



DIRECTIONAL POWER SENSORS

OPERATION MANUAL

MODEL 5009, 5010B, AND 5014

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.

WARNING

Do Not Service Or Adjust Alone

Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

WARNING

Safety Earth Ground

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

WARNING

Resuscitation

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

WARNING

Remove Power

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

Safety Symbols

WARNING

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

CAUTION

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

Note: *Calls attention to supplemental information.*

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

Leaking RF energy is a potential health hazard. DO NOT connect or disconnect equipment from the transmission line while RF power is being applied. Severe burns, electrical shock, or death can occur.

On page 2.

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 page 5.

WARNING

RF voltage may be present in RF element socket. Keep element in socket during operation.

On page 5.

Caution Statements

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

CAUTION

If the element cannot be fully inserted into the socket, do not force it. This may damage the element.

On page 2.

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 EFFETTUARRE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

RF VOLTAGE MAY BE PRESENT IN RF ELEMENT SOCKET - KEEP ELEMENT IN SOCKET DURING OPERATION.

DE LA TENSION H.F. PEAT ÊTRE PRÉSENTE DANS LA PRISE DE L'ÉLÉMENT H.F. - CONSERVER L'ÉLÉMENT DANS LA PRISE LORS DE L'EMPLOI.

HF-SPANNUNG KANN IN DER HF-ELEMENT-BUCHSE ANSTEHEN - ELEMENT WÄHREND DES BETRIEBS EINGESTÖPSELT LASSEN.

PUEDE HABER VOLTAJE RF EN EL ENCHUFE DEL ELEMENTO RF - MANTENGA EL ELEMENTO EN EL ENCHUFE DURANTE LA OPERACION.

IL PORTAELEMENTO RF PUÒ PRESENTARE VOLTAGGIO RF - TENERE L'ELEMENTO NELLA PRESA DURANTE IL FUNZIONAMENTO.

About This Manual

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

5009

5010 B

5014

5010 T

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 Directional Power Sensor and Element Types.

Installation — Describes how to connection and install the Directional Power Sensor into the system that is being monitored.

Specifications — Describes the basic information, settings, and ranges of the Digital Power Sensor.

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Description

The DPS Power Sensors are intended for use in coaxial transmission lines of 50 ohm nominal impedance. The sensors utilize elements in order to make power measurements. Each element has an arrow on it that represents the direction in which it measures power. The elements ignore power in the opposite direction with a directivity of at least 25 dB. The DPS series can make power measurements using either 43 type or APM/DPM elements, and the readings available vary, based on which elements are being used.

Since the DPS uses two elements, it can measure the quality of the system by comparing the forward and the reflected power. This is usually presented in the form of VSWR (voltage standing wave ratio) or Return Loss.

Element Types

43 Type Elements

The 43 type elements are normally used to measure peak power. These elements can measure the peak power of a system with an accuracy of +/-8% of full scale as long as the signal meets the following requirements:

- At least 15 pulses per second (PPS)
- Minimum pulse width of 15 μ s (800 ns if frequency is greater than 100 MHz)
- Minimum Duty Cycle of 0.01%

In addition, 43 type elements can be used to measure average power in signals with a peak-to-average ratio close to 1, like a CW or FM signals. In these cases, the average power is measured with an accuracy of +/- 5% of full scale.

APM/DPM Elements

The APM/DPM elements are used to measure true average power. True average power means the sensor provides equivalent heating power of the signal, regardless of modulation or number of carriers. These elements can measure average power with an accuracy of +/-5% of reading from full scale down to 2.5% of full scale.

Note: *The equivalent heating power is dependent on the duty cycle of a signal. If a system puts out 50 watts with a 50% duty cycle, the APM/DPM elements will measure 25 watts.*

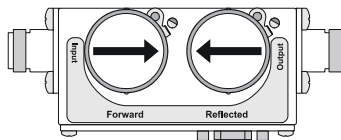
Element Orientation

WARNING

Leaking RF energy is a potential health hazard. DO NOT connect or disconnect equipment from the transmission line while RF power is being applied. Severe burns, electrical shock, or death can occur.

The forward element and the reflected element must be of the same series (APM or 43). The power rating of the forward element must be 10x the power rating of the reverse element.

Insert the forward element into the forward socket with its arrow pointing in the direction of forward power. Insert the reflected element into the reflected socket with its arrow pointing in the direction of reverse power.



Element Contact Alignment

Continuous insertion or rotation of the element might cause a slight change in the position of the contact spring in the element socket. If the contact spring changes position, erratic power readings may be experienced.

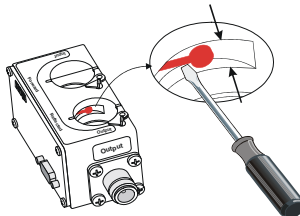
The position of the contact spring may be adjusted with a small screwdriver to reestablish contact.

CAUTION

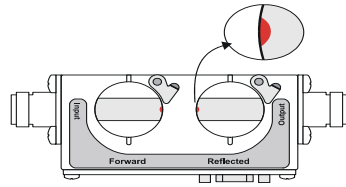
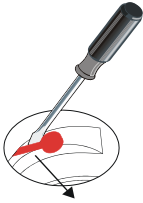
If the element cannot be fully inserted into the socket, do not force it. This may damage the element.

Perform the following steps to adjust the contact spring:

1. Using a small flat head screwdriver, place the flat side of the screwdriver behind the contact bar as indicated and bend the contact bar so that the contact rests in the center of the slot adjacent to the element socket.



2. After centering the contact, bend the contact bar slightly toward the center of the element socket bore, so that the profile of the element contact is visible when viewing the element socket from the top of the socket bore.



Note: *If the contact is accidentally moved too far, the element will not slide into the socket. Move the contact back into the recessed area and repeat the process.*

Unpacking and Inspection

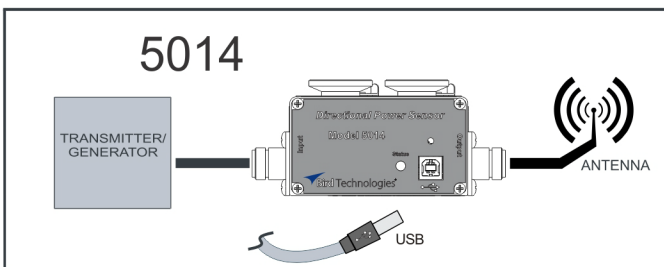
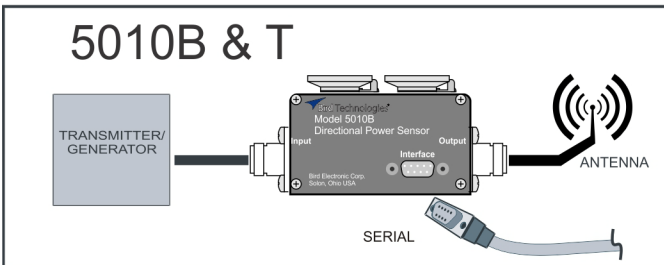
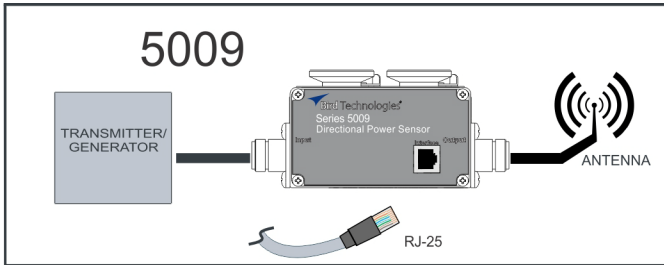
1. Carefully inspect shipping container for signs of damage.
 - If the shipping container is damaged, do not unpack the unit. Immediately notify the shipping carrier and Bird Technologies.
 - If the shipping container is not damaged, unpack the unit. Save shipping materials for repackaging.
2. Inspect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

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

Connecting the Directional Power Sensor (DPS).

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

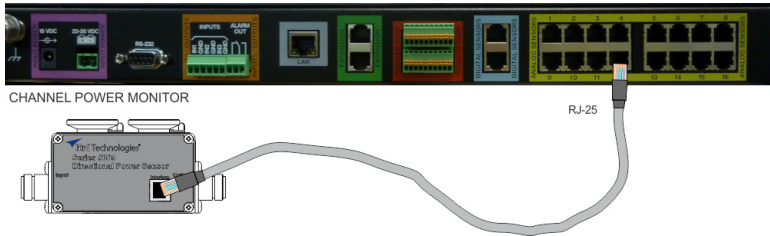
RF voltage may be present in RF element socket. Keep element in socket during operation.

1. Do one of the following:
 - a. To connect a 5009 DPS:

Note: Only use DPM elements in the 5009 DPS.

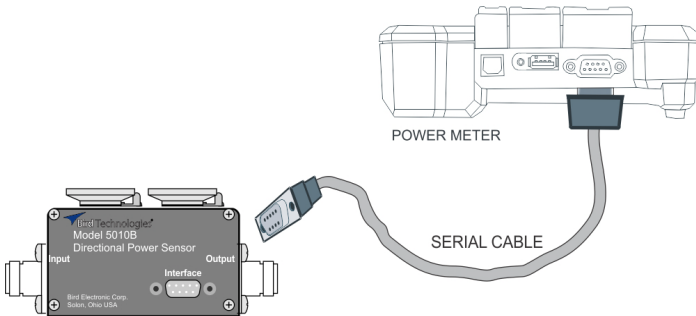
- Connect one end of data cable to the RJ-25 connector on the 5009.
- Connect the other end of the data cable to one of the channel input connectors on a Bird Channel Power Monitor.

Figure 1 5009 Cable Connection



- b. To connect a 5010B or 5010T DPS:
- Connect the DPS to the “Sensor” serial port on the Bird Digital Power Meter using the sensor cable provided.

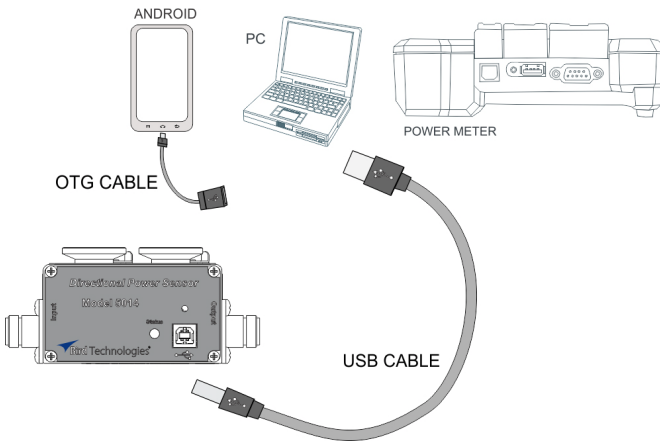
Figure 2 5010 Cable Connection



- c. To connect a 5014 DPS:

Note: There are currently three connection options for the 5014 DPS.

- Connect the DPS to a USB port on a PC using the sensor cable provided. Use VPM3 software to communicate with the DPS.
- Connect the DPS to the “Sensor” USB port on a Bird Digital Power Meter using the sensor cable provided.
- Connect the DPS to an Android device using an OTG cable and USB Cable. Use the Bird RF Meter App to communicate with the DPS.

Figure 3 5014 Cable Connections

2. Connect the RF line to the DPS so that the arrow on the sensor points towards the load, [see "Element Orientation" on page 2](#).

Note: The arrow on the forward element should point towards the load.

Note: The arrow on the reflected element should point towards the source.

Note: Both elements must be either APM/DPM or 43 types, do not mix elements.

3. Refer to DPM/VPM3/CPM manuals for setup parameters for the desired measurement.

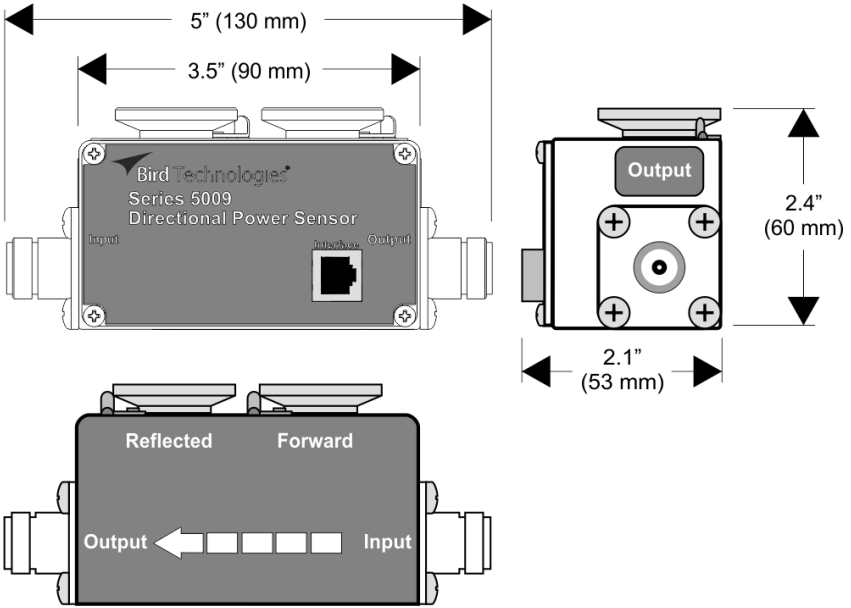
Note: Use the forward element's power rating when setting up the device.

5009 Specifications

Sensor Type	Thru-line two-element line section
Elements	DPM elements ONLY Select two elements from the same series, with RFL power 1/10 of FWD power.
Frequency Range ¹	2 – 1000 MHz ¹
Average Power Measurements	
DPM Elements, Forward or Reflected Direction	
Power Measurement Range	0.1 W to 1 kW
Power Measurement Accuracy	± 5% of full scale average power (95% c.l.)
Match Measurement	
Match Range Return Loss Rho (ρ) VSWR	0 to 20 dB 0.1 to 1 1.22 to 99.99
Uncertainty	Twice the Avg Power Uncertainty (Calculated from forward and reflected uncertainty)
Settling Time, Max	2.5 seconds
Impedance, Nominal	50 ohms
Insertion Loss, Max	0.05 dB up to 1 GHz
Input VSWR, Max.	1.05:1 up to 1 GHz
Directivity, Typical ¹	30 dB
RF Connectors	QC Type (N(F) normally supplied)
Interface Connector	RJ-25
Power Supply	From host instrument via interface cable
Mechanical Shock and Vibration	In accordance with MIL-PRF-28800F Class 3
CE	CE compliant. Refer to DOC for specific standards.
Recommended Calibration Interval	1 year
Temp, Operating	-10 to +50 °C (+14 to +122 °F)

Temp, Storage	-40 to +75 °C (-40 to +167 °F)
Humidity, Max	95% (non-condensing)
Altitude, Max	3,000 m (10,000 ft.)
Dimensions, Nominal	5.0" x 2.4" x 2.0" (130 x 60 x 50 mm)
Weight, Nominal	0.9 lb. (0.4 kg)

1 Exact value depends on element selected

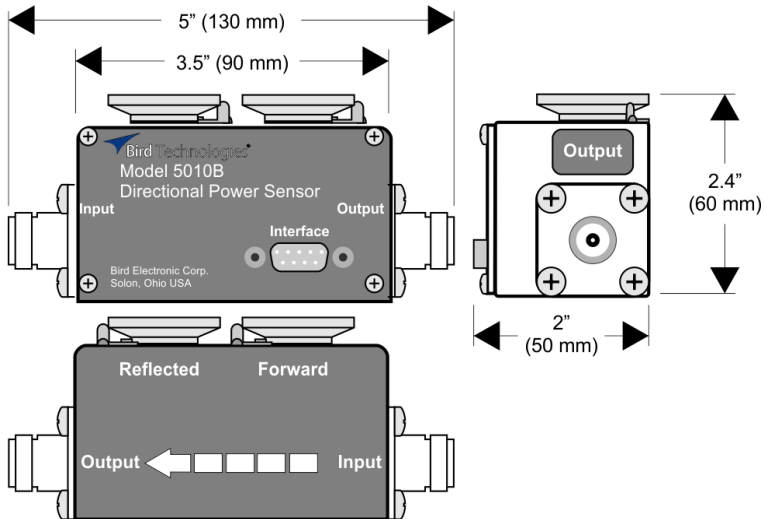


5010B, 5010T Specifications

Sensor Type	Thru-line two-element line section
Elements	Select two elements from the same series, with RFL power 1/10 of FWD power.
5010B 5010T	APM or 43 series elements APM elements <i>only</i>
Frequency Range ¹	2 – 3600 MHz ¹
Average Power Measurement	
APM Elements, Forward or Reflected Direction	
Power Measurement Range ¹	0.1 W to 1 kW
Accuracy ²	± 5% of reading (95% c.l.)
Peak/Average Ratio, Max	10 dB
Detector Response (5010T only)	230 ms
43 Elements, Forward or Reflected Direction	
Power Measurement Range	0.1 W to 10 kW
Power Measurement Accuracy	± 5% of full scale average power (95% c.l.)
Peak Power Measurement	
43 Elements only, Forward direction only	
Pulse Width, Min	15 µs
2 – 25 MHz	1.5 µs
25 – 100 MHz	800 ns
> 100 MHz	
Rep. Rate, Min	15 PPS
Duty Cycle, Min	1 x 10 ⁻⁴
Accuracy ²	± 8% of full-scale peak envelope power (95% c.l.)
Match Measurement	
Match Range	
Return Loss	0 to 20 dB
Rho (ρ)	0.1 to 1
VSWR	1.22 to 99.99
Uncertainty	Twice the Avg Power Uncertainty (Calculated from forward and reflected uncertainty)
Settling Time, Max	2.5 seconds
Impedance, Nominal	50 ohms
Insertion Loss, Max	0.05 dB up to 1 GHz

Input VSWR, Max.	1.05:1 up to 1 GHz
Directivity, Typical ¹	30 dB
RF Connectors	QC Type (N(F) normally supplied)
Interface Connector	DB-9
Power Supply	From host instrument via cable
Mechanical Shock and Vibration	In accordance with MIL-PRF-28800F Class 3
CE	CE compliant. Refer to DOC for specific standards.
Recommended Calibration Interval	1 year
Temp, Operating	-10 to +50 °C (+14 to +122 °F)
Temp, Storage	-40 to +75 °C (-40 to +167 °F)
Humidity, Max	95% (non-condensing)
Altitude, Max	3,000 m (10,000 ft.)
Dimensions, Nominal	5.0" x 2.4" x 2.0" (130 x 60 x 50 mm)
Weight, Nominal	0.9 lb. (0.4 kg)

- 1 Exact value depends on element selected
- 2 Above 35 °C or below 15 °C add 2%

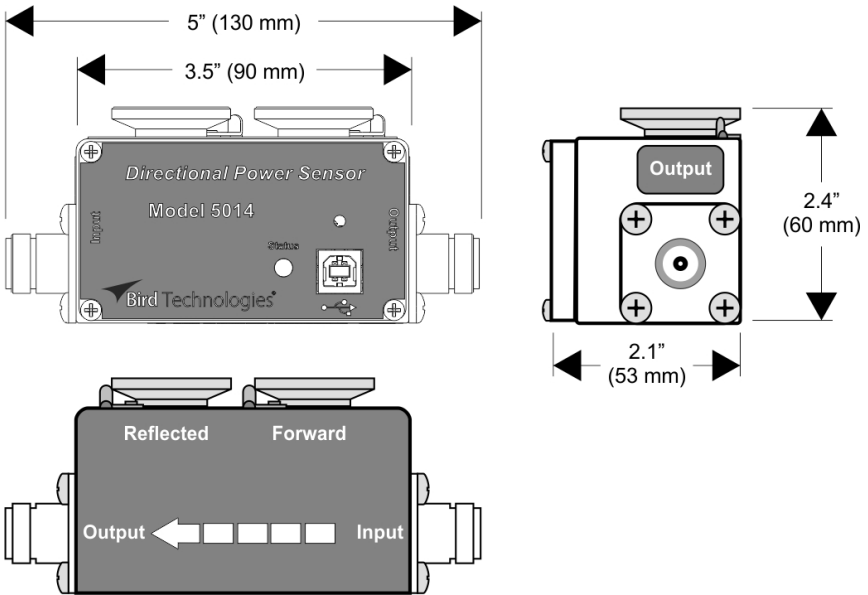


5014 Specifications

Sensor Type	Thruline two-element line section
Elements	APM or 43 series elements. Select two elements from the same series, with RFL power 1/10 of FWD power.
Frequency Range ¹	2 – 3600 MHz
Average Power Measurement	
APM Elements, Forward or Reflected Direction	
Power Measurement Range ¹	0.1 W to 1 kW
Accuracy ²	± 5% of reading (95% c.l.)
Peak/Average Ratio, Max	10 dB
43 Elements, Forward or Reflected Direction	
Power Measurement Range	0.1 W to 10 kW
Power Measurement Accuracy	± 5% of full scale average power (95% c.l.)
Peak Power Measurement	
43 Elements only, Forward direction only	
Pulse Width, Min 2 – 25 MHz 25 – 100 MHz > 100 MHz	15 µs 1.5 µs 800 ns
Rep. Rate, Min	15 pps
Duty Cycle, Min	1×10^{-4}
Accuracy ²	± 8% of full-scale peak envelope power (95% c.l.)
Match Measurement	
Match Range Return Loss Rho (ρ) VSWR	0 to 20 dB 0.1 to 1 1.22 to 99.99
Uncertainty	Twice the Avg Power Uncertainty (Calculated from forward and reflected uncertainty)
Settling Time, Max	2.5 seconds
Impedance, Nominal	50 ohms
Insertion Loss, Max	0.05 dB up to 1 GHz
Input VSWR, Max.	1.05:1 up to 1 GHz

Directivity, Typical ¹	30 dB
RF Connectors	QC Type (N(F) normally supplied)
Interface Connector	USB 2.0 Type B
Power Supply	From host instrument via cable
Mechanical Shock and Vibration	In accordance with MIL-PRF-28800F Class 3
CE	CE compliant. Refer to DOC for specific standards.
Recommended Calibration Interval	1 year
Temp, Operating	-10 to +50 °C (+14 to +122 °F)
Temp, Storage	-40 to +75 °C (-40 to +167 °F)
Humidity, Max	95% (non-condensing)
Altitude, Max	3,000 m (10,000 ft.)
Dimensions, Nominal	5.0" x 2.4" x 2.0" (130 x 60 x 50 mm)
Weight, Nominal	0.9 lb. (0.4 kg)

- 1 Exact value depends on element selected
- 2 Above 35 °C or below 15 °C add 2%



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>

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.