

## Standard Metal Film Leaded Resistors



A homogeneous film of metal alloy is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps.

The resistors are coated with a colored lacquer (light-blue for type SFR16S; light-green for type SFR25 and red-brown for type SFR25H) which provides electrical, mechanical and climatic protection. The encapsulation is resistant to all cleaning solvents in accordance with IEC 60068-2-45.

### FEATURES

- Low cost
- Low noise (max. 1.5  $\mu\text{V/V}$  for  $R > 1 \text{ M}\Omega$ )
- Small size (SFR16S: 0204, SFR25/25H: 0207)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

### APPLICATIONS

- General purpose resistors

| TECHNICAL SPECIFICATIONS                                                                                                                                                     |                 |                                                                                              |                                                                                              |                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| DESCRIPTION                                                                                                                                                                  | UNIT            | SFR16S                                                                                       | SFR25                                                                                        | SFR25H                                                                                      |
| Resistance Range                                                                                                                                                             | $\Omega$        | $\pm 5 \%$ ; 1 to 3M<br>$\pm 1 \%$ ; 4.99 to 3M<br>Jumper (0 $\Omega$ )                      | $\pm 5 \%$ ; 0.22 to 10M<br>$\pm 1 \%$ ; 1 to 10M<br>Jumper (0 $\Omega$ )                    |                                                                                             |
| Resistance Tolerance                                                                                                                                                         | %               | $\pm 1$ , E24/E96 series; $\pm 5$ , E24 series                                               |                                                                                              |                                                                                             |
| Temperature Coefficient:<br>$R \leq 4.7 \Omega$<br>$4.7 \Omega < R \leq 100 \text{ k}\Omega$<br>$100 \text{ k}\Omega < R \leq 1 \text{ M}\Omega$<br>$R > 1 \text{ M}\Omega$  | ppm/K           | $\leq \pm 250$<br>$\leq \pm 100$<br>$\leq \pm 250$<br>$\leq \pm 250$                         | $\leq \pm 100$<br>$\leq \pm 100$<br>$\leq \pm 100$<br>$\leq \pm 250$                         | $\leq \pm 100$<br>$\leq \pm 100$<br>$\leq \pm 100$<br>$\leq \pm 250$                        |
| Rated Dissipation, $P_{70}$                                                                                                                                                  | W               | 0.5                                                                                          | 0.4                                                                                          | 0.5                                                                                         |
| Thermal Resistance, $R_{th}$                                                                                                                                                 | K/W             | 170                                                                                          | 200                                                                                          | 150                                                                                         |
| Maximum Permissible Voltage, ( $U_{max}$ . AC/DC)                                                                                                                            | V               | 200                                                                                          | 250                                                                                          | 350                                                                                         |
| Noise:<br>$R < 68 \text{ k}\Omega$<br>$68 \text{ k}\Omega \leq R \leq 100 \text{ k}\Omega$<br>$100 \text{ k}\Omega \leq R \leq 1 \text{ M}\Omega$<br>$R > 1 \text{ M}\Omega$ | $\mu\text{V/V}$ | max. 0.1<br>max. 0.5<br>max. 1.5<br>max. 1.5                                                 | max. 0.1<br>max. 0.1<br>max. 0.1<br>max. 1.5                                                 | max. 0.1<br>max. 0.1<br>max. 0.1<br>max. 1.5                                                |
| Basic Specifications                                                                                                                                                         |                 | IEC 60115-1                                                                                  |                                                                                              |                                                                                             |
| Climatic Category (IEC 60068-1)                                                                                                                                              |                 | 55/155/56                                                                                    |                                                                                              |                                                                                             |
| Stability, $\Delta R$ max., after:<br>Load (1000 h, $P_{70}$ ):<br>$R$ Range<br>Long Term Damp Heat Test (56 Days):<br>$R \leq 1 \text{ M}\Omega$<br>$R > 1 \text{ M}\Omega$ |                 | $\pm (2 \% R + 0.05 \Omega)$<br>$\pm (1 \% R + 0.05 \Omega)$<br>$\pm (1 \% R + 0.05 \Omega)$ | $\pm (2 \% R + 0.05 \Omega)$<br>$\pm (1 \% R + 0.05 \Omega)$<br>$\pm (1 \% R + 0.05 \Omega)$ | $\pm (2 \% R + 0.05 \Omega)$<br>$\pm (1 \% R + 0.05 \Omega)$<br>$\pm (2 \% R + 0.1 \Omega)$ |
| Soldering (10 s, 260 °C)                                                                                                                                                     |                 | $\pm (0.25 \% R + 0.05 \Omega)$                                                              | $\pm (0.25 \% R + 0.05 \Omega)$                                                              | $\pm (0.25 \% R + 0.05 \Omega)$                                                             |
| Short Time Overload                                                                                                                                                          |                 | $\pm (0.25 \% R + 0.05 \Omega)$                                                              | $\pm (0.25 \% R + 0.05 \Omega)$                                                              | $\pm (1 \% R + 0.05 \Omega)$                                                                |

### Note

- $R$  value is measured with probe distance of 24 mm  $\pm$  1 mm using 4-terminal method

| PART NUMBER AND PRODUCT DESCRIPTION                                                                                                                                                                                                                                                                                                                                  |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-----|-----------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----|--------------------------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------------------|------------------------------|
| PART NUMBER: SFR2500001001FA500                                                                                                                                                                                                                                                                                                                                      |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| <div style="display: flex; justify-content: space-around; font-weight: bold; font-size: 1.2em;"> <span>S</span><span>F</span><span>R</span><span>2</span><span>5</span><span>0</span><span>0</span><span>0</span><span>0</span><span>1</span><span>0</span><span>0</span><span>1</span><span>F</span><span>A</span><span>5</span><span>0</span><span>0</span> </div> |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| MODEL/SIZE                                                                                                                                                                                                                                                                                                                                                           | VARIANT                                     | TCR/MATERIAL               | VALUE                                                                                                                                                                                                                                                                                          | TOLERANCE                            | PACKAGING <sup>(1)</sup>                                                                                                                                                                                                 | SPECIAL                                                       |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| SFR16S0<br>SFR2500<br>SFR25H0                                                                                                                                                                                                                                                                                                                                        | 0 = Neutral<br>Z = Value overflow (special) | 0 = Standard<br>Z = Jumper | <b>3 digit value</b><br><b>1 digit multiplier</b><br><b>MULTIPLIER</b><br>7 = *10 <sup>-3</sup> 2 = *10 <sup>2</sup><br>8 = *10 <sup>-2</sup> 3 = *10 <sup>3</sup><br>9 = *10 <sup>-1</sup> 4 = *10 <sup>4</sup><br>0 = *10 <sup>0</sup> 5 = *10 <sup>5</sup><br>1 = *10 <sup>1</sup> Z = 0000 | F = ± 1 %<br>J = ± 5 %<br>Z = Jumper | N4<br>A5<br>A1<br>R5                                                                                                                                                                                                     | The 2 digits are used for all special parts.<br>00 = Standard |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| PRODUCT DESCRIPTION: SFR25 1 % A5 1K0                                                                                                                                                                                                                                                                                                                                |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| <table border="1" style="width: 100%;"> <tr><td style="text-align: center;">SFR25</td></tr> <tr><td style="text-align: center;">MODEL/SIZE</td></tr> <tr><td style="text-align: center;">SFR16S<br/>SFR25<br/>SFR25H</td></tr> </table>                                                                                                                              |                                             | SFR25                      | MODEL/SIZE                                                                                                                                                                                                                                                                                     | SFR16S<br>SFR25<br>SFR25H            | <table border="1" style="width: 100%;"> <tr><td style="text-align: center;">1 %</td></tr> <tr><td style="text-align: center;">TOLERANCE</td></tr> <tr><td style="text-align: center;">± 1 %<br/>± 5 %</td></tr> </table> |                                                               | 1 % | TOLERANCE | ± 1 %<br>± 5 % | <table border="1" style="width: 100%;"> <tr><td style="text-align: center;">A5</td></tr> <tr><td style="text-align: center;">PACKAGING <sup>(1)</sup></td></tr> <tr><td style="text-align: center;">N4<br/>A5<br/>A1<br/>R5</td></tr> </table> |  | A5 | PACKAGING <sup>(1)</sup> | N4<br>A5<br>A1<br>R5 | <table border="1" style="width: 100%;"> <tr><td style="text-align: center;">1K0</td></tr> <tr><td style="text-align: center;">RESISTANCE VALUE</td></tr> <tr><td style="text-align: center;">47K = 47 kΩ<br/>51R1 = 51.1 Ω</td></tr> </table> | 1K0 | RESISTANCE VALUE | 47K = 47 kΩ<br>51R1 = 51.1 Ω |
| SFR25                                                                                                                                                                                                                                                                                                                                                                |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| MODEL/SIZE                                                                                                                                                                                                                                                                                                                                                           |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| SFR16S<br>SFR25<br>SFR25H                                                                                                                                                                                                                                                                                                                                            |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| 1 %                                                                                                                                                                                                                                                                                                                                                                  |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| TOLERANCE                                                                                                                                                                                                                                                                                                                                                            |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| ± 1 %<br>± 5 %                                                                                                                                                                                                                                                                                                                                                       |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| A5                                                                                                                                                                                                                                                                                                                                                                   |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| PACKAGING <sup>(1)</sup>                                                                                                                                                                                                                                                                                                                                             |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| N4<br>A5<br>A1<br>R5                                                                                                                                                                                                                                                                                                                                                 |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| 1K0                                                                                                                                                                                                                                                                                                                                                                  |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| RESISTANCE VALUE                                                                                                                                                                                                                                                                                                                                                     |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |
| 47K = 47 kΩ<br>51R1 = 51.1 Ω                                                                                                                                                                                                                                                                                                                                         |                                             |                            |                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                          |                                                               |     |           |                |                                                                                                                                                                                                                                                |  |    |                          |                      |                                                                                                                                                                                                                                               |     |                  |                              |

**Notes**

<sup>(1)</sup> Please refer to table PACKAGING

- The jumper has a maximum resistance  $R_{max.} = 30 \text{ m}\Omega$  at 3 A (SFR16S)
- The jumper has a maximum resistance  $R_{max.} = 30 \text{ m}\Omega$  at 5 A (SFR25)
- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

| PACKAGING     |           |              |           |      |        |      |
|---------------|-----------|--------------|-----------|------|--------|------|
| MODEL         | TOLERANCE | TAPING       | AMMO PACK |      | REEL   |      |
|               |           |              | PIECES    | CODE | PIECES | CODE |
| SFR16S        | 1 %       | Axial, 52 mm | 5000      | A5   | 5000   | R5   |
| SFR16S        | 5 %       | Axial, 52 mm | 5000      | A5   | 5000   | R5   |
|               |           |              | 1000      | A1   |        |      |
| SFR25, SFR25H | 1 %       | Axial, 52 mm | 5000      | A5   | 5000   | R5   |
| SFR25, SFR25H | 5 %       | Axial, 52 mm | 5000      | A5   | 5000   | R5   |
|               |           |              | 1000      | A1   |        |      |
| SFR25, SFR25H | 1 %       | Radial       | 4000      | N4   | -      | -    |
| SFR25, SFR25H | 5 %       | Radial       | 4000      | N4   | -      | -    |

**DIMENSIONS**


| DIMENSIONS - Resistor types and relevant physical dimensions in millimeters |                     |                     |                     |             |
|-----------------------------------------------------------------------------|---------------------|---------------------|---------------------|-------------|
| TYPE                                                                        | Ø D <sub>max.</sub> | L <sub>1 max.</sub> | L <sub>2 max.</sub> | Ø d         |
| SFR16S                                                                      | 1.9                 | 3.5                 | 4.1                 | 0.45 ± 0.05 |
| SFR25                                                                       | 2.5                 | 6.5                 | 7.5                 | 0.58 ± 0.05 |
| SFR25H                                                                      | 2.5                 | 6.5                 | 7.5                 | 0.58 ± 0.05 |

| MASS PER UNIT |           |
|---------------|-----------|
| TYPE          | MASS (mg) |
| SFR16S        | 102       |
| SFR25         | 205       |
| SFR25H        | 205       |

**OUTLINES**

The length of the body ( $L_1$ ) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation (IEC 60294).

**MARKING**

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC 60062, marking codes for resistors and capacitors.

**PRODUCTS WITH RADIAL LEADS (SFR25, SFR25H)**


| DIMENSIONS - Radial taping |                                                 |       |           |      |
|----------------------------|-------------------------------------------------|-------|-----------|------|
| SYMBOL                     | PARAMETER                                       | VALUE | TOLERANCE | UNIT |
| P                          | Pitch of components                             | 12.7  | $\pm 1.0$ | mm   |
| $P_0$                      | Feed-hole pitch                                 | 12.7  | $\pm 0.2$ | mm   |
| $P_1$                      | Feed-hole centre to lead at topside at the tape | 3.85  | $\pm 0.5$ | mm   |
| $P_2$                      | Feed-hole center to body center                 | 6.35  | $\pm 1.0$ | mm   |
| F                          | Lead-to-lead distance                           | 4.8   | + 0.7/- 0 | mm   |
| W                          | Tape width                                      | 18.0  | $\pm 0.5$ | mm   |
| $W_0$                      | Minimum hold down tape width                    | 5.5   | -         | mm   |
| H1                         | Component height                                | 29    | Max.      | mm   |
| $H_0$                      | Lead wire clinch height                         | 16.5  | $\pm 0.5$ | mm   |
| $H_0$                      | Height of component from tape center            | 19.5  | $\pm 1$   | mm   |
| $D_0$                      | Feed-hole diameter                              | 4.0   | $\pm 0.2$ | mm   |
| L                          | Maximum length of snapped lead                  | 11.0  | -         | mm   |
| $L_1$                      | Minimum lead wire (tape portion) shortest lead  | 2.5   | -         | mm   |

**Note**

- Please refer to document "Packaging" for more detail ([www.vishay.com/doc?28721](http://www.vishay.com/doc?28721)).



**FUNCTIONAL PERFORMANCE  
PRODUCT CHARACTERIZATION**

Standard values of nominal resistance are taken from the E96/E24 series for resistors with a tolerance of ± 1 % or ± 5 %. The values of the E96/E24 series are in accordance with IEC 60063.

The power that the resistor can dissipate depends on the operating temperature



Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the ambient temperature ( $T_{amb}$ )



SFR16S Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )



SFR16S Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max}$ ) as a function of pulse duration ( $t_i$ )



SFR25 Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )



SFR25 Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max}$ ) as a function of pulse duration ( $t_i$ )



SFR25H Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )



SFR25H Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max}$ ) as a function of pulse duration ( $t_i$ )



SFR16S Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power



SFR25/SFR25H Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power

**Note**

- The maximum permissible hot-spot temperature is 155 °C.

**Application Information**



**TESTS AND REQUIREMENTS**

Essentially all tests are carried out in accordance with IEC 60115-1 specification, category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category temperature; damp heat, steady state, test duration: 56 days).

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

In the Test Procedures and Requirements table, tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2-xx test methods. A short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying. All soldering tests are performed with mildly activated flux.

| TEST PROCEDURES AND REQUIREMENTS |                         |                                          |                                                                                                                                          |                            |                                                                                                                                                                                              |       |                                                     |
|----------------------------------|-------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------|
| IEC 60115-1 CLAUSE               | IEC 60068-2 TEST METHOD | TEST                                     | PROCEDURE                                                                                                                                | RESISTANCE RANGE           | REQUIREMENTS                                                                                                                                                                                 |       |                                                     |
|                                  |                         |                                          |                                                                                                                                          |                            | SFR16S                                                                                                                                                                                       | SFR25 | SFR25H                                              |
| 4.16                             |                         | Robustness of terminations:              |                                                                                                                                          |                            | Number of failures <math> < 10 \times 10^{-6}</math><br><br>Number of failures <math> < 10 \times 10^{-6}</math><br><br>No damage<br>$\Delta R \text{ max.: } \pm (0.25 \% R + 0.05 \Omega)$ |       |                                                     |
| 4.16.2                           | 21 (Ua1)                | Tensile all samples                      | $\varnothing$ 0.45 mm, load 5 N; 10 s<br>$\varnothing$ 0.58 mm, load 10 N; 10 s                                                          |                            |                                                                                                                                                                                              |       |                                                     |
| 4.16.3                           | 21 (Ub)                 | Bending half number of samples           | $\varnothing$ 0.45 mm, load 2.5 N; 4 x 90°<br>$\varnothing$ 0.58 mm, load 5 N; 4 x 90°                                                   |                            |                                                                                                                                                                                              |       |                                                     |
| 4.16.4                           | 21 (Uc)                 | Torsion other half of samples            | 3 x 360° in opposite directions                                                                                                          |                            |                                                                                                                                                                                              |       |                                                     |
| 4.17                             | 20 (Ta)                 | Solderability                            | 2 s; 235 °C: Solder bath method; SnPb40<br>3 s; 245 °C: Solder bath method; SnAg3Cu0.5                                                   |                            | Good tinning ( $\geq 95 \%$ covered); no damage                                                                                                                                              |       |                                                     |
|                                  |                         | Solderability (after aging)              | 8 h steam or 16 h 155 °C; leads immersed 6 mm; for 2 s at 235 °C: Solder bath (SnPb40) for 3 s at 245 °C: Solder bath (SnAgCu0.5) method |                            | Good tinning ( $\geq 95 \%$ covered); no damage                                                                                                                                              |       |                                                     |
| 4.18                             | 20 (Tb)                 | Resistance to soldering heat             | Thermal shock: 10 s; 260 °C; 3 mm from body                                                                                              |                            | $\Delta R \text{ max.: } \pm (0.25 \% R + 0.05 \Omega)$                                                                                                                                      |       |                                                     |
| 4.19                             | 14 (Na)                 | Rapid change of temperature              | 30 min at - 55 °C and 30 min at + 155 °C; 5 cycles                                                                                       |                            | $\Delta R \text{ max.: } \pm (0.25 \% R + 0.05 \Omega)$                                                                                                                                      |       |                                                     |
| 4.20                             | 29 (Eb)                 | Bump                                     | 3 x 1500 bumps in 3 directions; 40 g                                                                                                     |                            | No damage<br>$\Delta R \text{ max.: } \pm (0.25 \% R + 0.05 \Omega)$                                                                                                                         |       |                                                     |
| 4.22                             | 6 (Fc)                  | Vibration                                | Frequency 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)                                   |                            | No damage<br>$\Delta R \text{ max.: } \pm (0.25 \% R + 0.05 \Omega)$                                                                                                                         |       |                                                     |
| 4.23                             | 2 (Ba)                  | Climatic sequence: Dry heat              | 16 h; 155 °C                                                                                                                             |                            | $R_{\text{ins min.:}} 1000 \text{ M}\Omega$<br><br><br><br>$\Delta R \text{ max.: } \pm (1 \% R + 0.05 \Omega)$                                                                              |       |                                                     |
| 4.23.2                           |                         | Damp heat                                | 24 h; 55 °C;                                                                                                                             |                            |                                                                                                                                                                                              |       |                                                     |
| 4.23.3                           | 30 (Db)                 | (accelerated) 1 <sup>st</sup> cycle      | 90 % to 100 % RH                                                                                                                         |                            |                                                                                                                                                                                              |       |                                                     |
| 4.23.4                           | 1 (Aa)                  | Cold                                     | 2 h; - 55 °C                                                                                                                             |                            |                                                                                                                                                                                              |       |                                                     |
| 4.23.5                           | 13 (M)                  | Low air pressure                         | 2 h; 8.5 kPa; 15 °C to 35 °C                                                                                                             |                            |                                                                                                                                                                                              |       |                                                     |
| 4.23.6                           | 30 (Db)                 | Damp heat (accelerated) remaining cycles | 5 days; 55 °C; 95 % to 100 % RH                                                                                                          |                            |                                                                                                                                                                                              |       |                                                     |
|                                  |                         |                                          |                                                                                                                                          | $R \leq 1 \text{ M}\Omega$ | $\Delta R \text{ max.: } \pm (1 \% R + 0.05 \Omega)$                                                                                                                                         |       |                                                     |
|                                  |                         |                                          |                                                                                                                                          | $R > 1 \text{ M}\Omega$    | $\Delta R \text{ max.: } \pm (1 \% R + 0.05 \Omega)$                                                                                                                                         |       | $\Delta R \text{ max.: } \pm (2 \% R + 0.1 \Omega)$ |





| TEST PROCEDURES AND REQUIREMENTS |                         |                             |                                                                                                                                                                 |                                                                                                                   |                                                                                                                              |                                                                                                                              |                                                                                                                              |
|----------------------------------|-------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| IEC 60115-1 CLAUSE               | IEC 60068-2 TEST METHOD | TEST                        | PROCEDURE                                                                                                                                                       | RESISTANCE RANGE                                                                                                  | REQUIREMENTS                                                                                                                 |                                                                                                                              |                                                                                                                              |
|                                  |                         |                             |                                                                                                                                                                 |                                                                                                                   | SFR16S                                                                                                                       | SFR25                                                                                                                        | SFR25H                                                                                                                       |
| 4.24                             | 78 (Cab)                | Damp heat (steady state)    | 56 days; 40 °C; 90 % to 95 % RH; loaded with 0.01 $P_{70}$ (steps: 0 V to 100 V)                                                                                |                                                                                                                   | $R_{ins}$ min.: 1000 M $\Omega$<br>$\Delta R$ max.: $\pm (2 \% R + 0.05 \Omega)$                                             |                                                                                                                              |                                                                                                                              |
| 4.25.1                           |                         | Endurance (at 70 °C)        | 1000 h; loaded with $P_{70}$ or $U_{max}$ ; 1.5 h ON and 0.5 h OFF                                                                                              |                                                                                                                   | $\Delta R$ max.: $\pm (2 \% R + 0.05 \Omega)$                                                                                |                                                                                                                              |                                                                                                                              |
| 4.8                              |                         | Temperature coefficient     | Between - 55 °C and + 155 °C                                                                                                                                    | $R < 4.7 \Omega$<br>$R \leq 100 \text{ k}\Omega$<br>$R \leq 1 \text{ M}\Omega$<br>$R > 1 \text{ M}\Omega$         | $\leq \pm 250 \text{ ppm/K}$<br>$\leq \pm 100 \text{ ppm/K}$<br>$\leq \pm 250 \text{ ppm/K}$<br>$\leq \pm 250 \text{ ppm/K}$ | $\leq \pm 100 \text{ ppm/K}$<br>$\leq \pm 100 \text{ ppm/K}$<br>$\leq \pm 100 \text{ ppm/K}$<br>$\leq \pm 250 \text{ ppm/K}$ | $\leq \pm 100 \text{ ppm/K}$<br>$\leq \pm 100 \text{ ppm/K}$<br>$\leq \pm 100 \text{ ppm/K}$<br>$\leq \pm 250 \text{ ppm/K}$ |
| 4.7                              |                         | Voltage proof on insulation | $U_{RMS} = 400 \text{ V}$ (SFR16S) or $U_{RMS} = 600 \text{ V}$ (SFR25 and SFR25H); during 1 min; V-block method                                                |                                                                                                                   | No breakdown                                                                                                                 |                                                                                                                              |                                                                                                                              |
| 4.12                             |                         | Noise                       | IEC 60195                                                                                                                                                       | $R < 68 \text{ k}\Omega$<br>$R \leq 100 \text{ k}\Omega$<br>$R \leq 1 \text{ M}\Omega$<br>$R > 1 \text{ M}\Omega$ | max. 0.1 $\mu\text{V/V}$<br>max. 0.5 $\mu\text{V/V}$<br>max. 1.5 $\mu\text{V/V}$<br>max. 1.5 $\mu\text{V/V}$                 | max. 0.1 $\mu\text{V/V}$<br>max. 0.1 $\mu\text{V/V}$<br>max. 0.1 $\mu\text{V/V}$<br>max. 1.5 $\mu\text{V/V}$                 | max. 0.1 $\mu\text{V/V}$<br>max. 0.1 $\mu\text{V/V}$<br>max. 0.1 $\mu\text{V/V}$<br>max. 1.5 $\mu\text{V/V}$                 |
| 4.6.1.1                          |                         | Insulation resistance       | $U_{max}$ , DC = 500 V during 1 min; V-block method                                                                                                             |                                                                                                                   | $R_{ins}$ min.: 1000 M $\Omega$                                                                                              |                                                                                                                              |                                                                                                                              |
| 4.13                             |                         | Short time overload         | Room temperature; $P = 6.25 \times P_n$ (SFR25, SFR25H) or 6.25 x 0.25 W (SFR16S); (voltage not more than 2 x limiting voltage); 10 cycles; 5 s ON and 45 s OFF |                                                                                                                   | $\Delta R$ max.: $\pm (0.25 \% R + 0.05 \Omega)$                                                                             |                                                                                                                              | $\Delta R$ max.: $\pm 1 \% R + 0.05 \Omega$                                                                                  |

**HISTORICAL 12NC INFORMATION**

- The resistors had a 12-digit numeric code starting with 23.
- The subsequent 6 digits for 1 % or 7 digits for 5 % indicated the resistor type and packaging.
- The remaining digits indicated the resistance value:
  - The first 3 digits for 1 % or 2 digits for 5 % indicated the resistance value.
  - The last digit indicated the resistance decade.

**Resistance Decade for  $\pm 5 \%$  Tolerance**

| RESISTANCE DECADE                | LAST DIGIT |
|----------------------------------|------------|
| 0.10 $\Omega$ to 0.91 $\Omega$   | 7          |
| 1 $\Omega$ to 9.1 $\Omega$       | 8          |
| 10 $\Omega$ to 91 $\Omega$       | 9          |
| 100 $\Omega$ to 910 $\Omega$     | 1          |
| 1 k $\Omega$ to 9.1 k $\Omega$   | 2          |
| 10 k $\Omega$ to 91 k $\Omega$   | 3          |
| 100 k $\Omega$ to 910 k $\Omega$ | 4          |
| 1 M $\Omega$ to 9.1 M $\Omega$   | 5          |
| = 10 M $\Omega$                  | 6          |

**Resistance Decade for  $\pm 1 \%$  Tolerance**

| RESISTANCE DECADE                | LAST DIGIT |
|----------------------------------|------------|
| 1 $\Omega$ to 9.76 $\Omega$      | 8          |
| 10 $\Omega$ to 97.6 $\Omega$     | 9          |
| 100 $\Omega$ to 976 $\Omega$     | 1          |
| 1 k $\Omega$ to 9.76 k $\Omega$  | 2          |
| 10 k $\Omega$ to 97.6 k $\Omega$ | 3          |
| 100 k $\Omega$ to 976 k $\Omega$ | 4          |
| 1 M $\Omega$ to 9.76 M $\Omega$  | 5          |
| = 10 M $\Omega$                  | 6          |

**12NC Example**

The 12NC of a SFR25 resistor, value 5600  $\Omega \pm 5 \%$ , taped on a bandolier of 5000 units in ammpack was: 2322 181 43562.



| <b>HISTORICAL 12NC - Resistor type and packaging</b> |        |                          |                |                |                      |
|------------------------------------------------------|--------|--------------------------|----------------|----------------|----------------------|
| TYPE                                                 | TOL.   | 23.. ... ..              |                |                |                      |
|                                                      |        | BANDOLIER<br>IN AMMOPACK |                |                | BANDOLIER<br>ON REEL |
|                                                      |        | RADIAL TAPED             | STRAIGHT LEADS |                | STRAIGHT LEADS       |
|                                                      |        | 4000 UNITS               | 1000 UNITS     | 5000 UNITS     | 5000 UNITS           |
| SFR16S                                               | ± 5 %  | -                        | ..22 187 73... | ..22 187 53... | ..06 187 23...       |
|                                                      | ± 1 %  | -                        | -              | ..06 187 3...  | ..06 187 1....       |
|                                                      | Jumper | -                        | -              | ..06 187 90013 | ..22 187 90346       |
| SFR25                                                | ± 5 %  | ..06 184 03...           | ..22 181 53... | ..22 181 43... | ..22 181 63...       |
|                                                      | ± 1 %  | -                        | -              | ..22 188 2...  | ..06 181 8....       |
|                                                      | Jumper | -                        | ..22 181 90018 | ..22 181 90019 | ..06 181 90011       |
| SFR25H                                               | ± 5 %  | ..06 186 03...           | ..22 186 16... | ..22 186 76... | ..06 186 63...       |
|                                                      | ± 1 %  | -                        | -              | ..22 186 3.... | ..06 186 8....       |



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