

# TCN Series



## Conductive Polymer Solid Electrolytic Chip Capacitors Undertab Series



### FEATURES

- Conductive polymer electrode
- Benign failure mode under recommended use conditions
- Lower ESR
- Undertab terminations layout:
  - High Volumetric Efficiency
  - High PCB assembly density
  - High capacitance in smaller dimensions
- 3x reflow 260°C compatible
- 8 case sizes available



### APPLICATIONS

- Consumer applications (e.g. mobiles, MP3 etc.)

### CASE DIMENSIONS: millimeters (inches)

| Code | EIA Code | EIA Metric | L±0.20 (0.008) | W+0.20 (0.008) -0.10 (0.004) | H max.       | W <sub>P</sub> ±0.10 (0.004) | W <sub>N</sub> ±0.10 (0.004) | A <sub>P</sub> ±0.10 (0.004) | A <sub>N</sub> ±0.10 (0.004) | S Min.       |
|------|----------|------------|----------------|------------------------------|--------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------|
| N    | 0805     | 2012-10    | 2.05 (0.081)   | 1.30 (0.051)                 | 1.00 (0.039) | 1.00 (0.039)                 | 1.00 (0.039)                 | 0.85 (0.033)                 | 0.85 (0.033)                 | 0.40 (0.016) |
| K    | 1206     | 3216-10    | 3.20 (0.126)   | 1.60 (0.063)                 | 1.00 (0.039) | 1.30 (0.051)                 | 1.30 (0.051)                 | 1.15 (0.045)                 | 1.15 (0.045)                 | 0.90 (0.035) |
| S    | 1206     | 3216-12    | 3.20 (0.126)   | 1.60 (0.063)                 | 1.20 (0.047) | 1.30 (0.051)                 | 1.30 (0.051)                 | 1.15 (0.045)                 | 1.15 (0.045)                 | 0.90 (0.035) |
| L    | 1210     | 3528-10    | 3.50 (0.138)   | 2.80 (0.110)                 | 1.00 (0.039) | 2.50 (0.098)                 | 2.10 (0.083)                 | 1.15 (0.045)                 | 1.35 (0.053)                 | 1.00 (0.039) |
| T    | 1210     | 3528-12    | 3.50 (0.138)   | 2.80 (0.110)                 | 1.20 (0.047) | 2.50 (0.098)                 | 2.10 (0.083)                 | 1.15 (0.045)                 | 1.35 (0.053)                 | 1.00 (0.039) |
| X    | 2917     | 7343-15    | 7.30 (0.287)   | 4.30 (0.169)                 | 1.50 (0.059) | 3.25 (0.128)                 | 3.25 (0.128)                 | 2.00 (0.079)                 | 3.20 (0.126)                 | 2.10 (0.083) |
| 3    | 2924     | 7361-15    | 7.30 (0.287)   | 6.10 (0.240)                 | 1.50 (0.059) | 4.75 (0.187)                 | 4.75 (0.187)                 | 2.00 (0.079)                 | 3.20 (0.126)                 | 2.10 (0.083) |
| 4    | 2924     | 7361-20    | 7.30 (0.287)   | 6.10 (0.240)                 | 2.00 (0.079) | 4.75 (0.187)                 | 4.75 (0.187)                 | 2.00 (0.079)                 | 3.20 (0.126)                 | 2.10 (0.083) |

W<sub>1</sub> dimension applies to the termination width for A dimensional area only.

### MARKING

#### K, L, S, T, X CASE



#### N CASE



#### 3, 4 CASE



### HOW TO ORDER

**TCN**

Type

**L**

Case Size  
See table above

**157**

Capacitance Code  
pF code: 1st two digits represent significant figures, 3rd digit represents multiplier (number of zeros to follow)

**M**

Tolerance  
M = ±20%

**006**

Rated DC Voltage  
006 = 6.3Vdc  
016 = 16Vdc  
025 = 25Vdc  
035 = 35Vdc

**R**

Packaging  
R = Pure Tin 7" Reel  
S = Pure Tin 13" Reel

**0200**

ESR in mΩ

### TECHNICAL SPECIFICATIONS

|                                    |   |     |     |    |    |    |    |  |
|------------------------------------|---|-----|-----|----|----|----|----|--|
| Technical Data:                    | All technical data relate to an ambient temperature of +25°C                                |     |     |    |    |    |    |  |
| Capacitance Range:                 | 1.0 µF to 1500 µF   |     |     |    |    |    |    |  |
| Capacitance Tolerance:             | ±20%  |     |     |    |    |    |    |  |
| Leakage Current DCL:               | 0.1CV   |     |     |    |    |    |    |  |
| Rated Voltage (V <sub>R</sub> )    | ≤ +85°C:  | 4   | 6.3 | 10 | 16 | 25 | 35 |  |
| Category Voltage (V <sub>C</sub> ) | ≤ +105°C:   | 3.2 | 5   | 8  | 13 | 20 | 28 |  |
| Surge Voltage (V <sub>S</sub> )    | ≤ +85°C:  | 5.2 | 8   | 13 | 21 | 33 | 46 |  |
| Surge Voltage (V <sub>S</sub> )    | ≤ +105°C:   | 4   | 6   | 10 | 16 | 25 | 35 |  |
| Temperature Range:                 | -55°C to +105°C   |     |     |    |    |    |    |  |
| Reliability:                       | 1% per 1000 hours at 85°C, V <sub>R</sub> with 0.1Ω/V series impedance 60% confidence level |     |     |    |    |    |    |  |

NOTE: Conductive Polymer Capacitors are designed to operate within the limits of the environmental conditions specified for each series. If operated continuously at their maximum temperature and / or humidity limit, or beyond these limits, capacitors may exhibit a parametric shift in capacitance and increases in ESR. These changes may occur earlier if the specified environmental conditions are exceeded. Similarly, their normal operational time period will be significantly extended if their general duty cycle includes operation below maximum temperature within humidity controlled environments. Careful attention should be paid to maximum temperature with associated high humidity environments as well as voltage derating, ripple current and current surges. Please reference the AVX Conductive Polymer Capacitor Guidelines for more information or contact factory for application assistance.



### CAPACITANCE AND RATED VOLTAGE RANGE (LETTER DENOTES CASE SIZE)

| Capacitance |      | Rated Voltage DC to 85°C / 0.66DC to 105°C |  |                                  |                   |              |               |
|-------------|------|--|--|----------------------------------|-------------------|--------------|---------------|
| µF          | Code | 4V (G)                                     | 6.3V (J)                               | 10V (A)                          | 16V (C)           | 25V (E)      | 35V (V)       |
| 1.0         | 105  |  |  |                                  |                   |              | O*            |
| 4.7         | 475  |  |  |                                  |                   | N(500)       | L(300)/T(200) |
| 10          | 106  |  |  |                                  |                   |              | T(200)        |
| 15          | 156  |  |  | N(500)*                          |                   |              |               |
| 22          | 226  |  |  | N(500)*                          |                   | T(200)/X*    | X(100)*       |
| 33          | 336  | N(500)*                                    | K(500)*N(500)*                         | K(500)*N(500)*                   | L(200)/T(200)     |              |               |
| 47          | 476  | N(500)*                                    | K(500)*M(250)*<br>N(500)*              | K(500)*S(500)*                   | L(250)/T(150,200) | X(100)       | X(100)        |
| 68          | 686  | K(500)*N(500)*                             | K(500)*S(500)*                         | G(150)*L(150)*<br>S(500)*        |                   |              |               |
| 100         | 107  | K(500)*S(500)*                             | G(200)*<br>K(200,250)<br>L(200)/S(250) | G(150)*L(150)*<br>S(150)*T(150)* |                   | 3(70)/4(100) | 4(100)        |
| 150         | 157  | G(200)*L(200)*<br>S(500)*                  | K(200)*L(200)<br>S(250)/T(200)         | G(150)*H(150)*<br>T(150)*        | X(100)            | 4(70)        |               |
| 220         | 227  | G(200)*L(150)*<br>S(200)*T(150)*           | H(100,200)*<br>T(200)                  | H(150)*                          | 4(70)             |              |               |
| 330         | 337  | H(150)*T(150)*                             | H(200)*                                |                                  | 4(70)             |              |               |
| 470         | 477  | H(150)*                                    | X(50)                                  |                                  | 4(100)            |              |               |
| 1000        | 108  |  | X(200)/3(100)<br>4(55)                 |                                  |                   |              |               |
| 1500        | 158  |  | 4(55)                                  |                                  |                   |              |               |

Available Ratings, (ESR ratings in mOhms in brackets)

Engineering samples - please contact manufacturer

\*Codes under development - subject to change

Note: Voltage ratings are minimum values. AVX reserves the right to supply higher ratings in the same case size, to the same reliability standards.

# TCN Series



## Conductive Polymer Solid Electrolytic Chip Capacitors Undertab Series

### RATINGS & PART NUMBER REFERENCE

| AVX Part No.           | Case Size | Cap (µF) | Rated Voltage (V) | Maximum Operating Temperature (°C) | DCL Max. (µA) | DF Max. (%) | ESR Max. @ 100kHz (mΩ) | MSL | 100kHz RMS Current (mA) |      |       | Product Category |
|------------------------|-----------|----------|-------------------|------------------------------------|---------------|-------------|------------------------|-----|-------------------------|------|-------|------------------|
|                        |           |          |                   |                                    |               |             |                        |     | 45°C                    | 85°C | 105°C |                  |
| <b>6.3 Volt @ 85°C</b> |           |          |                   |                                    |               |             |                        |     |                         |      |       |                  |
| TCNK107M006#0200       | K         | 100      | 6.3               | 105                                | 60            | 10          | 200                    | 3   | 700                     | 500  | 300   | 3                |
| TCNK107M006#0250       | K         | 100      | 6.3               | 105                                | 60            | 10          | 250                    | 3   | 600                     | 400  | 300   | 3                |
| TCNL107M006#0200       | L         | 100      | 6.3               | 105                                | 60            | 10          | 200                    | 3   | 700                     | 500  | 300   | 3                |
| TCNS107M006#0250       | S         | 100      | 6.3               | 85                                 | 60            | 10          | 250                    | 3   | 600                     | 400  | –     | 5                |
| TCNL157M006#0200       | L         | 150      | 6.3               | 105                                | 90            | 10          | 200                    | 3   | 700                     | 500  | 300   | 3                |
| TCNS157M006#0250       | S         | 150      | 6.3               | 85                                 | 90            | 10          | 250                    | 3   | 600                     | 400  | –     | 5                |
| TCNT157M006#0200       | T         | 150      | 6.3               | 105                                | 90            | 10          | 200                    | 3   | 700                     | 500  | 300   | 3                |
| TCNT227M006#0200       | T         | 220      | 6.3               | 85                                 | 132           | 10          | 200                    | 3   | 700                     | 500  | –     | 5                |
| TCNX477M006#0050       | X         | 470      | 6.3               | 85                                 | 282           | 10          | 50                     | 3   | 1900                    | 1300 | –     | 5                |
| TCNX108M006#0200       | X         | 1000     | 6.3               | 85                                 | 600           | 30          | 200                    | 3   | 900                     | 600  | –     | 5                |
| TCN3108M006#0100       | 3         | 1000     | 6.3               | 105                                | 600           | 20          | 100                    | 4   | 1200                    | 840  | 480   | 3                |
| TCN4108M006#0055       | 4         | 1000     | 6.3               | 85                                 | 600           | 20          | 55                     | 4   | 1860                    | 1302 | –     | 5                |
| TCN4158M006#0055       | 4         | 1500     | 6.3               | 85                                 | 900           | 20          | 55                     | 4   | 1860                    | 1302 | –     | 5                |
| <b>16 Volt @ 85°C</b>  |           |          |                   |                                    |               |             |                        |     |                         |      |       |                  |
| TCNL336M016#0200       | L         | 33       | 16                | 85                                 | 52.8          | 6           | 200                    | 3   | 700                     | 500  | –     | 5                |
| TCNT336M016#0200       | T         | 33       | 16                | 85                                 | 52.8          | 6           | 200                    | 3   | 700                     | 500  | –     | 5                |
| TCNL476M016#0250       | L         | 47       | 16                | 85                                 | 75.2          | 6           | 250                    | 3   | 600                     | 400  | –     | 5                |
| TCNX476M016#0150       | T         | 47       | 16                | 85                                 | 75.2          | 6           | 150                    | 3   | 800                     | 600  | –     | 5                |
| TCNT476M016#0200       | T         | 47       | 16                | 85                                 | 75.2          | 6           | 200                    | 3   | 700                     | 500  | –     | 5                |
| TCNX157M016#0100       | X         | 150      | 16                | 85                                 | 240           | 6           | 100                    | 3   | 1300                    | 900  | –     | 5                |
| TCN4227M016#0070       | 4         | 220      | 16                | 105                                | 352           | 20          | 70                     | 4   | 1650                    | 1155 | 660   | 2                |
| TCN4337M016#0070       | 4         | 330      | 16                | 105                                | 528           | 20          | 70                     | 4   | 1650                    | 1155 | 660   | 3                |
| TCN4477M016#0100       | 4         | 470      | 16                | 85                                 | 752           | 20          | 100                    | 4   | 1380                    | 966  | –     | 5                |
| <b>25 Volt @ 85°C</b>  |           |          |                   |                                    |               |             |                        |     |                         |      |       |                  |
| TCNN475M025#0500       | N         | 4.7      | 25                | 105                                | 11.8          | 10          | 500                    | 3   | 400                     | 300  | 200   | 3                |
| TCNT226M025#0200       | T         | 22       | 25                | 105                                | 55            | 6           | 200                    | 3   | 700                     | 500  | 300   | 3                |
| TCNX476M025#0100       | X         | 47       | 25                | 105                                | 117.5         | 6           | 100                    | 3   | 1300                    | 900  | 600   | 2                |
| TCN3107M025#0070       | 3         | 100      | 25                | 105                                | 250           | 6           | 70                     | 4   | 1440                    | 1008 | 576   | 2                |
| TCN4107M025#0100       | 4         | 100      | 25                | 105                                | 250           | 6           | 100                    | 4   | 1380                    | 966  | 552   | 2                |
| TCN4157M025#0070       | 4         | 150      | 25                | 105                                | 375           | 6           | 70                     | 4   | 1650                    | 1155 | 660   | 2                |
| <b>35 Volt @ 85°C</b>  |           |          |                   |                                    |               |             |                        |     |                         |      |       |                  |
| TCNL475M035#0300       | L         | 4.7      | 35                | 105                                | 16.5          | 6           | 300                    | 3   | 600                     | 400  | 300   | 2                |
| TCNT475M035#0200       | T         | 4.7      | 35                | 85                                 | 16.5          | 10          | 200                    | 3   | 700                     | 500  | –     | 5                |
| TCNT106M035#0200       | T         | 10       | 35                | 85                                 | 35            | 10          | 200                    | 3   | 700                     | 500  | –     | 5                |
| TCNX476M035#0100       | X         | 47       | 35                | 105                                | 164.5         | 10          | 100                    | 3   | 1300                    | 900  | 600   | 2                |
| TCN4107M035#0100       | 4         | 100      | 35                | 105                                | 350           | 10          | 100                    | 4   | 1380                    | 966  | 552   | 3                |

Moisture Sensitivity Level (MSL) is defined according to J-STD-020.

All technical data relates to an ambient temperature of +25°C. Capacitance and DF are measured at 120Hz, 0.5RMS with DC bias of 2.2 volts. DCL is measured at rated voltage after 5 minutes.

ESR allowed to move up to 1.25 times catalog limit post mounting.

For typical weight and composition see page 223.

**NOTE: AVX reserves the right to supply a higher voltage rating or tighter tolerance part in the same case size, to the same reliability standards.**

### RECOMMENDED DERATING FACTOR

Voltage and temperature derating as percentage of Vr

Product Category 2



Product Category 3



Product Category 5



### PRODUCT CATEGORY 2, 3 (TEMPERATURE RANGE -55°C TO +105°C)

| TEST                         | Condition   | Characteristics  |                                  |       |       |           |       |           |            |     |
|------------------------------|---|--|----------------------------------|-------|-------|-----------|-------|-----------|------------|-----|
| <b>Endurance</b>             | Determine after application of rated voltage for 2000 +48/-0 hours at 85±2°C and then leaving 1-2 hours at room temperature. Also determine after application of 105°C temperature. For CATEGORY 2: Rated voltage for 2000 +48/-0 hours For CATEGORY 3: 0.8x rated voltage for 2000 +48/-0 hours And then leaving 1-2 hours at room temperature. Power supply impedance to be ≤ 0.1Ω/V. | Visual examination   | no visible damage                |       |       |           |       |           |            |     |
|                              |   | DCL  | 1.25 x initial limit             |       |       |           |       |           |            |     |
|                              |   | ΔC/C   | within ±20% of initial value     |       |       |           |       |           |            |     |
|                              |   | DF   | 1.5 x initial limit              |       |       |           |       |           |            |     |
|                              |   | ESR  | 2 x initial limit                |       |       |           |       |           |            |     |
| <b>Storage Life</b>          | 105°C, 0V, 2000h  | Visual examination   | no visible damage                |       |       |           |       |           |            |     |
|                              |   | DCL (V <sub>R</sub> ≤ 75V)   | 1.25 x initial limit             |       |       |           |       |           |            |     |
|                              |   | DCL (V <sub>R</sub> > 75V)   | 2 x initial limit                |       |       |           |       |           |            |     |
|                              |   | ΔC/C   | within ±20% of initial value     |       |       |           |       |           |            |     |
|                              |   | DF   | 1.5 x initial limit              |       |       |           |       |           |            |     |
|                              |   | ESR  | 2 x initial limit                |       |       |           |       |           |            |     |
| <b>Humidity</b>              | Determine after storage without applied voltage at 65±2°C and 95±2% relative humidity for 500hrs and then recovery 1-2 hours at room temperature.   | Visual examination   | no visible damage                |       |       |           |       |           |            |     |
|                              |   | DCL  | 3 x initial limit                |       |       |           |       |           |            |     |
|                              |   | ΔC/C   | within +30/-20% of initial value |       |       |           |       |           |            |     |
|                              |   | DF   | 1.5 x initial limit              |       |       |           |       |           |            |     |
|                              |   | ESR  | 2 x initial limit                |       |       |           |       |           |            |     |
| <b>Temperature Stability</b> | Step  | Temperature°C  | Duration(min)                    |       |       |           |       |           |            |     |
|                              | 1   | +20±2  | 15                               | +20°C | -55°C | +20°C     | +85°C | +105°C    | +20°C      |     |
|                              | 2   | -55+0/-3   | 15                               | DCL   | IL*   | n/a       | IL*   | 10 x IL*  | 12.5 x IL* | IL* |
|                              | 3   | +20±2  | 15                               | ΔC/C  | n/a   | +0/-20%   | ±5%   | +20/-0%   | +30/-0%    | ±5% |
|                              | 4   | +85+3/-0   | 15                               | DF    | IL*   | 1.5 x IL* | IL*   | 1.5 x IL* | 2 x IL*    | IL* |
|                              | 5   | +105+3/-0  | 15                               |       |       |           |       |           |            |     |
|                              | 6   | +20±2  | 15                               |       |       |           |       |           |            |     |
| <b>Surge Voltage</b>         | Test temperature: 105°C+3/0°C<br>For CATEGORY 2:<br>Surge voltage: 1.3x rated voltage at 105°C<br>For CATEGORY 3:<br>Surge voltage: 1.3x 0.8x rated voltage at 105°C<br>Charge/Discharge resistance: 1000±100Ω<br>Number of cycles: 1000x<br>Cycle duration: 6 min; 30 sec charge,<br>5 min 30 sec discharge  | Visual examination   | no visible damage                |       |       |           |       |           |            |     |
|                              | DCL   | initial limit  |                                  |       |       |           |       |           |            |     |
|                              | ΔC/C  | within +10/-20% of initial value for V <sub>r</sub> ≤ 10V<br>within +20/-30% of initial value for V <sub>r</sub> ≥ 16V |                                  |       |       |           |       |           |            |     |
|                              | DF  | 1.25 x initial limit   |                                  |       |       |           |       |           |            |     |

\*Initial Limit

Initial measurement max. 1hr after the removal from dry pack or after pretreatment at 85°C for 24 hours.

### PRODUCT CATEGORY 5 (TEMPERATURE RANGE -55°C TO +85°C)

| TEST                         | Condition   | Characteristics  |                                  |       |       |           |       |           |     |
|------------------------------|---|--|----------------------------------|-------|-------|-----------|-------|-----------|-----|
| <b>Endurance</b>             | Determine after application of rated voltage for 2000 +48/-0 hours at 85±2°C and then leaving 1-2 hours at room temperature. Power supply impedance to be ≤ 0.1Ω/V.                                     | Visual examination   | no visible damage                |       |       |           |       |           |     |
|                              |   | DCL  | 1.25 x initial limit             |       |       |           |       |           |     |
|                              |   | ΔC/C   | within ±20% of initial value     |       |       |           |       |           |     |
|                              |   | DF   | 1.5 x initial limit              |       |       |           |       |           |     |
|                              |   | ESR  | 2 x initial limit                |       |       |           |       |           |     |
| <b>Storage Life</b>          | 85°C, 0V, 2000h   | Visual examination   | no visible damage                |       |       |           |       |           |     |
|                              |   | DCL  | 1.25 x initial limit             |       |       |           |       |           |     |
|                              |   | ΔC/C   | within ±20% of initial value     |       |       |           |       |           |     |
|                              |   | DF   | 1.5 x initial limit              |       |       |           |       |           |     |
|                              |   | ESR  | 2 x initial limit                |       |       |           |       |           |     |
| <b>Humidity</b>              | Determine after storage without applied voltage at 65±2°C and 95±2% relative humidity for 500hrs and then recovery 1-2 hours at room temperature.   | Visual examination   | no visible damage                |       |       |           |       |           |     |
|                              |   | DCL  | 5 x initial limit                |       |       |           |       |           |     |
|                              |   | ΔC/C   | within +40/-20% of initial value |       |       |           |       |           |     |
|                              |   | DF   | 1.5 x initial limit              |       |       |           |       |           |     |
|                              |   | ESR  | 2 x initial limit                |       |       |           |       |           |     |
| <b>Temperature Stability</b> | Step  | Temperature°C  | Duration(min)                    |       |       |           |       |           |     |
|                              | 1   | +20±2  | 15                               | +20°C | -55°C | +20°C     | +85°C | +20°C     |     |
|                              | 2   | -55+0/-3   | 15                               | DCL   | IL*   | n/a       | IL*   | 10 x IL*  | IL* |
|                              | 3   | +20±2  | 15                               | ΔC/C  | n/a   | +0/-20%   | ±5%   | +20/-0%   | ±5% |
|                              | 4   | +85+3/-0   | 15                               | DF    | IL*   | 1.5 x IL* | IL*   | 1.5 x IL* | IL* |
|                              | 5   | +20±2  | 15                               |       |       |           |       |           |     |
| <b>Surge Voltage</b>         | Test temperature: 85+3/0°C<br>Surge voltage: 1.3x rated voltage<br>Charge/Discharge resistance: 1000±100Ω<br>Number of cycles: 1000x<br>Cycle duration: 6 min; 30 sec charge,<br>5 min 30 sec discharge | Visual examination   | no visible damage                |       |       |           |       |           |     |
|                              | DCL   | initial limit  |                                  |       |       |           |       |           |     |
|                              | ΔC/C  | within +10/-20% of initial value for V <sub>r</sub> ≤ 10V<br>within +20/-30% of initial value for V <sub>r</sub> ≥ 16V |                                  |       |       |           |       |           |     |
|                              | DF  | 1.25 x initial limit   |                                  |       |       |           |       |           |     |

\*Initial Limit

Initial measurement max. 1hr after the removal from dry pack or after pretreatment at 85°C for 24 hours.

## Данный компонент на территории Российской Федерации

### Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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