

## Automotive Conductive Polymer Chip Capacitors



### FEATURES

- Conductive polymer electrode
- Benign failure mode under recommended use conditions
- Robust design for automotive applications
- Meets requirements of AEC-Q200
- Humidity 85°C/85%RH, Vr, (up to 500 or 1000 hours see reference table)
- Basic reliability 1%/1000hrs@85°C Vr with 60% confidence level
- -55 to +125°C operation temperature
- Full voltage range: 4-35V
- DCL 0.1 CV
- 3x reflow 260°C compatible



### APPLICATIONS

- Automotive, DC/DC converters, Telecommunications, Industrial
- Reference AVX polymer guide for more information.

### MARKING

#### B, D, Y CASE



AVX's qualification of TCQ capacitors meets requirements of AEC-Q200. TCQ series is manufactured in an ISO TS 16949 certified facility.

### CASE DIMENSIONS: millimeters (inches)

| Code | EIA Code | EIA Metric | L±0.20 (0.008) | W±0.20 (0.008)<br>-0.10 (0.004) | H±0.20 (0.008)<br>-0.10 (0.004) | W <sub>1</sub> ±0.20 (0.008) | A±0.30 (0.012)<br>-0.20 (0.008) | S Min.       |
|------|----------|------------|----------------|---------------------------------|---------------------------------|------------------------------|---------------------------------|--------------|
| B    | 1210     | 3528-21    | 3.50 (0.138)   | 2.80 (0.110)                    | 1.90 (0.075)                    | 2.20 (0.087)                 | 0.80 (0.031)                    | 1.40 (0.055) |
| D    | 2917     | 7343-31    | 7.30 (0.287)   | 4.30 (0.169)                    | 2.90 (0.114)                    | 2.40 (0.094)                 | 1.30 (0.051)                    | 4.40 (0.173) |
| Y    | 2917     | 7343-20    | 7.30 (0.287)   | 4.30 (0.169)                    | 2.00 (0.079) max                | 2.40 (0.094)                 | 1.30 (0.051)                    | 4.40 (0.173) |

W1 dimension applies to the termination width for A dimensional area only.

### HOW TO ORDER

**TCQ**

Type

**B**

Case Size  
See table above

**476**

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  
004 = 4Vdc  
006 = 6.3Vdc  
010 = 10Vdc  
016 = 16Vdc  
020 = 20Vdc  
025 = 25Vdc  
035 = 35Vdc

**#**

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

**0070**

ESR in mΩ

### TECHNICAL SPECIFICATIONS

|                        |   |
|------------------------|---|
| Technical Data:        | All technical data relate to an ambient temperature of +25°C  |
| Capacitance Range:     | 4.7 µF to 220 µF  |
| Capacitance Tolerance: | ±20%  |
| Leakage Current DCL:   | 0.1CV   |
| Temperature Range:     | -55°C to +125°C   |
| Reliability:           | 1% per 1000 hours at 85°C, V <sub>R</sub> with 0.1Ω/V series impedance<br>60% confidence level<br>Meets requirements of AEC-Q200<br>(for humidity 85°C/85%RH, V <sub>R</sub> details see reference table) |

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.

## Automotive Conductive Polymer Chip Capacitors

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

| Capacitance |      | Rated Voltage DC (V <sub>R</sub> ) @ 105°C |          |          |         |         |         |         |
|-------------|------|--|----------|----------|---------|---------|---------|---------|
| µF          | Code | 4V (G)                                     | 6.3V (J) | 10V (A)  | 16V (C) | 20V (D) | 25V (E) | 35V (V) |
| 3.3         | 335  |  |          |          |         |         |         |         |
| 4.7         | 475  |  |          |          |         |         |         | B(200)* |
| 6.8         | 685  |  |          |          |         |         | B(200)* |         |
| 10          | 106  |  |          |          |         | B(200)* |         | D(70)   |
| 15          | 156  |  |          |          |         |         | D(70)   |         |
| 22          | 226  |  | B(70)    | B(70)*   |         | D(70)   |         |         |
| 33          | 336  |  | B(70)    | B(70)*   | D(70)   |         |         |         |
| 47          | 476  |  | B(70)    | B(70)*   | D(70)   |         |         |         |
| 68          | 686  |  |          | D(25,40) |         |         |         |         |
| 100         | 107  |  |          | D(25,40) |         |         |         |         |
| 150         | 157  |  | D(25,40) |          |         |         |         |         |
| 220         | 227  | D(25), Y(25)                               |          |          |         |         |         |         |

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.

### RATINGS & PART NUMBER REFERENCE

| AVX Part No.     | Case Size | Capacitance (µF) | Rated Voltage (V) | Maximum Operating Temp. (°C) | DCL Max (µA) | DF Max (%) | ESR Max @ 100kHz (mΩ) | MSL | 100kHz RMS Current (mA) |      |       |       | Humidity 85°C/85%RH, Vr (hrs) |
|------------------|-----------|------------------|-------------------|------------------------------|--------------|------------|-----------------------|-----|-------------------------|------|-------|-------|-------------------------------|
|                  |           |                  |                   |                              |              |            |                       |     | 45°C                    | 85°C | 105°C | 125°C |                               |
| <b>4 Volt</b>    |           |                  |                   |                              |              |            |                       |     |                         |      |       |       |                               |
| TCQD227M004#0025 | D         | 220              | 4                 | 125                          | 88           | 6          | 25                    | 3   | 3000                    | 2100 | 1350  | 750   | 1000                          |
| TCQY227M004#0025 | Y         | 220              | 4                 | 125                          | 88           | 6          | 25                    | 3   | 2720                    | 1904 | 1224  | 680   | 500                           |
| <b>6.3 Volt</b>  |           |                  |                   |                              |              |            |                       |     |                         |      |       |       |                               |
| TCQB226M006#0070 | B         | 22               | 6.3               | 125                          | 13.2         | 6          | 70                    | 3   | 1336                    | 935  | 601   | 334   | 500                           |
| TCQB336M006#0070 | B         | 33               | 6.3               | 125                          | 19.8         | 6          | 70                    | 3   | 1336                    | 935  | 601   | 334   | 500                           |
| TCQB476M006#0070 | B         | 47               | 6.3               | 125                          | 28.2         | 6          | 70                    | 3   | 1336                    | 935  | 601   | 334   | 500                           |
| TCQD157M006#0025 | D         | 150              | 6.3               | 125                          | 90           | 6          | 25                    | 3   | 3000                    | 2100 | 1350  | 750   | 1000                          |
| TCQD157M006#0040 | D         | 150              | 6.3               | 125                          | 90           | 6          | 40                    | 3   | 2372                    | 1660 | 1067  | 593   | 1000                          |
| <b>10 Volt</b>   |           |                  |                   |                              |              |            |                       |     |                         |      |       |       |                               |
| TCQD686M010#0025 | D         | 68               | 10                | 125                          | 68           | 6          | 25                    | 3   | 3000                    | 2100 | 1350  | 750   | 1000                          |
| TCQD686M010#0040 | D         | 68               | 10                | 125                          | 68           | 6          | 40                    | 3   | 2372                    | 1660 | 1067  | 593   | 1000                          |
| TCQD107M010#0025 | D         | 100              | 10                | 125                          | 100          | 6          | 25                    | 3   | 3000                    | 2100 | 1350  | 750   | 1000                          |
| TCQD107M010#0040 | D         | 100              | 10                | 125                          | 100          | 6          | 40                    | 3   | 2372                    | 1660 | 1067  | 593   | 1000                          |
| <b>16 Volt</b>   |           |                  |                   |                              |              |            |                       |     |                         |      |       |       |                               |
| TCQD336M016#0070 | D         | 33               | 16                | 125                          | 52.8         | 6          | 70                    | 3   | 1793                    | 1255 | 807   | 448   | 1000                          |
| TCQD476M016#0070 | D         | 47               | 16                | 125                          | 75.2         | 6          | 70                    | 3   | 1793                    | 1255 | 807   | 448   | 1000                          |
| <b>20 Volt</b>   |           |                  |                   |                              |              |            |                       |     |                         |      |       |       |                               |
| TCQD226M020#0070 | D         | 22               | 20                | 125                          | 44           | 6          | 70                    | 3   | 1793                    | 1255 | 807   | 448   | 1000                          |
| <b>25 Volt</b>   |           |                  |                   |                              |              |            |                       |     |                         |      |       |       |                               |
| TCQD156M025#0070 | D         | 15               | 25                | 125                          | 37.5         | 6          | 70                    | 3   | 1793                    | 1255 | 807   | 448   | 1000                          |
| <b>35 Volt</b>   |           |                  |                   |                              |              |            |                       |     |                         |      |       |       |                               |
| TCQD106M035#0070 | D         | 10               | 35                | 125                          | 35           | 6          | 70                    | 3   | 1793                    | 1255 | 807   | 448   | 1000                          |

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  $V_r$ .

| Rated voltage     | Operating Temperature   |                     |                     |
|-------------------|-------------------------|---------------------|---------------------|
|                   | $\leq 85^\circ\text{C}$ | $105^\circ\text{C}$ | $125^\circ\text{C}$ |
| $\leq 10\text{V}$ | 90%                     | 90%                 | 60%                 |
| $\geq 16\text{V}$ | 80%                     | 80%                 | 54%                 |



### QUALIFICATION TABLE

| TEST                         | TCQ series (Temperature range $-55^\circ\text{C}$ to $125^\circ\text{C}$ )   |                              |               |                    |  |                      |                      |                      |                       |                      |  |
|------------------------------|--|------------------------------|---------------|--------------------|--|----------------------|----------------------|----------------------|-----------------------|----------------------|--|
|                              | Condition  |                              |               | Characteristics    |  |                      |                      |                      |                       |                      |  |
| <b>Endurance</b>             | Determine after application of $125^\circ\text{C}$ temperature, 2/3 rated voltage for 1000 +48/-0 hours and then leaving 1-2 hours at room temperature. Power supply impedance to be $\leq 0.1\Omega/V$ .  |                              |               | Visual examination | no visible damage  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | DCL                | 2 x initial limit  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | $\Delta C/C$       | within +10/-20% of initial value   |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | DF                 | 2 x initial limit  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | ESR                | 2 x initial limit  |                      |                      |                      |                       |                      |  |
| <b>Storage Life</b>          | $125^\circ\text{C}$ , 0V, 1000h  |                              |               | Visual examination | no visible damage  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | DCL                | 2x initial limit   |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | $\Delta C/C$       | within +10/-20% of initial value   |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | DF                 | 2 x initial limit  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | ESR                | 2 x initial limit  |                      |                      |                      |                       |                      |  |
| <b>Biased Humidity</b>       | Determine after leaving for 1000 (500) hours at $85\pm 2^\circ\text{C}$ , 85% relative humidity and rated voltage and then recovery 1-2 hours at room temperature.   |                              |               | Visual examination | no visible damage  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | DCL                | 2 x initial limit  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | $\Delta C/C$       | within +35/-5% of initial value  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | DF                 | 1.5 x initial limit  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | ESR                | 2 x initial limit  |                      |                      |                      |                       |                      |  |
| <b>Temperature Stability</b> | Step   | Temperature $^\circ\text{C}$ | Duration(min) |                    | +20 $^\circ\text{C}$   | -55 $^\circ\text{C}$ | +20 $^\circ\text{C}$ | +85 $^\circ\text{C}$ | +125 $^\circ\text{C}$ | +20 $^\circ\text{C}$ |  |
|                              | 1  | +20 $\pm$ 2                  | 15            | DCL                | IL*  | n/a                  | IL*                  | 10 x IL*             | 12.5 x IL*            | IL*                  |  |
|                              | 2  | -55+0/-3                     | 15            |                    |  |                      |                      |                      |                       |                      |  |
|                              | 3  | +20 $\pm$ 2                  | 15            | $\Delta C/C$       | n/a  | $\pm 20\%$           | $\pm 5\%$            | $\pm 20\%$           | $\pm 30\%$            | $\pm 5\%$            |  |
|                              | 4  | +85+3/-0                     | 15            | DF                 | IL*  | IL*                  | IL*                  | 1.2 x IL*            | 1.5 x IL*             | IL*                  |  |
|                              | 5  | +125+3/-0                    | 15            |                    |  |                      |                      |                      |                       |                      |  |
| 6                            | +20 $\pm$ 2  | 15                           |               |                    |  |                      |                      |                      |                       |                      |  |
| <b>Surge Voltage</b>         | Test temperature: $125^\circ\text{C} +3/0^\circ\text{C}$<br>Surge voltage: 1.3x 2/3x rated voltage at $125^\circ\text{C}$<br>Charge/Discharge resistance: $1000\pm 100\Omega$<br>Number of cycles: 1000x<br>Cycle duration: 6 min; 30 sec charge, 5 min 30 sec discharge |                              |               | Visual examination | no visible damage  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | DCL                | initial limit  |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | $\Delta C/C$       | within +10/-20% of initial value for $V_r \leq 10\text{V}$<br>within +20/-30% of initial value for $V_r \geq 16\text{V}$ |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | DF                 | initial limit for $V_r \leq 10\text{V}$<br>1.25x initial limit for $V_r \geq 16\text{V}$                                 |                      |                      |                      |                       |                      |  |
|                              |  |                              |               | ESR                | 1.25 x initial limit   |                      |                      |                      |                       |                      |  |

\*Initial Limit

For use outside of recommended conditions and special request, please contact manufacturer.

Initial measurement max. 1hr after the removal from dry pack or after pretreatment at  $85^\circ\text{C}$  for 24 hours.