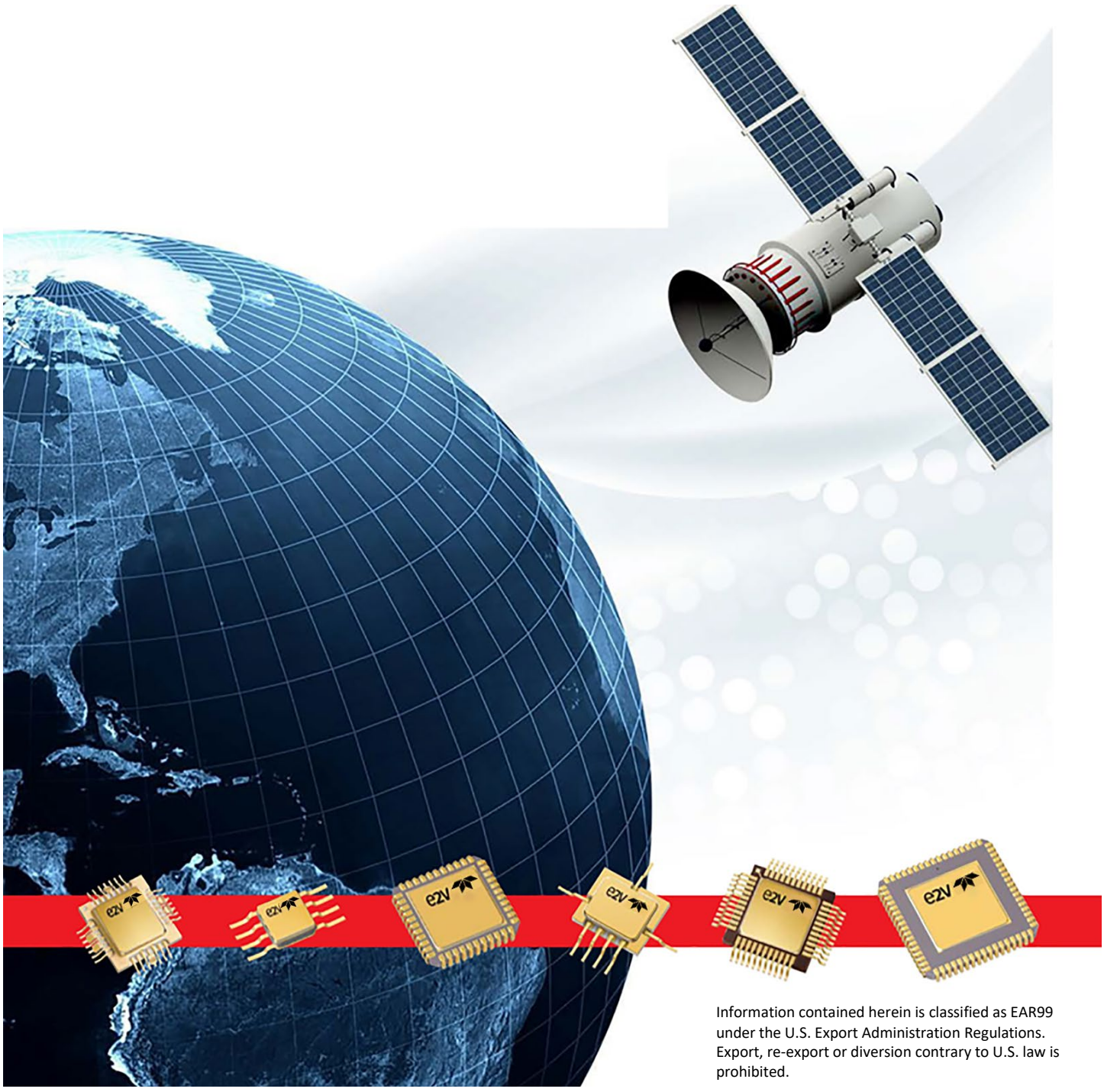
High Reliability

Space RF Product Catalog

TELEDYNE e2v
HIREL ELECTRONICS
Everywhereyoulook™



Teledyne e2v HiRel Electronics

Leader in Aerospace & Defense

Bringing life to technology, Teledyne e2v HiRel is a leading provider of specialist technology for high-performance systems and equipment.

For over 30 years, Teledyne e2v HiRel has manufactured high-reliability semiconductor solutions for leading global aerospace & defense companies. Through partnerships with semiconductor manufacturers, Teledyne e2v HiRel supports complete QML solutions to help customers solve design challenges. With over 3,600 QML-approved products, Teledyne e2v offers one of the largest Hi-Rel product portfolios on 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. When system performance or program screening requirements call for more than Teledyne e2v HiRel's standard catalog space screened parts, Teledyne e2v can tailor a solution by taking a standard catalog device, assembling with proven assembly processes and tailoring a custom screening program that can be created by either adding screening options or by generating a program specific sequence.

Process Technologies

- Silicon on Sapphire
- AlGaAs Diodes
- GaAs MESFET
- GaAs pHEMT
- HMIC Technology
- Silicon Diodes

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 Hi-Rel RF switches feature high linearity, isolation and exceptionally rugged performance for space applications.

Hi-Rel RF Switches

Product Description*	Part Number	Operating Frequency (MHz)		Linearity IIP3 (dBm)	P0.1dB (dBm)	Insertion Loss (dB)	Isolation (dB)		Typical I_{DD} (µA)	V_{DD} (V)	V_{SS} (V)	ESD HBM (V)	Package
		Min	Max				Min	Max					
SPDT, R	PE9354	10	3000	55	31	0.55	28	32	28	2.7–3.3	—	200	8L CFP, Die
SPDT, A	PE95420	1	8500	60	33	0.77	38	75.6	100	3.0–3.6	–3.6 to –3.0	2000	7L CQFP
SPDT, A	PE95421	1	8500	60	33	0.77	38	75.6	100	3.0–3.6	–3.6 to –3.0	1000	7L CQFP
SPDT, R	TDSW0602T	.09	6000	48	31	1.1	29	36	0.39	2.7 – 3.3	-2.7 to -3.3	1000	Flip Chip Die

Note: * Absorptive (A) or Reflective (R).

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
PE9309 – Divide-by-4	3000	13500	4	16 @ 2.6V	2.45–2.75	250	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 TDLM025100 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 TDLM025100 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	Power Handling (Pulsed, W)	Recovery Time (nS)	Operating Frequency (MHz)		Insertion Loss (dB)	Input IP3 (dBm)	ESD HBM (V)	Package
			Min	Max				
TDLM06100	100	< 1	10	6000	0.95	70	7000	24L CQFP
TDLM025100	100	< 1	10	2500	0.95	70	7000	24L CQFP

RF Gain Blocks

The Teledyne TDGB01□ 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	28.0	5.5	3.90	50	2L CGW
TDGB010BL2	0.1	10	15.2	16.5	28.0	5.5	3.90	50	2L CGW
TDGB010CL2	0.1	10	16.3	18.4	28.0	5.5	4.30	50	2L CGW

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 (GHz) RF PLL	Max Input Operating Freq (MHz) Ref	Max Input Operating Freq (MHz) Compare	Prescaler	Reference Counters	Typical I_{DD} (mA)	V_{DD} Range (V)	ESD HBM (V)	Package
PE9601	CP	Par, Ser, Hardwire	–210	2.2	100	20	10/11	6-bit	24	2.85–3.15	1000	44L CQFJ, Die
PE9701	CP	Par, Ser, Hardwire	–210	3.0	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.

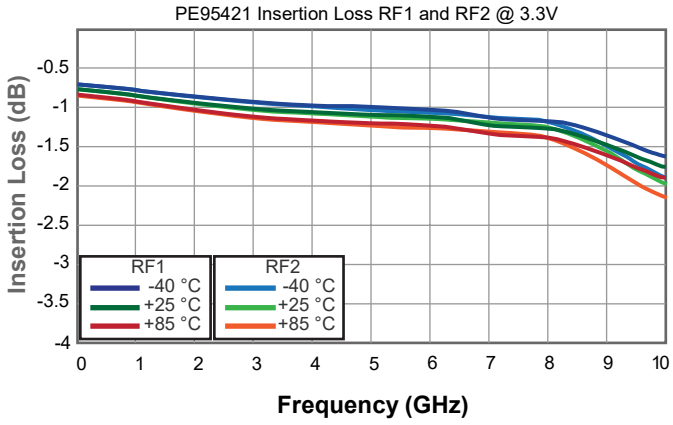
Hi-Rel Delta-Sigma Modulated Fractional-N PLL Frequency Synthesizers*

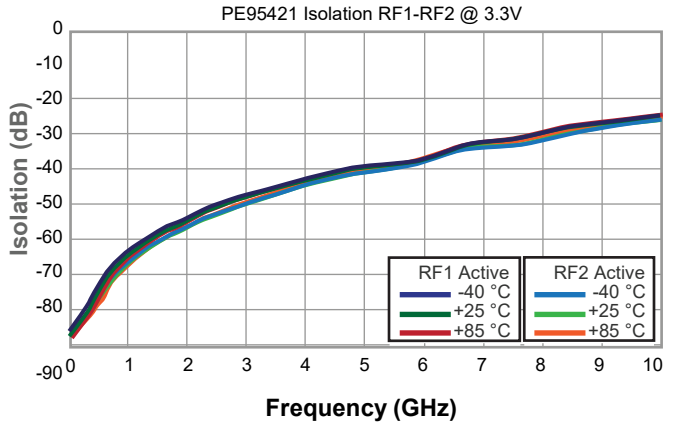
Part Number	Description	Programming Mode	Normalized Phase Noise (dBc/Hz)	Max Input Operating Freq (GHz) RF PLL	Max Input Operating Freq (MHz) Ref	Max Input Operating Freq (MHz) Compare	Prescaler	Reference Counters	Typical I_{DD} (mA)	V_{DD} Range (V)	ESD HBM (V)	Package
PE97640	Ultra-Low Phase Noise 3rd Order DSM	Ser, Hardwire	–225	5.0	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.

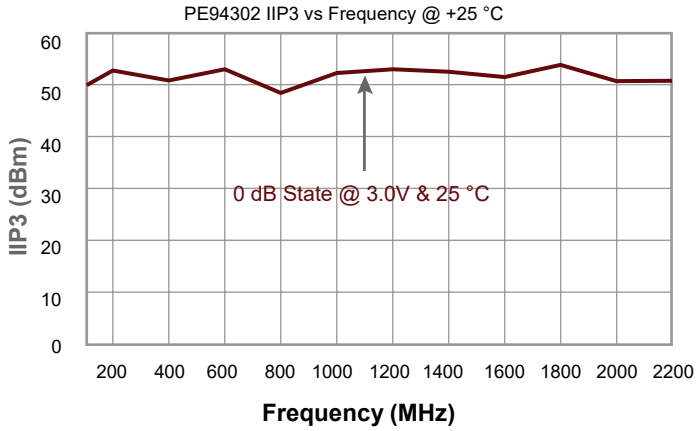
UltraCMOS Technology Delivers High Linearity and Low Phase Noise

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

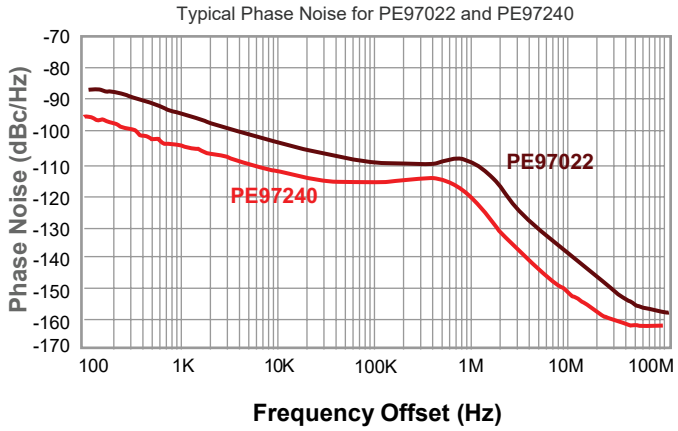




The PE94302 DSA features unprecedented levels of broadband linearity down to 100 kHz.



PE97022 and PE97240 phase noise: V_{DD} = 2.8 V, temp = +25 °C, Fvco = 4 GHz, Fcomp = 50 MHz, loop bandwidth = 500 kHz



Power Management Products

Teledyne e2v's power management products follow a steep tradition of high performance and efficiency. The flagship power management family supports dc-to-dc conversion with radiation-tolerant, point-of-load (POL) synchronous buck regulators with integrated switches. These devices offer SEE immunity to a linear energy transfer (LET) greater than 90 MeV.cm^2/mg and TID of 100 krad(Si). By offering superior performance, smaller size and reduced weight, these power management products can replace multichip modules in sensitive space applications.

Hi-Rel Point-of-Load DC-DC Buck Regulators

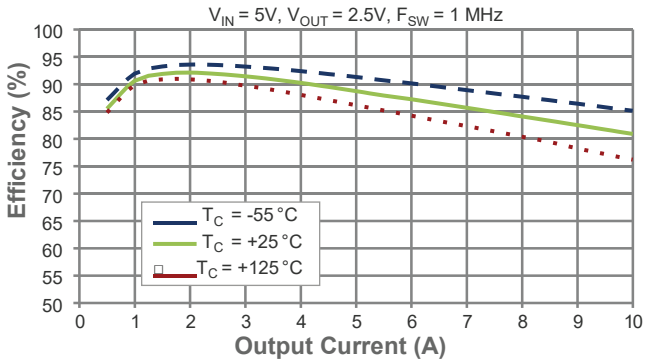
Part Number	Product Description	I_{OUT} (Max) (A)	V_{IN} (Min) (V)	V_{IN} (Max) (A)	V_{OUT} (Min) (V)	V_{OUT} (Max) (V)	Async Switching Frequency (kHz)	Sync Switching Frequency (kHz)		ESD HBM (V)	Package
								Min	Max		
PE99151	2A DC-DC Buck Regulator	2	4.6	6	1	3.6	500/1000	100	5000	1000	32L CQFP, Die
PE99153	6A DC-DC Buck Regulator	6	4.6	6	1	3.6	500/1000	100	5000	1000	32L CQFP, Die
PE99155	10A DC-DC Buck Regulator	10	4.6	6	1	3.6	500/1000	100	5000	1000	32L CQFP, Die

Radiation Tolerant POL Synchronous Buck Regulators

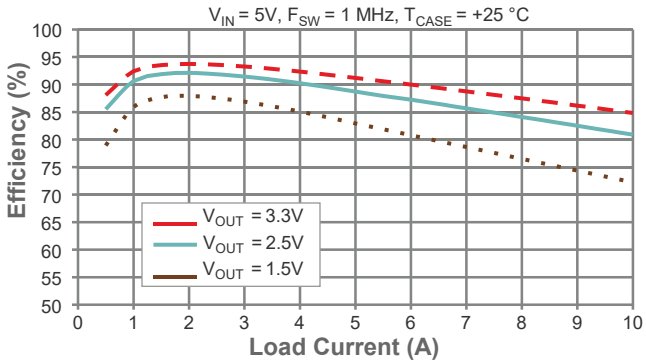
- Integrated synchronous FET switches with 93% peak efficiency.
- Peak current mode control and voltage mode control for wide loop bandwidth and excellent load step response.
- Better than 1% initial accuracy at +25 °C.
- Powers up into pre-biased loads allowing safe start-up with load applied.
- Adjustable switching frequency (100 kHz to 5 MHz) allows operation at the optimum frequency to minimize RF spur impact and minimize inductor size and weight.
- Inverted sync buffer pin for easy poly-phase operation, enabling ripple reduction and faster loop response.
- Adjustable soft-start with external capacitor to adjust load voltage/current rise-time.
- Integrated power good pin for sequencing and telemetry.
- Shutdown function pin for remote on/off control.
- Accurate and simple current sharing for higher power loads.
- Adjustable current threshold and over current protection.
- N+K redundant control through simple enable pin.
- Hermetic ceramic package with exposed thermal pad.
- Inherently ELDRS-free as bipolar minority carrier elements are not used.

Power Conversion Efficiency Curves

PE99155 Efficiency vs Output Current



PE99155 Efficiency vs Load Current



The PE9915x POL buck regulators are capable of supplying high load currents at low output voltages while maintaining high efficiency.

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.

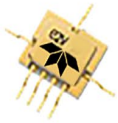
Teledyne e2v HiRel products use the test methods and procedures defined under MIL-STD-883 and MIL- PRF-38535 to fabricate, assemble, test, screen and qualify space-level applications.

Ceramic Packaging. Hermetically Sealed, Rigorously Tested.

High-reliability bare die available on select products.

8L CFP
4.6 × 4.6 × 1.8

7L CQFP
6.6 × 5.5 × 1.7



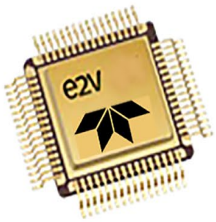
28L CQFP
9.1 × 9.9 × 1.3

44L CQFP
9.83 × 9.83 × 1.48

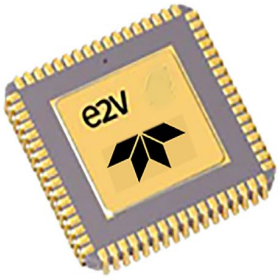
32L CQFP
12.57 × 13.08 × 1.15

44L CQFJ
16.5 × 16.5 × 2.9

64L CQFP
13.1 × 13.1 × 1.6



68L CQFJ
24.1 × 24.1 × 3.1



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