PERFORMANCE KIT
DURABILITY GUIDE

STARLINK

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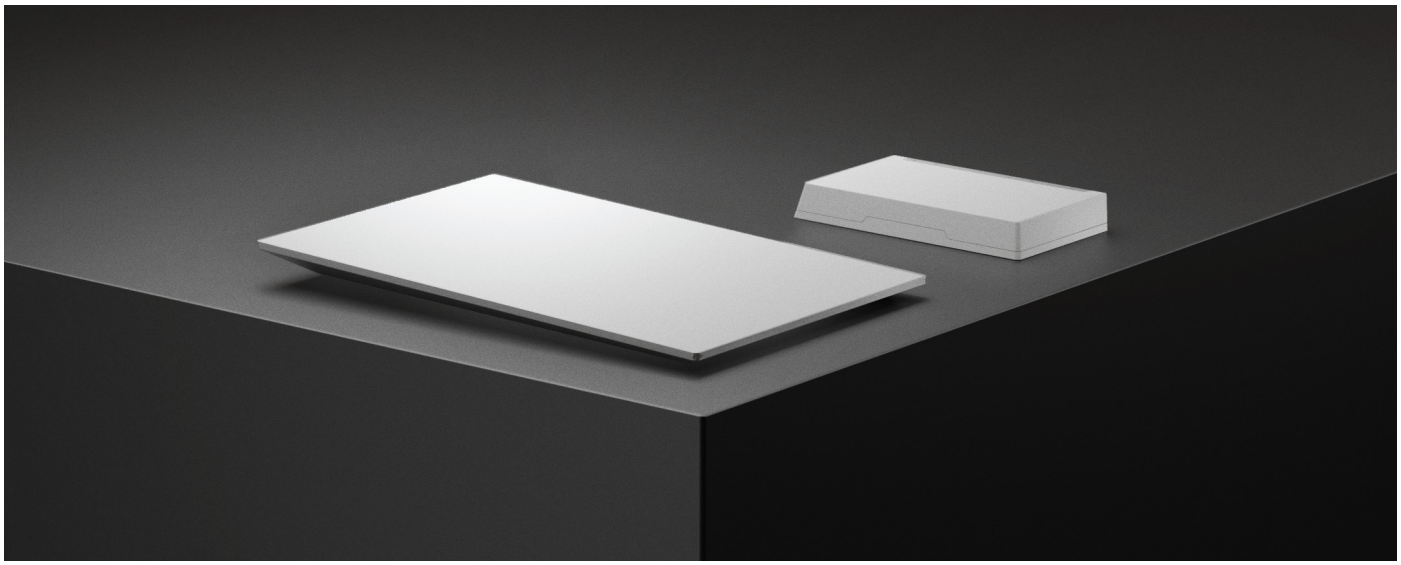
01. OVERVIEW

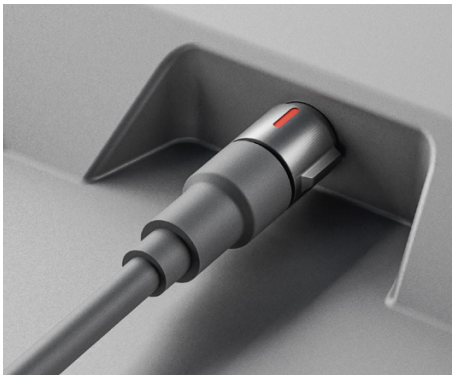
This document is intended to provide additional information on the durability of the Starlink Performance Kit product offering as related to real world environments. This information does not supersede any product certifications or advised use limits and is intended for reference only.

1.1 | STARLINK PERFORMANCE HIGHLIGHTS

Starlink Performance was designed to be a ruggedized solution for customers who require reliable, high-speed connectivity in the harshest environments. Some of the state-of-the-art durability features include:

- A powder-coated aluminum enclosure for impact protection and corrosion resistance
- Water and dust resistant to IP68 without a connector installed, and a locking connector that provides water and dust resistance to IP69K
- Designed to withstand aggressive vibration and shock environments
- 140° scan angle ideal for enterprise and mobility applications
- Advanced Power Supply capable of AC (primary), DC (primary), or AC (primary) + DC (backup) power
- Field terminatable connector for custom installations
- Stainless steel threaded inserts for robust mounting
- Thermal performance improvements for efficient snow melting and higher performance at extreme temperatures



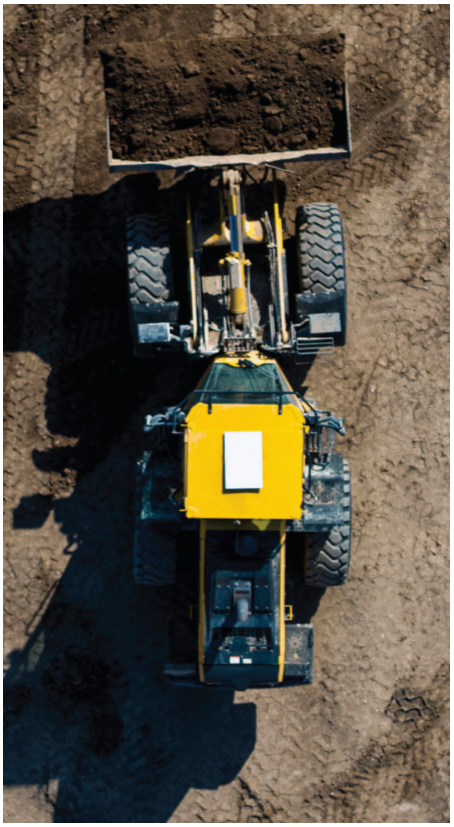


The Starlink Performance Kit was rigorously tested to pass the conditions outlined in Table 1, with a 10-year design life driven by worst-case environments. Reliability test profiles were derived from the most extreme climates, including those representative of desert and arctic conditions, along with high vibration and moisture-rich environments.

Table 1: Starlink Performance Durability Overview

Durability Test		Starlink Performance	Starlink Advanced Power Supply
Hail		1.25"	1.25"
Drop		1.0m	1.5m
Vibration	PSD	3.96 GRMS	3.96 GRMS
	Duration	34 Hours / Axis	34 Hours / Axis
Shock	Functional	50g, 11ms half-sine pulse	50g, 11ms half-sine pulse
	Crash	75g, 6ms sawtooth pulse	-
Dust / Water Ingress		IP69K	IP68
Corrosion / Marine Environment		ASTM B117 & G85 A3	-
Operational Thermal Limits	Max Temp	60°C (140°F)*	60°C (140°F)
	Min Temp	-40°C (-40°F)	-40°C (-40°F)
Wind		270+ kph (170+mph)	-

*Performance throttling might begin at lower temperature to protect device (varies based on throughput)
**Tested on Starlink wedge and flat mounts



02. STARLINK PERFORMANCE DURABILITY DETAILS

2.1 | SNOW MELT

Starlink Performance is capable of melting snow at a rate of 8.9 cm/hr (3.5 in/hr) when snow density is 100 kg/m3, and at a rate of 13.2 cm/hr (5.2 in/hr) when snow density is 68 kg/m3. The user terminal should be installed with either a wedge mount, wall mount or pipe adapter to ensure water sheds from the surface to maintain the best signal with Starlink satellites.

2.2 | HAIL

Starlink Performance and Starlink Advanced Power Supply were qualified to survive impacts from hail up to 1.25" in diameter without effecting performance.

2.3 | DROP

Starlink Performance remains functional after one drop onto steel from 1m on any of its surfaces, and Starlink Advanced Power Supply remains functional after one drop onto steel from 1.5m on any of its surfaces.

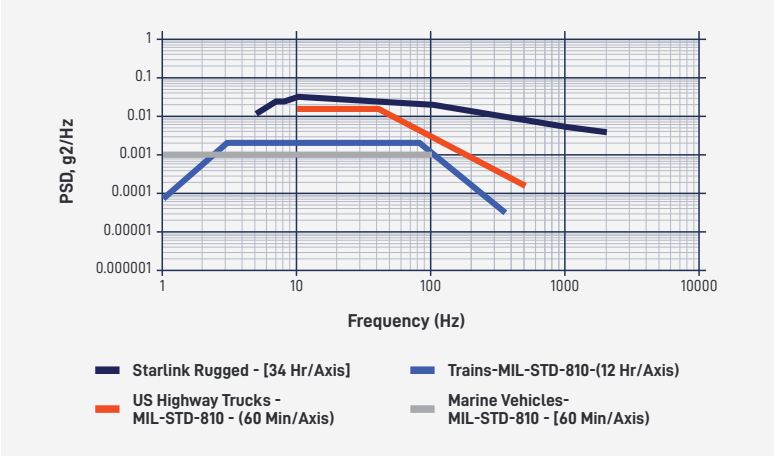
2.4 | VIBRATION

Starlink Performance and Starlink Advanced Power Supply were qualified to a rugged vibration profile on the wedge and flat mobility mounts. This profile was generated by adjusting power spectral density (PSD) levels, frequency breakpoints, and test duration to envelope rail, construction, ground vehicle, marine vehicle, and agriculture use cases with an equivalent mission life of 10 years. Although some industry profiles might show higher PSD at some frequencies, the cumulative damage added from increased test duration provides additional coverage to account for PSD differences. Each axis is run at the same levels to qualify the hardware for any install orientation.

Table 2: Starlink Rugged Profile Exposure Levels

Vertical/Traverse/Longitudinal	
Frequency (Hz)	**PSD, g2/Hz**
5	0.0115
7	0.0231
8	0.0231
10	0.0249
100	0.0192
1000	0.0050
2000	0.0037
Test Duration: 34 Hours per Axis	
GRMS: 3.69	

Figure 1: Comparison Across Common Use Vibration Test Profiles – Vertical Axis



Above are test profile comparisons between our qualified levels and MIL-STD-810H. Note that test durations vary and are included in the legend.

2.5 | SHOCK

Starlink Performance and Starlink Advanced Power Supply were qualified to an internally derived shock profile consisting of 3x 50g half-sine shock pulses with a pulse duration of 11ms in each of the six equipment orientations on a wedge and flat mount. This testing qualifies the hardware for installation in any orientation, and envelopes most off-road and marine environments.

In addition to functional shock testing, Starlink Performance survives the MIL-STD-810H crash hazard shock profile consisting of a 75g sawtooth shock pulse with a pulse duration of 6ms installed on a wedge and flat mount.

2.6 | WATER AND DUST INGRESS

Starlink Performance was qualified to IP68 with the connector unplugged and IP69K with the connector mated. Unmated submersion testing was completed to a depth of 1.1m for more than 30 minutes. The IPx9K testing was conducted using water pressures greater than 8 MPa and temperatures greater than 80°C. The test includes 30 seconds of active spray at each nozzle, with nozzle locations set every 30 degrees across each face of the user terminal. The maximum distance from the user terminal to the high-pressure jet is 150 mm.

Starlink Advanced Power Supply was qualified to IP68 with all connectors properly mated. Internal IPx8 submersion testing was completed to a depth of 1.1m for more than 30 minutes. Additional testing was performed to IPx5 (low pressure water jet), IPx6 (high pressure water jet), and IPx7 (submersion <1m) with passing results.

2.7 | THERMAL

Table 3: Thermal Environment Performance Summary

	Max Temperature	Min Temperature
Starlink Performance	60°C (140°F)	-40°C (-40°F)
Starlink Advanced Power Supply	60°C (140°F)	-40°C (-40°F)

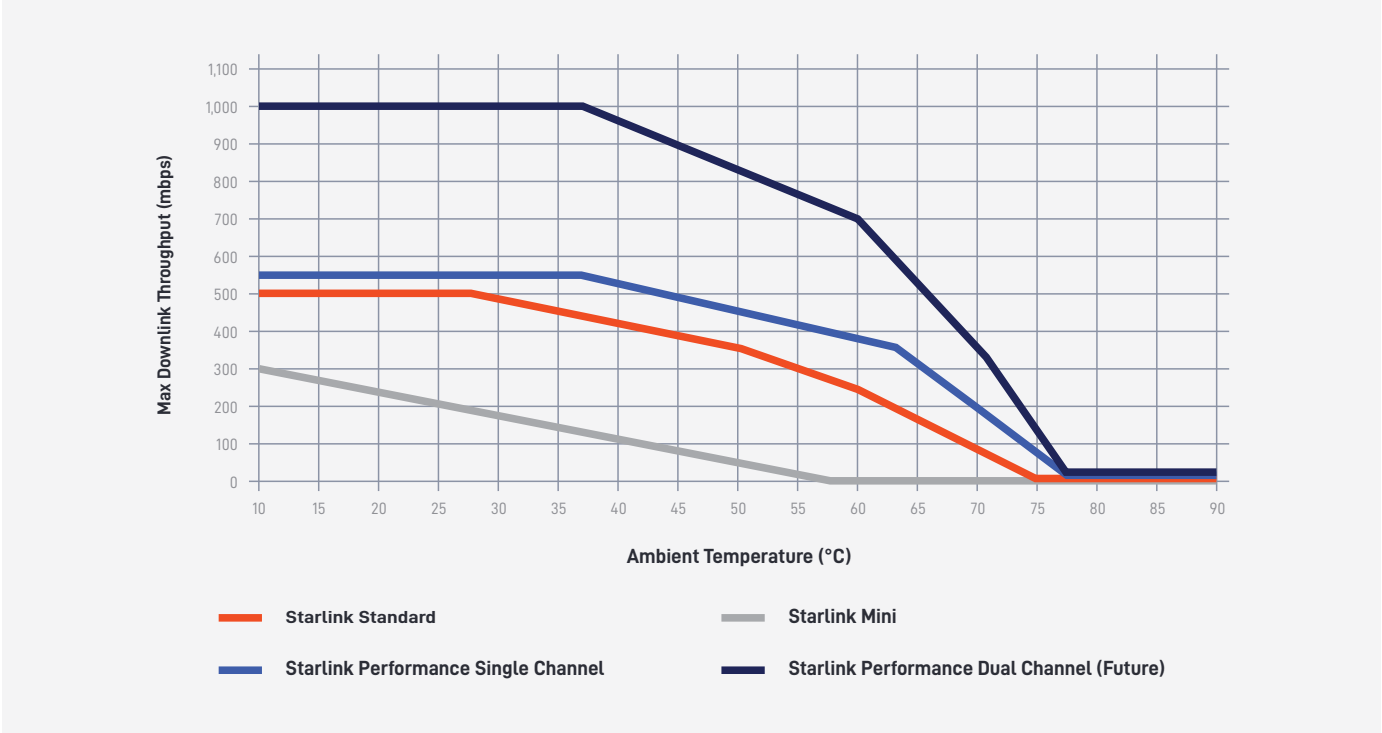
These temperatures assume worst-case conditions (no wind and max solar load).
Functional testing performed up to 80C.

2.7.1 | THERMAL PERFORMANCE LIMITS

"Max temperature" indicates the maximum ambient temperature at which the hardware can function with minimal impact to performance. When ambient temperature exceeds this value, the product continues to function but will throttle its duty cycle to protect itself, reducing maximum allowable throughput until it is forced to shut down at temperatures >75°C (167°F). Wind, solar intensity, and mounting location can all impact the duration and severity of throttling. See plot below for more details. Note the dual-channel throughput capability shown below in Figure 2 will be a future network upgrade available for Starlink Performance.

All products are qualified to function in temperatures as low as -40°C (-40°F) without impact to performance. Power draw at lower temperatures will increase when snow melt mode is activated.

Figure 2: Throughput vs Ambient Temperature w/ Full Solar Load



2.7.2 | THERMAL ACCELERATED LIFE TESTING

In addition to functional testing in real-world environments, Starlink Performance went through rigorous accelerated life testing to qualify the product for a 10-year minimum mission life.

Table 4: Thermal Accelerated Life Test Summary

Test	Profile	10 Year Equivalent Duration
Thermal Cycling	-40°C to 90°C (-40°F to 195°F)	1,040 Cycles
Freeze-Thaw Cycling w/ Water Drip	-15°C to 15°C (5°F to 60°F)	560 Cycles
Hot Humidity Soak	85% RH, 90°C (195°F)	125 Hours
Hot Soak	100°C (212°F)	220 Hours

2.8 | CORROSION/MARINE ENVIRONMENT

Starlink Performance was qualified to 3000 hours of ASTM B117 and 400 hours of ASTM G85 A3 with no impact to structure or performance. Testing was performed with sealing connectors properly installed.

2.9 | WIND

Starlink Performance was qualified to 270+ kph (170+ mph) in all orientations on a Starlink flat mount and on a Starlink wedge mount. The Starlink wall and pole mount configurations were qualified to 177 kph (110 mph), the equivalent of a Category 2 hurricane.

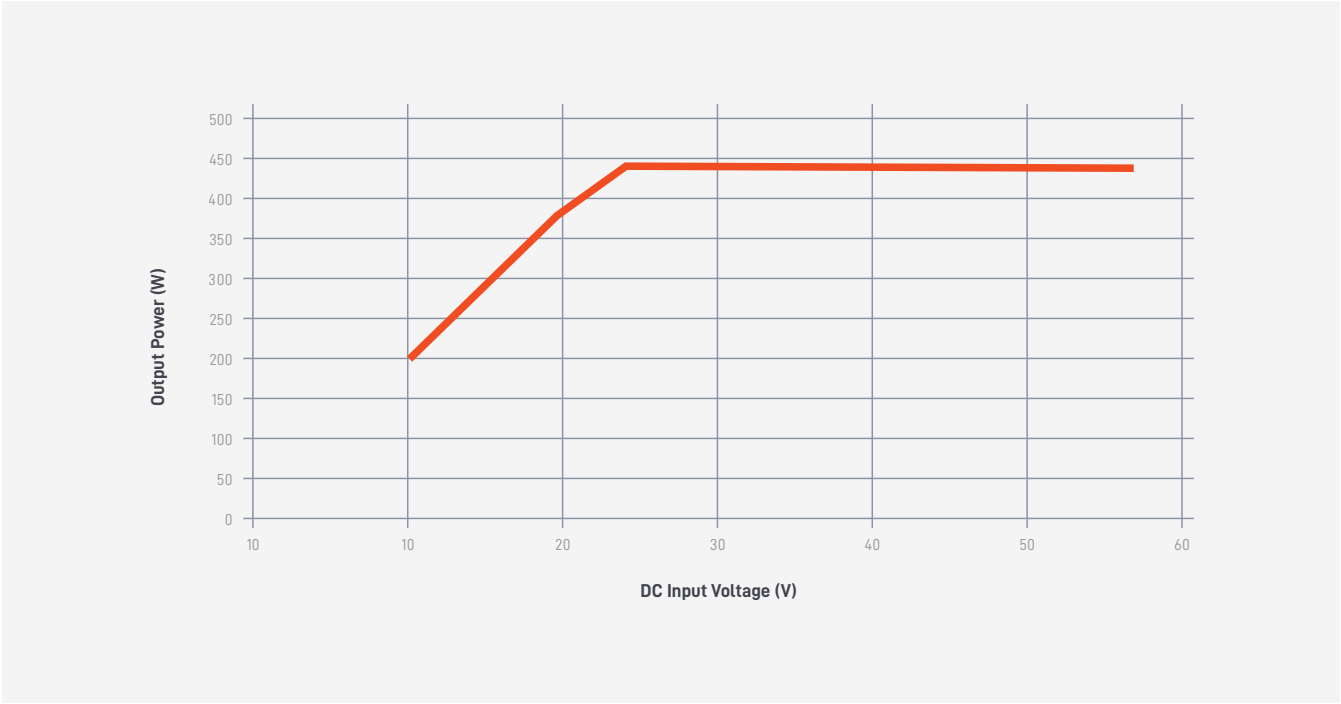
03. STARLINK ADVANCED POWER SUPPLY DETAILS

3.1 | INPUT VOLTAGE AND FREQUENCY

Starlink Advanced Power Supply AC input was qualified for input voltages from 90V to 264V, covering single phase grid voltages across the globe. Additionally, the power supply was qualified for frequencies from 47Hz to 64Hz covering terrestrial 50Hz to 60Hz ± 5% grids.

Starlink Advanced Power Supply DC input was qualified for input voltages from 10.5V to 57V. However, it is recommended to power the system at DC voltages above 20V when possible. At lower input voltages, output power will be reduced to limit the total amperage from the power supply to less than 20 amps. In these cases, user terminals demanding high power (very high throughput with snow melt active) may throttle due to the power limitation.

Figure 3: DC Input Voltage vs Output Power



3.2 | IEC STANDARDS TESTING

Table 5: Starlink Advanced Power Supply IEC Standards Testing

	IEC Standard	Test Result
Electro-Static Discharge (ESD)	IEC 61000-4-2	Pass
Electrical Fast Transient	IEC-61000-4-4	Pass
Surge Immunity	IEC-61000-4-5	Pass

04. STARLINK PERFORMANCE POWER DRAW

Power draw is highly dependent on Starlink usage and ambient temperature. Different amounts of time spent in send (TX) and receive (RX) modes will increase or decrease power consumption. Note that these numbers are averaged estimates and will vary with use, different power inputs, and unit to unit variability.

Table 6: Starlink Performance Power Draw 25°C (77°F Ambient)

Mode	Avg Power (W)	Peak Power (W)	Avg Current (A)	Peak Current (A)
Max	240	305	4.43	5.75
Average	91.6	185.6	1.71	3.4
Idle	11.4	14.5	0.21	0.27

The above table does not include power consumed by a router. The router port on Starlink Advanced Power Supply is capable of up to 40W Power-Over-Ethernet (POE) to power a router if desired. Total consumed power inclusive of a connected router will depend on the type of router. The Starlink Router will require an additional 8W – 12W to the above values.

05. REFERENCES

Document Number	Document Name
ASTM-G85	Standard Practice for Modified Salt Spray (Fog) Testing
ASTM-B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
MIL-STD-810H	Department of Defense Test Method Standard: Environmental Engineering Considerations and Laboratory Tests
IEC 61000-4-2	International Electrotechnical Commissions Test Standard for Electrostatic Discharge Immunity
IEC 61000-4-4	International Electrotechnical Commission's Immunity Standard for Electrical Fast Transient/Burst Transients
IEC 61000-4-5	International Electrotechnical Commissions Test Standard for Surge Immunity Testing

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