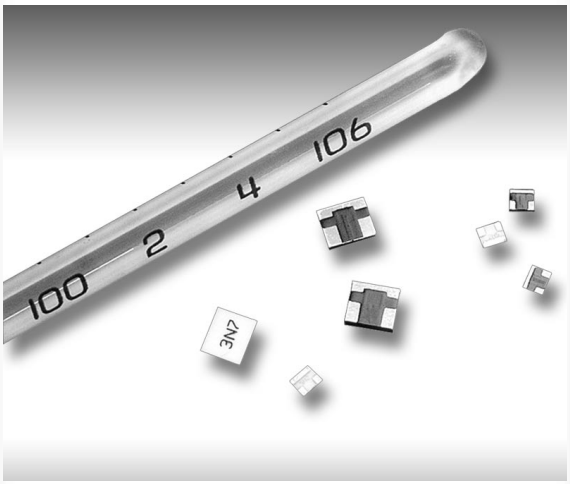
Features

- *Lead Free Option Available*
- *Impedance 50 and 75 Ohms*
- *Frequency Ranges from DC to 46 GHz*
- *Attenuation Values from 1 to 10 dB*
- *Wire Bondable Connections Available*
- *Negative and Positive Coefficients of Attenuation Available*
- *Space and Military Qualified*
- *Power Handling Up to 2 Watts*
- *Surface Mount Packaging*

Applications

- *Broadcast (TV and Radio)*
- *Power Amplifier*
- *Military*
- *Mixers*
- *Power Dividers*
- *Satellite Communication*
- *Gain Blocks*
- *MMIC Amplifiers*
- *Directional Couplers*
- *Diode Detectors*

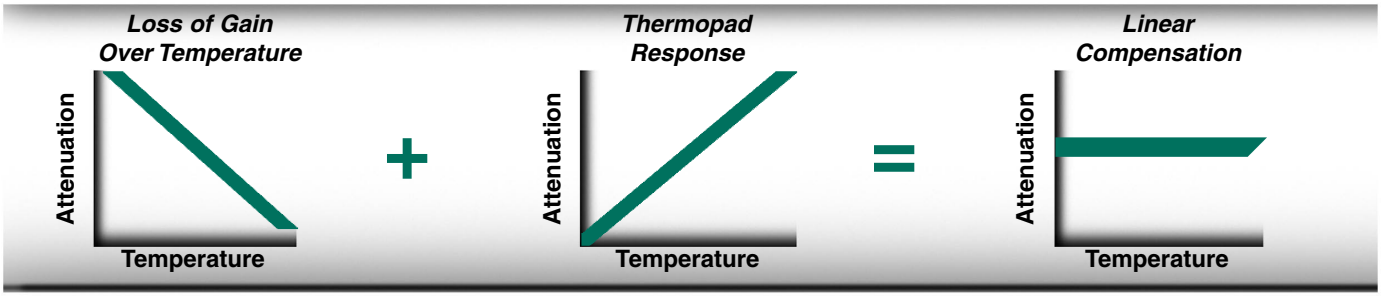


The Thermopad® (Patent # 5,332,981) is a totally passive, surface mountable temperature variable attenuator. It requires no bias or control voltages and does not generate distortion. The Thermopad® can be used in place of a standard chip attenuator to combine level setting or buffering and temperature compensation in a single chip design. This will reduce component count, increase reliability, and lower costs.

Quick Selector Chart

Series	Frequency Range (GHz)	Impedance (Ohms)
TVA	DC-6	50
MTVA	DC-18	50
HTVA	DC-20	50
CTVA	DC-2	75
KTVA	18-46	50
Coaxial TVA	DC-6	50

Table of Contents



- *Small Footprint*
- *Surface Mountable*
- *Zero Distortion*
- *Totally Passive*
- *Power Handling up to 2 Watts*
- *Several Metallization and Packaging Options Available*
- *Tailored response to cancel amplifier gain variations over temperature*
- *Requires no DC Power*

The Thermopad® is a patented (Patent # 5,332,981), absorptive microwave attenuator, which provides power dissipation that varies with temperature. The device can be used in any application that requires a known amount of attenuation change for a particular temperature shift. This is particularly useful for maintaining constant gain in amplifiers, mixers, power dividers, and other signal processing components over temperature.

In applications from DC-46 GHz, EMC's Thermopad® is the ideal temperature compensation solution for cost, performance, and reliability. The Thermopad® can replace closed loop temperature compensation circuits with a single chip device requiring no bias or control. It excels in applications involving multiple tones and complex modulation schemes such as cellular base station applications to radar because of its low cost and because it produces no signal distortion.

In high reliability, military, and spacecraft applications, the Thermopad® reduces system complexity and cost while improving overall reliability. The Thermopad® is available in a wide variety of package styles. Most styles are available in tape and reel packaging.

Thermopad® Temperature Shift Cross Reference Chart (Attenuation Shift in dB per 10°C)

TCA* dB/dB/°C	Attenuation at 25°C 1 dB	2 dB	3 dB	4 dB	5 dB	6 dB	7 dB	8 dB	9 dB	10 dB
-0.003	-0.03	-0.06	-0.09	-0.12	-0.15	-0.18	-0.21	-0.24	-0.27	-0.30
-0.004	-0.04	-0.08	-0.12	-0.16	-0.20	-0.24	-0.28	-0.32	-0.36	-0.40
-0.005	-0.05	-0.10	-0.15	-0.20	-0.25	-0.30	-0.35	-0.40	-0.45	-0.50
-0.006	-0.06	-0.12	-0.18	-0.24	-0.30	-0.36	-0.42	-0.48	-0.54	-0.60
-0.007	-0.07	-0.14	-0.21	-0.28	-0.35	-0.42	-0.49	-0.56	-0.63	-0.70
-0.009	-0.09	-0.18	-0.27	-0.36	-0.45	-0.54	-	-	-	-
+0.003	+0.03	-	+0.09	-	-	+0.18	-	-	-	-
+0.005	+0.05	-	+0.15	-	-	+0.30	-	-	-	-
+0.006	+0.06	-	-	-	-	-	-	-	-	-
+0.007	+0.07	+0.14	+0.21	-	-	+0.42	-	-	-	-
+0.008	-	-	-	-	-	+0.48	-	-	-	-

* TCA = Temperature Coefficient of Attenuation

Available Configurations of Thermopad®

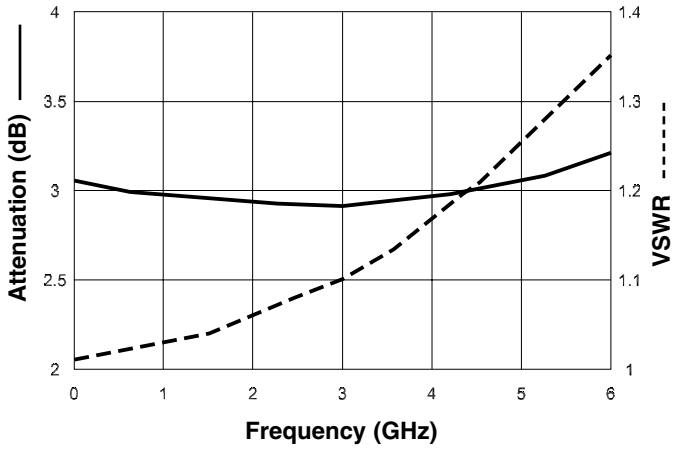
Temperature Coefficient Code	TCA* dB/dB/°C	Attenuation at 25°C 1 dB	2 dB	3 dB	4 dB	5 dB	6 dB	7 dB	8 dB	9 dB	10 dB
N03	-0.003	M,T	M,T	M,T	M,T	M,T	M,T	T	M,T	T	T
N04	-0.004	M,T	M,T	H,M,T	M,T	T	H,M,T	T	T	T	T
N05	-0.005	M,T	M,T	M,T,K	M,T,K	M,T	M,T	T	T	T	T
N06	-0.006	T	M,T	M,T	M,T,K	T	T	T	T	T	T
N07	-0.007	T	C,M,T	C,M,T	C,M,T	M,T	M,T,K	T	T	T	T
N09	-0.009	T	C,T	C,M,T	T	T	M,T	-	-	-	-
P03	+0.003	T	-	T	-	-	T	-	-	-	-
P05	+0.005	T	-	T	-	-	T	-	-	-	-
P06	+0.006	T	-	-	-	-	-	-	-	-	-
P07	+0.007	T	T	T	-	-	T	-	-	-	-
P08	+0.008	-	-	-	-	-	T	-	-	-	-

The configurations most popular with designers are indicated in shaded area.

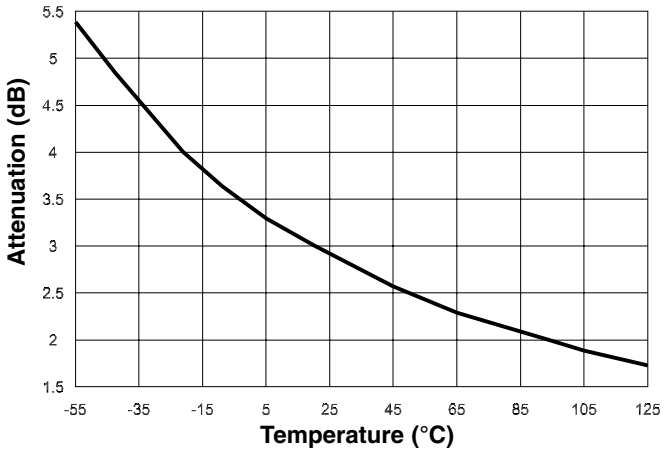
* TCA = Temperature Coefficient of Attenuation

T = TVA series chips and 42TVA (Coaxial TVA)
M = MTVA series chips
H = HTVA series chips
C = CTVA (75 Ohm version of TVA)
K = KTVA series chips

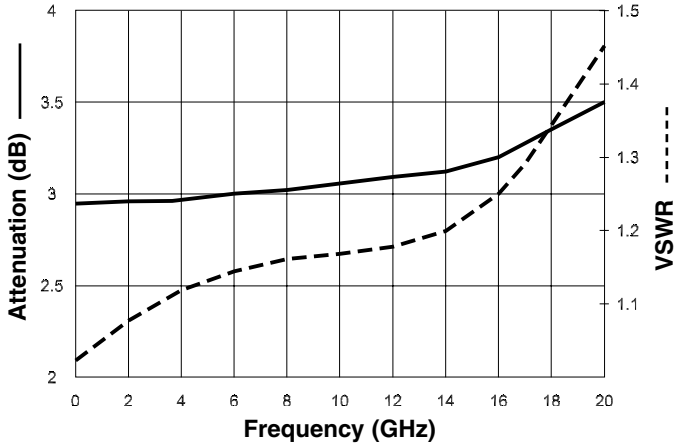
Typical Thermopad® RF Performance TVA0300N07



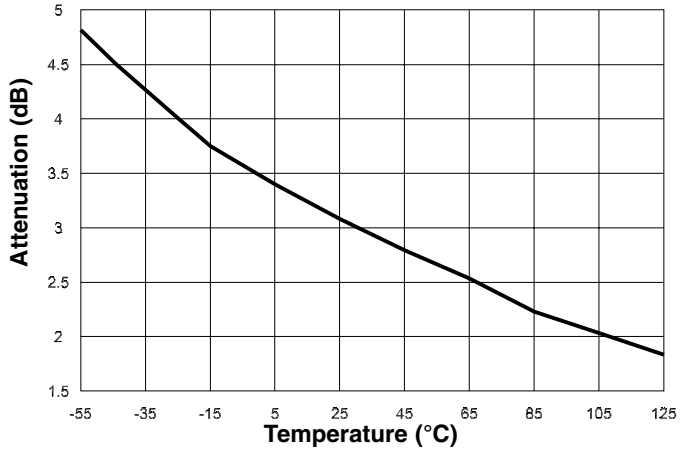
Thermopad® Attenuation vs. Temperature for TVA0300N07



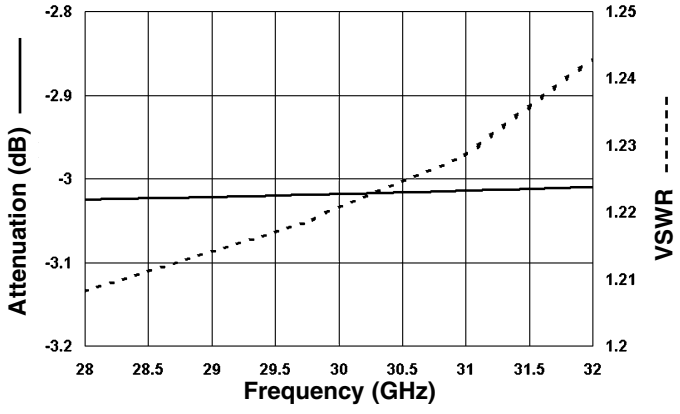
Typical Thermopad® RF Performance MTVA0300N05



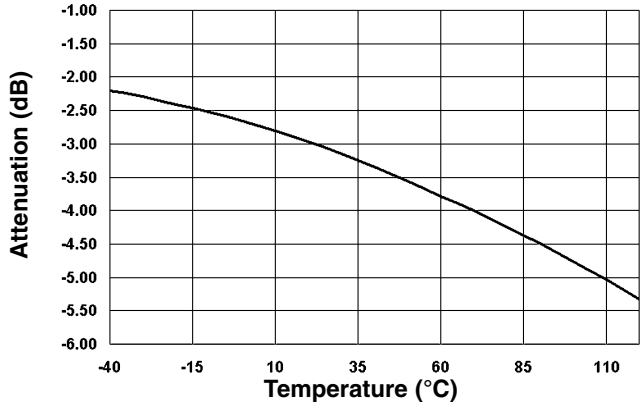
Thermopad® Attenuation vs. Temperature for MTVA0300N05



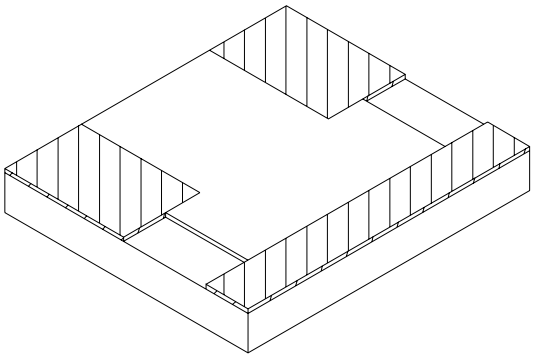
Typical Thermopad® RF Performance KTVA0300N062832



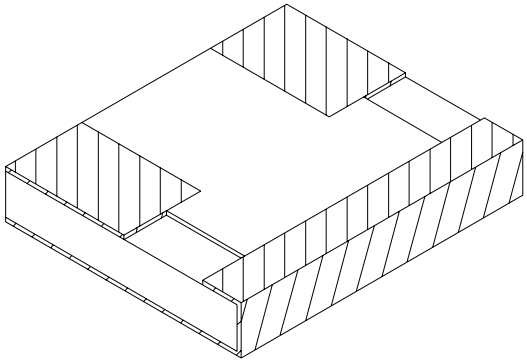
Thermopad® Attenuation vs. Temperature for KTVA0300N062832



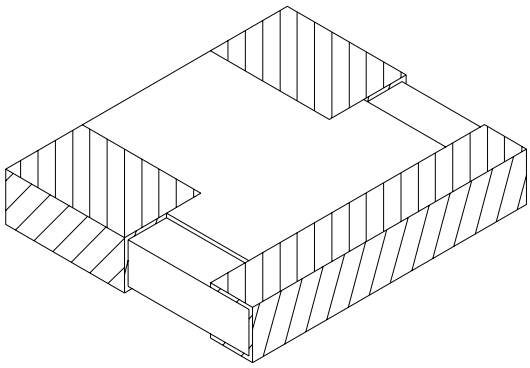
Planar Configuration



W1/WB1 Configuration

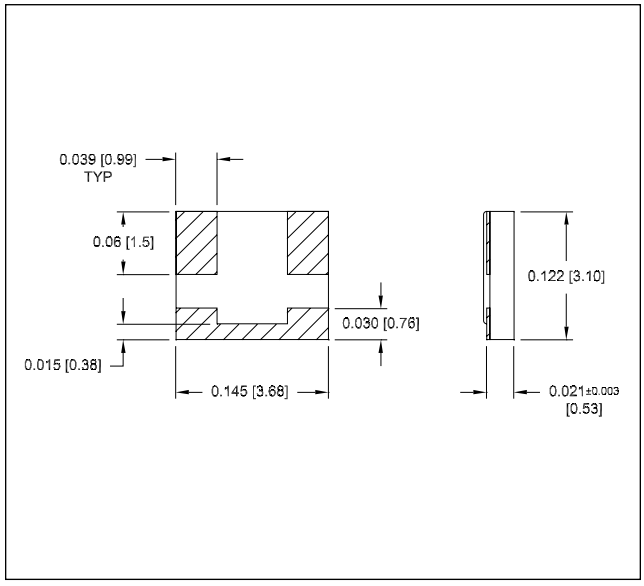


W3 Configuration

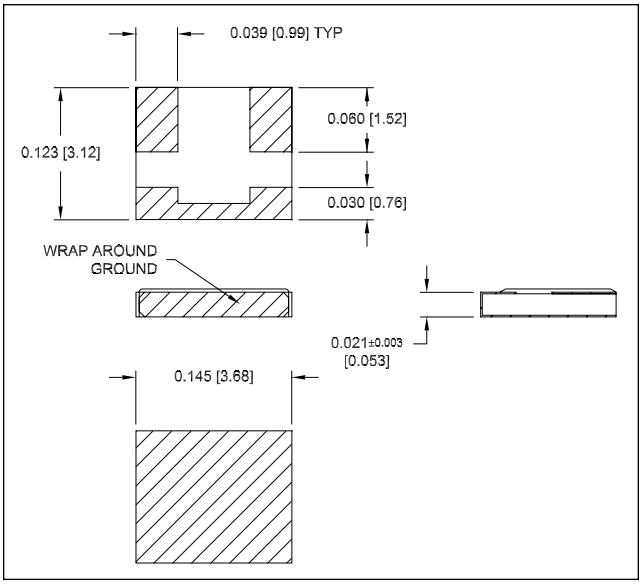


Metallization Options

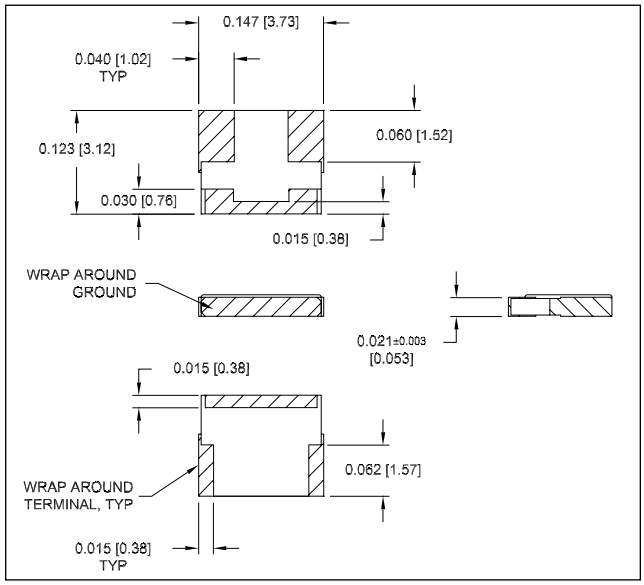
- **Planar (no code)** Planar device for flip chip mounting offers the best RF performance and lowest cost.
- **Triple Wrap (W3)** Metallization wraps around input, output, and ground terminals. Permits inspectable solder fillets when flip chip mounting. See Application Note 004 on page 66.
- **Single Wrap (W1)** Metallization wraps around ground terminal only. Full backside metallization.
- **Pretinned (S)** Pretinned (with Sn 62) terminals improve solderability (available on all of the above options).
- **Lead Free (F)** Lead free, pure tin plating options are available (excludes WB1 and G metallization options).
- **Single Wrap (WB1)** (MTVA Series only) Metallization wraps around ground terminal only. Full backside metallization. Input and output terminals have wire bondable gold metallization.
- **Gold (G)** (MTVA and HTVA Series only) Planar device with gold metallization. Typically used for wirebonding.



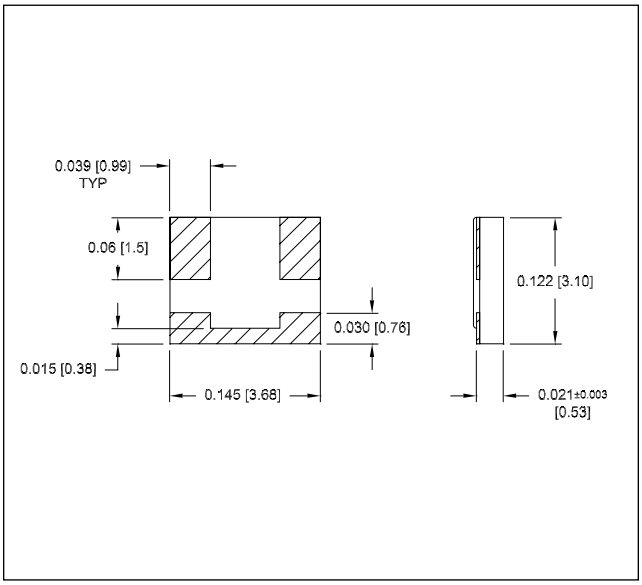
TVA Planar Configurations

TVA W1 Configuration

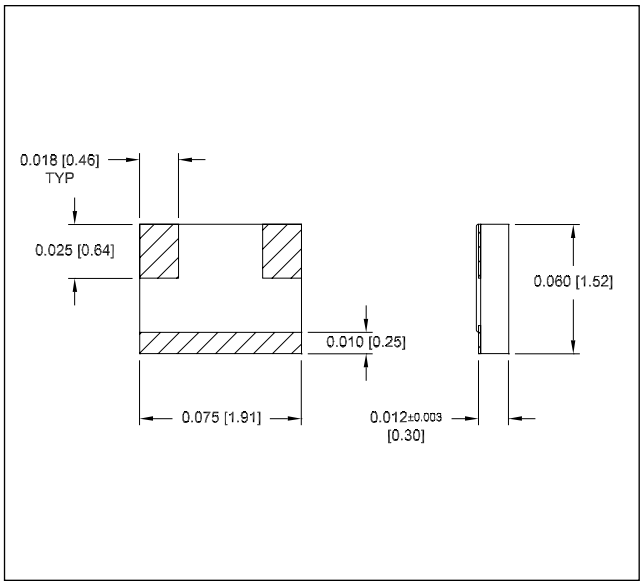


TVA W3 Configuration

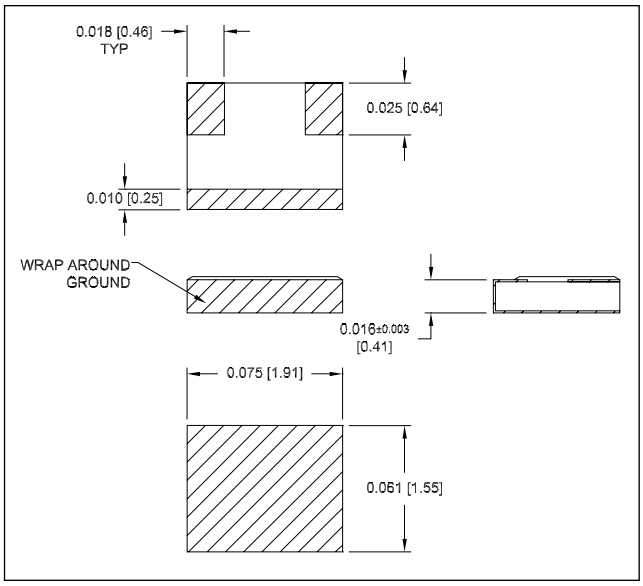



CTVA Planar Configuration

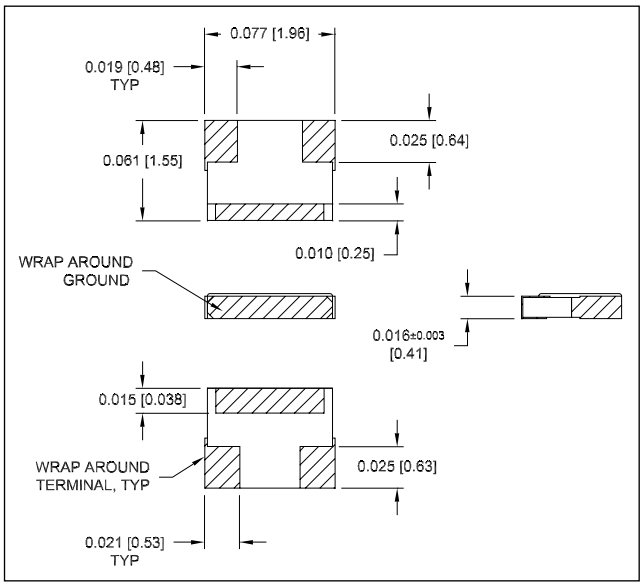

See Application Note 001 on page 59.



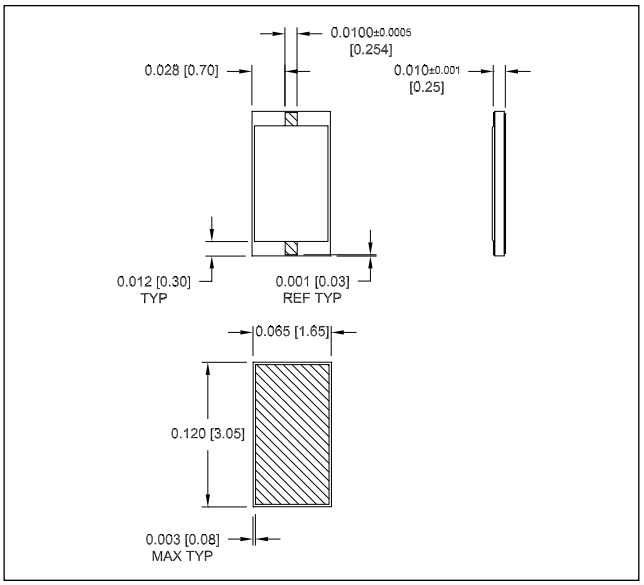
MTVA Planar/G Configuration



MTVA W1/WB1 Configuration



MTVA W3 Configuration



KTVA Configuration

See Application Note 001 on page 59.

Catalog Numbering Code

TVA	03	00	N	07	W3		S
Configuration Code (3-5 digits) TVA, MTVA, HTVA, CTVA, KTVA, 42TVA	**Attenuation Value** (01 to 10)	**EMC Code**	**Direction of Shift** N = Negative P = Positive	**Attenuation Shift** (2 digits)	**Metallization Option** (blank, 1, 2 or 3 alphanumeric digits, examples: G, W1, WB1) Not applicable for HTVA, KTVA series	KTVA series only: **Frequency** (4 digit beginning and ending frequency)	**Pretinning** (blank, S or F) Not applicable for HTVA, KTVA series or G metallization

Temperature Coefficient of Attenuation (TCA) Code

Example: P/N TVA0300N07W3S is TVA configuration code, 3 dB nominal value at +25 °C, negative shifting thermopad with TCA of 0.007dB/dB/°C, triple wrap with pretinning.

Metallization Options

- **Planar (no code)** Planar device for flip chip mounting offers the best RF performance and lowest cost.
- **Triple Wrap (W3)** Metallization wraps around input, output, and ground terminals. Permits inspectable solder fillets when flip chip mounting.
- **Single Wrap (W1)** Metallization wraps around ground terminal only. Full backside metallization.
- **Pretinned (S)** Pretinning (with Sn 62) improves solderability (available on all of the above options except Option G and KTVA).
- **Lead Free (F)** Lead free, pure tin plating options are available (excludes WB1 and G metallization options).
- **Single Wrap (WB1)** Metallization wraps around ground terminal only. Full backside metallization. Input and output terminals have gold metallization for wire bonding (MTVA series only).
- **Gold (G)** Planar device with gold metallization. Typically used for wire bonding (MTVA and HTVA series only).

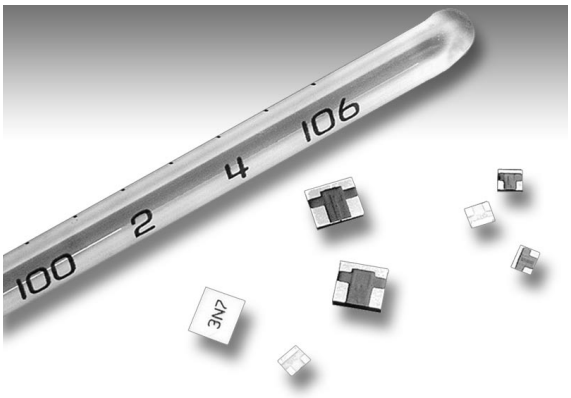
Note: KTVA has backside ground metalization. Input and output terminals have gold metalization for wire bonding.

Part Marking

Thermopads are marked with attenuation value and temperature coefficient of attenuation code as follows:

XX	X	XX	XXXX
Attenuation Value 1 or 2 digits	**TCA Direction of Shift** N = Negative P = Positive	**Value of Shift** (two digits x 10^{-3} dB/dB/°C)	**Frequency** (KTVA only) Lower Freq. 18-46 Upper Freq. 18-46

Note: TVA – W1, HTVA, MTVA – W1, WB1 and G units not marked.



EMC Technology's TVA Thermopads are microwave absorbtive attenuators which provide power dissipation that varies with temperature and operate in frequency ranges from DC to 6 GHz. This surface mount, temperature variable attenuator requires no bias or control voltages and generates zero distortion. TVA Thermopads are also well suited for pre-amplified IF circuits.

General Specifications

Nominal Impedance . . . . . .50 Ohms Nominal
Frequency Range . . . . . DC to 6 GHz
Attenuation Accuracy . . . . . .± 0.5 dB
TCA Tolerance . . . . . .± 0.001 dB/dB/°C
VSWR (Typical) . . . . . .1.30 @ 1 GHz
Power Rating . . . . . .2.0 Watts
Power Derating . . . . . .100% @ 125° C
Derates to 0% @ 150° C
Operating Temperature . . . . . -55° C to +150° C

Material Specifications

Substrate . . . . . Alumina
Resistive Material . . . . . Thick Film
Termination Material . . Thick Film, Nickel Barrier with Solder Plated Finish

Usable Frequency Range Reference Table

CTVA . . . . . .DC to 2 GHz
***TVA**, W1, W3 . . . . . DC to 6 GHz*
MTVA, G (N3, N4, N5) . . . . . DC to 18 GHz
MTVA, G (N6, N7) . . . . . .DC to 12.4 GHz
MTVA, W3, WB1, W1 . . . . . DC to 12.4 GHz
HTVA . . . . . .DC to 20 GHz
KTVA . . . . . .18 to 46 GHz
Coaxial TVA . . . . . .DC to 6 GHz

Ordering Information

TVA 03 00 N 05 W3 S

SERIES
TVA

NOMINAL ATTENUATION
01 = 1 dB
02 = 2 dB
03 = 3 dB
04 = 4 dB
05 = 5 dB
06 = 6 dB
07 = 7 dB
08 = 8 dB
09 = 9 dB
10 = 10 dB

EMC CODE

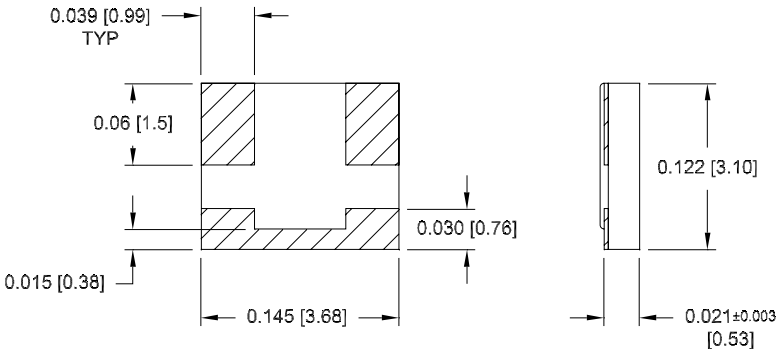
TCA SLOPE
N = Negative
P = Positive

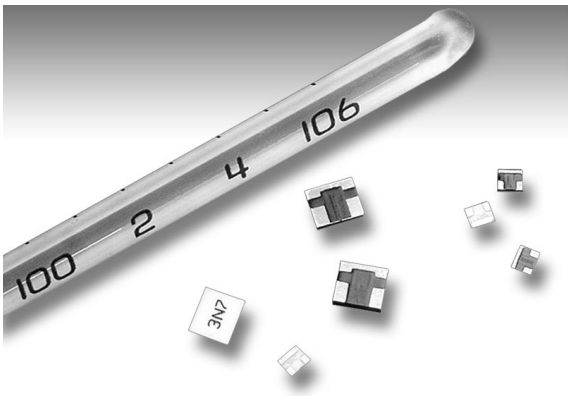
TCA (dB/dB/°C)
03 = .003
04 = .004
05 = .005
06 = .006
07 = .007
09 = .009

METALLIZATION
(blank) = Planar
W3 = Triple Wrap
W1 = Single Wrap

PRETINNING
(blank) = Standard
S = Pretinning
F = Lead Free

Product Dimensions





EMC Technology's MTVA Thermopads are microwave absorbtive attenuators which offer a smaller physical size with increased frequency range. The series operates DC to 18 GHz. The MTVA version of the Thermopad also offers wire bondable terminals for use with alternative high frequency attachment methods and space applications.

General Specifications

Nominal Impedance . . . . . .50 Ohms Nominal
Frequency Range . . . . . DC to 18 GHz
Attenuation Accuracy . . . . . .± 0.5 dB
TCA Tolerance . . . . . .± 0.001 dB/dB/°C
VSWR (Typical) . . . . . .1.30 @ 1 GHz
Power Rating . . . . . .200 mWatts
Power Derating . . . . . .100% @ 125° C
Derates to 0% @ 150° C
Operating Temperature . . . . . -55° C to +150° C

Material Specifications

Substrate . . . . . Alumina
Resistive Material . . . . . Thick Film
Termination Material . . Thick Film, Nickel Barrier with Solder Plated Finish
Gold and Wire Bondable Options Available

Usable Frequency Range Reference Table

CTVA . . . . . .DC to 2 GHz
TVA, W1, W3 . . . . . DC to 6 GHz
***MTVA**, G (N3, N4, N5) . . . . . DC to 18 GHz*
***MTVA**, G (N6, N7) . . . . . .DC to 12.4 GHz*
***MTVA**, W3, WB1, W1 . . . . . DC to 12.4 GHz*
HTVA . . . . . .DC to 20 GHz
KTVA . . . . . .18 to 46 GHz
Coaxial TVA . . . . . .DC to 6 GHz

Ordering Information

MTVA 03 00 N 05 W3 S

SERIES
MTVA

NOMINAL ATTENUATION
01 = 1 dB
02 = 2 dB
03 = 3 dB
04 = 4 dB
05 = 5 dB
06 = 6 dB
08 = 8 dB

EMC CODE

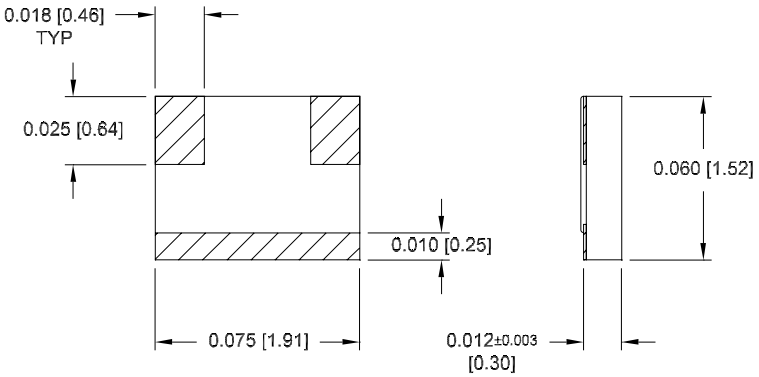
TCA SLOPE
N = Negative

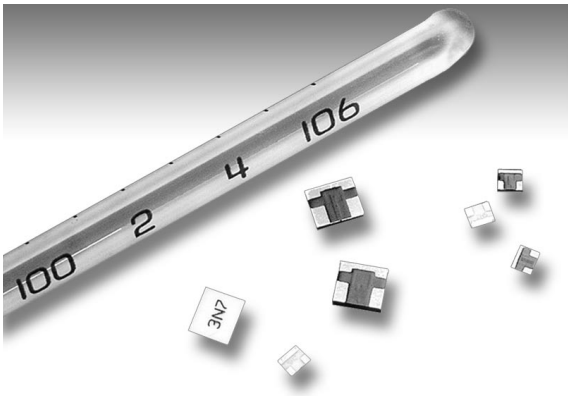
TCA (dB/dB/°C)
03 = .003
04 = .004
05 = .005
06 = .006
07 = .007
09 = .009

METALLIZATION
(blank) = Planar
W3 = Triple Wrap
W1 = Single Wrap
WB1 = Single Wrap
G = Gold Metallization

PRETINNING
(blank) = Standard
S = Pretinning
F = Lead Free
Not available on WB1 or G

Product Dimensions





EMC Technology's HTVA Thermopads are microwave absorbtive attenuators which operate in ultra-broadband applications from DC to 20 GHz and offer a smaller 0.55 sq chip size. Thermopads reduce component count, increase reliability, and reduce costs.

General Specifications

Nominal Impedance . . . . . .50 Ohms Nominal
Frequency Range . . . . . DC to 20 GHz
Attenuation Accuracy . . . . . .± 0.5 dB
TCA Tolerance . . . . . .± 0.001 dB/dB/°C
VSWR (Typical) . . . . . .1.30 @ 1 GHz
Power Rating . . . . . .200 mWatts
Power Derating . . . . . .100% @ 125° C
Derates to 0% @ 150° C
Operating Temperature . . . . . -55° C to +150° C

Material Specifications

Substrate . . . . . Alumina
Resistive Material . . . . . Thick Film
Termination Material . . . . . Thick Film with Wire Bondable Gold

Usable Frequency Range Reference Table

CTVA . . . . . .DC to 2 GHz
TVA, W1, W3 . . . . . DC to 6 GHz
MTVA, G (N3, N4, N5) . . . . . DC to 18 GHz
MTVA, G (N6, N7) . . . . . .DC to 12.4 GHz
MTVA, W3, WB1, W1 . . . . . DC to 12.4 GHz
***HTVA** . . . . . .DC to 20 GHz*
KTVA . . . . . .18 to 46 GHz
Coaxial TVA . . . . . .DC to 6 GHz

Ordering Information

HTVA 03 00 N 04

SERIES
HTVA

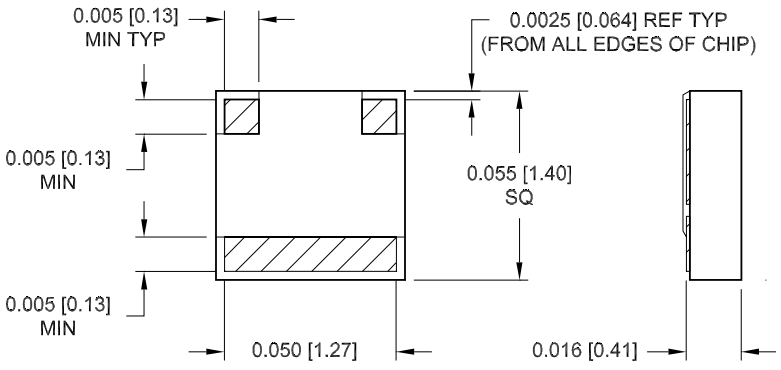
NOMINAL ATTENUATION
03 = 3 dB
06 = 6 dB

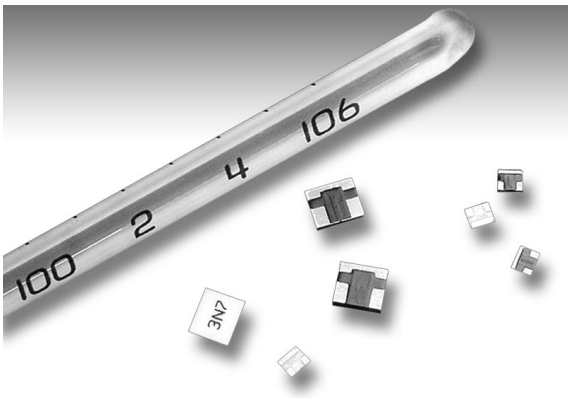
EMC CODE

TCA SLOPE
N = Negative

TCA (dB/dB/°C)
04 = .004

Product Dimensions





EMC Technology's CTVA Thermopad is a 75 ohm version of the standard temperature variable attenuator. It can be used in 75 ohm applications where variable dissipated power is required over temperature.

General Specifications

Nominal Impedance . . . . . .75 Ohms Nominal
Frequency Range . . . . . DC to 2 GHz
Attenuation Accuracy . . . . . .± 0.5 dB
TCA Tolerance . . . . . .± 0.001 dB/dB/°C
VSWR (Typical) . . . . . .1.25 @ 1 GHz
Power Rating . . . . . .2.0 Watts
Power Derating . . . . . .100% @ 125° C
Derates to 0% @ 150° C
Operating Temperature . . . . . -55° C to +150° C

Material Specifications

Substrate . . . . . Alumina
Resistive Material . . . . . Thick Film
Termination Material . . Thick Film, Nickel Barrier with Solder Plated Finish

Usable Frequency Range Reference Table

***CTVA** . . . . . .DC to 2 GHz*
TVA, W1, W3 . . . . . DC to 6 GHz
MTVA, G (N3, N4, N5) . . . . . DC to 18 GHz
MTVA, G (N6, N7) . . . . . .DC to 12.4 GHz
MTVA, W3, WB1, W1 . . . . . DC to 12.4 GHz
HTVA . . . . . .DC to 20 GHz
KTVA . . . . . .18 to 46 GHz
Coaxial TVA . . . . . .DC to 6 GHz

Ordering Information

CTVA — **SERIES CTVA**

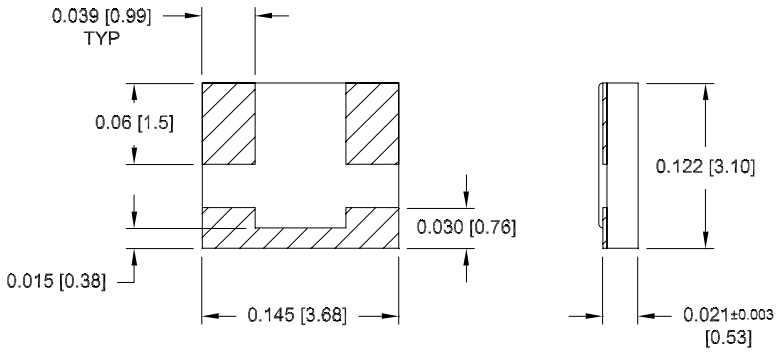
03 — **NOMINAL ATTENUATION**
1.5 = 1.5 dB
02 = 2 dB
03 = 3 dB
04 = 4 dB

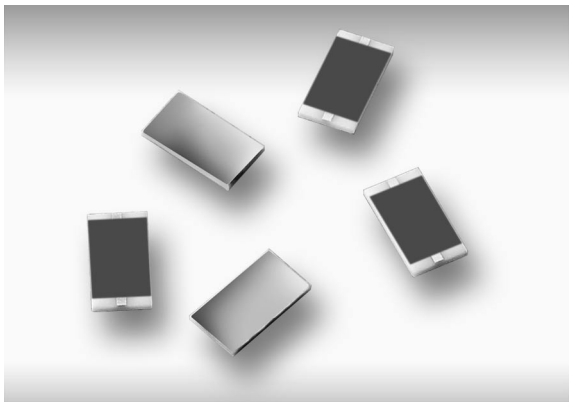
00 — **EMC CODE**

N — **TCA SLOPE**
N = Negative

05 — **TCA (dB/dB/°C)**
07 = .007
08 = .008
09 = .009
10 = .010
11 = .011

Product Dimensions





EMC Technology's KTVA high frequency Thermopads are ideal for millimeter-wave amplifiers. These temperature variable attenuators are wire bondable and designed to work in frequencies from 18 to 46 GHz. The devices have a small footprint and a low profile.

General Specifications

Nominal Impedance . . . . . .50 Ohms Nominal
Frequency Range . . . . . .18 to 46 GHz
Attenuation Accuracy . . . . . .± 0.5 dB to ±1.0 dB
TCA Tolerance . . . . . .± 0.001 dB/dB/°C
VSWR (Max) 1.35
Power Rating . . . . . .100 mWatts
Power Derating . . . . . .100% @ 125° C
Derates to 0% @ 150° C
Operating Temperature . . . . . .-55° C to 150° C

Material Specifications

Substrate . . . . . Alumina
Resistive Material . . . . . Thick Film
Termination Material . . . . . Thick Film, Wire Bondable Gold

Usable Frequency Range Reference Table

CTVA . . . . . DC to 2 GHz
TVA, W1, W3 . . . . . DC to 6 GHz
MTVA, G (N3, N4, N5) . . . . . DC to 18 GHz
MTVA, G (N6, N7) . . . . . .DC to 12.4 GHz
MTVA, W3, WB1, W1 . . . . . DC to 12.4 GHz
HTVA . . . . . .DC to 20 GHz
***KTVA** . . . . . .18 to 46 GHz*
Coaxial TVA . . . . . .DC to 6 GHz

Ordering Information

KTVA 03 00 N 05 1832

SERIES
KTVA

EMC CODE

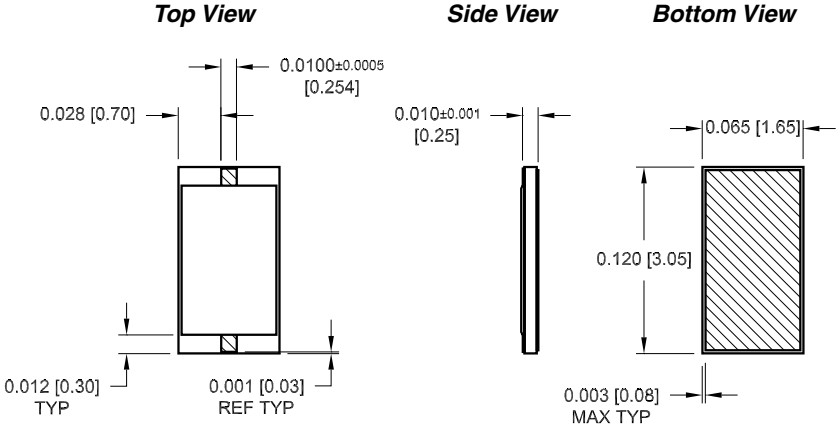
NOMINAL ATTENUATION
03 = 3dB
04 = 4dB
06 = 6dB

TCA SLOPE
N = Negative

TCA (dB/dB/°C)
05 = .005
06 = .006
07 = .007

FREQ. RANGE (GHz)
18-22
18-32
28-31
42-46

Product Dimensions



EMC Technology offers the popular temperature variable attenuator in a coaxial package. The coaxial Thermopad offers the same benefits as the standard temperature variable attenuator with the added benefit of a SMA male to SMA female interface.

General Specifications

Nominal Impedance . . . . . .50 Ohms Nominal
Frequency Range . . . . . DC to 6 GHz
Attenuation Accuracy . . . . . ±0.5 dB
TCA Tolerance . . . . . ±0.001 dB/dB/°C
VSWR (Typical) . . . . . .1.35 @ 1 GHz
Power Rating . . . . . .2.0 Watts
Power Derating . . . . . 100% @ 125° C
Derates to 0% @ 150° C
Operating Temperature . . . . . -55° C to +150° C

Material Specifications

Substrate . . . . . Alumina
Resistive Material . . . . . Thick Film
Termination Material . . Thick Film, Nickel Barrier with Solder Plated Finish
Body and Nut . . . . . Stainless Steel
Contact . . . . . Beryllium Copper
Dielectric . . . . . .Tetreflourethylene
Interface . . . . . .SMA Male/SMA Female

Finish
Body . . . . . .Passivated
Coupling Nut . . . . . .Passivated
Contact . . . . . .Gold

Usable Frequency Range Reference Table

CTVA . . . . . .DC to 2 GHz
TVA, W1, W3 . . . . . DC to 6 GHz
MTVA, G (N3, N4, N5) . . . . . DC to 18 GHz
MTVA, G (N6, N7) . . . . . .DC to 12.4 GHz
MTVA, W3, WB1, W1 . . . . . DC to 12.4 GHz
HTVA . . . . . .DC to 20 GHz
KTVA . . . . . .18 to 46 GHz
***Coaxial TVA** . . . . . .DC to 6 GHz*

Ordering Information

42TVA | 03 | 00 | N | 05

SERIES
42TVA

NOMINAL ATTENUATION
01 = 1 dB
02 = 2 dB
03 = 3 dB
04 = 4 dB
05 = 5 dB
06 = 6 dB
07 = 7 dB
08 = 8 dB
09 = 9 dB
10 = 10 dB

EMC CODE

TCA SLOPE
N = Negative
P = Positive

TCA (dB/dB/°C)
03 = .003
04 = .004
05 = .005
06 = .006
07 = .007
09 = .009

Note: All TVA values are available in Coaxial.

Product Dimensions