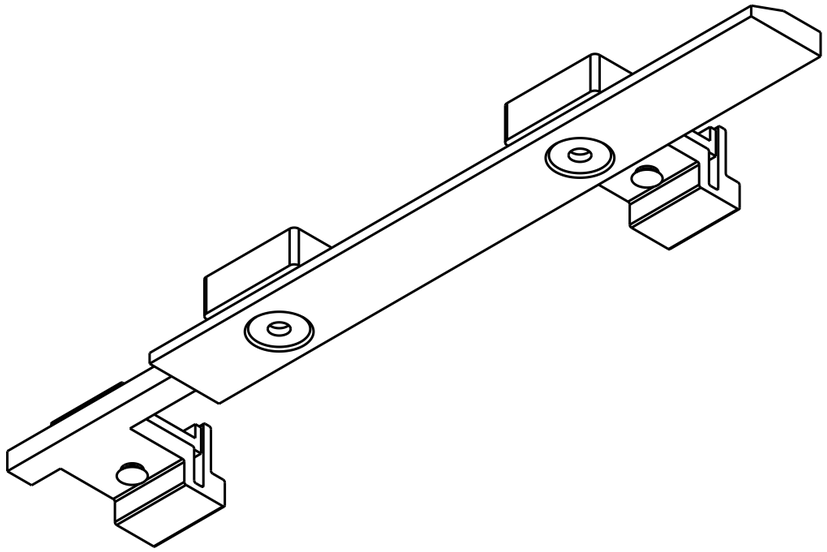
damgood Bottom-edge drawing system

ENGINEERING PROTOTYPE / FOR MANUFACTURING REVIEW / PRODUCTION RELEASE: HOLD

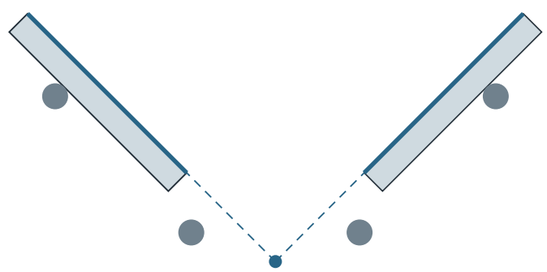
DG-200 / two removable drawing shoes

A bottom-mounted pair for a bare iPhone Duo, used upright on paper. Each shoe carries a 50 mm ruler and a straight tracing edge. The two edges follow the phone leaves as the opening angle changes.



CAD-derived right shoe

POM body / aluminum blade / soft liner / standard hardware



Intended use. Hold the phone steady on a flat surface. Set the angle, trace both edges, lift the phone, then extend the two lines with a straightedge until they meet. This design does not provide a physical pivot pin or one-step vertex mark.

Operating configuration. Development drawing range: 30 to 150 degrees. This is a model-screened range, not a validated accuracy claim. Remove both shoes before folding the phone closed. These shoes are not a freestanding phone stand.

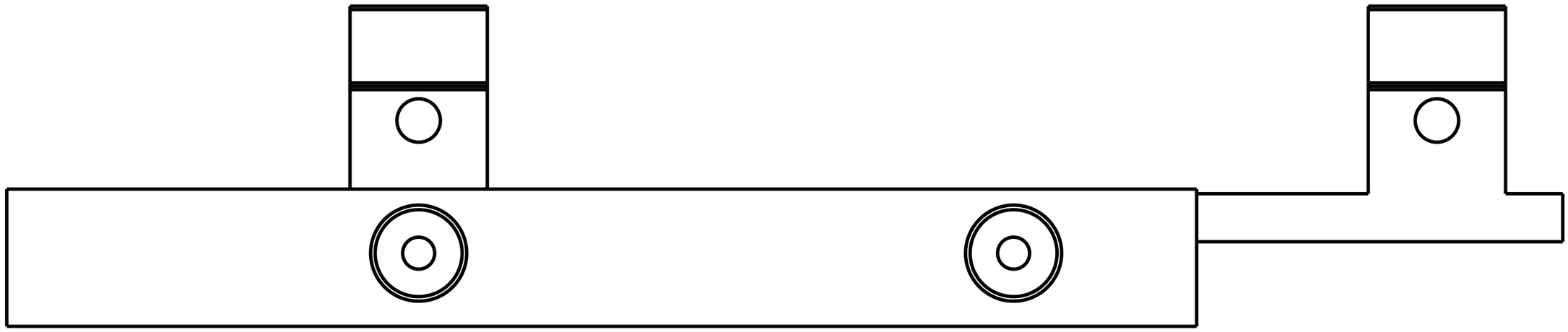
Release status. Rev C replaces the DG-100 side-rail architecture for the drawing use case. A factory can review manufacturability and quote prototype work. Contact geometry, clamp forces, real hinge clearance and accuracy remain unreleased.

Document authority. This PDF controls the stated prototype dimensions and holds. STEP defines nominal custom-part geometry. Hardware STEP files are simplified envelopes; supplier drawings control purchased parts.

damgood

Assembly and bill of materials

ENGINEERING PROTOTYPE / FOR MANUFACTURING REVIEW / PRODUCTION RELEASE: HOLD



Part	Qty / pair	Material / source	Function
DG-201-L / R	1 + 1	Unfilled POM copolymer; grade qualification pending	Two contact stations, rear support feet and blade locating rib
DG-202-L / R	1 + 1	6061-T6 aluminum; NS / SW finish	Thin tracing nose; 50 mm engraved scale
DG-203	4	Polyether TPU; candidate Desmopan 9370AU, 70A	Soft chassis contact and mechanical push-through key
DG-204	4	Accu SHK-M2-4-V2-A2; ISO 14581; M2 x 4 T6 A2	Recessed screws fitted from underside
DG-205	4	Accu HPN-M2-A2; DIN 934; M2 x 0.4 A2	Hex nuts captured in carrier pockets

Nominal pair mass: 5.05 g, from CAD volumes and assumed densities. Sixteen instances; seven unique STEP files. Confirm mass on samples. Handed blades have separately oriented numerals; do not mirror left-hand lettering in CAM.

Assembly envelope per shoe: X22..90 = 68 mm; Z-5..9 = 14 mm; Y-4..1.4 = 5.4 mm. Coordinates reference a provisional common hinge axis; they do not establish the actual installed location on a phone.

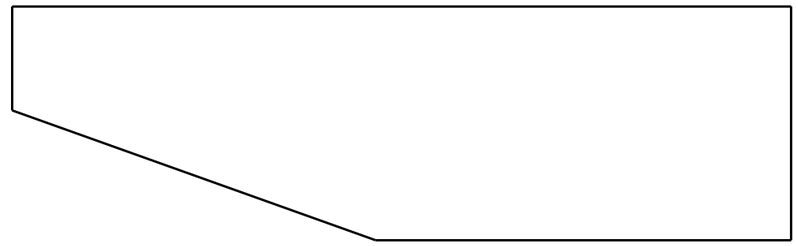
damgood

Tracing blade: DG-202-L / R

ENGINEERING PROTOTYPE / FOR MANUFACTURING REVIEW / PRODUCTION RELEASE: HOLD

BOTTOM VIEW (-Y) / datum A is the paper-contact face

Blue edge: datum B, straight tracing edge at Z9.00

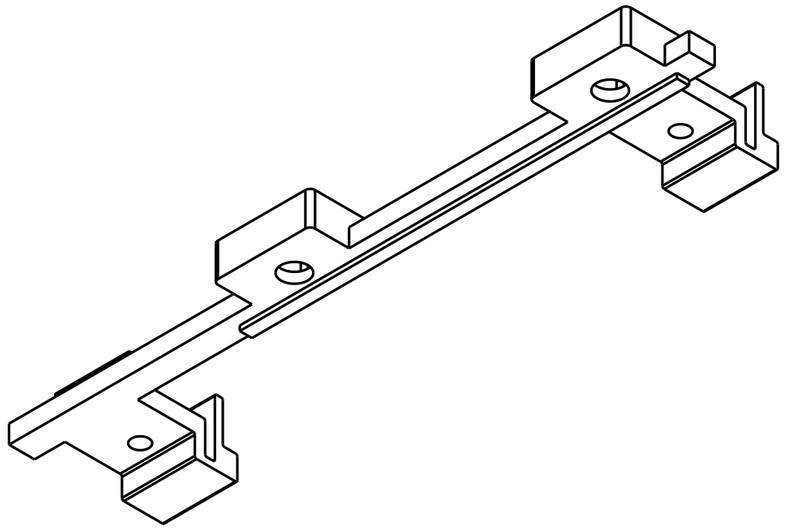


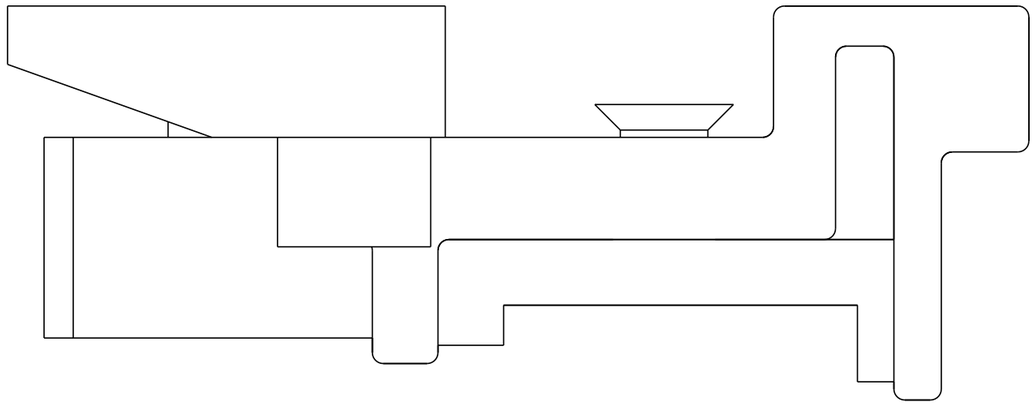
Characteristic	Prototype requirement
Datums	A: underside Y-4.00. B: tracing edge Z9.00. C: inboard end X38.00.
Overall blade / nose	52.00 +/-0.05 long; 6.00 +/-0.05 wide. Nose thickness 0.80 +/-0.05 at B.
Mounting ledge / taper	1.80 thick at Z3..6.2. Top tapers from Y-2.20 at Z6.20 to Y-3.20 at Z9.00.
Mount holes, 2X	X46 /72; Z5.80. Dia 2.20 +0.05/-0. Position +/-0.03 to B and C.
Countersinks from A	Dia 4.20 +/-0.05, 90 degrees +/-0.5. Verify actual screw head recession 0.10 minimum.
Locating groove	X39.95..76.05; Z3.26..4.34. Width 1.08 +0.02/-0. Depth 0.46 +0.02/-0 from mounting ledge.
Surface / edge controls	A flatness 0.05. B straightness 0.03 over 50. Surface Ra <=1.6 micrometres. Deburr non-drawing edges; tracing edge radius <=0.05, no burr. Edge finishing is a process note, not all breaks are modeled.
Scale / artwork	51 ticks; 1 mm pitch; X39..89. Span 50.00 +/-0.10; adjacent 10 mm +/-0.05 at 20 +/-2 C. Depth 0.025 nominal; numerals 0..50 separately handed.
Unspecified metal dimensions	+/-0.05; angular +/-0.5 degree. Values apply after surface finishing.

damgood

Carrier, soft contacts and port clearance

ENGINEERING PROTOTYPE / FOR MANUFACTURING REVIEW / PRODUCTION RELEASE: HOLD





Feature	Prototype geometry / control
Carrier and contact positions	Bridge X22..78. Stations X27.50 and 72.00; each 6.00 wide. Station position +/-0.05. No pads beneath the intervening port areas.
Front contact / display boundary	Soft contact top Y0.65; free surface Z2.20. Front rigid jaw begins Z3.10. Rigid chassis land and flexible-display boundary must be confirmed on a measured phone before fitting.
Rear contact / compliance	Free rear pad surface Z-2.65. Rear jaw thickness 0.65; relief slot Z-3.15..-2.35, Y-3.45..-0.70 extends compliance. Cross-section root radii R0.15 as modeled. Force is NOT established by this geometry.
Soft liner dimensions	Width 5.60; free gap 4.85. Front/rear pad thickness 0.90/0.50. Bottom pad nominal 0.90. Contact coordinates +/-0.025 development inspection target, not demonstrated molding capability.
Mechanical liner retention	Stem dia 1.20; head max dia 1.90 into dia 1.40 body hole. Snap strain and pull-out require samples. No adhesive is specified.
Support plane	POM rear feet and blade underside nominal Y-4.00. Inspect assembled coplanarity 0.05. No rocking on a flat plate. Do not use soft protruding feet that change the reference plane.
Blade registration	POM rib X40..76, Z3.30..4.30; width 1.00 +0/-0.02; height 0.40 +0/-0.02. Groove limits on sheet 3.
Process	CNC development body from traceable POM stock. Proposed production resin: BASF Ultraform N2320 003 AT, subject to spring/creep tests. No production mold draft, shrinkage or gates are released. Printed parts assess shape only unless their performance is qualified.

damgood

Assembly process and tolerance checks

ENGINEERING PROTOTYPE / FOR MANUFACTURING REVIEW / PRODUCTION RELEASE: HOLD

Step	Work instruction / inspection
1 - Incoming inspection	Verify part revisions, resin lots, blade finish, scale and all contact surfaces. Inspect the rear flexure for cracks or machining damage.
2 - Soft liners	Install two keyed liners into each carrier. Seat the stems fully; no twist, flash or exposed sharp polymer at phone contacts. Verify free gap optically with a defined low-force method.
3 - Blade and nuts	Seat the locating rib in the blade groove. Load the two M2 nuts into the hex pockets; hold them in an assembly nest until the screws engage.
4 - Fasteners	Fit M2 x4 T6 screws from below. Establish the torque window experimentally using actual coated blades and molded/machined carriers. No numeric production torque or threadlocker is released.
5 - Final inspection	Head recess >=0.10 below A; no nut rotation, looseness or blade yaw. Check A coplanarity, B straightness and readable scale. Actual thread engagement and seating must be inspected.

Stack-up	Result / consequence
Registration clearances	Rib 0.98..1.00; groove 1.08..1.10: total side clearance 0.08..0.12. Depth clearance 0.06..0.10. Limits prevent nominal interference; supplier must control position/straightness as well.
Possible blade yaw	0.12/36 gives about 0.191 degree per shoe, or 0.382 degree between two shoes. Clamp friction and calibration still need validation.
Pad gap	Two +/-0.025 contact face coordinates give free gap 4.80..4.90. Actual phone land span is unknown, so preload, installation force and retention cannot be calculated reliably.
Purchased hardware	Nominal head recession 0.20; screw-to-nut axial overlap 1.55 in the proxy. Nut height tolerance, lead-in chamfers, thread runout and screw length tolerance are not captured by that number. Inspect actual fasteners.
Paper and angle stability	Hold the phone during drawing. The phone hinge is not mechanically locked by these clips. A stored angle reading does not prevent the actual angle from moving under pencil pressure.

damgood Verification evidence and remaining gaps

ENGINEERING PROTOTYPE / FOR MANUFACTURING REVIEW / PRODUCTION RELEASE: HOLD

Check	Result	Scope / limitation
BREP and STEP	PASS	Seven unique parts; each is one valid solid. STEP round-trip volume error below 0.0001 mm3.
Internal component interference	PASS	No unintended material overlap at nominal assembly coordinates. Threads are simplified envelopes.
Shoe-to-shoe fold screening	481 poses / PASS	30..150 degrees at 0.25-degree steps. Minimum buffered projected clearance 1.049 mm. Continuous nominal lower bound 0.851 mm under the stated ideal hinge model.
Port placement screening	CONDITIONAL	Contact spans 24.5..30.5 and 69..75 avoid the candidate port/acoustic windows inferred from the AR model. Cable housings, audio response, local tolerances and actual attachment position have not been tested.
Drawing-angle relationship	GEOMETRY ONLY	Edges parallel to their corresponding ideal phone leaves form the same included angle. This is not a sensor calibration or physical accuracy result.
Physical validation	NOT PERFORMED	No actual-device fit, phone damage assessment, installation-force, fatigue, creep, slip, hinge drift, RF, audio or accuracy test.

Apple reference boundary. Published overall dimensions are 117.8 high, 164.6 open width and 5.2 open depth; closed 84.1 wide and 11.3 deep [A1]. The public accessory drawing catalog inspected did not contain a Duo manufacturing drawing [A2]. Apple's USDZ presentation model was inspected locally [A3]; it has no released interface tolerances or load-bearing-land definition.

The transformed AR frame mesh spans approximately 164.91 x 117.95 mm, slightly different from the published overall envelope. It is useful for feature screening, but is not sufficiently authoritative to set a +/-0.025 mm contact specification. No Apple mesh is redistributed with this package.

Vertex geometry. For the ideal common-axis model, the trace-line intersection lies 9*cot(angle/2) mm along each leaf direction from the hinge projection. The blade begins at X38: the untraced gap is 4.4 mm at 30 degrees, 29.0 mm at 90 degrees and 35.6 mm at 150 degrees. Extend both lines after lifting the phone; do not treat the hinge center as the paper vertex.

damgood

Prototype test plan and release gates

ENGINEERING PROTOTYPE / FOR MANUFACTURING REVIEW / PRODUCTION RELEASE: HOLD

Test / evidence	Procedure	Development acceptance target
Metrology / interface freeze	Measure at least 3 bare phones of the target model. Record chassis sections, rigid lands, display boundary, bottom ports, antenna regions and moving hinge positions. Use CMM/optical methods with an uncertainty budget.	Minimum sample count supports initial development only; establish production device tolerance bounds separately. Update CAD before fit trials if any hard interference is possible.
Initial fit / phone protection	Use measured rigid surrogates first, then actual phones. Inspect all contact patches; use force-displacement instrumentation and magnified before/after photographs.	No pressure on flexible display; no hard contact with phone; no damage or unintended control activation. Force limits require device-load review before testing.
Install, remove and retention	Record forces in installation, removal, axial and lateral directions at 0/23/35 C. Test with dry and lightly contaminated pads.	Proposed install/remove 3..15 N per shoe. Proposed pull-off retention >=5 N per shoe. These are targets, not established safe phone loads.
Drawing stability and accuracy	Use flat paper and a calibrated angular fixture at 30/45/60/90/120/150. Ten resets per angle; record both force directions under 0.5 N pencil load and prescribed hand restraint.	Maximum system error <=2 degrees; slip <=0.20 mm per stroke; repeatability spread <=1 degree. Report reference uncertainty and sensor/app contribution.
Endurance / dwell	500 fit/remove cycles on surrogates; seven-day clamped dwell at 45 C. Use matched unloaded controls. Recheck fit/force at 23 C.	No cracks, pad tear or loose hardware; retention loss <=20%; no permanent datum distortion >0.05mm. Characterize longer-term creep before release.
Device function / compatibility	Test target USB-C cable and charger housings, speakers/microphones, touch/Touch ID, cameras, wireless charging, RF/thermal behavior and the actual hinge sweep.	No blocked intended function; quantify differences against the bare device. RF lab to set model/band-specific acceptance budgets [A4].
Production pilot	Supplier DFM, final resin/pigment/coating approval, tool study, controlled torque, inspection gauges, material traceability and golden samples.	Written engineering release after closure of every hold; factory quote or attractive rendering is not production approval.

All force, durability and accuracy values above are proposed development criteria. None is a reported test result. Do not perform destructive load tests on an actual phone before a safe surrogate-based procedure and allowable device loads are agreed.

damgood

Finish, quotation and traceable sources

ENGINEERING PROTOTYPE / FOR MANUFACTURING REVIEW / PRODUCTION RELEASE: HOLD

Item	Specification / supplier response
Night Sky / DG-200-C-NS	6061-T6 satin bead-blast plus dark cool charcoal Type II anodize. Target 10 +/-3 micrometres, subject to process confirmation. Light contrasting laser marks.
Star White / DG-200-C-SW	Pale satin clear-anodized aluminum to coordinate with the light phone finish; dark laser marks. This is metallic silver, not opaque white.
Color approval	Apple lists Night Sky and Star White [A1]. Viewer colors are approximate. Approve actual-alloy plaques and finished samples under neutral and warm light; proposed deltaE00 <=1.5 to the agreed master, <=0.8 within a pair.
Polymer qualification	Candidate body resin: Ultraform N2320 003 AT [M1]. Candidate liner: Desmopan 9370AU DPS070 [M2]. Exact pigment, friction, compression response and aging must be approved; hardness alone does not define grip.
Quotation scope	Quote metrology/DFM, 10 prototype pairs, fit iterations, coating/liner samples, assembly fixtures, production tooling and unit prices at 500 / 1,000 / 5,000 pairs. State color split assumptions, yield, inspection, lead time, packaging and tooling ownership.
Supplier deliverables	Marked-up drawings, manufacturability changes, material certificates, measured first articles, assembly/torque results, validated test reports and production control plan. No supplier outreach or order has been placed.

SOURCE REGISTER / inspected 2026-09-26

A1 Apple iPhone Duo technical specifications

A2 Apple accessory dimensional drawing catalog

A3 Apple Star White USDZ presentation model; source URL and SHA-256 recorded in reference/apple-ar-mesh-inventory.json

A4 Apple Accessory Design Guidelines R31, sections 4.8/4.9 and 5.1.2

H1 Accu M2 x4 T6 countersunk screw SHK-M2-4-V2-A2

H2 Accu M2 nut HPN-M2-A2, DIN 934

M1 BASF Ultraform N2320 003 AT product datasheet

M2 Covestro Desmopan 9370AU DPS070 product data