

National Radio Astronomy Observatory  
Socorro, New Mexico

**VLA-VLBA INTERFERENCE MEMO No. 10**

**Frequency Allocations and Footnotes  
for Radio Astronomy and Passive Radio Services**

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## INTRODUCTION

Radio Astronomy, Earth Exploration-Satellite (passive) and Space Research (passive) radio services have a small fraction of the radio spectrum allocated to them. Most of that fraction of spectrum is shared with other radio services which emit power levels many orders of magnitude higher than the sensitivity of the receivers of the passive services, especially radio astronomy.

At every location on and above the earth, the incident radio spectrum occupancy and power flux densities increase with time. The increase accelerates. Although more spectrum usage provides more communications and identification/location services for more people, it creates radio polluting interference that degrades the scientific capabilities of the passive users of the radio spectrum.

Frequency allocations by the International Telecommunications Union (ITU), and in the U.S. by the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC), set the framework within which spectrum usage and pollution evolve.

Therefore the frequency allocation table and footnotes to the table provide a means for the passive services to predict potential interference currently and for the future, and to help identify sources of observed interference.

Through the VLA-VLBA Interference Memo series of NRAO - Socorro, we provide the U.S. and international frequency allocations and footnotes for the passive radio services. We will update this approximately annually, after significant changes appear in the NTIA semi-annual revisions and FCC annual revisions. Future ITU World Radio Councils (WRC) will revise the allocations. This memo is available on the World Wide Web via the NRAO home page (the address is <http://www.nrao.edu/doc/vla/html/rfa.htm>), and in the World Wide Web version, each relevant footnote listed in the table is linked to the actual footnote text. Please send comments and report errors via E-mail to [wbrundag@ao.nrao.edu](mailto:wbrundag@ao.nrao.edu).

## Radio Frequency Allocation Table

### Notes on Reading the Radio Frequency Allocation Table

**Primary status** is indicated in the table by all capital letters. A primary service cannot claim protection from harmful interference from another primary service which shares the same allocation. **Secondary status** is indicated in the table by words that only begin with capital letters. A secondary service shall not cause harmful interference to a primary service, and cannot claim protection from harmful interference from a primary service. **Footnotes** may add allocations, and may add limited protection or remove protection from harmful interference for a service. Footnotes relevant to radio astronomy, the earth exploration-satellite (passive) or space research (passive) are summarized by all lowercase letters. Where it is indicated that a footnote offers protection, it should be understood that protection is often extremely limited. For full understanding of a footnote, the reader should refer to the end of the table where the full text of relevant footnotes is reproduced. The **“US” column** of the table lists only footnotes that make the statuses of radio astronomy, the earth exploration-satellite (passive), or space research (passive) different in the United States than they are in the rest of Region 2. **Readers are advised** that some changes concerning the frequencies allocated to radio astronomy, the earth exploration-satellite (passive) and space research (passive) were made at WRC-95 and future FCC and NTIA regulations may reflect these changes.

Frequency	US <i>Deviations from Region 2</i>	Region 1 <i>Europe, Africa, northern Asia</i>	Region 2 <i>North and South America</i>	Region 3 <i>southern Asia, Australia, south Pacific</i>
13.36-13.41 MHz	G115	<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149 FIXED		
25.55-25.67 MHz	radio astronomy protection limited by US74	<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149		
37.5-38.25 MHz	radio astronomy protected between <b>38-38.25</b> by US81 NG 59, NG124	<b>Radio Astronomy</b> radio astronomy protected by S5.149 FIXED MOBILE		
73-74.6 MHz	radio astronomy protection limited by US74	radio astronomy protected by S5.149 FIXED MOBILE except aeronautical mobile S5.174, S5.175, S5.177, S5.179	<b>RADIO ASTRONOMY</b> S5.178	radio astronomy protected by S5.149 FIXED MOBILE S5.176, S5.179

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>79.75-80.25 MHz</b>				<b>RADIO ASTRONOMY</b> (with national exceptions) by S5.186 <b>radio astronomy protected</b> by S5.149 FIXED MOBILE S5.182 S5.183 S5.188
<b>150.05-153 MHz</b>		<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 <b>radio astronomy protected</b> from harmful interference from adjacent bands by S5.208A FIXED MOBILE except aeronautical mobile	<b>RADIO ASTRONOMY</b> in Australia and India by S5.225 <b>radio astronomy protected</b> from harmful interference from adjacent bands by S5.208A FIXED MOBILE S5.226 S5.227	
<b>225-235 MHz</b>				<b>Radio Astronomy</b> in China by S5.250 FIXED MOBILE AERONAUTICAL RADIONAVIGATION
<b>322-328.6 MHz</b>	G27, G100	<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 <b>radio astronomy protected</b> from harmful interference from adjacent bands by S5.208A FIXED MOBILE		
<b>406.1-410 MHz</b>	<b>radio astronomy protection limited</b> by US74 <b>radio astronomy protected</b> by G6 US117 G5, US13	<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 <b>radio astronomy protected</b> from harmful interference from adjacent bands by S5.208A FIXED MOBILE except aeronautical mobile		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>606-614 MHz</b>		<b>RADIO ASTRONOMY</b> in Africa by S5.304 <b>Radio Astronomy</b> between <b>608-614</b> everywhere else in region 1 by S5.306 <b>radio astronomy protected</b> by S5.149 between <b>608-614</b> <b>radio astronomy protected</b> from harmful interference from adjacent bands by S5.208A between <b>608-614</b> <b>BROADCASTING</b> S5.294 S5.296 S5.300 S5.302 S5.311 S5.312		<b>RADIO ASTRONOMY</b> in China by S5.305 <b>Radio Astronomy</b> everywhere else in region 3 by S5.306 <b>radio astronomy protected</b> by S5.149 between <b>608-614</b> <b>radio astronomy protected</b> from harmful interference from adjacent bands by S5.208A between <b>608-614</b> <b>FIXED MOBILE BROADCASTING RADIONAVIGATION</b> S5.307
<b>608-614 MHz</b>	<b>radio astronomy protection limited</b> by US74 transmissions prohibited by US246		<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> from harmful interference from adjacent bands by S5.208A Mobile-Satellite except aeronautical mobile-satellite (Earth-to-space)	
<b>1330-1400 MHz</b>	<b>radio astronomy allowed</b> but unprotected between <b>1350-1400</b> by US311 G2	<b>radio astronomy protected</b> by S5.149 AERONAUTICAL RADIONAVIGATION S5.337 Radiolocation		
<b>1370-1400 MHz</b>	<b>radio astronomy allowed</b> but unprotected between <b>1350-1400</b> by US311 G2, G27, G114	<b>Space Research (passive) and Earth Exploration-Satellite (passive)</b> by S5.339 <b>FIXED MOBILE RADIOLOCATION</b> S5.338	<b>Space Research (passive) and Earth Exploration-Satellite (passive)</b> by S5.339 <b>RADIOLOCATION</b> S5.334	



<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>1400-1427 MHz</b>	radio astronomy protection limited by US74 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340 S5.341: frequencies between <b>1400-1727 MHz</b> , <b>101-120 GHz</b> , and <b>197-220 GHz</b> are being used to look for intentional extraterrestrial transmissions		
<b>1610.6-1613.8 MHz</b>	US208, US260	<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149 radio astronomy protected by S5.372 MOBILE-SATELLITE (Earth-to-space) AERONAUTICAL RADIONAVIGATION S5.341 S5.355 S5.359 S5.363 S5.364 S5.366 S5.367 S5.368 S5.369 S5.373	<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149 radio astronomy protected by S5.372 MOBILE-SATELLITE (Earth-to-space) AERONAUTICAL RADIONAVIGATION RADIO DETERMINATION-SATELLITE (Earth-to-space) S5.341 S5.364 S5.366 S5.367 S5.368 S5.370	<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149 radio astronomy protected by S5.372 MOBILE-SATELLITE (Earth-to-space) AERONAUTICAL RADIONAVIGATION Radiodetermination-Satellite (Earth-to-space) S5.341 S5.355 S5.359 S5.364 S5.366 S5.367 S5.368 S5.369
<b>1660-1660.5 MHz</b>	US309	<b>RADIO ASTRONOMY</b> <b>RADIO ASTRONOMY</b> between in Australia, Canada, Mexico by S5.361 radio astronomy protected between <b>1660-1670</b> by S5.149 LAND MOBILE-SATELLITE (Earth-to-space) S5.341 S5.351 S5.354 S5.360 S5.362		
<b>1660.5-1668.4 MHz</b>	radio astronomy protection limited by US74 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> radio astronomy protected between <b>1660-1670</b> by S5.149 radio astronomy protected from interference from adjacent bands by S5.379A <b>SPACE RESEARCH (passive)</b> Fixed Mobile except aeronautical mobile S5.341 S5.379		
<b>1668.4-1670 MHz</b>	radio astronomy protection limited by US74 radio astronomy protected by US211 US99	<b>RADIO ASTRONOMY</b> radio astronomy protected between <b>1660-1670</b> by S5.149 METEOROLOGICAL AIDS FIXED MOBILE except aeronautical mobile S5.341		
<b>1718.8-1722.2 MHz</b>	radio astronomy allowed but unprotected by US256	Radio Astronomy by S5.385 radio astronomy protected by S5.149 FIXED MOBILE S5.381 S5.341 S5.386 S5.387 S5.388		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>2640-2655 MHz</b>		<b>Space Research (passive) and Earth Exploration-Satellite (passive)</b> by S5.339 FIXED S5.416 S5.417 S5.418 MOBILE except aeronautical mobile <b>BROADCASTING-SATELLITE</b> S5.409 S5.413 S5.403 S5.405 S5.408 S5.410 S5.411 S5.412	<b>Space Research (passive) and Earth Exploration-Satellite (passive)</b> by S5.339 FIXED S5.416 S5.418 FIXED SATELLITE (space-to-Earth) S5.415 MOBILE except aeronautical mobile <b>BROADCASTING-SATELLITE</b> S5.409 S5.413 S5.403	<b>Space Research (passive) and Earth Exploration-Satellite (passive)</b> by S5.339 FIXED S5.416 S5.418 MOBILE except aeronautical mobile <b>BROADCASTING-SATELLITE</b> S5.409 S5.413 S5.410
<b>2655-2690 MHz</b>	<b>radio astronomy protected</b> from harmful interference from adjacent frequencies by US269 US205, NG47, NG101, NG102	<b>Radio Astronomy radio astronomy protected</b> by S5.149 <b>Earth Exploration-Satellite (passive)</b> <b>Space Research (passive)</b> FIXED S5.416 S5.417 S5.418 MOBILE except aeronautical mobile <b>BROADCASTING-SATELLITE</b> S5.409 S5.413 S5.411 S5.412 S5.420 MOBILE-SATELLITE (Earth-to-space) S5.419, S5.420 between <b>2670-2690</b>	<b>Radio Astronomy radio astronomy protected</b> by S5.149 <b>Earth Exploration-Satellite (passive)</b> <b>Space Research (passive)</b> FIXED S5.416 S5.418 FIXED-SATELLITE (Earth-to-space)(space-to-Earth) S5.415 MOBILE except aeronautical mobile <b>BROADCASTING-SATELLITE</b> S5.409 S5.413 S5.420 MOBILE-SATELLITE (Earth-to-space) S5.419 S5.420 between <b>2655-2690</b>	<b>Radio Astronomy radio astronomy protected</b> by S5.149 <b>Earth Exploration-Satellite (passive)</b> <b>Space Research (passive)</b> FIXED S5.416 S5.418 FIXED-SATELLITE (Earth-to-space) S5.415 MOBILE except aeronautical mobile <b>BROADCASTING-SATELLITE</b> S5.409 S5.413 S5.420 MOBILE-SATELLITE (Earth-to-space) S5.419 S5.420 between <b>2655-2690</b>
<b>2690-2700 MHz</b>	<b>radio astronomy protection limited</b> by US74 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.413 <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340 S5.421 S5.422		
<b>3260-3267 MHz</b>	US110, G59	<b>radio astronomy protected</b> by S5.149 <b>RADIOLOCATION</b> S5.333 S5.428		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>3332–3339 MHz</b>	between 3300-3350 G31	<b>radio astronomy protected by S5.149</b> RADIOLOCATION S5.429 S5.430	<b>radio astronomy protected by S5.149</b> RADIOLOCATION Amateur Fixed Mobile S5.430	<b>radio astronomy protected by S5.149</b> RADIOLOCATION Amateur S5.429
<b>3345.8-3352.5 MHz</b>	between 3300-3350 G31	<b>radio astronomy protected by S5.149</b> RADIOLOCATION S5.429 S5.430	<b>radio astronomy protected by S5.149</b> RADIOLOCATION Amateur Fixed Mobile S5.430	<b>radio astronomy protected by S5.149</b> RADIOLOCATION Amateur S5.429
<b>4200-4400 MHz</b>		<b>Earth Exploration Satellite (passive) and Space Research (passive) by S5.438</b> AERONAUTICAL RADIONAVIGATION S5.437 S5.439 S5.440		
<b>4800-4900 MHz</b>		<b>Radio Astronomy</b> <b>radio astronomy protected by S5.149</b> FIXED MOBILE S5.442 S5.443, S5.339		
<b>4825-4835 MHz</b>	<b>radio astronomy protected by US203</b>	<b>RADIO ASTRONOMY in Argentina, Australia, Canada by S5.443</b> <b>radio astronomy protected by S5.149</b> FIXED MOBILE S5.442		
<b>4950-4990 MHz</b>	<b>radio astronomy protected by US257</b>	<b>RADIO ASTRONOMY in Argentina, Australia, Canada by S5.443</b> <b>radio astronomy protected by S5.149</b> <b>Earth Exploration-Satellite and Space Research by S5.339</b> FIXED MOBILE S5.442		
<b>4990-5000 MHz</b>	radio astronomy <b>protection limited by US74</b> <b>radio astronomy protected by US211</b> transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>radio astronomy protected by S5.149</b> <b>radio astronomy protected by S5.402</b> <b>Space Research (passive)</b> FIXED MOBILE except aeronautical mobile		
<b>6650-6675.2 MHz</b>		<b>radio astronomy protected by S5.149</b> <b>radio astronomy protected from harmful interference from an adjacent band by S5.458C</b> FIXED FIXED-SATELLITE (Earth-to-space) MOBILE S5.540, S4.458		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>10.6-10.68 GHz</b>	<b>RADIO ASTRONOMY</b> (unprotected) by US277	<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149 <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED MOBILE except aeronautical mobile Radiolocation S5.482		
<b>10.68-10.7 GHz</b>	radio astronomy protection limited by US74 radio astronomy protected by US211 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340 S5.483		
<b>14.47-14.5 GHz</b>	radio astronomy protected by US203 US287	<b>Radio Astronomy</b> radio astronomy protected by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) S5.506 MOBILE except aeronautical mobile Land mobile-satellite (Earth-to-space)		
<b>15.20-15.35 GHz</b>	US211	<b>Space Research (passive) and Earth Exploration-Satellite (passive)</b> by S5.339 FIXED MOBILE Space Research		
<b>15.35-15.4 GHz</b>	radio astronomy protection limited by US74 radio astronomy protected by US211 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> radio astronomy protected from harmful interference in adjacent bands by S5.511A <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340 S5.511		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>18.6-18.8 GHz</b>	US254, US255, NG144	<b>Earth Exploration-Satellite (passive)</b> <b>Space Research (passive)</b> <b>passive Earth Exploration Satellite and Space Research sensors protected by S5.522 and S5.523</b> <b>FIXED</b> <b>FIXED-SATELLITE (space-to-Earth)</b> <b>MOBILE except aeronautical mobile</b>	<b>SPACE RESEARCH (passive)</b> <b>EARTH EXPLORATION-SATELLITE (passive )</b> <b>passive Earth Exploration Satellite and Space Research sensors protected by S5.522 and S5.523</b> <b>FIXED</b> <b>FIXED-SATELLITE (space-to-Earth)</b> <b>MOBILE except aeronautical mobile</b>	<b>Earth Exploration-Satellite (passive)</b> <b>Space Research (passive)</b> <b>passive Earth Exploration Satellite and Space Research sensors protected by S5.522 and S5.523</b> <b>FIXED</b> <b>FIXED-SATELLITE (space-to-Earth)</b> <b>MOBILE except aeronautical mobile</b>
<b>21.2- 21.4 GHz</b>	<b>earth exploration-satellite(passive) and space research (passive) unprotected by US263</b>	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> <b>FIXED</b> <b>MOBILE</b>		
<b>22.01-22.21 GHz</b>		<b>radio astronomy protected by S5.149</b> <b>FIXED</b> <b>MOBILE except aeronautical mobile</b>		
<b>22.21-22.5 GHz</b>	<b>radio astronomy protected by US211</b> <b>earth exploration-satellite (passive) and space research (passive) unprotected by US263</b>	<b>RADIO ASTRONOMY</b> <b>radio astronomy protected by S5.149</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> <b>earth exploration-satellite, space research limited by S5.532</b> <b>FIXED</b> <b>MOBILE except aeronautical mobile</b>		
<b>22.81-22.86 GHz</b>	<b>radio astronomy protected by US211</b> <b>US278</b>	<b>radio astronomy protected by S5.149</b> <b>FIXED</b> <b>INTER-SATELLITE</b> <b>MOBILE</b>		
<b>23.07-23.12 GHz</b>	US278	<b>radio astronomy protected by S5.149</b> <b>FIXED</b> <b>INTER-SATELLITE</b> <b>MOBILE</b>		
<b>23.6-24 GHz</b>	<b>radio astronomy protection limited by US74</b> <b>radio astronomy protected by US211</b> transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340		



<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>31.2-31.3 GHz</b>	US211	<b>radio astronomy protected</b> by S5.149 FIXED MOBILE Standard Frequency and Time Signal-Satellite (space-to-Earth) Space Research S5.544 S5.545		
<b>31.3-31.5 GHz</b>	<b>radio astronomy protected</b> by US211 <b>radio astronomy protection limited</b> by US74 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340		
<b>31.5-31.8 GHz</b>	<b>radio astronomy protection limited</b> by US74 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> Fixed Mobile except aeronautical mobile S5.546	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> Emissions prohibited by S5.340	<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> Fixed Mobile except aeronautical mobile
<b>36-37 GHz</b>	<b>earth exploration satellite (passive) and space research (passive) unprotected</b> by US263	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED MOBILE		
<b>36.43-36.5 GHz</b>	<b>earth exploration satellite (passive) and space research (passive) unprotected</b> by US263	<b>radio astronomy protected</b> by S5.149 <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED MOBILE		
<b>42.5-43.5 GHz</b>	<b>radio astronomy protected</b> by US211	<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) S5.552 MOBILE except aeronautical mobile		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>42.77-42.87 GHz</b>		<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) S5.552 MOBILE except aeronautical mobile		
<b>43.07-43.17 GHz</b>		<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) S5.552 MOBILE except aeronautical mobile		
<b>43.37-43.47 GHz</b>		<b>RADIO ASTRONOMY</b> radio astronomy protected by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) S5.552 MOBILE except aeronautical mobile		
<b>48.94-49.04 GHz</b>	US264, US297	<b>RADIO ASTRONOMY</b> by S5.555 radio astronomy protected by S5.149 emissions prohibited by S5.340 FIXED FIXED-SATELLITE (Earth-to-space) S5.552 MOBILE		
<b>50.2-50.4 GHz</b>	earth exploration satellite (passive) and space research (passive) unprotected by US263	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED MOBILE		
<b>51.4-54.25 GHz</b>	transmissions prohibited by US246	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> radio astronomy may be carried out under national arrangements by S5.556 emissions prohibited by S5.340		
<b>54.25-58.2 GHz</b>	earth exploration satellite (passive) and space research (passive) unprotected by US263	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED INTER-SATELLITE MOBILE S5.558 S5.557		
<b>58.2-59 GHz</b>	transmissions prohibited by US246	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> radio astronomy may be carried out under national arrangements by S5.556 emissions prohibited by S5.340		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>64-65 GHz</b>		<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> Emissions prohibited by S5.340 <b>radio astronomy may be carried out</b> under national arrangements by S5.556		
<b>72.77-72.91 GHz</b>	<b>radio astronomy protected</b> by US270	<b>radio astronomy protected</b> by S5.149 <b>radio astronomy may be carried out</b> under national arrangements by S5.556 <b>FIXED</b> FIXED-SATELLITE (Earth-to-space) <b>MOBILE</b> MOBILE-SATELLITE (Earth-to-space)		
<b>86-92 GHz</b>	<b>radio astronomy protection limited</b> by US74 <b>radio astronomy protected</b> by US211 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340		
<b>93.07-93.27 GHz</b>		<b>radio astronomy protected</b> by S5.149 <b>FIXED</b> FIXED-SATELLITE (Earth-to-space) <b>MOBILE</b> RADIOLOCATION S5.556		
<b>97.88-98.08 GHz</b>		<b>RADIO ASTRONOMY</b> by S5.555 <b>radio astronomy protected</b> by S5.149 <b>MOBILE</b> S5.553 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE Radiolocation S5.554		
<b>100-102 GHz</b>	<b>radio astronomy protected</b> by US211 transmissions prohibited by US246	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> <b>FIXED</b> <b>MOBILE</b> S5.341: frequencies between <b>1400-1727 MHz, 101-120GHz, and 197-220 GHz</b> are being used to look for intentional extra-terrestrial emissions		
<b>105-116 GHz</b>	<b>radio astronomy protection limited</b> by US74 <b>radio astronomy protected</b> by US211 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340 S5.341		



<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>116-119.98 GHz</b>	earth exploration satellite (passive) and space research unprotected between <b>116-126</b> by US263 US211	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED INTER-SATELLITE MOBILE S5.558 S5.138 S5.341		
<b>119.98-120.02 GHz</b>	earth exploration satellite (passive) and space research unprotected between <b>116-126</b> by US263 US211	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED INTER-SATELLITE MOBILE S5.558 Amateur S5.138 S5.341		
<b>120.02-126 GHz</b>	earth exploration satellite (passive) and space research unprotected between <b>116-126</b> by US263 US211	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED INTER-SATELLITE MOBILE S5.558 S5.138, S5.341		
<b>140.69-140.98 GHz</b>		<b>RADIO ASTRONOMY</b> by S5.555 <b>radio astronomy protected</b> by S5.149 MOBILE S5.553 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE Radiolocation emissions prohibited by S5.340 S5.554		
<b>144.68-144.98 GHz</b>		<b>RADIO ASTRONOMY</b> by S5.555 <b>radio astronomy protected</b> by S5.149 RADIOLOCATION Amateur Amateur-Satellite		
<b>145.45-145.75 GHz</b>		<b>RADIO ASTRONOMY</b> by S5.555 <b>radio astronomy protected</b> by S5.149 RADIOLOCATION Amateur Amateur-Satellite		
<b>146.82-147.12 GHz</b>		<b>RADIO ASTRONOMY</b> by S5.555 <b>radio astronomy protected</b> by S5.149 RADIOLOCATION Amateur Amateur-Satellite		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>150-151 GHz</b>	radio astronomy protected by US211 earth exploration- satellite (passive) and space research (passive) unprotected by US263	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> Radio Astronomy by S5.385 radio astronomy protected by S5.149 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE		
<b>156-158 GHz</b>		<b>EARTH EXPLORATION-SATELLITE (passive)</b> FIXED FIXED-SATELLITE (space-to-Earth) MOBILE		
<b>164-168 GHz</b>	transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b>		
<b>174.42-175.02 GHz</b>		<b>RADIO ASTRONOMY</b> by S5.385 radio astronomy protected by S5.149 FIXED INTER-SATELLITE MOBILE S5.558		
<b>174.5-176.5 GHz</b>	earth exploration- satellite (passive) and space research (passive) unprotected by US263	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED INTER-SATELLITE MOBILE S5.558		
<b>177-177.4 GHz</b>	US211	<b>Radio Astronomy</b> by S5.385 radio astronomy protected by S5.149 FIXED INTER-SATELLITE MOBILE S5.558		
<b>178.2-178.6 GHz</b>	US211	<b>Radio Astronomy</b> by S5.385 radio astronomy protected by S5.149 FIXED INTER-SATELLITE MOBILE S5.558		
<b>181-181.46 GHz</b>	US211	<b>Radio Astronomy</b> by S5.385 radio astronomy protected by S5.149 FIXED INTER-SATELLITE MOBILE S5.558		
<b>182 -185 GHz</b>	radio astronomy protected by US211 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340 S5.563		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>186.2-186.6 GHz</b>	US211	<b>Radio Astronomy</b> by S5.385 <b>radio astronomy protected</b> by S5.149 FIXED INTER-SATELLITE MOBILE S5.558		
<b>200-202 GHz</b>	earth exploration-satellite (passive) and space research (passive) unprotected by US263	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED MOBILE S5.341: frequencies between <b>1400-1727 MHz, 101-120 GHz, and 197-220 GHz</b> are being used to look for intentional extra-terrestrial emissions		
<b>217-231 GHz</b>	radio astronomy protection limited by US74 transmissions prohibited by US246	<b>RADIO ASTRONOMY</b> <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> emissions prohibited by S5.340 S5.341		
<b>235-238 GHz</b>	earth exploration-satellite (passive) and space research (passive) unprotected by US263	<b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b> FIXED FIXED-SATELLITE (space-to-Earth) MOBILE		
<b>250-252 GHz</b>		<b>RADIO ASTRONOMY</b> between <b>250-251</b> by S5.555 <b>radio astronomy protected</b> between <b>250-251</b> by S5.149 <b>EARTH EXPLORATION-SATELLITE (passive)</b> <b>SPACE RESEARCH (passive)</b>		
<b>257.5-258 GHz</b>	US211	<b>Radio Astronomy</b> by S5.385 <b>radio astronomy protected</b> by S5.149 MOBILE S5.553 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE S5.554		
<b>261-265 GHz</b>		<b>RADIO ASTRONOMY</b> in Spain, Argentina, Germany, Finland, France, Italy , India, the Netherlands and Sweden by S5.564 <b>radio astronomy protected</b> by S5.149 MOBILE S5.553 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE S5.554		

<b>Frequency</b>	<b>US</b> <i>Deviations from Region 2</i>	<b>Region 1</b> <i>Europe, Africa, northern Asia</i>	<b>Region 2</b> <i>North and South America</i>	<b>Region 3</b> <i>southern Asia, Australia, south Pacific</i>
<b>262.24-262.76 GHz</b>		<b>RADIO ASTRONOMY</b> by S5.555 <b>radio astronomy protected</b> by S5.149 MOBILE S5.553 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE S5.554		
<b>265-275 GHz</b>		<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE		
<b>265.64-266.16 GHz</b>		<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE		
<b>267.34-267.86 GHz</b>		<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE		
<b>271.74-272.26 GHz</b>		<b>RADIO ASTRONOMY</b> <b>radio astronomy protected</b> by S5.149 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE		
<b>275-277 GHz</b>		space research (passive) and earth exploration-satellite (passive) protected by S5.565		
<b>278-280 GHz</b>		radio astronomy protected by S5.565		
<b>300-302 GHz</b>		space research (passive) and earth exploration-satellite (passive) protected by S5.565		
<b>324-326 GHz</b>		space research (passive) and earth exploration-satellite (passive) protected by S5.565		
<b>343-348 GHz</b>		radio astronomy protected by S5.565		
<b>345-347 GHz</b>		space research (passive) and earth exploration-satellite (passive) protected by S5.565		
<b>363-365 GHz</b>		space research (passive) and earth exploration-satellite (passive) protected by S5.565		
<b>379-381 GHz</b>		space research (passive) and earth exploration-satellite (passive) protected by S5.565		

**GOVERNMENT (U.S.) FOOTNOTES RELEVANT TO RADIO ASTRONOMY, EARTH  
EXPLORATION-SATELLITE (passive), and SPACE RESEARCH (passive) SERVICES**

**G2**-In the bands 216-225, 420-450 (except as provided by US217), 890-902, 928-942, 1300-1400, 2300-2450, 2700-2900, 5650-5925, and 9000-9200 MHz, the Government radiolocation is limited to the military services.

**G5**-In the bands 162.0125-173.2, 173.4-174, 406.1-410 and 410-420 MHz, the fixed and mobile services are all allocated on a primary basis to the Government non-military agencies.

**G6**-Military tactical fixed and mobile operations may be conducted nationally on a secondary basis; (1) to the meteorological aids service in the band 403-406 MHz; and (2) to the radio astronomy service in the band 406.1-410 MHz. Such fixed and mobile operations are subject to local coordination to ensure that harmful interference will not be caused to the services to which the bands are allocated.

**G27**-In the bands 225-328.6, 335.4-399.9, and 1350-1400 MHz, the fixed and mobile services are limited to the military services.

**G30**-In the bands 138-144, 148-149.9, 150.05-150.8, 1427-1429 and 1429-1435 MHz, the fixed and mobile services are limited primarily to operations by the military services.

**G31**-In the bands 3300-3500 MHz, the Government radiolocation is limited to the military services, except as provided by footnote US108.

**G59**-In the bands 902-928 MHz, 3100-3300 MHz, 3500-3700 MHz, 5250-5650 MHz, 8500-9000 MHz, 9200-9300 MHz, 13.4-14.0 GHz, 15.7-17.7 GHz and 24.05-24.25 GHz, all Government non-military radiolocation shall be secondary to military radiolocation, except in the sub-band 15.7-16.2 GHz airport surface detection equipment (ASDE) is permitted on a co-equal basis subject to coordination with the military departments.

**G100**-The bands 235-322 MHz and 335.4-399.9 MHz are also allocated on a primary basis to the mobile-satellite service, limited to military operations.

**G101**-In the band 2200-2290 MHz, space operations (Space-to-Earth) and (Space-to-Space), and earth exploration-satellite (Space-to-Earth) and (Space-to-Space) services, may be accommodated on a co-equal basis with fixed, mobile and space research service.

**G114**-In the band 1350-1400 MHz, the frequency 1381.05 MHz with emissions limited to  $\pm 12$  MHz is also allocated to Fixed and Mobile Satellite Services (Space-to-Earth) for the relay of nuclear burst data.

**G115**-In the band 13360-13410 kHz, the fixed service is allocated on a primary basis outside the coterminous

United States. Within the coterminous United States, assignments in the fixed service are permitted, and will be protected for national defense purposes or, if they are to be used only in an emergency jeopardizing life, public safety, or important property under conditions calling for immediate communication where other means of communication do not exist.

**NON-GOVERNMENT (U.S.) FOOTNOTES RELEVANT TO RADIO ASTRONOMY, EARTH  
EXPLORATION SATELLITE (passive) and SPACE RESEARCH (passive) SERVICES**

**NG47**-In the band 2500-2690 MHz, channels in 2500-2686 MHz and the corresponding response frequencies 2686.0625-2689.8125 MHz may be assigned to stations in the Instructional Television Fixed Service (Part 74 of this Chapter) CFR47; channels in 2596-2644 MHz and response frequencies 2686.5625-2689.6875 MHz may be assigned to Multipoint Distribution Services stations (Part 21 of this Chapter); and channels 2650-2656 MHz, 2662-2668 MHz and 2674-2680 MHz and response frequencies 2686.9375 MHz, 2687.9375 MHz and 2688.9375 MHz may be assigned to stations in the Operational Fixed Service (Part 94 of this Chapter). In Alaska, however, frequencies within the band 2655-2690 MHz are not available for assignment to terrestrial stations.

**NG59**-The frequencies 37.60 and 37.85 MHz may be authorized only for use by base, mobile and operational fixed stations participating in an interconnected or coordinated power service utility system.

**NG101**-The use of the band 2500-2690 MHz by the broadcasting-satellite service is limited to domestic and regional systems for community reception of educational television programming and public service information. Such use is subject to agreement among administrations concerned and those having services operating in accordance with the table, which may be affected. Unless such agreement includes the use of higher values, the power flux-density at the earth's surface produced by emissions from a space station in this service shall not exceed those values set forth in Part 73 of the rules for this frequency band.

**NG102**-The frequency bands 2500-2655 MHz (space-to-Earth) and 2655-2690 MHz (Earth-to-space) are allocated for use in the fixed-satellite service as follows:

- (a) For common carrier use in Alaska, for intra-Alaska service only, and, in the mid and western Pacific area including American Samoa, the Trust Territory of the Pacific Island, Guam and Hawaii;
- (b) For educational use in the contiguous United States, Alaska, and the mid and western Pacific area including American Samoa, the Trust Territory of the Pacific Island, Guam and Hawaii.

Such use is subject to agreement with administrations having services operating in accordance with the table, which may be affected. In the band 2500-2655 MHz unless such agreement includes the use of higher values, the power flux density at the earth's surface produced by emissions from a space station in this service shall not exceed the values set forth in Part 25 of the rules for this frequency band.

**NG124**-In the Public Safety Radio Service allocation within the bands 30-50 MHz, 150-174 MHz and 450-470 MHz, Police Radio Service licensees are authorized to operate low powered radio transmitters on a secondary non-interference basis in accordance with the provisions of Section 2.803 and 90.19 (f) (5) of the Rules.

**NG144**-Stations authorized as of September 9, 1983, to use frequencies in the band 17.7-19.7 GHz may, upon proper application, continue to be authorized for such operation.

**U. S. FOOTNOTES RELEVANT TO RADIO ASTRONOMY, EARTH EXPLORATION-  
SATELLITE (passive), AND SPACE RESEARCH (passive) SERVICES**

**US13-**For the specific purpose of transmitting hydrological and meteorological data in cooperation with agencies of the Federal Government, the following frequencies may be authorized to non-Government fixed stations on the condition that harmful interference will not be caused to Government stations:

MHz	MHz	MHz	MHz
169.425	170.275	171.125	406.175
169.450	170.300	171.825	409.675
169.475	170.325	171.850	409.725
169.500	171.025	171.875	412.625
169.525	171.050	171.900	412.675
170.225	171.075	171.925	412.725
170.250	171.100	406.125	412.775

Licensees holding a valid authorization on June 11, 1962, to operate on the frequencies 169.575, 170.375, or 171.975 MHz may continue to be authorized for such operations on the condition that harmful interference will not be caused to Government stations.

**US74-**In the bands 25.55-25.67, 73-74.6, 406.1-410, 608-614, 1400-1427, 1660.5-1670, 2690-2700, and 4990-5000 MHz, and in the bands 10.68-1.7, 15.35-15.4, 23.6-24, 31.3-31.8, 86-92, 105-116, and 217-231 GHz, the radio astronomy service shall be protected from extraband radiation only to the extent such radiation exceeds the level which would be present if the offending station were operating in compliance with the technical standards or criteria applicable to the service in which it operates.

**US81-**The band 38-38.25 MHz is used by both Government and non-Government radio astronomy observatories. No new fixed or mobile assignments are to be made and Government stations in the band 38-38.25 MHz will be moved to other bands on a case-by-case basis, as required, to protect radio astronomy observations from harmful interference. As an exception, however, low powered military transportable and mobile stations used for tactical and training purposes will continue to use the band. To the extent practicable, the latter operations will be adjusted to relieve such interference as may be caused to radio astronomy operations. In the event of harmful interference from such local operations, radio astronomy observatories may contact local military commands directly, with a view to effecting relief. A list of military commands, areas of coordination, and points of contact for purposes of relieving interference may be obtained upon request from the Office of the Chief Scientist, Federal Communications Commission, Washington, D.C. 20554.

**US99-**In the band 1668.4-1670 MHz, the meteorological aids service (radiosonde) will avoid operations to the maximum extent possible. Whenever it is necessary to operate radiosondes in the band 1668.4-1670 MHz within the United States, notification of the operations shall be sent as far in advance as possible to the Electromagnetic Spectrum Management Unit, National Science Foundation, Washington, D.C. 20550.

**US110-**In the frequency bands 3100-3300 MHz, 3500-3700 MHz, 5250-5350 MHz, 8500-9000 MHz, 9200-9300 MHz, 9500-10000 MHz 13.4-14.0 GHz, 15.7-17.3 GHz, 24.05-24.25 GHz, and 33.4-36 GHz, the non-Government radiolocation service shall be secondary to the Government radiolocation service and to airborne doppler radars at 8800 MHz, and shall provide protection to airport surface detection equipment (ASDE) operating between 15.7-16.2 GHz.

**US117-**In the band 406.1-410 MHz, all new authorizations will be limited to a maximum 7 watts per kHz of necessary bandwidth; existing authorizations as of November 30, 1970 exceeding this power are permitted to continue in use. New authorizations in this band for stations, other than mobile stations, within the following



areas are subject to prior coordination by the applicant through the Electromagnetic Spectrum Management Unit, National Science Foundation, Washington, D.C. 20550 (202-357-9696):

**Arecibo Observatory:**

Rectangle between latitudes 17° 30' N and 19° 00' N and between longitudes 65° 10' W and 68° 00' W.

**Owens Valley Radio Observatory:**

Two contiguous rectangles, one between latitudes 36° N and 37° N and between longitudes 117° 40' W and 118° 30' W and the second between latitudes 37° N and 38° N and between longitudes 118° W and 118° 50' W.

**Sagamore Hill Radio Observatory:**

Rectangle between latitudes 42d 10' N and 43d 00' N and between longitudes 70d 31' W and 71d 31' W.

**Table Mountain Solar Observatory (NOAA) Boulder, Colorado (407-409 MHz only):**

Rectangle between latitudes 39d 30' N and 40d 30' N and between longitudes 104d 30' W and 106d 00' W or the Continental Divide whichever is farther east.

The non-Government use of this band is limited to the radio astronomy service and as provided by footnote US13.

**US203**-Radio astronomy observations of the formaldehyde line frequencies 4825-4835 MHz and 14.470-14.500 GHz may be made at certain radio astronomy observatories as indicated below:

Bands to be observed		Observatory
4 GHz	14 GHz	
X		National Astronomy and Ionospheric Center Arecibo, Puerto Rico
X	X	National Radio Astronomy Observatory Green Bank, West Virginia
X	X	National Radio Astronomy Observatory Socorro, New Mexico
X	X	Hat Creek Observatory (U of Calif.) Hat Creek, California
X	X	Haystack Radio Observatory (MIT-Lincoln Lab) Tyngsboro, Massachusetts
X	X	Owens Valley Radio Observatory (Cal. Tech.) Big Pine, California
	X	Five College Radio Astronomy Observatory Quabbin Reservoir (near Amherst), Massachusetts

Every practicable effort will be made to avoid the assignment of frequencies to stations in the fixed or

mobile services in these bands. Should such assignments result in harmful interference to these observations, the situation will be remedied to the extent practicable.

**US205-**Tropospheric scatter systems are prohibited in the band 2500-2690 MHz.

**US208-**Planning and use of the band 1559-1626.5 MHz necessitate the development of technical and/or operational sharing criteria to ensure the maximum degree of electromagnetic compatibility with existing and planned systems within the band.

**US211-**In the bands 1670-1690, 5000-5250 MHz, and 10.7-11.7, 15.1365-15.35, 15.4-15.7, 22.5-22.55, 24-24.05, 31.0-31.3, 40.5-42.5, 84-86, 102-105, 116-126, 151-164, 176.5-182, 185-190, 231-235, 252-265 GHz, applicants for airborne or space station assignments are urged to take all practicable steps to protect radio astronomy observations in the adjacent bands from harmful interference; however, US74 applies.

**US246-**No stations will be authorized to transmit in the bands 608-614 MHz, 1420-1427 MHz, 1660.5-1668.4 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.3-31.8 GHz, 51.4-54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 100-102 GHz, 105-116 GHz, 164-168 GHz, 182-185 GHz and 217-231 GHz.

**US254-**In the band 18.6-18.8 GHz, the fixed and mobile services shall be limited to a maximum equivalent isotopically radiated power of +35 dBw and the power delivered to the antenna shall not exceed -3dBw.

**US255-** In the band 18.6-18.8 GHz, the fixed satellite service shall be limited to a power flux density at the Earth's surface of -101 dbW/m<sup>2</sup> in a 200 MHz band for all angles of arrival.

**US256-**Radio astronomy observations may be made in the band 1718.8-1722.2 MHz on an unprotected basis. Agencies providing other services in this band in the geographic areas listed below should bear in mind that their operations may affect those observations, and those agencies are encouraged to minimize potential interference to the observations insofar as it is practicable.

National Astronomy and Ionosphere Center Arecibo, Puerto Rico	Rectangle between latitudes 17d30'N and 19d00'N and between longitudes 65d10'W and 68d00'W.
Haystack Radio Observatory Tyngsboro, Massachusetts	Rectangle between latitudes 41d00'N and 43d00'N and between longitudes 71d00'W and 73d00'W.
National Radio Astronomy Observatory Green Bank, West Virginia	Rectangle between latitudes 37d00'N and 39d15'N and between longitudes 78d30'W and 80d30'W.
National Radio Astronomy Observatory Socorro, New Mexico	Rectangle between latitudes 32d30'N and 35d30'N and between longitudes 106d00'W and 109d00'W.

Owens Valley Radio Observatory Big Pine, California	Two contiguous rectangles, one between latitudes 36d00'N and 37d00'N and between longitudes 117d40'W and 118d30'W and the second between latitudes 37d00'N and 38d00'N and between longitudes 118d00'W and 118d50'W.
Hat Creek Observatory Hat Creek, California	Rectangle between latitudes 40d00'N and 42d00'N and between longitudes 120d15'W and 122d15'W.

**US257**-Radio astronomy observations may be made in the 4950-4990 MHz band at certain Radio Astronomy Observatories indicated below:

Hat Creek Observatory Hat Creek, California	Rectangle between latitudes 40d00'N and 42d00'N and between longitudes 120d15'W and 122d15'W.
Owens Valley Radio Observatory Big Pine, California	Two contiguous rectangles, one between latitudes 36d00'N and 37d00'N and between longitudes 117d40'W and 118d30'W and the second between latitudes 37d00'N and 38d00'N and between longitudes 118d00'W and 118d50'W.
Haystack Radio Observatory Tyngsboro, Massachusetts	Rectangle between latitudes 41d00'N and 43d00'N and between longitudes 71d00'W and 73d00'W.
National Astronomy Ionosphere Center Arecibo, Puerto Rico	Rectangle between latitudes 17d30'N and 19d00'N and between longitudes 65d10'W and 68d00'W.
National Radio Astronomy Observatory Socorro, New Mexico	Rectangle between latitudes 32d30'N and 35d30'N and between longitudes 106d00'W and 109d00'W.
National Radio Astronomy Observatory Green Bank, West Virginia	Rectangle between latitudes 37d00'N and 39d15'N and between longitudes 78d30'W and 80d30'W.

Every practicable effort will be made to avoid the assignment of frequencies in the band 4950-4990 MHz to stations in the fixed and mobile services within the geographic areas given above. In addition, every practicable effort will be made to avoid the assignment of frequencies in this band to stations in the aeronautical mobile service which operate outside of those geographic areas, but which may cause harmful interference to the listed observatories. Should such assignments result in harmful interference to these observatories, the situation will be remedied to the extent practicable.

**US260**-Aeronautical mobile communications which are an integral part of aeronautical radionavigation systems may be satisfied in the bands 1559-1626.5 MHz, 5000-5250 MHz and 15.4-15.7 GHz.

**US263**-In the frequency band 21.2-21.4, 22.21-22.5, 36-37, 50.2-50.4, 54.25-58.2, 116-126, 150-151, 174.5-

176.5, 200-202 and 235-238 GHz, the Space Research and the Earth Exploration-Satellite Services shall not receive protection from the Fixed and Mobile Services operating in accordance with the Table of Frequency Allocations.

**US264**-In the band 48.94-49.04 GHz, airborne stations shall not be authorized.

**US265**-In the band 10.6-10.68 GHz, the fixed service shall be limited to a maximum equivalent isotopically radiated power of 40 dBW and the power delivered to the antenna shall not exceed -3 dBW, per 250 kHz.

**US269**-In the band 2500-2690 MHz, applicants for space station assignments are urged to take all practicable steps to protect radio astronomy observations in the adjacent band, 2690-2700 MHz, from harmful interference. Further, all applicants are urged to coordinate their proposed systems through the Electromagnetic Spectrum Management Unit, National Science Foundation, Washington, D.C. 20550.

**US270**-The band 72.77-72.91 GHz is also allocated to the radio astronomy service. Applicants for frequency assignments in this band are urged to take all practicable steps to protect radio astronomy observations from harmful interference.

**US277**-The band 10.6-10.68 GHz is also allocated on a primary basis to the radio astronomy service. However, the radio astronomy service shall not receive protection from stations in the Fixed Service which are licensed to operate in the one hundred most populous urbanized areas as defined by the U.S. Census Bureau. The following radio astronomy sites have been coordinated for observations in this band: National Radio Astronomy Observatory, Green Bank, West Virginia (38 26 08N; 79 49 42W); National Radio Astronomy Observatory, Socorro, New Mexico (34 04 43N; 107 37 04W); Harvard Radio Astronomy Station, Fort Davis, Texas (30 38 08N; 103 56 42W); Hat Creek Observatory, Hat Creek, California (40 49 03N; 121 28 24W); Owens Valley Radio Observatory, Big Pine, California (37 13 54N; 118 17 36W); Naval Research Laboratory, Maryland Point, Maryland (38 22 26N; 77 14 00W).

**US278**-In the 22.55-23.55 and 32.33 GHz bands, non-geostationary inter-satellite links may operate on a secondary basis to geostationary inter-satellite links.

**US287**-The band 14-14.5 GHz is also allocated to the non-Government land mobile-satellite service (Earth-to-space) on a secondary basis.

**US297**-The bands 47.2-49.2 GHz and 74.0-75.5 GHz are also available for feeder links for the broadcasting-satellite service.

**US303**-In the band 2285-2290 MHz, non-Government space stations in the space research, space operations and earth-exploration-satellite services may be authorized to transmit to the Tracking and Data Relay Satellite System subject to such conditions as may be applied on a case-by-case basis. Such transmissions shall not cause harmful interference to authorized Government stations. The power flux density at the Earth's surface from such non-Government stations shall not exceed -144 to -154 dBW/m<sup>2</sup>/4 kHz, depending on angle of arrival, in accordance with ITU Radio Regulation 2557.

**US306**-The band 1610-1626.5 MHz is also allocated for use by the radiodetermination satellite service in the Earth-to-space direction.

**US309**-Transmissions in the band 1545-1559 MHz from terrestrial aeronautical stations directly to aircraft stations, or between aircraft stations, in the aeronautical mobile (R) service are also authorized when such transmissions are used to extend or supplement the satellite-to-aircraft links. Transmissions in the band 1646.5-1660.5 MHz from aircraft stations in the aeronautical mobile (R) service directly to terrestrial aeronautical stations, or between aircraft stations, are also authorized when such transmissions are used to extend or supplement the aircraft-to-satellite links.

**US311-**Radio astronomy observations may be made in the 1350-1400 MHz band on an unprotected basis at certain Radio Astronomy Observatories indicated below:

National Astronomy and Ionosphere Center Arecibo, Puerto Rico	Rectangle between latitudes 17 30'N and 19 00'N and between longitudes 65 10'W and 68 00'W.	
National Radio Astronomy Observatory Socorro, New Mexico	Rectangle between latitudes 32 30'N and 35 30'N between longitudes 106 00'W and 109 00'W.	
National Radio Astronomy Observatory Green Bank, West Virginia	Rectangle between latitudes 37 30'N and 39 15'N and between longitudes 78 30'W and 80 30'W.	
National Radio Astronomy Observatory Very Long Baseline Array Stations	80 kilometers (50 mile radius centered on:	
	Latitude (North)	Longitude (West)
Pie Town, NM	34 18'	108 07'
Kitt Peak, AZ	31 57'	111 37'
Los Alamos, NM	35 47'	106 15'
Fort Davis, TX	30 38'	103 47'(57')
North Liberty, IA	41 46'	91 41'(34')
Brewster, WA	48 08'	119 41'
Owens Valley, CA	37 14'	118 17'
Saint Croix, VI	17 46'	64 35'
Mauna Kea, HI	19 49'	155 28'
Hancock, NH	42 56'	71 59'

Every practicable effort will be made to avoid the assignment of frequencies in the band 1350-1400 MHz to stations in the fixed and mobile services which could interfere with radio astronomy observations within the geographic area given above. In addition, every practicable effort will be made to avoid assignment of frequencies in this band to stations in the aeronautical mobile service which operate outside of those geographic areas, but which may cause harmful interference to the listed observatories. Should such assignments result in harmful interference to these observatories, the situation will be to remedied to the extent practicable.

**FOOTNOTES FROM WRC-95 RELEVANT TO RADIO ASTRONOMY, EARTH EXPLORATION-SATELLITE (passive), AND SPACE RESEARCH (passive) SERVICES**

**Summary of symbols used:**

**MOD** Substantial change

**(MOD)** This symbol may have two meanings:

- if used in column 2 ("VGE proposal"): editorial change, without substantial change, proposed by the VGE
- if used in column 4 ("WRC-95 decision"): editorial change made by the WRC-95

**SUP** Deletion of a provision

**SUP\*** Transfer elsewhere of an RR provision (appears at the point from which the provision has been transferred) (See Document 241)

**(ADD)** Transfer of a provision from elsewhere (appears at the point to which the provision has been transferred)

**ADD** Addition of a new provision

**NOC** No change

**NOC S5.138**

The following bands:

6 765 - 6 795 kHz (centre frequency 6 780 kHz),

433.05 - 434.79 MHz (centre frequency 433.92 MHz) in Region 1 except in the countries mentioned in No. **S5.280**,

61-65 GHz (centre frequency 61.25 GHz),

122 - 123 GHz (centre frequency 122.5 GHz), and

244 - 246 GHz (centre frequency 245 GHz)

are designated for industrial, scientific and medical (ISM) applications. The use of these frequency bands for ISM applications shall be subject to special authorization by the administration concerned, in agreement with other administrations whose radiocommunication services might be affected. In applying this provision, administrations shall have due regard to the latest relevant ITU-R Recommendations.

**MOD S5.149**

In making assignments to stations of other services to which the bands:

13 360 - 13 410 kHz,	4 825 - 4 835 MHz*,	93.07 - 93.27 GHz*,
25 550 - 25 670 kHz,	4 950 - 4 990 MHz,	97.88 - 98.08 GHz*,
37.5 - 38.25 MHz,	4 990 - 5 000 MHz,	140.69 - 140.98 GHz*,
73 - 74.6 MHz in Regions 1 and 3,	6 650 - 6 675.2 MHz*,	144.68 - 144.98 GHz*,
79.75 - 80.25 MHz in Region 3,	10.6 - 10.68 GHz,	145.45 - 145.75 GHz*,
150.05 - 153 MHz in Region 1,	14.47 - 14.5 GHz*,	146.82 - 147.12 GHz*,
322 - 328.6 MHz*,	22.01 - 22.21 GHz*,	150 - 151 GHz*,
406.1 - 410 MHz,	22.21 - 22.5 GHz,	174.42 - 175.02 GHz*,
608 - 614 MHz in Regions 1 and 3,	22.81 - 22.86 GHz*,	177 - 177.4 GHz*,
1 330 - 1 400 MHz*,	23.07 - 23.12 GHz*,	178.2 - 178.6 GHz*,
1 610.6 - 1 613.8 MHz*,	31.2 - 31.3 GHz,	181 - 181.46 GHz*,
1 660 - 1 670 MHz,	31.5 - 31.8 GHz in Regions 1 and 3,	186.2 - 186.6 GHz*,
1 718.8 - 1 722.2 MHz*,	36.43 - 36.5 GHz*,	250 - 251 GHz*,
2 655 - 2 690 MHz,	42.5 - 43.5 GHz,	257.5 - 258 GHz*,
3 260 - 3 267 MHz*,	42.77 - 42.87 GHz*,	261 - 265 GHz,
3 332 - 3 339 MHz*,	43.07 - 43.17 GHz*,	262.24 - 262.76 GHz*,
3 345.8 - 3 352.5 MHz*,	43.37 - 43.47 GHz*,	265 - 275 GHz,
	48.94 - 49.04 GHz*,	265.64 - 266.16 GHz*,
	72.77 - 72.91 GHz*,	267.34 - 267.86 GHz*,
		271.74 - 272.26 GHz*

are allocated (\* indicates radio astronomy use for spectral line observations), administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from spaceborne or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. S4.5 and S4.6 and Article S29).

**MOD S5.178**

*Additional allocation:* in Colombia, Costa Rica, Cuba, El Salvador, Guatemala, Guyana, Honduras and Nicaragua, the band 73 - 74.6 MHz is also allocated to the fixed and mobile services on a secondary basis.

**MOD S5.186**

*Additional allocation:* in Region 3 (except in the Republic of Korea, India, Japan, Malaysia, the Philippines and Singapore), the band 79.75 - 80.25 MHz is also allocated to the radio astronomy service on a primary basis.

**ADD S5.208A**

In making assignments to space stations in the mobile-satellite service in the bands 137 - 138 MHz, 387 - 390 MHz and 400.15 - 401 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05 - 153 MHz, 322 - 328.6 MHz, 406.1 - 410 MHz and 608 - 614 MHz from harmful interference from unwanted emissions. For information, the threshold levels of interference detrimental to the radio astronomy service to be protected are shown in Table 1 of Recommendation ITU-R RA.769-1.

**NOC S5.225**

*Additional allocation:* in Australia and India, the band 150.05 - 153 MHz is also allocated to the radio astronomy service on a primary basis.

**NOC S5.250**

*Additional allocation:* in China, the band 225 - 235 MHz is also allocated to the radio astronomy service on a secondary basis.

**MOD S5.254**

The bands 235 - 322 MHz and 335.4 - 399.9 MHz may be used by the mobile- satellite service, subject to agreement obtained under No. S9.21, on condition that stations in this service do not cause harmful interference to those of other services operating or planned to be operated in accordance with the Table of Frequency Allocations.

**NOC S5.304**

*Additional allocation:* in the African Broadcasting Area (see Nos. S5.10 to S5.13), the band 606 - 614 MHz is also allocated to the radio astronomy service on a primary basis.

**NOC S5.305**

*Additional allocation:* in China, the band 606 - 614 MHz is also allocated to the radio astronomy service on a primary basis.

**NOC S5.306**

*Additional allocation:* in Region 1, except in the African Broadcasting Area (see Nos. S5.10 to S5.13), and in Region 3, the band 608 - 614 MHz is also allocated to the radio astronomy service on a secondary basis.

**NOC S5.307**

*Additional allocation:* in India, the band 608 - 614 MHz is also allocated to the radio astronomy service on a primary basis.

**NOC S5.339**

The bands 1 370 - 1 400 MHz, 2 640 - 2 655 MHz, 4 950 - 4 990 MHz and 15.20 - 15.35 GHz are also allocated to the space research (passive) and earth exploration-satellite (passive) services on a secondary basis.

**(MOD) S5.340**

All emissions are prohibited in the following bands:

- 1 400 - 1 427 MHz,
- 2 690 - 2 700 MHz except those provided for by Nos. S5.421 and S5.422,
- 10.68 - 10.7 GHz except those provided for by No. S5.483,
- 15.35 - 15.4 GHz except those provided for by No. S5.511,



23.6 - 24 GHz,  
 31.3 - 31.5 GHz,  
 31.5 - 31.8 GHz in Region 2,  
 48.94 - 49.04 GHz from airborne stations,  
 51.4 - 54.25 GHz,  
 58.2 - 59 GHz,  
 64 - 65 GHz,  
 86 - 92 GHz,  
 105 - 116 GHz,  
 140.69 - 140.98 GHz from airborne stations and from space stations in the  
 space-to-Earth direction,  
 182 - 185 GHz except those provided for by No. S5.563,  
 217 - 231 GHz.

**NOC S5.341**

In the bands 1 400 - 1 727 MHz, 101 - 120 GHz and 197 - 220 GHz, passive research is being conducted by some countries in a programme for the search for intentional emissions of extraterrestrial origin.

**NOC S5.361**

*Alternative allocation:* in Australia, Canada and Mexico, the band 1 555 - 1 559 MHz is allocated to the mobile-satellite (space-to-Earth) service, the band 1 656.5 - 1 660 MHz is allocated to the mobile-satellite (Earth-to-space) service, and the band 1 660 - 1 660.5 MHz is allocated to the mobile-satellite (Earth-to-space) and the radio astronomy services, on a primary basis.

**NOC S5.362**

*Alternative allocation:* in Argentina and the United States, the band 1 555 - 1 559 MHz is allocated to the mobile-satellite (space-to-Earth) service, the band 1 656.5 - 1 660 MHz is allocated to the mobile-satellite (Earth-to-space) service, and the band 1 660 - 1 660.5 MHz is allocated to the mobile-satellite (Earth-to-space) and radio astronomy services, on a primary basis subject to the following conditions: the aeronautical mobile-satellite (R) service shall have priority access and immediate availability over all other mobile-satellite communications within a network operating under this provision; mobile-satellite systems shall be interoperable with the aeronautical mobile-satellite (R) service; account shall be taken of the priority of safety-related communications in the other mobile-satellite services.

**NOC S5.372**

Harmful interference shall not be caused to stations of the radio astronomy service using the band 1 610.6 - 1 613.8 MHz by stations of the radiodetermination-satellite and mobile-satellite services. (No. S29.13 applies.)

**ADD S5.379A**

Administrations are urged to give all practicable protection in the band 1 660.5 - 1 668.4 MHz for future research in radio astronomy, particularly by eliminating air-to-ground transmissions in the meteorological aids service in the band 1 664.4 - 1 668.4 MHz as soon as practicable.

**NOC S5.385**

*Additional allocation:* the bands 1 718.8 - 1 722.2 MHz, 150 - 151 GHz, 174.42 - 175.02 GHz, 177 - 177.4 GHz, 178.2 - 178.6 GHz, 181 - 181.46 GHz, 186.2 - 186.6 GHz and 257.5 - 258 GHz are also allocated to the radio astronomy service on a secondary basis for spectral line observations.

**MOD S5.402**

The use of the band 2 483.5 - 2 500 MHz by the mobile-satellite and the radiodetermination-satellite services is subject to the coordination under No. S9.11bis. Administrations are urged to take all

practicable steps to prevent harmful interference to the radio astronomy service from emissions in the 2 483.5 - 2 500 MHz band, especially those caused by second-harmonic radiation that would fall into the 4 990 - 5 000 MHz band allocated to the radio astronomy service worldwide

**NOC S5.413**

In the design of systems in the broadcasting-satellite service in the bands between 2500 MHz and 2690 MHz, administrations are urged to take all necessary steps to protect the radio astronomy service in the band 2 690 - 2 700 MHz.

**(MOD) S5.421**

*Additional allocation:* in Germany and Austria, the band 2 690 - 2 695 MHz is also allocated to the fixed service on a primary basis. Such use is limited to equipment in operation by 1 January 1985.

**MOD S5.422**

*Additional allocation:* in Saudi Arabia, Armenia, Azerbaijan, Bahrain, Belarus, Bosnia and Herzegovina, Brunei Darussalam, Bulgaria, Cameroon, the Central African Republic, the Congo, Côte d'Ivoire, Cuba, Egypt, the United Arab Emirates, Eritrea, Ethiopia, Gabon, Georgia, Guinea, Guinea-Bissau, the Islamic Republic of Iran, Iraq, Israel, Jordan, Kazakhstan, Lebanon, Lithuania, Malaysia, Malawi, Mali, Morocco, Mauritania, Moldova, Mongolia, Nigeria, Oman, Uzbekistan, Pakistan, the Philippines, Qatar, Syria, Kyrgyzstan, Romania, Russia, Singapore, Somalia, Tajikistan, Thailand, Tunisia, Turkmenistan, Ukraine, Yemen, Yugoslavia, Zaire and Zambia, the band 2 690 - 2 700 MHz is also allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis. Such use is limited to equipment in operation by 1 January 1985.

**NOC S5.438**

Use of the band 4 200 - 4 400 MHz by the aeronautical radionavigation service is reserved exclusively for radio altimeters installed on board aircraft and for the associated transponders on the ground. However, passive sensing in the earth exploration-satellite and space research services may be authorized in this band on a secondary basis (no protection is provided by the radio altimeters).

**NOC S5.443**

*Different category of service:* in Argentina, Australia and Canada, the allocation of the bands 4 825 - 4 835 MHz and 4 950 - 4 990 MHz to the radio astronomy service is on a primary basis (see No. S5.33)

**MOD S5.458**

In the band 6 425 - 7 075 MHz, passive microwave sensor measurements are carried out over the oceans. In the band 7 075 - 7 250 MHz, passive microwave sensor measurements are carried out. Administrations should bear in mind the needs of the Earth exploration-satellite (passive) and space research (passive) services in their future planning of the bands 6 425 - 7 025 MHz and 7 075 - 7 250 MHz.

**ADD S5.458C**

In making assignments in the band 6 700 - 7 075 MHz to space stations of the fixed-satellite service, administrations are urged to take all practicable steps to protect spectral line observations of the radio astronomy service in the band 6 650 - 6 675.2 MHz from harmful interference from unwanted emissions.

**MOD S5.483**

*Additional allocation:* in Saudi Arabia, Armenia, Azerbaijan, Bahrain, Belarus, Bosnia and Herzegovina, Bulgaria, Cameroon, China, Colombia, the Republic of Korea, Costa Rica, Cuba, Egypt, the United Arab Emirates, Georgia, the Islamic Republic of Iran, Iraq, Israel, Japan, Jordan, Kazakhstan, Kuwait, Latvia, Lebanon, Moldova, Mongolia, Uzbekistan, Pakistan, Qatar, Kyrgyzstan, the Democratic People's Republic of Korea, Romania, Russia, Tajikistan, Turkmenistan, Ukraine, Yemen and Yugoslavia, the band 10.68 - 10.7 GHz is also allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis. Such use is limited to equipment in operation by 1 January 1985.

**MOD S5.511**

*Additional allocation:* in Saudi Arabia, Bahrain, Bosnia and Herzegovina, Cameroon, Egypt, the United Arab Emirates, Guinea, the Islamic Republic of Iran, Iraq, Israel, Kuwait, The Former Yugoslav Republic of Macedonia, Lebanon, Libya, Pakistan, Qatar, Syria, Slovenia, Somalia and Yugoslavia, the band 15.35 - 15.4 GHz is also allocated to the fixed and mobile services on a secondary basis.

**ADD S5.511A**

Use of the band 15.4 - 15.7 GHz by the fixed-satellite service (space-to-Earth) is limited to feeder links of non-geostationary systems in the mobile-satellite service, subject to coordination under No. S9.11bis. Emissions from a non-geostationary space station shall not exceed the power flux-density limits at the Earth's surface of -146 dB(W/m<sup>2</sup>/MHz) in the bands 15.4 - 15.45 GHz and 15.65 - 15.7 GHz, and -111 dB(W/m<sup>2</sup>/MHz) in the band 15.45 - 15.65 GHz, for all angles of arrival. These limits relate to the power flux-density which would be obtained under assumed free-space propagation conditions. In the band 15.45 - 15.65 GHz, where an administration plans emissions from a non-geostationary space station that exceed -146 dB(W/m<sup>2</sup>/MHz) for all angles of arrival, it shall coordinate with affected administrations. Moreover, harmful interference shall not be caused to stations of the radio astronomy service using the band 15.35 - 15.4 GHz. The threshold levels of interference and associated power flux-density limits which are detrimental to the radio astronomy service are given in Recommendation ITU-R RA.769. The power flux-density limits and coordination threshold in this footnote shall apply, subject to review by ITU-R and based on the studies referred to in Resolution COM5-4 (WRC-95), until changed by a future competent world radiocommunication conference.

**NOC S5.522**

In making assignments to stations in the fixed and mobile services, administrations are invited to take account of passive sensors in the earth-exploration satellite and space research services operating in the band 18.6 - 18.8 GHz. In this band, administrations should endeavour to limit as far as possible both the power delivered by the transmitter to the antenna and the e.i.r.p. in order to reduce the risk of interference to passive sensors to the minimum.

**NOC S5.523**

In assigning frequencies to stations in the fixed-satellite service in the direction space-to-Earth, administrations are requested to limit as far as practicable the power flux-density at the Earth's surface in the band 18.6 - 18.8 GHz, in order to reduce the risk of interference to passive sensors in the earth exploration-satellite and space research services.

**NOC S5.532**

The use of the band 22.21 - 22.5 GHz by the earth exploration-satellite (passive) and space research (passive) services shall not impose constraints upon the fixed and mobile, except aeronautical mobile, services.

**NOC S5.538**

In the band 28.5 - 30 GHz, the earth exploration-satellite service is limited to the transfer of data between stations and not to the primary collection of information by means of active or passive sensors.

**NOC S5.544**

In the band 31 - 31.3 GHz the power flux-density limits specified in Article S21, Table [AR28] shall apply to the space research service.

**MOD S5.545**

*Different category of service:* in Armenia, Azerbaijan, Belarus, Bulgaria, Georgia, Kazakhstan, Moldova, Mongolia, Poland, Kyrgyzstan, Russia, Tajikistan, Turkmenistan and Ukraine, the allocation of the band 31 - 31.3 GHz to the space research service is on a primary basis (see No. S5.33).

**NOC S5.555**

*Additional allocation:* the bands 48.94 - 49.04 GHz, 97.88 - 98.08 GHz, 140.69 - 140.98 GHz, 144.68 - 144.98 GHz, 145.45 - 145.75 GHz, 146.82 - 147.12 GHz, 250 - 251 GHz and 262.24 - 262.76 GHz are also allocated to the radio astronomy service on a primary basis.

**MOD S5.556**

In the bands 51.4 - 54.25 GHz, 58.2 - 59 GHz, 64 - 65 GHz, 72.77 - 72.91 GHz and 93.07 - 93.27 GHz, radio astronomy observations may be carried out under national arrangements.

**NOC S5.563**

*Additional allocation:* in the United Kingdom, the band 182 - 185 GHz is also allocated to the fixed and mobile services on a primary basis

**(MOD) S5.564**

In Germany, Argentina, Spain, Finland, France, India, Italy, the Netherlands and Sweden, the band 261 - 265 GHz is also allocated to the radio astronomy service on a primary basis.

**NOC S5.565**

The frequency band 275 - 400 GHz may be used by administrations for experimentation with, and development of, various active and passive services. In this band a need has been identified for the following spectral line measurements for passive services:

- radio astronomy service: 278 - 280 GHz and 343 - 348 GHz;
- space research service (passive) and earth exploration-satellite service (passive): 275 - 277 GHz, 300 - 302 GHz, 324 - 326 GHz, 345 - 347 GHz, 363 - 365 GHz and 379 - 381 GHz.

Future research in this largely unexplored spectral region may yield additional spectral lines and continuum bands of interest to the passive services. Administrations are urged to take all practicable steps to protect these passive services from harmful interference until the next competent world administrative radio conference.

International Telecommunications Union (ITU)

Radio Regulations (RR) 1982

Definitions Pertinent to Interference Protection

December 1994

ARTICLE 1

- 2.1 *Allocations* (of a frequency band): Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space *radiocommunication services* or the *radio astronomy service* under specified conditions. This term shall also be applied to the frequency band concerned.
- 6.3 *Class of Emission*: The set of characteristics of an *emission*, designated by standard symbols, e.g. type of modulation of the main carrier, modulation signal, type of information to be transmitted, and also if appropriate, any additional signal characteristics.
- 6.8 *Out-of-band Emission\**: *Emission* on a frequency or frequencies immediately outside the *necessary bandwidth* which results from the modulation process, but excluding *spurious emissions*.
- 6.9 *Spurious Emission\**: *Emission* on a frequency or frequencies which are outside the *necessary bandwidth* and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic *emissions*, parasitic *emissions*, intermodulation products and frequency conversion products, but exclude *out-of-band emissions*.
- 6.10 *Unwanted Emissions\**: Consist of *spurious emissions* and *out-of-band emissions*.
- 6.16 *Necessary Bandwidth*: For a given *class of emissions*, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.
- 6.17 *Occupied Bandwidth*: The width of a frequency band such that, below the lower and above the upper frequency limits, the *mean powers* emitted are each equal to a specified percentage  $\frac{1}{2}$  of the total *mean power* of a given *emission*.  
Unless otherwise specified by the CCIR for the appropriate *class of emission*, the value of  $\frac{1}{2}$  should be taken as 0.5%.
- 6.20 *Power*: Whenever the power of a radio transmitter etc. is referred to it shall be expressed in one of the following forms, according to the *class of emission*, using the arbitrary symbols indicated:
- *peak envelope power* (PX or X);
  - *mean power* (PY or Y);
  - *carrier power* (PZ or Z).

For different *classes of emission*, the relationships between *peak envelope power*, *mean power* and *carrier power*, under the conditions of normal operation and of no modulation, are contained in CCIR Recommendations which may be used as a guide.

For use in formulae, the symbol  $P$  denotes power expressed in watts and the symbol  $P_{dB}$  denotes power expressed in decibels relative to a reference level.

- 6.21 *Peak Envelope Power* (of a radio transmitter): The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle at the crest of the modulation envelope taken under normal operating conditions.
- 6.22 *Mean Power* (of a radio transmitter): The average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions.
- 6.23 *Carrier Power* (of a radio transmitter): The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle taken under the condition of no modulation.
- 6.24 *Gain of an Antenna*: The ratio, usually expressed in decibels, of the power required at the input of a loss-free reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field strength or the same power flux-density at the same distance. When not specified otherwise, the gain refers to the direction of maximum radiation. The gain may be considered for specified polarization.

Depending on the choice of the reference antenna a distinction is made between:

- a) *absolute or isotropic gain* ( $G_i$ ), when the reference antenna is an isotropic antenna isolated in space:
- b) *gain relative to a half-wave dipole* ( $G_d$ ), when the reference antenna is a half-wave dipole isolated in space whose equatorial plane contains the given direction:
- c) *gain relative to a short vertical antenna* ( $G_v$ ), when the reference antenna is a linear conductor, much shorter than one quarter of the wavelength, normal to the surface of a perfectly conducting plane which contains the given direction.
- 6.25 *Equivalent Isotropically Radiated Power* (e.i.r.p.): The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (*absolute or isotropic gain*).
- 6.26 *Effective Radiated Power* (e.r.p.) (in a given direction): The product of the power supplied to the antenna and its *gain relative to a half-wave dipole* in a given direction.
- 7.1 *Interference*: The effect of unwanted energy due to one or a combination of *emissions*, *radiations*, or inductions upon reception in a *radiocommunication* system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

- 7.2 *Permissible Interference:* Observed or predicted *interference* which complies with quantitative *interference* and sharing criteria contained in these Regulations or in CCIR Recommendations or in special agreements as provided for in these Regulations.
- 7.3 *Accepted Interference:* Interference at a higher level than that defined as *permissible interference* and which has been agreed upon between two or more administrations without prejudice to other administrations.
- 7.4 *Harmful Interference:* Interference which endangers the functioning of a *radionavigation service* or of other *safety services* or seriously degrades, obstructs, or repeatedly interrupts a *radiocommunication service* operating in accordance with these Regulations.
- 7.6 *Coordination Area:* The area associated with an *earth station* outside of which a *terrestrial station* sharing the same frequency band neither causes nor is subject to interfering *emissions* greater than a permissible level.
- 7.8 *Coordination Distance:* Distance on a given azimuth from an *earth station* beyond which a *terrestrial station* sharing the same frequency band neither causes nor is subject to interfering *emissions* greater than a permissible level.

#### ARTICLE 6

- 6 For the purpose of resolving cases of harmful interference, the radio astronomy services shall be treated as a radiocommunication service. However, protection from services in other bands shall be afforded the radio astronomy service only to the extent that such services are afforded protection from each other.