



Geoscience and Remote Sensing Society

Frequency Allocations in Remote Sensing Technical Committee (FARS-TC)



CORF Spring Meeting

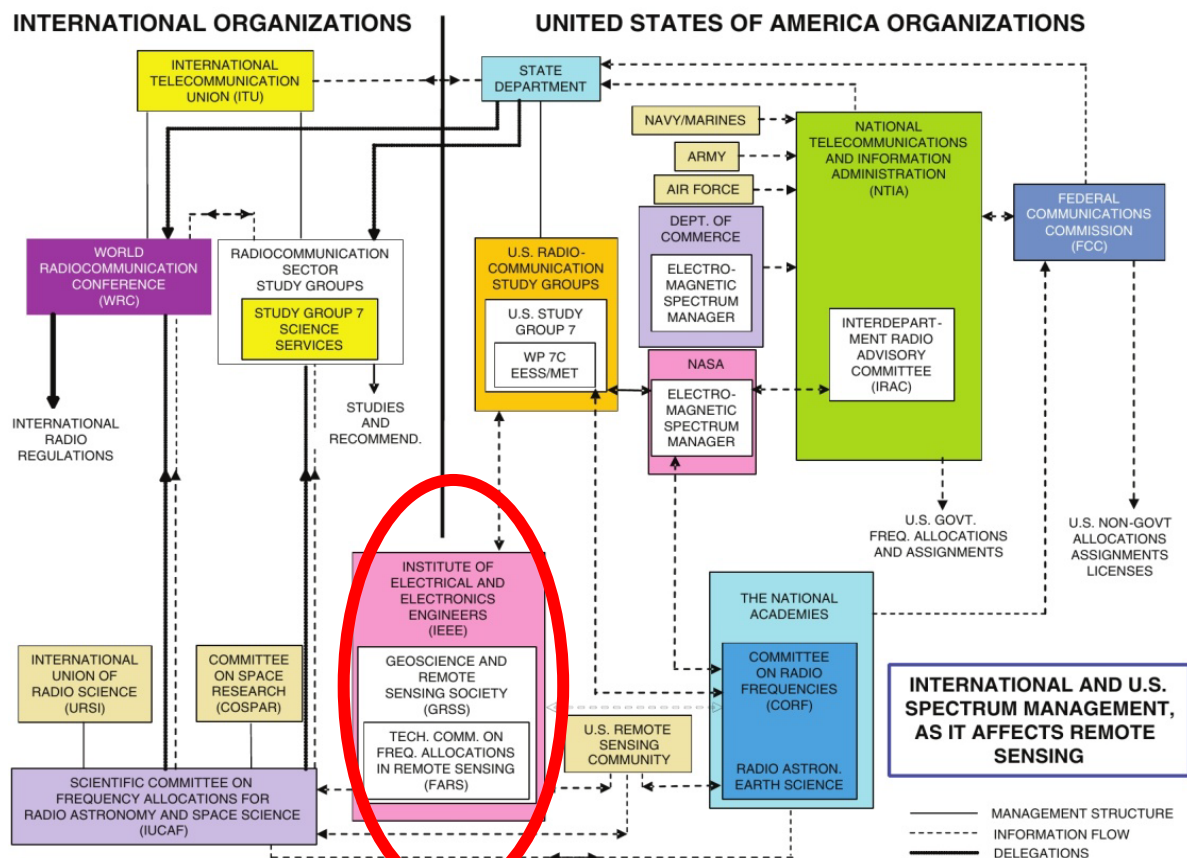
May 29, 2024

Introduction

The Frequency allocations in Remote Sensing Technical Committee goal is to ***interface between GRSS and the radio-frequency regulatory world*** by

- ❑ educating the remote sensing community on spectrum management processes and issues
- ❑ promoting the development of radio frequency interference detection and mitigation technology
- ❑ organizing technical sessions at conferences, workshops, etc. on the above processes, issues and technologies
- ❑ providing spectrum managers and regulators with technical input and perspective from remote sensing scientists and engineers
- ❑ fostering the exchange of information between researchers in different fields, such as remote sensing, radio astronomy, telecommunications, etc. with the common scope of minimizing harmful interference between systems

Our Place in the Spectrum Domain

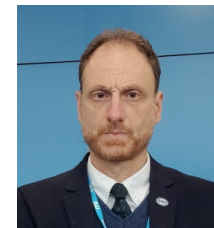


we are here!

FARS-TC Leadership

- **Chair:**

Paolo de Matthaeis (NASA Goddard Space Flight Center)



- **Co-chairs:**

Beau Backus (Johns Hopkins Applied Physics Lab)

Ming-Liang Tao (Northwestern Polytechnical University, China)

Raúl Díez García (European Space Agency)



- **Secretary:**

Aravind Venkitasubramony (University of Colorado)



Summary of FARS activities

Education and promotion

- Organization of RFI sessions at conferences (IGARSS, URSI)
- Articles, webinars, etc. on RFI and spectrum management for remote sensing
- Presentation of FARS activities at different conferences

Development activities

- Web tools for RFI and Frequency management to support our members
- Monitor activities related to 5G deployment at 24 GHz: PocketQube

Participation in regulatory process

- Involvement and contribution to spectrum management activities:
SFCG and ITU
- Development of Standard related to quantification of RFI in EESS bands
- Filing of Comments with the FCC
- Identifying the WRC-27 agenda items and other topics on which to focus.

CONFERENCES

IGARSS 2024

- 7-12 Jul 2024 in Athens, Greece
- FARS Annual Meeting
- Two Session on RFI in microwave remote sensing and related topics



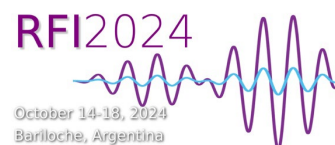
AT-RASC 2024

- 19-24 May 2024 in Gran Canaria, Spain
One session on RFI within Commission F



OTHERS

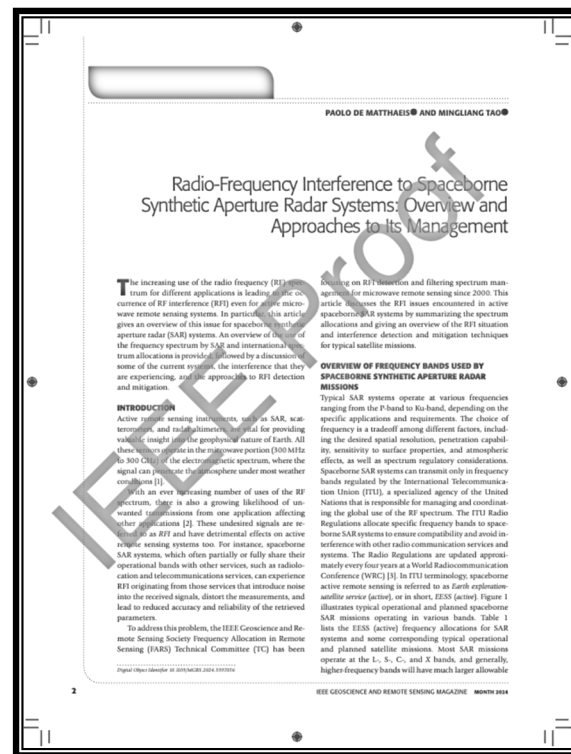
- AMS Meeting 2024 in Baltimore
(presentation on RFI Standard by FARS)
- MicroRad 2024 in Alexandria: session on RFI
- IEEE IMS 2024: Panel session
- RFI 2024 Workshop



PUBLICATIONS

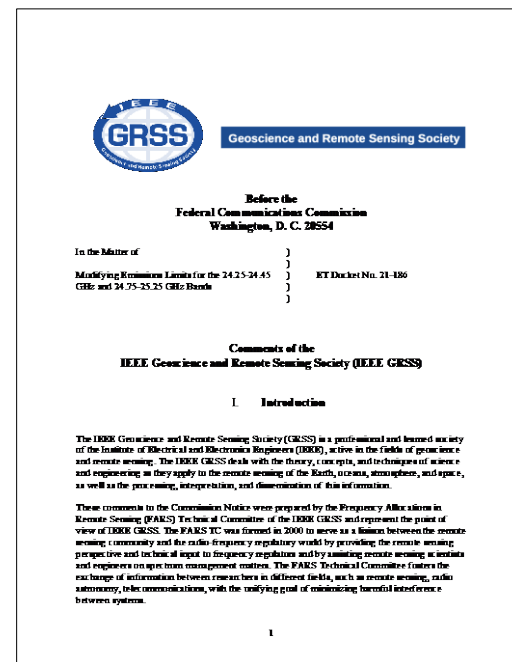
Column articles in the Geoscience and Remote Sensing Magazine:

- **December 2023**
Open PocketQube Kit,
by the Polytechnical University of Catalonia (UPC)
- **In Press**
Radio Frequency Interference Signatures to Spaceborne Synthetic Aperture Radar Systems: Overview of Approaches to Its Management,
by FARS-TC Co-Chair Ming-Liang Tao and FARS-TC Chair Paolo de Matthaeis



Comments to the FCC

- Comments prepared and filed to the US Federal Communications Commission (FCC) on behalf of IEEE GRSS, in response to a *Notice of Proposed Rulemaking (NPRM) on Out-of-Band Emissions (OOBE) limits for the 24.25-24.45 GHz and 24.75-25.25 GHz bands*.
- This NPRM was issued as a follow up to the April 2021 FCC Public Notice requesting comments on whether and how to implement the emissions limits decided at WRC-19 in its **Res. 750** within the US and solicits further input on this topic (comments also submitted at that time).
- **Res. 750** sets OOBE limits for current IMT devices as well as more stringent limits starting by September 1, 2027. IEEE GRSS recommends adoption of the **Res. 750** limits in the US and calls for an earlier switch to the second stricter set of limits.

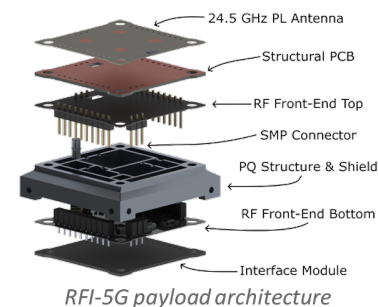
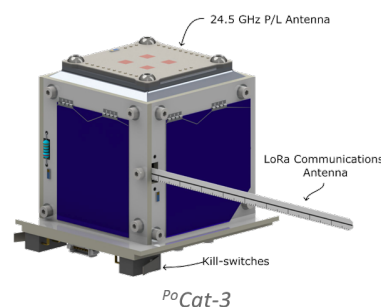


PocketQube for K-band RFI monitoring

- Third of a series of PocketQube (PQ) designed and built as part of an educational initiative
- Goal is to detect out-of-band emissions from 5G systems transmitting at 24.25-27.5 GHz
- PQ is participating in ESA “Fly your Satellite” 4
- Payload is being validated mounted on a drone
 - two test campaigns for hardware validation performed in Spain in early December
 - two more hardware testing campaigns to be carried out in the 2nd quarter of 2024
 - RFI measuring campaign in early planning (maybe Spain, if mmW 5G deployment moves forward there)



Drone + PocketQube

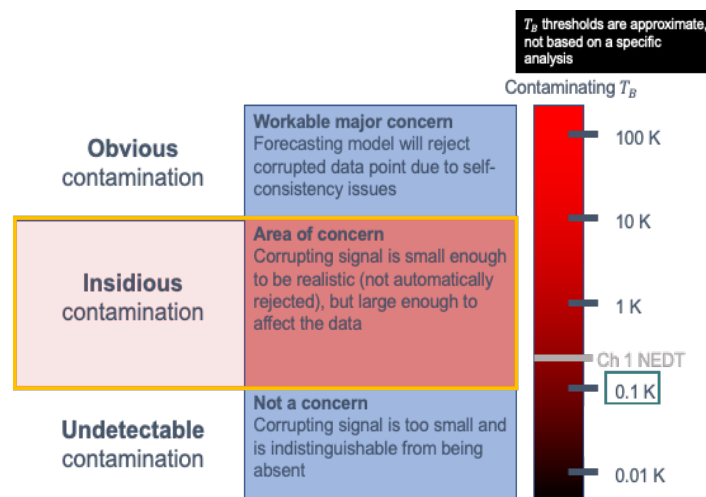


Standard for RFI Impact Assessment

Focused on the development of a standard to address the concerns for degradation to remote active and passive sensors caused by Radio Frequency Interference (RFI).

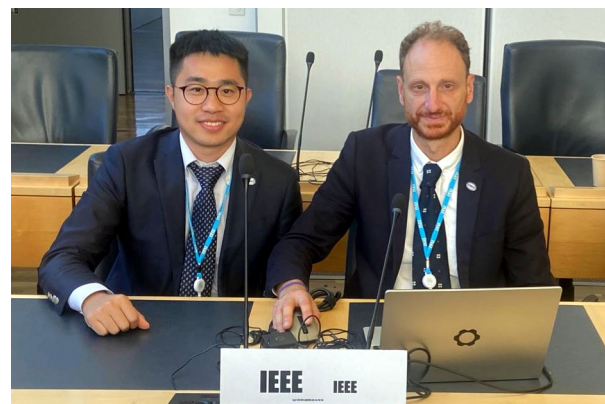
Will provide guidelines and methods to quantitatively assess RFI on the affected frequency bands.

- Information from this standard is expected to be used to inform policy decision makers and the public regarding the status, over time, of anthropogenic caused RFI in any given remote sensing frequency band and its impact on remote sensing operations and products.
- Intended to be used in RFI impact evaluations and monitoring of frequency bands allocated to space-based remote sensing.
- Standard will provide a definition of RFI as it relates to space-based remote sensing operations.

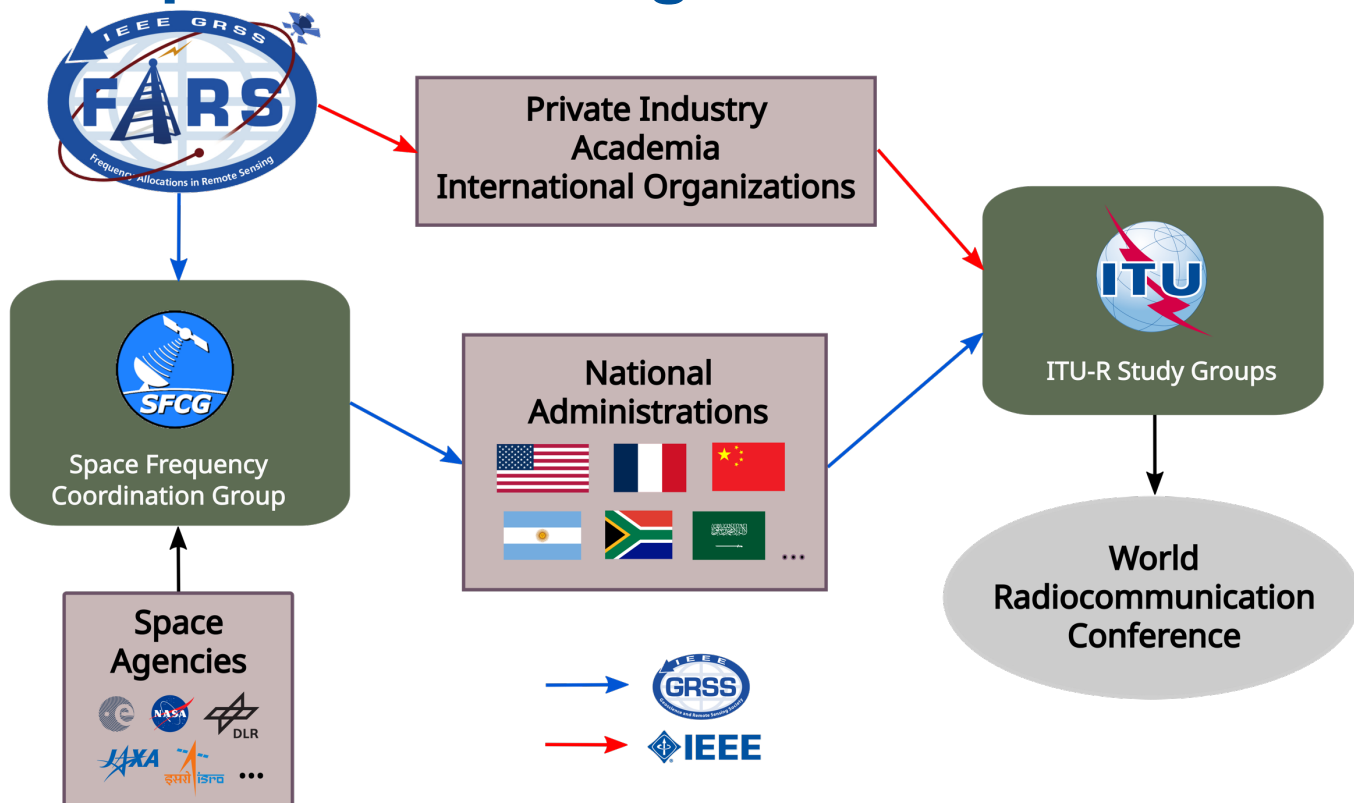


International Spectrum Management Activities

- Being under IEEE GRSS, the FARS TC can represent the remote sensing community without having to compromise its position with other interests.
- The FARS TC has been involved in management international particularly through the
 - Space Frequency Coordination Group since 2015;
 - ITU-R Study Groups since 2018.



Spectrum Management Activities





ITU-R Study Groups and SFCG

- ITU-R Working Party 7C (Remote Sensing Systems)
 - continuing to work on the **report on 18 GHz RFI** caused by surface reflections of telecommunication signals initiated by the FARS TC in 2018 (September 2023 and March 2024 meetings)
 - participated in **the revision of Recommendation ITU-R RS.1166 *Performance and interference criteria for active spaceborne sensors*** (September 2023 meeting)
- ITU-R Working Party 3J (Propagation Fundamentals)
 - continuing activities on **Earth surface scattering models** in CG 3J-17
 - Submitted document to 3J on **Software Implementation of Recommendation ITU-R P.2146 on Sea Surface Bistatic Scattering**
- Space Frequency Coordination Group Annual Meeting (SFCG-43)
 - contributing to **AI 43-94 on the *Commercial Satellite Spectrum Management Association (CSSMA) Liaison and Workshop***
 - One input documents on **AI 43-84 Ultra Wide Band Radiometry in the 0.4-2.0 GHz Frequency Range**



GRSS Views on WRC-23 Agenda Items

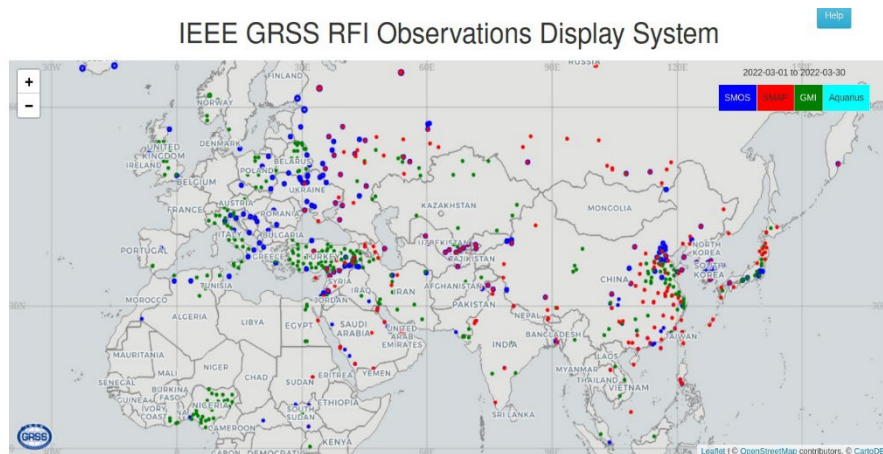
- Document explaining the Views of IEEE GRSS on the WRC-23 Agenda Items related to remote sensing
- Concerns and opportunities from the GRSS perspective on the proposed modifications to the Radio Regulations are discussed
- It joins similar documents by the SFCG, WMO, CORF, etc., and gives the perspective of remote sensing scientists and engineers.



GRSS FARS Online Tools

RFI Observations Database

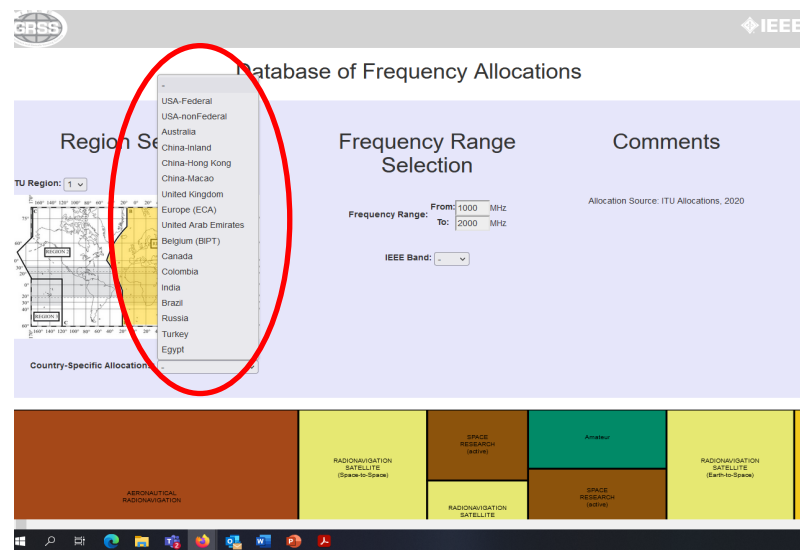
- entries for SMOS (L-band), SMAP (L-band) and GMI (10 and 18 GHz)



www.classic.grss-ieee.org/rfi_observations.html

Frequency Allocations Display System

- National Tables for: Australia, Belgium, Brazil, Canada, Colombia, China (Inland, Macao, Hong Kong), Egypt, Europe, India, Russia, Turkey, UAE, UK, USA (Fed + non-Fed)



www.classic.grss-ieee.org/frequency_allocations.html

Thank you for you attention!



Any questions?

Scope of the Standard

- New IEEE standard to define a methodology to quantitatively evaluate the amount of man-made Radio Frequency Interference (RFI) in any given frequency band allocated to space-based remote sensing
- Useful in understanding the situation of all the bands allocated to remote sensing, follow their trends and in defining priorities for our spectrum managers.

GRSS Views on WRC-23 Agenda Items

- Official GRSS document on its position on tWRC-23 Agenda Items that could impact remote sensing
- Expected to be ready in July 2023

Potential Impact of Agenda Items of the World Radiocommunication Conference 2023 on Remote Sensing and Views of the IEEE GRSS

Agenda Item 1.15 to harmonizing the use of the frequency band 12.75-13.25 GHz (Earth-to-space) by Earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service globally, in accordance with Resolution 172 (WRC-19).

ITU-R WP 4A is the responsible group for this agenda item and WP 7C was added as a Contributing group in 2021.

Resolution 172 (WRC-19) focuses mainly on the use of the band 12.75-13.25 GHz for uplink transmissions by Earth Stations in Motion (ESIM) on aircraft (A-ESIM) and vessels (M-ESIM) communicating with GEO space stations in the fixed-satellite service (FSS), as pictured in Figure 1. Resolution 172 also states that the FSS space station downlinks in the 10.7-10.95 GHz frequency band should not affect the adjacent EESS passive operations in the 10.6-10.7 GHz frequency band according to No. 5.340. Within the 10.6-10.7 GHz frequency range, the 10.68-10.7 GHz portion is identified in No. 5.340 which prohibits all emissions. However, the provisions of No. 5.340 protect the identified bands within the footnote from *in-band emissions* and does not address *out-of-band emissions* which are considered under this agenda item.

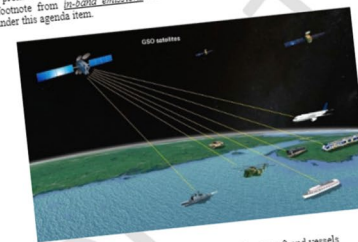


Fig. 1 ESIM on different moving platforms like aircraft and vessels

Although it is not exceedingly clear from the text of Resolution 172 (WRC-19), FSS (space-to-Earth) operations in the 10.7-10.95 GHz frequency band and EESS (passive) operations in the adjacent 10.6-10.7 GHz frequency band could also be examined for compatibility under this agenda item if, as a result of this agenda item, any change in RR provisions in regard to, or FSS use of, the 10.7-10.95 GHz frequency band would occur. For instance, an alteration of this FSS usage of this FSS allocated frequency band would occur if the result of the agenda item was the creation of new FSS downlink beams to serve airborne and ocean going ESIMs over ocean surfaces where FSS downlink beams do not currently exist. Such a modification of FSS usage may cause increased RFI to EESS (passive) operating in the 10.68-10.7 GHz frequency band resulting from out-of-band FSS downlink emissions reflecting off of ocean surfaces.

The frequency bands used by remote sensing that could potentially be affected are:

- for active instruments:
- 13 250-13 750 MHz
- for passive instruments:

Nov 2022

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