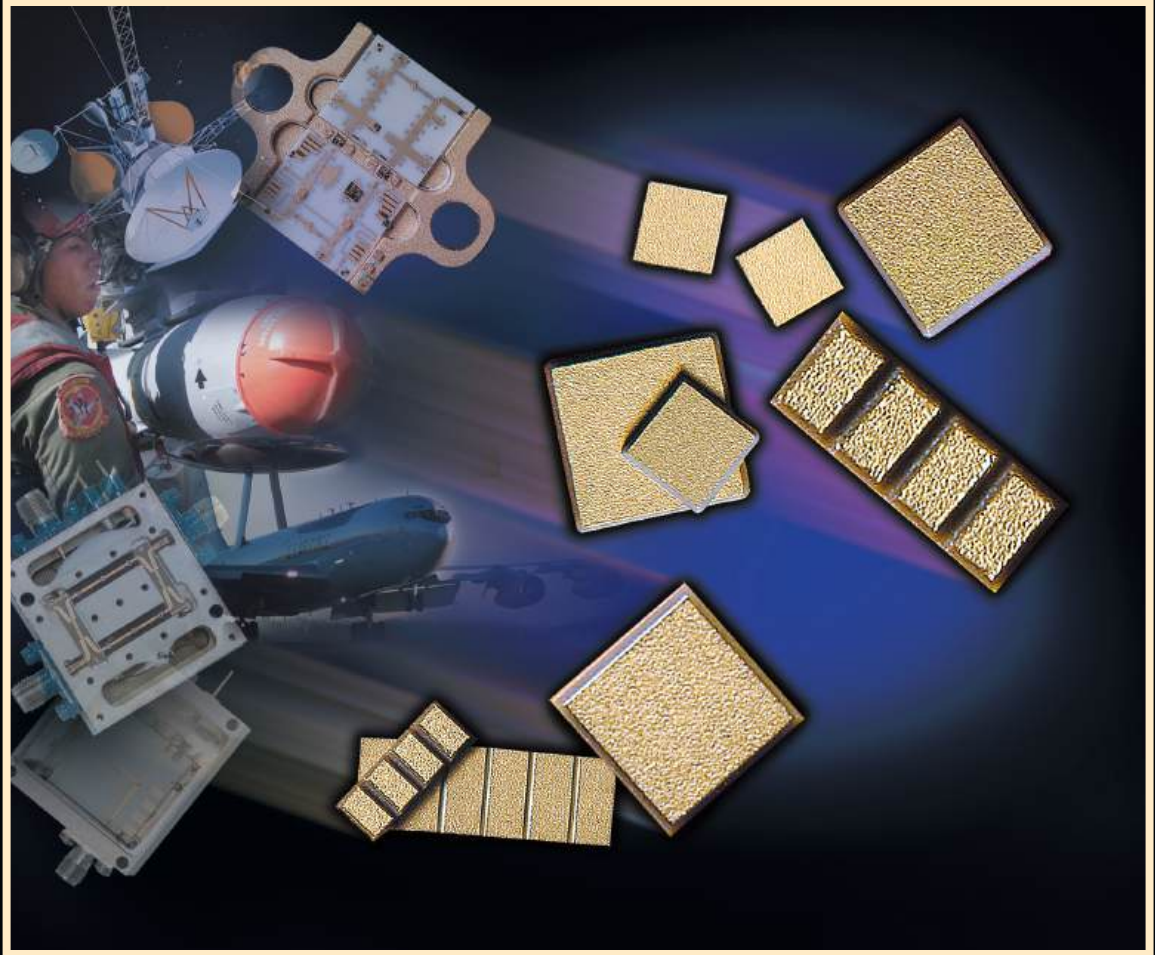




AMERICAN  
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## SINGLE LAYER CAPACITOR PRODUCTS



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ISO 9001  
REGISTERED  
COMPANY

# NEW ATC SLC QUIK PICK SELECTION GUIDE

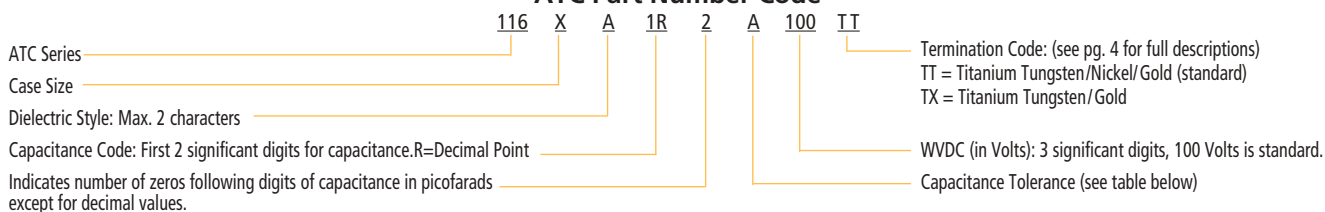
The table below lists ATC SLC products available for **immediate shipment**. There is a **100 piece cap pac minimum order** per value. To order smaller quantities, please see Custom SLC Custom Design Kits, page 15.

## SLC Selection Guide – Quik Pick™ 48 Hour Shipment™

| Series / Case Size<br>(L & W) | 116 R<br>.015 (.381) nom. | 116 T<br>.025 (.635) nom. | 116 U<br>.035 (.889) nom. | 116 X<br>.050 (1.27) nom. |                 |
|-------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|-----------------|
| Cap (pF)                      | Cap Code                  | 0.1 to 100 pF             | 0.2 to 330 pF             | 0.4 to 820 pF             | 0.8 to 1000 pF  |
| 0.1                           | 0R1                       | 116RA0R1A100TT            |                           |                           |                 |
| 0.2                           | 0R2                       | 116RBB0R2A100TT           | 116TA0R2A100TT            |                           |                 |
| 0.3                           | 0R3                       | 116RBB0R3A100TT           | 116TA0R3A100TT            |                           |                 |
| 0.4                           | 0R4                       | 116RCA0R4B100TT           | 116TA0R4A100TT            | 116UA0R4A100TT            |                 |
| 0.5                           | 0R5                       | 116RCA0R5B100TT           | 116TBB0R5A100TT           | 116UA0R5A100TT            |                 |
| 0.8                           | 0R8                       | 116RDB0R8B100TT           | 116TBB0R8B100TT           | 116UBB0R8A100TT           | 116XA0R8A100TT  |
| 1.0                           | 1R0                       | 116RDB1R0C100TT           | 116TCA1R0B100TT           | 116UBB1R0B100TT           | 116XA1R0A100TT  |
| 1.2                           | 1R2                       | 116RDB1R2C100TT           | 116TCA1R2B100TT           | 116UBB1R2B100TT           | 116XA1R2A100TT  |
| 2.7                           | 2R7                       | 116REA2R7M100TT           | 116TDB2R7C100TT           | 116UCA2R7C100TT           | 116XBB2R7C100TT |
| 3                             | 3R0                       | 116REA3R0M100TT           | 116TDB3R0C100TT           | 116UCA3R0C100TT           | 116XBB3R0C100TT |
| 3.6                           | 3R6                       | 116REA3R6M100TT           | 116TDB3R6D100TT           | 116UCA3R6D100TT           | 116XCA3R6C100TT |
| 5.1                           | 5R1                       | 116REA5R1M100TT           | 116TDB5R1D100TT           | 116UDB5R1D100TT           | 116XCA5R1C100TT |
| 10                            | 100                       | 116RF100M100TT            | 116TEA100K100TT           | 116UDB100K100TT           | 116XDB100J100TT |
| 15                            | 150                       | 116RF150M100TT            | 116TEA150K100TT           | 116UEA150K100TT           | 116XDB150J100TT |
| 22                            | 220                       | 116RGA220M100TT           | 116TEA220K100TT           | 116UEA220K100TT           | 116XDB220K100TT |
| 27                            | 270                       | 116RGA270M100TT           | 116TF270K100TT            | 116UEA270K100TT           | 116XDB270K100TT |
| 33                            | 330                       | 116RGA330M100TT           | 116TF330K100TT            | 116UEA330K100TT           | 116XEA330K100TT |
| 47                            | 470                       | 116RG470M100TT            | 116TF470K100TT            | 116UF470K100TT            | 116XEA470K100TT |
| 56                            | 560                       | 116RG560M100TT            | 116TF560K100TT            | 116UF560K100TT            | 116XEA560K100TT |
| 68                            | 680                       | 116RK680M100TT            | 116TGA680K100TT           | 116UF680K100TT            | 116XEA680K100TT |
| 82                            | 820                       | 116RK820M100TT            | 116TGA820K100TT           | 116UF820K100TT            | 116XEA820K100TT |
| 100                           | 101                       | 116RL101M100TT            | 116TGA101K100TT           | 116UF101K100TT            | 116XF101K100TT  |
| 220                           | 221                       |                           | 116TK221M100TT            | 116UG221M100TT            | 116XF221K100TT  |
| 330                           | 331                       |                           | 116TL331M100TT            | 116UK331M100TT            | 116XGA331K100TT |
| 470                           | 471                       |                           |                           | 116UK471M100TT            | 116XGA471K100TT |
| 560                           | 561                       |                           |                           | 116UL561M100TT            | 116XG561M100TT  |
| 680                           | 681                       |                           |                           | 116UL681M100TT            | 116XK681M100TT  |
| 820                           | 821                       |                           |                           | 116UL821M100TT            | 116XK821M100TT  |
| 1000                          | 102                       |                           |                           |                           | 116XK102M100TT  |

Inches (mm)

### ATC Part Number Code



### Capacitance Tolerances

| Code | A (pF) | B (pF) | C (pF) | D (pF) | F (%) | G (%) | J (%) | K (%) | M (%) |
|------|--------|--------|--------|--------|-------|-------|-------|-------|-------|
| Tol. | ± 0.05 | ± 0.1  | ± 0.25 | ± 0.5  | ± 1   | ± 2%  | ± 5   | ± 10  | ± 20% |

The above part number refers to a 116 series, case size X, A dielectric, 1.2 pF, with a capacitance tolerance of A (±0.05pF), 100 WVDC, with thin film gold termination.

ATC accepts orders for our parts using designations with or without the "ATC" prefix. Both methods of defining the part number are equivalent, i.e., part numbers referenced with the "ATC" prefix are interchangeable to parts referenced without the "ATC" prefix. Customers are free to use either in specifying or procuring parts from American Technical Ceramics.

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# TABLE OF CONTENTS

|                                                                   |               |
|-------------------------------------------------------------------|---------------|
| <b>Introduction and General Specifications.....</b>               | <b>2 - 7</b>  |
| Introduction.....                                                 | 2 - 3         |
| General Specifications.....                                       | 4 - 5         |
| Dielectric and Typical TCC Data.....                              | 6 - 7         |
| <b>Individual Product Descriptions.....</b>                       | <b>8 - 14</b> |
| Straight Sided Microcap® - ATC 116 Series .....                   | 8             |
| ATC 116 Series MAXX-K™ SLCs .....                                 | 9             |
| Beveled Microcap® - ATC 111 Series .....                          | 10            |
| Single Sided Recessed Metalization SLCs - ATC 118 Series.....     | 11            |
| TWIN/CAP® SLC - ATC 113 Series .....                              | 12            |
| Multiple Pad SLCs (Custom Capacitor Arrays)- ATC 117 Series ..... | 13            |
| SLC Custom Design Kits.....                                       | 14            |
| ATC SLC High Reliability Certification (COTS) Program .....       | 15            |
| <b>Contact Information .....</b>                                  | <b>16</b>     |



## Front Cover:

Circuit images, top to bottom:

- 1) FET Amplifier, 10 to 16 GHz for optical transmitter application – courtesy of Frequency Electronics, Inc. (FEI)
- 2) Pin Attenuator, 6 to 12 GHz – courtesy of American Microwave
- 3) DRO, 6.5 to 8.8 GHz – courtesy of Miteq

End product application images:

- 1) Cassini Mission "Saturn Orbiter and Titan Probe Spacecraft" – courtesy of NASA
- 2) U.S. Air Force E-3 Sentry Airborne Warning and Control System (AWACS) – courtesy of DefenseLINK

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## Corporate Profile

ATC designs, develops, manufactures and markets Multilayer Capacitors, Single Layer Capacitors, Resistive Products, Inductors and Custom Thin Film Products for RF, microwave and millimeter-wave applications. Our products are primarily focused on the wireless communications infrastructure, fiber optic, medical electronics, semiconductor manufacturing equipment, defense, aerospace, and satellite communications markets. For over fifty years, ATC's family of superior component and custom integrated packaging solutions has been represented by **THE ENGINEERS' CHOICE™** brand.

Customer interface is administered by our own personnel and independent sales representatives. American Technical Ceramics is headquartered in Huntington Station, New York and has an Advanced Technology Center in Jacksonville, Florida. This is the center of excellence for our traditional product lines and the development and manufacturing facilities for Thin Film and Resistive Products.

American Technical Ceramics' Sales and Customer Service Center, serving Europe, Africa and the Middle East, is located in the Czech Republic. ATC has Regional Sales Offices in Surrey, England and Hallbergmoos, Germany. The Company's wholly-owned subsidiary offering Sales and Technical Support for Asia is located in Shenzhen, P.R. China.

American Technical Ceramics is a wholly-owned subsidiary of AVX Corp. The common stock of AVX is listed on the New York Stock Exchange (symbol "AVX").

### RLC Products

- Multilayer Ceramic Capacitors
- Capacitor Assemblies for Power Applications
- Single Layer Ceramic Capacitors
- Resistor Products
- Inductor Products

### Process and Packaging

- Thin Film Custom Products: metalization and patterned substrates for a broad range of hybrid circuit requirements

### Markets Served

- Wireless Communications Infrastructure
- Semiconductor Manufacturing Equipment
- Medical Diagnostic Equipment
- Sattelite Systems
- Public Safety Radio
- Avionic Systems
- Military and Aerospace
- Commerical Broadcast Transmitters
- Fiber Optic Communications
- Automotive Electronics

### Facilities

- Huntington Station, New York – Sales, Applications Support, Manufacturing and Distribution Center
- Jacksonville, Florida – Advanced Technology Center, Manufacturing Facility



▲ Advanced Technology Center, Manufacturing Facility, Jacksonville, Florida



Autopacking center ► packages chips into waffle packs

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# INTRODUCTION

ATC's extensive line of Single Layer Capacitor (SLC) products offers solutions to the most demanding microwave and millimeter wave requirements. Broadband applications with operating frequencies up to 100 GHz are achievable with ATC's SLC products. With an extensive range of dielectrics, capacitance values from 0.04 pF to 10,000 pF are available. Dielectric constants from 14 to 25,000 are available in standard case sizes from 10 mils. ATC also offers a "design your own" option to facilitate specific outline dimensions to meet exact circuit trace width matching requirements. ATC's single layer products are derived from the highest quality materials that result in ultra high Q and reliable performance. All SLC products have a voltage rating of up to 100 WVDC. All ATC Design and Manufacturing facilities are certified to ISO9000 quality standards.

The following pages of this catalog contain a broad listing of ATC's standard single layer capacitors. The catalog provides an overview of general single layer product specifications and ceramic capacitor dielectrics as well as a more detailed description of each product group, listing case sizes, capacitance values, and available tolerances. ATC standard single layer capacitors are listed in order of ascending dielectric constant per the size and capacitance value available. Available capacitance tolerances are listed. For non-EIA capacitor values or sizes not shown in this catalog, please contact the Factory and our Engineering Design Support Group will be glad to assist in any way possible.



◀ *Niro Spray Dryer - Spray drying is a unique drying process involving both particle formation and drying*



▲ *Spin Coat - Applying positive photoresist via spin coating*



*LSP6 - Dual Plate Lapping Machine ▶*

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# GENERAL SPECIFICATIONS



## Features

- Broadband applications up to 100 GHz
- Rugged construction
- Ultra-high Q
- Standard capacitance range 0.04 to 10,000 pF
- Dielectric constants from 14 to 25,000
- Voltage ratings up to 100 WVDC
- Low cost
- All SLC products are RoHS compliant

## Electrical Characteristics

|                                 |                                                                        |
|---------------------------------|------------------------------------------------------------------------|
| <b>Operating Frequency:</b>     | Up to 100 GHz                                                          |
| <b>Resonant Frequency:</b>      | See curve                                                              |
| <b>Insulation Resistance:</b>   | $1 \times 10^{11}$ Ohms min @ +25°C and rated voltage                  |
| <b>Voltage Rating:</b>          | Up to 100 WVDC (for higher ratings, contact factory)                   |
| <b>Dielectric Test Voltage:</b> | 250% of voltage rating for 5 seconds<br>Impervious to static discharge |

## Mechanical Characteristics

**Resistance to Solvents:** ATC's dielectrics are virtually unaffected by moisture and commonly used cleaning solvents.

**Bond Strength:** All terminations meet or exceed MIL-STD-883 Method 2019 for Die Shear Strength. Wire bondability meets or exceeds MIL-C-49464 Para. 3.12 and MIL-STD-883 Method 2011.

## Termination

**TT:** Titanium Tungsten/Nickel/Gold, (>100  $\mu$ -in. Au, over 1500  $\pm$ 200 Å Ni, over 500  $\pm$ 100 Å TiW) (Standard)

**TX:** Titanium Tungsten/Gold, (>100  $\mu$ -in. Au, over 500  $\pm$ 100 Å TiW) Contact ATC for alternate termination styles.

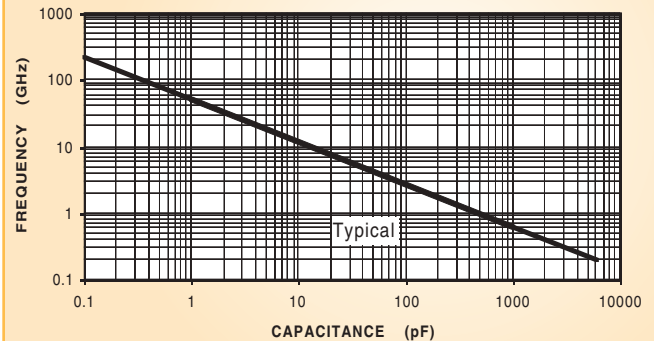
## Environmental Characteristics

**Operating Temperature:** Refer to TCC data on pages 6 and 7 for temperature limits.

## Additional Environmental Characteristics:

ATC Capacitors are designed and manufactured to meet or exceed the environmental limits as defined in MIL-C-49464.

## Series Resonance vs Capacitance for Minimum Thickness



Inspection ►

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# GENERAL SPECIFICATIONS

## Quality Program

Stringent process procedures and exacting material requirements ensure that only the highest quality parts are shipped. ATC's manufacturing and Quality Testing facilities comply with the following specifications:

- ISO 10012-1 Quality Assurance for Measuring Equipment
- ISO 9001 qualified facility
- ANSI / NCSL Z540-1-1994 Calibration Laboratories and Measuring and Test Equipment - General Requirements

## Qualification Testing

ATC's Microcap® products are designed and manufactured to meet or exceed the following requirements as detailed in MIL-STD-202 and MIL-C-49464:

- Immersion (MIL-STD-202 meth. 104)
- Resistance to solder heat (MIL-STD-202 meth. 210)
- Moisture resistance (MIL-STD-202 meth. 106)
- Life Test (MIL-STD-202 meth. 108, cond. F) +125°C at 2x Rated Voltage.
- Solderability (MIL-STD-202 meth. 208)
- Voltage Conditioning (MIL-STD-202 meth. 108, cond. A) +125°C at 2X Rated Voltage.
- Low voltage humidity (MIL-C-49464)

## High Reliability Certification Program

For enhanced reliability applications, ATC's Commercial Off The Shelf (COTS) High Reliability Program is available for single layer capacitors. See Page 15 for a full program description.

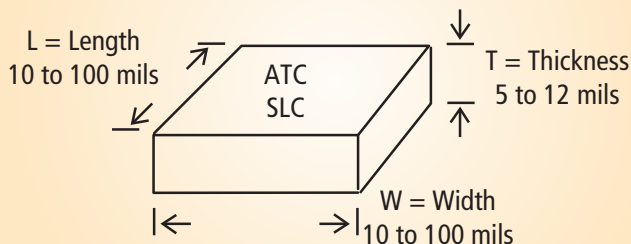


## Custom Designs

Custom Sizes: ATC internally manufactures substrates for the Microcap® product line. As such ATC can accommodate virtually any size or thickness single layer capacitor. Contact ATC to discuss your specific requirements

For higher capacitance values and voltage, consult factory.

## Dimension Guidelines



## Design Your Own Single Layer Capacitor

ATC gives you the ability to create custom values and dimensions. When circuit board area is tight or you need to match your stripline width, you can optimize the size and shape of required SLCs. This same technique can be used to build special values that fall outside of the standard offerings.

## Design Guidelines

$$C = \text{Capacitance (pF)} \quad C = \frac{(.225 K \times L \times W)}{(1000 \times T)}$$

**L = Length** 10 to 100 mils

**W = Width** 10 to 100 mils

**T = Thickness** 5 to 12 mils, less than or equal to L/2 or W/2

## Custom Values and Sizes

Optimize the best combination of length, width, thickness and dielectric material for your circuit/stripline capacitor requirements.

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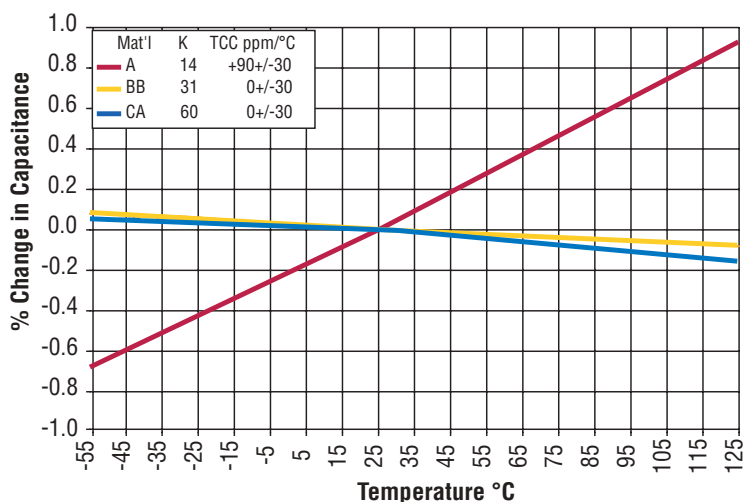
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# DIELECTRIC AND TYPICAL TCC DATA

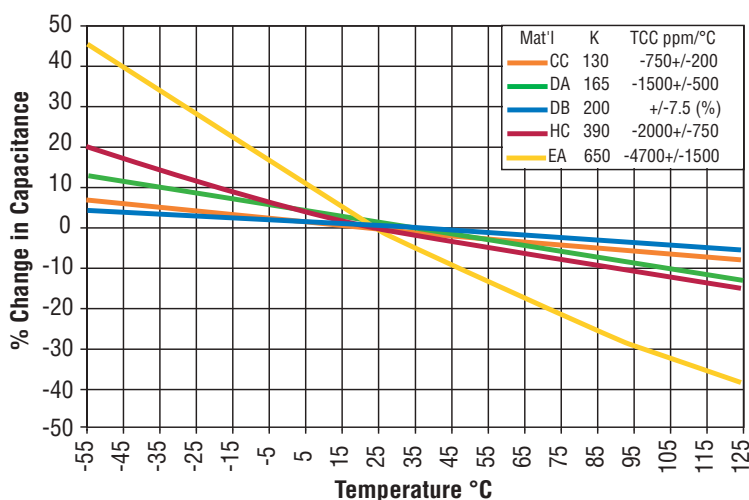
## Stable K Dielectrics

| Dielectric Code | Dielectric Const. (K) | TCC<br>(-55°C to +125°C) | Cap. Range<br>(pF) | Max. DF<br>@ 1 MHz (%) | Q                |
|-----------------|-----------------------|--------------------------|--------------------|------------------------|------------------|
| A               | 14                    | +90 ±30 PPM/°C           | 0.04 to 5.6        | 0.01                   | 11,000 @ 6.4 GHz |
| BB              | 31                    | 0 ±30 PPM/°C             | 0.06 to 13         | 0.15                   | 950 @ 4.5 GHz    |
| CA              | 60                    | 0 ±30 PPM/°C             | 0.1 to 27          | 0.15                   | 770 @ 5 GHz      |



## Mid-K Dielectrics

| Dielectric Code | Dielectric Const. (K) | TCC<br>(-55°C to +125°C)       | Cap. Range<br>(pF) | Max. DF (%)* |         | Q             |
|-----------------|-----------------------|--------------------------------|--------------------|--------------|---------|---------------|
|                 |                       |                                |                    | @ 1 MHz      | @ 1 KHz |               |
| CC              | 130                   | -750 ±200 PPM/°C               | 0.3 to 56          | 0.15         | —       | 2310 @ 5 GHz  |
| DA              | 165                   | -1500 ±500 PPM/°C              | 0.4 to 68          | 0.25         | —       | 500 @ 1.8 GHz |
| DB              | 200                   | ±7.5% max. change (non-linear) | 0.5 to 82          | 0.25         | —       | 29 @ 5 GHz    |
| HC              | 420                   | -2000 ±500 PPM/°C              | 1.1 to 180         | 0.7          | 0.3     | —             |
| EA              | 650                   | -4700 ±1500 PPM/°C             | 1.5 to 270         | 0.3          | 0.3     | —             |



\* Capacitance and DF are measured at 1 MHz for C ≤ 100 pF and 1 KHz for C > 100 pF.

- DF readings are not accurately measurable for capacitor values < 4.7 pF in all ceramic types.
- For products made with A Dielectric, DF readings are not accurately measurable for capacitor values < 10 pF.

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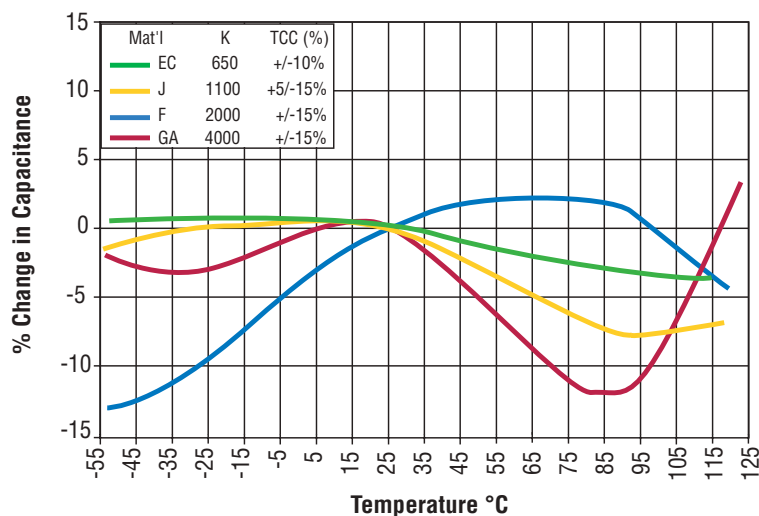
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## High-K Dielectrics

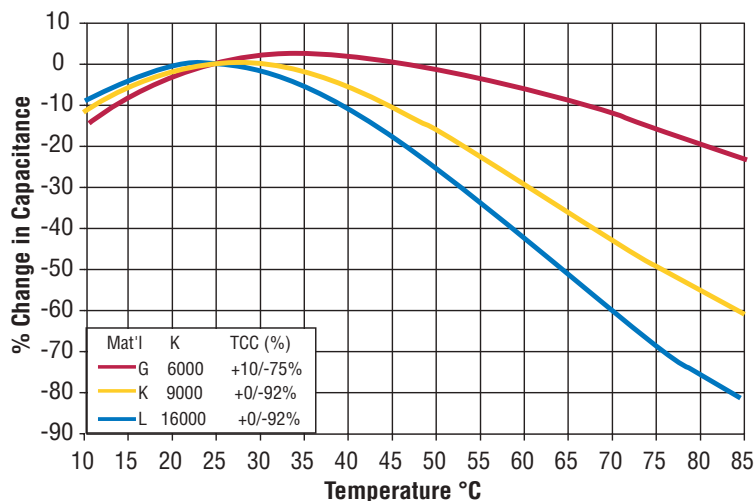
| Dielectric Code | Dielectric Const. (K) | TCC<br>(-55°C to +125°C)      | Cap. Range<br>(pF) | Max. DF (%)* |         |
|-----------------|-----------------------|-------------------------------|--------------------|--------------|---------|
|                 |                       |                               |                    | @ 1 MHz      | @ 1 KHz |
| EC              | 650                   | ±10% max. change (non-linear) | 1.5 to 270         | 1.5          | 1.5     |
| J               | 1100                  | +5% to -15% max. change (non- | 2.4 to 470         | 2.5          | 2.0     |
| F               | 2000                  | ±15% max. change (non-linear) | 4.3 to 820         | 2.5          | 2.0     |
| GA              | 4000                  | ±15%                          | 10 to 1800         | 4.0**        | 2.0**   |

\*\*DF is 6.5% max. for 118, 113 and 117 Series with Photoetched Process.



## Ultra High-K Dielectrics

| Dielectric Code | Dielectric Const. (K) | TCC<br>(+10°C to +85°C)               | Cap. Range<br>(pF) | Max. DF (%)* |         |
|-----------------|-----------------------|---------------------------------------|--------------------|--------------|---------|
|                 |                       |                                       |                    | @ 1 MHz      | @ 1 KHz |
| G               | 6000                  | +10% to -75% max. change (non-linear) | 13 to 2400         | 2.5          | 2.0     |
| K               | 9000                  | 0% to -92% max. change (non linear)   | 20 to 3300         | 4.0          | 2.0     |
| L               | 16,000                | 0/-92%                                | 33 to 6200         | 3.5          | 2.0     |



## MAXX-K™ Dielectric

| Dielectric Code | Dielectric Const. (K) | TCC (-55°C to +125°C)<br>See page 9 for curve | Cap. Range<br>(pF) | Max. DF @ 1 KHz (%)* |
|-----------------|-----------------------|-----------------------------------------------|--------------------|----------------------|
| M               | 25,000                | ±15%                                          | 150 to 10,000      | 2.5                  |

\* Capacitance and DF are measured at 1 MHz for C ≤ 100 pF and 1 KHz for C > 100 pF.

• DF readings are not accurately measurable for capacitor values < 4.7 pF in all ceramic types.

• For products made with A Dielectric, DF readings are not accurately measurable for capacitor values < 10 pF.

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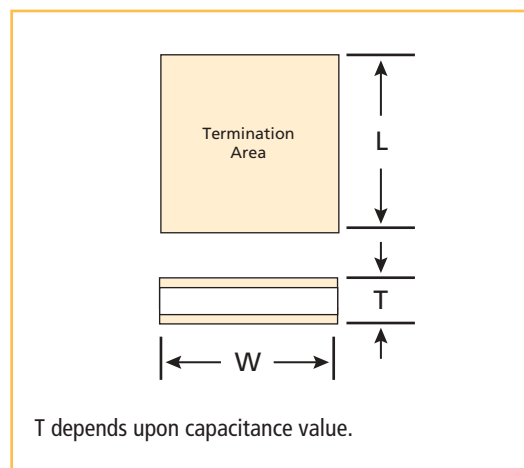
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# ATC 116 SERIES MICROCAPS®



ATC 116 SERIES MICROCAP® – The 116 series SLC with a conventional straight-sided design offers the highest capacitance per outline size. This design allows the user to match line width or design a custom capacitor for limited circuit dimensions.

## Selection Guide

| Case Size          |       | R                            |      |         | S                            |      |            | T                            |      |            | U                            |      |            | X                            |      |               | Y                            |      |               | Z                            |      |            |
|--------------------|-------|------------------------------|------|---------|------------------------------|------|------------|------------------------------|------|------------|------------------------------|------|------------|------------------------------|------|---------------|------------------------------|------|---------------|------------------------------|------|------------|
| Dimensions (L&W)   |       | .015 (.381)<br>± .003 (.076) |      |         | .018 (.457)<br>± .003 (.076) |      |            | .025 (.635)<br>± .005 (.127) |      |            | .035 (.889)<br>± .005 (.127) |      |            | .050 (1.27)<br>± .010 (.254) |      |               | .070 (1.78)<br>± .010 (.254) |      |               | .090 (2.29)<br>± .010 (.254) |      |            |
| Min. Thickness (T) |       | .0045 (.114)                 |      |         | .0045 (.114)                 |      |            | .0045 (.114)                 |      |            | .0045 (.114)                 |      |            | .0045 (.114)                 |      |               | .0045 (.114)                 |      |               | .0045 (.114)                 |      |            |
| Max. Thickness (T) |       | .012 (.305)                  |      |         | .012 (.305)                  |      |            | .012 (.305)                  |      |            | .012 (.305)                  |      |            | .012 (.305)                  |      |               | .012 (.305)                  |      |               | .012 (.305)                  |      |            |
|                    |       | Capacitance (pF)             |      |         | Capacitance (pF)             |      |            | Capacitance (pF)             |      |            | Capacitance (pF)             |      |            | Capacitance (pF)             |      |               | Capacitance (pF)             |      |               | Capacitance (pF)             |      |            |
|                    |       | Min.                         | Max. | Tol.    | Min.                         | Max. | Tol.       | Min.                         | Max. | Tol.       | Min.                         | Max. | Tol.       | Min.                         | Max. | Tol.          | Min.                         | Max. | Tol.          | Min.                         | Max. | Tol.       |
| Dielectric         | K     |                              |      |         |                              |      |            |                              |      |            |                              |      |            |                              |      |               |                              |      |               |                              |      |            |
| A                  | 14    | 0.06                         | 0.2  | A       | 0.08                         | 0.2  | A          | 0.2                          | 0.4  | A, B       | 0.4                          | 0.9  | A, B, C    | 0.6                          | 2    | A, B, C       | 1.3                          | 3.9  | A, B, C       | 2.2                          | 5.6  | A, B, C    |
| BB                 | 31    | 0.2                          | 0.5  | A, B    | 0.2                          | 0.5  | A, B       | 0.4                          | 1    | A, B, C    | 0.7                          | 2    | A, B, C, D | 1.5                          | 4.7  | B, C, D       | 3                            | 8.2  | B, C, D       | 5.1                          | 13   | C, D       |
| CA                 | 60    | 0.3                          | 1    | B, C    | 0.4                          | 1.1  | A, B, C, D | 0.8                          | 2    | B, C, D    | 1.5                          | 3.9  | B, C, D    | 2.7                          | 9.1  | C, D          | 6.2                          | 16   | D, G, J, K, M | 10                           | 27   | G, J, K, M |
| CC                 | 130   | 0.6                          | 2    | C, D    | 0.8                          | 2.2  | B, C, D    | 1.5                          | 4.3  | C, D       | 3                            | 8.2  | C, D       | 5.6                          | 20   | D, G, J, K, M | 12                           | 36   | G, J, K, M    | 22                           | 56   | G, J, K, M |
| DA                 | 165   | 0.7                          | 2.7  | C, D    | 1                            | 2.7  | C, D       | 2                            | 5.6  | C, D       | 3.9                          | 11   | D, J, K, M | 6.8                          | 24   | D, G, J, K, M | 15                           | 43   | G, J, K, M    | 27                           | 68   | G, J, K, M |
| DB                 | 200   | 0.8                          | 3.0  | C, D    | 1.2                          | 3.6  | C, D       | 2.4                          | 6.8  | C, D       | 4.7                          | 13   | D, J, K, M | 8.2                          | 30   | G, J, K, M    | 20                           | 56   | G, J, K, M    | 33                           | 82   | G, J, K, M |
| HC                 | 420   | 1.5                          | 5.6  | D, K, M | 2.2                          | 6.2  | D, J, K, M | 4.3                          | 12   | D, J, K, M | 8.2                          | 22   | J, K, M    | 15                           | 51   | G, J, K, M    | 33                           | 91   | G, J, K, M    | 56                           | 150  | G, J, K, M |
| EA                 | 650   | 2.7                          | 10   | K, M    | 4.3                          | 11   | D, J, K, M | 7.5                          | 22   | J, K, M    | 15                           | 43   | J, K, M    | 27                           | 100  | G, J, K, M    | 62                           | 180  | G, J, K, M    | 110                          | 270  | G, J, K, M |
| EC                 | 650   | 2.7                          | 10   | K, M    | 4.3                          | 11   | D, J, K, M | 7.5                          | 22   | J, K, M    | 15                           | 43   | J, K, M    | 27                           | 100  | G, J, K, M    | 62                           | 180  | G, J, K, M    | 110                          | 270  | G, J, K, M |
| J                  | 1100  | 4.7                          | 18   | K, M    | 6.8                          | 18   | J, K, M    | 13                           | 36   | J, K, M    | 27                           | 75   | J, K, M    | 47                           | 160  | J, K, M       | 100                          | 300  | J, K, M       | 180                          | 470  | J, K, M    |
| F                  | 2000  | 8.2                          | 33   | K, M    | 13                           | 36   | J, K, M    | 24                           | 68   | J, K, M    | 47                           | 130  | J, K, M    | 82                           | 300  | J, K, M       | 220                          | 560  | J, K, M       | 330                          | 820  | J, K, M    |
| GA                 | 4000  | 18                           | 68   | K, M    | 30                           | 75   | J, K, M    | 56                           | 150  | J, K, M    | 110                          | 300  | J, K, M    | 180                          | 680  | J, K, M       | 430                          | 1200 | J, K, M       | 750                          | 1800 | J, K, M    |
| G                  | 6000  | 27                           | 91   | M       | 39                           | 100  | M          | 75                           | 200  | M          | 150                          | 390  | M          | 240                          | 910  | M             | 560                          | 1600 | M             | 1000                         | 2400 | M          |
| K                  | 9000  | 36                           | 130  | M       | 56                           | 130  | M          | 110                          | 270  | M          | 220                          | 510  | M          | 360                          | 1200 | M             | 910                          | 2200 | M             | 1500                         | 3300 | M          |
| L                  | 16000 | 62                           | 220  | M       | 91                           | 270  | M          | 180                          | 510  | M          | 390                          | 1000 | M          | 620                          | 2200 | M             | 1500                         | 3900 | M             | 2400                         | 6200 | M          |

Availability of above products may vary. See Quik Pick list on page inside front cover for stock items.

Inches (mm)

### ATC Part Number Code

116

X

A

1R

5

B

100

TT

ATC Series

Case Size

Dielectric Style: Max. 2 characters

Capacitance Code: First 2 significant digits for capacitance.R=Decimal Point

Indicates number of zeros following digits of capacitance in picofarads except for decimal values.

Termination Code: (see pg. 4 for full descriptions)

TT = Titanium Tungsten/Nickel/Gold (standard)

TX = Titanium Tungsten/Gold

WVDC (in Volts): 3 significant digits, 100 Volts is standard.

Capacitance Tolerance (see table below)

| Capacitance Tolerances |        |        |        |        |       |       |       |       |       |  |
|------------------------|--------|--------|--------|--------|-------|-------|-------|-------|-------|--|
| Code                   | A (pF) | B (pF) | C (pF) | D (pF) | F (%) | G (%) | J (%) | K (%) | M (%) |  |
| Tol.                   | ± 0.05 | ± 0.1  | ± 0.25 | ± 0.5  | ± 1   | ± 2%  | ± 5   | ± 10  | ± 20% |  |

The above part number refers to a 116 series, case size X, A dielectric, 1.5 pF, with a capacitance tolerance of B (±0.1pF), 100 WVDC, with thin film gold termination.

ATC accepts orders for our parts using designations with or without the "ATC" prefix. Both methods of defining the part number are equivalent, i.e., part numbers referenced with the "ATC" prefix are interchangeable to parts referenced without the "ATC" prefix. Customers are free to use either in specifying or procuring parts from American Technical Ceramics.

**A M E R I C A N   T E C H N I C A L   C E R A M I C S**

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# ATC 116 SERIES MAXX-K™ M DIELECTRIC SLCs

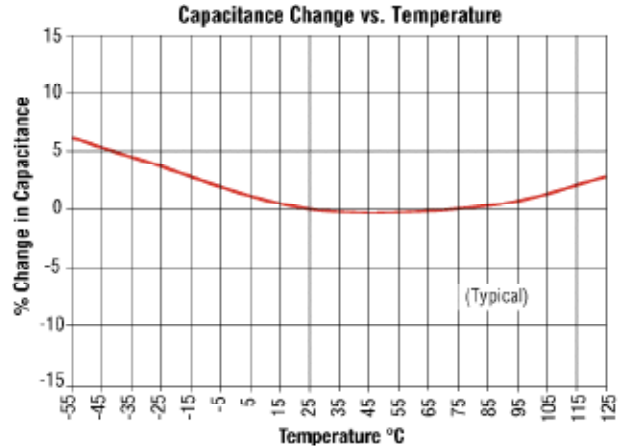
ATC's 116 Series MAXX-K™ single layer capacitors provide the highest capacitance per unit area with a stable X7R temperature coefficient of capacitance ( $\pm 15\%$ ).

## Features

- X7R Dielectric  $\pm 15\%$  (-55 °C to +125 °C)
- Capacitance Range 150 to 10,000 pF
- Dielectric Constant 25,000 typ.

## Specifications

- DF 2.5% max., measured at 1 KHz
- Insulation Resistance:  $10^4$  M $\Omega$  (typ.) @ 25°C
- Working Voltage: 50 WVDC
- Aging Rate: less than 3% per decade hour
- Bond Strength and Die Shear: MIL-STD-883



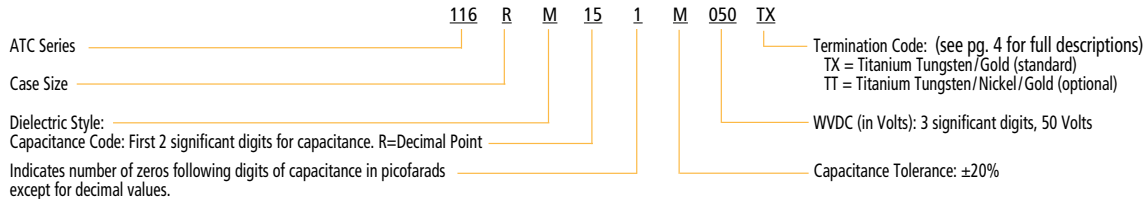
## Selection Guide

| Case Size             |          | R                                          | T                                          | U                                          | X                                          | Y                                          | Z                                          |
|-----------------------|----------|--------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|
| Dimensions (L&W nom.) |          | .015 (.381)<br>± .005 (.127)               | .025 (.635)<br>± .005 (.127)               | .035 (.889)<br>± .005 (.127)               | .050 (1.27)<br>± .010 (.254)               | .070 (1.78)<br>± .010 (.254)               | .090 (2.29)<br>± .010 (.254)               |
| 50 V Thickness (T)    |          | .007 (.178)<br>+ .002 (.051) - .001 (.025) | .007 (.178)<br>+ .002 (.051) - .001 (.025) | .007 (.178)<br>+ .002 (.051) - .001 (.025) | .007 (.178)<br>+ .002 (.051) - .001 (.025) | .007 (.178)<br>+ .002 (.051) - .001 (.025) | .007 (.178)<br>+ .002 (.051) - .001 (.025) |
| Cap (pF)              | Cap Code |                                            |                                            |                                            |                                            |                                            |                                            |
| 150                   | 151      | 116RM151M050TX                             |                                            |                                            |                                            |                                            |                                            |
| 220                   | 221      | 116RM221M050TX                             |                                            |                                            |                                            |                                            |                                            |
| 270                   | 271      | 116RM271M050TX                             |                                            |                                            |                                            |                                            |                                            |
| 330                   | 331      | 116RM331M050TX                             |                                            |                                            |                                            |                                            |                                            |
| 390                   | 391      |                                            | 116TM391M050TX                             |                                            |                                            |                                            |                                            |
| 470                   | 471      |                                            | 116TM471M050TX                             |                                            |                                            |                                            |                                            |
| 560                   | 561      |                                            | 116TM561M050TX                             |                                            |                                            |                                            |                                            |
| 680                   | 681      |                                            | 116TM681M050TX                             |                                            |                                            |                                            |                                            |
| 750                   | 751      |                                            | 116TM751M050TX                             |                                            |                                            |                                            |                                            |
| 820                   | 821      |                                            | 116TM821M050TX                             | 116UM821M050TX                             |                                            |                                            |                                            |
| 1000                  | 102      |                                            |                                            | 116UM102M050TX                             |                                            |                                            |                                            |
| 1200                  | 122      |                                            |                                            | 116UM122M050TX                             |                                            |                                            |                                            |
| 1500                  | 152      |                                            |                                            | 116UM152M050TX                             | 116XM152M050TX                             |                                            |                                            |
| 1800                  | 182      |                                            |                                            |                                            | 116XM182M050TX                             |                                            |                                            |
| 2200                  | 222      |                                            |                                            |                                            | 116XM222M050TX                             |                                            |                                            |
| 2700                  | 272      |                                            |                                            |                                            | 116XM272M050TX                             |                                            |                                            |
| 3300                  | 332      |                                            |                                            |                                            | 116XM332M050TX                             | 116YM332M050TX                             |                                            |
| 3900                  | 392      |                                            |                                            |                                            |                                            | 116YM392M050TX                             |                                            |
| 4700                  | 472      |                                            |                                            |                                            |                                            | 116YM472M050TX                             |                                            |
| 5600                  | 562      |                                            |                                            |                                            |                                            | 116YM562M050TX                             |                                            |
| 6200                  | 622      |                                            |                                            |                                            |                                            | 116YM622M050TX                             | 116ZM622M050TX                             |
| 6800                  | 682      |                                            |                                            |                                            |                                            | 116YM682M050TX                             | 116ZM682M050TX                             |
| 7500                  | 752      |                                            |                                            |                                            |                                            |                                            | 116ZM752M050TX                             |
| 8200                  | 822      |                                            |                                            |                                            |                                            |                                            | 116ZM822M050TX                             |
| 10000                 | 103      |                                            |                                            |                                            |                                            |                                            | 116ZM103M050TX                             |

Prototype quantities available in 1 week. Custom sizes available upon request.

Inches (mm)

## ATC Part Number Code



The above part number refers to a 116 series, case size R, M dielectric, 150 pF, with a capacitance tolerance of M ( $\pm 20\%$ ), 50 WVDC, with titanium tungsten gold termination. ATC accepts orders for our parts using designations with or without the "ATC" prefix. Both methods of defining the part number are equivalent, i.e., part numbers referenced with the "ATC" prefix are interchangeable to parts referenced without the "ATC" prefix. Customers are free to use either in specifying or procuring parts from American Technical Ceramics.

**A M E R I C A N   T E C H N I C A L   C E R A M I C S**

ATC North America

ATC Europe

ATC Asia

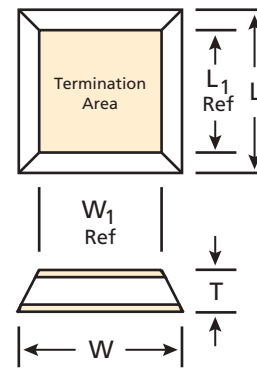
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# ATC 111 SERIES MICROCAPS®



| Case Size | Ref. W <sub>1</sub> or L <sub>1</sub> |
|-----------|---------------------------------------|
| S         | .014 (.356)                           |
| T         | .019 (.483)                           |
| U         | .030 (.762)                           |
| X         | .045 (1.14)                           |
| Y         | .065 (1.65)                           |
| Z         | .085 (2.16)                           |

T depends upon capacitance value.

ATC 111 SERIES MILLIMETER WAVELENGTH MICROCAP® – The beveled edges featured in the 111 Series minimize the potential for cracking due to mechanical or thermal shock. The longer path along the beveled edge also provides additional protection against arc-over.

## Selection Guide

| Case Size             | S                            |      |         | T                            |      |         | U                            |      |            | X                            |      |            | Y                            |      |            | Z                            |      |            |
|-----------------------|------------------------------|------|---------|------------------------------|------|---------|------------------------------|------|------------|------------------------------|------|------------|------------------------------|------|------------|------------------------------|------|------------|
| Dimensions (L&W nom.) | .018 (.457)<br>± .003 (.076) |      |         | .025 (.635)<br>± .005 (.127) |      |         | .035 (.889)<br>± .005 (.127) |      |            | .050 (1.27)<br>± .010 (.254) |      |            | .070 (1.78)<br>± .010 (.254) |      |            | .090 (2.29)<br>± .010 (.254) |      |            |
| Min. Thickness (T)    | .0045 (.114)                 |      |         | .0045 (.114)                 |      |         | .0045 (.114)                 |      |            | .0045 (.114)                 |      |            | .0045 (.114)                 |      |            | .0045 (.114)                 |      |            |
| Max. Thickness (T)    | .012 (.305)                  |      |         | .012 (.305)                  |      |         | .012 (.305)                  |      |            | .012 (.305)                  |      |            | .012 (.305)                  |      |            | .012 (.305)                  |      |            |
|                       | Capacitance (pF)             |      |         | Capacitance (pF)             |      |         | Capacitance (pF)             |      |            | Capacitance (pF)             |      |            | Capacitance (pF)             |      |            | Capacitance (pF)             |      |            |
|                       | Min.                         | Max. | Tol.    | Min.                         | Max. | Tol.    | Min.                         | Max. | Tol.       | Min.                         | Max. | Tol.       | Min.                         | Max. | Tol.       | Min.                         | Max. | Tol.       |
| Dielectric K          |                              |      |         |                              |      |         |                              |      |            |                              |      |            |                              |      |            |                              |      |            |
| A 14                  | 0.1                          | 0.2  | A, B    | 0.2                          | 0.4  | A, B    | 0.4                          | 0.9  | A, B, C    | 0.6                          | 2    | B, C       | 1.3                          | 3.6  | B, C       | 2.4                          | 5.6  | B, C       |
| BB 31                 | 0.3                          | 0.4  | A, B, C | 0.4                          | 1.0  | B, C    | 0.8                          | 1.8  | B, C, D    | 1.3                          | 4.3  | C, D       | 3                            | 8.2  | C, D       | 5.1                          | 13   | D, J, K, M |
| CA 62                 | 0.5                          | 0.9  | B, C, D | 0.8                          | 2    | C, D    | 1.5                          | 3.9  | C, D       | 2.7                          | 9.1  | D, J, K, M | 6.2                          | 16   | D, J, K, M | 10                           | 24   | G, J, K, M |
| CC 130                | 0.9                          | 2.0  | C, D    | 1.5                          | 4.3  | D, K, M | 3.3                          | 8.2  | D, J, K, M | 5.6                          | 18   | J, K, M    | 12                           | 33   | J, K, M    | 22                           | 56   | G, J, K, M |
| DA 165                | 1.2                          | 2.4  | C, D    | 2.0                          | 5.6  | D, K, M | 4.3                          | 10   | D, J, K, M | 7.5                          | 24   | J, K, M    | 15                           | 43   | J, K, M    | 27                           | 68   | G, J, K, M |
| DB 200                | 1.5                          | 3.0  | D, K, M | 2.4                          | 6.8  | D, K, M | 5.1                          | 12   | J, K, M    | 9.1                          | 30   | J, K, M    | 20                           | 51   | J, K, M    | 33                           | 82   | G, J, K, M |
| HC 420                | 2.4                          | 5.6  | K, M    | 4.3                          | 12   | K, M    | 9.1                          | 22   | J, K, M    | 15                           | 47   | J, K, M    | 33                           | 91   | J, K, M    | 56                           | 150  | G, J, K, M |
| EA 650                | 4.7                          | 10   | K, M    | 7.5                          | 22   | K, M    | 16                           | 39   | J, K, M    | 27                           | 91   | J, K, M    | 62                           | 160  | J, K, M    | 110                          | 270  | G, J, K, M |
| EC 650                | 4.7                          | 10   | K, M    | 7.5                          | 22   | K, M    | 16                           | 39   | J, K, M    | 27                           | 91   | J, K, M    | 62                           | 160  | J, K, M    | 110                          | 270  | G, J, K, M |
| J 1100                | 7.5                          | 15   | K, M    | 15                           | 36   | K, M    | 27                           | 68   | J, K, M    | 47                           | 160  | J, K, M    | 100                          | 300  | J, K, M    | 180                          | 470  | J, K, M    |
| F 2000                | 15                           | 27   | K, M    | 27                           | 68   | K, M    | 51                           | 120  | J, K, M    | 91                           | 300  | J, K, M    | 200                          | 510  | J, K, M    | 330                          | 820  | J, K, M    |
| GA 4000               | 33                           | 68   | K, M    | 56                           | 150  | K, M    | 110                          | 270  | J, K, M    | 200                          | 680  | J, K, M    | 430                          | 1200 | J, K, M    | 750                          | 1800 | J, K, M    |
| G 6000                | 47                           | 91   | M       | 75                           | 180  | M       | 150                          | 360  | M          | 270                          | 820  | M          | 560                          | 1600 | M          | 1000                         | 2400 | M          |
| K 9000                | 62                           | 120  | M       | 110                          | 270  | M       | 220                          | 510  | M          | 390                          | 1200 | M          | 820                          | 2200 | M          | 1500                         | 3300 | M          |
| L 16,000              | 110                          | 220  | M       | 180                          | 510  | M       | 390                          | 910  | M          | 680                          | 2200 | M          | 1500                         | 3900 | M          | 2400                         | 6200 | M          |

Inches (mm)

## ATC Part Number Code

111 U CA 1R 5 C 100 TT

ATC Series

Case Size

Dielectric Style: Max. 2 characters

Capacitance Code: First 2 significant digits for capacitance. R=Decimal Point  
Indicates number of zeros following digits of capacitance in picofarads except for decimal values.

Termination Code: (see pg. 4 for full descriptions)

TT = Titanium Tungsten/Nickel/Gold (standard)

TX = Titanium Tungsten/Gold

WVDC (in Volts): 3 significant digits, 100 Volts is standard.

Capacitance Tolerance (see table below)

### Capacitance Tolerances

| Code | A (pF) | B (pF) | C (pF) | D (pF) | F (%) | G (%) | J (%) | K (%) | M (%) |
|------|--------|--------|--------|--------|-------|-------|-------|-------|-------|
| Tol. | ± 0.05 | ± 0.1  | ± 0.25 | ± 0.5  | ± 1   | ± 2%  | ± 5   | ± 10  | ± 20% |

The above part number refers to a 111 series, case size U, CA dielectric, 1.5 pF, with a capacitance tolerance of C (±0.25 pF), 100 WVDC, with thin film gold termination.

ATC accepts orders for our parts using designations with or without the "ATC" prefix. Both methods of defining the part number are equivalent, i.e., part numbers referenced with the "ATC" prefix are interchangeable to parts referenced without the "ATC" prefix. Customers are free to use either in specifying or procuring parts from American Technical Ceramics.

AMERICAN TECHNICAL CERAMICS

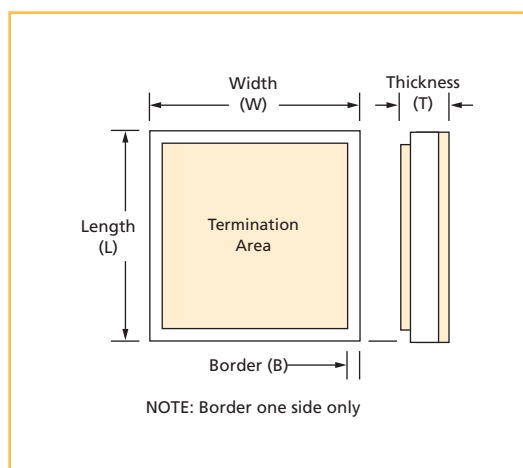
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# ATC 118 SERIES SINGLE SIDED RECESSED METALIZATION SLCs



ATC 118 SERIES SINGLE RECESSED METALIZATION SLCs – have been designed to minimize potential shorting resulting from epoxy or solder attachments. Contact ATC for further information.

## Features:

- Capacitance Range: 0.05 pF to 1800 pF
- Exposed Borders for: Automated Visual Equipment, Solder Resist Area to Reduce Shorts
- Operating Frequency up to 100 GHz

## Applications:

- Microwave Integrated Circuits
- Automated MIC Construction
- Chip and Wire Construction
- Matching and Filtering Circuits
- Bypass and Coupling

## Selection Guide

| Case Size                              | C                                  |     |      | D                                  |     |      | E                                  |     |      | F                                  |     |         | G                                  |     |         | H                                  |     |      | J                                  |      |         |
|----------------------------------------|------------------------------------|-----|------|------------------------------------|-----|------|------------------------------------|-----|------|------------------------------------|-----|---------|------------------------------------|-----|---------|------------------------------------|-----|------|------------------------------------|------|---------|
| Width (W)<br>(L&W)                     | .015 (.381)<br>±.002 (.0508)       |     |      | .020 (.508)<br>±.002 (.0508)       |     |      | .025 (.635)<br>±.002 (.0508)       |     |      | .030 (.762)<br>±.002 (.0508)       |     |         | .035 (.899)<br>±.002 (.0508)       |     |         | .040 (1.016)<br>±.002 (.0508)      |     |      | .050 (1.270)<br>±.002 (.0508)      |      |         |
| Recessed Metalization<br>Area (L&W)    | .011 (.279)<br>+0 -.003 (.0762)    |     |      | .016 (.406)<br>+0 -.003 (.0762)    |     |      | .021 (.533)<br>+0 -.003 (.0762)    |     |      | .026 (.660)<br>+0 -.003 (.0762)    |     |         | .031 (.787)<br>+0 -.003 (.0762)    |     |         | .036 (.914)<br>+0 -.003 (.0762)    |     |      | .046 (1.168)<br>+0 -.003 (.0762)   |      |         |
| Min. Thickness (T)                     | .0045 (.114)                       |     |      | .0045 (.114)                       |     |      | .0045 (.114)                       |     |      | .0045 (.114)                       |     |         | .0045 (.114)                       |     |         | .0045 (.114)                       |     |      | .0045 (.114)                       |      |         |
| Max. Thickness (T)                     | .012 (.305)                        |     |      | .012 (.305)                        |     |      | .012 (.305)                        |     |      | .012 (.305)                        |     |         | .012 (.305)                        |     |         | .012 (.305)                        |     |      | .012 (.305)                        |      |         |
| Equivalent Series<br>Capacitance (ESC) | Capacitance (pF)<br>Min. Max. Tol. |     |      | Capacitance (pF)<br>Min. Max. Tol. |     |      | Capacitance (pF)<br>Min. Max. Tol. |     |      | Capacitance (pF)<br>Min. Max. Tol. |     |         | Capacitance (pF)<br>Min. Max. Tol. |     |         | Capacitance (pF)<br>Min. Max. Tol. |     |      | Capacitance (pF)<br>Min. Max. Tol. |      |         |
| Dielectric K                           |                                    |     |      |                                    |     |      |                                    |     |      |                                    |     |         |                                    |     |         |                                    |     |      |                                    |      |         |
| A 14                                   | 0.06                               | 0.1 | A    | 0.2                                | 0.2 | A, B | 0.2                                | 0.3 | A, B | 0.3                                | 0.4 | A, B    | 0.4                                | 0.6 | A, B    | 0.5                                | 0.9 | B, C | 0.8                                | 1.3  | B, C    |
| BB 31                                  | 0.2                                | 0.2 | A, B | 0.3                                | 0.4 | B, C | 0.4                                | 0.7 | B, C | 0.6                                | 1.0 | B, C, D | 0.8                                | 1.5 | C, D    | 1.1                                | 2.0 | C, D | 1.8                                | 3.0  | C, D    |
| CA 60                                  | 0.3                                | 0.4 | B, C | 0.5                                | 0.8 | C, D | 0.8                                | 1.3 | C, D | 1.2                                | 2.0 | C, D    | 1.6                                | 3.0 | C, D    | 2.2                                | 3.9 | C, D | 3.6                                | 6.2  | D, K, M |
| CC 130                                 | 0.6                                | 0.9 | C, D | 1                                  | 1.8 | C, D | 1.8                                | 3.0 | D, M | 2.4                                | 4.3 | D, K, M | 3.6                                | 6.2 | D, K, M | 4.7                                | 8.2 | K, M | 7.5                                | 13   | K, M    |
| DA 165                                 | 0.7                                | 1.2 | C, D | 1.3                                | 2.2 | D    | 2.2                                | 3.9 | D, M | 3.3                                | 5.6 | D, K, M | 4.3                                | 7.5 | K, M    | 5.6                                | 10  | K, M | 9.1                                | 16   | K, M    |
| DB 200                                 | 0.9                                | 1.3 | D, M | 1.5                                | 2.7 | D, M | 2.7                                | 4.7 | M    | 3.9                                | 6.8 | K, M    | 5.1                                | 9.1 | K, M    | 6.8                                | 13  | K, M | 11                                 | 20   | K, M    |
| HC 420                                 | 1.5                                | 2.4 | D, M | 2.7                                | 4.7 | M    | 4.7                                | 8.2 | M    | 6.8                                | 12  | K, M    | 9.1                                | 16  | K, M    | 12                                 | 22  | K, M | 20                                 | 36   | K, M    |
| EA 650                                 | 2.7                                | 4.7 | M    | 4.7                                | 9.1 | M    | 8.2                                | 15  | M    | 12                                 | 22  | K, M    | 18                                 | 30  | K, M    | 22                                 | 39  | K, M | 36                                 | 62   | K, M    |
| EC 650                                 | 2.7                                | 4.7 | M    | 4.7                                | 9.1 | M    | 8.2                                | 15  | M    | 12                                 | 22  | K, M    | 18                                 | 30  | K, M    | 22                                 | 39  | K, M | 36                                 | 62   | K, M    |
| J 1100                                 | 4.7                                | 7.5 | M    | 8.2                                | 15  | M    | 15                                 | 24  | M    | 22                                 | 36  | K, M    | 30                                 | 51  | K, M    | 39                                 | 68  | K, M | 62                                 | 110  | K, M    |
| F 2000                                 | 9.1                                | 13  | M    | 16                                 | 27  | M    | 27                                 | 47  | M    | 39                                 | 68  | K, M    | 51                                 | 91  | K, M    | 68                                 | 120 | K, M | 110                                | 200  | K, M    |
| GA 4000                                | 20                                 | 33  | M    | 36                                 | 62  | M    | 56                                 | 100 | M    | 91                                 | 150 | K, M    | 120                                | 200 | K, M    | 160                                | 270 | K, M | 270                                | 430  | K, M    |
| G 6000                                 | 27                                 | 43  | M    | 47                                 | 82  | M    | 75                                 | 130 | M    | 120                                | 200 | M       | 160                                | 270 | M       | 220                                | 360 | M    | 330                                | 620  | M       |
| K 9000                                 | 39                                 | 56  | M    | 68                                 | 110 | M    | 120                                | 180 | M    | 180                                | 270 | M       | 240                                | 390 | M       | 330                                | 510 | M    | 510                                | 820  | M       |
| L 16,000                               | 68                                 | 100 | M    | 120                                | 180 | M    | 200                                | 300 | M    | 300                                | 470 | M       | 390                                | 620 | M       | 510                                | 820 | M    | 820                                | 1800 | M       |

Border Dimensions (See B in drawing above): .001 (.0254) min. for case sizes C through J

Inches (mm)

## ATC Part Number Code

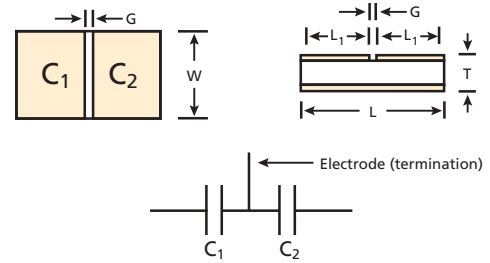
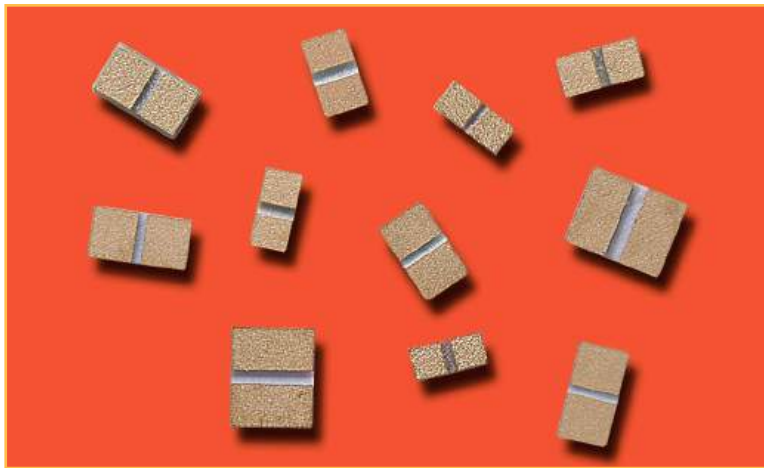
|                                                                                                    |     |   |   |    |   |   |     |    |                                                                   |
|----------------------------------------------------------------------------------------------------|-----|---|---|----|---|---|-----|----|-------------------------------------------------------------------|
| ATC Series                                                                                         | 118 | H | A | OR | 5 | B | 100 | TT | Termination Code:<br>TT and TX (see page 4 for full descriptions) |
| Case Size                                                                                          |     |   |   |    |   |   |     |    | WVDC (in Volts): 3 significant digits, 100 Volts is standard.     |
| Dielectric Style: Max. 2 characters                                                                |     |   |   |    |   |   |     |    | Capacitance Tolerance (see table below)                           |
| Capacitance Code: First 2 significant digits for capacitance. R=Decimal Point                      |     |   |   |    |   |   |     |    |                                                                   |
| Indicates number of zeros following digits of capacitance in picofarads except for decimal values. |     |   |   |    |   |   |     |    |                                                                   |

| Capacitance Tolerances |        |        |        |        |       |       |       |       |       |
|------------------------|--------|--------|--------|--------|-------|-------|-------|-------|-------|
| Code                   | A (pF) | B (pF) | C (pF) | D (pF) | F (%) | G (%) | J (%) | K (%) | M (%) |
| Tol.                   | ± 0.05 | ± 0.1  | ± 0.25 | ± 0.5  | ± 1   | ± 2%  | ± 5   | ± 10  | ± 20% |

The above part number refers to a 118 series, case size H, A dielectric, 0.5 pF, with a capacitance tolerance of B (±0.1 pF), 100 WVDC, with thin film gold termination.

ATC accepts orders for our parts using designations with or without the "ATC" prefix. Both methods of defining the part number are equivalent, i.e., part numbers referenced with the "ATC" prefix are interchangeable to parts referenced without the "ATC" prefix. Customers are free to use either in specifying or procuring parts from American Technical Ceramics.

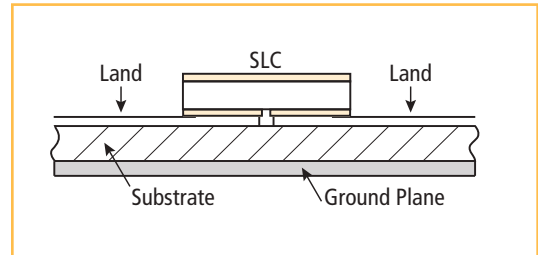
# ATC 113 SERIES TWIN CAP® SLCs



$$\text{Equivalent Series Capacitance} = \frac{C_1}{2} = \frac{C_2}{2}$$

Terminations  $C_1$  and  $C_2$  may be mounted directly to the microstrip line or with the top electrode (termination) facing down in the flip chip configuration.

The unique configuration of the ATC 113 Series Twin Cap® provides a wide range of capacitance values with a 100 WVDC rating in a low profile package. The low insertion loss and extremely high self-resonant frequencies of the 113 Series make it ideal for RF / microwave and millimeter wave applications.



## Selection Guide

| Case Size                           | C                                  |      |     |      | D                                  |      |      | E                                  |     |      | F                                  |     |   | G                                  |     |   | H                                  |     |      | J                                  |     |      |
|-------------------------------------|------------------------------------|------|-----|------|------------------------------------|------|------|------------------------------------|-----|------|------------------------------------|-----|---|------------------------------------|-----|---|------------------------------------|-----|------|------------------------------------|-----|------|
| Width (W)                           | .015 (.381)<br>+0 -.003 (.076)     |      |     |      | .020 (.500)<br>+0 -.003 (.076)     |      |      | .025 (.635)<br>+0 -.003 (.076)     |     |      | .030 (.762)<br>+0 -.003 (.076)     |     |   | .035 ± .005<br>(.899 ± .130)       |     |   | .040 ± .005<br>(1.016 ± .130)      |     |      | .050 ± .005<br>(1.27 ± .130)       |     |      |
| Length (L)                          | .040 (1.016) max.                  |      |     |      | .050 (1.270) max.                  |      |      | .080 (2.032) max.                  |     |      | .080 (2.032) max.                  |     |   | .080 (2.032) max.                  |     |   | .080 (2.032) max.                  |     |      | .080 (2.032) max.                  |     |      |
| Gap Width (G)                       | .008 (.203)                        |      |     |      | .008 (.203)                        |      |      | .020 (.508)                        |     |      | .020 (.508)                        |     |   | .020 (.508)                        |     |   | .020 (.508)                        |     |      | .020 (.508)                        |     |      |
| Min. Thickness (T)                  | .005 (.127)                        |      |     |      | .005 (.127)                        |      |      | .005 (.127)                        |     |      | .006 (.152)                        |     |   | .006 (.152)                        |     |   | .006 (.152)                        |     |      | .006 (.152)                        |     |      |
| Max. Thickness (T)                  | .010 (.254)                        |      |     |      | .010 (.254)                        |      |      | .010 (.254)                        |     |      | .012 (.300)                        |     |   | .012 (.300)                        |     |   | .012 (.300)                        |     |      | .012 (.300)                        |     |      |
| Equivalent Series Capacitance (ESC) | Capacitance (pF)<br>Min. Max. Tol. |      |     |      | Capacitance (pF)<br>Min. Max. Tol. |      |      | Capacitance (pF)<br>Min. Max. Tol. |     |      | Capacitance (pF)<br>Min. Max. Tol. |     |   | Capacitance (pF)<br>Min. Max. Tol. |     |   | Capacitance (pF)<br>Min. Max. Tol. |     |      | Capacitance (pF)<br>Min. Max. Tol. |     |      |
| Dielectric                          | K                                  |      |     |      |                                    |      |      |                                    |     |      |                                    |     |   |                                    |     |   |                                    |     |      |                                    |     |      |
| A                                   | 14                                 | —    | —   | —    | 0.05                               | 0.08 | B, C | 0.08                               | 0.1 | B, C | 0.08                               | 0.1 | B | 0.1                                | 0.2 | B | 0.1                                | 0.2 | B    | 0.2                                | 0.2 | B    |
| BB                                  | 31                                 | 0.05 | 0.1 | B, C | 0.1                                | 0.1  | B, C | 0.2                                | 0.2 | B, C | 0.2                                | 0.3 | B | 0.3                                | 0.4 | B | 0.3                                | 0.5 | B    | 0.3                                | 0.6 | B    |
| CA                                  | 62                                 | 0.2  | 0.2 | B, C | 0.2                                | 0.3  | B, C | 0.4                                | 0.6 | B, C | 0.4                                | 0.6 | B | 0.5                                | 0.8 | B | 0.6                                | 1.0 | C    | 0.8                                | 1.2 | C    |
| CC                                  | 130                                | 0.3  | 0.4 | B, C | 0.4                                | 0.8  | C, D | 0.8                                | 1.5 | C, D | 0.8                                | 1.5 | C | 1.0                                | 1.8 | C | 1.2                                | 2.2 | C, D | 1.5                                | 3.0 | D    |
| DB                                  | 200                                | 0.5  | 0.6 | C, D | 1.0                                | 1.2  | C, D | 1.8                                | 2.2 | D    | 1.8                                | 2.2 | D | 2.2                                | 3.3 | D | 2.7                                | 3.6 | D    | 3.3                                | 4.7 | D    |
| HC                                  | 420                                | 0.8  | 1.2 | C, D | 1.5                                | 2.2  | D    | 2.7                                | 4.7 | M    | 2.7                                | 4.7 | M | 3.6                                | 5.6 | M | 3.9                                | 6.8 | M    | 5.1                                | 8.2 | K, M |
| EA                                  | 650                                | 1.5  | 1.8 | C, D | 2.7                                | 3.9  | M    | 5.1                                | 6.8 | M    | 5.1                                | 6.8 | M | 6.8                                | 10  | M | 8.2                                | 12  | M    | 10                                 | 15  | K, M |
| EC                                  | 650                                | 1.5  | 1.8 | C, D | 2.7                                | 3.9  | M    | 5.1                                | 6.8 | M    | 5.1                                | 6.8 | M | 6.8                                | 10  | M | 8.2                                | 12  | M    | 10                                 | 15  | K, M |
| J                                   | 1100                               | 2.2  | 3.3 | M    | 4.7                                | 6.8  | M    | 8.2                                | 12  | M    | 8.2                                | 12  | M | 12                                 | 15  | M | 15                                 | 18  | M    | 18                                 | 22  | M    |
| F                                   | 2000                               | 3.6  | 6.8 | M    | 8.2                                | 12   | M    | 15                                 | 22  | M    | 15                                 | 22  | M | 18                                 | 30  | M | 20                                 | 33  | M    | 27                                 | 39  | M    |
| GA                                  | 4000                               | 8.2  | 12  | M    | 15                                 | 27   | M    | 27                                 | 51  | M    | 27                                 | 51  | M | 33                                 | 68  | M | 39                                 | 82  | M    | 47                                 | 100 | M    |
| G                                   | 6000                               | 15   | 18  | M    | 30                                 | 39   | M    | 56                                 | 62  | M    | 56                                 | 68  | M | 68                                 | 82  | M | 100                                | 120 | M    | 120                                | 130 | M    |

Inches (mm)

## ATC Part Number Code

ATC Series 113  
Case Size D  
Dielectric Style: Max. 2 characters DB  
Capacitance Code: First 2 significant digits for capacitance. R=Decimal Point 1R  
Indicates number of zeros following digits of capacitance in picofarads except for decimal values. 0  
Termination Code: (see pg. 4 for full descriptions)  
TT = Titanium Tungsten/Nickel/ Gold (standard)  
TX = Titanium Tungsten/Gold

Termination Code: (see pg. 4 for full descriptions)  
TT = Titanium Tungsten/Nickel/ Gold (standard)  
TX = Titanium Tungsten/Gold

WVDC (in Volts): 3 significant digits, 100 Volts is standard  
Capacitance Tolerance (see table below)

| Capacitance Tolerances |        |        |        |        |       |       |       |       |       |  |
|------------------------|--------|--------|--------|--------|-------|-------|-------|-------|-------|--|
| Code                   | A (pF) | B (pF) | C (pF) | D (pF) | F (%) | G (%) | J (%) | K (%) | M (%) |  |
| Tol.                   | ± 0.05 | ± 0.1  | ± 0.25 | ± 0.5  | ± 1   | ± 2%  | ± 5   | ± 10  | ± 20% |  |

The above part number refers to a 113 series, case size D, DB dielectric, 1.0 pF, with a capacitance tolerance of D (±0.5 pF), 100 WVDC, with thin film gold termination.

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**A M E R I C A N T E C H N I C A L C E R A M I C S**

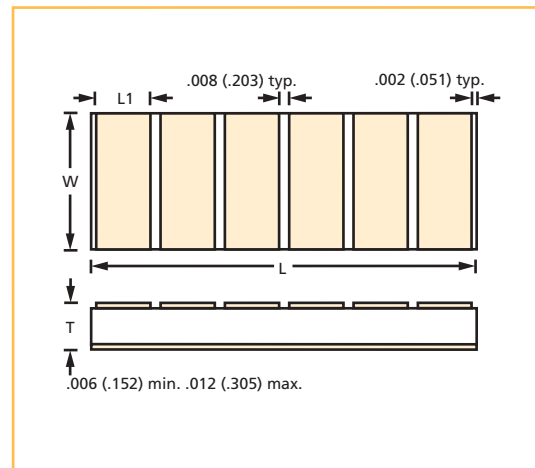
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# ATC 117 SERIES MULTIPLE PAD SLCs



ATC 117 SERIES MULTIPLE PAD SLCs are ideal for circuits such as MMIC devices requiring multiple capacitance applications, i.e., bypassing and bias circuits. The 117 Multicaps in the Selection Guide below are listed using ATC's GA and K dielectrics, with a pad length of .015 (.380). However, ATC will build Multiple Pad SLCs to customer specifications, up to .050 (1.27) pad length, using any dielectric offered in this catalog. Please consult factory.

## Selection Guide

| Style | Total Width (W)<br>± .003<br>(.076) | Total Length (L)<br>± .005<br>(.127) | W x L Per Pad             | Cap. Value (pF)<br>Per Pad |     | Number<br>of Pads | Part<br>Number "GA" | Part<br>Number "K" |
|-------|-------------------------------------|--------------------------------------|---------------------------|----------------------------|-----|-------------------|---------------------|--------------------|
|       |                                     |                                      |                           | GA                         | K   |                   |                     |                    |
| CC    | .015 (.381)                         | .065 (1.65)                          | .015 (.381) x .015 (.381) | 33                         | 70  | 3                 | 117CC3GA990MTT      | 117CC3K211MTT      |
| DC    | .020 (.508)                         | .065 (1.65)                          | .020 (.508) x .015 (.381) | 40                         | 90  | 3                 | 117DC3GA121MTT      | 117DC3K271MTT      |
| EC    | .025 (.635)                         | .065 (1.65)                          | .025 (.635) x .015 (.381) | 50                         | 110 | 3                 | 117EC3GA151MTT      | 117EC3K331MTT      |
| EC    | .025 (.635)                         | .090 (2.29)                          | .025 (.635) x .015 (.381) | 50                         | 110 | 4                 | 117EC4GA201MTT      | 117EC4K441MTT      |
| FC    | .030 (.762)                         | .065 (1.65)                          | .030 (.762) x .015 (.381) | 60                         | 130 | 3                 | 117FC3GA181MTT      | 117FC3K391MTT      |
| FC    | .030 (.762)                         | .090 (2.29)                          | .030 (.762) x .015 (.381) | 60                         | 130 | 4                 | 117FC4GA241MTT      | 117FC4K521MTT      |
| GC    | .035 (.889)                         | .065 (1.65)                          | .035 (.889) x .015 (.381) | 80                         | 140 | 3                 | 117GC3GA241MTT      | 117GC3K421MTT      |
| GC    | .035 (.889)                         | .090 (2.29)                          | .035 (.889) x .015 (.381) | 80                         | 140 | 4                 | 117GC4GA321MTT      | 117GC4K561MTT      |
| GC    | .035 (.889)                         | .135 (3.43)                          | .035 (.889) x .015 (.381) | 80                         | 140 | 6                 | 117GC6GA481MTT      | 117GC6K841MTT      |
| HC    | .040 (1.02)                         | .065 (1.65)                          | .040 (1.02) x .015 (.381) | 90                         | 150 | 3                 | 117HC3GA271MTT      | 117HC3K451MTT      |
| HC    | .040 (1.02)                         | .090 (2.29)                          | .040 (1.02) x .015 (.381) | 90                         | 150 | 4                 | 117HC4GA361MTT      | 117HC4K601MTT      |
| HC    | .040 (1.02)                         | .135 (3.43)                          | .040 (1.02) x .015 (.381) | 90                         | 150 | 6                 | 117HC6GA541MTT      | 117HC6K901MTT      |
| IC    | .045 (1.14)                         | .065 (1.65)                          | .045 (1.14) x .015 (.381) | 100                        | 200 | 3                 | 117IC3GA301MTT      | 117IC3K601MTT      |
| IC    | .045 (1.14)                         | .090 (2.29)                          | .045 (1.14) x .015 (.381) | 100                        | 200 | 4                 | 117IC4GA401MTT      | 117IC4K801MTT      |
| IC    | .045 (1.14)                         | .135 (3.43)                          | .045 (1.14) x .015 (.381) | 100                        | 200 | 6                 | 117IC6GA601MTT      | 117IC6K122MTT      |
| JC    | .050 (1.27)                         | .065 (1.65)                          | .050 (1.27) x .015 (.381) | 110                        | 220 | 3                 | 117JC3GA331MTT      | 117JC3K661MTT      |
| JC    | .050 (1.27)                         | .090 (2.29)                          | .050 (1.27) x .015 (.381) | 110                        | 220 | 4                 | 117JC4GA441MTT      | 117JC4K881MTT      |
| JC    | .050 (1.27)                         | .135 (3.43)                          | .050 (1.27) x .015 (.381) | 110                        | 220 | 6                 | 117JC6GA661MTT      | 117JC6K132MTT      |

Thickness (T): .006 (0.15) min.; .012 (0.30) max.

Gap between pads: .008 (.203) typical.

Note: Other sizes and configurations are available using any dielectric in this catalog.

## ATC Part Number Code

117 HC 6 GA 54 1 M TT

ATC Series \_\_\_\_\_

Multicap Style: 2 characters \_\_\_\_\_

Number of Pads \_\_\_\_\_

Dielectric Style: Max. 2 characters \_\_\_\_\_

Termination Code:  
TT and TX (see page 4 for descriptions)

Capacitance Tolerance (see table below, left).

Indicates number of zeros following digits of  
capacitance in picofarads except for decimal values.

Capacitance Code: First 2 significant digits for capacitance.  
R = Decimal Point.

| Capacitance Tolerances |        |        |        |        |       |       |       |       |       |
|------------------------|--------|--------|--------|--------|-------|-------|-------|-------|-------|
| Code                   | A (pF) | B (pF) | C (pF) | D (pF) | F (%) | G (%) | J (%) | K (%) | M (%) |
| Tol.                   | ± 0.05 | ± 0.1  | ± 0.25 | ± 0.5  | ± 1   | ± 2%  | ± 5   | ± 10  | ± 20% |

NOTE: Working Voltage = 100 WVDC

The above part number refers to a 117 Series, style HC, 6 pad Multicap, GA dielectric, 540 pF, with a capacitance tolerance of M (± 20%), with thin film gold termination.

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**A M E R I C A N   T E C H N I C A L   C E R A M I C S**

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# ATC SLC CUSTOM DESIGN KITS

**NEW SLC Custom Design Kits - Call +1-631-622-4700 to Order**

| Kit #    | Item#  | Description                                                              | Cap. Value Range (pF) | Price    |
|----------|--------|--------------------------------------------------------------------------|-----------------------|----------|
| Kit 6100 | DK6100 | 116 Series Microcaps®<br>100 piece total, 10 values, 10 pieces per value | 0.1 to 1000 pF        | \$120.00 |
| Kit 6150 | DK6150 | 116 Series Microcaps®<br>150 piece total, 15 values, 10 pieces per value | 0.1 to 1000 pF        | \$170.00 |

ATC's SLC Custom Design Kits are based on the Quik Pick™ Selection Guide below. Select values from this list to build your custom Kit. For KIT 6100, select 10 different values from the Quik Pick™ List. You will receive 10 pieces of each value (total 100 pieces). For KIT 6150, select 15 values from the list. You will receive 10 pieces per value (total 150 pieces).

## SLC Selection Guide – 3 to 5 Day Shipment

| Series / Case Size<br>(L & W) |          | 116 R<br>.015 (.381) nom. | 116 T<br>.025 (.635) nom. | 116 U<br>.035 (.889) nom. | 116 X<br>.050 (1.27) nom. |
|-------------------------------|----------|---------------------------|---------------------------|---------------------------|---------------------------|
| Cap (pF)                      | Cap Code | 0.1 to 100 pF             | 0.2 to 330 pF             | 0.4 to 820 pF             | 0.8 to 1000 pF            |
| 0.1                           | 0R1      | 116RA0R1A100TT            |                           |                           |                           |
| 0.2                           | 0R2      | 116RBB0R2A100TT           | 116TA0R2A100TT            |                           |                           |
| 0.3                           | 0R3      | 116RBB0R3A100TT           | 116TA0R3A100TT            |                           |                           |
| 0.4                           | 0R4      | 116RCA0R4B100TT           | 116TA0R4A100TT            | 116UA0R4A100TT            |                           |
| 0.5                           | 0R5      | 116RCA0R5B100TT           | 116TBB0R5A100TT           | 116UA0R5A100TT            |                           |
| 0.8                           | 0R8      | 116RDB0R8B100TT           | 116TBB0R8B100TT           | 116UBB0R8A100TT           | 116XA0R8A100TT            |
| 1.0                           | 1R0      | 116RDB1R0C100TT           | 116TCA1R0B100TT           | 116UBB1R0B100TT           | 116XA1R0A100TT            |
| 1.2                           | 1R2      | 116RDB1R2C100TT           | 116TCA1R2B100TT           | 116UBB1R2B100TT           | 116XA1R2A100TT            |
| 2.7                           | 2R7      | 116REA2R7M100TT           | 116TDB2R7C100TT           | 116UCA2R7C100TT           | 116XBB2R7C100TT           |
| 3.0                           | 3R0      | 116REA3R0M100TT           | 116TDB3R0C100TT           | 116UCA3R0C100TT           | 116XBB3R0C100TT           |
| 3.6                           | 3R6      | 116REA3R6M100TT           | 116TDB3R6D100TT           | 116UCA3R6D100TT           | 116XCA3R6C100TT           |
| 5.1                           | 5R1      | 116REA5R1M100TT           | 116TDB5R1D100TT           | 116UDB5R1D100TT           | 116XCA5R1C100TT           |
| 10                            | 100      | 116RF100M100TT            | 116TEA100K100TT           | 116UDB100K100TT           | 116XDB100J100TT           |
| 15                            | 150      | 116RF150M100TT            | 116TEA150K100TT           | 116UEA150K100TT           | 116XDB150J100TT           |
| 22                            | 220      | 116RGA220M100TT           | 116TEA220K100TT           | 116UEA220K100TT           | 116XDB220K100TT           |
| 27                            | 270      | 116RGA270M100TT           | 116TF270K100TT            | 116UEA270K100TT           | 116XDB270K100TT           |
| 33                            | 330      | 116RGA330M100TT           | 116TF330K100TT            | 116UEA330K100TT           | 116XEA330K100TT           |
| 47                            | 470      | 116RG470M100TT            | 116TF470K100TT            | 116UF470K100TT            | 116XEA470K100TT           |
| 56                            | 560      | 116RG560M100TT            | 116TF560K100TT            | 116UF560K100TT            | 116XEA560K100TT           |
| 68                            | 680      | 116RK680M100TT            | 116TGA680K100TT           | 116UF680K100TT            | 116XEA680K100TT           |
| 82                            | 820      | 116RK820M100TT            | 116TGA820K100TT           | 116UF820K100TT            | 116XEA820K100TT           |
| 100                           | 101      | 116RL101M100TT            | 116TGA101K100TT           | 116UF101K100TT            | 116XF101K100TT            |
| 220                           | 221      |                           | 116TK221M100TT            | 116UG221M100TT            | 116XF221K100TT            |
| 330                           | 331      |                           | 116TL331M100TT            | 116UK331M100TT            | 116XGA331K100TT           |
| 470                           | 471      |                           |                           | 116UK471M100TT            | 116XGA471K100TT           |
| 560                           | 561      |                           |                           | 116UL561M100TT            | 116XG561M100TT            |
| 680                           | 681      |                           |                           | 116UL681M100TT            | 116XK681M100TT            |
| 820                           | 821      |                           |                           | 116UL821M100TT            | 116XK821M100TT            |
| 1000                          | 102      |                           |                           |                           | 116XK102M100TT            |

Inches (mm)

### ATC Part Number Code

|                                                                                                    |     |   |   |    |   |   |     |    |                                                                                                                                     |
|----------------------------------------------------------------------------------------------------|-----|---|---|----|---|---|-----|----|-------------------------------------------------------------------------------------------------------------------------------------|
| ATC Series                                                                                         | 116 | X | A | 1R | 2 | A | 100 | TT | Termination Code: (see pg. 4 for full descriptions)<br>TT = Titanium Tungsten/Nickel/Gold (standard)<br>TX = Titanium Tungsten/Gold |
| Case Size                                                                                          |     |   |   |    |   |   |     |    |                                                                                                                                     |
| Dielectric Style: Max. 2 characters                                                                |     |   |   |    |   |   |     |    |                                                                                                                                     |
| Capacitance Code: First 2 significant digits for capacitance. R=Decimal Point                      |     |   |   |    |   |   |     |    | WVDC (in Volts): 3 significant digits, 100 Volts is standard.                                                                       |
| Indicates number of zeros following digits of capacitance in picofarads except for decimal values. |     |   |   |    |   |   |     |    | Capacitance Tolerance (see table below)                                                                                             |

### Capacitance Tolerances

| Code | A (pF) | B (pF) | C (pF) | D (pF) | F (%) | G (%) | J (%) | K (%) | M (%) |
|------|--------|--------|--------|--------|-------|-------|-------|-------|-------|
| Tol. | ± 0.05 | ± 0.1  | ± 0.25 | ± 0.5  | ± 1   | ± 2%  | ± 5   | ± 10  | ±20%  |

The above part number refers to a 116 series, case size X, A dielectric, 1.2 pF, with a capacitance tolerance of A (±0.05pF), 100 WVDC, with thin film gold termination.

ATC accepts orders for our parts using designations with or without the "ATC" prefix. Both methods of defining the part number are equivalent, i.e., part numbers referenced with the "ATC" prefix are interchangeable to parts referenced without the "ATC" prefix. Customers are free to use either in specifying or procuring parts from American Technical Ceramics.

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# ATC SLC HIGH RELIABILITY CERTIFICATION PROGRAM

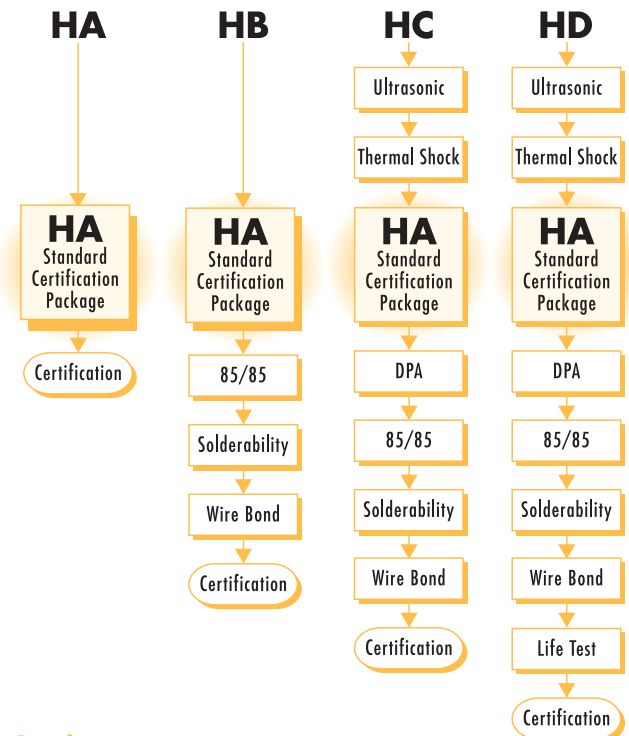


## Commercial Off The Shelf High Reliability Certification Program

The ATC COTS Program provides a cost efficient approach to qualifying standard products for enhanced reliability applications. This flexible program offers standard screening packages with options to support specifics of customer-driven program requirements.

### Applications:

- Ruggedized Commercial  
(Medical, Industrial, Telecommunications)
- Military  
(Ground, Naval, Airborne)
- Space/Satellite



### ATC COTS Screening Options

#### HD: Highest Screening Level

The highest screening option adds life testing as an assurance in mission critical applications and is often used as an alternative in space qualified applications.

#### HC: Airborne Applications

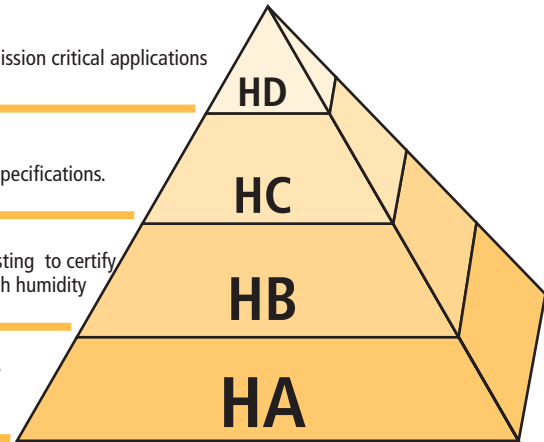
Often used in airborne applications, this profile closely models the military specifications.

#### HB: Additional Sample Testing

Built upon our standard HA Screening, this program provides additional sample testing to certify the termination for attachment integrity and the ability to survive and perform in high humidity environments.

#### HA: Standard Upscreen Package

ATC's Standard Hi Rel certification screening profile is typically used as a lower cost means to certify product reliability. HA screening is used throughout the industry in ground based military applications as well as stringent commercial applications.



| P/N Prefix |    |    |    | Evaluation Operation                                 | Sample Size |
|------------|----|----|----|------------------------------------------------------|-------------|
| HA         | HB | HC | HD |                                                      |             |
|            |    | X  | X  | Ultrasonic Screening†                                | 100%        |
|            |    | X  | X  | Thermal Shock (5 Cycles for HC and 20 Cycles for HD) | 100%        |
| X          | X  | X  | X  | Standard Hi-Rel Certification Package (HA)           | 100%        |
|            |    | X  | X  | Destructive Physical Analysis                        | see table*  |
|            | X  | X  | X  | 85/85 (Low Voltage Moisture Humidity)                | 13 units*   |
|            | X  | X  | X  | Solderability (Solderable or Solder Coated Only)     | 5 units*    |
|            | X  | X  | X  | Wire Bond Test (Gold Terminated Chips Only)          | 13 units*   |
|            |    |    | X  | Life Test (2000)                                     | 25 units*   |

\* Additional sample units required that have passed the 100% testing along with the deliverable (flight) quantity.

† Ultrasonic Screening does not apply to SLC products.

| DPA Sample Table |        |
|------------------|--------|
| Lot Size         | Sample |
| 1 - 500          | 14     |
| 501 - 10,000     | 32     |
| 10,001 - 35,000  | 50     |
| 35,001 and up    | 80     |

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