

# 18–40 GHz Surface Mount Voltage Variable Attenuator



**AV850M2-A2**  
Patent Pending

## Features

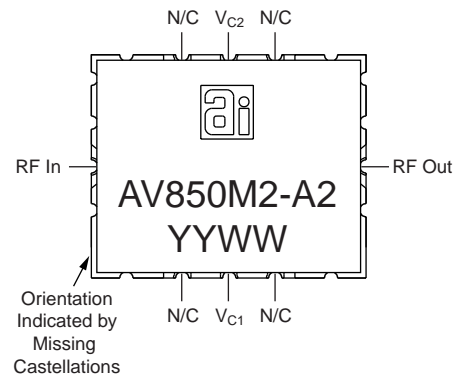
- Surface Mount Package
- 30 dB Attenuation Range
- +10 dBm  $P_1$  dB All Attenuation States
- Low Insertion Loss
- 100% RF and DC Testing

## Description

The AV850M2-A2 is a broadband millimeterwave voltage variable attenuator in a rugged surface mount package that is compatible with high-volume solder installation. The attenuator is designed for use in millimeterwave communication and sensor systems as a variable attenuation stage in the receiver or transmitter chain when wide dynamic range and high linearity are required. The robust ceramic surface mount package provides excellent electrical performance and a high degree of environmental protection for long-term reliability. All attenuators are screened at the operating frequencies prior to shipment for guaranteed performance. Attenuator is targeted for high-volume millimeterwave applications such as point-to-point and point-to-multipoint wireless communications systems. Control voltage  $V_{C2}$  sets the attenuation level while  $V_{C1}$  adjusts return loss for the part.



## Pin Out



## Electrical Specifications at 25°C

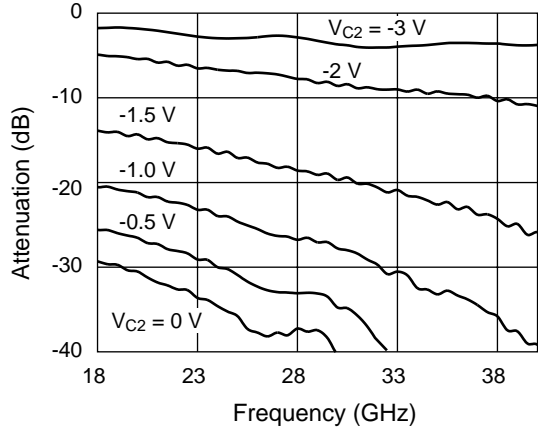
### RF

Parameter	Symbol	Min.	Typ.	Max.	Unit
Bandwidth	BW	18		40	GHz
Insertion Loss at Minimum Attenuation	$IL_{Min}$		3	4	dB
Insertion Loss at Maximum Attenuation	$IL_{Max}$	27	33		dBm
Input Return Loss	$RL_I$		10		dB
Output Return Loss	$RL_O$		10		dB
Output Power at 1 dB Gain Compression (For All Attenuation Levels)	$P_1$ dB	8	10		dBm
Temperature Coefficient of Attenuation	dG/dT		-0.002		dB/C

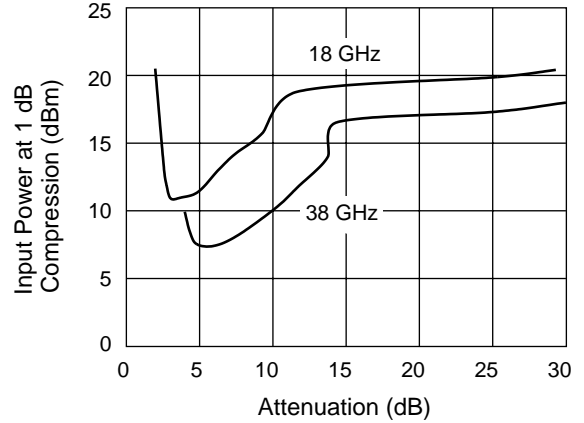
### DC

Parameter	Symbol	Min.	Typ.	Max.	Unit
Control Current	$I_{C1} + I_{C2}$		<1		mA

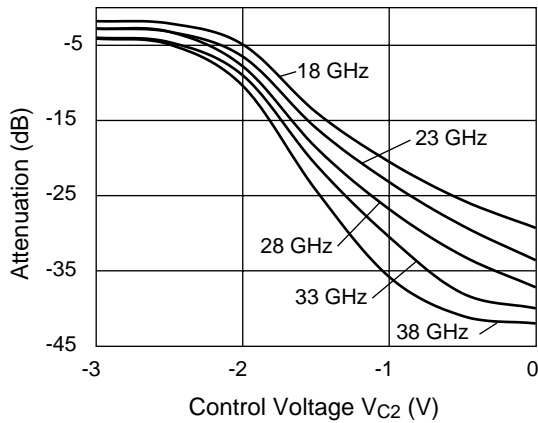
Typical Performance Data



Attenuation vs. Frequency



1 dB Compression vs. Attenuation

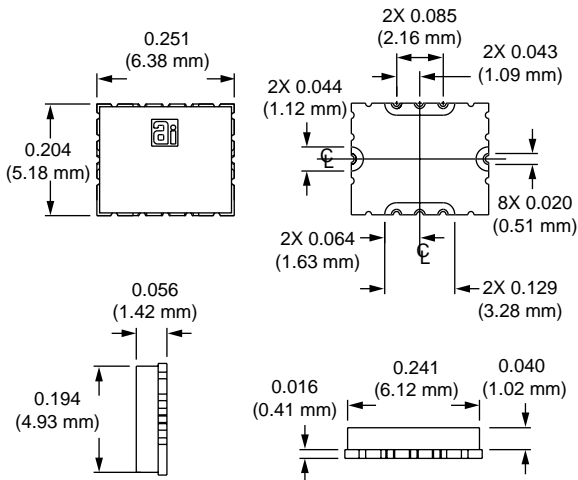


Attenuation vs. Control Voltage

Absolute Maximum Ratings

Characteristic	Value
Operating Temperature ( $T_C$ )	-55°C to +90°C
Storage Temperature ( $T_{ST}$ )	-65°C to +150°C
Control Voltage ( $V_{C1}$ )	-7 $V_{DC}$
Control Voltage ( $V_{C2}$ )	-7 $V_{DC}$
Power In ( $P_{IN}$ )	30 dBm

Outline



Typical S-Parameters at 25°C ( $V_{C1} = 0\text{ V}$ ,  $V_{C2} = -2.0\text{ V}$ )

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	Mag. (dB)	Ang. (Deg.)	Mag. (dB)	Ang. (Deg.)	Mag. (dB)	Ang. (Deg.)	Mag. (dB)	Ang. (Deg.)
10	-14.37	38.2	-1.33	100.4	-1.32	100.5	-9.22	-62.9
12	-10.98	-26.8	-1.64	48.7	-1.64	48.9	-8.79	-98.0
14	-8.31	-97.9	-1.94	-1.6	-1.91	-1.3	-9.30	-128.6
16	-9.35	-139.2	-4.78	-57.2	-4.80	-57.1	-11.69	-154.9
18	-14.03	-170.7	-4.90	-112.0	-4.94	-112.1	-16.49	-155.6
20	-18.93	-133.4	-5.43	-167.8	-5.46	-167.9	-14.19	-128.9
22	-12.60	-133.0	-6.20	137.5	-5.99	138.1	-10.86	-150.9
24	-10.72	-160.2	-6.69	85.1	-6.41	85.3	-11.50	179.0
26	-11.51	-178.6	-7.04	31.5	-6.80	31.5	-16.43	163.2
28	-11.48	173.2	-7.76	-24.1	-7.75	-23.9	-17.54	-159.4
30	-10.31	158.3	-8.60	-77.1	-8.33	-77.0	-12.63	-174.8
32	-10.67	137.2	-8.99	-130.8	-8.54	-131.2	-12.30	151.0
34	-12.16	125.6	-9.03	174.1	-8.96	173.1	-14.97	115.2
36	-12.40	120.7	-9.57	115.3	-9.58	114.4	-22.73	66.2
38	-11.55	108.5	-10.37	54.3	-10.06	53.8	-27.99	-73.0
40	-11.20	78.8	-10.96	-8.8	-10.40	-11.0	-18.34	-114.6
42	-12.60	49.9	-11.74	-79.2	-11.93	-80.8	-13.31	-137.7
44	-13.69	-163.7	-16.18	-170.9	-16.25	-171.4	-8.52	-158.5
46	-1.17	91.4	-21.20	-117.9	-20.84	-125.3	-1.21	132.6
48	-3.80	13.8	-16.82	142.0	-17.75	140.9	-2.88	63.1
50	-6.06	-20.5	-18.90	69.6	-18.69	67.7	-5.77	-1.7

Typical S-Parameters at 25°C ( $V_{C1} = 0\text{ V}$ ,  $V_{C2} = -1.5\text{ V}$ )

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	Mag. (dB)	Ang. (Deg.)	Mag. (dB)	Ang. (Deg.)	Mag. (dB)	Ang. (Deg.)	Mag. (dB)	Ang. (Deg.)
10	-10.75	-12.4	-4.64	98.3	-4.63	98.4	-5.28	-76.6
12	-9.15	-54.8	-4.88	46.6	-4.74	46.7	-5.86	-115.3
14	-6.20	-95.6	-13.10	-8.1	-13.19	-7.7	-7.30	-150.7
16	-6.78	-126.0	-13.60	-60.1	-13.41	-59.8	-10.21	175.2
18	-7.73	-151.5	-13.88	-113.4	-13.55	-113.2	-17.10	142.1
20	-8.76	-172.7	-14.32	-167.4	-14.31	-167.6	-27.30	-78.3
22	-9.99	166.5	-15.36	138.6	-15.49	138.7	-14.32	-103.7
24	-12.10	148.4	-16.59	84.8	-16.42	84.9	-10.57	-129.9
26	-15.52	135.5	-17.65	32.0	-17.23	32.1	-9.06	-156.0
28	-20.66	134.9	-18.59	-19.7	-18.57	-19.1	-9.05	176.8
30	-20.36	178.8	-19.68	-72.6	-19.38	-72.9	-9.43	149.7
32	-15.81	-177.1	-20.60	-127.5	-20.15	-128.3	-10.93	115.0
34	-12.49	172.3	-21.70	177.9	-21.85	177.7	-14.17	69.5
36	-10.17	151.7	-23.16	122.6	-22.76	122.0	-16.34	-7.0
38	-8.90	129.3	-24.30	62.1	-23.75	60.9	-13.69	-82.6
40	-8.01	97.7	-25.88	-0.2	-26.17	-3.5	-10.76	-131.7
42	-8.54	63.5	-28.12	-64.0	-28.13	-65.7	-9.37	-170.3
44	-19.54	-160.6	-31.87	-163.0	-30.84	-159.6	-10.51	174.9
46	-0.14	91.4	-45.47	-81.4	-48.12	-107.4	-0.44	129.9
48	-1.73	11.0	-34.72	173.4	-36.37	173.9	-1.55	49.4
50	-3.65	-27.5	-35.09	97.1	-36.54	102.4	-4.82	-18.549

## “Alpha Two” Surface Mount Package Handling and Mounting

Millimeterwave components require careful mounting design to maintain optimal performance. The Alpha Two surface mount package (patent pending) provides a rugged and repeatable electrical connection using standard solder techniques.

### Handling

The Alpha Two surface mount package is very rugged. However, due to ceramic's brittle nature, one should exercise care when handling with metal tools. Do not apply heavy pressure to the lid. Vacuum tools may be used to pick and place this part.

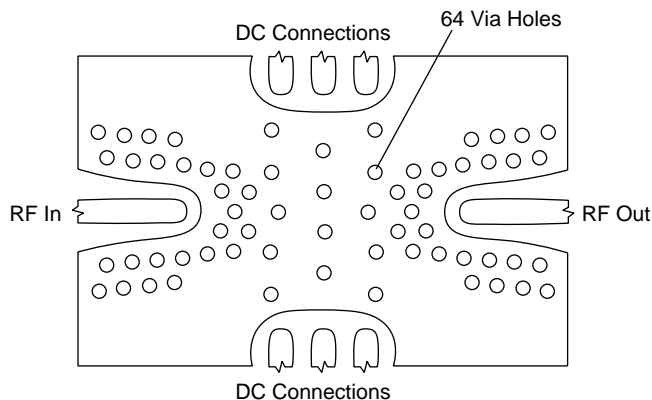
Only personnel trained in both ESD precautions and handling precautions should be allowed to handle these packages.

### Package Construction

The Alpha Two surface mount package consists of a base and a lid. The package base is ceramic with filled vias and plated castellations. The package lid is unplated alumina. The lid seal is epoxy.

### Mounting Design

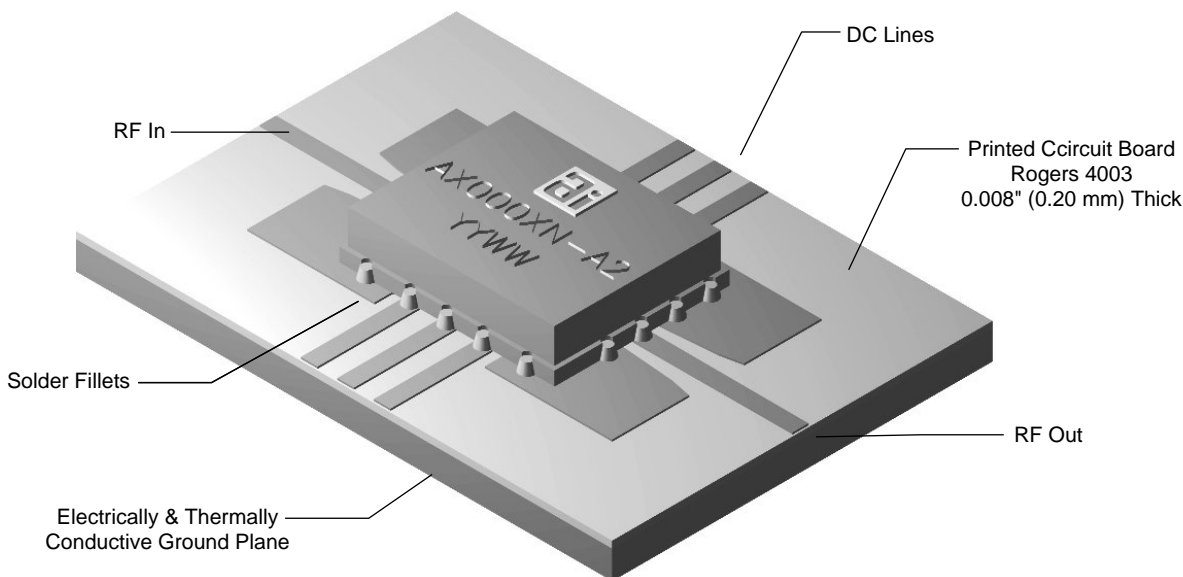
The Alpha Two surface mount package is installed on top of a printed circuit board on a specially designed footprint. Mounting footprint geometry will be supplied by Alpha Industries in electronic formats or paper drawing.



**Footprint Geometry for Alpha Two  
Surface Mount Package**

### Mounting the Package

The Alpha Two surface mount package is compatible with high-volume surface mount installation using solder. RF and DC connections are accomplished with metallized edge castellations that hold solder fillets. Ground connections are accomplished by both metallized edge castellations and filled vias to the bottom of the package. Care should be taken to ensure that there are no voids or gaps in the solder so that a good RF, DC, and ground contact is maintained.



**Alpha Two Surface Mount Package Installation**