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TOR VERGATA

UNIVERSITÀ DEGLI STUDI DI ROMA

Project GAMA

Satellite Systems Innovative Equipment

"EquipaGgiamenti innovAtivi per sisteMi SAtellitari"

SAPIENZA

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Integrated Systems

ATEN IS

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Dec. 2021

GAMA Project

Project Target

Design, manufacture and validate innovative equipment for on-board and on-ground satellite equipment in Q and V band.

Project Team

N.2 SMEs

- Wave Advanced Technology Applications S.r.l.
- ATEN IS S.r.l.

N.2 Universities:

- University of Rome Tor Vergata
- University of Roma La Sapienza

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GAMA Project: Target Market & Applications

Deep Space

Deep Space applications in the 31-35 GHz Band.

- ✓ Design, manufacture and test an SSPA (on-board payload)
- ✓ Design, manufacture and test a Satellite Signal Generator to correctly test SSPA performances

5G/SATCOM on the Move

Uniquitous connectivity applications based on V band SATCOM (47-51GHz) communications.

- ✓ Design, manufacture and test an SSPA (ground terminal)
- ✓ Design, manufacture and test a Satellite Signal Generator to correctly test SSPA performances

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GAMA Project: Dissemination and Marketing

GAMA Project has been designed with a strong market attention.

Requirement definition

Interaction with major stakeholders to define target requirements

Marketing & Dissemination

Disseminate project results and refine market/stakeholders requirements for the engineering of commercial viable products.

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GAMA Project: Stackeholders

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Agenzia Spaziale Italiana - U.O. TLC e Navigation

Joint Board on Communication Satellite Programmes

Corpo Nazionale dei Vigili del Fuoco

Dipartimento Regionale Vigili del Fuoco Lazio

Dipartimento Regionale Vigili del Fuoco Umbria

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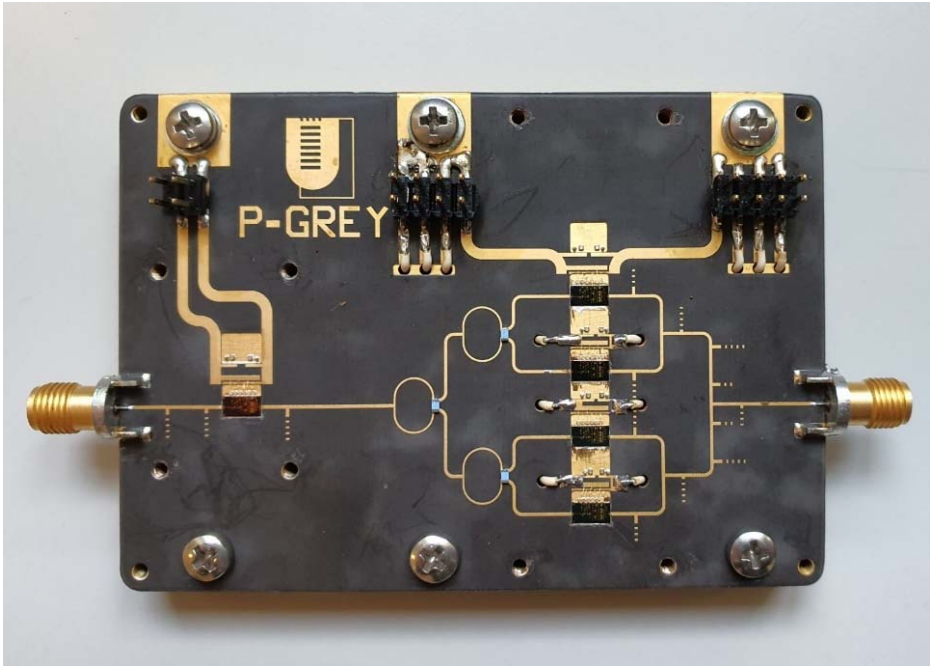
Deep Space SSPA: P-GREY (1)

- Operating band: 31 – 34 GHz
- maximum output power: > 40 dB
- Gain greater than 30 dB
- Drain Efficiency: 15%
- Dimensions: 60.6 mm x 86.3 mm
- Input and output K-type connector
- Input/output return loss better than 10 dB
- Bias: VDD=9V / VGG=-1.3V
- Maximum current 8 A



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Deep Space SSPA: P-GREY (2)

- The circuit is intended for Deep Space communications
- Two operation modes are foreseen
  - High bias voltage , high output power mode for ground segment equipment
  - Medium bias voltage , medium output power mode for space segment equipment
- Data in the previous slide refers to the space segment operation
- The MMIC High Power Amplifiers are in an advanced industrial Gallium Nitride technology
- The Deep Space HPA has been designed, manufactured and tested

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Satellite Signal Generator (1)

- The signal generator is a board hosting a FPGA and a SDR. A script has been developed that allows generation of waveform samples with the most common satellite modulation formats, setting their carrier frequency, modulation format and sampling frequency

Modulation	BPSK, QPSK, 8PSK, 16PSK, 16QAM
Symbol rates f_B	128Ksps – 7.68Msps
Sampling rates f_S	7.68Msps – 61.44Msps
Carrier frequency f_C	50MHz – 6GHz

- The waveform samples are sent to an FPGA and then modulated in a SDR. Finally, the RF waveform is available at the transmitter's SMA connector.

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Satellite Signal Generator (2)

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Satellite Signal Generator (3)

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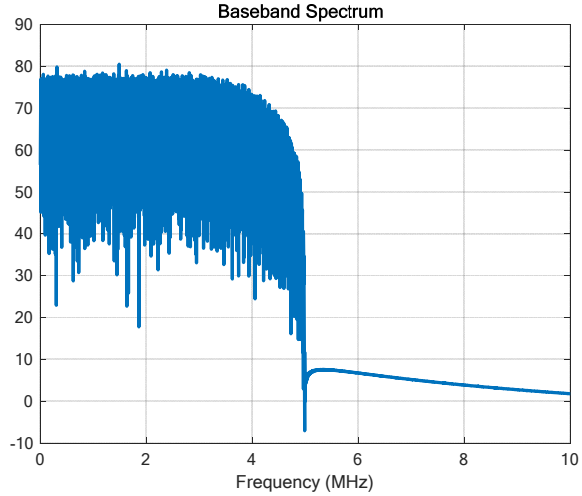
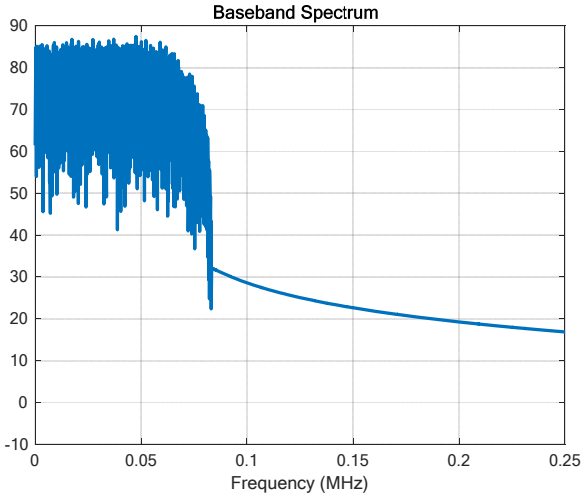
Simulation, at base-band

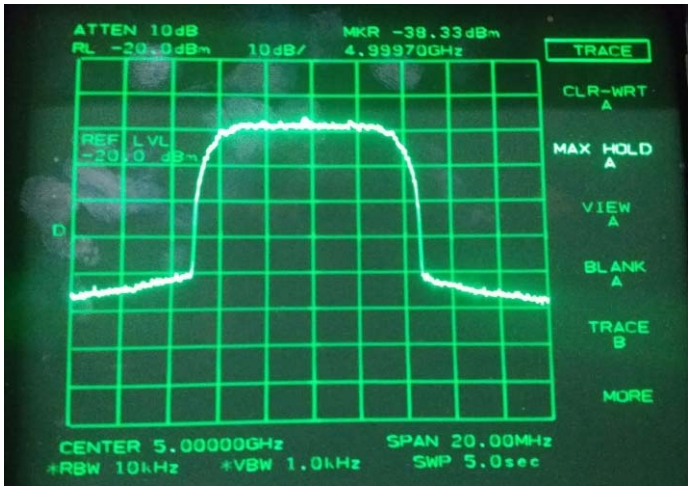


BPSK

f_B = 7.68Msps

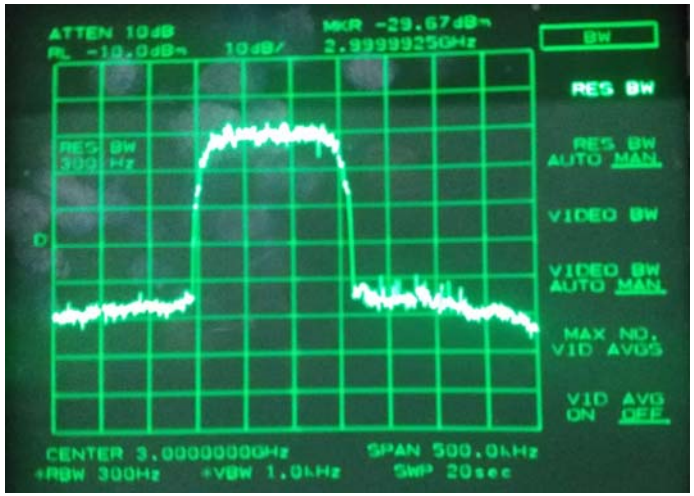


Measurement at RF



8PSK

f_B = 128Ksps



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SATCOM on the Move SSPA (1)

A strong technological trend is driving Mega- Constellations (One Web and Starlink): Ubiquitous Connectivity.

Ubiquitous 5G/High Troughput Internet connection is required by many upcoming and pervasive applications: Connected Car is the main one.

V band (47,5 – 51,4GHz) is the selected band to deliver the highest throughput service with extremely low latency for real time car autonomous drive.

Wave has decided to enter the market with an innovative SSPA based on spatial combining technologies, delivering enough power for a solid satellite link between LEO Mega-Constellations and a mobile user.

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SATCOM on the Move SSPA (2)

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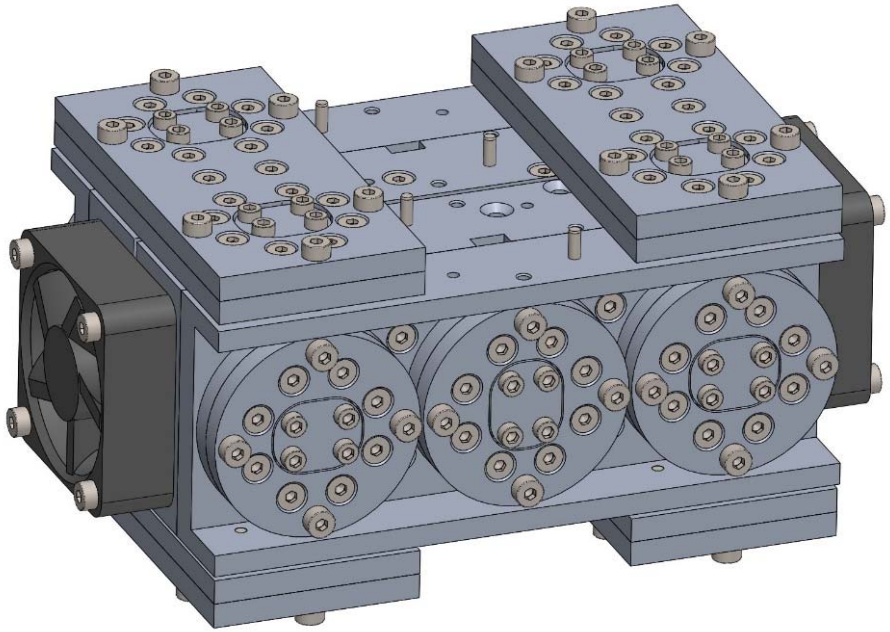
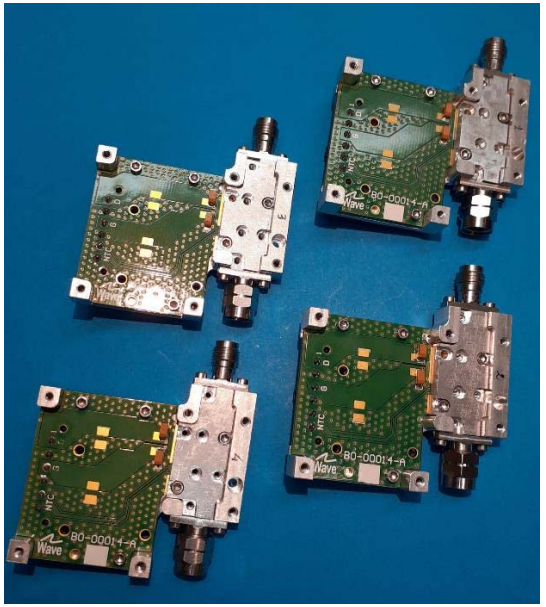
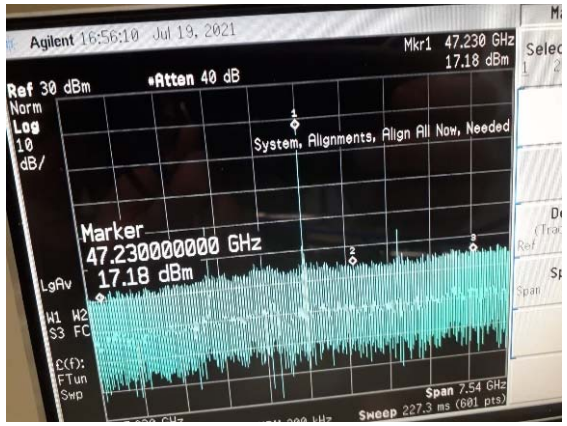
- ✓ Operating Frequencies: 47 ÷ 52GHz
- ✓ Small Signal Gain: 32dB
- ✓ Psat: 32dBm @ 15% PAE
- ✓ Drain Voltage: 5V
- ✓ Dimensions: 13cm x 9cm x 7cm
- ✓ RF I/O: WR19

V band SSPA



Single Channel Breadboard





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