

Units of ESR: ohms

| Unknown type of electrolytic capacitor. f = 7 Hz |      |      |      |      |      |      |       |       |       |       |       |
|--------------------------------------------------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
|                                                  | 10 V | 16 V | 25 V | 35 V | 50 V | 63 V | 100 V | 160 V | 250 V | 350 V | 450 V |
| 1 $\mu$ F                                        | -    | -    | 2.1  | 2.4  | 4.5  | 4.5  | 8.5   | 9.5   | 8.7   | 8.5   | 3.6   |
| 2.2 $\mu$ F                                      | -    | -    | 2.0  | 2.4  | 4.5  | 4.5  | 2.3   | 4.0   | 6.1   | 4.2   | 3.6   |
| 3.3 $\mu$ F                                      | -    | -    | 2.0  | 2.3  | 4.7  | 4.5  | 2.2   | 3.1   | 4.6   | 1.6   | 3.5   |
| 4.7 $\mu$ F                                      | -    | -    | 2.0  | 2.2  | 3.0  | 3.8  | 2.0   | 3.0   | 3.5   | 1.6   | 5.65  |
| 10 $\mu$ F                                       | -    | 8.0  | 5.3  | 2.2  | 1.6  | 1.9  | 2.0   | 1.2   | 1.4   | 1.2   | 6.5   |
| 22 $\mu$ F                                       | 5.4  | 3.6  | 1.5  | 1.5  | 0.8  | 0.9  | 1.5   | 1.1   | 0.7   | 1.1   | 1.5   |
| 33 $\mu$ F                                       | 4.6  | 2.0  | 1.2  | 1.2  | 0.6  | 0.8  | 1.2   | 1.0   | 0.5   | 1.1   | -     |
| 47 $\mu$ F                                       | 2.2  | 1.0  | 0.9  | 0.7  | 0.5  | 0.6  | 0.7   | 0.5   | 0.4   | 1.1   | -     |
| 100 $\mu$ F                                      | 1.2  | 0.7  | 0.3  | 0.3  | 0.3  | 0.4  | 0.75  | 0.3   | 0.2   | -     | -     |
| 220 $\mu$ F                                      | 0.6  | 0.3  | 0.25 | 0.2  | 0.2  | 0.1  | 0.1   | 0.2   | 0.2   | -     | -     |
| 330 $\mu$ F                                      | 0.24 | 0.2  | 0.25 | 0.1  | 0.2  | 0.1  | 0.1   | 0.1   | 0.2   | -     | -     |
| 470 $\mu$ F                                      | 0.24 | 0.18 | 0.12 | 0.1  | 0.1  | 0.1  | 0.1   | 0.1   | 0.15  | -     | -     |
| 1000 $\mu$ F                                     | 0.12 | 0.15 | 0.08 | 0.1  | 0.1  | 0.1  | 0.1   | 0.1   | 0.1   | -     | -     |
| 2200 $\mu$ F                                     | 0.12 | 0.14 | 0.14 | 0.1  | 0.1  | 0.1  | 0.1   | 0.1   | 0.1   | -     | -     |
| 3300 $\mu$ F                                     | 0.12 | 0.13 | 0.12 | 0.1  | 0.1  | 0.1  | 0.1   | 0.1   | 0.1   | -     | -     |
| 4700 $\mu$ F                                     | 0.12 | 0.12 | 0.12 | 0.1  | 0.1  | 0.1  | 0.1   | 0.1   | 0.1   | -     | -     |

| Typical ESR values for Electrolytic Capacitors<br>according to the Atlas ESR70 meter's guide<br>f = 100 kHz |      |      |      |      |      |       |       |       |       |
|-------------------------------------------------------------------------------------------------------------|------|------|------|------|------|-------|-------|-------|-------|
|                                                                                                             | 10 V | 16 V | 25 V | 35 V | 63 V | 160 V | 250 V | 400 V | 630 V |
| 4.7 $\mu$ F                                                                                                 | 42   | 35   | 29   | 24   | 20   | 16    | 13    | 11    | 8.5   |
| 10 $\mu$ F                                                                                                  | 20   | 16   | 14   | 11   | 9.3  | 7.7   | 6.3   | 5.3   | 4     |
| 22 $\mu$ F                                                                                                  | 9    | 7.5  | 6.2  | 5.1  | 4.2  | 3.5   | 2.9   | 2.4   | 1.8   |
| 47 $\mu$ F                                                                                                  | 4.2  | 3.5  | 2.9  | 2.4  | 2    | 1.6   | 1.3   | 1.1   | 0.85  |
| 100 $\mu$ F                                                                                                 | 2    | 1.6  | 1.4  | 1.1  | 0.93 | 0.77  | 0.63  | 0.53  | 0.4   |
| 220 $\mu$ F                                                                                                 | 0.9  | 0.75 | 0.62 | 0.51 | 0.42 | 0.35  | 0.29  | 0.24  | 0.18  |
| 470 $\mu$ F                                                                                                 | 0.42 | 0.35 | 0.29 | 0.24 | 0.2  | 0.16  | 0.13  | 0.11  | 0.09  |
| 1000 $\mu$ F                                                                                                | 0.2  | 0.16 | 0.14 | 0.11 | 0.09 | 0.08  | 0.06  | 0.05  | 0.04  |
| 2200 $\mu$ F                                                                                                | 0.09 | 0.08 | 0.06 | 0.05 | 0.04 | 0.04  | 0.03  | 0.02  | 0.02  |
| 4700 $\mu$ F                                                                                                | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01  | 0.01  | 0.01  | 0.01  |
| 10000 $\mu$ F                                                                                               | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01  | 0.01  | 0.01  | 0     |
| 22000 $\mu$ F                                                                                               | 0.01 | 0.01 | 0.01 | 0.01 | 0    | 0     | 0     | 0     | 0     |

| Jamicon<br>Low ESR High ripple current Radial Aluminum<br>Electrolytic Capacitors<br>MZ Series, f = 100 kHz |       |       |       |       |
|-------------------------------------------------------------------------------------------------------------|-------|-------|-------|-------|
|                                                                                                             | 6.3 V | 10 V  | 16 V  | 25 V  |
| 470 $\mu$ F                                                                                                 | -     | -     | 0.036 | 0.019 |
| 680 $\mu$ F                                                                                                 | -     | 0.036 | 0.028 | -     |
| 820 $\mu$ F                                                                                                 | 0.036 | -     | -     | -     |
| 1000 $\mu$ F                                                                                                | 0.028 | 0.028 | 0.019 | -     |
| 1200 $\mu$ F                                                                                                | 0.028 | -     | -     | -     |
| 1500 $\mu$ F                                                                                                | 0.020 | 0.019 | 0.013 | -     |
| 1800 $\mu$ F                                                                                                | 0.018 | 0.013 | 0.012 | -     |
| 2200 $\mu$ F                                                                                                | 0.015 | 0.012 | -     | -     |
| 3300 $\mu$ F                                                                                                | 0.012 | -     | -     | -     |
| 3900 $\mu$ F                                                                                                | 0.012 | -     | -     | -     |
| 4700 $\mu$ F                                                                                                | 0.014 | -     | -     | -     |

| Rubycon<br>Low ESR Chip Aluminum Electrolytic Capacitors<br>TKV Series, f = 100 kHz |       |      |      |      |      |
|-------------------------------------------------------------------------------------|-------|------|------|------|------|
|                                                                                     | 6.3 V | 10 V | 16 V | 25 V | 35 V |
| 33 $\mu$ F                                                                          | -     | -    | -    | 0.26 | 0.26 |
| 47 $\mu$ F                                                                          | -     | -    | 0.26 | -    | 0.26 |
| 68 $\mu$ F                                                                          | -     | -    | -    | 0.26 | 0.16 |
| 100 $\mu$ F                                                                         | 0.26  | -    | 0.16 | 0.16 | 0.08 |
| 150 $\mu$ F                                                                         | -     | 0.26 | -    | 0.08 | 0.08 |
| 220 $\mu$ F                                                                         | 0.26  | 0.16 | -    | 0.08 | 0.08 |
| 330 $\mu$ F                                                                         | 0.16  | 0.08 | 0.08 | 0.08 | 0.06 |
| 390 $\mu$ F                                                                         | -     | -    | -    | -    | 0.08 |
| 470 $\mu$ F                                                                         | 0.08  | 0.08 | 0.08 | 0.06 | -    |
| 560 $\mu$ F                                                                         | -     | -    | -    | 0.08 | -    |
| 680 $\mu$ F                                                                         | -     | 0.08 | 0.06 | -    | -    |
| 820 $\mu$ F                                                                         | -     | -    | 0.08 | -    | -    |
| 1000 $\mu$ F                                                                        | 0.08  | 0.06 | -    | -    | -    |
| 1200 $\mu$ F                                                                        | -     | 0.08 | -    | -    | -    |
| 1500 $\mu$ F                                                                        | 0.06  | -    | -    | -    | -    |
| 1800 $\mu$ F                                                                        | 0.08  | -    | -    | -    | -    |

| Nippon Chemi-con<br>Low ESR Miniature Aluminum Electrolytic Capacitors<br>KYC Series, f = 100 kHz |       |       |       |       |
|---------------------------------------------------------------------------------------------------|-------|-------|-------|-------|
|                                                                                                   | 16 V  | 25 V  | 35 V  | 50 V  |
| 180 $\mu$ F                                                                                       | -     | -     | -     | 0.14  |
| 300 $\mu$ F                                                                                       | -     | -     | -     | 0.1   |
| 390 $\mu$ F                                                                                       | -     | -     | 0.14  | -     |
| 430 $\mu$ F                                                                                       | -     | -     | -     | 0.065 |
| 560 $\mu$ F                                                                                       | -     | 0.14  | 0.1   | -     |
| 680 $\mu$ F                                                                                       | -     | -     | -     | 0.05  |
| 820 $\mu$ F                                                                                       | -     | 0.1   | 0.065 | -     |
| 910 $\mu$ F                                                                                       | 0.14  | -     | -     | 0.037 |
| 1200 $\mu$ F                                                                                      | -     | -     | -     | 0.038 |
| 1300 $\mu$ F                                                                                      | 0.1   | 0.065 | 0.05  | 0.029 |
| 1500 $\mu$ F                                                                                      | -     | -     | -     | 0.037 |
| 1600 $\mu$ F                                                                                      | -     | -     | -     | 0.031 |
| 1800 $\mu$ F                                                                                      | -     | -     | 0.037 | -     |
| 2000 $\mu$ F                                                                                      | 0.065 | 0.05  | -     | 0.025 |
| 2200 $\mu$ F                                                                                      | -     | -     | 0.038 | 0.03  |
| 2400 $\mu$ F                                                                                      | 0.05  | -     | 0.029 | -     |
| 2700 $\mu$ F                                                                                      | -     | -     | -     | 0.024 |
| 3000 $\mu$ F                                                                                      | -     | 0.037 | 0.037 | -     |
| 3300 $\mu$ F                                                                                      | -     | -     | 0.031 | -     |
| 3600 $\mu$ F                                                                                      | -     | 0.038 | -     | -     |
| 3900 $\mu$ F                                                                                      | -     | 0.029 | 0.025 | -     |
| 4300 $\mu$ F                                                                                      | -     | -     | 0.03  | -     |
| 4700 $\mu$ F                                                                                      | 0.037 | 0.037 | -     | -     |
| 5100 $\mu$ F                                                                                      | -     | 0.031 | 0.025 | -     |
| 5600 $\mu$ F                                                                                      | 0.038 | -     | -     | -     |
| 6200 $\mu$ F                                                                                      | -     | 0.025 | -     | -     |
| 6800 $\mu$ F                                                                                      | 0.037 | 0.03  | -     | -     |
| 7500 $\mu$ F                                                                                      | 0.031 | -     | -     | -     |
| 8200 $\mu$ F                                                                                      | -     | 0.024 | -     | -     |
| 9100 $\mu$ F                                                                                      | 0.025 | -     | -     | -     |
| 10000 $\mu$ F                                                                                     | 0.03  | -     | -     | -     |
| 12000 $\mu$ F                                                                                     | 0.024 | -     | -     | -     |

| ELNA<br>Low ESR Miniature Aluminum Electrolytic Capacitors<br>BKD Series, f = 100 kHz |       |       |       |       |       |       |       |       |       |
|---------------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                                                                       | 10 V  | 16 V  | 25 V  | 35 V  | 50 V  | 63 V  | 80 V  | 100 V |       |
| 100 $\mu$ F                                                                           | -     | 0.153 | 0.153 | 0.153 | -     | -     | -     | -     | -     |
| 220 $\mu$ F                                                                           | 0.153 | 0.098 | 0.098 | 0.075 | 0.081 | -     | -     | -     | 0.11  |
| 330 $\mu$ F                                                                           | 0.098 | 0.098 | 0.075 | 0.057 | -     | -     | 0.11  | 0.079 | 0.079 |
| 470 $\mu$ F                                                                           | 0.098 | 0.075 | 0.057 | 0.04  | 0.057 | 0.085 | 0.079 | 0.052 | 0.052 |
| 560 $\mu$ F                                                                           | -     | -     | -     | -     | -     | -     | 0.64  | 0.045 | 0.045 |
| 820 $\mu$ F                                                                           | -     | -     | -     | -     | 0.053 | 0.053 | 0.044 | 0.039 | 0.039 |
| 1000 $\mu$ F                                                                          | 0.057 | 0.04  | 0.032 | 0.024 | 0.031 | 0.044 | 0.039 | -     | -     |
| 1200 $\mu$ F                                                                          | -     | -     | 0.04  | 0.029 | -     | -     | -     | -     | -     |
| 1500 $\mu$ F                                                                          | -     | -     | -     | 0.02  | -     | -     | -     | -     | -     |
| 1800 $\mu$ F                                                                          | -     | -     | 0.032 | 0.02  | 0.025 | 0.032 | -     | -     | -     |
| 2200 $\mu$ F                                                                          | 0.032 | 0.024 | 0.024 | 0.019 | 0.022 | -     | -     | -     | -     |
| 2700 $\mu$ F                                                                          | -     | -     | 0.023 | 0.018 | -     | -     | -     | -     | -     |
| 3300 $\mu$ F                                                                          | 0.024 | 0.02  | 0.02  | 0.017 | -     | -     | -     | -     | -     |
| 3900 $\mu$ F                                                                          | -     | -     | 0.019 | -     | -     | -     | -     | -     | -     |
| 4700 $\mu$ F                                                                          | 0.02  | 0.018 | 0.017 | 0.016 | -     | -     | -     | -     | -     |
| 5600 $\mu$ F                                                                          | -     | -     | 0.017 | 0.015 | -     | -     | -     | -     | -     |
| 6800 $\mu$ F                                                                          | -     | -     | 0.016 | -     | -     | -     | -     | -     | -     |
| 8200 $\mu$ F                                                                          | -     | -     | 0.015 | -     | -     | -     | -     | -     | -     |

| Wima Capacitor<br>General purpose Aluminum Electrolytic Capacitors<br>CKHICKE Series, f = 120 Hz |       |      |      |      |      |        |        |        |        |        |         |         |         |         |   |
|--------------------------------------------------------------------------------------------------|-------|------|------|------|------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---|
|                                                                                                  | 6.3 V | 10 V | 16 V | 25 V | 35 V | 50 V   | 63 V   | 100 V  | 160 V  | 200 V  | 250 V   | 350 V   | 400 V   | 450 V   |   |
| 0.47 $\mu$ F                                                                                     | -     | -    | -    | -    | -    | -      | -      | 282.19 | -      | -      | -       | -       | -       | -       | - |
| 1 $\mu$ F                                                                                        | -     | -    | -    | -    | -    | 165.79 | -      | 165.79 | -      | -      | 248.68  | -       | 331.57  | 331.573 | - |
| 2.2 $\mu$ F                                                                                      | -     | -    | -    | -    | -    | 75.358 | -      | 75.358 | -      | -      | 113.036 | 150.71  | 150.71  | 150.71  | - |
| 3.3 $\mu$ F                                                                                      | -     | -    | -    | -    | -    | 50.238 | -      | 40.19  | -      | 75.358 | 75.358  | 100.477 | 100.477 | 100.477 | - |
| 4.7 $\mu$ F                                                                                      | -     | -    | -    | -    | -    | -      | -      | 36.274 | 52.911 | 52.911 | 53.911  | 70.547  | 70.547  | 70.547  | - |
| 6.8 $\mu$ F                                                                                      | -     | -    | -    | -    | -    | 24.381 | -      | -      | -      | -      | -       | -       | -       | 48.76   | - |
| 10 $\mu$ F                                                                                       | -     | -    | -    | -    | -    | 16.579 | 16.579 | 16.579 | 24.868 | 24.868 | 24.868  | 33.157  | 33.157  | 33.157  | - |
| 15 $\mu$ F                                                                                       | -     | -    | -    | -    | -    | 11.052 | -      | -      | -      | -      | 22.1    | -       | 22.1    | 22.1    | - |
| 22 $\mu$ F                                                                                       | -     | -    | -    | -    | -    | 7.53   | 7.53   | 7.53   | 11.3   | 11.3   | 11.3    | 15.07   | -       | 15.07   | - |
| 33 $\mu$ F                                                                                       | -     | -    | -    | -    | -    | 5.02   | 5.02   | 5.02   | 7.53   | 7.53   | 7.53    | 10.04   | 10.04   | 10.04   | - |
| 47 $\mu$ F                                                                                       | -     | -    | -    | 4.93 | 4.23 | 3.52   | 3.52   | 3.52   | 5.29   | 5.29   | 5.29    | 7.05    | 7.05    | 7.05    | - |
| 68 $\mu$ F                                                                                       | -     | -    | -    | -    | -    | 2.43   | 2.43   | 2.43   | 4.87   | 4.87   | 4.87    | -       | 4.87    | 4.87    | - |
| 100 $\mu$ F                                                                                      | -     | -    | -    | 2.32 | 1.98 | 1.65   | 1.65   | 2.48   | -      | 2.48   | 2.48    | 3.31    | 3.31    | -       | - |
| 150 $\mu$ F                                                                                      | -     | -    | -    | -    | -    | -      | -      | 1.1    | 1.65   | 1.65   | 1.65    | -       | -       | 2.21    | - |
| 220 $\mu$ F                                                                                      | -     | 1.65 | 1.2  | 1.05 | 0.9  | 0.75   | 0.75   | 0.75   | 1.13   | 1.13   | 1.13    | -       | -       | -       | - |
| 330 $\mu$ F                                                                                      | -     | 1.1  | 0.8  | 0.49 | 0.6  | 0.5    | 0.5    | 1      | 0.75   | -      | -       | -       | -       | -       | - |
| 470 $\mu$ F                                                                                      | -     | 0.77 | 0.56 | 0.49 | 0.42 | 0.35   | 0.35   | 0.35   | -      | -      | -       | -       | -       | -       | - |
| 680 $\mu$ F                                                                                      | 0.05  | -    | 0.39 | -    | 0.29 | 0.24   | 0.24   | -      | -      | -      | -       | -       | -       | -       | - |
| 1000 $\mu$ F                                                                                     | 0.39  | 0.36 | 0.26 | 0.23 | 0.19 | 0.16   | 0.16   | 0.16   | -      | -      | -       | -       | -       | -       | - |
| 1500 $\mu$ F                                                                                     | 0.28  | -    | 0.19 | 0.17 | 0.15 | 0.13   | -      | -      | -      | -      | -       | -       | -       | -       | - |
| 2200 $\mu$ F                                                                                     | 0.21  | 0.19 | 0.19 | 0.13 | 0.12 | 0.1    | -      | -      | -      | -      | -       | -       | -       | -       | - |
| 3300 $\mu$ F                                                                                     | 0.15  | 0.14 | 0.11 | 0.1  | 0.09 | 0.08   | -      | -      | -      | -      | -       | -       | -       | -       | - |
| 4700 $\mu$ F                                                                                     | -     | 0.1  | 0.08 | 0.07 | 0.07 | -      | -      | -      | -      | -      | -       | -       | -       | -       | - |
| 6800 $\mu$ F                                                                                     | 0.08  | 0.07 | 0.07 | 0.06 | 0.05 | -      | -      | -      | -      | -      | -       | -       | -       | -       | - |
| 10000 $\mu$ F                                                                                    | 0.06  | 0.06 | 0.05 | 0.05 | -    | -      | -      | -      | -      | -      | -       | -       | -       | -       | - |
| 15000 $\mu$ F                                                                                    | 0.05  | 0.05 | 0.04 | -    | -    | -      | -      | -      | -      | -      | -       | -       | -       | -       | - |
| 22000 $\mu$ F                                                                                    | 0.04  | 0.04 | -    | -    | -    | -      | -      | -      | -      | -      | -       | -       | -       | -       | - |

| TDK<br>Aluminum electrolytic capacitors<br>B41850 Series, f = 10 kHz, T = 20 °C |       |       |       |       |       |       |       |
|---------------------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|
|                                                                                 | 10 V  | 16 V  | 25 V  | 35 V  | 50 V  | 63 V  | 100 V |
| 22 µF                                                                           | -     | -     | -     | -     | -     | -     | 1.222 |
| 33 µF                                                                           | -     | -     | -     | -     | -     | -     | 0.654 |
| 47 µF                                                                           | -     | -     | -     | -     | -     | -     | 0.461 |
| 68 µF                                                                           | -     | -     | -     | -     | -     | 0.541 | -     |
| 100 µF                                                                          | -     | -     | -     | 0.274 | 0.646 | 0.577 | 0.305 |
| 120 µF                                                                          | -     | -     | -     | 0.274 | 0.373 | 0.308 | 0.204 |
| 150 µF                                                                          | -     | -     | -     | 0.274 | 0.373 | 0.308 | -     |
| 180 µF                                                                          | -     | -     | 0.274 | 0.129 | 0.175 | 0.199 | 0.173 |
| 220 µF                                                                          | -     | -     | 0.274 | 0.129 | 0.175 | 0.199 | 0.099 |
| 270 µF                                                                          | -     | 0.274 | 0.129 | -     | -     | 0.169 | 0.131 |
| 330 µF                                                                          | 0.274 | 0.274 | 0.129 | 0.118 | 0.125 | 0.169 | 0.097 |
| 390 µF                                                                          | 0.274 | -     | -     | -     | -     | 0.124 | 0.072 |
| 470 µF                                                                          | 0.274 | 0.129 | 0.118 | 0.073 | 0.11  | 0.124 | 0.068 |
| 560 µF                                                                          | 0.129 | 0.118 | 0.118 | 0.073 | 0.069 | -     | 0.068 |
| 680 µF                                                                          | 0.129 | 0.118 | 0.073 | 0.062 | 0.046 | 0.072 | 0.044 |
| 820 µF                                                                          | 0.118 | 0.073 | 0.073 | -     | 0.034 | 0.054 | -     |
| 1000 µF                                                                         | 0.118 | 0.073 | 0.062 | 0.038 | 0.032 | 0.054 | -     |
| 1200 µF                                                                         | 0.118 | 0.073 | -     | 0.038 | 0.048 | 0.052 | -     |
| 1500 µF                                                                         | 0.073 | 0.062 | 0.041 | 0.03  | 0.038 | 0.044 | -     |
| 1800 µF                                                                         | 0.073 | 0.041 | 0.038 | 0.031 | 0.029 | 0.038 | -     |
| 2200 µF                                                                         | 0.062 | 0.041 | 0.03  | 0.027 | 0.027 | -     | -     |
| 2700 µF                                                                         | 0.041 | 0.038 | 0.024 | 0.021 | 0.021 | -     | -     |
| 3300 µF                                                                         | 0.041 | 0.03  | 0.027 | 0.021 | -     | -     | -     |
| 3900 µF                                                                         | 0.038 | 0.024 | 0.021 | 0.02  | -     | -     | -     |
| 4700 µF                                                                         | 0.034 | 0.027 | 0.021 | 0.016 | -     | -     | -     |
| 5600 µF                                                                         | 0.03  | -     | 0.02  | -     | -     | -     | -     |
| 6800 µF                                                                         | 0.024 | 0.021 | 0.016 | -     | -     | -     | -     |
| 8200 µF                                                                         | 0.021 | 0.02  | -     | -     | -     | -     | -     |
| 10000 µF                                                                        | 0.02  | 0.016 | -     | -     | -     | -     | -     |