

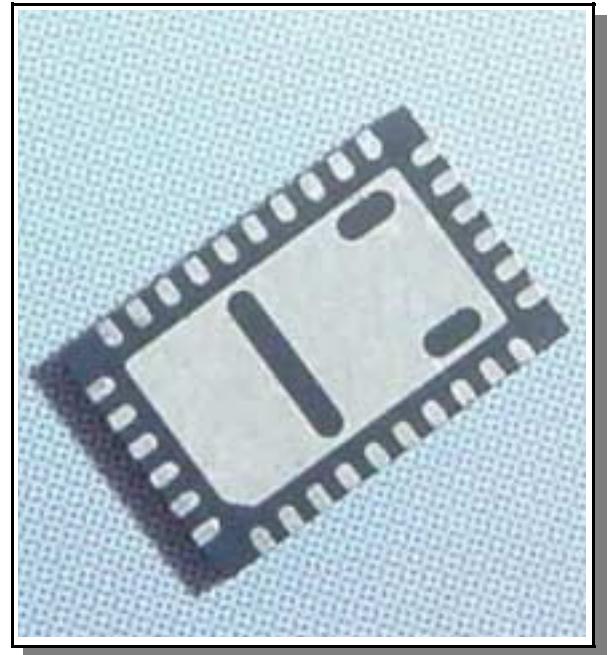
## Features

- Attenuation: 1 dB Steps to 15 dB
- Single Positive Supply
- Contains Internal DC to DC Converter
- Small Footprint, JEDEC Package
- Integral TTL Driver
- 50 Ohm Impedance
- Test Boards Available
- Tape and Reel Packaging Available

## Description

M/A-COM's AT90-1413 is a GaAs FET 4-Bit digital attenuator with integral driver. Step size is 1 dB providing a 15 dB attenuation range. This device is in an FQFP-N plastic surface mount package. The AT90-1413 is suited for single supply applications where accuracy, fast speed, low power consumption and low costs are required. For dual supply designs without switching noise, use AT90-0413.

## CSP-1



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

Parameter	Test Conditions	Frequency	Units	Min.	Typ.	Max.
Insertion Loss	—	DC-2.5 GHz	dB	—	2.0	2.5
		DC-4.0 GHz	dB	—	2.5	3.0
Attenuation Accuracy	Individual Bits or Combination of Bits	DC-2.5 GHz	dB	—	—	$\pm(0.3+4\%$ of atten setting)
		DC-4.0 GHz	dB	—	—	$\pm(0.3+6\%$ of atten setting)
VSWR	Full Attenuation Range	DC-2.5 GHz	Ratio	—	1.5:1	1.8:1
		DC-4.0 GHz	Ratio	—	1.8:1	2.0:1
Switching Speed	50% Cntl to 90%/10% RF 10% to 90% or 90% to 10%	—	nS	—	75	150
		—	nS	—	20	50
1 dB Compression	—	50 MHz	dB	—	+21	—
		0.5-4.0 GHz	dB	—	+29	—
Input $IP_3$	Two-tone Inputs up to +5 dBm	50 MHz	dB	—	+35	—
		0.5-4.0 GHz	dB	—	+48	—
+Vcc	—	—	V	4.75	5.0	5.25
Logic "0"	Sink Current is 20 $\mu\text{A}$ max.	—	V	0.0	—	0.8
Logic "1"	Sink Current is 20 $\mu\text{A}$ max.	—	V	2.0	—	5.0
$I_{cc}^1$	Vcc min to max, Logic "0" or "1"	—	mA	—	6	10
Turn-on Current <sup>2</sup>	For guaranteed start-up	—	mA	—	—	125
Switching Noise	Generated from DC-DC Converter with recommended capacitors	3.5 MHz	dBm	—	-93	—
Thermal Resistance $\theta_{jc}$	—	—	$^\circ\text{C/W}$	—	15	—

1. During turn-on, the device requires an initial start up current ( $I_{cc}$ ) specified as "Turn-on Current". Once operational,  $I_{cc}$  will drop to the specified levels.
2. The DC-DC converter is guaranteed to start in 100  $\mu\text{s}$  as long as the power supplies have the maximum turn-on current available for start-up.

Pin Configuration

Pin No.	Function	Pin No.	Function
1	GND	17	N/C
2	C8	18	N/C
3	C4	19	+Vcc <sup>4</sup>
4	C2	20	N/C
5	C1	21	Cp <sup>6</sup>
6	GND	22	N/C
7	GND	23	Cp <sup>6</sup>
8	N/C	24	N/C
9	N/C	25	-Vee <sup>5</sup>
10	N/C <sup>3</sup>	26	GND
11	GND	27	RF2
12	RF1	28	GND
13	GND	29	N/C <sup>3</sup>
14	N/C	30	-Vee <sup>5,7</sup>
15	N/C	31	N/C
16	N/C	32	+Vcc <sup>4,8</sup>

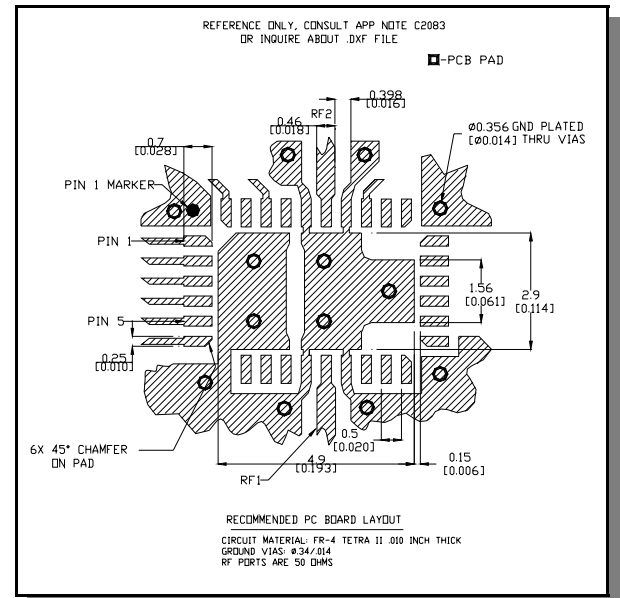
- 3. Pins 10 & 29 must be isolated.
- 4. Pin 19 must be connected to Pin 32.
- 5. Pin 25 must connect to Pin 30.
- 6. A .01 µF cap must be connected between Pins 21 and 23.
- 7. -Vee is produced internally and requires a .1 µF cap to GND. Generated noise is typical of switching DC-DC Converters.
- 8. +Vcc requires a .1 µF cap to GND.

Truth Table

C8	C4	C2	C1	Attenuation
0	0	0	0	Loss, Reference
0	0	0	1	1.0 dB
0	0	1	0	2.0 dB
0	1	0	0	4.0 dB
1	0	0	0	8.0 dB
1	1	1	1	15.0 dB

0 = TTL Low; 1 = TTL High

Recommended PCB Layout<sup>9</sup>



9. Application Note C2083 is available on line at [www.macom.com](http://www.macom.com)

Absolute Maximum Ratings<sup>10</sup>

Parameter	Absolute Maximum
Max. Input Power 0.05 GHz 0.5 - 4.0 GHz	+27 dBm +34 dBm
+Vcc	+5.5V
Logic Voltages <sup>11</sup>	-0.5 to +Vcc + 0.5V
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +125°C

- 10. Operation of this device above any one of these parameters may cause permanent damage.
- 11. Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

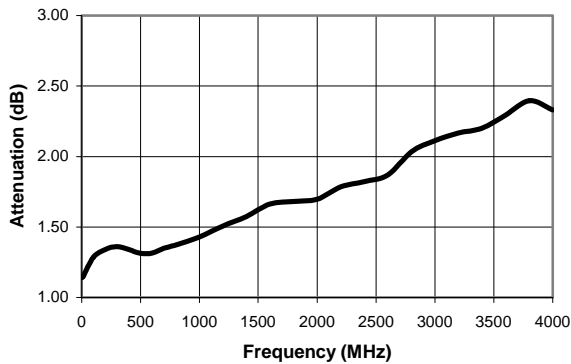
Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.



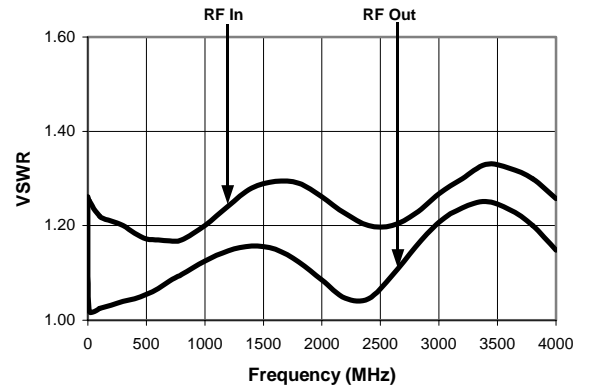
- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020

## Typical Performance Curves

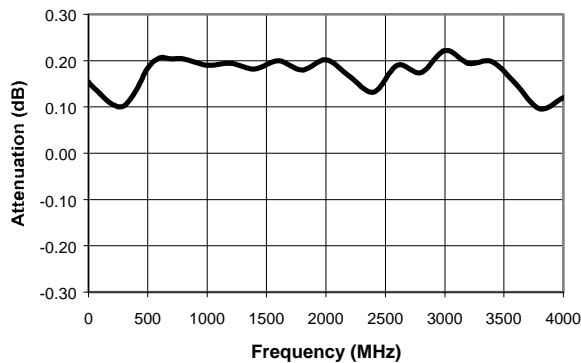
*Insertion Loss*



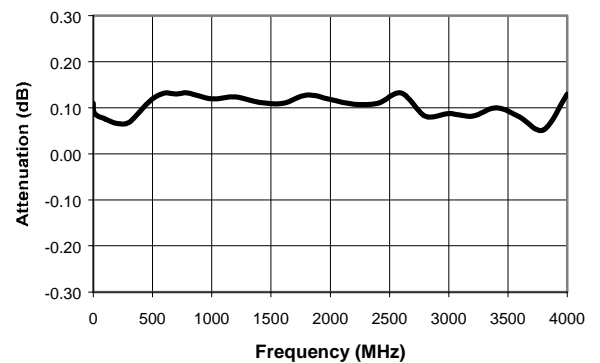
*VSWR @ Insertion Loss*



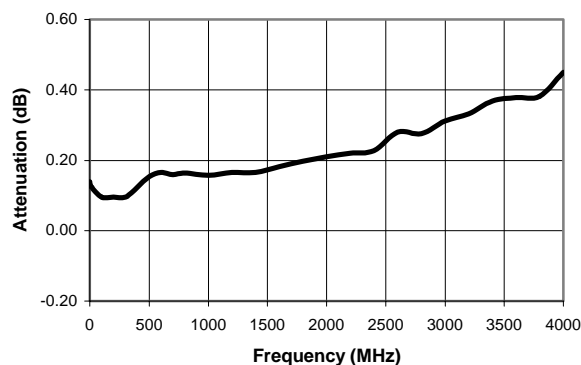
*Attenuation Error, 1 dB Bit*



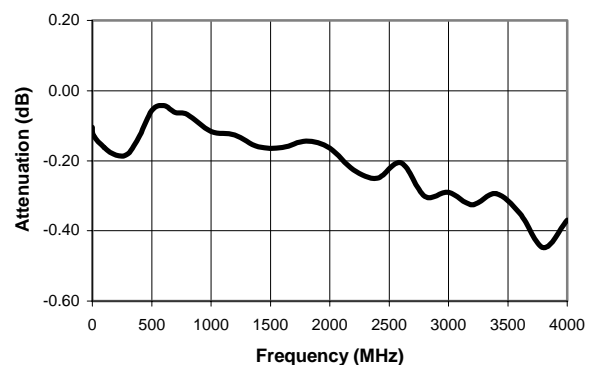
*Attenuation Error, 2 dB Bit*



*Attenuation Error, 4 dB Bit*



*Attenuation Error, 8 dB Bit*



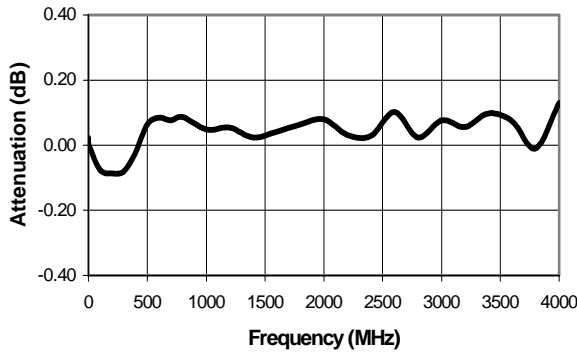
M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.

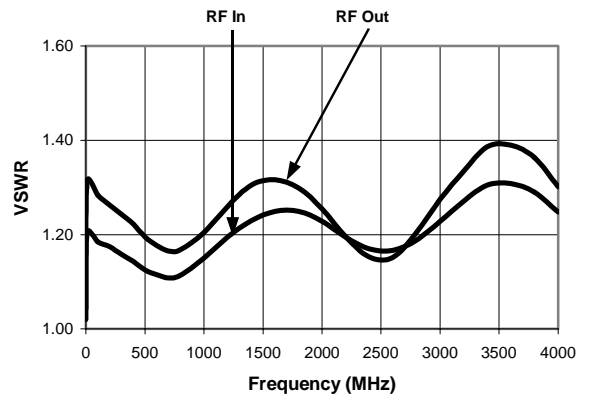
- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020

Typical Performance Curves

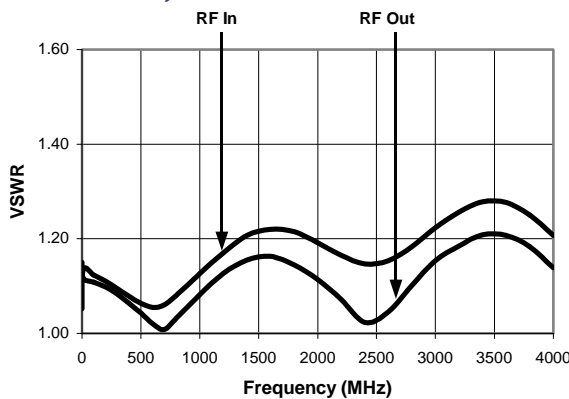
Attenuation Error, Max. Attenuation



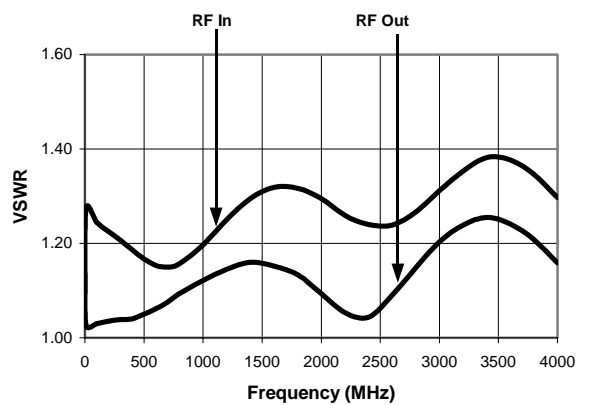
VSWR, 1 dB Bit



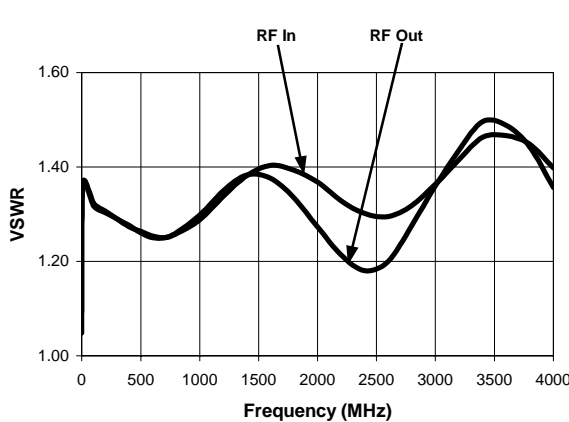
VSWR, 2 dB Bit



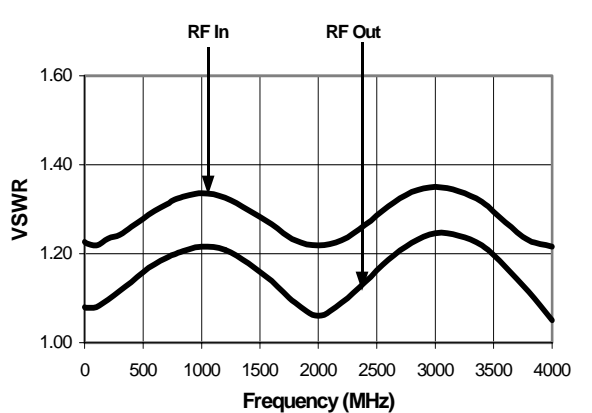
VSWR, 4 dB Bit



VSWR, 8 dB Bit



VSWR, Max. Attenuation

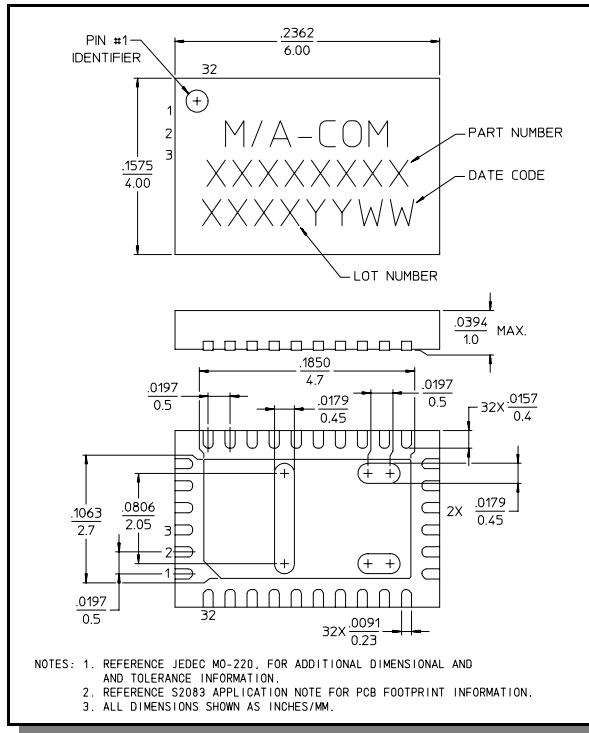


M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020

CSP-1



Ordering Information

Part Number	Package
AT90-1413	Bulk Packaging
AT90-1413TR	Tape and Reel (1K Reel)
AT90-1413-TB	Units Mounted on Test Board

Note: Reference Application Note M513 for reel size information.

M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020

