

Product Description

The PE42442 is a HaRP[™] technology-enhanced absorptive SP4T RF switch designed for use in 3G/4G wireless infrastructure and other high performance RF applications.

This switch is a pin-compatible four throw version of the PE42451 with 1.8V control logic. It is comprised of four symmetric RF ports and has very high isolation. An integrated CMOS decoder facilitates a two- or three-pin low voltage CMOS control interface and an external negative supply option. In addition, no external blocking capacitors are required if 0V DC is present on the RF ports.

The PE42442 is manufactured on Peregrine's UltraCMOS[®] process, a patented variation of silicon-on-insulator (SOI) technology on a sapphire substrate.

Peregrine's HaRP[™] technology enhancements deliver high linearity and excellent harmonics performance. It is an innovative feature of the UltraCMOS[®] process, offering the performance of GaAs with the economy and integration of conventional CMOS.

Product Specification

PE42442

UltraCMOS[®] SP4T RF Switch 450–4000 MHz

Features

- Four symmetric, absorptive RF ports
- High isolation
 - 61 dB @ 900 MHz
 - 55 dB @ 2100 MHz
 - 52 dB @ 2700 MHz
 - 43 dB @ 4000 MHz
- High linearity
 - IIP2 of 97 dBm
 - IIP3 of 58 dBm
- 1.8V control logic compatible
- 105°C operating temperature
- Fast switching time of 255 ns
- Two- or three-pin CMOS logic control
- External negative supply option
- ESD performance

Figure 2. Package Type

- 4kV HBM on RF pins to GND
- 2kV HBM on all pins



Figure 1. Functional Diagram



24-lead 4x4 mm QFN



Table 1. Electrical Specifications @ 25°C ($Z_s = Z_L = 50\Omega$) unless otherwise noted Normal mode¹: $V_{DD} = 3.3V$, $Vss_{EXT} = 0V$ or Bypass mode²: $V_{DD} = 3.3V$, $Vss_{EXT} = -3.3V$

Parameter	Path	Condition	Min	Тур	Max	Unit
Operating frequency			450		4000	MHz
Insertion loss	RFC-RFX	450 MHz–900 MHz 900 MHz–2100 MHz 2100 MHz–2700 MHz 2700 MHz–4000 MHz		0.90 1.10 1.15 1.25	1.05 1.35 1.40 1.50	dB dB dB dB
Isolation	RFC-RFX	450 MHz–900 MHz 900 MHz–2100 MHz 2100 MHz–2700 MHz 2700 MHz–4000 MHz	55 52 50 42	61 55 52 43		dB dB dB dB
Isolation	RFX-RFX	450 MHz–900 MHz 900 MHz–2100 MHz 2100 MHz–2700 MHz 2700 MHz–4000 MHz	56 51 50 41	61 54 52 44		dB dB dB dB
Return loss (active port)	RFX	450–4000 MHz		17		dB
Return loss (terminated port)	RFX	450–4000 MHz		22		dB
Input 0.1 dB compression point ³	RFC-RFX	900 MHz		35		dBm
Input IP2	RFC-RFX	1900 MHz		97		dBm
Input IP3	RFC-RFX	1900 MHz		58		dBm
Switching time		50% control to 90% or 10% RF		255	330	ns

Notes: 1. Normal mode: single external positive supply used

Bypass mode: both external positive supply add external negative supply used
The input 0.1 dB compression point is a linearity figure of merit. Refer to *Table 3* for the operating RF input power (50Ω)



Figure 3. Pin Configuration (Top View)



Table 2. Pin Descriptions

Pin #	Name	Description
1-3, 4, 6, 7, 9, 10, 12, 13, 15, 21, 23, 24	GND	Ground
5	RF4 ¹	RF port 4
8	RF3 ¹	RF port 3
11	RF2 ¹	RF port 2
14	RF1 ¹	RF port 1
16	V _{DD}	Supply voltage
17	V1	Digital control logic input 1
18	V2	Digital control logic input 2
19	V3 ²	Digital control logic input 3
20	Vss _{EXT} ³	External Vss negative voltage control/ ground
22	RFC ¹	RF common
Pad	GND	Exposed pad: Ground for proper operation

Notes: 1. RF pins 5, 8, 11, 14, and 22 must be at 0V DC. The RF pins do not require DC blocking capacitors for proper operation if the 0V DC requirement is met

Pin 19 must be grounded for 2-pin control, refer to *Table 5A* Use Vss_{EXT} (pin 20, refer to *Table 3*) to bypass and disable internal negative voltage generator. Connect Vss_{EXT} (pin 20, Vss_{EXT} = GND) to bypass to the product of t

enable internal negative voltage generator Exceeding absolute maximum ratings may cause permanent damage. Operation should be

restricted to the limits in the Operating Ranges table. Operation between operating range maximum and absolute maximum for extended periods may reduce reliability.

Table 3. Operating Ranges

Parameter	Symbol	Min	Тур	Max	Unit
Normal mode ¹					
Supply voltage	V _{DD}	2.3		5.5	V
Supply current	I _{DD}		110		μA
Bypass mode ²					
Supply voltage	V _{DD}	2.7		5.5	V
Supply current	I _{DD}		50		μA
Negative supply voltage	Vss _{ext}	-3.6		-3.2	v
Normal or Bypass mod	le				
Digital input high (V1, V2, V3)	V _{IH}	1.17		3.6	v
Digital input low (V1, V2, V3)	V _{IL}	-0.3		0.6	v
Digital input current ³				1	μA
RF input power, CW	P _{MAX,CW}			33	dBm
RF input power into terminated ports, CW	P _{MAX,TERM}			24	dBm
Operating temperature range	T _{OP}	-40		+105	°C

Notes: 1. Normal mode: connect pin 20 to GND to enable internal negative voltage generator

2. Bypass mode: apply a negative voltage to Vss_{EXT} (pin 20) to

bypass and disable internal negative voltage generator 3. The pull-down resistor in the EVK schematic may increase control current

Table 4. Absolute Maximum Ratings

Parameter/Condition	Symbol	Min	Max	Unit
Supply voltage	V _{DD}	-0.3	5.5	v
Voltage on any DC input	Vı	-0.3	3.6	v
Maximum input power	$P_{MAX,ABS}$		34	dBm
Storage temperature range	T _{ST}	-65	+150	°C
ESD voltage HBM ¹ All pins RF pins to ground	V _{ESD,HBM}		2.0 4.0	kV kV
ESD voltage MM ² , all pins	$V_{\text{ESD,MM}}$		150	V
ESD voltage CDM ³ , all pins	V _{ESD,CDM}		250	v

Notes: 1. Human Body Model (MIL_STD 883 Method 3015)

2. Machine Model (JEDEC JESD22-A115)

3. Charged Device Model (JEDEC JESD22-C101D)



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 rating specified.

Latch-Up Avoidance

Unlike conventional CMOS devices, UltraCMOS[®] devices are immune to latch-up.

Switching Frequency

The PE42442 has a maximum 25 kHz switching rate in normal mode (pin 20 = GND). A faster switching rate is available in bypass mode (pin 20 = Vss_{EXT}). The rate at which the PE42442 can be switched is then limited to the switching time as specified in *Table 1*.

Switching frequency describes the time duration between switching events. Switching time is the time duration between the point the control signal reaches 50% of the final value and the point the output signal reaches within 10% or 90% of its target value.

Moisture Sensitivity Level

The Moisture Sensitivity Level rating for the PE42442 in the 24-lead 4x4 QFN package is MSL1.

Table 5. Truth Table (3-pin control)¹

Mode	V3	V2	V1
Unsupported	0	0	0
RF1 on	0	0	1
RF2 on	0	1	0
RF3 on	0	1	1
RF4 on	1	0	0
All off	1	0	1
All off	1	1	0
Unsupported	1	1	1

Note 1: 3-pin control intended for legacy product support to PE42450 and PE42451 or if All Off mode is required. Logic States 000 and 111 are unsupported and should not be used under any operating conditions

Table 5A. Truth Table (2-pin control¹)²

Mode	V2	V1
RF4 on	0	0
RF1 on	0	1
RF2 on	1	0
RF3 on	1	1

Notes: 1. Pin 19 = V3 must be grounded 2. 2-pin control is recommended for new product designs if All Off mode is not required

Optional External Vss Control (VssEXT)

For applications the require a faster switching rate or spur-free performance, this part can be operated in bypass mode. Bypass mode requires an external negative voltage in addition to an external V_{DD} supply voltage.

As specified in *Table 3*, the external negative voltage (Vss_{EXT}) when applied to pin 20 will disable and bypass the internal negative voltage generator.

Spurious Performance

The typical low-frequency spurious performance of the PE42442 in normal mode is -120 dBm (pin 20 = GND). If spur-free performance is desired, the internal negative voltage generator can be disabled by applying a negative voltage to Vss_{EXT} (pin 20).



Typical Performance Data @ 25°C and V_{DD} = 3.3V unless otherwise noted



Figure 4. Insertion Loss (All Paths)

Figure 5. Insertion Loss vs Temp (RFC-RFX)



Figure 6. Insertion Loss vs V_{DD} (RFC–RFX)





Typical Performance Data @ 25°C and V_{DD} = 3.3V unless otherwise noted



Figure 9. Isolation vs Temp (RFX-RFX)



Figure 8. Isolation vs V_{DD} (RFC–RFX)



Figure 10. Isolation vs V_{DD} (RFX–RFX)





Typical Performance Data @ 25°C and V_{DD} = 3.3V unless otherwise noted



Figure 13. RFC Port Return Loss vs Temp



Figure 15. Return Loss (All Ports Terminated)



Figure 12. Active Port Return Loss vs V_{DD}



Figure 14. RFC Port Return Loss vs V_{DD}



Figure 16. IIP3 vs Frequency







Evaluation Kit

The SP4T switch Evaluation Board was designed to ease customer evaluation of Peregrine's PE42442. The RF common port is connected through a 50 Ω transmission line via the top SMA connector. RF1, RF2, RF3, and RF4 are connected through 50Ω transmission lines via side SMA connectors. A through 50Ω transmission is available via SMA connectors RFCAL1 and RFCAL2. This transmission line can be used to estimate the loss of the PCB over the environmental conditions being evaluated.

The EVK board is constructed with four metal layers on dielectric materials of Rogers 4003C and 4450 with a total thickness of 32 mils. Layer 1 and layer 3 provide ground for the 50Ω transmission lines. The 50 Ω transmission lines are designed in layer 2 for high isolation purpose and use a stripline waveguide design with a trace width of 9.4 mils and trace metal thickness of 1.8 mils. The board stack up for 50 ohm transmission lines has 8 mil thickness of Rogers 4003C between layer 1 and layer 2, and 10 mil thickness of Rogers 4450 between layer 2 and layer 3. Please consult manufacturer's guidelines for proper board material properties in your application. The PCB should be designed in such a way that RF transmission lines and sensitive DC I/O traces such as Vss_{EXT} are heavily isolated from one another, otherwise the true performance of the PE42442 will not be vielded.

Peregrine PRT-29105-01 RF1 RF4 RF3 RFCAL2 RECAL R2 C6 R4 R6 R8 R1 R9 R3 R5 R7

DOC-59282



Figure 17. Evaluation Board Layout





Figure 18. Evaluation Board Schematic





Figure 19. Package Drawing



Figure 20. Marking Specifications

Ref.





Figure 21. Tape and Reel Drawing



Table 6. Ordering Information

Ordering Code	ode Description Package		Shipping Method	
PE42442A-Z	PE42442 SP4T RF switch	Green 24-lead 4x4 mm QFN	3000 units/T&R	
EK42442-01	PE42442 Evaluation kit	Evaluation kit	1/Box	

Sales Contact and Information

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