TELEDYNE e2v
HIREL ELECTRONICS
Everywhereyoulook™

Product Specification

PE95421

Radiation Tolerant UltraCMOS® SPDT RF Switch Hermetically Sealed Ceramic Package and Die, 1–8500 MHz

Features

- HaRP™ technology enhanced
  - Eliminates gate and phase lag
  - No insertion loss or phase drift
- High linearity: 60 dBm IIP3
- Low insertion loss
  - 0.77 dB @ 100 MHz
  - 1.00 dB @ 3000 MHz
  - 1.15 dB @ 6000 MHz
  - 1.38 dB @ 8500 MHz
- High isolation (RF1–RF2)
  - 86.5 dB @ 100 MHz
  - 48.2 dB @ 3000 MHz
  - 36.6 dB @ 6000 MHz
  - 27.8 dB @ 8500 MHz
- Fast switching time
  - 700 ns RF ON
  - 700 ns RF OFF
- Low power consumption: 3.3 µW @ 3.3V
- 1dB compression point of +33 dBm
- Single-pin 3.3V CMOS logic control
- ESD tolerant to 1000V HBM
- Absorptive/non-reflective
- Offered in a 7-lead hermetic CQFP surface-mount package and in DIE form
- TID Radiation Performance = 100 krad(Si)

Product Description

The PE95421 is an RF SPDT switch available in a hermetically sealed ceramic package and also available in die. It covers a broad range of applications from 1-to-8500 MHz and has been designed for use in various high reliability (Hi-Rel) industries and applications requiring broadband performance. The PE95421 uses pSemi's UltraCMOS® process and features HaRP™ technology enhancements to deliver high linearity and exceptional harmonics performance. HaRP technology is an innovative feature of the UltraCMOS process providing upgraded linearity performance.

The PE95421 is an absorptive/non-reflective switch design which is an ideal termination method for RF elements in a system design. A single-pin 3.3V CMOS logic control in a single chip solution reduces the number of control lines.

Typical Industries

- Medical
- Down-hole oil/gas
- Military
- Space applications

Figure 1. Functional Diagram

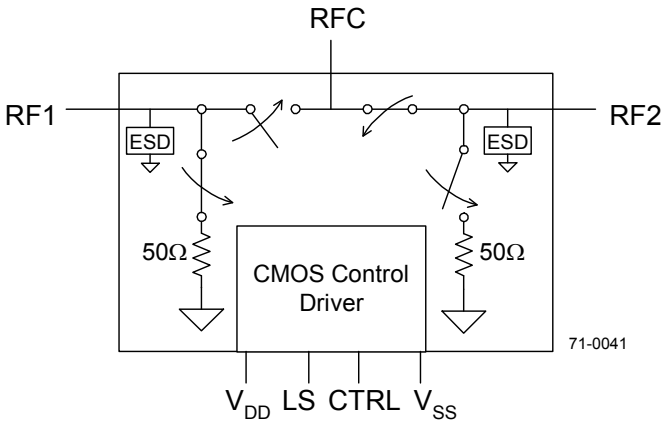


Figure 2. Package Type
7-lead CQFP

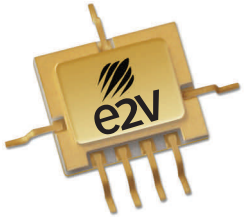


Table 1. Electrical Specifications @ –40 °C ≤ T ≤ +85 °C, 3.0V ≤ V_{DD} ≤ 3.6V and –3.0V ≤ V_{SS} ≤ –3.6V

Parameter	Condition	Min	Typ	Max	Unit
Operational frequency		1		8500	MHz
Insertion loss	100 MHz		0.77	0.95	dB
	3000 MHz		1	1.28	dB
	6000 MHz		1.15	1.42	dB
	8500 MHz		1.38	1.72	dB
Isolation – RFC to RF1	100 MHz	74	75.6		dB
	3000 MHz	46	47.4		dB
	6000 MHz	43.8	48		dB
	8500 MHz[2]	31	38		dB
Isolation – RFC to RF2	100 MHz	73.7	75.4		dB
	3000 MHz	46.8	48.3		dB
	6000 MHz	45	52.1		dB
	8500 MHz[2]	31	38		dB
Isolation – RF1 to RF2	100 MHz		86.5		dB
	3000 MHz		48.2		dB
	6000 MHz		36.6		dB
	8500 MHz		27.8		dB
Return loss active port – ON state	100 MHz		21		dB
	3000 MHz		33		dB
	6000 MHz		20		dB
	8500 MHz		15		dB
Return loss active port – OFF state	100 MHz		20		dB
	3000 MHz		18		dB
	6000 MHz		15		dB
	8500 MHz		8		dB
Input 1dB compression[1]	100–8500 MHz		33		dBm
Input IP3	100–8500 MHz, 18 dBm input power/tone		60		dBm
Switching time	50% CTRL to 90% of final value when RF ON		700		ns
	50% CTRL to 10% of final value when RF OFF		700		ns

Notes: 1. Please note maximum operating P_{IN} (50Ω) of +24 dBm in *Table 4.*
2. Guaranteed but not tested.

Figure 3. Pin Layout (Top View)

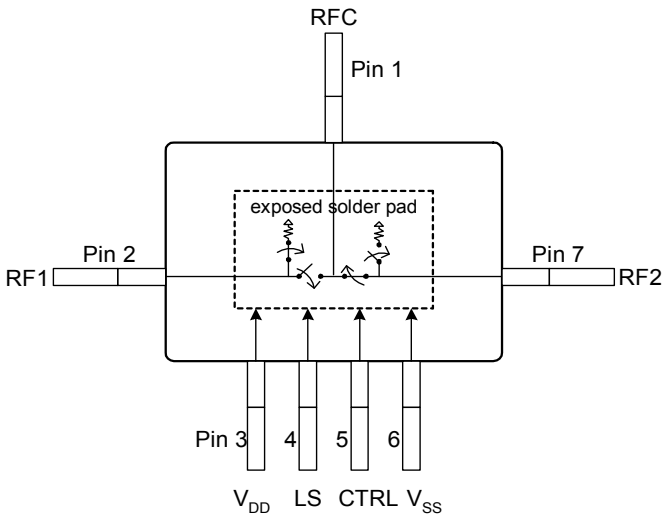


Table 2. Pin Descriptions

Pin #	Pin Name	Description
1	RFC[1]	RF common
2	RF1[1]	RF port
3	V_{DD}	Supply voltage (nominal 3.3V)
4	LS	Selects the RF1 to RFC path or RF2 to RFC (See *Table 5*)
5	CTRL	Unused (See *Table 5*)
6	V_{SS}	Negative power supply. Apply nominal – 3.3V supply
7	RF2[1]	RF port
Pad	GND[2]	Exposed pad: Grounded for proper operation

Notes: 1. All RF pins must be DC blocked with an external series capacitor or held at 0 VDC.
2. Must be soldered to PCB RF ground for proper operation.

Table 3. Operating Ranges

Symbol	Parameter/Condition	Min	Typ	Max	Unit
V_{DD}	Positive supply voltage	3.0	3.3	3.6	V
V_{SS}	Negative supply voltage	–3.6	–3.3	–3.0	V
I_{DD}	Supply current (V_{DD} = 3.3V, LS or CTRL = 3.3V)		1		µA
I_{SS}	Supply current (V_{SS} = –3.3V)		1		µA
	Control voltage high	0.7xV_{DD}			V
	Control voltage low			0.3xV_{DD}	V
T_{OP}	Operating temperature range	–40		+85	°C
P_{IN}	RF power in (50Ω): 1 MHz ≤ 8.5 GHz			24	dBm

Table 4. Absolute Maximum Ratings

Symbol	Parameter/Condition	Min	Max	Unit
V_{DD}	Positive supply voltage	–0.3	4.0	V
V_{SS}	Negative supply voltage	–4.0	0.3	V
V_{C1}	Voltage on LS input	–0.3	V_{DD}+0.3	V
V_{C2}	Voltage on CTRL input	–0.3	V_{DD}+0.3	V
P_{IN}	RF input power (50Ω) 1 MHz ≤ 8.5 GHz		27	dBm
Θ_{JC}	Theta JC		24	°C/W
T_j	Junction temperature maximum		+125	°C
T_{ST}	Storage temperature range	–65	+150	°C
V_{ESD}	ESD voltage HBM*, all pins		1000	V

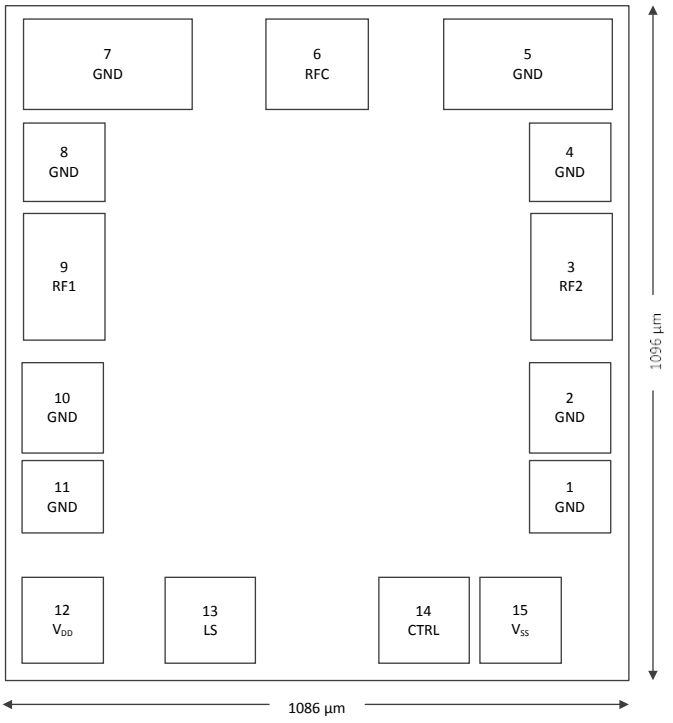
Note: * Human Body Model (MIL-STD-883 Method 3015)

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 5. Die Mechanical Specifications

Parameter	Minimum	Typical	Maximum	Unit
Die size, singulated (x,y)		1190 × 1200		µm
Wafer thickness	180	200	220	µm
Wafer size		150		mm

Figure 4. Pad Layout (Active Side Up)*



Note: * Figure not drawn to scale.

Table 6. Pad Coordinates and Descriptions

Pin #	Pin Name	Description	Pin Center (µm)*	
			X	Y
1	GND	Ground	988.3	297.3
2	GND	Ground	988.3	442.3
3	RF2	RF port	988.3	653.7
4	GND	Ground	988.3	841.6
5	GND	Ground	913.3	997.3
6	RFC	RF common	542.6	997.3
7	GND	Ground	171.9	997.3
8	GND	Ground	96.9	841.6
9	RF1	RF port	96.9	653.7
10	GND	Ground	96.9	442.3
11	GND	Ground	96.9	297.3
12	V_{DD}	Supply voltage (nominal 3.3V)	96.9	96.9
13	LS	Selects the RF1 to RFC path or RF2 to RFC	355.1	96.9
14	CTRL	Unused	729.9	96.9
15	V_{SS}	Negative power supply (nominal 3.3V)	899.9	96.9

Note: * All pin locations originate from the die center and refer to the center of the pin.

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.

Latch-Up Immunity

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

Table 5. Truth Table

LS	CTRL	RFC–RF1	RFC–RF2	Logic State
0	X	off	on	RF2 active
1	X	on	off	RF1 active

Table 7 Post Radiation Table

Total Dose	Parameter	Min	Max	Unit
Post 100 kRad	I_{DD} Positive supply current		100	µA
	I_{SS} Negative supply current	–100		µA

Table 8. Single Event Effects

SEE Mode	Effective linear energy transfer (LET)
SEL/SEB/SEGR	90 MeV•mg/cm^2
SEFI	90 MeV•mg/cm^2
SEU	90 MeV•mg/cm^2
SET	90 MeV•mg/cm^2

SEL, SEB, SEGR, SEFI, SEU: None observed, Au/60 degrees.
SET: No events exceeding ±10 mV transient observed.

ELDRS

UltraCMOS devices do not include bipolar minority carrier elements and; therefore, do not exhibit enhanced low-dose-rate sensitivity.

Typical Performance Data

Figure 5 Insertion Loss: RF1 @ V_{DD} = –V_{SS} = 3.3V

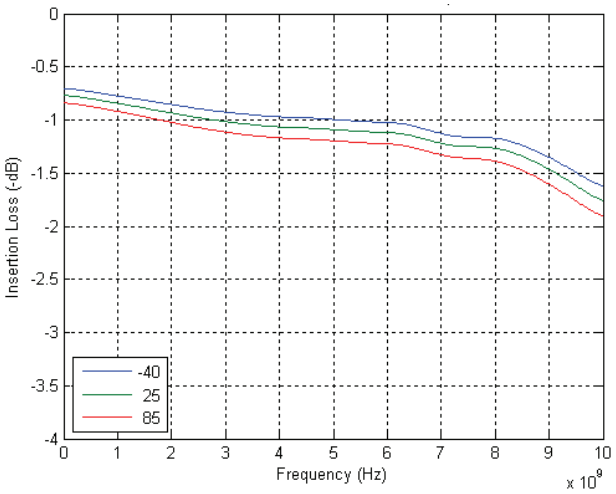


Figure 6. Insertion Loss: RF1 @ 25 °C

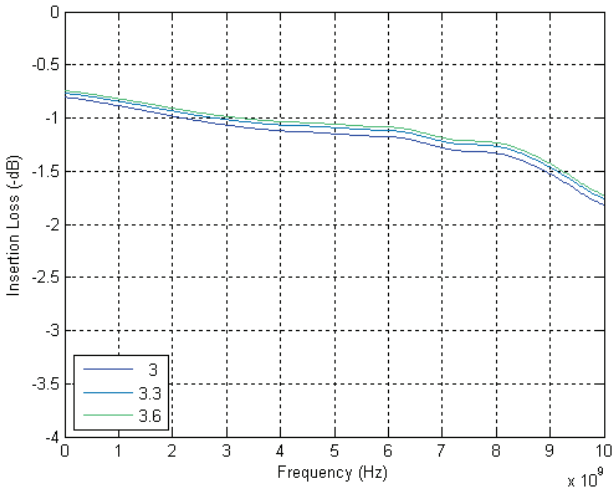


Figure 7. Insertion Loss: RF2 @ V_{DD} = –V_{SS} = 3.3V

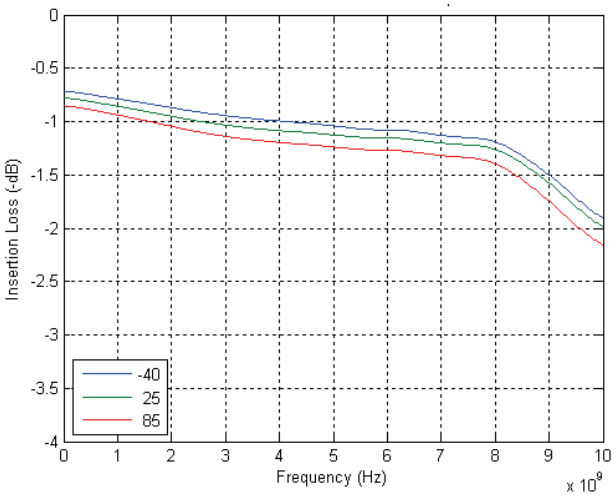
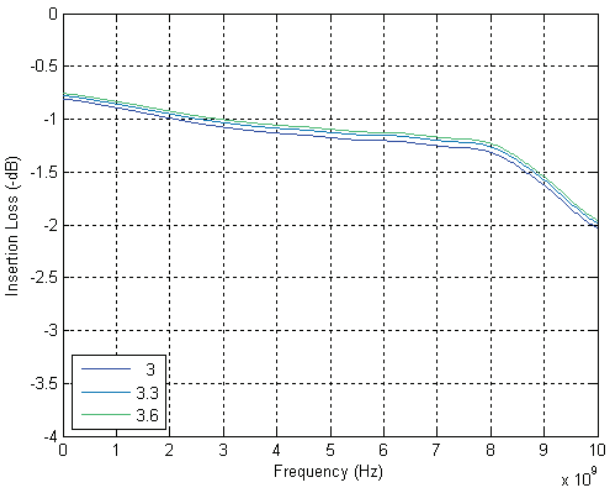


Figure 8. Insertion Loss: RF2 @ 25 °C



Typical Performance Data (continued)

Figure 9. Isolation: RF1–RF2, RF1 Active @ V_{DD} = –V_{SS} = 3.3V

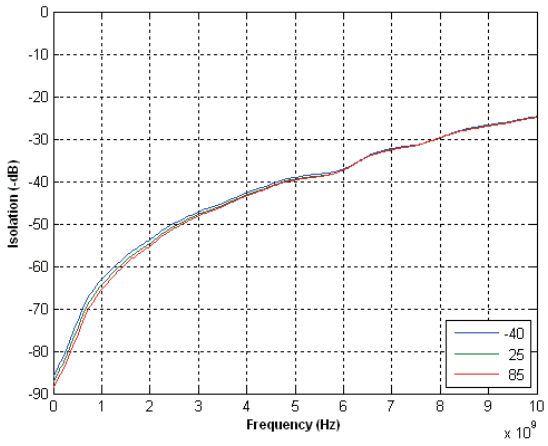


Figure 10. Isolation: RF2–RF1, RF2 Active @ V_{DD} = –V_{SS} = 3.3V

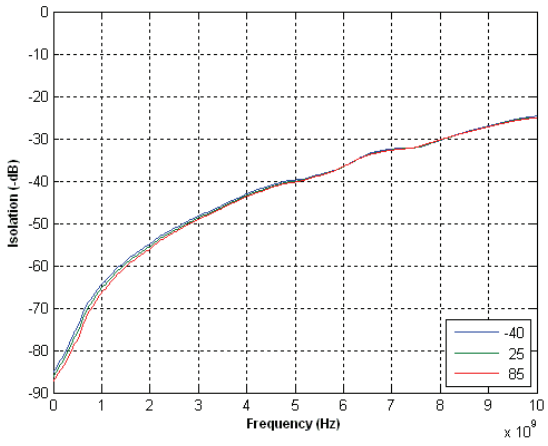


Figure 11. Isolation: RF1–RF2, RF1 Active @ 25 °C

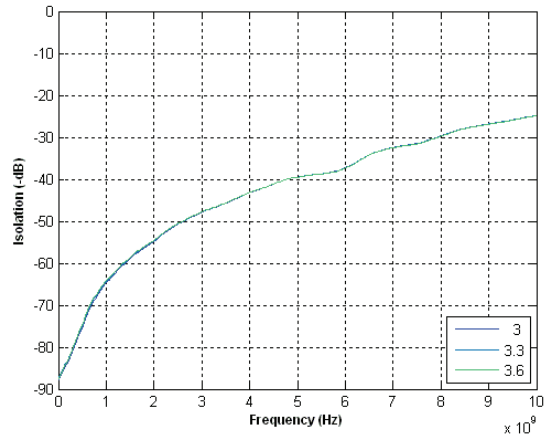


Figure 12. Isolation: RF2–RF1, RF2 Active @ 25 °C

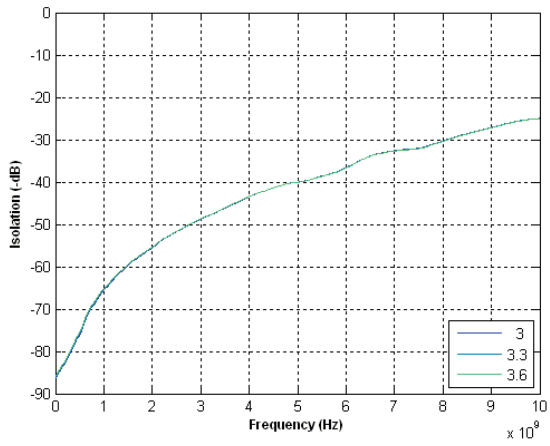


Figure 13. Isolation: RFC–RF1, RF2 Active @ V_{DD} = –V_{SS} = 3.3V

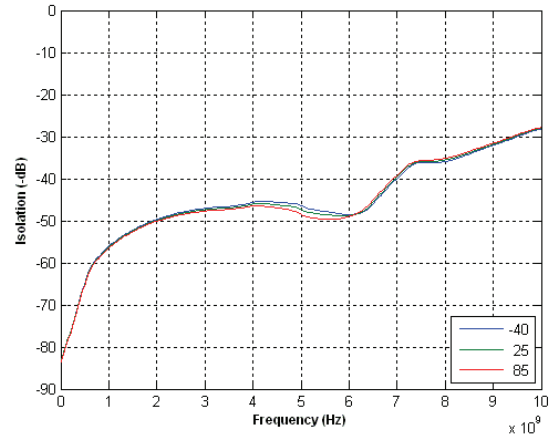
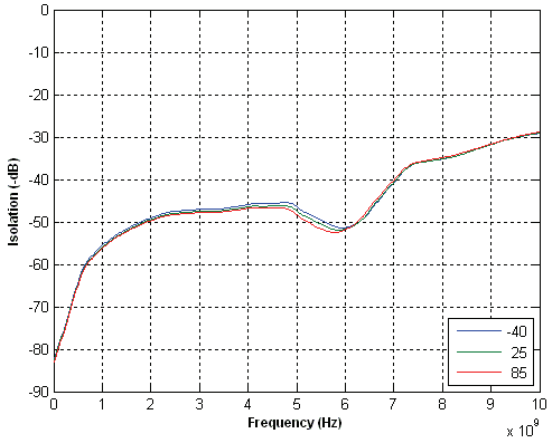


Figure 14. Isolation: RFC–RF2, RF1 Active @ V_{DD} = –V_{SS} = 3.3V



Typical Performance Data (continued)

Figure 15. Isolation: RFC–RF1, RF2 Active @ 25 °C

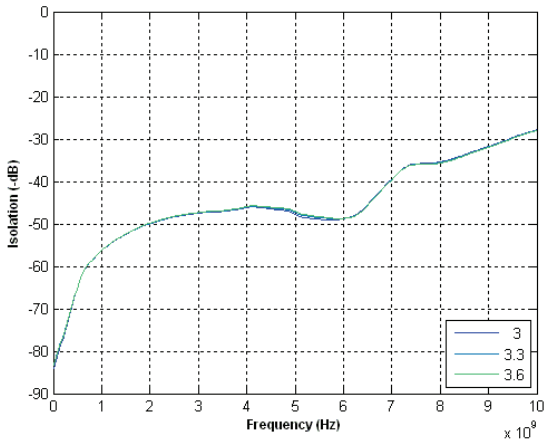


Figure 16. Isolation: RFC–RF2, RF1 Active @ 25 °C

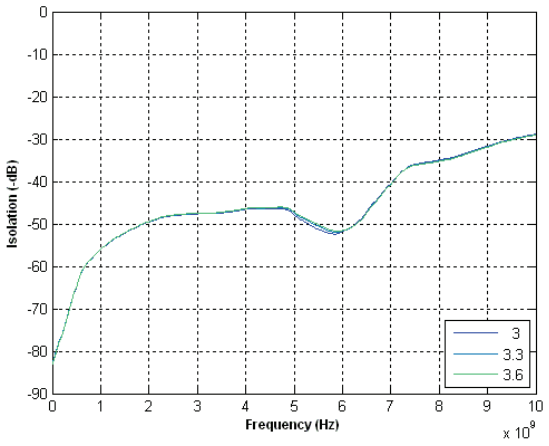


Figure 17. Isolation: RFC–RF1, OFF state @ V_{DD} = –V_{SS} = 3.3V

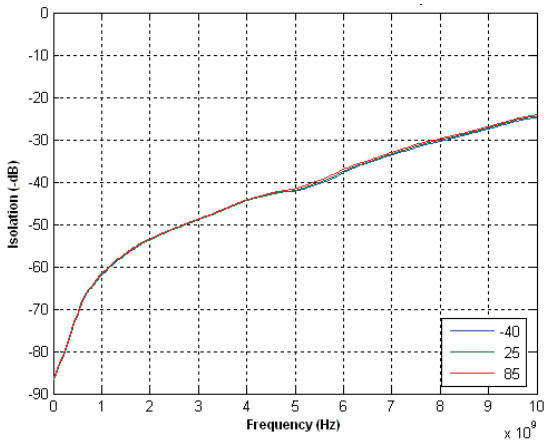


Figure 18. Isolation: RFC–RF2, OFF state @ V_{DD} = –V_{SS} = 3.3V

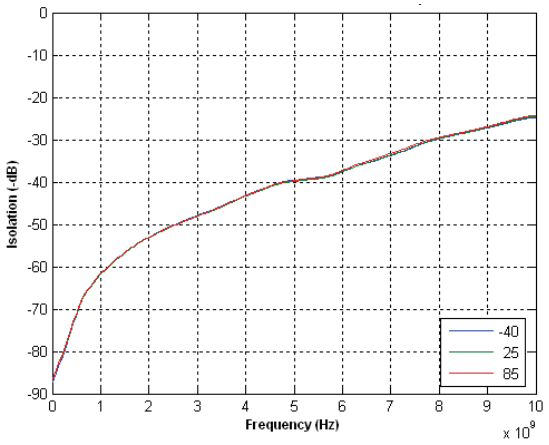


Figure 19. Isolation: RFC–RF1, OFF state @ 25 °C

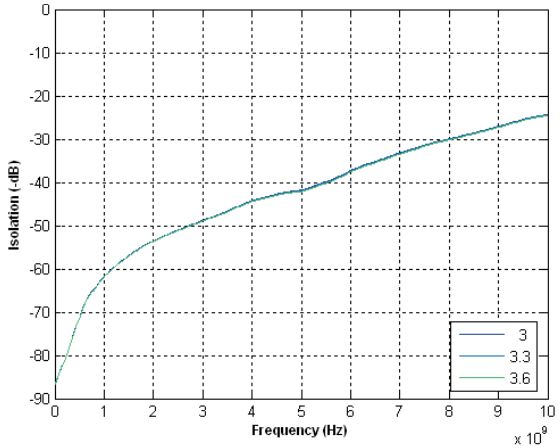
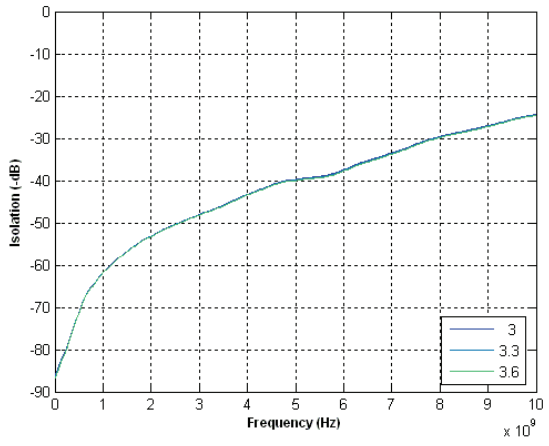


Figure 20. Isolation: RFC–RF2, OFF state @ 25 °C



Typical Performance Data (continued)

Figure 21. Return Loss: RF1 @ V_{DD} = –V_{SS} = 3.3V

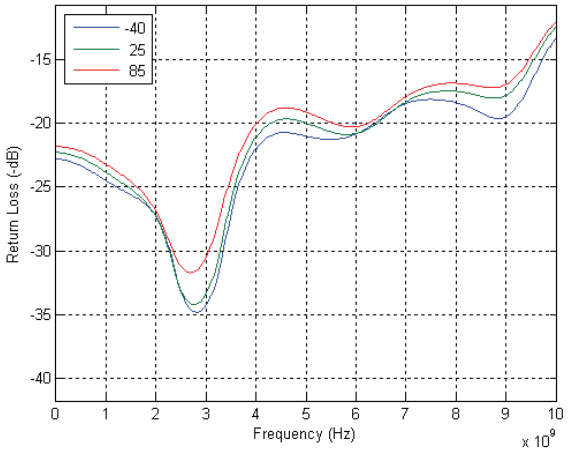


Figure 22. Return Loss: RF2 @ V_{DD} = –V_{SS} = 3.3V

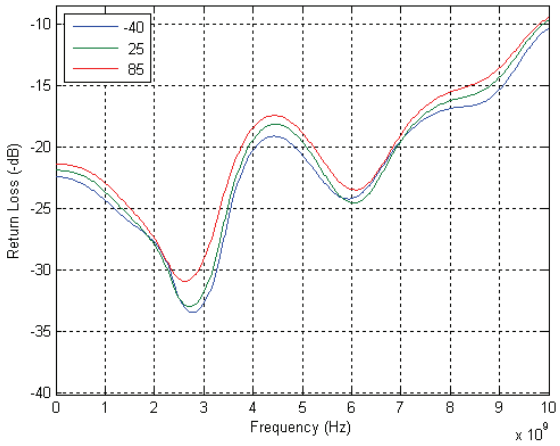


Figure 23. Return Loss: RF1 @ 25 °C

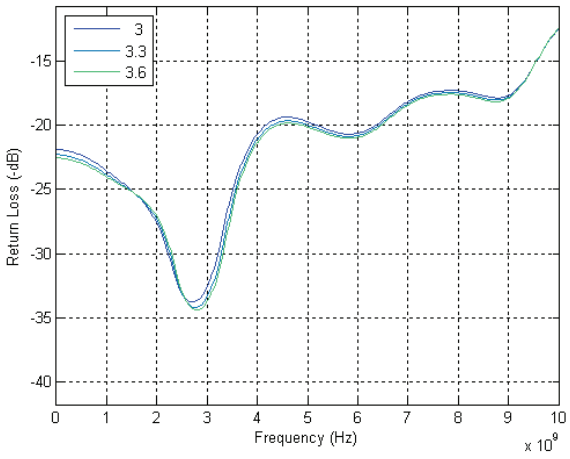


Figure 24. Return Loss: RF2 @ 25 °C

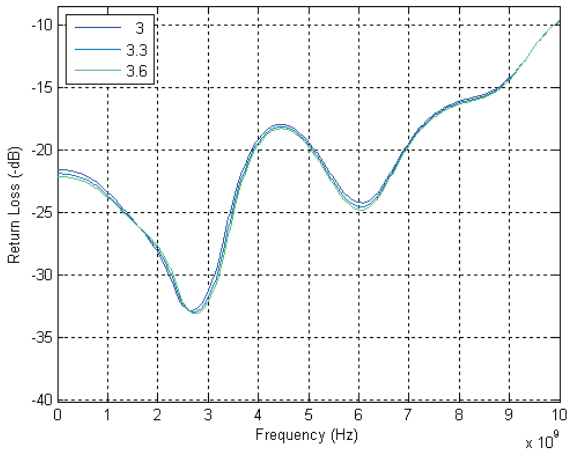
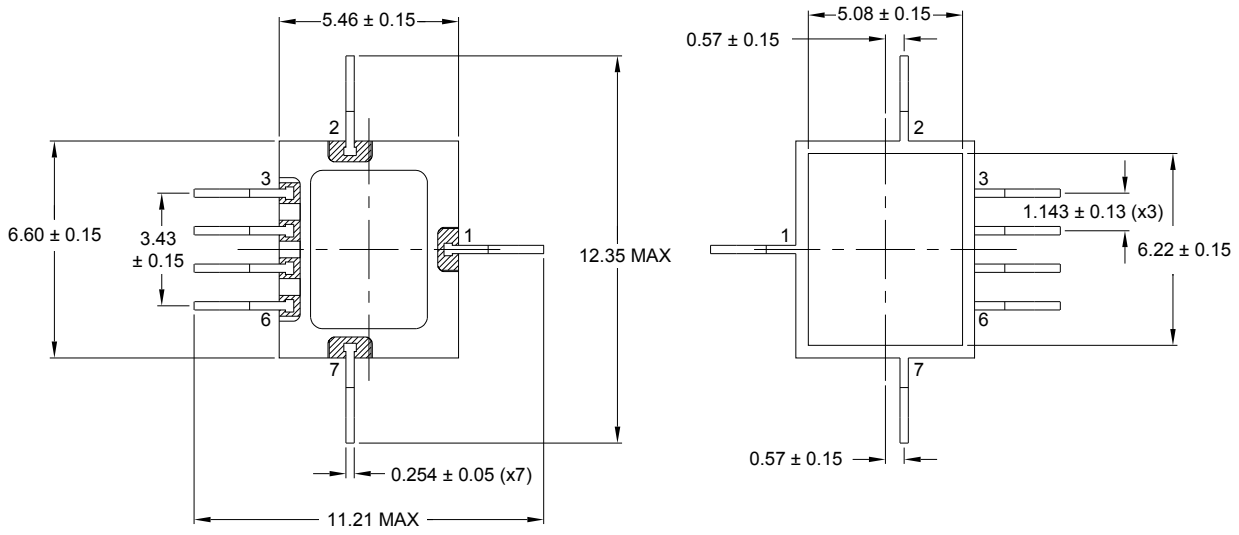
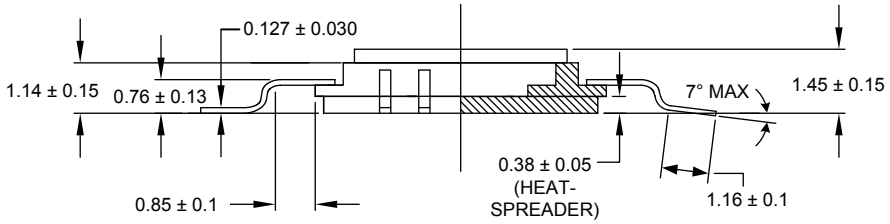


Figure 25. Package Drawing (dimensions in millimeters)
7-lead CQFP



TOP VIEW **BOTTOM VIEW**



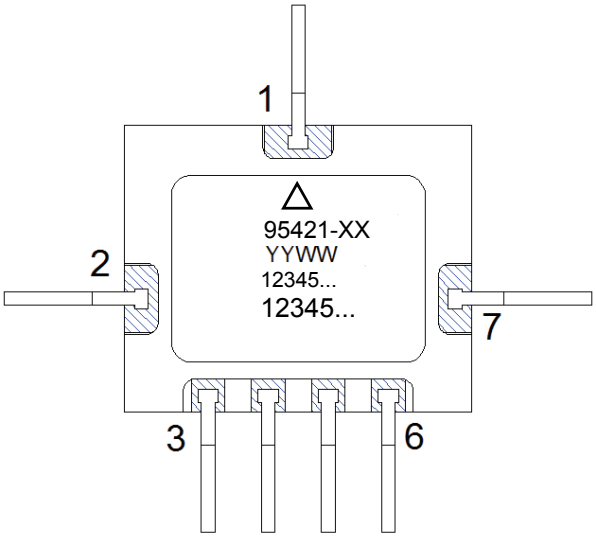
SIDE VIEW

LEADTIPS PLANAR WITH SEATING
PLANE OF HEATSPREADER
WITHIN 0.10 MM

DIMS IN MM
NOT TO SCALE

Rev. 02 081717
IIGNALB

Figure 26. Top Marking Specification



Not to scale

Line 1: Pin 1 indicator△ No e2v or pSeim logos present Line 2: Part number (XX will be specified by the purchase order) Line 3: Date code (last two digits of the year and work week) Line 4: DOP # (e2v internal / 5 digits / optional, as room allows) Line 5: Serial # (5 digits minimum)

Note: There is **NO** backside symbolization on any of the Teledyne e2v / pSemi products.

PRT-24929

Table 9. Ordering Information

Order Code	Description	Package	Shipping Method
95421-01*	Engineering packaged samples	7-lead CQFP	18 Units / tray
95421-98	Engineering bare-die samples	Die	Waffle pack
95421-99	Flight die	Die	400 Units / waffle pack
95421-11	Production Units	7-lead CQFP	18 units / tray
95421-00	Evaluation kit	Evaluation board	1 / box

Note: * The PE95421-01 devices are ES (engineering sample) prototype units intended for use as initial evaluation units for customers of the PE95421-11 flight units. The PE95421-01 device provides the same functionality and footprint as the PE95421-11 space qualified device, and intended for engineering evaluation only. They are tested at +25 °C only and processed to a non-compliant flow (e.g. No burn-in, non-hermetic, etc). These units are non-hermetic and are not suitable for qualification, production, radiation testing or flight use. Bare die is dc probed only, and ac parameters are not tested.

Sales Contact and Information

Contact Information:
Teledyne e2v ~ http://www.tdehirel.com ~ email: hirel@teledyne.com

Advance Information: The product is in a formative or design stage. The datasheet contains design target specifications for product development. Specifications and features may change in any manner without notice.
Preliminary Specification: The datasheet contains preliminary data. Additional data may be added at a later date.t to change specifications at any time without notice in order to supply the best possible product.
Product Specification: The datasheet contains final data. In the event Teledyne e2v decides to change the specifications, e2v will notify customers of the intended changes by issuing a CNF (Customer Notification Form).