



# RESISTOR CATALOG

1933

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International Resistance Company

2006 Chestnut Street

Philadelphia, Pa.

Canadian Plant

Toronto, Ont., Canada



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## SPECIAL NOTICE

The prices quoted in this catalog are list prices and are subject to change without notice. Our regular discounts apply to jobbers, dealers and servicemen. Special quantity prices will be quoted to manufacturers and quantity users, on request.

All I. R. C. Products are available through the regular jobber, dealer and mail order channels.

If you cannot obtain I. R. C. products from your regular source of supply, please send us your order direct and we shall see that it is filled by the jobber or dealer nearest to you.

**International Resistance Co.**

**2006 Chestnut Street**

**Philadelphia, Pa.**

**U. S. A.**

## OHMS' LAW AND POWER FORMULAS

When making resistor calculations, two fundamental formulas are employed. One, known as Ohm's Law, shows the relation between voltage, current and resistance in a circuit, while the other gives the power consumed in the circuit.

To simplify the calculations involving any of the factors used in these two fundamental factors, we have prepared the following chart which indicates quickly the formula to use to solve for any factor when the other factors are known.

Since the currents used

VOLTAGE in Volts	CURRENT in Ma.	RESISTANCE in Ohms	POWER in Watts
KNOWN	KNOWN	$\frac{\text{Volts} \times 1,000}{\text{Ma.}}$	$\frac{\text{Volts} \times \text{Ma.}}{1,000}$
KNOWN	$\frac{\text{Volts} \times 1,000}{\text{Ohms}}$	KNOWN	$\frac{\text{Volts} \times \text{Volts}}{\text{Ohms}}$
KNOWN	$\frac{\text{Watts} \times 1,000}{\text{Volts}}$	$\frac{\text{Volts} \times \text{Volts}}{\text{Watts}}$	KNOWN
$\frac{\text{Ma.} \times \text{Ohms}}{1,000}$	KNOWN	KNOWN	$\frac{\text{Ma.} \times \text{Ma.} \times \text{Ohms}}{1,000,000}$
$\frac{\text{Watts} \times 1,000}{\text{Ma.}}$	KNOWN	$\frac{\text{Watts} \times 1,000,000}{\text{Ma.} \times \text{Ma.}}$	KNOWN
$\sqrt{\text{Ohms} \times \text{Watts}}$	$1,000 \sqrt{\frac{\text{Watts}}{\text{Ohms}}}$	KNOWN	KNOWN

in radio are usually given in milliamperes, correction factors have been included so that the currents may be used in milliamperes.

If the formulas are to be used with amperes, all that is necessary is to take out the numbers, 1,000 or 1,000,000 which appear in the formulas.

When using the chart, find the horizontal line in which the known values heading the columns are marked "KNOWN" and the formula for either of the two remaining values will be found along the same horizontal line in the other two columns.

## RESISTORS IN SERIES AND PARALLEL

### Resistors in Series

When resistors such as R1, R2, are connected in series, the total resistance, R, of the combination is equal to the sum of the resistors connected in series:

$$R = R1 + R2, \text{ etc.}$$

where R is the total resistance of the combination and R1, R2, etc., are the resistances of the individual units connected in series.

### Resistors in Parallel

When two or more resistors such as R1, R2, are connected in parallel, the total resistance, R, of the combination is found by using the formula:

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2} \text{ etc.}$$

where R is the total resistance of the combination and R1, R2, etc., are the resistances of the individual units connected in parallel.

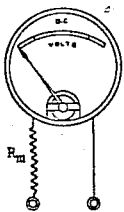
## GRID BIAS RESISTOR CALCULATIONS

Determining the proper value of grid bias resistor to use with different types and combinations of tubes is a comparatively simple matter if the grid bias voltage required, and the plate current drawn by the tube or combination of tubes is

known. The resistance is found by using Ohm's Law, dividing the voltage required, by the current drawn by the tube or combination of tubes.

The power dissipated by the resistors is found by using the power formula given above.

## CONVERSION OF AND EXTENSION OF RANGES OF METERS



Extending the Range of a D. C. Voltmeter

$R_v$  = Resistance of the voltmeter in ohms, or, if ohms per volt, is given,  $R_v$  can be found by multiplying the ohms per volt by the maximum reading in volts of the voltmeter.

$V_1$  = Original maximum reading of the meter in volts.

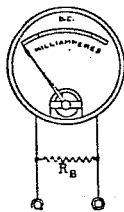
$V_2$  = The desired new maximum reading of the voltmeter in volts.

$N$  = Multiplying factor =

$$\frac{V_2}{V_1}$$

$R_m$  = Resistance in ohms required in the meter multiplier as an external resistor.

Then:  $R_m = R_v \times (N-1)$



Converting a D. C. Milliammeter into a D. C. Voltmeter

$I$  = Original maximum reading in milliamperes.

$V$  = Desired maximum reading in volts.

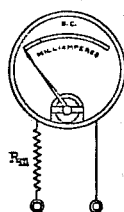
$R_m$  = Resistance of multiplier required, in ohms.

Then:

$$R_m = \frac{V \times 1,000}{I}$$

Note: The internal resistance of the milliammeter may be neglected without seriously affecting the result, for all practical purposes.

**I. R. C. Precision Wire Wound Resistors are specially suited for use in converting or extending the range of meters.**



Finding the Shunt Required to Extend the Range of a D. C. Milliammeter

$R_m$  = Resistance of the meter in ohms.

$I_m$  = The original maximum reading in milliamperes.

$I$  = The desired new maximum reading, in milliamperes.

$N$  = Multiplying factor =

$$\frac{I}{I_m}$$

$R_s$  = The value of resistance in ohms of the shunt required.

Then:

$$R_s = \frac{R_m}{N-1}$$

In using the above method, the resistance of the meter must be known accurately. If the meter resistance is not accurately known, greater ac-



curacy in scale conversion may be obtained by using two I.R.C. Precision Wire Wound Resistors as shown in the accompanying illustration. The use of this circuit arrangement, reduces considerably the error that would otherwise occur when the resistance of the meter is not accurately known.

$R_m$  = Approximate meter resistance, as from manufacturer's catalog.

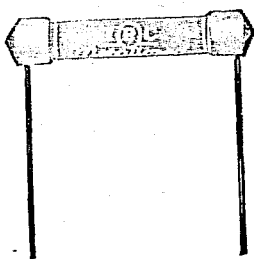
$R_k$  = A resistor, equal in ohms, to 9 times  $R_m$ .

Then:

$$R_s = \frac{R_k + R_m}{N-1} = \frac{10 \times R_m}{N-1}$$

See list of Free I.R.C. Service Helps on Pages 15-16

# I. R. C. METALLIZED RESISTORS—STOCK SINGLE UNITS



Type F-1—1 Watt

The I. R. C. Metallized Resistor, introduced in radio in 1923 by the International Resistance Co., was the first really practical high resistance unit for grid leak, plate coupling resistance and resistance filter use, and quickly replaced the makeshift paper and carbon type grid leak resistors.

The millions of I. R. C. Metallized units now in operation in every field and their continued success in service is the best proof of their dependability.

The efficiency and long life of these units is due to their unique construction. The resistance unit is a Metallized filament consisting of a glass rod, coated with a specially developed resistance material which is baked on to the glass rod at very high temperatures.

The resistance element is then inserted in a special grade ceramic tube which has the following characteristics:

- (a) Non-hygroscopic (does not absorb moisture).
- (b) High heat conductivity enabling the resistor to dissipate power.
- (c) High mechanical strength to withstand handling and assembly.

The metal ends which serve as the terminals are then moulded around the ends of the Metallized glass filament which protrude at both ends of the enclosing ceramic tube. A special alloy is employed for this purpose which shrinks around the Metallized filament and makes a very tight, noiseless contact.

In the wire lead and soldering lug type units, the wire leads or lugs are also moulded in the ends making a positive contact throughout.

The complete resistor is then impregnated in a moisture-proof mate-



Type F-1/2—1/2 Watt

*Metallized*

GENERAL CHARACTERISTICS AND PRICES						
Code No.	Rating Watts	Resistance Range Ohms	Dimensions		List Price	
			Len.	Dia.		
METALLIZED RESISTORS IN CERAMIC TUBES						
F-1/8	1/8	30 to 3,000,000	5/8"	3/2"	.20	
F-1/2	1/2	50 to 5,000,000	1 1/2"	3/2"	.20	
F-1	1	100 to 10,000,000	1 1/2"	1 1/2"	.20	
F-2	2	50 to 5,000,000	2 1/2"	7/8"	.30	
F-3	3	100 to 5,000,000	2 5/8"	1 1/2"	.40	
Special	—	10,000,000 to 200,000,000	1 1/2"	1 1/2"	Note 1	
METALLIZED RESISTORS ENCLOSED IN GLASS TUBES						
MG-3	—	Up to 250,000,000	3"	1 1/2"	Note 1	
MG-6	—	Up to 10,000,000,000	6"	1 1/2"	Note 1	
MG-12	—	Up to 10,000,000,000	12"	1 1/2"	Note 1	
SPECIAL NOTES						
NOTE 1: Prices are special and will be quoted on request.						
STANDARD TERMINALS: Unless otherwise specified all units are furnished regularly with wire leads which can be cut off if not required, for mounting between grid leak clips. Standard length of wire leads is 1 1/2" but leads of any length desired can be furnished on quantity orders at slightly higher prices.						
TOLERANCE: The standard resistance tolerance of all stock values of I. R. C. Metallized Resistors is 10%. They can be furnished to 5% tolerance at slightly higher list price. Prices on units with tolerance closer than 5% on application.						

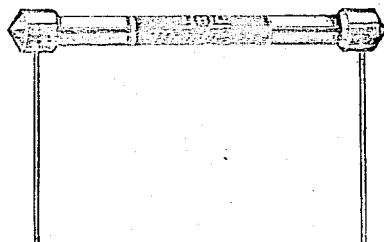


Type F-2—2 Watts Without Wire Leads

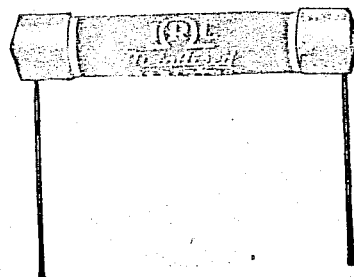
rial which results in the exceptional behavior of Metallized resistors under high humidity conditions.

### Stock Resistance and Power Ratings

I. R. C. Metallized Resistors are available in a wide variety of power and resistance ratings to meet every requirement for resistors of this type. The stock resistance ranges and power ratings in which the various standard units are available are listed in this section. Complete stocks of these



Type MG Glass Enclosed Resistors



Type F-3—3 Watts

values are kept on hand constantly so that orders can be filled immediately.

Special units can be made to suit the resistance, wattage and tolerance requirements of manufacturers and other quantity users.

### Very High Resistance Units

For special applications such as Sound and Photocell Equipment and X-Ray and other high-voltage work requiring very high resistance values from 10 to 10,000 megohms, I. R. C. now makes available a standard line of very high resistance Metallized Resistors incorporating the same features used in our other Metallized Resistors, and therefore stable and quiet in operation.

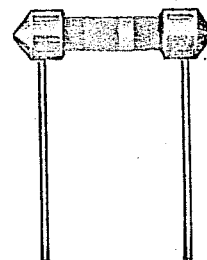
These units consist of a Metallized Filament of the proper resistance characteristics enclosed in either a glass tube or the ceramic tube used in our standard Metallized Resistors.

They are available in standard F-1 ceramic tube or 3-inch, 6-inch and 12-inch glass tubes. Special lengths to suit requirements can be furnished on request.

### Standard Terminals

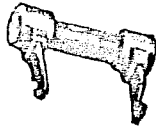
I. R. C. Metallized Resistors are regularly made with metal grid leak end terminals, with wire leads and with soldering lug terminals.

The grid leak end terminal types are designed so that the units can be inserted between the clips of standard grid leak mountings. In applications or assemblies where the wire leads are not required, the leads can be cut at the terminals.



Type F-1/2—1/2 Watt

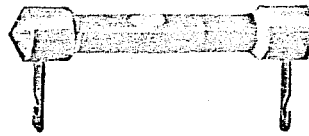
## I. R. C. METALLIZED RESISTORS—LUG AND SPECIAL TERMINALS



Type F- $\frac{1}{2}$  with Lug Terminals

I. R. C. Metallized Resistors are specially designed to permit the use of a wide variety of terminals to suit individual assembly requirements.

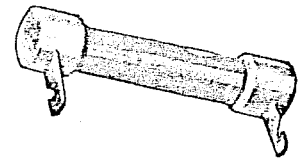
The standard terminals regularly supplied with our F- $\frac{1}{2}$  ( $\frac{1}{2}$  watt), F-1 (1 watt), F-2 (2 watt) and F-3 (3 watt) Metallized Resistors are the grid



Type F-1 with Lug Terminals

leak end terminals and wire leads illustrated on the opposite page and the soldering lug terminals illustrated in this section.

On special quantity orders they can be furnished with any type of special terminals required.



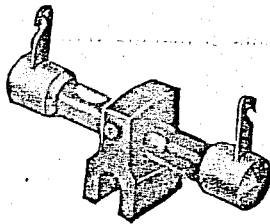
Type F-2 with Lug Terminals

Unless otherwise specified, wire lead terminals will be furnished on all regular orders. When other terminals are required they should be specified thus:—

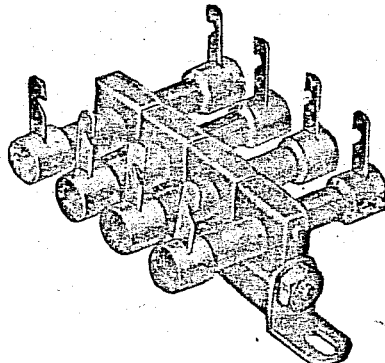
Type F-1 without wire leads.

Type F-1 with lug terminals, etc.

## CENTER-MOULD MOUNTING—SINGLE UNIT AND GANG ASSEMBLIES



Type F-1 with Lug Terminal and C-M Mounting



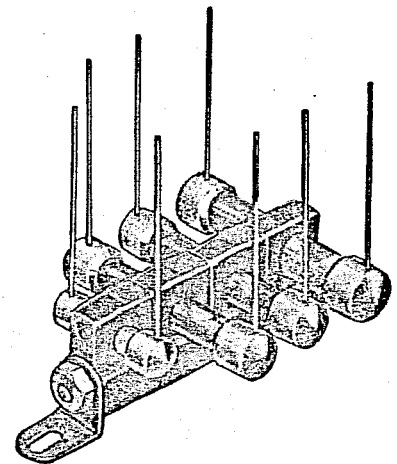
Metallized Resistors with Lugs and Center-Mould Gang Mountings

I. R. C. Metallized Resistors, fitted with standard wire lead, soldering lug or special terminals, lend themselves to an unlimited number of gang arrangements which simplify receiver assembly and wiring and cut down production costs.

The center-mould type of mounting for single units or gang assemblies developed by the International Resistance Co. and illustrated in this section has proved very popular for both experimental and production assemblies. This type of unit is sturdily constructed, compact and low in cost. It is designed to cut assembly costs and eliminate servicing troubles which usually result from insecure mounting of resistors.

Any number of I. R. C. Metallized Resistors, of similar or different power ratings and resistance values can be ganged together in this manner.

Prices will be quoted on receipt of specifications.

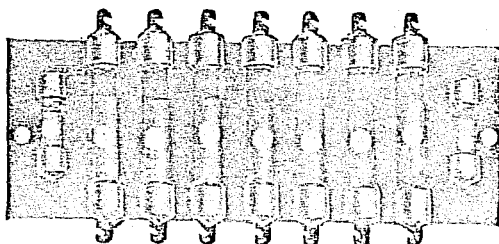


Metallized Resistors with Wire Leads and Center-Mould Gang Mountings

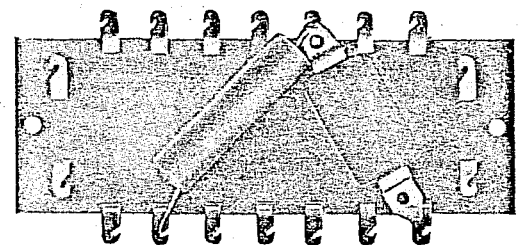
## I. R. C. METALLIZED RESISTOR PANEL GANG ASSEMBLIES

When assembly costs must be cut to the minimum and every available inch of space must be utilized in the demand for more compact sets, the I. R. C. Resistor Panel Gang Assemblies step in to fill a long-felt need.

The illustrations in this section speak for themselves. The units are equipped with lugs which slip through holes provided for them in the panel. The lugs are then bent over to fasten the resistor firmly in place on the panel. This construction eliminates eyeletting, soldering, rivetting and mounting costs and makes these lug type units ideally suited for gang assemblies.



Resistor Panel—Front View



Resistor Panel—Rear View  
Showing Adaptability for Mounting Other Units

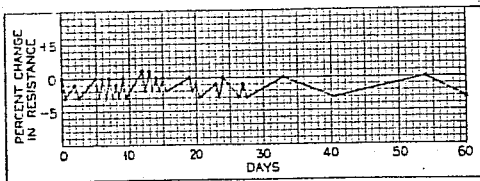
Flexibility is the keynote of this idea. Any number or combination of different types of resistors can be used. And the clear space on the back of the panel provides support for other component parts.

We can furnish resistors in quantities with our standard lugs which you can mount in this way or we can furnish completely mounted units on panels in accordance with your specifications. Prices will be quoted on receipt of your specifications.

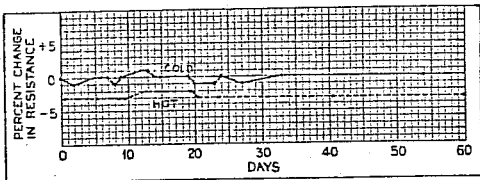
# PERFORMANCE CHARACTERISTICS—I. R. C. METALLIZED RESISTORS

CLAIMS BASED ON FACTS AND TESTS

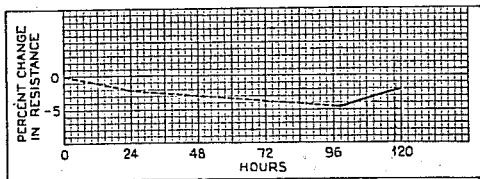
All the claims made for I. R. C. Metallized Resistors are based on actual tests and known facts. The data given in this section indicates the extent to which International Resistance Co. engineers have gone to give their customers actual facts on which to base their designs of radio and electrical equipment.



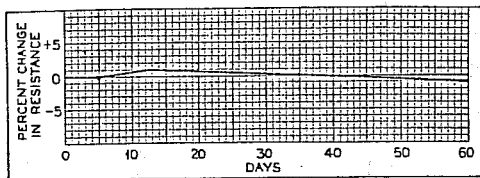
**PERMANENCE CHARACTERISTIC**  
At Intermittent, Rated 1.0 Watt Load



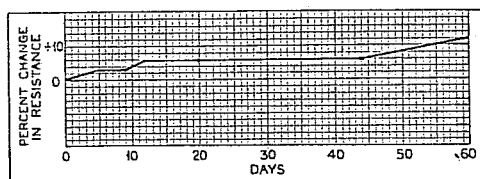
**ENVELOPES OF HOT AND COLD RESISTANCES**  
OF ABOVE CURVE



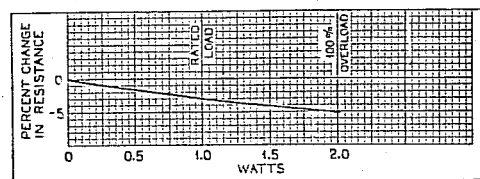
**OVERLOAD CHARACTERISTIC**  
At Continuous 50% Overload



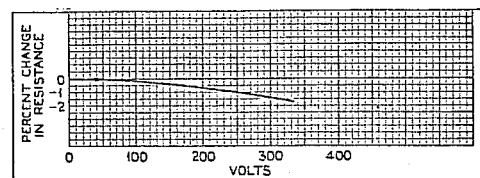
**AGING CHARACTERISTIC**



**HOT MOISTURE CHARACTERISTIC**  
90% Relative Humidity, 40° C. Temperature



**LOAD CHARACTERISTIC**



**VOLTAGE CHARACTERISTIC**

## PERFORMANCE CURVES

**I. R. C. METALLIZED RESISTORS**  
100,000-OHM RANGE

Typical of Power Resistor Ranges Up to 150,000 Ohms

## PERFORMANCE CURVES OF I. R. C. METALLIZED RESISTORS

The performance curves given on the charts on this and the opposite page represent results of measurements and tests of large numbers of I. R. C. Metallized Resistors. Two representative ranges have been covered in these curves—100,000 ohms in the power range and 1 megohm in the grid leak range. The performance of the 100,000-ohm resistors is representative of the performance of I. R. C. Metallized Resistors in all values up to 150,000 ohms. The performance of the 1 megohm resistors is representative of I. R. C. Metallized Resistors in all values above 150,000 ohms, where the power requirements are low.

## RESISTANCE RATING

All I. R. C. Metallized Resistors are accurately tested and are warranted to be within their specified resistance ratings. Because of the process used, and the care employed in manufacturing and testing these units, they will remain accurate even after years of use.

## PERMANENCE CHARACTERISTICS

The "Permanence Characteristics" curves show the performance to be expected of I. R. C. Metallized Resistors. Rated load is applied intermittently, and resistance is measured after the "on" and "off" periods at intervals. It will be observed that in the power ranges (100,000-ohm curve) no appreciable permanent change results from operation, under normal load, the units always coming back to their initial value. The envelopes of the hot and cold resistance show the constancy of performance and the permanence characteristic of I. R. C. Metallized Resistors.

In the grid leak range, the "Permanence" curve has been drawn for a load of 0.42 watts, corresponding to a voltage of 650 volts. This is much in excess of normal operating voltages for this value. Even at this high voltage, the "Permanence" curve and envelopes show the constancy and high degree of uniformity to be expected of I. R. C. Metallized Resistors.

## LOAD CHARACTERISTICS

The "Load Characteristic" curve shows the manner in which I. R. C. Metallized Resistors behave when subjected to varying loads up to twice normal rating. The loads were applied for a period of ten minutes and resistance measured. These curves make possible a quick determination of the behavior of I. R. C. Metallized Resistors under any load up to twice normal rating.

## OVERLOAD CHARACTERISTICS

The "Overload Characteristics" are a measure of the safety factor incorporated in I. R. C. Metallized Resistors and show their ability to stand heavy overloads. In accordance with recently adopted R. M. A. standards, 50% overload was applied to the resistors continuously for 100 hours in an ambient temperature of 40 degrees C. and hot resistance measured daily. At the end of the 100-hour period, units were allowed to cool and a final resistance measurement was made to determine the permanent change. I. R. C. Metallized Resistors in the power range show a change of resistance under 50% overload not exceeding 5%, and recover to within 2% to 3% of their initial value.

# PERFORMANCE CHARACTERISTICS—I. R. C. METALLIZED RESISTORS

## AGING CHARACTERISTICS

The "Aging Characteristics" of I. R. C. Metallized Resistors are a measure of their shelf life. I. R. C. Metallized Resistors show no appreciable aging effect over long periods of time. Change in range due to aging does not exceed 1% to 2% depending upon the range.

## HUMIDITY CHARACTERISTICS

The humidity characteristics show the ability of I. R. C. Metallized Resistors to withstand conditions of high humidity. The units tested were measured initially for resistance and then placed in a humidifier under controlled conditions in which the temperature was 40 degrees C. and the relative humidity was 90%. Resistances were measured from day to day to determine the effect on range. Over extended periods of time, I. R. C. Metallized Resistors did not change more than about 10%, proving their constancy.

## TEMPERATURE COEFFICIENT

The temperature coefficient of I. R. C. Metallized Resistors averages 0.04% per degree Centigrade.

## VOLTAGE COEFFICIENT

The "Voltage Characteristic" curves are indices of the behavior of I. R. C. Metallized Resistors when subjected to various potentials. It will be observed that the resistance of these units shows a negligible change with voltages up to and beyond normal rating.

## NOISE CHARACTERISTICS

Because of their exceptionally uniform characteristics under all conditions of operation, resulting from the homogeneous coating used in I. R. C. Metallized Resistors, these units are exceptionally quiet in operation, even after long periods of constant use.

## MECHANICAL CHARACTERISTICS

I. R. C. Metallized Resistors are the most rugged, compact, easily-assembled units available in their respective classes of resistance and power ratings.

To test the mechanical strength of I. R. C. Metallized Resistors, Type F-1, 1-watt I. R. C. Metallized Resistors were placed on knife edges spaced to a distance equal to 75% of the overall length of the units. Weights were applied, in the case of each resistor, to a third knife edge centrally placed on top of each resistor. The load was gradually increased until failure occurred, and it was found that the average I. R. C. Type F-1 Metallized Resistor has a static strength of 65 lbs.

The strength of the leads were tested by supporting a resistor vertically by clamping one lead and hanging weights from the end of the other lead until failure occurred. It was found that an average of 45 lbs. loading is required to tear a lead at the joint of a standard Type F-1, 1-watt I. R. C. Metallized Resistor.

## SUMMARY OF CHARACTERISTICS

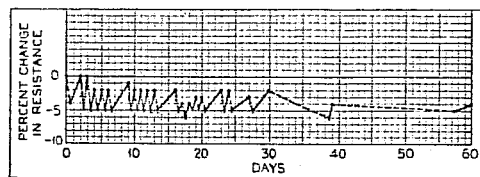
A consideration of the above data shows that I. R. C. Metallized Resistors measure up to the highest standards of performance on all counts, not simply on one or two.

It is this overall performance or coordination of characteristics that makes them dependable under all conditions of operation over long periods of time.

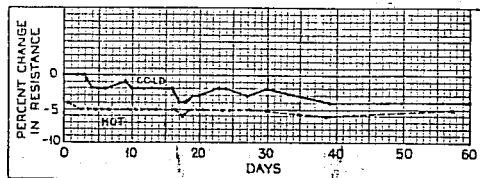
## SPECIAL SERVICE

During the course of our many years of specialized experience in the resistor field, we have accumulated a wealth of data on the characteristics of resistor units, and their application in the solution of a wide variety of resistor problems.

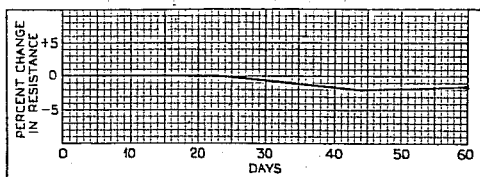
If you have any problems involving resistor designs or applications, please do not hesitate to communicate with us. In many cases we will probably have solved similar problems in the past and can therefore help in the solution of your particular problem at a saving to you of time and money.



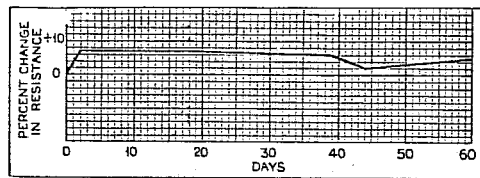
PERMANENCE CHARACTERISTIC  
At Intermittent 0.42 Watt Load



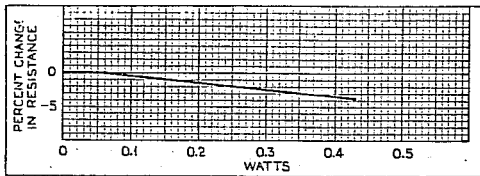
ENVELOPES OF HOT AND COLD RESISTANCES  
OF ABOVE CURVE



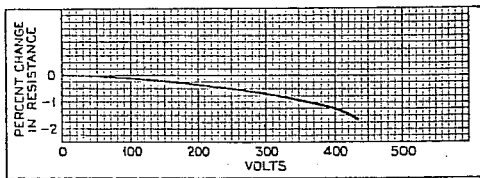
AGING CHARACTERISTIC



HOT MOISTURE CHARACTERISTIC  
90% Relative Humidity, 40° C. Temperature



LOAD CHARACTERISTIC



VOLTAGE CHARACTERISTIC

## PERFORMANCE CURVES

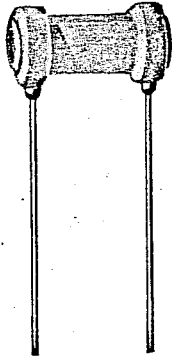
I. R. C. METALLIZED RESISTORS  
1.0-MEGOHM RANGE

Typical of Grid Leak Ranges Above 150,000 Ohms

## I. R. C. POWER WIRE WOUND RESISTORS

The general details of construction of the I. R. C. Power Wire Wound Resistors are shown at the right.

This illustrates a unit completely assembled except for the insulating coating. An accurately spaced winding of resistance wire having a low temperature coefficient, is wound on a ceramic core. This core is non-hygroscopic and has a high mechanical strength which eliminates loss due to breakage.



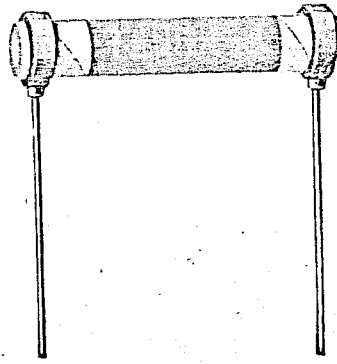
Type PA  
Power Wire Wound Resistor

### Positive Contact

Since open contacts and loose connections have been responsible for most of the trouble encountered in the use of power wire wound resistors, considerable time and effort was spent in overcoming that weakness.

In our wire wound units, contact is made by the exclusive I. R. C. method. A band of metal is moulded at the ends of the winding and the resistance wire is brought through the moulded end, thus assuring positive contact. Lugs or wire leads are also moulded in at the same time.

No mechanical stress is applied to the wire, as often occurs when clamping the resistance wire to the terminal. As a result the I. R. C. method of

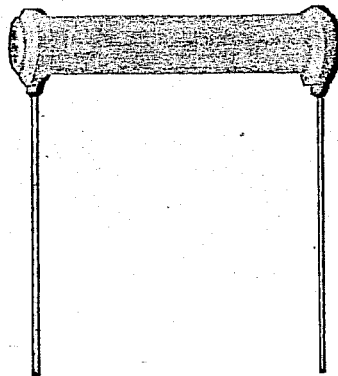


Power Wire Wound Resistor  
with Insulating Coating Removed

making contact eliminates the common failures such as breakage of wire at contacts, and loose connections.

### Insulating Coating

The ability of a wire wound resistor to withstand high humidity is a very important factor and should be checked carefully before making a choice of any resistor of this type. Unless a resistor can withstand high humidity,



Type PB  
Power Wire Wound Resistor

damage to the coating and trouble at the contact is likely to occur in service.

The coating of I. R. C. Power Wire Wound Resistors is specially selected to protect the unit against high humidity conditions, without sacrificing its ability to withstand high temperatures.

This enables the units to meet the conditions which develop during operation without danger of damage or change in characteristics.

The insulating coating used is a good conductor of heat and acts to bring the heat developed in the resistance wire to the surface to be dissipated quickly.

The hard coating forms an ideal mechanical protection for the wire.

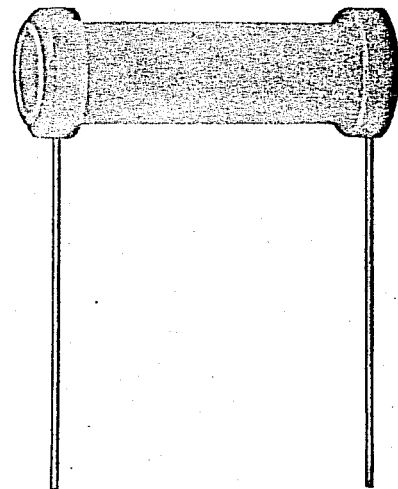
### Power Rating

The ratings assigned to I. R. C. Power Wire Wound Resistors are the maximum powers which may be applied when the resistor is used in free air. Under this condition the surface temperature rise of the resistor, at its hottest spot, is about 175 degrees Centigrade.

In general practice it is not possible to obtain such good ventilation conditions and as a result it is necessary to operate resistors below their nominal power ratings.

In addition to the ventilation conditions under which the resistor is to be operated it is important to take into consideration the proximity of the resistor to other parts which may be affected by excessive temperatures, such as filter condensers, transformers, chokes, etc., and the Fire Underwriters requirements.

These factors limit the maximum power which may be applied to any resistor of a given nominal maximum watt rating.



Type PC  
Power Wire Wound Resistor

### I. R. C. POWER WIRE WOUND RESISTORS

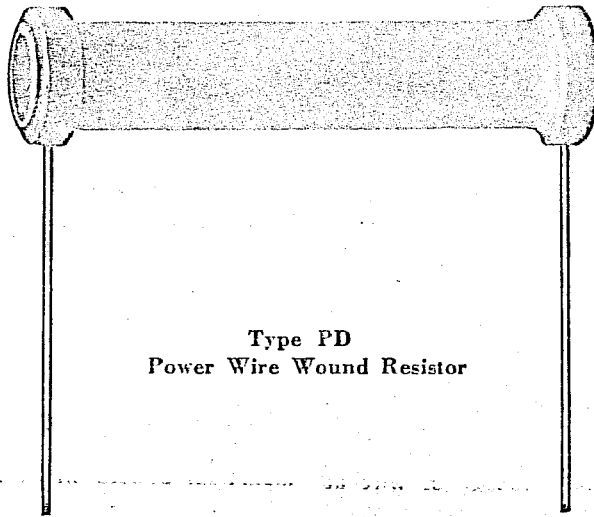
Type No.	Max. Rating in Free Air Watts	Resistance Range Ohms	*Standard Tolerance	Dimensions		†List Price
				Len.	Dia.	
PA	3	Up to 5,000	5%	3/8"	1/8"	\$ .35
PB	5	Up to 15,000	5%	1 1/4"	1/8"	.35
PC	10	Up to 30,000	5%	2 "	1/8"	.50
PD	15	Up to 50,000	5%	3 "	1/8"	.65

Note\*: Can be furnished to closer tolerances at increased list price. Price on request.

Note†: List prices are subject to jobber and servicemen's discounts. Quantity prices to manufacturers on application.



I. R. C. POWER WIRE WOUND RESISTORS (CONTINUED)



Type PD  
Power Wire Wound Resistor

In ordering resistors, it is highly desirable that we be given as specific information as possible regarding the maximum current which will be carried by the resistor, or the maximum voltage which will be applied across it, and the mechanical layout or ventilation conditions in the receiver or equipment in which the resistor is to be used.

With such information, we shall be in a better position to recommend the most suitable unit or units for the purpose.

**Resistance Tolerance**

Standard I. R. C. Wire Wound Resistors are regularly made to normal tolerances of 5% plus or minus, making them better suited than ordinary wire wound resistors, that are available only in tolerances of 10% plus or minus, for applications requiring accurate resistors.

For special applications, these resistors can be furnished to closer tolerances. Such units are ideally suited for precision work in the high wattage field.

Prices for units made to closer tolerances are somewhat higher than those of units made to the standard tolerance of 5%, and will be quoted on receipt of specifications.

**Standard and Special Terminals**

These units are furnished regularly with wire lead terminals unless otherwise specified. They can also be furnished with soldering lug or fuse clip terminals on order.



Wire Wound Resistor with Fuse Clip Terminals

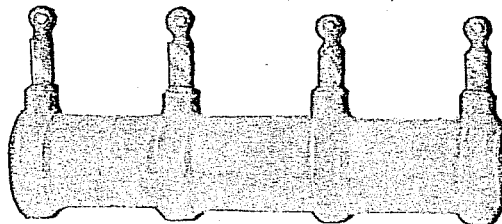
The prices given apply to either wire lead or soldering lug terminals. Special prices, which will be quoted on request, apply to the fuse clip terminals.

**Tapped Units and Voltage Dividers**

All of the I. R. C. Wire Wound Resistors can be furnished with taps on special order.

Tapped units can be furnished regularly with wire leads or soldering lug terminals.

All tapped units are made on special order and prices will be quoted on receipt of specifications.



Wire Wound Resistor with Soldering Lug Taps

The standard tolerance on tapped units is 10% plus or minus. Units can be made to closer tolerances at somewhat higher prices.

**Ordering Suggestions**

Complete specifications, accompanying orders for samples or quantities of I. R. C. Wire Wound Resistors will eliminate confusion and delay in filling such orders with the exact type of units required.

In ordering, please include in your specifications:

1. Type of Resistor Required by I. R. C. Type No. or if the exact type is not shown in this catalog mention "Similar to Type....."
2. Value of Resistance in Ohms.
3. Tolerance Required. (Standard I. R. C. Tolerance is 5% for untapped units and 10% for tapped units. If wider or closer tolerances are required, state tolerance).
4. Total Wattage Dissipation or maximum voltage across the resistor, or maximum current through the resistor.
5. Type of Terminal Required. (Wire leads, soldering lugs, fuse clip terminals or special terminals give specifications).
6. Ventilation Conditions and if possible layout showing location in equipment and characteristics of parts located near the resistor.
7. Circuit in which the resistor is to be used and any special comments regarding the particular application.
8. Name and position or title of individual ordering the unit and name and address of the firm.

# I. R. C. PRECISION WIRE WOUND RESISTORS

I. R. C. Precision Wire Wound Resistors have been developed to meet the most exacting demands of accuracy and durability by eliminating the most important weaknesses found in ordinary resistors.

They are specially adapted for use as meter multipliers, and shunts in increasing the range of

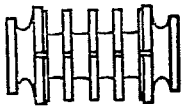


Fig. 1

Winding Form Construction

single range voltmeters and milliammeters and for other equipment such as faders, gang controls, pads, etc.

On page 15 of this catalog, you will find descriptions of a number of testing instruments and equipment which you can build at nominal cost by using standard, inexpensive meters, I. R. C. resistors and I. R. C. instructions which we shall be glad to furnish you on request.

These instruments will help you to do better work in less time and will increase your profits.

### Construction and Characteristics

The winding form of these units, shown in Fig 1, is made of a non-hygroscopic (non-moisture absorbing) ceramic having high insulation qualities, high mechanical strength and low coefficient of expansion.



Type WW-1

Precision Wire Wound Resistor

Wound in 6 Sections

Dimensions:  $2\frac{1}{8}$ " x  $\frac{1}{8}$ "

### RATING

Below 360,000 Ohms—1 Watt  
Above 360,000 Ohms—600 volts Max.

### SPECIAL SERVICE

As specialists in the development, design and production of this type of resistor, our knowledge, experience and facilities are at the disposal of the trade in the solution of special resistor problems and applications. We invite manufacturers to communicate with us whenever we can be of service.

BECAUSE OF THE SPECIAL, SECTIONAL CONSTRUCTION WHICH PERMITS THE WINDING OF ADJACENT SECTIONS IN OPPOSITE DIRECTIONS A NON-INDUCTIVE WINDING OF LOW DISTRIBUTED CAPACITY, IS MADE POSSIBLE. THE IMPEDANCE CHARACTERISTICS OF THESE UNITS ARE PRACTICALLY UNIFORM AND INDEPENDENT OF FREQUENCY UP TO 50,000 CYCLES.

Only ample size, accurately gauged special alloy wire, specially enamelled to meet a rigid insulation test is used in making these units.

The temperature coefficient of resistance is only 0.00002 to 0.0001 per degree C. depending on the wire used.

The winding is impregnated with a special varnish, which improves the insulation and eliminates breakdowns and shorted turns. The characteristics of this impregnating compound are such that it hardens with high temperatures instead of softening as is the case with the wax-impregnated units found in the average wire wound resistor.

### Exclusive, Positive Contact

To insure positive connection at the terminals, the exclusive I. R. C. moulded contact shown in Fig. 2 is employed in these units. This eliminates the weakness encountered in a mechanically clamped, soldered or welded contact and forestalls contact resistance, loose connections and noise.



Type WW-2

Precision Wire Wound Resistor

Wound in 8 Sections

Dimensions:  $2\frac{1}{8}$ " x  $\frac{1}{8}$ "

### RATING

Below 1,000,000 Ohms—1 Watt

Above 1,000,000 Ohms

1,000 volts Max.

### Resistance Tolerances

I. R. C. Precision Wire Wound Resistors are furnished regularly in stock values to a tolerance of 1% of the marked resistance value. They can be furnished, on special order, to tolerances of  $\frac{1}{4}$  and  $\frac{1}{2}$  of 1% at prices somewhat higher than the list prices of the standard 1% tolerance units.

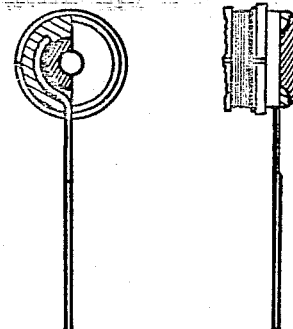


Fig. 2

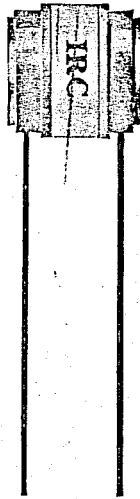
Moulded Contact Construction

# I. R. C. PRECISION WIRE WOUND RESISTORS (CONTINUED)

## Stock and Special Values

These resistors are regularly carried on hand in the wide range of resistance values listed in this section. The stock values have been chosen with care to meet the majority of requirements for resistors of this type.

Intermediate values not listed herewith can be supplied at short notice on special order, at the price of the next lower resistance value.



**Type WW-3**  
Precision Wire Wound Resistor

Wound in 2 Sections

Dimensions:  $\frac{3}{16}$ " x  $\frac{3}{16}$ "

Clearance Hole Through Resistor  
for No. 6-32 Screw for Panel Mounting

### RATING

Below 40,000 Ohms—1 Watt  
Above 40,000 Ohms—200 volts Max.

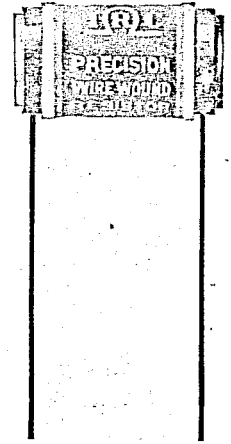
### Wattage Ratings

The power and wattage ratings of I. R. C. Precision Wire Wound Resistors are indicated under the respective illustrations of the various types of units.

Type No.	WW-1	WW-2	WW-3	WW-4
Resistance Ohms	List Price	List Price	List Price	List Price
1 to 9	\$1.50			\$1.50
10	1.25			1.25
25	1.25			1.25
50	1.25			1.25
100	1.25			1.25
150	1.25			1.25
200	1.25		\$.75	1.25
500	1.25		.75	1.25
1,000	1.25		.80	1.25
2,500	1.25		.80	1.25
5,000	1.25		1.00	1.25
7,500	1.25		1.00	1.25
10,000	1.50		1.00	1.50
12,500	1.50		1.00	1.50
15,000	1.50		1.00	1.50
20,000	1.50		1.15	1.50
25,000	1.50		1.25	1.50
30,000	1.50		1.25	1.50
35,000	1.50		1.25	1.50
40,000	1.50		1.25	1.50
50,000	1.50		1.50	1.50
60,000	1.50		1.50	1.50
75,000	1.50		1.50	1.50
100,000	2.00		2.00	2.00
125,000	2.00			2.00
150,000	2.25			2.25
175,000	2.25			2.25
200,000	2.50			2.50
225,000	2.75			2.75
250,000	2.75			2.75
300,000	3.00			3.00
400,000	3.50			3.50
500,000	4.00	\$4.00		4.00
750,000		4.50		
1,000,000		5.00		
1,250,000		7.50		
1,500,000		7.50		
1,750,000		9.00		
2,000,000		10.00		
2,250,000		12.50		
2,500,000		12.50		

### Standard Terminals

Types WW-1 and WW-2 units are regularly furnished with the binding post screw and nut terminals illustrated. Types WW-3 and WW-4 units are regularly furnished with wire lead terminals. All types can also be furnished with the soldering lug terminals illustrated at the lower right hand corner of this page.



**Type WW-4**  
Precision Wire Wound Resistor

Wound in 4 Sections

Dimensions: 1" x  $\frac{3}{16}$ "

Clearance Hole Through Resistor  
for No. 6-32 Screw for Panel Mounting

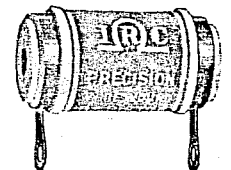
### RATING

Below 160,000 Ohms—1 Watt  
Above 160,000 Ohms—400 volts Max.

In ordering Precision Wire Wound Resistors with lug terminals, specify them as follows: "Type WW-3, with lug terminals."

### Prices

All prices quoted for Precision Wire Wound Resistors are list prices subject to our regular trade discounts which will be quoted on application on your letterhead. Special prices on quantity orders will be quoted to manufacturers and quantity users on request.



**Lug Type**  
Precision Wire Wound Resistors  
All Units in This Section Can Be  
Furnished with This Type of Lug

## I. R. C. SERVICEMEN'S HANDY RESISTOR KITS

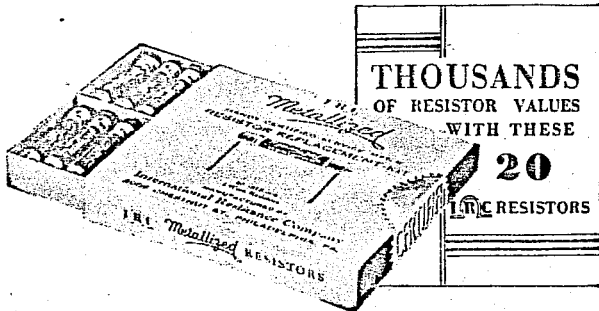
While thousands of resistance values and wattage ratings are commonly called for in radio work, it is entirely possible to select a comparatively few average resistor values in different power ratings to meet most of the experimental and replacement requirements commonly encountered.

This has been done in the following I. R. C. Kits. Each one contains a carefully selected assortment

of resistors which, through combination in series or in parallel, make it easy to fulfill practically every need. Formulas included with each kit show how to combine the resistors to get thousands of additional values. Thus, merely by keeping his kits complete at all times, the service man is equipped to select the proper resistance value for any job that comes along.

Every kit is factory sealed, tested and guaranteed.

### THE ORIGINAL I.R.C. HANDY CERTIFIED RESISTOR KIT NO. 1



Original Handy Certified Resistor Kit No. 1  
Consisting of Type F-1, 1-watt Metallized Resistors  
List Price—\$4.00

The Original Type No. 1 I. R. C. Handy Certified Resistor Kit consists of 20 Type F-1 (1-watt) I. R. C. Metallized Resistors with a carefully selected range of resistance values which makes it possible to take care of any experimental or repair job by using either the standard values included in the kit or by using a combination of units in series or in parallel to obtain the values of resistance required.

The Kit contains one each of the following values of Type F-1 (1-watt) Metallized Resistors:

OHMS:—500; 1,000; 2,000; 5,000; 10,000; 15,000;  
20,000 25,000; 50,000; 60,000; 70,000; 75,000;  
100,000; 200,000; 250,000; 500,000.

MEGOHMS:—1.0; 1.5; 2.0; 3.0.

### THE NEW I. R. C. HANDY CERTIFIED RESISTOR KIT NO. 2

I. R. C. Kit No. 2 containing 20 F-2 (2-Watt) Metallized Resistors was designed for heavier duty work requiring the same range of resistance values included in No. 1 Kit. These Resistors have higher wattage ratings to enable the service man to meet higher voltage or current requirements. Formula Booklet tells how to combine units for thousands of additional values.

**CERTIFIED RESISTOR KIT NO. 2** is the same in Appearance as Kit No. 1 Shown Above Except That it Contains 20 Type F-2, 2-Watt I. R. C. Metallized Resistors.

List Price \$6.00

A valuable kit for service men who believe in being prepared to render prompt, accurate service on all jobs. Contains the following resistance values:

OHMS:—500; 1,000; 2,000; 5,000;  
10,000; 15,000; 20,000; 25,000;  
50,000; 60,000; 70,000; 75,000;  
100,000; 200,000; 250,000;  
500,000.

MEGOHMS:—1.0; 1.5; 2.0; 3.0.

### CERTIFIED KIT NO. 3—20 TYPE F-1/2 MIDGET RESISTORS

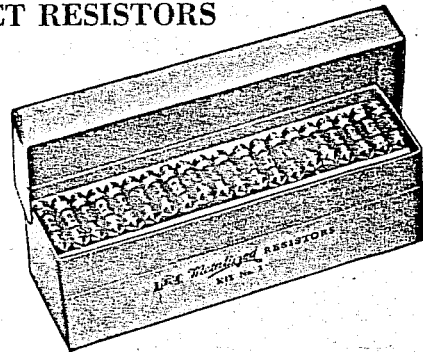
You couldn't get a handier kit than this for prompt, efficient service on midget sets requiring accurate, space-saving resistors. Includes twenty I. R. C. Metallized Resistors of values shown by our extensive records to be most commonly required as replacements in sets of leading manufacture.

Contains the following F-1/2 (1/2-watt) Metallized Resistors:

OHMS:—50; 100; 250; 500; 1,000; 1,500; 2,000; 5,000; 10,000; 20,000  
25,000; 50,000; 75,000.

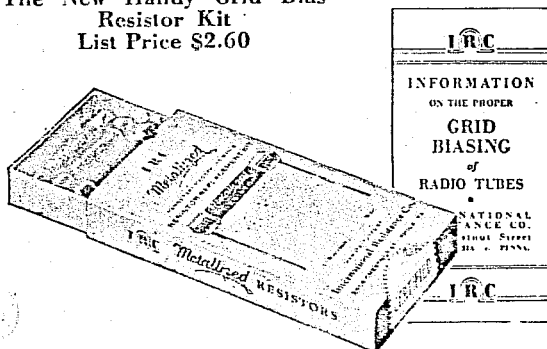
MEGOHMS:—1; 0.25; 0.5; 1.0; 1.5; 2.0; and 3.0.

List Price \$4.00



### THE NEW I. R. C. HANDY GRID BIAS RESISTOR KIT

The New Handy Grid Bias Resistor Kit  
List Price \$2.60



Contains ten assorted F-1 and F-2 I. R. C. Metallized and 5-Watt Power Wire Wound Resistors selected with special attention to the grid bias requirements of different tubes and tube combinations. Tubes that can be quickly balanced with these resistors include types '24-'26-'27-'71A-'10-'45-'50 and '47. Kit also contains values that can be used as grid suppressors in radio frequency circuits and for other uses where dependable units of these values and ratings are required. Free booklet gives wiring diagrams and information on proper biasing of tubes.

Kit contains one resistor of each of the following ranges:

450 ohms, F-1 (1-Watt)	225 ohms, F-2 (2-Watt)
1,600 " " "	1,000 " " "
2,000 " " "	1,500 " " "
10,000 " " "	
30,000 " " "	

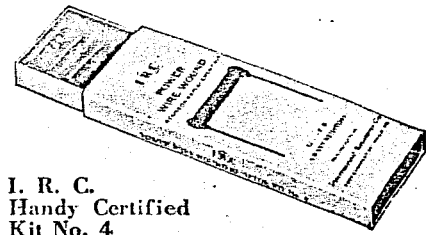
750 ohms P-B Power Wire Wound (5-Watts)  
1,450 " " " " " "

**CERTIFIED KIT NO. 4—5-WATT I. R. C. POWER WIRE WOUND RESISTORS**

This assortment of 5-Watt Power Wire Wound Resistors is one of the most popular of the I. R. C. Kits, containing units to replace those which take the greatest load in the average radio set and which therefore burn out most frequently. It is often advisable to relace burned-out resistors of lower rating with this inexpensive 5-Watt size. Quiet—give excellent results in all amplifiers.

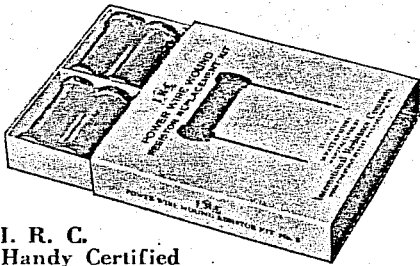
Kit contains the following ranges:

OHMS:—50; 100; 200; 500; 1,000; 1,500; 2,000; 3,000; 5,000; 10,000; 12,500; and 15,000.



I. R. C.  
Handy Certified  
Kit No. 4  
List Price \$4.20

**CERTIFIED KIT NO. 5—10-WATT I. R. C. POWER WIRE WOUND RESISTORS**



I. R. C.  
Handy Certified  
Kit No. 5  
List Price \$6.00

I. R. C. Certified Kit No. 5 contains twelve Power Wire Wound Resistors of higher wattage (10-watt) for general requirements. These resistors safely replace defective sections in voltage dividers and are frequently needed for biasing power tubes. Whenever in doubt about a rating, use an I. R. C. 10-Watt Power Wire Wound Resistor.

Kit contains the following ranges:

OHMS:—100; 500; 1,000; 2,000; 3,000; 5,000; 7,500; 10,000; 15,000; 20,000; 25,000 and 30,000.

**107 RESISTORS FOR EVERY NEED — FOUR FREE SERVICE HELPS—**

**I. R. C. SPECIAL COMBINATION KIT NO. 6**

Here you are—the finest, most complete set of resistors ever offered by I. R. C.—our biggest, most popular offer!

As to resistor replacements, the I. R. C. Special Combination Kit is a completely equipped service department in itself. It contains a carefully selected assortment of 107 I. R. C. Metallized and Power Wire Wound Resistors which permit the handling of practically any service or experimental job without lost time or effort.

Equally important are the four leading I. R. C. service helps which are included absolutely without any additional charge. These are (1) the New Resistor Indicator, value \$2.40; (2) Durable Steel Resistor Cabinet as shown in the illustration, value \$2.50; (3) Resistor Replacement Guide, value \$1 and (4) Color Code Chart, 25c—a total value of \$23.55 for only \$16.50, net. Purchased singly, the Resistors in the Kit would cost the service man \$17.40 alone. These are net prices to the service man.

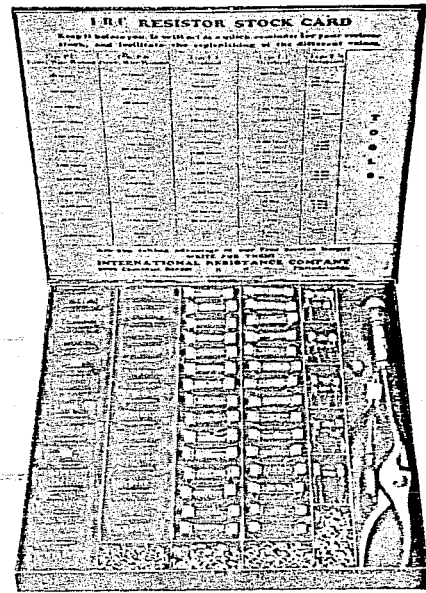
The I. R. C. Resistor Indicator is a handy service tool that will save you many a bad half hour while the sturdy Steel Cabinet is equally useful—the finest designed for keeping your stock of resistors in clean, easily accessible condition. Indicator, Replacement Guide and Color Code Chart are described in detail elsewhere in this catalog.

Kit contains the following ranges:

½ Watt—1 each	
50 ohms	20,000 ohms
100 "	30,000 "
250 "	50,000 "
500 "	100,000 "
1,000 "	¼ meg.
2,000 "	½ "
5,000 "	1 "
10,000 "	
1 Watt	
2- 500 ohms	2- 25,000 ohms
2- 750 "	2- 30,000 "
4- 1,000 "	4- 50,000 "
4- 2,500 "	4- 100,000 "
2- 5,000 "	4- ¼ megohms
2- 7,500 "	4- ½ "
4- 10,000 "	4- 2 "
2- 15,000 "	

2 Watt	
1- 100 ohms	1- 15,000 ohms
1- 500 "	1- 20,000 "
2- 1,000 "	2- 25,000 "
1- 1,500 "	1- 40,000 "
2- 2,000 "	2- 50,000 "
1- 3,000 "	2- 100,000 "
1- 5,000 "	2- ½ megohms
2- 10,000 "	

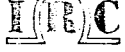
5 Watt Power Wire Wound Resistors—1 each	
50 ohms	2,000 ohms
100 "	3,000 "
200 "	5,000 "
500 "	10,000 "
1,000 "	12,500 "
1,500 "	15,000 "
10 Watt Power Wire Wound Resistors—1 each	
100 ohms	7,500 ohms
500 "	10,000 "
1,000 "	15,000 "
2,000 "	20,000 "
3,000 "	25,000 "
5,000 "	30,000 "



With This I. R. C. Combination Kit No. 6

**YOU GET FREE**  
I R C RESISTOR INDICATOR  
DURABLE STEEL RESISTOR CABINET  
RESISTOR REPLACEMENT GUIDE  
COLOR CODE CHART

All for Less Than the Regular Price of the Resistors Alone!



# THE INTERNATIONAL RESISTOR REPLACEMENT GUIDE

## An Absolute Necessity in Every Serviceman's Kit

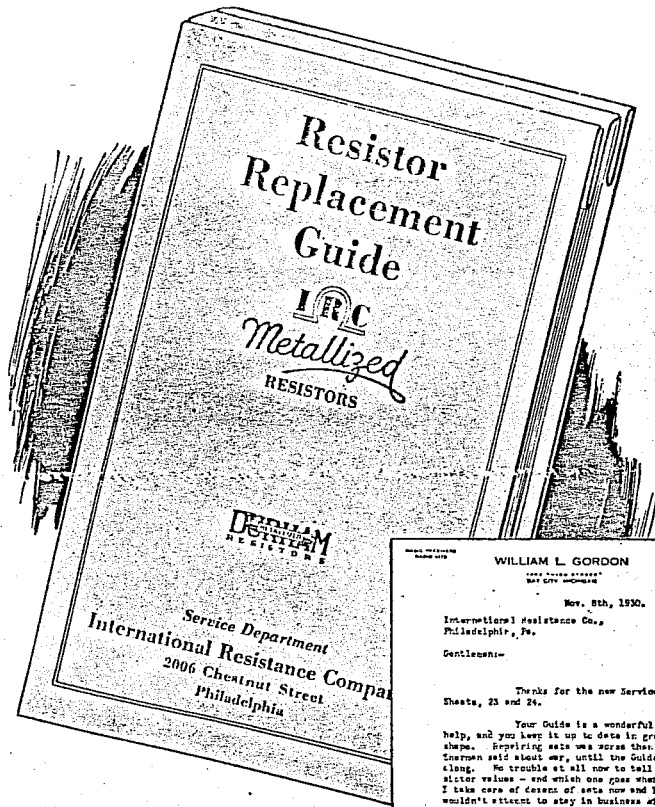
There is no more guesswork, no more groping in the dark, no need to make time-consuming and money-wasting false moves when you have this Guide in your kit. All the resistor data you need to know about any popular receiver is contained in this book.

The International Resistor Replacement Guide is speeding up the daily work and increasing the good-will of over 10,000 Servicemen day after day by telling them the value, color and position in the circuit of every resistor in the sets listed, together with information on how to locate troubles which may be due to faulty resistors.

— FREE —

### With 20 Metallized Resistors or a No. 1 or No. 2 Resistor Kit

The regular price of this Guide is \$1.00 if bought alone but you can get a copy of this International Resistor Replacement Guide and also one of our R. M. A. Color Code Charts absolutely **FREE OF CHARGE** by ordering 20 I. R. C. Metallized Resistors of the type listed on pages 4 and 5, or with either the No. 1 or No. 2 Handy Resistor Kits listed on page 12.



WILLIAM L. GORDON  
 Nov. 8th, 1930.  
 International Resistance Co.,  
 Philadelphia, Pa.  
 Gentlemen:-

Thanks for the new Service  
 Sheets, 25 and 26.

Your Guide is a wonderful  
 help, and you have it up to date in great  
 shape. Repairing sets was worse than what  
 Engram said about me, until the Guide came  
 along. No trouble at all now to tell resis-  
 tor values - and with one good spare.  
 I take care of desert of sets now and I  
 wouldn't expect to stay in business with-  
 out your help.

Sincerely,  
*Wm. L. Gordon*

## WHAT THEY SAY ABOUT THE I. R. C. RESISTOR REPLACEMENT GUIDE

I would not give up your Serviceman's Guide for ten times the price paid for it. It is my constant companion in my resistor work. Saves me many hours of guesswork and hard work figuring what resistors to use in various sets. Your resistors are more dependable than any others I have used since I began radio work.

DAVID HILL,  
Grayson, La.

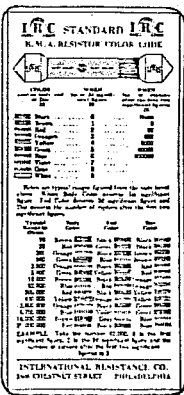
Frankly, I cannot thank you too much for the help you are giving me. The service sheets are the biggest time saver I know of. If we got as much cooperation from other manufacturing concerns as we get from you, the servicing game would be more pleasant and profitable all around. Your Guide book is worth \$5.00 as it stands today.

NORMAN HIRST,  
Cleveland, O.

Through the assistance of your Service Guide, I was able to tell a serviceman who has been in business several years, what ailed a set he had spent many hours on and couldn't tell what was wrong with it. I myself have been in the repair business only two months.

WILLIAM E. MCKINZIE,  
Brookfield, Mo.

## I. R. C. STANDARD R. M. A. RESISTOR COLOR CODE CHART



In line with our policy of helpfulness to the Engineer, Serviceman and Experimenter, we have made available without charge, the most simple, efficient, Resistor Color Code Chart devised thus far.

This handy chart eliminates the confusion which often results in using other types of charts and thereby prevents errors in reading resistance values or determining the proper color code to use on resistors of a given resistance value.

The chart contains a diagram of the usual type of resistor which is color coded for resistance value, indicating the sections of the resistor which are marked by the colors, and

the names assigned to each section for color code purposes.

A list of the colors and the numerals and number of ciphers by which each color is represented is given.

A large number of representative examples are illustrated to help the user in understanding the manner in which the code works.

All colors are shown in actual color, which greatly increases the value of the chart.

One of these charts should be in the service kit of every Engineer, Jobber, Dealer, Experimenter and Serviceman. Send for yours today. **IT'S FREE.**