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DIRECT

Electronics Tech.

# (DR) Smooth Wound Tubular Power Resistor


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# Product Introduction

## Direct's (DR) series is the best cost-effective smooth-wound tubular power resistors for high energy applications.

**Features :**

- Fixed, adjustable, or tapped styles are available.
- Special terminals are available for unusual applications.
- Special temperature coefficients, tolerances, and resistance value can be specified.
- Ayrton Perry type non-inductive winding formats are available. See DRS Series when requied.
- Standard resistance tolerance is ±5% and ±10%. Closer tolerances are available upon request.
- Standard lug terminals available with or without terminal hardware.
- Single and double quick connect terminals can be specified.
- The wire is spot welded to the terminal bands and then "fastened" onto the core with a silicone, cement, or vitreous enamel coating.

**Applications :**

- Ideal for educational modeling applications, load testing, industrial machinery, electric power distribution, instruments, automation control installations, etc.
- Typical applications for roundwire (DR) series in motor/motion control include areas such as dynamic braking, motor starting, speed/torque control, industrial machinery, electric power distribution, and plugging.
- Other applications include load dumping, current limiting, elevators, UPS systems, lift trucks, and voltage dropping.

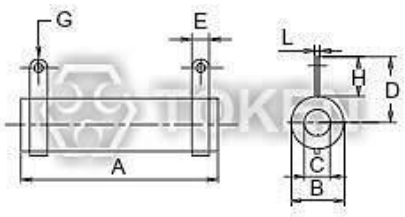
A tubular ceramic has two terminals and is wound with copper round wire or chromium alloy round wire to provide the resistance. Coated with non-flammable resin in high temperature. Insulation is applied through a high-temperature process and the mounts are attached. Due to Direct excellent winding technology applied, many taps can be added, impedance is low and the shape can be altered to produce many types.


The (DR) Series is RoHS compliant and lead free. Order individual replacement units, or entire grids with various mounting configurations, or custom specifications, contact us to discuss the details. Or link to Direct official website "High Power Resistors" to get more information.

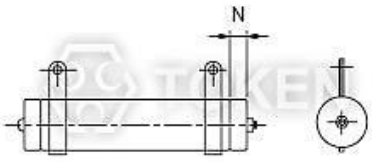
# DR-A Dimensions

## Dimensions (DR-A 10W ~ 1300W)

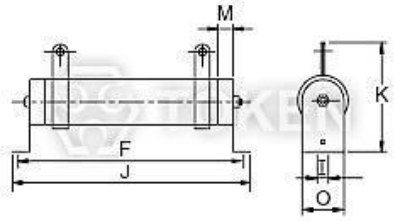
| Wattage Rating | Dimensions (Unit: mm) | | | | | | | | | | | | | | | Resistance Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | |
| **10W** | 45 | 12 | 6 | 15 | 4 | 54 | 2 | 9 | 3 | 62 | 28 | 1.0 | - | 6 | 10 | 1~1KΩ |
| **20W** | 60 | 17 | 8 | 22 | 5 | 78 | 2 | 12 | 4 | 90 | 36 | 1.0 | - | 6 | 16 | 1~2KΩ |
| **30W** | 80 | 17 | 8 | 22 | 5 | 100 | 2 | 12 | 4 | 112 | 36 | 1.0 | - | 6 | 16 | 1~3KΩ |
| **40W** | 110 | 17 | 8 | 22 | 5 | 128 | 2 | 12 | 4 | 140 | 36 | 1.0 | - | 6 | 16 | 1~4KΩ |
| **50W** | 110 | 25 | 16 | 30 | 8 | 150 | 5 | 18 | 6 | 166 | 58 | 1.2 | 6 | - | 27 | 1.5~5KΩ |
| **60W** | 90 | 28 | 18 | 32 | 8 | 130 | 5 | 19 | 6 | 146 | 60 | 1.2 | 6 | - | 27 | 1.5~6KΩ |
| **80W** | 110 | 28 | 18 | 32 | 8 | 150 | 5 | 19 | 6 | 166 | 60 | 1.2 | 6 | - | 27 | 2~8KΩ |
| **100W** | 140 | 28 | 18 | 32 | 8 | 180 | 5 | 19 | 6 | 196 | 60 | 1.2 | 6 | - | 27 | 2~10KΩ |
| **120W** | 160 | 28 | 18 | 32 | 8 | 200 | 5 | 19 | 6 | 216 | 60 | 1.2 | 6 | - | 27 | 3~12KΩ |
| **150W** | 195 | 28 | 18 | 32 | 8 | 235 | 5 | 19 | 6 | 251 | 60 | 1.2 | 6 | - | 27 | 3~15KΩ |
| **160W** | 185 | 35 | 24 | 36 | 10 | 225 | 5 | 19 | 8 | 245 | 76 | 1.6 | 6 | - | 34 | 5~16KΩ |
| **200W** | 210 | 35 | 24 | 36 | 10 | 250 | 5 | 19 | 8 | 274 | 76 | 1.6 | 6 | - | 34 | 6~20KΩ |
| **250W** | 210 | 40 | 25 | 38 | 12 | 250 | 5 | 20 | 8 | 274 | 78 | 1.6 | 6 | - | 34 | 6~25KΩ |
| **300W** | 260 | 40 | 25 | 38 | 12 | 300 | 5 | 20 | 8 | 320 | 78 | 1.6 | 6 | - | 34 | 7~30KΩ |
| **400W** | 330 | 40 | 25 | 38 | 12 | 370 | 5 | 20 | 8 | 395 | 78 | 1.6 | 6 | - | 34 | 8~40KΩ |
| **500W** | 330 | 50 | 35 | 50 | 12 | 380 | 6 | 25 | 9 | 400 | 100 | 1.6 | 8 | - | 40 | 8~50KΩ |
| **600W** | 400 | 50 | 35 | 50 | 12 | 450 | 6 | 25 | 9 | 470 | 100 | 1.6 | 8 | - | 40 | 8~60KΩ |
| **700W** | 460 | 50 | 35 | 50 | 12 | 510 | 6 | 25 | 9 | 530 | 100 | 1.6 | 8 | - | 40 | 12~70KΩ |
| **800W** | 460 | 60 | 40 | 55 | 15 | 515 | 6 | 30 | 10 | 535 | 110 | 1.6 | 10 | - | 50 | 12~80KΩ |
| **1000W** | 540 | 60 | 40 | 55 | 15 | 595 | 6 | 30 | 10 | 615 | 110 | 1.6 | 10 | - | 50 | 15~100KΩ |
| **1300W** | 650 | 65 | 42 | 62 | 15 | 702 | 6 | 30 | 10 | 722 | 115 | 1.6 | 10 | - | 50 | 15~130KΩ |




(DR-A) N - No Mount




(DR-A) Z - Vertical Mount

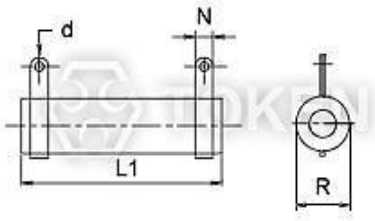



(DR-A) G - Horizontal Mount

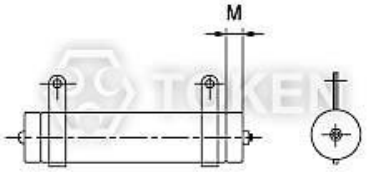
# DR-B Dimensions

## Dimensions (DR-B 15W ~ 20000W)

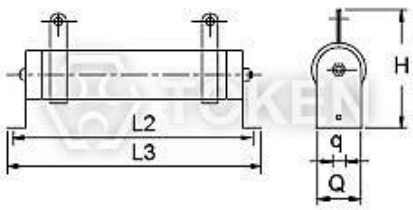
| Wattage Rating | Dimensions (Unit: mm) | | | | | | | | | | Resistance Range |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R | L1 | L2 | L3 | H | N | d | M | q | Q | |
| **15W** | 15 | 45 | 65 | 85 | 40 | 6 | 3.5 | 3.5 | 4.5 | 15 | 1~1KΩ |
| **20W** | 15 | 50 | 70 | 90 | 40 | 6 | 3.5 | 3.5 | 4.5 | 15 | 1~1KΩ |
| **25W** | 20 | 50 | 80 | 100 | 50 | 6 | 3.5 | 5 | 5 | 20 | 2~1KΩ |
| **30W** | 20 | 70 | 100 | 120 | 50 | 6 | 3.5 | 5 | 5 | 20 | 2~1KΩ |
| **40W** | 20 | 87 | 115 | 137 | 50 | 6 | 3.5 | 5 | 5 | 20 | 2~1KΩ |
| **50W** | 28 | 90 | 115 | 143 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 5~1KΩ |
| **80W** | 28 | 90 | 115 | 143 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 5~2KΩ |
| **100W** | 28 | 170 | 195 | 223 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 10~3KΩ |
| **150W** | 28 | 215 | 240 | 268 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 10~3KΩ |
| **200W** | 28 | 267 | 292 | 320 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 10~5KΩ |
| **250W** | 28 | 267 | 292 | 320 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 10~5KΩ |
| **300W** | 40 | 267 | 300 | 343 | 90 | 10 | 4.5 | 6 | 6 | 39 | 20~5KΩ |
| **400W** | 40 | 330 | 365 | 406 | 90 | 10 | 4.5 | 6 | 6 | 39 | 20~5KΩ |
| **500W** | 50 | 330 | 365 | 415 | 98 | 10 | 6 | 8.5 | 8 | 49 | 20~5KΩ |
| **600W** | 50 | 330 | 365 | 415 | 98 | 10 | 6 | 8.5 | 8 | 49 | 20~5KΩ |
| **700W** | 50 | 400 | 435 | 485 | 95 | 10 | 6 | 8.5 | 8 | 49 | 20~5KΩ |
| **800W** | 70 | 300 | 320 | 362 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **1000W** | 70 | 300 | 320 | 362 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **1500W** | 70 | 415 | 435 | 477 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **2000W** | 70 | 510 | 530 | 572 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **2500W** | 70 | 600 | 620 | 662 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **3000W** | 70 | 600 | 620 | 662 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **4000W** | 100 | 430 | 450 | 521 | 155 | 15 | 8 | - | 8 | 99 | 40~500Ω |
| **5000W** | 100 | 500 | 620 | 691 | 155 | 15 | 8 | - | 8 | 99 | 40~500Ω |
| **6000W** | 100 | 600 | 720 | 791 | 155 | 15 | 8 | - | 8 | 99 | 40~500Ω |
| **10000W** | 150 | 600 | 625 | 720 | 350 | 30 | 8 | - | 10 | 150 | 40~500Ω |
| **12000W** | 150 | 660 | 685 | 780 | 350 | 30 | 8 | - | 10 | 150 | 40~500Ω |
| **15000W** | 150 | 660 | 685 | 780 | 350 | 30 | 8 | - | 10 | 150 | 40~500Ω |
| **20000W** | 150 | 1000 | 1030 | 1120 | 350 | 30 | 8 | - | 10 | 150 | 40~500Ω |




(DR-B) N - No Mount




(DR-B) Z - Vertical Mount




(DR-B) G - Horizontal Mount

# Introduction

## Introduction (DR*N)

The **Nonflammable Round-Wound Non-Inductive Resistor** (DR*N) Series is lead-free and RoHS compliant.
Please contact us for details with your specific needs.
DR*N round-wire resistor applies Ayrton Perry non-inductive winding method to compensate residual inductance and to allow for efficient heat dissipation at higher temperature ranges.

**Non-Inductance :**

- Ayrton Perry type non-inductive winding is applied. When required add "N" to the part number.

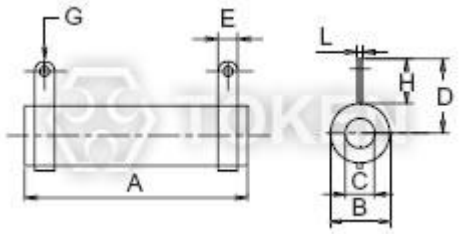
**Resistance Tolerance :**

- K(±10%), J(±5%)

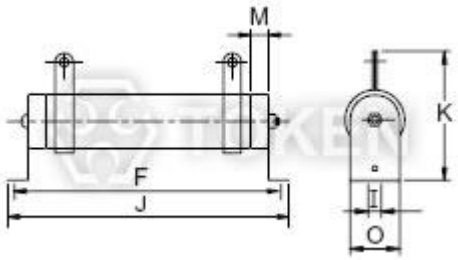
# DRAN Dimensions

## Dimensions (DRAN 50W ~ 1300W)

| Wattage Rating | Dimensions (Unit: mm) | | | | | | | | | | | | | | Resistance Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | K | L | M | O | |
| **50W** | 110 | 25 | 16 | 30 | 8 | 150 | 5 | 18 | 6 | 166 | 58 | 1.2 | 6 | 27 | 1.5~2KΩ |
| **60W** | 90 | 28 | 18 | 32 | 8 | 130 | 5 | 19 | 6 | 146 | 60 | 1.2 | 6 | 27 | 1.5~3KΩ |
| **80W** | 110 | 28 | 18 | 32 | 8 | 150 | 5 | 19 | 6 | 166 | 60 | 1.2 | 6 | 27 | 2~4KΩ |
| **100W** | 140 | 28 | 18 | 32 | 8 | 180 | 5 | 19 | 6 | 196 | 60 | 1.2 | 6 | 27 | 2~5KΩ |
| **120W** | 160 | 28 | 18 | 32 | 8 | 200 | 5 | 19 | 6 | 216 | 60 | 1.2 | 6 | 27 | 3~6KΩ |
| **150W** | 195 | 28 | 18 | 32 | 8 | 235 | 5 | 19 | 6 | 251 | 60 | 1.2 | 6 | 27 | 3~7KΩ |
| **160W** | 185 | 35 | 24 | 36 | 10 | 225 | 5 | 19 | 8 | 245 | 76 | 1.6 | 6 | 34 | 5~8KΩ |
| **200W** | 210 | 35 | 24 | 36 | 10 | 250 | 5 | 19 | 8 | 274 | 76 | 1.6 | 6 | 34 | 6~10KΩ |
| **250W** | 210 | 40 | 25 | 38 | 12 | 250 | 5 | 20 | 8 | 274 | 78 | 1.6 | 6 | 34 | 6~12KΩ |
| **300W** | 260 | 40 | 25 | 38 | 12 | 300 | 5 | 20 | 8 | 320 | 78 | 1.6 | 6 | 34 | 7~15KΩ |
| **400W** | 330 | 40 | 25 | 38 | 12 | 370 | 5 | 20 | 8 | 395 | 78 | 1.6 | 6 | 34 | 8~20KΩ |
| **500W** | 330 | 50 | 35 | 50 | 12 | 380 | 6 | 25 | 9 | 400 | 100 | 1.6 | 8 | 40 | 8~25KΩ |
| **600W** | 400 | 50 | 35 | 50 | 12 | 450 | 6 | 25 | 9 | 470 | 100 | 1.6 | 8 | 40 | 8~30KΩ |
| **700W** | 460 | 50 | 35 | 50 | 12 | 510 | 6 | 25 | 9 | 530 | 100 | 1.6 | 8 | 40 | 12~35KΩ |
| **800W** | 460 | 60 | 40 | 55 | 15 | 515 | 6 | 30 | 10 | 535 | 110 | 1.6 | 10 | 50 | 12~40KΩ |
| **1000W** | 540 | 60 | 40 | 55 | 15 | 595 | 6 | 30 | 10 | 615 | 110 | 1.6 | 10 | 50 | 15~50KΩ |
| **1300W** | 650 | 65 | 42 | 62 | 15 | 702 | 6 | 30 | 10 | 722 | 115 | 1.6 | 10 | 50 | 15~60KΩ |




**(DRAN) N - No Mount**

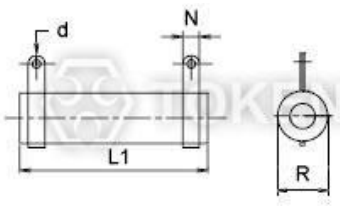



**(DRAN) G - Horizontal Mount**

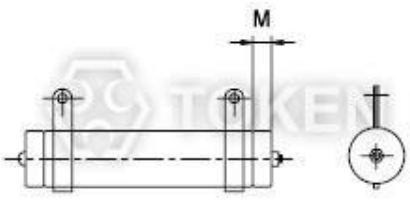
# DRBN Dimensions

## Dimensions (DRBN 15W ~ 20000W)

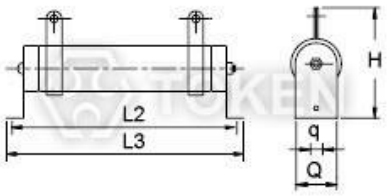
| Wattage Rating | Dimensions (Unit: mm) | | | | | | | | | | Resistance Range |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R | L1 | L2 | L3 | H | N | d | M | q | Q | |
| **15W** | 15 | 45 | 65 | 85 | 40 | 6 | 3.5 | 3.5 | 4.5 | 15 | 1~1KΩ |
| **20W** | 15 | 50 | 70 | 90 | 40 | 6 | 3.5 | 3.5 | 4.5 | 15 | 1~1KΩ |
| **25W** | 20 | 50 | 80 | 100 | 50 | 6 | 3.5 | 5 | 5 | 20 | 2~1KΩ |
| **30W** | 20 | 70 | 100 | 120 | 50 | 6 | 3.5 | 5 | 5 | 20 | 2~1KΩ |
| **40W** | 20 | 87 | 115 | 137 | 50 | 6 | 3.5 | 5 | 5 | 20 | 2~1KΩ |
| **50W** | 28 | 90 | 115 | 143 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 5~1KΩ |
| **80W** | 28 | 90 | 115 | 143 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 5~2KΩ |
| **100W** | 28 | 170 | 195 | 223 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 10~3KΩ |
| **150W** | 28 | 215 | 240 | 268 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 10~3KΩ |
| **200W** | 28 | 267 | 292 | 320 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 10~5KΩ |
| **250W** | 28 | 267 | 292 | 320 | 68 | 9 | 4.5 | 5.5 | 6 | 27 | 10~5KΩ |
| **300W** | 40 | 267 | 300 | 343 | 90 | 10 | 4.5 | 6 | 6 | 39 | 20~5KΩ |
| **400W** | 40 | 330 | 365 | 406 | 90 | 10 | 4.5 | 6 | 6 | 39 | 20~5KΩ |
| **500W** | 50 | 330 | 365 | 415 | 98 | 10 | 6 | 8.5 | 8 | 49 | 20~5KΩ |
| **600W** | 50 | 330 | 365 | 415 | 98 | 10 | 6 | 8.5 | 8 | 49 | 20~5KΩ |
| **700W** | 50 | 400 | 435 | 485 | 95 | 10 | 6 | 8.5 | 8 | 49 | 20~5KΩ |
| **800W** | 70 | 300 | 320 | 362 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **1000W** | 70 | 300 | 320 | 362 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **1500W** | 70 | 415 | 435 | 477 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **2000W** | 70 | 510 | 530 | 572 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **2500W** | 70 | 600 | 620 | 662 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **3000W** | 70 | 600 | 620 | 662 | 138 | 15 | 8 | - | 8 | 69 | 40~500Ω |
| **4000W** | 100 | 430 | 450 | 521 | 155 | 15 | 8 | - | 8 | 99 | 40~500Ω |
| **5000W** | 100 | 500 | 620 | 691 | 155 | 15 | 8 | - | 8 | 99 | 40~500Ω |
| **6000W** | 100 | 600 | 720 | 791 | 155 | 15 | 8 | - | 8 | 99 | 40~500Ω |
| **10000W** | 150 | 600 | 625 | 720 | 350 | 30 | 8 | - | 10 | 150 | 40~500Ω |
| **12000W** | 150 | 660 | 685 | 780 | 350 | 30 | 8 | - | 10 | 150 | 40~500Ω |
| **15000W** | 150 | 660 | 685 | 780 | 350 | 30 | 8 | - | 10 | 150 | 40~500Ω |
| **20000W** | 150 | 1000 | 1030 | 1120 | 350 | 30 | 8 | - | 10 | 150 | 40~500Ω |




**(DRBN) N - No Mount**




**(DRBN) Z - Vertical Mount**




**(DRBN) G - Horizontal Mount**

# Specifications

## Specifications (DR)

| Test Item | Test Methods | Characterstics |
|---|---|---|
| **Load life** | JIS-C-5202 7-10<br>90 minutes ON - 30 minutes OFF500 hours | Free of appearance or structural irregularity<br>Surface coating crack ΔR/R≤ ±(1%+0.05Ω) |
| **Load rating** | JIS-C-5202 5-4 | ΔR/R≤±(0.5%+0.1Ω) Surface temperature up 350℃ MAX |
| **Humidity** | JIS-C-5202 7-5<br>40℃ 90%RH 240 hours | Free of appearance or structural irregularity<br>Surface coating crack ΔR/R≤ ±(3%+0.1Ω) |
| **Vibration** | JIS-C-5202 6-3<br>1.5m/m 10 ~ 50 ~ 10 Hz/min X-Y-Z 2 hours each | Free of appearance or structural irregularity<br>Surface coating crack ΔR/R≤ ±(1%+0.05Ω) |
| **Thermal shock** | JIS-C-5202 7-3<br>Room temp 30 minutes ON-55℃ 15 minutes OFF | Free of structural irregularity ΔR/R≤ ±(2%+0.1Ω) |
| **Terminal strength** | JIS-C-5202 6-1 8kg 30 seconds | Free of appearance or structural irregularity |
| **Flame retardation** | JIS-C-5202 7-13-3-2<br>100% - 600% rated wattage load | US UL-94 flame retardation test V-0 grade noncombustible |
| **Resistance tolerance** | JIS-C-5202 5-1 | Resistance Nominal Tolerance<br>1≤R 1>R ±5%(J) ±10%(K) |
| **Short-term overload** | JIS-C-5202 5-5<br>1000% rated wattage 5 seconds | Free of appearance or structural irregularity<br>ΔR/R≤ ±(2%+0.1Ω) |
| **Insulation resistance** | JIS-C-5202 5-6 500VDC | 100MΩ min |
| **Temperature coefficient** | JIS-C-5202 5-2 | ±200PPM/℃ MAX |
| **Dielectric withstanding voltage** | JIS-C-5202 5-7<br>1000VDC 1 minute Between terminal and anchor stand | Free of appearance or structural irregularity<br>ΔR/R≤ ±(0.1%+0.05Ω) |
| **REMARKS:** | 1. Resistance and resistance tolerance were tested in-house with micro resistance meter.<br>2. Coating refers to UL-certified data provided by supplier. | |

# Order Codes

## Order Codes (DR)

| DRA | 600W | 100R | J | G |
|---|---|---|---|---|

| Part Number |
|---|
| DRA |
| DRB |
| DRAN |
| DRBN |

| Rated Power (W) |
|---|
| 10W~1300W |
| 15W~20000W |
| 50W~1300W |
| 15W~20000W |

| Resistance Value (Ω) | |
|---|---|
| 0R1 | 0.1Ω |
| 1R | 1Ω |
| 10R | 10Ω |
| 100R | 100Ω |
| 1K | 1KΩ |
| 10K | 10KΩ |
| 100K | 100KΩ |

| Resistance Tolerance (%) | |
|---|---|
| J | ±5% |
| K | ±10% |

| Assembly Method | |
|---|---|
| N | No mount. |
| C | Clip mount. |
| G | Horizontal mount. |
| Z | Vertical mount. |

# General Information

### Benefits & Features

Providing design engineers with an economical resistor with high quality performance, Direct Electronics offers industry grade power wire wound devices.

Direct provide terminal blocks, thermal switches, fusing, fans, junction boxes, screened or solid bottom plates, conduit knockouts, and customer specified requirements. For large applications a welded frame construction is utilized to provide a robust design for power resistor mounting in both indoor and outdoor environments.

Products range from large capacity metal clad, nonflammable fixed and adjustable, wave ribbon wire-wound, slide, starter, box type, to nonflammable flat type. Direct extends a complete line for both military and commercial applications.

### Utilization Notes

1. Smoke emitted from non-flammable resistors on initial use in powered circuits is a normal phenomenon and the component can be safely utilized.
2. All resistors manufactured by Direct Electronics Industry Corporation comply with the U.S. UL-94 non- flammability test, Class V-0, a continuous combustion period of zero seconds.
3. Never use organic solvents to clean non-flammable resistors.
4. Non-flammable resistors cannot be utilized in oil.
5. Non-flammable resistors cannot be used in high frequency machinery because of the inductance produced by the windings. A suitable type of resistor must be selected. Contact us for details.
6. In applications where resistors are subject to intermittent current surges and spikes, be sure in advance that the components selected are capable of withstanding brief durations of increased load.
7. Do not exceed the recommended usable load. Resistors must use within the rated voltage range to prevent the shortening of service life and/or failure of the wound resistance elements.
8. Minimum load. Resistors must be utilized at 1/10 or more of the rated voltage to prevent poor conductance due to oxidation build-up.
9. Although the hardness exceeds that of a 3H pencil lead, do not nick the resistor coating with screw drivers or other pointed objects.
10. Avoid touching non-flammable resistors in operation; the surface temperature ranges from approximately 350℃ ~ 400℃ when utilized at the full rated value. Maintaining a surface temperature of 200℃ or less will extend resistor service life.
11. Keep temperature from rising by choosing a resistor with a higher rated capacity; do not use a component having the exact load value required. For considerations of safety in extended period applications, the resistor rating should be more than four times higher than the actual wattage involved, but never use a resistor at less than 25% of its rated power.
12. Application and Placement: Wire-wound resistors use different gauges of wire as resistance elements. Sometimes the gauge is extremely thin (finer than a strand of human hair) and very susceptible to breakage in environments containing salts, ash, dust and corrosives. Avoid utilization in such environments. Do not install in dusty areas because the accumulation will cause shorts and poor conductance.