

# HPRS SERIES

## High-Power Decade Resistance Substituter User and Service Manual



Copyright © 2018 IET Labs, Inc.  
Visit [www.ietlabs.com](http://www.ietlabs.com) for manual revision updates

HPRS im/Sept. 2018



---

**IET LABS, INC.**

**[www.ietlabs.com](http://www.ietlabs.com)**  
Email: [info@ietlabs.com](mailto:info@ietlabs.com)  
TEL: (516) 334-5959 • FAX: (516) 334-5988

## WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable IET specifications. If within one year after original shipment, it is found not to meet this standard, it will be repaired or, at the option of IET, replaced at no charge when returned to IET. Changes in this product not approved by IET or application of voltages or currents greater than those allowed by the specifications shall void this warranty. IET shall not be liable for any indirect, special, or consequential damages, even if notice has been given to the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

**Revision History:**

<b>Date</b>	<b>Description</b>	<b>By</b>
March 2013	Initial release	LB
Sept 2018	Major update for standardization of marking and required information in the manual	BB

## **SAFETY SUMMARY**

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. Such noncompliance would also violate safety standards of design, manufacture, and intended use of the instrument.

IET Labs assumes no liability for the customer's failure to comply with these precautions.

The HPRS Series comply with INSTALLATION CATEGORY I as well as POLLUTION DEGREE 2 as defined in IEC61010-1.

Voltages of up to 1000 Vdc maybe present at measurement terminals.

If an instrument is marked CAT I (IEC Measurement Category I), or it is not marked with a measurement category, its measurement terminals must not be connected to line-voltage mains and it is not designed for use as for measurements within measurement categories II, III and IV,

The HPRS Series are an indoor use product.

### **DANGEROUS PROCEDURE WARNINGS**

Comply with all WARNINGS - Procedures throughout in this manual prevent you from potential hazard. These instructions contained in the warnings must be followed.

### **BEFORE APPLYING POWER**

Verify that all safety precautions are taken. Make all connections to the instrument before applying power. Note the instrument's external markings described under "Safety Symbols".

### **GROUND THE INSTRUMENT**

This is a Safety Class I instrument. To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The power terminal and the power cable must meet International Electrotechnical Commission (IEC) safety standards.

## SAFETY SUMMARY CONTINUED



CAUTION



- DO NOT Operate in an Explosive Atmosphere
- DO NOT operate the instrument in the presence of inflammable gasses or fumes
- Operation of any electrical instrument in such an environment clearly constitutes a safety hazard
- Use Caution around live circuits
- To prevent electrical shock operators must not remove instrument covers
- Component replacement and internal adjustments must be made by qualified maintenance personnel only
- DO NOT substitute parts or modify the instrument
- There are no user serviceable parts inside.
- Refer servicing to qualified personnel.
- Only replaced fuses with correct size and rating to prevent electrical shock

To avoid the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument.

Return the instrument to an IET Labs for service and repair to ensure that safety features are maintained in operational condition.



## WARNING



OBSERVE ALL SAFETY RULES  
WHEN WORKING WITH HIGH VOLTAGES OR LINE VOLTAGES.

**Dangerous voltages may be present inside this instrument. Do not open the case  
Refer servicing to qualified personnel**

### **HIGH VOLTAGES MAY BE PRESENT AT THE TERMINALS OF THIS INSTRUMENT**

WHENEVER HAZARDOUS VOLTAGES (> 45 V) ARE USED, TAKE ALL MEASURES TO  
AVOID ACCIDENTAL CONTACT WITH ANY LIVE COMPONENTS.

USE MAXIMUM INSULATION AND MINIMIZE THE USE OF BARE  
CONDUCTORS WHEN USING THIS INSTRUMENT.

**Use extreme caution when working with bare conductors or bus bars.**

WHEN WORKING WITH HIGH VOLTAGES, POST WARNING SIGNS AND  
KEEP UNREQUIRED PERSONNEL SAFELY AWAY.



## CAUTION



DO NOT APPLY ANY VOLTAGES OR CURRENTS TO THE TERMINALS OF THIS  
INSTRUMENT IN EXCESS OF THE MAXIMUM LIMITS INDICATED ON  
THE FRONT PANEL OR THE OPERATING GUIDE LABEL.

# Contents

WARRANTY .....	3
Revision History .....	4
Safety Summary .....	5
WARNING.....	7
Chapter 1	
<b>INTRODUCTION .....</b>	<b>9</b>
Chapter 2	
<b>SPECIFICATIONS .....</b>	<b>10</b>
Chapter 3	
<b>INSTALLATION .....</b>	<b>12</b>
3.1 Initial Inspection .....	12
3.2 Installation .....	12
3.3 Storage .....	12
Chapter 4	
<b>OPERATION .....</b>	<b>13</b>
4.1. General Considerations.....	13
4.2 Duty Cycle .....	13
4.3 Electrical Considerations .....	13
4.4 Dial Setting .....	13
4.5 Environmental Conditions .....	13
Chapter 5	
<b>MAINTENANCE .....</b>	<b>14</b>
5.1 Preventive Maintenance.....	14
5.2 Verification of Performance .....	14
5.2.1 Calibration Interval .....	14
5.2.2 General Considerations .....	14
5.2.3 Procedure.....	14
5.3 Schematic and Replacement Parts .....	15
5.4 Troubleshooting .....	15
5.5 Disassembly, Component Replacement, and Reassembly... 15	
5.5.1 Disassembly .....	15
5.5.2 Component Replacement .....	15
5.5.3 Reassembly.....	15
5.6 Customer Service.....	15
5.7 Instrument Return .....	16



# Chapter 1

## INTRODUCTION

The High-Power Decade Resistance Substituter (**HPRS**) Series is a family of instruments offering a broad choice of high-power, excellent-performance resistance sources (Figure 1.1). High-power resistors are made available without sacrificing other electrical properties. Any number of decades is available in a choice of two accuracies.

The **HPRS** Series employs state-of-the-art precision resistors of various types for high accuracy, high stability, and low temperature and power coefficients-of-resistance.

The standard models offer a choice of three to nine decades. The panels are clearly labeled showing the step size and maximum voltage and current limitations for each decade.

With a resolution as low as 1 mΩ and a maximum resistance of 10 MΩ, the **HPRS** Series may be used as a general purpose substituter as well as a high-power load for testing power supplies and for other high-power applications.

Applications include calibration of meters and instruments. **HPRS** instruments are useful development tools wherever precise resistances with high-power handling capacity are required.

It is important to keep the amount of time power is applied the the HPRS within the duty cycles below. The duty cycles assume an ambient temperature of around 23°C.

Power	Time on	Time off
<101 W	continuous	none
>101 W	5 minutes	10 minutes

Exceeding the time on can cause damage to the resistors.

If continuous use is required to full rated power see DRS-900 High Power Resistance Substituter.



**Figure 1.1 DRS-900 High-Power Decade Resistance Substituter**

The HPRS series complements the HRRS and HARS series, providing resistance steps as low as 1 mΩ. The units may be rack-mounted to serve as components in measurement and control systems.

This series is part of a family of resistance substituters suited to fill many engineering and testing needs. Consult IET for:

- High power substituters - up to 400 W*
- High resistance substituters - to 1 TΩ*
- RTD simulators*
- Laboratory-standard-grade substituters - to 20 ppm accuracy*
- Programmable substituters - IEEE-488, USB or Ethernet.*



**Figure 1.2 HPRS Series High-Power Decade Resistance Substituter**

# Chapter 2

## SPECIFICATIONS

### SPECIFICATIONS

Resistance per step	Total decade resistance	Max current*	Max power per step* (W)	Temperature coefficient (ppm/°C)	Resistor Type
1 mΩ	0.009 Ω	8 A	0.036	±50	Resistance Wire
10 mΩ	0.09 Ω	6 A	0.36	±50	
100 mΩ	0.9 Ω	6 A	3.6	±20	
1 Ω	9 Ω	5 A	25	-20 to +80	Power Film
10 Ω	90 Ω	1.5 A	25	-20 to +80	
100 Ω	900 Ω	0.5 A	25	-20 to +80	
1 kΩ	9 kΩ	150 mA†	25†	-20 to +80	
10 kΩ	90 kΩ	50 mA†	25†	-20 to +80	
100 kΩ	900 kΩ	V limit†	V limit†	-20 to +80	Wirewound/ metal film
1 MΩ	9 MΩ	V limit†	V limit†	±50	Wirewound/film

\*Subject to maximum of 250 W max. per unit

†Subject to 1000 V (dc+ac) peak max

**Accuracy:**

after subtraction of zero resistance, at 23°C; traceable to SI

**Option F:** ±(1% + 20 mΩ)

**Option C:** ±(0.5% + 20 mΩ)

**Zero Resistance:**

<5 mΩ per decade

**Terminals:**

Two five-way binding posts and one ground post electrically connected to case.

**Dimensions:**

43.9 cm W x 8.9 cm H x 10.2 cm D (17.3" W x 3.5" H x 4" D)

**Weight:**

2.4 kg (5.3 lbs), nominal

### ORDERING INFORMATION

Model* (1.0% accuracy shown)	Total resistance (Ω)	No of Dials	Resolution (Ω)
HPRS-F-3-0.001	0.999	3	0.001
HPRS-F-3-0.01	9.99	3	0.01
HPRS-F-3-0.1	99.9	3	0.1
HPRS-F-3-1	999	3	1
HPRS-F-3-10	9.99 k	3	10
HPRS-F-3-100	99.9 k	3	100
HPRS-F-3-1K	999 k	3	1 k
HPRS-F-3-10K	9.99 M	3	10 k
HPRS-F-4-0.001	9.999	4	0.001
HPRS-F-4-0.01	99.99	4	0.01
HPRS-F-4-0.1	999.9	4	0.1
HPRS-F-4-1	9.999 k	4	1
HPRS-F-4-10	99.99 k	4	10
HPRS-F-4-100	999.9 k	4	100
HPRS-F-4-1K	9.999 M	4	1 k
HPRS-F-5-0.001	99.999	5	0.001
HPRS-F-5-0.01	999.99	5	0.01
HPRS-F-5-0.1	9.999 9 k	5	0.1
HPRS-F-5-1	99.999 k	5	1
HPRS-F-5-10	999.99 k	5	10
HPRS-F-5-100	9.999 9 M	5	100

Model* (1.0% accuracy shown)	Total resistance (Ω)	No of Dials	Resolution (Ω)
HPRS-F-6-0.001	999.999	6	0.001
HPRS-F-6-0.01	9.999 99 k	6	0.01
HPRS-F-6-0.1	99.999 9 k	6	0.1
HPRS-F-6-1 (HPRS-150)	999.999 k	6	1
HPRS-F-6-10	9.999 99 M	6	10
HPRS-F-7-0.001	9.999 999 k	7	0.001
HPRS-F-7-0.01 (HPRS-200)	99.999 99 k	7	0.01
HPRS-F-7-0.1	999.999 9 k	7	0.1
HPRS-F-7-1	9.999 999 M	7	1
HPRS-F-8-0.001	99.999 999 k	8	0.001
HPRS-F-8-0.01	999.999 99 k	8	0.01
HPRS-F-8-0.1 (HPRS-200W)	9.999 999 9 M	8	0.1

\* For 0.5% accuracy, substitute "C" for "F" in part number

**Options:**

-RM for rack mountable version

For programmable versions see PRS-300 and PRS-200/202

## HPRS SERIES HIGH POWER DECADE RESISTANCE SUBSTITUTER

CONSULT INSTRUCTION MANUAL FOR PROPER INSTRUMENT OPERATION

Resistance per step	Total decade resistance	Max current*	Power per step† (W)	Temp. coefficient (ppm/°C)	Resistor type
1 mΩ	0.009 Ω	8 A	0.036	±50	Resistance Wire
10 mΩ	0.09 Ω	6 A	0.36	±50	
100 mΩ	0.9 Ω	6 A	3.6	±20	Power Film
1 Ω	9 Ω	5 A	25	-20 to +80	
10 Ω	90 Ω	4.5 A	25	-20 to +80	Wirewound† metal film
100 Ω	900 Ω	0.5 A	25	-20 to +80	
1 kΩ	9 kΩ	150 mA†	25†	-20 to +80	Wirewound† metal film
10 kΩ	90 kΩ	50 mA†	25†	-20 to +80	
100 kΩ	900 kΩ	V limit†	V limit†	-20 to +80	Wirewound† metal film
1 MΩ	9 MΩ	V limit†	V limit†	±50	

\*Subject to maximum of 250 W per unit  
†Subject to 1000 V (dc-ac) peak max

**Accuracy:**  
at 23°C; traceable to SI

**HPRS-F Series:** ±(1% + 20 mΩ) after subtraction of zero resistance

**HPRS-C Series:** ±(0.5% + 20 mΩ) after subtraction of zero resistance

**Zero Resistance:**  
<5 mΩ per decade

**Terminals:**  
Two five-way binding posts and one ground post electrically connected to case.

**MODEL: HPRS-F-6-0.1**

**SN: E1-18361535**

**WARNING**  
**BURN HAZARD**  
**CASE MAY BE HOT UNDER POWER**

**WARNING**  
Observe all safety rules when working with high voltages or line voltages. Connect the (G) terminal to earth ground in order to maintain the case at a safe voltage. Whenever hazardous voltages (>45 V) are used, take all measures to avoid accidental contact with any live components: a) Use maximum insulation and minimize the use of bare conductors. b) Remove power when adjusting switches. c) Post warning signs and keep personnel safely away.

**IET LABS, INC.**  
CAGE CODE: 62015

Long Island, NY • Email: [info@ietlabs.com](mailto:info@ietlabs.com) • (516) 334-5959 • Fax: (516) 334-5988

[www.ietlabs.com](http://www.ietlabs.com)

HPRS:LBL by HPRS:gen@ietlabs.com

Figure 2.1. Typical Operating Guide Affixed to Unit

## Chapter 3

# INSTALLATION

### 3.1 Initial Inspection

IET instruments receive a careful mechanical and electrical inspection before shipment. Upon receipt, verify that the contents are intact and as ordered. The instrument should then be given a visual and operational inspection.

If any shipping damage is found, contact the carrier and IET Labs. If any operational problems are encountered, contact IET Labs and refer to the warranty at the beginning of this manual. IET Labs will work with you until you are satisfied that your instrument is operating to fulfill the needs of your applications.

Save all original packing material for convenience in case shipping of the instrument should become necessary.

### 3.2 Installation

For a rack-mounted model, installation in a 19-inch rack may be made using the slots in the rack mounting ears. A mounting location that does not expose the unit to excessive heat is recommended.

For bench models, no installation as such is required, because this instrument series is not powered. Since it is a high-accuracy instrument, bench space should be provided that will not expose it to abuse and keep it protected from temperature extremes and contaminants.

### 3.3 Storage

If this instrument is to be stored for any lengthy period of time, it should be sealed in plastic and stored in a dry location. It should not be subjected to temperature extremes beyond the specifications. Extended exposure to such temperatures can result in an irreversible change in resistance, and require repair and/or recalibration

# Chapter 4

## OPERATION

### 4.1 General Considerations

The HPRS Series Decade unit provides three terminals labeled **H** (high), **L** (low), and **G** (ground.) The **H** and **L** terminals are connected to the ends of the resistor being set. the **G** terminal is connected to the case. The **G** terminal may be used as a guard or shield terminal. It may also be connected using a shorting link to either terminal to allow two-terminal as opposed to three-terminal measurement. See Figure 5.1.

In order to make proper use of the full performance capabilities of the HPRS unit, especially if low resistance or high power are important, take care in connecting to the terminals of the decade box.

In order to keep contact resistance to a minimum, make the most substantial and secure connection to the binding posts. They accept banana plugs, telephone tips, spade lugs, alligator clips, and bare wire. The largest or heaviest mating connection should be made, and, where applicable, the binding post should be securely tightened.

### 4.2 Duty Cycle

It is important to keep the amount of time power is applied the the HPRS within the duty cycles below. The duty cycles assume an ambient temperature of around 23°C.

Power	Time on	Time off
<101 W	continuous	none
>101 W	5 minutes	10 minutes

Exceeding the time on can cause damage to the resistors. If continuous use is required to full rated power see DRS-900 High Power Resistance Substituter.

### 4.3 Electrical Considerations

As a good safety practice, the case should be grounded using the **G** terminal.

Since high voltages may be present, it is important to observe all precautions and safety rules.

- **CONNECT THE G (GND) TERMINAL TO EARTH OR OTHER SUITABLE GROUND IN ORDER TO MAINTAIN THE CASE AT A SAFE VOLTAGE.**
- **WHENEVER HAZARDOUS VOLTAGES (>45 V) ARE USED, TAKE ALL MEASURES TO AVOID ACCIDENTAL CONTACT WITH ANY LIVE COMPONENTS:**
- **-USE MAXIMUM INSULATION AND MINIMIZE THE USE OF BARE CONDUCTORS.**
- **- REMOVE POWER WHEN SETTING SWITCHES.**
- **EXERCISE CARE WHEN HANDLING UNIT. CASE - ESPECIALLY REAR AND BOTTOM MAY BECOME HOT IF HIGH POWER IS APPLIED FOR AN EXTENDED PERIOD.**
- **POST WARNING SIGNS AND KEEP PERSONNEL SAFELY AWAY.**

### 4.4 Dial Setting

Whenever the dials are used for positions 0-9, the resulting resistance is simply read from the panel dial setting directly. Both the decimal point and the steps are clearly marked on the panel.

### 4.5 Environmental Conditions

For optimal accuracy, the decade box should be used in an environment near 23°C and <50% RH. It should be allowed to stabilize at those conditions for at least two hours after any significant temperature variation.

# Chapter 5

## MAINTENANCE

### 5.1 Preventive Maintenance

The HPRS Decade Substituter is packaged in a ventilated case. If it is maintained in a generally clean or air-conditioned environment, cleaning will seldom be necessary. In a contaminated atmosphere, cleaning may be required.

To maintain optimal accuracy and stability, it is best not to open the case of the unit. In normal service, the switches require no additional lubrication. During the manufacturing process, a light lubrication is applied which in most instances is sufficient for the service life of the switches, and yet will not tend to collect dust.

### 5.2 Verification of Performance

#### 5.2.1 Calibration Interval

The HPRS Series instruments should be verified for performance at a calibration interval of twelve (12) months. This procedure may be carried out by the user, if a calibration capability, is available, by IET Labs, or by a certified calibration laboratory. If the user should choose to perform this procedure, then the considerations below should be observed.

#### 5.2.2 General Considerations

It is important, whenever testing the HPRS Series Decade Units, to be very aware of the capabilities and limitations of the test instruments used. There are a some bridges and direct reading resistance me-

ters or digital multimeters available that can verify the accuracy of these units, *especially* when used in conjunction with standards that can serve to confirm or improve the accuracy of the testing instrument.

Such instruments would have to be *significantly* more accurate than the specified accuracies for all applicable ranges, in order to perform this task, allowing for a band of uncertainty of the instrument itself. A few commercial models, bridges and meters, do exist that can do this; consult IET Labs for information.

It is important to allow both the testing instrument and the HPRS Substituter to stabilize for a number of hours at the nominal operating temperature of 23°C, and at < 50% RH. There should be no temperature gradients across the unit under test.

Proper metrology practices should be followed in performing this verification.

#### 5.2.3 Procedure

1. Confirm the zero resistance of the unit.
2. Determine the allowable upper and lower limits for each resistance setting of each decade following the specified accuracy given in the Specifications Section of Chapter 2.
3. Confirm that the resistances fall within these limits.
4. If any resistances fall outside these limits, the associated switch assembly may be trimmed, repaired or replaced.

### 5.3 Schematic and Replacement Parts

Refer to Figure 5.1 for a basic schematic of the HPRS decade unit.

If you must order parts, give the model number and serial number from the bottom label, and a detailed description of the part or assembly.

### 5.4 Troubleshooting

If the verification procedure results in a failure, disassemble the unit as described below, and examine the parts in question to determine the necessary repair or replacement.

### 5.5 Disassembly, Component Replacement, and Reassembly

It is recommended that service be performed only by IET Labs or by qualified personnel.

#### 5.5.1 Disassembly

Referring to Figure 5.2 to locate part numbers, proceed as follows:

1. Work in a clean environment.
2. Place the instrument on a flat surface and remove the 4 housing screws from the bottom of the instrument. The housing may now be removed.

#### 5.5.2 Component Replacement

Determine and locate any faulty component that requires replacement.

To remove a decade switch assembly proceed as follows:

1. Label and unsolder the bus wires connecting the switch assembly to the resistive loads.
2. Loosen the screw holding the knob on the switch shaft and remove the knob.
3. Remove the nut holding the switch assembly on the front panel and remove the assembly.
4. Replace the assembly by reversing the above steps, making certain that the knob screw is aligned with the flat portion of the switch shaft.

#### 5.5.3 Reassembly

1. Make certain that the 4 standoffs have not become loose; tighten as required.
2. Replace the housing: line up the holes in the standoffs with the holes in the case, and install the 4 housing screws.

### 5.6 Customer Service

The IET warranty attests to the quality of materials and workmanship in our products. For application assistance or if difficulties occur, our engineers will assist in any way possible. If you cannot eliminate the difficulty, please e-mail, FAX, or phone our Service Department, giving full information of the trouble and of steps taken to remedy it. Be sure to include the type and serial number of the instrument.

Call 516-334-5959 for technical support or customer service

[www.ietlabs.com](http://www.ietlabs.com)

## 5.7 Instrument Return

Before returning an instrument to IET for service please call our Service Department at 516-334-5959 for Return Material Authorization (RMA) or visit [www.ietlabs.com](http://www.ietlabs.com) to request an RMA online.

Include a Purchase Order Number to insure expedient processing.

Units under warranty will be repaired at no charge.

For any questions on repair costs or shipment instructions, please contact our Service Department at the above number or visit [www.ietlabs.com](http://www.ietlabs.com) to request an RMA online.

To safeguard an instrument during shipment, please use packaging that is adequate to protect it from damage, (i.e., equivalent to the original packaging) and mark the box "Delicate Electronic Instrument". Return material should be sent freight prepaid to:

IET Labs, Inc.  
1202 VFW Parkway  
West Roxbury, MA 02132

Attention: RMA #



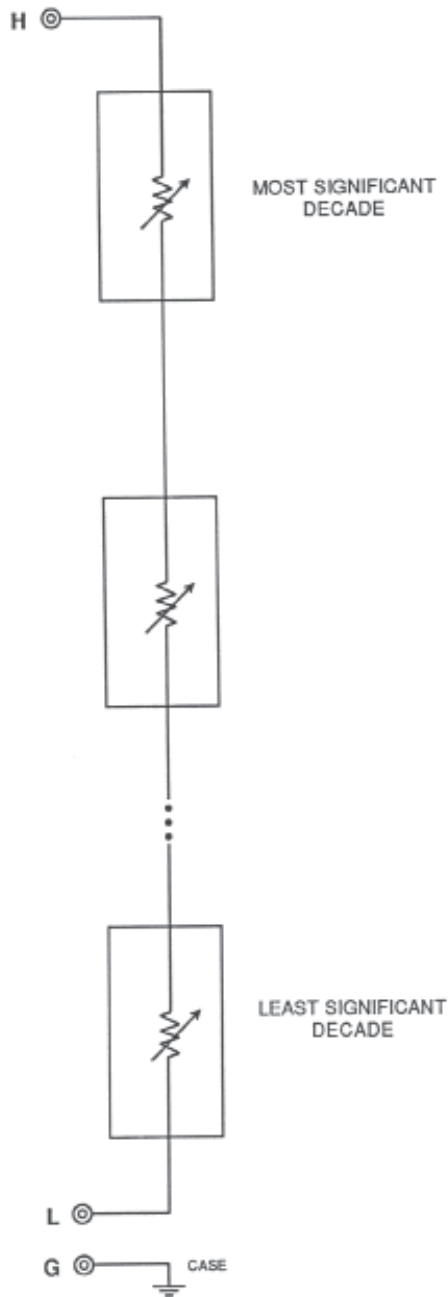


Figure 5.1. HPRS Series Schematic Diagram