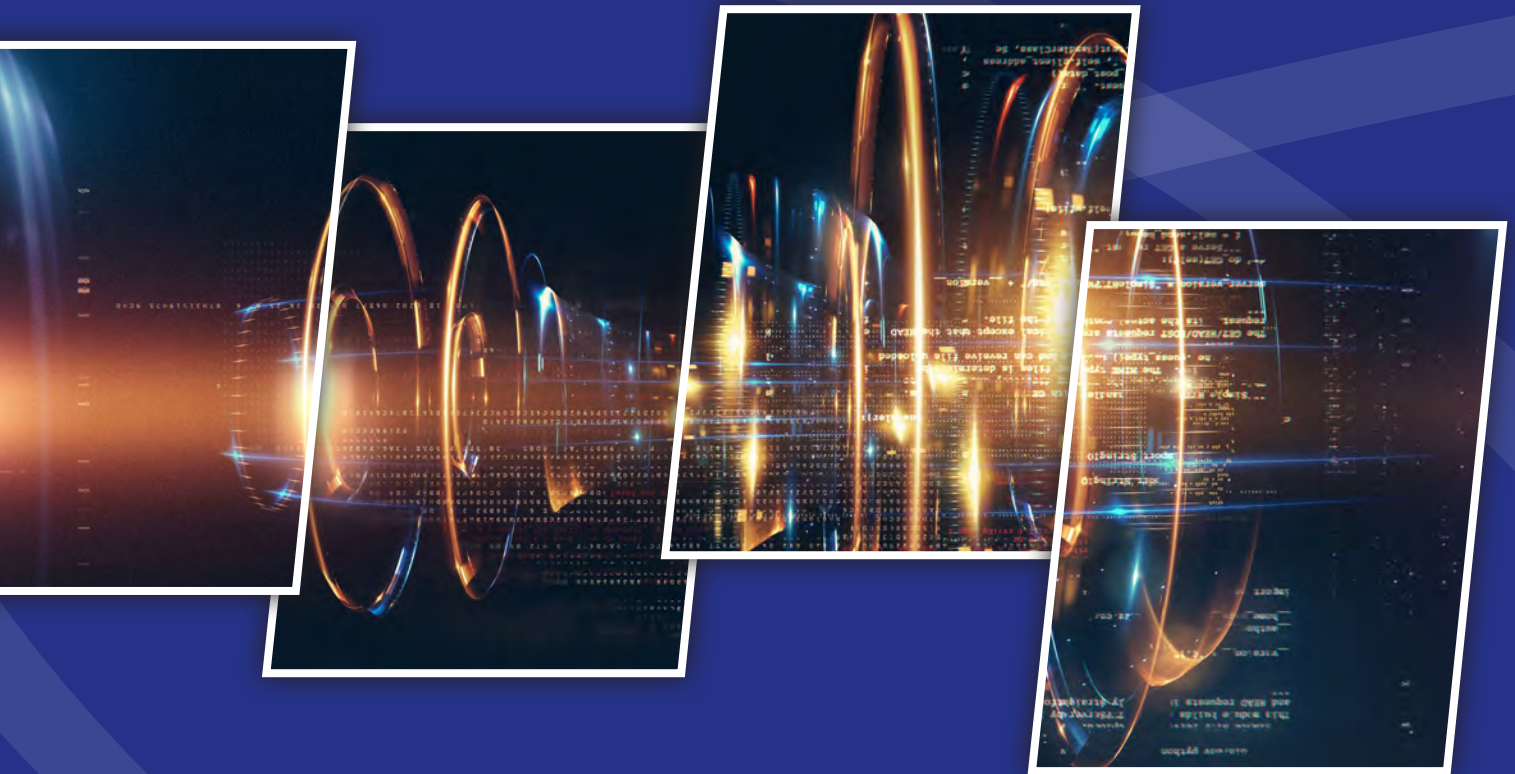


APITECH ATTENUATORS FOR CRYOGENIC APPLICATIONS



Learn how APITech's newest attenuators, tested to 4mK, support quantum computing installations and cryogenic applications.

You'll find APITech attenuators in satellites, radar systems, in the newest mobile testing equipment, helping service providers deliver coverage, and performing under some of the harshest conditions.

Table of Contents

APITech Attenuators for Cryogenic Applications

- 3 Cryo Attenuators for Quantum Computing**
- 4 Powerfilm Chip Attenuators for Cryogenic Applications**
- 5 Model 9102 (SMA, 18 GHz)**
- 6 Model 9103 (SMPM, 18 GHz)**
- 7 Model 9104 (2.92mm, 40 GHz)**
- 8 Model 2142 (SMA-SMA Bulkhead Adapter/Attenuator 18GHz with lock nut)**
- 9 Model 3175M (SMA-Male 18GHz Termination)**
- 11 Model CCAAW (Chip Attenuator, DC-18 GHz)**
- 12 Model CCAAF (Chip Attenuator, DC-8 GHz)**

Access our Cryo Attenuators Resource Page [here](#).

Cryo Attenuators for Quantum Computing

Helping solve the problems of thermal noise in cryogenic chambers

APITech is working to customize and optimize fixed attenuators for use in cryogenic cooling systems to support quantum computing. Quantum computing will revolutionize our understanding of the world by analyzing datasets that today's most powerful supercomputers can't handle. Instead of bits, quantum computers use quantum bits (qubits) which can only be detected at extremely small energy levels -- and at temperatures close to absolute zero. This requires cryogenic refrigeration systems with multiple stages of cooling and numerous RF cables of significant length, all of which introduces thermal noise, harming the integrity of the qubit. APITech's coaxial cryo-attenuators, mounted at different temperature stages of the cryo chamber, help solve this problem.

Ensuring Integrity of the Qubit

To be 'read' a qubit must be isolated from even the most minute amount of interference. The cryogenic chambers needed for this function can reach temperatures down to 4mK (milli-Kelvin). This can require thousands of coaxial attenuators able to function in this environment. APITech's attenuators, designed for mK operation to avoid self-heating, are reliable at temperatures these cryo installations require.

APITech cryo attenuators tested to 4mK

Eliminating thermal noise in a quantum computing installation demands a high degree of innovation and reliability. APITech's experience delivering custom components for use in harsh environments and high reliability requirements, like space, is the foundation supporting our work in cryogenic technology.



*DC-40 GHz cryo attenuator with
2.92mm connector (Model 9104)*



Quantum Computer

Using our in-house resistor fabrication processes and materials, APITech is able to optimize the resistor material, substrate and fabrication processes as well as the mechanical design needed to offer a "thermally quiet" attenuator solution at mK temperatures.

Innovation & Customization

For over 60 years, APITech has been the world's leading innovator and supplier of passive coaxial and RF components. Features of the attenuators used in these cryo environments include:

- Gold plated beryllium copper conductors
- DC - 40 GHz (2.92mm connector)
- DC - 18 GHz (SMA and SMPM connectors)
- Available dB values of 0, 3, 6, 10, 20 dB
- Proprietary thin film resistor material
- Operating temperature down to 20mK

Technical Contact

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Product Line Director
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Keep Me Informed

Powerfilm Chip Attenuators for Cryogenic Applications

Proprietary thin-film technology maintains resistance down to near absolute zero

APITech's line of Powerfilm chip attenuators and resistors are used in aerospace, satellite, and other extreme environments, so it's no surprise our parts are a go-to choice for cryogenic applications such as quantum computing. Powerfilm cryogenic chip attenuators retain their electrical characteristics down to near absolute zero (0K) temperatures where quantum effects are dominant.

Performance Maintained at Cryo Temperatures

Eliminating thermal noise in a quantum computing installation, or supporting any cryo application, demands a high degree of performance and reliability. Most common thick-film resistors become insulators and turn attenuators into opens. Common thin-film resistors become super-conductive and turn attenuators into shorts. Powerfilm's cryogenic thin-film technology maintains its resistance to less than 1K.

The leader in high power attenuators, resistors and terminations, with the proven ability to customize designs and deliver for any quantity.

APITech's expertise in delivering custom components for use in harsh environments with high reliability requirements, like space, is the foundation supporting our work in cryogenic technology. Design, testing, manufacturing and application support are performed in-house.



Powerfilm CCA cryogenic chip attenuators have gold terminals suitable for both solderable or wire-bondable applications.



Testing, Customization & Optimization

The Powerfilm team can analyze each customer's application requirements and determine opportunities to deliver optimized performance for power, frequency, size, finish, attenuator accuracy, volumes, mounting, and how the chip should be placed; all to deliver optimum results.

For our standard Cryo Low Temp chip attenuator, features include:

Cryo Low Temp Chip Attenuators:

- Frequency range DC - 18 GHz
- 0 - 20 dB
- 50 Ohms
- Alumina substrate
- Gold terminals; gold, silver, tin-lead and lead-free solder finishes available
- Mounted circuit side up or down
- 4 mK to +150 Celsius
- MIL-PRF-55342, MIL-PRF-55182, MIL-DTL-8833 testing available

Technical Contact

Aaron Singer
Applications Engineer
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[Learn More](#)

Attenuator, SMA

Model 9102-CRYO

Features

- Stable Attenuation over temperature
- Low thermal noise characteristics
- Minimal self heating, achieves temperature faster.
- Optimized non-magnetic material selection.

Technical Specifications

Parameter	Value
Frequency Range	DC to 18 GHz
Standard dB Values	0, 3, 6, 10 & 20dB
Attenuation Accuracy (dB)	
0dB	+0/-0.4dB
3 & 6dB	±0.3dB
10 & 20dB	±0.5dB
VSWR	
DC – 4 GHz	1.15:1 Max.
4 – 12.4 GHz	1.25:1 Max.
12.4 – 18 GHz	1.35:1 Max.
(1-20dB)	
12.4 – 18 GHz	1.45:1 Max.
(0dB only)	
Input Power	2 Watts Avg. @ 25°C
Impedance	50 Ohms
Operating Temp. Range	4°mK to +125°C

Frequency Range: DC to 18.0 GHz
Power: 2Watts

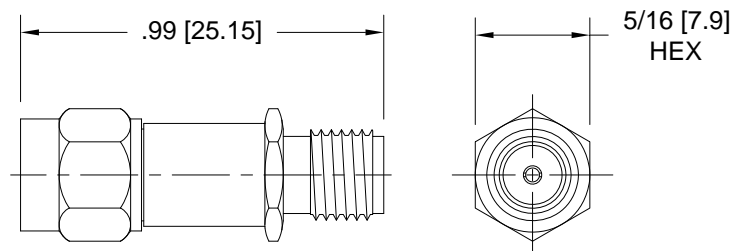


Mechanical

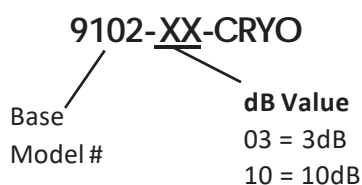
Feature	Material
SMA Connectors <i>Mates with MIL-STD-348</i>	White Bronze Plated Brass
Conductors	Gold Plated Beryllium Copper
Substrate	Beryllium Oxide
Resistor Material	Proprietary Thin Film

Physical Dimensions

Model Number: 9102-03-CRYO shown



How to Order



Note: Dimensions in Brackets [] are expressed in millimeters and are for reference only.

Order Examples

Model Number: 9102-03-CRYO
DC-18 GHz, 3dB, SMA Male/Fem

Design Specifications are subject to change without notice.

rev A

Attenuator, SMPM

Model 9103-CRYO

Features

- Stable Attenuation over temperature
- Low thermal noise characteristics
- Minimal self heating, achieves temperature faster.
- Optimized non-magnetic material selection.

Technical Specifications

Parameter	Value
Frequency Range	DC to 18 GHz
Standard dB Values	0, 3, 6, 10 & 20dB
Attenuation Accuracy (dB)	
0, 3 & 6dB	±0.6dB
10dB	±0.8dB
20dB	±1.2dB
VSWR	1.35:1 Max.
Input Power	2 Watts Avg. @ 25°C
Impedance	50 Ohms
Operating Temp. Range	4°mK to +125°C

Frequency Range: DC to 18.0 GHz
Power: 2Watts



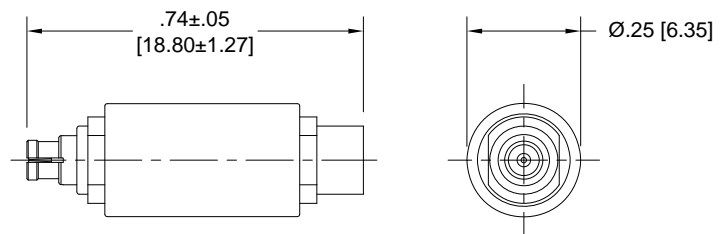
Mechanical

Feature	Material
SMPM Connectors <i>Mates with GPPO** Connectors</i>	Gold Plated Beryllium Copper
Barrel	Gold Plated Brass
Conductors	Gold Plated Beryllium Copper
Substrate	Beryllium Oxide
Resistor Material	Proprietary Thin Film

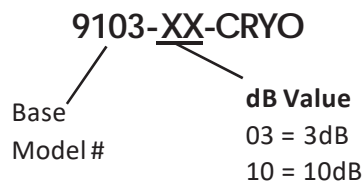
**GPPO is a trademark of Corning Gilbert, Inc.

Physical Dimensions

Model Number: 9103-03-CRYO shown



How to Order



Order Examples

Model Number: 9103-03-CRYO
DC-18 GHz, 3dB, SMPM Male/Fem

Note: Dimensions in Brackets [] are expressed in millimeters and are for reference only.

Attenuator, 2.92mm

Model 9104-CRYO

Features

- Stable Attenuation over temperature
- Low thermal noise characteristics
- Minimal self heating, achieves temperature faster.
- Optimized non-magnetic material selection.

Technical Specifications

Parameter	Value	
Frequency Range	DC to 40 GHz	
Standard dB Values	0, 3, 6, 10, 20 & 30dB	
Attenuation Accuracy (dB)	DC – 26.5 GHz	26.5 – 40 GHz
	0, 3 & 6dB	±0.5dB ±0.8dB
	10 & 20dB	±0.6dB ±1.0dB
	30dB	±0.8dB ±1.0dB
VSWR	DC – 18 GHz	1.30:1 Max.
	18 – 40 GHz	1.40:1 Max.
Input Power	2 Watts Avg. @ 25°C	
Impedance	50 Ohms	
Operating Temp. Range	4°mK to +125°C	

Frequency Range: DC to 40.0 GHz
Power: 2Watts



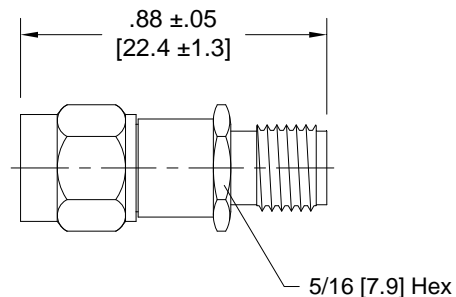
Mechanical

Feature	Material
2.92mm Connectors	White Bronze Plated Brass
<i>Mates both mechanically & electrically with all SMA, K* & 3.5mm series connectors.</i>	
Conductors	Gold Plated Beryllium Copper
Resistor Material	Proprietary Thin Film

*K is a trademark of Anritsu/Wiltron Corp.

Physical Dimensions

Model Number: 9104-03-CRYO shown



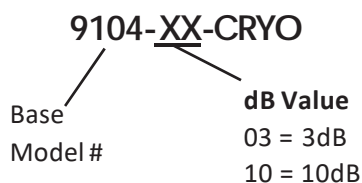
Note: Dimensions in Brackets [] are expressed in millimeters and are for reference only.

Order Examples

Model Number: 9104-03-CRYO

DC-40 GHz, 3dB, 2.92mm Male/Fem

How to Order



Design Specifications are subject to change without notice.

rev A

Bulkhead Attenuator, SMA

Model 2142-CRYO

Features

- Stable Attenuation over temperature
- Low thermal noise characteristics
- Minimal self heating, achieves temperature faster.
- Optimized non-magnetic material selection.

Technical Specifications

Parameter	Value
Frequency Range	DC to 18 GHz
Standard dB Values	3, 6, 10 & 20dB
Attenuation Accuracy (dB)	
3 & 6dB	±0.3dB
10 & 20dB	±0.5dB
VSWR	
DC – 4 GHz	1.15:1 Max.
4 – 18 GHz	1.20:1 Max.
8 – 12.4 GHz	1.25:1 Max.
12.4 – 18 GHz	1.35:1 Max.
Input Power	2 Watts Avg. @ 25°C <i>Derated Linearly to 1.1 Watts @ +125°C</i>
Peak Power	250 Watts Max. <i>(5uSec Pulse, .05% Duty Cycle)</i>
Impedance	50 Ohms
Operating Temp. Range	-55°C to +125°C

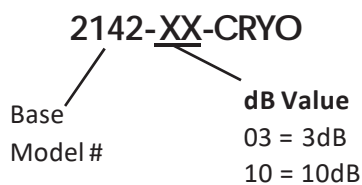
Frequency Range: DC to 18.0 GHz
Power: 2 Watts



Mechanical

Feature	Material
SMA Connectors <i>Mates with MIL-STD-348</i>	Gold Plated Brass
Conductors	Gold Plated Beryllium Copper
Substrate	Beryllium Oxide
Resistor Material	Proprietary Thin Film
Springs	Beryllium Copper

How to Order



Order Examples

Model Number: 2142-03-CRYO
DC-18 GHz, 3dB, SMA Fem/Fem

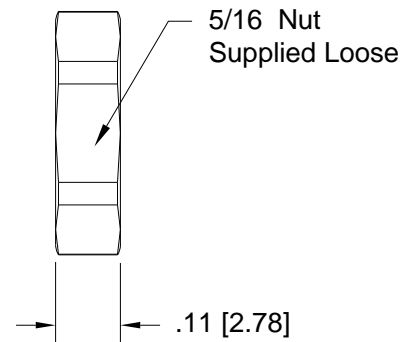
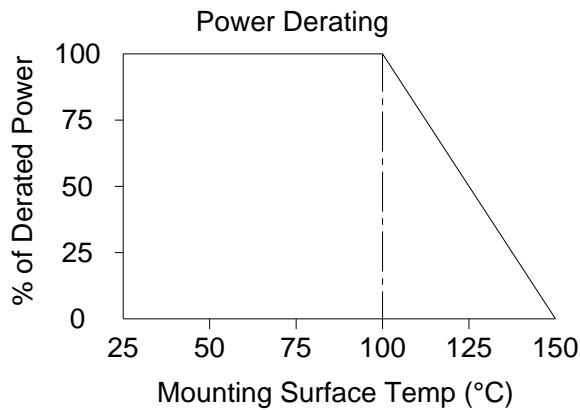
Model Number: 2142-10-CRYO
DC-18 GHz, 10dB, SMA Fem/Fem

Bulkhead Attenuator, SMA

Model 2142-CRYO

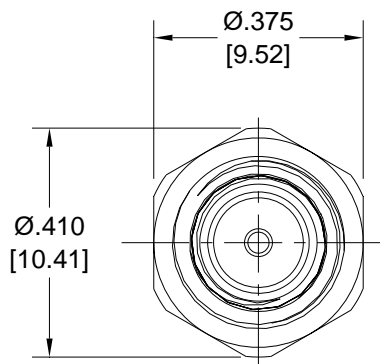
Frequency Range: DC to 18.0 GHz
Power: 2 Watts

Performance Characteristics

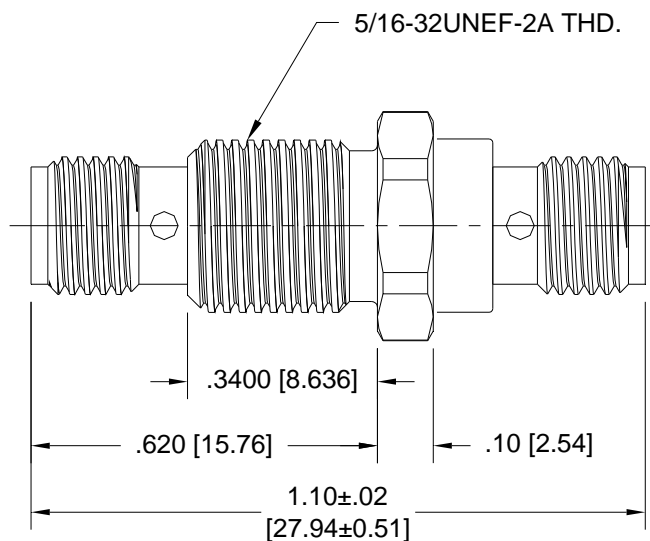


Physical Dimensions

Model Number: 2142-03-CRYO shown



Tolerance: .XXX" = ±.010"



Note: Dimensions in Brackets [] are expressed in millimeters and are for reference only.

Design Specifications are subject to change without notice.

rev A

Termination, SMA

Model 3175M-CRYO

Frequency Range: DC to 18.0 GHz
Power: 2 Watts

Features

- Stable Attenuation over temperature
- Low thermal noise characteristics
- Minimal self heating, achieves temperature faster
- Optimized non-magnetic material selection



Technical Specifications

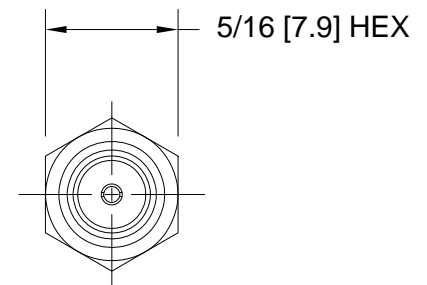
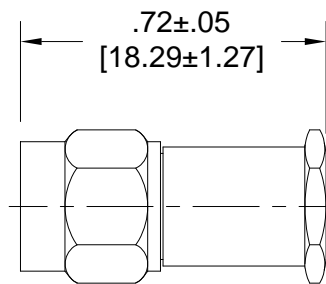
Parameter	Value
Frequency Range	DC to 18 GHz
VSWR	1.25:1 Max.
Input Power	2 Watts Avg. @ 25°C
Impedance	50 Ohms
Operating Temp. Range	-4°mK to +125°C

Mechanical

Feature	Material
SMA Connectors <i>Mates with MIL-STD-348</i>	White Bronze Plated Brass
Conductors	Gold Plated Beryllium Copper
Substrate	Beryllium Oxide

Physical Dimensions

Model Number: 3175M-CRYO shown



How to Order

3175M - CRYO

Base

Model #

Dimensions in brackets [] are expressed in Millimeters and are for reference only.
Design Specifications are subject to change without notice.

REV B

Attenuator Chip, Cryo Low Temp

**DC - 18 GHz
CCAAW**

Models:

Specifications

Electrical:

Frequency Range	DC - 18 GHz
Normal Impedance	50 Ohms
Standard dB Values	0 thru 20 dB
Attenuation Accuracy (dB)	

dB Value	DC-4 GHz	4-8 GHz	8-12.4 GHz	12.4-18 GHz
0	+0.5/-0	+0.5/-0	+0.5/-0	+0.5/-0
1-3	±0.5	±0.5	±0.5	±0.5
4-6	±0.5	±0.5	±0.5	±0.75
7-10	±0.5	±0.5	±0.75	±1.00
11-15	±0.75	+0.5/-3	+0.5/-4	
16-20	±1.00	+0.5/-4		

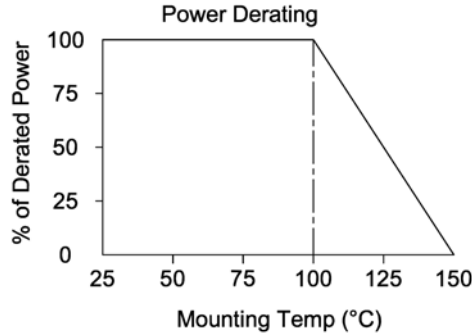
VSWR

DC - 4 GHz	1.25:1 Max.
4 - 8 GHz	1.35:1 Max.
8 - 18 GHz	1.50:1 Max.

Rated Power (Mounted Circuit side up or down)

dB Value	Watts	dB Value	Watts	dB Value	Watts
0	4.0	3	2.0	12	0.75
1	4.0	6	1.0	15	0.75
2	2.0	10	1.0	20	0.75

Operating Temp. Range 4°mK to +150°C



Mechanical

Substrate Alumina
Wirebondable Terminals Gold

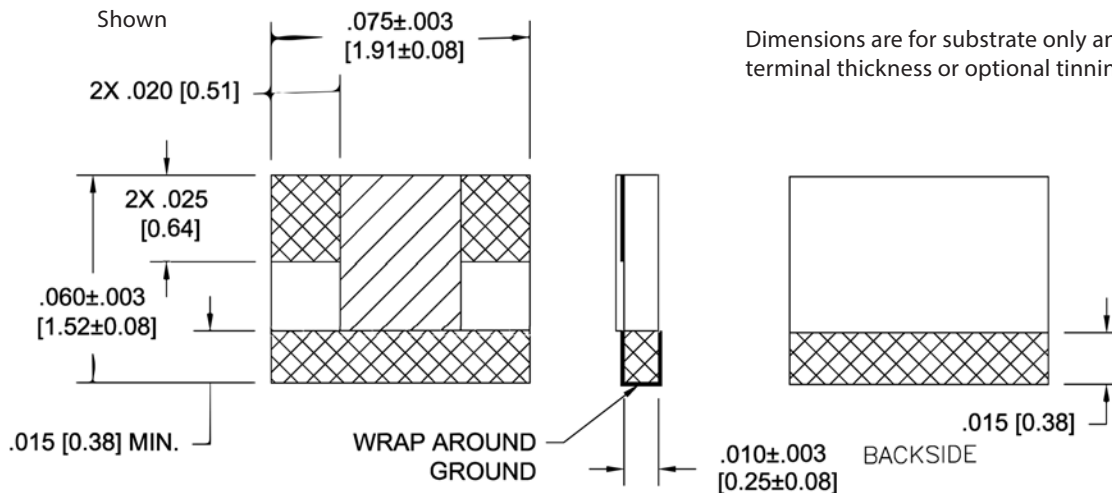
See "How to Order" for Tinning & other options

How to Order

Model Number: **CCAAW - Y X**

Terminal Options _____ dB Value
 = Silver over Nickel
 T = Tin Lead Solder
 H = Lead Free Solder
 G = Gold Plated

Model Number: CCAAW-G3



Tolerance .XXX = ±.010

Dimensions are for substrate only and do not include terminal thickness or optional tinning thickness.

Note: Dimensions in Brackets are Expressed in Millimeters and are for Reference Only.
 Design specifications are subject to change without notice.

Attenuator Chip, Cryo Low Temp

**DC - 8 GHz
CCAAF**

Models: CCAAF-X, CCAAF-TX, CCAAF-HX, CCAAF-GX

Specifications

Electrical:

- Frequency Range** DC - 8 GHz
- Norminal Impedance** 50 Ohms
- Standard dB Values** 0 thru 20 dB
- Attenuation Accuracy (dB)**

dB Value	DC-4 GHz	4-8 GHz
0	+0.5/-0	+0.5/-0
1-10	±0.5	±0.5
11-15	±0.75	+0.5/-3
16-20	±1.0	+0.5/-4

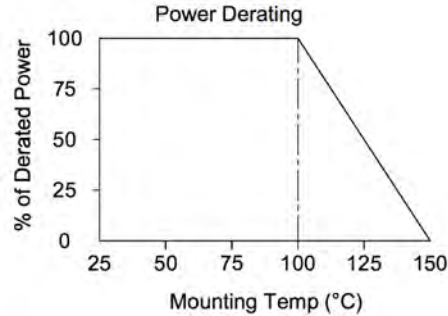
VSWR

- DC - 4 GHz** 1.25:1 Max.
- 4 - 8 GHz** 1.35:1 Max.

Rated Power (Mounted Circuit side up or down)

dB Value	Watts	dB Value	Watts	dB Value	Watts
0	5.0	3	2.0	12	0.75
1	5.0	6	1.0	15	0.75
2	2.0	10	1.0	20	0.75

Operating Temp. Range 4°mK to +150°C



Mechanical

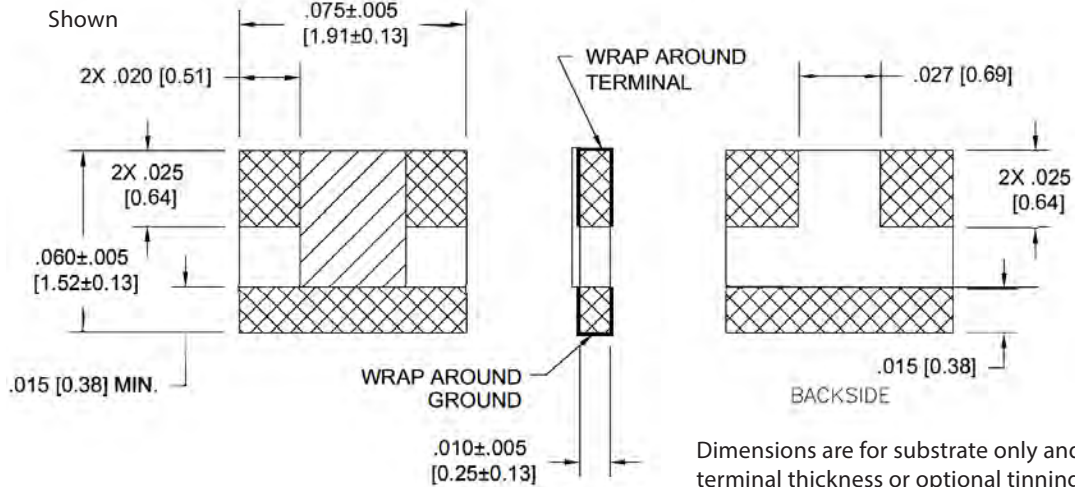
- Substrate** Alumina
 - Terminals** Tin Lead Solder (Standard)
- See "How to Order" for Tinning & other options

How to Order

Model Number: CCAAF - Y X

- Terminal Options** _____ dB Value
- = Silver over Nickel
 - T = Tin Lead Solder
 - H = Lead Free Solder
 - G = Gold Plated

Model Number: CCAAF-T3



Note: Dimensions in Brackets are Expressed in Millimeters and are for Reference Only.
Design specifications are subject to change without notice.