



Provisional Recommendation SFCG 6-2R2

**TRANSPONDER TURNAROUND FREQUENCY RATIOS
FOR SPACE RESEARCH, CATEGORY A, and EARTH
EXPLORATION SATELLITE SERVICES ⁽¹⁾⁽²⁾**

The SFCG,

CONSIDERING

- a) that many space missions require coherency between the Earth-to-space and space-to-Earth links in order to provide accurate Doppler frequency shift and range delay measurements;
- b) that a Transponder Turnaround Frequency Ratio (TTFR) must be defined for those missions which require coherency;
- c) that standardized transponder turnaround frequency ratios are necessary for one agency's spacecraft to be supported by another agency's earth stations;
- d) that care should be exercised in the selection of the numbers comprising the turnaround frequency ratios;
- e) that TTFR ratios for Space Research Service (SRS) allocations have previously been defined and used extensively and successfully in the 2, 7, and 8 GHz Category A frequency bands;
- f) that Earth Exploration Satellite Service (EESS) missions can use Earth-to-space links in the 2025-2110 MHz and 7190-7250 MHz bands in conjunction with space-to-Earth links in the 2200-2290 MHz and 8025-8400 MHz bands, respectively;
- g) that EESS missions also require coherency between the Earth-to-space and space-to-Earth links for TTC and TTFR for EESS allocations must be defined;

- h) that the 7190-7250 MHz and the 8025-8400 MHz EESS frequency bands differ regarding the available bandwidth and therefore multiple TTFRs are needed to allow almost full access of the entire 8025-8400 MHz band;
- i) that TTFRs resulting in coherent downlink carrier frequencies close to 8400 MHz should be avoided, in order to protect Earth stations of Space Research Service (Category B⁽³⁾) missions using the adjacent 8400 – 8450 MHz band allocation,

RECOMMENDS

1. that, for SRS Category A missions, SFCG member agencies utilize the TTFRs listed in Table 1.
2. that, for EESS missions, SFCG member agencies utilize the TTFRs listed in Table 2.

NOTES:

- (1) Category A missions are those having an altitude above the Earth of less than 2×10^6 km
- (2) CCSDS has adopted similar Recommendations.
- (3) Category B missions are those having a distance from the Earth equal or greater than 2×10^6 km.

TABLE 1 - TTFRs for SRS Category A missions

Frequency ratio	Allocated band (MHz)	Nominal ⁽¹⁾ available band (MHz)	Allocated band (MHz)	Nominal ⁽¹⁾ available band (MHz)
<u>E-S/S-E</u> 221/240 749/880 221/900 765/240	<u>E - S</u> 2025 - 2110 7190 - 7235 2025 - 2110 7190 - 7235	<u>E - S</u> 2025 - 2110 7190 - 7235 2075 - 2087 7190 - 7235	<u>S - E</u> 2200 - 2290 8450 - 8500 8450 - 8500 2200 - 2290	<u>S - E</u> 2200 - 2290 8450 - 8500 8450 - 8500 2256 - 2270
<u>E-S/E-S</u> 221/765	<u>E - S</u> 2025 - 2110	<u>E - S</u> 2077 - 2090	<u>E - S</u> 7190 - 7235	<u>E - S</u> 7190 - 7235
<u>S-E/S-E</u> 240/900	<u>S - E</u> 2200 - 2290	<u>S - E</u> 2253 - 2267	<u>S - E</u> 8450 - 8500	<u>S - E</u> 8450 - 8500

Note to TABLE 1

- (1) The nominal available band for a particular direction is determined by the frequency ratio and the width of the allocated band for the other direction. The figures listed are approximate. For some frequency ratios, for example 221/900, the width of the nominal available band in one of the directions will be less than the allocation width in that direction. These cases are shown in bold face type.

TABLE 2 –TTFRs for EESS missions

TTFR (E-S/S-E)	Allocated E-S Band (MHz)	Available E-S Coherent Band (MHz)	Allocated S-E Band (MHz)	Available S-E Coherent Band (1) (MHz)
221/240	2025 - 2110	2025 - 2110	2200 - 2290	2200 - 2290
749/836	7190 – 7250	7190 – 7250	8025 – 8400	8025.154 – 8092.123
749/840	7190 – 7250	7190 – 7250	8025 – 8400	8063.551 – 8130.841
749/846	7190 – 7250	7190 – 7250	8025 – 8400	8121.148 – 8188.919
749/850	7190 – 7250	7190 – 7250	8025 – 8400	8159.546 – 8227.637
749/854	7190 – 7250	7190 – 7250	8025 – 8400	8197.944 – 8266.355
749/858	7190 – 7250	7190 – 7250	8025 – 8400	8236.342 – 8305.073
749/864	7190 – 7250	7190 – 7250	8025 – 8400	8293.939 – 8363.151

Note to TABLE 2

- (1) The available coherent band refers to the range of frequency which are coherent with the corresponding Earth-to-space or space-to-Earth band in the opposite direction.