

# New Product Update

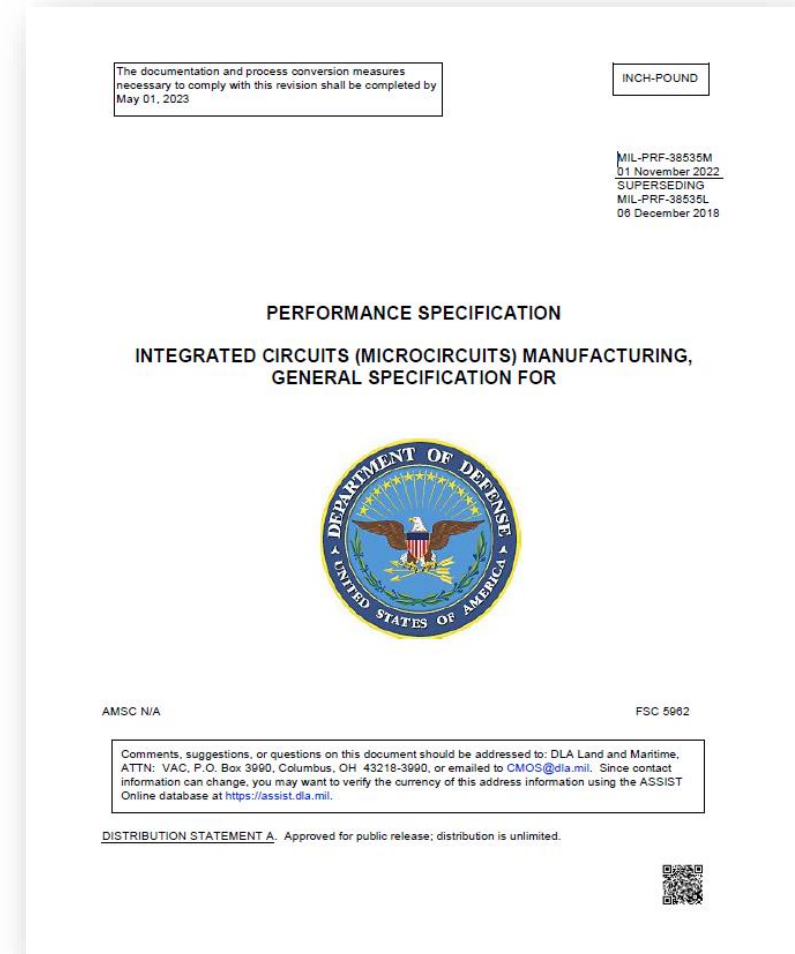
Space Power radiation-hardened  
QMLP value proposition and  
portfolio update

**Kurt Eckles**

Product marketing engineer

# MIL-PRF-38535 specification

- Developed in the late 1980's and still the key standard for defense & space grade semiconductors, the MIL-PRF-38535 specification was driven in JEDEC with support from DLA, NASA and other industry experts.
- To have the Defense Logistic Agency (DLA) assign and release a SMD 5962-xxxx spec, all the Qualified Manufacturer List (QML) programs and requirements must be followed including audits of each of the manufacturing sites.



# Advanced, Reliable, QML Worldwide Production



## MIHO

- 200mm wafers
- CMOS & BiCMOS
- Miho, Japan



## SFAB

- 200mm wafers
- Bipolar, CMOS & BiCMOS
- Sherman, Texas



## FFAB

- 200mm wafers
- CMOS & BiCMOS
- Freising, Germany



## DMOS 5

- 200mm wafers
- CMOS & BiCMOS
- Dallas, Texas
- 350 - 130 nm



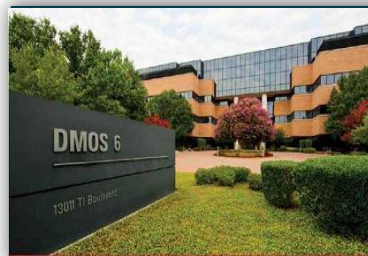
## MFAB

- 200mm wafers
- CMOS & BiCMOS
- South Portland, Maine
- 250 - 130nm



## RFAB 1 & RFAB 2

- 300mm wafers
- CMOS & BiCMOS
- Richardson, Texas
- 350 - 130nm



## DMOS 6

- 300mm wafers
- CMOS
- Dallas, Texas
- 350 - 65nm

# Setting a new standard for electronics in space

## QML Class P

- Hermetic QML Class V for space & hermetic QML Class Q for defense systems have been part of the MIL standard for many years.
- Until QML Class P there had not been any standardized use of plastic packaging specifically for the space environment.
- For TI's first QMLP releases are on the same SMD as our QMLV devices and are assigned a 5962-xxxxxxPYE orderable part number

Rating				Space		
		Classification	Space EP	SHP	QML-P	QML-Y
Production testing and documentation provided	Vendor item drawing (VID)	✓	✓	✗	✗	✗
	Standard microcircuit drawing (SMD)	✗	✗	✓	✓	✓
	Process conformance report	✓	✓	✓	✓	✓
	Process conformance report content	See product page		MIL-PRF-38535 Group A, B, C, D, E		
Manufacturing	Single controlled baseline	✓	✓	✓	✓	✓
	Multiple wafer lots per reel possible	✗	✗	✗	✗	✗
	Life test per wafer lot	✗	✓	✓	✓	✓
Packaging	Package construction	Plastic	Plastic	Plastic - Wirebond or flip chip with overmold	Plastic - flip chip w/o overmold	Hermetic
	Bond wires	Au	Au	Au	N/A	Al
	Pure tin (Sn) lead finish possible?	✗	✗	✗	✗	✗
	>97% Tin (Sn) inside package possible*			✓ for flip chip		✗
	Production burn-in required	✗	✓	✓	✓	✓
	Outgassing tested per ASTM E595	✓	✓	✓	✓	N/A
Radiation	TID characterization range (krad/Si)	30 to 50		50 to 300		
	TID radiation lot acceptance testing (RLAT) range - RHA (krad/Si)	20, 30 or 50		50, 100 or 300		
	SEL immunity (MeV*cm2/mg)	≥ 43		≥ 60		
Typical temperature range				-55-125°C		

Table illustrates typical values for each Classification rating. For precise data or detailed information, please refer to the product-specific page.

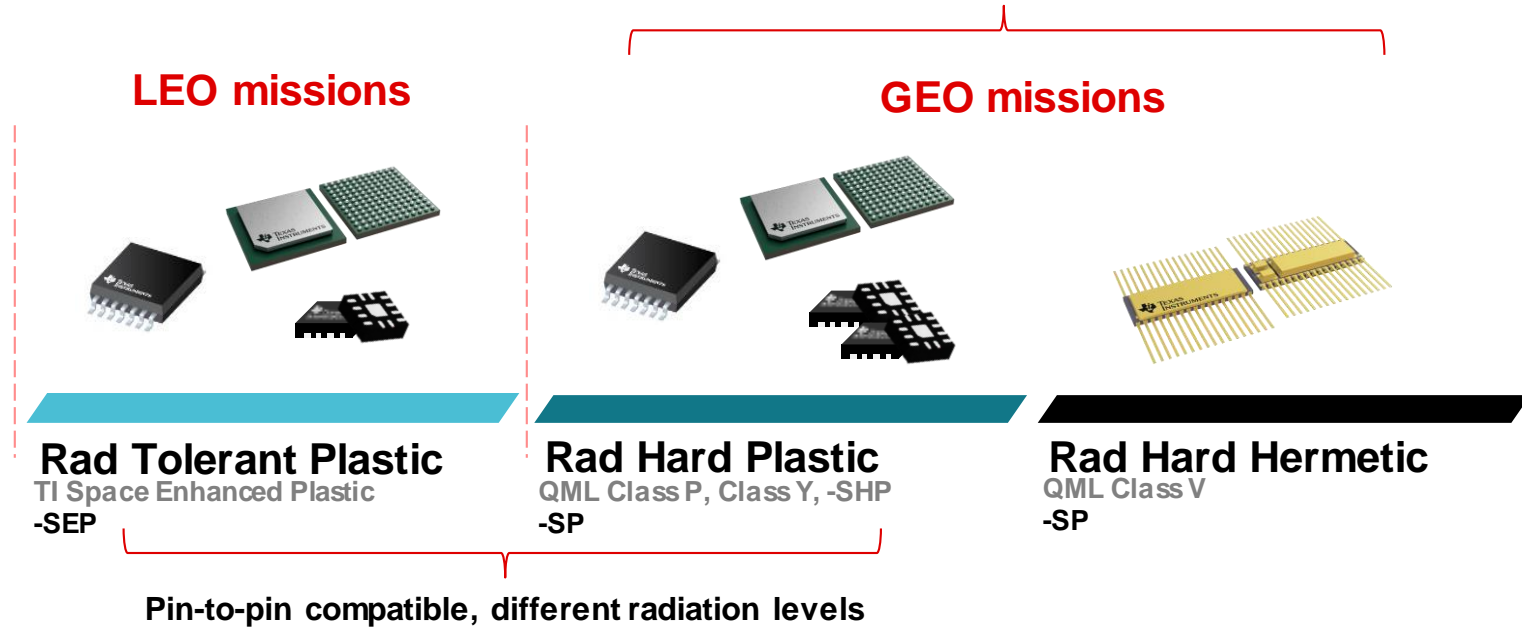
\* BI unless Optimization aligned with DLA

TID = Total Ionizing Dose  
VID = Vendor Item Drawing  
SEL = Single-Event Latch-up

RHA = Radiation Hardness Assured  
QML = Qualified Manufacturers List  
SMD = Standard Microcircuit Drawing

# TI Space product grades

Same radiation levels, same qualification, different package



<b>Packaging</b>	Plastic	Plastic	Ceramic / Metal Can
<b>Mil. Spec</b>	Vendor Item Drawing	Standard Microcircuit Drawing	
<b>Burn-in</b>	No	Yes	Yes
<b>TID Char</b>	30 – 50 krad(Si)	<----- 50 – 300 krad(Si) ----->	
<b>TID RLAT</b>	20, 30, or 50 krad(Si)	<----- Non-RHA, 50, 100, or 300 krad(Si) ----->	
<b>SEL</b>	43 MeV·cm <sup>2</sup> /mg	<----- ≥ 60 MeV·cm <sup>2</sup> /mg ----->	

# TI's Rad-hard plastic power portfolio as of Feb 2024

Product or Part number	DLA SMD #	Subcategory	Status
<a href="#"><u>TPS7H4001-SP</u></a>	<a href="#"><u>5962-18205</u></a>	Buck converters	ACTIVE
<a href="#"><u>TPS7H1111-SP</u></a>	<a href="#"><u>5962-21203</u></a>	Linear LDO regulators	ACTIVE
<a href="#"><u>TPS7H3302-SP</u></a>	<a href="#"><u>5962-14228</u></a>	DDR memory power ICs	ACTIVE
<a href="#"><u>TPS7H5001-SP</u></a>	<a href="#"><u>5962-18222</u></a>	PWM controllers	ACTIVE
<a href="#"><u>TPS7H2211-SP</u></a>	<a href="#"><u>5962-18220</u></a>	eFuse controllers	ACTIVE
<a href="#"><u>TPS7H2201-SP</u></a>	<a href="#"><u>5962-17220</u></a>	eFuse controllers	ACTIVE

Additional released TI Rad-hard plastic categories include:

- High speed data converter
- High speed clocking & timing devices
- Low-power microcontrollers

**With many more devices throughout 2024 & beyond**

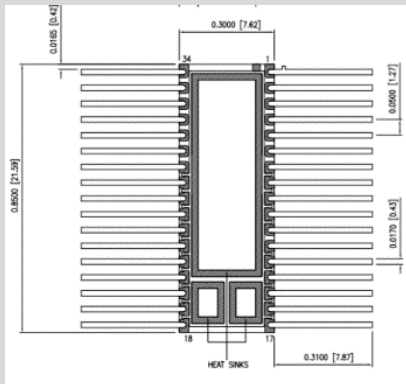
# Benefits of TI's plastic devices for space -SP & -SEP

- **Significant reduction in board area vs equivalent hermetic offerings**
- Improved electrical specifications for high-speed signal chain devices
- Reduced mass vs hermetic equivalent offerings
- Improved thermal performance vs hermetic equivalent offerings
- Option for pin-to-pin option covering a wider range of missions

# Benefits in plastic flat packs (roughly half the package size of hermetic options)

## Switching regulator

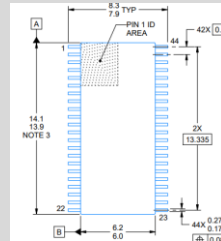
TI TPS7H4001-SP  
18A Ceramic  
QMLV  
5962R1820501VXC



Pkg Size w/2mm leads:  
21.8mm x 11.8mm = 257mm<sup>2</sup>

Power density w/1V output  
~70 mW/mm<sup>2</sup>

TI TPS7H4001-SP  
18A Plastic  
QMLP  
5962R1820502PYE

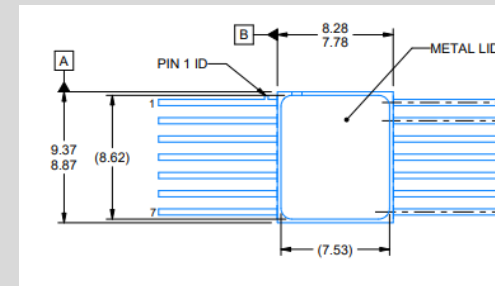


Pkg Size w/leads:  
14.1mm x 8.3mm = 117mm<sup>2</sup>

Power density w/1V output  
~154 mW/mm<sup>2</sup>

## Linear regulator

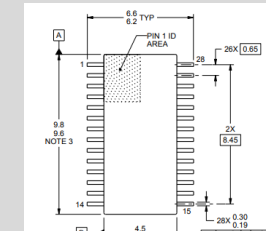
TI TPS7H1111-SP  
1.5A Ceramic  
QMLV  
5962R2120301VXC



Pkg Size w/2mm leads:  
9.3mm x 12.3mm = 115mm<sup>2</sup>

Power density w/1V output  
~13 mW/mm<sup>2</sup>

TI TPS7H1111-SP  
1.5A Plastic  
QMLP  
5962R2120302PYE



Pkg Size w/leads:  
9.8mm x 6.6mm = 65mm<sup>2</sup>

Power density w/1V output  
~23 mW/mm<sup>2</sup>



# Benefits of TI's plastic devices for space -SP & -SEP

- Significant reduction in board area vs equivalent hermetic offerings
- **Improved electrical specifications for high-speed signal chain devices**
  - The relative permittivity of the plastic packages is ~3.7; for ceramic, it is ~9.8. As a result, capacitive coupling for plastic packages is over 2.5 times less, thus improving crosstalk
  - The lower capacitance plastic substrates improve the bandwidth and return loss
- Reduced mass vs hermetic equivalent offerings
- Improved thermal performance vs hermetic equivalent offerings
- Option for pin-to-pin option covering a wider range of missions

# Benefits of TI's plastic devices for space -SP & -SEP

- Significant reduction in board area vs equivalent hermetic offerings
- Improved electrical specifications for high-speed signal chain devices
- **Reduced mass vs hermetic equivalent offerings**
  - TPS7H4001-SP QMLV ceramic package (34-pin CDFP) mass is 2612mg
  - TPS7H4001-SP QMLP plastic package (44-pin HTSSOP) mass is 243mg = ~ 90% less
  - TPS7H1111-SP QMLV ceramic package (14-pin CDFP) mass is 1230mg
  - TPS7H1111-SP QMLP plastic package (28-pin HTSSOP) mass is 198mg = ~ 80% less
- Improved thermal performance vs hermetic equivalent offerings
- Option for pin-to-pin option covering a wider range of missions

# Benefits of TI's plastic devices for space -SP & -SEP

- Significant reduction in board area vs equivalent hermetic offerings
- Improved electrical specifications for high-speed signal chain devices
- Reduced mass vs hermetic equivalent offerings
- **Improved thermal performance vs hermetic equivalent offerings**
  - Traditional ceramic packages place the die in a cavity, this leaves an airgap between the die and the metal lid. With flip-chip BGA -SHP packaging, the metal lid connects to the back of the flip-chip die directly.
  - TI has seen an improvement in thermal efficiency from the die to the package, with the thermal resistance reducing from ~16 C/W in column-grid array ceramic packages to ~0.8 C/W in plastic BGA packages.
- Option for pin-to-pin option covering a wider range of missions

# Benefits of TI's plastic devices for space -SP & -SEP

- Significant reduction in board area vs equivalent hermetic offerings
- Improved electrical specifications for high-speed signal chain devices
- Reduced mass vs hermetic offerings
- Improved thermal performance vs hermetic offerings
- **Option for pin-to-pin option covering a wider range of missions**
  - Many of TI' rad-hard plastic devices (-SP) will be offered in a pin-to-pin rad-tolerant plastic (-SEP) variant
  - The objective of this is to provide designers more options and more flexibility to enable maximum reuse and to have a common architecture for LEO, MEO and/or GEO missions.

# TI's Rad-hard plastic power portfolio as of Feb 2024

Product or Part number	DLA SMD #	Subcategory	-SEP Pin-to-Pin option
<a href="#"><u>TPS7H4001-SP</u></a>	<a href="#"><u>5962-18205</u></a>	Buck converters	<a href="#"><u>TPS7H4003-SEP</u></a>
<a href="#"><u>TPS7H1111-SP</u></a>	<a href="#"><u>5962-21203</u></a>	Linear LDO regulators	<a href="#"><u>TPS7H1111-SEP</u></a>
<a href="#"><u>TPS7H3302-SP</u></a>	<a href="#"><u>5962-14228</u></a>	DDR memory power ICs	<a href="#"><u>TPS7H3302-SEP</u></a>
<a href="#"><u>TPS7H5001-SP</u></a>	<a href="#"><u>5962-18222</u></a>	PWM controllers	<a href="#"><u>TPS7H5005-SEP</u></a>
<a href="#"><u>TPS7H2211-SP</u></a>	<a href="#"><u>5962-18220</u></a>	eFuse controllers	<a href="#"><u>TPS7H2211-SEP</u></a>
<a href="#"><u>TPS7H2201-SP</u></a>	<a href="#"><u>5962-17220</u></a>	eFuse controllers	<a href="#"><u>TPS7H2201-SEP</u></a>

# TI plastic space power portfolio as of Feb 2024

Classification	Product or Part number	Subcategory	Radiation, TID (typ) (krad)	Radiation, SEL (MeV·cm <sup>2</sup> /mg)
Rad-hard QMLP	<a href="#">TPS7H3302-SP</a>	DDR memory power ICs	100	72
	<a href="#">TPS7H1111-SP</a>	Linear & low-dropout (LDO) regulators	100	75
	<a href="#">TPS7H2211-SP</a>	eFuses & hot swap controllers	100	75
	<a href="#">TPS7H5001-SP</a>	PWM controllers	100	75
	<a href="#">TPS7H4001-SP</a>	Buck converters (integrated switch)	100	75
	<a href="#">TPS7H2201-SP</a>	eFuses & hot swap controllers	100	75
Rad-tolerant -SEP	<a href="#">TPS7H2140-SEP</a>	eFuses & hot swap controllers	30	43
	<a href="#">TPS7H2201-SEP</a>	eFuses & hot swap controllers	50	43
	<a href="#">TPS7H2211-SEP</a>	eFuses & hot swap controllers	50	43
	<a href="#">TPS7H1111-SEP</a>	Linear & low-dropout (LDO) regulators	50	43
	<a href="#">TPS7H3302-SEP</a>	DDR memory power ICs	50	43
	<a href="#">TPS7H2221-SEP</a>	Load switches	30	43
	<a href="#">TPS7H5005-SEP</a>	PWM controllers	50	43
	<a href="#">TPS7H5008-SEP</a>	PWM controllers	50	43
	<a href="#">TPS7H5007-SEP</a>	PWM controllers	50	43
	<a href="#">TPS7H5006-SEP</a>	PWM controllers	50	43
	<a href="#">TPS7H4003-SEP</a>	Buck converters (integrated switch)	50	43
	<a href="#">TPS7H1210-SEP</a>	Linear & low-dropout (LDO) regulators	30	43
	<a href="#">TPS7H4010-SEP</a>	Buck converters (integrated switch)	30	43
	<a href="#">TL7700-SEP</a>	Supervisor & reset ICs	30	43
<a href="#">TPS73801-SEP</a>	Linear & low-dropout (LDO) regulators	50	43	

# Getting started

You can start evaluating these devices leveraging the following:

Content type	Content title	Link to content or more details
Selection Guide	TI Space Products Guide	<a href="https://www.ti.com/lit/sg/slyt532i/slyt532i.pdf">https://www.ti.com/lit/sg/slyt532i/slyt532i.pdf</a>
Technical Article	Setting a new standard for electronics in space	<a href="https://news.ti.com/setting-a-new-standard-for-electronics-in-space">https://news.ti.com/setting-a-new-standard-for-electronics-in-space</a>
Parametric Table	View our QML Class P, Y and SHP products	<a href="https://www.ti.com/applications/industrial/aerospace-defense/space/products.html#2954=FCCSP%3BHTQFP%3BHTSSOP%3BSOIC%3BSOT-223%3BSOT-23-THN%3BSOT-SC70%3BSSOP%3BTSSOP%3BVQFN%3BVQFNP%3BVSSOP%3BWQFN&amp;-1=-SP%3Bfalse&amp;">https://www.ti.com/applications/industrial/aerospace-defense/space/products.html#2954=FCCSP%3BHTQFP%3BHTSSOP%3BSOIC%3BSOT-223%3BSOT-23-THN%3BSOT-SC70%3BSSOP%3BTSSOP%3BVQFN%3BVQFNP%3BVSSOP%3BWQFN&amp;-1=-SP%3Bfalse&amp;</a>



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