State of the Art, Inc.

MISSION-CRITICAL RESISTOR SPECIALISTS.

All products are made in the USA.

Market/Products

We have been supplying the aerospace, biomedical, defense, and communications industries with high reliability, mission-critical chip resistors for over 40 years.

All of our products are designed and manufactured with performance and reliability as the guiding principles. Our other products include:

- **Thin film on silicon resistors for hybrid applications**
- **High frequency products, including attenuators, terminations, and chip resistors**
- **Surface mount resistor networks and custom thick and thin film networks**
- **High power resistors on beryllia or aluminum nitride**
- **Special application resistors including high voltage, high value, power moisture, and current sensing**

Customer Service

Outstanding customer service is just as important as the quality of the product. State of the Art, Inc. delivers that extra level of service for every customer, offering:

- **Application-specific engineering assistance**
- **A large inventory of ready-to-ship resistors for rapid delivery**
- **Well-trained, knowledgeable sales staff**
- **Best-in-class packaging and documentation**

From accurate, timely quotations to the packaging and documentation that accompanies the product, you will appreciate the State of the Art, Inc. advantage.

History

State of the Art, Inc. was founded in 1969 as a business presenting short courses on thick film processing. We began manufacturing chip resistors in 1972 and our products have been used in mission-critical space and military programs since 1975. We have been qualified to supply MIL-PRF-55342 film chip resistors since 1980.

Our comprehensive line of resistor products and our uncompromising dedication to quality, reliability, and customer service have established State of the Art, Inc.'s worldwide reputation as a leading supplier of chip resistors for mission-critical applications.

All of our resistor products are made in the USA at our State College, Pennsylvania facility. We use the same design, materials, quality systems, and production line to produce our standard, high reliability, and QPL military products. All of our products are designed for reliability in demanding applications. State of the Art, Inc. remains a privately held and financially strong manufacturer dedicated to serving the high reliability market.

Contents

Quality Systems

Our ISO 9001 and AS9100 registered quality systems, MIL-PRF-55342, MIL-PRF-32159, and MIL-PRF-914 QPL qualifications, and long-standing continuous improvement philosophy attest to our commitment to manufacturing the highest reliability resistor and attenuator products.

ISO 9001 & AS9100 Registration
Eagle Registration, Inc.

Quality Systems	ISO 9001 & AS9100
Reliability Assurance	MIL-STD-790
Failure Rate Procedures	MIL-STD-690
Defect Level (ppm)	EIA-554
Statistical Process Control	EIA-557
Calibration System	ISO 10012

Product Grades

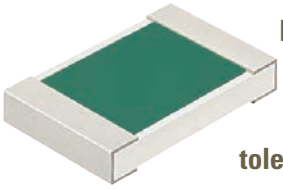
State of the Art, Inc. offers military, high reliability, and standard grade products that share the same design, materials, quality system, and production line. All of our products are subject to a quality system designed to meet the rigors of supplying established reliability military chip resistors. Military, high reliability, and standard grade products are identical except for the extent of screening performed.

Military Grade Our MIL-PRF-55342 chip resistors are subject to in-process inspections and Group A, B, and C lot acceptance testing. MIL-PRF-55342 resistors are maintained at S failure rate level on the basis of life testing. State of the Art, Inc. is listed on the QPL55342 (fixed chip resistors) for all product levels (M, P, R, S, U, V, and space level T) and all 13 slash sheets. Similarly, we are listed on QPL32159 (zero ohm chip resistors) for product levels M and space level T and all 13 slash sheets. We are also listed on QPL914 (surface mount resistor networks) for the /03, /04, and /05 slash sheets.

High Reliability Grade High reliability products are used in mission-critical applications where QPL products are not available or are not adequate. High reliability products include DLA Land and Maritime drawings NASA EEE-INST-002, customer source control drawings, and our own test protocols based on MIL-PRF-55342 created for our customers' convenience. Most of the high reliability screening we perform is based upon the lot acceptance testing of MIL-PRF-55342.

Standard Grade Standard grade resistors are ideal for non-mission-critical applications. These products are designed for reliability and only differ from our military products in the screening performed. Our standard grade products are subject to DC resistance on a 100% basis, and solderability, temperature coefficient of resistance, and visual inspection on a sample basis during manufacturing. Standard grade resistors are not subject to any lot acceptance testing.

MIL-PRF-55342 Chip Resistors



MIL-PRF-55342 provides established reliability fixed film chip resistors in a variety of cases, product levels, temperature characteristics, tolerances, and termination materials.

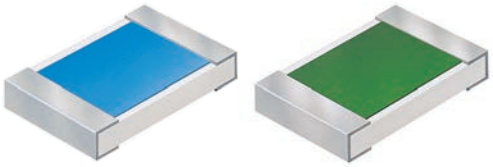
MIL-PRF-55342 includes precision and semi-precision part numbers that use thick film and thin film materials and processes to provide the complete range of part numbers.

Precision thin film chip resistors have resistance tolerances of ±0.1, ±0.25, and ±0.5% and/or temperature coefficient of resistance of ±25 and ±50 ppm/°C. Thin film materials are sputter deposited and patterned using photolithography. These thin film resistor materials exhibit low current noise and lower drift than semi-precision thick film resistors.

Semi-precision thick film devices have resistance tolerances of ±1, ±2, ±5, and ±10% and/or temperature coefficient of resistance of ±100, ±200, and ±300 ppm/°C. Thick film pastes are screen printed onto alumina substrates and fired at 850°C. These thick film resistors have higher current capacity than precision thin film resistors.

Surface Mount Chip Resistors

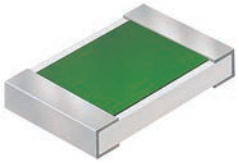
Precision and semi-precision chip resistors with termination material B are assembled using surface mount tin-lead soldering processes. Termination material B devices have wraparound terminations with SN60 solder over a nickel barrier layer.



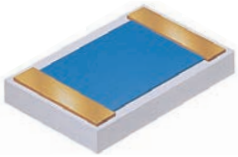
Chip Resistors for Hybrids

Chip resistors with termination materials C (silver based) and G (gold) are assembled into hybrid circuits using conductive epoxy. These semi-precision thick film chip resistors have wraparound terminations which are not solderable.

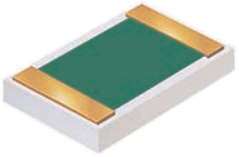
Precision and semi-precision chip resistors with termination material W are also assembled into hybrid circuits using wire bonds. These devices have planar terminations on the top surface of the resistor with a gold finish.



Epoxy Bondable



Wire Bondable



Wire Bondable

MIL-PRF-55342 Cases and Ratings

	Case Size Code*	Rated Power (mW)	Rated Voltage (V)
M55342 /13	RM0302	40	15
M55342 /11	RM0402	50	30
M55342 /01	RM0502	50	40
M55342 /02	RM0505	125	40
M55342 /12	RM0603	100	50
M55342 /06	RM0705	150	50
M55342 /03	RM1005	200	75
D55342 /07	RM1206	250	100
M55342 /04	RM1505	150	125
M55342 /10	RM1010	500	75
M55342 /08	RM2010	800	150
M55342 /05	RM2208	225	175
M55342 /09	RM2512	1000	200

*Case size code indicates nominal part size.
Example: RM0402 is 40 x 20 mils.

Product Levels
All product levels share the same design, materials, and construction processes. Product levels only differ in the conformance inspection performed in Groups A and B.

Product levels M, P, R, and S resistors are subject to precap visual inspection and 100% DC resistance on a production lot basis. Thermal shock and solderability have been deleted with qualifying activity approval. Visual inspection, resistance to solvents, and all of Group B are performed on an inspection lot basis.

Product levels U and V subjects R and S level resistors to Group B on a production lot basis.

Space product level T subjects R and S level resistors to Groups A and B testing on a production lot basis. Power conditioning and visual inspection (100%) are added to Group A, subgroup 2, to provide infant mortality screening.

Group C is performed on an inspection lot basis for all product levels.

M55342 K 06 B 100D S

Product Level Designation
M: 1% per 1000 hrs **S & V:** 0.001% per 1000 hrs
P: 0.1% per 1000 hrs **T:** Space Level
R & U: 0.01% per 1000 hrs

Resistance & Tolerance Code
Three significant digits, with a letter indicating the decimal location, the tolerance, and the value range (Ω, kΩ, MΩ)

	0.1%	0.25%	0.5%	1%	2%	5%	10%
Ω	A	R	W	D	G	J	M
kΩ	B	U	Y	E	H	K	N
MΩ	C	V	Z	F	T	L	P

Termination Materials
B: SN60 solder over nickel barrier wraparound
C: Epoxy bondable palladium/silver wraparound (thick film only)
W: Gold wire bondable **G:** Epoxy bondable gold wraparound (thick film only)

Size Code
01: RM0502 **02:** RM0505 **03:** RM1005 **04:** RM1505 **05:** RM2208 **06:** RM0705 **07:** RM1206 **08:** RM2010 **09:** RM2512 **10:** RM1010 **11:** RM0402 **12:** RM0603 **13:** RM0302

Temperature Characteristic
E: ±25 ppm **H:** ±50 ppm **K:** ±100 ppm **M:** ±300 ppm **L:** ±200 ppm

Performance Specification MIL-PRF-55342

MIL-PRF-55342 Screening

Group A
Precap Visual Inspection
100% DC Resistance *(T level only)*
100% Thermal Shock
100% Power Conditioning *(T level only)*
100% DC Resistance
100% Visual Inspection *(T level only)*
Visual Inspection
Solderability
Resistance to Solvents

Group B
Resistance Temperature Characteristic
Short Time Overload
Mounting Integrity

Group C
Life Test
Thermal Shock
Low Temperature Operation
Resistance to Soldering Heat
Moisture Resistance
High Temperature Exposure

Packaging
MIL-PRF-55342 devices are packaged in waffle trays or on tape and reel, and may be indicated by using -W or -TR after the part number.

MIL-PRF-32159 Cases and Ratings

	Case Size Code*	Rated Power (mW)	Rated Current** (I)
M32159 /13	RCZ0302	40	1.10
M32159 /11	RCZ0402	50	1.20
M32159 /01	RCZ0502	50	1.30
M32159 /02	RCZ0505	125	2.20
M32159 /12	RCZ0603	100	1.50
M32159 /06	RCZ0705	150	2.70
M32159 /03	RCZ1005	200	2.80
M32159 /07	RCZ1206	250	3.20
M32159 /04	RCZ1505	150	2.10
M32159 /10	RCZ1010	500	5.00
M32159 /08	RCZ2010	800	5.70
M32159 /05	RCZ2208	225	2.50
M32159 /09	RCZ2512	1000	6.30

*Case size code indicates nominal part size. *Example:* RCZ0603 is 60 x 30 mils.

** Current rating for B & G material product. Consult data sheet for ratings of other termination materials.

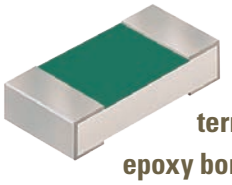
MIL-PRF-32159 Screening

Group A
Precap Visual Inspection
100% Thermal Shock
100% Power Conditioning *(T level only)*
100% DC Resistance
Visual Inspection
Solderability
Resistance to Solvents

Group B
Short Time Overload
Mounting Integrity

Group C
Life Test
Thermal Shock
Low Temperature Operation
Resistance to Soldering Heat
Moisture Resistance
High Temperature Exposure

MIL-PRF-32159 Zero Ohm Chip Resistors



MIL-PRF-32159 provides zero ohm chip resistors in a variety of cases, product levels, and termination materials suitable for soldering and epoxy bonding applications.

Surface Mount Zero Ohm Chip Resistors

Zero ohm chip resistors with termination material B are assembled using surface mount tin-lead soldering processes. Termination material B devices have wraparound terminations with SN60 solder over nickel barrier.

Zero Ohm Chip Resistors for Hybrids

Zero ohm chip resistors with termination materials C (silver based) and G (gold) are assembled into hybrid circuits using conductive epoxy. These termination materials have wraparound terminations which are not solderable.

Product Levels

All product levels share the same design, materials, and construction processes. The product levels differ in the conformance inspection testing performed in Groups A and B. Group C is performed on an inspection lot basis for all product levels. MIL-PRF-32159 devices do not have an established reliability failure rate level.

Military product level M zero ohm chip resistors are subject to precap visual inspection and 100% DC resistance on a production lot basis. Thermal shock and solderability have been deleted with qualifying activity approval. Visual inspection, resistance to solvents, and all of Group B are performed on an inspection lot basis.

Space product level T subjects M level zero ohm resistors to Groups A and B on a production lot basis with no deletions. Power conditioning and visual inspection (100%) are added to Group A, subgroup 2, to provide infant mortality screening.

M32159 B 01 M

Product Level M: Military Level T: Space Level

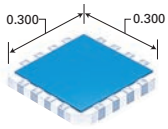
Size Code: This page

Termination Materials:
B: SN60 solder over nickel barrier wraparound
C: Epoxy bondable palladium/silver wraparound
G: Epoxy bondable gold wraparound

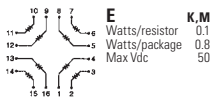
Performance Specification MIL-PRF-32159

MIL-PRF-914 Surface Mount Resistor Networks

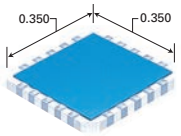
MIL-PRF-914 surface mount resistor networks are available in three sizes and with three schematics each.



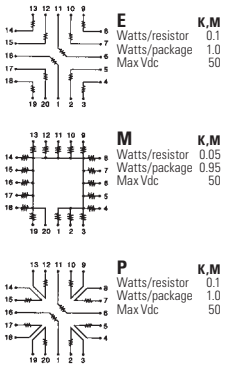
03 Thick Film (16 I/O)



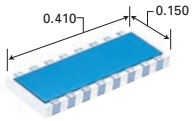
	E	M	W
	K,M	K,M	K,M
Watts/resistor	0.1	0.05	0.1
Watts/package	0.8	0.75	0.8
Max Vdc	50	50	50



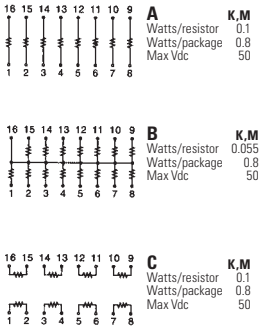
04 Thick Film (20 I/O)



	E	M	P
	K,M	K,M	K,M
Watts/resistor	0.1	0.05	0.1
Watts/package	1.0	0.95	1.0
Max Vdc	50	50	50



05 Thick Film (16 I/O)



	A	B	C
	K,M	K,M	K,M
Watts/resistor	0.1	0.055	0.1
Watts/package	0.8	0.8	0.8
Max Vdc	50	50	50

MIL-PRF-914 provides product level M, which is maintained at an established reliability rating of 1%/1000 hours. Group A includes 100% thermal shock, 100% power conditioning, and 100% DC resistance performed on a production lot basis. Visual inspection and solderability are performed on an inspection lot basis. Group B and Group C are performed on an inspection lot basis. The inclusion of 100% power conditioning in MIL-PRF-914's Group A inspection mimics the space level infant mortality screening found in MIL-PRF-55342.

MIL-PRF-914 includes two termination materials with similar tin-lead solder over nickel materials. Termination material D is electroplated SN60 solder over nickel barrier. Termination material G is made by immersing devices with the D material into molten SN60 solder (hot solder dip finish).

M914 D 04 K 1002 F M M

- **Product Level Designator**
  M: 1 % per 1000 hours ER life failure rate
- **Schematic Configuration**
  See diagram above
- **Tolerance**
  F: 1% G: 2% J: 5%
- **Resistance Value**
  Four digits are used, with the three leading digits being significant. The last digit indicates the number of zeros to add. The letter R indicates the decimal when required.
- **Temperature Characteristic**
  K: ±100 ppm M: ±300 ppm
- **Size Code**
  03: 0.300 x 0.300" **04**: 0.350 x 0.350" **05**: 0.410 x 0.150"
- **Termination Material**
  D: Plated SN60 solder over nickel barrier G: Hot solder dip SN60 solder over nickel barrier
- Military Performance Specification MIL-PRF-914

MIL-PRF-914 Screening

Group A
100% Thermal Shock
100% Power Conditioning
100% DC Resistance
Visual Inspection
Solderability

Group B
Visual & Mechanical Inspection
Temperature Coefficient of Resistance (TCR)
Resistance to Solvents

Group C
Thermal Shock
Dielectric Withstanding Voltage
Insulation Resistance
Low Temperature Operation
Short-time Overload
Adhesion
Resistance to Soldering Heat
Moisture Resistance
Life
Steady State Humidity
Shock & Vibration
High Temperature Exposure
Low Temperature Storage

Packaging

SOTA's surface mount resistor networks are packaged in chip tray carriers ("waffle packs"). Tape and reel packaging is available as an option for the /04 and /05 MIL-PRF-914 networks.

Part Marking

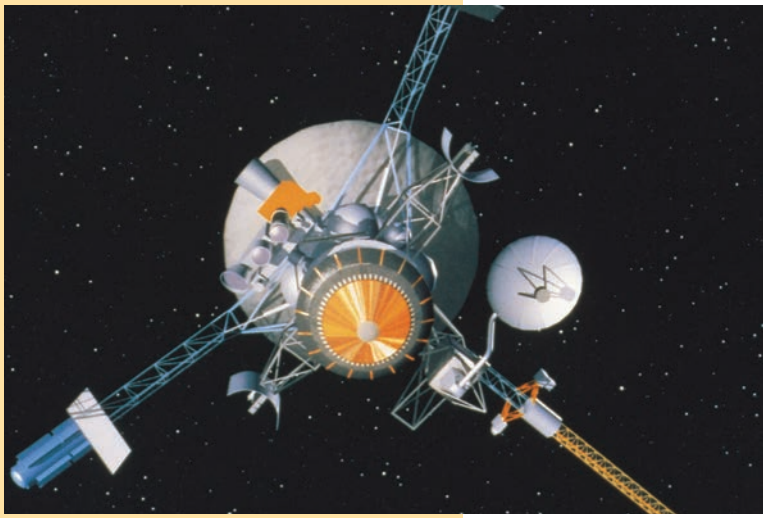
Line 1–
Digits 1-3: Date code.
Digit 1 = year.
Digits 2 & 3 = week.
Digit 4 = TCR.

Line 2–
Digits 1-4: Resistance value.
Three significant digits and multiplier.

Line 3–
Digit 1: Tolerance.
Digit 2: Schematic configuration.
Digit 3: Failure rate.
Digit 4: Military JAN certification.

A dot is used to mark the pin one location.

High Reliability PRODUCTS



High reliability screening is available for all of our products.

High reliability screening can be used to identify anomalous lots with excessive drift that could threaten the success of your mission. High reliability screening is typically specified using a customer source control drawing, a DLA Land and Maritime (DESC, DSCC, etc.) drawing, or a State of the Art, Inc. screening drawing. High reliability screening is often based upon the lot acceptance testing of MIL-PRF-55342.

Customer Source Control Drawings
Source control drawings are created by customers to communicate the performance requirements for devices used in their application. These drawings often use MIL-PRF-55342 screening methods but can add additional requirements, additional tests, and custom test criteria. We welcome the opportuity to review your SCD.

DLA Land and Maritime Drawings
Our high reliability products also include many DLA Land and Maritime, DESC, and DSCC drawings for high reliability chip resistor and surface mount resistor networks. These drawings include various chip resistors and resistor networks not included in MIL-PRF-55342 and MIL-PRF-914. Please consult your sales contact for more information on these drawing products.

- Values < 1 Ω
- Zero Ohm Chips
- Power Moisture Resistors
- Non-QPL Case Sizes
- High Power Resistors
- Surface Mount Resistor Networks

Consult DLA Land and Maritime for more specific information on these DESC, DSCC, and DLA Land and Maritime drawings.

State of the Art, Inc. Test Drawings
Our test drawings specify screening, sampling plans, test methods, and pass/fail criteria. These drawings are based upon the lot acceptance testing of MIL-PRF-55342 and may be adapted to meet the needs of particular products (silicon resistors, high power resistors, etc.).

Test Drawings

Groups A & B per MIL-PRF-55342 Military Levels
SOTA 001
SOTA 014 Attenuators
SOTA 006 (+ 100% visual inspection)
SOTA 021 (+ 1000 hour life test)

Groups A & B per MIL-PRF-55342 Space Level T 100% power conditioning
SOTA 002

100% High Temperature (125°C) Exposure
SOTA 004
SOTA 015 Attenuators

Groups A, B & C MIL-PRF-55342 Military Levels
SOTA 036
SOTA 042 Attenuators

Groups A, B & C MIL-PRF-55342 Military Levels and Sample power conditioning
SOTA 007
SOTA 008 (+100% visual inspection)

Group A per MIL-PRF-55342 Military Levels
SOTA 013

Group C per MIL-PRF-55342
SOTA 000
SOTA 016 attenuators

Life Test
SOTA 022 1000 hours
SOTA 033 2000 hours

Element Evaluation per MIL-PRF-38534
SOTA 023 Class H
SOTA 024 Class K

EEE-INST-002
SOTA 031 Level 1
SOTA 040 Level 2
SOTA 043 Level 3

Recertification of older date code product
SOTA 020 DC Resistance and Solderability

MIL-PRF-55342 Military Levels

Group A
- Precap Visual Inspection
- Thermal Shock (100%)
- DC Resistance (100%)
- Visual Inspection
- Solderability
- Resistance to Solvents

Group B
- Resistance Temperature Characteristic
- Short Time Overload
- Mounting Integrity

MIL-PRF-55342 Space Level T

Group A
- Precap Visual Inspection
- DC Resistance (100%)
- Thermal Shock (100%)
- Power Conditioning (100%)
- DC Resistance (100%)
- Visual Inspection (100%)
- Visual Inspection
- Solderability
- Resistance to Solvents

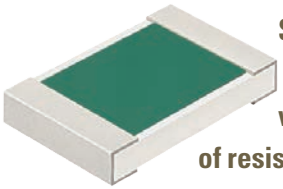
Group B
- Resistance Temperature Characteristic
- Short Time Overload
- Mounting Integrity

MIL-PRF-55342

Group C
- Life
- Thermal Shock
- Low Temperature Operation
- Resistance to Soldering Heat or Resistance to Bonding Exposure
- Moisture Resistance
- High Temperature Exposure

Standard and High Reliability Chip Resistors

Surface Mount
Semi-Precision Thick Film



Semi-precision thick film chip resistors are available in a wide range of resistance values with tolerances to 1% and temperature coefficient of resistance (TCR) to 100 ppm/°C.

Semi-precision thick film resistors are available with resistance values from 20 mΩ to 300 MΩ. Thick film resistors have higher current capacity than the precision thin film resistors. Low resistance value devices have low current noise, but current noise increases with resistance value.

Wraparound terminations (C type) with the X finish (SN60 solder over nickel barrier) are used for surface mount applications using tin-lead based solders. The Y finish (silver over nickel barrier) is offered for use with RoHS solder alloys.

Other termination types and finishes are offered for other applications. Wire bond applications use A, D, or E termination types with a gold (G) finish. Epoxy bondable applications use C termination type with silver (C) or gold (G) finish for use with conductive epoxies.

Thick Film Chip Resistors Cases and Ratings

Case Size Code*	Rated Power (mW)	Rated Voltage (V)	Thermal Resistance (°C/W)
0402	50	30	48.9
0502	60	40	36.8
0504	125	40	29.0
0505	125	40	20.9
0603	100	50	30.5
0705	200	50	23.7
1005	250	75	26.9
1010	500	75	13.8
1206	250	100	22.6
1505	330	125	35.7
2010	1000	150	22.4
2208	750	175	21.3
2512	1500	200	13.6

* Case size indicates nominal part size.
Example: 0705 is 75 x 50 mils.

S 0603 C P X 150 J 20 *(optional)*

TCR Certification
10: ±100 ppm **20:** ±200 ppm **30:** ±300 ppm

Tolerance
D: 0.5% **F:** 1% **G:** 2% **J:** 5% **K:** 10% **M:** 20%

Resistance Value
Three or four digits are used, with all leading digits significant. Four digits are used for 1% tolerance or lower; otherwise, three digits are used. The last digit specifies the number of zeros to add. The letter R is used to represent the decimal for fractional ohmic values.
Example: 5R6 is 5.6 Ω; 15R0 is 15 Ω.

Termination Finish
X: SN60 solder over nickel barrier **Y:** Silver over nickel barrier
Z: Gold over nickel barrier **K:** SN60 solder bump **C:** Silver bearing **G:** Gold

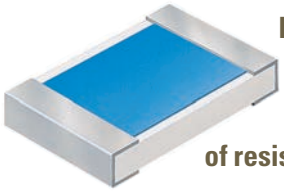
Product Designation
P: Thick film on alumina
B: High power on beryllia
V: High voltage on alumina
H: High value on alumina
U: Untrimmed alumina
K: 4-terminal Kelvin
R: High frequency on beryllia
F: High frequency on alumina

Termination Type
A: Top-side termination/bottom isolated
C: Wraparound termination
G: Wraparound/large bottoms
M: Wraparound/one large bottom
D: Top-side termination/bottom metallized
E: Single wraparound/bottom metallized
H: Wraparound/isolated center pad

Size Code
See Cases and Ratings Table

Grade
S: Standard Production **H:** High Reliability

Surface Mount
Precision Thin Film

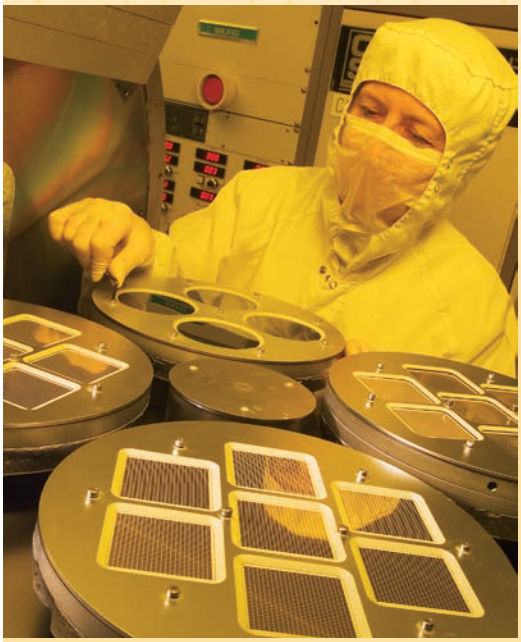


Precision thin film chip resistors are available in a range of resistance values with tolerances to 0.1% and temperature coefficient of resistance (TCR) to 25 ppm/°C.

Precision thin film resistors are available with resistance values from 5 Ω to 1 MΩ. The maximum resistance value decreases with decreasing case size. Thin film resistors have lower current capacity than semi-precision thick film resistors. Precision thin film resistors have low noise regardless of resistance value.

Wraparound terminations (C type) with the B finish (SN60 solder over nickel barrier) are used for surface mount applications using tin-lead based solders. The Y finish (silver over nickel barrier) is offered for use with RoHS solder alloys.

Other termination types and finishes are offered for other applications. Wire bond applications use A, D, or E termination types with a gold (W) finish. Epoxy bondable applications use C terminations type with gold (W) finish for use with conductive epoxies.



S 0505 C A 1001 F H B

Termination Finish
B: SN60 solder over nickel barrier Y: Silver over nickel barrier
K: SN60 solder bump M: Au/Sn solder bump
W: Gold A: Aluminum

Temperature Characteristic
E: ±25 ppm H: ±50 ppm K: ±100 ppm

Tolerance
B: 0.1% C: 0.25% D: 0.5% F: 1% G: 2% J: 5%

Resistance Value
Three or four digits are used, with all leading digits significant. Four digits are used for 1% tolerance or lower; otherwise, three digits are used. The last digit specifies the number of zeros to add. The letter R is used to represent the decimal for fractional ohmic values. Example: 5R6 is 5.6 Ω; 10R0 is 10 Ω.

Product Designation
A: Thin film on alumina
F: High frequency on alumina
L: High frequency on aluminum nitride
N: High power on aluminum nitride
S: Thin film on silicon

Termination Type
A: Top-side termination/bottom isolated
C: Wraparound termination
F: Back Contact
H: Wraparound/isolated center pad
L: High frequency termination
D: Top-side termination/bottom metallized
E: Single wraparound/bottom metallized
G: Wraparound/large bottoms
M: Wraparound/one large bottom

Size Code
See Cases and Ratings Table

Grade
S: Standard Production H: High Reliability

Thin Film Chip Resistors Cases and Ratings

Case Size Code*	Rated Power (mW)	Rated Voltage (V)	Thermal Resistance (°C/W)
0202	25	20	32.2
0302	40	15	38.1
0303	50	30	22.3
0402	50	30	37.3
0404	75	40	17.4
0502	60	40	29.3
0505	125	40	18.9
0603	100	50	25.7
0705	200	50	21.4
1005	250	75	24.9
1010	500	75	12.1
1206	250	100	21.0
1505	330	125	30.4
2010	1000	150	13.1
2208	750	175	18.8
2512	1500	200	12.7

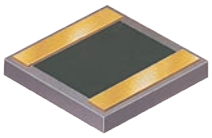
* Case size indicates nominal part size.
Example: 1206 is 120 x 60 mils.

Chip Resistors for Hybrids

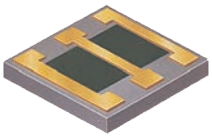
Wire Bondable Precision Thin Film on Silicon

The high thermal conductivity of the silicon substrate provides for higher power ratings and lower thermal resistance values than comparable resistors built on alumina.

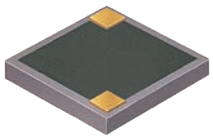
These wire bondable resistors are built on silicon substrates with a 10000Å thick insulating layer of silicon dioxide which provides a breakdown voltage of 400 V minimum and insulation resistance of $10^{12}\Omega$ minimum. Silicon resistors are available in termination types A (top surface planar), D (top surface planar with metal back), and F (back contact) with gold or aluminum finish. Configuration varies with resistance value.



B Pad (low value)

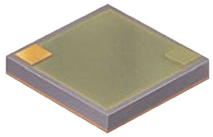


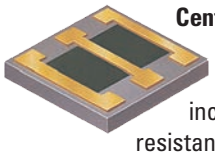
Center-Tap (mid value)



P Pad (high value)

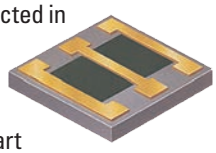
Back-Contact Resistors utilize the conductive silicon substrate as connection from the resistor to the back-contact on the chip. This back-contact eliminates one wire bond connection. These back-contact resistors are available in the 0202 case with resistance values >100Ω. *Example:* S0202FS1001DKW *(see page 9)*

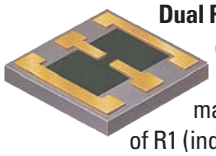




Center-Tap Resistors have resistor elements of similar value connected in series. Center-tap resistor part numbers include –CT at the end of the precision thin film part number *(see page 9)* and may include a match tolerance code (-CTB) for the two resistors. The total resistance value is coded in the part number. *Examples:* S0303AS1001FEW-CT, S0303AS1001FEW-CTF *(see page 9)*

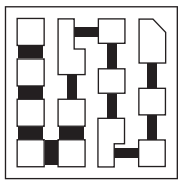
Dual-Tap Resistors have resistor elements of dissimilar value connected in series. Dual-tap resistor part numbers include –DT at the end of the precision thin film part number *(see page 9)* and may include a match tolerance code (-DTB) for the two resistors. The resistance value of R1 (indicated by the rounded contact) is coded within the part number. The resistance value of R2 is coded at the end of the part number. *Examples:* S0303AS1001FEW-DT2001, S0303AS1001FEW-DTB2001 *(see page 9)*



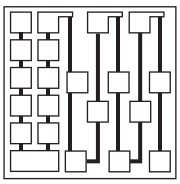


Dual Resistors provide two electrically isolated resistor elements of similar or dissimilar values. Dual resistor part numbers include –DR at the end of the precision thin film part number *(see page 9)* and may include a match tolerance code (-DRB) for the two resistors. The resistance value of R1 (indicated by the rounded contact) is coded within the part number. The resistance value of R2 is coded at the end of the part number when R1 and R2 have dissimilar values. *Examples:* S0303AS1001FEW-DR, S0303AS1001FEW-DRB2001 *(see page 9)*

Multi-Tap Resistors are comprised of 12 (MT1) or 20 (MT20) resistor elements connected in series through taps. MT1 devices are comprised of seven R1 and five R2 resistor elements where the resistance value of R1 is five times the value of R2. MT2 devices are comprised of ten R1 and ten R2 resistor elements where the resistance value of R1 is ten times the value of R2. The total resistance value is coded in the part number. Tolerances of five and ten percent are available. Multi-tap chip resistor part numbers include –MT1 or –MT2 at the end of the precision thin film part number. *Example:* S0303AS1103JKW-MT2 *(see page 9)*



MT1



MT2

Center-Tap, Dual-Tap, and Dual Resistors are all comprised of two resistor elements on a single chip resistor with six contacts or taps. These resistor elements can have resistance values matched to as low as 0.05% and track with temperature to as low as 5 ppm/°C.

Silicon Chip Resistors Cases and Ratings

Case Size Code*	Rated Power (mW)	Rated Voltage (V)
0202	100	100
0303	250	100
0404	350	100
0505	500	100

* Case size indicates nominal part size. *Example:* 0202 is 20 x 20 mils.

Wire and Epoxy Bondable Precision Thin Film and Semi-Precision Thick Film on Ceramic

State of the Art, Inc. offers a variety of chip resistor and attenuator products for wire bond or epoxy bond applications.

MIL-PRF-55342 and MIL-PRF-32159 provides QPL chip resistors for hybrid applications. Termination material W provides devices for wire bonding, while the C and G materials provide devices for conductive epoxy attachment. *Examples:* **Wire bond:** M55342K02W10D0S, **Conductive epoxy bond:** silver M55342K02C10D0S, gold M55342K02G10D0S *(see pages 3 and 4)*

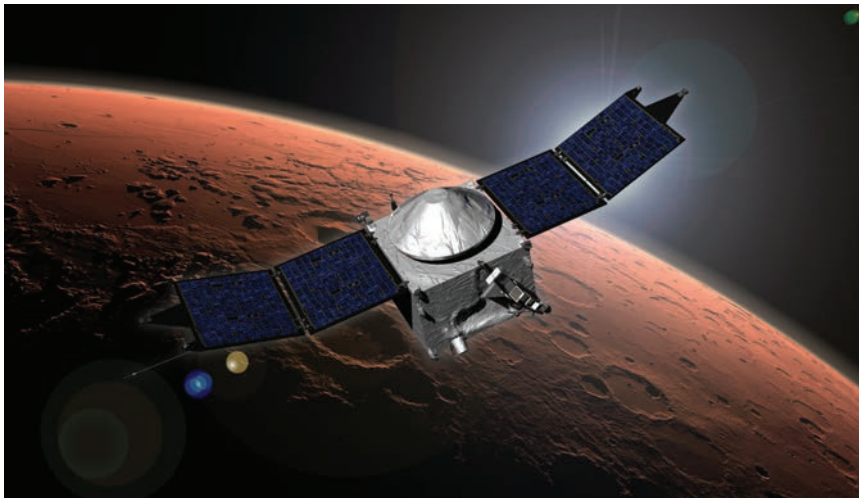
Standard and high reliability grade devices built on alumina ceramic substrates are also available for wire bond and epoxy bond applications in hybrids. High power wire bondable devices are also available that are built on beryllia (semi-precision thick film) and aluminum nitride (precision thin film) ceramic substrates.

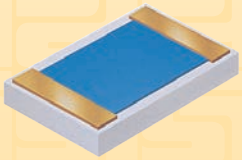
Wire bondable devices have A, D, or E termination types with gold finish and are available in both precision thin film and semi-precision thick film products. *Examples:* **Semi-precision thick film:** S0402APG10R0F10, **Precision thin film:** S0505AA1001BEW *(see pages 8 and 9)*

Conductive epoxy devices have C termination type with gold or silver finish. The gold finish is available in both precision and semi-precision products, while the silver finish is only available as semi-precision thick film products. *Examples:* **Semi-precision thick film:** S0402CPG10R0F10, **Precision thin film:** S0402CA1001BEW *(see pages 8 and 9)*

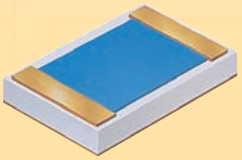
Most of our special application resistors (current sense, high power, high voltage, etc.) are available in configurations suitable for wire bond or conductive epoxy applications. *(see pages 14 and 15)*

Our products for high frequency applications are also available for use in hybrids. We offer wire bondable fixed and temperature variable attenuators as well as wire bondable high frequency resistors and terminations. (see pages 12 and 13)

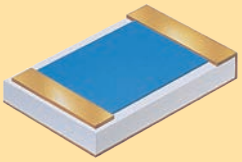




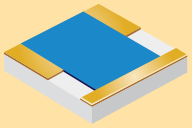
A Termination Type



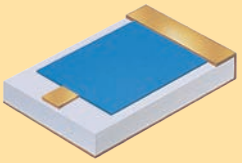
D Termination Type



E Termination Type

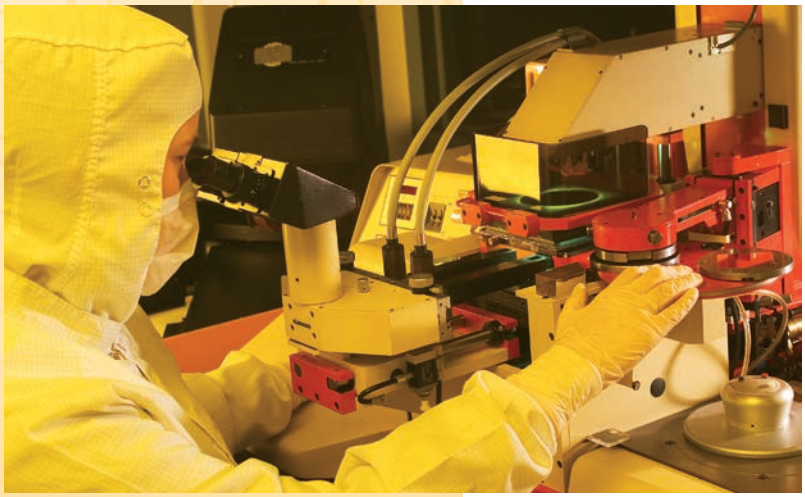


Attenuator



High Frequency Termination Resistor

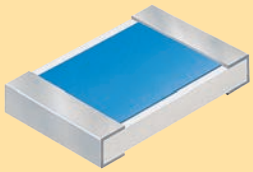
High Frequency Resistors



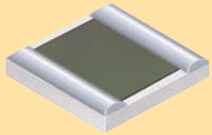
Chip Resistors

High frequency chip resistors are available in a wide range of resistance values and are designed to minimize loss at higher frequencies.

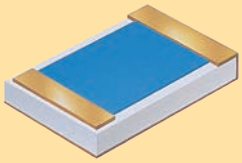
High frequency resistors made using thin film materials have lower loss at high frequency than resistors made using thick film materials. High frequency resistors with values from 5 to 200 ohms can be made using thin film materials. Thick film materials are used to produce high frequency resistors with resistance values from mΩ to MΩ .



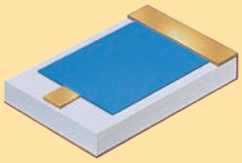
C Termination Type



A Termination Type



E Termination Type



L Termination Type

Surface Mount Chip Resistors
Wraparound termination type C is used at frequencies <4 GHz. At frequencies >4GHz, inductive losses associated with the wraparound degrades performance. Flip chip mounting (film side down) reduces the inductive losses while providing a solder fillet that is readily inspected. *Examples:* **Precision thin film:** S0402CF500GKB, **Semi-precision thick film:** S0402CFX1R0G10 *(see pages 8 and 9)*

The planar terminations of the A termination type minimize inductive losses at higher frequencies when the device is flip chip soldered (film side down). *Examples:* **Precision thin film:** S0402AF500GKB, **Semi-precision thick film:** S0402AFX103G10 *(see pages 8 and 9)*

Termination Resistors
Termination resistors are available on alumina, beryllia (semi-precision high power), and aluminum nitride (precision high power) substrates using either the E or L termination type in solderable or wire bondable termination finishes.

Our E termination type devices perform well up to 5 GHz and are available in many cases. *Examples:* **Semi-precision high power:** S1206EBX500G20, **Precision high power:** S2525EN500GNB *(see pages 8 and 9)*

Our L termination type devices perform well up to 40 GHz and are available on aluminum nitride: *Examples:* S0505LL500GNW, S2525LL500GNB *(see pages 8 and 9)*

Chip Resistors for Hybrids
High frequency chip resistors, and termination resistors are available as wire bondable devices for use in hybrid packages.

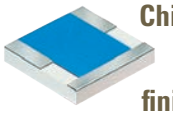
Resistors: *Examples:* **Semi-precision thick film:** S0505AFG1001F20, **Precision thin film:** S0402AF50R0FEW *(see pages 8 and 9)*

Termination Resistors (<5 GHz): *Examples:* **Semi-precision high power:** S1206EBG502G20, **Precision high power:** S2525EN500GNW *(see pages 8 and 9)*

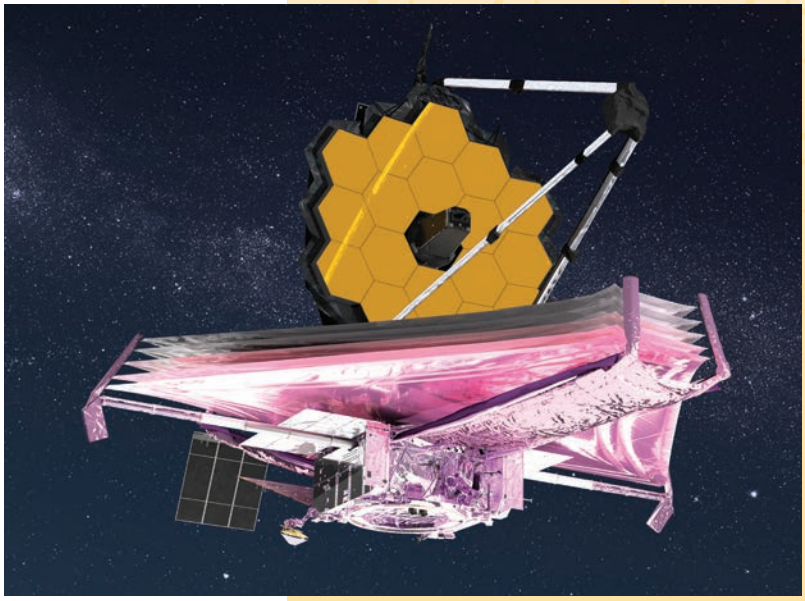
Termination Resistors (>5GHz): *Examples:* S0505LL500GNW, S2525LL500GNW *(see pages 8 and 9)*

Attenuators

Fixed Chip Attenuators



Chip attenuators are available in various termination types and finishes for applications at frequencies up to 40 GHz and beyond.



Surface Mount Chip Attenuators
Wraparound termination type C is used at frequencies <4 GHz. At frequencies >4GHz, inductive losses associated with the wraparound degrades performance. Flip chip mounting (film side down) reduces the inductive losses while providing a solder fillet that is readily inspected. *Example:* S1512CW3B0B

The planar terminations of the A termination type minimize inductive losses at higher frequencies (>4 GHz) when the device is flip chip soldered (film side down). *Example:* S0706AC10B0B

Chip Attenuators for Hybrids
Chip attenuators for hybrids have a gold finish for wire bonding and either A or E termination type. *Examples:* S0706AC1B0W, S1512EC10B0W

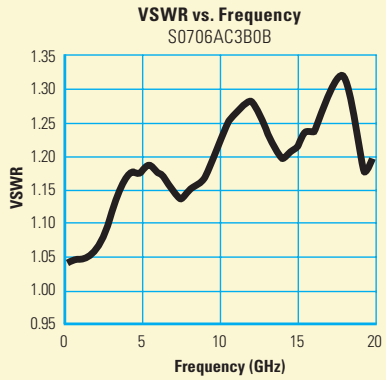
Coplanar Chip Attenuators
Coplanar fixed chip attenuators are offered for both surface mount and hybrid applications. *Examples:* **Surface mount:** S0303AC3B0B, **Wire bondable:** S0303AC3B0W

S 0706 A C 10B0 W

- Termination Finish
  B: SN60 solder over nickel barrier W: Gold
- Attenuation Factor
  Three or four characters indicating the attenuation factors with the B indicating the decimal
- Product Designation
  C: Thin film fixed on alumina W: Thick film fixed on alumina
- Termination Type
  A: planar top side C: wraparound E: ground wraparound to metal back
- Case Size
- Grade
  S: Standard Grade H: High Reliability Grade

Fixed Attenuators

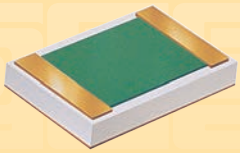
Case Size Code	Rated Power (mW)	Frequency Range
0303	50	DC - 35 GHz
0706	125	DC - 20 GHz
1005	250	DC - 18 GHz
1512	500	DC - 10 GHz



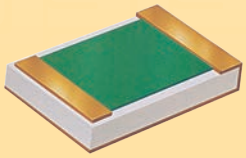
High Power

High power resistors are built on high thermal conductivity substrates. Semi-precision thick film devices are constructed on beryllia, while our precision thin film devices are built on aluminum nitride.

High power devices with termination types D and E have the lowest thermal resistance values (or highest power rating) for a case size. These termination types use the metal back as the primary thermal path to ground. The metal back is typically attached to a heat sink. Assembly is required to make the electrical connection to the device using ribbon leads or wire bonds. High power resistors (like all surface mount resistors) are conduction cooled – your thermal management scheme must spread the heat from the device to thermal ground. Termination finishes for soldering and wire bonding are available. *Examples:* **Precision thin film:** S2525EN50R0GKB, **Semi-precision thick film:** S0505DBG101G20 *(see pages 8 and 9)*



Type D Termination



Type E Termination

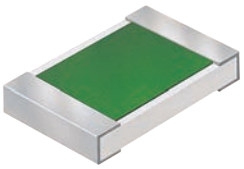
High Power Chip Resistors Cases and Power Ratings

Case Size Code*	Termination Type D, E (W)	C (W)	G, M (W)	H (W)
0505	10	1.0	1.5	
0705	4	0.75	1.0	
1010	14	1.25	1.5	
1206	14	1.5	2.0	2.0
1512	20	2.0	3.0	3.0
2010	30	2.5	4.0	4.0
2512	50	2.5	4.0	4.0
2525	100	4.0	8.0	8.0
3825	150	4.0	15.0	15.0
3838	200	5.0	20.0	20.0

* Case size indicates nominal part size. *Example:* 3838 is 375 x 375 mils.

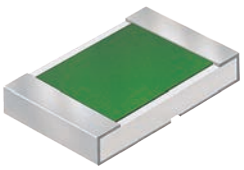
Surface Mount High Power

High power resistors are offered in several termination types and finishes suitable for surface mount applications. We offer SN60 solder over nickel barrier for applications using tin-lead solder. We also offer silver over nickel barrier for RoHS lead-free soldering.



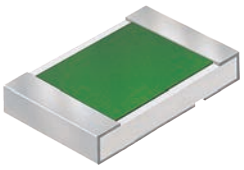
Type C Termination

Termination type C employs bottom end bands typically found on surface mount resistors. The heat produced by the resistor element is conducted through the device to the solder fillets and spread by the traces on the board that carry the electrical signal.



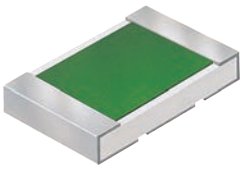
Type G Termination

Termination type G uses two large bottom end bands of equal length to shorten the thermal path through the device to the traces on the board that carry the electrical signal.



Type M Termination

Termination type M uses one very large bottom end band to shorten the thermal path to one of the traces on board.



Type H Termination

Termination type H uses the end band configuration found on the C type and adds an electrically isolated central pad that is used to remove the heat. A trace can connect the central thermal management pad to a thermal via or ground plane to spread the heat away from the resistor.

Current Sense

Four terminal current sense resistors provide separate current source and sense inputs for precise current sense applications. Current sense resistors are available in resistance values from 0.020Ω to 5Ω in surface mount and wire bondable types. Current sense resistors are specified using product code K. *Example:* S2010CKX0R05J *(see page 8)*

High Voltage

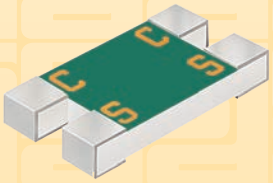
High voltage chip resistors are available in resistance values from 5 kΩ to 1 GΩ with ratings from 600 V to 5 kV. High voltage resistors are available in surface mount and wire bondable types. High voltage resistors are specified using product code V. *Examples:* S2010CVX1003F10, S2010AVG1004F10 *(see page 8)*

Zero Ohm Jumpers

Zero ohm jumpers (chip resistors) are available in all the cases cited on p. 8. These jumpers are made using thick film materials and use 000 as the value code in the thick film part number scheme found on p. 8. Termination finishes are available for solderable applications (X & Y) as well as for hybrid applications (G, P, & C). *Examples:* S0705CPX000, S0505APG000 *(see page 8)*

Untrimmed Resistors

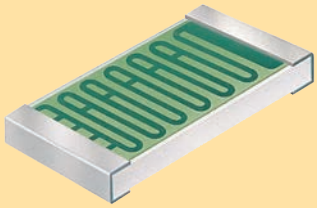
Untrimmed thick film resistors can be mounted into a circuit and subsequently dynamically laser trimmed to tune circuit performance. Untrimmed resistors also perform better than trimmed resistors in pulse power applications due to reduced current crowding around the trim. Untrimmed resistors are available in 10 and 20% tolerances. Untrimmed resistors are specified using the U product code in the thick film part number. *Example:* S1206CUX101M20 *(see page 8)*



Current Sense Chip Resistors Cases and Ratings

Case Size Code*	Rated Power (mW)	Rated Voltage (V)
1206	150	100
2010	650	150
2512	1000	200

* Case size indicates nominal part size. *Example:* 2512 is 250 x 125 mils.



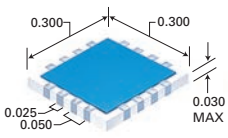
High Voltage Chip Resistors Cases and Ratings

Case Size Code*	Rated Power (mW)	Rated Voltage (V)
2010	1000	600
2512	1500	1200
3818	2000	2500
3838	3000	5000

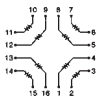
* Case size indicates nominal part size. *Example:* 2010 is 200 x 100 mils.

Resistor Networks

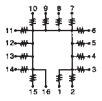
JEDEC Styles



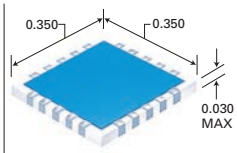
CA16 (16 I/O)



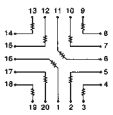
A
Watts/resistor 0.1
Watts/package 0.8
Max Vdc 50



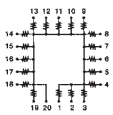
B
Watts/resistor 0.05
Watts/package 0.75
Max Vdc 50



CB20 (20 I/O)

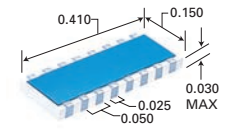


A
Watts/resistor 0.1
Watts/package 1.0
Max Vdc 50

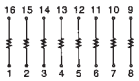


B
Watts/resistor 0.05
Watts/package 0.95
Max Vdc 50

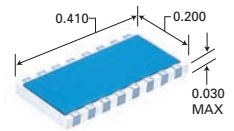
SLAMDIP Styles



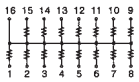
1516 (16 I/O)



A
Watts/resistor 0.1
Watts/package 0.8
Max Vdc 50



2016 (16 I/O)



B
Watts/resistor 0.055
Watts/package 0.8
Max Vdc 50

JEDEC and SLAMDIP surface mount resistor networks provide semi-precision performance in a high density package.

The resistors comprising the network typically have a single resistance value ranging from 5 to 10 MΩ but we have produced custom designs with differing resistance values.

Available tolerances include 1, 2, 5, and 10%.

Available temperature characteristics of resistance values include ±100, 200, and 300 ppm/°C.

The SN60 solder over nickel barrier termination finish is used for surface mount applications using tin-lead solder.

S J CB 20 L 1001 F A

Schematic Configuration
A: Isolated **B:** Common Connection

Tolerance
F: 1% **G:** 2% **J:** 5%

Resistance Code
Four digits are used with all leading digits significant. The last digit specifies the number of zeros to add. The letter R is used to represent the decimal for fractional ohmic values. Example: 10R0 is 10 Ω; 16R9 is 16.9 Ω, etc.

Temperature Characteristic
K: ±100 ppm **L:** ±200 ppm **M:** ±300ppm

Total I/O Count

Device Size

JEDEC Styles	SLAMDIP Styles
CA: 0.300 x 0.300"	**15:** 0.150 x 0.410 "
CB: 0.350 x 0.350"	**20:** 0.200 x 0.410"

Package Type
J: Indicates SOTA JEDEC Type C leadless network
D: Indicates SOTA SLAMDIP leadless network

Grade
S: Standard Production
H: High Reliability Screening

Resistor Performance

Power Rating

Power ratings for MIL-PRF-55342 products are assigned by the specification. Our power ratings have been set to ensure the devices will operate reliably at full power in a 70°C ambient temperature. Both military and standard grade resistors are linearly derated from full rated power at 70°C ambient to zero power at 150°C ambient to limit the film temperature to 150°C maximum.

Power Handling Capability

State of the Art, Inc. resistor products are conduction-cooled devices. Maintaining the film temperature at ≤150°C is the most important factor in reliable operation of these resistor products. The maximum power handling capability is determined by the ability of the chip and the mounting method to remove the heat generated by the resistor. SOTA lists thermal resistance values so our customers can determine how much power can be dissipated in their application.

Voltage Rating

The rated voltage of a chip resistor is determined by the continuous voltage stress the device can accommodate. Operation in excess of the rated voltage may compromise stability. Short time overloads (less than 5 seconds) up to twice the rated voltage will not degrade the chip significantly.

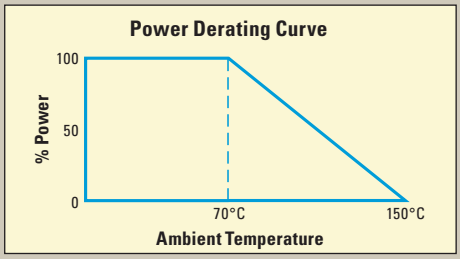
Life Test Performance

State of the Art, Inc. (SOTA) maintains the established reliability rating of our MIL-PRF-55342 resistors at level S (0.001%/1,000hours). SOTA performs >120 million unit hours of life testing in order to maintain these failure rates. A life test failure is defined as a change in resistance value larger than ±2.0% for failure rate maintenance and ±0.5% for qualification. These life tests are performed at 70°C ambient at maximum operating voltage applied for 90 minutes on, 30 minutes off, for 10,000 hours.

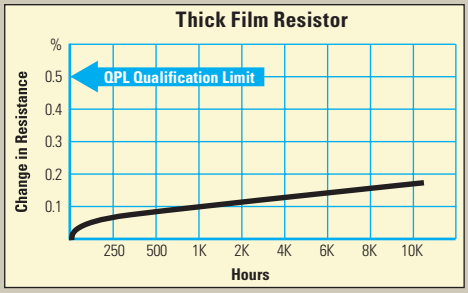
Test Criteria

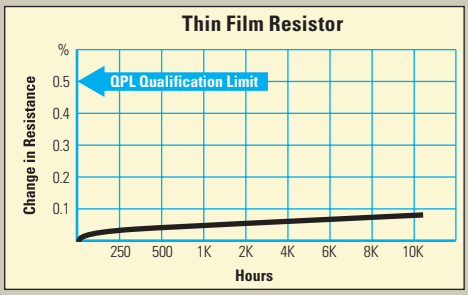
Pass/fail criteria for our standard and high reliability thick and thin resistors as well as our MIL-PRF-55342 qualified chip resistors are listed in the table below. The criteria for the MIL-PRF-55342 product are based upon the resistance temperature characteristic. Temperature characteristics K and M are typically produced using thick film technology, while temperature characteristics E and H can only be produced using thin film technology. The pass/fail criteria for our standard grade thick and thin film products mimic those stated in MIL-PRF-55342.

Power Ratings/Life Tests



Typical Life Test Performance



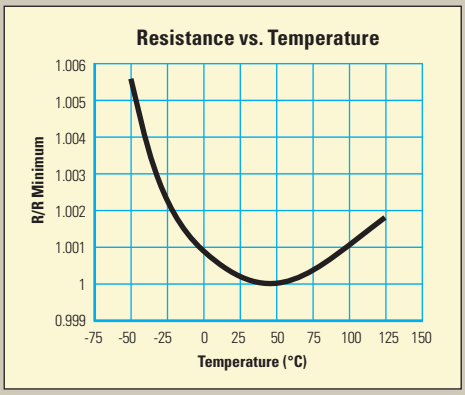


	MIL-PRF-55342					Standard	
Test Conditions	E	H	K	L	M	Thin Film	Thick Film
Resistance Range	5.6Ω–1MΩ	5.6Ω–1MΩ	1Ω–1MΩ	1Ω–1MΩ	1Ω–22MΩ	5Ω–5.6MΩ	0Ω–100MΩ
TCR (-55 to +125°C) in ppm/°C	±25	±50	±100	±200	±300	to±25	to±100
Max. Ambient Temperature, Full Power	70°C	70°C	70°C	70°C	70°C	70°C	70°C
Max. Temperature, Zero Wattage	150°C	150°C	150°C	150°C	150°C	150°C	150°C
Thermal Shock (max % change)*	±0.1	±0.25	±0.5	±0.5	±0.5	±0.1	±0.5
Low Temperature Operation (max % change)*	±0.1	±0.25	±0.25	±0.25	±0.5	±0.1	±0.25
Short-time Overload (max % change)*	±0.1	±0.1	±0.25	±0.25	±0.5	±0.1	±0.25
Resistance to Soldering Heat (max % change)*	±0.2	±0.25	±0.25	±0.25	±0.25	±0.2	±0.25
Moisture Resistance (max % change)*	±0.2	±0.4	±0.5	±0.5	±0.5	±0.2	±0.5
Life (max % change)*	±2.0	±2.0	±2.0	±2.0	±2.0	±2.0	±2.0
High Temperature Exposure (max % change)*	±0.1	±0.2	±0.5	±0.5	±1.0	±0.1	±0.5

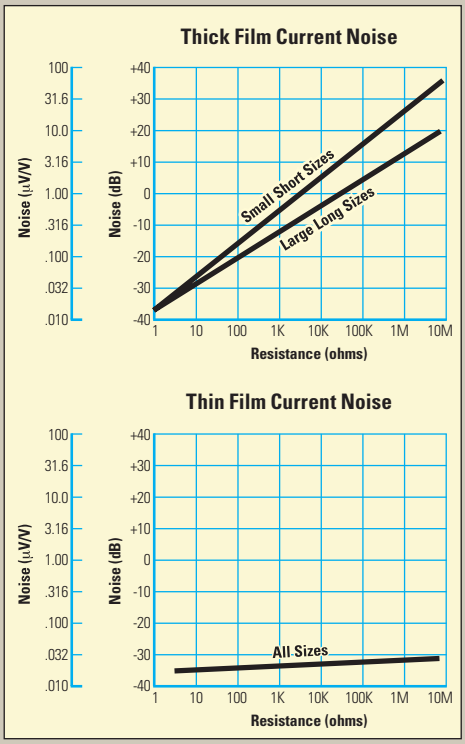
*Typical change in resistance values range from 10% to 50% of the pass/fail criteria.

Resistor Performance

TCR



Noise Performance



Temperature Coefficient of Resistance (TCR)
TCR is a measure of the stability of the resistance value with respect to changes in temperature. Standard TCR values for our thick film resistors are ± 100, 200, and 300 ppm/°C. Standard thin film TCR values are ±25, 50, and 100 ppm/°C.

TCR Tracking
Resistors of similar value from the same manufacturing lot show little variation in TCR behavior from chip to chip. TCR values within a typical thick film lot vary less than 50 ppm, while TCR values within a typical thin film manufacturing lot vary less than 30 ppm. Tracking less than 15 ppm can be achieved in a thin film lot when required. Resistors from different manufacturing lots can have a much wider variation in TCR. If close tracking is required, please specify when ordering so that we can supply you with selected resistors from a single manufacturing lot.

Voltage Coefficient of Resistance (VCR)
VCR is a measure of the stability of the resistor with respect to changes in voltage. Thick film resistors can exhibit significant VCR values. Low value chips may have a VCR of less than 10 ppm/V, while high value chips may change by 200 or 300 ppm/V or more. Thin film resistors have low VCR values regardless of size and resistance value, with a typical change in resistance of less than 2 ppm/V. Where VCR is critical, thin film resistors or high voltage products can provide the desired performance.

Pulse Handling Capability
State of the Art, Inc. resistor products are capable of withstanding short duration pulses that exceed the device's power or voltage ratings. Pulses less than the short time overload test conditions (2.5 times the working voltage, not to exceed two times the rated voltage for 5 seconds) are easily accommodated by the devices. Pulses exceeding the short time overload test conditions must be assessed on a case-by-case basis. Please consult our factory for an assessment of your application.

Frequency Response
The frequency response of a chip resistor is primarily determined by its inductive and capacitive properties and is nearly ideal into the GHz region. The interelectrode capacitance of our resistors is typically 0.05 to 0.12 picofarads. The actual value is determined by the size of the chip (smaller case sizes have lower capacitance) and the termination style (planar, style A, devices have lower capacitance than wraparound, style C, devices). Inductance is typically less than 0.5 nanohenries, with the same design influences as listed for the capacitance values of the chips.

Noise
Current noise is expressed as the ratio of the rms value of the current noise voltage to the applied voltage. The magnitude of this noise is dependent on the resistive material, chip length, and termination materials. Noise increases with resistance value and shorter case length in thick film resistors. Thin film resistors exhibit low noise levels in all case sizes and resistance values.

Operating Range
State of the Art, Inc. resistor products have a wide operating range, from cryogenic temperatures to 150°C. Permanent drift occurs when the resistors are operated above 150°C due to degradation to the terminations and the resistor film.

Storage Conditions
Chip resistors should be stored at 23±5°C and 10-70% relative humidity and avoid oxidizing conditions which adversely affect the termination finish. Exposure to excessive humidity, direct sunlight, and contact with sulfur-containing materials (rubber bands, etc.) should be avoided. Storage under an inert atmosphere should be considered if these devices are to be stored for extended time periods.

Product supplied on tape and reel packaging can be stored for up to two years at 23±5°C and 10-70% relative humidity with no degradation in the quality of the tape and reel packaging.

Electrostatic Discharge (ESD) Susceptibility
Thick and thin film chip resistors are classified as ESD sensitive devices by MIL-HDBK-263. ESD precautions should be taken when handling these devices. Tested in accordance with MIL-STD-883, Method 3015, thick and thin film resistors are Class 1 (<2000 V), Class 2 (<4000 V), or Class 3 (>4000 V) per MIL-STD-1686. ESD sensitivity depends on the manufacturing technology, the case length, and the resistance value.

Thick Film Resistors: Resistors with a case length less than 0.055" are Class 1. Resistors with a case length between 0.055" and 0.135" are Class 2. Resistors with a case length greater than 0.135" are Class 3.

Thin Film Resistors: Resistors with a case length of less than 0.090" are Class 2. Resistors with a length greater than 0.090" are Class 3.

Radiation Hardness
Neither thick nor thin film resistors are affected by radiation. They are classified as radiation hard devices.

Outgassing
Space and other vacuum applications require that all organic materials be non-outgassing. Inorganic materials, such as ceramics and metals, are not subject to outgassing. All organic materials used in State of the Art, Inc. products comply with the outgassing requirements of Space Level MIL-PRF-55342 when tested in accordance with ASTM E595.

Moisture Sensitivity Level (MSL)
All of our surface mount products are classified as MSL 1 per JSTD-020D.1.

Prohibited Materials
XRF is used to show lead (Pb) in solder finish.

Ordering Information

Part Marking

Resistance value may be coded on some devices. Three digit codes can be marked on 0603 and larger case sizes. Those values that require four digit codes can be marked on 1005 and larger cases. Two marking schemes are available.

The first option uses a three digit code for 2% and higher tolerances and four digit code for 1% and lower tolerances, where the leading digits are the significant digits of the value and the last digit is the multiplier, indicating the number of zeros to add. The letter R is used as the decimal. For example, 1000Ω ±2% is coded 102 while 1000Ω ±1% is coded 1001. This significant digit and multiplier method is most commonly used to mark resistance value.

The second option uses the EIA-96 marking scheme and allows the coding of 1% values using three digits and a look up table. The first two digits code the three significant digits of the resistance value, while the third character is a letter designating the multiplier. For example, 49.9 kΩ ±1% is coded 68C. This method can also be used to mark 1% standard values at tolerances less than 1%.

Custom markings are also available. Please consult the factory with your requirements.

The marking code is specified by adding a blank space followed by **–CC1001** to our part number to code 1000 ohms. *Example:* **S0705CPX1001F10 –CC01B** codes 1000 ohms using the EIA-96 method.

Alternative Method: EIA-96

Code	R Value	Code	R Value	Code	R Value	Code	R Value
01	100	25	178	49	316	73	562
02	102	26	182	50	324	74	576
03	105	27	187	51	332	75	590
04	107	28	191	52	340	76	604
05	110	29	196	53	348	77	619
06	113	30	200	54	357	78	634
07	115	31	205	55	365	79	649
08	118	32	210	56	374	80	665
09	121	33	215	57	383	81	681
10	124	34	221	58	392	82	698
11	127	35	226	59	402	83	715
12	130	36	232	60	412	84	732
13	133	37	237	61	422	85	750
14	137	38	243	62	432	86	768
15	140	39	249	63	442	87	787
16	143	40	255	64	453	88	806
17	147	41	261	65	464	89	825
18	150	42	267	66	475	90	845
19	154	43	274	67	487	91	866
20	158	44	280	68	499	92	887
21	162	45	287	69	511	93	909
22	165	46	294	70	523	94	931
23	169	47	301	71	536	95	953
24	174	48	309	72	549	96	976

This table shows the first two digits for the three-digit EIA-96 part marking scheme. The third character is a letter multiplier:

S=10^{-2} **R**=10^{-1} **A**=10^{0} **B**=10^{1} **C**=10^{2} **D**=10^{3} **E**=10^{4} **F**=10^{5}

Standard Resistance Values

This table shows the standard resistance values for various resistance tolerances per decade. MIL-PRF-55342 only allows standard 1%, 2%, 5%, and 10% values to be JAN branded. Non-standard values can be supplied without the JAN brand. Although it is not cited in the table, 50 is considered a standard value for all product except MIL-PRF-55342.

Tolerance																															
0.1	0.25	0.5	1.0	2.0	5.0	10	0.1	0.25	0.5	1.0	2.0	5.0	10	0.1	0.25	0.5	1.0	2.0	5.0	10	0.1	0.25	0.5	1.0	2.0	5.0	10	0.1	0.25	0.5	1.0	2.0	5.0	10	0.1	0.25	0.5	1.0	2.0	5.0	10
100	100	100	100	137	137	-	-	187	187	-	-	252	-	-	-	332	332	-	-	437	-	-	-	583	-	-	-	777	-	-	-
101	-	-	-	138	-	-	-	189	-	-	-	255	255	-	-	336	-	-	-	442	442	-	-	590	590	-	-	787	787	-	-
102	102	-	-	140	140	-	-	191	191	-	-	258	-	-	-	340	340	-	-	448	-	-	-	597	-	-	-	796	-	-	-
104	-	-	-	142	-	-	-	193	-	-	-	261	261	-	-	344	-	-	-	453	453	-	-	604	604	-	-	806	806	-	-
105	105	-	-	143	143	-	-	196	196	-	-	264	-	-	-	348	348	-	-	459	-	-	-	612	-	-	-	816	-	-	-
106	-	-	-	145	-	-	-	198	-	-	-	267	267	-	-	352	-	-	-	464	464	-	-	619	619	-	-	-	-	820	820
107	107	-	-	147	147	-	-	200	200	200	-	-	-	270	270	357	357	-	-	470	-	470	470	-	-	620	-	825	825	-	-
109	-	-	-	149	-	-	-	203	-	-	-	271	-	-	-	-	-	360	-	475	475	-	-	626	-	-	-	835	-	-	-
110	110	110	-	150	150	150	150	205	205	-	-	274	274	-	-	361	-	-	-	481	-	-	-	634	634	-	-	845	845	-	-
111	-	-	-	152	-	-	-	208	-	-	-	277	-	-	-	365	365	-	-	487	487	-	-	642	-	-	-	856	-	-	-
113	113	-	-	154	154	-	-	210	210	-	-	280	280	-	-	370	-	-	-	493	-	-	-	649	649	-	-	866	866	-	-
114	-	-	-	156	-	-	-	213	-	-	-	284	-	-	-	374	374	-	-	499	499	-	-	657	-	-	-	876	-	-	-
115	115	-	-	158	158	-	-	215	215	-	-	287	287	-	-	379	-	-	-	505	-	-	-	665	665	-	-	887	887	-	-
117	-	-	-	160	-	160	-	218	-	-	-	291	-	-	-	383	383	-	-	-	-	510	-	673	-	-	-	898	-	-	-
118	118	-	-	162	162	-	-	-	-	220	220	294	294	-	-	388	-	-	-	511	511	-	-	-	-	680	680	909	909	-	-
120	-	120	120	164	-	-	-	221	221	-	-	298	-	-	-	-	-	390	390	517	-	-	-	681	681	-	-	-	-	910	-
121	121	-	-	165	165	-	-	223	-	-	-	-	-	300	-	392	392	-	-	523	523	-	-	690	-	-	-	920	-	-	-
123	-	-	-	167	-	-	-	226	226	-	-	301	301	-	-	397	-	-	-	530	-	-	-	698	698	-	-	931	931	-	-
124	124	-	-	169	169	-	-	229	-	-	-	305	-	-	-	402	402	-	-	536	536	-	-	706	-	-	-	942	-	-	-
126	-	-	-	172	-	-	-	232	232	-	-	309	309	-	-	407	-	-	-	542	-	-	-	715	715	-	-	953	953	-	-
127	127	-	-	174	174	-	-	234	-	-	-	312	-	-	-	412	412	-	-	549	549	-	-	723	-	-	-	965	-	-	-
129	-	-	-	176	-	-	-	237	237	-	-	316	316	-	-	417	-	-	-	556	-	-	-	732	732	-	-	976	976	-	-
130	130	130	-	178	178	-	-	240	-	240	-	320	-	-	-	422	422	-	-	-	-	560	560	741	-	-	-	988	-	-	-
132	-	-	-	180	-	180	180	243	243	-	-	324	324	-	-	427	-	-	-	562	562	-	-	750	750	750	-				
133	133	-	-	182	182	-	-	246	-	-	-	328	-	-	-	-	-	430	-	569	-	-	-	759	-	-	-				
135	-	-	-	184	-	-	-	249	249	-	-	-	-	330	330	432	432	-	-	576	576	-	-	768	768	-	-	192	96	24	12

Total/Decade

Labeling

Our packages are labeled using a non-corrosive label citing your part number, our part number, date code, lot, quantity, and value and tolerance.

Packaging

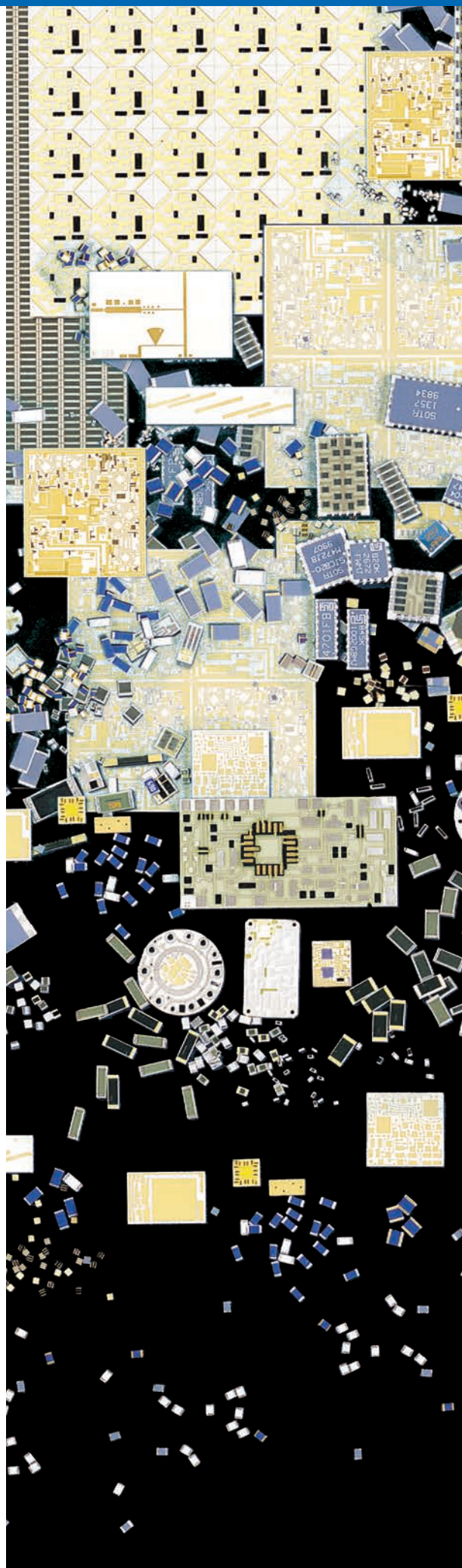
Product may be shipped in re-sealable bags, waffle trays, or carrier tape.

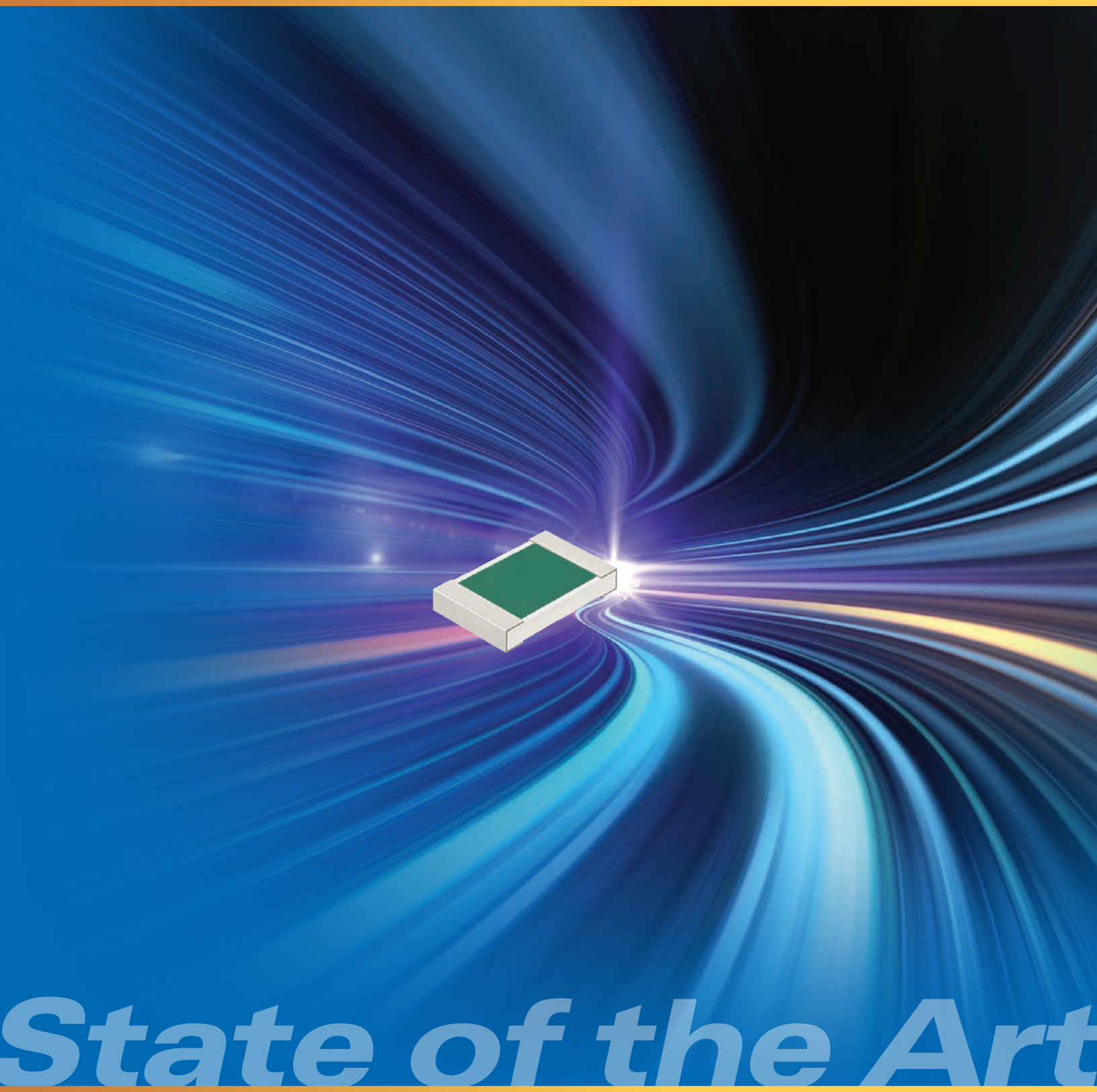
Bulk packaging in re-sealable, anti-static bags is limited to standard grade chips. Bulk packaging is the default packaging for standard grade chips if a packaging method is not specified. Packaging of one device per bag is available for high reliability chips.

Military and high reliability chips are shipped in waffle trays or carrier tape. Waffle tray packaging of surface mount chips is more cost effective at lower quantities but becomes more costly than carrier tape packaging at higher quantities. Most wire bondable chips are supplied in waffle trays, including all silicon chip resistors.

Waffle tray packaging may be indicated by adding a space and **-W** to the end of our part number. *Example:* **H1206CA1001FHB -W**

Carrier tape packaging (tape and reel) may be indicated by adding a space and **-TR** to the end of our part number. *Example:* **H1206CA1001FHB -TR**





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