



# Thin-Film Technology

Accu-F<sup>®</sup> / Accu-P<sup>®</sup>

Thin-Film RF/Microwave Capacitors

## Thin-Film Technology

### THE IDEAL CAPACITOR

The non-ideal characteristics of a real capacitor can be ignored at low frequencies. Physical size imparts inductance to the capacitor and dielectric and metal electrodes result in resistive losses, but these often are of negligible effect on the circuit. At the very high frequencies of radio communication (>100MHz) and satellite systems (>1GHz), these effects become important. Recognizing that a real capacitor will exhibit inductive and resistive impedances in addition to capacitance, the ideal capacitor for these high frequencies is an ultra low loss component which can be fully characterized in all parameters with total repeatability from unit to unit.

Until recently, most high frequency/microwave capacitors were based on fired-ceramic (porcelain) technology. Layers of ceramic dielectric material and metal alloy electrode paste are interleaved and then sintered in a high temperature oven. This technology exhibits component variability in dielectric quality (losses, dielectric constant and insulation resistance), variability in electrode conductivity and variability in physical size (affecting inductance). An alternate thin-film technology has been developed which virtually eliminates these variances. It is this technology which has been fully incorporated into Accu-F® and Accu-P® to provide high frequency capacitors exhibiting truly ideal characteristics.

The main features of Accu-F® and Accu-P® may be summarized as follows:

- High purity of electrodes for very low and repeatable ESR.
- Highly pure, low-K dielectric for high breakdown field, high insulation resistance and low losses to frequencies above 40GHz.
- Very tight dimensional control for uniform inductance, unit to unit.
- Very tight capacitance tolerances for high frequency signal applications.

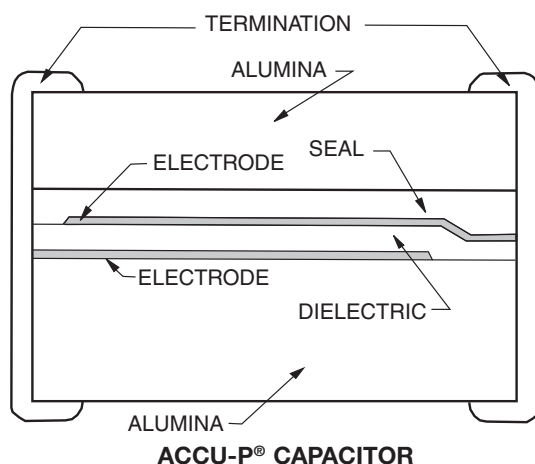
This accuracy sets apart these Thin-Film capacitors from ceramic capacitors so that the term Accu has been employed as the designation for this series of devices, an abbreviation for “accurate.”

### THIN-FILM TECHNOLOGY

Thin-film technology is commonly used in producing semiconductor devices. In the last two decades, this technology has developed tremendously, both in performance and in process control. Today's techniques enable line definitions of below 1µm, and the controlling of thickness of layers at 100Å (10<sup>-2</sup>µm). Applying this technology to the manufacture of capacitors has enabled the development of components where both electrical and physical properties can be tightly controlled.

The thin-film production facilities at AVX consist of:

- Class 1000 clean rooms, with working areas under laminar-flow hoods of class 100, (below 100 particles per cubic foot larger than 0.5µm).
- High vacuum metal deposition systems for high-purity electrode construction.
- Photolithography equipment for line definition down to 2.0µm accuracy.
- Plasma-enhanced CVD for various dielectric depositions (CVD=Chemical Vapor Deposition).
- High accuracy, microprocessor-controlled dicing saws for chip separation.
- High speed, high accuracy sorting to ensure strict tolerance adherence.



## Thin-Film Chip Capacitors

### ACCU-F® TECHNOLOGY

The use of very low-loss dielectric materials, silicon dioxide and silicon oxynitride, in conjunction with highly conductive electrode metals results in low ESR and high Q. These high-frequency characteristics change at a slower rate with increasing frequency than for ceramic microwave capacitors.

Because of the thin-film technology, the above-mentioned frequency characteristics are obtained without significant compromise of properties required for surface mounting.

The main Accu-F® properties are:

- Internationally agreed sizes with excellent dimensional control.
- Small size chip capacitors (0603) are available.
- Tight capacitance tolerances.
- Low ESR at VHF, UHF and microwave frequencies.
- High stability with respect to time, temperature, frequency and voltage variation.
- Nickel/solder-coated terminations to provide excellent solderability and leach resistance.

### ACCU-F® FEATURES

Accu-F® meets the fast-growing demand for low-loss (high-Q) capacitors for use in surface mount technology especially for the mobile communications market, such as cellular radio of 450 and 900 MHz, UHF walkie-talkies, UHF cordless telephones to 2.3 GHz, low noise blocks at 11-12.5 GHz and for other VHF, UHF and microwave applications.

Accu-F® is currently unique in its ability to offer very low capacitance values (0.1pF) and very tight capacitance tolerances ( $\pm 0.05\text{pF}$ ). Typically Accu-F® will be used in small signal applications in VCO's, matching networks, filters, etc.

Inspection test and quality control procedures in accordance with ISO 9001, CECC, IECQ and USA MIL Standards yield products of the highest quality.

### APPLICATIONS

Cellular Communications  
CT2/PCN (Cordless  
Telephone/Personal Comm.  
Networks)  
Satellite TV  
Cable TV  
GPS (Global Positioning Systems)  
Vehicle Location Systems  
Vehicle Alarm Systems  
Paging  
Military Communications

Radar Systems  
Video Switching  
Test & Measurements  
Filters  
VCO's  
Matching Networks

### APPROVALS

ISO 9001

### ACCU-P® TECHNOLOGY

As in the Accu-F® series the use of very low-loss dielectric materials (silicon dioxide and silicon oxynitride) in conjunction with highly conductive electrode metals results in low ESR and high Q. At high frequency these characteristics change at a slower rate with increasing frequency than conventional ceramic microwave capacitors. Using thin-film technology, the above-mentioned frequency characteristics are obtained without significant compromise of properties required for surface mounting. The use of high thermal conductivity materials results in excellent RF power handling capabilities.

The main Accu-P® properties are:

- Enhanced RF power handling capability.
- Improved mechanical characteristics.
- Internationally agreed sizes with excellent dimensional control.
- Ultra Small size chip capacitors (0201) are available.
- Tight capacitance tolerances.
- Low ESR at UHF, VHF, and microwave frequencies.
- High-stability with respect to time, temperature, frequency and voltage variation.
- High temperature nickel/solder-coated terminations as standard to provide excellent solderability and leach resistance.

### ACCU-P® FEATURES

- Minimal batch to batch variability of parameters at high frequency.
- The Accu-P® has the same unique features as the Accu-F® capacitor such as low ESR, high Q, availability of very low capacitance values and very tight capacitance tolerances.
- The RF power handling capability of the Accu-P® allows for its usage in both small signal and RF power applications.
- Inspection, test and quality control procedures in accordance with ISO 9001, CECC, IECQ and USA MIL Standards guarantee product of the highest quality.
- Hand soldering Accu-P®: Due to their construction utilizing relatively high thermal conductivity materials, Accu-P's have become the preferred device in R & D labs and production environments where hand soldering is used. Accu-P's are available in all sizes and are electrically identical to their Accu-F counterparts.

### APPLICATIONS

Cellular Communications  
CT2/PCN (Cordless  
Telephone/Personal Comm.  
Networks)  
Satellite TV  
Cable TV  
GPS (Global Positioning Systems)  
Vehicle Location Systems  
Vehicle Alarm Systems  
Paging  
Military Communications

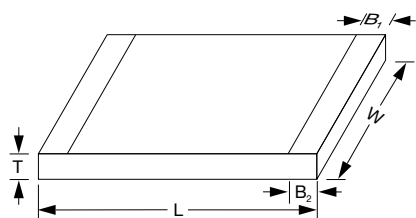
Radar Systems  
Video Switching  
Test & Measurements  
Filters  
VCO's  
Matching Networks  
RF Amplifiers

### APPROVALS

ISO 9001

# Accu-F® \*/ Accu-P®

## Thin-Film Chip Capacitors for RF Signal and Power Applications



### ACCU-F® \*(Signal Type Capacitors)

|          | 0603                      | 0805                      |
|----------|---------------------------|---------------------------|
| <b>L</b> | 1.60±0.1<br>(0.063±0.004) | 2.01±0.1<br>(0.079±0.004) |
| <b>W</b> | 0.81±0.1<br>(0.032±0.004) | 1.27±0.1<br>(0.050±0.004) |
| <b>T</b> | 0.63±0.1<br>(0.025±0.004) | 0.63±0.1<br>(0.025±0.004) |
| <b>B</b> | 0.30±0.1<br>(0.012±0.004) | 0.30±0.1<br>(0.012±0.004) |

\*Not recommended for new designs.  
Accu-P's are recommended.

**DIMENSIONS:**  
millimeters (inches)

### ACCU-P® (Signal and Power Type Capacitors)

|                      | 0201                          | 0402*                                                                  | 0603*                      | 0805*                     | 1210                      |
|----------------------|-------------------------------|------------------------------------------------------------------------|----------------------------|---------------------------|---------------------------|
| <b>L</b>             | 0.60±0.05<br>(0.023±0.002)    | 1.00±0.1<br>(0.039±0.004)                                              | 1.60±0.1<br>(0.063±0.004)  | 2.01±0.1<br>(0.079±0.004) | 3.02±0.1<br>(0.119±0.004) |
| <b>W</b>             | 0.325±0.050<br>(0.0128±0.002) | 0.55±0.07<br>(0.022±0.003)                                             | 0.81±0.1<br>(0.032±0.004)  | 1.27±0.1<br>(0.050±0.004) | 2.5±0.1<br>(0.100±0.004)  |
| <b>T</b>             | 0.225±0.050<br>(0.009±0.002)  | 0.40±0.1<br>(0.016±0.004)                                              | 0.63±0.1<br>(0.025±0.004)  | 0.93±0.2<br>(0.036±0.008) | 0.93±0.2<br>(0.036±0.008) |
| <b>B<sub>1</sub></b> | 0.10±0.10<br>(0.004±0.004)    | 0.00 <sup>+0.1<br/>-0.0</sup><br>(0.000 <sup>+0.004<br/>-0.000</sup> ) | 0.35±0.15<br>(0.014±0.006) | 0.30±0.1<br>(0.012±0.004) | 0.43±0.1<br>(0.017±0.004) |
| <b>B<sub>2</sub></b> | 0.15±0.05<br>(0.006±0.002)    | 0.20±0.1<br>(0.008±0.004)                                              | 0.35±0.15<br>(0.014±0.006) | 0.30±0.1<br>(0.012±0.004) | 0.43±0.1<br>(0.017±0.004) |

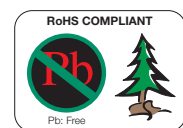
\*Mount Black Side Up

**DIMENSIONS:** millimeters (inches)

## HOW TO ORDER

| 0402<br>T                                              | 3<br>T                                                                 | J<br>T                                                                                                           | 4R7<br>T                                                                                                                                                                                                  | A<br>T                                                                                                                                                                                                                                                                                                                                                                                       | B<br>T                                                                        | S<br>T                                                                                                                                                                                                                                                                                                                                                | TR<br>T                                   |
|--------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| <b>Size</b><br>0201*<br>0402*<br>0603<br>0805<br>1210* | <b>Voltage</b><br>1 = 100V<br>5 = 50V<br>3 = 25V<br>Y = 16V<br>Z = 10V | <b>Temperature Coefficient (1)</b><br>J = 0±30ppm/°C<br>(-55°C to +125°C)<br>K = 0±60ppm/°C<br>(-55°C to +125°C) | <b>Capacitance</b><br>Capacitance expressed in pF.<br>(2 significant digits + number of zeros)<br><b>for values &lt;10pF,</b><br>letter R denotes decimal point.<br>Example:<br>68pF = 680<br>8.2pF = 8R2 | <b>Tolerance for C≤2.0pF*</b><br>P = ±0.02pF<br>Q = ±0.03pF<br>A = ±0.05pF<br>B = ±0.1pF<br>C = ±0.25pF<br><b>for C≤3.0pF</b><br>Q = ±0.03pF<br>A = ±0.05pF<br>B = ±0.1pF<br>C = ±0.25pF<br><b>for C≤5.6pF</b><br>A = ±0.05pF<br>B = ±0.1pF<br>C = ±0.25pF<br><b>for 5.6pF&lt;C&lt;10pF</b><br>B = ±0.1pF<br>C = ±0.25pF<br>D = ±0.5pF<br><b>for C≥10pF</b><br>F = ±1%<br>G = ±2%<br>J = ±5% | <b>Specification Code</b><br>A = Accu-F® technology<br>B = Accu-P® technology | <b>Termination Code</b><br>W = Nickel/Solder Coated<br><b>Accu-F®</b> Sn63, Pb37<br><b>Accu-P® 0402</b> Sn90, Pb10<br>T = Nickel/High Temperature Solder Coated<br><b>Accu-P® 0805**, 1210**</b> Sn96, Ag4<br>Nickel/Solder Coated<br><b>Accu-P® 0603</b> Sn63, Pb37<br>**S = Nickel/Lead Free Solder Coated<br><b>Accu-P® 0201, 0402, 0603</b> Sn100 | <b>Packaging Code</b><br>TR = Tape & Reel |

(1) TC's shown are per EIA/IEC Specifications.



Please select correct termination style

**Engineering Kits Available  
see pages 90-91**

\* Tolerances as tight as ±0.01pF are available. Please consult the factory.

## ELECTRICAL SPECIFICATIONS

|                                         |                                                                        |
|-----------------------------------------|------------------------------------------------------------------------|
| Operating and Storage Temperature Range | -55°C to +125°C                                                        |
| Temperature Coefficients (1)            | 0 ± 30ppm/°C dielectric code "J" / 0 ± 60ppm/°C dielectric code "K"    |
| Capacitance Measurement                 | 1 MHz, 1 Vrms                                                          |
| Insulation Resistance (IR)              | ≥10 <sup>11</sup> Ohms (≥10 <sup>10</sup> Ohms for 0201 and 0402 size) |
| Proof Voltage                           | 2.5 U <sub>R</sub> for 5 secs.                                         |
| Aging Characteristic                    | Zero                                                                   |
| Dielectric Absorption                   | 0.01%                                                                  |

(1) TC's shown are per EIA/IEC Specifications.

## Signal Type Capacitors

### Accu-F® Capacitance Ranges (pF)

#### TEMP. COEFFICIENT CODE

“J” = 0±30ppm/°C  
(-55°C to +125°C)<sup>(2)</sup>

| Size                     |          | 0603 |    |    | 0805 |    |    |
|--------------------------|----------|------|----|----|------|----|----|
| Size Code                |          | 0603 |    |    | 0805 |    |    |
| Voltage                  |          | 100  | 50 | 25 | 100  | 50 | 25 |
| Cap in pF <sup>(1)</sup> | Cap code |      |    |    |      |    |    |
| 0.1 — 0R1                |          |      |    |    |      |    |    |
| 0.2 — 0R2                |          |      |    |    |      |    |    |
| 0.3 — 0R3                |          |      |    |    |      |    |    |
| 0.4 — 0R4                |          |      |    |    |      |    |    |
| 0.5 — 0R5                |          |      |    |    |      |    |    |
| 0.6 — 0R6                |          |      |    |    |      |    |    |
| 0.7 — 0R7                |          |      |    |    |      |    |    |
| 0.8 — 0R8                |          |      |    |    |      |    |    |
| 0.9 — 0R9                |          |      |    |    |      |    |    |
| 1.0 — 1R0                |          |      |    |    |      |    |    |
| 1.2 — 1R2                |          |      |    |    |      |    |    |
| 1.5 — 1R5                |          |      |    |    |      |    |    |
| 1.8 — 1R8                |          |      |    |    |      |    |    |
| 2.2 — 2R2                |          |      |    |    |      |    |    |
| 2.7 — 2R7                |          |      |    |    |      |    |    |
| 3.3 — 3R3                |          |      |    |    |      |    |    |
| 3.9 — 3R9                |          |      |    |    |      |    |    |
| 4.7 — 4R7                |          |      |    |    |      |    |    |
| 5.6 — 5R6                |          |      |    |    |      |    |    |
| 6.8 — 6R8                |          |      |    |    |      |    |    |
| 8.2 — 8R2                |          |      |    |    |      |    |    |
| 10 — 100                 |          |      |    |    |      |    |    |
| 12 — 120                 |          |      |    |    |      |    |    |
| 15 — 150                 |          |      |    |    |      |    |    |
| 18 — 180                 |          |      |    |    |      |    |    |
| 22 — 220                 |          |      |    |    |      |    |    |
| 27 — 270                 |          |      |    |    |      |    |    |
| 33 — 330                 |          |      |    |    |      |    |    |
| 39 — 390                 |          |      |    |    |      |    |    |
| 47 — 470                 |          |      |    |    |      |    |    |
| 56 — 560                 |          |      |    |    |      |    |    |
| 68 — 680                 |          |      |    |    |      |    |    |
| 82 — 820                 |          |      |    |    |      |    |    |
| 100 — 101                |          |      |    |    |      |    |    |
| 120 — 121                |          |      |    |    |      |    |    |
| 150 — 151                |          |      |    |    |      |    |    |

<sup>(1)</sup> For capacitance values higher than listed in table, please consult factory.

<sup>(2)</sup> TC shown is per EIA/IEC Specifications.

#### TEMP. COEFFICIENT CODE

“K” = 0±60ppm/°C  
(-55°C to +125°C)<sup>(2)</sup>

| Size                     |          | 0603 |    |    | 0805 |    |    |
|--------------------------|----------|------|----|----|------|----|----|
| Size Code                |          | 0603 |    |    | 0805 |    |    |
| Voltage                  |          | 100  | 50 | 25 | 100  | 50 | 25 |
| Cap in pF <sup>(1)</sup> | Cap code |      |    |    |      |    |    |
| 0.1 — 0R1                |          |      |    |    |      |    |    |
| 0.2 — 0R2                |          |      |    |    |      |    |    |
| 0.3 — 0R3                |          |      |    |    |      |    |    |
| 0.4 — 0R4                |          |      |    |    |      |    |    |
| 0.5 — 0R5                |          |      |    |    |      |    |    |
| 0.6 — 0R6                |          |      |    |    |      |    |    |
| 0.7 — 0R7                |          |      |    |    |      |    |    |
| 0.8 — 0R8                |          |      |    |    |      |    |    |
| 0.9 — 0R9                |          |      |    |    |      |    |    |
| 1.0 — 1R0                |          |      |    |    |      |    |    |
| 1.2 — 1R2                |          |      |    |    |      |    |    |
| 1.5 — 1R5                |          |      |    |    |      |    |    |
| 1.8 — 1R8                |          |      |    |    |      |    |    |
| 2.2 — 2R2                |          |      |    |    |      |    |    |
| 2.7 — 2R7                |          |      |    |    |      |    |    |
| 3.3 — 3R3                |          |      |    |    |      |    |    |
| 3.9 — 3R9                |          |      |    |    |      |    |    |
| 4.7 — 4R7                |          |      |    |    |      |    |    |
| 5.6 — 5R6                |          |      |    |    |      |    |    |
| 6.8 — 6R8                |          |      |    |    |      |    |    |
| 8.2 — 8R2                |          |      |    |    |      |    |    |
| 10 — 100                 |          |      |    |    |      |    |    |
| 12 — 120                 |          |      |    |    |      |    |    |
| 15 — 150                 |          |      |    |    |      |    |    |
| 18 — 180                 |          |      |    |    |      |    |    |
| 22 — 220                 |          |      |    |    |      |    |    |
| 27 — 270                 |          |      |    |    |      |    |    |
| 33 — 330                 |          |      |    |    |      |    |    |
| 39 — 390                 |          |      |    |    |      |    |    |
| 47 — 470                 |          |      |    |    |      |    |    |
| 56 — 560                 |          |      |    |    |      |    |    |
| 68 — 680                 |          |      |    |    |      |    |    |
| 82 — 820                 |          |      |    |    |      |    |    |
| 100 — 101                |          |      |    |    |      |    |    |
| 120 — 121                |          |      |    |    |      |    |    |
| 150 — 151                |          |      |    |    |      |    |    |

<sup>(1)</sup> For capacitance values higher than listed in table, please consult factory.

<sup>(2)</sup> TC shown is per EIA/IEC Specifications.

Intermediate values are available within the indicated range.

\*Not recommended for new designs.  
Accu-P's are recommended.

**“K” =  $0 \pm 60 \text{ ppm}/^\circ\text{C}$  ( $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ )<sup>(2)</sup>**

| Size                        |   |          | 805 |    |    | 1210 |                  |
|-----------------------------|---|----------|-----|----|----|------|------------------|
| Size Code                   |   |          | 805 |    |    | 1210 |                  |
| Voltage                     |   |          | 100 | 50 | 25 | 100  | 50 <sup>6)</sup> |
| Cap in<br>pF <sup>(1)</sup> |   | Cap code |     |    |    |      |                  |
| 0.1                         | — | 0R1      |     |    |    |      |                  |
| 0.2                         | — | 0R2      |     |    |    |      |                  |
| 0.3                         | — | 0R3      |     |    |    |      |                  |
| 0.4                         | — | 0R4      |     |    |    |      |                  |
| 0.5                         | — | 0R5      |     |    |    |      |                  |
| 0.6                         | — | 0R6      |     |    |    |      |                  |
| 0.7                         | — | 0R7      |     |    |    |      |                  |
| 0.8                         | — | 0R8      |     |    |    |      |                  |
| 0.9                         | — | 0R9      |     |    |    |      |                  |
| 1.0                         | — | 1R0      |     |    |    |      |                  |
| 1.1                         | — | 1R1      |     |    |    |      |                  |
| 1.2                         | — | 1R2      |     |    |    |      |                  |
| 1.3                         | — | 1R3      |     |    |    |      |                  |
| 1.4                         | — | 1R4      |     |    |    |      |                  |
| 1.5                         | — | 1R5      |     |    |    |      |                  |
| 1.6                         | — | 1R6      |     |    |    |      |                  |
| 1.7                         | — | 1R7      |     |    |    |      |                  |
| 1.8                         | — | 1R8      |     |    |    |      |                  |
| 1.9                         | — | 1R9      |     |    |    |      |                  |
| 2.0                         | — | 2R0      |     |    |    |      |                  |
| 2.1                         | — | 2R1      |     |    |    |      |                  |
| 2.2                         | — | 2R2      |     |    |    |      |                  |
| 2.3                         | — | 2R3      |     |    |    |      |                  |
| 2.4                         | — | 2R4      |     |    |    |      |                  |
| 2.5                         | — | 2R5      |     |    |    |      |                  |
| 2.6                         | — | 2R6      |     |    |    |      |                  |
| 2.7                         | — | 2R7      |     |    |    |      |                  |
| 2.8                         | — | 2R8      |     |    |    |      |                  |
| 2.9                         | — | 2R9      |     |    |    |      |                  |
| 3.0                         | — | 3R0      |     |    |    |      |                  |
| 3.1                         | — | 3R1      |     |    |    |      |                  |
| 3.2                         | — | 3R2      |     |    |    |      |                  |
| 3.3                         | — | 3R3      |     |    |    |      |                  |
| 3.4                         | — | 3R4      |     |    |    |      |                  |
| 3.5                         | — | 3R5      |     |    |    |      |                  |
| 3.6                         | — | 3R6      |     |    |    |      |                  |
| 3.7                         | — | 3R7      |     |    |    |      |                  |
| 3.8                         | — | 3R8      |     |    |    |      |                  |
| 3.9                         | — | 3R9      |     |    |    |      |                  |
| 4.0                         | — | 4R0      |     |    |    |      |                  |
| 4.1                         | — | 4R1      |     |    |    |      |                  |
| 4.2                         | — | 4R2      |     |    |    |      |                  |
| 4.3                         | — | 4R3      |     |    |    |      |                  |
| 4.4                         | — | 4R4      |     |    |    |      |                  |
| 4.5                         | — | 4R5      |     |    |    |      |                  |
| 4.6                         | — | 4R6      |     |    |    |      |                  |
| 4.7                         | — | 4R7      |     |    |    |      |                  |
| 5.1                         | — | 5R1      |     |    |    |      |                  |
| 5.6                         | — | 5R6      |     |    |    |      |                  |
| 6.2                         | — | 6R2      |     |    |    |      |                  |
| 6.8                         | — | 6R8      |     |    |    |      |                  |
| 7.5                         | — | 7R5      |     |    |    |      |                  |
| 8.2                         | — | 8R2      |     |    |    |      |                  |
| 9.1                         | — | 9R1      |     |    |    |      |                  |
| 10.0                        | — | 100      |     |    |    |      |                  |
| 11.0                        | — | 110      |     |    |    |      |                  |
| 12.0                        | — | 120      |     |    |    |      |                  |
| 13.0                        | — | 130      |     |    |    |      |                  |
| 14.0                        | — | 140      |     |    |    |      |                  |
| 15.0                        | — | 150      |     |    |    |      |                  |
| 16.0                        | — | 160      |     |    |    |      |                  |
| 17.0                        | — | 170      |     |    |    |      |                  |
| 18.0                        | — | 180      |     |    |    |      |                  |
| 19.0                        | — | 190      |     |    |    |      |                  |
| 20.0                        | — | 200      |     |    |    |      |                  |
| 21.0                        | — | 210      |     |    |    |      |                  |
| 22.0                        | — | 220      |     |    |    |      |                  |
| 24.0                        | — | 240      |     |    |    |      |                  |
| 27.0                        | — | 270      |     |    |    |      |                  |
| 30.0                        | — | 300      |     |    |    |      |                  |
| 33.0                        | — | 330      |     |    |    |      |                  |
| 39.0                        | — | 390      |     |    |    |      |                  |
| 47.0                        | — | 470      |     |    |    |      |                  |
| 56.0                        | — | 560      |     |    |    |      |                  |
| 68.0                        | — | 680      |     |    |    |      |                  |

(3) For 50 volt range, please consult factory.



## 0201 Typical Electrical Tables

| Capacitance<br>@ 1 MHz<br>(pF) | Self<br>Resonance<br>Frequency<br>(GHz)<br>Typical | 250MHz                 |           |                     | 500MHz                 |           |                     | 750MHz                 |           |                     | 1000MHz                |           |                     | 1250MHz                |           |                     |
|--------------------------------|----------------------------------------------------|------------------------|-----------|---------------------|------------------------|-----------|---------------------|------------------------|-----------|---------------------|------------------------|-----------|---------------------|------------------------|-----------|---------------------|
|                                |                                                    | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) |
| 0.8                            | 9.1                                                | 0.84                   | 2154      | 360                 | 0.84                   | 630       | 603                 | 0.85                   | 424       | 594                 | 0.85                   | 327       | 577                 | 0.86                   | 255       | 588                 |
| 1.2                            | 7.6                                                | 1.21                   | 1375      | 405                 | 1.21                   | 525       | 517                 | 1.22                   | 341       | 527                 | 1.23                   | 267       | 503                 | 1.23                   | 208       | 515                 |
| 1.8                            | 6.3                                                | 1.84                   | 1298      | 271                 | 1.85                   | 520       | 341                 | 1.86                   | 337       | 347                 | 1.87                   | 270       | 326                 | 1.88                   | 201       | 347                 |
| 2.2                            | 5.7                                                | 2.23                   | 1355      | 214                 | 2.24                   | 512       | 281                 | 2.25                   | 335       | 284                 | 2.27                   | 264       | 270                 | 2.29                   | 199       | 284                 |
| 3.3                            | 4.6                                                | 3.29                   | 1295      | 156                 | 3.31                   | 430       | 230                 | 3.33                   | 285       | 230                 | 3.36                   | 220       | 223                 | 3.40                   | 159       | 242                 |
| 3.9                            | 4.3                                                | 3.91                   | 1902      | 93                  | 3.93                   | 460       | 181                 | 3.97                   | 298       | 185                 | 4.02                   | 227       | 181                 | 4.08                   | 163       | 198                 |
| 4.7                            | 3.9                                                | 4.71                   | 1677      | 84                  | 4.74                   | 391       | 174                 | 4.80                   | 252       | 178                 | 4.87                   | 181       | 183                 | 4.97                   | 130       | 200                 |
| 5.6                            | 3.6                                                | 5.62                   | 1391      | 84                  | 5.67                   | 370       | 154                 | 5.74                   | 257       | 148                 | 5.83                   | 195       | 144                 | 5.95                   | 140       | 157                 |
| 6.8                            | 3.3                                                | 6.77                   | 1135      | 84                  | 6.83                   | 314       | 149                 | 6.91                   | 217       | 142                 | 7.03                   | 164       | 139                 | 7.18                   | 118       | 151                 |

| Capacitance<br>@ 1 MHz<br>(pF) | Self<br>Resonance<br>Frequency<br>(GHz)<br>Typical | 1500MHz                |           |                     | 1750MHz                |           |                     | 2250MHz                |           |                     | 2500MHz                |                |                     | 2750MHz                |           |                     |
|--------------------------------|----------------------------------------------------|------------------------|-----------|---------------------|------------------------|-----------|---------------------|------------------------|-----------|---------------------|------------------------|----------------|---------------------|------------------------|-----------|---------------------|
|                                |                                                    | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q<br>M | Typ.<br>ESR<br>(mΩ) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(mΩ) |
| 0.8                            | 9.1                                                | 0.86                   | 204       | 611                 | 0.87                   | 168       | 631                 | 0.88                   | 141       | 587                 | 0.89                   | 126            | 571                 | 0.90                   | 122       | 532                 |
| 1.2                            | 7.6                                                | 1.24                   | 155       | 565                 | 1.26                   | 129       | 577                 | 1.28                   | 92        | 570                 | 1.30                   | 89             | 566                 | 1.31                   | 81        | 558                 |
| 1.8                            | 6.3                                                | 1.90                   | 148       | 388                 | 1.92                   | 123       | 395                 | 1.96                   | 96        | 395                 | 1.99                   | 83             | 396                 | 2.02                   | 74        | 397                 |
| 2.2                            | 5.7                                                | 2.32                   | 145       | 320                 | 2.34                   | 123       | 322                 | 2.41                   | 93        | 329                 | 2.46                   | 81             | 328                 | 2.50                   | 72        | 330                 |
| 3.3                            | 4.6                                                | 3.45                   | 119       | 266                 | 3.50                   | 101       | 263                 | 3.63                   | 74        | 277                 | 3.73                   | 64             | 276                 | 3.84                   | 55        | 281                 |
| 3.9                            | 4.3                                                | 4.16                   | 122       | 216                 | 4.25                   | 103       | 214                 | 4.46                   | 75        | 224                 | 4.63                   | 64             | 223                 | 4.79                   | 56        | 225                 |
| 4.7                            | 3.9                                                | 5.08                   | 99        | 213                 | 5.23                   | 83        | 212                 | 5.55                   | 60        | 221                 | 5.83                   | 50             | 222                 | 6.10                   | 43        | 224                 |
| 5.6                            | 3.6                                                | 6.11                   | 108       | 166                 | 6.31                   | 91        | 164                 | 6.76                   | 64        | 174                 | 7.16                   | 53             | 175                 | 7.56                   | 45        | 141                 |
| 6.8                            | 3.3                                                | 7.38                   | 93        | 155                 | 7.63                   | 76        | 158                 | 8.22                   | 54        | 166                 | 8.74                   | 44             | 169                 | 9.29                   | 37        | 173                 |

## 0402 Typical Electrical Tables

| Capacitance<br>& Tolerance*<br>@ 1 MHz<br>(pF) | Self<br>Resonance<br>Frequency<br>(GHz)<br>Typical | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) |
|------------------------------------------------|----------------------------------------------------|----------------------|------------------------|-----------|--------------------|----------------------|------------------------|-----------|--------------------|----------------------|------------------------|-----------|--------------------|----------------------|------------------------|-----------|--------------------|----------------------|------------------------|-----------|--------------------|
| 0.1±0.05                                       | 19.4                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.2±0.05                                       | 16.4                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.3±0.05                                       | 14.6                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.4±0.05                                       | 12.5                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.5±0.05                                       | 11.3                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.6±0.05                                       | 10.4                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.7±0.05                                       | 9.5                                                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.8±0.05                                       | 9.1                                                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.9±0.05                                       | 8.8                                                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 1.00±0.05                                      | 8                                                  | 247                  | 1.16                   | 1635      | 0.34               | 494                  | 1.15                   | 1283      | 0.22               | 742                  | 1.13                   | 870       | 0.22               | 991                  | 1.12                   | 620       | 0.23               | 1240                 | 1.14                   | 474       | 0.25               |
| 1.10±0.05                                      | 7.8                                                | 246                  | 1.25                   | 1581      | 0.32               | 492                  | 1.22                   | 1219      | 0.21               | 740                  | 1.21                   | 791       | 0.22               | 989                  | 1.19                   | 561       | 0.24               | 1238                 | 1.21                   | 425       | 0.25               |
| 1.20±0.05                                      | 7.4                                                | 245                  | 1.34                   | 1538      | 0.30               | 491                  | 1.33                   | 1153      | 0.21               | 738                  | 1.31                   | 727       | 0.22               | 986                  | 1.3                    | 503       | 0.25               | 1234                 | 1.33                   | 372       | 0.25               |
| 1.30±0.05                                      | 7                                                  | 244                  | 1.42                   | 1502      | 0.29               | 490                  | 1.42                   | 1109      | 0.21               | 736                  | 1.4                    | 701       | 0.21               | 983                  | 1.35                   | 480       | 0.24               | 1230                 | 1.41                   | 350       | 0.25               |
| 1.40±0.05                                      | 6.8                                                | 243                  | 1.53                   | 1476      | 0.28               | 488                  | 1.54                   | 1061      | 0.20               | 733                  | 1.52                   | 680       | 0.21               | 980                  | 1.49                   | 461       | 0.23               | 1229                 | 1.53                   | 333       | 0.25               |
| 1.50±0.05                                      | 6.5                                                | 242                  | 1.63                   | 1454      | 0.28               | 486                  | 1.63                   | 1002      | 0.20               | 731                  | 1.58                   | 638       | 0.21               | 978                  | 1.6                    | 438       | 0.23               | 1226                 | 1.65                   | 316       | 0.25               |
| 1.60±0.05                                      | 6.5                                                | 242                  | 1.71                   | 1448      | 0.27               | 485                  | 1.76                   | 986       | 0.20               | 729                  | 1.69                   | 622       | 0.21               | 986                  | 1.71                   | 429       | 0.23               | 1224                 | 1.77                   | 309       | 0.24               |
| 1.70±0.05                                      | 6.4                                                | 241                  | 1.85                   | 1444      | 0.27               | 483                  | 1.81                   | 970       | 0.19               | 728                  | 1.75                   | 612       | 0.20               | 985                  | 1.75                   | 422       | 0.22               | 1223                 | 1.86                   | 305       | 0.23               |
| 1.80±0.05                                      | 6.2                                                | 240                  | 1.93                   | 1430      | 0.26               | 482                  | 1.86                   | 931       | 0.19               | 727                  | 1.83                   | 597       | 0.20               | 983                  | 1.8                    | 413       | 0.22               | 1220                 | 1.91                   | 299       | 0.23               |
| 1.90±0.05                                      | 6                                                  | 239                  | 2.01                   | 1421      | 0.25               | 481                  | 1.93                   | 897       | 0.19               | 726                  | 1.91                   | 583       | 0.20               | 972                  | 1.91                   | 401       | 0.21               | 1219                 | 1.97                   | 294       | 0.22               |
| 2.00±0.05                                      | 5.7                                                | 239                  | 2.11                   | 1410      | 0.24               | 480                  | 2.06                   | 896       | 0.18               | 722                  | 2.11                   | 582       | 0.19               | 969                  | 2.01                   | 400       | 0.20               | 1215                 | 2.11                   | 293       | 0.21               |
| 2.10±0.05                                      | 5.4                                                | 238                  | 2.21                   | 1406      | 0.23               | 478                  | 2.14                   | 893       | 0.17               | 720                  | 2.21                   | 581       | 0.18               | 966                  | 2.1                    | 398       | 0.19               | 1213                 | 2.22                   | 291       | 0.20               |
| 2.20±0.05                                      | 5.1                                                | 237                  | 2.28                   | 1406      | 0.22               | 476                  | 2.27                   | 893       | 0.16               | 718                  | 2.26                   | 581       | 0.17               | 964                  | 2.27                   | 396       | 0.18               | 1212                 | 2.35                   | 289       | 0.19               |
| 2.30±0.05                                      | 5                                                  | 237                  | 2.32                   | 1405      | 0.20               | 475                  | 2.36                   | 870       | 0.16               | 716                  | 2.4                    | 549       | 0.17               | 962                  | 2.3                    | 379       | 0.18               | 1209                 | 2.4                    | 262       | 0.20               |
| 2.40±0.05                                      | 4.9                                                | 236                  | 2.45                   | 1404      | 0.19               | 473                  | 2.48                   | 845       | 0.16               | 715                  | 2.51                   | 501       | 0.17               | 960                  | 2.41                   | 358       | 0.19               | 1208                 | 2.53                   | 253       | 0.20               |
| 2.50±0.05                                      | 4.7                                                | 235                  | 2.49                   | 1404      | 0.18               | 472                  | 2.6                    | 821       | 0.16               | 714                  | 2.62                   | 486       | 0.17               | 959                  | 2.52                   | 349       | 0.19               | 1205                 | 2.7                    | 240       | 0.20               |
| 2.60±0.05                                      | 4.6                                                | 234                  | 2.6                    | 1402      | 0.16               | 470                  | 2.71                   | 799       | 0.15               | 712                  | 2.73                   | 477       | 0.17               | 958                  | 2.65                   | 331       | 0.19               | 1204                 | 2.85                   | 231       | 0.20               |
| 2.70±0.05                                      | 4.5                                                | 233                  | 2.84                   | 1399      | 0.15               | 469                  | 2.83                   | 778       | 0.15               | 711                  | 2.82                   | 464       | 0.17               | 956                  | 2.86                   | 313       | 0.19               | 1203                 | 3                      | 224       | 0.20               |
| 2.80±0.05                                      | 4.5                                                | 233                  | 2.85                   | 1395      | 0.15               | 468                  | 2.94                   | 769       | 0.15               | 710                  | 2.9                    | 458       | 0.16               | 954                  | 2.91                   | 308       | 0.18               | 1202                 | 3.12                   | 220       | 0.20               |
| 2.90±0.05                                      | 4.4                                                | 232                  | 2.87                   | 1395      | 0.15               | 467                  | 3.11                   | 751       | 0.15               | 710                  | 2.99                   | 450       | 0.16               | 953                  | 3.15                   | 303       | 0.18               | 1201                 | 3.24                   | 218       | 0.19               |
| 3.00±0.05                                      | 4.4                                                | 231                  | 2.88                   | 1392      | 0.14               | 466                  | 3.39                   | 746       | 0.15               | 709                  | 3.11                   | 440       | 0.16               | 952                  | 3.41                   | 299       | 0.18               | 1201                 | 3.33                   | 212       | 0.19               |
| 3.10±0.05                                      | 4.4                                                | 230                  | 2.9                    | 1392      | 0.14               | 465                  | 3.45                   | 733       | 0.15               | 708                  | 3.22                   | 429       | 0.16               | 951                  | 3.48                   | 291       | 0.18               | 1199                 | 3.45                   | 207       | 0.19               |
| 3.20±0.05                                      | 4.3                                                | 230                  | 2.91                   | 1391      | 0.14               | 464                  | 3.61                   | 725       | 0.15               | 707                  | 3.3                    | 421       | 0.16               | 950                  | 3.68                   | 285       | 0.17               | 1198                 | 3.58                   | 203       | 0.19               |
| 3.30±0.05                                      | 4.3                                                | 229                  | 2.92                   | 1391      | 0.14               | 462                  | 3.72                   | 711       | 0.14               | 707                  | 3.42                   | 415       | 0.16               | 949                  | 3.8                    | 282       | 0.17               | 1197                 | 3.61                   | 198       | 0.19               |
| 3.40±0.05                                      | 4.3                                                | 228                  | 2.93                   | 1390      | 0.14               | 461                  | 3.78                   | 705       | 0.14               | 706                  | 3.53                   | 407       | 0.15               | 948                  | 3.79                   | 276       | 0.17               | 1196                 | 3.78                   | 195       | 0.19               |
| 3.50±0.05                                      | 4.2                                                | 227                  | 2.95                   | 1389      | 0.13               | 460                  | 3.82                   | 693       | 0.14               | 705                  | 3.6                    | 402       | 0.15               | 947                  | 3.85                   | 273       | 0.16               | 1195                 | 3.91                   | 191       | 0.18               |
| 3.60±0.05                                      | 4.2                                                | 226                  | 2.97                   | 1382      | 0.13               | 459                  | 3.87                   | 688       | 0.14               | 704                  | 3.7                    | 395       | 0.15               | 946                  | 3.89                   | 270       | 0.16               | 1194                 | 4                      | 186       | 0.18               |
| 3.70±0.05                                      | 4.1                                                | 226                  | 2.99                   | 1381      | 0.13               | 458                  | 3.93                   | 667       | 0.14               | 702                  | 3.81                   | 389       | 0.15               | 945                  | 3.95                   | 262       | 0.16               | 1193                 | 4.1                    | 181       | 0.18               |
| 3.80±0.05                                      | 4                                                  | 225                  | 4                      | 1380      | 0.13               | 458                  | 4                      | 658       | 0.13               | 699                  | 3.9                    | 386       | 0.15               | 944                  | 4.02                   | 256       | 0.16               | 1192                 | 4.23                   | 177       | 0.18               |
| 3.90±0.05                                      | 3.9                                                | 224                  | 4.01                   | 1379      | 0.13               | 457                  | 4.01                   | 649       | 0.13               | 697                  | 4.02                   | 384       | 0.15               | 943                  | 4.11                   | 251       | 0.16               | 1191                 | 4.37                   | 172       | 0.18               |
| 4.00±0.05                                      | 3.9                                                | 224                  | 4.09                   | 1372      | 0.12               | 457                  | 4.07                   | 650       | 0.13               | 696                  | 4.11                   | 381       | 0.14               | 942                  | 4.18                   | 250       | 0.16               | 1190                 | 4.46                   | 170       | 0.18               |
| 4.10±0.05                                      | 3.8                                                | 223                  | 4.18                   | 1370      | 0.12               | 456                  | 4.18                   | 655       | 0.13               | 696                  | 4.2                    | 380       | 0.14               | 941                  | 4.23                   | 248       | 0.15               | 1190                 | 4.52                   | 169       | 0.17               |
| 4.20±0.05                                      | 3.8                                                | 223                  | 4.27                   | 1356      | 0.12               | 455                  | 4.27                   | 658       | 0.12               | 695                  | 4.29                   | 379       | 0.14               | 940                  | 4.37                   | 247       | 0.15               | 1199                 | 4.66                   | 167       | 0.17               |
| 4.30±0.05                                      | 3.7                                                | 222                  | 4.36                   | 1355      | 0.12               | 454                  | 4.34                   | 657       | 0.12               | 694                  | 4.43                   | 373       | 0.14               | 939                  | 4.58                   | 246       | 0.15               | 1195                 | 4.75                   | 168       | 0.17               |
| 4.40±0.05                                      | 3.7                                                | 222                  | 4.44                   | 1351      | 0.11               | 453                  | 4.45                   | 660       | 0.12               | 693                  | 4.5                    | 369       | 0.14               | 939                  | 4.62                   | 246       | 0.14               | 1192                 | 4.82                   | 162       | 0.16               |
| 4.50±0.05                                      | 3.6                                                | 221                  | 4.53                   | 1350      | 0.11               | 452                  | 4.52                   | 665       | 0.12               | 692                  | 4.6                    | 364       | 0.13               | 938                  | 4.7                    | 245       | 0.14               | 1190                 | 4.96                   | 161       | 0.16               |
| 4.60±0.05                                      | 3.6                                                | 221                  | 4.62                   | 1347      | 0.11               | 451                  | 4.62                   | 670       | 0.11               | 691                  | 4.72                   | 359       | 0.13               | 938                  | 4.79                   | 244       | 0.14               | 1188                 | 5.07                   | 161       | 0.16               |
| 4.70±0.05                                      | 3.5                                                | 220                  | 4.75                   | 1343      | 0.11               | 450                  | 4.74                   | 673       | 0.11               | 690                  | 4.74                   | 351       | 0.13               | 937                  | 4.86                   | 244       | 0.14               | 1186                 | 5.18                   | 159       | 0.16               |
| 5.10±0.05                                      | 3.4                                                | 217                  | 5.19                   | 1310      | 0.11               | 447                  | 5.16                   | 589       | 0.11               | 687                  | 5.23                   | 348       | 0.13               | 934                  | 5.53                   | 230       | 0.14               | 1184                 | 5.82                   | 131       | 0.16               |
| 5.60±0.05                                      | 3.3                                                | 214                  | 5.74                   | 1297      | 0.11               | 443                  | 5.75                   | 576       | 0.11               | 684                  | 5.81                   | 342       | 0.12               | 932                  | 6.01                   | 201       | 0.14               | 1182                 | 6.62                   | 129       | 0.16               |
| 6.2±0.1                                        | 3                                                  | 211                  | 6.31                   | 1244      | 0.10               | 440                  | 6.09                   | 585       | 0.10               | 681                  | 6.33                   | 339       | 0.11               | 928                  | 6.68                   | 202       | 0.12               | 1180                 | 7.34                   | 128       | 0.15               |
| 6.8±0.1                                        | 2.8                                                | 208                  | 6.92                   | 1202      | 0.09               | 436                  | 6.94                   | 591       | 0.09               | 678                  | 7.04                   | 334       | 0.10               | 926                  | 7.39                   | 203       | 0.11               | 1177                 | 8.22                   | 127       | 0.14               |
| 7.5±0.1                                        | 2.7                                                | 205                  | 7.57                   | 1155      | 0.08               | 433                  | 7.51                   | 567       | 0.09               | 675                  | 7.85                   | 320       | 0.10               | 924                  | 8.17                   | 191       | 0.10               | 1176                 | 9.01                   | 120       | 0.13               |
| 8.2±0.1                                        | 2.6                                                | 202                  | 8.35                   | 1116      | 0.08               | 430                  | 8.36                   | 542       | 0.08               | 673                  | 8.48                   | 306       | 0.09               | 922                  | 8.93                   | 186       | 0.10               | 1174                 | 10.04                  | 118       | 0.13               |
| 9.1±0.1                                        | 2.5                                                | 199                  | 9.23                   | 1059      | 0.09               | 428                  | 9.28                   | 458       | 0.09               | 670                  | 9.87                   | 249       | 0.10               | 920                  | 10.2                   | 152       | 0.11               | 1172                 | 11.98                  | 88        | 0.13               |
| 10.0±1%                                        | 2.4                                                | 196                  | 10.14                  | 936       | 0.09               | 424                  | 10.24                  | 385       | 0.10               | 668                  | 10.55                  | 202       | 0.11               | 919                  | 11.49                  | 118       | 0.13               | 1171                 | 13.75                  | 70        | 0.12               |
| 11.0±1%                                        | 2.3                                                | 193                  | 11.19                  | 912       | 0.08               | 421                  | 11.17                  | 363       | 0.09               | 666                  | 11.81                  | 185       | 0.11               | 917                  | 12.87                  | 103       | 0.12               | 1170                 | 15.3                   | 61        | 0.12               |
| 12.0±1%                                        | 2.2                                                | 189                  | 12.16                  | 889       | 0.08               | 418                  | 12.3                   | 348       | 0.09               | 664                  | 12.77                  | 173       | 0.11               | 915                  | 14.16                  | 95        | 0.13               | 1168                 | 17.63                  | 52        | 0.12               |
| 13.0±1%                                        | 2.2                                                | 186                  | 13.3                   | 984       | 0.07               | 416                  | 13.32                  | 363       | 0.08               | 661                  | 14.1                   | 183       | 0.09               | 912                  | 15.8                   | 101       | 0.11               | 1164                 | 23.9                   | 47        | 0.12               |
| 14.0±1%                                        | 2.1                                                | 184                  | 14.26                  | 802       | 0.08               | 414                  | 14.44                  | 298       | 0.09               | 660                  | 15.03                  | 149       | 0.12               | 913                  | 16.72                  | 76.7      | 0.14               | 1167                 | 23.1                   | 40        | 0.15               |
| 15.0±1%                                        | 2.1                                                | 182                  | 15.34                  | 791       | 0.07               | 413                  | 15.46                  | 283       | 0.08               | 660                  | 16.16                  | 138       | 0.10               | 912                  | 18.51                  | 82        | 0.16               | 1166                 | 23.6                   | 44        | 0.13               |
| 16.0±1%                                        | 2                                                  | 179                  | 16.3                   | 780       | 0.07               | 410                  | 16.4                   | 270       | 0.08               | 657                  | 17.6                   | 129       | 0.11               | 909                  | 20.2                   | 68        | 0.13               | 1161                 | 34.7                   | 28        | 0.14               |
| 17.0±1%                                        | 1.9                                                | 178                  | 17.6                   | 765       | 0.07               | 410                  | 17.7                   | 263       | 0.08               | 657                  | 18.2                   | 130       | 0.11               | 909                  | 21.3                   | 70        | 0.12               | 1163                 | 34.9                   | 28        | 0.14               |
| 18.0±1%                                        | 1.8                                                | 176.5                | 18.13                  | 754       | 0.07               | 409                  | 18.42                  | 258       | 0.07               |                      |                        |           |                    |                      |                        |           |                    |                      |                        |           |                    |



## 0402 Typical Electrical Tables

| Capacitance<br>& Tolerance*<br>@ 1 MHz<br>(pF) | Self<br>Resonance<br>Frequency<br>(GHz)<br>Typical | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) | Ref<br>Freq<br>(MHz) | Typ.<br>C(eff)<br>(pF) | Typ.<br>Q | Typ.<br>ESR<br>(Ω) |
|------------------------------------------------|----------------------------------------------------|----------------------|------------------------|-----------|--------------------|----------------------|------------------------|-----------|--------------------|----------------------|------------------------|-----------|--------------------|----------------------|------------------------|-----------|--------------------|----------------------|------------------------|-----------|--------------------|
| 0.1±0.05                                       | 19.4                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.2±0.05                                       | 16.4                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.3±0.05                                       | 14.6                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.4±0.05                                       | 12.5                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.5±0.05                                       | 11.3                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.6±0.05                                       | 10.4                                               | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.7±0.05                                       | 9.5                                                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.8±0.05                                       | 9.1                                                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 0.9±0.05                                       | 8.8                                                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                | n/a                  | n/a                    | n/a       | n/a                |
| 1.00±0.05                                      | 8                                                  | 1489                 | 1.18                   | 380       | 0.25               | 1739                 | 1.25                   | 314       | 0.25               | 1988                 | 1.32                   | 265       | 0.24               | 2240                 | 1.38                   | 229       | 0.23               | 2493                 | 1.41                   | 200       | 0.23               |
| 1.10±0.05                                      | 7.8                                                | 1485                 | 1.29                   | 342       | 0.25               | 1735                 | 1.33                   | 275       | 0.25               | 1986                 | 1.41                   | 232       | 0.24               | 2238                 | 1.49                   | 201       | 0.24               | 2490                 | 1.55                   | 177       | 0.25               |
| 1.20±0.05                                      | 7.4                                                | 1483                 | 1.37                   | 307       | 0.25               | 1732                 | 1.45                   | 251       | 0.25               | 1982                 | 1.54                   | 208       | 0.24               | 2234                 | 1.59                   | 173       | 0.25               | 2488                 | 1.62                   | 149       | 0.27               |
| 1.30±0.05                                      | 7                                                  | 1479                 | 1.45                   | 289       | 0.25               | 1729                 | 1.58                   | 240       | 0.25               | 1980                 | 1.66                   | 196       | 0.24               | 2230                 | 1.73                   | 166       | 0.25               | 2485                 | 1.76                   | 137       | 0.27               |
| 1.40±0.05                                      | 6.8                                                | 1477                 | 1.6                    | 265       | 0.25               | 1726                 | 1.71                   | 221       | 0.25               | 1977                 | 1.78                   | 179       | 0.24               | 2229                 | 1.88                   | 154       | 0.25               | 2483                 | 1.89                   | 125       | 0.26               |
| 1.50±0.05                                      | 6.5                                                | 1474                 | 1.72                   | 252       | 0.25               | 1724                 | 1.82                   | 203       | 0.25               | 1974                 | 1.94                   | 169       | 0.24               | 2227                 | 2.01                   | 143       | 0.25               | 2481                 | 2.03                   | 115       | 0.27               |
| 1.60±0.05                                      | 6.5                                                | 1472                 | 1.81                   | 246       | 0.24               | 1722                 | 1.91                   | 201       | 0.24               | 1971                 | 2.01                   | 168       | 0.23               | 2226                 | 2.1                    | 142       | 0.24               | 2479                 | 2.1                    | 119       | 0.25               |
| 1.70±0.05                                      | 6.4                                                | 1470                 | 1.92                   | 241       | 0.23               | 1719                 | 1.99                   | 199       | 0.23               | 1970                 | 2.1                    | 167       | 0.22               | 2225                 | 2.23                   | 141       | 0.23               | 2478                 | 2.23                   | 120       | 0.24               |
| 1.80±0.05                                      | 6.2                                                | 1469                 | 1.98                   | 240       | 0.22               | 1718                 | 2.06                   | 198       | 0.22               | 1969                 | 2.24                   | 166       | 0.21               | 2223                 | 2.34                   | 141       | 0.22               | 2477                 | 2.35                   | 122       | 0.22               |
| 1.90±0.05                                      | 6                                                  | 1468                 | 2.06                   | 239       | 0.22               | 1717                 | 2.19                   | 197       | 0.21               | 1968                 | 2.33                   | 165       | 0.21               | 2222                 | 2.41                   | 140       | 0.21               | 2476                 | 2.42                   | 123       | 0.21               |
| 2.00±0.05                                      | 5.7                                                | 1466                 | 2.12                   | 233       | 0.21               | 1716                 | 2.22                   | 190       | 0.21               | 1968                 | 2.51                   | 160       | 0.20               | 2220                 | 2.62                   | 138       | 0.21               | 2475                 | 2.65                   | 118       | 0.21               |
| 2.10±0.05                                      | 5.4                                                | 1463                 | 2.31                   | 230       | 0.20               | 1714                 | 2.43                   | 185       | 0.21               | 1966                 | 2.62                   | 155       | 0.20               | 2219                 | 2.76                   | 132       | 0.2                | 2474                 | 2.81                   | 115       | 0.20               |
| 2.20±0.05                                      | 5.1                                                | 1461                 | 2.47                   | 228       | 0.20               | 1711                 | 2.65                   | 183       | 0.20               | 1964                 | 2.83                   | 149       | 0.20               | 2217                 | 2.91                   | 126       | 0.19               | 2473                 | 2.91                   | 108       | 0.20               |
| 2.30±0.05                                      | 5                                                  | 1460                 | 2.51                   | 214       | 0.20               | 1709                 | 2.81                   | 168       | 0.20               | 1963                 | 2.98                   | 132       | 0.19               | 2216                 | 3.15                   | 121       | 0.19               | 2471                 | 3.16                   | 99        | 0.22               |
| 2.40±0.05                                      | 4.9                                                | 1459                 | 2.6                    | 196       | 0.20               | 1708                 | 3                      | 151       | 0.20               | 1962                 | 3.16                   | 120       | 0.19               | 2215                 | 3.42                   | 109       | 0.2                | 2469                 | 3.42                   | 91        | 0.23               |
| 2.50±0.05                                      | 4.7                                                | 1458                 | 2.77                   | 182       | 0.20               | 1706                 | 3.12                   | 144       | 0.20               | 1960                 | 3.32                   | 112       | 0.19               | 2214                 | 3.58                   | 92        | 0.21               | 2468                 | 3.66                   | 81        | 0.23               |
| 2.60±0.05                                      | 4.6                                                | 1455                 | 2.85                   | 173       | 0.20               | 1705                 | 3.25                   | 132       | 0.20               | 1957                 | 3.51                   | 97        | 0.19               | 2212                 | 3.73                   | 85        | 0.22               | 2467                 | 3.73                   | 72        | 0.24               |
| 2.70±0.05                                      | 4.5                                                | 1453                 | 3.18                   | 164       | 0.20               | 1703                 | 3.47                   | 122       | 0.20               | 1956                 | 3.75                   | 94        | 0.20               | 2211                 | 3.89                   | 78        | 0.24               | 2466                 | 3.89                   | 66        | 0.25               |
| 2.80±0.05                                      | 4.5                                                | 1451                 | 3.25                   | 159       | 0.20               | 1702                 | 3.62                   | 120       | 0.20               | 1956                 | 3.93                   | 88        | 0.20               | 2210                 | 3.97                   | 75        | 0.24               | 2466                 | 4.03                   | 65        | 0.25               |
| 2.90±0.05                                      | 4.4                                                | 1450                 | 3.33                   | 156       | 0.19               | 1702                 | 3.77                   | 117       | 0.20               | 1956                 | 4.02                   | 84        | 0.20               | 2210                 | 4.12                   | 73        | 0.24               | 2466                 | 4.17                   | 63        | 0.25               |
| 3.00±0.05                                      | 4.4                                                | 1449                 | 3.49                   | 150       | 0.19               | 1701                 | 3.99                   | 114       | 0.20               | 1955                 | 4.21                   | 81        | 0.20               | 2209                 | 4.26                   | 72        | 0.24               | 2465                 | 4.21                   | 61        | 0.25               |
| 3.10±0.05                                      | 4.4                                                | 1448                 | 3.61                   | 148       | 0.19               | 1700                 | 4.16                   | 109       | 0.20               | 1952                 | 4.4                    | 79        | 0.20               | 2209                 | 4.45                   | 70        | 0.24               | 2465                 | 4.33                   | 59        | 0.25               |
| 3.20±0.05                                      | 4.3                                                | 1447                 | 3.7                    | 145       | 0.19               | 1700                 | 4.31                   | 105       | 0.20               | 1952                 | 4.62                   | 77        | 0.19               | 2208                 | 4.62                   | 69        | 0.23               | 2464                 | 4.49                   | 58        | 0.25               |
| 3.30±0.05                                      | 4.3                                                | 1446                 | 3.79                   | 143       | 0.19               | 1699                 | 4.47                   | 101       | 0.20               | 1951                 | 4.76                   | 76        | 0.20               | 2207                 | 4.81                   | 68        | 0.23               | 2464                 | 4.66                   | 55        | 0.25               |
| 3.40±0.05                                      | 4.3                                                | 1446                 | 4.01                   | 138       | 0.19               | 1698                 | 4.62                   | 101       | 0.20               | 1950                 | 4.92                   | 75        | 0.20               | 2206                 | 4.93                   | 66        | 0.22               | 2464                 | 4.92                   | 52        | 0.24               |
| 3.50±0.05                                      | 4.2                                                | 1445                 | 4.11                   | 133       | 0.19               | 1697                 | 4.78                   | 95        | 0.20               | 1950                 | 5.18                   | 73        | 0.19               | 2206                 | 5.21                   | 65        | 0.23               | 2463                 | 5.15                   | 51        | 0.24               |
| 3.60±0.05                                      | 4.2                                                | 1445                 | 4.2                    | 130       | 0.19               | 1697                 | 4.91                   | 94        | 0.20               | 1949                 | 5.34                   | 71        | 0.20               | 2205                 | 5.4                    | 63        | 0.22               | 2463                 | 5.25                   | 51        | 0.24               |
| 3.70±0.05                                      | 4.1                                                | 1444                 | 4.28                   | 126       | 0.19               | 1696                 | 5.05                   | 92        | 0.19               | 1949                 | 5.5                    | 69        | 0.20               | 2205                 | 5.62                   | 62        | 0.22               | 2462                 | 5.41                   | 49        | 0.24               |
| 3.80±0.05                                      | 4                                                  | 1443                 | 4.44                   | 125       | 0.19               | 1696                 | 5.11                   | 90        | 0.19               | 1948                 | 5.61                   | 67        | 0.20               | 2204                 | 5.78                   | 61        | 0.22               | 2462                 | 5.66                   | 48        | 0.24               |
| 3.90±0.05                                      | 3.9                                                | 1442                 | 4.72                   | 121       | 0.19               | 1695                 | 5.26                   | 89        | 0.19               | 1948                 | 5.77                   | 66        | 0.21               | 2204                 | 5.94                   | 60        | 0.22               | 2461                 | 5.82                   | 47        | 0.24               |
| 4.00±0.05                                      | 3.9                                                | 1441                 | 4.8                    | 121       | 0.18               | 1694                 | 5.38                   | 88        | 0.19               | 1947                 | 5.81                   | 66        | 0.20               | 2203                 | 6.03                   | 60        | 0.21               | 2461                 | 5.86                   | 48        | 0.23               |
| 4.10±0.05                                      | 3.8                                                | 1440                 | 4.92                   | 121       | 0.18               | 1693                 | 5.5                    | 87        | 0.19               | 1947                 | 5.93                   | 65        | 0.19               | 2203                 | 6.11                   | 60        | 0.21               | 2460                 | 5.9                    | 49        | 0.23               |
| 4.20±0.05                                      | 3.8                                                | 1440                 | 5.01                   | 120       | 0.18               | 1692                 | 5.63                   | 87        | 0.18               | 1946                 | 6.05                   | 65        | 0.18               | 2203                 | 6.24                   | 59        | 0.21               | 2460                 | 5.95                   | 49        | 0.21               |
| 4.30±0.05                                      | 3.7                                                | 1439                 | 5.17                   | 120       | 0.18               | 1692                 | 5.78                   | 85        | 0.18               | 1946                 | 6.11                   | 64        | 0.18               | 2202                 | 6.35                   | 58        | 0.2                | 2459                 | 6.01                   | 50        | 0.20               |
| 4.40±0.05                                      | 3.7                                                | 1439                 | 5.28                   | 119       | 0.18               | 1691                 | 5.91                   | 85        | 0.18               | 1945                 | 6.23                   | 64        | 0.18               | 2202                 | 6.4                    | 57        | 0.2                | 2459                 | 6.12                   | 52        | 0.20               |
| 4.50±0.05                                      | 3.6                                                | 1438                 | 5.41                   | 119       | 0.18               | 1691                 | 6.04                   | 81        | 0.18               | 1945                 | 6.45                   | 64        | 0.19               | 2201                 | 6.52                   | 56        | 0.19               | 2458                 | 6.23                   | 52        | 0.19               |
| 4.60±0.05                                      | 3.6                                                | 1438                 | 5.49                   | 118       | 0.17               | 1691                 | 6.11                   | 80        | 0.18               | 1944                 | 6.66                   | 63        | 0.17               | 2201                 | 6.67                   | 55        | 0.18               | 2458                 | 6.29                   | 54        | 0.19               |
| 4.70±0.05                                      | 3.5                                                | 1437                 | 5.6                    | 118       | 0.17               | 1690                 | 6.23                   | 80        | 0.18               | 1944                 | 6.72                   | 63        | 0.17               | 2200                 | 6.71                   | 56        | 0.18               | 2457                 | 6.35                   | 54        | 0.19               |
| 5.10±0.05                                      | 3.4                                                | 1435                 | 6.59                   | 105       | 0.17               | 1689                 | 7.48                   | 75        | 0.18               | 1943                 | 7.97                   | 60        | 0.19               | 2200                 | 8.11                   | 45        | 0.2                | 2456                 | 8.1                    | 39        | 0.21               |
| 5.60±0.05                                      | 3.3                                                | 1434                 | 7.43                   | 90        | 0.17               | 1687                 | 8.75                   | 61        | 0.17               | 1942                 | 10.03                  | 51        | 0.21               | 2199                 | 10.42                  | 37        | 0.22               | 2456                 | 10.07                  | 28        | 0.23               |
| 6.2±0.1                                        | 3                                                  | 1432                 | 8.27                   | 91        | 0.15               | 1686                 | 10.21                  | 60        | 0.15               | 1941                 | 11.52                  | 48        | 0.18               | 2198                 | 11.88                  | 36        | 0.18               | 2455                 | 11.02                  | 33        | 0.19               |
| 6.8±0.1                                        | 2.8                                                | 1430                 | 9.41                   | 88        | 0.13               | 1684                 | 11.43                  | 58        | 0.13               | 1940                 | 13.36                  | 45        | 0.14               | 2196                 | 13.72                  | 37        | 0.14               | 2454                 | 12.85                  | 36        | 0.14               |
| 7.5±0.1                                        | 2.7                                                | 1429                 | 10.05                  | 85        | 0.13               | 1683                 | 12.25                  | 56        | 0.14               | 1939                 | 15.06                  | 40        | 0.13               | 2195                 | 15.24                  | 35        | 0.15               | 2454                 | 13.66                  | 33        | 0.14               |
| 8.2±0.1                                        | 2.6                                                | 1428                 | 11.64                  | 79        | 0.13               | 1682                 | 14.43                  | 52        | 0.13               | 1938                 | 16.85                  | 38        | 0.13               | 2195                 | 16.65                  | 32        | 0.14               | 2453                 | 15.32                  | 31        | 0.14               |
| 9.1±0.1                                        | 2.5                                                | 1427                 | 13.39                  | 60        | 0.13               | 1681                 | 19.07                  | 33        | 0.14               | 1937                 | 28.35                  | 25        | 0.15               | 2194                 | 31.08                  | 15        | 0.16               | 2452                 | 29.91                  | 15        | 0.16               |
| 10.0±1%                                        | 2.4                                                | 1425                 | 17.6                   | 41        | 0.14               | 1680                 | 26.51                  | 21        | 0.16               | 1936                 | 40.16                  | 11        | 0.17               | 2194                 | 45.46                  | 8         | 0.18               | 2452                 | 39.54                  | 8         | 0.18               |
| 11.0±1%                                        | 2.3                                                | 1424                 | 20.09                  | 36        | 0.15               | 1679                 | 32.66                  | 19        | 0.15               | 1935                 | 66.25                  | 8         | 0.17               | 2192                 | 81.07                  | 5         | 0.2                | 2451                 | 61.28                  | 6         | 0.18               |
| 12.0±1%                                        | 2.2                                                | 1423                 | 24.14                  | 29        | 0.15               | 1678                 | 43.51                  | 13        | 0.14               | 1934                 | 92.97                  | 5         | 0.18               | 2192                 | 123.19                 | 3         | 0.2                | 2450                 | 82.44                  | 4         | 0.19               |
| 13.0±1%                                        | 2.2                                                | 1417                 | 48.3                   | 18        | 0.13               | 1671                 | 63.2                   | 5         | 0.17               | 1934                 | 125                    | 3         | 0.18               | 2191                 |                        |           | 0.2                |                      |                        |           |                    |
| 14.0±1%                                        | 2.1                                                | 1422                 | 39.55                  | 17        | 0.15               | 1677                 | 122                    | 2         | 0.21               | 1934                 | 180.3                  | 1         | 0.19               | 2191                 |                        |           | 0.18               |                      |                        |           |                    |
| 15.0±1%                                        | 2.1                                                | 1421                 | 38.93                  | 20        | 0.14               | 1676                 | 154                    | 2         | 0.17               | 1933                 | 244.5                  |           | 0.16               | 2191                 |                        |           | 0.161              |                      |                        |           |                    |
| 16.0±1%                                        | 2                                                  | 1416                 | 79.3                   | 12        | 0.14               | 1670                 |                        |           | 0.17               | 1932                 |                        |           | 0.16               | 2191                 |                        |           | 0.16               |                      |                        |           |                    |
| 17.0±1%                                        | 1.9                                                | 1415                 | 77.6                   | 11        | 0.14               | 1670                 |                        |           | 0.17               | 1932                 |                        |           | 0.16               | 2191                 |                        |           | 0.16               |                      |                        |           |                    |
| 18.0±1%                                        | 1.8                                                | 1411                 | 83.13                  | 9         | 0.15               | 1675                 |                        |           | 0.17               | 1932                 |                        |           | 0.16               | 2182                 |                        |           | 0.16               |                      |                        |           |                    |
| 19.0±1%                                        | 1.8                                                | 1415                 | 79.6                   | 7         | 0.15               | 1673                 |                        |           | 0.16               |                      |                        |           |                    |                      |                        |           |                    |                      |                        |           |                    |

# Accu-F® / Accu-P®

## 0603 Typical Electrical Tables



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| Capacitance<br>& Tolerance*<br>@ 1 MHz<br>(pF) | Self<br>Resonance<br>Frequency<br>(GHz) | Ref<br>Freq.<br>MHz | Effective<br>Capacitance<br>Max/Min<br>(pF) | Max<br>ESR<br>(Ω) | Ref<br>Freq.<br>MHz | Effective<br>Capacitance<br>Max/Min<br>(pF) | Max<br>ESR<br>(Ω) | Ref<br>Freq.<br>MHz | Effective<br>Capacitance<br>Max/Min<br>(pF) | Max<br>ESR<br>(Ω) | Ref<br>Freq.<br>MHz | Effective<br>Capacitance<br>Max/Min<br>(pF) | Max<br>ESR<br>(Ω) |
|------------------------------------------------|-----------------------------------------|---------------------|---------------------------------------------|-------------------|---------------------|---------------------------------------------|-------------------|---------------------|---------------------------------------------|-------------------|---------------------|---------------------------------------------|-------------------|
| 0.1±0.05                                       | 18.0                                    |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 0.2±0.05                                       | 12.7                                    |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 0.3±0.05                                       | 10.4                                    |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 0.4±0.05                                       | 9.0                                     |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 0.5±0.05                                       | 8.1                                     |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 0.6±0.10                                       | 7.4                                     |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 0.7±0.10                                       | 6.8                                     |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 0.8±0.10                                       | 6.4                                     |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 0.9±0.10                                       | 6.0                                     |                     | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               | N/A                 | N/A                                         | N/A               |
| 1.0±0.10                                       | 5.7                                     | 245                 | 1.15/0.90                                   | .280              | 491                 | 1.10/0.90                                   | .220              | 738                 | 1.10/0.90                                   | .220              | 987                 | 1.15/0.90                                   | .300              |
| 1.1±0.10                                       | 5.4                                     | 244                 | 1.25/1.00                                   | .270              | 490                 | 1.25/1.00                                   | .210              | 736                 | 1.11/1.00                                   | .210              | 985                 | 1.25/1.00                                   | .290              |
| 1.2±0.10                                       | 5.2                                     | 243                 | 1.35/1.10                                   | .260              | 487                 | 1.35/1.05                                   | .200              | 734                 | 1.40/1.05                                   | .210              | 981                 | 1.35/1.05                                   | .280              |
| 1.3±0.10                                       | 5.0                                     | 242                 | 1.45/1.15                                   | .260              | 486                 | 1.45/1.15                                   | .200              | 732                 | 1.45/1.15                                   | .200              | 974                 | 1.45/1.15                                   | .270              |
| 1.4±0.10                                       | 4.8                                     | 241                 | 1.55/1.25                                   | .250              | 485                 | 1.55/1.25                                   | .190              | 731                 | 1.45/1.25                                   | .200              | 977                 | 1.55/1.25                                   | .260              |
| 1.5±0.10                                       | 4.7                                     | 241                 | 1.65/1.35                                   | .250              | 484                 | 1.65/1.35                                   | .180              | 729                 | 1.65/1.35                                   | .190              | 976                 | 1.70/1.35                                   | .250              |
| 1.6±0.10                                       | 4.5                                     | 240                 | 1.75/1.45                                   | .240              | 483                 | 1.75/1.45                                   | .180              | 727                 | 1.75/1.45                                   | .190              | 973                 | 1.80/1.50                                   | .250              |
| 1.7±0.10                                       | 4.4                                     | 240                 | 1.85/1.55                                   | .230              | 482                 | 1.85/1.60                                   | .170              | 725                 | 1.85/1.60                                   | .180              | 971                 | 1.90/1.60                                   | .250              |
| 1.8±0.10                                       | 4.2                                     | 239                 | 2.10/1.70                                   | .220              | 479                 | 2.10/1.70                                   | .160              | 723                 | 2.10/1.70                                   | .170              | 969                 | 2.15/1.70                                   | .250              |
| 1.9±0.10                                       | 4.1                                     | 239                 | 2.15/1.78                                   | .210              | 478                 | 2.15/1.80                                   | .160              | 721                 | 2.15/1.80                                   | .167              | 967                 | 2.20/1.80                                   | .240              |
| 2.0±0.10                                       | 4.0                                     | 238                 | 2.11/1.80                                   | .205              | 477                 | 2.11/1.80                                   | .155              | 720                 | 2.11/1.80                                   | .165              | 966                 | 2.25/1.90                                   | .230              |
| 2.1±0.10                                       | 3.9                                     | 237                 | 2.25/1.95                                   | .200              | 475                 | 2.25/1.98                                   | .150              | 718                 | 2.35/1.98                                   | .162              | 964                 | 2.35/2.00                                   | .220              |
| 2.2±0.10                                       | 3.8                                     | 236                 | 2.40/2.05                                   | .190              | 474                 | 2.45/2.05                                   | .145              | 717                 | 2.42/2.05                                   | .160              | 962                 | 2.45/2.10                                   | .210              |
| 2.4±0.25                                       | 3.7                                     | 234                 | 2.70/2.15                                   | .175              | 471                 | 2.75/2.15                                   | .140              | 713                 | 2.80/2.15                                   | .150              | 958                 | 2.80/2.15                                   | .200              |
| 2.7±0.25                                       | 3.5                                     | 232                 | 3.00/2.45                                   | .160              | 468                 | 3.10/2.45                                   | .125              | 709                 | 3.10/2.45                                   | .145              | 954                 | 3.15/2.48                                   | .190              |
| 3.0±0.25                                       | 3.3                                     | 230                 | 3.40/2.75                                   | .150              | 465                 | 3.40/2.75                                   | .120              | 706                 | 3.40/2.75                                   | .140              | 951                 | 3.60/2.80                                   | .170              |
| 3.3±0.25                                       | 3.1                                     | 226                 | 3.60/3.05                                   | .130              | 459                 | 3.70/3.05                                   | .120              | 699                 | 3.70/3.05                                   | .130              | 945                 | 3.80/3.10                                   | .165              |
| 3.6±0.25                                       | 3.0                                     | 224                 | 3.90/3.30                                   | .128              | 456                 | 4.25/3.35                                   | .119              | 697                 | 3.90/3.35                                   | .125              | 942                 | 4.10/3.40                                   | .160              |
| 3.9±0.25                                       | 2.9                                     | 223                 | 4.20/3.65                                   | .125              | 455                 | 4.35/3.70                                   | .115              | 695                 | 4.90/3.75                                   | .120              | 940                 | 5.15/3.75                                   | .150              |
| 4.3±0.25                                       | 2.7                                     | 220                 | 4.60/4.00                                   | .122              | 451                 | 4.80/4.05                                   | .117              | 692                 | 5.10/4.05                                   | .115              | 937                 | 5.30/4.05                                   | .150              |
| 4.7±0.25                                       | 2.6                                     | 218                 | 5.00/4.45                                   | .120              | 448                 | 5.20/4.45                                   | .110              | 689                 | 5.30/4.50                                   | .115              | 935                 | 5.50/4.55                                   | .145              |
| 5.1±0.25                                       | 2.5                                     | 216                 | 5.40/4.85                                   | .115              | 445                 | 5.70/4.89                                   | .105              | 686                 | 6.00/4.90                                   | .115              | 931                 | 6.20/5.00                                   | .140              |
| 5.6±0.25                                       | 2.4                                     | 214                 | 5.90/5.35                                   | .110              | 443                 | 6.10/5.35                                   | .100              | 684                 | 6.15/5.40                                   | .110              | 929                 | 6.50/5.50                                   | .135              |
| 6.2±0.25                                       | 2.3                                     | 211                 | 6.50/5.95                                   | .105              | 439                 | 6.90/5.95                                   | .099              | 680                 | 7.10/6.00                                   | .110              | 927                 | 8.00/6.10                                   | .130              |
| 6.8±0.25                                       | 2.2                                     | 208                 | 7.20/6.55                                   | .100              | 435                 | 7.25/6.55                                   | .099              | 677                 | 7.50/6.60                                   | .110              | 925                 | 9.00/6.65                                   | .130              |
| 7.5±0.50                                       | 2.1                                     | 205                 | 8.10/7.00                                   | .095              | 432                 | 8.10/7.00                                   | .099              | 675                 | 8.20/7.00                                   | .110              | 925                 | 9.50/7.05                                   | .125              |
| 8.2±0.50                                       | 2.0                                     | 202                 | 8.80/7.70                                   | .090              | 429                 | 8.80/7.70                                   | .098              | 672                 | 9.00/7.70                                   | .110              | 921                 | 10.00/7.80                                  | .125              |
| 9.1±0.50                                       | 1.9                                     | 200                 | 9.80/8.60                                   | .090              | 425                 | 10.95/8.65                                  | .098              | 670                 | 12.00/9.00                                  | .110              | 919                 | 13.00/9.10                                  | .120              |
| 10±5%                                          | 1.8                                     | 195                 | 10.70/9.50                                  | .085              | 422                 | 11.60/9.50                                  | .097              | 667                 | 12.50/9.60                                  | .110              | 917                 | 16.00/9.90                                  | .120              |
| 11±5%                                          | 1.7                                     | 191                 | 11.60/10.90                                 | .085              | 420                 | 12.20/10.60                                 | .095              | 665                 | 13.20/10.50                                 | .110              | 916                 | 17.00/10.00                                 | .120              |
| 12±5%                                          | 1.6                                     | 189                 | 12.90/11.40                                 | .085              | 418                 | 13.40/11.50                                 | .095              | 663                 | 14.60/11.90                                 | .110              | 914                 | 18.00/12.00                                 | .120              |
| 13±5%                                          | 1.6                                     | 187                 | 13.10/12.90                                 | .080              | 416                 | 14.00/13.00                                 | .095              | 661                 | 16.00/13.50                                 | .110              | 913                 | 21.00/14.00                                 | .120              |
| 14±5%                                          | 1.5                                     | 185                 | 14.90/13.25                                 | .080              | 414                 | 16.90/14.00                                 | .090              | 660                 | 19.00/15.00                                 | .110              | 912                 | 26.00/15.00                                 | .120              |
| 15±5%                                          | 1.5                                     | 182                 | 15.90/14.25                                 | .080              | 412                 | 17.50/15.30                                 | .090              | 659                 | 21.00/16.50                                 | .100              | 911                 | 29.00/17.00                                 | .120              |
| 16±5%                                          | 1.4                                     | 179                 | 17.00/15.15                                 | .070              | 410                 | 18.00/15.90                                 | .085              | 657                 | 22.00/17.00                                 | .100              | 910                 | 30.00/18.00                                 | .120              |
| 18±5%                                          | 1.3                                     | 176                 | 19.50/17.00                                 | .070              | 408                 | 20.20/17.10                                 | .085              | 656                 | 23.70/19.00                                 | .100              | 908                 | 33.00/21.00                                 | .120              |
| 22±5%                                          | 1.2                                     | 170                 | 24.00/20.90                                 | .066              | 404                 | 25.00/20.90                                 | .080              | 654                 | 28.00/21.00                                 | .10               | 906                 | 39.00/21.50                                 | .120              |
| 24±5%                                          | 1.2                                     | 168                 | 26.00/22.80                                 | .066              | 403                 | 30.00/23.00                                 | .080              | 653                 | N/A                                         | .10               | 905                 | N/A                                         | .120              |
| 27±5%                                          | 1.1                                     | 165                 | 29.00/25.60                                 | .065              | 402                 | 36.00/27.00                                 | .080              | 652                 | N/A                                         | .10               | 905                 | N/A                                         | .120              |
| 30±5%                                          | 1.0                                     | 163                 | 32.00/28.50                                 | .064              | 401                 | 40.00/30.00                                 | .080              | 651                 | N/A                                         | .10               | 904                 | N/A                                         | .120              |
| 33±5%                                          | 1.0                                     | 160                 | 37.65/31.35                                 | .064              | 400                 | 45.00/33.00                                 | .080              | 650                 | N/A                                         | .10               | 904                 | N/A                                         | .120              |

\* Other tolerances are available, see page 8

## 0805 Typical Electrical Tables

| Capacitance & Tolerance* @ 1 MHz (pF) | Self Resonance Frequency (GHz) | Ref Freq. MHz | Effective Capacitance Max/Min (pF) | Max ESR (Ω) | Ref Freq. MHz | Effective Capacitance Max/Min (pF) | Max ESR (Ω) | Ref Freq. MHz | Effective Capacitance Max/Min (pF) | Max ESR (Ω) | Ref Freq. MHz | Effective Capacitance Max/Min (pF) | Max ESR (Ω) |
|---------------------------------------|--------------------------------|---------------|------------------------------------|-------------|---------------|------------------------------------|-------------|---------------|------------------------------------|-------------|---------------|------------------------------------|-------------|
| 0.1±0.05                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 0.2±0.05                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 0.3±0.05                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 0.4±0.05                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 0.5±0.05                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 0.6±0.10                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 0.7±0.10                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 0.8±0.10                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 0.9±0.10                              |                                |               | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         | N/A           | N/A                                | N/A         |
| 1.0±0.10                              | 5.6                            | 250           | 1.20/0.90                          | .320        | 500           | 1.20/0.90                          | .300        | 750           | 1.20/0.90                          | .270        | 999           | 1.20/0.90                          | .300        |
| 1.1±0.10                              | 5.4                            | 248           | 1.30/1.00                          | .290        | 496           | 1.30/1.00                          | .270        | 754           | 1.30/1.00                          | .250        | 993           | 1.30/1.00                          | .290        |
| 1.2±0.10                              | 5.1                            | 245           | 1.40/1.10                          | .270        | 492           | 1.40/1.10                          | .250        | 739           | 1.40/1.10                          | .240        | 987           | 1.40/1.10                          | .280        |
| 1.3±0.10                              | 4.9                            | 243           | 1.50/1.20                          | .260        | 488           | 1.50/1.20                          | .230        | 734           | 1.50/1.10                          | .230        | 980           | 1.50/1.20                          | .270        |
| 1.4±0.10                              | 4.8                            | 242           | 1.60/1.30                          | .240        | 487           | 1.60/1.20                          | .220        | 733           | 1.60/1.20                          | .220        | 979           | 1.60/1.30                          | .260        |
| 1.5±0.10                              | 4.6                            | 242           | 1.70/1.40                          | .230        | 486           | 1.70/1.40                          | .210        | 731           | 1.70/1.40                          | .220        | 977           | 1.70/1.40                          | .260        |
| 1.6±0.10                              | 4.5                            | 241           | 1.80/1.50                          | .220        | 484           | 1.85/1.50                          | .210        | 729           | 2.00/1.50                          | .220        | 975           | 2.00/1.50                          | .250        |
| 1.7±0.10                              | 4.3                            | 240           | 1.90/1.60                          | .210        | 483           | 1.95/1.60                          | .200        | 728           | 2.05/1.60                          | .210        | 974           | 2.20/1.60                          | .240        |
| 1.8±0.10                              | 4.2                            | 239           | 2.00/1.70                          | .200        | 482           | 2.05/1.70                          | .190        | 726           | 2.10/1.70                          | .210        | 972           | 2.30/1.70                          | .230        |
| 1.9±0.10                              | 4.1                            | 239           | 2.10/1.80                          | .200        | 481           | 2.15/1.80                          | .190        | 724           | 2.25/1.80                          | .200        | 970           | 2.40/1.80                          | .230        |
| 2.0±0.10                              | 4.0                            | 238           | 2.20/1.90                          | .190        | 479           | 2.30/1.90                          | .180        | 722           | 2.40/1.90                          | .200        | 967           | 2.60/1.95                          | .220        |
| 2.1±0.10                              | 3.9                            | 237           | 2.30/2.00                          | .190        | 477           | 2.40/2.00                          | .170        | 720           | 2.60/2.00                          | .190        | 964           | 2.80/2.06                          | .210        |
| 2.2±0.10                              | 3.8                            | 236           | 2.40/2.10                          | .180        | 475           | 2.60/2.10                          | .170        | 716           | 2.80/2.14                          | .190        | 962           | 3.06/2.17                          | .210        |
| 2.4±0.25                              | 3.6                            | 235           | 2.85/2.15                          | .170        | 473           | 3.13/2.29                          | .170        | 714           | 3.17/2.30                          | .190        | 960           | 3.31/2.31                          | .210        |
| 2.7±0.25                              | 3.4                            | 233           | 3.19/2.45                          | .160        | 470           | 3.47/2.55                          | .150        | 711           | 3.52/2.60                          | .170        | 957           | 3.67/2.60                          | .200        |
| 3.0±0.25                              | 3.3                            | 231           | 3.51/2.75                          | .150        | 465           | 3.76/2.86                          | .140        | 707           | 3.84/2.93                          | .160        | 952           | 4.00/3.00                          | .190        |
| 3.3±0.25                              | 3.1                            | 229           | 3.83/3.05                          | .140        | 463           | 4.04/3.10                          | .140        | 704           | 4.15/3.19                          | .160        | 948           | 4.38/3.30                          | .190        |
| 3.6±0.25                              | 3.0                            | 228           | 4.16/3.35                          | .140        | 462           | 4.35/3.42                          | .130        | 704           | 4.50/3.53                          | .150        | 947           | 4.80/3.60                          | .190        |
| 3.9±0.25                              | 2.9                            | 227           | 4.48/3.65                          | .130        | 459           | 4.67/3.72                          | .120        | 701           | 4.85/3.86                          | .150        | 944           | 5.23/3.90                          | .180        |
| 4.3±0.25                              | 2.7                            | 223           | 4.91/4.05                          | .130        | 456           | 5.11/4.13                          | .120        | 697           | 5.32/4.25                          | .150        | 940           | 5.79/4.50                          | .180        |
| 4.7±0.25                              | 2.6                            | 220           | 5.35/4.45                          | .120        | 451           | 5.52/4.53                          | .110        | 691           | 5.79/4.60                          | .140        | 936           | 6.36/4.80                          | .170        |
| 5.1±0.25                              | 2.5                            | 218           | 5.78/4.85                          | .120        | 447           | 5.94/4.94                          | .110        | 688           | 6.25/5.20                          | .140        | 934           | 7.16/5.74                          | .160        |
| 5.6±0.25                              | 2.4                            | 215           | 6.00/5.35                          | .100        | 444           | 6.82/5.40                          | .100        | 684           | 7.27/5.60                          | .120        | 930           | 8.25/5.90                          | .150        |
| 6.2±0.25                              | 2.3                            | 212           | 7.00/5.95                          | .100        | 442           | 7.52/6.00                          | .100        | 683           | 8.08/6.10                          | .120        | 927           | 9.35/6.80                          | .150        |
| 6.8±0.25                              | 2.2                            | 208           | 7.20/6.55                          | .100        | 435           | 8.21/6.88                          | .100        | 677           | 8.90/6.96                          | .120        | 925           | 10.46/7.32                         | .150        |
| 7.5±0.05                              | 2.1                            | 206           | 8.64/7.00                          | .100        | 434           | 9.02/7.10                          | .100        | 675           | 9.85/7.50                          | .120        | 924           | 11.75/8.42                         | .150        |
| 8.2±0.05                              | 2.0                            | 203           | 9.40/7.70                          | .090        | 432           | 9.83/7.90                          | .080        | 673           | 10.80/8.25                         | .110        | 922           | 13.04/9.53                         | .150        |
| 9.1±0.05                              | 1.9                            | 199           | 10.37/8.60                         | .080        | 429           | 10.88/8.76                         | .080        | 670           | 12.02/9.10                         | .110        | 920           | 14.70/10.70                        | .150        |
| 10±5%                                 | 1.8                            | 196           | 11.00/9.50                         | .080        | 423           | 11.92/9.76                         | .080        | 668           | 13.24/10.00                        | .110        | 918           | 15.37/11.80                        | .140        |
| 11±5%                                 | 1.8                            | 193           | 12.50/10.45                        | .080        | 420           | 13.23/10.50                        | .080        | 665           | 15.07/11.00                        | .110        | 916           | 16.00/12.20                        | .140        |
| 12±5%                                 | 1.6                            | 190           | 13.61/11.40                        | .070        | 418           | 14.50/11.90                        | .080        | 663           | 16.90/12.82                        | .110        | 915           | N/A                                | .140        |
| 13±5%                                 | 1.6                            | 187           | 14.75/12.35                        | .070        | 416           | 15.80/13.00                        | .080        | 662           | 18.87/14.00                        | .110        | 914           | N/A                                | .140        |
| 14±5%                                 | 1.5                            | 184           | 15.88/13.30                        | .070        | 414           | 17.22/14.00                        | .080        | 661           | 20.84/16.00                        | .110        | 913           | N/A                                | .140        |
| 15±5%                                 | 1.5                            | 182           | 17.02/14.25                        | .070        | 414           | 18.56/15.19                        | .080        | 660           | 22.62/19.13                        | .110        | 912           | N/A                                | .130        |
| 16±5%                                 | 1.4                            | 179           | 18.16/15.20                        | .070        | 411           | 19.90/16.28                        | .080        | 659           | 27.00/20.89                        | .100        | 911           | N/A                                | .130        |
| 18±5%                                 | 1.3                            | 176           | 20.42/17.10                        | .070        | 408           | 22.69/18.57                        | .070        | 657           | 33.00/22.10                        | .100        | 910           | N/A                                | .130        |
| 20±5%                                 | 1.3                            | 173           | 22.70/19.00                        | .060        | 406           | 25.38/20.78                        | .070        | 656           | 38.00/23.15                        | .100        | 908           | N/A                                | .130        |
| 22±5%                                 | 1.2                            | 171           | 24.95/20.90                        | .060        | 405           | 28.08/21.00                        | .070        | 655           | 42.00/24.00                        | .100        | 907           | N/A                                | .130        |
| 24±5%                                 | 1.2                            | 168           | 27.20/22.80                        | .060        | 403           | 31.31/25.61                        | .070        | 654           | N/A                                | .090        | 907           | N/A                                | .130        |
| 27±5%                                 | 1.1                            | 165           | 30.78/25.69                        | .060        | 401           | 36.10/32.20                        | .070        | 652           | N/A                                | .090        | 906           | N/A                                | .130        |
| 30±5%                                 | 1.0                            | 163           | 34.23/28.50                        | .050        | 400           | 40.58/33.20                        | .070        | 651           | N/A                                | .090        | 905           | N/A                                | .130        |
| 33±5%                                 | 1.0                            | 159           | 37.85/31.35                        | .050        | 399           | 46.65/35.00                        | .070        | 650           | N/A                                | .090        | 904           | N/A                                | .120        |
| 36±5%                                 | 0.9                            | 157           | 41.19/34.20                        | .050        | 397           | 52.22/38.00                        | .070        | 649           | N/A                                | .090        | 903           | N/A                                | .120        |
| 39±5%                                 | 0.9                            | 155           | 44.79/37.05                        | .050        | 396           | 59.08/47.08                        | .070        | 648           | N/A                                | .090        | 902           | N/A                                | .120        |
| 43±5%                                 | 0.9                            | 153           | 49.99/40.85                        | .050        | 395           | 70.50/53.04                        | .060        | 647           | N/A                                | .090        | 901           | N/A                                | .120        |
| 47±5%                                 | 0.8                            | 152           | 55.19/44.65                        | .050        | 394           | 81.99/59.00                        | .060        | 646           | N/A                                | .090        | 900           | N/A                                | .110        |

\* Other tolerances are available, see page 8

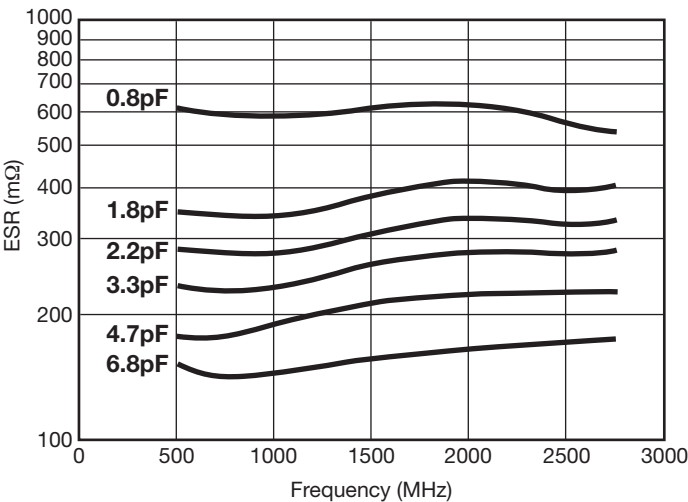
## 1210 Typical Electrical Tables

1

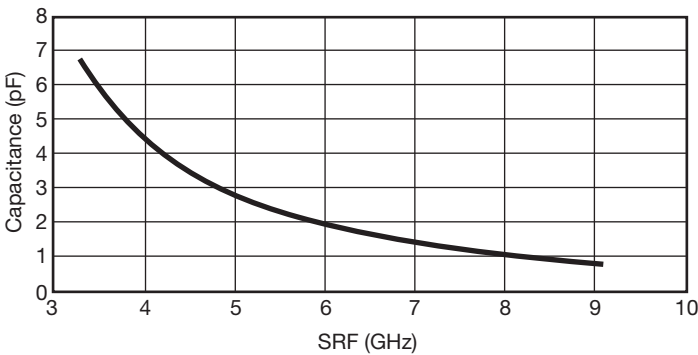
| Capacitance & Tolerance*<br>@ 1 MHz<br>(pF) | Self<br>Resonance<br>Frequency<br>(GHz) | Ref<br>Freq.<br>(MHz) | Effective<br>Capacitance<br>Max/Min<br>(pF) | Max<br>ESR<br>(Ω) | Ref<br>Freq.<br>(MHz) | Effective<br>Capacitance<br>Max/Min<br>(pF) | Max<br>ESR<br>(Ω) | Ref<br>Freq.<br>(MHz) | Effective<br>Capacitance<br>Max/Min<br>(pF) | Max<br>ESR<br>(Ω) | Ref<br>Freq.<br>(MHz) | Effective<br>Capacitance<br>Max/Min<br>(pF) | Max<br>ESR<br>(Ω) |
|---------------------------------------------|-----------------------------------------|-----------------------|---------------------------------------------|-------------------|-----------------------|---------------------------------------------|-------------------|-----------------------|---------------------------------------------|-------------------|-----------------------|---------------------------------------------|-------------------|
| 1.0±0.25                                    | 4.98                                    | 247                   | 1.23/0.75                                   | .350              | 495                   | 1.34/0.86                                   | .260              | 745                   | 1.46/0.94                                   | .280              | 995                   | 1.6/0.99                                    | .350              |
| 1.2±0.25                                    | 4.55                                    | 245                   | 1.32/0.95                                   | .310              | 491                   | 1.45/1.00                                   | .240              | 739                   | 1.64/1.1                                    | .260              | 987                   | 2.00/1.2                                    | .320              |
| 1.5±0.25                                    | 4.07                                    | 242                   | 1.6/1.23                                    | .250              | 486                   | 1.75/1.3                                    | .230              | 731                   | 1.82/1.95                                   | .250              | 978                   | 2.1/1.4                                     | .270              |
| 1.8±0.25                                    | 9.71                                    | 240                   | 2.1/1.55                                    | .200              | 482                   | 2.21/1.56                                   | .200              | 731                   | 2.4/1.6                                     | .200              | 978                   | 2.54/1.7                                    | .210              |
| 2.2±0.25                                    | 9.96                                    | 237                   | 2.48/1.95                                   | .170              | 476                   | 2.68/2.00                                   | .170              | 727                   | 2.85/2.1                                    | .180              | 969                   | 3.02/2.2                                    | .200              |
| 2.7±0.25                                    | 2.70                                    | 233                   | 3.42/2.45                                   | .140              | 466                   | 3.49/2.55                                   | .140              | 708                   | 3.73/2.63                                   | .150              | 952                   | 3.89/2.70                                   | .170              |
| 3.3±0.25                                    | 2.60                                    | 229                   | 4.02/3.05                                   | .140              | 463                   | 4.09/3.15                                   | .130              | 704                   | 4.33/3.23                                   | .140              | 948                   | 4.49/3.30                                   | .160              |
| 3.6±0.25                                    | 2.50                                    | 228                   | 4.18/3.35                                   | .130              | 462                   | 4.32/3.43                                   | .130              | 704                   | 4.50/3.32                                   | .140              | 947                   | 4.78/3.45                                   | .160              |
| 3.9±0.25                                    | 2.40                                    | 227                   | 4.53/3.65                                   | .130              | 458                   | 4.66/3.73                                   | .120              | 701                   | 4.85/3.75                                   | .140              | 944                   | 5.18/3.90                                   | .150              |
| 4.3±0.25                                    | 2.30                                    | 223                   | 5.01/4.05                                   | .120              | 456                   | 5.11/4.14                                   | .110              | 697                   | 5.32/4.29                                   | .130              | 940                   | 5.72/4.30                                   | .140              |
| 4.7±0.25                                    | 2.20                                    | 220                   | 5.48/4.45                                   | .120              | 451                   | 5.62/4.50                                   | .110              | 691                   | 5.94/4.60                                   | .130              | 936                   | 6.56/4.70                                   | .140              |
| 5.1±0.25                                    | 2.10                                    | 218                   | 5.88/4.85                                   | .110              | 447                   | 6.04/4.90                                   | .110              | 683                   | 6.36/5.10                                   | .130              | 933                   | 7.20/5.40                                   | .140              |
| 5.6±0.25                                    | 2.00                                    | 215                   | 6.49/5.35                                   | .110              | 441                   | 6.72/5.56                                   | .100              | 681                   | 7.17/5.67                                   | .120              | 928                   | 8.15/6.00                                   | .140              |
| 6.2±0.25                                    | 1.90                                    | 212                   | 7.19/5.95                                   | .100              | 442                   | 7.26/6.07                                   | .100              | 679                   | 7.99/6.10                                   | .110              | 927                   | 9.18/7.00                                   | .130              |
| 6.8±0.25                                    | 1.80                                    | 208                   | 7.38/6.55                                   | .100              | 435                   | 8.16/6.42                                   | .100              | 677                   | 8.81/6.93                                   | .110              | 925                   | 10.20/7.42                                  | .130              |
| 7.5±0.25                                    | 1.70                                    | 206                   | 8.60/7.90                                   | .100              | 434                   | 8.90/7.25                                   | .100              | 675                   | 9.58/7.60                                   | .100              | 924                   | 11.36/8.00                                  | .130              |
| 8.2±0.25                                    | 1.70                                    | 203                   | 9.36/7.70                                   | .100              | 432                   | 9.76/7.96                                   | .090              | 673                   | 10.68/8.31                                  | .100              | 922                   | 13.00/9.10                                  | .130              |
| 9.1±0.25                                    | 1.60                                    | 199                   | 10.34/8.60                                  | .090              | 429                   | 10.87/8.88                                  | .090              | 670                   | 12.10/9.66                                  | .090              | 920                   | 15.11/10.25                                 | .130              |
| 10±5%                                       | 1.50                                    | 196                   | 11.33/9.50                                  | .090              | 423                   | 11.97/9.79                                  | .090              | 668                   | 13.51/10.05                                 | .090              | 918                   | 17.22/11.06                                 | .130              |
| 11±5%                                       | 1.50                                    | 193                   | 12.50/10.45                                 | .090              | 420                   | 13.23/10.83                                 | .090              | 665                   | 15.07/11.33                                 | .090              | 916                   | N/A                                         | .130              |
| 12±5%                                       | 1.40                                    | 190                   | 13.61/11.40                                 | .080              | 418                   | 14.59/11.90                                 | .080              | 663                   | 16.90/12.82                                 | .090              | 915                   | N/A                                         | .120              |
| 13±5%                                       | 1.30                                    | 185                   | 14.75/12.35                                 | .080              | 416                   | 15.64/13.00                                 | .080              | 662                   | 18.80/13.60                                 | .090              | 914                   | N/A                                         | .120              |
| 14±5%                                       | 1.30                                    | 183                   | 15.89/13.30                                 | .080              | 415                   | 17.22/14.00                                 | .080              | 661                   | 20.85/16.00                                 | .090              | 913                   | N/A                                         | .120              |
| 15±5%                                       | 1.20                                    | 182                   | 17.02/14.25                                 | .080              | 414                   | 18.56/15.19                                 | .080              | 660                   | 22.62/17.00                                 | .090              | 912                   | N/A                                         | .110              |
| 16±5%                                       | 1.20                                    | 180                   | 18.16/15.20                                 | .080              | 411                   | 19.90/16.28                                 | .080              | 659                   | 25.12/18.00                                 | .090              | 911                   | N/A                                         | .110              |
| 18±5%                                       | 1.10                                    | 176                   | 20.42/17.10                                 | .070              | 408                   | 22.69/18.57                                 | .080              | 657                   | 30.00/24.00                                 | .080              | 909                   | N/A                                         | .110              |
| 20±5%                                       | 1.10                                    | 173                   | 22.70/19.00                                 | .070              | 406                   | 25.36/20.78                                 | .080              | 656                   | 35.00/26.00                                 | .080              | 908                   | N/A                                         | .110              |
| 22±5%                                       | 1.00                                    | 171                   | 24.95/20.90                                 | .070              | 405                   | 28.06/22.96                                 | .080              | 655                   | 42.00/27.00                                 | .080              | 908                   | N/A                                         | .110              |
| 24±5%                                       | 0.98                                    | 168                   | 27.20/22.60                                 | .070              | 403                   | 31.31/25.60                                 | .080              | 654                   | N/A                                         | .080              | 907                   | N/A                                         | .110              |
| 25±5%                                       | 0.96                                    | 166                   | 26.39/23.75                                 | .070              | 402                   | 32.91/26.00                                 | .080              | 653                   | N/A                                         | .080              | 907                   | N/A                                         | .110              |
| 27±5%                                       | 0.92                                    | 164                   | 30.78/25.65                                 | .070              | 401                   | 36.10/28.00                                 | .070              | 652                   | N/A                                         | .080              | 906                   | N/A                                         | .110              |
| 28±5%                                       | 0.91                                    | 163                   | 31.93/26.50                                 | .070              | 401                   | 37.60/30.76                                 | .070              | 651                   | N/A                                         | .080              | 906                   | N/A                                         | .110              |
| 30±5%                                       | 0.88                                    | 162                   | 34.23/28.50                                 | .070              | 400                   | 40.50/33.20                                 | .070              | 651                   | N/A                                         | .080              | 905                   | N/A                                         | .110              |
| 32±5%                                       | 0.85                                    | 161                   | 36.51/30.40                                 | .070              | 399                   | 44.63/34.50                                 | .070              | 650                   | N/A                                         | .080              | 905                   | N/A                                         | .110              |
| 33±5%                                       | 0.84                                    | 159                   | 37.65/31.35                                 | .060              | 399                   | 46.65/35.00                                 | .070              | 650                   | N/A                                         | .080              | 905                   | N/A                                         | .110              |
| 34±5%                                       | 0.82                                    | 158                   | 38.83/32.30                                 | .060              | 398                   | 48.51/37.00                                 | .070              | 649                   | N/A                                         | .080              | 904                   | N/A                                         | .110              |
| 36±5%                                       | 0.80                                    | 157                   | 41.20/34.20                                 | .060              | 397                   | 52.22/41.00                                 | .070              | 649                   | N/A                                         | .070              | 904                   | N/A                                         | .110              |
| 39±5%                                       | 0.77                                    | 155                   | 44.79/37.05                                 | .060              | 396                   | 59.00/43.00                                 | .070              | 649                   | N/A                                         | .070              | 904                   | N/A                                         | .110              |
| 43±5%                                       | 0.73                                    | 153                   | 49.99/40.85                                 | .060              | 396                   | 70.00/46.00                                 | .070              | 648                   | N/A                                         | .070              | 904                   | N/A                                         | .110              |
| 47±5%                                       | 0.70                                    | 152                   | 55.69/44.65                                 | .060              | 395                   | 81.00/53.00                                 | .070              | 648                   | N/A                                         | .070              | 903                   | N/A                                         | .110              |

\* Other tolerances are available, see page 8

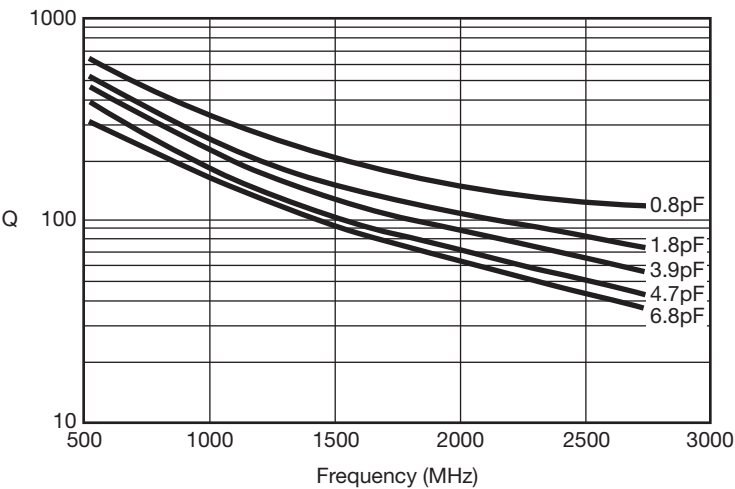
Typical ESR vs. Frequency  
Accu-P® 0201



Typical SRF vs. Capacitance  
Accu-P® 0201



Typical Q vs. Frequency  
Accu-P® 0201

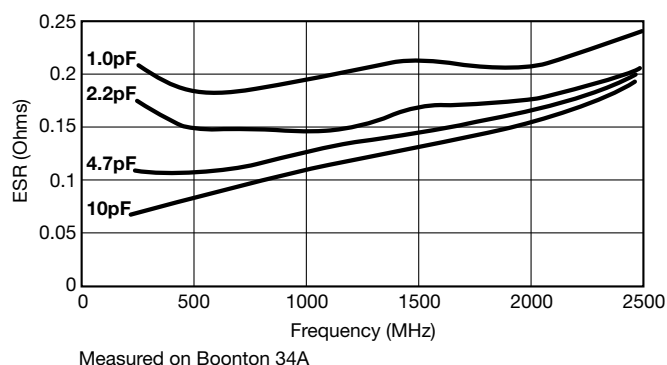


# Accu-F® / Accu-P®

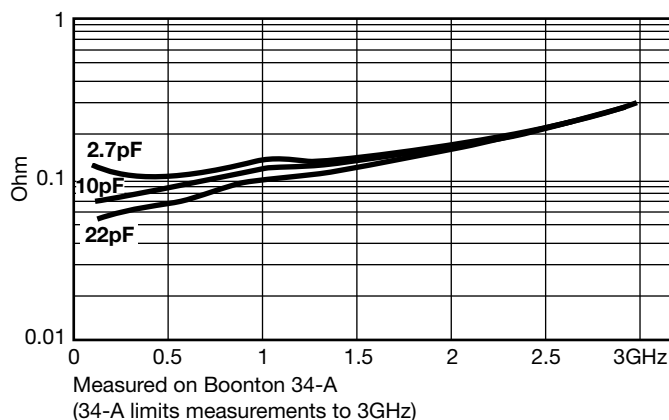
## High Frequency Characteristics



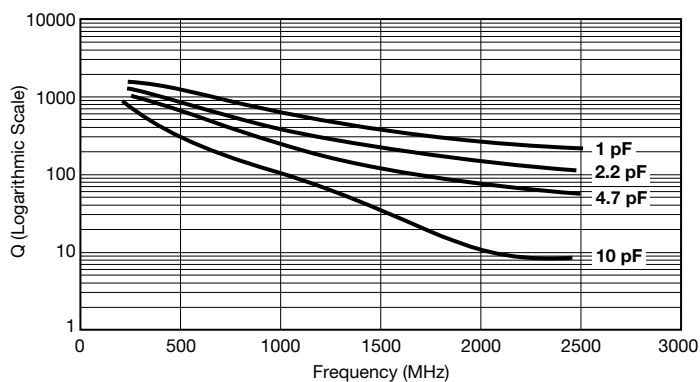
Typical ESR vs. Frequency  
Accu-P® 0402



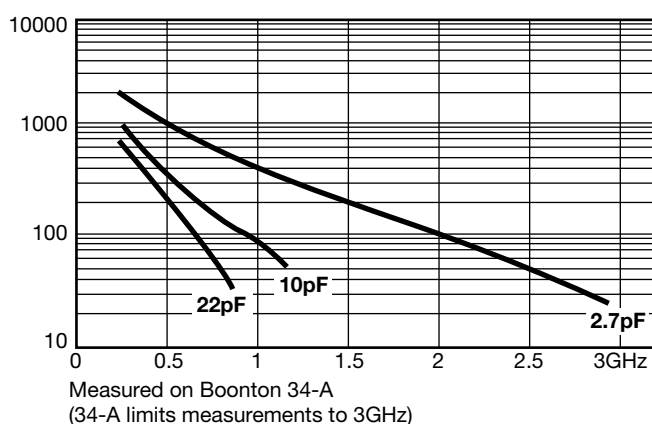
Typical ESR vs. Frequency  
Accu-F®/Accu-P® 0603



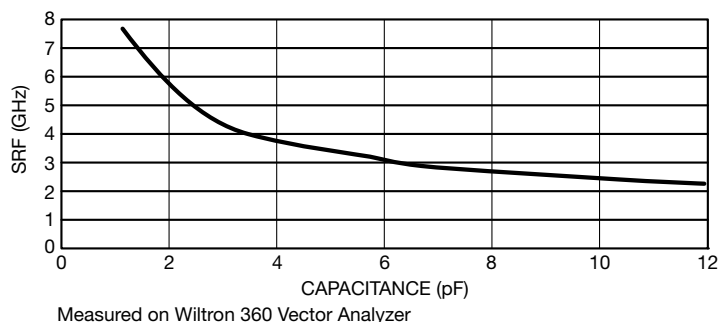
Typical Q vs. Frequency  
Accu-P® 0402



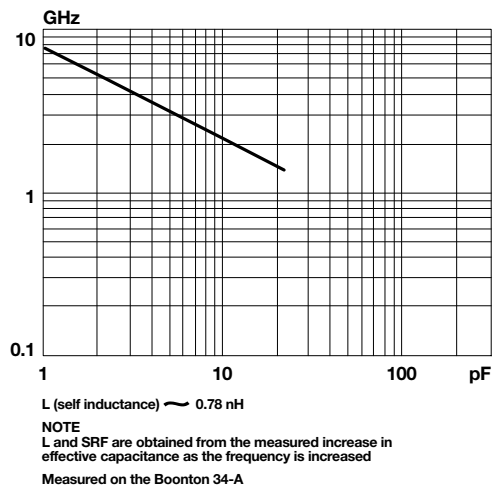
Typical Q vs. Frequency  
Accu-F®/Accu-P® 0603



Typical Self Resonant Frequency vs. Capacitance  
Accu-P® 0402



Typical Self Resonant Frequency vs. Capacitance  
Accu-F®/Accu-P® 0603

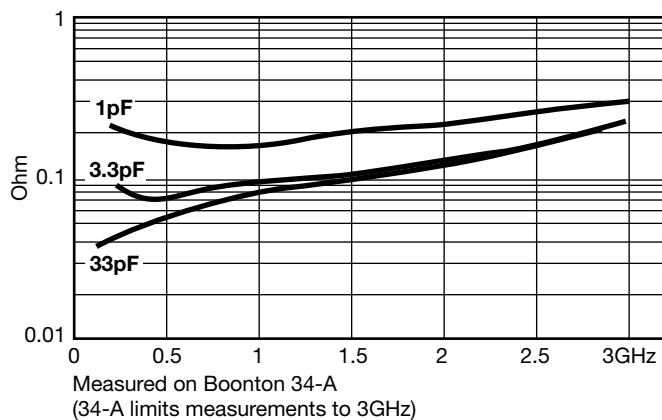


# Accu-F® / Accu-P®

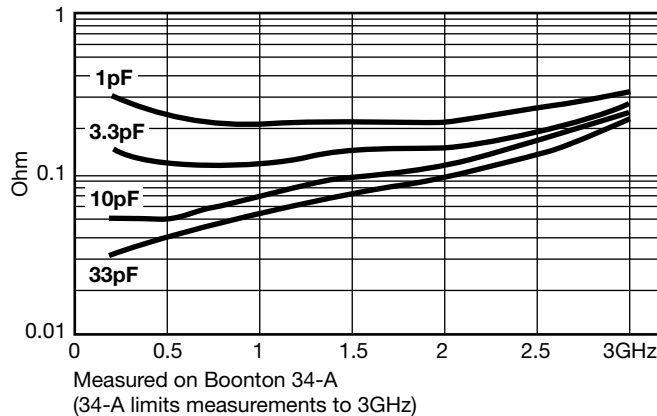
## High Frequency Characteristics



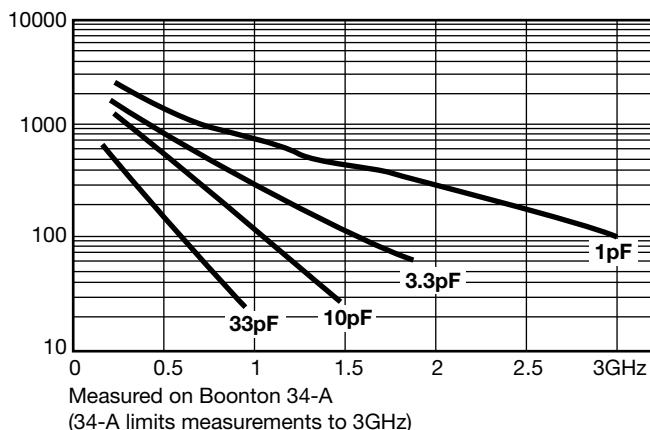
Typical ESR vs. Frequency  
Accu-F®/Accu-P® 0805



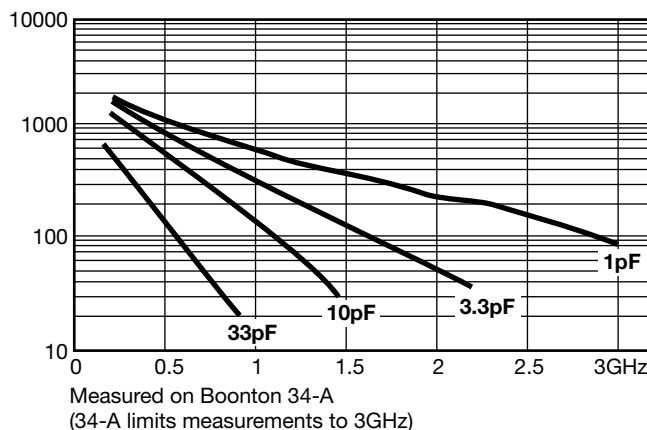
Typical ESR vs. Frequency  
Accu-P® 1210



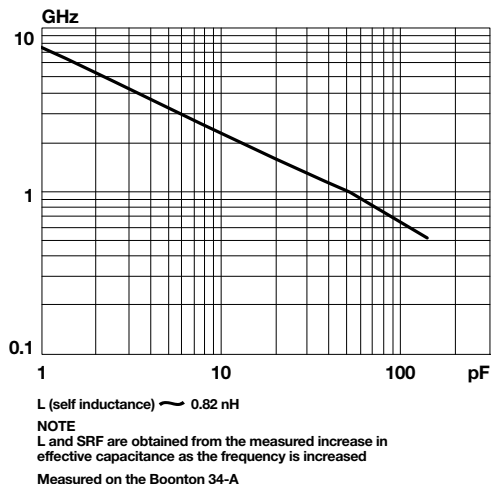
Typical Q vs. Frequency  
Accu-F®/Accu-P® 0805



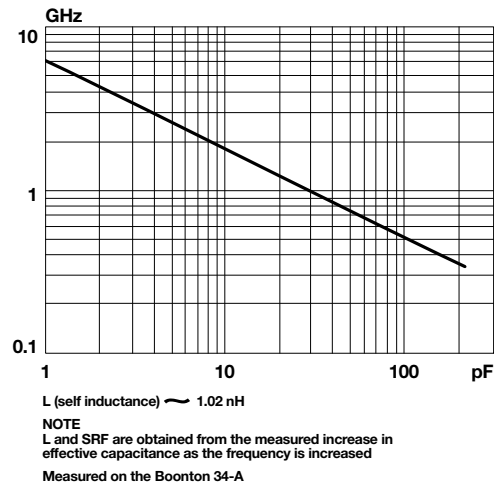
Typical Q vs. Frequency  
Accu-P® 1210



Typical Self Resonant Frequency vs. Capacitance  
Accu-F®/Accu-P® 0805



Typical Self Resonant Frequency vs. Capacitance  
Accu-P® 1210



## Environmental / Mechanical Characteristics

### ENVIRONMENTAL CHARACTERISTICS

| TEST                                                                                 | CONDITIONS                                                                  | REQUIREMENT                                                                                                              |
|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Life (Endurance)</b><br>MIL-STD-202F Method 108A                                  | 125°C, 2U <sub>R</sub> , 1000 hours                                         | No visible damage<br>$\Delta C/C \leq 2\%$ for $C \geq 5\text{pF}$<br>$\Delta C \leq 0.25\text{pF}$ for $C < 5\text{pF}$ |
| <b>Accelerated Damp Heat Steady State</b><br>MIL-STD-202F Method 103B                | 85°C, 85% RH, U <sub>R</sub> , 1000 hours                                   | No visible damage<br>$\Delta C/C \leq 2\%$ for $C \geq 5\text{pF}$<br>$\Delta C \leq 0.25\text{pF}$ for $C < 5\text{pF}$ |
| <b>Temperature Cycling</b><br>MIL-STD-202F Method 107E<br>MIL-STD-883D Method 1010.7 | -55°C to +125°C, 15 cycles – Accu-P®<br>-55°C to +125°C, 5 cycles – Accu-F® | No visible damage<br>$\Delta C/C \leq 2\%$ for $C \geq 5\text{pF}$<br>$\Delta C \leq 0.25\text{pF}$ for $C < 5\text{pF}$ |
| <b>Resistance to Solder Heat</b><br>IEC-68-2-58                                      | 260°C $\pm$ 5°C for 10 secs                                                 | C remains within initial limits                                                                                          |

### MECHANICAL CHARACTERISTICS

| TEST                                                                             | CONDITIONS                                                                                                                                           | REQUIREMENT                                                                                                              |
|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Solderability</b><br>IEC-68-2-58                                              | Components completely immersed in a solder bath at 235°C for 2 secs.                                                                                 | Terminations to be well tinned, minimum 95% coverage                                                                     |
| <b>Leach Resistance</b><br>IEC-68-2-58                                           | Components completely immersed in a solder bath at 260 $\pm$ 5°C for 60 secs.                                                                        | Dissolution of termination faces $\leq 15\%$ of area<br>Dissolution of termination edges $\leq 25\%$ of length           |
| <b>Adhesion</b><br>MIL-STD-202F Method 211A                                      | A force of 5N applied for 10 secs.                                                                                                                   | No visible damage                                                                                                        |
| <b>Termination Bond Strength</b><br>IEC-68-2-21 Amend. 2                         | Tested as shown in diagram<br><br>D = 3mm Accu-P<br>D = 1mm Accu-F | No visible damage<br>$\Delta C/C \leq 2\%$ for $C \geq 5\text{pF}$<br>$\Delta C \leq 0.25\text{pF}$ for $C < 5\text{pF}$ |
| <b>Robustness of Termination</b><br>IEC-68-2-21 Amend. 2                         | A force of 5N applied for 10 secs.                                                                                                                   | No visible damage                                                                                                        |
| <b>High Frequency Vibration</b><br>MIL-STD-202F Method 201A, 204D (Accu-P® only) | 55Hz to 2000Hz, 20G                                                                                                                                  | No visible damage                                                                                                        |
| <b>Storage</b>                                                                   | 12 months minimum with components stored in "as received" packaging                                                                                  | Good solderability                                                                                                       |

### QUALITY & RELIABILITY

Accu-P® is based on well established thin-film technology and materials.

#### • ON-LINE PROCESS CONTROL

This program forms an integral part of the production cycle and acts as a feedback system to regulate and control production processes. The test procedures, which are integrated into the production process, were developed after long research work and are based on the highly developed semiconductor industry test procedures and equipment. These measures help AVX to produce a consistent and high yield line of products.

#### • FINAL QUALITY INSPECTION

Finished parts are tested for standard electrical parameters and visual/mechanical characteristics. Each production lot is 100% evaluated for: capacitance and proof voltage at 2.5 U<sub>R</sub>. In addition, production is periodically evaluated for:

Average capacitance with histogram printout for capacitance distribution;  
IR and Breakdown Voltage distribution;  
Temperature Coefficient;  
Solderability;  
Dimensional, mechanical and temperature stability.

### QUALITY ASSURANCE

The reliability of these thin-film chip capacitors has been studied intensively for several years. Various measures have been taken to obtain the high reliability required today by the industry. Quality assurance policy is based on well established international industry standards. The reliability of the capacitors is determined by accelerated testing under the following conditions:

|                                    |                                            |
|------------------------------------|--------------------------------------------|
| Life (Endurance)                   | 125°C, 2U <sub>R</sub> , 1000 hours        |
| Accelerated Damp Heat Steady State | 85°C, 85% RH, U <sub>R</sub> , 1000 hours. |



## Performance Characteristics RF Power Applications

### RF POWER APPLICATIONS

In RF power applications capacitor losses generate heat. Two factors of particular importance to designers are:

- Minimizing the generation of heat.
- Dissipating heat as efficiently as possible.

### CAPACITOR HEATING

- The major source of heat generation in a capacitor in RF power applications is a function of RF current (I) and ESR, from the relationship:

$$\text{Power dissipation} = I_{\text{RMS}}^2 \times \text{ESR}$$

- Accu-P® capacitors are specially designed to minimize

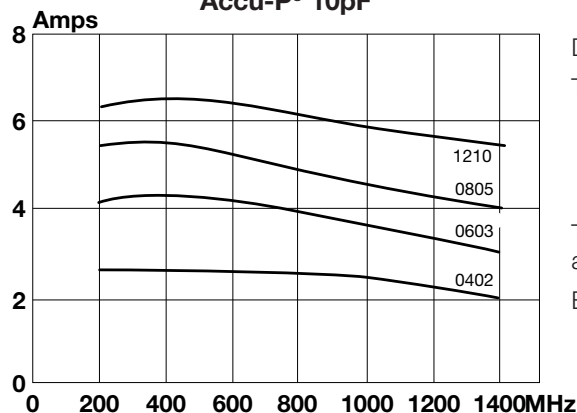
ESR and therefore RF heating. Values of ESR for Accu-P® capacitors are significantly less than those of ceramic MLC components currently available.

### HEAT DISSIPATION

- Heat is dissipated from a capacitor through a variety of paths, but the key factor in the removal of heat is the thermal conductivity of the capacitor material.
- The higher the thermal conductivity of the capacitor, the more rapidly heat will be dissipated.
- The table below illustrates the importance of thermal conductivity to the performance of Accu-P® in power applications.

| PRODUCT       | MATERIAL           | THERMAL CONDUCTIVITY W/mK |
|---------------|--------------------|---------------------------|
| Accu-P®       | Alumina            | 18.9                      |
| Microwave MLC | Magnesium Titanate | 6.0                       |

**Power Handling  
Accu-P® 10pF**



Data used in calculating the graph:

Thermal impedance of capacitors:

|      |         |
|------|---------|
| 0402 | 17°C/W  |
| 0603 | 12°C/W  |
| 0805 | 6.5°C/W |
| 1210 | 5°C/W   |

Thermal impedance measured using RF generator, amplifier and strip-line transformer.

ESR of capacitors measured on Boonton 34A

### THERMAL IMPEDANCE

Thermal impedance of Accu-P® chips is shown below compared with the thermal impedance of Microwave MLC's.

| CAPACITOR TYPE | CHIP SIZE | THERMAL IMPEDANCE (°C/W) |
|----------------|-----------|--------------------------|
| Accu-P®        | 0805      | 6.5                      |
|                | 1210      | 5                        |
| Microwave MLC  | 0505      | 12                       |
|                | 1210      | 7.5                      |

The thermal impedance expresses the temperature difference in °C between chip center and termination caused by a power dissipation of 1 watt in the chip. It is expressed in °C/W.

### ADVANTAGES OF ACCU-P® IN RF POWER CIRCUITS

The optimized design of Accu-P® offers the designer of RF power circuits the following advantages:

- Reduced power losses due to the inherently low ESR of Accu-P®.
- Increased power dissipation due to the high thermal conductivity of Accu-P®.

• THE ONLY TRUE TEST OF A CAPACITOR IN ANY PARTICULAR APPLICATION IS ITS PERFORMANCE UNDER OPERATING CONDITIONS IN THE ACTUAL CIRCUIT.

### PRACTICAL APPLICATION IN RF POWER CIRCUITS

- There is a wide variety of different experimental methods for measuring the power handling performance of a capacitor in RF power circuits. Each method has its own problems and few of them exactly reproduce the conditions present in "real" circuit applications.
- Similarly, there is a very wide range of different circuit applications, all with their unique characteristics and operating conditions which cannot possibly be covered by such "theoretical" testing.

## Application Notes

### GENERAL

Accu-F® and Accu-P® SMD capacitors are designed for soldering to printed circuit boards or other substrates. The construction of the components is such that they will withstand the time/temperature profiles used in both wave and reflow soldering methods.

### HANDLING

SMD capacitors should be handled with care to avoid damage or contamination from perspiration and skin oils. The use of plastic tipped tweezers or vacuum pick-ups is strongly recommended for individual components. Bulk handling should ensure that abrasion and mechanical shock are minimized. For automatic equipment, taped and reeled product gives the ideal medium for direct presentation to the placement machine.

### CIRCUIT BOARD TYPE

The circuit board types which may be used with Accu-F® and Accu-P® are as follows:

Accu-F®: All flexible types of circuit boards (eg. FR-4, G-10).

Accu-P®: All flexible types of circuit boards (eg. FR-4, G-10) and also alumina.

For other circuit board materials, please consult factory.

### COMPONENT PAD DESIGN

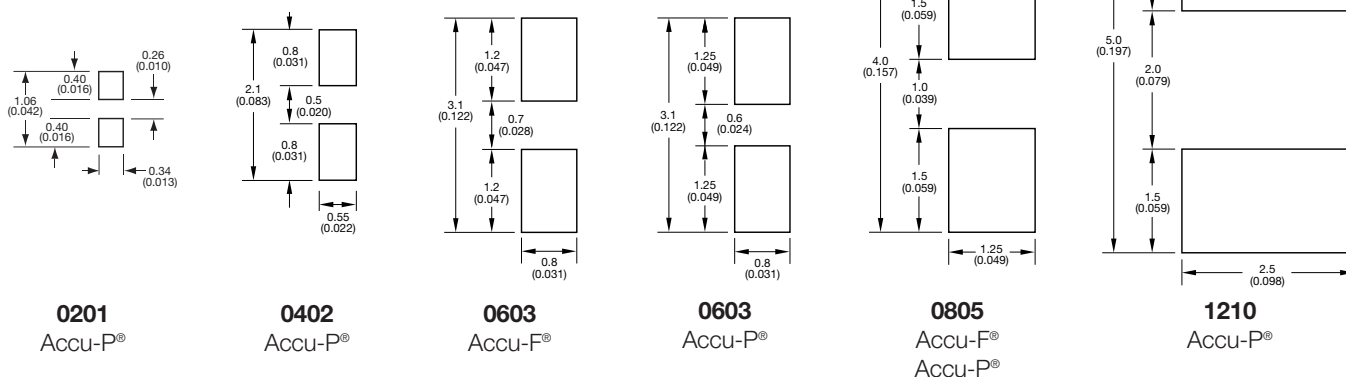
Component pads must be designed to achieve good joints and minimize component movement during reflow soldering. Pad designs are given below for both wave and reflow soldering.

The basis of these designs is:

- Pad width equal to component width. It is permissible to decrease this to as low as 85% of component width but it is not advisable to go below this.
- Pad overlap 0.5mm beneath large components. Pad overlap about 0.3mm beneath small components.
- Pad extension of 0.5mm for reflow of large components and pad extension about 0.3mm for reflow of small components. Pad extension about 1.0mm for wave soldering.

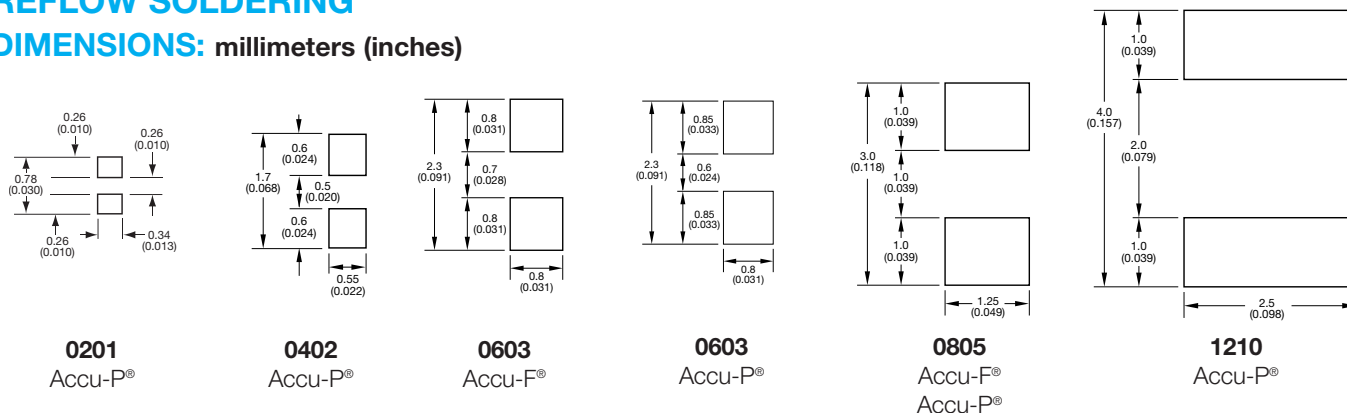
### WAVE SOLDERING

#### DIMENSIONS: millimeters (inches)



### REFLOW SOLDERING

#### DIMENSIONS: millimeters (inches)



## Application Notes

### PREHEAT & SOLDERING

The rate of preheat in production should not exceed 4°C/second and a recommended maximum is about 2°C/second. Temperature differential from preheat to soldering should not exceed 100°C.

For further specific application or process advice, please consult AVX.

### COOLING

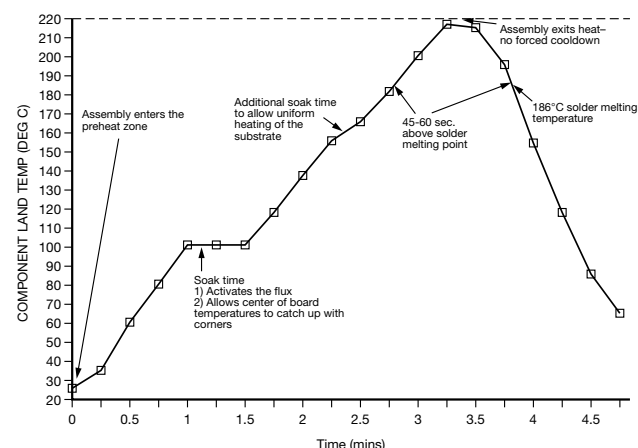
After soldering, the assembly should preferably be allowed to cool naturally. In the event of assisted cooling, similar conditions to those recommended for preheating should be used.

### HAND SOLDERING & REWORK

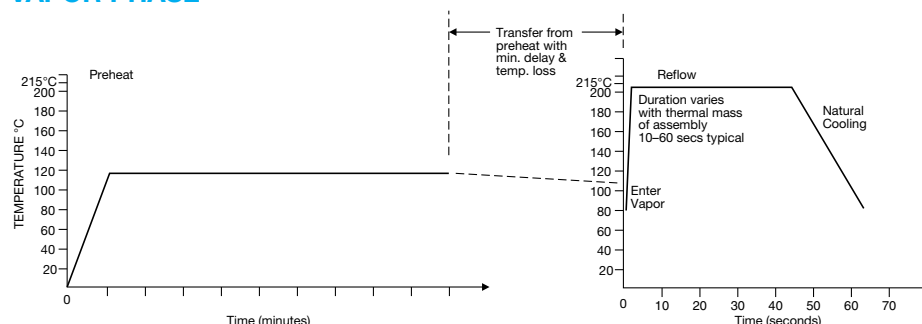
Hand soldering is permissible. Preheat of the PCB to 150°C is required. The most preferable technique is to use hot air soldering tools. Where a soldering iron is used, a temperature controlled model not exceeding 30 watts should be used and set to not more than 260°C.

## RECOMMENDED SOLDERING PROFILE

### IR REFLOW



### VAPOR PHASE



### CLEANING RECOMMENDATIONS

Care should be taken to ensure that the devices are thoroughly cleaned of flux residues, especially the space beneath the device. Such residues may otherwise become conductive and effectively offer a lossy bypass to the device. Various recommended cleaning conditions (which must be optimized for the flux system being used) are as follows:

Cleaning liquids. . . . . i-propanol, ethanol, acetylacetone, water and other standard PCB cleaning liquids.

Ultrasonic conditions . . power-20w/liter max.  
frequency-20kHz to 45kHz.

Temperature . . . . . 80°C maximum (if not otherwise limited by chosen solvent system).

Time . . . . . 5 minutes max.

### STORAGE CONDITIONS

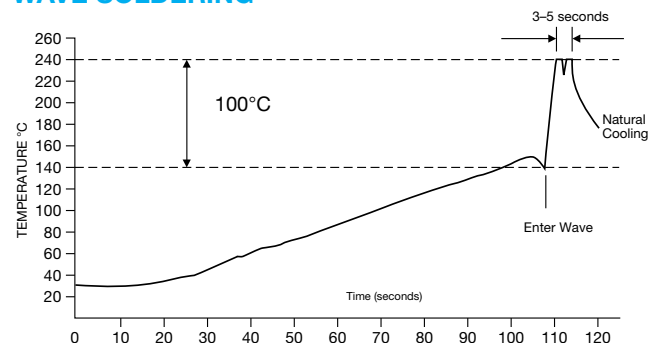
Recommended storage conditions for Accu-F® and Accu-P® prior to use are as follows:

Temperature . . . . . 15°C to 35°C

Humidity . . . . . ≤65%

Air Pressure . . . . . 860mbar to 1060mbar

### WAVE SOLDERING



# Accu-F®/Accu-P®

## Automatic Insertion Packaging



### TAPE & REEL

All tape and reel specifications are in compliance with EIA 481-1-A.  
(equivalent to IEC 286 part 3).

- 8mm carrier
- Reeled quantities: Reels of 3,000 per 7" reel or 10,000 pieces per 13" reel  
0201 and 0402 = 5,000 pieces per 7" reel and 20,000 pieces per 13" reel

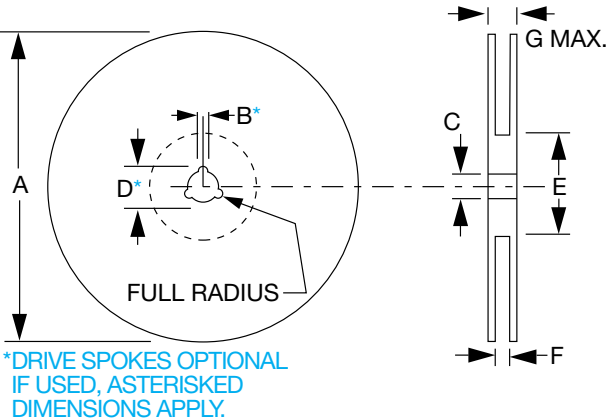
### REEL

#### DIMENSIONS: millimeters (inches)

| A <sup>(1)</sup>         | B                        | C                         | D                         | E                       | F                          | G                         |
|--------------------------|--------------------------|---------------------------|---------------------------|-------------------------|----------------------------|---------------------------|
| 180±1.0<br>(7.087±0.039) | 1.5 min.<br>(0.059 min.) | 13±0.2<br>(0.512 ± 0.008) | 20.2 min.<br>(0.795 min.) | 50 min.<br>(1.969 min.) | 9.6±1.5<br>(0.370 ± 0.050) | 14.4 max.<br>(0.567 max.) |

Metric dimensions will govern.  
Inch measurements rounded and for reference only.

(1) 330mm (13 inch) reels are available.

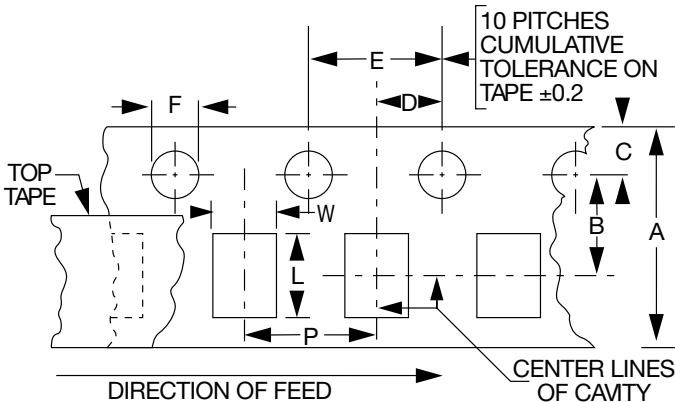


### CARRIER

#### DIMENSIONS: millimeters (inches)

| A                            | B                             | C                           | D                             | E                            | F                                                                                   |
|------------------------------|-------------------------------|-----------------------------|-------------------------------|------------------------------|-------------------------------------------------------------------------------------|
| 8.0 ± 0.3<br>(0.315 ± 0.012) | 3.5 ± 0.05<br>(0.138 ± 0.002) | 1.75±0.1<br>(0.069 ± 0.004) | 2.0 ± 0.05<br>(0.079 ± 0.002) | 4.0 ± 0.1<br>(0.157 ± 0.004) | 1.5 <sup>+0.1</sup> <sub>-0.0</sub><br>(0.059 <sup>+0.004</sup> <sub>-0.000</sub> ) |

NOTE: The nominal dimensions of the component compartment (W,L) are derived from the component size.



P = 4mm except 0201 and 0402 where P = 2mm

NOTE: AVX reserves the right to change the information published herein without notice.