WORKSHOP ON HIGH END DIGITAL PROCESSING TECHNOLOGIES AND EEE COMPONENTS FOR FUTURE SPACE MISSIONS

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intersil™

RENESAS

INDUSTRY MISCONCEPTION

The fallacy of COTS economics for space applications

- The cost reduction may not be there when the dust settles
  - DPA, up-screen plan, rad evaluation, schedule delays, etc.

Limited issues will be encountered when operating COTS devices in what is commonly thought of to be a benign low earth orbit (LEO) space environment.

Part Number	Description	Issues Encountered
ISL71123	Single Supply, SPDT Analog Switch	Non-functional at 20krad, switch stays open
ISL85033	24V point of load	4.3% Vref shift by 45krad, 76% Vin derating at LET 43, 400mV deviations on the output
ISL78600	Multi-Cell Li-Ion Battery Manager for 12 series stack cells	Catastrophic damage at LET 20V, derating below targeted battery stacks > 30V.

HOW THE STORY BEGAN

For Intersil our goal was to help support the large satellite constellation

- Our engagement started around 4 years ago
- The number of large GEO satellites was on the decline
- >1000 satellites using our devices was enticing

To reduce time to market we utilized devices from our existing rad hard portfolio

- Constantly looking at other solutions in our commercial and automotive product lines

The goal was to reduce size and cost

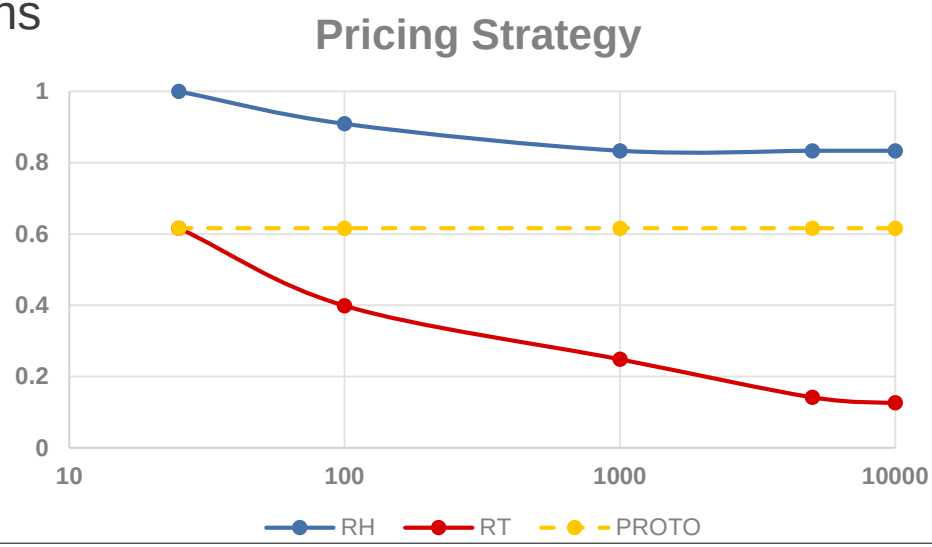
- Plastic packages and elimination of back-end tests and screens

Keys to our success

- Access to plastic assembly
- Experience with automotive qualification
- Robust pricing strategy

Key to your success

- Consolidation (devices & processes)



MISSION PROFILE FOR “NEW SPACE”

Expected Life Cycle ≤ 5 years

- Satellites will be replaced with system upgrades

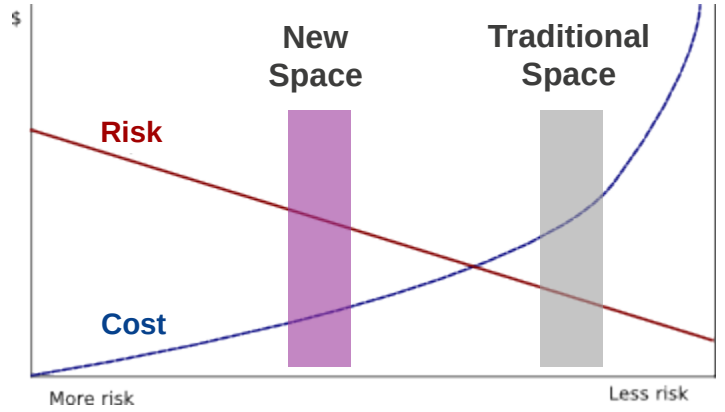
Total radiation exposure = 10 - 30krad(Si)

- Margin may be needed, devices may need to meet as high as 60krad(Si)

SEE expectations = LET of 30 – 43MeV·cm²/mg

- Destructive SEE causes early termination of satellite life cycle
- Non-destructive SEE can be typically handled with redundancy, EDAC, filtering, etc.
  - An SET on the FPGA can causes errors on the logic
  - An SET on the PM IC can damage the FPGA

Willing to accept more risk at a lower price point



RADIATION TOLERANT PRODUCT QUALIFICATION

One time characterization to 30krad(Si) at a dose rate of ≤10mrad/sec.
- Summary of ELDRS testing included in the datasheet

SEE characterization for destructive and transient events at 43MeV·cm^2/mg
- Summary of SEE testing included in the datasheet

2 lot temperature characterization to -55C and +125C
- To set datasheet limits

Automotive "like" qualification
- 2000 hours of life test
- Moisture resistance test (MRT)
- 500 Temperature Cycles (-55C to +125C)
- Unbiased HAST
- Biased HAST
- 1000 hour Storage life
- +125C latch-up and ESD
- Surface mount leaded packages with NiPdAu finish

RADIATION TOLERANT PRODUCTS SUPPLY CHAIN

In cases where there is a RH equivalent, wafer lots are split

- Wafer level testing on predetermined WAT limits
- No radiation lot or wafer assurance testing

Offshore assembly & test

- 25°C electrical screening (w/ -55°C to +125°C guard banded limits)

Change control implemented on all products

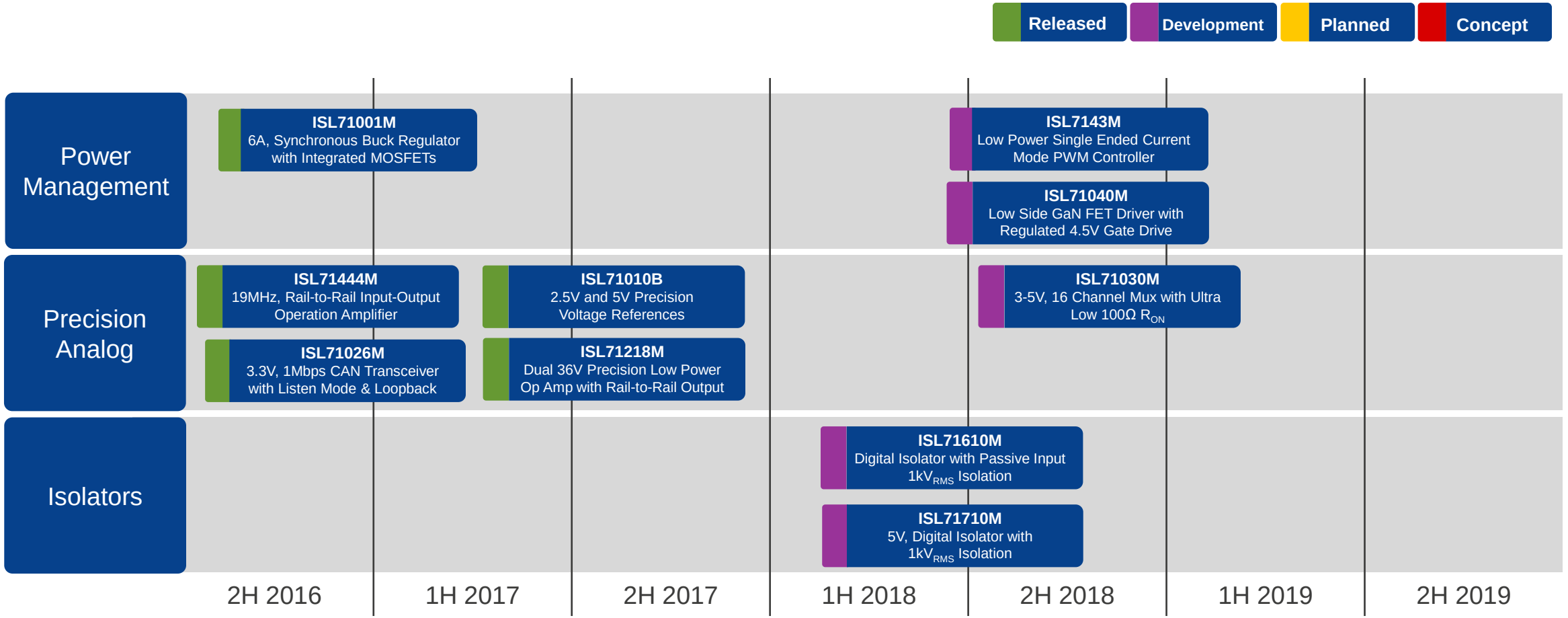
Single manufacturing site for both assembly & test

- Same as Enhanced Product (EP) flow in this regard

Ongoing reliability monitors (volume dependent)

- Burn-in
- Temperature cycle
- Unbiased HAST & MSL
- Storage life

RADIATION TOLERANT PRODUCTS ROADMAP



OTHER POSITIVE ATTRIBUTES

- In the majority of the cases the die robustness is still there
  - In regards to functioning in a space environment
- Heat transfer capability is equal or better than the traditional hermetic package
- Mass and physical size are much less than the hermetic counter part
- Mechanically more rugged than many hermetic packages
  - Especially under shock & vibration
- The only difference is the handling, storage and preconditioning for board assembly
  - Nothing new compared to commercial applications
  - MSL sensitivity is not an issue once in space
- Outgassing of molding compound tested to ASTM E 595 specification
- With the Renesas acquisition we have a broad portfolio of digital products to leverage for this new space market
- All these devices are EAR99 and have limited export restrictions!

BIG IDEAS FOR SPACE
THANK YOU.

BACK-UP

OUT GAS TESTING ON MOLD COMPOUND

Mold compound meets NASA standard for outgassing

Results:

Table 1: Outgas test results.

Sample	TML (%)	CVCM (%)	WVR (%)
ISL71010MBZ	0.06	<0.01	0.03
ISL71444MVZ	0.06	<0.01	0.03
ISL71001MNZ	0.05	<0.01	0.02
G700	0.11	<0.01	0.03
G600	0.10	<0.01	0.03

- A total mass loss (TML) of 1% and collected volatile condensable material (CVCM) of 0.1% are rejects
- Testing was performed in vacuum of 5 x 10^{-5} torr for 24 hrs. at 125°C per ASTM E 595 specification

HERITAGE OF INNOVATION IN HI-REL

- **Legacy of ground-breaking innovation in the most challenging applications**

1960
1961 First CMOS IC
1964 First Rad Hard SOI IC
1970
1980
1984 First Rad Hard Multiplexer
1990
1996 First PC multi-phase Vcore
2000
2010
2010 First radiation hardened POL
2018 Reinvest into RH MOSFET market
2020
2018 Release RH GaN FETs and first low side GaN driver
Beyond 2020 Become the leading supplier of space components