AT90-1413

Digital Attenuator
15 dB, 4-Bit, TTL Driver, DC-4.0 GHz

Rev. V9

Features

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

Description

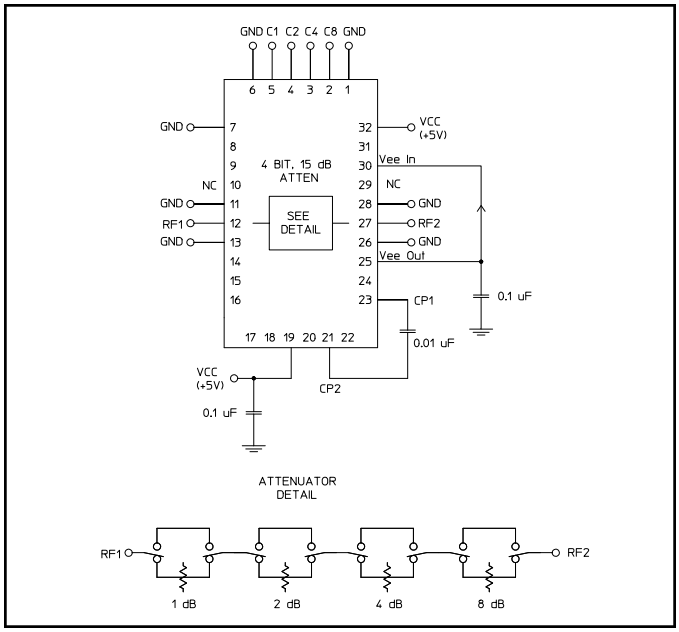
M/A-COM's AT90-1413 is a GaAs FET 4-Bit digital attenuator with integral driver. Step size is 1 dB providing a 15 dB attenuation range. This device is in an PQFN plastic surface mount package. The AT90-1413 is suited for single supply applications where accuracy, fast speed, low power consumption and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

Ordering Information

Part Number	Package
AT90-1413	Bulk Packaging
AT90-1413TR	1000 piece reel
AT90-1413-TB	Sample Test Board

Note: Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration

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

1. Pins 10 & 29 must be isolated.
2. Vee is produced internally and requires a .1 µF cap to GND. Generated noise is typical of switching DC-DC Converters.
3. The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)

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Digital Attenuator
15 dB, 4-Bit, TTL Driver, DC-4.0 GHz

Electrical Specifications: T_A = 25°C, Z_0 = 50Ω

Parameter	Test Conditions	Frequency	Units	Min	Typ	Max
Insertion Loss	—	DC-2.5 GHz DC-4.0 GHz	dB dB	— —	2.0 2.5	2.5 3.0
Attenuation Accuracy	Individual Bits or Combination of Bits	DC-2.5 GHz DC-4.0 GHz	dB dB	— —	— —	±(0.3+4% of atten setting) ±(0.3+6% of atten setting)
VSWR	Full Attenuation Range	DC-2.5 GHz DC-4.0 GHz	Ratio Ratio	— —	1.5:1 1.8:1	1.8:1 2.0:1
Switching Speed	50% Cntl to 90%/10% RF 10% to 90% or 90% to 10%	— —	ns ns	— —	75 20	150 50
1 dB Compression	—	50 MHz 0.5-4.0 GHz	dBm dBm	— —	+21 +29	— —
Input IP_3	Two-tone Inputs up to +5 dBm	50 MHz 0.5-4.0 GHz	dBm dBm	— —	+35 +48	— —
Vcc	—	—	V	4.75	5.0	5.25
V_{IL} V_{IH}	LOW-level input voltage HIGH-level input voltage	— —	V V	0.0 2.0	— —	0.8 5.0
Iin (Input Leakage Current)	Vin = V_{CC} or GND	—	uA	-1.0	—	1.0
Icc[4]	Vcc min to max, Logic “0” or “1”	—	mA	—	6	10
Turn-on Current[5]	For guaranteed start-up	—	mA	—	—	125
ΔIcc (Additional Supply Current Per TTL Input Pin)	V_{CC} = Max, Vcntrl = V_{CC} - 2.1 V	—	mA	—	—	1.0
Switching Noise	Generated from DC-DC Converter with recommended capacitors	3.5 MHz	dBm	—	-93	—
Thermal Resistance θjc	—	—	°C/W	—	15	—

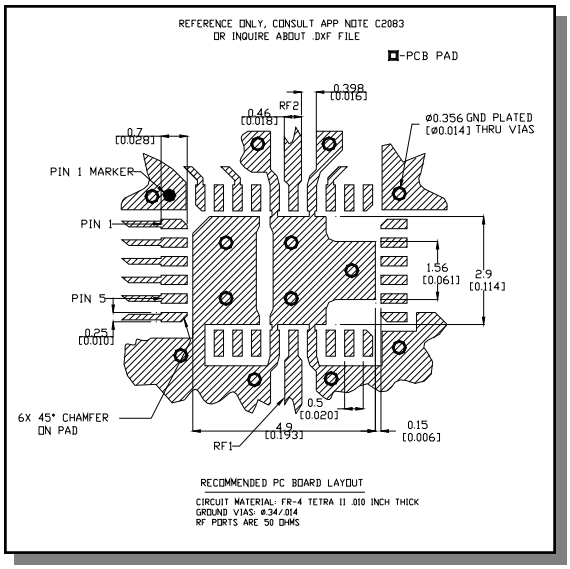
4. During turn-on, the device requires an initial start up current (Icc) specified as “Turn-on Current”. Once operational, Icc will drop to the specified levels.
5. The DC-DC converter is guaranteed to start in 100 µs as long as the power supplies have the maximum turn-on current available for start-up.

Absolute Maximum Ratings [6,7]

Parameter	Absolute Maximum
Max. Input Power 0.05 GHz 0.5 - 4.0 GHz	 +27 dBm +34 dBm
V_{CC}	-0.5V ≤ V_{CC} ≤ +6.0V
Vin[8]	-0.5V ≤ Vin ≤ V_{CC} + 0.5V
Operating Temperature	-40ºC to +85ºC
Storage Temperature	-65ºC to +125ºC

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. M/A-COM does not recommend sustained operation near these survivability limits.
8. Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

Recommended PCB Configuration[9]



9. Application Note S2083 is available on line at www.macom.com

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Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

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

Moisture Sensitivity

The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.

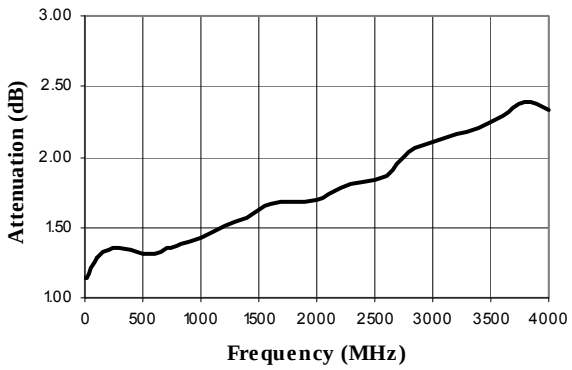
Truth Table (Digital Attenuator)

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

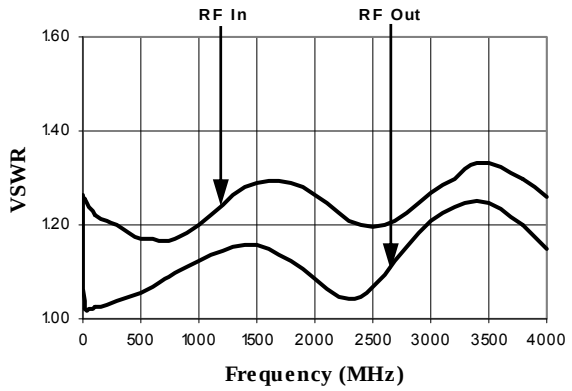
0 = TTL Low; 1 = TTL High

Typical Performance Curves

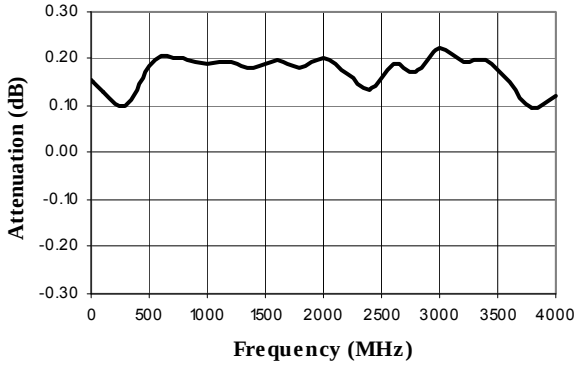
Insertion Loss



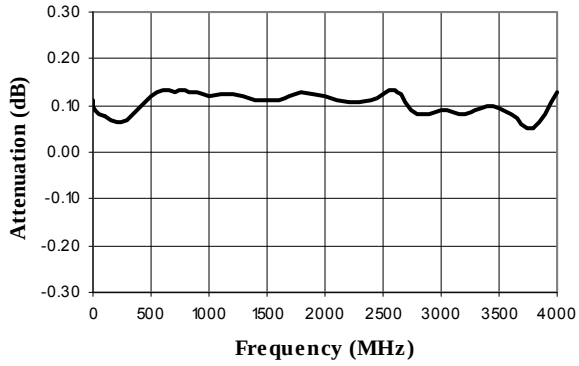
VSWR @ Insertion Loss



Attenuation Error, 1 dB Bit



Attenuation Error, 2 dB Bit



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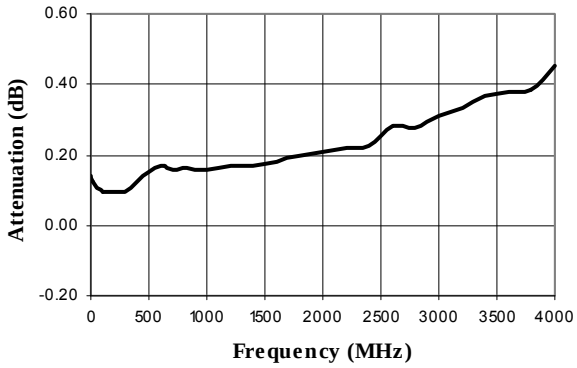
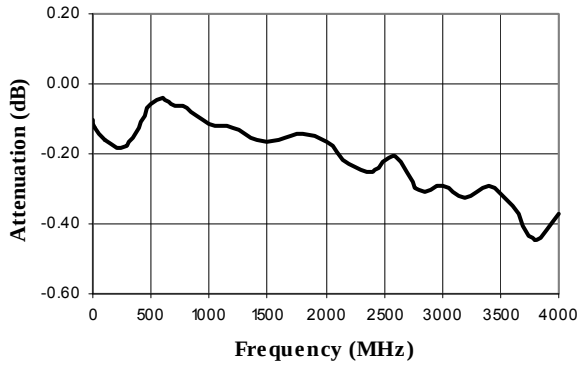
Typical Performance Curves

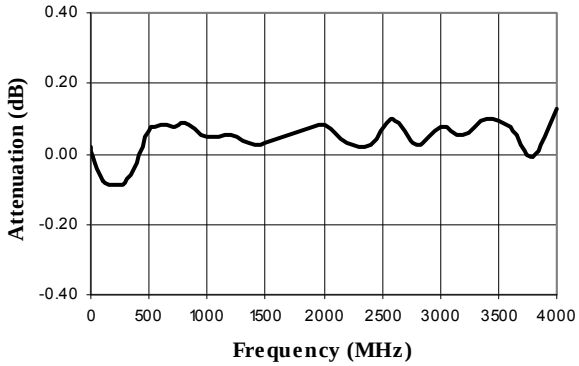
Attenuation Error, 4 dB Bit



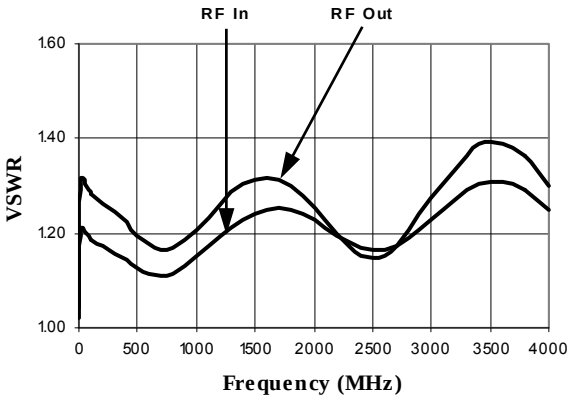
Attenuation Error, 8 dB Bit



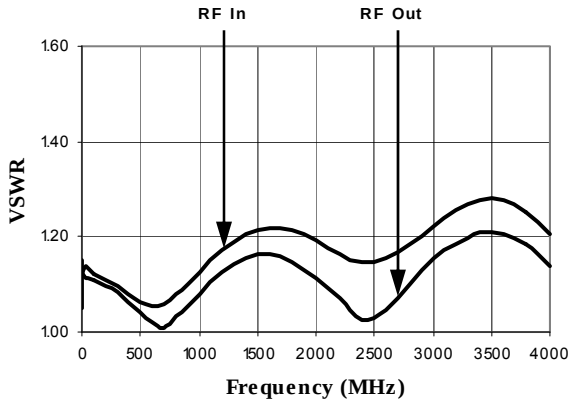
Attenuation Error, Max. Attenuation



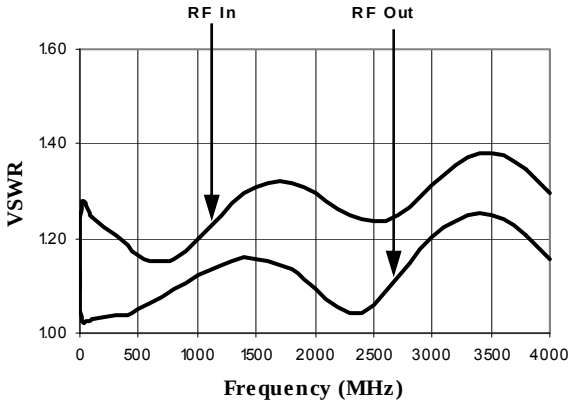
VSWR, 1 dB Bit



VSWR, 2 dB Bit



VSWR, 4 dB Bit



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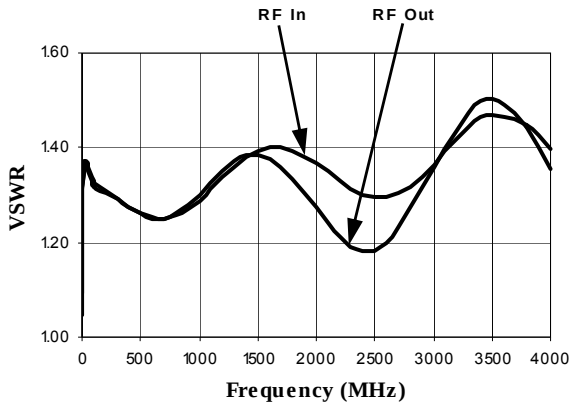
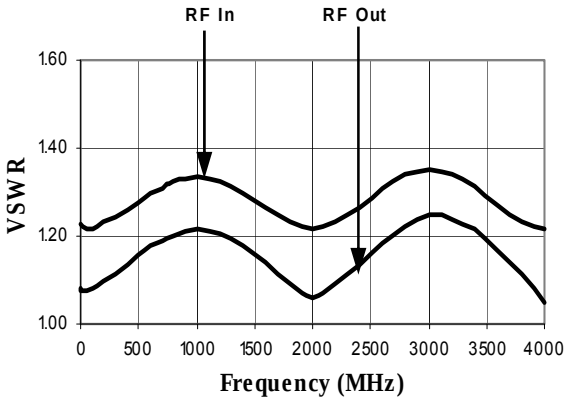
Typical Performance Curves

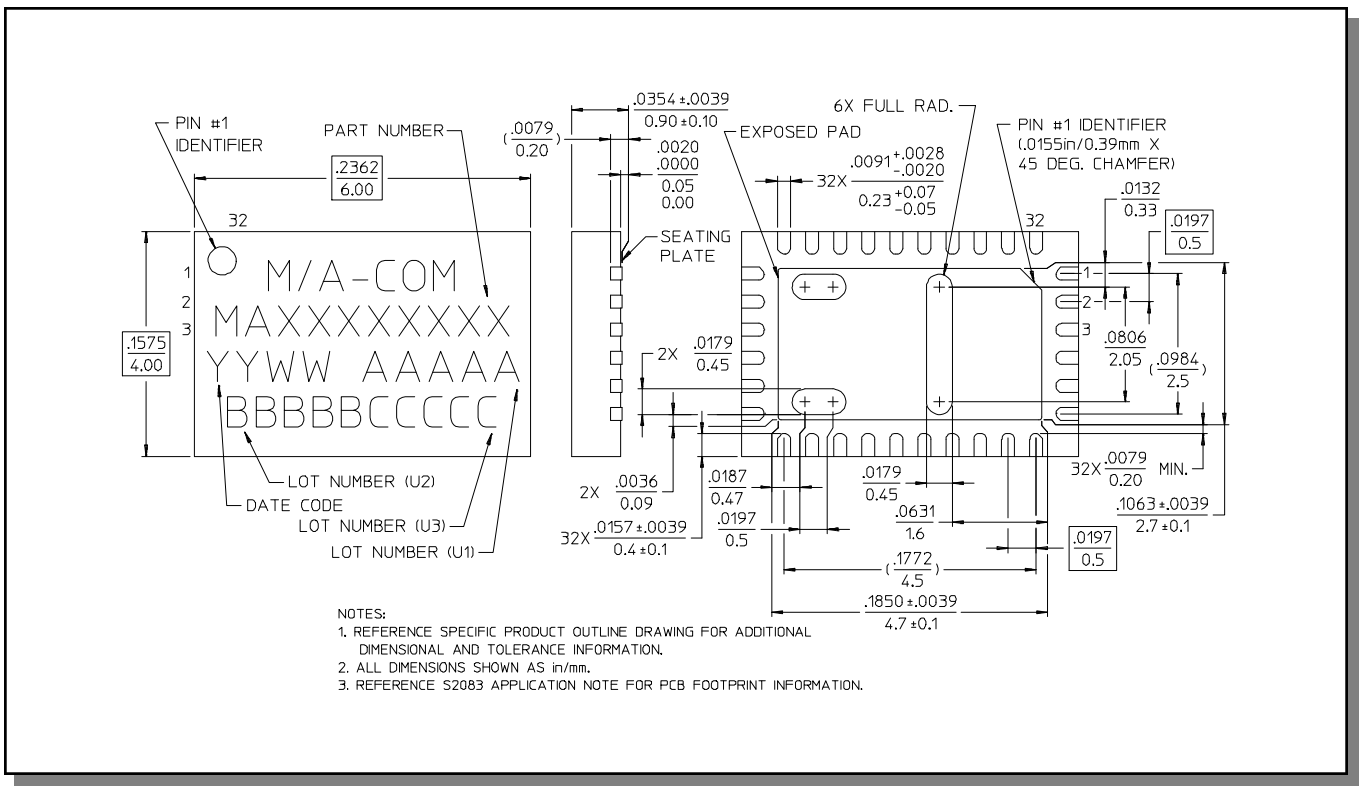
VSWR, 8 dB Bit



VSWR, Maximum Attenuation



CSP-1, 4 x 6 mm, 32-lead PQFN†



† Reference Application Note M538 for lead-free solder reflow recommendations.

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