The Cybenetics SAFE Standard

Safety and Functional Certification Protocol for Affordable AC-DC Power Supplies

Revision 1.2

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Revision History

Version	Release Date	Notes
1.0	July 2026	First draft. Companion document to the Cybenetics Test Protocol Rev. 3.8 (ETA / LAMBDA / Overall Performance Rating), scoped exclusively to safety and correct-operation certification of budget-oriented AC-DC power supplies.
1.1	July 2026	Removed the minimum hold-up time requirement (retained as a reported, non-pass/fail value) and removed dynamic step-load transient response testing, reflecting the cost realities of the affordable PSU segment. Made the PWR_OK-to-hold-up-time margin (≥ 1 ms) the sole mandatory hold-up-related pass/fail check, regardless of the PSU's actual hold-up time. Re-scoped Electrical Safety Bench Tests: hipot, insulation resistance, and ground continuity are now manufacturer-supplied ISO/IEC 17025 lab results rather than in-house Cybenetics measurements; Cybenetics independently measures only leakage (touch) current as verification. Added a step-by-step test methodology for AC Input Protection & Tolerance. Added a capacity-based exception (≤ 550 W) to the dual-EPS-on-one-cable restriction. Clarified the ambient condition for the cable thermal check. Renamed Section 10 and Certification Category E to reflect the PWR_OK-signal focus. Fixed a pagination defect that produced blank pages between sections.
1.2	July 2026	Standard ambient raised to 25–30 °C throughout. No-Load Operation hold time reduced from 10 minutes to 30 seconds. Startup test reworked from full load to 50% load at minimum rated voltage. Brownout / Low-Line Survival reworked to a no-load condition, and its PASS criterion reworded to remove the implication that a clean shutdown is mandatory (only that the unit is not damaged and does not behave unsafely). AC Input methodology wording corrected to match actual lab practice: removed references to a formal "soak" and to measuring inrush decay time, and removed "bank"/"realistically" language from the startup step. Load Regulation reference point raised from 20 W to 40 W, and its ATX design-guide citation corrected to the v3.1 guide [11]. Ripple & Noise PASS criterion reworded to state that Cybenetics SAFE always applies the latest published ATX revision's limits. Scope and Applicability restructured into explicit "In Scope" and "Out of Scope" subsections. Conductor material identification clarified as visual. Added a note that cabling requirements apply identically to fully modular, semi-modular, and non-modular designs. Corrected the UL 62368-1 and GB 4943.1 (now GB 4943.1-2022) reference entries and refined the JCGM 100:2008 citation. Added Input Under Voltage (ATX v3.1 section 4.1.3, REQUIRED) as the governing citation for

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		Brownout / Low-Line Survival, and added the explicit ATX v3.1 Table 4-13 OVP voltage limits to the Over Voltage Protection PASS criterion. Removed Under Voltage Protection (UVP) as a mandatory PSU Protection Feature and from all category listings, since ATX v3.1 defines no DC-output UVP requirement (only AC-side Input Under Voltage, already covered under Brownout / Low-Line Survival). Reclassified Fan Failure / No-Fan Protection as an optional, non-pass/fail check for this revision: it is still tested and reported, but no longer contributes to the overall FAIL determination. Corrected the brownout methodology step to "checking" rather than "logging" rail voltages and PWR_OK.

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Definitions

AC Signal

A time-varying signal whose polarity varies with a period of time T and whose average value is zero. [1]

Ambient Temperature

The temperature of the ambient air immediately surrounding the unit under test (UUT). Unless a specific test states otherwise, Cybenetics SAFE uses 25–30 °C (see Section 5).

AWG

AWG (American Wire Gauge) is a standardized system used to measure the diameter of electrically conducting wires. The higher the AWG number, the thinner the wire.

DUT / UUT

Device/Unit Under Test — the PSU sample submitted for Cybenetics SAFE evaluation.

Dielectric Withstand (Hipot) Test

A test that applies a high AC or DC voltage between mutually isolated circuits (e.g., mains-side to secondary-side, or mains-side to chassis/ground) for a specified duration to confirm that the insulation can withstand transient over-voltages without breakdown or flashover. Under Cybenetics SAFE this result is supplied by the manufacturer from an ISO/IEC 17025-accredited laboratory (Section 6.1), not measured in-house.

Ground (Protective Earth) Continuity

A test confirming that all exposed conductive parts of the PSU intended to be earthed are bonded to the protective earth pin of the AC inlet with sufficiently low resistance to safely carry fault current and operate the upstream branch-circuit protection. Under Cybenetics SAFE this result is supplied by the manufacturer from an ISO/IEC 17025-accredited laboratory (Section 6.3), not measured in-house.

Hold-Up Time

The duration a PSU can sustain regulated output after AC input is removed, at full rated load. Cybenetics SAFE measures and reports this value but does not impose a minimum; only the PWR_OK-to-hold-up-time margin is pass/fail (Sections 9 and 10.4).

Leakage (Touch) Current

The current that flows through a person or object that comes into contact with an accessible part of the equipment under normal or single-fault conditions, measured per IEC 60990. This is the one Electrical Safety Bench Test that Cybenetics measures independently on the received sample (Section 6.4).

MOV (Metal Oxide Varistor)

A voltage-dependent component connected across the AC input that clamps transient over-voltages (surges) to protect downstream circuitry.

NTC Thermistor

A Negative Temperature Coefficient thermistor placed in series with the AC input to limit inrush current at power-on; typically bypassed by a relay once the unit reaches steady state to avoid continuous power dissipation.

OCP / OPP / OVP / OTP / SCP

Over Current, Over Power, Over Voltage, Over Temperature, and Short Circuit Protection, respectively — the set of protection circuits expected in a modern switching PSU to prevent damage to the unit, the host system, or the user under fault or abusive conditions.

PSU

Power Supply Unit converting AC input voltage to one or more regulated DC output voltages (rails).

Rail or DC Bus

Any of the DC outputs of the PSU which delivers power to the connected system. The standard rails for multi-rail PSUs are +12V, +5V, +3.3V, and +5VSB.

Rated AC Input Voltage Range

The input voltage range (minimum/maximum) declared by the manufacturer on the PSU's power label.

Rated DC Output Power and Current

The maximum continuous load a PSU can provide at a specified ambient temperature on each of its rails, as declared on the power label. If the label and any other manufacturer documentation disagree, the power label governs.

Steady State

The operating condition of a system wherein the observed variable has reached an equilibrium condition in response to an input or other stimulus. [1]

PWR_OK

A “power good” signal defined by the ATX specification that must be asserted high only when all monitored output rails are within regulation and sufficient hold-up energy is stored, and must be de-asserted before any monitored rail exits regulation.

ATX Spec

ATX (Advanced Technology eXtended) is a motherboard and power supply configuration specification originally developed by Intel. This document refers throughout to the specific ATX revision(s) declared by the PSU manufacturer (e.g., ATX v2.x, ATX v3.0, ATX v3.1). [6][7]

Prologue

The Cybenetics Test Protocol Rev. 3.8 (ETA / LAMBDA / Overall Performance Rating) [12] was built to characterize the full performance envelope of a power supply — efficiency across more than 1,450 load combinations, acoustic output, power factor, ripple, transient response, and a weighted Overall Performance Rating. That level of testing is appropriate for enthusiast and enterprise-grade units where efficiency and acoustics are purchase-deciding factors, but it is disproportionately expensive, in both time and equipment, to apply to the affordable end of the PSU market.

A large share of PSUs sold worldwide are bought on price alone: bundled units, budget office builds, low-cost gaming rigs, and OEM replacement parts. These units rarely compete on efficiency or noise, but they still connect directly to mains voltage, still carry the same fire, shock, and component-damage risks as any other switching power supply, and are, in practice, the segment of the market where corners are most often cut on protection circuitry, wire gauge, and genuine safety certification.

Cybenetics SAFE exists to answer one question only: is this power supply safe to operate, and does it behave correctly under both normal and reasonably foreseeable fault conditions? It does not measure efficiency, standby power, power factor, or acoustic output, and it does not produce a numeric performance score. A unit either passes every mandatory requirement in this protocol, or it does not. There are no partial credits and no bonus points.

Manufacturers seeking recognition for efficiency, noise, or overall performance should submit their units separately under the Cybenetics Test Protocol Rev. 3.8 for ETA, LAMBDA, and Overall Performance Rating certification. Cybenetics SAFE and the Rev. 3.8 protocol are independent and may be pursued together or separately.

Several further simplifications reflect the economics of the affordable segment specifically. Cybenetics SAFE sets no minimum hold-up time: hold-up time is chiefly a function of primary bulk capacitance, and that capacitance is one of the first areas a manufacturer trims to hit an aggressive price point. That is a legitimate cost trade-off, not a safety defect — but the correctness of the PWR_OK signal relative to whatever hold-up time a unit actually has remains fully mandatory (Section 9), because a false or late PWR_OK signal is a genuine safety and data-integrity issue regardless of how short the underlying hold-up time is. Cybenetics SAFE also does not require dynamic step-load transient response testing, which calls for programmable pulse-capable electronic loads that are not economical to mandate for a low-cost certification tier; load regulation and ripple are still verified across the full rated load range (Section 10).

Finally, Electrical Safety Bench Tests (Section 6) are handled differently than in a from-scratch safety lab: hipot, insulation resistance, and ground continuity are already mandatory under whatever regulatory safety certification the unit must hold to be sold at all (Section 12), and duplicating that equipment and labor in-house would materially raise the cost of Cybenetics SAFE without adding new information. Cybenetics therefore accepts the manufacturer's own ISO/IEC 17025-accredited laboratory results for those three tests, and performs only an independent leakage (touch) current measurement on the physical sample received, as a lightweight verification that the submitted unit matches what was certified.

Scope and Applicability

Cybenetics SAFE applies to AC-DC PSUs of any wattage or form factor (ATX, SFX, TFX, ATX12VO, flex, redundant, etc.) submitted for safety-and-correct-operation certification. It is intended primarily, but not exclusively, for the affordable / budget segment of the market.

In Scope

Cybenetics SAFE covers, and issues a pass/fail result on, the following:

- Electrical Safety Bench Tests: manufacturer-supplied ISO/IEC 17025-accredited lab results for hipot, insulation resistance, and ground continuity, plus an independent Cybenetics measurement of leakage (touch) current (Section 6).
- AC Input Protection & Tolerance: fuse, surge, inrush, startup, and brownout survival (Section 7).
- PSU Protection Features: OCP, OPP, OVP, SCP, OTP, and no-load operation (Section 8).
- PWR_OK signal correctness and timing, including the mandatory PWR_OK-to-hold-up-time margin (Section 9).
- Basic regulation, ripple and noise, turn-on overshoot, and the Power Ok Signal's Accuracy check (Section 10).
- Cabling and connector safety, including minimum wire gauge and the cable thermal check (Section 11).
- Verification that required agency/regulatory safety markings are present and internally consistent (Section 12).

Out of Scope

The following remain the responsibility of the Cybenetics Test Protocol Rev. 3.8 (or are outside Cybenetics' scope entirely), and receive no pass/fail judgment under Cybenetics SAFE:

- Energy efficiency measurement and ETA certification.
- Acoustic (noise) output measurement and LAMBDA certification.
- Overall Performance Rating and any weighted or bonus-point scoring.
- A minimum hold-up time requirement. Hold-up time is measured and reported, but not judged pass/fail (Sections 9 and 10.4).
- A mandatory pass/fail requirement for Fan Failure / No-Fan Protection. This is currently an optional, non-pass/fail check under Cybenetics SAFE: fan-failure behavior is still tested and recorded (Section 8), but a FAIL result on this item alone does not affect the unit's overall Cybenetics SAFE Certified outcome.
- Dynamic step-load transient response testing.
- In-house hipot, insulation-resistance, and ground-continuity testing. These are accepted from the manufacturer's ISO/IEC 17025-accredited lab report (Section 6).
- Independent EMI/EMC emissions measurement (conducted or radiated). Compliance with CISPR 32 / EN 55032, FCC Part 15, or equivalent regional EMC regulations remains the manufacturer's regulatory responsibility; Section 12 of this document verifies that the required regulatory markings and declarations are present and internally consistent, but does not re-measure emissions.

Test Setup & Measurement Conditions

Testing Equipment Requirements

All measurements are performed with calibrated instrumentation, traceable to SI units, meeting at minimum:

1. AC source (programmable): 90–264 Vac (or wider), 45–65 Hz, sine output, low distortion; power capability adequate for the DUT's rated power plus margin; capable of a controlled voltage ramp for brownout testing.
2. DC electronic loads (multi-channel): constant-current mode mandatory; fast step capability for fault-simulation tests (OCP, OPP, SCP); current accuracy ≤ ±0.5% rdg.
3. Oscilloscope: ≥ 100 MHz analog bandwidth, ≥ 1 GS/s sample rate, differential/low-noise probing suitable for mV-level ripple, inrush-current, and hold-up/PWR_OK timing capture. Single-shot / pre-trigger capture capability is required for cold-start inrush.
4. Current probe or calibrated shunt on the AC line conductor, suitable for capturing cold-start inrush current peaks.
5. Leakage (touch) current meter or network per IEC 60990 — used by Cybenetics for the independent verification measurement in Section 6.4.
6. DMM (bench-grade): DCV accuracy ≤ ±0.05% rdg class, for spot checks and cross-verification.
7. Temperature measurement: thermocouples / IR, ≤ ±0.5 °C accuracy, for cable-jacket and heatsink hot-spot checks.
8. Tachometer: 0–10,000+ rpm, ≤ ±1% rdg, for fan-failure simulation.
9. Isolation transformer and online UPS on the AC source feed, to protect lab equipment during intentional fault testing (SCP, brownout, surge).

Note on electrical safety bench equipment: hipot testers, insulation-resistance (megohmmeter) testers, and ground-bond testers are not part of the routine Cybenetics SAFE equipment list, since Sections 6.1–6.3 are accepted from the manufacturer's ISO/IEC 17025-accredited laboratory report rather than re-measured in-house. Cybenetics may still maintain such equipment for occasional independent audit re-testing at its own discretion, but it is not required for a routine certification.

General Test Conditions

Unless otherwise stated for a specific test, measurements are performed at the standard ambient temperature of 25–30 °C — this is the ambient used for every test in this protocol that does not specify its own temperature condition, including the Cable Thermal Check (Section 11) and the AC Input Protection & Tolerance tests (Section 7), unless that section calls for an elevated ambient. Fault-condition and stress tests (OCP, OPP, OTP, SCP) are additionally repeated at an elevated ambient of 40–45 °C to represent a realistically loaded case environment, consistent with the approach used in the Cybenetics Test Protocol Rev. 3.8.

The PSU is allowed to reach thermal steady state (no significant drift in internal temperature over a 5-minute window) before any pass/fail reading is recorded, except where a test specifically targets cold-start behavior.

Electrical Safety Bench Tests

These four tests confirm basic electrical safety independent of the PSU's control circuitry. Hipot, insulation resistance, and ground continuity are already mandatory under whatever regulatory safety standard the unit must meet to be legally sold (IEC/EN/UL 62368-1, or IEC/EN/UL 60950-1 for legacy-certified designs); Cybenetics SAFE does not duplicate that equipment and labor in-house. Instead, the manufacturer must supply current, model-matched results for Sections 6.1–6.3 from an ISO/IEC 17025-accredited laboratory. Cybenetics performs its own independent measurement only for Section 6.4, Leakage (Touch) Current, as a lightweight verification that the physical sample received matches what was certified.

Dielectric Withstand (Hipot) Test — Manufacturer-Supplied

A high AC or DC test voltage applied for a specified dwell time between: (a) primary (mains) circuit and secondary (DC output) circuit, (b) primary circuit and chassis/protective earth, and (c) secondary circuit and chassis/protective earth (where the secondary is not intentionally earthed). The test voltage and dwell time follow the working voltage and insulation class declared for the unit under the applicable clause of IEC 62368-1 (or IEC 60950-1).

PASS criterion: the manufacturer provides a current ISO/IEC 17025-accredited laboratory report showing a PASS result for the exact model, rating, and insulation class submitted, covering all three isolation boundaries above. The report's date must fall within the same production/BOM revision window as the sample under test. Cybenetics does not independently repeat this test as part of routine certification.

Insulation Resistance Test — Manufacturer-Supplied

Insulation resistance measured between the same isolation boundaries as the hipot test, using a megohmmeter at a DC test voltage appropriate to the insulation class (typically 500 V DC).

PASS criterion: the manufacturer's ISO/IEC 17025-accredited report shows insulation resistance meeting or exceeding the minimum specified by the declared safety standard for the equipment class (commonly ≥ 2 MΩ for basic insulation, higher for reinforced/double insulation), for the exact model and rating submitted.

Protective Earth (Ground) Continuity — Manufacturer-Supplied

A low-impedance, high-current test verifying the bond between the AC inlet earth pin and every exposed conductive part of the PSU intended to be earthed (chassis, mounting bracket, shielded connector shells, etc.).

PASS criterion: the manufacturer's ISO/IEC 17025-accredited report shows resistance not exceeding the limit specified by the declared safety standard (commonly ≤ 0.1 Ω, exclusive of the AC cord) at every bonded point checked, for the exact model and rating submitted.

Leakage (Touch) Current — Cybenetics-Verified

Unlike Sections 6.1–6.3, touch current is measured directly by Cybenetics on the physical sample received, per IEC 60990, under normal condition and, where applicable, single-fault condition (e.g., open protective earth), at rated voltage and both line polarities.

PASS criterion: Cybenetics' own measured touch current does not exceed the limit applicable to the equipment's class and the target market's adopted safety standard, as declared in the manufacturer's compliance file for the unit. If Cybenetics' measurement differs materially from the manufacturer's own declared figure, the unit is referred for engineering review, and Cybenetics may, at its discretion, escalate to an independent re-test of Sections 6.1–6.3 as well.

AC Input Protection & Tolerance Tests

Fuse Presence and Rating

The AC input line must incorporate a fuse (or equivalent over-current interrupting device) of a rating consistent with the PSU's maximum input current, accessible only with the enclosure open.

PASS criterion: fuse present, correctly rated, and located on the line conductor ahead of other primary-side circuitry.

Surge Protection (MOV / TVS)

The AC input must incorporate a Metal Oxide Varistor (MOV), Transient Voltage Suppressor (TVS) diode, or a documented equivalent, across line-neutral (and, where applicable, line/neutral-to-ground) to clamp transient surges.

PASS criterion: MOV/TVS (or equivalent) present and correctly connected; this is a mandatory requirement under Cybenetics SAFE, not an optional bonus item.

Inrush Current Protection

The AC input must incorporate an NTC thermistor (or equivalent active inrush limiting), typically bypassed by a relay once steady state is reached. Inrush current is measured at cold start, at both minimum and maximum rated line voltage.

PASS criterion: NTC thermistor (or equivalent) present; measured cold-start inrush current does not exceed the manufacturer's declared rating or trip upstream branch-circuit protection under normal lab conditions.

Startup Under Load at Minimum Rated Voltage

Per ATX spec section 4.1 [7], the PSU must be able to start up at 50% of its rated load at the bottom of its declared input range (e.g., 90 VAC for wide-range units, or the corresponding minimum for split-range units, e.g., 180 VAC). The unit is held at 50% load and minimum rated voltage for 5 minutes.

PASS criterion: PSU starts and sustains 50% rated load for the full 5-minute period without shutdown, protection trip, or abnormal output behavior.

Brownout / Low-Line Survival

This test covers Input Under Voltage, a REQUIRED protection under ATX spec section 4.1.3 [7]: input voltage is reduced below the declared minimum rated voltage (typically to 80 VAC for wide-range units, or 170 VAC for 200–240 VAC-only units) under no load.

PASS criterion: the PSU is not damaged and does not operate in any unsafe way (sustained oscillation, erratic output, or a protection latch-up accompanied by visible or measured component damage) as input voltage drops below its declared minimum, and resumes normal operation once nominal AC input is restored. The PSU is not required to shut down at any specific voltage, nor to sustain regulated output below its declared input range — only to survive the condition without harm to itself, the connected system, or the user, and to recover normally.

Step-by-Step Test Methodology

This subsection defines exactly how the five checks above are conducted in the lab, in sequence, on a single sample. All steps are performed at the standard ambient of 25–30 °C (Section 5) unless noted.

1. Visual and teardown inspection: with the unit fully de-energized and safely discharged, open the enclosure and visually confirm the presence, placement, and rating of the AC input fuse, the MOV/TVS, and the NTC thermistor (plus bypass relay, if fitted). Photograph each component for the report record. This step alone determines the PASS/FAIL result for Fuse Presence and Surge Protection.
2. Fuse rating cross-check: compare the fuse's printed rating against the PSU's maximum declared input current at minimum rated voltage. A fuse that is undersized relative to the declared input current is a FAIL; an oversized fuse (failing to protect the declared rating) is also a FAIL.
3. Cold-start inrush measurement: use a unit that has not been recently energized, so its internal temperature is at ambient (avoid testing immediately after a prior run). Connect the AC feed through a calibrated current probe or shunt on the line conductor, and configure the oscilloscope for a single-shot, pre-triggered capture. With the PSU's own power switch already in the ON position, energize the AC source at the PSU's minimum rated line voltage and capture the inrush waveform at the instant AC is first applied. Record the peak current. Allow the unit to return to ambient between runs, then repeat for a total of 3 runs at minimum rated voltage.
4. Repeat step 3 at the PSU's maximum rated line voltage (3 runs), since cold-start inrush is typically highest at the top of the input range. Record peak current for each run at both voltage extremes; this data feeds the Inrush Current Protection PASS/FAIL criterion above.
5. Startup at 50% load, minimum rated voltage: with the unit again at ambient, pre-configure the electronic load to 50% of the PSU's rated capacity, distributed across rails per the manufacturer's declared configuration. Set the AC source to the PSU's minimum declared input voltage. Power on the PSU with the load already connected (or apply the load within 1 second of power-on) and hold for 5 minutes, continuously logging all rail voltages, the PWR_OK state, and case/heatsink temperature. This run produces the PASS/FAIL result for Startup Under Load.
6. Brownout / low-line survival: with the PSU running under no load at minimum rated voltage, ramp the AC source voltage down at a controlled rate (nominally 1 V/s) toward the applicable survival threshold (80 VAC for wide-range units, 170 VAC for 200–240 VAC-only units), continuously checking rail voltages and PWR_OK. The unit must not be damaged and must not exhibit unsafe behavior (erratic output, sustained oscillation, or a protection latch-up accompanied by visible or measured component damage) as the input voltage drops below its declared minimum.
7. Recovery check: immediately after step 6, restore nominal AC input and confirm the PSU returns to normal regulated operation — either by continuing to run throughout, or by restarting cleanly if it shut down at any point during the ramp — without any manual intervention beyond a routine power cycle. This confirms the Brownout / Low-Line Survival PASS/FAIL criterion above.
8. Surge protection is verified by the component-level inspection in step 1 (correct MOV/TVS part present and correctly wired across L-N, and L/N-to-ground where fitted) rather than by injecting an actual high-energy surge pulse, since combination-wave surge testing per IEC 61000-4-5 is already required under the regulatory safety/EMC certification referenced in Section 12. Cybenetics may, at its discretion, apply an independent surge

pulse using a calibrated combination-wave generator for spot-audit purposes, but this is not part of the routine Cybenetics SAFE procedure.

Data to record (minimum): fuse rating and photo; MOV/TVS part number and photo; NTC thermistor (and relay, if fitted) part number and photo; peak inrush current for each of the 6 cold-start runs (3 at minimum, 3 at maximum rated voltage); the full 5-minute startup log at minimum rated voltage (50% load); the AC voltage at which any brownout-related shutdown or unsafe behavior occurred (if any); and confirmation of normal recovery after the brownout ramp.

PSU Protection Features (Output Side)

Every PSU submitted under Cybenetics SAFE must demonstrate a complete and correctly triggered protection scheme. Unlike the bonus-point treatment of these same features in the Cybenetics Test Protocol Rev. 3.8, each item below is a mandatory pass/fail requirement, with one exception: Fan Failure / No-Fan Protection is currently an optional, non-pass/fail check (see below). For every other item, any single failure results in an overall FAIL for the unit.

Over Current Protection (OCP)

OCP is tested independently on each significant rail (+12V, +5V, +3.3V; each +12V rail individually on multi-rail designs).

PASS criterion: OCP triggers at or below 130% of the rail's rated maximum current for single +12V-rail designs (135% for multi-rail +12V designs), and does not trigger below 100% of rated current under normal conditions. The PSU must shut down safely (no smoke, flame, or component rupture) and recover normally once the overload is removed and the unit is power-cycled.

Over Power Protection (OPP)

Total DC output power is increased until OPP engages.

PASS criterion: OPP triggers at or below 130% of the PSU's total rated output power, with safe shutdown and normal recovery after the overload is removed.

Over Voltage Protection (OVP)

Each monitored rail is forced above its regulation window (via an external bias supply or equivalent method) to confirm OVP engagement.

PASS criterion: OVP engages before any rail exceeds the maximum limit defined in ATX v3.1 Table 4-13 [11]: +12VDC – 15.6 V; +5VDC – 7.0 V; +3.3VDC – 4.3 V; +5VSB – 7.0 V (OVP is RECOMMENDED, not REQUIRED, on +5VSB). Shutdown must be safe on every rail tested.

Short Circuit Protection (SCP)

Per the ATX spec, a short circuit is defined as any output impedance below 0.1 Ω. Each rail is shorted independently.

PASS criterion: the PSU shuts down immediately and safely on every rail tested, with the sole exception of +5VSB (already in standby operation), which must simply return to normal operation once the short is removed. The PSU must survive repeated/prolonged SCP cycling without degradation.

Over Temperature Protection (OTP)

Internal temperature is raised (via elevated ambient, restricted airflow, or heat-gun assist on the relevant heatsink) until OTP engages.

PASS criterion: OTP engages before the secondary-side heatsink (or equivalent monitored hot-spot) exceeds 190 °C, with safe shutdown and normal recovery once the unit cools.

Fan Failure / No-Fan Protection (Optional)

The PSU's fan is stalled or disconnected (as applicable to the fan-control topology) under load.

Result criterion (optional, non-pass/fail): ideally, the PSU detects the fan failure and either shuts down safely or engages a protective de-rating/OTP response before internal components reach an unsafe temperature. Fan Failure / No-Fan Protection is currently an optional check under Cybenetics SAFE: the result is measured and recorded in the test report for transparency, but does not by itself cause an overall FAIL for the unit.

No-Load Operation

The PSU is started and held with zero (or minimum ATX-defined) load on its main rails for at least 30 seconds.

PASS criterion: the PSU starts normally, does not shut down, oscillate, or exhibit unsafe output excursions, and all rails remain within the applicable ATX regulation tolerance.

PWR_OK Signal and Timing Verification

The PWR_OK (Power-Good) signal is verified for correct assertion, de-assertion, and timing per the ATX specification, at both 20% and 100% load. This section is one of the most important in Cybenetics SAFE: because Section 10.4 sets no minimum hold-up time, the accuracy of PWR_OK relative to whatever hold-up time a unit actually has is the primary safety backstop protecting the host system from an unannounced loss of regulated power.

- PWR_OK must be asserted high (nominally 5V) only when +12V, +5V, and +3.3V are all within their regulation windows and sufficient hold-up energy is stored.
- PWR_OK's own hold-up time (AC-loss to PWR_OK de-assertion) must be 1 ms or lower than the PSU's actual, as-measured hold-up time — i.e., PWR_OK must de-assert at least 1 ms before any of +12V, +5V, or +3.3V actually exits its regulation window. This margin is mandatory no matter how long or short the measured hold-up time turns out to be — Cybenetics SAFE sets no minimum hold-up time (Section 10.4), but the PWR_OK margin against whatever hold-up time the unit actually has is never optional.
- Power-on time (T1) must be under 150 ms.
- PWR_OK delay (T3) must fall within the 100–150 ms window.

PASS criterion: all four conditions above are met at both load points tested. A PWR_OK signal that remains asserted after any monitored rail has left regulation, or whose own hold-up time is not at least 1 ms shorter than the PSU's actual measured hold-up time, is an automatic FAIL — it constitutes a false safety signal to the host system regardless of the PSU's absolute hold-up time.

Basic Regulation, Ripple, Turn-On Overshoot, and Power Ok Signal's Accuracy

These checks confirm the PSU operates within the applicable ATX specification's electrical limits across its rated load range. Consistent with the cost realities of the affordable PSU segment (see Prologue), Cybenetics SAFE does not require dynamic step-load transient response testing, and does not impose a minimum hold-up time — the pass/fail weight in this area falls instead on the PWR_OK signal's own accuracy (Section 9). No weighting or scoring is applied to any result in this section — each check is strictly within-spec or out-of-spec.

Load (Voltage) Regulation

Each rail is measured from a light-load reference point (typically 40 W applied load, to avoid no-load instability on units without no-load protection) up to full rated load.

PASS criterion: every rail remains within the regulation tolerance defined by the applicable ATX specification across the full tested load range (commonly ±5% for +5V, +3.3V, and +5VSB; and, for ATX v3.x designs, +5%/–8% for +12V on the 12V-2x6/12VHPWR connector or +5%/–7% for +12V on other connectors, per Tables 3-5 and 4.2 of the ATX v3.1 design guide [11]).

Output Voltage Ripple & Noise

Peak-to-peak ripple and noise is measured at full rated load on each significant rail, per the bandwidth-limiting method defined by the applicable ATX specification.

PASS criterion: ripple and noise on each rail does not exceed the limit defined by the latest published ATX specification revision for that rail (commonly cited baseline values are 120 mV p-p for +12V and 50 mV p-p for +5V, +3.3V, and +5VSB). Cybenetics SAFE always applies the limits of the latest ATX revision at the time of testing, regardless of which ATX revision the manufacturer originally designed against.

Turn-On Overshoot

The PSU is switched on under a representative load, and the peak voltage overshoot on +12V and +5VSB during the turn-on transient is recorded.

PASS criterion: the turn-on overshoot does not exceed the maximum momentary excursion permitted by the applicable ATX specification for that rail.

Power Ok Signal's Accuracy (Hold-Up Time Cross-Check)

Hold-up time is measured directly (the duration the PSU sustains regulated output after AC input is removed, at full rated load) and recorded in every test report. Cybenetics SAFE sets no minimum for this value — see the Prologue for the cost rationale specific to the affordable PSU segment.

Reporting requirement: the as-measured hold-up time is always recorded (Section 14), regardless of its value.

Mandatory safety requirement, independent of the measured value: whatever the PSU's actual hold-up time turns out to be, the PWR_OK signal's own hold-up time must be 1 ms or lower than it — i.e., PWR_OK must de-assert at least 1 ms before that time is exhausted (Section 9). That margin check, not the hold-up time itself, is what is scored pass/fail here.

Cabling and Connector Safety Requirements

Undersized or substandard cabling is a fire and reliability risk that is disproportionately common in the affordable PSU segment. Cybenetics SAFE therefore applies hard minimum gauge requirements and a thermal check, regardless of conductor material.

Connector	Minimum AWG (power conductors)
Main Power Connector (24-pin)	18 AWG (22 AWG for sense lines)
EPS (4+4 pin)	18 AWG
PCIe 6+2 pin	18 AWG (20 AWG for sense lines)
PCIe 12+4 pin (12VHPWR / 12V-2x6)	16 AWG (28 AWG for sense lines)
SATA	18 AWG
Molex 4-pin	18 AWG

PASS criterion (gauge): every measured power conductor meets or exceeds the minimum gauge in the table above, regardless of conductor material (pure copper, CCA, or CCS).

Conductor material (pure copper, Copper-Clad Aluminum, or Copper-Clad Steel) is visually identified and recorded for transparency, since material affects resistance, heat rise, and long-term fatigue resistance even at equal gauge. Pure copper is recommended; CCA and CCS conductors are permitted under this protocol only if they pass the thermal check below.

These requirements apply identically regardless of whether the PSU is fully modular, semi-modular, or non-modular — cable and connector design style has no bearing on the minimum gauge, thermal check, or dual-EPS requirements below.

Cable Thermal Check

Cable jacket temperature is measured at the connector body after 30 minutes of continuous operation at full rated load through that connector, with the unit operated at the standard ambient of 25–30 °C defined in Section 5 (General Test Conditions) — i.e., normal room temperature, not an elevated or reduced ambient.

PASS criterion: measured cable jacket temperature does not exceed the temperature rating of the insulation used, with a minimum practical margin of 15 °C.

Connector Sharing — Dual EPS Restriction

Placing two high-power connectors on a single cable concentrates heat and current on shared conductors. Cybenetics SAFE specifically restricts dual EPS (4+4 pin) connectors sharing one cable, since EPS feeds the CPU and is routinely run near its rated current in real systems.

PASS criterion: a single cable must not carry two EPS connectors unless the PSU's total rated capacity is 550 W or lower. Above 550 W, a dual-EPS cable is an automatic FAIL regardless of the thermal check result. At or below 550 W, a dual-EPS cable is permitted only if it also passes the Cable Thermal Check above under simultaneous full-load operation of both connectors.

The same reasoning is recommended, though not mandated, for dual PCIe 6+2 connectors sharing a single cable; such designs are flagged in the report and must still pass the Cable Thermal Check under simultaneous full-load operation.

Agency Certification Marking Verification

Counterfeit or misapplied safety certification marks are a recurring problem in the budget PSU segment. This section confirms that the markings present on the unit and its documentation are genuine, current, and applicable to the exact model and rating tested.

The tester checks, at minimum, for the following marks/schemes as applicable to the unit's declared markets, and verifies each against the issuing body's public database where one exists:

- UL / cUL (United States / Canada) — verify against UL Product iQ.
- CB Scheme (IECEE) — verify CB certificate/test report number.
- CE marking (European Economic Area) — verify the Declaration of Conformity references the correct model, standards, and notified body (if applicable).
- TUV or other EU-recognized mark, where present.
- CCC (China Compulsory Certification), where the unit is marketed in China.
- PSE (Japan), KC (South Korea), BSMI (Taiwan), RCM (Australia/New Zealand), EAC (Eurasian Economic Union), or other regional marks as applicable to the unit's declared markets.

PASS criterion: every mark present on the unit corresponds to a valid, current certificate covering the exact model, rated voltage range, and rated power tested; no mark is found to be fabricated, expired, or applicable only to a different model/revision. A unit sold into a market that requires a mark it does not genuinely hold is an automatic FAIL, regardless of how it performs in Sections 6–11. This is also where the manufacturer's ISO/IEC 17025 hipot, insulation-resistance, and ground-continuity report (Section 6) is checked for authenticity — i.e., that the issuing laboratory's accreditation is current and the report genuinely covers the model tested.

Certification Criteria — Cybenetics SAFE Pass/Fail Model

Cybenetics SAFE uses a single binary outcome: Cybenetics SAFE Certified, or FAIL. There are no tiers, scores, or bonus points. A unit is Cybenetics SAFE Certified only if it passes every mandatory category below in full.

#	Category	Sections
A	Electrical Safety Bench Tests (Manufacturer-Supplied ISO 17025 Hipot / Insulation / Ground Reports; Cybenetics-Verified Leakage Current)	6
B	AC Input Protection & Tolerance (Fuse, Surge, Inrush, Startup, Brownout Survival)	7
C	PSU Protection Features (OCP, OPP, OVP, SCP, OTP, No-Load; Fan-Failure is optional, non-pass/fail)	8
D	PWR_OK Signal Correctness and Timing (incl. PWR_OK-to-Hold-Up Margin)	9
E	Regulation, Ripple, Turn-On Overshoot, and Power Ok Signal's Accuracy	9–10
F	Cabling and Connector Safety (incl. Dual-EPS Restriction)	11
G	Agency Certification Marking Verification	12

Any single FAIL in any category, in any sub-item, results in an overall FAIL for the unit. Partial results are not published as a certification outcome; a manufacturer may resubmit a corrected unit for re-testing.

Cybenetics SAFE Certified units may display the Cybenetics SAFE mark alongside, but never in place of, any required regulatory safety certification (UL, CE, CB, etc.) — Cybenetics SAFE is a supplementary verification and does not substitute for mandatory regulatory certification in any market.

Relationship to CybenPass

As with the Cybenetics Test Protocol Rev. 3.8, manufacturers are encouraged to enroll Cybenetics SAFE-certified models in the CybenPass multi-sample program. Because the affordable PSU segment carries a higher risk of unannounced component substitution to cut cost, periodic re-testing of retail samples is particularly important for maintaining the validity of a Cybenetics SAFE certification over a model's production life.

Certification Validity, Fee, and Part Analysis

A Cybenetics SAFE Certified result is valid for a specific period from the date the unit passes every category above. The certification fee covers the full Section 6–12 test battery and includes a detailed part (component) analysis delivered alongside the pass/fail report — covering PCB revision, primary/secondary capacitor brand and temperature/hour rating, PWM/PFC controller and protection ICs, transformer construction, bridge rectifier, and the specific MOV/TVS and

NTC/relay parts used — consistent with the part-analysis transparency already provided under the Cybenetics Test Protocol Rev. 3.8.

To retain the Cybenetics SAFE mark, the manufacturer must resubmit a current retail sample for re-testing before the 12-month validity period expires. Cybenetics recommends timing renewal sampling to coincide with any declared bill-of-materials revision, given the affordable segment's higher exposure to unannounced component substitution noted above.

Test Report Template

The following minimum fields are recorded for every Cybenetics SAFE evaluation.

DUT Identification

- Manufacturer, model, and revision/PCB code.
- Rated power, rated input voltage range, rail configuration.
- Declared ATX specification revision (if any) and declared safety standard (IEC 62368-1 / IEC 60950-1).
- Sample source (retail purchase, manufacturer-submitted sample, CybenPass draw).
- Manufacturer-supplied ISO/IEC 17025 laboratory report reference(s) covering hipot, insulation resistance, and ground continuity (Section 6.1–6.3), including issuing lab, accreditation number, and report date.

Results Summary

Category	Result (PASS/FAIL)	Notes
A — Electrical Safety Bench Tests		
B — AC Input Protection & Tolerance		
C — PSU Protection Features		
D — PWR_OK Signal & Timing		
E — Regulation / Ripple / Turn-On Overshoot / Power Ok Signal's Accuracy		
F — Cabling & Connector Safety		
G — Agency Certification Marking		
Overall Result		

Reported for information alongside the above (not scored pass/fail): as-measured hold-up time.

Detailed per-test data (numeric readings, oscilloscope captures, thermal images, and certificate verification records) are retained in the full internal test record and are available on request for ISO/IEC 17025 [8] verification purposes.

Measurement Uncertainty, Traceability, and Guard-Banding

All instruments used under this protocol are calibrated and traceable to national/SI standards. Because Cybenetics SAFE results are binary (pass/fail against a fixed limit) rather than scored, measurement uncertainty is handled through a guard-band decision rule rather than through an uncertainty budget on a continuous score, consistent with ILAC-G8 [10].

Where a measured value falls within the instrument's expanded uncertainty (k=2, ~95% confidence) of the applicable pass/fail limit, the result is treated as inconclusive rather than a pass, and the test is repeated with tightened conditions or referred for engineering review before a final PASS or FAIL is recorded. This ensures a PASS result is never awarded on a measurement that could, within its own uncertainty, actually be a marginal fail. This applies in particular to the PWR_OK-to-hold-up-time margin (Section 9), where the 1 ms margin is evaluated against the timing instrument's own uncertainty rather than treated as an exact boundary.

For the manufacturer-supplied results in Sections 6.1–6.3, the uncertainty budget of record is the one stated in the issuing ISO/IEC 17025-accredited laboratory's own report; Cybenetics does not restate or second-guess that budget, but does confirm the issuing lab's accreditation scope covers the specific test performed (Section 12).

Efficiency, acoustic, and EMI measurement uncertainty are outside the scope of this document; refer to the Cybenetics Test Protocol Rev. 3.8 [12] for those uncertainty budgets.

Epilogue

The purpose of this document is to give buyers of affordable power supplies the same basic assurance that enthusiast-grade, fully-certified units already provide: that the unit will not catch fire, will not damage the system it powers, and will behave predictably when something goes wrong — without requiring the cost and time of a full efficiency and acoustic evaluation.

Cybenetics SAFE is deliberately narrow in scope and binary in outcome. We believe this makes it practical for manufacturers to certify high-volume, low-margin products that would otherwise never be tested to any independent standard beyond the minimum regulatory mark, and gives reviewers and consumers a fast, unambiguous signal: Cybenetics SAFE Certified, or not.

References

1. IEEE Std 1515-2000, IEEE Recommended Practice for Electronic Power Subsystems: Parameter Definitions, Test Conditions, and Test Methods.
2. IEC 62368-1, Audio/video, information and communication technology equipment — Part 1: Safety requirements.
3. IEC 60950-1, Information technology equipment — Safety — Part 1: General requirements (legacy, for units certified under the superseded standard).
4. IEC 60990, Methods of measurement of touch current and protective conductor current.
5. UL 62368-1, Standard for Safety of Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements (US national adoption of IEC 62368-1).
6. GB 4943.1-2022, Audio/video, information and communication technology equipment — Part 1: Safety requirements — China compulsory safety standard (CCC), effective August 2023, superseding GB 4943.1-2011 and GB 8898-2011 and aligned with IEC 62368-1:2018.
7. ATX Version 3.0 Multi-Rail Desktop Platform Power Supply Design Guide, Intel Corporation.
8. ISO/IEC 17025:2017, General requirements for the competence of testing and calibration laboratories.
9. JCGM 100:2008, Evaluation of measurement data — Guide to the expression of uncertainty in measurement (GUM 1995 with minor corrections).
10. ILAC-G8:09/2019, Guidelines on Decision Rules and Statements of Conformity.
11. ATX Version 3.1 Multi-Rail Desktop Platform Power Supply Design Guide, Intel Corporation.
12. Cybenetics Test Protocol Rev. 3.8, “The Complete Cybenetics Test Protocol, Including Energy Efficiency, Output Noise, And Overall Performance Calculation of AC-DC Power Supplies,” Aristeidis Bitziopoulos, June 2026.