

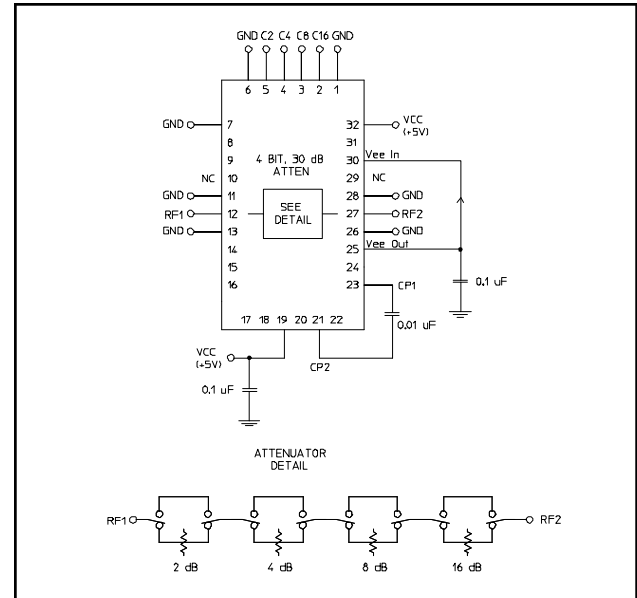
Features

- Attenuation: 2 dB Steps to 30 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 AT90-1233 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 FQFP-N plastic surface mount package. The AT90-1233 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 AT90-0233.

Functional Schematic



Pin Configuration³

Pin No.	Function	Pin No.	Function
1	GND	17	NC
2	C16	18	NC
3	C8	19	Vcc
4	C4	20	NC
5	C2	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 and 29 must be isolated.
2. VEE is produced internally and requires a .1 μ F 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)

Ordering Information

Part Number	Package
AT90-1233	Bulk Packaging
AT90-1233TR	1000 piece reel
AT90-1233-TB	Sample Test Board

Note: Reference Application Note M513 for reel size information.

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.
PRELIMINARY: Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

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

Rev. V8

Electrical Specifications: $T_A = 25^\circ\text{C}$, $Z_0 = 50\Omega$

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	—	—	$\pm(.3 + 5\% \text{ of atten setting})$
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	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
I_{in} (Input Leakage Current)	$V_{in} = V_{CC}$ or GND	—	μA	-1.0	—	1.0
I_{CC}^4	V_{CC} min to max, Logic "0" or "1"	—	mA	—	6	10
Turn-on Current ⁵	For guaranteed start-up	—	mA	—	—	125
ΔI_{CC} (Additional Supply Current Per TTL Input Pin)	$V_{CC} = \text{Max}$, $V_{ctrl} = V_{CC} - 2.1 \text{ V}$	—	mA	—	—	1.0
Switching Noise	Generated from DC-DC Converter with recommended capacitors	3.5 MHz	dBm	—	-93	—
Thermal Resistance θ_{jc}	—	—	$^\circ\text{C/W}$	—	15	—

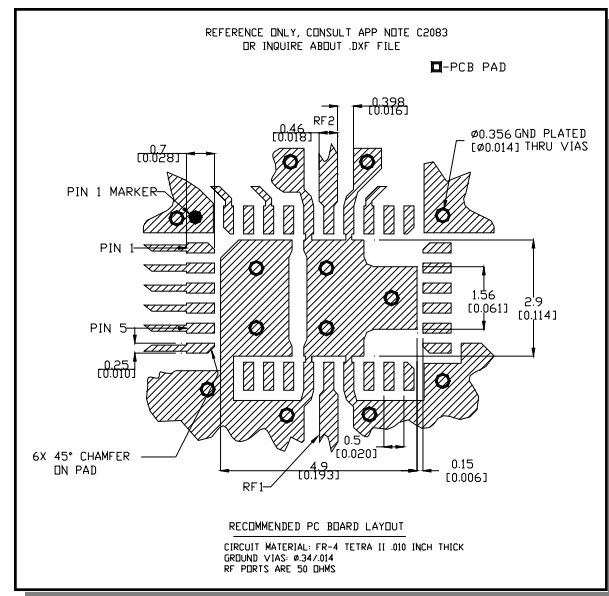
- During turn-on, the device requires an initial start up current (I_{CC}) specified as "Turn-on Current". Once operational, I_{CC} will drop to the specified levels.
- The DC-DC converter is guaranteed to start in 100 μs as long as the power supplies have the maximum turn-on current available for start-up.

Absolute Maximum Ratings^{6,7}

Parameter	Absolute Maximum
Max. Input Power 0.05 GHz 0.5 - 2.5 GHz	+27 dBm +34 dBm
V_{CC}	$-0.5\text{V} \leq V_{CC} \leq +6.0\text{V}$
V_{in}^8	$-0.5\text{V} \leq V_{in} \leq V_{CC} + 0.5\text{V}$
Operating Temperature	-40°C to $+85^\circ\text{C}$
Storage Temperature	-65°C to $+125^\circ\text{C}$

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

Recommended PCB Configuration⁹



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

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

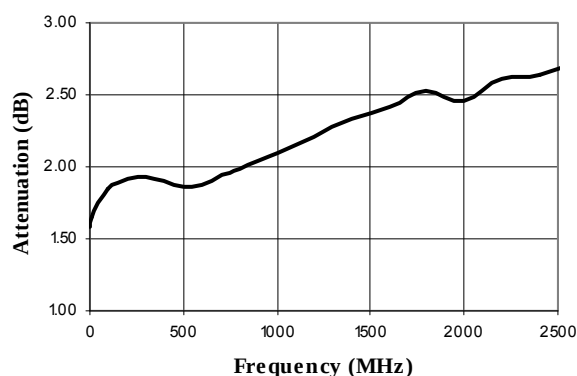
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Moisture Sensitivity

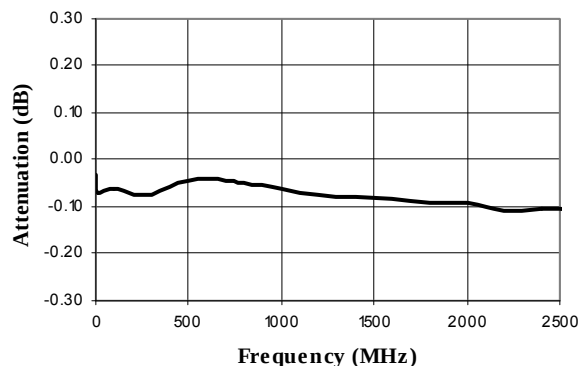
The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.

Typical Performance Curves

Insertion Loss



Attenuation Error, 2 dB Bit

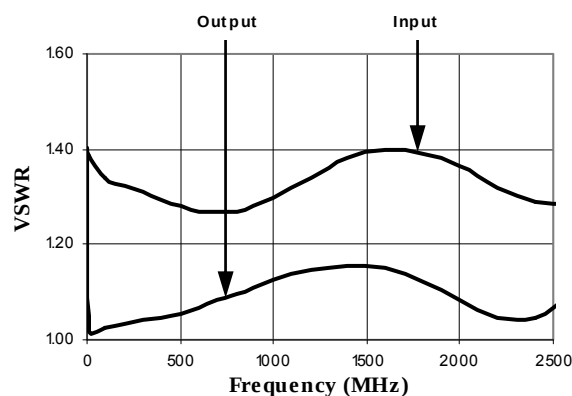


Truth Table (Digital Attenuator)

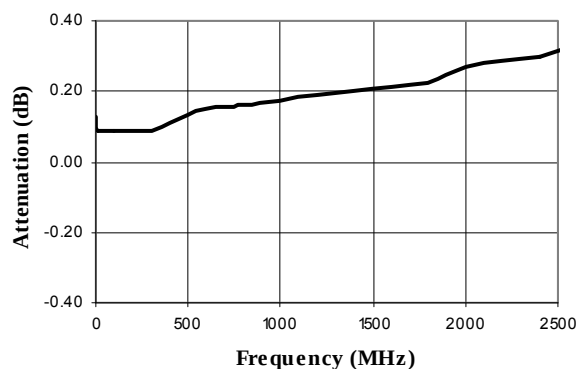
C16	C6	C4	C2	Attenuation
0	0	0	0	Loss, Reference
0	0	0	1	2.0 dB
0	0	1	0	4.0 dB
0	1	0	0	8.0 dB
1	0	0	0	16.0 dB
1	1	1	1	30.0 dB

0 = TTL Low; 1 = TTL High

VSWR @ Insertion Loss

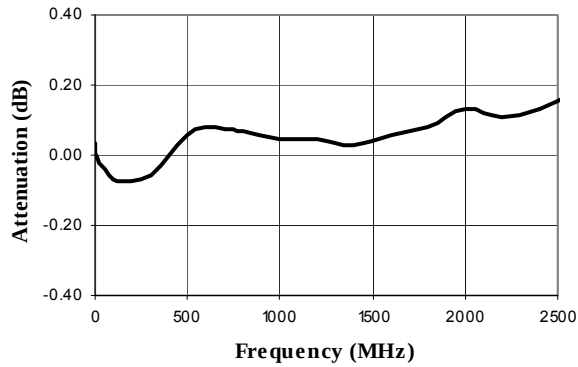


Attenuation Error, 4 dB Bit

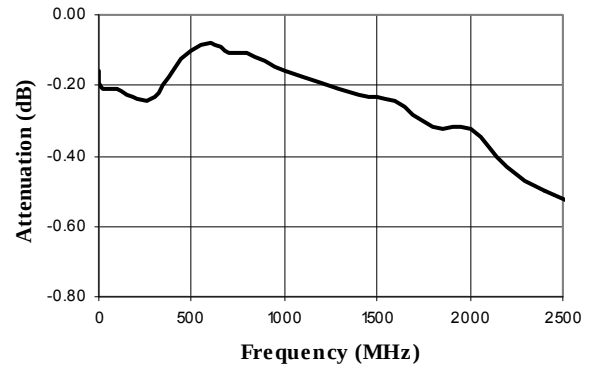


Typical Performance Curves

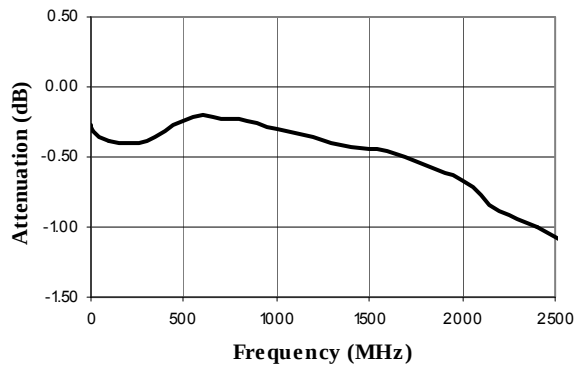
Attenuation Error, 8 dB Bit



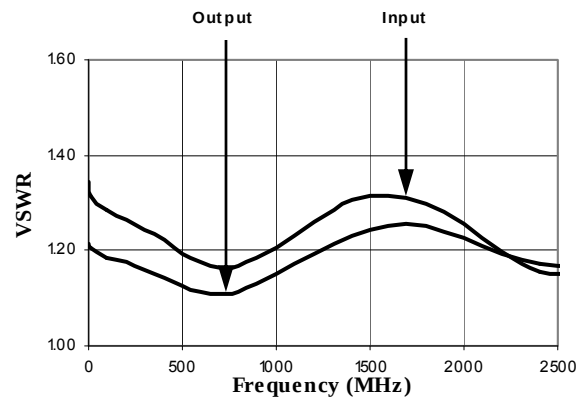
Attenuation Error, 16 dB Bit



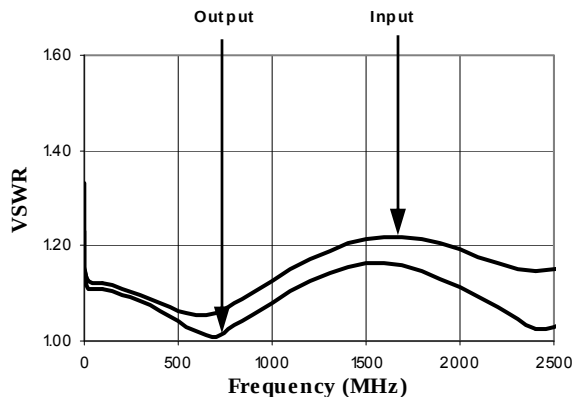
Attenuation Error, Max. Attenuation



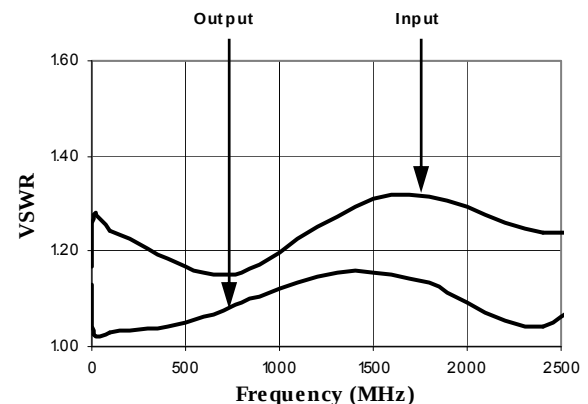
VSWR, 2 dB Bit



VSWR, 4 dB Bit



VSWR, 8 dB Bit

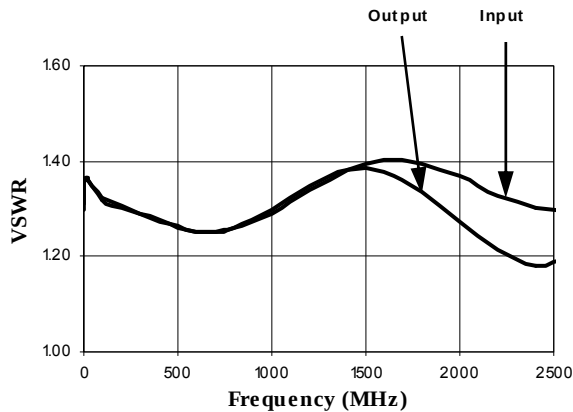


Digital Attenuator 30.0 dB, 4-Bit, TTL Driver, DC-2.5 GHz

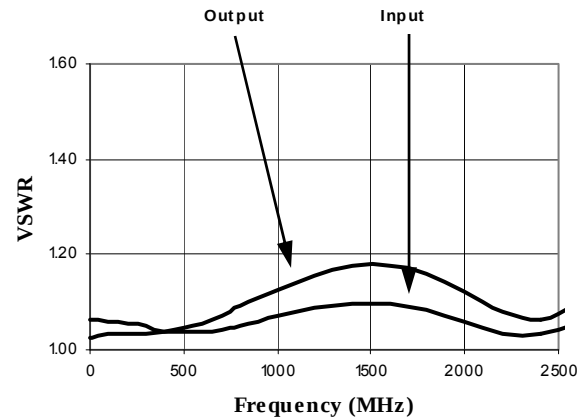
Rev. V8

Typical Performance Curves

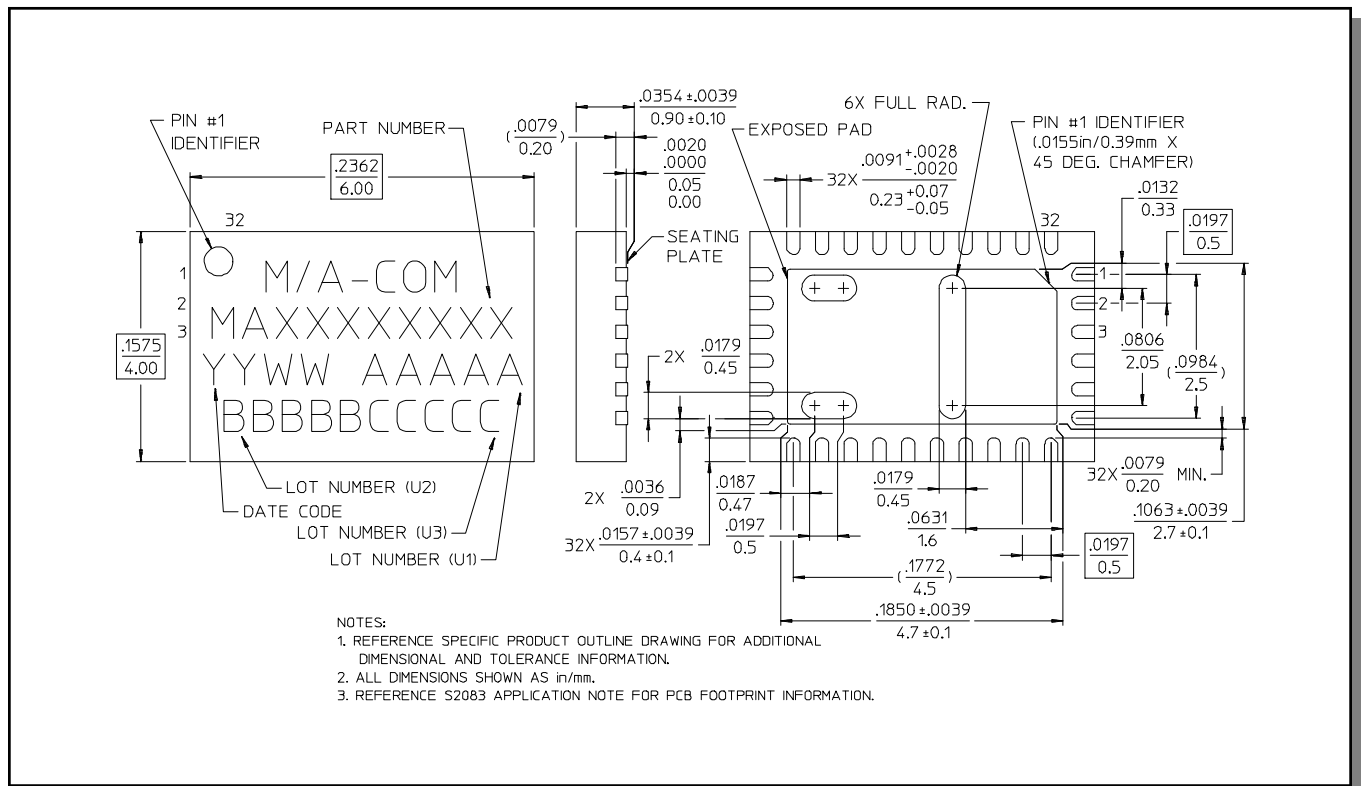
VSWR, 16 dB Bit



VSWR, Maximum Attenuation



CSP-1, 4 x 6 mm, 32-lead PQFN[†]



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