

-0 VCC (+5V)

+ 0,1 ũ

. 16 dB

0.1 uE

Rev. V9

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 ² | 26 | GND | |
| 11 | GND | 27 | RF2 | |
| 12 | RF1 | 28 | GND | |
| 13 | GND | 29 | NC ² | |
| 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 ₃ | 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 _{IL} V _{IH} | LOW-level input voltage HIGH-level input voltage | _ | V V | 0.0 — 2.0 — | | 0.8 5.0 |
| lin (Input Leakage Current) | Vin = V _{CC} or GND | _ | uA | -1.0 | _ | 1.0 |
| Icc (Quiescent Supply Current) | Vcntrl = V _{CC} or GND | GND — uA - | | — | 250 | 400 |
| ∆Icc ³ (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 ^{3,4}

| Parameter | Absolute Maximum | | |
|---|--|--|--|
| Max. Input Power 0.05 GHz 0.5 - 2.4 GHz | +27 dBm +34 dBm | | |
| V _{cc} | $-0.5 V \le V_{CC} \le +7.0 V$ | | |
| V _{EE} | $-8.5 \text{V} \leq \text{V}_{\text{EE}} \leq +0.5 \text{V}$ | | |
| V _{CC} - V _{EE} | $-0.5 V \leq V_{CC} - V_{EE} \leq 14.5 V$ | | |
| 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

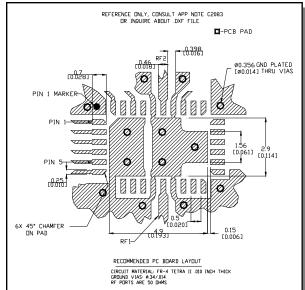
Please observe the following precautions to avoid damage:

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

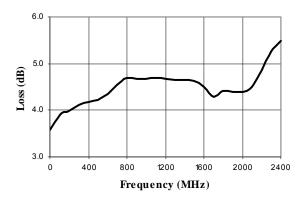
The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.



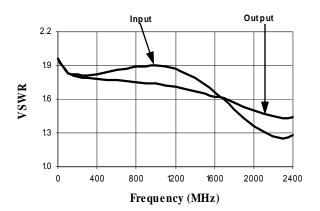
6. Application Note C2083 is available on line at www.macom.com

Typical Performance Curves

Insertion Loss



VSWR @ Insertion Loss



Recommended PCB Configuration⁶

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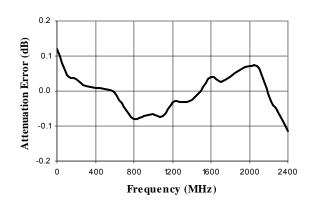
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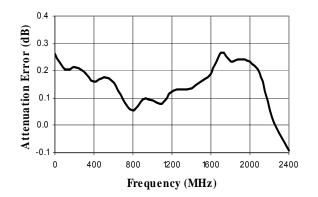
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Typical Performance Curves

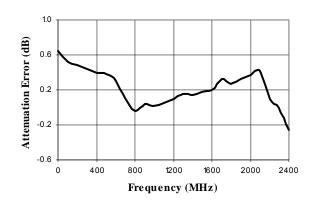
Attenuation Error, 1 dB Bit



Attenuation Error, 4 dB Bit



Attenuation Error, 16 dB Bit

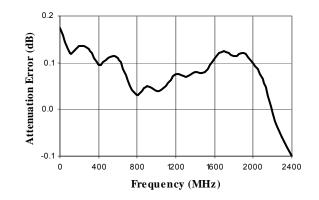


4

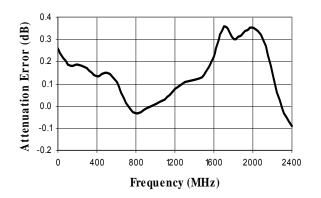
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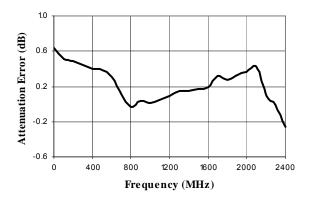
Attenuation Error, 2 dB Bit



Attenuation Error, 8 dB Bit



Attenuation Error, 32 dB Bit



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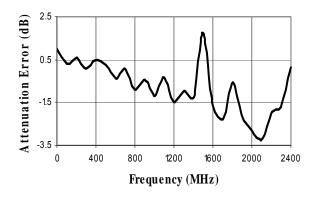


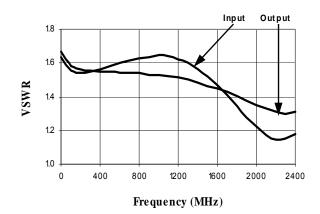
Rev. V9

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

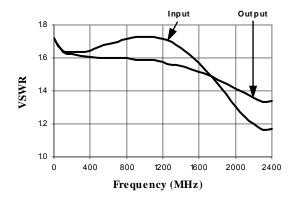
Typical Performance Curves

Attenuation Error, Max. Attenuation

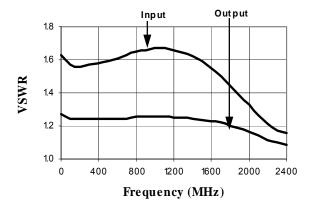




VSWR, 2 dB Bit



VSWR, 8 dB Bit

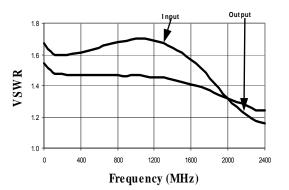




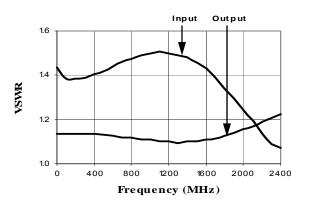
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VSWR, 4 dB Bit



VSWR, 16 dB Bit



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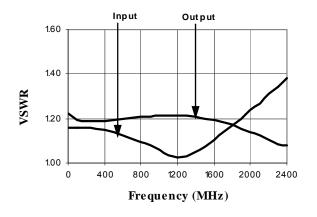
VSWR, 1 dB Bit



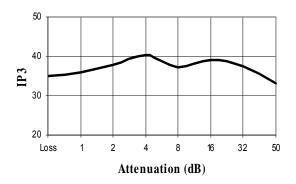
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Typical Performance Curves

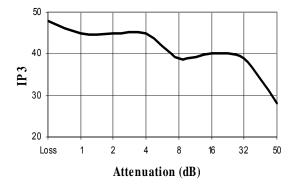
VSWR, 32 dB Bit



Maximum IP3 over Temperature Range and Attenuation @ 50 MHz



Maximum IP3 over Temperature Range and Attenuation @ 1900 MHz

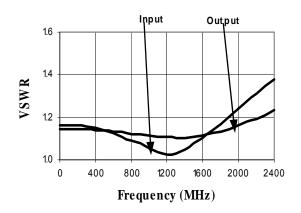


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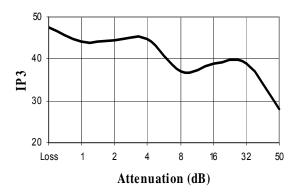
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VSWR, Maximum Attenuation



Maximum IP3 over Temperature Range and Attenuation @ 950 MHz



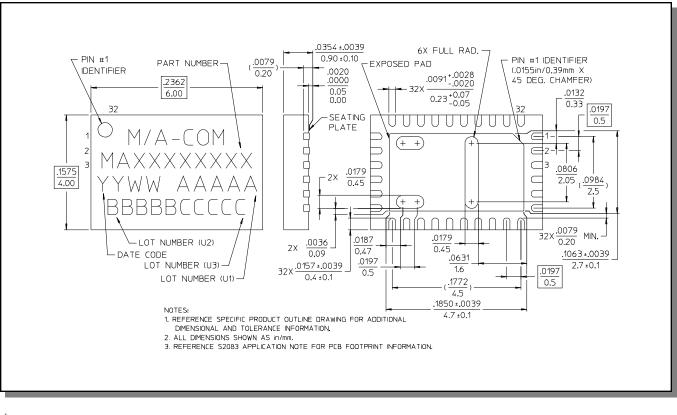
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AT90-0106



Rev. V9

CSP-1, 4 x 6 mm, 32-lead PQFN[†]



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

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