

COTS for Space The ADI perspective

Jim Ryan

Product Marketing

Space Products Group – Aerospace & Defence BU



Aerospace and Defence Spectrum Usage

Complete Solutions for the Entire Spectrum



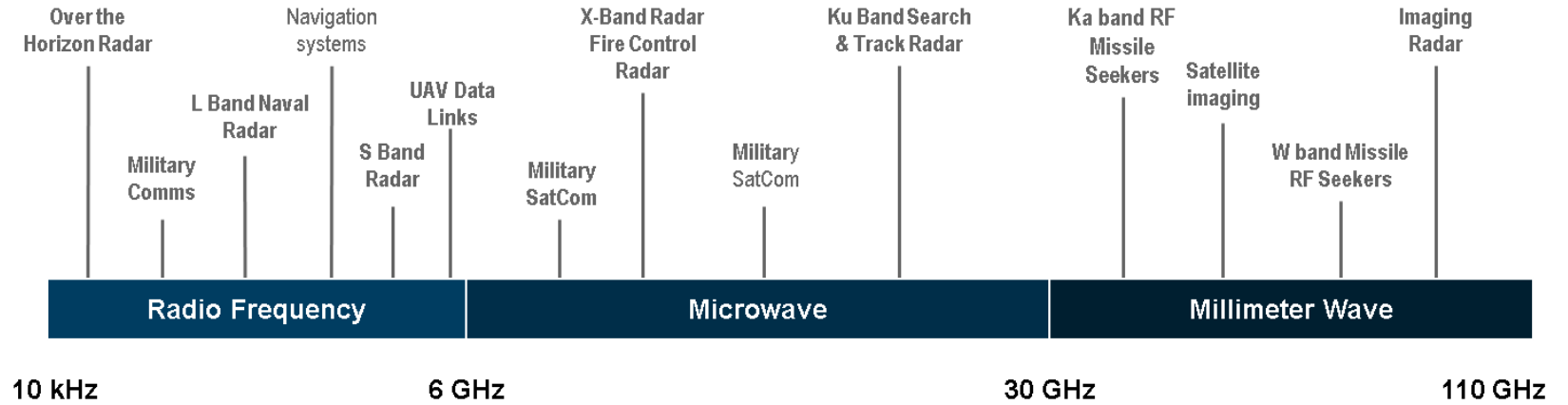
- ▶ ADCs/DACs
- ▶ DSPs and processors
- ▶ MEMS and sensors
- ▶ Interfaces
- ▶ Switches and multiplexers
- ▶ Optical



- ▶ RF and microwave Modules



- ▶ Power management
- ▶ Signal conditioning
- ▶ Monitor and control
- ▶ μModule® regulators
- ▶ Wireless sensor networks
- ▶ ADCs/DACs



Industry's Broadest Portfolio of Solutions Across Entire Signal Chain

Broadest Process Technology Portfolio

GaN, GaAs, SiGe, BiCMOS, CMOS, MEMS, SOI



Avionics



Space



Radar

Advanced Integrated Solutions

Antenna-to-bits portfolio and ability to integrate on-chip and in-package

Security Capabilities

Hardware- and software-based cybersecurity and cryptographic technologies

Space Market Dynamics



Driving factors:

- ▶ **Increasing demand for data**
 - Mobile data traffic expected to grow at 25% CAGR
 - Global IP traffic expected to grow at 20% CAGR
- ▶ **Increasing constellation size**
 - Typical GEO : 2-10
 - Typical LEO : 100-1000's
- ▶ **Reducing launch costs facilitates larger constellations**
 - Past: \$200M ULA
 - Present: \$60M SpaceX
 - Future: SpaceX target is \$5M
- ▶ **Lower satellite costs**
 - Past: \$500M – large GEO
 - Present: \$500k – OneWeb LEO
 - Future: ??
- **Program Life-times are reducing**
 - Need to shorten time from concept to launch

COTS in Space – Achieving a balance

PROs



Quicker access to the latest technology and products



Lower cost (compared to QML-V products)

CONs



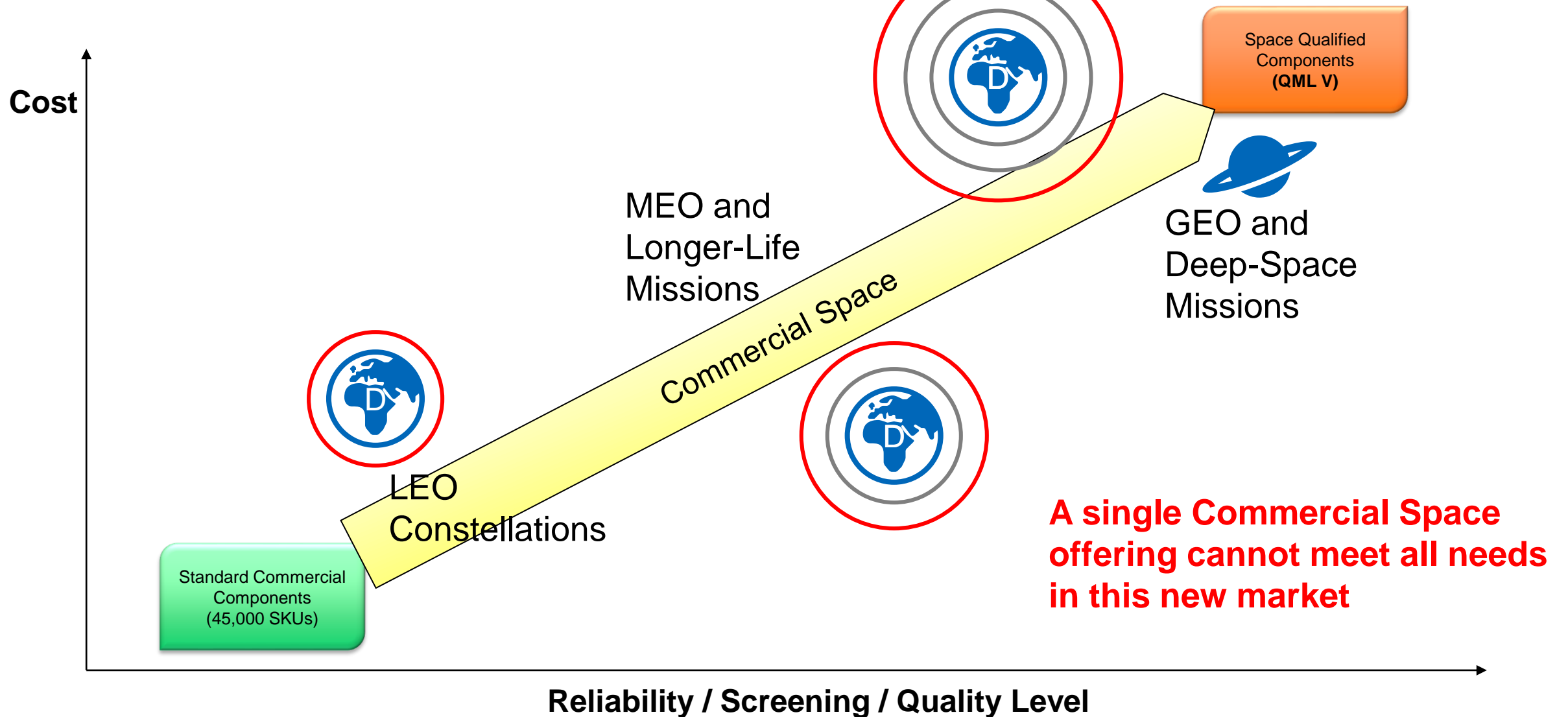
Commercial Packaging (Typically non-hermetic)



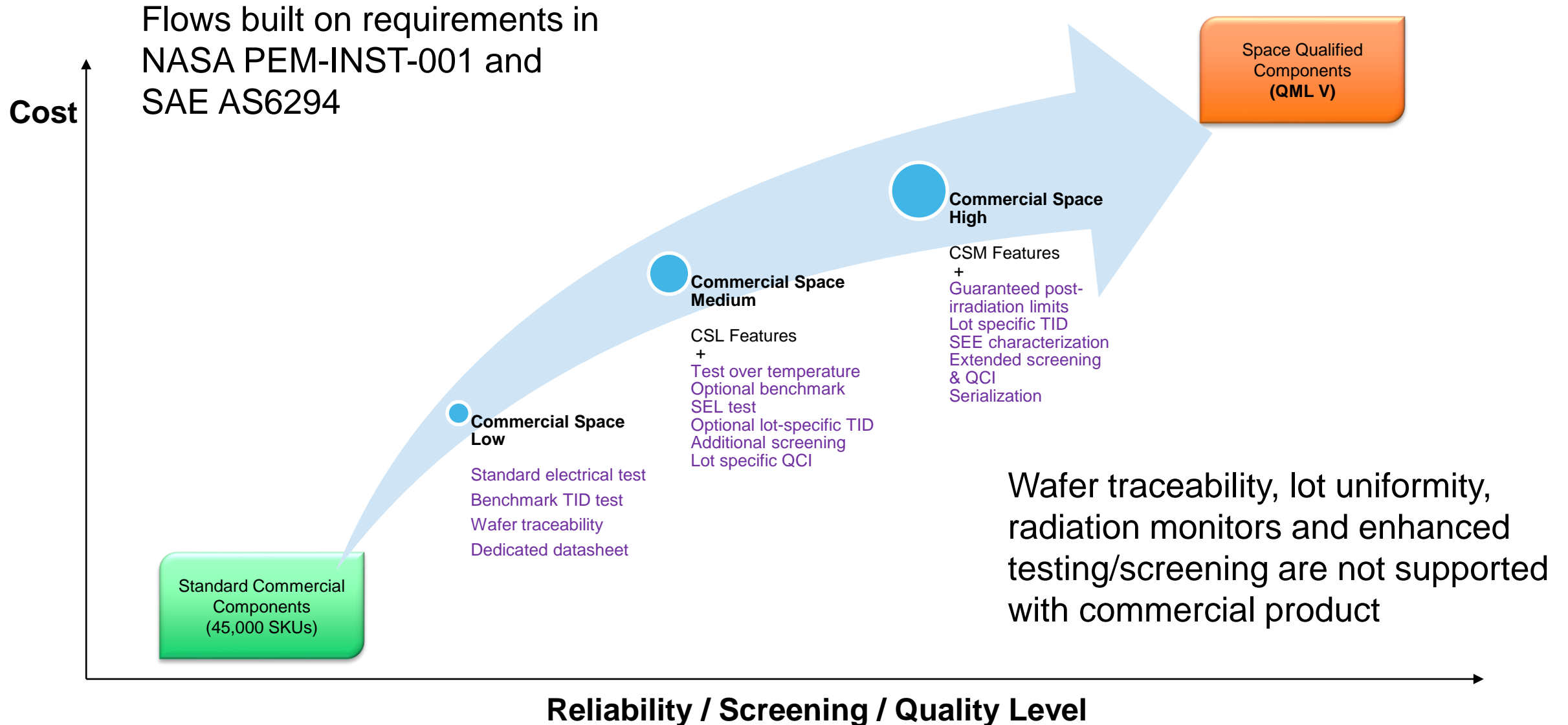
No special treatment for RAD performance*

The Risk Profile will depend on the Mission lifetime and requirements

Where does Commercial Space fit?



Commercial Space Flow Overview



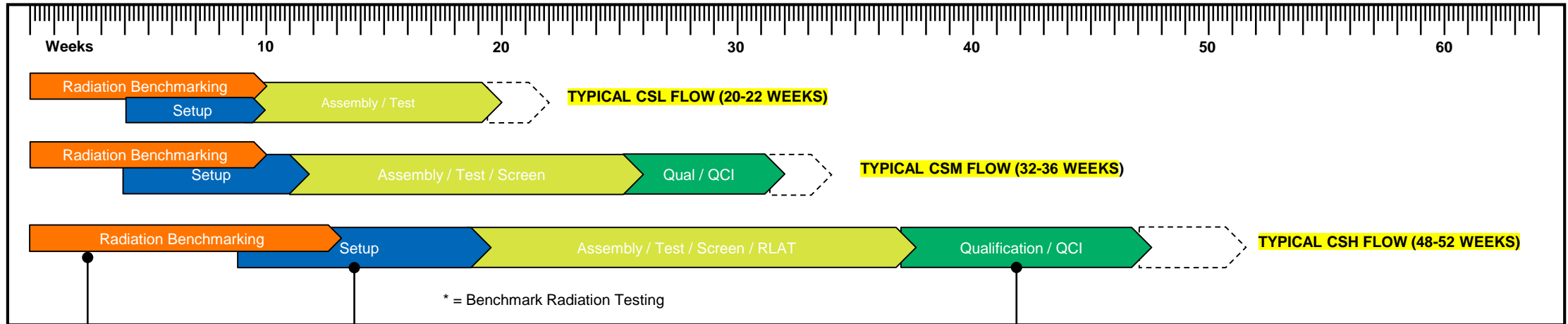
CS Product Availability

- ▶ CS products are [based on released products](#)
 - Best available grade is selected for CSL/CSM (can be automotive if available)
 - CSH operating temperature target is -55/125°C (product dependent)
 - Same package as commercial version
 - Matte Tin is default terminal finish (NiPdAu or SnPb may be possible)
 - A minimum business case will be required to support the engineering investment

- ▶ How are products selected for CS grade
 - Some roadmap parts will be implemented according to generic demands
 - Specific customer and program requirements
 - Process technology / design suitability (likely radiation responses)

- ▶ CS products will become generally available once implemented
 - It will take some time to create a catalog of parts

CS Product Implementation



Setup becomes more complex moving from CSL to CSM/CSH, includes h/w fixturing and test development. Some tasks may be performed in parallel with radiation benchmarking.

No additional qualification is performed on CSL flow, leveraging existing qualification. CSM and CSH have increasing complex qualification and QCI requirements.

Benchmark target (CSL/CSM/CSH) is 50Krad TID + SEL characterization, and SEFI (CSH only), testing performed is dependent on process technology and existing data. Insufficient safety margin may require selection of alternative product adding to the overall implementation time.

CS Products in Development

AD9213 High Speed ADC - CSH



12-Bit, 6 GSPS/10.25 GSPS, JESD204B, RF Analog-to-Digital Converter

Data Sheet

AD9213

FEATURES

High instantaneous dynamic range

NSD

-155 dBFS/Hz at 10 GSPS with -9 dBFS, 170 MHz input

-153 dBFS/Hz at 10 GSPS with -1 dBFS, 170 MHz input

SFDR: 70 dBFS at 10 GSPS with -1 dBFS, 1000 MHz input

SFDR excluding H2 and H3 (worst other spur): 89 dBFS at 10 GSPS with -1 dBFS, 1000 MHz input

Low power dissipation: <4.6 W typical at 10 GSPS

Integrated input buffer (6.5 GHz input bandwidth)

1.4 V p-p full-scale analog input with $R_{IN} = 50 \Omega$

Overvoltage protection

16-lane JESD204B output (up to 16 Gbps line rate)

Multichip synchronization capable with 1 sample accuracy

DDC NCO synchronization included

Integrated DDC

Selectable decimation factors

16 profile settings for fast frequency hopping

Fast overrange detection for efficient AGC

On-chip temperature sensor

On-chip negative voltage generators

Low CER: $<1 \times 10^{-16}$

12 mm × 12 mm, 192-ball BGA-ED package

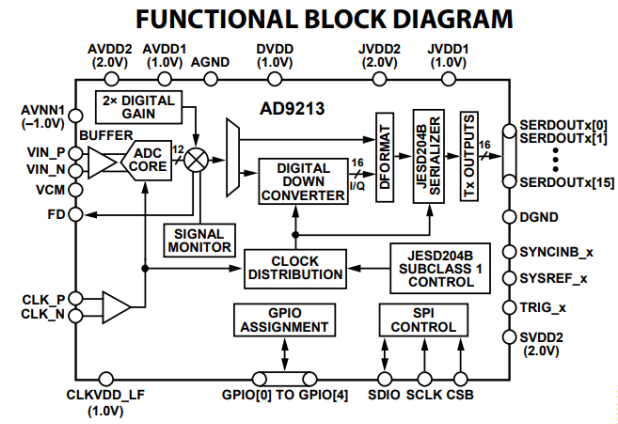


Figure 1.

AD9361 Transceiver - CSL



RF Agile Transceiver

Data Sheet

AD9361

FEATURES

RF 2 × 2 transceiver with integrated 12-bit DACs and ADCs

TX band: 47 MHz to 6.0 GHz

RX band: 70 MHz to 6.0 GHz

Supports TDD and FDD operation

Tunable channel bandwidth: <200 kHz to 56 MHz

Dual receivers: 6 differential or 12 single-ended inputs

Superior receiver sensitivity with a noise figure of 2 dB at 800 MHz LO

RX gain control

Real-time monitor and control signals for manual gain

Independent automatic gain control

Dual transmitters: 4 differential outputs

Highly linear broadband transmitter

TX EVM: ≤ -40 dB

TX noise: ≤ -157 dBm/Hz noise floor

TX monitor: ≥ 66 dB dynamic range with 1 dB accuracy

Integrated fractional-N synthesizers

2.4 Hz maximum local oscillator (LO) step size

Multichip synchronization

CMOS/LVDS digital interface

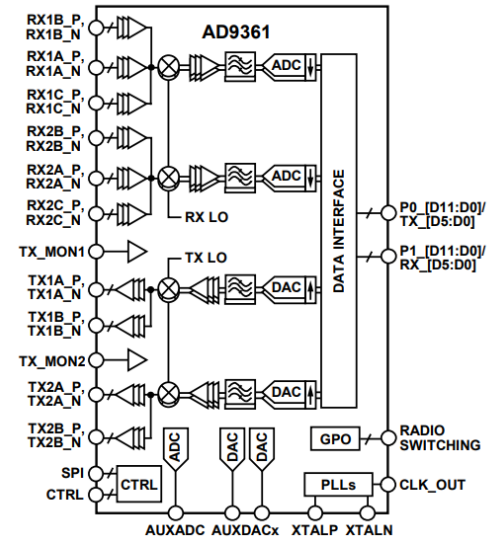
APPLICATIONS

Point to point communication systems

Femtocell/picocell/microcell base stations

General-purpose radio systems

FUNCTIONAL BLOCK DIAGRAM



NOTES
1. SPI, CTRL, P0_[D11:D0]/TX_[D5:D0], P1_[D11:D0]/RX_[D5:D0],
AND RADIO SWITCHING CONTAIN MULTIPLE PINS.

Figure 1.

10-935-001



0.5 dB LSB, 6-Bit, Silicon Digital Attenuator, 9 kHz to 40 GHz

Data Sheet

ADRF5720

FEATURES

Ultrawideband frequency range: 9 kHz to 40 GHz

Attenuation range: 0.5 dB steps to 31.5 dB

Low insertion loss with impedance match

2.0 dB up to 18 GHz

2.8 dB up to 26 GHz

4.5 dB up to 40 GHz

Attenuation accuracy with impedance match

$\pm(0.20 + 1.0\%$ of attenuation state) up to 18 GHz

$\pm(0.20 + 1.5\%$ of attenuation state) up to 26 GHz

$\pm(0.40 + 3.0\%$ of attenuation state) up to 40 GHz

Typical step error with impedance match

± 0.25 dB up to 26 GHz

± 0.65 dB up to 40 GHz

High input linearity

P0.1 dB insertion loss state: 30 dBm

P0.1 dB other attenuation states: 27 dBm

IP3: 50 dBm typical

High RF input power handling: 27 dBm average, 30 dBm peak

Tight distribution in relative phase

No low frequency spurious signals

SPI and parallel mode control, CMOS/LVTTL compatible

RF amplitude settling time (0.1 dB of final RF output): 8 μ s

24-terminal, 4 mm \times 4 mm LGA package

Pin-compatible with ADRF5730, fast switching version

FUNCTIONAL BLOCK DIAGRAM

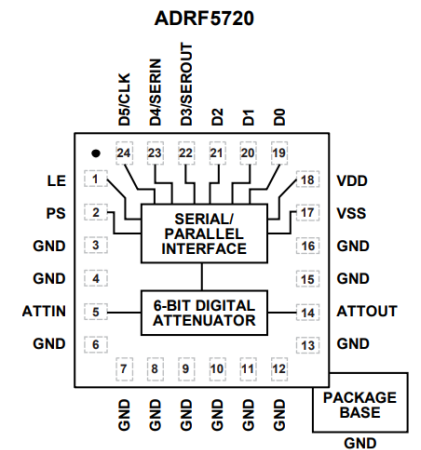


Figure 1.

LTC5596 40GHz RMS Detector - CSH



LTC5596

100MHz to 40GHz
Linear-in-dB RMS Power Detector with
35dB Dynamic Range

FEATURES

- Ultra Wide Matched Input Frequency Range: 100MHz to 40GHz
- 35dB Linear Dynamic Range (< ±1dB Error)
- 29mV/dB Logarithmic Slope
- ±1dB Flat Response from 200MHz to 30GHz
- Accurate RMS Power Measurement of High Crest Factors (Up to 12dB) Modulated Waveforms
- Low Power Shutdown Mode
- Low Supply Current: 30mA at 3.3V (Typical)
- Small 2mm × 2mm Plastic DFN8 Package
- I-Grade: -40°C to 105°C Rated
- H-Grade: -40°C to 125°C Rated with Guaranteed Log-Slope and Log-Intercept
- ESD Rating: 3500V HBM, 1500V CDM

APPLICATIONS

- Point-to-Point Microwave Links
- Instrumentation and Measurement Equipment
- Military Radios
- LTE, WiFi, WiMax Wireless Networks
- RMS Power Measurement
- Receive and Transmit Gain Control
- RF PA Transmit Power Control

DESCRIPTION

The LTC[®]5596 is a high accuracy RMS power detector that provides a very wide RF input bandwidth, from 100MHz up to 40GHz. This makes the device suitable for a wide range of RF and microwave applications, such as point-to-point microwave links, instrumentation and power control applications.

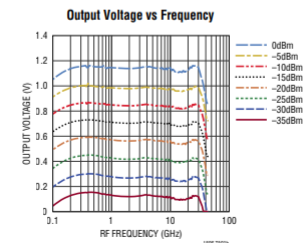
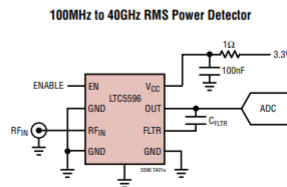
The DC output voltage of the detector is an accurate representation of the average signal power applied to the RF input. The response is linear-in-dB with 29mV/dB logarithmic slope over a 35dB dynamic range with typically better than ±1dB accuracy. The detector is particularly suited for measurement of waveforms with crest factor (CF) as high as 12dB, and waveforms that exhibit a significant variation of the crest factor during the measurement.

To achieve higher accuracy and lower output ripple, the averaging bandwidth can be externally adjusted by a capacitor connected between the FLTR and OUT pins.

The enable interface switches the device between active measurement mode and a low power shutdown mode.

LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners. Protected by U.S. patents, including 9330283 B2.

TYPICAL APPLICATION



For more information www.linear.com/LTC5596

1

Visit our Space microsite on www.analog.com

<https://www.analog.com/en/applications/markets/aerospace-and-defense-pavilion-home/adev-solutions/space-solution.html>



Search



MYANALOG

MY HISTORY

PRODUCTS

APPLICATIONS

DESIGN CENTER

EDUCATION

SUPPORT

SPACE DEVICES AND SYSTEMS

ADI space products stand the test of space.

Find space solutions



Search



MYANALOG

MY HISTORY

PRODUCTS

APPLICATIONS

DESIGN CENTER

EDUCATION

SUPPORT

Applications > Markets > Aerospace and Defense > Solutions > Space

Print



Space