

EURORACK INTERFACE SPECIFICATION (EIS)

EIS is a free, open specification for Eurorack hardware. It says what modules, enclosures, bus boards, power supplies, and cables owe each other so that products from different makers fit, power up, and patch together. A rule is a shall only where two products would otherwise fail to work together; everything else is written “EIS recommends”. Every requirement has an identifier, a product type, and a machine-readable model behind it.

Get it: lzxindustries.net/eis has the PDF, a design reference for each product type, and the machine-readable models to download, and every clause as a web page with a URL for each requirement. In this repository, start at Scope or, to design a product, at the designer's guide.

Claim it: a product states its product type and any feature in one line, EIS draft, module (VID-REF-IN), and can keep what it publishes in a claim file that `eis claim eis-claim.yaml` validates.

Change it: open an issue or a pull request at git.lzxindustries.net/lzx/eurorack-specification. CONTRIBUTING.md says what belongs in EIS and how a change is made. A proposal for a new shall names the two products that would stop working together without it.

Identifier	EIS
Status	Working draft
Edition	v0.1.0
Maintainer	LZX Industries
License	CC BY 4.0 on the specification, MIT on the tooling; details in COPYRIGHT.md
SPDX	CC-BY-4.0 (specification), MIT (code)

DOCUMENT MAP

CLAUSE	PAGE	READ IT WHEN YOU DESIGN
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2 Normative references	spec/normative-references.md	

CLAUSE	PAGE	READ IT WHEN YOU DESIGN
3 Terms	spec/terms.md	The words with a special meaning
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5.1 Rack dimensions	spec/rack.md	The 19-inch frame a row sits in
5.2 Modules	spec/modules.md , front panels, boards	A module, its panel, or its boards
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5.4 Enclosures	spec/enclosures.md	The case a module mounts in
6.1 Power architecture	spec/power-architecture.md	The power domains, sources, distribution, entries, and the rules for every domain
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6.3 Grounding and 0 V	spec/grounding.md	The 0 V reference, protective earth, and joining cases
6.4 The bus	spec/bus-power.md	PWR-BUS: rails, header, pinout, marking, keying, and a module on the bus
6.5 Bus boards	spec/bus-boards.md	Capacity, links, ribbons
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6.7 12 V DC power (PWR-DC12)	spec/dc-12.md	Feature PWR-DC12: a barrel or multi-pin DC entry and the DC rail it feeds
6.8 ± 6 V analog power (PWR-A6)	spec/analog-6.md	Feature PWR-A6: the A6-VH3 entry, its voltage window, sources, and cables
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7.3 Video timing	spec/video-timing.md	The formats a video reference port lists
7.4 Video on 75 Ω coaxial jacks (VID-75)	spec/video-75.md	The 75 Ω coaxial interface: the video reference ports VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU, VID-REF-LOOPTHRU, the reference tree, and the coaxial cable
8.1 USB service port and parameter interface (CTRL-USB)	spec/ctrl-usb.md	Feature CTRL-USB: the USB service port and the MIDI 2.0 parameter interface
8.2 Host bridge protocol	spec/host-bridge.md	The host bridge protocol a case host offers a computer
9 Assembling a system	spec/assembly.md	The rules for whoever fits a row together

CLAUSE	PAGE	READ IT WHEN YOU DESIGN
Annexes A to Q	annex/	Informative: rail and insert catalogs, survey, verification, planning aids, rationale, worked examples
Bibliography	spec/bibliography.md	

MACHINE-READABLE MODELS

`data/` holds the register and every normative number: `requirements.json`, the mechanical models, `signals.json`, `video_timings.json`, `video_75.json`, and `dc_12.json`. A product's claim file follows `data/claim.schema.json`; the examples are in `data/examples/`.

The market survey behind Annex F and the catalog rail sections behind Annexes A to D are in the separate eis-reference repository. They are informative and do not size anything EIS requires; a copy of the survey is kept in `data/survey/` so that Annex F builds here alone. Third-party documents are not stored here; `data/sources.json` records each one the specification cites.

TOOLING

`pip install -e ".[build,test]"` installs one command, `eis`:

COMMAND	DOES
<code>eis check</code>	Runs every generator and check (<code>python -m pytest tests</code>)
<code>eis gen</code>	Rewrites the generated pages, tables, and figure cards
<code>eis build pdf, refs, site, or all</code>	Builds <code>build/eis.pdf</code> , the design references <code>build/eis-ref-<type>.pdf</code> , and the static site
<code>eis claim FILE</code>	Validates a claim file and prints its claim line

Every subcommand is a script under `tools/`. Figure cards in `figures/` follow one house style, `tools/card.py`. CI builds the PDFs and the site on every push, and a tag `v*` publishes them at lzxindustries.net/eis (CONTRIBUTING.md).

FOREWORD

This page carries the edition of the specification, its status, and what each edition changed. It is the one page of EIS that narrates change; the

clauses describe EIS as it is, and a reader who wants to know what differs between two editions reads this page, not the clauses. The page is informative.

Edition	v0.1.0
Status	Working draft
Date	2026-10-20
Maintainer	LZX Industries
Public review	2026-10-26 to 2026-12-07; comments as issues at https://git.lzxindustries.net/lzx/eurorack-specification/issues or to support@lzxindustries.net
Claims against this edition	EIS draft until v0.1.0 is tagged; a claim then names the tag (4.2)

The identifiers of the requirements register are frozen from this edition onward (CONTRIBUTING.md): an identifier is never reused or resequenced, and a requirement whose meaning changes gets a new one. Every example claim in the draft names EIS draft, and the claim tool refuses to print a release-shaped claim line until the edition is tagged.

CHANGE SUMMARY

V0.1.0 (WORKING DRAFT)

The first edition. It defines the interface between Eurorack modules, enclosures, bus boards, power supplies and power converters, and the cables that join them, in six parts: a framework (scope, normative references, terms, conformance, and the generated requirements register); the mechanical interface (the rack, modules and their front panels and boards, rails, inserts, mounting screws, and enclosures); power (the power domains, supplies and converters, grounding, the bus and its boards, bus CV and gate, PWR-DC12, and PWR-A6); signals and video (the port list, patch signal classes, video timing, and VID-75); control (CTRL-USB and the host bridge protocol); and assembly, which binds the person who fits a row together. Every requirement has an identifier, the product types it applies to, the role or interface it binds, how it is verified, its provenance, and a line of rationale, and the same model generates the register, the figure cards, the design references, and the site. A product conforms by a claim line in the grammar of clause 4.2, kept in a claim file that eis claim validates, and publishes the figures the register asks of it. Seventeen informative annexes carry the rail and insert catalogs, the module survey, the verification measurements, the planning aids, the rationale, and worked examples.

ERRATA

None. An erratum to a released edition is listed here with the identifier it corrects and the date, and is carried into the next vX.Y.Z+1 edition.

PART 1 — FRAMEWORK

What EIS is and how a product conforms to it. Scope says what the specification covers and where its values come from; normative references lists the publications it applies; terms defines the words that carry a special meaning; conformance defines the product types, the interfaces and features, the Core tier, and the claim; the requirements register lists every requirement with its identifier.

Parts 2 to 6 hold the requirements. Part 2 (mechanical), the bus of Part 3, and the patch jacks and video timing of Part 4 are *EIS Core*: what every Eurorack product shares, whoever makes it. The other interfaces of Parts 3, 4, and 5 are features a product adds, each with its own clause, so that a maker who builds no video or control hardware reads only Core.

1 SCOPE

1.1 PURPOSE

The Eurorack Interface Specification (EIS) defines the mechanical and electrical interface between Eurorack modules, enclosures, bus boards, power supplies and power converters, and the cables that join them.

A requirement is a shall only where, without it, a conforming product from one maker could fail to fit, power up, or work with a conforming product from another. That covers mechanical fit, power entry and distribution, published supply figures, and declared signal classes. Construction choices that do not change interoperability, such as board material, module depth, rail section, or screw finish, are described and recommended, not required.

1.2 APPLICABILITY

EIS applies to six product types (Conformance):

- A *module*: front panel, board clearance, patch jacks, power entries and header current, the port list with signal classes and the formats of its rear video reference ports, patch safety; a DC entry panel or a reference distributor in module form claims the features of what it carries (5.1, 5.2, 6.1, 6.3, 6.4, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 8.1).
- An *enclosure*: rack frame, rails, inserts, mounting screws, published row width and depth; what is built in claims its own role: a built-in supply is a

power supply, a built-in bus board a bus board; a case DC entry claims PWR-DC12-IN (5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 6.5, 6.7, 7.3, 7.4, 8.1).

- A *bus board*: headers, links, published capacity, one 0 V, row wiring terminals; and whatever else it carries behind the panel: a DC rail, the ± 6 V rails, the video reference tree, or the case's CTRL-USB-HOST, each a feature it claims (6.1, 6.3, 6.4, 6.5, 6.7, 7.3, 7.4, 8.1).
- A *power supply*: rails, output connector, protection, published ratings and ripple, the earth bond of 0 V, row wiring terminals; a supply may also make the 12 V DC rail or the ± 6 V rails and claims that domain (6.1, 6.2, 6.3, 6.4, 6.7, 6.8, 6.9, 8.1).
- A *power converter*: a source for one product that makes one power domain from another, such as ± 6 V from the bus on the back of a module (6.1, 6.2, 6.3, 6.4, 6.7, 6.8, 6.9, 8.1).
- A *cable*: the interface it mates: power ribbon, video, DC, PWR-A6, or CTRL-USB (6.4, 6.5, 6.7, 6.8, 6.9, 7.4, 8.1).

Fourteen optional features, PWR-BUS-IN, PWR-BUS-OUT, PWR-DC12-IN, PWR-DC12-OUT, PWR-A6-IN, PWR-A6-OUT, PWR-A15-IN, PWR-A15-OUT, VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU, VID-REF-LOOPTHRU, CTRL-USB-DEV, and CTRL-USB-HOST, add requirements to a product that claims them. Every power domain is a feature a product claims for its entries and outlets, and distributing a rail or the video reference is a capability it claims through those features, not a product type. A product that claims none of them conforms to *EIS Core*: Part 2 (mechanical), Part 4 (signals and video, patch jacks and video timing only). Chapter 9 binds the person who assembles a system, not a product.

1.3 EXCLUSIONS

EIS does not specify:

- product catalogs, mains wiring or earthing, or the safety or EMC certification of a product;
- the internal protocol of digital video or data streams;
- ports other than patch jacks, video reference ports, power entries, and CTRL-USB ports, such as coaxial picture video, line and microphone audio, MIDI, DMX512, word clock, and the ILDA connector; Annex I gives an informative vocabulary for naming them;
- power rails outside the power domains of 6.1;
- a precision control-voltage class beyond *MOD-CV-1VOCT* pitch tracking; the stability of a DC reference or the accuracy of a quantizer is a product figure;
- factory test procedures (4.3).

1U in EIS is the Intellijel 1U format: a 39.65 mm panel with a 33.65 mm hole span. Pulp Logic 1U tiles, 43.18 mm high, are a different format, physically incompatible with it, and are outside EIS.

1.4 WHERE THE VALUES COME FROM

Every requirement records the origin of its value, its *provenance* (Terms):

- *Quoted* from a dated publication. Rack geometry comes from IEC 60297-3-101:2004 and IEC 60297-3-100:2008: the HP, the rack unit, and the frame dimensions a rack-mount enclosure meets (RACK-003). The M3 thread pitch and major diameter come from ISO 261:1998 (RAIL-006, RAIL-007).
- *Inherited* from the Doepfer A-100 and restated in EIS words: the 3U panel height, the hole inset and drill, the patch jack, the panel width and thickness ceilings, the power header pinout, marking, and keying, the ± 12 V and +5 V rails, the gate thresholds, and the bus CV and gate levels, regions, and links. The 1U panel height is inherited from the Intellijel 1U format.
- *Set by EIS*: the M3 mounting screw and its length window, board edge clearance, the published width, depth, and current of a module, the power header form and its current limit, the signal classes and their ranges, patch safety, the video class *MOD-VIDEO*, the 0 V reference and its earth bond, bus-board capacity, supply protection, published ripple and the ripple floor, rail and enclosure geometry, and the features of 4.1.

The patch levels are EIS figures, not inherited ones. Doepfer publishes typical ranges (audio 10 Vpp, LFOs ± 2.5 V, envelopes 0 to +8 V) and no impedance. EIS sets audio and control CV at ± 10 V peak because modules in use exceed those ranges and an input has to accept what an output may send (Annex E).

Where EIS states a value, that value governs a conformance claim. The tests compare EIS with the published A-100 figures and report where they differ.

2 NORMATIVE REFERENCES

EIS applies the following publications by dated reference. Only the editions listed apply. Rack dimensions quotes the figures EIS takes from the IEC publications.

DESIGNATION	TITLE	PUBLISHER	USED BY EIS FOR
IEC 60297-3-101:2004	Dimensions of mechanical structures of the 482,6 mm (19 in) series — Part 3-101: Subracks and associated plug-in units — Basic dimensions	IEC	HP (5.08 mm) and rack-unit height (44.45 mm), RACK-001 and RACK-002; flange width and the 84 HP row width for a rack-mount frame, RACK-003
IEC 60297-3-100:2008	Dimensions of mechanical structures of the 482,6 mm (19 in) series — Part 3-100: Basic dimensions of front panels, subracks, chassis, racks and cabinets	IEC	3U front panel height H1, flange mounting-hole span H2 and end distance H3, the oval mounting tab, and the rack mounting grid, RACK-003
ISO 261:1998	ISO general purpose metric screw threads — General plan	ISO	M3 pitch and major diameter, RAIL-006 and RAIL-007
ITU-R BT.601-4 (1994)	Encoding parameters of digital television for studio applications	ITU	The placement of the digital active line against OH for the interlaced SD formats, VID-002
SMPTE ST 170:2004	Composite analog video signal — NTSC for studio applications	SMPTE	525i59.94 timing, VID-002
ITU-R BT.470-7 (1998)	Conventional analogue television systems	ITU	625i50 timing, VID-002
ITU-R BT.1358-1 (2007)	Studio parameters of 625 and 525 line progressive television systems	ITU	576p50 timing, VID-002
SMPTE ST 293:2003	720 × 483 active line at 59.94 Hz progressive scan production — Digital representation	SMPTE	480p59.94 timing, VID-002
SMPTE ST 296:2012	1280 × 720 progressive image sample structure — Analog and digital representation and analog interface	SMPTE	720p timings, VID-002
SMPTE ST 274:2008	1920 × 1080 image sample structure, digital representation and digital timing reference sequences for multiple picture rates	SMPTE	1080-line timings, VID-002
USB 2.0 (2000) with its errata and ECNs	Universal Serial Bus Specification, Revision 2.0	USB-IF	The full-speed device port of CTRL-USB, USB-001 and USB-002
USB MIDI 2.0 (2020)	Universal Serial Bus Device Class Definition for MIDI Devices, Release 2.0	USB-IF	The USB-MIDI 2.0 function, USB-007
M2-101-UM v1.2	MIDI Capability Inquiry (MIDI-CI)	MIDI Association / AMEI	Discovery and Property Exchange transport, USB-006 and USB-008
M2-103-UM v1.2	Common Rules for MIDI-CI Property Exchange	MIDI Association / AMEI	ResourceList, DeviceInfo, JSONSchema, and subscriptions, USB-008, USB-010, USB-012

DESIGNATION	TITLE	PUBLISHER	USED BY EIS FOR
M2-104-UM v1.1.2	Universal MIDI Packet (UMP) Format and MIDI 2.0 Protocol	MIDI Association / AMEI	UMP endpoints and 32-bit controller messages, USB-007 and USB-009
M2-117-UM v1.0	MIDI-CI Property Exchange Controller Resources	MIDI Association / AMEI	AllCtrlList and CtrlMapList, USB-008 and USB-009

data/video_timings.json names the publication behind each format. The raster figures in 7.3 agree with those publications and with a hardware-verified timing contract, which tests/video_timings_contract.py checks.

INHERITED CONVENTIONS

EIS restates the following conventions in its own words. These pages are not normative references: a change to them does not change EIS. They are cited so that every inherited requirement in the register names its origin.

SOURCE	RETRIEVED	INHERITED BY EIS
Doepfer, Construction Details A-100	2026-10-09	3U panel height 128.5 mm (PANEL-006), hole inset 3.0 mm (PANEL-008), hole drill Ø3.2 mm (PANEL-010), width and thickness ceilings (PANEL-002, PANEL-004)
Doepfer, Technical Details A-100	2026-10-16	Rails (BUS-001, BUS-006), pinout and marking (BUS-003, BUS-004), bus CV and gate jumper (BUS-016), bus CV and gate levels (BUS-017, BUS-018), gate thresholds (SIG-011), 3.5 mm mono jacks (PANEL-005), the 10-pin header (BUS-007), split CV and gate regions and links (BUS-013, BUS-014), one CV and one gate transmitter per line (ASM-002). The patch audio and CV levels are EIS figures (Scope 1.4).
Doepfer, A-100 Accessories, A-100BUS V6 technical note	2026-10-14	Shrouded header keying (BUS-005) and module cable keying (BUS-010)
Doepfer, FAQ A-100, notes concerning bus boards with boxed pin headers	2026-10-14	Shrouded bus headers (BUS-005), with the row above
Intellijel, 1U technical specifications	2026-10-16	1U panel height 39.65 mm (PANEL-007)

3 TERMS AND DEFINITIONS

Only words EIS uses in a sense a reader could not guess are defined here. A module, an enclosure, a bus board, a power supply, a cable, a rail, a rail insert, and a mounting screw mean what they mean in any Eurorack catalog; clauses 5 to 7 say what EIS requires of each.

PRODUCT TYPE

What a requirement applies to: module, enclosure, bus board, power supply, power converter, or cable.

FEATURE

An optional set of requirements a product claims in addition to its product type, named FAMILY-KIND-DIRECTION: PWR-BUS-IN, PWR-DC12-IN, PWR-A6-IN, or PWR-A15-IN for a power domain it takes at an entry and the matching -OUT for one it gives at outlets; VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU, or VID-REF-LOOPTHRU for a video reference port; CTRL-USB-DEV for a service port and CTRL-USB-HOST for a case host. In a power designator the word names the topology and the number the rail voltage: BUS is the Eurorack bus, DCnn a single-rail nn V DC domain, Ann a bipolar $\pm nn$ V analog domain (6.1). A feature describes what happens behind the panel or inside the case; a port on the front is in the port list.

PORT AND PORT LIST

A *port* is one jack or connector on a module. The *port list* is the part of a module's documentation that names, for every port, its signal class or unclassified, the range it claims when that is not the class default, and, for a port that generates or locks to a video reference, the formats it supports (SIG-001, VID-001). It is published in the manual or a claim file.

SIGNAL CLASS AND RANGE

A *signal class* is a named set of level and impedance limits for a port, such as *MOD-AUDIO* or *MOD-VIDEO* (7.2). A *range* is the full-scale swing a port is built for, such as B10 (-10 to +10 V) or U1 (0 to +1 V); a class lists the ranges it takes and its default.

PATCH JACK

A 3.5 mm mono socket on a module's front panel that takes a patch cable between modules and carries a class from 7.2 or is unclassified. A 3.5 mm TRS socket for MIDI, headphones, or a stereo pair is a port, not a patch jack.

CLASS CEILING AND DAMAGE LIMIT

The *nominal* level of a class is the level a port works at, such as ± 5 V for audio; the *full scale* is the swing the port's range allows, ± 10 V at B10. The *class ceiling* is the largest signal that is still in class; an output claiming the class does not exceed it. The *damage limit* is the level an input withstands indefinitely without damage. On every patch input it is ± 12 V (SIG-002), whatever the class ceiling; a *MOD-VIDEO* input has a ± 1.2 V class ceiling and a ± 12 V damage limit.

COVER, MOUNTING FACE, THROAT, SEAT, AND D

On a rail, *cover* is the amount of panel face the rail hides; the *mounting face* is the face the panel bears on; the *throat* is the opening in front of the insert that the screw passes through; the *seat* is the depth of the insert's front face behind the mounting face; *D* is the depth behind the mounting face at which metal closes the cavity a screw tip enters. Cover limits the board clearance (5.2.2); seat and D set the screw length window (5.3).

VIDEO SYNC

The horizontal and vertical timing pulses of a video signal, alone (black burst, bi-level or tri-level video sync) or within a composite picture. EIS writes video sync in full, so the word is never ambiguous, and uses it for the pulses and their structure (7.3); the signal a row distributes to lock its modules is the *video reference*.

VIDEO REFERENCE

The signal a row's video modules lock their timing to: black burst, bi-level or tri-level video sync, or a composite picture, of one 7.3 format. It travels behind the panel on the $75\ \Omega$ coaxial interface (7.4), from a VID-REF-OUT to each VID-REF-IN, and never on a patch jack (7.1). A product's

reference ports are claimed by kind: VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU (a buffered pass-through), VID-REF-LOOPTHRU (a loop-through with a termination switch). A *video reference distributor* is any product, usually a bus board, with VID-REF-PASSTHRU ports beside its VID-REF-IN: the *tree* is the star of 75 Ω cables from its PASSTHRU ports to each module's VID-REF-IN.

POWER DOMAIN, POWER ENTRY, AND OUTLET

A *power domain* is a set of rails with its own connectors, distribution, and limits: *the bus* (+12 V, -12 V, optional +5 V), *PWR-DC12* (12 V DC), or *PWR-A6* (± 6 V) (6.1). A *power entry* is where a domain enters a product: a module's power header, a DC entry, or a PWR-A6 entry. An *outlet* is where a power supply, a power converter, or a distribution product delivers it: a supply's output terminals, a bus board's headers, a product's PWR-DC12 outlets, a converter's PWR-A6 outlet. A *power converter* is a source for one product, mounted on or beside it, that makes one domain from another.

0 V AND PROTECTIVE EARTH

0 V is the reference every rail and signal of a row is measured from: the 0 V pins of the power header, the sleeve of a patch jack, the shell of a coaxial jack, and the -V of a DC rail. *Protective earth* is the mains safety conductor. They are different conductors; a system joins them at one point, the bond a supply publishes (6.3).

DC ENTRY AND DC RAIL

A *DC entry* is the inlet at which nominal 12 V DC from an external adapter enters a product: a center-positive barrel (*DC-BAR21* or *DC-BAR25*) or a multi-pin connector (*DC-VH2* from a DC distribution product, or, above 10 A, *DC-DIN4*, *DC-MF6*, or *DC-MF8*). The *DC rail* is the 12 V DC that a DC entry feeds, one +V and -V pair, carried to modules directly or through a *DC distribution* product on DC-BAR21 or DC-VH2; each module filters or regulates it locally. The DC rail is not the ± 12 V bus (6.7).

CTRL-USB PORT AND CASE HOST

A *CTRL-USB port* is a USB 2.0 device port behind a product's panel through which its settings are listed and changed with the MIDI 2.0

standards (8.1). A *CTRL-USB device* is a product with such a port. A *case host* is a module that claims CTRL-USB in the other role: it connects to the CTRL-USB ports of a case and edits them.

VIDEO TIMING FORMAT

A named raster, such as 525i59.94 or 1080p30, with its line count, sample clock, and video sync structure tabulated in `data/video_timings.json`. 7.3 lists the formats EIS defines.

PROVENANCE

The origin of a requirement's value, recorded per row in `data/requirements.json`: *quoted* from a dated external publication; *inherited* from a Doepfer A-100 convention or the Intellijel 1U format, with the page and the date it was retrieved; *measured* on a named vendor part; *calculated* from other EIS requirements, which the record names; or *eis*, set by EIS itself.

REQUIREMENT LANGUAGE

TERM	MEANING
shall	Mandatory requirement
shall not	Mandatory prohibition
may	Permission
EIS recommends	Advice; a product that does otherwise still conforms, and its claim records nothing
can	Capability or possibility; not a requirement

EIS does not use RFC 2119 MUST, SHOULD, or MAY, and has no “should” level.

Every shall statement in a normative clause carries a requirement identifier, written in prose without the EIS- prefix (PANEL-009), and the requirements register lists it. A may statement is a permission and need not carry one. A recommendation carries none. Text in a normative clause that uses none of these words is informative: it explains, gives an example, or restates a requirement made elsewhere. Sections, tables, and annexes marked informative impose no requirements. Where a clause and the register differ, the register governs the level and the product types, and the clause governs the technical content.

4 CONFORMANCE

4.1 PRODUCT TYPES AND FEATURES

Every requirement in EIS applies to one or more *product types*. A product conforms to EIS when it meets every shall that applies to its product type.

PRODUCT TYPE	WHAT ITS REQUIREMENTS COVER	CLAUSES
module	Front panel, board clearance, patch jacks, power entries and header current, the port list with signal classes and the formats of its rear video reference ports, patch safety; a DC entry panel or a reference distributor in module form claims the features of what it carries	5.1, 5.2, 6.1, 6.3, 6.4, 6.6, 6.7, 6.8, 6.9, 7.1, 7.2, 7.3, 7.4, 8.1
enclosure	Rack frame, rails, inserts, mounting screws, published row width and depth; what is built in claims its own role: a built-in supply is a power supply, a built-in bus board a bus board; a case DC entry claims PWR-DC12-IN	5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 6.5, 6.7, 7.3, 7.4, 8.1
bus board	Headers, links, published capacity, one 0 V, row wiring terminals; and whatever else it carries behind the panel: a DC rail, the ± 6 V rails, the video reference tree, or the case's CTRL-USB-HOST, each a feature it claims	6.1, 6.3, 6.4, 6.5, 6.7, 7.3, 7.4, 8.1
power supply	Rails, output connector, protection, published ratings and ripple, the earth bond of 0 V, row wiring terminals; a supply may also make the 12 V DC rail or the ± 6 V rails and claims that domain	6.1, 6.2, 6.3, 6.4, 6.7, 6.8, 6.9, 8.1
power converter	A source for one product that makes one power domain from another, such as ± 6 V from the bus on the back of a module	6.1, 6.2, 6.3, 6.4, 6.7, 6.8, 6.9, 8.1
cable	The interface it mates: power ribbon, video, DC, PWR-A6, or CTRL-USB	6.4, 6.5, 6.7, 6.8, 6.9, 7.4, 8.1

The optional *features* add requirements to a product that claims them. A product that does not claim a feature owes none of its requirements.

FEATURE	ADDS	CLAUSE
PWR-BUS-IN	Takes the Eurorack bus at a power header: ± 12 V and optional +5 V (the domain nearly every module claims)	6.4, 6.5, 6.6
PWR-BUS-OUT	Gives the Eurorack bus: a supply's terminals, a bus board's headers, a case with a supply built in	6.4, 6.5, 6.6
PWR-DC12-IN	Takes 12 V DC at a DC entry: a module's DC-BAR21 or DC-VH2, a case entry on DC-BAR25, DC-DIN4, DC-MF6, or DC-MF8	6.7
PWR-DC12-OUT	Gives 12 V DC at DC-12 outlets to modules: a supply, a bus board, a DC entry panel, a distributor	6.7
PWR-A6-IN	Takes ± 6 V at an A6-VH3 entry	6.8
PWR-A6-OUT	Gives ± 6 V at A6-VH3 outlets: a supply, a power converter, a bus board	6.8

FEATURE	ADDS	CLAUSE
PWR-A15-IN	Takes ± 15 V at an A15-MF4 entry	6.9
PWR-A15-OUT	Gives ± 15 V at A15-MF4 outlets: a supply, a power converter, a bus board	6.9
VID-REF-IN	A video reference input behind the panel: a rear COAX-IN the module locks to, with the formats it locks to	7.3, 7.4
VID-REF-OUT	A video reference output behind the panel: a rear COAX-OUT giving a reference the module generates, with its formats	7.3, 7.4
VID-REF-PASSTHRU	With VID-REF-IN, a buffered pass-through of the reference input (COAX-PASSTHRU, marked PASSTHRU); not an output claim	7.3, 7.4
VID-REF-LOOPTHRU	With VID-REF-IN, the input as a loop-through pair with a termination switch (COAX-LOOPTHRU, marked TERM)	7.3, 7.4
CTRL-USB-DEV	A USB 2.0 service port and the MIDI 2.0 parameter interface as a device: the USB-PH4 port, identity, Property Exchange controls, current values	8.1
CTRL-USB-HOST	A case host: a module or a bus board that connects to the CTRL-USB ports of a case and edits its devices	8.1

Every power domain is a pair of features, one for each direction: a product claims PWR-BUS-IN, PWR-DC12-IN, PWR-A6-IN, or PWR-A15-IN for each domain it takes at an entry, and PWR-BUS-OUT, PWR-DC12-OUT, PWR-A6-OUT, or PWR-A15-OUT for each it gives at outlets, so a module with a power header claims PWR-BUS-IN, a passive module claims none, a supply that makes only ± 6 V claims PWR-A6-OUT alone, and a DC entry panel claims PWR-DC12-IN and PWR-DC12-OUT. A CTRL-USB port is CTRL-USB-DEV on the product that is edited and CTRL-USB-HOST on the case host that edits it. No product type implies a feature. *Distribution is a capability, not a product type*: a product that claims PWR-DC12-OUT distributes the DC rail, and a product with VID-REF-PASSTHRU ports beside its VID-REF-IN distributes the video reference, whether it is a bus board, a module, or an enclosure with those built in; it claims the feature and meets that feature's outlet or port rules. Claiming VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU, or VID-REF-LOOPTHRU claims the coaxial interface rules of 7.4 with it; VID-75 on its own is a coaxial picture port or a coaxial cable.

ROLES AND INTERFACES

Underneath the product types, every requirement binds a *role* or an *interface*, and the register names which. An interface is a place where two products mate: the front panel (PANEL), the rail and its screw (RAIL), the bus (PWR-BUS), a DC entry (PWR-DC12), a PWR-A6 entry (PWR-A6), a patch jack (PATCH), a coaxial video port (VID-75), a USB service port (CTRL-USB). A role is what a product does and publishes: module, panel, enclosure, bus board, power supply, power converter, distribution, cable, host. A product is a composition: an enclosure with a built-in supply and

bus board plays the enclosure, power supply, and bus board roles and owes every requirement of each; a case host is a module, or a bus board, in the host role; a bus board that also distributes a DC rail, the $\pm 6\text{ V}$ rails, or the video reference, or hosts the case's CTRL-USB, claims the matching feature beside PWR-BUS (BUS-020). The product type a product claims names its main role; what is built in or added claims its own.

EIS CORE

EIS Core is what every Eurorack product shares, whoever makes it: Part 2 (mechanical) and the patch jacks and video timing of Part 4. A product that claims a product type and no feature conforms to EIS Core; PWR-BUS is the feature nearly every module adds, and the other features add the interfaces of Parts 3, 4, and 5.

Product types are written in lower-case words, as they read in a sentence; DC keeps its capitals as an abbreviation. Features and interfaces are written in capitals with a hyphen, like every other EIS identifier: signal classes (MOD-CV), port modes (COAX-IN), and connector variants (DC-BAR21). A product type is never written as a code, and a feature never in lower case.

The requirements register lists each requirement with its product types and, in a column of its own, its feature. Chapter 9 binds the person assembling a system, not a product.

EIS · Product types and the clauses that bind them

	5.1	5.2	5.3	5.4	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.1	7.2	7.3	7.4	8.1	8.2	9
	rack	panel	rails	case	power	PSU	0 V	bus board	CV	DC	$\pm 6\text{ V}$	$\pm 15\text{ V}$	V ports	class	video	coax	USB	bridge	fit	
module	2	14			6		1	2+9		3	10	5	5	5	10	2	10	16		
enclosure	3	2	11	1	6	7	2		1		9					2	10	11		
bus board					5		2	6	1+3		9					2	10	16		
power supply					6	8	2	1			9	3	3					11		
power converter					2	8	1	7			6	3	3					11		
cable								4	2		3	2	2				1	1		
installer (9)																				9

☒ every product of the type ☐ only with the feature (PWR-BUS-IN, PWR-BUS-OUT, PWR-DC12-IN, PWR-DC12-OUT, PWR-CTRL-USB, PWR-VIDEO, PWR-COAX, PWR-USB, PWR-BRIDGE, PWR-FIT)

Each number counts the requirements of that clause that bind the product type (data/requirements.json). A product meets every one in its row, plus the outlined ones of a feature it claims.

4.2 CLAIMS

A conformance claim names the EIS edition, the product type, and every feature claimed beyond the one its product type implies, and for a cable what it mates; a statement that omits one of them is not an EIS claim. The claim applies to the product as a whole.

Examples of the claim line:

CLAIM LINE	PRODUCT
EIS draft, module	A passive module: a panel, a mult, an attenuator; no power, no coaxial port
EIS draft, module (PWR-BUS-IN)	Any module on the bus; its port list is in its manual or claim file
EIS draft, module (PWR-BUS-IN, VID-REF-IN)	A module that locks to the row's video reference at a rear COAX-IN
EIS draft, module (PWR-BUS-IN, VID-REF-IN, VID-REF-PASSTHRU)	The same, with a buffered pass-through of the reference for the next module
EIS draft, module (PWR-BUS-IN, VID-REF-IN, VID-REF-LOOPTHRU)	The same, with the input as a loop-through pair and a termination switch
EIS draft, module (PWR-BUS-IN, VID-REF-OUT)	A module that generates the row's video reference, such as a video reference generator
EIS draft, module (PWR-BUS-IN, VID-REF-IN, VID-REF-OUT)	A generator that also genlocks to an external reference
EIS draft, module (PWR-BUS-IN)	A module whose only coaxial jacks are picture ports on the front, such as a composite encoder's output or a decoder's input: they are in its port list as VID-CVBS or VID-YPBPR and add no feature
EIS draft, module (PWR-BUS-IN, PWR-DC12-IN)	A dual-source module with a 12 V DC entry
EIS draft, module (PWR-DC12-IN)	A DC entry panel: a case DC entry on DC-DIN4 or DC-MF8 that feeds PWR-DC12 outlets to modules
EIS draft, module (PWR-BUS-IN, PWR-A6-IN)	A module that takes its analog rails at a PWR-A6 entry and its logic from the bus
EIS draft, module (PWR-BUS-IN, CTRL-USB-DEV)	A module whose settings a case host or a computer edits over its CTRL-USB port
EIS draft, module (PWR-BUS-IN, CTRL-USB-HOST)	A case host: the case's USB host and editor, a module in the host role (8.1)
EIS draft, power converter (PWR-BUS-IN, PWR-A6-OUT)	A ± 6 V converter on the back of a module, fed from the bus
EIS draft, bus board (PWR-BUS-OUT)	A bus board

CLAIM LINE	PRODUCT
EIS draft, bus board (PWR-BUS-OUT, VID-REF-IN, VID-REF-PASSTHRU)	A bus board that also carries the video reference tree: a video reference distributor (6.5)
EIS draft, bus board (PWR-BUS-OUT, PWR-DC12-OUT)	A bus board with PWR-DC12 outlets beside its headers
EIS draft, bus board (PWR-BUS-OUT, CTRL-USB-HOST)	A bus board that is the case's USB host
EIS draft, power supply (PWR-BUS-OUT)	A standalone bus supply
EIS draft, power supply (PWR-BUS-OUT, PWR-DC12-OUT)	A bus supply that takes 12 V DC at a DC entry, or gives a DC rail at PWR-DC12 outlets (SUP-009); its claim file says which
EIS draft, power supply (PWR-A6-OUT)	A supply that makes only the ± 6 V rails
EIS draft, enclosure	A case with nothing built in
EIS draft, enclosure + power supply + bus board (PWR-BUS-OUT, PWR-DC12-OUT)	A case with a built-in supply and bus board, fed at a case DC entry
EIS draft, cable (PWR-BUS)	A power ribbon; or (VID-75) for a coaxial cable, (PWR-DC12), (PWR-A6), (CTRL-USB): a cable names the one interface it mates

The edition is a tag on the specification's repository, and until the edition in work is tagged a claim names draft. A claim names one edition and stays valid for it when later editions change. A product that plays several roles names them all, joined by a plus sign: an enclosure with a built-in supply and bus board claims EIS draft, enclosure + power supply + bus board. A claim that names no feature is an EIS Core claim (4.1).

CLAIM LINE GRAMMAR

The claim line in ABNF (RFC 5234), generated from the register by `tools/claim.py (eis claim --grammar)`:

```

claim      = "EIS " edition ", " roles [" (" features ")"]
edition    = "v" 1*DIGIT "." 1*DIGIT "." 1*DIGIT / "draft" ; a tag of the
repository, or draft until one exists
roles      = role *(" + " role) ; the product type, then
every other role the product plays
role       = "module" / "enclosure" / "bus board" / "power supply" / "power
converter" / "cable"
features    = feature *(", " feature) ; every power domain and
video reference port kind the product has, behind the panel or inside the case
feature     = "PWR-BUS-IN" / "PWR-BUS-OUT" / "PWR-DC12-IN" / "PWR-DC12-OUT" /
"PWR-A6-IN" / "PWR-A6-OUT" / "PWR-A15-IN" / "PWR-A15-OUT" / "VID-REF-IN" / "VID-
REF-OUT" / "VID-REF-PASSTHRU" / "VID-REF-LOOPTHRU" / "CTRL-USB-DEV" / "CTRL-USB-
HOST"
cable-claim = "EIS " edition ", cable (" interface ")" ; a cable names the one
interface it mates
interface   = "PWR-BUS" / "PWR-DC12" / "PWR-A6" / "PWR-A15" / "VID-75" / "CTRL-
USB"

```

SELF-DECLARATION

A maker states conformance on one page: the claim line, what the product publishes, how it was verified, and the date. `data/examples/eis-declaration.md` is the template; `eis claim prints`, for a valid claim file, the register rows the product owes and how each is verified, which is the list the declaration's verification statement covers.

CLAIM FILE

What a product publishes under EIS goes in its manual or product page: a module's port list (SIG-001, VID-001), width, depth, and rail currents (PANEL-003, PWR-001); a supply's rail ratings and ripple (PWR-002, SUP-001); and so on for each product type. EIS recommends keeping the claim line and all of these in one *claim file*, `eis-claim.yaml`, in the form of `data/claim.schema.json`. Its power block lists the product's power entries and outlets by domain, each with the current on every rail of that domain (6.1).

`eis claim eis-claim.yaml` checks that the file carries every figure the register requires of its product type, that its classes, ranges, and formats exist, and that its header currents and ripple are inside their limits, and then prints the claim line. Worked examples of every product type are in `data/examples/`.

EIS · Claim line and port list from a claim file

EIS draft, module (PWR-BUS-IN, VID-REF-IN, VID-REF-OUT)

Example video reference generator, Example Maker · 3U, 4 HP, 32 mm deep, +12 V 0.22 A, -12 V 0.05 A, +5 V 0 A

Port	Class	Range	Direction	Formats or note
H	MOD-VIDEO	U1	out	Horizontal ramp
V	MOD-VIDEO	U1	out	Vertical ramp
FIELD	MOD-GATE	—	out	—
RATE	MOD-CV	B5	in	—
Rear coaxial portMode		Jack	Formats (VID-001)	
REF IN	COAX-IN	BNC	525i5994, 625i50, ... 1080i60 (6 formats)	
REF OUT	COAX-OUT	BNC	525i5994, 625i50, ... 1080p30 (15 formats)	

The port list is what a buyer checks: every port names its signal class, or unclassified, its direction, and the range it claims. The video reference is a rear port claimed by kind (VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU, VID-REF-LOOPTHRU), never a The claim line names the edition tag, the product type, and every feature; the file carries the published figures. python tools/claim.py --check eis-claim.yaml validates a file and prints its claim line.

4.3 VERIFICATION

EIS defines interfaces and limits, not factory test procedures; each product documents its own verification. A maker demonstrates conformance by inspection and measurement against the figures and tables in the normative clauses, or by documented analysis. Annex G describes typical measurements and adds no requirements. The tests compare selected EIS figures with external publications; a test does not change a requirement.

4.4 REQUIREMENTS REGISTER (NORMATIVE)

Generated from data/requirements.json by tools/requirements.py. Do not edit by hand.

Each row is one requirement: its identifier, its level, the roles and interfaces it binds, the product types and feature it applies to in a claim, and its text. The register and the data models are the specification; the clause pages, the PDF, and the design references render them, and a mismatch in a rendering is an erratum. A row with a feature applies only to a product that claims it; no product type implies a feature. Provenance (quoted, inherited, measured, calculated, or EIS) and how a row is verified (Annex G) are recorded per row in data/requirements.json. Roles, interfaces, product types, and features are defined in Conformance. Clause

prose cites identifiers without the EIS- prefix. Identifiers are frozen:
never reused, never resequenced; a changed requirement gets a new one.

PRODUCT TYPE	SHALL	MAY	SHALL, WITH A FEATURE
module	40	0	59
enclosure	31	1	33
bus board	7	1	45
power supply	15	1	27
power converter	11	0	30
cable	0	0	15
feature PWR-BUS-IN	0	0	—
feature PWR-BUS-OUT	0	0	—
feature PWR-DC12-IN	0	0	—
feature PWR-DC12-OUT	0	0	—
feature PWR-A6-IN	0	0	—
feature PWR-A6-OUT	0	0	—
feature PWR-A15-IN	0	0	—
feature PWR-A15-OUT	0	0	—
feature VID-REF-IN	1	0	—
feature VID-REF-OUT	1	0	—
feature VID-REF-PASSTHRU	1	0	—
feature VID-REF-LOOPTHRU	1	0	—
feature CTRL-USB-DEV	0	0	—
feature CTRL-USB-HOST	0	0	—
assembling a system (chapter 9, binds the installer)	9	0	—

5.1 RACK DIMENSIONS

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-RACK-001	shall	PANEL, RAIL	module, enclosure	One HP shall be 5.08 mm.
EIS-RACK-002	shall	PANEL, RAIL	module, enclosure	One rack unit shall be 44.45 mm.
EIS-RACK-003	shall	enclosure	enclosure	A rack-mount frame shall meet IEC 60297-3-101:2004 and IEC 60297-3-100:2008 for the flange width, flange mounting-hole positions and tab, the 3U subrack aperture height, and the 84 HP row width.

5.2 MODULES

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-PANEL-001	shall	PANEL	module	A module shall be 1U or 3U high.
EIS-PANEL-002	shall	PANEL	module	An N HP panel shall be no wider than $N \times 5.08$ mm, where N is a positive whole number.
EIS-PANEL-003	shall	module	module	A module shall publish its width in HP and how far it extends behind the panel's back face.
EIS-PANEL-004	shall	PANEL	module	A front panel shall be no more than 2.0 mm thick.
EIS-PANEL-005	shall	PATCH	module	A patch jack shall be a 3.5 mm mono (TS) socket.
EIS-PANEL-006	shall	PANEL	module	A 3U front panel shall be 128.5 mm high.
EIS-PANEL-007	shall	PANEL	module	A 1U front panel shall be 39.65 mm high.
EIS-PANEL-008	shall	PANEL	module	Mounting holes shall be 3.0 mm in from the top and bottom panel edges.
EIS-PANEL-009	shall	PANEL, RAIL	module, enclosure	The mounting-hole span, on the panel and between the inserts of a row's two rails, shall be 122.5 mm at 3U and 33.65 mm at 1U.
EIS-PANEL-010	shall	PANEL	module	Mounting holes shall be drilled $\varnothing 3.2$ mm, or slotted 3.2 mm wide and no longer than 5.5 mm along the rail, centered on the hole position.
EIS-PANEL-011	shall	PANEL	module	Each mounting hole shall be a whole number of HP plus 2.54 mm from the panel's nominal left edge.
EIS-PANEL-012	shall	PANEL, RAIL	module, enclosure	A board shall stay at least 9.25 mm clear of the top and bottom panel edges, and a rail shall cover no more than 9.25 mm of the panel face at each edge.
EIS-PANEL-013	shall	PANEL	module	A dimension of clauses 5.2 and 5.3 shall hold within the tolerance the register states for its requirement; a dimension with no tolerance stated is a limit.
EIS-PANEL-014	shall	PANEL	module	A front panel thinner than 1.6 mm shall ship with mounting screws whose length fits the window of clause 5.3 for its own thickness.

5.3 RAILS, INSERTS, AND MOUNTING SCREWS

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-RAIL-001	shall	RAIL	enclosure	The holes in a rail insert shall be 5.08 mm apart.
EIS-RAIL-002	shall	RAIL	enclosure	A rail for an N HP row shall give at least $N \times 5.08$ mm of mounting length.
EIS-RAIL-003	shall	RAIL	enclosure	An insert shall be threaded M3.
EIS-RAIL-004	shall	RAIL	enclosure	An insert shall be at least 1.5 mm thick, three thread pitches.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-RAIL-005	shall	RAIL	enclosure	A mounting screw shall be M3.
EIS-RAIL-006	shall	RAIL	enclosure	A mounting screw's thread pitch shall be 0.5 mm.
EIS-RAIL-007	shall	RAIL	enclosure	A mounting screw's major diameter shall be 3.0 mm.
EIS-RAIL-008	shall	RAIL	enclosure	The screw shall engage at least three full threads through a 2.0 mm panel.
EIS-RAIL-009	shall	RAIL	enclosure	The mounting-screw length L shall satisfy $2.0\text{ mm} + \text{seat} + 1.5\text{ mm} \leq L \leq 1.6\text{ mm} + D$, with seat and D measured behind the rail's mounting face, and the throat in front of the insert shall clear 3.0 mm.
EIS-RAIL-010	shall	RAIL	enclosure	The mounting-screw head shall be at most 7.0 mm across.
EIS-RAIL-011	shall	enclosure	enclosure	An enclosure shall state the mounting-screw length, and shall supply those screws or name them.

5.4 ENCLOSURES

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-ENC-001	shall	enclosure	enclosure	An enclosure shall publish, for each row, its width in HP and the depth it keeps clear behind the panel's back face.

6.1 POWER ARCHITECTURE

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-PWR-001	shall	module, power supply, power converter, bus board, enclosure	module, power supply, bus board, enclosure, power converter	A product shall publish, for each power entry, the maximum current it takes on each rail at the entry's nominal voltage, stating 0 for a rail it does not draw.
EIS-PWR-002	shall	power supply, bus board, power converter	module, power supply, bus board, enclosure, power converter	A power supply, a power converter, a bus board, and any product with outlets of a power domain shall publish the maximum current it delivers on each rail, in total and at each outlet.
EIS-PWR-003	shall	module	module	A product whose power entries are alternatives, each able to power it alone, shall not require more than one of them to be connected at the same time.
EIS-PWR-004	shall	module	module	A module shall not source current into a rail of any of its power entries.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-PWR-005	shall	PWR-BUS, PWR-DC12	module, power supply, bus board, enclosure	Where a power supply, a bus board, or a product with PWR-DC12 outlets takes or gives a rail or 0 V on discrete wires, each terminal shall be a 6.3 mm × 0.8 mm quick-connect tab, a stud or screw that takes a ring terminal, or a wire-clamp terminal block, and the product shall publish the terminal type and the conductor sizes it accepts.
EIS-PWR-006	shall	PWR-BUS, PWR-DC12	module, power supply, bus board, enclosure	A row wiring conductor between a power supply, a bus board, a product with PWR-DC12 outlets, or a DC entry shall be stranded copper, insulated and rated 105 °C or more, of at least 16 AWG, at least 14 AWG where it carries more than 5 A, and at least 12 AWG where it carries more than 8 A, terminated by a crimped terminal at each end; a joint shall not rely on solder alone.
EIS-PWR-007	shall	PWR-BUS, PWR-DC12	power supply, bus board, enclosure	The 0 V conductor between a power supply and a bus board, and between linked bus boards, shall be of at least the gauge of the rail conductors beside it.
EIS-PWR-008	shall	PWR-BUS, PWR-DC12, PWR-A6	power supply, enclosure	Where a product bonds its 0 V to its chassis or to a protective-earth terminal, the bond shall be a conductor of at least 14 AWG with a ring terminal on a stud or screw through bare metal under a toothed lock washer, or a bus bar of equivalent section.

6.2 POWER SUPPLIES AND POWER CONVERTERS

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-SUP-001	shall	power supply, power converter	power supply, power converter	A power supply shall publish its ripple and noise on each rail it provides, peak-to-peak, measured as stated in clause 6.2.
EIS-SUP-002	shall	power supply, power converter	power supply, enclosure, power converter	A power-supply output on a plug-and-socket connector shall not mate with reversed polarity.
EIS-SUP-003	shall	power supply, power converter	power supply, enclosure, power converter	A power-supply output on individual 1/4 in quick-connect tabs or screw terminals shall mark each terminal with its rail.
EIS-SUP-004	shall	power supply, power converter	power supply, enclosure, power converter	Each rail shall survive an indefinite short to 0 V without damage.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-SUP-005	shall	power supply, power converter	power supply, enclosure, power converter	During power-up, power-down, or a fault, no rail shall swing more than one diode drop toward the opposite polarity.
EIS-SUP-006	shall	power supply, power converter	power supply, enclosure, power converter	At start-up, no rail shall overshoot its nominal voltage by more than 10 %.
EIS-SUP-007	shall	power supply, power converter	power supply, enclosure, power converter	Each rail shall have ripple and noise below the limit of its domain tabulated in 6.2, 150 mV peak-to-peak on the bus, measured as stated in clause 6.2.
EIS-SUP-008	shall	power converter	power converter	A power converter shall publish the heat it dissipates at its rated output and how far it extends behind the product it is mounted on.
EIS-SUP-009	may	PWR-DC12, PWR-A6	power supply, enclosure	A power supply may make the 12 V DC rail of 6.7 or the ± 6 V rails of 6.8, beside or instead of the bus; it then claims PWR-DC12-OUT or PWR-A6-OUT, publishes the current of each outlet, and meets that domain's outlet rules.

6.3 GROUNDING AND 0 V

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-GND-001	shall	module, power supply, power converter, bus board, enclosure	module, power supply, power converter, bus board, enclosure	A product shall connect every 0 V pin of its power headers and PWR-A6 entries, and the -V of its DC entry, to its 0 V.
EIS-GND-002	shall	bus board	bus board	A bus board shall join the 0 V pins of every header to one 0 V that runs to the supply's 0 V terminal.
EIS-GND-003	shall	power supply	power supply, enclosure	A power supply shall publish whether its 0 V output is connected to protective earth, and where.

6.4 THE BUS

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-BUS-001	shall	PWR-BUS	bus board, power supply (PWR-BUS)	The bus shall provide +12 V and -12 V, and may provide +5 V, at every power header.
EIS-BUS-002	shall	PWR-BUS	module, bus board, cable, power converter (PWR-BUS)	A power header on a module or a bus board shall be a 2 × 5 or 2 × 8 pin header on a 2.54 mm grid, and a power cable shall end in IDC ribbon sockets that mate it.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-BUS-003	shall	PWR-BUS	module, bus board, cable, power converter (PWR-BUS)	A power header on a module, a bus board, or a cable shall follow the pinout of clause 6.4: -12 V on pins 1-2, 0 V on 3-8, +12 V on 9-10, and on a 16-pin header +5 V on 11-12, CV on 13-14, and gate on 15-16.
EIS-BUS-004	shall	PWR-BUS	module, bus board, cable, power converter (PWR-BUS)	On a module, a bus board, and a power ribbon cable, the marked conductor shall be -12 V and shall point to the -12 V end of the header.
EIS-BUS-005	shall	PWR-BUS	module, bus board, cable, power converter (PWR-BUS)	A shrouded power header on a module or a bus board shall be keyed so that, viewed from the mating side with the -12 V end at the bottom, the key gap is on the right, and a keyed cable socket shall match it.
EIS-BUS-006	shall	PWR-BUS	module (PWR-BUS)	A module powered from the bus shall draw only +12 V and -12 V, and may also draw +5 V.
EIS-BUS-007	may	PWR-BUS	module (PWR-BUS)	A module that uses neither +5 V nor bus CV or gate may use the 10-pin header.
EIS-BUS-008	shall	PWR-BUS	module, power converter (PWR-BUS)	A module shall not draw more than 2 A on any rail through one power header.
EIS-BUS-009	shall	PWR-BUS	module, power converter (PWR-BUS)	A module shall tolerate reverse polarity at its power header without damage.
EIS-BUS-010	shall	cable	module	A bus cable supplied with a module shall be keyed so that it enters a shrouded header only with the marked conductor on -12 V.
EIS-BUS-011	shall	module	module	A header on a module that is not its power header shall either not mate a Eurorack power ribbon socket or tolerate one fitted to it, either way round, without damage.
EIS-BUS-019	shall	PWR-BUS	module, bus board, power converter (PWR-BUS)	A module and a bus board shall mark the -12 V end of each power header on the board.

6.5 BUS BOARDS

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-BUS-012	shall	PWR-BUS	bus board, enclosure (PWR-BUS)	The per-header limit a bus board publishes shall not exceed 2 A per rail.
EIS-BUS-013	may	PWR-BUS	bus board (PWR-BUS)	A bus board may split CV and gate into two regions.
EIS-BUS-014	shall	PWR-BUS	bus board, cable (PWR-BUS)	A link between two bus boards shall join CV to CV and gate to gate.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-BUS-015	shall	PWR-BUS	cable (PWR-BUS)	A power ribbon from a bus header to a module shall be no longer than 400 mm and shall use conductors of at least 28 AWG.
EIS-BUS-020	may	PWR-BUS	bus board	A bus board may also distribute a DC rail, the ± 6 V analog rails, or the video reference behind the panel, or be the case's CTRL-USB-HOST; it then claims the matching feature, PWR-DC12, PWR-A6, the VID-REF ports, or CTRL-USB-HOST, beside PWR-BUS and meets its requirements.

6.6 BUS CV AND GATE

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-BUS-016	shall	PWR-BUS	module (PWR-BUS)	A module shall listen to or transmit bus CV or gate only when a jumper or switch on the module is set to do so.
EIS-BUS-017	shall	PWR-BUS	module (PWR-BUS)	A module that drives or receives bus CV shall meet the BUS-CV limits of clause 6.6.
EIS-BUS-018	shall	PWR-BUS	module (PWR-BUS)	A module that drives or receives bus gate shall meet the BUS-GATE limits of clause 6.6.

6.7 12 V DC POWER (PWR-DC12)

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-DC-001	shall	PWR-DC12	module, bus board, enclosure, power supply, power converter (PWR-DC12)	A product shall publish its DC entry variant: DC-BAR21, DC-BAR25, DC-VH2, DC-DIN4, DC-MF6, or DC-MF8, as tabulated in 6.7.
EIS-DC-002	shall	PWR-DC12	module, bus board, enclosure, power supply, power converter (PWR-DC12)	A product shall publish the minimum and maximum DC input voltage its DC entry accepts.
EIS-DC-003	shall	PWR-DC12	module, bus board, enclosure, power supply, power converter (PWR-DC12)	A DC entry shall not use the pinout of a Eurorack 10-pin or 16-pin power header.
EIS-DC-004	shall	PWR-DC12	module, bus board, enclosure, power supply, power converter (PWR-DC12)	A DC-BAR21 or DC-BAR25 barrel DC entry shall be center positive.
EIS-DC-005	shall	PWR-DC12	module, bus board, enclosure, power supply, power converter (PWR-DC12)	A product with a DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall implement the pin functions tabulated for that variant in 6.7.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-DC-006	shall	PWR-DC12	module (PWR-DC12)	A module's barrel DC entry shall tolerate reverse polarity without damage.
EIS-DC-007	shall	PWR-DC12	cable (PWR-DC12)	A straight DC barrel cable shall connect tip to tip and sleeve to sleeve at both ends.
EIS-DC-008	shall	PWR-DC12	cable (PWR-DC12)	A cable for a DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall connect each pin to the same pin and function at both ends.
EIS-DC-009	shall	PWR-DC12	module, bus board, power supply, enclosure (PWR-DC12)	A product with PWR-DC12 outlets to modules shall feed them only through DC-BAR21 jacks or DC-VH2 headers, and shall not use DC-BAR25 for an output to a module.
EIS-DC-010	shall	PWR-DC12	cable (PWR-DC12)	A cable from a PWR-DC12 outlet to a module shall end in DC-BAR21 plugs or DC-VH2 housings and connect +V to +V and -V to -V, tip and pin 1 being +V.
EIS-DC-011	shall	PWR-DC12	module, bus board, enclosure, power supply, power converter (PWR-DC12)	A DC entry shall be marked beside it with its polarity symbol, its nominal voltage, and its maximum current.
EIS-DC-012	shall	PWR-DC12	module, bus board, power supply, enclosure (PWR-DC12)	A product with PWR-DC12 outlets shall protect each output separately and shall publish the current at which the protection acts.
EIS-DC-013	shall	PWR-DC12	module, bus board, power supply, enclosure (PWR-DC12)	A DC entry that feeds PWR-DC12 outlets shall tolerate reverse polarity without damage.

6.8 ±6 V ANALOG POWER (PWR-A6)

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-A6-001	shall	PWR-A6	module, power supply, power converter, cable (PWR-A6)	A PWR-A6 entry or outlet shall be an A6-VH3 connector with the pin functions tabulated in 6.8.
EIS-A6-002	shall	PWR-A6	power supply, power converter (PWR-A6)	A PWR-A6 outlet shall hold each rail between 5.75 V and 6.25 V in magnitude from no load to its published rating.
EIS-A6-003	shall	PWR-A6	module (PWR-A6)	A module shall meet its published behavior with each PWR-A6 rail between 5.55 V and 6.25 V in magnitude at its entry.
EIS-A6-004	shall	PWR-A6	module (PWR-A6)	A PWR-A6 entry shall withstand 6.6 V in magnitude on either rail without damage.
EIS-A6-005	shall	PWR-A6	module (PWR-A6)	A module shall not draw more than 1 A on either rail through one PWR-A6 entry.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-A6-006	shall	PWR-A6	cable (PWR-A6)	A PWR-A6 cable shall connect each pin to the same pin at both ends, be no longer than 500 mm, and use conductors of at least 22 AWG.
EIS-A6-007	shall	PWR-A6	module, power supply, power converter (PWR-A6)	A PWR-A6 entry or outlet shall be marked ± 6 V beside it.

6.9 ± 15 V ANALOG POWER (PWR-A15)

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-A15-001	shall	PWR-A15	module, power supply, power converter, cable (PWR-A15)	A PWR-A15 entry or outlet shall be an A15-MF4 connector with the pin functions tabulated in 6.9.
EIS-A15-002	shall	PWR-A15	power supply, power converter (PWR-A15)	A PWR-A15 outlet shall hold each rail between 14.4 V and 15.6 V in magnitude from no load to its published rating.
EIS-A15-003	shall	PWR-A15	module (PWR-A15)	A module shall meet its published behavior with each PWR-A15 rail between 14.0 V and 15.6 V in magnitude at its entry.
EIS-A15-004	shall	PWR-A15	module (PWR-A15)	A PWR-A15 entry shall withstand 16.5 V in magnitude on either rail without damage.
EIS-A15-005	shall	PWR-A15	module (PWR-A15)	A module shall not draw more than 2 A on either rail through one PWR-A15 entry.
EIS-A15-006	shall	PWR-A15	cable (PWR-A15)	A PWR-A15 cable shall connect each pin to the same pin at both ends, be no longer than 500 mm, and use conductors of at least 20 AWG.
EIS-A15-007	shall	PWR-A15	module, power supply, power converter (PWR-A15)	A PWR-A15 entry or outlet shall be marked ± 15 V beside it.

7.1 SIGNALS

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-SIG-001	shall	PATCH	module	A module shall publish a port list naming, for every port, its signal class or unclassified.
EIS-SIG-002	shall	PATCH	module	A patch input shall withstand ± 12 V indefinitely.
EIS-SIG-003	shall	PATCH	module	A patch output shall withstand an indefinite short to 0 V or to another patch output.
EIS-SIG-004	shall	PATCH	module	A patch output shall not drive the patch tip beyond ± 12 V.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-SIG-015	shall	PATCH	module	A patch jack shall carry patched signals only: a module shall neither take nor give its video reference at a patch jack, and no patch jack shall list a format of clause 7.3.

7.2 PATCH SIGNAL CLASSES

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-SIG-005	shall	PATCH	module	A port claiming MOD-AUDIO shall meet the MOD-AUDIO limits of clause 7.2.
EIS-SIG-006	shall	PATCH	module	A port claiming MOD-CV shall meet the MOD-CV limits of clause 7.2.
EIS-SIG-007	shall	PATCH	module	A port claiming MOD-CV-1VOCT shall meet the MOD-CV-1VOCT limits of clause 7.2.
EIS-SIG-008	shall	PATCH	module	A port claiming MOD-VIDEO shall meet the MOD-VIDEO limits of clause 7.2.
EIS-SIG-009	shall	PATCH	module	A MOD-VIDEO input shall present $100\text{ k}\Omega \pm 10\%$ to 0 V at the patch tip.
EIS-SIG-010	shall	PATCH	module	A MOD-VIDEO output shall drive through a $75\text{ }\Omega \pm 5\%$ total series source impedance at the patch tip.
EIS-SIG-011	shall	PATCH	module	A port claiming MOD-GATE shall meet the MOD-GATE limits of clause 7.2.
EIS-SIG-012	shall	PATCH	module	A port claiming MOD-TRIG shall meet the MOD-TRIG limits of clause 7.2.
EIS-SIG-013	shall	PATCH	module	A port claiming MOD-CLK shall meet the MOD-CLK limits of clause 7.2.
EIS-SIG-014	shall	PATCH	module	A port claiming a range shall meet that range's limits of clause 7.2: an output keeps its full-scale signal within the range's ceiling, and an input accepts the range's full swing without clipping.

7.3 VIDEO TIMING

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-VID-001	shall	VID-75	module, bus board, enclosure (VID-75)	A product's port list shall name, for each VID-REF-IN and VID-REF-OUT port, every format of clause 7.3 the port accepts or generates, by its format ID.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-VID-002	shall	VID-75	module, bus board, enclosure (VID-75)	When a listed format is selected or published on a port, that port's horizontal and vertical timing and its video sync structure shall match the format's publication within the tolerances that publication states; for a progressive or high-definition format the row of clause 7.3 is that publication's raster, sample for sample.

7.4 VIDEO ON 75 Ω COAXIAL JACKS (VID-75)

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-V75-001	shall	VID-75	module, bus board, enclosure (VID-75)	Every jack in a VID-75 tree shall be an RCA, BNC, or SMA jack.
EIS-V75-002	shall	VID-75	module, bus board, enclosure (VID-75)	On every jack in a VID-75 tree, the center pin shall carry the video signal and the shell shall be 0 V.
EIS-V75-003	removed	VID-75	bus board, enclosure	Removed: the VID-REF-IN port is the designated input, named in the port list (V75-011).
EIS-V75-004	removed	VID-75	bus board, enclosure	Removed: a VID-REF-IN is a COAX-IN, terminated by V75-009.
EIS-V75-005	shall	VID-75	module, bus board, enclosure (VID-75)	A VID-REF-OUT or VID-REF-PASSTHRU port shall drive one COAX-IN load, and an output shall not be split passively to several terminated ports.
EIS-V75-006	removed	VID-75	module	Removed: V75-009 states the rule for every coaxial video port, not only one in a tree.
EIS-V75-007	shall	VID-75	cable (VID-75)	A VID-75 cable shall be a 75 Ω coaxial cable, with RCA, BNC, or SMA plugs, that connects center pin to center pin and shell to shell at both ends.
EIS-V75-008	removed	VID-75	module, bus board, enclosure	Removed: V75-016 states the marking rule for video reference ports; a picture port follows its own standard's labelling.
EIS-V75-009	removed	VID-75	module, bus board, enclosure	Removed: V75-015 states the port rule for video reference ports; a coaxial picture port is an external interface listed in the port list with an Annex I class, not a feature.
EIS-V75-010	shall	VID-75	module, bus board, enclosure (VID-75)	A module that generates or locks to an external video reference shall take or give it at a video reference port on its rear.
EIS-V75-011	shall	VID-75	module, bus board, enclosure (VID-REF-IN)	A product that claims VID-REF-IN shall take the video reference at its VID-REF-IN port, a COAX-IN on its rear, lock any video timing of its own to it, and list the formats it accepts.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-V75-012	shall	VID-75	module, bus board, enclosure (VID-REF-OUT)	A product that claims VID-REF-OUT shall give a video reference of a listed format at its VID-REF-OUT port, a COAX-OUT on its rear, that it generates itself; a copy of a reference it takes at VID-REF-IN is a VID-REF-PASSTHRU, not a VID-REF-OUT.
EIS-V75-013	shall	VID-75	module, bus board, enclosure (VID-REF-PASSTHRU)	A product shall claim VID-REF-PASSTHRU only with VID-REF-IN; each VID-REF-PASSTHRU port shall be a COAX-PASSTHRU, a buffered copy of the reference at VID-REF-IN driven as a COAX-OUT into one COAX-IN load, and be marked PASSTHRU.
EIS-V75-014	shall	VID-75	module, bus board, enclosure (VID-REF-LOOPTHRU)	A product shall claim VID-REF-LOOPTHRU only with VID-REF-IN; its VID-REF-IN shall then be a COAX-LOOPTHRU, two bridged jacks on one line with a termination switch that presents 75 Ω to 0 V across the line when on and no load when off, marked TERM, and the product shall lock the same with the switch on or off.
EIS-V75-015	shall	VID-75	module, bus board, enclosure (VID-75)	Every video reference port shall be a COAX-IN (75 Ω to 0 V at the jack), a COAX-OUT (75 Ω series source driven at twice the line level), a COAX-PASSTHRU, or a COAX-LOOPTHRU port, never a patch jack.
EIS-V75-016	shall	VID-75	module, bus board, enclosure (VID-75)	A video reference port shall be marked beside it as an input (IN), an output (OUT), a pass-through (PASSTHRU), or, for a loop-through pair, with its termination switch (TERM).

8.1 USB SERVICE PORT AND PARAMETER INTERFACE (CTRL-USB)

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-USB-001	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A CTRL-USB device shall have a USB 2.0 full-speed device port on a USB-PH4 connector with the pin functions tabulated in 8.1.
EIS-USB-002	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A CTRL-USB port shall be marked USB beside it and shall withstand 5.25 V or 0 V on any of its pins without damage.
EIS-USB-003	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A product shall draw no more than 100 mA from VBUS at its CTRL-USB port and shall not drive VBUS.
EIS-USB-004	shall	CTRL-USB	cable (CTRL-USB)	A CTRL-USB lead shall connect each pin to the same pin at both ends, be no longer than 300 mm, and twist the D+ and D- conductors as a pair.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-USB-005	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A CTRL-USB device's iProduct string shall be the product name its claim gives, and its iSerial string shall be unique to the unit and the same at every enumeration.
EIS-USB-006	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A CTRL-USB device shall use its maker's own System Exclusive manufacturer ID in MIDI-CI, never the non-commercial ID 7D.
EIS-USB-007	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A CTRL-USB device shall present a USB-MIDI 2.0 function with alternate setting 1 carrying one Universal MIDI Packet endpoint pair, and alternate setting 0 carrying USB-MIDI 1.0.
EIS-USB-008	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A CTRL-USB device shall answer MIDI-CI discovery and Property Exchange with the resources ResourceList, DeviceInfo, and AllCtrlList, and CtrlMapList when any control is a toggle or a list.
EIS-USB-009	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	Each AllCtrlList entry shall give a CtrlMapList for a toggle or a list and a stepCount for a control that moves in steps, and shall be set by a 32-bit Control Change, RPN, or NRPN message.
EIS-USB-010	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	On a Property Exchange subscription to AllCtrlList, a CTRL-USB device shall send the current value of every control whose transmit is not false as its controller message, and send it again whenever it changes.
EIS-USB-011	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A CTRL-USB device shall keep working when a host closes its MIDI endpoints and opens them again.
EIS-USB-012	shall	CTRL-USB	module, power supply, power converter, bus board, enclosure (CTRL-USB)	A device that gives an x-units object on a controller entry shall serve the ctrl-units-v1 schema as the JSONSchema resource with resId ctrl-units-v1 and follow it.
EIS-USB-013	shall	host, CTRL-USB	module, bus board (CTRL-USB host)	A case host shall give each downstream port its own current limit of at most 500 mA and a switch that power-cycles that port alone.
EIS-USB-014	shall	host, CTRL-USB	module, bus board (CTRL-USB host)	A case host shall mark each downstream port with the number it shows for that port.
EIS-USB-015	shall	host, CTRL-USB	module, bus board (CTRL-USB host)	A case host shall find and edit the controls of any CTRL-USB device with the interfaces of clause 8.1 alone, showing a control without x-units by its standard fields.
EIS-USB-016	shall	host, CTRL-USB	module, bus board (CTRL-USB host)	A case host that closes a device's endpoints shall subscribe to AllCtrlList again when it opens them.

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-USB-017	shall	host, CTRL-USB	module, bus board (CTRL-USB host)	A case host that offers a computer a link to the products behind it shall implement the host bridge protocol of 8.2.

9 ASSEMBLING A SYSTEM

ID	LEVEL	BINDS	APPLIES TO	REQUIREMENT
EIS-ASM-001	shall	installer	installer	A module shall be added to a row only while, on each rail of each power domain, the sum of the published currents stays within the published totals of every source and distribution product that feeds it, and the current through each outlet stays within that outlet's limit.
EIS-ASM-002	shall	installer	installer	At most one module shall transmit on each CV line and at most one on each gate line, where a line runs across linked bus boards up to a region split.
EIS-ASM-003	shall	installer	installer	Installation shall not connect bus power and DC entry power to the same dual-source module at the same time.
EIS-ASM-004	shall	installer	installer	Installation shall not insert a DC-BAR25 plug into a DC-BAR21 DC entry.
EIS-ASM-005	shall	installer	installer	Each DC rail shall be fed from one adapter or one case DC entry at a time.
EIS-ASM-006	shall	installer	installer	A DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall be mated only with that variant's plug.
EIS-ASM-007	shall	installer	installer	Each video reference tree in a row shall have exactly one source, a VID-REF-OUT or an external reference at one VID-REF-IN, and each VID-REF-IN shall be fed by one output.
EIS-ASM-008	shall	installer	installer	Each PWR-A6 entry shall be fed by one source at a time.
EIS-ASM-009	shall	installer	installer	Row wiring an installer adds between a power supply, bus boards, a product with PWR-DC12 outlets, or a DC entry shall meet PWR-006 and PWR-007, with each conductor landed on a terminal of the type the product publishes.

PART 2 — MECHANICAL

What makes a module fit a row and a row fit a rack: the HP and the rack unit (5.1), the front panel and the boards behind it (5.2), the rails, inserts, and mounting screws (5.3), and the enclosure (5.4). The requirements here are the Doepfer A-100 conventions restated with the few figures they left open, and the Intellijel 1U format for 1U rows. Part 2 is EIS Core: every module and every enclosure meets it.

5.1 RACK DIMENSIONS

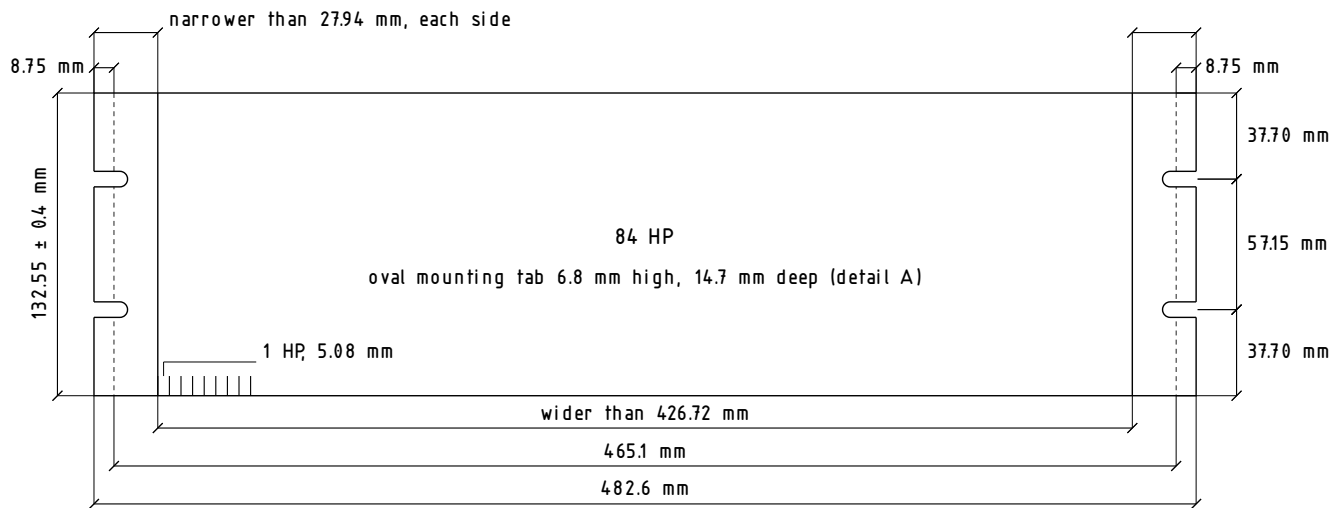
The HP and the rack unit bind modules and enclosures: one HP shall be 5.08 mm (RACK-001) and one rack unit shall be 44.45 mm (RACK-002), quoted from IEC 60297-3-101:2004. A rack-mount frame, one that fastens into a 19-inch rack, shall meet IEC 60297-3-101:2004 and IEC 60297-3-100:2008 for the flange width, the flange mounting-hole positions and tab, the 3U subrack aperture height, and the 84 HP row width (RACK-003). A desktop or portable case needs no flanges; its rows keep the same HP, rack unit, and mounting-hole span (PANEL-009).

The figures RACK-003 applies:

QUANTITY	VALUE	SOURCE
Panel width over mounting flanges	482.6 mm, ±0.4 mm	IEC 60297-3-101:2004, Figure 3; IEC 60297-3-100:2008, Figure 2
Mounting-hole centers across flanges	465.1 mm	IEC 60297-3-100:2008, clause 6.2 rack mounting grid
Mounting hole from outer edge	8.75 mm	derived
Mounting-hole vertical steps	12.7 mm and 31.75 mm	IEC 60297-3-100:2008, clause 6.2 rack mounting grid
3U flange mounting-hole span H2	57.15 mm	IEC 60297-3-100:2008, Table 1
3U flange hole from each end H3	37.70 mm	IEC 60297-3-100:2008, Table 1
Oval mounting tab	6.8 mm high, 14.7 mm deep	IEC 60297-3-100:2008, detail A
3U front panel and subrack height H1	132.55 mm, ±0.4 mm	IEC 60297-3-100:2008, Table 1
19-inch row width	84 HP	IEC 60297-3-101:2004, Figure 3 (84 × 5.08 mm)
Three rack units	133.35 mm	3 × 44.45 mm

QUANTITY	VALUE	SOURCE
Mounting flange, each side	narrower than 27.94 mm	$(482.6 - 84 \times 5.08) / 2$

EIS · IEC 60297-3-101



IEC 60297-3-100 applies H1, H2 and H3 to front panels, chassis and subracks alike (its clause 5.1). Detail A draws the tab as an oval open at the outer edge, 6.8 mm high (+0.5 / 0) and 14.7 mm deep (±1.2), and also permits a second hole type; the card draws the open oval. The 12.7 mm and 31.75 mm steps are the rack grid.

A front panel sits in the 3U aperture, between the rails. The IEC publications do not set rail depth; Annex A gives the recommended section.

The figures are in data/standards.json. The panel and flange figures (482.6 mm, H1, H2, H3, detail A, 1U, 84 × 5.08 mm) were read from the publications' own pages, IEC 60297-3-100:2008 clause 5 with Figure 2 and Table 1 and IEC 60297-3-101:2004 Figures 3 and 5, which the IEC's public preview reaches (bibliography). The rack mounting grid (465.1 mm centers, 12.7 mm and 31.75 mm steps) is in IEC 60297-3-100:2008 clause 6, beyond the preview, and was transcribed from the Schroff standards summary; where that summary and the publication differ, the publication governs. The IEC publications themselves are not stored in this repository.

5.2 MODULES

A module fills HP in a row: a front panel, the boards behind it, and the parts on them. It takes power from the row's bus board through its power entry and screws to the rails of an enclosure.

A module shall be 1U or 3U high (PANEL-001); the panel height, the mounting holes, and the board clearance follow that choice. Its width is any positive whole number of HP (PANEL-002). A module shall publish its width in HP and how far it extends behind the panel's back face (PANEL-003), so that a buyer can check it against a row's published width and depth.

A MODULE'S	CLAUSE
Panel height, width, thickness, holes, patch jacks	5.2.1 Front panels
Board clearance and depth	5.2.2 Boards
Power entries and published current	6.1 Power architecture
Power header and draw	6.4 The bus
0 V and protective earth	6.3 Grounding and 0 V
Port list, signal classes, patch safety	7 Signals

Fitting a module into a row, with the current check that comes first, is in Assembling a system.

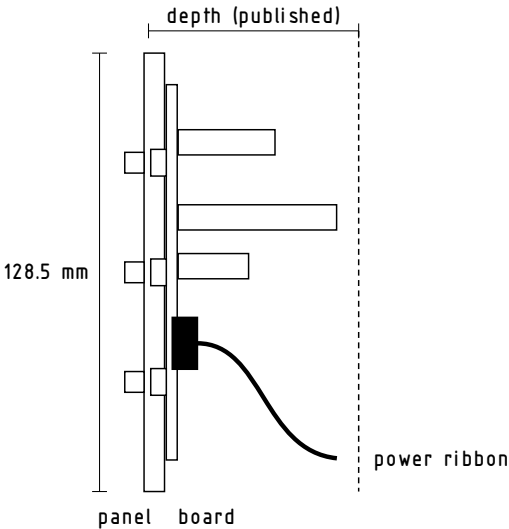
TOLERANCES

A dimension of clauses 5.2 and 5.3 shall hold within the tolerance the register states for its requirement, and a dimension with no tolerance stated is a limit (PANEL-013). The tolerances are in `data/requirements.json` and tabulated here:

ID	FIGURE	TOLERANCE
RACK-001	One HP shall be 5.08 mm.	exact: the grid value
RACK-002	One rack unit shall be 44.45 mm.	exact: the grid value
PANEL-002	An N HP panel shall be no wider than $N \times 5.08$ mm, where N is a positive whole number.	ceiling; -0.3 mm recommended
PANEL-004	A front panel shall be no more than 2.0 mm thick.	ceiling
PANEL-005	A patch jack shall be a 3.5 mm mono (TS) socket.	none: a connector type
PANEL-006	A 3U front panel shall be 128.5 mm high.	± 0.2 mm
PANEL-007	A 1U front panel shall be 39.65 mm high.	± 0.2 mm

ID	FIGURE	TOLERANCE
PANEL-008	Mounting holes shall be 3.0 mm in from the top and bottom panel edges.	± 0.1 mm
PANEL-009	The mounting-hole span, on the panel and between the inserts of a row's two rails, shall be 122.5 mm at 3U and 33.65 mm at 1U.	± 0.1 mm
PANEL-010	Mounting holes shall be drilled $\varnothing 3.2$ mm, or slotted 3.2 mm wide and no longer than 5.5 mm along the rail, centered on the hole position.	+0.1 / -0 mm on the 3.2 mm width
PANEL-011	Each mounting hole shall be a whole number of HP plus 2.54 mm from the panel's nominal left edge.	± 0.1 mm
PANEL-012	A board shall stay at least 9.25 mm clear of the top and bottom panel edges, and a rail shall cover no more than 9.25 mm of the panel face at each edge.	minimum and maximum
PANEL-013	A dimension of clauses 5.2 and 5.3 shall hold within the tolerance the register states for its requirement; a dimension with no tolerance stated is a limit.	the policy itself
RAIL-001	The holes in a rail insert shall be 5.08 mm apart.	± 0.05 mm per pitch; ± 0.1 mm over any ten holes
RAIL-002	A rail for an N HP row shall give at least $N \times 5.08$ mm of mounting length.	minimum
RAIL-004	An insert shall be at least 1.5 mm thick, three thread pitches.	minimum
RAIL-006	A mounting screw's thread pitch shall be 0.5 mm.	ISO 965-1 class 6g on the screw, 6H in the insert
RAIL-007	A mounting screw's major diameter shall be 3.0 mm.	ISO 965-1 class 6g on the screw, 6H in the insert
RAIL-008	The screw shall engage at least three full threads through a 2.0 mm panel.	minimum
RAIL-009	The mounting-screw length L shall satisfy $2.0 \text{ mm} + \text{seat} + 1.5 \text{ mm} \leq L \leq 1.6 \text{ mm} + D$, with seat and D measured behind the rail's mounting face, and the throat in front of the insert shall clear 3.0 mm.	a window: both bounds are limits
RAIL-010	The mounting-screw head shall be at most 7.0 mm across.	maximum

EIS · A module: what it is, and what it publishes



- 5.2 Size**
1U or 3U (PANEL-001); N HP, no wider than N × 5.08 mm (PANEL-002); publishes width and depth (PANEL-003)
- 5.2 Holes**
Ø3.2 mm on the HP grid (PANEL-010, PANEL-011)
- 6.1 Power**
Publishes its rail currents (PWR-001); survives a reversed ribbon (BUS-009)
- 6.3 0 V**
Every 0 V header pin tied to its 0 V (GND-001)
- 7.1 Ports**
A port list with each port's class (SIG-001); patch inputs survive ±12 V (SIG-002)

The claim names the edition and the product type, and adds a feature for each power domain and video reference port kind behind the panel: module (PWR-BUS-IN), module (PWR-BUS-IN, VID-REF-IN), module (PWR-DC12-IN).

5.2.1 FRONT PANELS

The plate on the front of a module, or a blank that fills unused width in a row. It screws to the rails through a rail insert.

A front panel shall be no more than 2.0 mm thick (PANEL-004). EIS recommends 5052 aluminum or FR-4 circuit board, from 1.6 mm to 2.0 mm thick. FR-4 is less stiff, so an FR-4 panel needs extra mounting holes at a narrower width than aluminum (Annex J). The screw length window in 5.3 assumes a panel no thinner than 1.6 mm and keeps room for one up to 2.0 mm; a front panel thinner than 1.6 mm shall ship with mounting screws whose length fits that window for its own thickness (PANEL-014), since the enclosure's screws can bottom out through it.

A patch jack shall be a 3.5 mm mono (TS) socket (PANEL-005). 7.1 recommends insulating jacks from the panel.

A blank panel plays the panel role of 4.1 and meets the same height, width, thickness, and hole requirements as a module's panel.

HEIGHT

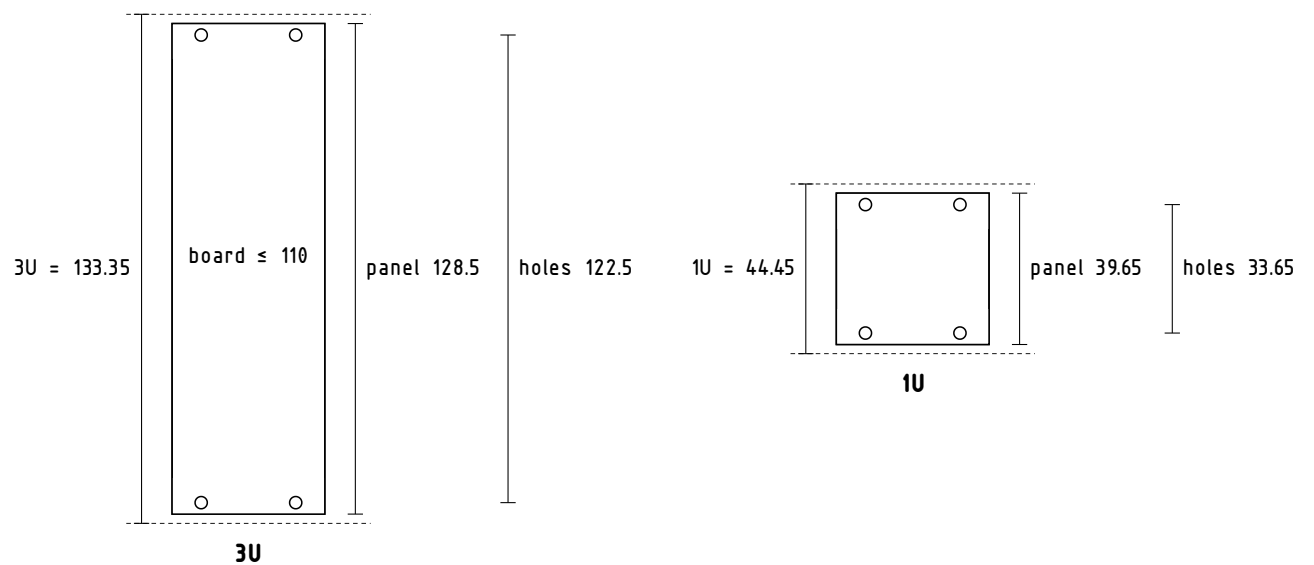
FORMAT	PANEL HEIGHT	HOLE SPAN	HOLES FROM PANEL CENTER	PROVENANCE
1U	39.65 mm	33.65 mm	±16.825 mm	inherited: Intellijel 1U
3U	128.5 mm	122.5 mm	±61.25 mm	inherited: Doepfer A-100

A 3U front panel shall be 128.5 mm high (PANEL-006). Three rack units are 133.35 mm, so a 3U panel is 4.85 mm shorter and sits in the 132.55 ± 0.4 mm aperture of 5.1. The 4.85 mm is clearance, not a rail lip; the lip EIS recommends, where a rail has one, is at most 1.5 mm (Annex A).

A 1U front panel shall be 39.65 mm high (PANEL-007), the Intellijel 1U format. That is 4.80 mm under one rack unit. EIS defines no other panel height.

Mounting holes shall be 3.0 mm in from the top and bottom panel edges (PANEL-008). The hole span is the panel height less 6.0 mm, 122.5 mm at 3U and 33.65 mm at 1U, and it shall be the same on the panel and between the inserts of a row's two rails (PANEL-009).

EIS · The 3U and 1U vertical budget, at one scale



3U panels are 128.5 mm (PANEL-006) and 1U panels 39.65 mm (PANEL-007); holes sit 3.0 mm in from each edge. A rail covers at most 9.25 mm of the panel face, and a board stays 9.25 mm clear of each edge (PANEL-012): grey is rail, blue is board.

WIDTH

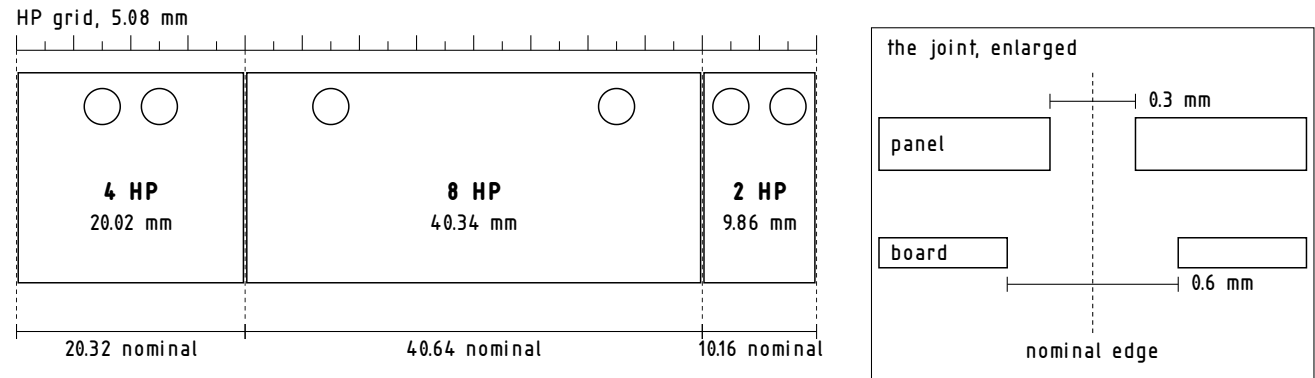
The nominal width of an N HP panel is $N \times 5.08$ mm, where N is any positive whole number. An N HP panel shall be no wider than its nominal

width (PANEL-002). EIS recommends making it 0.3 mm narrower, so that neighboring panels do not bind:

$$\text{panel width} = N \times 5.08 - 0.3 \text{ mm}$$

The board behind the panel is 0.6 mm under the nominal width (5.2.2). A rail is at least the nominal width of its row, so a row of panels at either width fits it.

EIS · Panel and board widths on the HP grid



An N HP panel is no wider than $N \times 5.08$ mm (PANEL-002). EIS recommends $N \times 5.08 - 0.3$ mm, so that neighbors do not bind; the board behind it is $N \times 5.08 - 0.6$ mm.

Panels sit on the HP grid wherever they are in the row: each is centered between its nominal edges, so the clearance splits evenly between neighbors. The joint is drawn about 25 times larger than the row.

HP	NOMINAL (mm)	PANEL (mm)	BOARD (mm)
1	5.08	4.78	4.48
2	10.16	9.86	9.56
3	15.24	14.94	14.64
4	20.32	20.02	19.72
6	30.48	30.18	29.88
8	40.64	40.34	40.04
10	50.80	50.50	50.20
12	60.96	60.66	60.36
14	71.12	70.82	70.52
16	81.28	80.98	80.68
18	91.44	91.14	90.84
20	101.60	101.30	101.00
24	121.92	121.62	121.32
28	142.24	141.94	141.64

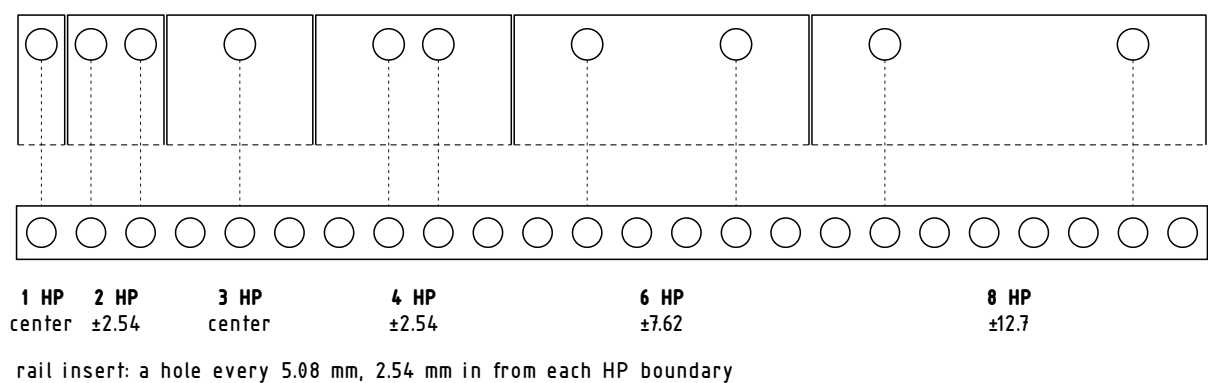
HP	NOMINAL (mm)	PANEL (mm)	BOARD (mm)
32	162.56	162.26	161.96
36	182.88	182.58	182.28
42	213.36	213.06	212.76
84	426.72	426.42	426.12
104	528.32	528.02	527.72

MOUNTING HOLES

Mounting holes shall be drilled Ø3.2 mm, or slotted 3.2 mm wide and no longer than 5.5 mm along the rail, centered on the hole position (PANEL-010); either clears the M3 mounting screw, and a short slot takes up the position error of a rail without letting the panel drop.

Along the rail, each mounting hole shall be a whole number of HP plus 2.54 mm from the panel's nominal left edge (PANEL-011). The nominal edges are $N \times 5.08$ mm apart and centered on the panel, so every hole meets a hole in the rail insert, whatever the panel's width and wherever it sits in the row. Measured from the panel center, the holes of an odd-HP panel are a whole number of HP out, and those of an even-HP panel a whole number of HP plus 2.54 mm. The outer hole is 7.62 mm in from each nominal edge, except that a 1 HP panel has one hole on its center and a 2 HP panel has its holes at ± 2.54 mm. Each rail gets the same row of holes.

EIS · Mounting holes from 1 to 8 HP, over one rail insert

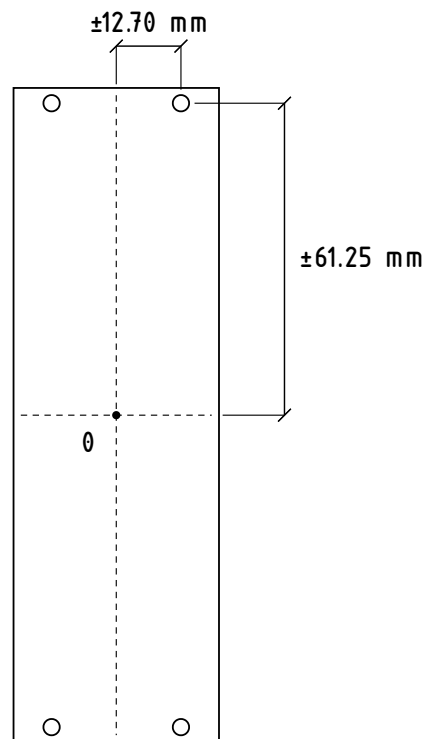


Each hole is a whole number of HP plus 2.54 mm from the panel's nominal left edge (PANEL-011), so it meets an insert hole wherever the panel sits in the row. Holes are drilled Ø3.2 mm (PANEL-010) and are 3.0 mm in from the top and bottom edges (PANEL-008).

Under each width: the hole positions from the panel's center, in millimeters. The outer hole is 7.62 mm in from each nominal edge; a 1 HP or a 3 HP panel has one hole on its center, and a 2 HP panel has its holes at ± 2.54 mm.

The cards show an 8 HP panel. Each dimension runs from the panel center to one hole; the other three holes mirror it.

EIS · 3U front panel



3U front panel

8 HP

40.34 × 128.50 mm

holes measured from the center

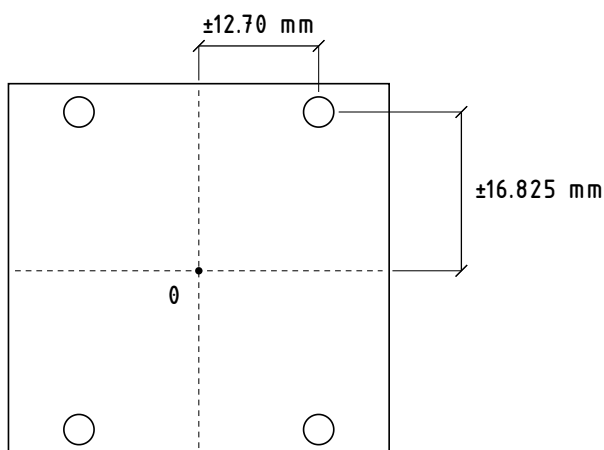
± 12.70 mm along the rail

± 61.25 mm up the panel

drill $\varnothing 3.20$ mm

the other holes mirror the center

EIS · 1U front panel



1U front panel

8 HP

40.34 × 39.65 mm

holes measured from the center

± 12.70 mm along the rail

± 16.825 mm up the panel

drill $\varnothing 3.20$ mm

the other holes mirror the center

Four holes are the usual pattern. How wide a panel can be on four screws before it flexes under a plug, and where to add holes on a wider one, is in Annex J.

The numbers are in `data/module.json`. `tools/module.py` derives the hole spans and widths, computes the hole patterns of Annex J, and draws these cards.

5.2.2 BOARDS

The circuit boards behind a front panel. A module has a parallel board, a right-angle board, or both.

EDGE CLEARANCE

The one board requirement that affects fit is edge clearance. A board shall stay at least 9.25 mm clear of the top and bottom panel edges, and a rail shall cover no more than 9.25 mm of the panel face at each edge (PANEL-012). The opening between the rails' inner faces is then at least 110 mm at 3U, and a 110 mm board is the tallest that fits; at 1U the opening is at least 21.15 mm, and the usual board, two rack units shorter than the 3U board, is 21.10 mm.

FORMAT	USUAL BOARD HEIGHT	CLEAR OF EACH PANEL EDGE
1U	21.10 mm	9.275 mm
3U	110.00 mm	9.25 mm

On a rail whose inner face is 5.075 mm from the hole center, such as Schroff 34560-184, the 3U opening is 112.35 mm and a 110 mm board has 1.175 mm to spare on each side. Annex A gives inner-face measurements of catalog rails.

The rest of this clause describes common construction and places no requirement. The numbers are in `data/module.json`.

PARALLEL BOARDS

A parallel board faces the panel. Its front face is usually 10 mm behind the panel's back face, the height of a jack body. Its width is 0.6 mm under the nominal width of the panel, twice the panel clearance:

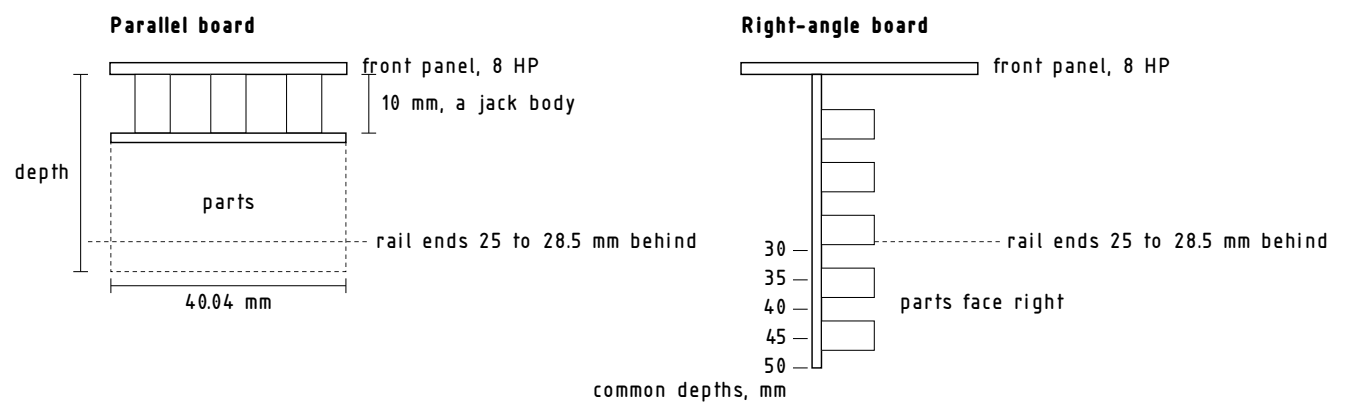
$$\text{board width} = N \times 5.08 - 0.6 \text{ mm}$$

An 8 HP parallel board is 40.04 mm wide and 110 mm tall at 3U, or 21.10 mm tall at 1U. 1.6 mm FR-4 is the usual material.

RIGHT-ANGLE BOARDS

A right-angle board stands square to the back of the panel, with no gap. Its edge toward the panel is the left edge of the board, and the board faces right. Its height is the board height above; its depth back from the panel is a design choice, commonly 30, 35, 40, 45, or 50 mm. A 30 mm right-angle board already extends past a rail of the recommended section (5.4).

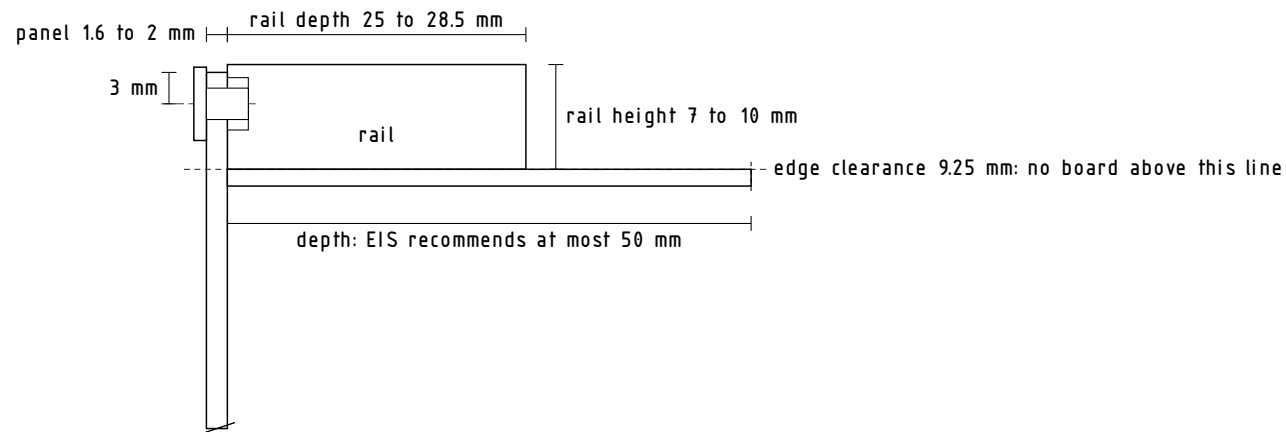
EIS · Parallel and right-angle boards, seen from above



A parallel board stands about 10 mm behind the panel, the height of a jack body, and is $N \times 5.08 - 0.6$ mm wide. A right-angle board stands on the panel's back with its left edge to the panel. Either way the module publishes how far it reaches behind the panel (PANEL-003); EIS recommends at most 50 mm.

MODULE DEPTH

EIS · Module cut at the top rail, seen along the rail



The rail is drawn at the most cover EIS allows: its inner face on the edge-clearance line, 9.25 mm below the panel's top edge. The mounting hole is 3 mm from the edge, drilled 3.2 mm; an M3 pan-head screw, head at most 7 mm, engages at least 3 threads in an insert that sits in a groove at least 5 × 2 mm.

The board is 1.6 mm thick and stands on the panel's back below the clearance line, so the rail clears it. Depth is measured from the panel's back face to the module's deepest point.

EIS recommends that a module extend no more than 50 mm behind the panel's back face, measured to its deepest point. A deeper module still conforms; its published depth (PANEL-003) is checked against the row's (ENC-001). In the survey of Annex F, 94.8 % of 287 modules are within 50 mm and the median is 35 mm.

5.3 RAILS, INSERTS, AND MOUNTING SCREWS

A front panel screws to a pair of rails through a threaded rail insert in each. Five things make a module fit any conforming row:

WHAT	VALUE	REQUIREMENT
Hole span	122.5 mm at 3U, 33.65 mm at 1U, between the inserts of a row's two rails	PANEL-009
Cover	At most 9.25 mm of the panel face at each edge	PANEL-012
Hole pitch	5.08 mm along the insert	RAIL-001
Thread	M3, in the insert and on the screw	RAIL-003, RAIL-005

WHAT	VALUE	REQUIREMENT
Screw length	Inside the length window below	RAIL-009

RAILS AND INSERTS

The holes in a rail insert shall be 5.08 mm apart (RAIL-001), so that every panel hole meets one. A rail for an N HP row shall give at least $N \times 5.08$ mm of mounting length (RAIL-002).

An insert shall be threaded M3 (RAIL-003) and shall be at least 1.5 mm thick, three thread pitches (RAIL-004).

MOUNTING SCREWS

A mounting screw shall be M3 (RAIL-005): its thread pitch shall be 0.5 mm (RAIL-006) and its major diameter 3.0 mm (RAIL-007), as ISO 261:1998 gives them. M3 is the thread of the Doepfer A-100 frame, of nearly every Eurorack case on sale, and of the screws modules ship with. IEC subrack hardware is often M2.5, and the Vector T-strut takes #4-40 groove nuts; a case built on such rails is not an EIS row, though a module's Ø3.2 mm hole (PANEL-010) still clears those screws.

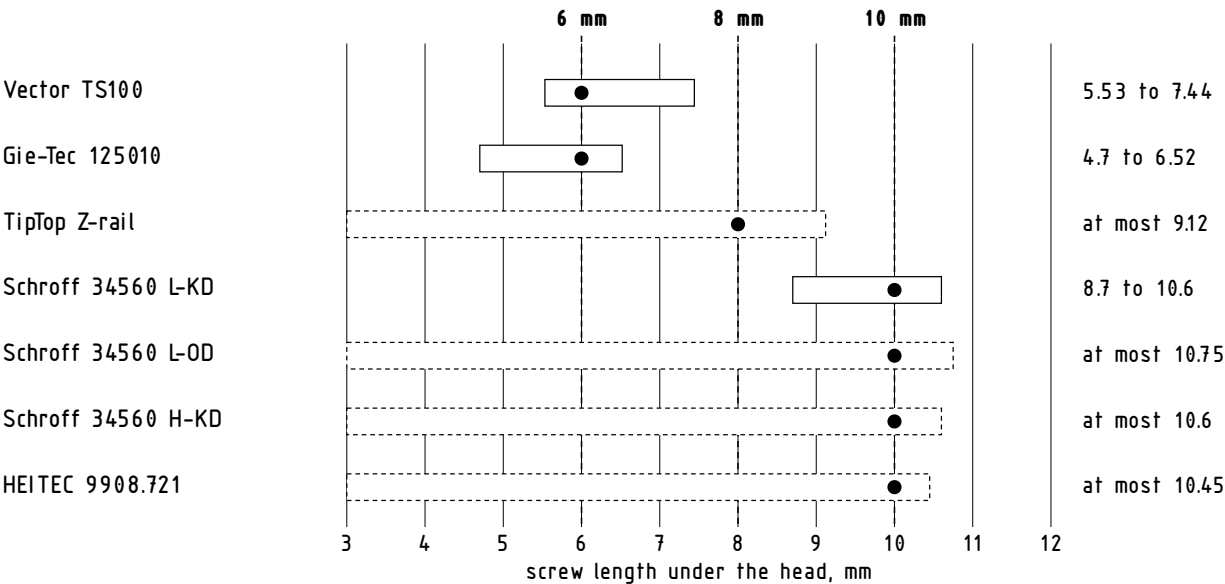
The screw shall engage at least three full threads through a 2.0 mm panel (RAIL-008). Its length L shall fall inside this window, which keeps the tip off the cavity floor through a 1.6 mm panel, the thinnest EIS recommends, and the throat in front of the insert shall clear the 3.0 mm major diameter (RAIL-009):

$$2.0 \text{ mm} + \text{seat} + 1.5 \text{ mm} \leq L \leq 1.6 \text{ mm} + D$$

Seat is the depth of the insert's front face behind the rail's mounting face, and D is the depth of the screw cavity behind it (Terms). The screw head shall be at most 7.0 mm across (RAIL-010): the narrowest catalog rail face reaches 3.7 mm past the hole center (Annex A), so a head of that size bears on the panel and on the rail face of every catalog rail, and an ISO 7045 pan head or a 7 mm washer fits.

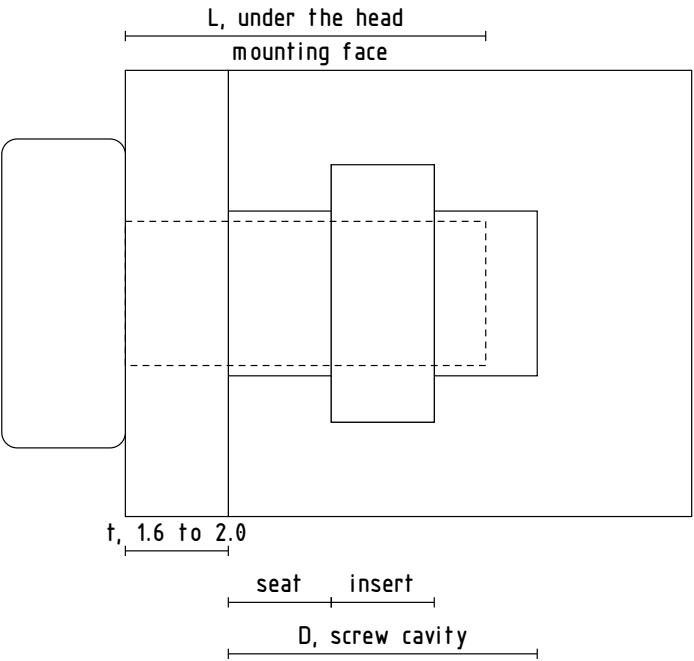
The enclosure shall state the mounting-screw length, and shall supply those screws or name them (RAIL-011). A module need not ship with screws.

EIS · The M3 screw length window of each catalog rail



Shortest: 2.0 mm panel + seat + three 0.5 mm threads; longest: 1.6 mm panel + D (RAIL-009). A dashed bar is a rail whose insert seat is not published, so only the longest length is known. The dot is the screw of Annex A.3: the shortest stock length inside the window, or the longest that does not bottom out.

EIS · Mounting screws



Thread	Lengths under the head
M3	6 mm, 8 mm, 10 mm
M2.5	6 mm, 8 mm, 10 mm
#4-40 UNC	1/4 in, 5/16 in, 3/8 in

Pan head, at most 7.0 mm across
 $t_{\text{max}} + \text{seat} + 3 \times \text{pitch} \leq L \leq t_{\text{min}} + D$
The throat clears the major diameter

RECOMMENDED PRACTICE

Everything else about a rail, an insert, and a screw is construction: the extrusion section and its lip, the groove, the insert width and ends, the screw lengths, the tap drill, the head form, and the finish. Annex A gives the section EIS recommends for a new rail, the 5.0 mm × 2.0 mm insert, the 6, 8, and 10 mm screw lengths, and the screw that fits each catalog rail. The numbers are in `data/rail.json`, `data/insert.json`, and `data/screw.json`; `tools/rail.py`, `tools/insert.py`, `tools/insert_card.py`, and `tools/screw.py` check them and draw the cards.

5.4 ENCLOSURES

The case a module screws into. An enclosure is made of rows; each row has a pair of rails with an insert in each, and a bus board behind the panels.

ROWS

A row is 1U or 3U, matching the front panels it holds; a 6U case is two 3U rows. A row's usable width is a whole number of HP. 84 HP fits a 19-inch rack; wider rows, such as 104 HP, are a case choice.

An enclosure shall publish, for each row, its width in HP and the depth it keeps clear behind the panel's back face (ENC-001).

FRAME

The frame is a 19-inch rack frame, which meets RACK-003 (5.1), or a desktop or portable frame with the same rows and hole span (5.3).

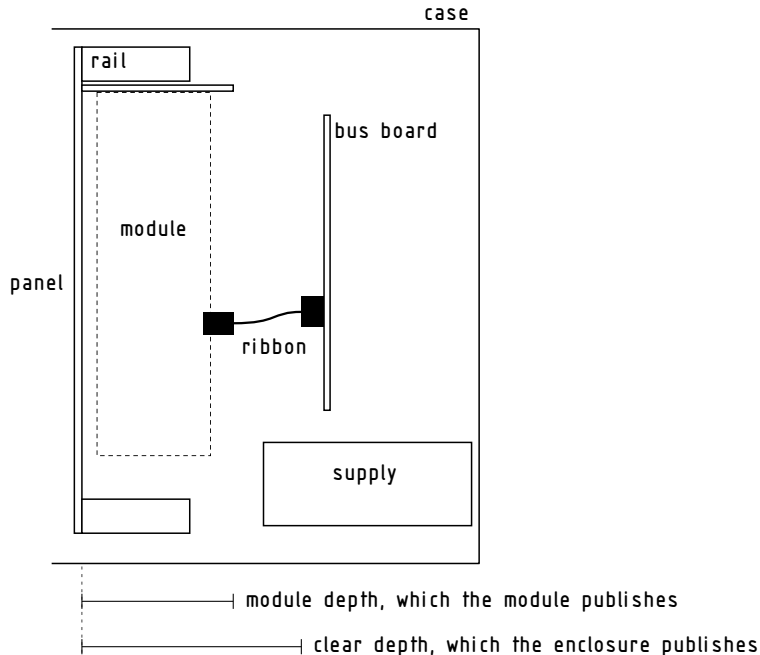
The front rails take the mounting screws of 5.3. Other rails carry the bus board or stiffen the frame. Side plates, top, bottom, and rear covers, and on a rack frame the mounting flanges, close the box. Mains inlet, fusing, and the construction of a supply are outside EIS.

DEPTH

A rail of the recommended section (Annex A) is 25 mm to 28.5 mm deep, front face to back face. EIS recommends that a row keep at least 50 mm

clear behind the panel's back face, the module depth 5.2.2 recommends. In the case catalog behind Annex F, 20 of 25 current cases give 50 mm somewhere in the row and 17 give it over the whole row; the shallow part is usually over the supply or the bus board.

EIS · A 3U row cut from front to back



Both depths are measured from the panel's back face.

The enclosure publishes each row's width in HP and the depth it keeps clear behind the panels (ENC-001).

The module publishes its width and how far it reaches behind the panel (PANEL-003).

A module fits a row when its depth is no more than the row's clear depth. The clear depth is the least depth over the whole row, often set by the supply or the bus board.

EIS recommends a row with at least 50 mm clear, and modules no deeper than 50 mm.

BUILT-IN SUPPLY

An enclosure with a built-in supply is also a power supply, and one with a built-in bus board is also a bus board: what is built in claims its own role (4.1), and the enclosure's documentation carries what each publishes. The built-in supply publishes its rail ratings and its ripple and noise (PWR-002, SUP-001), meets SUP-002 to SUP-007 (6.2), and publishes how its 0 V meets protective earth (GND-003, 6.3). The built-in bus board publishes its totals and its per-header limit (PWR-002, BUS-012).

EIS recommends that an enclosure publish, for each row, the dissipation it carries for a 10 °C rise above room temperature; Annex O gives the method.

The informative row budget is a planning table for one row: header count, bus and supply currents, and video reference distribution.

PART 3 — POWER

EIS power comes in *power domains*, each with its own connectors, distribution, and limits (6.1). *PWR-BUS* is the bus every Eurorack row has: ± 12 V and optional +5 V from a supply through bus boards and ribbons to each module's power header (6.4 to 6.6); it is EIS Core. Three more domains are features a product adds.

PWR-DC12 (6.7) carries nominal 12 V DC from an external adapter into a product at a DC entry. It exists for two cases the bus does not serve: a product whose draw exceeds what one power header carries, and a product meant to run on a desk, or in a case with no bus, from a wall adapter. A DC rail is filtered or regulated in each product, so the rail's own noise does not reach a signal.

PWR-A6 (6.8) carries ± 6 V to the analog circuits of a module. Video and other wideband analog circuits run from ± 5 V regulated locally; a ± 6 V rail gives a low-dropout regulator per circuit block the headroom it needs, while a ± 12 V rail would turn the difference into heat on every module. A supply or a power converter makes it, and the module finishes the regulation.

PWR-A15 (6.9) carries ± 15 V to analog circuits that run at the full rail: the op-amp stages of an analog computing module, a display amplifier, or a video output stage with ± 10 V of swing. Its connector and pin map are the LZS Deflect series' Mini-Fit Jr entry.

What is common to every domain is in 6.1 to 6.3: the currents a product publishes, the protection and ripple of a source, and the one 0 V that a row's signals are measured from.

6.1 POWER ARCHITECTURE

EIS power comes in *power domains*. A domain is a set of rails with its own connectors, its own way of reaching a module, and its own limits. EIS has four: *PWR-BUS*, the +12 V and -12 V (and optional +5 V) that a power supply feeds through bus boards and power ribbons to each module's power header; *PWR-DC12*, nominal 12 V DC from an external adapter that enters a product at a DC entry; *PWR-A6*, ± 6 V for analog circuits from a supply or a power converter to a module's A6-VH3 entry; and *PWR-A15*, ± 15 V for analog circuits that run at the full rail, at an A15-MF4 entry. Each domain is two features, one per direction: a product claims the IN

feature for an entry of the domain and the OUT feature for its outlets (4.1).

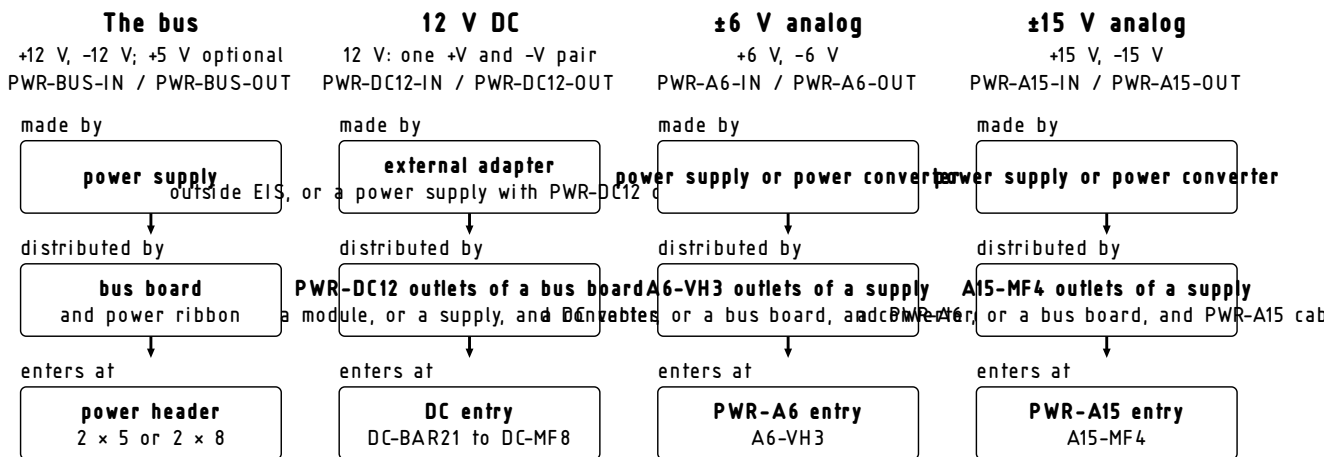
The designators follow one rule. The word after PWR names the domain's topology and the number its rail voltage: *BUS* is the Eurorack bus, defined by its header pinout rather than by one voltage, so it carries no number; *DCnn* is a single-rail nn V DC domain fed from an adapter, the DC jack of the trade; *Ann* is a bipolar $\pm nn$ V analog domain. A later single-rail domain would be PWR-DCnn and a later bipolar one PWR-Ann; the bus stays the bus.

This clause and the next two hold what is common to every domain: the published currents, sources (6.2), and 0 V (6.3). Each domain then has its own clauses: the bus in 6.4 to 6.6, PWR-DC12 in 6.7, PWR-A6 in 6.8, PWR-A15 in 6.9. Mains voltage, safety certification, and the internal construction of a supply are outside EIS.

DOMAINS

DOMAIN	RAILS	FEATURE	MADE BY	DISTRIBUTED BY	ENTERS A PRODUCT AT	CLAUSES
The bus	+12 V, -12 V; +5 V optional	PWR-BUS-IN, PWR-BUS-OUT	power supply	bus board and power ribbon	power header, 2 × 5 or 2 × 8	6.4, 6.5, 6.6
12 V DC	12 V: one +V and -V pair	PWR-DC12-IN, PWR-DC12-OUT	external adapter, outside EIS, or a power supply with PWR-DC12 outlets (6.2)	PWR-DC12 outlets of a bus board, a module, or a supply, and DC cables	DC entry, DC-BAR21 to DC-MF8	6.7
±6 V analog	+6 V, -6 V	PWR-A6-IN, PWR-A6-OUT	power supply or power converter	A6-VH3 outlets of a supply, a converter, or a bus board, and PWR-A6 cables	PWR-A6 entry, A6-VH3	6.8
±15 V analog	+15 V, -15 V	PWR-A15-IN, PWR-A15-OUT	power supply or power converter	A15-MF4 outlets of a supply, a converter, or a bus board, and PWR-A15 cables	PWR-A15 entry, A15-MF4	6.9

EIS · Power domains: where each is made, how it is distributed, where it enters



In every domain a product publishes the current at each power entry (PWR-001) and at each outlet (PWR-002); it needs only one of its alternative entries connected (PWR-003) and never drives current back into one (PWR-004). Every entry's 0 V, and the -V of a DC entry, is the product's one 0 V (GND-001).

SOURCES, DISTRIBUTION, AND ENTRIES

In each domain, a *source*, a power supply for a row or a power converter for one product, makes the power; *distribution* passes it on without converting it, and a product takes it at a *power entry*. A source or a distribution product delivers at *outlets*: a supply's output terminals, a bus board's headers, the PWR-DC12 outlets of a bus board, a module, or a supply, DC-BAR21 jacks or DC-VH2 headers. A module's power header, its DC entry, and its PWR-A6 entry are all power entries.

One product can sit in two domains. A power supply that takes PWR-DC12 at a DC entry and delivers the bus is a PWR-DC12 entry and a bus source; a dual-source module has a power header and a DC entry; a power converter is an entry of the domain it takes and a source of the one it makes.

RULES FOR EVERY DOMAIN

A product shall publish, for each power entry, the maximum current it takes on each rail at the entry's nominal voltage, stating 0 for a rail it does not draw (PWR-001). A power supply, a power converter, a bus board, and any product with outlets of a power domain shall publish the maximum current it delivers on each rail, in total and at each outlet (PWR-002).

These published figures are what the person assembling a system budgets a row with.

A product whose power entries are alternatives, each able to power it alone, shall not require more than one of them to be connected at the same time (PWR-003); the installer connects one (ASM-003). Entries that feed different circuits, such as PWR-A6 for a module's analog rails and the bus for its logic, are not alternatives, and the claim file says which the product needs. A module shall not source current into a rail of any of its power entries (PWR-004): a module with its own +5 V regulator leaves pins 11 and 12 of its power header undriven, and a module with a DC entry does not feed its DC rail onto the bus.

Every power entry's 0 V, and the -V of a DC entry, is the product's one 0 V (6.3). An isolated converter joins its output 0 V to its input's 0 V.

EIS recommends limiting inrush current when a product's rails come up: a row of modules is a large capacitive load on its source.

ROW WIRING

Between a power supply and its bus boards, between linked bus boards, between a case DC entry and the supply, bus board, or PWR-DC12 outlets it feeds, and from a supply's 0 V to the chassis or earth, a row is wired with discrete conductors rather than a connector of a domain. Where a power supply, a bus board, or a product with PWR-DC12 outlets takes or gives a rail or 0 V on such wires, each terminal shall be a 6.3 mm × 0.8 mm quick-connect tab, a stud or screw that takes a ring terminal, or a wire-clamp terminal block, and the product shall publish the terminal type and the conductor sizes it accepts (PWR-005). Each terminal is marked with its rail (SUP-003).

A row wiring conductor between a power supply, a bus board, a product with PWR-DC12 outlets, or a DC entry shall be stranded copper, insulated and rated 105 °C or more, of at least 16 AWG, at least 14 AWG where it carries more than 5 A, and at least 12 AWG where it carries more than 8 A, terminated by a crimped terminal at each end (PWR-006); a joint shall not rely on solder alone (PWR-006). The 0 V conductor between a power supply and a bus board, and between linked bus boards, shall be of at least the gauge of the rail conductors beside it (PWR-007). Where a product bonds its 0 V to its chassis or to a protective-earth terminal, the bond shall be a conductor of at least 14 AWG with a ring terminal on a stud or screw through bare metal under a toothed lock washer, or a bus bar of equivalent section (PWR-008). An installer who joins a supply and bus boards from different makers wires them the same way (ASM-009, 9.1).

TERMINAL (PWR-005)	SIZE	MATES WITH	RATED	EIS RECOMMENDS IT FOR
quick-connect tab	6.3 mm × 0.8 mm (1/4 in, the 250 series)	fully insulated receptacle, crimped	15 A	bus board inputs and links; supply outputs on a board
stud or screw for a ring terminal	M3 or M4 (ring terminal sized to the stud)	insulated ring terminal, crimped, under a toothed lock washer	20 A	0 V and earth bonds; bus bars; metal-case supplies
wire-clamp terminal block	screw or spring clamp for 12 to 16 AWG	bare stranded end with a crimped ferrule	15 A	the output block of a metal-case supply

CURRENT IN THE CONDUCTOR	CONDUCTOR (PWR-006)
up to 5 A	at least 16 AWG (1.3 mm ²) most rows: a 16 AWG rail conductor drops about 25 mV per metre at 3 A
up to 8 A	at least 14 AWG (2.1 mm ²) a large row, or several bus boards on one pair
up to 15 A	at least 12 AWG (3.3 mm ²) the limit of a 6.3 mm tab; above it, use a second pair

EIS recommends the quick-connect tab for bus board inputs and links and for supply outputs on a board, with a fully insulated receptacle crimped onto the wire and a double (piggyback) receptacle where one tab feeds two boards; the ring terminal, under a toothed lock washer, for every 0 V and earth bond and for a bus bar; and, on a metal-case supply's wire-clamp block, a crimped ferrule on each stranded end. EIS recommends 105 °C PVC wire (UL 1015 at 600 V or UL 1007 at 300 V), or silicone where the wire flexes, with tin-plated brass or phosphor-bronze terminals crimped with the terminal maker's tool, so that each joint stays under 5 mΩ; the rail conductors and their 0 V run together, bundled or twisted, to keep the loop small; the colors of 6.4: red +12 V, blue -12 V, black 0 V, and green-and-yellow only for an earth bond. A wire nut, an insulation-displacement splice, a soldered strand under a screw, and a bare wire wrapped around a tab are not row wiring.

6.2 POWER SUPPLIES AND POWER CONVERTERS

A power supply is the source of a power domain for a row, and a *power converter* the source of one for a single product, such as ±6 V made on the back of a module from the bus (6.1). A bus supply feeds the row's bus

board with the rails of 6.4: +12 V and -12 V, and +5 V if it provides one. It may be built into an enclosure or sold on its own. The rules below bind every outlet of a supply or a converter, whatever its domain; the limits that differ by domain are in the table at the end of the clause. The 12 V of PWR-DC12 comes from an external adapter, which is outside EIS; a supply that takes it at a DC entry is also a PWR-DC12 product (6.7).

SUPPLIES IN THE OTHER DOMAINS

A power supply may make the 12 V DC rail of 6.7 or the ± 6 V rails of 6.8, beside or instead of the bus; it then claims PWR-DC12-OUT or PWR-A6-OUT, publishes the current of each outlet, and meets that domain's outlet rules (SUP-009): PWR-DC12 outlets are DC-BAR21 jacks or DC-VH2 headers, each protected separately (DC-009, DC-012), and PWR-A6 outlets are A6-VH3 within the window of 6.8 (A6-001, A6-002). A claim names each domain the supply gives, power supply (PWR-DC12-OUT) or power supply (PWR-A6-OUT), and each it takes, PWR-DC12-IN for a supply fed from a brick; the direction is in the name, and the claim file carries the figures.

WHAT A SUPPLY PUBLISHES

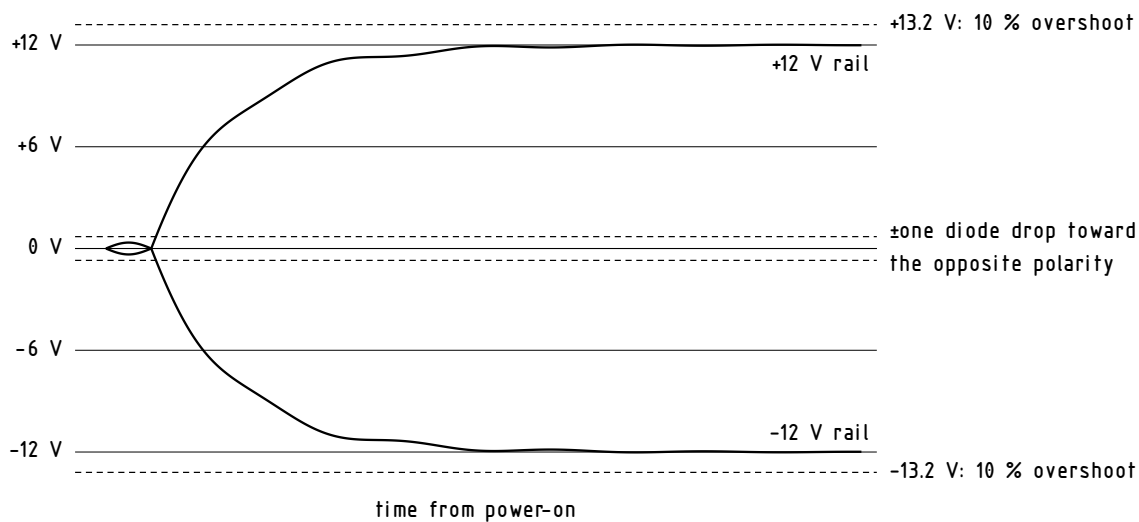
A power supply publishes the current it delivers on each rail, in total and at each outlet (PWR-002). It shall publish its ripple and noise on each rail it provides, peak-to-peak, measured as stated below (SUP-001).

OUTPUT CONNECTOR AND PROTECTION

An output on a plug-and-socket connector, such as a keyed header, a wire-to-board housing, or a DC plug, shall not mate with reversed polarity (SUP-002). An output on individual 1/4 in quick-connect tabs or screw terminals cannot be keyed and is exempt; each such terminal shall be marked with its rail (SUP-003).

Each rail shall survive an indefinite short to 0 V without damage (SUP-004). During power-up, power-down, or a fault, no rail shall swing more than one diode drop toward the opposite polarity (SUP-005). At start-up, no rail shall overshoot its nominal voltage by more than 10 % (SUP-006).

EIS · A supply's rails at power-up



At start-up no rail overshoots its nominal voltage by more than 10 % (SUP-006). During power-up, power-down, or a fault, no rail swings more than one diode drop toward the opposite polarity (SUP-005). Each rail survives an indefinite short to 0 V (SUP-004). The traces are illustrative.

EIS recommends constant-current or hiccup current limiting rather than foldback: a row is a large capacitive load, and a foldback limiter can fail to start into it. EIS recommends bringing the rails up in an order that avoids reverse stress on modules; SUP-005 bounds the reverse swing whatever the order.

OUTPUT QUALITY

EIS requires no particular topology. EIS recommends a setpoint within ± 1 % and load regulation within ± 1 % from 10 % to 100 % load.

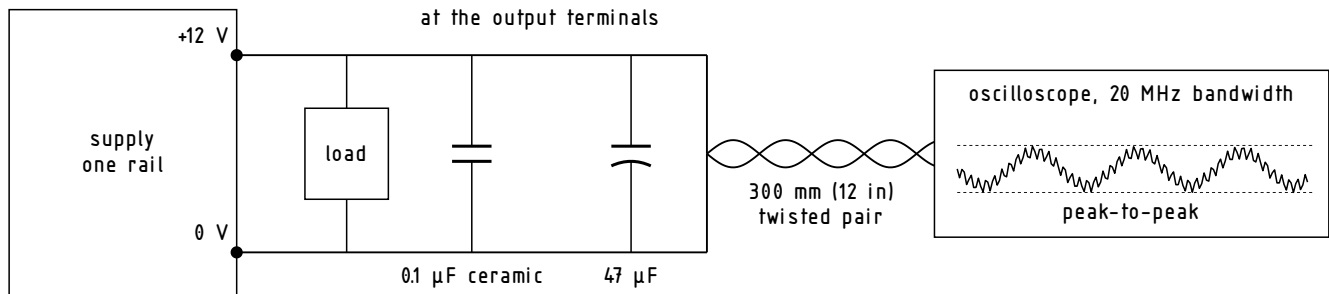
Each rail shall have ripple and noise below the limit of its domain (SUP-007):

DOMAIN	RIPPLE AND NOISE, PEAK-TO-PEAK	
The bus	below 150 mV	Most open-frame switching supplies meet it.
12 V DC	—	Not set: the adapter that makes it is outside EIS.
± 6 V analog	below 20 mV	For the analog rails a module regulates locally; a linear source is typically under 5 mV.
± 15 V analog	below 20 mV	For the ± 15 V analog rails of op-amp circuits that run at the full rail; a linear source is typically under 5 mV.

A linear or post-regulated supply is typically under 10 mV, which suits a row of MOD-VIDEO modules.

Ripple and noise are measured peak-to-peak on each rail at the supply's output terminals, or at test points the product publishes, with each rail loaded at the maker's stated test current, at 20 MHz oscilloscope bandwidth, with a 0.1 μF ceramic capacitor in parallel with a 47 μF electrolytic across the measurement point and a 300 mm (12 in) twisted pair from there to the probe. This is the method common supply datasheets use, so one maker's figure is comparable with another's.

EIS · Measuring ripple and noise



Each rail is loaded at the maker's stated test current and measured at the supply's output terminals, or at test points the product publishes, with 0.1 μF in parallel with 47 μF across the measurement point and a 300 mm (12 in) twisted pair to a 20 MHz oscilloscope.

The supply publishes the peak-to-peak figure for each rail (SUP-001); every rail stays below 150 mV (SUP-007). A linear or post-regulated supply, typically under 10 mV, suits a row of MOD-VIDEO modules.

POWER CONVERTERS

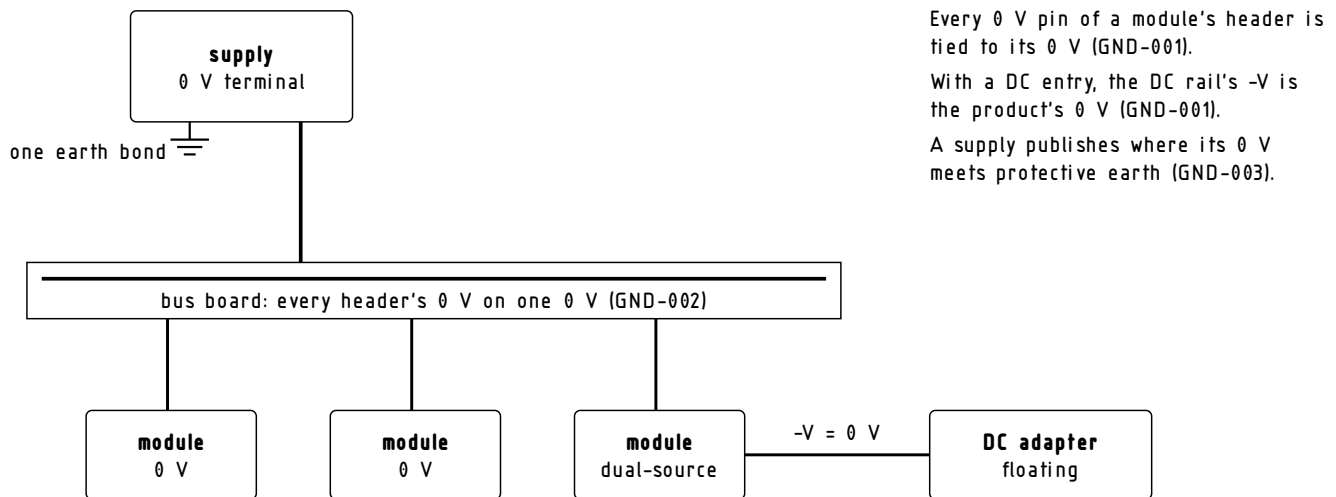
A power converter shall publish the heat it dissipates at its rated output and how far it extends behind the product it is mounted on (SUP-008). It publishes the current it takes at its input as every power entry does (PWR-001): for a linear converter on the bus, the output current plus its own. A module sold with an adapter publishes the currents and the depth of the pair. The PWR-A6 converters are in 6.8.

EIS recommends that a power converter's board fit the outline of a 1U module board (5.2.2): a parallel board no taller than 21.10 mm, with the 1U mounting-hole span of 33.65 mm (PANEL-009) behind a 1U panel, so that the same converter can be mounted as a 1U module in a row that has one, or behind the product it feeds.

6.3 GROUNDING AND 0 V

Where the 0 V reference of a row runs, across its power domains, and how it meets protective earth and the next case. Every patch cable and every coaxial cable joins the 0 V of the two products it connects, so the products in a system share one 0 V whether or not anyone planned it; this clause makes that shared reference predictable.

EIS · Grounding: one 0 V for the bus, the DC rail, and the jacks; one bond to earth



Patch sleeves and coax shells join the 0 V of the products they connect. A second earth bond makes a loop: hum on audio, slow bars on a picture.

IN A ROW

A product shall connect every 0 V pin of its power headers and PWR-A6 entries, and the -V of its DC entry, to its 0 V (GND-001). The header's 0 V pins share the return current of all three bus rails, and a module that uses only some of them puts that current through fewer contacts. A module that runs from either of two power entries has one reference for its signals whichever is connected, and a supply that takes PWR-DC12 and delivers the bus keeps both domains on one 0 V. A bus board shall join the 0 V pins of every header to one 0 V that runs to the supply's 0 V terminal (GND-002).

EIS recommends keeping any panel-mounted part whose body touches the panel free of a connection to the module's 0 V; an insulated jack (7.1) meets that.

PROTECTIVE EARTH

A power supply shall publish whether its 0 V output is connected to protective earth, and where (GND-003). A built-in supply publishes the same in the enclosure's documentation. Mains safety, including the bonding of a metal case to protective earth, follows the safety standard the supply or case is certified to, not EIS.

EIS recommends one bond between the bus 0 V and protective earth in a system, at the supply, so that the 0 V of a row cannot carry mains-frequency current between two earth points. A DC adapter whose output floats, the usual Class II desktop adapter, adds no second bond.

EIS recommends that chassis ground carry only metalwork and screens and bond to 0 V at one point: at the supply or at the bus board, not independently at both. The bond itself is a ring terminal on bare metal under a toothed lock washer, 14 AWG or a bus bar (PWR-008, 6.1).

The front panels and rails of a case are bonded to each other by the mounting screws. With insulated jacks (7.1), the panel carries no signal return, and bonding the case metal to the supply's earth terminal, where it has one, is a shielding choice rather than a signal path.

BETWEEN CASES

A patch cable or a VID-75 cable between two cases joins their 0 V through its sleeve or shell (V75-002). EIS recommends that the cases of one system take their 0 V from supplies that are all bonded to protective earth at the same outlet strip, or all floating, and that a system spread over several cases join their 0 V with one short, heavy conductor rather than through signal cables alone. A loop through two earth bonds shows as hum on audio and as slow-moving horizontal bars on a picture.

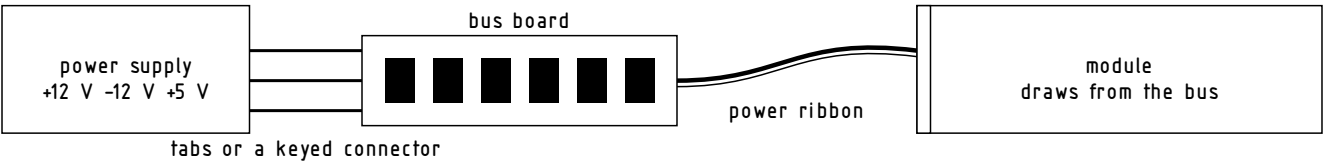
Annex 0 covers the heat a row's current becomes; the currents published under 6.1 are the same figures.

6.4 THE BUS

The bus is the power domain every Eurorack row has: +12 V and -12 V, and optionally +5 V, made by a power supply, carried by bus boards and power ribbons, and taken by each module at its power header. This clause defines the rails, the power header, its pinout, marking, and keying once, and what

a module owes at its header; 6.5 adds the bus board and the ribbon, and 6.6 the CV and gate lines.

EIS · From the supply to the module: what each part owes



Power supply

Publishes each rail's rating (PWR-002) and its ripple and noise (SUP-001), below 150 mV (SUP-007).
Survives a short (SUP-004); no reverse swing (SUP-005); overshoot $\leq 10\%$ (SUP-006).
Keyed connector (SUP-002), or terminals marked with their rail (SUP-003).

Bus board

+12 V and -12 V, and optionally +5 V, at every header (BUS-001).
Publishes its rail totals and the limit per header (PWR-002), at most 2 A per rail (BUS-012).
A link joins CV to CV and gate to gate (BUS-014).

Ribbon

At most 400 mm, at least 28 AWG (BUS-015).
Marked conductor on -12 V (BUS-004); keyed (BUS-005).

Module

Draws only ± 12 V, and +5 V if it needs it (BUS-006).
Publishes its maximum current on each rail (PWR-001).
At most 2 A per rail through one header (BUS-008); never feeds a rail (PWR-004).
Survives a reversed ribbon (BUS-009).

The installer adds a module only while each rail's sum fits the bus board and the supply (ASM-001).

RAILS

The bus shall provide +12 V and -12 V, and may provide +5 V, at every power header (BUS-001).

HEADER AND PINOUT

A power header on a module or a bus board shall be a 2 × 5 or 2 × 8 pin header on a 2.54 mm grid, and a power cable shall end in IDC ribbon sockets that mate it (BUS-002). It shall follow this pinout (BUS-003):

PINS	10-PIN HEADER	16-PIN HEADER
1, 2	-12 V	-12 V
3 to 8	0 V	0 V
9, 10	+12 V	+12 V
11, 12	—	+5 V
13, 14	—	CV
15, 16	—	Gate

Some community tables give a different order, with +12 V on pins 7 and 8 and +5 V on pins 15 and 16. A cable or bus board made to such a table puts +12 V on a module's 0 V pins.

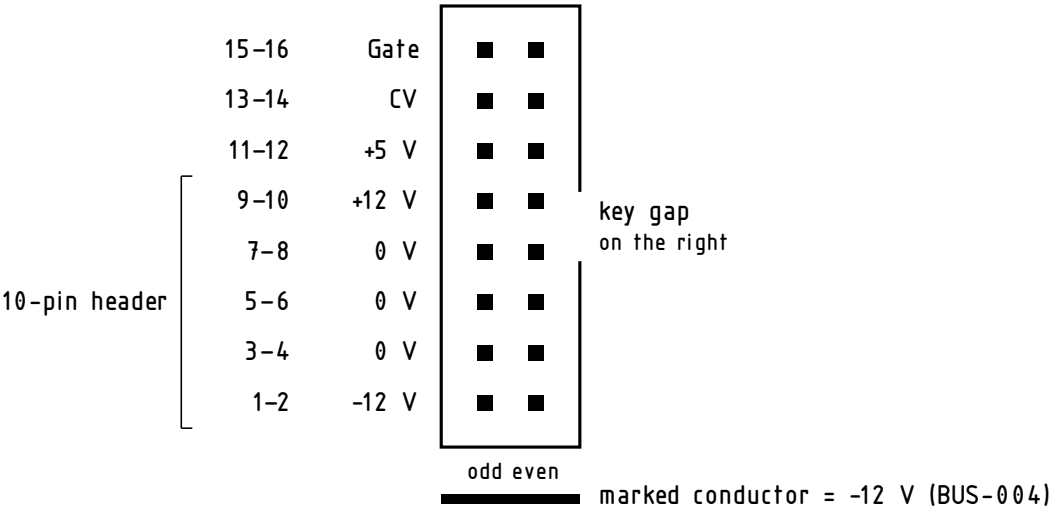
On a 16-pin header, pins 13 and 14 carry one CV line and pins 15 and 16 one gate line. Using them is optional; their levels and the rules for a module on them are in 6.6.

MARKING AND KEYING

On a module, a bus board, and a power ribbon cable, the marked conductor shall be -12 V and shall point to the -12 V end of the header (BUS-004). A module and a bus board shall mark the -12 V end of each power header on the board (BUS-019), so that an unshrouded header can be oriented by eye at both ends.

A shrouded power header on a module or a bus board shall be keyed so that, viewed from the mating side with the -12 V end at the bottom, the key gap is on the right, and a keyed cable socket shall match it (BUS-005). The figure below is the reference view: pins 1 and 2 at the bottom, the gap centered in the right-hand wall; a drawing of a header shows the same view. Shrouded headers in the field are keyed both ways, so a keyed cable from a conforming product enters a conforming bus board and may not enter another.

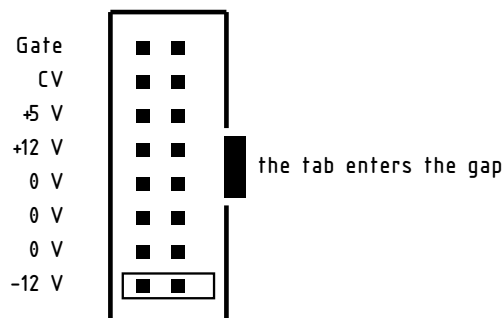
EIS · Power header, 16-pin, from the mating side



Viewed looking into the pins with the -12 V end at the bottom: the shroud key gap is on the right (BUS-005). Pinout: BUS-003.

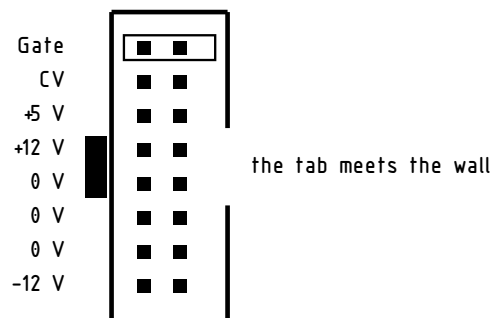
EIS · The marked conductor and the shroud key

Socket the right way round



marked conductor on -12 V

Socket reversed



marked conductor on gate

Seen from the mating side with the -12 V end at the bottom, the shroud's key gap is on the right (BUS-005). On a module, a bus board, and a ribbon, the marked conductor is -12 V and points to the -12 V end of the header (BUS-004).

A cable that comes with a module is keyed, so it enters a shrouded header only the right way round (BUS-010). An unshrouded header cannot stop a reversed socket, so every module also survives one (BUS-009).

Any voltage on these pins other than the pinout and a reversed ribbon is outside EIS.

A MODULE ON THE BUS

A module powered from the bus shall draw only +12 V and -12 V, and may also draw +5 V (BUS-006). A module that uses neither +5 V nor bus CV or gate may use the 10-pin header (BUS-007). It publishes its current on each rail as every power entry does (PWR-001).

A module shall not draw more than 2 A on any rail through one power header (BUS-008): an IDC contact is rated about 1 A, and each rail has two. A module that needs more uses a second header or a DC entry.

EIS · Module power entry: what a module may draw, and through which header

9 +12 V	10 +12 V
7 0 V	8 0 V
5 0 V	6 0 V
3 0 V	4 0 V
1 -12 V	2 -12 V

10-pin
no +5 V, CV, or gate
pin 1 at the marked conductor

15 gate	16 gate
13 CV	14 CV
11 +5 V	12 +5 V
9 +12 V	10 +12 V
7 0 V	8 0 V
5 0 V	6 0 V
3 0 V	4 0 V
1 -12 V	2 -12 V

16-pin
the full bus

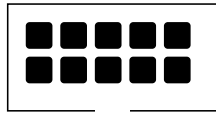
- Draws only +12 V and -12 V, and may draw +5 V (BUS-006).
- The 10-pin header is enough when the module uses neither +5 V nor bus CV or gate (BUS-007).
- At most 2 A on any rail through one header: two IDC contacts of about 1 A each (BUS-008). A module that needs more takes a second header or a DC entry.
- Never sources current into a bus rail (PWR-004).
- Survives a reversed ribbon (BUS-009); its every 0 V pin is tied to its 0 V (GND-001).
- Another header on the module does not mate a power ribbon, or survives one (BUS-011).

A module shall tolerate reverse polarity at its power header without damage (BUS-009): a ribbon fitted backwards is the commonest field fault. A bus cable supplied with a module shall be keyed so that it enters a shrouded header only with the marked conductor on -12 V (BUS-010). On a bus board whose shroud is keyed the other way, outside EIS, the installer fits an unkeyed cable with the marked conductor on -12 V.

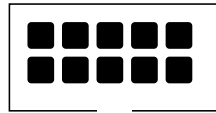
OTHER HEADERS

A header on a module that is not its power header shall either not mate a Eurorack power ribbon socket or tolerate one fitted to it, either way round, without damage (BUS-011). A 2 × 7 header mates a 2 × 5 socket as readily as a 2 × 5 header does, so a module that takes its video sync on a rear ribbon header is one this rule reaches. Expander and link headers are often 2 × 5 or 2 × 8 pin headers on the same grid, and a power ribbon fitted to one puts ±12 V on its signal pins. A shrouded header keyed differently, a different pin count, or a different connector family meets this; Annex N covers expanders and links.

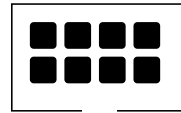
EIS · An expander header beside the power header



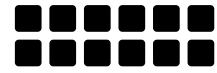
power header, 2 × 5



expander, 2 × 5, same key
a power ribbon fits



expander, 2 × 4
a power ribbon does not fit



expander, 2 × 6, unshrouded
fits only if it survives ±12 V

A header that is not the power header either does not mate a power ribbon socket or survives one fitted to it, either way round (BUS-011).

A different pin count, a different key, or another connector family meets the first; protection on every pin meets the second.

Annex N lists expanders and digital links on the port list as unclassified, named by what they connect to.

WIRING

EIS recommends blue for -12 V, black for 0 V, and red for +12 V in the distribution wiring of bus boards and supplies, and names no color for +5 V. Chassis ground is in 6.3.

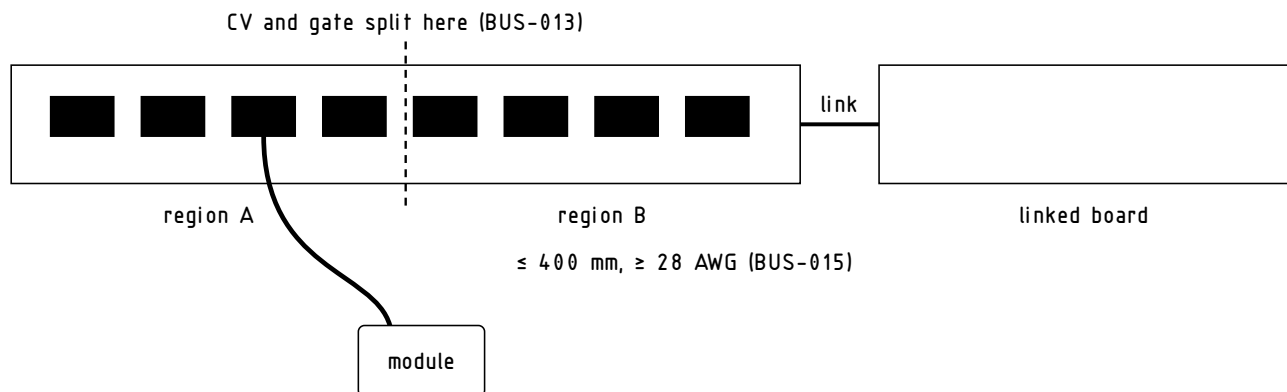
6.5 BUS BOARDS

The board in a row that carries power from the supply to every module. An enclosure row has one or more, behind the panels. Every header on a bus board is an outlet of the bus (6.4): the rails, the header form, the pinout, the marked conductor on -12 V, and the shroud key.

CAPACITY

A bus board publishes its maximum current on each rail, in total and at each header (PWR-002). The per-header limit it publishes shall not exceed 2 A per rail (BUS-012), the module limit of BUS-008.

EIS · Bus boards: published totals, the per-header limit, regions, and links



Publishes its maximum current on +12 V, -12 V, and +5 V, in total and per header (PWR-002), never more than 2 A per rail (BUS-012).

A link joins CV to CV and gate to gate (BUS-014); every header's 0 V runs to the supply's 0 V (GND-002).

LINKS AND CV AND GATE REGIONS

A bus board may split CV and gate into two regions (BUS-013). A link between two bus boards shall join CV to CV and gate to gate (BUS-014). How many modules may transmit on a line is a rule for assembling a system.

The supply-to-bus-board and bus-board-to-bus-board connections are row wiring (6.1): the board's terminals are quick-connect tabs, ring-terminal studs, or a wire-clamp block, published with the conductor sizes they take (PWR-005), and EIS recommends the 6.3 mm quick-connect tab for them.

DISTRIBUTION ON A BUS BOARD

A bus board may also distribute a DC rail, the ± 6 V analog rails, or the video reference behind the panel, or be the case's CTRL-USB-HOST; it then claims the matching feature, PWR-DC12, PWR-A6, the VID-REF ports, or CTRL-USB-HOST, beside PWR-BUS and meets its requirements (BUS-020). Its PWR-DC12 outlets are those of 6.7, each protected (DC-009, DC-012); its PWR-A6 outlets are A6-VH3 outlets fed from a PWR-A6 supply or a converter on the board (6.8); as a video reference distributor it takes the reference at a VID-REF-IN and gives each module a buffered copy at a VID-REF-PASSTHRU (7.4); as a case host it has the downstream ports and

limits of 8.1. The claim line names each feature, bus board (PWR-BUS-OUT, VID-REF-IN, VID-REF-PASSTHRU) or bus board (PWR-BUS-OUT, CTRL-USB-HOST) (4.2). A board that carries no bus at all, only a DC rail or the reference tree, is still a bus board: it claims the features it carries and not PWR-BUS. The board's one 0 V is shared by every domain on it (6.3).

POWER RIBBON CABLES

A power ribbon from a bus header to a module shall be no longer than 400 mm and shall use conductors of at least 28 AWG (BUS-015), the conductor of standard 1.27 mm pitch ribbon: the voltage drop of a longer or thinner ribbon at the header limit eats into the module's rails. At 28 AWG (0.21 Ω /m) a 400 mm ribbon drops about 85 mV on a rail carrying 2 A over its two conductors, and a third of that on the 0 V return over its six. A power ribbon cable sold on its own meets the marking and keying of 6.4 (BUS-004, BUS-005). The figures are in `data/power_ribbon.json`.

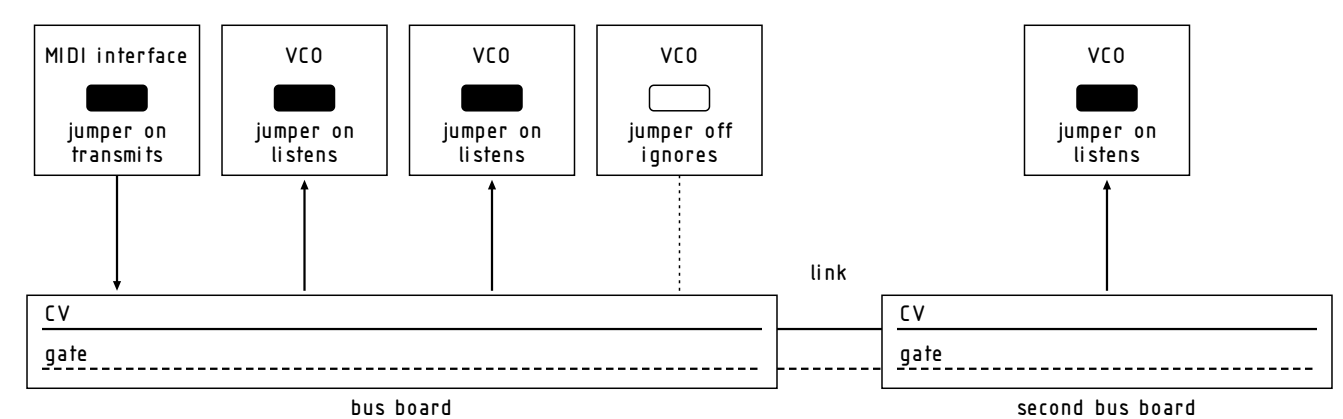
6.6 BUS CV AND GATE

The CV and gate lines of the 16-pin power header (6.4): when a module may use them, and their levels. Both follow A-100 practice.

The bus CV line carries 1 V/octave pitch CV from one transmitter, such as a MIDI interface or a keyboard controller, to the oscillators that listen to it. *BUS-CV* is therefore pitch CV, with the scale of *MOD-CV-1VOCT*, not general control CV: a module that put an LFO or an envelope on it would detune every listening oscillator. The bus gate line carries a 0 / +5 V gate; *BUS-GATE* keeps the *MOD-GATE* receiver thresholds, high at +3 V or more and low at +1 V or less.

A module shall listen to or transmit bus CV or gate only when a jumper or switch on the module is set to do so (BUS-016). A module that drives or receives bus CV shall meet the *BUS-CV* limits below (BUS-017), and one that drives or receives bus gate shall meet the *BUS-GATE* limits (BUS-018). At most one module transmits on each line, across linked bus boards (ASM-002). The patch classes are in 7.2.

EIS · Bus CV and gate: one transmitter, many listeners



At most one module transmits on each CV line and one on each gate line, across linked bus boards (ASM-002); a link joins CV to CV and gate to gate (BUS-014), so linked boards share one transmitter.

A module listens or transmits only when its jumper or switch says so (BUS-016). Bus CV is 1 V/octave pitch CV (BUS-017); bus gate is 0 / +5 V, high at +3 V or more (BUS-018).

CLASS TABLE

CLASS	CONNECTOR	COUPLING	NOMINAL	CLASS CEILING	SOURCE Z	LOAD Z
BUS-CV	16-pin Eurorack bus (CV net)	DC	1.00 V/octave pitch CV (bus CV)	±12 V	1 kΩ	100 kΩ
BUS-GATE	16-pin Eurorack bus (Gate net)	DC	0 / +5 V gate (bus gate); high ≥ +3 V, low ≤ +1 V at the receiver	±12 V	1 kΩ	100 kΩ

6.7 12 V DC POWER (PWR-DC12)

PWR-DC12 is the power domain of nominal 12 V DC, and an optional feature for the products in it: a module with a rear *DC entry*, a *DC entry panel* or a bus board with *PWR-DC12 outlets* that feeds several modules from one entry, a case DC entry on an enclosure, a power supply that takes 12 V DC and delivers the bus, and the cables between them. The 12 V DC comes from an external adapter, the domain's source, enters at a DC entry, and feeds a *DC rail*, one +V and -V pair that each product filters or regulates locally (Terms). The DC rail is separate from the bus (6.4); the rules common to both domains are in 6.1 to 6.3.

Filtering, output connectors, ripple at PWR-DC12 outlets, and the adapter a product ships with are product documentation, not EIS. The connection

rules for the person fitting it are in 9.3. The tables are in `data/dc_12.json`.

DC ENTRIES

A product shall publish its DC entry variant: DC-BAR21, DC-BAR25, DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 (DC-001), and the minimum and maximum DC input voltage its DC entry accepts (DC-002). Two kinds of DC entry share the domain. A *module DC entry*, DC-BAR21 or DC-VH2, takes the rail for one module from a PWR-DC12 outlet. A *case DC entry*, DC-BAR25, DC-DIN4, DC-MF6, or DC-MF8, takes a brick's output for a row: it sits on an enclosure, which then claims PWR-DC12-IN, or on a *DC entry panel*, a module that claims PWR-DC12-IN and feeds the supply, the bus board, or its own PWR-DC12 outlets, for which it claims PWR-DC12-OUT too. The wires from a case DC entry to what it feeds are row wiring (6.1). A DC entry shall be marked beside it with its polarity symbol, its nominal voltage, and its maximum current (DC-011), as the trade marks every DC inlet. The current it takes at its DC entry, or delivers at each distribution output, is published at 12 V like every domain's (PWR-001, PWR-002). A DC entry shall not use the pinout of a Eurorack 10-pin or 16-pin power header (DC-003).

A barrel DC entry, DC-BAR21 or DC-BAR25, shall be center positive (DC-004).

VARIANT	PIN × BARREL (mm)	TYPICAL NOTES CONTINUOUS (A)
DC-BAR21	2.1 × 5.5	2.5 Also a PWR-DC12 outlet to a module (DC-009).
DC-BAR25	2.5 × 5.5	5 Higher current, from an adapter; never an output to a module (DC-009). A DC-BAR25 plug enters a DC-BAR21 DC entry but makes unreliable contact (ASM-004).

DC-VH2 is a 2-pin JST VH wire-to-board header, rated 10 A, that takes power from a PWR-DC12 outlet. Above 5 A, EIS recommends DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 rather than a barrel: a through-hole 2.1 mm jack is rated about 2.5 A and a 2.5 mm jack about 5 A, and the product publishes its own figure (PWR-001). A product with a DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall implement the pin functions tabulated for that variant (DC-005). The receptacle and plug named are reference parts; an interchangeable part rated for the published current may be used.

VARIANT	RECEPTACLE (REFERENCE)	MATING PLUG (REFERENCE)	RATED RATING BASIS CONTINUOUS (A)
DG-VH2	JST B2P-VH or B2PS-VH	JST VHR-2N	10 1 contact per pole × 10 A (JST VH)
DG-DIN4	Kycon KPJX-4S-S	Kycon KPPX-4P	15 2 contacts per pole × 7.5 A (Kycon KPJX-4S-S)
DG-MF6	Molex 39-30- 1060	Molex 39-01-2060	24 3 circuits per pole × 8 A at 18 AWG (Molex PS-5556-001, 4 to 6 circuits)
DG-MF8	Molex 39-30- 1080	Molex 39-01-2080	28 4 circuits per pole × 7 A at 18 AWG (Molex PS-5556-001, 7 to 10 circuits)

DG-VH2 pins

PIN	FUNCTION
1	+V
2	-V

DG-DIN4 pins

PIN	FUNCTION
1	+V
2	-V
3	-V
4	+V
5	shell (optional)

DG-MF6 pins

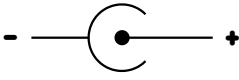
PIN	FUNCTION
1	+V
2	+V
3	+V
4	-V
5	-V
6	-V

DG-MF8 pins

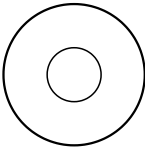
PIN	FUNCTION
1	+V
2	+V
3	+V

PIN FUNCTION	
4	+V
5	-V
6	-V
7	-V
8	-V

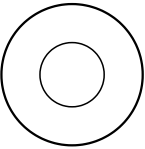
EIS · PWR-DC12 power entry: barrel polarity and multi-pin pin functions



center positive
DC-004



DC-BAR21
2.1 × 5.5 mm
about 2.5 A



DC-BAR25
2.5 × 5.5 mm
about 5 A

Pin × barrel. A DC-BAR25 plug fits a DC-BAR21 DC entry loosely and is never inserted (ASM-004).

Multi-pin variants and their pin functions

DC-VH2
10 A

pin 1
+V

pin 2
-V

DC-DIN4
15 A

pin 1
+V

pin 2
-V

pin 3
-V

pin 4
+V

pin 5
shell

DC-MF6
24 A

pin 1
+V

pin 2
+V

pin 3
+V

pin 4
-V

pin 5
-V

pin 6
-V

DC-MF8
28 A

pin 1
+V

pin 2
+V

pin 3
+V

pin 4
+V

pin 5
-V

pin 6
-V

pin 7
-V

pin 8
-V

A product with a multi-pin variant implements these pin functions (DC-005); its cables connect each pin to the same pin (DC-008).

Modules take power from a PWR-DC12 outlet on DC-BAR21 or DC-VH2, never DC-BAR25 (DC-009).

MODULES WITH A DC ENTRY

A module may have both a power header and a DC entry. Such a module does not require both sources to be connected at the same time (PWR-003), and the installer connects only one (ASM-003). When the DC entry carries the load, the module’s published bus currents (PWR-001) state what it draws from the bus, which may be nothing. It does not feed its DC rail back onto the bus (PWR-004), and the DC rail’s -V is its 0 V (GND-001).

A module’s barrel DC entry shall tolerate reverse polarity without damage (DC-006).

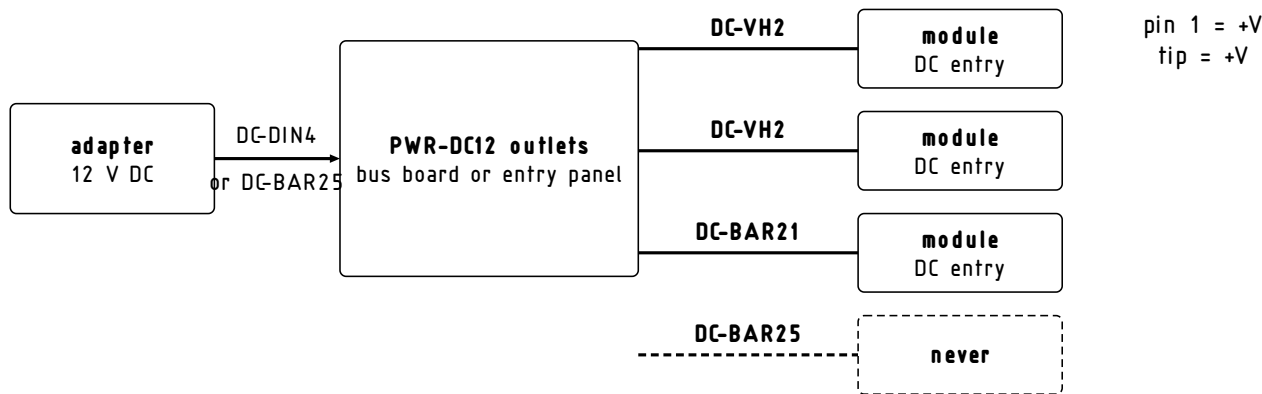
CABLES

A straight DC barrel cable shall connect tip to tip and sleeve to sleeve at both ends (DC-007). A cable for a DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall connect each pin to the same pin and function at both ends (DC-008).

DISTRIBUTION TO MODULES

A product with PWR-DC12 outlets to modules, a bus board, a DC entry panel, or a power supply (SUP-009), shall feed them only through DC-BAR21 jacks or DC-VH2 headers, never DC-BAR25 (DC-009). It shall protect each output separately and shall publish the current at which the protection acts (DC-012), so that one shorted cable takes down one module and not the rail, and its own DC entry shall tolerate reverse polarity without damage (DC-013). A cable from a DC distribution output to a module shall end in DC-BAR21 plugs or DC-VH2 housings and connect +V to +V and -V to -V, tip and pin 1 being +V (DC-010). A DC-BAR25 DC entry takes power from an adapter, not from a distribution product.

EIS · PWR-DC12 distribution: from the adapter to the modules

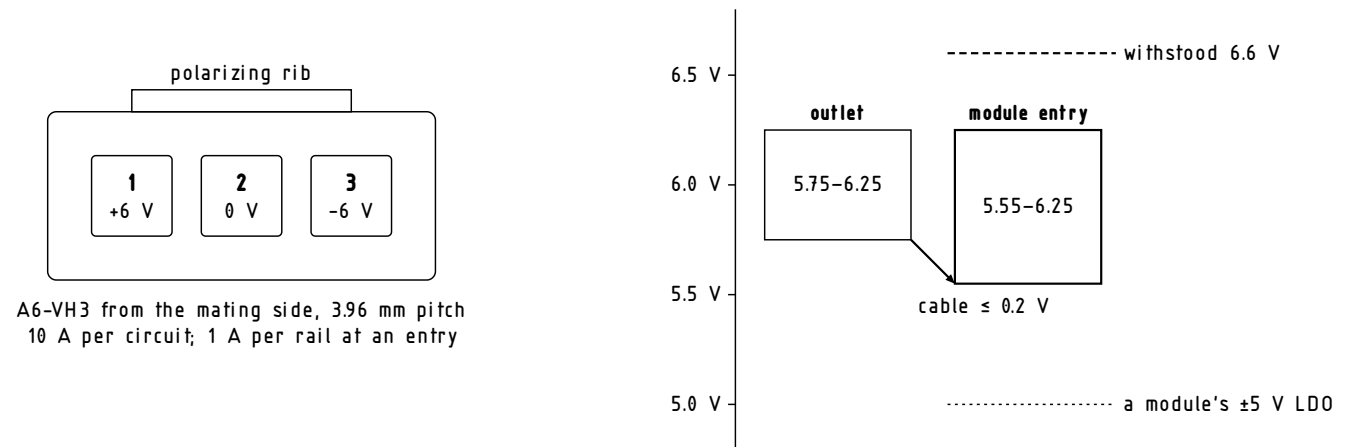


A product with PWR-DC12 outlets feeds modules only through DC-BAR21 jacks or DC-VH2 headers, never DC-BAR25 (DC-009); its cables keep +V to +V (DC-010). DC-BAR25 takes power from an adapter. A DC-BAR25 plug fits a DC-BAR21 entry loosely and is never inserted (ASM-004).

6.8 ±6 V ANALOG POWER (PWR-A6)

PWR-A6 is the power domain of ±6 V for analog circuits, and an optional feature for the products in it: a module with an *PWR-A6 entry*, a power supply that makes ±6 V for a row, a *power converter* that makes it for one product from the bus or from PWR-DC12, and the cables between them. A module on PWR-A6 finishes its own regulation, typically ±5 V from a low-dropout regulator per circuit block, so that the drop and pickup of the cable land on the module's regulator headroom and not on its signals. PWR-A6 is separate from the bus (6.4) and from PWR-DC12 (6.7); the rules common to every domain are in 6.1 to 6.3, and the ripple limit of PWR-A6 is in the table of 6.2. The figures are in data/analog_6.json.

EIS · PWR-A6: the A6-VH3 entry and the voltage window



CONNECTOR AND PINS

A PWR-A6 entry or outlet shall be an A6-VH3 connector, a JST VH 3-circuit header on a 3.96 mm pitch with its polarized housing, with the pin functions tabulated below (A6-001). No other EIS domain uses a 3-circuit VH; a DC-VH2 housing fits two of its pins, which is why the ±6 V mark beside the connector matters (A6-007) and why an entry withstands 6.6 V and no more (A6-004). A PWR-A6 entry or outlet shall be marked ±6 V beside it (A6-007). The header and housing named are reference parts; an interchangeable part rated for the published current may be used.

VARIANT	HEADER (REFERENCE)	MATING HOUSING (REFERENCE)	RATED PER CIRCUIT (A)
A6-VH3	JST B3P-VH (straight) or B3PS-VH (right angle) 3-circuit header	JST VHR-3N housing with SVH-21T-P1.1 crimp terminals	10

A6-VH3 pins

PIN	FUNCTION
1	+6 V
2	0 V
3	-6 V

VOLTAGE WINDOW

A PWR-A6 outlet shall hold each rail between 5.75 V and 6.25 V in magnitude, from no load to its published rating (A6-002). A module shall meet its published behavior with each rail anywhere from 5.55 V to 6.25 V in magnitude at its entry (A6-003); the 0.2 V between the two windows is the allowance for the cable and the connectors at the entry limit. A PWR-A6 entry shall withstand 6.6 V in magnitude on either rail without damage (A6-004), the start-up overshoot that SUP-006 allows a source.

FIGURE	VALUE
Nominal	$\pm$ 6 V
At an outlet, no load to rating	5.75 V to 6.25 V
At an entry, where the module meets its behavior	5.55 V to 6.25 V
Withstood at an entry	6.6 V
Ripple and noise at an outlet	below 20 mV p-p
Per rail through one entry	1 A
Cable	at most 500 mm, at least 22 AWG

EIS recommends that a source clamp its outlet so that a failed pass element cannot put its input voltage on a module, and that a module's entry carry a resettable fuse and a clamp per rail.

MODULES

A module shall not draw more than 1 A on either rail through one PWR-A6 entry (A6-005). It publishes its current on each rail as every power entry does (PWR-001). A module that takes its analog rails from PWR-A6 and its logic supply from the bus needs both connected; its entries are not alternatives, and its claim file says so.

CABLES

A PWR-A6 cable shall connect each pin to the same pin at both ends, be no longer than 500 mm, and use conductors of at least 22 AWG (A6-006). A power converter mounted on the back of the module it powers connects to the module's entry by such a cable; EIS defines no board-to-board mate.

SOURCES

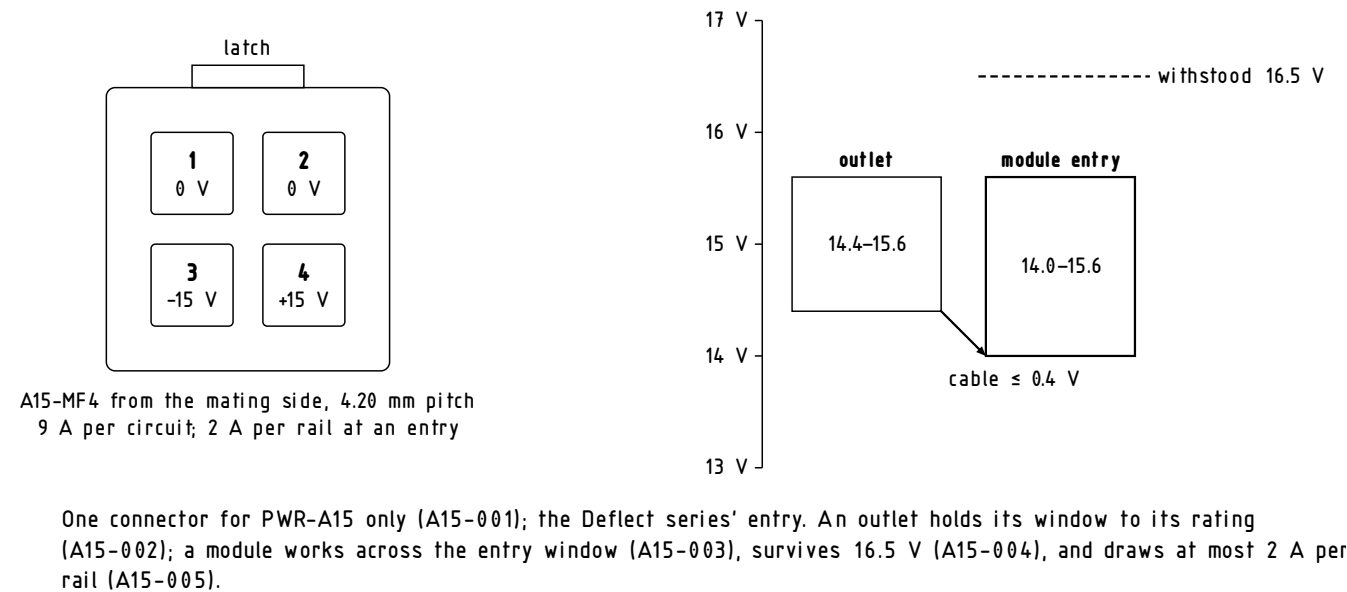
A power supply that makes PWR-A6 for a row publishes the current of each outlet and its total (PWR-002), and meets the rules of 6.2 at every outlet. A power converter makes PWR-A6 for one product: from the bus, by stepping each rail down, or from PWR-DC12, which needs an isolated or inverting converter for the negative rail. A linear converter on the bus draws the module's full current from the bus and turns the difference into heat; its published bus current and heat (PWR-001, SUP-008) are what the installer budgets.

EIS recommends a linear or post-regulated source for PWR-A6, typically under 5 mV of ripple and noise.

6.9 ± 15 V ANALOG POWER (PWR-A15)

PWR-A15 is the power domain of ± 15 V for analog circuits that run at the full rail, and an optional feature for the products in it: a module with a *PWR-A15 entry*, a power supply that makes ± 15 V for a row, a *power converter* that makes it for one product from PWR-DC12 or from the bus, and the cables between them. Where PWR-A6 feeds a module that finishes its own regulation to ± 5 V, PWR-A15 feeds op-amp circuits directly: the ± 10 V signal swing of an analog computing or display amplifier, the headroom a video output stage needs, and the ± 15 V parts of the broadcast trade. The connector and pin map are those of the LZX Deflect series, whose every powered module takes ± 15 V this way. The tables are in data/analog_15.json.

EIS · PWR-A15: the A15-MF4 entry and the voltage window



CONNECTOR AND PINS

A PWR-A15 entry or outlet shall be an A15-MF4 connector, a Molex Mini-Fit Jr 4-circuit header, two rows of two on a 4.20 mm pitch, with its latched polarized housing, with the pin functions tabulated below (A15-001). No other EIS domain uses a 4-circuit Mini-Fit Jr; the case DC entries DC-MF6 and DC-MF8 are the same family with six and eight circuits and do not mate it, which is why the ±15 V mark beside the connector matters (A15-007) and why an entry withstands 16.5 V and no more (A15-004). Pins 1 and 2 are both 0 V so that the return carries the same current as either rail; pin 3 is -15 V and pin 4 is +15 V.

VARIANT	HEADER (REFERENCE)	MATING HOUSING (REFERENCE)	RATED PER CIRCUIT (A)
A15-MF4	Molex 39-30-1040 (vertical) or 39-30-1041 (right angle) 4-circuit header, 5569 series	Molex 39-01-2040 receptacle housing with 5556 crimp terminals	9

A15-MF4 pins

PIN	FUNCTION
1	0 V
2	0 V
3	-15 V
4	+15 V

VOLTAGE WINDOW

A PWR-A15 outlet shall hold each rail between 14.4 V and 15.6 V in magnitude, from no load to its published rating (A15-002). A module shall meet its published behavior with each rail anywhere from 14.0 V to 15.6 V in magnitude at its entry (A15-003); the 0.4 V between the two windows is the allowance for the cable and the connectors at the entry limit. A PWR-A15 entry shall withstand 16.5 V in magnitude on either rail without damage (A15-004): a source that overshoots on start-up, or a supply set a volt high, does not take a module with it.

FIGURE	VALUE
Nominal	±15 V
At an outlet, no load to rating	14.40 V to 15.60 V
At an entry, where the module meets its behavior	14.00 V to 15.60 V
Withstood at an entry	16.5 V
Ripple and noise at an outlet	below 20 mV p-p
Per rail through one entry	2 A
Cable	at most 500 mm, at least 20 AWG

EIS recommends that a source clamp its outlet so that a failed pass element cannot put its input voltage on a module, and that a module's entry carry a resettable fuse and a reverse-polarity element per rail.

MODULES

A module shall not draw more than 2 A on either rail through one PWR-A15 entry (A15-005). It publishes its current on each rail as every power entry does (PWR-001). A module on PWR-A15 alone has no bus header and claims no PWR-BUS; one that also takes the bus for its logic needs both connected, and its claim file says so.

CABLES

A PWR-A15 cable shall connect each pin to the same pin at both ends, be no longer than 500 mm, and use conductors of at least 20 AWG (A15-006). The Mini-Fit Jr housing latches; a cable is pulled by its latch, never by the wire.

SOURCES

A power supply that makes PWR-A15 for a row publishes the current of each outlet and its total (PWR-002), and meets the rules of 6.2 at every outlet. A power converter makes PWR-A15 for one product from PWR-DC12 by an isolated or boost converter, or from the bus by stepping each rail up; a linear source needs an input above the window, so a converter from the bus is a switching stage followed by a linear post-regulator.

EIS recommends a linear or post-regulated source for PWR-A15, typically under 5 mV of ripple and noise.

PART 4 — SIGNALS AND VIDEO

What travels on a port, and what every patch jack owes whatever it carries. 7.1 defines the port list and patch safety; 7.2 the classes a patch jack may claim, audio, control CV, pitch CV, gate, trigger, clock, and video, and their ranges; 7.3 the video timing formats a video reference port lists. The patch jacks and the timing formats are EIS Core. 7.4 is the 75 Ω coaxial interface and its features: VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU, and VID-REF-LOOPTHRU for a module's video reference ports behind the panel, and VID-75 for a picture on a coaxial jack.

7.1 SIGNALS

How a module declares what travels on each port, and the rules every patch jack follows whatever it carries.

CLAUSE	COVERS
7.2 Patch signal classes	Audio, control CV, pitch CV, gate, trigger, clock, and video on patch jacks, and their ranges
7.3 Video timing	The formats a video reference port lists
7.4 Video on 75 Ω coaxial jacks (VID-75)	The 75 Ω coaxial interface: the video reference ports VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU, VID-REF-LOOPTHRU, the reference tree, and the coaxial cable
Annex I	Informative names for ports that are not patch jacks

PORT LIST

A module shall publish a port list naming, for every port, its signal class or unclassified (SIG-001). A module with no ports publishes an empty list. Beside the class, the port list names the range a port claims when it is not the class default (7.2), and a port that generates or locks to a video reference lists its formats (7.3). The port list belongs in the manual, on the product page, or in a claim file.

A port that claims a class meets that class's limits in 7.2. A port that is neither a patch jack nor a video reference port, such as a coaxial picture jack, line audio, or MIDI, is listed as unclassified or by a name from Annex I; EIS places no requirement on it. EIS recommends labelling each port with its class, on the panel or in the manual.

PATCH SAFETY

These requirements apply to every patch jack on a module, whatever its class:

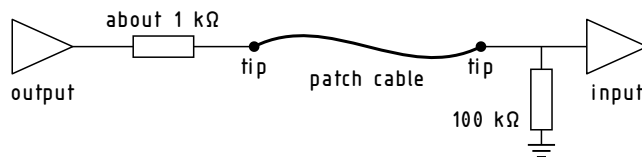
- A patch input shall withstand ± 12 V indefinitely (SIG-002).
- A patch output shall withstand an indefinite short to 0 V or to another patch output (SIG-003).
- A patch output shall not drive the patch tip beyond ± 12 V (SIG-004).

The ± 12 V is the rails' nominal figure; a supply's 10 % start-up overshoot (SUP-006) is a rail figure, and no conforming output drives a tip beyond ± 12 V while its rails are anywhere inside the supply's limits.

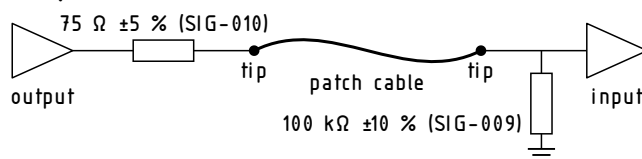
EIS recommends that every patch jack, and every RCA, BNC, or SMA jack, have its sleeve or shell insulated from the panel metal, so that no signal return runs through the panel and the case.

EIS · The patch interface and its limits

Audio, CV, pitch, gate, trigger, and clock



Video, MOD-VIDEO



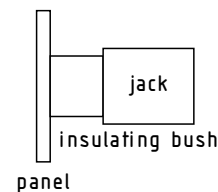
On every patch jack

An input withstands ± 12 V indefinitely (SIG-002).

An output survives a short to 0 V or to another output (SIG-003).

An output never drives the tip beyond ± 12 V (SIG-004).

Insulated jacks, recommended



EIS recommends insulating every patch, RCA, BNC, and SMA jack from the panel.

75 Ω into 100 k Ω arrives at almost unity gain. A MOD-VIDEO output has no other source impedance (SIG-010), so every video output and input in a system match.

VIDEO REFERENCE IN A ROW

Video modules in a row share one video reference, and a module takes it behind the panel at a VID-REF-IN port, a rear 75 Ω coaxial jack under 7.4: fed from the VID-REF-OUT of a video reference generator, from the VID-REF-PASSTHRU of the module before it, or from a distributor, usually a bus board, whose VID-REF-PASSTHRU ports fan one reference out to one VID-REF-IN per module. A module claims each reference port it has by

kind, VID-REF-IN, VID-REF-OUT, VID-REF-PASSTHRU, or VID-REF-LOOPTHRU. A patch jack shall carry patched signals only: a module shall neither take nor give its video reference at a patch jack, and no patch jack shall list a format of clause 7.3 (SIG-015). The reference is system configuration, wired once behind the panel, so patching never changes a module's timing. Informative Annex M describes the choices. Power for a video distribution product is ordinary module or case wiring, from the bus or a DC entry, and is not part of the feature.

7.2 PATCH SIGNAL CLASSES

The signal classes a patch jack may claim, and the ranges a class may take. Every patch jack also follows the patch-safety rules of 7.1: its input withstands ± 12 V and its output never exceeds it.

All classes but MOD-VIDEO share one interface: about 1 k Ω source impedance into 100 k Ω loads. Each class has a *nominal* level, the level a port works at, a *full scale*, the swing its range allows, a *class ceiling*, and a *damage limit* (Terms): audio is nominally ± 5 V and may swing to ± 10 V, which is what an input has to accept. The levels are EIS figures; the gate thresholds follow A-100 practice (Scope 1.4).

AUDIO

MOD-AUDIO (SIG-005) is Eurorack audio at ± 10 V peak on the patch tip, 7.07 V RMS for a full-scale sine. Coupling may be AC or DC.

CONTROL CV

MOD-CV (SIG-006) is control voltage: envelopes, LFOs, offsets, and any other control that is not calibrated for pitch. Its level is the range the port claims, bipolar or unipolar at 1, 5, or 10 V full scale; B10, -10 to +10 V, when the port list names none.

PITCH CV

MOD-CV-1VOCT (SIG-007) is precision pitch CV: 1.00 V per octave. EIS recommends that 0 V correspond to C0, that the tracking accuracy of a pitch output be published in the manual, and that pitch ports be labeled *1 V/oct* so that they are not mistaken for video ports; every oscillator has

a tune control, so the absolute pitch at 0 V is a calibration figure, not a requirement.

VIDEO

MOD-VIDEO (SIG-008) carries video on patch jacks, pictures, ramps, keys, and control at video rate, 0 to +1 V DC with a +1.2 V class ceiling. A MOD-VIDEO input shall present $100\text{ k}\Omega \pm 10\%$ to 0 V at the patch tip (SIG-009). A MOD-VIDEO output shall drive through a $75\text{ }\Omega \pm 5\%$ total series source impedance at the patch tip (SIG-010). A $75\text{ }\Omega$ source into a $100\text{ k}\Omega$ load arrives at almost unity gain; the cable's capacitance sets the bandwidth, about 70 MHz over 300 mm of 100 pF/m patch cable and about 20 MHz over a metre.

Video on a $75\text{ }\Omega$ RCA, BNC, or SMA jack is a COAX-IN or COAX-OUT port (7.4), not a patch jack, and a module's video reference is a rear coaxial port, never a patch jack (SIG-015, V75-010); the formats a VID-REF-IN or VID-REF-OUT port lists are in 7.3.

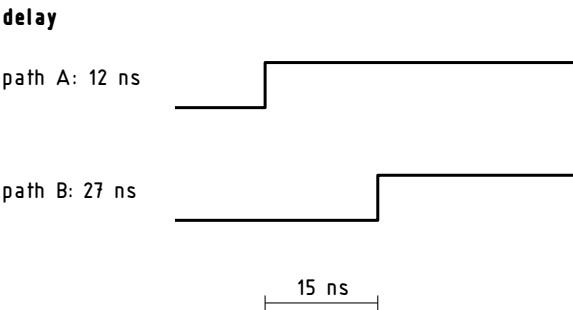
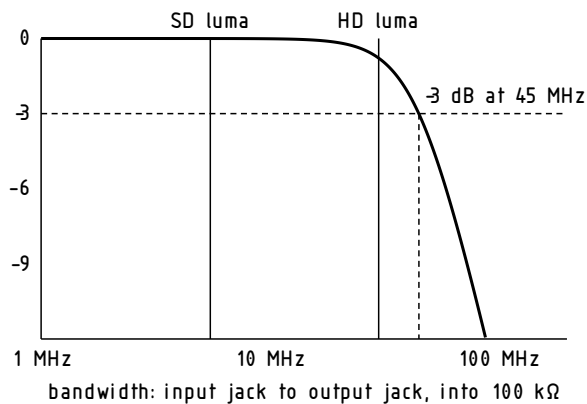
BLACK, BANDWIDTH, AND DELAY

EIS recommends that a picture signal on MOD-VIDEO place black at 0 V and full scale (white, or a color channel at full saturation) at +1 V, so that a mixer or keyer can treat any two picture sources alike.

Two figures decide whether video patched through several modules stays sharp and stays in place on the screen, and EIS recommends that a video module publish both for each MOD-VIDEO path, as optional claim-file fields (*bandwidth_mhz*, *delay_ns*):

- *Bandwidth*: the -3 dB frequency of the path from input jack to output jack, into a $100\text{ k}\Omega$ load. A path narrower than the format's luma bandwidth, about 5.5 MHz for SD and 30 MHz for HD, softens the picture.
- *Delay*: the time from an edge at the input jack to the same edge at the output jack, in nanoseconds. Two copies of one picture that reach a mixer by paths of different delay land side by side on the screen, offset by the difference; at 74.25 MHz one sample is 13.5 ns.

EIS · A MOD-VIDEO path: bandwidth and delay



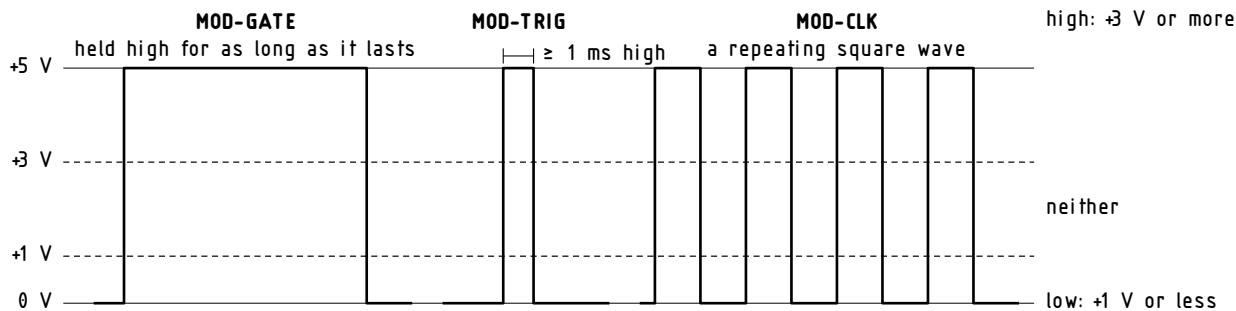
Two copies of one picture through paths 15 ns apart land about one HD sample apart on the screen (13.5 ns at 74.25 MHz).

EIS recommends publishing both figures for each MOD-VIDEO path in the claim file, and placing black at 0 V and full scale at +1 V.

GATE, TRIGGER, AND CLOCK

MOD-GATE (SIG-011), *MOD-TRIG* (SIG-012), and *MOD-CLK* (SIG-013) use the same receiver thresholds: high at +3 V or more, low at +1 V or less. *MOD-GATE* is a sustained high or low level. *MOD-TRIG* is a short pulse, at least 1 ms high. *MOD-CLK* is a repeating square wave. The gate line on the 16-pin header is *BUS-GATE* (6.6).

EIS · Gate, trigger, and clock against the receiver thresholds



MOD-GATE (SIG-011), *MOD-TRIG* (SIG-012), and *MOD-CLK* (SIG-013) share the receiver thresholds, which follow A-100 practice: an input reads +3 V or more as high and +1 V or less as low. The bus gate line, *BUS-GATE*, keeps the same thresholds.

alone. A range on *MOD-CV-1VOCT* states the span of pitch CV a port accepts or produces; the scale stays 1.00 V per octave. Gate, trigger, and clock ports have thresholds, not ranges. For example, an envelope from 0 to +8 V is *MOD-CV* at U10, and an LFO at ± 2.5 V is *MOD-CV* at B5.

CLASS TABLE

CLASS	REQUIREMENT	CONNECTOR	COUPLING	NOMINAL	FULL SCALE	CLASS CEILING	DAMAGE SOURCE LIMIT Z	LOAD	Z RANGES
MOD-AUDIO	SIG-005	3.5 mm mono (TS)	AC or DC	± 5 V (10 V peak-to-peak)	± 10 V peak (B10)	± 12 V	± 12 V 1 k Ω	100 k Ω	B10 default; B5, B1
MOD-CV	SIG-006	3.5 mm mono (TS)	DC	± 5 V or 0 to +5 V, typical control; by range	the claimed range; ± 10 V at B10	By range; ± 12 V at B10	± 12 V 1 k Ω	100 k Ω	B10 default; U10, B5, U5, B1, U1
MOD-CV-1VOCT	SIG-007	3.5 mm mono (TS)	DC	1.00 V/octave pitch CV	by range; B10 or B5 when claimed	± 12 V	± 12 V 1 k Ω	100 k Ω	none by default; B10, B5
MOD-GATE	SIG-011	3.5 mm mono (TS)	DC	0 / +5 V; — high $\geq +3$ V, low $\leq +1$ V		± 12 V	± 12 V 1 k Ω	100 k Ω	—
MOD-TRIG	SIG-012	3.5 mm mono (TS)	DC	0 / +5 V; — rising edge $\geq +3$ V, width ≥ 1 ms		± 12 V	± 12 V 1 k Ω	100 k Ω	—
MOD-CLK	SIG-013	3.5 mm mono (TS)	DC	0 / +5 V — square wave; high $\geq +3$ V, low $\leq +1$ V		± 12 V	± 12 V 1 k Ω	100 k Ω	—
MOD-VIDEO	SIG-008	3.5 mm mono (TS)	DC	0 to +1 V DC: black 0 V, full scale +1 V	+1 V (U1)	+1.2 V	± 12 V 75 Ω ± 5 % series	100 k Ω	U1 default

The table is generated from `data/signals.json`. Source and load impedances are typical, except for MOD-VIDEO, whose are limits (SIG-009,

SIG-010).

7.3 VIDEO TIMING

EIS defines the video timing formats tabulated below: four standard-definition and fourteen high-definition rasters. The three 1080-line formats at 50, 59.94, and 60 frames per second are listed because display equipment defaults to them; on an analog component interface at 148.5 MHz they are rare, and a port lists one only when it generates or locks to it.

A module's port list shall name, for each VID-REF-IN and VID-REF-OUT port, every format from this clause the port locks to or generates, by its format ID (VID-001). A port may list one format or all of them; a VID-REF-PASSTHRU carries its VID-REF-IN's formats, and a patch jack lists none (7.1). A format that is not in the table is listed under its own name, and EIS says nothing about it.

When a listed format is selected or published on a port, that port's horizontal and vertical timing and its video sync structure shall match the format's publication within the tolerances that publication states, and for a progressive or high-definition format the row below is that publication's raster, sample for sample (VID-002). For the two interlaced formats the row is the reference raster: the publication's figures in microseconds, with the digital active line placed as ITU-R BT.601 places it against the timing reference OH, 16 and 122 luminance samples for the 525-line system and 12 and 132 for the 625-line system.

Composite color encoding (NTSC or PAL) applies only to the interlaced SD formats. A component output (YPbPr or RGB) may use any listed format. A port that locks to an external video reference takes the selected format; EIS does not require format conversion.

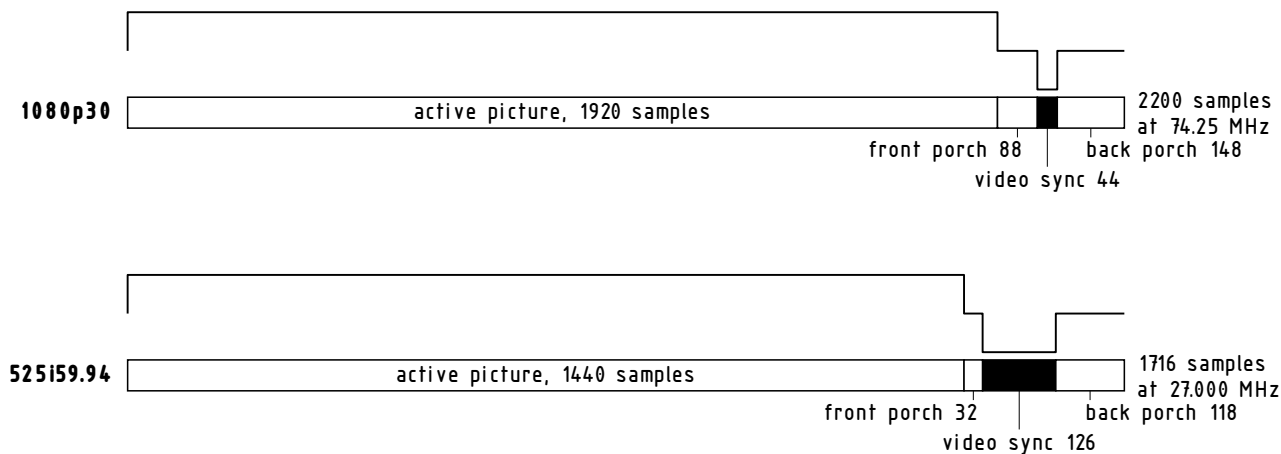
FORMATS

The tables are generated from `data/video_timings.json`, where each row cites its SMPTE or ITU publication. Sample clocks are exact. SD formats are stated at 27.000 MHz: two samples per 13.5 MHz luma sample for the interlaced formats, so 525i59.94 has 1716 samples per line, and one per luma sample for the progressive formats, so 480p59.94 has 858. HD formats are at 74.25 MHz or 74.25/1.001 MHz, and the three 1080p formats at 50 Hz and above at 148.5 MHz or 148.5/1.001 MHz.

For an interlaced format, the vertical front porch and video sync counts cover both fields. Active lines are the count each publication gives for the format.

Interlaced formats in the publication's terms. The analog publications state a line in microseconds, with tolerances EIS does not restate: for 525i59.94 (SMPTE ST 170) a 63.556 μ s line with a 4.7 μ s video sync pulse, a 1.5 μ s front porch, and 10.7 to 10.9 μ s of blanking; for 625i50 (ITU-R BT.470) a 64 μ s line with a 4.7 μ s video sync pulse, a 1.5 μ s front porch, and 12 μ s of blanking. A port meets VID-002 inside those tolerances; the row is where a sample-domain design places the active line.

EIS · One line of video, to scale: an HD and an SD format



Each bar is one line, in samples at the format's sample clock, in order: active picture, front porch, video sync, back porch. The trace above it is the video sync level through the line. Every format's figures are in clause 7.3 and data/video_timings.json.

When a port selects or publishes a format, its timing and video sync structure match that format's row (VID-002).

Line. Samples at the sample clock: total per line, active picture, front porch, video sync, back porch.

FORMAT ID	SAMPLE CLOCK	SAMPLES/LINE	ACTIVE	H FRONT	H VIDEO SYNC	H BACK
525i59.94	27.000 MHz	1716	1440	32	126	118
625i50	27.000 MHz	1728	1440	24	126	138
480p59.94	27.000 MHz	858	720	16	62	60
576p50	27.000 MHz	864	720	12	64	68
720p50	74.25 MHz	1980	1280	440	40	220
720p59.94	74.25/1.001 MHz	1650	1280	110	40	220
720p60	74.25 MHz	1650	1280	110	40	220
1080i50	74.25 MHz	2640	1920	528	44	148

FORMAT ID	SAMPLE CLOCK	SAMPLES/LINE	ACTIVE	H FRONT	H VIDEO SYNC	H BACK
1080i59.94	74.25/1.001 MHz	2200	1920	88	44	148
1080i60	74.25 MHz	2200	1920	88	44	148
1080p23.98	74.25/1.001 MHz	2750	1920	638	44	148
1080p24	74.25 MHz	2750	1920	638	44	148
1080p25	74.25 MHz	2640	1920	528	44	148
1080p29.97	74.25/1.001 MHz	2200	1920	88	44	148
1080p30	74.25 MHz	2200	1920	88	44	148
1080p50	148.5 MHz	2640	1920	528	44	148
1080p59.94	148.5/1.001 MHz	2200	1920	88	44	148
1080p60	148.5 MHz	2200	1920	88	44	148

Frame. Lines per frame: total, active, front porch, video sync; the rate is the field rate of an interlaced format and the frame rate of a progressive one. SD marks the four standard-definition formats.

FORMAT ID	LINES	ACTIVE LINES	V FRONT	V VIDEO SYNC	RATE (Hz)	INTERLACED	SD
525i59.94	525	486	6	6	59.94	yes	yes
625i50	625	576	5	5	50	yes	yes
480p59.94	525	480	9	6	59.94	no	yes
576p50	625	576	5	5	50	no	yes
720p50	750	720	5	5	50	no	—
720p59.94	750	720	5	5	59.94	no	—
720p60	750	720	5	5	60	no	—
1080i50	1125	1080	4	10	50	yes	—
1080i59.94	1125	1080	4	10	59.94	yes	—
1080i60	1125	1080	4	10	60	yes	—
1080p23.98	1125	1080	4	5	23.98	no	—
1080p24	1125	1080	4	5	24	no	—
1080p25	1125	1080	4	5	25	no	—
1080p29.97	1125	1080	4	5	29.97	no	—
1080p30	1125	1080	4	5	30	no	—
1080p50	1125	1080	4	5	50	no	—
1080p59.94	1125	1080	4	5	59.94	no	—
1080p60	1125	1080	4	5	60	no	—

PHASE

A module that locks to a video reference produces its output a fixed time after the reference. EIS recommends publishing that offset, horizontal and in nanoseconds, at each listed format, and any adjustment the module offers, so that several generators locked to one reference can be lined up on the screen.

VERIFICATION

A maker compares samples per line, lines per frame, field or frame rate, and video sync pulse width and placement with the tables and the cited publication. `tests/video_timings_contract.py` checks every row against a hardware-verified timing contract, clock for clock.

7.4 VIDEO ON 75 Ω COAXIAL JACKS (VID-75)

VID-75 is the 75 Ω coaxial interface of EIS: video between products on 75 Ω coaxial cable with RCA, BNC, or SMA jacks. It carries the *video reference* of a row, black burst or bi-level or tri-level video sync of a 7.3 format, behind the panel from one source to every module that locks to it: this distribution is what conforms to EIS for interoperability, and a module claims it port by port with the features *VID-REF-IN*, *VID-REF-OUT*, *VID-REF-PASSTHRU*, and *VID-REF-LOOPTHRU* below. A feature describes what happens behind the panel or inside the case, so *VID-75* is the interface those features use and is not claimed on its own. A *picture* on a coaxial jack on the front, composite or component video, is an external interface like line-level audio: it is listed in the port list with its Annex I class (VID-CVBS, VID-YPBPR, VID-RGBS) and the formats it carries, claims nothing, and EIS recommends that it take the COAX-IN or COAX-OUT form of this clause. A product with VID-REF-PASSTHRU ports beside its VID-REF-IN, usually a bus board, is a *video reference distributor* that fans the reference out to several modules, and a *cable* of the interface joins them. The tables are in `data/video_75.json`.

The front of a module is patched (7.2): the reference never reaches a patch jack (SIG-015), and a module that generates or locks to an external video reference takes or gives it at a video reference port on its rear (V75-010).

VIDEO REFERENCE PORTS AND CLAIMS

A module names what each of its video reference ports does, and claims it, with one feature per port kind. The difference between an input and an output is the one a buyer needs most: a VID-REF-OUT can be the row's reference, a VID-REF-IN follows it, and a pass-through is neither a source nor a second input.

FEATURE	PORT	WHAT IT IS
VID-REF-IN	a COAX-IN on the rear	The module locks its video timing to the video reference here and lists the formats it locks to (V75-011)
VID-REF-OUT	a COAX-OUT on the rear	The module gives a video reference it generates itself, of a listed format; a copy of VID-REF-IN is a VID-REF-PASSTHRU, not a VID-REF-OUT (V75-012)
VID-REF-PASSTHRU	a COAX-PASSTHRU on the rear	With VID-REF-IN only: a buffered copy of the reference at VID-REF-IN, driven as a COAX-OUT into one COAX-IN load, marked PASSTHRU (V75-013)
VID-REF-LOOPTHRU	VID-REF-IN as a COAX-LOOPTHRU	With VID-REF-IN only: two bridged jacks on one line with a termination switch, 75 Ω across the line when TERM is on and no load when off; the module locks either way (V75-014)

A module that claims VID-REF-IN shall lock its video timing to the video reference at its VID-REF-IN port, a COAX-IN on its rear, and list the formats it locks to (V75-011). A module that claims VID-REF-OUT shall give a video reference of a listed format at its VID-REF-OUT port, a COAX-OUT on its rear, that it generates itself (V75-012); a copy of a reference it takes at VID-REF-IN is a VID-REF-PASSTHRU, not a VID-REF-OUT. A module shall claim VID-REF-PASSTHRU only with VID-REF-IN (V75-013); its VID-REF-PASSTHRU port shall be a COAX-PASSTHRU, a buffered copy of the reference at VID-REF-IN driven as a COAX-OUT into one COAX-IN load, and be marked PASSTHRU (V75-013). A module shall claim VID-REF-LOOPTHRU only with VID-REF-IN (V75-014); its VID-REF-IN shall then be a COAX-LOOPTHRU, two bridged jacks on one line with a termination switch that presents 75 Ω to 0 V across the line when on and no load when off, marked TERM, and the module shall lock the same with the switch on or off (V75-014).

The claim line names every port kind the module has: module (VID-REF-IN), module (VID-REF-IN, VID-REF-PASSTHRU), module (VID-REF-IN, VID-REF-LOOPTHRU), module (VID-REF-OUT), or module (VID-REF-IN, VID-REF-OUT) for a generator that also genlocks; its picture jacks are in its port list and add nothing to the line. Claiming any VID-REF feature brings the jack and port rules of this clause with it. A distributor claims VID-REF-IN and VID-REF-PASSTHRU, bus board (PWR-BUS-OUT, VID-REF-

IN, VID-REF-PASSTHRU) (6.5); distribution is a capability of whatever product has those ports, not a product type.

JACKS

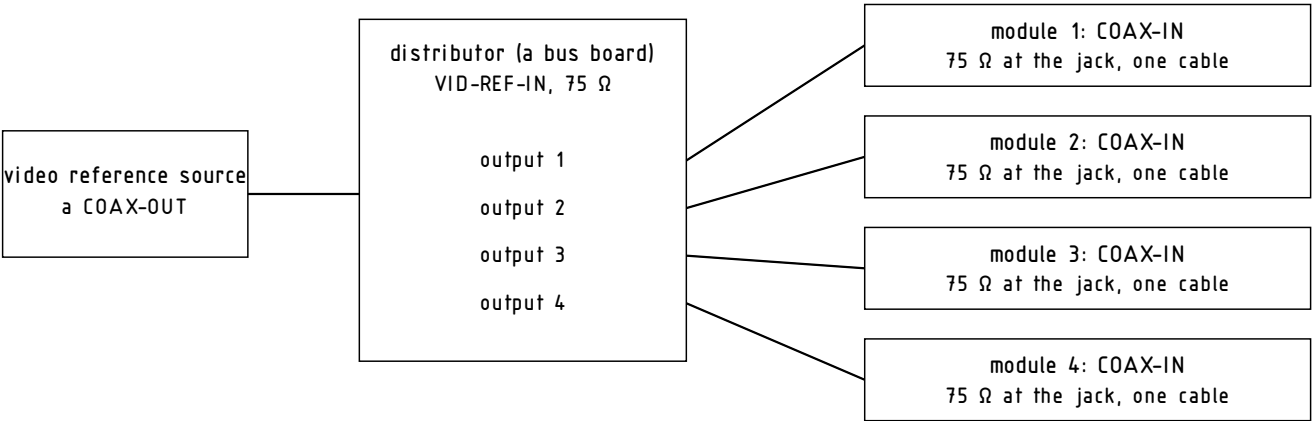
Every jack in a VID-75 tree shall be an RCA, BNC, or SMA jack (V75-001); EIS recommends that it be insulated from the panel (7.1). Its center pin shall carry the video signal and its shell shall be 0 V (V75-002). The three jack types are electrically the same here: an SMA jack is a 50 Ω connector and an RCA jack has no controlled impedance, but both are electrically short at video frequencies, below 100 MHz, so the discontinuity does not matter. A product picks the one that suits its panel, and a cable may change type from one end to the other. A video reference port shall be marked beside it as an input (IN), an output (OUT), a pass-through (PASSTHRU), or, for a loop-through pair, with its termination switch (TERM) (V75-016); V75-008, which asked the same of every coaxial port, is removed and its number stays unused.

TOPOLOGY

A *tree* is the star of cables from one source to the VID-REF-IN of every module in it: the source is a VID-REF-OUT, or an external reference arriving at the VID-REF-IN of a distributor, and the branches are its VID-REF-PASSTHRU ports. The VID-REF-IN is the tree's designated input, named in the port list (V75-011), and terminated as every COAX-IN is (V75-009); V75-003 and V75-004, which asked for that separately, are removed and their numbers stay unused.

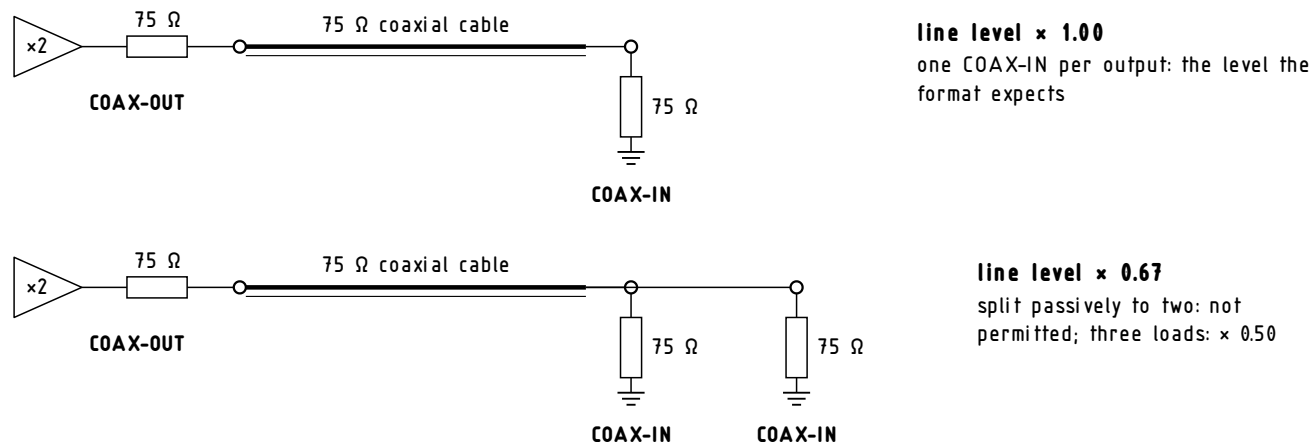
A VID-REF-OUT or VID-REF-PASSTHRU port shall drive one COAX-IN load, and an output shall not be split passively to several terminated ports (V75-005): a second termination on the same output drops the level to two thirds, and a third to half.

EIS · VID-75: one star per video sync source



One source, a VID-REF-OUT or an external reference at a distributor's VID-REF-IN, feeds each tree; each VID-REF-PASSTHRU or VID-REF-OUT drives one COAX-IN load. An output is not split passively. Jacks and plugs may be RCA, BNC, or SMA; every cable is 75 Ω coaxial, center to center and shell to shell.

EIS · VID-75 levels: one load per output



A COAX-OUT drives twice the line level through 75 Ω, so a 75 Ω COAX-IN at the far end sees the line level (V75-009). Each distribution output drives one COAX-IN (V75-005). Jacks may be RCA, BNC, or SMA.

VIDEO REFERENCE PORTS

Every video reference port shall be a COAX-IN (75 Ω to 0 V at the jack), a COAX-OUT (75 Ω series source driven at twice the line level), a COAX-PASSTHRU, or a COAX-LOOPTHRU port, never a patch jack (V75-015); the four port modes are defined in the summary, and a product with one claims the matching feature. V75-009, which asked the same of every

coaxial jack including a picture port, and V75-006, which stated the rule for a port in a tree alone, are removed and their numbers stay unused: a picture port is an external interface, and a product cannot know how its owner cables a jack. A picture port, composite or component video on an RCA, BNC, or SMA jack on the front, or a digital port such as SDI on a BNC jack, is named by its Annex I class in the port list; EIS recommends the COAX-IN termination and the COAX-OUT back-termination of this clause for an analog picture port, so that it drives and loads a 75 Ω line the same way the reference does.

A module that generates or locks to an external video reference shall take or give it at a video reference port on its rear (V75-010): the reference is system cabling, wired once behind the panel, and the patch field carries patched signals only (SIG-015, 7.1).

The patch jacks of a video module use MOD-VIDEO (7.2). The video reference waveform, black burst or bi-level or tri-level video sync, follows the selected 7.3 format. *Line level* is the level of the signal's own standard at a terminated input: the 1 V p-p composite scale for composite video and black burst, ±300 mV for tri-level video sync. A buffered distributor may AG-couple its PASSTHRU outputs when its manual says so.

CABLES

A VID-75 cable shall be a 75 Ω coaxial cable, with RCA, BNC, or SMA plugs, that connects center pin to center pin and shell to shell at both ends (V75-007).

SUMMARY

ITEM	VALUE
Jack	RCA, BNC, or SMA jack, insulated from the panel (recommended)
Center pin	video
Shell	0 V
Signal	The video reference: black burst, or bi-level or tri-level video sync, of the selected clause 7.3 format
Line impedance	75 Ω
COAX-IN	Terminated input: 75 Ω to 0 V at the jack; a module's VID-REF-IN.
COAX-OUT	Back-terminated output: 75 Ω series source, driven at twice the line level so that the terminated line sees the line level; a module's VID-REF-OUT or a distributor's PASSTHRU.

ITEM	VALUE
COAX-PASSTHRU	Buffered pass-through: A COAX-OUT driven from the reference at REF-IN, one COAX-IN load; a module's REF-PASSTHRU, marked PASSTHRU. Not a reference the module generates.
COAX-LOOPTHRU	Loop-through pair: Two bridged jacks on one line with a termination switch: 75 Ω to 0 V across the line when TERM is on, no load when off; a module's REF-LOOPTHRU form of REF-IN.
Topology	Star. One source, a VID-REF-OUT or an external reference at a distributor's VID-REF-IN, feeds each tree; each VID-REF-PASSTHRU or VID-REF-OUT drives one COAX-IN load. An output is not split passively.
Cable	75 Ω coaxial with RCA, BNC, or SMA plugs; center pin to center pin, shell to shell at both ends

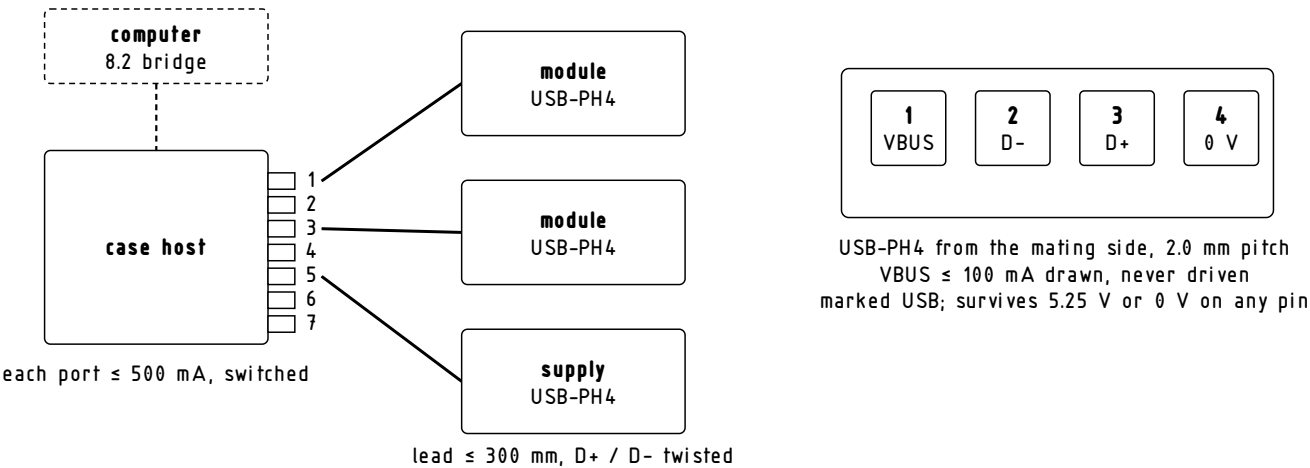
PART 5 — CONTROL

How a product's settings are seen and changed from outside it. *CTRL-USB* (8.1) is a feature: a USB 2.0 service port behind the panel through which a case host, or MIDI 2.0 software on a computer, lists and sets a product's parameters with the MIDI-CI Property Exchange standards. The host bridge protocol (8.2) is what a case host offers a computer so that the computer reaches each product's console, and updates its firmware, through the host. This part is a protocol specification; nothing in it changes whether a product fits a row or patches to another.

8.1 USB SERVICE PORT AND PARAMETER INTERFACE (CTRL-USB)

CTRL-USB is an optional feature in two roles: a *CTRL-USB device*, a module, supply, converter, bus board, or enclosure whose settings are seen and changed through a *CTRL-USB port* behind its panel; and a *case host*, a module or a bus board that connects to those ports and edits them. The leads between them are cables of the feature; a claim file gives the role. The port is a USB 2.0 device; its parameters follow the MIDI 2.0 standards of the MIDI Association and AMEI, so any conforming host, and any MIDI 2.0 software on a computer, can list and set them without knowing the product. EIS adds what those standards leave open: the connector, the read-back of current values, and an optional description of units. The figures are in `data/ctrl_usb.json`; the units schema is `data/ctrl-units-v1.schema.json`.

EIS · CTRL-USB: a case host, its ports, and the USB-PH4 port behind each product



A USB 2.0 full-speed device on USB-PH4 (USB-001), marked and robust (USB-002), drawing ≤ 100 mA from VBUS (USB-003); a straight lead (USB-004).

The host limits and switches each port (USB-013) and numbers it (USB-014).

THE PORT

A CTRL-USB device shall have a USB 2.0 full-speed device port on a USB-PH4 connector with the pin functions tabulated below (USB-001). The port shall be marked USB beside it and shall withstand 5.25 V or 0 V on any of its pins without damage (USB-002): a lead made for another purpose with the same housing can be fitted to it. A product shall draw no more than 100 mA from VBUS at its CTRL-USB port and shall not drive VBUS (USB-003). In a row it runs from its power entries (6.1); VBUS may power it on a bench.

VARIANT	HEADER (REFERENCE)	MATING HOUSING (REFERENCE)	RATED PER CIRCUIT (A)
USB-PH4	JST B4B-PH-K-S (top entry) or S4B-PH-K-S (side entry)	JST PHR-4 with SPH-002T-P0.5S crimp terminals	2

USB-PH4 pins

PIN	FUNCTION
1	VBUS
2	D-
3	D+
4	0 V (GND)

FIGURE	VALUE
Signalling	USB 2.0 full speed, 12 Mbit/s
VBUS drawn by a device	at most 100 mA; never driven
Withstood on any pin	5.25 V or 0 V
Lead	at most 300 mm, D+ and D- twisted, at least 28 AWG
Case host port	current limit at most 500 mA, switched per port

A CTRL-USB lead shall connect each pin to the same pin at both ends, be no longer than 300 mm, and twist the D+ and D- conductors as a pair (USB-004). The CTRL-USB lead joins the 0 V of the two products it connects, like a patch cable (6.3).

IDENTITY

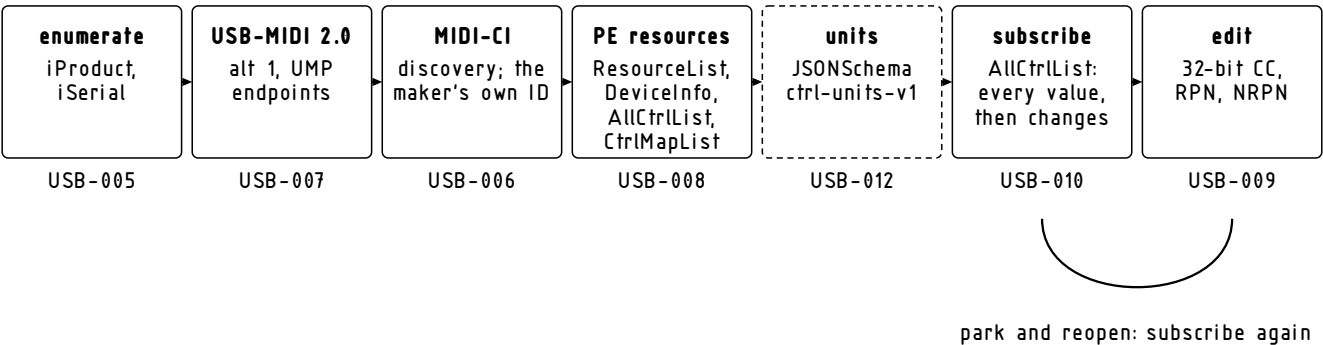
A CTRL-USB device's iProduct string shall be the product name its claim gives, and its iSerial string shall be unique to the unit and the same at every enumeration (USB-005). A host tells two units of one product apart by iSerial, and finds a unit again after it moves to another port. Products of one maker may share a USB product ID; iProduct names the product.

A CTRL-USB device shall use its maker's own System Exclusive manufacturer ID in MIDI-CI, never the non-commercial ID 7D (USB-006). A manufacturer ID is a paid, one-time registration with the MIDI Association; it is the one cost this feature puts on a maker.

PARAMETER INTERFACE

A CTRL-USB device shall present a USB-MIDI 2.0 function with alternate setting 1 carrying one Universal MIDI Packet endpoint pair, and alternate setting 0 carrying USB-MIDI 1.0 (USB-007). It shall answer MIDI-CI discovery and Property Exchange with the resources ResourceList, DeviceInfo, and AllCtrlList, and CtrlMapList when any control is a toggle or a list (USB-008). Each AllCtrlList entry shall give a CtrlMapList for a toggle or a list and a stepCount for a control that moves in steps, and shall be set by a 32-bit Control Change, RPN, or NRPN message (USB-009).

EIS · CTRL-USB: what a case host asks a device, from enumeration to edited values



The host knows no product: it lists and sets controls with these standard steps alone (USB-015). Units are optional; without them it shows a percentage, the step, or the map's titles. A device keeps working when parked (USB-011) and the host subscribes again when it reopens it (USB-016).

The standards give a host no way to read a control's current value. On a Property Exchange subscription to AllCtrlList, a CTRL-USB device shall send the current value of every control whose transmit is not false as its controller message, and send it again whenever it changes (USB-010). A CTRL-USB device shall keep working when a host closes its MIDI endpoints and opens them again (USB-011); a host with few endpoints parks the devices it is not showing.

UNITS

A control's 32-bit value says nothing of its engineering units. A device that gives an x-units object on a controller entry shall serve the ctrl-units-v1 schema as the JSONSchema resource with resId ctrl-units-v1 and follow it (USB-012): the engineering values at the two ends of the entry's range, mapped linearly, with a unit, decimals, a fine and a coarse step, and the origin of a bipolar bar.

FIELD		MEANING
min	required	Engineering value at minMax[0]
max	required	Engineering value at minMax[1]
unit	optional	Shown after the value: an SI symbol (ns, kHz, ms, V), %, °, or a short word
decimals	optional	
step	optional	Fine step in engineering units; values are rounded to it. Default 10 ^{-decimals}
coarse	optional	Normal (coarse) step; default = step

FIELD	MEANING
zero	optional Bar origin for bipolar controls; default 0 when $\min < 0 < \max$, else min

Mapping: $v = \min + (\text{raw} - \text{minMax}[0]) / (\text{minMax}[1] - \text{minMax}[0]) \times (\max - \min)$; a value outside minMax is clamped.

EIS recommends x-units on every continuous control: "+2000 ns" tells the user more than "53.1 %". A host that finds no ctrl-units-v1 resource ignores every x-units the device sends and shows the standard fields.

CASE HOST

A case host is a module or a bus board in the host role: it claims module (CTRL-USB-HOST) or bus board (CTRL-USB-HOST), meets every requirement of its own role, and these as well. A case host shall give each downstream port its own current limit of at most 500 mA and a switch that power-cycles that port alone (USB-013), and shall mark each downstream port with the number it shows for that port (USB-014). It shall find and edit the controls of any CTRL-USB device with the interfaces of this clause alone, showing a control without x-units by its standard fields: a percentage of its range, its step, or its map's titles (USB-015). A case host that closes a device's endpoints shall subscribe to AllCtrlList again when it opens them (USB-016).

A case host that offers a computer a link to the products behind it, for their consoles or their firmware, shall implement the host bridge protocol of 8.2 (USB-017). The products' own console commands and firmware formats stay their makers'.

tools/pe_check.py checks a device's Property Exchange resources, saved as JSON, against USB-008, USB-009, and USB-012; data/examples/pe-video-reference-generator.json is a worked example.

8.2 HOST BRIDGE PROTOCOL

A case host that offers a computer a link to the products behind it implements this protocol (USB-017, 8.1). The computer then reaches each product's console through the host, and updates a product's firmware through the host, without the product ever appearing on the computer's own USB. The machine-readable form is data/bridge_v1.json.

8.2.1 THE LINK

The host is a USB device on the computer with one CDC interface. In *console mode* the interface carries the host's own text console, whose commands are the host maker's. The console command bridge switches it to *bridge mode*: framed binary, until a CLOSE frame on channel 0 or until the computer drops DTR. One interface for both keeps the computer from having to tell two interfaces apart.

8.2.2 FRAMES

Each frame is COBS-encoded and ends with one 0x00 byte; multi-byte fields are little-endian. CRC: CRC-16/CCITT-FALSE (poly 0x1021, init 0xFFFF, no reflection, no final XOR) over every field before it.

FIELD	BYTES	
ver	1	Protocol version, 1
chan	1	0 is the control channel; 1 to 255 are assigned by open or update
type	1	Frame type, below
seq	2	Per channel; a reply echoes the request's seq
len	2	Payload length, at most max_payload
payload	len	JSON for CTRL and EVENT; bytes for DATA; a u32 byte count for CREDIT
crc	2	CRC over the fields above

TYPE	CODE	
CTRL	1	A request, or the reply to one
EVENT	2	Something changed; no reply
DATA	3	Bytes for a tunnel or an update
CREDIT	4	The receiver grants more bytes on the channel
CLOSE	5	The channel ends; on channel 0, bridge mode ends

A frame with a bad CRC or a bad COBS encoding is dropped. The sender of a request retries it after a timeout. Flow control is by credit, per channel: the receiver grants bytes with CREDIT, and the sender never has more than that in flight. A host grants no more than the buffer it has for the channel.

8.2.3 CONTROL CHANNEL

Requests and replies are CTRL frames on channel 0 with JSON payloads. `hello` is the first frame of a session.

Each request is a JSON object whose `cmd` names the command; its other fields and the reply's are below.

CMD	REQUEST FIELDS	REPLY FIELDS	
<code>hello</code>	<code>proto</code>	<code>proto</code> , <code>host (fw, serial)</code> , <code>ports</code> , <code>maxPayload</code>	The first frame of a session; versions and limits
<code>ports</code>	—	for each port: <code>port</code> , <code>power</code> , <code>mode (app, update, empty)</code> , <code>usb (vid, pid, manufacturer, product, serial, classes)</code> , <code>last</code>	Each downstream port; last is the product that was on it before it entered update mode
<code>open</code>	<code>port</code>	<code>chan</code>	A tunnel: a byte pipe to the product's console interface
<code>close</code>	<code>chan</code>	—	Ends a tunnel or an update
<code>update</code>	<code>port</code> , <code>method</code> , <code>size</code> , <code>sha256</code> , <code>product</code> , and the method's own	<code>chan</code> , <code>credit</code>	Streams a firmware image on DATA frames; the method names how the host writes it
<code>power_cycle</code>	<code>port</code>	—	Switches the port's power off and on (USB-013)

EVENT	PAYLOAD FIELDS	
<code>attach</code>	the port's <code>ports</code> entry	A product appeared on a port
<code>detach</code>	<code>port</code>	A product left a port
<code>state</code>	<code>port</code> , <code>mode</code>	A port's mode changed
<code>update</code>	<code>chan</code> , <code>stage</code> , <code>pct</code> ; or stage error with code and message	Progress of an update

A product's identity in `ports` is its iSerial (USB-005), which survives the product's reboots and a move to another port. `last` is the identity a port had before it entered update mode, when a boot loader answers there in the product's place; it lets the computer recover a product that stopped in its boot loader.

8.2.4 UPDATES

`update` names a method, and the host runs that method's stages, reporting each in an update event. The host streams the image: it holds no copy, writes each block as it arrives, and checks the SHA-256 of the whole stream before the last block. One update runs at a time; tunnels to other products stay open. An abort before the write leaves the product

running; an abort during the write leaves it in its boot loader, from which the same update recovers it. The one method defined suits any product whose boot loader presents a UF2 mass-storage volume; the boot ROMs of the RP2040 and RP2350 microcontrollers are two such loaders, and a product names its UF2 family in the update request.

METHOD	FOR	STAGES	
uf2-msc	Any product whose boot loader presents a UF2 mass-storage volume	PREFLIGHT, ENTER, WAIT_LOADER, CHECK, WRITE, WAIT_APP, VERIFY, DONE	The host asks the product to enter its boot loader, waits for the mass-storage volume on the same port, checks the first UF2 block's family and size, writes each 512-byte block as it arrives, and waits for the product to return with the same iSerial

ERROR

no_module	Nothing in app mode on the port
product_mismatch	The port's iProduct is not the update's product
no_loader	The product did not enter its boot loader
loader_timeout	No boot loader appeared on the port
bad_image	The image's format, family, or size is wrong
write_failed	The host could not write a block
hash_mismatch	The streamed image's SHA-256 is not the one announced
no_app	The product did not return after the write; the port stays in update mode, recoverable

A host that updates a product whose outputs a row depends on, such as a video reference generator, asks the user before it starts: the row loses them until the product returns.

PART 6 — ASSEMBLY

The rules for the person who fits a system together (9). They bind the installer, not a product: a product conforms whether or not its owner follows them. Each protects a conforming product from a system that is put together wrongly: a row over its power budget, two transmitters on one bus line, two sources on one entry, a passive split of a video tree.

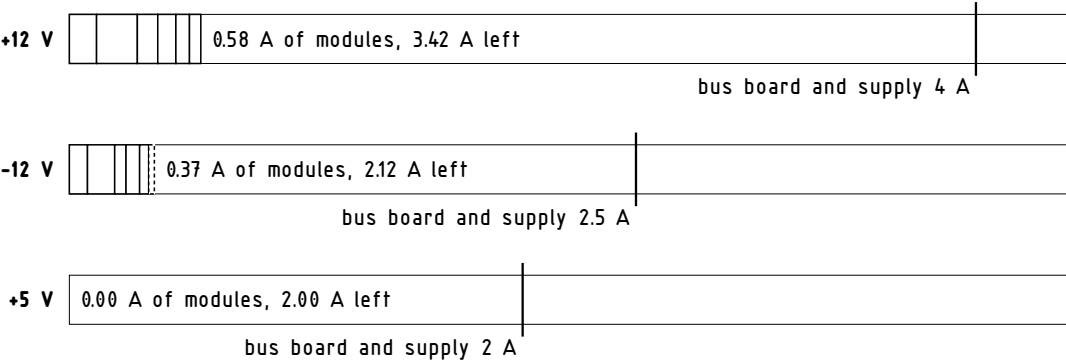
9 ASSEMBLING A SYSTEM

Rules for the person who fits modules, bus boards, supplies, power converters, DC rails, PWR-A6, and the video reference into a row. They bind the installer, not a product: a product conforms whether or not its owner follows them. Each rule protects a conforming product from a system that is put together wrongly.

9.1 POWER

A module shall be added to a row only while, on each rail of each power domain, the sum of the published currents (PWR-001) stays within the published totals of every source and every product with outlets that feeds it, such as the bus board and the supply, and the current through each outlet, such as one bus header, stays within that outlet's limit (PWR-002) (ASM-001). Each rail counts on its own, and a row with several bus boards sums each board separately. The informative row budget is a worksheet for the sum.

EIS · A row's current budget on the bus: the example row 'performance'



- ☐ Audio I/O: +12 V 0.12 A, -12 V 0.08 A
- ☐ VCO: +12 V 0.09 A, -12 V 0.05 A
- ☐ Envelope/LFO: +12 V 0.06 A, -12 V 0.04 A
- ☐ Mixer: +12 V 0.18 A, -12 V 0.12 A
- ☐ VCF/VCA: +12 V 0.08 A, -12 V 0.06 A
- ☐ MIDI utility (Type A): +12 V 0.05 A, -12 V not published

A module goes into a row only while each rail's sum stays within the bus board's totals, its per-header limit, and the supply's rating (ASM-001). The dashed segment plans a module that publishes no -12 V figure at 50 % of its +12 V draw, as EIS recommends.

When a module publishes its +12 V current but not its -12 V current, EIS recommends planning -12 V at 50 % of +12 V. In the survey of Annex F, +12 V usually runs out first.

Before a module goes in, the power is off. The ribbon is seated square at both ends with the marked conductor toward -12 V (6.4), the panel is screwed to the rails, and any blank panel that was removed is put back.

Row wiring an installer adds between a power supply, bus boards, a product with PWR-DC12 outlets, or a DC entry shall meet PWR-006 and PWR-007, with each conductor landed on a terminal of the type the product publishes (ASM-009); the terminals, gauges, and the recommended parts are in 6.1.

9.2 BUS CV AND GATE

At most one module shall transmit on each CV line and at most one on each gate line, where a line runs across linked bus boards up to a region split (ASM-002). Any number may listen (6.6). With no CV transmitter on a line, EIS recommends leaving the listening jumpers of oscillators off, so that a floating CV line cannot detune them.

9.3 DC POWER ENTRY

Installation shall not connect bus power and DC entry power to the same dual-source module at the same time (ASM-003). Installation shall not insert a DC-BAR25 plug into a DC-BAR21 DC entry (ASM-004). Each DC rail shall be fed from one adapter or one case DC entry at a time (ASM-005). A DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall be mated only with that variant's plug (ASM-006).

The product rules for the DC entry are in 6.7.

9.4 VIDEO REFERENCE

Each video reference tree in a row shall have exactly one source, a VID-REF-OUT or an external reference at one VID-REF-IN, and each VID-REF-IN shall be fed by one output (ASM-007). The product rules are in 7.4; choosing how to distribute the video reference is the informative Annex M.

9.5 PWR-A6

Each PWR-A6 entry shall be fed by one source at a time (ASM-008). A linear power converter on the bus counts in the bus budget of 9.1 at its published input current, which is about the module's own ± 6 V current; its heat counts in Annex O. The product rules are in 6.8.

TESTS

`python -m pytest tests (eis check)` runs every generator in `tools/`, every check here, and fails if a generated file in `spec/`, `figures/`, `annex/`, `data/`, or `README.md` differs from the committed one. CI runs the same (`.forgejo/workflows/checks.yml`). Each test module covers one concern and names what failed.

MODULE	WHAT IT CHECKS	WHAT IT DOES NOT DO
<code>test_model.py</code>	The document model (<code>data/document.json</code>) is consistent; every register row binds a role or an interface and names how it is verified; the identifiers match <code>data/register.lock.json</code> , never reused or resequenced, their text never changed silently; no tool types the identifier prefixes.	It does not write the lock: <code>python tools/model.py -lock</code> does, deliberately.

MODULE	WHAT IT CHECKS	WHAT IT DOES NOT DO
<code>test_generators.py</code>	Every generator listed in <code>tools/eis.py</code> validates its model and runs; the example claim files, row budget, and Property Exchange dump check; the generated files are committed.	It does not set any model.
<code>test_claims.py</code>	Claim files: product types and implied features, the power block per domain, PWR-A6 entries and a power converter.	It does not validate a product's claim; <code>eis claim FILE</code> does.
<code>test_pages.py</code>	Every relative link and <code>#anchor</code> resolves, every figure is referenced, every shall sentence carries an identifier, the prose keeps one voice (<code>links.py</code>); every figure card follows the house style (<code>figures.py</code>); every example names the edition in <code>pyproject.toml</code> (<code>eis_edition.py</code>); the site builds with no broken link.	
<code>test_sources.py</code>	HP, rack unit, and the 3U panel height match the published A-100 construction page (<code>doepfer.py</code>); the published Technical Details figures are quoted and the places EIS chose otherwise reported (<code>doepfer_technical.py</code>); every row of <code>data/video_timings.json</code> matches the hardware-verified timing contract, clock for clock (<code>video_timings_contract.py</code> , <code>--yaml PATH</code> checks a full one); the survey copy in <code>data/survey/</code> is the eis-reference survey when that checkout is beside this one (Annex F itself is checked by the generator, <code>tools/survey.py --check</code>).	None of these sets a model: a difference is reported, not applied.

The scripts `links.py`, `figures.py`, `eis_edition.py`, `doepfer.py`, `doepfer_technical.py`, and `video_timings_contract.py` also run on their own (`python tests/links.py`).

Construction page: Construction Details A-100, retrieved 2026-10-09.

Signal page: Technical Details A-100, retrieved 2026-10-16. The comparison is summarized in Annex E. Where each normative number comes from is in the requirements register.

INFORMATIVE ANNEXES

These annexes collect reference data, catalog research, and planning aids.

An annex marked informative imposes no requirement; an annex marked normative is cited by a requirement that applies it.

ANNEX	TITLE	USE IT FOR
A	Collected rail sections	The rail section EIS recommends, catalog rail sections, and the screw that fits each
B	Rail sections outside the recommended limits	Catalog rails a new design does not copy
C	Rails with no published section	What is known of rails sold without a drawing
D	Rail insert catalog	Catalog inserts and slide nuts against the recommended section
E	A-100 reference figures	Where EIS restates or differs from the Doepfer pages
F	Eurorack module survey	Module widths, depths, and currents; case depths
G	Verification measurements	How each requirement is verified, and typical bench checks for a claim
H	Patch level map	The patch classes on one page
I	Port vocabulary	Names for ports that are not patch jacks
J	Front panel stiffness and extra mounting holes	When a wide panel needs more than four holes
K	Designer's guide	What each product claims, and where to start reading
L	Row budget	A planning worksheet for one row
M	Video reference distribution	The video reference behind the panel: direct links or a tree, never patched
N	Expanders and inter-module links	Expander headers, I ² C, and analog links behind the panel
O	Heat and mechanical load	A row's dissipation, a case's temperature rise, screw torque, and module mass
P	Rationale	Why each requirement exists, one line each
Q	Worked examples	A module, a case, and a video row taken to their claims

ANNEX A (INFORMATIVE) — COLLECTED RAIL SECTIONS

The requirements that make a panel fit a row are in 5.3. Everything else about a rail, an insert, and a screw is practice, collected here: the section

EIS recommends for a new rail (A.0), catalog rail sections (A.1, A.2), and the screw that fits each (A.3).

The T-strut height is drawing 5280006. The inner face is the 34560-184 section with the mounting hole on the cavity center.

CONSTANT	VALUE	SOURCE
T-strut height across the panel	7.391 mm	Vector, drawing 5280006
Inner face, in from the mounting hole	5.075 mm	Schroff, 34560-184

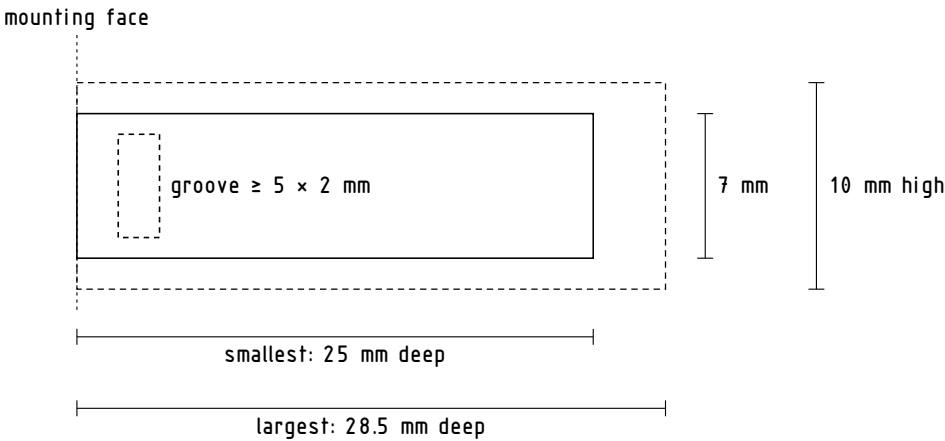
A.0 RECOMMENDED SECTION, STRIP, AND SCREW

A new rail that stays inside these limits takes the 5.0 mm × 2.0 mm M3 strip most Eurorack cases use and a 6, 8, or 10 mm screw. They are the envelope of the two extrusions EIS measured, the Vector T-strut at the small end and the Schroff L-KD at the large, rounded; a rail built another way conforms if it meets 5.3.

RAIL SECTION	MILLIMETERS
Height, across the panel	7.0 to 10.0
Depth, front face to back face (F + D + G)	25.0 to 28.5
Lip, if present, across the panel	at most 1.5
Lip, if present, into the case	at most 3.1
Groove, across	at least 5.0
Groove, into the rail	at least 2.0

A lip is optional. Where present it covers at most 1.5 mm across the panel and extends at most 3.1 mm into the case from the mounting face, corner radius included. The groove admits a rectangular insert 5.0 mm across and 2.0 mm thick; a larger groove is fine so long as that rectangle enters and stays. The throat in front of the insert clears 3.0 mm (RAIL-009). EIS recommends that a rail maker publish the insert seat, the screw-cavity depth D, and a screw length that fits the window (RAIL-009).

EIS · The recommended rail section



 the smallest section  the largest

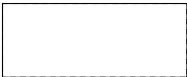
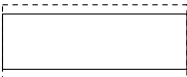
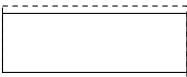
A rail whose section lies between the two takes the 5.0 mm × 2.0 mm insert and a 6, 8, or 10 mm screw. A lip is optional: at most 1.5 mm across the panel and 3.1 mm into the case.

THREADED STRIP	MILLIMETERS
Across the groove	5.0
Thickness	1.5 to 2.0
Hole pitch	5.08 (RAIL-001)
First hole, from one end	3.58
Margin past the last hole	6.08

An N HP strip is $N \times 5.08 + 4.58$ mm long with N holes, or cut from a longer strip; the first hole and end margin are measured on the Schroff 34561-484 model. A slide nut fits inside the same 5.0 mm × 2.0 mm section; a DIN 562 M3 square nut, 5.5 mm across flats, does not, and M3 slide nuts for Eurorack rails are made to the groove.

EIS · Rail inserts

End sections. Dashed: the 5.0 mm × 2.0 mm groove. M3, M2.5, or #4-40 UNC; at least three thread pitches thick. No #4-40 part publishes a section.

		Thread	Form
	nVent Schroff 34561-484, tap 2.5 mm	M3	strip
	nVent Schroff 34561-3xx and 34565-196, tap 2.05 mm	M2.5	strip
	Gie-Tec 138049	M3	strip
	apra M2.5, 5 mm × 1.5 mm	M2.5	strip
	DIN 562 M2.5, 5.0 mm × 1.6 mm	M2.5	slide nut

SCREW

Lengths	6, 8, or 10 mm, measured under the head; each is the pick for at least one rail in A.3
Insert tap drill	2.5 mm, the Schroff figure
Head	Pan head with an H, Z, or hexalobular recess (ISO 7045:2011, ISO 14583:2011); at most 7.0 mm across (RAIL-010)
Finish	Zinc-plated steel, black-finished steel, or A2 stainless steel
Pick	The shortest length inside the window; where a catalog rail's seat is not published, the longest that does not bottom out through a 1.6 mm panel, then confirm three threads engage (RAIL-008)

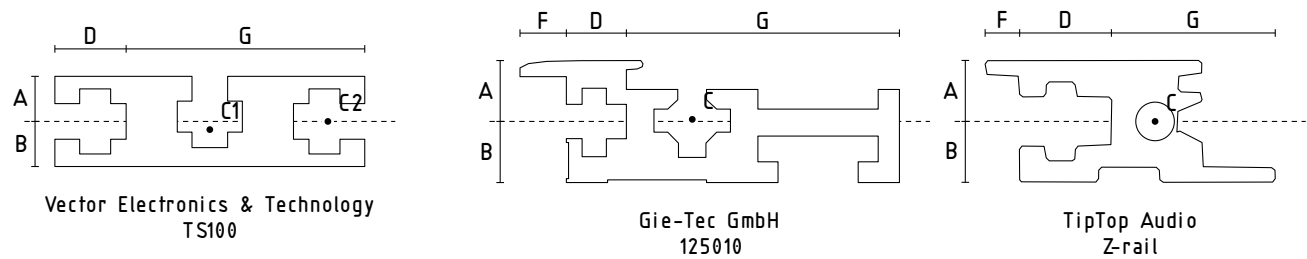
The numbers are in `data/rail.json`, `data/insert.json`, and `data/screw.json`, where the M2.5 and #4-40 rows are marked as subrack hardware outside EIS; `tools/rail.py`, `tools/insert.py`, `tools/insert_card.py`, and `tools/screw.py` check them and draw the cards.

A.1 SECTIONS WITH A 6 mm OR 8 mm SCREW

The sections on this sheet are Vector TS100, Gie-Tec 125010, and the Tiptop Audio Z-rail. Gie-Tec 125010 has a 3.8 mm lip and the Z-rail is shallower than 25.0 mm, so a new rail does not copy either; both remain reference sections. Each takes a mounting screw of 8 mm or shorter: 6 mm

or 1/4 in on Vector and Gie-Tec, at most 8 mm or 5/16 in on the Z-rail.
The table below also carries the sections in A.2.

EIS · Collected rail sections: Vector TS100, Gie-Tec 125010, TipTop Z-rail



The card is drawn by vendors/collected.py in the reference repository from the three vendor models; the letters are the datasheet figures in the table below.

A is the distance from the centerline to the upper edge, the outer face. B is the distance from the centerline to the lower edge, the inner face. Outer span is a pair of the same section with the centerlines 122.5 mm apart. It runs from one outer edge to the other, $122.5\text{ mm} + 2 \times A$. C is the center of the hole that fastens the rail to the enclosure. Cx is that center's distance from the front face, into the case. Cy is its distance from the centerline, positive toward the inner edge. F is the lip, from the left edge of the section to the front panel's mounting face. A rail with no lip has $F = 0$. D is the depth of the screw cavity, from that mounting face along the centerline to the metal that closes the cavity. G is the depth behind the cavity, from that metal to the back face. The depth of the section, from the front face to the back face, is $F + D + G$.

Columns marked datasheet come from the vendor drawing, printed there or measured on that sheet. Columns marked derived are calculated from them. G is the published depth from the front face to the back face, minus F, minus D.

The enclosure screw fastens the rail to the side of the case, through the hole at C. The published module screw is the panel fastener the vendor, or the case built on that rail, names. Vector names a #4-40 groove nut, NT4-7PA. Doepfer fastens to Gie-Tec 125010 with an M3×6 DIN 7985. TipTop names an M3 strip and no length. Schroff's own front-panel screw is an M2.5×12.3 collar screw, for 2.5 mm Schroff panels. HEITEC names none. The screw EIS picks for each section is in A.3.

SECTION	A	B	OUTER CX SPAN		CY	F	G	D ENCLOSURE SCREW	PUBLISHED MODULE SCREW
	<i>datasheet</i>	<i>datasheet</i>	<i>derived</i>	<i>datasheet</i>	<i>datasheet</i>	<i>derived</i>	<i>datasheet</i>	<i>datasheet</i>	<i>datasheet</i>
Vector TS100	3.696	3.696	129.892	12.700, 22.38	-0.67, 0	0	19.558	5.842 #10-32 UNC, HD90	#4-40 groove nut NT4-7PA
Gie-Tec 125010	4.99	5.01	132.48	14.12	0.17	3.8	22.38	4.92 M4	M3×6 DIN 7985 (Doepfer)
Tiptop Z- rail	5.00	4.99	132.50	13.93	0	2.83	13.43	7.52 M4	M3, no length
Schroff 34560 L- KD	5.03	4.97	132.56	15.75	0.17	3.00	16.50	9.00 M4×14 Torx 20	M2.5×12.3 collar screw
Schroff 34560 L- OD	5.02	4.98	132.54	12.97	0	0	16.78	9.15 M4×14 Torx 20	M2.5×12.3 collar screw
Schroff 34560 H-KD	5.00	4.98	132.50	15.75	0	3.00	21.55	9.00 M4×14 Torx 20	M2.5×12.3 collar screw
HEITEC 9908.721	4.75	5.25	132.00	15.25, 35.25	-0.75	3.00	26.60	8.85 M4×12	not published
Minimum	3.696	3.696	129.892	12.700	-0.75	0	13.43	4.92 —	—
Maximum	5.03	5.25	132.56	35.25	0.17	3.8	26.60	9.15 —	—

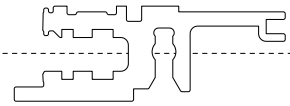
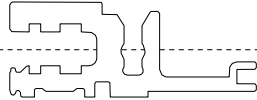
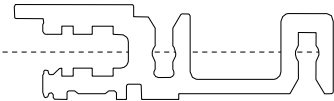
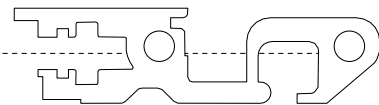
Minimum and Maximum are the extremes of the dimension columns. Where a section has two holes, both are counted. Those columns are millimeters. The screw columns are the published fastener, and they have no minimum or maximum.

A.2 SECTIONS WITH A 10 mm SCREW

These four sections have screw cavities 8.85 mm to 9.15 mm deep. On L-KD, the one whose seat is measured, a 6 mm screw does not reach the strip. The 10 mm mounting screw fastens them. Schroff L-KD and L-OD are inside the recommended rail limits. H-KD and 9908.721 are deeper than 28.50 mm behind the mounting face, so a new rail does not copy them. They remain reference sections for cases already built on them.

EIS · Rail sections that take the longer mounting screws

Screw from the mounting-screw set: the shortest length inside the window, or the longest that does not bottom out where the seat is not published.
Recommended limits: the section limits for a new rail. A catalog section outside them is still reference data.

	Screw	Within recommended limits
 nVent Schroff 34560 L-KD	M3×10, M2.5×10, #4-40×3/8	yes
 nVent Schroff 34560 L-OD	at most 10 mm or 3/8 in	yes
 nVent Schroff 34560 H-KD	at most 10 mm or 3/8 in	no, too deep
 HEITEC 9908.721	at most 10 mm or 3/8 in	no, too deep

The seat in L-KD is measured on the 34560-184 section. The strip groove runs from 8.2 mm to 10.4 mm behind the front face, which is 5.2 mm to 7.4 mm behind the mounting face, and the cavity closes 9.00 mm behind the mounting face. The other three sections are catalog figures that do not show the insert seat.

A.3 MOUNTING-SCREW PICKS

Each pick is the shortest screw inside the length window of 5.3. M3 is the EIS thread; the M2.5 and #4-40 columns are for cases built on subrack hardware. "At most" marks a section whose insert seat is not published. That length is the longest that does not bottom out through a 1.6 mm panel.

SECTION	M3	M2.5	#4-40 UNC
Vector TS100	6 mm, only on a throat above 3.0 mm	6 mm	1/4 in
Gie-Tec 125010	6 mm	6 mm	1/4 in
Tiptop Z-rail	at most 8 mm	at most 8 mm	at most 5/16 in
Schroff 34560 L-KD	10 mm	10 mm	3/8 in
Schroff 34560 L-OD	at most 10 mm	at most 10 mm	at most 3/8 in
Schroff 34560 H-KD	at most 10 mm	at most 10 mm	at most 3/8 in
HEITEC 9908.721	at most 10 mm	at most 10 mm	at most 3/8 in

The Vector throat on drawing 5280006 is 0.115 in, +0.015 / -0, which is 2.921 mm to 3.302 mm. An M3 screw, 3.0 mm nominal, passes only when the throat is made above its nominal. #4-40, at 2.845 mm, and M2.5 pass at any throat inside the tolerance. Seats and cavities are in data/screw-fits.json. tools/screw.py computes this table.

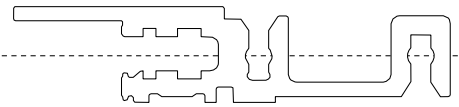
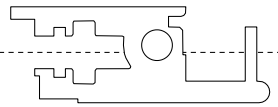
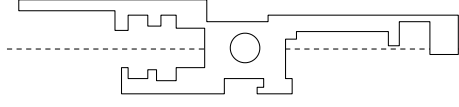
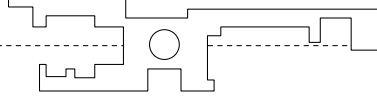
ANNEX B (INFORMATIVE) — RAIL SECTIONS OUTSIDE THE RECOMMENDED LIMITS

These catalog sections have a lip outside the recommended lip limits in A.0: more than 3.1 mm into the case, or more than 1.5 mm across the panel. A front panel does not sit flat on the mounting face of these rails.

SECTION	LIP
Schroff 34560 H-LD	11.25 mm past the mounting face
HEITEC 3684.562	2.5 mm printed projection across the panel
Verotec 959-262227	10.71 mm past the mounting face
Verotec 959-262230	3.23 mm past the mounting face

EIS · Rail sections outside the recommended limits

Lip too long: more than 3.10 mm into the case, or more than 1.50 mm across the panel. 3684.562 prints a 2.5 mm projection across the panel.

	Lip too long
 nVent Schroff 34560 H-LD	yes
 HEITEC 3684.562	yes
 Verotec 959-262227	yes
 Verotec 959-262230	yes

HEITEC 3684.562 is also shallower than 25.0 mm, front face to back face.
H-LD and both Verotec sections are also deeper than 28.5 mm.

ANNEX C (INFORMATIVE) — RAILS WITH NO PUBLISHED SECTION

These rails are sold. No cross-section was found, so none is drawn.

RAIL	WHAT WAS FOUND
Synthrotek	A drill template. No cross-section. The bracket screw is a #10-24 × 1 in screw into the center slot.
SynthRacks	No drawing. One face has a lip and the other has none. The case screw is an M5×35. The module screw is an M3. The end fixing takes the same M5 screw as a Gie-Tec rail.
Elby Designs Construct-A-Rack	No cross-section. The rail end is tapped M5. A module is fastened with an M3×10 screw, or an M2.5 screw. M3×10 is an EIS mounting screw; M2.5 is subrack hardware outside EIS.
apra 241-022	Standard module rail. The catalog gives M2.5 threaded inserts, 7 mm × 2 mm. That insert is wider than the recommended groove; apra's 5 mm × 1.5 mm M2.5 insert fits the recommended groove (A.0) but is subrack hardware, not an EIS insert (RAIL-003). The catalog does not print the rail section. Part 241-049 is the same rail with a 10 mm roof for an extractor handle.
Elma IEC and IEEE front extrusions	The retrieved datasheets are front panels, not the subrack rail. The rail section was not in them.
Polyrack FerroRAIL	An optional IEEE 1101.10 front rail is named. The catalog does not print its section.
Tech Creation Lab, Exploding Shed	Type A has a lid. Type B has no lid. Each has a low-profile version, the same rail without the back. The module screw is M3. The case hole is an untapped M5. No section is published.
MDLR	Rails in the cases are flush with the side and take an M3 threaded insert. No section is published.

A search of manufacturer pages and of ModWiggler and Reddit found no published rail section from Intellijel, 4ms, Befaco, Erica, Make Noise, Pittsburgh, Arturia, Behringer, or Cre8audio. Community DXF files of the Synthrotek rail and of the Gie-Tec rail are not manufacturer drawings, so they are not used here.

ANNEX D (INFORMATIVE) — RAIL INSERT CATALOG

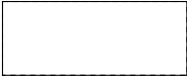
Insert requirements and the recommended section are in Rail inserts. This annex lists catalog parts against them. M2.5 and #4-40 parts are subrack hardware, not EIS inserts (RAIL-003).

D.1 PARTS WITH A PUBLISHED SECTION

INSERT	FORM	THREAD	WHAT WAS PUBLISHED
nVent Schroff 34561-484	Threaded strip	M3	5.0 mm by 2.0 mm, tap drill 2.5 mm, pitch 5.08 mm, 84 holes, 431.3 mm, nickel plated. The order line calls the family zinc-plated steel.
nVent Schroff 34561-384, -320, -328, -340, -342, -363, and 34565-196	Threaded strip	M2.5	5.0 mm by 2.0 mm, tap drill 2.05 mm, zinc. Same section and hole pattern as 34561-484, in 84, 20, 28, 40, 42, 63, and 196 HP lengths respectively.
Gie-Tec 138049	Threaded strip	M3	5.0 mm by 2.0 mm, pitch 5.08 mm. 426.7 mm at 19 inch. 203.2 mm at 10 inch.
apra threaded insert	Threaded strip	M2.5	5 mm by 1.5 mm. The hole pattern is not printed.
DIN 562 M2.5	Slide nut	M2.5	Square nut, nominal 5.0 mm across flats and 1.6 mm thick.

EIS · Rail inserts

End sections. Dashed: the 5.0 mm × 2.0 mm groove. M3, M2.5, or #4-40 UNC; at least three thread pitches thick. No #4-40 part publishes a section.

		Thread	Form
	nVent Schroff 34561-484, tap 2.5 mm	M3	strip
	nVent Schroff 34561-3xx and 34565-196, tap 2.05 mm	M2.5	strip
	Gie-Tec 138049	M3	strip
	apra M2.5, 5 mm × 1.5 mm	M2.5	strip
	DIN 562 M2.5, 5.0 mm × 1.6 mm	M2.5	slide nut

Gie-Tec prints 426.7 mm for the 19-inch strip and 203.2 mm for the 10-inch strip. Those lengths are catalog figures. They are not the EIS strip length formula. The Schroff strips are listed in `vendors/schroff/inserts.json` in the reference repository.

D.2 INSERTS WITHOUT A PUBLISHED SECTION

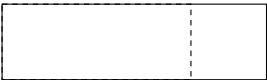
INSERT	FORM	THREAD	WHAT WAS PUBLISHED
Tiptop Audio Z-rail strip	Threaded strip	M3	Mild steel, pitch 5.08 mm. No section.
Synthrotek SN-3MM	Slide nut	M3	The seller says it fits Synthrotek and Vector rails. No section.
Tech Creation Lab	Threaded strip, or slide nut	M3	No section.
Elby Designs	Threaded strip	M3, or M2.5 as an option	No section.
MDLR	Threaded insert	M3	No section.
Pulp Logic square rail nuts	Slide nut	M2.5	The seller prints no section.
Vector NT4-7PA	Groove nut	#4-40	Vector's own nut for the T-strut. No section was retrieved.

Whether each fits the recommended groove, and is three thread pitches thick, is not published.

D.3 INSERTS OUTSIDE THE RECOMMENDED SECTION

EIS · Inserts outside the recommended section

End sections. Dashed: the 5.0 mm × 2.0 mm groove. These parts do not enter it.

		Thread	Reason
	DIN 562 M3, 5.5 mm × 1.8 mm	M3	Wider than 5.0 mm
	apra M2.5, 7 mm × 2 mm	M2.5	Wider than 5.0 mm

INSERT	WHY
DIN 562 M3	Nominal 5.5 mm across flats and 1.8 mm thick. Wider than the 5.0 mm groove, and wider than the 5.334 mm head of the Vector T-slot.
apra threaded insert, M2.5, 7 mm × 2 mm	Wider than the 5.0 mm groove. It fits the apra rail, not every rail of the recommended section.

ANNEX E (INFORMATIVE) — A-100 REFERENCE FIGURES

Where EIS restates the Doefer A-100 pages, and where it differs from them.

E.1 CONSTRUCTION DETAILS

Doefer publishes Construction Details A-100, retrieved 2026-10-09. EIS restates some of its figures as inherited requirements; it does not apply the page by reference. The A-100 check compares selected figures with EIS.

FIGURE ON THE PAGE	VALUE	EIS REQUIREMENT	PROVENANCE
3U front panel height	128.5 mm	PANEL-006, 128.5 mm	inherited
Front panel mounting-hole inset	3.0 mm	PANEL-008	inherited
Front panel mounting-hole drill	Ø3.2 mm	PANEL-010	inherited
Front panel thickness	2 mm	PANEL-004, at most 2.0 mm; EIS recommends 1.6 mm to 2.0 mm	inherited; EIS
Front panel widths	below N × 5.08 mm	PANEL-002, at most N × 5.08 mm for any positive whole N; EIS recommends 0.3 mm below	inherited; EIS
Mean front panel width gap	0.309 mm	The 0.3 mm width clearance EIS recommends	EIS

The panel figures EIS derives from these are in 5.2.1.

E.2 TECHNICAL DETAILS

Doefer publishes Technical Details A-100, retrieved 2026-10-16. The signal check quotes its figures and reports where EIS differs. The page's patch levels are typical ranges; modules in use exceed them, and an input has to accept what an output may send, so EIS sets audio and control CV at ±10 V peak.

FIGURE ON THE PAGE	VALUE	EIS CLASS	PROVENANCE
Audio	typically 10 Vpp (-5 to +5 V)	MOD-AUDIO ±10 V peak	EIS
LFO	-2.5 to +2.5 V	MOD-CV at range B5 (±5 V)	EIS
ADSR	0 to +8 V	MOD-CV at range U10 (0 to +10 V)	EIS

FIGURE ON THE PAGE	VALUE	EIS CLASS	PROVENANCE
Gate, trigger, clock	typically 0/+5 V; above about +3 V is high, below 1 V is low; withstands up to +12 V	<i>MOD-GATE</i> high $\geq +3$ V, low $\leq +1$ V; <i>BUS-GATE</i> 0/+5 V	inherited
Pitch CV	1 V per octave; no CV value is assigned an absolute pitch	<i>MOD-CV-1VOCT</i> 1.00 V/octave, 0 V = C0 (the reference is EIS's); <i>BUS-CV</i> 1 V/octave	EIS; inherited
Input and output impedance	not stated	1 k Ω source, 100 k Ω load	EIS

ANNEX F (INFORMATIVE) — EURORACK MODULE SURVEY

Generated by `tools/survey.py` from the copy of the eis-reference survey in `data/survey/` (copied at commit 3604e0e, 2026-10-20). Do not edit by hand.

The figures come from makers' pages, manuals, drawings, and listings, and each row keeps its source. They are evidence for EIS recommendations, not requirements. The samples are not random: they follow the makers whose figures could be found. F1 shows where the figures come from and how much the result moves when every maker counts equally. Community-entered listing figures are not used.

F.1 MODULE DEPTH

Depth behind the panel's back face, as each maker or listing states it.

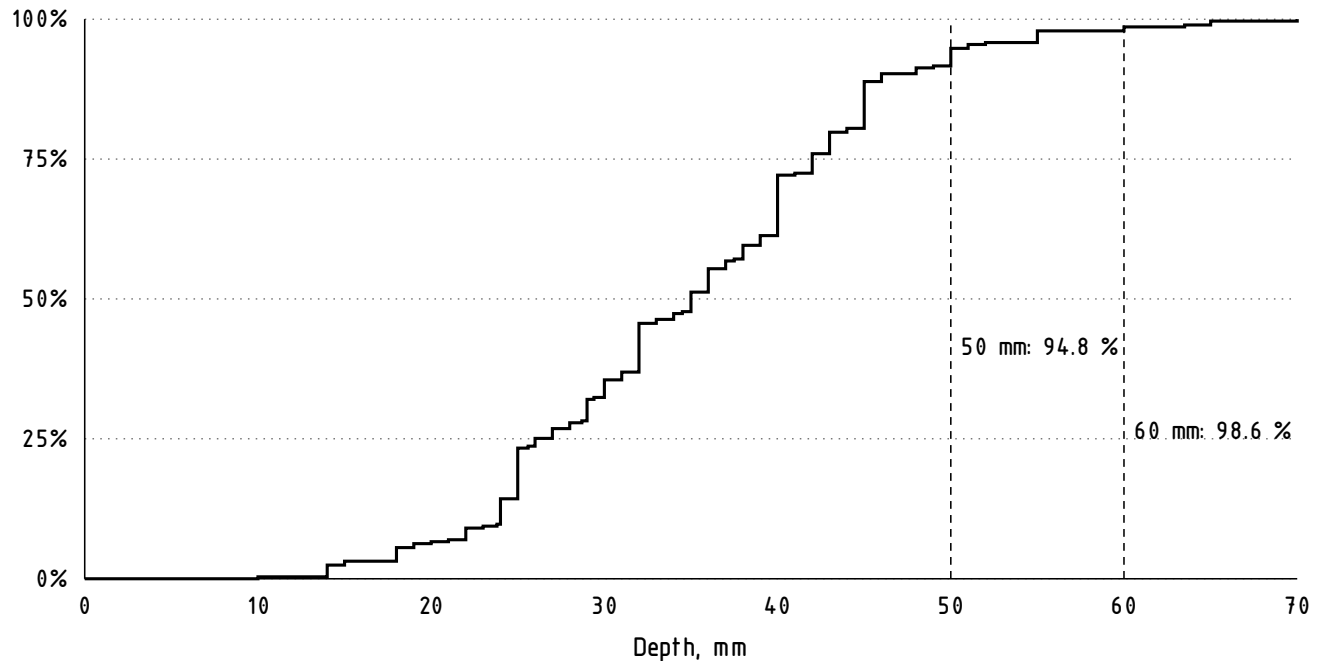
SAMPLE	MODULES	MIN	MEDIAN	90TH	95TH	MAX	≤ 50 mm	≤ 60 mm
Depth survey	19	31	32	45	63.5	63.5	94.7 %	94.7 %
Flight-case sample	268	10	35	48	51	100	94.8 %	98.9 %
Combined	287	10	35	46	51	100	94.8 %	98.6 %

The depth survey covers Doepfer and LZX Industries; 2 rows have sources that disagree and keep the survey's figure. The flight-case sample is a second sample: Intellijel, Tiptop, 4ms, Make Noise, Expert Sleepers, a 23-module Doepfer spot sample, and Xaoc, each from the maker's spec page. No module is in both samples. Percentiles are nearest-rank.

SOURCE OF THE FIGURE	DEPTH SURVEY	FLIGHT-CASE SAMPLE
maker page	12	268
retailer listing	7	0

Weighting each of the 8 makers equally, rather than each module, 92.8 % are within 50 mm and 97.8 % within 60 mm, and the median of the makers' medians is 34 mm.

EIS · Module depth behind the panel, 287 surveyed modules



Makers with at least ten modules in the combined sample:

MAKER	MODULES	MEDIAN	MAX
Intellijel	73	32	45
Tiptop Audio	47	40	52
4ms	41	25	40
Make Noise	32	36	48
Expert Sleepers	30	42	51
Doepfer	25	50	100
Xaoc Devices	22	32	46
LZX Industries	17	32	63.5

Bearing on EIS: 94.8 % of the combined sample is within the 50 mm module depth EIS recommends, which is also the deepest common right-

angle board depth (5.2.2). A row with 50 mm clear, which EIS also recommends, takes the same share.

F.1.1 COMMERCIAL CASES

cases.json: the deepest and shallowest module depth that 25 current cases from 11 makers take, from the makers' pages (checked 2026-09-26).

The shallow figure is usually over the supply or the bus board.

MAKER	CASE	ROWS	HP PER ROW	DEEPEST, mm	SHALLOWEST, mm
Intellijel	7U Performance Case Gen-2 104HP	2x3U + 1U	104	73	43
Intellijel	4U Palette 62HP	1x3U + 1U	62	45.5	37.4
Intellijel	4U Palette 104HP	1x3U + 1U	104	45.5	37.4
Tiptop Audio	Mantis	2x3U	104	61	50
Make Noise	2 Zone Skiff	1x3U	104	63.5	50.8
Make Noise	4 Zone CV Bus Case	2x3U + CV bus row	104	63.5	63.5
Doepfer	A-100 LC6 (PSU3)	2x3U	84	110	80
Doepfer	A-100 LC9 (PSU3)	3x3U	84	110	80
Doepfer	A-100 P6 suitcase (PSU3)	2x3U	84	100	70
Doepfer	A-100 P9 suitcase (PSU3)	3x3U	84	100	70
Erica Synths	1x42HP Pico Case	1x3U	42	35	35
Erica Synths	2x84HP Aluminum Skiff	2x3U	84	55	33
Erica Synths	2x104HP Carbon Travel Case	2x3U	104	67	54
Befaco	7U Case	2x3U + 1U	104	70	53
4ms	Pod20 (powered)	1x3U	20	34	34
4ms	Pod48X (powered)	1x3U	48	50	50
4ms	Pod60 (powered)	1x3U	60	34	34
4ms	Pod64X (powered)	1x3U	64	55	55
4ms	Pod104X (powered)	1x3U	104	55	55
Behringer	EuroRack Go	2x3U	140	62	40
Arturia	RackBrute 3U	1x3U	88	53	53
Arturia	RackBrute 6U	2x3U	88	75	53
Pittsburgh Modular	Structure 208 Travel Case	2x3U	104	95.3	69.9
Pittsburgh Modular	Structure 360 Travel Case	3x3U	120	95.3	69.9
Cre8audio	NiftyCASE	1x3U	84	55	55

Bearing on EIS: 20 of 25 current cases give 50 mm somewhere in the row and 17 of 25 give it everywhere; the median case is 62 mm at its deepest and 53 mm at its shallowest. The 50 mm clear depth is a recommendation for that reason: some cases on sale today do not meet it over the supply.

F.2 MODULE CURRENT DRAW

module-power.json, read 2026-09-30: 223 modules, each from the maker's own figure. Figures are the stated maximums. The statistics use the 219 modules with a width and both 12 V figures that draw from the bus; power sources and host-powered modules are left out.

RAIL	MEDIAN mA/HP	90TH mA/HP	MEAN mA/HP
+12 V	11.2	39.0	15.6
-12 V	2.5	11.7	4.3

None of the 219 modules with a known +5 V figure draws +5 V from the bus. Modules with a jumper-selectable +5 V (some 4ms and Noise Engineering modules) are recorded in the setting that takes none. 13.7 % draw nothing on -12 V. The largest +12 V draw in the sample is 1500 mA. Over the whole sample the -12 V draw is 33 % of the +12 V draw.

Bearing on EIS: no module in the sample needs +5 V from the bus. EIS keeps +5 V optional (BUS-001, BUS-006), because the A-100 bus carries it and some modules use it.

F.2.1 SUPPLIES

supplies.json, read 2026-09-30: 99 supplies, powered bus boards, rail modules, and bricks, with each rating's source and confidence; prices are left out. 53 feed modules and state both 12 V ratings.

Median rating: 1500 mA on +12 V and 1200 mA on -12 V; the median -12 V rating is 83 % of the +12 V rating. 96 % of the 53 with a known +5 V rating provide +5 V.

Bearing on EIS: modules draw about 33 % as much on -12 V as on +12 V, and supplies are rated about 83 %, so +12 V runs out first in most rows. A row is within its supply only when each rail is (ASM-001).

F.3 BUS BOARDS

bus-boards.json, read 2026-09-30: 12 bus boards, from makers' manuals, drawings, and listings. The file also records header positions, outlines, mounting holes, and ribbon lengths.

MAKER	PRODUCT	HEADERS	CONFIDENCE	POWER INPUT
Konstant Lab	Filtered Bus Board #2	shrouded or keyed	published	other
Konstant Lab	Pocket Bus Board	shrouded or keyed	listing	other
Doepfer	A-100BUS V6	shrouded or keyed	published	1/4 in quick-connect
Synthrotek	Noise Filtering Power Distribution Board	shrouded or keyed	published	other
Synthrotek	Mini Power Distribution Board	shrouded or keyed	listing	other
Befaco	Passive Bus	shrouded or keyed	published	other
Befaco	Lunchbus	not recorded	—	not recorded
Tiptop Audio	Zeus Passive Bus Board	not recorded	—	1/4 in quick-connect
Tiptop Audio	Flying Bus Board	shrouded or keyed	published	other
4ms	Bus Stick [Shrouded Headers]	shrouded or keyed	published	other
LeftHandPooch (open hardware, GitHub)	Bus Bone EuroRack Bus Board	shrouded or keyed	published	1/4 in quick-connect
Pulp Logic	Passive Bus Block	not recorded	—	not recorded

Bearing on EIS: 9 of the 9 boards with a recorded header type use shrouded or keyed headers, which supports keying them (BUS-005). 3 take power on 1/4 in quick-connect tabs, among them Doepfer's A-100BUS V6, enough to recommend them (6.5), not to require them.

Header type is recorded per bus board, not per module. No source found records which modules use a 10-pin or a 16-pin header.

ANNEX G (INFORMATIVE) — VERIFICATION MEASUREMENTS

Typical bench checks for selected requirements. This annex adds no requirements; a product's own documented procedure, or an equivalent analysis, serves as well.

METHOD PER REQUIREMENT

Every requirement names how it is verified, from the `verify` field of `data/requirements.json`:

METHOD	MEANING
inspection	Inspection of the product, its drawings, or its documentation
analysis	Documented analysis or calculation from the product's design figures
measurement	A bench measurement against the figure the requirement states

INTERFACE PANEL, FRONT PANEL

ID	METHOD	REQUIREMENT
RACK-001	inspection	One HP shall be 5.08 mm.
RACK-002	inspection	One rack unit shall be 44.45 mm.
PANEL-001	inspection	A module shall be 1U or 3U high.
PANEL-002	inspection	An N HP panel shall be no wider than $N \times 5.08$ mm, where N is a positive whole number.
PANEL-004	inspection	A front panel shall be no more than 2.0 mm thick.
PANEL-006	inspection	A 3U front panel shall be 128.5 mm high.
PANEL-007	inspection	A 1U front panel shall be 39.65 mm high.
PANEL-008	inspection	Mounting holes shall be 3.0 mm in from the top and bottom panel edges.
PANEL-009	analysis	The mounting-hole span, on the panel and between the inserts of a row's two rails, shall be 122.5 mm at 3U and 33.65 mm at 1U.
PANEL-010	inspection	Mounting holes shall be drilled $\varnothing 3.2$ mm, or slotted 3.2 mm wide and no longer than 5.5 mm along the rail, centered on the hole position.
PANEL-011	analysis	Each mounting hole shall be a whole number of HP plus 2.54 mm from the panel's nominal left edge.
PANEL-012	inspection	A board shall stay at least 9.25 mm clear of the top and bottom panel edges, and a rail shall cover no more than 9.25 mm of the panel face at each edge.
PANEL-013	measurement: each dimension of 5.2 and 5.3 against its tolerance	A dimension of clauses 5.2 and 5.3 shall hold within the tolerance the register states for its requirement; a dimension with no tolerance stated is a limit.
PANEL-014	inspection	A front panel thinner than 1.6 mm shall ship with mounting screws whose length fits the window of clause 5.3 for its own thickness.

INTERFACE RAIL, RAIL, INSERT, AND MOUNTING SCREW

ID	METHOD	REQUIREMENT
RACK-001	inspection	One HP shall be 5.08 mm.
RACK-002	inspection	One rack unit shall be 44.45 mm.
PANEL-009	analysis	The mounting-hole span, on the panel and between the inserts of a row's two rails, shall be 122.5 mm at 3U and 33.65 mm at 1U.
PANEL-012	inspection	A board shall stay at least 9.25 mm clear of the top and bottom panel edges, and a rail shall cover no more than 9.25 mm of the panel face at each edge.
RAIL-001	analysis	The holes in a rail insert shall be 5.08 mm apart.
RAIL-002	analysis	A rail for an N HP row shall give at least $N \times 5.08$ mm of mounting length.
RAIL-003	analysis	An insert shall be threaded M3.
RAIL-004	analysis	An insert shall be at least 1.5 mm thick, three thread pitches.
RAIL-005	inspection	A mounting screw shall be M3.
RAIL-006	inspection	A mounting screw's thread pitch shall be 0.5 mm.
RAIL-007	inspection	A mounting screw's major diameter shall be 3.0 mm.
RAIL-008	inspection	The screw shall engage at least three full threads through a 2.0 mm panel.
RAIL-009	analysis	The mounting-screw length L shall satisfy $2.0 \text{ mm} + \text{seat} + 1.5 \text{ mm} \leq L \leq 1.6 \text{ mm} + D$, with seat and D measured behind the rail's mounting face, and the throat in front of the insert shall clear 3.0 mm.
RAIL-010	analysis	The mounting-screw head shall be at most 7.0 mm across.

INTERFACE PWR-BUS, THE BUS

ID	METHOD	REQUIREMENT
PWR-005	inspection	Where a power supply, a bus board, or a product with PWR-DC12 outlets takes or gives a rail or 0 V on discrete wires, each terminal shall be a 6.3 mm × 0.8 mm quick-connect tab, a stud or screw that takes a ring terminal, or a wire-clamp terminal block, and the product shall publish the terminal type and the conductor sizes it accepts.
PWR-006	inspection	A row wiring conductor between a power supply, a bus board, a product with PWR-DC12 outlets, or a DC entry shall be stranded copper, insulated and rated 105 °C or more, of at least 16 AWG, at least 14 AWG where it carries more than 5 A, and at least 12 AWG where it carries more than 8 A, terminated by a crimped terminal at each end; a joint shall not rely on solder alone.
PWR-007	inspection	The 0 V conductor between a power supply and a bus board, and between linked bus boards, shall be of at least the gauge of the rail conductors beside it.
PWR-008	inspection	Where a product bonds its 0 V to its chassis or to a protective-earth terminal, the bond shall be a conductor of at least 14 AWG with a ring terminal on a stud or screw through bare metal under a toothed lock washer, or a bus bar of equivalent section.

ID	METHOD	REQUIREMENT
BUS-001	inspection	The bus shall provide +12 V and -12 V, and may provide +5 V, at every power header.
BUS-002	inspection	A power header on a module or a bus board shall be a 2 × 5 or 2 × 8 pin header on a 2.54 mm grid, and a power cable shall end in IDC ribbon sockets that mate it.
BUS-003	inspection	A power header on a module, a bus board, or a cable shall follow the pinout of clause 6.4: -12 V on pins 1-2, 0 V on 3-8, +12 V on 9-10, and on a 16-pin header +5 V on 11-12, CV on 13-14, and gate on 15-16.
BUS-004	inspection	On a module, a bus board, and a power ribbon cable, the marked conductor shall be -12 V and shall point to the -12 V end of the header.
BUS-005	inspection	A shrouded power header on a module or a bus board shall be keyed so that, viewed from the mating side with the -12 V end at the bottom, the key gap is on the right, and a keyed cable socket shall match it.
BUS-006	inspection	A module powered from the bus shall draw only +12 V and -12 V, and may also draw +5 V.
BUS-007	inspection	A module that uses neither +5 V nor bus CV or gate may use the 10-pin header.
BUS-008	measurement: current on each rail through one header, at most 2 A	A module shall not draw more than 2 A on any rail through one power header.
BUS-009	measurement: no damage after a reversed ribbon	A module shall tolerate reverse polarity at its power header without damage.
BUS-019	inspection	A module and a bus board shall mark the -12 V end of each power header on the board.
BUS-012	inspection	The per-header limit a bus board publishes shall not exceed 2 A per rail.
BUS-013	inspection	A bus board may split CV and gate into two regions.
BUS-014	inspection	A link between two bus boards shall join CV to CV and gate to gate.
BUS-015	inspection	A power ribbon from a bus header to a module shall be no longer than 400 mm and shall use conductors of at least 28 AWG.
BUS-016	inspection	A module shall listen to or transmit bus CV or gate only when a jumper or switch on the module is set to do so.
BUS-017	measurement: BUS-CV level and impedance at the header	A module that drives or receives bus CV shall meet the BUS-CV limits of clause 6.6.
BUS-018	measurement: BUS-GATE levels and thresholds at the header	A module that drives or receives bus gate shall meet the BUS-GATE limits of clause 6.6.

ID	METHOD	REQUIREMENT
BUS-020	inspection	A bus board may also distribute a DC rail, the ± 6 V analog rails, or the video reference behind the panel, or be the case's CTRL-USB-HOST; it then claims the matching feature, PWR-DC12, PWR-A6, the VID-REF ports, or CTRL-USB-HOST, beside PWR-BUS and meets its requirements.

INTERFACE PWR-DC12, 12 V DC ENTRY

ID	METHOD	REQUIREMENT
PWR-005	inspection	Where a power supply, a bus board, or a product with PWR-DC12 outlets takes or gives a rail or 0 V on discrete wires, each terminal shall be a 6.3 mm × 0.8 mm quick-connect tab, a stud or screw that takes a ring terminal, or a wire-clamp terminal block, and the product shall publish the terminal type and the conductor sizes it accepts.
PWR-006	inspection	A row wiring conductor between a power supply, a bus board, a product with PWR-DC12 outlets, or a DC entry shall be stranded copper, insulated and rated 105 °C or more, of at least 16 AWG, at least 14 AWG where it carries more than 5 A, and at least 12 AWG where it carries more than 8 A, terminated by a crimped terminal at each end; a joint shall not rely on solder alone.
PWR-007	inspection	The 0 V conductor between a power supply and a bus board, and between linked bus boards, shall be of at least the gauge of the rail conductors beside it.
PWR-008	inspection	Where a product bonds its 0 V to its chassis or to a protective-earth terminal, the bond shall be a conductor of at least 14 AWG with a ring terminal on a stud or screw through bare metal under a toothed lock washer, or a bus bar of equivalent section.
SUP-009	inspection	A power supply may make the 12 V DC rail of 6.7 or the ± 6 V rails of 6.8, beside or instead of the bus; it then claims PWR-DC12-OUT or PWR-A6-OUT, publishes the current of each outlet, and meets that domain's outlet rules.
DC-001	inspection	A product shall publish its DC entry variant: DC-BAR21, DC-BAR25, DC-VH2, DC-DIN4, DC-MF6, or DC-MF8, as tabulated in 6.7.
DC-002	inspection	A product shall publish the minimum and maximum DC input voltage its DC entry accepts.
DC-003	inspection	A DC entry shall not use the pinout of a Eurorack 10-pin or 16-pin power header.
DC-004	inspection	A DC-BAR21 or DC-BAR25 barrel DC entry shall be center positive.
DC-005	inspection	A product with a DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall implement the pin functions tabulated for that variant in 6.7.
DC-006	measurement: no damage after a reversed barrel adapter	A module's barrel DC entry shall tolerate reverse polarity without damage.
DC-007	inspection	A straight DC barrel cable shall connect tip to tip and sleeve to sleeve at both ends.

ID	METHOD	REQUIREMENT
DC-008	inspection	A cable for a DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall connect each pin to the same pin and function at both ends.
DC-009	inspection	A product with PWR-DC12 outlets to modules shall feed them only through DC-BAR21 jacks or DC-VH2 headers, and shall not use DC-BAR25 for an output to a module.
DC-010	inspection	A cable from a PWR-DC12 outlet to a module shall end in DC-BAR21 plugs or DC-VH2 housings and connect +V to +V and -V to -V, tip and pin 1 being +V.
DC-011	inspection	A DC entry shall be marked beside it with its polarity symbol, its nominal voltage, and its maximum current.
DC-012	inspection	A product with PWR-DC12 outlets shall protect each output separately and shall publish the current at which the protection acts.
DC-013	measurement: no damage after a reversed input	A DC entry that feeds PWR-DC12 outlets shall tolerate reverse polarity without damage.

INTERFACE PWR-A6, ± 6 V ANALOG ENTRY

ID	METHOD	REQUIREMENT
PWR-008	inspection	Where a product bonds its 0 V to its chassis or to a protective-earth terminal, the bond shall be a conductor of at least 14 AWG with a ring terminal on a stud or screw through bare metal under a toothed lock washer, or a bus bar of equivalent section.
SUP-009	inspection	A power supply may make the 12 V DC rail of 6.7 or the ± 6 V rails of 6.8, beside or instead of the bus; it then claims PWR-DC12-OUT or PWR-A6-OUT, publishes the current of each outlet, and meets that domain's outlet rules.
A6-001	inspection	A PWR-A6 entry or outlet shall be an A6-VH3 connector with the pin functions tabulated in 6.8.
A6-002	measurement: each outlet rail between 5.75 V and 6.25 V from no load to rating	A PWR-A6 outlet shall hold each rail between 5.75 V and 6.25 V in magnitude from no load to its published rating.
A6-003	measurement: published behavior with each rail at 5.55 V and at 6.25 V at the entry	A module shall meet its published behavior with each PWR-A6 rail between 5.55 V and 6.25 V in magnitude at its entry.
A6-004	measurement: no damage at 6.6 V on either rail at the entry	A PWR-A6 entry shall withstand 6.6 V in magnitude on either rail without damage.
A6-005	measurement: current per rail through one entry, at most 1 A	A module shall not draw more than 1 A on either rail through one PWR-A6 entry.

ID	METHOD	REQUIREMENT
A6-006	inspection	A PWR-A6 cable shall connect each pin to the same pin at both ends, be no longer than 500 mm, and use conductors of at least 22 AWG.
A6-007	inspection	A PWR-A6 entry or outlet shall be marked ± 6 V beside it.

INTERFACE PWR-A15, ± 15 V ANALOG ENTRY

ID	METHOD	REQUIREMENT
A15-001	inspection	A PWR-A15 entry or outlet shall be an A15-MF4 connector with the pin functions tabulated in 6.9.
A15-002	measurement: each outlet rail between 14.4 V and 15.6 V from no load to rating	A PWR-A15 outlet shall hold each rail between 14.4 V and 15.6 V in magnitude from no load to its published rating.
A15-003	measurement: published behavior with each rail at 5.55 V and at 6.25 V at the entry	A module shall meet its published behavior with each PWR-A15 rail between 14.0 V and 15.6 V in magnitude at its entry.
A15-004	measurement: no damage at 16.5 V on either rail at the entry	A PWR-A15 entry shall withstand 16.5 V in magnitude on either rail without damage.
A15-005	measurement: current per rail through one entry, at most 1 A	A module shall not draw more than 2 A on either rail through one PWR-A15 entry.
A15-006	inspection	A PWR-A15 cable shall connect each pin to the same pin at both ends, be no longer than 500 mm, and use conductors of at least 20 AWG.
A15-007	inspection	A PWR-A15 entry or outlet shall be marked ± 15 V beside it.

INTERFACE PATCH, PATCH JACK

ID	METHOD	REQUIREMENT
PANEL-005	inspection	A patch jack shall be a 3.5 mm mono (TS) socket.
SIG-001	inspection	A module shall publish a port list naming, for every port, its signal class or unclassified.
SIG-002	measurement: no damage after ± 12 V held on each patch input	A patch input shall withstand ± 12 V indefinitely.
SIG-003	measurement: no damage after each patch output is shorted to 0 V and to another output	A patch output shall withstand an indefinite short to 0 V or to another patch output.
SIG-004	inspection	A patch output shall not drive the patch tip beyond ± 12 V.
SIG-005	measurement: MOD-AUDIO levels and impedances at the jack	A port claiming MOD-AUDIO shall meet the MOD-AUDIO limits of clause 7.2.
SIG-006	measurement: MOD-CV levels and impedances at the jack	A port claiming MOD-CV shall meet the MOD-CV limits of clause 7.2.

ID	METHOD	REQUIREMENT
SIG-007	measurement: 1.00 V/octave scale at the jack	A port claiming MOD-CV-1VOCT shall meet the MOD-CV-1VOCT limits of clause 7.2.
SIG-008	measurement: MOD-VIDEO levels at the jack	A port claiming MOD-VIDEO shall meet the MOD-VIDEO limits of clause 7.2.
SIG-009	measurement: 100 k Ω $\pm$ 10 % to 0 V at each MOD-VIDEO input	A MOD-VIDEO input shall present 100 k Ω $\pm$ 10 % to 0 V at the patch tip.
SIG-010	measurement: 75 Ω $\pm$ 5 % series from the buffer to the tip of each MOD-VIDEO output	A MOD-VIDEO output shall drive through a 75 Ω $\pm$ 5 % total series source impedance at the patch tip.
SIG-011	measurement: gate thresholds at the jack	A port claiming MOD-GATE shall meet the MOD-GATE limits of clause 7.2.
SIG-012	measurement: trigger edge and width at the jack	A port claiming MOD-TRIG shall meet the MOD-TRIG limits of clause 7.2.
SIG-013	measurement: clock levels at the jack	A port claiming MOD-CLK shall meet the MOD-CLK limits of clause 7.2.
SIG-014	measurement: full scale within the claimed range's ceiling; the range's full swing accepted	A port claiming a range shall meet that range's limits of clause 7.2: an output keeps its full-scale signal within the range's ceiling, and an input accepts the range's full swing without clipping.
SIG-015	inspection	A patch jack shall carry patched signals only: a module shall neither take nor give its video reference at a patch jack, and no patch jack shall list a format of clause 7.3.

INTERFACE VID-75, 75 Ω COAXIAL VIDEO PORT

ID	METHOD	REQUIREMENT
VID-001	inspection	A product's port list shall name, for each VID-REF-IN and VID-REF-OUT port, every format of clause 7.3 the port accepts or generates, by its format ID.
VID-002	measurement: line and frame timing and the video sync structure of each listed format, within the publication's tolerances	When a listed format is selected or published on a port, that port's horizontal and vertical timing and its video sync structure shall match the format's publication within the tolerances that publication states; for a progressive or high-definition format the row of clause 7.3 is that publication's raster, sample for sample.
V75-001	inspection	Every jack in a VID-75 tree shall be an RCA, BNC, or SMA jack.
V75-002	inspection	On every jack in a VID-75 tree, the center pin shall carry the video signal and the shell shall be 0 V.
V75-005	inspection	A VID-REF-OUT or VID-REF-PASSTHRU port shall drive one COAX-IN load, and an output shall not be split passively to several terminated ports.
V75-007	measurement: 75 Ω coaxial cable; center pin to center pin and shell to shell at both ends	A VID-75 cable shall be a 75 Ω coaxial cable, with RCA, BNC, or SMA plugs, that connects center pin to center pin and shell to shell at both ends.

ID	METHOD	REQUIREMENT
V75-010	inspection	A module that generates or locks to an external video reference shall take or give it at a video reference port on its rear.
V75-011	measurement: the module's video timing follows the reference at VID-REF-IN in each listed format	A product that claims VID-REF-IN shall take the video reference at its VID-REF-IN port, a COAX-IN on its rear, lock any video timing of its own to it, and list the formats it accepts.
V75-012	measurement: a video reference of each listed format at VID-REF-OUT, with no reference at VID-REF-IN	A product that claims VID-REF-OUT shall give a video reference of a listed format at its VID-REF-OUT port, a COAX-OUT on its rear, that it generates itself; a copy of a reference it takes at VID-REF-IN is a VID-REF-PASSTHRU, not a VID-REF-OUT.
V75-013	measurement: the reference at VID-REF-IN appears at VID-REF-PASSTHRU at line level into 75 Ω ; the mark PASSTHRU beside the port	A product shall claim VID-REF-PASSTHRU only with VID-REF-IN; each VID-REF-PASSTHRU port shall be a COAX-PASSTHRU, a buffered copy of the reference at VID-REF-IN driven as a COAX-OUT into one COAX-IN load, and be marked PASSTHRU.
V75-014	measurement: 75 Ω to 0 V at the loop with TERM on, no load with TERM off; the module locks either way	A product shall claim VID-REF-LOOPTHRU only with VID-REF-IN; its VID-REF-IN shall then be a COAX-LOOPTHRU, two bridged jacks on one line with a termination switch that presents 75 Ω to 0 V across the line when on and no load when off, marked TERM, and the product shall lock the same with the switch on or off.
V75-015	measurement: 75 Ω to 0 V at each COAX-IN; twice the line level open-circuit at each COAX-OUT	Every video reference port shall be a COAX-IN (75 Ω to 0 V at the jack), a COAX-OUT (75 Ω series source driven at twice the line level), a COAX-PASSTHRU, or a COAX-LOOPTHRU port, never a patch jack.
V75-016	inspection	A video reference port shall be marked beside it as an input (IN), an output (OUT), a pass-through (PASSTHRU), or, for a loop-through pair, with its termination switch (TERM).

INTERFACE CTRL-USB, USB SERVICE PORT

ID	METHOD	REQUIREMENT
USB-001	inspection	A CTRL-USB device shall have a USB 2.0 full-speed device port on a USB-PH4 connector with the pin functions tabulated in 8.1.
USB-002	measurement: no damage at 5.25 V or 0 V on each pin of the port	A CTRL-USB port shall be marked USB beside it and shall withstand 5.25 V or 0 V on any of its pins without damage.
USB-003	measurement: VBUS current at most 100 mA; VBUS never driven	A product shall draw no more than 100 mA from VBUS at its CTRL-USB port and shall not drive VBUS.
USB-004	inspection	A CTRL-USB lead shall connect each pin to the same pin at both ends, be no longer than 300 mm, and twist the D+ and D- conductors as a pair.

ID	METHOD	REQUIREMENT
USB-005	inspection	A CTRL-USB device's iProduct string shall be the product name its claim gives, and its iSerial string shall be unique to the unit and the same at every enumeration.
USB-006	inspection	A CTRL-USB device shall use its maker's own System Exclusive manufacturer ID in MIDI-CI, never the non-commercial ID 7D.
USB-007	inspection	A CTRL-USB device shall present a USB-MIDI 2.0 function with alternate setting 1 carrying one Universal MIDI Packet endpoint pair, and alternate setting 0 carrying USB-MIDI 1.0.
USB-008	inspection	A CTRL-USB device shall answer MIDI-CI discovery and Property Exchange with the resources ResourceList, DeviceInfo, and AllCtrlList, and CtrlMapList when any control is a toggle or a list.
USB-009	inspection	Each AllCtrlList entry shall give a CtrlMapList for a toggle or a list and a stepCount for a control that moves in steps, and shall be set by a 32-bit Control Change, RPN, or NRPN message.
USB-010	inspection	On a Property Exchange subscription to AllCtrlList, a CTRL-USB device shall send the current value of every control whose transmit is not false as its controller message, and send it again whenever it changes.
USB-011	inspection	A CTRL-USB device shall keep working when a host closes its MIDI endpoints and opens them again.
USB-012	inspection	A device that gives an x-units object on a controller entry shall serve the ctrl-units-v1 schema as the JSONSchema resource with resId ctrl-units-v1 and follow it.
USB-013	measurement: current limit of each downstream port at most 500 mA; each port switched alone	A case host shall give each downstream port its own current limit of at most 500 mA and a switch that power-cycles that port alone.
USB-014	inspection	A case host shall mark each downstream port with the number it shows for that port.
USB-015	inspection	A case host shall find and edit the controls of any CTRL-USB device with the interfaces of clause 8.1 alone, showing a control without x-units by its standard fields.
USB-016	inspection	A case host that closes a device's endpoints shall subscribe to AllCtrlList again when it opens them.
USB-017	inspection	A case host that offers a computer a link to the products behind it shall implement the host bridge protocol of 8.2.

ROLE: MODULE

ID	METHOD	REQUIREMENT
PANEL-003	inspection	A module shall publish its width in HP and how far it extends behind the panel's back face.

ID	METHOD	REQUIREMENT
PWR-001	inspection	A product shall publish, for each power entry, the maximum current it takes on each rail at the entry's nominal voltage, stating 0 for a rail it does not draw.
PWR-003	inspection	A product whose power entries are alternatives, each able to power it alone, shall not require more than one of them to be connected at the same time.
PWR-004	inspection	A module shall not source current into a rail of any of its power entries.
GND-001	inspection	A product shall connect every 0 V pin of its power headers and PWR-A6 entries, and the -V of its DC entry, to its 0 V.
BUS-011	inspection	A header on a module that is not its power header shall either not mate a Eurorack power ribbon socket or tolerate one fitted to it, either way round, without damage.

ROLE: ENCLOSURE

ID	METHOD	REQUIREMENT
RACK-003	inspection	A rack-mount frame shall meet IEC 60297-3-101:2004 and IEC 60297-3-100:2008 for the flange width, flange mounting-hole positions and tab, the 3U subrack aperture height, and the 84 HP row width.
RAIL-011	inspection	An enclosure shall state the mounting-screw length, and shall supply those screws or name them.
ENG-001	inspection	An enclosure shall publish, for each row, its width in HP and the depth it keeps clear behind the panel's back face.
PWR-001	inspection	A product shall publish, for each power entry, the maximum current it takes on each rail at the entry's nominal voltage, stating 0 for a rail it does not draw.
GND-001	inspection	A product shall connect every 0 V pin of its power headers and PWR-A6 entries, and the -V of its DC entry, to its 0 V.

ROLE: BUS BOARD

ID	METHOD	REQUIREMENT
PWR-001	inspection	A product shall publish, for each power entry, the maximum current it takes on each rail at the entry's nominal voltage, stating 0 for a rail it does not draw.
PWR-002	inspection	A power supply, a power converter, a bus board, and any product with outlets of a power domain shall publish the maximum current it delivers on each rail, in total and at each outlet.
GND-001	inspection	A product shall connect every 0 V pin of its power headers and PWR-A6 entries, and the -V of its DC entry, to its 0 V.
GND-002	inspection	A bus board shall join the 0 V pins of every header to one 0 V that runs to the supply's 0 V terminal.

ROLE: POWER SUPPLY

ID	METHOD	REQUIREMENT
PWR-001	inspection	A product shall publish, for each power entry, the maximum current it takes on each rail at the entry's nominal voltage, stating 0 for a rail it does not draw.
PWR-002	inspection	A power supply, a power converter, a bus board, and any product with outlets of a power domain shall publish the maximum current it delivers on each rail, in total and at each outlet.
SUP-001	measurement: ripple and noise per rail, peak-to-peak, by the 6.2 method	A power supply shall publish its ripple and noise on each rail it provides, peak-to-peak, measured as stated in clause 6.2.
SUP-002	inspection	A power-supply output on a plug-and-socket connector shall not mate with reversed polarity.
SUP-003	inspection	A power-supply output on individual 1/4 in quick-connect tabs or screw terminals shall mark each terminal with its rail.
SUP-004	measurement: no damage after an indefinite short of each rail to 0 V	Each rail shall survive an indefinite short to 0 V without damage.
SUP-005	measurement: reverse swing of each rail at power-up, power-down, and fault, at most one diode drop	During power-up, power-down, or a fault, no rail shall swing more than one diode drop toward the opposite polarity.
SUP-006	measurement: overshoot of each rail at start-up, at most 10 % of nominal	At start-up, no rail shall overshoot its nominal voltage by more than 10 %.
SUP-007	measurement: ripple and noise per rail below the domain limit, by the 6.2 method	Each rail shall have ripple and noise below the limit of its domain tabulated in 6.2, 150 mV peak-to-peak on the bus, measured as stated in clause 6.2.
GND-001	inspection	A product shall connect every 0 V pin of its power headers and PWR-A6 entries, and the -V of its DC entry, to its 0 V.
GND-003	inspection	A power supply shall publish whether its 0 V output is connected to protective earth, and where.

ROLE: POWER CONVERTER

ID	METHOD	REQUIREMENT
PWR-001	inspection	A product shall publish, for each power entry, the maximum current it takes on each rail at the entry's nominal voltage, stating 0 for a rail it does not draw.
PWR-002	inspection	A power supply, a power converter, a bus board, and any product with outlets of a power domain shall publish the maximum current it delivers on each rail, in total and at each outlet.

ID	METHOD	REQUIREMENT
SUP-001	measurement: ripple and noise per rail, peak-to-peak, by the 6.2 method	A power supply shall publish its ripple and noise on each rail it provides, peak-to-peak, measured as stated in clause 6.2.
SUP-002	inspection	A power-supply output on a plug-and-socket connector shall not mate with reversed polarity.
SUP-003	inspection	A power-supply output on individual 1/4 in quick-connect tabs or screw terminals shall mark each terminal with its rail.
SUP-004	measurement: no damage after an indefinite short of each rail to 0 V	Each rail shall survive an indefinite short to 0 V without damage.
SUP-005	measurement: reverse swing of each rail at power-up, power-down, and fault, at most one diode drop	During power-up, power-down, or a fault, no rail shall swing more than one diode drop toward the opposite polarity.
SUP-006	measurement: overshoot of each rail at start-up, at most 10 % of nominal	At start-up, no rail shall overshoot its nominal voltage by more than 10 %.
SUP-007	measurement: ripple and noise per rail below the domain limit, by the 6.2 method	Each rail shall have ripple and noise below the limit of its domain tabulated in 6.2, 150 mV peak-to-peak on the bus, measured as stated in clause 6.2.
SUP-008	inspection	A power converter shall publish the heat it dissipates at its rated output and how far it extends behind the product it is mounted on.
GND-001	inspection	A product shall connect every 0 V pin of its power headers and PWR-A6 entries, and the -V of its DC entry, to its 0 V.

ROLE: CABLE

ID	METHOD	REQUIREMENT
BUS-010	inspection	A bus cable supplied with a module shall be keyed so that it enters a shrouded header only with the marked conductor on -12 V.

ROLE: HOST

ID	METHOD	REQUIREMENT
USB-013	measurement: current limit of each downstream port at most 500 mA; each port switched alone	A case host shall give each downstream port its own current limit of at most 500 mA and a switch that power-cycles that port alone.
USB-014	inspection	A case host shall mark each downstream port with the number it shows for that port.
USB-015	inspection	A case host shall find and edit the controls of any CTRL-USB device with the interfaces of clause 8.1 alone, showing a control without x-units by its standard fields.
USB-016	inspection	A case host that closes a device's endpoints shall subscribe to AllCtrlList again when it opens them.

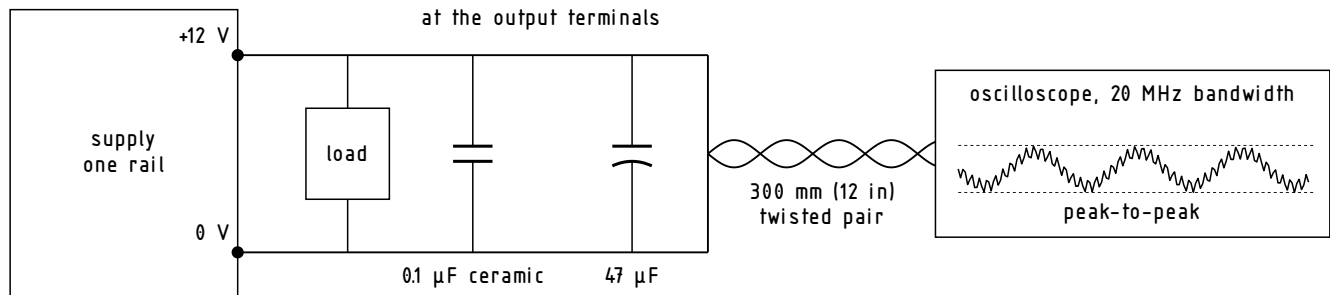
ID	METHOD	REQUIREMENT
USB-017	inspection	A case host that offers a computer a link to the products behind it shall implement the host bridge protocol of 8.2.

ROLE: INSTALLER

ID	METHOD	REQUIREMENT
ASM-001	inspection	A module shall be added to a row only while, on each rail of each power domain, the sum of the published currents stays within the published totals of every source and distribution product that feeds it, and the current through each outlet stays within that outlet's limit.
ASM-002	inspection	At most one module shall transmit on each CV line and at most one on each gate line, where a line runs across linked bus boards up to a region split.
ASM-003	inspection	Installation shall not connect bus power and DC entry power to the same dual-source module at the same time.
ASM-004	inspection	Installation shall not insert a DC-BAR25 plug into a DC-BAR21 DC entry.
ASM-005	inspection	Each DC rail shall be fed from one adapter or one case DC entry at a time.
ASM-006	inspection	A DC-VH2, DC-DIN4, DC-MF6, or DC-MF8 DC entry shall be mated only with that variant's plug.
ASM-007	inspection	Each video reference tree in a row shall have exactly one source, a VID-REF-OUT or an external reference at one VID-REF-IN, and each VID-REF-IN shall be fed by one output.
ASM-008	inspection	Each PWR-A6 entry shall be fed by one source at a time.
ASM-009	inspection	Row wiring an installer adds between a power supply, bus boards, a product with PWR-DC12 outlets, or a DC entry shall meet PWR-006 and PWR-007, with each conductor landed on a terminal of the type the product publishes.

SUPPLY RIPPLE AND NOISE

EIS · Measuring ripple and noise



Each rail is loaded at the maker's stated test current and measured at the supply's output terminals, or at test points the product publishes, with 0.1 µF in parallel with 47 µF across the measurement point and a 300 mm (12 in) twisted pair to a 20 MHz oscilloscope.

The supply publishes the peak-to-peak figure for each rail (SUP-001); every rail stays below 150 mV (SUP-007). A linear or post-regulated supply, typically under 10 mV, suits a row of MOD-VIDEO modules.

Measure each rail as stated in 6.2 and compare peak-to-peak with the published figure (SUP-001) and the 150 mV limit (SUP-007).

MODULE HEADER CURRENT

Measure each rail's current at the module's header under its heaviest load; confirm it is within the published figure (PWR-001) and no more than 2 A (BUS-008). With the module running from a bench supply, confirm no current flows out of any rail pin into the supply (PWR-004).

DC ENTRY

Confirm polarity, center positive on a barrel (DC-004) and the tabulated +V and -V pins on a multi-pin variant (DC-005), and that the published input voltage range is met at the published continuous current (PWR-001, DC-002).

VID-75 TERMINATION AND DRIVE

Measure the DC resistance from center pin to shell at the designated input and at each COAX-IN port: 75 Ω (V75-004, V75-006). At a COAX-OUT port, confirm the open-circuit level is twice the level into a 75 Ω load (V75-006).

MOD-VIDEO LEVELS

DC-couple at the patch tip, and check the output against its claimed range:
0 to +1 V with a +1.2 V ceiling at U1 (SIG-008, SIG-014).

MOD-VIDEO IMPEDANCES

For each MOD-VIDEO output, measure series resistance from the buffer output node to the patch tip: $75\ \Omega \pm 5\%$ (SIG-010). For each input, measure $100\ \text{k}\Omega \pm 10\%$ to 0 V at the tip (SIG-009). EIS recommends checking that each patch jack barrel is insulated from the panel (7.1).

PATCH AUDIO AND CV

Check *MOD-AUDIO* and *MOD-CV* ports against their claimed ranges (SIG-005, SIG-006, SIG-014), and confirm that an input survives $\pm 12\ \text{V}$ and an output survives a short (SIG-002, SIG-003).

ANNEX H (INFORMATIVE) — PATCH LEVEL MAP

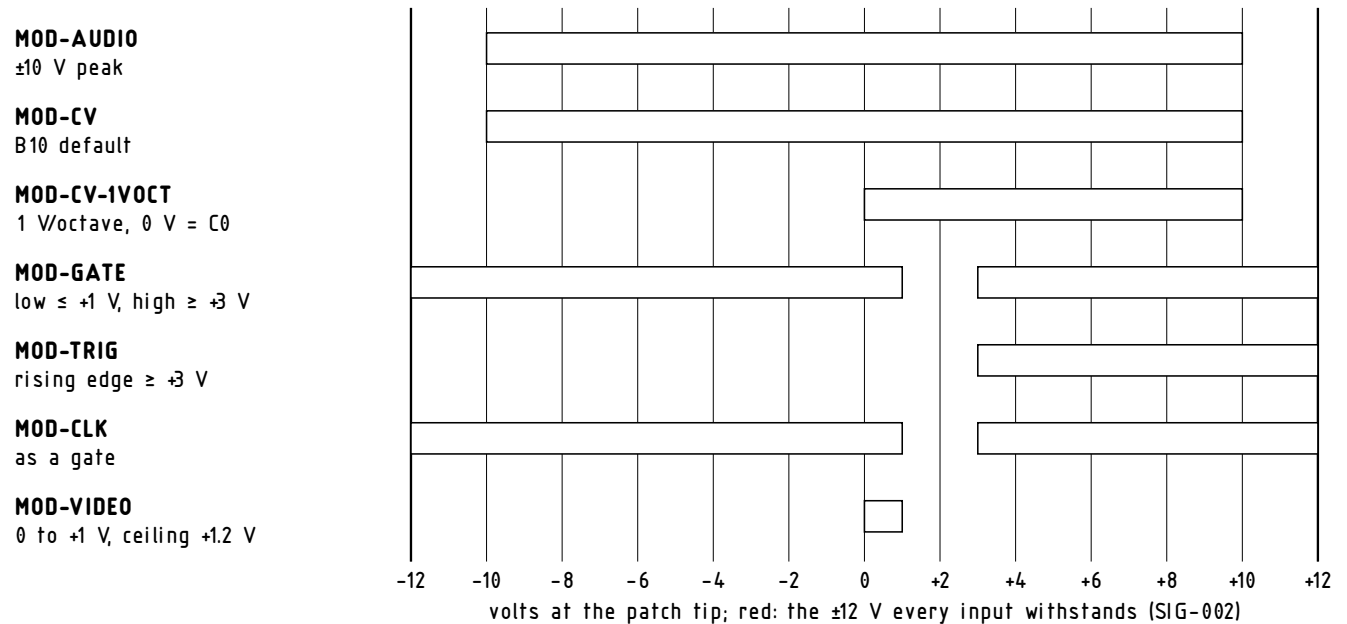
The patch classes on one page. The limits are in 7.2.

PLANE	CLASS	NOMINAL	FULL SCALE	IMPEDANCE
Audio	<i>MOD-AUDIO</i>	$\pm 5\ \text{V}$ (10 V peak-to-peak)	$\pm 10\ \text{V}$ peak (B10)	1 k Ω out, 100 k Ω in
Control CV	<i>MOD-CV</i>	$\pm 5\ \text{V}$ or 0 to +5 V, typical control; by range	the claimed range; $\pm 10\ \text{V}$ at B10	1 k Ω out, 100 k Ω in
Pitch CV	<i>MOD-CV-1VOCT</i>	1.00 V/octave pitch CV	by range; B10 or B5 when claimed	1 k Ω out, 100 k Ω in
Gate, trigger, clock	<i>MOD-GATE</i> , <i>MOD-TRIG</i> , <i>MOD-CLK</i>	0 / +5 V; high $\geq +3\ \text{V}$, low $\leq +1\ \text{V}$	—	1 k Ω out, 100 k Ω in
Video	<i>MOD-VIDEO</i>	0 to +1 V DC: black 0 V, full scale +1 V	+1 V (U1)	$75\ \Omega \pm 5\%$ series out, 100 k Ω in
Bus CV / gate (16-pin)	<i>BUS-CV</i> , <i>BUS-GATE</i>	1.00 V/octave pitch CV (bus CV)	—	1 k Ω out, 100 k Ω in

The table is generated from `data/signals.json`; the bus classes are in 6.6.

Every 3.5 mm input withstands ± 12 V (SIG-002) whatever its class. A range (B1, U1, B5, U5, B10, U10) names a port's full-scale swing; EIS recommends that an output claim the smallest that contains its signal and an input the largest it accepts (SIG-014).

EIS · Every patch class on one ± 12 V axis



ANNEX I (INFORMATIVE) — PORT VOCABULARY

Names a module may use for a port that is not a patch jack: line, instrument, and microphone audio, analog and digital video, MIDI, DMX512, DIN sync, word clock, and the ILDA laser connector. Such a port does not change whether one Eurorack product fits or works with another, so EIS places no requirement on it. The names let manuals and port lists (SIG-001) describe such ports the same way.

A port on a 3.5 mm mono patch jack is a patch jack whatever it carries, and the patch-safety rules of 7.1 apply to it. A port in this annex is listed as unclassified or by its vocabulary name in the port list; either satisfies SIG-001.

Levels and impedances below are the usual industry figures, given for orientation. Where a published standard governs a port, the product cites that standard directly; EIS does not apply any of them by reference.

I.1 EXTERNAL AUDIO

CLASS	CONNECTOR	COUPLING	NOMINAL	CLASS CEILING	SOURCE Z	LOAD Z
LINE-BAL	6.35 mm TRS or XLR	AC	+4 dBu (1.228 V RMS)	+24 dBu	200 Ω	10 k Ω
LINE-UNBAL	6.35 mm TS or RCA	AC	-10 dBV (316 mV RMS)	+8 dBV	600 Ω	10 k Ω
INST	6.35 mm TS	AC	Instrument level; passive pickup source 5 k Ω to 20 k Ω	+12 dBu	—	1 M Ω
MIC	XLR	AC	-60 to -40 dBu typical	+10 dBu	200 Ω	2 k Ω

I.2 EXTERNAL VIDEO

Composite and component video on 75 Ω coaxial jacks on the front are external interfaces like the audio ports above: VID-CVBS and VID-YPBPR below, listed in the port list with the formats they carry. EIS recommends that such a port take the COAX-IN termination or the COAX-OUT back-termination of 7.4; the video reference ports behind the panel are 7.4's own and are claimed as features. RGBS and RGBHV (VGA) are not the same connector contract; a product states which. The HDMI specification is available to adopters only, so a product states its HDMI version in its own documentation.

CLASS	CONNECTOR	COUPLING	NOMINAL	CLASS CEILING	SOURCE Z	LOAD Z
VID-CVBS	RCA, BNC, or SMA, 75 Ω	DC	Composite video, 1 V p-p into 75 Ω per SMPTE ST 170 or ITU-R BT.1700	Per the composite standard	75 Ω	75 Ω
VID-YPBPR	3 × RCA, BNC, or SMA, 75 Ω	DC	Component video, Y 1 V p-p and Pb, Pr 700 mV p-p into 75 Ω per SMPTE ST 274, ST 296, or EIA-770	Per the component standard	75 Ω	75 Ω
VID-SVIDEO	4-pin mini-DIN	DC	Y and C per SMPTE ST 170	Per SMPTE ST 170	75 Ω	75 Ω
VID-RGBS	D-sub 15 or BNC	DC	RGBS/VGA timing per VESA	Per connector standard	75 Ω	75 Ω
VID-HDMI	HDMI Type A	Digital	HDMI Type A connector; version per product documentation	Per HDMI specification	—	—
VID-SDI	BNC 75 Ω	Digital	SD-SDI, HD-SDI, or 3G-SDI per SMPTE	Per SMPTE ST 259, ST 292, ST 424	75 Ω	75 Ω

I.3 CONTROL AND DATA

MIDI-TRS-A wires tip to DIN pin 5, ring to pin 4, and sleeve to pin 2 (RP-054); Type B swaps tip and ring and is incompatible with Type A. EIS recommends that a product with Type B wiring say so next to the jack.

CLASS	CONNECTOR	COUPLING	NOMINAL	CLASS CEILING	SOURCE Z	LOAD Z
MIDI-DIN	5-pin DIN	Digital	MIDI 1.0 current loop	Per MIDI 1.0	—	—
MIDI-TRS-A	3.5 mm TRS Type A	Digital	MIDI Association RP-054 Type A	Per MMA CA-033	—	—
MIDI-TRS-B	3.5 mm TRS Type B	Digital	MIDI Association RP-054 Type B	Per MMA CA-033	—	—
DMX512	XLR-5	Digital	ANSI E1.11 DMX512-A	Per ANSI E1.11	—	—
SYNC-DIN	5-pin DIN	DC	DIN sync 24 ppqn, 0/+5 V TTL clock and run/stop	TTL (5 V)	—	—
CLK-WORD	BNC	DC	Word clock, TTL-level square wave at the sample rate	TTL (5 V)	75 Ω	75 Ω

I.4 ILDA LASER

Laser safety and interlock behavior follow the ILDA document and the applicable laser safety regulations, not EIS.

CLASS	CONNECTOR	COUPLING	NOMINAL	CLASS CEILING
ILDA-DB25	DB-25	Analog	ILDA ISP-DB25 ± 10 V X/Y, 0–5 V color, interlock	Per ILDA ISP-DB25

ANNEX J (INFORMATIVE) — FRONT PANEL STIFFNESS AND EXTRA MOUNTING HOLES

Four mounting holes are the usual pattern. EIS places no requirement on hole count. This annex estimates when a wide panel flexes under a plug and where extra holes go when a designer wants them; `tools/module.py` computes the tables.

J.1 SPAN

Between screws, the panel is a simply supported beam as tall as the panel and as thick as the sheet. A 10 N push at midspan, about the force

of seating a 3.5 mm plug, is allowed to bow it 0.5 mm. The ends are free to rotate. With $l = \text{height} \times \text{thickness}^3 / 12$, that span is

$$L = (48 E I \times 0.5 \text{ mm} / 10 \text{ N})^{1/3}$$

5052 aluminum has a modulus of 70.3 GPa. FR-4, across the weave, has a flexural modulus of 16.5 GPa. At the span these numbers allow, the bending stress stays under 20 MPa. The 0.5 mm bow is reached first.

The recommended panel is 5052 aluminum or FR-4, from 1.6 mm to 2.0 mm, so for each material the 1.6 mm row covers the thicker sheet. At the same span, 1.6 mm FR-4 bows about eight times as far as 2.0 mm 5052.

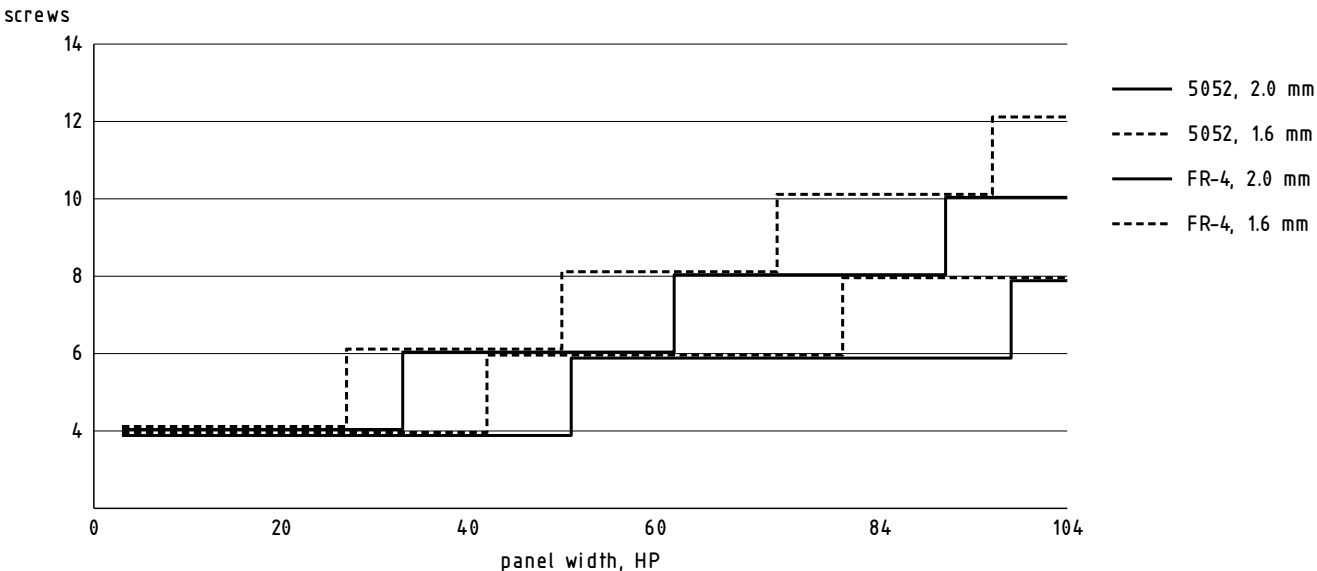
The span between the outer holes is $(N - 3) \times 5.08 \text{ mm}$. While that span is inside the limit, four screws are enough. Past it, a panel can take more holes, added two at a time, until every gap is inside the limit. Every gap is a whole number of HP, so splitting the span can leave one gap an HP longer than an equal split, and that step is enough to cross the limit; the count follows the gaps as they are actually placed.

1.6 mm FR-4 is the most flexible of these four sheets. A 104 HP panel of it needs 12 screws on 3U and 16 screws on 1U, and that is as far as the ladder goes. A dash means a 104 HP panel of that sheet still fits the previous screw count. The widths are the secondary pattern.

SHEET	THICKNESS	3U SPAN	MORE THAN 4	MORE THAN 6	MORE THAN 8	MORE THAN 10
5052	1.6 mm	194.9 mm	42 HP	80 HP	—	—
5052	2.0 mm	243.6 mm	51 HP	98 HP	—	—
FR-4	1.6 mm	120.2 mm	27 HP	50 HP	73 HP	96 HP
FR-4	2.0 mm	150.3 mm	33 HP	62 HP	91 HP	—

SHEET	THICKNESS	1U SPAN	MORE THAN 4	MORE THAN 6	MORE THAN 8	MORE THAN 10	MORE THAN 12	MORE THAN 14
5052	1.6 mm	131.7 mm	29 HP	54 HP	79 HP	104 HP	—	—
5052	2.0 mm	164.6 mm	36 HP	68 HP	100 HP	—	—	—
FR-4	1.6 mm	81.2 mm	19 HP	34 HP	49 HP	64 HP	79 HP	94 HP
FR-4	2.0 mm	101.5 mm	23 HP	42 HP	61 HP	80 HP	99 HP	—

EIS · Screws a 3U panel needs as it gets wider, per sheet



Secondary pattern, 0.5 mm bow under a 10 N plug push. FR-4 needs more screws sooner than aluminum; the counts are in Annex J.

J.2 EVEN PATTERN

The even pattern keeps an even number of holes on each rail: 2, then 4, then 6, and so on. Each step adds a symmetric pair, which is four screws on the panel, so it skips six, ten, and fourteen screws. Every gap is a whole number of HP, and the center gap is the wider one. Because the gaps must be whole HP, the count can rise at an odd width and fall back at the next even one. Because it adds holes in pairs, on a 1U panel it can need more screws than the secondary pattern at the same width: 2.0 mm 5052 first needs 12 screws at 98 HP, 2.0 mm FR-4 first needs 16 screws at 95 HP, and 1.6 mm FR-4 first needs 16 screws at 75 HP.

J.3 SECONDARY PATTERN

The secondary pattern adds a middle hole. The count on each rail then goes 2, 3, 4, 5, and so on, through 6 holes on a 3U rail and 8 holes on a 1U rail for a 104 HP panel of 1.6 mm FR-4. Each step adds one hole on each rail, which is two screws on the panel. Every gap is a whole number of HP, as equal as that allows. On an odd HP panel the middle hole is on the center. On an even HP panel the center is 2.54 mm off the strip pitch, so the middle hole sits 2.54 mm to one side of it. The tables and the model put it on the left, seen from the front; either side is valid.

On a 3U panel the two patterns first diverge at 42 HP

PATTERN	2.54 mm STEPS FROM CENTER	MILLIMETERS FROM CENTER	SCREWS
Even	± 13 and ± 39	± 33.02 and ± 99.06	8
Secondary	-1 and ± 39	-2.54 and ± 99.06	6

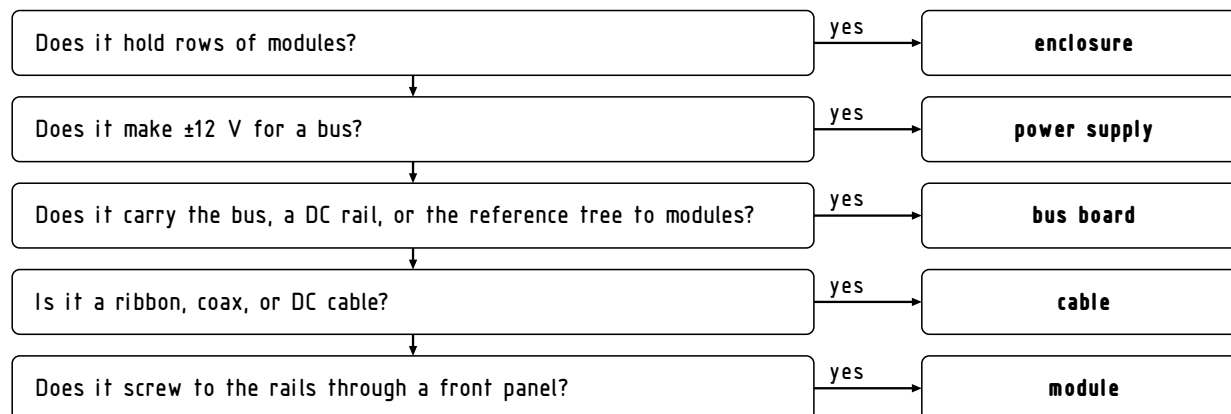
On a 1U panel they first diverge at 29 HP: the secondary pattern is 6 screws at 0 and ± 66.04 mm, and the even pattern is 8 screws at ± 25.40 mm and ± 66.04 mm.

ANNEX K (INFORMATIVE) — DESIGNER'S GUIDE

A short path through EIS for someone designing a new product. The normative clauses govern where this page and they differ.

WHAT EACH PRODUCT CLAIMS AND PUBLISHES

EIS · Which product type a product claims



Take the first yes: a case with a built-in supply is an enclosure, and a board that fans the reference or a DC rail out behind the panel is a bus board. Distribution is a feature, not a type. Then add a feature for each power domain and video reference port kind.

PRODUCT	CLAIM	PUBLISHES
module	module, plus (PWR-BUS-IN), (PWR-BUS-OUT), (PWR-DC12-IN), (PWR-DC12-OUT), (PWR-A6-IN), (PWR-A6-OUT), (PWR-A15-IN), (PWR-A15-OUT), (VID-REF-IN), (VID-REF-OUT), (VID-REF-PASSTHRU), (VID-REF-LOOPTHRU), (CTRL-USB-DEV), (CTRL-USB-HOST) for each power domain it takes or gives, each video reference port kind, and a CTRL-USB device or host port	PANEL-003, PWR-001, PWR-002, PWR-005, SIG-001
enclosure	enclosure, plus (PWR-BUS-IN), (PWR-BUS-OUT), (PWR-DC12-IN), (PWR-DC12-OUT), (VID-REF-IN), (VID-REF-OUT), (VID-REF-PASSTHRU), (VID-REF-LOOPTHRU), (CTRL-USB-DEV), (CTRL-USB-HOST) for each power domain it takes or gives, each video reference port kind, and a CTRL-USB device or host port	RAIL-011, ENC-001, PWR-001, PWR-002, PWR-005, GND-003
bus board	bus board (PWR-BUS-OUT), plus (PWR-DC12-IN), (PWR-DC12-OUT), (VID-REF-IN), (VID-REF-OUT), (VID-REF-PASSTHRU), (VID-REF-LOOPTHRU), (CTRL-USB-DEV), (CTRL-USB-HOST) for a DC rail, ± 6 V or ± 15 V outlets, or the video reference tree it also carries (BUS-020); a case host claims (CTRL-USB-HOST)	PWR-001, PWR-002, PWR-005
power supply	power supply, plus (PWR-BUS-IN), (PWR-BUS-OUT), (PWR-DC12-IN), (PWR-DC12-OUT), (PWR-A6-IN), (PWR-A6-OUT), (PWR-A15-IN), (PWR-A15-OUT), (CTRL-USB-DEV), (CTRL-USB-HOST) for each power domain it takes or gives, each video reference port kind, and a CTRL-USB device or host port	PWR-001, PWR-002, PWR-005, SUP-001, GND-003
power converter	power converter, plus (PWR-BUS-IN), (PWR-BUS-OUT), (PWR-DC12-IN), (PWR-DC12-OUT), (PWR-A6-IN), (PWR-A6-OUT), (PWR-A15-IN), (PWR-A15-OUT), (CTRL-USB-DEV), (CTRL-USB-HOST) for each power domain it takes or gives, each video reference port kind, and a CTRL-USB device or host port	PWR-001, PWR-002, SUP-001, SUP-008
cable	cable (PWR-BUS-IN), cable (PWR-BUS-OUT), cable (PWR-DC12-IN), cable (PWR-DC12-OUT), cable (PWR-A6-IN), cable (PWR-A6-OUT), cable (PWR-A15-IN), cable (PWR-A15-OUT), cable (VID-REF-IN), cable (VID-REF-OUT), cable (VID-REF-PASSTHRU), cable (VID-REF-LOOPTHRU), cable (CTRL-USB-DEV), cable (CTRL-USB-HOST): the one interface it mates; PWR-BUS is a power ribbon, VID-75 a coaxial cable	Nothing; it meets the wiring rules of its interface

MODULES BY ROLE

MODULE	CLAIM	PORT LIST
Audio I/O, mixer, VCO, VCF, VCA, envelope, LFO, logic	module	A class per patch jack; unclassified for line and headphone jacks
Quantizer	module	MOD-CV-1VOCT ports; EIS recommends publishing the tracking accuracy
MIDI interface	module	MIDI jacks unclassified, or named from Annex I

MODULE	CLAIM	PORT LIST
SD encoder or monitor locked to a rear reference	module (PWR-BUS-IN, VID-REF-IN); its composite jack is a VID-CVBS port in the port list	MOD-VIDEO patch ports; the VID-REF-IN lists the four SD formats
HD encoder, scaler, or video I/O	module (PWR-BUS-IN, VID-REF-IN); its component or composite jacks are VID-YPBPR or VID-CVBS ports in the port list	MOD-VIDEO patch ports; the VID-REF-IN lists the formats it locks to
Video reference generator with rear coaxial outputs	module (PWR-BUS-IN, VID-REF-OUT), or with VID-REF-IN when it genlocks	Each VID-REF-OUT lists the formats it generates
Module locked to a rear video reference	module (PWR-BUS-IN, VID-REF-IN), plus VID-REF-PASSTHRU for a buffered pass-through or VID-REF-LOOPTHRU for a loop-through with a termination switch	The rear port is COAX-IN on an RCA, BNC, or SMA jack; no patch jack is the reference (SIG-015, V75-010)
DC entry panel or bus board with PWR-DC12 outlets	module (PWR-DC12-IN) or bus board (PWR-BUS-OUT, PWR-DC12-OUT)	The entry variant and input range; each outlet's current and protection (DC-009, DC-012)
Video reference distributor	bus board (PWR-BUS-OUT, VID-REF-IN, VID-REF-PASSTHRU)	REF IN lists the formats it accepts; each PASSTHRU drives one module
Dual-source module	module (PWR-BUS-IN, PWR-DC12-IN)	Runs from either source alone (PWR-003); the installer connects one (ASM-003)
Module with editable settings	module (PWR-BUS-IN, CTRL-USB-DEV), role device	A USB-PH4 port; PE controls with maps, steps, and x-units; current values on subscription
Case host	module (CTRL-USB-DEV), role host	Its ports and their limit; a computer link follows 8.2
Video module on ± 6 V	module (PWR-BUS-IN, PWR-A6-IN)	Its ± 6 V currents at the A6-VH3 entry; the bus currents for its logic, if any; regulates ± 5 V locally

A module that draws more than one power header allows (BUS-008), or that is meant to run without a Eurorack bus, may add a DC entry beside its power header.

READING ORDER

1. Conformance: product types, features, and the claim.
2. Front panels and boards for a module; rack, rails, enclosures, and the row budget for a case.
3. Power interface, module power entry, bus boards, power supplies, DC power entry, and bus CV and gate, and grounding.
4. Signals, patch signal classes, video timing, and VID-75; for a video system, video reference distribution.

5. Worked examples for a module, a case, and a video row; Annex N for expanders, Annex O for heat, and Annex P for why each requirement exists.

MACHINE-READABLE NUMBERS

Read the numbers from the models rather than from the PDF tables:

TOPIC	FILE
Requirements	<code>requirements.json</code>
Document structure	<code>document.json</code>
A claim file	<code>claim.schema.json</code>
Panels, rails, inserts, screws	<code>module.json</code> , <code>rail.json</code> , <code>insert.json</code> , <code>screw.json</code> , <code>screw-fits.json</code>
Rack figures	<code>standards.json</code>
Third-party sources cited	<code>sources.json</code>
Locked identifiers	<code>register.lock.json</code>
Power domains	<code>power_domains.json</code>
Power ribbons	<code>power_ribbon.json</code>
Signals, video, and DC entry	<code>signals.json</code> , <code>video_timings.json</code> , <code>video_75.json</code> , <code>dc_12.json</code>
PWR-A6	<code>analog_6.json</code>
PWR-A15	<code>analog_15.json</code>
CTRL-USB	<code>ctrl_usb.json</code> , <code>ctrl-units-v1.schema.json</code>
Host bridge (8.2)	<code>bridge_v1.json</code>
Row budget (Annex L)	<code>row_budget.schema.json</code>
Examples	<code>data/examples/</code>

ANNEX L (INFORMATIVE) — ROW BUDGET

A planning worksheet for one row. The requirements behind it are ENG-001 (width and clear depth), PWR-001 and PWR-002 (the currents every power entry and outlet publishes, 6.1), BUS-012 (a bus board's per-header limit), SUP-001 (supply ripple), and the installation sum ASM-001. EIS does not require an enclosure to publish this table; a schema and a validator come with it.

A row is budgeted per power domain (6.1): *the bus*, *PWR-DC12*, *PWR-A6*, and *PWR-A15*, each where a source of that domain feeds modules in the

row. Each domain's sources are listed with their totals (+12 V, -12 V; +5 V optional on the bus; 12 V: one +V and -V pair on PWR-DC12; +6 V, -6 V on PWR-A6; +15 V, -15 V on PWR-A15), and each module with its draw in each domain it uses.

PER-ROW TABLE

FIELD	SOURCE
Row id / name	Maker
Width (HP)	ENC-001
Clear depth behind panel (mm)	ENC-001
Video reference distribution	none or VID-75 (a coaxial tree)

SOURCES, ONE PER LINE, PER DOMAIN

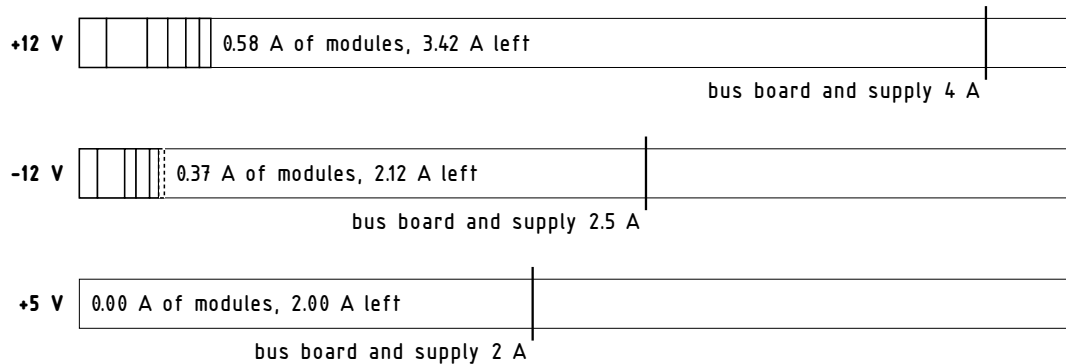
FIELD	SOURCE
Domain	one of 6.1
Source	bus board, supply, power converter, or a product with PWR-DC12 outlets
Total per rail (A), on each rail of the domain	PWR-002
Outlets and the limit at each (A): bus board headers at most 2 A per rail	PWR-002, BUS-012
Ripple and noise, mV p-p (a supply)	SUP-001

MODULES

FIELD	SOURCE
HP and depth	PANEL-003
Draw per domain and rail (A)	PWR-001

For each domain and rail, the modules' sum stays within every source of that domain, and each module's draw within one outlet's limit (ASM-001). When a module publishes no -12 V current, 9.1 recommends planning it at 50 % of its +12 V current.

EIS · A row's current budget on the bus: the example row 'performance'



☐ Audio I/O: +12 V 0.12 A, -12 V 0.08 A

☐ VCO: +12 V 0.09 A, -12 V 0.05 A

☐ Envelope/LFO: +12 V 0.06 A, -12 V 0.04 A

☐ Mixer: +12 V 0.18 A, -12 V 0.12 A

☐ VCF/VCA: +12 V 0.08 A, -12 V 0.06 A

☐ MIDI utility (Type A): +12 V 0.05 A, -12 V not published

A module goes into a row only while each rail's sum stays within the bus board's totals, its per-header limit, and the supply's rating (ASM-001). The dashed segment plans a module that publishes no -12 V figure at 50 % of its +12 V draw, as EIS recommends.

MACHINE-READABLE EXAMPLE

data/examples/row_budget_two_row.yaml describes an example two-row instrument. Check it with:

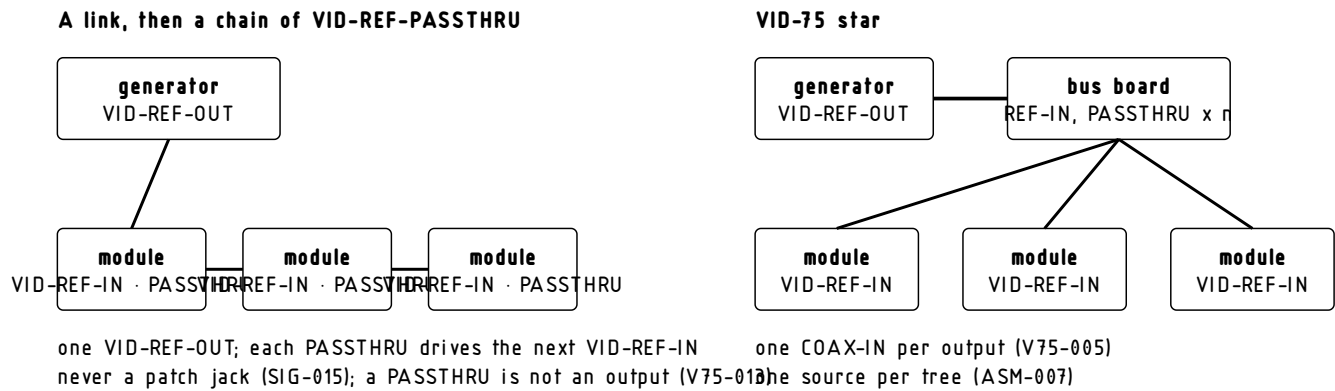
```
python tools/row_budget.py --check data/examples/row_budget_two_row.yaml
```

Schema: data/row_budget.schema.json.

ANNEX M (INFORMATIVE) — VIDEO REFERENCE DISTRIBUTION

How to bring one video reference to every video module in a system. The reference travels on the 75 Ω coaxial interface of 7.4, behind the panel, from a VID-REF-OUT to each module's VID-REF-IN, and never on a patch cable: a patch jack carries patched signals only (SIG-015), and a module takes or gives the reference at a rear port it claims by kind (V75-010). The video reference is video, so the same cabling carries a composite picture.

EIS · Video reference in a row: direct links, a PASSTHRU chain, or a star



The reference is rear coaxial cabling, wired once: a link suits a few modules, a PASSTHRU chain or a LOOP run suits a row that has them, the star suits many locking to one reference, and BNC takes a facility reference. Jack types may be mixed in a tree; a passive split is never used.

SITUATION	TYPICAL CHOICE
A few modules and a generator with several VID-REF-OUT ports	One coaxial link from a VID-REF-OUT to each module's VID-REF-IN; no distributor
Modules with VID-REF-PASSTHRU, in a row	A chain: generator VID-REF-OUT to the first module's VID-REF-IN, its VID-REF-PASSTHRU to the next VID-REF-IN, and so on; each PASSTHRU drives one input
Modules with VID-REF-LOOPTHRU	One cable run through the loop pairs, the termination switch on at the last module only
Many modules lock to one reference	A star: a distributor, usually a bus board that carries the tree (BUS-020), one VID-REF-PASSTHRU per VID-REF-IN
The facility already distributes black burst or tri-level video sync between racks	The facility reference at the distributor's VID-REF-IN; BNC jacks suit it
Two rows, one for performance and one for processing	A distributor per row, or one coaxial link from the first row's tree to the second row's VID-REF-IN

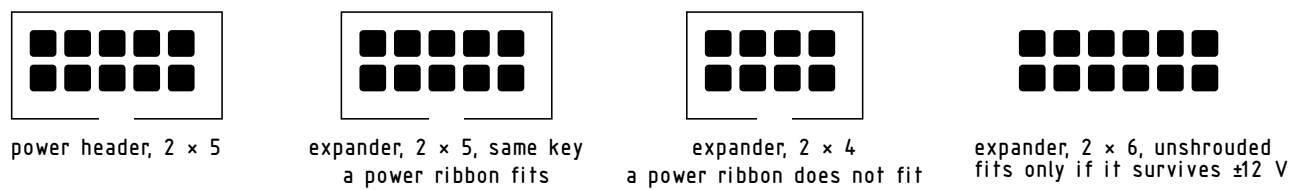
Jack types may be mixed in a tree, and each output drives one terminated input (V75-005); see 7.4. A VID-REF-PASSTHRU is not a source: a row needs one VID-REF-OUT, or an external reference at a designated input, and the module claims say which ports are which. A module's front patch jacks carry its pictures, ramps, keys, and control (7.2); none of them is the reference, so a patch never changes a module's timing.

Many video modules in use take their video reference on a rear 2 × 7 ribbon header, which is not a port of 7.4; such a header mates a power ribbon socket, so it is one that BUS-011 reaches (6.4), and a product with one lists it on its port list as unclassified, named for what it connects to (Annex N).

ANNEX N (INFORMATIVE) — EXPANDERS AND INTER-MODULE LINKS

How to describe and build the connections modules make with each other behind the panel: expander headers and digital links such as I²C. EIS places one requirement on them, BUS-011 in 6.4: a header that is not the power header either does not mate a Eurorack power ribbon socket or survives one fitted to it. Everything else here is recommended practice.

EIS · An expander header beside the power header



A header that is not the power header either does not mate a power ribbon socket or survives one fitted to it, either way round (BUS-011).

A different pin count, a different key, or another connector family meets the first; protection on every pin meets the second.

Annex N lists expanders and digital links on the port list as unclassified, named by what they connect to.

N.1 EXPANDERS

An expander is a second module that adds jacks, controls, or memory to a main module through a short cable behind the panel. The signals on that cable are private to the maker, so EIS does not classify them.

TOPIC	PRACTICE
Port list	List the expander header as a port, unclassified, named for what it connects to, for example EXPANDER (to main module)
Connector	A pin count or connector family that a power ribbon does not fit, or a shrouded header keyed against it; the label on the board says what the header is
Cable	Supplied with the expander, keyed, and long enough to reach the neighboring HP positions it is meant for, typically 100 mm to 150 mm
Power	The expander takes power from its own power header or through the main module, as its manual states; its currents are published either way (PWR-001)
Placement	The manual states where the expander may sit relative to the main module: adjacent, same row, or any row the cable reaches

N.2 I²C LINKS

Several module families share an I²C bus between modules, usually on a 3-pin header carrying SDA, SCL, and 0 V. I²C is defined by its own specification (NXP UM10204); EIS recommends the following so that modules from different makers can share one bus.

TOPIC	PRACTICE
Logic level	3.3 V logic, with inputs that tolerate 5 V
Pull-ups	Only the products that say so fit pull-ups; the manual states their value and whether they can be switched off
Bus loading	The total bus capacitance stays within the I ² C limit of 400 pF; a bus that spans more than one row or more than about 1 m of cable is a design to check, not a default
Addresses and roles	The manual lists each address the module answers and whether it acts as controller or target
Header	Pin order SDA, SCL, 0 V is common but not universal; the board marks each pin

A link header is listed on the port list like an expander header, unclassified, named by its function, for example I²C.

N.3 ANALOG LINKS

A cable that carries analog signals between modules behind the panel, such as a normalised bus or a chained clock, joins the 0 V of the modules it links (6.3). EIS recommends listing it on the port list with the class its signals would have on a patch jack, so that its levels are known.

ANNEX O (INFORMATIVE) — HEAT AND MECHANICAL LOAD

The heat a row produces, how a case gets rid of it, and the forces a panel and its screws carry. EIS places no requirement here; the figures are planning aids built on the currents modules already publish (PWR-001).

0.1 HEAT FROM A ROW

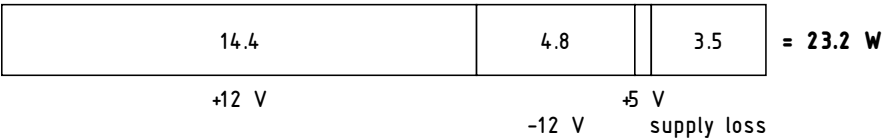
Every watt a module draws from the bus becomes heat inside the case. From the published currents, a module dissipates at most

$$P = 12\text{ V} \times I(+12\text{ V}) + 12\text{ V} \times I(-12\text{ V}) + 5\text{ V} \times I(+5\text{ V})$$

and a row dissipates the sum over its modules. A published current is a maximum, so the sum is an upper bound. A supply inside the case adds its own loss, $P \times (1 / \eta - 1)$, where η is its efficiency at that load.

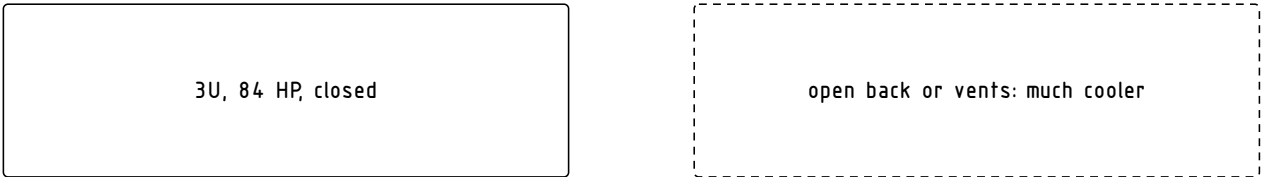
EIS · The heat of a row: published currents, supply loss, and the case's rise

Watts inside one 84 HP row



Temperature rise of a closed case

$\Delta T \approx P / (h \times A) = 23\text{ W} / (5 \times 0.33) \approx 14\text{ }^{\circ}\text{C}$
 $h \approx 5\text{ W per square meter and kelvin in still air; A, the outer surface in square meters}$



$P = 12\text{ V} \times I(+12) + 12\text{ V} \times I(-12) + 5\text{ V} \times I(+5)$, from the published currents (PWR-001); an upper bound.

A worked figure, for one 84 HP row whose modules publish 1.2 A on +12 V, 0.40 A on -12 V, and 0.10 A on +5 V:

SOURCE	CALCULATION	WATTS
+12 V	12 V × 1.2 A	14.4
-12 V	12 V × 0.40 A	4.8
+5 V	5 V × 0.10 A	0.5
Modules	sum	19.7
Supply loss at $\eta = 0.85$	$19.7 \times (1 / 0.85 - 1)$	3.5
Inside the case		23.2

A linear power converter that makes PWR-A6 from the bus adds its own loss: $(12\text{ V} - 6\text{ V}) \times I$ on each rail. One feeding a module at 0.3 A per rail turns 3.6 W into heat behind the module, as much as the module's own $\pm 6\text{ V}$ load; it publishes the figure (SUP-008), and the row budget counts its input current on the bus.

0.2 HOW WARM THE CASE GETS

A closed case loses heat mainly by natural convection from its outer surfaces. A rough estimate of the rise of the air inside above the room is

$$\Delta T \approx P / (h \times A)$$

with h about $5 \text{ W/m}^2\cdot\text{K}$ for still air on painted metal or wood, and A the outer surface area. A 3U, 84 HP case about 0.48 m wide, 0.15 m deep, and 0.15 m tall has about 0.33 m^2 of surface, so 23 W raises it by about 14 °C. The same row in an open-backed or vented case runs much cooler.

EIS recommends that an enclosure publish, for each row, the dissipation it carries for a 10 °C rise above room temperature, and that a module whose dissipation is much higher than its current suggests, such as one with a linear regulator dropping 12 V to 3.3 V, say so in its manual.

0.3 MECHANICAL LOAD

LOAD	PLANNING FIGURE	WHERE IT COMES FROM
Plug insertion at a jack	10 N	The force Annex J uses for panel bow
Mounting-screw torque	at most 0.5 N·m	An M3 screw holds in three threads of a 1.5 mm to 2.0 mm insert (5.3); more strips the insert before it tightens the panel
Module mass	publish it when it is more than the panel and board alone	A heavy module on a portable case loads its four screws in transport

EIS recommends that a module whose mass would bend its panel in transport, such as one with a large transformer or a display, publish its mass and supply a support bracket where it needs one.

ANNEX P (INFORMATIVE) — RATIONALE

Why each requirement exists, one line each: the failure it prevents, the fit it secures, or where its number comes from. Generated from the `rationale` field of `data/requirements.json` by `tools/requirements.py`. The requirement itself is in its clause and in the register; this annex adds no requirement.

5.1 RACK DIMENSIONS

ID WHY

- | | |
|----------|---|
| RACK-001 | Every width in a row is a multiple of the HP, so quoting the IEC value lets panels and rails from different makers line up hole for hole. |
| RACK-002 | The rack unit sets the 3U and 1U heights that panels, rails, and 19-inch rack frames share, so quoting IEC keeps them all on one grid. |
| RACK-003 | Meeting the IEC flange, tab, aperture, and row figures lets a rack-mount frame bolt into any 19-inch rack and hold a full 84 HP row. |

5.2 MODULES

ID WHY

- | | |
|-----------|---|
| PANEL-001 | These are the only two panel heights EIS defines; a module of any other height fits no conforming row. |
| PANEL-002 | A panel at or under its nominal width lets neighbors sit side by side without binding, so N HP of panels always fits an N HP row. |
| PANEL-003 | A buyer compares these two figures with a row's published width and clear depth to know the module fits before buying it. |
| PANEL-004 | The mounting-screw length window is computed for panels up to 2.0 mm; a thicker panel leaves too few threads engaged in the insert. |
| PANEL-005 | One patch connector across all modules means any patch cable joins any output to any input, whoever made the modules. |
| PANEL-006 | Three rack units less 4.85 mm of clearance, 128.5 mm lets the panel sit inside the 132.55 mm IEC aperture between the rails. |
| PANEL-007 | Matching the established Intellijel 1U format, 4.80 mm under one rack unit, lets 1U modules fit the 1U rows already in use. |
| PANEL-008 | A fixed inset from each edge puts every panel's holes on the same line as the rail inserts, whatever the maker. |
| PANEL-009 | The span is the panel height less twice the 3.0 mm inset, and the rails must match it or the panel holes miss the inserts. |
| PANEL-010 | A 3.2 mm hole clears the 3.0 mm M3 screw with room for small position errors between panel and insert; a short slot along the rail takes up rail position error without letting the panel drop. |
| PANEL-011 | Offsetting holes by half an HP from the nominal edge puts every hole on an insert hole, whatever the panel width and wherever it sits. |
| PANEL-012 | $(128.5 \text{ mm} - 110 \text{ mm}) / 2$ is 9.25 mm, so the usual 110 mm board fits between rails that cover no more of the panel. |
| PANEL-013 | A panel drawn to a nominal figure without a tolerance cannot be checked or rejected; one stated tolerance policy makes every mechanical figure measurable the same way. |

ID	WHY
PANEL-014	The screw length window keeps a screw's tip off the cavity floor through a 1.6 mm panel; an enclosure's screws can bottom out through a thinner one, so the thin panel brings screws that fit.

5.3 RAILS, INSERTS, AND MOUNTING SCREWS

ID	WHY
RAIL-001	Insert holes one HP apart line up with panel holes placed on the HP grid, so a panel screws down at any position in the row.
RAIL-002	N panels at their full nominal width need $N \times 5.08$ mm of rail, so a shorter rail cannot hold the row's published width.
RAIL-003	The insert thread has to take the M3 mounting screw that every module hole is drilled to clear.
RAIL-004	An insert three 0.5 mm pitches thick gives the screw the three full threads RAIL-008 needs to hold a panel without stripping.
RAIL-005	M3 is the thread of nearly every Eurorack case on sale and of the screws modules ship with, so one screw fits any row.
RAIL-006	Quoting the ISO 261 coarse pitch means any off-the-shelf M3 screw threads into any conforming insert.
RAIL-007	Quoting the ISO 261 diameter fixes the size that the 3.2 mm panel hole and the rail throat are made to clear.
RAIL-008	Three engaged threads through the thickest allowed panel keep a screw from stripping out as cables are plugged and pulled.
RAIL-009	The lower bound gives three threads through a 2.0 mm panel, and the upper keeps the tip off the cavity floor through a 1.6 mm panel.
RAIL-010	The narrowest catalog rail face reaches 3.7 mm past the hole center (Vector T-strut, Annex A), so a head up to 7.0 mm across bears on the panel and the rail face on every catalog rail; it admits an ISO 7045 pan head and the common 7 mm M3 washer.
RAIL-011	The right screw length depends on the rail's seat and cavity depth, which only the enclosure maker knows.

5.4 ENCLOSURES

ID	WHY
ENC-001	A buyer compares these figures with a module's published width and depth to know it fits the row before buying.

6.1 POWER ARCHITECTURE

ID	WHY
PWR-001	These figures are what an installer sums against a source's and a distribution product's ratings, and what a buyer sizes a DC adapter from; stating 0 shows a rail was not forgotten.
PWR-002	An installer checks a row's summed currents against the source and each outlet before adding a module (ASM-001); outlets can be rated below their rails, and traces and connectors that carry more than they are rated for overheat.
PWR-003	The installer connects only one of a product's alternative sources (ASM-003), so the product has to run from any one of them alone; entries that feed different circuits, such as PWR-A6 for the analog rails and the bus for logic, are not alternatives.
PWR-004	A module that drives a rail fights its source's regulator and can back-power other products when the source is off.
PWR-005	Three terminal types cover every supply and bus board sold, and naming them lets a harness from one maker land on a board from another without an adapter.
PWR-006	A row's rails and its 0 V carry every module's current through one or two conductors; the gauges keep the drop and the heating small, the temperature rating suits a closed case, and a crimp holds where a soldered strand fractures.
PWR-007	The 0 V conductor returns the current of every rail at once, so it is never the thinner one.
PWR-008	A bond through paint or a loose terminal is a bond only until it corrodes; a toothed washer on bare metal keeps it low impedance for the life of the case.

6.2 POWER SUPPLIES AND POWER CONVERTERS

ID	WHY
SUP-001	A ripple figure taken one stated way lets a buyer compare supplies and pick a quiet one for video or audio work.
SUP-002	A supply connected backwards reverses every rail on the bus and can damage every module in the row at once.
SUP-003	Loose tabs and terminals cannot be keyed, so a clear rail marking is the only guard against wiring a rail to the wrong place.
SUP-004	A short from a miswired ribbon or bus board is a routine fault, and the supply has to outlast it until someone finds it.
SUP-005	Op-amps and polarized capacitors on modules tolerate little reverse voltage, so a diode drop is the most any rail may reverse, in any sequence.
SUP-006	Parts on modules are chosen for 12 V rails, and a large start-up overshoot eats the voltage margin they were sized with.
SUP-007	A 150 mV ceiling gives modules a worst case to design against, at a level most open-frame switching supplies already meet.
SUP-008	A linear converter turns the difference between its input and output into heat in the case, and it adds to the depth of the module it sits behind; the installer budgets both (Annex O, ENC-001).

ID	WHY
SUP-009	A case supply that gives a DC rail or the analog rails directly saves a brick or a converter per module, and naming the domain keeps its outlets under the rules every product of that domain expects.

6.3 GROUNDING AND 0 V

ID	WHY
GND-001	The 0 V pins share the return current of all three bus rails, and using only some crowds it onto fewer contacts; with the DC rail's -V on the same 0 V, a product keeps one reference for its signals whichever entry is connected.
GND-002	One 0 V back to the supply terminal gives every module in the row the same reference and a defined path for return current.
GND-003	A system wants one bond between 0 V and protective earth; a second bond lets mains-frequency current flow in 0 V as hum.

6.4 THE BUS

ID	WHY
BUS-001	Every module may count on ± 12 V at its header, while +5 V stays optional because many modules regulate their own.
BUS-002	One header form, the 2.54 mm IDC header of the Doepfer bus, lets any power ribbon mate any module and any bus board.
BUS-003	Ribbons and bus boards made to a different pin order put +12 V on a module's 0 V pins; one pinout prevents that.
BUS-004	A marked conductor tied to -12 V lets an installer orient a ribbon by eye at both ends, the only guide on an unshrouded header.
BUS-005	A key in one fixed position lets a keyed socket enter a shrouded header only the right way round, whoever made each part.
BUS-006	These are the only rails a conforming bus delivers, so a module that needs any other rail cannot run from a conforming row.
BUS-007	Pins 11 to 16 carry nothing such a module uses, so the smaller header saves board space without losing any connection.
BUS-008	Two IDC contacts per rail at about 1 A each set the 2 A ceiling for current through one header.
BUS-009	A reversed ribbon is the commonest field fault; surviving it keeps one mistake from destroying a module.
BUS-010	A keyed cable makes the shroud do its job, so the ribbon that ships with a module cannot be fitted backwards into a shrouded header.
BUS-011	Expander and link headers often share the power header's form, and a power ribbon fitted to one puts ± 12 V on its signal pins.

ID	WHY
BUS-019	The marked conductor of a ribbon can only be matched to the header when the board says which end is -12 V; on an unshrouded header the marking is the only guide.

6.5 BUS BOARDS

ID	WHY
BUS-012	A header carries each rail on two IDC contacts of about 1 A, the same limit modules are held to under BUS-008.
BUS-013	A split lets one long bus board carry two separate CV and gate lines, each with its own transmitter.
BUS-014	A crossed link would send pitch CV to gate listeners and gate pulses to oscillators on the next board.
BUS-015	The voltage drop of a longer or thinner ribbon at the 2 A header limit eats into the rails the module receives; 28 AWG is the conductor of standard 1.27 mm pitch ribbon.
BUS-020	One board behind the panel can carry the bus, the DC rail, the analog rails, the video reference tree, and the case's USB hub; naming each feature keeps every outlet and port on it under the rule written for that interface.

6.6 BUS CV AND GATE

ID	WHY
BUS-016	The bus CV and gate lines are shared across a row, so a module left at its default never fights a transmitter or reacts to stray levels.
BUS-017	Every listening oscillator follows the one bus CV line, so shared levels and impedances keep any transmitter and listener in tune.
BUS-018	Shared thresholds and impedances let any module's gate on the bus register reliably at every listening module.

6.7 12 V DC POWER (PWR-DC12)

ID	WHY
DC-001	The variant tells a buyer which plug, cable, and distribution product will physically mate with the product.
DC-002	Nominal 12 V adapters vary in output, so the accepted range tells a buyer which adapters the product can safely use.
DC-003	A DC entry wired like a bus header invites a bus ribbon to be plugged into it, putting 12 V across the wrong pins.
DC-004	Center positive is the usual convention of 12 V adapters, so fixing it keeps a common adapter from reversing the DC rail.

ID	WHY
DC-005	Fixed pin functions let any cable or distribution product of that variant deliver +V and -V to the right pins.
DC-006	Center-negative adapters fit the same barrel, so a reversed adapter is a likely mistake that must not destroy the module.
DC-007	A straight cable has to keep the center-positive polarity of both ends, or it reverses the DC rail it carries.
DC-008	Pin-for-pin wiring keeps +V and -V where the far end expects them, so the cable never reverses or shorts the DC rail.
DC-009	A DC-BAR25 plug enters a DC-BAR21 entry with unreliable contact, so outputs to modules use only connectors that fit module entries properly.
DC-010	Module entries are center positive with pin 1 at +V, so a distribution cable has to keep that polarity at both ends.
DC-011	An adapter is chosen at the inlet; the polarity symbol, the voltage, and the current beside it are what keeps a wrong adapter off a product.
DC-012	One shorted cable on an unprotected output takes every module on the rail down; a limit per output keeps the fault to one module.
DC-013	An entry that feeds a row is plugged by whoever assembles the case; a reversed brick must not take the row with it.

6.8 ± 6 V ANALOG POWER (PWR-A6)

ID	WHY
A6-001	One connector family used by no other domain keeps a PWR-DC12 or bus cable from mating an analog entry; the pin functions make any PWR-A6 cable fit any entry.
A6-002	A module's local regulators are designed to this window; it holds the ± 4 % of common fixed regulators.
A6-003	The 0.2 V below the outlet window covers the cable and connector drop at the entry limit, so any conforming source works with any conforming module.
A6-004	A source may overshoot by 10 % at start-up (SUP-006); the module must survive what a conforming source can deliver.
A6-005	The limit keeps the cable drop inside the 0.2 V allowance and lets a source rate its outlets once for every module.
A6-006	A straight-through cable keeps the pin functions; the length and gauge hold the drop at 1 A inside the window allowance.
A6-007	The A6-VH3 housing is keyed, and the marking tells an installer what the connector is before a cable is sought; a two-circuit VH housing fits two of its pins, so the ± 6 V mark beside it is what stops a DC-VH2 cable going there.

6.9 ± 15 V ANALOG POWER (PWR-A15)

ID	WHY
A15-001	One connector family used by no other domain keeps a PWR-DC12 Mini-Fit case entry (six or eight circuits) or any other cable from mating a ± 15 V entry; the pin functions make any PWR-A15 cable fit any entry.
A15-002	A module's local regulators are designed to this window; it holds the ± 4 % of common ± 15 V supplies.
A15-003	The 0.2 V below the outlet window covers the cable and connector drop at the entry limit, so any conforming source works with any conforming module.
A15-004	A source may overshoot by 10 % at start-up (SUP-006); the module must survive what a conforming source can deliver.
A15-005	The limit keeps the cable drop inside the 0.2 V allowance and lets a source rate its outlets once for every module.
A15-006	A straight-through cable keeps the pin functions; the length and gauge hold the drop at 2 A inside the window allowance.
A15-007	The A15-MF4 housing is keyed, and the marking tells an installer what the connector is before a cable is sought; a two-circuit VH housing fits two of its pins, so the ± 15 V mark beside it is what stops a DC-VH2 cable going there.

7.1 SIGNALS

ID	WHY
SIG-001	The port list tells a user which class and limits each jack meets, so a patch can be checked before it is made.
SIG-002	± 12 V is the most any rail or conforming output can put on a jack, so an input that withstands it survives any patch.
SIG-003	Patching an output to 0 V or to another output is a routine mistake on a patch panel, and one cable must not destroy a module.
SIG-004	Keeping outputs within ± 12 V keeps them within what every patch input is built to withstand under SIG-002.
SIG-015	The video reference is system configuration, not a patch: it stays on the rear coaxial interface, so that patching never changes a module's timing reference and no patch cable has to be a system cable.

7.2 PATCH SIGNAL CLASSES

ID	WHY
SIG-005	Modules in use exceed the typical 10 V peak-to-peak audio level, and an input has to accept what an output may send.
SIG-006	Shared control limits let an envelope or LFO from one maker drive a control input from another without clipping.

ID	WHY
SIG-007	One scale lets any pitch source drive any oscillator; the absolute pitch at 0 V is a recommendation, since every oscillator has a tune control.
SIG-008	Shared video limits let pictures patch between video modules from different makers at the right level.
SIG-009	A high, tightly held input impedance lets a 75 Ω output arrive at almost unity gain, so video levels match from module to module.
SIG-010	A 75 Ω series source keeps a short unterminated patch cable from ringing, and one fixed value keeps level and edges alike from module to module.
SIG-011	The Doepfer thresholds, high at +3 V and low at +1 V, let any gate output switch any gate input with margin against noise.
SIG-012	Shared thresholds and a minimum width make a short trigger long enough for any receiving input to catch it.
SIG-013	Clock outputs and inputs share the gate thresholds, so any clock source drives any clocked module reliably.
SIG-014	A named range is the contract between an output and an input, so matching ranges patch together without clipping.

7.3 VIDEO TIMING

ID	WHY
VID-001	Listing formats by ID on the reference ports lets a buyer check that a video reference generator and the modules that lock to it share a format; a patch jack lists none, because it is never the reference.
VID-002	Two products locked to one format have to agree on its raster; the publication's tolerances, not a clock-exact row, are what an analog interlaced format can be held to, while a sample-defined format is exact.

7.4 VIDEO ON 75 Ω COAXIAL JACKS (VID-75)

ID	WHY
V75-001	The three jack types are electrically the same here, so any 75 Ω cable with the matching plugs joins any two products.
V75-002	One center and shell convention lets any coaxial cable carry the signal and join the 0 V of the products it connects.
V75-003	The number stays unused; a port claimed by kind needs no second publication.
V75-004	The number stays unused; the termination rule of the port mode covers the designated input.
V75-005	A second termination on one output drops the level to two thirds and a third drops it to half.
V75-006	The number stays unused; the rule was conditional on how an installer cabled a port, which a product cannot know.

ID	WHY
V75-007	A 75 Ω cable keeps the line impedance continuous from source to termination, so the star stays matched and free of reflections.
V75-008	The number stays unused.
V75-009	The number stays unused; a feature describes what happens behind the panel or inside the case, and a front picture jack is an external connection like line-level audio.
V75-010	The reference is system cabling: at the rear, on the coaxial interface, it is wired once behind the panel and stays out of the patch field.
V75-011	VID-REF-IN says what a buyer needs to know first: this module follows the row's reference, through this rear port, in these formats.
V75-012	An output claim means the module can be the row's reference; a pass-through cannot, and the two are easy to confuse on a panel marked OUT.
V75-013	A buffered pass-through lets a reference chain through modules without a distribution product, and the mark keeps it from being cabled as a source.
V75-014	A loop-through chains a reference through several modules on one cable run with one termination at the end; the switch is what lets the last module terminate it.
V75-015	The reference tree works only when every port in it is terminated once and driven once; the port modes say what each jack does. A picture port on the front is an external interface in the port list and claims nothing.
V75-016	The installer cables the reference once, behind the panel, and reads the marking, not the manual.

8.1 USB SERVICE PORT AND PARAMETER INTERFACE (CTRL-USB)

ID	WHY
USB-001	One connector and pinout behind the panel lets one short straight lead join any CTRL-USB product to any case host.
USB-002	The housing is common: a lead made for another purpose can be fitted to the port, and the marking and the withstand keep that from damaging the product.
USB-003	In a row the product runs from its power entries; a host can then budget every port at 100 mA, and no product back-feeds the host's 5 V.
USB-004	A straight lead keeps the pinout; the length and the twisted pair keep full-speed signalling inside a case.
USB-005	A host names a product from iProduct and tells two units apart by iSerial, including after a move to another port or a reboot into a boot loader.
USB-006	MIDI-CI identifies a device by its manufacturer ID; 7D is reserved for non-commercial and development use and would collide between makers. A manufacturer ID is a paid, one-time registration with the MIDI Association, the one cost CTRL-USB puts on a maker.
USB-007	The USB-IF MIDI 2.0 class is what hosts and computers already drive; one endpoint pair keeps a host's endpoint budget small, and alternate setting 0 serves MIDI 1.0 hosts.

ID	WHY
USB-008	These standard resources are all a host needs to list a product's controls and name them, with no product-specific code.
USB-009	Without the map or the step count a generic host can only show a percentage; 32-bit controller messages carry the full resolution of the entry's range.
USB-010	MIDI 2.0 has no read-back of a controller's value; this convention lets a host show current values with standard messages only.
USB-011	A host with few endpoints parks the devices it is not showing; a device that stops when parked would be lost to the host.
USB-012	Serving the schema is how a host knows the x-units it reads mean what EIS says; a host ignores x-units from a device that does not serve it.
USB-013	One stuck or shorted product must not take the other ports with it, and the host can restart one product without disturbing the rest.
USB-014	The user finds the product the host shows by the port it is plugged into.
USB-015	Any conforming product then works with any conforming host, including products the host's maker never saw.
USB-016	Values sent while the endpoints were closed are lost; a new subscription brings them back (USB-010).
USB-017	One protocol lets any computer software reach products behind any host, for their consoles and their firmware updates.

9 ASSEMBLING A SYSTEM

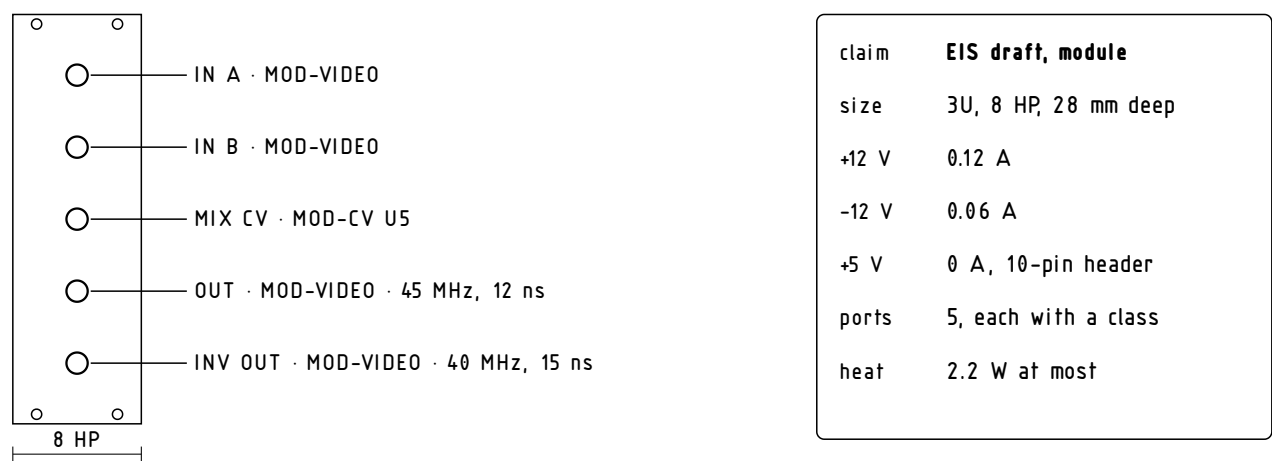
ID	WHY
ASM-001	Exceeding a bus board, header, or supply rating overheats contacts or trips the supply; the published currents exist so it can be checked first.
ASM-002	Two transmitters on one line drive against each other, leaving a level that is neither and stressing both outputs.
ASM-003	Two sources on one module can feed current from one into the other through the module's power circuit.
ASM-004	A DC-BAR25 plug enters a DC-BAR21 entry but makes unreliable contact, which can run hot or drop power under load.
ASM-005	Two adapters or entries on one DC rail fight each other's regulation and can feed current back into each other.
ASM-006	Each multi-pin variant has its own pin functions and contact rating, so only its own plug puts +V and -V on the right pins at its rated current.
ASM-007	Two sources on one tree fight; one input on two outputs is a passive split.
ASM-008	Two sources on one entry fight each other's regulation and can back-feed one another.
ASM-009	A supply and a bus board from different makers are joined by the installer; the wiring rules travel with the installer, not with either product.

ANNEX Q (INFORMATIVE) — WORKED EXAMPLES

Three products taken from first sketch to claim, so that a first-time reader can see how the clauses fit together. The figures are illustrative; each example has a claim file in `data/examples/` that eis claim accepts.

Q.1 A MODULE: A TWO-CHANNEL VIDEO MIXER

EIS · Worked example: a two-channel video mixer, from panel to claim



`data/examples/claim-module-video-mixeryaml`; Annex Q.1 walks through each requirement it meets.

STEP	DECISION	REQUIREMENT
Size	3U, 8 HP: a panel 128.5 mm high and no wider than 40.64 mm, made 40.34 mm; four Ø3.2 mm holes on the HP grid	PANEL-002, PANEL-006, PANEL-010, PANEL-011
Board	28 mm deep behind the panel, 9.25 mm clear of the top and bottom edges	PANEL-003, PANEL-012
Power	Draws 0.12 A on +12 V, 0.06 A on -12 V, nothing on +5 V; uses no bus CV or gate, so the 10-pin header is enough	BUS-007, PWR-001
Protection	Survives a reversed ribbon; every 0 V pin of the header is tied to the board's 0 V	BUS-009, GND-001
Ports	IN A and IN B are MOD-VIDEO inputs, 100 kΩ; OUT and INV OUT drive through 75 Ω; MIX CV is MOD-CV claiming U5, 0 to +5 V	SIG-001, SIG-006, SIG-009, SIG-010, SIG-014
Patch safety	Every input survives ±12 V; every output survives a short and stays within ±12 V	SIG-002, SIG-003, SIG-004

STEP	DECISION	REQUIREMENT
Video paths	Publishes 45 MHz bandwidth and 12 ns delay for OUT (recommended)	7.2

It owns no feature, so its claim line is EIS draft, module, and its claim file is `claim-module-video-mixer.yaml`. It dissipates at most $12\text{ V} \times 0.12\text{ A} + 12\text{ V} \times 0.06\text{ A} = 2.2\text{ W}$ (Annex O).

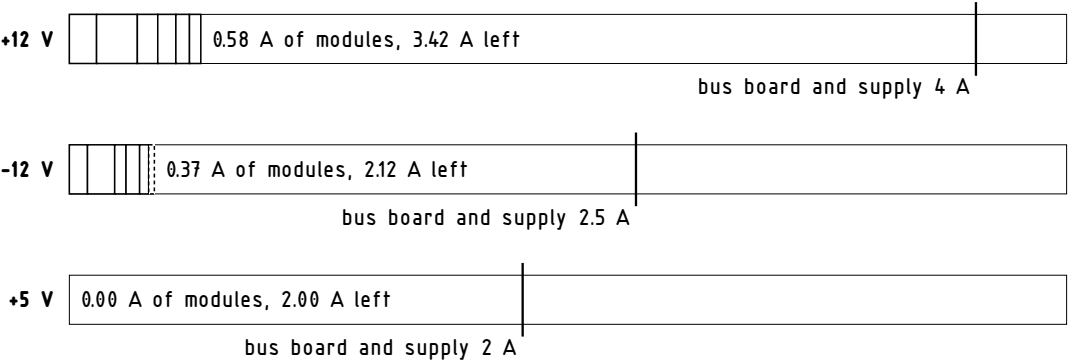
Q.2 A CASE: TWO ROWS WITH A BUILT-IN SUPPLY

The case of `claim-enclosure.yaml` has two 104 HP rows, each 55 mm deep behind the panel, a built-in supply of 4.0 A, 2.0 A, and 2.0 A, and a bus board that allows 1.5 A per header.

STEP	DECISION	REQUIREMENT
Rows	Publishes 104 HP and 55 mm for each row, so a 28 mm module fits and a 60 mm one does not	ENC-001, PANEL-003
Rails	Rails of the recommended section with M3 inserts; ships 6 mm M3 screws and says so	RAIL-003, RAIL-009, RAIL-011
Supply	Publishes each rail's rating and ripple, all below 150 mV; survives a short; no reverse swing or overshoot	PWR-002, SUP-001 to SUP-007
Bus board	Publishes its totals and the 1.5 A per-header limit; every header's 0 V runs to the supply's 0 V	PWR-002, BUS-012, GND-002
Earth	Its 0 V is bonded to protective earth at the IEC inlet, and the documentation says so	GND-003

The person filling it then budgets each row (9.1). The example rows in `row_budget_two_row.yaml` carry 1.48 A on +12 V and 0.70 A on -12 V on the processing row, about 26 W of heat by Annex O, with one module whose -12 V figure is unpublished planned at half its +12 V figure.

EIS · A row's current budget on the bus: the example row 'performance'

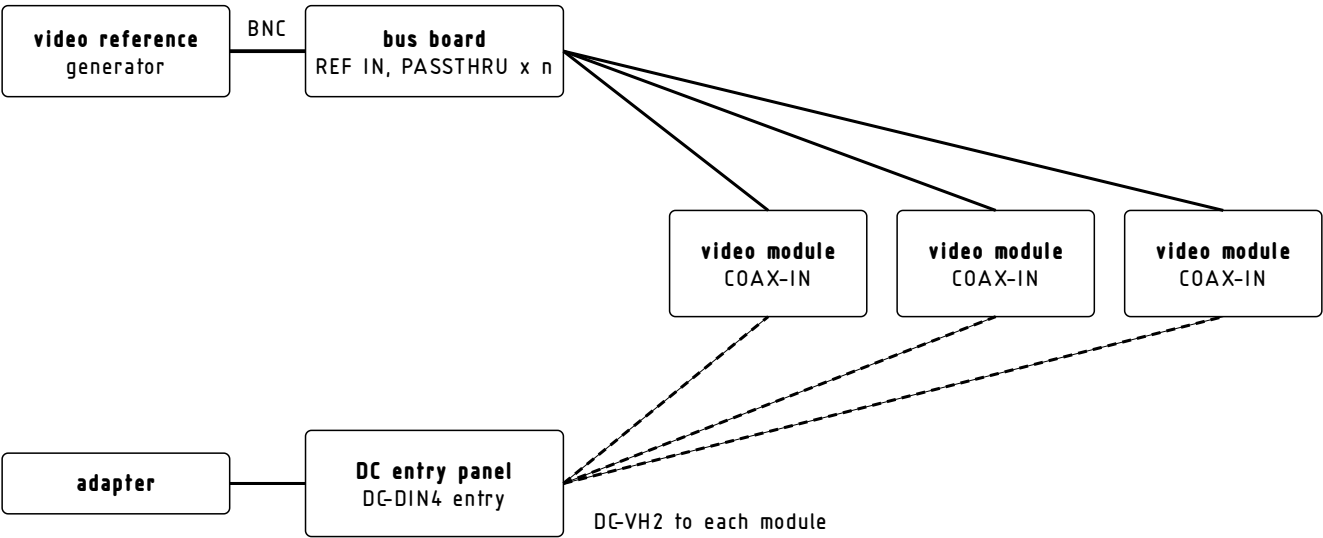


- ☐ Audio I/O: +12 V 0.12 A, -12 V 0.08 A
- ☐ VCO: +12 V 0.09 A, -12 V 0.05 A
- ☐ Envelope/LFO: +12 V 0.06 A, -12 V 0.04 A
- ☐ Mixer: +12 V 0.18 A, -12 V 0.12 A
- ☐ VCF/VCA: +12 V 0.08 A, -12 V 0.06 A
- ☐ MIDI utility (Type A): +12 V 0.05 A, -12 V not published

A module goes into a row only while each rail's sum stays within the bus board's totals, its per-header limit, and the supply's rating (ASM-001). The dashed segment plans a module that publishes no -12 V figure at 50 % of its +12 V draw, as EIS recommends.

Q.3 A VIDEO ROW: ONE REFERENCE, ONE DC RAIL

EIS · Worked example: one video reference and one DC rail across a row



One source per tree (ASM-007); each module on one source (ASM-003); shells and -V are 0 V (V75-002, GND-001).

PART	CLAIM	WHAT IT DOES IN THE ROW
Video reference generator	module (PWR-BUS-IN, VID-REF-IN, VID-REF-OUT), claim-module-video-reference-generator.yaml	Its REF OUT, a COAX-OUT on BNC, drives the distributor's designated input
Video bus board	bus board (PWR-BUS-OUT, VID-REF-IN, VID-REF-PASSTHRU), claim-bus-board-video-reference.yaml	Takes the generator's reference at REF IN and gives each module a buffered copy at a PASSTHRU
Video modules	module (PWR-BUS-IN, VID-REF-IN)	Each takes the reference at a VID-REF-IN, a COAX-IN at the rear, on RCA, BNC, or SMA
DC entry panel	module (PWR-DC12-IN), claim-module-dc-entry.yaml	Takes 12 V at a DC-DIN4 case entry and feeds modules at DC-BAR21 outlets, each protected
Cables	cable (VID-75), cable (PWR-DC12)	75 Ω coax center to center; DC cables +V to +V

The installer keeps one source per tree (ASM-007) and connects each dual-source module to one source (ASM-003). Every coaxial shell and the DC rail's -V are the modules' 0 V (V75-002, GND-001), so the reference, the picture, and the power share one 0 V; with the DC adapter floating and one earth bond at the case supply, there is no loop to show as hum bars (6.3).

BIBLIOGRAPHY (INFORMATIVE)

These sources explain or justify EIS; they are not normative. Third-party documents are not stored in this repository: data/sources.json records the URL, retrieval date, and checksum of each one the specification cites, and the reference repository does the same for the survey and the catalog sections.

SOURCE	USE IN EIS
nVent Schroff EuropacPRO catalog, December 2025, threaded inserts p. 6.37, front rails pp. 6.26 to 6.32, collar screws p. 6.74	Evidence for the 5.0 mm × 2.0 mm M3 insert section and tap drill; the L-KD, L-OD, H-KD, and H-LD sections in Annex A
IEC 60297-3-100:2008 and IEC 60297-3-101:2004 public preview pages (IEC samples)	The front panel, flange and slot figures of 5.1, read from the publications' own Figure 2, Table 1, Figure 3 and Figure 5
nVent Schroff standards summary	Transcription of the IEC 60297-3-100 rack mounting grid (465.1 mm centers, 12.7 mm and 31.75 mm steps) in 5.1, beyond the public preview
TraceParts solid of Schroff 34560-184	Measured L-KD section, insert seat, and end machining (Annex A)

SOURCE	USE IN EIS
Vector Electronics drawing 5280006, T-strut	Collected rail section; T-slot dimensions; the lower rail limits
Gie-Tec Trägerprofil sheet 2.5 and accessory sheet 2.18	Collected rail section and the M3 insert 138049 in the Doepfer A-100 frame
HEITEC horizontal rail page (3684.562, 9908.721); Verotec KM6-RF front extrusions; Tiptop Audio Z-rail data sheet	Catalog sections in Annexes A and B
Doepfer pages restating A-100 conventions; Intellijel 1U technical specifications	Listed with retrieval dates under inherited conventions
Doepfer, A-100 short-form manual 2026, retrieved 2026-10-14	The keying of shrouded bus headers (6.4)
LZX Industries, Eurorack module depth survey and flight-case sample, 2026-09	Module depths in survey/module-depths.json; Annex F
LZX Industries, Eurorack module power survey, 2026-09-30	Module widths and current draws in survey/module-power.json
LZX Industries, Eurorack power supply and bus board survey, 2026-09-30	Bus boards and supplies in survey/
LZX Industries, Eurorack case catalog, maker pages checked 2026-09-26	Commercial case depths in survey/cases.json
Mean Well RT-65B and GST series datasheets, retrieved 2026-10-16	Ripple ratings of common Eurorack and desktop supplies, behind the 150 mV ripple floor (6.2)
JST VH connector product specification (B3P-VH and B3PS-VH headers, VHR-3N housings, SVH-21T-P1.1 terminals)	Reference parts for the A6-VH3 PWR-A6 connector (6.8)
JST VH, Kycon KPJX/KPPX, and Molex Mini-Fit Jr PS-5556 product specifications	Reference parts for the multi-pin DC entries (6.7)
3M 3365 series ribbon cable, distributor listings, retrieved 2026-10-19	The 28 AWG conductor of standard 1.27 mm pitch ribbon behind BUS-015 (6.5)
Same Sky PJ-002A data sheet, retrieved 2026-10-19	The 2.5 A rating of a through-hole 2.1 mm DC jack (6.7)
ITU-R BT.601-4, table 3, retrieved 2026-10-19	The placement of the digital active line against OH for the 525 and 625 line systems (7.3)
DIN 562 square thin nuts	M2.5 slide nut inside the recommended section; M3 nut too wide (Annex D)
apra 19-inch catalog, rail 241-022; Vector groove nut NT4-7PA; No. 43 twist drill	M2.5 and #4-40 subrack hardware in Annexes A, C, and D
MIDI Association RP-054, TRS adapter specification; ITU-R BT.1700; SMPTE ST 253; AES11; ANSI E1.11; ILDA ISP-DB25	Named in the informative port vocabulary, Annex I