



MULTI-SENSOR
CAL CART
SYSTEM

OPERATION MANUAL

WARNING

**This unit requires the supplied vent plug be installed prior to use.
Operating the unit without the vent plug installed WILL result in equipment damage and may
cause personal injury.**

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

Shock Hazard

Do not attempt to remove the RF transmission line while RF power is present. Capacitors can store a dangerous electrical charge. Avoid contact with all system capacitors. If it is necessary to perform work near a system capacitor, be sure to discharge the capacitor through a low resistance.

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

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

CAUTION

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



The caution symbol appears on the equipment indicating there is important information in the instruction manual regarding that particular area.

NOTE

Notes call attention to supplemental information.

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

Potential Fire Hazard

Do not regularly exchange the power sensors installed in this Cal-Cart. Frequent interchange of power sensors can lead to cable / connector interface stresses that may impact the integrity of the cable outer conductor, resulting in points of high current density in the cable outer conductor. When this condition occurs, failure of the interconnecting RF cable is likely due to heating.

On pages 2, 6, and 18

WARNING

Refer to the supplied load manual for load-specific warnings and cautions.

On pages 3 and 6.

WARNING

The Cal Carts weigh 290 lbs. (132 kg), do not attempt to lift alone. Two or more people, or mechanical assistance, are required to lift the load. Injury may result from lifting alone.

On page 4.

WARNING

The vent plug must be used at all times when the unit is in operation or cooling. Always check to ensure vent plug is installed prior to operation. Failure to do so WILL result in damage to the equipment and endanger the operator's safety.

On page 4, 6 and 21.

WARNING

Outlets must match the supplied AC plug, never modify the plug in any way. Do not use any adapter plugs with grounded components. If the plug will not fit the outlet, have a proper outlet installed and grounded by a qualified electrician in accordance with all codes and ordinances. Standardized, grounded plugs and outlets will reduce risk of electric shock.

On page 5.

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

On pages 5, 6, 13, and 18.

WARNING

RF Safety Cover provides protection against RF power. Do not defeat this safety device.

On page 5.

WARNING

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

On pages 13 15 16 17 and 18.

WARNING

Care should be used when handling the RF cable and connector. DO NOT pull, pry, or tug on the RF cable or connector. Otherwise, damage may occur to the cable housing and may cause a fire.

On page 20

WARNING

The load is heavy, do not attempt to lift alone. Two or more people, or mechanical assistance, are required to lift the load. Injury may result from lifting alone.

On page 20.

Caution Statements

The following equipment cautions appear in the text whenever the equipment is in danger of damage and are repeated here for emphasis.

CAUTION

Changing the sensor's connectors will invalidate calibration data, and may reduce the maximum power rating of the unit.

On pages 2, 5, 18, 25, 26, and 28.

CAUTION

Do not attempt to lift the cart by the handle.

On pages 4.

CAUTION

Do not block airflow around the load. The air intake vent on the bottom of the load must not be obstructed.

On pages 5,6.

CAUTION

Maximum power dissipation is severely reduced when the blower is not running. If the indicator light should turn off, immediately reduce RF power by 75%.

On pages 6 and 7.

CAUTION

The Bird 4421A contains no user-serviceable parts. Do not remove its cover.

On pages 13.

CAUTION

Due to the complexity of the Bird Power Sensor, field repairs beyond general maintenance should not be attempted. Removal or disturbance of the power sensor cover can result in cancellation of lifetime warranty.

On pages 13 and 18.

CAUTION

Failure to install the properly rated fuses may result in equipment damage.

On pages 16.

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 HACERLO.

WARTUNG

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

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

ENTRETIEN

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 EFFETTUARE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

About This Manual

This manual covers the operating & maintenance instructions for models with part numbers beginning with:

MSCC7	X	XX	XX	XX	XX	X	
	Meter	Sensor 1	Sensor 2	Load	Connector 1	Connector 2	Voltage
2) 4421A802-3	Meter, Serial	01) 4027A10M 02) 4027A250K 03) 4027A400K 04) 4027A800K 05) 4027A2M 06) 4027A4M 07) 4027A12M 08) 4027A25M 11) 4021 13) 4024 14) 4025 17) 4027F10M 18) 4027F2M	10-15 MHz 250-400 kHz 400-550 kHz 800-950kHz 1.5 - 2.5 MHz 3 - 5 MHz 10-15MHz 25-30MHz 1.8-32 MHz 1.5-32 MHz 0.1-2.5 MHz 13.56MHz 1.8-2.2MHz	01) 8921A100 5 kW Load 02) 8931A400-115 10 kW Load, 115V 03) 8931A400-230 10 kW Load, 230V	01) 4240-062 N, Female 02) 4240-344 IEC 7/16, Female 03) 4240-031 LC, Female 04) 4240-268 HN, Female 05) 4240-371 TRU-6934, Female 06) 4240-372 TRU-7958, Female 07) 4240-063 N, Male 08) 4240-025 LC, Male 09) 4240-363 7/16, Male 10) 4240-373 TRU8027SNT 11) 4240-100 C, Female 12) 4240-278 HN, Male	1) 115V N. America 2) 230V N. America 3) 115V INTL 4) 230V INTL	

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 Cal Cart, lists equipment supplied and optional equipment, and provides power-up instructions.

Setup — Describes the power supply and connection instructions.

Operating Instructions — Describes the base level operation instructions.

4421A Instructions — All instructions necessary to operate the 4421A Power Meter in conjunction with the Bird Semiconductor Cal Cart.

Maintenance — Lists routine maintenance tasks as well as troubleshooting for common problems. Specifications and parts information are also included.

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The Bird Cal Cart is designed for immediate, effortless use. It has three primary components. The Bird 4421A RF Power Meter displays radio frequency (RF) power. Bird 4020, 4027A, and 4027F Series Power Sensors are highly accurate sensors that measure RF power without requiring calibration or external couplers or attenuators. Bird Loads are low reflection 50 Ω terminations that can dissipate 5 kW to 10 kW max., depending on the model. These components are installed on a cart for easy transportation, and connected so that the only setup required is connecting AC and RF power. The cart is suitable for use in a cleanroom environment, and is equipped with four swivel casters for maximum maneuverability.

Items Supplied

Stainless Steel Cart with the following items installed:

- Bird 4421A RF Power Meter
- Two (2) Bird 4020, 4027A, or 4027F Series Sensors
- Bird Load with Shipping and Vent Plugs
- Cabling
- Instruction Manual

RF Power Meter

The Bird 4421A RF Power Meter measures forward and reflected RF power when used in conjunction with a Bird power sensor. Measurements can be made in units of either Watts or dBm. Because of the precision of the attached load, reflected power will be negligible and can usually be ignored.

Power Sensor

Sensors are available with a variety of connectors. Since the accuracy is critically dependent on the connectors used at calibration, do not remove or change the connectors. Sensors are controlled by the Bird 4421A Power Meter.

WARNING

Potential Fire Hazard

Do not regularly exchange the power sensors installed in this Cal-Cart. Frequent interchange of power sensors can lead to cable / connector interface stresses that may impact the integrity of the cable outer conductor, resulting in points of high current density in the cable outer conductor. When this condition occurs, failure of the interconnecting RF cable is likely due to heating.



CAUTION

Changing the sensor's connectors will invalidate calibration data, and may reduce the maximum power rating of the unit.

4020 Series

Bird 4020 Series Power Sensors are designed for lab or field use and are accurate to within $\pm 3\%$ of reading.

4027A Series

Bird 4027A Series Power Sensors are designed for use in semiconductor processing and calibration applications. Stringent calibration provides long-term unit-to-unit repeatability, allowing consistent amounts of RF energy to be applied to the etch process over many etch cycles. 4027A Sensors are accurate to $\pm 1\%$ at specified calibration frequencies and power levels.

4027F Series

Bird 4027F Series Power Sensors are similar to the 4027A series. However, additional filtering allows the 4027F to ignore harmonics of the signal being measured. The 4027F is also less sensitive to AM components of the signal. 4027F Sensors are accurate to $\pm 1\%$ at specified calibration frequencies and power levels.

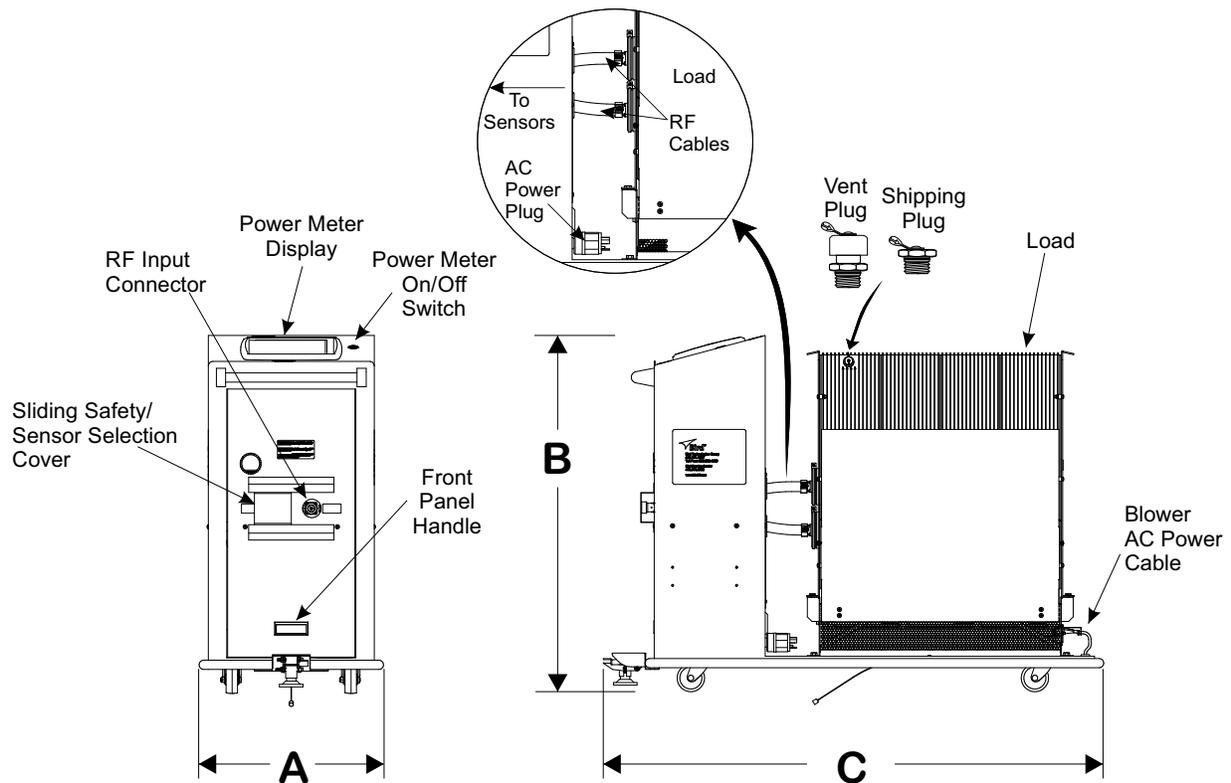
Load

Bird loads are available in power ranges from 5 – 10 kW. The loads have a coolant chamber surrounded by radiator fins. The front and rear fins form mounting flanges which are used as brackets for mounting the load on the Cal Cart. Vent plug(s) at the top of the load relieve internal pressure from coolant expansion. For further information, refer to the load manual included.

WARNING

Refer to the supplied load manual for load-specific warnings and cautions.

Figure 1 Cal Cart Outline Drawing



DIM. A	DIM. B	DIM. C
20" (508 mm)	39" (990 mm)	55" (1397 mm)

Unpacking and Inspection

WARNING

The Cal Cart weighs 290 lbs. (132 kg), do not attempt to lift alone. Two or more people, or mechanical assistance, are required to lift the Cal Cart.
Injury may result from lifting alone.

CAUTION

Do not attempt to lift the cart by the handle.

1. Carefully inspect shipping container for signs of damage.
 - If the shipping container is damaged, do not unpack the unit. Immediately notify the shipping carrier and Bird Technologies.
 - If the shipping container is not damaged, unpack the unit. Save shipping materials for repackaging.
2. Inspect unit for visual signs of damage.

NOTE

If there is damage, immediately notify the shipping carrier and Bird Technologies.

Initial Setup

Initial Setup consists of installing the vent plug in the load. The vent plug must be installed prior to using the Cal Cart.

WARNING

**The vent plug must be used at all times when the unit is in operation or cooling.
Always check to ensure vent plug is installed prior to operation.**

Failure to do so WILL result in damage to the equipment and endanger the operator's safety.

1. Locate the vent hole for the plug, located on the top of the load near the front. See [Figure 1 on page 3](#).
2. Remove the shipping plug.
3. Verify the O-Ring is installed on the vent plug.
4. Install the vent plug.

RF and Electrical Connections

CAUTION

Do not block airflow around the load. The air intake vent on the bottom of the load must not be obstructed.

- Use the Bird Cal Cart in a dry, dust and vibration free environment. Do not use outdoors or in areas of condensing humidity. Allow at least 12" (30 cm) of clearance around the load.

WARNING

Outlets must match the supplied AC plug, never modify the plug in any way. Do not use any adapter plugs with grounded components. If the plug will not fit the outlet, have a proper outlet installed and grounded by a qualified electrician in accordance with all codes and ordinances. Standardized, grounded plugs and outlets reduce risk of electric shock, serious injury, or death.

- The Cal Cart requires 115/230 V @ 50/60 Hz, up to 490 W, depending on the Cal Cart's configuration.
1. Connect the Cal Cart's AC Power plug to facility power.

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

WARNING

**RF Safety Cover provides protection against RF power.
Do not defeat this safety device.**

CAUTION

Changing the sensor's connectors will invalidate calibration data, and may reduce the maximum power rating of the unit.

NOTE

To connect the Cal Cart to the RF source, use 50 ohm coaxial cable suitable for the frequency and power level of operation. Use a connector which will mate with the Cal Cart's exposed RF connector.

2. Slide the safety cover to expose the desired sensor connector.
3. Using a 50 ohm coaxial cable with the appropriate mating connector, connect the RF Source to the Cal Cart's RF input connector.

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

WARNING

Refer to the supplied load manual for load-specific warnings and cautions.

CAUTION

Do not block airflow around the load. The air intake vent on the bottom of the load must not be obstructed.

Use the Bird Cal Cart in a dry, dust and vibration free environment. Do not use outdoors or in areas of condensing humidity. Allow at least 12" (30 cm) of clearance around the load.

Normal Operation

WARNING

The vent plug must be used at all times when the unit is in operation or cooling.
Always check to ensure vent plug is installed prior to operation.
Failure to do so WILL result in damage to the equipment and endanger the operator's safety.

WARNING**Potential Fire Hazard**

Do not regularly exchange the power sensors installed in this Cal-Cart. Frequent interchange of power sensors can lead to cable / connector interface stresses that may impact the integrity of the cable outer conductor, resulting in points of high current density in the cable outer conductor. When this condition occurs, failure of the interconnecting RF cable is likely due to heating.

Prior to operating the Cal Cart perform ["Initial Setup" on page 4](#) and ["RF and Electrical Connections" on page 5](#).

1. Press the ON/OFF button next to the power meter display.

Step 2 is only for loads equipped with blower units.

CAUTION

Maximum power dissipation is severely reduced when the blower is not running. If the indicator light should turn off, immediately reduce RF power by 75%.

2. If the load is equipped with a blower unit, verify that the "AC ON" indicator light is illuminated.
 - a. Set the blower switch to MANUAL.
3. Apply RF power.
4. Make measurements.

NOTE

See ["4421A User Interface" on page 8](#) for specific instructions on controlling the meter.

Operation Under Abnormal Conditions

CAUTION

Maximum power dissipation is severely reduced when the blower is not running. If the “AC ON” indicator light should turn off, immediately reduce RF power by 75%.

If the “AC ON” indicator light turns off or the blower unit stops unexpectedly, immediately turn off RF power or reduce RF power by 75%. Refer to the troubleshooting section of the load manual to correct the problem.

Shutdown

1. Turn off RF power at the source.
2. Press the ON/OFF button next to the power meter display.

NOTE

For blower-equipped loads, wait approximately 15 minutes or for the fans to stop running. This will allow the load to cool without causing heat stress.

3. For blower equipped units, wait 15 minutes after removing RF power.
4. Disconnect the AC line.

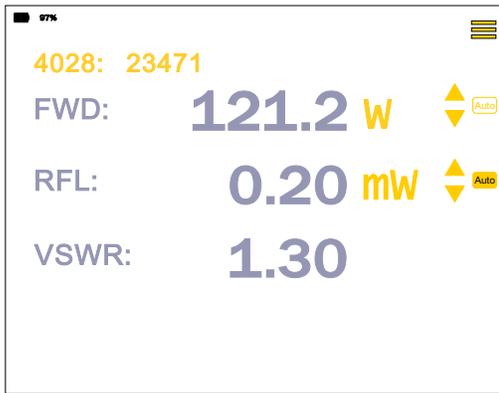
The 4421A displays the measurement information from the Cal Cart's sensor. See [Figure 2](#).

The display may be configured to display the following measurements from a sensor:

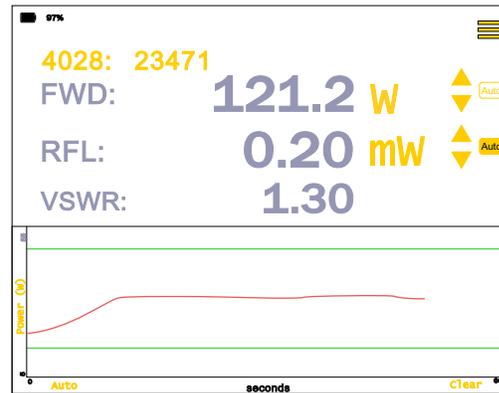
- Forward Power
- Reflected Power
- VSWR
- Return Loss
- Reflection Coefficient

These measurements may also be displayed graphically.

Figure 2 *Sensor Measurements Display*



Measurement Display

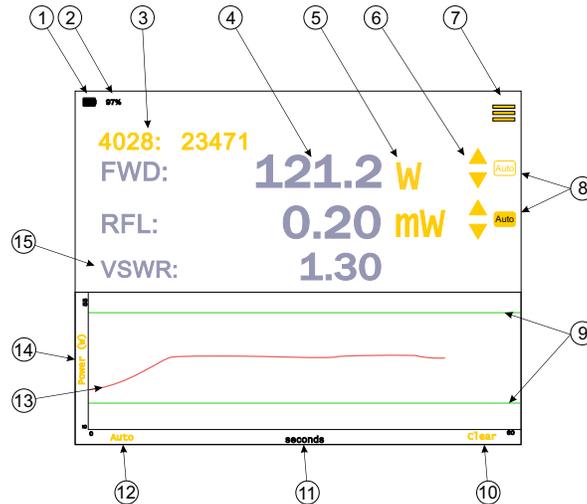


Measurement Display with Graph

Display Controls and Indicators

The display is used for presenting information and controlling the behavior of the 4421A. The controls are those items displayed on the screen, that, when tapped cause a change in the 4421A's behavior. Controls can be identified by their color, on screen controls are yellow. The table in [Figure 3](#) describes the on screen controls and indicators.

Figure 3 Display Controls



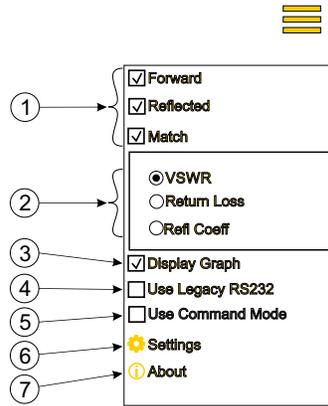
Item	Indicator	Description
1	Battery/AC Power indicator	<p>When connected to AC power, and battery is below 100%, the charge indicator is displayed.</p> <p>When connected to AC power and battery is fully charged, a facsimile of an AC Power Plug is displayed.</p> <p>When on battery power, the charge level of the battery in displayed.</p>
2	Battery Remaining	Indicates the remaining charge of the internal battery.
3	Sensor model/SN	<p>Displays Connecting... for several seconds after initially connecting a sensor. The sensor model number and serial number are displayed above the sensor's measurement data. When tapped, opens a sensor information window.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p style="text-align: center;">Sensor 1 Information:</p> <p>Model: 4027A25M Firmware Revision: 9/17/93 Serial Number: 11989 Max Power: 9000.00 W Min Power: 3.00 W</p> <p style="text-align: right;">← OK</p> </div>
4	Forward and Reflected Power	<p>The sensor readings for Forward and Reflected power may be displayed in milliwatts, Watts, Kilowatts, or dBm.</p> <p>In overrange situations, the 4421A will display the word "RANGE" in place of the actual power reading.</p> <p>When Reflected power measurement is dBm, -inf dBm means the reflected power was 0 W (exactly).</p>
5	Measurement Unit	The 4421A will display the signal measurements in Watts or dBm .

6	Manual Range Controls	<p>Up and Down arrows are used to change the scale of the displayed power readings.</p> <div style="text-align: center;"> </div> <p>Note: Stops automatic scaling. Auto indicator (item 8) turns off.</p> <p>Note: Manual Range not available when measurement unit is dBm.</p>
7	Settings Menu	<p>The settings menu is used to configure what measurement information is displayed, and to configure LAN and Serial Port settings. See "Settings Menu" on page 11.</p>
8	Auto Range	<p>Auto - When button is on, indicates range scale is set to auto.</p> <p>Auto - When button is off, indicates range scale is in manual control, see item 6.</p> <p>Note: Auto Range not available when measurement unit is dBm.</p>
9	Limit Lines	<p>Min and max limit lines (green horizontal lines) may be set to display in the graph's display area.</p> <p>The position of the two lines are set in the "Graph Settings Menu" on page 12.</p>
10	Clear	<p>Tapping Clear discards the graph's accumulated data and resets time scale to 60 seconds.</p>
11	Time Scale	<p>The graph's time scale auto expands as data accumulates with the following scales:</p> <ul style="list-style-type: none"> • 60, 120, 240, 480 seconds • 15, 30, 60, 120, 240 minutes • 8, 16, 24 hours <p>Data accumulation stops at 24 hours.</p> <p>When graph is turned off then back on the accumulated data is discarded and time scale resets to 60 second span.</p>
12	Auto	<p>Tap Auto to adjust the graph's power scale to fit accumulated data.</p>
13	Measurement Trace	<p>Forward Power is plotted on the graph in watts on the vertical axis (y) versus time in the horizontal axis (x). The trace is displayed as a red line.</p> <p>The graph accumulates data at 1 sample/sec as long as a sensor is connected.</p> <ul style="list-style-type: none"> • If no sensor is connected, accumulation pauses until a sensor is connected. • The graph does not account for any gap while a sensor is disconnected. That is accumulation will resume as if only 1 second has elapsed since the last sample. • The graph does not account for mixing sensors (i.e. switching sensors in the middle of accumulation). • Plotted data is either raw data or averaged data. Mode is set in the "Graph Settings Menu" on page 12
14	Power	<p>Power scale defaults to the min/max power specification for a connected sensor. The measurement unit will match that selected by the measurement unit selection (see item 5).</p> <ul style="list-style-type: none"> • Power scale may be adjusted automatically (see item 12, Auto) or via the Graph Settings Menu. • Tap to open power dialog.
15	VSWR / Return Loss/ Reflection Coefficient	<p>This line on the display can be set to display one of three measurements: VSWR, Return Loss, or Reflection Coefficient.</p> <p>The Settings Menu is used to select which measurement is displayed.</p> <p>+inf will be displayed if Reflected power = Forward power (an uncommon scenario, but could occur with an open circuit).</p>

Settings Menu

The setting menu is used to select what information will appear on the 4421A's display as well as configuration of the LAN and Serial Ports. [Figure 4](#) describes the options available via the setting menu.

Figure 4 Settings Menu

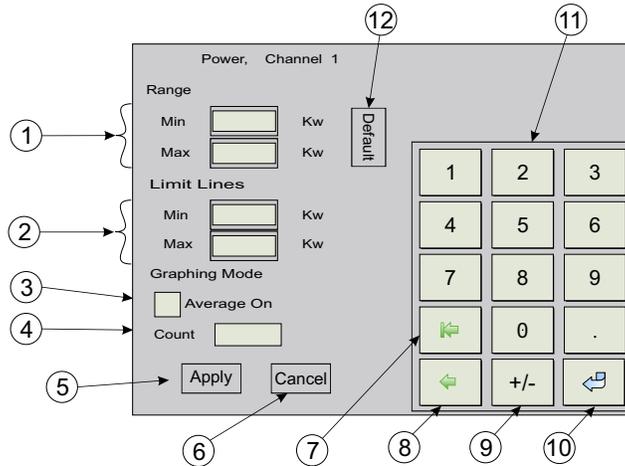


Item	Title	Description
1	Measurements	Check boxes used to select which measurements are displayed for the attached sensor(s).
2	Match Format	Radio buttons used to select the format for the match measurement.
3	Display Graph	When check box is selected, a graph is displayed on the screen with the associated measurements.
4	Use Legacy RS232	This is typically not used for Cal Cart operation.
5	Use Command Mode	This is typically not used for Cal Cart operation.
6	Settings Icon	When tapped, a menu is displayed for selecting the LAN or Serial configuration menus. <ul style="list-style-type: none"> When LAN is tapped, the 4421A's IP address configuration menu is displayed. This menu is typically not used for Cal Cart operation. When Serial is tapped, the 4421A's serial port settings dialog box is displayed. This menu is typically not used for Cal Cart operation.
7	About	Displays the units Model Number, Serial Number, and Firmware ID. Compliance and software licensing information may also be viewed from the About menu.

Graph Settings Menu

The Graph Settings menu is accessed by tapping the power scale on the graph. [Figure 5](#) describes the options in the Graph Settings menu.

Figure 5 Graph Settings Menu



Item	Title	Description
1	Range	Text entry boxes for the entry of Min and Max range for the Power Scale on the Graph. Min and Max values specify the upper and lower limit of the power scale of the graph.
2	Limit Lines	Text entry boxes for the entry of Min and Max value for the limit lines displayed on the Graph. Two horizontal limit lines may be set to user specified levels on the power scale. The Min value sets the location of the lower limit line, while the Max value sets the location of the upper limit line.
3	Average On, Graphing Mode	Graphing Mode allows the measurement results to be displayed either raw or averaged. When Average On is checked, each point plotted on the graph is the arithmetic mean of several raw graph samples.
4	Count, Graphing Mode	Numeric entry for specifying the number of samples used for the moving average. Applied when Average On is selected.
5	Apply	When tapped, applies all menu changes and closes the dialog box.
6	Cancel	When tapped, cancels all menu changes and closes the dialog box.
7	Clear Text	When tapped, clears all characters in a selected text box.
8	Backspace	When tapped, while entering a new value in a text box, deletes the character at the end of the entry. Deletes entire value when highlighted.
9	Plus/Minus	If power on power graph is in dBm units, it can be used to make power values on the power graph positive or negative. If power units on the graph is W, kW, or mW, this button is disabled.
10	Enter	Advances cursor to next text entry box without effecting entered values.
11	Keypad	Numerical keypad used to enter values into the varies text boxes within the dialog box.
12	Default	When tapped, sets all text entry boxes in the dialog box to Default values.

This chapter describes routine maintenance, along with troubleshooting instructions for the power meter and power sensor. Disassembly instructions for the Bird Cal Cart are also provided. For service beyond this level, 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, including fuse replacement.

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

CAUTION

The Bird 4421A contains no user-serviceable parts. Do not open the cover.

Troubleshooting

The power meter and power sensor only work when connected together.

1. Verify the cable is connected between the power sensor and the power meter.
2. Determine which is malfunctioning.
 - a. If the power meter is malfunctioning, refer to the troubleshooting table below.
 - b. If the power sensor is malfunctioning, return it for service.

CAUTION

Due to the complexity of the Bird Power Sensor, field repairs beyond general maintenance should not be attempted. Removal or disturbance of the power sensor cover can invalidate the lifetime warranty.

This manual cannot list all malfunctions that may occur, or corrective actions. If a malfunction is not listed or is not corrected by the listed corrective actions, contact a qualified service center.

NOTE

For all power sensor tests, following the test procedure will check the sensor not covered by the safety cover. To test the other sensor slide the safety cover over, then proceed as normal.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Power meter has no power	The power meter's AC power cord is not connected to the terminal strip	Connect the power cord
	The Cal Cart's AC power cord is not connected to the AC line.	Connect AC power.
	The ON/OFF switch is set to OFF.	Set the switch to ON.
	The power meter fuse is blown. Note: unplug the Cal Cart to check fuse.	Replace fuses. See " Replace the Power Meter Fuses " on page 16 .
Display blank or not updating	The meter is defective.	Return meter for service.

Routine Maintenance

The Bird Cal Cart and 4421A Power Meter require only simple, routine maintenance.

- Wipe off dust and dirt regularly.
- Inspect the connectors and cables for damage.
- Clean the RF connector contacts with alcohol or dry cleaning solvent.
- Clean the load cooling fins.

NOTE

Excessive dust on the cooling fins will interfere with heat dissipation.

- For Blower equipped Cal Carts, the blower intake grills, fans, and inside of the baffles should be wiped free of dust and dirt when necessary. Refer to the loads manual for cleaning instructions.
- Inspect the load, at least, every six months.
 - a. Check for coolant leakage around the clamping band.
 - b. Check for coolant leakage around the thermoswitch, if installed.
 - c. Check for corrosion.

Load Coolant Inspection

Coolant lifetime will vary greatly depending on the operating temperature. Inspect the coolant in accordance with the following guidelines:

- **Heavy Use (full RF power for long times, high ambient temperature, 50 Hz AC supply):**
Inspect the coolant every 500 hours.
- **Light Use (fraction of full power, low ambient temperature, 60 Hz AC supply):**
Inspect coolant every 2,000 hours.

Refer to the loads manual for coolant inspection instructions.

Repairing the Cal Cart

WARNING

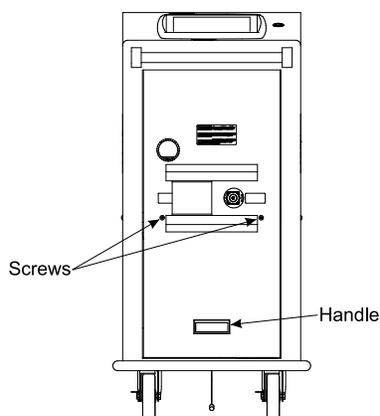
To avoid personal injury, disconnect the power cord from the AC line before performing any maintenance, including fuse replacement.

Remove Cal Cart Front Panel

To access the power sensor or the AC connections, it will be necessary to remove the front panel of the Cal Cart.

1. Remove two screws on the front panel, see [Figure 6](#).

Figure 6 *Front Panel*



2. Pull on the handle set into the base of the front panel.
3. Remove the front panel.

Install Cal Cart Front Panel

1. Position the front panel in the open at the front of the Cal Cart. See [Figure 6](#).
2. Install two screws to secure the front panel to the Cal Cart.

Replace the Power Meter Fuses

WARNING

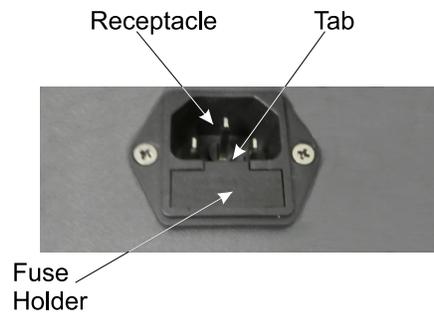
To avoid personal injury, disconnect the power cord from the AC line before performing any maintenance, including fuse replacement.

CAUTION

Failure to install the properly rated fuses may result in equipment damage.

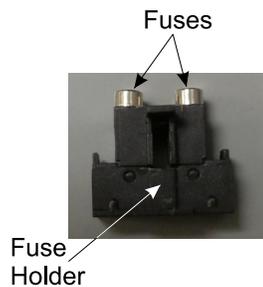
1. Remove the Cal Cart's front panel. See "[Remove Cal Cart Front Panel](#)" on page 15.
2. Disconnect the AC power Cable from the receptacle on the left side of the 4421A Power Meter. See [Figure 7](#).
3. Gently pry on the fuse holder tab and pull the fuse holder out of the AC receptacle.

Figure 7 4421A AC Power Receptacle



4. Pull the two fuses out of the fuse holder. See [Figure 8](#).
5. Insert two new fuses into the fuse holder.

Figure 8 AC Line Fuses



Fuse Rating
FUSE,SLO-BLO,5x20mm, 1 AMP TYPE T

6. With fuse holder tab facing up ([Figure 7](#)), press fuse holder into the 4421A AC receptacle until fully seated.
7. Connect the AC power Cable to the receptacle on the left side of the 4421A Power Meter.
8. Install the Cal Cart's front panel. See "[Install Cal Cart Front Panel](#)" on page 15

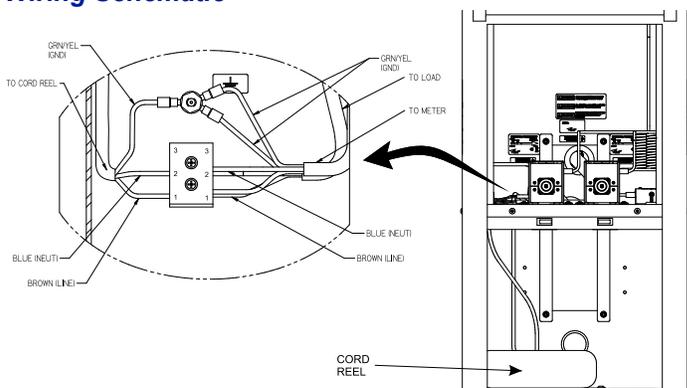
Replace Cord Reel

WARNING

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

1. Remove the Cal Cart's front panel. See "[Remove Cal Cart Front Panel](#)" on page 15.
2. Disconnect the cord reel wire from the terminal strip and the ground stud. See [Figure 9](#).
3. Unscrew the AC connector.
4. Unscrew and remove the cord reel.
5. Screw the replacement cord reel into place.
6. Thread the wire through the grommet for the AC Connector.
7. Connect the AC connector.
8. Crimp a ring terminal to the green/yellow wire.
9. Connect the ring terminal to the ground stud. See [Figure 9](#).
10. Connect the remaining wires on the terminal strip.
11. Install the Cal Cart's front panel. See "[Install Cal Cart Front Panel](#)" on page 15.

Figure 9 Cal Cart Wiring Schematic



Replace Power Sensor

Replacement of the power sensor is only recommended when replacing failed or malfunctioning units. Power Sensors should not be changed as a regular operational activity.

WARNING

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

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

WARNING

Potential Fire Hazard

Do not regularly exchange the power sensors installed in this Cal-Cart. Frequent interchange of power sensors can lead to cable / connector interface stresses that may impact the integrity of the cable outer conductor, resulting in points of high current density in the cable outer conductor. When this condition occurs, failure of the interconnecting RF cable is likely due to heating.

CAUTION



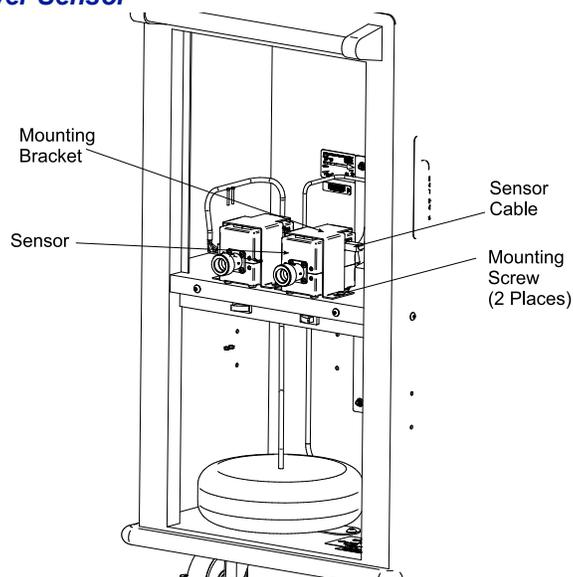
Changing the sensor's connectors will invalidate calibration data, and may reduce the maximum power rating of the unit.

CAUTION

Due to the complexity of the Bird Power Sensor, field repairs beyond general maintenance should not be attempted. Removal or disturbance of the power sensor cover can result in cancellation of lifetime warranty.

Remove the Power Sensor

1. Disconnect the RF line from the Cal Cart.
2. Disconnect AC power line.
3. Disconnect the RF line from the Cal Cart.
4. Remove the Cal Cart front panel (see ["Remove Cal Cart Front Panel" on page 15](#)).
5. Disconnect the sensor data cable from the power sensor.
6. Disconnect the RF cable from the sensor output port.
7. Remove the screws on the sensor mounting bracket.
8. Remove the sensor from the mounting bracket.

Figure 10 Replacing Power Sensor**Install the Power Sensor**

1. Put the new sensor in the bracket and screw it into place.
2. Ensure the arrow on the side of the sensor points towards the load, and that the end labeled "SOURCE" points towards the front of the Cal Cart.
3. Connect the RF cable to the sensor end labeled "LOAD".
4. Connect the sensor cable.
5. Install the Cal Cart's front panel. See "[Install Cal Cart Front Panel](#)" on page 15.

Remove Load

WARNING

Care should be used when handling the RF cable and connector. **DO NOT** pull, pry, or tug on the RF cable or connector. Otherwise, damage may occur to the cable housing and may cause a fire.

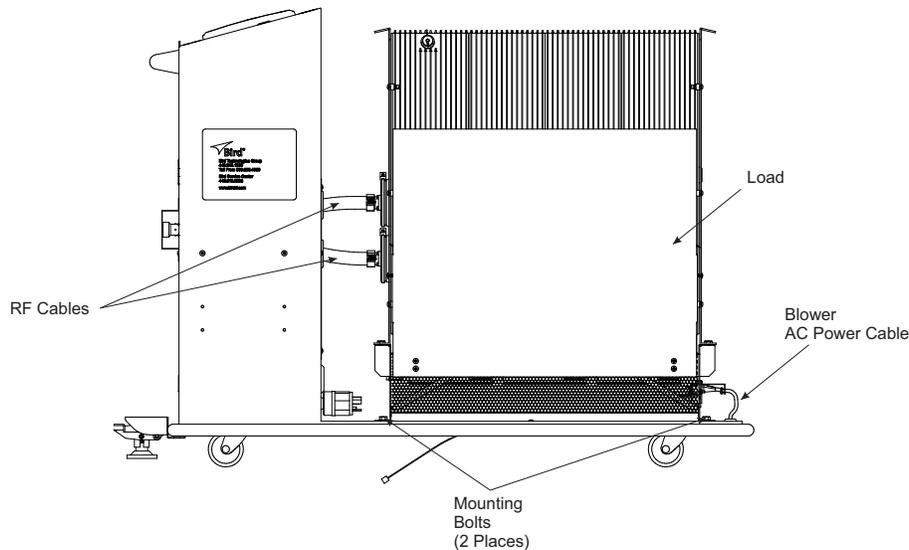
1. Disconnect the RF cables from the RF connectors on the load.
2. On blower-equipped loads, unplug the blower assembly.
3. Remove the vent plug.
4. Verify the O-Ring is installed on the shipping plug.
5. Install the shipping plug.
6. Remove the mounting bolts connecting the load to the Cal Cart.

WARNING

The load is heavy, do not attempt to lift alone. Two or more people, or mechanical assistance, are required to lift the load. Injury may result from lifting alone.

7. Remove the load.

Figure 11 Removing the Load



Install the Load

WARNING

The load is heavy, do not attempt to lift alone. Two or more people, or mechanical assistance, are required to lift the load. Injury may result from lifting alone.

1. Position the load on the Cal Cart with the RF Connectors facing the front of the cart. See [Figure 11 on page 20](#).
2. Install the mounting bolts to secure the load to the Cal Cart.
3. Connect the RF cables to the RF Connectors on the load.

WARNING

The vent plug must be used at all times when the unit is in operation or cooling.

Always check to ensure vent plug is installed prior to operation.

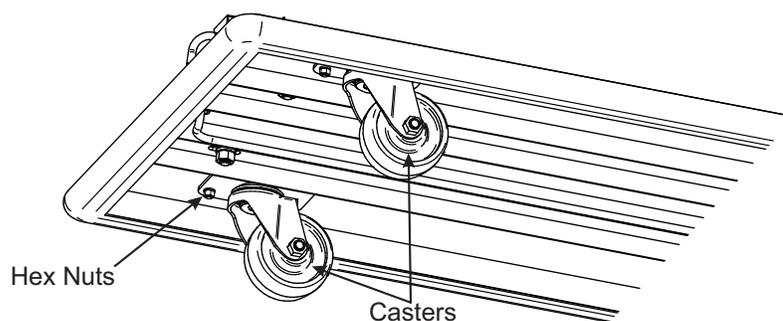
Failure to do so WILL result in damage to the equipment and endanger the operator's safety.

4. Remove the shipping plug.
5. Verify the O-Ring is installed on the vent plug.
6. Install the vent plug.
7. Plug AC power cable into the blower assembly.

Replace Casters

1. Remove the load (See "[Remove Load](#)" on page 20).
2. Flip the cart over.
3. Remove four hex nuts and screws securing the defective caster.
4. Install the new caster securing it in place with the four hex nuts and screws.
5. Flip the cart over onto its casters.
6. Install the load. See "[Install the Load](#)" on page 20.

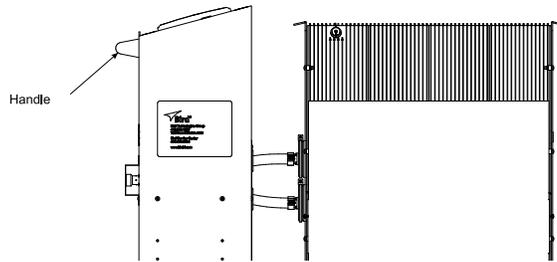
Figure 12 Removing Casters



Replace Handle

1. Remove the Cal Cart front panel. See ["Remove Cal Cart Front Panel" on page 15.](#)
2. Unscrew and remove the old handle.
3. Screw the new handle into place.
4. Install the Cal Cart's front panel. See ["Install Cal Cart Front Panel" on page 15.](#)

Figure 13 *Handle Replacement*



Storage and Shipment

Storing the Cal Cart

- Cover the unit before storing to keep out dust and dirt.

NOTE

It is not necessary to install the shipping plug.

- Store in a dry, dust-free environment where the ambient temperature will remain between -20 and $+70$ °C (-4 to $+158$ °F).

Shipping the Cal Cart

NOTE

Before shipping the Bird Cal Cart, take the following precautions:

The Cal Cart may be shipped with the coolant still in the load; however, do not ship the unit with its coolant if the unit has developed a leak. Drain the coolant first.

1. Remove the vent plug.
2. Verify the O-Ring is installed on the shipping plug.
3. Install the shipping plug.
4. Wrap the vent plugs with padding and tape them to the side of the load for protection.

NOTE

With the shipping plugs installed, it is not necessary to empty out the coolant.

5. Wrap the connector in padding.
6. Pack and brace the load in a sturdy wooden crate for shipment.

NOTE

All instruments returned for service must be shipped prepaid and to the attention of the Customer Service Group. See [Customer Service](#).

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>

Specifications

NOTE

Certain sensors or connectors may be incompatible with some models. For a list of available components, contact Bird Applications Engineering.

Max. Power

Under normal operating conditions, the Cal Cart's maximum power is the MINIMUM of the max. power of the sensor and the max. power of the load. The following modifiers apply:

- Due to the wide variety of available connectors, frequency range and maximum power may be reduced. Insertion loss is specified with female N connectors. Choose connectors appropriate for the frequency and power of operation.
- Derate RF power by 2.5% for every 305m (1,000 ft.) above 1,520m (5,000 ft.).

Bird Cal Cart

Frequency Range	Sensor dependent
Power Range	Dependent on sensor, sensor connectors, and load
Connectors	Customer specified (See " Available Connectors " on page 28)
AC Power	100 - 240 VAC @ 50 / 60 Hz, 490 W
Dimensions	52" L x 20" W x 41" H (1321 x 508 x 1067 mm)
Weight, Nominal	290 lbs. (114 kg)
Temperature Range	
Operating	0 to +35 °C (32 to +95 °F)
Storage	-20 to +70 °C (-4 °F to +158 °F)
Altitude	1520 m (5000 ft.)
Humidity	85% noncondensing max
Calibration Cycle, Nominal	1 year
CE	CE Compliant. Refer to Declaration of Conformity for specific standards.

Bird 4421A RF Power Meter

Frequency Range	Sensor dependent
Power Range	Sensor dependent
VSWR Display	1.0 – 199.9 max
Return Loss Display	0 to 40 dB max
Display	9.7 in TFT full color LCD with touch screen
Interfaces	RS-232, LAN
Fuse Rating	1A, IEC (5 x 20 mm), time-delay
CE	CE Compliant. Refer to Declaration of Conformity for specific standards.
Humidity	95% max. (noncondensing)
Altitude	Up to 15,000 feet (4572 m)
Operating Temperature	0° to 40° C (32° to 104° F)

Storage Temperature	-20 to +70 °C (-4 °F to +158 °F)
Dimensions	10.6 in x 9.7 in x 3.6 in (269 mm x 246 mm x 91 mm)
Weight, Nominal	Less than 5 lb, 2.3 kg

CAUTION

Changing the sensor's connectors will invalidate calibration data, and may reduce the maximum power rating of the unit.

Specifications Common to all Sensors

Impedance, Nominal	50 ohms
Max. Allowable Terminating VSWR	2.00:1
Calibration Technique	Frequency-specific calibration factors stored in nonvolatile memory in each sensor. Sensor output corrected for frequency and temperature within specified ranges.
Accuracy, Reflected	Calculated from FWD accuracy and FWD power $\text{RFL Accuracy} = \text{FWD Accuracy} + \frac{\text{FWD Power}}{10^{\text{Directivity}/10}}$
Accuracy, VSWR	Calculated from FWD and RFL power $\text{VSWR} = \left(1 + \sqrt{\frac{P_R}{P_F}} \right) / \left(1 - \sqrt{\frac{P_R}{P_F}} \right)$
Sampling Rate, Nominal	2 readings/second
Operating Power	Supplied by power meter via sensor cable
Dimensions 4028B10M 4028A Series All other models	6.75" L x 3.5" W x 4.75" H (175 x 89 x 121 mm) 4.7" L x 3.2" W x 3.8" H (120 x 82 x 97 mm) 5.2" L x 2.5" W x 3.25" H (137 x 64 x 83 mm)
Weight, Nominal 4028B10M 4028A2M, 3M, 4M, 10M, & 25M All other models	5 lb. 2 oz. (2.33 kg) 3 lb. 5 oz. (1.5 kg) 1 lb. 13 oz. (0.8 kg)

Bird 4020 Series RF Power Sensors

RF Power Range 4021, 4022 4024, 4025	300 mW – 1 kW 3 W – 10 kW
Frequency Range 4021 4022 4024 4025	1.8 – 32 MHz 25 MHz – 1 GHz 1.5 – 32 MHz 100 kHz – 2.5 MHz
Accuracy, Fwd, Best Case¹	± 3% (1σ)
VSWR, Max. 4021, 4024, 4025 4022	1.05:1 1.05:1, 25 – 512 MHz 1.10:1, 512 MHz – 1 GHz
Insertion Loss, Max. 4021, 4024, 4025 4022	0.05 dB 0.05 dB, 25 – 512 MHz 0.13 dB, 512 MHz – 1 GHz
Directivity, Min. 4021 4022 4024 4025	30 dB 26 dB (28 dB typ), 400 – 1000 MHz 30 dB, 25 – 400 MHz 28 dB, 1.5 – 2.5 and 25 – 32 MHz 30 dB, 2.5 – 25 MHz 28 dB, 100 – 125 kHz 30 dB, 125 – 2500 kHz

1 For rated accuracy, no more than 1% AM; Harmonics –50 dBc or less
Derate accuracy by 3.0% (1σ) below 15 °C and above 35 °C

CAUTION



Changing the sensor's connectors will invalidate calibration data, and may reduce the maximum power rating of the unit.

Bird 4027A Series RF Power Sensors

Frequency Range			
4027A250K	250 – 400 kHz		
4027A400K	400 – 550 kHz		
4027A800K	800 – 950 kHz	4027A12M	10 – 15 MHz
4027A2M	1.5 – 2.5 MHz	4027A25M	25 – 30 MHz
4027A4M	3 – 5 MHz		
4027A10M	10 – 15 MHz		
RF Power Range			
4027A12M	300 mW – 1 kW	All other models	3 W – 10 kW
4027A25M	3 W – 9 kW		

Accuracy, Fwd, Best Case¹	± 1.0% (1σ)		
Calibration Frequencies, Typical (MHz)²			
4027A250K	0.25, 0.40		
4027A400K	0.40		
4027A800K	0.90	4027A12M	10.0, 13.56, 15.0
4027A2M	1.8, 2.0, 2.17	4027A25M	25.76, 27.12, 28.48
4027A4M	4.0, 5.0		
4027A10M	10.0, 13.56, 15.0		
Calibration Power, Typical			
4027A12M	700 W		
All other models	1.7 kW		
VSWR, Max.	1.05:1		
Insertion Loss, Max.	0.05 dB (with female “N” connectors)		
Directivity, Min.			
4027A12M	30 dB		
All other models	28 dB		

1 For rated accuracy, no more than 1% AM; Harmonics –50 dBc or less
Derate accuracy by 1% (1σ) outside cal. power or cal. frequency
Derate accuracy by 1% (1σ) below 15 °C and above 35 °C

2 Other calibration frequencies available upon request

Bird 4027F Series RF Power Sensors

Frequency Range	
4027F2M	1.8 – 2.2 MHz
4027F10M	12 – 15 MHz
RF Power Range	
4027F2M, 4027F10M	0.1 – 10 kW
Accuracy, Fwd, Best Case	± 1.0% (2σ)
Calibration Frequencies, Typical¹	
4027F2M	1.8, 2.0, 2.17 MHz
4027F10M	12.0, 12.5, 13.56, 14.0, 15.0 MHz
Calibration Power, Typical	1.7 kW
Harmonic Rejection, Min.	
4027F2M	26 dB @ 3.6 – 3.8 MHz, 30 dB @ > 3.8 MHz
4027F10M	30 dB @ > 25 MHz
Low Frequency Rejection, Min.	
4027F10M	30 dB @ < 1 MHz
Max Error Induced by 10% AM	
4027F2M, 4027F10M	0.2% @ < 5 kW, 1.0% @ 5 – 10 kW
VSWR, Max.	1.05:1
Insertion Loss, Max.	0.05 dB (with female “N” connectors)
Directivity, Min.	28 dB

1 Other calibration frequencies available upon request

Replacement Parts

Description	Qty	Part Number
Fuse, IEC (5 x 20 mm) Time Lag 1 Amp, Type T	1	5A2257-16
Cord, AC Power, Harmonized	1	5A2416
Plug, 115 VAC	1	5A2626
Cable, Sensor	1	4421-038
Grommet	1	4421A372
Cordreel	1	4421A383
Casters	4	4421A384
Handle	1	4421A385

Available Connectors

CAUTION



Changing the sensor's connectors will invalidate calibration data, and may reduce the maximum power rating of the unit.

Connector	Part Number
HN (F)	4240-268
HN (M)	4240-278
LC (F)	4240-031
N (F)	4240-062
7/16 Jack, IEC Type 169-4	4240-344
TRU 6934 (F)	4240-371
TRU 7958 (F)	4240-372

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.

The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR SELLER ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.

Special Lifetime Warranty - Series 4020, Series 4027A, Series 4027F, and Series 4028 Power Sensor Head

In addition to its standard warranty, the Bird Electronic Corporation warrants its Series 4020, Series 4027A, Series 4027F, and Series 4028 Thruline Power Sensor Heads for lifetime to original purchaser. This extended warranty is against burnout. For the warranty to apply, the Sensor Head must be used with the correct Bird Electronic Corporation Display Unit, the maximum power rating of the Sensor must not be exceeded, the Sensor RF circuit must be properly terminated and the Sensor not subjected to physical abuse.

Bird Electronic Corporation, at its option, will repair or replace the defective Sensor at its world Headquarters at 30303 Aurora Road, Solon, Ohio 44139.

The customer is responsible to pay transportation charges to return the defective sensor to Bird.