

Digital Attenuator

30.0 dB, 4-Bit, TTL Driver, DC-2.5 GHz

Rev. V5

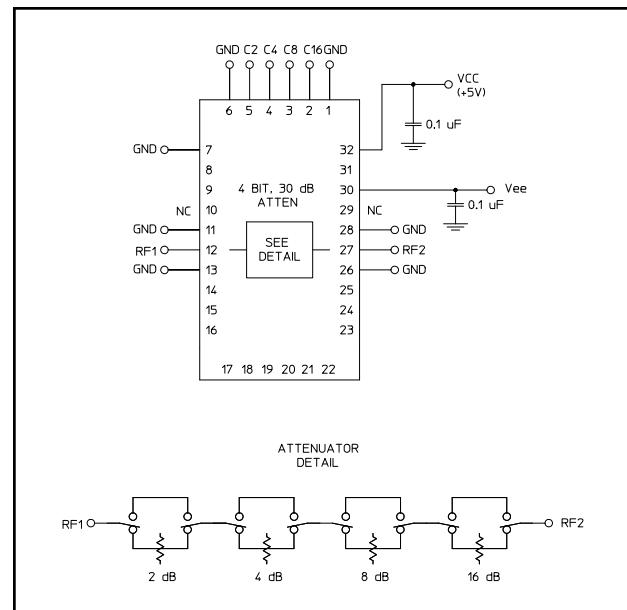
Features

- Attenuation: 2 dB Steps to 30 dB
- Low DC Power Consumption
- Small Footprint, JEDEC Package
- Integral TTL Driver
- 50 Ohm Impedance
- Test Boards Available
- Tape and Reel Packaging Available
- CSP-1 Package

Description

M/A-COM's AT90-0233 is a GaAs FET 4-Bit digital attenuator with integral driver. Step size is 2 dB providing a 30 dB attenuation range. This device is in an PQFN plastic surface mount package. The AT90-0233 is suited for use where accuracy, fast speed, very low power consumption and low costs are required.

Schematic with Off-Chip Components



Pin Configuration

Pin No.	Function	Pin No.	Function
1	GND	17	N/C
2	C16	18	N/C
3	C8	19	N/C
4	C4	20	N/C
5	C2	21	N/C
6	GND	22	N/C
7	GND	23	N/C
8	N/C	24	N/C
9	N/C	25	N/C
10	N/C ¹	26	GND
11	GND	27	RF2
12	RF1	28	GND
13	GND	29	N/C ¹
14	N/C	30	VEE
15	N/C	31	N/C
16	N/C	32	Vcc

1. Pins 10 and 29 must be isolated.
2. The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)

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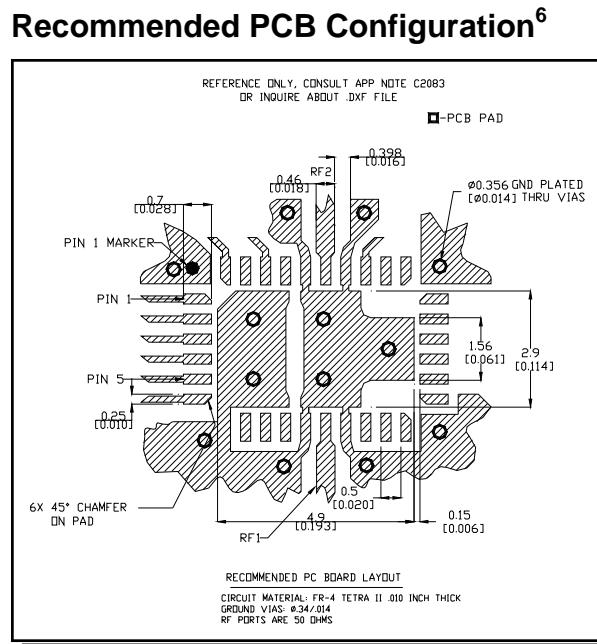
Electrical Specifications: $T_A = +25^\circ\text{C}$

Parameter	Test Conditions	Frequency	Units	Min	Typ	Max
Insertion Loss	—	DC - 2.5 GHz	dB	—	2.7	3.0
Attenuation Accuracy	Individual Bits or Combination of Bits	DC - 2.5 GHz	dB	—	—	±(.3 +5% of atten setting)
VSWR	Full Range	DC - 2.5 GHz	Ratio	—	1.5:1	1.8:1
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 - 2.5 GHz	dBm dBm	— —	+21 +29	— —
Input IP ₃	Two-tone inputs up to +5 dBm	50 MHz 0.5 - 2.5 GHz	dB dB	— —	+35 +48	— —
V _{CC} V _{EE}	— —	— —	V V	4.75 -8.0	5.0 -5.0	5.25 -4.75
V _{IL} V _{IH}	LOW-level input voltage HIGH-level input voltage		V V	0.0 2.0	— —	0.8 5.0
I _{IN} (Input Leakage Current)	V _{IN} = V _{CC} or GND		uA	-1.0	—	1.0
I _{QC} (Quiescent Supply Current)	V _{CNTRL} = V _{CC} or GND		uA	—	250	400
ΔI _{QC} (Additional Supply Current Per TTL Input Pin)	V _{CC} = Max, V _{CNTRL} = V _{CC} - 2.1 V		mA	—	—	1.0
I _{EE}	V _{EE} min to max, V _{IN} = V _{IL} or V _{IH}		mA	-1.0	-0.2	—
Thermal Resistance θ _{JC}	—	—	°C/W	—	15	—

Absolute Maximum Ratings^{3,4}

Parameter	Absolute Maximum
Max. Input Power	
0.05 GHz	+27 dBm
0.5 - 2.5 GHz	+34 dBm
V_{CC}	$-0.5V \leq V_{CC} \leq +7.0V$
V_{EE}	$-8.5V \leq V_{EE} \leq +0.5V$
$V_{CC} - V_{EE}$	$-0.5V \leq V_{CC} - V_{EE} \leq 14.5V$
V_{in}^5	$-0.5V \leq V_{in} \leq V_{CC} + 0.5V$
Operating Temperature	$-40^{\circ}C$ to $+85^{\circ}C$
Storage Temperature	$-65^{\circ}C$ to $+125^{\circ}C$

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



6. Application Note C2083 is available on line at www.macom.com

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Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

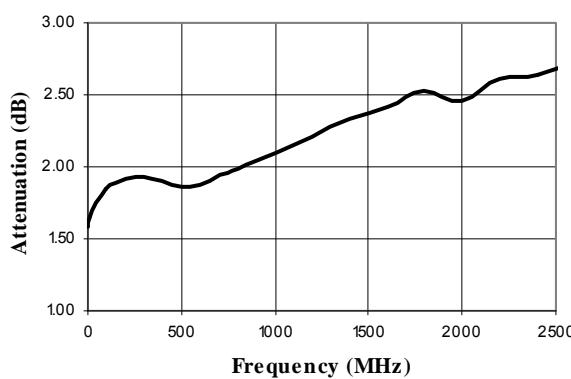
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Moisture Sensitivity

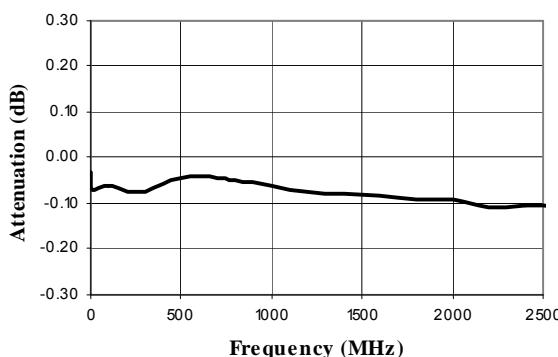
The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.

Typical Performance Curves

Insertion Loss



Attenuation Error, 2 dB Bit

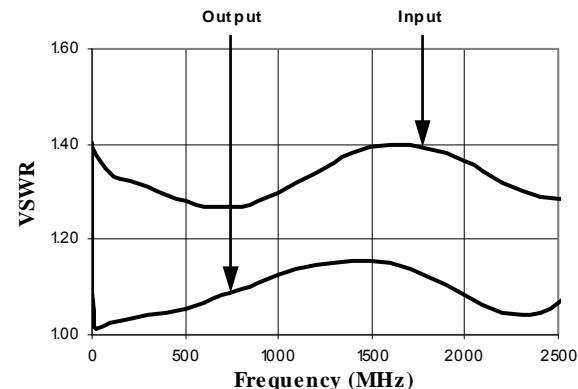


Truth Table (Digital Attenuator)

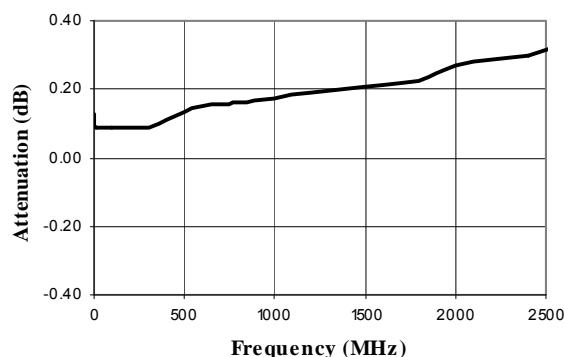
C16	C8	C4	C2	Attenuation
0	0	0	0	Loss, Reference
0	0	0	1	2.0 dB
0	0	1	0	4.0 dB
0	1	0	0	8.0 dB
1	0	0	0	16.0 dB
1	1	1	1	30.0 dB

0 = TTL Low; 1 = TTL High

VSWR @ Insertion Loss



Attenuation Error, 4 dB Bit



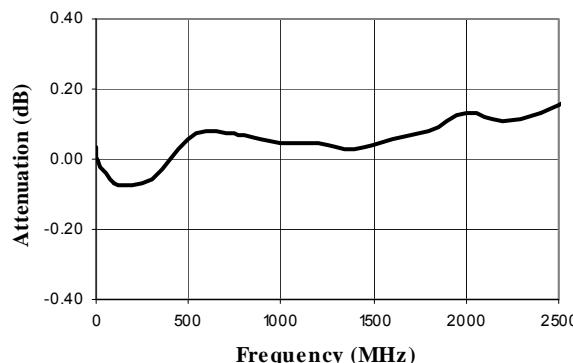
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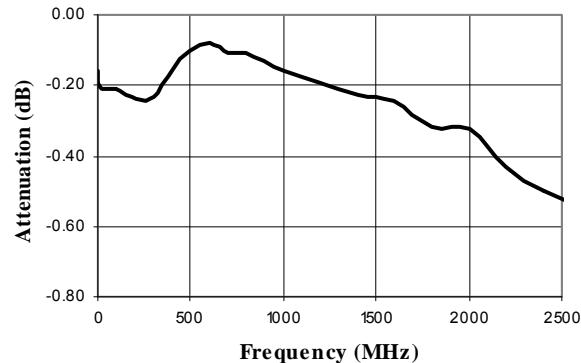
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Typical Performance Curves

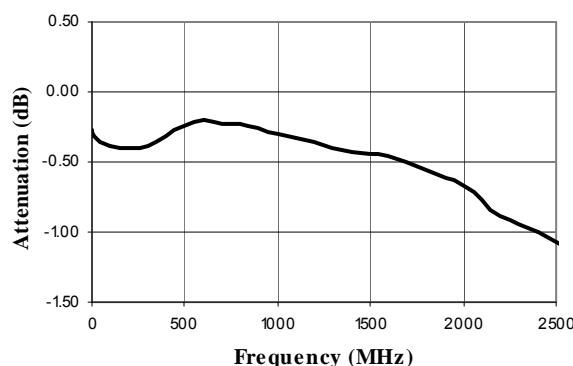
Attenuation Error, 8 dB Bit



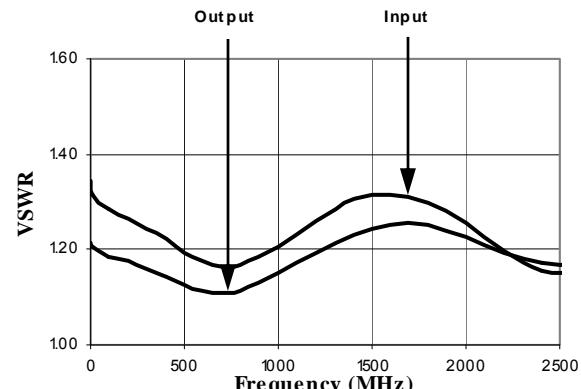
Attenuation Error, 16 dB Bit



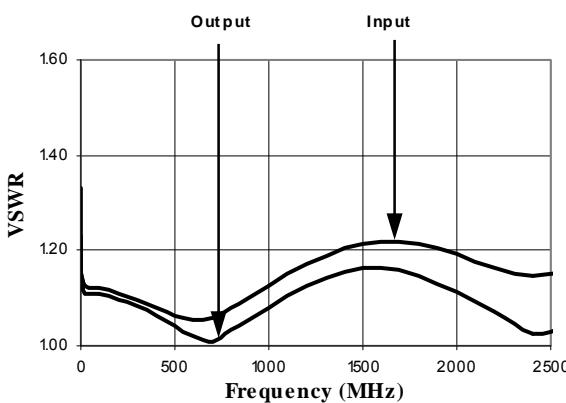
Attenuation Error, Max. Attenuation



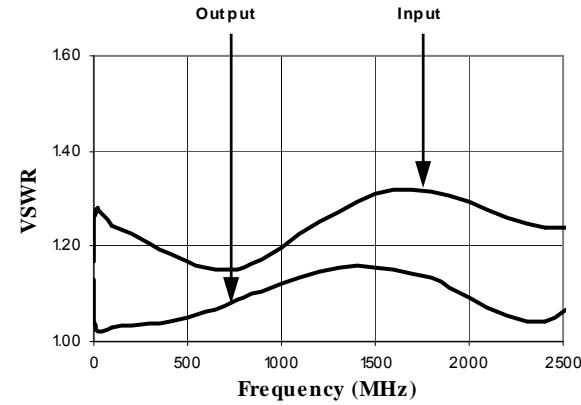
VSWR, 2 dB Bit



VSWR, 4 dB Bit



VSWR, 8 dB Bit



ADVANCED: Data Sheets contain information regarding a product M/A-COM Technology Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.

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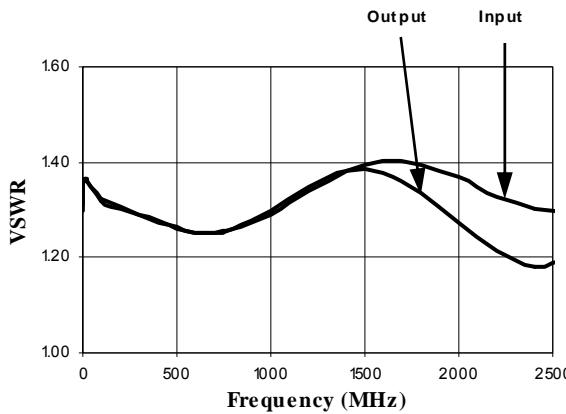
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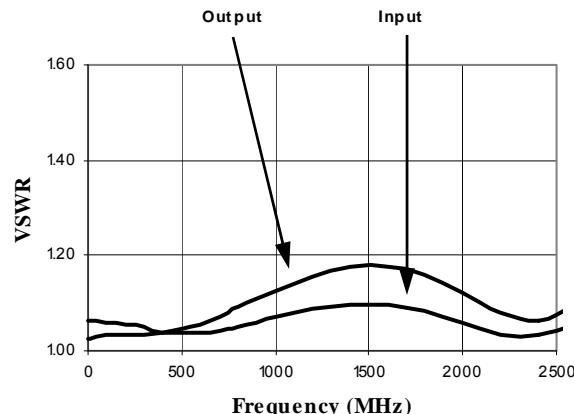
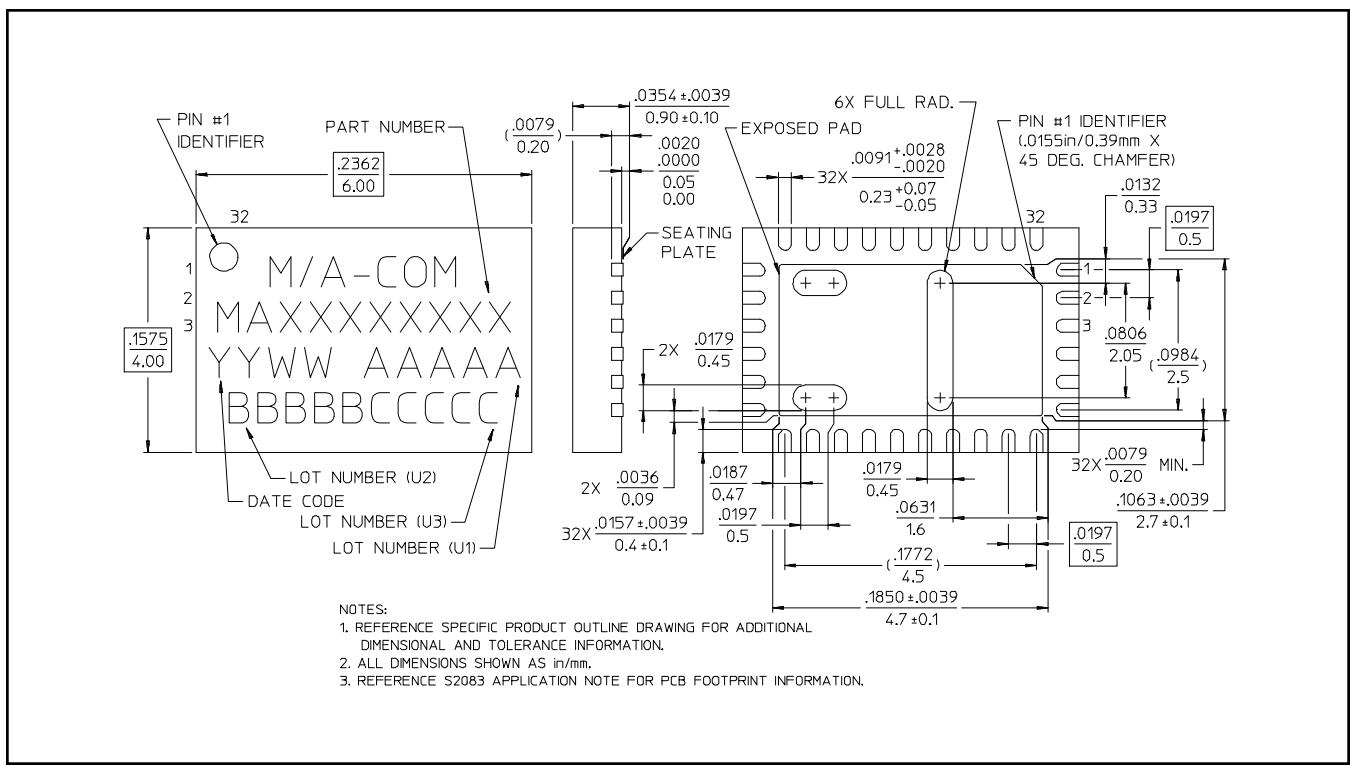
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Typical Performance Curves

VSWR, 16 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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