Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

Application of **SPACE EXPLORATION HOLDINGS, LLC** For Modification of Authorization for the SpaceX Gen2 NGSO Satellite System to Add a Supplemental Coverage from Space System	GN Docket No. 23-135 ICFS File No. SAT-MOD-20230207-00021

CONSOLIDATED OPPOSITION TO PETITIONS AND RESPONSE TO COMMENTS OF SPACE EXPLORATION HOLDINGS, LLC

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EXECUTIVE SUMMARY

SpaceX and T-Mobile are on the cusp of bringing truly ubiquitous connectivity to millions of American consumers. SpaceX's application to upgrade its second-generation constellation to add capabilities to provide Supplemental Coverage from Space ("SCS") will eliminate dead spots, enhance emergency preparedness, and empower American industries. SpaceX will use T-Mobile's exclusive, nationwide PCS G Block spectrum to ensure T-Mobile customers stay connected in every corner of the United States. By granting SpaceX's application expeditiously, the Commission will maintain America's leadership in innovative mobile and space-based connectivity and follow through on its commitment to rapidly process SCS applications while it considers long-term rules.

Given these public interest benefits, only a few parties raised concerns with SpaceX's application and even these can be quickly addressed. Each of these opponents rely on either misinterpretations of Commission rules or fundamentally flawed technical "studies." Unfortunately, a few parties hoping to build competing systems also resort to the growingly common tactic of trying to have the Commission force SpaceX to make public unrelated proprietary information for unnecessary but competitively harmful reasons.

As an initial matter, the Commission correctly accepted SpaceX's application for filing, as its application materials are complete and compliant with relevant Commission rules. DISH and NRAO mistakenly argue the Commission erred because they claim an application cannot seek to waive the Table of Frequency Allocations. But the Commission has waived it in the past and has even proposed to eliminate the rule altogether. Nonetheless, SpaceX is already coordinating with NRAO to address its concerns and looks forward to reaching a resolution that will allow Americans to receive the benefits of SCS while still coexisting with radio astronomy.

On the other hand, in their apparent haste to find anything to slow the Commission's review, AT&T and DISH raise arguments that run right into each other. While AT&T claims SpaceX requested too few waivers, DISH turns around and argues SpaceX asked for too many. It seems SpaceX may have gotten it just right. But the number of waivers requested is irrelevant considering that even the Commission has recognized that it must waive certain rules to enable this barrier-breaking new service that benefits consumers without causing harmful interference to others. And to the extent the Commission finds that additional rules should be waived, SpaceX requests such waivers here.

Although some parties seek to raise concerns about out-of-band emissions, SpaceX has demonstrated that it can deliver this cutting-edge service while avoiding harmful interference. SpaceX and T-Mobile have entered into a spectrum manager lease arrangement and have agreed to technical limits consistent with well-established rules for PCS G Block spectrum, even when those rules are more restrictive than comparable satellite rules that could be applied instead. This approach aligns with the Commission's well-established flexible use and secondary market rules, and will ensure that in-band, out-of-band, and cross-border users, including passive services and operational satellite systems, do not experience harmful interference.

Even a cursory review of the applicable protection criteria finds that any adjacent-band emissions from satellites in the PCS G Block will be below the noise floor by the time they reach the ground, causing no risk of interference to terrestrial systems. And while Omnispace mentions the possibility of space-to-space interference into its speculative system, its study adopts unrealistic assumptions that, when corrected, reveal no such risk.

Next, Omnispace provides a useful recitation of the history of the rules for Mobile Satellite Service, but it then concludes with a simple misreading of SpaceX's ITU filings. DISH also attempts to make hay of SpaceX's ITU filings, but DISH should have checked with its sister company Echostar that sought and obtained the same sort of authorization SpaceX seeks in its application.

Finally, because SpaceX's new antennas will be mounted on SpaceX's Gen2 satellites that have already been authorized, this application will not add any new objects in space. SpaceX is committed to continuing to apply the same world-leading orbital debris mitigation strategies that it has pioneered for its Gen1 and Gen2 systems, and will operate within the parameters and analyses that SpaceX provided for the Gen2 system.

SpaceX and T-Mobile have entered into a revolutionary partnership that takes advantage of a new technology that will bring tremendous benefits to millions of American consumers. Supplemental coverage of terrestrial networks from space stands to benefit billions of people around the world. The few concerns raised in the record from opponents to SpaceX's application can be easily addressed and offer no sound reason to delay or deny Americans those benefits. The Commission should expeditiously approve SpaceX's proposed modification.

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SpaceX's new capability to provide supplemental coverage for terrestrial networks from satellites can enable connectivity for anyone, anywhere. And SpaceX's partnership with T-Mobile will ensure its customers quickly benefit from this new service, even using their existing devices. This new cutting-edge service will allow millions of Americans to access mobile service in areas where terrestrial mobile networks do not exist, and in disaster situations where those networks have been adversely impacted.[1] And this new service will enable a wide range of exciting applications, including Internet-of-Things devices that can support scientific research, precision agriculture, transportation, and emergency response. By authorizing SpaceX's Supplemental Coverage from Space ("SCS") payload, the Commission will promote competition in mobile services, enhance the value of scarce mobile spectrum, and maintain America's leadership in space innovation.

[1] *See* Application for Modification of Authorization for the SpaceX Gen2 NGSO Satellite System to Add a Direct-to-Cellular System, ICFS File No. SAT-MOD-20230207-00021, at 9-13 (Feb. 7, 2023) ("SCS Application").

Given these benefits for American consumers will come without causing harmful interference to others or requiring any new satellites, only a few parties raised concerns with SpaceX's application. SpaceX herein responds to the comments filed by AT&T, the National Radio Astronomy Observatory ("NRAO"), Omnispace, and the Rural Wireless Association ("RWA"),[2] and opposes the petition filed by DISH,[3] with respect to the above-referenced application to authorize deployment of an SCS payload, including authority for operations in the United States using the 1910-1915 MHz and 1990-1995 MHz bands (the "PCS G Block").[4]

As discussed further below, these parties fail to present any reason to deny, defer, or condition this application, and the Commission should grant it expeditiously. A prompt review and approval of this application would align with the Commission's commitment not to delay authorization of innovative SCS proposals while its underlying rulemaking progresses.[5] By acting swiftly, the Commission will ensure that consumers—particularly those in remote areas and in emergency situations—can benefit from ubiquitous mobile connectivity as soon as possible.

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2 *See* Comments of AT&T ("AT&T Comments"); Opposition of National Radio Astronomy Observatory and Green Bank Observatory (May 4, 2023) ("NRAO Opposition"); Opposition of Omnispace, LLC ("Omnispace Opposition"); Comments of the Rural Wireless Association, Inc. ("RWA Comments"). Unless otherwise noted, these filings were submitted in GN Docket No. 23-135 and ICFS File No. SAT-MOD-20230207-00021 on May 18, 2023.

3 *See* Petition to Dismiss or Deny of DISH Network Corporation, ICFS File No. SAT-MOD-20230207-00021 (May 18, 2023) ("DISH Petition").

4 As SpaceX noted in its application, its SCS payload will be capable of transmitting across the 1429 MHz to 2690 MHz range outside the United States, subject to cooperation with local terrestrial partners authorized to provide service on specified frequencies, and consistent with spectrum reuse authorizations within each country. *See* SCS Application, Technical Narrative at 13-14. As such, SpaceX requests that any authorization issued in this proceeding accommodate such prospective partnerships outside the United States, consistent with similar Commission authorizations. *See Lynk Global, Inc*, DA 22-969, ¶ 11 (rel. Sept. 16, 2022).

5 *See Single Network Future: Supplemental Coverage from Space*, FCC 23-22, ¶ 43 (rel. Mar. 17, 2023) ("*SCS NPRM*").

I. SPACEX'S APPLICATION WILL SERVE THE PUBLIC INTEREST

SpaceX established in its application how its partnership with T-Mobile to provide supplemental coverage for its network from space would serve the public interest, enabling mobile connectivity anywhere, facilitating a wide range of exciting applications, enhancing the value of scarce mobile spectrum, and maintaining America's leadership in space innovation. Even commenters in this proceeding recognize the strong public interest in enabling this new technology for American consumers—so long SpaceX is not the one enabling it.

For example, in its recent FCC Form 608 announcing its prospective SCS arrangement with AST SpaceMobile, AT&T explained how "SCS will promote the public interest in several significant ways," including ubiquitous connectivity, emergency response, network innovation, and competition among operators.[6] DISH "agree[s] that SCS can expand access to emergency communications for consumers and first responders in addition to extending the reach of terrestrial networks,"[7] before working at every turn to block SpaceX from deploying this new paradigm-shifting service or even getting access to the spectrum DISH has left fallow. Even DISH's front group, RWA, recognizes the public interest in this technology and asks the Commission to expand access to the service, while simultaneously seeking to block SpaceX's proposal to protect its benefactor, DISH.[8] And Omnispace explains that satellite-based non-terrestrial networks "hold enormous potential to establish ubiquitous broadband connectivity for enterprise and consumer

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6 *See* FCC Form 608, Exhibit 1: Description of Lease, Public Interest Statement and Request for Waivers, ULS File No. 0010538493, at 3 (May 10, 2023).

7 *See* Comments, GN Docket No. 23-65 and IB Docket No. 22-271, at 1 (May 12, 2023) ("DISH SCS NPRM Comments").

8 *See* Comments of the Rural Wireless Association, Inc., GN Docket No. 23-65 and IB Docket No. 22-271, at 2-3 (May 12, 2023) ("RWA SCS NPRM Comments").

communications,"[9] even as it asks the Commission to deny millions of American consumers that promise—for decades—to protect an aging MEO satellite and two experimental LEO nano-satellites that do not provide commercial service in the United States.

All parties in this proceeding—including SpaceX—share the Commission's view that this new technology can bring massive benefits to the American public and address some of the most pressing challenges in telecommunications policy. And as explained in more detail below, the specific challenges that opponents raise against SpaceX's application here all either lack support, misinterpret Commission rules, or would needlessly upend established flexible use and secondary market policies. As such, the Commission should recognize this small handful of oppositions for what they are—anticompetitive attempts to block a competitor from rapidly bringing these benefits to millions of Americans.

II. SPACEX'S APPLICATION IS PROCEDURALLY SOUND

While a few parties raise procedural challenges to SpaceX's application, none of them have merit. NRAO and DISH misinterpret filing rules, including rules the Commission itself has proposed to eliminate, to argue that the Commission should not have accepted SpaceX's application, despite explicit Commission policy in favor of expeditiously processing these sorts of applications. AT&T tries to claim that SpaceX seeks too few waivers, while DISH takes the opposite tack of claiming SpaceX asked for too many. Yet, most of the rules that AT&T cites do not even apply to the PCS G Block for which SpaceX applied. And DISH is forced to misread the Commission's unbuilt systems rule to come to an absurd result that SpaceX must launch all of its Gen2 satellites before it is allowed to modify them. DISH and Omnispace also incorrectly claim

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9 *See* Comments of Omnispace LLC, GN Docket No. 23-65 and IB Docket No. 22-271, at 6 (May 12, 2023) ("Omnispace SCS NPRM Comments").

that SpaceX's ITU filings conflict with its SCS application, but they could reach that conclusion only by misreading both the application and SpaceX's ITU filings. The Commission should therefore reject these procedural claims.

A. The Commission appropriately accepted SpaceX's Application for filing

The Commission has committed to quickly bring the benefits of supplemental coverage from space to millions of Americans and maintain American leadership in space by expeditiously processing individual applications in parallel to its consideration of long-term rules for this new service.[10] Following through on its commitment, the Commission rightly accepted SpaceX's application for filing to begin the licensing process for SpaceX and T-Mobile's innovative partnership. Standing against Commission policy, NRAO and DISH both argue that the Commission should not have accepted SpaceX's application, but their claims are based on gross misinterpretations of the Commission's rules. In fact, even if they had interpreted the rules correctly—which they do not—the Commission itself has proposed or sought comment on whether to eliminate these rules because they needlessly stand in the way of innovative offerings, such as SpaceX and T-Mobile's proposed new services.

As SpaceX has previously noted, it has been working closely with NRAO to coordinate on both this service and others.[11] Unfortunately, NRAO erroneously claims that the Commission should not have accepted SpaceX's application for filing because it proposes to use frequencies that have not been allocated internationally for mobile-satellite service ("MSS"). NRAO argues

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[10] *See SCS NPRM* ¶ 43, Statement of Commissioner Brendan Carr at 80; Statement of Commissioner Geoffrey Starks at 83; Statement of Commissioner Nathan Simington at 84; *see also Remarks of Chairwoman Jessica Rosenworcel, Mobile World Congress, "Leadership for Future Connectivity,"* FCC 3-4 (Feb. 27, 2023), https://docs.fcc.gov/public/attachments/DOC-391271A1.pdf.

[11] *See, e.g.*, Letter from David Goldman to Marlene H. Dortch, ICFS File No. SAT-MOD-20230207-00021 and GN Docket No. 23-135 (May 18, 2023) ("NSF/NRAO Coordination Letter") (discussing SpaceX's coordination efforts).

that under Section 25.112(a)(3), which deems applications that seek to operate outside of the International Table of Frequency Allocations unacceptable for filing, such requests "may not be cured with a waiver request."[12] But as SpaceX explained in its application, NRAO's claim is incorrect. The Commission can and has waived this rule under circumstances where, as here, an application is not a "mere placeholder" and the applicant has sought to provide MSS in bands not allocated internationally for that service.[13] Moreover, the Commission has recognized this rule is outdated and therefore sought comment on and proposed to modify Section 25.112(a)(3) because it needlessly precludes satellite services that stand to benefit consumers.[14] Indeed, notwithstanding the lack of MSS allocations in parts of PCS G Block, the Commission has made clear that it will process SCS applications while its rulemaking is ongoing, and followed through with this commitment by accepting SpaceX's application. NRAO's claim that Section 25.112(a)(3) precludes such processing is wrong both on law and policy. SpaceX nonetheless looks forward to continuing its precedent-setting coordination discussions with NRAO that are finding ways to allow consumers to benefit from this new service, while coexisting with radio astronomy.

For its part, DISH follows its normal course of trying to stop SpaceX from serving American consumers by relying on tortured misinterpretations of the Commission's rules. This time DISH cites the Commission's unbuilt system rule to claim that SpaceX's application is premature. First, DISH claims that SpaceX's application violates this rule because SpaceX has two pending modifications—one for SCS using PCS G Block and another for MSS using the 2 GHz band—to its authorized Gen2 system, and both modifications would use the underlying

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12 *See* NRAO Opposition at 3-4.

13 *See* SCS Application, Waiver Requests, at 8 & nn. 24-25.

14 *See SCS NPRM* ¶ 50; *Expediting Initial Processing of Satellite and Earth Station Applications*, FCC 22-95, ¶ 13 (rel. Dec. 22, 2022) ("*Satellite Streamlining NPRM*").

authorized frequencies in the Gen2 system.[15] DISH is wrong for several reasons. As an initial matter, the unbuilt system rule only applies to subsequent applications *for the same spectrum*, which is not the case here, since the PCS G Block and 2 GHz band are different and SpaceX does not seek to reauthorize its existing Gen2 frequencies. Even were this not the case, the unbuilt system rule does not apply because SpaceX's Gen2 system is not "unbuilt." The Commission recently confirmed that its rule was not meant to force operators to deploy most or all satellites for one system before applying to deploy new services, but instead to discourage speculative applications.[16] SpaceX has already deployed hundreds of Gen2 satellites in just a matter of months, laying to rest any possible concern with speculation. Moreover, DISH's interpretation of the rule would make no sense. SpaceX is requesting to add new antennas to the Gen2 system, but DISH would have SpaceX wait until it deploys the entire Gen2 system before it could *even apply* to add new frequencies to satellites that would now be already in orbit. Ultimately, DISH's attempt to block SpaceX and T-Mobile from expeditiously bringing an innovative technology to millions of people only further validates the need to eliminate the unbuilt system rule for NGSO systems.[17]

DISH next bizarrely claims that SpaceX's modification is not actually a modification at all because, DISH asserts, an FSS authorization cannot be modified to add MSS spectrum.[18] DISH cites no rule to support this assertion because it is patently false. The Commission has established a default presumption in Section 25.117 for granting modification requests, subject to limited exceptions that are not implicated here.[19] As if more proof were needed, the Commission

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15 *See* DISH Petition at 2-3.

16 *See Space Exploration Holdings, LLC*, FCC 22-91, ¶ 13 (rel. Dec. 1, 2022) ("*Gen2 Order*").

17 *See Satellite Streamlining NPRM* ¶ 15 (seeking comment on whether to amend or eliminate the unbuilt system rule as "a hindrance to the acceptability of legitimate satellite applications").

18 *See* DISH Petition at 3.

19 47 C.F.R. § 25.117(d)(2).

previously granted O3b Limited a modification of its NGSO FSS authorization to add MSS spectrum—a fact that DISH seems to have conveniently overlooked.[20] Indeed, if the Commission were to accept DISH's interpretation of the rules, it would effectively destroy the ability of next-generation satellite systems to add diverse capacity to better serve consumers, frustrating fundamental Commission policy and leaving American consumers with only old technology aging in space.

Compounding its flawed logic, DISH further asserts that SpaceX's SCS payload is a new system rather than a modification of its Gen2 system because it relies on a German ITU filing that has been submitted on behalf of a German subsidiary.[21] Yet DISH's own corporate family set the precedent that SpaceX now follows. DISH's sister company EchoStar requested and was granted a modification of its U.S. license so that it could operate its EchoStar-15 satellite under a Brazilian ITU filing for the benefit of its affiliated corporation, HNS Americas Comunicações Ltda.[22] As Echostar's modification confirms, the fact that SpaceX proposes to rely on a German administration ITU filing to allow T-Mobile to bring new benefits to its subscribers does not present any procedural bar to expeditiously granting SpaceX's application.

Finally, the Commission should reject DISH's fishing expedition for unrelated details about SpaceX's current and future operations and business plans.[23] SpaceX's application relates solely to SpaceX's request to add a new antenna to 7,500 currently authorized Gen2 satellites. As such, any questions about SpaceX's other current or future Gen1 or Gen2 operations and plans are irrelevant. Moreover, much of the information that DISH seeks—including information about

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[20] *See O3b Limited*, 33 FCC Rcd. 5508, ¶ 21 (2018).

[21] *See* DISH Petition at 4.

[22] *See* Stamp Grant, ICFS File No. SAT-MOD-20120814-00130 (issued Dec. 13, 2012); Application for Modification, ICFS File No. SAT-MOD-20120814-00130, at 1-2 (Aug. 13, 2012).

[23] *See* DISH Petition at 8-10.

satellite launches, on-orbit satellites, applications, and authorizations—are publicly available, raising questions about the depth and rigor of DISH's Petition. DISH has not explained how having a Commission-sponsored business intelligence operation, jammed into a narrow modification proceeding, could serve the public interest.

B. SpaceX requested and justified all necessary waivers

With AT&T claiming that SpaceX did not request enough waivers, and DISH claiming that SpaceX requested too many, SpaceX's application must have gotten it just right. In its application, SpaceX established that its request presents just the sort of "special circumstances" that warrant a waiver of the Table of Frequency Allocations and other rules to enable new services to benefit T-Mobile subscribers, bringing ubiquitous mobile connectivity to American consumers through an innovative new solution while presenting a low risk of interference to other spectrum users.[24] SpaceX's approach aligns with the Commission's commitment to considering SCS applications through a case-by-case waiver approach to "realize the[] public interest benefits as rapidly as possible" and not "discourage or delay the development" of this innovative new technology.[25]

AT&T claims that SpaceX should have requested a large number of waivers of Part 24 rules applicable to terrestrial operations, including technical rules related to height above average terrain ("HAAT"), base stations, power and antenna height, and interference protection for fixed microwave licensees.[26] But the Commission's rules make clear that most of those rules apply to other PCS spectrum bands but do not apply to the PCS G Block.[27] Only two rules identified by

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[24] *See generally* SCS Application, Waiver Requests.

[25] *SCS NPRM* ¶¶ 42-43.

[26] *See* AT&T Comments at 5-8.

[27] *See* 47 C.F.R. § 24.200 (specifying the scope of the rules as applying to PCS operations in the 1850-1910 and 1930-1990 MHz bands).

AT&T generally apply in the relevant band, one requiring type approval for PCS stations (Section 24.51) and the other requiring operators to maintain specific transmitter locations (Section 24.815). In both cases, AT&T correctly notes that the rules are either impractical or impossible in the SCS context.[28] Nonetheless, to the extent that the Commission determines that SpaceX did not already request a waiver of any relevant rules—or any other rules not appropriate for SCS—it requests such waivers here based on the same special circumstances and public interest benefits that support its existing waiver requests.

On the other hand, DISH takes the exact opposite view, claiming that SpaceX requested too many waivers to warrant grant of its application.[29] DISH fails to cite any rule or policy setting out the appropriate number of waivers an application for a new service should include. In fact, the Commission itself recognizes that this new service does not fall neatly within the existing authorization framework and therefore requires a "novel" regulatory approach,[30] and has sought to relax or eliminate many of the rules that DISH claims it should not waive here. For example, the Commission has proposed to eliminate its rule that prevents parties from seeking a waiver of the Table of Frequency Allocations,[31] and has strongly suggested that processing round rules should not apply in the SCS context.[32] If accepted, DISH's anti-competitive "count the waivers" approach would effectively preclude innovative service proposals such as SCS, while DISH continues to enjoy the increased value it received when it was given terrestrial rights to add to its

[28] *See* AT&T Comments at 6-7.

[29] *See* DISH Petition at 5.

[30] *See SCS NPRM* ¶ 24.

[31] *See Satellite Streamlining NPRM* ¶ 13; *SCS NPRM* ¶ 50 & n.132.

[32] *See SCS NPRM* ¶ 58 ("[D]o processing rounds serve a meaningful purpose where our proposed framework requires a nexus between a single satellite operator and a single terrestrial licensee, or would adherence to the existing processing rounds procedure create unnecessary complexity without concomitant benefit?").

still fallow S-band satellite licenses. But unlike DISH's approach of sitting on its rights for years, SpaceX will immediately begin deploying service upon authorization. The Commission should reject this regressive and anticompetitive argument.

C. SpaceX's ITU filings are proper and cover all necessary frequencies

Omnispace incorrectly claims that SpaceX's ITU filings for its SCS operations conflict with its modification application, but it appears that Omnispace simply neglected to review the record sufficiently. Specifically, Omnispace incorrectly claims that "SpaceX's German ITU coordination filing identified the 1990-1995 MHz band as uplink only; however, SpaceX's application seeks authority to use the 1990-1995 MHz as downlink only."[33]

As SpaceX explained in its application, the German administration submitted two ITU filings for the benefit of SpaceX's SCS operations—MARS-VLS and MRS-ULS. These filings cover frequencies from 1429 MHz to 2690 MHz, including the PCS G Block.[34] While Omnispace is correct that the MARS-VLS filing identifies 1990-1995 MHz for uplink, it is wrong when it suggests that SpaceX has not sought to use those frequencies for downlink operations. In fact, SpaceX's companion MARS-ULS filing requests 1990-1995 MHz for downlink. As such, SpaceX's German ITU filings present no conflict with SpaceX's SCS application. But perhaps more importantly, SpaceX's filings align with the directionality that the Commission established for PCS G Block mobile services,[35] that T-Mobile uses for its mobile service, and that tens of millions of mobile handsets use in the United States today.

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[33] Omnispace Opposition at 8 (footnote omitted).

[34] *See* SCS Application, Technical Narrative at 13-14.

[35] *See SCS NPRM* ¶ 29.

Moreover, as explained below, SpaceX's direct-to-cellular operations in the United States pursuant to T-Mobile's exclusive, nationwide license in the PCS G Block will not cause harmful interference to Omnispace's supposed international uplink operations in the band, or those of any other mobile satellite service in the band. In any event, the Commission should not deprive millions of Americans ubiquitous mobile coverage based on speculative claims from a spectrum holding company with no U.S. operations and at best limited foreign operations.

III. SPACEX'S TECHNICAL COMMITMENTS ARE SUFFICIENT TO PROTECT OTHER SYSTEMS

In its application, SpaceX committed to comply with relevant Part 24 interference protection criteria for PCS G Block spectrum to protect in-band, adjacent-band, and cross-border users from harmful interference,[36] and SpaceX has worked with T-Mobile to ensure that all operations are compatible with T-Mobile's primary terrestrial mobile operations. These commitments—buttressed by the Commission's own proposal to permit this service in the PSC G Block[37]—are sufficient to warrant a waiver of the Table of Frequency Allocations and grant SpaceX's modification application. In their filings, several parties demand detailed information and technical showings from SpaceX and T-Mobile that appear primarily designed to siphon proprietary information as those parties prepare their own competing offerings.[38] Unfortunately, this tactic is becoming too common by competitors trying to have the Commission force SpaceX to give up competitively-sensitive proprietary information, presumably to help these competitors

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[36] *See* SCS Application, Technical Narrative at 10-11.

[37] *See SCS NPRM* ¶ 29.

[38] AT&T also suggests that SpaceX must clarify whether and how it will comply with a range of service rules, including 911 and Wireless Emergency Alerts ("WEA"). *See* AT&T Comments at 10 n.32. SpaceX has already committed to comply with the relevant MSS 911 rules in Section 9.18 of the Commission's rules, and has clarified to the Commission that T-Mobile and SpaceX intend to provide WEA. *See* SCS Application, Technical Narrative at 9 (911 Compliance); *SCS NPRM* ¶ 92 n.208 (discussing WEA). In any event, these obligations are most appropriately addressed through T-Mobile and SpaceX's spectrum manager lease arrangement.

build their own systems. The Commission should reject these requests, which not only are unnecessary to ensure compliance with relevant technical rules, but also would undermine the benefits of both flexible use licensing and the Commission's secondary market policies.

A. SpaceX's operations will not cause in-band interference

AT&T and Omnispace demand additional technical showings and commitments with respect to SpaceX's operations within the PCS G Block, despite the fact that neither company has any commercial operations in the band or in adjacent bands within the United States. The Commission should reject these requests and permit SpaceX and T-Mobile to coordinate their in-band operations consistent with their spectrum manager lease arrangement and T-Mobile's license.

Terrestrial interference. AT&T asserts that SpaceX must demonstrate how its operations in T-Mobile's nationwide, exclusive PCS G Block spectrum will ensure that *T-Mobile's own subscribers* will not experience harmful interference, and that T-Mobile's competitors must have the ability to challenge that demonstration.[39] While AT&T's concerns for T-Mobile's customers is noble, providing mobile operators with a veto right over their competitor's in-band operations would upend long-standing secondary market policies, stymying deployment of innovative services and competition. Specifically, the Commission's secondary market policies are designed to "permit parties to enter into a variety of dynamic forms of spectrum leasing arrangements" while "avoiding placing regulatory barriers on licensees (or spectrum lessees) that wish to provide for opportunistic uses of spectrum pursuant to the terms and conditions that they set."[40] The Commission's spectrum leasing rules do not mention interference showings of any kind, including

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[39] AT&T Comments at 8-9.

[40] *Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets*, 19 FCC Rcd. 17503, ¶¶ 86, 88 (2004).

with respect to in-band operations.[41] Indeed, in the inverse context—i.e., when the Commission authorized MSS operators to lease spectrum used for their ancillary terrestrial component—the Commission did not require lessees to prove they will not cause interference, instead concluding that the lease would enable "coordination of any terrestrial use with satellite use so that the terrestrial use is consistent with the MSS service and interference rules."[42] In the *SCS NPRM*, the Commission validated this approach, noting its expectation that "a terrestrial licensee and its co-channel satellite partner seeking to provide SCS would coordinate regarding technical parameters to jointly ensure that their co-channel operations do not cause harmful interference to one another."[43]

Here, SpaceX has entered into a spectrum manager lease agreement that will enable T-Mobile to deliver SCS service to its subscribers, while ensuring that SpaceX's operations comply with appropriate protection limits for T-Mobile's terrestrial operations.[44] Consistent with the Commission's obligations for spectrum manager leases, SpaceX and T-Mobile have agreed to technical limits for satellite operations in its PCS G Block spectrum such that they will be "indistinguishable from terrestrial PCS G Block operations from an interference perspective"[45] and will not cause harmful interference to existing terrestrial operations. These commitments align

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41 *See* 47 C.F.R. § 1.9020.

42 *Fixed and Mobile Services in the Mobile Satellite Service Bands at 1525-1559 MHz and 1626.5-1660.5 MHz, 1610-1626.5 MHz and 2483.5-2500 MHz, and 2000-2020 MHz and 2180-2200 MHz*, 26 FCC Rcd. 5710, ¶ 17 (2011). *See also* 47 C.F.R. § 1.9049(b) (authorizing MSS operators to lease ATC spectrum with no provision for any interference showing).

43 *SCS NPRM* ¶ 115.

44 *See id.* ¶ 111 (explaining that "in spectrum manager leasing arrangements, through contractual provisions and oversight and enforcement of such provisions, the licensee must act in a manner sufficient to ensure that the spectrum lessee operates in conformance with applicable technical and use rules governing the license authorization.") (citing 47 C.F.R. § 1.9010(b)(1)(i)).

45 SCS Application at ii.

with the Commission's long-standing secondary market policies and provide a sufficient basis to assess and grant SpaceX's application.

The Commission should be extremely reluctant to countenance competitor-directed fishing expeditions in this context, especially where the terrestrial partner holds a nationwide, exclusive license for the spectrum at issue—negating the possibility for in-band interference to its competitor's operations. Ultimately, AT&T's suggested approach would only further fuel the sorts of baseless attacks that commenters have raised in this proceeding

Satellite interference. In its petition, foreign-licensed spectrum holding company Omnispace asks the Commission to prioritize its three placeholder satellites—which have no commercial operations or spectrum protection in the United States—over the needs of millions of American consumers, including rural Americans and emergency responders. Specifically, Omnispace falsely claims that SpaceX will cause harmful interference to Omnispace's virtually nonexistent overseas operations and speculative future operations, demanding that SpaceX and T-Mobile abandon their plan to bring ubiquitous mobile connectivity to American consumers or protect Omnispace in perpetuity.

As an initial matter, the Commission should place Omnispace in its appropriate context. Omnispace is a decade-old spectrum holding company comprising a few dozen employees in a corporate office near the Washington, DC beltway. Like other legacy MSS companies, Omnispace's spectrum portfolio has lain largely fallow over its existence, and it appears to have little if any commercial satellite operations. Indeed, Omnispace has only three satellites, an aging MEO satellite launched over two decades ago and two experimental LEO nano-satellites. It has no market access in the United States, and must operate its three satellites on a non-interference, non-protection basis with respect to licensed U.S. operations, including T-Mobile's PCS G Block operations and those of its lessees.[46] Omnispace has no arrangement with a U.S. terrestrial mobile carrier for SCS operations—nor could it in the PCS G Block, as its proposed operations conflict with the directionality that the Commission has established for the band and that has been implemented for millions of T-Mobile subscribers. If Omnispace ultimately seeks U.S. market access for MSS services and triggers a processing round, any authorization would split the available spectrum with all other duly licensed operators in that round pursuant to established sharing rules, irrespective of ITU filing status.[47] For these reasons, it is troubling that Omnispace claims that "no meaningful interference-mitigation options exist"[48] in the band, and perhaps explains why Omnispace avoids seeking access to the U.S. market and clings to its ITU status, while demanding that the Commission prevent duly licensed mobile operators from making more intensive use of the band for millions of Americans.

But even if Omnispace were a true commercial satellite system, its interference claims are dramatically overstated. Specifically, Omnispace falsely claims that SpaceX will cause harmful and unresolvable interference with Omnispace's three satellites—one MEO and two LEO—that may provide commercial service only outside of the United States.[49] In support of its claims, Omnispace provides a technical study that adopts a number of incorrect or unrealistic assumptions about SpaceX's and Omnispace's satellites.

For example, while Omnispace assumed that the gain of SpaceX's SCS antennas toward Omnispace's satellites would be 8 dBi, in fact, given the large off-axis angles involved, the gain will be closer to -20 dBi. Similarly, while Omnispace assumed that its own antenna gain toward

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46 *See* Experimental Authorizations, ELS File Nos. 0426-EX-CN-2022 (granted Mar. 31, 2023) and 0018-EX-CM-2023 (granted Feb. 14, 2023).

47 *See* 47 C.F.R. § 25.157(e).

48 Omnispace Opposition at 4.

49 *See id.* at 10-11.

SpaceX satellites would be 10 dBi, the antenna pattern described for use in NGSO interference analyses in ITU Recommendation S.1528 shows (very conservatively) the gain for far-out sidelobes (i.e., off-axis angles over 60 degrees) should be 0 dBi.[50] Moreover, Omnispace presents a worst-case scenario for short-term interference, with its satellite placed as close as possible to the SpaceX satellites providing service to the United States, while still being able to provide some service to Colombia at its edge of coverage. Replicating Omnispace's worst-case analysis of its 630 km experimental satellite providing service to Colombia and receiving interference from all SpaceX satellites over the United States, but correcting for gain, SpaceX was able to show that the aggregate interference from SpaceX's SCS operations will fall below the -12.2 dB I/N that Omnispace deemed acceptable for its own operations, posing no risk of harmful interference.

Importantly, even if SpaceX's satellites were to exceed the -12.2 dB I/N threshold, it would not necessarily demonstrate an unacceptable level of interference for Omnispace, but only trigger a need to determine whether coordination is necessary. Indeed, as per Recommendation ITU-R S.1323-2 guidance, short term I/N between NGSO systems may be significantly higher than -12.2 dB, as long as the throughput degradation and the reduction in unavailability is acceptable.

Finally, contrary to Omnispace's baseless claim, NGSO systems have mechanisms available to efficiently share spectrum, including in the PCS G Block. As such, to the extent that Omnispace's concerns relate to the supposed operations of its foreign-licensed systems outside the United States, those concerns are much better addressed through private coordination, where the parties can share more detailed information and reach efficient sharing outcomes. In the meantime, Omnispace's speculative assertions and wildly exaggerated technical analysis provide no reason

50 *See* Rec. ITU-R S.1528.

for the Commission to delay the deployment of beneficial services to millions of American consumers.

B. SpaceX's operations will protect cross-border users

AT&T, which does not operate in the PCS G Block or adjacent bands in the United States or across either the Canadian or Mexican border, seeks detailed proprietary information about SpaceX's cross-border operations,[51] which would potentially aid AT&T's own partner, AST SpaceMobile, in development of a competing SCS system.

SpaceX has agreed to observe a maximum PFD based on the equivalent Part 24 field strength limits that would protect cross-border users from harmful interference, and has committed to space downlink beams away from borders to protect primary terrestrial mobile operations in Canada and Mexico from interference. SpaceX further explained that it would only exceed these limits where it has been authorized pursuant to an approval from the regulatory authority of the appropriate border country and after providing documentation of such approval to the Commission.[52] Permitting SpaceX and T-Mobile the flexibility to work out appropriate cross-border limits within the scope of T-Mobile's exclusive license and corresponding authorizations from neighboring countries would not only ensure that cross-border users do not experience harmful interference, but also would enable T-Mobile and adjacent-country operators to develop tailored arrangements that more efficiently protect each other's operations. The Commission should not allow T-Mobile's competitors to stymie innovation and consumer value by second-guessing those arrangements.

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51 *See* AT&T Comments at 11-12.

52 *See* SCS Application, Technical Narrative at 10-11.

C. SpaceX's operations will protect adjacent band users

SpaceX's operations will also comply with relevant out-of-band emission limits in Part 24 to protect adjacent band users. SpaceX explained in its application that it will comply with the out-of-band emissions limits for terrestrial base stations in PCS G Block set forth in Section 24.238, although Part 25 contains its own satellite-specific out-of-band-emission limit for the band that is less restrictive.[53] This conservative approach will protect adjacent band users regardless of whether a T-Mobile user is connecting via SCS or a terrestrial base station, and no commenter has provided data to show otherwise. Nonetheless, three commenters—AT&T, DISH, and RWA—argue that SpaceX must provide additional information to demonstrate compliance with frequency stability rules in Section 24.235 and out-of-band limits in Section 24.238 of the Commission's rules.[54]

Commenters' baseless fears about out-of-band emissions from SCS reveal a fundamental misunderstanding about satellite communications, and particularly direct-to-cellular connectivity. SpaceX explained in its application that it will comply with the out-of-band emissions limits for terrestrial base stations in PCS G Block set forth in Section 24.238. This out-of-band emission mask is far stricter than the mask for satellite communications in Part 25. That is because terrestrial out-of-band emission limits are designed to protect adjacent band users that may be in close physical proximity to one another (less than a kilometer), such that adjacent-channel emissions from one base station are well above the thermal noise when reaching a potential victim. By contrast, an SCS antenna on a satellite will always be hundreds of kilometers away from a potential victim receiver. Consequently, when an SCS downlink reaches the ground, the combination of

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[53] *See id.*, Technical Narrative at 11.

[54] *See* AT&T Comments at 10-11; DISH Petition at 6-7; RWA Comments at 2-3.

the Part 24 emissions mask and path loss over hundreds of kilometers places the out-of-band emissions well below the noise floor. As shown in **Figure 1** below, out-of-band emissions from the PCS G Block are well below the noise floor when a satellite operator uses the Section 25.202 mask, and are dramatically lower when using the more restrictive Section 24.238 mask:

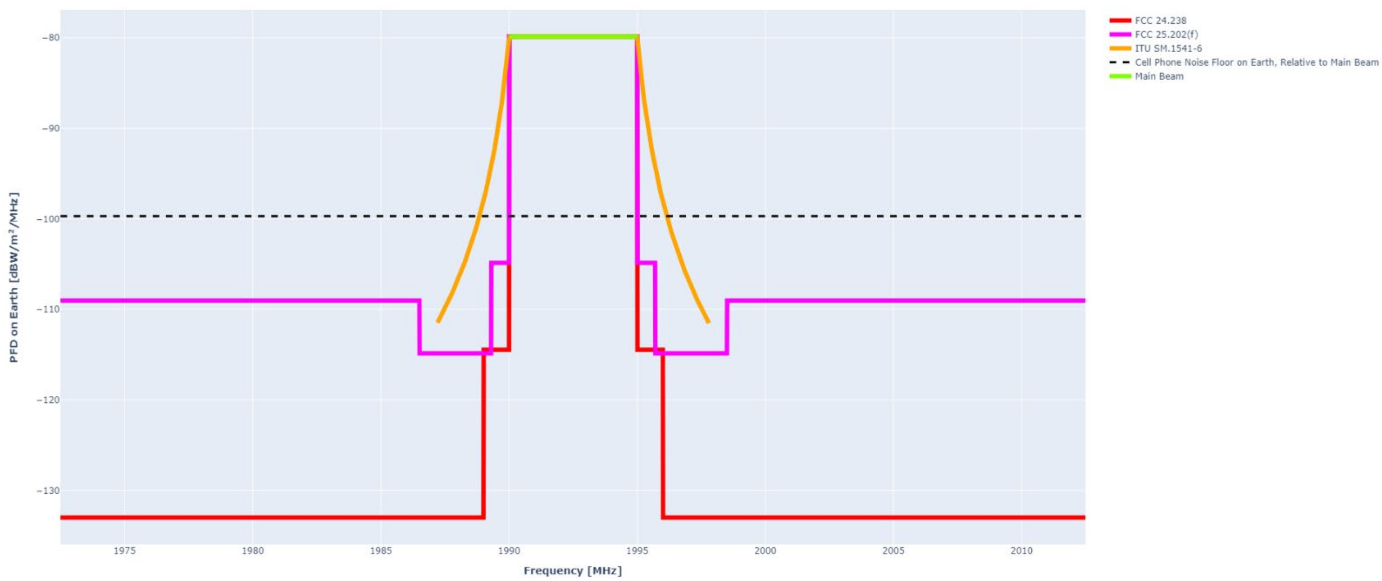

Figure 1: Out-of-band emissions from satellite enabling SCS

In other words, a victim receiver in a band adjacent to SpaceX's SCS operations will be desensed by thermal noise well before being desensed by an SCS downlink signal. And because SpaceX's SCS operations will be so far below the noise floor, their contribution to out-of-band emissions will be negligible even when combined with in-band operations of a terrestrial base station. For these reasons, the cumbersome technical showings and field trials demanded by AT&T, DISH, and RWA are entirely unnecessary and will serve only to slow deployment of service to consumers. With respect to frequency stability, SpaceX already met the Commission's requirement to "ensure that the fundamental emission stays within the authorized frequency block,"[55] when it explained in its application that it would "compensate and correct for Doppler and time synchronization effects both inside and between beams."[56] AT&T fails to provide any specific need it has for more detailed information other than competitive advantage.

In any event, neither the Commission's satellite rules nor its terrestrial flexible use rules require operators to provide technical details on how an operator will meet a given emissions limit or demonstrate frequency stability, and the parties provide no reason to depart from that successful approach here.

D. SpaceX will coordinate with radio astronomy

In its opposition, NRAO speculates that SpaceX and T-Mobile's proposed partnership may impact radio astronomy in the National Radio Quiet Zone ("NRQZ") around the Green Bank Observatory. To address these issues, NRAO expresses optimism that "coordination may be possible" with study, and "encourages and invites SpaceX to address the impact of its Direct-to-Cell system on the [NRQZ]."[57] SpaceX agrees, especially given SpaceX's unprecedented past coordination to address previous interference concerns.

As SpaceX explained in its earlier filing in this proceeding, SpaceX has coordinated in good faith with the National Science Foundation ("NSF"), the NRAO, and the wider radio astronomy community to ensure the success of important scientific research while providing American consumers with robust next-generation satellite connectivity.[58] As a part of this commitment, SpaceX and NSF recently reached an historic coordination agreement addressing

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[55] 47 C.F.R. § 24.235.

[56] SCS Application, Technical Narrative at 4.

[57] NRAO Opposition at 5.

[58] *See* NSF/NRAO Coordination Letter.

SpaceX's first- and second-generation satellite systems,[59] and the parties continue to collaborate in good faith to extend that agreement to cover SpaceX's application to enable T-Mobile to provide SCS to its subscribers.

SpaceX had already offered to work with NRAO to address any concerns it may have, including in the months before SpaceX filed its application to supplement T-Mobile's mobile service. SpaceX was therefore surprised to see NRAO's letter in this proceeding. But more to the point, the issues NRAO raises appear more appropriately addressed in the Commission's general rulemaking to establish industry-wide rules for SCS. SpaceX remains committed to continuing to work with NRAO on this and other issues through its ongoing and successful direct coordination efforts. By working together collaboratively, SpaceX and NRAO can find solutions that will protect radio astronomy while still allowing the American people to benefit from a potentially life-saving new service.

E. SpaceX's payload falls within its authorized orbital debris parameters

DISH questions SpaceX's orbital debris mitigation showings, baselessly challenging SpaceX's decision to incorporate by reference the showings from its authorized Gen2 system rather than submit an unnecessary and duplicative ODAR report for its SCS payload.[60] DISH's concern about space sustainability even though it has zero low-Earth-orbit satellites and zero experience with NGSO orbital debris mitigation is laudable. But its claims here are misplaced because SpaceX's existing commitments and showings already accommodate its proposed SCS operations. Given DISH's new-found interest in space sustainability, SpaceX looks forward to it

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59 *See* Letter from David Goldman to Marlene H. Dortch, ICFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (Jan. 17, 2023).

60 *See* DISH Petition at 9.

participating more productively in general proceedings on the matter and for it to weigh in with its opinions on the applications of other satellite operators.

But addressing DISH's highly-localized concerns about sustainability thus far, SpaceX has invested more than any other operator to lead the way in promoting safe and sustainable orbital resources. SpaceX has developed and deployed world-leading collision avoidance technologies and generally will take maneuver responsibility for potential conjunctions with other operators, including when addressing potential conjunctions in overlapping and adjacent orbits. Moreover, SpaceX actively collaborates with NASA pursuant to a Space Act Agreement to promote space sustainability and the efficient use of orbital resources, consistent with our shared mission and values, and SpaceX will continue those collaborations when deploying its SCS payload. In addition, the Commission has imposed exacting orbital debris mitigation conditions on SpaceX's Gen1 and Gen2 licenses that further promote space sustainability, including performance-based obligations for its Gen2 system that the Commission has opted to apply to no other operator. Together, these commitments, conditions, and world-leading space sustainability practices will ensure that SpaceX remains the most responsible operator in space, even as it deploys a revolutionary new service.

With respect to SpaceX's orbital debris mitigation showings, SpaceX's Gen2 application materials and supplemental filings provide sufficient information for parties to evaluate the sustainability of SpaceX's SCS operations. Specifically, these operations will fall within the area-to-mass ratio of the largest form factor that the Commission approved for the Gen2 system in the *Gen2 Order*. Further, contrary to DISH's demands, the Commission's rules do not require an operator to submit a formal ODAR with its orbital debris mitigation showing, and the Commission has granted past applications—including SpaceX's Gen2 system—without requiring such a report.

Nevertheless, SpaceX attaches as **Attachment A** information about two of its SCS payload form factors and sample DAS logs that demonstrate that this new payload fits well within the parameters SpaceX already provided. As demonstrated in this attachment, SpaceX's SCS operations will fall within orbital debris collision probabilities that the Commission has already approved in the *Gen2 Order*, and as such raise no new issues that require a departure from the conditions the Commission already adopted in the *Gen2 Order*. To be clear, these demonstrations are for illustrative purposes, and it would be contrary to established rules and disincentivize operators from sharing such information in the future if the Commission were to use this information that SpaceX's provides voluntarily to establish new conditions on SpaceX's operations.

CONCLUSION

SpaceX is excited to enable the strong public interest benefits of its new service for T-Mobile's subscribers throughout the United States. SpaceX urge the Commission to process SpaceX's modification application expeditiously.

Respectfully submitted,

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May 30, 2023

ATTACHMENT A

SATELLITE DIMENSIONS AND DAS OUTPUTS

The tables below present illustrative information for proposed form factors of SpaceX Gen2 satellites with SCS capabilities: one of which will be launched on Falcon 9 rockets and one that will be launched on Starship. For convenience, these satellites are labeled satellites F9-3 and Starship-2, respectively, following the naming convention SpaceX used for its authorized Gen2 satellites. Note that to better reflect a non-maneuverable satellite in a tumbling deorbit a 0.5 scaling factor has been applied to the area-to-mass ratios used with NASA's Debris Assessment Software ("DAS"). Further note that while the specific dimensions of the bus of the Starship-2 satellite is larger than the Starship-1 satellite, reflecting a deployed SCS antenna, the DAS analysis of the Starship-2 satellite is identical to the Starship-1 analysis that the Commission approved in the *Gen2 Order* because the area-to-mass ratio used for the analysis is the same. These demonstrations are for illustrative purposes, and it would be contrary to established rules and disincentivize operators from sharing such information in the future if the Commission were to use this information that SpaceX's provides here voluntarily to establish new conditions on SpaceX's operations.

	Length	Width	Number	Area	DAS Area	DAS Mass
Solar Array F9-3	12.8	4.1	2	105.0		
Bus F9-3	7.4	2.7	1	20.0		
Total Area F9-3				125.0	130	970
Solar Array Starship-2	20.2	6.36	2	256.94		
Bus Starship-2	10.1	2.7	1	27.27		
Total Area Starship-2				284.21	294	2000

SpaceX Gen2 F9-3 Satellite DAS input parameters:
Area = 130 m^2
Mass = 970 kg
Area-to-Mass = 0.067 (tumbling)

DAS 3.2.3 - SpaceX Gen 2, F9-3 Satellite			
Altitude	Inclination	Demise Time (yrs)	Large Debris Passive Decay PC
535	33	1.74	3.71e-4
530	43	1.63	3.24e-4
525	53	1.51	2.62e-4

SpaceX Gen2 Starship-2 Satellite DAS input parameters:

Area = 294 m^2
Mass = 2000 kg
Area-to-Mass = 0.0735 (tumbling)

DAS 3.2.3 SpaceX Gen 2, Starship Satellite			
Altitude	Inclination	Demise Time (yrs)	Large Debris Passive Decay PC
535	33	1.66	8.25E-04
530	43	1.56	6.28E-04
525	53	1.47	7.87E-04
360	96.9	0.06	1.31E-04
350	38	0.05	8.12E-05
345	46	0.04	8.09E-05
340	53	0.04	7.99E-05
604	148	3.23	2.17E-03
614	116.7	3.85	2.89E-03

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Run Data

==============

INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2023.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.3502E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2023.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 2.6928E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2023.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 5.4956E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2023.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 8.0758E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

Run Data

==============

INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2024.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1337E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2024.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1922E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2024.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.3286E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2024.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 4.3912E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

==============

Run Data

==============

INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2025.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.0757E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2025.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1407E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2025.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.2837E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2025.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.4526E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

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Run Data

==============

INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2026.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1150E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2026.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1800E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2026.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.3165E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2026.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 2.4431E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

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Run Data

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INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2027.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.0970E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2027.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.1685E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2027.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 3.0130E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2027.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 2.0871E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

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Run Data

==============

INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2028.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 2.0058E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2028.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 3.9415E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2028.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 4.1889E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2028.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 5.1107E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

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Run Data

==============

INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2029.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 4.7316E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2029.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 4.9957E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2029.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 7.0619E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2029.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 7.9581E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

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Run Data

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INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2030.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 5.2641E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2030.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 6.3039E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2030.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 7.4410E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2030.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 6.8064E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

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Run Data

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INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2031.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 6.2652E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2031.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 7.0449E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2031.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 4.5493E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2031.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 7.5125E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

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Run Data

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INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2032.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 2.2398E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2032.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 4.1221E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2032.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 5.3945E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2032.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 7.6622E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

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Run Data

==============

INPUT

Space Structure Name = F9-3_525

Space Structure Type = Payload

Perigee Altitude = 525.000 (km)

Apogee Altitude = 525.000 (km)

Inclination = 33.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2033.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.2739E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_530

Space Structure Type = Payload

Perigee Altitude = 530.000 (km)

Apogee Altitude = 530.000 (km)

Inclination = 43.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2033.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.3584E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_535

Space Structure Type = Payload

Perigee Altitude = 535.000 (km)

Apogee Altitude = 535.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2033.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 1.5274E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Space Structure Name = F9-3_550

Space Structure Type = Payload

Perigee Altitude = 550.000 (km)

Apogee Altitude = 550.000 (km)

Inclination = 53.000 (deg)

RAAN = 0.000 (deg)

Argument of Perigee = 0.000 (deg)

Mean Anomaly = 0.000 (deg)

Final Area-To-Mass Ratio = 0.0670 (m^2/kg)

Start Year = 2033.000 (yr)

Initial Mass = 970.000 (kg)

Final Mass = 970.000 (kg)

Duration = 7.000 (yr)

Station-Kept = False

Abandoned = True

Long-Term Reentry = False

OUTPUT

Collision Probability = 2.2188E-04

Returned Message: Normal Processing

Date Range Message: Normal Date Range

Status = Pass

==============

INPUT

Start Year = 2023.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.950034 (yr)

Time Spent in LEO during Lifetime = 0.950034 (yr)

Last year of Propagation = 2023 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2024.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.739220 (yr)

Time Spent in LEO during Lifetime = 0.739220 (yr)

Last year of Propagation = 2024 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2025.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.629706 (yr)

Time Spent in LEO during Lifetime = 0.629706 (yr)

Last year of Propagation = 2025 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2026.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.662560 (yr)

Time Spent in LEO during Lifetime = 0.662560 (yr)

Last year of Propagation = 2026 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2027.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.873374 (yr)

Time Spent in LEO during Lifetime = 0.873374 (yr)

Last year of Propagation = 2027 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2028.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 1.552361 (yr)

Time Spent in LEO during Lifetime = 1.552361 (yr)

Last year of Propagation = 2029 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2029.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 3.340178 (yr)

Time Spent in LEO during Lifetime = 3.340178 (yr)

Last year of Propagation = 2032 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2030.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 3.167693 (yr)

Time Spent in LEO during Lifetime = 3.167693 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2031.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 2.395619 (yr)

Time Spent in LEO during Lifetime = 2.395619 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2032.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 1.524983 (yr)

Time Spent in LEO during Lifetime = 1.524983 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2033.000000 (yr)

Perigee Altitude = 525.000000 (km)

Apogee Altitude = 525.000000 (km)

Inclination = 33.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.752909 (yr)

Time Spent in LEO during Lifetime = 0.752909 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2023.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 1.040383 (yr)

Time Spent in LEO during Lifetime = 1.040383 (yr)

Last year of Propagation = 2024 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2024.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.804928 (yr)

Time Spent in LEO during Lifetime = 0.804928 (yr)

Last year of Propagation = 2024 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2025.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.687201 (yr)

Time Spent in LEO during Lifetime = 0.687201 (yr)

Last year of Propagation = 2025 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2026.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.731006 (yr)

Time Spent in LEO during Lifetime = 0.731006 (yr)

Last year of Propagation = 2026 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2027.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.982888 (yr)

Time Spent in LEO during Lifetime = 0.982888 (yr)

Last year of Propagation = 2027 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2028.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 1.831622 (yr)

Time Spent in LEO during Lifetime = 1.831622 (yr)

Last year of Propagation = 2029 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2029.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 3.682409 (yr)

Time Spent in LEO during Lifetime = 3.682409 (yr)

Last year of Propagation = 2032 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2030.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 3.282683 (yr)

Time Spent in LEO during Lifetime = 3.282683 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2031.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 2.480493 (yr)

Time Spent in LEO during Lifetime = 2.480493 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2032.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 1.593429 (yr)

Time Spent in LEO during Lifetime = 1.593429 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2033.000000 (yr)

Perigee Altitude = 530.000000 (km)

Apogee Altitude = 530.000000 (km)

Inclination = 43.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.804928 (yr)

Time Spent in LEO during Lifetime = 0.804928 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2023.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 1.127995 (yr)

Time Spent in LEO during Lifetime = 1.127995 (yr)

Last year of Propagation = 2024 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2024.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.873374 (yr)

Time Spent in LEO during Lifetime = 0.873374 (yr)

Last year of Propagation = 2024 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2025.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.752909 (yr)

Time Spent in LEO during Lifetime = 0.752909 (yr)

Last year of Propagation = 2025 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2026.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.802190 (yr)

Time Spent in LEO during Lifetime = 0.802190 (yr)

Last year of Propagation = 2026 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2027.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 1.100616 (yr)

Time Spent in LEO during Lifetime = 1.100616 (yr)

Last year of Propagation = 2028 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2028.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 2.171116 (yr)

Time Spent in LEO during Lifetime = 2.171116 (yr)

Last year of Propagation = 2030 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2029.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 3.928816 (yr)

Time Spent in LEO during Lifetime = 3.928816 (yr)

Last year of Propagation = 2032 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2030.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 3.389459 (yr)

Time Spent in LEO during Lifetime = 3.389459 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2031.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 2.557153 (yr)

Time Spent in LEO during Lifetime = 2.557153 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2032.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 1.659138 (yr)

Time Spent in LEO during Lifetime = 1.659138 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

INPUT

Start Year = 2033.000000 (yr)

Perigee Altitude = 535.000000 (km)

Apogee Altitude = 535.000000 (km)

Inclination = 53.000000 (deg)

RAAN = 0.000000 (deg)

Argument of Perigee = 0.000000 (deg)

Area-To-Mass Ratio = 0.067000 (m^2/kg)

OUTPUT

Orbital Lifetime from Start Year = 0.856947 (yr)

Time Spent in LEO during Lifetime = 0.856947 (yr)

Last year of Propagation = 2033 (yr)

Returned Error Message: Object reentered

ENGINEERING CERTIFICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this filing, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this filing, and that it is complete and accurate to the best of my knowledge and belief.

/s/ *Mihai Albulet*

Mihai Albulet, PhD
Principal RF Engineer
SPACE EXPLORATION TECHNOLOGIES CORP.

May 30, 2023

Date

CERTIFICATE OF SERVICE

I hereby certify that, on this 30th day of May, 2023, a copy of the foregoing pleading was served via First Class mail upon:

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