

Wideband Fixed Attenuator Family, DIE DC - 50 GHz



ENGAT00000 - ENGAT00010

Rev. V1

Features

- Ultra Wideband Performance
- Excellent Return Loss: >20 dB
- Tight Attenuation Control
- RF Power Handling: 27 dBm
- Die Size:
0.76 x 0.76 x 0.1 mm
0.030 x 0.030 x 0.004 inch
- RoHS* Compliant

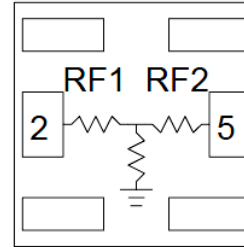
Applications

- Space Hybrids
- Military Hybrids
- Microwave Radios
- Prototype Kits
- Test & Measurement Systems

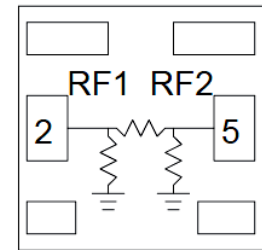
Description

The ENGAT000XX are a line of fixed precision attenuators matched to 50 Ω . They have attenuation values of 0, 1, 2, 3, 4, 6, 8, and 10 dB. They come in both PI and T style resistor configurations. The attenuators have gold backside metallization and are designed to be silver epoxy attached. Low inductance on-chip vias are utilized and no additional ground interconnects are required. The RF interconnects are designed to account for wire bonds and external microstrip flares for optimal integrated return loss. Nichrome resistors with low temperature coefficients are set up to handle half watt RF input power levels.

Functional Block Diagram



T Style
(AT00002, 4, 5, 7, 8, 9)



PI Style
(AT00001, 3, 6, 10)

Ordering Information

Part Number	Package
ENGAT000xx	Die

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Wideband Fixed Attenuator Family, DIE DC - 50 GHz



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Electrical Specifications: $T_A = +25^\circ\text{C}$

Part Number	Attenuator Value (dB)	DC to 35 GHz		35 to 50 GHz	
		Return Loss (dB)	Attenuation Tolerance (dB)	Return Loss (dB)	Attenuation Tolerance (dB)
AT00000	0.1 (Thru line)	25	+0.1 / -0.07	20	+0.15 / -0.05
AT00001	1 ("PI")	20	+0.2 / -0.2	15	+0.3 / -0.3
AT00002	2 ("T")	25	+0.3 / -0.3	20	+0.4 / -0.5
AT00003	3 ("PI")	25	+0.3 / -0.3	20	+0.4 / -0.5
AT00004	4 ("T")	23	+0.3 / -0.3	18	+0.4 / -0.5
AT00005	6 ("T")	25	+0.4 / -0.4	15	+0.5 / -0.6
AT00006	6 ("PI")	25	+0.4 / -0.4	20	+0.5 / -0.6
AT00007	3 ("T")	25	+0.3 / -0.3	20	+0.4 / -0.5
AT00008	8 ("T")	22	+0.4 / -0.4	15	+0.5 / -0.6
AT00009	10 ("T")	20	+0.5 / -0.5	15	+0.5 / -0.7
AT00010	10 ("PI")	25	+0.5 / -0.5	18	+0.5 / -0.7

Absolute Maximum Ratings^{1,2:}

Parameter	Absolute Maximum
RF Power	30 dBm except for: 28 dBm for AT00006, AT00010
DC Voltage (applied to one port)	8 V except for: 5 V for AT00006, AT00010
Operating Temperature	-55°C to +125°C
Storage Temperature	-65°C to +150°C

1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.

Handling Procedures

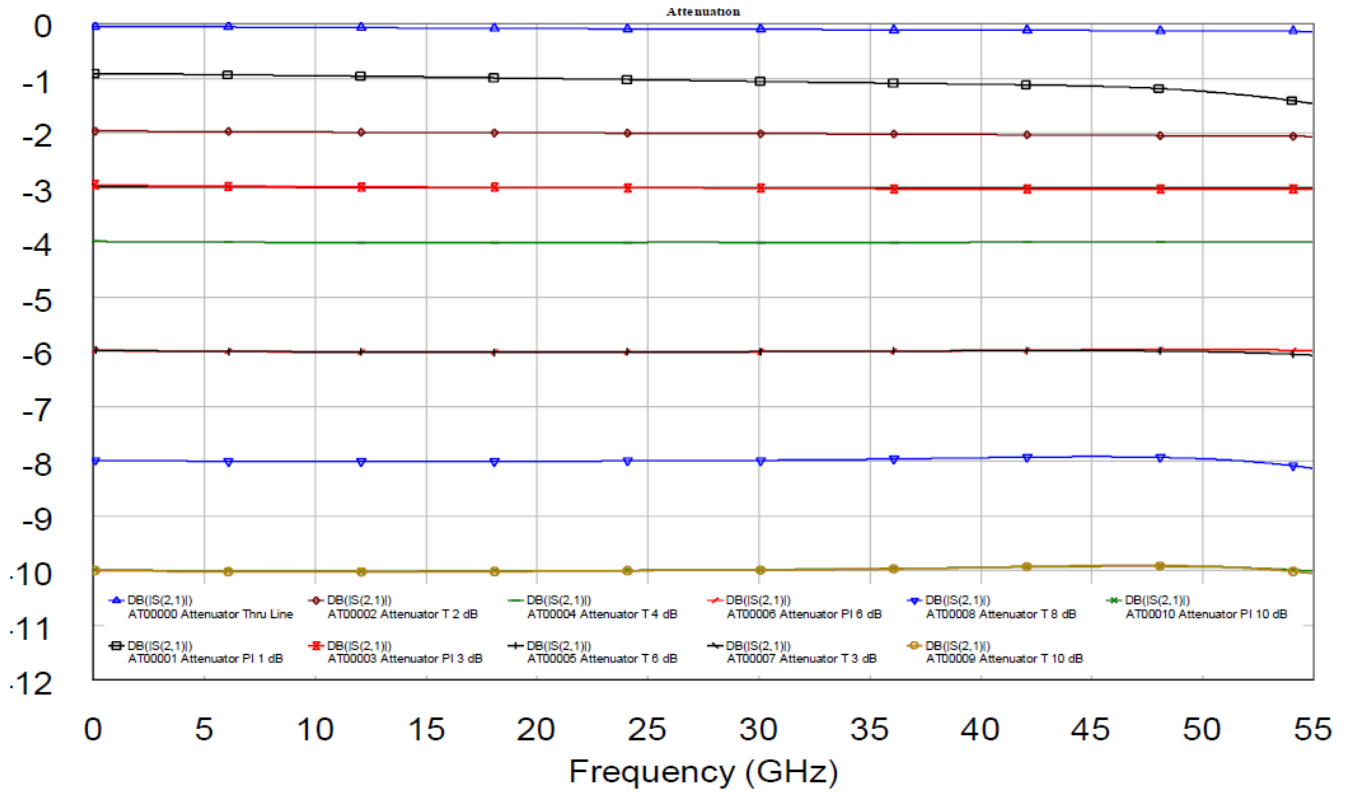
Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

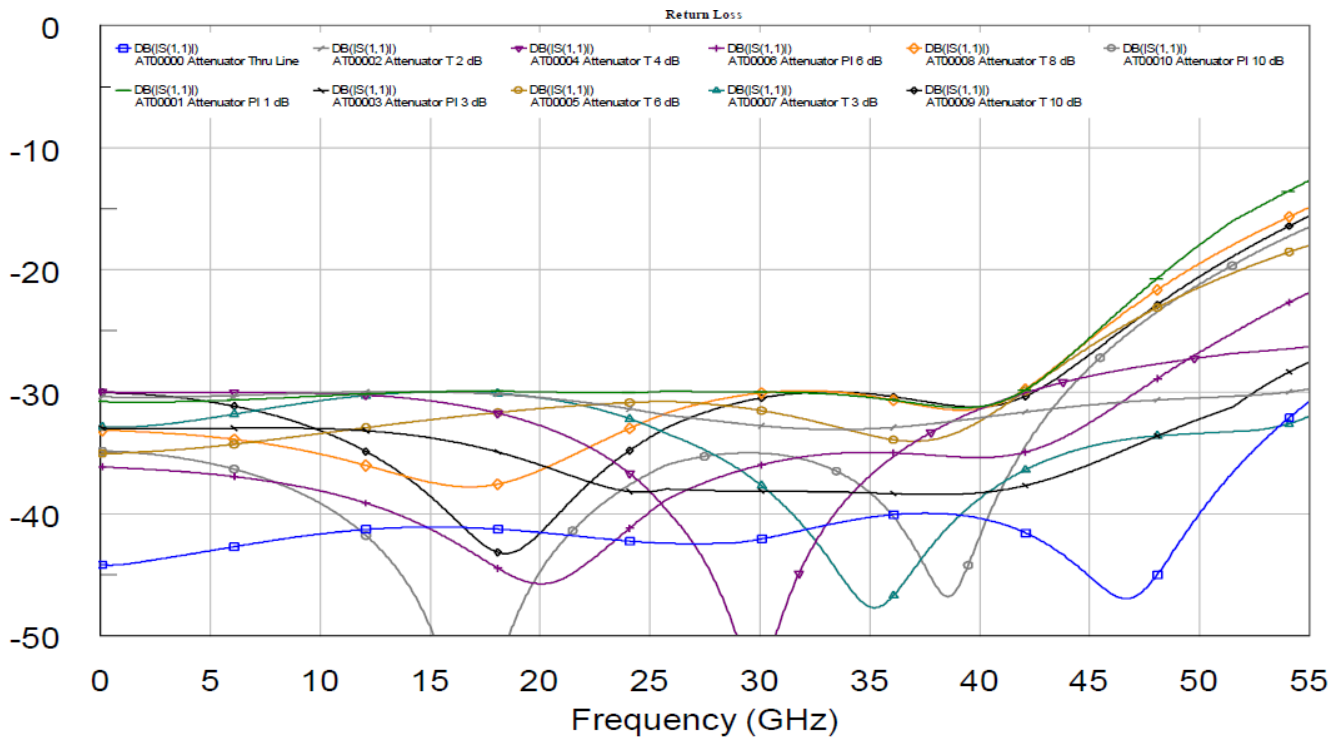
RF Data With Wirebonds and External Flare Pads

Predicted Attenuation



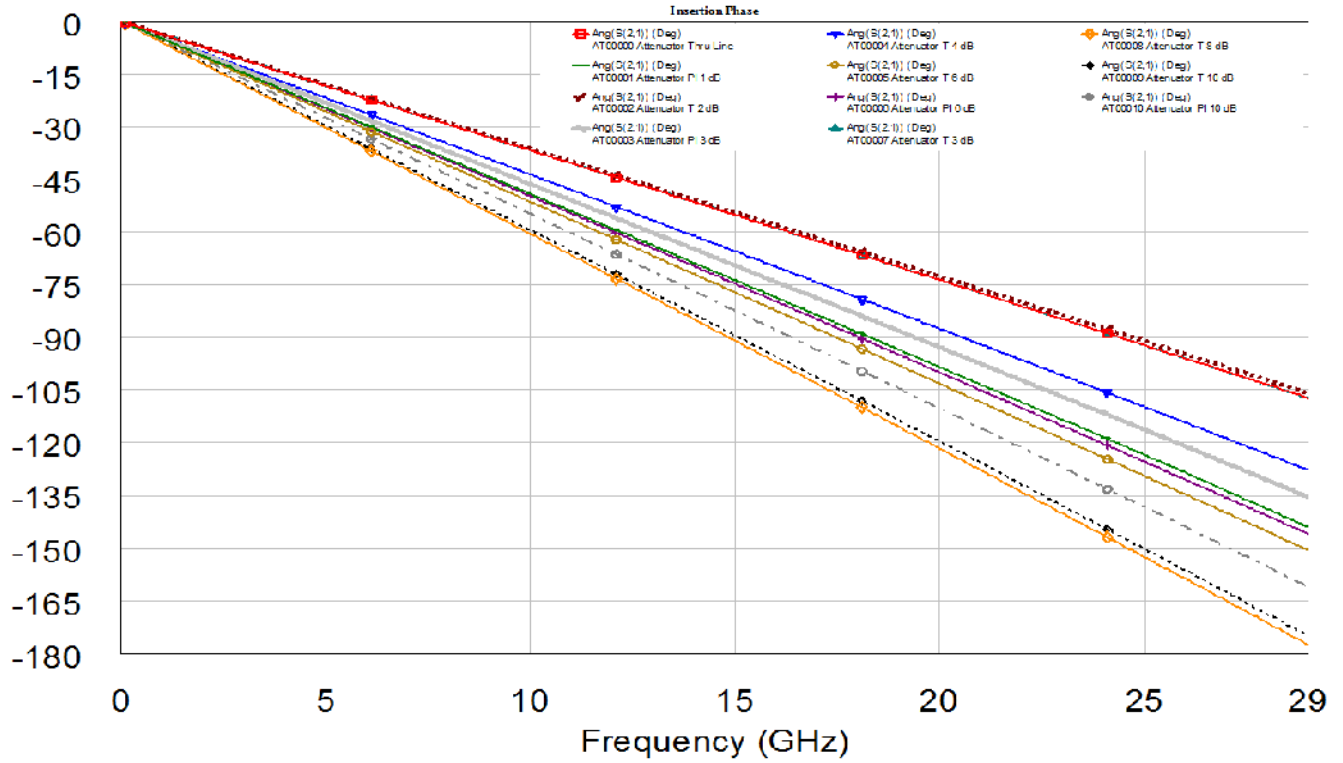
RF Data With Wirebonds and External Flare Pads

Predicted Return Loss



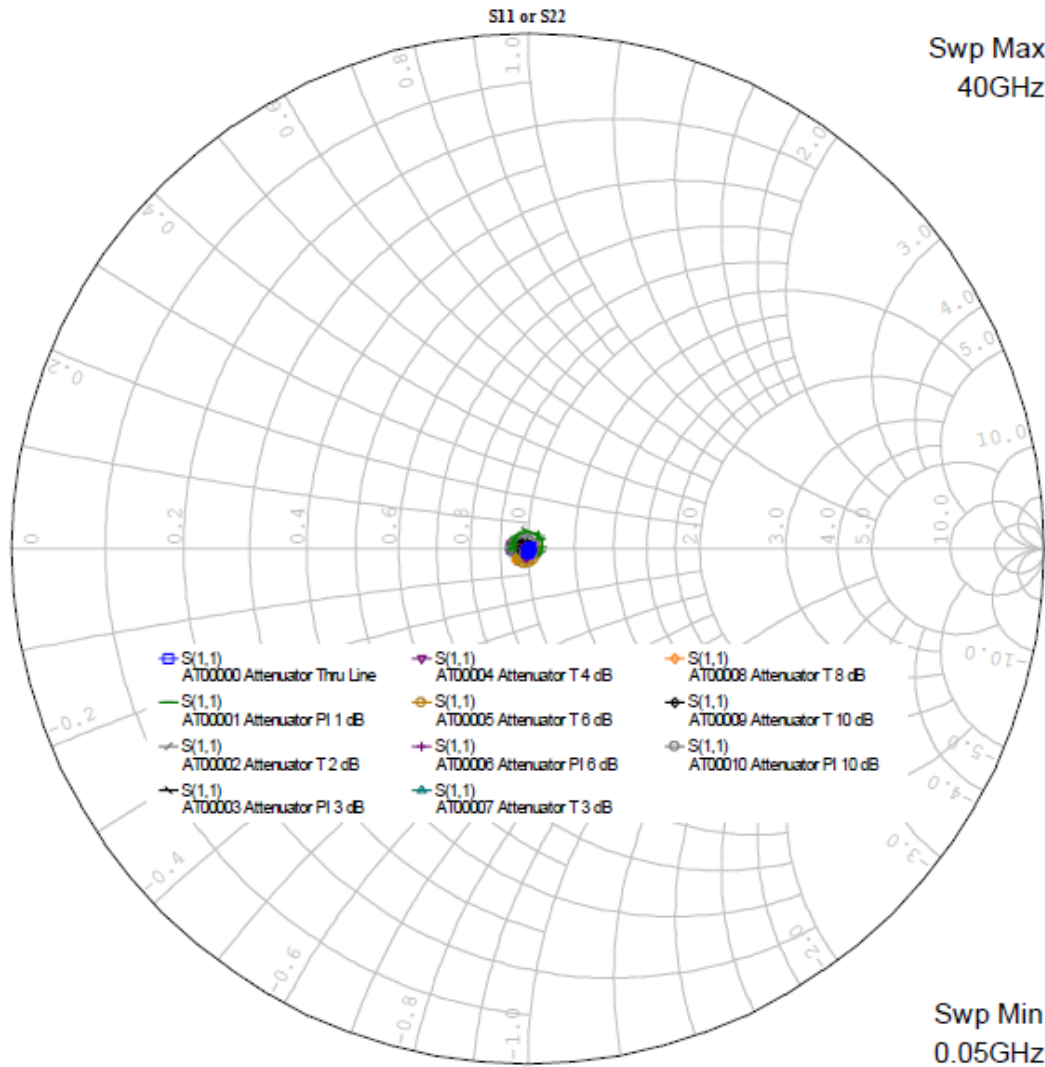
RF Data With Wirebonds and External Flare Pads

Predicted Insertion Phase



RF Data With Wirebonds and External Flare Pads

Predicted S11 or S22 (I/O reflection coefficients) to 40 GHz



External I/O Microstrip Flare Dimensions (on 5-mil Alumina) and I/O Bond Wire Inductances – For Optimum Insertion and Return Loss Performance to 35 GHz

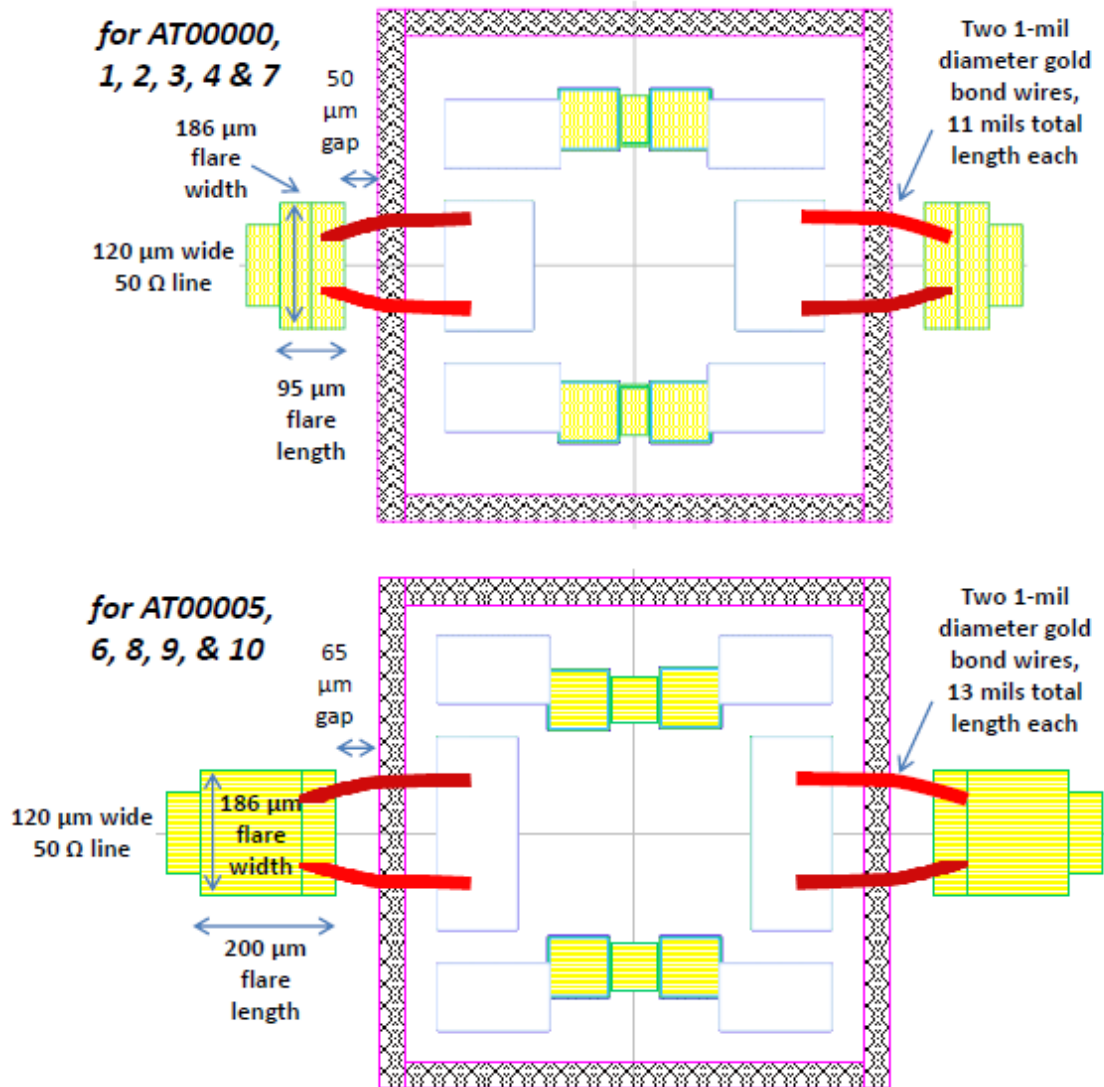
A single external microstrip flare width x length and wire inductance can be used for attenuators AT00000, 1, 2, 3, 4, & 7; and a second flare length dimension and wire inductance for attenuators AT00005, 6, 8, 9, & 10, to achieve best return loss performance through 35 GHz.

Part Number	Attenuator Value (dB)	RF I/O port - External Microstrip Flares on 5-mil Alumina			
		Flare Width (y, μm)	Flare Length (x, μm)	Wire Inductance (nH)	Wire Length (2 wires) (mils)
AT00000	0 (Thru line)	186	95	0.13	11
AT00001	1 ("PI")	186	95	0.13	11
AT00002	2 ("T")	186	95	0.13	11
AT00003	3 ("PI")	186	95	0.13	11
AT00004	4 ("T")	186	95	0.13	11
AT00007	3 ("T")	186	95	0.13	11
AT00005	6 ("T")	186	200	0.16	13
AT00006	6 ("PI")	186	200	0.16	13
AT00008	8 ("T")	186	200	0.16	13
AT00009	10 ("T")	186	200	0.16	13
AT00010	10 ("PI")	186	200	0.16	13

Notes:

- To achieve bond wire inductance noted, bond the number of wires shown in parallel from each external flare to each associated MMIC RF bond pad as shown above.
- Gold Wire Details:
 Diameter: 25.4 μm (1 mil)
 Spacing: 4 mils (~ 100 μm) typical
 Height above Ground: 8 mils (~ 200 μm) typical (wedge bonds)
- Wire Length is total length if the wire were made perfectly straight.

External I/O Microstrip Flare Dimensions (on 5-mil Alumina) and I/O Bond Wire Inductances – Assembly Diagrams For Optimum Insertion and Return Loss Performance to 35 GHz



External I/O Microstrip Flare Dimensions (on 5-mil Alumina) and I/O Bond Wire Inductances – For Optimum Insertion and Return Loss Performance to 50 GHz

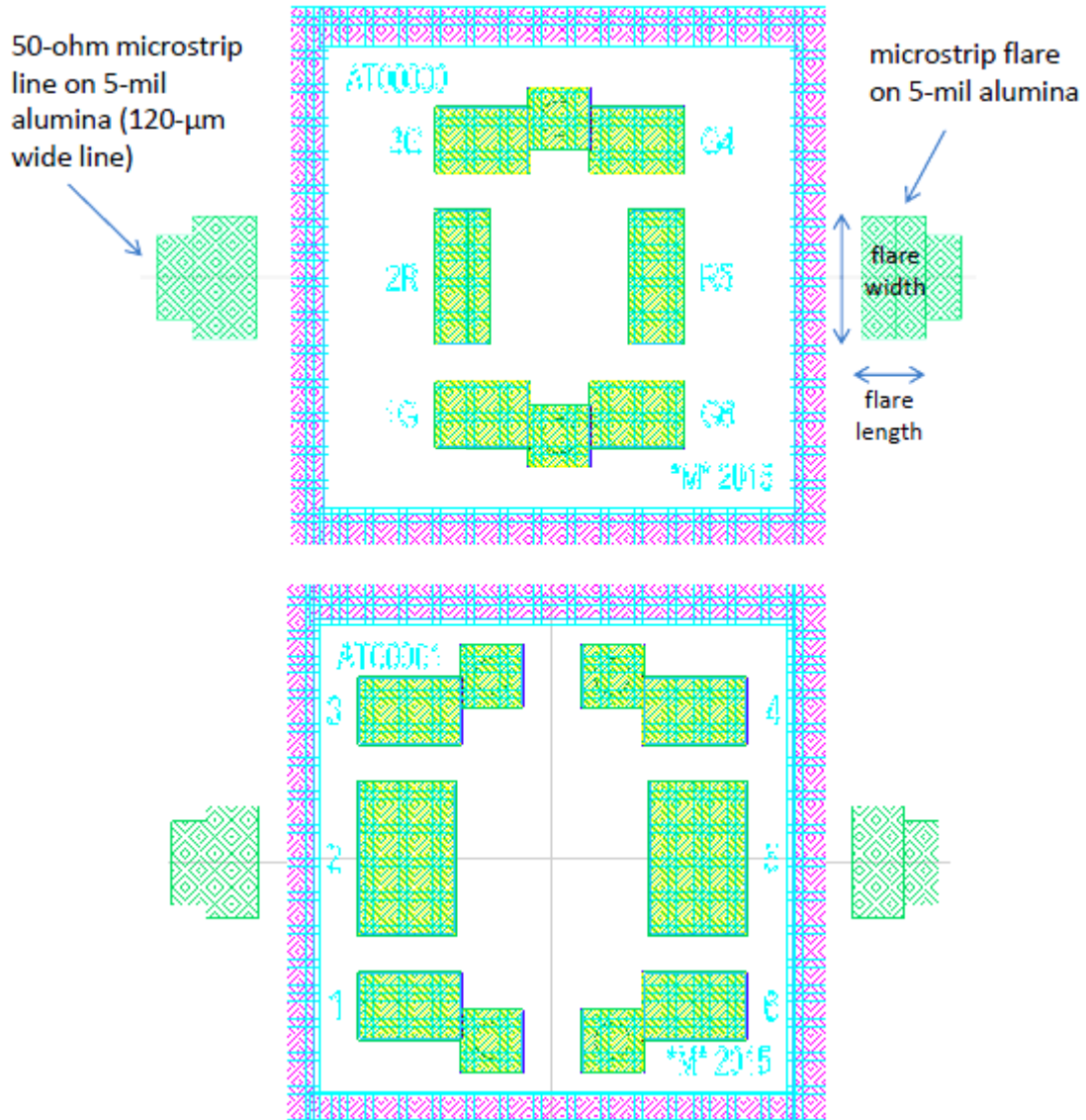
To achieve best return and insertion loss performance to 50 GHz, separate external microstrip flare dimensions and wire inductances are provided in the table below for each attenuator.

Part Number	Attenuator Value (dB)	RF I/O port - External Microstrip Flares on 5-mil Alumina			
		Flare Width (y, μm)	Flare Length (x, μm)	Wire Inductance (nH)	Wire Length (2 wires) (mils)
AT00000	0 (Thru line)	175	92	0.12	10
AT00001	1 ("PI")	163	75	0.14	11
AT00002	2 ("T")	189	96	0.12	10
AT00003	3 ("PI")	183	96	0.12	10
AT00004	4 ("T")	195	104	0.13	11
AT00005	6 ("T")	193	150	0.16	13
AT00006	6 ("PI")	180	166	0.15	12
AT00007	3 ("T")	223	95	0.12	10
AT00008	8 ("T")	180	252	0.17	14
AT00009	10 ("T")	182	239	0.16	13
AT00010	10 ("PI")	181	217	0.16	13

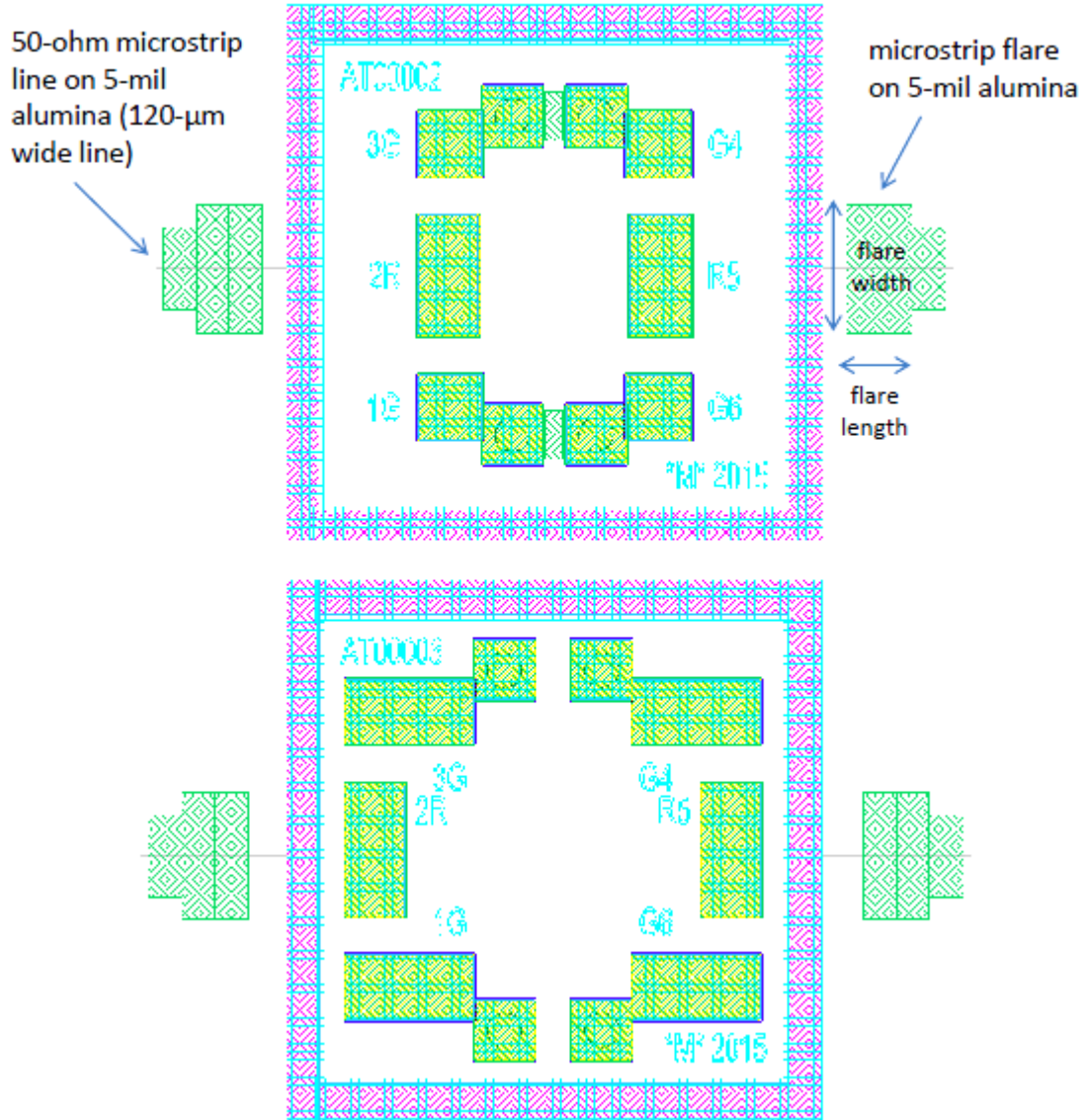
Notes:

- To achieve bond wire inductance noted, bond the number of wires shown in parallel from each external flare to each associated MMIC RF bond pad as shown above.
- Gold Wire Details:
 Diameter: 25.4 μm (1 mil)
 Spacing: 4 mils (~ 100 μm) typical
 Height above Ground: 8 mils (~ 200 μm) typical (wedge bonds)
- Wire Length is total length if the wire were made perfectly straight.

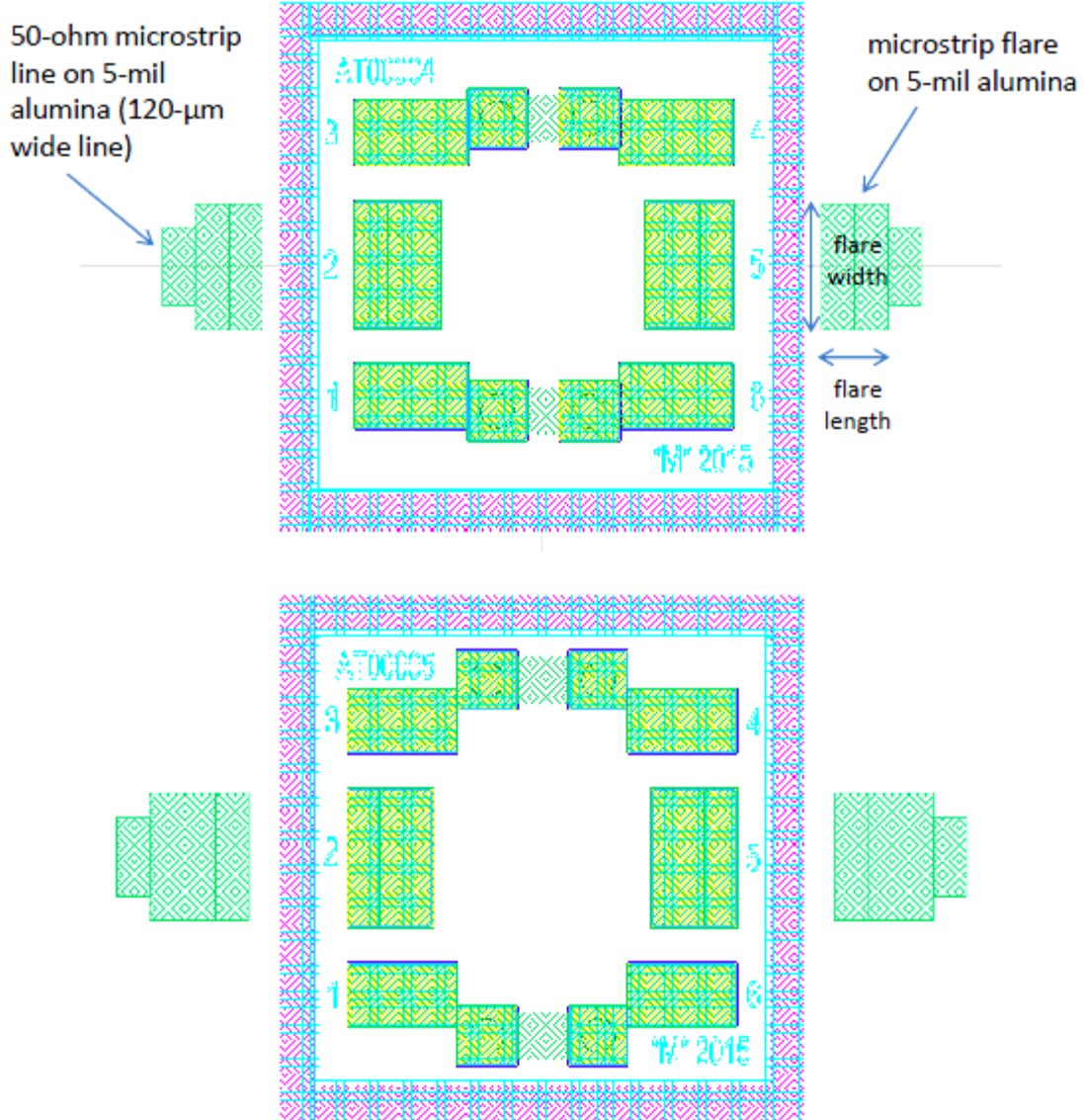
Attenuator Bond Pads and External Microstrip Flares (on 5-mil Alumina)



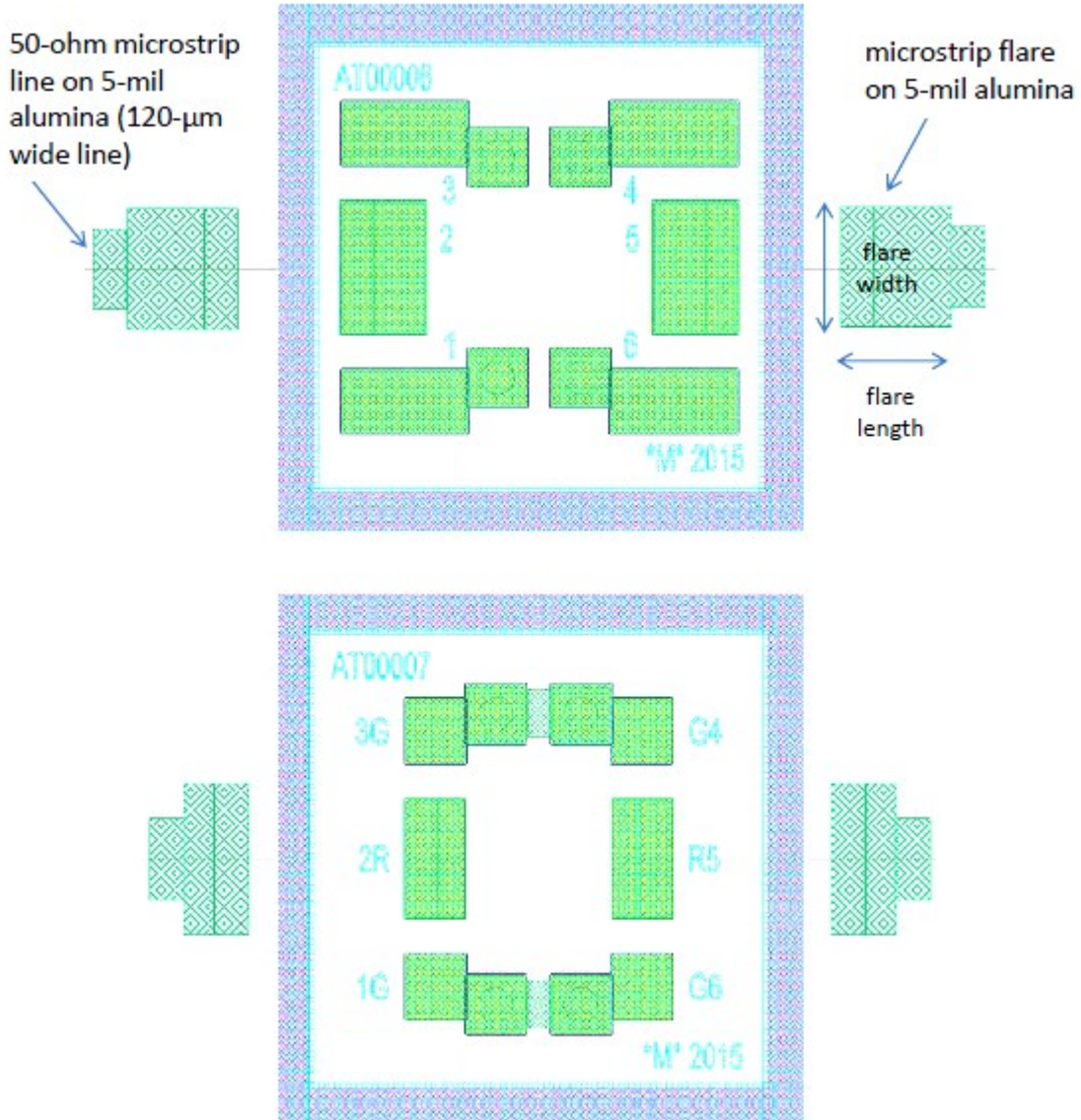
Attenuator Bond Pads and External Microstrip Flares (on 5-mil Alumina)



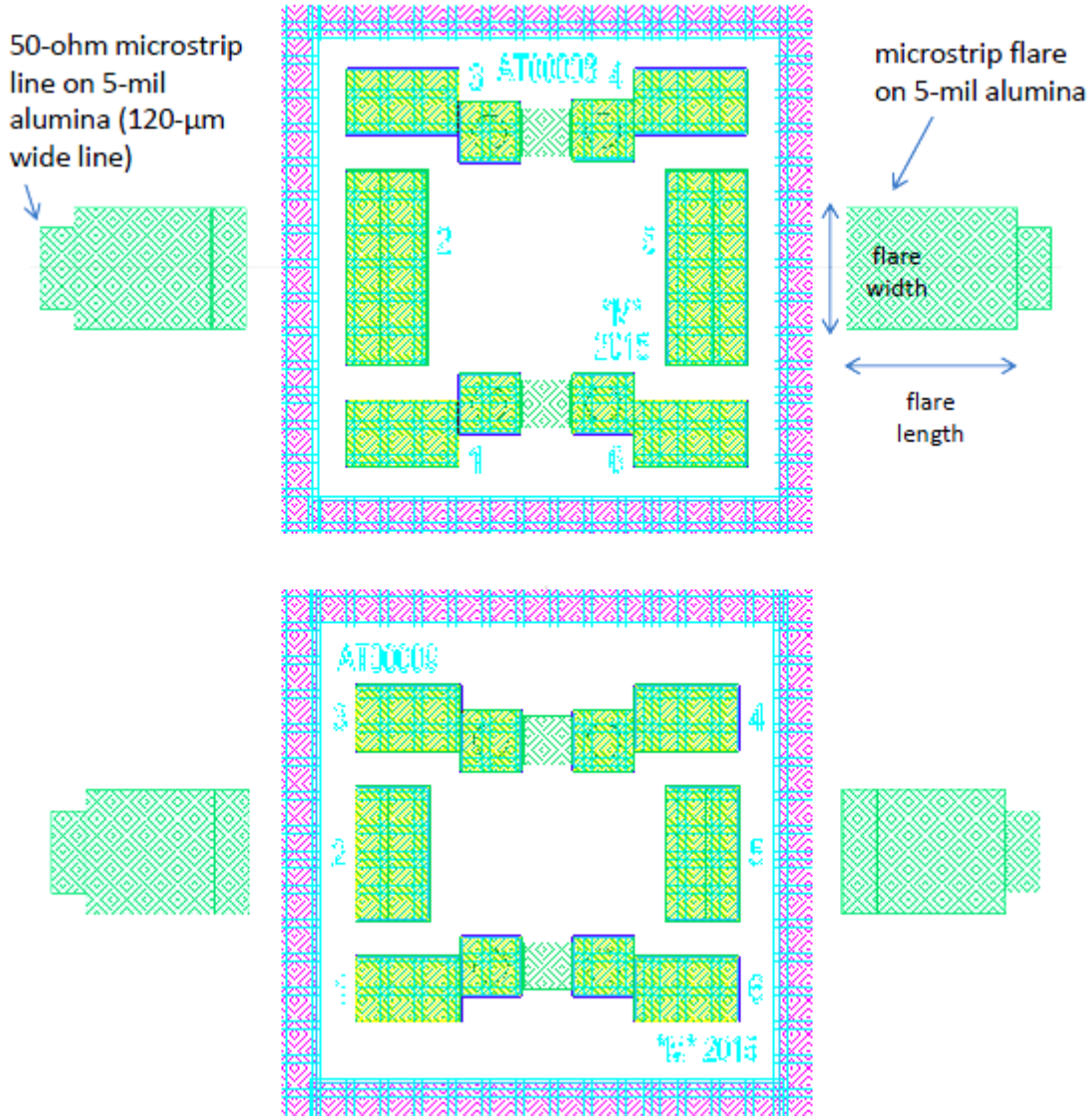
Attenuator Bond Pads and External Microstrip Flares (on 5-mil Alumina)



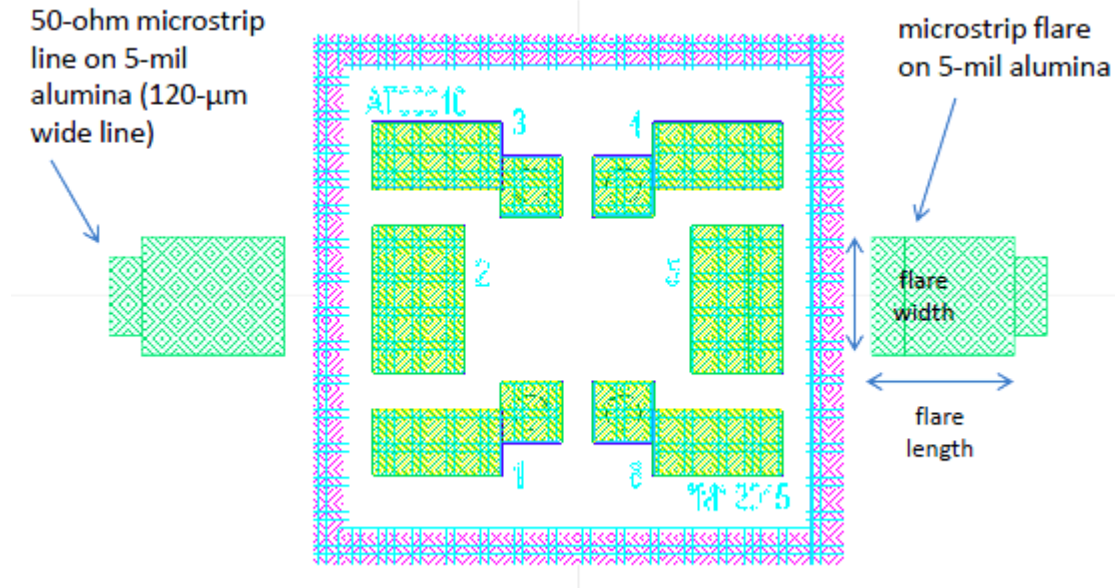
Attenuator Bond Pads and External Microstrip Flares (on 5-mil Alumina)



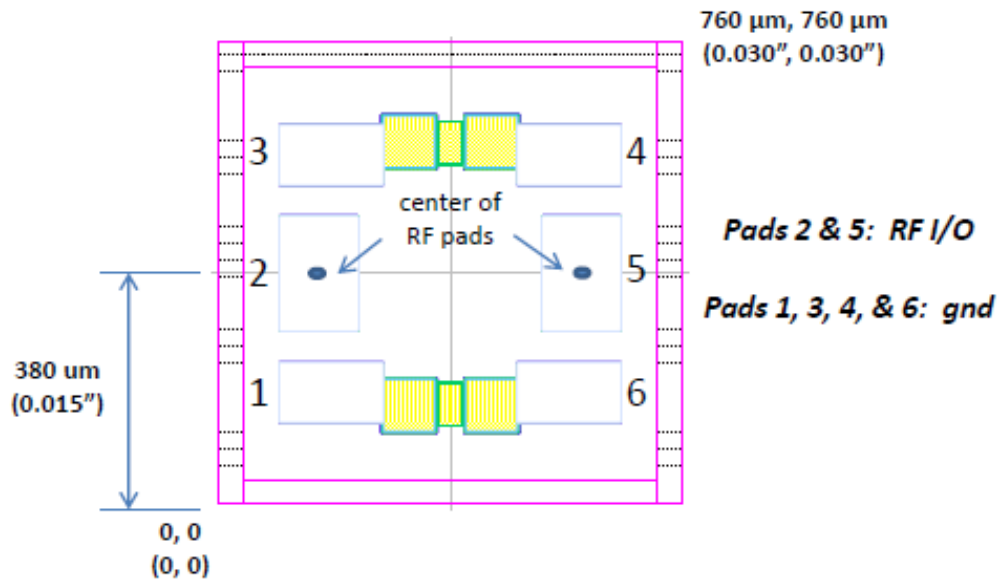
Attenuator Bond Pads and External Microstrip Flares (on 5-mil Alumina)



Attenuator Bond Pads and External Microstrip Flares (on 5-mil Alumina)



Outline Drawing



Pad Dimensions

Part Number	Attenuator Value (dB)	RF Bond Pad Dimensions		RF Bond Pad Center Point Coordinates		
		Length (x-dim, μm)	Width (y-dim, μm)	RF Pad 2 (x-dim, μm)	Pads 2 and 5 (y-dim, μm)	RF Pad 5 (x-dim, μm)
AT00000	0 (Thru line)	84	195	240	380	520
AT00001	1 ("PI")	142	220	173	380	587
AT00002	2 ("T")	93	180	227	380	533
AT00003	3 ("PI")	90	200	121	380	639
AT00004	4 ("T")	131	190	164	380	596
AT00005	6 ("T")	130	209	153	380	607
AT00006	6 ("PI")	131	203	145	380	615
AT00007	3 ("T")	90	180	226	380	534
AT00008	8 ("T")	117	287	146	380	614
AT00009	10 ("T")	110	200	152	380	608
AT00010	10 ("PI")	136	218	148	380	612

Notes:

All dimensions are given in both μm and mils.

Substrate thickness: 100 μm (0.004").

Backside metallization is gold.

Bond pad metallization is gold.

Dimension of RF in/out pad (port 2, 5) and location to edge of MMIC vary based on attenuator part number to optimize return loss performance.

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