

-0 VCC (+5V)

+ 0,1 ũ

. 16 dB

0.1 uE

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RF2

32 dB

## **Features**

- Attenuation: 1 dB Steps to 50 dB •
- Low DC Power Consumption
- Small Footprint, JEDEC Package
- Integral TTL Driver •
- 50 ohm Impedance
- Test Boards are Available •

**Ordering Information** 

Part Number

AT90-0106

AT90-0106TR

AT90-0106-TB

information.

Note: Reference Application Note M513 for reel size

- Tape and Reel Packaging Available
- **CSP-1** Package

# Description

M/A-COM's AT90-0106 is a GaAs FET 6-bit digital attenuator with integral TTL driver. Step size is 1 dB providing a 50 dB total attenuation range. This device is in a PQFN plastic surface mount package. The AT90-0106 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required.

2 dB

1 dB

**Functional Schematic** 

GND C

GND O-

GND O-

RE10-12

C32 C1 C2 C4 C8 C16

6 BIT, 50 dB ATTEN

SEE DETAIL

17 18 19 20 21 22

4 dB

10 NC

11

13

14

15

16

2

32

30

29 NC -O GND

28

27

26

25

74

23

8 dB

ATTENUATOR DETAIL

-O RF2

-O GND

Pin No.	Function	Pin No.	Function	
1	C16	17	NC	
2	C8	18	NC	
3	C4	19	NC	
4	C2	20	NC	
5	C1	21	NC	
6	C32	22	NC	
7	GND	23	NC	
8	NC	24	NC	
9	NC	25	NC	
10	NC <sup>2</sup>	26	GND	
11	GND	27	RF2	
12	RF1	28	GND	
13	GND	29	NC <sup>2</sup>	
14	NC	30	-Vee	
15	NC	31	NC	
16	NC	32	+Vcc	

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

2. Pins 10 and 29 must be isolated.

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Package

**Bulk Packaging** 

1000 piece reel

Sample Test Board

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

Parameter	Test Conditions	Frequency Units		Min	Тур	Max
Insertion Loss	_	DC - 2.4 GHz dB —				6.0
Attenuation Accuracy	Individual Bits 1-2-4-8-16-32 dB         DC - 2.4 GHz         dB         —         —           Any Combination of Bits 1 to 50 dB         DC - 2.4 GHz         dB         —         —         —					±(.3 +5% of atten setting) ±(.5 +8% of atten setting)
VSWR	Full Range	DC - 2.4 GHz	Ratio	—	1.8:1	2:1
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 dBm — +21 0.5 - 2.40 GHz dBm — +24			—	
Input IP <sub>3</sub>	Two-tone inputs up to +5 dBm	50 MHz 0.5-2.4 GHz	dB dB			—
+Vcc -Vee	—				5.25 -4.75	
Logic "0"	Sink Current is 20 µA max.	— V 0.0 —		_	0.8	
Logic "1"	Source Current is 20 µA max.	—	— V 2.0 —		_	5.0
V <sub>IL</sub> V <sub>IH</sub>	LOW-level input voltage HIGH-level input voltage	_	V V	0.0 — 2.0 —		0.8 5.0
lin (Input Leakage Current)	Vin = V <sub>CC</sub> or GND	_	uA	-1.0	_	1.0
Icc (Quiescent Supply Current)	Vcntrl = V <sub>CC</sub> or GND	GND — uA -		—	250	400
∆Icc <sup>3</sup> (Additional Supply Current Per TTL Input Pin)	$V_{CC}$ = Max, Vcntrl = $V_{CC}$ - 2.1 V	_	mA			1.0
IEE	VEE min to max, Vin = $V_{IL}$ or $V_{IH}$	_	mA	-1.0	-0.2	_
Thermal Resistance θjc	—		°C/W	—	15	—

# Absolute Maximum Ratings <sup>3,4</sup>

Parameter	Absolute Maximum		
Max. Input Power 0.05 GHz 0.5 - 2.4 GHz	+27 dBm +34 dBm		
V <sub>cc</sub>	$-0.5 V \le V_{CC} \le +7.0 V$		
V <sub>EE</sub>	$-8.5 \text{V} \leq \text{V}_{\text{EE}} \leq +0.5 \text{V}$		
V <sub>CC</sub> - V <sub>EE</sub>	$-0.5 V \leq V_{CC} - V_{EE} \leq 14.5 V$		
Vin⁵	$-0.5 \text{V} \leq \text{Vin} \leq \text{V}_{\text{CC}} + 0.5 \text{V}$		
Operating Temperature	-40°C to +85°C		
Storage Temperature	-65°C to +125°C		

3. 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.

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# **Truth Table**

C32	C16	C8	C4	C2	C1	Attenuation
0	0	0	0	0	0	Loss, Reference
0	0	0	0	0	1	1.0 dB
0	0	0	0	1	0	2.0 dB
0	0	0	1	0	0	4.0 dB
0	0	1	0	0	0	8.0 dB
0	1	0	0	0	0	16.0 dB
1	0	0	0	0	0	32.0 dB
1	1	0	0	1	0	50.0 dB

0 = TTL Low; 1 = TTL High

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# **Handling Procedures**

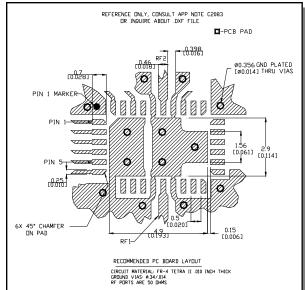
Please observe the following precautions to avoid damage:

# **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**

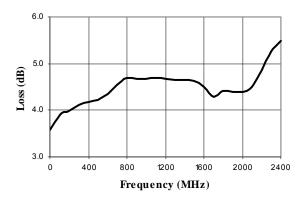
The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.



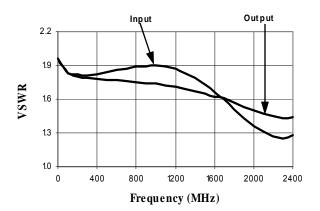
6. Application Note C2083 is available on line at www.macom.com

# **Typical Performance Curves**

Insertion Loss



#### VSWR @ Insertion Loss



# Recommended PCB Configuration<sup>6</sup>

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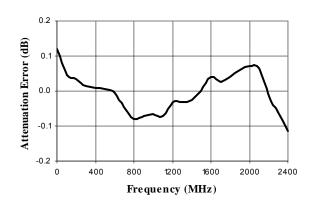
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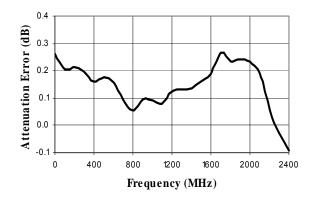
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# **Typical Performance Curves**

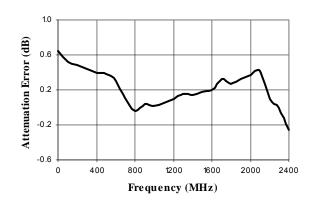
#### Attenuation Error, 1 dB Bit



Attenuation Error, 4 dB Bit



Attenuation Error, 16 dB Bit

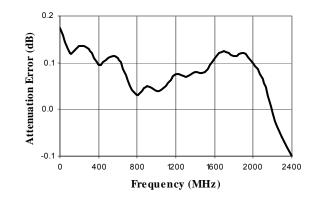


4

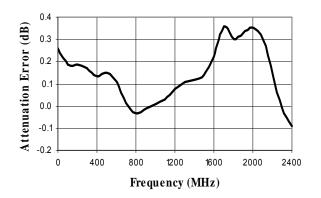
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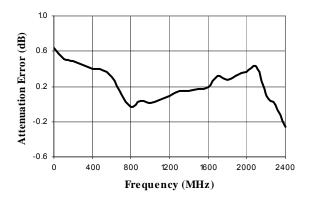
#### Attenuation Error, 2 dB Bit



Attenuation Error, 8 dB Bit



Attenuation Error, 32 dB Bit



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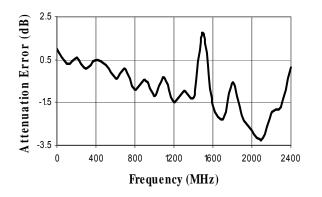


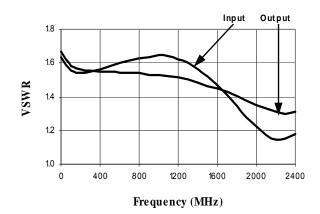
Rev. V9

# Digital Attenuator 50 dB, 6-Bit, TTL Driver, DC - 2.4 GHz

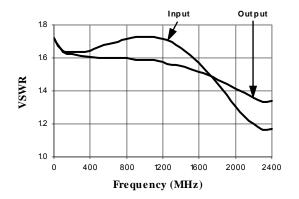
# **Typical Performance Curves**

#### Attenuation Error, Max. Attenuation

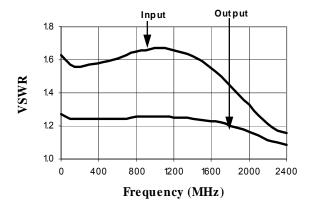




VSWR, 2 dB Bit



VSWR, 8 dB Bit

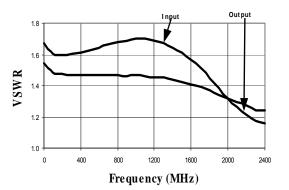




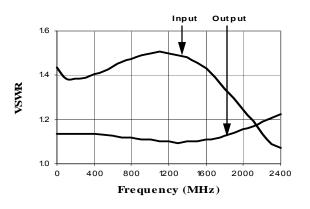
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VSWR, 4 dB Bit



#### VSWR, 16 dB Bit



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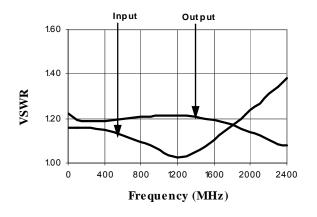
VSWR, 1 dB Bit



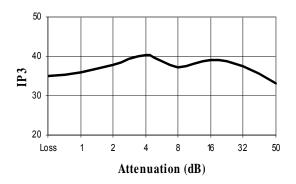
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## **Typical Performance Curves**

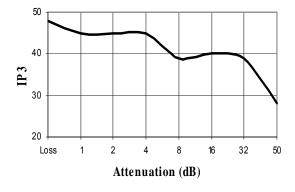
#### VSWR, 32 dB Bit



Maximum IP3 over Temperature Range and Attenuation @ 50 MHz



Maximum IP3 over Temperature Range and Attenuation @ 1900 MHz

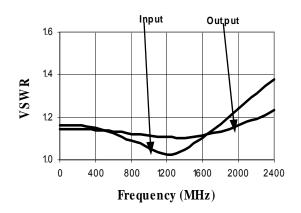


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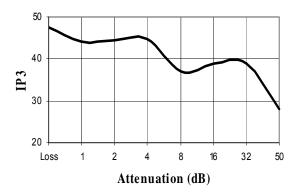
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#### VSWR, Maximum Attenuation



Maximum IP3 over Temperature Range and Attenuation @ 950 MHz



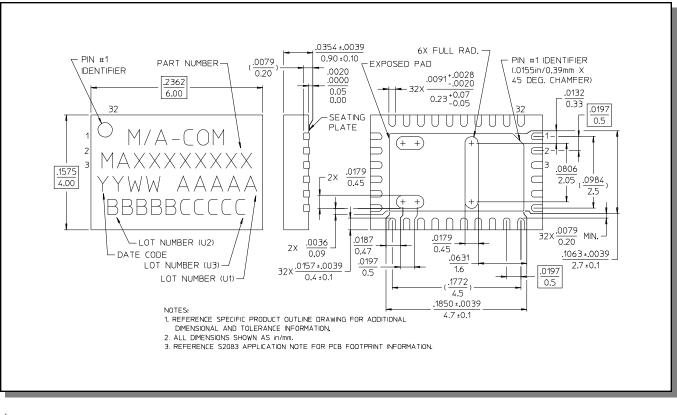
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# AT90-0106



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# *CSP-1,* 4 x 6 mm, 32-lead PQFN<sup>†</sup>



<sup>†</sup> Reference Application Note M538 for lead-free solder reflow recommendations.

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