

Welcome!

Texas Instruments New Product Update

- This webinar will be recorded and available at www.ti.com/npu
- Phone lines are muted
- Please post questions in the chat or contact your TI sales contact or field applications engineer

LEARN ABOUT TI'S LEADING POWER DENSITY ICs FOR SPACE GRADE POWER MANAGEMENT

New Product Update

Kenny Matthews

- Product Marketing Engineer

Agenda

- Space grade product flows
 - Radiation tolerant space enhanced plastic and radiation hardened QML Class V
- Buck converter overview
 - Power density
 - FPGA core rail challenge and paralleling
 - Ease of layout
- LDO regulator overview
 - General purpose LDOs
 - DDR Termination Regulators
 - High performance RF LDO

Space power trends

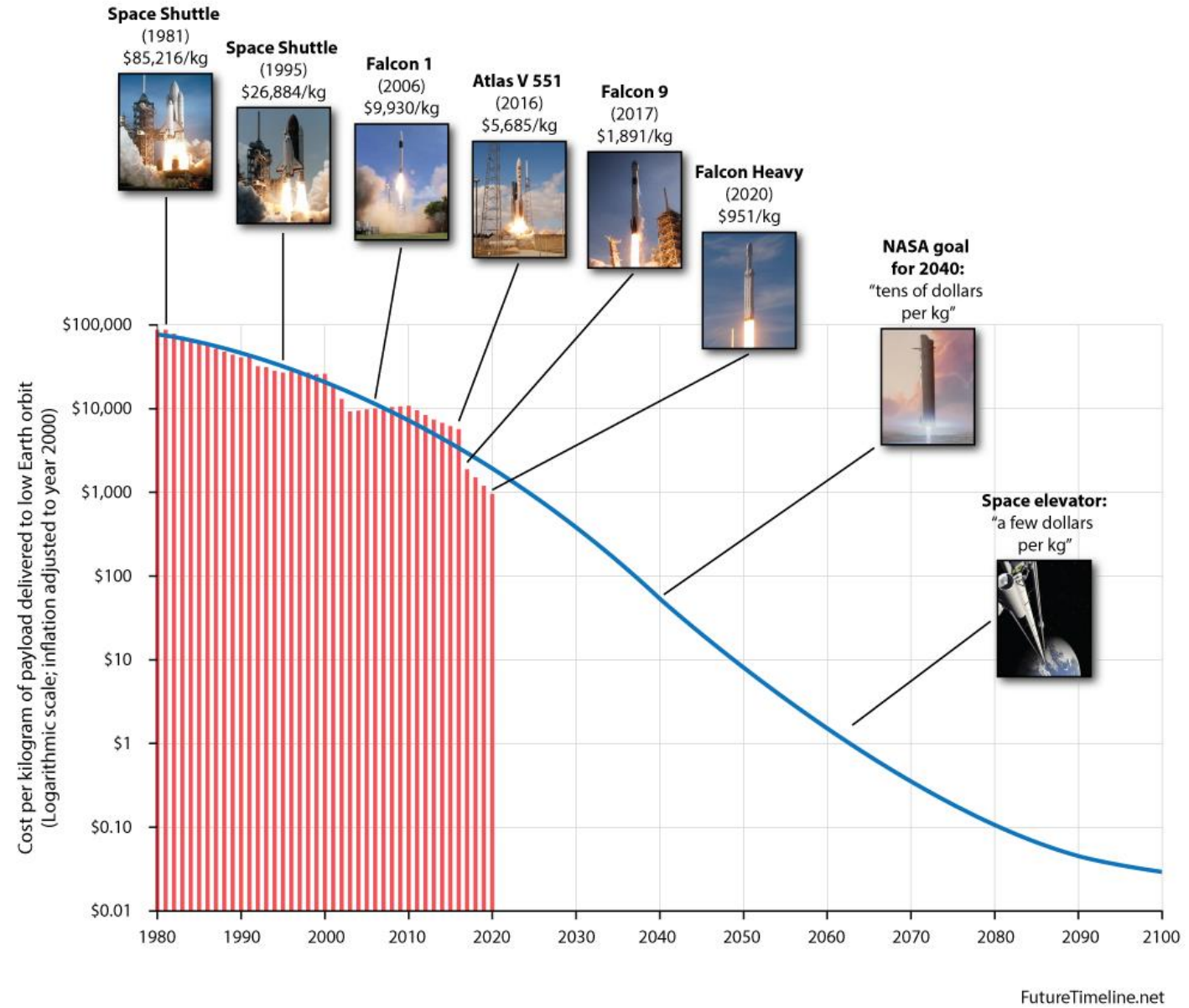
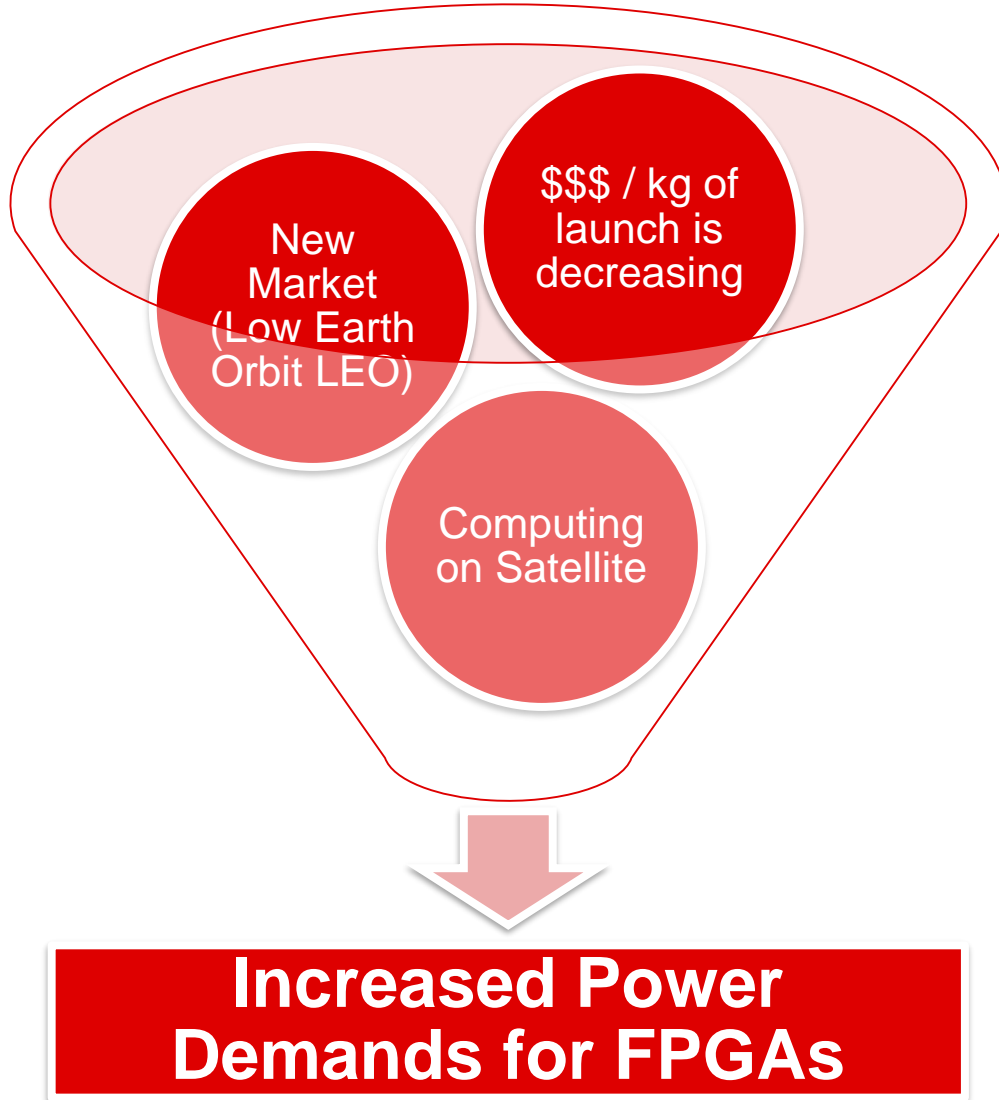


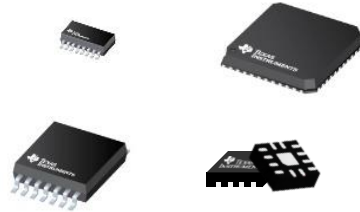
Figure 1

FutureTimeline.net

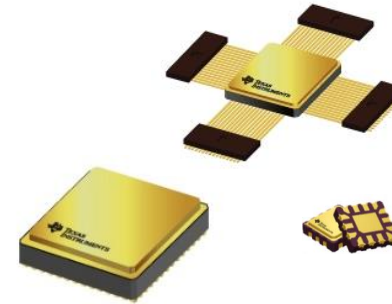
Space product grades



Rad Tolerant Plastic
TI Space EP



Rad Hard Plastic
QML Class P Precursor



Rad Hard Hermetic
QML Class V

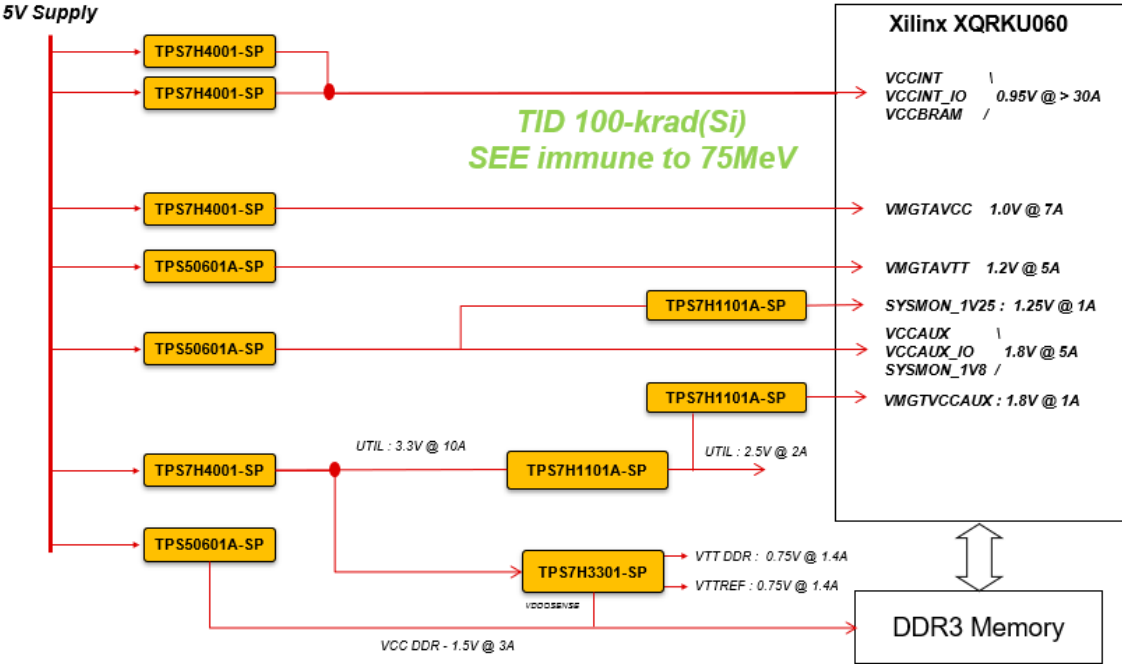
Packaging	Plastic	Plastic	Ceramic / Metal Can
Mil. Spec	VID	VID/SMD*	SMD
Burnin	No	Yes	Yes
TID Char	30 – 50 krad(Si)	<----- 50krad(Si) – 300 krad(Si) ----->	
TID RLAT	20, 30, or 50 krad(Si)	<----- Non-RHA, 50, 100, or 300 krad(Si) ----->	
SEL	43 MeV·cm ² /mg	<----- ≥ 60 MeV·cm ² /mg ----->	

TI's space-grade manufacturing flows

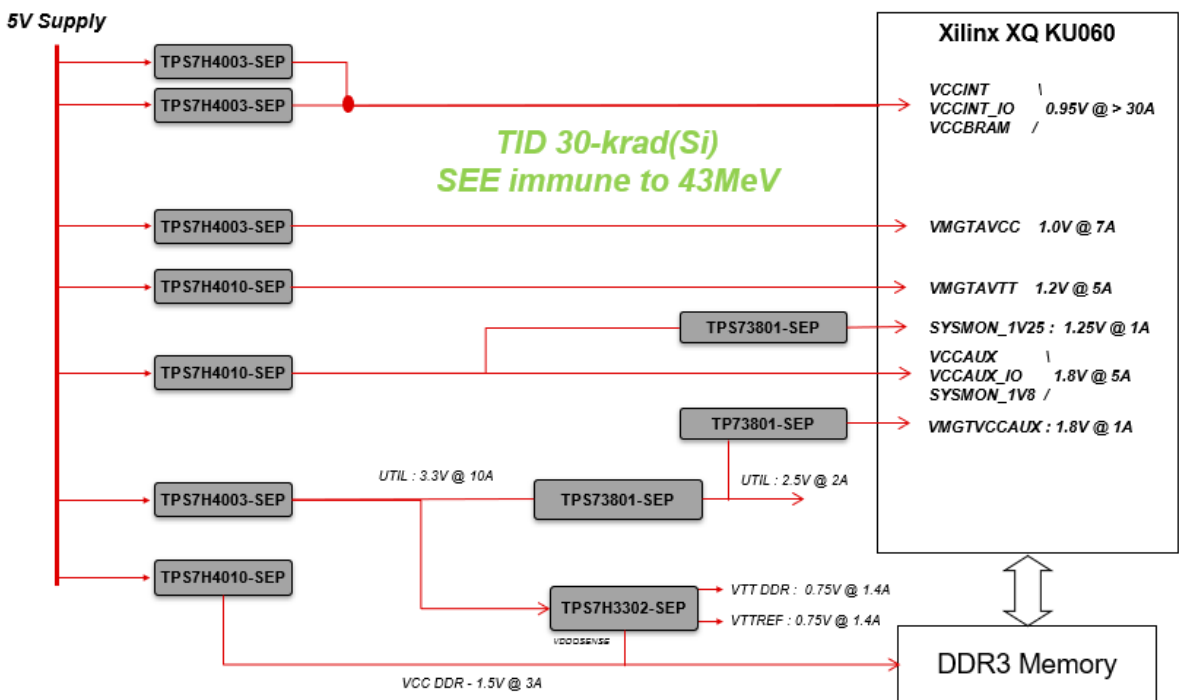
	TI defined Space Enhanced Product (-SEP) flow	MIL-SPEC-38535 defined QML Class-P (-SP) flow	MIL-SPEC-38535 defined QML Class-V (-SP) flow
Part Number	TI defined TPS7HxxxxSEP	5962xxxxxxxPxx	5962xxxxxxxVxx
Packaging	Plastic	Plastic	Ceramic-Hermetic
Single Controlled Baseline	Yes	Yes	Yes
Bond Wires	Au	Au	Al
Meets DLA spec for less than 2% Sn	Yes	Yes	Yes
Production Burn-in	No	Yes	Yes
Typical Temperature Range	-55°C - 125°C	-55°C - 125°C	-55°C - 125°C
Characterized Radiation Performance	Yes	Yes	Yes
Per lot TID Radiation Lot Acceptance Testing (RLAT)	Yes	Yes	Yes
Outgassing tested per ASTM E595	Yes	Yes	N/A
Lot Level Temp Cycle	Yes	Yes	Yes
Per tube, tray or reel single lot date code	Yes	Yes	Yes
Life Test Per Wafer Lot	No	Yes	Yes
Group reports	Basic PCR report & Group E & P reports	PCR report & Group B, C, D, E, WLA reports	PCR report & Group B, C, D, E, WLA reports

Full space-grade power management solution

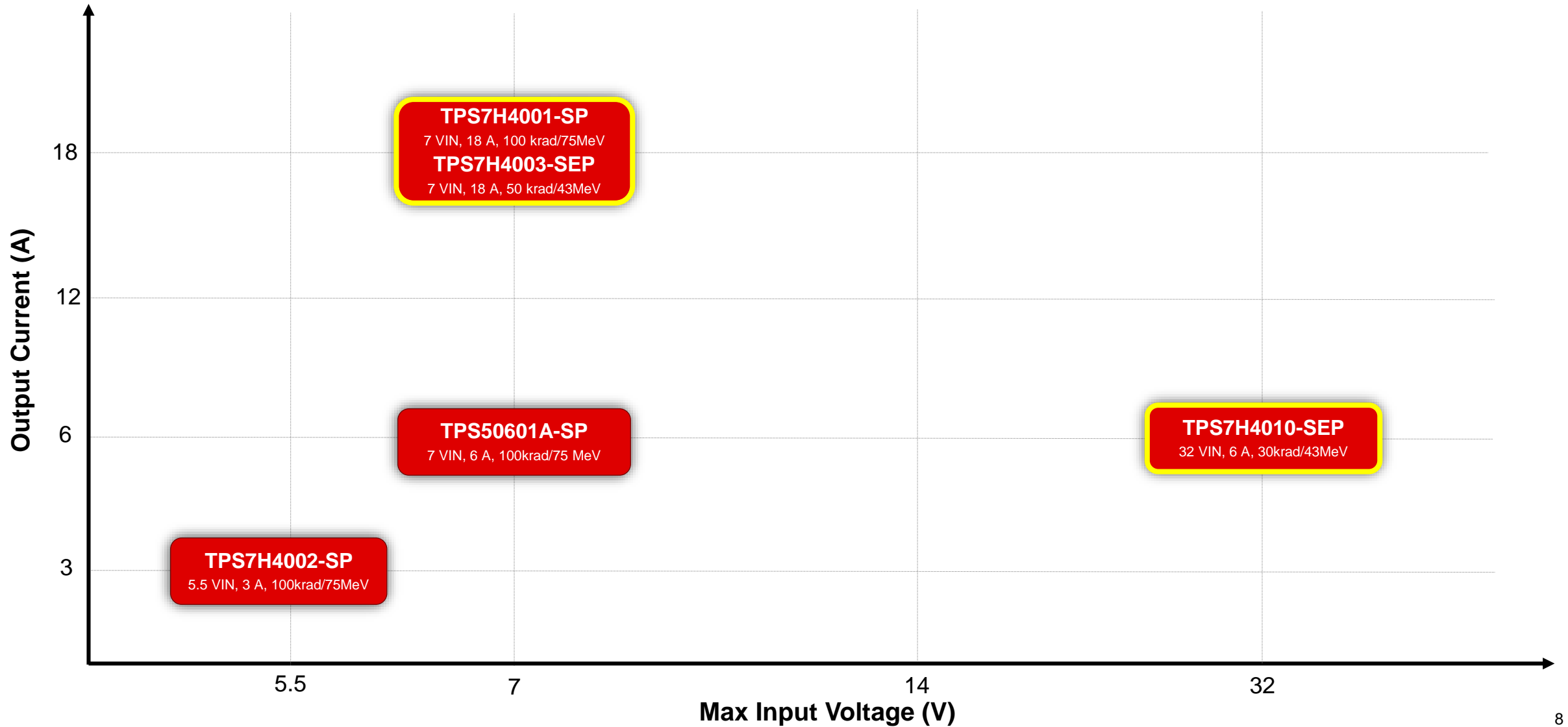
Rad-hard hermetically sealed QMLV solution



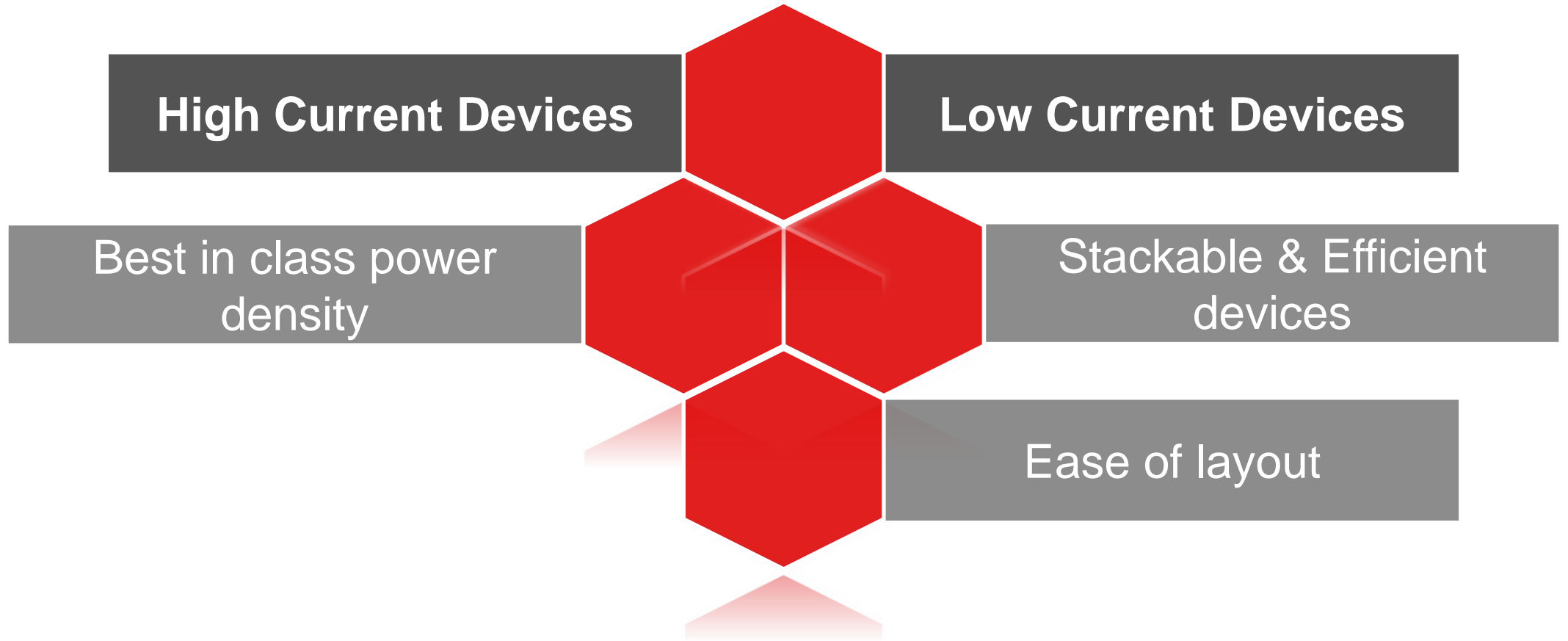
Rad-tolerant space enhanced plastic solution



Radiation qualified switching regulators

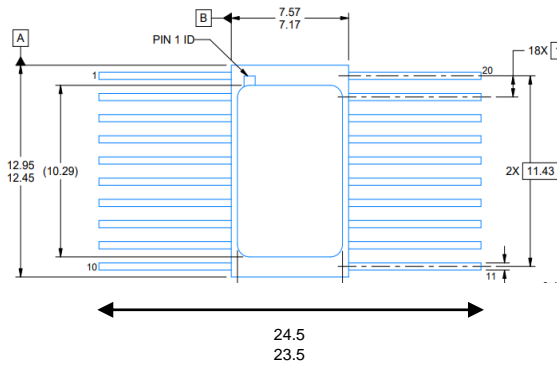


TI Key Benefits | Buck Converters



Power Density (considering pin layout)

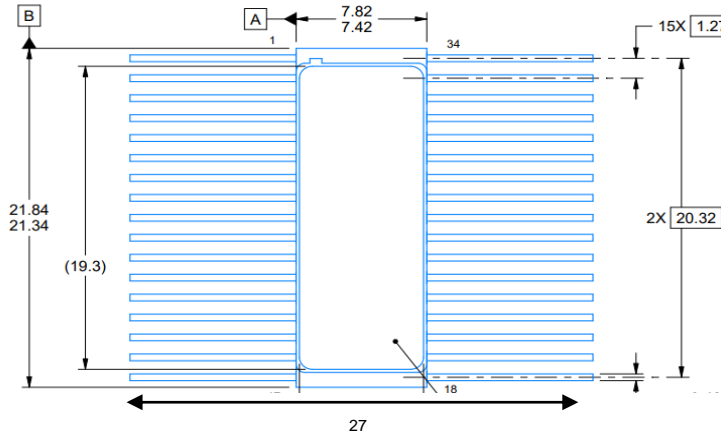
TPS50601A-SP /
TPS7H4002-SP



Package Size with 2.5mm leads:
12.4mm x 12.7mm = 157.5mm²

Power density: 1V_{out} @ Max I_{out}
TPS50601A-SP: 38mW/mm²
TPS7H4002-SP: 19mW/mm²

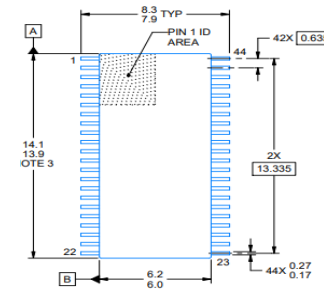
TPS7H4001-SP



Package Size with 2.5mm leads:
12.6mm x 21.6mm = 272.2mm²

Power density: 1V_{out} @ Max I_{out}
66.1mW/mm²

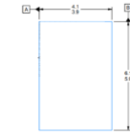
TPS7H4003-SEP



Package Size with leads:
8.1mm x 14mm = 113.4mm²

Power density: 1V_{out} @ Max I_{out}
158.7mW/mm²

TPS7H4010-SEP



Package Size (leadless):
4mm x 6mm = 24mm²

Power density: 1V_{out} @ Max I_{out}
250mW/mm²

Evolution of Core Power Rails

TI Key Benefits

Best in class power density

Stackable & Efficient Devices

Ease of layout

**Microsemi
RTG4**
12 Watts
1.2 V @ 10A

**Xilinx
XQRKU060**
34.2 Watts
.95V @ 36A

Xilinx Versal
120 Watts
.8V @ 150A

Power

Achieving higher current

**High Current / Core Rail
(4 devices parallel use /
no external clocking
needed)**

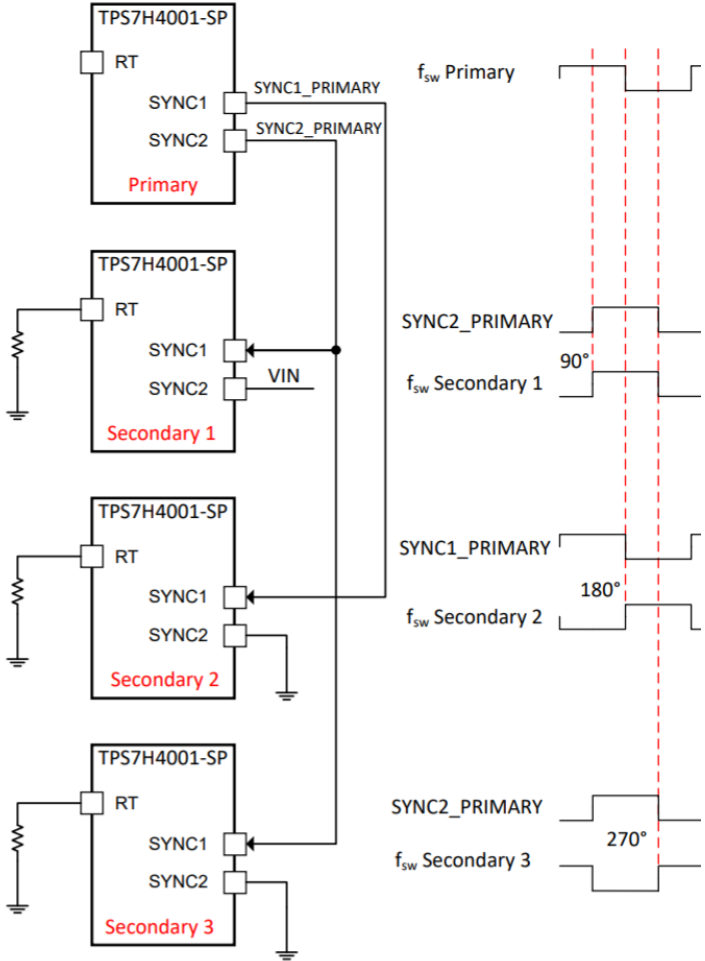
TPS7H4001-SP
72A (18A x 4)

TPS7H4003-SEP
72A (18A x 4)

**Low Current Devices /
Auxiliary Rails
(2 devices parallel use /
no external clocking
needed)**

TPS50601A-SP
12A (6A x 2)

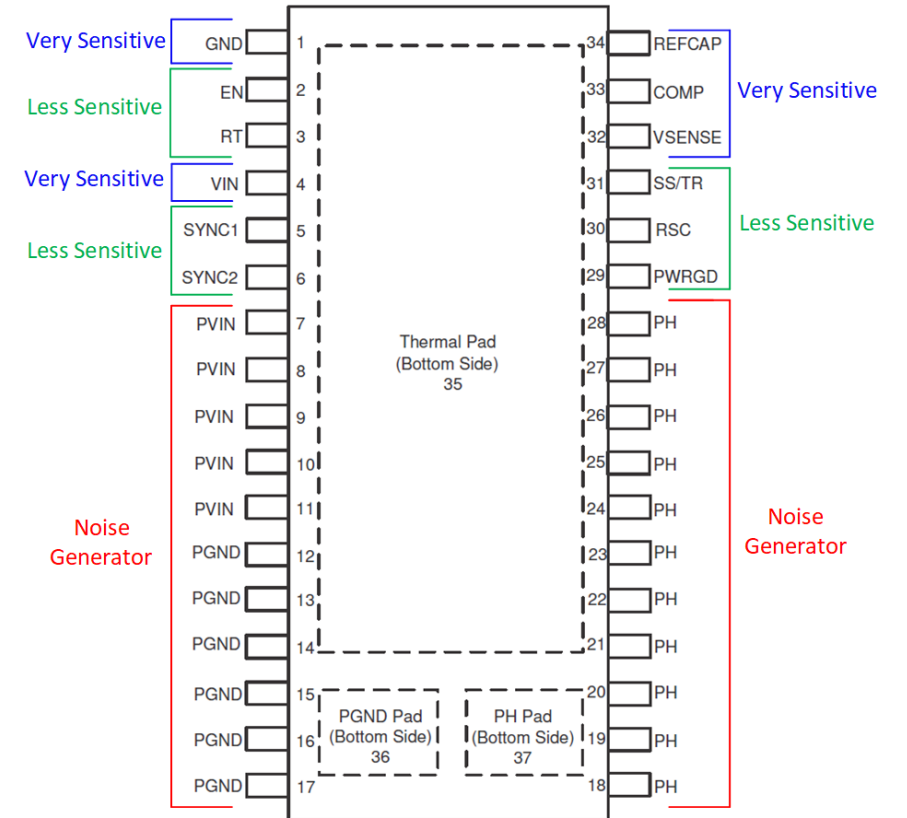
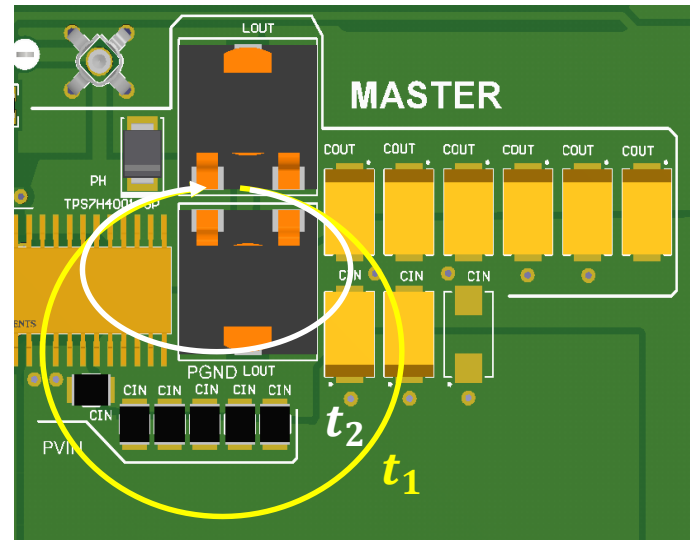
TPS7H4002-SP
6A (3A x 2)



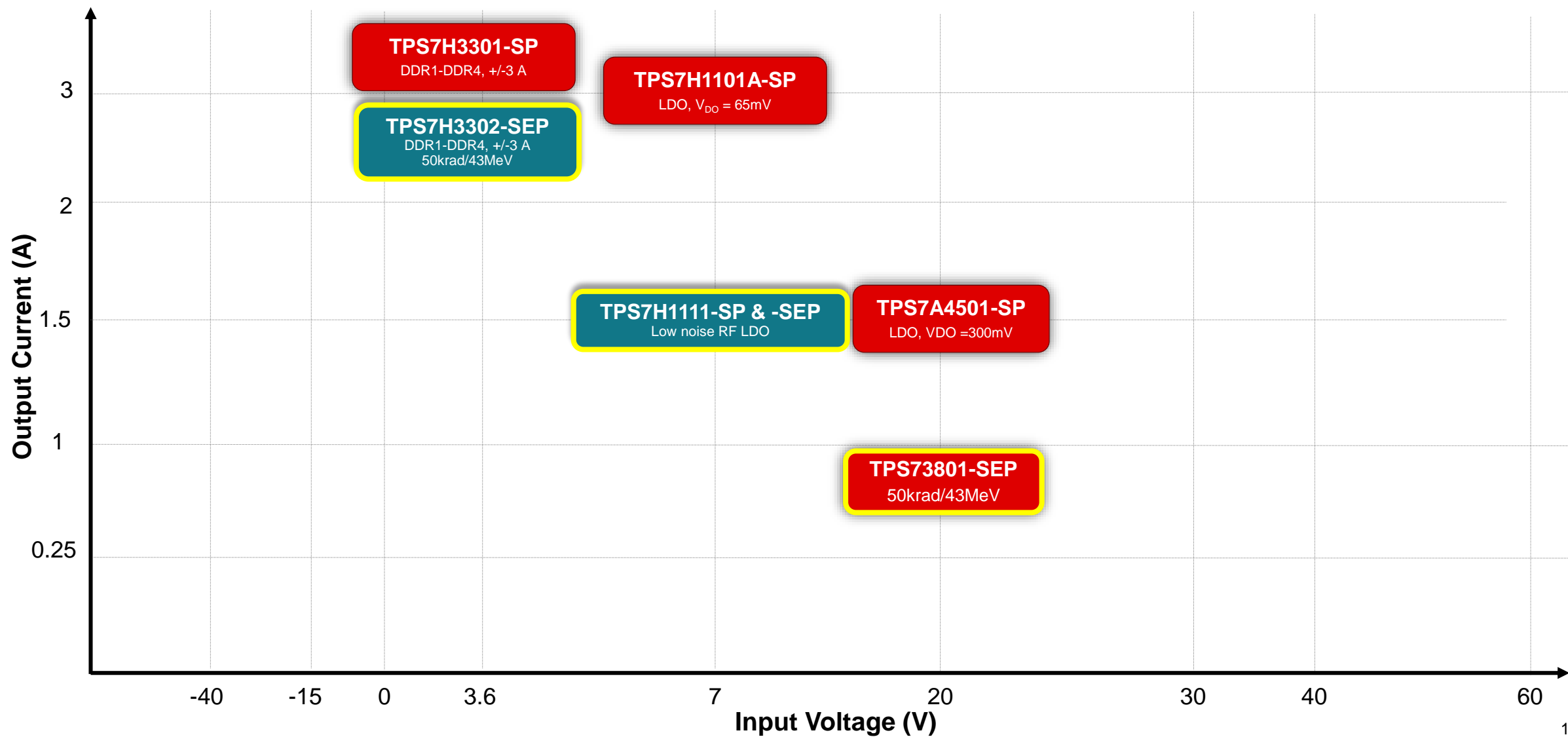
Ease of Layout with example

Ease of Layout (Bucks)

- Designed with flow through in mind
- Smaller loops to minimize switching noise and parasitics
- Power node (PH) grouped together on one side (ideal layout to LC filter)



Space qualified linear regulators



TI Key Benefits | LDO

Existing Solutions

General Purpose / High current

01

TPS7H1111-SP/-SEP

Made for noise sensitive applications
(DACs, ADCs, Clock)

02

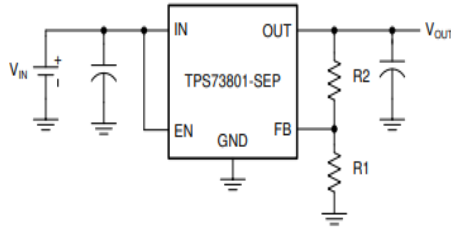
03

TPS7H3302-SEP

Power Dissipation and Data Integrity
via DDR termination

Existing solutions for noise sensitive rails

General Purpose -SEP



TPS73801-SEP

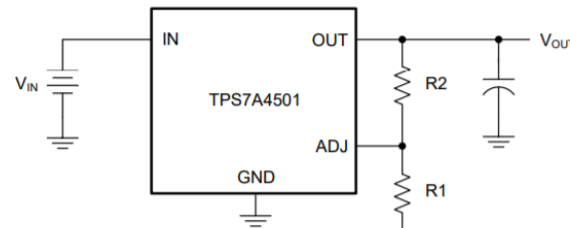
Small Form Factor: 6.5mm x 3.5mm 6-SOT-223 package

Wide input voltage range: 2.2V to 20V

Current: 1A

Space enhanced plastic device

General Purpose QMLV



TPS7A4501-SP

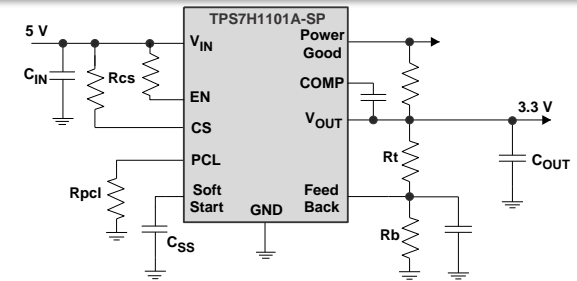
Small Form Factor: 7.0mm x 7.2mm 10-pin CDFP package

Wide input voltage range: 2.3V to 20V

Current: 1.5A

QMLV and RHA

High Current with integrated features



TPS7H1101A-SP

Package: 9.9mm x 11.3mm 16-pin CDFP

Input Voltage: 1.5V to 7V

Current: 3A

QMLV and RHA

Enable, configurable soft start and power good for power sequencing applications

Integrated current foldback protection

Double Data Rate (DDR) Termination LDO

TPS7H3302-SEP

Summary: Radiation-tolerant 3 A source-sink DDR termination regulator in a plastic package

Use Case:

- VLDO input down to 0.8 V
- 10 mA Buffered VTTREF
- Source/Sink VTT voltage output with drop compensation

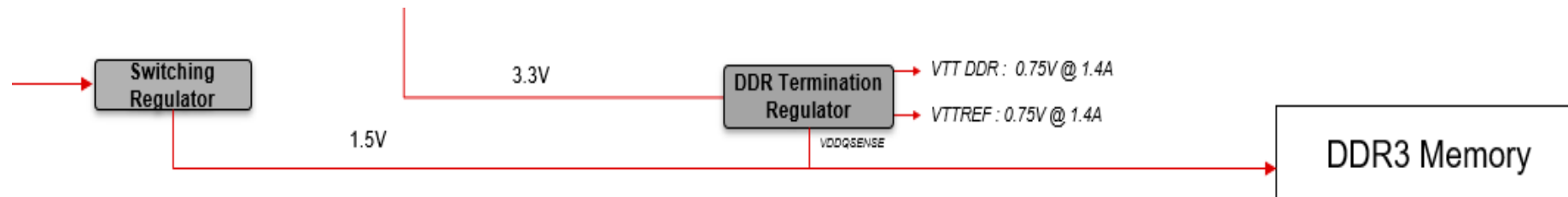
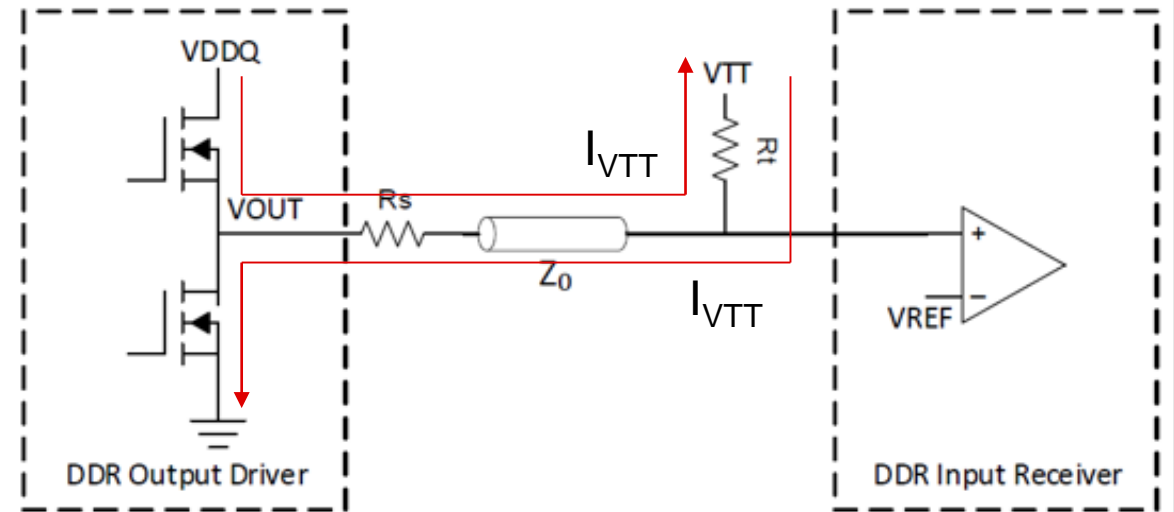
Design Benefits:

- Compact Power solution: no inductor \ nor compensation needed
- Only a few passives are required for operation



Powering DDR1 – DDR4

- VDDQ supplied externally by buck regulator
- TPS7H3302-SEP VTT output able to sink and source current
- Supports the multiple spec differences to power DDR, DDR2, DDR3, DDR3L, and DDR4
- VTTSENS pin for remote sensing and more accurate regulation
- Internal resistor dividers to generate VTTREF



Noise sensitive application LDO

TPS7H1111-SEP

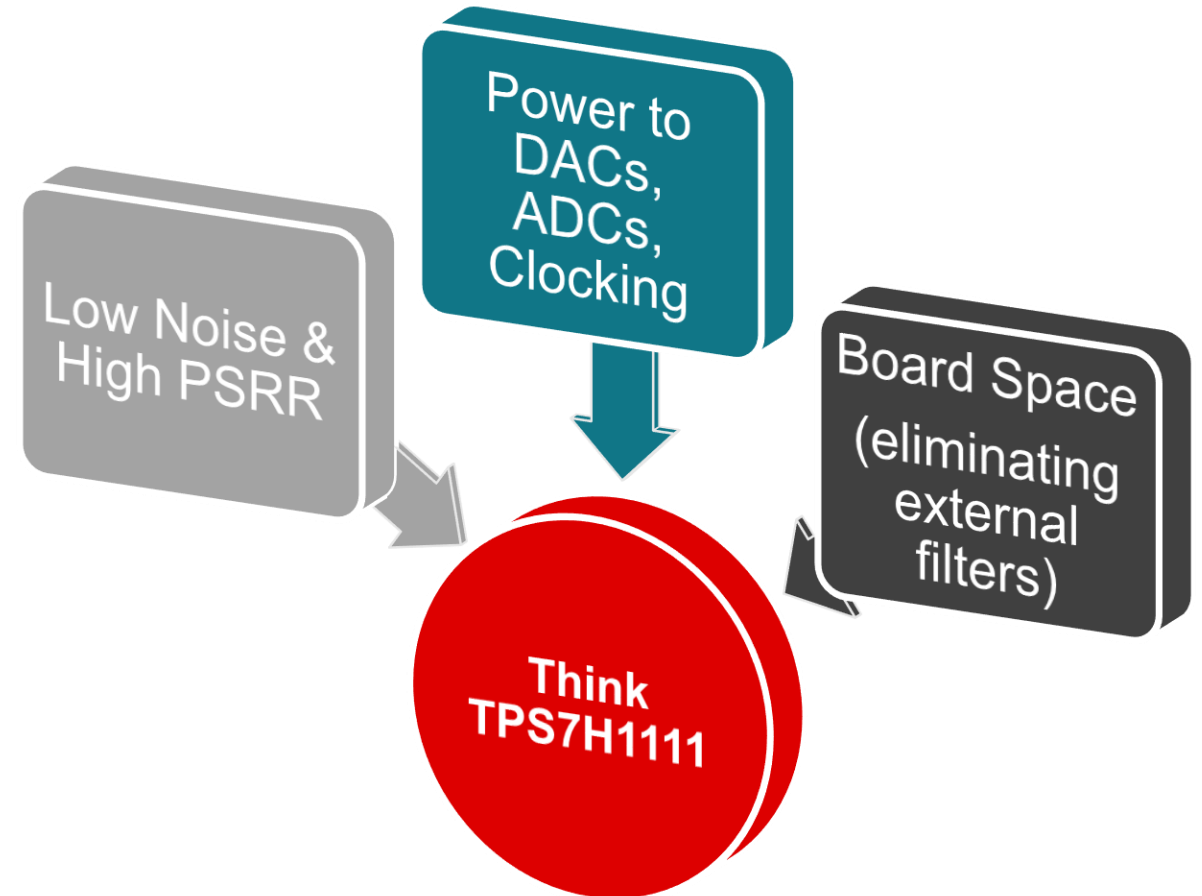
Summary: 0.85 V – 7 V VIN, 2.2 V – 14 V VBIAS, 1.5 A, RF, LDO

Use Case: Low Noise and High PSRR

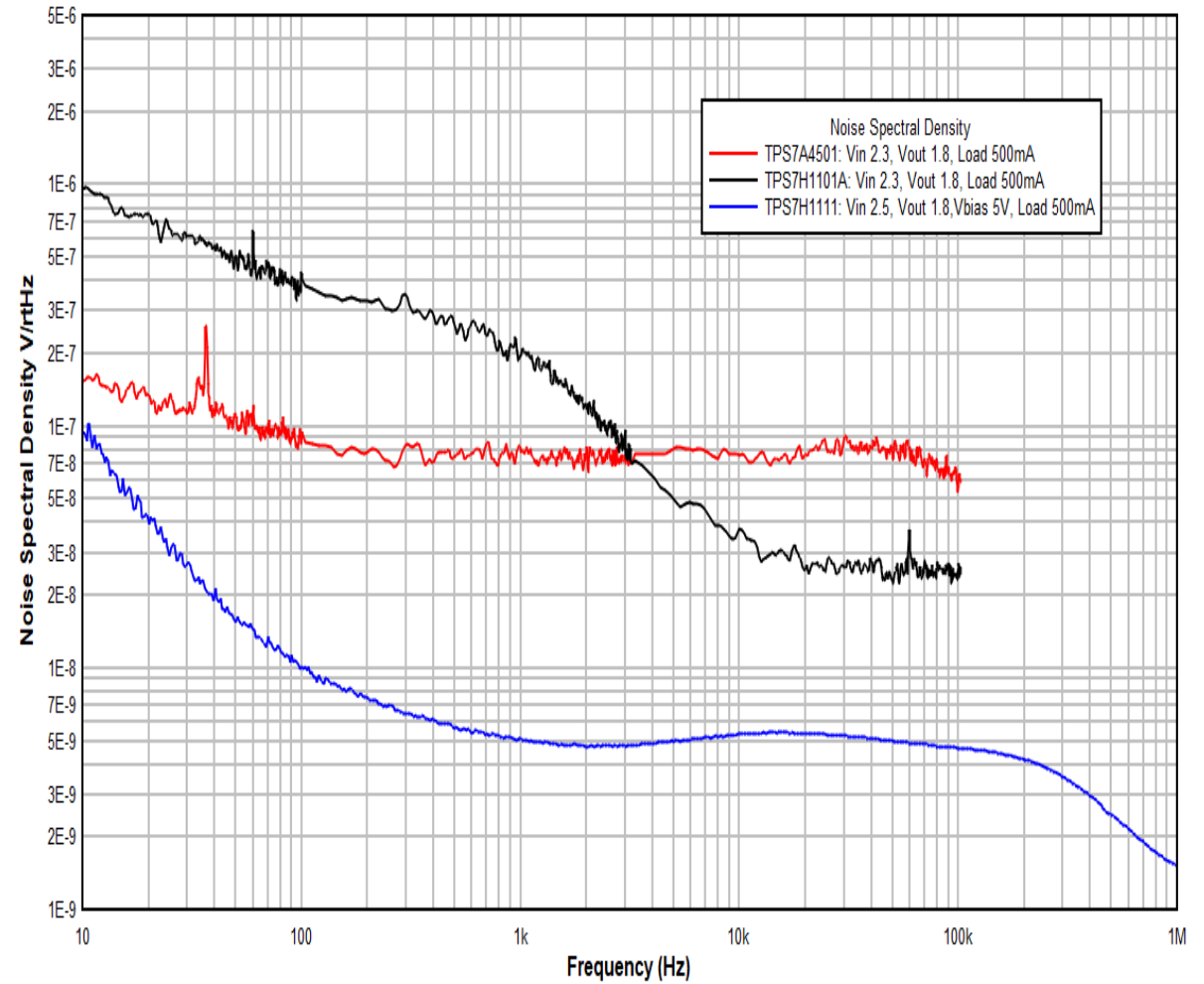
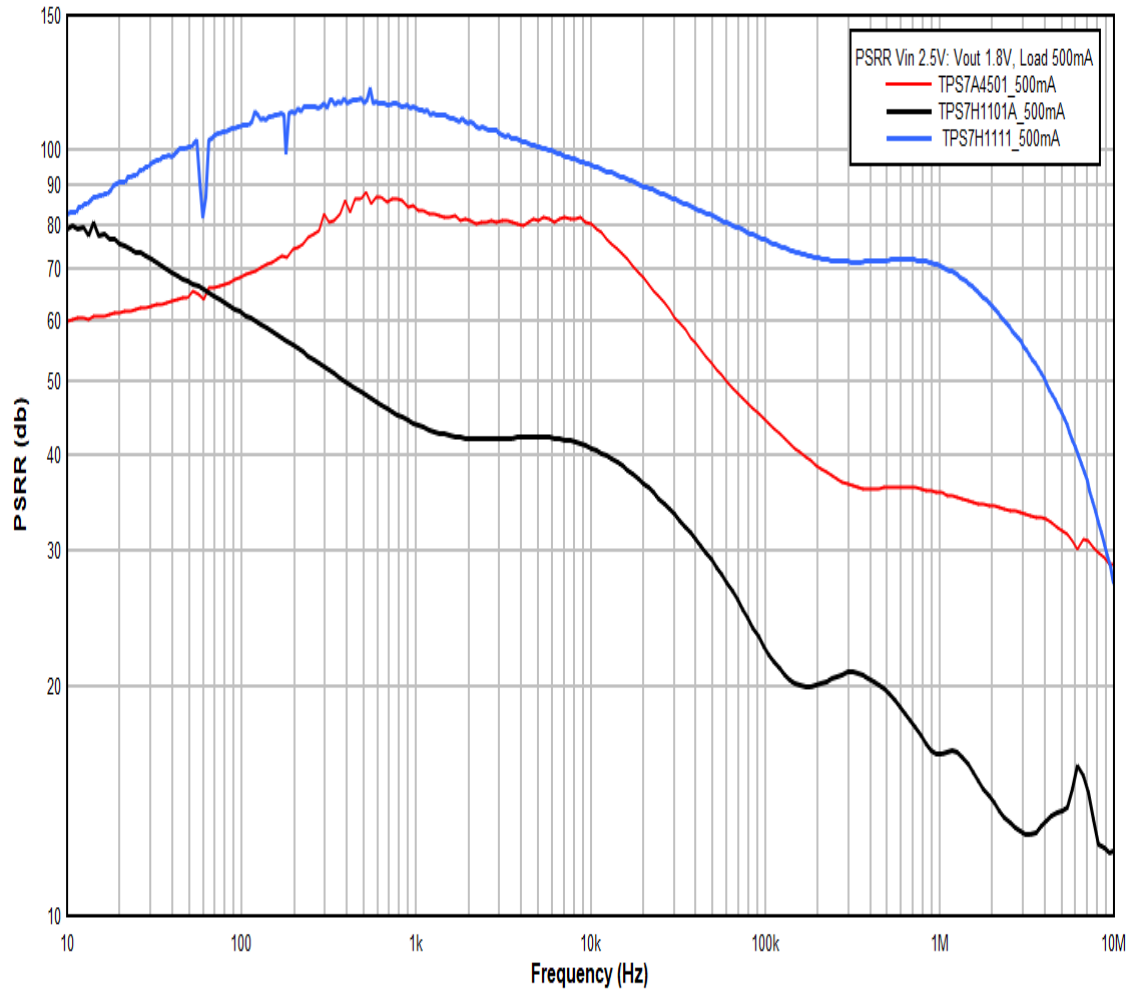
- VCOs (voltage controlled oscillators)
- Data Converters: ADCs and DACs (analog-to digital and digital-to-analog converters)
- PLLs (phase-lock-loops), SerDes (serializer and deserializers), Imaging sensors
- Accurate supply for precision ASIC and FPGA supply rails

Design Benefits:

- Highly integrated features (programmable soft start)
- Low output voltage
- Enhanced Noise and PSRR performance (helping eliminate need for external filters)

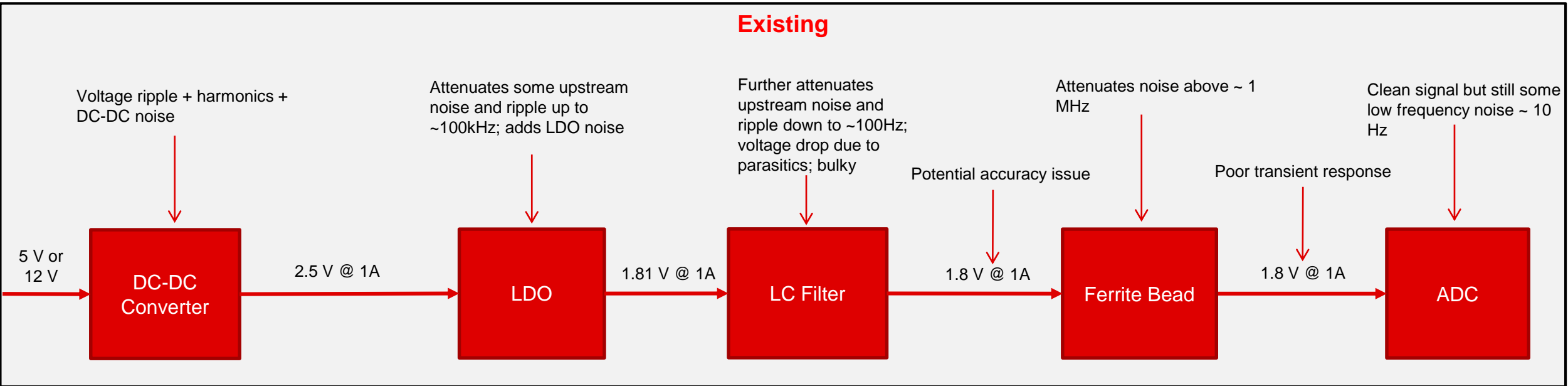


Comparison performance over frequency for leading LP-SP LDOs

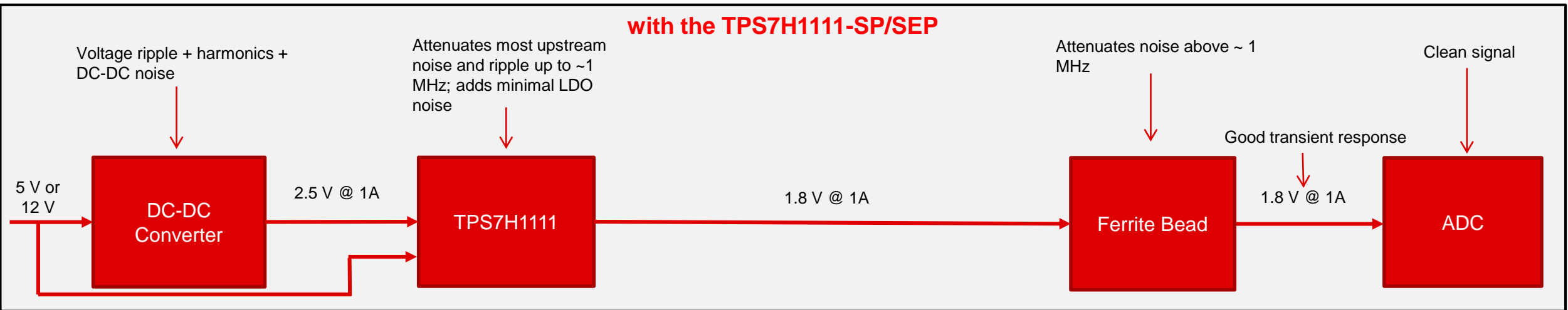


Example of creating an ultra-clean rail

Existing



with the TPS7H1111-SP/SEP



Getting started

You can start evaluating this device leveraging the following:

Content type	Content title	Link to content or more details
Selection Guide	TI Space Products Guide	https://www.ti.com/lit/sg/slyt532i/slyt532i.pdf
Application Note	Reduce the Risk in Low-Earth Orbit Missions with Space Enhanced Plastic Products	https://www.ti.com/lit/an/sboa344a/sboa344a.pdf
Whitepaper	Powering a New Era of High-Performance Space-Grade Xilinx FPGAs	https://www.ti.com/lit/wp/slraf47/slraf47.pdf
Application Note	TI Space Rated Power Solution for Microsemi® RTG4™ FPGA	https://www.ti.com/lit/an/slva857b/slva857b.pdf

Visit www.ti.com/npu

For more information on the New Product Update series, calendar and archived recordings



© Copyright 2022 Texas Instruments Incorporated. All rights reserved.

This material is provided strictly “as-is,” for informational purposes only, and without any warranty.
Use of this material is subject to TI’s **Terms of Use**, viewable at [TI.com](https://www.ti.com)

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated