Peregrine Semiconductor

Advance Information

PE94302

50 Ω RF Digital Step Attenuator
For Rad-Hard Space Applications
6-bit, 31.5 dB, DC – 4.0 GHz

Product Description

The PE94302 is a high linearity, 6-bit UltraCMOS™ RF Digital Step Attenuator (DSA) specifically optimized for rad-hard space applications. This 50-ohm RF DSA covers a 31.5 dB attenuation range in 0.5 dB steps. It provides both parallel and serial CMOS control interface which operate on a single 3-volt supply. It also has a unique control interface that allows the user to select an initial attenuation state at power-up. The PE 94302 maintains high attenuation accuracy over frequency and temperature and exhibits very low insertion loss and power consumption.

The PE94302 is manufactured in Peregrine's patented Ultra Thin Silicon (UTSi®) CMOS process, offering the performance of GaAs with the economy and integration of conventional CMOS.

Features

- Attenuation: 0.5 dB steps to 31.5 dB
- Flexible parallel and serial programming interfaces
- Unique power-up state selection
- Positive CMOS control logic
- High attenuation accuracy and linearity over temperature and frequency
- Very low power consumption
- Single-supply operation
- 50 Ω impedance

Figure 1. Functional Schematic Diagram

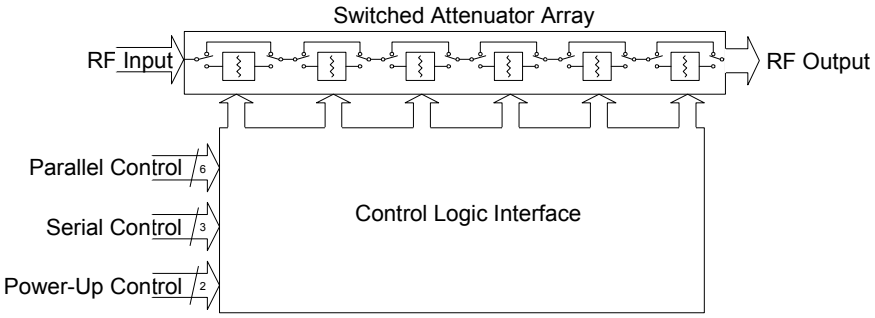


Figure 2. Package Type
28-lead CQFP

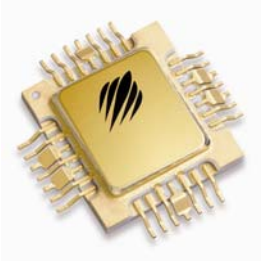


Table 1. Electrical Specifications @ +25°C, V_{DD} = 3.0 V

Parameter	Test Conditions	Frequency	Typical	Max	Units
Operation Frequency[3]		DC-4000			MHz
Insertion Loss		DC - 2.2 GHz	1.5		dB
Attenuation Accuracy	Any Bit or Bit Combination 0.5 dB - 23.5 dB Attenuation 24 dB - 31.5 dB Attenuation	DC ≤ 1.0 GHz 1.0 GHz ≤ 2.2 GHz 1.0 GHz ≤ 2.2 GHz	+/-(0.25 + 3% of attenuation setting) +/-(0.25 + 5% of attenuation setting) +/-(11% of attenuation setting)		dB
1 dB Compression[1,2]		1 MHz - 2.2 GHz	34		dBm
Input IP3[1]	Two-tone inputs	1 MHz - 2.2 GHz	52		dBm
Return Loss		DC - 2.2 GHz	20		dB
RF Input Power (50 Ω)				12	dBm
Switching Speed	50% control to 0.5 dB of final value		1		µs

Notes: 1. Device Linearity will begin to degrade below 1 MHz
2. Maximum Operating Power = +12 dBm
3. Specs are guaranteed to 2.2 GHz, Characterized to 4.0 GHz

Figure 3. Pin Configuration (Top View)

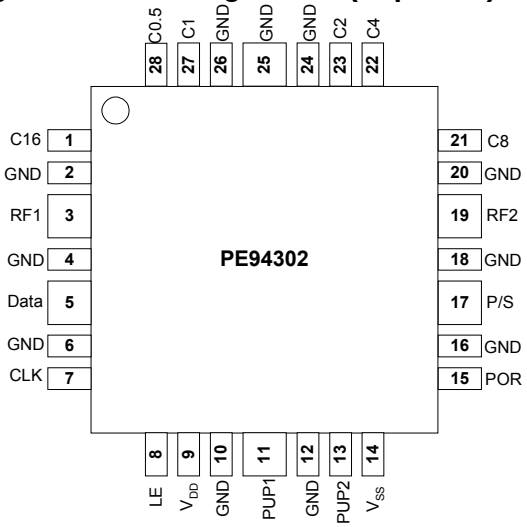


Table 2. Pin Descriptions

Pin No.	Pin Name	Description
1	C16	Attenuation control bit, 16dB
2	GND	Ground connection
3	RF1	RF port (Note 1).
4	GND	Ground connection
5	Data	Serial interface data input
6	GND	Ground connection
7	CLK	Serial interface clock input.
8	LE	Latch Enable input (Note 2).
9	V_{DD}	Power supply pin.
10	GND	Ground connection
11	PUP1	Power-up selection bit, MSB.
12	GND	Ground connection
13	PUP2	Power-up selection bit, LSB.
14	V_{SS}	Negative supply voltage
15	POR	Power reset
16	GND	Ground connection
17	P/S	Parallel/Serial mode select.
18	GND	Ground connection
19	RF2	RF port (Note 1).
20	GND	Ground connection
21	C8	Attenuation control bit, 8 dB.
22	C4	Attenuation control bit, 4 dB.
23	C2	Attenuation control bit, 2 dB.
24	GND	Ground connection
25	GND	Ground connection
26	GND	Ground connection
27	C1	Attenuation control bit, 1 dB.
28	C0.5	Attenuation control bit, 0.5 dB.
Paddle	GND	Ground connection

Note 1: Both RF ports must be held at 0 V_{DC} or DC blocked with an external series capacitor.
2: Latch Enable (LE) has an internal 100 kΩ resistor to V_{DD}.

Table 3. Absolute Maximum Ratings

Symbol	Parameter/Conditions	Min	Max	Units
V_{DD}	Power supply voltage	-0.3	4.0	V
V_I	Voltage on any input	-0.3	V_{DD}+	V
T_{ST}	Storage temperature range	-65	150	°C
P_{IN}	Input power (50Ω)		24	dBm
V_{ESD}	ESD voltage (Human Body		500	V

Absolute Maximum Ratings are those values listed in the above table. Exceeding these values may cause permanent device damage. Functional operation should be restricted to the limits in the DC Electrical Specifications table. Exposure to absolute maximum ratings for extended periods may affect device reliability.

Table 4. DC Electrical Specifications

Parameter	Min	Typ	Max	Units
V_{DD} Power Supply Voltage	2.7	3.0	3.3	V
I_{DD} Power Supply Current			100	µA
T_{OP} Operating	-40		85	°C
Digital Input High	0.7xV_{DD}			V
Digital Input Low			0.3xV_{DD}	V
Digital Input Leakage			1	µA

Exposed Solder Pad Connection

The exposed solder pad on the bottom of the package must be grounded for proper device operation.

Electrostatic Discharge (ESD) Precautions

When handling this UltraCMOS™ device, observe the same precautions that you would use with other ESD-sensitive devices. Although this device contains circuitry to protect it from damage due to ESD, precautions should be taken to avoid exceeding the rate specified in Table 3.

Latch-Up Avoidance

Unlike conventional CMOS devices, UltraCMOS™ devices are immune to latch-up.

Switching Frequency

The PE94302 has a maximum 25 kHz switching rate.

Typical Performance Data (25°C, V_{DD}=3.0 V)

Figure 4. Insertion Loss Vs. Frequency

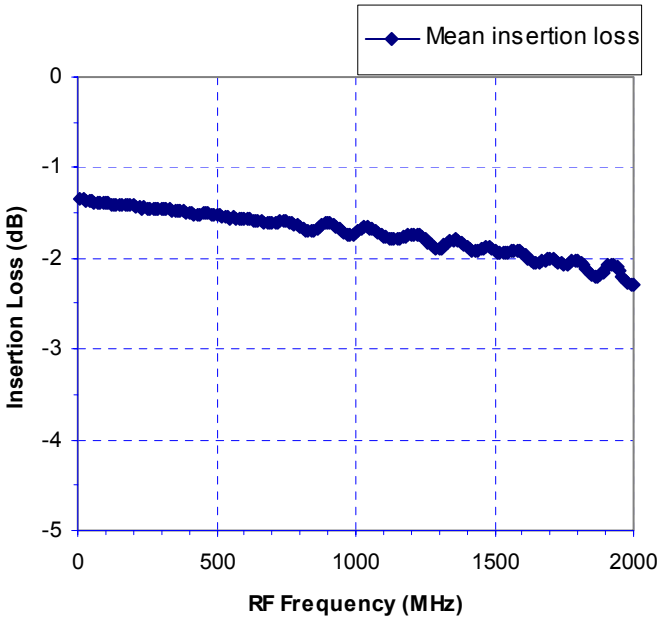


Figure 5. Attenuation Error Vs. Attenuation Setting

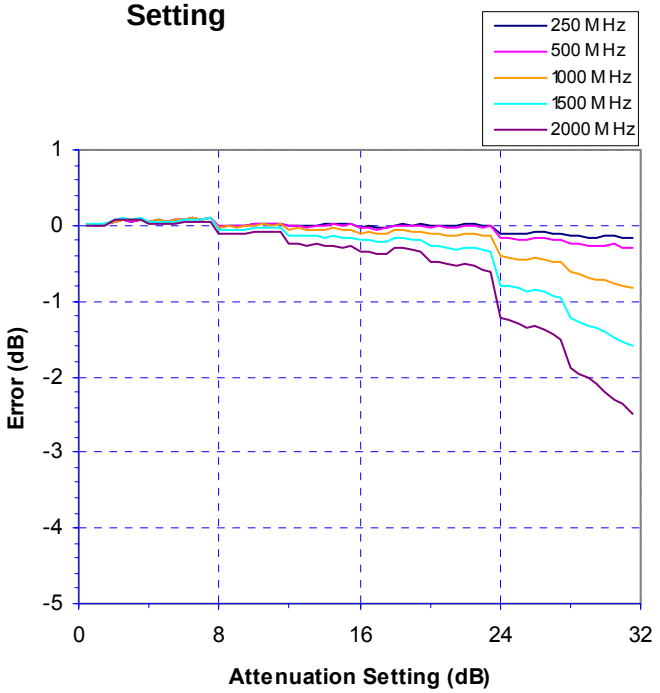
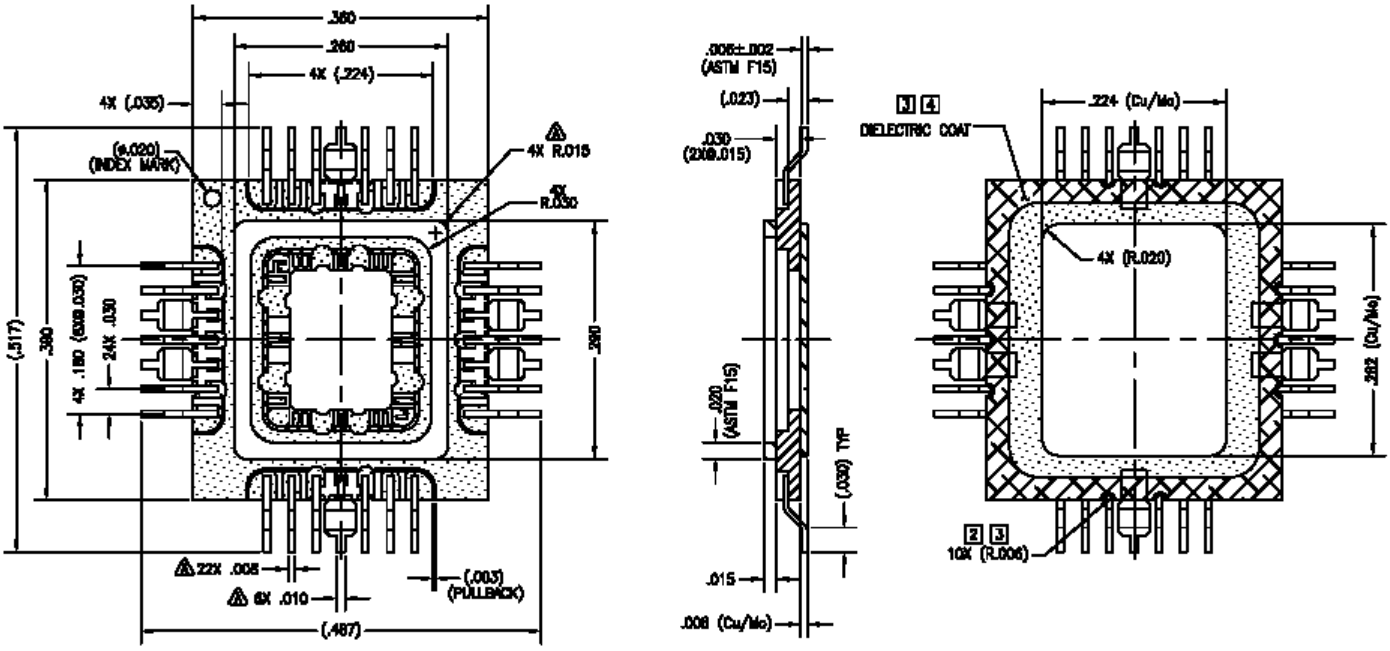


Figure 6. Package Drawing

28-lead CQFP



NOTES:
1. METALLIZATION/ PLATING: REFRACTORY METAL = Ni (75~350u") = Au (50u"MIN)
2. METALLIZED CASTELLATIONS.
3. DIELECTIC RUN INTO CASTELLATIONS SHALL BE ACCEPTABLE.
4. GOLD SPECKLES ON DIELECTRIC COAT SHALL BE ACCEPTABLE.
5. VISUAL ANOMALIES IN CASTELLATION METALLIZATION ACCEPTABLE.
6. TEXT AND ITS LOCATIONS ON LEAD FRAME ARE VENDOR'S OPTION.
7. SLIGHT PATTERN MISMATCH WITH DRAWING DUE TO DIELECTRIC COAT MISALIGNMENT SHALL BE ACCEPTABLE.
8. SEAL RING & HEAT SINK ARE CONNECTED TO GND.
9. LEAD INTEGRITY (ADHESION/ ALIGNMENT/ COPRANARITY), CASTELLATION QUALITY ARE BEST EFFORT BASIS.

Table 10. Ordering Information

Order Code	Part Marking	Description	Package	Shipping Method
94302-01	94302	PE94302-28CQFP-50B Engineering Samples	28-lead CQFP	50 Count Trays
94302-11	94302	PE94302-28CQFP-50B Production Units	28-lead CQFP	50 Count Trays
94302-00	PE94302-EK	PE94302 Evaluation Kit	Evaluation Board	1 / Box

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Data Sheet Identification

Advance Information

The product is in a formative or design stage. The data sheet contains design target specifications for product development. Specifications and features may change in any manner without notice.

Preliminary Specification

The data sheet contains preliminary data. Additional data may be added at a later date. Peregrine reserves the right to change specifications at any time without notice in order to supply the best possible product.

Product Specification

The data sheet contains final data. In the event Peregrine decides to change the specifications, Peregrine will notify customers of the intended changes by issuing a DCN (Document Change Notice).

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