

High Accuracy Decade Resistance Substituter

HARS-X Series p. 1 of 2

Tight tolerance laboratory grade decade substituters, for applications requiring a cost effective high performance resistance decade box.

- Resistance from 1 mΩ to 111 MΩ
- Excellent stability - 10 ppm/yr, 25 ppm/ 3 yrs
- Wide choice - single through 11 decade units
- High accuracy - 0.01% (100 ppm)
- Very low zero resistance: <1 mΩ per decade
- High performance solid silver alloy switches
- Low temperature coefficient - 5 ppm/°C
- Noninductive or low inductance resistors

- Rack mounting available
- Special and custom configurations available



6 Decade **HARS-X** High Accuracy Resistance Substituter

- See HRRS Series for higher resistance
- See HPRS Series for higher power
- See HARS-L Series for higher accuracy
- See RTD Series for RTD simulators
- See PRS Series for programmable models

SPECIFICATIONS

| Resistance per Step | Total Decade Resistance | Stability (±ppm/year) | Long Term Stability (±ppm/3 years) | Temperature Coefficient (±ppm/°C) | Max. Power (W/step) | Maximum current (per decade) | Maximum voltage (per step) |
|---------------------|-------------------------|-----------------------|------------------------------------|-----------------------------------|---------------------|------------------------------|----------------------------|
| 1 mΩ | 10 mΩ | 100 | 700 | 50 | 0.025 | 5 A | 5 mV |
| 10 mΩ | 100 mΩ | 50 | 350 | 20 | 0.2 | 4 A | 40 mV |
| 100 mΩ | 1 Ω | 30 | 50 | 20 | 0.25 | 1.6 A | 0.16 V |
| 1 Ω | 10 Ω | 10 | 25 | 20 | 0.6 | 0.8 A | 0.8 V |
| 10 Ω | 100 Ω | 10 | 25 | 15 | 0.6 | 0.25 A | 2.5 V |
| 100 Ω | 1 kΩ | 10 | 25 | 5 | 0.6 | 80 mA | 8 V |
| 1 kΩ | 10 kΩ | 10 | 25 | 5 | 0.5 | 23 mA | 23 V |
| 10 kΩ | 100 kΩ | 10 | 25 | 5 | 0.5 | 7 mA | 70 V |
| 100 kΩ | 1 MΩ | 10 | 25 | 5 | 0.5* | 2.3* mA | 230 V* |
| 1 MΩ | 10 MΩ | 10 | 25 | 10 | 0.5* | 0.7* mA | 700 V* |
| 10 MΩ | 100 MΩ | 25 | 40 | 10 | 0.1* | 0.1* mA | 1000 V* |

* Subject to maximum of 2000 V.

Accuracy: After subtraction of zero resistance, at 23°C; traceable to NIST.

- HARS-L: ± 20 ppm (see p 17)
- HARS-Z: ±(50 ppm + 1 mΩ)
- HARS-X: ±(0.01% + 2 mΩ)
- HARS-A: ±(0.05% + 2 mΩ)
- HARS-Q: ±(0.02% + 2 mΩ)
- HARS-B: ±(0.1% + 4 mΩ)

Zero Resistance: <1 mΩ per decade, at dc; slightly higher for 7-10 decades.

Maximum Voltage to Case: 2000 V peak.

Switch Type: 11 positions; "0"- "10"; multiple solid silver alloy contacts.

Switch Capacitance: <4 pF per switch, low loss.

Terminals: Low thermal emf beryllium copper binding posts with standard 3/4 inch spacing plus shield terminal; connections from the rear of the instrument are available with **RO** option. Solderable terminals for single decade units.

Mechanical:

| Model | Dimensions | Weight |
|-------------|--|---------------------|
| 1 decade | 7.7 cm W x 7.7 cm H x 8.4 cm D (3" x 3" x 3.3") | 0.45 kg (1.0 lb) |
| 2-4 decades | 37.5 cm W x 8.9 cm H x 10.2 cm D (14.8" x 3.5" x 4") | 1.7 kg (3.8 lb) |
| 5 decades | | 2.0 kg (4.3 lb) |
| 6 decades | 43.9 cm W x 8.9 cm H x 10.2 cm D (17.3" x 3.5" x 4") | 2.2 kg (4.8 lb) |
| 7 decades | | 2.4 kg (5.3 lb) |
| 8 decades | | 2.6 kg (5.7 lb) |
| 9 decades | 48.3 cm W x 17.8 cm H x 19.7 cm D (19.0" x 7.0" x 7.8") | 5.1 kg (11.2 lb) |
| 10 decades | | 5.3 kg (11.7 lb) |
| 11 decades | | 5.4 kg (11.9 lb) |

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HARS-X Series p. 2 of 2

SINGLE DECADE UNITS

Single decade units are available with resistance as low as 1 mΩ per step to as high as 10 MΩ per step. These units satisfy many system applications requiring only a single decade while maintaining all the quality features of the **HARS** series.

Each decade is enclosed in an aluminum case which can serve as a shield.

It may be panel mounted and integrated with additional units to form potentiometer circuits or other configurations.

Each unit consists of low inductance resistors in series, with a high performance solid silver alloy contact switch.



Single Decade **HARS-X** Unit

ORDERING INFORMATION

| Model* (0.01% Accuracy) | Total Res. (Ω) | No. of Decades | Resolution (Ω) |
|----------------------------|-------------------|-------------------|-------------------|
| HARS-X-1-0.001 | 0.01 | 1 | 0.001 |
| HARS-X-1-0.01 | 0.1 | 1 | 0.01 |
| HARS-X-1-0.1 | 1 | 1 | 0.1 |
| HARS-X-1-1 | 10 | 1 | 1 |
| HARS-X-1-10 | 100 | 1 | 10 |
| HARS-X-1-100 | 1 k | 1 | 100 |
| HARS-X-1-1K | 10 k | 1 | 1 k |
| HARS-X-1-10K | 100 k | 1 | 10 k |
| HARS-X-1-100K | 1 M | 1 | 100 k |
| HARS-X-1-1M | 10 M | 1 | 1 M |
| HARS-X-1-10M | 100 M | 1 | 10 M |
| HARS-X-2-0.001 | 0.11 | 2 | 0.001 |
| HARS-X-2-0.01 | 1.1 | 2 | 0.01 |
| HARS-X-2-0.1 | 11 | 2 | 0.1 |
| HARS-X-2-1 | 110 | 2 | 1 |
| HARS-X-2-10 | 1.1 k | 2 | 10 |
| HARS-X-2-100 | 11 k | 2 | 100 |
| HARS-X-2-1K | 110 k | 2 | 1 k |
| HARS-X-2-10K | 1.1 M | 2 | 10 k |
| HARS-X-2-100K | 11 M | 2 | 100 k |
| HARS-X-2-1M | 110 M | 2 | 1 M |
| HARS-X-3-0.001 | 1.11 | 3 | 0.001 |
| HARS-X-3-0.01 | 11.1 | 3 | 0.01 |
| HARS-X-3-0.1 | 111 | 3 | 0.1 |
| HARS-X-3-1 | 1.11 k | 3 | 1 |
| HARS-X-3-10 | 11.1 k | 3 | 10 |
| HARS-X-3-100 | 111 k | 3 | 100 |
| HARS-X-3-1K | 1.11 M | 3 | 1 k |
| HARS-X-3-10K | 11.1 M | 3 | 10 k |
| HARS-X-3-100K | 111 M | 3 | 100 k |
| HARS-X-4-0.001 | 11.11 | 4 | 0.001 |
| HARS-X-4-0.01 | 111.1 | 4 | 0.01 |
| HARS-X-4-0.1 | 1.111 k | 4 | 0.1 |
| HARS-X-4-1 | 11.11 k | 4 | 1 |

| Model* (0.01% Accuracy) | Total Res. (Ω) | No. of Decades | Resolution (Ω) |
|----------------------------|-------------------|-------------------|-------------------|
| HARS-X-4-10 | 111.1 k | 4 | 10 |
| HARS-X-4-100 | 1.111 M | 4 | 100 |
| HARS-X-4-1K | 11.11 M | 4 | 1 k |
| HARS-X-4-10K | 111.1 M | 4 | 10 k |
| HARS-X-5-0.001 | 111.11 | 5 | 0.001 |
| HARS-X-5-0.01 | 1.1111 k | 5 | 0.01 |
| HARS-X-5-0.1 | 11.111 k | 5 | 0.1 |
| HARS-X-5-1 | 111.11 k | 5 | 1 |
| HARS-X-5-10 | 1.1111 M | 5 | 10 |
| HARS-X-5-100 | 11.111 M | 5 | 100 |
| HARS-X-5-1K | 111.11 M | 5 | 1 k |
| HARS-X-6-0.001 | 1.111 11 k | 6 | 0.001 |
| HARS-X-6-0.01 | 11.1111 k | 6 | 0.01 |
| HARS-X-6-0.1 | 111.111 k | 6 | 0.1 |
| HARS-X-6-1 | 1.111 11 M | 6 | 1 |
| HARS-X-6-10 | 11.1111 M | 6 | 10 |
| HARS-X-6-100 | 111.111 M | 6 | 100 |
| HARS-X-7-0.001 | 11.111 11 k | 7 | 0.001 |
| HARS-X-7-0.01 | 111.1111 k | 7 | 0.01 |
| HARS-X-7-0.1 | 1.111 111 M | 7 | 0.1 |
| HARS-X-7-1 | 11.111 11 M | 7 | 1 |
| HARS-X-7-10 | 111.1111 M | 7 | 10 |
| HARS-X-8-0.001 | 111.111 11 k | 8 | 0.001 |
| HARS-X-8-0.01 | 1.111 111 1 M | 8 | 0.01 |
| HARS-X-8-0.1 | 11.111 111 M | 8 | 0.1 |
| HARS-X-8-1 | 111.111 11 M | 8 | 1 |
| HARS-X-9-0.001 | 1.111 111 11 M | 9 | 0.001 |
| HARS-X-9-0.01 | 11.111 111 1 M | 9 | 0.01 |
| HARS-X-9-0.1 | 111.111 111 M | 9 | 0.1 |
| HARS-X-10-0.001 | 11.111 111 11 M | 10 | 0.001 |
| HARS-X-10-0.01 | 111.111 111 1 M | 10 | 0.01 |
| HARS-X-11-0.001 | 111.111 111 11 M | 11 | 0.001 |

* For less exacting applications, more economical tolerances are available:
 - use "A" for "X" in part number for 0.05% basic accuracy, in lieu of .01%
 - use "Q" for "X" in part number for 0.02% basic accuracy, in lieu of .01%
 - use "B" for "X" in part number for 0.1% basic accuracy, in lieu of .01%

OPTIONS

- **RM** Rack mountable case for standard 19" rack
- **K** Kelvin type 4-terminal binding posts
- **RO** Rear output binding posts