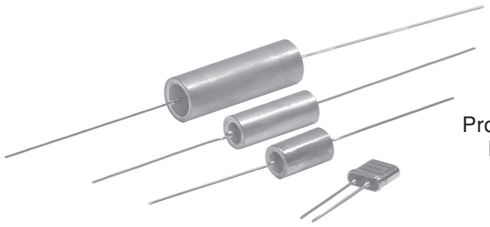
Bulk Metal® Foil Technology
Hermetically Sealed Resistors, Metrology/Laboratory



Product may not be to scale

The H series resistors are oil filled, hermetically sealed ultra precision resistors. The function of hermetic sealing is to eliminate the ingress of moisture and oxygen both of which play a roll in the long term degradation of unsealed resistors. A further enhancement in both short and long term stability is achieved by oil filling. The oil also acts as a thermal conductor allowing the device to accept short periods of overload without degradation.

With accuracies of ± 0.001% and a resistance range from 5 ohms to 1.84 megohms and long term shelf life of less than 5ppm, these devices are virtually secondary standards that can be carried in sets for daily or periodic calibration of factory measurement systems.

FEATURES

- Nominal Temperature Coefficient of Resistance: + 0.6ppm/°C (0°C to + 25°C); – 0.6ppm/°C (+ 25°C to + 60°C); + 2.2ppm/°C (– 55°C to + 25°C); – 1.8ppm/°C (+ 25°C to + 125°C)
- Load-Life Stability: 0.002% Max ΔR at 0.1 W and + 60°C, no burn-in.
- Power Rating: 0.3 to 2.5 watt at + 25°C (depending on model).
- Resistance Tolerance (Initial Resistance Accuracy): ± 0.001% tightest.
- Resistance Range: 5 Ω to 1M84 Ω.
- Current Noise: < 0.010μV (RMS)/Volt of Applied Voltage.
- Thermal EMF: 0.1μV/°C Max; 0.05μV/°C Typ; VHP202, 1μV/W.
- The most precise and stable resistors available.
- Impervious to harmful environments — oil filled.

THROUGH HOLE

FIGURE 1 - STANDARD IMPRINTING AND DIMENSIONS

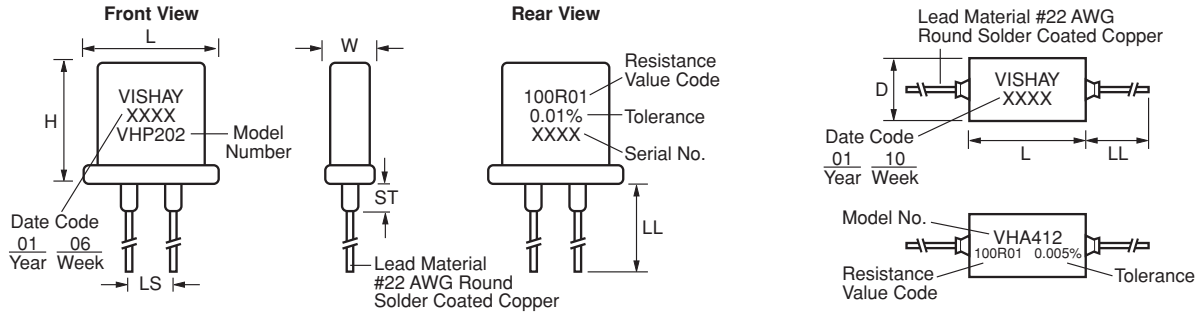


TABLE 1 - ORDERING INFORMATION

Please specify Vishay H Series resistors as follows: (See Table 2 for details).

Example: **VHP202** (MODEL NO.) **100R01** (RESISTANCE VALUE) **0.005%** (TOLERANCE)

Resistance Value, in ohms, is expressed by a series of 6 characters, 5 of which represent significant digits while the 6th is a dual purpose letter that designates both the multiplier and the location of the comma or decimal.

RESISTANCE RANGE*	LETTER DESIGNATOR	MULTIPLIER FACTOR	EXAMPLE
5Ω to < 1KΩ	R	x 1	100R01 = 100.01Ω
1KΩ to < 1MΩ	K	x 10^3	15K231 = 15,231Ω
1MΩ to 1M 84Ω	M	x 10^6	1M500 = 1,500,000Ω

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TABLE 2 - MODEL SELECTION

MODEL NUMBER	RESISTANCE RANGE (Ω)	STANDARD RESISTANCE TOLERANCE TIGHTEST	STANDARD RESISTANCE TOLERANCE LOOSEST	MAXIMUM WORKING VOLTAGE[2]	POWER RATING AT +25°C	AVERAGE WEIGHT IN GRAMS	CONSTRUCTION BRIEF	DIMENSIONS[3] Inches	DIMENSIONS[3] mm
VHP202	5 to 100K >100K to 150K			300	0.3 W 0.2 W	1.4	Oil-filled, tinned copper leads, nickel shell, kovar and glass header.	W: 0.185 ±0.020 L: 0.435 ±0.020 H: 0.430 ±0.020** LL: 1.000 ±0.125 LS: 0.150 ±0.010[4] ST: 0.095 Max	4.70 ±0.51 11.05 ±0.51 10.92 ±0.51 25.4 ±3.18 3.81 ±0.25 2.41 Max
VHA412	5 to 100K >100K to 150K			250	0.3 W 0.2 W	4.6		L: 0.625 ±0.031 D: 0.375 ±0.031 LL: 1.000 Min	15.88 ±0.79 9.53 ±0.79 25.4 Min
VHA414	5 to 200K >200K to 335K	1K to □[1] ±0.001%	±0.1%	350	0.5 W 0.3 W	7.3		L: 1.000 ±0.031 D: 0.375 ±0.031 LL: 1.000 Min	25.4 ±0.79 9.53 ±0.79 25.4 Min
VHA512*	5 to 300K >300K to 500K	500 to <1K ±0.0025% 50Ω to <500Ω ±0.005% 30Ω to <50Ω ±0.01% 20Ω to <30Ω ±0.02% 10Ω to <20Ω ±0.05% 5Ω to <10Ω ±0.1%	±0.1% ±0.1% ±0.1% ±0.1% ±0.1% ±0.1%	350	0.75 W 0.4 W	6.3	Oil-filled, tinned copper leads, tinned brass shell, kovar and glass end bells.	L: 0.625 ±0.031 D: 0.500 ±0.031 LL: 1.000 Min	15.88 ±0.79 12.7 ±0.79 25.4 Min
VHA516-4* VHA516-5* VHA516-6*	5 to 400K >400K to 668K 5 to 500K >500K to 835K 5 to 600K >600K to 1M			500	1.0 W 0.5 W 1.25 W 0.6 W 1.5 W 0.7 W	9.2		L: 1.000 ±0.031 D: 0.500 ±0.031 LL: 1.000 Min	25.4 ±0.79 12.7 ±0.79 25.4 Min
VHA518-7* VHA518-8* VHA518-9* VHA518-10* VHA518-11*	5 to 700K >700K to 1M17 5 to 800K >800K to 1M34 5 to 900K >900K to 1M5 5 to 1.0M >1.0M to 1M67 5 to 1.0M >1.0M to 1M84			600	1.75 W 0.8 W 2.0 W 0.9 W 2.25 W 1.0 W 2.5 W 1.1 W 2.5 W 1.2 W	13.5		L: 1.500 ±0.031 D: 0.500 ±0.031 LL: 1.000 Min	38.1 ±0.79 12.7 ±0.79 25.4 Min

*Available in a 4-lead terminal

**0.375 H available

See next page for numbered footnotes

FIGURE 2 - POWER DERATING CURVE

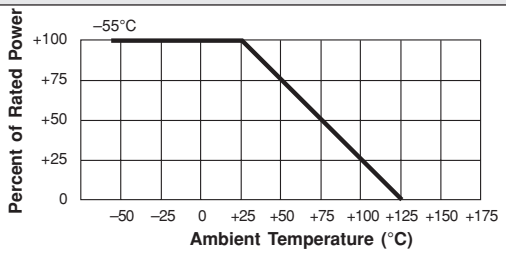

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TABLE 3 - "H" SERIES SPECIFICATIONS[5]

TEMPERATURE COEFFICIENT OF RESISTANCE	
Nominal TCR[6] (See Fig. 1 and 2 in data sheet "7 Technical Reasons to Specify Vishay Bulk Metal® Foil Resistive Components.")	+ 0.6ppm/°C (0°C to + 25°C) – 0.6ppm/°C (+ 25° to + 60°C) + 2.2ppm/°C (– 55°C to + 25°C) – 1.8ppm/°C (+ 25°C to + 125°C)
Standard TCR Spread from Nominal[7] (See Fig. 5 and 6 in data sheet "7 Technical Reasons to Specify Vishay Bulk Metal® Foil Resistive Components.")	± 1.5ppm/°C (0°C to + 25°C and + 25°C to + 60°C) ± 2.0ppm/°C (– 55°C to + 25°C and + 25°C to + 125°C)
Maximum TCR Spread from Nominal[8] (See Fig. 5 and 6 in data sheet "7 Technical Reasons to Specify Vishay Bulk Metal® Foil Resistive Components.")	± 2.5ppm/°C (0°C to + 25°C and + 25°C to + 60°C) ± 2.3ppm/°C (– 55°C to + 25°C and + 25°C to + 125°C)
Selected[9] TCR Tracking[10] (Closest Spread)	0.5ppm/°C
Stability[14] Load Life at 2,000 hrs. Shelf Life	± 0.002% maximum ΔR @ 0.1 Watt per chip and at + 60°C ± 5ppm (0.0005%) Maximum ΔR after 1 year ± 10ppm (0.001%) Maximum ΔR after 3 years
Current Noise	< 0.010μV (RMS)/Volt of applied voltage (– 40dB)
High Frequency Operation Rise/Decay Time Inductance (L)[11] Capacitance (C)	 1.0 ns at 1KΩ 0.1μH maximum; 0.08μH typical[5] 1.0pF maximum; 0.5pF typical[5]
Voltage Coefficient	< 0.1ppm/V[12]
Thermal EMF[13]	0.1μV/°C Maximum; 0.05μV/°C Typical; 1μV/watt Maximum
Hermeticity	10^{-7} Atmospheric cc/sec Maximum

THROUGH HOLE

NOTES:

1. Upper end of resistance range varies with model selected (i.e. VHP202; the range is to 150Kohms; VHA518-10, the range is to 1M67 ohms).
2. Not to exceed power rating of resistor.
3. Insulating Sleeve— a special case insulating plastic sleeve is available on VHA models— specify letter "P" as a suffix to model number (i.e. VHA412P).
4. 0.200" (5.08mm) lead spacing available— specify VH202J.
5. Maximum is 1.0% A.Q.L. standard for all specifications except TCR. (For TCR information, see notes 6-10.) Typical is a designers reference which represents that 85% of the units supplied, over a long period of time, will be at least the figure shown or better.
6. Vishay Nominal TCR is defined as the chord slopes of the relative change of resistance/temperature, expressed in ppm (parts per million), called (RT) curve from 0°C to + 25°C and + 25°C to + 60°C ("Instrument" Range); and from – 55°C to + 25°C and + 25°C to + 125°C ("Military" Range). These specifications and the definition of Nominal TCR apply to all resistance values including low-value resistors.
7. Vishay Standard TCR Spread is defined as a designers reference which represents that at least 92% of the units, and 82% of the lots, supplied by Vishay will be within the stated band centered on the nominal curve. This definition of the Vishay Standard TCR Spread from Nominal applies to all resistance values. However, as the resistance value decreases below 80Ω, the Vishay Standard TCR Spread from Nominal specification starts to increase. (See Figure 3 in data sheet "7 Technical Reasons to Specify Vishay Bulk Metal® Foil Resistive Components.")
8. Vishay Maximum TCR Spread is defined as the 3 σ (Sigma) limit of a normal Gaussian distribution (99.73% of a production lot) which is within a band, centered on the nominal curve. This Vishay Maximum TCR Spread is no greater than ± 2.5ppm/°C from nominal throughout the full temperature range. This definition of the Vishay Maximum TCR Spread from Nominal applies to all resistance values. However, as the resistance value decreases below 80 Ω, the Vishay maximum TCR Spread from Nominal specification starts to increase. (See Figure 3 in data sheet "7 Technical Reasons to Specify Vishay Bulk Metal® Foil Resistive Components.")
9. Selected TCR Tracking is available for specially ordered lots of resistors. The selected TCR tracking can be 3, 2, 1 and as close as 0.5ppm/°C throughout the full temperature range.
10. TCR tracking is a measure of the similarity of resistance value change in two or more resistors which are undergoing the same temperature changes. Tracking could be expressed as the difference in the temperature coefficients of the resistors, expressed in ppm/°C as $(\Delta R_1/R_1 - \Delta R_2/R_2) \times 10^{-6}/\Delta T°C$. When a number of resistors are referenced to a nominal TCR, the spread or envelope around the nominal would be the difference. If the spread is ± 1.5ppm/°C about a nominal, the tracking, as defined above, will be 3ppm/°C.
11. Inductance (L) due mainly to the leads.
12. The resolution limit of existing test equipment (within the measurement capability of the equipment, or "essentially zero.")
13. μV/°C relates to EMF due to lead temperature difference and μV/watt due to power applied to the resistor.
14. Load life ΔR max. can be reduced through burn-in procedure.