

## Silicon Bipolar MMIC Cascadable Amplifier

### MP4TD0400

#### Features

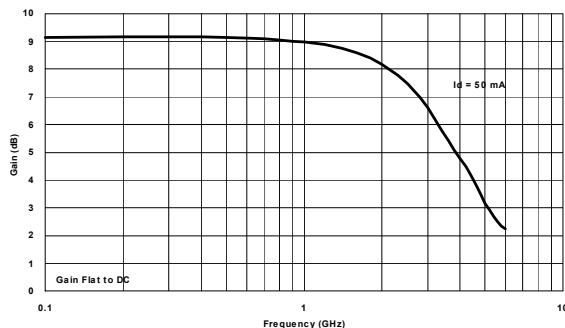
- Cascadable 50Ω Gain Block
- 3dB Bandwidth: DC to 3.2 GHz
- 9.0 dB Typical Gain @ 1.0 GHz
- Unconditionally Stable ( $k > 1$ )

#### Description

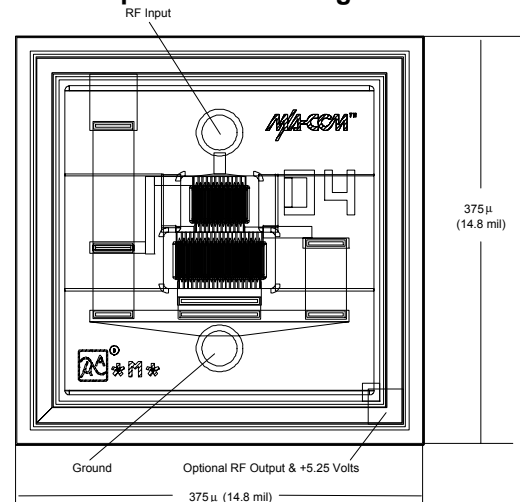
M-Pulse's MP4TD0400 is a high performance silicon bipolar MMIC chip. The MP4TD0400 is designed for use where a general purpose 50Ω gain block is required. Typical applications include narrow and wide band IF and RF amplifiers in industrial and military applications.

The MP4TD0400 is fabricated using a 10 GHz  $f_T$  silicon bipolar technology that features gold metalization and IC passivation for increased performance and reliability.

#### TYPICAL POWER GAIN vs FREQUENCY



Chip Outline Drawing<sup>1,2,3,4</sup>



Notes: (unless otherwise specified)

1. Chip Thickness is 120 μm; 4.8 mils
2. Bond Pads are 40 μm; 1.6 mils typical in diameter
3. RF Output Contact & +DC Voltage Is Normally Made On Backside Of Chip At Die Attach
4. Tolerance: μm .xx = ±.13; mil .x = ±.5

#### Ordering Information

| Model No.     | Type of Carrier |
|---------------|-----------------|
| MP4TD0400 GEL | GEL PACK        |
| MP4TD0400 WAF | Waffle Pack     |
| MP4TD0400 TF  | Tape Frame      |

#### Electrical Specifications @ $T_A = +25^\circ\text{C}$ , $I_d = 50 \text{ mA}$ ; $Z_o = 50\Omega$

| Symbol                    | Parameters                             | Test Conditions                       | Units | Min. | Typ. | Max. |
|---------------------------|----------------------------------------|---------------------------------------|-------|------|------|------|
| $G_p$                     | Power Gain ( $ S_{21} ^2$ )            | $f = 0.1 \text{ GHz}$                 | dB    | -    | 9.0  | -    |
| $\Delta G_p$              | Gain Flatness                          | $f = 0.1 \text{ to } 2.0 \text{ GHz}$ | dB    | -    | ±0.6 | -    |
| $f_{3 \text{ dB}}$        | 3 dB Bandwidth                         | -                                     | GHz   | -    | 3.2  | -    |
| $\text{SWR}_{\text{in}}$  | Input SWR                              | $f = 0.1 \text{ to } 2.0 \text{ GHz}$ | -     | -    | 1.4  | -    |
| $\text{SWR}_{\text{out}}$ | Output SWR                             | $f = 0.1 \text{ to } 2.0 \text{ GHz}$ | -     | -    | 1.7  | -    |
| $P_{1 \text{ dB}}$        | Output Power @ 1 dB Gain Compression   | $f = 1.0 \text{ GHz}$                 | dBm   | -    | 12.5 | -    |
| NF                        | 50 Ω Noise Figure                      | $f = 1.0 \text{ GHz}$                 | dB    | -    | 6.2  | -    |
| $\text{IP}_3$             | Third Order Intercept Point            | $f = 1.0 \text{ GHz}$                 | dBm   | -    | 25.5 | -    |
| $t_D$                     | Group Delay                            | $f = 1.0 \text{ GHz}$                 | ps    | -    | 125  | -    |
| $V_d$                     | Device Voltage                         | -                                     | V     | 4.75 | 5.25 | 5.75 |
| $dV/dT$                   | Device Voltage Temperature Coefficient | -                                     | mV/°C | -    | -8.0 | -    |

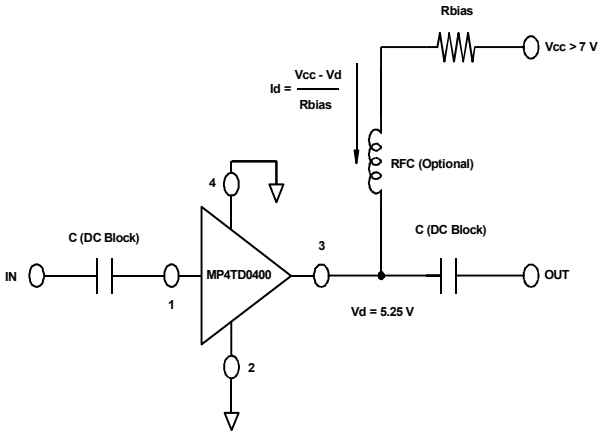
Specification Subject to Change Without Notice

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Absolute Maximum Ratings

| Parameter                                                         | Absolute Maximum |
|-------------------------------------------------------------------|------------------|
| Device Current                                                    | 100 mA           |
| Power Dissipation <sup>2,3</sup>                                  | 650 mW           |
| RF Input Power                                                    | +13 dBm          |
| Junction Temperature                                              | 200°C            |
| Storage Temperature                                               | -65°C to +200°C  |
| Thermal Resistance: $\theta_{jms} = 35\text{ }^{\circ}\text{C/W}$ |                  |

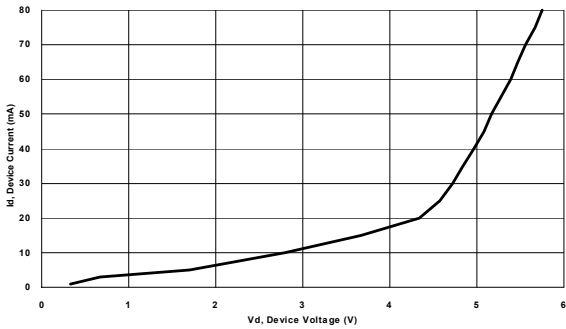
1. Exceeding these limits may cause permanent damage.
2. Mounting Surface Temperature ( $T_{MS}$ )= 25 °C.
3. Derate at 28.6 mW/°C for  $T_{MS} > 177^{\circ}\text{C}$

Typical Bias Configuration

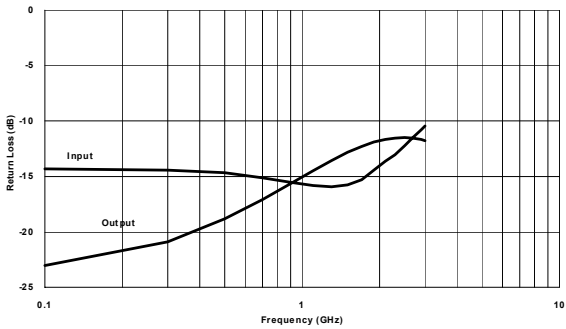


Typical Performance Curves @  $I_D = 50\text{ mA}$ ,  $T_A = +25^{\circ}\text{C}$  (unless otherwise noted)

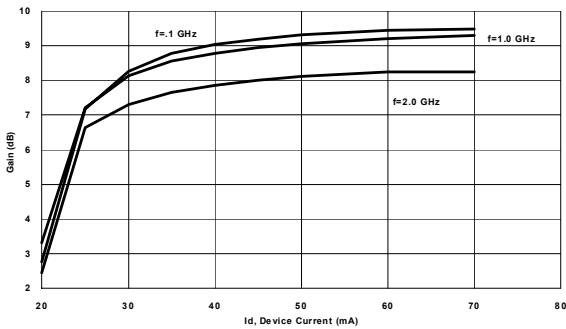
DEVICE CURRENT vs DEVICE VOLTAGE



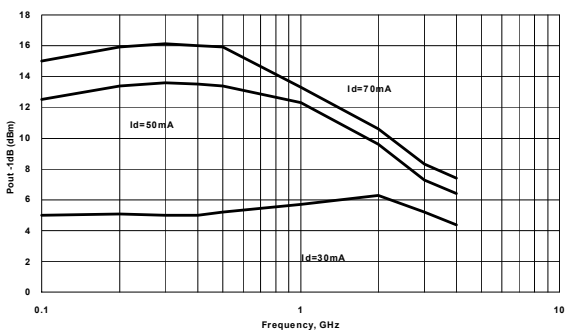
RETURN LOSS vs FREQUENCY



POWER GAIN vs CURRENT



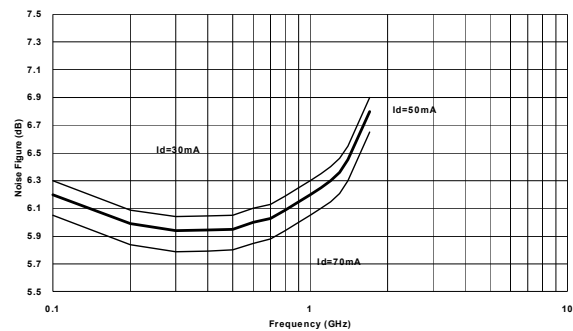
$P_{OUT}$  @ -1DB GAIN COMPRESSION vs FREQUENCY



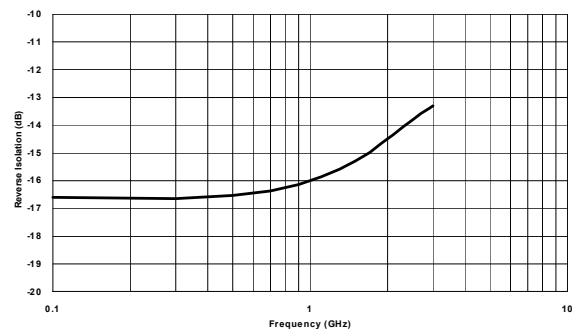
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NOISE FIGURE vs FREQUENCY



REVERSE ISOLATION vs FREQUENCY



Typical Scattering Parameters

$Z_0 = 50\Omega$ ,  $T_A = +25^\circ\text{C}$ ,  $I_d = 50\text{ mA}$

| Frequency<br>(GHz) | S11   |        | S22  |       | S12   |       | S22   |        |
|--------------------|-------|--------|------|-------|-------|-------|-------|--------|
|                    | Mag.  | Angle  | Mag. | Angle | Mag.  | Angle | Mag   | Angle  |
| 0.1                | 0.192 | 169.4  | 2.86 | 174.6 | 0.148 | 4.9   | 0.070 | 3.8    |
| 0.2                | 0.191 | 170.2  | 2.86 | 171.9 | 0.147 | 5.4   | 0.079 | -12.4  |
| 0.4                | 0.188 | 171.7  | 2.86 | 164.9 | 0.147 | 7.3   | 0.102 | -47.9  |
| 0.6                | 0.180 | 170.6  | 2.85 | 157.3 | 0.150 | 10.4  | 0.128 | -73.9  |
| 0.8                | 0.171 | 169.6  | 2.83 | 149.8 | 0.154 | 13.8  | 0.153 | -90.2  |
| 1.0                | 0.165 | 170.1  | 2.80 | 142.4 | 0.158 | 17.0  | 0.177 | -102.2 |
| 1.5                | 0.163 | 176.1  | 2.71 | 124.2 | 0.172 | 24.0  | 0.228 | -126.3 |
| 2.0                | 0.199 | -178.6 | 2.57 | 106.6 | 0.188 | 28.6  | 0.258 | -146.0 |
| 2.5                | 0.245 | 179.8  | 2.37 | 88.7  | 0.204 | 31.4  | 0.266 | -161.5 |
| 3.0                | 0.300 | 173.3  | 2.14 | 75.6  | 0.216 | 33.8  | 0.258 | -171.2 |
| 3.5                | 0.355 | 163.9  | 1.91 | 64.4  | 0.228 | 35.5  | 0.253 | -177.6 |
| 4.0                | 0.407 | 153.3  | 1.73 | 55.0  | 0.234 | 37.2  | 0.251 | 178.5  |
| 4.5                | 0.456 | 142.3  | 1.58 | 46.2  | 0.241 | 40.3  | 0.262 | 176.4  |
| 5.0                | 0.508 | 131.2  | 1.44 | 39.1  | 0.252 | 42.8  | 0.279 | 173.8  |

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