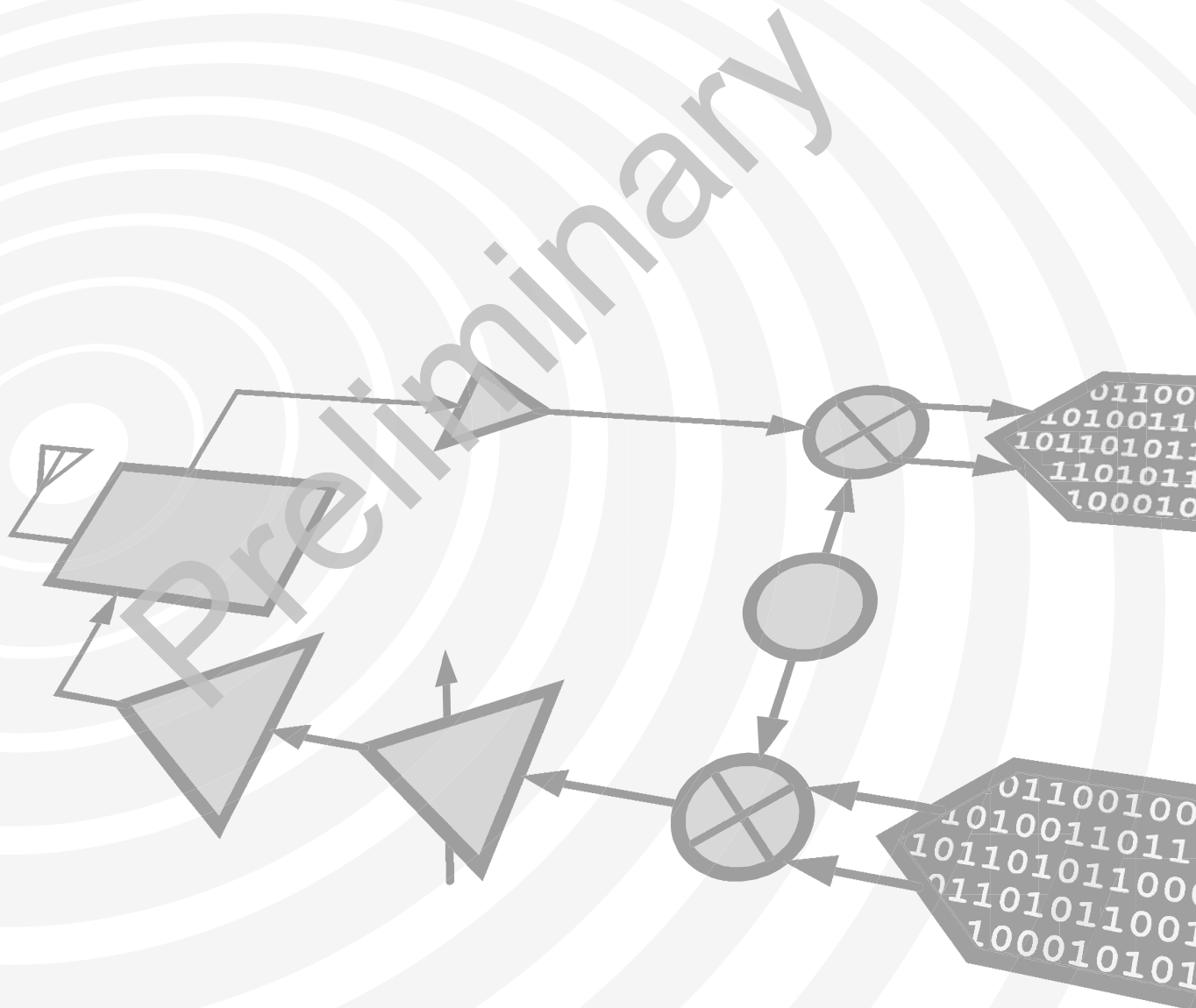


# Analog Devices Welcomes Hittite Microwave Corporation



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Preliminary

## 0.5 dB LSB GaAs MMIC 5-BIT DIGITAL ATTENUATOR, 0.1 - 30 GHz

### Typical Applications

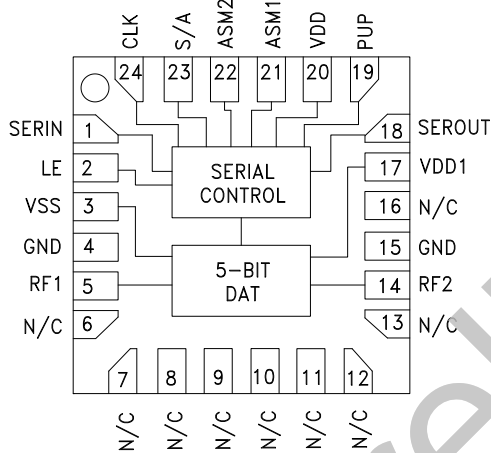
The HMC1019ALP4E is ideal for:

- Fiber Optics & Broadband Telecom
- Microwave Radio & VSAT
- Military Radios, Radar & ECM
- Space Applications
- Sensors
- Test & Measurement Equipment

### Features

- 0.5 dB LSB Steps to 15.5 dB
- TTL/CMOS Compatible, Serial Control
- Unique Asynchronous Mode Control Allows Immediate Attenuation Level Setting
- ±0.5 dB Typical Bit Error
- High Input IP3: +45 dBm
- 24 Lead 4x4mm SMT Package: 16mm<sup>2</sup>

### Functional Diagram



### General Description

The HMC1019ALP4E is a broadband 5-bit GaAs IC digital attenuator in a low cost leadless surface mount package. Covering 0.1 to 30.0 GHz, the insertion loss is less than 4.0 dB typical. The attenuator bit values are 0.5 (LSB), 1, 2, 4, 8 for a total attenuation of 15.5 dB. Attenuation accuracy is excellent at ±0.3 dB typical step error with an IIP3 of +45 dBm. The control interface is CMOS/TTL compatible and accepts a three wire serial input. The HMC1019ALP4E features a user selectable power up state and a serial-output port for cascading other Hittite serial controlled components.

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , With $V_{dd} = V_{dd1} = +5\text{V}$ , $V_{ss} = -5\text{V}$

| Parameter  | Frequency (GHz)     | Min.  | Typ.                               | Max. | Units |
|--|---------------------|---|------------------------------------|------|-------|
| Insertion Loss   | 0.1 - 18.0 GHz      |   | 3.0                                | 4.5  | dB    |
|  | 18.0 - 26.5 GHz     |   | 4.0                                | 6.0  | dB    |
|  | 26.5 - 30.0 GHz     |   | 5.0                                | 6.5  | dB    |
| Attenuation Range  | 0.1 - 30.0 GHz      |   | 31                                 |      | dB    |
| Return Loss (RF1 & RF2, All Atten. States)                                   | 0.1 - 30.0 GHz      |   | 12                                 |      | dB    |
| Attenuation Accuracy: (Referenced to Insertion Loss)                         | 0.5 - 7.5 dB States | 0.1 - 30.0 GHz  | ± (0.3 + 6%) of Atten. Setting Max |      | dB    |
|  | 8 - 15.5 dB States  | 0.1 - 30.0 GHz  | ± (0.3 + 8%) of Atten. Setting Max |      | dB    |
| Input Power for 0.1 dB Compression   | 0.1 - 0.5 GHz       |   | 22                                 |      | dBm   |
|  | 0.5 - 30.0 GHz      |   | 27                                 |      | dBm   |
| Input Third Order Intercept Point<br>(Two-Tone Input Power= 0 dBm Each Tone) | 0.1 - 0.5 GHz       |   | 42                                 |      | dBm   |
|  | 0.5 - 30.0 GHz      |   | 45                                 |      | dBm   |
| Switching Characteristics  | 0.1 - 30.0 GHz      |   | 60                                 |      | ns    |
|  |                     | tRISE, tFALL (10/90% RF)<br>tON/tOFF (50% CTL to 10/90% RF) | 90                                 |      | ns    |
| I <sub>dd1</sub>   | 0.1 - 30.0 GHz      | 2.5   | 4.5                                | 6.5  | mA    |
| I <sub>ss</sub>  | 0.1 - 30.0 GHz      | -7.0  | -5.0                               | -3.0 | mA    |

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ATTENUATOR, 0.1 - 30 GHz**
**Asynchronous Mode Truth Table**

| ASM1 | ASM2 | Attenuation State RF1-RF2 |
|------|------|---------------------------|
| High | High | Reference I.L.            |
| High | Low  | 1.5 dB                    |
| Low  | High | 14 dB                     |
| Low  | Low  | 15.5 dB                   |

**PUP Truth Table**

| PUP  | Attenuation State |
|------|-------------------|
| High | Reference I.L.    |
| Low  | 15.5 dB           |

Note: The logic state of ASM1-ASM2 determines the power-up state of the part per truth table for the asynchronous mode when LE is high at power-up.

**Bias Voltages & Currents**

|      |              |
|------|--------------|
| Vdd  | +5V @ 0.2 mA |
| Vdd1 | +5V @ 4.5 mA |
| Vss  | -5V @ 5 mA   |

**Control Voltage**

| State | Bias Condition        |
|-------|-----------------------|
| Low   | 0 to 0.8V @ 1 $\mu$ A |
| High  | 2 to 5V @ 1 $\mu$ A   |

**Serial Mode Truth Table**

| Control Voltage Input |            |            |            |              | Attenuation State RF1 - RF2 |
|-----------------------|------------|------------|------------|--------------|-----------------------------|
| P4<br>8 dB            | P3<br>4 dB | P2<br>2 dB | P1<br>1 dB | P0<br>0.5 dB |                             |
| High                  | High       | High       | High       | High         | Reference I.L.              |
| High                  | High       | High       | High       | Low          | 0.5 dB                      |
| High                  | High       | High       | Low        | High         | 1 dB                        |
| High                  | High       | Low        | High       | High         | 2 dB                        |
| High                  | Low        | High       | High       | High         | 4 dB                        |
| Low                   | High       | High       | High       | High         | 8 dB                        |
| Low                   | Low        | Low        | Low        | Low          | 15.5 dB                     |

Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

| Parameter                                 | Typ.   |
|---|--------|
| Min. serial period, $t_{SCK}$             | 100 ns |
| Control set-up time, $t_{CS}$             | 20 ns  |
| Control hold-time, $t_{CH}$               | 20 ns  |
| LE setup-time, $t_{LN}$                   | 10 ns  |
| Min. LE pulse width, $t_{LEW}$            | 10 ns  |
| Min LE pulse spacing, $t_{LES}$           | 630 ns |
| Serial clock hold-time from LE, $t_{CKN}$ | 10 ns  |
| Hold Time, $t_{PH}$                       | 0 ns   |
| Latch Enable Minimum Width, $t_{LEN}$     | 10 ns  |
| Setup Time, $t_{PS}$                      | 2 ns   |

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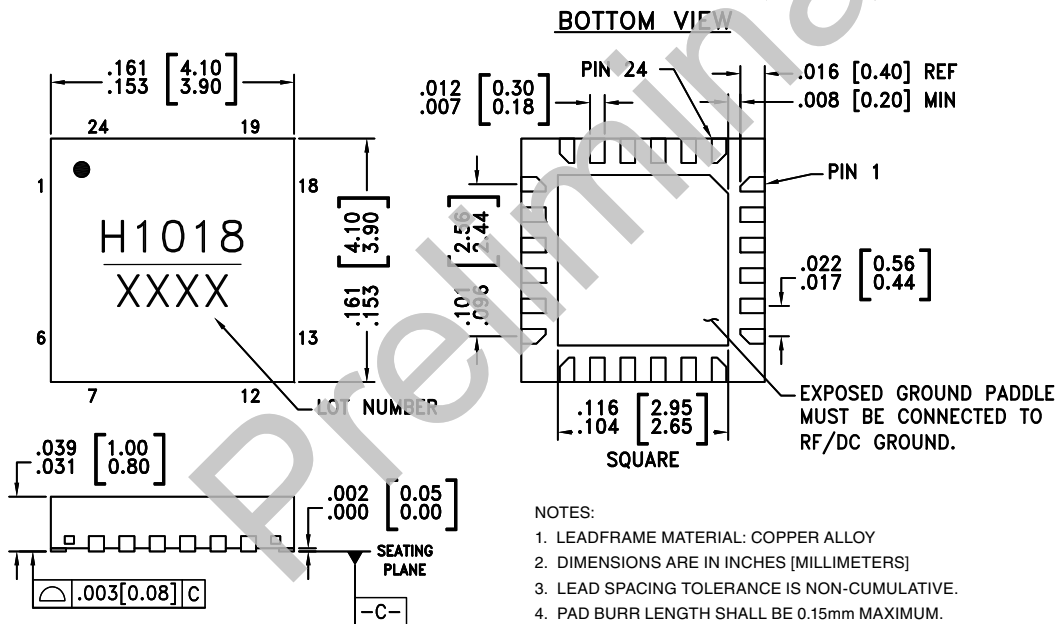
### Absolute Maximum Ratings

|  |                |
|--|----------------|
| RF Input Power (0.1 to 30.0 GHz)   | +27 dBm        |
| Control Voltage (CLK, SERIN, LE, PUP, ASM1, ASM2, S/A)                     | Vdd + 0.5V     |
| Vdd, Vdd1  | +7 Vdc         |
| Vss  | -7 Vdc         |
| Channel Temperature  | 150 °C         |
| Continuous P <sub>diss</sub> (T = 85 °C)<br>(derate 6.8 mW/°C above 85 °C) | 0.445 W        |
| Thermal Resistance   | 146 °C/W       |
| Storage Temperature  | -65 to +150 °C |
| Operating Temperature  | -40 to +85 °C  |
| ESD Sensitivity (HBM)  | Class 1A       |



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

### Outline Drawing



NOTES:

- LEADFRAME MATERIAL: COPPER ALLOY
- DIMENSIONS ARE IN INCHES [MILLIMETERS]
- LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
- PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM.  
PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
- PACKAGE WARP SHALL NOT EXCEED 0.05mm.
- ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
- REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.