



RF TEST SET

OPERATION MANUAL



# Safety Precautions

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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.



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

**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

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 6.

## **Safety Statements**

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### **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

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

7003A001-5

7003A001-8

7003A001-6

7003A001-9

7003A001-7

7003A001-19

## Changes to this Manual

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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 comments 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.

## Chapter Layout

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**Introduction** — Lists the components included in the RF Test Set.

**Operation** — Provides brief information on operating instructions for the equipment found in the RF Test Set.

**Specifications** — Includes specifications for the equipment contained in the RF Test Set.

# TABLE OF CONTENTS

<b>Safety Precautions</b> .....	<b>i</b>
Safety Symbols .....	ii
Warning Statements .....	ii
Safety Statements .....	iii
<b>About This Manual</b> .....	<b>v</b>
Changes to this Manual .....	v
Chapter Layout .....	v
<b>Chapter 1 Introduction</b> .....	<b>1</b>
Items Supplied .....	1
SiteHawk Analyzer .....	4
Power Meter Application .....	4
Power Sensors .....	5
7020 .....	5
5017D-AV .....	5
Termination .....	5
<b>Chapter 2 Operation</b> .....	<b>6</b>
SiteHawk Analyzer .....	6
Power Meter Application .....	6
Wideband Power Sensor .....	6
Customer Service .....	7
<b>Chapter 3 Specifications</b> .....	<b>8</b>
SiteHawk Analyzer Specifications .....	8
Calibration Combo Specifications .....	9
Wideband Power Sensors .....	10
7020/7020 Low Frequency .....	10
5017D-AV .....	11
25 Watt Termination .....	14
RF Cable .....	14
Hard Case .....	15
<b>Limited Warranty</b> .....	<b>16</b>



The RF Test Set is designed for use in the calibration and testing of communications and navigation systems.

**Figure 1 Bird RF Test Set**



## Items Supplied

Each RF Test Set contains the equipment indicated in [Table 1](#) and [Table 2](#).

**Table 1 Items Supplied, kits ending in -5, -6, -7**

Description	Part Number	7003A001-5	7003A001-6	7003A001-7
SiteHawk Analyzer	SK-4500-SC	✓	✓	✓
USB Adapter	SK-CONN-OTG-2	✓	✓	✓
AC Adapter (12VDC)	SK05T-1200300Z	✓	✓	✓
Touch Pen (stylus)	SK-TP-112	✓	✓	✓

Description	Part Number	7003A001-5	7003A001-6	7003A001-7
USB Drive	5A2745-1	✓	✓	✓
Calibration Combination (Cal Combo), DC - 6 GHz	SK-CAL-MN-C6	✓	✓	✓
Operation Manual <sup>1</sup>	920-SK-4500	✓	✓	✓
Model 7020, 350 - 4000 MHz, Wideband Power Sensor <sup>2</sup>	7020-1-010101		✓	
Model 7020, Low Frequency, Wideband Power Sensor <sup>2</sup>	7020-1-030301			✓
Model 5017D, Wideband Power Sensor <sup>2</sup>	5017D	✓		
Model 5019D, Wideband Power Sensor <sup>2</sup>	5019D			
Model 7022, Statistical Power Sensor <sup>2</sup>	7022-1-020201			
Termination, 25 Watt	25-T-MN	✓	✓	✓
Cable, RF N(m) to N(f), 3m	5A12970-16-120B	✓	✓	✓
Adapter, N(m) to SMA(m)	4240-500-23			
Adapter, N(m) to SMA(f)	4240-500-10			
Adapter, Coax Plug to SMA Jack	4240-443			
Adapter, Coax 5 pin contact to SMA Jack	4240-444			
Adapter Kit	4240-401	✓	✓	✓
Hard Carrying Case	5000-035	✓	✓	✓

- 1 Operation manuals are supplied digitally on a CD in PDF format.
- 2 Each Power Sensor includes a USB Cable, Virtual Power Meter Software, and an Operation Manual.

**Table 2 Items Supplied, kits ending in -8, -9, -19**

Description	Part Number	7003A001-8	7003A001-9	7003A001-19
SiteHawk Analyzer	SK-4500-SC	✓	✓	✓
USB Adapter	SK-CONN-OTG-2	✓	✓	✓
AC Adapter (12VDC)	SK05T-1200300Z	✓	✓	✓
Touch Pen (stylus)	SK-TP-112	✓	✓	✓
USB Drive	5A2745-1	✓	✓	✓
Calibration Combination (Cal Combo), DC - 6 GHz	SK-CAL-MN-C6	✓	✓	✓
Operation Manual <sup>1</sup>	920-SK-4500	✓	✓	✓
Model 7020, 350 - 4000 MHz, Wideband Power Sensor <sup>2</sup>	7020-1-010101			
Model 7020, Low Frequency, Wideband Power Sensor <sup>2</sup>	7020-1-030301			
Model 5017D, Wideband Power Sensor <sup>2</sup>	5017D	✓		
Model 5019D, Wideband Power Sensor <sup>2</sup>	5019D			✓
Model 7022, Statistical Power Sensor <sup>2</sup>	7022-1-020201		✓	
Termination, 25 Watt	25-T-MN	✓	✓	✓
Cable, RF N(m) to N(f), 3m	5A12970-16-120B	✓	✓	✓
Adapter, N(m) to SMA(m)	4240-500-23			
Adapter, N(m) to SMA(f)	4240-500-10			
Adapter, Coax Plug to SMA Jack	4240-443			
Adapter, Coax 5 pin contact to SMA Jack	4240-444			
Adapter Kit	4240-401	✓	✓	✓

Description	Part Number	7003A001-8	7003A001-9	7003A001-19
Hard Carrying Case	5000-035	✓	✓	✓

- 1 Operation manuals are supplied digitally on a CD in PDF format.
- 2 Each Power Sensor includes a USB Cable, Virtual Power Meter Software, and an Operation Manual.

## SiteHawk Analyzer

The SiteHawk Analyzer is a multifunction test instrument for use in installation and maintenance of RF communications systems.

The SK-4500 has a frequency range of 1 MHz to 4.5 GHz. Additional SiteHawk specifications can be found in the specifications chapter, See "[SiteHawk Analyzer Specifications](#)" on page 8.

Antenna systems are tested by using a SiteHawk Analyzer to measure match conditions. Data points measured across a user-specified frequency band or distance range are graphed on a 1920 x 1080 pixel touch screen display area.

For complete instructions on how to use the SiteHawk Analyzer refer to the SiteHawk Operation Manual, PN 920-SK-4500.

## Power Meter Application

The SiteHawk Analyzer includes the Bird Power Meter Application, The Bird RF Meter is an Android App which allows the SiteHawk to be used with the Bird Power Sensors available in the RF Test Set. To measure transmitter power, connect the power sensor to the SiteHawk, as shown [Figure 2 on page 7](#). Power measurements verify and monitor the condition of a transmitter system. Additional information on how to use the Bird RF Meter App can be viewed within the Bird RF Meter by opening the on-board Help system.

## Power Sensors

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Certain models of the RF Test Set include a Bird Power Sensor, please see "[Items Supplied](#)" [on page 1](#) to determine which test sets include a Power Sensor.

The following Power Sensor models are available in the Test Sets:

- 7020, 350 - 4000 MHz
- 7020, 25 - 1000 MHz
- 5017D, 100 - 1300 MHz
- 5017D-AV, 100 - 1300 MHz
- 5019D, 100 - 1300 MHz
- 7022,

### 7020

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The Bird 7020 series Wideband Power Sensors are ThruLine sensors that can measure forward and reflected average power and VSWR. The 7020 can be used with the Bird SiteHawk Analyzer by launching the Bird RF Power Meter App, or it may be used with a PC by using the Bird Virtual Power Meter Software (VPM3).

For complete instructions on how to use the 7020 Wideband Power Sensor refer to the 7020 Series Power Sensor Operation Manual, PN 920-7020S.

### 5017D-AV

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The Bird 5017D-AV Wideband Power Sensors are ThruLine sensors that can measure average, peak, or burst power, VSWR, crest factor, and Complementary Cumulative Distribution Function (CCDF). The 5017D-AV can be used with the Bird SiteHawk Analyzer by launching the Bird RF Power Meter App, or it may be used with a PC by using the Bird Virtual Power Meter Software (VPM3).

For complete instructions on how to use the 5017D-AV Wideband Power Sensor refer to the 5012 Series Power Sensor Operation Manual, PN 920-5012S.

## Termination

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Bird's RF termination is a high-quality, robust termination with a conservative power rating. The use of non-magnetic materials and plating provide safety when used in high magnetic fields such as MRI. Model 25-T-MN is rated to 4 GHz and 25 Watts.

**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.

## SiteHawk Analyzer

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The SiteHawk Analyzer has a Female N connector for connecting to RF cables, antenna, etc. Use phase-stable RF cables for best results.

For complete instructions on how to use the SiteHawk Analyzer refer to the SiteHawk Operation Manual, PN 920-SK-4500.

## Power Meter Application

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The Bird RF Meter App, included on the SiteHawk Analyzer will allow the Wideband Power Sensor to interface with the SiteHawk Analyzer.

Instructions on how to use the Bird RF Meter App can be viewed within the Bird RF Meter App by opening the Help system.

## Wideband Power Sensor

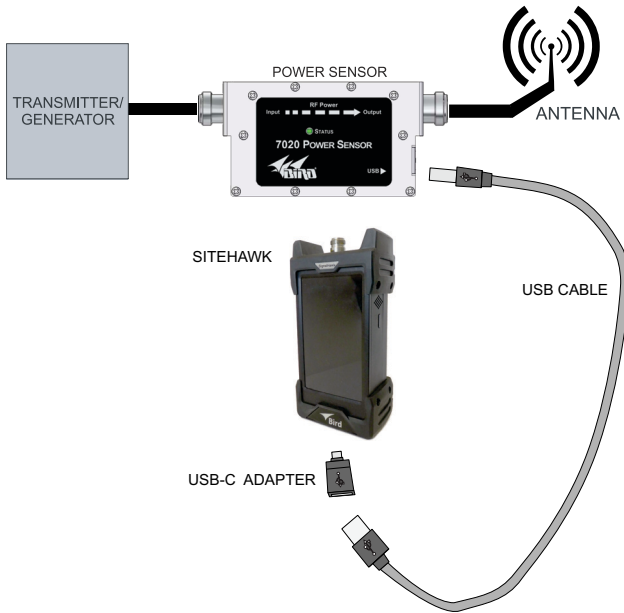
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Certain models of the RF Test Set include a Bird Wideband Power Sensor, please see ["Items Supplied" on page 1](#) to determine which test sets include a Power Sensor.

Power Sensors are used for direct RF power Measurement, the type of measurements that can be made vary with the sensor type. For complete instructions on how to use the Power Sensor and the measurements that can be performed refer to the Power Sensor's Operation Manual.

See [Figure 2 on page 7](#) for an example of how the sensor should be connected (a PC running Bird's VPM3 software may be substituted for the SiteHawk Analyzer).

**Figure 2 SiteHawk - Power Sensor Connections**



## Customer Service

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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](mailto:bsc@birdrf.com)

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

<http://www.birdrf.com>

The Contents of each RF Test Set varies by model number, see "[Items Supplied](#)" on [page 1](#) for a listing of what is included with each RF Test Set.

## SiteHawk Analyzer Specifications

Frequency Range SK-4500-SC	1 MHz to 4.5 GHz
Frequency Accuracy	±2.5 ppm
Frequency Resolution Setting	1 kHz
Output Power	-10 dBm
Reflected Amplitude Accuracy -15 dB — 0 dB -25 dB — -15 dB -35 dB — -25 dB	±0.4 dB ±1.5 dB ±4.0 dB
Trace Noise Amplitude (IFBW 1kHz)	0.02 dB rms
Single Point Measure Time	1.0 ms
Data Points	51 to 3201
Measure Bandwidth	100 Hz to 30 kHz
Temperature Stability	0.01 dB/°F 0.02 dB/°C
Return Loss Measurement Range Resolution	0 dB to -60 dB 0.01 dB
VSWR Measurement Range Resolution	1.0 to 65.0 0.01
Cable Loss Measurement Range Resolution	0 dB to 30 dB 0.01 dB
DTF Range	0 to 5000 ft (0 to 1500 m)
Test Port Connector Impedance	N-type, Female 50 ohms
Data Connector	USB-C, USB 3.0
Dimensions (L × W × H)	7.7 x 3.6 x 2.4 in. (195 x 90 x 60 mm)
Weight	1.98 lbs. 0.9 kg
Maximum Input Power	+22 dBm
Maximum Input Voltage	50 V
Operating Temperature	14° to 131° F (-10° to +55° C)
Storage Temperature	-40° to 176° F (-40° to +80° C)
Battery Charging Temperature	32° to 95° F (0 to +35° C)



Altitude	Up to 15000 ft. (4600 m)
Humidity	95±5° max (non-condensing)
Pressure	84 to 106.7 kPa
Warm-Up Time	15 minutes
Power Measurement	Yes, with RF Meter App
Compatible Devices	4043, 5012D, 5014, 5015, 5015-EF, 5016D, 5017D, 5018D, 5019D, 7020, 7022, 7023
Storage Capacity	16 GB
Immunity to Interfering Signals	+13 dBm
CE	CE compliant. EMC, Safety, and RoHS
Battery	10 hours continuous use 7.4 V, 6800 mAh
Battery Charge Time	
Power Off:	5 Hrs for full charge
Power On:	8 Hrs for full charge
Languages	English, Chinese, Spanish

## Calibration Combo Specifications

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Frequency	DC - 6 GHz
Resistance	50 Ohm
Average Power	≤ 1 W
Connectors	
Load	
Return Loss	≤ -38 dB
VSWR	≤ 1.025
Open	
Phase Deviation	≤ ± 0.6°
Short	
Phase Deviation	≤ ± 0.6°
Operating Temperature	49° to 95° F (15° to 35° C)
Storage Temperature	-40° to 167° F (-40° to 75° C)

## Wideband Power Sensors

### 7020/7020 Low Frequency

Measurement Type	ThruLine Power
Frequency Range 7020 7020 Low Frequency	350-4000 MHz 25-1000 MHz
Power Measurement Range 7020 7020 Low Frequency	0.15 W to 150 W 0.5 W to 500 W
Measurement Accuracy	+/- (4% of reading +0.05 W) Above 35° C or below 15° C, add 3%.
Peak/Avg Ratio	12 dB
Insertion Loss, Max	0.1 dB
Insertion Loss, VSWR 7020 7020 Low Frequency	1.10 Max. 1.05 Max
Impedance, Nominal	50 ohms
Response Time 7020 7020 Low Frequency	3 Sec 0.1 Sec
VSWR Range	1.15 to 99.9
Min. Forward Power for Reflected Measurement	5.0 W
RF Connectors	N Female
Directivity, Min 7020 7020 Low Frequency	28 dB 29 dB
Power Supply Source Current Draw	5 VDC from USB host 35 mA Max.
Recommended Calibration Interval	Annually
Interface Protocol Connector	USB 2.0 USB Type 'B' with SeaLATCH locking USB connector

Mechanical and Environmental	
Shock	Mil-PRF-28800F Class 3
Vibration	Mil-PRF-28800F Class 3
Temperature	
Operating, 7020	-10 to +50°C (+14 to +122°F)
Operating, 7020 Low Frequency	-30 to +60°C (+22 to +140°F)
Storage	-40 to +80°C (-40 to +176°F)
Humidity, Max	95% (non-condensing)
Altitude, Max	4,572 m (15,000ft)
Data Logging	In SK-4500 and VPM3 Software
Dimensions, Nominal	4.8" x 2.2" x 1.3" (122mm x 54mm x 32mm)
Weight, nominal	0.8 lbs (0.36 kg)
Standards Compliance	
CE	Directive 2014/30/EU, Electromagnetic Compatibility (EMC) European Standard EN 61326-1:2006 )
RoHS	Compliant Directive 2011/65/EU
Inter-operable Display	SK-4500, SA-XT Series, VPM3, 5000XT

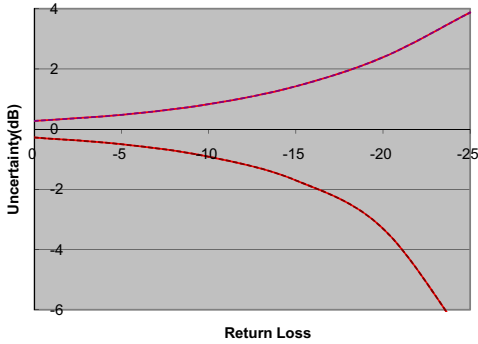
## 5017D-AV

Measurement Type	ThruLine Power
Frequency Range	100-1300 MHz
Power Measurement Range	500 mW to 500 W
Impedance, Nominal	50 ohms
Insertion Loss, Max	0.05 dB from 100 to 1000 MHz 0.1 dB from 1000 to 1300 MHz
Insertion VSWR	1.05 Max
RF Connectors	N Female
Directivity, Min	30 dB
Interface	
DPM, Male DB-9, EIA-232	9600 Baud, no parity, 8 data bits, 1 stop bit
PC (Serial), Female DB-9, EIA-232	9600 Baud, no parity, 8 data bits, 1 stop bit
USB	USB 2.0
Power Supply	
DPM/USB	Via data connection
DC Connector	7-18 VDC, 100 mA power supply
<b>AVERAGE POWER MEASUREMENT</b>	
Power Measurement Range	500 mW to 500 W
Peak/Avg Ratio	12 dB

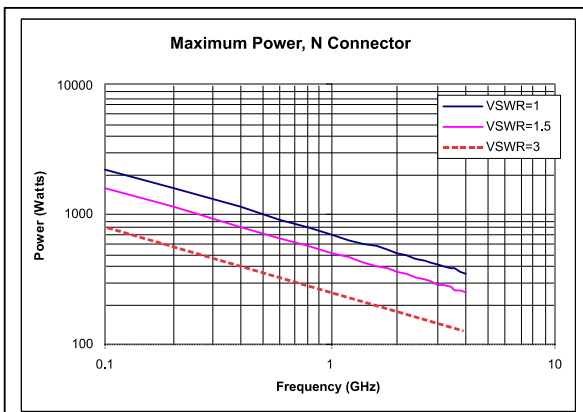
Measurement Uncertainty	+/- (4% of reading +0.17 W) Above 35° C or below 15° C, add 3%.
<b>REFLECTION MEASUREMENT</b>	
Measurement Range Return Loss VSWR Rho	0 to 23 dB 1.15 to 99.9 0.07 to 1.0
Forward Power, Min	0.5 W
Measurement Uncert.	See <a href="#">Figure 3 on page 13</a> .
<b>PEAK ENVELOPE POWER</b>	
Power Measurement Range	13.3 to 1300 W Power depends on frequency and system VSWR. See <a href="#">Figure 4 on page 13</a> .
Measurement Uncert.: burst width > 200 µs 1 µs < b.w. < 200 µs burst width < 1 µs burst width < 0.5 µs	± (7% of reading + 0.7 W) ± (10% of reading + 1.4 W) ± (15% of reading + 1.4 W) ± (20% of reading + 1.4 W)
<b>BURST AVERAGE POWER</b>	
Power Measurement Range	13.0 W to 500 W average
Burst Width	1 µs – 5 ms
Repetition Rate, Min	5 Hz
Duty Cycle (D) (D = Burst Width / Period) (Duty Cycle and CCDF read out dependent on display method.)	0.02 to 1
Measurement Uncert.	± (6% of reading + 0.05/D W) (Above 35 °C or below 15 °C add 3%)
<b>CREST FACTOR (PEAK-TO-AVERAGE RATIO)</b>	
RF Power Range	500 mW to 500 W average, 13.3W minimum peak
Measurement Uncert.	Linear sum of peak and average power uncertainty
<b>COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTION (CCDF)</b>	
Measurement Range (Duty Cycle and CCDF read out dependent on display method.)	0.1 – 100%
Measurement Uncert.	± 2%
Threshold Level Range	13.0 W to 1300 W peak
Level Set Accuracy	As peak power uncert. + 2%
Recommended Calibration Interval	Annually

Mechanical and Environmental Temperature Operating Storage Humidity, Max Altitude, Max	-10 to +50°C (+14 to +122°F) -40 to +80°C (-40 to +176°F) 95% (non-condensing) 4,572 m (15,000ft)
Data Logging	In SK-4500 and VPM3 Software
Dimensions, Nominal	4.75" x 4.6" x 1.3" (121mm x 117mm x 33mm)
Weight, nominal	1.2 lbs (0.55 kg)
Inter-operable Display	SK-4500, SA-XT Series, VPM3, 5000XT

**Figure 3 Match Measure Uncertainty**



**Figure 4 Max. Peak Power**



## 25 Watt Termination

Power Rating	25 W
Frequency Range	DC - 4 GHz
VSWR	
DC - 1 GHz	1.10:1 max.
1 GHz - 4 GHz	1.15:1 max.
Impedance	50 Ohms, Nominal
Temperature Range	-40° to +40° C (-40° to 104° F)
Product Type	Dry (Convection-Cooled)
Operating Position	Any
Connector	N-type, male
Finish	Black Anodized
Dimensions	4.7" L x 2.3" Dia. (119.4 x 58.5 mm)
Weight	7 oz. (198g)

## RF Cable

Frequency Range	DC to 6 GHz
VSWR	
DC - 4 GHz	1.30:1 max.
4 GHz - 6 GHz	1.35:1 max.
Insertion Loss	(dB/ft.)
100 MHz	.04 max
1 GHz	.13 max
3 GHz	.24 max
5 GHz	.36 max
Velocity of Propagation	69%
Capacitance	29.4 pF/ft.
Coax Type	RG142
Connectors	1 - N(m) 1- N(f)
Minimum Bend Radius	1 inch
Length	10 ft (3m)

## Hard Case

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Exterior (L x W x D):	15.27 x 12.13 x 6.69" (38.8 x 30.8 x 17.0 cm)
Body:	Polypropylene
Temperature Range:	-40° to 210° F(-40° to 99° C)
Weight Without Foam:	4.5 lbs
Certifications	IP67, MIL-STD 810F 512.4, Drop test per MIL-STD-3010C method 5007

# 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.



