Axial Cemented Fusible Leaded Wirewound Safety Resistors

FEATURES
- UL1412 recognized; UL file no. E362452
- Flameproof insulation coating meets UL 94 V-0 requirements
- Impulse voltage handling capability (up to 6 kV) (1.2 / 50 μs pulse in IEC 61000-4-5)
- Silent and safe fusing
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS
- Energy meters
- White goods
- Power supplies
- LED drivers

ACxx-CS series wirewound safety resistors are designed to be used as fusible safety resistors (or AC mains input resistors). The resistor fuses “without a bang” when AC mains voltage is applied (1). At the same time, it acts as an in-rush current limiting resistor for normal operation. The specially developed lacquer coating has superior thermal and electrical insulating properties. This allows designers to more easily meet the requirements of safety approval, whilst eliminating the need to put additional fuses in series with the input resistor.

Note
(1) For ohmic values below 3R9, silent fusing is not established when AC mains voltage of 120 VRMS / 240 VRMS is applied

STANDARD ELECTRICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>POWER RATING $P_{50}$</th>
<th>POWER RATING $P_{70}$</th>
<th>LIMITING VOLTAGE $U_{\text{max}}$</th>
<th>RESISTANCE RANGE (1)</th>
<th>TOLERANCE</th>
<th>TEMPERATURE COEFFICIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC01-CS</td>
<td>1.1 W</td>
<td>1 W</td>
<td>$\sqrt{P \times R}$</td>
<td>1 Ω to 100 Ω</td>
<td>± 5 %</td>
<td>± 200 ppm/K</td>
</tr>
<tr>
<td>AC03-CS</td>
<td>3 W</td>
<td>2.7 W</td>
<td>$\sqrt{P \times R}$</td>
<td>1 Ω to 100 Ω</td>
<td>± 5 %</td>
<td>± 200 ppm/K</td>
</tr>
<tr>
<td>AC05-CS</td>
<td>5 W</td>
<td>4.5 W</td>
<td>$\sqrt{P \times R}$</td>
<td>1 Ω to 100 Ω</td>
<td>± 5 %</td>
<td>± 200 ppm/K</td>
</tr>
</tbody>
</table>

Note
(1) Resistance value to be selected for ± 5 % from E24 series

TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>AC01-CS</th>
<th>AC03-CS</th>
<th>AC05-CS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature range</td>
<td>-40 °C to 200 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. resistance change for 116 % of $P_{70}$, $\Delta R$ max., after 1000 h:</td>
<td>± (5 % ( R + 0.1 ) Ω)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### PART NUMBER AND PRODUCT DESCRIPTION

**Part Number:** AC03000002209JACCS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>VERSION</th>
<th>TCR/MATERIAL</th>
<th>RESISTANCE</th>
<th>TOLERANCE</th>
<th>PACKAGING</th>
<th>SPECIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC01</td>
<td>0</td>
<td>0 = neutral</td>
<td>3 digit value</td>
<td>J = ± 5 %</td>
<td>AC</td>
<td>CS = safety</td>
</tr>
<tr>
<td>AC03</td>
<td>1</td>
<td>1 = radial taped</td>
<td>1 digit multiplier</td>
<td></td>
<td>6B</td>
<td></td>
</tr>
<tr>
<td>AC05</td>
<td>A</td>
<td>A = ≤ 4 kV or</td>
<td>8 = 10^-2</td>
<td></td>
<td>R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>B = ≤ 6 kV for</td>
<td>9 = 10^-1</td>
<td></td>
<td>RB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>AC05-CS are not necessary</td>
<td>0 = 10^0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Product Description:** AC03-CS 22R 5 % AC G63 CDxxxx

<table>
<thead>
<tr>
<th>TYPE</th>
<th>RESISTANCE</th>
<th>TOLERANCE</th>
<th>PACKAGING</th>
<th>TAPE WIDTH</th>
<th>SPECIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC03-CS</td>
<td>22R</td>
<td>± 5 %</td>
<td>AC</td>
<td>G63</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 %</td>
<td></td>
<td>6B</td>
<td>G83</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6F</td>
<td>G93</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PACKAGING

<table>
<thead>
<tr>
<th>TYPE</th>
<th>CODE</th>
<th>QUANTITY</th>
<th>PACKAGING STYLE</th>
<th>WIDTH</th>
<th>PITCH</th>
<th>DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC01-CS</td>
<td>AC</td>
<td>500</td>
<td>Taped acc. to IEC 60286-1 fan-folded in a box</td>
<td>63 mm</td>
<td>10 mm</td>
<td>85 mm x 72 mm x 260 mm</td>
</tr>
<tr>
<td></td>
<td>R1</td>
<td>1000</td>
<td>Taped acc. to IEC 60286-2 on a reel</td>
<td>-</td>
<td>-</td>
<td>365 mm x 370 mm x 60 mm</td>
</tr>
<tr>
<td>AC03-CS</td>
<td>AC</td>
<td>500</td>
<td>Taped acc. to IEC 60286-1 fan-folded in a box</td>
<td>63 mm</td>
<td>10 mm</td>
<td>85 mm x 120 mm x 270 mm</td>
</tr>
<tr>
<td></td>
<td>R1</td>
<td>1000</td>
<td>Taped acc. to IEC 60286-2 on a reel</td>
<td>-</td>
<td>-</td>
<td>365 mm x 370 mm x 60 mm</td>
</tr>
<tr>
<td></td>
<td>6B</td>
<td>250</td>
<td>Taped acc. to IEC 60286-1 fan-folded in a box</td>
<td>83 mm</td>
<td>15 mm</td>
<td>110 mm x 120 mm x 270 mm</td>
</tr>
<tr>
<td></td>
<td>6F</td>
<td>250</td>
<td>Taped acc. to IEC 60286-1 fan-folded in a box</td>
<td>93 mm</td>
<td>-</td>
<td>120 mm x 120 mm x 270 mm</td>
</tr>
<tr>
<td></td>
<td>RB</td>
<td>250</td>
<td>Taped acc. to IEC 60286-2 on a reel</td>
<td>-</td>
<td>-</td>
<td>365 mm x 370 mm x 67 mm</td>
</tr>
</tbody>
</table>
AC01-CS, AC03-CS, AC05-CS

Vishay Draloric

DESCRIPTION
ACxx-CS wirewound safety resistor series is designed to be used as fusible safety resistor (or, AC mains input resistors). It uses specially selected resistive winding wire and special non-flammable silicone cement coating material to ensure safe and silent fusing operation in overload conditions. The resistor fuses “without a bang” when AC mains voltage is applied (1). At the same time, it acts as an in-rush current limiting resistor for the normal operation. The specially developed lacquer coating has superior thermal and electrical insulating properties. This allows designers to more easily meet the requirements of safety approval, whilst eliminating the need to put additional fuses in series with the input resistor.

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. Plated steel termination caps are firmly pressed on the ceramic rods. Connecting wires of electrolytic copper plated with 100 % pure matte tin are welded to the termination caps. Suitable resistive wire is selected as a winding material. An optimized number of windings are wound on a high grade ceramic body. The resistor elements are covered by a green protective coating designed for electrical, mechanical and climatic protection. The special coating provides ideal and silent fusing of the component in overload conditions, without burning or explosion (1).

The ohmic value, tolerance, rated dissipation is stamp marked. Also “S” is marked for safety version.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with IEC 60286-1.

MATERIALS
Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein (2)
- The Global Automotive Declarable Substance List (GADSL) (3)
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) (4) for its supply chain
- IEC 60115-1 (5). The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

APPROVALS
These resistors AC01-CS, AC03-CS, and AC05-CS have UL 1412 recognition UL file no. E362452.

RELATED PRODUCTS
For a correlated range of wirewound resistors with high pulse handling capability, please see:
Z300-Cxx series
“High Surge Axial Cemented Wirewound Resistors”
www.vishay.com/doc?21027
For a correlated range of standard wirewound resistors, please see:
Z300 series
“Industrial Axial Cemented Wirewound Resistors”
www.vishay.com/doc?21007
and Z300-C00 series
“Commercial Axial Cemented Wirewound Resistors”
www.vishay.com/doc?21047

Notes
(1) For ohmic values below 3R9, silent fusing is not established when AC mains voltage of 120 Vrms / 240 Vrms is applied
(2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474
(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org
(4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table
(5) Other cleaning solvents with aggressive chemicals should be evaluated in actual cleaning process for their suitability

Revision: 25-Oct-2023
For technical questions, contact: ww1resistors@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000
FUNCTIONAL PERFORMANCE

DERATING

Fusing time window defined against overload power applied.

FUSING CHARACTERISTICS
OF AC01-CS: $1 \leq R \leq 2.7 \Omega$

FUSING CHARACTERISTICS
OF AC03-CS: $4.3 \leq R \leq 100 \Omega$

FUSING CHARACTERISTICS
OF AC05-CS: $1 \leq R \leq 4.3 \Omega$

FUSING CHARACTERISTICS
OF AC03-CS: $4.7 \leq R \leq 100 \Omega$
**FUNCTIONAL PERFORMANCE**

**FUSING CHARACTERISTICS**

OF AC05-CS: $1 \Omega \leq R \leq 9.1 \Omega$

**FUSING CHARACTERISTICS**

OF AC05-CS: $10 \Omega \leq R \leq 100 \Omega$

Pulse energy curve defined against the offered ohmic range.

**PULSE ENERGY CURVE FOR AC01-CS**

(1.2 / 50 μs; 10 pulses at 30 s interval)

**PULSE ENERGY CURVE FOR AC03-CS**

(1.2 / 50 μs; 10 pulses at 30 s interval)

**PULSE ENERGY CURVE FOR AC05-CS: 1 Ω to 9.1 Ω**

(1.2 / 50 μs; 10 pulses at 30 s interval)

**PULSE ENERGY CURVE FOR AC05-CS: 10 Ω to 100 Ω**

(1.2 / 50 μs; 10 pulses at 30 s interval)
FUNCTIONAL PERFORMANCE

Peak voltage (1.2 / 50 μs) graph defined against offered ohmic range.

PEAK PULSE VOLTAGE LIMIT FOR AC01-CS
(1.2 / 50 μs; 10 pulses at 30 s interval)

PEAK PULSE VOLTAGE LIMIT FOR AC03-CS
(1.2 / 50 μs; 10 pulses at 30 s interval)

PEAK PULSE VOLTAGE LIMIT FOR AC05-CS: 1 Ω to 9.1 Ω
(1.2 / 50 μs; 10 pulses at 30 s interval)

PEAK PULSE VOLTAGE LIMIT FOR AC05-CS: 10 Ω to 100 Ω
(1.2 / 50 μs; 10 pulses at 30 s interval)
TEST PROCEDURES AND REQUIREMENTS

All tests are carried out in accordance with the following specifications:

- IEC 60115-1, generic specification (includes tests)

The test and requirements table contains only the most important tests. For the full test schedule refer to the documents above.

The tests are carried out in accordance with IEC 60068-2-xx test method and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3.

Climatic category -40 / 200 / 56 (rated temperature range: lower category temperature, upper category temperature; damp heat, steady state, test duration: 56 days) is valid.

Unless otherwise specified the following values apply:

- Temperature: 15 °C to 35 °C
- Relative humidity: 45 % to 75 %
- Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar)

For performing some of the tests, the components are mounted on a test board in accordance with IEC 60115-1, 5.5.

In test table below, only the relevant and commonly referred tests and related clauses of IEC 60115-1 and IEC 60068-2-xx test methods are mentioned.

<table>
<thead>
<tr>
<th>IEC 60115-1 CLAUSE</th>
<th>IEC 60068-2 TEST METHOD</th>
<th>TEST</th>
<th>PROCEDURE</th>
<th>REQUIREMENTS PERMISSIBLE CHANGE (ΔR_MAX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1</td>
<td>-</td>
<td>Short time overload</td>
<td>Room temperature; 10x rated power P_{40}; 5 s</td>
<td>± (2 % R + 0.1 Ω)</td>
</tr>
<tr>
<td>9.5</td>
<td>21 (Ua), 21 (Ub), 21 (Uc)</td>
<td>Robustness of terminations</td>
<td>Tensile, bending and torsion</td>
<td>No damage ± (0.5 % R + 0.05 Ω)</td>
</tr>
<tr>
<td>11.2</td>
<td>20 (Tb)</td>
<td>Resistance to soldering heat</td>
<td>Unmounted components (260 ± 5) °C; (10 ± 1) s</td>
<td>± (0.5 % R + 0.05 Ω)</td>
</tr>
<tr>
<td>10.3</td>
<td>2 (Bb)</td>
<td>Climatic sequence:</td>
<td>16 h; 200 °C</td>
<td></td>
</tr>
<tr>
<td>10.3.4.2</td>
<td>30 (Db)</td>
<td>Dry heat</td>
<td>24 h; 55 °C; 90 % to 100 % RH</td>
<td></td>
</tr>
<tr>
<td>10.3.4.3</td>
<td>1 (Ab)</td>
<td>Damp heat (accelerated) 1st cycle</td>
<td>2 h; -55 °C</td>
<td>± (1 % R + 0.05 Ω)</td>
</tr>
<tr>
<td>10.3.4.4</td>
<td>13 (M)</td>
<td>Cold</td>
<td>2 h; 8.5 kPa; 15 °C to 35 °C</td>
<td></td>
</tr>
<tr>
<td>10.3.4.5</td>
<td>30 (Db)</td>
<td>Low air pressure</td>
<td>5 days; 55 °C; 95 % to 100 % RH; 5 cycles</td>
<td></td>
</tr>
<tr>
<td>10.4</td>
<td>78 (Cab)</td>
<td>Damp heat, (steady state)</td>
<td>56 days; (40 ± 2) °C; (93 ± 5) % RH</td>
<td>± (5 % R + 0.1 Ω)</td>
</tr>
<tr>
<td>7.2</td>
<td>-</td>
<td>Endurance (at room temperature)</td>
<td>1000 h; loaded with 116 % of P_{70}; 1.5 h ON and 0.5 h OFF</td>
<td>± (5 % R + 0.1 Ω)</td>
</tr>
<tr>
<td>7.3</td>
<td>-</td>
<td>Endurance (at 200 °C)</td>
<td>1000 h; loaded with 30 % of P_{70}; 1.5 h ON and 0.5 h OFF</td>
<td>± (5 % R + 0.1 Ω)</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>1.2 / 50 μs impulse test as defined in IEC 61000-4-5 (up to 6 kV)</td>
<td>Internal impedance of surge tester is 2 Ω; 10 pulses at 30 s interval</td>
<td>± (5 % R + 0.1 Ω)</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Fail safe mains fusing (1) at 230 V_{AC}</td>
<td>-</td>
<td>Resistance &gt; 100 kΩ, fusing time &lt; 2 s (fusing without flame and explosion)</td>
</tr>
</tbody>
</table>

Note

(1) For ohmic values below 3R9, silent fusing is not established when AC mains voltage of 120 V_{RMS} / 240 V_{RMS} is applied.
DIMENSIONS - Leaded resistor types, mass and relevant physical dimensions

<table>
<thead>
<tr>
<th>MODEL</th>
<th>( L_{\text{max.}} )</th>
<th>( L_{1\text{max.}} )</th>
<th>( D_{\text{max.}} )</th>
<th>( d_{\text{nom.}} )</th>
<th>( B )</th>
<th>MASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC01-CS (1)</td>
<td>11.0 mm</td>
<td>15.0 mm</td>
<td>5.0 mm</td>
<td>0.7 mm</td>
<td>63 mm</td>
<td>0.52 g</td>
</tr>
<tr>
<td>AC03-CS</td>
<td>13.0 mm</td>
<td>19.0 mm</td>
<td>6.0 mm</td>
<td>0.8 mm</td>
<td>63 mm</td>
<td>0.78 g</td>
</tr>
<tr>
<td>AC05-CS (2)</td>
<td>17.0 mm</td>
<td>17.0 mm</td>
<td>10.0 mm</td>
<td>0.8 mm</td>
<td>83 mm</td>
<td>2.25 g</td>
</tr>
</tbody>
</table>

Notes
(1) For AC01-CS, dimension given is applicable for 10R to 100R; for lower ohmic values < 10R, \( D_{\text{max.}} \) might reach 5.5 mm
(2) For AC05-CS, \( L = L_1 \); there is no lacquer on termination lead

**AC01-CS RADIAL**
Pitch of components 5.0 mm

**AC03-CS RADIAL**
Pitch of components 5.0 mm

**AC05-CS RADIAL**
Pitch of components 7.50 mm
Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay’s knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer’s responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer’s technical experts. Product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.