
INSTRUCTION BOOK

MULTI-SENSOR CAL CART SYSTEM

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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.

Keep Away From Live Circuits

Operating personnel must at all times observe normal safety regulations. Do not replace components or make adjustments inside the equipment with high voltage turned on. To avoid casualties, always remove power.

Shock Hazard

Do not attempt to remove the RF transmission line while RF power is present.

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.

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.

Chemical Hazard

Dry cleaning solvents for cleaning parts may be potentially dangerous. Avoid inhalation of fumes or prolonged contact with skin.

Resuscitation

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

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.




This symbol indicates that a shock hazard exists if the precautions in the instruction manual are not followed.



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



This symbol indicates that the unit radiates heat and should not be touched while hot.

 **NOTE:** Calls 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

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

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

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

WARNING

Heavy load. Do not attempt to lift unaided.

WARNING

Do not attempt to lift the cart by the handle.

WARNING

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

WARNING

All vent plugs must be installed on the load at all times when the unit is operating or cooling. Failure to do so could result in an explosion or severe burns.

WARNING

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

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

Check the local electrical code for proper ac hookup prior to operation of the unit. Make sure the neutral or return hookup is only used for that purpose.

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.

CAUTION

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

CAUTION

Failure to install the properly rated fuse may result in equipment damage or nuisance failures.

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%.

CAUTION

The Bird 4421 must be powered off when connecting or disconnecting the power sensor from the power meter.

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 GEFÄHRLICHER, ELEKTRISCHER SCHOCKS, SIND WARTUNGSARBEITEN AUSSCHLIEßLICH VON QUALIFIZIERTEM SERVICEPERSONAL DURCHFÜHREN.

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.



UNITS ARE EQUIPPED WITH RECHARGEABLE BATTERIES. THESE ARE TO BE REPLACED BY AUTHORIZED SERVICE PERSONNEL ONLY!!!

LAS UNIDADES VIENEN EQUIPADAS CON BATERIAS RECARGABLES. ¡¡¡Y SOLAMENTE EL PERSONAL DE SERVICIO AUTORIZADO PUEDE REEMPLAZARLAS!!!

GERÄTE SIND MIT WIEDER AUFLADBAREN BATTERIEN BESTÜCKT. BATTERIEN SIND NUR VON QUALIFIZIERTEM SERVICE PERSONAL AUSZUWECHSELN!!!

CES DISPOSITIFS SONT ÉQUIPÉS DE BATTERIES RECHARGEABLES. SEUL LE PERSONNEL D'ENTRETIEN AUTORISÉ EST HABILITÉ À LES REMPLACER !

LE UNITÀ SONO DOTATE DI BATTERIE RICARICABILI, CHE DEVONO DA COME SPECIFICATO DAL PRODUTTORE LA PROTEZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.



USE CORRECT VOLTAGE SETTING AND FUSE - SEE MANUAL.

UTILISER UNE TENSION ET UN FUSIBLE CORRECTS - CONSULTER LE MODE D'EMPLOI.

USE LA INSTALACION Y FUSIBLE DE VOLTAJE CORRECTO - VEA EL MANUAL.

AUSSCHLIESSLICH VORSCHRIFTSMÄSSIGE
WECHSELSPANNUNGS-EINSTELLUNG UND SICHERUNG
BENUTZEN - SIEHE DAZU HANDBUCH.

UTILLIZZARE TENSIONE E FUSIBLE ADATTI - FARE
RIFERIMENTO AL MANUALE.



BE SURE THE 115/230V AC VOLTAGE SELECTOR IS SET
TO THE PROPER LINE VOLTAGE, AND THE CORRECT AC
LINE FUSE IS INSTALLED BEFORE AC POWER IS
APPLIED.

S'ASSURER QUE LE SÉLECTEUR DE TENSION 115/230V C.A. EST
BIEN RÉGLÉ POUR LA TENSION DU RÉSEAU ET QUE LE FUSIBLE
DE LIGNE C.A. CORRECT EST EN PLACE AVANT DE METTRE SOUS
TENSION C.A.

CERCIORSE QUE EL SELECTOR DE VOLTAJE DE 115/230V CA
ESTE COLOCADO A LA LINEA DE VOLTAJE APROPIADA Y QUE EL
FUSIBLE ESTE INSTALADO A LA LINEA CA ANTES DE APLICAR
LA CORRIENTE ALTERNA.

VOR EINSCHALTEN DER WECHSELSTROMZUFUHR
SICHERSTELLEN, DASS DER 115/230V WECHSELSPANNUNGS-
SELEKTOR AUF DIE VORSCHRIFTSMÄSSIGE
LEITUNGSSPANNUNG EINGESTELLT UND DIE RICHTIGE
WECHSELSTROM-HAUPTSICHERUNG EINGESETZT IST.

PRIMA DI EROGARE CORRENTE, ASSICURARSI CHE IL
SELETTORE DI VOLTAGGIO 115/230 V.C.A. SIA REGOLATO
CORRETTAMENTE E CHE IL FUSIBLE ADATTO ALLA LINEA DI
ALIMENTAZIONE C.A. SIA INSTALLATO.

This instruction book covers the Bird Multi-Sensor Cal Cart System. A sample model number and a table listing all the components are provided at the end of this section. The example shows the model number for a Cal Cart with Bird 4027F2M and 4027F10M Power Sensors, both with female N connectors, an 8921A100 5 kW Load, and a 115V power supply and standard US plug. All Cal Carts include the Bird 4421 Power Meter. Refer to the specifications in this manual and in the attached load manual for frequency and power information.

The manual is arranged so that essential information on safety is contained in the front of the book. Reading the Safety Precautions Section before operating the equipment is strongly advised.

The remainder of this instruction book is divided into Chapters and Sections. At the beginning of each chapter a general overview describes the contents of that chapter.

Operation

First time operators should read Chapter 1 – Introduction, and Chapter 2 – Setup, to get an overview of equipment capabilities and how to set it up. An experienced operator can refer to Chapter 3 – Operating Instructions and Chapter 4 – 4421 Operating Instructions. All instructions necessary to operate the equipment are contained in these sections.

Maintenance

All personnel should be familiar with preventative maintenance found in Chapter 5 – Maintenance. If a failure should occur, the troubleshooting section will aid in isolating and repairing the failure. Parts lists and repair instructions are also in this chapter.

Changes

We have made every effort to ensure this manual is accurate at the time of publication. If you should discover any errors or if you have suggestions for improving this manual, please send your comment to our factory. This manual may be periodically updated, when inquiring about updates to this manual refer to the part number and revision level on the title page.

Figure 1: Sample Model MSCC7117180101011
 Cal Cart with 4421 meter, 4027F2M sensor, 4027F10M sensor,
 8921A100 load, two female N connectors,
 115Vac power supply and standard US plug

Sensor 1 & Sensor 2		Load		Connector 1 & Connector 2		Voltage and Plug Style	
01	4027A10M	01	8921A100	01	N (F)	1	115V, 15A Nema 5-15P
02	4027A250K	02	8931A400-115	02	7-16 DIN	2	230V, 30A Nema L6-30P
03	4027A400K	03	8931A400-230	03	LC (F)	3	115V, 10A International
04	4027A800K			04	HN (F)	4	230V, 10A International
05	4027A2M			05	TRU 6934 F		
06	4027A4M			06	TRU 7958 F		
07	4027A12M			07	4240-025		
08	4027A25M			08	4240-063		
				09	4240-363		
11	4021						
13	4024						
14	4025						
17	4027F10M						
18	4027F2M						

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This instruction book is intended for use by operators of the Bird Multi-Sensor Cal Cart System. This chapter contains introductory information including component descriptions and items supplied.

The Bird Cal Cart is designed for immediate, effortless use. It has three primary components. The Bird 4421 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 1 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 4421 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 4421 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.

 **NOTE:** The 4421 is equipped with rechargeable batteries. These are shipped uncharged. Connect the unit to ac power the first time you use it to charge the batteries.

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 4421 Power Meter.



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.

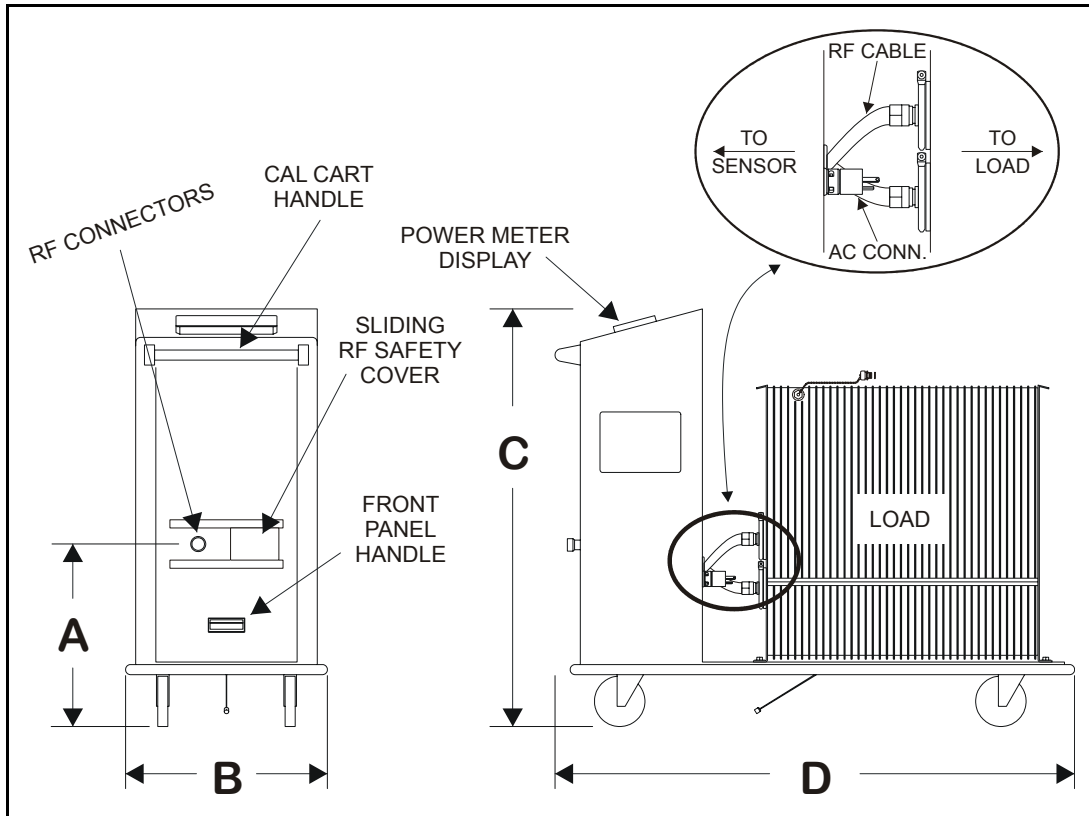
Load

Bird loads are available in power ranges from 1 – 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	DIM. D
	22.5"	20"	42"	42"
	(572 mm)	(508 mm)	(1067 mm)	(1067 mm)

Figure 2
Shipping Plug

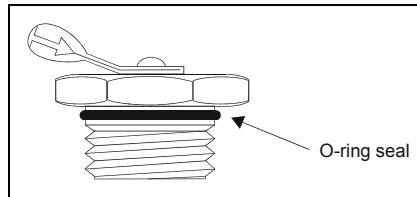
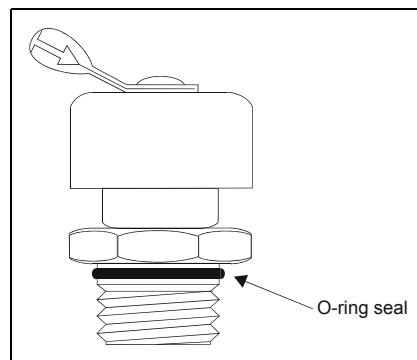


Figure 3
Vent Plug



This chapter provides information for on-site requirements, unpacking, inspection, and preparing the Bird Cal Cart for use.

Unpacking and Inspection

- Carefully inspect the shipping container for signs of damage. If damage is noticed, do not unpack the unit. Immediately notify the shipping carrier and Bird Electronic Corporation.
- If the container is not damaged, unpack the unit. Save the packing materials in case the unit needs to be shipped again.
- Inspect all of the components for visible signs of damage. Immediately notify the shipping carrier and Bird Electronic Corporation of equipment damage or missing parts.

Setup

Setup consists of three basic steps: moving the Cal Cart into position, installing the vent plugs, and connecting ac power and the RF line. These steps are explained in more detail below.

WARNING

Do not attempt to lift the cart by the handle.

WARNING

All vent plugs must be installed on the load at all times when the unit is operating or cooling. Failure to do so could result in an explosion or severe burns.

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

Check the electrical code for proper ac hookup prior to operation of the unit. Make sure the neutral or return hookup is only used for that purpose.



CAUTION

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

- 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.
- Remove the shipping plugs from the load and replace them with the vent plugs, shown in Figure 2 and Figure 3.
- The ac power supply required is 115/230 V @ 50/60 Hz, 1f. The unit is equipped with an IEC 320 "cold" (65°C) ac inlet.

🔊 NOTE: If the load is not equipped with a blower, then the Bird Cal Cart may run on battery power after the 4421's batteries have been charged.

WARNING

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

- Slide the safety cover to expose the desired sensor connector.
- 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 cart's exposed RF 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.

Normal Operation

After setting up the Bird Cal Cart:

1. Connect the unit to the ac line, if necessary.
2. Press the ON/OFF button on the Bird 4421. The power up display will appear for approximately one second and then change to the normal operating display.
3. For the 8931 and other loads with attached blowers **ONLY**:

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%.

- a. Check that the indicator light is on.
 - b. Check that the switch is set to MANUAL.
4. Apply RF power.
5. Make measurements. See “4421 Operating Instructions” on page 9 for specific instructions on controlling the meter.

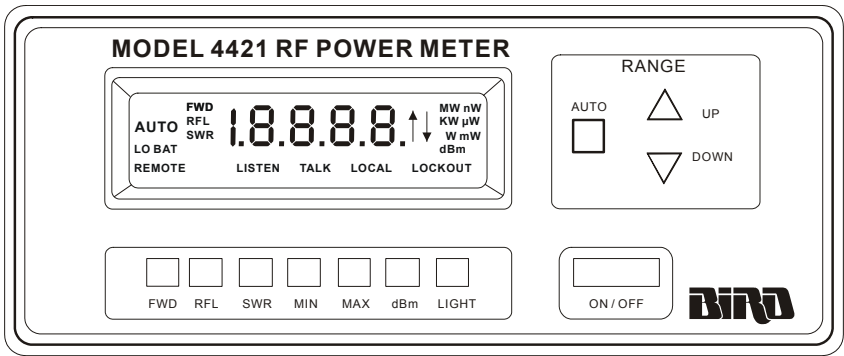
Shutdown

1. Turn off RF power at the source.
2. Press the ON/OFF button on the 4421.
3. 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.
4. Disconnect the ac line.

This chapter describes operator controls and indicators on the Bird 4421 RF Power Meter.

Push Button Functions

Figure 4
Push Buttons



Push Button	Description
FWD, RFL	Press to measure forward (reflected) RF power. FWD (RFL) indicator and current unit of measure turn on.
SWR	Press to measure standing wave ratio. SWR indicator turns on. Value displayed will be between 1.0 and 199.9
MIN, MAX	Used after pressing FWD, RFL, SWR, or dBm. Displays the minimum (maximum) measured value of the previous function as long as MIN (MAX) is held down.
dBm	Used after pressing FWD or RFL. dBm indicator turns on. Power is displayed in dBm units. Used after pressing SWR. Return loss is displayed.
LIGHT	Press to turn on or turn off the display's backlight. If left on, the light automatically shuts off after 30 minutes.
AUTO	Press to automatically set the scale. AUTO turns on.
UP, DOWN	Press to select the next higher (lower) scale. If the scale is too high for the power sensor, an error will be displayed. Used while AUTO indicator is on. Stops automatic scaling. AUTO indicator turns off.
ON/OFF	Press to turn the power meter on or off.

Error Codes

The Bird 4421 displays error codes when the RF power is either below the selected range (underrange) or above the selected range (overrange). Figure 5 displays the error codes and Figure 6 lists the function limits.

*Figure 5
Error Codes*

Symbol	Explanation
□ □	Value greater than overrange limit of function
□ □	Value less than underrange limit of function

*Figure 6
Function Limits*

Function	Limit	Error
FWD, RFL	Power > 199.9% of full scale or 120% of top range	Overrange
FWD dBm, RFL dBm	Power > 120% of full scale Power < 3% of low range	Overrange Underrange
SWR	FWD < 20% of low range FWD – RFL = 0	Underrange Overrange
Return Loss	FWD < 20% of low range RFL < 20% of low range Return Loss > 40 dB	Underrange Underrange Underrange

Audible Warning

If the RF power level exceeds 120% of the power sensor's maximum power capability, the power meter will sound a warning buzzer.

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.

WARNING

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

The Bird 4421 Power Meter requires only simple, routine maintenance.

- Wipe off dust and dirt regularly.
- Check the connectors and cables for damage.
- Clean the connector contacts with alcohol or dry cleaning solvent.


Power Meter Troubleshooting

Since the power meter and power sensor can only work together, the first step is to determine which is malfunctioning. Connect the power sensor to the meter and perform the functional test on page 12. If the power meter is malfunctioning, refer to the troubleshooting table below. 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 result in cancellation of 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.

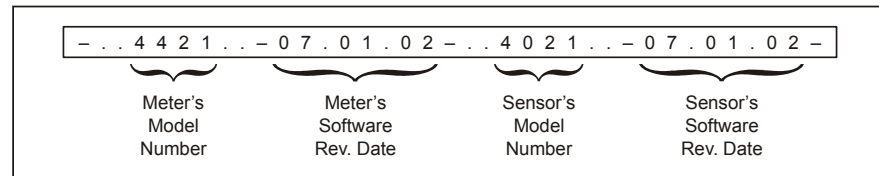
PROBLEM	POSSIBLE CAUSE	CORRECTION
Power meter has no power	Have the batteries been charged?	Recharge the batteries
	Is the power meter's ac power cord connected to the terminal strip?	Connect the power cord
	Is the Cal Cart's ac power cord connected to the ac line?	Connect ac power
	Is the ON/OFF rocker switch on the rear panel set to OFF?	Set the switch to ON
	Unplug the Cal Cart. Has the power meter fuse blown?	Check fuse rating and replace fuse (see "Replacing Fuses" on page 15)
Dash moves across the display	Is the ac power cord defective?	Replace ac power cord
	Is the sensor cable connected to both the power meter and power sensor?	Connect sensor cable
	Is the sensor cable defective?	Replace sensor cable
Display blank or not updating	Have the batteries been charged?	NO: Recharge battery YES: Return meter for service
Power meter turns off while on battery power	Is "LO BAT" displayed?	YES: Recharge battery NO: Return meter for service
Push buttons do not respond	Test the push buttons (see "Push Button Test" on page 13). Are they defective?	Return meter for service.
Every segment on the display is lit		Return meter for service

Functional Test This test determines whether the power meter or the sensor is malfunctioning.

1. Disconnect the ac power cable and turn the power meter off. The ON/OFF switch on the *rear* panel of the meter should be ON.
2. Connect the ac power cable.
3. While holding down the FWD and SWR push buttons, press the ON/OFF button on the *front* panel of the power meter. Immediately release all three.
4. The power meter's model number and revision date should scroll across the display. If a dash "-" is displayed instead, then the meter is malfunctioning.

5. The power sensor's model number and revision date should scroll across the display. If a dash is displayed after the power meter data, then the power sensor is malfunctioning.

Figure 7
Test Display,
No Malfunction



Push Button Test

This test checks that the push buttons and display are functioning properly. If a push button is malfunctioning, return the power meter.

1. Disconnect the power sensor.
2. Turn the power meter ON.
3. After the power up display disappears, three dashes “— — —” should scroll across the display.
4. “AUTO” and “FWD” should be displayed, and a reading of “.000 W”.
5. Press RFL. “FWD” should change to “RFL” on the display. The reading should remain the same.
6. Press SWR. “RFL” should change to “SWR”. “.000 W” should change to “□ □” (underrange error).
7. Hold down MIN. “□ □” should change to “□ □” (overrange error).
8. Release MIN. “□ □” should change to “□ □”.
9. Hold down MAX. “□ □” should change to “.000”.
10. Release MAX. “.000” should change to “□ □”.
11. Press dBm. “SWR” should change to “dBm”.
12. Press dBm. “dBm” should change to “SWR”.
13. Press FWD. “SWR” should change to “FWD” and “□ □” to “.000 W”.
14. Press LIGHT. The back-light should turn on.
15. Press LIGHT. The back-light should turn off.
16. Press ▲ (up). The power meter should change ranges each time it is pressed until it reaches “.000 KW”.
17. Press ▼ (down). The power meter should change ranges each time it is pressed until it reaches “.000 W”.
18. Turn the power meter OFF.

Repair

WARNING

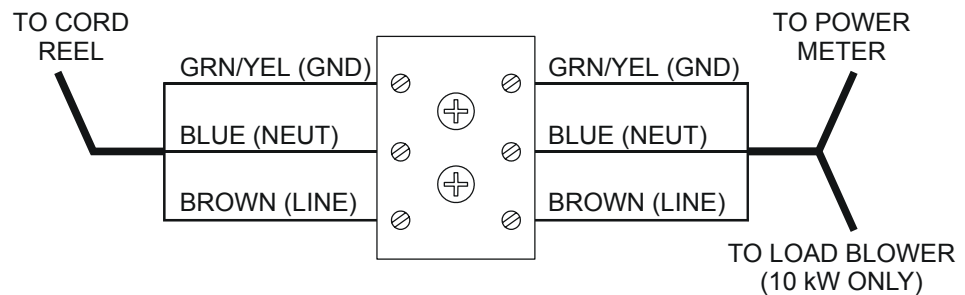
To avoid personal injury, disconnect the power cord from the ac line before performing any maintenance, including fuse replacement.

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

- Remove both screws on the front panel, between the RF connector and the handle.
- Pull on the handle set into the base of the front panel to remove it.

When making ac connections, refer to the following wiring diagram.

Figure 8
Cal Cart Wiring
Schematic



Cord Reel To replace the cord reel:

- Disconnect the cord reel from the terminal strip.
- Unscrew the ac connector.
- Unscrew and remove the cord reel.
- Screw the replacement cord reel into place.
- Thread the ac connector through the grommet, and connect the wires on the other end to the terminal strip (See Figure 8).

Replacing Fuses

WARNING

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

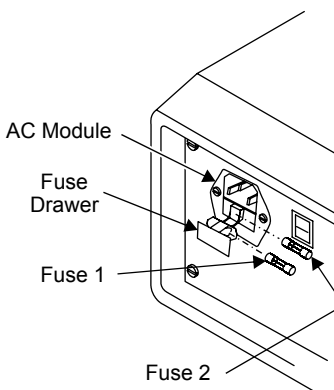
CAUTION

Failure to install the properly rated fuse may result in equipment damage or nuisance failures.

1. Gently pry the fuse drawer out of the ac module. The fuse holder does not detach from the ac module.
2. Install the replacement fuses then close and secure the fuse holder. Fuse 1 is a spare fuse and fuse 2 is the active fuse.

AC Line Voltage	Fuse Rating
115 Vac	T630 mA, 5x20 mm Time Lag Fuse
230 Vac	T315 mA, 5x20 mm Time Lag Fuse

Figure 9
AC Line Fuse



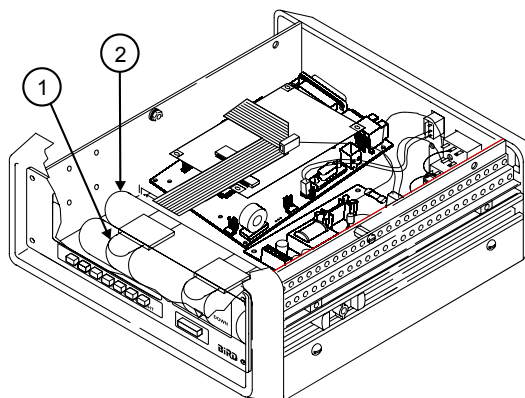
Replacing Batteries

WARNING

Exposed ac line voltage (115 VAC or 230 VAC). Disconnect the power cord from the ac line before replacing the batteries. Failure to comply may result in severe electrical shock or death.

1. Disconnect the ac power cord from the ac mains supply.
2. Remove the four screws that secure the top cover.
3. Lift the top cover to access the attached ground wire then disconnect the ground wire and remove the cover.
4. Unfasten the battery retaining belts then remove the battery tubes (Figure 10). Be sure to note the polarity and orientation of the battery tubes before removing them.
5. Remove the batteries from each tube and insert replacement batteries. Be sure to note the polarity (positive and negative) arrangement of the batteries.
6. Install the battery tubes into the unit and secure with the retaining belts. Be sure to position the retaining belts as they were before removal and tighten them securely.
7. Connect the ground wire to the top cover.
8. Install the top cover and secure it with the four screws removed earlier.

Figure 10
Batteries



Item	Description
1	Battery retaining belt
2	Battery tube (batteries inside)

Power Sensor To replace a power sensor:**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 4421 must be powered off when connecting or disconnecting the power sensor from the power meter.

**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.

- Disconnect the RF line from the Cal Cart.
 - Remove the Cal Cart front panel (see “Front Panel” on page 14).
 - Disconnect the sensor cable from the power sensor.
 - Disconnect the RF cable from the sensor output port.
 - Remove the screws on the sensor mounting bracket.
 - Remove the sensor from the mounting bracket.
 - Put the new sensor in the bracket and screw it into place.
- ☞ **NOTE:** Make sure 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.
- Connect the RF cable to the sensor end labeled “LOAD”. Connect the sensor cable.
 - Replace the Cal Cart front panel.

Load To remove the load from the cart:

WARNING

Heavy load. Do not attempt to lift unaided.

- Disconnect the RF cables from the RF connectors on the load.
- On blower-equipped loads, unplug the blower assembly.
- Replace the vent plugs with the shipping plugs.
- Remove the mounting bolts connecting the load to the Cal Cart.
- Remove the load.

Casters To replace the casters:

- Remove the load (See “Load” on page 18).
- Flip the cart over.
- Unscrew the defective caster.
- Screw the new caster into place and replace the load.

Handle To replace the handle:

- Unscrew and remove the old handle.
- Screw the new handle into place.

Storage and Shipment

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

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

- Remove the vent plugs and replace them with the shipping plugs. 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.
- Repack in the original carton or contact Bird for a transit case.

Customer Service

If you need to return the unit for any reason, contact the Bird Service Center for a return authorization. All instruments returned must be shipped prepaid and to the attention of Bird Service Center.

Bird Service Center

30303 Aurora Road

Cleveland (Solon), Ohio 44139-2794

Phone: (440) 519-2298

Fax: (440) 519-2326


E-mail: bsc@bird-technologies.com

For the location of the sales office nearest you, give us a call or visit our Web site at:

<http://www.bird-electronic.com>

Specifications

To determine the model numbers of the Cal Cart components, refer to the model number breakdown on page viii. For load specifications, refer to the load manual included.

 **NOTE:** Certain sensors or connectors may be incompatible with some models. Refer to the model number breakdown on page viii for a list of available components, or contact Customer Service.

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, 30 MHz max.
Power Range	Dependent on sensor, sensor connectors, and load
Connectors	Customer specified (See "Available Connectors" on page 27)
Dimensions	52"L x 20"W x 42"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 4421 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 Accuracy	± 1 on least significant digit
AC Power	115/230 Vac @ 50/60 Hz
Batteries	8 Nickel Metal Hydride rechargeable 1.2 volt cells
Battery Life	Approximately 8 hours continuous usage
Battery Charger	Built-in battery charger. Drained batteries require approximately 28 hours to recharge.
Display	LCD, 4½ digit display. Indicates mode, measurement units, battery condition, remote status, and signal increase/decrease. Self contained backlight.
Fuse Rating 115 Vac 230 Vac	IEC (5 x 20 mm) Time Lag Type T T630 mA T315 mA
Dimensions	15.5”L x 12.25”W x 4.25”H (393 x 311 x 108 mm)
Weight, Nominal	9.5 lbs. (4.3 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	6.75"L x 3.5"W x 4.75"H (175 x 89 x 121 mm)
4028A Series	4.7"L x 3.2"W x 3.8"H (120 x 82 x 97mm)
All other models	5.2"L x 2.5"W x 3.25"H (137 x 64 x 83 mm)
Weight, Nominal	
4028B10M	5 lb. 2 oz. (2.33 kg)
4028A2M, 3M, 4M, 10M, and 25M	3 lb. 5 oz. (1.5 kg)
All other models	1 lb. 13 oz. (0.8 kg)

Bird 4020 Series RF Power Sensors

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

* 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	4027A12M	10 – 15 MHz
4027A400K	400 – 550 kHz	4027A25M	25 – 30 MHz
4027A800K	800 – 950 kHz		
4027A2M	1.5 – 2.5 MHz		
4027A4M	3 – 5 MHz		
4027A10M	10 – 15 MHz		
RF Power Range			
4027A12M	300 mW – 1 kW	All other	3 W – 10 kW
4027A25M	3 W – 9 kW	models	
Accuracy, Fwd, Best Case [*] ± 1.0% (1σ)			
Calibration Frequencies, Typical (MHz) [†]			
4027A250K	0.25, 0.40	4027A12M	10.0, 13.56, 15.0
4027A400K	0.40	4027A25M	25.76, 27.12, 28.48
4027A800K	0.90		
4027A2M	1.8, 2.0, 2.17		
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		

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

[†] 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	
$\pm 1.0\%$ (2σ)	
Calibration Frequencies, Typical*	
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	

* Other calibration frequencies available upon request

Uncertainty Budget, 4027F Series***4027F2M****4027F10M**

Frequency Error...	at cal freq	$\pm 0.1\%$	$\pm 0.1\%$
	not at cal freq	$\pm 0.5\%$	$\pm 1.5\%$
Power Linearity...	at cal power	$\pm 0.1\%$	$\pm 0.1\%$
	not at cal power	$\pm 1.0\%$	$\pm 0.5\%$
Temperature Uncert...	within 20 to 30°C	$\pm 0.65\%$	$\pm 0.6\%$
	outside 20 to 30°C	$\pm 3.2\%$	$-3.0, +0.75\%$
Calibration Uncertainty		$\pm 0.6\%$	$\pm 0.6\%$
Resolution Uncert...	at cal power	$\pm 0.06\%$	$\pm 0.06\%$
	not at cal power [†]	$\pm 0.34\%$	$\pm 0.34\%$
Other sources of error		$\pm 0.4\%$	$\pm 0.5\%$
Best Case RSS Uncertainty		$\pm 1.0\%$	$\pm 1.0\%$

* All values 2σ

† Resolution uncertainty is error due to limited display digits. Actual uncertainty can be calculated as

$$\pm (1 \text{ in least significant digit}) / \text{Reading}$$

For a 3.5-digit display, worst case is at 300W. Least significant digit is one watt, uncertainty is $\pm 1\text{W}$ out of 300 or 0.34%. For a 4.5-digit display, least significant digit is 0.1W, so the uncertainty is 0.034%

Replacement Parts

Description	Qty	Part Number
Fuse, IEC (5 x 20 mm) Time Lag Type T 115 Vac, T630 mA 230 Vac, T315 mA	1	5A2257-10 5A2257-7
Cord, AC Power 115 Vac 230 Vac Harmonized	1	5-1286 5A2416
Plug, 115 Vac	1	5A2626
Cable, Sensor	1	4421-038
Grommet	1	4421A372
Cordreel	1	4421A383
Casters	4	4421A384
Handle	1	4421A385
Battery, C size, NiMH	8	5A1230

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	Connector	Part Number	Connector	Part Number
HN (F)	4240-268	N (F)	4240-062	TRU 6934 (F)	4240-371
LC (F)	4240-031	7/16 Jack, IEC Type 169-4	4240-344	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 (10) 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.

DECLARATION OF CONFORMITY

Manufacturer: Bird Electronic Corporation
30303 Aurora Road
Cleveland, Ohio 44139-2794

Product: Multi-Sensor Calibration Cart

Models: All active configurable models per table 1 in the format of
MSCC7 ☐ ☐ ☐ ☐ ☐ ☐ ☐

Table 1

Meter		Sensor 1				Sensor 2			
1	4421	01	4027A10M	10		01	4027A10M	10	
		02	4027A250K	11	4021	02	4027A250K	11	4021
		03	4027A400K	12		03	4027A400K	12	
		04	4027A800K	13	4024	04	4027A800K	13	4024
		05	4027A2M	14	4025	05	4027A2M	14	4025
		06	4027A4M	15		06	4027A4M	15	
		07	4027A12M	16		07	4027A12M	16	
		08	4027A25M	17	4027F10M	08	4027A25M	17	4027F10M
		09		18	4027F2M	09		18	4027F2M

Load		Connector 1		Connector 2		Voltage Plug Type	
01	8921A100	01	4240-062 (N F)	01	4240-062 (N F)	1	115V NA
02	8931A400-115	02	4240-344 (7-16 F)	02	4240-344 (7-16 F)	2	230V NA
03	8931A400-230	03	4240-031 (LC F)	03	4240-031 (LC F)	3	115V Int'l
		04	4240-268 (HN F)	04	4240-268 (HN F)	4	230V Int'l
		05	4240-371 (TRU 6934 F)	05	4240-371 (TRU 6934 F)		
		06	4240-372 (TRU 7958 F)	06	4240-372 (TRU 7958 F)		
		07	4240-025	07	4240-025		
		08	4240-063	08	4240-063		
		09	4240-363	09	4240-363		

The undersigned hereby declares, on behalf of Bird Electronic Corporation of Cleveland, Ohio, that the above referenced products, to which this declaration relates, are in conformance with the provisions of the following standards.

- European Standard EN 61326-1:1997 incorporating Amendments A1:1998 and A2:2001 – Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements

These standards are in accordance with EMC Directive (89/336/EEC).

- European Standard EN 61010-1:1993 including Amendment 2, 1995 – Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use: Including Amendment 2: 1995

This standard is in accordance with Low Voltage Directive (73/23/EEC), 1973 Including Amendment (93/68/EEC), 1993

The technical documentation supporting compliance with these directives is maintained at Bird Electronic Corporation, 30303 Aurora Road, Cleveland, Ohio 44139.



Bob Gardiner
Director of Quality
Bird Electronic Corporation