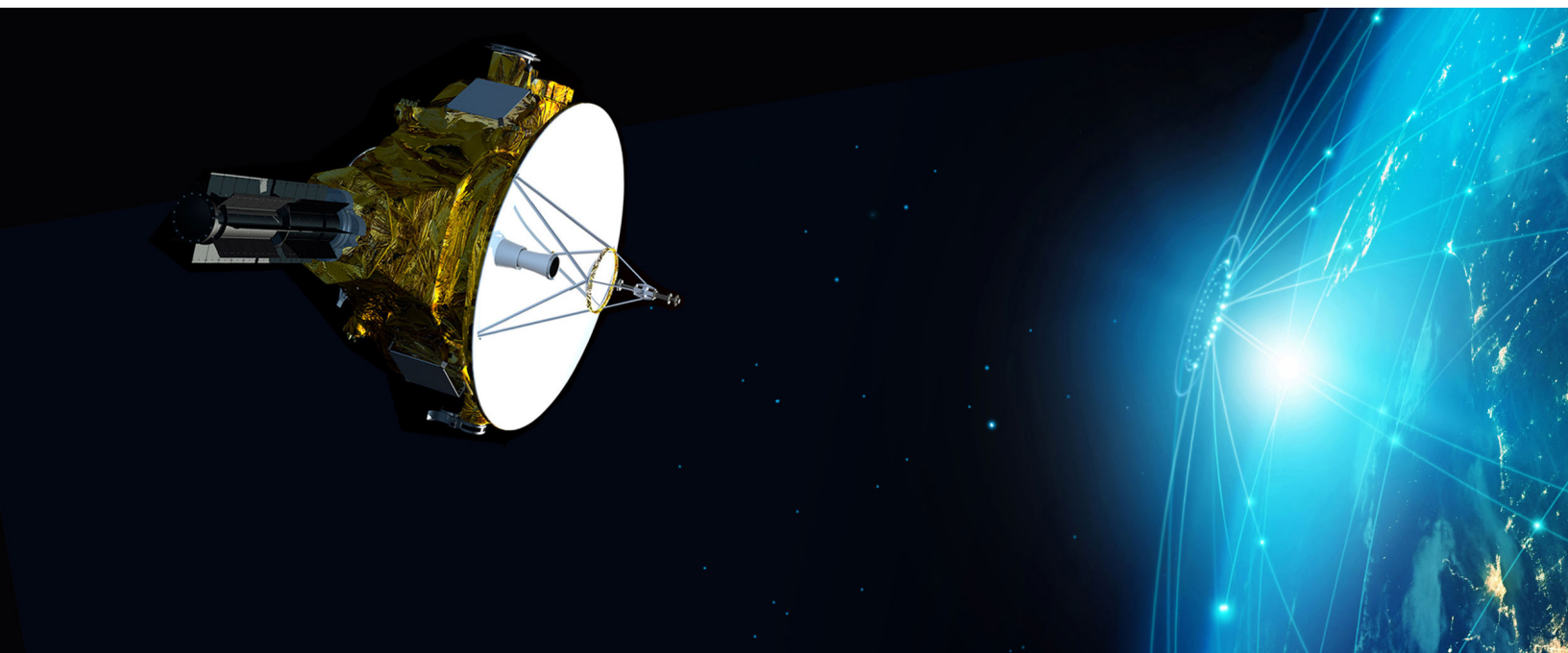


High Reliability

RF Product Catalog



TELEDYNE e2V
HIREL ELECTRONICS

Leader in Aerospace & Defense

Teledyne e2v HiRel Electronics has a rich heritage offering space grade solutions which spans over 30 years manufacturing high-reliability semiconductor solutions for global aerospace & defense companies and space agencies.

We focus on radiation performance coupled with best-in-class performance of our space grade products with qualifications to complete QML solutions to help customers solve the most critical space environment design challenges. With over 3,600 QML-approved products, we offer one of the industry's largest Hi-Rel product portfolios in the market.

Teledyne e2v HiRel's standard screened line of RF and microwave components provides a cost and time effective approach to meet the requirements commonly found in space applications. Our space products are offered in radiation tolerant ceramic

and plastic packages and are supported with Total Ionizing Dose (TID) test reports to address the space reliability product requirements.

When system performance or program screening requirements call for more than our standard catalog space screened parts, we can tailor a solution by taking a standard catalog device, assembling it with proven assembly processes and create a tailored custom screening program by either adding screening options or generate a program specific sequence.

Process Technologies

- Silicon on Sapphire
- GaN
- InP
- InGaP
- GaAs MESFET
- GaAs pHEMT
- HMIC Technology
- Silicon Diodes

Max GHz	2	4	8	12	18	26	40	50	60
Frequency Bands	L	S	C	X	Ku	K	Ka	Q	V
Product Families									
RF Gain Blocks	●	●	●	●	●	●	●		
LNAs	●	●	●	●	●	●	●		
Power Amplifiers		●	●	●	●		●		
Limiters	●	●	●	●					
Digital Step Atten.		●	●	●					
RF Switches	●	●	●	●	●	●	●	●	●
VCOs				●	●	●	●		
PLL/Synthesizers		●	●	●					
Prescalers	●	●	●	●	●	●	●	●	
Mixers/ Upconv.				●	●	●	●	●	
Multiplier/ 2x				●	●	●	●	●	

Production
 Targeted Development

RF Products

Teledyne e2v HiRel S-level standard and semi-custom RFICs are based on high-volume commercial products and are designed to meet the rad-hard, low-power needs of space applications. UltraCMOS® technology delivers a cost-effective solution compared to the higher-voltage GaAs, SiGe or bulk silicon devices.

RF Switches

Teledyne e2v HiRel RF switches feature high linearity, isolation and exceptionally rugged performance for space applications.

Hi-Rel RF Switches

Product Desc.*	Part Number	Application	Operating Frequency (MHz)		Linearity IIP3 (dBm)	P0.1dB (dBm)	Insertion Loss (dB)	Isolation (dB) (min)	Typical I _{DD} (μA)	V _{DD} (V)	V _{SS} (V)	ESD HBM (V)	Package
			Min	Max									
SPDT, A	TDSW02040	Military	100	2000		56	.08	47	N/A	N/A	N/A	500	8x5mm Hybrid
SPDT, R	PE9354	Space	10	3000	55	31	0.55	28	28	2.7 to 3.3	---	200	8L CFP, Die
SPDT, A	PE95240	Space	1	8500	60	24	0.77	38	100	3.0 - 3.6	-3.6 to -3.0	2000	7L CQFP
SPDT, A	PE95241	Space	1	8500	60	24	0.77	38	100	3.0 - 3.6	-3.6 to -3.0	1000	7L CQFP
SPDT, R	TDSW0602T	Space	.09	60,000	48	31	1.1	29	0.39	2.7 to 3.3	-2.7 to -3.3	1000	Flip Chip Die
SPDT, A	TDSW020A2T	Space	DC	20,000	N/A	28	3	40	2000	4.5 to 5.5	-4.5 to -5.5	250	7L CQFN Die

Digital Step Attenuator

The PE94302 digital step attenuator (DSA) provides highly competitive IP3, accuracy, temperature stability and ESD protection, with lower distortion and power consumption. The combination of these features enables excellent performance and cost-effectiveness.

Hi-Rel Digital Step Attenuators (Monolithic) – 50Ω

Part Number, Product Description	Attenuation (dB) (range / steps)	Programming Mode	Operating Frequency (MHz)		Insertion Loss (dB)	Input IP3 (dBm)	Attenuation Accuracy (dB @ 1 GHz)	Switching Speed (μs)	ESD HBM (V)	Package
			Min	Max						
PE94302 – 6-bit	31.5 / 0.5	Parallel, Serial	0.25	4000	1.5	52	±(0.55 + 7% of setting)	1	500	28L CQFP, Die

RF Prescalers

The high-performance UltraCMOS RF prescaler family offers a fixed divide ratio of 2, 4 or 8. These prescalers operate across a frequency range from dc to 13.5 GHz on a nominal 3-volt supply while drawing between 6.5 and 16 mA. These devices have excellent sensitivity and are well suited for microwave phase-locked loop (PLL) synthesis solutions.

Hi-Rel Prescalers

Part Number, Product Description	Operating Frequency (MHz)		Divide Ratio	Typical I _{DD} (μA)	V _{DD} Range (V)	ESD HBM (V)	Package
	Min	Max					
PE9304 – Divide-by-2	1000	7000	2	14	2.85–3.15	500	8L CFP, Die
PE9311 – Divide-by-2	DC	1500	2	6.5	2.85–3.15	1000	8L CFP, Die
PE9312 – Divide-by-4	DC	1500	4	6.5	2.85–3.15	1000	8L CFP, Die
PE9313 – Divide-by-8	DC	1500	8	6.5	2.85–3.15	1000	8L CFP, Die

RF Limiters

The TDLM06100 is a technology-enhanced power limiter designed for use in high-performance, power-limiting applications in radar applications, military electronic counter-measure transceivers and satellite receivers. Unlike traditional PIN diode solutions, the TDLM06100 achieves an adjustable input 1dB compression point or limiting threshold via a low current control voltage (VCTRL) eliminating the need for external bias components such as dc blocking capacitors, RF choke inductors and bias resistors. It delivers low insertion loss and high linearity under non-limiting power levels and extremely fast response time in a limiting event, ensuring protection of sensitive circuitry.

Hi-Rel RF Limiters									
Part Number	Application	Power Handling (Pulsed, W)	Recovery Time (nS)	Operating Frequency		Insertion Loss (dB)	Input IP3 (dBm)	ESD HBM (V)	Package
				Min (MHz)	Max (GHz)				
TDLM202402	Military	1000	1000	2000	4	0.5	N/A	500	8x5mm Hybrid
TDLM05402	Military	2000	1500	500	4	0.7	N/A	500	8x5mm Hybrid
TDLM961122	Military	1000	200	960	1.215	0.4	N/A	500	8x5mm Hybrid
TDLM06100	Space	100	< 1	10	6	0.95	70	7000	24L CQFP
TDLM025100	Space	100	< 1	10	2.5	0.95	70	7000	24L CQFP

RF Gain Blocks

The Teledyne e2v HiRel TDGB010 cascadable broadband InGaP HBT MMIC amplifier family is a high-performance solution for general-purpose, high-reliability RF and microwave amplification needs. This 50-ohm gain block is based upon a mature and reliable Heterojunction Bipolar Transistor (HBT), Indium Gallium Phosphide (InGaP) process and utilizes proprietary MMIC design techniques.

Hi-Rel RF Gain Blocks									
Part Number	Min Freq (GHz)	Max Freq (GHz)	P1dB (dBm)	Gain (dB)	OIP3 (dBm)	NF (dB)	Vd (V)	Icc (mA)	Package
TDGB010AL2	0.1	10	14.3	13.6	28	5.5	3.9	50	2L CGW
TDGB010BL2	0.1	10	15.2	16.5	28	5.5	3.9	50	2L CGW
TDGB010CL2	0.1	10	16.3	18.4	28	5.5	4.3	50	2L CGW

Low Noise Amplifiers

The Teledyne e2v HiRel TDLNA001013 is a three-stage, ultra-low-noise amplifier that operates from 8.0-12.0 GHz. The LNA features 26 dB gain and has a typical mid-band noise figure of 1.35 dB. The LNA has nominal input/output return losses of 10 dB. The nominal P1dB is 12 dBm. Self-bias technique has been employed to facilitate single-supply operation. Circuit ground is provided through vias to backside metallization.

Hi-Rel RF Low Noise Amplifiers									
Part Number	Min Freq (GHz)	Max Freq (GHz)	P1dB (dBm)	Gain (dB)	OIP3 (dBm)	Vd (V)	Icc (mA)	Package	
TDLNA002093	1	6	19.0	21.0	30.0	3.0	50	6L DFN	
TDLNA001013	8.0	12.0	12.0	26.0	23.0	3.90	50	Wire Bond Die	
TDLNA0430	0.4	3.0	18.5	21.5	37.5	5.0	60	8L DFN	
TDLNA2626	17.0	22.0	20.0	25.0	28.0	4.50	45	16L QFN	
TDLNA2628	22.0	31.5	19.0	23.0	27.0	3.50	90	16L QFN	

Phase-locked Loop Frequency Synthesizers

Teledyne e2v HiRel's integer-N and fractional-N PLL frequency synthesizers deliver superior phase noise performance where low phase noise is critical. The new PE97240 integer-N and PE97640 fractional-N PLLs feature improved normalized phase noise of -230 and -225 dBc/Hz, respectively and offer an additional 5/6 prescaler divide ratio.

Hi-Rel Integer-N PLL Frequency Synthesizers*

Part Number	Φ Det Type	Programming Mode	Normalized Phase Noise (dBc/Hz)	Max Input Operating Freq			Prescaler	Reference Counters	Typical I _{DD} (mA)	V _{DD} Range (V)	ESD HBM (V)	Package
				(GHz) RF PLL	(MHz) Ref	(MHz) Compare						
PE9701	CP	Par, Ser, Hardwire	-210	3	100	20	10 / 11	6-bit	24	2.85-3.15	1000	44L CQFJ, Die
PE97240	PD	Serial, Hardwire	-230	5	100	100	5/6 and 10/11	6-bit	75	2.6-2.8	1000	44L CQFP

Note: * Main Counters M, A = 9-bit, 4-bit.

Hi-Rel Delta-Sigma Modulated Fractional-N PLL Frequency Synthesizers*

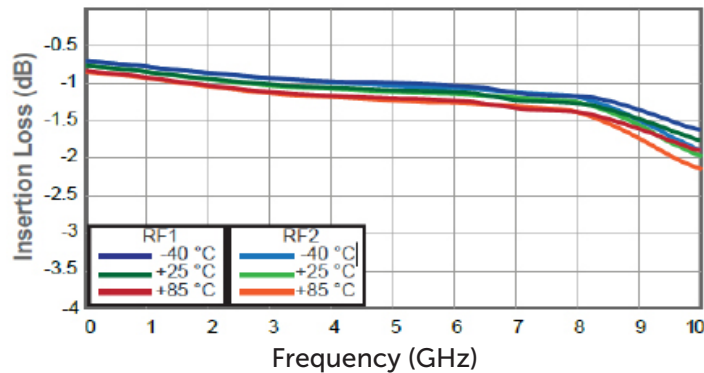
Part Number	Description	Programming Mode	Normalized Phase Noise (dBc/Hz)	Max Input Operating Freq			Prescaler	Reference Counters	Typical I _{DD} (mA)	V _{DD} Range (V)	ESD HBM (V)	Package
				(GHz) RF PLL	(MHz) Ref	(MHz) Compare						
PE97640	Ultra-Low Phase Noise 3rd Order DSM	Ser, Hardwire	-225	5	100	50	5/6 and 10/11	6-bit	80	2.6-2.8	1000	64L CQFP

Note: * Main Counters M, A, K = 9-bit, 4-bit, 18-bit.

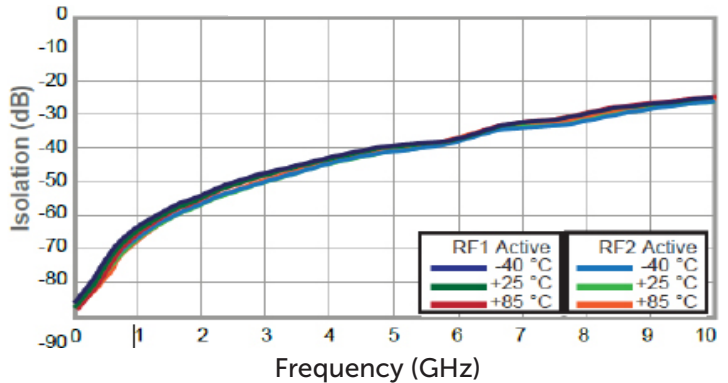
UltraCMOS Technology Delivers High Linearity and Low Phase Noise

HaRPTM technology enhancements allow for excellent linearity and minimize gate lag, insertion loss and phase drift.

PE95421 Insertion Loss RF1 and RF2 @ 3.3V

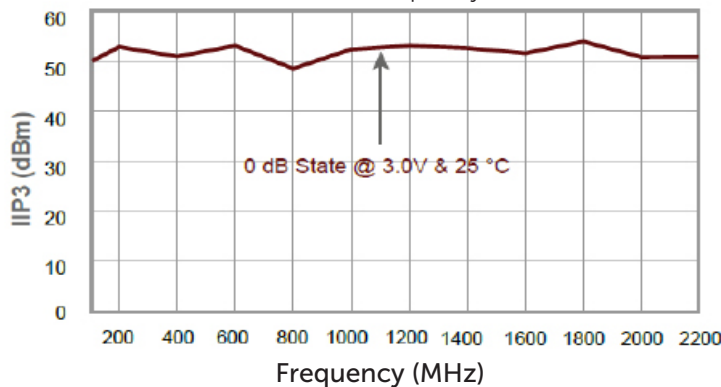


PE95421 Isolation RF1-RF2 @ 3.3V



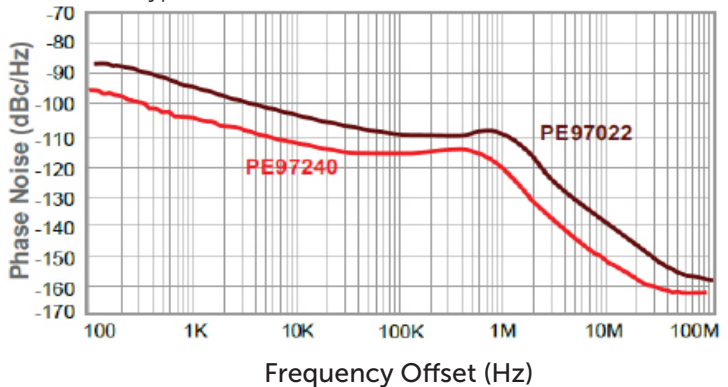
The PE94302 DSA features unprecedented levels of broadband linearity down to 100 kHz

PE94302 IIP3 vs Frequency @ +25 °C



PE97022 & PE97240 phase noise: V_{DD} = 2.8 V, temp = +25 °C, F_{vc0} = 4 GHz, F_{comp} = 50 MHz, loop bandwidth = 500 kHz

Typical Phase Noise for PE97022 and PE97240



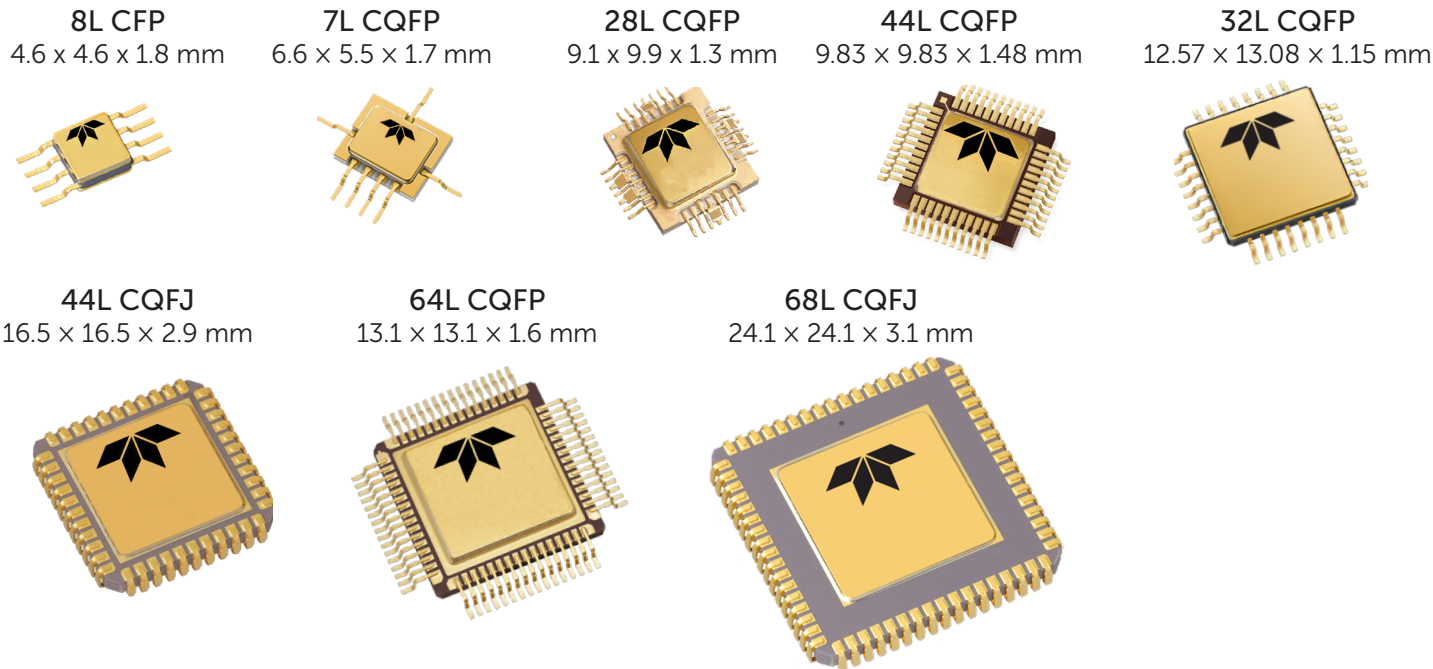
Quality and Reliability

Teledyne e2v HiRel is committed to providing high quality products that exceed customers' expectations. Teledyne e2v HiRel maintains AS9100C certification to address the strict quality systems requirements of the aerospace industry.

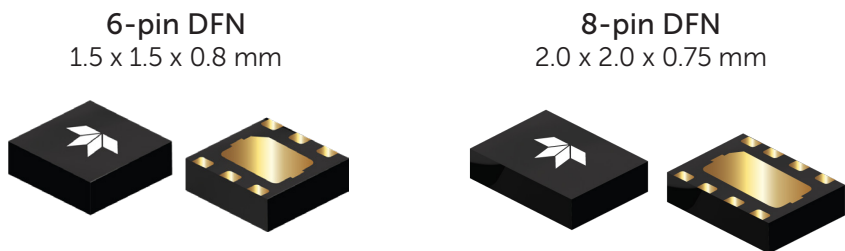
Teledyne e2v HiRel products use the test methods and procedures defined under MIL-STD-883 and MIL-PRF-38535 to fabricate, assemble, test, screen and qualify space-level applications.

Ceramic Packaging. Hermetically Sealed, Rigorously Tested.

High-reliability bare die available on select products.



Plastic Packaging. Rigorously Tested.



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