prior to packaging for shipment.

Package instrument using the original shipping container. If the original shipping container is not available, use a corrugated box. Place shock absorbing material around all sides of the instrument to prevent movement during handling or shipment. Equipment packaging shall be in accordance with best commercial practices.

Customer Service

Any maintenance or service procedure beyond the scope of those in this chapter should be referred to a qualified service center.

If the unit needs to be returned for any reason, request an Return Material Authorization (RMA) through the Bird Technologies website. All instruments returned must be shipped prepaid and to the attention of the RMA number.

Bird Service Center
30303 Aurora Road
Cleveland (Solon), Ohio 44139-2794
Fax: (440) 248-5426
E-mail: *bsc@birdrf.com*

For the location of the Sales Office nearest you, visit our Web site at:

http://www.birdrf.com

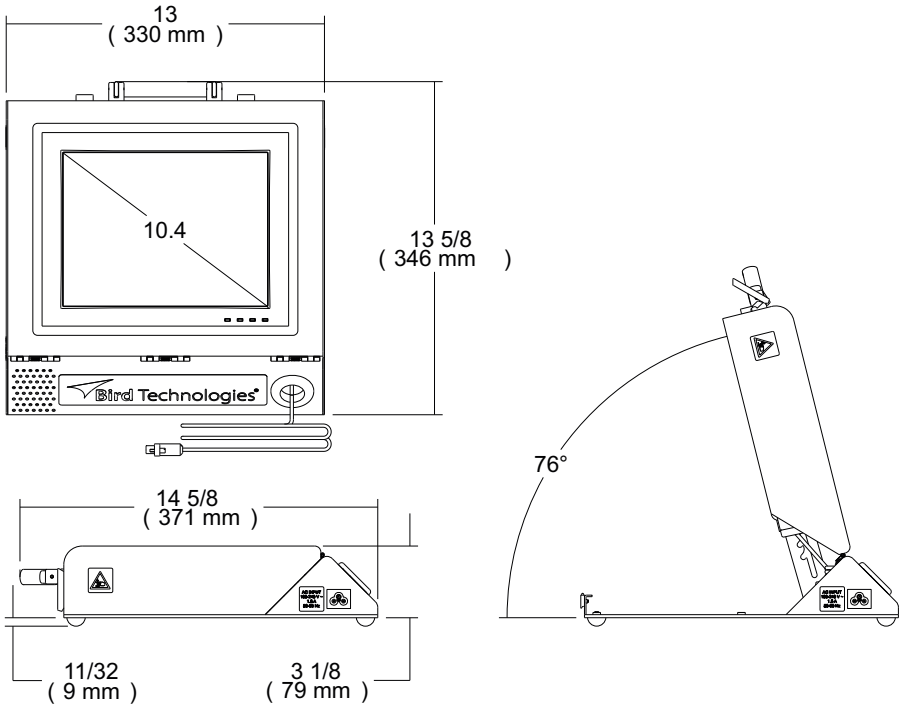
Bird 4422 Power Meter Specifications

Compatible Bird Power Sensors	5012, 5014, 5015, 5016, 5017, 5018, 5019, 7020, 7022, 7023, 4021, 4022, 4023, 4024, 4025, 4027, 4028†
Sensor Detection	Automatic Sensor detection opens appropriate display for each sensor type.
Multiple sensor support	Enable individual windows for each sensor connected.
Connection to sensor	Wired
Data Logging	From VPM3
Display	
Type	10.4" TFT LCD (LED back light)
Resolution	800x600
View ability	Indoor Viewable
Touch Screen	Five wire resistive
Languages	English, Chinese, Spanish
Calibration interval	Not required
Operating System	Windows 7 Embedded
I/O Connectors COM Ports RS-232/422/485 RS-232 USB 2.0 Gigabit Ethernet VGA Port DIO Port	 4 1 3 4 2 1 1
Environment	
Operating Temperature Open Chassis Closed Chassis	 0° to 50° C (32° to 122° F) 0° to 45° C (32° to 113° F)
Storage Temperature	-20° to 60° C (-4° to 140° F)
Relative Humidity	10 to 95% at 40° C (Non-Condensing)
Altitude, max	15,000 ft (4500 m)
Shock	10 G Peak acceleration (11 ms duration)
Vibration	5 to 500 Hz, 1 G RMS
IP Grade	IP65 (LCD panel only)
Cooling	Fanless/Passive

AC/DC Power Supply	
Input Voltage	100 - 240 VAC, 50 - 60 Hz, 1.5 A
Power Consumption	25 W
Physical Characteristics	
Dimensions, nominal: Open Stowed	 14 5/8 in. x 13 5/8 in. x 13 in.(371 mm x 346 mm x 330 mm) 14 5/8 in. x 3 1/8 in. x 13 in.(371 mm x 79 mm x 330 mm)
Weight, max	11.1 lbs (5035 g)
Clean Room Rating	Class 100 / ISO 5
Certifications	EMC Directive 2004/108/EC - Industrial Environment: (EN 55011, EN 61000-6-4, EN 61000-6-2, EN 55022, EN 55024) EMC Directive 2004/108/EC - Residential, Commercial & Light-industrial Environments: (EN 55011, EN 61000-6-3, EN 61000-6-1, EN 55022, EN 55024) FCC Part 15 Class B IC ICES-003 RoHS2 per Directive 2011/65/EU

†. All 402x series Precision Power Sensors require the use of the 4421B540-2 Sensor Interface Module.

Bird 4422 Power Meter Dimensions



Replacement Parts

Description	Qty	Part Number
Cable, USB	1	5A2653-6L
AC Power Supply	1	5A2976-10-1
AC Power Cord	1	5A2976-10-2

Optional Accessories

Description	Part Number
Sensor Interface Module (Converts 402x Power Sensor I/O to USB)	4421B540-2

Limited Warranty

All products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one (1) year, unless otherwise specified, from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation charges prepaid by Buyer). In the event any of our products are proved to be other than as warranted, transportation costs (cheapest way) to and from Seller's plant, will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing within ten days from the date of discovery of the defect.

The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications. Routine (regularly required) calibration is not covered under this limited warranty. In addition, Seller's warranties do not extend to the failure of tubes, transistors, fuses and batteries, or to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to Seller.

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