Accessory Design Guidelines for Apple Devices

Release R25

Contents

Overview

1. Introduction

Note:
These Accessory Design Guidelines for Apple Devices ('Guidelines') are subject to the terms and conditions set forth on the final page of this document. By downloading, accessing, or otherwise utilizing these Guidelines, you agree to be bound by, and only utilize the Guidelines in accordance with, such terms and conditions.

These guidelines address:

- Physical compatibility with iPhone, iPad, Apple Watch, AirPods, Apple TV, and Apple Vision Pro.
- Using USB-C to connect to iPhone, iPad, and AirPods.
- Using Bluetooth to connect to iPhone, iPad, Apple Watch, Apple TV, Apple Vision Pro, and Mac computers.
- AC power adapters and battery packs compatible with iPhone, iPad, and AirPods.
- Qi wireless transmitters compatible with iPhone and AirPods.

Some aspects of accessory interaction are not addressed in this document and may require access to the Apple MFi Program (page 26) and the Accessory Interface Specification (page 26).

2. Requirements

The use of the words *shall*, *shall not*, *required*, *prohibited*, *should*, *should not*, *recommended*, *not recommended*, *may*, *optional*, and *deprecated* in a statement have the following meanings:

- *shall*, or *required* means the statement is an absolute requirement.
- *shall not* or *prohibited* means the statement is an absolute prohibition.
- *should* or *recommended* means the full implications shall be understood before choosing a different course.
- *should not* or *not recommended* means the full implications shall be understood before choosing this course.
- *may* or *optional* means the statement is truly optional, and its presence or absence cannot be assumed.
- *deprecated* means the statement is provided for historical purposes only and is equivalent to 'shall not'.

3. Terminology

3.1 Device

Device refers to an iPhone, iPad, or iPod.

iOS device refers to an iPhone or iPod running iOS.

iPadOS device refers to an iPad running iPadOS.

watchOS device refers to an Apple Watch running watchOS.

tvOS device refers to an Apple TV running tvOS.

Where appropriate, specific Apple product and operating system references will also be used.

3.2 Accessory

Accessory refers to any product connecting to a *device* using the interfaces described in this specification.

3.3 Component

A *component* is a functional unit or a constituent part of an accessory. Components inter-connect and function as a part of a greater system. Examples include:

- Integrated circuits, micro-processors, flash memory, microphones, and speakers.
- Data transport interface, such as a Lightning connector, USB connector, or Bluetooth radio.
- Power sources, such as a battery or power supply.
- Human Interface Device (HID) Control Surface (page 25), such as a play/pause button.

A *component* may also refer to a group or collection, such as the keyboard portion of a keyboard/trackpad accessory.

3.4 Control Surface

A *control surface* is a human interface device (HID) component enabling user interaction with an accessory. Examples include:

- Connectors
- Buttons
- Switches
- Rotary knobs
- Joysticks
- Touchscreens or touch-sensitive surfaces
- Microphones
- Motion/presence sensors

References to specific types of control surfaces such as buttons or switches are only applicable to those control surface types. If a requirement calls for a physical button to be implemented, a physical button shall be present.

3.5 Direct User Action

A *direct user action* is defined as user interaction with an accessory using a Control Surface (page 25). Examples include:

- Physical gestures, such as:
  - Attaching an accessory to a device.
  - Pressing a button.
  - Actuating a switch.
  - Turning a knob.
  - Interacting with a touchscreen.
  - Waving a hand.
  - Moving in/out of range (for wireless accessories).
- Voice input.

Accessories shall not autonomously perform user inputs unless explicitly authorized by the user.

3.6 Built-In Cable

A *built-in cable* is a cable with one end permanently attached to the accessory enclosure.

3.7 Apple MFi Program

The Apple MFi Program provides access to specifications, components, connectors, and other resources to create accessories capable of communicating with devices.

See https://mfi.apple.com for more information.

3.8 Accessory Interface Specification

The *Accessory Interface Specification* is available through the Apple MFi Program (page 26).

Use of some features requires accessory developers to be a member of the program and to integrate specific MFi hardware into the accessory.

Accessories

4. All Accessories

4.1 Scratches and Damage

Accessories shall not scratch or damage any device.

Accessories with abrasive surfaces and sharp edges (such as hard plastic, metal, or glass) shall not contact the active area of the device display.

4.2 Compliance Testing

Accessories shall not assume evidence of functionality when attached to a device means the accessory is specification compliant. Such an approach does not account for future devices or software releases, and runs a high risk of dependence on un-documented device behavior which is subject to change at any time.

If available, accessories should validate their design and implementation using the recommended test procedures for all supported features.

4.3 USB-B Receptacles

Accessories integrating USB-B receptacles shall comply with *USB Battery Charging Specification –Release 1.2*.

4.4 User Supplied Cables and AC Power Adapters

Accessories intended for use with user-supplied cables and/or AC power adapters shall be designed to work with any cables, AC Power Adapters (page 85), or Battery Packs (page 88) compliant with this specification, including Apple branded cables and AC power adapters. Such accessories shall not declare compatibility with only Apple branded USB cables or AC power adapters.

This compatibility requirement applies to all aspects of user-supplied cables and power adapters. For example:

- Connector receptacles on accessories shall accommodate all specification-compliant connector overmolds, and any accessory opening surrounding the device receptacle shall provide sufficient clearance for specification-compliant connector overmolds.
- Accessories shall work with all specification-compliant cables in regards to electrical DCR and SI.

Such accessories shall be tested with a wide variety of specification-compliant cables (including various lengths of the same cable if applicable) and AC power adapters during accessory development, in addition to Apple branded cables and AC power adapters.

4.5 TDMA Noise

GSM phones emit radiated and conducted RF noise, which can produce time division multiple access (TDMA) sounds from audio outputs. Accessories shall minimize coupling of audible interference from the device (commonly known as *TDMA noise* or *chopper noise*) into an accessory's electronics.

4.6 Attachments

Accessories shall remain compliant with the specification when connected to any attachments designed for the accessory.

Examples of accessory attachments include, but are not limited to:

- Car or desk mounts for a case.
- Wireless charging mats for a dongle or case.
- Detachable barcode scanners/credit card readers for a dock.

4.7 Magnetic Interference

Unless otherwise specified, Apple recommends avoiding the use of magnets and metal components in accessories.

Accessories claiming compatibility with a device with a digital compass (magnetometer) shall minimize interference with the digital compass and shall not repeatedly trigger compass recalibration.

Accessories claiming compatibility with a device with autofocus (AF) and/or optical image stabilization (OIS) shall not affect the operation of those features.

Devices featuring optical image stabilization:

- iPhone 16e
- iPhone 16 Pro Max

- iPhone 16 Pro
- iPhone 16 Plus
- iPhone 16
- iPhone 15 Pro Max
- iPhone 15 Pro
- iPhone 15 Plus
- iPhone 15
- iPhone 14 Pro Max
- iPhone 14 Pro
- iPhone 14 Plus
- iPhone 14
- iPhone SE (3rd generation)
- iPhone 13 Pro Max
- iPhone 13 Pro
- iPhone 13
- iPhone 13 mini
- iPhone 12 Pro Max
- iPhone 12 Pro
- iPhone 12
- iPhone 12 mini
- iPhone SE (2nd generation)
- iPhone 11 Pro Max
- iPhone 11 Pro
- iPhone 11
- iPhone XS Max
- iPhone XS
- iPhone XR
- iPhone X
- iPhone 8 Plus
- iPhone 8
- iPhone 7 Plus
- iPhone 7
- iPhone 6s Plus
- iPhone 6 Plus
- iPad Pro 12.9-inch (2nd generation)
- iPad Pro 10.5-inch

4.8 Radio Frequency (RF) Performance

4.8.1 Materials and Coatings

Accessories should avoid use of:

- Metals
- Conductive materials or coatings
- Materials with high dielectric (permittivity >5 F/m)

Such materials absorb radio frequency energy and may impair or degrade the performance of antennas for cellular communication, GPS, Wi-Fi, Bluetooth, and NFC.

Examples include, but are not limited to:

- Steel, aluminum, magnesium, titanium, etc.
- Plastics with any carbon content, glass content, or metallic plating
- Metallic paints
- Black paints with high carbon loading
- White paints with high titanium dioxide loading
- Metallic Physical Vapor Deposition (PVD) coatings

4.8.2 Antenna Keep-Out

Antenna keep-out regions can be found in Device Dimensional Drawings (page 294).

Accessory Materials and Coatings (page 31) which absorb radio frequency energy located in the antenna keep-out region have a higher risk of degrading device's wireless performance.

4.8.3 Over The Air (OTA) Transmission/Reception

Accessories shall not excessively degrade device's RF transmission efficiency. This can be quantified by measuring Total Radiated Power (TRP) across all of the device's operating bands.

Accessories shall not excessively degrade device's RF reception sensitivity. This can be quantified by measuring Effective Isotropic Sensitivity (EIS) across all of the device's operating bands.

Accessories may have a higher risk of excessively degrading device's RF performance if they:

- Contain magnets.
- Intrude on device Antenna Keep-Out (page 31) zones.
- Contain active electronic circuitry, such as:
  - Bluetooth radios.
  - Switched-mode power supplies.
  - High speed data interfaces.

Accessory configurations shall be taken into account when designing for maximum RF compatibility. Examples include, but are not limited to:

- Accessory on/off.
- Accessory open/closed.
- Attachments (page 29) present/not present.

Good design practices shall be followed to minimize emissions and maximize RF compatibility. These include, but are not limited to:

- Shielding digital circuitry and clock signals.
- Minimizing radiation from digital interfaces.
- Decoupling high frequency signals and power supplies.
- Filtering off-board signals.
- Maintaining ground plane circuit board integrity.
- Minimizing current loop areas.
- Ensuring proper cable shielding terminations.

4.8.4 Specific Absorption Rate (SAR)

A list of labs performing SAR testing with devices is available through the Apple MFi Program (page 26).

4.8.5 Near Field Communication (NFC)

Accessories shall not degrade device's NFC transaction performance.

Accessories may have a higher risk of degrading device's NFC transaction performance if they intrude on device Antenna Keep-Out (page 31) zones.

Devices featuring NFC:

- iPhone 16e
- iPhone 16 Pro Max
- iPhone 16 Pro
- iPhone 16 Plus
- iPhone 16
- iPhone 15 Pro Max
- iPhone 15 Pro
- iPhone 15 Plus
- iPhone 15
- iPhone 14 Pro Max
- iPhone 14 Pro
- iPhone 14 Plus
- iPhone 14

- iPhone SE (3rd generation)
- iPhone 13 Pro Max
- iPhone 13 Pro
- iPhone 13
- iPhone 13 mini
- iPhone 12 Pro Max
- iPhone 12 Pro
- iPhone 12
- iPhone 12 mini
- iPhone SE (2nd generation)
- iPhone 11 Pro Max
- iPhone 11 Pro
- iPhone 11
- iPhone XS Max
- iPhone XS
- iPhone XR
- iPhone X
- iPhone 8 Plus
- iPhone 8
- iPhone 7 Plus
- iPhone 7
- iPhone SE
- iPhone 6s Plus
- iPhone 6s
- iPhone 6 Plus
- iPhone 6

4.9 Thermal Management

The accessory's supported temperature range shall be greater than or equal to the published temperature ranges of every device the accessory claims compatibility with.

4.10 Tripod Connections

Tripod connections shall comply with *ISO 1222:2010, Photography — Tripod connections*, see https://www.iso.org/standard/55918.html.

4.11 Anthropometric Considerations

Children and people with smaller hands (5th percentile), as well as people with larger hands (95th percentile) should all be considered during the accessory design process.

Apple recommends using design resources such as:

- AnthroKids (https://math.nist.gov/~SRessler/anthrokids/).
- U.S. Army Anthropometry Survey (http://mreed.umtri.umich.edu/mreed/downloads.html#ansur2).
- Civilian American and European Surface Anthropometry Resource (CAESAR).

5. Cases

Cases are accessories substantially enclosing devices.

The requirements shall be applied to each component separately for cases with multiple user-detachable components substantially enclosing the device.

5.1 Product Design

A well-designed case will securely house a device without interfering with the device's operation. Significant factors in mechanical design include access to the device's sensors, controls, and connectors. See Device Dimensional Drawings (page 294).

5.1.1 Device Protection

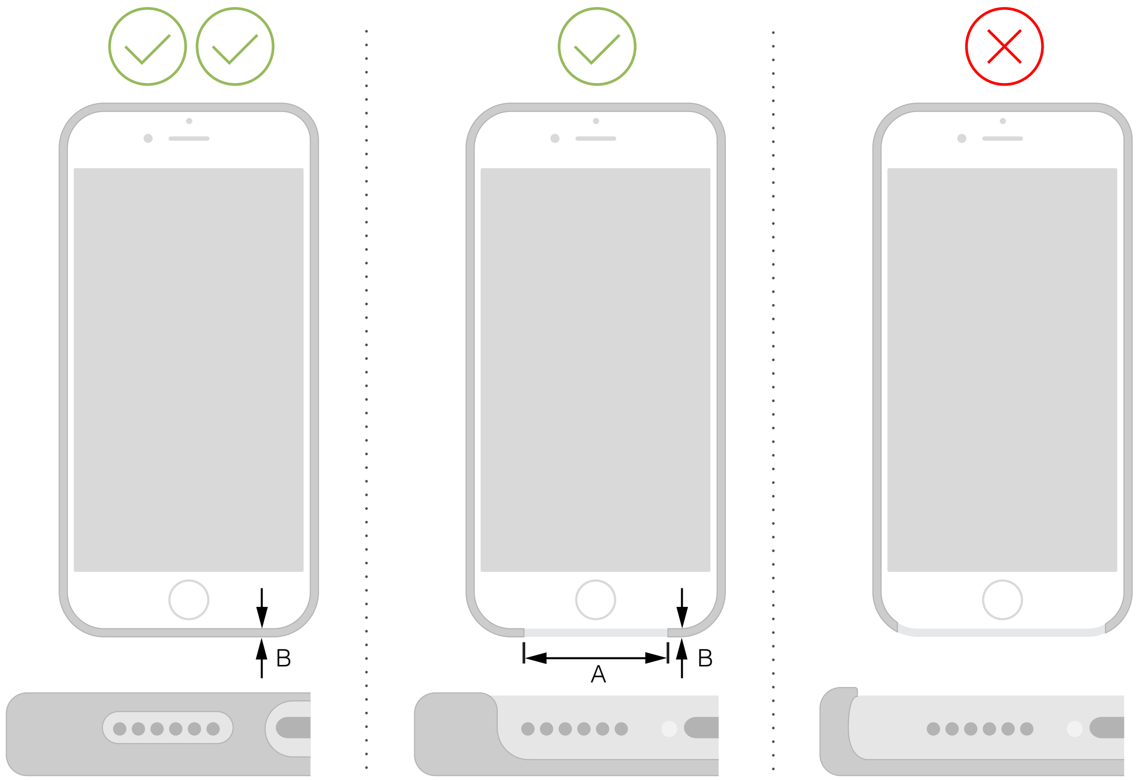
Cases shall protect the device from a 1 m drop onto a hard paved surface in any orientation.

Exposed glass on the device shall not come within 0.85 mm of a flat surface, such as a table or floor, in any orientation when the case is attached. Ideally the glass should not come within 1.00 mm. Device protection should be achieved by creating features around the exposed glass to keep it away from the flat surface.

Care should be given to the design of the bottom of the case to achieve both device protection and provide access to device speakers, microphones, and connectors. For example, the bottom of iPhone X cases should:

- Not have an opening wider than 50 mm, see dimension 'A' in Figure 5-1 (page 36).
- Be made of polycarbonate (PC) at least 1.15 mm thick, see dimension 'B' in Figure 5-1 (page 36).

Figure 5-1 Device protection



5.1.2 Access to Inputs and Interconnects

Cases shall readily permit user access to inputs and interconnects.

5.1.2.1 Access to Controls

Cases shall readily permit user access and operation of the device's mechanical controls, such as:

- Volume buttons.
- Camera Control.
- Side/Top button.
- Action button.
- Ring/Silent switch.
- Home button.
- Touch ID sensor.

5.1.2.2 Access to the Camera Control

Cases for devices with Camera Control shall accommodate the following gestures across the entire surface of the Camera Control:

- Click.

- Light press.
- Slide.
- Swipe.

The case shall either:

- Have an opening meeting the keep-out defined in the Device Dimensional Drawings (page 294).
- Integrate the Camera Control Case Interface (page 37).

The opening shall be large with smooth edges and a wide angle designed to accommodate:

- Various grip styles, including:
  - Portrait orientation, when held with either the right or left hand.
  - Landscape orientation, with the Camera Control at the top, when held with either one or two hands.
- Diverse hand and finger sizes, see Anthropometric Considerations (page 34).
- Diverse finger nail lengths, including nails extending beyond the tip of the finger.

The opening should not have sharp or hard edges causing the user to experience finger discomfort when engaging with the Camera Control.

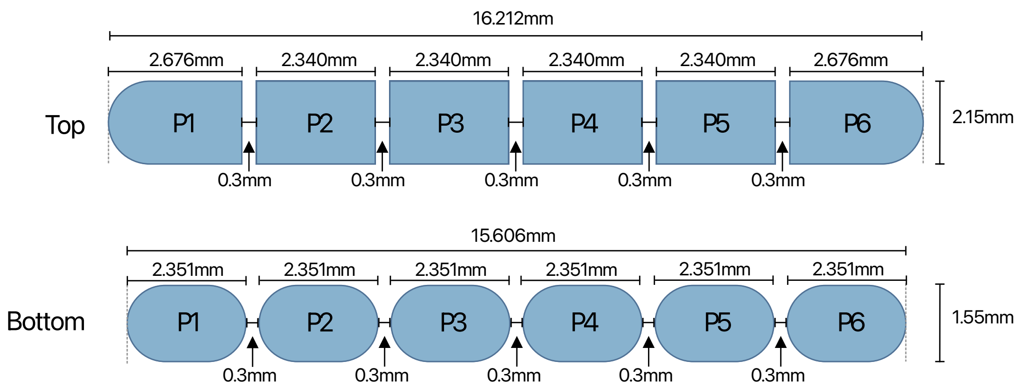
5.1.2.2.1 Camera Control Case Interface

Cases may integrate their own Camera Control case interface.

A Camera Control case interface shall have a:

- Bottom layer consisting of 6 copper pads connecting to the Camera Control, see Figure 5-2 (page 38).
- Top layer consisting of 6 copper pads, see Figure 5-2 (page 38).
- PCB-like material to connect the bottom and top layers and to achieve proper thickness for the case design.

Figure 5-2 Camera Control case interface top and bottom layers



Camera Control case interface shall:

- Have a top cap, such as a sapphire crystal.
- Have a flatness of less than 25 µm where it makes contact with the Camera Control.
- Have a tilt of less than 160 µm in all directions.
- Have a static (no user contact) misalignment center to center along:
  - The width of the Camera Control of less than 160 µm.
  - The length of the Camera Control of less than 190 µm.
- Have a dynamic (user contact) misalignment center to center in all directions of less than 130 µm.
- Have a maximum stiffness of 180 gf/mm.
  - Target stiffness should be 90 gf/mm throughout its range of travel.
- Be designed to maintain contact with the Camera Control across all copper pads and shall:
  - Have a case applied force (preload) of 45 gf or less at maximum button offset.
  - Not trigger a light press when the area around the Camera Control is squeezed up to 1050 gf.
  - Not have an air gap greater than 50 µm to the Camera Control. Apple recommends no air gap.
- Have a capacitance greater than 0.362 pF for pads P1 and P6.
- Have a capacitance greater than 0.432 pF for pads P2, P3, P4, and P5.
- Have a sheet resistance for inks and coatings greater than 50 G-Ω/sq.

5.1.2.2.2 User Study

A study evaluating the usability and comfort of the Camera Control by end users shall be completed. Users should be able to perform all gestures without discomfort from pressing into the case material surrounding the Camera Control.

The study population shall include:

- Various hand sizes as defined in Anthropometric Considerations (page 34).
- Various finger shapes, taking into account:

    - Taper.
    - Flatness.
- Various finger nail lengths:
    - Shorter than the fingertip.
    - At the fingertip.
    - Slightly longer than the fingertip.
    - Much longer than the fingertip.

The user study shall be performed using the Gestures (page 70) portion of the Camera Control (page 70) test.

5.1.2.3 Access to the USB-C Connector

Cases shall provide easy access to a device's USB-C connector, if present.

The USB-C receptacle keep-out:
- Shall be at least 12.35 mm by 6.50 mm.
- Should be at least 12.45 mm by 6.60 mm with full radii rounded edges for the greatest compatibility with the widest variety of cables and docks, see USB-C receptacle accessory keep-out (page 287).

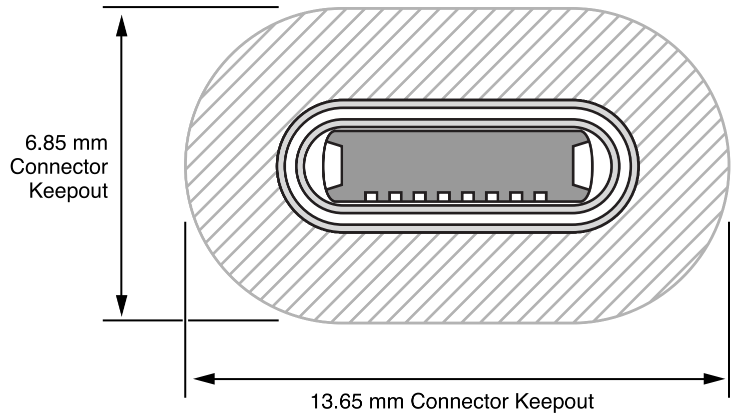
USB-C connector openings shall be designed with enough margin to compensate for shifting or dimensional changes of the case material.

5.1.2.4 Access to the Lightning Connector

Cases shall provide easy access to a device's Lightning connector, if present.

The Lightning receptacle keep-out:
- Shall be at least 12.05 mm by 6.30 mm with full radii rounded edges.
- Should be at least 13.65 mm by 6.85 mm for the greatest compatibility with the widest variety of cables and docks, see Figure 5-3 (page 40).

Figure 5-3 Lightning Receptacle (C37) keep-out



Lightning connector openings shall be designed with enough margin to compensate for shifting or dimensional changes of the case material.

5.1.2.5 Access to the Headset Jack

Cases shall provide easy access to a device's headset jack, if present.

The headset jack keep-out:

- Shall be at least 6.0 mm in diameter and at most 14.0 mm deep.
- Should be at least 6.5 mm in diameter and at most 10.0 mm deep for the best compatibility with a range of headsets.

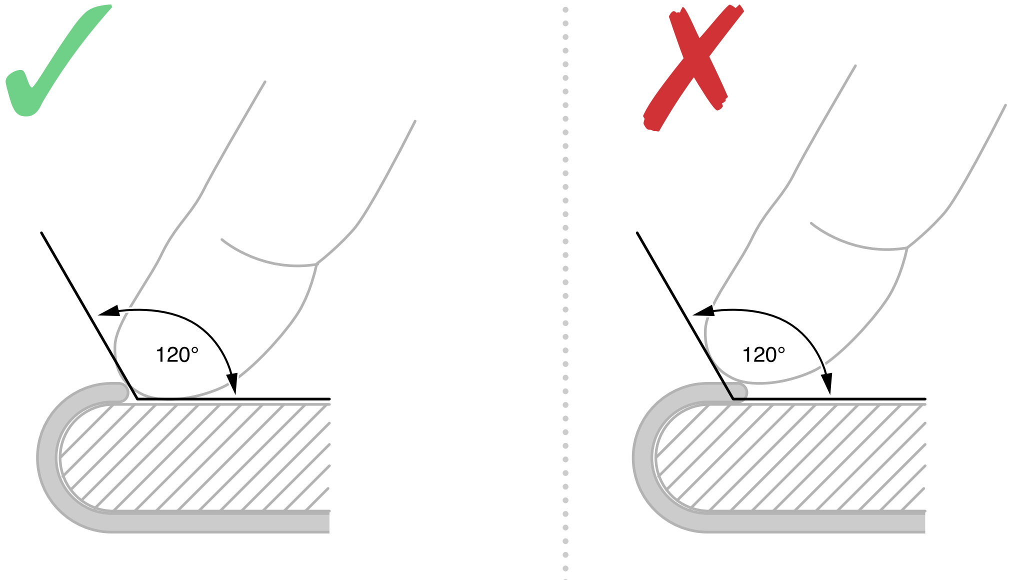
Headset jack openings shall be designed with enough margin to compensate for shifting or dimensional changes of the case material.

5.1.2.6 Touchscreen

Cases should not have edges trapping water on the touchscreen when the device is held at a 30° angle relative to the horizon.

Cases shall allow a 120° opening, see Figure 5-4 (page 41), along the edges of a touchscreen's active area to ensure compatibility with touchscreen features. See Device Dimensional Drawings (page 294) for active areas.

Figure 5-4 Touchscreen keep-out angle



5.1.2.7 Edge Swipe Gestures

Users shall be able to easily use edge swipe gestures.

Examples of such gestures include, but are not limited to:

- Swipe in from the top edge for Control Center or Notification Center.
- Swipe in from the bottom edge for Home, App Switcher, or Reachability.
- Swipe in from the left edge in Messages or Mail to go back from a conversation.

5.1.2.8 Cover Glass Contact

Cases should not contact the cover glass of:

- iPhone SE (3rd generation)
- iPhone SE (2nd generation)
- iPhone 11 Pro Max
- iPhone 11 Pro
- iPhone 11
- iPhone XS Max
- iPhone XS
- iPhone XR
- iPhone X
- iPhone 8 Plus
- iPhone 8

- iPhone 7 Plus
- iPhone 7
- iPhone 6s Plus
- iPhone 6s
- iPhone 6 Plus
- iPhone 6

5.1.3 Dock Compatibility

The distance from bottom of the device to the outside of a case should not exceed 1.8 mm for compatibility with docks.

5.1.4 Wireless Power

Cases claiming compatibility with MagSafe or Qi wireless power 2.0 or later, see Device Power (Inductive) (page 165), shall:

- Integrate a MagSafe Case Magnet Array (page 177).
- Not have rear pockets or holders for credit cards, RFID cards, or other similar items. Cards may be damaged and/or impact wireless charging performance.

5.2 Acoustics

Cases shall not impair or degrade the acoustic performance of a device.

5.2.1 Call Quality

Cases shall not impair or degrade the user experience making and receiving audio calls over a cellular network or audio/video calls using FaceTime in both handset and speakerphone modes. Cases should not change the frequency response of the speakers or microphones. In addition, the user should not hear distortion or echo resulting from using the case.

Cases shall not obstruct microphones during a phone call. Occluding microphones can result in call quality degradation.

5.2.2 Speaker to Microphone Coupling

Cases shall not facilitate the conduction of sound from speakers to microphones. Such sound conduction may cause echoing in phone calls.

5.2.3 Speaker/Microphone Openings

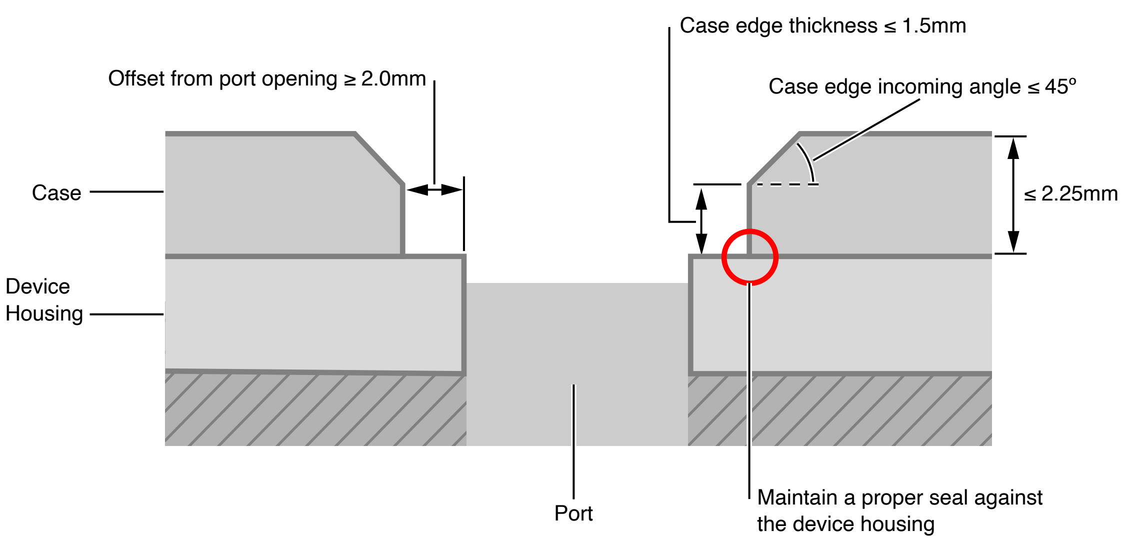
Device speaker/microphone port locations vary from model to model, see Device Dimensional Drawings (page 294).

5.2.3.1 Thin Cases (≤2.25 mm)

Microphone/speaker openings in thin cases should:

- Be offset at least 2.0 mm from the edge of any device speaker/microphone port.
- Be at most 1.5 mm thick along their inner diameter.
- Have a maximum 45° incoming angle to their inner diameter.
- Maintain a proper seal against the device between speaker/microphone ports.

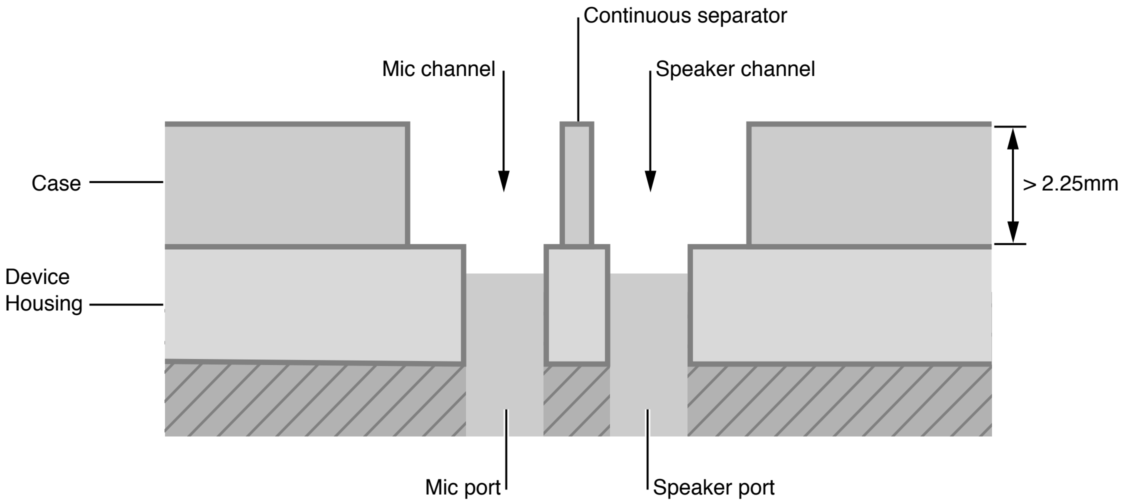
Figure 5-5 Microphone/speaker opening recommendations for thin cases



5.2.3.2 Thick Cases (>2.25 mm)

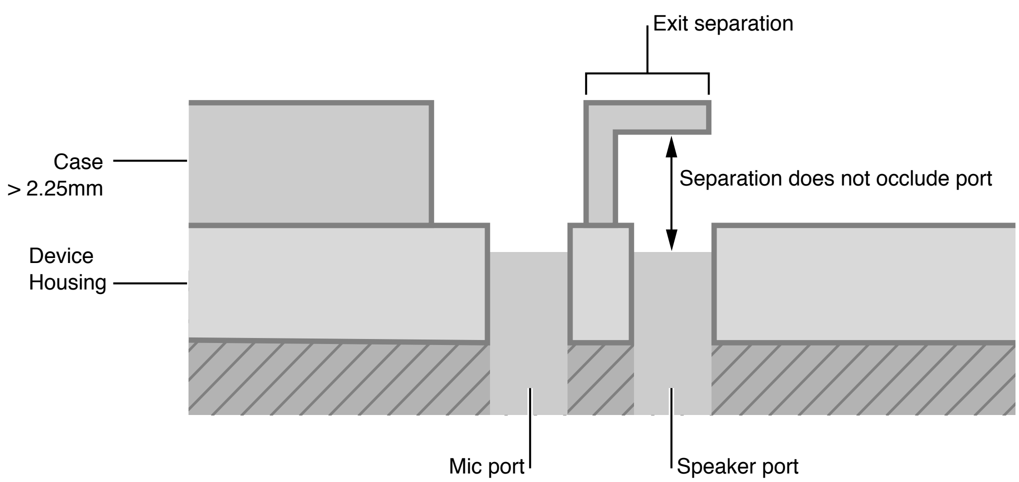
Speaker and microphone openings should be channeled independently and without interruption to/from the outside surface of a thick case.

Figure 5-6 Thick case acoustic channels



Thick cases should maximize exit separation between speaker and microphone channels.

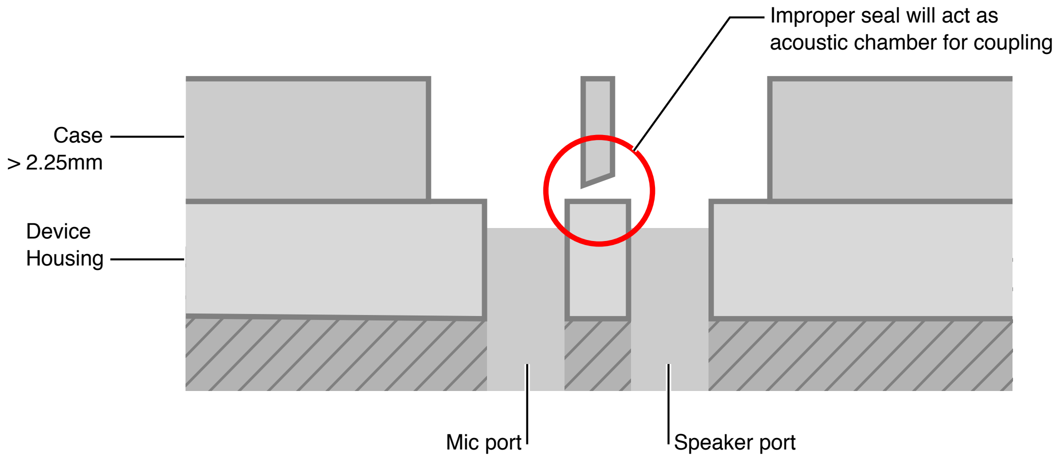
Figure 5-7 Thick case microphone and speaker exit separation



Thick case channels may act as a resonance chamber and detune microphone/speaker frequency response. The resulting frequency response may vary according to channel size/shape.

If a thick case does not maintain a proper seal against the device between microphone/speaker channels, the case itself may become an acoustic chamber.

Figure 5-8 Improper thick case seal



5.3 Ambient Light Sensor and Proximity Sensor

Ambient light sensor and proximity sensor locations for various devices are illustrated in the Device Dimensional Drawings (page 294). Some drawings indicate sensor keep-out areas.

5.4 Haptics

Cases should not cause a substantial change in the feel of the device's haptic feedback.

5.5 Magnetic Interference

Cases shall not interfere with the device's:

- Magnetic compass.
- Rear camera autofocus (AF).
- Rear camera optical image stabilization (OIS), if present.
- Front camera autofocus, if present.

See Magnetic Interference (page 29) for additional details.

5.6 Touch ID

Cases shall not inhibit use of the device's Touch ID sensor. Touch ID sensor keep-outs are indicated in the Device Dimensional Drawings (page 294).

Cases overlaying the sensor may cause users to have difficulty using Touch ID.

5.7 Camera

The camera field of view (FOV) and the illumination provided by the flash are designed for each devices' camera. It is exceptionally important manufacturers consult Device Dimensional Drawings (page 294) for each device, and shall not assume any parameters are shared between devices.

Images from the camera may be affected by the geometry, color, and surface finish of the case, particularly when using a flash. Camera opening trim should be designed to avoid reflecting light into the camera.

5.7.1 Geometry

The camera lens FOV shall not be blocked. Making opening dimensions too small around the camera and flash may block the lens FOV and the illumination from the flash. Blocking the FOV may cause vignetting in the image, where one or more corners of the image are darker than the center. Blocking marginal rays just outside the lens FOV may also reduce the sharpness and contrast of the image. Blocking flash illumination may cause haze in the image, resulting in reduced contrast. See Device Dimensional Drawings (page 294) for camera keep-outs.

Case openings shall not be designed in a manner directing stray light into the camera lens. If the opening is too narrow or too steep, it may reflect light into the camera lens washing out the image or adding unwanted color casting. Adding a chamfer to the opening trim near the camera may help direct stray light away from the camera lens. When the device includes a flash, a narrow or steep opening may reflect light from the camera and flash opening back into the camera lens. This may cause images to appear washed out or cause unwanted artifacts. Designers should also ensure mechanical keep-outs as outlined in the Device Dimensional Drawings (page 294) are maintained with worst-case X-Y placement tolerances to minimize the risk of image haze.

5.7.2 Color

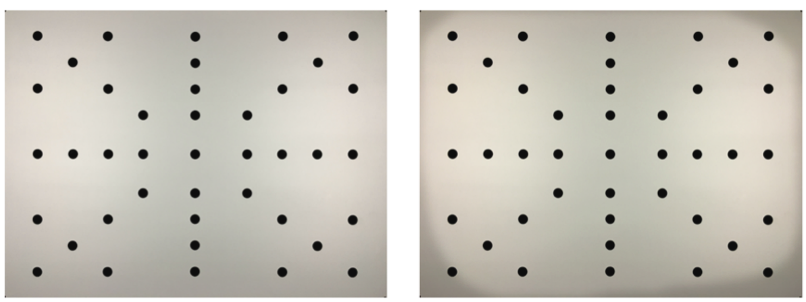
Light reflected from a case may carry the color of the case. Black material or black coatings may help avoid color bleeding into the camera lens from an external light source or the flash. The darker the color the less likely light from a flash or external source may be reflected off the case and into the camera lens. Apple recommends a semi-gloss black material or coating around the camera and flash openings.

5.7.3 Surface Finish

Matte or diffuse materials scatter light in all directions increasing the likelihood light from the flash or other strong light sources may be reflected into camera lenses. Semi-gloss materials may direct light away from the camera lens.

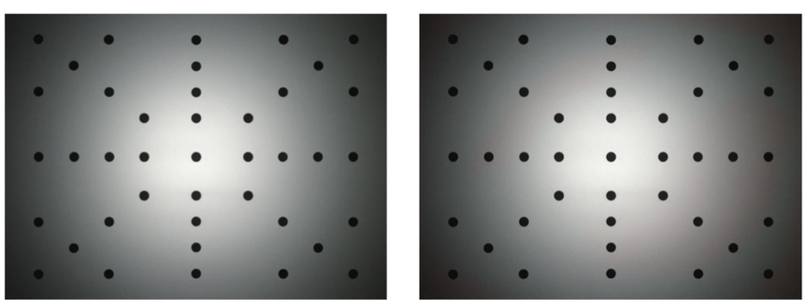
5.7.4 Image Degradation Examples

Figure 5-9 Sample image degradation by image blocking in an ambient condition



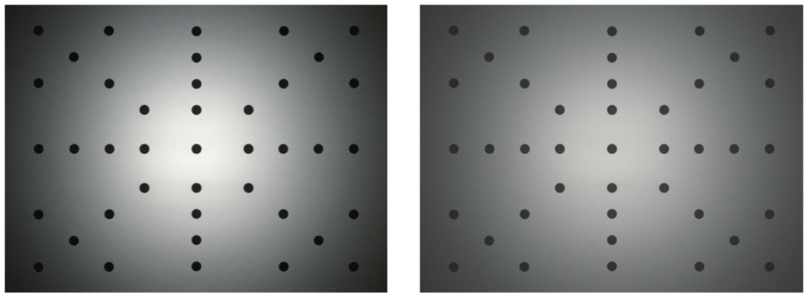
Reference Degraded

Figure 5-10 Sample image degradation by color shift through accessory with strong color



Reference Degraded

Figure 5-11 Sample image degradation by flash interference



Reference Degraded

5.8 Reliability

Cases shall be tested to verify they will withstand long-term use under typical use conditions, and will not impair, functionally degrade a device, cause Scratches and Damage (page 28) to the device or its immediate surroundings, or adversely affect the user.

5.8.1 Device Insertion and Removal

Cases shall hold the device securely while permitting easy insertion and removal. A case shall not cause Scratches and Damage (page 28) to the device by the repeated insertion and removal of the device from the case under conditions representative of long-term use in a variety of environments.

5.8.2 Colorfastness

Dyes, inks, or coatings in or on the case shall not transfer or bleed color onto either the device or user, particularly while the case is in contact with common substances such as water, hand sanitizer, sunscreen or lotions.

5.9 Environmental

Cases shall comply with applicable environmental regulations for the regions in which such accessories are to be sold, as well as applicable substance or material restrictions including:

- Organic tin compounds, PFOS, PFOA, phthalates, azo dyes, polybrominated biphenyls (PBBs) and PAHs, per requirements of the EU REACh regulation EC 1907/2006.
- Nickel leach rate on surfaces in prolonged skin contact, per requirements of the EU REACh regulation EC 1907/2006.

- Cadmium, lead, hexavalent chromium, and nickel, per requirements of EU Directive 2009/48/EC.
- Natural rubber latex, per requirements of EU Directive EC 93/42/EEC.
- Dimethylfumarate (DMFu), per requirements of EU Regulation 412/2012.
- pH and Formaldehyde, per requirements of China GB 18401 for textiles and China GB 20400 for leather.
- Endangered species of flora and fauna in products or packaging (US Lacey Act).
- Polybrominated diphenyl ethers (PBDE).
- Compliance with California proposition 65, as applicable.

5.10 Verification

5.10.1 Device Models

Case testing procedures vary depending on the device they enclose.

5.10.1.1 iPhone 16e

Table 5-1 iPhone 16e case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 16e	
Haptics (page 70)	iPhone 16e	
Autofocus & Optical Image Stabilization (page 72)	iPhone 16e	
Near-Field Communication (NFC) (page 73)	iPhone 16e	
Acoustics (page 75)	iPhone 16e	

5.10.1.2 iPhone 16 Pro Max

Table 5-2 iPhone 16 Pro Max case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 16 Pro Max	
Camera Control (page 70)	iPhone 16 Pro Max	
Haptics (page 70)	iPhone 16 Pro Max	
Autofocus & Optical Image Stabilization (page 72)	iPhone 16 Pro Max	
Near-Field Communication (NFC) (page 73)	iPhone 16 Pro Max	
Acoustics (page 75)	iPhone 16 Pro Max	
MagSafe Case Magnet Array (page 192)	iPhone 16 Pro Max	Cases supporting MagSafe only.

5.10.1.3 iPhone 16 Pro

Table 5-3 iPhone 16 Pro case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 16 Pro	
Camera Control (page 70)	iPhone 16 Pro	
Haptics (page 70)	iPhone 16 Pro	
Autofocus & Optical Image Stabilization (page 72)	iPhone 16 Pro	
Near-Field Communication (NFC) (page 73)	iPhone 16 Pro	
Acoustics (page 75)	iPhone 16 Pro	
MagSafe Case Magnet Array (page 192)	iPhone 16 Pro	Cases supporting MagSafe only.

5.10.1.4 iPhone 16 Plus

Table 5-4 iPhone 16 Plus case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 16 Plus	
Camera Control (page 70)	iPhone 16 Plus	
Haptics (page 70)	iPhone 16 Plus	
Autofocus & Optical Image Stabilization (page 72)	iPhone 16 Plus	
Near-Field Communication (NFC) (page 73)	iPhone 16 Plus	
Acoustics (page 75)	iPhone 16 Plus	
MagSafe Case Magnet Array (page 192)	iPhone 16 Plus	Cases supporting MagSafe only.

5.10.1.5 iPhone 16

Table 5-5 iPhone 16 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 16	
Camera Control (page 70)	iPhone 16	
Haptics (page 70)	iPhone 16	
Autofocus & Optical Image Stabilization (page 72)	iPhone 16	
Near-Field Communication (NFC) (page 73)	iPhone 16	
Acoustics (page 75)	iPhone 16	
MagSafe Case Magnet Array (page 192)	iPhone 16	Cases supporting MagSafe only.

5.10.1.6 iPhone 15 Pro Max

Table 5-6 iPhone 15 Pro Max case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 15 Pro Max	
Haptics (page 70)	iPhone 15 Pro Max	
Autofocus & Optical Image Stabilization (page 72)	iPhone 15 Pro Max	
Near-Field Communication (NFC) (page 73)	iPhone 15 Pro Max	
Acoustics (page 75)	iPhone 15 Pro Max	
MagSafe Case Magnet Array (page 192)	iPhone 15 Pro Max	Cases supporting MagSafe only.

5.10.1.7 iPhone 15 Pro

Table 5-7 iPhone 15 Pro case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 15 Pro	
Haptics (page 70)	iPhone 15 Pro	
Autofocus & Optical Image Stabilization (page 72)	iPhone 15 Pro	
Near-Field Communication (NFC) (page 73)	iPhone 15 Pro	
Acoustics (page 75)	iPhone 15 Pro	
MagSafe Case Magnet Array (page 192)	iPhone 15 Pro	Cases supporting MagSafe only.

5.10.1.8 iPhone 15 Plus

Table 5-8 iPhone 15 Plus case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 15 Plus	
Haptics (page 70)	iPhone 15 Plus	
Autofocus & Optical Image Stabilization (page 72)	iPhone 15 Plus	
Near-Field Communication (NFC) (page 73)	iPhone 15 Plus	
Acoustics (page 75)	iPhone 15 Plus	
MagSafe Case Magnet Array (page 192)	iPhone 15 Plus	Cases supporting MagSafe only.

5.10.1.9 iPhone 15

Table 5-9 iPhone 15 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 15	
Haptics (page 70)	iPhone 15	
Autofocus & Optical Image Stabilization (page 72)	iPhone 15	
Near-Field Communication (NFC) (page 73)	iPhone 15	
Acoustics (page 75)	iPhone 15	
MagSafe Case Magnet Array (page 192)	iPhone 15	Cases supporting MagSafe only.

5.10.1.10 iPhone 14 Pro Max

Table 5-10 iPhone 14 Pro Max case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 14 Pro Max	
Haptics (page 70)	iPhone 14 Pro Max	
Autofocus & Optical Image Stabilization (page 72)	iPhone 14 Pro Max	
Near-Field Communication (NFC) (page 73)	iPhone 14 Pro Max	
Acoustics (page 75)	iPhone 14 Pro Max	
MagSafe Case Magnet Array (page 192)	iPhone 14 Pro Max	Cases supporting MagSafe only.

5.10.1.11 iPhone 14 Pro

Table 5-11 iPhone 14 Pro case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 14 Pro	
Haptics (page 70)	iPhone 14 Pro	
Autofocus & Optical Image Stabilization (page 72)	iPhone 14 Pro	
Near-Field Communication (NFC) (page 73)	iPhone 14 Pro	
Acoustics (page 75)	iPhone 14 Pro	
MagSafe Case Magnet Array (page 192)	iPhone 14 Pro	Cases supporting MagSafe only.

5.10.1.12 iPhone 14 Plus

Table 5-12 iPhone 14 Plus case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 14 Plus	
Haptics (page 70)	iPhone 14 Plus	
Autofocus & Optical Image Stabilization (page 72)	iPhone 14 Plus	
Near-Field Communication (NFC) (page 73)	iPhone 14 Plus	
Acoustics (page 75)	iPhone 14 Plus	
MagSafe Case Magnet Array (page 192)	iPhone 14 Plus	Cases supporting MagSafe only.

5.10.1.13 iPhone 14

Table 5-13 iPhone 14 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 14	
Haptics (page 70)	iPhone 14	
Autofocus & Optical Image Stabilization (page 72)	iPhone 14	
Near-Field Communication (NFC) (page 73)	iPhone 14	
Acoustics (page 75)	iPhone 14	
MagSafe Case Magnet Array (page 192)	iPhone 14	Cases supporting MagSafe only.

5.10.1.14 iPhone 13 Pro Max

Table 5-14 iPhone 13 Pro Max case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 13 Pro Max	
Haptics (page 70)	iPhone 13 Pro Max	
Autofocus & Optical Image Stabilization (page 72)	iPhone 13 Pro Max	
Near-Field Communication (NFC) (page 73)	iPhone 13 Pro Max	
Acoustics (page 75)	iPhone 13 Pro Max	
MagSafe Case Magnet Array (page 192)	iPhone 13 Pro Max	Cases supporting MagSafe only.

5.10.1.15 iPhone 13 Pro

Table 5-15 iPhone 13 Pro case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 13 Pro	
Haptics (page 70)	iPhone 13 Pro	
Autofocus & Optical Image Stabilization (page 72)	iPhone 13 Pro	
Near-Field Communication (NFC) (page 73)	iPhone 13 Pro	
Acoustics (page 75)	iPhone 13 Pro	
MagSafe Case Magnet Array (page 192)	iPhone 13 Pro	Cases supporting MagSafe only.

5.10.1.16 iPhone 13

Table 5-16 iPhone 13 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 13	
Haptics (page 70)	iPhone 13	
Autofocus & Optical Image Stabilization (page 72)	iPhone 13	
Near-Field Communication (NFC) (page 73)	iPhone 13	
Acoustics (page 75)	iPhone 13	
MagSafe Case Magnet Array (page 192)	iPhone 13	Cases supporting MagSafe only.

5.10.1.17 iPhone 13 mini

Table 5-17 iPhone 13 mini case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 13 mini	
Haptics (page 70)	iPhone 13 mini	
Autofocus & Optical Image Stabilization (page 72)	iPhone 13 mini	
Near-Field Communication (NFC) (page 73)	iPhone 13 mini	
Acoustics (page 75)	iPhone 13 mini	
MagSafe Case Magnet Array (page 192)	iPhone 13 mini	Cases supporting MagSafe only.

5.10.1.18 iPhone 12 Pro Max

Table 5-18 iPhone 12 Pro Max case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 12 Pro Max	
Haptics (page 70)	iPhone 12 Pro Max	
Autofocus & Optical Image Stabilization (page 72)	iPhone 12 Pro Max	
Near-Field Communication (NFC) (page 73)	iPhone 12 Pro Max	
Acoustics (page 75)	iPhone 12 Pro Max	
MagSafe Case Magnet Array (page 192)	iPhone 12 Pro Max	Cases supporting MagSafe only.

5.10.1.19 iPhone 12 Pro

Table 5-19 iPhone 12 Pro case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 12 Pro	
Haptics (page 70)	iPhone 12 Pro	
Autofocus & Optical Image Stabilization (page 72)	iPhone 12 Pro	
Near-Field Communication (NFC) (page 73)	iPhone 12 Pro	
Acoustics (page 75)	iPhone 12 Pro	
MagSafe Case Magnet Array (page 192)	iPhone 12 Pro	Cases supporting MagSafe only.

5.10.1.20 iPhone 12

Table 5-20 iPhone 12 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 12	
Haptics (page 70)	iPhone 12	
Autofocus & Optical Image Stabilization (page 72)	iPhone 12	
Near-Field Communication (NFC) (page 73)	iPhone 12	
Acoustics (page 75)	iPhone 12	
MagSafe Case Magnet Array (page 192)	iPhone 12	Cases supporting MagSafe only.

5.10.1.21 iPhone 12 mini

Table 5-21 iPhone 12 mini case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 12 mini	
Haptics (page 70)	iPhone 12 mini	
Autofocus & Optical Image Stabilization (page 72)	iPhone 12 mini	
Near-Field Communication (NFC) (page 73)	iPhone 12 mini	
Acoustics (page 75)	iPhone 12 mini	
MagSafe Case Magnet Array (page 192)	iPhone 12 mini	Cases supporting MagSafe only.

5.10.1.22 iPhone 11 Pro Max

Table 5-22 iPhone 11 Pro Max case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 11 Pro Max	
Haptics (page 70)	iPhone 11 Pro Max	
Autofocus & Optical Image Stabilization (page 72)	iPhone 11 Pro Max	
Near-Field Communication (NFC) (page 73)	iPhone 11 Pro Max	
Acoustics (page 75)	iPhone 11 Pro Max	

5.10.1.23 iPhone 11 Pro

Table 5-23 iPhone 11 Pro case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 11 Pro	
Haptics (page 70)	iPhone 11 Pro	
Autofocus & Optical Image Stabilization (page 72)	iPhone 11 Pro	
Near-Field Communication (NFC) (page 73)	iPhone 11 Pro	
Acoustics (page 75)	iPhone 11 Pro	

5.10.1.24 iPhone 11

Table 5-24 iPhone 11 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 11	
Haptics (page 70)	iPhone 11	
Autofocus & Optical Image Stabilization (page 72)	iPhone 11	
Near-Field Communication (NFC) (page 73)	iPhone 11	
Acoustics (page 75)	iPhone 11	

5.10.1.25 iPhone XS Max

Table 5-25 iPhone XS Max case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone XS Max	
Haptics (page 70)	iPhone XS Max	
Autofocus & Optical Image Stabilization (page 72)	iPhone XS Max	
Near-Field Communication (NFC) (page 73)	iPhone XS Max	
Acoustics (page 75)	iPhone XS Max	

5.10.1.26 iPhone XS

Table 5-26 iPhone XS case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone XS	
Haptics (page 70)	iPhone XS	
Autofocus & Optical Image Stabilization (page 72)	iPhone XS	
Near-Field Communication (NFC) (page 73)	iPhone XS	
Acoustics (page 75)	iPhone XS	

5.10.1.27 iPhone XR

Table 5-27 iPhone XR case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone XR	
Haptics (page 70)	iPhone XR	
Autofocus & Optical Image Stabilization (page 72)	iPhone XR	
Near-Field Communication (NFC) (page 73)	iPhone XR	
Acoustics (page 75)	iPhone XR	

5.10.1.28 iPhone X

Table 5-28 iPhone X case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone X	
Haptics (page 70)	iPhone X	
Autofocus & Optical Image Stabilization (page 72)	iPhone X	
Near-Field Communication (NFC) (page 73)	iPhone X	
Acoustics (page 75)	iPhone X	

5.10.1.29 iPhone 8 Plus/iPhone 7 Plus

Table 5-29 iPhone 8 Plus/iPhone 7 Plus case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 8 Plus and iPhone 7 Plus	
Haptics (page 70)	iPhone 8 Plus and iPhone 7 Plus	
Touch ID Sensor Overlays (page 71)	iPhone 8 Plus and iPhone 7 Plus	
Autofocus & Optical Image Stabilization (page 72)	iPhone 8 Plus	
Near-Field Communication (NFC) (page 73)	iPhone 8 Plus and iPhone 7 Plus	
Acoustics (page 75)	iPhone 8 Plus and iPhone 7 Plus	

It is not possible for a case to claim compatibility with only iPhone 8 Plus, or only iPhone 7 Plus.

5.10.1.30 iPhone SE (3rd generation)/iPhone SE (2nd generation)/iPhone 8/iPhone 7

Table 5-30 iPhone SE (3rd generation)/iPhone SE (2nd generation)/iPhone 8/iPhone 7 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone SE (3rd generation), iPhone SE (2nd generation), iPhone 8, and iPhone 7	
Haptics (page 70)	iPhone SE (3rd generation), iPhone SE (2nd generation), iPhone 8, and iPhone 7	
Touch ID Sensor Overlays (page 71)	iPhone SE (3rd generation), iPhone SE (2nd generation), iPhone 8, and iPhone 7	
Autofocus & Optical Image Stabilization (page 72)	iPhone SE (3rd generation) and iPhone SE (2nd generation)	
Near-Field Communication (NFC) (page 73)	iPhone SE (3rd generation) and iPhone SE (2nd generation)	
Acoustics (page 75)	iPhone SE (3rd generation), iPhone SE (2nd generation), iPhone 8, and iPhone 7	

It is not possible for a case to claim compatibility with only iPhone SE (3rd generation), or only iPhone SE (2nd generation), or only iPhone 8, or only iPhone 7.

5.10.1.31 iPhone 6s Plus/iPhone 6 Plus

Table 5-31 iPhone 6s Plus/iPhone 6 Plus case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 6s Plus and iPhone 6 Plus	
Autofocus & Optical Image Stabilization (page 72)	iPhone 6s Plus	
Near-Field Communication (NFC) (page 73)	iPhone 6s Plus and iPhone 6 Plus	
Haptics (page 70)	iPhone 6s Plus	

It is not possible for a case to claim compatibility with only iPhone 6s Plus, or only iPhone 6 Plus.

5.10.1.32 iPhone 6s/iPhone 6

Table 5-32 iPhone 6s/iPhone 6 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 6s and iPhone 6	
Near-Field Communication (NFC) (page 73)	iPhone 6s and iPhone 6	
Haptics (page 70)	iPhone 6s	

It is not possible for a case to claim compatibility with only iPhone 6s, or only iPhone 6.

5.10.1.33 iPhone 5/iPhone 5s/iPhone SE

Table 5-33 iPhone 5/iPhone 5s/iPhone SE case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone SE	

It is not possible for a case to claim compatibility with only iPhone 5, or only iPhone 5s, or only iPhone SE.

5.10.1.34 iPhone 5c

Table 5-34 iPhone 5c case testing matrix

Test	Using	Notes
Product Design (page 67)	iPhone 5c	
Compass (page 74)	iPhone 5c	

5.10.1.35 iPad Air 13-inch (M3) and iPad Air 13-inch (M2)

Table 5-35 iPad Air 13-inch (M3) and iPad Air 13-inch (M2) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Air 13-inch (M3)	
Compass (page 74)	iPad Air 13-inch (M3)	

It is not possible for a case to claim compatibility with only iPad Air 13-inch (M3), or only iPad Air 13-inch (M2).

5.10.1.36 iPad Air 11-inch (M3) and iPad Air 11-inch (M2)

Table 5-36 iPad Air 11-inch (M3) and iPad Air 11-inch (M2) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Air 11-inch (M3)	
Compass (page 74)	iPad Air 11-inch (M3)	

It is not possible for a case to claim compatibility with only iPad Air 11-inch (M3), or only iPad Air 11-inch (M2).

5.10.1.37 iPad (A16) and iPad (10th generation)

Table 5-37 iPad (A16) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad (A16)	
Compass (page 74)	iPad (A16)	

It is not possible for a case to claim compatibility with only iPad (A16), or only iPad (10th generation).

5.10.1.38 iPad Pro 13-inch (M4)

Table 5-38 iPad Pro 13-inch (M4) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 13-inch (M4)	
Compass (page 74)	iPad Pro 13-inch (M4)	

5.10.1.39 iPad Pro 11-inch (M4)

Table 5-39 iPad Pro 11-inch (M4) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 11-inch (M4)	
Compass (page 74)	iPad Pro 11-inch (M4)	

5.10.1.40 iPad Pro 12.9-inch (6th generation) and iPad Pro 12.9-inch (5th generation)

Table 5-40 iPad Pro 12.9-inch (6th generation) and iPad Pro 12.9-inch (5th generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 12.9-inch (6th generation)	
Compass (page 74)	iPad Pro 12.9-inch (6th generation)	

It is not possible for a case to claim compatibility with only iPad Pro 12.9-inch (6th generation), or only iPad Pro 12.9-inch (5th generation).

5.10.1.41 iPad Pro 11-inch (4th generation) and iPad Pro 11-inch (3rd generation)

Table 5-41 iPad Pro 11-inch (4th generation) and iPad Pro 11-inch (3rd generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 11-inch (4th generation)	
Compass (page 74)	iPad Pro 11-inch (4th generation)	

It is not possible for a case to claim compatibility with only iPad Pro 11-inch (4th generation), or only iPad Pro 11-inch (3rd generation).

5.10.1.42 iPad mini (A17 Pro) and iPad mini (6th generation)

Table 5-42 iPad mini (A17 Pro) and iPad mini (6th generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad mini (A17 Pro)	
Compass (page 74)	iPad mini (A17 Pro)	

It is not possible for a case to claim compatibility with only iPad mini (A17 Pro), or only iPad mini (6th generation).

5.10.1.43 iPad (7th generation)/iPad (8th generation)/iPad (9th generation)

Table 5-43 iPad (7th generation)/iPad (8th generation)/iPad (9th generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad (7th generation), iPad (8th generation), and iPad (9th generation)	
Compass (page 74)	iPad (7th generation), iPad (8th generation), and iPad (9th generation)	

It is not possible for a case to claim compatibility with only iPad (7th generation), or only iPad (8th generation), or only iPad (9th generation).

5.10.1.44 iPad Air (5th generation)/iPad Air (4th generation)

Table 5-44 iPad Air (5th generation)/iPad Air (4th generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Air (5th generation)	
Compass (page 74)	iPad Air (5th generation)	

5.10.1.45 iPad Pro 12.9-inch (4th generation)

Table 5-45 iPad Pro 12.9-inch (4th generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 12.9-inch (4th generation)	
Compass (page 74)	iPad Pro 12.9-inch (4th generation)	

5.10.1.46 iPad Pro 11-inch (2nd generation)

Table 5-46 iPad Pro 11-inch (2nd generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 11-inch (2nd generation)	

Test	Using	Notes
Compass (page 74)	iPad Pro 11-inch (2nd generation)	

5.10.1.47 iPad Air (3rd generation)

Table 5-47 iPad Air (3rd generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Air (3rd generation)	
Autofocus & Optical Image Stabilization (page 72)	iPad Air (3rd generation)	
Compass (page 74)	iPad Air (3rd generation)	

5.10.1.48 iPad mini (5th generation)

Table 5-48 iPad mini (5th generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad mini (5th generation)	
Compass (page 74)	iPad mini (5th generation)	

5.10.1.49 iPad Pro 12.9-inch (3rd generation)

Table 5-49 iPad Pro 12.9-inch (3rd generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 12.9-inch (3rd generation)	
Compass (page 74)	iPad Pro 12.9-inch (3rd generation)	

5.10.1.50 iPad Pro 11-inch (1st generation)

Table 5-50 iPad Pro 11-inch (1st generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 11-inch (1st generation)	
Compass (page 74)	iPad Pro 11-inch (1st generation)	

5.10.1.51 iPad Pro 10.5-inch

Table 5-51 iPad Pro 10.5-inch case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 10.5-inch	
Autofocus & Optical Image Stabilization (page 72)	iPad Pro 10.5-inch	
Compass (page 74)	iPad Pro 10.5-inch	

5.10.1.52 iPad Pro 12.9-inch (2nd generation)

Table 5-52 iPad Pro 12.9-inch (2nd generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 12.9-inch (2nd generation)	
Autofocus & Optical Image Stabilization (page 72)	iPad Pro 12.9-inch (2nd generation)	
Compass (page 74)	iPad Pro 12.9-inch (2nd generation)	

5.10.1.53 iPad (5th and 6th generation)

Table 5-53 iPad (5th and 6th generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad (5th generation) or iPad (6th generation)	
Compass (page 74)	iPad (5th generation) or iPad (6th generation)	

5.10.1.54 iPad Pro 9.7-inch

Table 5-54 iPad Pro 9.7-inch case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 9.7-inch	
Compass (page 74)	iPad Pro 9.7-inch	

5.10.1.55 iPad Pro 12.9-inch (1st generation)

Table 5-55 iPad Pro 12.9-inch (1st generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Pro 12.9-inch (1st generation)	
Compass (page 74)	iPad Pro 12.9-inch (1st generation)	

5.10.1.56 iPad mini 4

Table 5-56 iPad mini 4 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad mini 4	
Compass (page 74)	iPad mini 4	

5.10.1.57 iPad mini/iPad mini 2/iPad mini 3

Table 5-57 iPad mini/iPad mini 2/iPad mini 3 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad mini 3	
Compass (page 74)	iPad mini 2 and iPad mini 3	

It is not possible for a case to claim compatibility with only iPad mini, or only iPad mini 2, or only iPad mini 3.

5.10.1.58 iPad Air 2

Table 5-58 iPad Air 2 case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Air 2	
Compass (page 74)	iPad Air 2	

5.10.1.59 iPad Air

Table 5-59 iPad Air case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad Air	
Compass (page 74)	iPad Air	

5.10.1.60 iPad (4th generation)

Table 5-60 iPad (4th generation) case testing matrix

Test	Using	Notes
Product Design (page 67)	iPad (4th generation)	
Compass (page 74)	iPad (4th generation)	

5.10.1.61 iPod touch (5th generation)/iPod touch (6th generation)/iPod touch (7th generation)

Table 5-61 iPod touch (5th generation)/iPod touch (6th generation)/iPod touch (7th generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 67)	iPod touch (7th generation)	

It is not possible for a case to claim compatibility with only iPod touch (5th generation), or only iPod touch (6th generation), or only iPod touch (7th generation).

5.10.2 Product Design

5.10.2.1 Equipment

The following equipment is necessary:

- Device.
- Apple Lightning Digital AV Adapter for devices with a Lightning receptacle.
- Apple USB-C Digital AV Multiport Adapter for devices with a USB-C receptacle.
- EarPods with 3.5 mm Headphone Plug for devices with a 3.5 mm headset jack.
- Vernier calipers.

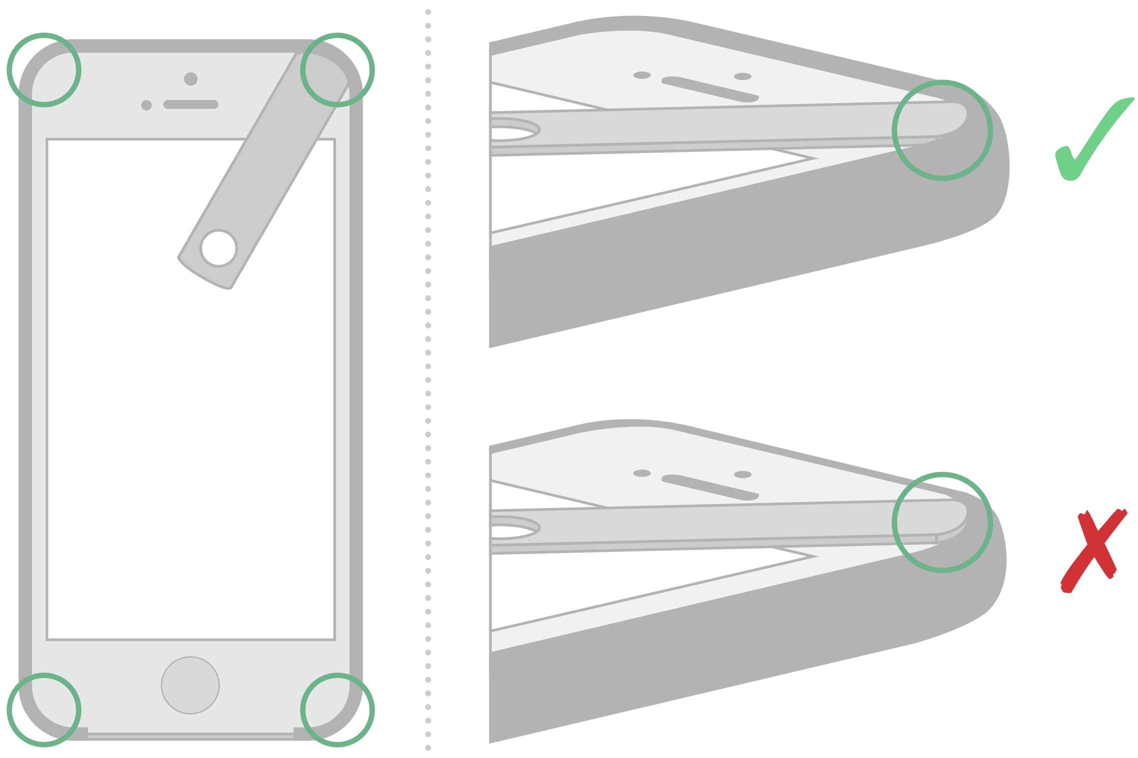
- 0.85 mm plastic feeler gauge.

5.10.2.2 Procedure

1. Insert the device into the case.
2. Verify the device completely fits inside the case.
3. Verify the device is not loose.
4. Verify all buttons are accessible.
5. Inspect for button feel. Verify all buttons are not too hard to press or take a lot of effort to press.
6. Verify speaker/microphone ports are not occluded.
7. If the device has an Apple Lightning receptacle:
    a. Insert the Apple Lightning Digital AV Adapter into the receptacle and verify it fits.
    b. Using vernier calipers, measure the Lightning connector opening on the case. Verify the opening is measured to be at least 12.05 mm by 6.30 mm.
8. If the device has a USB-C receptacle:
    a. Insert the Apple USB-C Digital AV Multiport Adapter into the receptacle and verify it fits.
    b. Using vernier calipers, measure the USB-C connector opening on the case. Verify the opening is measured to be at least 12.35 mm by 6.50 mm.
9. If the device has a 3.5 mm headset jack:
    a. Insert EarPods with 3.5 mm Headphone Plug into the headset jack and verify it fits.
    b. Using vernier calipers, measure the headset jack opening on the case. Verify the opening is measured to be at least 6 mm in diameter and no more than 14 mm deep.
10. If the device has a Touch ID sensor integrated with the Home button, use vernier calipers to verify the case is at least 2 mm away from the Touch ID sensor.
11. If the device has a Touch ID sensor integrated with the Top button, use vernier calipers to verify the case meets the keep-out defined for each device the accessory claims compatibility with. See Device Dimensional Drawings (page 294).

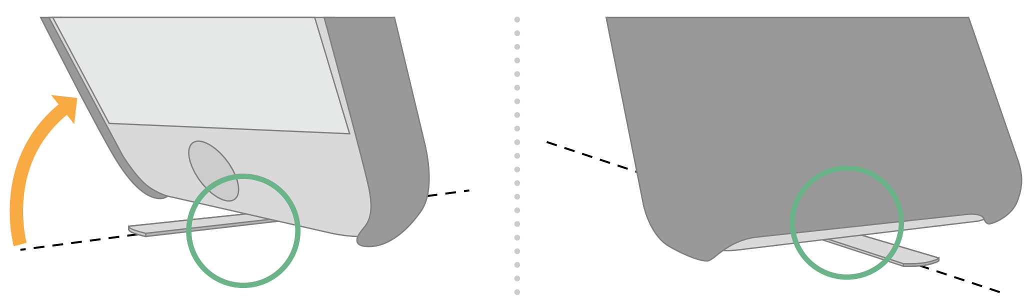
12. Verify the case is always proud of the feeler gauge when the gauge is placed at each corner of the device. See Figure 5-12 (page 69).

Figure 5-12 Device proudness test



13. Set the device flat on its face (screen facing down).
14. Roll the device towards any side not enclosed by the case until the gap between the device's exposed glass and flat surface is smallest.
15. Verify the feeler gauge fits into the gap between the device's exposed glass and flat surface.

Figure 5-13 Device gap test



16. If the case has an overlay, verify there are no air gaps introduced between it and the touchscreen.

5.10.3 Camera Control

This test applies to devices with Camera Control.

5.10.3.1 Equipment

The following equipment is necessary:

- Device running iOS 18.3 or later.
- Accessory Developer Assistant (ADA) (page 291) installed on the device.

5.10.3.2 Setup

1. Attach the case to the device.
2. Launch the Accessory Developer Assistant app and sign in.
3. Select Case, Camera Control.

5.10.3.3 Preload

1. Select Preload, and follow the on-screen instructions.
2. Verify the test passes.
3. Perform the Preload test again, firmly squeezing the device just above or below the Camera Control.
4. Verify the test passes.

5.10.3.4 Gestures

1. Perform the 'Light press', 'Click', and 'Slide' tests under Landscape, following the on-screen instructions for each.
2. Verify the tests pass.
3. Using only the left hand, perform the 'Light press', 'Click', and 'Slide' tests under Portrait, following the on-screen instructions for each.
4. Verify the tests pass.
5. Using only the right hand, perform the 'Light press', 'Click', and 'Slide' tests under Portrait, following the on-screen instructions for each.
6. Verify the tests pass.

5.10.4 Haptics

5.10.4.1 Equipment

The following equipment is necessary:

- Two devices of the same model.

5.10.4.2 Setup

Repeat the following for each device:

1. Open Settings > Sound & Haptics > Haptics, select Always Play.

5.10.4.3 Procedure

1. Attach the case to one device.
2. Verify the case does not cause substantial changes in the feel of the device's haptic feedback by comparing the haptic feedback between the devices for each of the following tasks:
   a. Toggle the Ring/Silent switch or use the Action button.
   b. Connect a charger, wait a few seconds, then disconnect the charger.
   c. Open Settings > Notifications > Phone > Sounds, select Reflection (Default).
   d. Open Settings > Notifications > Messages > Sounds, select Note (Default).
   e. Go to the Home Screen.
   f. Long press the Settings app to show the Quick Actions menu, then slide a finger across the menu and release to select Wi-Fi.
   g. Go to the Home Screen.
   h. Long press the Home app to show the Quick Actions menu. Release, then tap away from the menu to return to the Home Screen.
   i. Open the Clock app, select Timers, then scroll through the hours, minutes, and seconds.
   j. If the device has a Home button:
      a. Open Settings > General > Home Button, select option 2.
      b. Press the Home button.
      c. Place the device on a flat surface, like a table.
      d. Press the Home button.

5.10.5 Touch ID Sensor Overlays

This test procedure applies to accessories overlaying the Touch ID sensor.

5.10.5.1 Equipment

The following equipment is necessary:

- Nitrile gloves (for example, Ansell TNT Blue).
- Ethyl alcohol hand sanitizer (for example, Purell).
- Scissors.

5.10.5.2 Procedure

1. Cut off a square of material from the nitrile glove's wrist portion.
2. Install the accessory onto the device.

3. Press the Side/Top button to place the device into a sleep state (display off).
4. Place the square of nitrile glove material over the Touch ID sensor with the glove's outer side facing away from the device.
5. Apply a small amount of hand sanitizer (approximately 2 cm in diameter) to the glove over the Touch ID sensor.
6. Repeat the following steps 10 times:
   a. Press the Touch ID sensor with a thumb.
   b. Verify the device wakes (display on).
   c. Place the device into a sleep state (display off).
7. Repeat the following steps 10 times:
   a. Press the Touch ID sensor with an index finger.
   b. Verify the device wakes (display on).
   c. Place the device into a sleep state (display off).

5.10.5.3 Pass/Fail Criteria

Verify the device wakes every time the Touch ID sensor is pressed.

5.10.6 Camera

5.10.6.1 Autofocus & Optical Image Stabilization

This test applies to devices with Autofocus (AF) and/or Optical Image Stabilization (OIS).

5.10.6.1.1 Equipment

The following equipment is necessary:

- Device running iOS 18.3 or later or iPadOS 18.3 or later, see Device Models (page 49).
- Flat level non-ferrous test surface away from magnetic fields.
- Accessory Developer Assistant (ADA) (page 291) installed on the device.
- Autofocus & Optical Image Stabilization Test Profile (page 292) installed on the device.

5.10.6.1.2 Procedure

1. Launch the Accessory Developer Assistant app and sign in.
2. Select Case, Autofocus and Optical Image Stabilization.
3. Allow ADA to access the device camera, if prompted.
4. Set the device on the test surface.
5. Follow the on-screen instructions.
6. Select Measure Baseline and wait for the measurement to complete.
7. Attach the case being tested on the device.

8. Set the device back on the test surface.
9. Select Measure Attached and wait for the measurement to complete.
10. Verify all tests pass and note the results.

5.10.7 Near-Field Communication (NFC)

This test applies to devices with NFC.

5.10.7.1 Equipment

The following equipment is necessary:

- Device running iOS 18.3 or later.
- Accessory Developer Assistant (ADA) (page 291) installed on the device.
- NFC tag.
- NFC transmitter.
  - Separate device with the ADA app may be used as an NFC transmitter.
- Flat level non-ferrous test surface away from magnetic fields.
- Straight edge non-metallic ruler.

5.10.7.2 Setup

1. Place the NFC tag or transmitter on the flat level non-ferrous test surface.
2. Position the ruler to measure the vertical distance from the NFC tag or transmitter to the device.

5.10.7.3 Procedure

This procedure establishes a detection baseline without a case attached and then tests are rerun with the case attached. The procedure is repeated for both NFC tag & transmitter modes.

1. Launch the Accessory Developer Assistant app and sign in.
2. Select Near Field Communication.
3. Select 'Test with NFC tag', and follow the on-screen instructions.
   a. Measure baseline average distance with no case attached.
   b. Attach case.
   c. Repeat measurements with case attached.
   d. Verify test passes.
4. Select 'Test with an NFC transmitter', and follow the on-screen instructions.
   a. If using a second device as an NFC transmitter:
      a. Open ADA app on the second device.
      b. Select Apple Pay Detector.
      c. Select Start Detector.
   b. Measure baseline average distance with no case attached.

c. Attach case.
d. Repeat measurements with case attached.
e. Verify test passes.

5. Perform multi-angle detection.
6. Verify multi-angle detection test passes.

5.10.8 Compass

5.10.8.1 Equipment

The following equipment is necessary:

- Device running iPadOS 18.3 or later.
- Accessory Developer Assistant (ADA) (page 291) installed on the device.
- Flat level non-ferrous test surface away from magnetic fields.
- Magnetometer, such as the Meda FVM400.

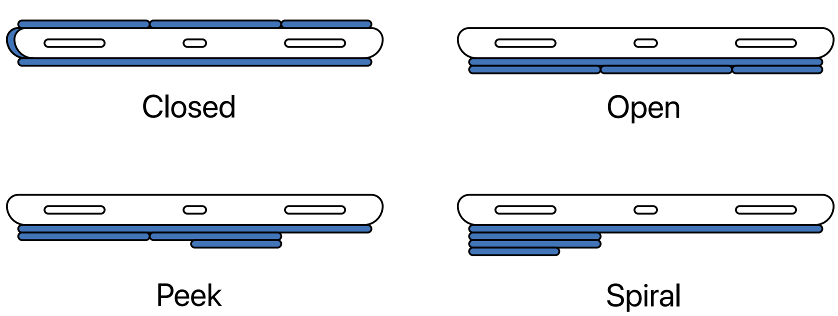
5.10.8.2 Setup

1. Place a mark on the test surface with a 90° angle to use for repeated device alignment. For example, use two pieces of tape perpendicular to each other.
2. Use the magnetometer to verify the test surface has a consistent magnetic field, not affected by nearby electronics or magnets.

5.10.8.3 Procedure

1. Launch the Accessory Developer Assistant app and sign in.
2. Select Compass and the case type, such as: Folio, Keyboard Folio, or Shell.
3. Scroll down and select all supported case configurations, see Figure 5-14 (page 74).

Figure 5-14 Case configurations



4. Scroll down and select all included case materials.

5. Select Start Test.
6. If a closed case configuration is selected, connect an external display and mouse when prompted.
7. Place the device with no case attached on the test surface, aligned to the mark.
8. Select Measure Baseline to collect an initial measurement.
9. Once the measurement is complete, follow the on-screen instructions to attach the case and collect a measurement for each supported case configuration.
10. Verify all tests pass and note the results.

5.10.9 Acoustics

Procedures apply to devices with a built in speaker and/or microphone.

5.10.9.1 Speakerphone Call

This procedure evaluates the impact of a case on the speakerphone performance of a device.

5.10.9.1.1 Setup

This procedure needs two operators in separate quiet rooms.

Room A:
- Operator A.
- The device used to evaluate the case with cellular service and at least two out of five bars of cellular reception within the room.

Room B:
- Operator B.
- Landline speakerphone.
- Digital audio recorder (for example, a device with the Voice Memo app).

5.10.9.1.2 Pass/Fail Criteria

There are two categories of failure for this procedure:
- Echo: If Operator B hears their own voice from the landline.
- Double talk: If Operator B hears Operator A inconsistently.

Establish the pass/fail threshold for these two categories by performing the test procedure using the device (without the case) as a reference. If there is no perceivable difference between the reference and the same procedure conducted with the case on the device, the test passes.

5.10.9.1.3 Procedure

1. Operator A: Use the device (without a case) in Room A to call the landline phone in Room B.

2. Operator A: Place the device in speakerphone mode.
3. Operator B: Answer the call with the landline phone in Room B.
4. Operator B: Place the landline phone in speakerphone mode.
5. Operator A and B: Simultaneously recite the following phrases to evaluate the call quality:
    a. The birch canoe slid on the smooth planks.
    b. Glue the sheet to the dark blue background.
    c. It's easy to tell the depth of a well.
    d. These days a chicken leg is a rare dish.
    e. Rice is often served in round bowls.
    f. The juice of lemons makes fine punch.
    g. The box was thrown beside the parked truck.
    h. The hogs were fed chopped corn and garbage.
    i. Four hours of steady work faced us.
    j. Large size in stockings is hard to sell.
6. Operator B: Evaluate the call. Ensure the call is audible and clear when there is no case on the device.
7. Operator A: Place the case on the device.
8. Operator B: Start audio recording using a digital audio recorder.
9. Operator A: State the test date and identify the manufacturer name, product name, and a unique identifier (UID) for case (production run name, design version, etc.).
10. Operator A and B: Simultaneously recite the same phrases as above.
11. Operator B: Stop audio recording.
12. Operator B: Evaluate the recording against the Pass/Fail Criteria (page 75).

The phrases used for this test procedure are from "IEEE Recommended Practice for Speech Quality Measurements," in *IEEE Transactions on Audio and Electroacoustics*, vol. 17, no. 3, pp. 225-246, September 1969.

6. Covers

Covers are accessories providing protection by covering device displays.

6.1 Device Protection

Covers shall not damage coatings on the display in any operating condition (for example, when closed, carrying in a backpack, or storing).

6.2 Magnetic Interference

Accessory covers shall not interfere with the device's:

- Magnetic compass.
- Rear camera autofocus (AF).
- Rear camera optical image stabilization (OIS), if present.
- Front camera autofocus, if present.

See Magnetic Interference (page 29) for additional details.

6.3 Smart Covers

Dimensional drawings indicating magnet and Hall effect sensor locations:

- iPad Air 13-inch (M3) and iPad Air 13-inch (M2), 3 of 5 (page 377)
- iPad Air 11-inch (M3) and iPad Air 11-inch (M2), 3 of 5 (page 382)
- iPad (A16) and iPad (10th generation), 3 of 7 (page 387)
- iPad (A16) and iPad (10th generation), 4 of 7 (page 388)
- iPad (A16) and iPad (10th generation), 5 of 7 (page 389)
- iPad mini (A17 Pro), 3 of 6 (page 394)
- iPad mini (A17 Pro), 4 of 6 (page 395)
- iPad Pro 13-inch (M4), 3 of 5 (page 400)
- iPad Pro 11-inch (M4), 3 of 5 (page 405)
- iPad Pro 12.9-inch (6th generation), 3 of 5 (page 410)
- iPad Pro 11-inch (4th generation), 3 of 5 (page 415)

7. Screen Overlays

The displays on Apple products have been carefully engineered and tested to deliver exacting visual performance. Many products also feature Multi-Touch technology to support user interactions. Any material overlaying the screen or between the surface and users' fingers (or writing instruments on iPad) may impact the visual, touch, or sensor performance.

7.1 Product Design

A screen overlay shall not:

- Degrade the performance of Multi-Touch, Apple Pencil, or sensors.
- Introduce air gaps between the touchscreen and overlay.
- Be electrically conductive.
- Cause any color tinge to cool white light sources.

A screen overlay should have a relative permittivity (dielectric) of 3.1 to 3.2.

A screen overlay should not:

- Exceed 0.3 mm in thickness.
- Exceed 0.095 mm in thickness to support Apple Pencil.
- Have a water contact angle <110°.

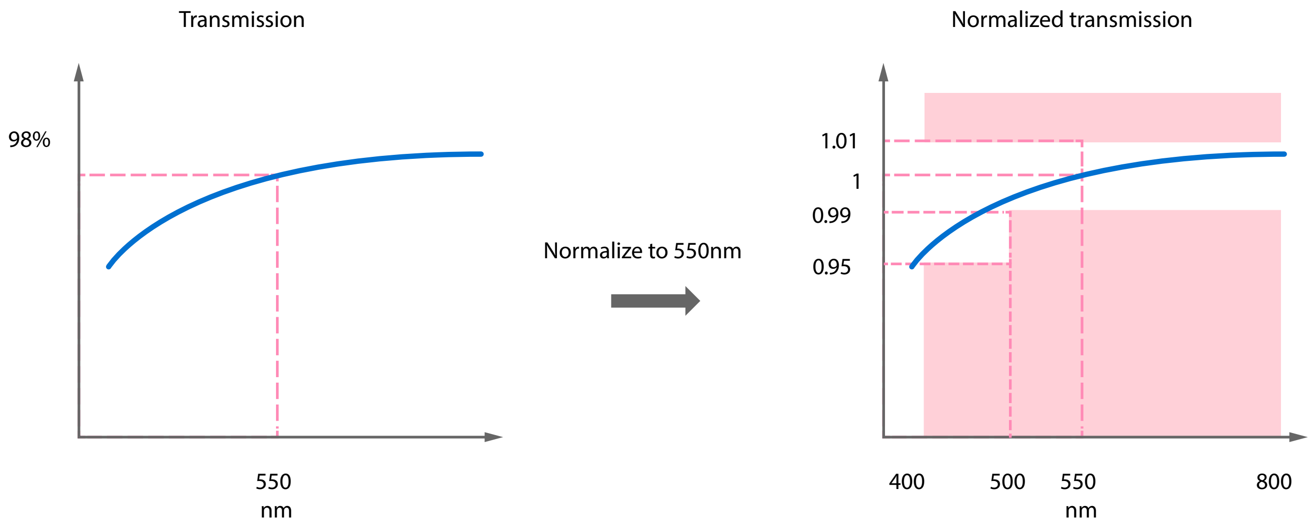
Note:
Non-glossy surfaces may accelerate Apple Pencil tip wear.

7.1.1 Optical Transmission

Optical transmission of screen overlays should:

- Be greater than 90% relative to clear glass for any viewing angle across the active display area, see Device Dimensional Drawings (page 294).
- Remain flat as defined in Figure 7-1 (page 80). Upon normalizing the transmission spectrum to the value at 550 nm, the normalized spectrum should fall in the range of [0.99, 1.01] from 500-800 nm and [0.95, 1.01] from 400-500 nm.

Figure 7-1 Transmission spectrum



7.1.2 Infrared Transmission

Infrared transmission variance shall not exceed 1.5%. The infrared transmission in the 1200 nm - 1500 nm range relative to light source should be greater than:

- 90% for an angle of incidence between 0° and 45°.
- 84% for an angle of incidence between 45° and 60°.

7.1.3 Transmission Haze

Transmission haze is the percentage of visible and infrared light scattered at more than 2.5° from the normal transmission. Screen overlay transmission haze should:

- Not exceed 0.3% for:
  - iPhone 16 Pro Max
  - iPhone 16 Pro
  - iPhone 16 Plus
  - iPhone 16
  - iPhone 15 Pro Max
  - iPhone 15 Pro
  - iPhone 15 Plus
  - iPhone 15
  - iPhone 14 Pro Max
  - iPhone 14 Pro
- Not exceed 13% for all other devices.
- Be measured with a haze meter, per *ASTM D1003*.

7.1.4 Dynamic Island

Screen overlays shall not have a punch-out for the Dynamic Island.

7.2 Edge Swipe Gestures

See Edge Swipe Gestures (page 41).

8. Camera Attachments

Camera attachments are accessories intentionally altering images captured by device cameras.

8.1 Magnetic Interference

Camera attachments shall not interfere with the device's:

- Magnetic compass.
- Rear camera autofocus (AF).
- Rear camera optical image stabilization (OIS), if present.
- Front camera autofocus, if present.

See Magnetic Interference (page 29) for additional details.

9. Adapters

An adapter accessory is a dongle or a Built-In Cable (page 25) enabling connections between physically incompatible devices and accessories.

Unless otherwise specified, accessories may integrate one or more adapter components as well as other accessory features to create more advanced multi-port adapters. For example, a Lightning or USB-C adapter may support audio, power, external storage, media controls, app communication, and more.

See the Accessory Interface Specification (page 26) for more information.

9.1 Headset Adapters (Lightning to 3.5 mm)

Lightning to 3.5 mm headset adapters are accessories enabling 3.5 mm audio connections.

See the Accessory Interface Specification (page 26) for more information.

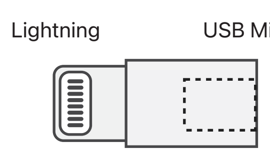
9.2 USB-A/USB-C to Lightning Headset Adapters

USB-A to Lightning or USB-C to Lightning headset adapters are accessories integrating a Lightning Receptacle (C37) to support Lightning headsets, speakers, and microphones.

See the Accessory Interface Specification (page 26) for more information.

9.3 Lightning to USB Micro-B Adapters

Figure9-1 Lightning to USB Micro-B adapter



Lightning to USB Micro-B adapters are Lightning dongle accessories functioning exactly like the Apple Lightning to USB Micro-B Adapter and shall consist of:

- Lightning connector.
- USB Micro-B receptacle.

See the Accessory Interface Specification (page 26) for more information.

10. AC Power Adapters

AC power adapters convert AC "mains" power to DC to provide power to a device and may provide power using:

- Device Power (Inductive) (page 165).
- Device Power (USB-C) (page 158).
- Device Power (Lightning) (page 160).

10.1 Converter Switching Frequencies

Device touchscreen or audio functionality may be degraded by converter switching frequencies. Converter switching frequencies shall:

- Be above 22 kHz under loads greater than 5 mA.
- Be above 60 kHz and should be above 450 kHz under loads greater than 20 mA.

10.2 YCAP AC Capacitor

AC power adapters should include a YCAP AC capacitor (up to 1000 pF) between the primary and secondary sections of the adapter's transformer to reduce common-mode noise at switching frequencies. These frequencies or their harmonics can interfere with device touchscreen sensors.

10.3 Impedance Stability

AC power adapter series impedance should not change abruptly. Sudden changes in impedance may cause touchscreen sensor output oscillations.

Bridge diodes used in full-wave bridge rectifiers can be a major source of abrupt changes in the series impedance. If the bridge diodes have large inherent reverse capacitance (greater than 100 pF), then the net impedance change due to diode switching may be acceptably small. However, diode reverse capacitance may decrease in more compact IC designs due to decreased chip area.

Impedance of bridge diodes with unacceptably low reverse capacitance can be stabilized using the example circuit shown in Figure 10-1 (page 86) and Table 10-1 (page 86). In this example, capacitors C1, C2, C3, and C4 have been placed in parallel with diodes D1, D2, D3, and D4 to stabilize the bridge impedance. Their values are larger than the inherent reverse capacitances of the diodes.

Resistors R1, R2, R3, and R4 are optional; if included, they can block noise at very high frequencies, which can help with EMI compatibility. The recommended values of R1, R2, R3, and R4 in Table 10-1 (page 86) were chosen to have trivial levels of impedance relative to the impedances of C1, C2, C3, and C4 at power line frequencies.

Figure 10-1 Typical AC power adapter diode bridge circuit

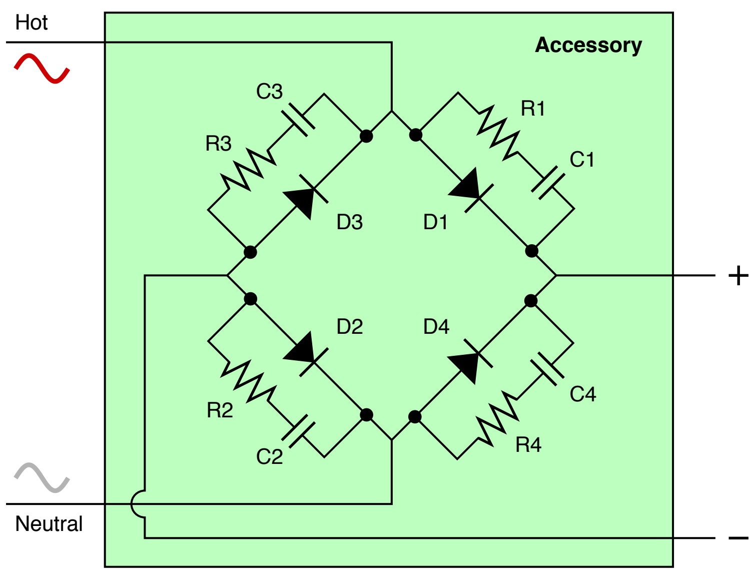


Table 10-1 Typical component values for an AC power adapter diode bridge circuit

Component	Value
C1, C2, C3, C4	47 pF
R1, R2, R3, R4	2 kΩ

10.4 Fuse Protection

A fuse should be present at the input of the AC power adapter to protect it under any fault condition.

10.5 Short Circuit Response

The output of the AC power adapter should drop or fold back without any resulting damage if its output is shorted to the secondary common (less than 10 mΩ).

11. Battery Packs

A battery pack is an accessory designed to provide power to the device.

The battery pack may provide power using:

- Device Power (Inductive) (page 165).
- Device Power (USB-C) (page 158).
- Device Power (Lightning) (page 160).

12. Headsets

Headsets provide users with personal audio experiences. Devices treat headsets differently from accessories with speakers.

Headsets shall comply with:

- TDMA Noise (page 29) requirements.
- Applicable volume limit regulations in the regions in which they are sold.

Wired headsets should support Apple Music Lossless or Hi-Res Lossless, see https://support.apple.com/en-us/118295.

12.1 Product Design

Headsets shall have:

- Drivers positioned at user's ears.
- Microphone(s) positioned to record user's voice.

12.2 Audio Interface

Headsets shall establish audio connections to devices using one of the following interfaces:

- USB-C Plug (page 281), including the Apple USB-C Analog Headset Module (page 254).
- Bluetooth (page 234):
  - Hands-Free Profile (HFP) (page 238)
  - Advanced Audio Distribution Profile (A2DP) (page 243)

If connected using the USB-C Plug (page 281), headsets shall integrate one of the following:

- Apple USB-C Analog Headset Module (page 254) (recommended for standard headsets).
- USB Audio Device Class 2.0 or 4.0 compliant codec.

12.3 Remote Controls

Controls shall be implemented using one of the following:

- Direct electrical connections to the Headset Remote and Microphone Transmitter (page 263) when integrating an Apple USB-C Analog Headset Module (page 254).
- HID Headset Remote (page 171) when using one of the following:
  - USB-C Plug (page 281) with a USB Audio Device Class 2.0 or 4.0 compliant codec.
  - Bluetooth (page 234).
- Bluetooth Audio/Video Remote Control Profile (AVRCP) (page 241).

Bluetooth headsets should implement controls identical to an Apple wired headset.

12.4 USB-C Headset Identification

USB-C headsets shall:

- Set the idVendor, idProduct, iManufacturer, iProduct, and iSerialNumber in the Standard Device Descriptor to reflect the accessory markings and packaging.
- Set the Output Terminal Type to `0x0302` (Headphones) if the headset does not integrate a microphone.
- Set the Output Terminal Type and Input Terminal Type to `0x0402` (Headset) if the headset integrates a microphone.
- Set the Audio Function Category to `0x04` (Headset).

USB-C headsets should:

- Set the iInterface Playback and iInterface Record strings to reflect the accessory markings and packaging.
- Set a unique iSerialNumber in the Standard Device Descriptor.

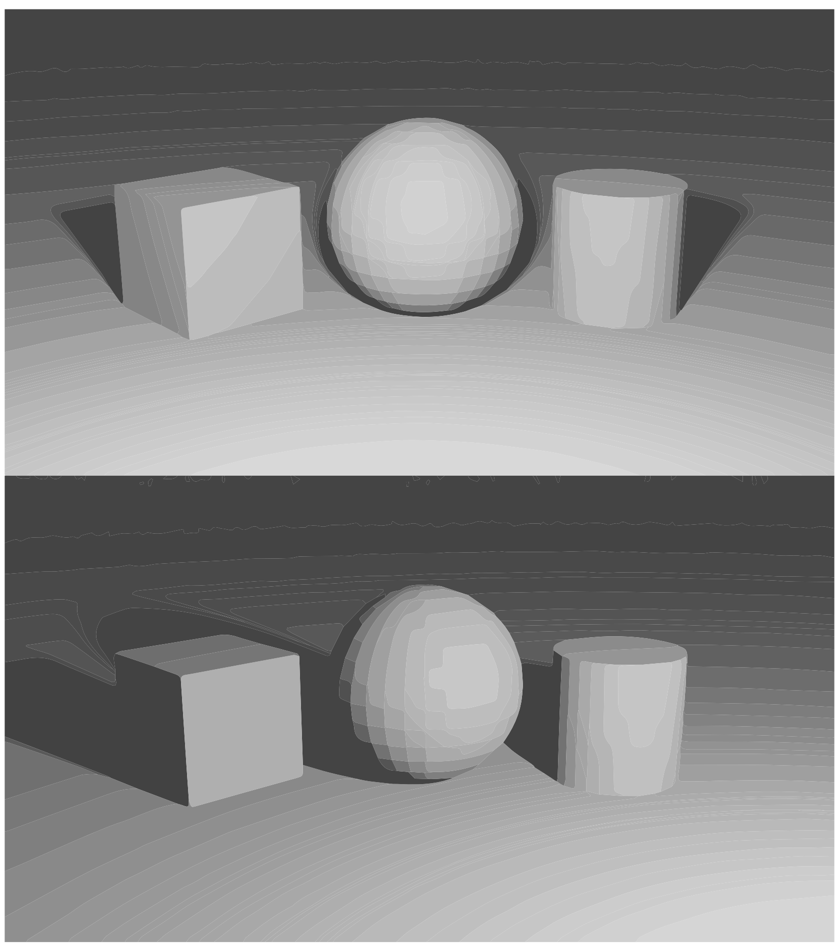
> **Note:**
> C125 has its Output Terminal Type and Input Terminal Type set to `0x0402` (Headset) and Audio Function Category set to `0x04` (Headset). These configurations cannot be overwritten.

13. Strobes

Strobe accessories replace a device's integrated flash when capturing a still image from either the front or rear-facing cameras. Photographers can use such accessories to control scene lighting for creative purposes.

Strobes are:
- Compatible with all iOS camera applications.
- Synchronized with iPhone camera using the Lightning connector.

Figure 13-1 Example of integrated flash (top) vs. external strobe (bottom)



Devices supporting strobe accessories:

- iPhone 14 Pro Max
- iPhone 14 Pro
- iPhone 14 Plus
- iPhone 14
- iPhone SE (3rd generation)
- iPhone 13 Pro Max
- iPhone 13 Pro
- iPhone 13
- iPhone 13 mini
- iPhone 12 Pro Max
- iPhone 12 Pro
- iPhone 12
- iPhone 12 mini
- iPhone SE (2nd generation)
- iPhone 11 Pro Max
- iPhone 11 Pro
- iPhone 11

This feature is supported on iOS 14.0 or later.

See the Accessory Interface Specification (page 26) for more information.

14. Keyboards

Devices may accept user input from accessory keyboards in place of the onscreen keyboard.

14.1 Requirements

Accessory keyboards shall:

- Support the Human Interface Device (HID) (page 230) protocol.
- Not identify themselves as Apple-branded accessories, for example, using the Apple Vendor ID and/or Product IDs.

Keyboard keys exhibiting any of the following behaviors are explicitly prohibited:

- Send anything other than 'key pressed' or 'key released' for key(s) physically pressed/released.
- Emulate combinations or sequences of keys (for example, a Copy button sending ⌘-C or macros generating a timed sequence of events).
- Emulate timed user actions, such as 'press-and-hold'.
- Send different HID usages depending on the state of another control surface.

HID reports sent from the keyboard shall only occur in response to a Direct User Action (page 25).

Keyboards may integrate LEDs to indicate the:

- Caps Lock status of the device.
- Connection status, such as Bluetooth state.
- Battery status of the accessory, if applicable.

Keyboards shall not incorporate any other status LEDs not supported by devices.

Keyboards should be integrated with Trackpads (page 99) when possible to provide an enhanced user experience.

Mechanical key layout shall be based on the *ISO/IEC 9995-2*, *ANSI-INCITS 154-1988*, or *JIS X 6002-1980* standards. Keyboard HID descriptors shall set the Keyboard Physical Layout usage to the appropriate layout code as defined in Table 14-5 (page 97).

Keyboard HID descriptors shall set the bCountryCode field to the appropriate country code as defined in *Device Class Definition for Human Interface Devices (HID) – Version 1.11, Section 6.2.1 HID Descriptor*.

Keyboard HID descriptors shall declare support for the HID Keyboard/Keypad Page. HID report descriptors may declare a input usage minimum of 0 and maximum of 255 as shown in Example HID Report Descriptor (page 98) for efficiency. Otherwise, the descriptor shall individually enumerate each HID Keyboard/Keypad page usage the keyboard is capable of sending.

Keyboards shall implement individual keys emitting the following HID Keyboard/Keypad page usages:

Table 14-1 Required HID Keyboard/Keypad Page (`0x07`) controls for use by keyboards

Usage ID	Usage Name	Apple Function
`0x0004`	a and A	a and A
`0x0005`	b and B	b and B
`0x0006`	c and C	c and C
`0x0007`	d and D	d and D
`0x0008`	e and E	e and E
`0x0009`	f and F	f and F
`0x000A`	g and G	g and G
`0x000B`	h and H	h and H
`0x000C`	i and I	i and I
`0x000D`	j and J	j and J
`0x000E`	k and K	k and K
`0x000F`	l and L	l and L
`0x0010`	m and M	m and M
`0x0011`	n and N	n and N
`0x0012`	o and O	o and O
`0x0013`	p and P	p and P
`0x0014`	q and Q	q and Q
`0x0015`	r and R	r and R
`0x0016`	s and S	s and S
`0x0017`	t and T	t and T
`0x0018`	u and U	u and U
`0x0019`	v and V	v and V
`0x001A`	w and W	w and W
`0x001B`	x and X	x and X
`0x001C`	y and Y	y and Y
`0x001D`	z and Z	z and Z
`0x001E`	1 and !	1 and !
`0x001F`	2 and @	2 and @
`0x0020`	3 and #	3 and #

Usage ID	Usage Name	Apple Function
`0x0021`	4 and $	4 and $
`0x0022`	5 and %	5 and %
`0x0023`	6 and ^	6 and ^
`0x0024`	7 and &	7 and &
`0x0025`	8 and *	8 and *
`0x0026`	9 and (	9 and (
`0x0027`	0 and)	0 and)
`0x0028`	Return/Enter	Return
`0x002A`	Delete/Backspace	Delete
`0x002B`	Tab	Tab
`0x002C`	Spacebar	Spacebar
`0x002D`	- and _	- and _
`0x002E`	= and +	= and +
`0x002F`	[and {	[and {
`0x0030`	] and }	] and }
`0x0031`	\ and |	\ and |
`0x0033`	; and :	; and :
`0x0034`	' and "	' and "
`0x0035`	Grave Accent and Tilde	` and ~
`0x0036`	, and <	, and <
`0x0037`	. and >	. and >
`0x0038`	/ and ?	/ and ?
`0x0039`	CapsLock	Caps Lock
`0x004F`	RightArrow	Right Arrow
`0x0050`	LeftArrow	Left Arrow
`0x0051`	DownArrow	Down Arrow
`0x0052`	UpArrow	Up Arrow
`0x00E1`	LeftShift	Left Shift
`0x00E2`	LeftAlt	Left Option / Alt
`0x00E3`	LeftGUI	Left Command / ⌘
`0x00E5`	RightShift	Right Shift
`0x00E6`	RightAlt	Right Option / Alt
`0x00E7`	RightGUI	Right Command / ⌘

Keyboards may implement individual keys emitting the following HID Keyboard/Keypad page usages:

Table 14-2 Optional HID Keyboard/Keypad Page (`0x07`) controls for use by keyboards

Usage ID	Usage Name	Apple Function
0x0029	Escape	Escape
0x00E0	LeftControl	Left Control
0x00E4	RightControl	Right Control
0x004A	Home	Home
0x004D	End	End
0x0054	Keypad /	Keypad /
0x0055	Keypad *	Keypad *
0x0056	Keypad -	Keypad -
0x0057	Keypad +	Keypad +
0x0058	Keypad Enter	Keypad Enter
0x0059	Keypad 1 and End	Keypad 1
0x005A	Keypad 2 and Down Arrow	Keypad 2
0x005B	Keypad 3 and PageDn	Keypad 3
0x005C	Keypad 4 and Left Arrow	Keypad 4
0x005D	Keypad 5	Keypad 5
0x005E	Keypad 6 and Right Arrow	Keypad 6
0x005F	Keypad 7 and Home	Keypad 7
0x0060	Keypad 8 and Up Arrow	Keypad 8
0x0061	Keypad 9 and PageUp	Keypad 9
0x0062	Keypad 0 and Insert	Keypad 0
0x0063	Keypad . and Delete	Keypad .
0x0067	Keypad =	Keypad =

Keyboards may implement individual keys emitting the following HID Consumer page usages:

Table 14-3 HID Consumer Page (`0x0C`) controls for use by keyboards

Usage ID	Usage Name	Apple Function
0x0030	Power	Lock
0x0040	Menu	Home Button
0x006F	Display Brightness Increment	Brighter
0x0070	Display Brightness Decrement	Dimmer
0x00B5	Scan Next Track	Transport Right
0x00B6	Scan Previous Track	Transport Left
0x00CD	Play/Pause	Play/Pause

Usage ID	Usage Name	Apple Function
0x00E2	Mute	Mute
0x00E9	Volume Increment	Louder
0x00EA	Volume Decrement	Softer
0x01AE	AL Keyboard Layout	Toggle Onscreen Keyboard
0x029D	AC Keyboard Layout Select	Globe Key
0x0221	AC Search	Spotlight
0x025B	Promote	Play More Like This
0x025C	Demote	Play Less Like This
0x0262	Add to Cart	Add to Wish List
0x02C3	Keyboard Physical Layout	Keyboard Physical Layout, see Table 14-5 (page 97).

Keyboards may implement individual keys emitting the following HID Generic Desktop page usages:

Table 14-4 HID Generic Desktop Page (0x01) controls for use by keyboards

Usage ID	Usage Name	Apple Function
0x009B	System Do Not Disturb	Toggle Focus Mode

Table 14-5 Keyboard Physical Layout codes

Value	Description
1	101 (for example, US) - ANSI
3	102 (for example, German) - ISO
5	106 (DOS/V Japan) - JIS

JIS keyboards shall also implement additional keys found on the Japanese Apple Magic Keyboard. Non-JIS keyboards shall not implement the Japanese keys.

Table 14-6 Required HID Keyboard/Keypad Page (0x07) controls for use by JIS keyboards

Usage ID	Usage Name	Apple Function
0x0087	Keyboard International1	_
0x0089	Keyboard International3	¥
0x0090	LANG1	Switch to Previous Language
0x0091	LANG2	Switch to Next Language

14.2 Examples

14.2.1 Example HID Report Descriptor

```
USAGE PAGE (Generic Desktop)                05 01
USAGE (Keyboard)                            09 06
COLLECTION (Application)                    A1 01
  USAGE PAGE (LEDs)                         05 08
  LOGICAL MINIMUM (0)                       15 00
  LOGICAL MAXIMUM (1)                       25 01
  USAGE (Caps Lock)                         09 02
  REPORT SIZE (1)                           75 01
  REPORT COUNT (1)                          95 01
  OUTPUT (Data,Var,Abs)                     91 02
  REPORT SIZE (7)                           75 07
  REPORT COUNT (1)                          95 01
  OUTPUT (Cnst,Var,Abs)                     91 03
  USAGE PAGE (Keyboard)                     05 07
  USAGE MINIMUM (Keyboard Left Control)     19 E0
  USAGE MAXIMUM (Keyboard Right GUI)        29 E7
  REPORT SIZE (1)                           75 01
  REPORT COUNT (8)                          95 08
  INPUT (Data,Var,Abs)                      81 02
  LOGICAL MINIMUM (0)                       15 00
  LOGICAL MAXIMUM (255)                     26 FF 00
  USAGE MINIMUM (0)                         19 00
  USAGE MAXIMUM (255)                       2A FF 00
  REPORT SIZE (8)                           75 08
  REPORT COUNT (5)                          95 05
  INPUT (Data,Ary,Abs)                      81 00
  USAGE PAGE (Consumer Devices)             05 0C
  LOGICAL MINIMUM (0)                       15 00
  LOGICAL MAXIMUM (1)                       25 01
  USAGE (Menu)                              09 40
  USAGE (AC Search)                         0A 21 02
  USAGE (AL Keyboard Layout)                0A AE 01
  USAGE (Scan Previous Track)               09 B6
  USAGE (Play/Pause)                        09 CD
  USAGE (Scan Next Track)                   09 B5
  USAGE (Mute)                              09 E2
  USAGE (Volume Down)                       09 EA
  USAGE (Volume Up)                         09 E9
  USAGE (Power)                             09 30
  REPORT SIZE (1)                           75 01
  REPORT COUNT (10)                         95 0A
  INPUT (Data,Var,Abs)                      81 02
  REPORT SIZE (6)                           75 06
  REPORT COUNT (1)                          95 01
  INPUT (Cnst,Var,Abs)                      81 03
END COLLECTION                              C0
```

15. Trackpads

Devices may accept user input from accessory trackpads.

This feature is supported on iPadOS 14.5 or later.

15.1 Requirements

Accessory trackpads shall:

- Support the Human Interface Device (HID) (page 230) protocol.
- Not identify themselves as Apple-branded accessories, for example, using the Apple Vendor ID (VID).

Accessory trackpads exhibiting any of the following behaviors are explicitly prohibited:

- Emulate combinations of touch gestures.
- Emulate timed user actions, such as 'click and hold', drag, and zoom gestures.
- Send different HID usages depending on the state of another control surface.

HID reports sent from the accessory trackpad shall only occur in response to a Direct User Action (page 25).

Trackpads shall support 2-5 simultaneous contacts on the digitizer surface.

15.1.1 Integration with Keyboards

Accessory trackpads shall be integrated with Keyboards (page 93) and simultaneously support both input methods. The following are examples of interactions involving both keyboard and trackpad input:

- Rapidly transitioning between cursor movement and keyboard entry.
- Pressing and holding modifier keys while performing a drag.
- Pressing ⌘-Tab to see the app switcher, then using the cursor to switch apps.
- Dragging an item using the trackpad, followed by pressing ⌘-Tab to switch apps.

15.1.2 HID Report Descriptor

HID report descriptors for an accessory trackpad shall declare support for the HID Digitizer Page.

Accessory trackpads shall implement the following HID Digitizer page usages:

Table 15-1 Required HID Digitizer Page (`0x0D`) controls for use by accessory trackpads

Usage ID	Usage Name	Apple Function
`0x01`	Button 1	Primary button state
`0x05`	Report ID	Feature Report ID
`0x22`	Finger	Number of contact collection points
`0x30`	X	X coordinate of contact position
`0x31`	Y	Y coordinate of contact position
`0x38` or `0x51`	Transducer Index or Contact ID	Index (from 0-4) uniquely identifying the finger/contact
`0x42`	Tip Switch	Contact is on the surface of the digitizer
`0x47`	Confidence	Touch is an intended, valid contact
`0x57`	Surface Switch	Digitizer surface on/off

Accessory trackpads may implement the following HID Digitizer page usages. These HID usages are recommended:

Table 15-2 Recommended HID Digitizer Page (`0x0D`) controls for use by accessory trackpads

Usage ID	Usage Name	Apple Function
`0x02`	Button 2	Secondary button state
`0x56`	Scan Time	Relative scan time
`0xA1`	Report Rate	Report rate (Hz)

15.1.3 Coexistence

Accessory trackpads shall:

- Not degrade the performance of Multi-Touch or Apple Pencil.
- Not support a drive voltage greater than 6 V_{pp}.
- Not support drive frequencies less than 500 kHz.
- Support 3 or more drive frequencies, separated by at least 50 kHz each.
- Dynamically switch between drive frequencies whenever effective resolution drops below 120 DPI. For example, effective resolution may drop in the presence of 50 mV RMS noise from external power sources.

Accessory trackpads should support a sine wave narrow band drive frequency.

15.1.4 Performance

Accessory trackpads shall:

- Behave uniformly across the digitizer surface.
- Uniquely detect contact points as close as 8 mm center to center.
- Detect contact sizes of at least 5 mm.
- Differentiate between multi-finger taps and single-finger drags.
- Maintain an effective input resolution less than 20 µm and immediately report positional updates greater than or equal to the effective input resolution.
- Maintain an effective resolution more than 600 DPI.
- Maintain the highest possible report rate to the device. Apple recommends 60 Hz or higher.
- Maintain a panning latency less than or equal to 23 ms.
- Maintain a touch down latency less than or equal to 35 ms.
- Maintain a positional accuracy less than or equal to 500 µm.
- Maintain a stationary contact jitter less than or equal to 210 µm.
- Not deviate more than 250 µm from an ideal line.

15.1.5 Input Confidence

Accessory trackpads shall:

- Set the Confidence usage when an input transitions from valid to invalid. Contact transitions should be quick, accurate, and stable to achieve the best user experience. Incorrect or fluctuating classification of contacts may result in recognition of unintended gestures, interruption, or cancelation of intended gestures.
- Detect and reject unintended/invalid inputs, such as palms, while continuing to report valid inputs to the device, such as multiple contacts.
- Distinguish between a valid large thumb and an invalid lightly resting palm.
- Reject inputs ≥1 mm from the tracking surface.

15.1.6 Click to Wake

Devices use Report ID usage to indicate to the trackpad whether surface contacts shall be reported or not. Devices will use the Surface Switch usage to tell the accessory to go into Click to Wake mode where only button clicks are accepted. Trackpads may use this opportunity to go into a low power mode where the digitizer surface does not have to be constantly scanned.

This feature report also doubles as an informational report. Devices may query the accessory trackpad at any time after enumeration to obtain the current state of the Surface Switch, and also to get the accessory's Report Rate.

15.2 Examples

15.2.1 Example HID Report Descriptor

The following descriptor is for a 92.10 mm x 50.60 mm trackpad with two buttons supporting up to five simultaneous contacts.

Additional modifications may be necessary in order to implement this HID report descriptor in the accessory trackpad firmware, specifically:

- Modify physical maximum values for X (`0x30`) and Y (`0x31`) positions of each finger to match the physical size of the accessory trackpad. Units are in tenths of a mm (0.1 mm). In the example, X goes from `0x0` to `0x0399` (92.10 mm) and Y goes from `0x0` to `0x01FA` (50.60 mm).
- Modify logical maximum values for the X (`0x30`) and Y (`0x31`) of each finger positions to match the resolution of the accessory trackpad. In the example, X (`0x30`) goes from 0 to `0x0451` (for a resolution of 92.10/1105 = ~0.083 mm) and Y (`0x31`) goes from 0 to `0x025F` (for the same resolution of 50.60/607 = ~0.083 mm).

```
USAGE PAGE (Digitizer Device Page)                   05 0D
USAGE (Touch Pad)                                    09 05
COLLECTION (Application)                             A1 01
  REPORT_ID (3)                                      85 03
  LOGICAL MAXIMUM (65535)                            27 FF FF 00 00
  USAGE (Relative Scan Time (DV=Dynamic Value))      09 56
  REPORT SIZE (16)                                   75 10
  REPORT COUNT (1)                                   95 01
  INPUT (Data,Var,Abs)                               81 02
  LOGICAL MAXIMUM (1)                                25 01
  REPORT SIZE (1)                                    75 01
  USAGE (Surface Switch)                             09 57
  FEATURE (Data,Var,Abs)                             B1 02
  LOGICAL MAXIMUM (32767)                            26 FF 7F
  REPORT SIZE (15)                                   75 0F
  USAGE (Report Rate)                                09 A1
  FEATURE (Data,Var,Abs)                             B1 02
  USAGE PAGE (Button Page)                           05 09
  LOGICAL MAXIMUM (1)                                25 01
  USAGE MINIMUM (Button 1)                           19 01
  USAGE MAXIMUM (Button 2)                           29 02
  REPORT COUNT (2)                                   95 02
  REPORT SIZE (1)                                    75 01
  INPUT (Data,Var,Abs)                               81 02
  REPORT COUNT (6)                                   95 06
  INPUT (Cost, Ary, Abs)                             81 01
  USAGE PAGE (Digitizer Device Page)                 05 0D
  USAGE (Finger)                                     09 22
  COLLECTION (Physical)                              A1 00
  USAGE (Tip Switch)                                 09 42
  USAGE (Confidence)                                 09 47
```

```
REPORT COUNT (2)                                  95 02
INPUT (Data,Var,Abs)                              81 02
LOGICAL MAXIMUM (5)                               25 05
USAGE (Transducer Index)                          09 38
REPORT SIZE (6)                                   75 06
REPORT COUNT (1)                                  95 01
INPUT (Data,Var,Abs)                              81 02
USAGE PAGE (Generic Desktop Page)                 05 01
PHYSICAL MAXIMUM (921)                            46 99 03
PHYSICAL MINIMUM (0)                              35 00
LOGICAL MAXIMUM (1105)                            26 51 04
REPORT SIZE (12)                                  75 0C
UNIT EXPONENT (Unit Value x .01)                  55 0E
GLOBAL UNIT (Distance in centimeters)             65 11
USAGE (X)                                         09 30
INPUT (Data,Var,Abs)                              81 02
PHYSICAL MAXIMUM (506)                            46 FA 01
LOGICAL MAXIMUM (607)                             26 5F 02
USAGE (Y)                                         09 31
INPUT (Data,Var,Abs)                              81 02
END COLLECTION (Physical)                         C0
USAGE PAGE (Digitizer Device Page)                05 0D
USAGE (Finger)                                    09 22
COLLECTION (PHYSICAL)                             A1 00
LOGICAL MAXIMUM (1)                               25 01
USAGE (Tip Switch)                                09 42
USAGE (Confidence)                                09 47
REPORT SIZE (1)                                   75 01
REPORT COUNT (2)                                  95 02
INPUT (Data,Var,Abs)                              81 02
USAGE (Transducer Index)                          09 38
LOGICAL MAXIMUM (5)                               25 05
REPORT SIZE (6)                                   75 06
REPORT COUNT (1)                                  95 01
INPUT (Data,Var,Abs)                              81 02
USAGE PAGE (Generic Desktop Page)                 05 01
PHYSICAL MAXIMUM (921)                            46 99 03
LOGICAL MAXIMUM (1105)                            26 51 04
REPORT SIZE (12)                                  75 0C
USAGE (X)                                         09 30
INPUT (Data,Var,Abs)                              81 02
PHYSICAL MAXIMUM (506)                            46 FA 01
LOGICAL MAXIMUM (607)                             26 5F 02
USAGE (Y)                                         09 31
INPUT (Data,Var,Abs)                              81 02
END COLLECTION (Physical)                         C0
USAGE PAGE (Digitizer Device Page)                05 0D
USAGE (Finger)                                    09 22
COLLECTION (Physical)                             A1 00
LOGICAL MAXIMUM (1)                               25 01
USAGE (Tip Switch)                                09 42
USAGE (Confidence)                                09 47
REPORT SIZE (1)                                   75 01
```

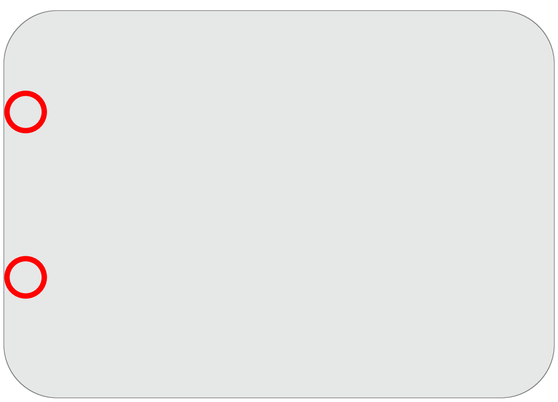
```
REPORT COUNT (2)                                  95 02
INPUT (Data,Var,Abs)                              81 02
USAGE (Transducer Index)                          09 38
LOGICAL MAXIMUM (5)                               25 05
REPORT SIZE (6)                                   75 06
REPORT COUNT (1)                                  95 01
INPUT (Data,Var,Abs)                              81 02
USAGE PAGE (Generic Desktop Page)                 05 01
PHYSICAL MAXIMUM (921)                            46 99 03
LOGICAL MAXIMUM (1105)                            26 51 04
REPORT SIZE (12)                                  75 0C
USAGE (X)                                         09 30
INPUT (Data,Var,Abs)                              81 02
PHYSICAL MAXIMUM (506)                            46 FA 01
LOGICAL MAXIMUM (607)                             26 5F 02
USAGE (Y)                                         09 31
INPUT (Data,Var,Abs)                              81 02
END COLLECTION (PHYSICAL)                         C0
USAGE PAGE (Digitizer Device Page)                05 0D
USAGE (Finger)                                    09 22
COLLECTION (PHYSICAL)                             A1 00
LOGICAL MAXIMUM (1)                               25 01
USAGE (Tip Switch)                                09 42
USAGE (Confidence)                                09 47
REPORT SIZE (1)                                   75 01
REPORT COUNT (2)                                  95 02
INPUT (Data,Var,Abs)                              81 02
USAGE (Transducer Index)                          09 38
LOGICAL MAXIMUM (5)                               25 05
REPORT SIZE (6)                                   75 06
REPORT COUNT (1)                                  95 01
INPUT (Data,Var,Abs)                              81 02
USAGE PAGE (Generic Desktop Page)                 05 01
PHYSICAL MAXIMUM (921)                            46 99 03
LOGICAL MAXIMUM (1105)                            26 51 04
REPORT SIZE (12)                                  75 0C
USAGE (X)                                         09 30
INPUT (Data,Var,Abs)                              81 02
PHYSICAL MAXIMUM (506)                            46 FA 01
LOGICAL MAXIMUM (607)                             26 5F 02
USAGE (Y)                                         09 31
INPUT (Data,Var,Abs)                              81 02
END COLLECTION (Physical)                         C0
USAGE PAGE (Digitizer Device Page)                05 0D
USAGE (Finger)                                    09 22
COLLECTION (PHYSICAL)                             A1 00
LOGICAL MAXIMUM (1)                               25 01
USAGE (Tip Switch)                                09 42
USAGE (Confidence)                                09 47
REPORT SIZE (1)                                   75 01
REPORT COUNT (2)                                  95 02
INPUT (Data,Var,Abs)                              81 02
USAGE (Transducer Index)                          09 38
```

```
  LOGICAL MAXIMUM (5)                               25 05
  REPORT SIZE (6)                                   75 06
  REPORT COUNT (1)                                  95 01
  INPUT (Data,Var,Abs)                              81 02
  USAGE PAGE (Generic Desktop Page)                 05 01
  PHYSICAL MAXIMUM (921)                            46 99 03
  LOGICAL MAXIMUM (1105)                            26 51 04
  REPORT SIZE (12)                                  75 0C
  USAGE (X)                                         09 30
  INPUT (Data,Var,Abs)                              81 02
  PHYSICAL MAXIMUM (506)                            46 FA 01
  LOGICAL MAXIMUM (607)                             26 5F 02
  USAGE (Y)                                         09 31
  INPUT (Data,Var,Abs)                              81 02
  END COLLECTION (Physical)                         C0
END COLLECTION (Application)                        C0
```

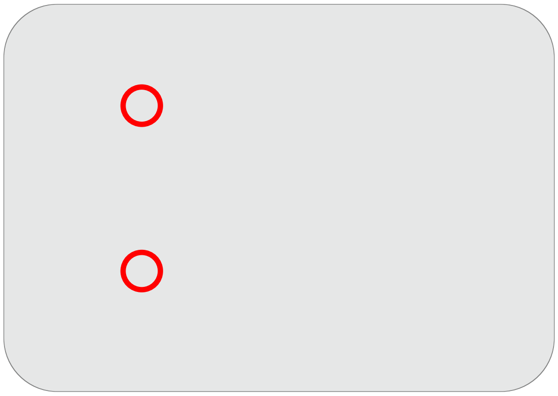
15.2.2 Example Trackpad

The following HID reports are for a 60 Hz accessory trackpad using the Example HID Report Descriptor (page 102):

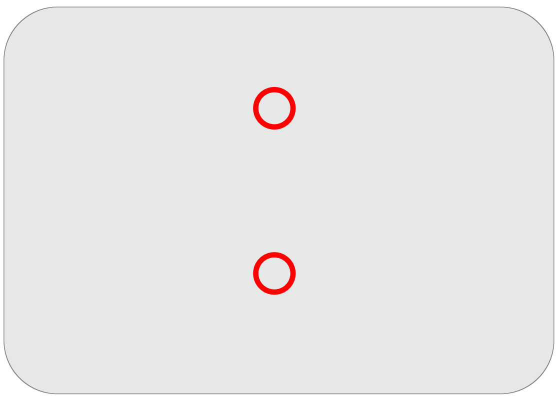
1. Two contacts are made on the surface of the accessory trackpad.
   `03000000 0300100F 0700C016 00000000 00000000 00000000`



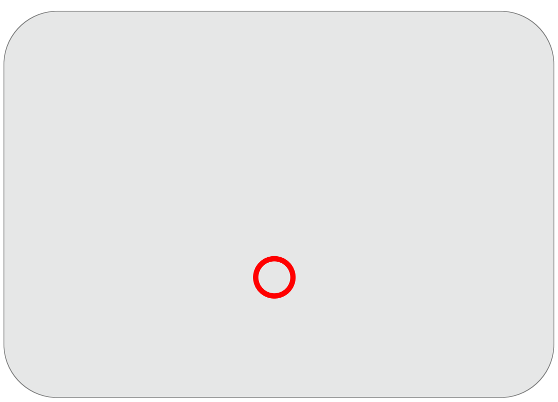
2. Two contacts move simultaneously along the X axis.
   `03A70000 0314110F 0714C116 00000000 00000000 00000000`



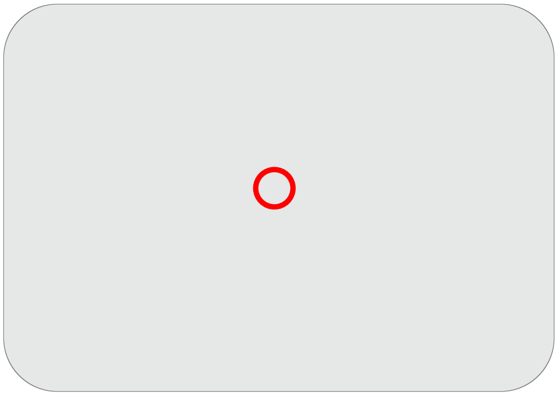
3. Two contacts continue moving until they reach the center of the digitizer surface.
   `034E0100 0328120F 0728C216 00000000 00000000 00000000`



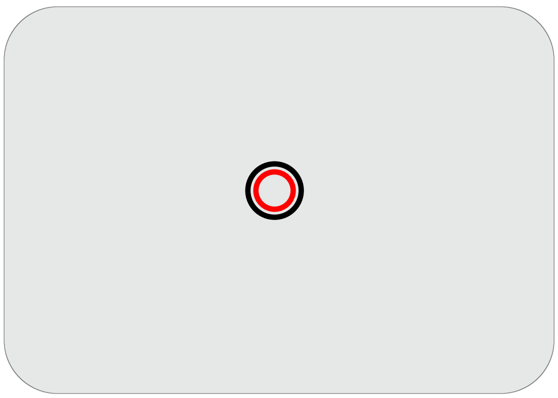
4. One contact is removed. Confidence for removed contact is still 1 and its coordinates are unchanged.
   `03F50100 0328120F 0628C216 00000000 00000000 00000000`



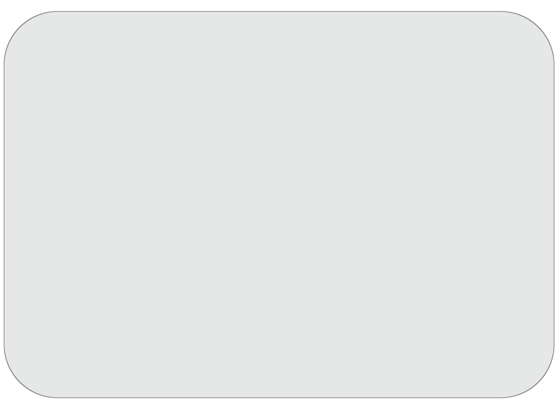
5. Remaining contact moves to the exact center of the digitizer surface. Confidence and coordinates of the removed contact are now 0.
   `039C0200 0328F212 00000000 00000000 00000000 00000000`



6. Button 1 is clicked.
   `03430301 0328F212 00000000 00000000 000000000 0000000`



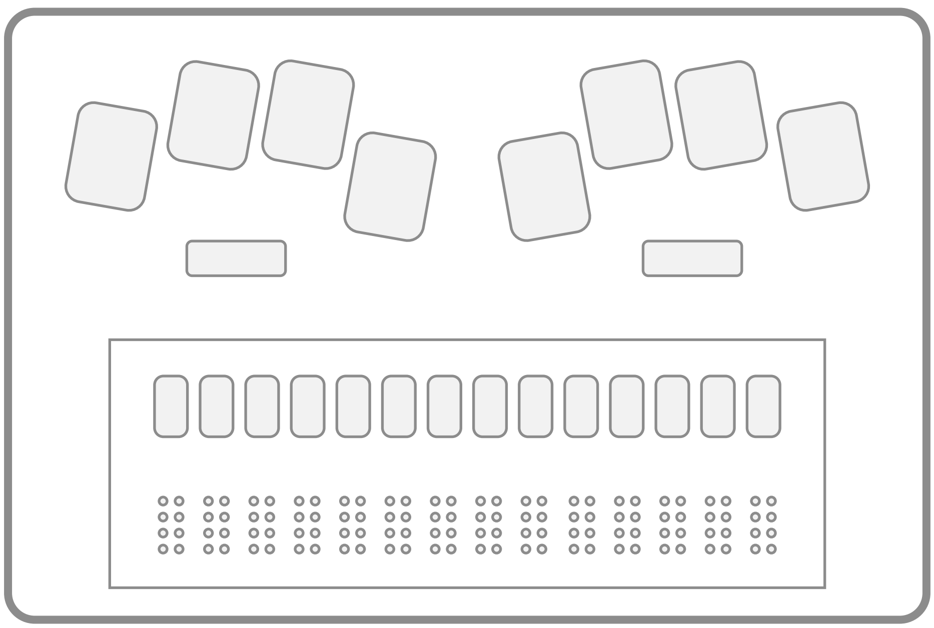
7. Button 1 is un-clicked and contact is removed. Confidence for removed contact is still 1 and its coordinates are unchanged.
   `03EA0300 0228F212 00000000 00000000 00000000 00000000`



16. Braille Displays and Keyboards

A braille display is an accessory enabling a user who is blind or has low vision to read text using raised pins. These accessories may include a braille keyboard to enter text, controls used to navigate a device, and controls to interface with a screen reader.

Figure 16-1 Braille display with keyboard



This feature is supported on iOS 12.0 or later, tvOS 12.0 or later, and macOS 10.14 Mojave or later.

16.1 Requirements

Braille display accessories shall:

- Support the Human Interface Device (HID) (page 230) protocol.
- Not identify themselves as Apple-branded accessories, for example, using the Apple Vendor ID.

Braille display keys exhibiting any of the following behaviors are explicitly prohibited:

- Sending anything other than a 'key pressed' or 'key released' for a physically pressed key.

- Emulating combinations of other keys (for example, macros like Command-C for Copy).
- Emulating timed user actions, such as 'press-and-hold'.

HID reports sent from braille displays shall only occur in response to Direct User Action (page 25).

HID report descriptors for braille displays shall declare support for the Braille Display Page (`0x41`). HID report descriptors shall individually enumerate each usage the accessory is capable of receiving or sending.

Braille display accessories shall declare a braille display collection containing one or more braille rows with 8 dot and/or 6 dot braille cells with the following usages:

Table 16-1 Required Braille Display Page (`0x41`) usages for use by display

Usage ID	Usage Name	Apple Function
`0x0001`	Braille Display	Braille Display
`0x0002`	Braille Row	Braille Row
`0x0003`	8 Dot Braille Cell	8 Dot Braille Cell
`0x0004`	6 Dot Braille Cell	6 Dot Braille Cell

Braille display accessories may support the following usages:

Table 16-2 Optional Braille Display Page (`0x41`) usages for use by display

Usage ID	Usage Name	Apple Function
`0x0005`	Number of Braille Cells	Number of Braille Cells
`0x00FA`	Router Set 1	Primary Button
`0x00FB`	Router Set 2	Secondary Button
`0x00FC`	Router Set 3	Tertiary Button
`0x0100`	Router Key	Router Key for a Braille Cell
`0x0101`	Row Router Key	Router Key for a Braille Row
`0x020C`	Braille Face Controls	Braille Face Controls
`0x020D`	Braille Left Controls	Braille Left Controls
`0x020E`	Braille Right Controls	Braille Right Controls
`0x020F`	Braille Top Controls	Braille Top Controls
`0x0210`	Braille Joystick Center	Braille Joystick Center
`0x0211`	Braille Joystick Up	Braille Joystick Up
`0x0212`	Braille Joystick Down	Braille Joystick Down
`0x0213`	Braille Joystick Left	Braille Joystick Left
`0x0214`	Braille Joystick Right	Braille Joystick Right

Usage ID	Usage Name	Apple Function
`0x0215`	Braille D-Pad Center	Braille D-Pad Center
`0x0216`	Braille D-Pad Up	Braille D-Pad Up
`0x0217`	Braille D-Pad Down	Braille D-Pad Down
`0x0218`	Braille D-Pad Left	Braille D-Pad Left
`0x0219`	Braille D-Pad Right	Braille D-Pad Right
`0x021A`	Braille Pan Left	Braille Pan Left
`0x021B`	Braille Pan Right	Braille Pan Right
`0x021C`	Braille Rocker Up	Braille Rocker Up
`0x021D`	Braille Rocker Down	Braille Rocker Down
`0x021E`	Braille Rocker Press	Braille Rocker Press

16.1.1 Braille Keyboards

Braille displays may include a braille keyboard to enter text.

Braille display accessories with braille keyboards shall implement individual keys emitting the following usages:

Table 16-3 Required Braille Display Page (`0x41`) controls for use by display with keyboard

Usage ID	Usage Name	Apple Function
`0x0200`	Braille Buttons	Braille Buttons
`0x0201`	Braille Keyboard Dot 1	Braille Keyboard Dot 1
`0x0202`	Braille Keyboard Dot 2	Braille Keyboard Dot 2
`0x0203`	Braille Keyboard Dot 3	Braille Keyboard Dot 3
`0x0204`	Braille Keyboard Dot 4	Braille Keyboard Dot 4
`0x0205`	Braille Keyboard Dot 5	Braille Keyboard Dot 5
`0x0206`	Braille Keyboard Dot 6	Braille Keyboard Dot 6
`0x0209`	Braille Keyboard Space	Braille Keyboard Space

Braille display accessories with braille keyboards may implement individual keys emitting the following usages:

Table 16-4 Optional Braille Display Page (`0x41`) controls for use by display with keyboard

Usage ID	Usage Name	Apple Function
`0x0207`	Braille Keyboard Dot 7	Braille Keyboard Dot 7
`0x0208`	Braille Keyboard Dot 8	Braille Keyboard Dot 8

Usage ID	Usage Name	Apple Function
0x020A	Braille Keyboard Left Space	Braille Keyboard Left Space
0x020B	Braille Keyboard Right Space	Braille Keyboard Right Space

Braille display accessories with braille keyboards shall support the ability to send all Braille Keyboard Dot and Space usages simultaneously.

16.1.2 Screen Reader Controls

Braille displays may include a controls to interface with a screen reader.

Braille display accessories supporting screen reader controls shall support the following usages:

Table 16-5 Required Braille Display Page (0x41) usages for use by display with screen reader controls

Usage ID	Usage Name	Apple Function
0x0006	Screen Reader Control	Screen Reader Controls (See Table 16-7 (page 112).)
0x0007	Screen Reader Identifier	Screen Reader Identifier (See Table 16-6 (page 111).)

The screen reader identifier is a 128 bit UUID from the device identifying the active screen reader. Table 16-6 (page 111) lists Apple screen reader identifiers.

VoiceOver (https://www.apple.com/accessibility/vision/) is the screen reader feature built into Apple's operating systems. Users who are blind or have low vision can interact with and control devices and Mac computers simply by moving their finger over the touchscreen or touch-sensitive trackpad. When VoiceOver is paired with a Braille display, users are able to use VoiceOver even if they are unable to touch the device display.

Table 16-6 Apple screen reader identifiers

Screen Reader	Screen Reader Identifier
iOS/iPadOS/tvOS VoiceOver	D211EC73-AE43-4B2B-A691-5F6620B4DBF6
macOS VoiceOver	BC4B74EA-B787-4A6D-B572-4E2D746A9AFD

The screen reader control array is populated with Button Page (0x09) usages. The behavior of each usage depends on the active screen reader. Table 16-7 (page 112) lists Apple screen reader functions for each usage.

Braille display accessories may support the following screen reader control usages:

Table 16-7 Optional Button Page (`0x09`) usages for use by display with screen reader controls

Usage ID	Usage Name	Apple Function
`0x01`	Button 1	Next Braille Input Mode
`0x02`	Button 2	Next Braille Output Mode
`0x03`	Button 3	Pan Braille Left
`0x04`	Button 4	Pan Braille Right
`0x05`	Button 5	Delete Braille
`0x06`	Button 6	Forward Delete Braille
`0x07`	Button 7	Activates Return Key
`0x08`	Button 8	Escape Current Context
`0x09`	Button 9	Toggle Contracted Braille
`0x0A`	Button 10	Toggle Eight-Dot Braille
`0x11`	Button 17	Go to Status Bar
`0x12`	Button 18	Go to First Item
`0x13`	Button 19	Go to Last item
`0x14`	Button 20	Move to Previous Item
`0x15`	Button 21	Move to Next Item
`0x16`	Button 22	Read Page
`0x17`	Button 23	Read Page Starting at Focused Item
`0x18`	Button 24	Scroll Left One Page
`0x19`	Button 25	Scroll Right One Page
`0x1A`	Button 26	Scroll Up One Page
`0x1B`	Button 27	Scroll Down One Page
`0x21`	Button 33	Next Virtual Menu Item
`0x22`	Button 34	Previous Virtual Menu Item
`0x23`	Button 35	Select Previous Virtual Menu Item Setting
`0x24`	Button 36	Select Next Virtual Menu Item Setting
`0x25`	Button 37	Perform Tap
`0x26`	Button 38	Pause/Continue Speech
`0x27`	Button 39	Perform Contextual Action
`0x31`	Button 49	Move to Desktop
`0x32`	Button 50	Move to Taskbar
`0x33`	Button 51	Move to Menu Bar
`0x34`	Button 52	Start Interaction with Item
`0x35`	Button 53	Stop Interaction with Item
`0x41`	Button 65	Navigate Up
`0x42`	Button 66	Navigate Down

Usage ID	Usage Name	Apple Function
0x43	Button 67	Navigate Left
0x44	Button 68	Navigate Right
0x45	Button 69	Navigate Up with Wrapping
0x46	Button 70	Navigate Down with Wrapping
0x47	Button 71	Navigate Left with Wrapping
0x48	Button 72	Navigate Right with Wrapping
0x49	Button 73	Next Heading
0x4A	Button 74	Previous Heading
0x4B	Button 75	Next Graphic
0x4C	Button 76	Previous Graphic
0x4D	Button 77	Next Table
0x4E	Button 78	Previous Table
0x4F	Button 79	Next List
0x50	Button 80	Previous List
0x51	Button 81	Next Control
0x52	Button 82	Previous Control
0x53	Button 83	Next Blockquote
0x54	Button 84	Previous Blockquote
0x55	Button 85	Next Same Blockquote
0x56	Button 86	Previous Same Blockquote
0x57	Button 87	Next Link
0x58	Button 88	Previous Link
0x59	Button 89	Next Visited Link
0x5A	Button 90	Previous Visited Link
0x5B	Button 91	Next Same Heading
0x5C	Button 92	Previous Same Heading
0x5D	Button 93	Next Bold Text
0x5E	Button 94	Previous BoldT ext
0x5F	Button 95	Next Italic Text
0x60	Button 96	Previous Italic Text
0x61	Button 97	Next Underline Text
0x62	Button 98	Previous Underline Text
0x63	Button 99	Next Misspelled Word
0x64	Button 100	Previous Misspelled Word
0x65	Button 101	Next Plain Text
0x66	Button 102	Previous Plain Text
0x67	Button 103	Next Color Change
0x68	Button 104	Previous Color Change

Usage ID	Usage Name	Apple Function
0x69	Button 105	Next Font Change
0x6A	Button 106	Previous Font Change
0x6B	Button 107	Next Style Change
0x6C	Button 108	Previous Style Change
0x6D	Button 109	Next Same Element
0x6E	Button 110	Previous Same Element
0x6F	Button 111	Next Different Element
0x70	Button 112	Previous Different Element

16.2 Examples

16.2.1 Example HID Report Descriptor

The following descriptor is for a 20 cell braille display with integrated keyboard and screen reader controls.

```
0x05, 0x41,        // Usage Page (Braille)
0x09, 0x01,        // USAGE (Braille Display)
0xA1, 0x01,        // Collection (Application)
0x1A, 0x01, 0x02,  //   Usage Minimum (Braille Keyboard Dot 1)
0x2A, 0x08, 0x02,  //   Usage Maximum (Braille Keyboard Dot 8)
0x75, 0x01,        //   Report Size (1)
0x95, 0x08,        //   Report Count (8)
0x15, 0x00,        //   Logical Minimum (0)
0x25, 0x01,        //   Logical Maximum (1)
0x81, 0x02,        //   Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0x05, 0x41,        //   Usage Page (Braille)
0x0A, 0x09, 0x02,  //   Usage (Braille Keyboard Space)
0x0A, 0x0A, 0x02,  //   Usage (Braille Keyboard Left Space)
0x0A, 0x0B, 0x02,  //   Usage (Braille Keyboard Right Space)
0x75, 0x01,        //   Report Size (1)
0x95, 0x03,        //   Report Count (3)
0x15, 0x00,        //   Logical Minimum (0)
0x25, 0x01,        //   Logical Maximum (1)
0x81, 0x02,        //   Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0x75, 0x01,        //   Report Size (1)
0x95, 0x05,        //   Report Count (5)
0x15, 0x00,        //   Logical Minimum (0)
0x25, 0x01,        //   Logical Maximum (1)
0x81, 0x02,        //   Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0x05, 0x41,        //   Usage Page (Braille)
0xA1, 0x02,        //   Collection (Logical)
0x05, 0x0A,        //     Usage Page (Ordinal)
0x09, 0x01,        //     Usage (Instance 1)
```

```
0xA1, 0x02,        //     Collection (Logical)
0x05, 0x41,        //       Usage Page (Braille)
0x0A, 0x10, 0x02,  //       Usage (Braille Joystick Center)
0x0A, 0x11, 0x02,  //       Usage (Braille Joystick Up)
0x0A, 0x12, 0x02,  //       Usage (Braille Joystick Down)
0x0A, 0x13, 0x02,  //       Usage (Braille Joystick Left)
0x0A, 0x14, 0x02,  //       Usage (Braille Joystick Right)
0x75, 0x01,        //       Report Size (1)
0x95, 0x05,        //       Report Count (8)
0x15, 0x00,        //       Logical Minimum (0)
0x25, 0x01,        //       Logical Maximum (1)
0x81, 0x02,        //       Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //     End Collection
0x05, 0x0A,        //     Usage Page (Ordinal)
0x09, 0x02,        //     Usage (Instance 2)
0xA1, 0x02,        //     Collection (Logical)
0x05, 0x41,        //       Usage Page (Braille)
0x0A, 0x10, 0x02,  //       Usage (Braille Joystick Center)
0x0A, 0x11, 0x02,  //       Usage (Braille Joystick Up)
0x0A, 0x12, 0x02,  //       Usage (Braille Joystick Down)
0x0A, 0x13, 0x02,  //       Usage (Braille Joystick Left)
0x0A, 0x14, 0x02,  //       Usage (Braille Joystick Right)
0x75, 0x01,        //       Report Size (1)
0x95, 0x05,        //       Report Count (8)
0x15, 0x00,        //       Logical Minimum (0)
0x25, 0x01,        //       Logical Maximum (1)
0x81, 0x02,        //       Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //     End Collection
0x75, 0x01,        //     Report Size (1)
0x95, 0x06,        //     Report Count (6)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //   End Collection
0x0A, 0x0D, 0x02,  //   Usage (Braille Left Controls)
0xA1, 0x02,        //   Collection (Logical)
0x05, 0x09,        //     Usage Page (Button)
0x19, 0x01,        //     Usage Minimum (Button 1)
0x29, 0x03,        //     Usage Maximum (Button 3)
0x75, 0x01,        //     Report Size (1)
0x95, 0x03,        //     Report Count (3)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0x05, 0x41,        //     Usage Page (Braille)
0x0A, 0x1A, 0x02,  //     Usage (Pan Left)
0x75, 0x01,        //     Report Size (1)
0x95, 0x01,        //     Report Count (1)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //   End Collection
0x05, 0x41,        //   Usage Page (Braille)
```

```
0x0A, 0x0E, 0x02,  //   Usage (Braille Right Controls)
0xA1, 0x02,        //   Collection (Logical)
0x05, 0x09,        //     Usage Page (Button)
0x19, 0x01,        //     Usage Minimum (Button 1)
0x29, 0x03,        //     Usage Maximum (Button 3)
0x75, 0x01,        //     Report Size (1)
0x95, 0x03,        //     Report Count (3)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0x05, 0x41,        //     Usage Page (Braille)
0x0A, 0x1B, 0x02,  //     Usage (Pan Right)
0x75, 0x01,        //     Report Size (1)
0x95, 0x01,        //     Report Count (1)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //   End Collection
0x05, 0x41,        //   Usage Page (Braille)
0x0A, 0x0F, 0x02,  //   Usage (Braille Top Controls)
0xA1, 0x02,        //   Collection (Logical)
0x05, 0x09,        //     Usage Page (Button)
0x19, 0x01,        //     Usage Minimum (Button 1)
0x29, 0x03,        //     Usage Maximum (Button 3)
0x75, 0x01,        //     Report Size (1)
0x95, 0x03,        //     Report Count (3)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0x05, 0x41,        //     Usage Page (Braille)
0x0A, 0x15, 0x02,  //     Usage (Braille D-Pad Center)
0x0A, 0x16, 0x02,  //     Usage (Braille D-Pad Up)
0x0A, 0x17, 0x02,  //     Usage (Braille D-Pad Down)
0x0A, 0x18, 0x02,  //     Usage (Braille D-Pad Left)
0x0A, 0x19, 0x02,  //     Usage (Braille D-Pad Right)
0x75, 0x01,        //     Report Size (1)
0x95, 0x05,        //     Report Count (5)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //   End Collection
0x05, 0x41,        //   Usage Page (Braille)
0x0A, 0x0C, 0x02,  //   Usage (Braille Face Controls)
0xA1, 0x02,        //   Collection (Logical)
0x05, 0x09,        //     Usage Page (Button)
0x19, 0x01,        //     Usage Minimum (Button 1)
0x29, 0x04,        //     Usage Maximum (Button 4)
0x75, 0x01,        //     Report Size (1)
0x95, 0x04,        //     Report Count (4)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0x05, 0x41,        //     Usage Page (Braille)
```

```
0x0A, 0x1C, 0x02,  //     Usage (Braille Rocker Up)
0x0A, 0x1D, 0x02,  //     Usage (Braille Rocker Down)
0x0A, 0x1E, 0x02,  //     Usage (Braille Rocker Press)
0x75, 0x01,        //     Report Size (1)
0x95, 0x03,        //     Report Count (3)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x03,        //     Input (Const,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0x75, 0x01,        //     Report Size (1)
0x95, 0x01,        //     Report Count (1)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x03,        //     Input (Const,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //   End Collection
0x05, 0x41,        //   Usage Page (Braille)
0x09, 0x06,        //   USAGE (Screen Reader Controls)
0xA1, 0x02,        //     Collection (Logical)
0x05, 0x09,        //     Usage Page (Button)
0x19, 0x01,        //     Usage Minimum (Button 1)
0x29, 0x08,        //     Usage Maximum (Button 8)
0x75, 0x01,        //     Report Size (1)
0x95, 0x08,        //     Report Count (8)
0x15, 0x00,        //     Logical Minimum (0)
0x25, 0x01,        //     Logical Maximum (1)
0x81, 0x02,        //     Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //   End Collection
0x05, 0x41,        //   Usage Page (Braille)
0x09, 0x02,        //   USAGE (Braille Row)
0xA1, 0x02,        //   Collection (Logical)
0x09, 0x04,        //     Usage (8 Dot Braille Cell)
0x15, 0x00,        //     Logical Minimum (0)
0x26, 0xFF, 0x00,  //     Logical Maximum (255)
0x75, 0x08,        //     Report Size (8)
0x95, 0xA,         //     Report Count (20)
0x91, 0x03,        //     Output (Const,Var,Abs,No Wrap,Linear,Preferred State,No Null
Position,Non-volatile)
0x09, 0xFA,        //     USAGE (Router Set 1)
0xA1, 0x02,        //     Collection (Logical)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
```

```
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x0A, 0x00, 0x01,  //       Usage (Router Key)
0x15, 0x00,        //       Logical Minimum (0)
0x25, 0x01,        //       Logical Maximum (1)
0x75, 0x01,        //       Report Size (1)
0x95, 0x14,        //       Report Count (20)
0x81, 0x02,        //       Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
// 4-bit padding
0x75, 0x04,        //       Report Size (4)
0x95, 0x01,        //       Report Count (1)
0x81, 0x02,        //       Input (Data,Var,Abs,No Wrap,Linear,Preferred State,No Null Position)
0xC0,              //     End Collection
0xC0,              //   End Collection
0x05, 0x41,        //   Usage Page (Braille)
0x09, 0x07,        //   USAGE (Screen Reader Identifier)
0x95, 0x01,        //   Report Count (1)
0x75, 0x80,        //   Report Size (128)
0xB1, 0x02,        //   FEATURE (Data,Var,Abs)
0xC0,              // End Collection
```

17. External Storage

Devices support external storage, such as USB drives and SD card readers, to:

- Store and access files.
- Import and export photos.
- Record video.

17.1 Overview

Accessories may support moving data to or from a device using:

- *USB Mass Storage Class Specification Overview–Version 1.4*, see https://www.usb.org/document-library/mass-storage-class-specification-overview-14.
- External Accessory Protocol (page 170).

17.2 Apple ProRes 4K

To support Apple ProRes capture at 4K, external storage shall:

- Be ExFAT formatted.
- Sustain a write speed of incompressible data, sampled every second, across the entire storage capacity, of at least:
  - 440 MiB/s for 4K at 120 fps.
  - 220 MiB/s for 4K at 60 fps.
- Not exceed 900 mA of current draw at any point in time. See Accessory Power (USB-C) (page 148).

For more information on Apple ProRes, including specific device support, see https://support.apple.com/en-us/109041.

17.3 Verification

17.3.1 Apple ProRes 4K

17.3.1.1 Equipment

The following equipment is necessary:

- Device supporting external Apple ProRes 4K capture running iOS 18.0 or later, see https://support.apple.com/en-us/109041.

17.3.1.2 Setup

1. Fully charge the device.
2. Attach the external storage.
3. Erase and format the external storage as ExFAT:
   a. Open Files and browse to the top level.
   b. Long press the external storage entry and select Erase.
   c. Verify the external storage is empty.
4. Open Settings > Camera > Formats and enable Apple ProRes under Video Capture.
5. Verify ProRes encoding is set to HDR.

17.3.1.3 Procedure

1. Attach the external storage to the device.
2. Open Camera, select Video and enable ProRes HDR from the Camera header.
3. Select the resolution indicator until it displays 4K.
4. Select the fps indicator until it displays:
   - 120 for devices and accessories supporting 4K at 120 fps.
   - 60 for devices and accessories supporting 4K at 60 fps.
5. Verify the Max Time indicator is displayed.
6. Verify the 'USB-C' indicator is displayed near the USB-C port.
7. Record video including motion (camera pan/tilt, people, vehicles) for at least 10 minutes.
8. Stop recording and wait for all data to be written to external storage.
9. Verify no error messages are displayed.
10. Attach the external storage to a Mac and play the video.
11. Verify the video playback is smooth, with no choppiness or missing frames.
12. Repeat the procedure, recording video until the drive is full, and verify all video is smooth, with no choppiness or missing frames.

18. AirPods Accessories

Accessories shall not interfere with AirPods operation. Keep-out regions may be found in the device dimensional drawings, see:

- AirPods 4 (page 556).
- AirPods Pro (2nd generation) (page 563).
- AirPods (3rd generation) (page 565).
- AirPods Max, 1 of 6 (page 566).
- AirPods Pro (1st generation) (page 573).
- AirPods (2nd generation) and AirPods (1st generation) (page 575).

18.1 Charging Case Covers

Charging case covers shall:

- Not interfere with AirPods charging case operation.
- Have a uniform thickness across the metal keep-out region.
- Not exceed 2.5 mm in thickness. Apple recommends 1.0 mm for maximum compatibility with inductive transmitters.

Keep-out regions may be found in the device dimensional drawings, see:

- Wireless Charging Case (USB-C) for AirPods 4, 1 of 3 (page 553).
- MagSafe Charging Case (USB-C) for AirPods Pro (2nd generation), 1 of 3 (page 557).
- MagSafe Charging Case for AirPods Pro (2nd generation), 1 of 3 (page 560).
- MagSafe Charging Case for AirPods (3rd generation) (page 564).
- Wireless Charging Case for AirPods Pro (1st generation) (page 572).
- Wireless Charging Case for AirPods (page 574).

Case covers claiming compatibility with Apple Watch chargers shall not obstruct the Apple Watch charger keep-out region, see:

- Wireless Charging Case (USB-C) for AirPods 4, 2 of 3 (page 554).
- MagSafe Charging Case (USB-C) for AirPods Pro (2nd generation), 2 of 3 (page 558).
- MagSafe Charging Case for AirPods Pro (2nd generation), 2 of 3 (page 561).

18.2 Chargers

Wired charging accessories shall:

- Provide 5 W (1.0 A at 5 V) at all times using:
  - *USB Battery Charging Specification –Release 1.2*.
  - USB enumeration.
  - USB Power Delivery (PD) (page 223).
  - USB Type-C Current (page 224).

Wireless charging accessories shall meet the requirements in Device Power (Inductive) (page 165).

18.3 AirPods Max Accessories

Accessories shall not stretch the headband or canopy. Accessories should use soft, compliant materials such as microfiber or silicone.

If the accessory is a case for AirPods Max (USB-C), the keep-out for the USB-C connector:

- Shall be at least 12.35 mm by 6.50 mm.
- Should be at least 12.45 mm by 6.60 mm with full radii rounded edges for the greatest compatibility with the widest variety of cables and docks, see USB-C receptacle accessory keep-out (page 287).

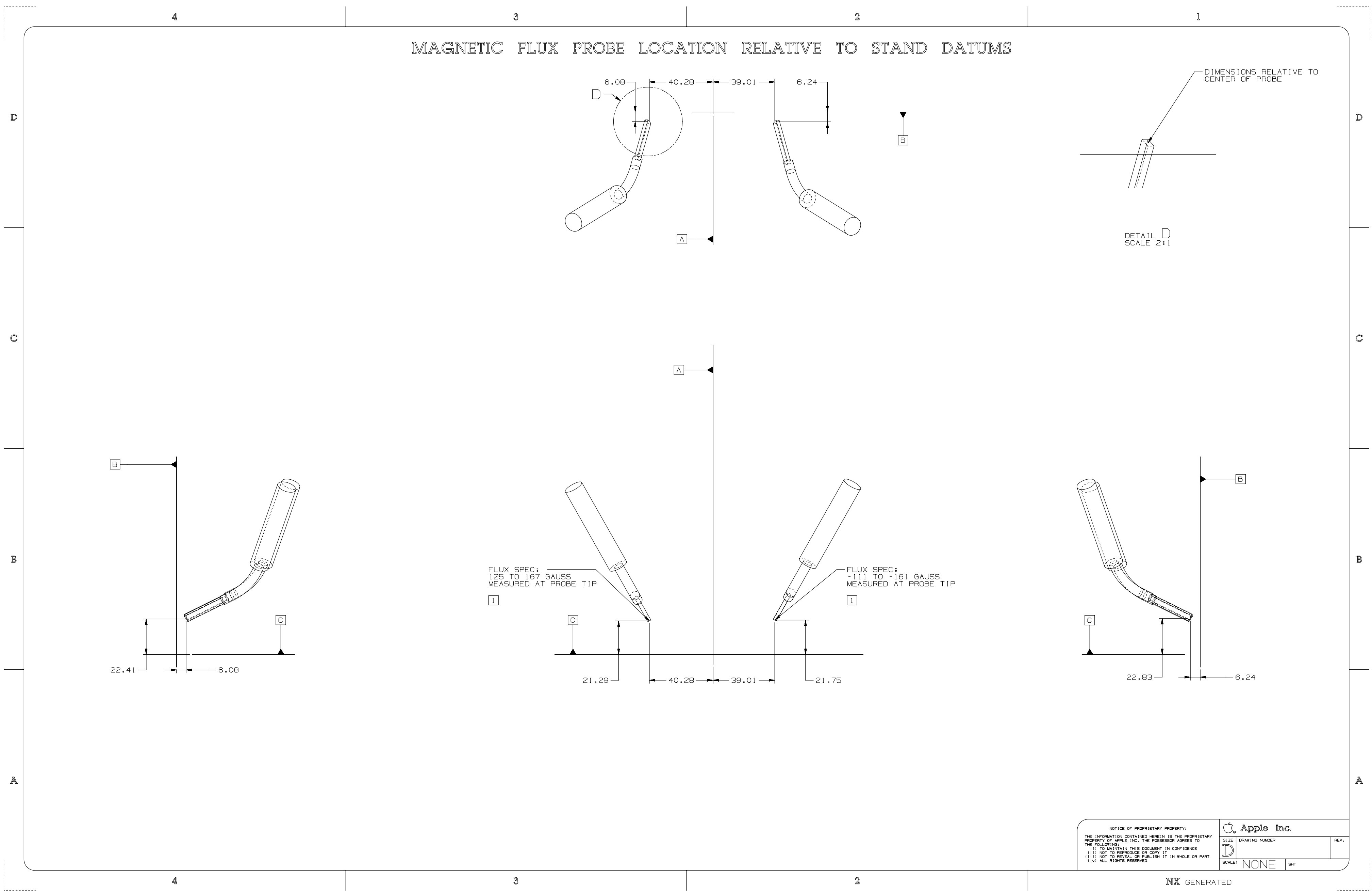
18.3.1 Sleep Mode

Accessories may enable sleep mode to help maintain the battery charge. Sleep mode is activated when AirPods Max:

- Is not charging.
- Magnetic flux at the:
  - Right earcup is 125 to 167 gauss.
  - Left earcup is -111 to -161 gauss.

See Magnetic Flux Probe (page 123) for the precise measuring point, and AirPods Max, 2 of 6 (page 567) for datums.

18.4 Magnetic Flux Probe



18.5 Verification

Test procedures for AirPods accessories.

18.5.1 MagSafe Charging with Case Cover

Power test procedures for AirPods charging case covers.

18.5.1.1 Equipment

The following equipment is necessary:

- AirPods.
- AirPods charging case.
- Apple MagSafe Charger.
- Device running iOS 18.3 or later.

18.5.1.2 Setup

1. Insert AirPods into charging case.
2. Unlock the device and open the charging case lid.
3. Pair AirPods with the device, if necessary.
4. Using the device, verify the state of charge for:
    a. Charging case is less than 80%.
    b. AirPods is less than 50%.
5. Close the charging case lid.
6. Verify the MagSafe charger is plugged into a functional power source.
7. Place the charging case onto the MagSafe charger on a flat surface.
8. Verify the charging case LED turns on momentarily.
9. Monitor the charging case LED for 30 seconds and verify the LED turns off.
10. Tap the charging case and verify the LED turns on momentarily.

18.5.1.3 Procedure

1. Attach the cover to the AirPods charging case.
2. Place the charging case and attached cover onto a MagSafe charger on a flat surface.
3. Verify the charging case LED turns on momentarily.
4. Monitor the charging case LED for 30 seconds and verify the LED turns off.
5. Tap the charging case and verify the LED turns on momentarily.

19. Apple Vision Pro Accessories

Accessories shall not interfere with Apple Vision Pro operation. Keep-out regions may be found in the device dimensional drawings, see:

- Apple Vision Pro, 1 of 6 (page 541)
- Apple Vision Pro, 2 of 6 (page 542)
- Apple Vision Pro, 3 of 6 (page 543)
- Apple Vision Pro, 4 of 6 (page 544)
- Apple Vision Pro, 5 of 6 (page 545)
- Apple Vision Pro, 6 of 6 (page 546)
- Apple Vision Pro Battery (page 547)
- Apple Vision Pro Audio Strap (page 548)
- ZEISS Optical Inserts, 1 of 4 (page 549)
- ZEISS Optical Inserts, 2 of 4 (page 550)
- ZEISS Optical Inserts, 3 of 4 (page 551)
- ZEISS Optical Inserts, 4 of 4 (page 552)

19.1 Apple Vision Pro Storage Cases

Storage cases shall:

- Not interfere with the click or rotation function of the top button, digital crown, and fit dial.
- Not apply force on the top button, digital crown, and fit dial.
- Minimize contact with all glass surfaces, including the display and optics. When necessary, use a soft non-abrasive material.
- Maintain a power cable bend radius of at least 13 mm at the Apple Vision Pro Battery.

19.2 Apple Vision Pro Battery Holders

Battery holders should maintain at least 25% surface exposure for heat dissipation, see Apple Vision Pro Battery (page 547).

19.3 Apple Vision Pro Bands

Bands attaching to the Apple Vision Pro Audio Strap connector shall:

- Be designed to prevent hair snag between the connector and mating parts, particularly in small spaces and between hard materials.
- Not detach with a peel force less than 100 N at 12 mm from the connector.
- Have a maximum insertion force of 18.3 N.
- Not have metal contact with the elastomer portion of Apple Vision Pro Audio Strap.
- Not have a material hardness exceeding 320 HV for portions contacting the Apple Vision Pro Audio Strap connector.
- Have a maximum normal pull force of 300 N on the Apple Vision Pro Audio Strap connector.

19.4 Verification

Test procedures for Apple Vision Pro accessories.

19.4.1 Equipment

The following equipment is necessary:

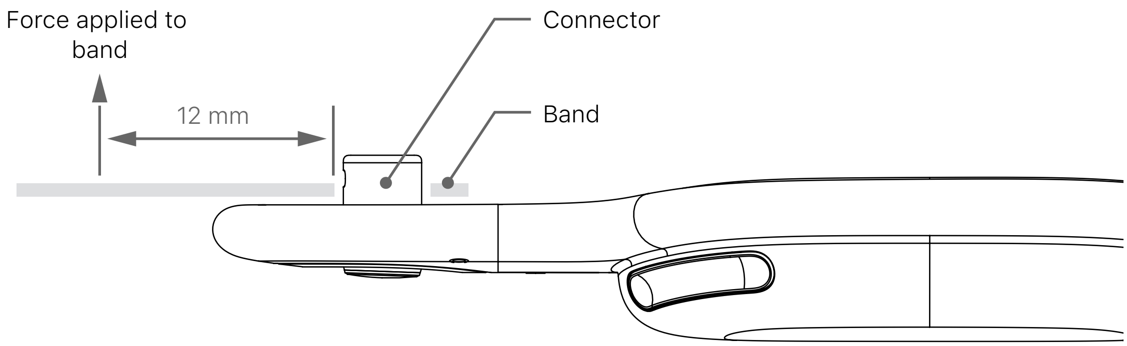
- Apple Vision Pro Audio Strap.
- Digital force gauge, such as the Chatillon DFX II.
- Hook attachment for digital force gauge.
- Clamps, or a vice, to securely hold the Apple Vision Pro Audio Strap on a flat level surface.

19.4.2 Peel Force Test

Peel force test procedure for Apple Vision Pro Bands.

1. Clamp the Apple Vision Pro Audio Strap as close to the connector as possible.
2. Apply ramping force to the band at 12 mm from the connector until 100 N of force is reached, see Figure 19-1 (page 127).
3. Verify the band is still attached to the Apple Vision Pro Audio Strap. Material failure on the band is allowed.

Figure 19-1 Peel force test setup



20. Watch Bands

A well-designed watch band will securely attach to Apple Watch without interfering with Apple Watch operation. See Device Dimensional Drawings (page 294) for Apple Watch keep-out zones.

20.1 Requirements

Watch bands for Apple Watch shall integrate two lugs to mate with the Apple Watch Band Interface (page 130). Apple Watch uses a high precision interface profile, see https://developer.apple.com/accessories/apple-watch-lug-profile.zip for a sample 2D lug profile. Lugs should lock into the watch band mating slot with a 'lug latch' feature to prevent accidental removal of the watch band.

Exposed edges of watch bands and lugs shall pass *UL 1439, Tests for Sharpness of Edges on Equipment* and *BS EN 71-1:2014, Safety of toys - Part 1: Mechanical and physical properties*.

The lug latch shall never become jammed in the extended position.

Watch bands shall not integrate magnetic chargers.

Watch bands and lugs should:

- Pass a 72 hour salt mist test as specified in *ASTM B117* with no visible corrosion.
- Resist a 5-20 kgf lateral slide-out force when installed in Apple Watch.
- Resist a 20 kgf or greater pull force as specified in *ISO-6245:1996, Specifications for Diver's Watches –Section 7.3*.
- Detach easily from Apple Watch when the watch band release buttons are pressed.
- Take into account the weight of Apple Watch.

Watch bands shall enable the user to maintain direct skin contact with Apple Watch heart sensors and the back of Apple Watch, and shall incorporate sufficient margin to compensate for shifting or dimensional changes of the watch band material. Failure to do so may interfere with Apple Watch wrist detect and Apple Pay features. Watch bands should:

- Have length sizing adjustment pitch of less than 7 mm (center to center).
- Provide sufficient adjustability for the user to achieve a snug, yet comfortable fit preventing movement of Apple Watch relative to the wearer's skin.

Watch bands intended for use during exercise should maintain a snug fit through a full range of motion to maintain compatibility with Apple Watch heart sensors.

Apple recommends the following materials for lug bodies:

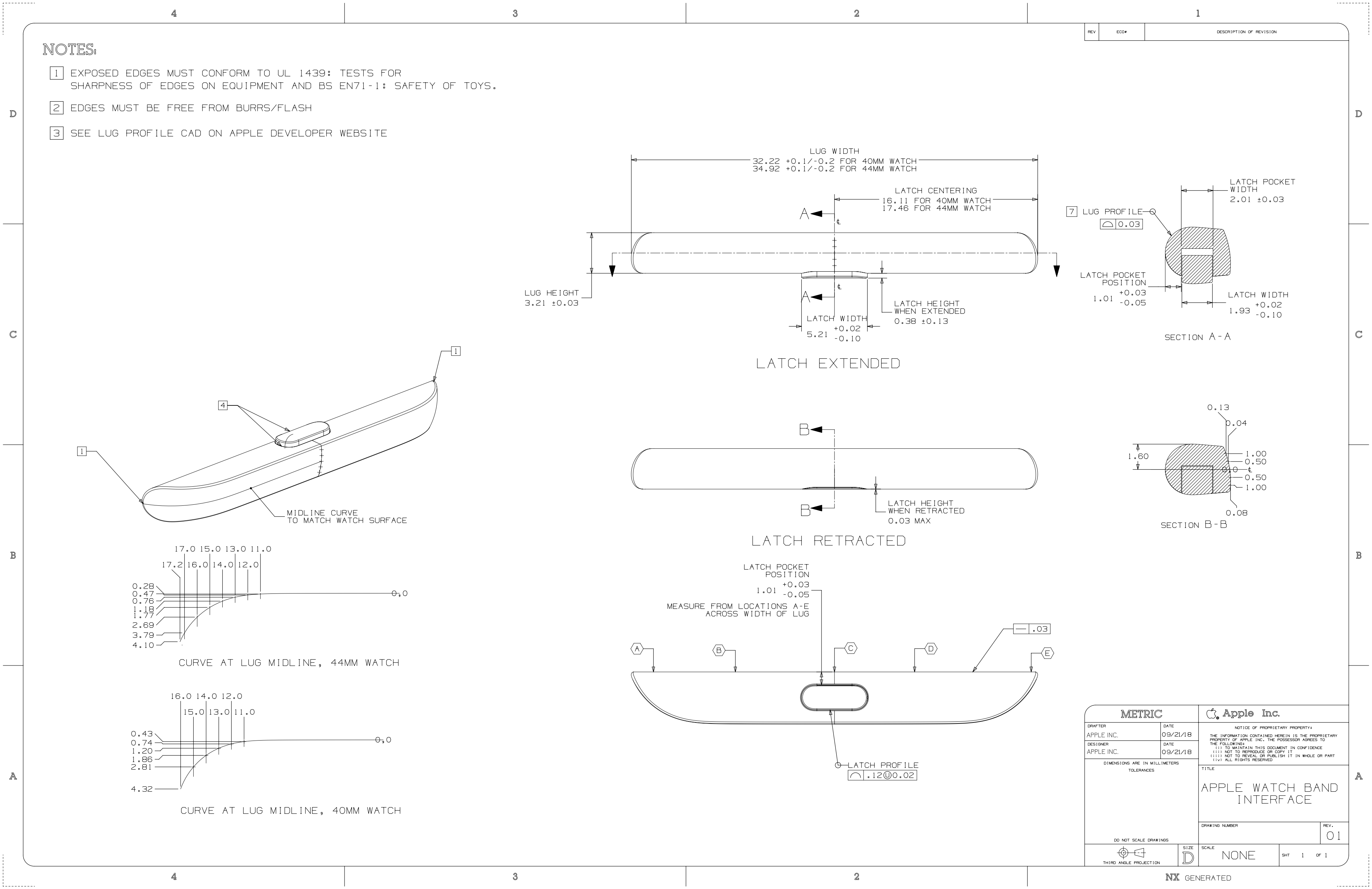
- 75 Shore A silicone.
- 50-55% glass-filled nylon.
- 240-270HV 316L / EN 1.4435 stainless steel.

Apple recommends the following materials for lug latches:

- 50-55% glass-filled nylon.
- 240-270HV 316L / EN 1.4435 stainless steel.

Watch bands for Apple Watch shall comply with applicable environmental regulations for the regions in which the watch bands are to be sold, and any applicable substance or material restrictions, including applicable restrictions on:

- Organic tin compounds, PFOS, PFOA, phthalates, azo dyes, polybrominated biphenyls (PBBs) and PAHs, per requirements of the EU REACh regulation EC 1907/2006.
- Nickel leach rate on surfaces in prolonged skin contact, per requirements of the EU REACh regulation EC 1907/2006.
- Cadmium, lead, hexavalent chromium, and nickel, per requirements of EU Directive 2009/48/EC.
- Natural rubber latex, per requirements of EU Directive EC 93/42/EEC.
- Dimethylfumarate (DMFu), per requirements of EU Regulation 412/2012.
- pH and Formaldehyde, per requirements of China GB 18401 for textiles and China GB 20400 for leather.
- Endangered species of flora and fauna in products or packaging (US Lacey Act).
- Polybrominated diphenyl ethers (PBDE).


NOTES:
1 EXPOSED EDGES MUST CONFORM TO UL 1439: TESTS FOR SHARPNESS OF EDGES ON EQUIPMENT AND BS EN71-1: SAFETY OF TOYS.
2 EDGES MUST BE FREE FROM BURRS/FLASH
3 SEE LUG PROFILE CAD ON APPLE DEVELOPER WEBSITE
LUG WIDTH
32.22 +0.1/-0.2 FOR 40MM WATCH
34.92 +0.1/-0.2 FOR 44MM WATCH
LATCH CENTERING
16.11 FOR 40MM WATCH
17.46 FOR 44MM WATCH
LUG HEIGHT
3.21 ±0.03
LATCH WIDTH
5.21 +0.02 -0.10
LATCH HEIGHT
WHEN EXTENDED
0.38 ±0.13
LATCH EXTENDED
7 LUG PROFILE
0.03
LATCH POCKET WIDTH
2.01 ±0.03
LATCH POCKET POSITION
1.01 +0.03 -0.05
LATCH WIDTH
1.93 +0.02 -0.10
SECTION A-A
MIDLINE CURVE
TO MATCH WATCH SURFACE
LATCH HEIGHT
WHEN RETRACTED
0.03 MAX
LATCH RETRACTED
0.13
0.04
1.60
1.00
0.50
0.50
1.00
0.08
SECTION B-B
17.0 15.0 13.0 11.0
17.2 16.0 14.0 12.0
0.28
0.47
0.76
1.18
1.77
2.69
3.79
4.10
0,0
CURVE AT LUG MIDLINE, 44MM WATCH
LATCH POCKET POSITION
1.01 +0.03 -0.05
MEASURE FROM LOCATIONS A-E
ACROSS WIDTH OF LUG
.03
LATCH PROFILE
.12 Ⓤ 0.02
16.0 14.0 12.0
15.0 13.0 11.0
0.43
0.74
1.20
1.86
2.81
4.32
0,0
CURVE AT LUG MIDLINE, 40MM WATCH
REV
ECO#
DESCRIPTION OF REVISION
METRIC
DRAFTER
APPLE INC.
DATE
09/21/18
DESIGNER
APPLE INC.
DATE
09/21/18
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
TITLE
APPLE WATCH BAND INTERFACE
DRAWING NUMBER
REV.
01
SIZE
D
SCALE
NONE
SHT 1 OF 1
NX GENERATED

20.3 Example Apple Watch Lug Assembly

Assembly instructions are based on Example Apple Watch Lug (page 133) and an assembly fixture with a clamping mechanism.

Proper assembly of the lug is critical to ensure the watch band securely attaches to Apple Watch. Improper assembly may result in damage to Apple Watch and/or the watch band.

Screw threads should be secured with Loctite 435. Previously installed/used screws should not be reused.

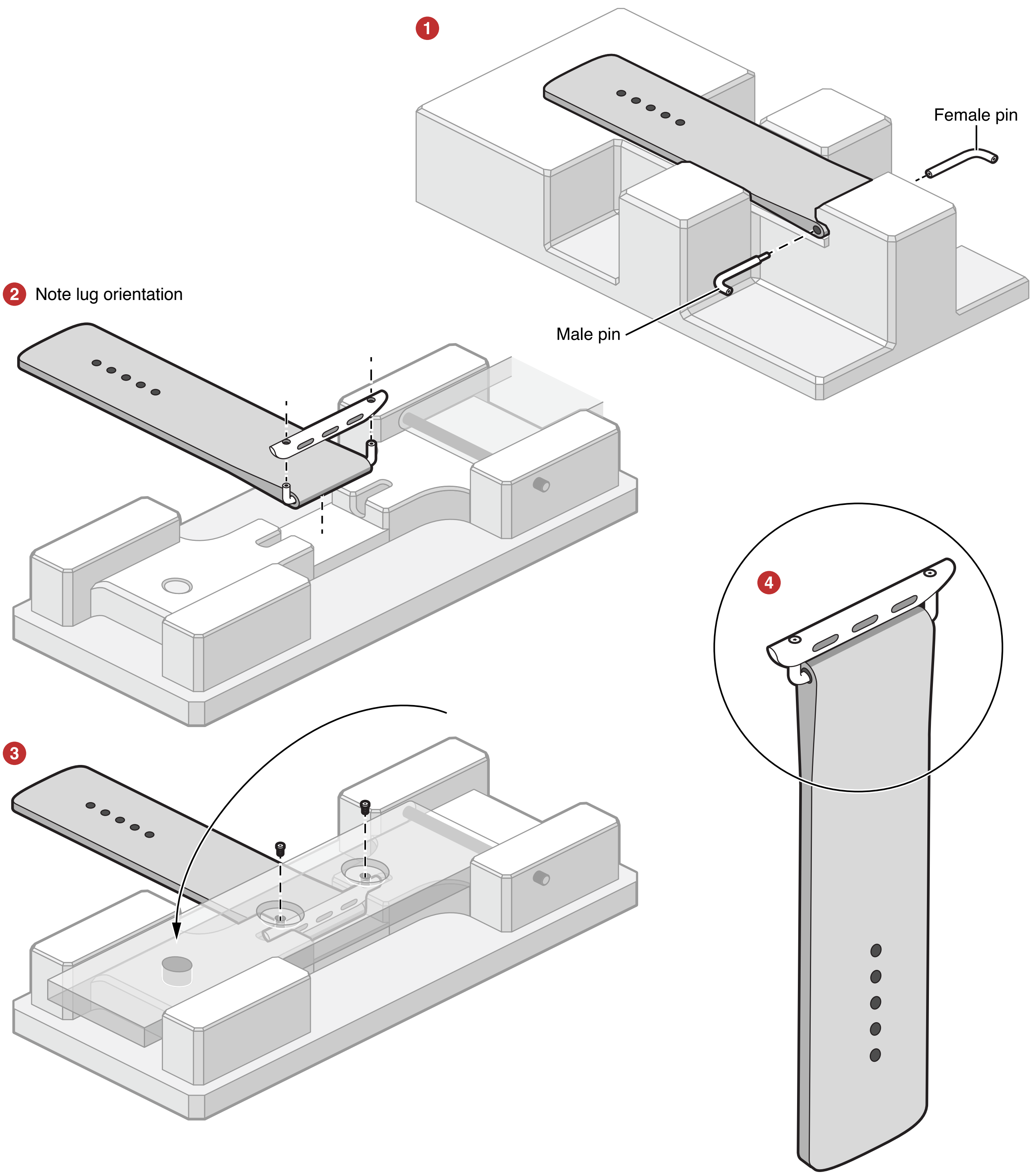
The assembly fixture should hold the lug assembly in place and a clamping mechanism should compress the lug during screw insertion.

Assemble the watch band and lug as follows, see Figure 20-1 (page 132).

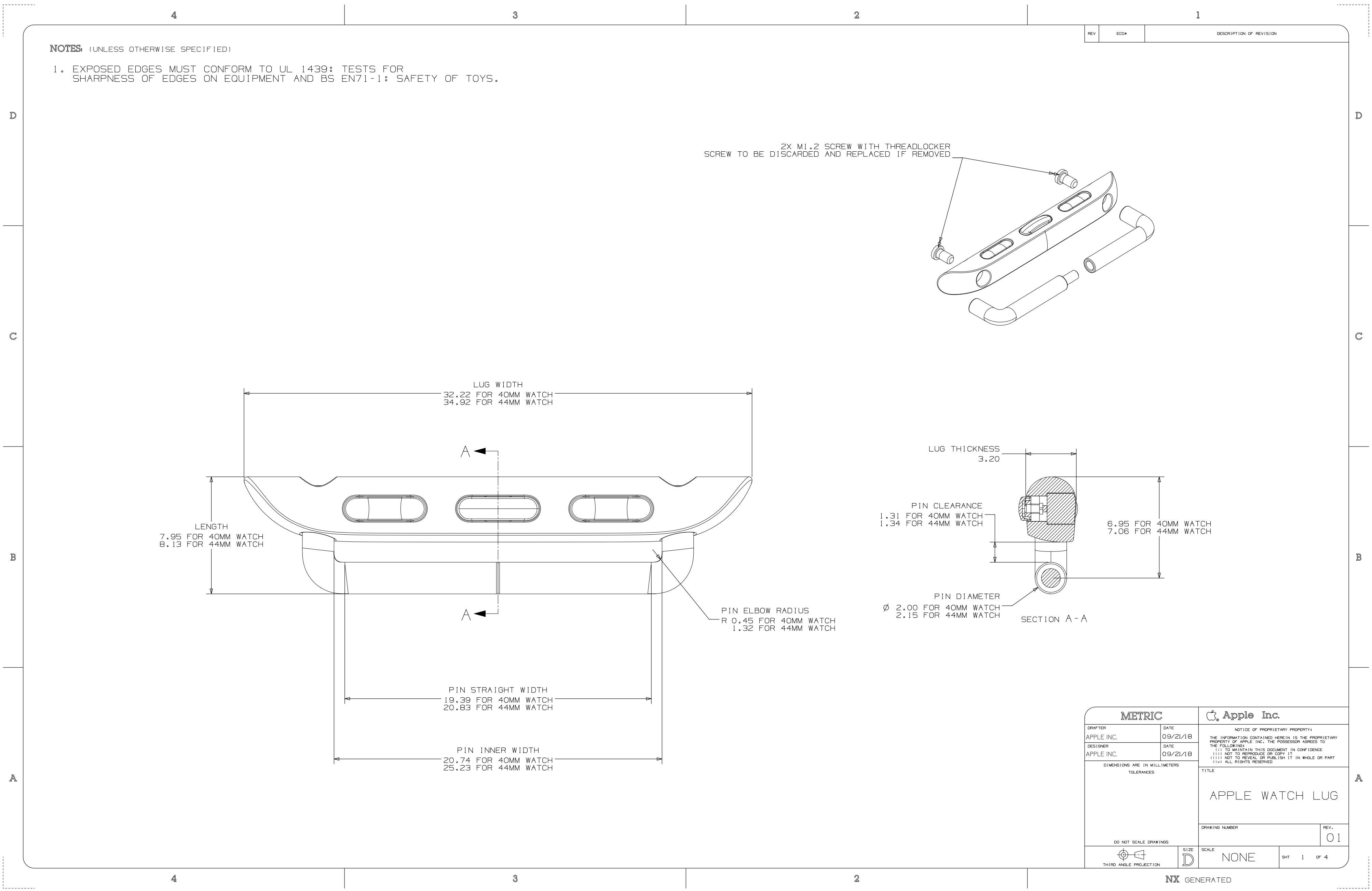
1. Lightly insert the long end of the female pin in the watch band until hard stop. Ensure there is no warping or damage in the watch band.
2. Lightly insert the long end of the male pin in the other side of the band until it interlocks with the female pin and both pins are seated together. Ensure there is no warping or damage in the watch band.
3. Align the holes on the bottom of the lug with the exposed ends of the female and male pins. Note lug latch top/bottom orientation relative to the watch band. Latch shall be on the side of the watch band against the wrist.
4. Apply Loctite 435 to screw threads.
5. Install both screws using the following specification:
   - Torque: 1.1 kgf-cm ±10%
   - RPM: 120 ±10%
6. Visually inspect at 1200-1400 lux for screw proudness and cross-threading.
7. Ensure screws are just sub-flush to the lowest part of the counterbore and appear parallel to the long axis of the lug.
8. Ensure screws are undamaged, flat, and concentric with the counterbore.

 |

Figure 20-1 Apple Watch lug assembly fixture



20.4 Example Apple Watch Lug



21. Apple MagSafe Charger Mounts

Apple MagSafe Charger mounts (stands, docks, and other holders) provide a means to hold and position the charger and may support StandBy, see StandBy Mounts (page 135).

21.1 Mechanical

Mounts shall be compatible with:

- Apple MagSafe Charger (1 m) and Apple MagSafe Charger (2 m) (page 576)
- Apple MagSafe Charger (page 577)

Mounts should keep the Apple MagSafe Charger secure when attaching, detaching, or rotating a device.

Mounts shall not interfere with or cause Scratches and Damage (page 28) to the device.

To avoid interference with devices, mounts shall:

- Not exceed 30 mm from the center of the Apple MagSafe Charger surface towards the top edge of the device for all supported device orientations. If the device can be attached in any orientation, the accessory shall not exceed 30 mm in radius around the center of the Apple MagSafe Charger surface.
- Maintain a clearance of 5 mm from the back of the device (mating surface) for any part of the accessory past the 30 mm keep-in constraint.
- Stay within the MagSafe Accessory Enclosure Geometry (page 191).

22. StandBy Mounts

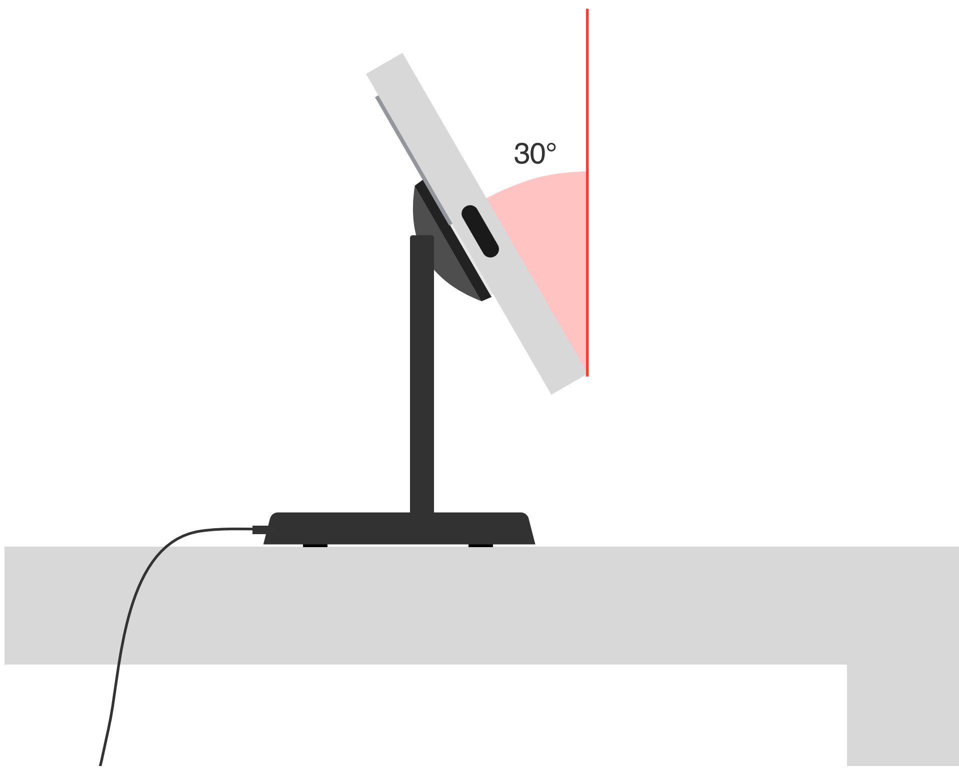
StandBy provides iPhone users a full-screen experience with glanceable information designed to be viewed from a distance when iPhone is in landscape orientation, locked, and charging. StandBy can be personalized to display a range of widgets and supports Live Activities, Siri, incoming calls, and notifications. StandBy remembers user's preferred views when using a MagSafe Charger.

Figure 22-1 MagSafe example

This feature is supported on iOS 17.0 or later.

22.1 Product Design

Figure 22-2 StandBy mount example



Mounts supporting StandBy shall:

- Support landscape orientation.
- Support inductive or wired device charging.
- Not obstruct or touch the device cover glass or any device sensors.
- Not cause Scratches and Damage (page 28).

Mounts may be Apple MagSafe Charger Mounts (page 134).

The mounts should:

- Prevent free rotation of the device.
- Enable an adjustable backward tilt of at least 30° for optimal visibility.

- Be stable to prevent unintentionally exiting StandBy.
- Not obstruct Access to Controls (page 36).
- Implement Qi Wireless Power (page 165), version 2.0 or later, or the MagSafe Accessory Magnet Array (page 184).

22.2 Verification

22.2.1 Equipment

The following equipment is necessary:

- Supported device running iOS 17.0 or later.
- Charger, if not integrated in accessory.

22.2.2 Enable StandBy

1. Attach locked device in landscape orientation to the accessory.
2. Attach a charger if the accessory does not integrate inductive or wired charging.
3. Verify device enters StandBy within a few seconds.

22.2.3 Product Design

Verify the StandBy Mount:

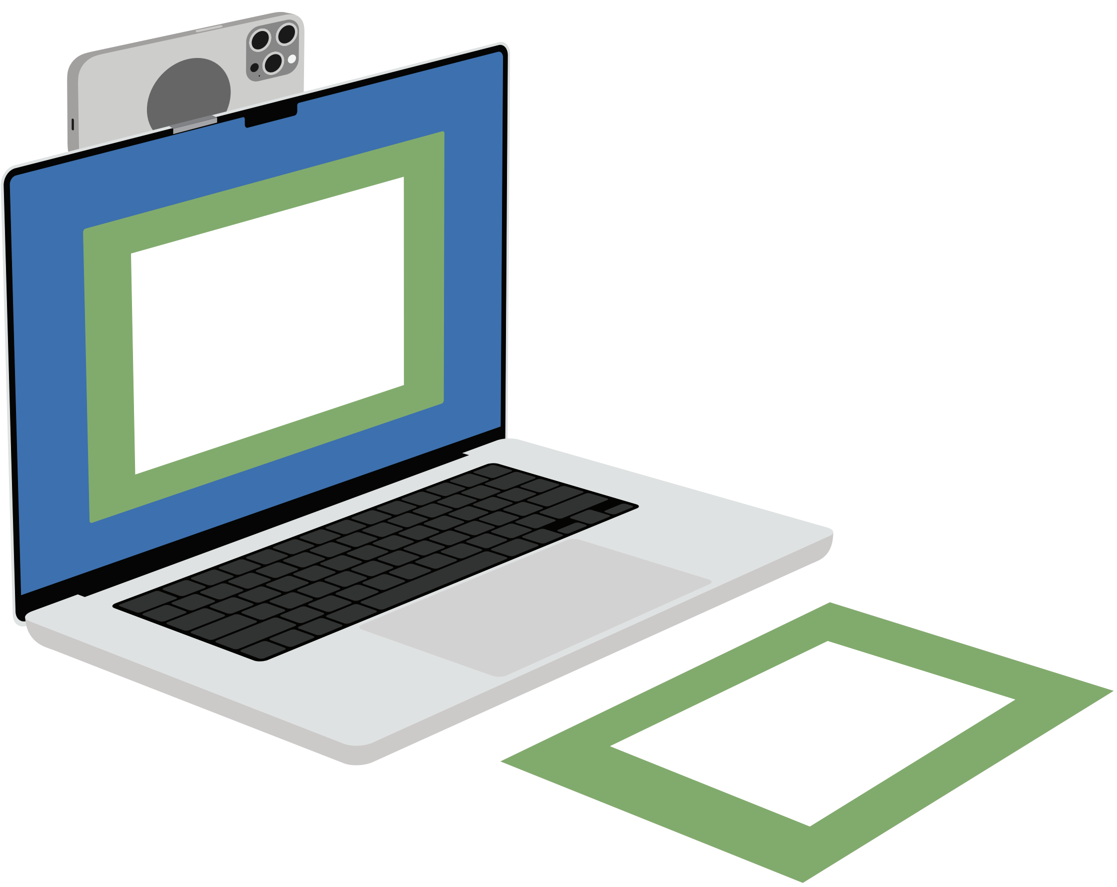
1. Supports landscape orientation.
2. Does not obstruct or touch the device cover glass or any device sensors.
3. Does not scratch or damage device.

23. Continuity Camera Mounts

Continuity Camera enables device cameras to be used with Apple TV or Mac and supports Portrait, Studio Light, Center Stage, Reactions, and Desk View video effects. System requirements for Continuity Camera are available at https://support.apple.com/en-us/108046#camera.

Mounts supporting Continuity Camera securely hold a device at the optimal height and angle to use with FaceTime and other apps.

Figure 23-1 MacBook Desk View example



23.1 Product Design

Mounts supporting Continuity Camera shall:

- Support devices in portrait and landscape orientations.
- Enable use of a USB-C cable or USB to Lightning charge cable.
- Not touch the device cover glass, block any device camera field of view, or obstruct any ambient light sensors, see Device Dimensional Drawings (page 294).
- Not cause Scratches and Damage (page 28).

The mounts should:

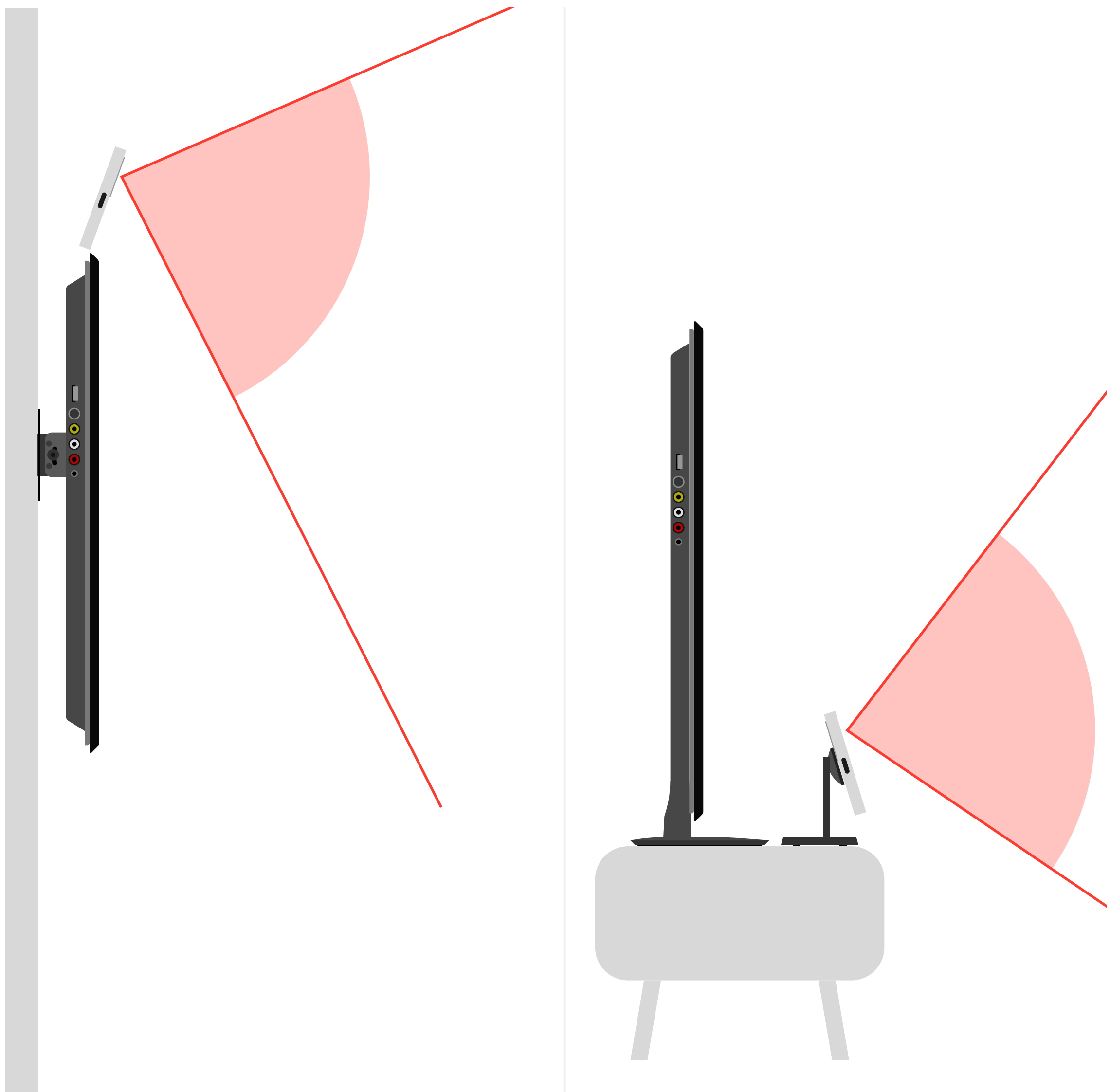
- Prevent free rotation of the device.
- Enable a device camera lens height of at least 228 mm to support Desk View.
- Not obstruct Access to Controls (page 36).
- Implement the MagSafe Accessory Magnet Array (page 184).
- Support Tripod Connections (page 33).

Additional requirements apply to mounts used in the following scenerios:

- Apple TV Mount (page 140)
- MacBook Mount (page 141)
- iMac or Display Mount (page 142)

23.2 Apple TV Mount

Figure 23-2 Apple TV mount example



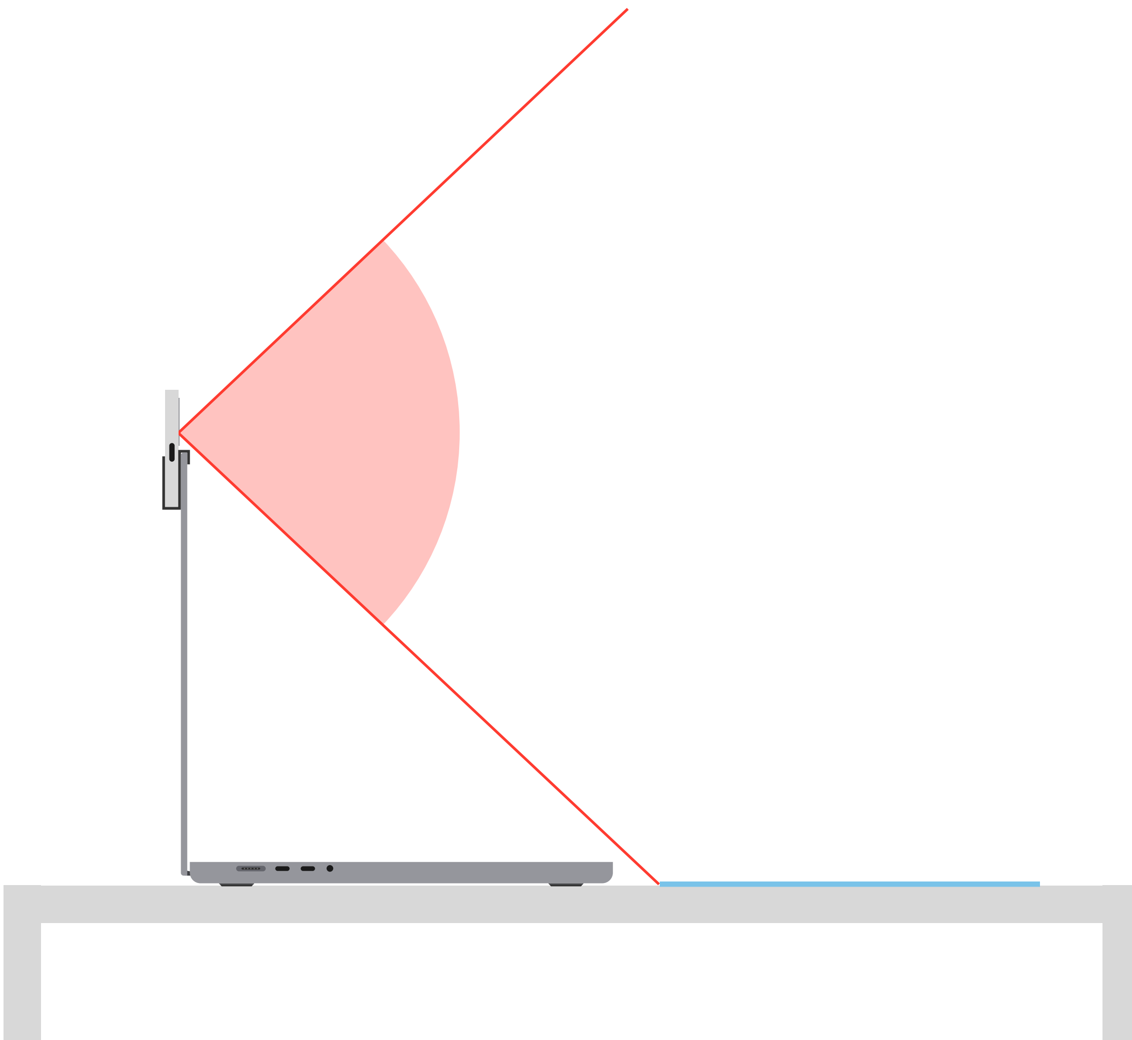
A mount designed for Apple TV shall:

- Be stable when placed on top, or in front of a TV.
- Not touch the display glass (active and non-active areas).
- Not sandwich or squeeze the TV and device together.

The mount should enable upward and downward tilt.

23.3 MacBook Mount

Figure 23-3 MacBook mount example



A mount designed for MacBook, MacBook Air, and MacBook Pro shall:

- Not scratch or damage the MacBook.
- Not touch the MacBook display glass (active and non-active areas).
- Not interfere with or prevent fully closing the MacBook.
- Not sandwich or squeeze the MacBook and device together.

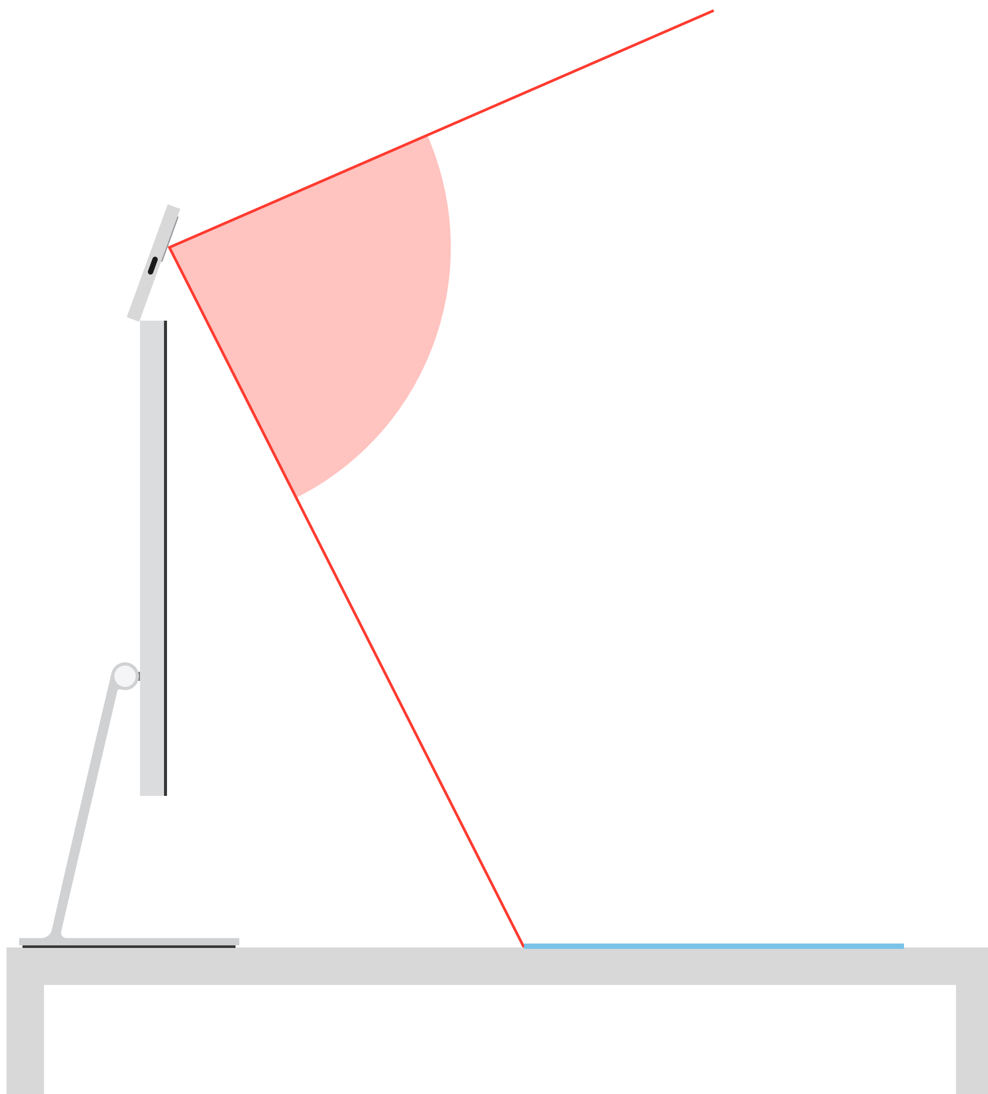
The mount should:

- Not cover or touch any portion of the MacBook display glass, camera, or other sensors.
- Enable a downward tilt in portrait orientation from 0° to 12° to support Desk View.

- Minimize the mass to maintain stability of the display.

23.4 iMac or Display Mount

Figure 23-4 Display mount example



A mount designed for iMac or displays shall:
- Not scratch or damage the iMac or display.
- Not touch the display glass (active and non-active areas).
- Not sandwich or squeeze the iMac or display and device together.

The mount should:

- Not cover or touch any portion of the display glass, camera, microphones, or other sensors.
- Enable a downward tilt from 0° to 30° to support Desk View.

23.5 Verification

23.5.1 Equipment

The following equipment is necessary:

- If the mount is designed for Apple TV:
  - Supported devices running iOS 17.0 or later.
  - Apple TV 4K (2nd generation) or later running tvOS 17.0 or later, connected to a TV.
- If the mount is designed for Mac:
  - Supported devices running iOS 16.0 or later.
  - Mac running macOS 13.0 Ventura or later.
  - MacBook, MacBook Air, and MacBook Pro if the mount is designed for MacBook.
  - iMac if the mount is designed for iMac.
  - Variety of displays if the mount is designed for external displays.
  - USB-C cable.
  - USB to Lightning charge cable.
- Apple Account with two-factor authentication enabled and used on devices, Apple TV, and all Mac computers.
- Tripod, if the mount is designed for tripod connections.

23.5.2 Setup

23.5.2.1 Enable Continuity Camera on Apple TV

Configure an Apple TV and a device to enable Continuity Camera:

1. Open FaceTime on the Apple TV.
2. Select the user matching the device Apple Account.
3. Using the device, select the Continuity Camera notification and select Accept.
4. Attach the device to mount and orient it as prompted.
5. Verify Continuity Camera view displays full screen in FaceTime.

23.5.2.2 Enable Continuity Camera on Mac

Configure a Mac and a device to enable Continuity Camera:

1. Connect the device to the Mac using a cable.

2. If the Mac is not a trusted computer, select Trust on the Trust This Computer alert on the device.
3. To use Continuity Camera wirelessly, disconnect the cable.
4. Attach the device to mount.
5. Open FaceTime on the Mac.
6. If the 'Use your iPhone as a Camera for your Mac' alert appears, select Continue.
7. Select the Continuity Camera option from the Video menu.
8. Verify Continuity Camera view displays in FaceTime.

Reconnect after the Mac and/or device are in sleep mode:

1. Wake the device and the Mac.
2. Connect the device to the Mac using a cable for a wired connection or disconnect the cable for a wireless connection.
3. Attach the device to the mount.
4. Open FaceTime on the Mac and select Continuity Camera from the Video menu.
5. Verify Continuity Camera view displays in FaceTime.

23.5.3 Product Design

Verify the mount:

1. Supports portrait and landscape orientations.
2. Does not touch the device cover glass or block any device camera field of view.
3. Does not scratch or damage the device.
4. When designed for tripods, complies with ISO 1222:2010.

If the mount is designed for Apple TV, verify the mount:

1. Is stable when placed on top, or in front of a TV.
2. Does not touch the display glass.
3. Does not sandwich or squeeze the TV and device together.

If the mount is designed for MacBook, iMac, or displays, verify the mount:

1. Does not touch the display glass.
2. Does not block any MacBook, iMac, or display camera field of view.
3. Does not sandwich or squeeze the device, MacBook, iMac, or display together.
4. Does not scratch or damage the device, MacBook, iMac, or display.
5. Enables use of USB-C cables or USB to Lightning charge cables.

23.5.4 Center Stage

Center Stage is a video effect available on Apple TV and in the Mac Control Center. Enabling Center Stage on Apple TV, or selecting it in the Control Center Video Effects causes the video to follow people's faces as they move within the Continuity Camera field of view. The video will zoom (in and out) and pan (left to right, right to left, up and down), to keep people's faces in the video frame.

23.5.4.1 Center Stage on Apple TV

Perform mount testing using the FaceTime app on Apple TV to ensure the mount is not visible in the field of view:

1. Observe the Continuity Camera video from different positions using Center Stage face tracking, from the most extreme visible positions (left, right, top, bottom, and all four corners).
2. Verify there are no visual anomalies caused by the mount in any position.

23.5.4.2 Center Stage on Mac

Perform mount testing using the Photo Booth app on the Mac, with and without Center Stage enabled, to ensure the mount is not visible in the field of view:

1. Open the Photo Booth app on the Mac:
   a. Use the Camera menu to select Continuity Camera.
   b. Use the still photo mode.
2. Use the Mac Control Center menu to select Video Effects, and enable Center Stage.
3. Capture photos from different positions using Center Stage face tracking, in portrait and landscape orientation from the most extreme visible positions (left, right, top, bottom, and all four corners), waiting 5 seconds between each photo.
4. Use the Mac Control Center menu to select Video Effects, and disable Center Stage.
5. Capture photos in portrait and landscape orientation, waiting 5 seconds between each photo.
6. Using the Photo Booth film strip feature, verify all photos taken during the test:
   a. Are saved to the computer.
   b. Are clearly displayed when viewed.
   c. Have no visual anomalies caused by the mount in either portrait and landscape orientation.

23.5.5 Desk View

Desk View is a video effect available in the Mac Control Center. Selecting Video Effects and enabling Desk View causes a confirmation dialog box to appear, then a separate Desk View window opens. The tilt angle of the mount and its position determines the Desk View field of view. Adjust the tilt angle as necessary to display the desktop subject matter. Remote viewers will see the subject matter from the presenters perspective. Closing the Desk View window disables Desk View.

1. Ensure the device is logged into the same Apple Account used on the Mac.
2. Place the device in the mount and on the MacBook, iMac, display, tripod or free-standing support.
3. Perform mount testing using the FaceTime app with the Desk View video effect enabled.
   a. Open the FaceTime app on the Mac, and use the Video menu to select the Continuity Camera.
   b. Use the Mac Control Center menu to select Video Effects, and enable Desk View.
   c. Verify the Desk View window is displayed.
4. In both landscape and portrait orientation:
   a. Adjust the tilt angle of the mount to display the desktop subject matter in the Desk View window.

b. Verify the desktop subject matter is visible in the Desk View window, and clearly displayed.
c. Verify there are no visible anomalies caused by the mount in the Desk View window.
d. Verify the user's face is still visible in FaceTime while Desk View is showing the desktop subject matter.

Features

24. Accessory Power (USB-C)

Accessory power enables accessories to draw a limited amount of power from a device, thereby avoiding the need to integrate a battery or connect to an external power source. This eliminates the need for users to monitor and charge the accessory and enables the accessory to function as long as the device has power. Accessories designed to temporarily connect to the device are good candidates for using accessory power.

Accessories drawing power from the device shall comply with *USB Type-C Cable and Connector Specification –Release 2.3*. Accessories should also support USB Power Delivery (PD) (page 223).

Accessories benefitting from accessory power include:

- Headsets (page 89).
- Adapters (page 83).
- Keyboards (page 93).
- External Storage (page 119).

24.1 Available Current

The following table lists the current available to an accessory.

Table 24-1 Available current

Device	Default	USB Type-C Current (page 224)	USB Power Delivery (PD) (page 223)
iPhone 16e	500 mA	500 mA	900 mA (4.5 W)
iPhone 16 Pro Max	900 mA	900 mA	900 mA (4.5 W)
iPhone 16 Pro	900 mA	900 mA	900 mA (4.5 W)
iPhone 16 Plus	500 mA	500 mA	900 mA (4.5 W)
iPhone 16	500 mA	500 mA	900 mA (4.5 W)
iPhone 15 Pro Max	900 mA	900 mA	900 mA (4.5 W)
iPhone 15 Pro	900 mA	900 mA	900 mA (4.5 W)
iPhone 15 Plus	500 mA	500 mA	900 mA (4.5 W)
iPhone 15	500 mA	500 mA	900 mA (4.5 W)
iPad Air 13-inch (M3)	900 mA	1.5 A	1.5 A (7.5 W)

Device	Default	USB Type-C Current (page 224)	USB Power Delivery (PD) (page 223)
iPad Air 11-inch (M3)	900 mA	1.5 A	1.5 A (7.5 W)
iPad (A16)	900 mA	1.5 A	1.5 A (7.5 W)
iPad mini (A17 Pro)	900 mA	1.5 A	1.5 A (7.5 W)
iPad Pro 13-inch (M4)	900 mA	3.0 A	3.0 A (15 W)
iPad Pro 11-inch (M4)	900 mA	3.0 A	3.0 A (15 W)
iPad Air 13-inch (M2)	900 mA	1.5 A	1.5 A (7.5 W)
iPad Air 11-inch (M2)	900 mA	1.5 A	1.5 A (7.5 W)
iPad Pro 12.9-inch (6th generation)	900 mA	3.0 A	3.0 A (15 W)
iPad Pro 12.9-inch (5th generation)	900 mA	3.0 A	3.0 A (15 W)
iPad Pro 12.9-inch (4th generation)	900 mA	1.5 A	1.5 A (7.5 W)
iPad Pro 12.9-inch (3rd generation)	900 mA	1.5 A	1.5 A (7.5 W)
iPad Pro 11-inch (4th generation)	900 mA	3.0 A	3.0 A (15 W)
iPad Pro 11-inch (3rd generation)	900 mA	3.0 A	3.0 A (15 W)
iPad Pro 11-inch (2nd generation)	900 mA	1.5 A	1.5 A (7.5 W)
iPad Pro 11-inch (1st generation)	900 mA	1.5 A	1.5 A (7.5 W)
iPad Air (5th generation)	900 mA	1.5 A	1.5 A (7.5 W)
iPad Air (4th generation)	900 mA	1.5 A	1.5 A (7.5 W)
iPad mini (6th generation)	900 mA	1.5 A	1.5 A (7.5 W)
iPad (10th generation)	500 mA	1.5 A	1.5 A (7.5 W)

24.2 Fast Role Swap (FRS)

iPads with a USB-C connector support USB Power Delivery (PD) (page 223) Fast Role Swap (FRS).

24.3 Verification

24.3.1 Maximum Accessory Power

This test procedure applies to accessories drawing power from the device. The accessory needs to be exercised to its full capability.

The example accessory in this test procedure is an external USB 3 drive claiming to draw up to 900 mA from the USB 3 host. The accessory is exercised by reading and writing a large file. Adapt this procedure as needed for different accessory types.

24.3.1.1 Equipment

The following equipment is necessary:

- External USB drive in APFS format (the example accessory).
- Mac with USB-C.
- USB-IF certified USB-C to USB-C Full-Featured cable.
- USB-C breakout board or USB-IF approved test fixture, such as:
  - FS-HUCP available at https://fixturesolution.com/product/usb2-0-type-c-signal-quality-test-fixture/.
  - FS-HUCR available at https://fixturesolution.com/product/usb-type-c-high-speed-signal-quality-test-fixture/ .
- Oscilloscope with a current probe.

24.3.1.2 Setup

1. Using the current probe attach the oscilloscope to the current loop circuit of the accessory, or the USB-C breakout board.
2. Verify the oscilloscope configuration settings match the following:
   a. Acquisition: >5 M samples/s.
   b. Current Channel: 200 mA/div.
   c. Horizontal Channel: 100 µs/div.
   d. Voltage Channel: 1 V/div, bandwidth limited.
   e. Infinite persistence (reset before each test case).
   f. Adjust offset down, to be able see 7 divisions.
   g. Adjust offset towards the left, to maximize the window.
   h. Trigger: Current Channel, Positive Threshold, 900 mA, Normal Mode.
3. Connect the Mac to the external USB drive using the USB-C cable.
4. Launch Terminal on the Mac, and enter the following command:
   - `dd if=/dev/random of=~/Desktop/testfile.dat count=1024 bs=78643200`
5. The new file `~/Desktop/testfile.dat` is the file to use for testing.

24.3.1.3 Procedure

24.3.1.3.1 Enumeration

1. Verify the external USB drive fully enumerates in the Mac System Report:
   a. Select Apple Menu > 'About this Mac'.
   b. Select 'More Info...'.
   c. Select 'System Report...'.
   d. Select USB from the sidebar.
2. Verify the accessory is displayed in the USB Device Tree.

3. Verify the speed displayed is one of the following:
   a. Up to 5 Gb/s.
   b. Up to 10 Gb/s.

24.3.1.3.2 Idle

1. Record the maximum current while idle.
2. Verify the maximum current does not exceed 900 mA.

24.3.1.3.3 Write to USB Drive

1. Use Finder to copy the `testfile.dat` from the Mac to the USB drive.
2. Record the maximum current.
3. Verify the maximum current does not exceed 900 mA.

24.3.1.3.4 Read from USB Drive

1. Use Finder to copy the `testfile.dat` from the USB drive to the Mac.
2. Record the maximum current.
3. Verify the maximum current does not exceed 900 mA.

25. Accessory Power (Lightning)

Accessory power enables accessories to draw a limited amount of power from a device, thereby avoiding the need to integrate a battery or connect to an external power source. This eliminates the need for users to monitor and charge the accessory and enables the accessory to function as long as the device has power. Accessories designed to temporarily connect to the device are good candidates for using accessory power.

See the Accessory Interface Specification (page 26) for more information.

26. App Discovery

The App Discovery feature enables accessories to retrieve a list of installed apps on the device capable of communicating with the accessory. See App Launch (page 154) to use the list.

See the Accessory Interface Specification (page 26) for more information.

27. App Launch

Accessories supporting the App Launch feature can request a device launch an app on its behalf.

Figure 27-1 App Launch alert

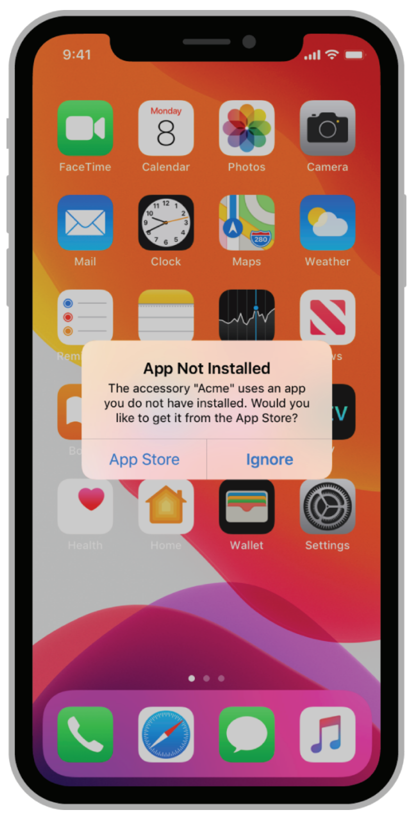
See the Accessory Interface Specification (page 26) for more information.

28. App Match

The App Match feature enables accessories supporting an External Accessory Protocol to match with compatible apps on the App Store.

When connected for the first time, the device asks the user if they would like to visit the App Store and view compatible apps. Subsequently, this action may be repeated using Settings > General > About > '[Accessory name]' > 'Find App for Accessory'.

Figure 28-1 App Match alert



See the Accessory Interface Specification (page 26) for more information.

29. Bluetooth HFP Siri and Battery Reporting

Apple-specific Bluetooth commands extend accessory capabilities beyond those supported by standard Bluetooth profiles. To enable Apple-specific features, the accessory shall support HFP Command AT+XAPL (page 156), which provides accurate information about the accessory's supported features. The device will use the information sent by this command to enable and disable custom commands.

The accessory shall send the following AT+XAPL command after making a successful HFP Service Level Connection (SLC) to the device. The accessory should send an AT+XAPL command first, before sending any additional Apple-specific commands. See Siri (page 201) and Bluetooth Headset Battery Level Indication (page 157).

29.1 HFP Command AT+XAPL

Description: Enables custom AT commands from an accessory.

Initiator: Accessory

Format: AT+XAPL=*vendorID-productID-version*,*features*

Parameters:
- *vendorID*: A string representation of the hex value of the vendor ID from the manufacturer, without the `0x` prefix.
- *productID*: A string representation of the hex value of the product ID from the manufacturer, without the `0x` prefix.
- *version*: The software version.
- *features*: A base-10 representation of a bit field. Available features are:
  - Bit 0 = reserved
  - Bit 1 = The accessory supports battery reporting (reserved only for battery operated accessories).
  - Bit 2 = The accessory is docked or powered (reserved only for battery operated accessories).
  - Bit 3 = The accessory supports Siri status reporting.
  - Bit 4 = the accessory supports noise reduction (NR) status reporting.
  - All other values are reserved.

Example: AT+XAPL=ABCD-1234-0100,10 (Supports battery reporting and Siri status)

Response: +XAPL=iPhone,*features*

30. Bluetooth Headset Battery Level Indication

Bluetooth headsets may display a battery level to the user as an indicator icon in the device status bar. This feature is supported on all devices supporting the Hands-Free Profile, including iPhone, iPod touch, and iPad.

Headset battery indication is implemented by two Apple-specific Bluetooth HFP AT commands, HFP Command AT+XAPL (page 156) and HFP Command AT+IPHONEACCEV (page 157)

30.1 HFP Command AT+IPHONEACCEV

Description: Reports a headset state change.

Initiator: Accessory

Format: `AT+IPHONEACCEV=`*Number of key/value pairs*`,`*key1*`,`*val1*`,`*key2*`,`*val2*`,...`

Parameters:

- *Number of key/value pairs*: The number of parameters coming next.
- *key*: the type of change being reported:
  - 1 = Battery Level
  - 2 = Dock State
- *val*: the value of the change:
  - Battery Level: string value between '`0`' and '9'
  - Dock State: `0` = undocked, `1` = docked

Example: `AT+IPHONEACCEV=1,1,3`

31. Device Power (USB-C)

Accessories may provide power to devices using USB-C.

Apple recommends providing power to the device whenever possible for the best user experience.

Accessories providing power to a device shall:

- Connect to the device either through an integrated USB-C Plug (page 281) or a USB-C cable.
- Use USB Type-C Current (page 224) to identify their power capability and should use USB Power Delivery (PD) (page 223) to provide higher power, see https://support.apple.com/en-us/102574.
- Provide power at all times unless a direct user action is taken turning the accessory 'off'. Failure to provide power at all times may result in the accessory being unable to charge a device whose battery level is too low to boot.

Accessories may use the iAP2 (page 229) protocol in conjunction with USB Type-C Current (page 224) to allow for more granular control of the available current after the initial connection. Accessories shall not use iAP2 (page 229) to adjust available current in conjunction with USB Power Delivery (PD) (page 223).

Accessories providing power from a USB-C receptacle, see Providing Power (page 286).

31.1 External Power Source

Accessories drawing power from external power sources and providing all or a portion of their power to the device shall:

- Identify the power source's capability and report accordingly to the device.
- Not manipulate a device into drawing more power from the external power source than the device would normally draw when directly connected to the external power source.
- Derate the available power by the amount of power consumed by the accessory, if applicable.

Accessories drawing power from external power sources may inform the device when power is not available or only available at a reduced level (for example, from an internal battery) or when the user unplugs the accessory from the external power source (for example, an AC power adapter or AC "mains" power outlet). Power to the device shall be restored and the updated power providing capability change shall be communicated to the device when the user re-connects the external power source.

See AC Power Adapters (page 85), Providing Power (page 286), and User Supplied Cables and AC Power Adapters (page 28) for additional requirements specific to external USB power supplies/cables.

31.2 Power State Changes

Accessories shall not change the amount of power provided to a device unless:

- Direct user action is taken to turn the accessory on or off.
- External power source (for example, mains electricity or battery) is connected to or disconnected from the accessory.
- Accessory's internal power source (for example, a battery) is depleted or loaded to the point where it is no longer capable of supplying its declared power providing capability or is now capable of supplying more power than previously declared.

32. Device Power (Lightning)

Accessories may provide power to devices using Lightning.

Apple recommends providing power to the device whenever possible for the best user experience.

Accessories providing power to a device shall connect to the device either through an integrated Lightning connector or a USB to Lightning cable. To incorporate an integrated Lightning connector, the accessory developer shall be a member of the Apple MFi Program (page 26).

Accessories providing power to a device shall either:

- Provide direct power, see Direct Power Source (page 160).
- Manage power from external sources, see External Power Source (page 160).

Accessories without the potential for data communication with the device shall provide direct power to the device, see Direct Power Source (page 160).

32.1 Direct Power Source

Accessories providing power directly shall provide power at all times unless disabled by a direct user action. Failure to provide power at all times may result in the accessory being unable to charge a device whose battery level is too low to boot.

Accessory power source testing shall be performed with programmable loads, not devices. Device power draw varies with environmental factors.

32.2 External Power Source

Accessories drawing power from external power sources and providing all or a portion of their power to the device:

- Shall identify the power source's capability and report accordingly to the device.
- Shall not manipulate a device into drawing more power from the external power source than the device would normally draw when directly connected to the external power source.
- Shall not manipulate a device into drawing less than the minimum power required by the accessory compatibility claims if it is available from the external source, see Providing Power using USB Connectors (page 161).

Accessories drawing power from external power sources may inform the device when power is not available or only available at a reduced level (for example, from an internal battery) or when the user unplugs the accessory from the external power source (for example, an AC power adapter or AC "mains" power outlet). Power to the device shall be restored and the updated power providing capability change shall be communicated to the device when the user re-connects the external power source.

See AC Power Adapters (page 85), Electrical (page 280), and User Supplied Cables and AC Power Adapters (page 28) for additional requirements specific to external USB power supplies/cables.

32.3 Declaring Capability

If the accessory provides power using a:

- USB-A receptacle, it shall use one of the following to declare its power providing capability:
  - USB Power Capability Vendor Request (page 219).
  - USB D+/D- Resistor Networks (page 220).
- USB-C receptacle, then:
  - It shall use one of the following to declare its power providing capability:
    - USB Type-C Current (page 224).
    - USB Power Delivery (PD) (page 223).
  - If the accessory does not have the potential for data communication with the device, it shall also support the *USB Battery Charging Specification –Release 1.2*.

32.4 Providing Power using USB Connectors

Accessories providing power from:

- USB-C receptacle, see USB-C Receptacle (page 285).
- USB-A receptacle, see USB-A Receptacle (page 280).

32.5 Labeling Multiple Connectors

If the accessory has multiple connectors with different device compatibilities, iPad-compatible connectors shall be labeled with the text 'iPad' unless it is physically impossible to connect an iPad to iPhone/iPod compatible connectors.

32.6 Fast Charge for iPhone (20 W)

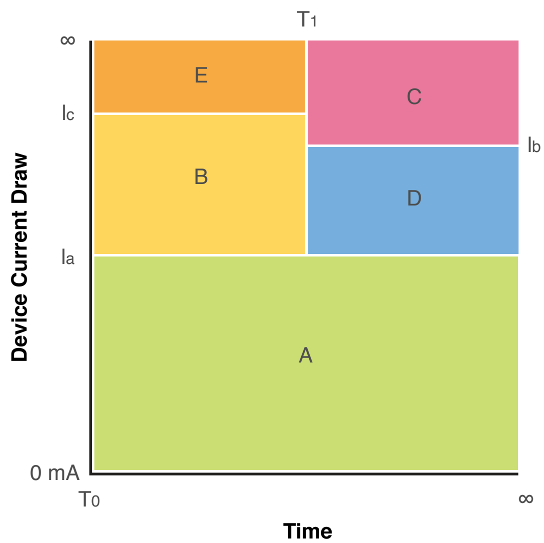
Accessories advertising "fast charge" for iPhone (https://support.apple.com/en-us/102574) shall:

- Support USB Power Delivery (PD) (page 223).
- Supply at least 20 W (2.22 A at 9 V) using USB PD.
- Claim compatibility with at least one of the following iPhone models:
  - iPhone 14 Pro Max
  - iPhone 14 Pro
  - iPhone 14 Plus
  - iPhone 14
  - iPhone SE (3rd generation)
  - iPhone 13 Pro Max
  - iPhone 13 Pro
  - iPhone 13
  - iPhone 13 mini
  - iPhone 12 Pro Max
  - iPhone 12 Pro
  - iPhone 12
  - iPhone 12 mini
  - iPhone SE (2nd generation)
  - iPhone 11 Pro Max
  - iPhone 11 Pro
  - iPhone 11
  - iPhone XS Max
  - iPhone XS
  - iPhone XR
  - iPhone X
  - iPhone 8 Plus
  - iPhone 8

Accessories such as charging cables should be capable of supporting up to 60 W (3 A at 20 V) to provide compatibility with a variety of sources and devices.

32.7 Overcurrent and Short Circuit Protection

Figure 32-1 Overcurrent and short circuit protection



Power-providing accessories shall implement overcurrent and short circuit protection for each region in Figure 32-1 (page 163) according to Table 32-1 (page 163), Table 32-2 (page 163), and Table 32-3 (page 164).

Table 32-1 Overcurrent / short circuit protection current thresholds

Threshold	Definition
I_a	Nominal accessory output current (for example, 1000 mA, 2100 mA, 2400 mA, 3000 mA).
I_b	I_a + 60%.
I_c	Lowest device current draw causing accessory output voltage (measured at Lightning Device Power) to drop below 2 V.

Table 32-2 Overcurrent / short circuit protection time thresholds

Threshold	Definition
T_0	Start of any device current draw transient.
T_1	Accessory overcurrent/short circuit deglitch/debounce time, shall ≥ T_0 + 1 ms.

Table 32-3 Overcurrent / short circuit protection behaviors

Region	Name	Accessory Behavior
A	Normal Operation	Accessory shall not limit or shutdown output current.
B	Overcurrent Transient	Accessory shall not shutdown output current. Accessory may limit output current to I_a or higher.
C	Overcurrent	Accessory shall shutdown output current.
D	Potential Overcurrent	Accessory may shutdown output current.
E	Potential Short Circuit	If Lightning Device Power voltage drops below 2 V, the accessory may trigger short circuit protection. Accessories shall not trigger short circuit protection on device current draw.

32.8 Overcurrent and Short Circuit Protection Resets

Accessory overcurrent and short circuit protection shall reset without mechanical intervention.

32.9 Power State Changes

Accessories shall not change the amount of power provided to a device unless:

- Direct user action is taken to turn the accessory on or off.
- External power source (for example, mains electricity or battery) is connected to or disconnected from the accessory.
- Accessory's internal power source (for example, a battery) is depleted or loaded to the point where it is no longer capable of supplying its declared power providing capability or is now capable of supplying more power than previously declared.

33. Device Power (Inductive)

Accessories may provide power to devices using inductive power transmitters, specifically:

- Qi Wireless Power (page 165)
- MagSafe (page 166)

33.1 Qi Wireless Power

Devices supporting Qi wireless power:

- iPhone 16e
- iPhone 16 Pro Max
- iPhone 16 Pro
- iPhone 16 Plus
- iPhone 16
- iPhone 15 Pro Max
- iPhone 15 Pro
- iPhone 15 Plus
- iPhone 15
- iPhone 14 Pro Max
- iPhone 14 Pro
- iPhone 14 Plus
- iPhone 14
- iPhone SE (3rd generation)
- iPhone 13 Pro Max
- iPhone 13 Pro
- iPhone 13
- iPhone 13 mini
- iPhone 12 Pro Max
- iPhone 12 Pro
- iPhone 12
- iPhone 12 mini
- iPhone SE (2nd generation)
- iPhone 11 Pro Max
- iPhone 11 Pro
- iPhone 11

- iPhone XS Max
- iPhone XS
- iPhone XR
- iPhone X
- iPhone 8 Plus
- iPhone 8
- Wireless Charging Case (USB-C) for AirPods 4
- MagSafe Charging Case (USB-C) for AirPods Pro (2nd generation)
- MagSafe Charging Case for AirPods Pro (2nd generation)
- MagSafe Charging Case for AirPods (3rd generation)
- Wireless Charging Case for AirPods

Accessories incorporating a Qi transmitter shall use an embedded Qi Certified subsystem or shall be Qi Certified according to *The Qi Wireless Power Transfer System, Power Class 0 Specification–Version 2.0 or later*, see https://www.wirelesspowerconsortium.com.

33.2 MagSafe

Devices supporting MagSafe:

- iPhone 16 Pro Max
- iPhone 16 Pro
- iPhone 16 Plus
- iPhone 16
- iPhone 15 Pro Max
- iPhone 15 Pro
- iPhone 15 Plus
- iPhone 15
- iPhone 14 Pro Max
- iPhone 14 Pro
- iPhone 14 Plus
- iPhone 14
- iPhone 13 Pro Max
- iPhone 13 Pro
- iPhone 13
- iPhone 13 mini
- iPhone 12 Pro Max
- iPhone 12 Pro
- iPhone 12
- iPhone 12 mini

- MagSafe Charging Case (USB-C) for AirPods Pro (2nd generation)
- MagSafe Charging Case for AirPods Pro (2nd generation)
- MagSafe Charging Case for AirPods (3rd generation)

33.3 Electromagnetic Compatibility (EMC)

Accessories providing inductive device power should be designed for electromagnetic compatibility.

Apple recommends shielding the magnetic field from the charging coil and maintaining a low impedance shield termination for cables to comply with regulatory EMC requirements for the completed product. Implementation, final compliance testing, report preparation, and labeling are the responsibilities of the company marketing and producing the product.

Cable termination is critical for reduced emissions. Cable termination and connectors should be kept away from the charging coil and cables should be routed away from the charging surface.

If emissions are present, adding clamp-on ferrites/absorbers to the cable can help reduce emissions. Selected ferrite/absorber materials should be rated for the failing frequencies.

Depending on the accessory's supported use cases, testing should be performed with the following power supplies:

- Apple USB-C Power Adapters:
  - Apple 140W USB-C Power Adapter
  - Apple 96W USB-C Power Adapter
  - Apple 70W USB-C Power Adapter
  - Apple 67W USB-C Power Adapter
  - Apple 30W USB-C Power Adapter
  - Apple 20W USB-C Power Adapter
  - Apple 35W Dual USB-C Port Compact Power Adapter
  - Apple 35W Dual USB-C Port Power Adapter
- Apple USB-A Power Adapters:
  - Apple 12W USB Power Adapter
  - Apple 5W USB Power Adapter
    - Model A1385 (US)
    - Model A1400 (Int.)
    - Model A1552 (UK)
    - Model A1443 (China)
    - Model A1444 (Australia)
    - Model A1486 (Brazil)
    - Model A1487 (Korea)
    - Model A1501 (Argentina)

- Apple Mac computers:
  - Apple MacBook Pro
  - Apple MacBook Air

If power sources are used differing from those listed above, emission testing should be performed while the power sources are on.

In addition to the use cases above, charging devices should be tested in idle mode for emissions.

Emissions tests should be conducted in accordance with standards referenced in the following:

- FCC CFR 47, Part 15
- ICES-003, Issue 5, CAN/CSA-CEI/IEC CISPR 22-10
- CISPR 22: 2008
- EN 55022: 2010
- AS/NZS CISPR 22:2009, TCVN 7189:2009
- VCCI V-3/2013.04
- GB 9254-2008, GB 17625.1-2012, GB 17625.2-2007, CNS 13438-2006
- CISPR 24: 2010
- EN 55024: 2010

Once the highest emitting combination is identified, complete testing should be performed on the configuration. Some regulatory domains may require EMC certification.

34. Ethernet over USB

Accessories may support Ethernet over USB using the Network Control Model (NCM) protocol to enable a device to access a wired network.

Accessories shall comply with the *Network Control Model Devices Specification –Revision 1.0*, see https://www.usb.org/document-library/network-control-model-devices-specification-v10-and-errata-and-adopters-agreement.

35. External Accessory Protocol

The External Accessory (EA) framework provides accessories the means to communicate with one or more apps using EA sessions, providing a read/write bytestream interface. Accessory developers specify a custom protocol between the application and the accessory. The design and maintenance of communication protocols between accessories and applications are entirely the responsibility of the accessory and app developers. External Accessory framework documentation can be found at https://developer.apple.com/documentation/externalaccessory.

See the Accessory Interface Specification (page 26) for more information.

36. HID Headset Remote

Devices may accept user input from headsets to control audio volume and media playback.

36.1 Requirements

Accessories implementing HID headset remote controls shall:

- Connect to the device using one of the following:
  - USB-C Plug (page 281).
  - Bluetooth (page 234).

HID headset remotes shall support the Human Interface Device (HID) (page 230) protocol.

The HID report descriptor for a headset remote shall declare support for the HID Consumer and/or Telephony pages and only send usages from Table 36-1 (page 171) and Table 36-2 (page 171).

Table 36-1 HID Consumer Page (`0x0C`) controls for use by headset remotes

Usage ID	Usage Name	Apple Function
`0x00B5`	Scan Next Track	Transport Right
`0x00B6`	Scan Previous Track	Transport Left
`0x00B9`	Random Play	Shuffle
`0x00BC`	Repeat	Repeat
`0x00E2`	Mute	Mute
`0x00E9`	Volume Increment	Volume Up
`0x00EA`	Volume Decrement	Volume Down
`0x025B`	Promote	Play More Like This
`0x025C`	Demote	Play Less Like This

Table 36-2 HID Telephony Page (`0x0B`) controls for use by headset remotes

Usage ID	Usage Name	Apple Function
`0x0021`	Flash	Center

If a user presses and holds the accessory control surface corresponding to the 'Transport Right' or 'Transport Left' function, devices may scrub forwards or backwards within the current playing media item. Accessories shall not present a separate 'Fast-Forward' or 'Reverse' control surface to the user for the same feature.

36.2 Examples

36.2.1 Headset Remote Example HID Report Descriptor (Telephony)

The following sample HID descriptor demonstrates how to implement telephony and volume controls.

```
USAGE_PAGE (Consumer Devices) 05 0C
USAGE (Consumer Control)      09 01
COLLECTION (Application)      A1 01
  LOGICAL_MINIMUM (0)         15 00
  LOGICAL_MAXIMUM (1)         25 01
  REPORT_SIZE (1)             75 01
  REPORT_COUNT (2)            95 02
  USAGE (Volume Increment)    09 E9    // Volume Up
  USAGE (Volume Decrement)    09 EA    // Volume Down
  INPUT (Data,Var,Abs)        81 02
  USAGE_PAGE (Telephony)      05 0B
  REPORT_COUNT (1)            95 01
  USAGE (Flash)               09 21    // Center
  INPUT (Data,Var,Abs)        81 02
  REPORT_SIZE (5)             75 05
  REPORT_COUNT (1)            95 01
  INPUT (Cnst, Var, Abs)      81 03
END_COLLECTION                C0
```

Each report is one byte, and each bit corresponds to one of the functions. For example, the following sample reports communicate the referenced button having been pressed:

- Volume Up is `0x01`
- Volume Down is `0x02`
- Center is `0x04`

36.2.2 Headset Remote Example HID Report Descriptor (Media Playback)

The following sample HID descriptor demonstrates how to implement media playback controls.

```
USAGE PAGE (Consumer Devices) 05 0C
USAGE (Consumer Control)      09 01
COLLECTION (Application)      A1 01
  LOGICAL MINIMUM (0)         15 00
```

```
  LOGICAL MAXIMUM (1)         25 01
  REPORT SIZE (1)             75 01
  REPORT COUNT (7)            95 07
  USAGE (Scan Next Track)     09 B5    // Transport Right
  USAGE (Scan Previous Track) 09 B6    // Transport Left
  USAGE (Mute)                09 E2    // Mute
  USAGE (Shuffle)             09 B9    // Shuffle
  USAGE (Repeat)              09 BC    // Repeat
  USAGE (Promote)             0A 5B 02 // Play More Like This
  USAGE (Demote)              0A 5C 02 // Play Less Like This
  INPUT (Data,Var,Abs)        81 02
END COLLECTION                C0
```

Each report is one byte, and each bit corresponds to one of the functions. For example, the following sample reports communicate the referenced button having been pressed:

- Transport Right is `0x01`
- Transport Left is `0x02`
- Mute is `0x04`

36.2.3 Headset Remote Example HID Report Descriptor (Telephony and Media Playback)

The following sample HID descriptor demonstrates how to implement all possible media playback controls along with the same controls found on the Apple headset remote.

```
USAGE_PAGE (Consumer Devices) 05 0C
USAGE (Consumer Control)      09 01
COLLECTION (Application)      A1 01
  LOGICAL_MINIMUM (0)         15 00
  LOGICAL_MAXIMUM (1)         25 01
  REPORT_SIZE (1)             75 01
  REPORT_COUNT (9)            95 09
  USAGE (Scan Next Track)     09 B5    // Transport Right
  USAGE (Scan Previous Track) 09 B6    // Transport Left
  USAGE (Mute)                09 E2    // Mute
  USAGE (Shuffle)             09 B9    // Shuffle
  USAGE (Repeat)              09 BC    // Repeat
  USAGE (Promote)             0A 5B 02 // Play More Like This
  USAGE (Demote)              0A 5C 02 // Play Less Like This
  USAGE (Volume Increment)    09 E9    // Volume Up
  USAGE (Volume Decrement)    09 EA    // Volume Down
  INPUT (Data,Var,Abs)        81 02
  USAGE_PAGE (Telephony)      05 0B
  REPORT_COUNT (1)            95 01
  USAGE (Flash)               09 21    // Center
  INPUT (Data,Var,Abs)        81 02
  REPORT_SIZE (5)             75 05
  REPORT_COUNT (1)            95 01
  INPUT (Cnst, Var, Abs)      81 03
```

```
END COLLECTION                  C0
```

Each report is two bytes. The bits are assigned top-to-bottom (from 'Transport Right' to 'Center'). For example, the following sample reports communicate the referenced button having been pressed:

- Transport Right is `0x0100`
- Transport Left is `0x0200`
- Mute is `0x0400`
- Volume Up is `0x8000`
- Volume Down is `0x0001`
- Center is `0x0002`

37. Location Information

Location features enable accessories to provide Global Navigation Satellite System (GNSS) and sensor data (for example, speed) to devices in the form of National Marine Electronics Association (NMEA) sentences. Devices can use the additional information to augment built-in location services. For example, some external accessories provide more accurate or more frequent position updates. Additionally, devices can conserve power by using location information from a self-powered external accessory.

See the Accessory Interface Specification (page 26) for more information.

38. MagSafe Attach

Devices supporting MagSafe Attach:

- iPhone 16 Pro Max
- iPhone 16 Pro
- iPhone 16 Plus
- iPhone 16
- iPhone 15 Pro Max
- iPhone 15 Pro
- iPhone 15 Plus
- iPhone 15
- iPhone 14 Pro Max
- iPhone 14 Pro
- iPhone 14 Plus
- iPhone 14
- iPhone 13 Pro Max
- iPhone 13 Pro
- iPhone 13
- iPhone 13 mini
- iPhone 12 Pro Max
- iPhone 12 Pro
- iPhone 12
- iPhone 12 mini

MagSafe Cases (page 35) shall:

- Claim compatibility with a MagSafe-capable device.
- Integrate a MagSafe Case Magnet Array (page 177).

Other MagSafe accessories shall:

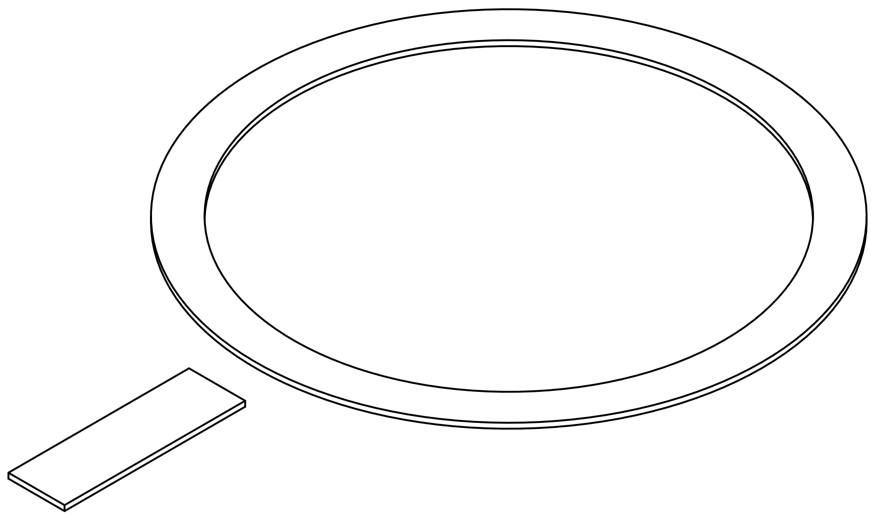
- Claim compatibility with a MagSafe-capable device.
- Integrate a MagSafe Accessory Magnet Array (page 184).

Apple recommends the following magnet array vendors:

- Baotou INST Magnetic New Materials Co., Ltd. (https://www.instmagnets.com)
- Ningbo Sanhuan Magsound Industry & Trade Co., Ltd. (https://www.magsound.com)
- Quadrant Solutions, Inc. (https://www.quadrant.us)

38.1 MagSafe Case Magnet Array

Figure 38-1 MagSafe case magnet array



38.1.1 Product Design

Cases integrating a MagSafe case magnet array shall:

- Enclose the device.
- Have a uniform thickness no greater than 2.1 mm; Apple recommends 2.0 mm.
- Firmly attach to the device without relying on the magnets.
- Not integrate magnets on the back of the case other than the MagSafe magnets.
- Comply with requirements for Cases (page 35).
- Work with:
    - Apple MagSafe Charger.
    - Apple MagSafe Battery Pack.
    - iPhone Leather Wallet with MagSafe.

38.1.2 Mechanical

Magnets in the MagSafe case magnet array shall be positioned in the same plane.

The case and MagSafe case magnet array shall enable MagSafe accessories to magnetically self align within a 1.55 mm radial maximum.

38.1.2.1 Magnets

MagSafe case magnets shall be N45SH NdFeB with a 8 µm - 16 µm epoxy coating (or similar non-metallic coating) and shall meet the requirements in Table 38-1 (page 178).

Table 38-1 Magnet properties

Property	Minimum	Maximum
Br	13.2 kGs	13.6 kGs
Hcb	12.75 kOe	
Hcj	20.50 kOe	
BHmax	43 MGOe	46 MGOe

38.1.2.2 Magnet Array

The magnets shall be positioned in the case following the dimensions and polarity shown in Figure 38-2 (page 179), Figure 38-3 (page 180) and Figure 38-4 (page 180).

Figure 38-2 MagSafe magnet array dimensions

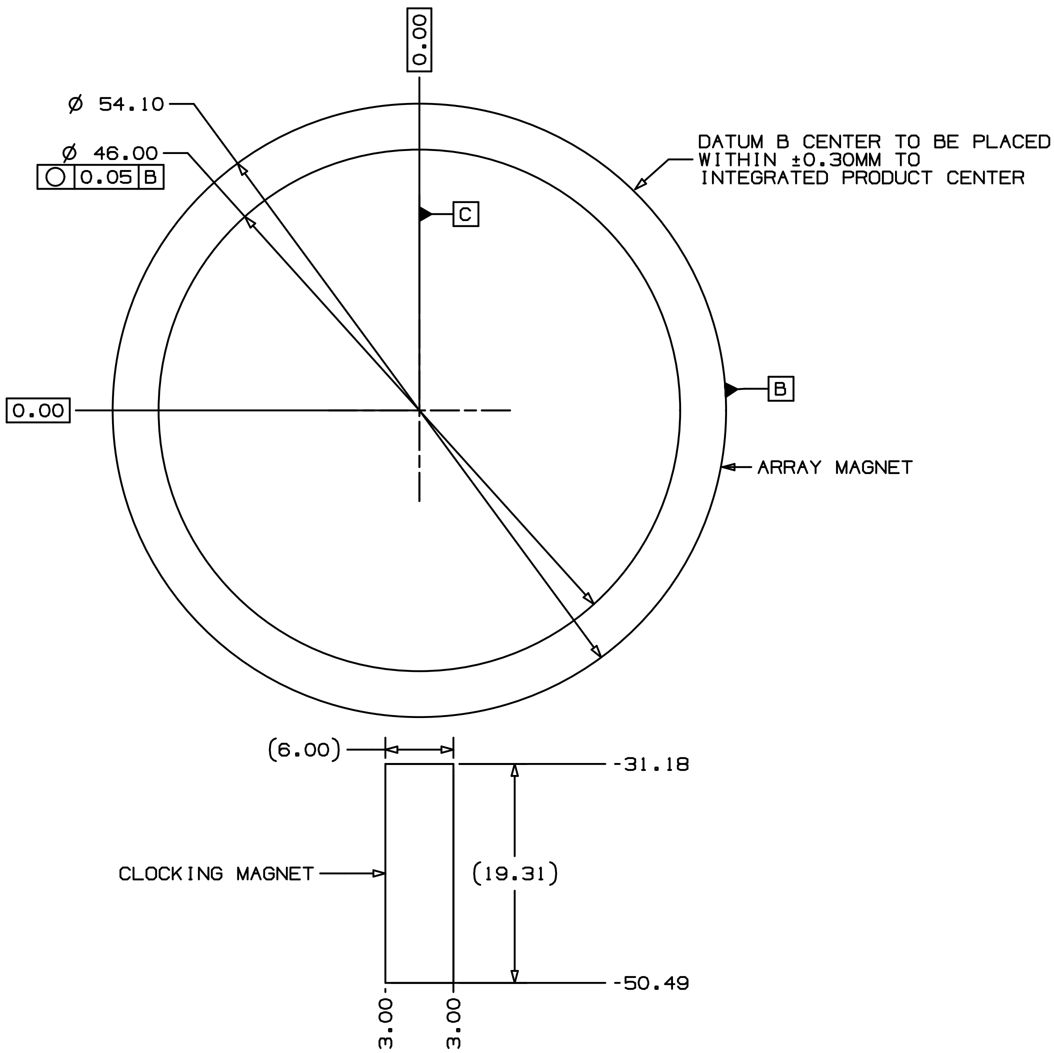


Figure 38-3 MagSafe magnet ring dimensions and polarity

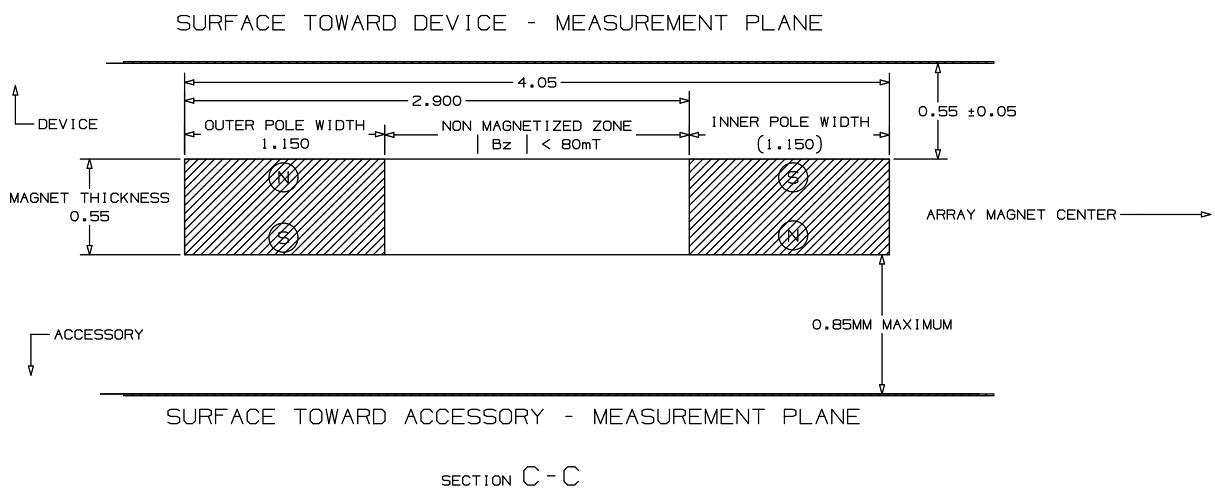
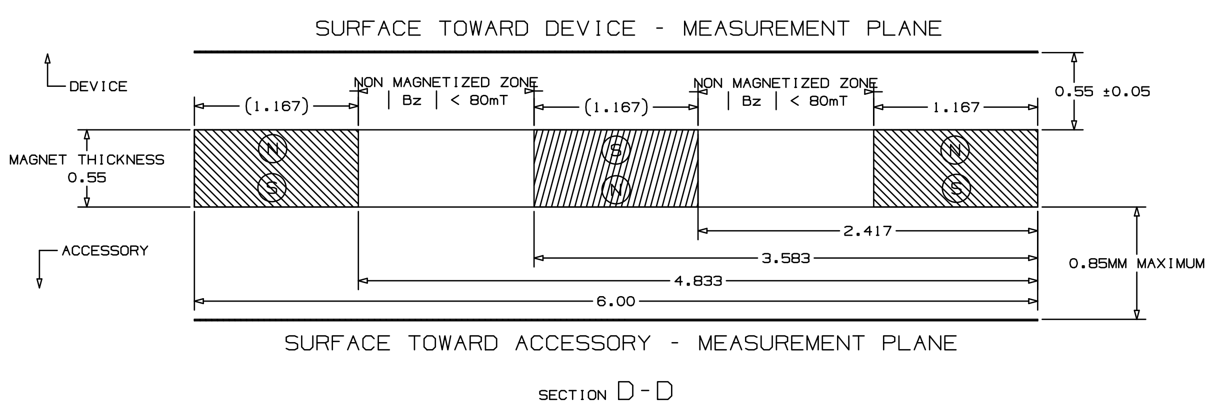


Figure 38-4 MagSafe orientation magnet dimensions and polarity



The flux density of a MagSafe case magnet ring shall comply with Table 38-2 (page 181) and Table 38-3 (page 182) across the 8 lines (S1 - S8) in Figure 38-5 (page 181).

Figure 38-5 MagSafe flux density measurement plane

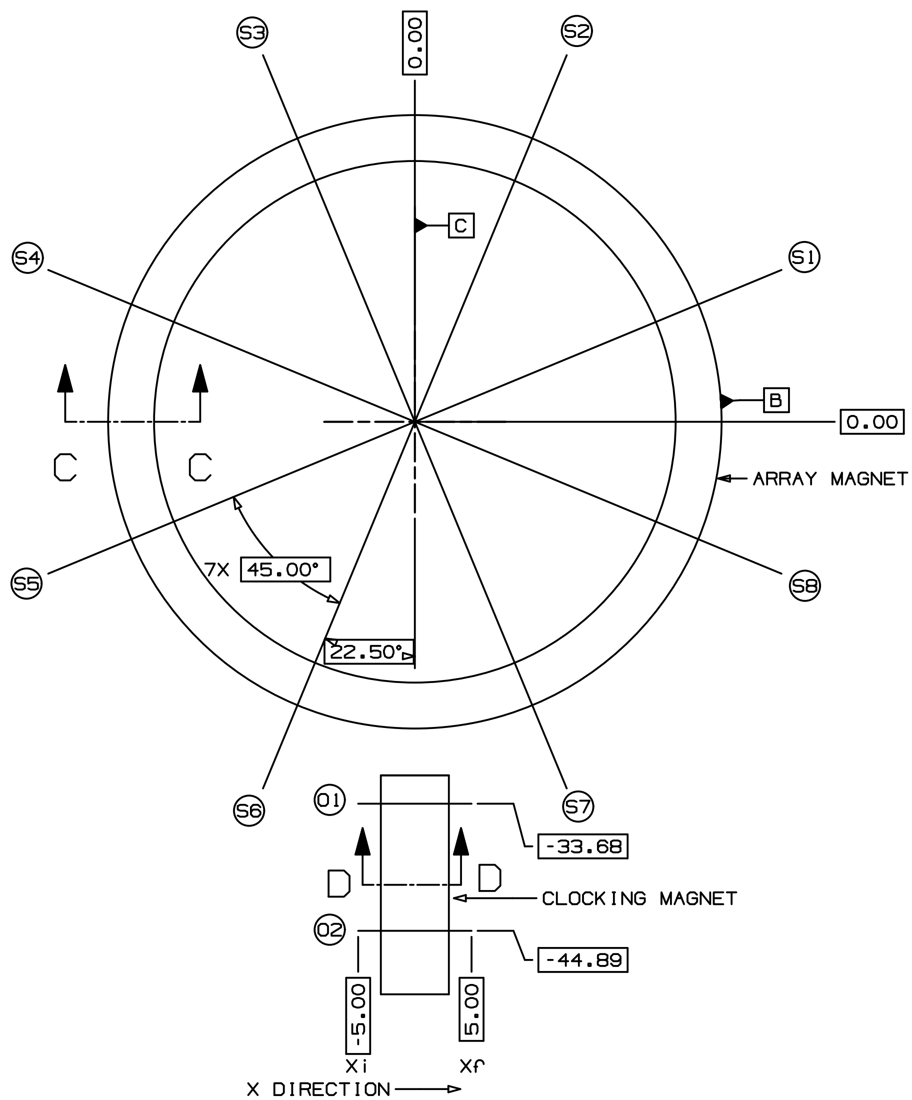


Table 38-2 Device side flux density at 0.55 mm from magnet ring surface

Minimum r	Maximum r	Minimum Bz	Maximum Bz	Minimum Bxy	Maximum Bxy
	19.5 mm	-0.020 T	0.020 T		0.025 T
19.5 mm	23 mm				0.075 T
23 mm	24 mm	-0.170 T	-0.125 T		
24 mm	26 mm			0.095 T	0.1325 T

Minimum r	Maximum r	Minimum Bz	Maximum Bz	Minimum Bxy	Maximum Bxy
26 mm	27 mm	0.125 T	0.170 T		
27 mm	30 mm				0.075 T
30 mm		-0.020 T	0.000 T		0.025 T

Table 38-3 Accessory side flux density at 0.80 mm from magnet ring surface

Minimum r	Maximum r	Minimum Bz	Maximum Bz	Minimum Bxy	Maximum Bxy
	19.5 mm	-0.020 T	0.020 T		0.025 T
19.5 mm	23 mm				0.065 T
23 mm	24 mm	-0.120 T	-0.085 T		
24 mm	26 mm			0.070 T	0.100 T
26 mm	27 mm	0.85 T	0.120 T		
27 mm	30 mm				0.065 T
30 mm		-0.020 T	0.000 T		0.025 T

The flux density of a MagSafe case orientation magnet shall comply with Table 38-4 (page 182) and Table 38-5 (page 183) across the 2 lines (O1 and O2) in Figure 38-5 (page 181).

Table 38-4 Device side flux density at 0.55 mm from orientation magnet surface

Minimum x	Maximum x	Minimum Bz	Maximum Bz	Minimum Bxy	Maximum Bxy
	-5.0 mm	-0.020 T	0.020 T		0.025 T
-5.0 mm	-4.5 mm	-0.020 T	0.020 T		
-4.5 mm	-2.75 mm			0.080 T	0.110 T
-2.75 mm	-2.0 mm	0.125 T	0.175 T		
-2.0 mm	-0.5 mm			0.110 T	0.155 T
-0.5 mm	0.5 mm	-0.1925 T	-0.140 T		
0.5 mm	2.0 mm			0.110 T	0.155 T
2.0 mm	2.75 mm	0.125 T	0.175 T		
2.75 mm	4.0 mm			0.080 T	0.110 T
4.0 mm	5.0 mm	-0.020 T	0.020 T		
5.0 mm		-0.020 T	0.020 T		0.025 T

Table 38-5 Accessory side flux density at 0.80 mm from orientation magnet surface

Minimum x	Maximum x	Minimum Bz	Maximum Bz	Minimum Bxy	Maximum Bxy
	-5.0 mm	-0.020 T	0.020 T		0.025 T
-5.0 mm	-4.5 mm	-0.020 T	0.020 T		
-4.5 mm	-2.75 mm			0.050 T	0.070 T
-2.75 mm	-2.0 mm	0.085 T	0.120 T		
-2.0 mm	-0.5 mm			0.0825 T	0.115 T
-0.5 mm	0.5 mm	-0.140 T	-0.0975 T		
0.5 mm	2.0 mm			0.0825 T	0.115 T
2.0 mm	2.75 mm	0.085 T	0.120 T		
2.75 mm	4.0 mm			0.050 T	0.070 T
4.0 mm	5.0 mm	-0.020 T	0.020 T		
5.0 mm		-0.020 T	0.020 T		0.025 T

38.1.2.3 Magnetic Force

The force normal to the back of the case needed to dislodge a MagSafe accessory, such as the Apple MagSafe Charger, shall meet the requirements in Table 38-6 (page 183).

Table 38-6 Magnetic force

Scenario	Minimum	Maximum
Case attached to device	800 gf	1100 gf
Case only	600 gf	900 gf

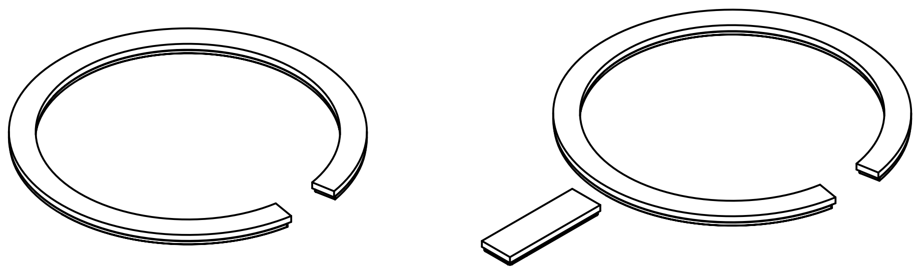
38.1.3 Magnetic Interference

Cases with an integrated MagSafe magnet array shall not interfere with:

- Inductive charging.
- Magnetic stripe cards in an attached iPhone Leather Wallet with MagSafe.

38.2 MagSafe Accessory Magnet Array

Figure 38-6 MagSafe accessory magnet array options



The MagSafe accessory magnet array shall be implemented as a Magnet Ring (page 186). The magnet ring enables the device and accessory to be attached in any orientation. To support a specific orientation, the accessory may include an Orientation Magnet (page 187) as part of the array.

38.2.1 Product Design

Accessories integrating the MagSafe accessory magnet array shall not enclose the device.

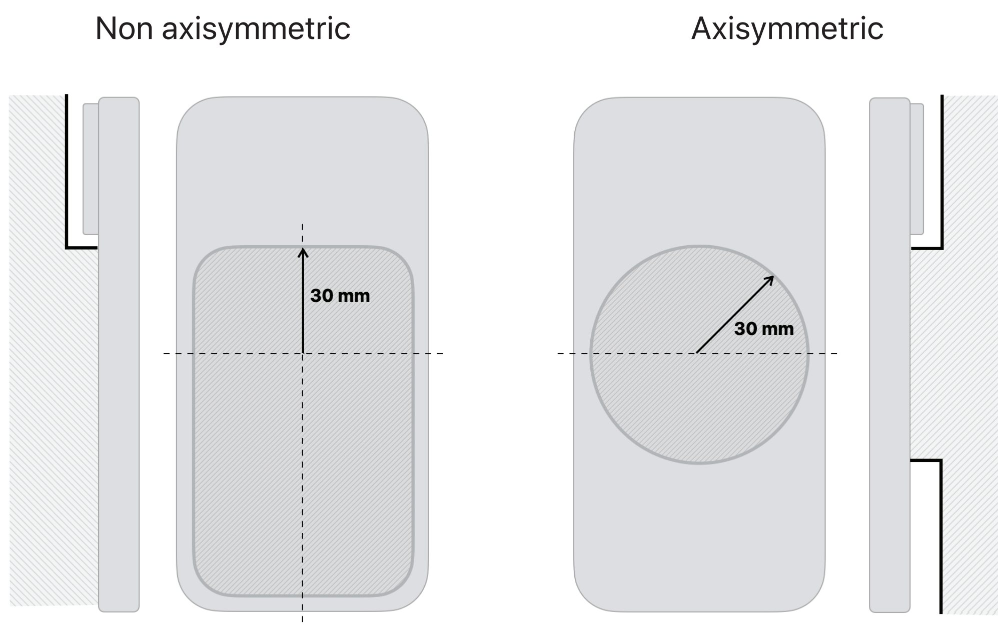
38.2.2 Mechanical

The accessory shall not interfere with or cause Scratches and Damage (page 28) to the device.

To avoid interference with devices, accessories shall:

- Not exceed 30 mm from the center of the magnet ring surface towards the top edge of the device for all supported device orientations. If the device can be attached in any orientation, the accessory shall not exceed 30 mm in radius around the center of the magnet ring surface.
- Maintain a clearance of 5 mm from the back of the device (mating surface) for any part of the accessory past the 30 mm keep-in constraint.
- Stay within the MagSafe Accessory Enclosure Geometry (page 191).

Figure 38-7 MagSafe accessory clearance



Magnets in the MagSafe accessory magnet array shall be positioned in the same plane.

The MagSafe accessory's Magnet Ring (page 186) shall magnetically self align to the device's magnet ring within a 1.55 mm radial maximum.

38.2.2.1 Magnets

MagSafe accessory magnets shall be N48H NdFeB with a 7 µm - 13 µm NiCuNi plating finish (or similar) and shall meet the requirements in Table 38-7 (page 185).

Table 38-7 Magnet properties

Property	Minimum	Maximum
Br	13.7 kGs	14.1 kGs
Hcb	13.25 kOe	
Hcj	17 kOe	
BHmax	45 MGOe	48 MGOe

38.2.2.2 Magnet Ring

The magnet ring shall be positioned in the accessory in compliance with the dimensions and polarity requirements in Figure 38-8 (page 186) and Figure 38-9 (page 187).

Figure 38-8 MagSafe magnet ring dimensions

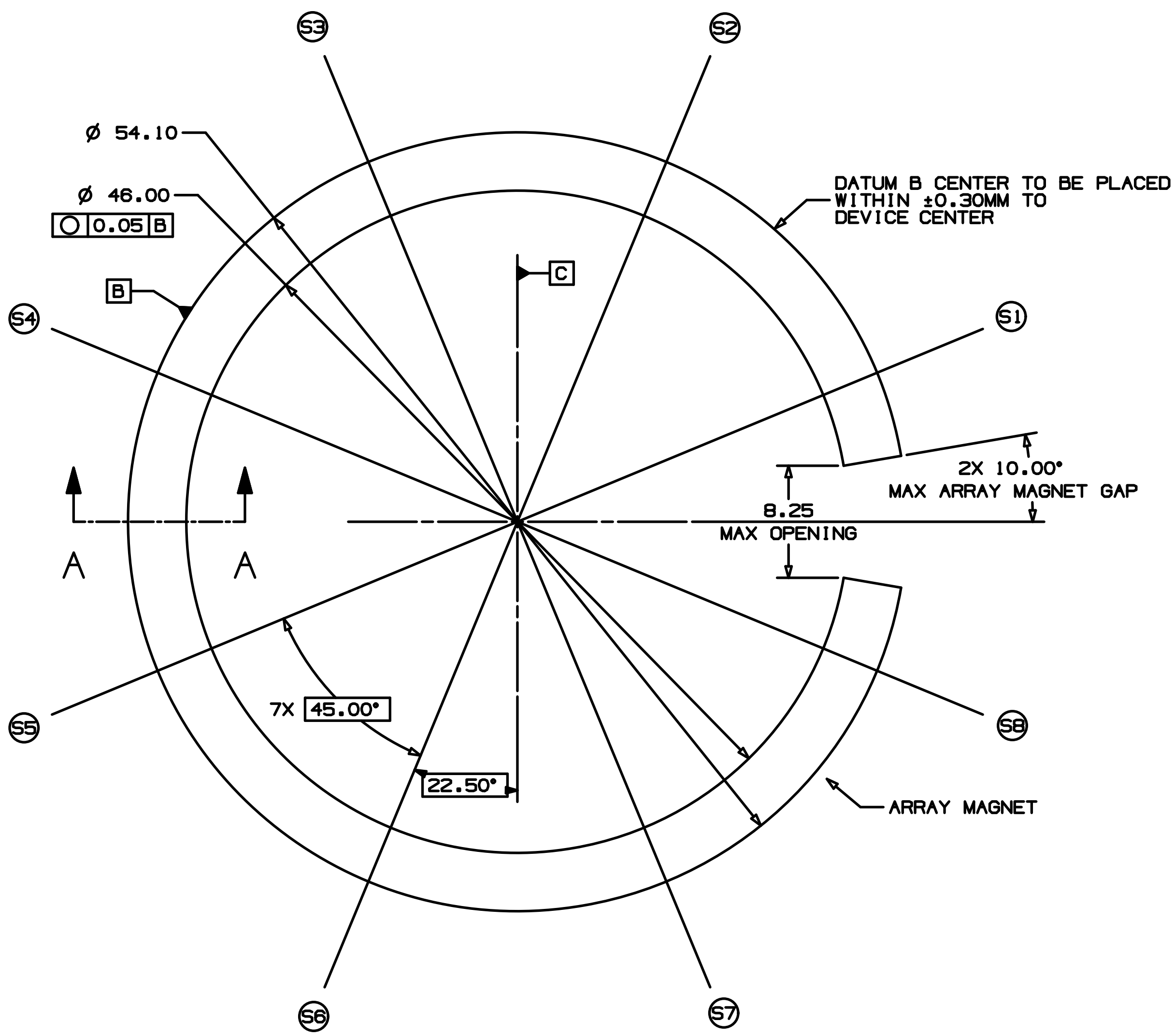
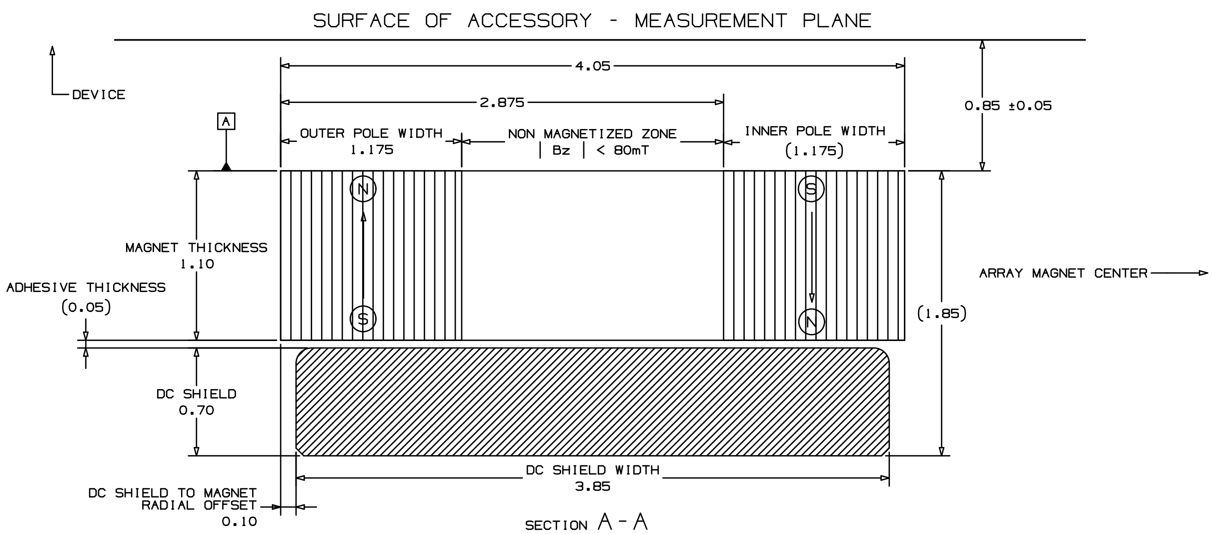


Figure 38-9 MagSafe magnet ring dimensions and polarity



See DC Shield (page 190) for additional requirements of the DC shield specified in Figure 38-9 (page 187).

The flux density of a MagSafe accessory magnet ring shall comply with Table 38-8 (page 187) across the 8 lines (S1 - S8) in Figure 38-8 (page 186).

Table 38-8 Flux density at 0.85 mm from magnet ring surface

Minimum r	Maximum r	Minimum Bz	Maximum Bz	Minimum Bxy	Maximum Bxy
0 mm	19.5 mm	-0.025 T	0.025 T		0.025 T
19.5 mm	23 mm				0.075 T
23 mm	24.5 mm	-0.215 T	-0.155 T		
24.5 mm	25.5 mm			0.170 T	0.215 T
25.5 mm	27 mm	0.155 T	0.215 T		
27 mm	30 mm				0.075 T
30 mm		-0.025 T	0.025 T		0.025 T

38.2.2.3 Orientation Magnet

If orientation magnets are included, the magnets shall be positioned according to Figure 38-10 (page 188) and Figure 38-11 (page 189).

Figure 38-10 MagSafe orientation magnet dimensions

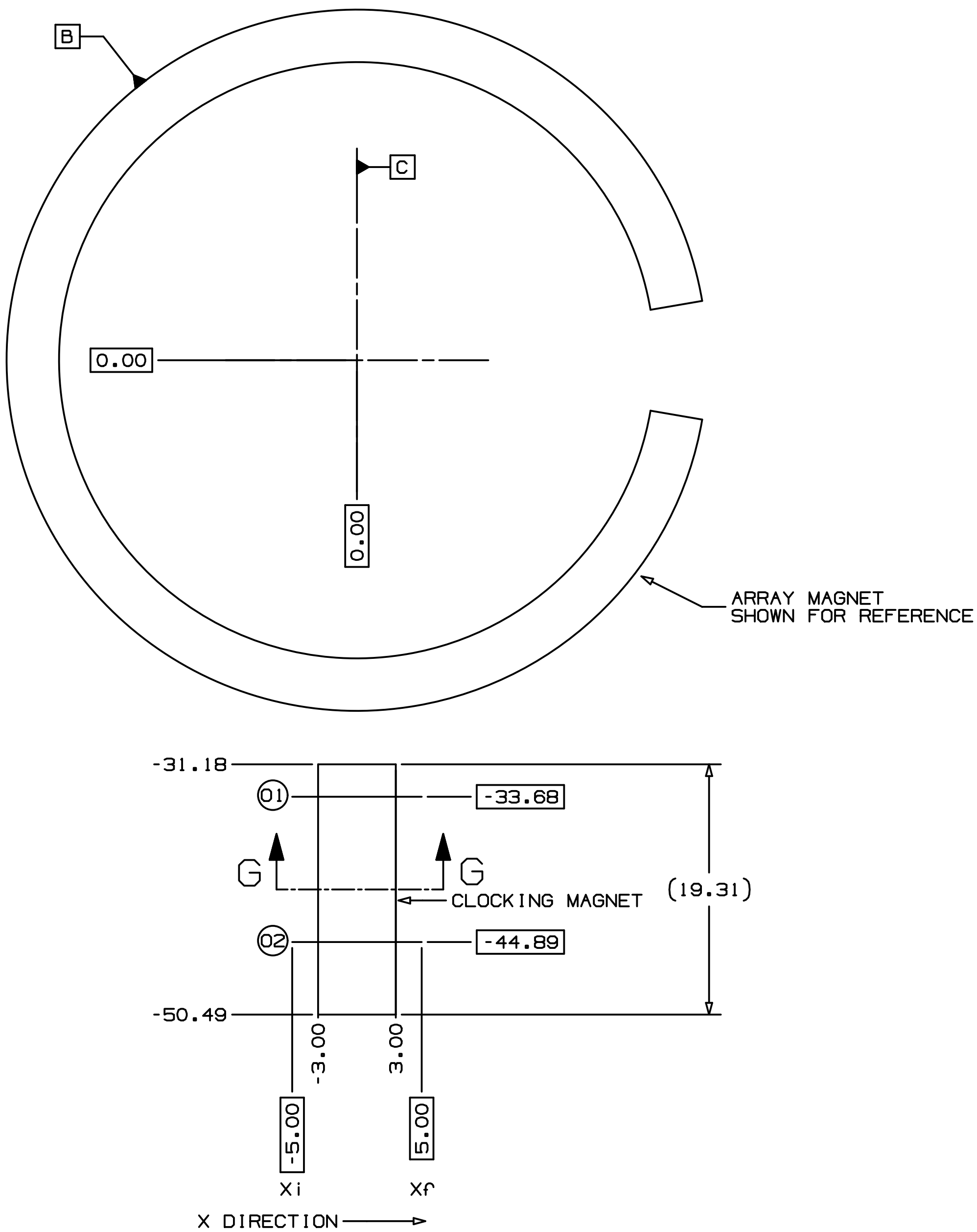
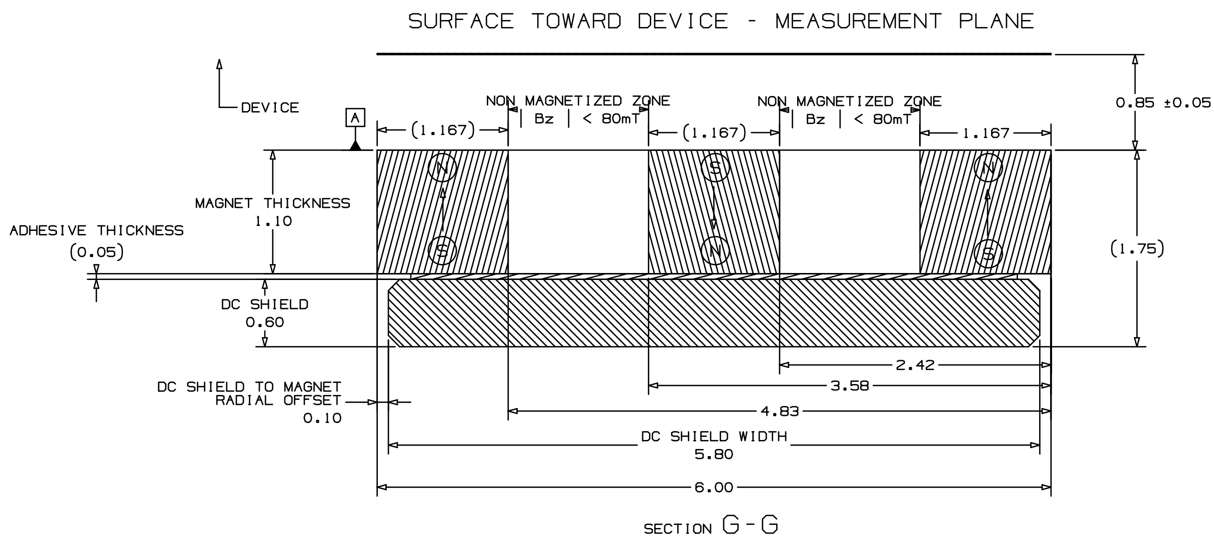


Figure 38-11 MagSafe orientation magnet dimensions and polarity



See DC Shield (page 190) for additional requirements of the DC shield specified in Figure 38-11 (page 189).

The flux density of a MagSafe accessory orientation magnet shall comply with Table 38-9 (page 189) across the 2 lines (O1 and O2) in Figure 38-10 (page 188).

Table 38-9 Flux density at 0.85 mm from orientation magnet surface

Minimum x	Maximum x	Minimum Bz	Maximum Bz	Minimum Bxy	Maximum Bxy
	-5.0 mm	-0.025 T	0.025 T		0.025 T
-5.0 mm	-4.5 mm	-0.025 T	0.025 T		
-4.5 mm	-3.0 mm			0.0625 T	0.0875 T
-3.0 mm	-2.0 mm	0.145 T	0.195 T		
-2.0 mm	-0.5 mm			0.165 T	0.215 T
-0.5 mm	0.5 mm	-0.250 T	-0.185 T		
0.5 mm	2.0 mm			0.165 T	0.215 T
2.0 mm	3.0 mm	0.145 T	0.195 T		
3.0 mm	4.0 mm			0.0625 T	0.0875 T
4.0 mm	5.0 mm	-0.025 T	0.025 T		
5.0 mm		-0.025 T	0.025 T		0.025 T

38.2.2.4 Magnetic Force

The force normal to the back of the device needed to dislodge the MagSafe accessory shall meet the requirements in Table 38-10 (page 190).

Table 38-10 Magnetic force

Scenario	Minimum	Maximum
Accessory attached to device	650 gf	900 gf

38.2.2.5 DC Shield

The DC shield shall be low carbon steel (1010, DT4 or similar), per ASTM848, with a 5 µm - 10 µm Ni plating finish or similar.

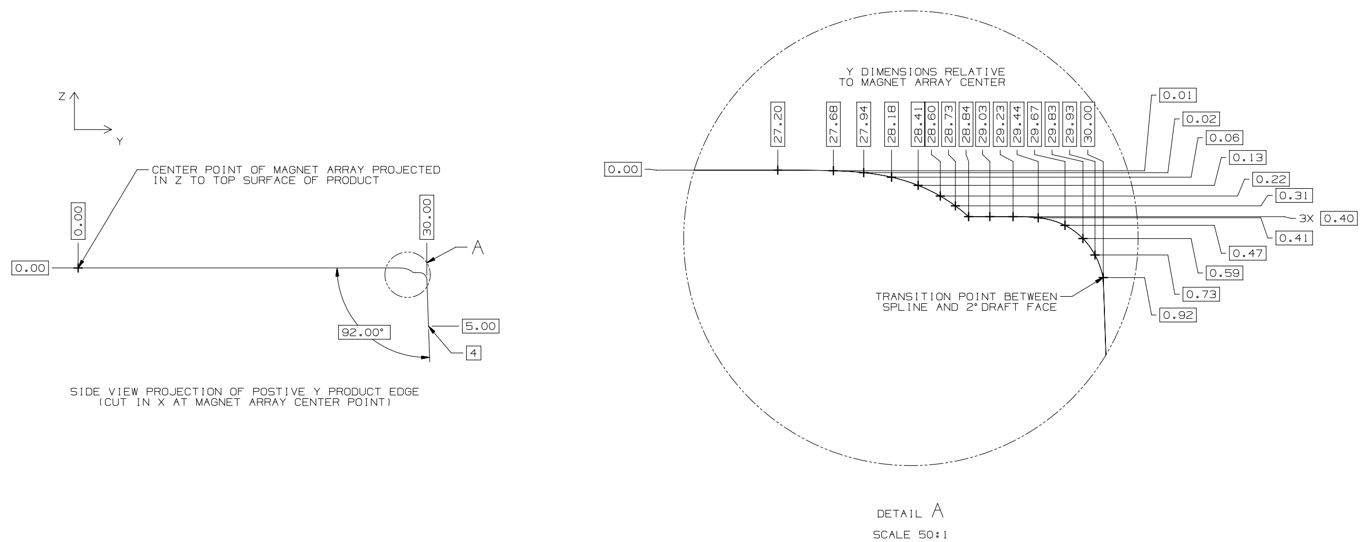
The DC shield shall have a saturation flux density (B_{sat}) of at least 2.0 T.

38.3 MagSafe Accessory Enclosure Geometry

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. SPLINE REPRESENTS MAX MATERIAL CONDITION FOR AN EXTERIOR PRODUCT SURFACE. MAGSAFE COMPATIBLE ACCESSORIES SHALL STAY WITHIN THE PROVIDED SPLINE.
2. FOR NON AXISYMMETRIC APPLICATIONS, SPLINE REPRESENTS MAX MATERIAL CONDITION WHEN VIEWED ALONG X AXIS
3. FOR AXISYMMETRIC APPLICATIONS, A REVOLUTION OF THE SPLINE AROUND THE Z AXIS THROUGH THE CENTER POINT OF THE MAGNET ARRAY REPRESENTS THE MAX MATERIAL CONDITION

[4] ANY CURVATURE DEVIATING BEYOND SPLINE TO EXIST BEYOND 5MM Z CLEARANCE FROM TOP OF PRODUCT



METRIC

DRAFTER: APPLE | DATE:
DESIGNER: APPLE | DATE:

DIMENSIONS ARE IN MILLIMETERS
TOLERANCES

DO NOT SCALE DRAWINGS

THIRD ANGLE PROJECTION

Apple Inc.

NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED

TITLE: MAGSAFE COMPATIBLE ENCLOSURE GEOMETRY

DRAWING NUMBER | REV. 01

SIZE D | SCALE NONE | SHT 1 OF 1

NX GENERATED

38.4 Verification

38.4.1 MagSafe Case Magnet Array

38.4.1.1 Case Thickness

38.4.1.1.1 Equipment

The following equipment is necessary:

- Digital thickness gauge, such as the Mitutoyo 547-520S.

38.4.1.1.2 Procedure

1. Using the digital thickness gauge, verify the thickness is less than or equal to 2.1 mm at:
    - Four points along the magnet ring.
    - Two points along the orientation magnet.

38.4.1.2 Accessory Clearance

38.4.1.2.1 Equipment

The following equipment is necessary:

- MagSafe-capable device.
- Apple MagSafe Battery Pack.

38.4.1.2.2 Procedure

1. Attach the case to the device.
2. Attach the Apple MagSafe Battery Pack to the back of the case.
3. Verify the case does not interfere with the Apple MagSafe Battery Pack and only the mating surface is in contact.

38.4.1.3 Magnetic Force

38.4.1.3.1 Equipment

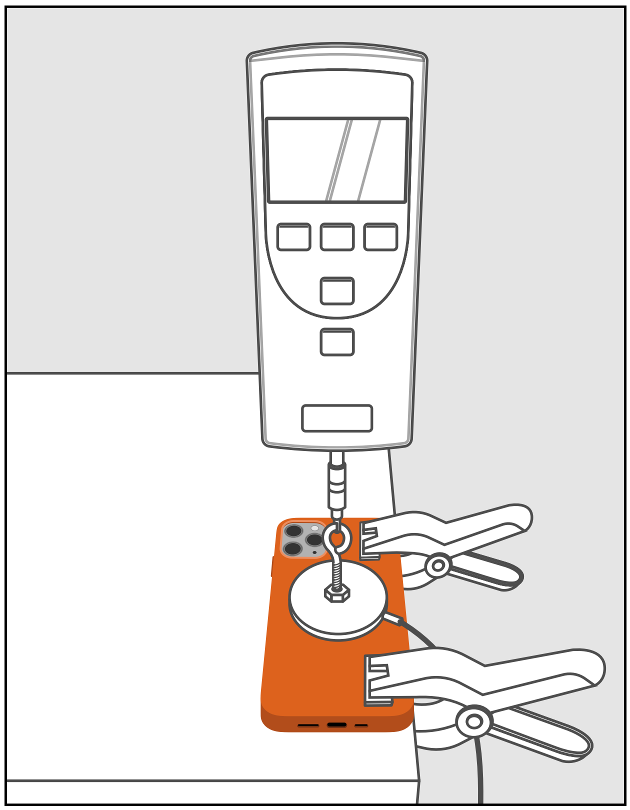
The following equipment is necessary:

- MagSafe-capable device.
- Apple MagSafe Charger.
- Non-magnetic eyelet screw.

- Digital force gauge capable of capturing peak values, such as the Chatillon DFX II.
- Hook attachment for digital force gauge.
- Clamps to securely hold the device on a flat level surface.

38.4.1.3.2 Setup

Figure 38-12 Magnetic force test setup



1. Attach the case to the device.
2. Place the device on a flat level surface with the display facing down and clamp it firmly in place.
3. Glue the non-magnetic eyelet to the center of the back of the Apple MagSafe Charger so pulling on the eyelet exerts a force on the center of the charger.

38.4.1.3.3 Procedure

1. Repeat the following steps 5 times:
    a. Attach the Apple MagSafe Charger and eyelet assembly to the back of the case, allowing them to magnetically align.
    b. Connect the force gauge hook to the eyelet.

   c. Reset the force gauge's peak force value.
   d. Pull the force gauge vertically until the Apple MagSafe Charger and eyelet assembly dislodge from the case.
   e. Note the peak value from the force gauge.
2. Calculate the average of the 5 peak force measurements.
3. Verify the average force is within the range of 800 gf to 1100 gf when removing the mass of the Apple MagSafe Charger and eyelet assembly.

38.4.1.4 iPhone Leather Wallet with MagSafe Detection

38.4.1.4.1 Equipment

The following equipment is necessary:

- MagSafe-capable device.
- iPhone Leather Wallet with MagSafe.

38.4.1.4.2 Procedure

1. Attach the case to the device.
2. Attach the wallet to the back of the case.
3. Verify the device displays the wallet animation.

38.4.1.5 Magnetic Stripe Cards in iPhone Leather Wallet with MagSafe

38.4.1.5.1 Equipment

The following equipment is necessary:

- MagSafe-capable device.
- iPhone Leather Wallet with MagSafe.
- Low Coercivity Magnetic stripe (LoCo) cards, such as cards from the following vendors:
  - American Card Service.
  - Allsafe.
  - CI Solutions.
  - PSA.
- LoCo card reader/writer, such as:
  - Q-card Mag3x.
  - Magtek InSpec 9000.
  - Misiri X6BT.
  - Deftun MSR605X.

38.4.1.5.2 Procedure

1. Attach the accessory to the device.
2. Repeat this procedure for three different brands of LoCo cards:
    a. Write to the LoCo card.
    b. Read from the LoCo card and verify it was written successfully.
    c. Insert the LoCo card into the wallet with the magnetic stripe facing the magnets.
    d. Place additional cards into the wallet to ensure a LoCo card is in contact with the magnetic side of the wallet.
    e. Attach the wallet to the accessory (attached to the device).
    f. Wait 10 seconds.
    g. Remove the wallet from the accessory.
    h. Remove the LoCo card from the wallet.
    i. Verify the LoCo card is readable and its contents have not changed.

38.4.2 MagSafe Accessory Magnet Array

38.4.2.1 Orientation Magnet

If the accessory includes an orientation magnet:

1. Use a straight edge to verify the device contact surfaces of the magnet ring and orientation magnet are coplanar (aligned in the same plane).
2. Attach a MagSafe-capable device to the accessory and align it with the orientation magnet. Verify there are no gaps between the:
    - MagSafe magnet ring and device.
    - MagSafe orientation magnet and device.

38.4.2.2 Magnetic Force

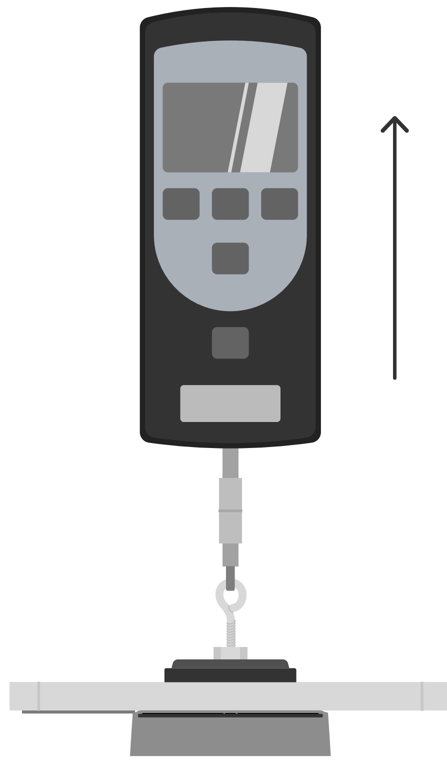
38.4.2.2.1 Equipment

The following equipment is necessary:

- MagSafe-capable device.
- Non-magnetic eyelet to attach to the device.
- Digital force gauge capable of capturing peak values, such as the Chatillon DFX II.
- Hook attachment for digital force gauge.
- Clamps, or a vice, to securely hold the accessory on a flat level surface.

38.4.2.2.2 Setup

Figure 38-13 Magnetic force test setup



1. Clamp the accessory in place so the MagSafe surface is level.
2. Attach the non-magnetic eyelet to the MagSafe-capable device so pulling on the eyelet exerts a force on the center of the back of the device. A bracket, strong suction cup, or glue may be used.

38.4.2.2.3 Procedure

1. Repeat the following steps 5 times:
   a. Attach the device and eyelet assembly to the accessory, allowing them to magnetically align.
   b. Connect the force gauge hook to the eyelet.
   c. Reset the force gauge's peak force value.
   d. Pull the force gauge vertically until the device and eyelet assembly dislodge from the accessory.
   e. Note the peak value from the force gauge.
2. Calculate the average of the 5 peak force measurements.
3. Verify the average force is within the range of 650 gf to 900 gf when removing the mass of the device and eyelet assembly.

39. Media Library Access

The Media Library feature allows accessories to download the metadata contents of a device's media libraries (not the media items themselves) and request playback of media items. The feature is divided into the following sub-features:

- Media Library Information informs the accessory about media libraries available on the device.
- Media Library Updates provide an accessory with an updated view of the contents of a particular media library.
- Media Library Playback allows the accessory to request playback of one or more items from a media library.

See the Accessory Interface Specification (page 26) for more information.

40. Musical Instrument Digital Interface (MIDI)

Compatible USB and Bluetooth Low Energy MIDI accessories can interface directly with iOS 17.0, iPadOS 17.0, and macOS 14.0 Sonoma apps using the Core MIDI framework, see https://developer.apple.com/documentation/coremidi.

40.1 Requirements

Accessories supporting MIDI as a USB device shall implement a MIDI Streaming IN endpoint and shall support either:

- *USB Device Class Definition for MIDI Devices – Version 2.0*, see https://www.usb.org/document-library/usb-class-definition-midi-devices-v20.
- *USB Device Class Definition for MIDI Devices – Release 1.0*, see https://www.usb.org/document-library/usb-midi-devices-10.

Accessories supporting MIDI over Bluetooth Low Energy shall support:

- *MIDI Association MIDI over Bluetooth Low Energy (BLE-MIDI) – Version 1.0a*, see https://midi.org/midi-over-bluetooth-low-energy-ble-midi.

40.2 Verification

Developers should test accessory designs against macOS 15.3 Sequoia using the Audio MIDI Setup app and its MIDI Studio and Test MIDI Setup features. See the user guide at https://support.apple.com/guide/audio-midi-setup/welcome/mac.

41. Now Playing Updates

The Now Playing feature enables an accessory to display information about the current "Now Playing" media source and media item on a device. Media sources include both the built-in Apple Music and Apple Video apps on devices and certain third-party iOS apps supporting the generation of Now Playing metadata, see *MPNowPlayingInfoCenter* in the iOS SDK documentation. Accessories shall be prepared for the Now Playing media source and media item to change at any time, whether the accessory requested the change or not.

See the Accessory Interface Specification (page 26) for more information.

42. Out-of-Band Bluetooth Pairing

Accessories with the ability to connect to a device using Bluetooth and a wired transport should use the Out-of-Band Bluetooth Pairing feature to simplify Bluetooth connection setup.

For example, USB to Lightning charge cables or Lightning to USB accessory cables can be used to exchange Bluetooth pairing information upon initial connection. This may reduce or eliminate the need for instruction manuals to describe how to:

- Put the accessory into a discoverable and pairable mode.
- Initiate Bluetooth pairing on the device using the Settings app.
- Download the accessory's companion app and initiate pairing from the app.

See the Accessory Interface Specification (page 26) for more information.

43. Siri

Siri enables a user to have rich interactions with a device by primarily using their voice.

Accessories supporting Siri over Bluetooth using HFP commands shall not use an icon resembling the Siri microphone icon.

To support Siri using other transports and protocols, the accessory developer shall be a member of the Apple MFi Program (page 26).

43.1 Enabling Custom Siri Commands

Accessories supporting Siri over Bluetooth using HFP commands shall support HFP Command AT+XAPL (page 156). The device will use the information sent by this command to enable and disable custom commands related to Siri.

To receive Siri status events, the accessory shall send the AT+XAPL command after making a successful HFP Service Level Connection (SLC) to the device. The accessory should send an AT+XAPL command first, before sending any of the additional Siri-specific commands described below.

43.2 Obtaining Siri Availability Information

After establishing an HFP profile connection, an accessory can determine if Siri is available and enabled on a device. It can also receive notifications of changes in Siri status. If Siri is disabled, Voice Control will be activated instead.

43.2.1 Obtaining Status Information at Connection

The accessory should send the following command after making a successful HFP profile (SLC) connection and sending an AT+XAPL command.

43.2.1.1 HFP Command AT+APLSIRI?

Description: An accessory sends this command to retrieve Siri status information.

Initiator: Accessory

Format: `AT+APLSIRI?`

Response: `+APLSIRI:`*value*

Defined Values:
- 0 = Siri is not available on this platform.
- 1 = Siri is available and enabled.
- 2 = Siri is available but not enabled.

Example: `+APLSIRI:1` (Siri is available and enabled)

43.2.2 Receiving Siri Availability Updates from the Device

After initialization has been completed, the device will send the accessory the following notification if there is a change in Siri status. This notification will be provided only if the accessory has requested Siri status (by sending `AT+APLSIRI?`) at least once after connection and if the device has reported Siri is available and enabled.

43.2.2.1 HFP Command +APLSIRI

Description: Unsolicited event indicating a change in Siri status.

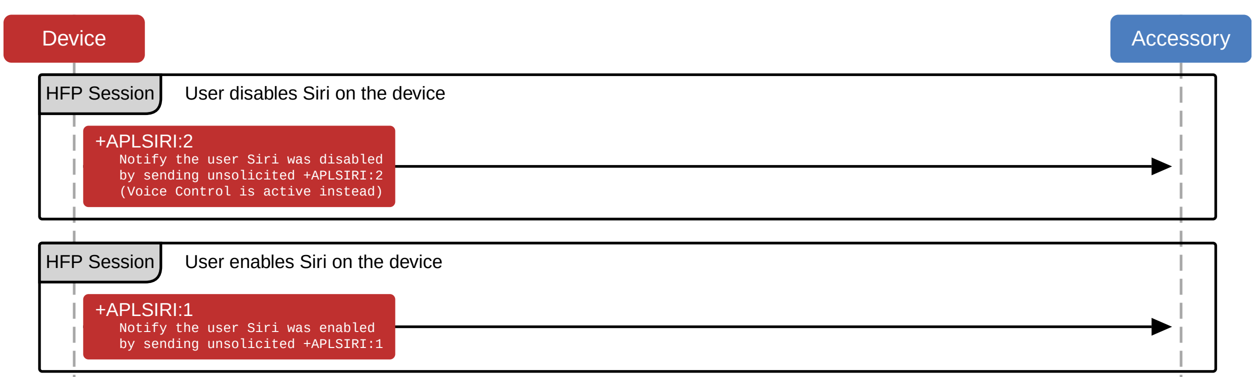
Initiator: Device

Format: `+APLSIRI:`*value*

Defined Values:
- 1 = Siri is available and enabled.
- 2 = Siri is available but not enabled.

Example: `+APLSIRI:2` (Siri is available but not enabled)

Figure 43-1 Siri is Disabled/Enabled from the Device's Settings



43.3 Initiating a Siri Session

Once support for Siri is established on both the accessory and the device, a Siri session can be started from either one.

43.3.1 Initiating a Session from the Accessory

The accessory should only initiate a Siri session as a result of a direct user action.

The accessory shall use the voice recognition command `AT+BVRA` defined in the *Bluetooth Hands-Free Profile Specification – Version 1.6, Section 4.25* to initiate a Siri session.

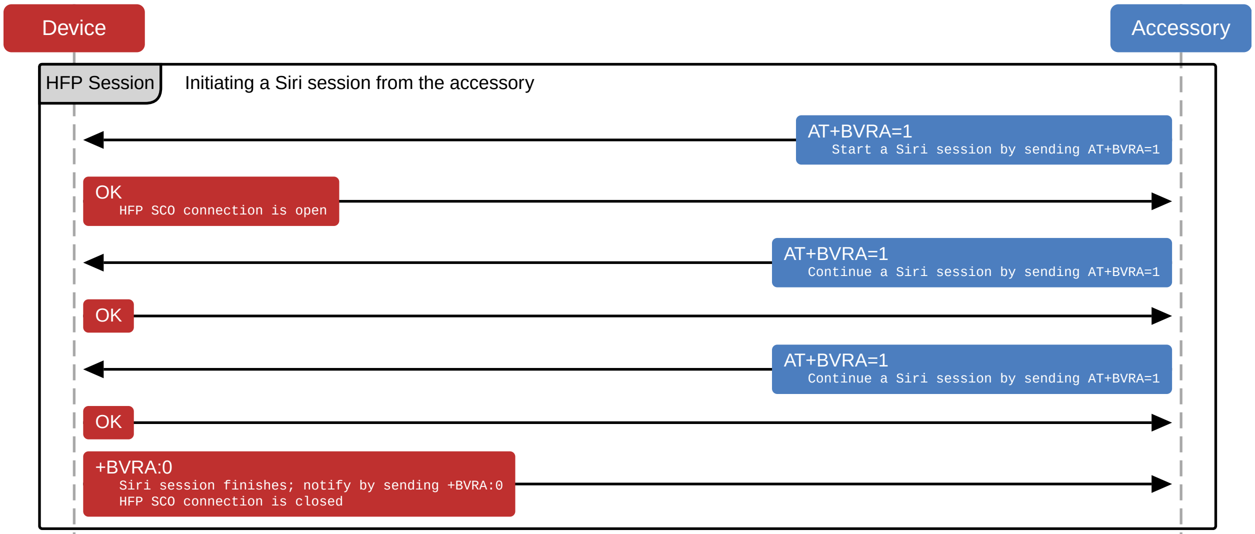
The HFP profile shall be connected and SLC shall exist.

The accessory should use the following command sequence:

- The accessory sends an `AT+BVRA=1` command to the device.
- The device sends an `OK` response.
- The device activates a Siri session and creates a Synchronous Connection (SCO) for the audio.
- If the Siri session is not finished, the accessory shall send `AT+BVRA=1` to continue the conversation. This may need to happen multiple times.
- When the Siri session is finished, the device sends a `+BVRA:0` result code to the accessory.
- The device disconnects the SCO connection.

While a Siri session is active, the accessory shall let the user continue the conversation and ask follow up questions within the current context. In order to do so, the accessory shall be able to send an `AT+BVRA=1` command to the device even after Siri has been already activated and before `+BVRA:0` is received. Figure 43-2 (page 204) shows an overview of the interaction when Siri is triggered from the accessory, the running session was continued twice and once Siri was finished, the device dismissed the session.

Figure 43-2 Initiating a Siri Session from the Accessory



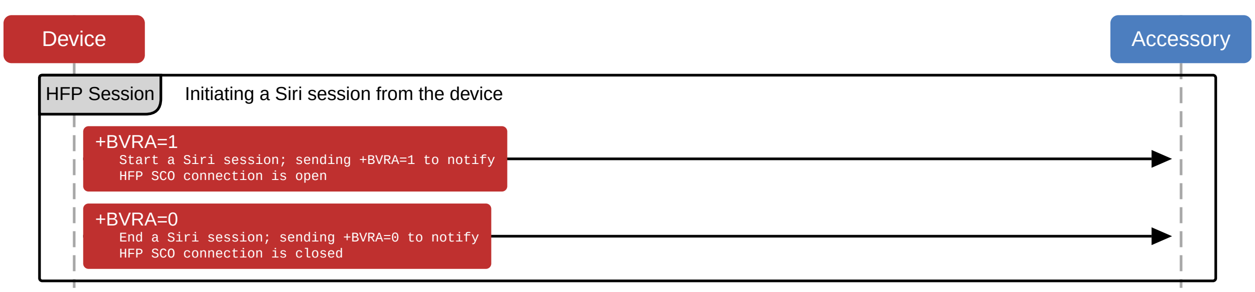
43.3.2 Initiating a Session from the Device

If the accessory supports voice recognition commands, the device sends a +BVRA event to indicate the start of a Siri session. The accessory shall enable support for voice recognition and indicate it in its feature response as described in the *Bluetooth Hands-Free Profile Specification—Version 1.6, Section 4.34.1*. Specifically, the HFP profile shall be connected, SLC shall exist, and voice recognition activation (bit 3) shall be enabled in the `AT+BRSF` command. The device will not use virtual call functionality for the Siri session if voice recognition activation is supported by the accessory.

The accessory should expect the following command sequence:

- The device sends a `+BVRA:1` event to the accessory.
- The device activates a Siri session and creates a SCO connection for the audio.
- When the Siri session is finished, the device sends a `+BVRA:0` result code to the accessory.
- The device disconnects the SCO connection.

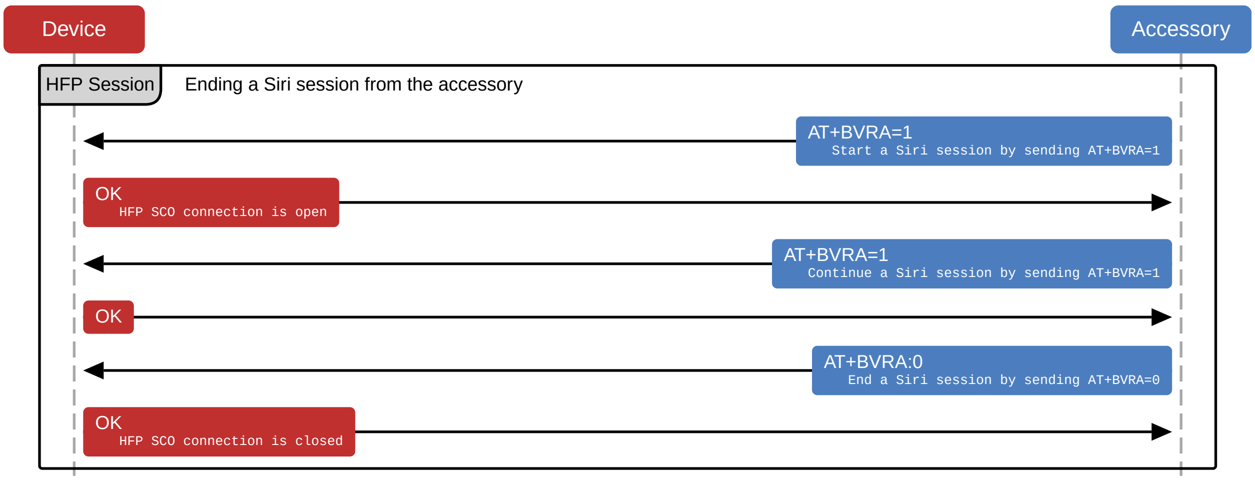
Figure 43-3 Initiating a Siri Session from the Device



43.3.3 Ending a Session from the Accessory

Once a Siri session is running the accessory shall be capable of ending the session by sending an `AT+BVRA=0` command to the device. Figure 43-4 (page 205) shows an example of ending a running Siri session from the accessory. The accessory should only end an active session as a result of a direct user action.

Figure 43-4 Ending a Siri Session from the Accessory



43.4 Siri Eyes Free Mode

Siri Eyes Free mode is a feature to control Siri responses including display information and can be enabled or disabled as needed. In Siri Eyes Free mode, the user experience is tailored towards a driving scenario and interactions with Siri are done primarily using voice to minimize the need for the user to look at a screen. Siri Eyes Free mode is supported only for Bluetooth-enabled vehicle entertainment systems and should not be used by any other accessories. Siri Eyes Free should not be triggered using a voice command.

The device will listen for the HFP AT command `AT+APLEFM` to enable or disable Siri Eyes Free mode.

This command is used by the device to modify Siri responses containing visual information or requiring user interaction. Suitable audio feedback and voice commands will be available to the user based on the initiated Siri use case.

Siri Eyes Free mode is disabled by default. Once the accessory has enabled Siri Eyes Free mode, it remains enabled for all subsequent Siri sessions initiated from the accessory until the accessory disables it or the Bluetooth connection is disconnected.

43.4.1 HFP Command AT+APLEFM

Description: An accessory sends this command to notify a device of the preferred state of Siri Eyes Free mode.

Initiator: Accessory

Format: `AT+APLEFM=`*value*

Response: `OK`

Defined Values:
- `0x00` = Disable Siri Eyes Free mode.
- `0x01` = Enable Siri Eyes Free mode.
- `0x02-0xFF` = reserved

Example: `AT+APLEFM=1`

43.5 Improving Voice Recognition

The microphone audio an accessory sends to the device during a Siri session should be suitable for voice recognition. Audio requirements for optimal voice recognition may differ from requirements for optimal human perception (for example, during a cellular phone call).

Filtering of the audio signal to remove echoes or feedback noise is acceptable.

To provide the best possible audio quality as Siri input, the accessory shall observe the following recommendations:
- **Echo cancellation and noise suppression (EC/NR)**: Directional microphones and linear beamforming with microphone arrays giving improved SNR are recommended. Linear echo cancellation for reducing unwanted audio sources (such as audio output from the system) without having any other effect on the speech signal are also recommended. However, single channel noise reduction methods (such as spectrum subtraction) shall not be applied, as they will be detrimental to the speech recognition accuracy. Similarly, automatic gain control, residual echo suppression and attempts to blank out non-speech periods in the waveform shall not be applied.
- **Signal gain**: When adjusting signal levels, the accessory shall avoid artifacts, dropouts, and clipping in all circumstances. Automatic Gain Control is not recommended. If the accessory adjusts signal gain, the gain should be held constant across each spoken utterance. The nominal level measured at the uplink output of the accessory should be A-weighted -30 dB ±2 dB root-mean-square (RMS), expressed in units relative to full-scale (dBFS(A)). Alternatively, the nominal level may be 13 dB ±2 dB SLR if using the ITU measurement procedure.
- **Signal-to-noise ratio (SNR)**: The average SNR should be greater than 20 dB. Below 20 dB, recognition rates will be impacted.

- **Reverberation**: An RT60 time less than 200 ms should be maintained.

43.5.1 Wide Band Speech Support

An accessory using Siri should support 16 kHz wide band speech audio for better audio quality and voice recognition performance. See the *Bluetooth Hands-Free Profile Specification –Version 1.6* for details about wide band speech audio. Narrow band audio signal (8 kHz) is supported but not recommended.

43.6 Optimizing the Siri Experience

The start of a Siri session should not be accompanied by local beeps or verbal indications (such as an announcement of "...voice dialing...") from the accessory. When a Siri session becomes active, the device sends two beeps indicating Siri is ready to receive instructions. Adding extra audible notifications only inserts delays in the system.

The accessory should wait for the device to end each Siri session.

The accessory should not send an `AT+BVRA=0` command unless it is prompted to do so by user interaction.

The accessory should be capable of rendering audio within 200 ms of SCO connection activation to ensure the user always hears the Siri introductory beeps.

43.7 Common Siri Applications

Siri can send messages, find points of interests, place phone calls, and much more. As Siri capabilities are constantly growing, additional use cases may become available after the initial integration. In Siri Eyes Free mode, some of these use cases may not be accessible as the user experience is tailored towards a driving scenario.

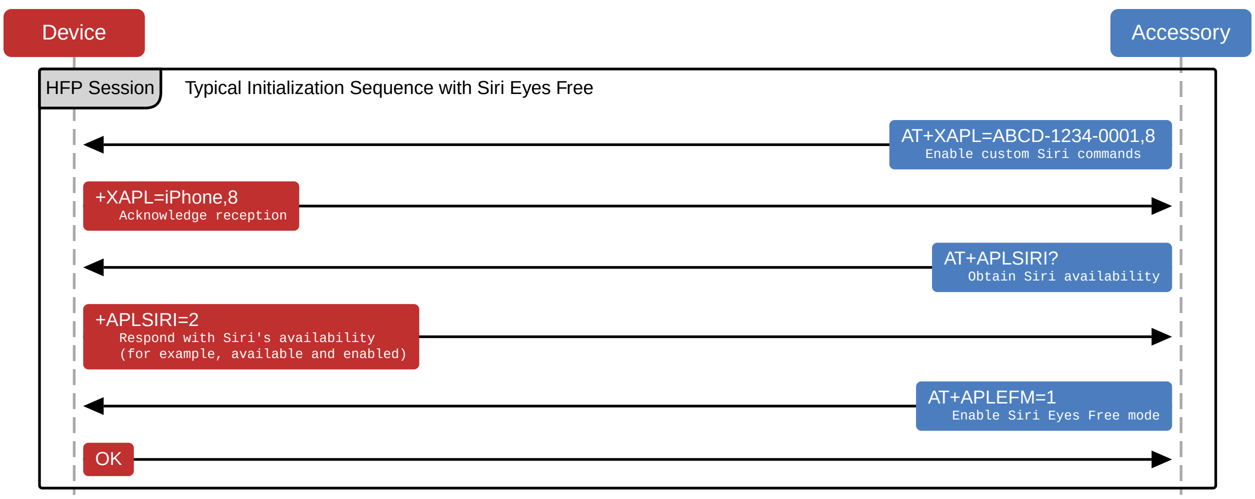
43.7.1 Initialization Procedure After Connection is Established

Figure 43-5 (page 208) outlines the sequence the accessory has to trigger to be able to use Siri on a device. After establishing an HFP profile connection, the accessory shall first enable the custom Siri commands by sending `AT+XAPL` and provide the features it supports. After a confirmation is received from the device, the accessory should determine Siri's availability with `AT+APLSIRI?`.

Vehicles with Bluetooth-enabled infotainment systems can also enable Siri Eyes Free Mode during initialization. This is detailed in Figure 43-6 (page 208).

Figure 43-5 Siri Initialization Procedure

Figure 43-6 Siri Initialization Procedure with Siri Eyes Free



43.7.2 Phone Dialing Using Siri

Upon user request, Siri can initiate an outgoing phone call. The device will initiate HFP call signaling to establish a phone call as described in Bluetooth (page 234). The accessory shall be able to transition to Hands-Free dialing at any time during or after a Siri session when signaled by the device.

43.7.3 Audio Routing and Media Playback Using Siri

Siri can control the media playback on a device, and if Siri determines the user wants to play or pause music, Siri will either start, pause or resume media playback. The device will send a notification to the accessory indicating a change in playback state and any associated track information. The accessory shall respond to the notifications, start or stop the music playback as requested, as well as update the correct playback state (for example, shuffle, repeat).

The accessory shall not force a change in the playback state after a Siri session is ended. If music was playing before Siri was started, it shall continue playing, if it was paused, it shall remain paused.

After Siri starts music playback the accessory shall set its current audio route to match the audio source, depending on how audio is being received from the device (using Bluetooth or by a wired connection).

The available media playback notifications depend on the audio route being used:

- Bluetooth audio routes shall use the approach described in Notifications (page 241) and Audio Data Received using A2DP Profile (page 243).
- Wired audio routes shall use iAP2.

43.7.4 Turn-By-Turn Directions Using Siri

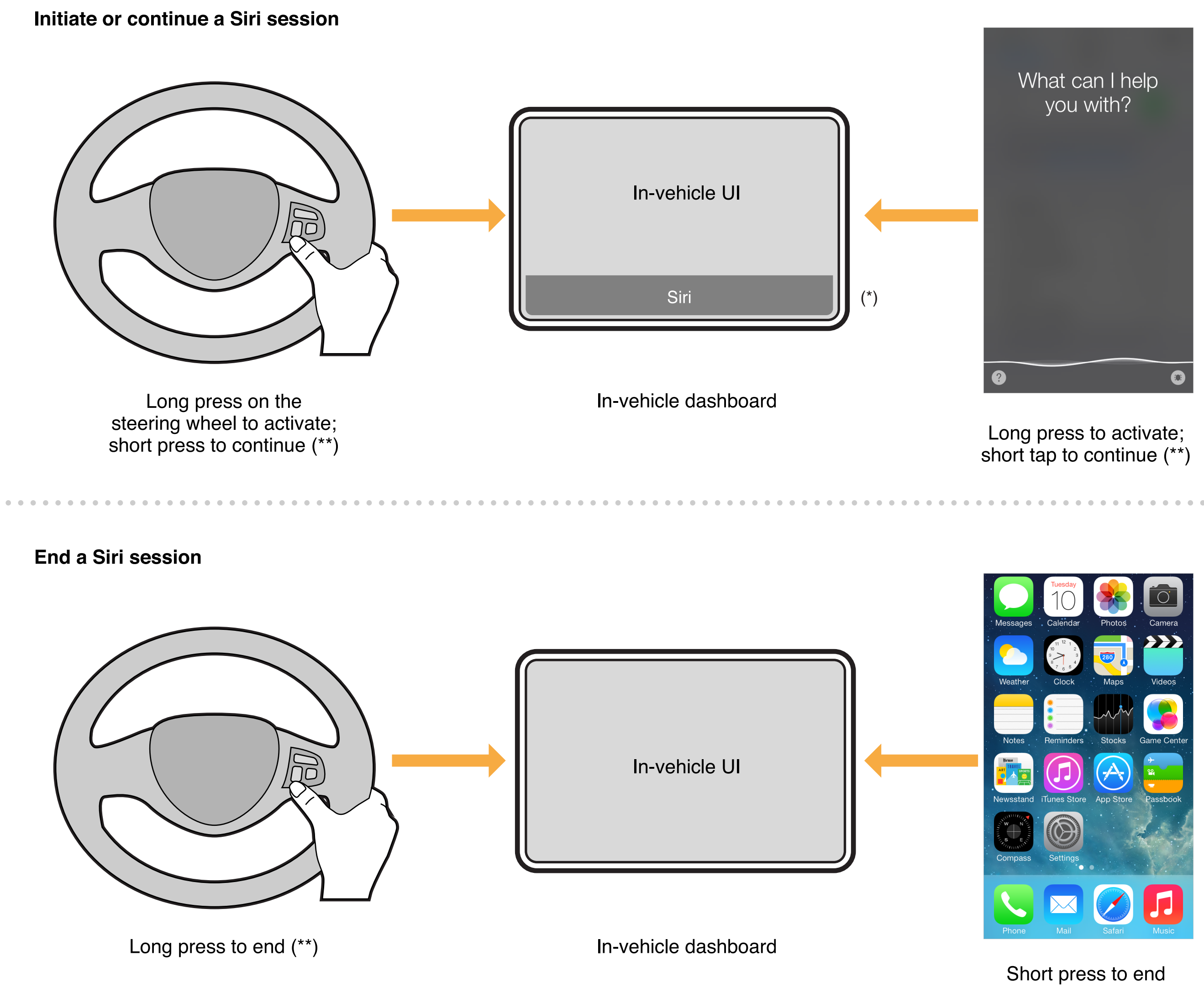
Siri can initiate active route guidance to provide turn-by-turn directions. In case the device is the active source and is already playing music, turn-by-turn directions will be mixed in as part of the audio stream. In case the device is not playing music, the accessory should be able to mix in turn-by-turn directions with the active audio source.

The device will notify the accessory to play turn-by-turn directions only over Bluetooth. Detailed information on how to distinguish between music playback and turn-by-turn notifications is available in Notifications (page 241).

43.8 User Interaction with Siri Eyes Free in a Vehicle

A vehicle using Siri Eyes Free mode shall integrate the Siri experience with the existing in-vehicle entertainment system and controls. The vehicle should provide a convenient interface to initiate, continue, and end a Siri session. Once a Siri session is running, the vehicle shall display a visual cue indicating voice recognition is in use. Figure 43-7 (page 210) outlines how a Siri interaction should be designed.

Figure 43-7 Siri Eyes Free user interaction



As shown in Figure 43-7 (page 210):

- (*) If the accessory wishes to indicate Siri is active, it shall either:
  - Display the word 'Siri' (as capitalized) with no additional text or icon.
  - Use generic text or icon not resembling the Siri microphone icon.
- (**) If the vehicle is equipped with steering wheel controls, the steering wheel shall have a dedicated button or a long-press action on a button to start, continue and end a Siri session. The button long-press shall be 600 ms or less. If no steering wheel controls are available, a soft button shall be available within the in-vehicle user interface to start, continue or end a Siri session.

When a vehicle enables Siri Eyes Free mode, the device will not display any onscreen Siri content. If the device was locked at the time the Siri session was activated from the vehicle, it will remain locked and the screen will not wake. If the user unlocks or manually activates the device while in an Eyes Free Session there will be a notification the device is in an active Siri session but there will be no visual Siri content displayed.

43.9 Enabling/Disabling Siri from the Device

The user has the ability to disable or enable Siri from the Settings menu on the device. When Siri is disabled, Voice Control becomes the recognition engine on the device and will be triggered by default. The accessory may choose to either:

- Activate Voice Control (in the same way Siri is activated) as in Figure 43-8 (page 211).
- Display a warning message and not send an activation command to the device as in Figure 43-9 (page 212).

Figure 43-8 Siri is disabled - activating Voice Control

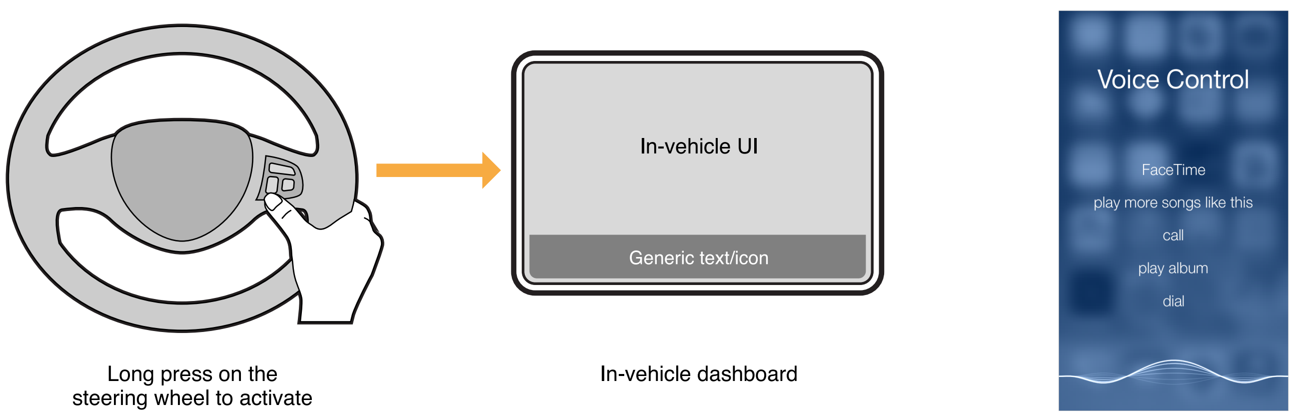
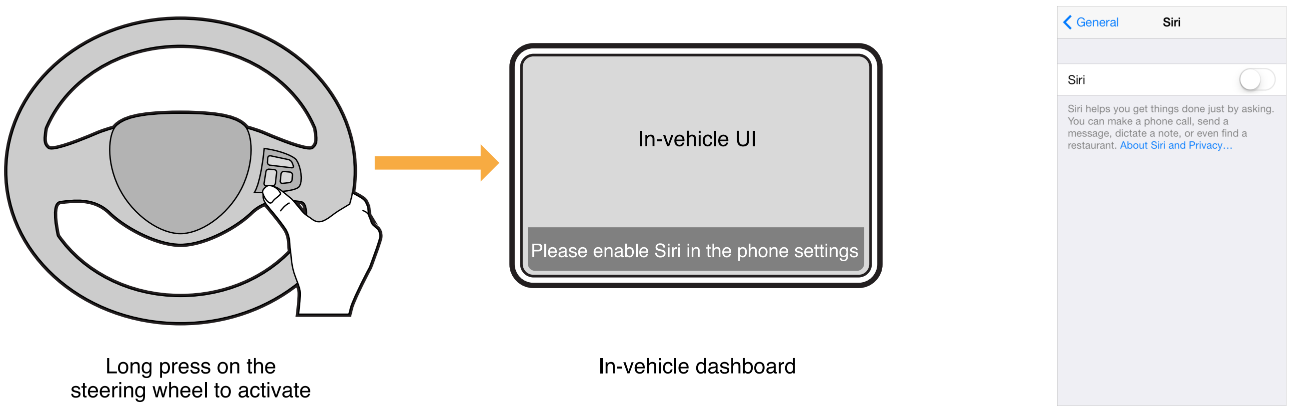


Figure 43-9 Siri is disabled - displaying a warning message



43.10 Verification

43.10.1 Siri Eyes Free

The following test procedures are applicable to accessories interacting with Siri Eyes Free.

The ideal test operator is a native speaker of North American English. If the operator's native language is not North American English, set Siri to the operator's native language and translate the provided phrases into their native language.

43.10.1.1 General

1. Pair and establish a Bluetooth Hands-Free Profile (HFP) connection between the device and the head unit. Activate Siri from the vehicle steering wheel button (for example, by pressing and holding):
   a. Observe the device screen remains inactive after a Siri session has started (a visual indicator will be visible on the device if the screen is activated manually).
   b. Ensure Siri's opening chime is heard completely through the vehicle speakers.
   c. Observe a visual notification in the in-car User Interface (UI) indicating a Siri session is active (for example, text notification, on-screen UI).
2. Activate Siri from the vehicle steering wheel button and say "Send a message to Peter. How are you?". While still saying the message, press the vehicle steering wheel button to cancel Siri:
   a. Ensure the device screen remains inactive (if manually activated, the visual indicator on the phone will disappear).
   b. Verify the in-car Siri UI interaction is dismissed and the head unit returns to its prior state before the Siri interaction.

3. Activate Siri from the vehicle steering wheel button and say "How is the weather in San Francisco?". Wait for Siri to respond with the weather forecast. Once the weather forecast is complete, resume Siri from the vehicle steering wheel button and say "What about New York?":
    a. Confirm the visual indicator is still active on the phone.
    b. Listen for the Siri opening chime.
    c. Verify the vehicle UI indicates a Siri session is active.
    d. Verify Siri responds with the weather forecast for New York.
4. In case the vehicle UI offers on-screen controls to activate/cancel/resume Siri, repeat steps (1) to (3) for all on-screen controls.
5. Activate Siri from the steering wheel button and say "What's the time?". Listen to the current time and do not interact with Siri or the device. After 5 seconds have expired:
    a. Observe the visual Siri session indicator on the phone is no longer visible.
    b. Verify the in-car UI for Siri interaction was dismissed.
    c. Verify the head unit returned to its prior state before the Siri interaction.
6. Listen to FM radio from the car speakers (for example, no A2DP streaming active). Press and hold the device Side/Top/Home button to activate Siri:
    a. Observe a visual notification in the in-car UI indicating a Siri session is active (textual notification, on-screen UI, etc.).
    b. Observe Siri's interaction on the device screen and ask "What's the time?".
    c. After Siri has responded, lock the device again to dismiss the Siri session by pressing the device Side/Top/Home button.
7. Open Settings and turn Siri off. Activate Siri from the head unit. Observe one of the following depending on the actual implementation (a) Voice Control starts instead of Siri (b) The head unit displays a warning indicating Siri Eyes Free is not available.
8. Open Settings and turn Siri back on. Verify Siri can be activated/cancelled from the head unit and from the device Side/Top/Home button.
9. Open Settings and turn Bluetooth off. Verify Siri cannot be started.
10. Open Settings and turn Bluetooth back on. Verify Bluetooth HFP profile reconnects and Siri can be activated/cancelled from the head unit and from the device Side/Top/Home button.
11. Confirm there is no accessory battery status level indicator icon displayed on the device status bar.

43.10.1.2 Siri Dialog

1. Activate Siri from the vehicle's steering wheel button and say "Send a text message to *insert contact name*". When Siri prompts "What would you like it to say?", dictate a short message. After Siri has read back the dictated message, say "Review it". After Siri has read back the message again, say "Review it" again. Repeat this cycle ~5 times to ensure the head unit is able to handle a long interaction with Siri. At the end say "Send it" and verify the message is sent. Verify the opening

chime is audible and the message is sent. After the Siri session is closed, verify the audio playback went back to the audio state it was in before Siri was activated (that is, if audio was paused it remains paused, if it was playing it resumes playing).

2. Start Siri from the vehicle's steering wheel button and ask for directions. Follow up through the dialog until the navigation is started. Verify the Siri session is closed and the audio playback returns to the audio state it was in before Siri was activated (that is, if audio was paused it remains paused, if it was playing it resumes playing).
3. Start Siri from the vehicle's steering wheel button and say "Search the web for polar bears". Verify Siri Eyes Free mode is on and this use case is blocked by Siri. In some implementations the vehicle has to be in motion before Siri Eyes Free is activated by the car kit.
4. Start Siri from the vehicle's steering wheel button and say "What is the current time in Munich?". After Siri answers but before ~5 seconds have elapsed, resume Siri (for example, using a short press on the steering wheel button) and verify Siri is activated again. Say "What about San Francisco?". Repeat (with a different city) and verify this can continue indefinitely as long as there is a short press on the steering wheel button within 5 seconds of the last response.

43.10.1.3 Bluetooth HFP A2DP Music

1. Establish a Bluetooth A2DP connection and switch to Bluetooth audio source on the head unit. Activate Siri and say "Next track". Verify the track advances and audio is played through the vehicle speakers. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
2. Activate Siri and say "Pause the music". Verify audio remains paused after Siri has been dismissed. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
3. Pause music playback on the head unit (using AVRCP command). Activate Siri and ask "What time is it?". Verify the music playback remains paused after the Siri session has been dismissed. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
4. Switch to FM radio on the head unit. Activate Siri and say "Play me a song". Verify the head unit is able to automatically switch to Bluetooth audio and music starts playing. Verify the beginning of the selected track is heard (for example, there is no skipping of audio packets). Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
5. Activate Siri and say "Shuffle all songs". Verify the head unit correctly updates the NowPlaying track information. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
6. Activate Siri and ask to play a specific artist or title. Verify the Siri session is dismissed after the music starts. Confirm the correct metadata is displayed on the screen. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.

43.10.1.4 Call

1. Activate Siri and call a contact with more than one phone number (for example, home and mobile). Wait for Siri's response asking which phone number to call. Answer with "home". Verify call transition is handled correctly by the head unit and any Siri UI displayed on the vehicle screen is dismissed.
2. While device music is playing, activate Siri and say "Call *(insert contact to call)*". Verify call transition is handled correctly by the head unit. Verify device music playback resumes after the call has been answered and terminated on the far end. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
3. While device music is playing, start Siri and say "Call *(insert contact to call)*". Verify call transition is handled correctly by the head unit. Verify device music playback resumes after the call has been answered and terminated on the near end (that is, on the head unit). Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
4. While in a Siri session, receive an incoming call on the head unit. Verify the head unit handles call-signaling correctly and transitions to the phone UI once the call has been accepted. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.

43.10.1.5 Bluetooth + Wired iAP2

1. Connect the device to the head unit. Switch to device audio and verify audio is playing. Activate Siri and say "Next track". Verify the track advances and the head unit displays the track metadata correctly. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
2. From the head unit UI, select a playlist with a single song and start playing it. Start Siri from the vehicle steering wheel and say "Play .... *make sure to select a song to play (a) not in the same album as the single-track playlist and (b) not song track index 0 of its album*". Verify the new song starts playing and the head unit correctly displays the track metadata for the new song. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
3. Turn Shuffle off on the head unit UI. Then start Siri and say "Shuffle all songs". Verify the shuffle indicator on the head unit UI is updated and the correct track metadata for the new now playing song is displayed correctly. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
4. Switch to FM radio on the head unit. Activate Siri and say "Play me a song". Verify the head unit is able to automatically switch to device audio source and music starts playing through the speakers. Verify there is no skipping of audio at the beginning of the selected track. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
5. Pause music playback on the head unit (using iAP2 commands). Activate Siri and ask "What time is it?". Verify music playback remains paused after the Siri session has been dismissed. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.

6. While device music is playing, start Siri and say "Call *(insert contact to call)*". Verify call transition is handled correctly by the head unit. Verify device music playback resumes after the call has been answered and terminated on the far end. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
7. While device music is playing, start Siri and say "Call *(insert contact to call)*". Verify call transition is handled correctly by the head unit. Verify device music playback resumes after the call has been answered and terminated on the near end (for example, on the head unit). Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.
8. Pause music playback on the head unit (using iAP2 commands). Start Siri and say "Call *insert contact name to call*". Verify call transition is handled correctly by the head unit. Verify device music playback remains paused after the call has been answered and terminated on the far end. Verify the Siri in-car UI is dismissed and the head unit returns to its initial audio state.

44. Wi-Fi Information Sharing

Wi-Fi configuration information can be exchanged between devices and accessories.

Devices can share Wi-Fi configuration information with an accessory. The accessory can initiate this process, but the user shall grant permission for the device to share this information. The device can only share information about the currently connected Wi-Fi network, and this feature will not account for other router-configured access control mechanisms, such as RADIUS or MAC address filtering.

Figure 44-1 Wi-Fi information sharing alert

See the Accessory Interface Specification (page 26) for more information.

Protocols

45. USB Power Capability Vendor Request

If the accessory is a USB host, and it does not implement iAP2 (page 229), then it may send an Apple-specific USB vendor request communicating how much power is available to the device. In this case, the accessory shall enumerate and identify the presence of a device, then send the vendor request. The vendor request shall be sent every time the device is enumerated by the accessory.

Table 45-1 USB Vendor Request for non-iAP2 accessory USB Embedded Host

Field	Value	Comments
`bmRequestType`	`0x40`	Device-to-host request, vendor-defined type, device is recipient.
`bRequest`	`0x40`	Vendor-defined USB get enabled capabilities request.
`wValue`	See comments.	Charging current available, expressed as an offset from 500 mA. Shall be 500 (1000 mA charging current available), 1000 (1500 mA charging current available), 1600 (2100 mA charging current available), 1900 (2400 mA charging current available), or 2500 (3000 mA charging current available).
`wIndex`	See comments.	Shall be the same as wValue.
`wLength`	`0`	0 bytes expected.

46. USB D+/D- Resistor Networks

Accessories not implementing any of the following may use USB resistor networks to identify their current capability:

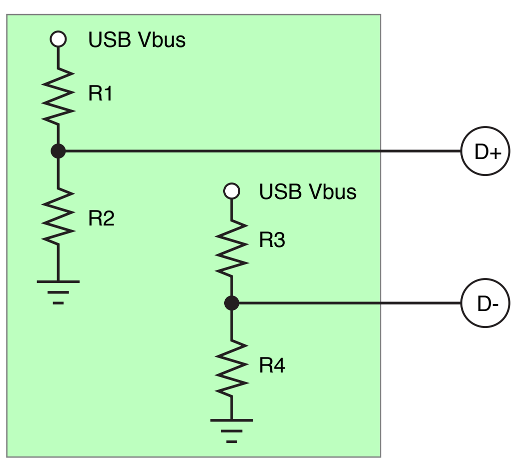
- iAP2 (page 229).
- USB Power Capability Vendor Request (page 219).
- USB Type-C Current (page 224).
- USB Power Delivery (PD) (page 223).

Device power draw varies with environmental factors. Accessory power source testing shall be performed with programmable loads, not devices.

46.1 Declaring Power Source Capability

Accessories shall connect the USB D+ and USB D- pins to resistor networks as shown in Figure 46-1 (page 220).

Figure 46-1 USB D+/D- resistor networks



Every iOS device-compatible connector on an accessory using a USB resistor network shall have its own set of resistors. The accessory shall be capable of supplying the total current required when all connectors are in use, regardless of whether the connectors are compatible with devices or not.

The resistor network shall be connected at all times unless the accessory uses one of the following methods to enable charging or detect the presence of a device. In these cases, it shall immediately present the resistor network. The accessory:

- Uses a direct user action to enable charging.
- Senses the attachment of the device using electromechanical means such as a contact switch.

The accessory shall not monitor the USB D+ and USB D- pins to detect the presence of a device.

Resistors used to implement the networks specified in Figure 46-1 (page 220) shall have a tolerance of 1% or better. The resistor network shall not be emulated by driving the voltage of the USB D+/D- pins using some other means.

Table 46-1 USB D+/D- resistor values

Max Current	R1	R2	R3	R4
3000 mA	43.2 kΩ	49.9 kΩ	24.9 kΩ	49.9 kΩ
2400 mA	43.2 kΩ	49.9 kΩ	43.2 kΩ	49.9 kΩ
2100 mA	43.2 kΩ	49.9 kΩ	75.0 kΩ	49.9 kΩ
1000 mA	75.0 kΩ	49.9 kΩ	43.2 kΩ	49.9 kΩ

46.2 Identifying Power Source Current Limit

Accessories shall take into account the variation of USB VBUS voltage and resistor tolerances.

The resistor network values and corresponding current source limits should be identified using the following procedures:

1. Read the VBUS voltage using an ADC. If value is less than 4.5 V, return no resistors detected.
2. Pull-down the D+ and D- lines and read the voltage using an ADC. If either voltage value is less than 1 V, return no resistors detected.
3. Disable the D+ and D- pull-downs and allow the voltage to return to normal.
4. Read the D+ and D- voltages using an ADC (to determine the value for R1 and R3 respectively):
   - If voltage is >2.995 V (based on 1 MΩ load impedance), assume a resistor value of 24.9 kΩ.
   - If voltage is between 2.320 V and 2.995 V (based on 1 MΩ load impedance), assume a resistor value of 43.2 kΩ.
   - If voltage is < 2.320 V (based on 1 MΩ load impedance), assume a resistor value of 75.0 kΩ.
5. Determine the max current based on Table 46-2 (page 222).
6. If resistor values could not be identified, proceed to identify the power available based on the *USB Battery Charging Specification –Release 1.2*.

Table 46-2 USB D+/D- resistor values

Max Current	R1	R2	R3	R4
1000 mA	24.9 kΩ	49.9 kΩ	24.9 kΩ	49.9 kΩ
1000 mA	24.9 kΩ	49.9 kΩ	43.2 kΩ	49.9 kΩ
1000 mA	24.9 kΩ	49.9 kΩ	75.0 kΩ	49.9 kΩ
3000 mA	43.2 kΩ	49.9 kΩ	24.9 kΩ	49.9 kΩ
2400 mA	43.2 kΩ	49.9 kΩ	43.2 kΩ	49.9 kΩ
2100 mA	43.2 kΩ	49.9 kΩ	75.0 kΩ	49.9 kΩ
1000 mA	75.0 kΩ	49.9 kΩ	24.9 kΩ	49.9 kΩ
1000 mA	75.0 kΩ	49.9 kΩ	43.2 kΩ	49.9 kΩ
500 mA	75.0 kΩ	49.9 kΩ	75.0 kΩ	49.9 kΩ

47. USB Power Delivery (PD)

Accessories providing direct power using USB Power Delivery (PD) or drawing power from USB PD sources shall comply with the *USB Power Delivery Specification –Revision 3.1, Version 1.3*, see https://www.usb.org/document-library/usb-power-delivery.

Accessories implementing USB PD shall incorporate a USB-IF certified PD controller with a *Silicon* Test ID from the USB-IF, see https://www.usb.org/products.

Apple recommends the GRL-USB-PD-C2 (see https://www.graniteriverlabs.com/en-us/test-solutions/protocol-power-test-solutions/usb-pd-c2) for USB PD testing and compliance verification.

48. USB Type-C Current

Accessories providing direct power using USB Type-C Current or drawing power from USB Type-C Current sources shall comply with the *USB Type-C Cable and Connector Specification –Release 2.3, Section 4.6.2*.

Apple recommends the GRL-USB-PD-C2 (see https://www.graniteriverlabs.com/en-us/test-solutions/protocol-power-test-solutions/usb-pd-c2) for USB Type-C Current testing and compliance verification.

49. Advanced Audio Distribution Profile (A2DP)

Accessories may implement the Advanced Audio Distribution Profile (A2DP) over Bluetooth (page 234) to receive audio from iPhone, iPad, Apple Watch, Apple TV, Mac, and Apple Vision Pro.

The audio content from the device can be broadly classified into two categories:

- Audio content from music, video, or gaming applications.
- System-generated sounds for alerts and notifications.

A2DP is often implemented in speakers and headsets.

Accessories implementing A2DP shall satisfy all requirements stated in Bluetooth (page 234).

49.1 Bluetooth A2DP Specification

Accessories implementing the Advanced Audio Distribution Profile (A2DP) shall meet the requirements of the Bluetooth *Advanced Audio Distribution Profile Specification – Version 1.2*.

49.1.1 AVDTP Transactions

Accessories shall respond to Audio/Video Distribution Transport Protocol (AVDTP) signaling transactions before the device's five second RTX_SIG_TIMER expires or the device will terminate the signaling channel. See Bluetooth *Audio/Video Distribution Transport Protocol – Version 1.3, Section 6.2 Transaction Model and Section 6.4 Signal Command Set*.

49.2 SubBand Codec (SBC)

The SBC Codec Specific Information Elements, defined in *Advanced Audio Distribution Profile Specification – Version 1.2, Section 4.3.2*, applicable to iOS devices and Mac computers are listed in Table 49-1 (page 226).

Table 49-1 SubBand Codec Information Elements for iOS devices and Mac computers

Element	Value
Sampling Frequency	44,100 Hz
Channel Mode	Stereo
Block Length	16
Subbands	8
Allocation Method	Loudness
Bitpool range	2 to 53. Accessories for iOS devices and Mac computers should support 53.

49.3 MPEG 2/4 AAC Codecs

Devices support the non-mandatory codec MPEG-2/4 AAC, as defined in *Advanced Audio Distribution Profile Specification – Version 1.2, Section 4.5*. Accessories should use the AAC codec in addition to SBC, because AAC provides higher audio quality for a given bit rate.

Note:
The following specifications provide details of Apple's implementation of the MPEG-2/4 AAC codec. In case of conflicts, the A2DP specification governs.

The MPEG 2/4 AAC Codec Specific Information Elements, defined in *Advanced Audio Distribution Profile Specification – Version 1.2, Section 4.5*, applicable to devices are listed in Table 49-2 (page 226).

Table 49-2 MPEG-2/4 AAC Codec Information Elements for devices

Element	Value
Object Type	MPEG-2 AAC LC
Sampling Frequency	44,100 Hz
Channels	2
Bit rate	264,630 bps
VBR	0

AAC audio stream packets in devices have the structure shown in Table 49-3 (page 227).

Table 49-3 AAC audio packet for devices

L2CAP	AVDTP	MPEG-4 LATM	MPEG-4 AAC
Header	Header	AudioMuxElement	Audio Payload

The AAC Media Payload Format, as defined in *Advanced Audio Distribution Profile Specification – Version 1.2, Section 4.5.4*, is formatted using LATM as defined in *IETF RFC 3016 – Section 4*. The following notes apply to the packet fields shown in Table 49-3 (page 227).

- The recommended L2CAP MTU value for each device's AAC streaming channel is 885 bytes.
- The AVDTP Header is shown as the RTP header in *RFC 3016 – Figure 4*, defined in Bluetooth *Audio/Video Distribution Transport Protocol – Version 1.2, Section 7.2.1*.
- The `AudioMuxElement` is the same as the *RFC 3016 – RTP payload*, defined in *ISO/IEC 14496-3:2009 – Subpart 1, Section 1.7.3, Table 1.41*. The `muxConfigPresent` argument to the `AudioMuxElement` is set to 1 (in-band mode), as recommended in *RFC 3016 – Section 4.1*. As recommended in *RFC 3016 – Section 4.3*, only one `AudioMuxElement` is put into each AVDTP packet.
- The audio payload is encoded using MPEG-4, as recommended in *Advanced Audio Distribution Profile Specification – Version 1.2, Section 4.5.4*.
- The accessory should support AAC-LC VBR and handle bit rate changes without audio gaps. Devices will vary AAC bit rate depending on the content.

49.4 Verification

49.4.1 Audio Quality

Verify there are no audio quality issues in each of the following scenarios:

1. Stream music from the Apple Music app.
2. Stream music from a radio station within the Apple Music app.
3. Stream audio using the Apple Podcasts app.

49.4.2 Audio Switching

1. During A2DP streaming, switch audio back to device and switch back to accessory.
2. Verify audio was routed to the intended source, and audio quality was good switching back to Bluetooth.

49.4.3 HFP Interaction

1. Make incoming/outgoing call during A2DP.
2. Verify audio was suspended during the call and resumed after the call.

49.4.4 Siri

1. Trigger Siri during A2DP.
2. Verify audio resumed after the Siri session.

49.4.5 Video Playback

1. Stream A2DP while watching a video.
2. Verify audio/video synchronization and quality is good.

50. iAP2

Accessories may use the iAP2 protocol to access advanced device features, such as:

- Communicating securely with third-party iOS/iPadOS apps using the External Accessory Protocol (page 170).
- Accessing the media library and retrieving album artwork using Media Library Access (page 197) and Now Playing Updates (page 199).
- Launching apps using App Launch (page 154).
- Discovering compatible apps using App Discovery (page 153).
- Helping users find compatible apps in the App Store using App Match (page 155).
- Providing GNSS location data using Location Information (page 175).
- Supporting connectivity with Out-of-Band Bluetooth Pairing (page 200) and Wi-Fi Information Sharing (page 217).

See the Accessory Interface Specification (page 26) for more information.

51. Human Interface Device (HID)

Devices can accept input from and send output to Human Interface Device (HID) accessories, such as external keyboards, trackpads, mice, and game controllers. This capability is made available system-wide for all apps on the device as well as to support features built into iOS, iPadOS, and tvOS. If an accessory is designed to provide human input events to a specific third-party app, the accessory should use the External Accessory Protocol feature instead; see the Accessory Interface Specification (page 26) for more information.

The HID protocol can be implemented over:

- USB
- Bluetooth

51.1 Requirements

Accessories shall only send HID reports for changes in physical or virtual control surfaces declared in the corresponding HID descriptor.

Accessories shall not send a HID report if there has not been any change in the state of the corresponding physical or virtual control surface. For example, the accessory shall never generate a "Play/Pause" event without the user pressing a dedicated "Play/Pause" button.

Each HID report shall contain the correct number of bytes as described in its corresponding HID descriptor.

The accessory shall not anticipate or assume corresponding state changes in the device after sending HID reports.

Unless otherwise specified:

- The accessory shall be capable of generating and receiving all HID usages declared in its HID descriptor.
- The accessory's declared HID usages shall map directly to physical or virtual control surfaces on a 1:1 basis. For example, a button labeled "Play/Pause" shall send a Play/Pause HID usage and not "Play" or "Pause" usages. Compound controls such as knobs, joysticks, and directional pads may be considered multiple control surfaces. For example, clockwise and counterclockwise rotation may map to separate HID usages.

- Physical or virtual control surfaces generating HID reports shall be labeled with appropriate iconography or text corresponding to the resulting device behavior. For example, a Play/Pause button shall be labeled with the text 'Play/Pause' or a Play/Pause icon.
- The accessory shall send one HID report in response to each direct user action on the corresponding physical or virtual control surface. For example:
  - When the user presses a button, one 'button pressed' HID report shall be sent to the device.
  - When the user releases the button, one 'button released' HID report shall be sent to the device.

51.1.1 Report Descriptor

When padding packets to align within a byte boundary, each Main item tag (Input, Output, or Feature) shall be marked constant. Padding bits should be set to 0.

When defining Variable type Input/Output fields, either:
- Report Count number shall correspond to the number of Usages specified.
- Report Size shall be 8 and the Report Count shall correspond to the size of a multi-byte blob.

51.1.2 USB

If implementing HID over USB, the accessory shall comply with the *Device Class Definition for Human Interface Devices (HID) –Version 1.11*, see https://www.usb.org/hid.

51.2 Verification

51.2.1 General

1. Verify the accessory generates and receives all HID usages declared in the component's HID descriptor.
2. Verify the accessory does not send a HID report if there has not been any change in the state of the control surfaces (that is, no polling of HID reports).
3. Verify if any accessory has physical or virtual control surfaces generating accessory HID usages, the controls are labeled with appropriate iconography or text corresponding to the resulting device behavior (for example, a Play/Pause button is labeled with the text "Play/Pause" or a Play/Pause icon).
4. Verify HID usages map to physical or virtual controls on a 1:1 basis (for example, Play button only sends Play usages, not Play/Pause).

5. Verify one accessory HID report is sent in response to each direct user action on the corresponding physical or virtual control surface. For example, when the user presses a button, one 'button pressed' usage report is sent, and a separate 'button released' usage report is sent when the user releases the button.

Transports

52. Bluetooth

Accessories integrating Bluetooth technology shall support the *Bluetooth Core Specification – Version 2.1+EDR or later*.

52.1 Enhanced Data Rate

The Enhanced Data Rate (EDR) feature introduced in the *Bluetooth 2.0 Specification* enables accessories to communicate more efficiently. Accessories shall use EDR for the following reasons:

- EDR provides higher data rates compared to Basic Data Rate (BDR).
- EDR communicates more efficiently, transferring more data bits in less time.
- EDR reduces power consumption per bit transferred.
- EDR improves coexistence with Wi-Fi and other Bluetooth accessories by using less airtime.
- EDR improves performance in multipoint configurations.

52.2 Adaptive Frequency Hopping

Adaptive Frequency Hopping (AFH) introduced in the *Bluetooth 1.2 Specification* improves coexistence with Wi-Fi and other connected Bluetooth accessories. Accessories shall use AFH.

52.3 Sniff Mode for Low Power Consumption

Minimizing power consumption is critical for all mobile devices, therefore accessories shall:

- Support and should request Bluetooth sniff mode.
- Accept sniff mode requests and support valid parameters from the Bluetooth specification.
- Support a sniff interval of 15 ms.
- Support sniff subrating.
- Not renegotiate sniff mode after it is established.

Accessories should use sniff mode values of:

- Max Interval: 15 ms
- Min Interval: 15 ms
- Sniff Attempt: 1

- Sniff Timeout: 0

Accessories compatible with iOS devices and Mac computers should use sniff mode as often as possible, especially when there is little or no data being transmitted over the Bluetooth link. Sniff mode enables better antenna sharing with Wi-Fi, in addition to the power consumption advantages.

Sniff mode parameters are specific to the usage model and Bluetooth profile. Accessories should request sniff mode with appropriate parameters for specific usage models. If the accessory does not send a sniff mode request, the device may send a sniff mode request. When the device sends a sniff mode request, the accessory shall accept the request and parameters without negotiation.

If the accessory requests sniff mode, the accessory shall set the sniff interval to less than a third of the Bluetooth baseband Link Supervision Timeout (page 237), to make the Bluetooth link less susceptible to interference. To improve link robustness, the accessory should use a shorter sniff interval instead of multiple sniff attempts.

Links with a sniff interval of 1 second or more require a large correlation window, which has to be taken into account when calculating the number of sniff attempts. With sniff intervals shorter than 1 second, multiple sniff attempts can improve link robustness, but will increase power consumption.

52.4 Role and Topology Management

Accessories shall:

- Accept device Role Switch requests.
- Continue with the connection when the device rejects a request for Role Switch.

In a Bluetooth connection, there are two entities:

- The Central entity establishes a common clock and frequency hopping synchronization reference.
- The Peripheral entity synchronizes with the Central entity.

The Central entity can be synchronized with multiple Peripheral entities, thus forming a piconet. The Central entity can also be a Peripheral entity to another Central entity, creating a scatternet.

Accessories simultaneously connecting to multiple iOS devices or Mac computers shall support creating a scatternet.

Scatternets create complications since the device has to alternate between piconets, wasting valuable bandwidth. Efficiently managing network topology is important to maximize performance. The device may request a Role Switch, depending on its current topology, and the accessory shall accept the request. The device may also reject a Role Switch request due to topology concerns, as suboptimal topologies may degrade audio quality and the user experience.

Accessories should avoid requesting to be the Central entity, as in more frequently occurring scenarios the device needs to be the Central entity. Accessories insisting on being the Central entity may negatively impact the overall user experience.

52.5 Extended Inquiry Response

Accessories shall provide the following information in their Extended Inquiry Response packet:

- Local Name of the accessory (Complete or Shortened).
- TX Power Level.

During Bluetooth discovery, devices display accessories Friendly Names when available. Extended Inquiry Response enables accessories to proactively send their Local Name, and other information, as part of an Inquiry Response to increase the speed and efficiency of the discovery process.

Accessory Local Name should match the accessory's labeling and packaging without colons ':' or semi-colons ';'. Accessories may append up to six differentiating characters to their Local Name, such as the last few digits of a serial number or MAC address, if users are likely to encounter multiple accessories at the same time using the same name. If the accessory allows a user to customize the Local Name parameter, the accessory should provide a means to restore the factory default name.

52.6 Secure Simple Pairing

Accessories shall:

- Use Secure Simple Pairing.
- Use the Numerical Comparison method, if it has a display and input device supporting it.

Secure Simple Pairing greatly increases security, and is a mandatory security feature in the *Bluetooth 2.1 Specification*. To protect against a 'man-in-the-middle' attack, the Numerical Comparison association model should be used whenever feasible. See *Bluetooth 2.1+EDR Specification – Volume 1, Section 5.4*.

52.7 Pairing Button

If the accessory has a labeled dedicated pairing control, it should use official Bluetooth branding. See https://www.bluetooth.com/develop-with-bluetooth/marketing-branding/.

52.8 Class of Device (CoD)

iOS devices and Mac computers use the accessory's Class of Device for UI purposes or to configure specific features. Accessories shall accurately set their Class of Device using the Bluetooth SIG defined Major Device Class and Minor Device Class. See *Bluetooth 5.0 Specification–Volume 3, Part C, Section 3.2.4*. For example, an audio/video accessory intended to operate in a vehicle should set Major Device Class to 'audio/video' and Minor Device Class to 'car-audio'.

52.9 Link Supervision Timeout

Link supervision timeout is used to detect link loss between an accessory and a device. An accessory shall set the link supervision timeout to 2 seconds or greater when it is the Central entity, to account for the unpredictable nature of RF signals, as well as the device's need to service other concurrent wireless systems.

52.10 Delay Reporting

As of iOS 8.2, devices support Delay Reporting commands as specified in the Bluetooth *Audio/Video Distribution Transport Protocol–Version 1.3*. Accessories should provide this information to improve audio/video synchronization for video playback. Accessories should not report a delay of more than 1000 ms, and should not update the delay more than 1 time per second.

52.11 Profiles

The Apple Bluetooth profiles knowledge base article https://support.apple.com/kb/ht3647 provides a complete list of the profiles supported by devices. Bluetooth specifications are the starting point for designing accessories compatible with these devices. The following sections provide additional information and requirements for common profiles to help accessory developers achieve superior results.

52.11.1 Device ID Profile (DID)

Accessories shall:

- Support Bluetooth Device ID Profile, Version 1.3 or later.

- Use their Company Identifier from the Assigned Numbers specification assigned by the Bluetooth SIG as the Vendor ID value (VID), see https://www.bluetooth.com/specifications/assigned-numbers/. Bluetooth HID Profile accessories may use a VID assigned by the USB Implementers Forum (USB-IF), see https://www.usb.org/getting-vendor-id, if the manufacturer does not have a Bluetooth SIG Company Identifier.
- Use its VID value for the end product manufacturer.
- Not use the Company ID assigned to Apple by the Bluetooth SIG, or the Vendor ID assigned to Apple by the USB Implementers Forum.
- Use the Vendor ID Source field to identify which organization assigned the value used in the Vendor ID field. See *Bluetooth Device ID Profile Specification –Section 5.6*.
- Use a ProductID value uniquely identifying the product.
- Use a Version value uniquely identifying the software version.

The Device ID record enables devices to identify the implementation of the accessory, which is used to bridge alternate interpretations of the Bluetooth specification when communicating with a accessory. It is important the information in the Device ID record uniquely identify the implementation in use.

In the case of Bluetooth car kit devices, the same car kit may be present in different car models. Ideally, the two car kits should have different ProductIDs. However, it is acceptable for them to have the same ProductID as long as they have identical hardware, software, and features. If the implementations differ at all, they should have different ProductIDs. The accessory can also use a secondary Device ID record to uniquely identify the product ID, or model number.

52.11.2 Service Discovery Protocol (SDP)

To facilitate caching Service Discovery Protocol service records, accessories shall:

- Support the ServiceDiscoveryServer Service Class.
- Support the ServiceDatabaseState attribute.
  - Attribute's value shall change whenever any SDP service record or attributes within a record are added, removed, or modified.
  - Attribute's value shall not change based on RFCOMM channel protocol parameters. Devices query these values separately at connection time.

52.11.3 Hands-Free Profile (HFP)

Accessories supporting Hands-Free Profile should meet the requirements of the *Bluetooth Hands-Free Profile Specification –Version 1.5 or later*.

Accessories can use the Bluetooth Hands-Free Profile for telephony. To achieve the best user experience, the accessory should support the following features, which are optional in the Bluetooth specification.

52.11.3.1 Remote Audio Volume Control

Accessories supporting HFP should:

- Support Remote Audio Volume Control, so speaker volume on the hands-free accessory can be controlled from the device as described in *Bluetooth Hands-Free Profile Specification – Version 1.5, Section 4.28*.
- Set the Remote Volume Control bit in the Supported Features bitmap sent with the `AT+BRSF=` command.

In some situations it is easier for the user to control the output volume through the device, instead of directly on the accessory. For example, a car passenger (or if the car is parked, the driver) could use the volume slider on the phone to control audio volume. Volume control synchronization is outlined in *Bluetooth Hands-Free Profile Specification – Version 1.5, Section 4.48.2*.

52.11.3.2 Indicator Event Reporting

Accessories supporting HFP should use Indicator Event Reporting, and not perform repetitive status polling.

iOS devices and Mac computers support all mandatory and optional indicators specified in HFP version 1.5 (`service`, `call`, `callsetup`, `callheld`, `signal`, `roam`, `battchg`). To minimize unnecessary status polling using the `AT+CIND?` command, the accessory should enable Indicator Event Reporting by sending an `AT+CMER` command. The device will then send a `+CIEV` event when there is a status change. The accessory should request initial status using the `AT+CIND=?` and `AT+CIND?` commands, according to the HFP specification.

52.11.3.3 Voice Recognition Activation

Accessories supporting HFP shall:

- Support Voice Recognition Activation, both Audio Gateway (AG) and Hands-Free (HF), initiated as described in *Bluetooth Hands-Free Profile Specification – Version 1.5, Section 4.25*.
- Set the Voice Recognition Activation bit in the Supported Features bitmap sent with the `AT+BRSF=` command.

iOS devices and Mac computers support voice recognition initiated by accessories (Hands-Free), and devices (Audio Gateway).

52.11.3.4 Echo Cancellation and Noise Reduction

When echo cancellation and noise reduction are performed locally on a hands-free accessory, the accessory should disable echo cancellation and noise reduction on the device by sending an `AT+NREC` command, as described in *Bluetooth Hands-Free Profile Specification – Version 1.5, Section 4.24*.

iOS devices and Mac computers support echo cancellation and noise reduction by default. If a hands-free accessory performs echo cancellation and noise reduction, the accessory needs to turn these features off on the device (the Audio Gateway), to avoid unnecessary audio quality degradation due to duplicate audio processing.

52.11.3.5 In-Band Ringing

Accessories supporting HFP should also support In-Band Ringing as specified in *Bluetooth Hands-Free Profile Specification – Version 1.5, Section 4.13.1*. If the user sets a ring tone on the device, the same ring tone should sound on the hands-free accessory.

52.11.3.6 Synchronous Connection

Accessories supporting HFP shall:

- Support eSCO parameter set S2 and S3 and accept requests for these settings. See *Bluetooth Hands-Free Profile Specification – Version 1.5, Section 5.6*.
- Request eSCO parameter set S2 or S3 when setting up a Synchronous Connection. eSCO parameter set S1 should not be requested.
- Render audio within 40 ms after the SCO/eSCO connection has been set up.

eSCO packet types offer packet retransmission, whereas traditional SCO packets are not retransmitted. This improves audio quality and the user experience. eSCO packet types 2-EV3 and 3-EV3 offer a greater time interval between packets, which can improve Wi-Fi performance and allow time for other concurrent Bluetooth connections to send data.

Apple strongly recommends the use of 2-EV3 and 3-EV3 packets for SCO connections. Using HV3 packets is highly discouraged. HV3 packets require more link time and do not allow audio packet retransmission, which impacts audio performance in the presence of RF interference.

52.11.3.7 Wide Band Speech

Accessories supporting HFP should support Wide Band Speech as described in the *Bluetooth Hands-Free Profile Specification – Version 1.6, Section 5.7.4*. If Wide Band Speech is supported, the accessory should support the T2 link parameter settings.

Devices running iOS 5 or later support Wide Band Speech. If both the device and the accessory support Wide Band Speech, the device will use it for eSCO connection scenarios such as cellular calls, FaceTime, and Siri.

52.11.4 Message Access Profile (MAP)

Accessories supporting Message Access Profile shall:

- Support Message Notification, as described in *Bluetooth Message Access Profile Specification –Version 1.1, Section 4.1*
- Register for notifications immediately after the connection is established, as described in *Message Access Profile Specification –Version 1.1, Section 4.5*.

Devices running iOS 13.0 or later support MAP 1.1.

52.11.5 Audio/Video Remote Control Profile (AVRCP)

Accessories supporting Audio/Video Remote Control Profile should meet the requirements of the *Bluetooth Audio/Video Remote Control Profile Specification –Version 1.4*.

52.11.5.1 Supported Operations

iOS devices and Mac computers support the following operation_IDs in passthrough commands:
- Play
- Stop
- Pause
- Fast Forward
- Rewind
- Forward
- Backward

52.11.5.2 Repeat and Shuffle Modes

Every device in the role of an AVRCP target supports Repeat and Shuffle modes. An AVRCP controller may use `SetPlayerApplicationSettingValue` to set a value on the device and `GetPlayerApplicationSettingValue` to read a value, as described in *Bluetooth Audio/Video Remote Control Profile Specification –Version 1.4, Sections 6.5.4 and 6.4.3*.

52.11.5.3 Notifications

Accessories supporting AVRCP shall:
- Register for notifications.
- Not perform repetitive device status polling.

Every device in the role of an AVRCP Target supports registering for notifications, as described in *Bluetooth Audio/Video Remote Control Profile Specification –Version 1.4, Section 6.7*. The commands `RegisterNotification` and `GetPlayStatus` are supported for these notifications:
- EVENT_PLAYBACK_STATUS_CHANGED
- EVENT_TRACK_CHANGED
- EVENT_NOW_PLAYING_CONTENT_CHANGED

- EVENT_AVAILABLE_PLAYERS_CHANGED
- EVENT_ADDRESSED_PLAYER_CHANGED
- EVENT_VOLUME_CHANGED

52.11.5.4 Play/Pause Button

Accessories supporting AVRCP implementing a Play/Pause control surface shall confirm the playback status of the device using AVRCP Notifications (page 241), before sending a Play or Pause command. See Supported Operations (page 241). Specifically:

- If a device notifies the accessory it is paused, pressing the accessory's Play/Pause control surface should send a Play command.
- If a device notifies the accessory it is playing, pressing the accessory's Play/Pause control surface should send a Pause command.
- The accessory should not infer device playback status based on the number of times the Play/Pause control surface has been pressed.

52.11.5.5 Volume Handling

Accessories supporting AVRCP should support Absolute Volume, as described in *Bluetooth Audio/Video Remote Control Profile Specification – Version 1.4, Section 6.13*.

Every device in the role of AVRCP Controller supports volume handling.

52.11.5.6 Browsing

Accessories supporting Browsing (in controller role) as part of AVRCP shall:

- Not try to index or cache the entire library upon connection. The device may contain tens of thousands of media items, and each may be present multiple times in the hierarchy.
- Not fetch all items when browsing a folder; only fetch items displayed to the user. The accessory may prefetch a few items to improve the responsiveness of the user interface.
- Not reorder items (for example, alphabetically).
- Not assume UIDs to be statically defined, especially in the root folder. The ordering and UIDs of folders and items may change at any point in future releases.
- Send the `SetBrowsedPlayer` command after receiving an EVENT_UIDS_CHANGED notification.
- Not assume the UID passed to the `PlayItem` command will result in the media player playing the UID.

Currently only the built-in Music app supports browsing. When switching between players, an EVENT_AVAILABLE_PLAYERS_CHANGED notification, and an EVENT_ADDRESSED_PLAYER_CHANGED notification will be generated. The UI needs to look at the feature bit mask of the listed player to determine whether browsing is currently available.

Devices running iOS 6.0 or later support AVRCP Browsing.

52.11.5.7 iOS App-Provided Metadata

An audio app running on a device may use the iOS Media Player Framework to provide metadata about the current audio stream to the accessory using AVRCP. Requirements and usage for these messages may be found in the `MPNowPlayingInfoCenter` class in Apple Media Player Framework documentation.

52.11.6 Advanced Audio Distribution Profile (A2DP)

See Advanced Audio Distribution Profile (A2DP) (page 225).

52.12 Audio Routing

Accessories can differentiate between various audio content provided by a device, and determine playback behavior.

An accessory can receive audio data from the device using either of two Bluetooth profiles:

- HFP using eSCO channel.
- A2DP using ACL channel.

The device determines which channel to use, depending on how the audio content is used. An audio path created for two-way communication (for example, phone calls or FaceTime) always uses the HFP (eSCO) route for sending audio data. Music and similar content uses the A2DP channel route. In the absence of a defined route, audio playback defaults to the device.

52.12.1 Audio Data Received using HFP Profile

Most of the audio content sent using HFP (eSCO) route requires two-way communication. Scenarios where HFP (eSCO) is used include, but are not limited to: cellular calls, FaceTime, and voice mail.

The accessory speaker and microphone should be dedicated to the HFP (eSCO) route, and not mixed/muxed with any other audio sources.

52.12.2 Audio Data Received using A2DP Profile

Audio content transferred using A2DP profiles can be broadly classified into two categories:

- Audio content from music, video, or game-like applications.
- System-generated sounds used for alerts and notifications.

52.12.2.1 Differentiating Audio Content from System Sounds

Music-like content can be differentiated from system sounds by adding support for Audio/Video Remote Control Profile (AVRCP) version 1.3 or later. The AVRCP profile allows an accessory to be aware of the audio playback device state, using notifications. See Audio/Video Remote Control Profile (AVRCP) (page 241).

When a device initiates audio playback over an A2DP channel for playing music content, an AVRCP notification EVENT_PLAYBACK_STATUS_CHANGED is sent to indicate playback status has changed to the play state. See *Bluetooth Audio/Video Remote Control Profile Specification–Version 1.4, Section 6.7.2*. This indicates audio data using the A2DP profile contains music. When a device initiates audio playback over an A2DP channel for playing system sounds, no AVRCP notifications are sent.

Figure 52-1 (page 244) and Figure 52-2 (page 245) show the difference between notifications for music playback, and system sounds.

Figure 52-1 Initiate Audio Playback (for example, music)

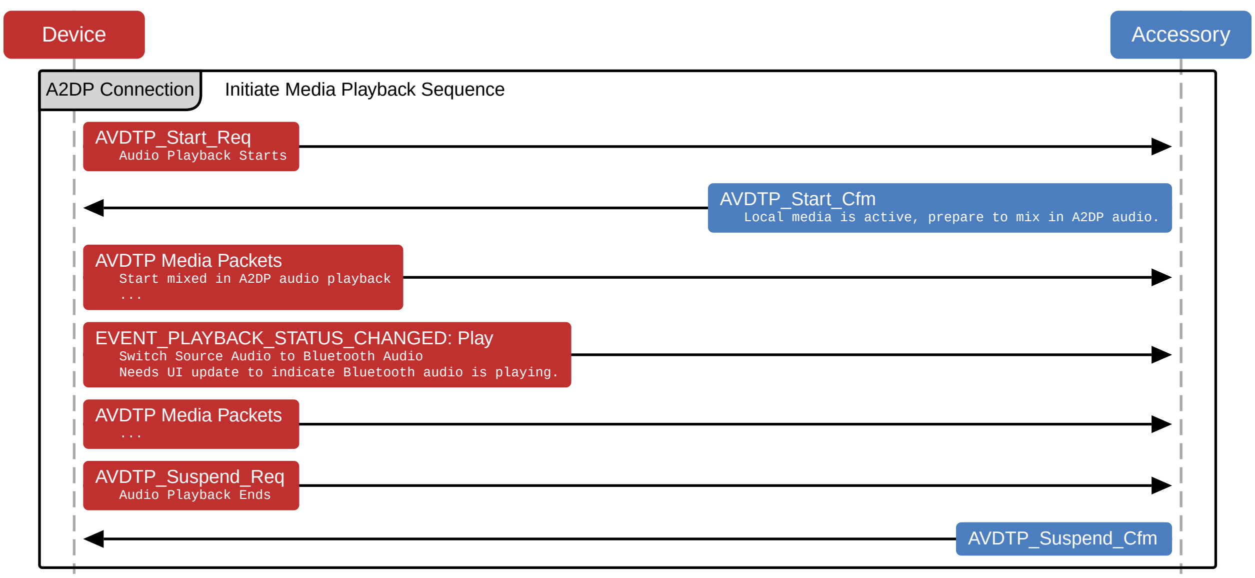
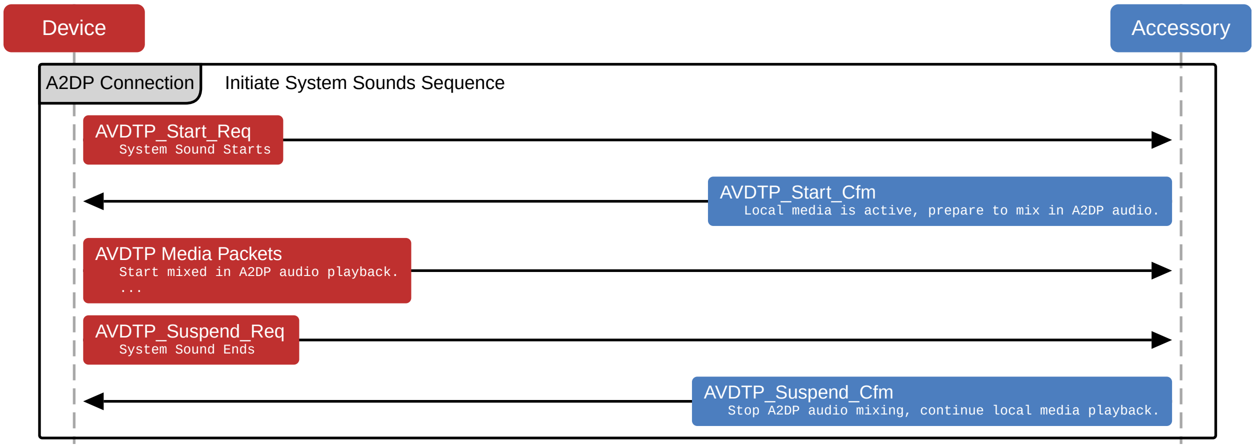


Figure 52-2 Initiate System Sound (such as turn-by-turn directions)



52.12.2.2 Expected Audio Routing Behavior for A2DP

The accessory should tune its audio routing behavior based on audio content over the A2DP channel.

If audio data contains music, accessory speakers are expected to be dedicated to audio data using the Bluetooth link, and any other audio playback is paused. If audio data contains system sounds, it is expected the accessory can render audio as desired. If the accessory is playing audio from a different source, it is not necessary to pause existing audio playback on the device, and system sound data can be mixed with the existing track for playback.

52.13 HID

When implementing HID over Bluetooth, the accessory should:

- Support Bluetooth HID Profile 1.1.
- Support Sniff Mode for Low Power Consumption (page 234).

The accessory should:

- Use the following parameters in SDP for sniff subrating:
  - HIDSSRHostMaxLatency - 450 ms (720 slots)
  - HIDSSRHostMinTimeout - 45 ms (72 slots)
- Use a typical report packet of 22 bytes or less. This is small enough to fit into a DH1 packet with L2CAP and HID header.

53. Bluetooth Low Energy (BLE)

Accessories integrating Bluetooth Low Energy (BLE) technology shall support the *Bluetooth 4.0 Specification* or later.

53.1 Role

The accessory should implement either the Peripheral role or the Broadcaster role as defined in the *Bluetooth 4.0 Specification – Volume 3, Part C, Section 2.2.2.3 and Section 2.2.2.1*.

53.2 Advertising Channels

The accessory should advertise on all three advertising channels (37, 38, and 39) at each advertising event. See the *Bluetooth 4.0 Specification – Volume 6, Part B, Section 4.4.2.1*.

53.3 Advertising PDU

The accessory should use one of the following advertising PDUs:

- ADV_IND
- ADV_NOCONN_IND
- ADV_SCAN_IND

ADV_DIRECT_IND should not be used. See the *Bluetooth 4.0 Specification – Volume 6, Part B, Section 2.3.1*.

53.4 Advertising Data

The advertising data sent by the accessory should contain at least the following information as described in the *Bluetooth Core Specification Supplement – Part A*:

- Flags
- TX Power Level
- Local Name

- Services

The Local Name should match the accessory's markings and packaging and not contain a colon ':' or semi-colon ';'.

The accessory may put the Local Name and the TX Power Level data in the SCAN_RSP PDU if, for example, it needs to reduce power consumption or not all of the advertising data fit into the advertising PDU. Depending on its state, the device may not always perform active scanning.

The primary services should always be advertised in the advertising PDU. Secondary services should not be advertised. Services not significant to the primary use case of the accessory may be omitted if space is limited in the Advertising PDU.

The advertising data and the scan response data in the SCAN_RSP PDU should comply with the formatting guidelines in the *Bluetooth 4.0 Specification – Volume 3, Part C, Section 18*: it starts with a length field, followed by AD Type and AD Data.

53.5 Advertising Interval

The accessory should first use the recommended advertising interval of 20 ms for at least 30 seconds.

If it is not discovered within the initial 30 seconds, Apple recommends using one of the following longer intervals to increase chances of discovery by the device:

- 152.5 ms
- 211.25 ms
- 318.75 ms
- 417.5 ms
- 546.25 ms
- 760 ms
- 852.5 ms
- 1022.5 ms
- 1285 ms

Note:
Longer advertising intervals usually result in longer discovery and connect times, but may lower accessory power consumption.

53.6 Connection Parameters

If both the Central and Peripheral support the Connection Parameters Request procedure, then either shall use the procedure. The device will not read or use the parameters in the Peripheral Preferred Connection Parameters characteristic. See *Bluetooth 5.3 Specification–Volume 6, Part B, Section 5.1.1 Connection Update*.

Connection parameter requests may be rejected if they do not meet these guidelines.

General connection parameter request guidelines:

- Peripheral Latency ≤ 30 connection intervals.
- Supervision Timeout from 6 seconds to 18 seconds.
- Interval Min ≥ 15 ms.
- Interval Min ≤ 2 seconds.
- Interval Min is a multiple of 15 ms.
- One of the following:
  - Interval Max at least 15 ms greater than Interval Min.
  - Interval Max and Interval Min are both 15 ms.
- Interval Max * (Peripheral Latency + 1) of 6 seconds or less.
- Supervision Timeout greater than Interval Max * (Peripheral Latency + 1) * 3.

If Bluetooth Low Energy HID is one of the connected services of an accessory, a connection interval down to 11.25 ms may be accepted by some devices.

Note:
When Interval Max and Interval Min are both 15 ms, some devices (such as Apple Watch) will offer a 30 ms interval to better balance power and performance constraints.

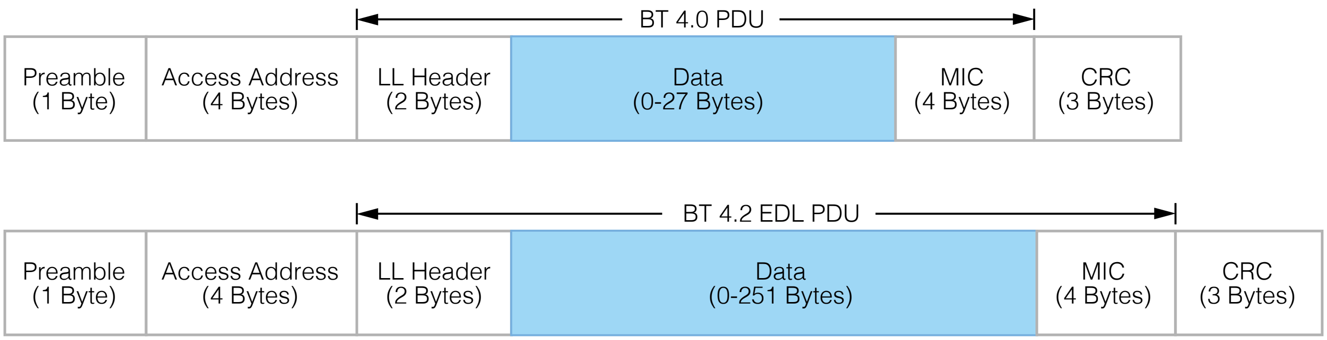
Apple Watch connection parameter request guidelines:

- Interval Min ≥ 30 ms.
- Interval Min is a multiple of 30 ms.
- One of the following:
  - Interval Max at least 30 ms greater than Interval Min.
  - Interval Max and Interval Min are both 30 ms.

53.7 Data Packet Length Extension

Data Packet Length Extension increases the maximum data length from 27 to 251. Using larger per-packet data lengths improves radio efficiency, greatly increasing application data rates and boosting battery life. See *Bluetooth 5.0 Specification–Volume 6, Part B, Section 4.6.6*.

Figure 53-1 Data Packet Length Extension



Accessories should support Data Packet Length Extension for best performance with devices.

iOS devices and Mac computers operating as the Central will negotiate optimal data packet lengths based on various factors, such as connection event length, system topology, and protocol.

53.8 Privacy

The accessory should be able to resolve a Resolvable Private Address in all situations. Due to privacy concerns, the device will use a Random Device Address as defined in the *Bluetooth 4.0 Specification –Volume 3, Part C, Section 10.8*.

53.9 Permissions

The accessory should not require special permissions, such as pairing, authentication, or encryption to discover services and characteristics. It may require special permissions only for access to a characteristic value or a descriptor value. See the *Bluetooth 4.0 Specification – Volume 3, Part G, Section 8.1*, fifth paragraph.

53.10 Pairing

The accessory should not request pairing until an ATT request is rejected using the Insufficient Authentication error code. See *Bluetooth 4.0 Specification – Volume 3, Part F, Section 4*.

If, for security reasons, the accessory requires a bonded relationship with the Central, the Peripheral should reject the ATT request using the Insufficient Authentication error code, as appropriate. As a result, the device may proceed with the necessary security procedures.

Similarly, if the device acts as a Central and a GATT server, it may reject an ATT request using the Insufficient Authentication error code. The accessory should initiate the security procedure for pairing in response.

Pairing may require user authorization depending on device. Once an accessory is paired with a device, the accessory shall retain the distributed keys of both central and peripheral for future use. If the pairing is no longer required, the accessory shall delete both sets of keys.

53.11 MTU Size

An accessory supporting packet length extension shall perform the packet length update procedure before performing the Exchange MTU Request handshake, see Data Packet Length Extension (page 248).

Devices will support and request an MTU size larger than the default during the Exchange MTU Request handshake. See the *Bluetooth 4.0 Specification – Volume 3, Part F, Section 3.2.8*.

When operating as ATT client, the device will request the optimal MTU size based on factors such as the Bluetooth topology, connection event length, maximum data length, and protocol (GATT or connection-oriented L2CAP).

An accessory operating as ATT server should select an MTU equal to or greater than the device's MTU request.

53.12 Services

53.12.1 Generic Access Profile Service

The accessory should implement the Device Name characteristic per the *Bluetooth 4.0 Specification – Volume 3, Part C, Section 12.1*. The Device Name characteristic should be writeable.

53.12.2 Generic Attribute Profile Service

The accessory shall implement the Service Changed characteristic only if the accessory has the ability to change its services during its lifetime.

The device may use the Service Changed characteristic to determine if it can rely on previously read (cached) information from the device. See the *Bluetooth 4.0 Specification – Volume 3, Part G, Section 7.1*.

53.12.3 Device Information Service

The accessory shall implement the Device Information Service. The service UUID for this service should not be advertised in the Advertising Data. The following characteristics should be supported:

- Manufacturer Name String (26 characters maximum).
- Model Number String (26 characters maximum).
- Firmware Revision String
- Software Revision String

53.12.4 Available Services

With iOS 7.0, any device makes Battery Service, Current Time Service and Apple Notification Center Service (ANCS) available to an accessory. The Current Time Service supports the current time and local time information characteristics. The service does not provide an "Adjust Reason" when the current time changes. ANCS uses `7905F431-B5CE-4E99-A40F-4B1E122D00D0` as its UUID.

These services are not guaranteed to be available immediately after connection and the accessory shall support Characteristic Value Indication of the Service Changed characteristic (see *Bluetooth 4.0 Specification – Volume 3, Part G, Section 7.1*) to be notified when the services become available. The device will maintain a connection to an accessory as long as it is paired and uses one of the available services.

53.13 GATT Server

With iOS 6.0, applications may contribute services and characteristics to the GATT server the device makes available to the accessory.

The following services are implemented internally by iOS and shall not be published by third-party iOS applications:

- Generic Attribute Profile Service
- Generic Access Profile Service
- Bluetooth Low Energy HID Service
- Battery Service
- Current Time Service
- Apple Notification Center Service

The device implements the GAP Service Changed characteristic, because the database contents can change at any time. The accessory should therefore support the Characteristic Value Indication of this characteristic and, upon receiving indications, invalidate its database cache accordingly. See the *Bluetooth 4.0 Specification – Volume 3, Part G, Section 7.1*.

The accessory should minimize the use of ATT/GATT requests and commands and only send what is necessary. For example, do not use GATT Discover All Services when the accessory is looking for specific services. Use Discover Primary Service By Service UUID instead. Less airtime equals less power consumption and better performance for both the accessory and the device.

When third-party iOS applications discover services on the accessory, the following services are used internally by iOS and are filtered out from the list of discovered services:

- Generic Attribute Profile Service
- Generic Access Profile Service
- Bluetooth Low Energy HID Service
- Apple Notification Center Service

The accessory should be robust enough to handle any error gracefully. Pairing and Characteristic Value reads/writes may fail if the application owning the service is not in the foreground and is not entitled to run in the background.

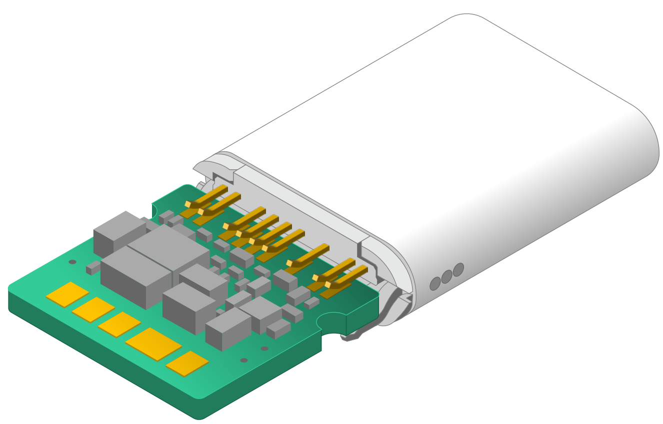
If an ATT Prepare Write Request is used, all queued attributes are contained within the same GATT Service.

Modules

54. Apple USB-C Analog Headset Module

The Apple USB-C Analog Headset Module (C125) may be used to create USB-IF compliant Headsets (page 89) supporting up to 24-bit/384 kHz stereo and up to 24-bit/48 kHz mono (microphone) audio. C125 supports Apple Music Lossless and Hi-Res Lossless.

Figure 54-1 USB-C Analog Headset Module (C125)



54.1 Overview

C125 is a USB-IF compliant USB Audio Device Class 2.0 and 3.0 codec with an integrated USB-IF certified USB-C plug (Test ID: 11559).

C125 supports:

- 16-bit and 24-bit samples.
- 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz stereo headphone-level output.
- Optional:
  - 176.4 kHz, 192 kHz, 384 kHz stereo headphone-level output.
  - 7-band output EQ.
- 44.1 kHz, 48 kHz mono microphone input.
- Optional:
  - 7-band microphone input EQ.
  - 3-band sidetone EQ.

- Volume Up, Volume Down, and Center buttons.

C125 does not support USB-C to 3.5 mm headset jack adapters.

54.1.1 Additional Specifications & Support

Additional software and support for C125 is available from Cirrus Logic, Inc.

Get started at https://www.cirrus.com/support/c125/.

54.1.2 Procurement

The C125 is available at https://c125.proscalnext.com/:

Variant	Part Number
C125	AB23169-1A033-AH

54.2 Mechanical

C125 has the following mechanical characteristics:
- Integrated USB-C connector.
- Not encapsulated.
- -20 °C to 65 °C working temperature range.

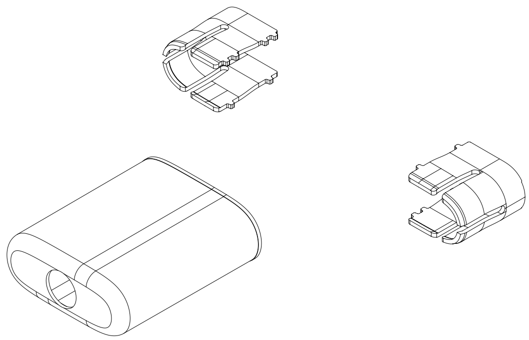
See C125 Dimensions (page 259) for dimensional drawing.

C125 headsets shall:
- Meet the requirements for USB-C connector integration, see Mechanical (page 281).
- Encapsulate both sides of C125.

54.2.1 Shielding

C125 headsets shall:
- Protect the C125 electronic components with a SUS shield.
- Laser weld the SUS shield to the C125 ground ring.

Figure 54-2 C125 recommended three-part shield design



Apple recommends the following three-part shield design as shown in Figure 54-2 (page 256) for C125:

- C125 Recommended Clamshell Shields (page 260)
- C125 Recommended Rear Shield (page 261)

54.3 Pad Assignments

Figure 54-3 (page 256) and Table 54-1 (page 257) detail the layout, names, description, and assignments of the C125 pads.

Figure 54-3 C125 pads

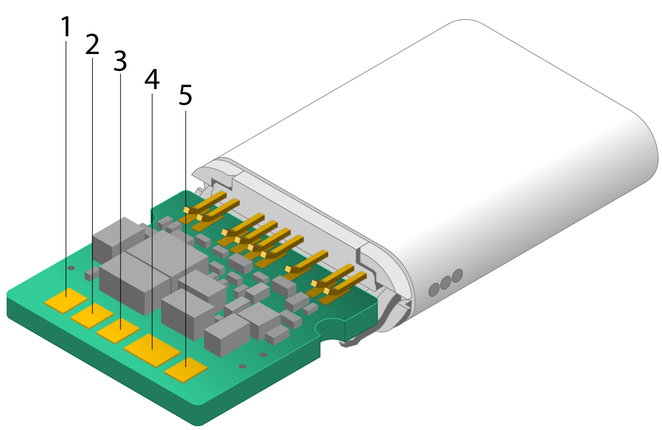


Table 54-1 C125 pad assignments

Pad	Name	Assignments
1	Left Driver	Left Driver
2	Microphone Bias	Microphone Bias
3	Reserved	NC
4	Ground	Right Return, Left Return, Microphone Return
5	Right Driver	Right Driver

54.4 Electrical

C125 headsets shall incorporate the Headset Remote and Microphone Transmitter (page 263) using Tone Mode (page 272).

The C125 shield may be treated as an electrical ground.

54.4.1 DAC Characteristics

The C125 DAC receives lossless 24-bit stereo audio from the device.

Table 54-2 C125 DAC characteristics, 24-bit/96 kHz mode

Driver	Parameter	Typical
32 Ω, 1 nF	Dynamic range (A-weighted)	117 dB
	THD+N (FS = 48 kHz, BW = 20 kHz)	-91 dB
	Full-scale output voltage	2.4 V_{PP}
	Output power	22.6 mW
16 Ω, 1 nF	Dynamic range (A-weighted)	112 dB
	THD+N (FS = 48 kHz, BW = 20 kHz)	-83 dB
	Full-scale output voltage	1.3 V_{PP}
	Output power	14.2 mW

Table 54-3 C125 DAC characteristics, 24-bit/384 kHz mode

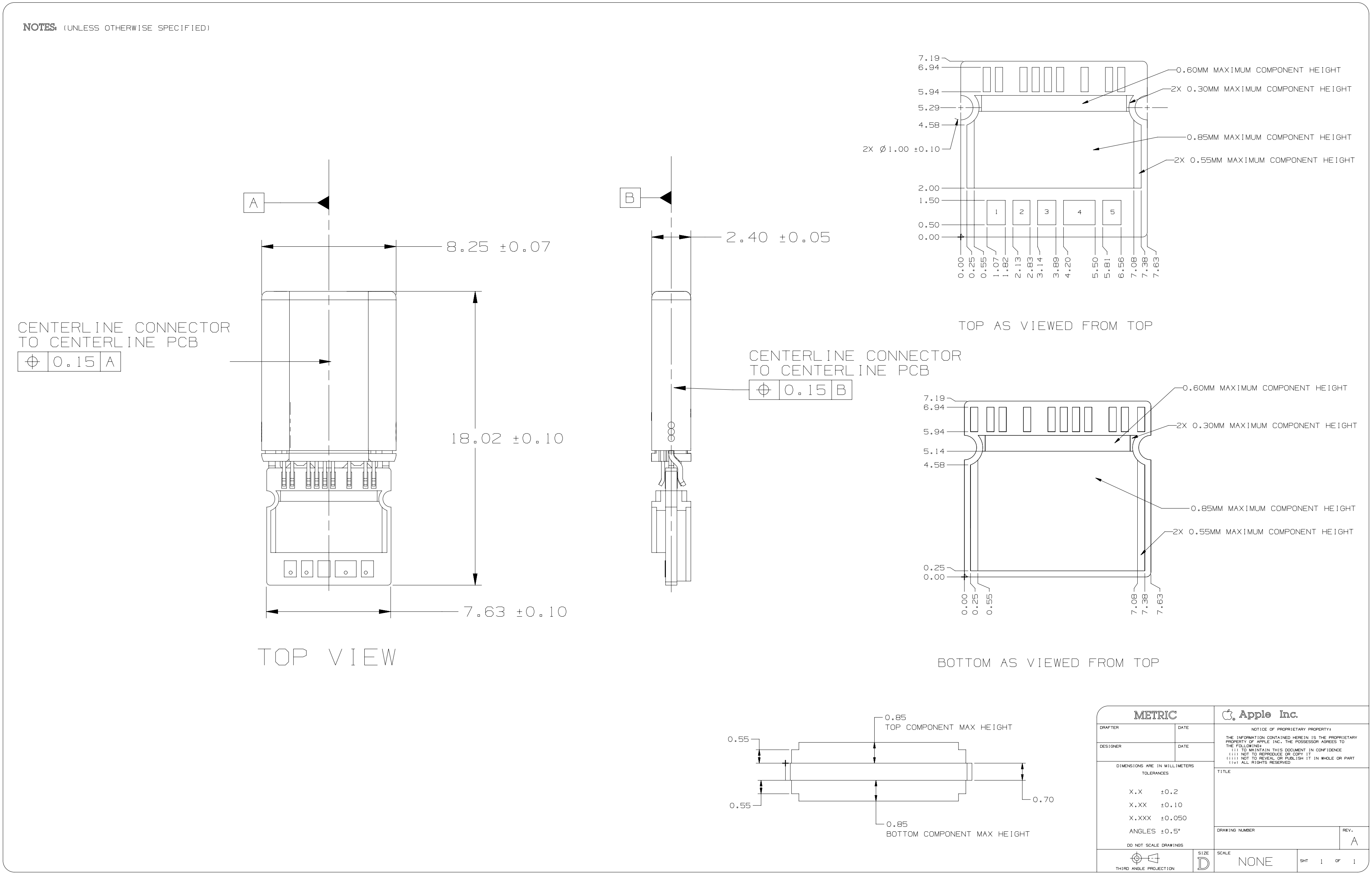
Driver	Parameter	Typical
32 Ω, 500 pF	Dynamic range (A-weighted)	117 dB

Driver	Parameter	Typical
	THD+N (FS = 48 kHz, BW = 20 kHz)	-91 dB
	THD+N (FS = 192 kHz, BW = 80 kHz)	-90 dB
	Full-scale output voltage	2.4 V_{PP}
	Output power	22.6 mW
16 Ω, 500 pF	Dynamic range (A-weighted)	112 dB
	THD+N (FS = 48 kHz, BW = 20 kHz)	-84 dB
	THD+N (FS = 192 kHz, BW = 80 kHz)	-83 dB
	Full-scale output voltage	1.3 V_{PP}
	Output power	14.2 mW

The characteristics in Table 54-2 (page 257) and Table 54-3 (page 257) were measured under the following conditions:

- Left Driver, Right Driver, and Ground pads on C125 connected to a load and an audio analyzer, such as the Audio Precision APx series.
- Microphone Bias pad connected to the Ground pad.
- Full-scale 1 kHz sine wave input test signal.

54.5 C125 Dimensions

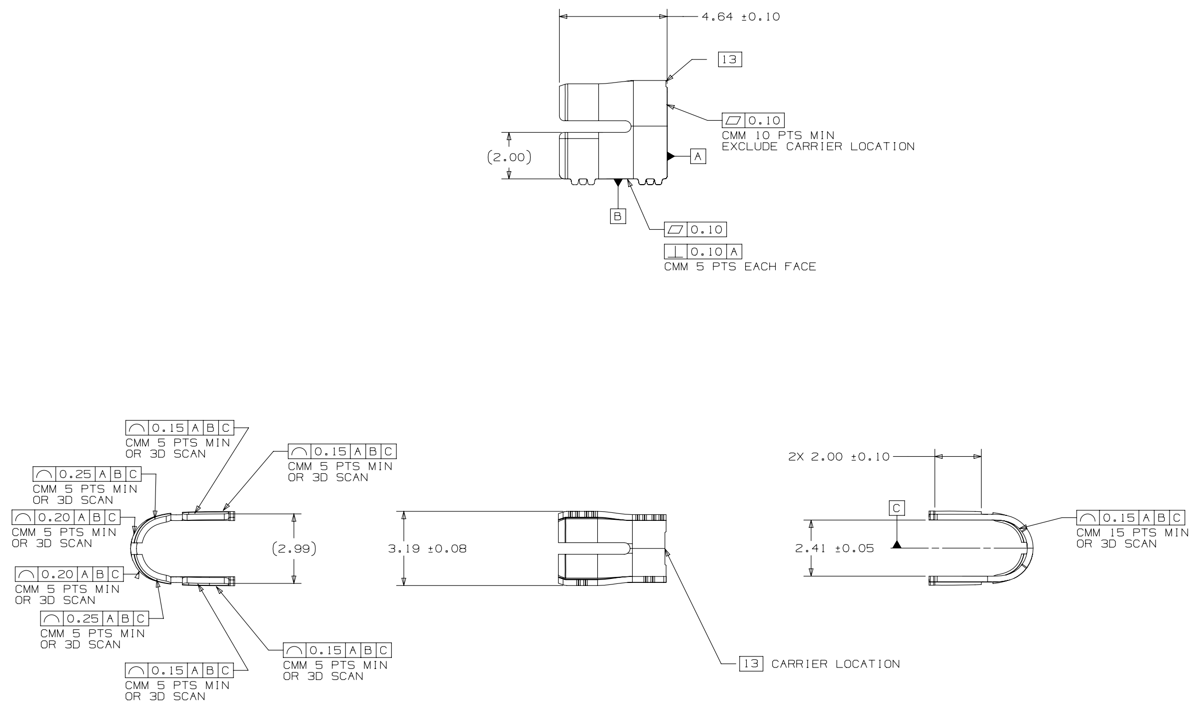


54.6 C125 Recommended Clamshell Shields

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL DIMENSIONS AND TOLERANCES APPLY PER ASME Y14.5M, 1994. IT IS EXPECTED THAT THE SUPPLIER UNDERSTAND AND COMPLY WITH ALL TOLERANCES AS DESCRIBED IN THIS STANDARD AND APPLIED TO THIS DRAWING.
2. DIMENSIONS ARE MEASURED AFTER PLATING.
3. ALL DIMENSIONS THAT LOCATE GEOMETRICAL TOLERANCE FEATURES (PROFILE AND POSITION CHARACTERISTICS) ARE CONSIDERED BASIC AS DEFINED IN THE ASME Y14.5M, 1994 STANDARD.
4. WHEN DATUMS ARE SPECIFIED ON A DRAWING, DIMENSIONS ARE RELATED TO DATUM A (AS THE PRIMARY DATUM), DATUM B (SECONDARY), AND DATUM C (TERTIARY).
5. PERFECT ORIENTATION AND/OR PERFECT LOCATION AT MMC REQUIRED FOR THE INTERRELATIONSHIP OF ALL DATUM FEATURES OF SIZE, UNLESS OTHERWISE SPECIFIED ON DRAWING.
6. UNLESS OTHERWISE SPECIFIED, ALL SURFACES TO BE WITHIN A SURFACE PROFILE TOLERANCE OF |⌓|0.1|A|B|C|.
7. ALL BURRS TO BE LESS THAN 0.02 mm.
8. BREAK ALL EDGES 0.05 mm R UNLESS SPECIFIED.
9. PART NEEDS TO SURVIVE 8HR SALT SPRAY TEST.
10. MATERIAL: SUS304-1/2H, 0.25mm THK
11. FINISH: 2-5 μm NICKEL PLATING PER AMS QQ-N-290
12. ALL PLATING TO OCCUR AFTER PART STAMPING AND FORMING

13 BURRS SHALL BE SUBFLUSH TO DATUM A



METRIC | Apple Inc.

DRAFTER | DATE

DESIGNER | DATE

DIMENSIONS ARE IN MILLIMETERS
TOLERANCES

NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED

TITLE

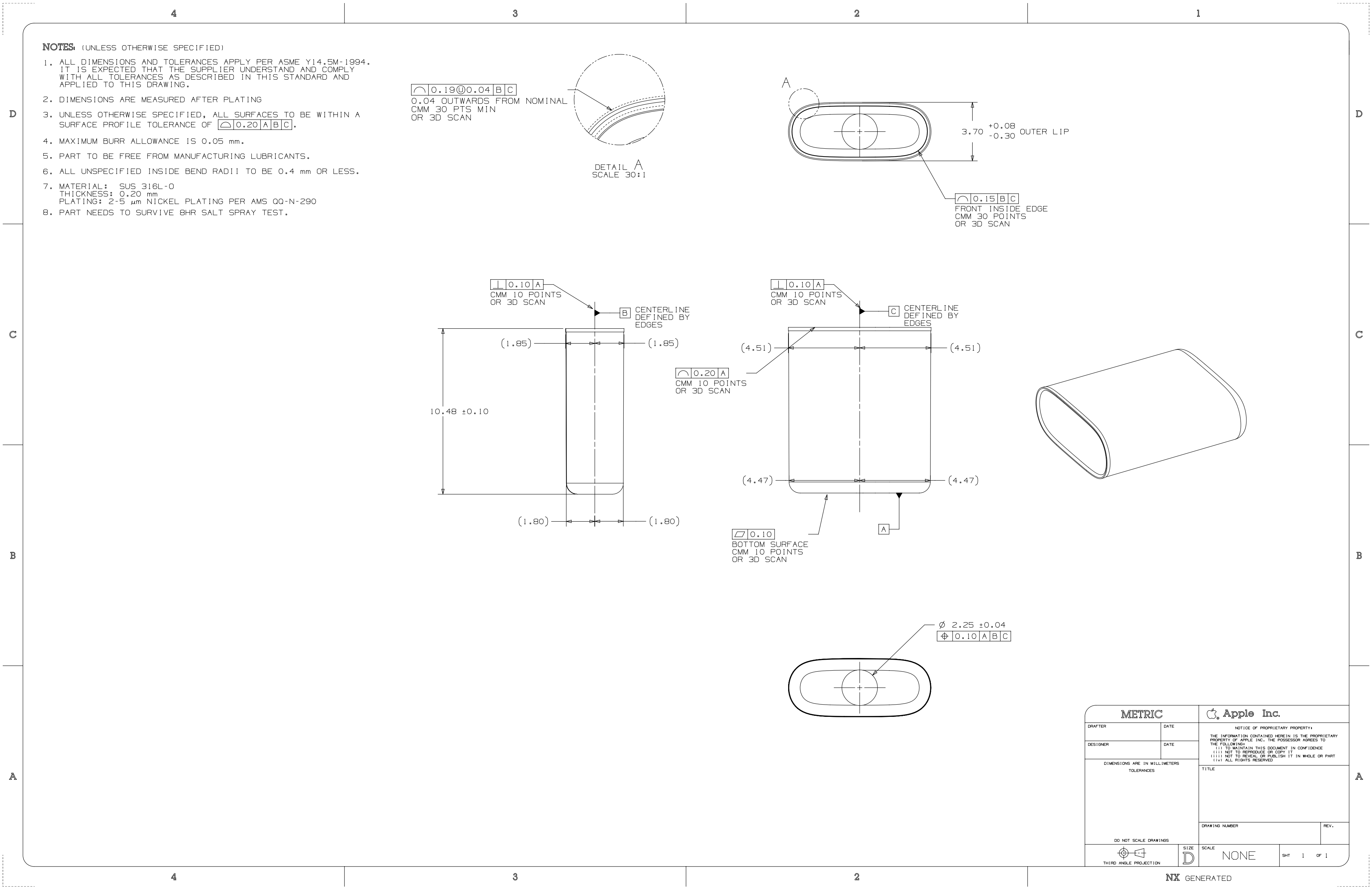
DRAWING NUMBER | REV.

DO NOT SCALE DRAWINGS

THIRD ANGLE PROJECTION | SIZE D | SCALE NONE | SHT 1 OF 1

NX GENERATED

54.7 C125 Recommended Rear Shield



Components

55. Headset Remote and Microphone Transmitter

Devices can receive button press information from Headsets (page 89) incorporating a Headset Remote and Microphone Transmitter using the Apple USB-C Analog Headset Module (page 254).

55.1 Overview

A Headset Remote and Microphone Transmitter is a component transmitting Volume Up, Volume Down, and Center button controls over the microphone bias to a C125.

Subjective listening tests with the latest devices are recommended to determine which part produces the best user experience.

55.2 Requirements

Headsets and headset cables implementing the Headset Remote and Microphone Transmitter shall:

- Locate the microphone 120-160 mm from the center of a headset driver when worn by the user.
- Have three physical remote buttons for Volume Up, Volume Down, and Center button functions.
- Use six wires from the plug corresponding to the following signals:
    - Right Driver
    - Right Return
    - Left Driver
    - Left Return
    - Microphone Bias
    - Microphone Return
- Run signals separately to their respective components.

Headsets and headset cables integrating the Headset Remote and Microphone Transmitter shall integrate a MEMS analog microphone.

Headset drivers shall have:

- Minimum load impedance of 16 Ω.
- Maximum load capacitance of 150 pF.

Headsets and headset cables shall implement one of the following configurations. The microphone and remote buttons may be located on either the left or right side of the headset.

Figure 55-1 USB-C Analog Headset Module (C125), single detachable cable

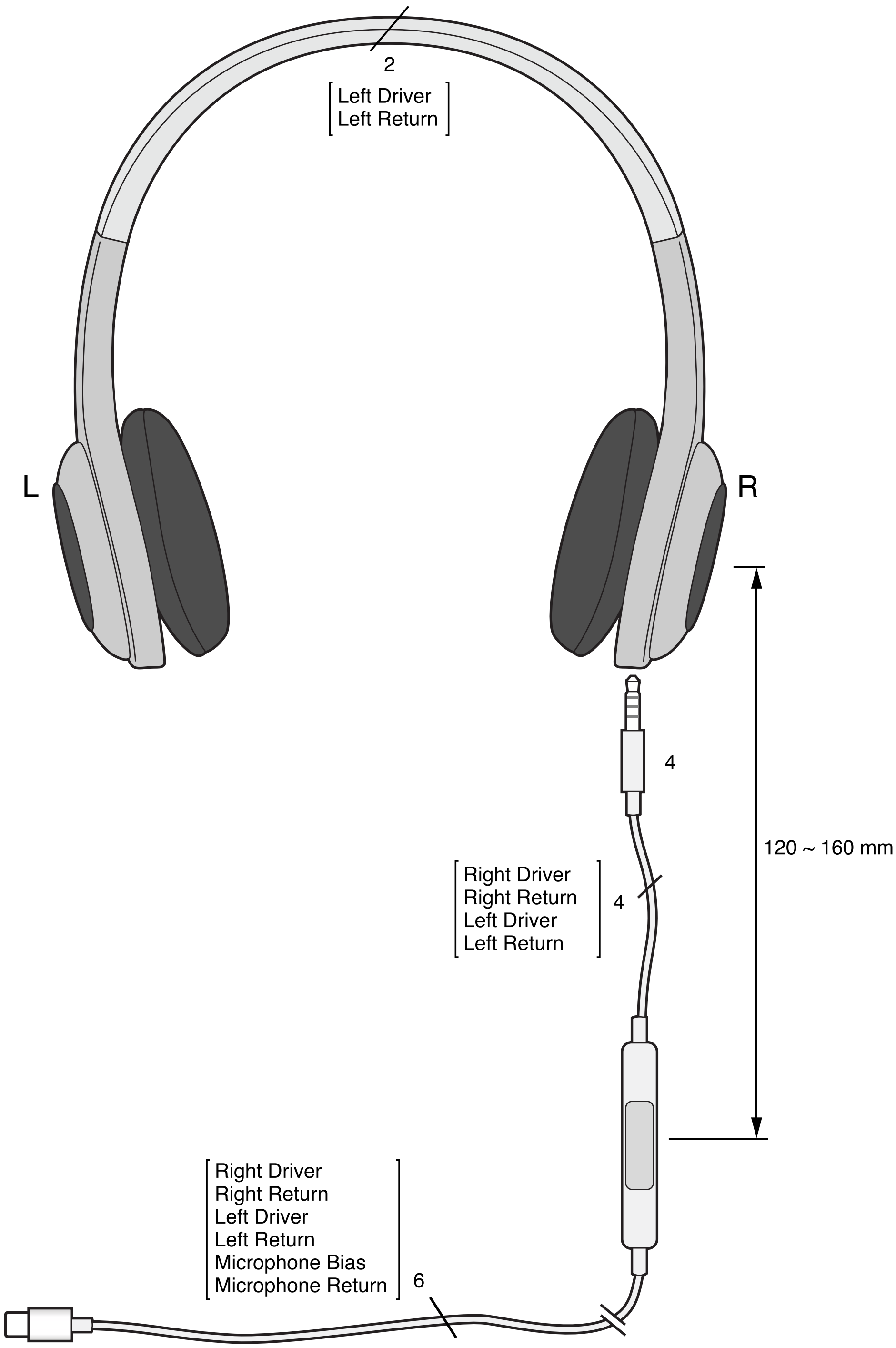


Figure 55-2 USB-C Analog Headset Module (C125), single built-in cable

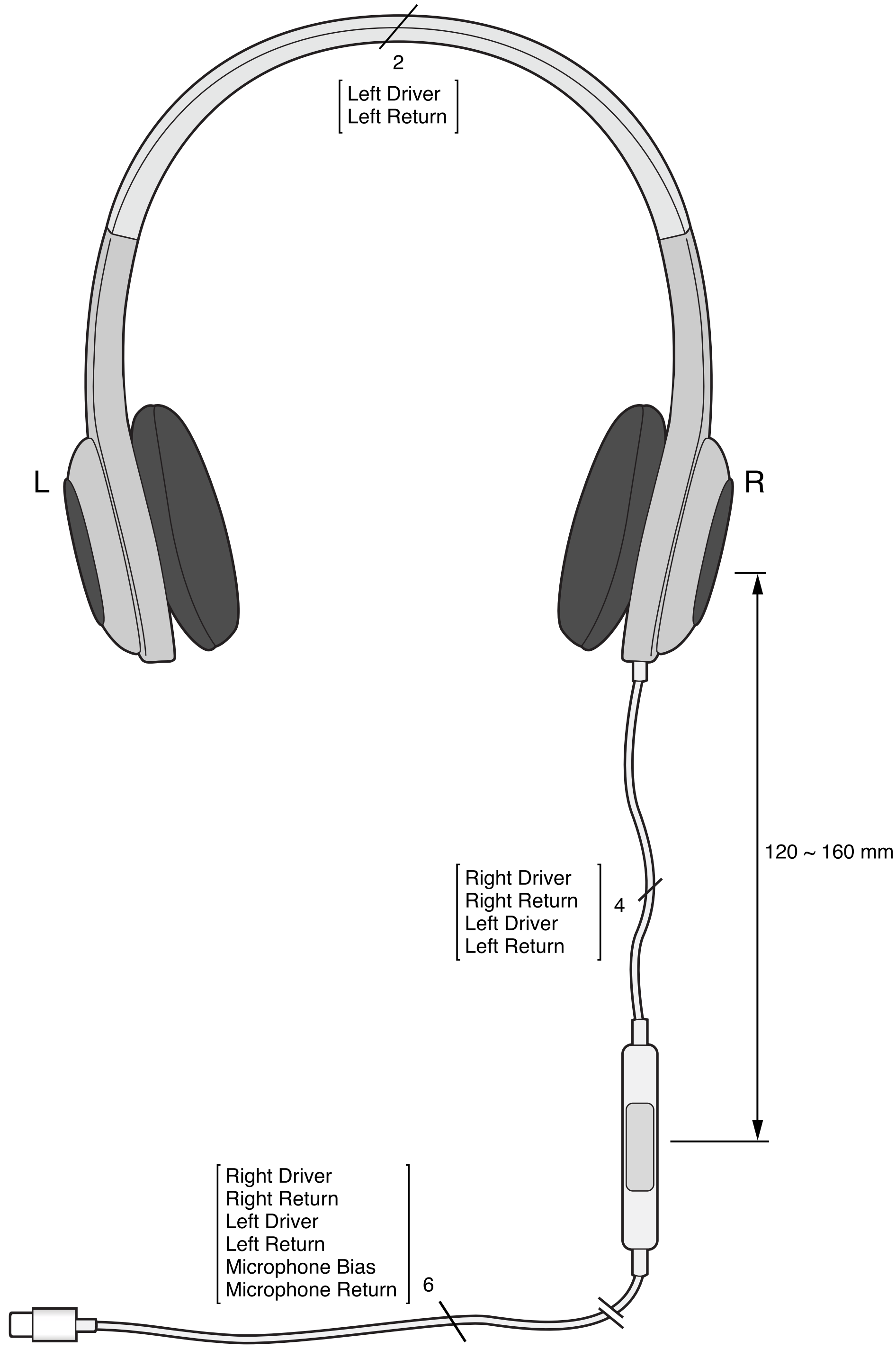


Figure 55-3 USB-C Analog Headset Module (C125), split detachable cable

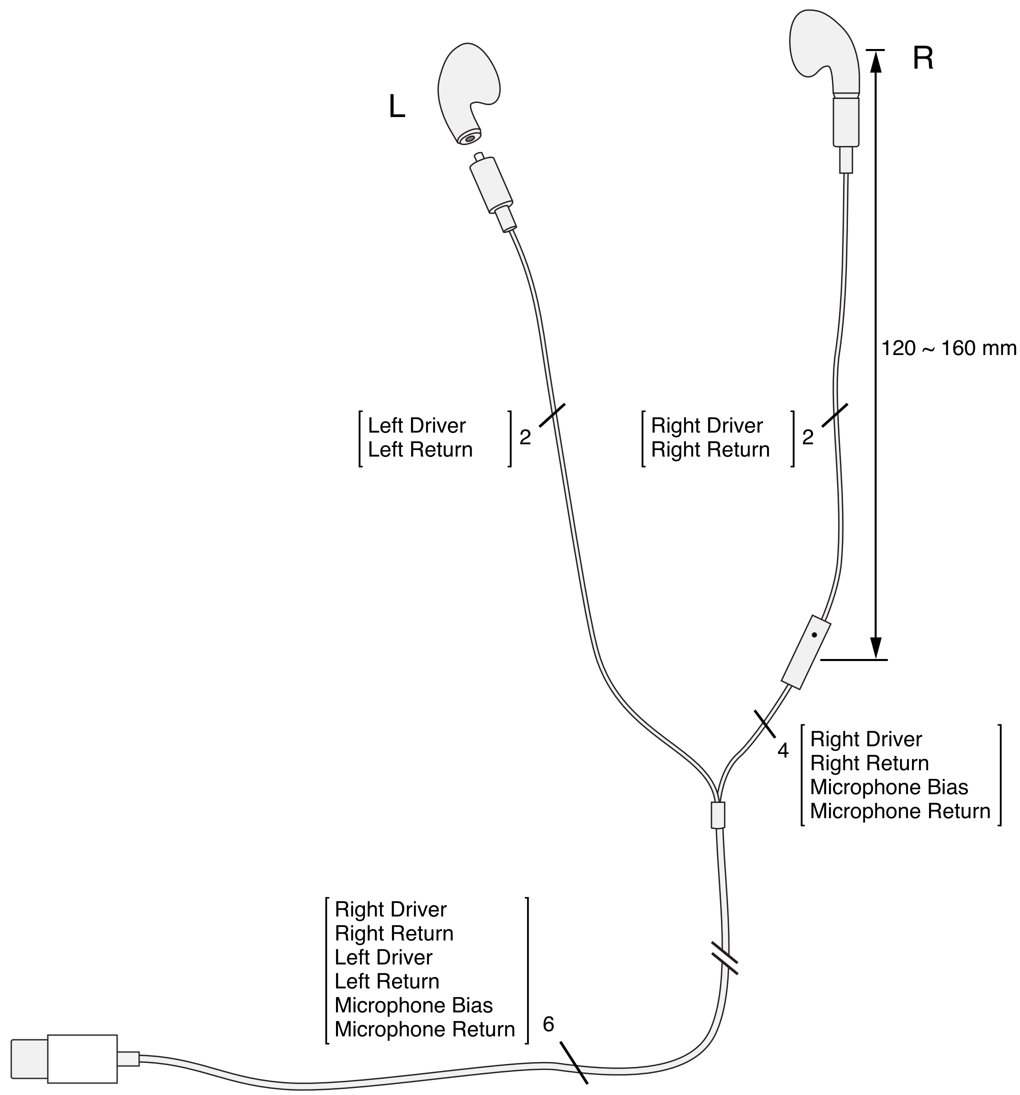
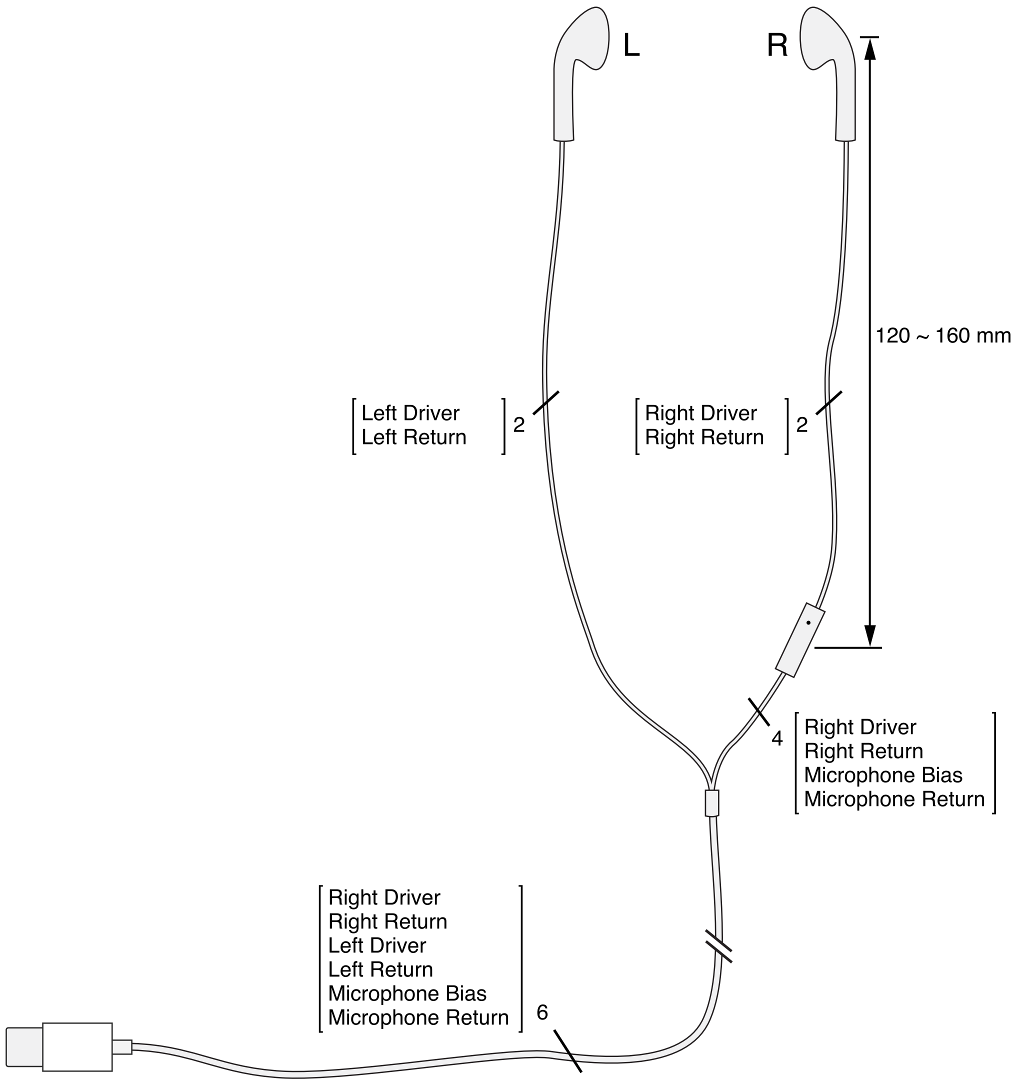


Figure 55-4 USB-C Analog Headset Module (C125), split built-in cable



55.3 Usage

The transmitter operates with a receiver in C125 to enable remote button press detection using the microphone bias line. The C125 provides regulated downstream power (nominally 2.7 V or 2.0 V) to the transmitter and MEMS microphone through the microphone bias line, and the C125 decodes the button information from the transmitter.

The transmitter sends button press state over the microphone bias line in either:

- Button mode.
- Tone mode.

If the voltage on the microphone bias line is less than 2.35 V, the microphone is not in use. The transmitter enters button mode and sends button-press information as discrete voltage levels.

If the voltage on the microphone bias line greater than 2.35 V, the microphone is in use. The transmitter enters tone mode and sends button-press information as ultrasonic tone sequences in the range of 99 kHz to 300 kHz.

55.3.1 Pin Assignments

Table 55-1 Headset Remote and Microphone Transmitter pin assignments

Name	I/O	Description
TONE	Output	Tone generator output
GND	Power	Audio return
MIC	Input	Microphone bias
REM	Input/output	Remote switch network
VSHUNT	Input	Shunt regulator supply
MICPWR	Output	Microphone power

55.3.2 Maximum Voltage and Current Ratings

Table 55-2 (page 268) lists the transmitter's maximum voltage and current ratings while operating over a free-air temperature range (T_A) of -40 °C to +85 °C.

Voltages are measured with respect to ground. Input and output clamp-current ratings shall be observed.

Table 55-2 Maximum voltage and current ratings

Symbol	Description	Minimum	Maximum
V_{SUPPLY}	Supply voltage, VSHUNT, MIC	-0.5 V	4.6 V
V_I	Input voltage, REM	-0.5 V	4.6 V
V_O	Output voltage, MICPWR, TONE	-0.5 V	4.6 V
I_{IK}	Input clamp current, REM ($V_I < 0$)	-20 mA	
I_{OK}	Output clamp current, MICPWR, TONE ($V_O < 0$)	-20 mA	
I_{SUPPLY}, I_{GND}	Continuous current through VSHUNT, MIC, or GND	-50 mA	50 mA

55.3.3 Electrical Characteristics

Table 55-3 (page 269), Table 55-4 (page 270), and Table 55-5 (page 270) list the transmitter's electrical and timing characteristics under the following conditions:

- Operating temperature = -40 °C to +85 °C.
- MIC is connected to $V_{MICBIAS}$ through a 2.21 kΩ ±1% resistor.
- Button mode, $V_{MICBIAS}$ = 1.8 to 2.1 V.
- Tone mode, $V_{MICBIAS}$ = 2.56 to 2.84 V.

The values in the Typical column of the tables are measured at 25 °C.

Table 55-3 Electrical characteristics (general)

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum
$I_{MICBIAS-B}$	Quiescent current into MIC+VSHUNT	Button mode, $V_{MICBIAS}$ = 2.1 V		3 µA	6 µA
$I_{MICBIAS-B}$	Quiescent current into MIC+VSHUNT	Button mode, $V_{MICBIAS}$ = 1.5 V		3 µA	6 µA
I_{MIC-T}	Quiescent current into MIC	Tone mode		34 µA	46 µA
$I_{VSHUNT-T}$	Quiescent current into VSHUNT	Tone mode (see note below)		60 µA	70 µA
I_{MIC-TA}	Active current into MIC	Tone mode		35 µA	45 µA
$I_{VSHUNT-TA}$	Active current into VSHUNT	(see note below)		104 µA	118 µA
V_{TR}	Tone mode threshold voltage	MIC rising (Microphone enable), V_{MICPWR} = 1.0 V	2.20 V	2.35 V	2.50 V
V_{TF}	Tone mode threshold voltage	MIC falling (Microphone disable), V_{MICPWR} = 400 mV	0.55 V	0.8 V	1 V
V_{MICPWR}	MICPWR output voltage	I_{MICPWR} = 120 - 150 µA	1.51 V	1.56 V	1.61 V
R_{SO}	Shunt regulator output impedance	Freq = 100 Hz	5 Ω	18 Ω	25 Ω
R_{SO}	Shunt regulator output impedance	Freq = 20 Hz	12 Ω	21 Ω	35 Ω
R_{ONA}	Switch A, R_{DSON}	Tone mode, I_{MICPWR} = 1 mA, $V_{MICBIAS}$ = 2.56 V		40 Ω	55 Ω
R_{ONB}	Switch B, R_{DSON}	V_{MIC} = 1.2 V, I_{REM} = 1 mA		22 Ω	30.5 Ω

Note:
This current is pulled through R_{VSHUNT} between MIC and VSHUNT and is the minimum current to keep VSHUNT regulated at 1.56 V. Excess current through R_{VSHUNT} is available to the load at MICPWR. Excess current not used by the load at MICPWR is internally shunted to GND.

Table 55-4 Electrical characteristics (tone mode)

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum
$e_{n\text{-}mic100}$	MIC integrated noise	100 Hz to 20 kHz		1.5 µVrms	2 µVrms
f_{TONE1}	Button 1 frequency	R_{REM} = 6.81 kΩ	109 kHz	130 kHz	159 kHz
f_{TONE2}	Button 2 frequency	R_{REM} = 9.42 kΩ	138 kHz	165 kHz	200 kHz
f_{REL}	Button released frequency		81 kHz	97 kHz	117 kHz
R_{BT1}	Button 1 boundary		6.61 kΩ	6.81 kΩ	7.01 kΩ
R_{BT2}	Button 2 boundary		9.33 kΩ	9.42 kΩ	9.51 kΩ
V_{TA}	Tone amplitude	R_{TONE} = 1 MΩ	350 mV	550 mV	720 mV
V_{TA}	Tone amplitude	R_{TONE} = 100 kΩ	300 mV	515 mV	710 mV

Table 55-5 Electrical characteristics (button mode)

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum
t_{ONA}	Switch A enable time		0.8 ms	1.2 ms	2 ms
t_{OFFB}	Switch B disable time		0.7 ms	1 ms	2 ms
t_{REG}	Shunt regulator enable time	Time from MIC = 2.3 V to MICPWR = 1.56 V	1 ms	2.5 ms	3.5 ms

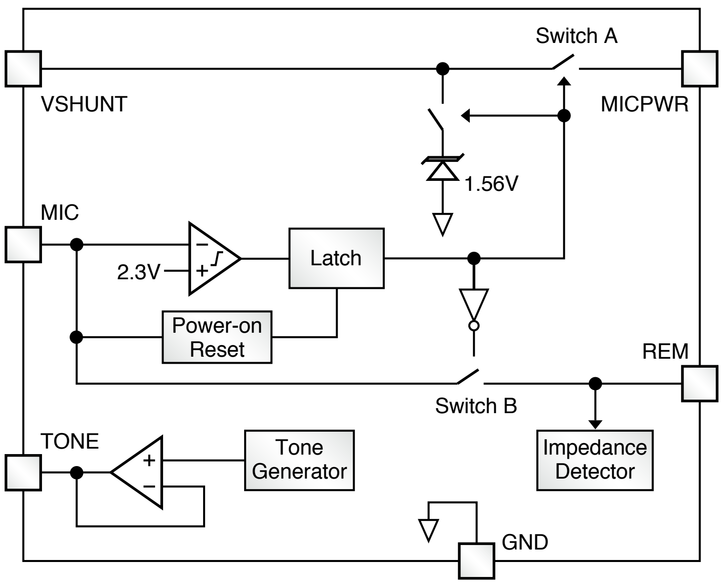
55.3.4 Theory of Operation

The transmitter provides:

- Interface to a button switch-resistor network.
- Power for a colocated microphone.
- Tone generator for sending discrete frequency tones on the microphone bias line corresponding to button events.

The receiver provides regulated downstream power (nominally 2.7 or 2.0 V) to the transmitter and microphone through the microphone bias line. Figure 55-5 (page 271) illustrates the functional components of the transmitter. In this diagram, a latch drives the configuration of switches A and B. The power-on reset monitors voltage on the MIC pin to ensure there is a enough power before initiating the power-on sequence; it shuts the transmitter down if there is insufficient voltage.

Figure 55-5 Block diagram



Button events are sent from the transmitter to the receiver in one of two modes, button mode or tone mode. When a microphone is not present or is not in use, the transmitter is put in button mode by the receiver, and button events are detected using discrete voltage levels. These discrete voltage levels are a percentage of a regulated output voltage on the microphone bias line. When a microphone is in use, the receiver puts the transmitter into tone mode by placing more than 2.35 V on the microphone bias line, and the transmitter then sends button events using tone sequences of discrete frequencies in the range 99 kHz to 300 kHz.

55.3.5 Button Mode

In button mode, the transmitter operates as a passthrough element switching a button switch-resistor network onto the bias line. Each switch represents a unique button. When a button is pressed, the DC level on the bias line is changed and detected by the receiver. Table 55-6 (page 272) shows the DETECT pin voltages with $V_{MICBIAS}$ = 2.0 V.

Table 55-6 DETECT pin voltages

Switch Closed	Voltage
S0	0.000 V ±1%
S1	1.510 V ±1%
S2	1.603 V ±1%

When the transmitter is in button mode (V_{MIC} has never reached 2.35 V), it shorts the MIC and REM pins together and disables all other inputs and outputs. When a button event occurs, the DC voltage on the microphone bias line changes. Table 55-6 (page 272) shows the DC voltage corresponding to a given button press when using the R1 and R4 resistor values listed in Table 55-7 (page 277). This DC level is then detected by the receiver. Switch S0 is a unique switch shorting the V_{MIC} line to ground.

When the V_{MIC} line is shorted to ground, power is removed from the transmitter. When power recovers, the transmitter enters button mode or tone mode, depending on the voltage detected at the MIC pin.

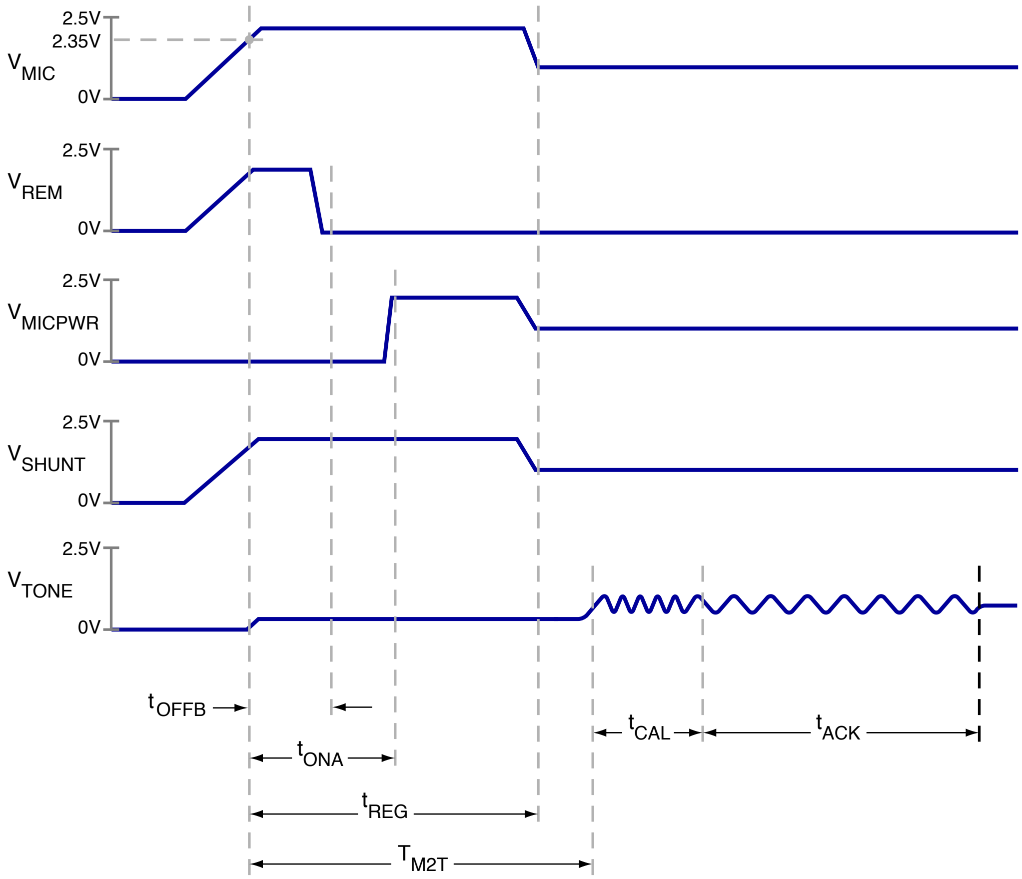
55.3.6 Tone Mode

When the transmitter detects a voltage greater than 2.35 V at the MIC pin, it enters tone mode. With a microphone biased and in use, the switch-resistor network used for button mode would cause large DC level shifts in the bias voltage. Such shifts would result in unwanted audible clicks or pops or would cause de-biasing of the microphone. To prevent this problem, when the transmitter enters tone mode it disconnects the switch-resistor network from the microphone bias line, enables the microphone using the FET switch, and engages the tone generation circuit shown in Figure 55-5 (page 271).

In tone mode the transmitter has two functions. First, it powers on the MEMS microphone by forcing a FET switch to ground. Second, it detects button events and places a discrete tone sequence onto the microphone bias line. The tone frequencies in each sequence are unique to each button press. The receiver detects the tones on the bias line and determines the corresponding button event.

The transmitter's startup timing when it enters tone mode is shown in Figure 55-6 (page 273). Values for the timing parameters are given in Table 55-4 (page 270).

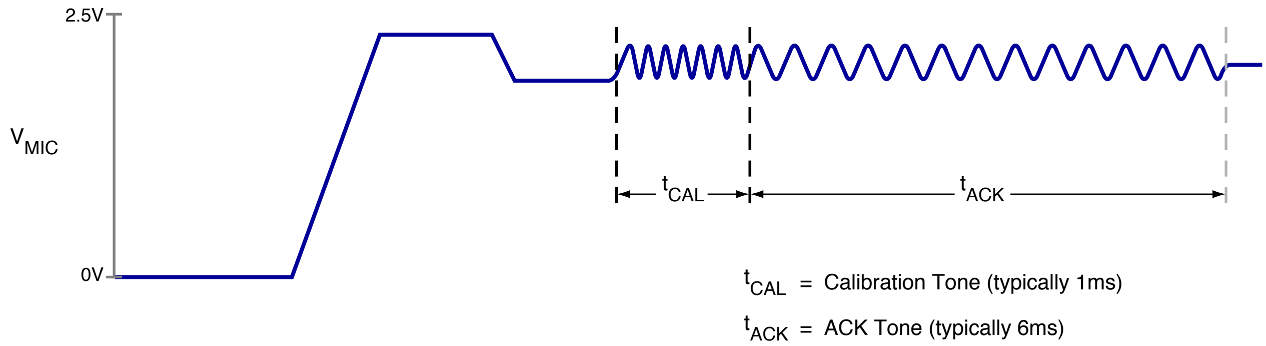
Figure 55-6 Startup timing



The tone mode startup sequence is as follows:

1. Upon detecting V_{MIC} > 2.35 V, the switch connecting the MIC and REM pins together is opened after time t_{OFFB}, see Figure 55-6 (page 273) and Table 55-4 (page 270).
2. After a delay of t_{REG} after V_{MIC} > 2.35 V, the SHUNT pin and the MICPWR pins are shorted. The microphone is enabled using the FET switch through the MICPWR pin.
3. Once the noise prevention process has settled, the transmitter sends a preset acknowledge (ACK) tone sequence.
4. The receiver detects the ACK sequence, see Figure 55-7 (page 274), and authenticates the presence of the transmitter.

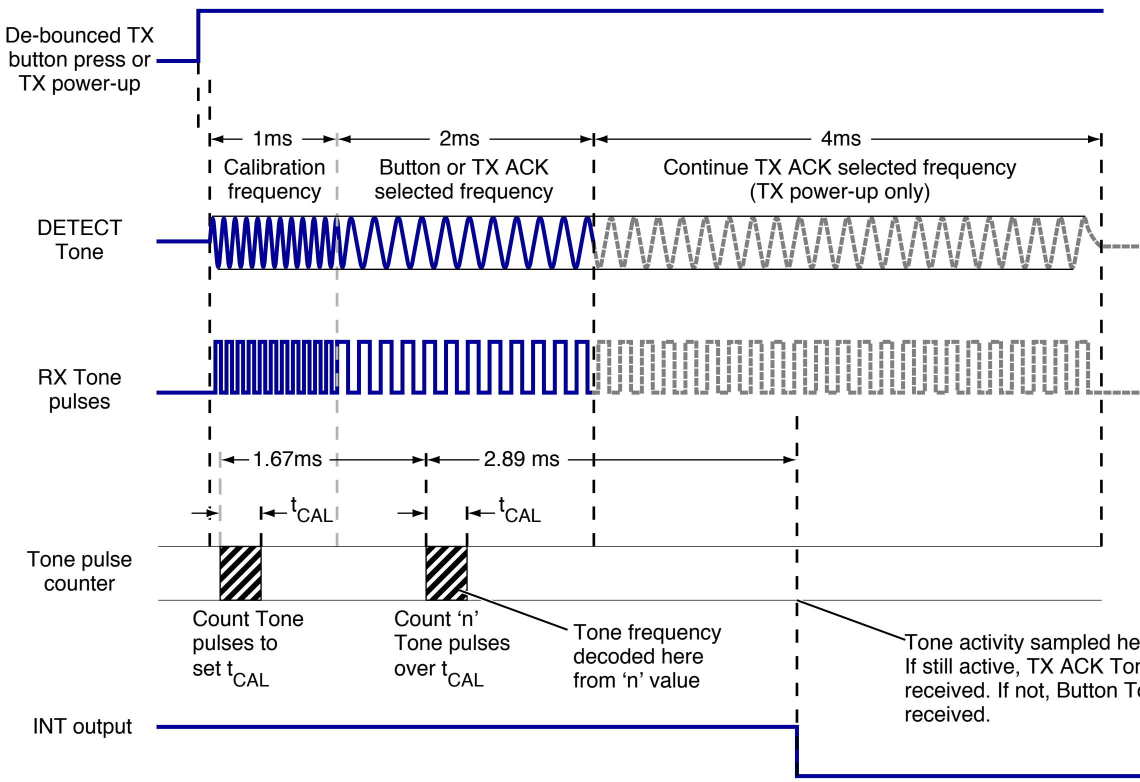
Figure 55-7 Tone mode ACK sequence



The tone generation circuit of the transmitter internally detects each button press and sends a high frequency tone sequence between 99 kHz and 300 kHz. The high frequency tone sequence is unique to each button. The receiver detects the frequency of each tone and translates it into a predetermined button event. A button release has a different frequency than a button press.

The transmitter sends two tones for each button press as shown in Figure 55-8 (page 275) to improve accuracy. The first tone, lasting 1 ms, is a calibration frequency and the second, lasting 2 ms, is the unique frequency for the selected button. The ratio of these two frequencies is calculated and translated into button press information. This provides a very accurate result independent of clock frequency variation.

Figure 55-8 Tone transmit/decode method



The transmitter remains in tone mode until the MIC pin is pulled below 0.8 V. When power recovers, the transmitter enters button mode or tone mode depending on the voltage detected at the MIC pin.

55.4 Button Detection Circuitry Usage

The circuits in the accessory supporting these components shall be those shown in Figure 55-9 (page 276) and Figure 55-10 (page 277). The nominal values of the components shown in these schematics are given in Table 55-7 (page 277).

These circuits are designed to produce a tone amplitude between the microphone bias line and the microphone return, at the end of a cable 1 meter long, of at least 30 mV peak-to-peak into a 2 kΩ load. If necessary, the value of R3 shall be adjusted to achieve this result. Figure 55-10 (page 277) shows how a voltage on the Microphone Power line from the transmitter enables the MEMS microphone chip through Q1. It also shows components R7, C4, and R8, which control the microphone frequency response. The equation determines the values of these components is given in Button Detection Circuitry Adjustments (page 278).

Figure 55-9 (page 276) and Figure 55-10 (page 277) are two parts of one circuit:

- The two microphone return lines shown in these sub-circuits shall be connected at the component locations.
- Their common return line and the return lines for each of the two drivers shall then be routed separately through the cable going to the device. The return lines shall be tied together only at the headset connector.

The above configuration minimizes crosstalk between the separate driver channels and the microphone.

Figure 55-9 Transmitter circuit

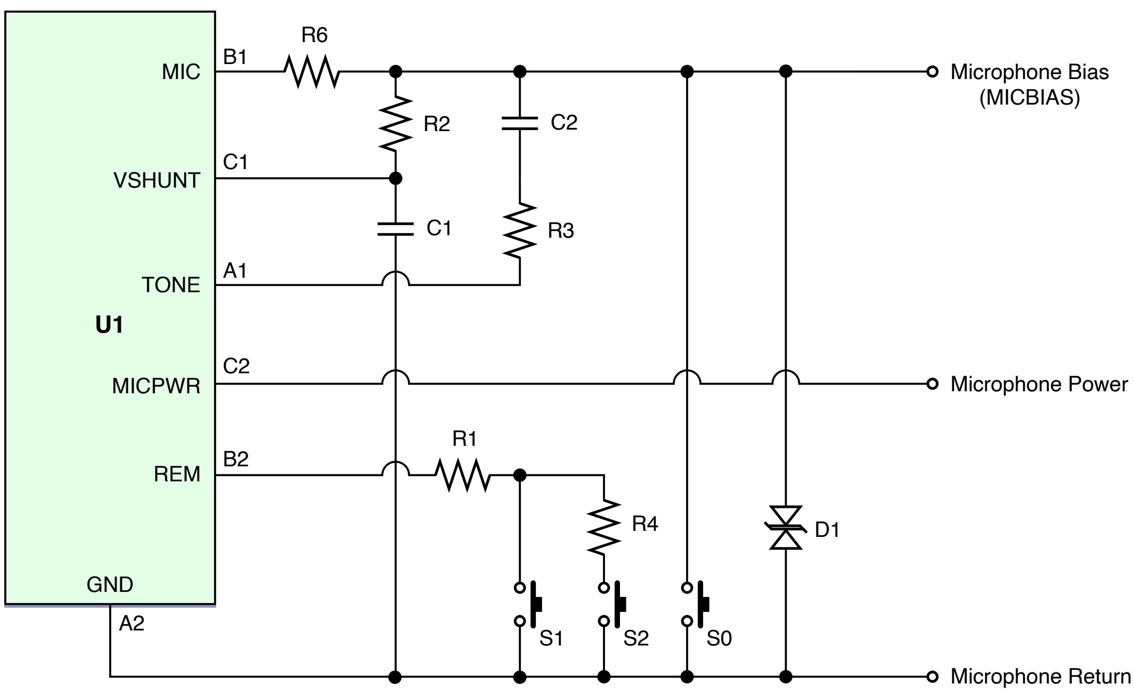


Figure 55-10 Microphone circuit

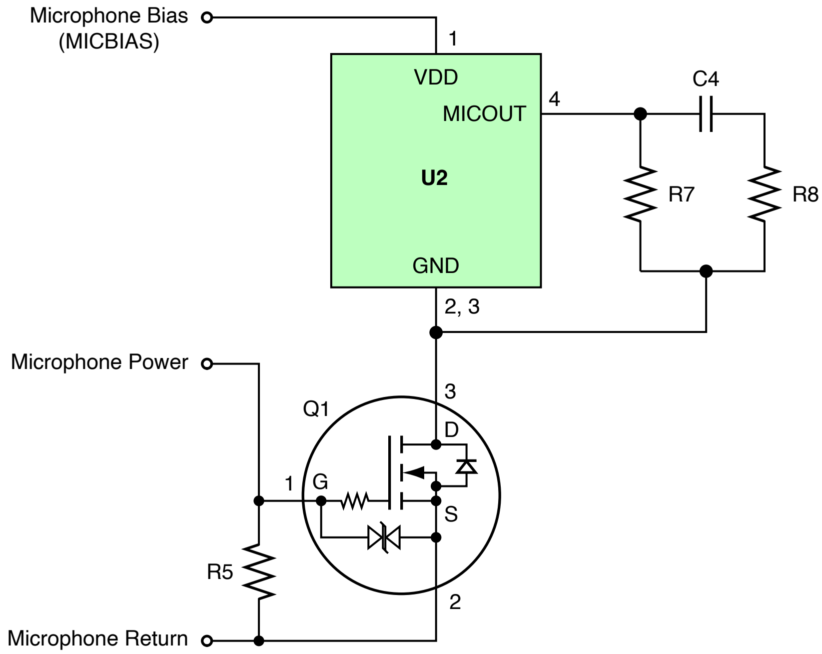


Table 55-7 Transmitter circuit components

Symbol	Description	Notes
C1	Capacitor, 0.1 µF ±10%, 6.3 V	
C2	Capacitor, 220 pF ±5%, 25 V	Ceramic
C4	Capacitor, 2.2 µF ±10%, 6.3 V	
D1	ESD protection diode, 5 pF, 6.1 V	ST Micro ESDALC6V1-1BU2; install as close to transmitter pin B1 as possible.
Q1	MOS field-effect transistor	CEDM 7001
R1	Resistor, 6.81 kΩ ±0.5%, 1/20 W	
R2	Resistor, 2 kΩ ±1%, 1/20 W	
R3	Resistor, 1.2 kΩ ±0.5%, 1/20 W	
R4	Resistor, 2.61 kΩ ±0.5%, 1/20 W	
R5	Resistor, 887 kΩ ±1%, 1/20 W	
R6	Resistor, 49.9 Ω +0.2%/-1%, 1/20 W	Shall not exceed 50 Ω.
R7	Resistor, 17.4 kΩ ±1%, 1/20 W	
R8	Resistor, value depends on U2.	See Additional Specifications & Support (page 255).
S0	Dome switch	Center button; shall not exceed 20 Ω when closed.
S1	Dome switch	Volume down; shall not exceed 20 Ω when closed.

Symbol	Description	Notes
S2	Dome switch	Volume up; shall not exceed 20 Ω when closed.
U1	Headset interface transmitter	Headset Remote and Microphone Transmitter
U2	MEMS analog microphone	See Additional Specifications & Support (page 255).

55.4.1 Button Detection Circuitry Adjustments

The values of some of the components listed in Table 55-7 (page 277) may be adjusted to optimize the performance of the headset accessory, using these formulas:

- **High-pass filter corner frequency in Hertz** $\approx 1/(2\pi \cdot R_8 \cdot C_4)$, where R_8 is the value of resistor R8 in ohms and C_4 is the value of capacitor C4 in Farads. This formula assumes the value of R7 is greater than the value of R8.
- **System sensitivity at 1 Pascal in Volts** = $(M_0/R_8) \cdot R_2$, where M_0 is the microphone sensitivity in Volts per Pascal, R_8 is the value of resistor R8 in ohms, and R_2 is the value of resistor R2 in ohms in parallel with 1.05 kΩ.
- **Maximum excursion of the microphone in Volts** = $(1/R_7) \cdot R_2$, where R_7 is the value of resistor R7 in ohms, and R_2 is the value of resistor R2 in ohms in parallel with 1.05 kΩ.

Note:
If the microphone bias voltage drops below 1.6 V, the transmitter will begin to fail and the microphone chip may produce indeterminate outputs.

Connectors

56. USB-A Receptacle

Accessories may incorporate a USB-A receptacle to:

- Provide power to a device.

56.1 Mechanical

The USB-A receptacle shall meet or exceed all applicable USB-IF mechanical specifications.

56.2 Electrical

The USB-A receptacle shall meet or exceed all applicable USB-IF electrical specifications.

57. USB-C Plug

Accessories incorporating a USB-C plug shall comply with the *USB Type-C Cable and Connector Specification –Release 2.3*.

Accessories may incorporate a USB-C plug to:

- Provide power to device.
- Draw power from USB Type-C Current sources.
- Draw power from USB Power Delivery sources.
- Draw power from USB Dedicated Charging Ports and USB hosts.

Accessories benefiting from integrating a USB-C plug include cables, headsets, battery packs, and adapters.

57.1 Overview

The USB-C plug shall be USB-IF certified and have an assigned *Connector* Test ID from the USB-IF, see https://www.usb.org/products.

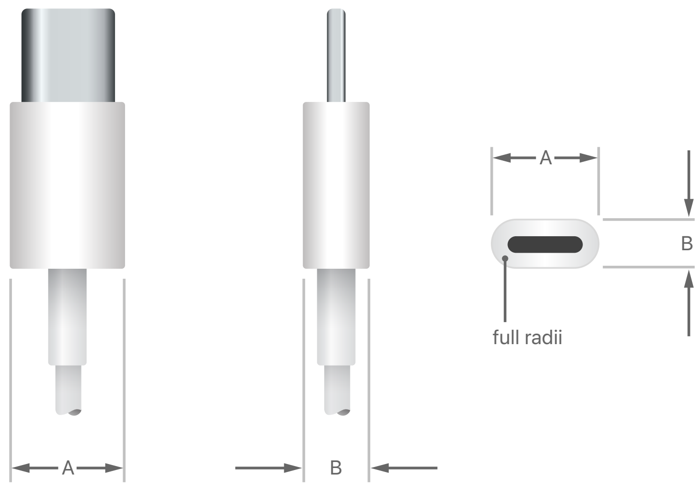
57.2 Mechanical

Accessories incorporating a USB-C plug shall comply with USB-C plug interface dimensions as specified in *USB Type-C Cable and Connector Specification –Release 2.3*.

USB-C plug enclosures shall not exceed the following dimensions as shown in Figure 57-1 (page 282):

- 'A' ≤ 12.35 mm.
- 'B' ≤ 6.50 mm.

Figure 57-1 USB-C plug example



USB-C plug enclosures should have full radii rounded edges for the greatest compatibility with the widest variety of cases, see USB-C receptacle accessory keep-out (page 287).

57.3 Electrical

57.3.1 Drawing Power

Accessories drawing power from the USB-C plug shall:

- Correctly identify all USB Type-C Current (page 224) sources.
- Correctly identify all USB Dedicated Charging Ports (DCP) as defined in the *USB Battery Charging Specification –Release 1.2*.
- Enumerate as a USB device when connected to a USB host and:
    - Not draw more than 100 mA of current until they have been successfully enumerated.
    - Request no more than 500 mA of charging current in their USB device descriptor.
- Not draw more power than the USB power source claims it is capable of providing using one of the above methods.

Accessories may also correctly identify all USB Power Delivery (PD) (page 223) sources.

Accessories drawing power from a device may do so using one of the following protocols:

- USB Type-C Current (page 224)
- USB Power Delivery (PD) (page 223)

57.3.2 Providing Power

Accessories providing power to a device using a USB-C plug shall:

- Provide at least 15 W (3 A at 5.0 V) of power.
- Support USB Type-C Current (page 224).

The accessories should:

- Support USB Power Delivery (PD) (page 223).
- Label the receptacle indicating how much power is supplied in watts.

57.4 Verification

57.4.1 Mechanical

Verify the dimensions of the USB-C plug comply with interface dimensions.

57.4.2 Connector Test ID

Verify the accessory's USB-C plug has an assigned *Connector* Test ID from the USB-IF, see https://www.usb.org/products.

57.4.3 Drawing Power

This procedure applies to accessories drawing power using the USB-C plug.

57.4.3.1 Equipment

The following equipment is necessary:

- Apple 140W USB-C Power Adapter
- Apple 96W USB-C Power Adapter
- Apple 70W USB-C Power Adapter
- Apple 67W USB-C Power Adapter
- Apple 30W USB-C Power Adapter
- Apple 20W USB-C Power Adapter
- Apple 35W Dual USB-C Port Compact Power Adapter
- Apple 35W Dual USB-C Port Power Adapter
- Bundled USB-C power adapter (if applicable)

57.4.3.2 Procedure

1. Verify the accessory correctly identifies all Apple branded or bundled power sources:
    a. Verify each USB-C power adapter is correctly identified and provides power.
2. Verify the accessory correctly identifies a Mac and iPad:
    a. Verify the Mac is correctly identified and provides power.
    b. Verify the iPad is correctly identified and provides power.

58. USB-C Receptacle

Accessories incorporating a USB-C receptacle shall comply with the *USB Type-C Cable and Connector Specification –Release 2.3*.

Accessories may incorporate a USB-C receptacle to:

- Provide power to device.
- Draw power from Apple branded power sources.
- Draw power from USB Type-C Current sources.
- Draw power from USB Power Delivery sources.
- Draw power from USB Dedicated Charging Ports and USB hosts.

Accessories benefiting from incorporating a USB-C receptacle include AC Power Adapters (page 85), Battery Packs (page 88), and speakers.

58.1 Overview

The USB-C receptacle shall be USB-IF certified and have a *Connector* Test ID from the USB-IF, see https://www.usb.org/products.

58.2 Mechanical

Accessories incorporating a USB-C receptacle shall comply with USB-C receptacle interface dimensions as specified in *USB Type-C Cable and Connector Specification –Release 2.3*.

See the recommended minimum USB-C receptacle accessory keep-out (page 287).

58.3 Electrical

58.3.1 Drawing Power

Accessories drawing power from the USB-C receptacle shall:

- Correctly identify all Apple branded power sources.

- Correctly identify all USB Type-C Current (page 224) sources.
- Enumerate as a USB device when connected to a USB host and:
  - Not draw more than 100 mA of current until they have been successfully enumerated.
  - Request no more than 500 mA of charging current in their USB device descriptor.
- Correctly identify all USB Dedicated Charging Ports (DCP) as defined in the *USB Battery Charging Specification –Release 1.2*.
- Not draw more power than the USB power source claims it is capable of providing using one of the above methods.

Accessories may also correctly identify all USB Power Delivery (PD) (page 223) sources.

58.3.2 Providing Power

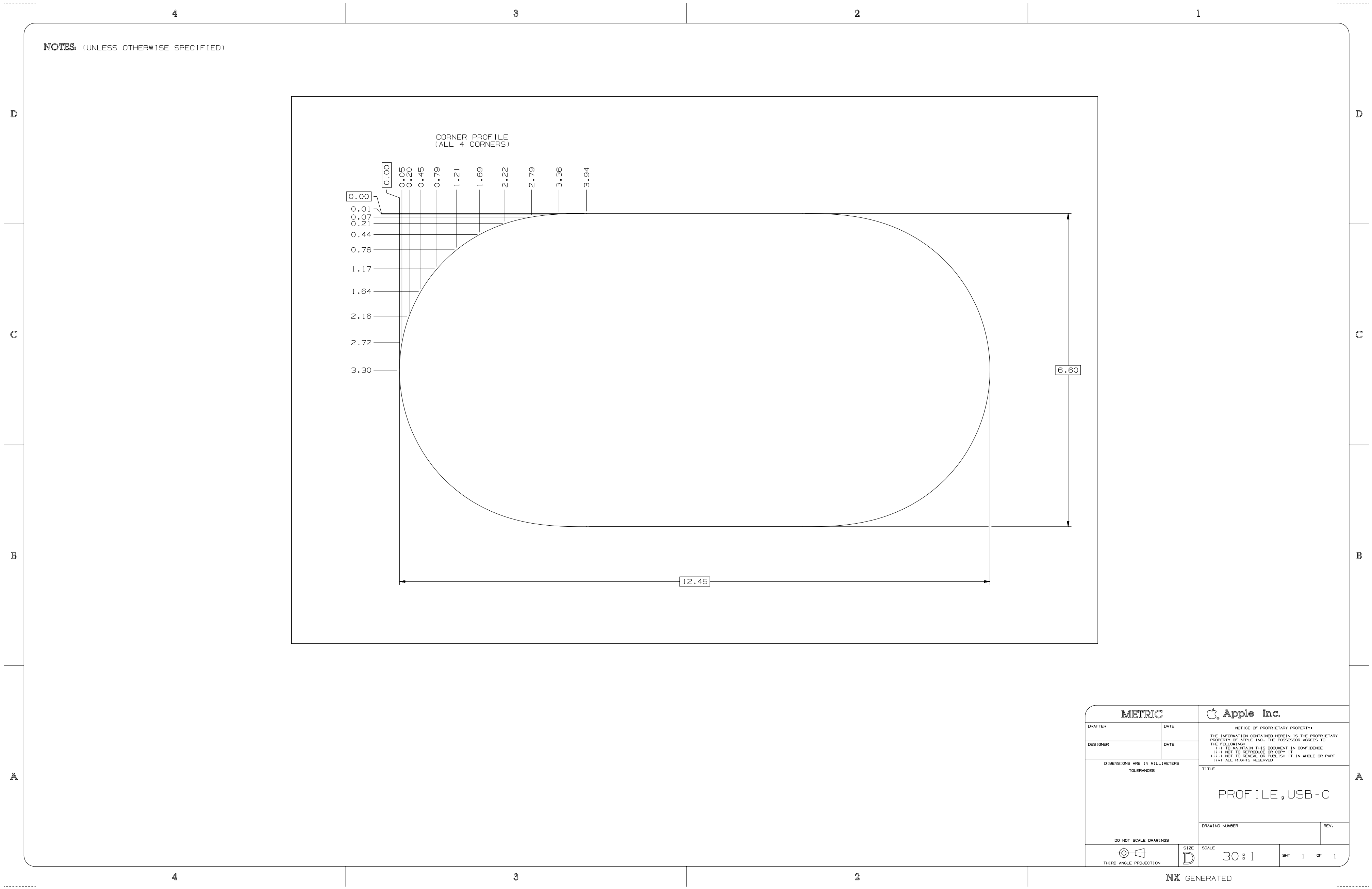
Accessories providing power to a device using a USB-C receptacle shall:

- Provide at least 15 W (3 A at 5.0 V) of power.
- Support USB Type-C Current (page 224).

The accessories should:

- Support USB Power Delivery (PD) (page 223).
- Label the receptacle indicating how much power is supplied in watts.

58.4 USB-C receptacle accessory keep-out



58.5 Verification

58.5.1 Connector Test ID

Verify the accessory's USB-C receptacle has an assigned *Connector* Test ID from the USB-IF, see https://www.usb.org/products.

58.5.2 Drawing Power

This procedure applies to accessories drawing power using the USB-C receptacle.

58.5.2.1 Equipment

The following equipment is necessary:

- Apple USB-C Charge Cable (1 m)
- Apple USB-C Charge Cable (2 m)
- Bundled USB-C to USB-C cable (if applicable)
- Bundled USB-A to USB-C cable (if applicable)
- 3rd-party USB-A to USB-C cable
- Apple 140W USB-C Power Adapter
- Apple 96W USB-C Power Adapter
- Apple 70W USB-C Power Adapter
- Apple 67W USB-C Power Adapter
- Apple 30W USB-C Power Adapter
- Apple 20W USB-C Power Adapter
- Apple 35W Dual USB-C Port Compact Power Adapter
- Apple 35W Dual USB-C Port Power Adapter
- Apple 12W USB Power Adapter
- Apple 5W USB Power Adapter
- Bundled USB-C power adapter (if applicable)
- Bundled USB-A power adapter (if applicable)

58.5.2.2 Procedure

1. Verify the accessory correctly identifies all Apple branded or bundled power adapters:
   a. Using each USB-A to USB-C cable, verify each USB-A power adapter is correctly identified and provides power.
   b. Using each USB-C to USB-C cable, verify each USB-C power adapter is correctly identified and provides power.
2. Verify the accessory correctly identifies a Mac and iPad:

   a. Using each USB-A to USB-C cable and USB-C to USB-C cable, verify the Mac is correctly identified and provides power.
   b. Using each USB-A to USB-C cable and USB-C to USB-C cable, verify the iPad is correctly identified and provides power.

58.5.3 Providing Power

This procedure applies to accessories providing power using the USB-C receptacle.

58.5.3.1 Equipment

The following equipment is necessary:

- Apple USB-C to Lightning Cable (1 m)
- Apple USB-C to Lightning Cable (2 m)
- Apple USB-C Charge Cable (1 m)
- Apple USB-C Charge Cable (2 m)
- Bundled USB-C to USB-C cable (if applicable)

58.5.3.2 Procedure

1. Verify the accessory correctly provides power to devices:
   a. Using each USB-C to Lightning cable, verify the accessory uses USB Type-C Current or USB PD to identify at least 15 W of power providing capability.
   b. Using each USB-C to Lightning cable, verify the accessory provides power to the device.
2. Verify the accessory correctly identifies a Mac and iPad:
   a. Using each USB-C to USB-C cable, verify the accessory is correctly identified and provides power to the Mac.
   b. Using each USB-C to USB-C cable, verify the accessory is correctly identified and provides power to the iPad.

Tools

59. Accessory Developer Assistant (ADA)

Some test procedures in this specification require use of the Accessory Developer Assistant app, available from the App Store at https://apps.apple.com/us/app/accessory-developer-assistant/id1635862694.

The Accessory Developer Assistant app is a set of utilities designed to help accessory makers test new accessories. Use the Accessory Developer Assistant app to ensure iPhone and iPad performance for features such as:

- Camera Control (page 70)
- Autofocus & Optical Image Stabilization (page 72)
- Image Quality
- Near-Field Communication (NFC) (page 73)
- Compass (page 74)

59.1 Autofocus & Optical Image Stabilization Test Profile

The Autofocus & Optical Image Stabilization (page 72) test procedure requires an additional profile to be installed:

1. Use the device to access the ADA Camera Test profile at https://download.developer.apple.com/Developer_Tools/Accessory_Developer_Assistant_Camera_Test_Profile/ADACamera.mobileconfig.
2. Install the profile to the device.
3. Open Settings > Profile Downloaded and complete the installation.
4. Reboot the device.

References

60. Device Dimensional Drawings

iPhone dimensional drawings:

iPad dimensional drawings:

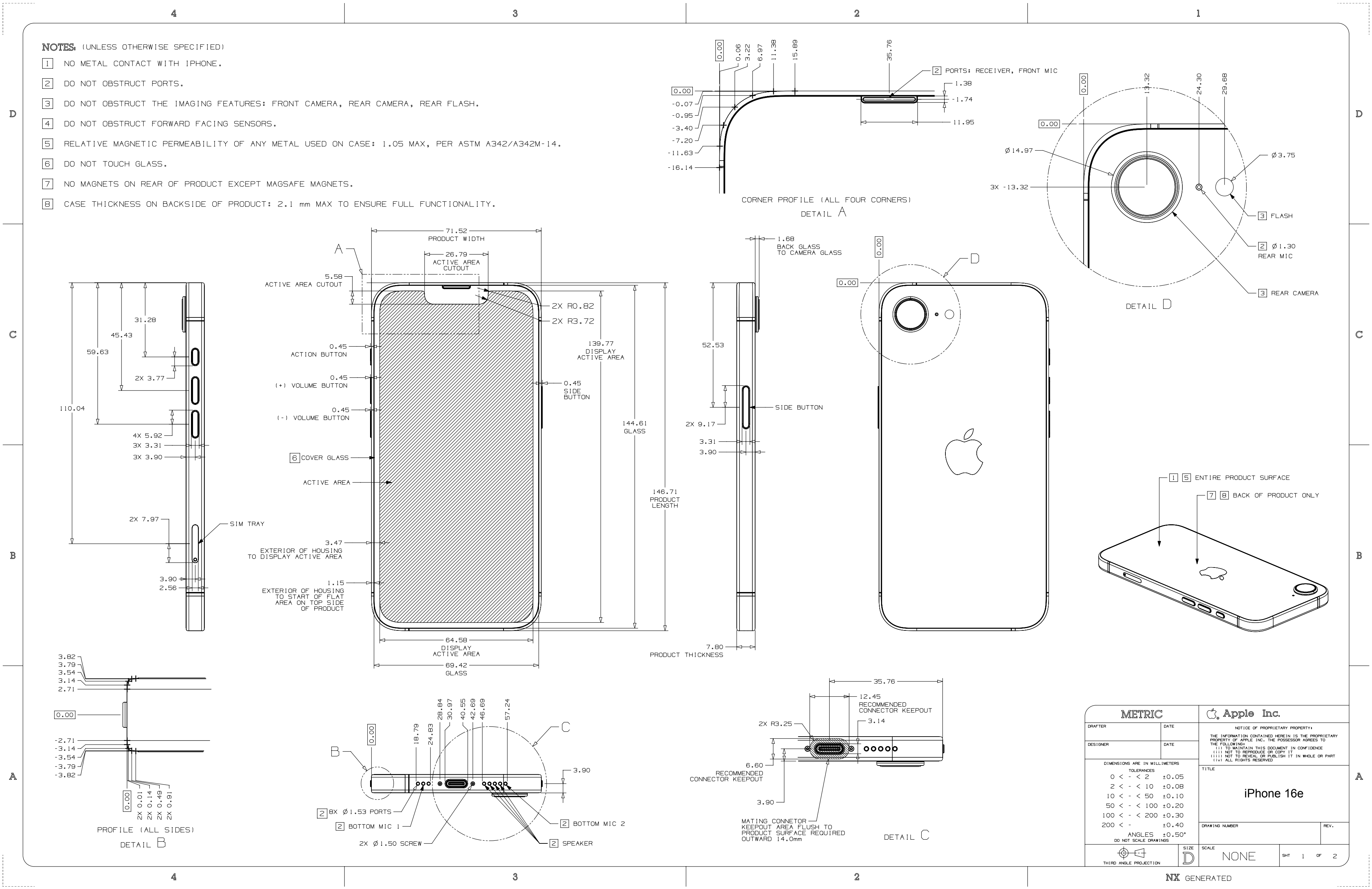
iPod dimensional drawings:

Apple Watch dimensional drawings:

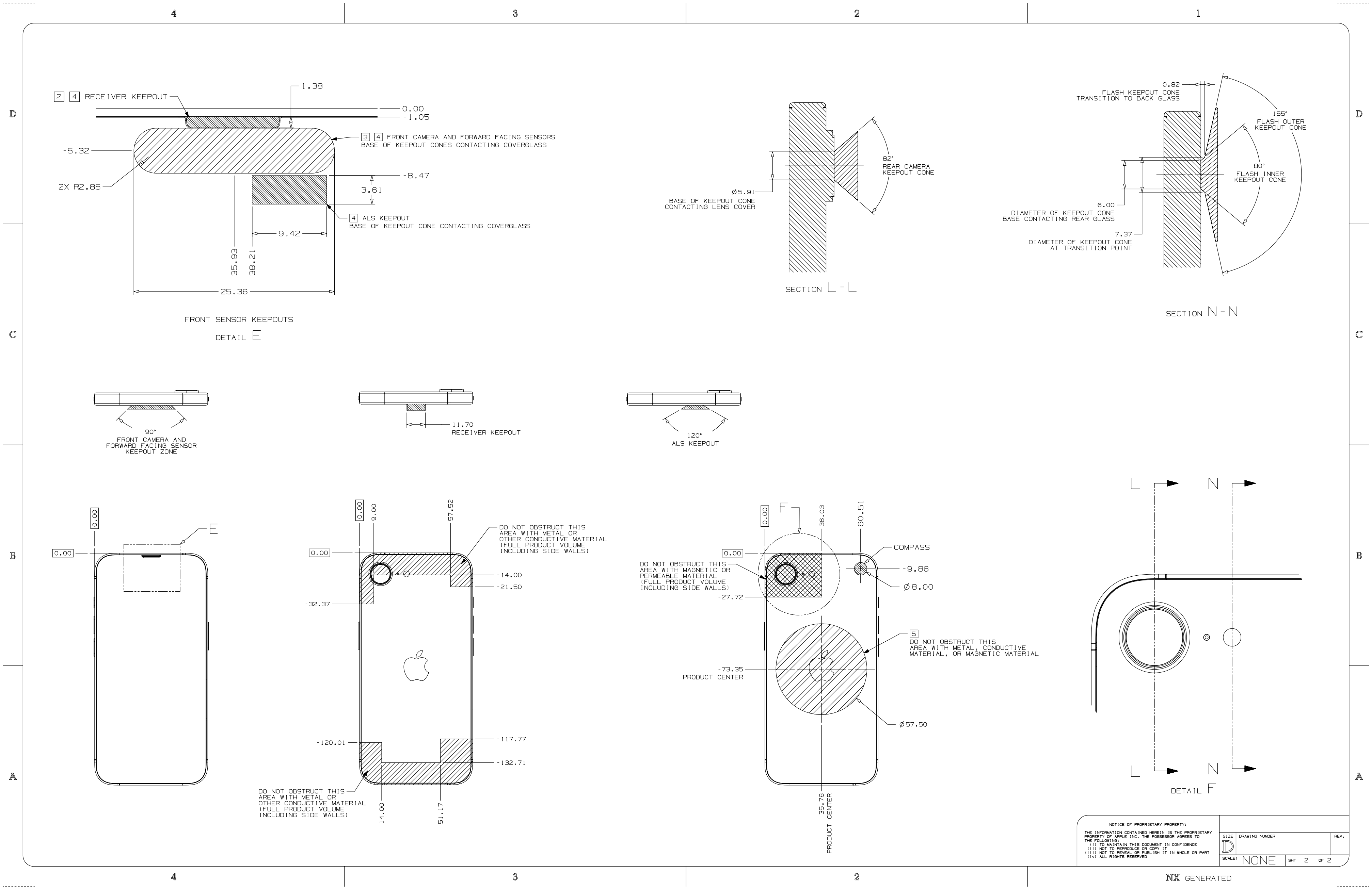
Apple Vision Pro dimensional drawings:

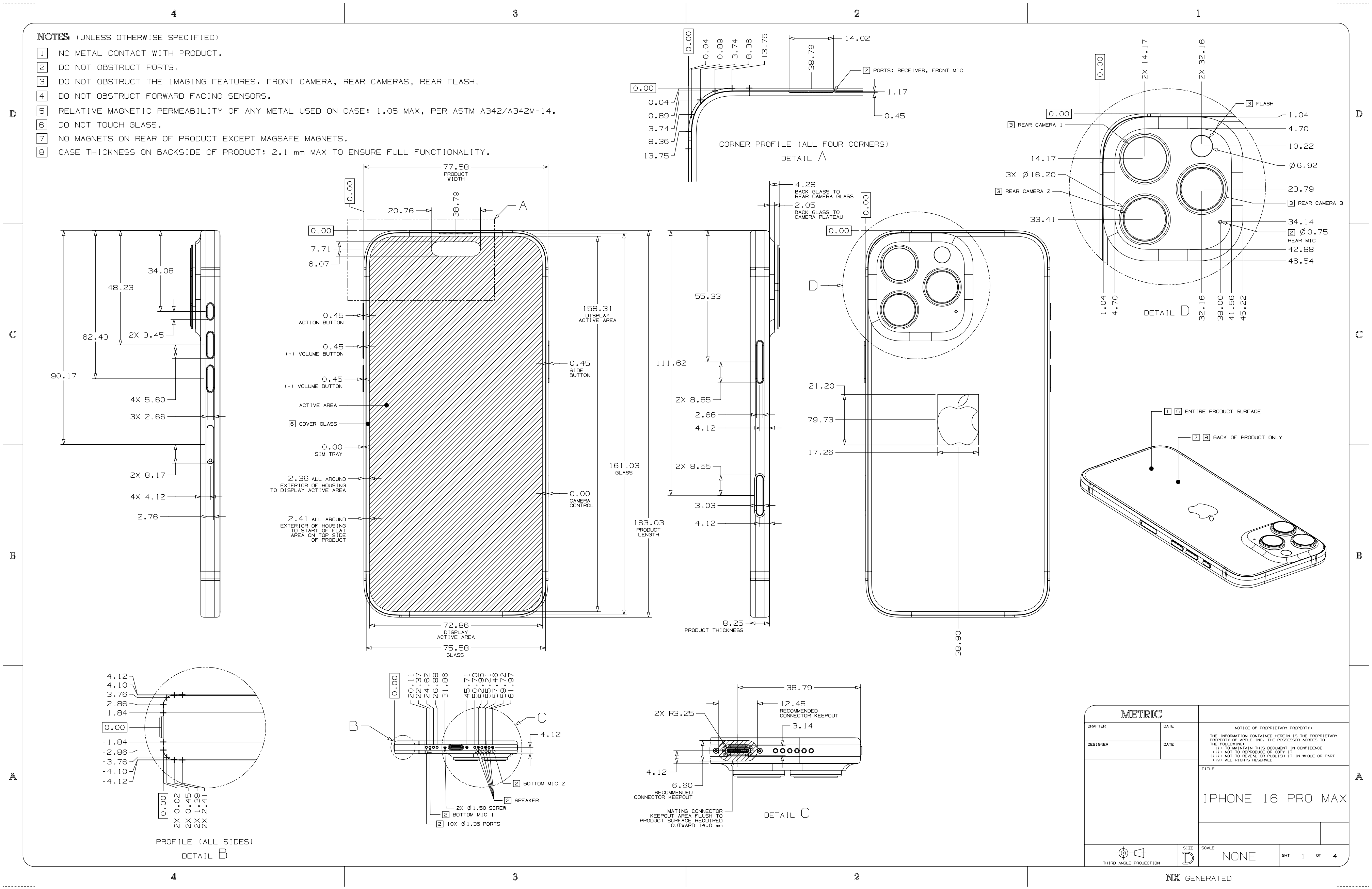
AirPods dimensional drawings:

Additional dimensional drawings:

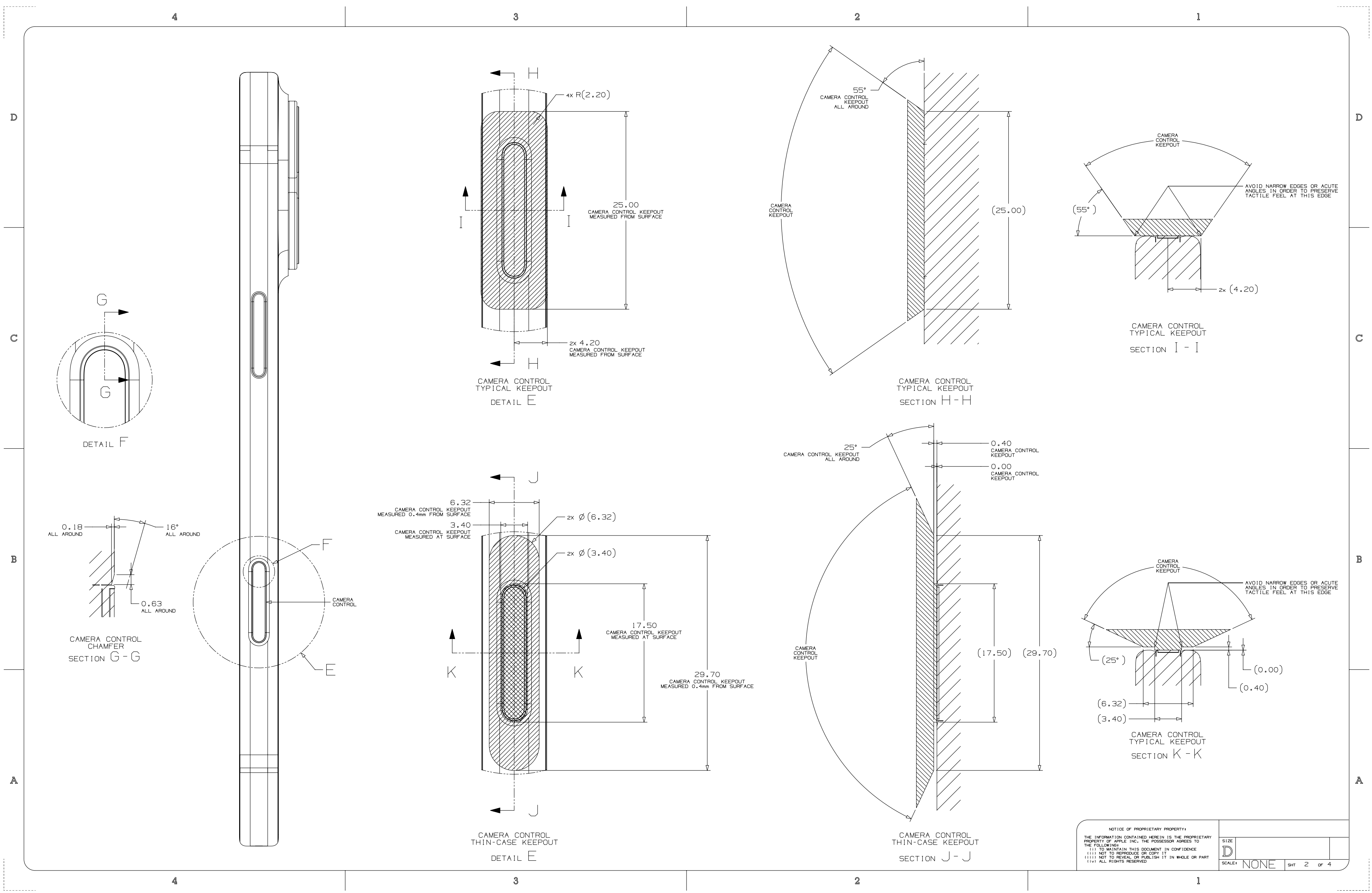

NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH IPHONE.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL A
2 PORTS: RECEIVER, FRONT MIC
DETAIL D
3 FLASH
2 Ø1.30 REAR MIC
3 REAR CAMERA
71.52 PRODUCT WIDTH
26.79 ACTIVE AREA CUTOUT
5.58 ACTIVE AREA CUTOUT
2X R0.82
2X R3.72
0.45 ACTION BUTTON
0.45 (+) VOLUME BUTTON
0.45 (-) VOLUME BUTTON
0.45 SIDE BUTTON
139.77 DISPLAY ACTIVE AREA
144.61 GLASS
146.71 PRODUCT LENGTH
6 COVER GLASS
ACTIVE AREA
SIM TRAY
3.47 EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
1.15 EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
64.58 DISPLAY ACTIVE AREA
69.42 GLASS
1.68 BACK GLASS TO CAMERA GLASS
SIDE BUTTON
7.80 PRODUCT THICKNESS
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
PROFILE (ALL SIDES)
DETAIL B
2 8X Ø1.53 PORTS
2 BOTTOM MIC 1
2X Ø1.50 SCREW
2 BOTTOM MIC 2
2 SPEAKER
12.45 RECOMMENDED CONNECTOR KEEPOUT
6.60 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0mm
DETAIL C
METRIC
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
II) NOT TO REPRODUCE OR COPY IT
III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
IV) ALL RIGHTS RESERVED
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
0 < - < 2 ±0.05
2 < - < 10 ±0.08
10 < - < 50 ±0.10
50 < - < 100 ±0.20
100 < - < 200 ±0.30
200 < - ±0.40
ANGLES ±0.50°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
TITLE
iPhone 16e
SIZE D
SCALE NONE
SHT 1 OF 2
NX GENERATED

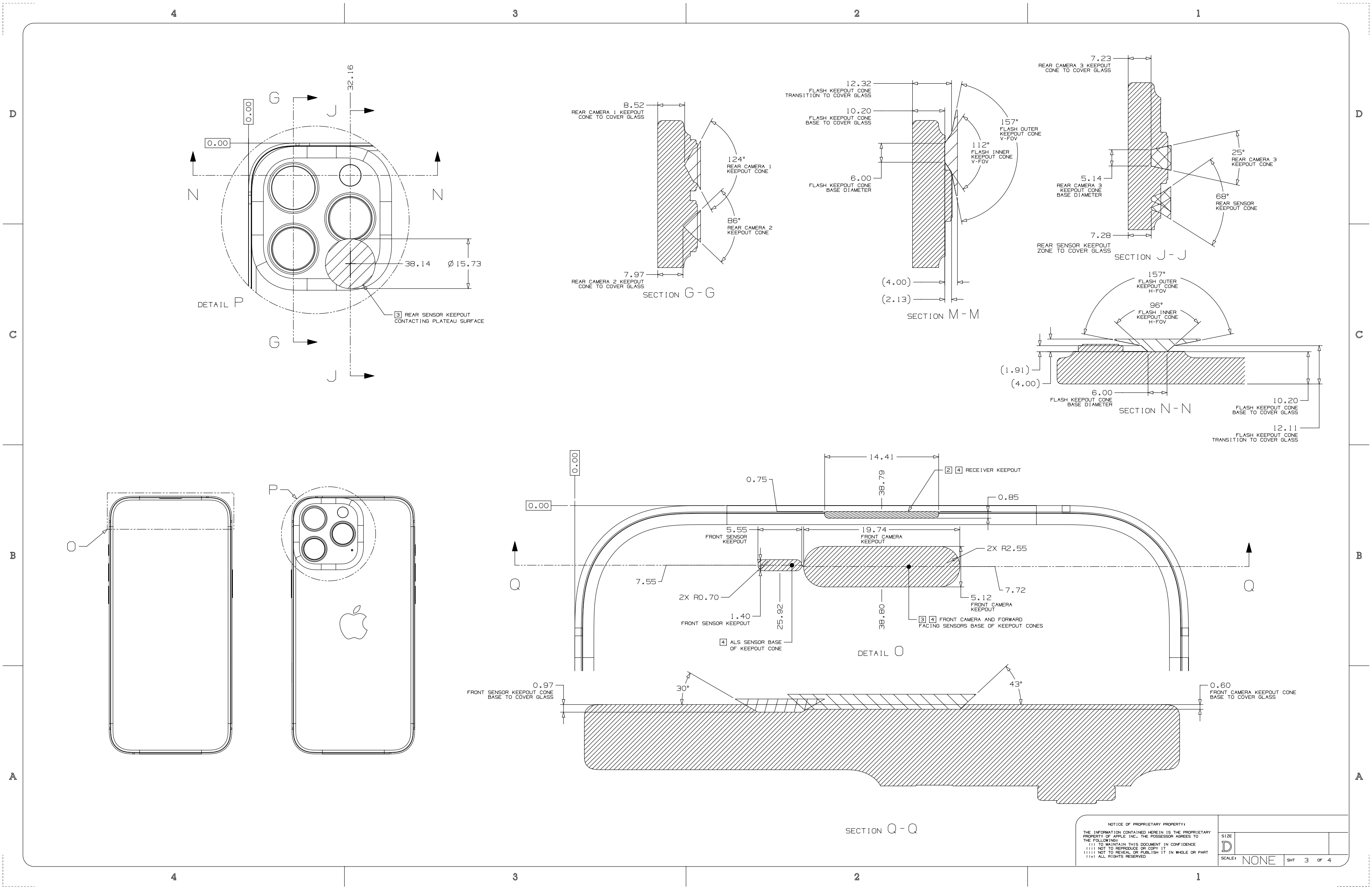
60.2 iPhone 16e, 2 of 2

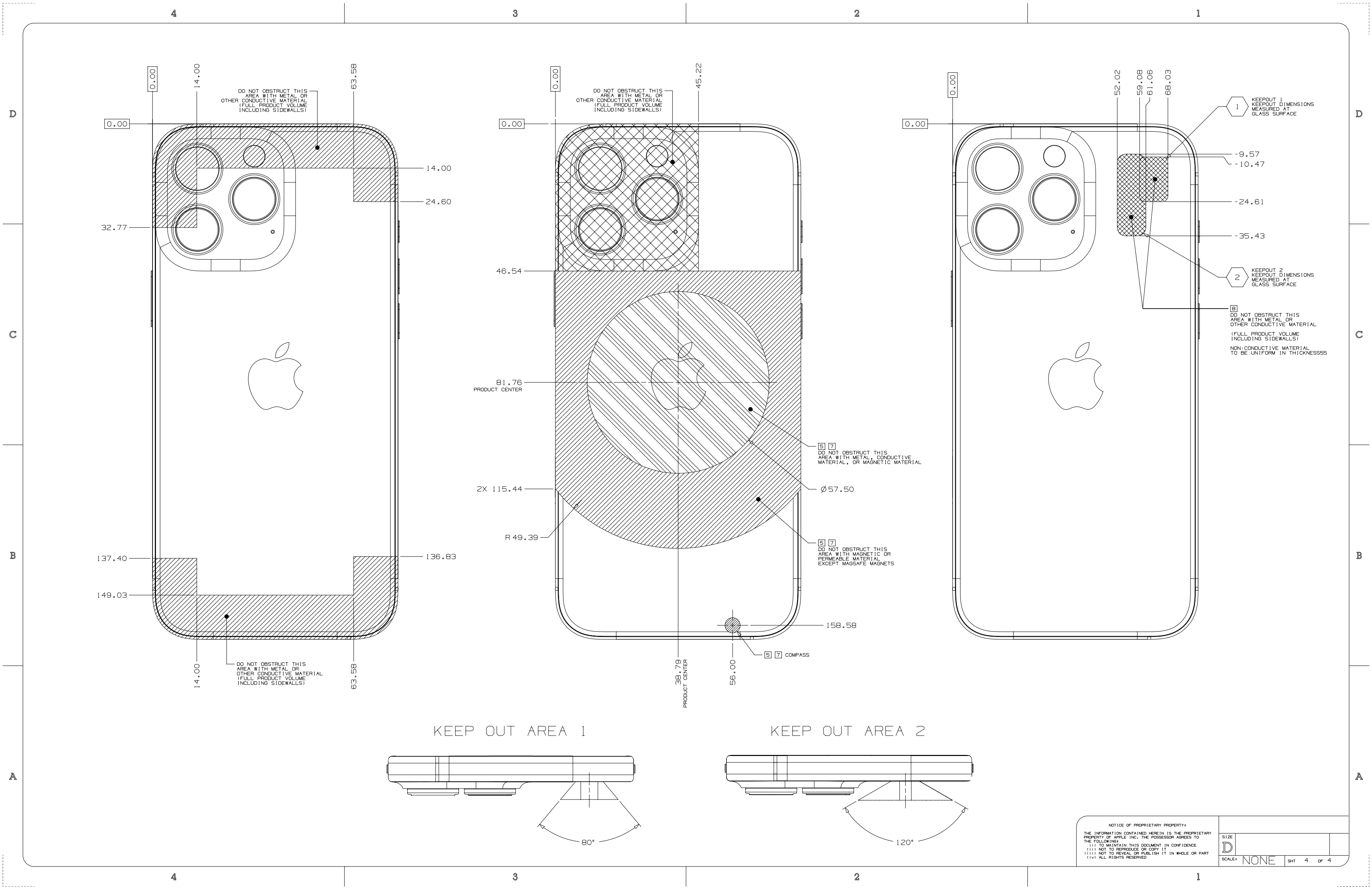


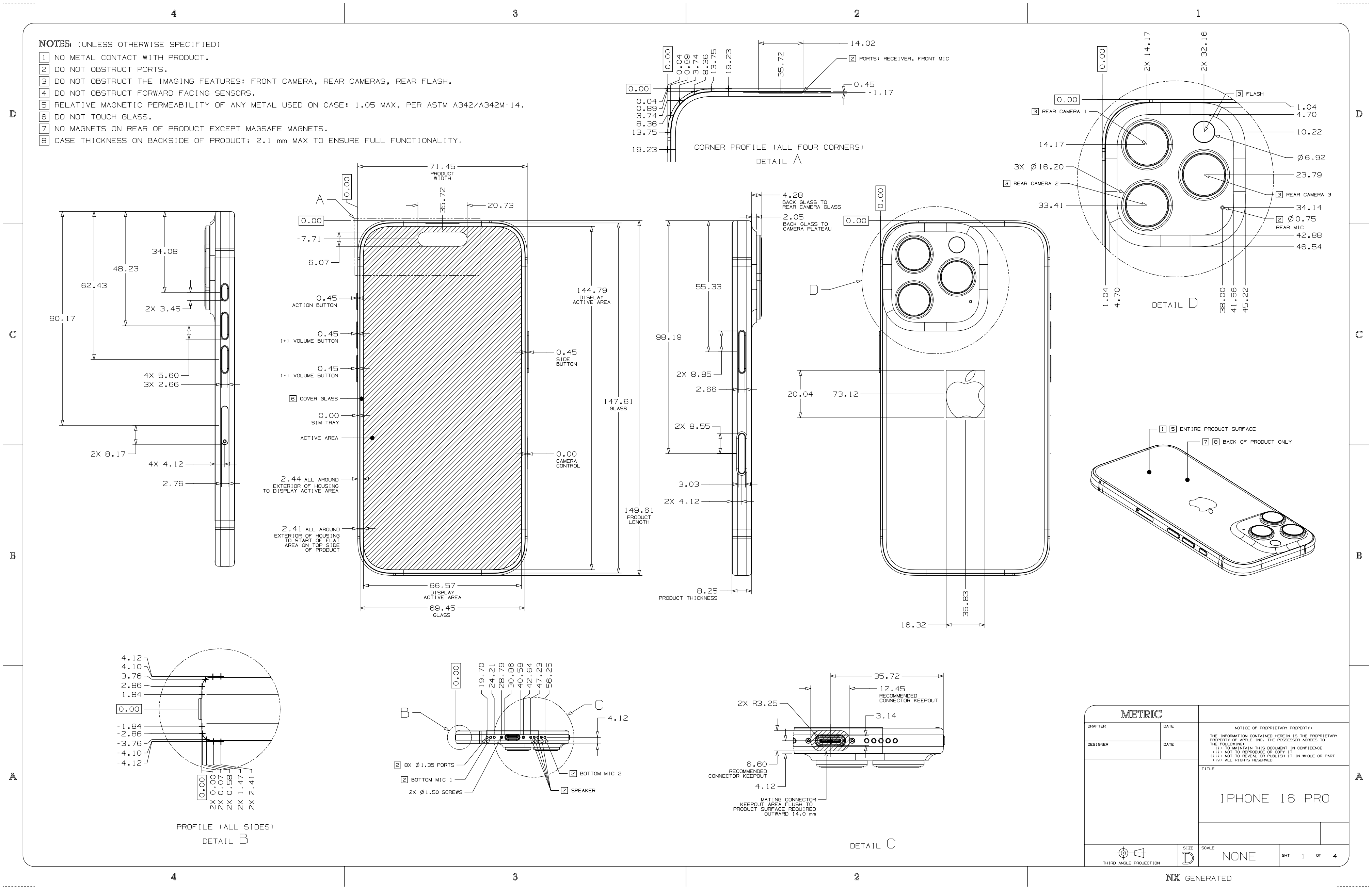

NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH PRODUCT.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL A
2 PORTS: RECEIVER, FRONT MIC
77.58 PRODUCT WIDTH
0.45 ACTION BUTTON
0.45 (+) VOLUME BUTTON
0.45 (-) VOLUME BUTTON
ACTIVE AREA
6 COVER GLASS
0.00 SIM TRAY
2.36 ALL AROUND EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
2.41 ALL AROUND EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
0.45 SIDE BUTTON
0.00 CAMERA CONTROL
158.31 DISPLAY ACTIVE AREA
161.03 GLASS
163.03 PRODUCT LENGTH
72.86 DISPLAY ACTIVE AREA
75.58 GLASS
4.28 BACK GLASS TO REAR CAMERA GLASS
2.05 BACK GLASS TO CAMERA PLATEAU
8.25 PRODUCT THICKNESS
3 FLASH
3 REAR CAMERA 1
3 REAR CAMERA 2
3 REAR CAMERA 3
2 Ø0.75 REAR MIC
DETAIL D
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
PROFILE (ALL SIDES)
DETAIL B
2 BOTTOM MIC 2
2 SPEAKER
2X Ø1.50 SCREW
2 BOTTOM MIC 1
2 10X Ø1.35 PORTS
12.45 RECOMMENDED CONNECTOR KEEPOUT
6.60 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
DETAIL C
METRIC
DRAFTER
DESIGNER
DATE
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
II) NOT TO REPRODUCE OR COPY IT
III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
IV) ALL RIGHTS RESERVED
TITLE
IPHONE 16 PRO MAX
THIRD ANGLE PROJECTION
SIZE D
SCALE NONE
SHT 1 OF 4
NX GENERATED

60.4 iPhone 16 Pro Max, 2 of 4

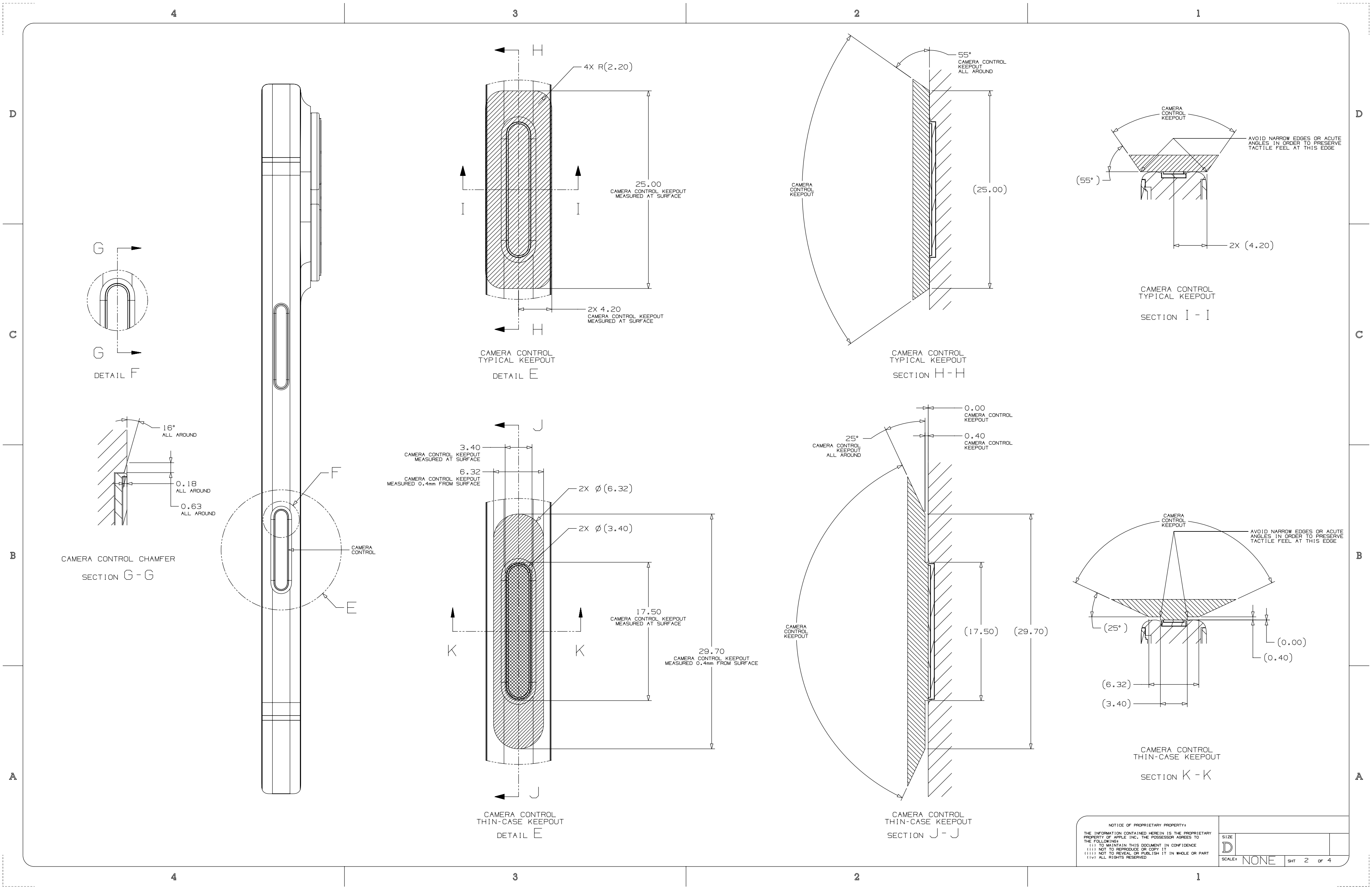



DETAIL P
0.00
32.16
38.14
Ø 15.73
3 REAR SENSOR KEEPOUT CONTACTING PLATEAU SURFACE
8.52
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
124°
REAR CAMERA 1 KEEPOUT CONE
86°
REAR CAMERA 2 KEEPOUT CONE
7.97
REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
SECTION G - G
12.32
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
10.20
FLASH KEEPOUT CONE BASE TO COVER GLASS
6.00
FLASH KEEPOUT CONE BASE DIAMETER
157°
FLASH OUTER KEEPOUT CONE V-FOV
112°
FLASH INNER KEEPOUT CONE V-FOV
(4.00)
(2.13)
SECTION M - M
7.23
REAR CAMERA 3 KEEPOUT CONE TO COVER GLASS
25°
REAR CAMERA 3 KEEPOUT CONE
5.14
REAR CAMERA 3 KEEPOUT CONE BASE DIAMETER
68°
REAR SENSOR KEEPOUT CONE
7.28
REAR SENSOR KEEPOUT ZONE TO COVER GLASS
SECTION J - J
157°
FLASH OUTER KEEPOUT CONE H-FOV
96°
FLASH INNER KEEPOUT CONE H-FOV
(1.91)
(4.00)
6.00
FLASH KEEPOUT CONE BASE DIAMETER
SECTION N - N
10.20
FLASH KEEPOUT CONE BASE TO COVER GLASS
12.11
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
14.41
2 4 RECEIVER KEEPOUT
0.75
38.79
0.85
5.55
FRONT SENSOR KEEPOUT
19.74
FRONT CAMERA KEEPOUT
2X R2.55
7.55
2X R0.70
1.40
FRONT SENSOR KEEPOUT
25.92
4 ALS SENSOR BASE OF KEEPOUT CONE
38.80
5.12
FRONT CAMERA KEEPOUT
7.72
3 4 FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES
DETAIL Q
0.97
FRONT SENSOR KEEPOUT CONE BASE TO COVER GLASS
30°
43°
0.60
FRONT CAMERA KEEPOUT CONE BASE TO COVER GLASS
SECTION Q - Q
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
SIZE D
SCALE: NONE
SHT 3 OF 4

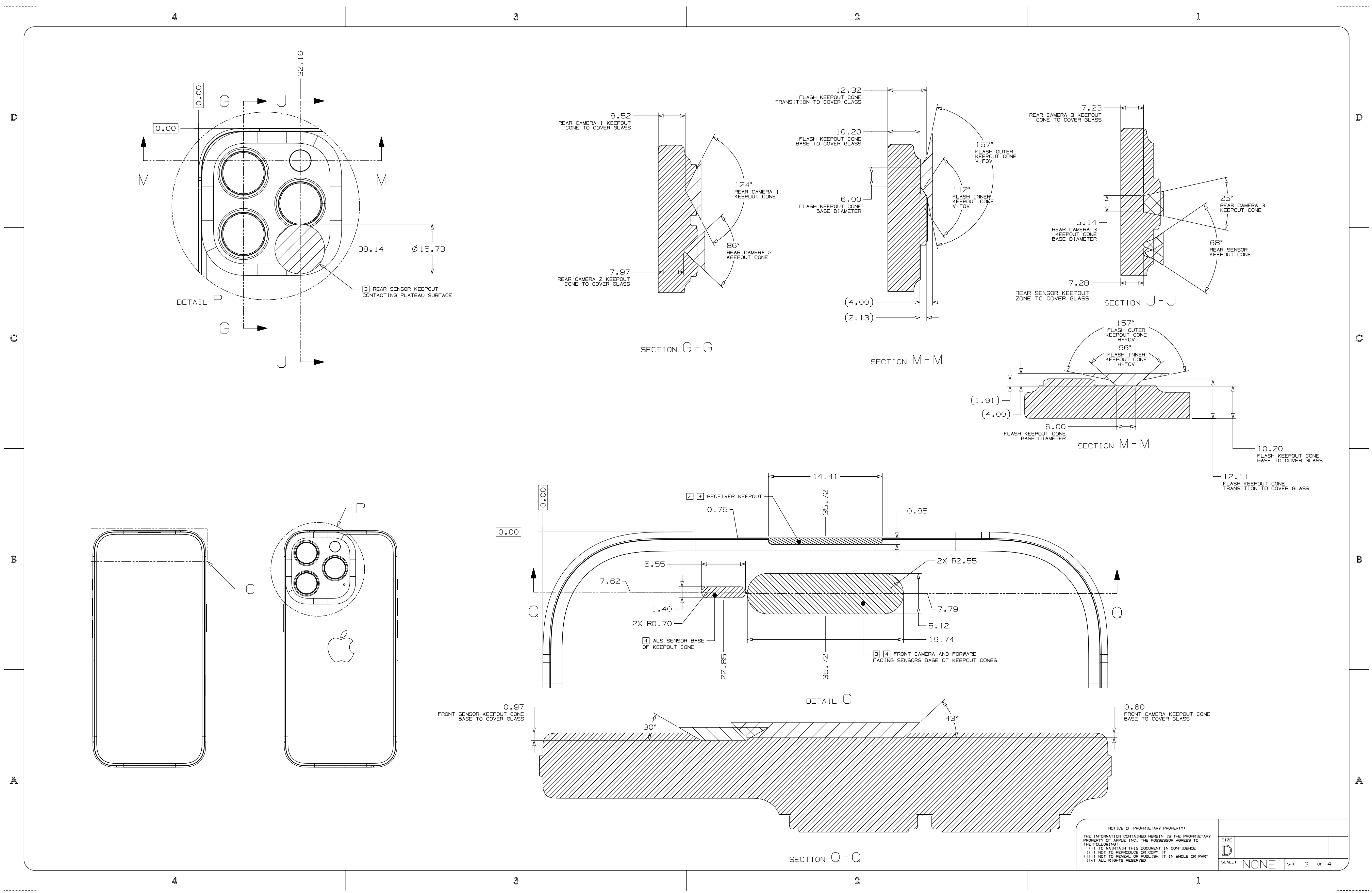

0.00
14.00
32.77
63.58
24.60
137.40
149.03
136.83
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS)
45.22
46.54
81.76 PRODUCT CENTER
2X 115.44
R 49.39
Ø57.50
158.58
38.79 PRODUCT CENTER
56.00
5 7 DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL, OR MAGNETIC MATERIAL
5 7 DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
5 7 COMPASS
52.02
59.08
61.06
68.03
-9.57
-10.47
-24.61
-35.43
1 KEEPOUT 1 KEEPOUT DIMENSIONS MEASURED AT GLASS SURFACE
2 KEEPOUT 2 KEEPOUT DIMENSIONS MEASURED AT GLASS SURFACE
8 DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS) NON-CONDUCTIVE MATERIAL TO BE UNIFORM IN THICKNESSSS
KEEP OUT AREA 1
80°
KEEP OUT AREA 2
120°
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
SIZE D
SCALE: NONE
SHT 4 OF 4


NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH PRODUCT.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL A
2 PORTS: RECEIVER, FRONT MIC
71.45 PRODUCT WIDTH
144.79 DISPLAY ACTIVE AREA
147.61 GLASS
149.61 PRODUCT LENGTH
66.57 DISPLAY ACTIVE AREA
69.45 GLASS
8.25 PRODUCT THICKNESS
0.45 ACTION BUTTON
0.45 (+) VOLUME BUTTON
0.45 (-) VOLUME BUTTON
6 COVER GLASS
0.00 SIM TRAY
ACTIVE AREA
0.45 SIDE BUTTON
0.00 CAMERA CONTROL
2.44 ALL AROUND EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
2.41 ALL AROUND EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
4.28 BACK GLASS TO REAR CAMERA GLASS
2.05 BACK GLASS TO CAMERA PLATEAU
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
3 REAR CAMERA 1
3 REAR CAMERA 2
3 REAR CAMERA 3
3 FLASH
2 Ø0.75 REAR MIC
DETAIL D
PROFILE (ALL SIDES)
DETAIL B
2 8X Ø1.35 PORTS
2 BOTTOM MIC 1
2X Ø1.50 SCREWS
2 BOTTOM MIC 2
2 SPEAKER
6.60 RECOMMENDED CONNECTOR KEEPOUT
12.45 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
DETAIL C
METRIC
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
II) NOT TO REPRODUCE OR COPY IT
III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
IV) ALL RIGHTS RESERVED
TITLE
IPHONE 16 PRO
THIRD ANGLE PROJECTION
SIZE D
SCALE NONE
SHT 1 OF 4
NX GENERATED

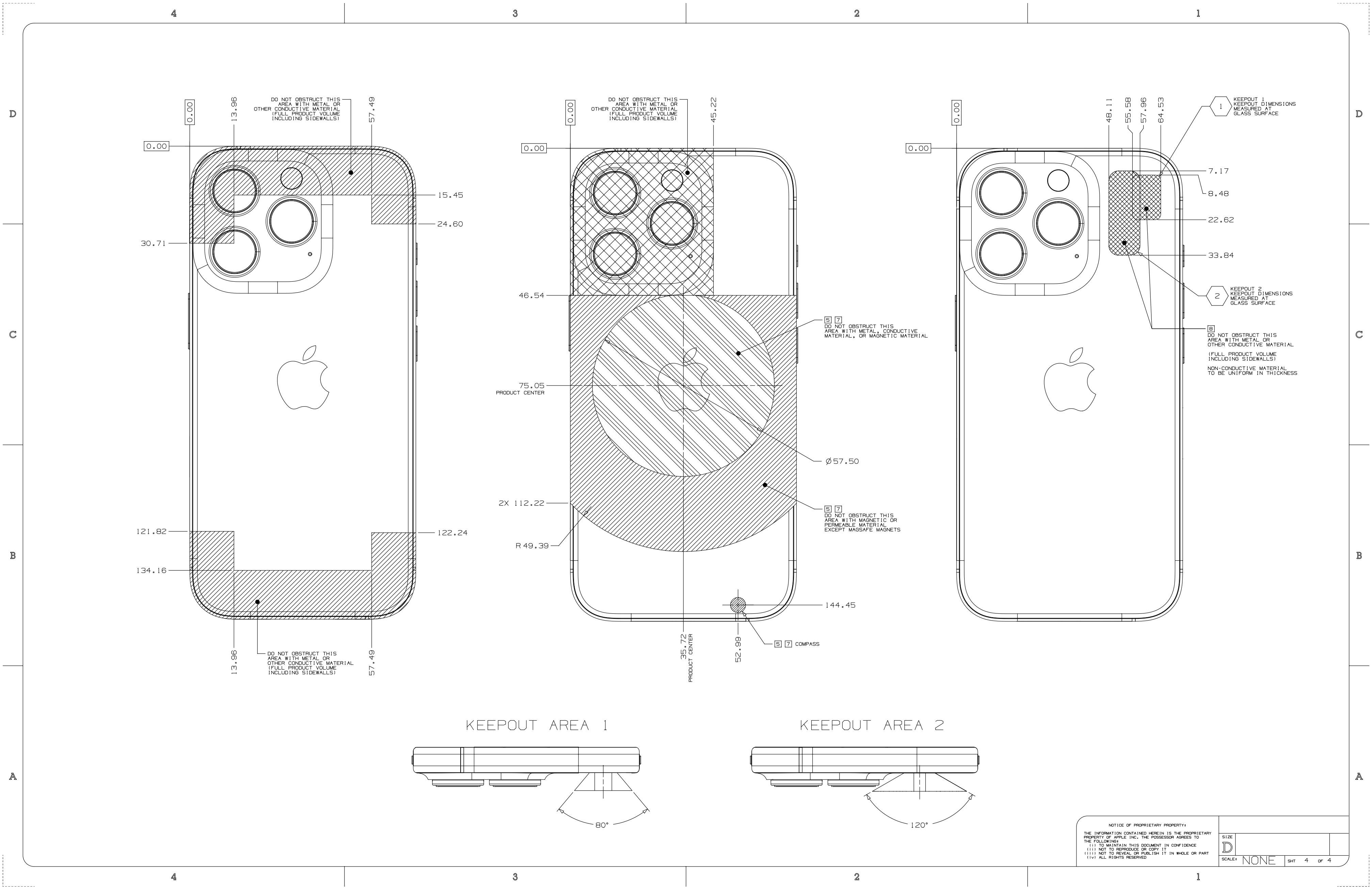
60.8 iPhone 16 Pro, 2 of 4

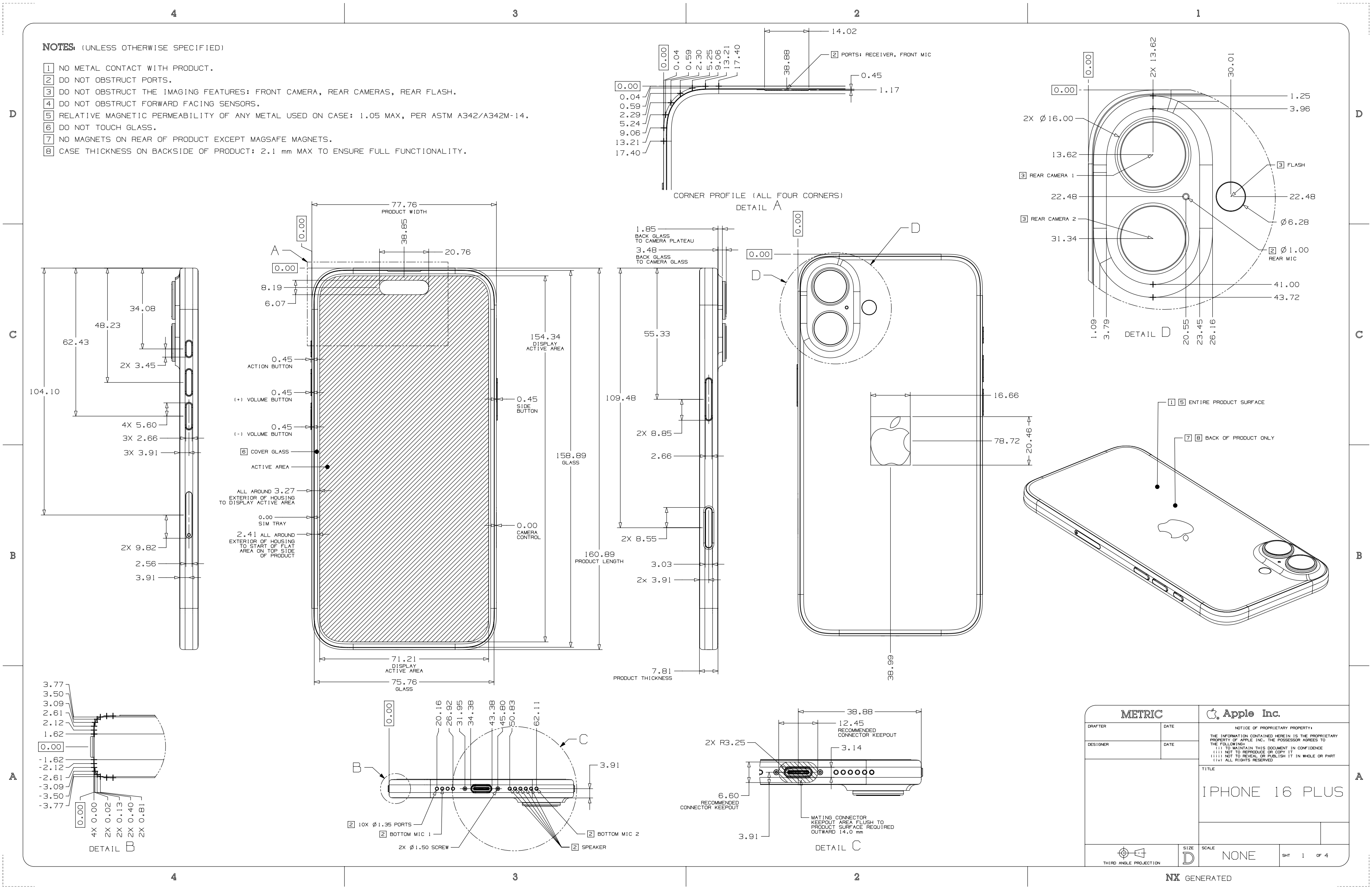


60.9 iPhone 16 Pro, 3 of 4

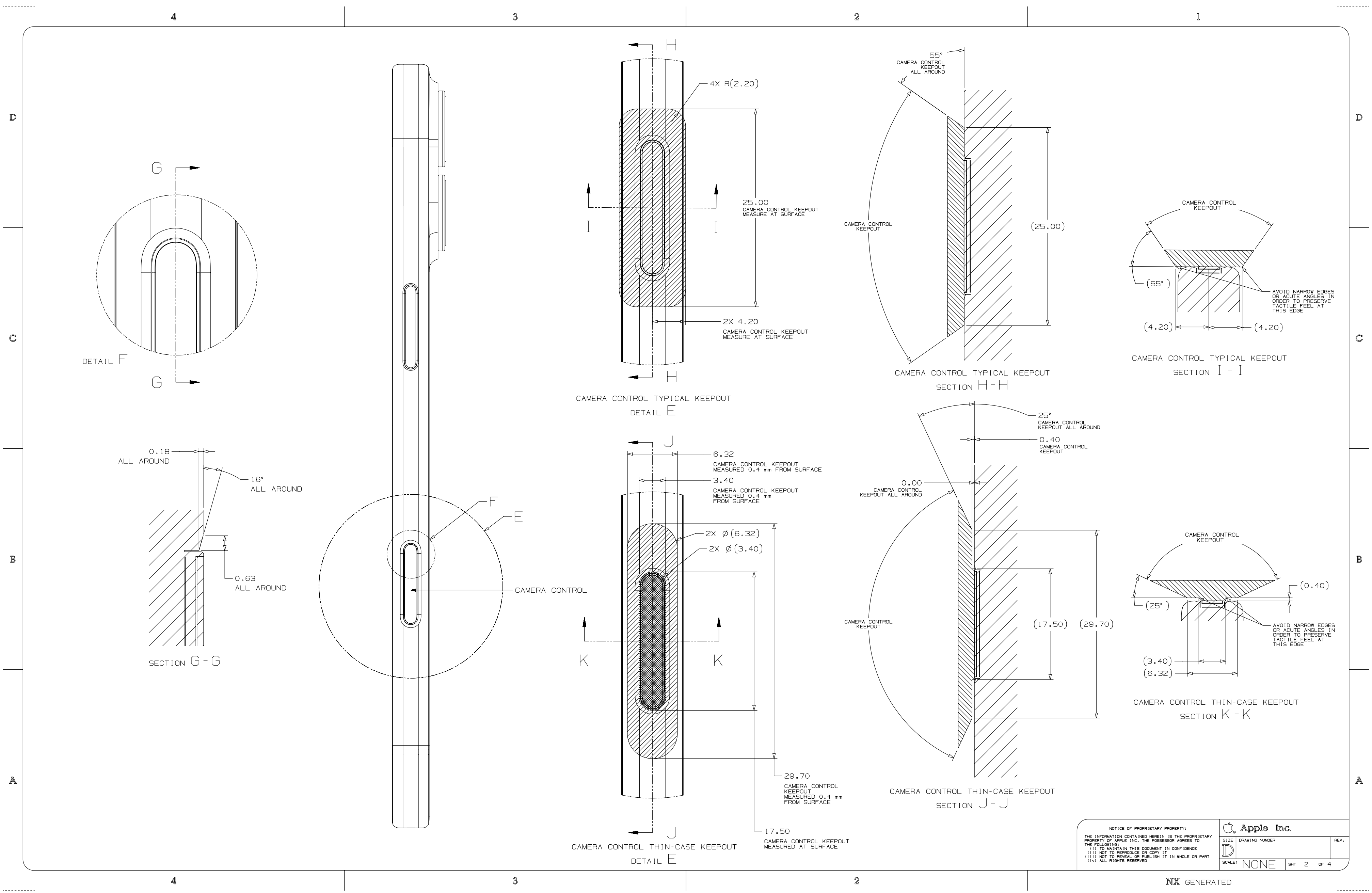


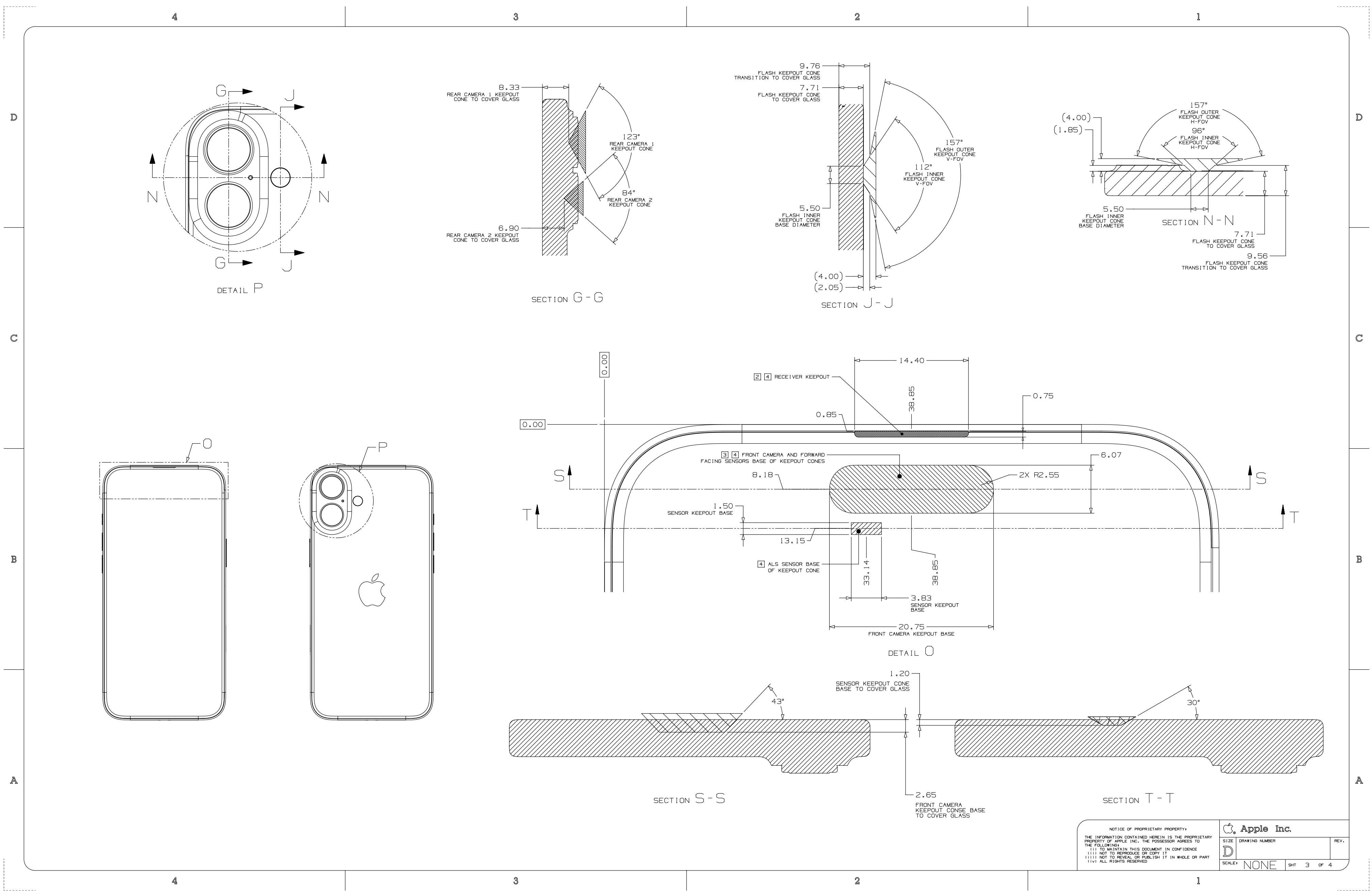
60.10 iPhone 16 Pro, 4 of 4



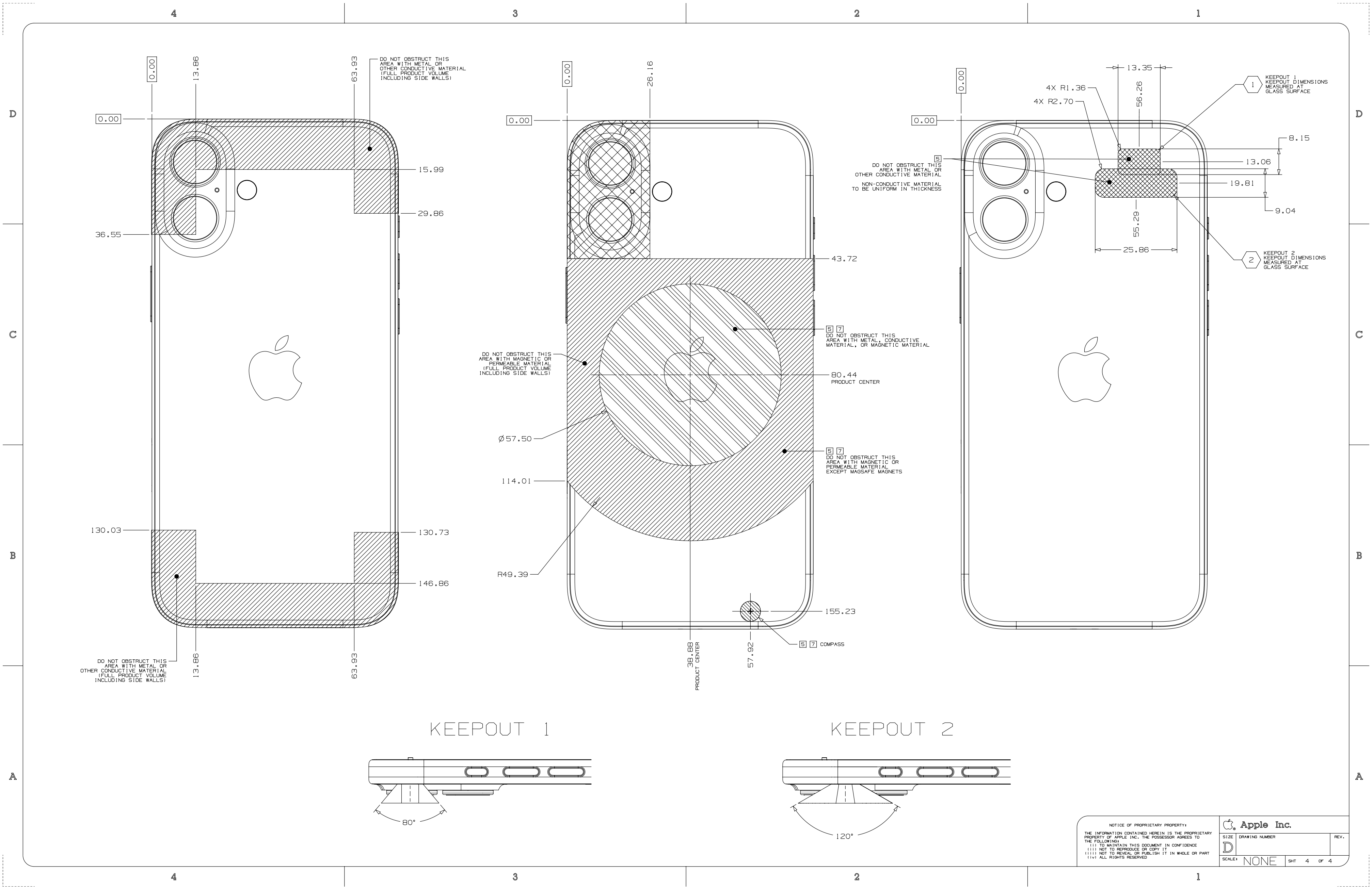

NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH PRODUCT.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL A
2 PORTS: RECEIVER, FRONT MIC
77.76 PRODUCT WIDTH
38.85
20.76
8.19
6.07
0.45 ACTION BUTTON
0.45 (+) VOLUME BUTTON
0.45 (-) VOLUME BUTTON
6 COVER GLASS
ACTIVE AREA
ALL AROUND 3.27 EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
0.00 SIM TRAY
2.41 ALL AROUND EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
154.34 DISPLAY ACTIVE AREA
0.45 SIDE BUTTON
0.00 CAMERA CONTROL
158.89 GLASS
160.89 PRODUCT LENGTH
71.21 DISPLAY ACTIVE AREA
75.76 GLASS
104.10
62.43
48.23
34.08
2X 3.45
4X 5.60
3X 2.66
3X 3.91
2X 9.82
2.56
3.91
1.85 BACK GLASS TO CAMERA PLATEAU
3.48 BACK GLASS TO CAMERA GLASS
55.33
109.48
2X 8.85
2.66
2X 8.55
3.03
2x 3.91
7.81 PRODUCT THICKNESS
16.66
78.72
20.46
38.99
2X Ø16.00
13.62
3 REAR CAMERA 1
22.48
3 REAR CAMERA 2
31.34
2X 13.62
30.01
1.25
3.96
3 FLASH
Ø6.28
2 Ø1.00 REAR MIC
41.00
43.72
1.09
3.79
DETAIL D
20.55
23.45
26.16
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
DETAIL B
2 10X Ø1.35 PORTS
2 BOTTOM MIC 1
2X Ø1.50 SCREW
2 BOTTOM MIC 2
2 SPEAKER
2X R3.25
38.88
12.45 RECOMMENDED CONNECTOR KEEPOUT
3.14
6.60 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
DETAIL C
METRIC
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
TITLE
IPHONE 16 PLUS
THIRD ANGLE PROJECTION
SIZE D
SCALE NONE
SHT 1 OF 4
NX GENERATED

60.12 iPhone 16 Plus, 2 of 4





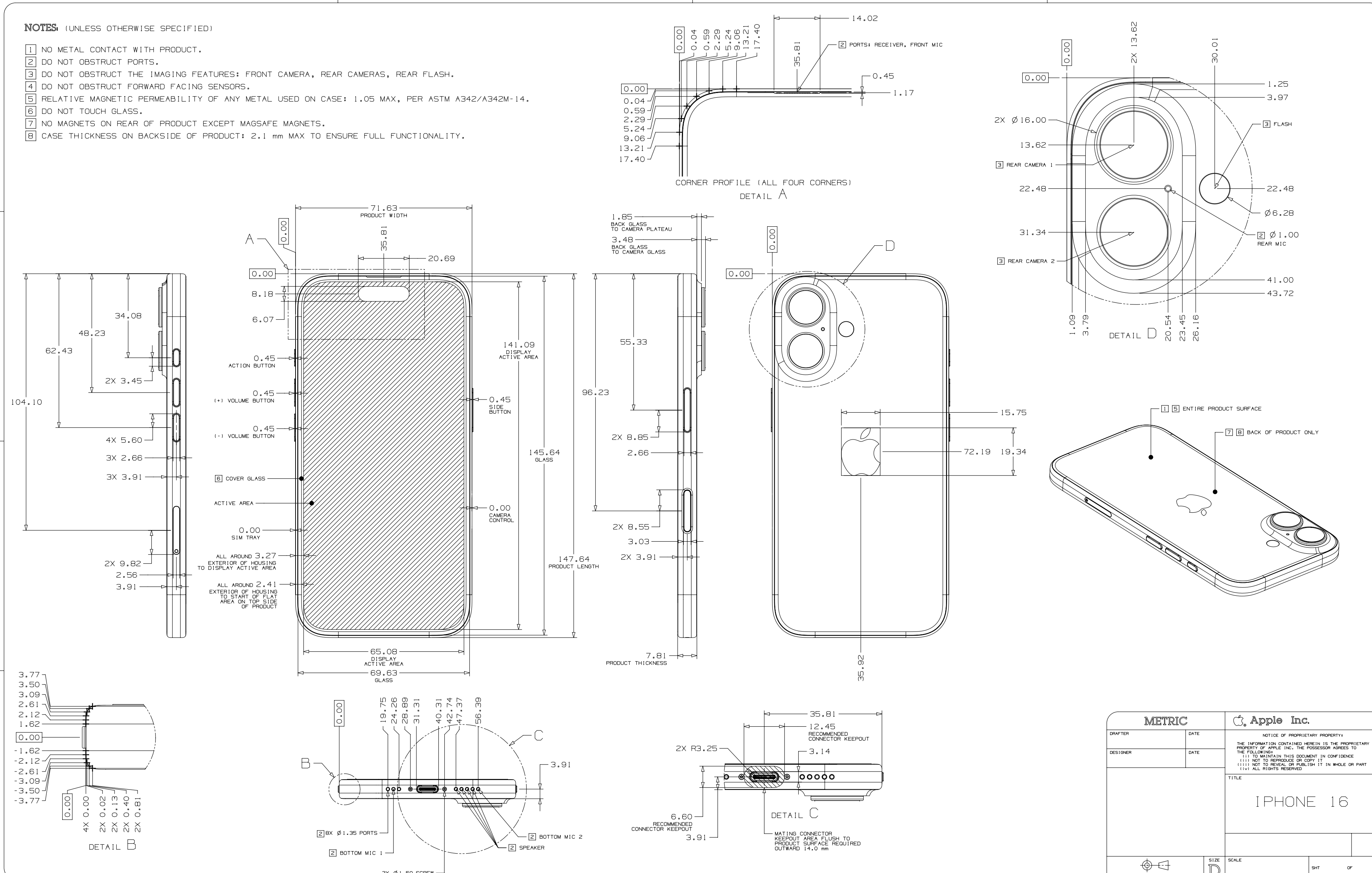
DETAIL P
SECTION G - G
8.33
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
6.90
REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
123°
REAR CAMERA 1 KEEPOUT CONE
84°
REAR CAMERA 2 KEEPOUT CONE
SECTION J - J
9.76
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
7.71
FLASH KEEPOUT CONE TO COVER GLASS
5.50
FLASH INNER KEEPOUT CONE BASE DIAMETER
157°
FLASH OUTER KEEPOUT CONE V-FOV
112°
FLASH INNER KEEPOUT CONE V-FOV
(4.00)
(2.05)
SECTION N - N
(4.00)
(1.85)
157°
FLASH OUTER KEEPOUT CONE H-FOV
96°
FLASH INNER KEEPOUT CONE H-FOV
5.50
FLASH INNER KEEPOUT CONE BASE DIAMETER
7.71
FLASH KEEPOUT CONE TO COVER GLASS
9.56
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
DETAIL O
0.00
0.00
14.40
2 4 RECEIVER KEEPOUT
38.85
0.85
0.75
3 4 FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES
6.07
8.18
2X R2.55
1.50
SENSOR KEEPOUT BASE
13.15
4 ALS SENSOR BASE OF KEEPOUT CONE
33.14
38.85
3.83
SENSOR KEEPOUT BASE
20.75
FRONT CAMERA KEEPOUT BASE
SECTION S - S
43°
1.20
SENSOR KEEPOUT CONE BASE TO COVER GLASS
2.65
FRONT CAMERA KEEPOUT CONSE BASE TO COVER GLASS
SECTION T - T
30°
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 3 OF 4



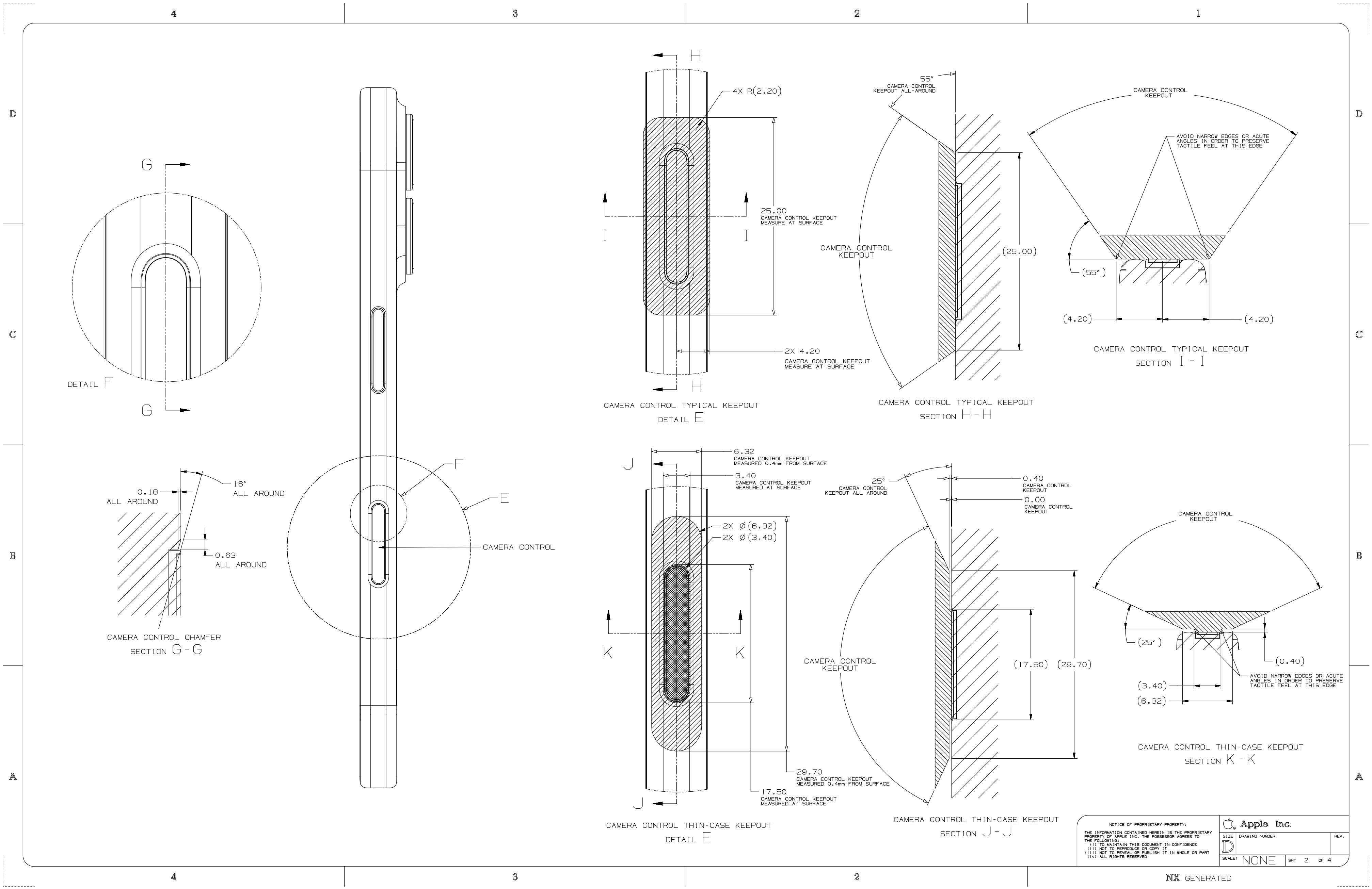
0.00
13.86
63.93
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
15.99
29.86
36.55
130.03
130.73
146.86
26.16
43.72
5 7 DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL, OR MAGNETIC MATERIAL
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
80.44 PRODUCT CENTER
Ø57.50
114.01
5 7 DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
R49.39
155.23
5 7 COMPASS
38.88 PRODUCT CENTER
57.92
13.35
4X R1.36
4X R2.70
56.26
1 KEEPOUT 1 KEEPOUT DIMENSIONS MEASURED AT GLASS SURFACE
5 DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM IN THICKNESS
8.15
13.06
19.81
9.04
55.29
25.86
2 KEEPOUT 2 KEEPOUT DIMENSIONS MEASURED AT GLASS SURFACE
KEEPOUT 1
80°
KEEPOUT 2
120°
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 4 OF 4

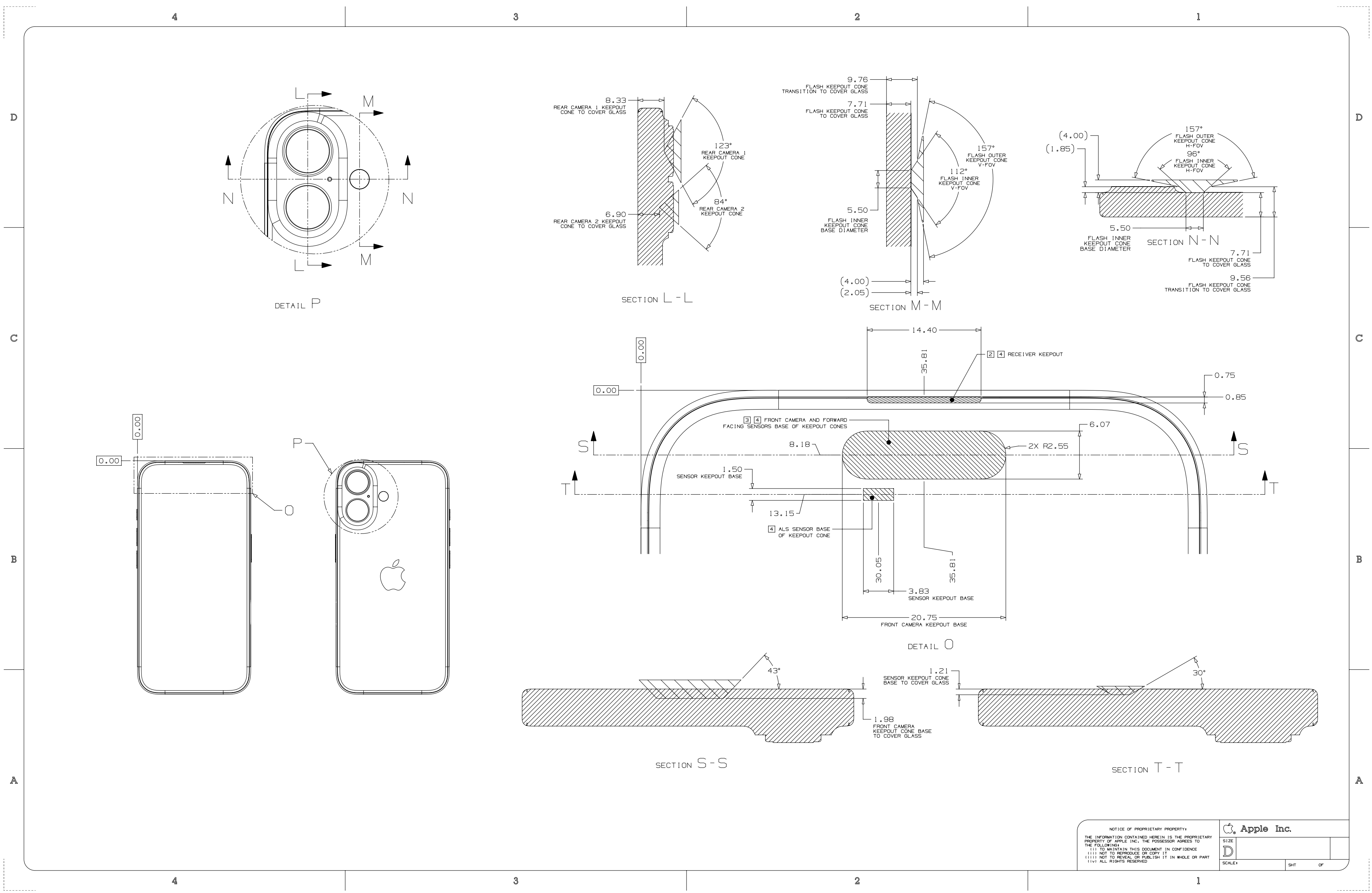
NOTES: (UNLESS OTHERWISE SPECIFIED)

1. NO METAL CONTACT WITH PRODUCT.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.

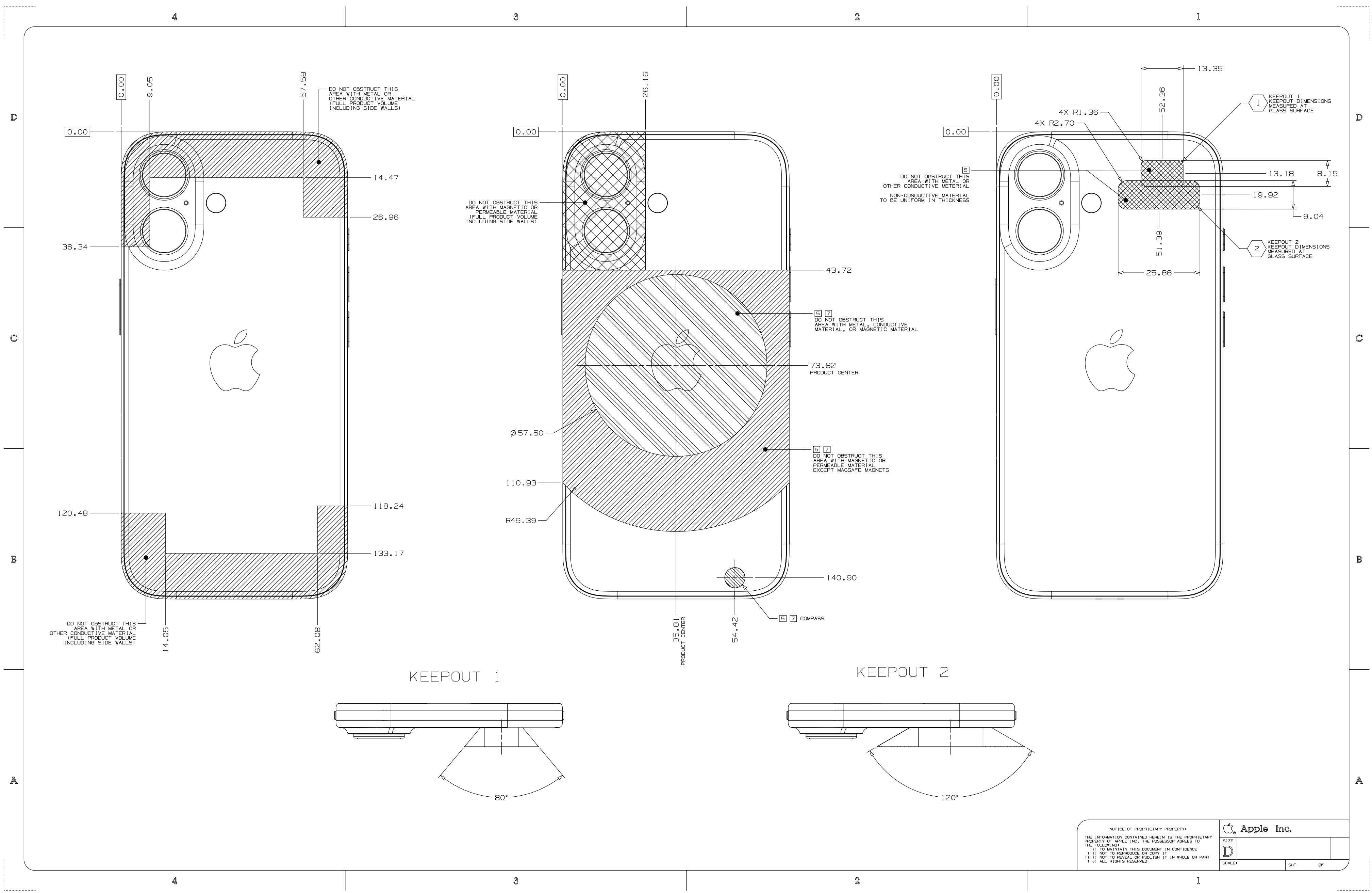


60.16 iPhone 16, 2 of 4



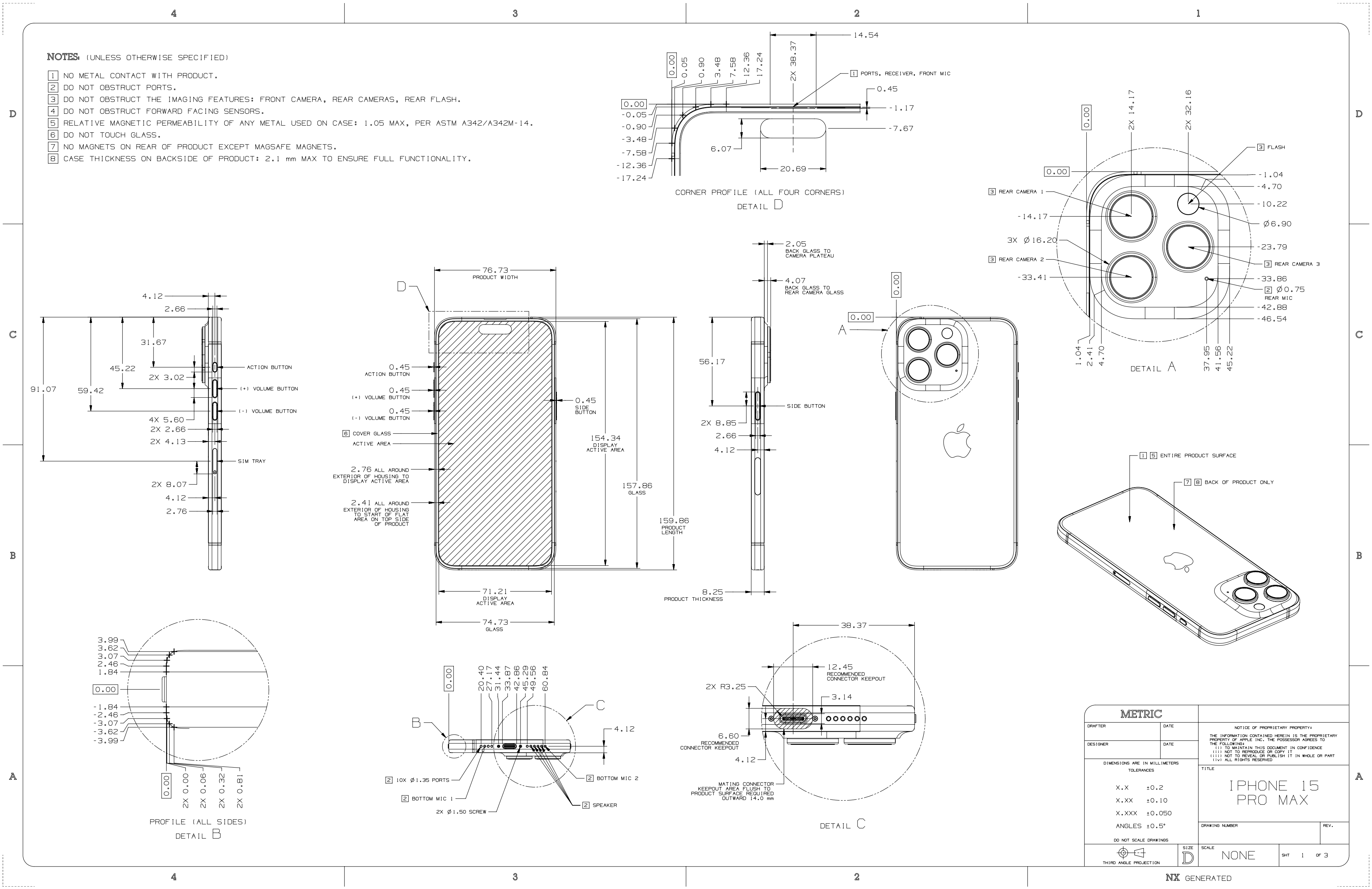


DETAIL P
SECTION L - L
8.33 REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
6.90 REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
123° REAR CAMERA 1 KEEPOUT CONE
84° REAR CAMERA 2 KEEPOUT CONE
SECTION M - M
9.76 FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
7.71 FLASH KEEPOUT CONE TO COVER GLASS
5.50 FLASH INNER KEEPOUT CONE BASE DIAMETER
(4.00)
(2.05)
157° FLASH OUTER KEEPOUT CONE V-FOV
112° FLASH INNER KEEPOUT CONE V-FOV
SECTION N - N
(4.00)
(1.85)
157° FLASH OUTER KEEPOUT CONE H-FOV
96° FLASH INNER KEEPOUT CONE H-FOV
5.50 FLASH INNER KEEPOUT CONE BASE DIAMETER
7.71 FLASH KEEPOUT CONE TO COVER GLASS
9.56 FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
0.00
P
O
DETAIL O
14.40
35.81
2 4 RECEIVER KEEPOUT
0.75
0.85
3 4 FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES
6.07
8.18
2X R2.55
1.50 SENSOR KEEPOUT BASE
13.15
4 ALS SENSOR BASE OF KEEPOUT CONE
30.05
35.81
3.83 SENSOR KEEPOUT BASE
20.75 FRONT CAMERA KEEPOUT BASE
SECTION S - S
43°
1.21 SENSOR KEEPOUT CONE BASE TO COVER GLASS
1.98 FRONT CAMERA KEEPOUT CONE BASE TO COVER GLASS
SECTION T - T
30°
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
SCALE:
SHT OF

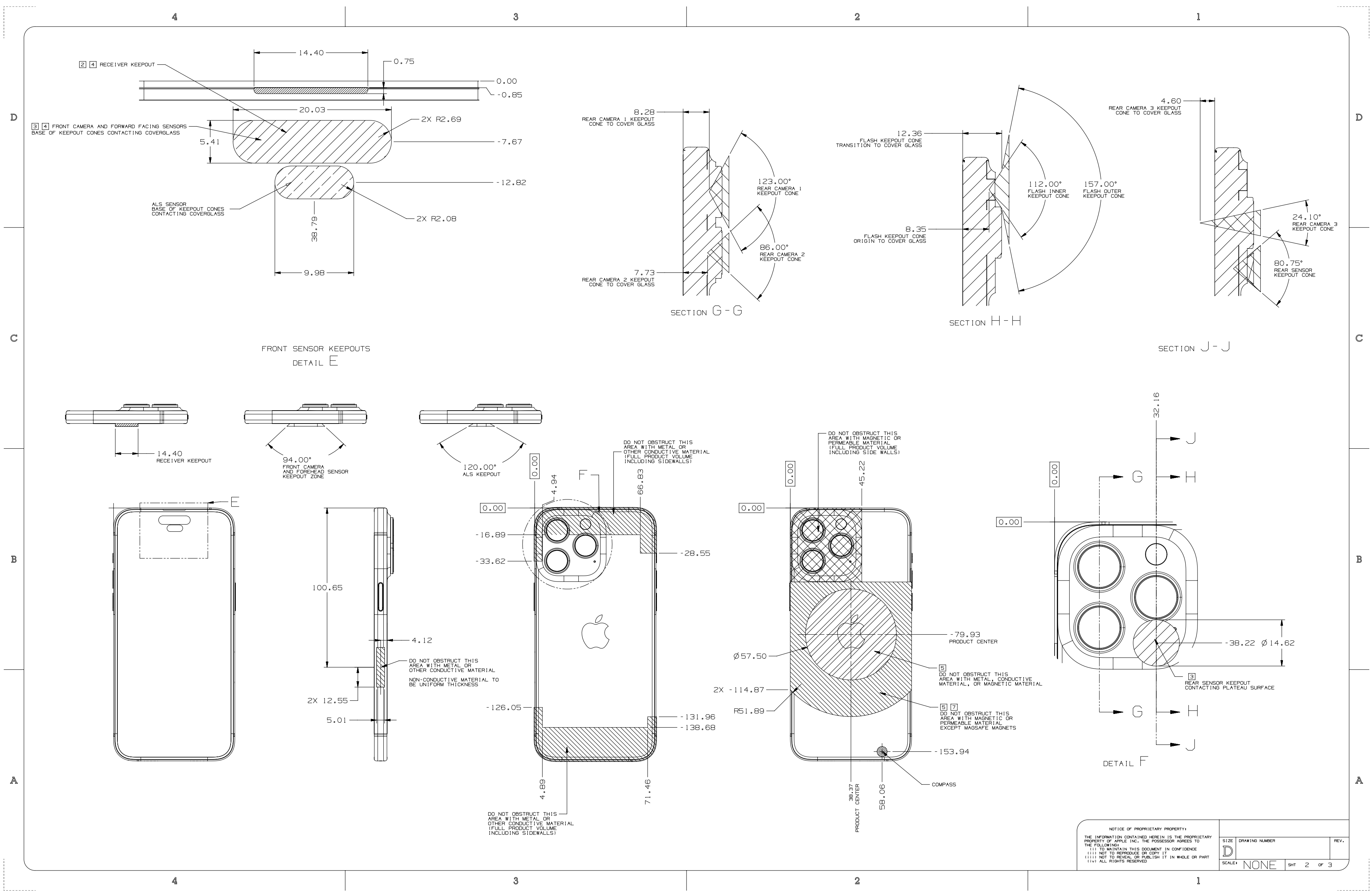

0.00
9.05
57.58
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
14.47
26.96
36.34
120.48
118.24
133.17
14.05
62.08
26.16
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
43.72
5 7 DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL, OR MAGNETIC MATERIAL
73.82 PRODUCT CENTER
Ø57.50
5 7 DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
110.93
R49.39
140.90
5 7 COMPASS
35.81 PRODUCT CENTER
54.42
13.35
52.36
4X R1.36
4X R2.70
1 KEEPOUT 1 KEEPOUT DIMENSIONS MEASURED AT GLASS SURFACE
5 DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE METERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM IN THICKNESS
13.18
8.15
19.92
9.04
2 KEEPOUT 2 KEEPOUT DIMENSIONS MEASURED AT GLASS SURFACE
51.39
25.86
KEEPOUT 1
80°
KEEPOUT 2
120°
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
SCALE:
SHT OF

NOTES: (UNLESS OTHERWISE SPECIFIED)

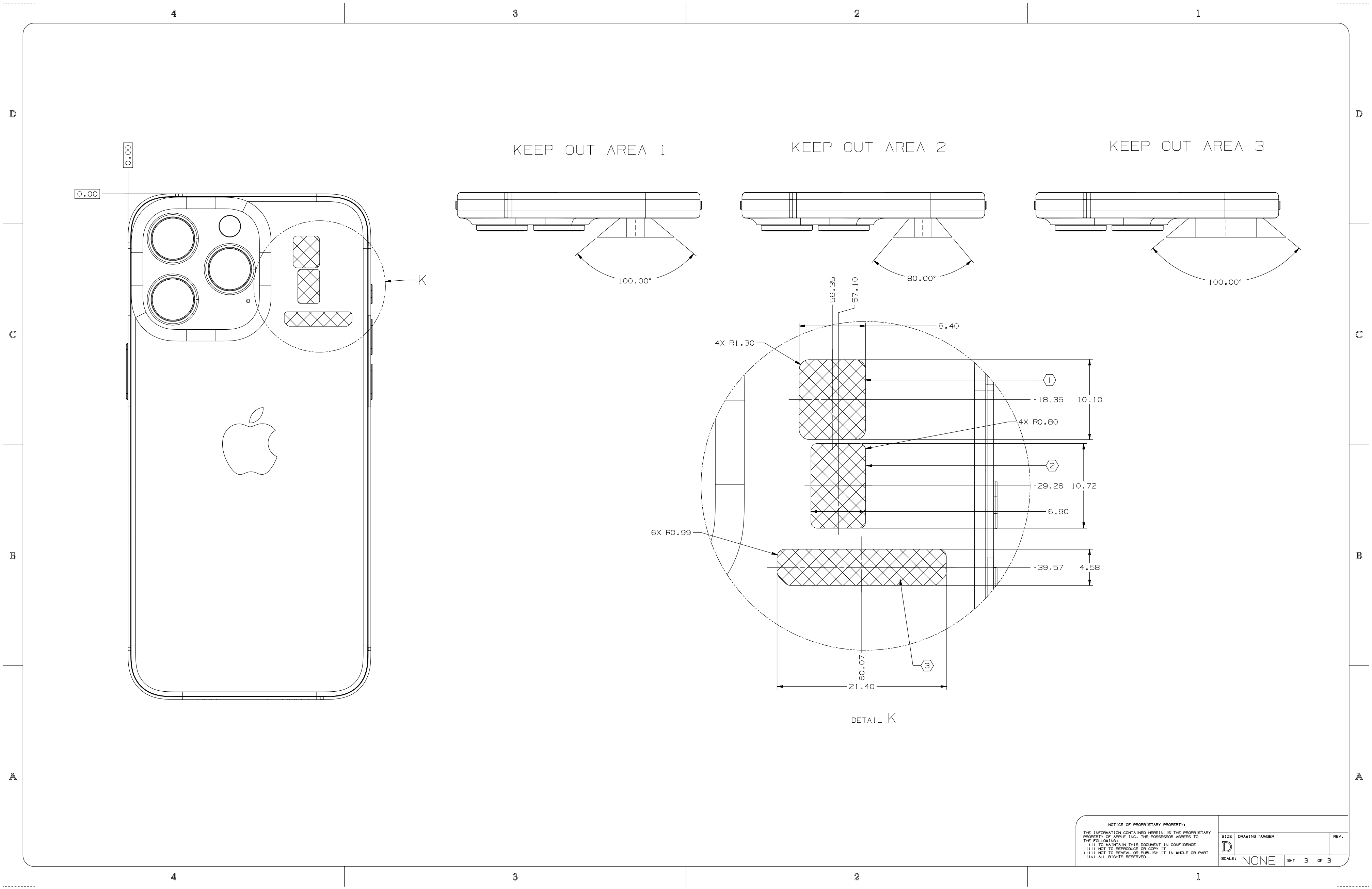
1. NO METAL CONTACT WITH PRODUCT.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.

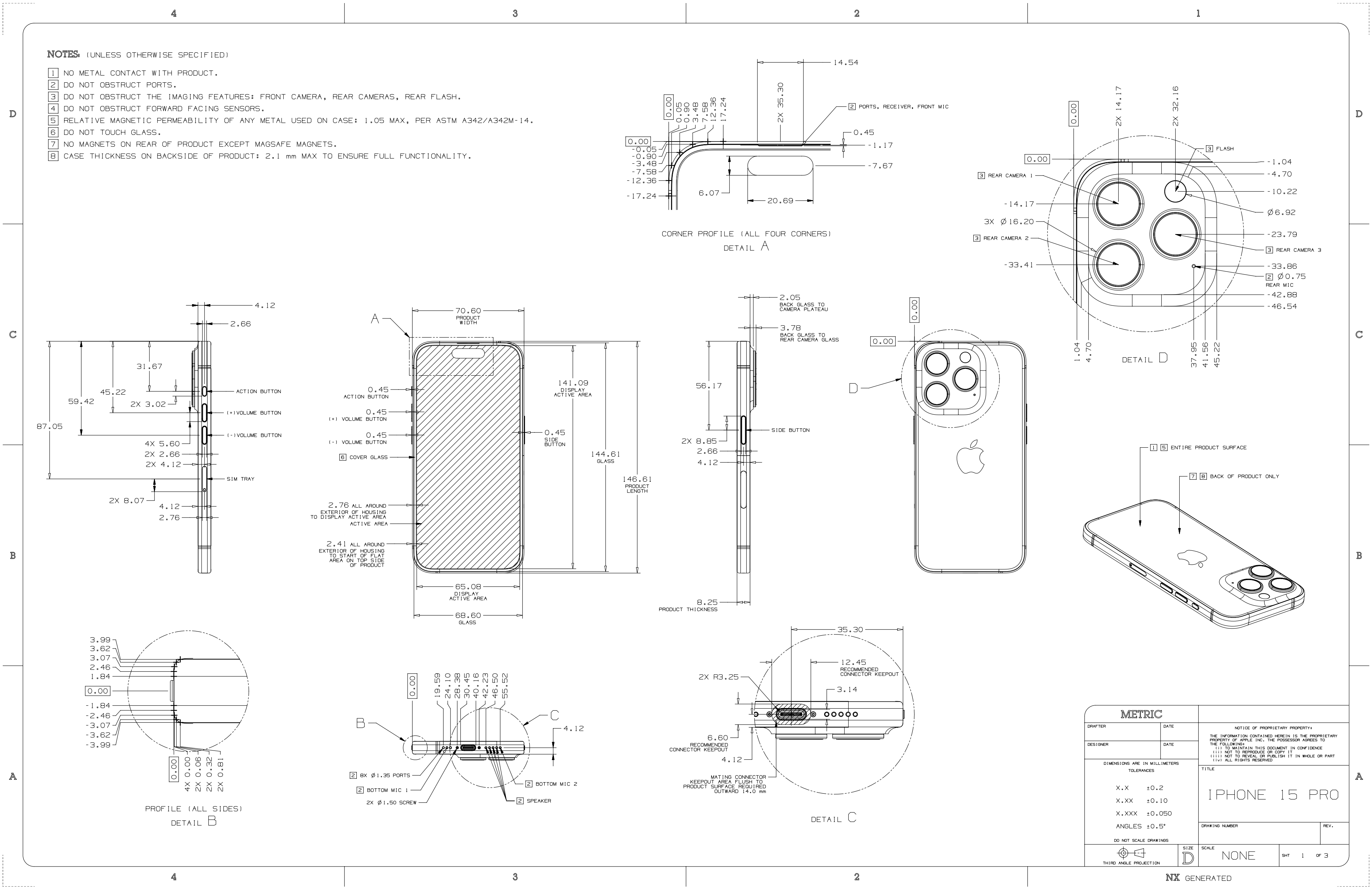


60.20 iPhone 15 Pro Max, 2 of 3

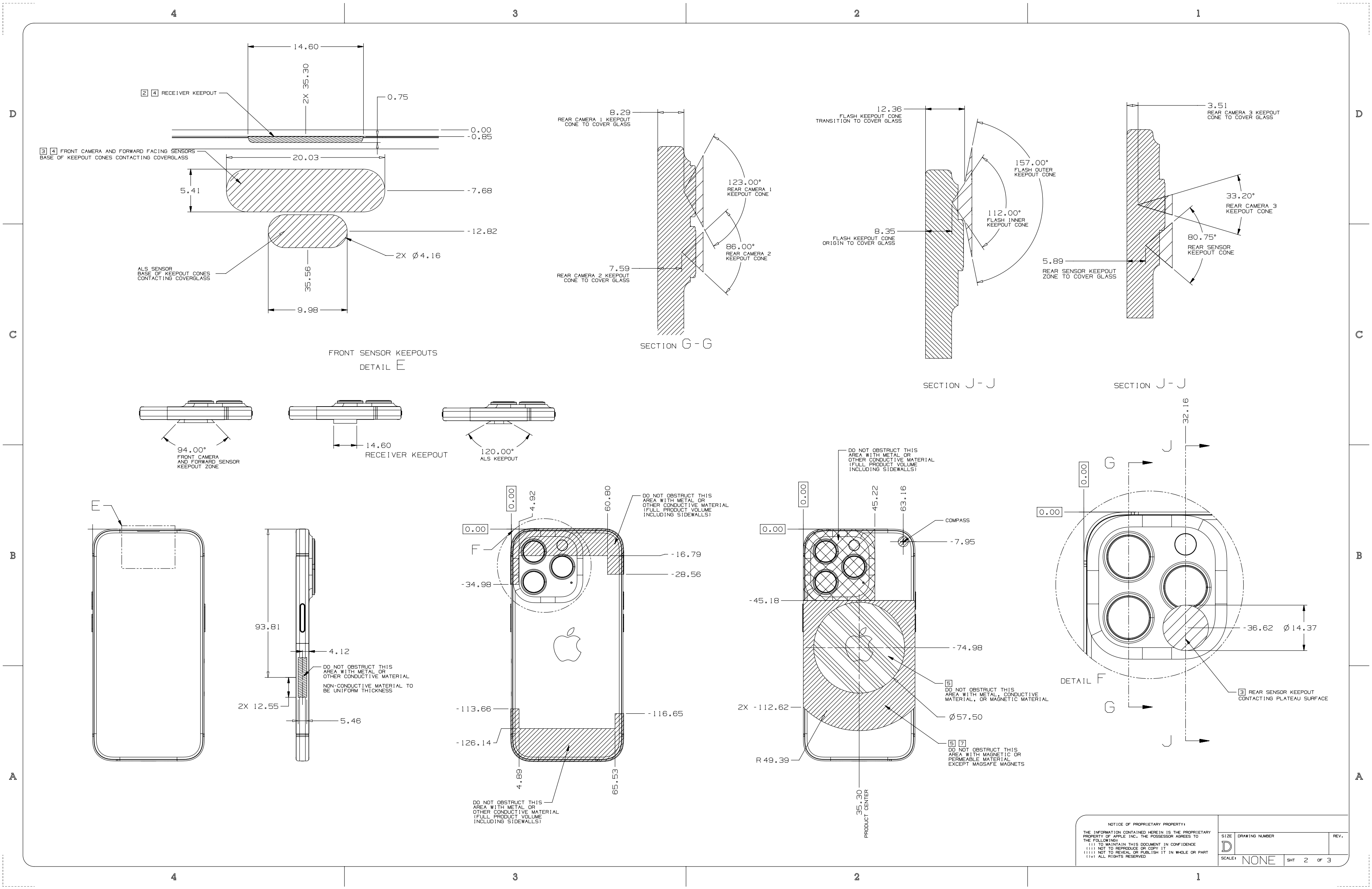


60.21 iPhone 15 Pro Max, 3 of 3

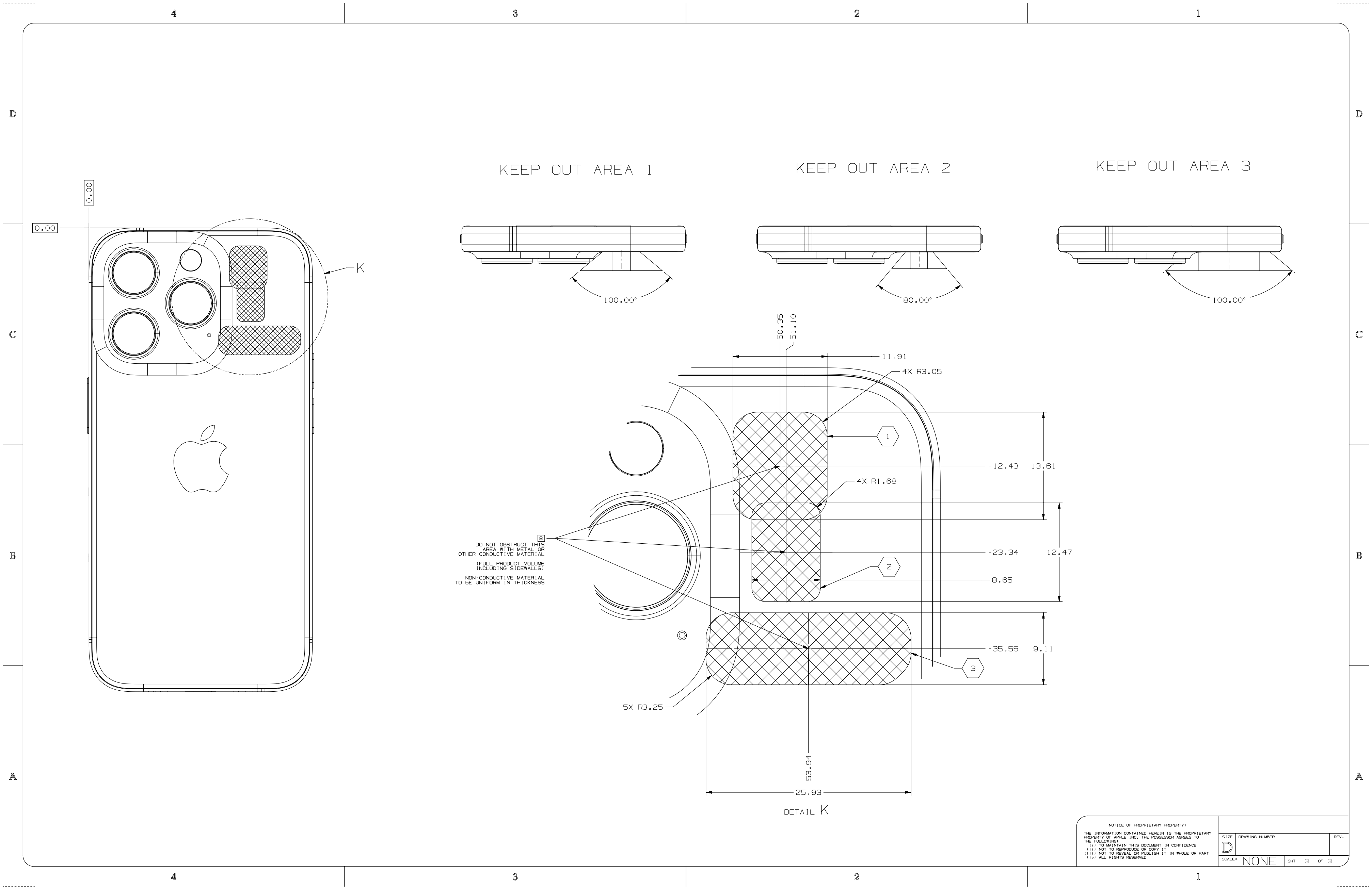



NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH PRODUCT.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL A
2 PORTS, RECEIVER, FRONT MIC
DETAIL D
3 REAR CAMERA 1
3 REAR CAMERA 2
3 REAR CAMERA 3
3 FLASH
2 Ø0.75 REAR MIC
ACTION BUTTON
(+)VOLUME BUTTON
(-)VOLUME BUTTON
SIM TRAY
70.60 PRODUCT WIDTH
141.09 DISPLAY ACTIVE AREA
144.61 GLASS
146.61 PRODUCT LENGTH
65.08 DISPLAY ACTIVE AREA
68.60 GLASS
0.45 SIDE BUTTON
6 COVER GLASS
2.76 ALL AROUND EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
2.41 ALL AROUND EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
2.05 BACK GLASS TO CAMERA PLATEAU
3.78 BACK GLASS TO REAR CAMERA GLASS
SIDE BUTTON
8.25 PRODUCT THICKNESS
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
PROFILE (ALL SIDES)
DETAIL B
2 8X Ø1.35 PORTS
2 BOTTOM MIC 1
2X Ø1.50 SCREW
2 BOTTOM MIC 2
2 SPEAKER
12.45 RECOMMENDED CONNECTOR KEEPOUT
6.60 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
DETAIL C
METRIC
DRAFTER
DATE
DESIGNER
DATE
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
X.X ±0.2
X.XX ±0.10
X.XXX ±0.050
ANGLES ±0.5°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
TITLE
IPHONE 15 PRO
DRAWING NUMBER
REV.
SIZE D
SCALE NONE
SHT 1 OF 3
NX GENERATED

60.23 iPhone 15 Pro, 2 of 3

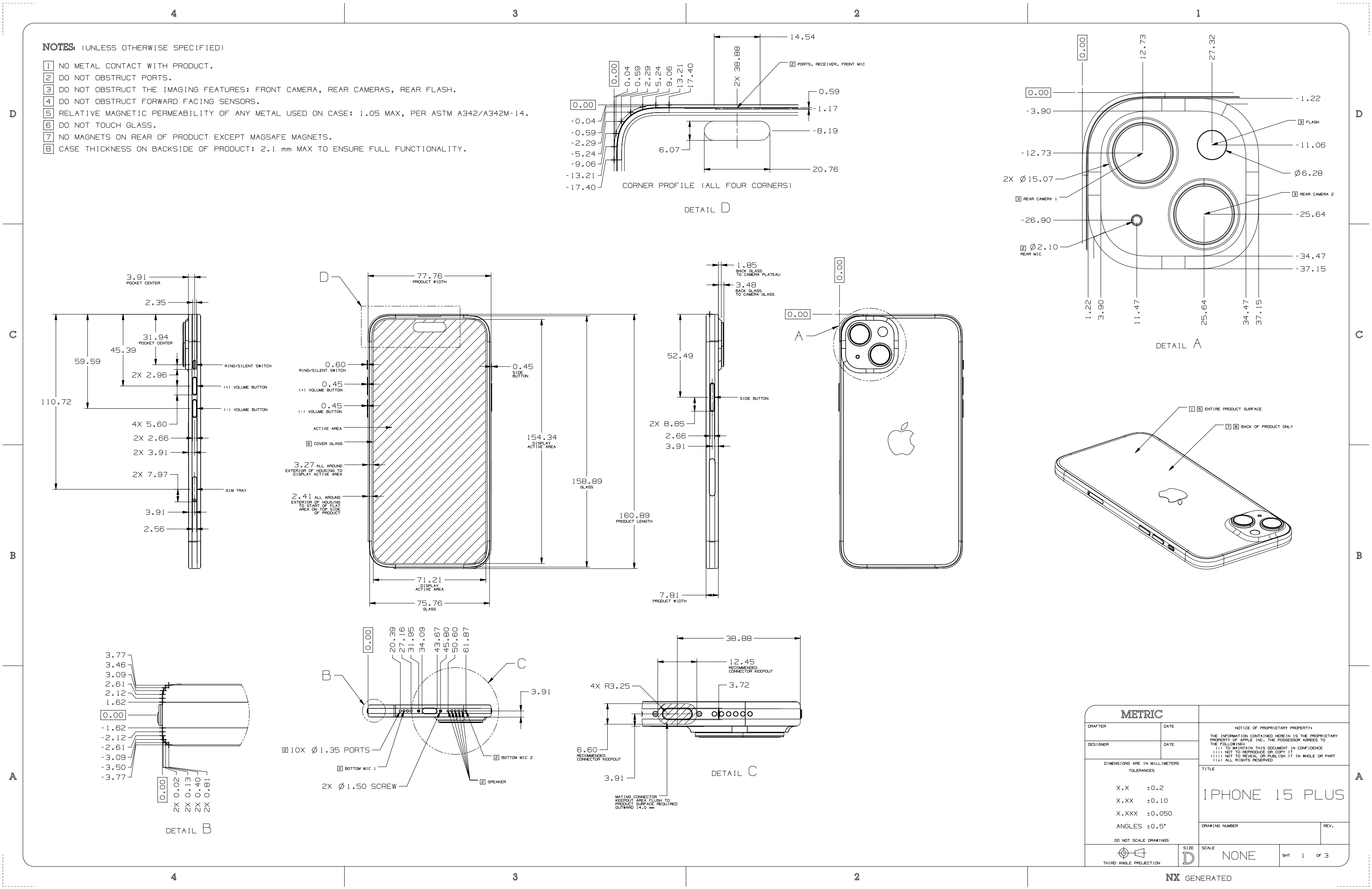


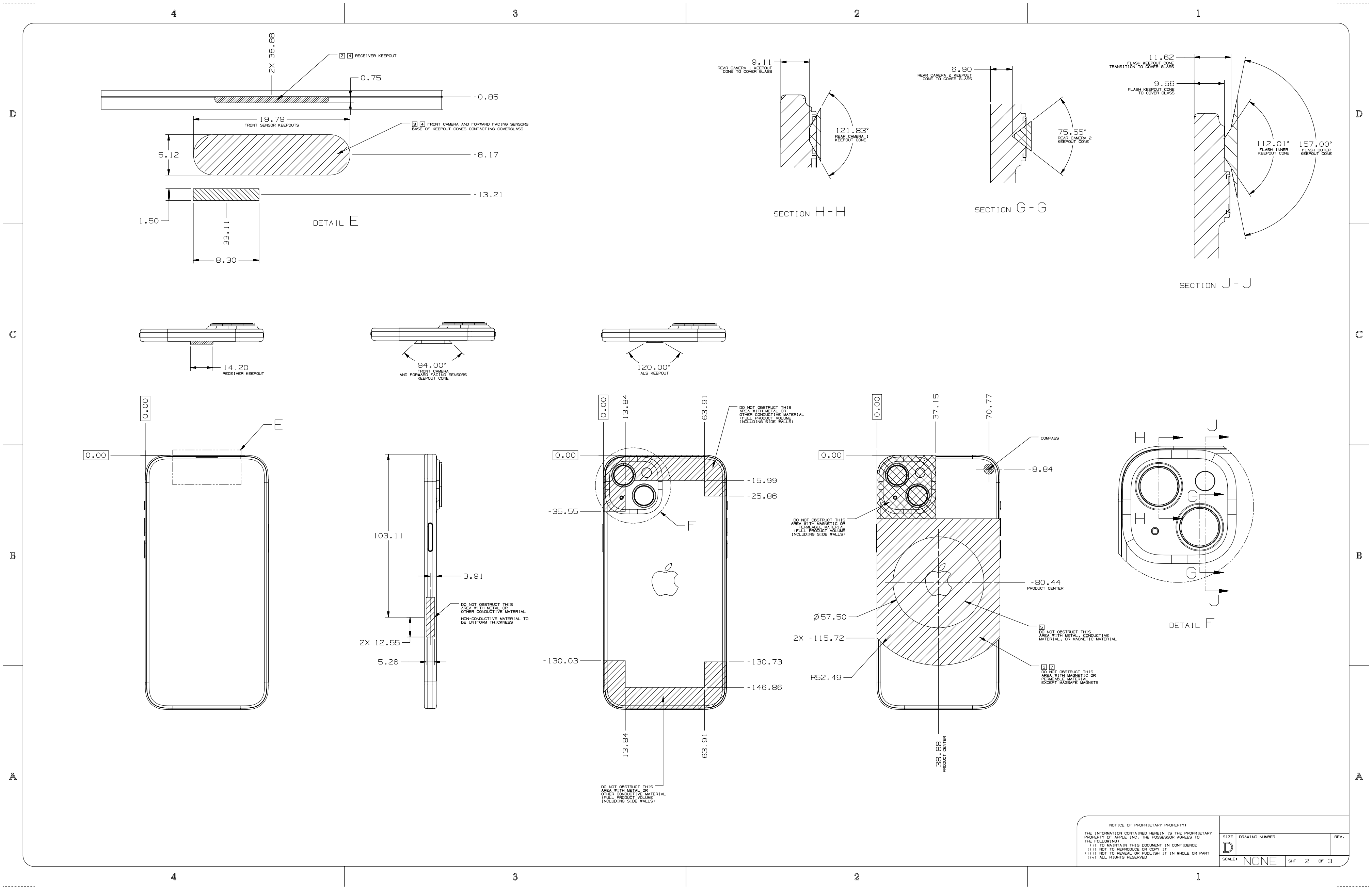
60.24 iPhone 15 Pro, 3 of 3



NOTES: (UNLESS OTHERWISE SPECIFIED)

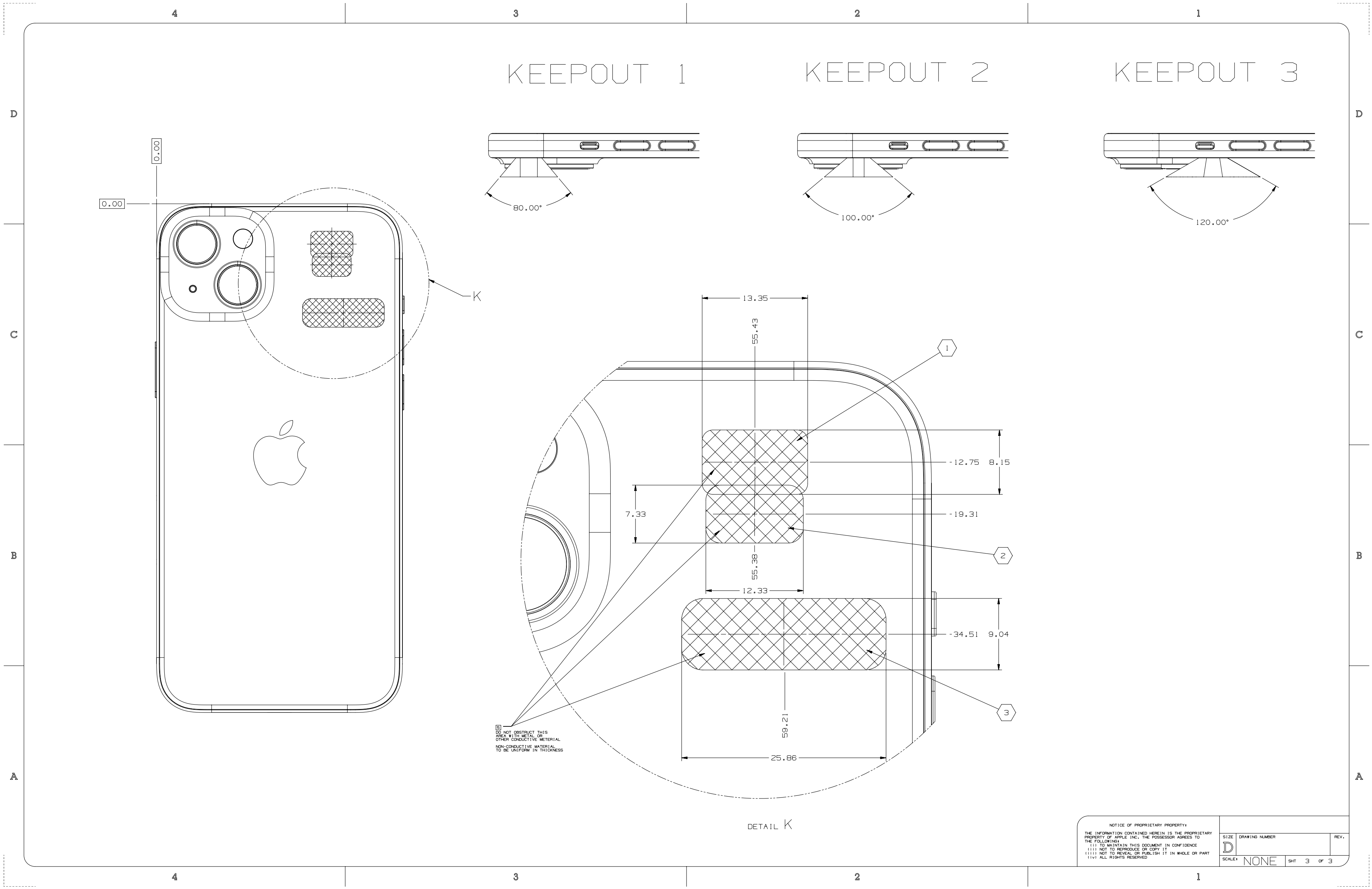
1. NO METAL CONTACT WITH PRODUCT.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.





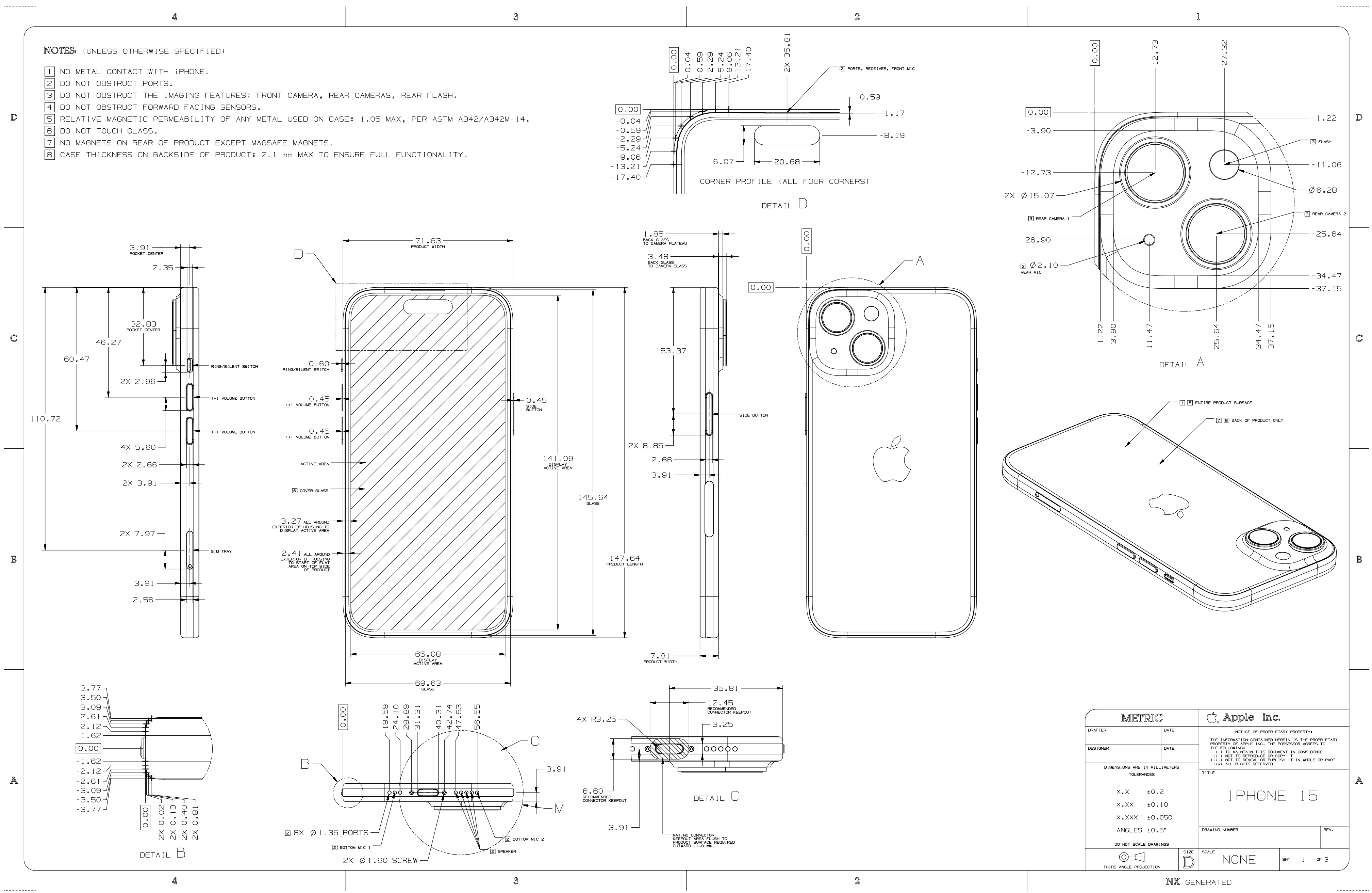
2X 38.88
2 4 RECEIVER KEEPOUT
0.75
-0.85
19.79
FRONT SENSOR KEEPOUTS
3 4 FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES CONTACTING COVERGLASS
5.12
-8.17
-13.21
1.50
33.11
8.30
DETAIL E
9.11
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
121.83°
REAR CAMERA 1 KEEPOUT CONE
SECTION H-H
6.90
REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
75.55°
REAR CAMERA 2 KEEPOUT CONE
SECTION G-G
11.62
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
9.56
FLASH KEEPOUT CONE TO COVER GLASS
112.01°
FLASH INNER KEEPOUT CONE
157.00°
FLASH OUTER KEEPOUT CONE
SECTION J-J
14.20
RECEIVER KEEPOUT
94.00°
FRONT CAMERA AND FORWARD FACING SENSORS KEEPOUT CONE
120.00°
ALS KEEPOUT
0.00
0.00
E
103.11
3.91
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
2X 12.55
5.26
0.00
13.84
63.91
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
0.00
-15.99
-25.86
-35.55
F
-130.03
-130.73
-146.86
13.84
63.91
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
0.00
37.15
70.77
COMPASS
0.00
-8.84
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
-80.44
PRODUCT CENTER
Ø57.50
2X -115.72
R52.49
5
DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL, OR MAGNETIC MATERIAL
5 7
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
38.88
PRODUCT CENTER
H
J
G
H
G
J
DETAIL F
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 2 OF 3

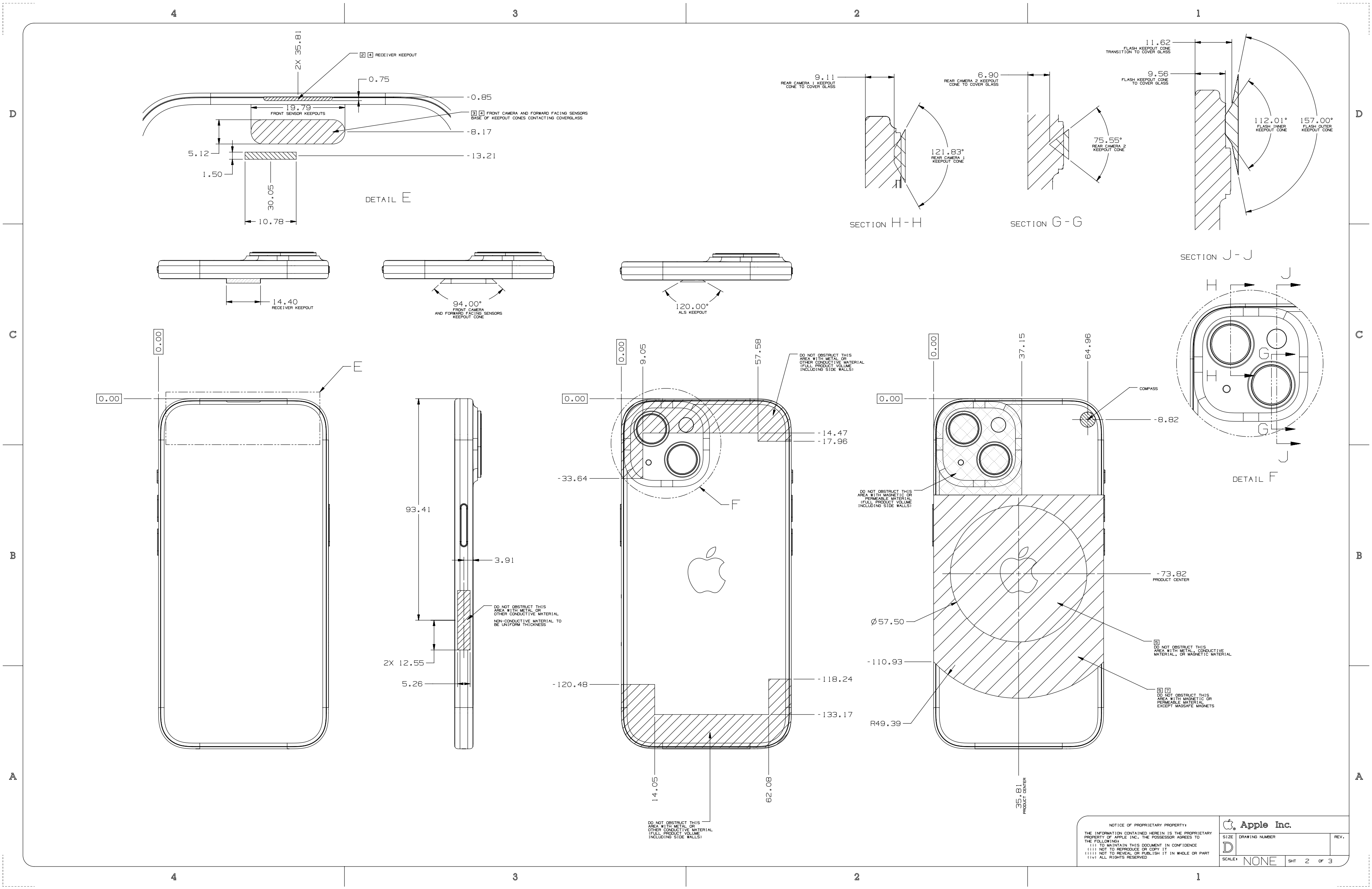
60.27 iPhone 15 Plus, 3 of 3



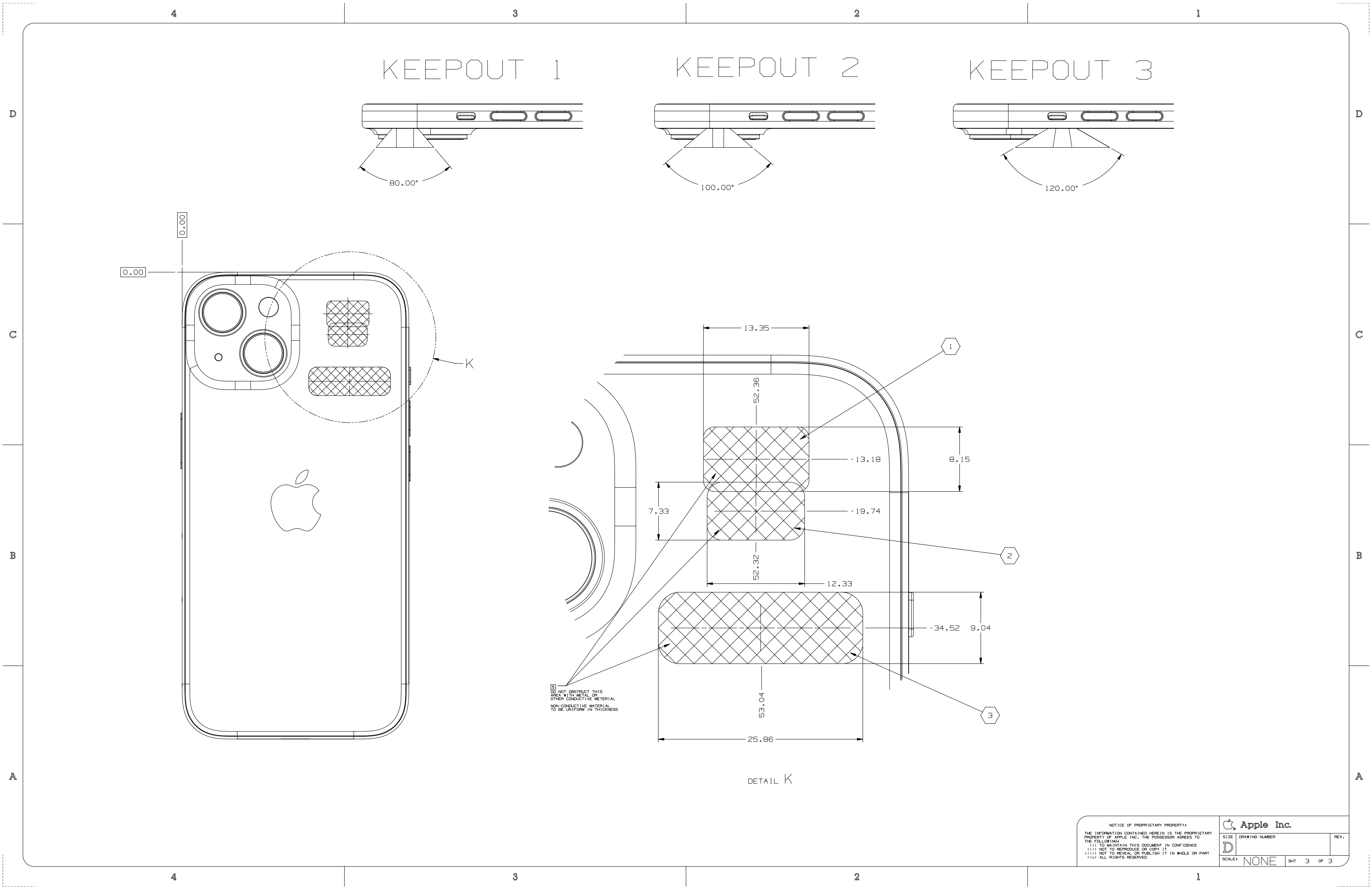
NOTES: (UNLESS OTHERWISE SPECIFIED)

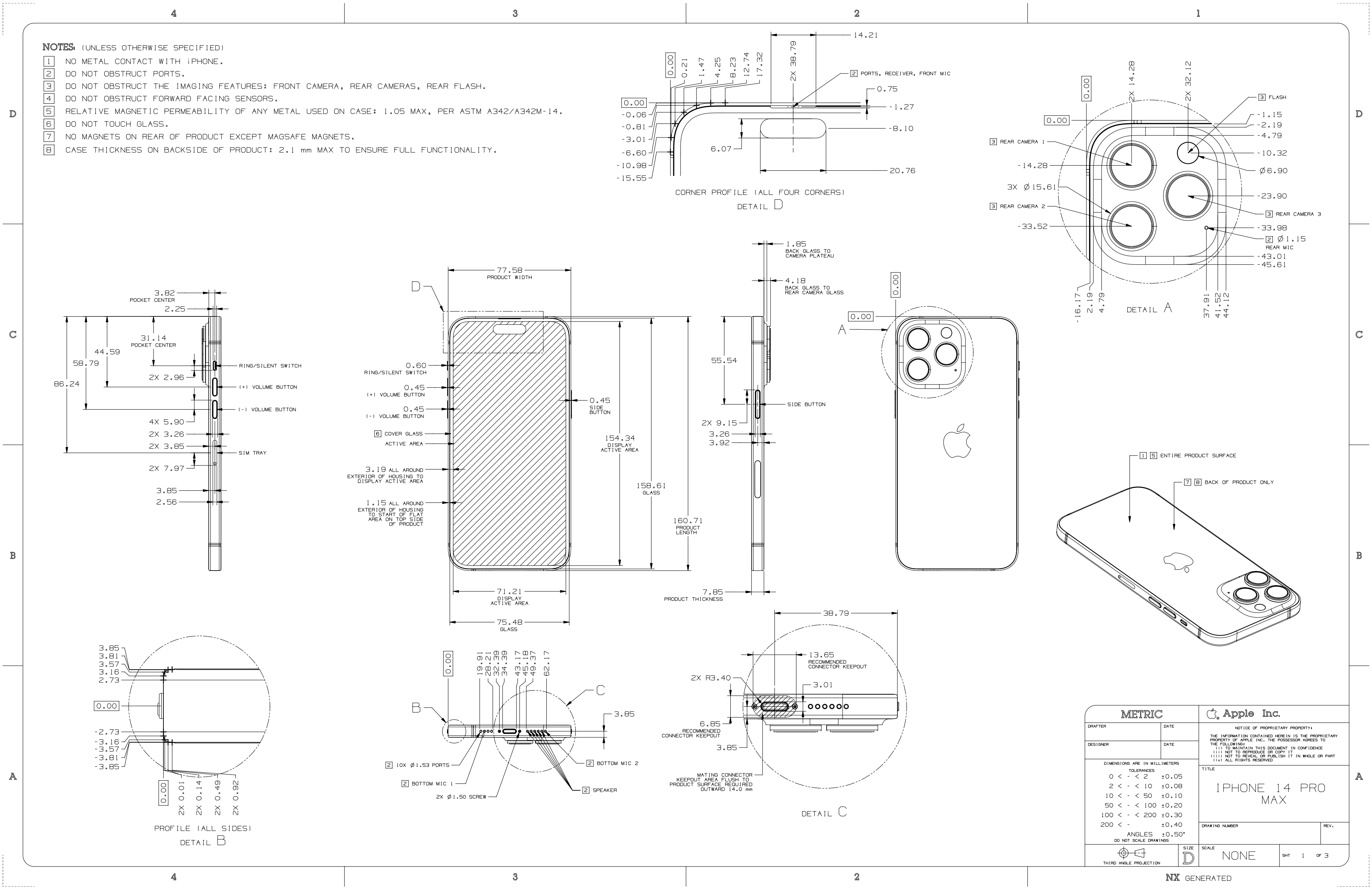
1. NO METAL CONTACT WITH iPHONE.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.




2X 35.81
RECEIVER KEEPOUT
0.75
-0.85
19.79
FRONT SENSOR KEEPOUTS
FRONT CAMERA AND FORWARD FACING SENSORS
BASE OF KEEPOUT CONES CONTACTING COVERGLASS
-8.17
5.12
1.50
-13.21
30.05
10.78
DETAIL E
9.11
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
121.83°
REAR CAMERA 1 KEEPOUT CONE
SECTION H-H
6.90
REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
75.55°
REAR CAMERA 2 KEEPOUT CONE
SECTION G-G
11.62
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
9.56
FLASH KEEPOUT CONE TO COVER GLASS
112.01°
FLASH INNER KEEPOUT CONE
157.00°
FLASH OUTER KEEPOUT CONE
SECTION J-J
14.40
RECEIVER KEEPOUT
94.00°
FRONT CAMERA AND FORWARD FACING SENSORS KEEPOUT CONE
120.00°
ALS KEEPOUT
0.00
E
93.41
3.91
2X 12.55
5.26
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
9.05
57.58
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
-14.47
-17.96
-33.64
F
-120.48
-118.24
-133.17
14.05
62.08
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
37.15
64.96
COMPASS
-8.82
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
-73.82
PRODUCT CENTER
Ø57.50
-110.93
R49.39
DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL, OR MAGNETIC MATERIAL
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
35.81
PRODUCT CENTER
DETAIL F
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 2 OF 3

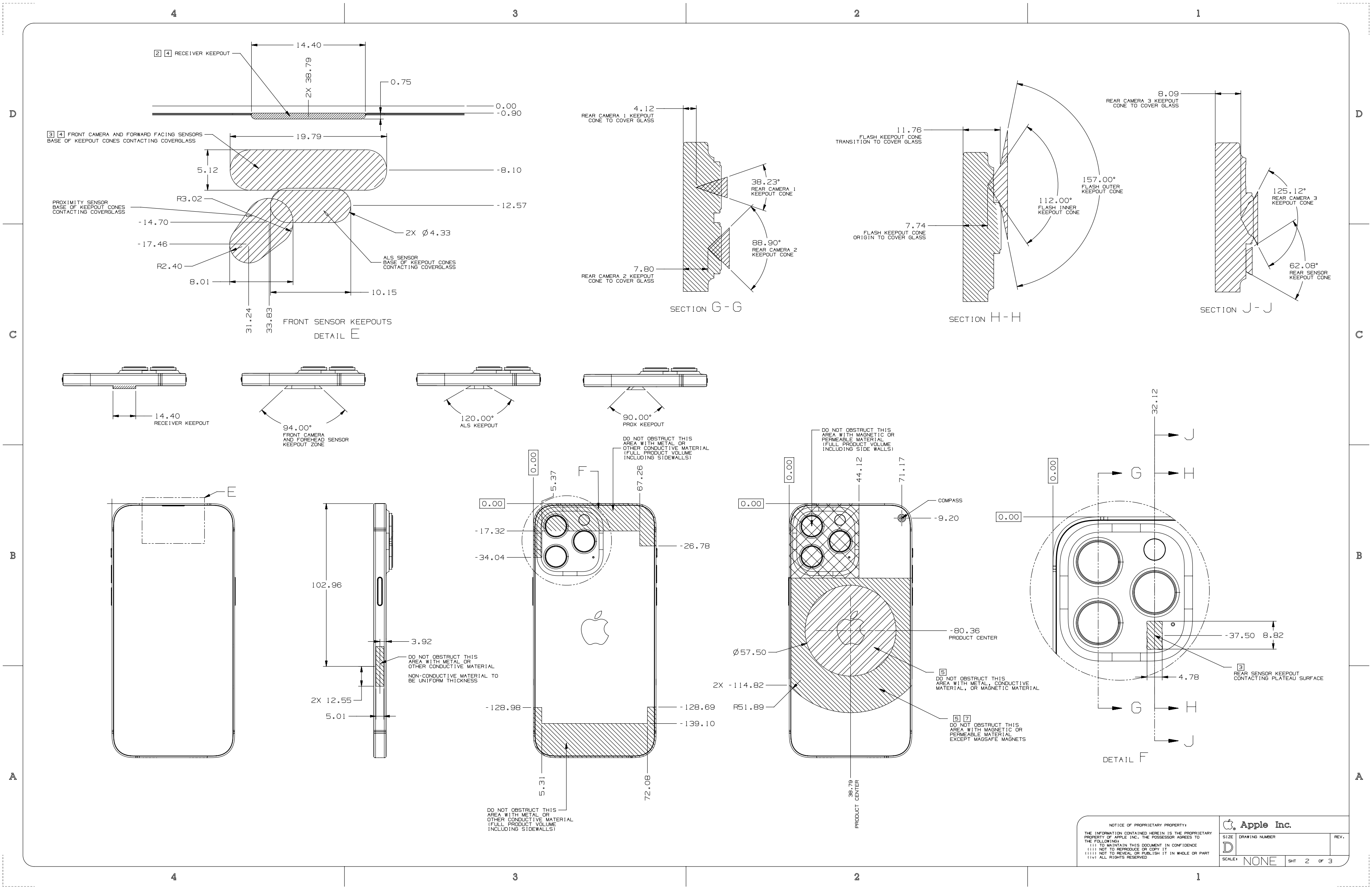
60.30 iPhone 15, 3 of 3





NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH iPHONE.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL D
2 PORTS, RECEIVER, FRONT MIC
DETAIL A
3 REAR CAMERA 1
3 REAR CAMERA 2
3 REAR CAMERA 3
3 FLASH
2 Ø1.15 REAR MIC
3X Ø15.61
3.82 POCKET CENTER
31.14 POCKET CENTER
RING/SILENT SWITCH
(+) VOLUME BUTTON
(-) VOLUME BUTTON
SIM TRAY
77.58 PRODUCT WIDTH
0.60 RING/SILENT SWITCH
0.45 (+) VOLUME BUTTON
0.45 (-) VOLUME BUTTON
6 COVER GLASS
ACTIVE AREA
3.19 ALL AROUND EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
1.15 ALL AROUND EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
0.45 SIDE BUTTON
154.34 DISPLAY ACTIVE AREA
158.61 GLASS
160.71 PRODUCT LENGTH
71.21 DISPLAY ACTIVE AREA
75.48 GLASS
1.85 BACK GLASS TO CAMERA PLATEAU
4.18 BACK GLASS TO REAR CAMERA GLASS
SIDE BUTTON
7.85 PRODUCT THICKNESS
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
PROFILE (ALL SIDES)
DETAIL B
2 10X Ø1.53 PORTS
2 BOTTOM MIC 1
2X Ø1.50 SCREW
2 BOTTOM MIC 2
2 SPEAKER
13.65 RECOMMENDED CONNECTOR KEEPOUT
6.85 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
DETAIL C
METRIC
DRAFTER DATE
DESIGNER DATE
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
0 < - < 2 ±0.05
2 < - < 10 ±0.08
10 < - < 50 ±0.10
50 < - < 100 ±0.20
100 < - < 200 ±0.30
200 < - ±0.40
ANGLES ±0.50°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
TITLE
IPHONE 14 PRO MAX
DRAWING NUMBER
REV.
SIZE D
SCALE NONE
SHT 1 OF 3
NX GENERATED

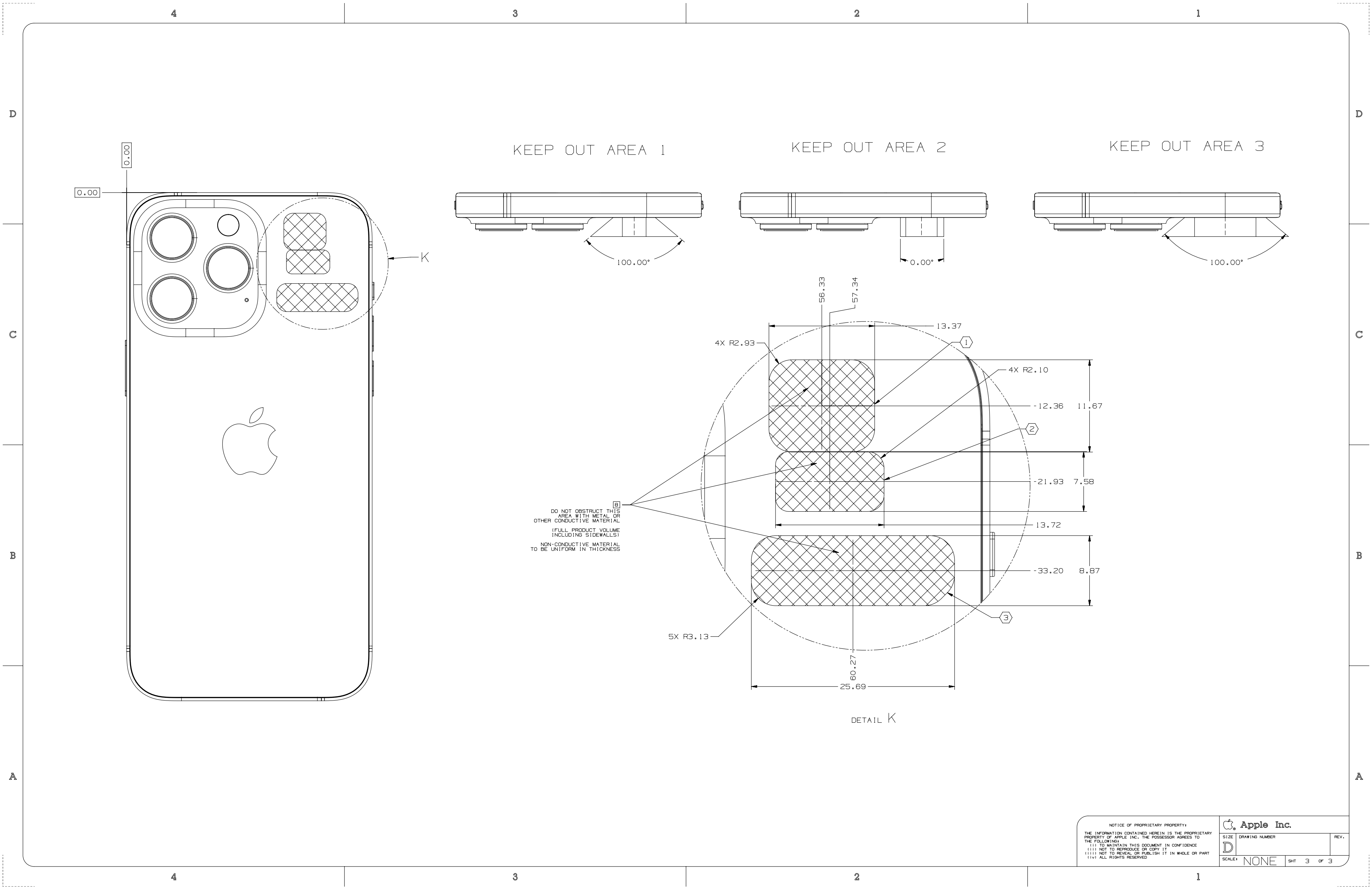
60.32 iPhone 14 Pro Max, 2 of 3

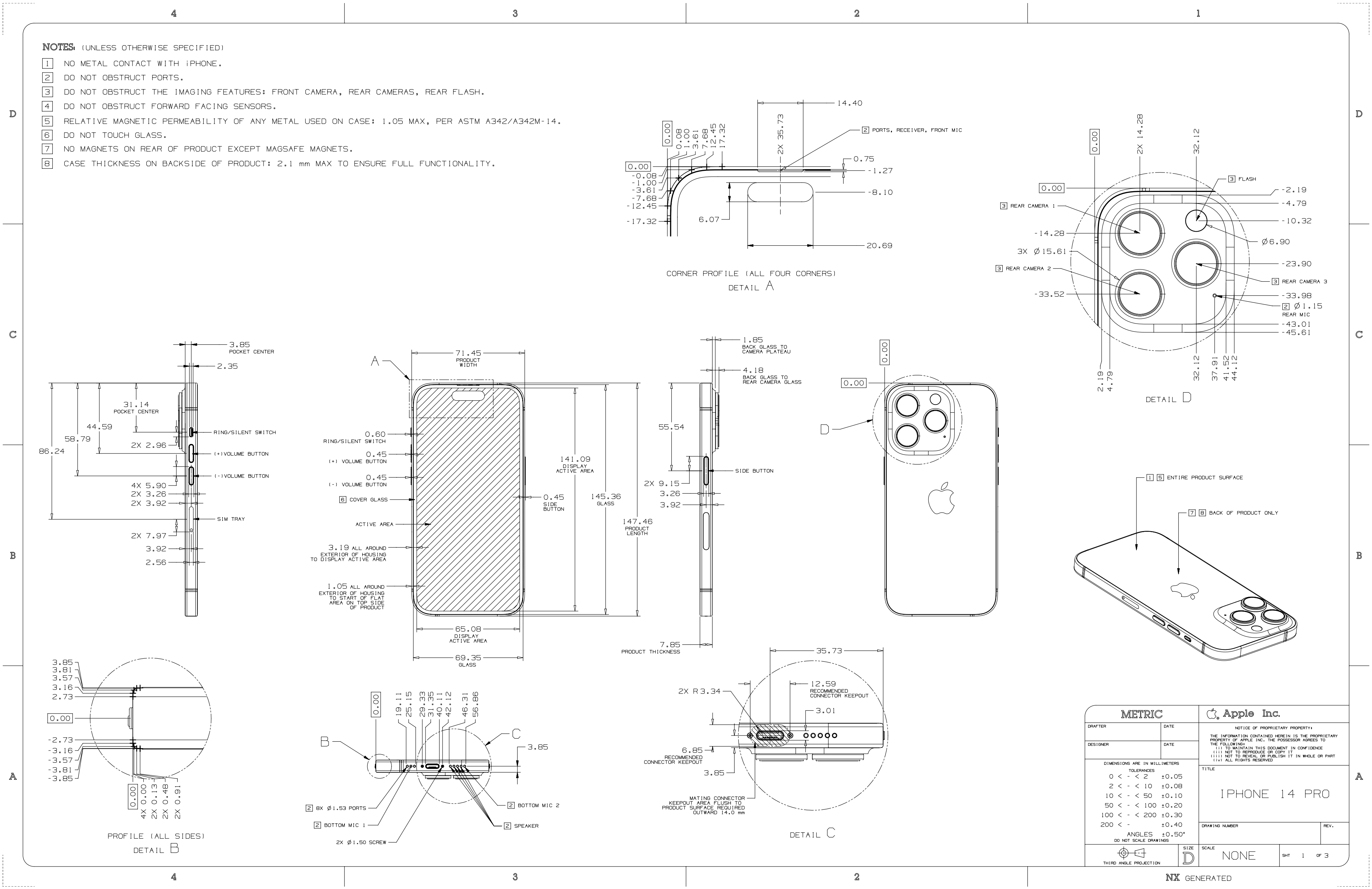


NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED

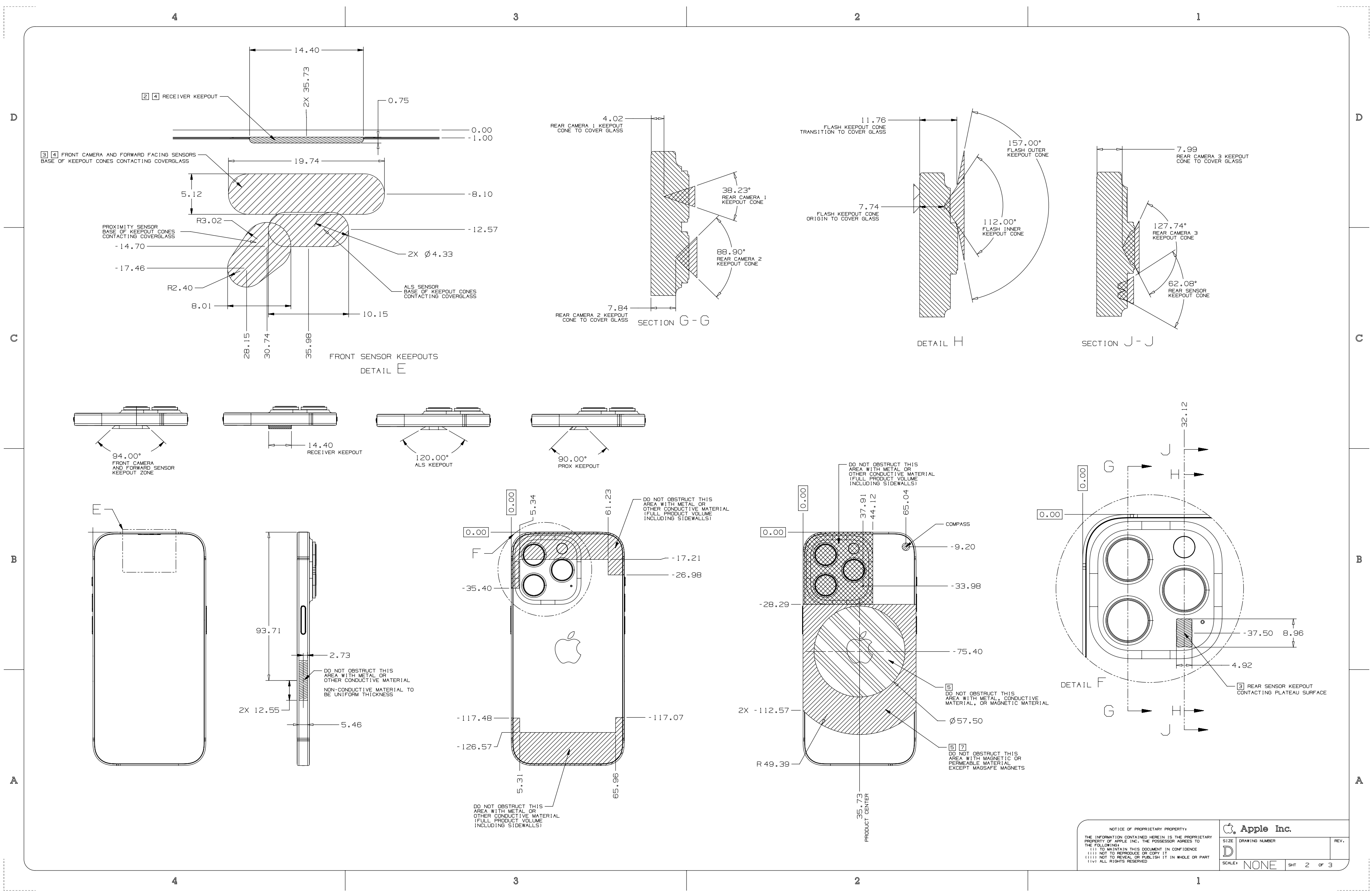
Apple Inc.		
SIZE D	DRAWING NUMBER	REV.
SCALE: NONE	SHT 2 OF 3	

60.33 iPhone 14 Pro Max, 3 of 3

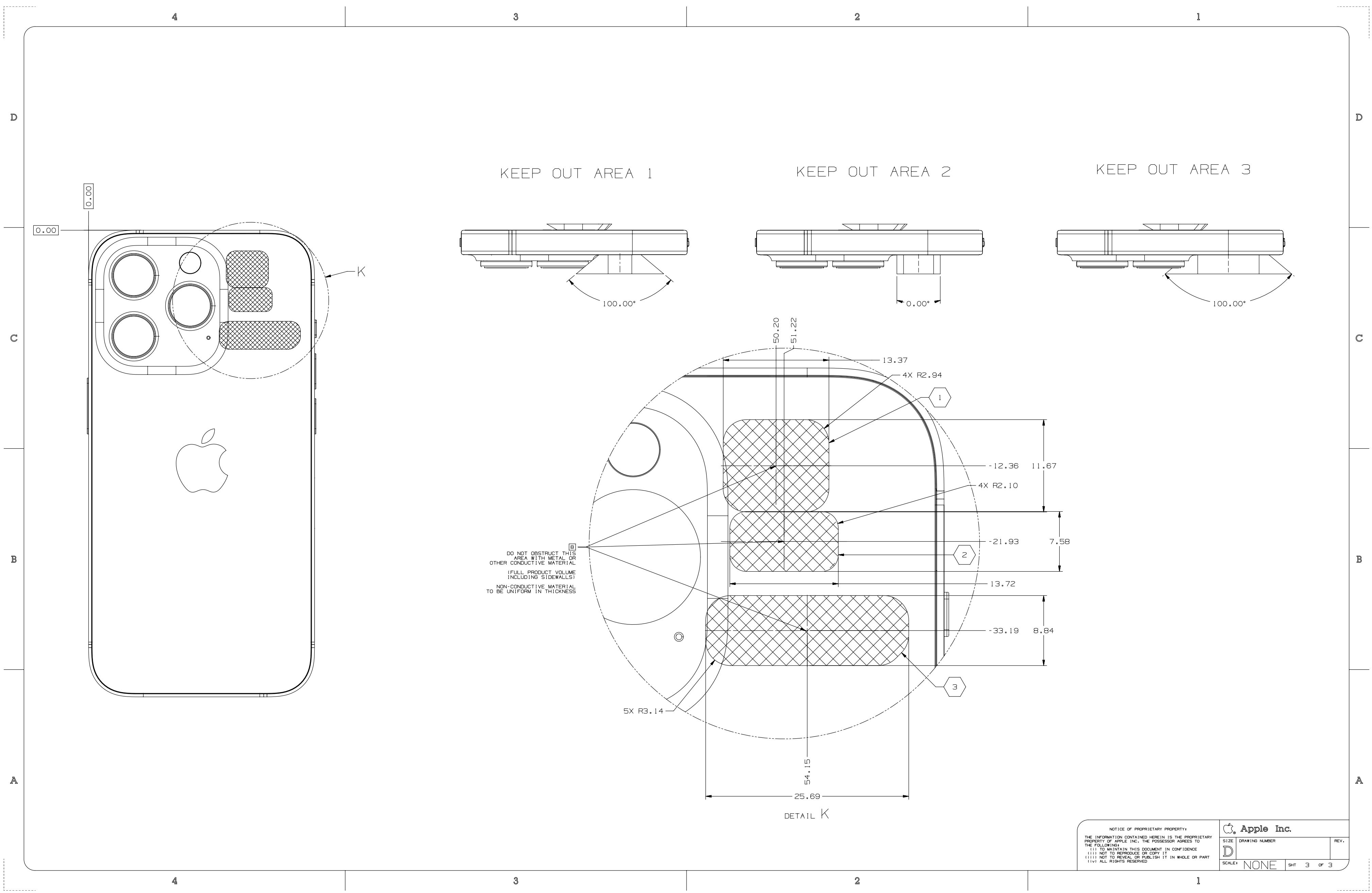



NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH iPHONE.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL A
2 PORTS, RECEIVER, FRONT MIC
3 REAR CAMERA 1
3 REAR CAMERA 2
3 REAR CAMERA 3
3 FLASH
2 Ø1.15 REAR MIC
3X Ø15.61
Ø6.90
DETAIL D
3.85 POCKET CENTER
2.35
31.14 POCKET CENTER
RING/SILENT SWITCH
(+)VOLUME BUTTON
(-)VOLUME BUTTON
SIM TRAY
71.45 PRODUCT WIDTH
0.60 RING/SILENT SWITCH
0.45 (+) VOLUME BUTTON
0.45 (-) VOLUME BUTTON
6 COVER GLASS
ACTIVE AREA
3.19 ALL AROUND EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
1.05 ALL AROUND EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
0.45 SIDE BUTTON
141.09 DISPLAY ACTIVE AREA
145.36 GLASS
147.46 PRODUCT LENGTH
65.08 DISPLAY ACTIVE AREA
69.35 GLASS
1.85 BACK GLASS TO CAMERA PLATEAU
4.18 BACK GLASS TO REAR CAMERA GLASS
SIDE BUTTON
7.85 PRODUCT THICKNESS
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
PROFILE (ALL SIDES)
DETAIL B
2 8X Ø1.53 PORTS
2 BOTTOM MIC 1
2X Ø1.50 SCREW
2 BOTTOM MIC 2
2 SPEAKER
2X R3.34
12.59 RECOMMENDED CONNECTOR KEEPOUT
6.85 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
35.73
DETAIL C
METRIC
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
0 < - < 2 ±0.05
2 < - < 10 ±0.08
10 < - < 50 ±0.10
50 < - < 100 ±0.20
100 < - < 200 ±0.30
200 < - ±0.40
ANGLES ±0.50°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
TITLE
IPHONE 14 PRO
SIZE D
SCALE NONE
SHT 1 OF 3
NX GENERATED

60.35 iPhone 14 Pro, 2 of 3

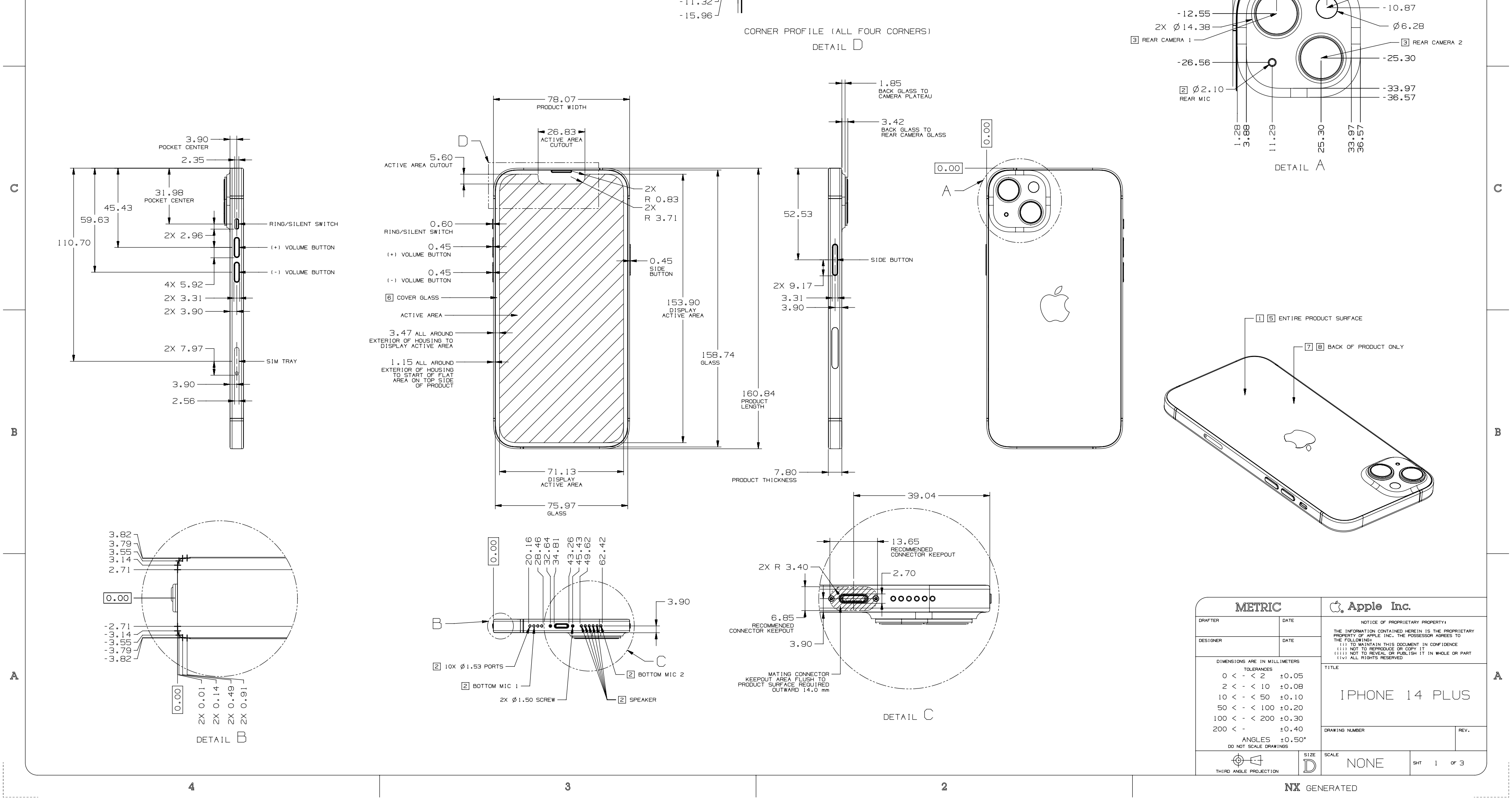


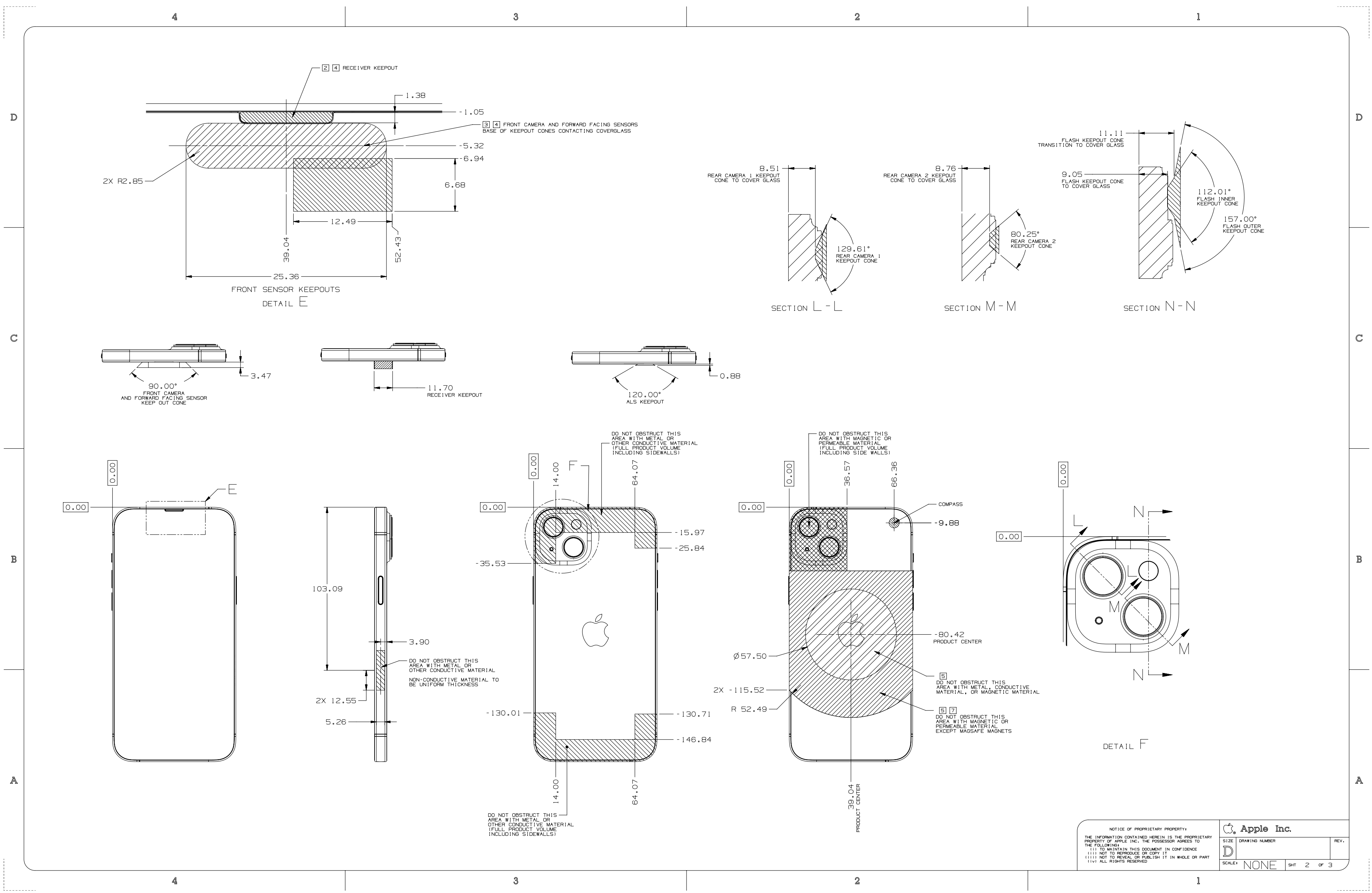
60.36 iPhone 14 Pro, 3 of 3



NOTES: (UNLESS OTHERWISE SPECIFIED)

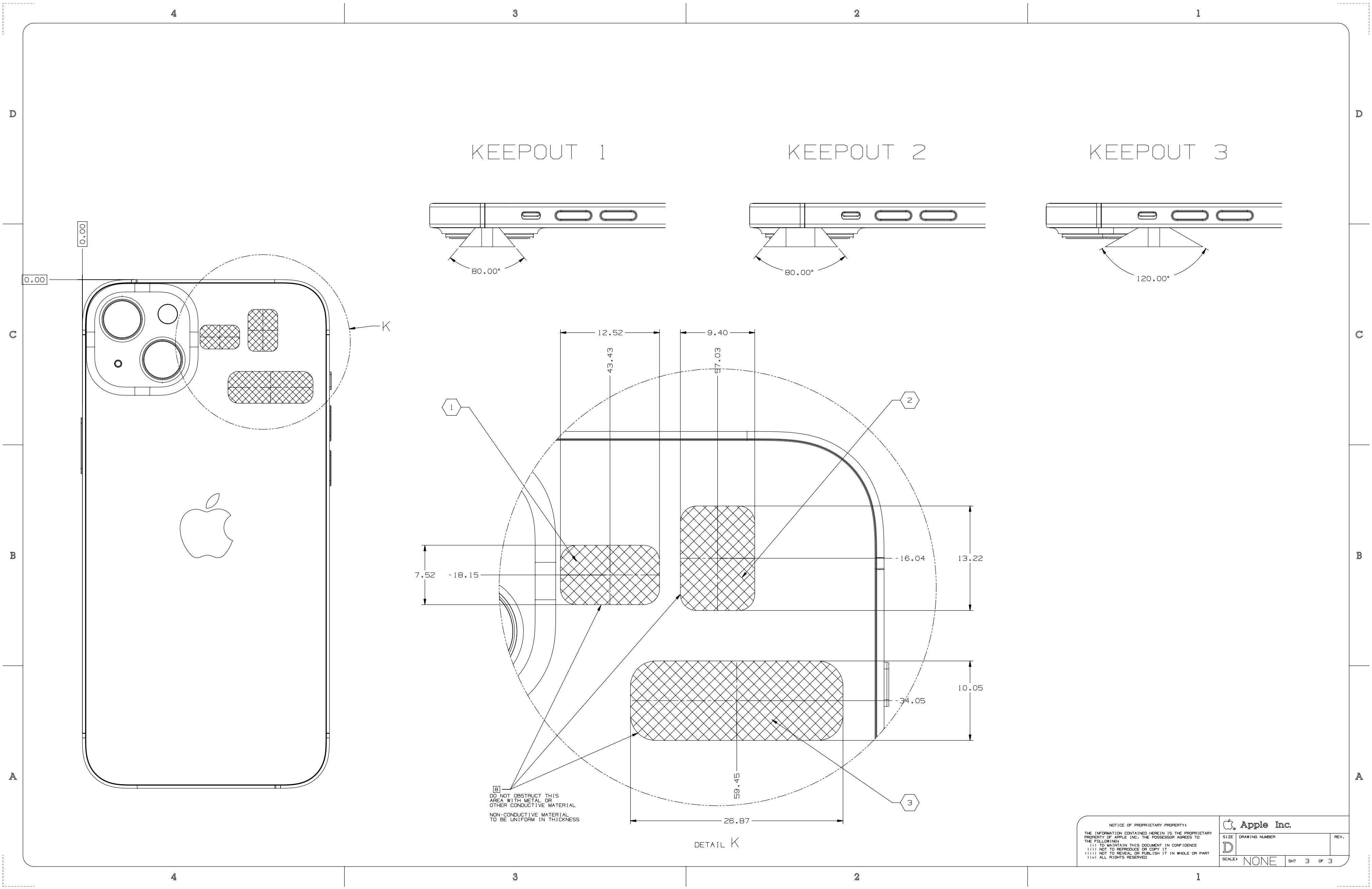
1. NO METAL CONTACT WITH iPHONE.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.

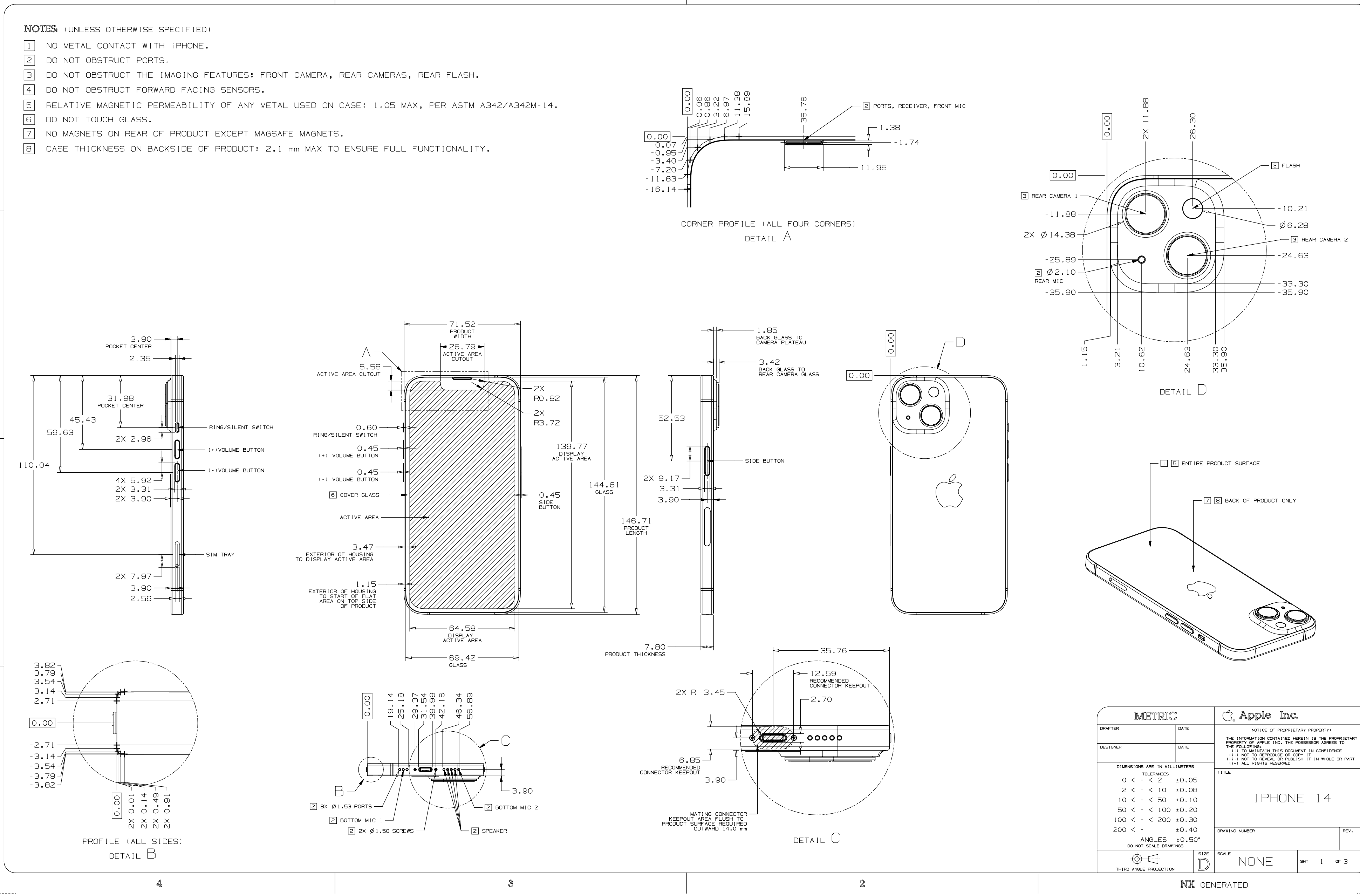




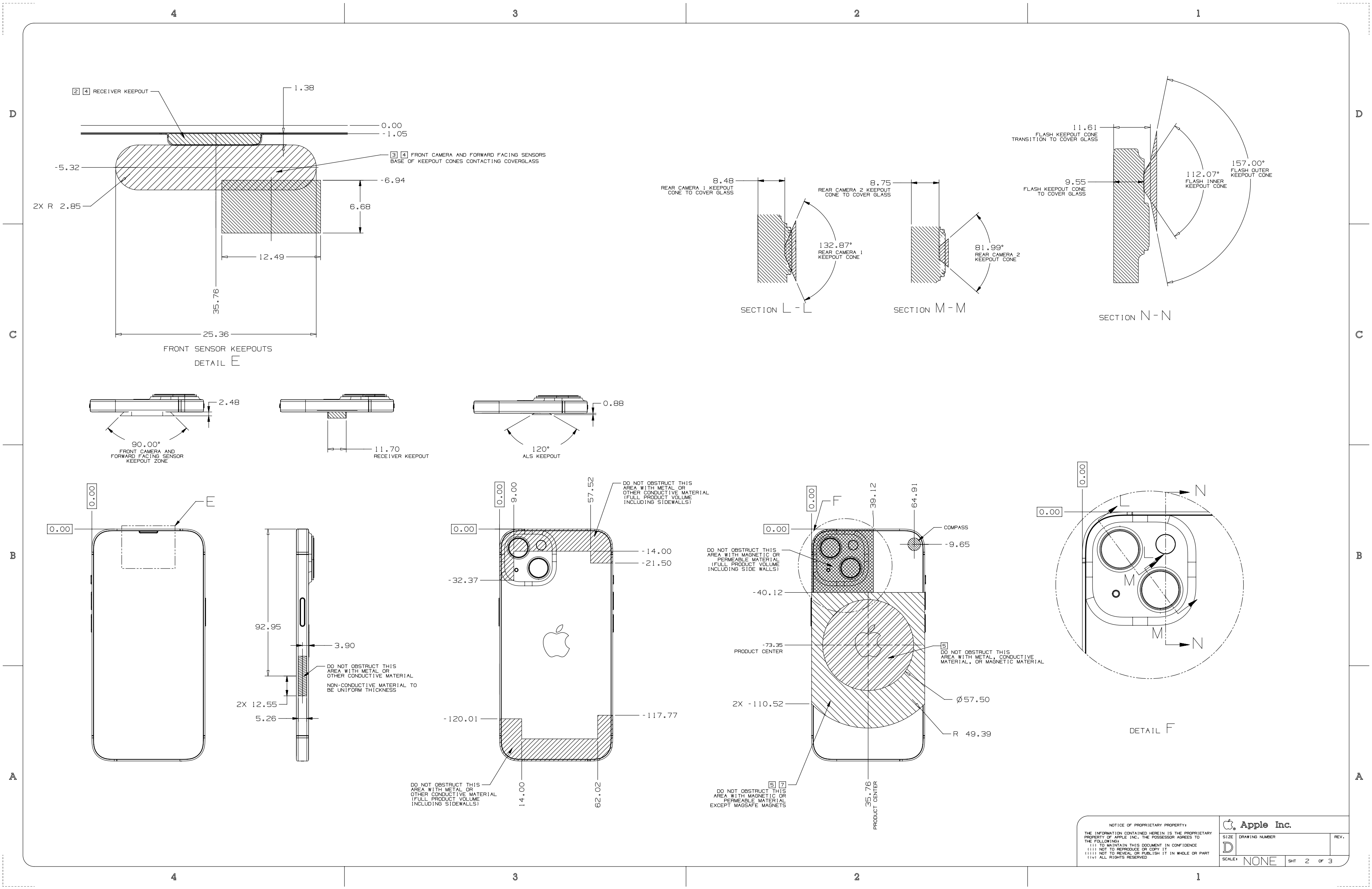
2 4 RECEIVER KEEPOUT
1.38
-1.05
3 4 FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES CONTACTING COVERGLASS
-5.32
-6.94
6.68
2X R2.85
12.49
39.04
52.43
25.36
FRONT SENSOR KEEPOUTS
DETAIL E
8.51
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
129.61°
REAR CAMERA 1 KEEPOUT CONE
SECTION L-L
8.76
REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
80.25°
REAR CAMERA 2 KEEPOUT CONE
SECTION M-M
11.11
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
9.05
FLASH KEEPOUT CONE TO COVER GLASS
112.01°
FLASH INNER KEEPOUT CONE
157.00°
FLASH OUTER KEEPOUT CONE
SECTION N-N
3.47
90.00°
FRONT CAMERA AND FORWARD FACING SENSOR KEEP OUT CONE
11.70
RECEIVER KEEPOUT
0.88
120.00°
ALS KEEPOUT
0.00
E
103.09
3.90
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
2X 12.55
5.26
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS)
14.00
F
64.07
-15.97
-25.84
-35.53
-130.01
-130.71
-146.84
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
36.57
66.36
COMPASS
-9.88
-80.42
PRODUCT CENTER
Ø57.50
2X -115.52
R 52.49
5 DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL, OR MAGNETIC MATERIAL
5 7 DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
39.04
PRODUCT CENTER
L
M
N
DETAIL F
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 2 OF 3

60.39 iPhone 14 Plus, 3 of 3

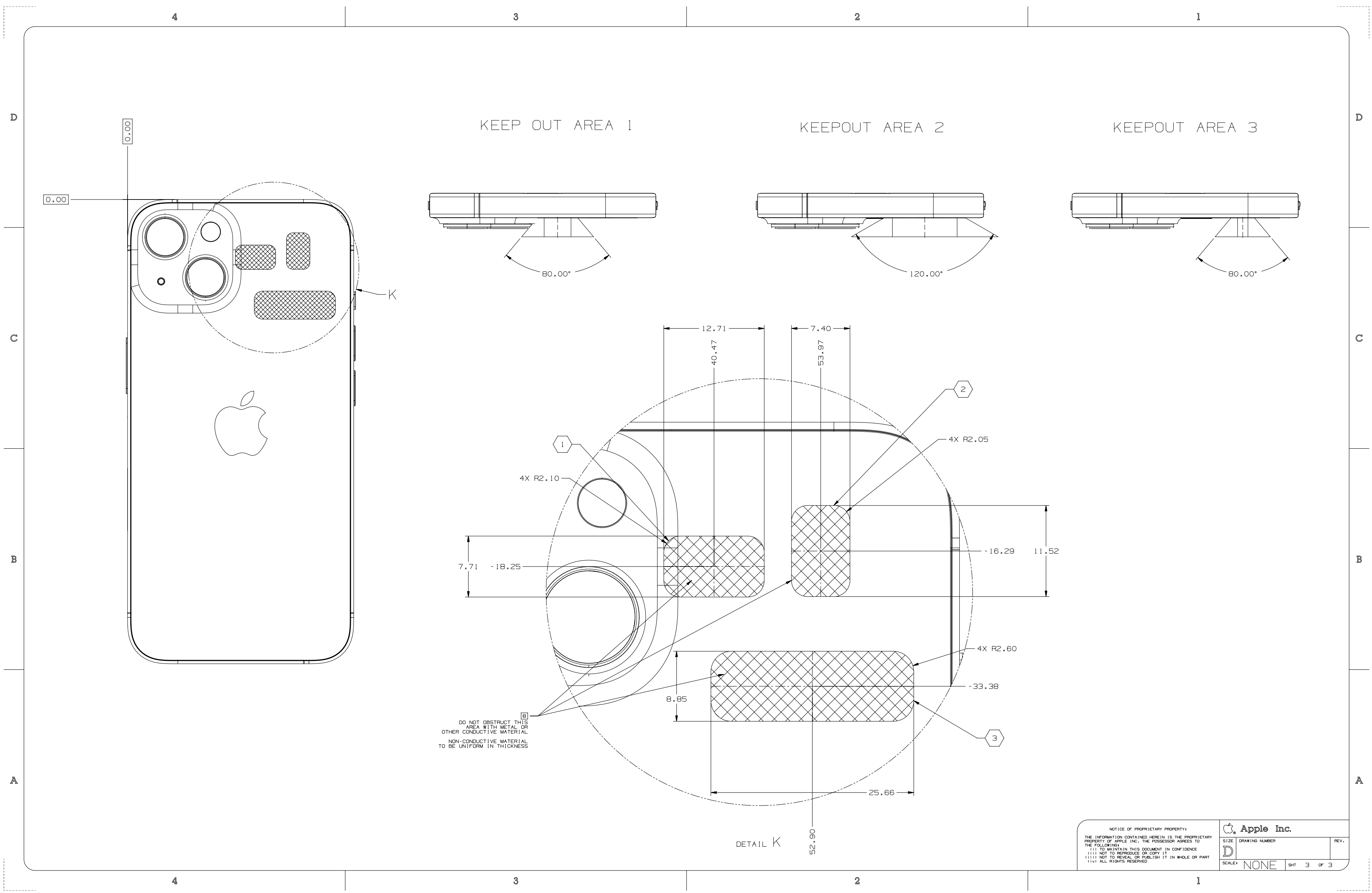



NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH iPHONE.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL A
2 PORTS, RECEIVER, FRONT MIC
DETAIL D
3 REAR CAMERA 1
3 FLASH
3 REAR CAMERA 2
2 Ø2.10 REAR MIC
2X Ø14.38
Ø6.28
3.90 POCKET CENTER
31.98 POCKET CENTER
RING/SILENT SWITCH
(+)VOLUME BUTTON
(-)VOLUME BUTTON
SIM TRAY
71.52 PRODUCT WIDTH
26.79 ACTIVE AREA CUTOUT
5.58 ACTIVE AREA CUTOUT
6 COVER GLASS
ACTIVE AREA
3.47 EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
1.15 EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
0.45 SIDE BUTTON
139.77 DISPLAY ACTIVE AREA
144.61 GLASS
146.71 PRODUCT LENGTH
64.58 DISPLAY ACTIVE AREA
69.42 GLASS
1.85 BACK GLASS TO CAMERA PLATEAU
3.42 BACK GLASS TO REAR CAMERA GLASS
SIDE BUTTON
7.80 PRODUCT THICKNESS
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
PROFILE (ALL SIDES)
DETAIL B
2 8X Ø1.53 PORTS
2 BOTTOM MIC 1
2 2X Ø1.50 SCREWS
2 BOTTOM MIC 2
2 SPEAKER
12.59 RECOMMENDED CONNECTOR KEEPOUT
6.85 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
DETAIL C
METRIC
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
DRAFTER
DATE
DESIGNER
DATE
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
0 < - < 2 ±0.05
2 < - < 10 ±0.08
10 < - < 50 ±0.10
50 < - < 100 ±0.20
100 < - < 200 ±0.30
200 < - ±0.40
ANGLES ±0.50°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
TITLE
IPHONE 14
DRAWING NUMBER
REV.
SIZE D
SCALE NONE
SHT 1 OF 3
NX GENERATED

60.41 iPhone 14, 2 of 3



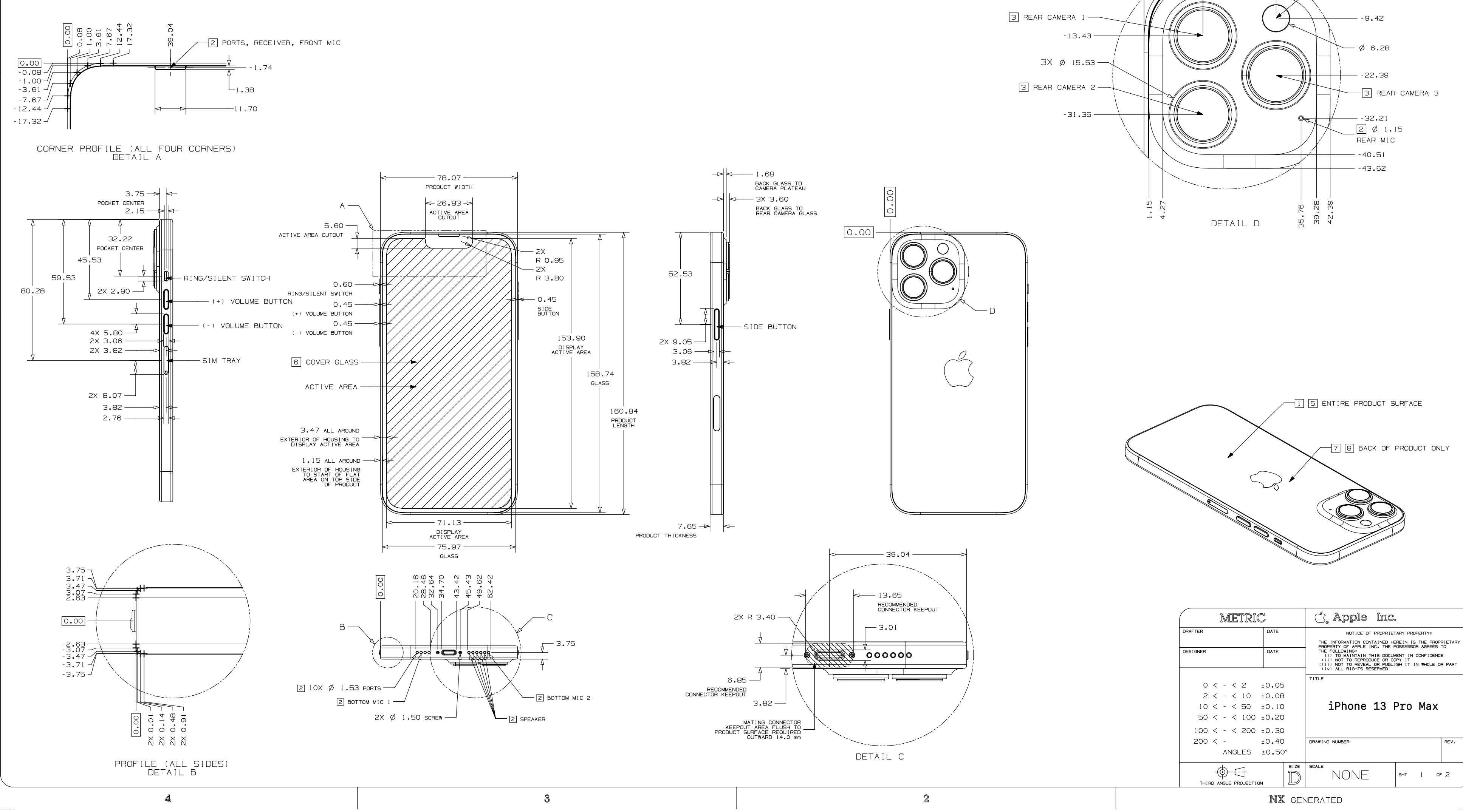
60.42 iPhone 14, 3 of 3



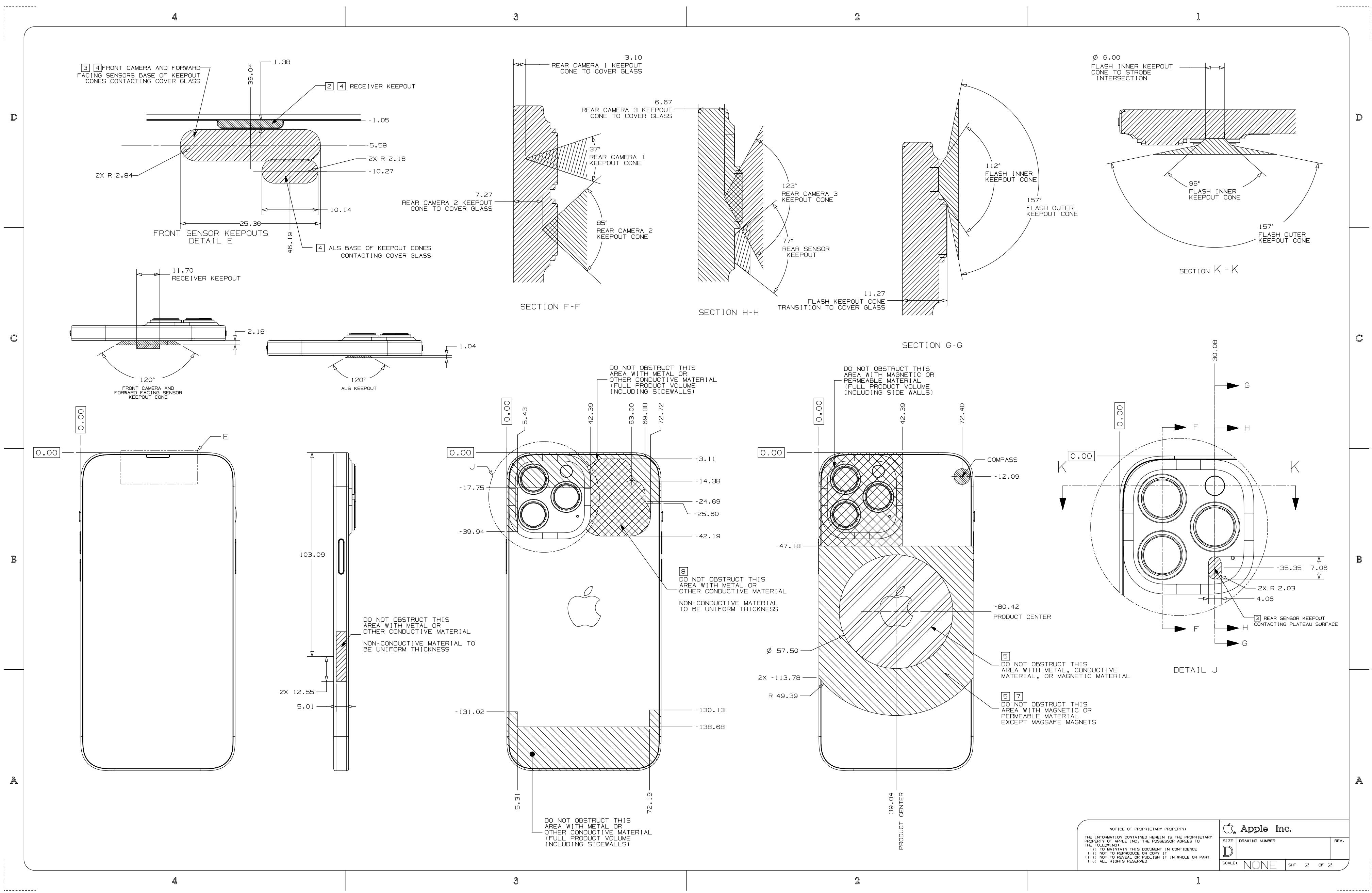
60.43 iPhone 13 Pro Max, 1 of 2

NOTES: (UNLESS OTHERWISE SPECIFIED)

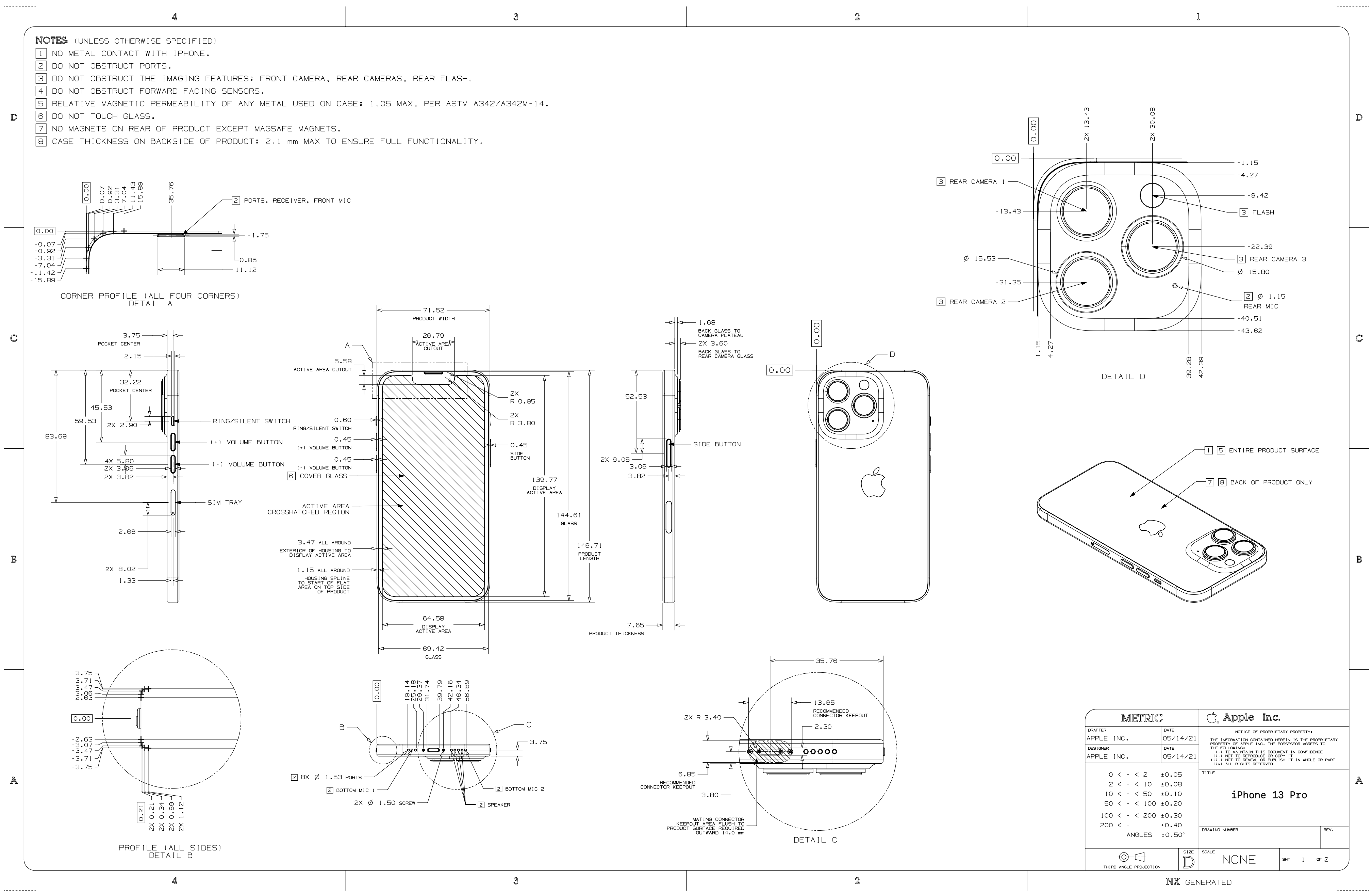
1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.



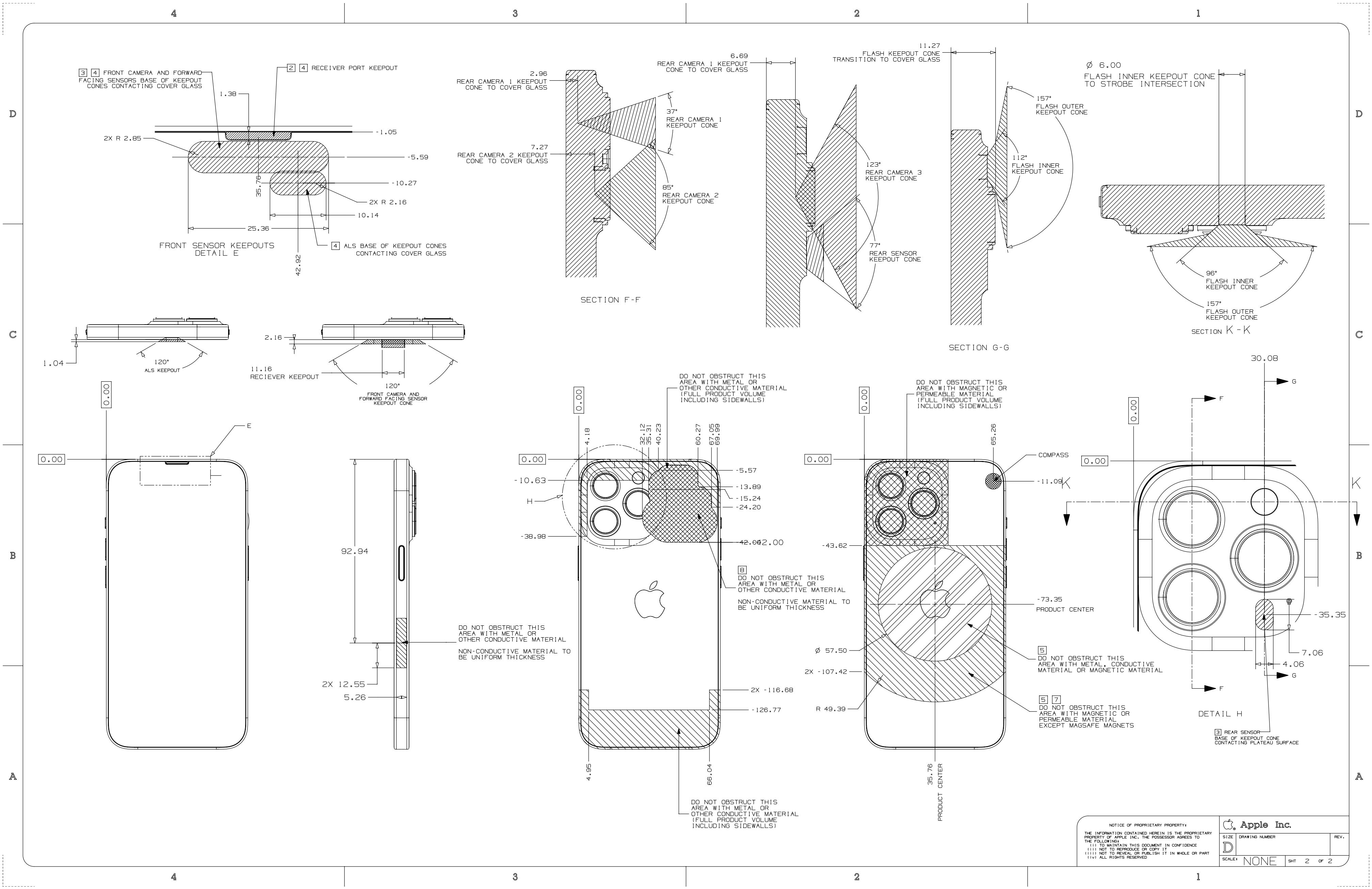
60.44 iPhone 13 Pro Max, 2 of 2

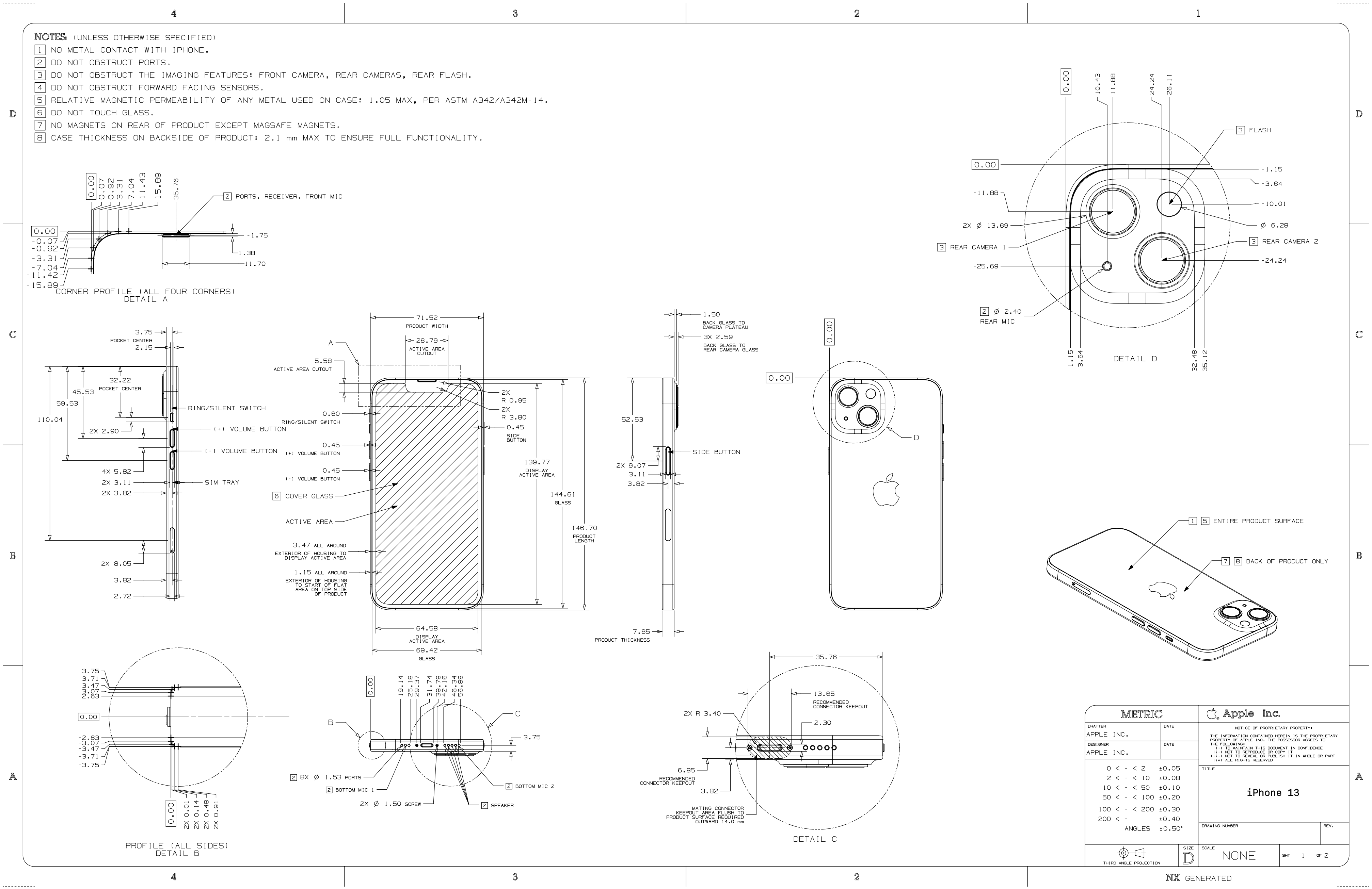


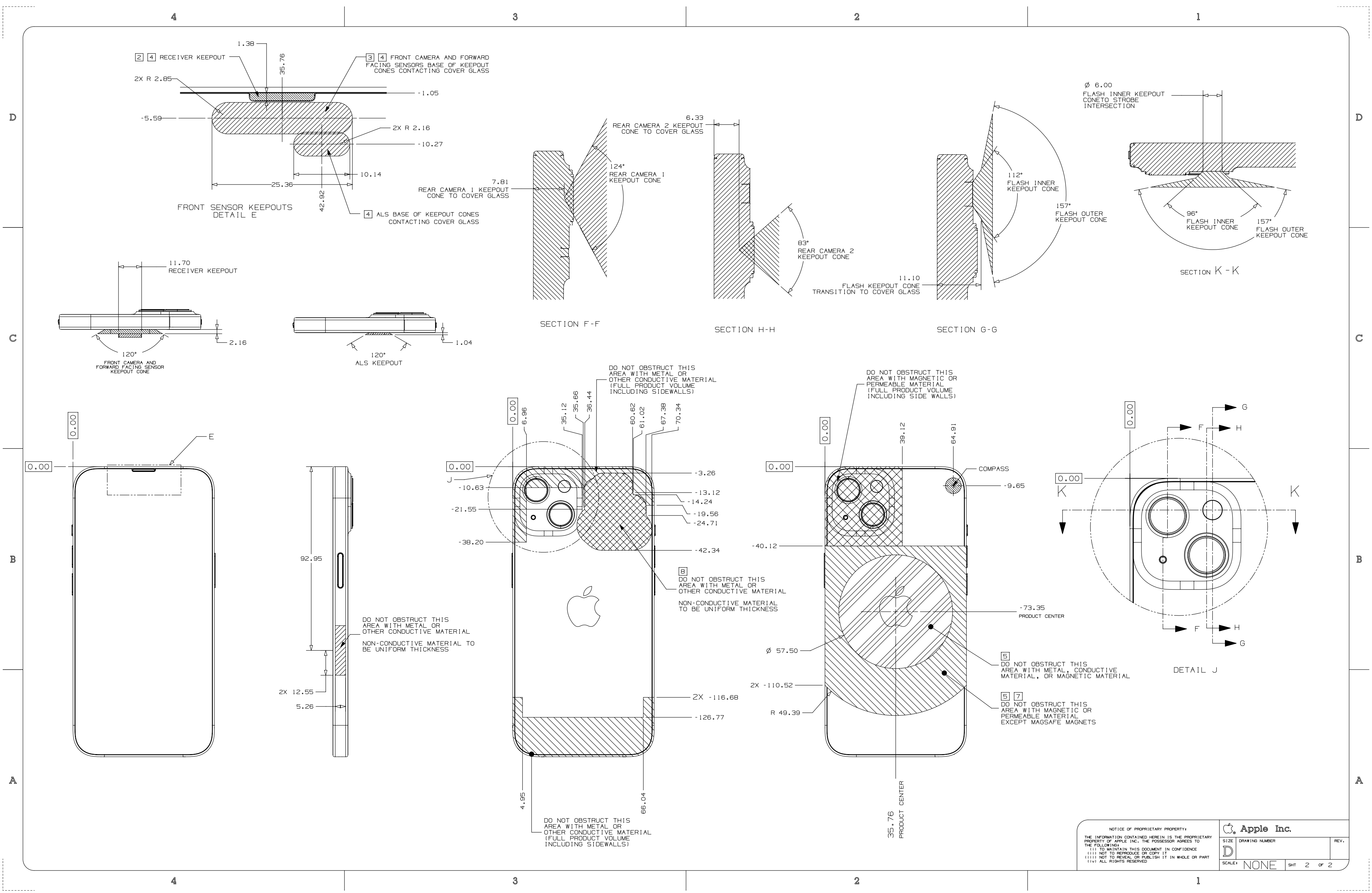
60.45 iPhone 13 Pro, 1 of 2



60.46 iPhone 13 Pro, 2 of 2



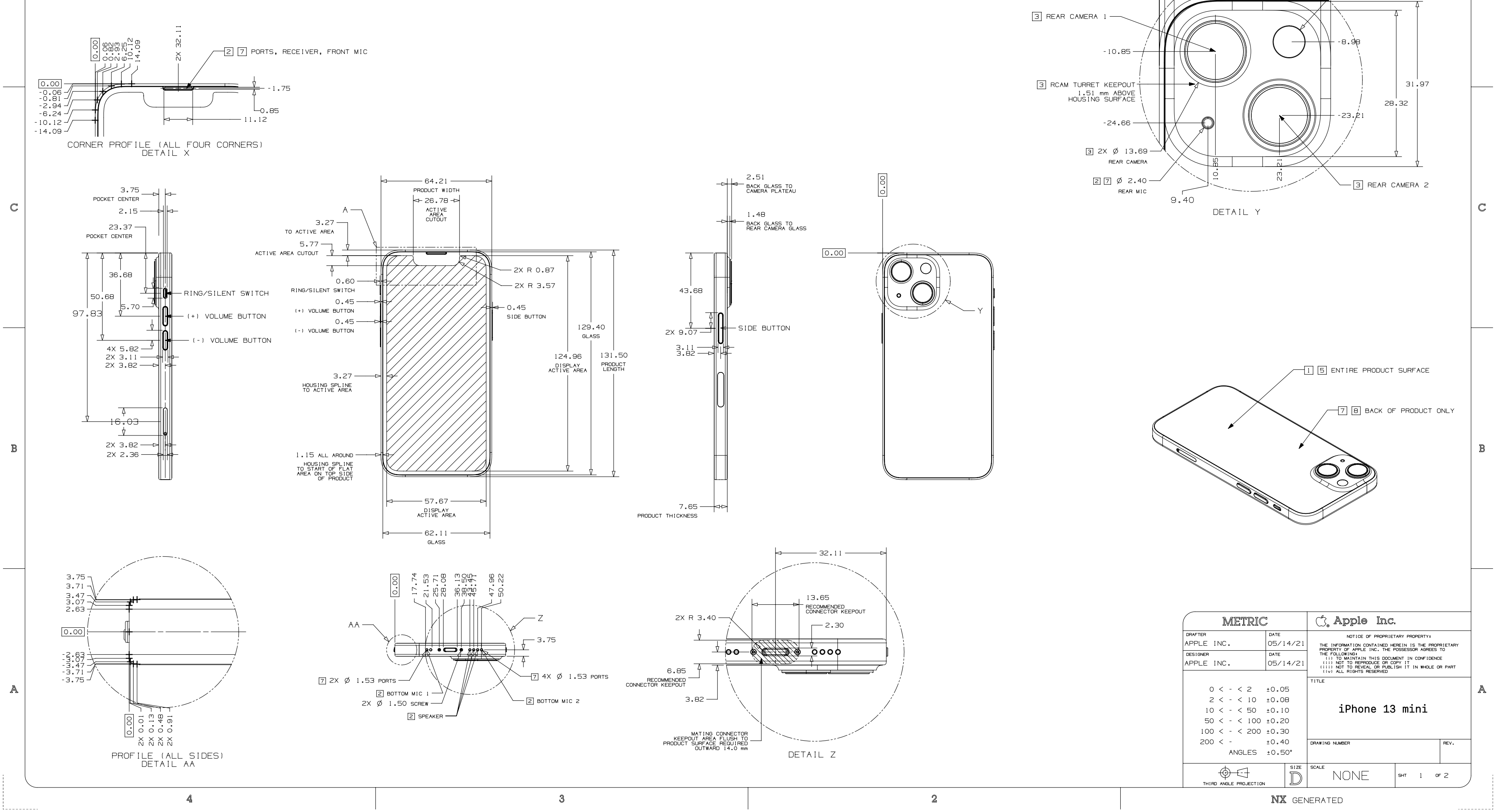

NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH IPHONE.
2 DO NOT OBSTRUCT PORTS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.
2 PORTS, RECEIVER, FRONT MIC
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL A
POCKET CENTER
RING/SILENT SWITCH
(+) VOLUME BUTTON
(-) VOLUME BUTTON
SIM TRAY
71.52 PRODUCT WIDTH
26.79 ACTIVE AREA CUTOUT
5.58 ACTIVE AREA CUTOUT
6 COVER GLASS
ACTIVE AREA
3.47 ALL AROUND EXTERIOR OF HOUSING TO DISPLAY ACTIVE AREA
1.15 ALL AROUND EXTERIOR OF HOUSING TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
139.77 DISPLAY ACTIVE AREA
144.61 GLASS
146.70 PRODUCT LENGTH
64.58 DISPLAY ACTIVE AREA
69.42 GLASS
1.50 BACK GLASS TO CAMERA PLATEAU
3X 2.59 BACK GLASS TO REAR CAMERA GLASS
SIDE BUTTON
7.65 PRODUCT THICKNESS
3 FLASH
2X Ø 13.69
3 REAR CAMERA 1
Ø 6.28
3 REAR CAMERA 2
2 Ø 2.40 REAR MIC
DETAIL D
1 5 ENTIRE PRODUCT SURFACE
7 8 BACK OF PRODUCT ONLY
PROFILE (ALL SIDES)
DETAIL B
2 8X Ø 1.53 PORTS
2 BOTTOM MIC 1
2X Ø 1.50 SCREW
2 BOTTOM MIC 2
2 SPEAKER
13.65 RECOMMENDED CONNECTOR KEEPOUT
6.85 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
DETAIL C
METRIC
DRAFTER APPLE INC.
DESIGNER APPLE INC.
0 < - < 2 ±0.05
2 < - < 10 ±0.08
10 < - < 50 ±0.10
50 < - < 100 ±0.20
100 < - < 200 ±0.30
200 < - ±0.40
ANGLES ±0.50°
THIRD ANGLE PROJECTION
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
TITLE iPhone 13
SCALE NONE
SHT 1 OF 2
NX GENERATED


RECEIVER KEEPOUT
FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES CONTACTING COVER GLASS
FRONT SENSOR KEEPOUTS DETAIL E
ALS BASE OF KEEPOUT CONES CONTACTING COVER GLASS
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
REAR CAMERA 1 KEEPOUT CONE
REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
REAR CAMERA 2 KEEPOUT CONE
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
FLASH INNER KEEPOUT CONE
FLASH OUTER KEEPOUT CONE
FLASH INNER KEEPOUT CONETO STROBE INTERSECTION
SECTION F-F
SECTION H-H
SECTION G-G
SECTION K-K
RECEIVER KEEPOUT
FRONT CAMERA AND FORWARD FACING SENSOR KEEPOUT CONE
ALS KEEPOUT
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS)
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
COMPASS
PRODUCT CENTER
DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL, OR MAGNETIC MATERIAL
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
DETAIL J
NOTICE OF PROPRIETARY PROPERTY:
Apple Inc.
SIZE D
SCALE: NONE
SHT 2 OF 2

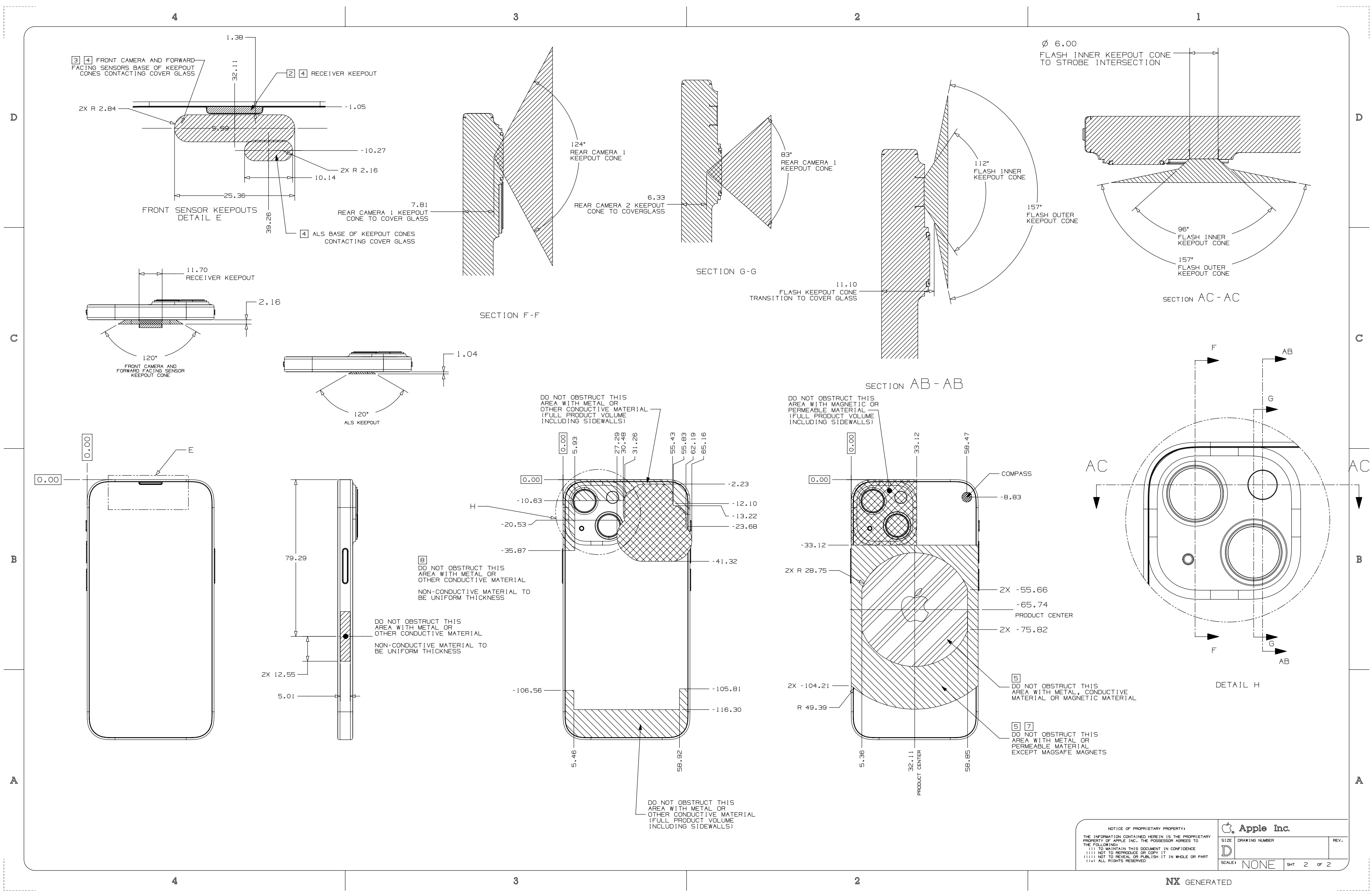
60.49 iPhone 13 mini, 1 of 2

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.



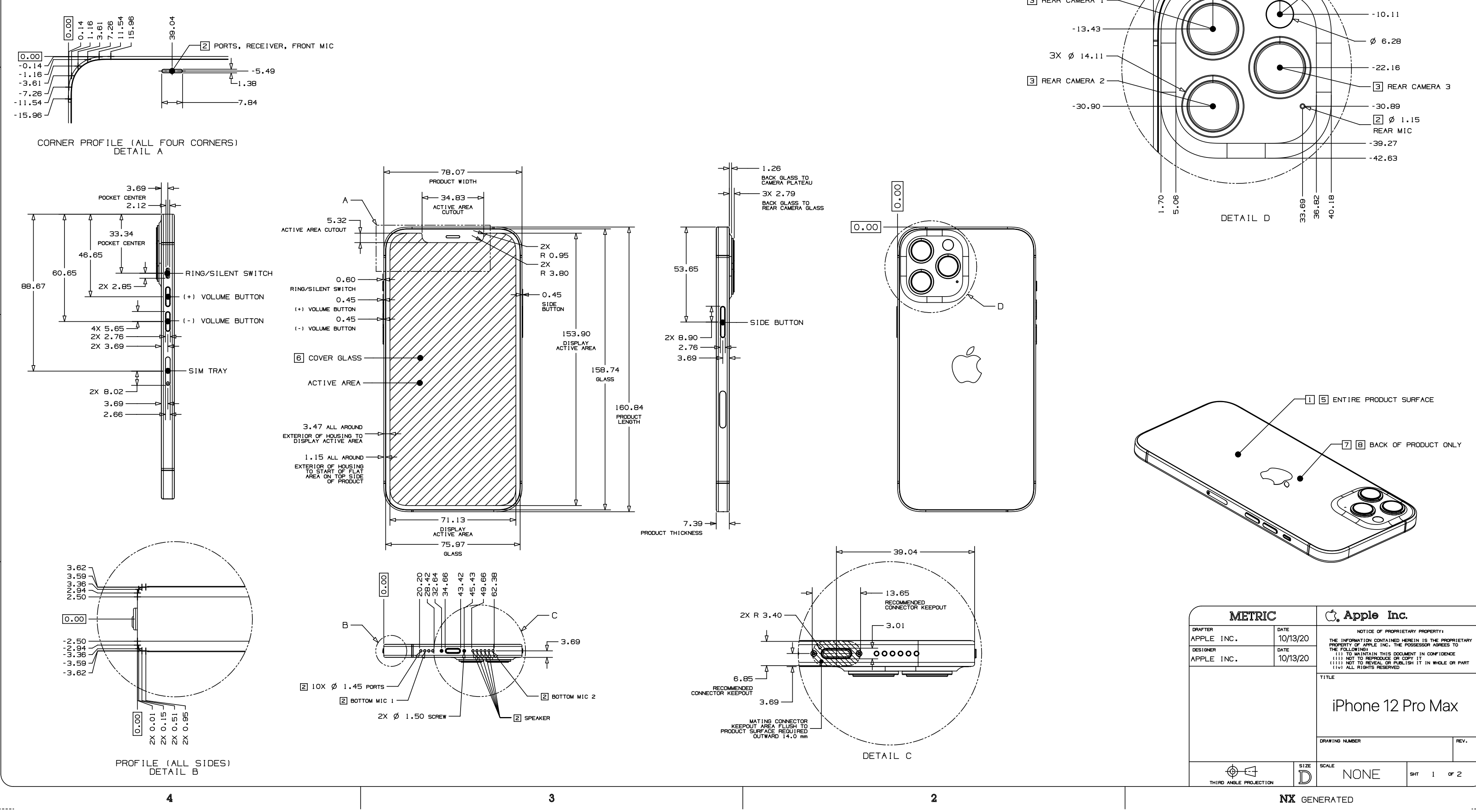
60.50 iPhone 13 mini, 2 of 2

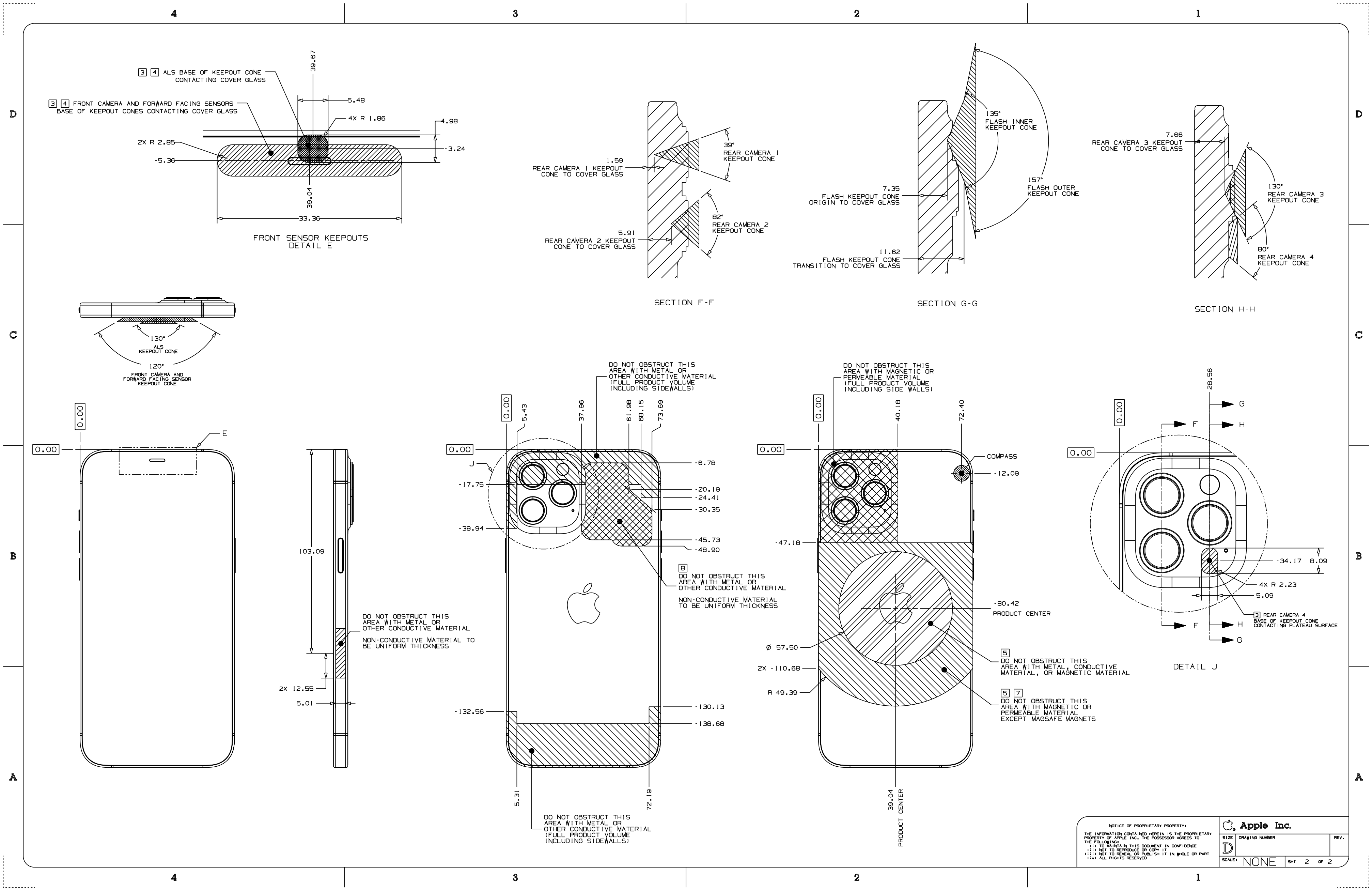


60.51 iPhone 12 Pro Max, 1 of 2

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.

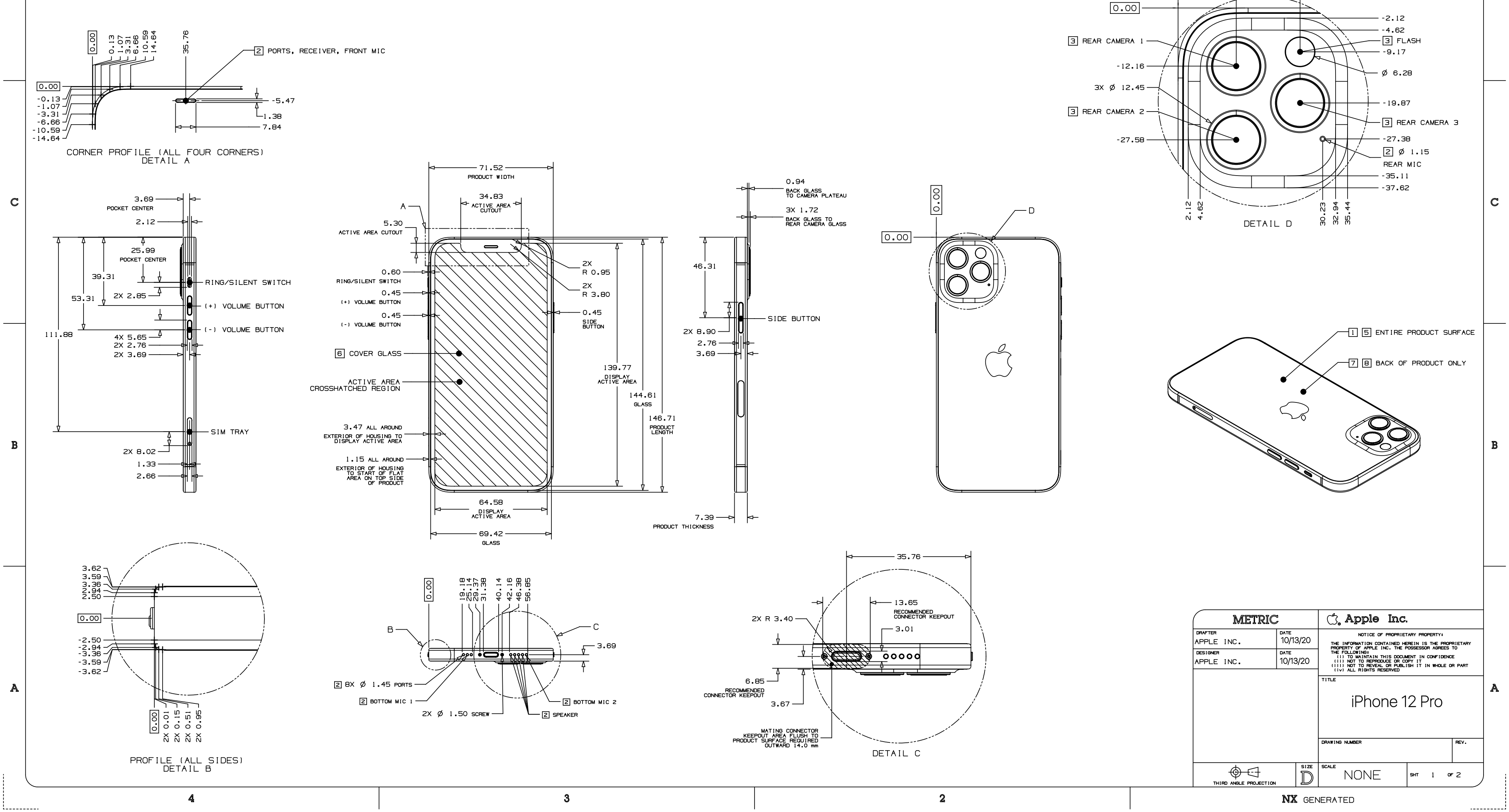


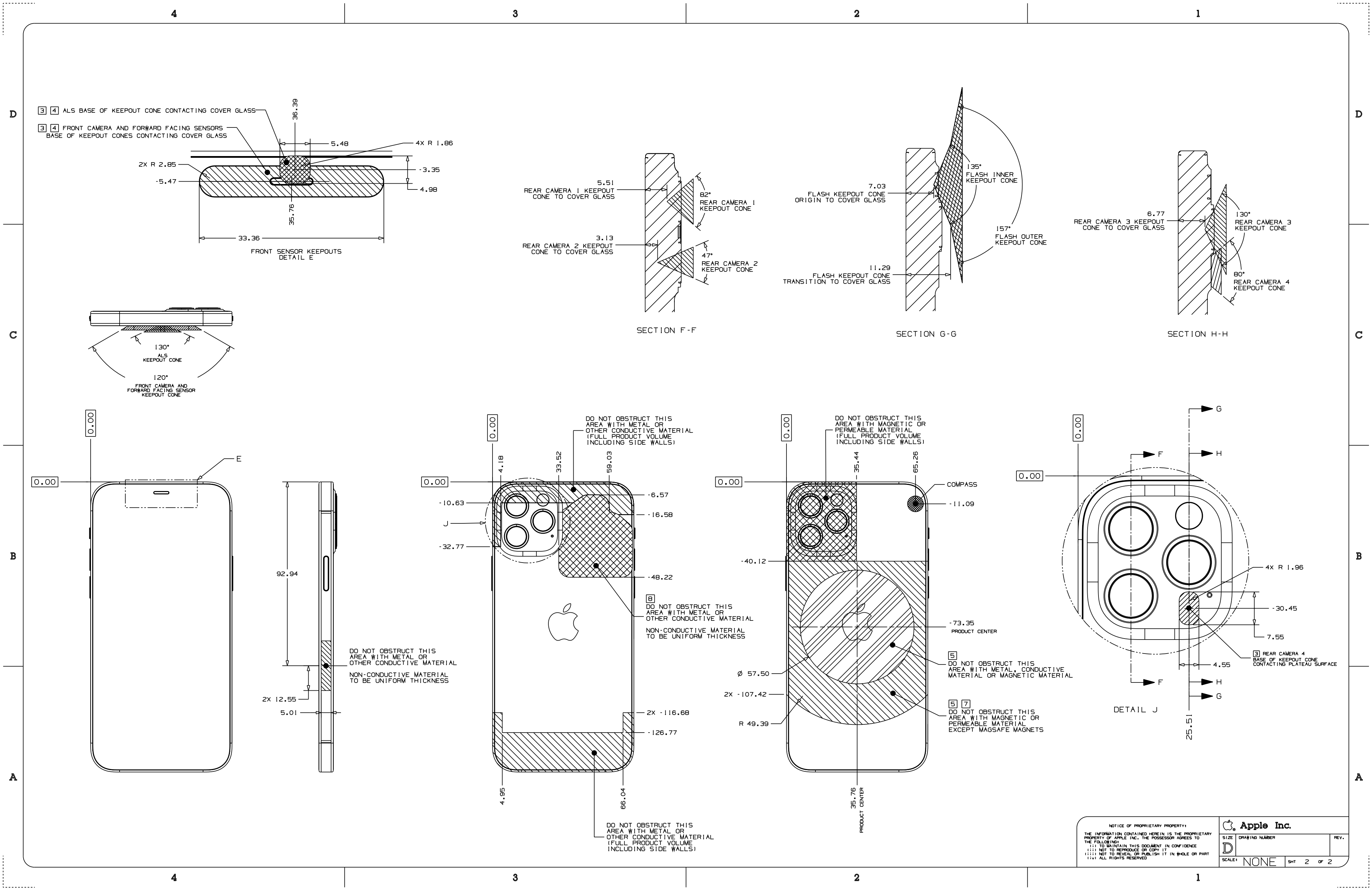


3 4 ALS BASE OF KEEPOUT CONE CONTACTING COVER GLASS
3 4 FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES CONTACTING COVER GLASS
39.67
5.48
4X R 1.86
4.98
3.24
2X R 2.85
-5.36
39.04
33.36
FRONT SENSOR KEEPOUTS
DETAIL E
130°
ALS KEEPOUT CONE
120°
FRONT CAMERA AND FORWARD FACING SENSOR KEEPOUT CONE
1.59
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
39°
REAR CAMERA 1 KEEPOUT CONE
82°
REAR CAMERA 2 KEEPOUT CONE
5.91
REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
SECTION F-F
135°
FLASH INNER KEEPOUT CONE
157°
FLASH OUTER KEEPOUT CONE
7.35
FLASH KEEPOUT CONE ORIGIN TO COVER GLASS
11.62
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
SECTION G-G
7.66
REAR CAMERA 3 KEEPOUT CONE TO COVER GLASS
130°
REAR CAMERA 3 KEEPOUT CONE
80°
REAR CAMERA 4 KEEPOUT CONE
SECTION H-H
0.00
E
103.09
2X 12.55
5.01
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS)
5.43
37.96
61.98
68.15
73.69
J
-17.75
-39.94
-6.78
-20.19
-24.41
-30.35
-45.73
-48.90
8 DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
-132.56
-130.13
-138.68
5.31
72.19
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS)
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
40.18
72.40
COMPASS
-12.09
-47.18
-80.42
PRODUCT CENTER
Ø 57.50
2X -110.68
R 49.39
5 DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL, OR MAGNETIC MATERIAL
5 7 DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
39.04
PRODUCT CENTER
28.56
G
F
H
-34.17
8.09
4X R 2.23
5.09
3 REAR CAMERA 4 BASE OF KEEPOUT CONE CONTACTING PLATEAU SURFACE
DETAIL J
NOTICE OF PROPRIETARY PROPERTY:
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 2 OF 2

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.

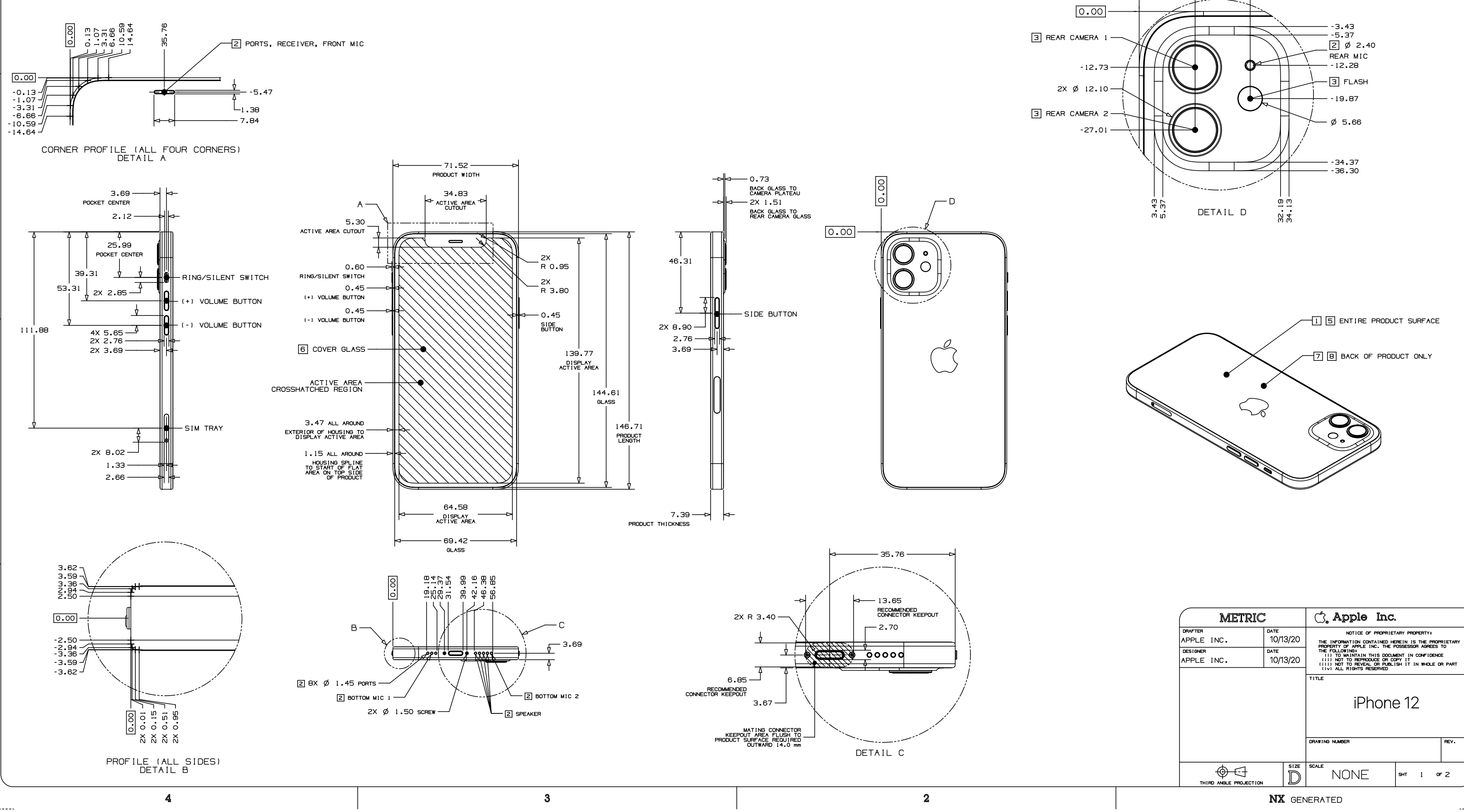



3 4 ALS BASE OF KEEPOUT CONE CONTACTING COVER GLASS
3 4 FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES CONTACTING COVER GLASS
2X R 2.85
-5.47
36.39
5.48
4X R 1.86
-3.35
4.98
35.76
33.36
FRONT SENSOR KEEPOUTS DETAIL E
130° ALS KEEPOUT CONE
120° FRONT CAMERA AND FORWARD FACING SENSOR KEEPOUT CONE
5.51 REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
82° REAR CAMERA 1 KEEPOUT CONE
3.13 REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
47° REAR CAMERA 2 KEEPOUT CONE
SECTION F-F
7.03 FLASH KEEPOUT CONE ORIGIN TO COVER GLASS
135° FLASH INNER KEEPOUT CONE
157° FLASH OUTER KEEPOUT CONE
11.29 FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
SECTION G-G
6.77 REAR CAMERA 3 KEEPOUT CONE TO COVER GLASS
130° REAR CAMERA 3 KEEPOUT CONE
80° REAR CAMERA 4 KEEPOUT CONE
SECTION H-H
0.00
E
92.94
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
2X 12.55
5.01
4.18
33.52
59.03
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
-6.57
-16.58
-10.63
J
-32.77
-48.22
8 DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
2X -116.68
-126.77
4.95
66.04
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDE WALLS)
35.44
65.26
COMPASS
-11.09
-40.12
-73.35 PRODUCT CENTER
5 DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL OR MAGNETIC MATERIAL
Ø 57.50
2X -107.42
R 49.39
5 7 DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
35.76 PRODUCT CENTER
G
F
H
4X R 1.96
-30.45
7.55
3 REAR CAMERA 4 BASE OF KEEPOUT CONE CONTACTING PLATEAU SURFACE
4.55
DETAIL J
25.51
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 2 OF 2

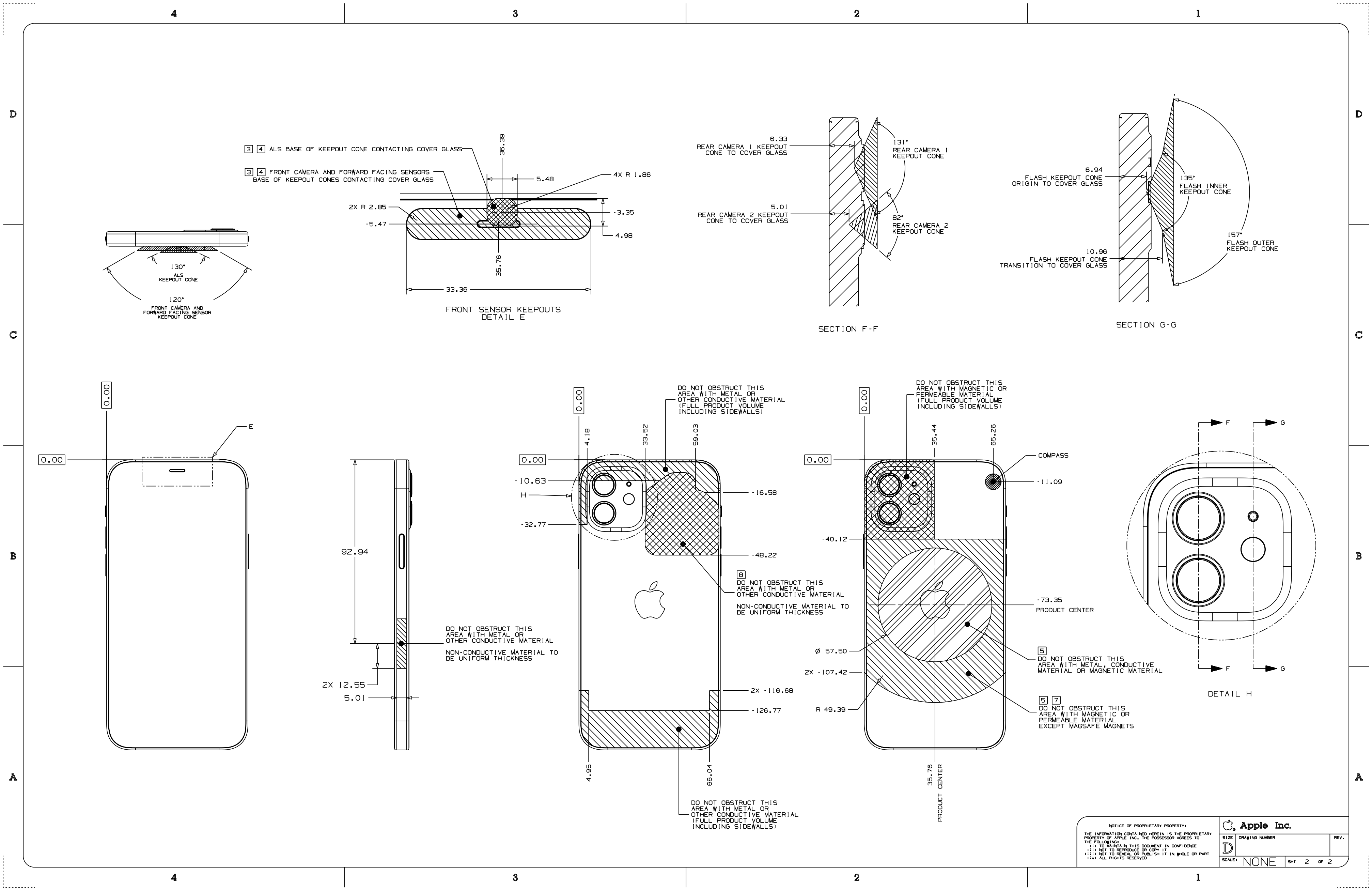
60.55 iPhone 12, 1 of 2

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.

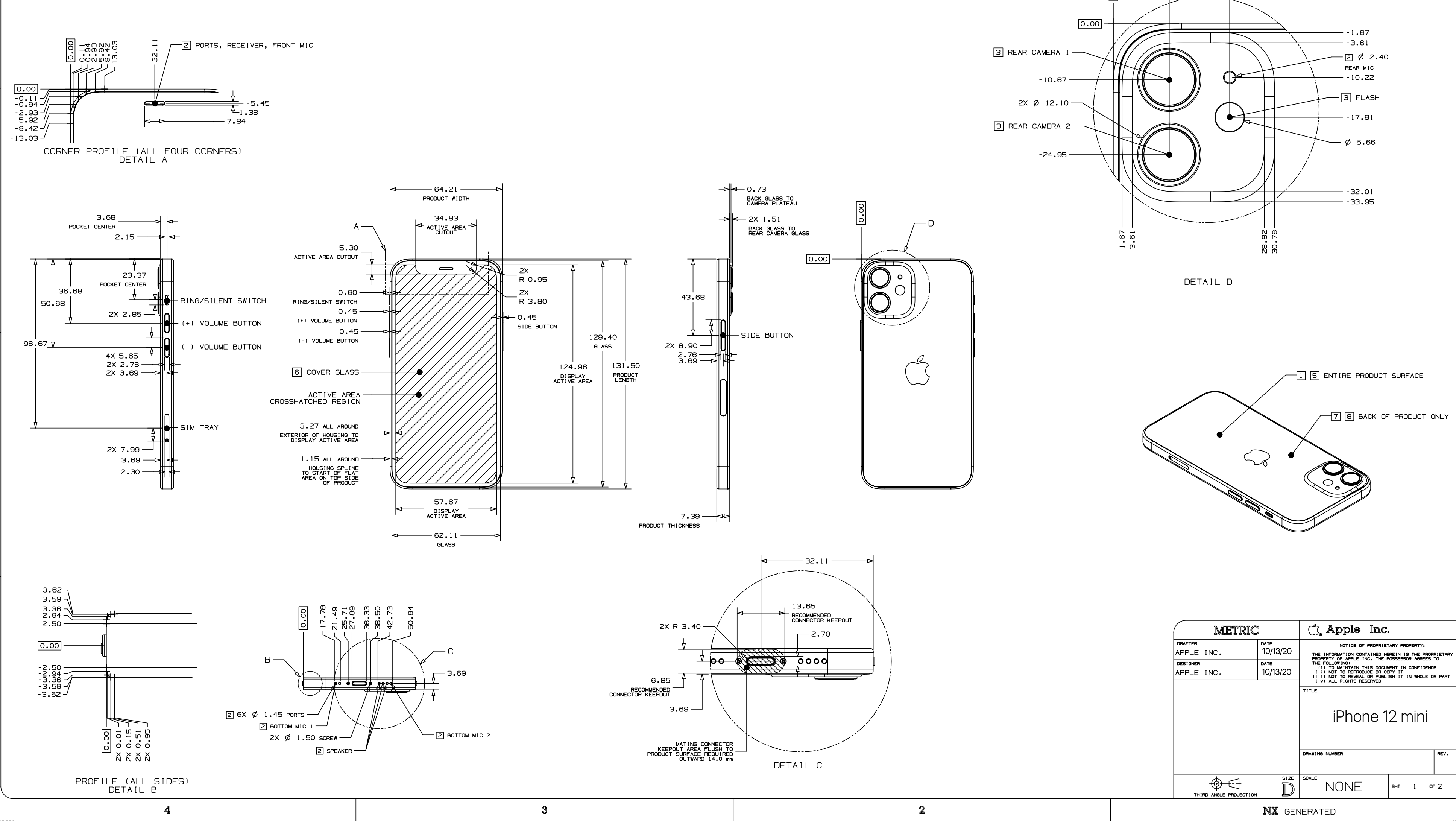


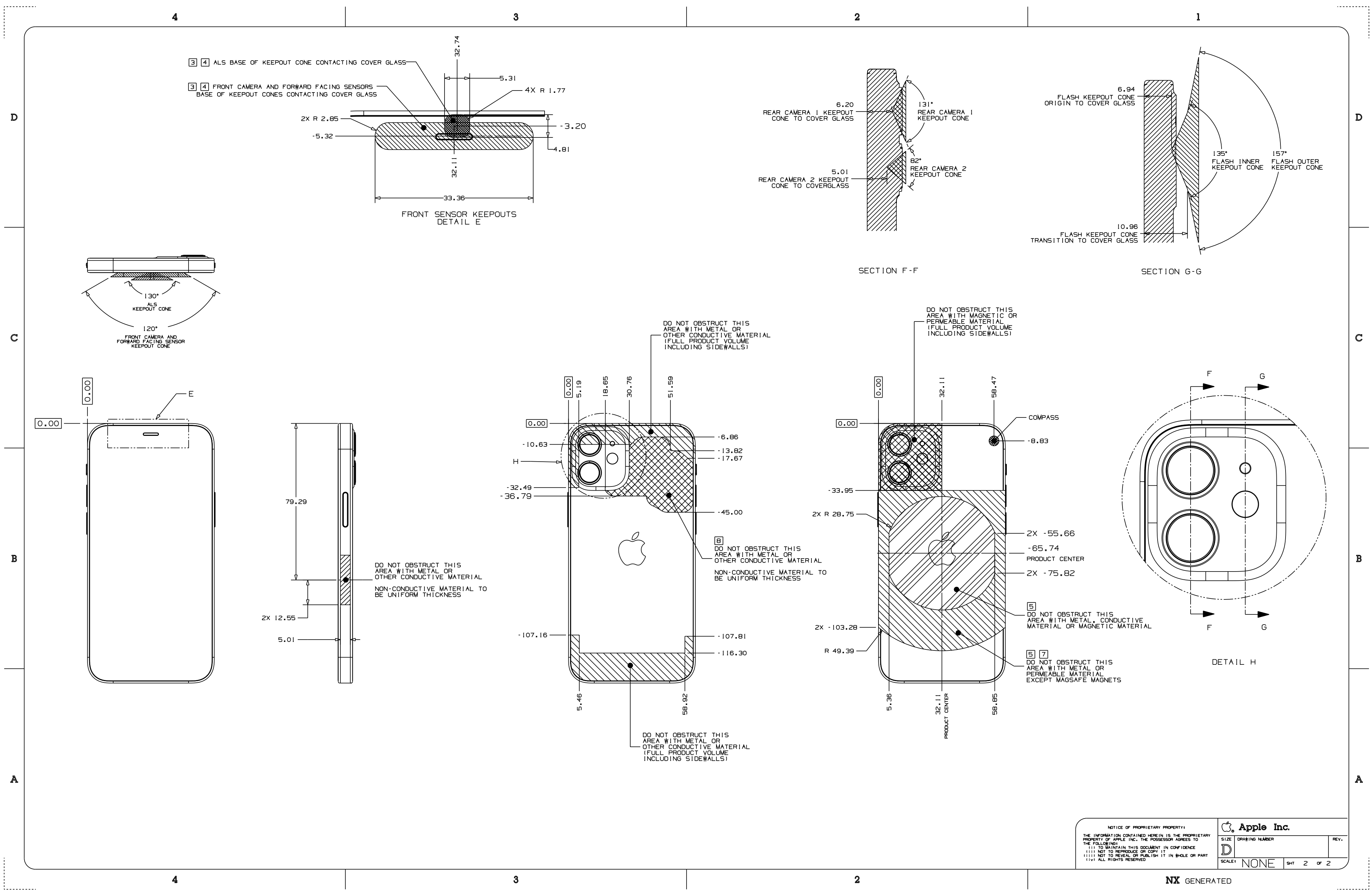
60.56 iPhone 12, 2 of 2



NOTES: (UNLESS OTHERWISE SPECIFIED)

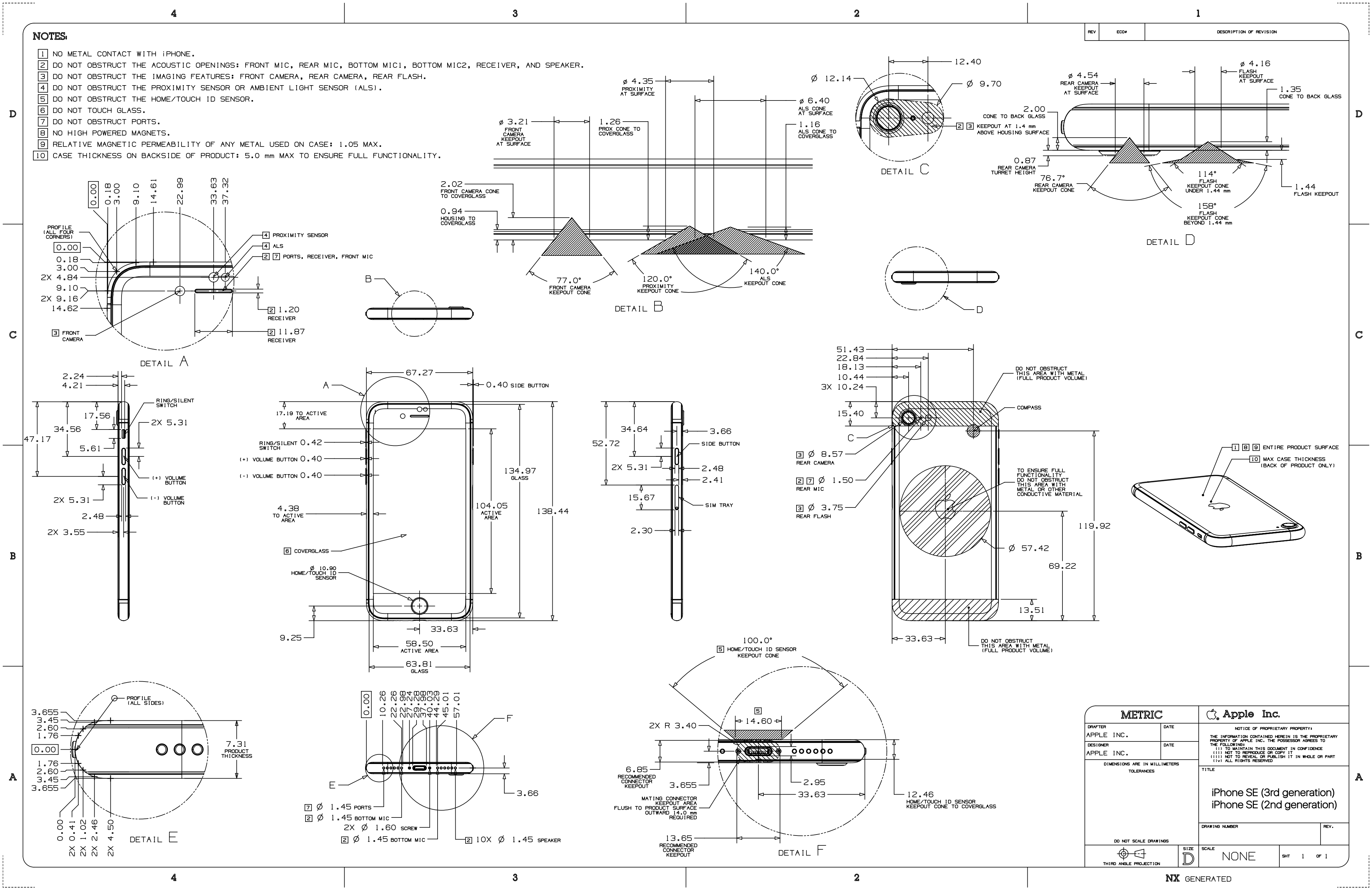
1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT PORTS.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
8. CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.

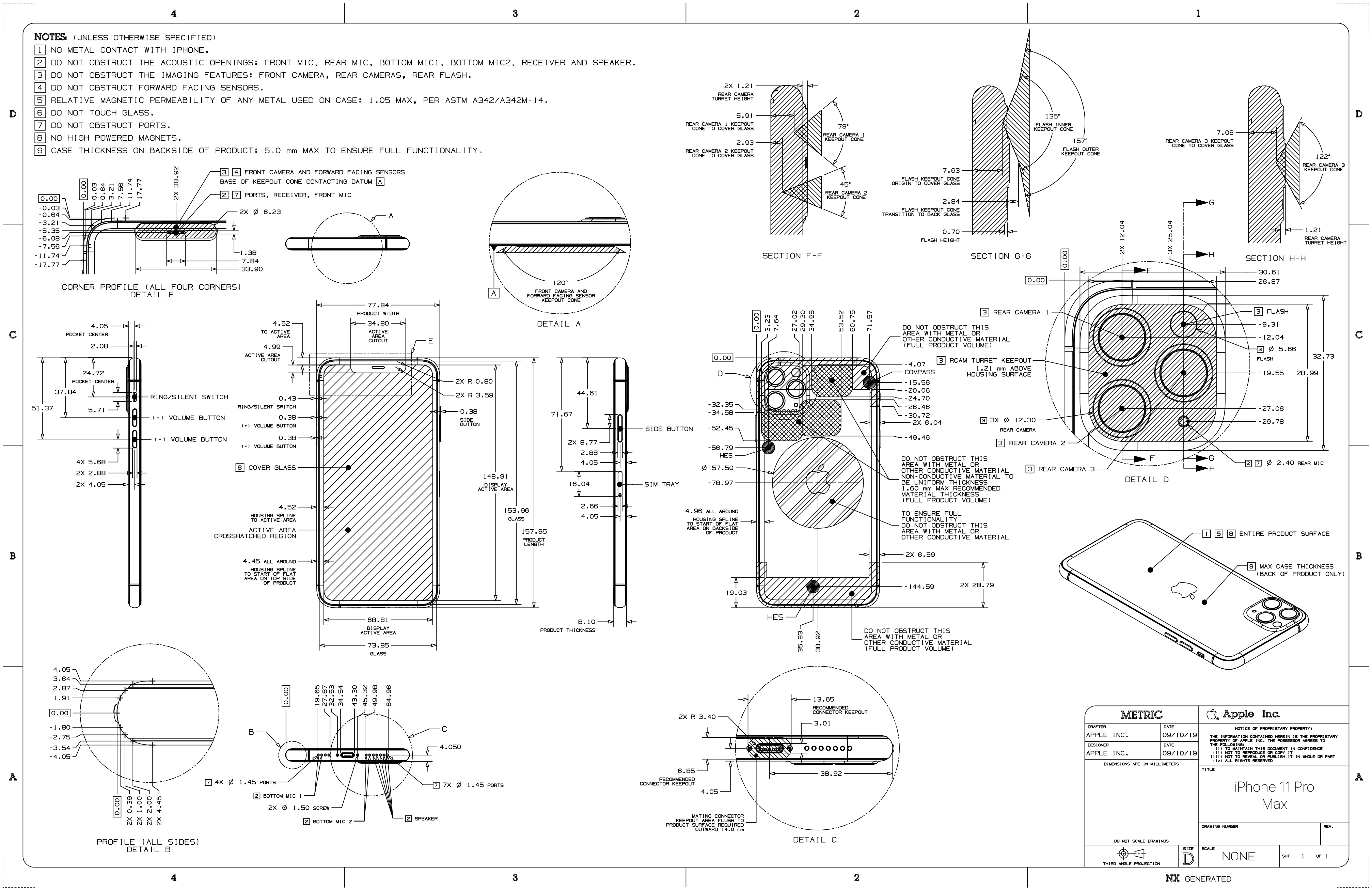




3 4 ALS BASE OF KEEPOUT CONE CONTACTING COVER GLASS
3 4 FRONT CAMERA AND FORWARD FACING SENSORS BASE OF KEEPOUT CONES CONTACTING COVER GLASS
32.74
5.31
4X R 1.77
2X R 2.85
-5.32
-3.20
4.81
32.11
33.36
FRONT SENSOR KEEPOUTS DETAIL E
6.20
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
131°
REAR CAMERA 1 KEEPOUT CONE
82°
REAR CAMERA 2 KEEPOUT CONE
5.01
REAR CAMERA 2 KEEPOUT CONE TO COVERGLASS
SECTION F-F
6.94
FLASH KEEPOUT CONE ORIGIN TO COVER GLASS
135°
FLASH INNER KEEPOUT CONE
157°
FLASH OUTER KEEPOUT CONE
10.96
FLASH KEEPOUT CONE TRANSITION TO COVER GLASS
SECTION G-G
130°
ALS KEEPOUT CONE
120°
FRONT CAMERA AND FORWARD FACING SENSOR KEEPOUT CONE
0.00
0.00
E
79.29
2X 12.55
5.01
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS)
0.00
5.19
18.65
30.76
51.59
0.00
-10.63
H
-32.49
-36.79
-6.86
-13.82
-17.67
-45.00
8 DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS
-107.16
-107.81
-116.30
5.46
58.92
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS)
DO NOT OBSTRUCT THIS AREA WITH MAGNETIC OR PERMEABLE MATERIAL (FULL PRODUCT VOLUME INCLUDING SIDEWALLS)
0.00
32.11
58.47
0.00
COMPASS
-8.83
-33.95
2X R 28.75
2X -55.66
-65.74
PRODUCT CENTER
2X -75.82
5 DO NOT OBSTRUCT THIS AREA WITH METAL, CONDUCTIVE MATERIAL OR MAGNETIC MATERIAL
2X -103.28
R 49.39
5 7 DO NOT OBSTRUCT THIS AREA WITH METAL OR PERMEABLE MATERIAL EXCEPT MAGSAFE MAGNETS
5.36
32.11
PRODUCT CENTER
58.85
F
G
F
G
DETAIL H
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
Apple Inc.
SIZE
DRAWING NUMBER
REV.
D
SCALE:
NONE
SHT 2 OF 2
NX GENERATED

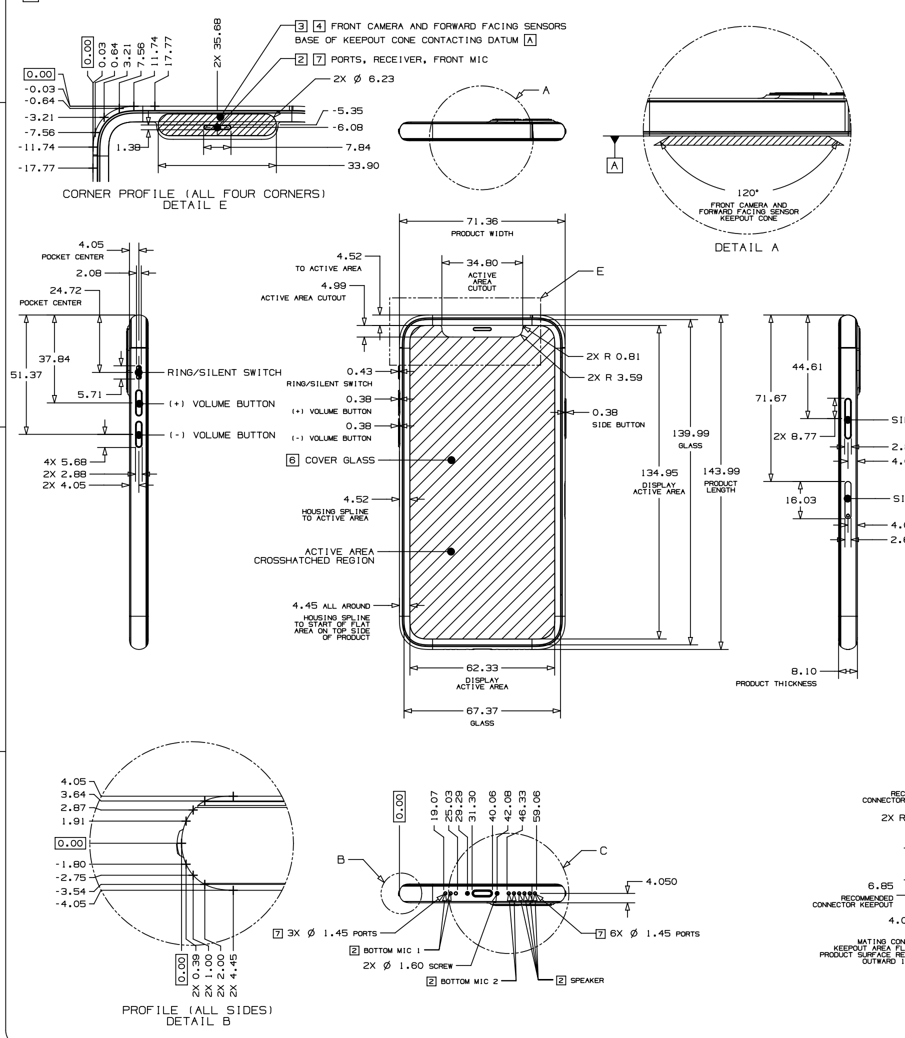
60.59 iPhone SE (3rd generation) and iPhone SE (2nd generation)

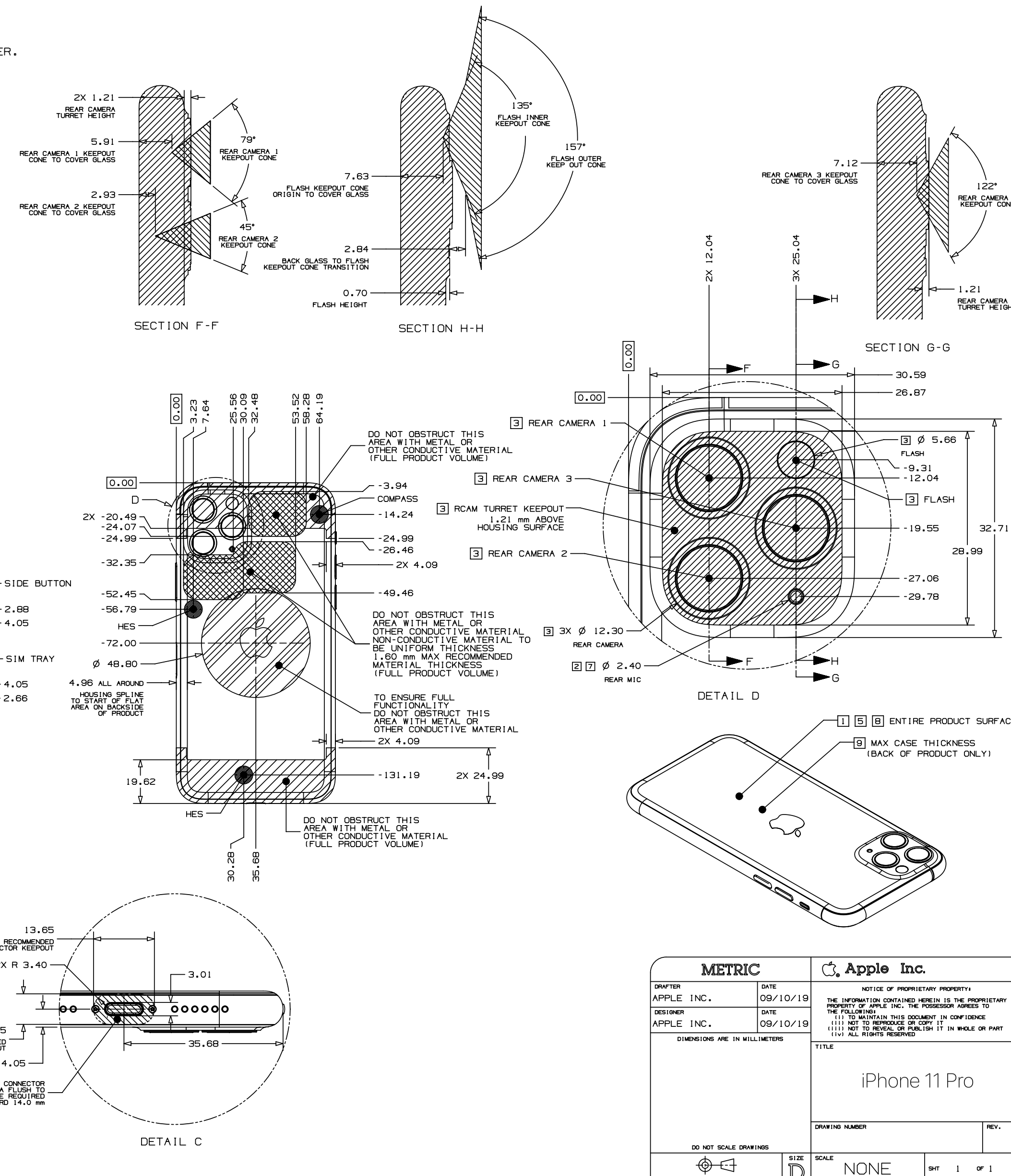



NOTES: (UNLESS OTHERWISE SPECIFIED)
1 NO METAL CONTACT WITH IPHONE.
2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER AND SPEAKER.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 DO NOT OBSTRUCT PORTS.
8 NO HIGH POWERED MAGNETS.
9 CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.
3 4 FRONT CAMERA AND FORWARD FACING SENSORS
BASE OF KEEPOUT CONE CONTACTING DATUM A
2 7 PORTS, RECEIVER, FRONT MIC
CORNER PROFILE (ALL FOUR CORNERS)
DETAIL E
DETAIL A
FRONT CAMERA AND FORWARD FACING SENSOR KEEPOUT CONE
SECTION F-F
SECTION G-G
SECTION H-H
REAR CAMERA TURRET HEIGHT
REAR CAMERA 1 KEEPOUT CONE TO COVER GLASS
REAR CAMERA 2 KEEPOUT CONE TO COVER GLASS
REAR CAMERA 1 KEEPOUT CONE
REAR CAMERA 2 KEEPOUT CONE
FLASH INNER KEEPOUT CONE
FLASH OUTER KEEPOUT CONE
FLASH KEEPOUT CONE ORIGIN TO COVER GLASS
FLASH KEEPOUT CONE TRANSITION TO BACK GLASS
FLASH HEIGHT
REAR CAMERA 3 KEEPOUT CONE TO COVER GLASS
REAR CAMERA 3 KEEPOUT CONE
POCKET CENTER
RING/SILENT SWITCH
(+) VOLUME BUTTON
(-) VOLUME BUTTON
PRODUCT WIDTH
TO ACTIVE AREA
ACTIVE AREA CUTOUT
6 COVER GLASS
HOUSING SPLINE TO ACTIVE AREA
ACTIVE AREA CROSSHATCHED REGION
4.45 ALL AROUND
HOUSING SPLINE TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
DISPLAY ACTIVE AREA
GLASS
PRODUCT LENGTH
SIDE BUTTON
SIM TRAY
PRODUCT THICKNESS
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME)
COMPASS
HES
4.96 ALL AROUND
HOUSING SPLINE TO START OF FLAT AREA ON BACKSIDE OF PRODUCT
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL NON-CONDUCTIVE MATERIAL TO BE UNIFORM THICKNESS 1.60 mm MAX RECOMMENDED MATERIAL THICKNESS (FULL PRODUCT VOLUME)
TO ENSURE FULL FUNCTIONALITY DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
3 REAR CAMERA 1
3 RCAM TURRET KEEPOUT 1.21 mm ABOVE HOUSING SURFACE
3 3X Ø 12.30 REAR CAMERA
3 REAR CAMERA 2
3 REAR CAMERA 3
3 FLASH
3 Ø 5.66 FLASH
2 7 Ø 2.40 REAR MIC
DETAIL D
1 5 8 ENTIRE PRODUCT SURFACE
9 MAX CASE THICKNESS (BACK OF PRODUCT ONLY)
PROFILE (ALL SIDES)
DETAIL B
7 4X Ø 1.45 PORTS
2 BOTTOM MIC 1
2X Ø 1.50 SCREW
2 BOTTOM MIC 2
2 SPEAKER
7 7X Ø 1.45 PORTS
RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
DETAIL C
METRIC
DRAFTER APPLE INC. DATE 09/10/19
DESIGNER APPLE INC. DATE 09/10/19
DIMENSIONS ARE IN MILLIMETERS
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
TITLE
iPhone 11 Pro Max
DRAWING NUMBER
REV.
SIZE D
SCALE NONE
SHT 1 OF 1
NX GENERATED

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER AND SPEAKER.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. DO NOT OBSTRUCT PORTS.
8. NO HIGH POWERED MAGNETS.
9. CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.

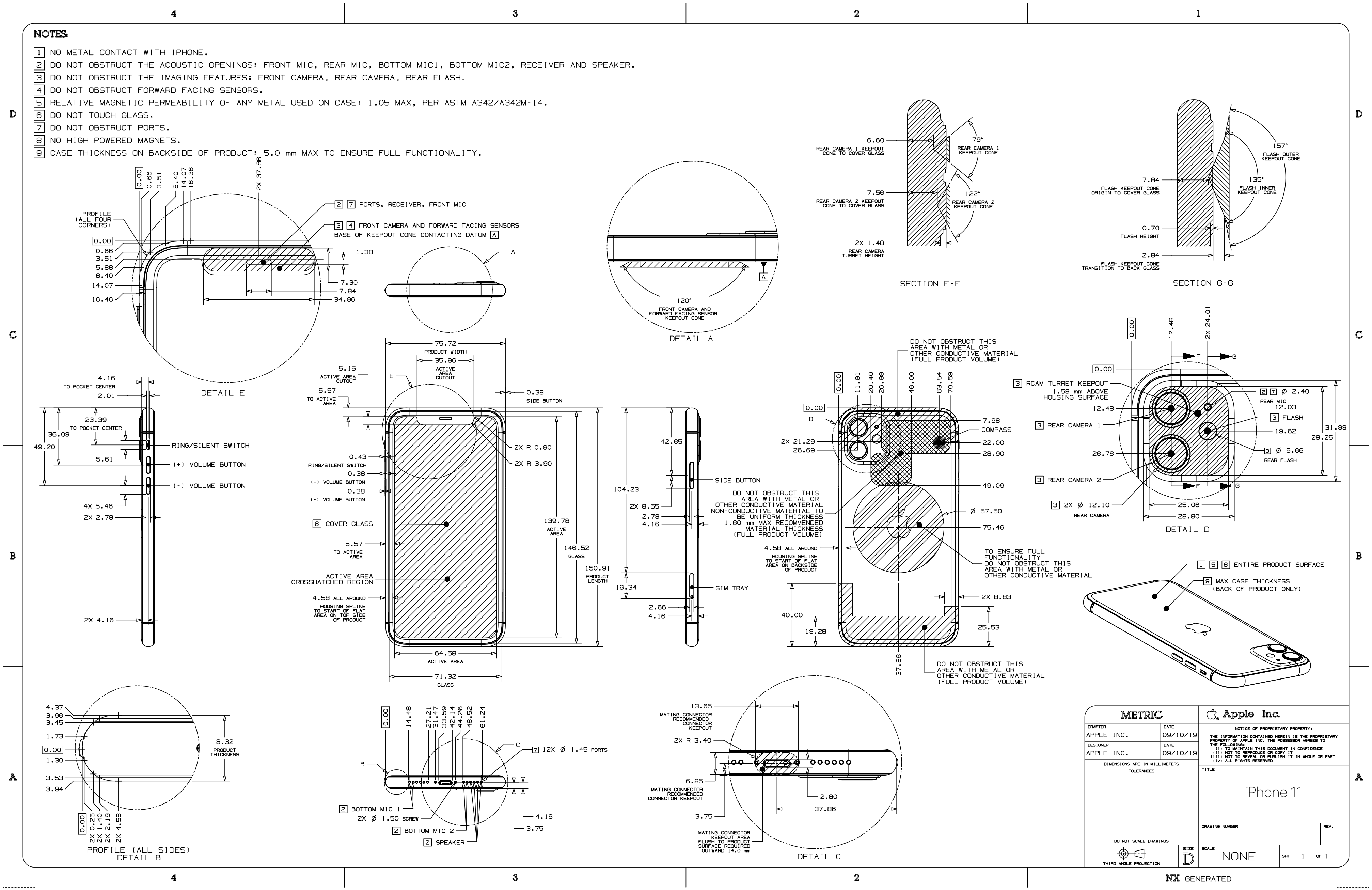




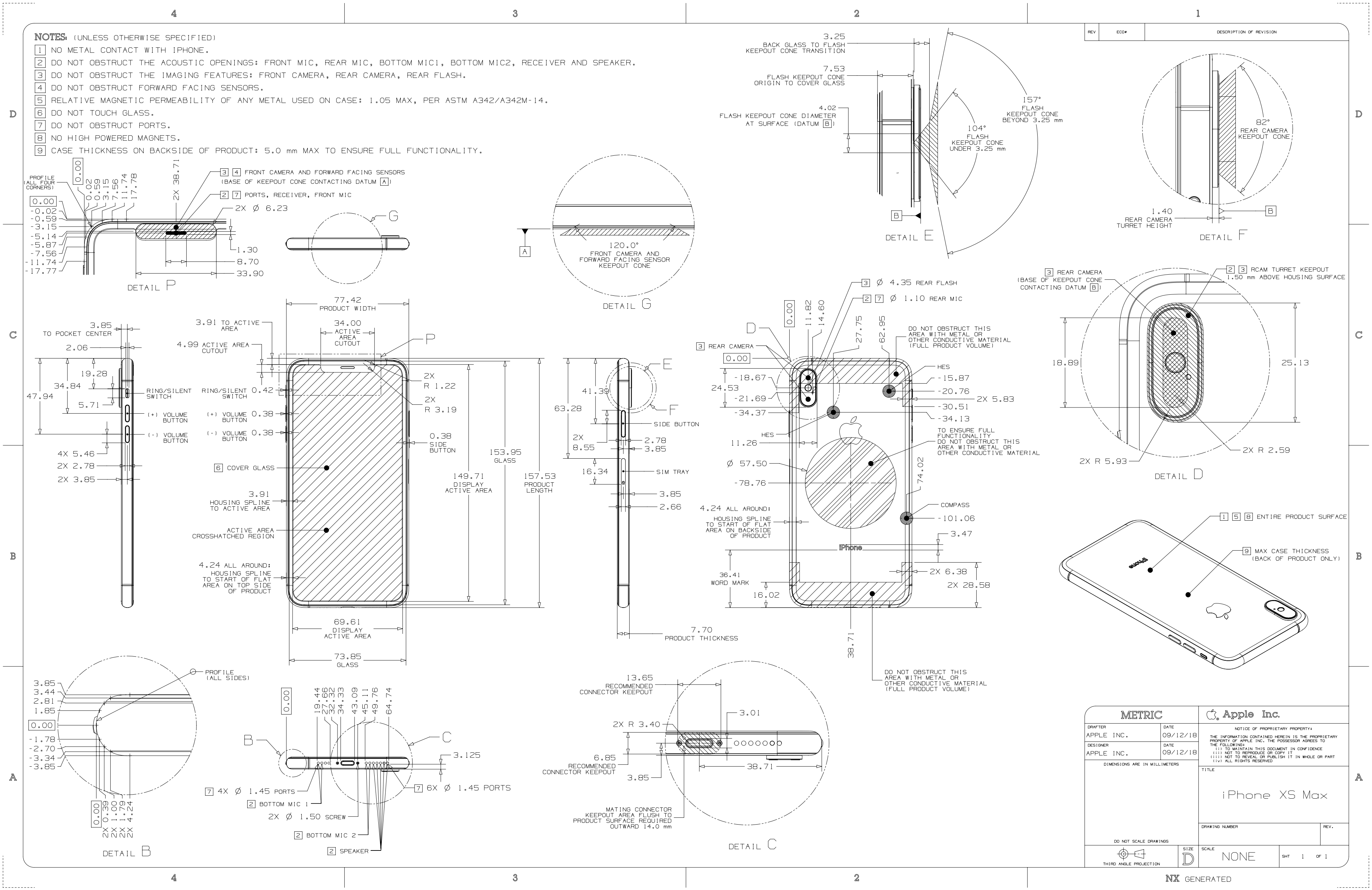
60.62 iPhone 11

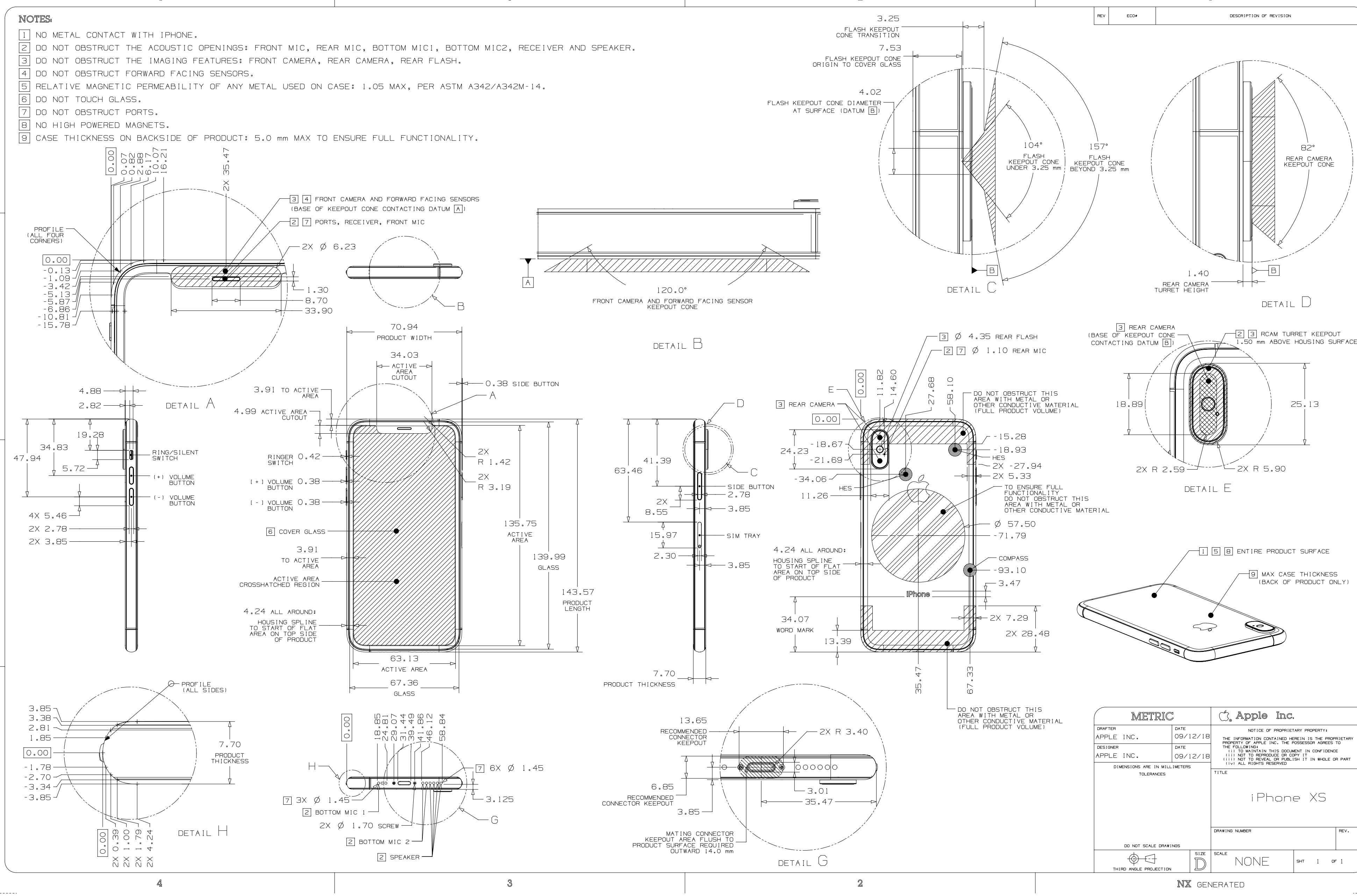
NOTES:

1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER AND SPEAKER.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. DO NOT OBSTRUCT PORTS.
8. NO HIGH POWERED MAGNETS.
9. CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.



60.63 iPhone XS Max



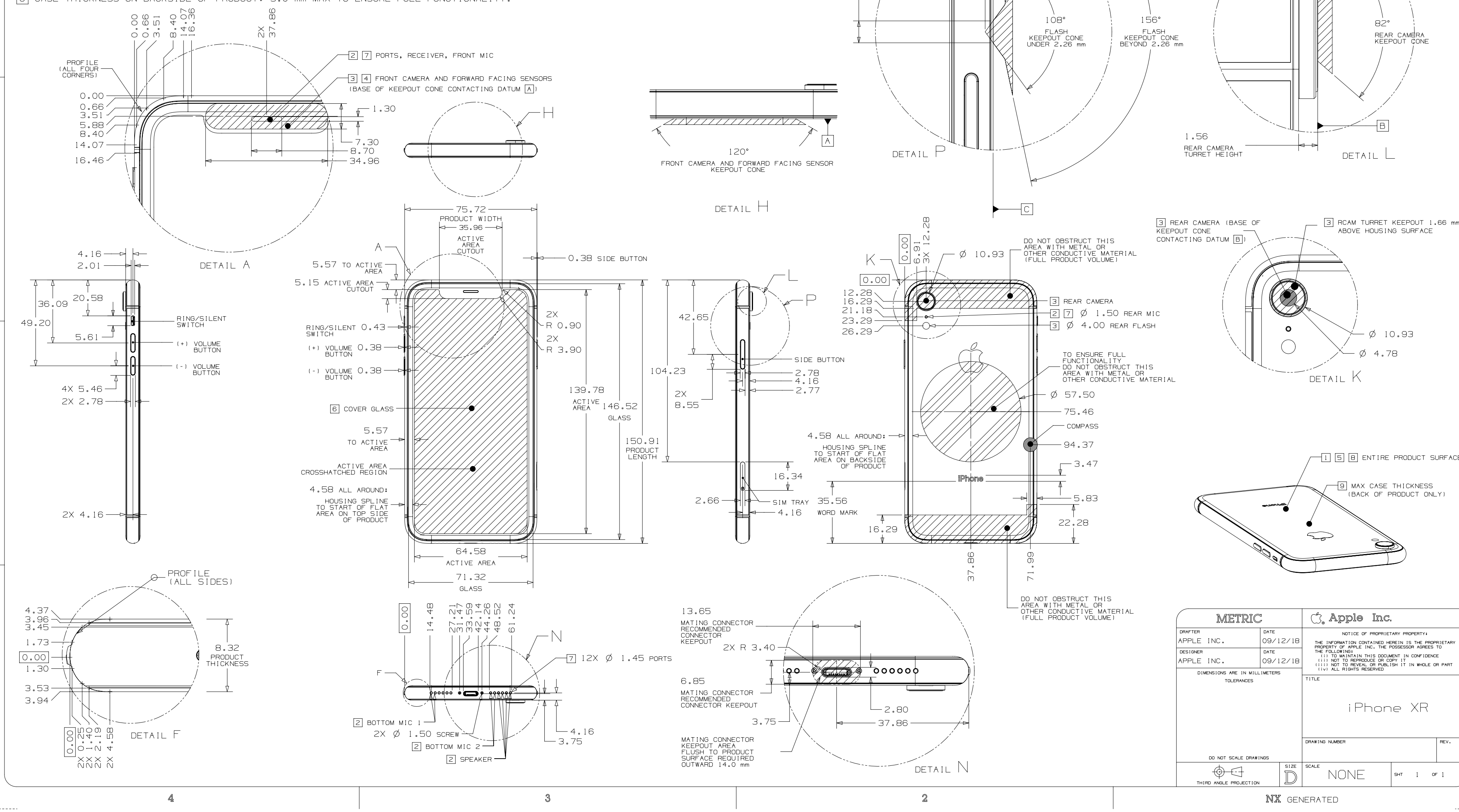


NOTES:
1 NO METAL CONTACT WITH IPHONE.
2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER AND SPEAKER.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6 DO NOT TOUCH GLASS.
7 DO NOT OBSTRUCT PORTS.
8 NO HIGH POWERED MAGNETS.
9 CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.
PROFILE (ALL FOUR CORNERS)
3 4 FRONT CAMERA AND FORWARD FACING SENSORS (BASE OF KEEPOUT CONE CONTACTING DATUM A)
2 7 PORTS, RECEIVER, FRONT MIC
2X Ø 6.23
2X 35.47
1.30
8.70
33.90
DETAIL A
120.0°
FRONT CAMERA AND FORWARD FACING SENSOR KEEPOUT CONE
DETAIL B
3.25
FLASH KEEPOUT CONE TRANSITION
7.53
FLASH KEEPOUT CONE ORIGIN TO COVER GLASS
4.02
FLASH KEEPOUT CONE DIAMETER AT SURFACE (DATUM B)
104°
FLASH KEEPOUT CONE UNDER 3.25 mm
157°
FLASH KEEPOUT CONE BEYOND 3.25 mm
DETAIL C
82°
REAR CAMERA KEEPOUT CONE
1.40
REAR CAMERA TURRET HEIGHT
DETAIL D
70.94
PRODUCT WIDTH
34.03
ACTIVE AREA CUTOUT
0.38 SIDE BUTTON
3.91 TO ACTIVE AREA
4.99 ACTIVE AREA CUTOUT
RINGER SWITCH 0.42
(+) VOLUME BUTTON 0.38
(-) VOLUME BUTTON 0.38
6 COVER GLASS
3.91 TO ACTIVE AREA
ACTIVE AREA CROSSHATCHED REGION
4.24 ALL AROUND: HOUSING SPLINE TO START OF FLAT AREA ON TOP SIDE OF PRODUCT
2X R 1.42
2X R 3.19
135.75 ACTIVE AREA
139.99 GLASS
143.57 PRODUCT LENGTH
63.13 ACTIVE AREA
67.36 GLASS
RING/SILENT SWITCH
(+) VOLUME BUTTON
(-) VOLUME BUTTON
SIDE BUTTON
SIM TRAY
7.70 PRODUCT THICKNESS
3 REAR CAMERA
3 Ø 4.35 REAR FLASH
2 7 Ø 1.10 REAR MIC
DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL (FULL PRODUCT VOLUME)
HES
TO ENSURE FULL FUNCTIONALITY DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL
Ø 57.50
COMPASS
34.07 WORD MARK
3 REAR CAMERA (BASE OF KEEPOUT CONE CONTACTING DATUM B)
2 3 RCAM TURRET KEEPOUT 1.50 mm ABOVE HOUSING SURFACE
2X R 2.59
2X R 5.90
DETAIL E
1 5 8 ENTIRE PRODUCT SURFACE
9 MAX CASE THICKNESS (BACK OF PRODUCT ONLY)
PROFILE (ALL SIDES)
7.70 PRODUCT THICKNESS
DETAIL H
7 3X Ø 1.45
2 BOTTOM MIC 1
2X Ø 1.70 SCREW
2 BOTTOM MIC 2
2 SPEAKER
7 6X Ø 1.45
3.125
13.65 RECOMMENDED CONNECTOR KEEPOUT
6.85 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE REQUIRED OUTWARD 14.0 mm
2X R 3.40
DETAIL G
METRIC
DRAFTER APPLE INC. DATE 09/12/18
DESIGNER APPLE INC. DATE 09/12/18
DIMENSIONS ARE IN MILLIMETERS
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
TITLE iPhone XS
SIZE D
SCALE NONE
SHT 1 OF 1
THIRD ANGLE PROJECTION
DO NOT SCALE DRAWINGS
NX GENERATED

60.65 iPhone XR

NOTES:

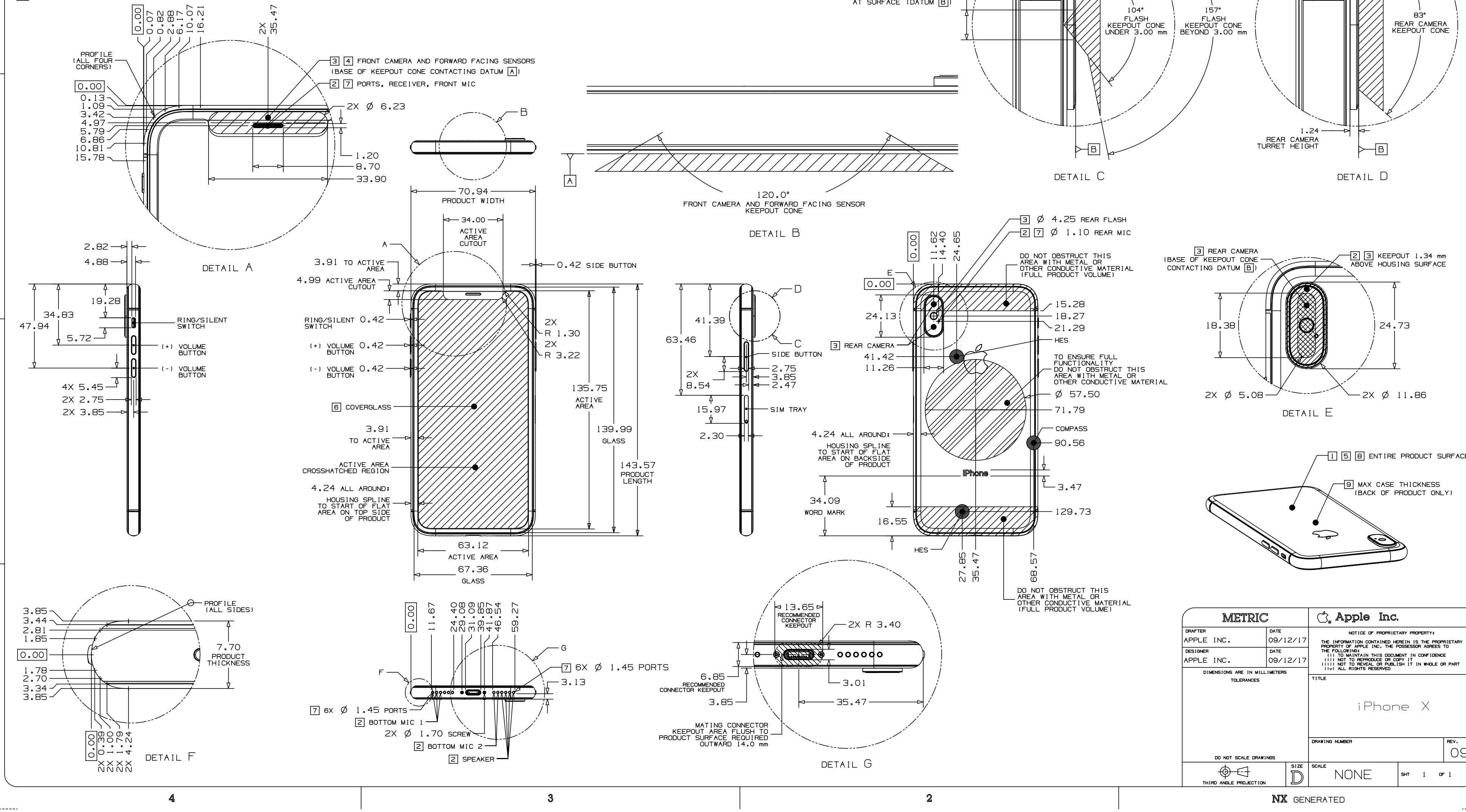
1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER AND SPEAKER.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE, 1.05 MAX, PER ASTM A342/A342M-14.
6. DO NOT TOUCH GLASS.
7. DO NOT OBSTRUCT PORTS.
8. NO HIGH POWERED MAGNETS.
9. CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.



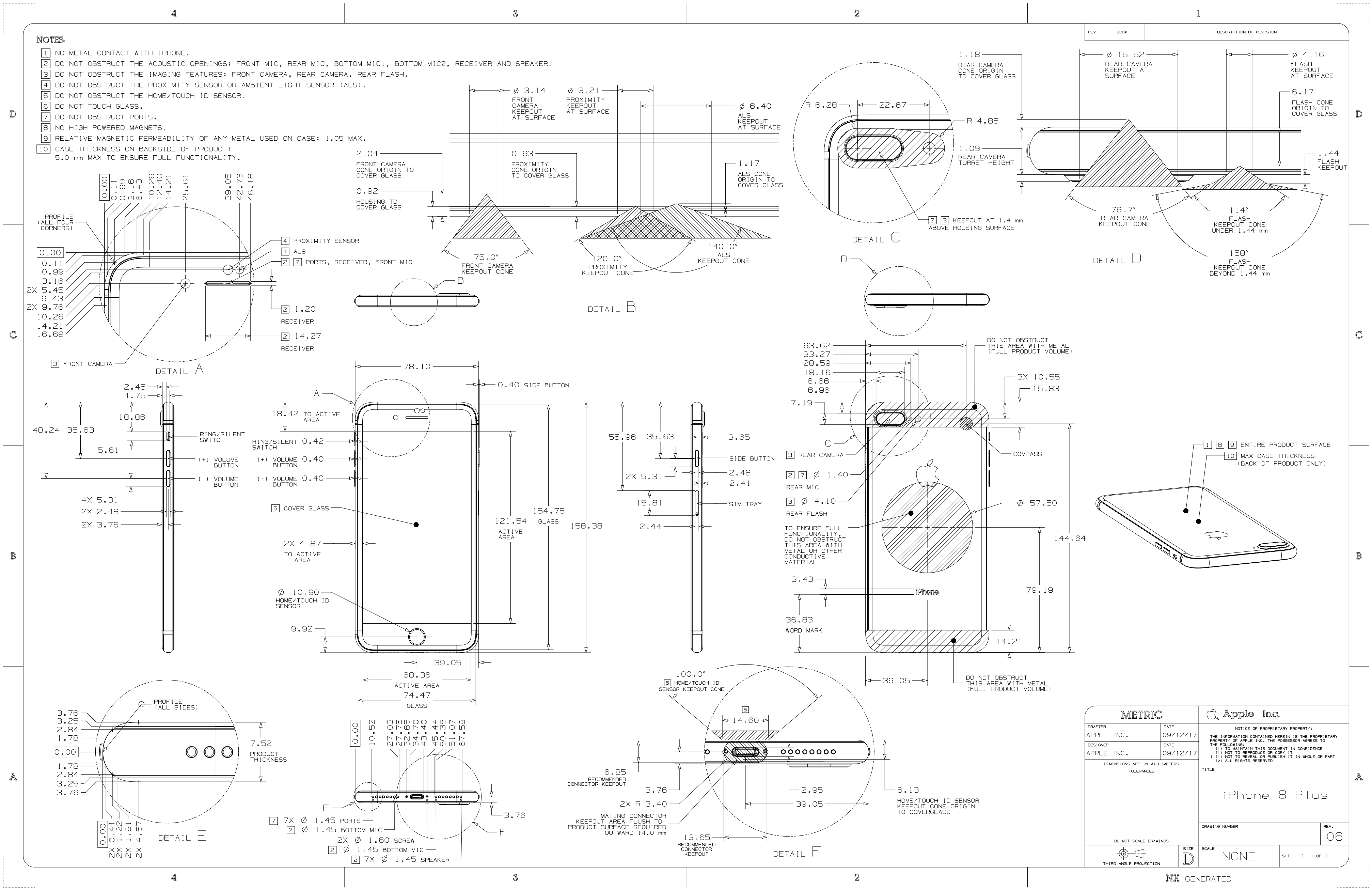
60.66 iPhone X

NOTES:

1. NO METAL CONTACT WITH IPHONE.
2. DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER AND SPEAKER.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
4. DO NOT OBSTRUCT FORWARD FACING SENSORS.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX.
6. DO NOT TOUCH GLASS.
7. DO NOT OBSTRUCT PORTS.
8. NO HIGH POWERED MAGNETS.
9. CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.



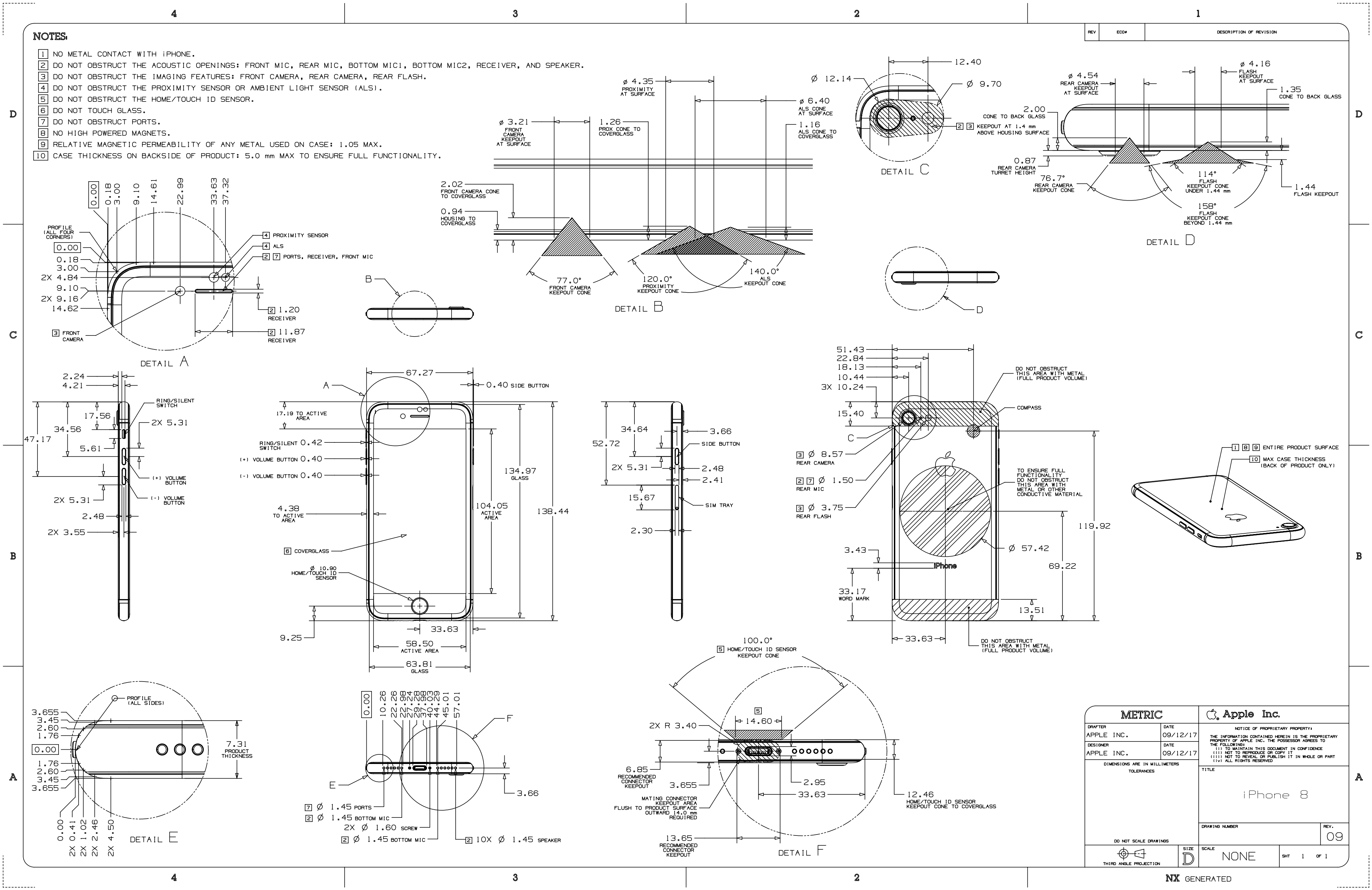
60.67 iPhone 8 Plus



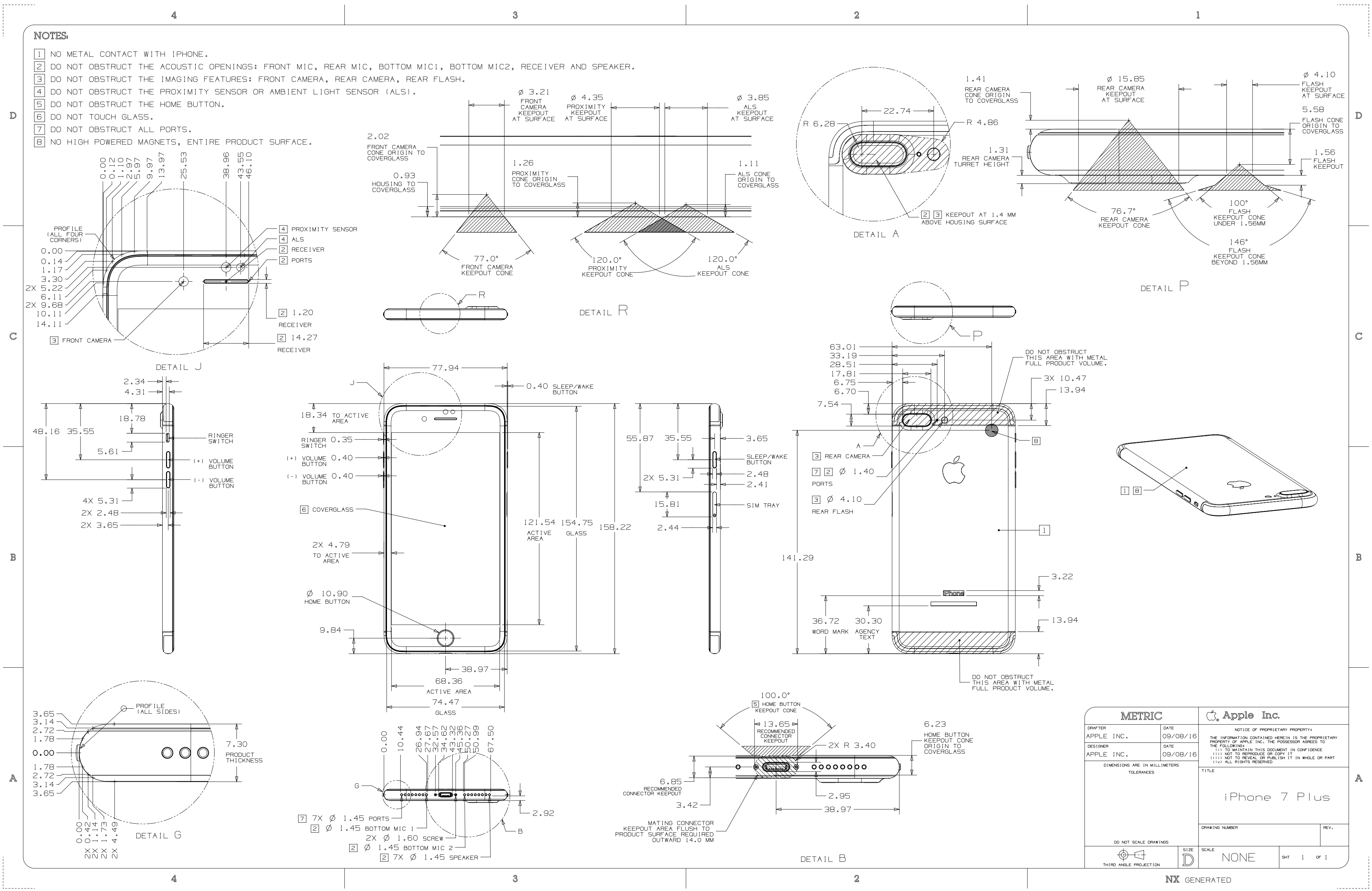
60.68 iPhone 8

NOTES:

1. NO METAL CONTACT WITH iPHONE.
2. DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER, AND SPEAKER.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
4. DO NOT OBSTRUCT THE PROXIMITY SENSOR OR AMBIENT LIGHT SENSOR (ALS).
5. DO NOT OBSTRUCT THE HOME/TOUCH ID SENSOR.
6. DO NOT TOUCH GLASS.
7. DO NOT OBSTRUCT PORTS.
8. NO HIGH POWERED MAGNETS.
9. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX.
10. CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.

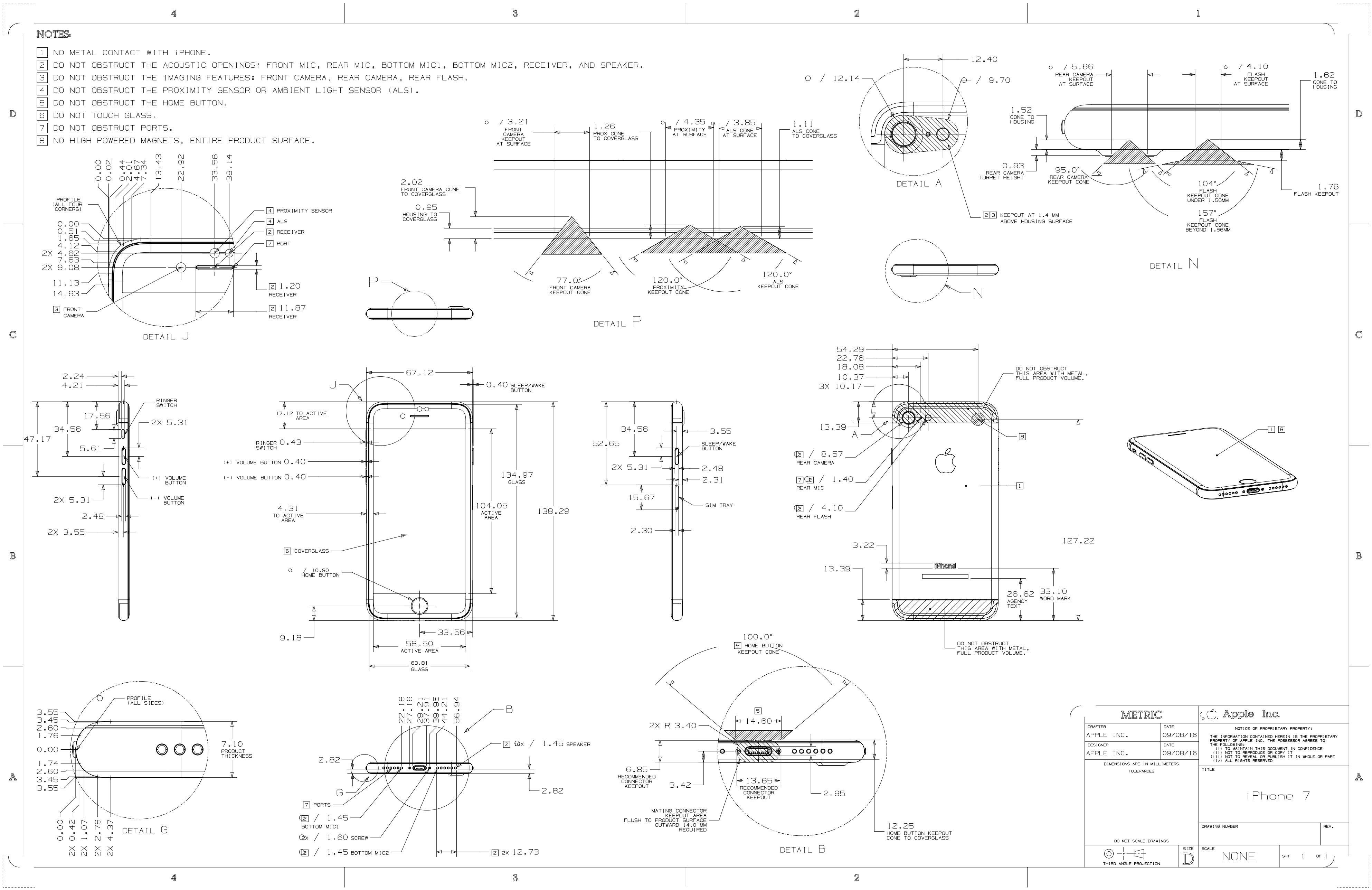


60.69 iPhone 7 Plus

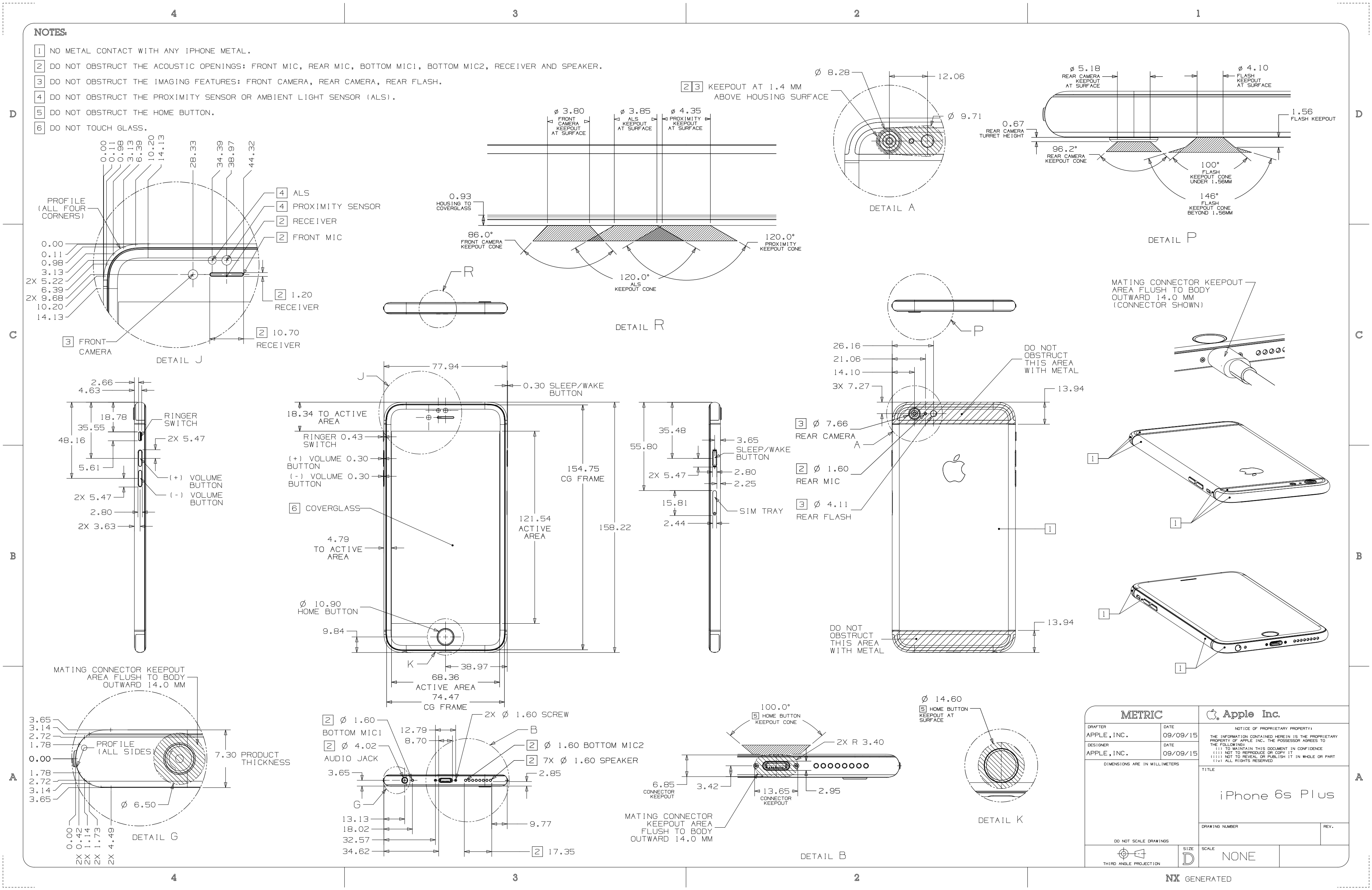


NOTES:

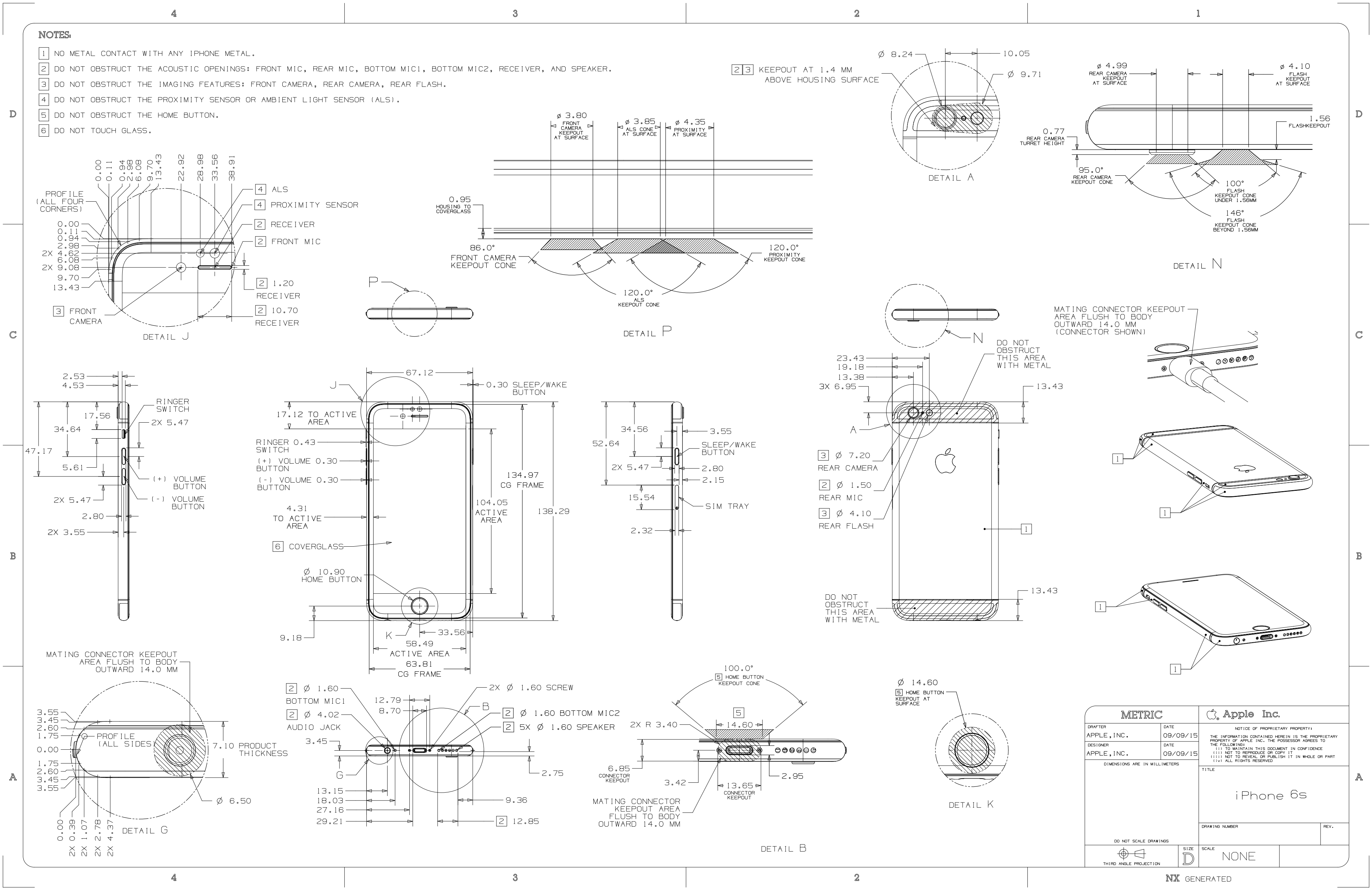
1. NO METAL CONTACT WITH iPHONE.
2. DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER, AND SPEAKER.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
4. DO NOT OBSTRUCT THE PROXIMITY SENSOR OR AMBIENT LIGHT SENSOR (ALS).
5. DO NOT OBSTRUCT THE HOME BUTTON.
6. DO NOT TOUCH GLASS.
7. DO NOT OBSTRUCT PORTS.
8. NO HIGH POWERED MAGNETS, ENTIRE PRODUCT SURFACE.



60.71 iPhone 6s Plus



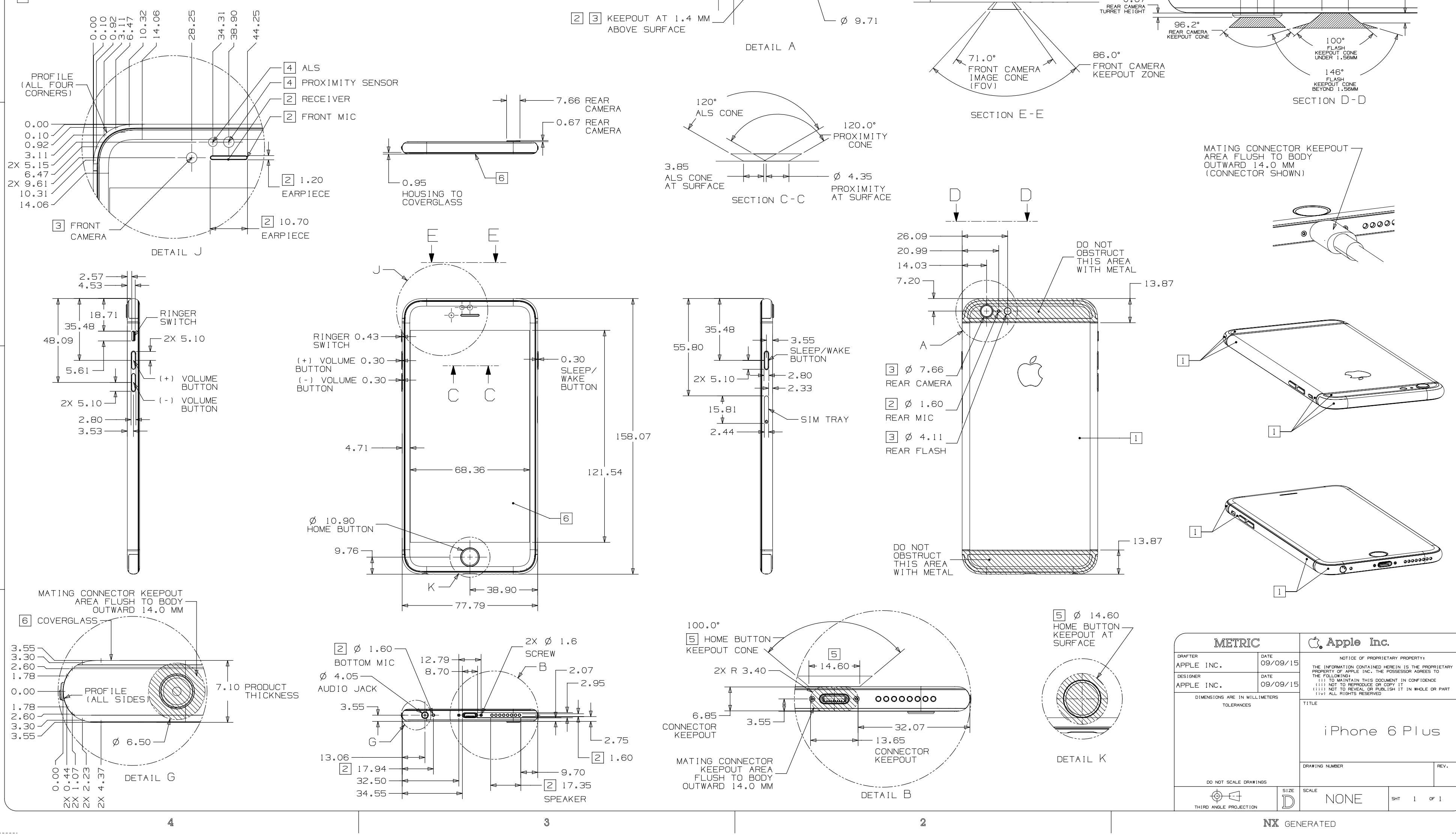
60.72 iPhone 6s



60.73 iPhone 6 Plus

NOTES:

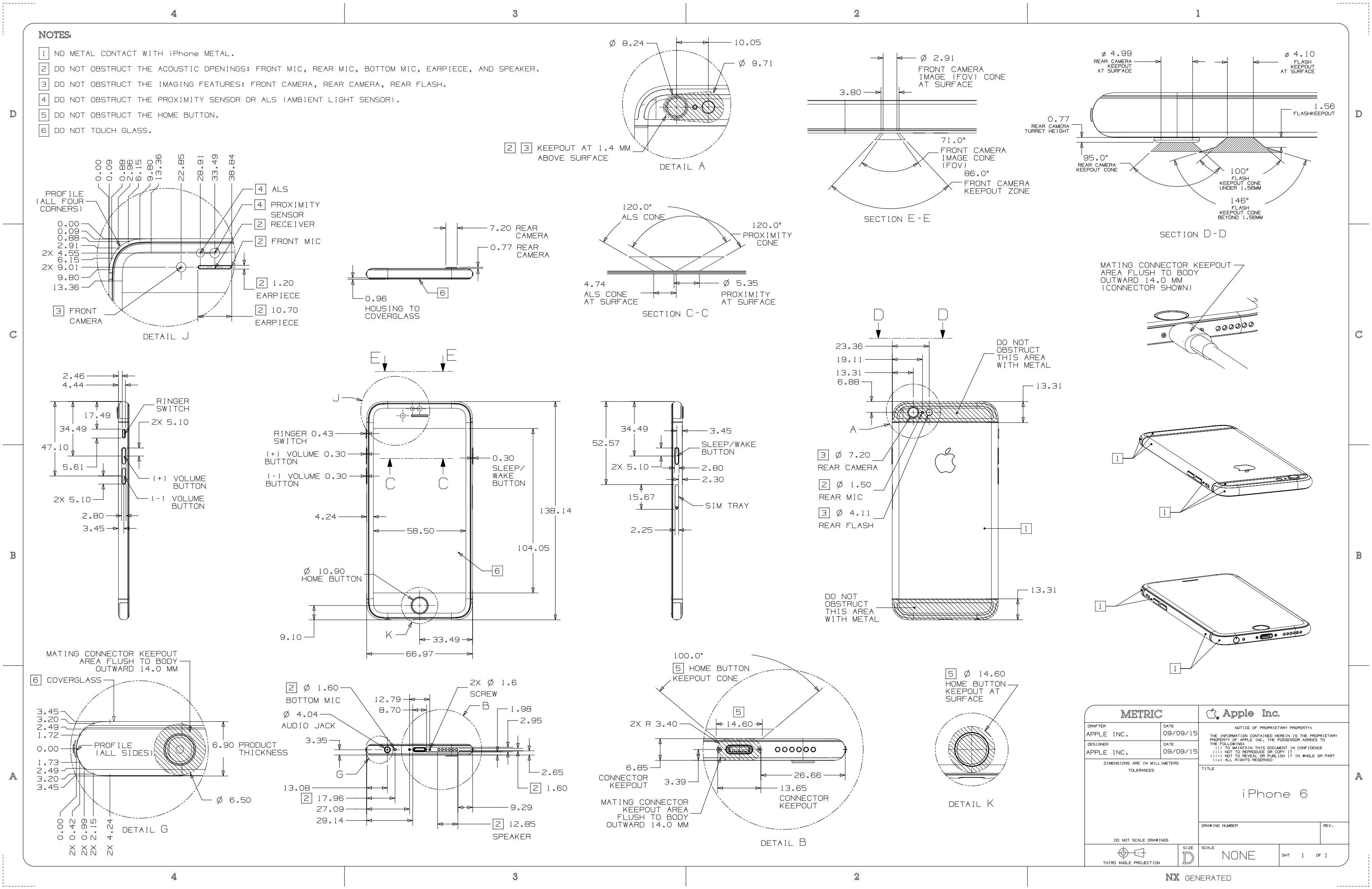
1. NO METAL CONTACT WITH iPhone METAL.
2. DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC, EARPIECE, AND SPEAKER.
3. DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
4. DO NOT OBSTRUCT THE PROXIMITY SENSOR OR ALS (AMBIENT LIGHT SENSOR).
5. DO NOT OBSTRUCT THE HOME BUTTON.
6. DO NOT TOUCH GLASS.



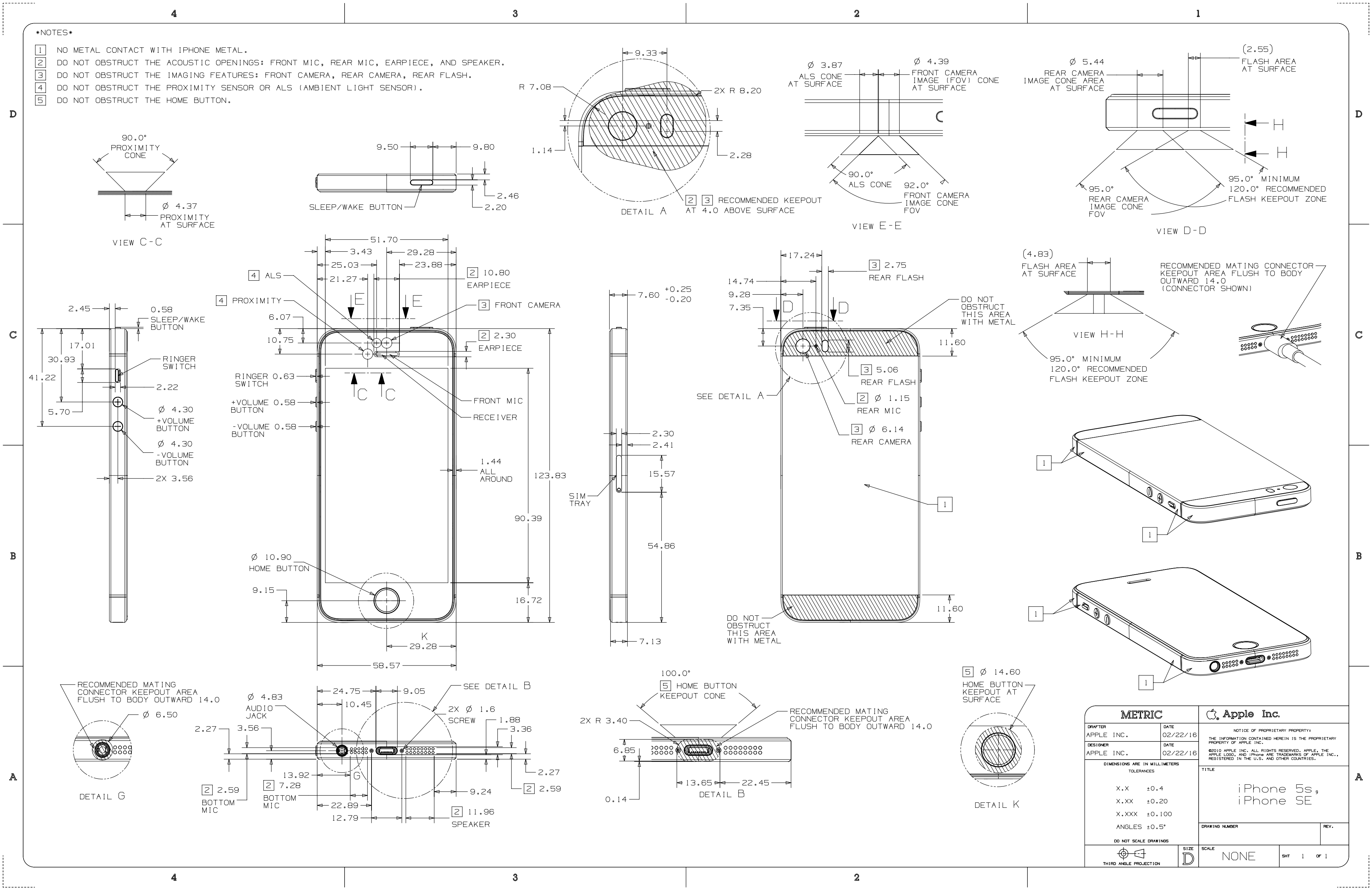
METRIC	Apple Inc.
DRAFTER: APPLE INC. DATE: 09/09/15	NOTICE OF PROPRIETARY PROPERTY: THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING: I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE II) NOT TO REPRODUCE OR COPY IT III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART IV) ALL RIGHTS RESERVED
DESIGNER: APPLE INC. DATE: 09/09/15	TITLE: iPhone 6 Plus
DIMENSIONS ARE IN MILLIMETERS TOLERANCES	DRAWING NUMBER / REV.
DO NOT SCALE DRAWINGS; THIRD ANGLE PROJECTION; SIZE D	SCALE NONE; SHT 1 OF 1

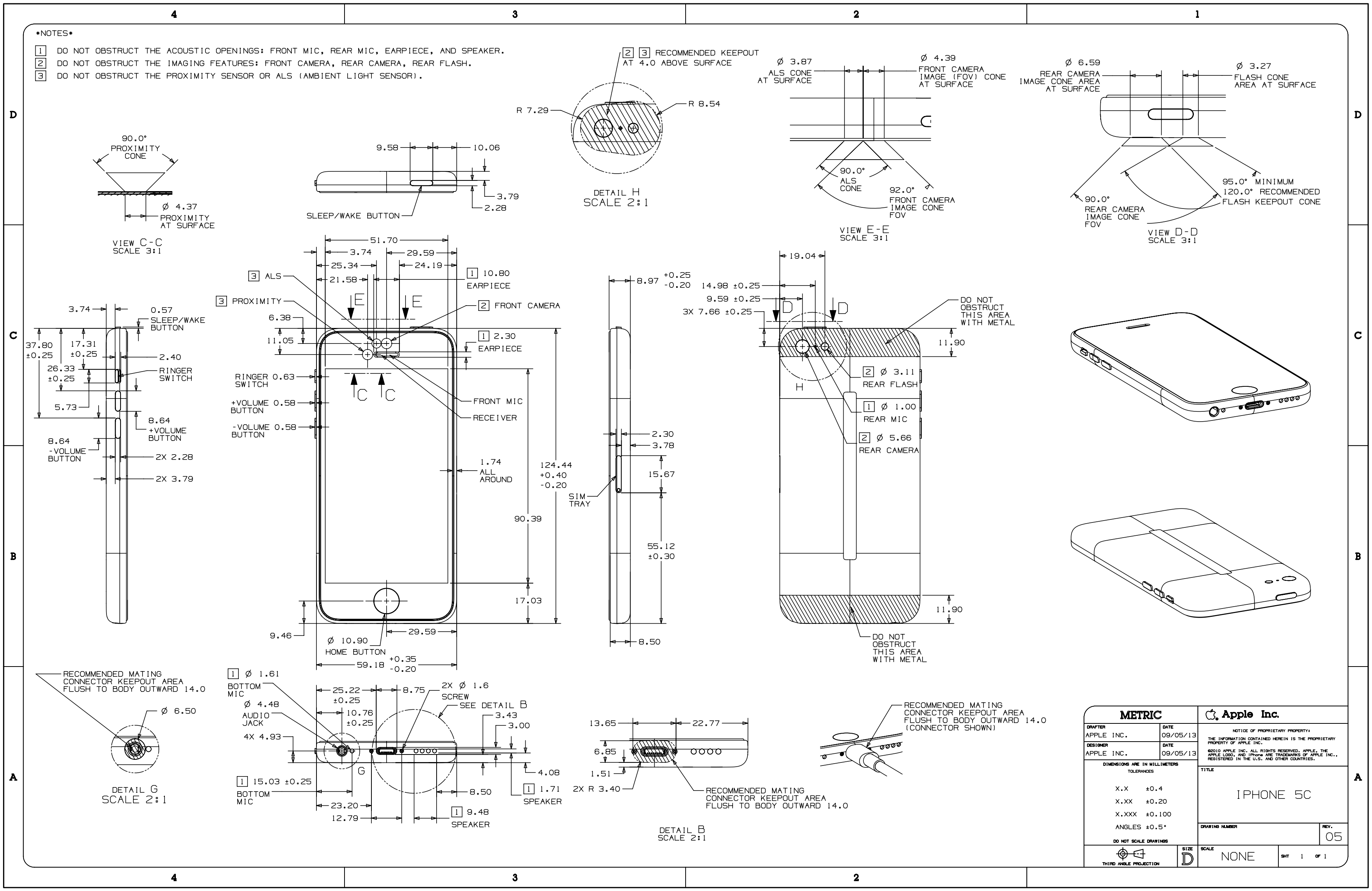
NX GENERATED

60.74 iPhone 6



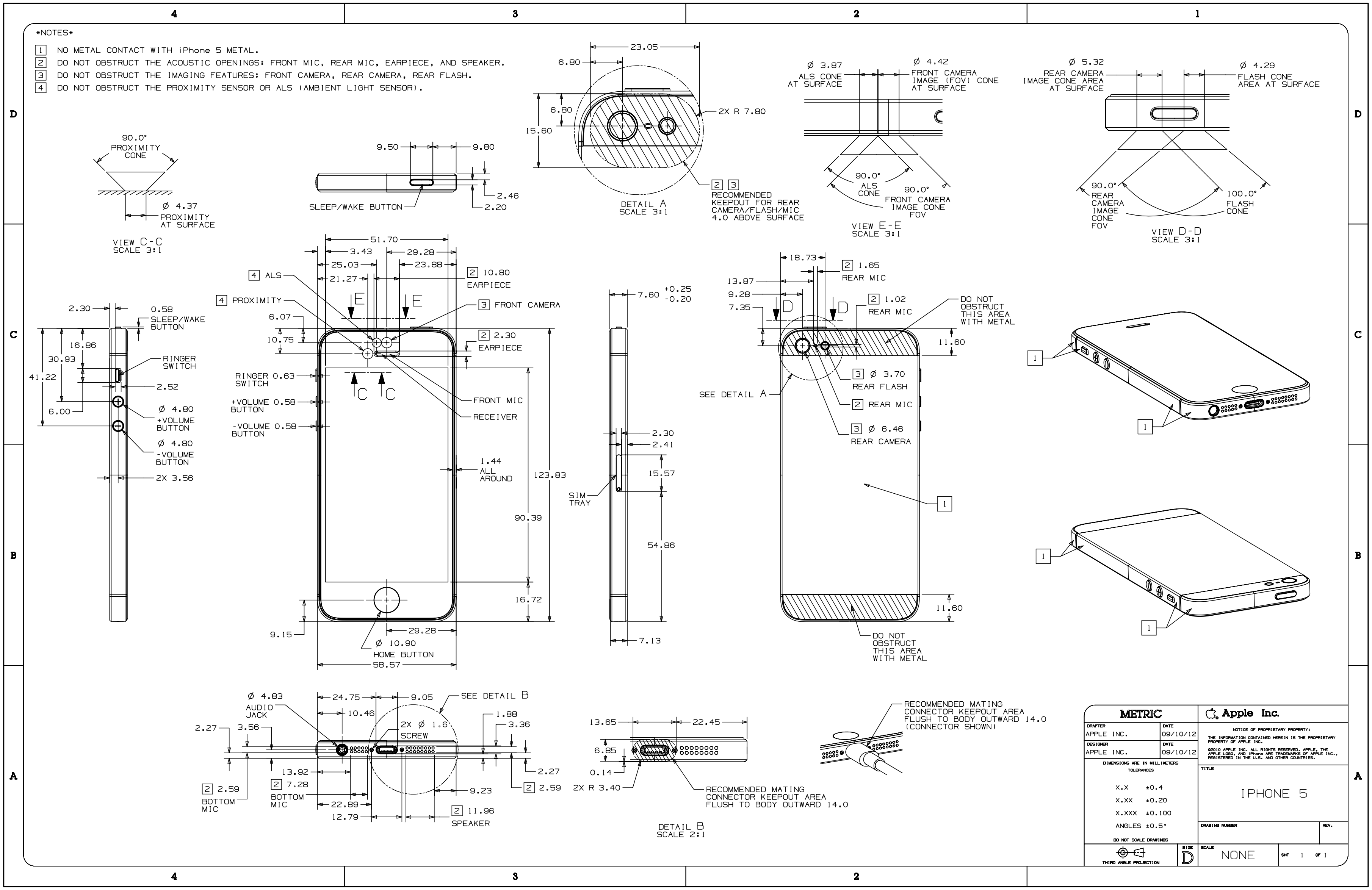
60.75 iPhone SE and iPhone 5s

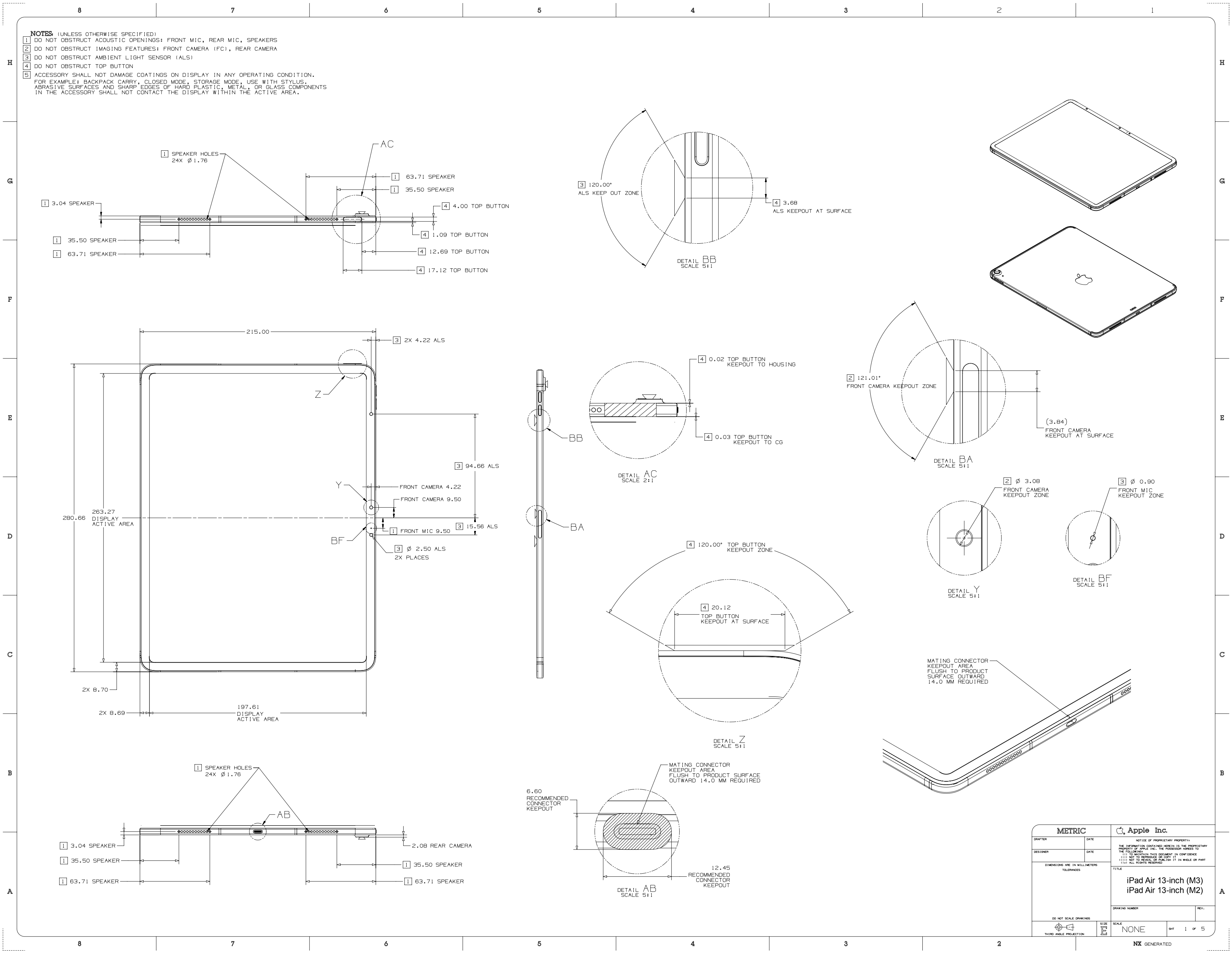




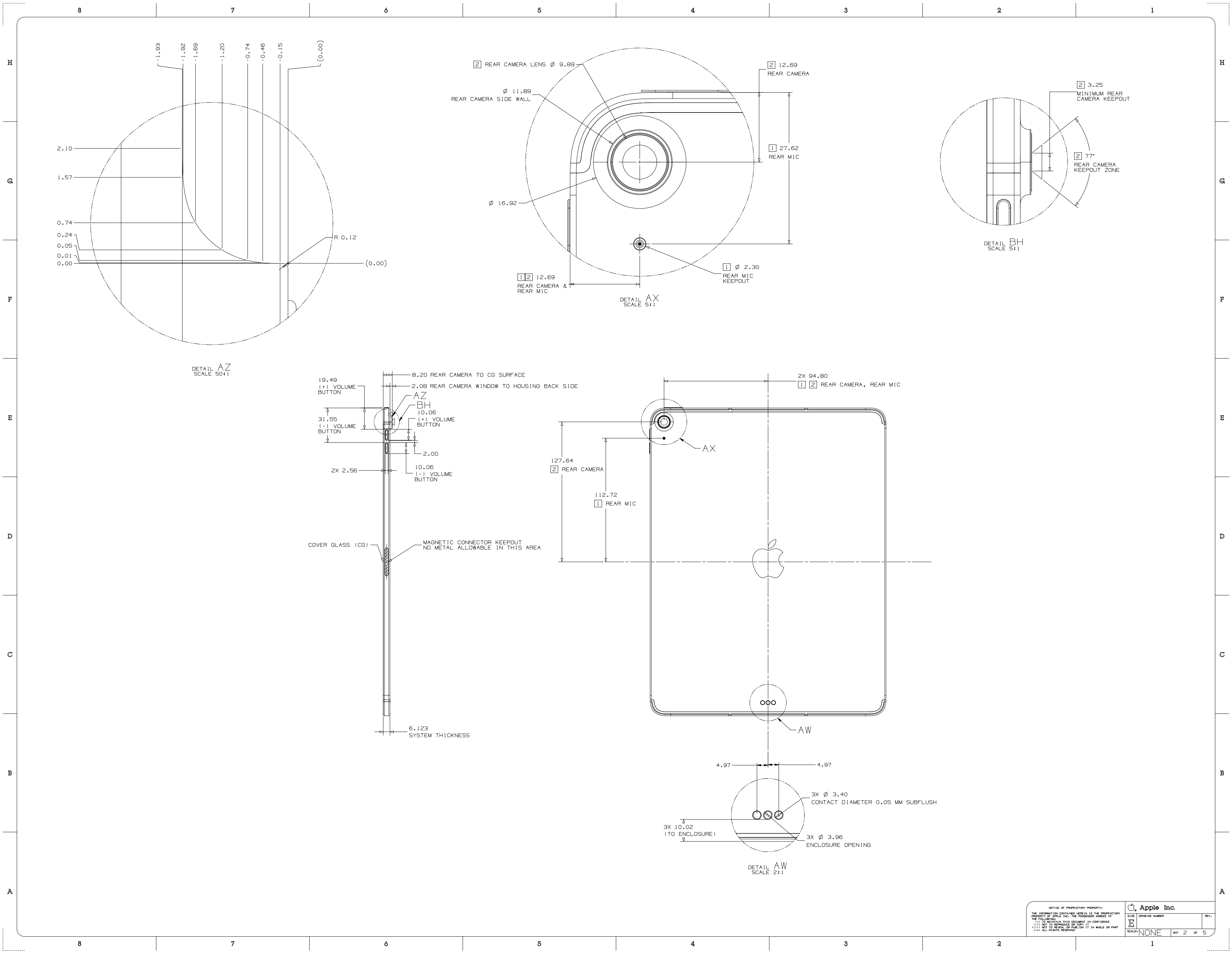
•NOTES•
1 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, EARPIECE, AND SPEAKER.
2 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
3 DO NOT OBSTRUCT THE PROXIMITY SENSOR OR ALS (AMBIENT LIGHT SENSOR).
90.0° PROXIMITY CONE
Ø 4.37 PROXIMITY AT SURFACE
VIEW C-C SCALE 3:1
SLEEP/WAKE BUTTON
DETAIL H SCALE 2:1
2 3 RECOMMENDED KEEPOUT AT 4.0 ABOVE SURFACE
R 7.29
R 8.54
Ø 3.87 ALS CONE AT SURFACE
Ø 4.39 FRONT CAMERA IMAGE (FOV) CONE AT SURFACE
90.0° ALS CONE
92.0° FRONT CAMERA IMAGE CONE FOV
VIEW E-E SCALE 3:1
Ø 6.59 REAR CAMERA IMAGE CONE AREA AT SURFACE
Ø 3.27 FLASH CONE AREA AT SURFACE
90.0° REAR CAMERA IMAGE CONE FOV
95.0° MINIMUM 120.0° RECOMMENDED FLASH KEEPOUT CONE
VIEW D-D SCALE 3:1
3 ALS
3 PROXIMITY
1 10.80 EARPIECE
2 FRONT CAMERA
1 2.30 EARPIECE
RINGER 0.63 SWITCH
+VOLUME 0.58 BUTTON
-VOLUME 0.58 BUTTON
FRONT MIC
RECEIVER
1.74 ALL AROUND
124.44 +0.40 -0.20
Ø 10.90 HOME BUTTON
59.18 +0.35 -0.20
SLEEP/WAKE BUTTON
RINGER SWITCH
+VOLUME BUTTON
-VOLUME BUTTON
SIM TRAY
DO NOT OBSTRUCT THIS AREA WITH METAL
2 Ø 3.11 REAR FLASH
1 Ø 1.00 REAR MIC
2 Ø 5.66 REAR CAMERA
RECOMMENDED MATING CONNECTOR KEEPOUT AREA FLUSH TO BODY OUTWARD 14.0
Ø 6.50
DETAIL G SCALE 2:1
1 Ø 1.61 BOTTOM MIC
Ø 4.48 AUDIO JACK
4X 4.93
2X Ø 1.6 SCREW
SEE DETAIL B
1 15.03 ±0.25 BOTTOM MIC
1 9.48 SPEAKER
1 1.71 SPEAKER
2X R 3.40
DETAIL B SCALE 2:1
RECOMMENDED MATING CONNECTOR KEEPOUT AREA FLUSH TO BODY OUTWARD 14.0 (CONNECTOR SHOWN)
METRIC
Apple Inc.
DRAFTER APPLE INC. DATE 09/05/13
DESIGNER APPLE INC. DATE 09/05/13
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
X.X ±0.4
X.XX ±0.20
X.XXX ±0.100
ANGLES ±0.5°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
TITLE IPHONE 5C
REV. 05
SIZE D
SCALE NONE
SHT 1 OF 1

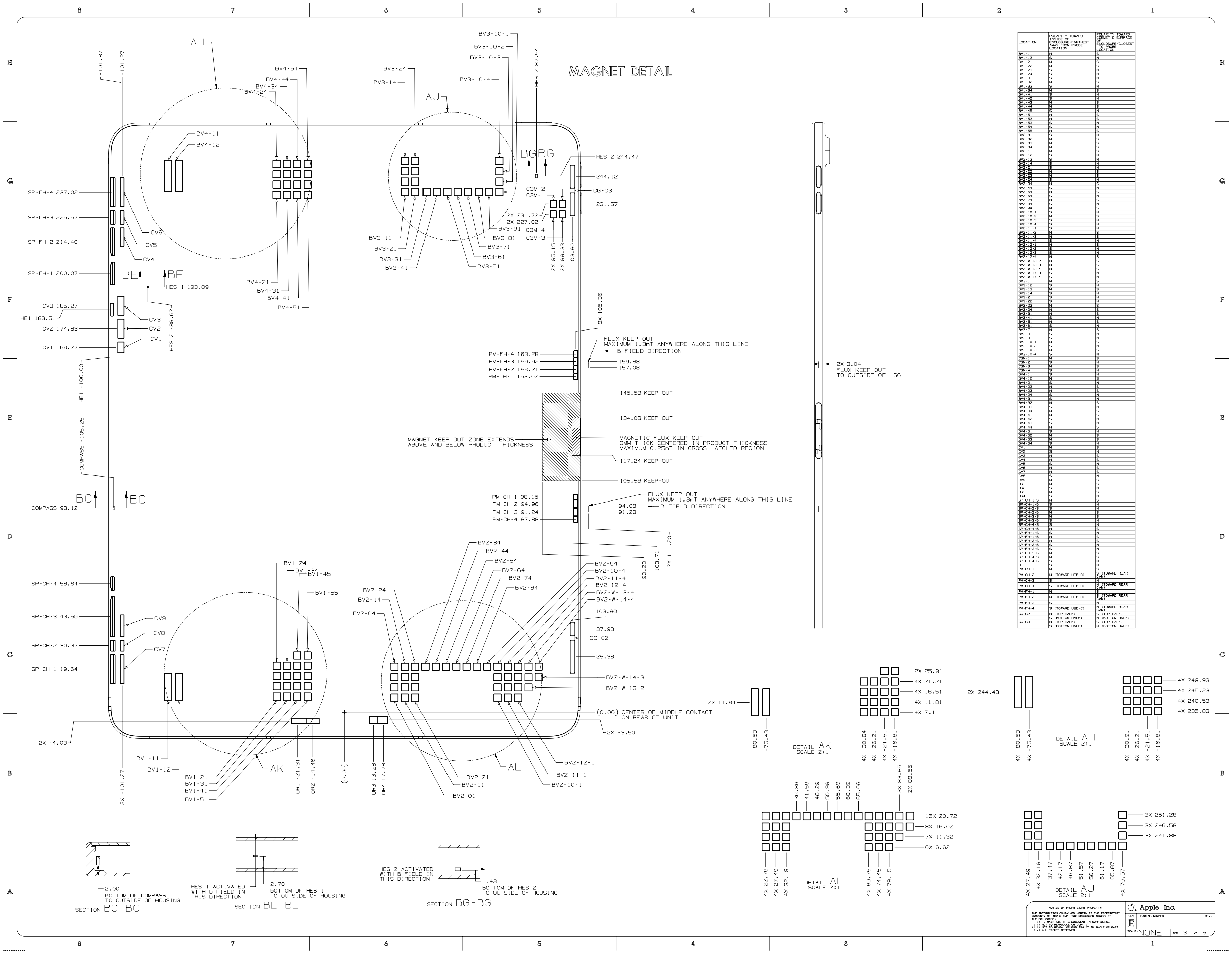
60.77 iPhone 5



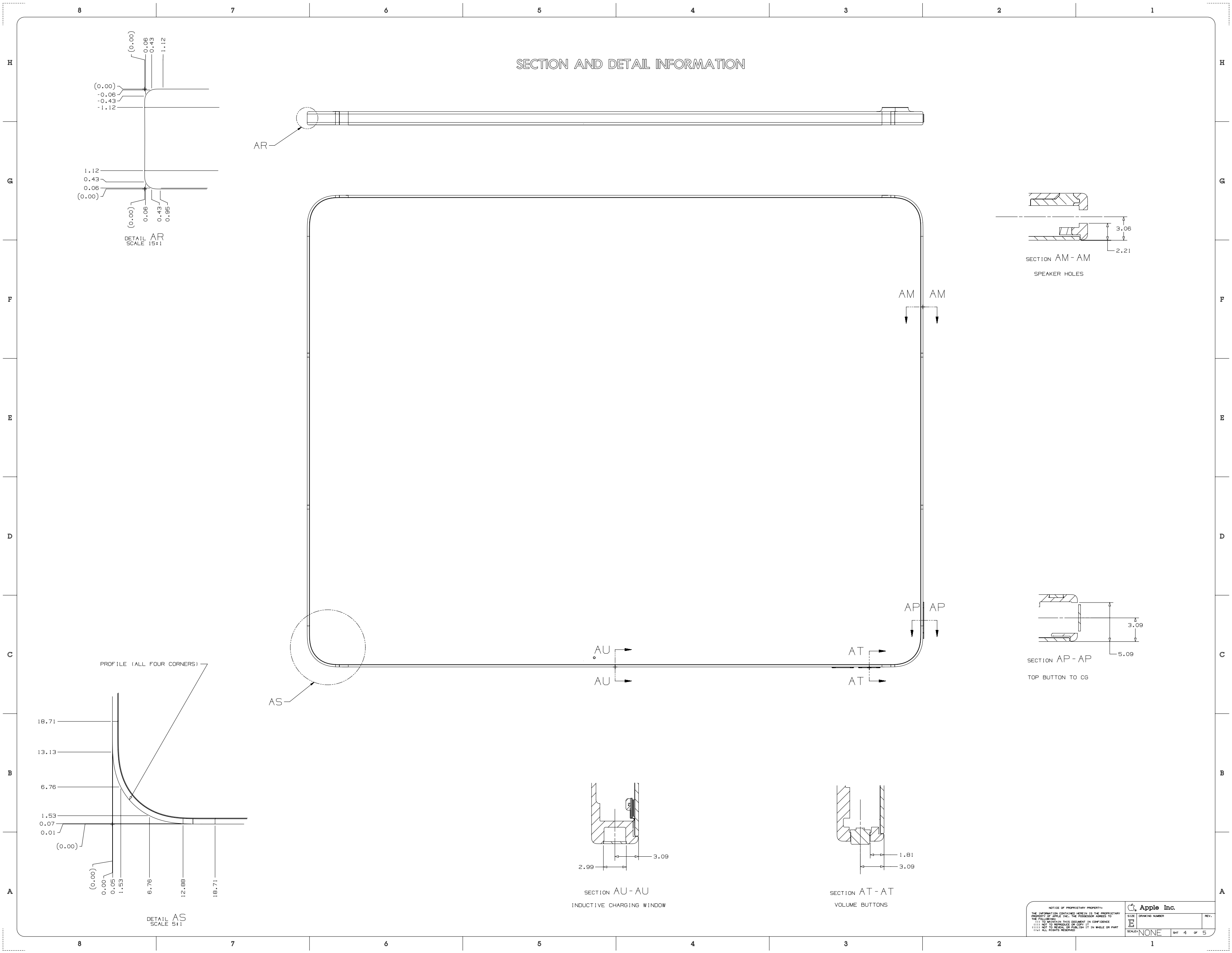

NOTES: (UNLESS OTHERWISE SPECIFIED)
1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT IMAGING FEATURES: FRONT CAMERA (FC), REAR CAMERA
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
4 DO NOT OBSTRUCT TOP BUTTON
5 ACCESSORY SHALL NOT DAMAGE COATINGS ON DISPLAY IN ANY OPERATING CONDITION. FOR EXAMPLE: BACKPACK CARRY, CLOSED MODE, STORAGE MODE, USE WITH STYLUS. ABRASIVE SURFACES AND SHARP EDGES OF HARD PLASTIC, METAL, OR GLASS COMPONENTS IN THE ACCESSORY SHALL NOT CONTACT THE DISPLAY WITHIN THE ACTIVE AREA.
1 SPEAKER HOLES 24X Ø1.76
AC
1 63.71 SPEAKER
1 35.50 SPEAKER
1 3.04 SPEAKER
4 4.00 TOP BUTTON
4 1.09 TOP BUTTON
4 12.69 TOP BUTTON
4 17.12 TOP BUTTON
3 120.00° ALS KEEP OUT ZONE
4 3.68 ALS KEEPOUT AT SURFACE
DETAIL BB SCALE 5:1
215.00
3 2X 4.22 ALS
Z
3 94.66 ALS
Y
FRONT CAMERA 4.22
FRONT CAMERA 9.50
280.66
263.27 DISPLAY ACTIVE AREA
1 FRONT MIC 9.50
3 15.56 ALS
BF
3 Ø 2.50 ALS 2X PLACES
2X 8.70
2X 8.69
197.61 DISPLAY ACTIVE AREA
BB
BA
4 0.02 TOP BUTTON KEEPOUT TO HOUSING
4 0.03 TOP BUTTON KEEPOUT TO CG
DETAIL AC SCALE 2:1
2 121.01° FRONT CAMERA KEEPOUT ZONE
(3.84) FRONT CAMERA KEEPOUT AT SURFACE
DETAIL BA SCALE 5:1
2 Ø 3.08 FRONT CAMERA KEEPOUT ZONE
3 Ø 0.90 FRONT MIC KEEPOUT ZONE
DETAIL Y SCALE 5:1
DETAIL BF SCALE 5:1
4 120.00° TOP BUTTON KEEPOUT ZONE
4 20.12 TOP BUTTON KEEPOUT AT SURFACE
DETAIL Z SCALE 5:1
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE OUTWARD 14.0 MM REQUIRED
1 SPEAKER HOLES 24X Ø1.76
AB
1 3.04 SPEAKER
1 35.50 SPEAKER
1 63.71 SPEAKER
2.08 REAR CAMERA
6.60 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE OUTWARD 14.0 MM REQUIRED
12.45 RECOMMENDED CONNECTOR KEEPOUT
DETAIL AB SCALE 5:1
METRIC
Apple Inc.
iPad Air 13-inch (M3)
iPad Air 13-inch (M2)
NONE
1 of 5
E
NX GENERATED

60.79 iPad Air 13-inch (M3) and iPad Air 13-inch (M2), 2 of 5

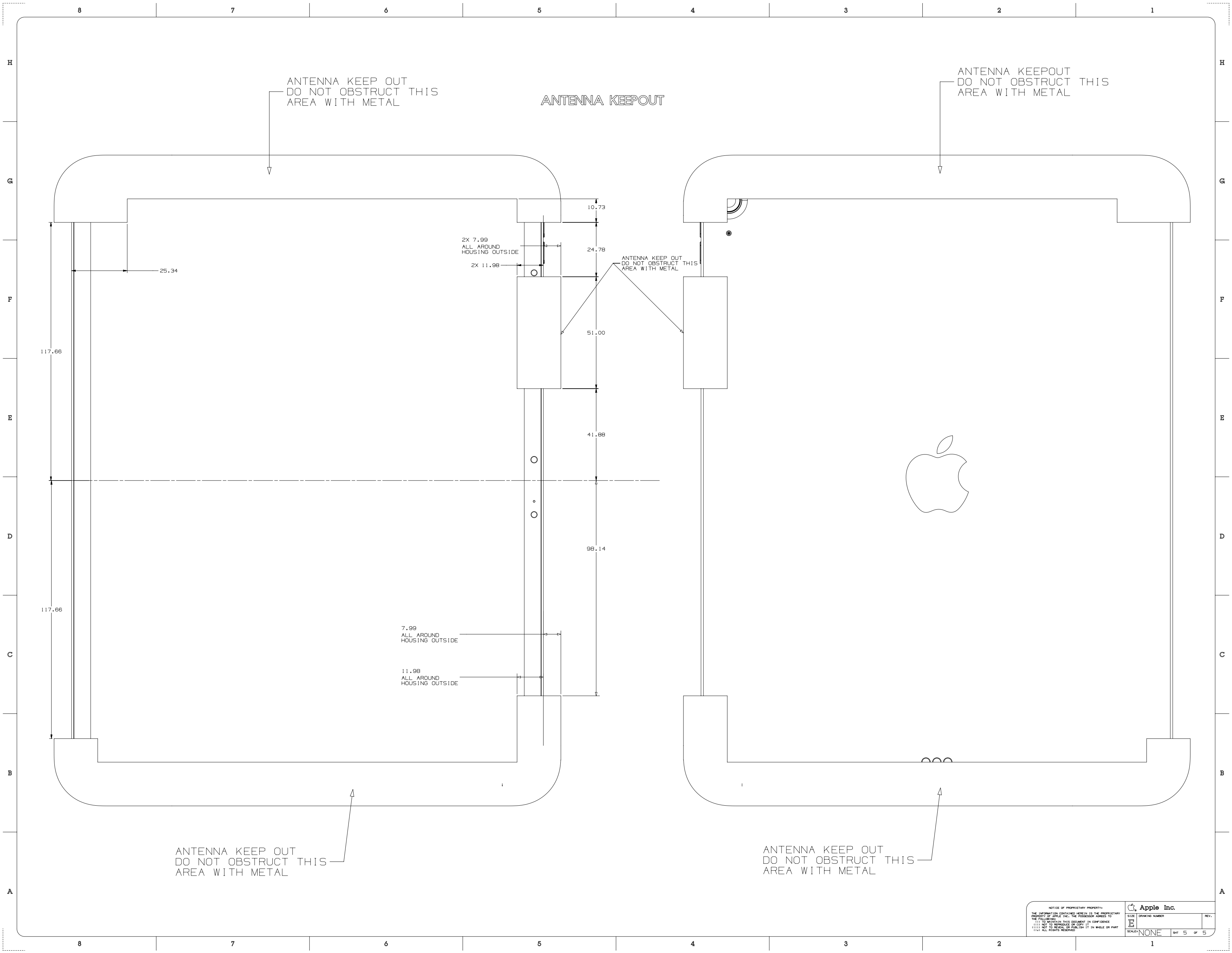



MAGNET DETAIL
AH
AJ
AK
AL
BC
BE
BG
SP-FH-4 237.02
SP-FH-3 225.57
SP-FH-2 214.40
SP-FH-1 200.07
CV3 185.27
HE1 183.51
CV2 174.83
CV1 166.27
HE1 -106.00
COMPASS -105.25
COMPASS 93.12
SP-CH-4 58.64
SP-CH-3 43.59
SP-CH-2 30.37
SP-CH-1 19.64
2X -4.03
3X -101.27
-101.87
-101.27
HES 1 193.89
HES 2 -89.62
HES 2 87.54
HES 2 244.47
244.12
CG-C3
231.57
2X 231.72
2X 227.02
2X 95.15
2X 99.33
103.80
8X 105.36
FLUX KEEP-OUT
MAXIMUM 1.3mT ANYWHERE ALONG THIS LINE
B FIELD DIRECTION
PM-FH-4 163.28
PM-FH-3 159.92
PM-FH-2 156.21
PM-FH-1 153.02
159.88
157.08
145.58 KEEP-OUT
134.08 KEEP-OUT
MAGNET KEEP OUT ZONE EXTENDS ABOVE AND BELOW PRODUCT THICKNESS
MAGNETIC FLUX KEEP-OUT
3MM THICK CENTERED IN PRODUCT THICKNESS
MAXIMUM 0.25mT IN CROSS-HATCHED REGION
117.24 KEEP-OUT
105.58 KEEP-OUT
PM-CH-1 98.15
PM-CH-2 94.96
PM-CH-3 91.24
PM-CH-4 87.88
94.08
91.28
90.23
103.71
2X 111.20
37.93
CG-C2
25.38
(0.00) CENTER OF MIDDLE CONTACT ON REAR OF UNIT
2X -3.50
OR1 -21.31
OR2 -14.46
(0.00)
OR3 13.28
OR4 17.78
2X 3.04
FLUX KEEP-OUT
TO OUTSIDE OF HSG
2.00
BOTTOM OF COMPASS TO OUTSIDE OF HOUSING
SECTION BC-BC
HES 1 ACTIVATED WITH B FIELD IN THIS DIRECTION
2.70
BOTTOM OF HES 1 TO OUTSIDE OF HOUSING
SECTION BE-BE
HES 2 ACTIVATED WITH B FIELD IN THIS DIRECTION
1.43
BOTTOM OF HES 2 TO OUTSIDE OF HOUSING
SECTION BG-BG
DETAIL AK SCALE 2:1
DETAIL AH SCALE 2:1
DETAIL AL SCALE 2:1
DETAIL AJ SCALE 2:1
LOCATION
POLARITY TOWARD INSIDE OF ENCLOSURE/FARTHEST AWAY FROM PROBE LOCATION
POLARITY TOWARD COSMETIC SURFACE OF ENCLOSURE/CLOSEST TO PROBE LOCATION
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY
SCALE NONE
SHT 3 OF 5

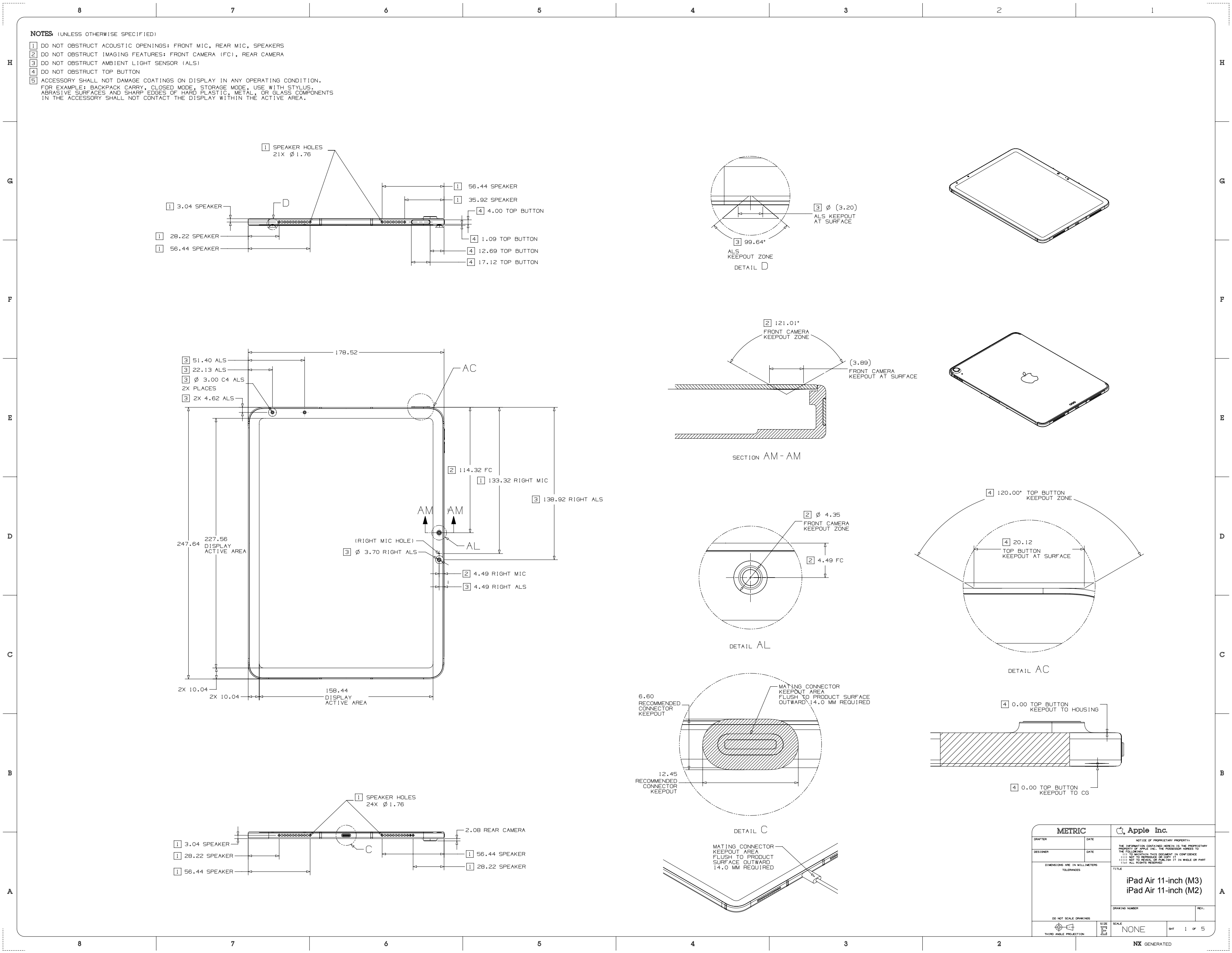
60.81 iPad Air 13-inch (M3) and iPad Air 13-inch (M2), 4 of 5



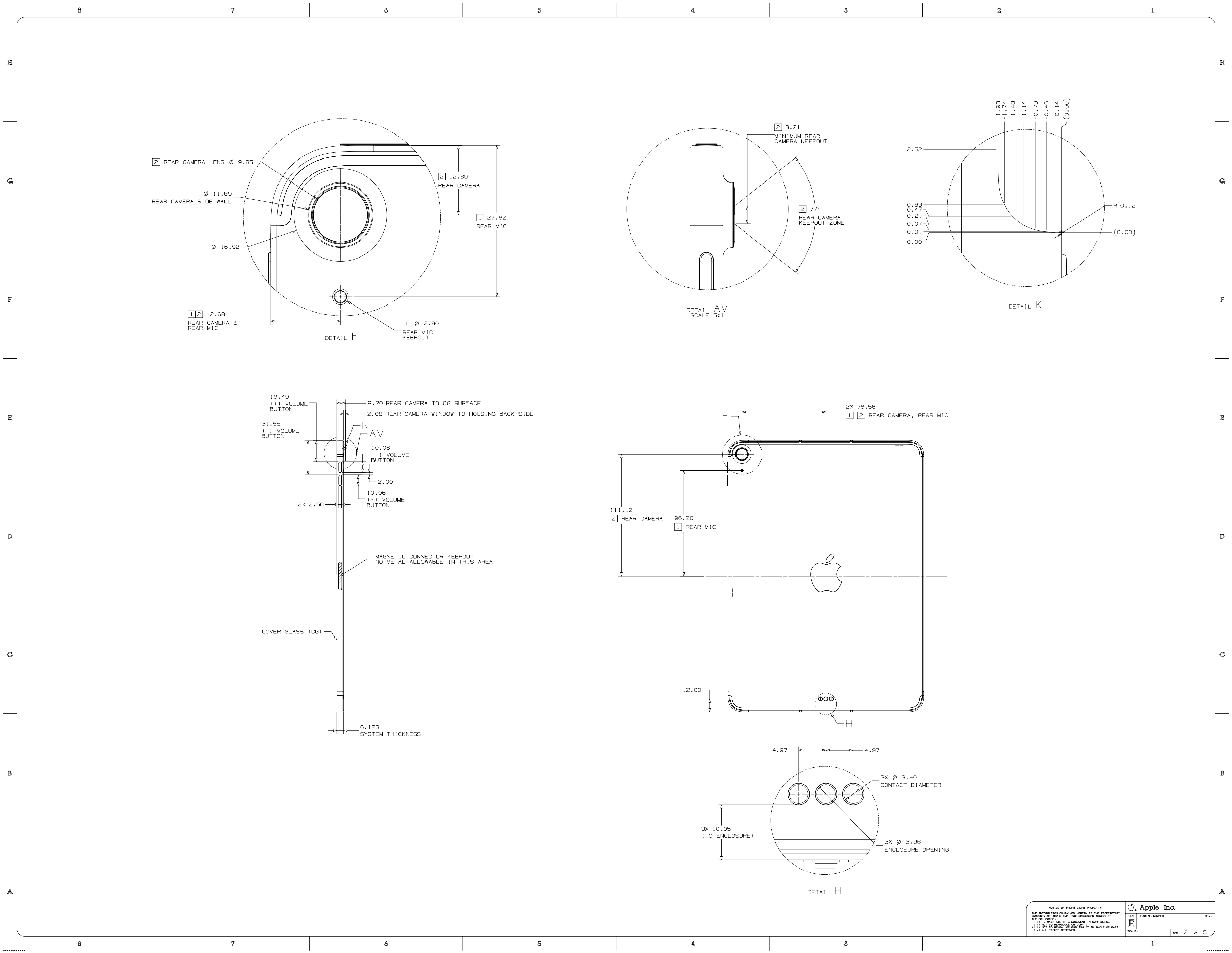
60.82 iPad Air 13-inch (M3) and iPad Air 13-inch (M2), 5 of 5



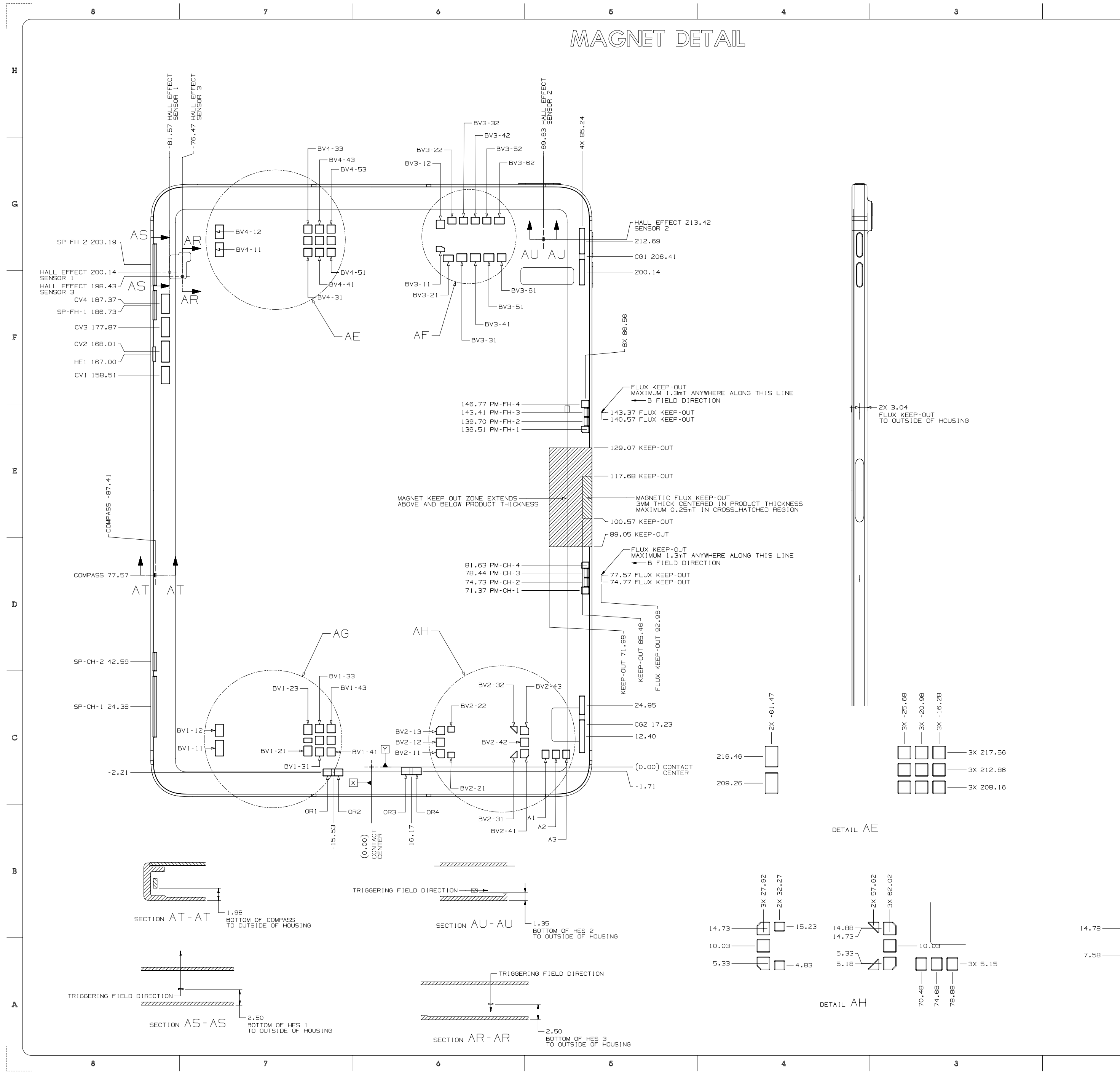
60.83 iPad Air 11-inch (M3) and iPad Air 11-inch (M2), 1 of 5



60.84 iPad Air 11-inch (M3) and iPad Air 11-inch (M2), 2 of 5

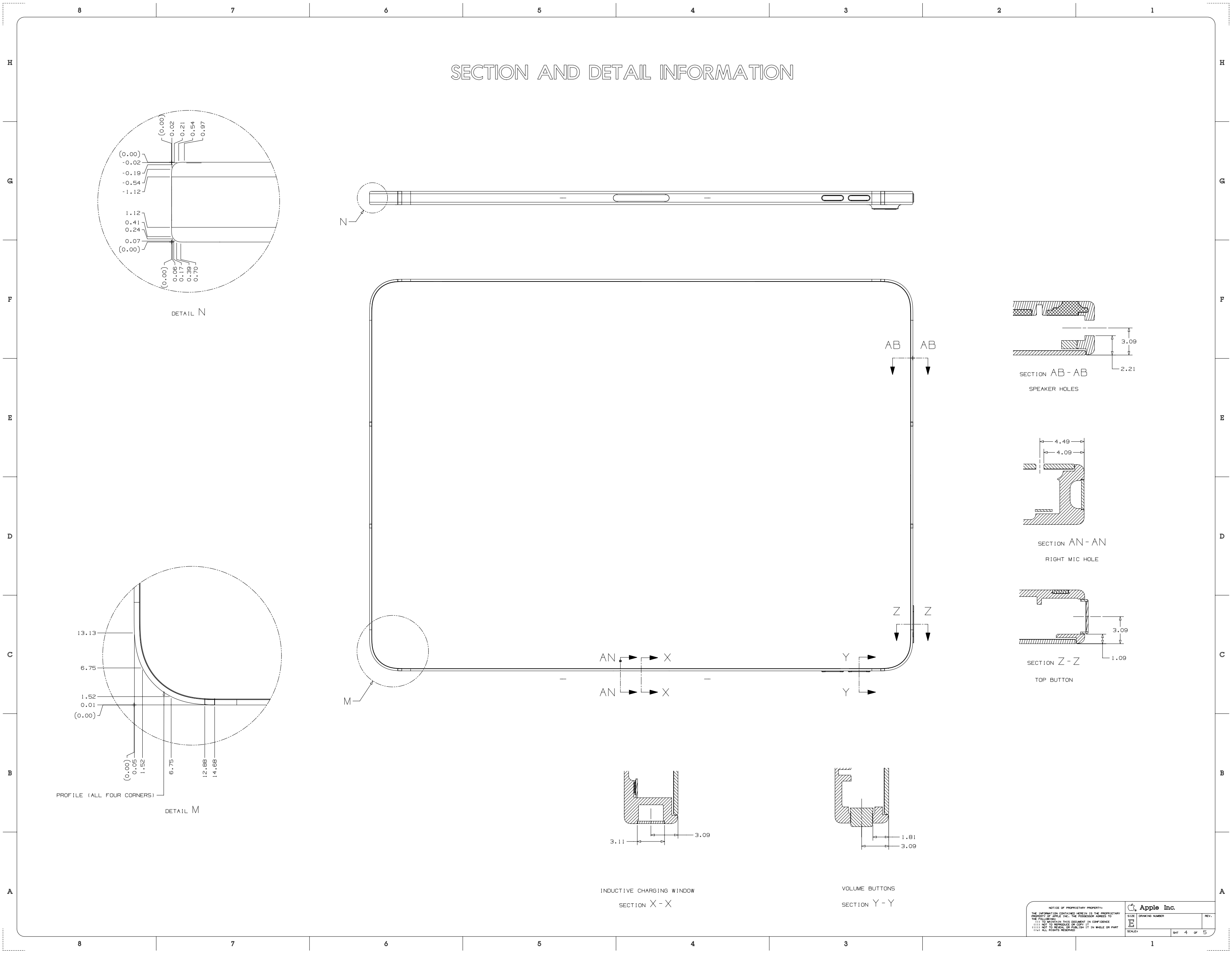


MAGNET DETAIL

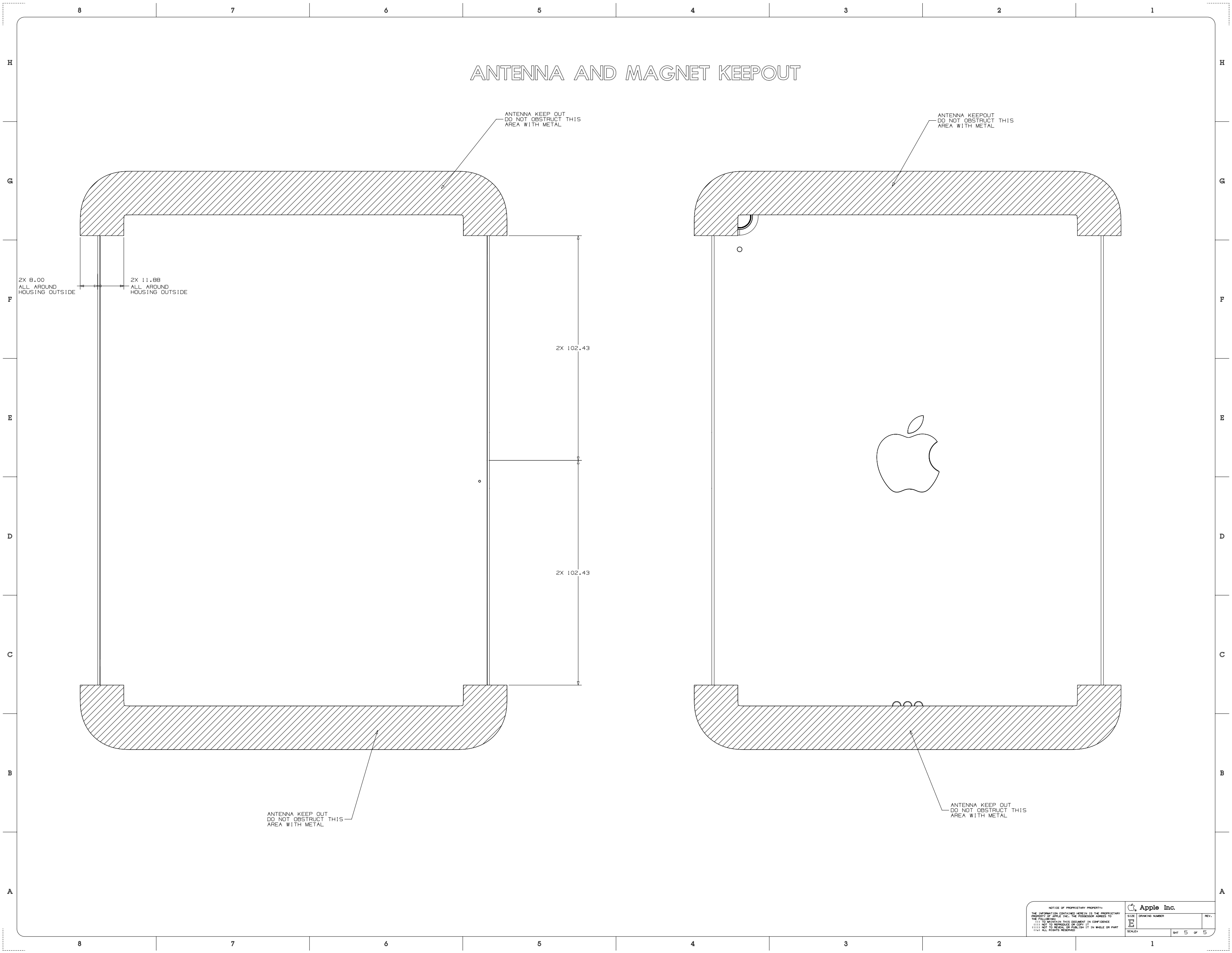


LOCATION	POLARITY TOWARD OUTER COSMETIC SURFACE OF ENCLOSURE	POLARITY TOWARD INSIDE OF PRODUCT
BV1-11	N	S
BV1-12	S	N
BV1-21	S	N
BV1-22	N	S
BV1-23	S	N
BV1-31	N	S
BV1-32	S	N
BV1-33	N	S
BV1-41	N	S
BV1-42	N	S
BV1-43	S	N
BV2-11	N	S
BV2-12	N	S
BV2-13	S	N
BV2-21	S	N
BV2-22	N	S
BV2-31	S	N
BV2-32	S	N
BV2-41	N	S
BV2-42	S	N
BV2-43	N	S
BV3-11	S	N
BV3-12	N	S
BV3-21	N	S
BV3-22	S	N
BV3-31	S	N
BV3-32	N	S
BV3-41	N	S
BV3-42	S	N
BV3-51	S	N
BV3-52	S	N
BV3-61	N	S
BV3-62	N	S
BV4-11	S	N
BV4-12	N	S
BV4-31	S	N
BV4-32	N	S
BV4-33	S	N
BV4-41	N	S
BV4-42	S	N
BV4-43	S	N
BV4-51	S	N
BV4-52	N	S
BV4-53	N	S
CV1	S	N
CV2	N	S
CV3	N	S
CV4	S	N
HE1	N	S
OR1	S	N
OR2	N	S
OR3	N	S
OR4	S	N
PM-CH-1	S (TOWARD USB-C)	N (TOWARD REAR CAM)
PM-CH-2	S	N
PM-CH-3	N (TOWARD USB-C)	S (TOWARD REAR CAM)
PM-CH-4	N	S
PM-FH-1	N	S
PM-FH-2	S (TOWARD USB-C)	N (TOWARD REAR CAM)
PM-FH-3	S	N
PM-FH-4	N (TOWARD USB-C)	S (TOWARD REAR CAM)
SP-CH-1	S	N
SP-CH-2	N	S
SP-FH-1	N	S
SP-FH-2	S	N
A1	S	N
A2	N	S
A3	S	N
CG1	N (TOP HALF), S (BOTTOM HALF)	S (TOP HALF), N (BOTTOM HALF)
CG2	S (TOP HALF), N (BOTTOM HALF)	N (TOP HALF), S (BOTTOM HALF)

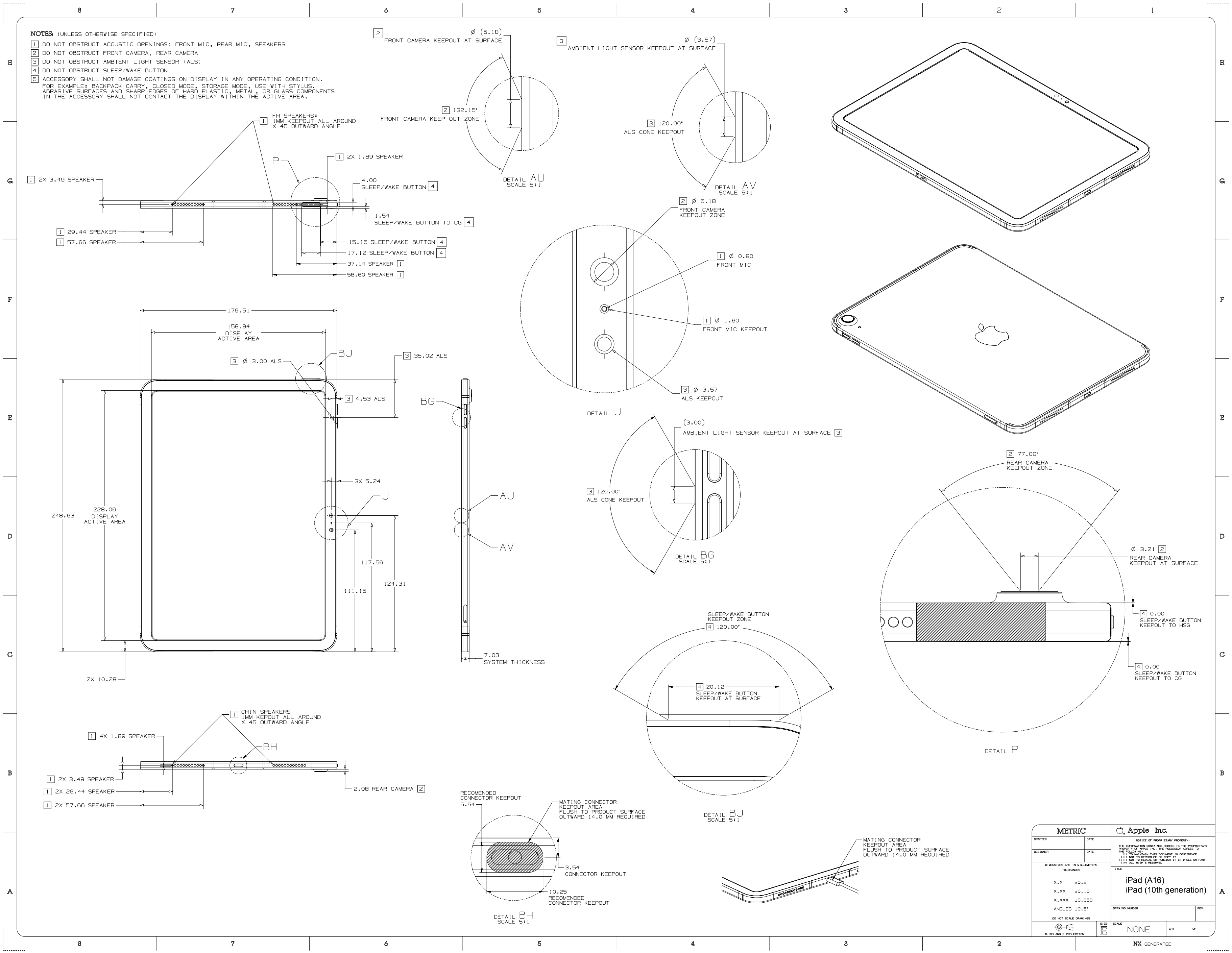
60.86 iPad Air 11-inch (M3) and iPad Air 11-inch (M2), 4 of 5

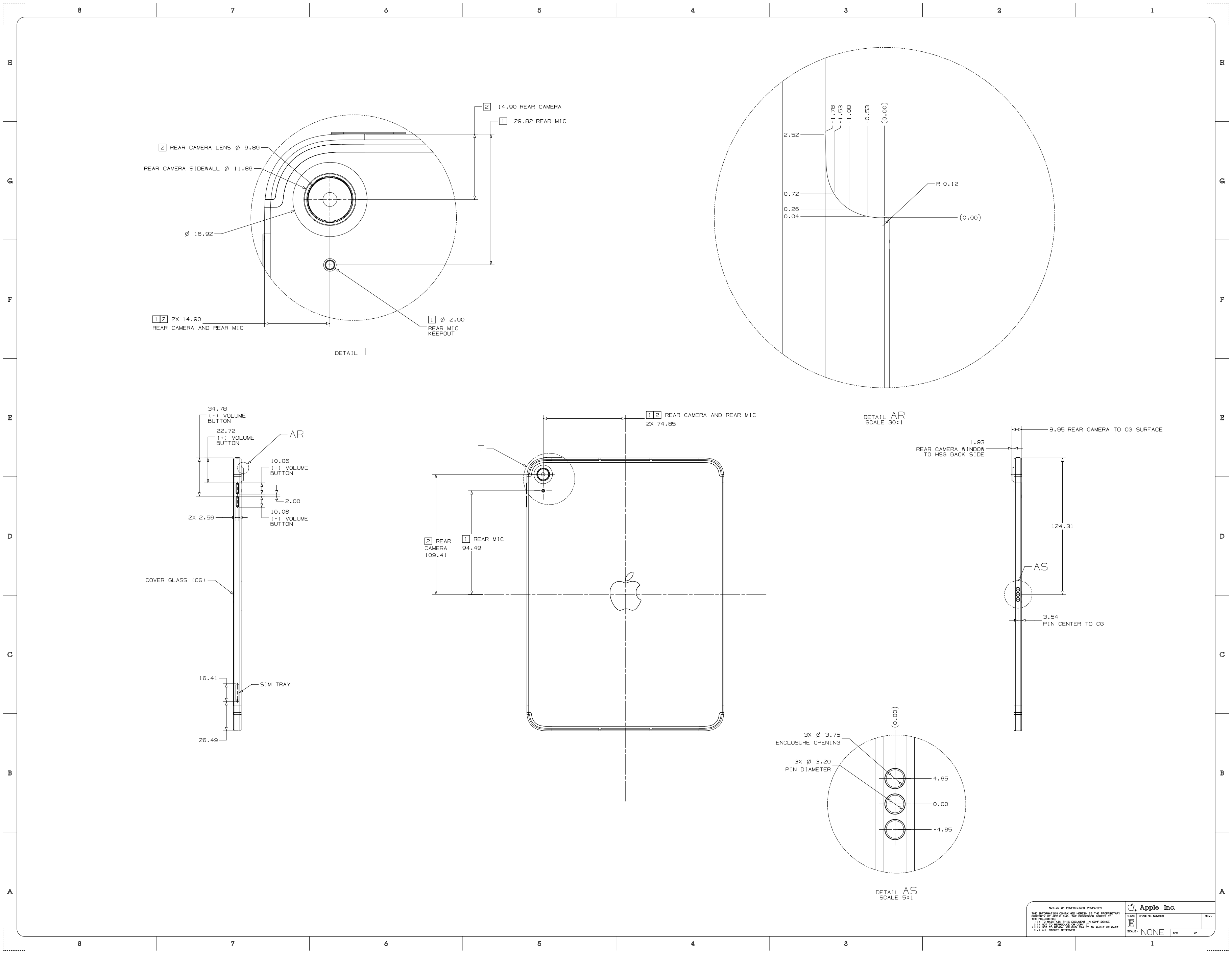


60.87 iPad Air 11-inch (M3) and iPad Air 11-inch (M2), 5 of 5



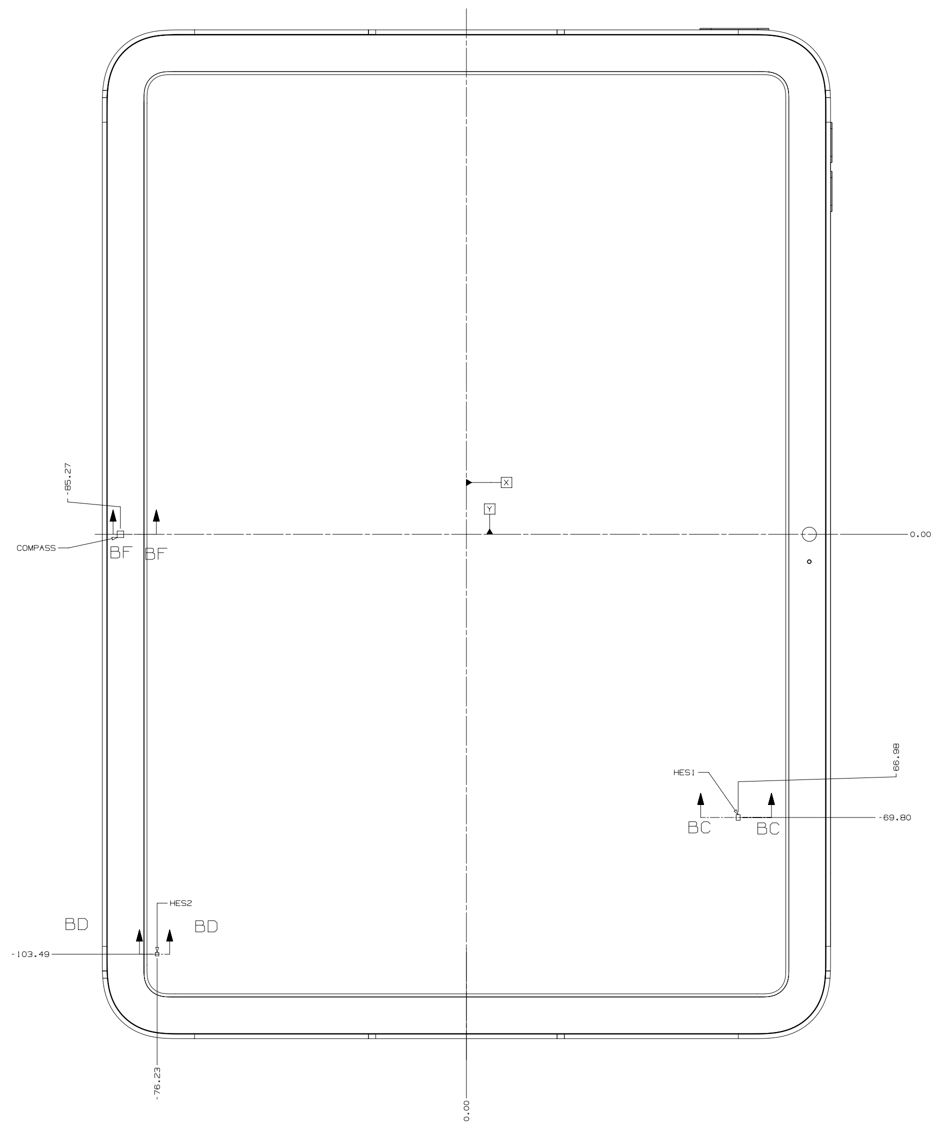
60.88 iPad (A16) and iPad (10th generation), 1 of 7





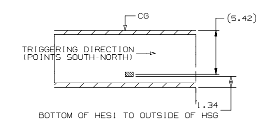
2 14.90 REAR CAMERA
1 29.82 REAR MIC
2 REAR CAMERA LENS Ø 9.89
REAR CAMERA SIDEWALL Ø 11.89
Ø 16.92
1 2 2X 14.90
REAR CAMERA AND REAR MIC
1 Ø 2.90
REAR MIC KEEPOUT
DETAIL T
2.52
-1.78
-1.53
-1.08
-0.53
(0.00)
R 0.12
0.72
0.26
0.04
(0.00)
DETAIL AR
SCALE 30:1
34.78
(-) VOLUME BUTTON
22.72
(+) VOLUME BUTTON
AR
10.06
(+) VOLUME BUTTON
2.00
10.06
(-) VOLUME BUTTON
2X 2.56
COVER GLASS (CG)
16.41
SIM TRAY
26.49
1 2 REAR CAMERA AND REAR MIC
2X 74.85
T
2 REAR CAMERA
109.41
1 REAR MIC
94.49
8.95 REAR CAMERA TO CG SURFACE
1.93
REAR CAMERA WINDOW TO HSG BACK SIDE
124.31
AS
3.54
PIN CENTER TO CG
(0.00)
3X Ø 3.75
ENCLOSURE OPENING
3X Ø 3.20
PIN DIAMETER
4.65
0.00
-4.65
DETAIL AS
SCALE 5:1
Apple Inc.
NONE

HALL EFFECT SENSORS AND COMPASS

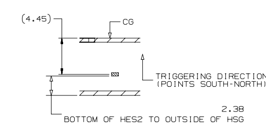


HALL EFFECT SENSOR TABLE

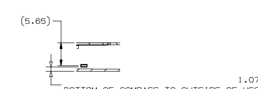
SENSOR	TRIGGERING FIELD (mT)	RELEASE FIELD (mT)
HES1	2.3-3.7	1.5-2.9
HES2	7.4-11.6	6.5-10.7



SECTION BC-BC



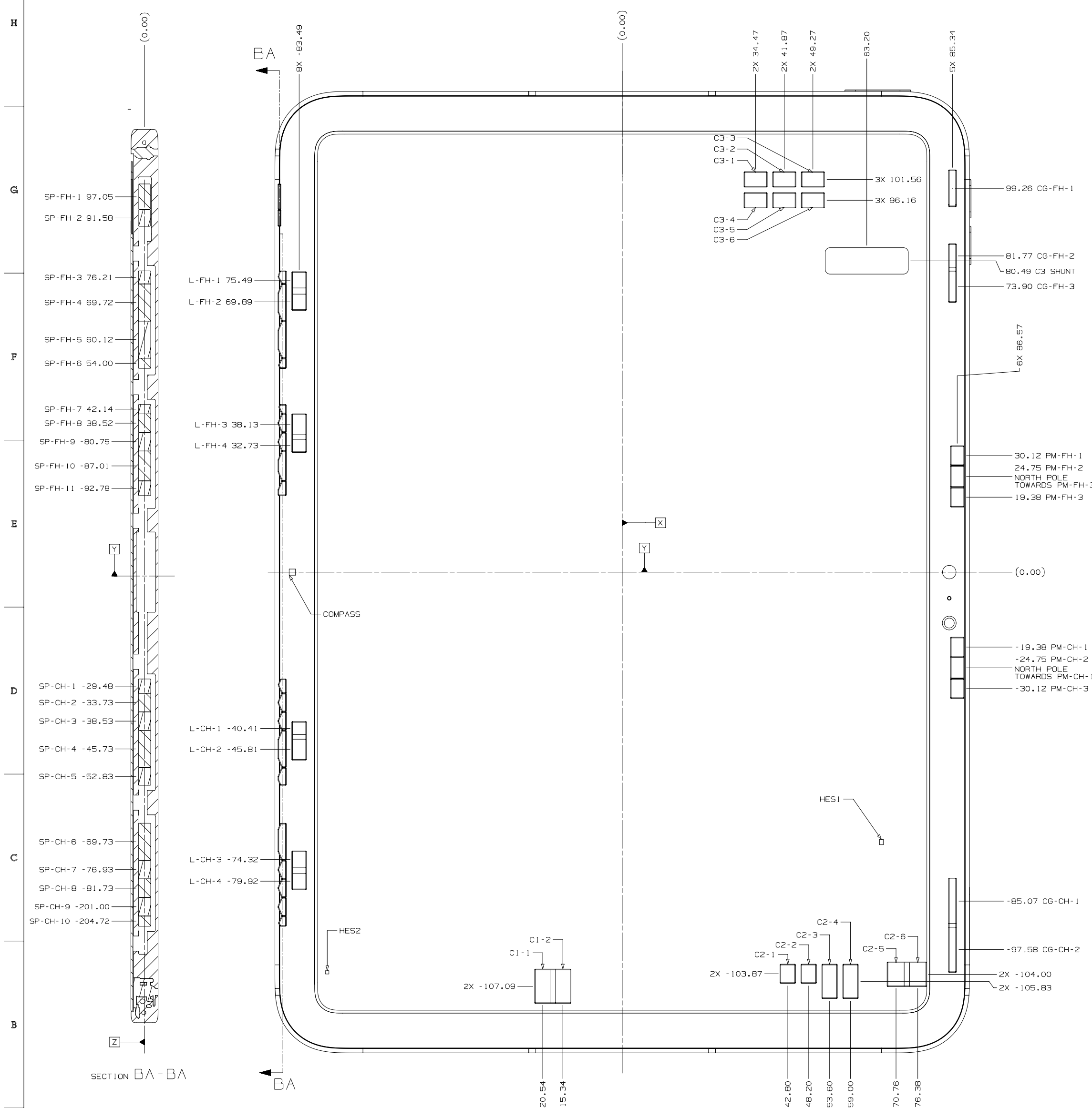
SECTION BD-BD



SECTION BF-BF

Apple Inc.
SIZE E
SCALE NONE

MAGNET DETAIL (10TH GENERATION)



COORDINATES ARE FOR MAGNET CENTER POSITION

MAGNET TABLE

LOCATION	POLARITY TOWARDS INSIDE OF ENCLOSURE	POLARITY TOWARDS OUTSIDE OF ENCLOSURE
PM-FH-1	N	S
PM-FH-2	SEE DWG DETAIL	SEE DWG DETAIL
PM-FH-3	S	N
PM-CH-1	S	N
PM-CH-2	SEE DWG DETAIL	SEE DWG DETAIL
PM-CH-3	N	S
CG-FH-1	S	N
CG-FH-2	S	N
CG-FH-3	N	S
CG-CH-1	N	S
CG-CH-2	S	N
SP-FH-1	N	S
SP-FH-2	S	N
SP-FH-3	N	S
SP-FH-4	S	N
SP-FH-5	N	S
SP-FH-6	S	N
SP-FH-7	N	S
SP-FH-8	S	N
SP-FH-9	N	S
SP-FH-10	S	N
SP-FH-11	N	S
SP-CH-1	S	N
SP-CH-2	N	S
SP-CH-3	S	N
SP-CH-4	N	S
SP-CH-5	S	N
SP-CH-6	S	N
SP-CH-7	N	S
SP-CH-8	S	N
SP-CH-9	N	S
SP-CH-10	S	N
L-FH-1	N	S
L-FH-2	S	N
L-FH-3	N	S
L-FH-4	S	N
L-CH-1	S	N
L-CH-2	N	S
L-CH-3	S	N
L-CH-4	N	S
C1-1	N	S
C1-2	S	N
C2-1	S	N
C2-2	N	S
C2-3	S	N
C2-4	N	S
C2-5	S	N
C2-6	N	S
C3-1	N	S
C3-2	S	N
C3-3	N	S
C3-4	S	N
C3-5	N	S
C3-6	S	N

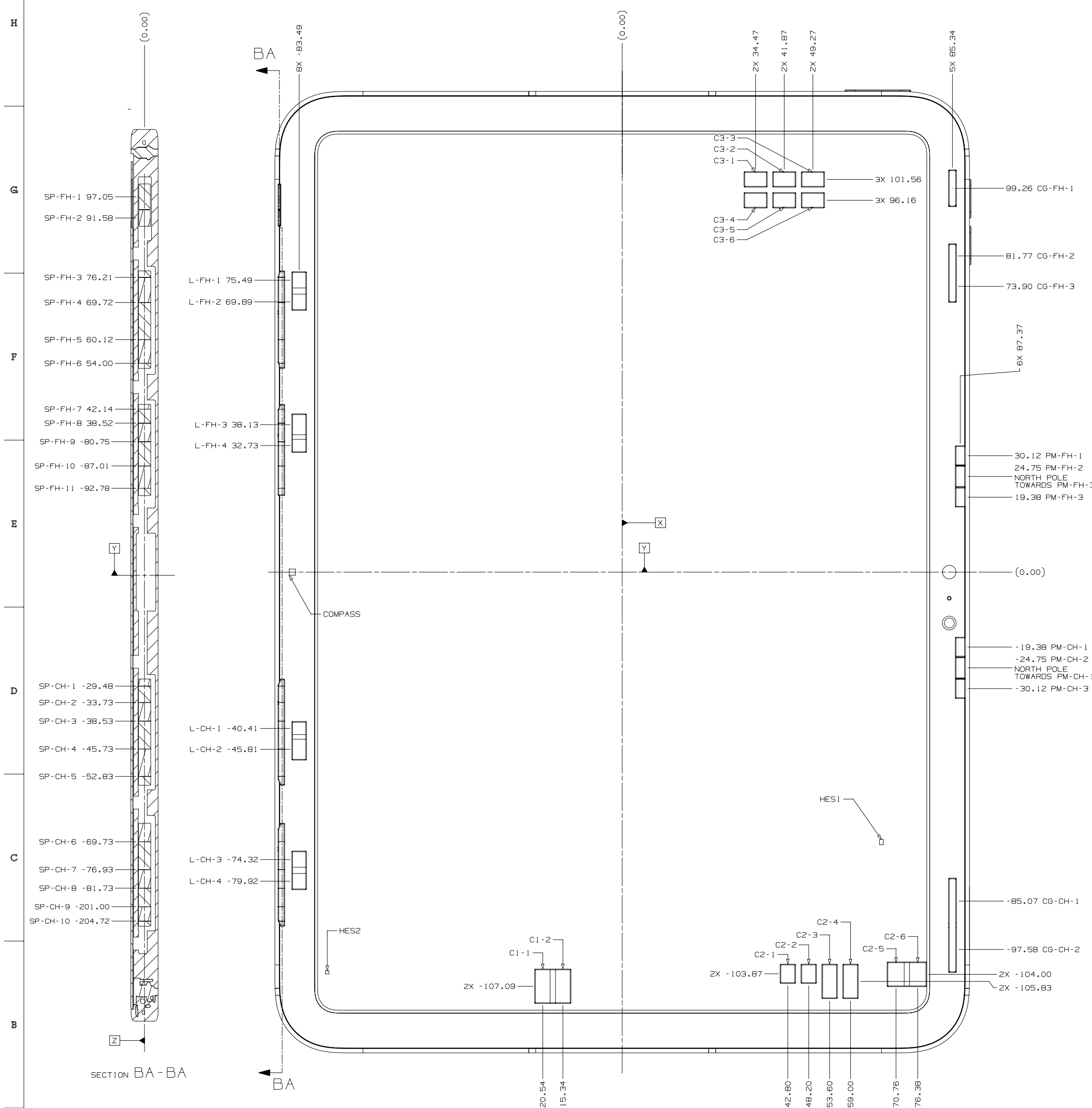
SHUNT TABLE

LOCATION	STEEL GRADE	SHUNT CENTER Z DIST. TO CG TOP SURFACE (MM)	THICKNESS (Z,MM)	WIDTH (Y,MM)	LENGTH (X,MM)
C3 SHUNT	1010	6.444	0.15	6.84	21.47

Apple Inc.

SCALE: NONE

MAGNET DETAIL (A16)



COORDINATES ARE FOR MAGNET CENTER POSITION

MAGNET TABLE

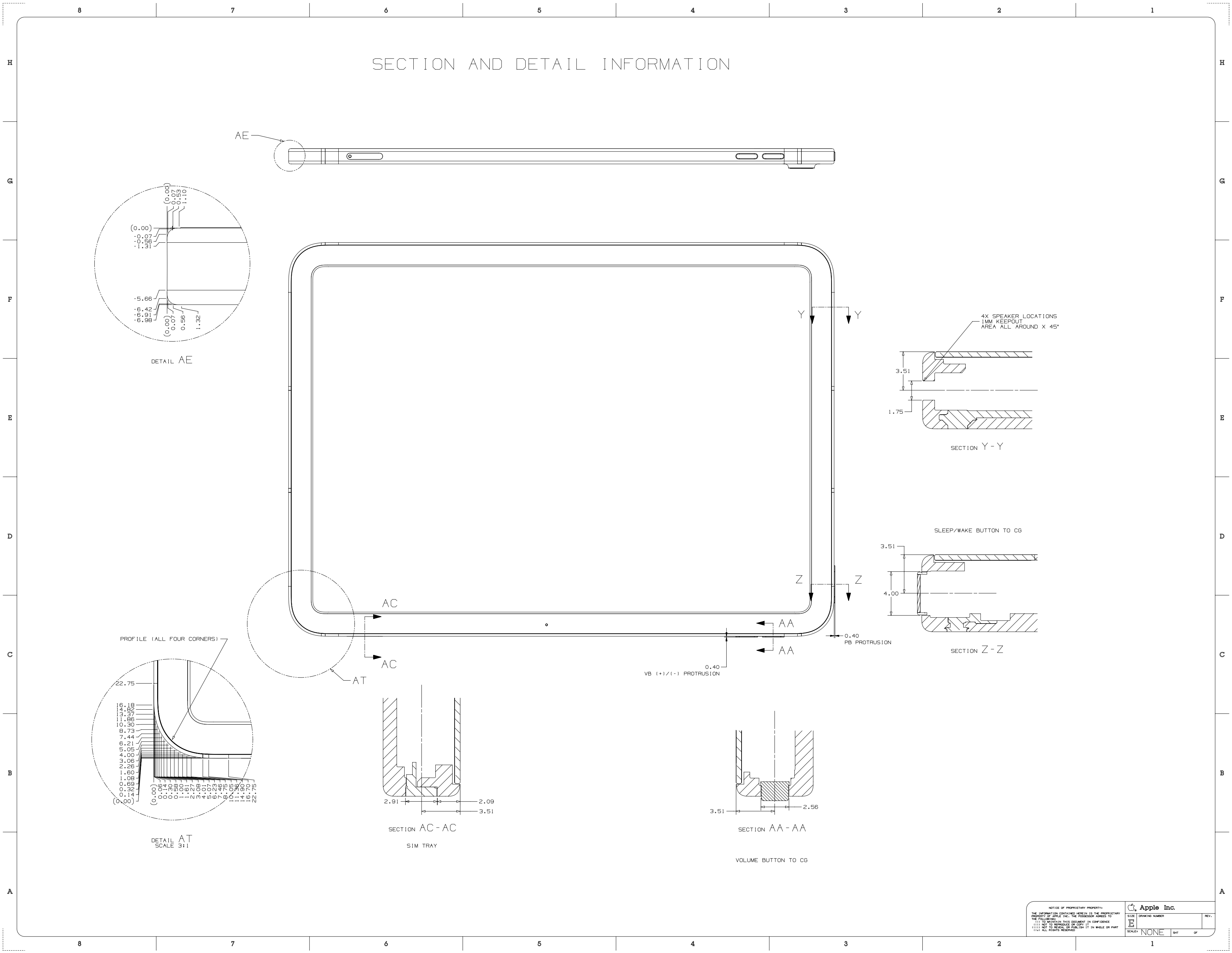
LOCATION	POLARITY TOWARDS INSIDE OF ENCLOSURE	POLARITY TOWARDS OUTSIDE OF ENCLOSURE
PM-FH-1	N	S
PM-FH-2	SEE DWG DETAIL	SEE DWG DETAIL
PM-FH-3	S	N
PM-CH-1	S	N
PM-CH-2	SEE DWG DETAIL	SEE DWG DETAIL
PM-CH-3	N	S
CG-FH-1	S	N
CG-FH-2	S	N
CG-FH-3	N	S
CG-CH-1	N	S
CG-CH-2	S	N
SP-FH-1	N	S
SP-FH-2	S	N
SP-FH-3	N	S
SP-FH-4	S	N
SP-FH-5	N	S
SP-FH-6	S	N
SP-FH-7	N	S
SP-FH-8	S	N
SP-FH-9	N	S
SP-FH-10	S	N
SP-FH-11	N	S
SP-CH-1	S	N
SP-CH-2	N	S
SP-CH-3	S	N
SP-CH-4	N	S
SP-CH-5	S	N
SP-CH-6	S	N
SP-CH-7	N	S
SP-CH-8	S	N
SP-CH-9	N	S
SP-CH-10	S	N
L-FH-1	N	S
L-FH-2	S	N
L-FH-3	N	S
L-FH-4	S	N
L-CH-1	S	N
L-CH-2	N	S
L-CH-3	S	N
L-CH-4	N	S
C1-1	N	S
C1-2	S	N
C2-1	S	N
C2-2	N	S
C2-3	S	N
C2-4	N	S
C2-5	S	N
C2-6	N	S
C3-1	N	S
C3-2	S	N
C3-3	N	S
C3-4	S	N
C3-5	N	S
C3-6	S	N

Apple Inc.

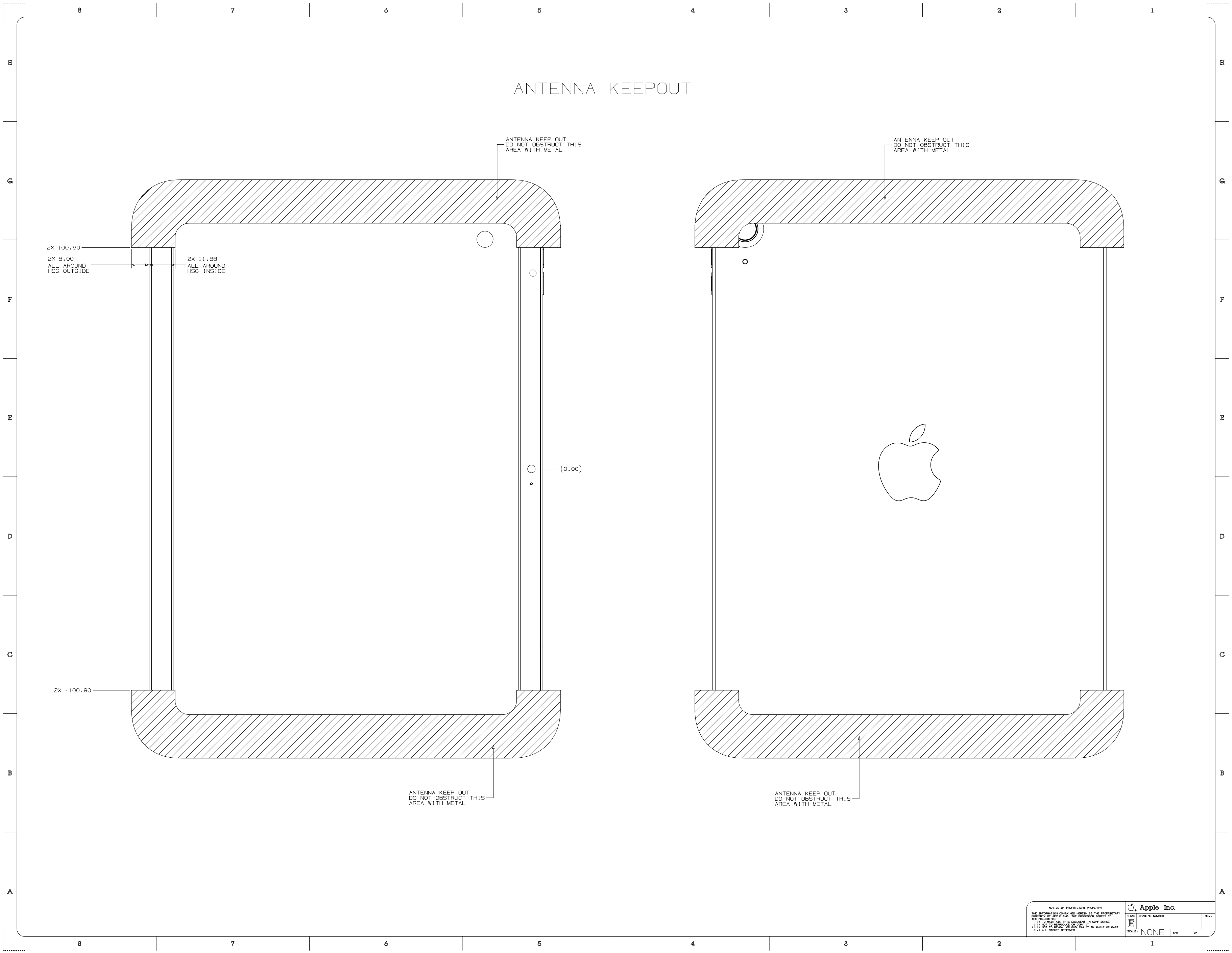
SCALE: NONE

SIZE: E

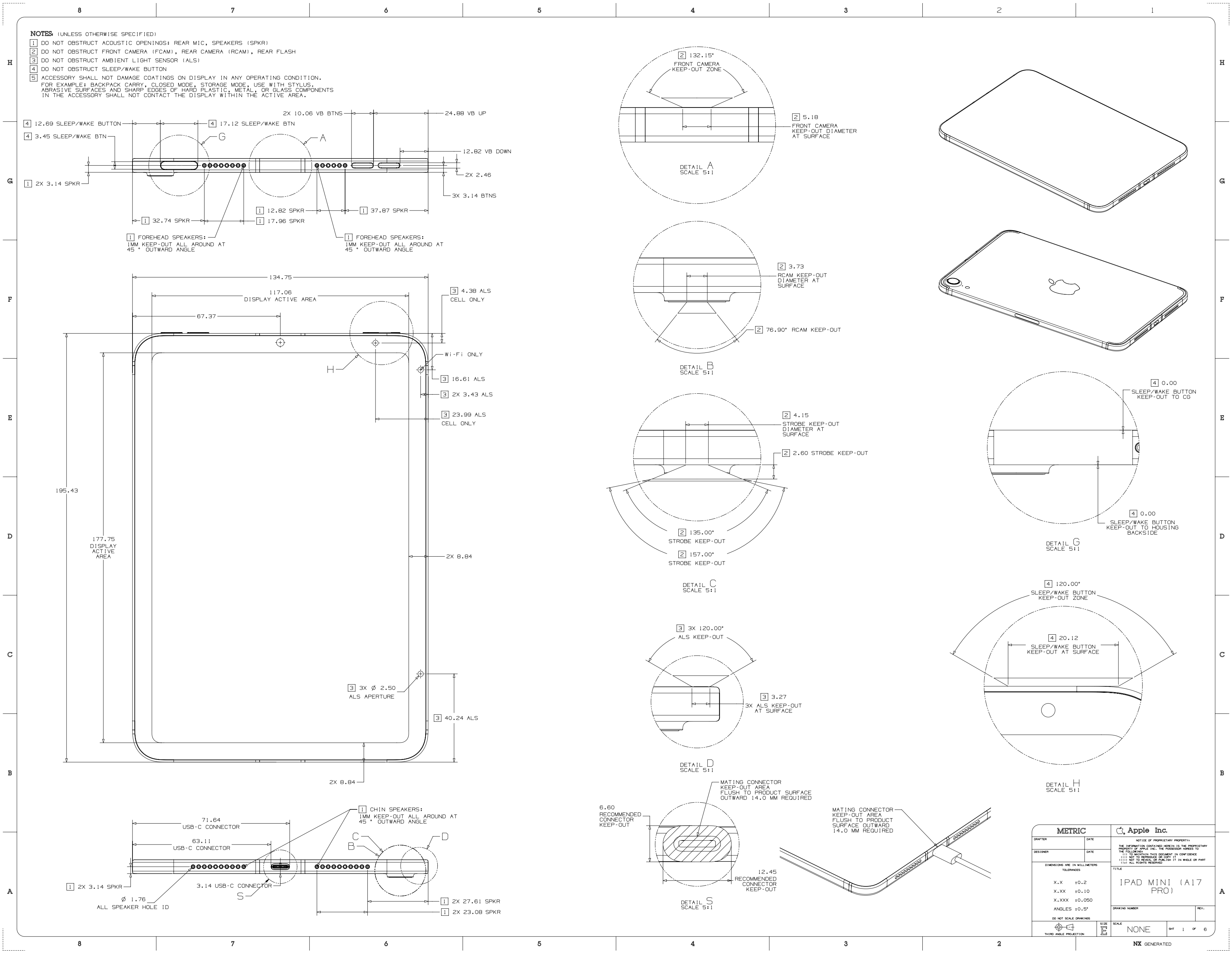
60.93 iPad (A16) and iPad (10th generation), 6 of 7

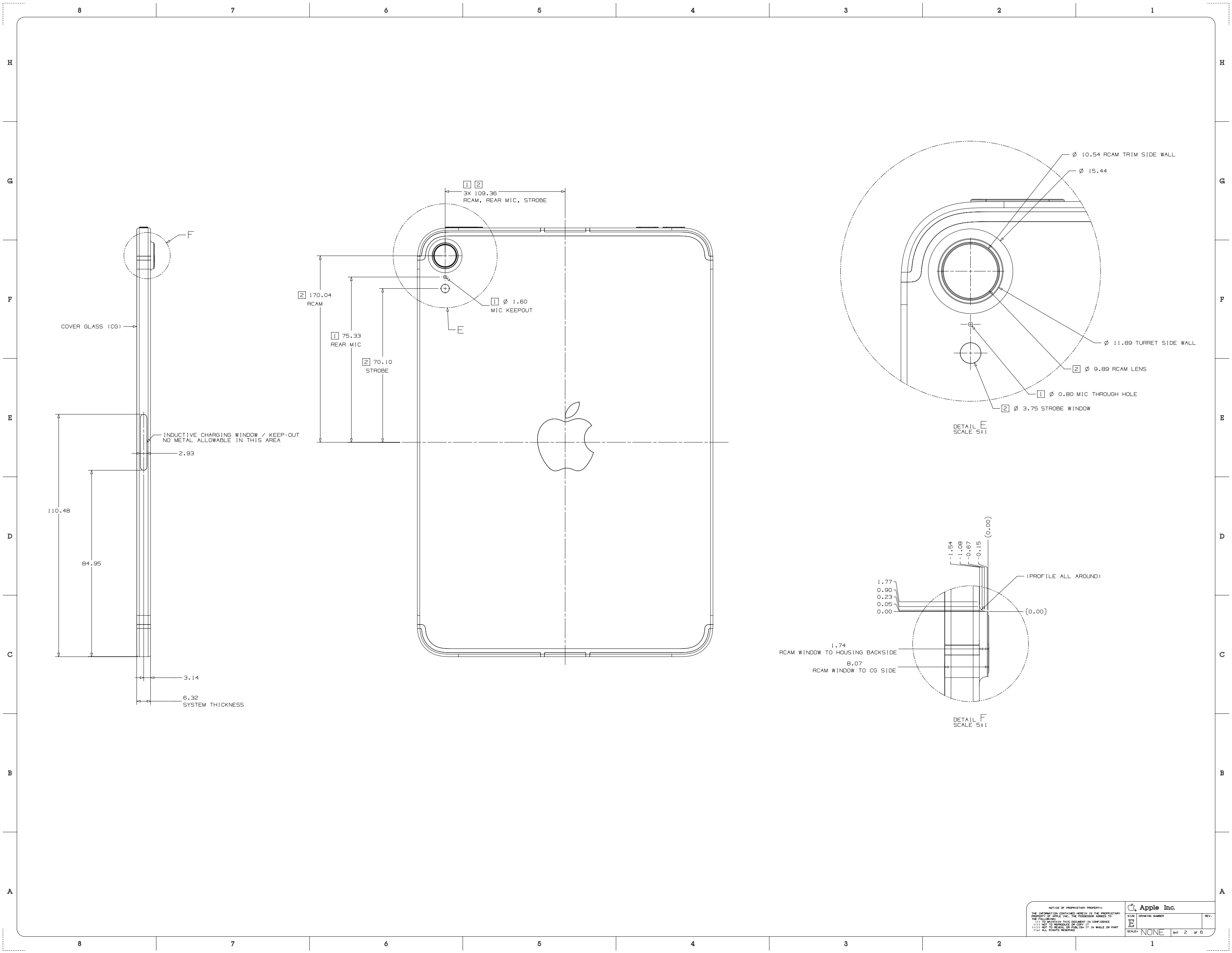


60.94 iPad (A16) and iPad (10th generation), 7 of 7



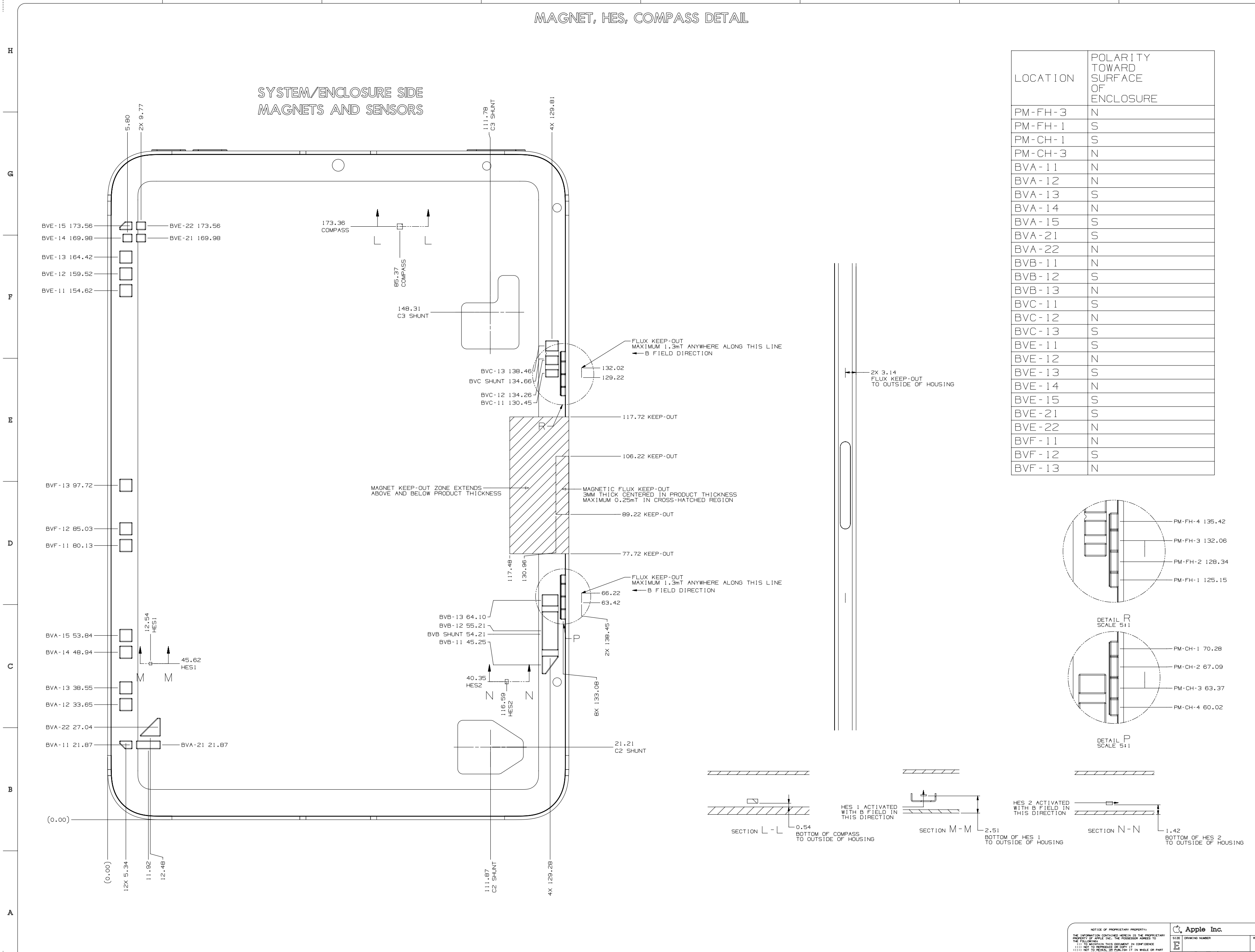
60.95 iPad mini (A17 Pro), 1 of 6



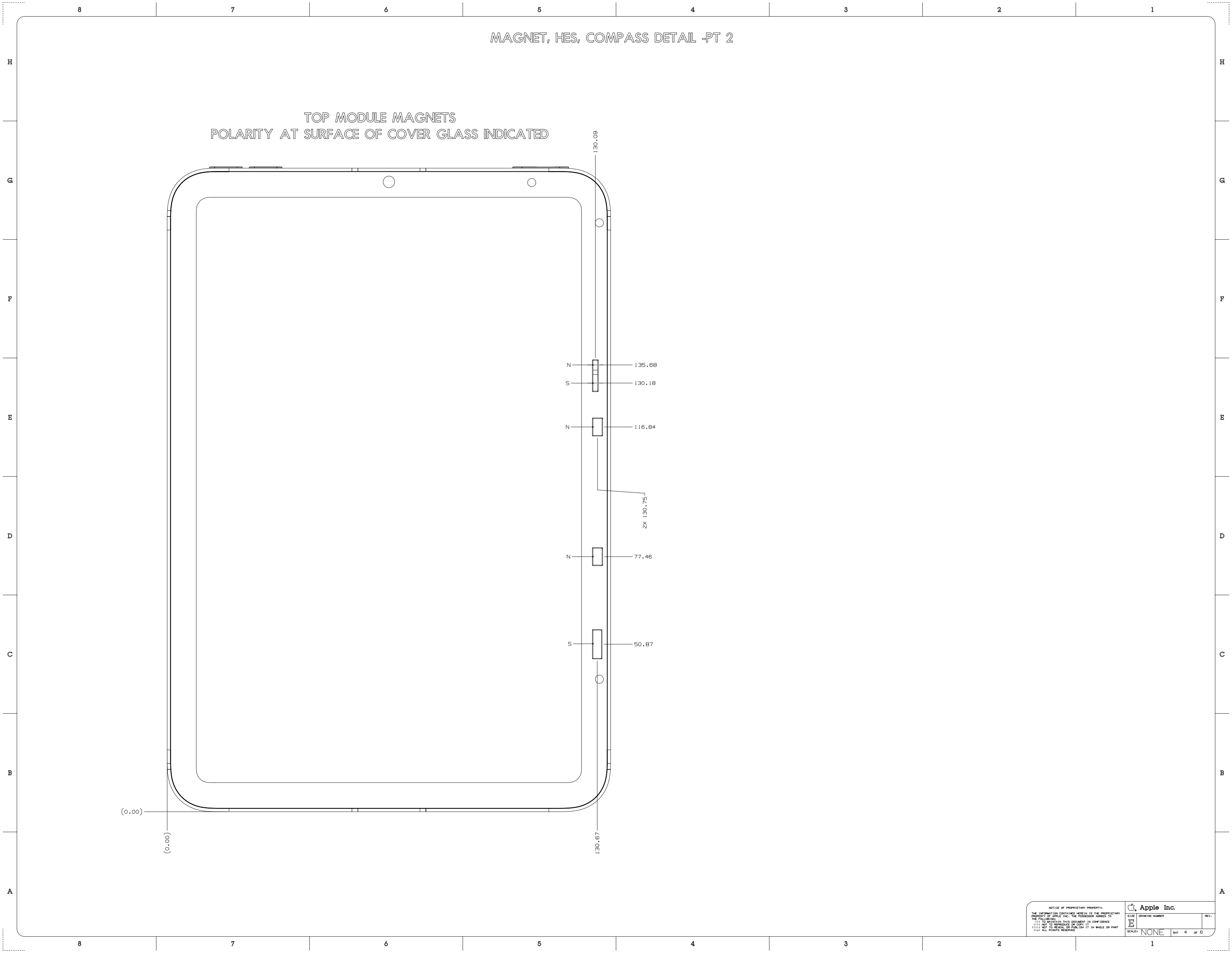


COVER GLASS (CG)
F
INDUCTIVE CHARGING WINDOW / KEEP-OUT
NO METAL ALLOWABLE IN THIS AREA
2.93
110.48
84.95
3.14
6.32
SYSTEM THICKNESS
3X 109.36
RCAM, REAR MIC, STROBE
170.04
RCAM
75.33
REAR MIC
70.10
STROBE
Ø 1.60
MIC KEEPOUT
E
Ø 10.54 RCAM TRIM SIDE WALL
Ø 15.44
Ø 11.89 TURRET SIDE WALL
Ø 9.89 RCAM LENS
Ø 0.80 MIC THROUGH HOLE
Ø 3.75 STROBE WINDOW
DETAIL E
SCALE 5:1
-1.54
-1.08
-0.67
-0.15
(0.00)
(PROFILE ALL AROUND)
1.77
0.90
0.23
0.05
0.00
(0.00)
1.74
RCAM WINDOW TO HOUSING BACKSIDE
8.07
RCAM WINDOW TO CG SIDE
DETAIL F
SCALE 5:1
NOTICE OF PROPRIETARY PROPERTY:
Apple Inc.
SIZE E
SCALE: NONE
SHT 2 OF 6

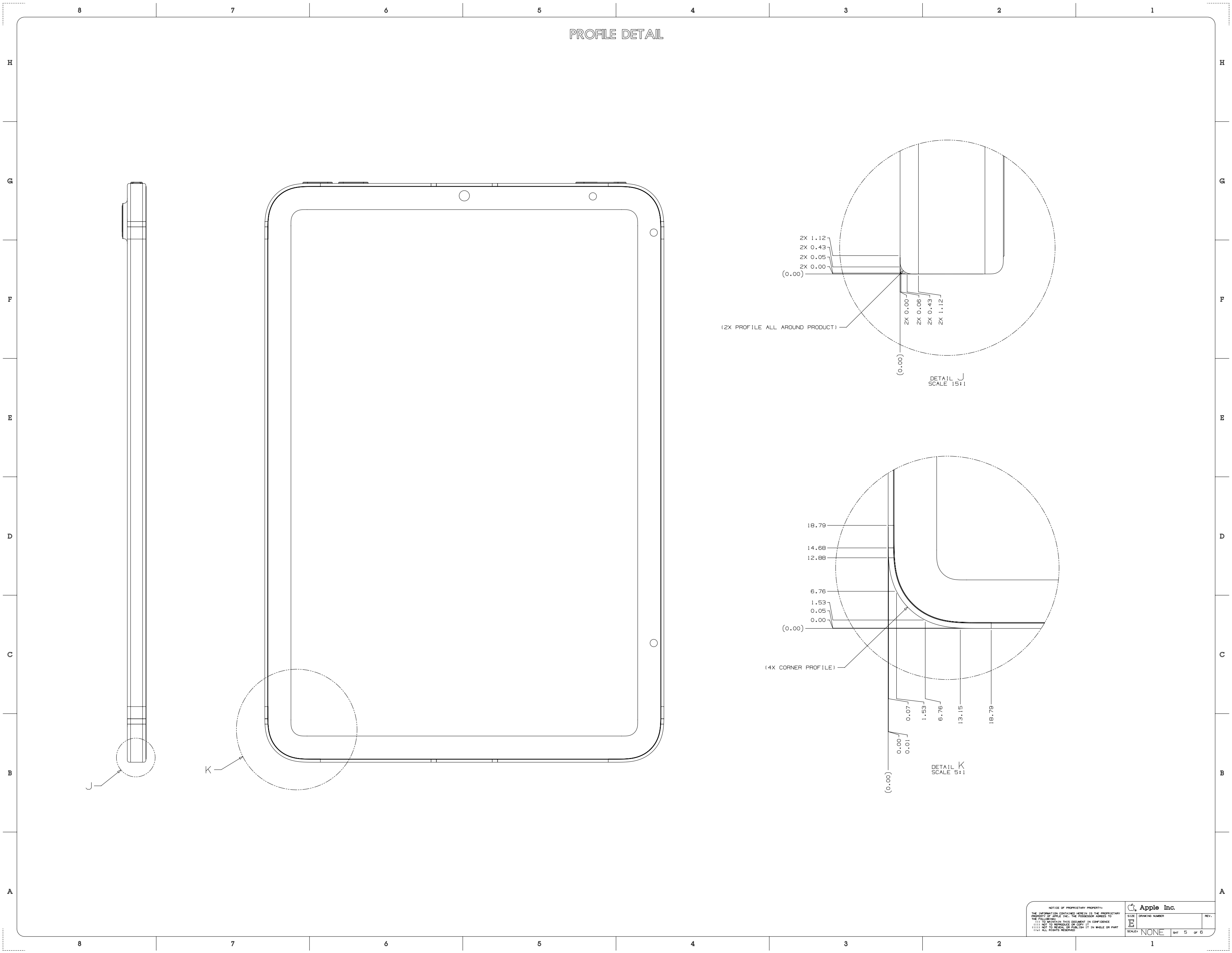
MAGNET, HES, COMPASS DETAIL

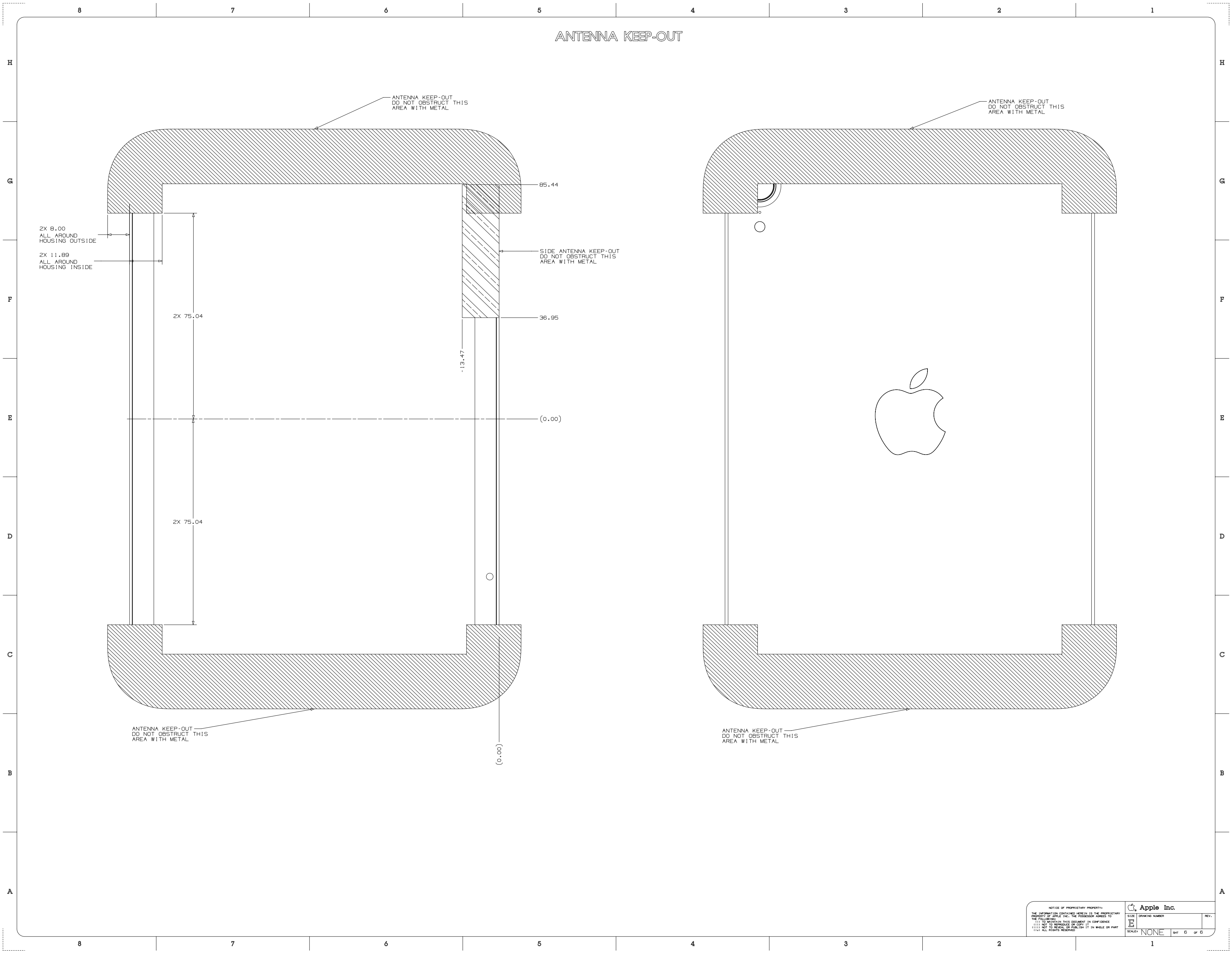


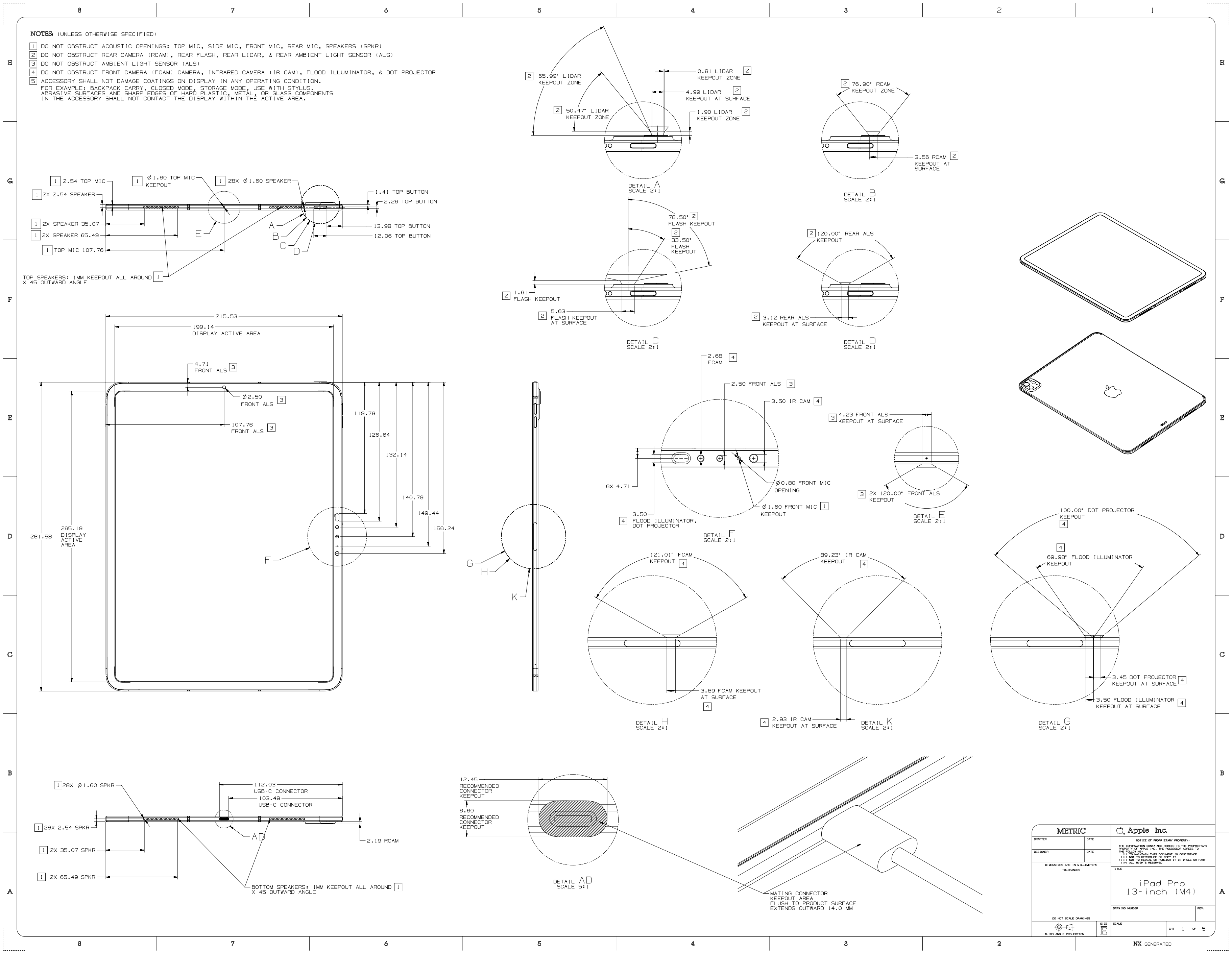
LOCATION	POLARITY TOWARD SURFACE OF ENCLOSURE
PM-FH-3	N
PM-FH-1	S
PM-CH-1	S
PM-CH-3	N
BVA-11	N
BVA-12	N
BVA-13	S
BVA-14	N
BVA-15	S
BVA-21	S
BVA-22	N
BVB-11	N
BVB-12	S
BVB-13	N
BVC-11	S
BVC-12	N
BVC-13	S
BVE-11	S
BVE-12	N
BVE-13	S
BVE-14	N
BVE-15	S
BVE-21	S
BVE-22	N
BVF-11	N
BVF-12	S
BVF-13	N

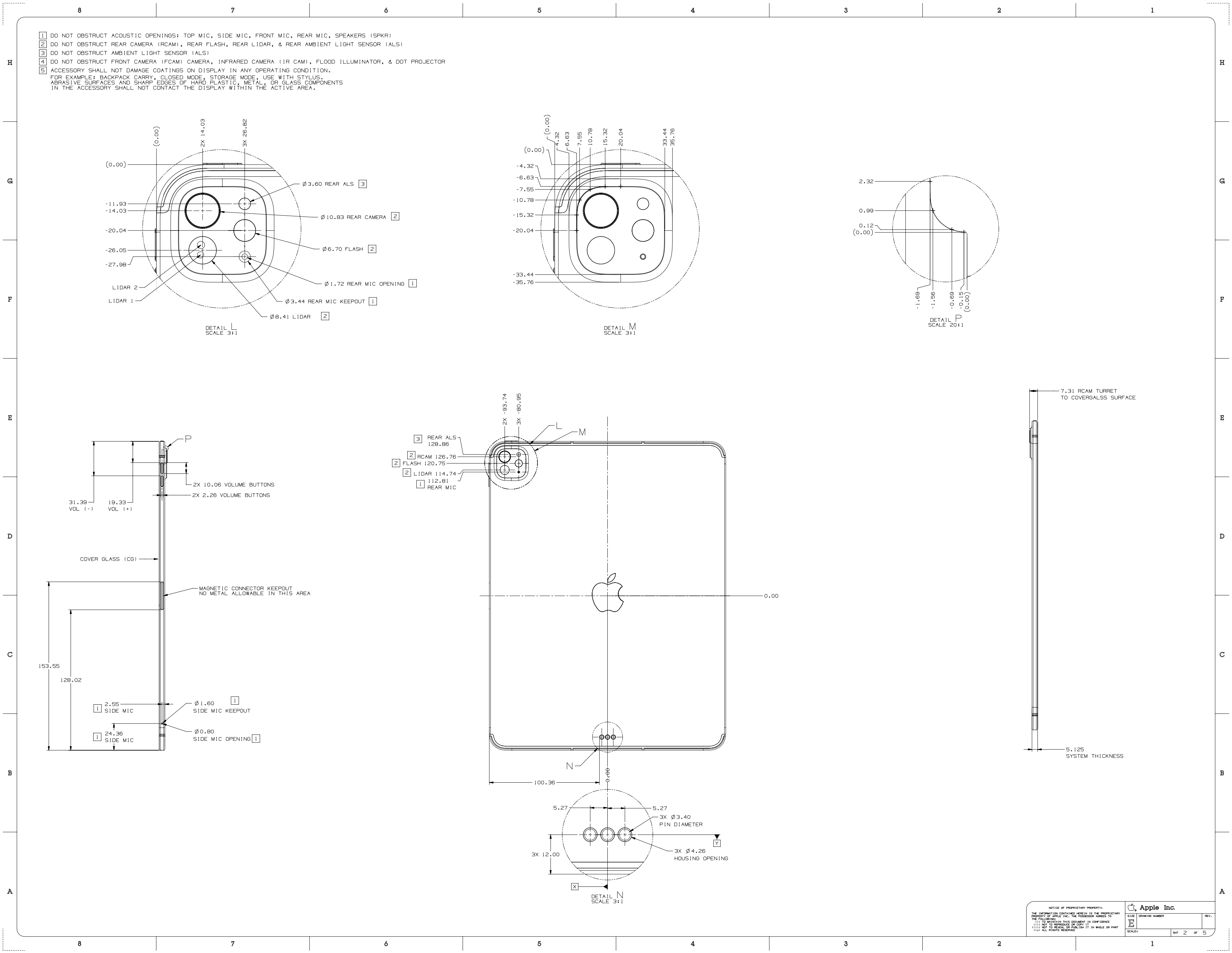

MAGNET, HES, COMPASS DETAIL -PT 2
TOP MODULE MAGNETS
POLARITY AT SURFACE OF COVER GLASS INDICATED
130.09
N
135.68
S
130.18
N
116.84
2X 130.75
N
77.46
S
50.87
(0.00)
(0.00)
130.67
Apple Inc.
E
NONE
SHT 4 OF 6

60.99 iPad mini (A17 Pro), 5 of 6

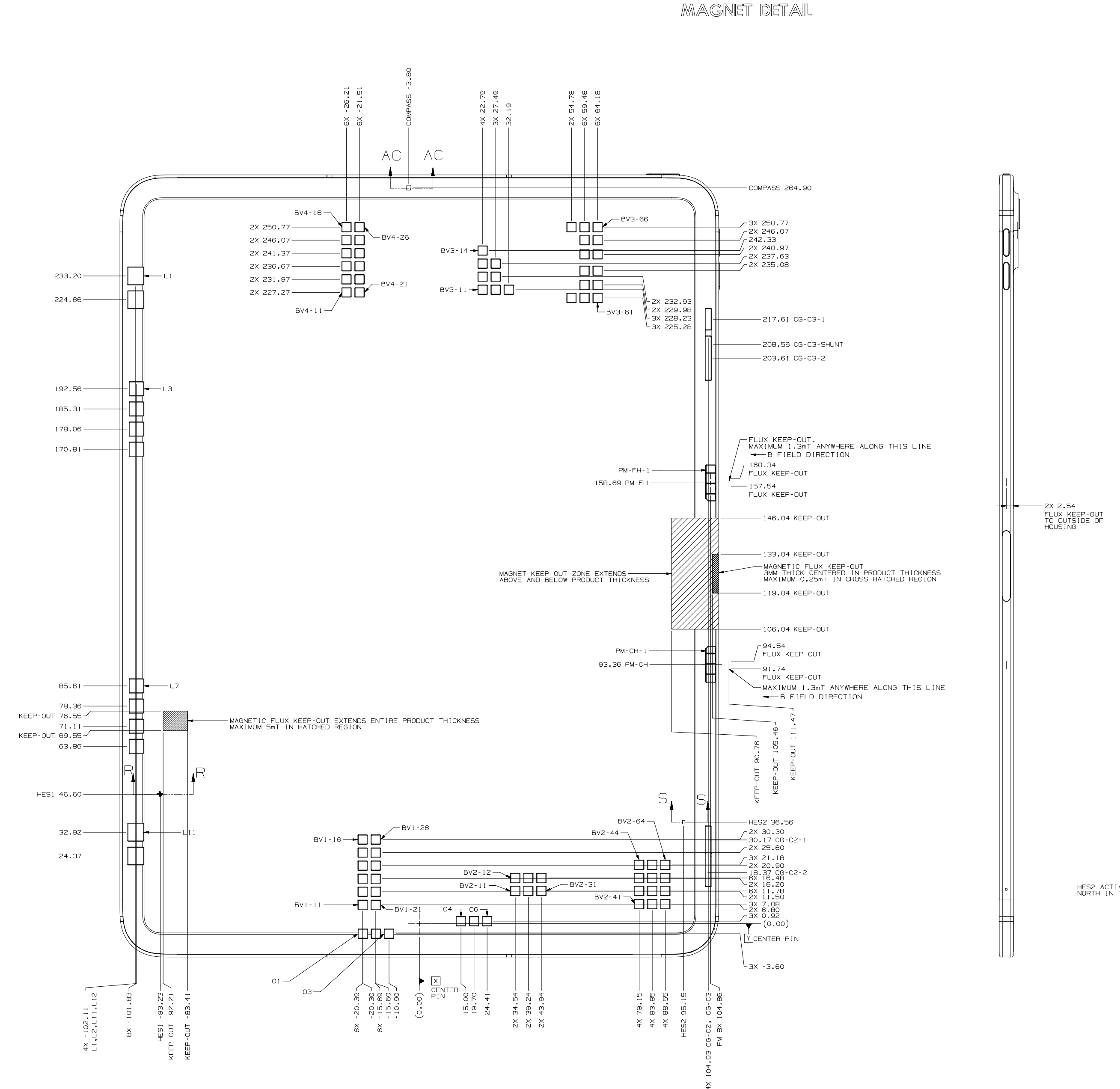



ANTENNA KEEP-OUT
ANTENNA KEEP-OUT
DO NOT OBSTRUCT THIS
AREA WITH METAL
2X 8.00
ALL AROUND
HOUSING OUTSIDE
2X 11.89
ALL AROUND
HOUSING INSIDE
85.44
SIDE ANTENNA KEEP-OUT
DO NOT OBSTRUCT THIS
AREA WITH METAL
2X 75.04
36.95
-13.47
(0.00)
2X 75.04
ANTENNA KEEP-OUT
DO NOT OBSTRUCT THIS
AREA WITH METAL
(0.00)
ANTENNA KEEP-OUT
DO NOT OBSTRUCT THIS
AREA WITH METAL
ANTENNA KEEP-OUT
DO NOT OBSTRUCT THIS
AREA WITH METAL
Apple Inc.
SIZE
E
SCALE: NONE
SHT 6 OF 6

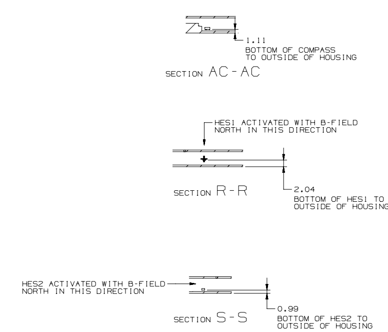

NOTES: (UNLESS OTHERWISE SPECIFIED)
1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: TOP MIC, SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS (SPKR)
2 DO NOT OBSTRUCT REAR CAMERA (RCAM), REAR FLASH, REAR LIDAR, & REAR AMBIENT LIGHT SENSOR (ALS)
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
4 DO NOT OBSTRUCT FRONT CAMERA (FCAM) CAMERA, INFRARED CAMERA (IR CAM), FLOOD ILLUMINATOR, & DOT PROJECTOR
5 ACCESSORY SHALL NOT DAMAGE COATINGS ON DISPLAY IN ANY OPERATING CONDITION.
FOR EXAMPLE: BACKPACK CARRY, CLOSED MODE, STORAGE MODE, USE WITH STYLUS.
ABRASIVE SURFACES AND SHARP EDGES OF HARD PLASTIC, METAL, OR GLASS COMPONENTS
IN THE ACCESSORY SHALL NOT CONTACT THE DISPLAY WITHIN THE ACTIVE AREA.
1 2.54 TOP MIC
1 Ø1.60 TOP MIC KEEPOUT
1 28X Ø1.60 SPEAKER
1 2X 2.54 SPEAKER
1 2X SPEAKER 35.07
1 2X SPEAKER 65.49
1 TOP MIC 107.76
1.41 TOP BUTTON
2.26 TOP BUTTON
13.98 TOP BUTTON
12.06 TOP BUTTON
TOP SPEAKERS: 1MM KEEPOUT ALL AROUND 1 X 45 OUTWARD ANGLE
215.53
199.14 DISPLAY ACTIVE AREA
4.71 FRONT ALS 3
Ø2.50 FRONT ALS 3
107.76 FRONT ALS 3
281.58
265.19 DISPLAY ACTIVE AREA
119.79
126.64
132.14
140.79
149.44
156.24
2 65.99° LIDAR KEEPOUT ZONE
2 50.47° LIDAR KEEPOUT ZONE
0.81 LIDAR KEEPOUT ZONE 2
4.99 LIDAR KEEPOUT AT SURFACE 2
1.90 LIDAR KEEPOUT ZONE 2
DETAIL A SCALE 2:1
2 76.90° RCAM KEEPOUT ZONE
3.56 RCAM KEEPOUT AT SURFACE 2
DETAIL B SCALE 2:1
78.50° 2 FLASH KEEPOUT
2 33.50° FLASH KEEPOUT
2 1.61 FLASH KEEPOUT
2 5.63 FLASH KEEPOUT AT SURFACE
DETAIL C SCALE 2:1
2 120.00° REAR ALS KEEPOUT
2 3.12 REAR ALS KEEPOUT AT SURFACE
DETAIL D SCALE 2:1
2.68 FCAM 4
2.50 FRONT ALS 3
3.50 IR CAM 4
6X 4.71
Ø0.80 FRONT MIC OPENING
Ø1.60 FRONT MIC 1 KEEPOUT
4 3.50 FLOOD ILLUMINATOR, DOT PROJECTOR
DETAIL F SCALE 2:1
3 4.23 FRONT ALS KEEPOUT AT SURFACE
3 2X 120.00° FRONT ALS KEEPOUT
DETAIL E SCALE 2:1
121.01° FCAM KEEPOUT 4
3.89 FCAM KEEPOUT AT SURFACE 4
DETAIL H SCALE 2:1
89.23° IR CAM KEEPOUT 4
4 2.93 IR CAM KEEPOUT AT SURFACE
DETAIL K SCALE 2:1
100.00° DOT PROJECTOR KEEPOUT 4
4 69.96° FLOOD ILLUMINATOR KEEPOUT
3.45 DOT PROJECTOR KEEPOUT AT SURFACE 4
3.50 FLOOD ILLUMINATOR KEEPOUT AT SURFACE 4
DETAIL G SCALE 2:1
1 28X Ø1.60 SPKR
1 28X 2.54 SPKR
1 2X 35.07 SPKR
1 2X 65.49 SPKR
112.03 USB-C CONNECTOR
103.49 USB-C CONNECTOR
2.19 RCAM
BOTTOM SPEAKERS: 1MM KEEPOUT ALL AROUND 1 X 45 OUTWARD ANGLE
12.45 RECOMMENDED CONNECTOR KEEPOUT
6.60 RECOMMENDED CONNECTOR KEEPOUT
DETAIL AD SCALE 5:1
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE EXTENDS OUTWARD 14.0 MM
METRIC
Apple Inc.
iPad Pro 13-inch (M4)
SHT 1 OF 5
NX GENERATED


1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: TOP MIC, SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS (SPKR)
2 DO NOT OBSTRUCT REAR CAMERA (RCAM), REAR FLASH, REAR LIDAR, & REAR AMBIENT LIGHT SENSOR (ALS)
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
4 DO NOT OBSTRUCT FRONT CAMERA (FCAM) CAMERA, INFRARED CAMERA (IR CAM), FLOOD ILLUMINATOR, & DOT PROJECTOR
5 ACCESSORY SHALL NOT DAMAGE COATINGS ON DISPLAY IN ANY OPERATING CONDITION.
FOR EXAMPLE: BACKPACK CARRY, CLOSED MODE, STORAGE MODE, USE WITH STYLUS.
ABRASIVE SURFACES AND SHARP EDGES OF HARD PLASTIC, METAL, OR GLASS COMPONENTS
IN THE ACCESSORY SHALL NOT CONTACT THE DISPLAY WITHIN THE ACTIVE AREA.
Ø3.60 REAR ALS 3
Ø10.83 REAR CAMERA 2
Ø6.70 FLASH 2
Ø1.72 REAR MIC OPENING 1
Ø3.44 REAR MIC KEEPOUT 1
Ø8.41 LIDAR 2
LIDAR 2
LIDAR 1
DETAIL L
SCALE 3:1
DETAIL M
SCALE 3:1
DETAIL P
SCALE 20:1
7.31 RCAM TURRET
TO COVERGALSS SURFACE
5.125
SYSTEM THICKNESS
2X 10.06 VOLUME BUTTONS
2X 2.26 VOLUME BUTTONS
31.39
VOL (-)
19.33
VOL (+)
COVER GLASS (CG)
MAGNETIC CONNECTOR KEEPOUT
NO METAL ALLOWABLE IN THIS AREA
153.55
128.02
2.55
SIDE MIC
24.36
SIDE MIC
Ø1.60
SIDE MIC KEEPOUT
Ø0.80
SIDE MIC OPENING
3 REAR ALS
128.86
2 RCAM 126.76
2 FLASH 120.75
2 LIDAR 114.74
1 112.81
REAR MIC
2X -93.74
3X -80.95
100.36
3X Ø3.40
PIN DIAMETER
3X Ø4.26
HOUSING OPENING
3X 12.00
DETAIL N
SCALE 3:1
Apple Inc.
SHT 2 OF 5

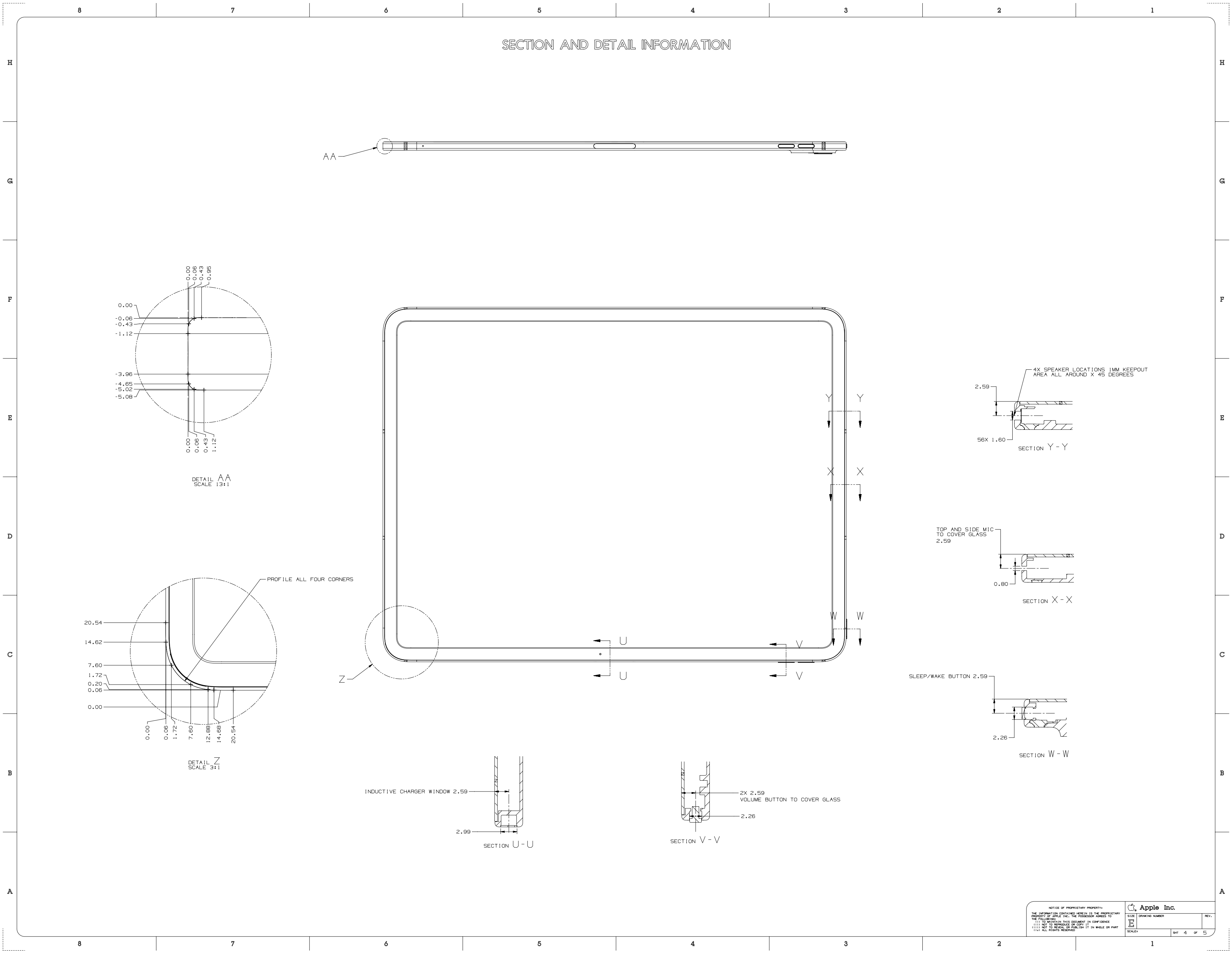
MAGNET DETAIL

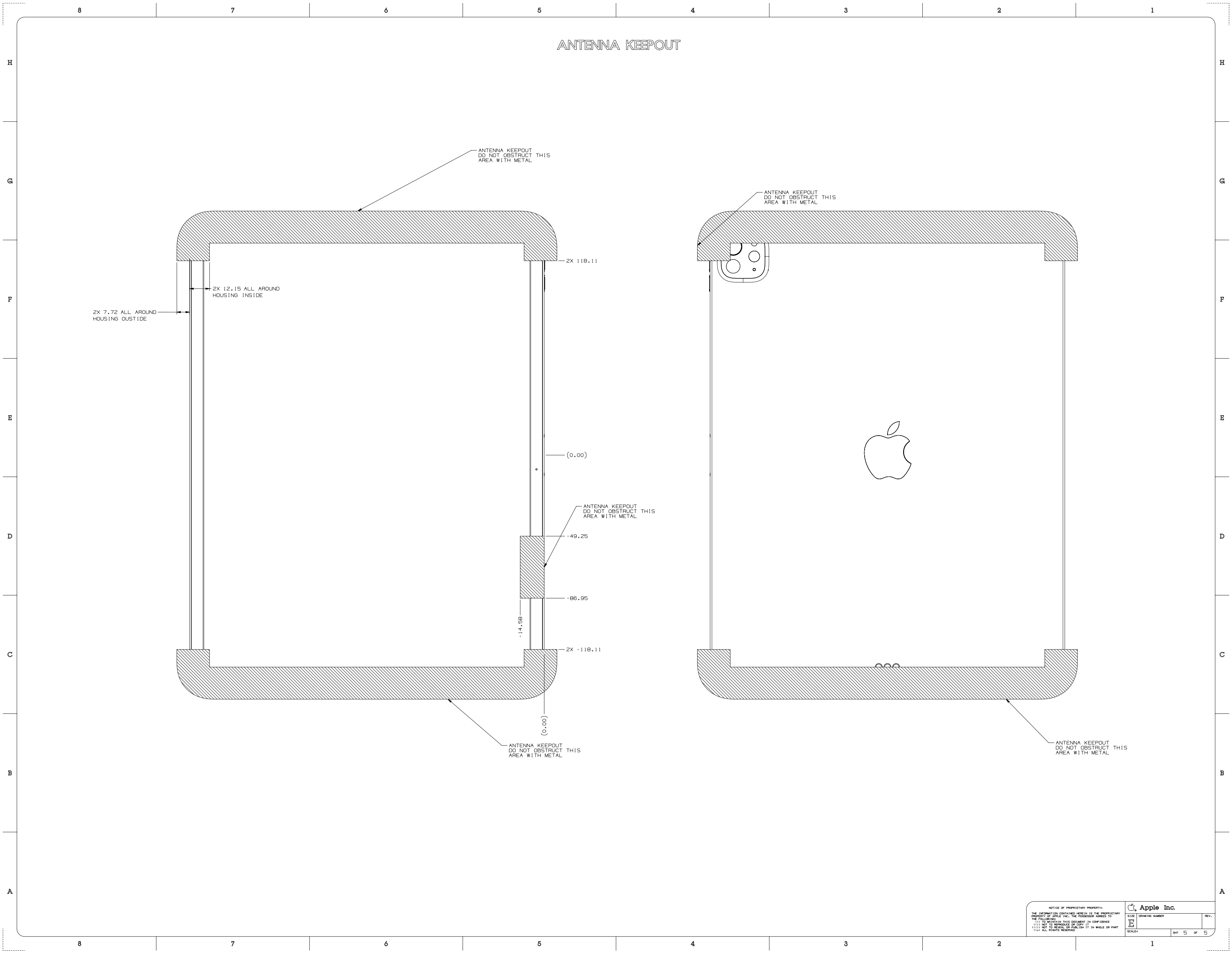


LOCATION	POLARITY TOWARD INSIDE OF DEVICE/FARTHEST AWAY FROM PROBE LOCATION	POLARITY TOWARD SURFACE OF DEVICE/CLOSEST TO PROBE LOCATION
L1	S	N
L2	N	S
L3	S	N
L4	N	S
L5	S	N
L6	N	S
L7	S	N
L8	N	S
L9	S	N
L10	N	S
L11	N	S
L12	S	N
BV1-11	N	S
BV1-12	S	N
BV1-13	N	S
BV1-14	S	N
BV1-15	N	S
BV1-16	N	S
BV1-21	S	N
BV1-22	N	S
BV1-23	S	N
BV1-24	N	S
BV1-25	S	N
BV1-26	S	N
O1	S	N
O2	N	S
O3	S	N
O4	S	N
O5	N	S
O6	S	N
BV2-11	N	S
BV2-12	S	N
BV2-21	S	N
BV2-22	N	S
BV2-31	N	S
BV2-32	S	N
BV2-41	N	S
BV2-42	S	N
BV2-43	N	S
BV2-44	S	N
BV2-51	S	N
BV2-52	S	N
BV2-53	N	S
BV2-54	S	N
BV2-61	N	S
BV2-62	N	S
BV2-63	S	N
BV2-64	N	S
PM-CH-1	N	S
PM-CH-2	N (TOWARD USB-C)	S (TOWARD REAR CAM)
PM-CH-3	S	N
PM-CH-4	S (TOWARD USB-C)	N (TOWARD REAR CAM)
PM-FH-1	N (TOWARD USB-C)	S (TOWARD REAR CAM)
PM-FH-2	S	N
PM-FH-3	S (TOWARD USB-C)	N (TOWARD REAR CAM)
PM-FH-4	N	S
BV3-11	S	N
BV3-12	S	N
BV3-13	N	S
BV3-14	N	S
BV3-21	N	S
BV3-22	N	S
BV3-23	S	N
BV3-31	S	N
BV3-41	S	N
BV3-42	N	S
BV3-51	N	S
BV3-52	S	N
BV3-53	N	S
BV3-54	S	N
BV3-55	N	S
BV3-56	S	N
BV3-61	N	S
BV3-62	N	S
BV3-63	S	N
BV3-64	N	S
BV3-65	S	N
BV3-66	S	N
BV4-11	S	N
BV4-12	N	S
BV4-13	N	S
BV4-14	S	N
BV4-15	N	S
BV4-16	S	N
BV4-21	N	S
BV4-22	S	N
BV4-23	S	N
BV4-24	N	S
BV4-25	S	N
BV4-26	N	S
CG-C3-1	S	N (TOWARD GLASS)
CG-C3-2	N	S (TOWARD GLASS)
CG-C3-SHUNT	NONE	NONE
CG-C2-1	N	S (TOWARD GLASS)
CG-C2-2	S	N (TOWARD GLASS)

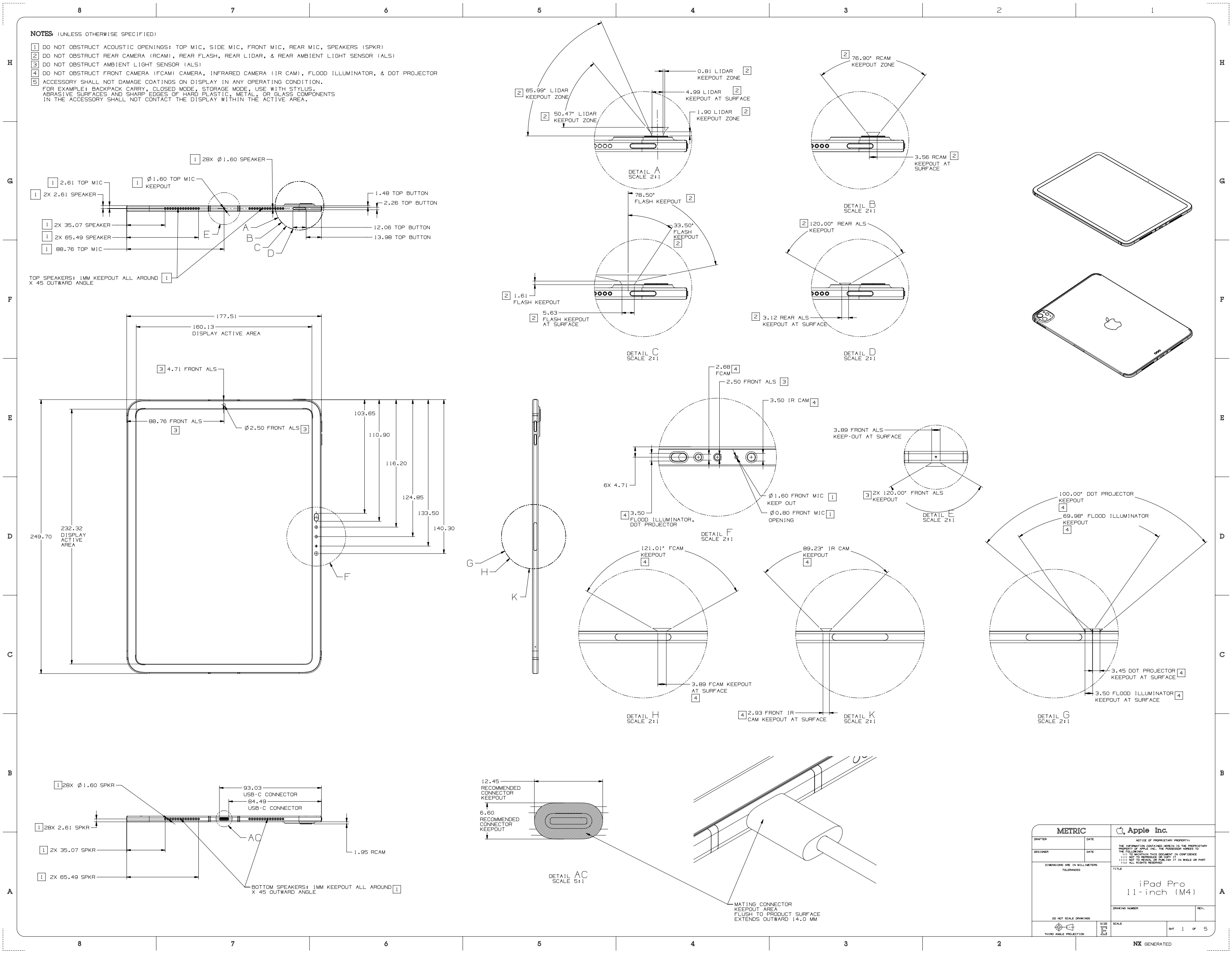


Apple Inc.
SIZE E SHT 3 OF 5

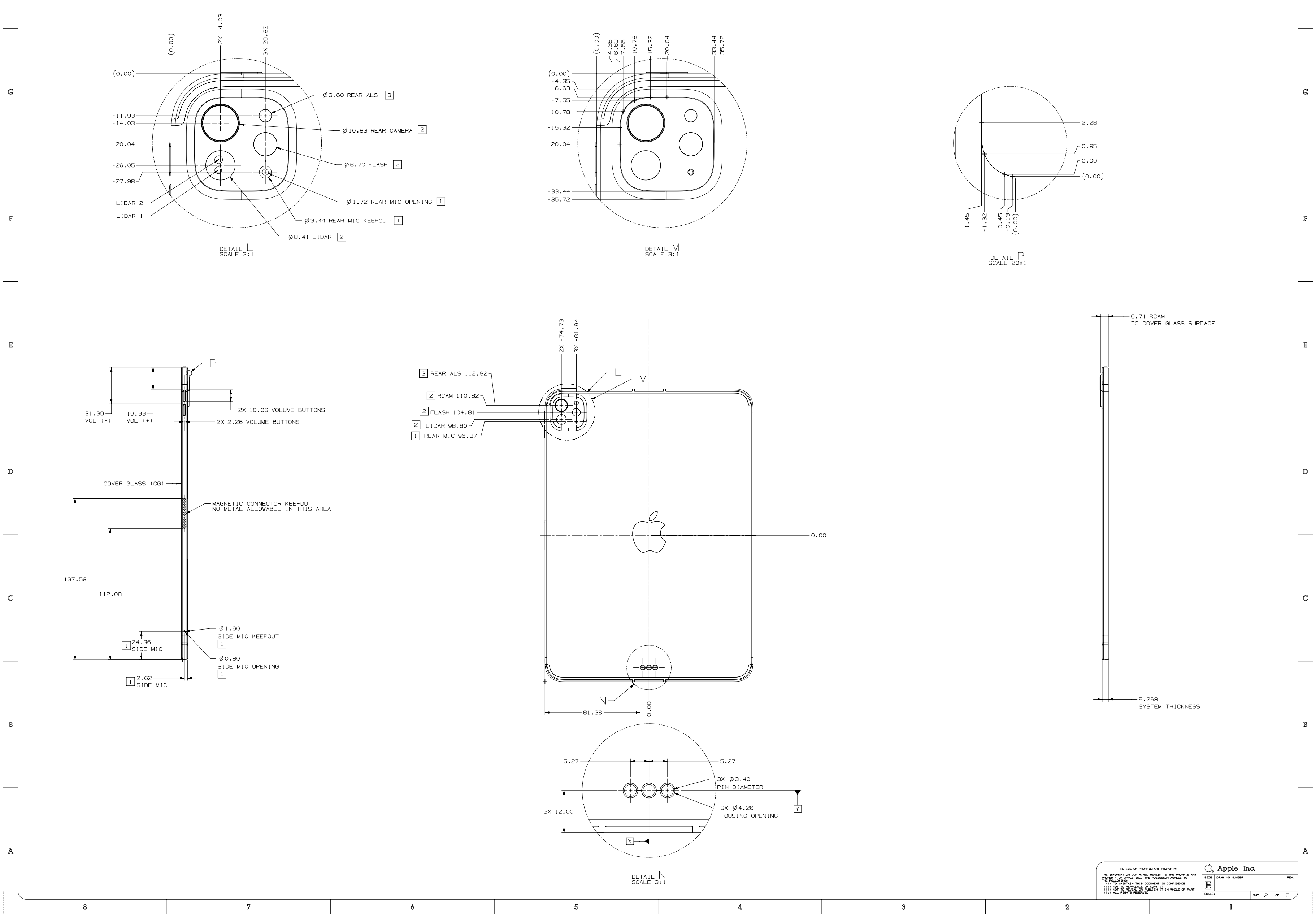

SECTION AND DETAIL INFORMATION
AA
Y
X
W
U
V
Z
0.00
0.06
0.43
0.95
-0.06
-0.43
-1.12
-3.96
-4.65
-5.02
-5.08
1.12
DETAIL AA
SCALE 13:1
PROFILE ALL FOUR CORNERS
20.54
14.62
7.60
1.72
0.20
12.88
14.68
DETAIL Z
SCALE 3:1
4X SPEAKER LOCATIONS 1MM KEEPOUT
AREA ALL AROUND X 45 DEGREES
2.59
56X 1.60
SECTION Y-Y
TOP AND SIDE MIC
TO COVER GLASS
2.59
0.80
SECTION X-X
SLEEP/WAKE BUTTON 2.59
2.26
SECTION W-W
INDUCTIVE CHARGER WINDOW 2.59
2.99
SECTION U-U
2X 2.59
VOLUME BUTTON TO COVER GLASS
2.26
SECTION V-V
Apple Inc.
E
SHT 4 OF 5


ANTENNA KEEPOUT
ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL
2X 12.15 ALL AROUND HOUSING INSIDE
2X 7.72 ALL AROUND HOUSING OUSTIDE
2X 118.11
(0.00)
ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL
-49.25
-86.95
-14.58
2X -118.11
(0.00)
ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL
ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL
ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL
Apple Inc.
SHT 5 OF 5

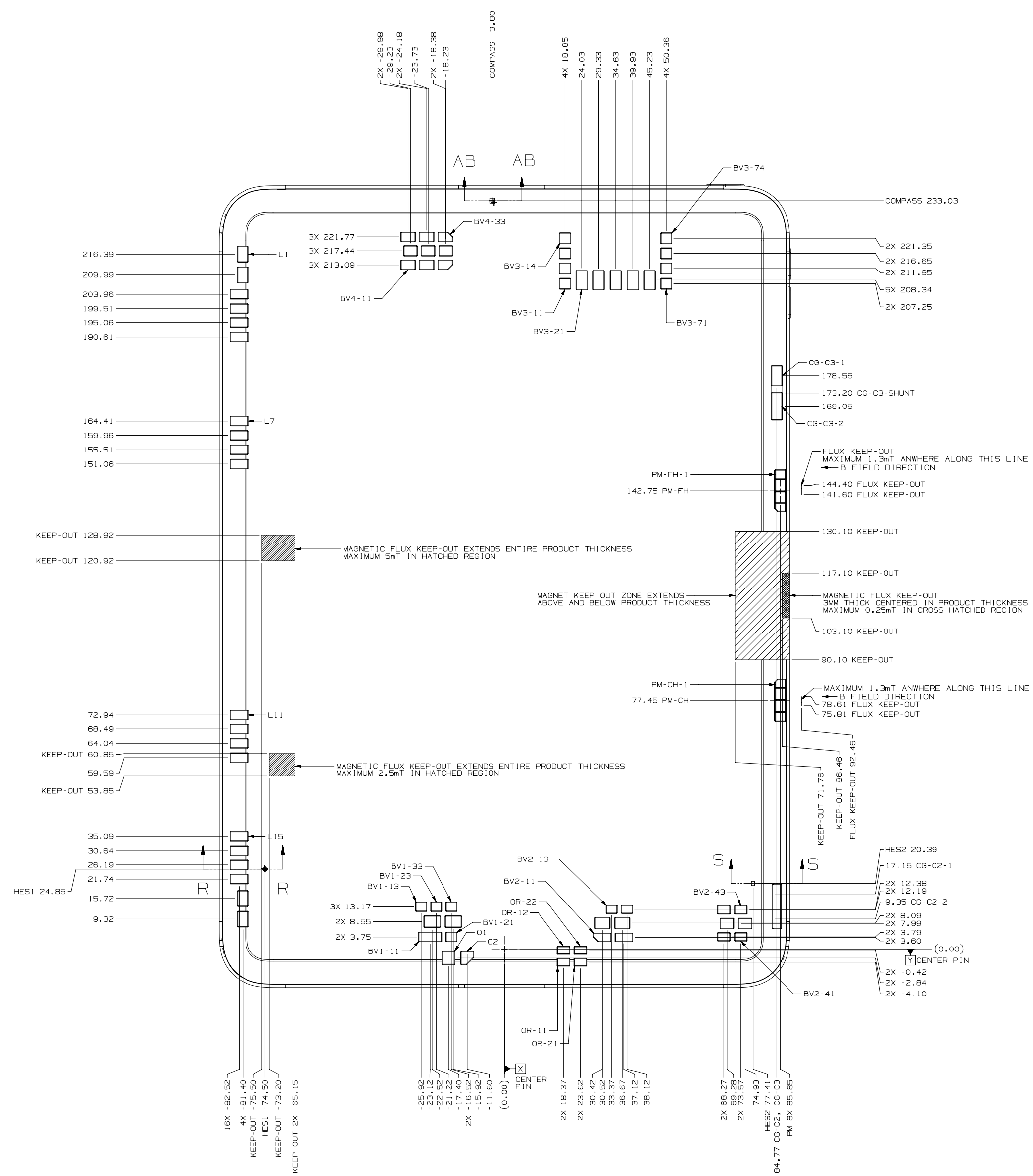
60.106 iPad Pro 11-inch (M4), 1 of 5

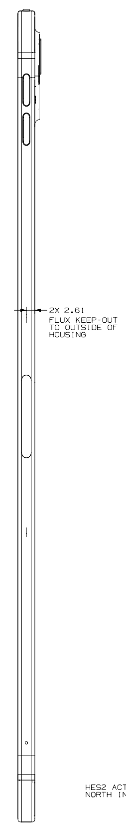


1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: TOP MIC, SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS (SPKR)
2 DO NOT OBSTRUCT REAR CAMERA (RCAM), REAR FLASH, REAR LIDAR, & REAR AMBIENT LIGHT SENSOR (ALS)
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
4 DO NOT OBSTRUCT FRONT CAMERA (FCAM) CAMERA, INFRARED CAMERA (IR CAM), FLOOD ILLUMINATOR, & DOT PROJECTOR
5 ACCESSORY SHALL NOT DAMAGE COATINGS ON DISPLAY IN ANY OPERATING CONDITION.
FOR EXAMPLE: BACKPACK CARRY, CLOSED MODE, STORAGE MODE, USE WITH STYLUS.
ABRASIVE SURFACES AND SHARP EDGES OF HARD PLASTIC, METAL, OR GLASS COMPONENTS IN THE ACCESSORY SHALL NOT CONTACT THE DISPLAY WITHIN THE ACTIVE AREA.

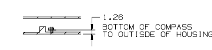


MAGNET DETAIL

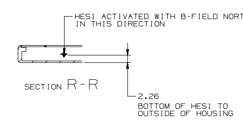




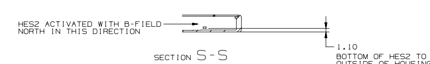
LOCATION	POLARITY TOWARD INSIDE OF DEVICE/FARTHEST AWAY FROM PROBE LOCATION	POLARITY TOWARD COSMETIC SURFACE OF DEVICE/CLOSEST TO PROBE LOCATION
L1	S	N
L2	N	S
L3	S	N
L4	N	S
L5	S	N
L6	N	S
L7	S	N
L8	N	S
L9	S	N
L10	N	S
L11	S	N
L12	N	S
L13	S	N
L14	N	S
L15	S	N
L16	N	S
L17	S	N
L18	N	S
L19	S	N
L20	N	S
BV1-11	N	S
BV1-12	S	N
BV1-13	S	N
BV1-21	S	N
BV1-22	N	S
BV1-23	N	S
BV1-33	S	N
O1	S	N
O2	N	S
OR-11	N	S
OR-12	S	N
OR-21	S	N
OR-22	N	S
BV2-11	S	N
BV2-12	N	S
BV2-13	N	S
BV2-21	N	S
BV2-22	S	N
BV2-23	S	N
BV2-31	N	S
BV2-32	S	N
BV2-33	S	N
BV2-41	S	N
BV2-42	N	S
BV2-43	N	S
PM-CH-1	N	S
PM-CH-2	S (TOWARD REAR CAM)	N (TOWARD USB-C)
PM-CH-3	S	N
PM-CH-4	N (TOWARD REAR CAM)	S (TOWARD USB-C)
PM-FH-1	S (TOWARD REAR CAM)	N (TOWARD USB-C)
PM-FH-2	S	N
PM-FH-3	N (TOWARD REAR CAM)	S (TOWARD USB-C)
PM-FH-4	N	S
BV3-11	N	S
BV3-12	S	N
BV3-13	N	S
BV3-14	S	N
BV3-21	S	N
BV3-31	N	S
BV3-41	S	N
BV3-51	N	S
BV3-61	S	N
BV3-71	S	N
BV3-72	N	S
BV3-73	S	N
BV3-74	N	S
BV4-11	S	N
BV4-12	N	S
BV4-13	N	S
BV4-21	N	S
BV4-22	S	N
BV4-23	N	S
BV4-31	S	N
BV4-32	N	S
BV4-33	S	N
CG-C3-1	S	N (TOWARD GLASS)
CG-C3-2	N	S (TOWARD GLASS)
CG-C3-SHUNT	NONE	NONE
CG-C2-1	S	N (TOWARD GLASS)
CG-C2-2	N	S (TOWARD GLASS)



SECTION AB-AB



SECTION R-R



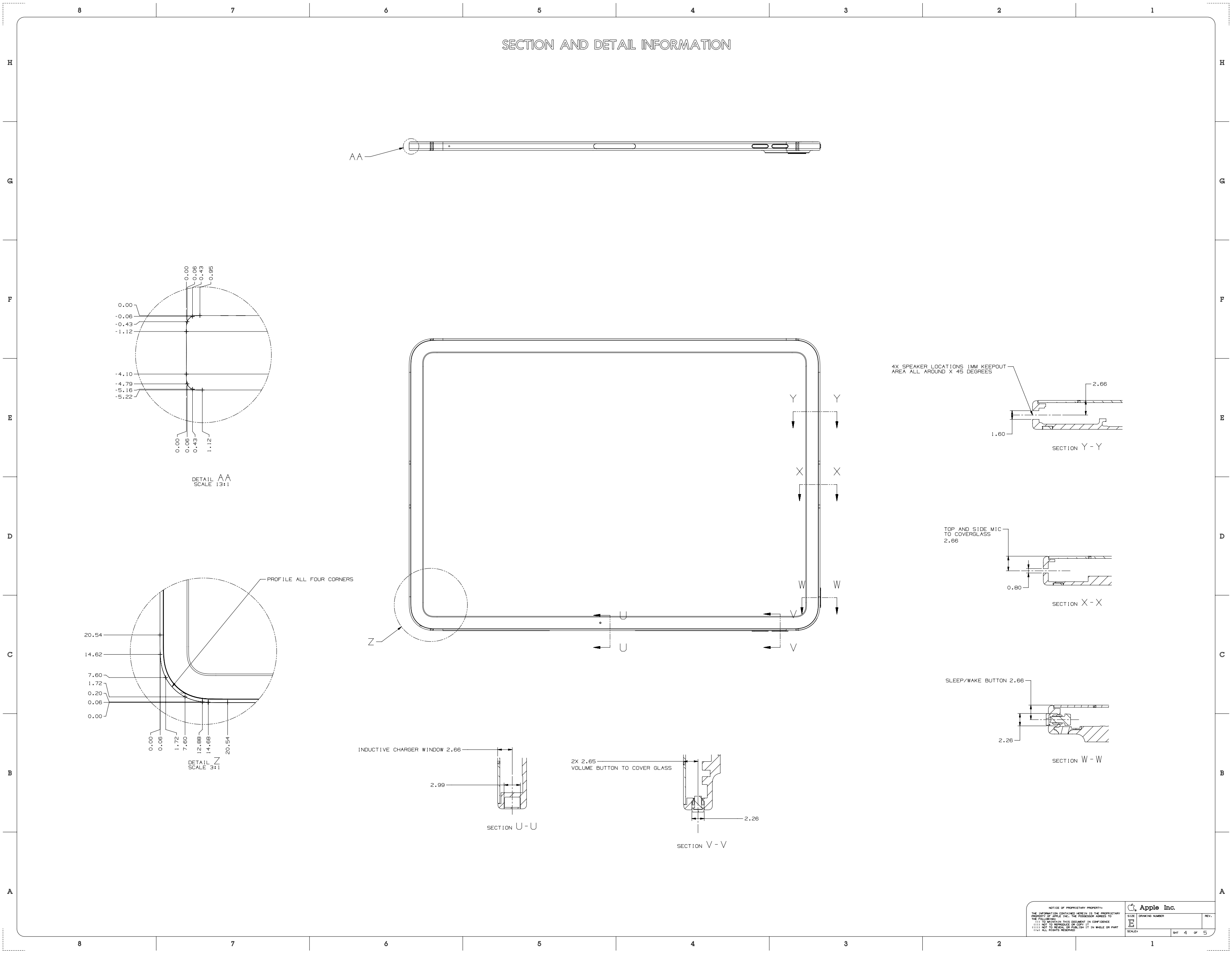
SECTION S-S

Apple Inc.

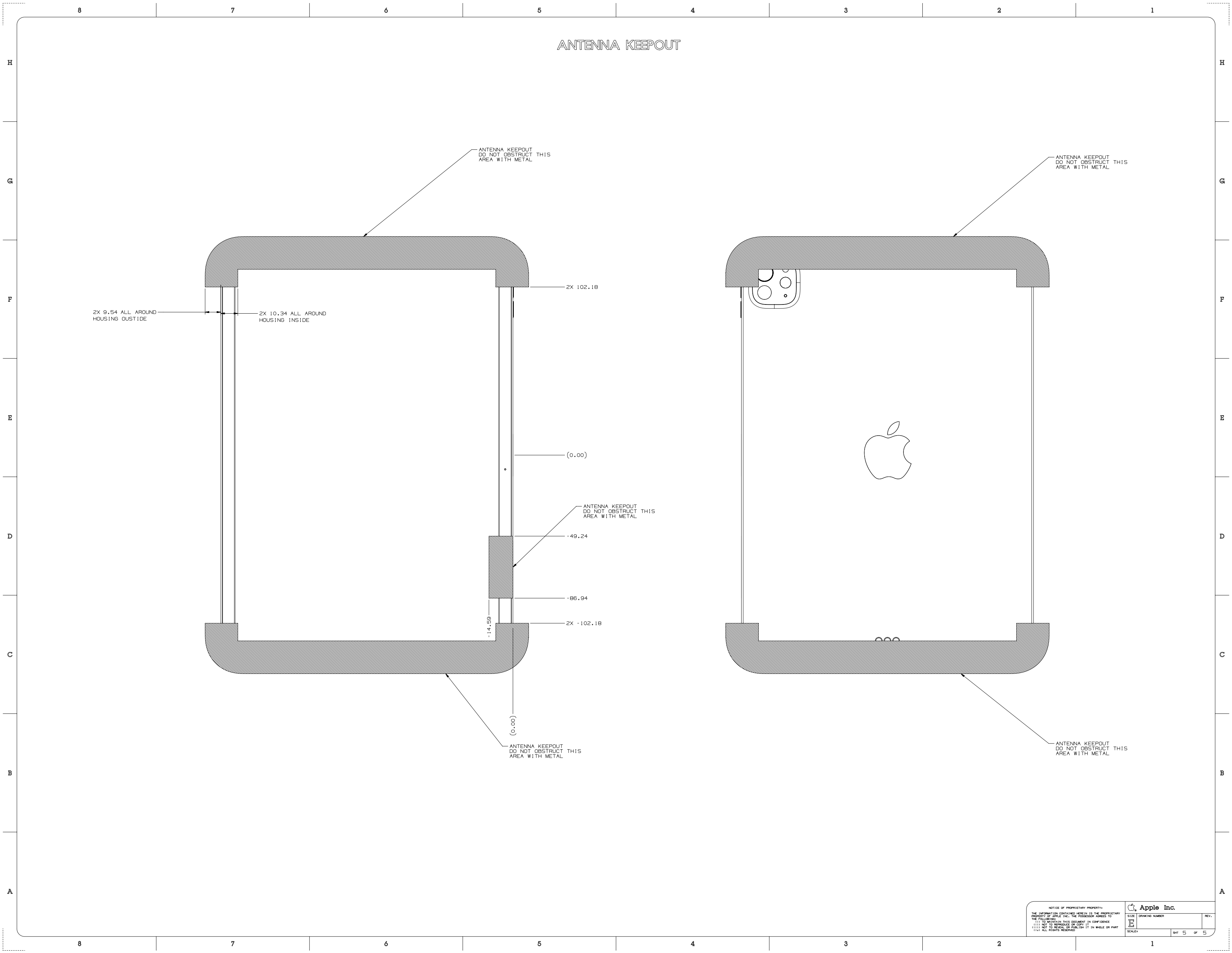
SIZE	DRAWING NUMBER	REV.
E		

SCALE: SHT 3 OF 5

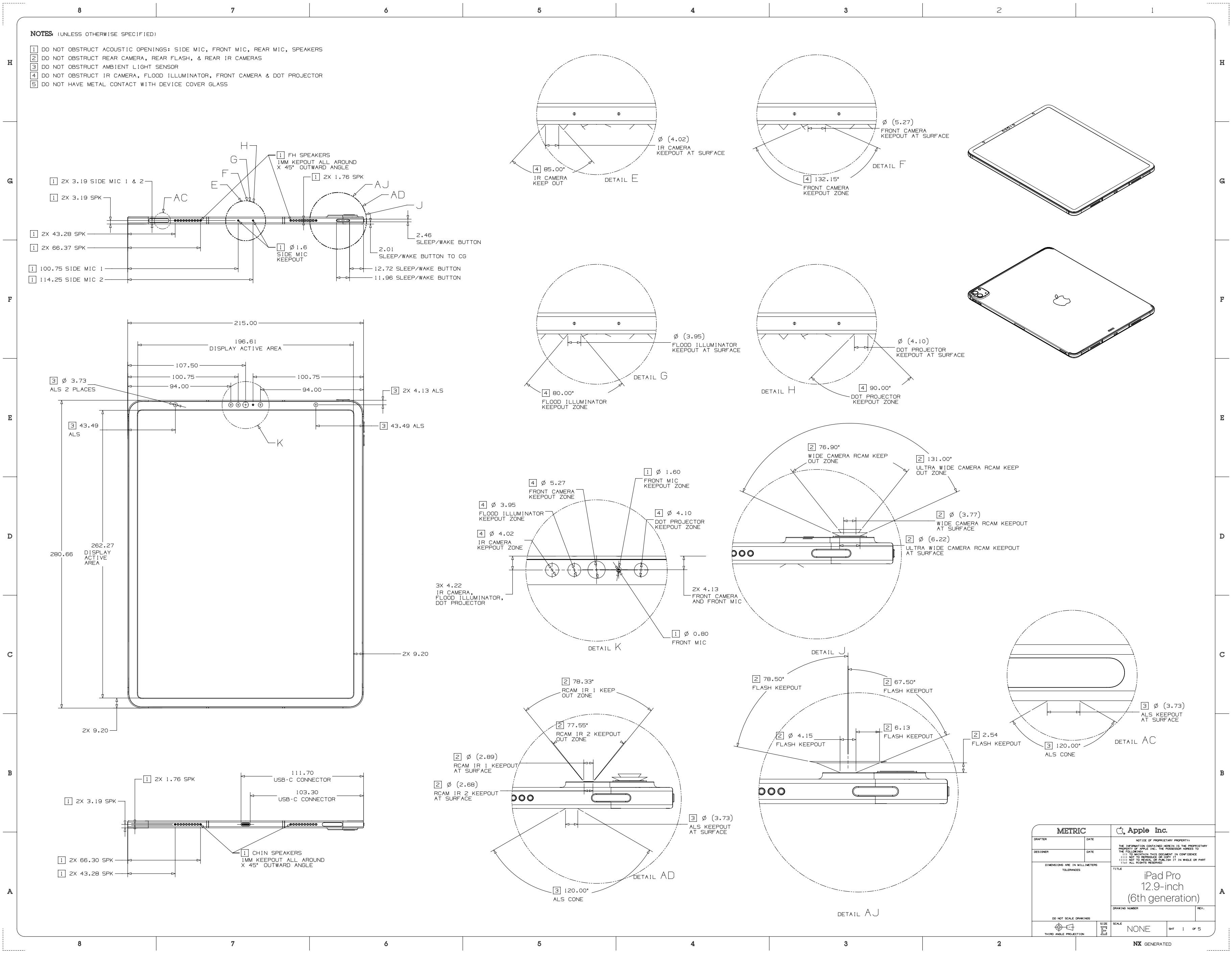
60.109 iPad Pro 11-inch (M4), 4 of 5



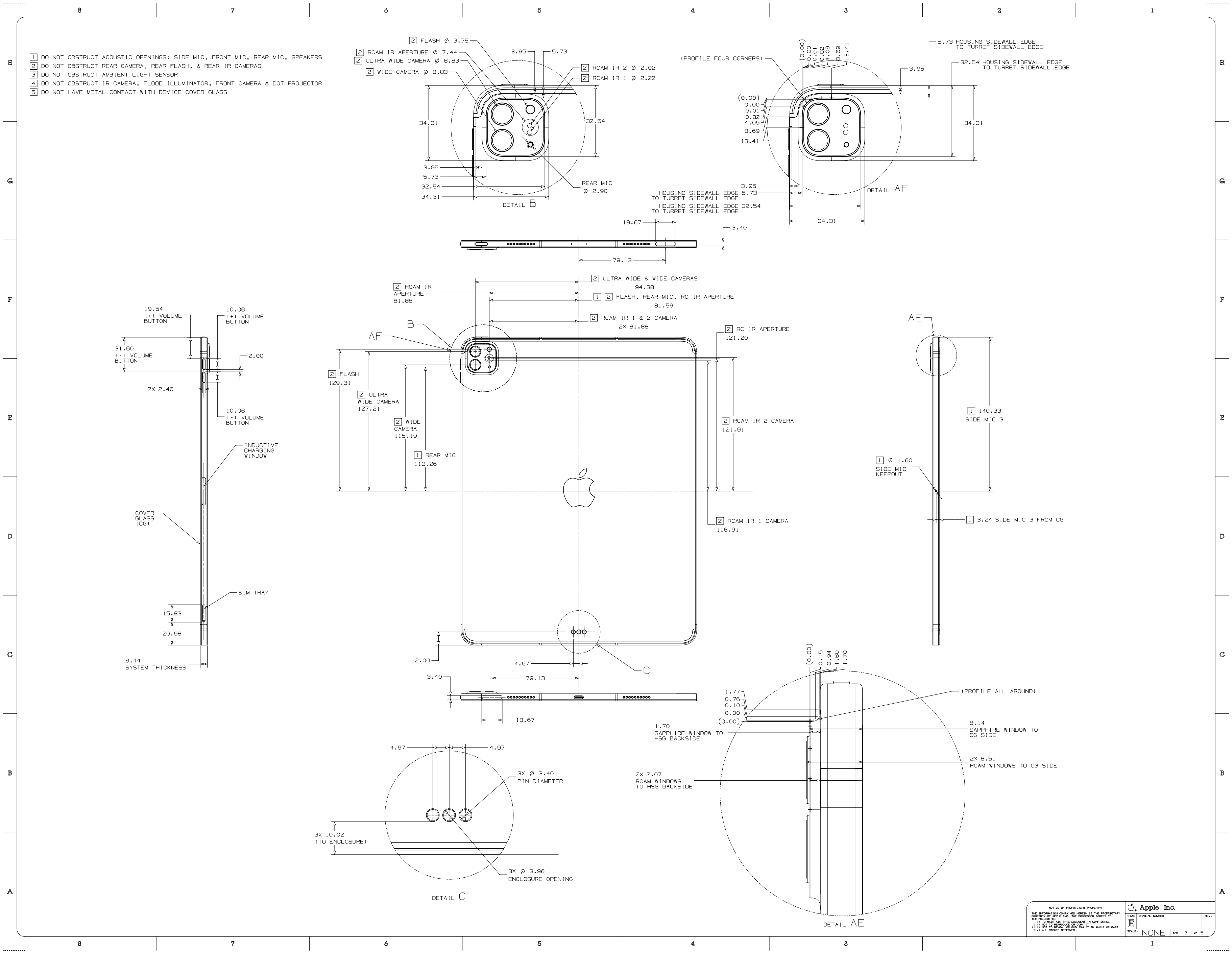
60.110 iPad Pro 11-inch (M4), 5 of 5

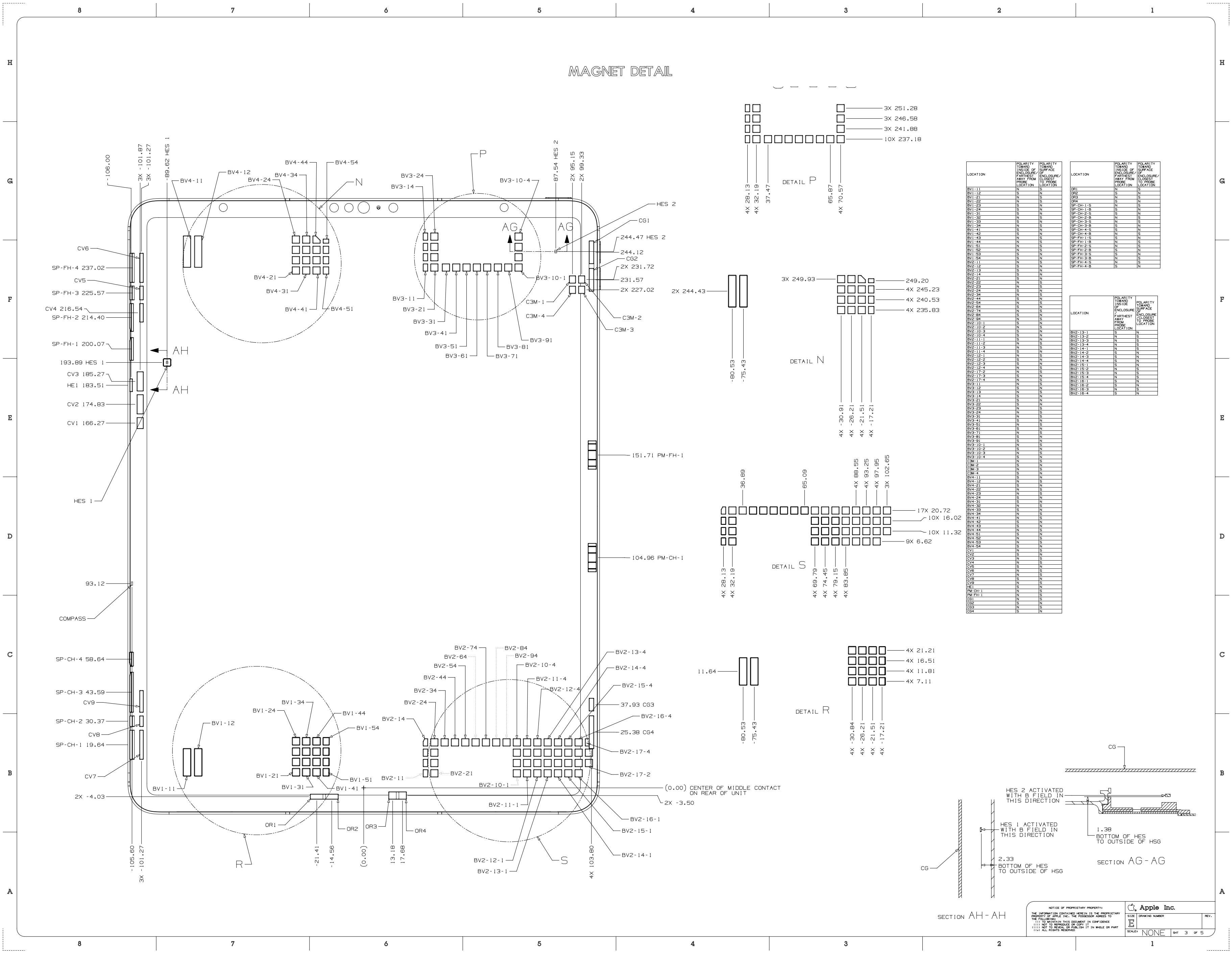


60.111 iPad Pro 12.9-inch (6th generation), 1 of 5



1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERAS
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
4 DO NOT OBSTRUCT IR CAMERA, FLOOD ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS



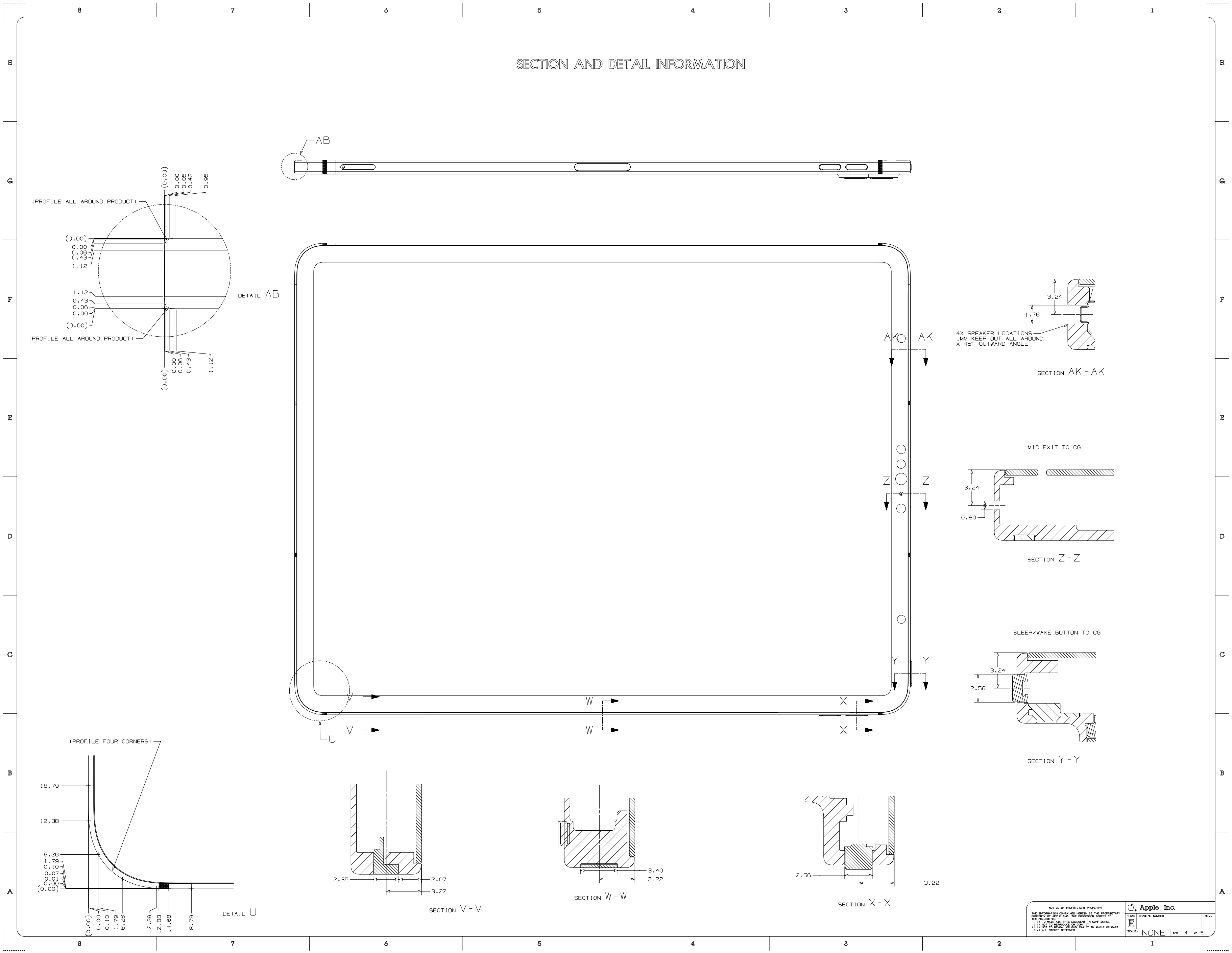


LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE/ FARTHEST AWAY FROM PROBE LOCATION	POLARITY TOWARD SURFACE OF ENCLOSURE/ CLOSEST TO PROBE LOCATION
BV1-11	N	S
BV1-12	S	N
BV1-21	N	S
BV1-22	N	S
BV1-23	S	N
BV1-24	S	N
BV1-31	S	N
BV1-32	N	S
BV1-33	S	N
BV1-34	N	S
BV1-41	S	N
BV1-42	S	N
BV1-43	N	S
BV1-44	N	S
BV1-51	N	S
BV1-52	N	S
BV1-53	S	N
BV1-54	S	N
BV2-11	N	S
BV2-12	S	N
BV2-13	S	N
BV2-14	S	N
BV2-21	S	N
BV2-22	N	S
BV2-23	N	S
BV2-24	S	N
BV2-34	N	S
BV2-44	S	N
BV2-54	N	S
BV2-64	S	N
BV2-74	N	S
BV2-84	S	N
BV2-94	N	S
BV2-10-1	S	N
BV2-10-2	N	S
BV2-10-3	S	N
BV2-10-4	S	N
BV2-11-1	S	N
BV2-11-2	N	S
BV2-11-3	N	S
BV2-11-4	S	N
BV2-12-1	N	S
BV2-12-2	S	N
BV2-12-3	S	N
BV2-12-4	N	S
BV2-17-2	N	S
BV2-17-3	S	N
BV2-17-4	N	S
BV3-11	N	S
BV3-12	S	N
BV3-13	N	S
BV3-14	S	N
BV3-21	S	N
BV3-22	S	N
BV3-23	N	S
BV3-24	N	S
BV3-31	N	S
BV3-41	S	N
BV3-51	N	S
BV3-61	S	N
BV3-71	N	S
BV3-81	S	N
BV3-91	S	N
BV3-10-1	N	S
BV3-10-2	S	N
BV3-10-3	N	S
BV3-10-4	S	N
C3M-1	N	S
C3M-2	S	N
C3M-3	N	S
C3M-4	S	N
BV4-11	S	N
BV4-12	N	S
BV4-21	S	N
BV4-22	N	S
BV4-23	N	S
BV4-24	S	N
BV4-31	S	N
BV4-32	N	S
BV4-33	S	N
BV4-34	N	S
BV4-41	N	S
BV4-42	S	N
BV4-43	S	N
BV4-44	N	S
BV4-51	S	N
BV4-52	N	S
BV4-53	N	S
BV4-54	S	N
CV1	N	S
CV2	S	N
CV3	N	S
CV4	N	S
CV5	S	N
CV6	N	S
CV7	N	S
CV8	S	N
CV9	N	S
HE1	S	N
PM-CH-1	N	S
PM-FH-1	N	S
CG1	N	S
CG2	S	N
CG3	N	S
CG4	S	N

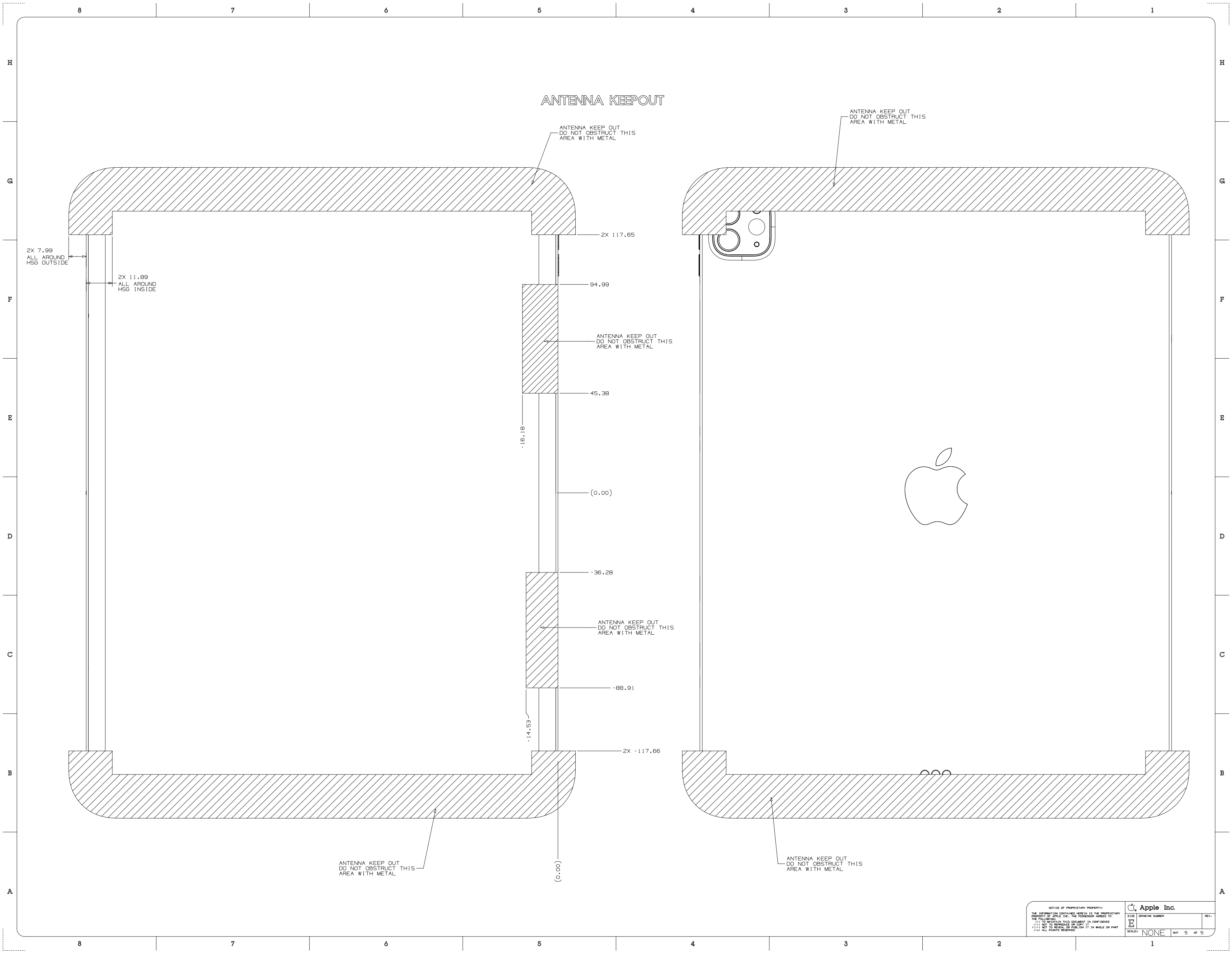
LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE/ FARTHEST AWAY FROM PROBE LOCATION	POLARITY TOWARD SURFACE OF ENCLOSURE/ CLOSEST TO PROBE LOCATION
OR1	N	S
OR2	S	N
OR3	N	S
OR4	S	N
SP-CH-1-S	N	S
SP-CH-1-B	S	N
SP-CH-2-S	S	N
SP-CH-2-B	N	S
SP-CH-3-S	N	S
SP-CH-3-B	S	N
SP-CH-4-S	S	N
SP-CH-4-B	N	S
SP-FH-1-S	S	N
SP-FH-1-B	N	S
SP-FH-2-S	N	S
SP-FH-2-B	S	N
SP-FH-3-S	S	N
SP-FH-3-B	N	S
SP-FH-4-S	N	S
SP-FH-4-B	S	N

LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE / FARTHEST AWAY FROM PROBE LOCATION	POLARITY TOWARD SURFACE OF ENCLOSURE /CLOSEST TO PROBE LOCATION
BV2-13-1	S	N
BV2-13-2	N	S
BV2-13-3	N	S
BV2-13-4	N	S
BV2-14-1	N	S
BV2-14-2	S	N
BV2-14-3	S	N
BV2-14-4	S	N
BV2-15-1	S	N
BV2-15-2	N	S
BV2-15-3	N	S
BV2-15-4	N	S
BV2-16-1	S	N
BV2-16-2	S	N
BV2-16-3	N	S
BV2-16-4	S	N

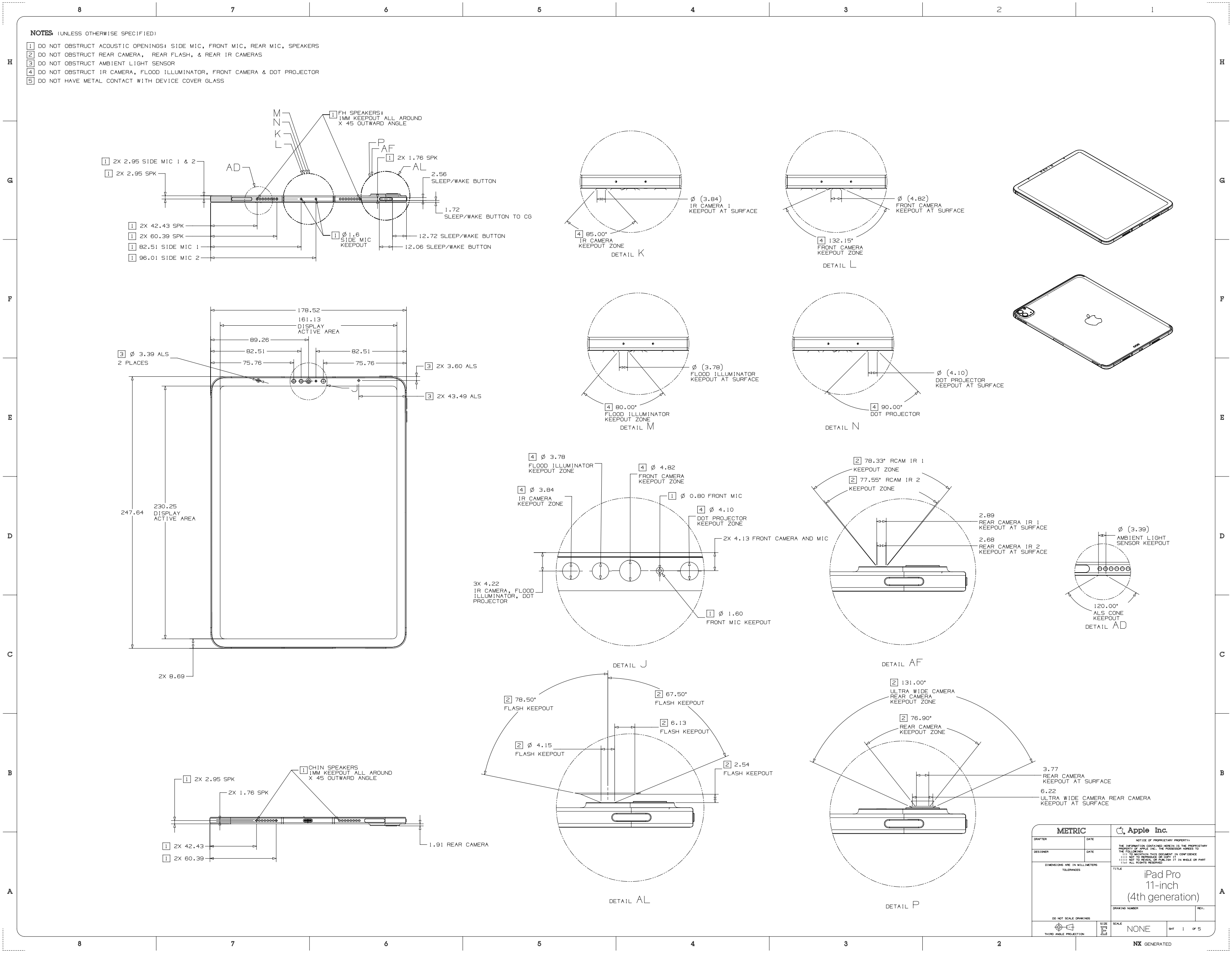
60.114 iPad Pro 12.9-inch (6th generation), 4 of 5



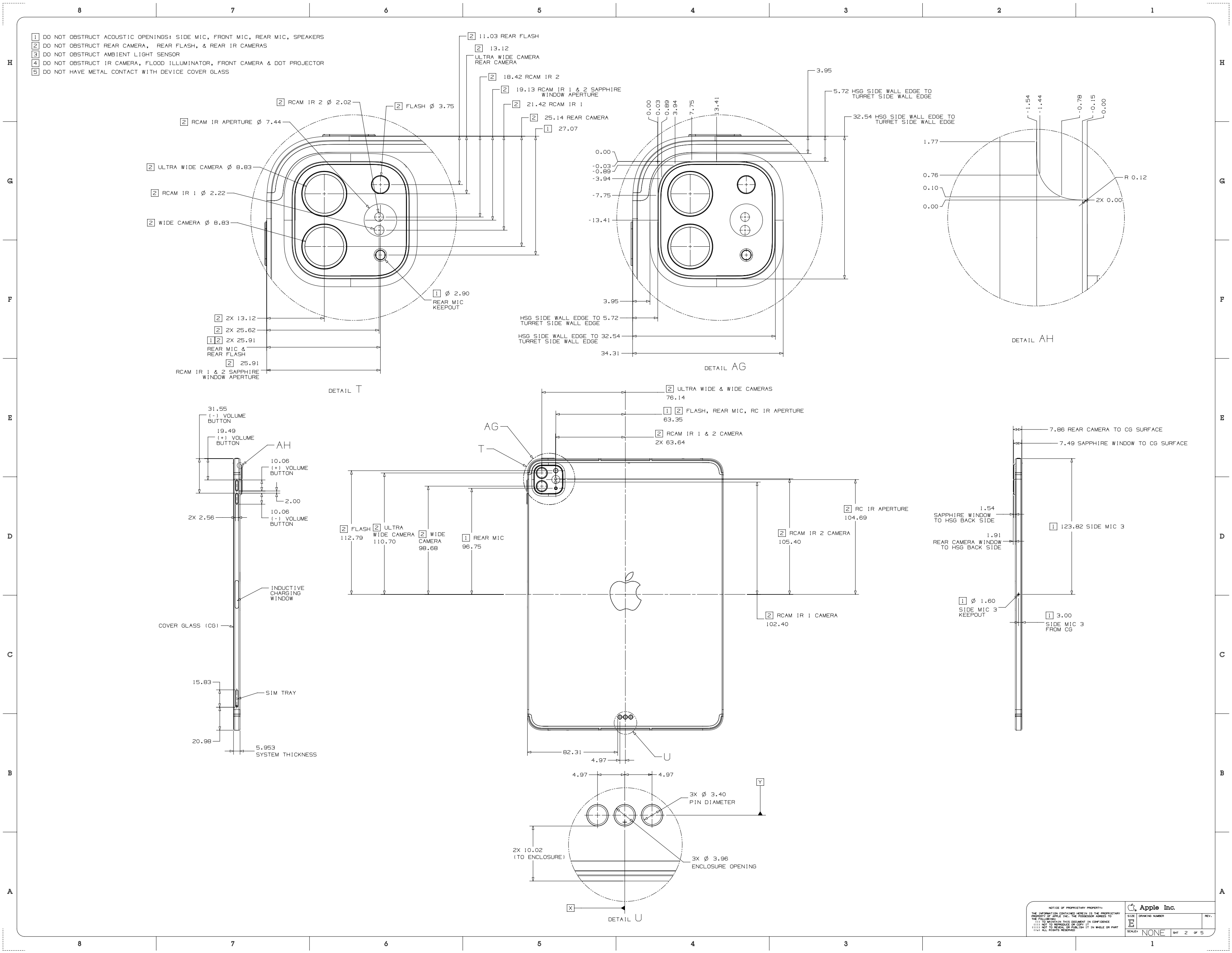
60.115 iPad Pro 12.9-inch (6th generation), 5 of 5



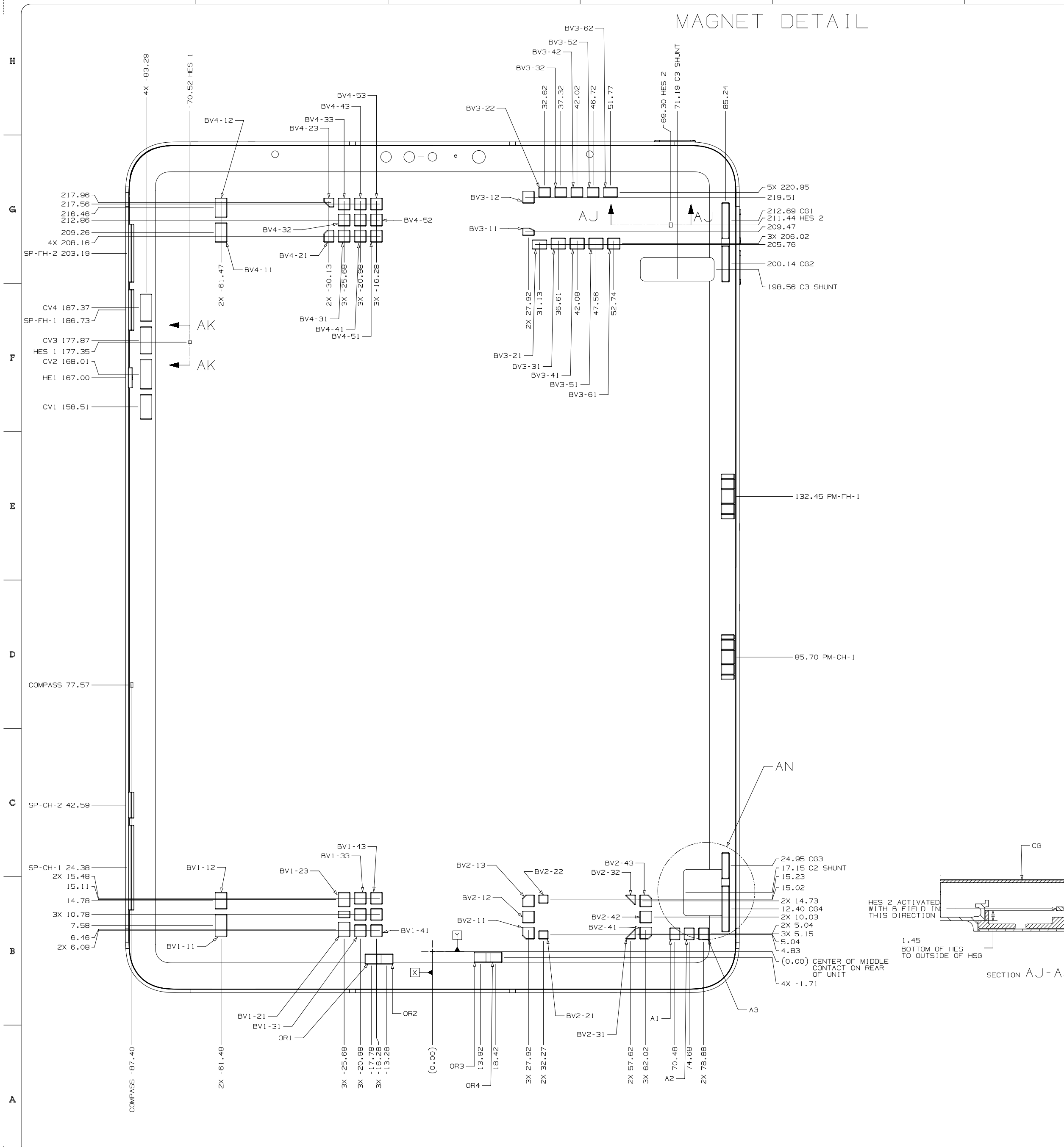
60.116 iPad Pro 11-inch (4th generation), 1 of 5



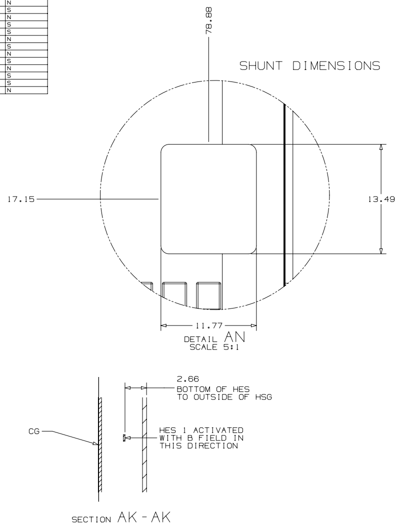
60.117 iPad Pro 11-inch (4th generation), 2 of 5



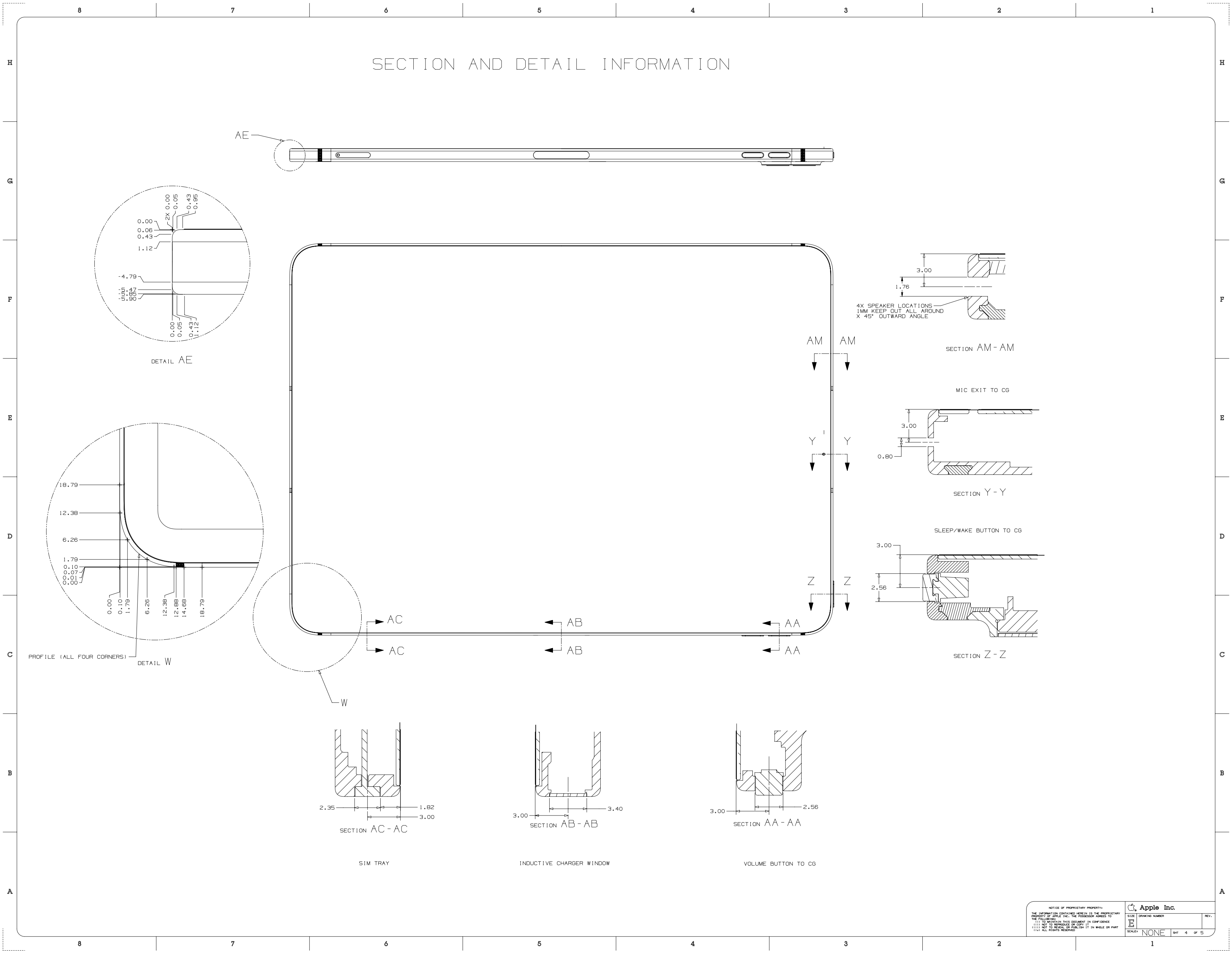
MAGNET DETAIL



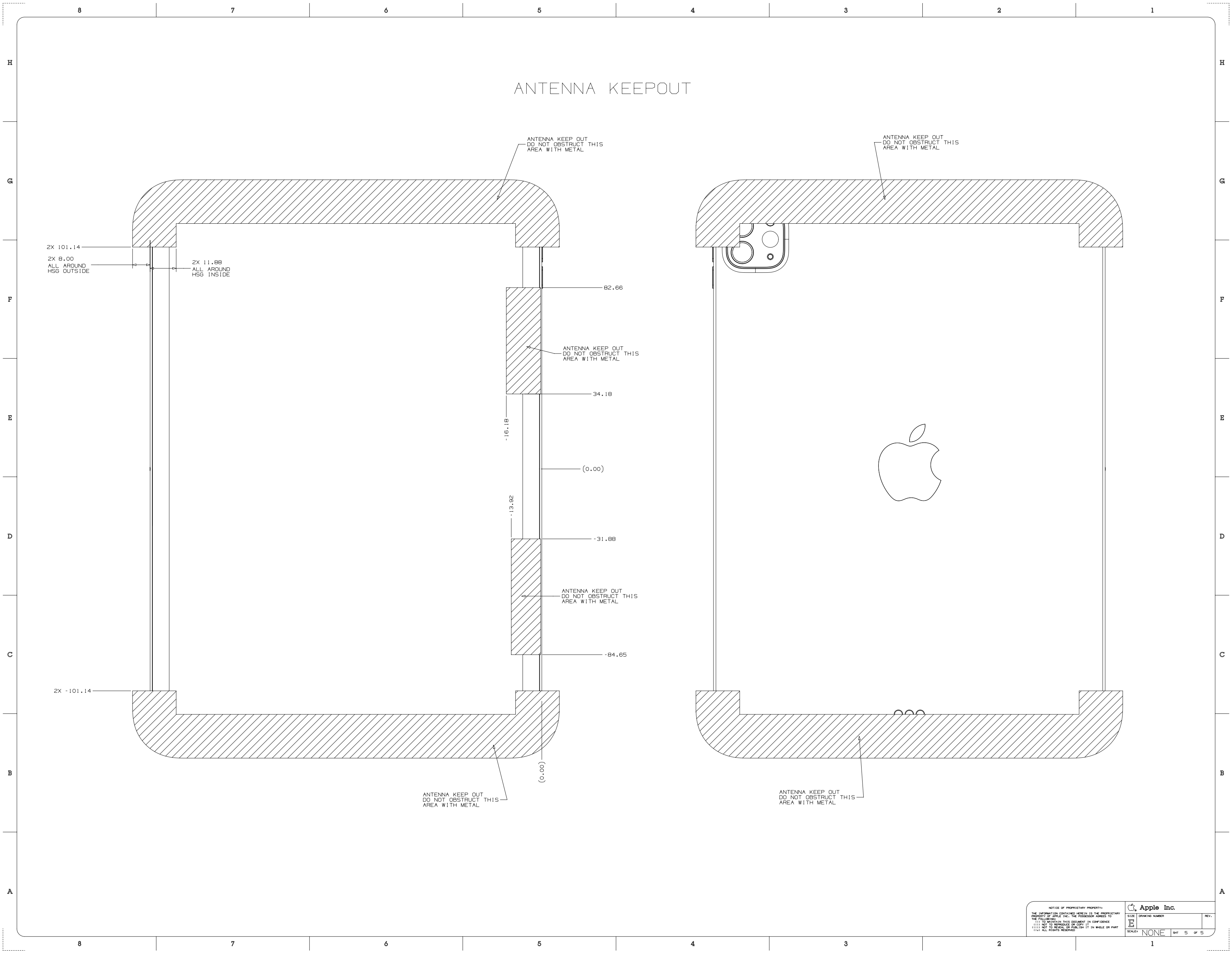
LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE	POLARITY TOWARD SURFACE OF ENCLOSURE
BV1-11	S	N
BV1-12	N	S
BV1-21	N	S
BV1-22	S	N
BV1-23	N	S
BV1-31	S	N
BV1-32	N	S
BV1-33	S	N
BV1-41	S	N
BV1-42	S	N
BV1-43	N	S
BV2-11	S	N
BV2-12	S	N
BV2-13	N	S
BV2-21	N	S
BV2-22	S	N
BV2-31	N	S
BV2-32	N	S
BV2-41	S	N
BV2-42	N	S
BV2-43	S	N
BV3-11	N	S
BV3-12	S	N
BV3-21	S	N
BV3-22	N	S
BV3-31	N	S
BV3-32	S	N
BV3-41	S	N
BV3-42	N	S
BV3-51	N	S
BV3-52	N	S
BV3-61	S	N
BV3-62	S	N
BV4-11	N	S
BV4-12	S	N
BV4-21	N	S
BV4-23	S	N
BV4-31	N	S
BV4-32	S	N
BV4-33	N	S
BV4-41	S	N
BV4-42	N	S
BV4-43	N	S
BV4-51	N	S
BV4-52	S	N
BV4-53	S	N
CV1	N	S
CV2	S	N
CV3	S	N
CV4	N	S
OR1	N	S
OR2	S	N
OR3	S	N
OR4	N	S
HE1	S	N
PM-FH-1	N	S
PM-CH-1	N	S
SP-CH-1-S	N	S
SP-CH-1-B	S	N
SP-CH-2-S	S	N
SP-CH-2-B	N	S
SP-FH-1-S	S	N
SP-FH-1-B	N	S
SP-FH-2-S	N	S
SP-FH-2-B	S	N
A1	N	S
A2	S	N
A3	N	S
CG1	S	N
CG2	N	S
CG3	N	S
CG4	S	N

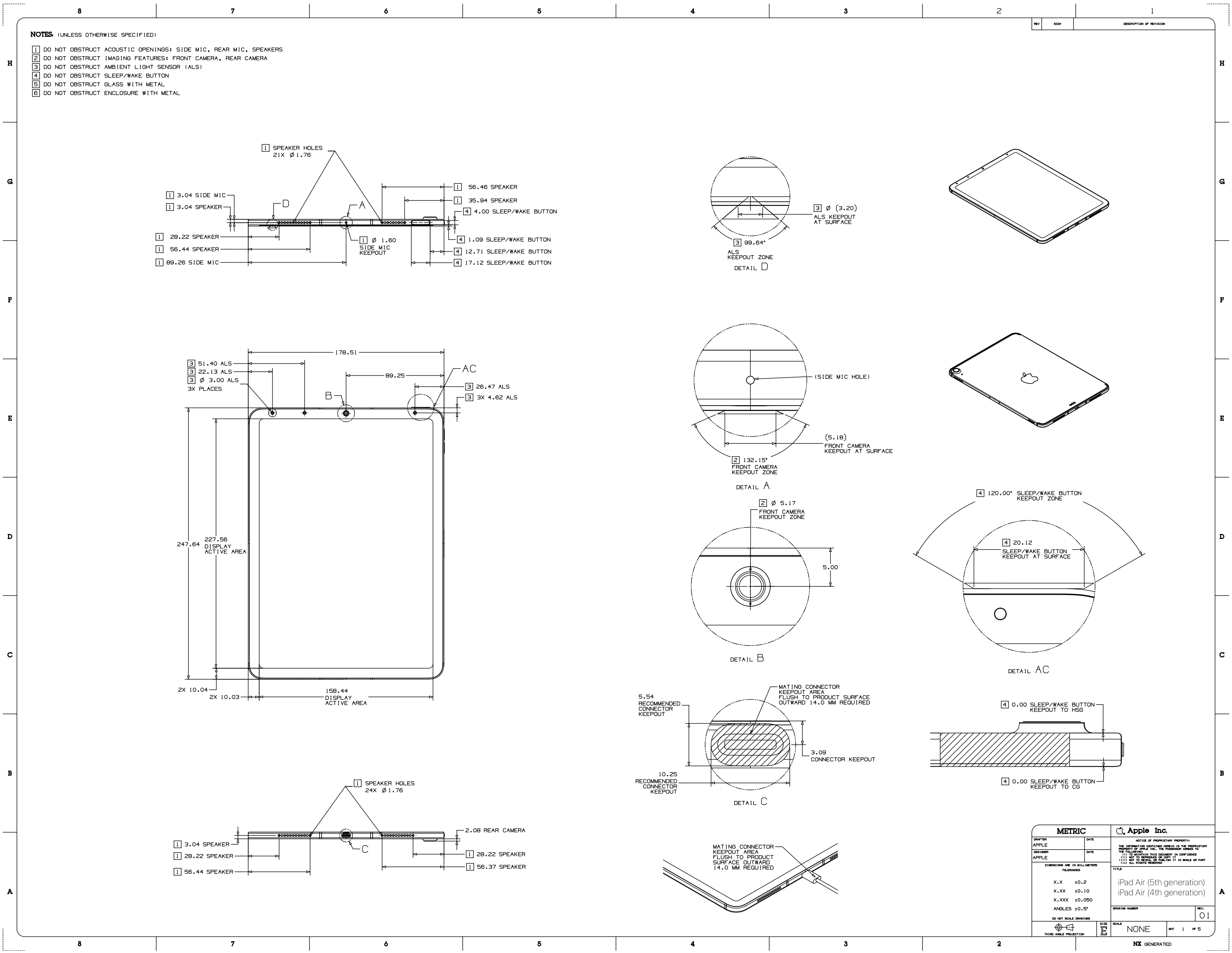


Apple Inc.
SIZE E
SCALE: NONE
SHT 3 OF 5

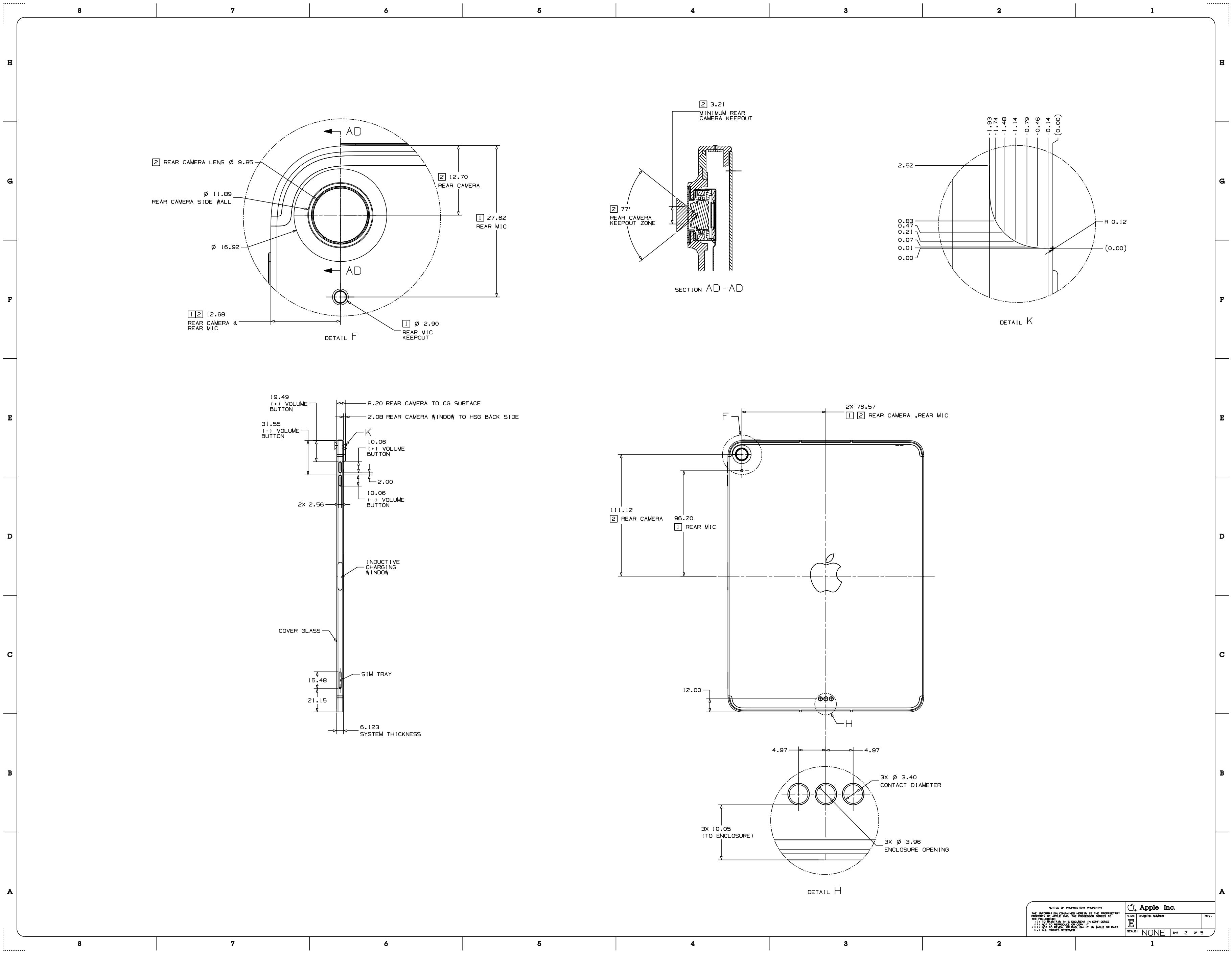

SECTION AND DETAIL INFORMATION
AE
DETAIL AE
PROFILE (ALL FOUR CORNERS)
DETAIL W
W
AC
AB
AA
AM
Y
Z
SECTION AM-AM
4X SPEAKER LOCATIONS 1MM KEEP OUT ALL AROUND X 45° OUTWARD ANGLE
MIC EXIT TO CG
SECTION Y-Y
SLEEP/WAKE BUTTON TO CG
SECTION Z-Z
SECTION AC-AC
SIM TRAY
SECTION AB-AB
INDUCTIVE CHARGER WINDOW
SECTION AA-AA
VOLUME BUTTON TO CG
Apple Inc.
NONE

60.120 iPad Pro 11-inch (4th generation), 5 of 5

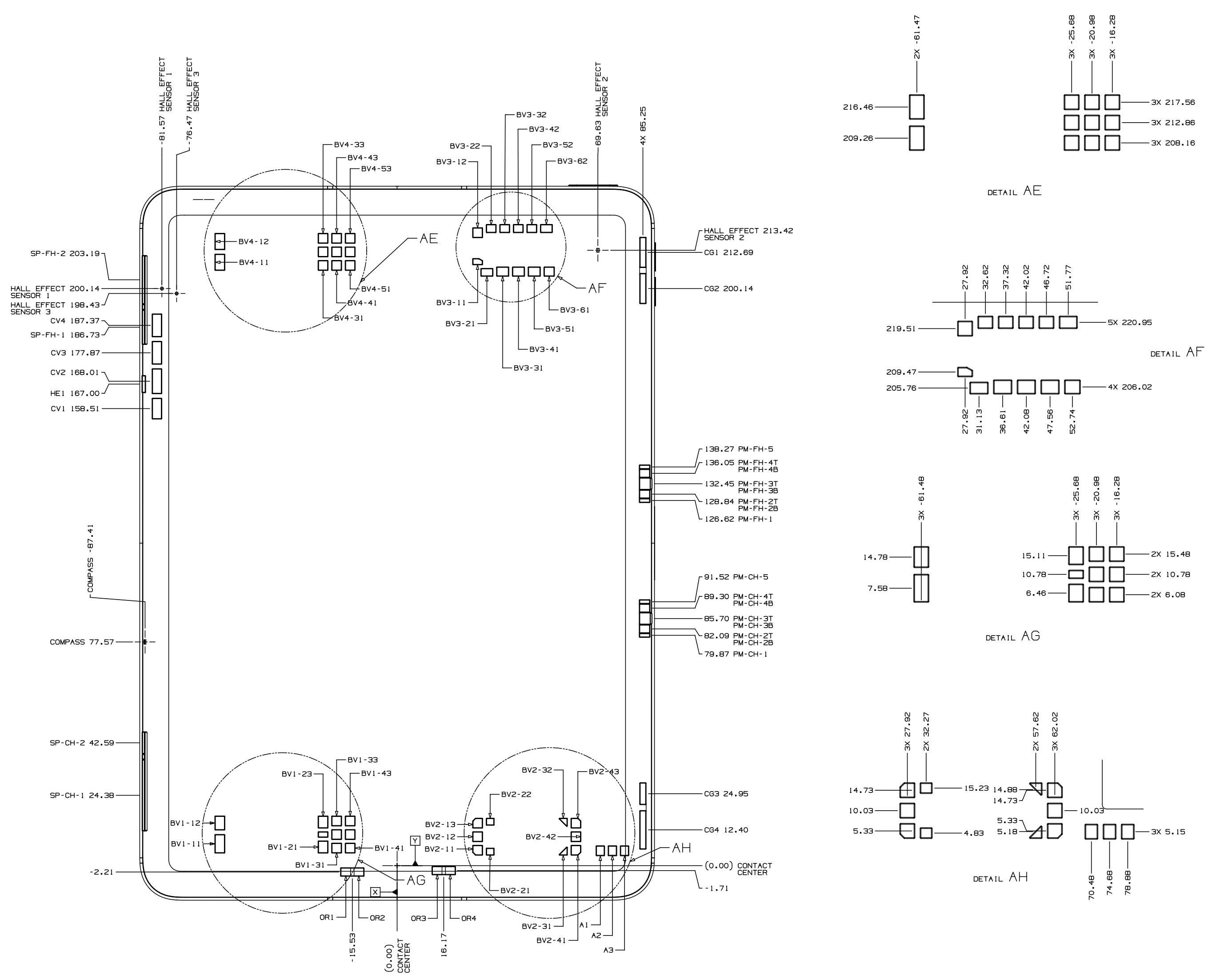



NOTES: (UNLESS OTHERWISE SPECIFIED)
1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT IMAGING FEATURES: FRONT CAMERA, REAR CAMERA
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
4 DO NOT OBSTRUCT SLEEP/WAKE BUTTON
5 DO NOT OBSTRUCT GLASS WITH METAL
6 DO NOT OBSTRUCT ENCLOSURE WITH METAL
SPEAKER HOLES 21X Ø1.76
3.04 SIDE MIC
3.04 SPEAKER
28.22 SPEAKER
56.44 SPEAKER
89.26 SIDE MIC
Ø 1.60 SIDE MIC KEEPOUT
56.46 SPEAKER
35.94 SPEAKER
4.00 SLEEP/WAKE BUTTON
1.09 SLEEP/WAKE BUTTON
12.71 SLEEP/WAKE BUTTON
17.12 SLEEP/WAKE BUTTON
178.51
51.40 ALS
22.13 ALS
Ø 3.00 ALS
3X PLACES
89.25
26.47 ALS
3X 4.62 ALS
247.64
227.56 DISPLAY ACTIVE AREA
2X 10.04
2X 10.03
158.44 DISPLAY ACTIVE AREA
SPEAKER HOLES 24X Ø1.76
2.08 REAR CAMERA
28.22 SPEAKER
56.37 SPEAKER
Ø (3.20) ALS KEEPOUT AT SURFACE
99.64° ALS KEEPOUT ZONE
DETAIL D
(SIDE MIC HOLE)
(5.18) FRONT CAMERA KEEPOUT AT SURFACE
132.15° FRONT CAMERA KEEPOUT ZONE
DETAIL A
Ø 5.17 FRONT CAMERA KEEPOUT ZONE
5.00
DETAIL B
120.00° SLEEP/WAKE BUTTON KEEPOUT ZONE
20.12 SLEEP/WAKE BUTTON KEEPOUT AT SURFACE
DETAIL AC
5.54 RECOMMENDED CONNECTOR KEEPOUT
MATING CONNECTOR KEEPOUT AREA FLUSH TO PRODUCT SURFACE OUTWARD 14.0 MM REQUIRED
3.09 CONNECTOR KEEPOUT
10.25 RECOMMENDED CONNECTOR KEEPOUT
DETAIL C
0.00 SLEEP/WAKE BUTTON KEEPOUT TO HSG
0.00 SLEEP/WAKE BUTTON KEEPOUT TO CG
METRIC
Apple Inc.
iPad Air (5th generation)
iPad Air (4th generation)
X.X ±0.2
X.XX ±0.10
X.XXX ±0.050
ANGLES ±0.5°
NONE
SHT 1 OF 5
01
NX GENERATED

60.122 iPad Air (5th generation) and iPad Air (4th generation), 2 of 5

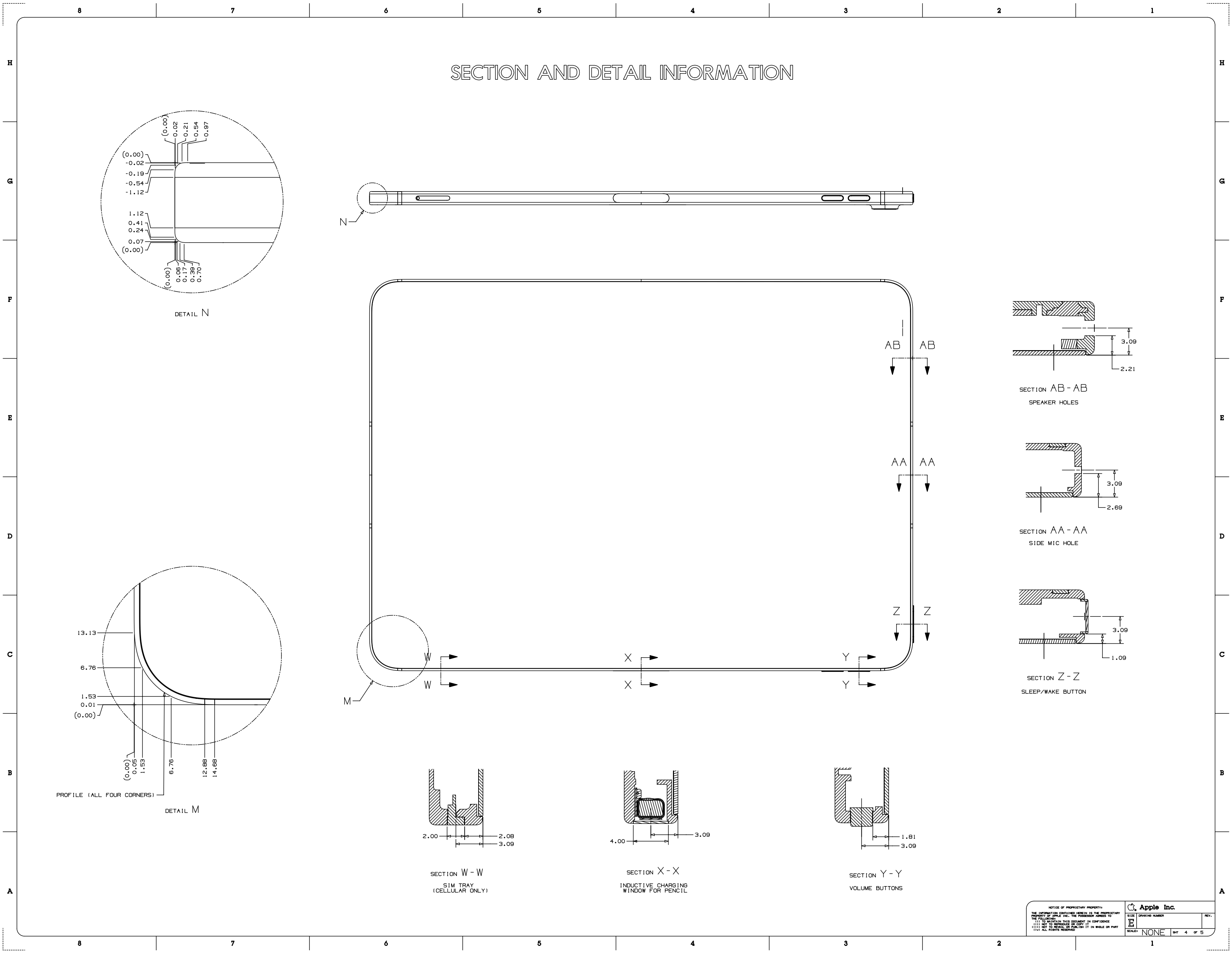


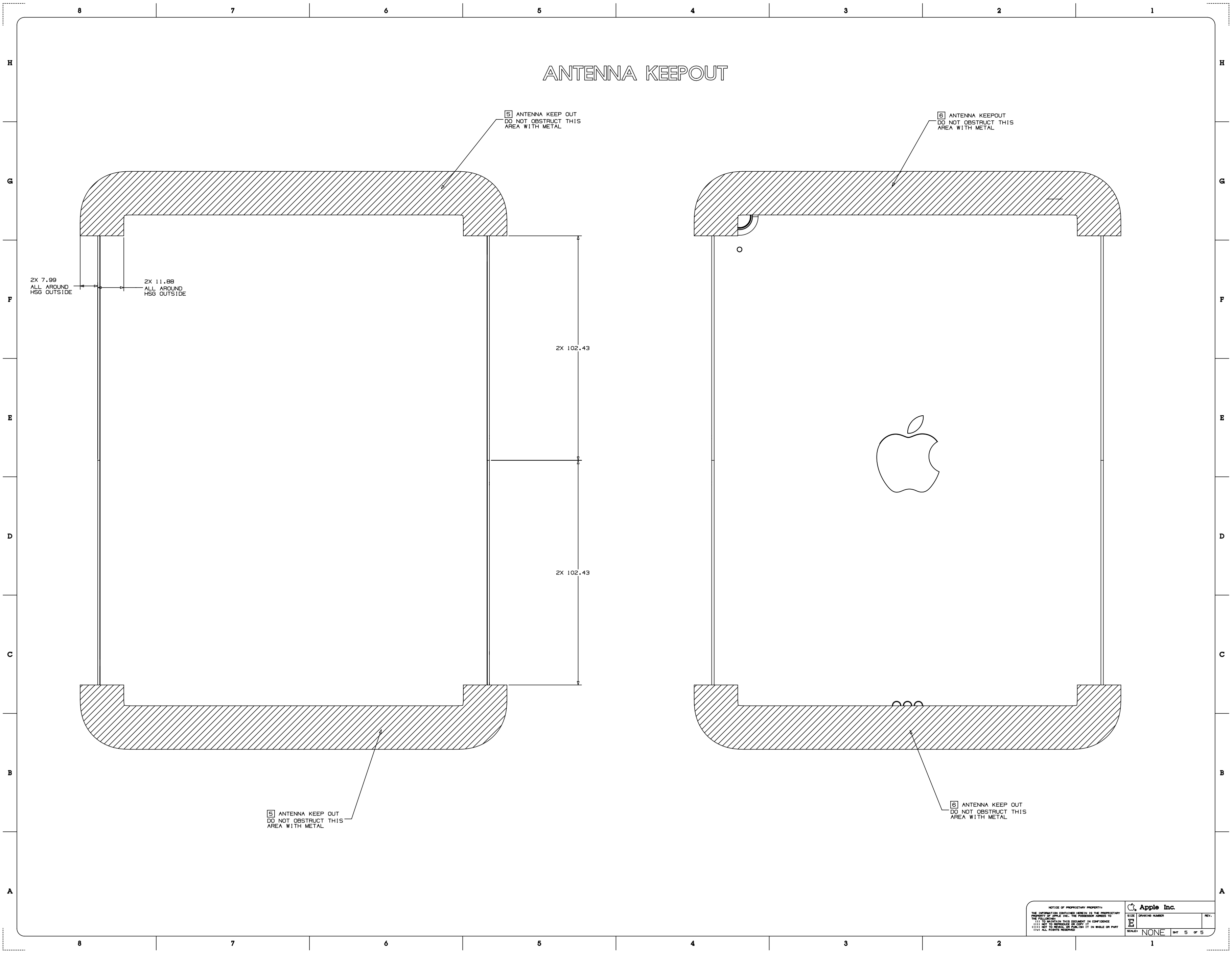
MAGNET DETAIL

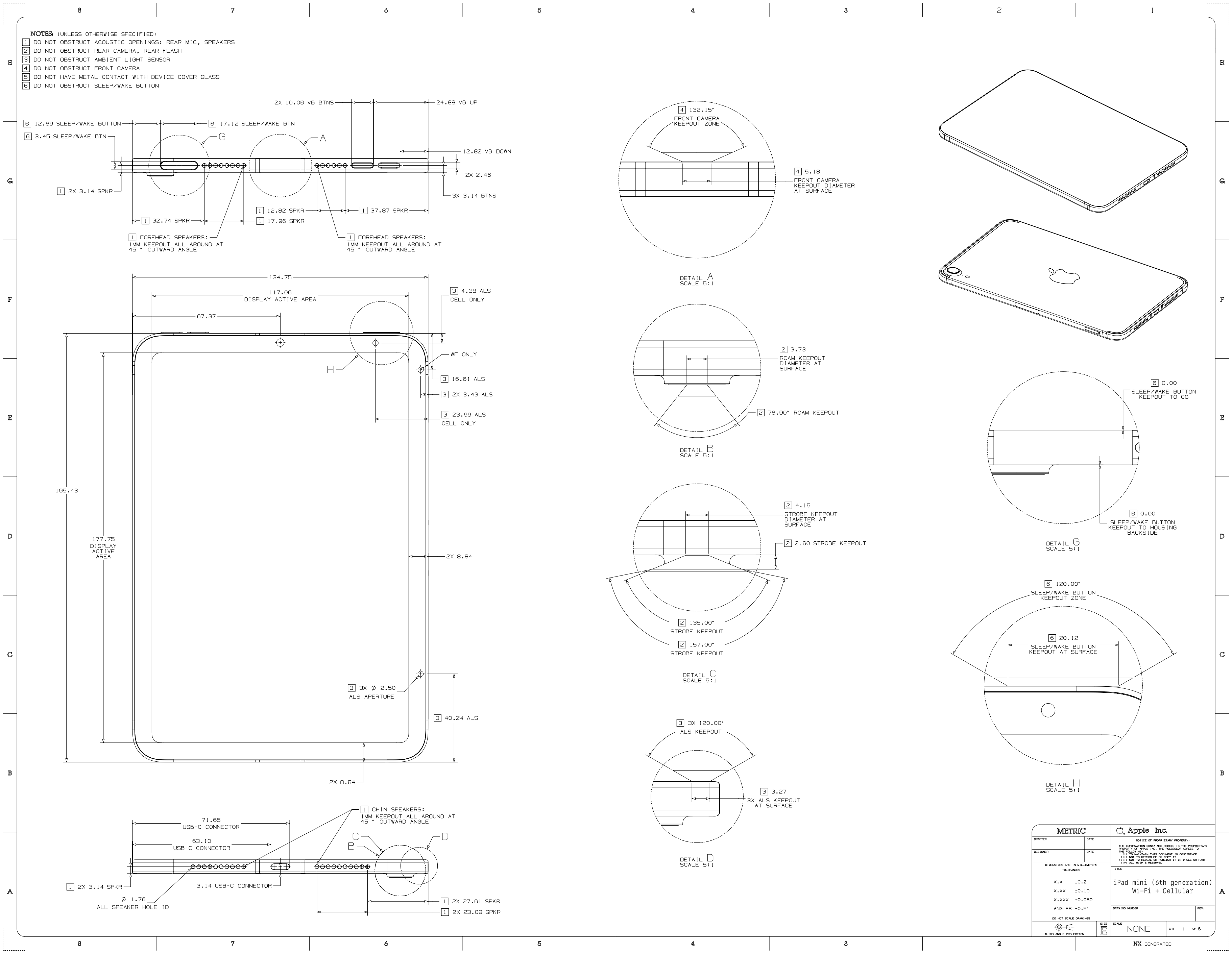


LOCATION	POLARITY TOWARD OUTER COSMETIC SURFACE OF ENCLOSURE	POLARITY TOWARD INSIDE OF PRODUCT
BV1-11	N	S
BV1-12	S	N
BV1-21	S	N
BV1-22	N	S
BV1-23	S	N
BV1-31	N	S
BV1-32	S	N
BV1-33	N	S
BV1-41	N	S
BV1-42	N	S
BV1-43	S	N
BV2-11	N	S
BV2-12	N	S
BV2-13	S	N
BV2-21	S	N
BV2-22	N	S
BV2-31	S	N
BV2-32	S	N
BV2-41	N	S
BV2-42	S	N
BV2-43	N	S
BV3-11	S	N
BV3-12	N	S
BV3-21	N	S
BV3-22	S	N
BV3-31	S	N
BV3-32	N	S
BV3-41	N	S
BV3-42	S	N
BV3-51	S	N
BV3-52	S	N
BV3-61	N	S
BV3-62	N	S
BV4-11	S	N
BV4-12	N	S
BV4-31	S	N
BV4-32	N	S
BV4-33	S	N
BV4-41	N	S
BV4-42	S	N
BV4-43	S	N
BV4-51	S	N
BV4-52	N	S
BV4-53	N	S
CV1	S	N
CV2	N	S
CV3	N	S
CV4	S	N
OR1	S	N
OR2	N	S
OR3	N	S
OR4	S	N
PM-FH-1	S	N
PM-CH-1	S	N
SP-CH-1-S	S	N
SP-CH-1-B	N	S
SP-CH-2-S	N	S
SP-CH-2-B	S	N
SP-FH-1-S	N	S
SP-FH-1-B	S	N
SP-FH-2-S	S	N
SP-FH-2-B	N	S
A1	S	N
A2	N	S
A3	S	N

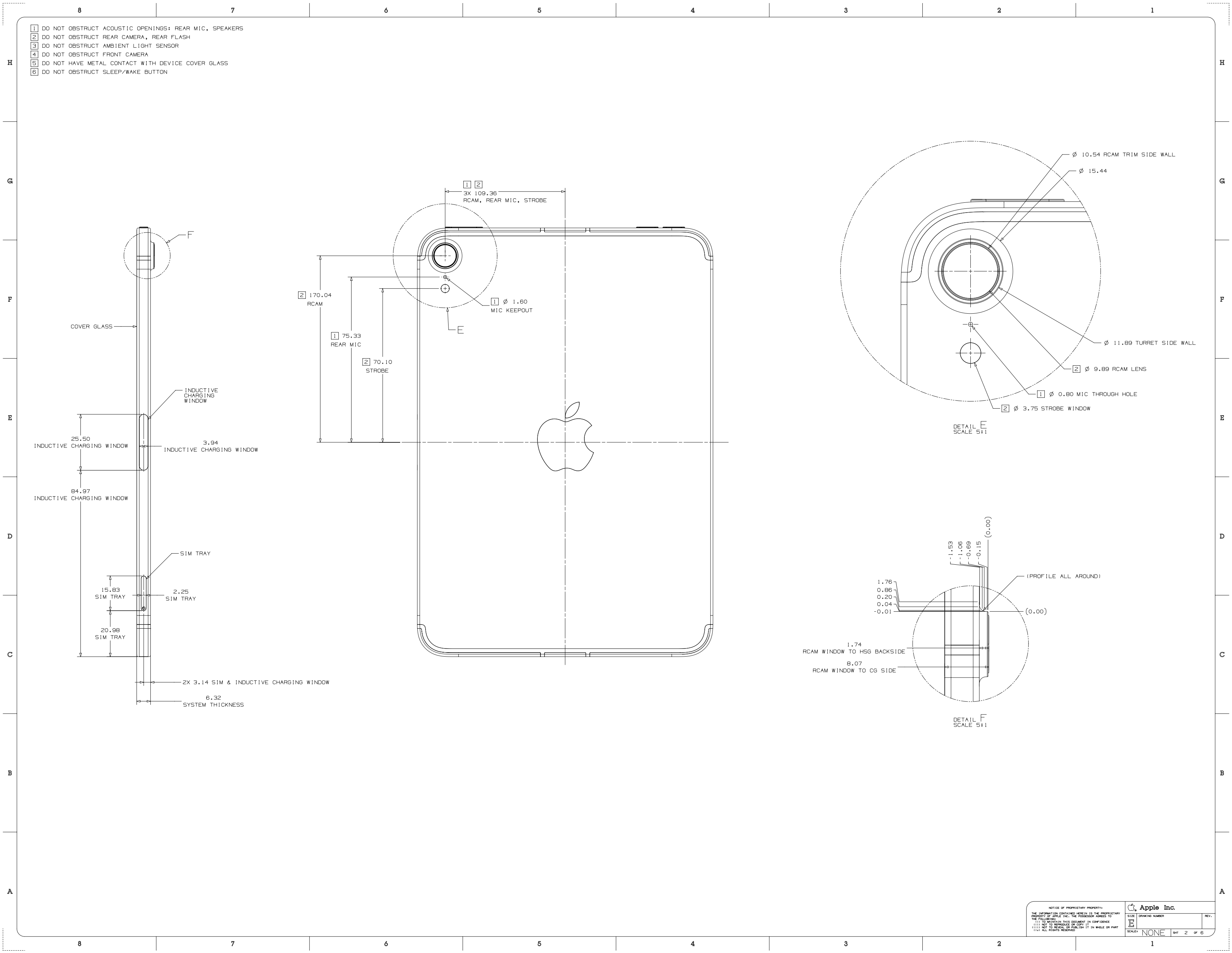
Apple Inc.
SIZE E
SCALE: NONE
SHT 3 OF 5


SECTION AND DETAIL INFORMATION
DETAIL N
(0.00)
0.02
0.21
0.54
0.97
(0.00)
-0.02
-0.19
-0.54
-1.12
1.12
0.41
0.24
0.07
(0.00)
(0.00)
0.06
0.17
0.39
0.70
DETAIL M
PROFILE (ALL FOUR CORNERS)
13.13
6.76
1.53
0.01
(0.00)
(0.00)
0.05
1.53
6.76
12.88
14.68
N
M
W
X
Y
Z
AA
AB
SECTION W - W
SIM TRAY
(CELLULAR ONLY)
2.00
2.08
3.09
SECTION X - X
INDUCTIVE CHARGING
WINDOW FOR PENCIL
4.00
3.09
SECTION Y - Y
VOLUME BUTTONS
1.81
3.09
SECTION AB - AB
SPEAKER HOLES
3.09
2.21
SECTION AA - AA
SIDE MIC HOLE
3.09
2.69
SECTION Z - Z
SLEEP/WAKE BUTTON
3.09
1.09
Apple Inc.
E
NONE
SHT 4 OF 5

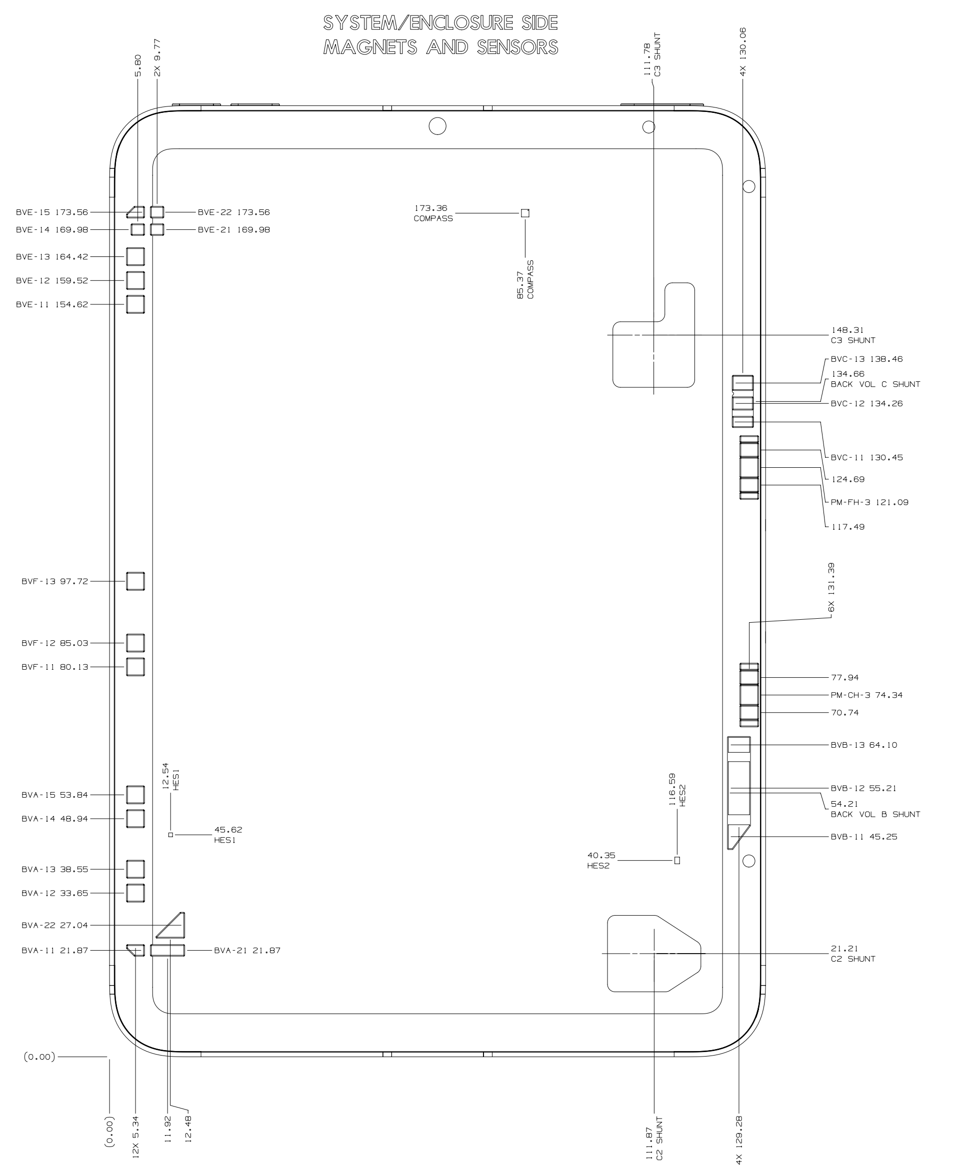

ANTENNA KEEPOUT
5 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL
6 ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL
2X 7.99 ALL AROUND HSG OUTSIDE
2X 11.88 ALL AROUND HSG OUTSIDE
2X 102.43
2X 102.43
5 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL
Apple Inc.
NONE


NOTES: (UNLESS OTHERWISE SPECIFIED)
1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
4 DO NOT OBSTRUCT FRONT CAMERA
5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
6 DO NOT OBSTRUCT SLEEP/WAKE BUTTON
2X 10.06 VB BTNS
24.88 VB UP
6 12.69 SLEEP/WAKE BUTTON
6 17.12 SLEEP/WAKE BTN
6 3.45 SLEEP/WAKE BTN
12.82 VB DOWN
2X 2.46
3X 3.14 BTNS
1 2X 3.14 SPKR
1 32.74 SPKR
1 12.82 SPKR
1 17.96 SPKR
1 37.87 SPKR
1 FOREHEAD SPEAKERS: 1MM KEEPOUT ALL AROUND AT 45° OUTWARD ANGLE
134.75
117.06 DISPLAY ACTIVE AREA
67.37
3 4.38 ALS CELL ONLY
WF ONLY
3 16.61 ALS
3 2X 3.43 ALS
3 23.99 ALS CELL ONLY
195.43
177.75 DISPLAY ACTIVE AREA
2X 8.84
3 3X Ø 2.50 ALS APERTURE
3 40.24 ALS
1 CHIN SPEAKERS: 1MM KEEPOUT ALL AROUND AT 45° OUTWARD ANGLE
71.65 USB-C CONNECTOR
63.10 USB-C CONNECTOR
3.14 USB-C CONNECTOR
Ø 1.76 ALL SPEAKER HOLE ID
1 2X 27.61 SPKR
1 2X 23.08 SPKR
4 132.15° FRONT CAMERA KEEPOUT ZONE
4 5.18 FRONT CAMERA KEEPOUT DIAMETER AT SURFACE
DETAIL A SCALE 5:1
2 3.73 RCAM KEEPOUT DIAMETER AT SURFACE
2 76.90° RCAM KEEPOUT
DETAIL B SCALE 5:1
2 4.15 STROBE KEEPOUT DIAMETER AT SURFACE
2 2.60 STROBE KEEPOUT
2 135.00° STROBE KEEPOUT
2 157.00° STROBE KEEPOUT
DETAIL C SCALE 5:1
3 3X 120.00° ALS KEEPOUT
3 3.27 3X ALS KEEPOUT AT SURFACE
DETAIL D SCALE 5:1
6 0.00 SLEEP/WAKE BUTTON KEEPOUT TO CG
6 0.00 SLEEP/WAKE BUTTON KEEPOUT TO HOUSING BACKSIDE
DETAIL G SCALE 5:1
6 120.00° SLEEP/WAKE BUTTON KEEPOUT ZONE
6 20.12 SLEEP/WAKE BUTTON KEEPOUT AT SURFACE
DETAIL H SCALE 5:1
METRIC
Apple Inc.
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
X.X ±0.2
X.XX ±0.10
X.XXX ±0.050
ANGLES ±0.5°
DO NOT SCALE DRAWING
THIRD ANGLE PROJECTION
iPad mini (6th generation) Wi-Fi + Cellular
SIZE E
SCALE NONE
SHT 1 OF 6
NX GENERATED

60.127 iPad mini (6th generation), 2 of 6

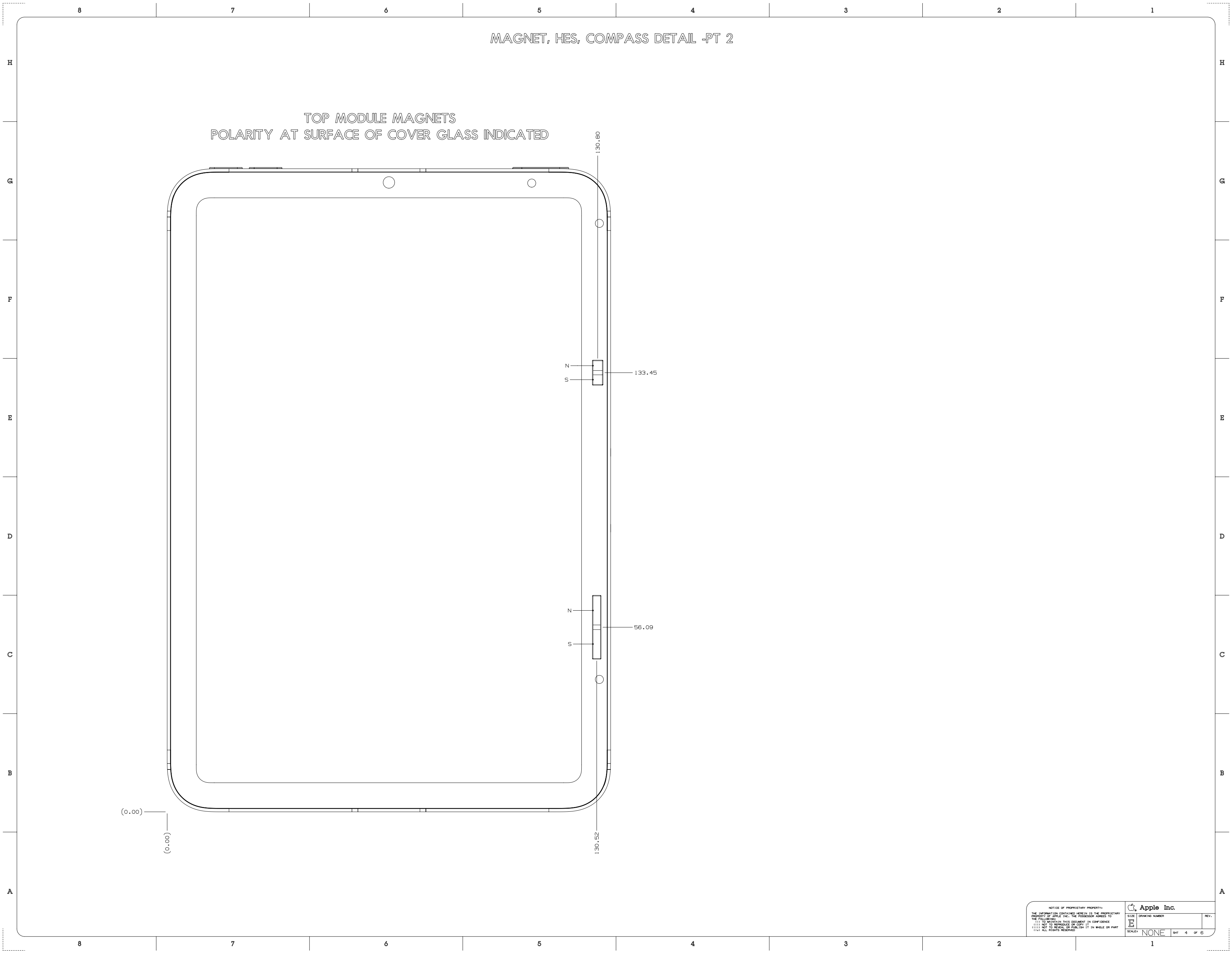


MAGNET, HES, COMPASS DETAIL

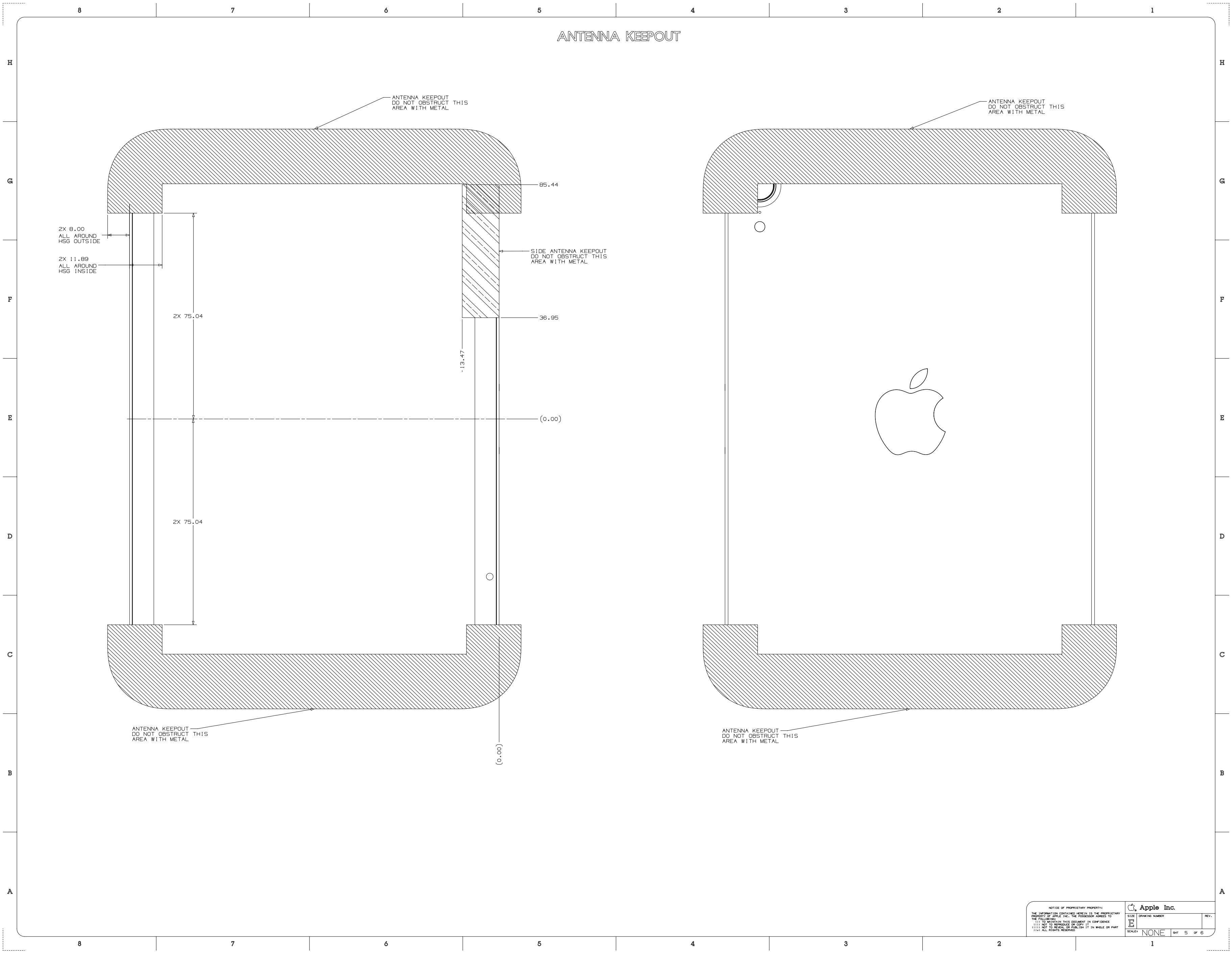


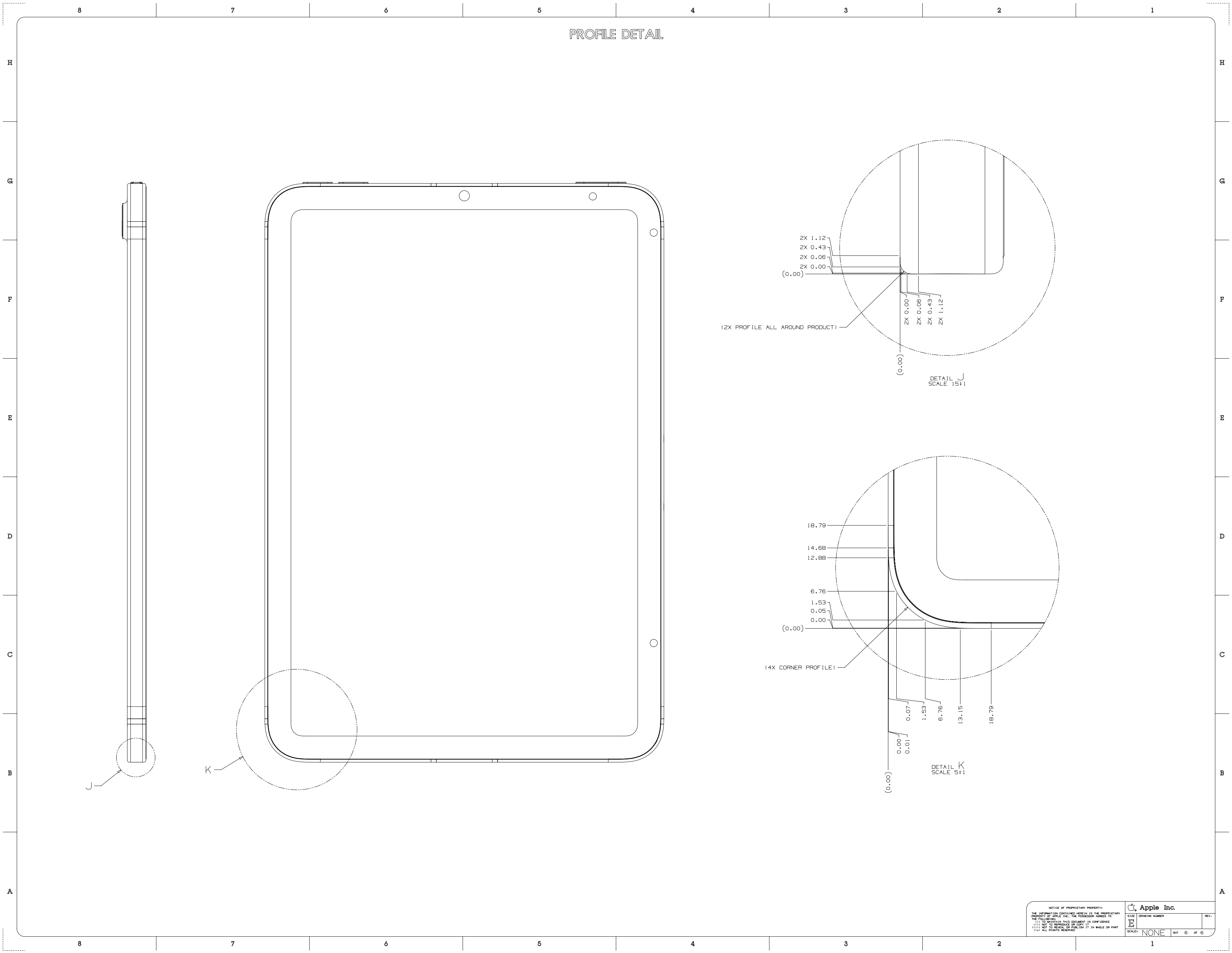
LOCATION	POLARITY TOWARD SURFACE OF ENCLOSURE
PM-FH-3	S
PM-CH-3	S
BVA-11	N
BVA-12	N
BVA-13	S
BVA-14	N
BVA-15	S
BVA-21	S
BVA-22	N
BVB-11	N
BVB-12	S
BVB-13	N
BVC-11	S
BVC-12	N
BVC-13	S
BVE-11	S
BVE-12	N
BVE-13	S
BVE-14	N
BVE-15	S
BVE-21	S
BVE-22	N
BVF-11	N
BVF-12	S
BVF-13	N

60.129 iPad mini (6th generation), 4 of 6



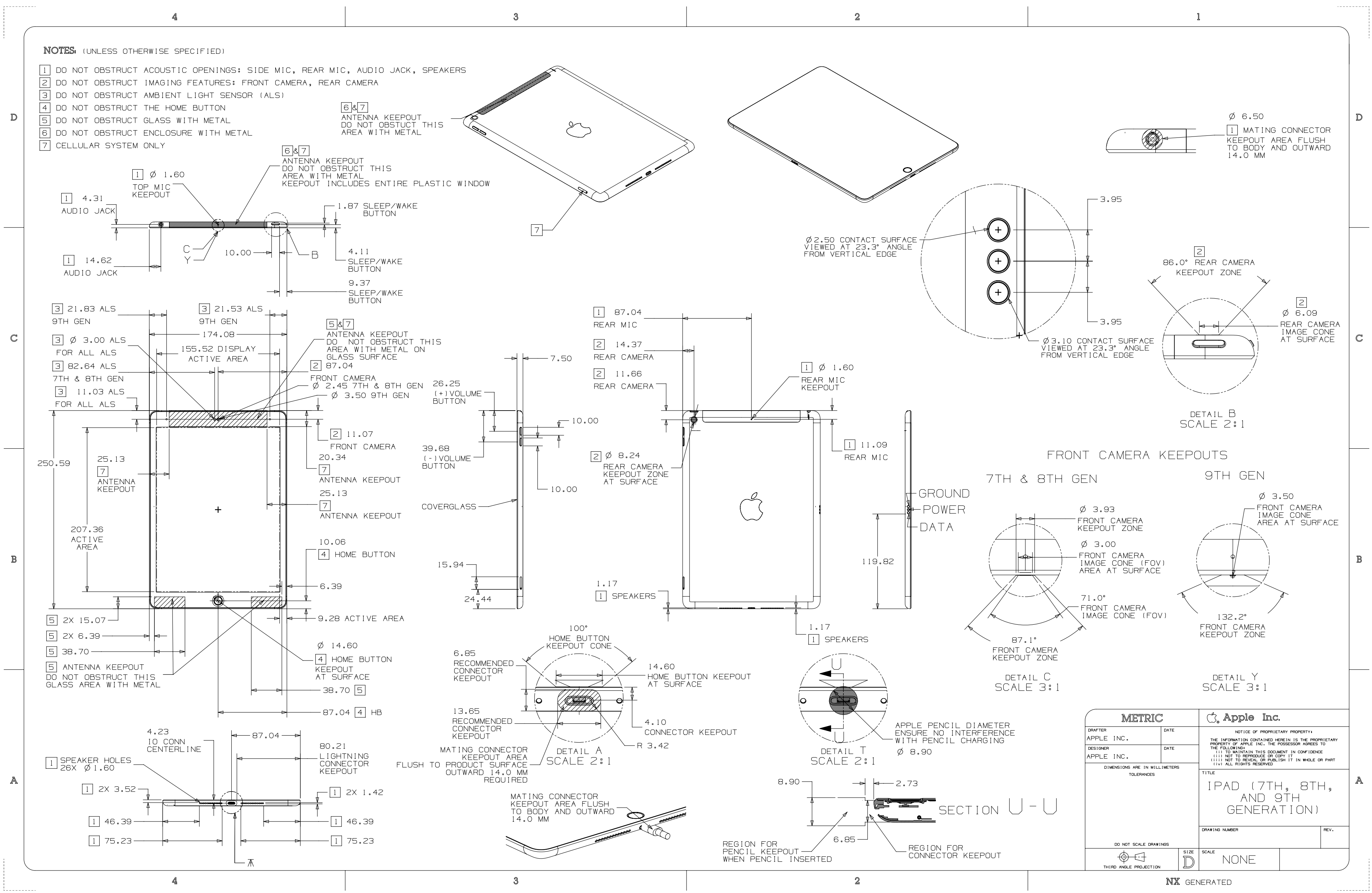
60.130 iPad mini (6th generation), 5 of 6



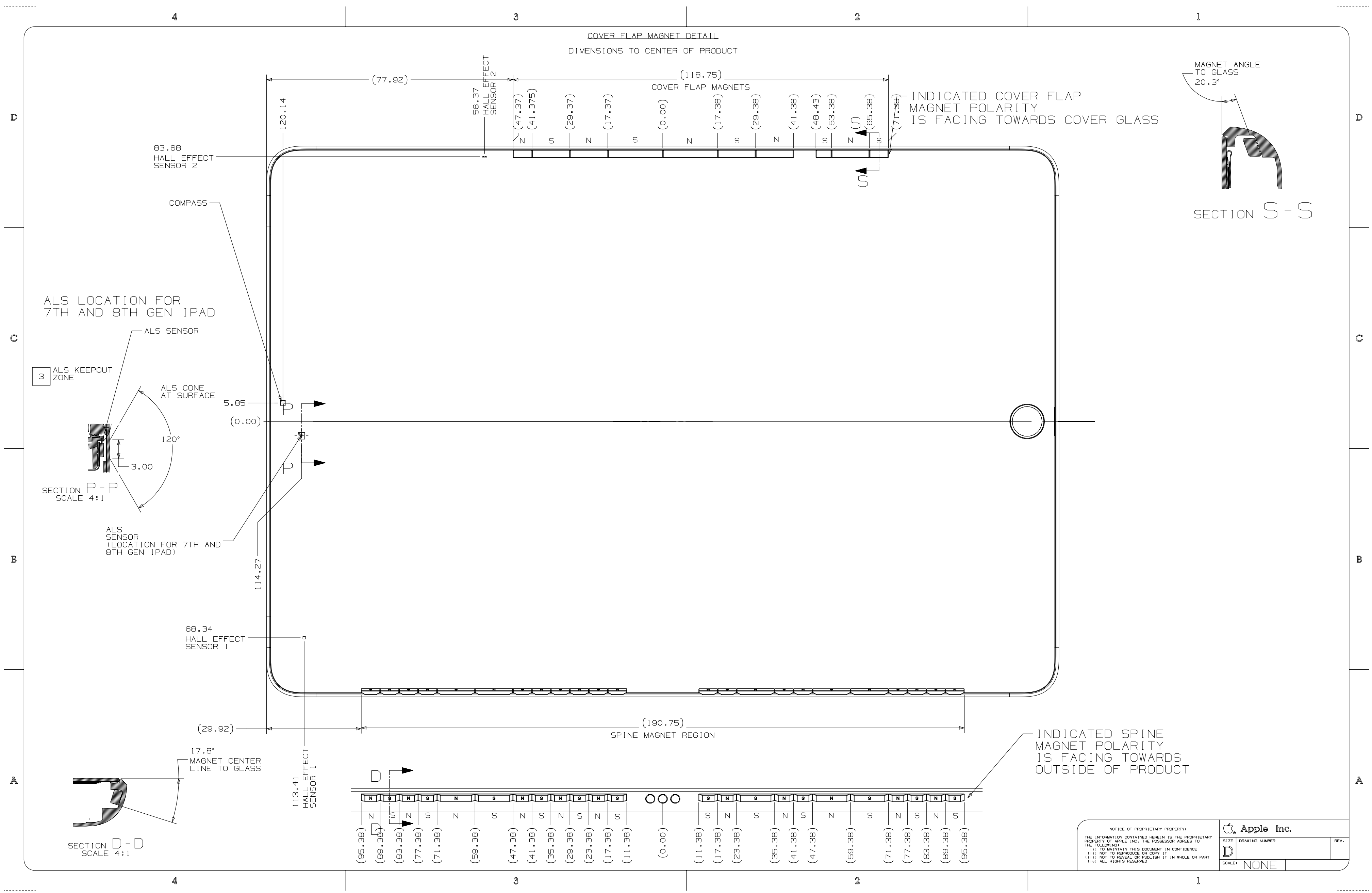


PROFILE DETAIL
J
K
2X 1.12
2X 0.43
2X 0.06
2X 0.00
(0.00)
(2X PROFILE ALL AROUND PRODUCT)
DETAIL J
SCALE 15:1
18.79
14.68
12.88
6.76
1.53
0.05
0.00
(4X CORNER PROFILE)
0.07
13.15
0.01
DETAIL K
SCALE 5:1
Apple Inc.
NONE
SHT 6 OF 6

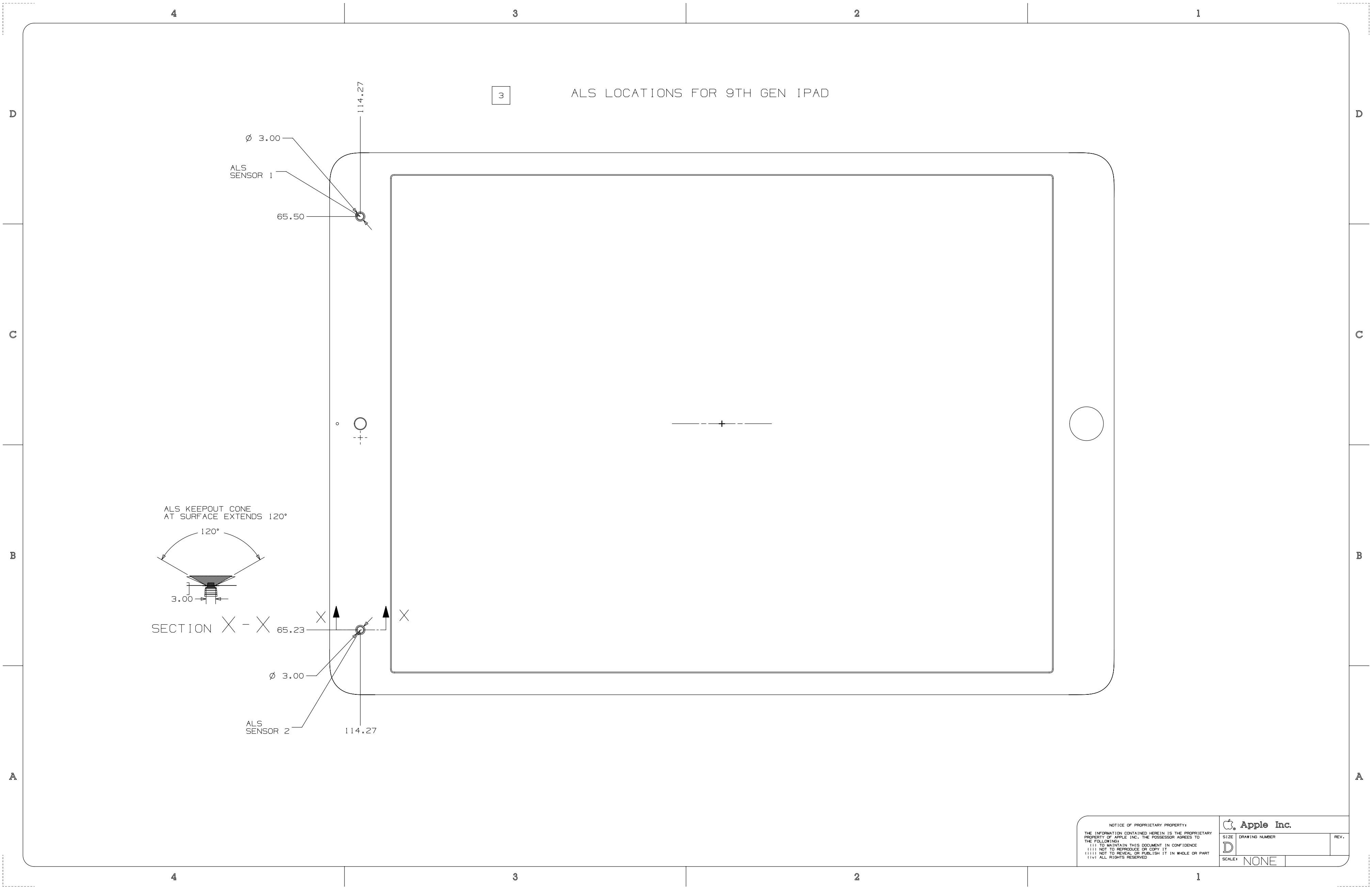
60.132 iPad (9th generation), iPad (8th generation) and iPad (7th generation), 1 of 4



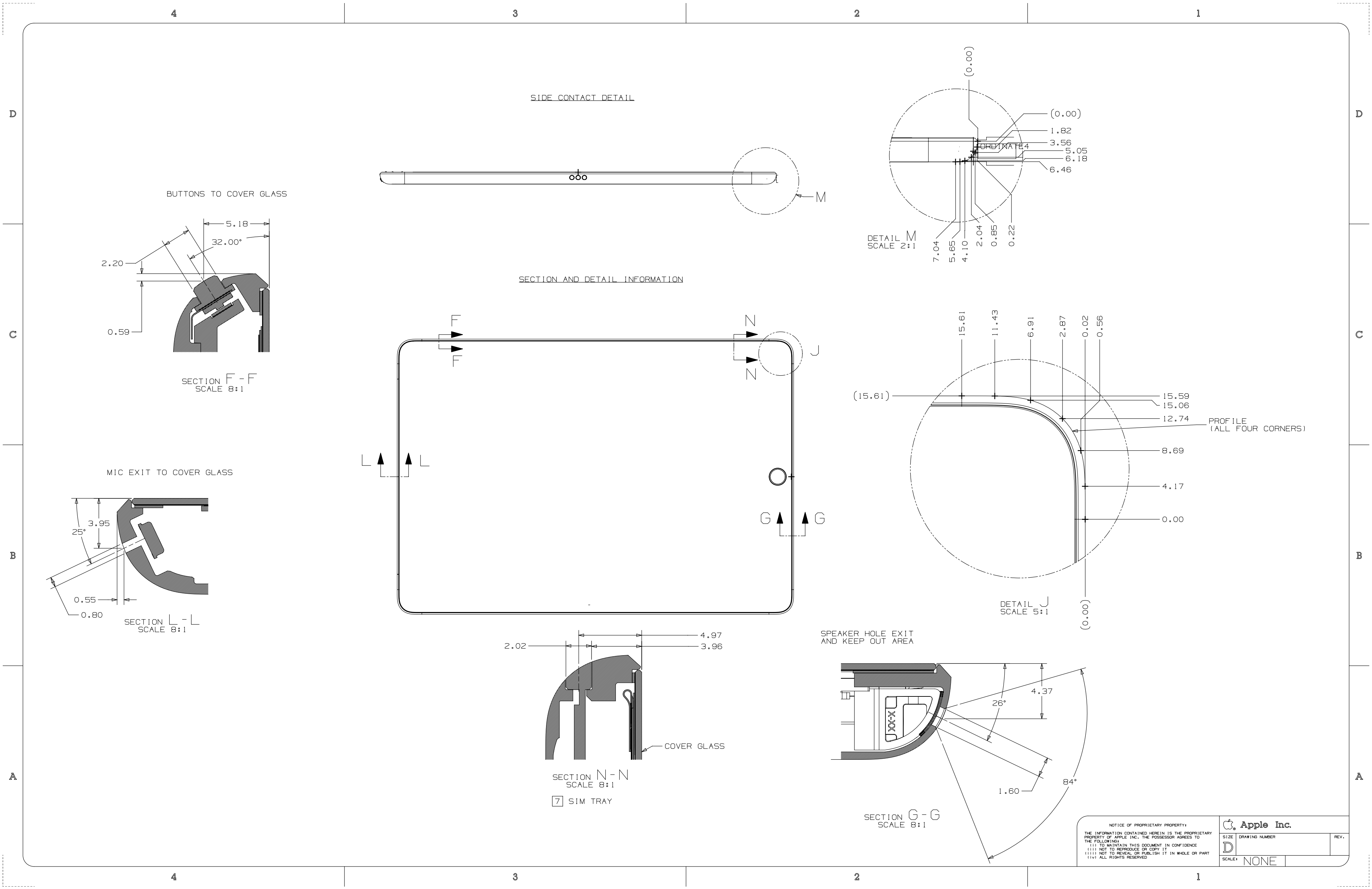
60.133 iPad (9th generation), iPad (8th generation) and iPad (7th generation), 2 of 4



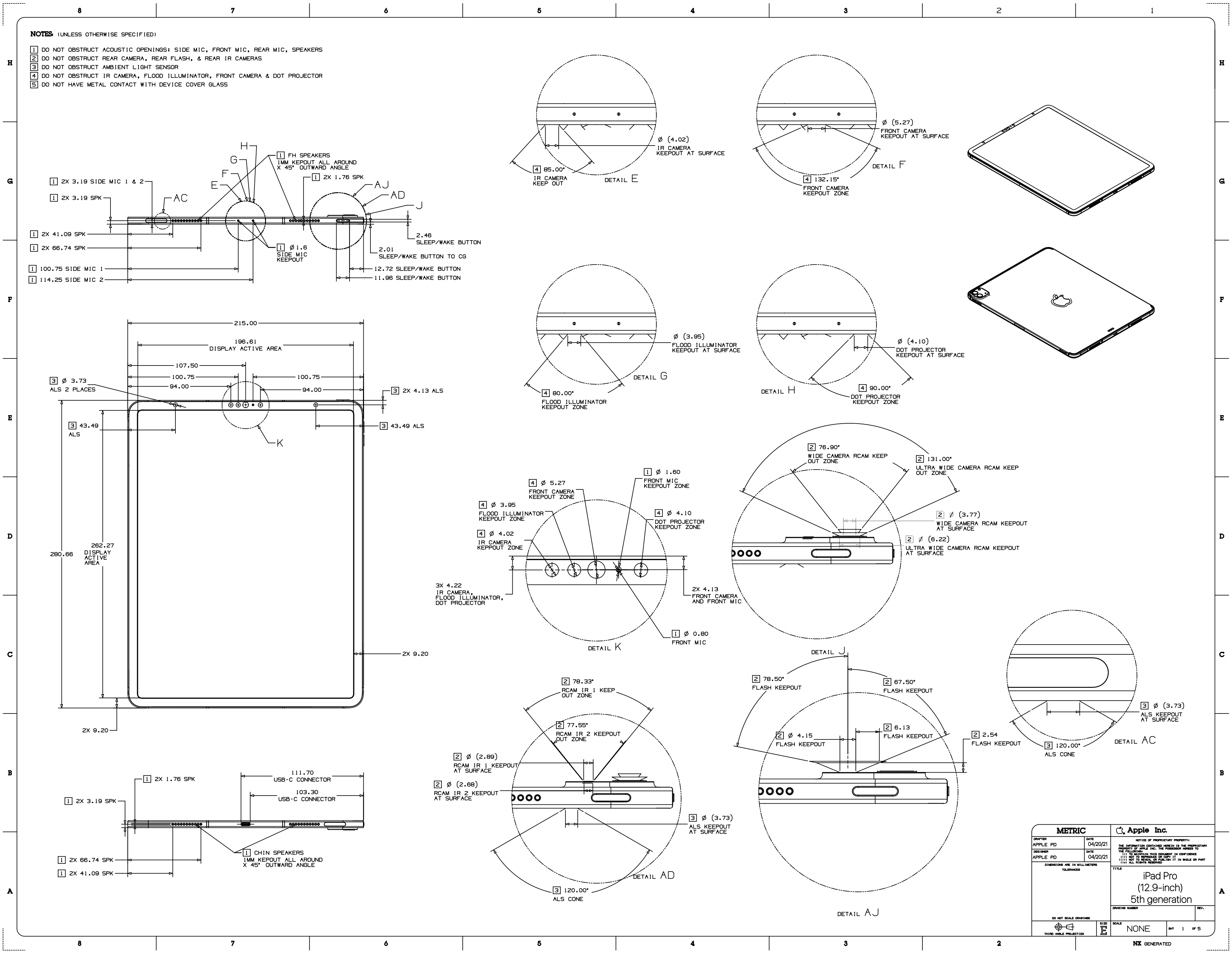
60.134 iPad (9th generation), iPad (8th generation) and iPad (7th generation), 3 of 4

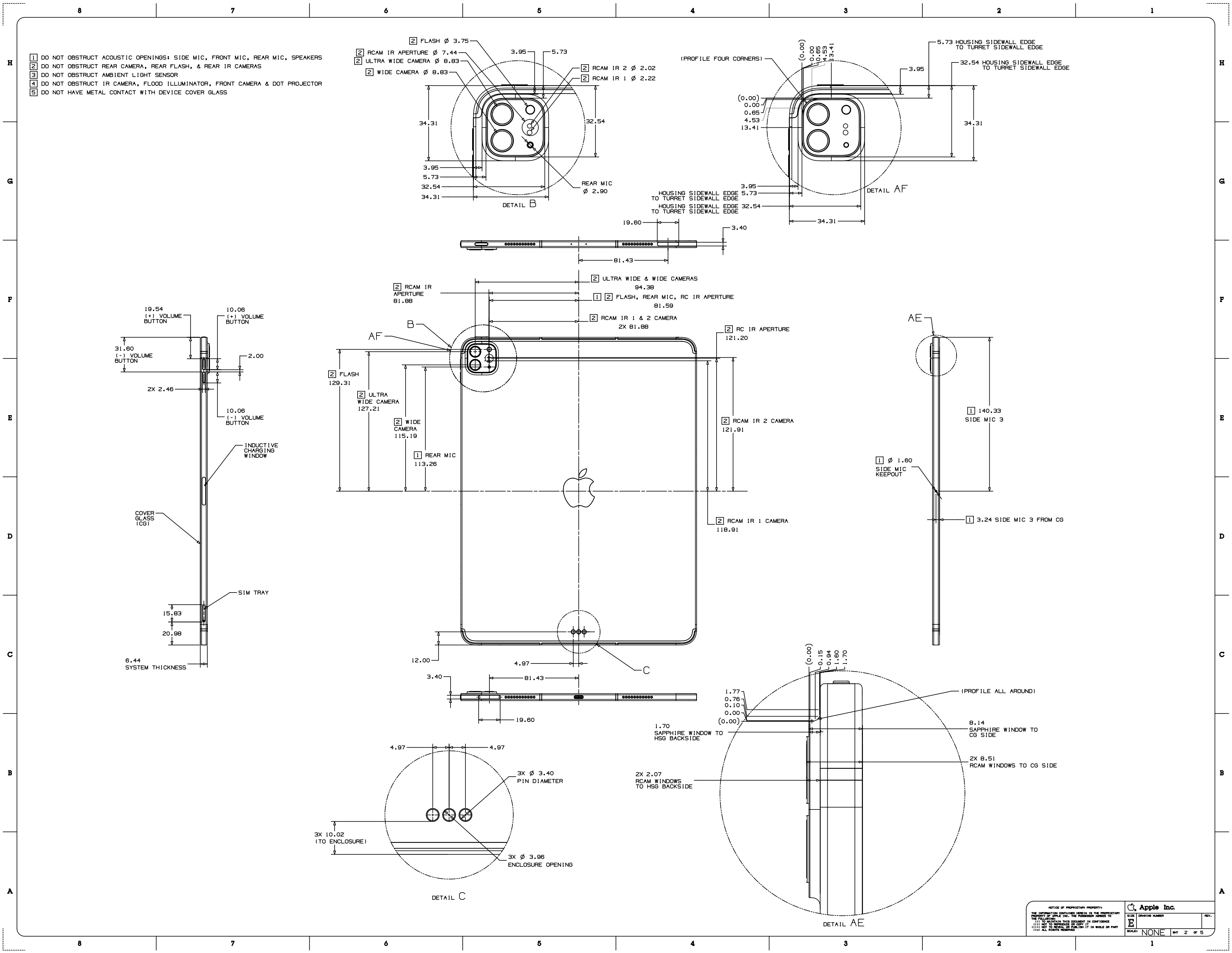


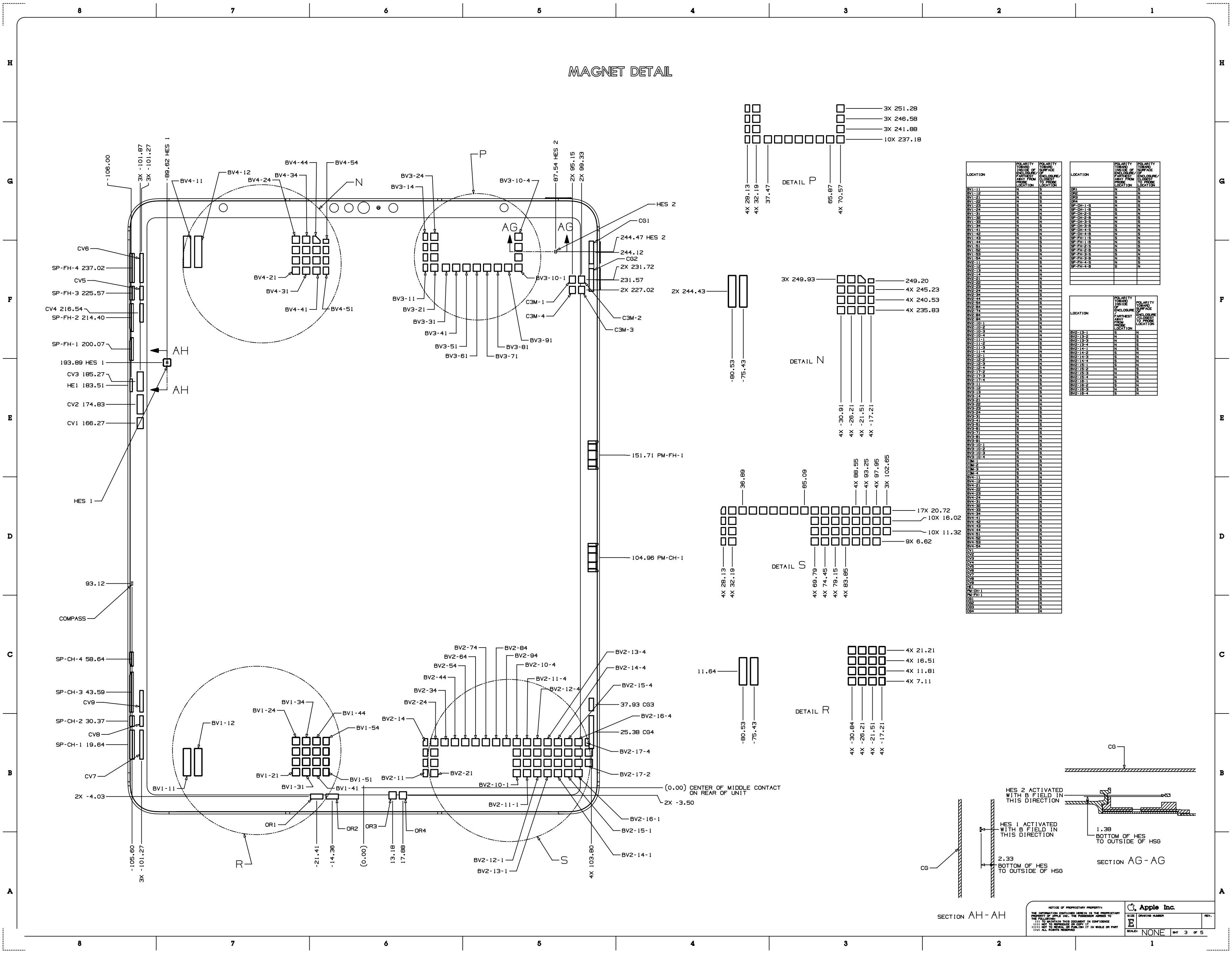
60.135 iPad (9th generation), iPad (8th generation) and iPad (7th generation), 4 of 4



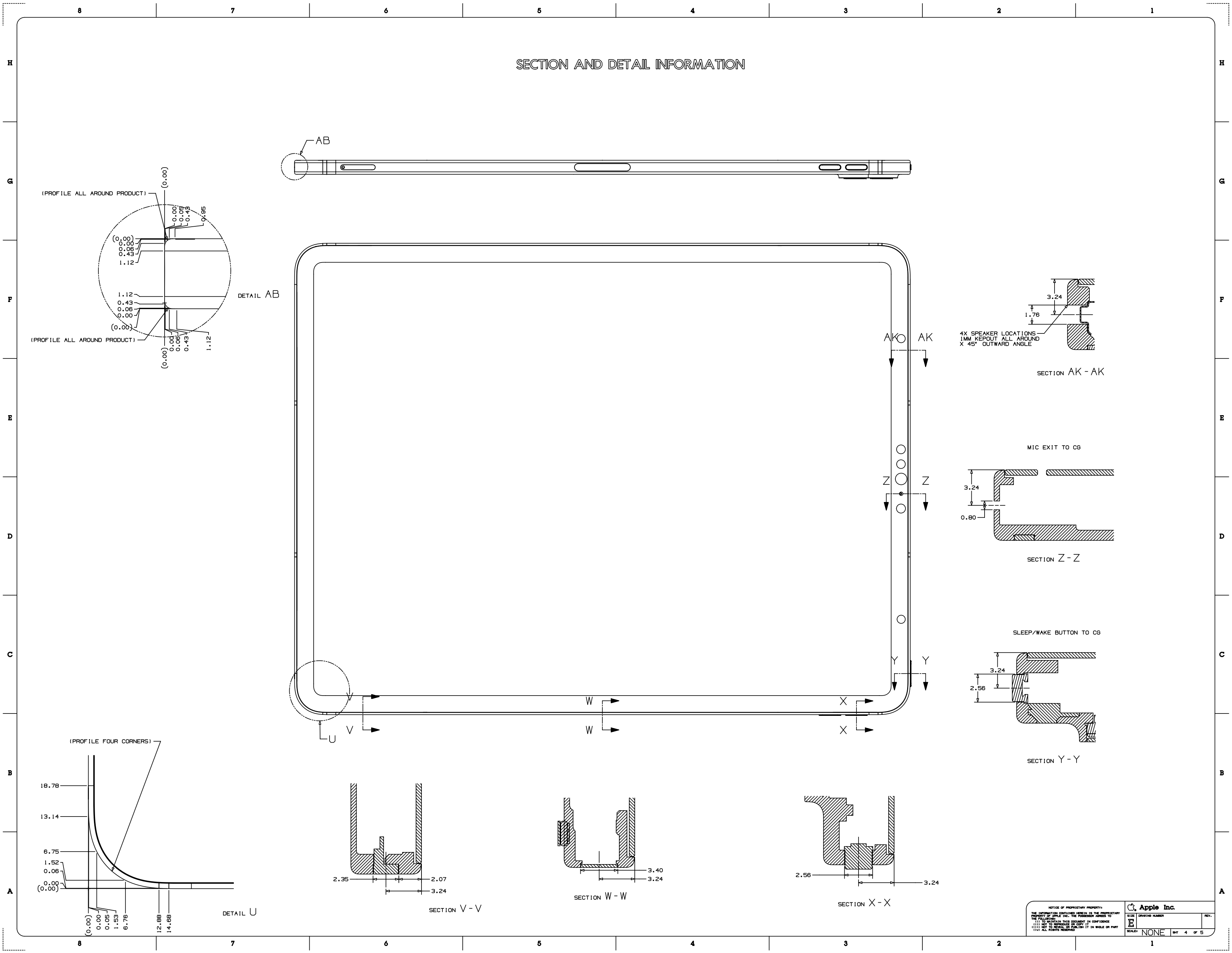
60.136 iPad Pro 12.9-inch (5th generation), 1 of 5

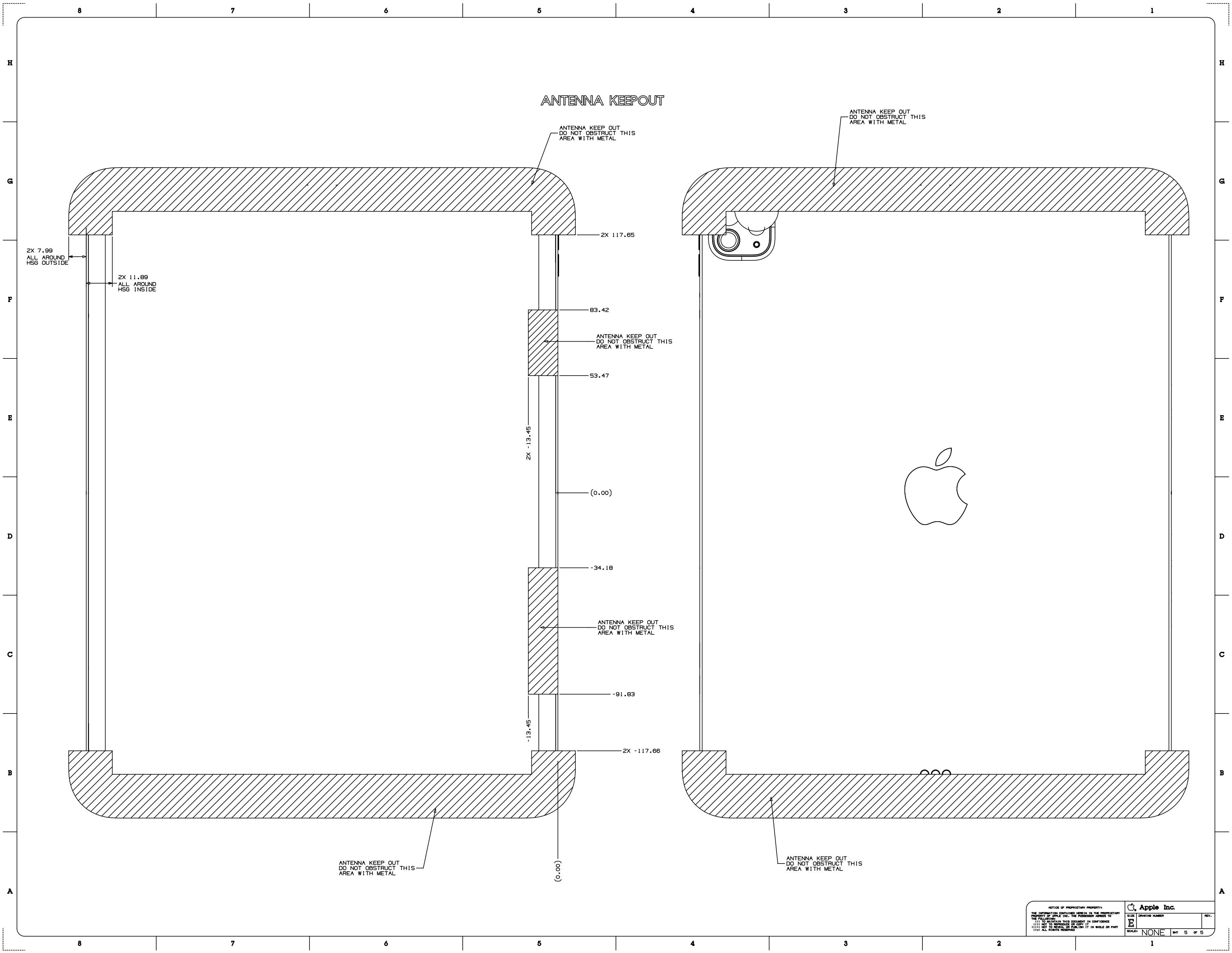


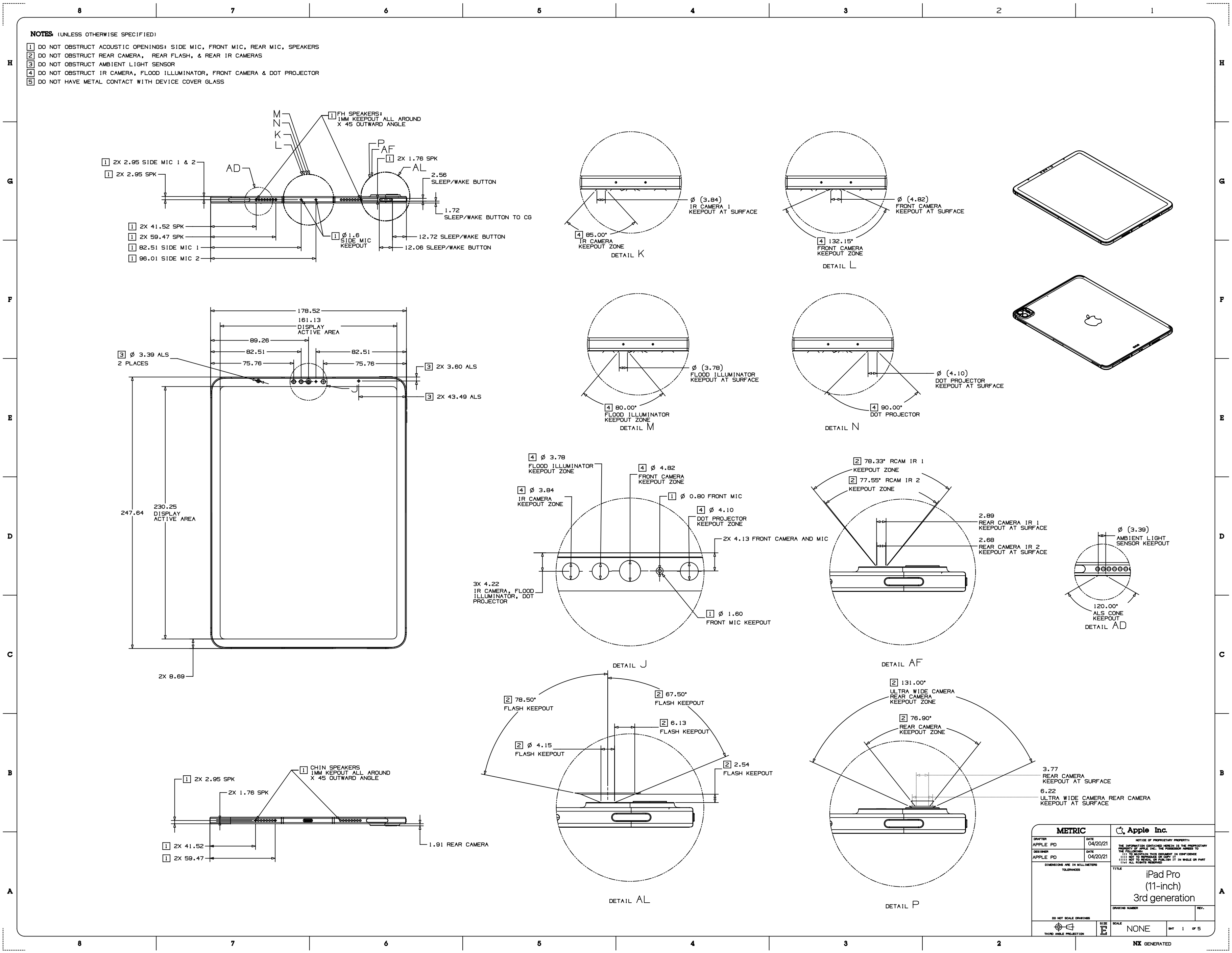

1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERAS
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
4 DO NOT OBSTRUCT IR CAMERA, FLOOD ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
2 FLASH Ø 3.75
2 RCAM IR APERTURE Ø 7.44
2 ULTRA WIDE CAMERA Ø 8.83
2 WIDE CAMERA Ø 8.83
2 RCAM IR 2 Ø 2.02
2 RCAM IR 1 Ø 2.22
REAR MIC Ø 2.90
DETAIL B
(PROFILE FOUR CORNERS)
5.73 HOUSING SIDEWALL EDGE TO TURRET SIDEWALL EDGE
32.54 HOUSING SIDEWALL EDGE TO TURRET SIDEWALL EDGE
HOUSING SIDEWALL EDGE TO TURRET SIDEWALL EDGE 5.73
HOUSING SIDEWALL EDGE TO TURRET SIDEWALL EDGE 32.54
DETAIL AF
19.54 (+) VOLUME BUTTON
10.06 (+) VOLUME BUTTON
31.60 (-) VOLUME BUTTON
2X 2.46
10.06 (-) VOLUME BUTTON
INDUCTIVE CHARGING WINDOW
COVER GLASS (CG)
SIM TRAY
6.44 SYSTEM THICKNESS
2 ULTRA WIDE & WIDE CAMERAS 94.38
1 2 FLASH, REAR MIC, RC IR APERTURE 81.59
2 RCAM IR 1 & 2 CAMERA 2X 81.88
2 RCAM IR APERTURE 81.88
2 RC IR APERTURE 121.20
2 FLASH 129.31
2 ULTRA WIDE CAMERA 127.21
2 WIDE CAMERA 115.19
1 REAR MIC 113.26
2 RCAM IR 2 CAMERA 121.91
2 RCAM IR 1 CAMERA 118.91
1 140.33 SIDE MIC 3
1 Ø 1.60 SIDE MIC KEEPOUT
1 3.24 SIDE MIC 3 FROM CG
3X Ø 3.40 PIN DIAMETER
3X 10.02 (TO ENCLOSURE)
3X Ø 3.96 ENCLOSURE OPENING
DETAIL C
(PROFILE ALL AROUND)
1.70 SAPPHIRE WINDOW TO HSG BACKSIDE
8.14 SAPPHIRE WINDOW TO CG SIDE
2X 8.51 RCAM WINDOWS TO CG SIDE
2X 2.07 RCAM WINDOWS TO HSG BACKSIDE
DETAIL AE
Apple Inc.
SCALE: NONE
SHT 2 OF 5

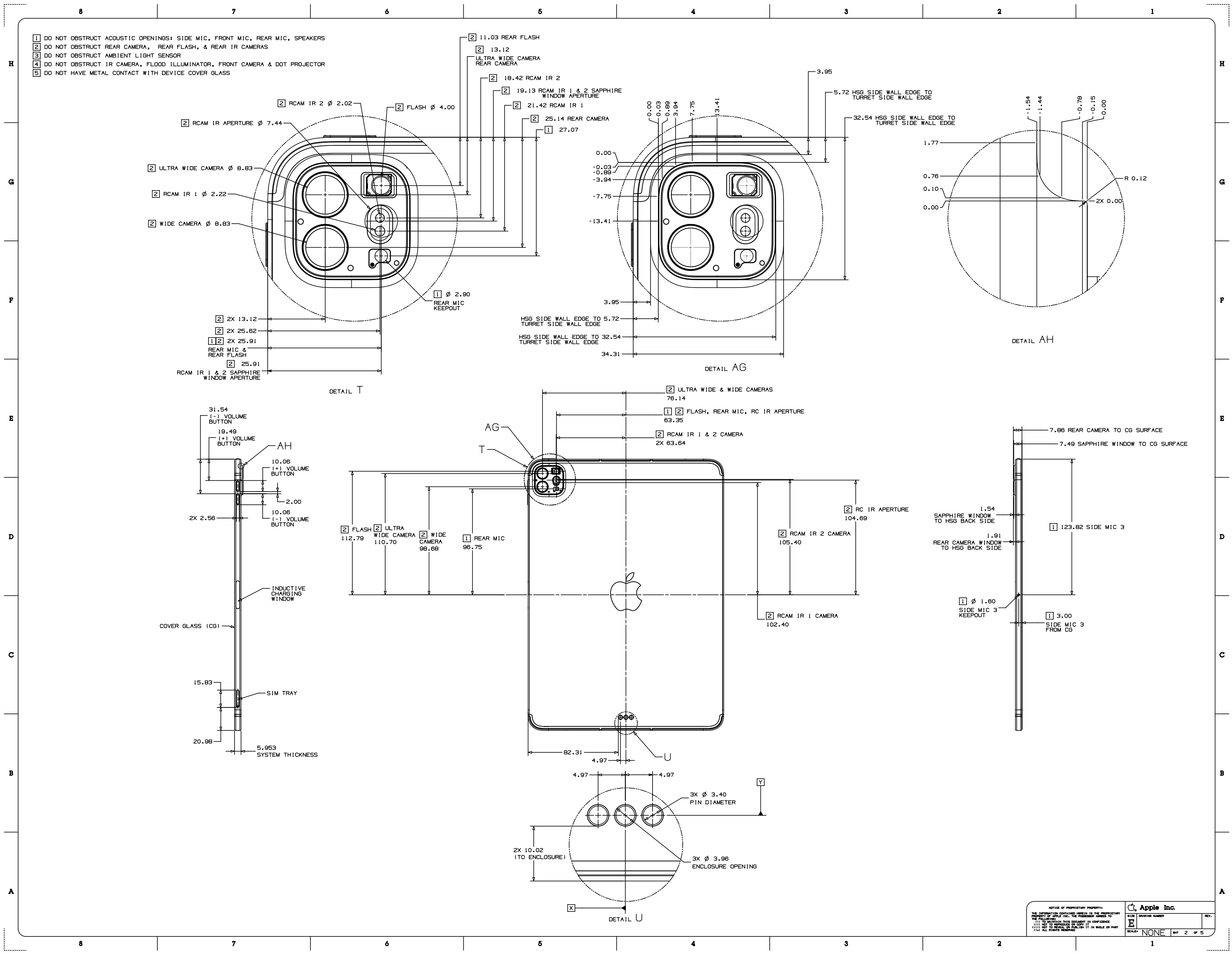

MAGNET DETAIL
DETAIL P
DETAIL N
DETAIL S
DETAIL R
SECTION AH-AH
SECTION AG-AG
HES 2 ACTIVATED WITH B FIELD IN THIS DIRECTION
HES 1 ACTIVATED WITH B FIELD IN THIS DIRECTION
1.38 BOTTOM OF HES TO OUTSIDE OF HSG
2.33 BOTTOM OF HES TO OUTSIDE OF HSG
(0.00) CENTER OF MIDDLE CONTACT ON REAR OF UNIT
Apple Inc.
NONE

60.139 iPad Pro 12.9-inch (5th generation), 4 of 5

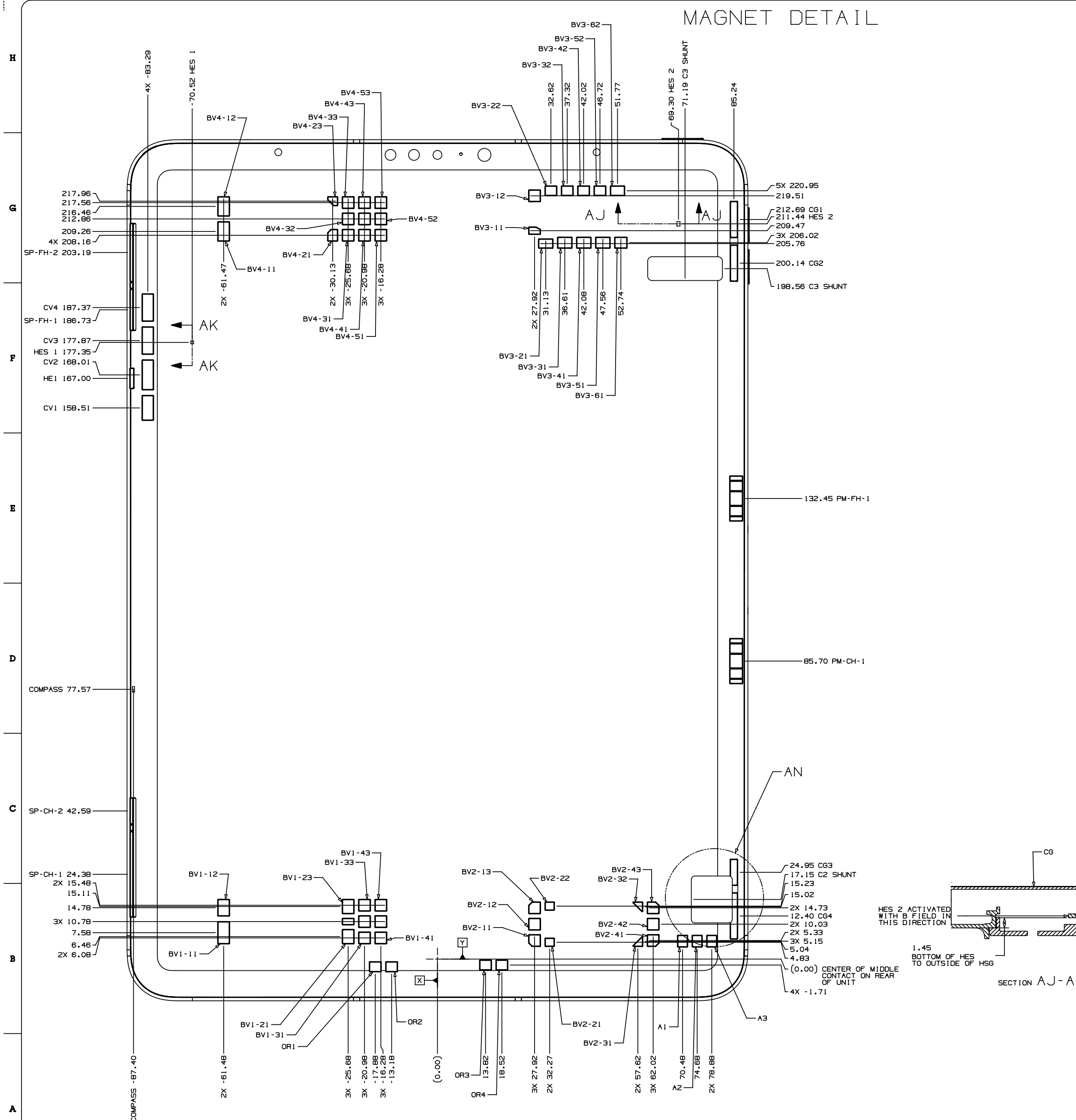



ANTENNA KEEPOUT
ANTENNA KEEP OUT
DO NOT OBSTRUCT THIS
AREA WITH METAL
2X 7.99
ALL AROUND
HSG OUTSIDE
2X 11.89
ALL AROUND
HSG INSIDE
2X 117.65
83.42
53.47
2X -13.45
(0.00)
-34.18
-91.83
-13.45
2X -117.66
Apple Inc.
NONE
SHT 5 OF 5


NOTES: (UNLESS OTHERWISE SPECIFIED)
1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERAS
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
4 DO NOT OBSTRUCT IR CAMERA, FLOOD ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
DETAIL K
DETAIL L
DETAIL M
DETAIL N
DETAIL J
DETAIL AF
DETAIL AD
DETAIL AL
DETAIL P
METRIC
Apple Inc.
iPad Pro
(11-inch)
3rd generation
NONE

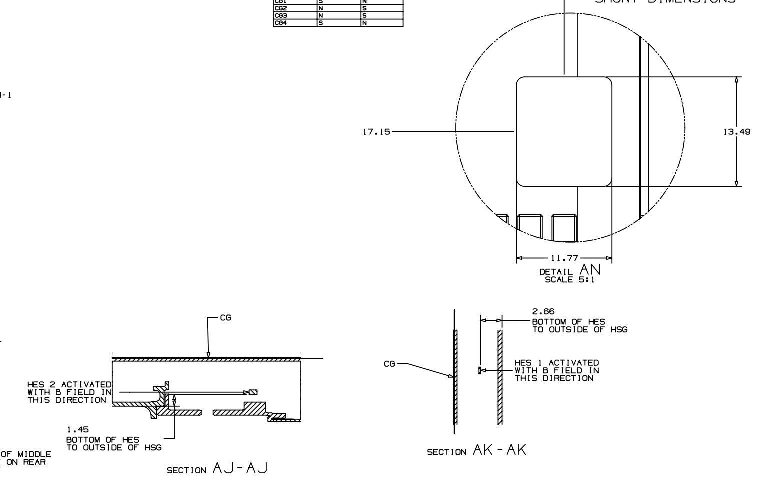

1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERAS
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
4 DO NOT OBSTRUCT IR CAMERA, FLOOD ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
2 11.03 REAR FLASH
2 13.12 ULTRA WIDE CAMERA REAR CAMERA
2 18.42 RCAM IR 2
2 19.13 RCAM IR 1 & 2 SAPPHIRE WINDOW APERTURE
2 21.42 RCAM IR 1
2 25.14 REAR CAMERA
1 27.07
2 RCAM IR 2 Ø 2.02
2 FLASH Ø 4.00
2 RCAM IR APERTURE Ø 7.44
2 ULTRA WIDE CAMERA Ø 8.83
2 RCAM IR 1 Ø 2.22
2 WIDE CAMERA Ø 8.83
1 Ø 2.90 REAR MIC KEEPOUT
2 2X 13.12
2 2X 25.62
1 2 2X 25.91 REAR MIC & REAR FLASH
2 25.91 RCAM IR 1 & 2 SAPPHIRE WINDOW APERTURE
DETAIL T
3.95
5.72 HSG SIDE WALL EDGE TO TURRET SIDE WALL EDGE
32.54 HSG SIDE WALL EDGE TO TURRET SIDE WALL EDGE
0.00 0.03 0.89 3.94 7.75 13.41
0.00 -0.03 -0.89 -3.94 -7.75 -13.41
3.95
HSG SIDE WALL EDGE TO 5.72 TURRET SIDE WALL EDGE
HSG SIDE WALL EDGE TO 32.54 TURRET SIDE WALL EDGE
34.31
DETAIL AG
-1.54 -1.44 -0.78 -0.15 0.00
1.77
0.76
0.10
0.00
R 0.12
2X 0.00
DETAIL AH
31.54 (-) VOLUME BUTTON
19.49 (+) VOLUME BUTTON
AH
10.06 (+) VOLUME BUTTON
2.00
10.06 (-) VOLUME BUTTON
2X 2.56
INDUCTIVE CHARGING WINDOW
COVER GLASS (CG)
15.83
SIM TRAY
20.98
5.953 SYSTEM THICKNESS
2 ULTRA WIDE & WIDE CAMERAS 78.14
1 2 FLASH, REAR MIC, RC IR APERTURE 63.35
2 RCAM IR 1 & 2 CAMERA 2X 63.64
AG
T
2 FLASH 112.79
2 ULTRA WIDE CAMERA 110.70
2 WIDE CAMERA 98.68
1 REAR MIC 96.75
2 RC IR APERTURE 104.69
2 RCAM IR 2 CAMERA 105.40
2 RCAM IR 1 CAMERA 102.40
82.31
4.97
U
4.97
4.97
Y
3X Ø 3.40 PIN DIAMETER
2X 10.02 (TO ENCLOSURE)
3X Ø 3.96 ENCLOSURE OPENING
X
DETAIL U
7.86 REAR CAMERA TO CG SURFACE
7.49 SAPPHIRE WINDOW TO CG SURFACE
1.54 SAPPHIRE WINDOW TO HSG BACK SIDE
1.91 REAR CAMERA WINDOW TO HSG BACK SIDE
1 123.82 SIDE MIC 3
1 Ø 1.60 SIDE MIC 3 KEEPOUT
1 3.00 SIDE MIC 3 FROM CG
Apple Inc.
E
NONE
SHT 2 OF 5

MAGNET DETAIL



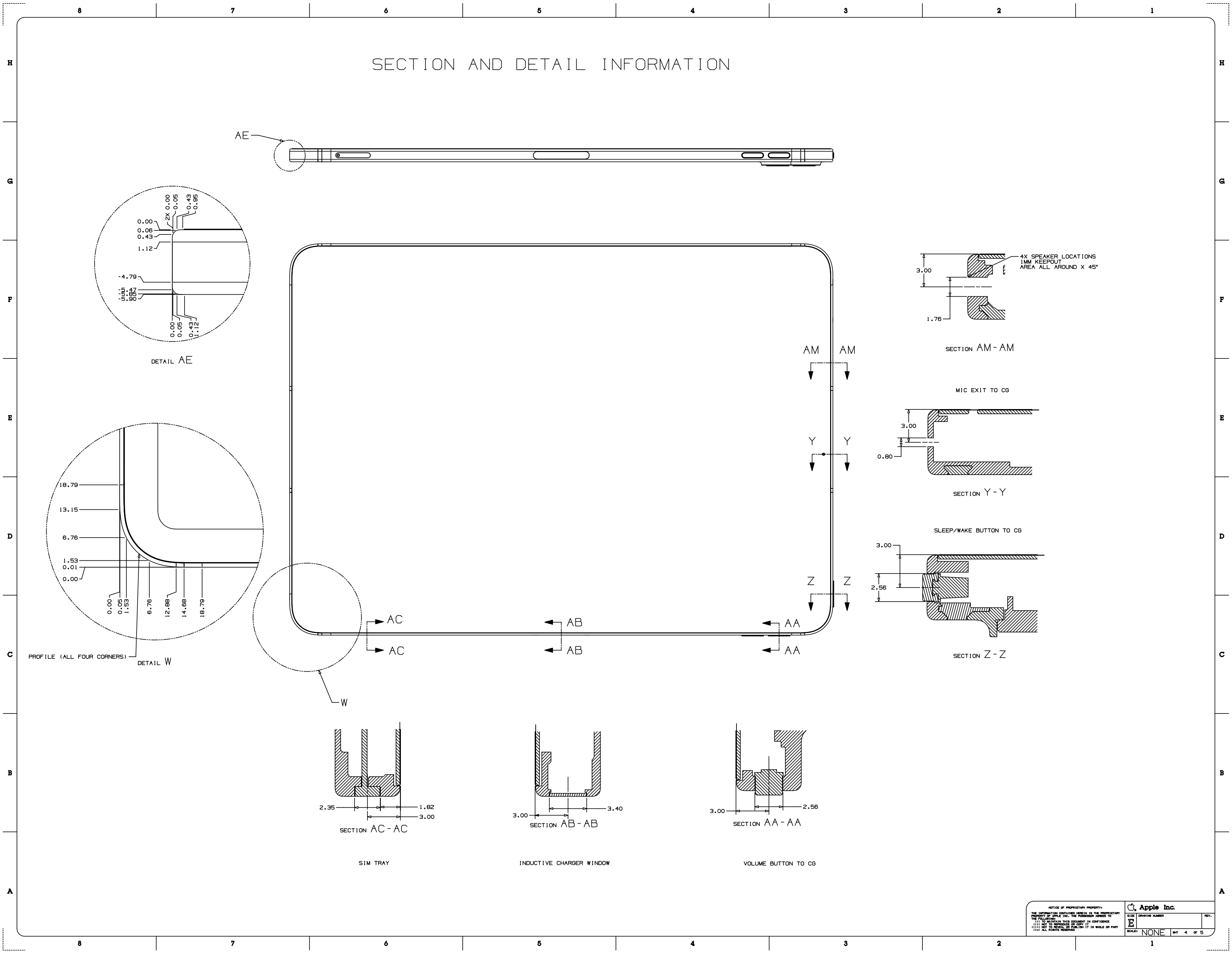
LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE	POLARITY TOWARD SURFACE OF ENCLOSURE
BV1-11	S	N
BV1-12	N	S
BV1-21	N	S
BV1-22	S	N
BV1-23	N	S
BV1-31	S	N
BV1-32	N	S
BV1-33	S	N
BV1-41	S	N
BV1-42	S	N
BV1-43	N	S
BV2-11	S	N
BV2-12	S	N
BV2-13	N	S
BV2-21	N	S
BV2-22	S	N
BV2-31	N	S
BV2-32	N	S
BV2-41	S	N
BV2-42	N	S
BV2-43	S	N
BV3-11	N	S
BV3-12	S	N
BV3-21	S	N
BV3-22	N	S
BV3-31	N	S
BV3-32	S	N
BV3-41	S	N
BV3-42	N	S
BV3-51	N	S
BV3-52	N	S
BV3-61	S	N
BV3-62	S	N
BV4-11	N	S
BV4-12	S	N
BV4-21	N	S
BV4-23	S	N
BV4-31	N	S
BV4-32	S	N
BV4-33	N	S
BV4-41	S	N
BV4-42	N	S
BV4-43	N	S
BV4-51	N	S
BV4-52	S	N
BV4-53	S	N
CV1	N	S
CV2	S	N
CV3	S	N
CV4	N	S
OR1	N	S
OR2	S	N
OR3	S	N
OR4	N	S
HE1	S	N
PM-FH-1	N	S
PM-CH-1	N	S
SP-CH-1-S	N	S
SP-CH-1-B	S	N
SP-CH-2-S	S	N
SP-CH-2-B	N	S
SP-FH-1-S	S	N
SP-FH-1-B	N	S
SP-FH-2-S	N	S
SP-FH-2-B	S	N
A1	N	S
A2	S	N
A3	N	S
CG1	S	N
CG2	N	S
CG3	N	S
CG4	S	N

SHUNT DIMENSIONS

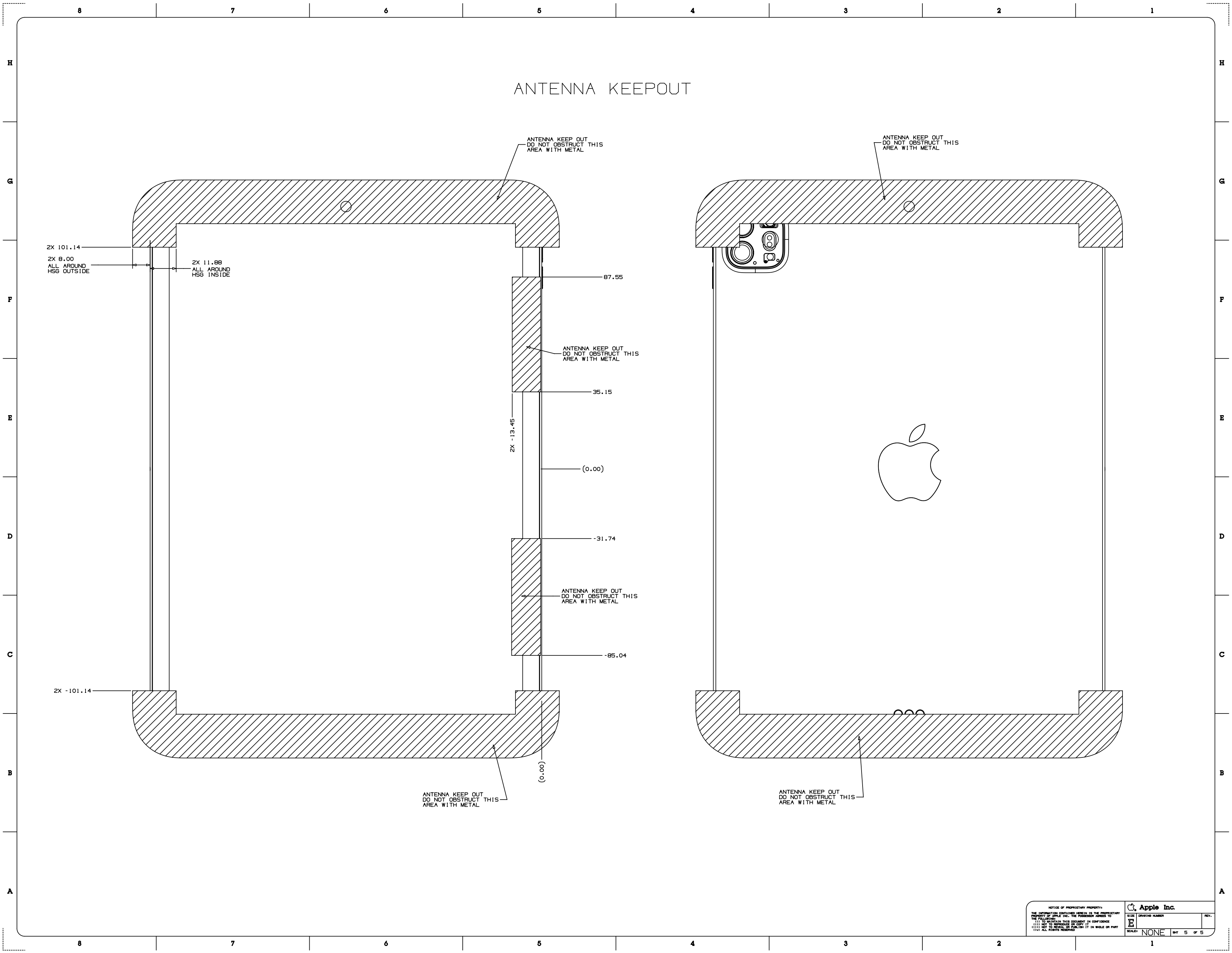


Apple Inc.

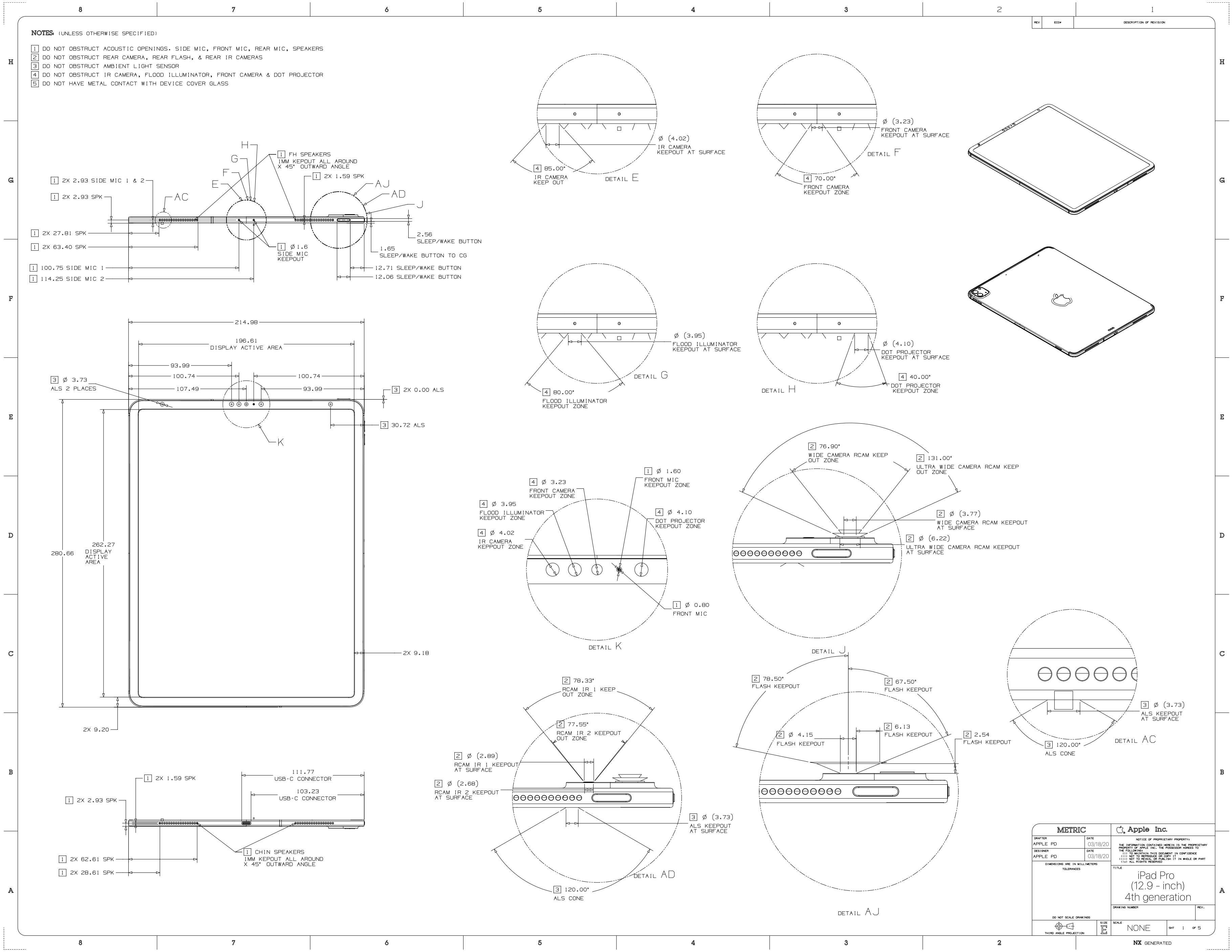
E NONE SHT 3 OF 5

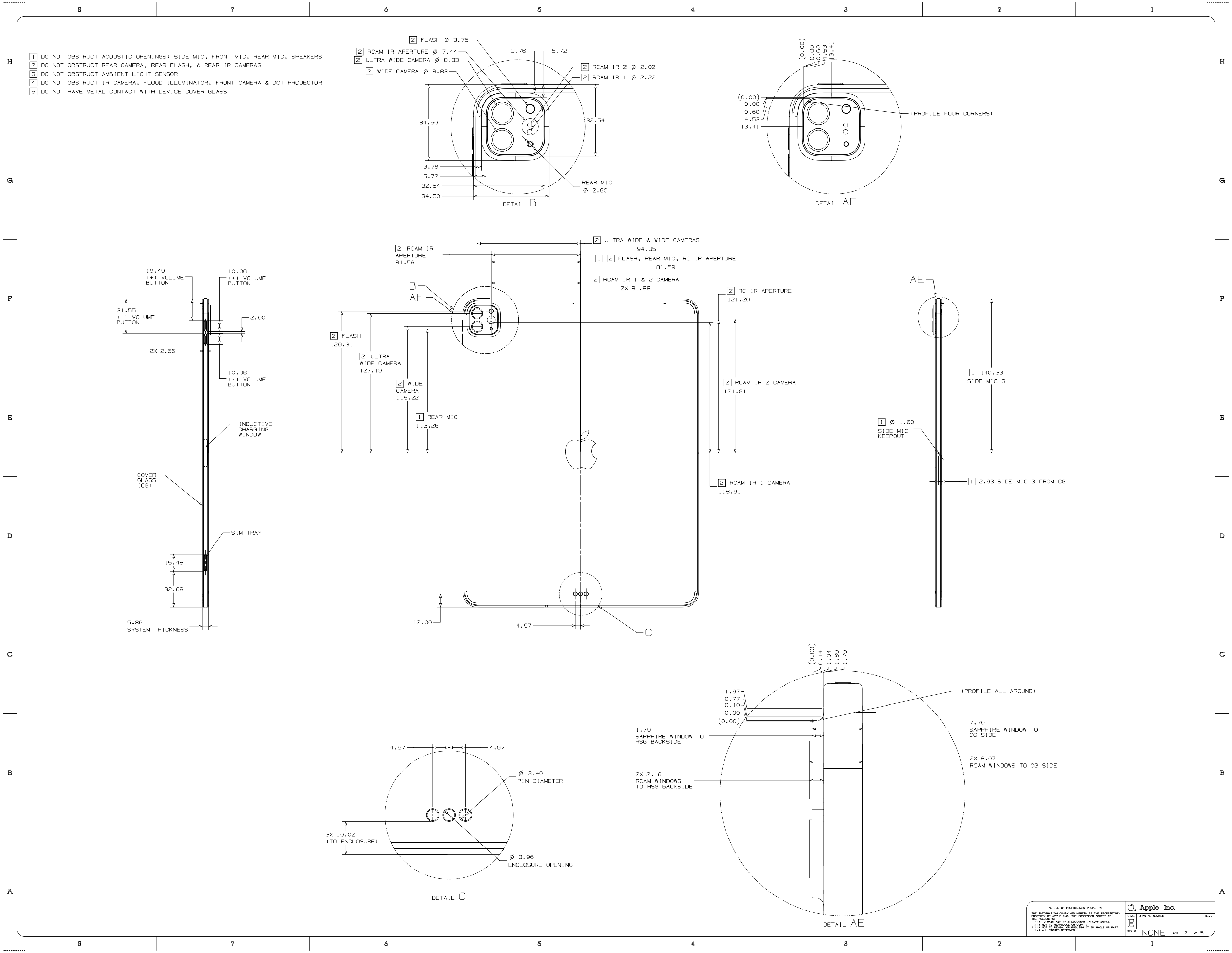

SECTION AND DETAIL INFORMATION
AE
DETAIL AE
0.00
0.06
0.43
1.12
2X 0.00
0.05
0.43
0.95
-4.79
-5.47
-5.85
-5.90
0.00
0.05
0.43
1.12
DETAIL W
PROFILE (ALL FOUR CORNERS)
18.79
13.15
6.76
1.53
0.01
0.00
0.00
0.05
1.53
6.76
12.88
14.68
18.79
W
AM
Y
Z
AC
AB
AA
4X SPEAKER LOCATIONS
1MM KEEPOUT
AREA ALL AROUND X 45°
3.00
1.76
SECTION AM-AM
MIC EXIT TO CG
3.00
0.80
SECTION Y-Y
SLEEP/WAKE BUTTON TO CG
3.00
2.56
SECTION Z-Z
2.35
1.82
3.00
SECTION AC-AC
SIM TRAY
3.00
3.40
SECTION AB-AB
INDUCTIVE CHARGER WINDOW
3.00
2.56
SECTION AA-AA
VOLUME BUTTON TO CG
NOTICE OF PROPRIETARY PROPERTY:
Apple Inc.
E
NONE
SHT 4 OF 5

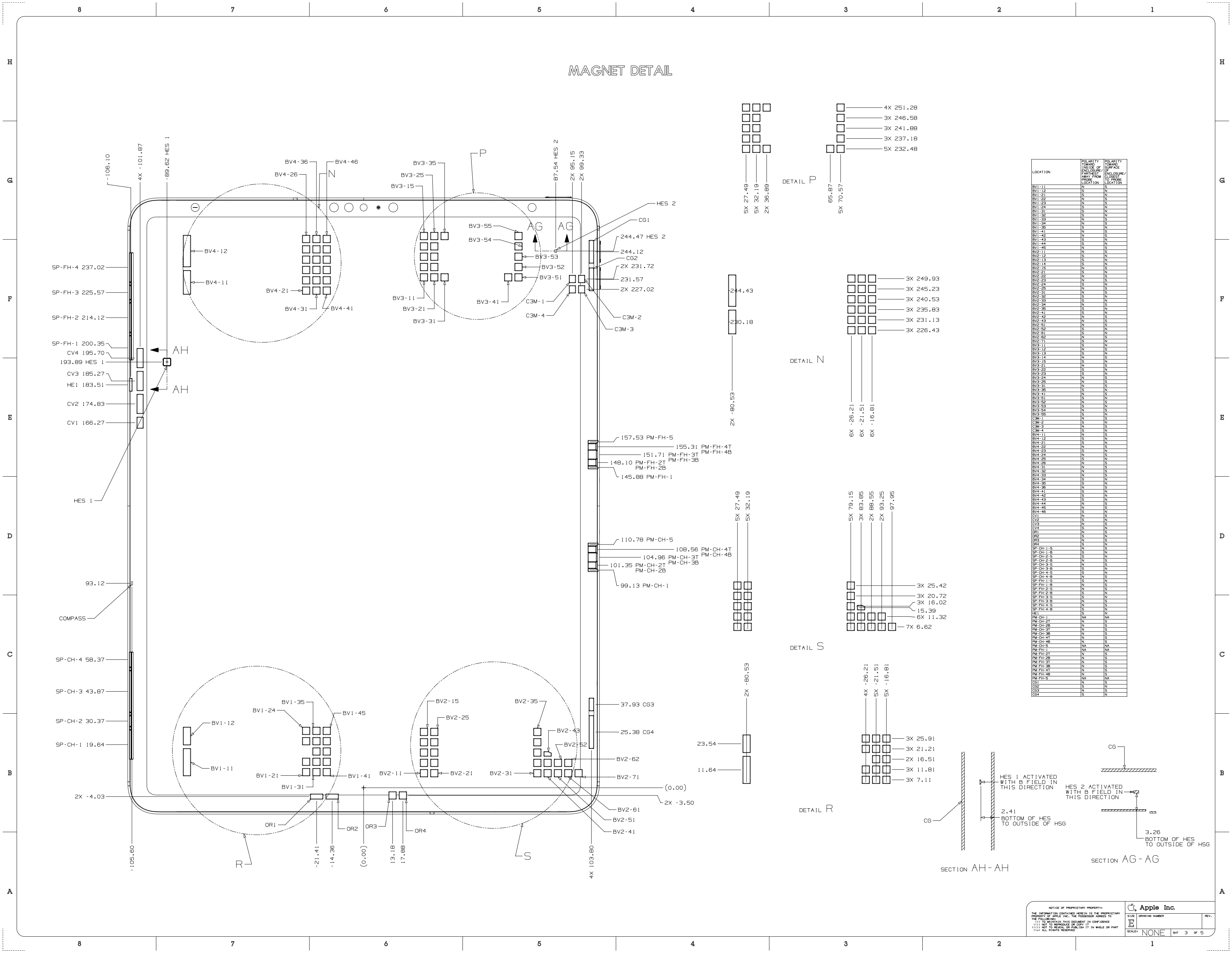
60.145 iPad Pro 11-inch (3rd generation), 5 of 5



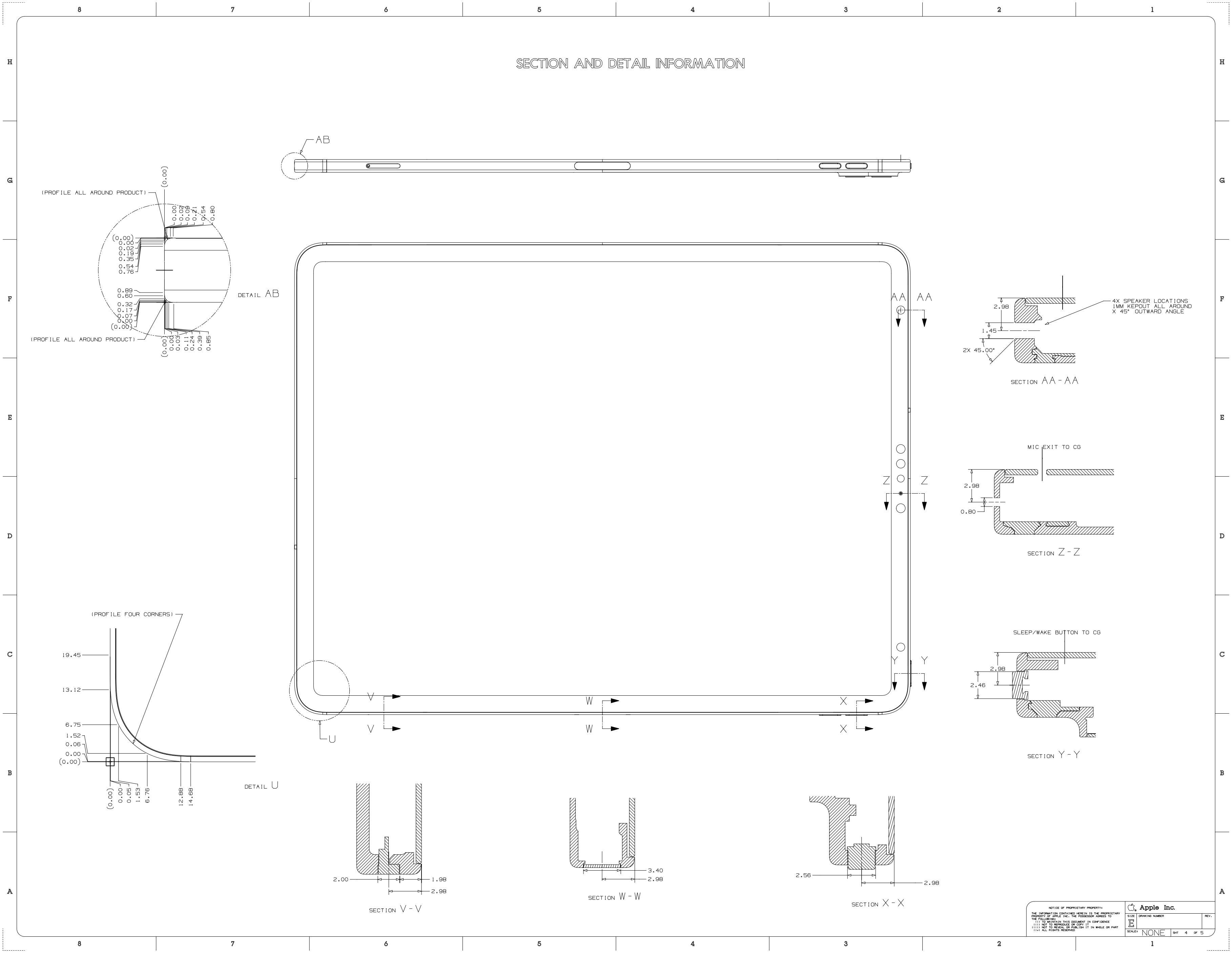
60.146 iPad Pro 12.9-inch (4th generation), 1 of 5



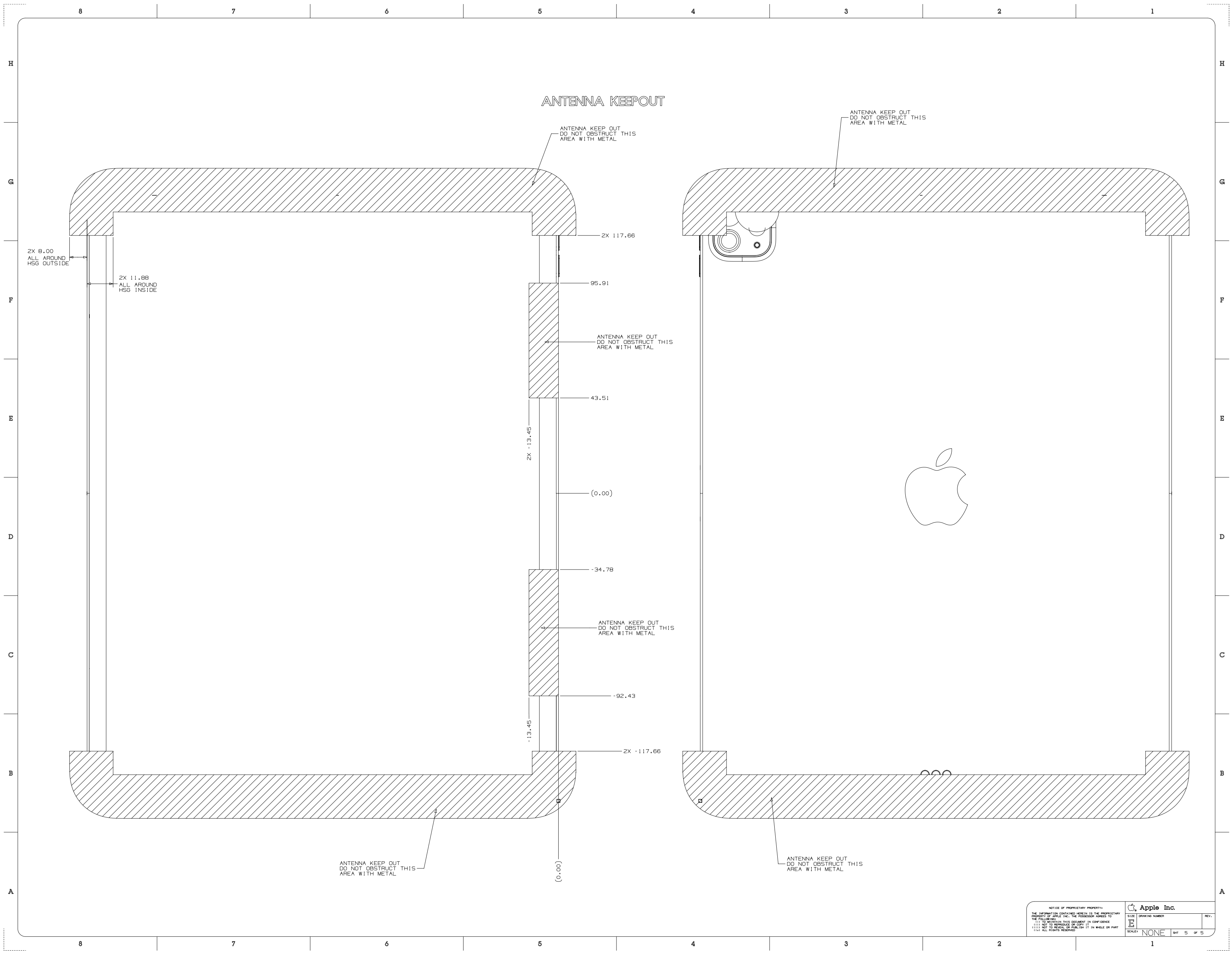

1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERAS
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
4 DO NOT OBSTRUCT IR CAMERA, FLOOD ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
2 FLASH Ø 3.75
2 RCAM IR APERTURE Ø 7.44
2 ULTRA WIDE CAMERA Ø 8.83
2 WIDE CAMERA Ø 8.83
2 RCAM IR 2 Ø 2.02
2 RCAM IR 1 Ø 2.22
REAR MIC Ø 2.90
DETAIL B
(PROFILE FOUR CORNERS)
DETAIL AF
19.49 (+) VOLUME BUTTON
10.06 (+) VOLUME BUTTON
31.55 (-) VOLUME BUTTON
2X 2.56
10.06 (-) VOLUME BUTTON
INDUCTIVE CHARGING WINDOW
COVER GLASS (CG)
SIM TRAY
5.86 SYSTEM THICKNESS
2 RCAM IR APERTURE 81.59
2 ULTRA WIDE & WIDE CAMERAS 94.35
1 2 FLASH, REAR MIC, RC IR APERTURE 81.59
2 RCAM IR 1 & 2 CAMERA 2X 81.88
2 RC IR APERTURE 121.20
2 FLASH 129.31
2 ULTRA WIDE CAMERA 127.19
2 WIDE CAMERA 115.22
1 REAR MIC 113.26
2 RCAM IR 2 CAMERA 121.91
2 RCAM IR 1 CAMERA 118.91
1 140.33 SIDE MIC 3
1 Ø 1.60 SIDE MIC KEEPOUT
1 2.93 SIDE MIC 3 FROM CG
Ø 3.40 PIN DIAMETER
3X 10.02 (TO ENCLOSURE)
Ø 3.96 ENCLOSURE OPENING
DETAIL C
(PROFILE ALL AROUND)
1.79 SAPPHIRE WINDOW TO HSG BACKSIDE
7.70 SAPPHIRE WINDOW TO CG SIDE
2X 2.16 RCAM WINDOWS TO HSG BACKSIDE
2X 8.07 RCAM WINDOWS TO CG SIDE
DETAIL AE
Apple Inc.
SCALE: NONE
SHT 2 OF 5



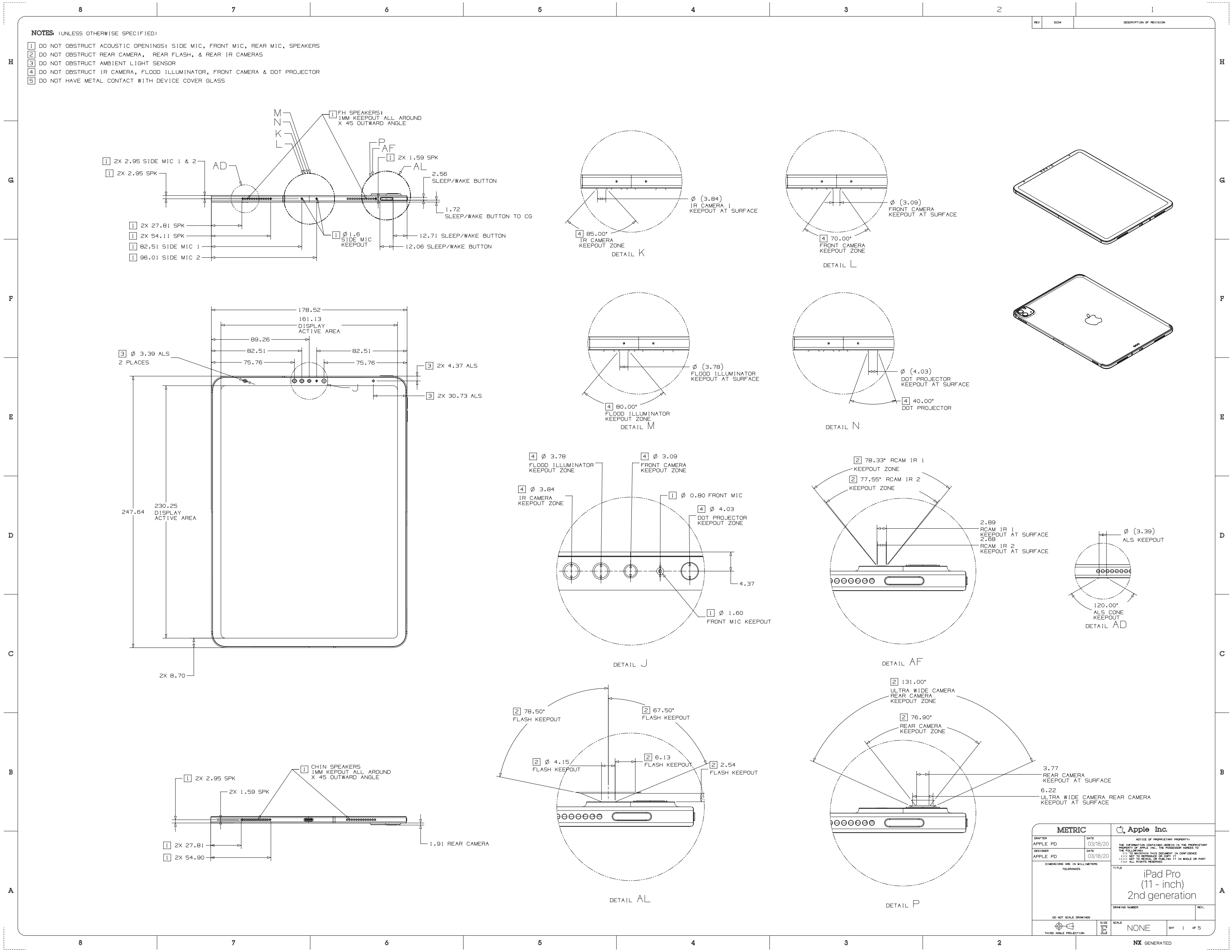
LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE/ FARTHEST AWAY FROM PROBE LOCATION	POLARITY TOWARD SURFACE OF ENCLOSURE/ CLOSEST TO PROBE LOCATION
BV1-11	N	S
BV1-12	S	N
BV1-21	S	N
BV1-22	N	S
BV1-23	N	S
BV1-24	S	N
BV1-31	S	N
BV1-32	S	N
BV1-33	N	S
BV1-34	N	S
BV1-35	S	N
BV1-41	N	S
BV1-42	N	S
BV1-43	S	N
BV1-44	S	N
BV1-45	N	S
BV2-11	N	S
BV2-12	S	N
BV2-13	S	N
BV2-14	S	N
BV2-15	N	S
BV2-21	S	N
BV2-22	N	S
BV2-23	N	S
BV2-24	S	N
BV2-25	N	S
BV2-31	N	S
BV2-32	S	N
BV2-33	S	N
BV2-34	N	S
BV2-35	S	N
BV2-41	S	N
BV2-42	N	S
BV2-43	N	S
BV2-51	N	S
BV2-52	S	N
BV2-61	S	N
BV2-62	N	S
BV2-71	S	N
BV3-11	S	N
BV3-12	N	S
BV3-13	S	N
BV3-14	N	S
BV3-15	S	N
BV3-21	N	S
BV3-22	S	N
BV3-23	S	N
BV3-24	N	S
BV3-25	N	S
BV3-31	N	S
BV3-35	S	N
BV3-41	N	S
BV3-51	S	N
BV3-52	N	S
BV3-53	S	N
BV3-54	N	S
BV3-55	S	N
C3M-1	N	S
C3M-2	S	N
C3M-3	N	S
C3M-4	S	N
BV4-11	N	S
BV4-12	S	N
BV4-21	S	N
BV4-22	N	S
BV4-23	S	N
BV4-24	N	S
BV4-25	S	N
BV4-26	N	S
BV4-31	N	S
BV4-32	N	S
BV4-33	N	S
BV4-34	S	N
BV4-35	S	N
BV4-36	N	S
BV4-41	S	N
BV4-42	S	N
BV4-43	S	N
BV4-44	N	S
BV4-45	N	S
BV4-46	S	N
CV1	N	S
CV2	S	N
CV3	N	S
CV4	S	N
OR1	N	S
OR2	S	N
OR3	N	S
OR4	S	N
SP-CH-1-S	N	S
SP-CH-1-B	S	N
SP-CH-2-S	S	N
SP-CH-2-B	N	S
SP-CH-3-S	N	S
SP-CH-3-B	S	N
SP-CH-4-S	S	N
SP-CH-4-B	N	S
SP-FH-1-S	S	N
SP-FH-1-B	N	S
SP-FH-2-S	N	S
SP-FH-2-B	S	N
SP-FH-3-S	S	N
SP-FH-3-B	N	S
SP-FH-4-S	N	S
SP-FH-4-B	S	N
HE1	S	N
PM-CH-1	NA	NA
PM-CH-2T	N	S
PM-CH-2B	N	S
PM-CH-3T	N	S
PM-CH-3B	N	S
PM-CH-4T	N	S
PM-CH-4B	N	S
PM-CH-5	NA	NA
PM-FH-1	NA	NA
PM-FH-2T	N	S
PM-FH-2B	N	S
PM-FH-3T	N	S
PM-FH-3B	N	S
PM-FH-4T	N	S
PM-FH-4B	N	S
PM-FH-5	NA	NA
CG1	N	S
CG2	S	N
CG3	N	S
CG4	S	N

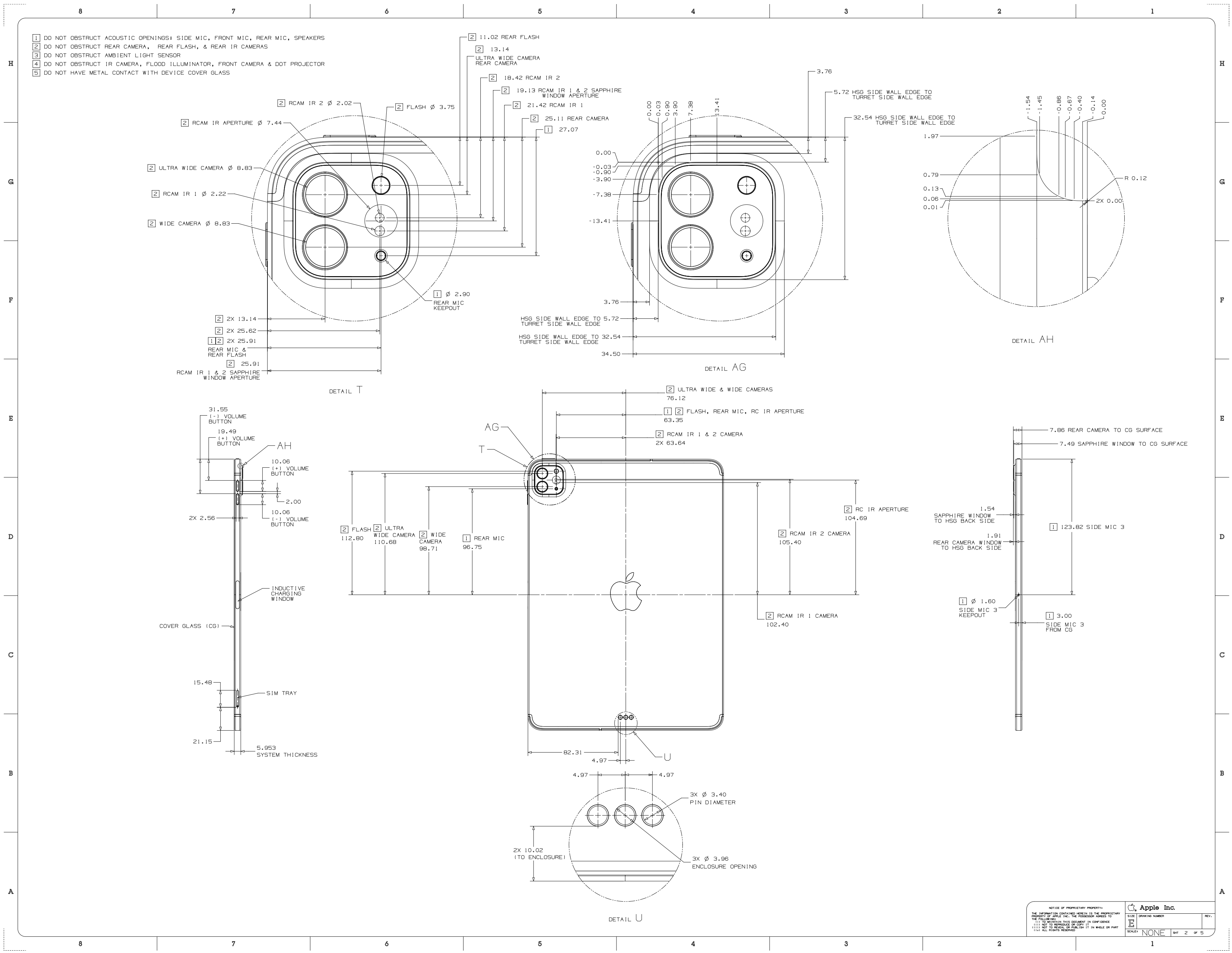

SECTION AND DETAIL INFORMATION
AB
(PROFILE ALL AROUND PRODUCT)
DETAIL AB
AA
SECTION AA - AA
4X SPEAKER LOCATIONS
1MM KEEPOUT ALL AROUND
X 45° OUTWARD ANGLE
2.98
1.45
2X 45.00°
MIC EXIT TO CG
SECTION Z - Z
2.98
0.80
SLEEP/WAKE BUTTON TO CG
SECTION Y - Y
2.98
2.46
(PROFILE FOUR CORNERS)
DETAIL U
19.45
13.12
6.75
1.52
0.06
0.00
(0.00)
12.88
14.68
SECTION V - V
2.00
1.98
2.98
SECTION W - W
3.40
2.98
SECTION X - X
2.56
2.98
Apple Inc.
NONE

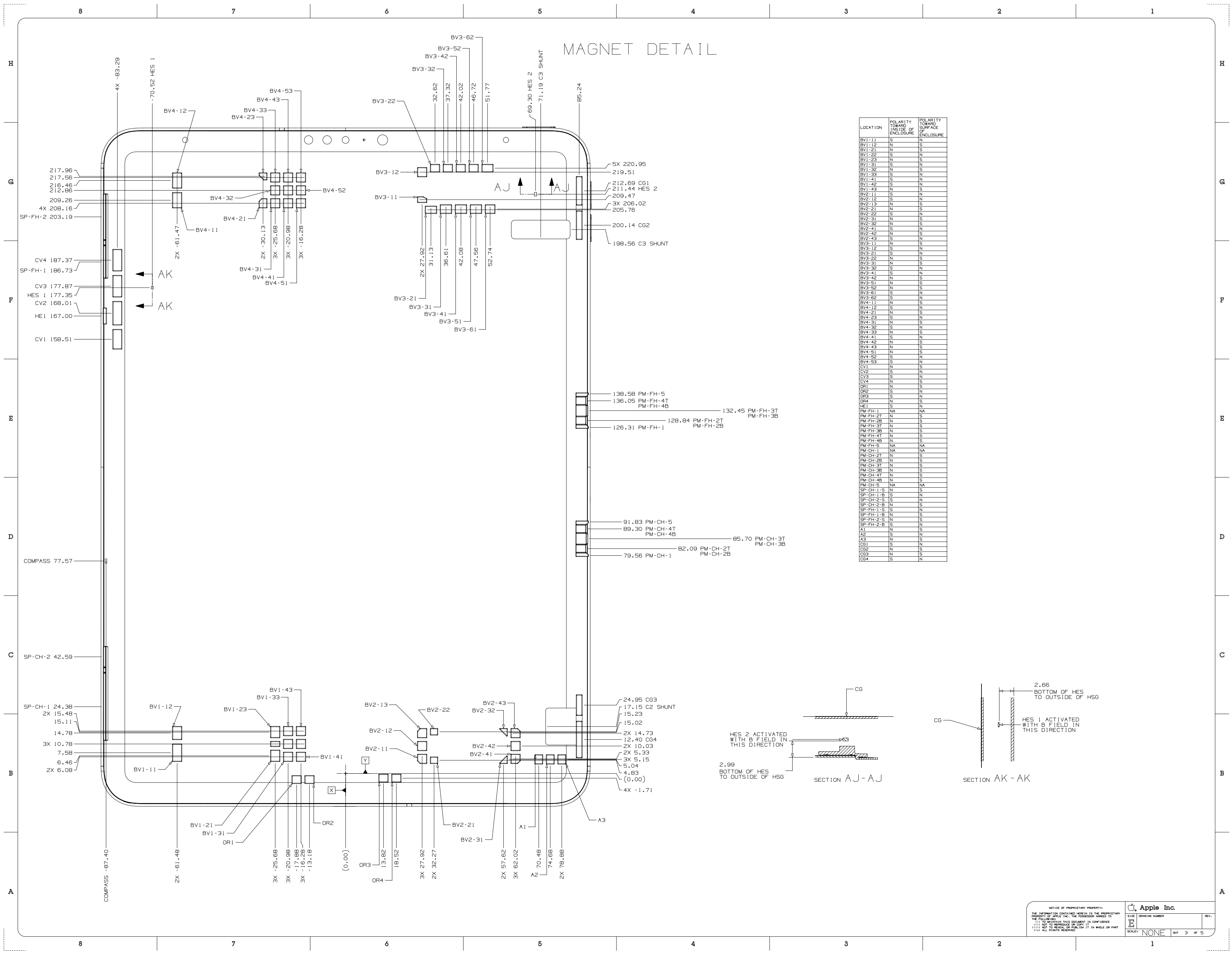
60.150 iPad Pro 12.9-inch (4th generation), 5 of 5



60.151 iPad Pro 11-inch (2nd generation), 1 of 5

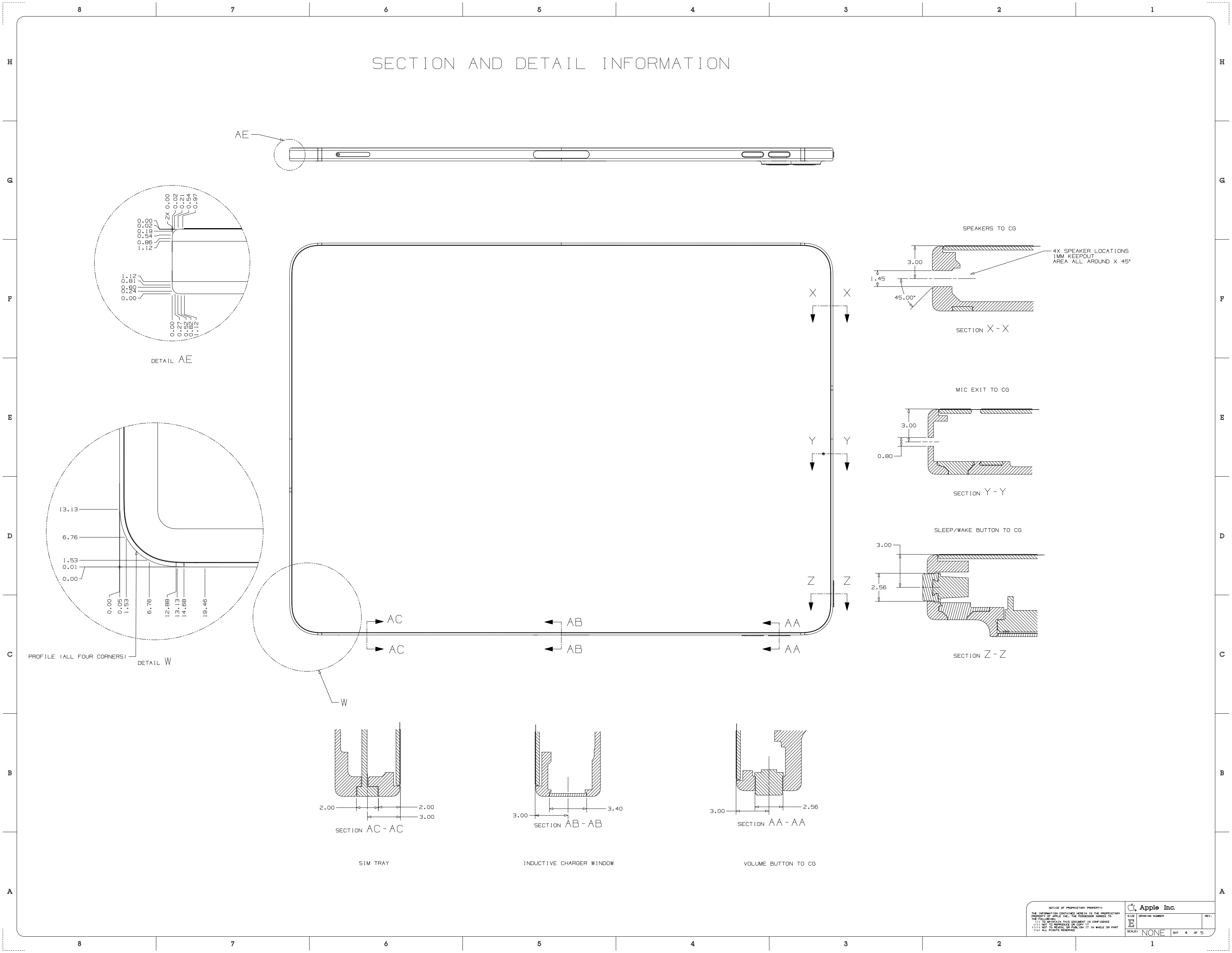


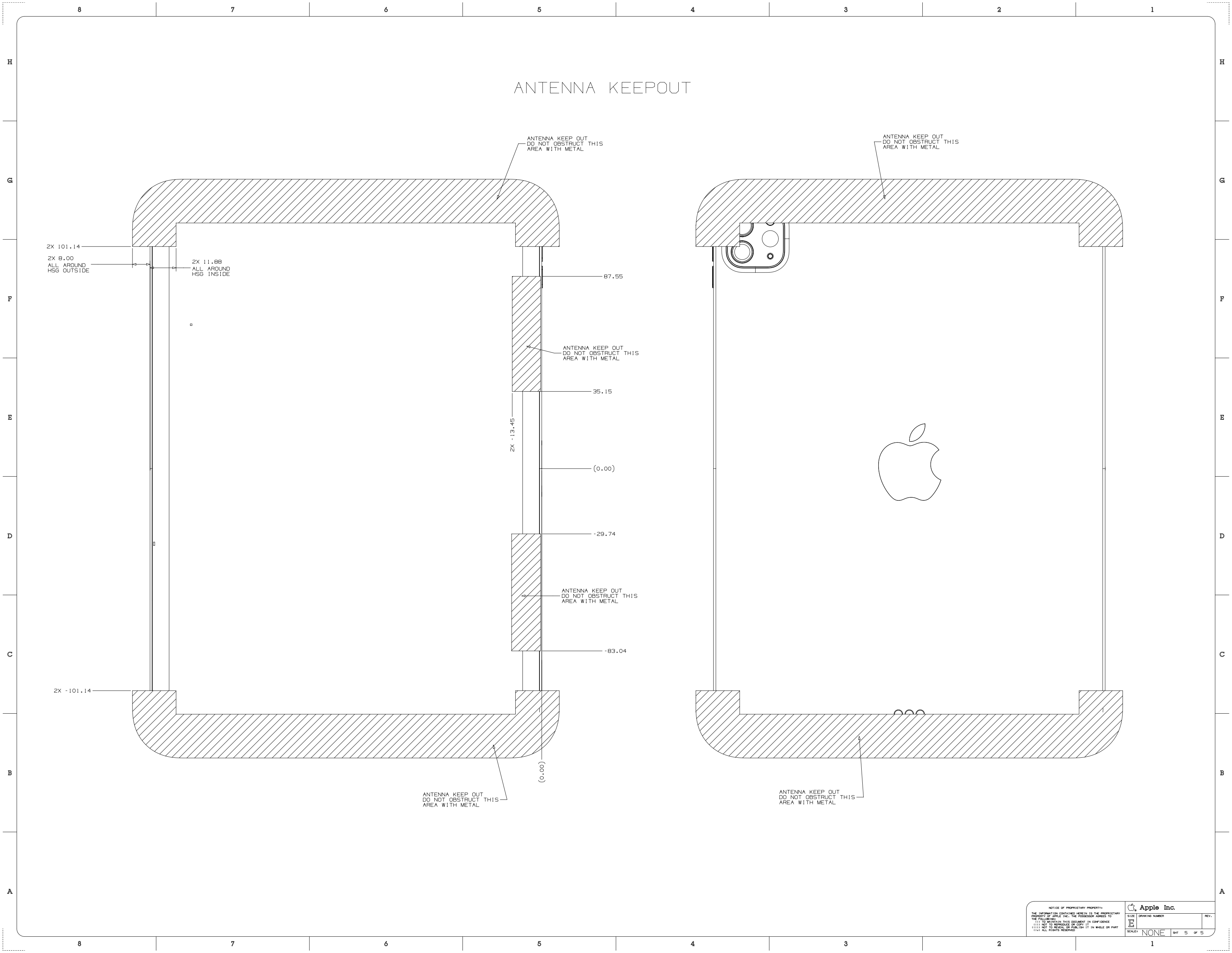

1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERAS
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
4 DO NOT OBSTRUCT IR CAMERA, FLOOD ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
2 RCAM IR 2 Ø 2.02
2 FLASH Ø 3.75
2 RCAM IR APERTURE Ø 7.44
2 ULTRA WIDE CAMERA Ø 8.83
2 RCAM IR 1 Ø 2.22
2 WIDE CAMERA Ø 8.83
1 Ø 2.90 REAR MIC KEEPOUT
2 2X 13.14
2 2X 25.62
1 2 2X 25.91 REAR MIC & REAR FLASH
2 25.91 RCAM IR 1 & 2 SAPPHIRE WINDOW APERTURE
DETAIL T
2 11.02 REAR FLASH
2 13.14 ULTRA WIDE CAMERA REAR CAMERA
2 18.42 RCAM IR 2
2 19.13 RCAM IR 1 & 2 SAPPHIRE WINDOW APERTURE
2 21.42 RCAM IR 1
2 25.11 REAR CAMERA
1 27.07
3.76
5.72 HSG SIDE WALL EDGE TO TURRET SIDE WALL EDGE
32.54 HSG SIDE WALL EDGE TO TURRET SIDE WALL EDGE
0.00 0.03 0.90 3.90 7.38 13.41
0.00 -0.03 -0.90 -3.90 -7.38 -13.41
3.76
HSG SIDE WALL EDGE TO 5.72 TURRET SIDE WALL EDGE
HSG SIDE WALL EDGE TO 32.54 TURRET SIDE WALL EDGE
34.50
DETAIL AG
-1.54 -1.45 -0.86 -0.67 -0.40 -0.14 0.00
1.97
0.79
0.13 0.06 0.01
R 0.12
2X 0.00
DETAIL AH
31.55 (-) VOLUME BUTTON
19.49 (+) VOLUME BUTTON
AH
10.06 (+) VOLUME BUTTON
2.00
10.06 (-) VOLUME BUTTON
2X 2.56
INDUCTIVE CHARGING WINDOW
COVER GLASS (CG)
15.48
SIM TRAY
21.15
5.953 SYSTEM THICKNESS
2 ULTRA WIDE & WIDE CAMERAS 76.12
1 2 FLASH, REAR MIC, RC IR APERTURE 63.35
2 RCAM IR 1 & 2 CAMERA 2X 63.64
AG
T
2 FLASH 112.80
2 ULTRA WIDE CAMERA 110.68
2 WIDE CAMERA 98.71
1 REAR MIC 96.75
2 RC IR APERTURE 104.69
2 RCAM IR 2 CAMERA 105.40
2 RCAM IR 1 CAMERA 102.40
82.31
4.97
U
4.97 4.97
3X Ø 3.40 PIN DIAMETER
2X 10.02 (TO ENCLOSURE)
3X Ø 3.96 ENCLOSURE OPENING
DETAIL U
7.86 REAR CAMERA TO CG SURFACE
7.49 SAPPHIRE WINDOW TO CG SURFACE
1.54 SAPPHIRE WINDOW TO HSG BACK SIDE
1.91 REAR CAMERA WINDOW TO HSG BACK SIDE
1 123.82 SIDE MIC 3
1 Ø 1.60 SIDE MIC 3 KEEPOUT
1 3.00 SIDE MIC 3 FROM CG
Apple Inc.
NONE
SHT 2 OF 5

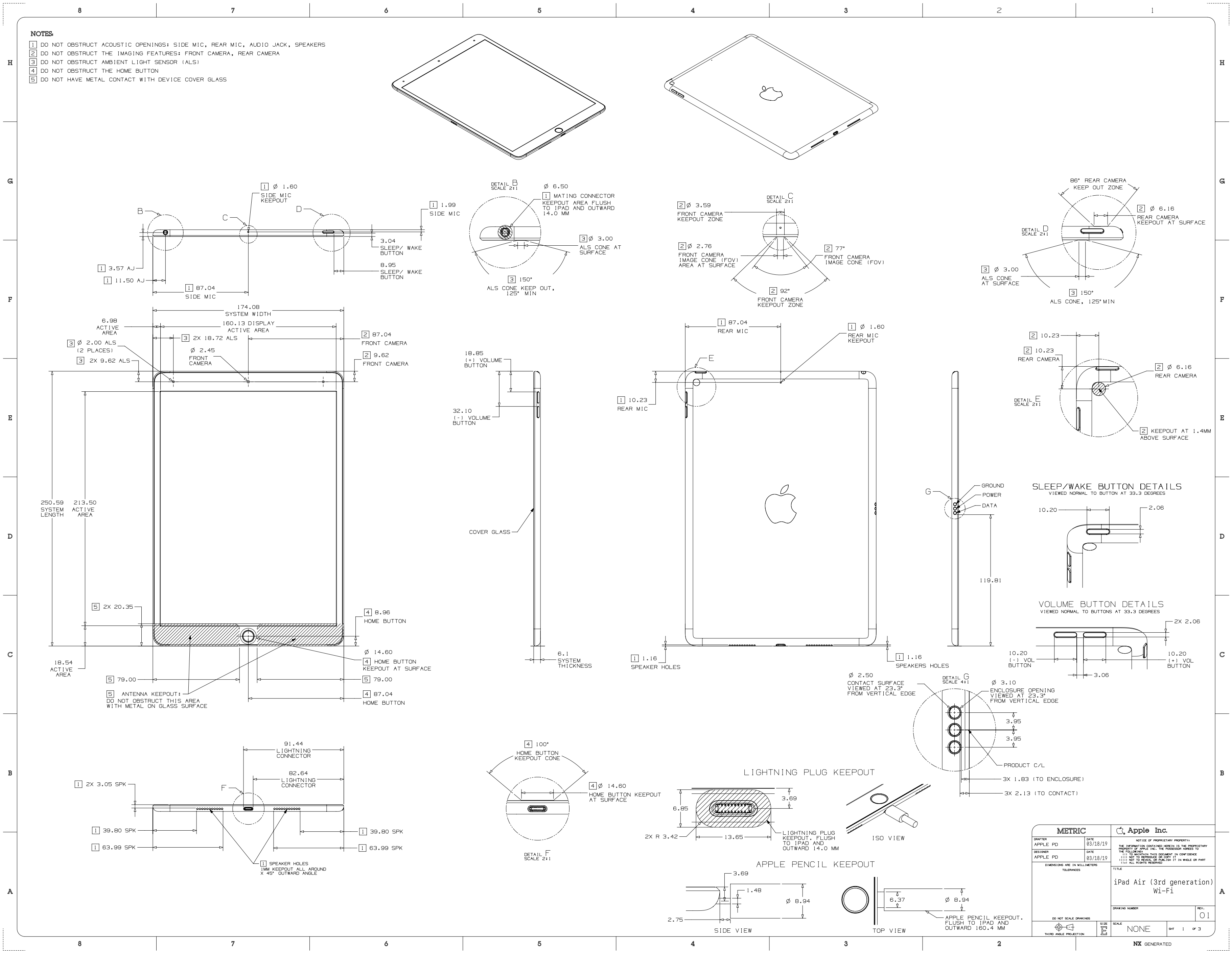


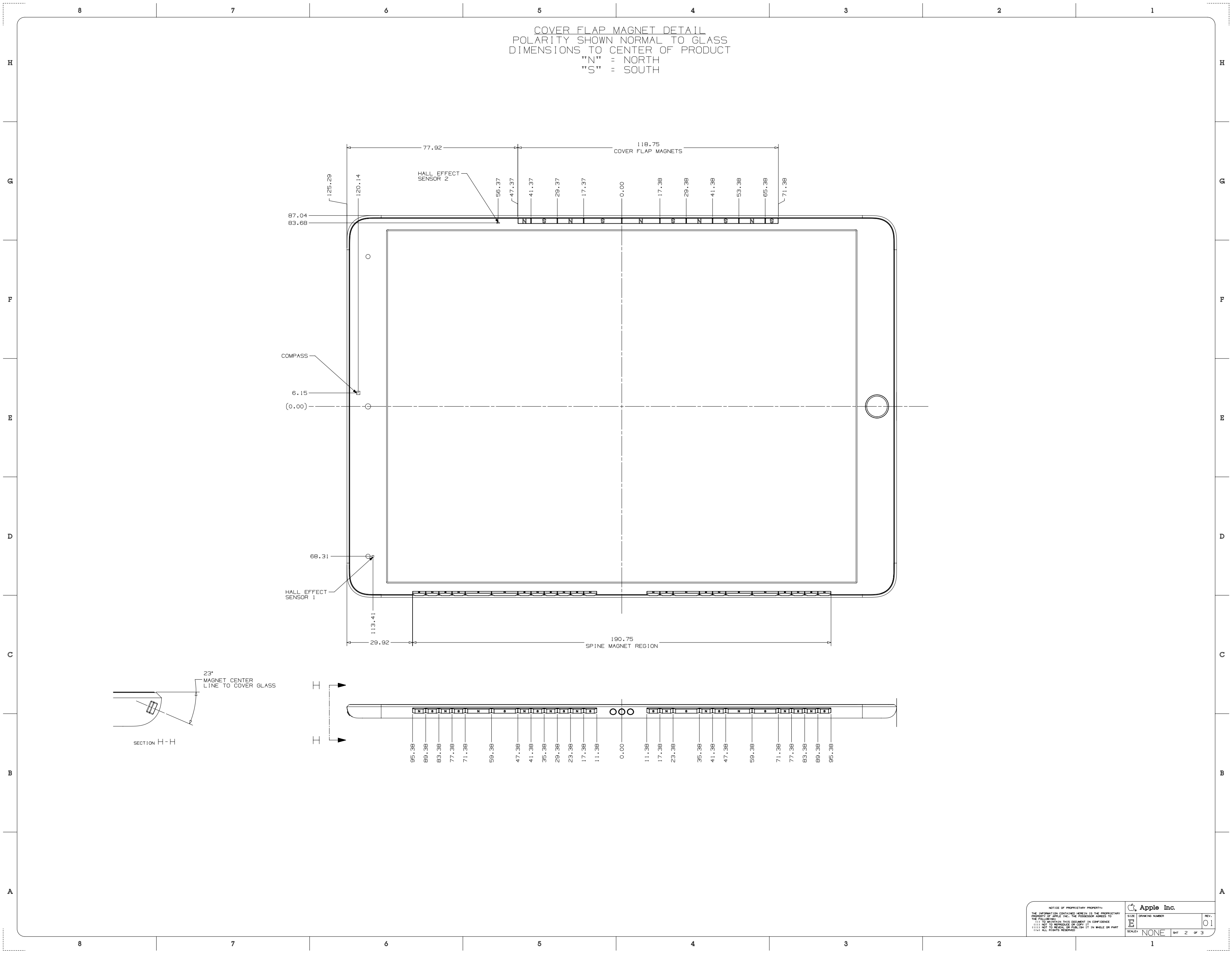
LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE	POLARITY TOWARD SURFACE OF ENCLOSURE
BV1-11	S	N
BV1-12	N	S
BV1-21	N	S
BV1-22	S	N
BV1-23	N	S
BV1-31	S	N
BV1-32	N	S
BV1-33	S	N
BV1-41	S	N
BV1-42	S	N
BV1-43	N	S
BV2-11	S	N
BV2-12	S	N
BV2-13	N	S
BV2-21	N	S
BV2-22	S	N
BV2-31	N	S
BV2-32	N	S
BV2-41	S	N
BV2-42	N	S
BV2-43	S	N
BV3-11	N	S
BV3-12	S	N
BV3-21	S	N
BV3-22	N	S
BV3-31	N	S
BV3-32	S	N
BV3-41	S	N
BV3-42	N	S
BV3-51	N	S
BV3-52	N	S
BV3-61	S	N
BV3-62	S	N
BV4-11	N	S
BV4-12	S	N
BV4-21	N	S
BV4-23	S	N
BV4-31	N	S
BV4-32	S	N
BV4-33	N	S
BV4-41	S	N
BV4-42	N	S
BV4-43	N	S
BV4-51	N	S
BV4-52	S	N
BV4-53	S	N
CV1	N	S
CV2	S	N
CV3	S	N
CV4	N	S
OR1	N	S
OR2	S	N
OR3	S	N
OR4	N	S
HE1	S	N
PM-FH-1	NA	NA
PM-FH-2T	N	S
PM-FH-2B	N	S
PM-FH-3T	N	S
PM-FH-3B	N	S
PM-FH-4T	N	S
PM-FH-4B	N	S
PM-FH-5	NA	NA
PM-CH-1	NA	NA
PM-CH-2T	N	S
PM-CH-2B	N	S
PM-CH-3T	N	S
PM-CH-3B	N	S
PM-CH-4T	N	S
PM-CH-4B	N	S
PM-CH-5	NA	NA
SP-CH-1-S	N	S
SP-CH-1-B	S	N
SP-CH-2-S	S	N
SP-CH-2-B	N	S
SP-FH-1-S	S	N
SP-FH-1-B	N	S
SP-FH-2-S	N	S
SP-FH-2-B	S	N
A1	N	S
A2	S	N
A3	N	S
CG1	S	N
CG2	N	S
CG3	N	S
CG4	S	N

60.154 iPad Pro 11-inch (2nd generation), 4 of 5

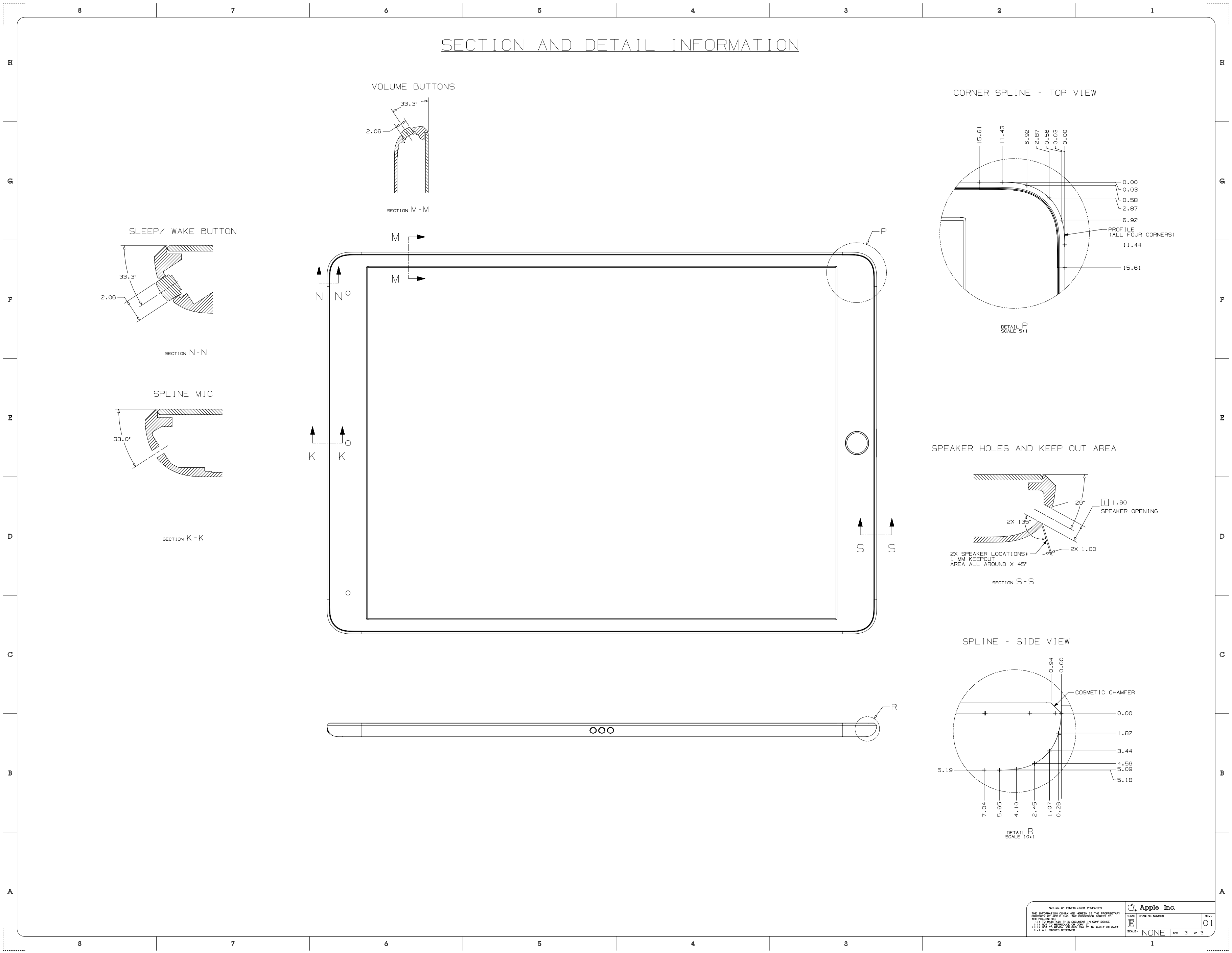



ANTENNA KEEPOUT
ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL
2X 101.14
2X 8.00 ALL AROUND HSG OUTSIDE
2X 11.88 ALL AROUND HSG INSIDE
87.55
35.15
2X -13.45
(0.00)
-29.74
-83.04
2X -101.14
Apple Inc.
NONE
SHT 5 OF 5

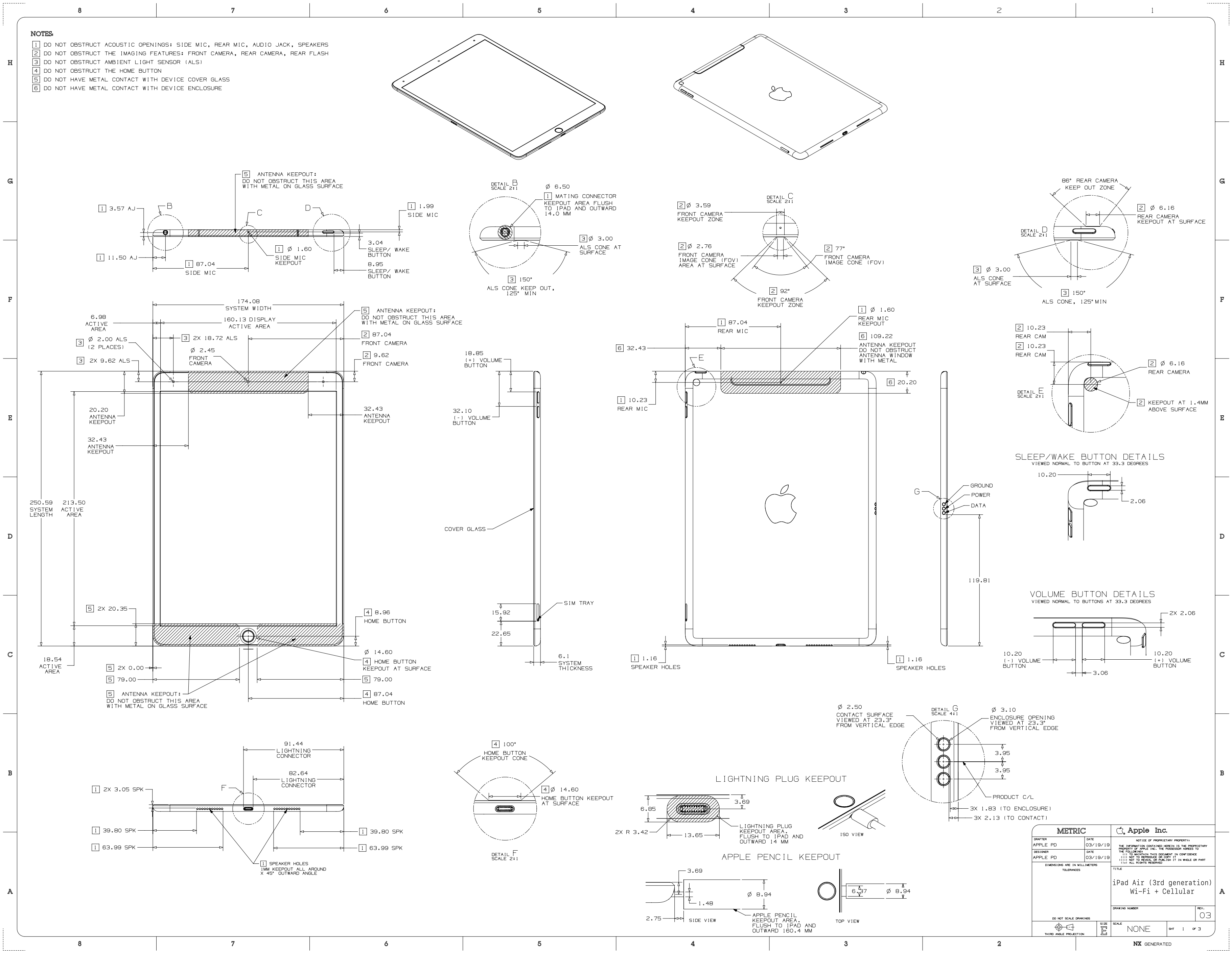

NOTES:
1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
2 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
4 DO NOT OBSTRUCT THE HOME BUTTON
5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
1 Ø 1.60 SIDE MIC KEEPOUT
1 1.99 SIDE MIC
3.04 SLEEP/ WAKE BUTTON
8.95 SLEEP/ WAKE BUTTON
1 3.57 AJ
1 11.50 AJ
1 87.04 SIDE MIC
DETAIL B SCALE 2:1
Ø 6.50
1 MATING CONNECTOR KEEPOUT AREA FLUSH TO IPAD AND OUTWARD 14.0 MM
3 Ø 3.00 ALS CONE AT SURFACE
3 150° ALS CONE KEEP OUT, 125° MIN
DETAIL C SCALE 2:1
2 Ø 3.59 FRONT CAMERA KEEPOUT ZONE
2 Ø 2.76 FRONT CAMERA IMAGE CONE (FOV) AREA AT SURFACE
2 77° FRONT CAMERA IMAGE CONE (FOV)
2 92° FRONT CAMERA KEEPOUT ZONE
86° REAR CAMERA KEEP OUT ZONE
2 Ø 6.16 REAR CAMERA KEEPOUT AT SURFACE
DETAIL D SCALE 2:1
3 Ø 3.00 ALS CONE AT SURFACE
3 150° ALS CONE, 125° MIN
174.08 SYSTEM WIDTH
160.13 DISPLAY ACTIVE AREA
6.98 ACTIVE AREA
3 Ø 2.00 ALS (2 PLACES)
3 2X 18.72 ALS
3 2X 9.62 ALS
Ø 2.45 FRONT CAMERA
2 87.04 FRONT CAMERA
2 9.62 FRONT CAMERA
250.59 SYSTEM LENGTH
213.50 ACTIVE AREA
5 2X 20.35
4 8.96 HOME BUTTON
Ø 14.60
4 HOME BUTTON KEEPOUT AT SURFACE
5 79.00
4 87.04 HOME BUTTON
18.54 ACTIVE AREA
5 ANTENNA KEEPOUT: DO NOT OBSTRUCT THIS AREA WITH METAL ON GLASS SURFACE
18.85 (+) VOLUME BUTTON
32.10 (-) VOLUME BUTTON
COVER GLASS
6.1 SYSTEM THICKNESS
1 87.04 REAR MIC
1 Ø 1.60 REAR MIC KEEPOUT
1 10.23 REAR MIC
1 1.16 SPEAKER HOLES
1 1.16 SPEAKERS HOLES
2 10.23
2 10.23 REAR CAMERA
2 Ø 6.16 REAR CAMERA
DETAIL E SCALE 2:1
2 KEEPOUT AT 1.4MM ABOVE SURFACE
GROUND
POWER
DATA
119.81
SLEEP/WAKE BUTTON DETAILS
VIEWED NORMAL TO BUTTON AT 33.3 DEGREES
10.20
2.06
VOLUME BUTTON DETAILS
VIEWED NORMAL TO BUTTONS AT 33.3 DEGREES
2X 2.06
10.20 (-) VOL BUTTON
10.20 (+) VOL BUTTON
3.06
Ø 2.50 CONTACT SURFACE VIEWED AT 23.3° FROM VERTICAL EDGE
DETAIL G SCALE 4:1
Ø 3.10 ENCLOSURE OPENING VIEWED AT 23.3° FROM VERTICAL EDGE
3.95
3.95
PRODUCT C/L
3X 1.83 (TO ENCLOSURE)
3X 2.13 (TO CONTACT)
91.44 LIGHTNING CONNECTOR
82.64 LIGHTNING CONNECTOR
1 2X 3.05 SPK
1 39.80 SPK
1 63.99 SPK
1 SPEAKER HOLES 1MM KEEPOUT ALL AROUND X 45° OUTWARD ANGLE
4 100° HOME BUTTON KEEPOUT CONE
4 Ø 14.60 HOME BUTTON KEEPOUT AT SURFACE
DETAIL F SCALE 2:1
LIGHTNING PLUG KEEPOUT
3.69
6.85
2X R 3.42
13.65
LIGHTNING PLUG KEEPOUT, FLUSH TO IPAD AND OUTWARD 14.0 MM
ISO VIEW
APPLE PENCIL KEEPOUT
3.69
1.48
Ø 8.94
2.75
SIDE VIEW
6.37
TOP VIEW
APPLE PENCIL KEEPOUT, FLUSH TO IPAD AND OUTWARD 160.4 MM
METRIC
APPLE PD
03/18/19
Apple Inc.
iPad Air (3rd generation) Wi-Fi
NONE
01
NX GENERATED

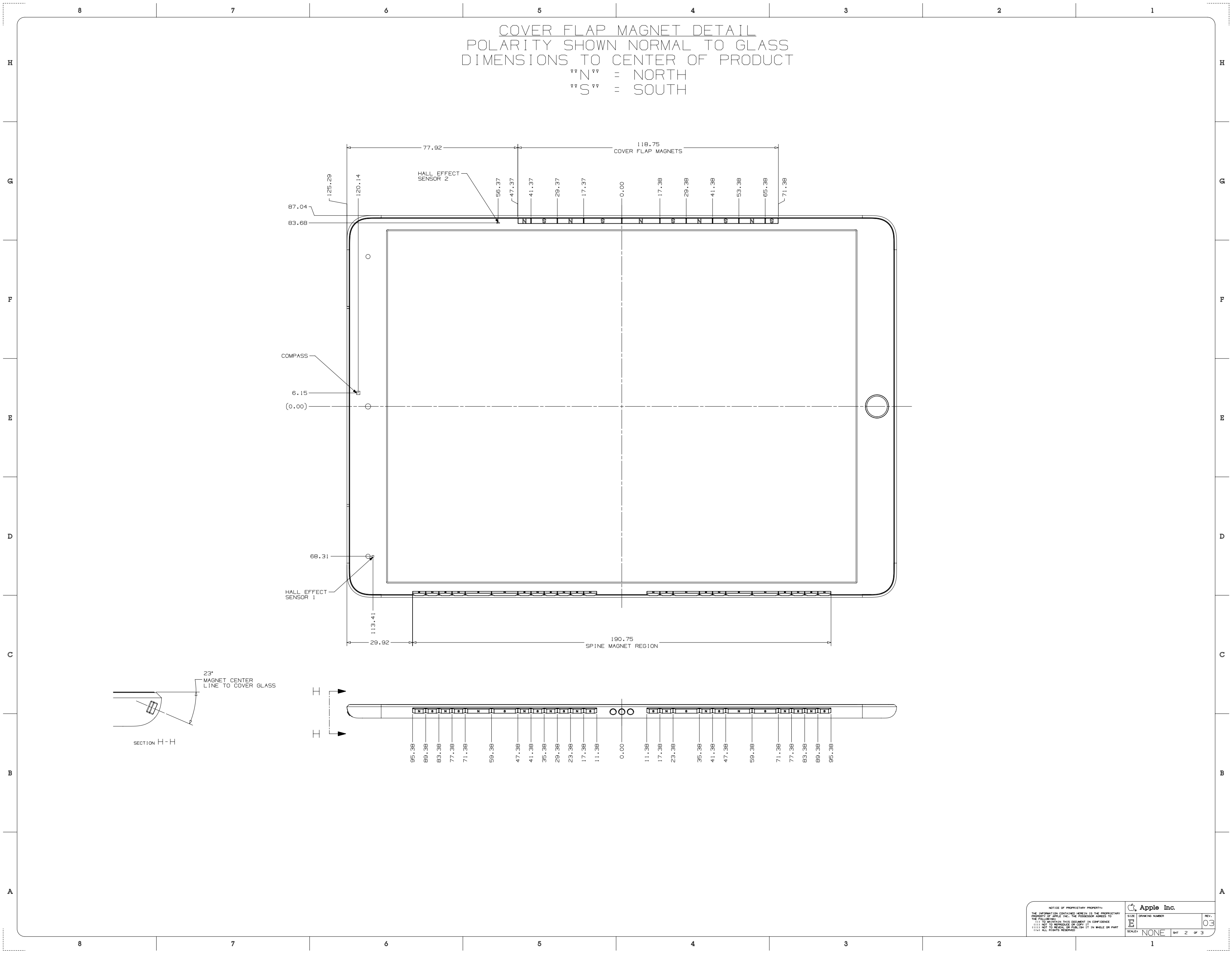

COVER FLAP MAGNET DETAIL
POLARITY SHOWN NORMAL TO GLASS
DIMENSIONS TO CENTER OF PRODUCT
"N" = NORTH
"S" = SOUTH
77.92
118.75
COVER FLAP MAGNETS
HALL EFFECT SENSOR 2
125.29
120.14
56.37
47.37
41.37
29.37
17.37
0.00
17.38
29.38
41.38
53.38
65.38
71.38
87.04
83.68
COMPASS
6.15
(0.00)
68.31
HALL EFFECT SENSOR 1
113.41
29.92
190.75
SPINE MAGNET REGION
23°
MAGNET CENTER LINE TO COVER GLASS
SECTION H-H
95.38
89.38
83.38
77.38
71.38
59.38
47.38
41.38
35.38
29.38
23.38
17.38
11.38
0.00
11.38
17.38
23.38
35.38
41.38
47.38
59.38
71.38
77.38
83.38
89.38
95.38
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY
E
NONE
SHT 2 OF 3
01

60.158 iPad Air (3rd generation), 3 of 3

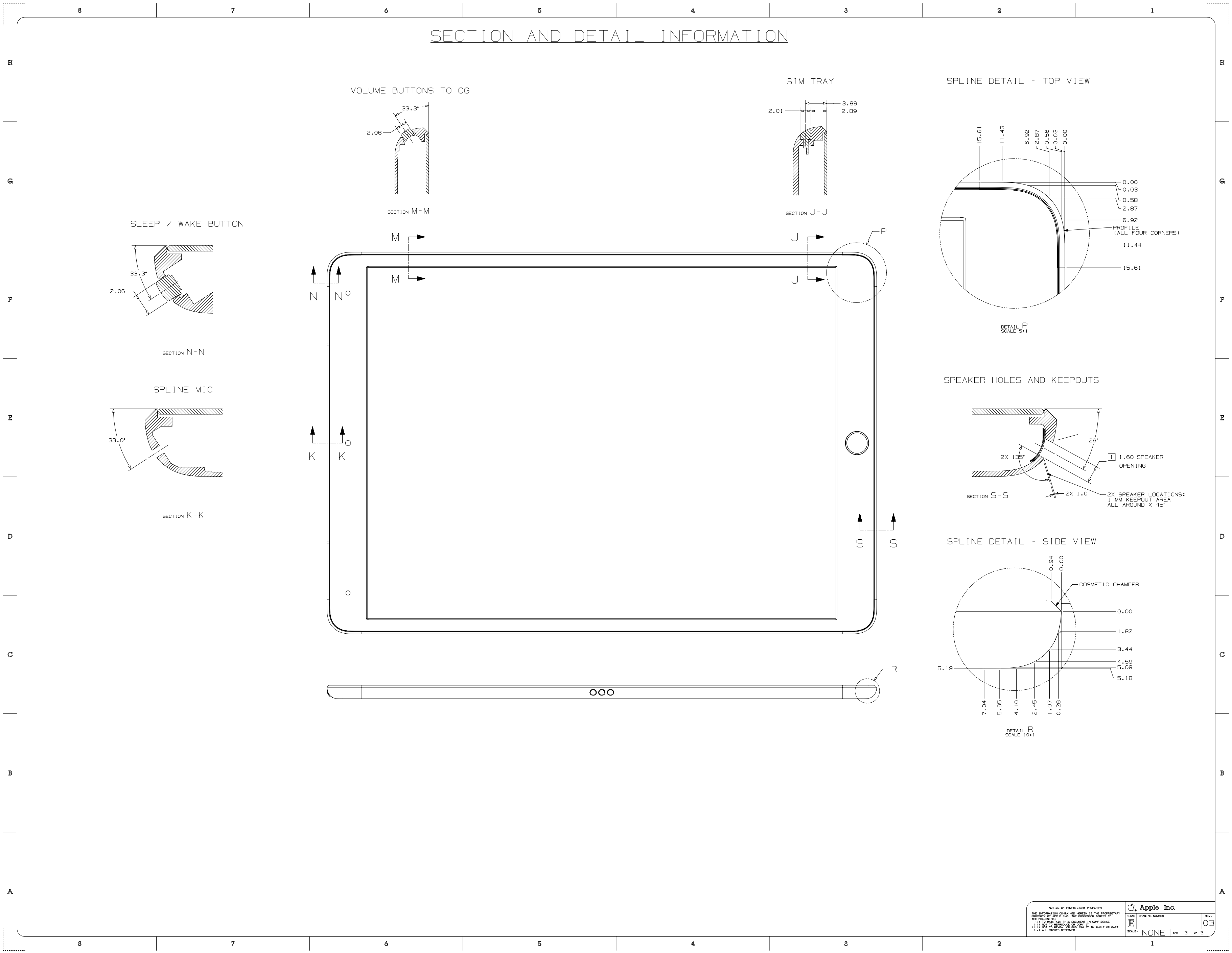


60.159 iPad Air (3rd generation) with Cellular, 1 of 3

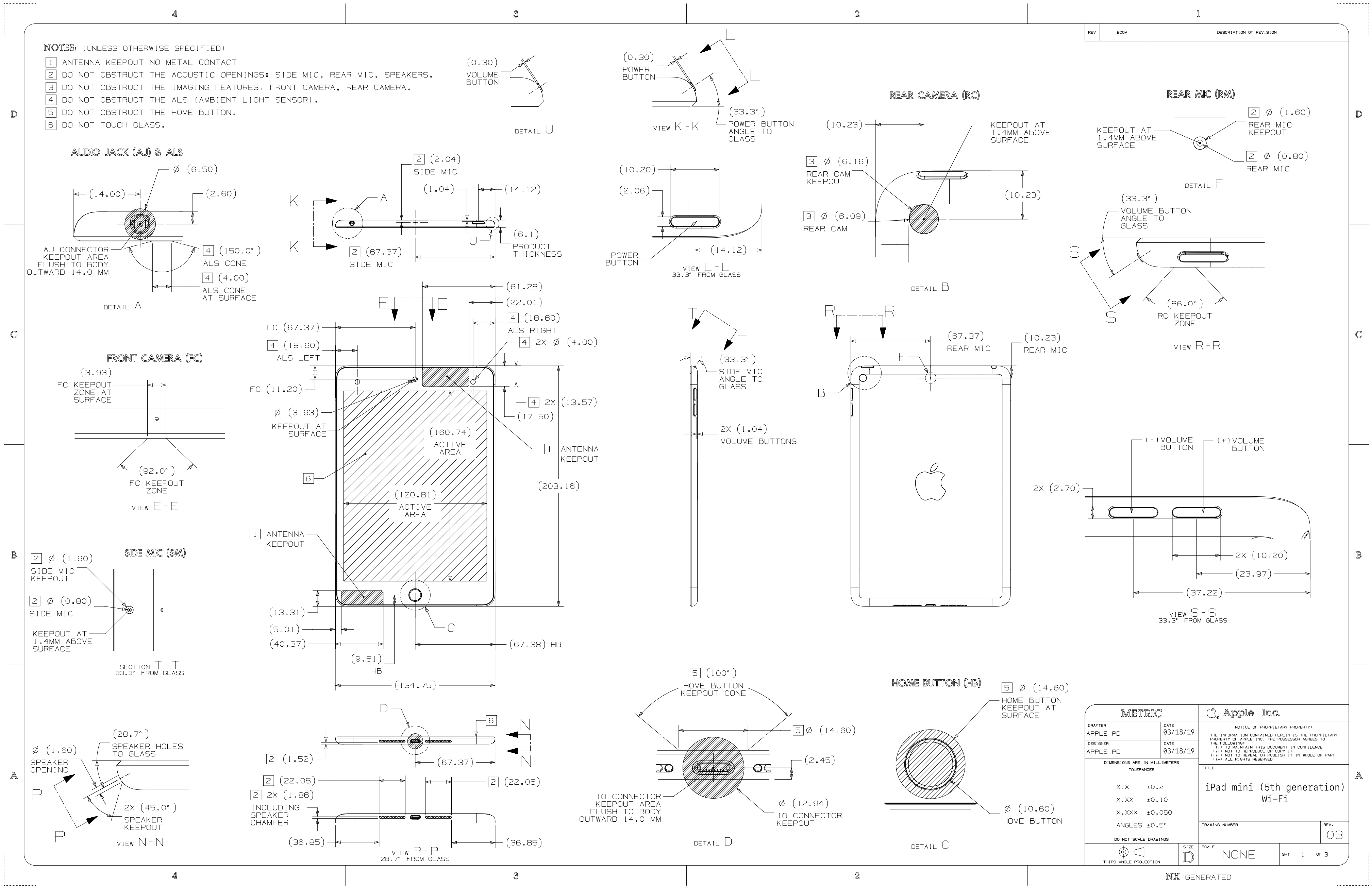




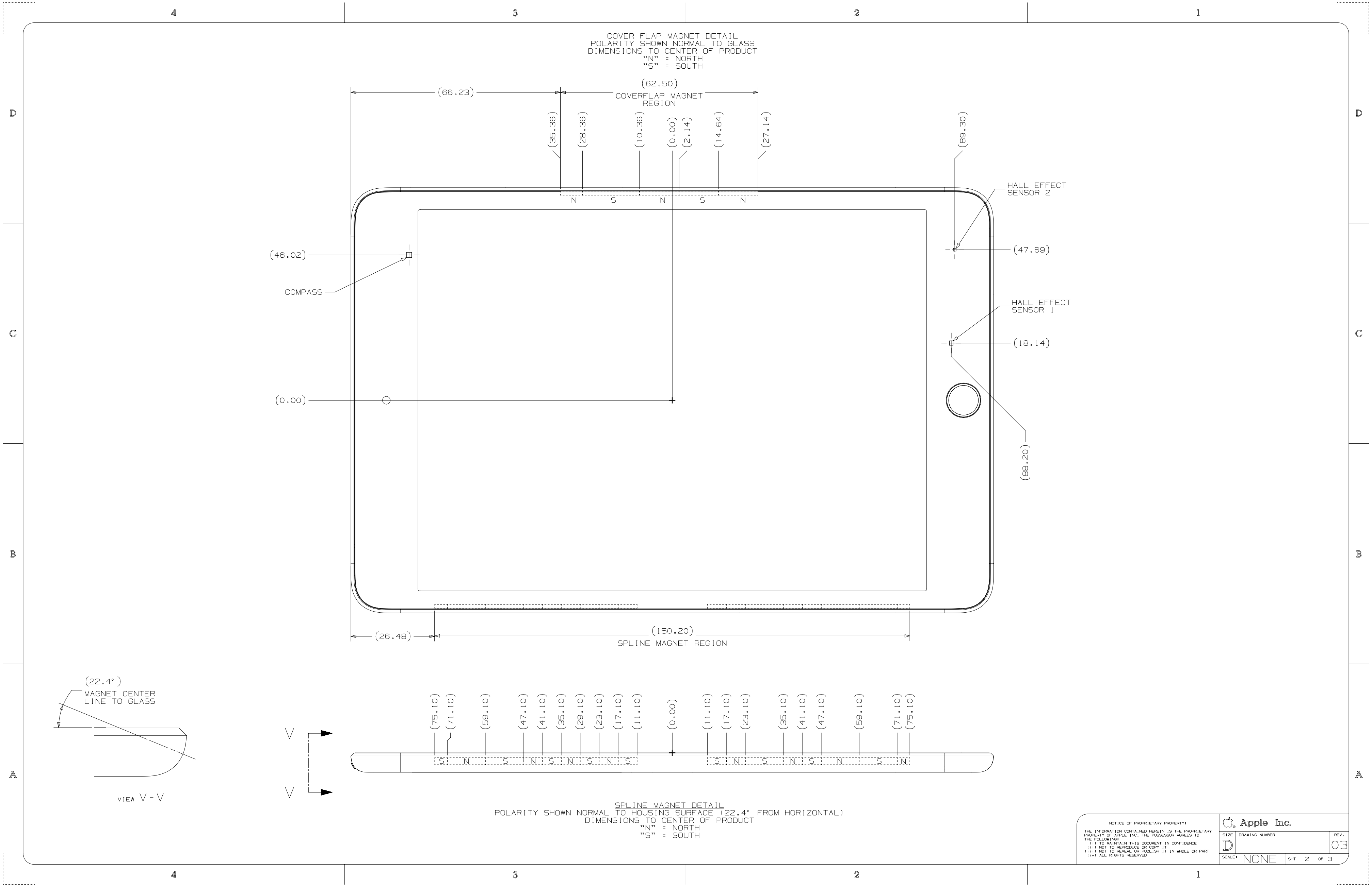
COVER FLAP MAGNET DETAIL
POLARITY SHOWN NORMAL TO GLASS
DIMENSIONS TO CENTER OF PRODUCT
"N" = NORTH
"S" = SOUTH
77.92
118.75
COVER FLAP MAGNETS
HALL EFFECT SENSOR 2
125.29
120.14
56.37
47.37
41.37
29.37
17.37
0.00
17.38
29.38
41.38
53.38
65.38
71.38
87.04
83.68
N S N S N S N S N S
COMPASS
6.15
(0.00)
68.31
HALL EFFECT SENSOR 1
113.41
29.92
190.75
SPINE MAGNET REGION
23°
MAGNET CENTER LINE TO COVER GLASS
SECTION H-H
H
H
95.38
89.38
83.38
77.38
71.38
59.38
47.38
41.38
35.38
29.38
23.38
17.38
11.38
0.00
11.38
17.38
23.38
35.38
41.38
47.38
59.38
71.38
77.38
83.38
89.38
95.38
Apple Inc.
E
NONE
03
SHT 2 OF 3


SECTION AND DETAIL INFORMATION
VOLUME BUTTONS TO CG
33.3°
2.06
SECTION M-M
SIM TRAY
2.01
3.89
2.89
SECTION J-J
SPLINE DETAIL - TOP VIEW
15.61
11.43
6.92
2.87
0.56
0.03
0.00
0.58
PROFILE
(ALL FOUR CORNERS)
11.44
DETAIL P
SCALE 5:1
SLEEP / WAKE BUTTON
33.3°
2.06
SECTION N-N
SPLINE MIC
33.0°
SECTION K-K
SPEAKER HOLES AND KEEPOUTS
29°
2X 135°
1.60 SPEAKER
OPENING
2X 1.0
2X SPEAKER LOCATIONS:
1 MM KEEPOUT AREA
ALL AROUND X 45°
SECTION S-S
SPLINE DETAIL - SIDE VIEW
0.94
0.00
COSMETIC CHAMFER
1.82
3.44
4.59
5.09
5.18
5.19
7.04
5.65
4.10
2.45
1.07
0.26
DETAIL R
SCALE 10:1
NOTICE OF PROPRIETARY PROPERTY:
Apple Inc.
E
NONE
03
SHT 3 OF 3

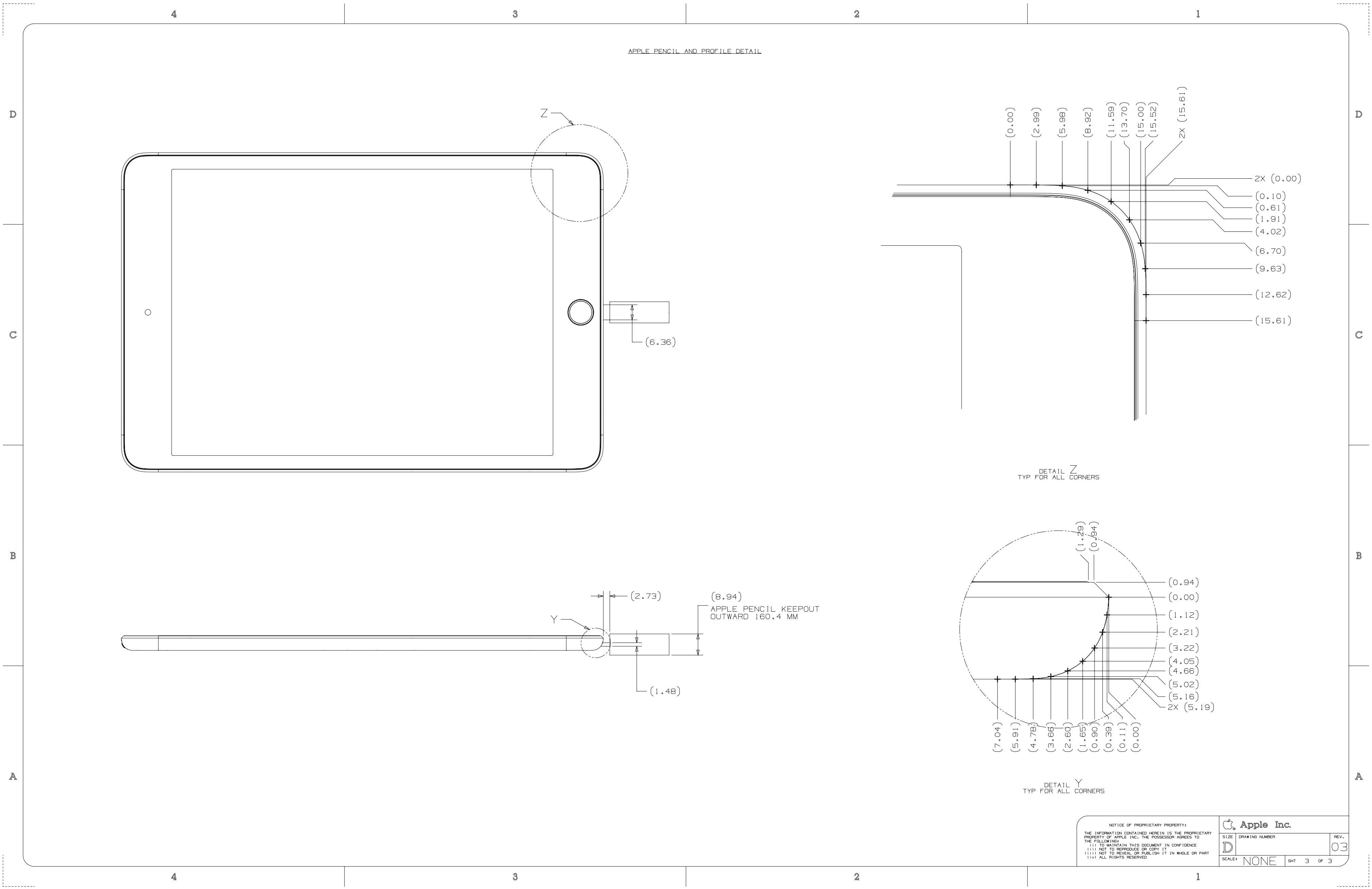
60.162 iPad mini (5th generation), 1 of 3

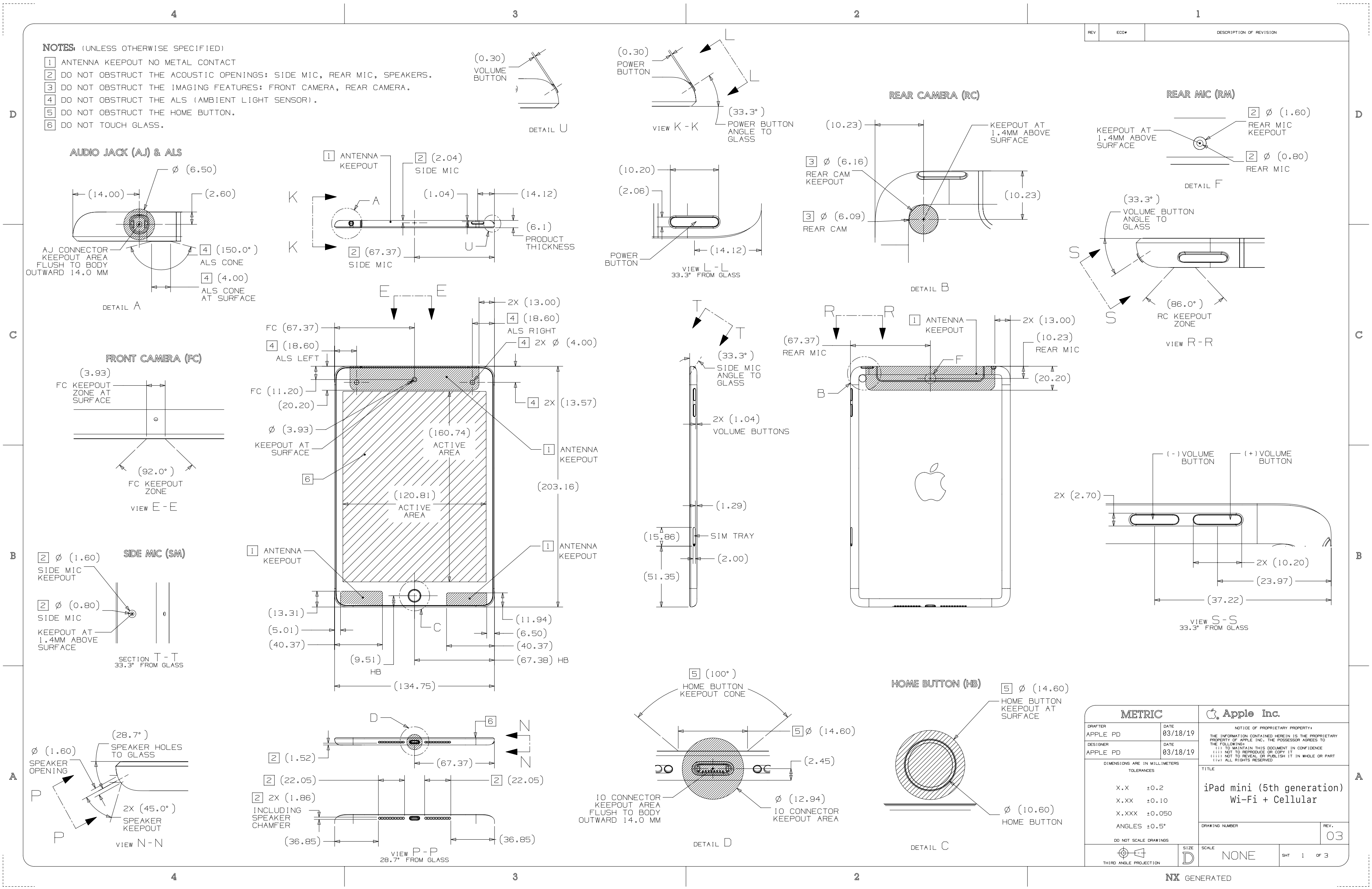


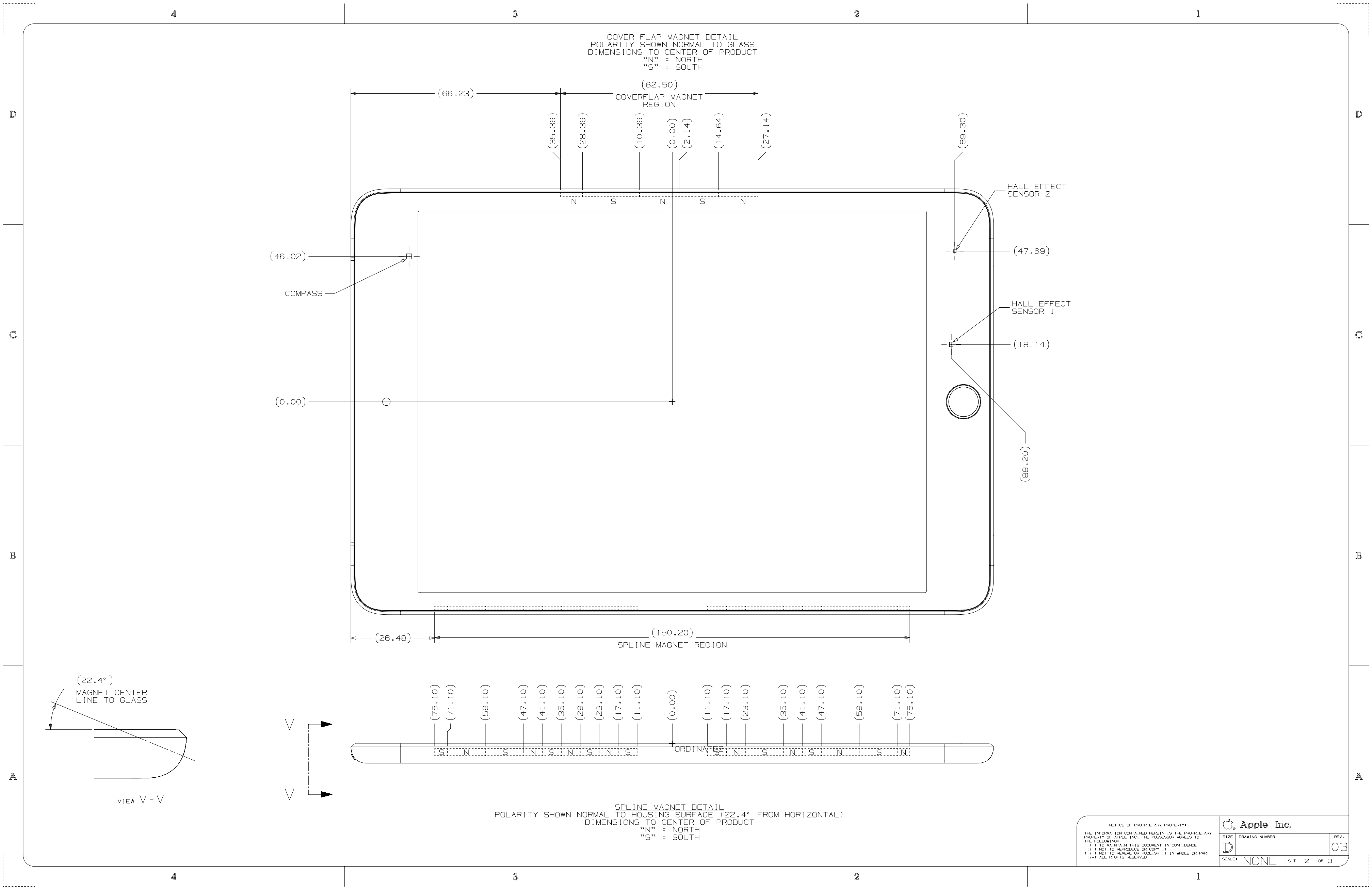
60.163 iPad mini (5th generation), 2 of 3



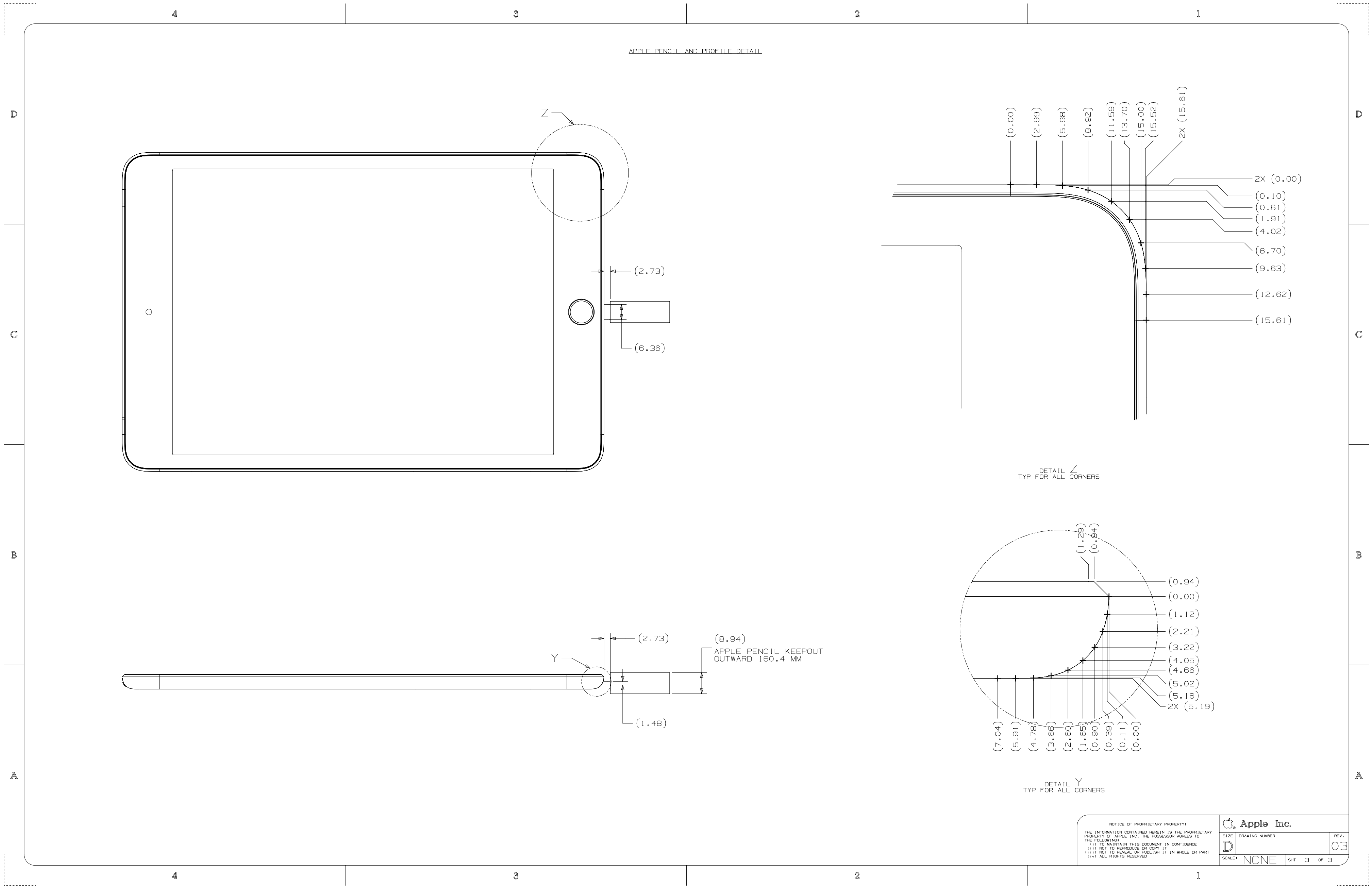
60.164 iPad mini (5th generation), 3 of 3



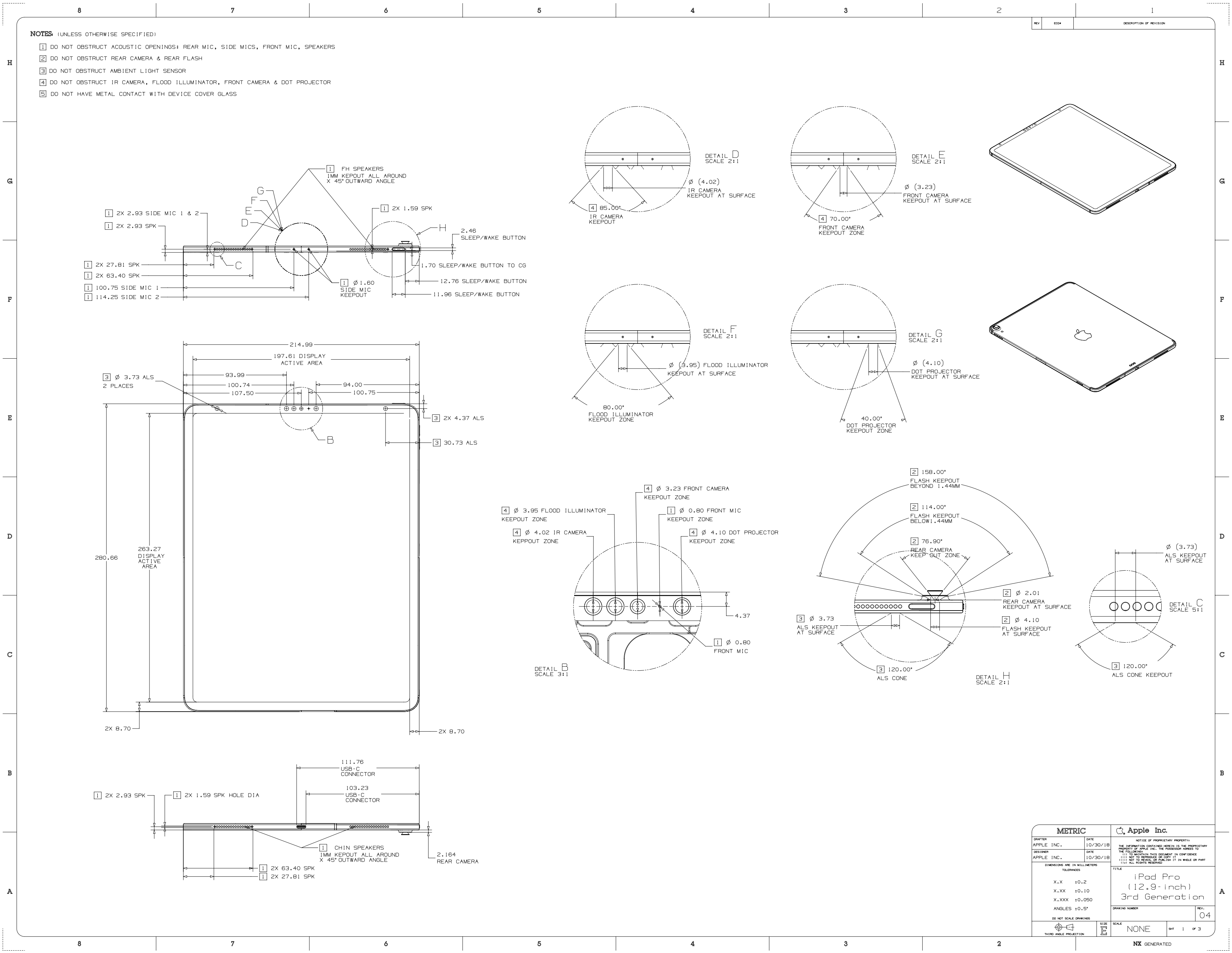

NOTES: (UNLESS OTHERWISE SPECIFIED)
1 ANTENNA KEEPOUT NO METAL CONTACT
2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, SPEAKERS.
3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA.
4 DO NOT OBSTRUCT THE ALS (AMBIENT LIGHT SENSOR).
5 DO NOT OBSTRUCT THE HOME BUTTON.
6 DO NOT TOUCH GLASS.
AUDIO JACK (AJ) & ALS
Ø (6.50)
(14.00)
(2.60)
AJ CONNECTOR KEEPOUT AREA FLUSH TO BODY OUTWARD 14.0 MM
4 (150.0°) ALS CONE
4 (4.00) ALS CONE AT SURFACE
DETAIL A
(0.30) VOLUME BUTTON
DETAIL U
(0.30) POWER BUTTON
(33.3°) POWER BUTTON ANGLE TO GLASS
VIEW K-K
1 ANTENNA KEEPOUT
2 (2.04) SIDE MIC
(1.04)
(14.12)
(6.1) PRODUCT THICKNESS
2 (67.37) SIDE MIC
(10.20)
(2.06)
POWER BUTTON
(14.12)
VIEW L-L 33.3° FROM GLASS
REAR CAMERA (RC)
(10.23)
KEEPOUT AT 1.4MM ABOVE SURFACE
3 Ø (6.16) REAR CAM KEEPOUT
3 Ø (6.09) REAR CAM
DETAIL B
REAR MIC (RM)
2 Ø (1.60) REAR MIC KEEPOUT
KEEPOUT AT 1.4MM ABOVE SURFACE
2 Ø (0.80) REAR MIC
DETAIL F
(33.3°) VOLUME BUTTON ANGLE TO GLASS
(86.0°) RC KEEPOUT ZONE
VIEW R-R
FRONT CAMERA (FC)
(3.93)
FC KEEPOUT ZONE AT SURFACE
(92.0°) FC KEEPOUT ZONE
VIEW E-E
FC (67.37)
4 (18.60) ALS LEFT
FC (11.20)
(20.20)
Ø (3.93)
KEEPOUT AT SURFACE
2X (13.00)
4 (18.60) ALS RIGHT
4 2X Ø (4.00)
4 2X (13.57)
(160.74) ACTIVE AREA
(120.81) ACTIVE AREA
1 ANTENNA KEEPOUT
(203.16)
(13.31)
(5.01)
(40.37)
(9.51) HB
(11.94)
(6.50)
(40.37)
(67.38) HB
(134.75)
(33.3°) SIDE MIC ANGLE TO GLASS
2X (1.04) VOLUME BUTTONS
(1.29)
(15.86)
SIM TRAY
(2.00)
(51.35)
(67.37) REAR MIC
1 ANTENNA KEEPOUT
2X (13.00)
(10.23) REAR MIC
(20.20)
(-) VOLUME BUTTON
(+) VOLUME BUTTON
2X (2.70)
2X (10.20)
(23.97)
(37.22)
VIEW S-S 33.3° FROM GLASS
SIDE MIC (SM)
2 Ø (1.60) SIDE MIC KEEPOUT
2 Ø (0.80) SIDE MIC
KEEPOUT AT 1.4MM ABOVE SURFACE
SECTION T-T 33.3° FROM GLASS
Ø (1.60) SPEAKER OPENING
(28.7°) SPEAKER HOLES TO GLASS
2X (45.0°) SPEAKER KEEPOUT
VIEW N-N
2 (1.52)
(67.37)
2 (22.05)
2 2X (1.86) INCLUDING SPEAKER CHAMFER
(36.85)
VIEW P-P 28.7° FROM GLASS
5 (100°) HOME BUTTON KEEPOUT CONE
5 Ø (14.60)
(2.45)
IO CONNECTOR KEEPOUT AREA FLUSH TO BODY OUTWARD 14.0 MM
Ø (12.94) IO CONNECTOR KEEPOUT AREA
DETAIL D
HOME BUTTON (HB)
5 Ø (14.60) HOME BUTTON KEEPOUT AT SURFACE
Ø (10.60) HOME BUTTON
DETAIL C
REV ECO# DESCRIPTION OF REVISION
METRIC
DRAFTER APPLE PD DATE 03/18/19
DESIGNER APPLE PD DATE 03/18/19
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
X.X ±0.2
X.XX ±0.10
X.XXX ±0.050
ANGLES ±0.5°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
TITLE
iPad mini (5th generation) Wi-Fi + Cellular
DRAWING NUMBER
REV. 03
SIZE D
SCALE NONE
SHT 1 OF 3
NX GENERATED

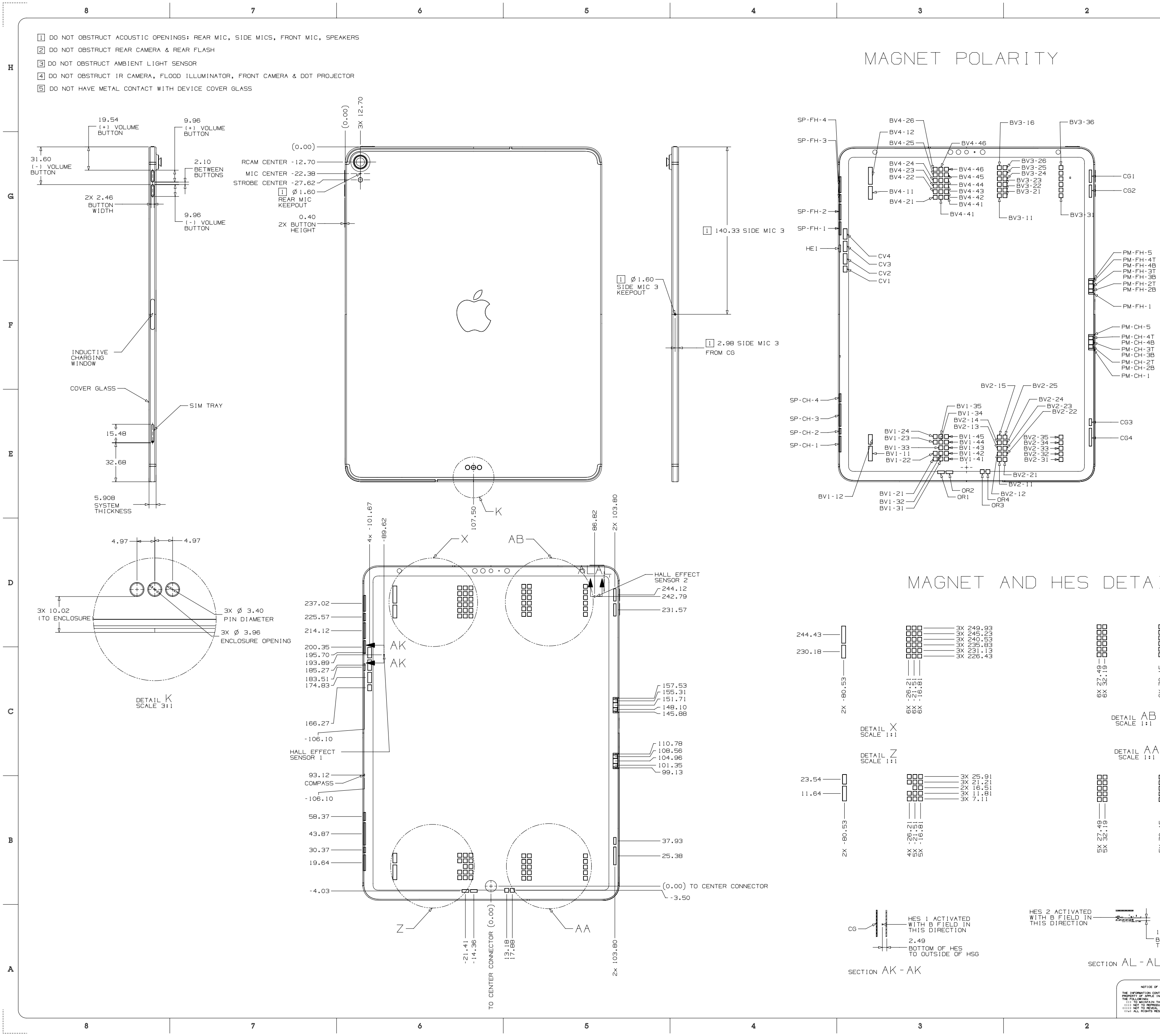

COVER FLAP MAGNET DETAIL
POLARITY SHOWN NORMAL TO GLASS
DIMENSIONS TO CENTER OF PRODUCT
"N" = NORTH
"S" = SOUTH
(66.23)
(62.50)
COVERFLAP MAGNET REGION
(35.36)
(28.36)
(10.36)
(0.00)
(2.14)
(14.64)
(27.14)
(89.30)
N
S
N
S
N
HALL EFFECT SENSOR 2
(46.02)
COMPASS
(47.69)
HALL EFFECT SENSOR 1
(18.14)
(0.00)
(88.20)
(26.48)
(150.20)
SPLINE MAGNET REGION
(22.4°)
MAGNET CENTER LINE TO GLASS
VIEW V - V
V
V
(75.10)
(71.10)
(59.10)
(47.10)
(41.10)
(35.10)
(29.10)
(23.10)
(17.10)
(11.10)
(0.00)
(11.10)
(17.10)
(23.10)
(35.10)
(41.10)
(47.10)
(59.10)
(71.10)
(75.10)
ORDINATE
SPLINE MAGNET DETAIL
POLARITY SHOWN NORMAL TO HOUSING SURFACE (22.4° FROM HORIZONTAL)
DIMENSIONS TO CENTER OF PRODUCT
"N" = NORTH
"S" = SOUTH
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV. 03
SCALE: NONE
SHT 2 OF 3
4
3
2
1
D
C
B
A

60.167 iPad mini (5th generation) with Cellular, 3 of 3

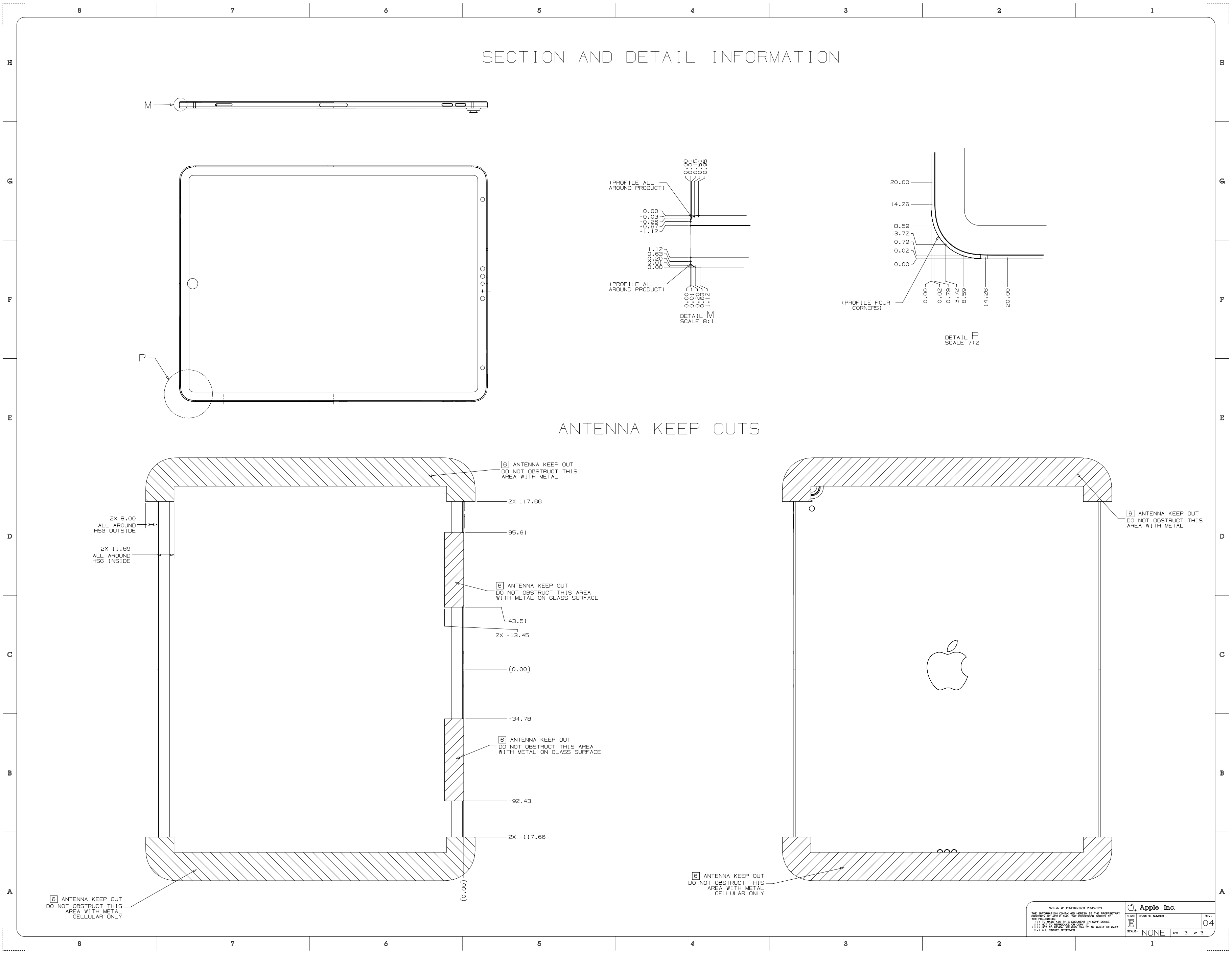


60.168 iPad Pro 12.9-inch (3rd generation), 1 of 3

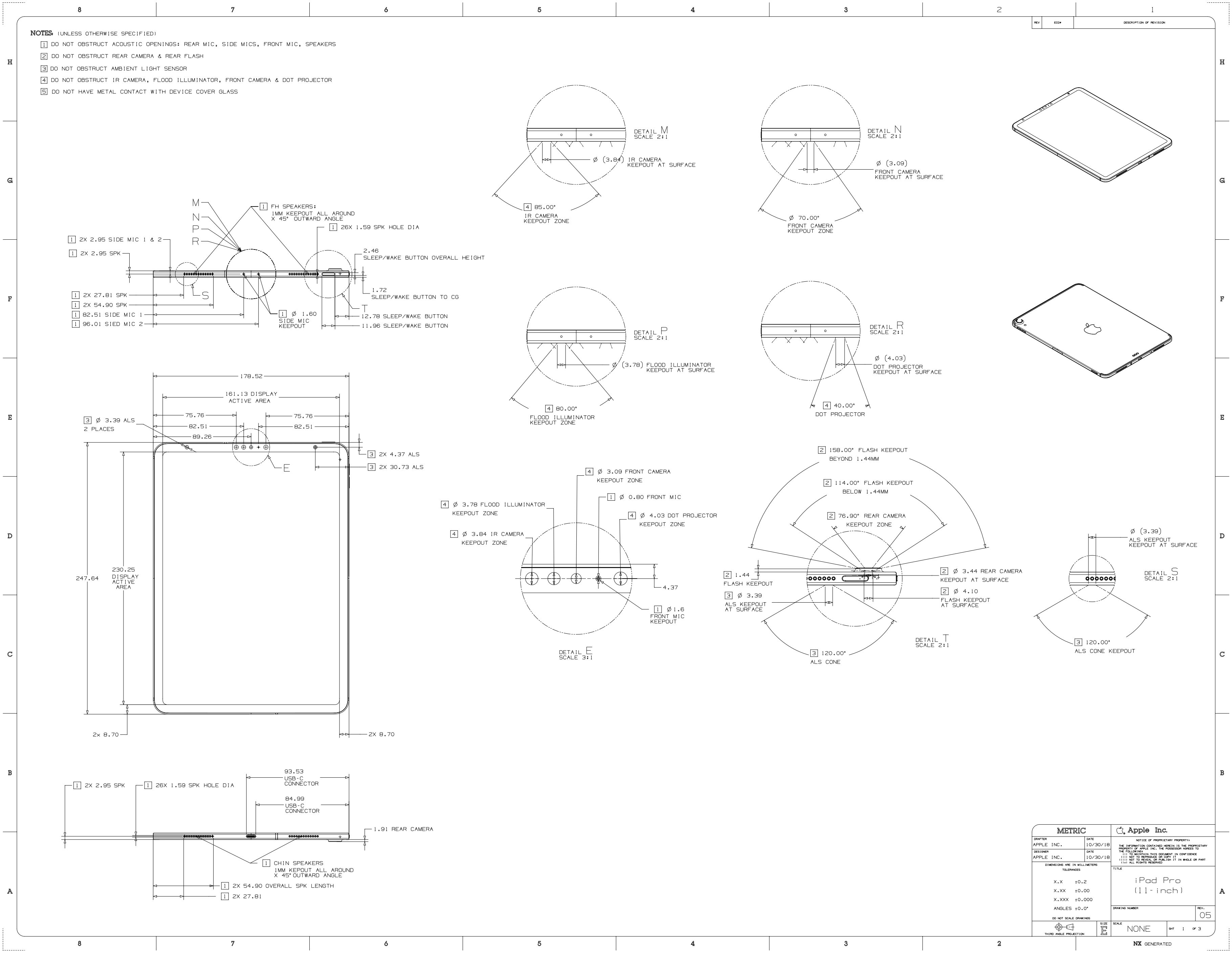


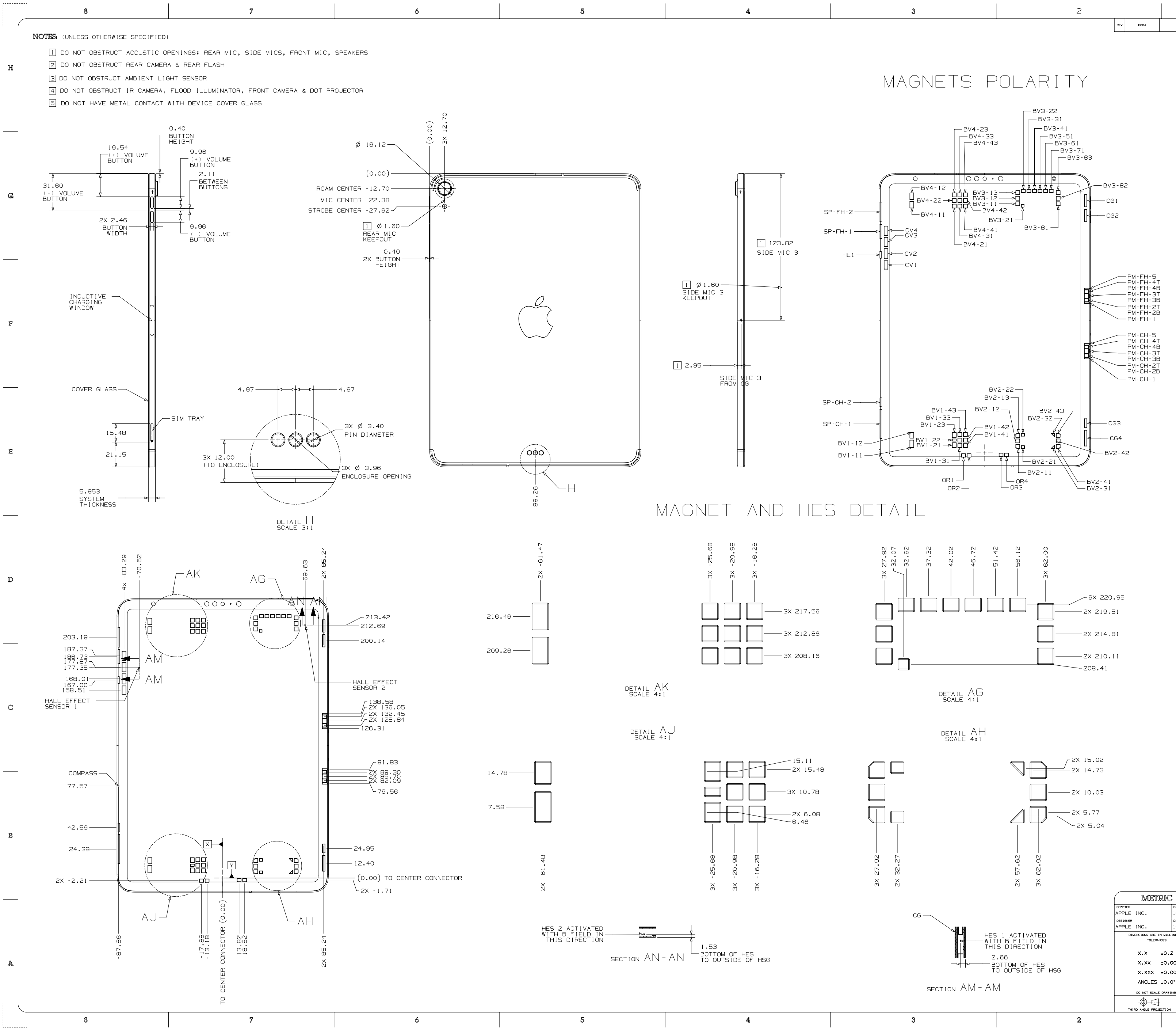


PEAK FLUX DENSITY FOR EACH MAGNET IN Gs (ABSOLUTE VALUE)		
LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE/FARTHEST AWAY FROM PROBE LOCATION	POLARITY TOWARD SURFACE OF ENCLOSURE/CLOSEST TO PROBE LOCATION
BV1-11	N	S
BV1-12	S	N
BV1-21	S	N
BV1-22	N	S
BV1-23	N	S
BV1-24	S	N
BV1-31	S	N
BV1-32	S	N
BV1-33	N	S
BV1-34	N	S
BV1-35	S	N
BV1-41	N	S
BV1-42	N	S
BV1-43	S	N
BV1-44	S	N
BV1-45	N	S
BV2-11	N	S
BV2-12	S	N
BV2-13	S	N
BV2-14	S	N
BV2-15	N	S
BV2-21	S	N
BV2-22	N	S
BV2-23	N	S
BV2-24	S	N
BV2-25	N	S
BV2-31	N	S
BV2-32	S	N
BV2-33	S	N
BV2-34	N	S
BV2-35	S	N
BV3-11	S	N
BV3-12	S	N
BV3-13	N	S
BV3-14	S	N
BV3-15	N	S
BV3-16	S	N
BV3-21	N	S
BV3-22	N	S
BV3-23	S	N
BV3-24	S	N
BV3-25	N	S
BV3-26	N	S
BV3-31	S	N
BV3-32	N	S
BV3-33	S	N
BV3-34	N	S
BV3-35	S	N
BV3-36	N	S
BV4-11	N	S
BV4-12	S	N
BV4-21	S	N
BV4-22	N	S
BV4-23	S	N
BV4-24	N	S
BV4-25	S	N
BV4-26	N	S
BV4-31	N	S
BV4-32	N	S
BV4-33	N	S
BV4-34	S	N
BV4-35	S	N
BV4-36	N	S
BV4-41	S	N
BV4-42	S	N
BV4-43	S	N
BV4-44	N	S
BV4-45	N	S
BV4-46	S	N
CV1	N	S
CV2	S	N
CV3	N	S
CV4	S	N
OR1	N	S
OR2	S	N
OR3	N	S
OR4	S	N
SP-CH-1-S	N	S
SP-CH-1-B	S	N
SP-CH-2-S	S	N
SP-CH-2-B	N	S
SP-CH-3-S	N	S
SP-CH-3-B	S	N
SP-CH-4-S	S	N
SP-CH-4-B	N	S
SP-FH-1-S	S	N
SP-FH-1-B	N	S
SP-FH-2-S	N	S
SP-FH-2-B	S	N
SP-FH-3-S	S	N
SP-FH-3-B	N	S
SP-FH-4-S	N	S
SP-FH-4-B	S	N
HE1	S	N
PM-CH-1	NA	NA
PM-CH-2T	N	S
PM-CH-2B	N	S
PM-CH-3T	N	S
PM-CH-3B	N	S
PM-CH-4T	N	S
PM-CH-4B	N	S
PM-CH-5	NA	NA
PM-FH-1	NA	NA
PM-FH-2T	N	S
PM-FH-2B	N	S
PM-FH-3T	N	S
PM-FH-3B	N	S
PM-FH-4T	N	S
PM-FH-4B	N	S
PM-FH-5	NA	NA
CG1	N	S
CG2	S	N
CG3	N	S
CG4	S	N

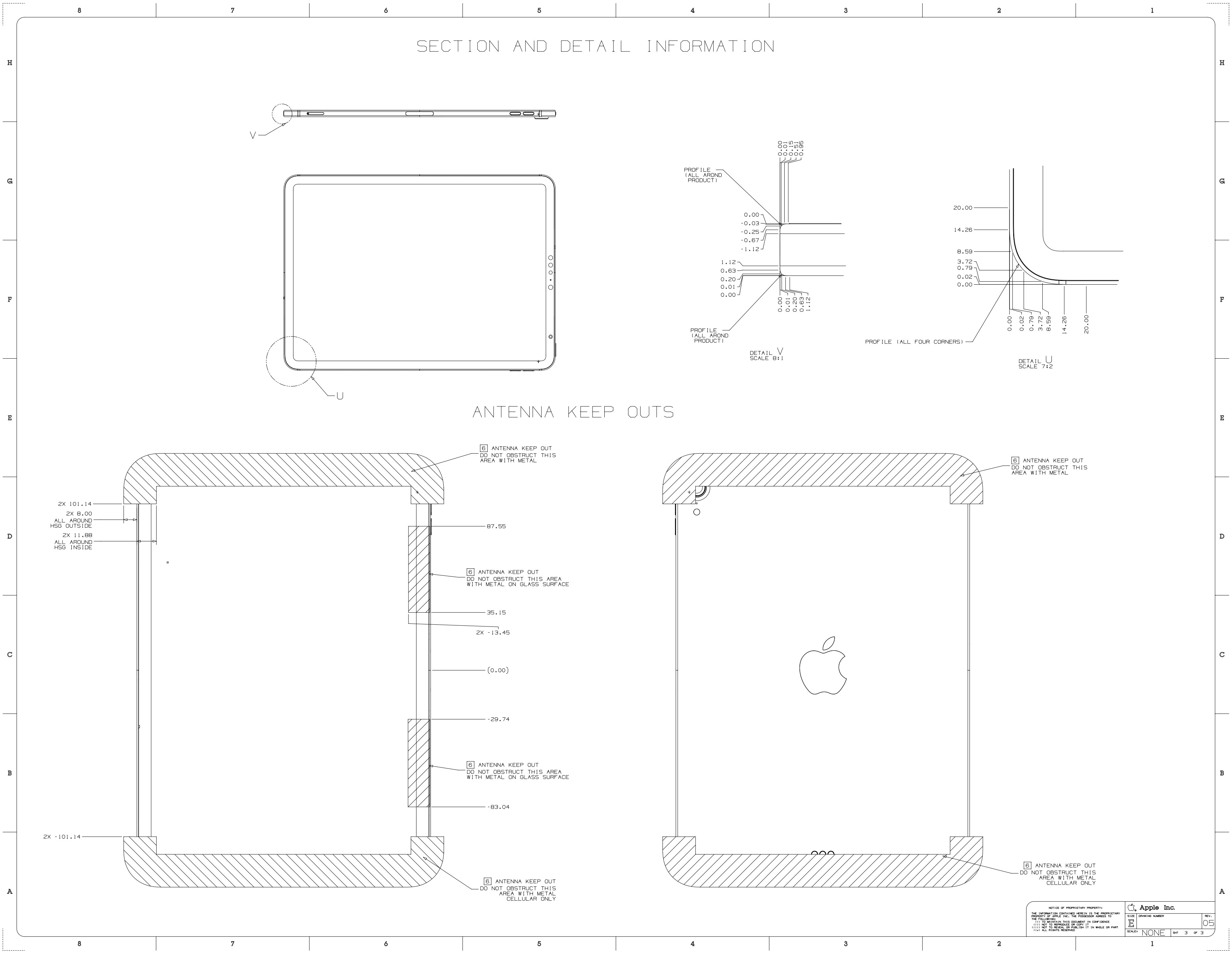

SECTION AND DETAIL INFORMATION
M
P
(PROFILE ALL AROUND PRODUCT)
0.00
-0.03
-0.26
-0.67
-1.12
1.12
0.63
0.20
0.01
0.00
DETAIL M
SCALE 8:1
(PROFILE FOUR CORNERS)
20.00
14.26
8.59
3.72
0.79
0.02
0.00
DETAIL P
SCALE 7:2
ANTENNA KEEP OUTS
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL
2X 117.66
95.91
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL ON GLASS SURFACE
43.51
2X -13.45
(0.00)
-34.78
-92.43
2X -117.66
2X 8.00 ALL AROUND HSG OUTSIDE
2X 11.89 ALL AROUND HSG INSIDE
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL CELLULAR ONLY
Apple Inc.
E
NONE
04
SHT 3 OF 3

60.171 iPad Pro 11-inch (1st generation), 1 of 3

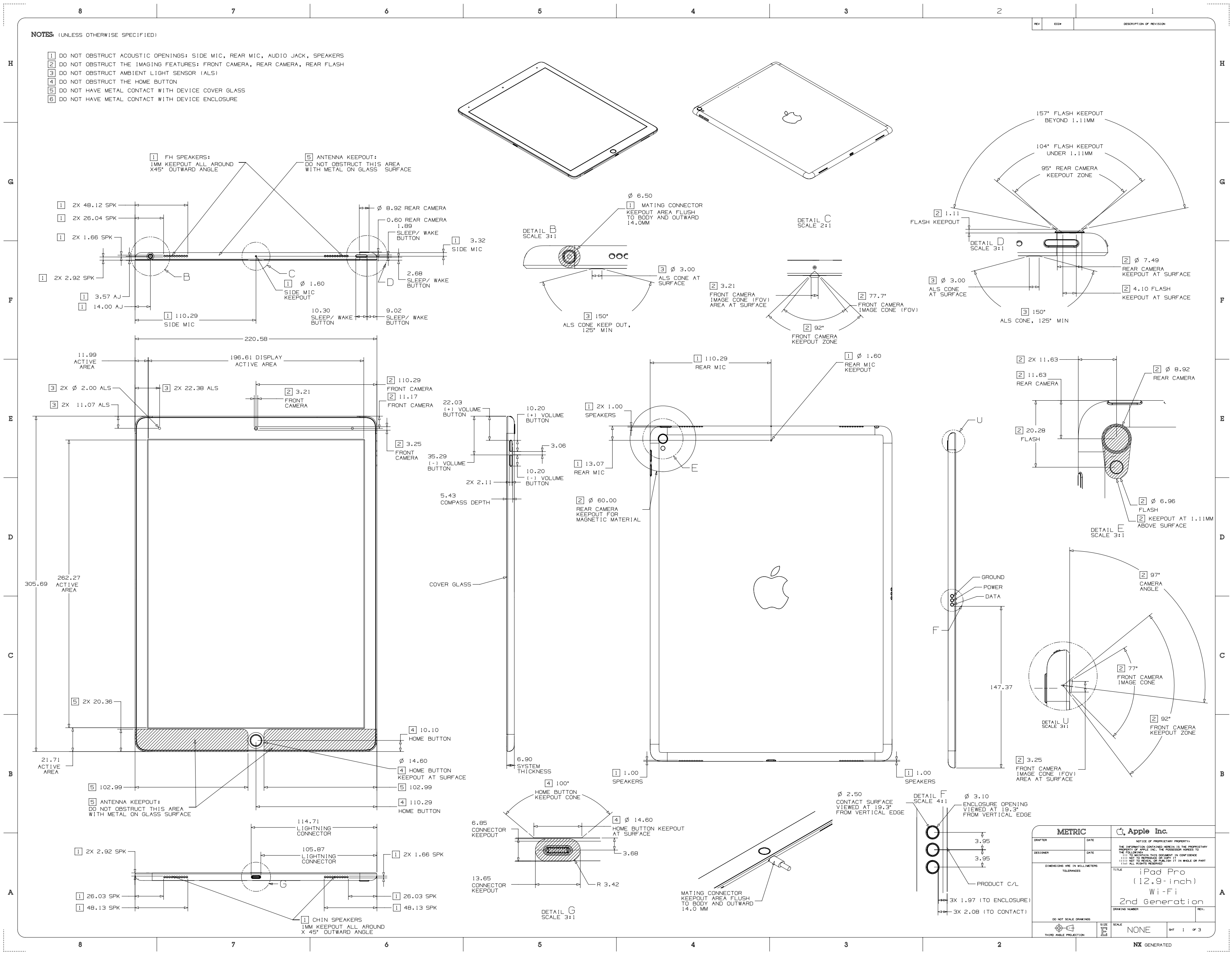




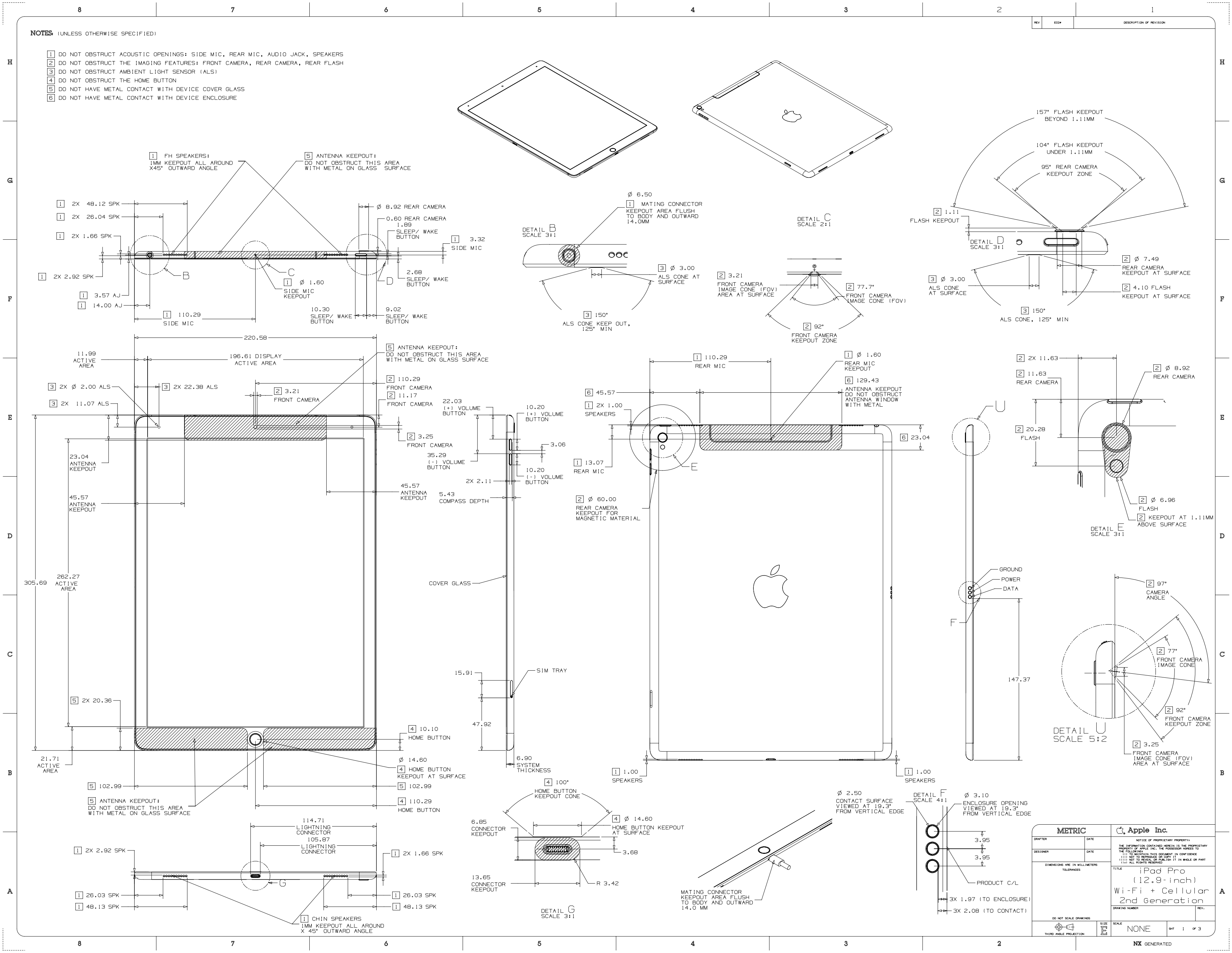
LOCATION	POLARITY TOWARD INSIDE OF ENCLOSURE	POLARITY TOWARD SURFACE OF ENCLOSURE
BV1-11	S	N
BV1-12	N	S
BV1-21	N	S
BV1-22	S	N
BV1-23	N	S
BV1-31	S	N
BV1-32	N	S
BV1-33	S	N
BV1-41	S	N
BV1-42	S	N
BV1-43	N	S
BV2-11	S	N
BV2-12	S	N
BV2-13	N	S
BV2-21	N	S
BV2-22	S	N
BV2-31	N	S
BV2-32	N	S
BV2-41	S	N
BV2-42	N	S
BV2-43	S	N
BV3-11	N	S
BV3-12	S	N
BV3-13	S	N
BV3-21	S	N
BV3-22	N	S
BV3-31	S	N
BV3-41	N	S
BV3-51	N	S
BV3-61	S	N
BV3-71	N	S
BV3-81	S	N
BV3-82	N	S
BV3-83	S	N
BV4-11	N	S
BV4-12	S	N
BV4-21	N	S
BV4-22	S	N
BV4-23	N	S
BV4-31	S	N
BV4-32	N	S
BV4-33	N	S
BV4-41	N	S
BV4-42	S	N
BV4-43	S	N
CV1	N	S
CV2	S	N
CV3	S	N
CV4	N	S
OR1	N	S
OR2	S	N
OR3	S	N
OR4	N	S
HE1	S	N
PM-FH-1	NA	NA
PM-FH-2T	N	S
PM-FH-2B	N	S
PM-FH-3T	N	S
PM-FH-3B	N	S
PM-FH-4T	N	S
PM-FH-4B	N	S
PM-FH-5	NA	NA
PM-CH-1	NA	NA
PM-CH-2T	N	S
PM-CH-2B	N	S
PM-CH-3T	N	S
PM-CH-3B	N	S
PM-CH-4T	N	S
PM-CH-4B	N	S
PM-CH-5	NA	NA
SP-CH-1-S	N	S
SP-CH-1-B	S	N
SP-CH-2-S	S	N
SP-CH-2-B	N	S
SP-FH-1-S	S	N
SP-FH-1-B	N	S
SP-FH-2-S	N	S
SP-FH-2-B	S	N
CG1	S	N
CG2	N	S
CG3	N	S
CG4	S	N


SECTION AND DETAIL INFORMATION
V
U
PROFILE (ALL AROND PRODUCT)
0.00
-0.03
-0.25
-0.67
-1.12
1.12
0.63
0.20
0.01
0.00
0.00
0.01
0.15
0.51
0.95
DETAIL V SCALE 8:1
20.00
14.26
8.59
3.72
0.79
0.02
0.00
PROFILE (ALL FOUR CORNERS)
DETAIL U SCALE 7:2
ANTENNA KEEP OUTS
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL
2X 101.14
2X 8.00 ALL AROUND HSG OUTSIDE
2X 11.88 ALL AROUND HSG INSIDE
87.55
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL ON GLASS SURFACE
35.15
2X -13.45
(0.00)
-29.74
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL ON GLASS SURFACE
-83.04
2X -101.14
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL CELLULAR ONLY
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL
6 ANTENNA KEEP OUT DO NOT OBSTRUCT THIS AREA WITH METAL CELLULAR ONLY
Apple Inc.
E
NONE
SHT 3 OF 3
05

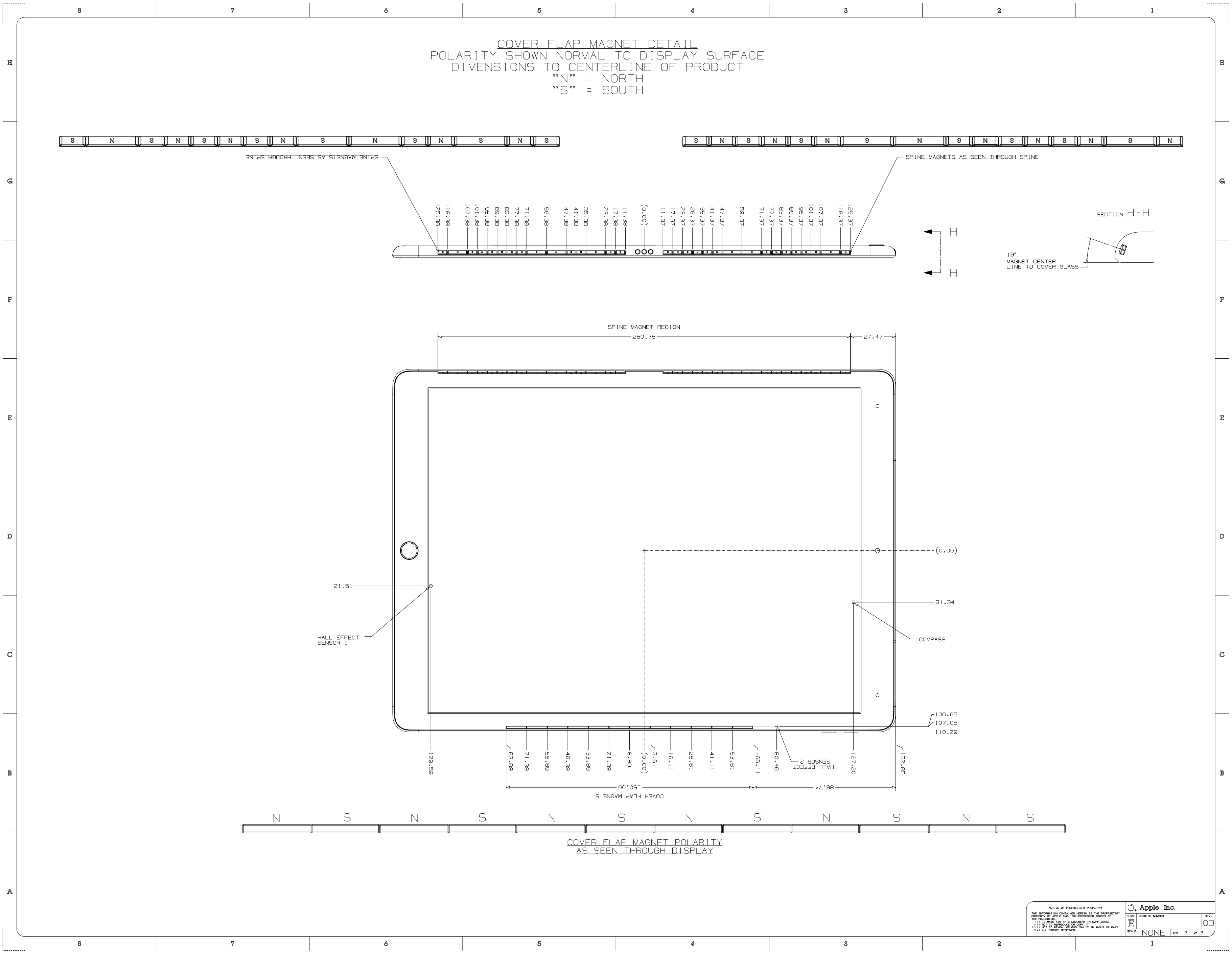
60.174 iPad Pro 12.9-inch (2nd generation)



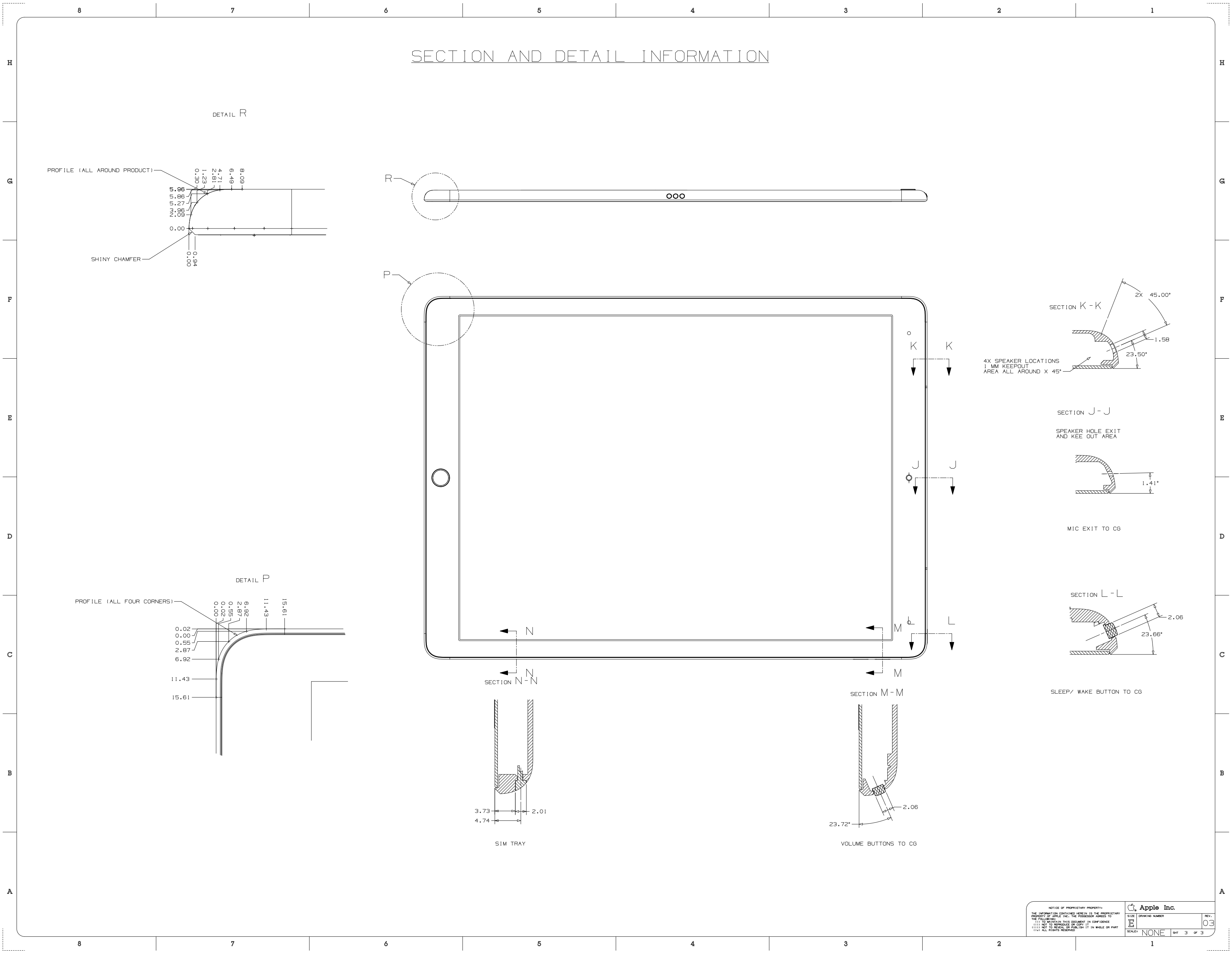
60.175 iPad Pro 12.9-inch (2nd generation) with Cellular



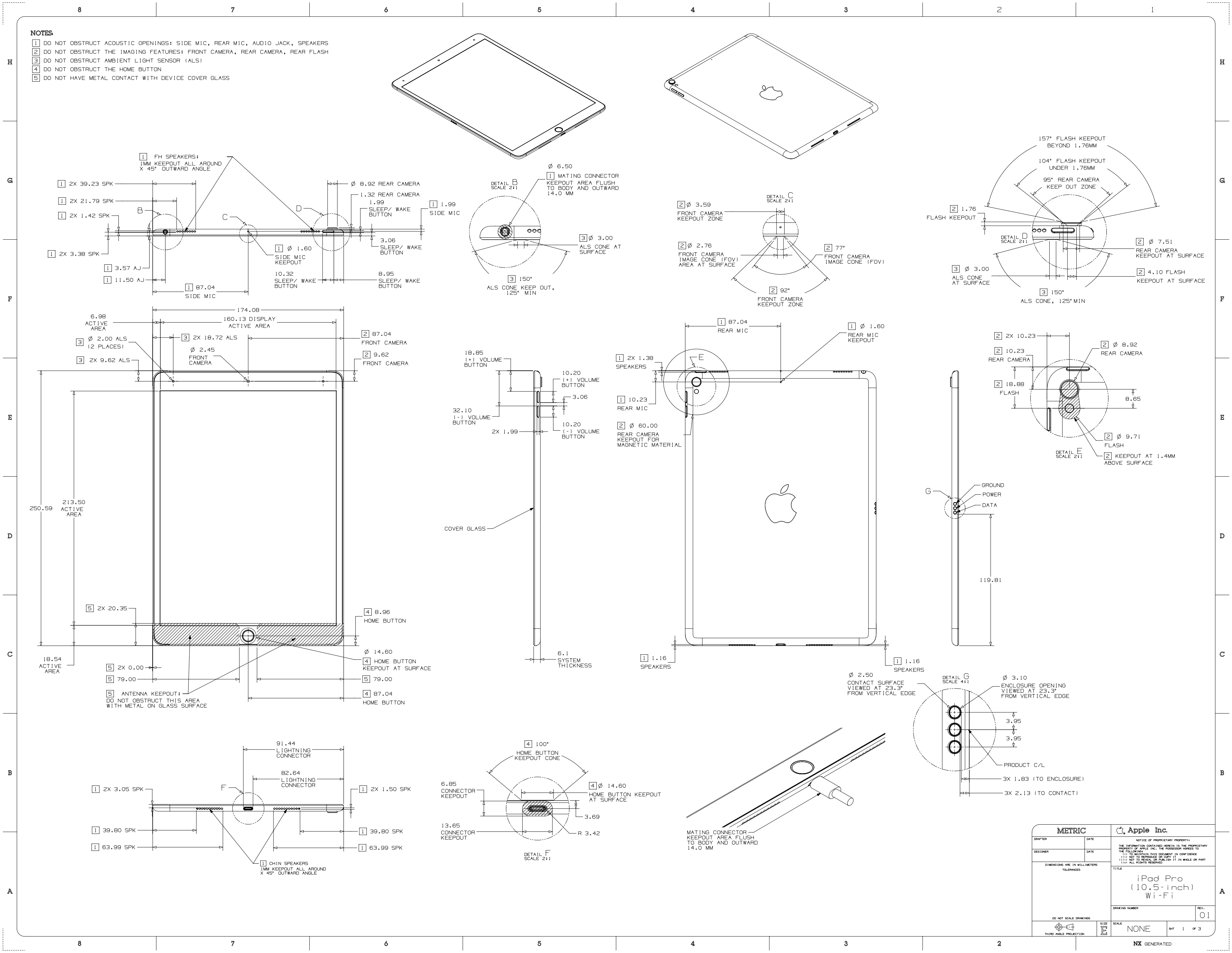
60.176 iPad Pro 12.9-inch (2nd generation) Magnet/Hall Effect Sensors, 1 of 2



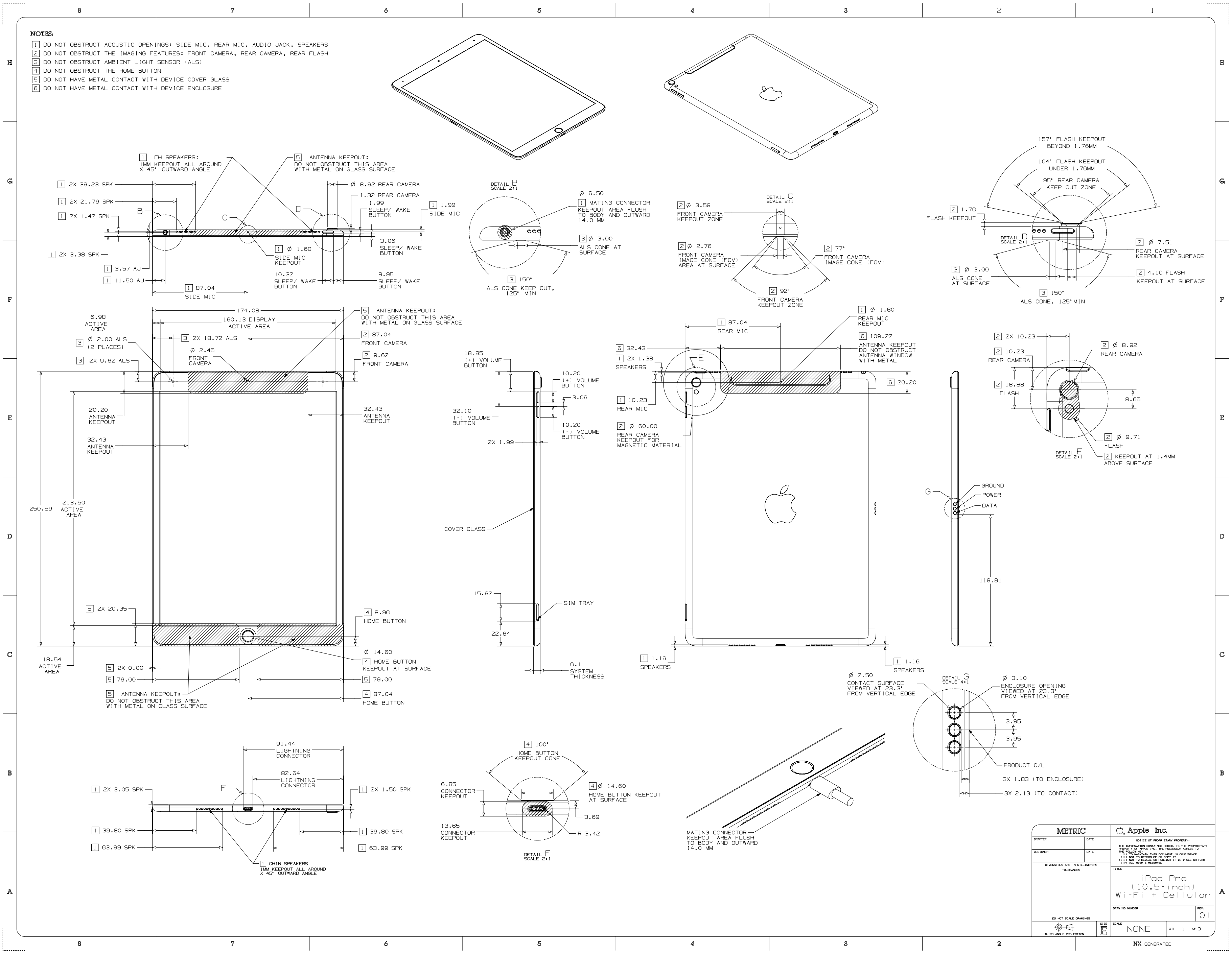
60.177 iPad Pro 12.9-inch (2nd generation) Magnet/Hall Effect Sensors, 2 of 2

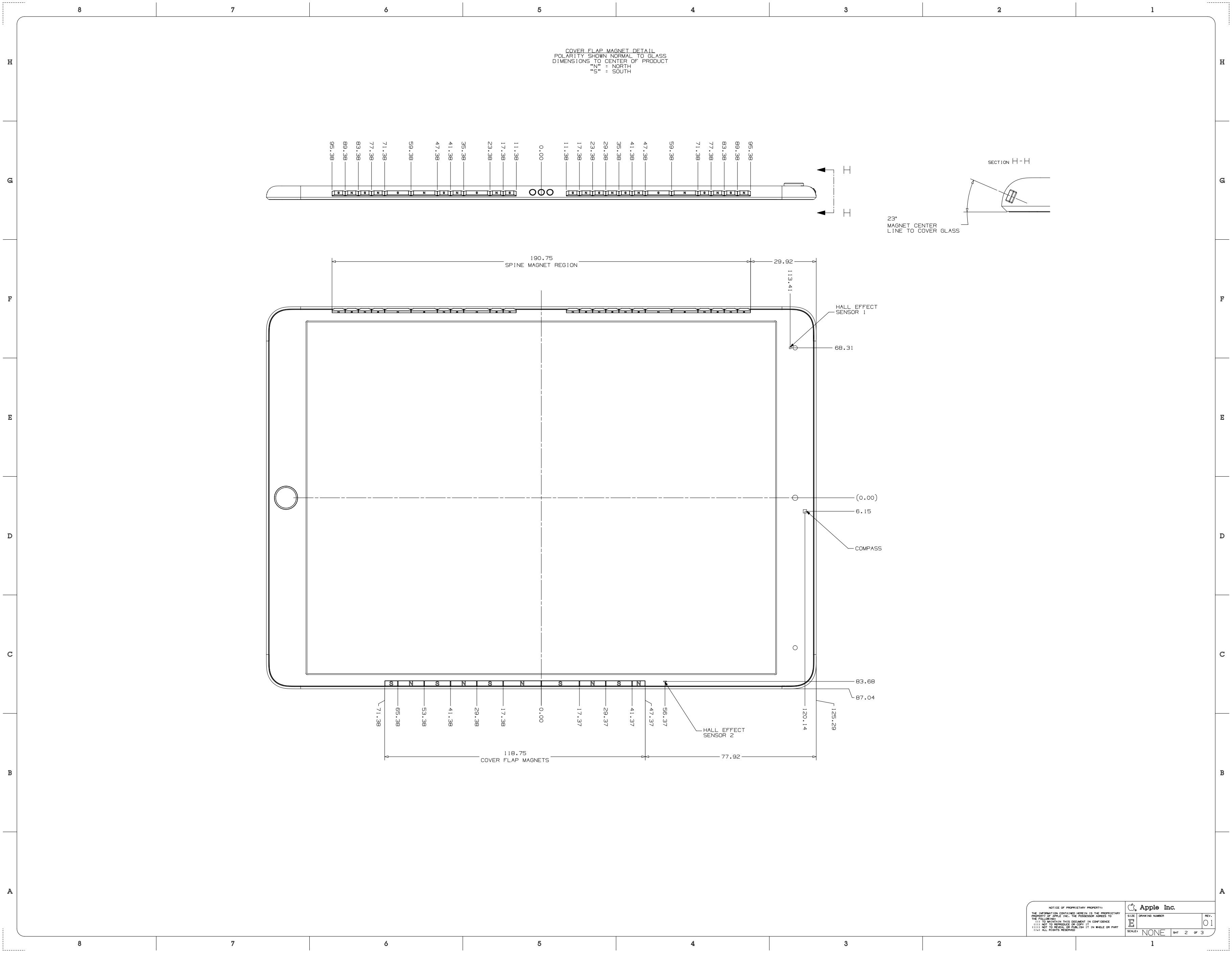


60.178 iPad Pro 10.5-inch

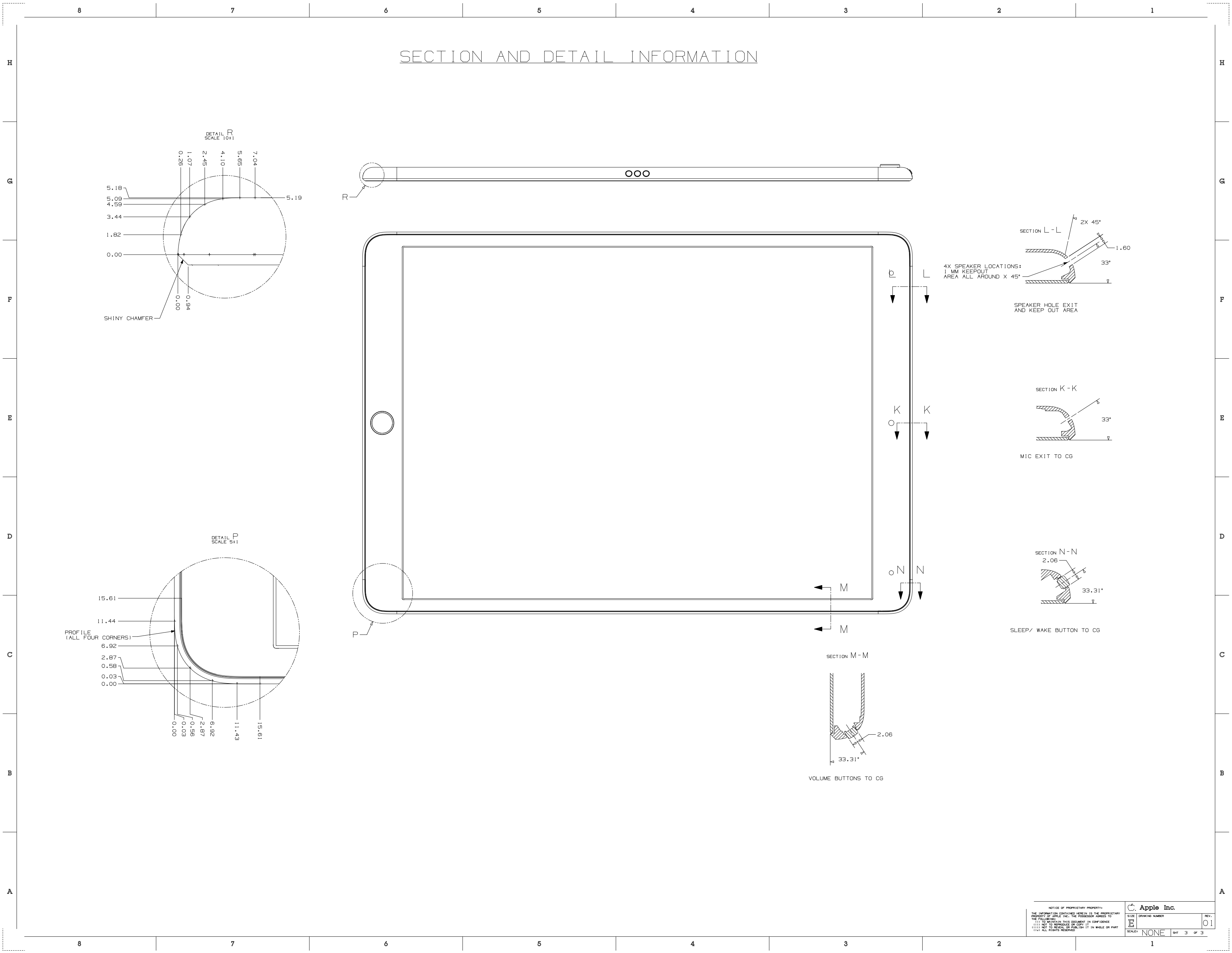


60.179 iPad Pro 10.5-inch with Cellular

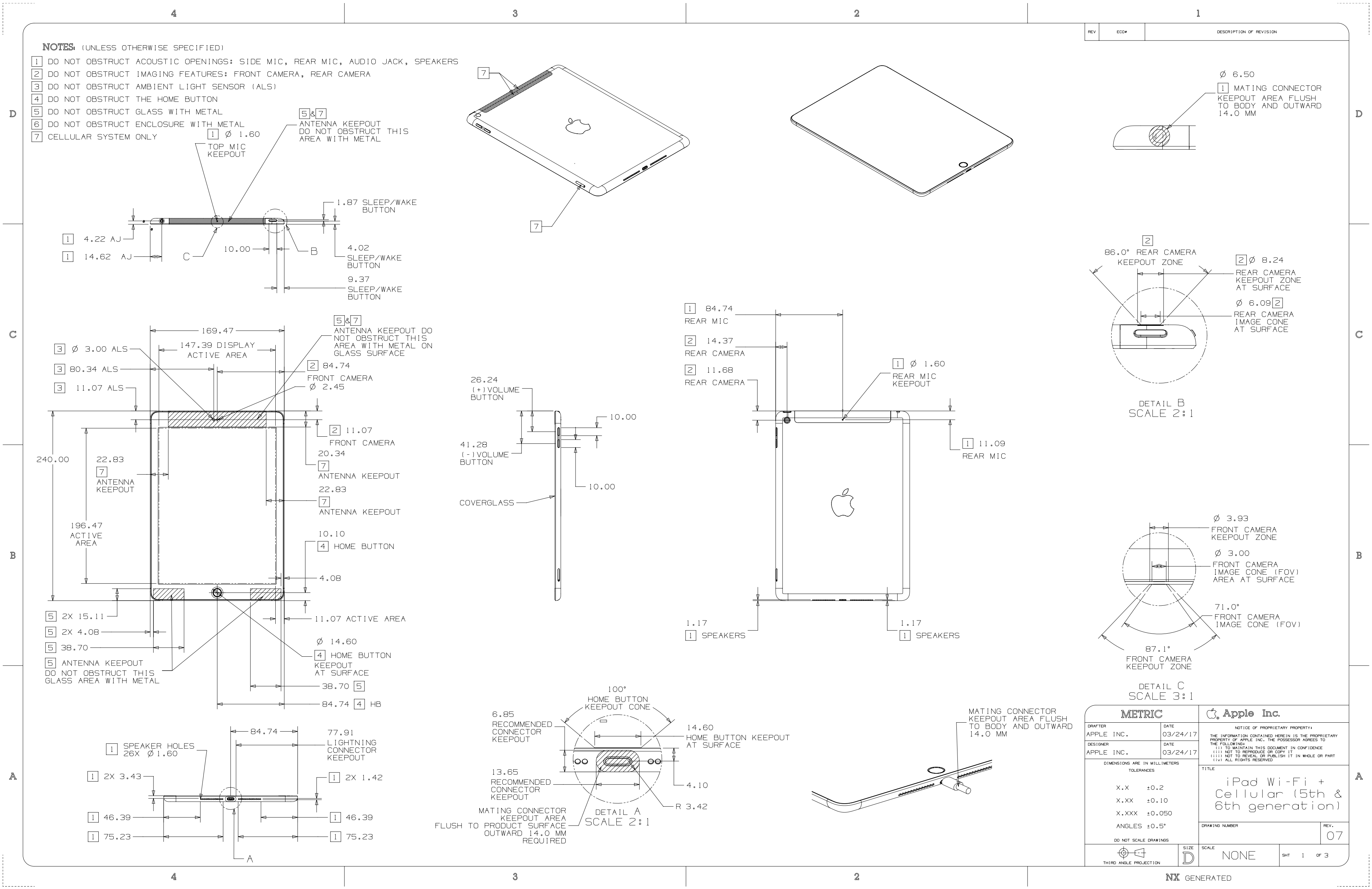



COVER FLAP MAGNET DETAIL
POLARITY SHOWN NORMAL TO GLASS
DIMENSIONS TO CENTER OF PRODUCT
"N" : NORTH
"S" : SOUTH
SECTION H-H
23°
MAGNET CENTER
LINE TO COVER GLASS
190.75
SPINE MAGNET REGION
29.92
113.41
HALL EFFECT
SENSOR 1
68.31
(0.00)
6.15
COMPASS
83.68
87.04
120.14
125.29
HALL EFFECT
SENSOR 2
118.75
COVER FLAP MAGNETS
77.92
Apple Inc.
NONE

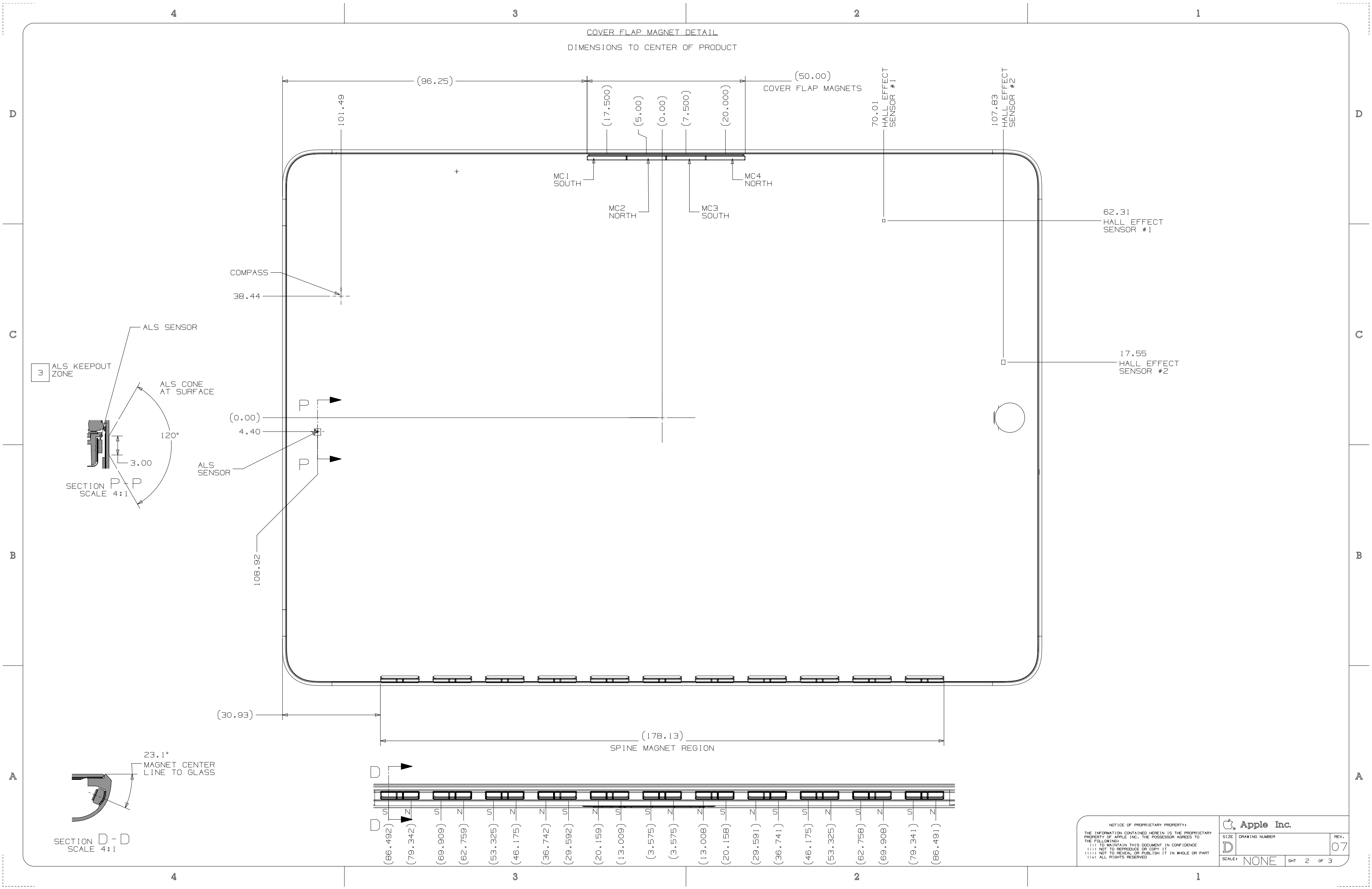
60.181 iPad Pro 10.5-inch Magnet/Hall Effect Sensors, 2 of 2



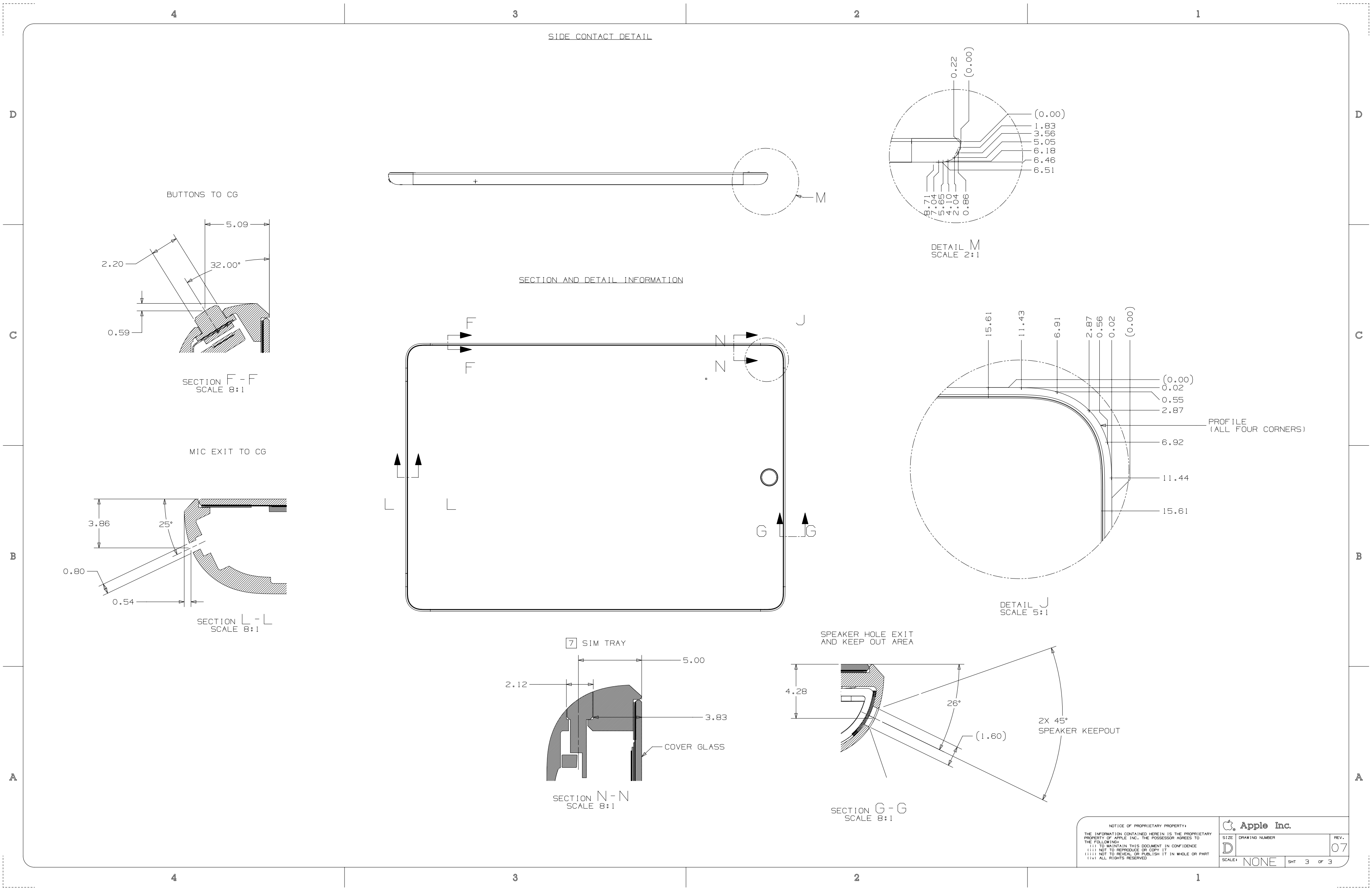
60.182 iPad (5th and 6th generation) with Cellular



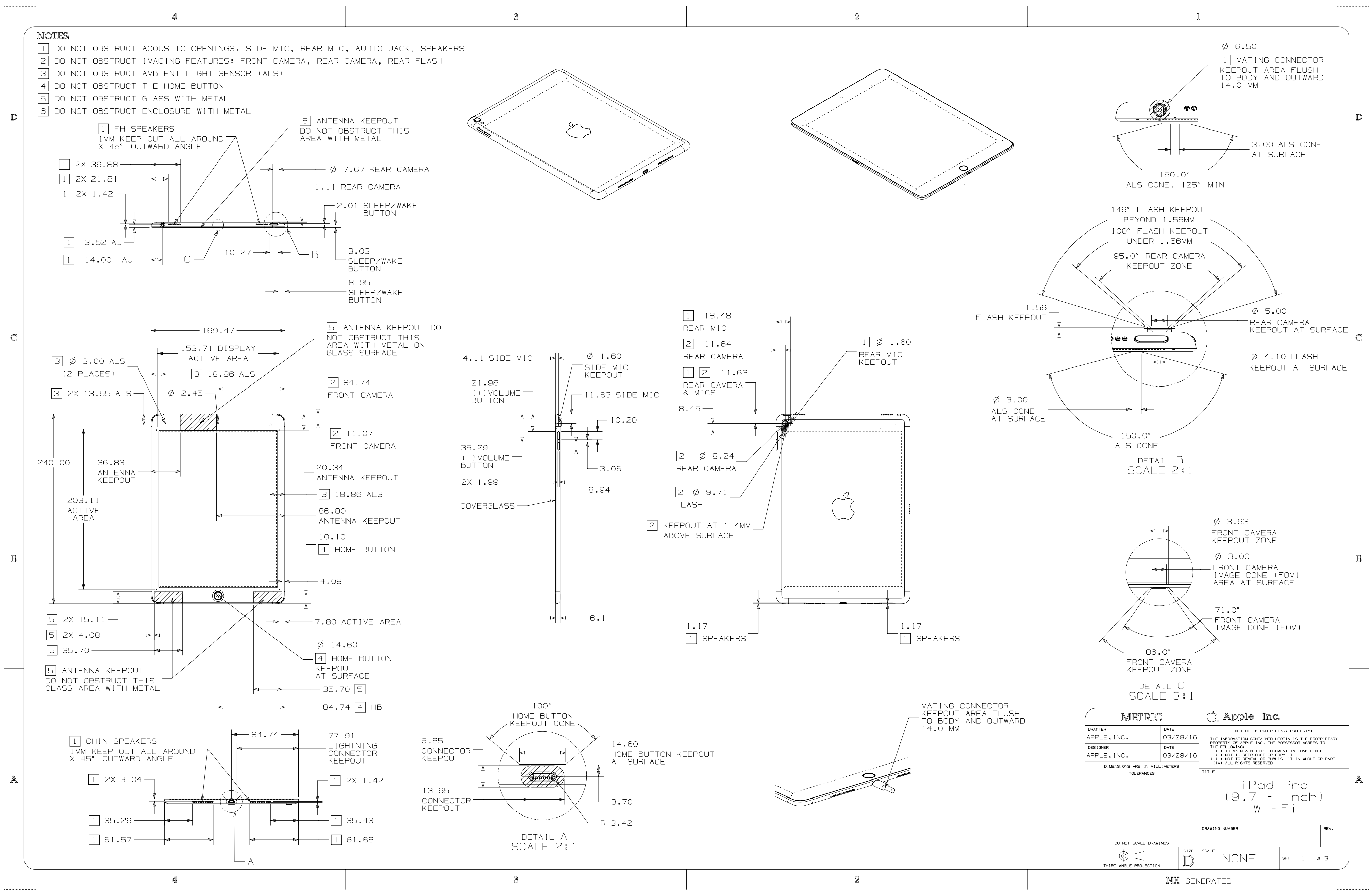
60.183 iPad (5th and 6th generation) Magnet/Hall Effect Sensors, 1 of 2

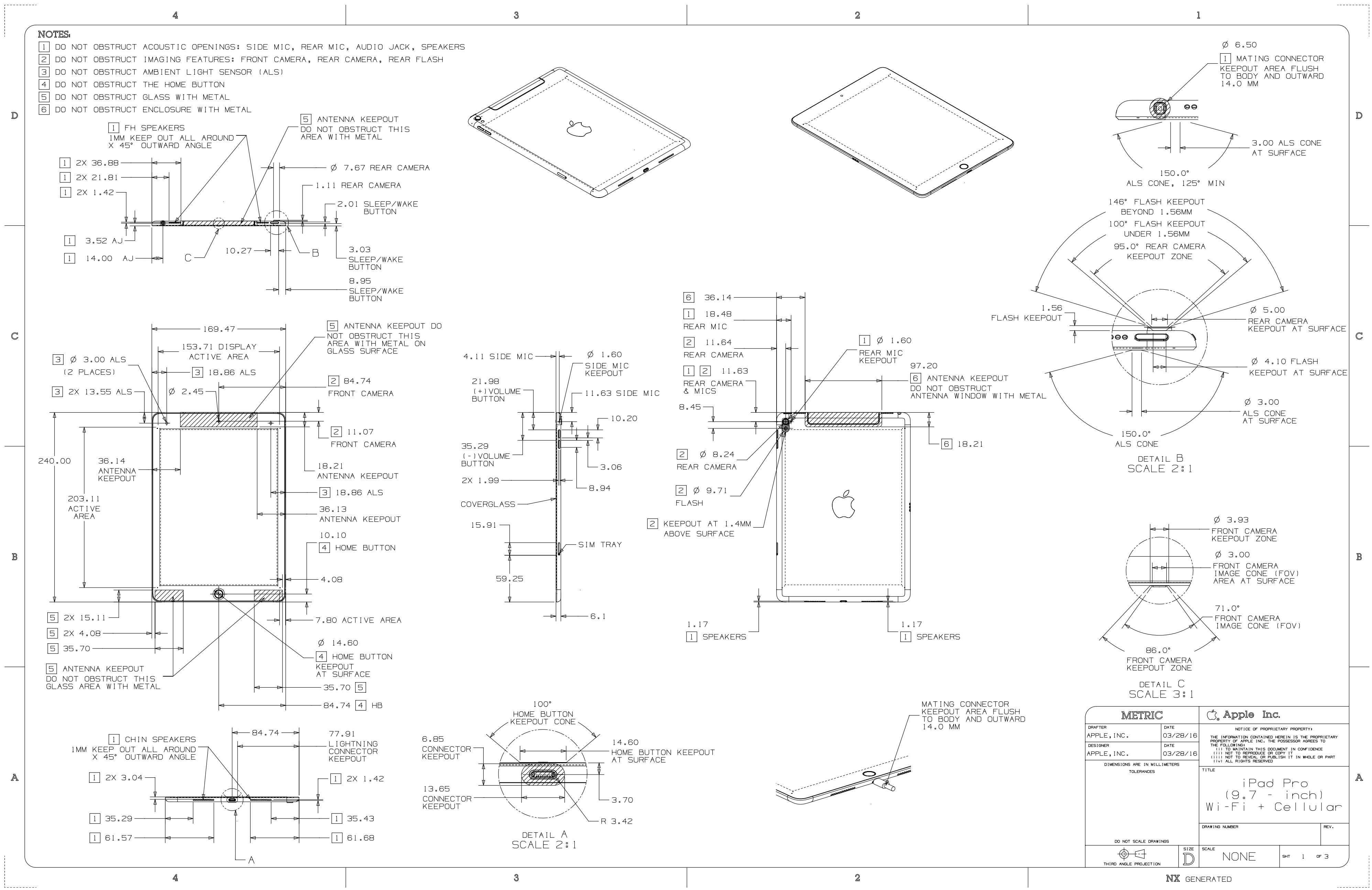


60.184 iPad (5th and 6th generation) Magnet/Hall Effect Sensors, 2 of 2

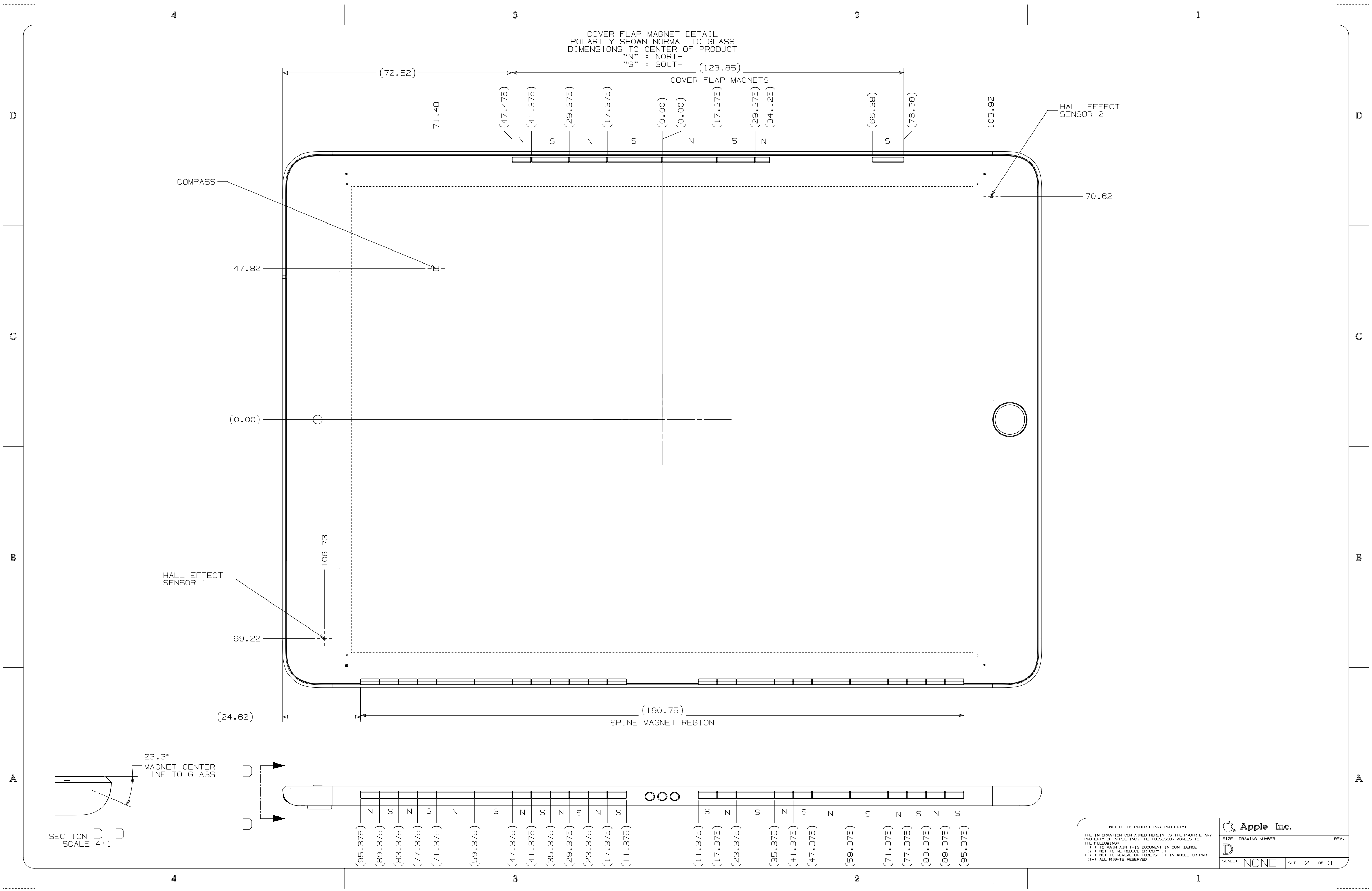


60.185 iPad Pro 9.7-inch

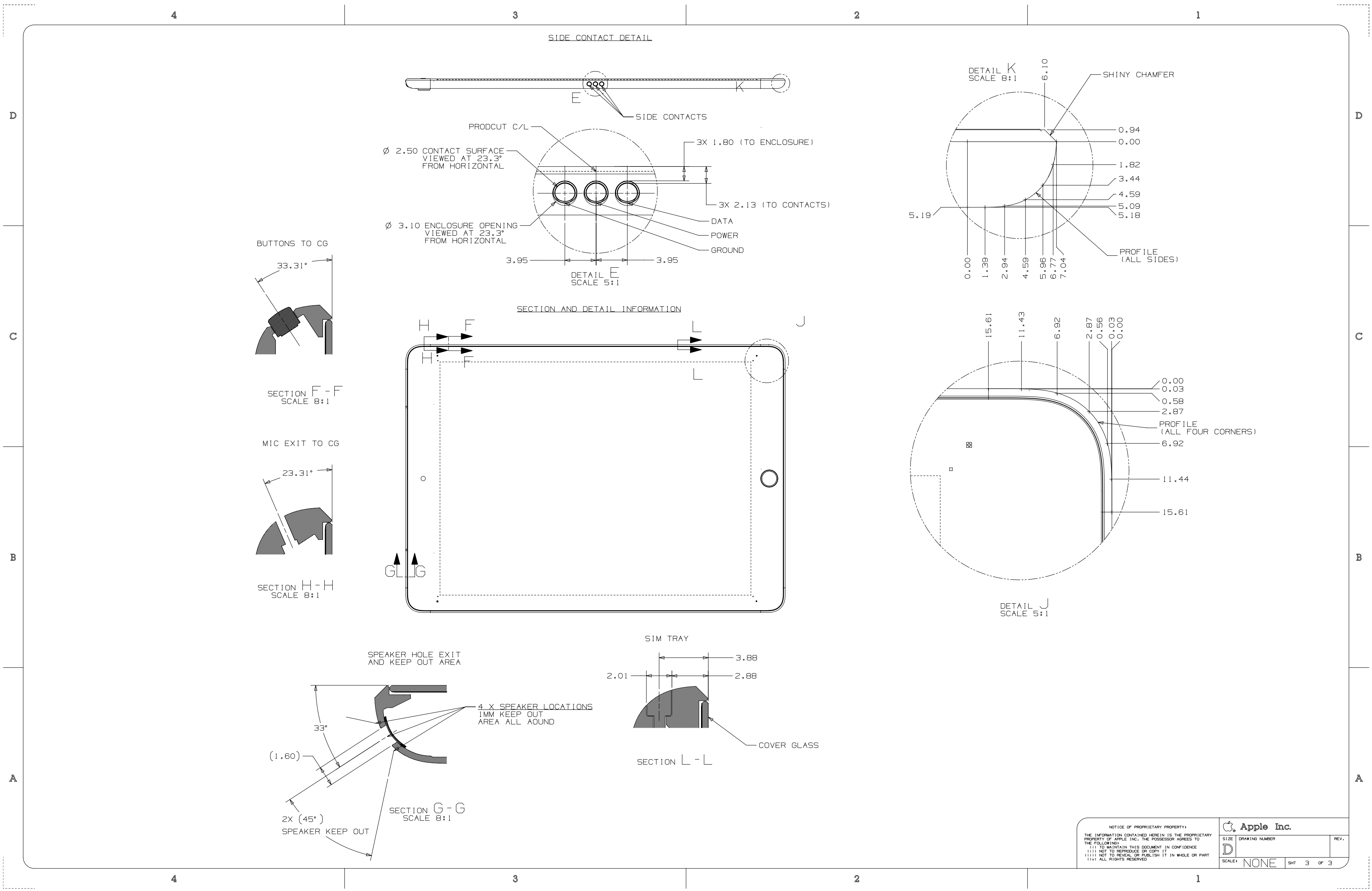



NOTES:
1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
2 DO NOT OBSTRUCT IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH
3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
4 DO NOT OBSTRUCT THE HOME BUTTON
5 DO NOT OBSTRUCT GLASS WITH METAL
6 DO NOT OBSTRUCT ENCLOSURE WITH METAL
1 FH SPEAKERS 1MM KEEP OUT ALL AROUND X 45° OUTWARD ANGLE
5 ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL
1 2X 36.88
1 2X 21.81
1 2X 1.42
Ø 7.67 REAR CAMERA
1.11 REAR CAMERA
2.01 SLEEP/WAKE BUTTON
1 3.52 AJ
1 14.00 AJ
C
10.27
B
3.03 SLEEP/WAKE BUTTON
8.95 SLEEP/WAKE BUTTON
169.47
153.71 DISPLAY ACTIVE AREA
5 ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL ON GLASS SURFACE
3 Ø 3.00 ALS (2 PLACES)
3 18.86 ALS
3 2X 13.55 ALS
Ø 2.45
2 84.74 FRONT CAMERA
2 11.07 FRONT CAMERA
240.00
36.14 ANTENNA KEEPOUT
18.21 ANTENNA KEEPOUT
203.11 ACTIVE AREA
3 18.86 ALS
36.13 ANTENNA KEEPOUT
10.10
4 HOME BUTTON
4.08
5 2X 15.11
5 2X 4.08
5 35.70
7.80 ACTIVE AREA
Ø 14.60
4 HOME BUTTON KEEPOUT AT SURFACE
5 ANTENNA KEEPOUT DO NOT OBSTRUCT THIS GLASS AREA WITH METAL
35.70 5
84.74 4 HB
4.11 SIDE MIC
Ø 1.60 SIDE MIC KEEPOUT
21.98 (+)VOLUME BUTTON
11.63 SIDE MIC
10.20
35.29 (-)VOLUME BUTTON
3.06
2X 1.99
8.94
COVERGLASS
15.91
SIM TRAY
59.25
6.1
6 36.14
1 18.48 REAR MIC
2 11.64 REAR CAMERA
1 2 11.63 REAR CAMERA & MICS
8.45
1 Ø 1.60 REAR MIC KEEPOUT
97.20
6 ANTENNA KEEPOUT DO NOT OBSTRUCT ANTENNA WINDOW WITH METAL
6 18.21
2 Ø 8.24 REAR CAMERA
2 Ø 9.71 FLASH
2 KEEPOUT AT 1.4MM ABOVE SURFACE
1.17
1 SPEAKERS
1.17
1 SPEAKERS
Ø 6.50
1 MATING CONNECTOR KEEPOUT AREA FLUSH TO BODY AND OUTWARD 14.0 MM
3.00 ALS CONE AT SURFACE
150.0° ALS CONE, 125° MIN
146° FLASH KEEPOUT BEYOND 1.56MM
100° FLASH KEEPOUT UNDER 1.56MM
95.0° REAR CAMERA KEEPOUT ZONE
1.56 FLASH KEEPOUT
Ø 5.00 REAR CAMERA KEEPOUT AT SURFACE
Ø 4.10 FLASH KEEPOUT AT SURFACE
Ø 3.00 ALS CONE AT SURFACE
150.0° ALS CONE
DETAIL B SCALE 2:1
Ø 3.93 FRONT CAMERA KEEPOUT ZONE
Ø 3.00 FRONT CAMERA IMAGE CONE (FOV) AREA AT SURFACE
71.0° FRONT CAMERA IMAGE CONE (FOV)
86.0° FRONT CAMERA KEEPOUT ZONE
DETAIL C SCALE 3:1
1 CHIN SPEAKERS 1MM KEEP OUT ALL AROUND X 45° OUTWARD ANGLE
84.74
77.91 LIGHTNING CONNECTOR KEEPOUT
1 2X 3.04
1 2X 1.42
1 35.29
1 35.43
1 61.57
1 61.68
A
100° HOME BUTTON KEEPOUT CONE
6.85 CONNECTOR KEEPOUT
14.60 HOME BUTTON KEEPOUT AT SURFACE
13.65 CONNECTOR KEEPOUT
3.70
R 3.42
DETAIL A SCALE 2:1
MATING CONNECTOR KEEPOUT AREA FLUSH TO BODY AND OUTWARD 14.0 MM
METRIC
Apple Inc.
DRAFTER APPLE, INC. DATE 03/28/16
DESIGNER APPLE, INC. DATE 03/28/16
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
TITLE
iPad Pro (9.7 - inch) Wi-Fi + Cellular
DRAWING NUMBER
REV.
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
SIZE D
SCALE NONE
SHT 1 OF 3
NX GENERATED

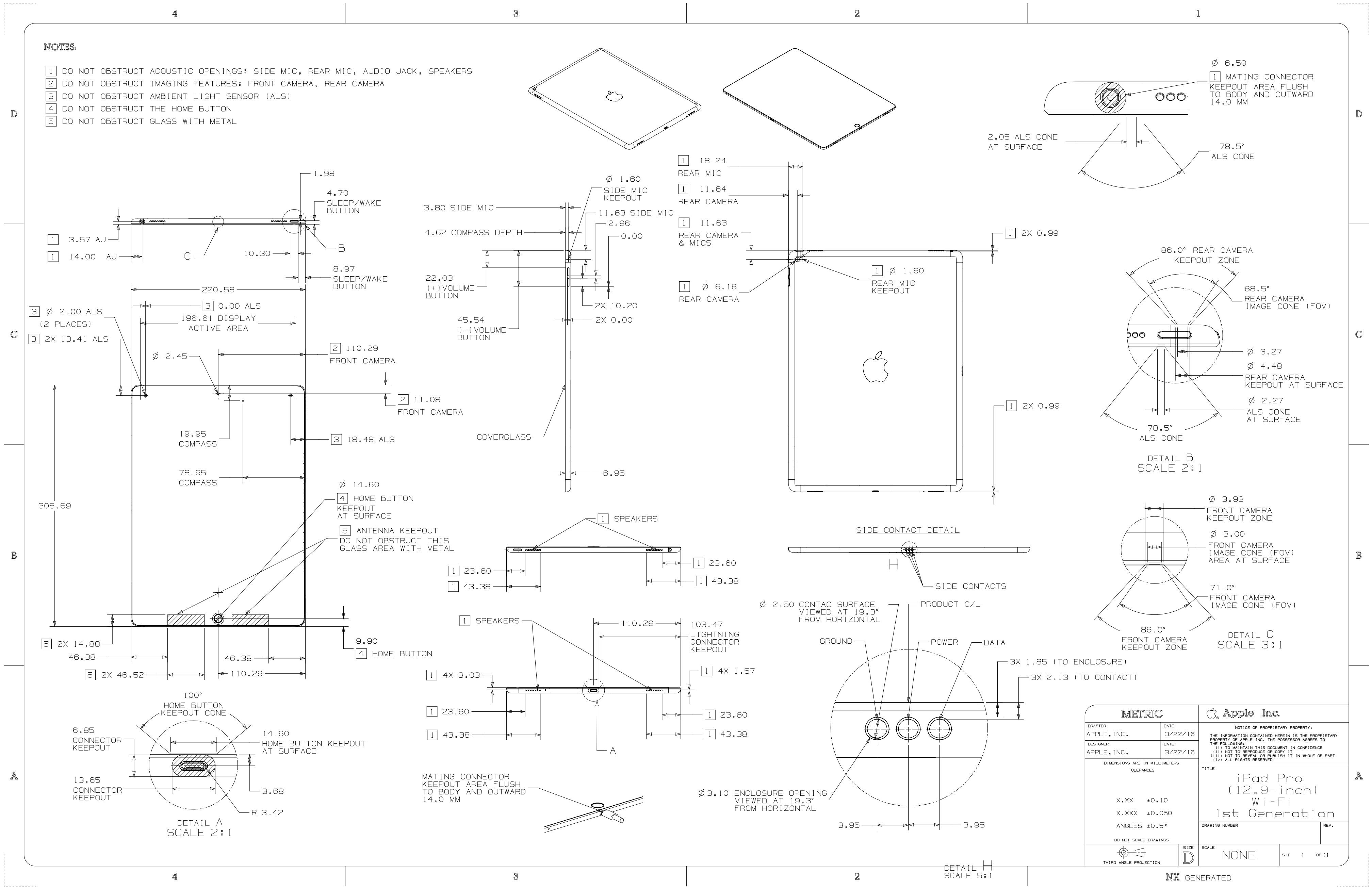
60.187 iPad Pro 9.7-inch Magnet/Hall Effect Sensors, 1 of 2



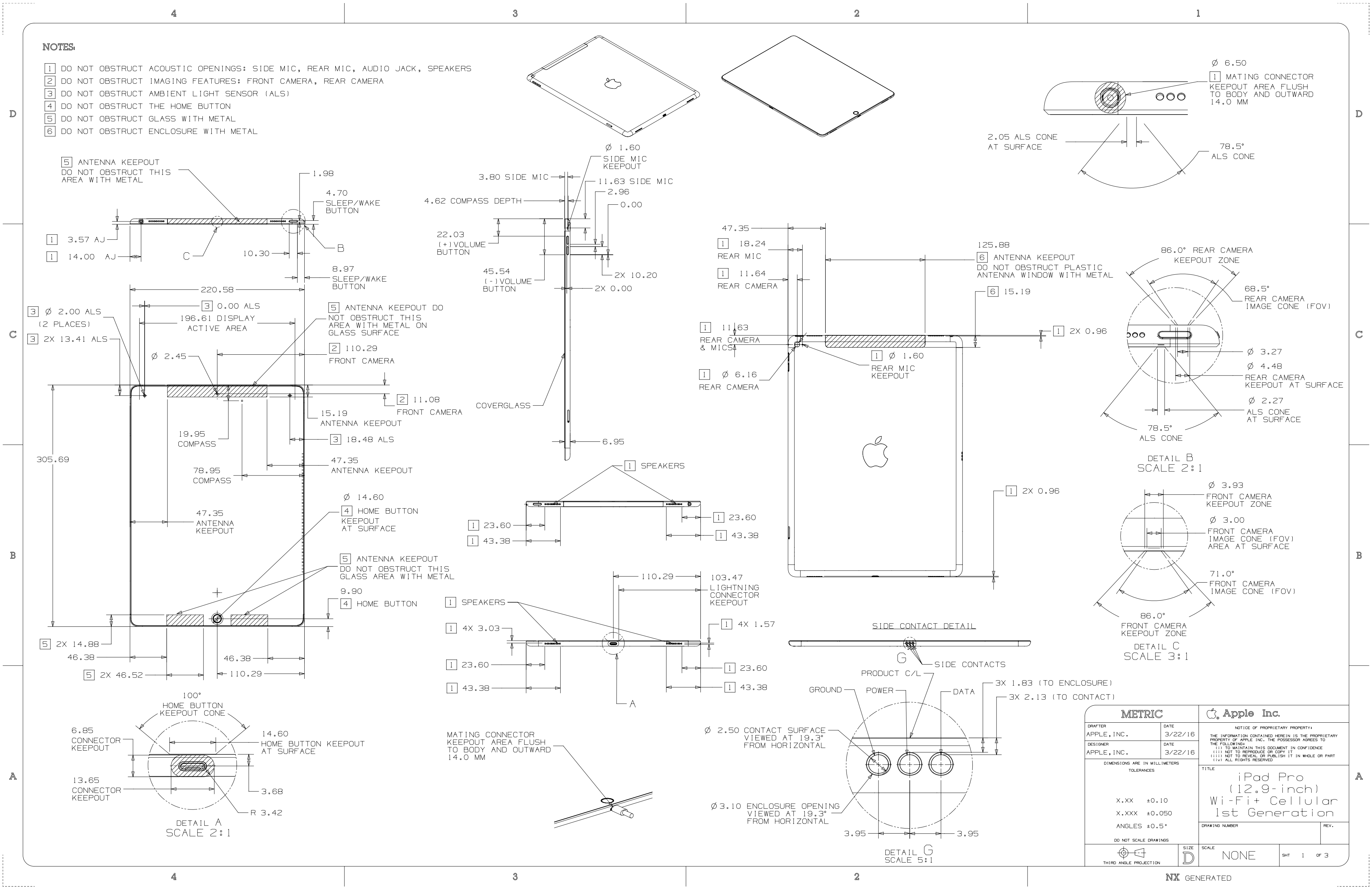
60.188 iPad Pro 9.7-inch Magnet/Hall Effect Sensors, 2 of 2



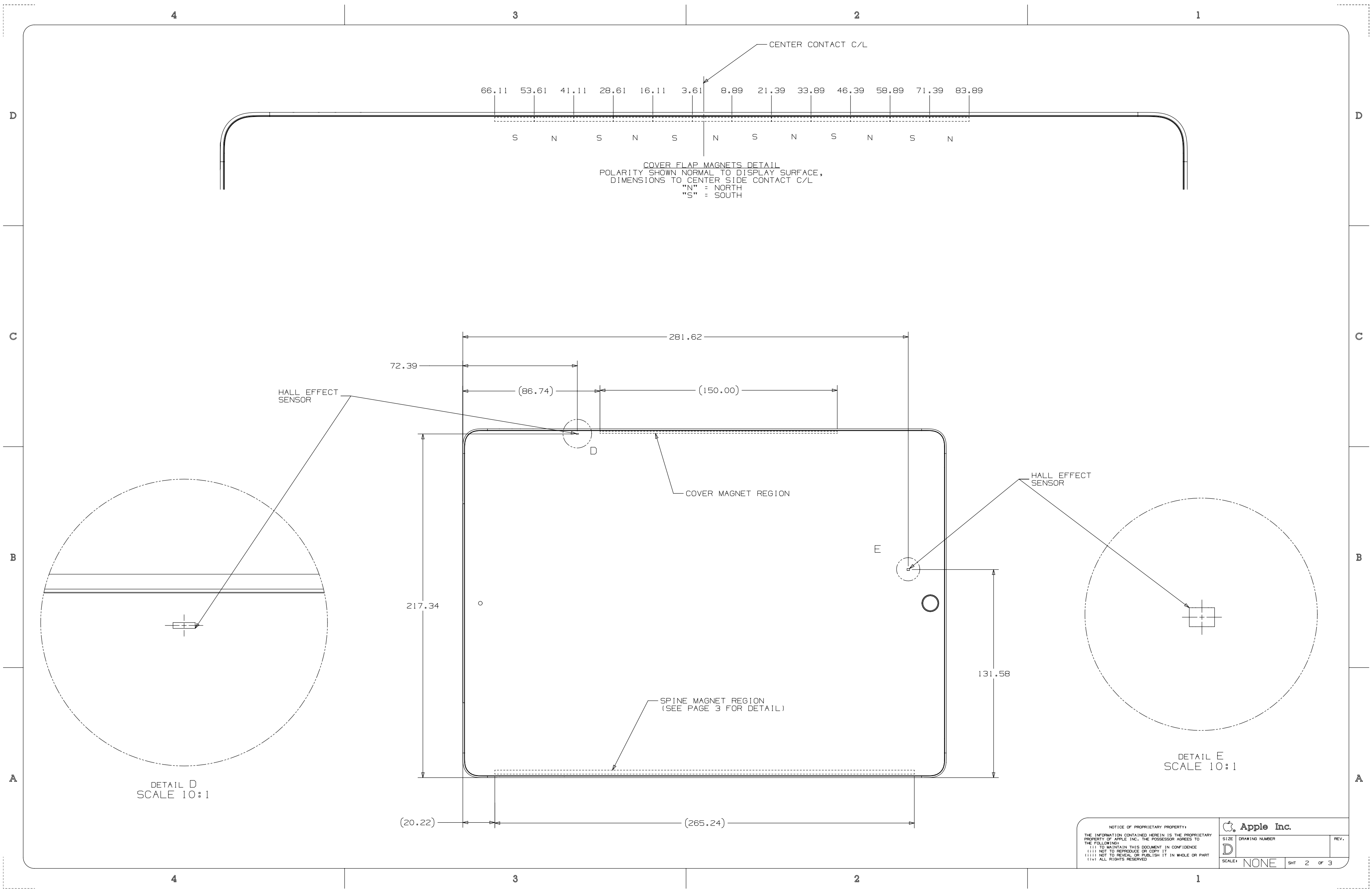
60.189 iPad Pro 12.9-inch (1st generation)



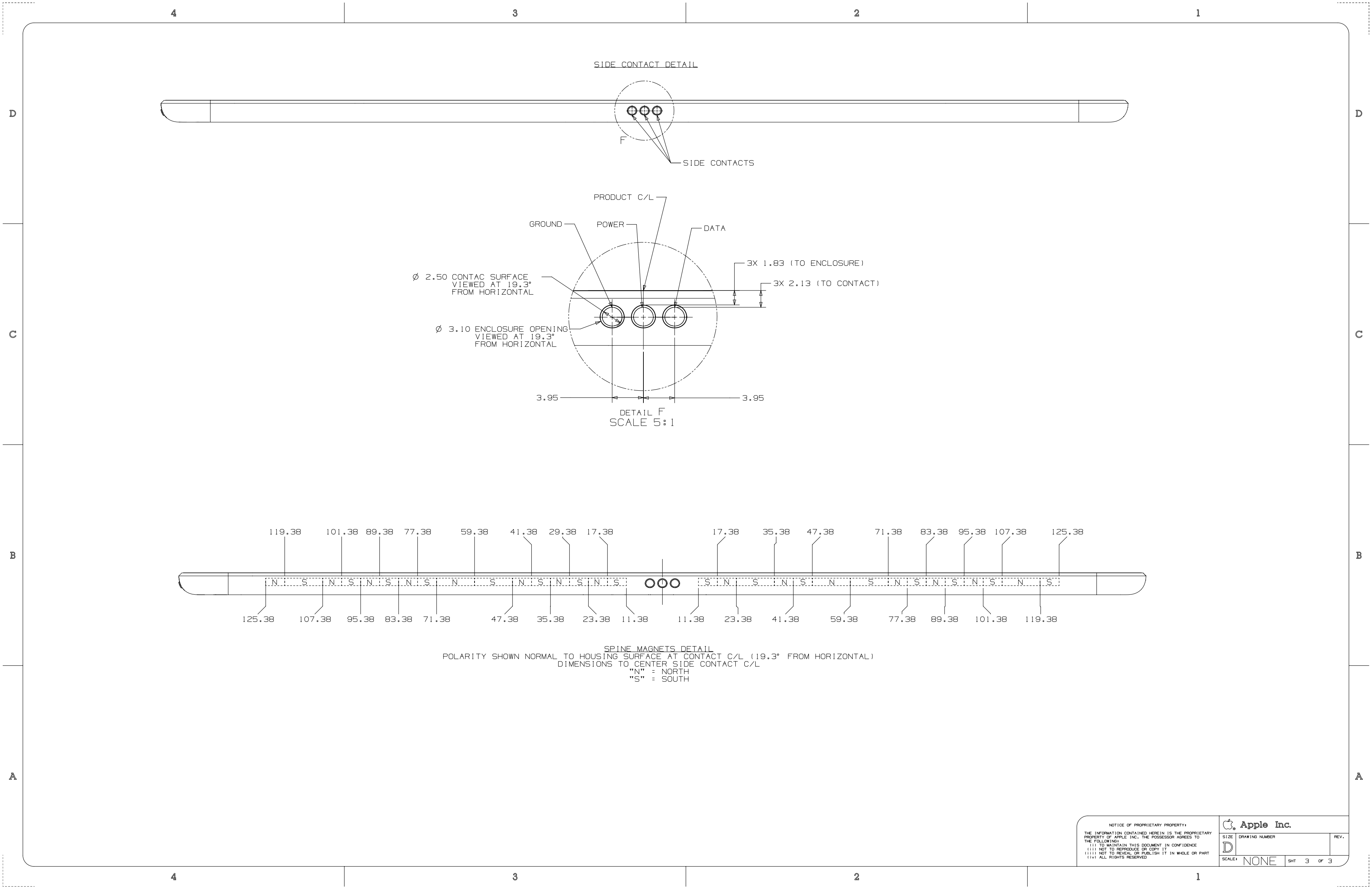
60.190 iPad Pro 12.9-inch (1st generation) with Cellular



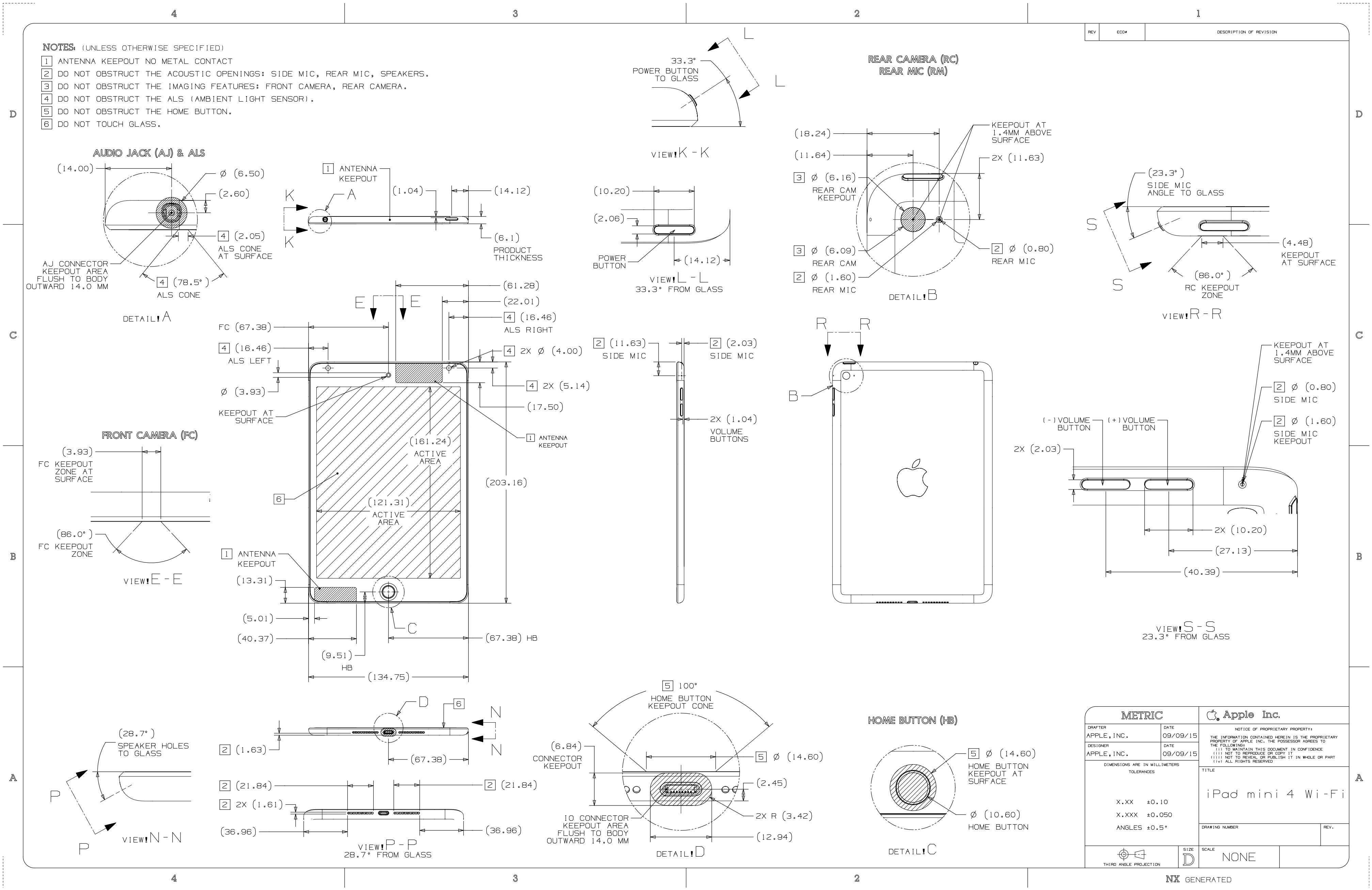
60.191 iPad Pro 12.9-inch (1st generation) Magnet/Hall Effect Sensors, 1 of 2



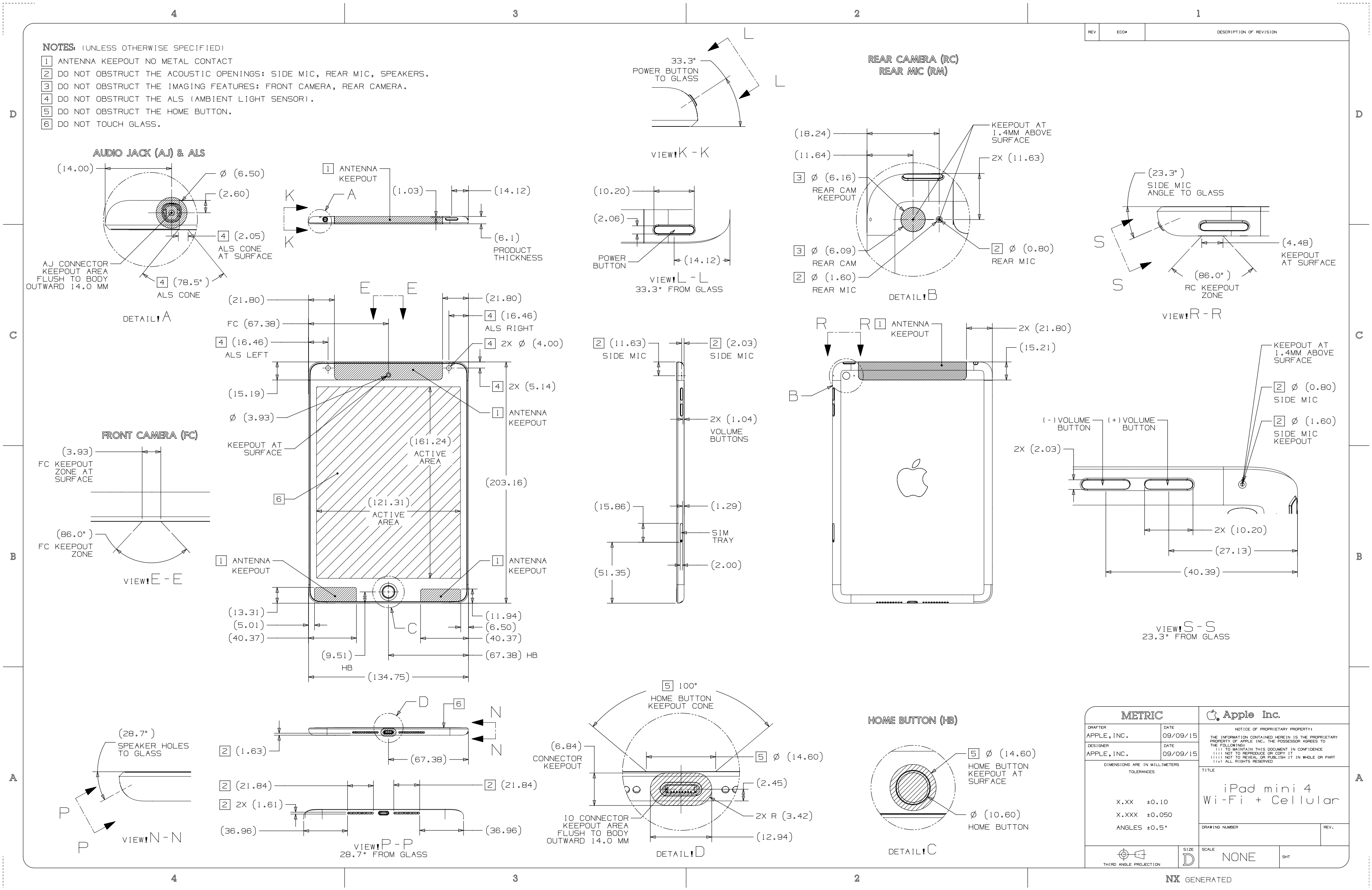
60.192 iPad Pro 12.9-inch (1st generation) Magnet/Hall Effect Sensors, 2 of 2



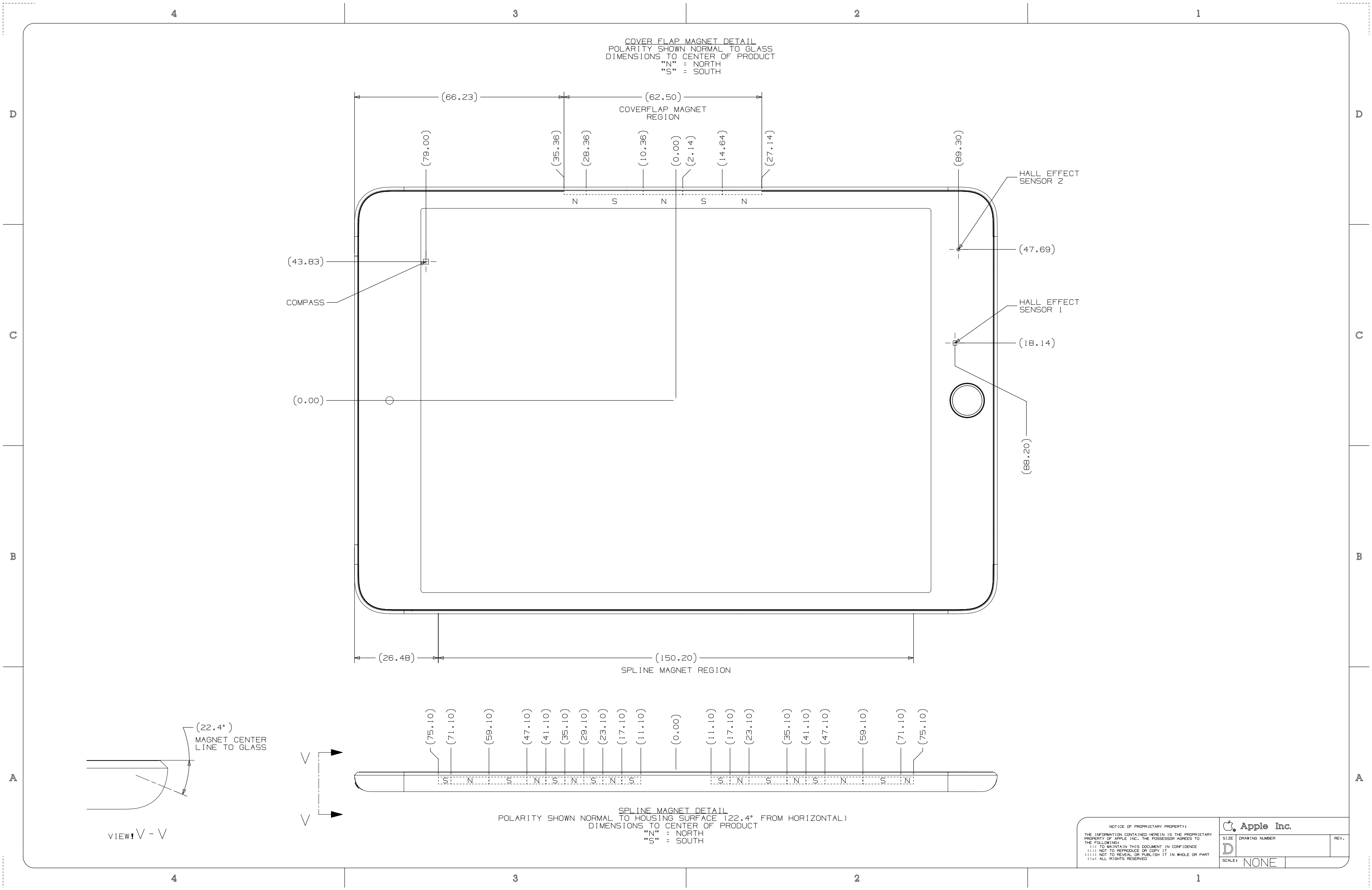
60.193 iPad mini 4



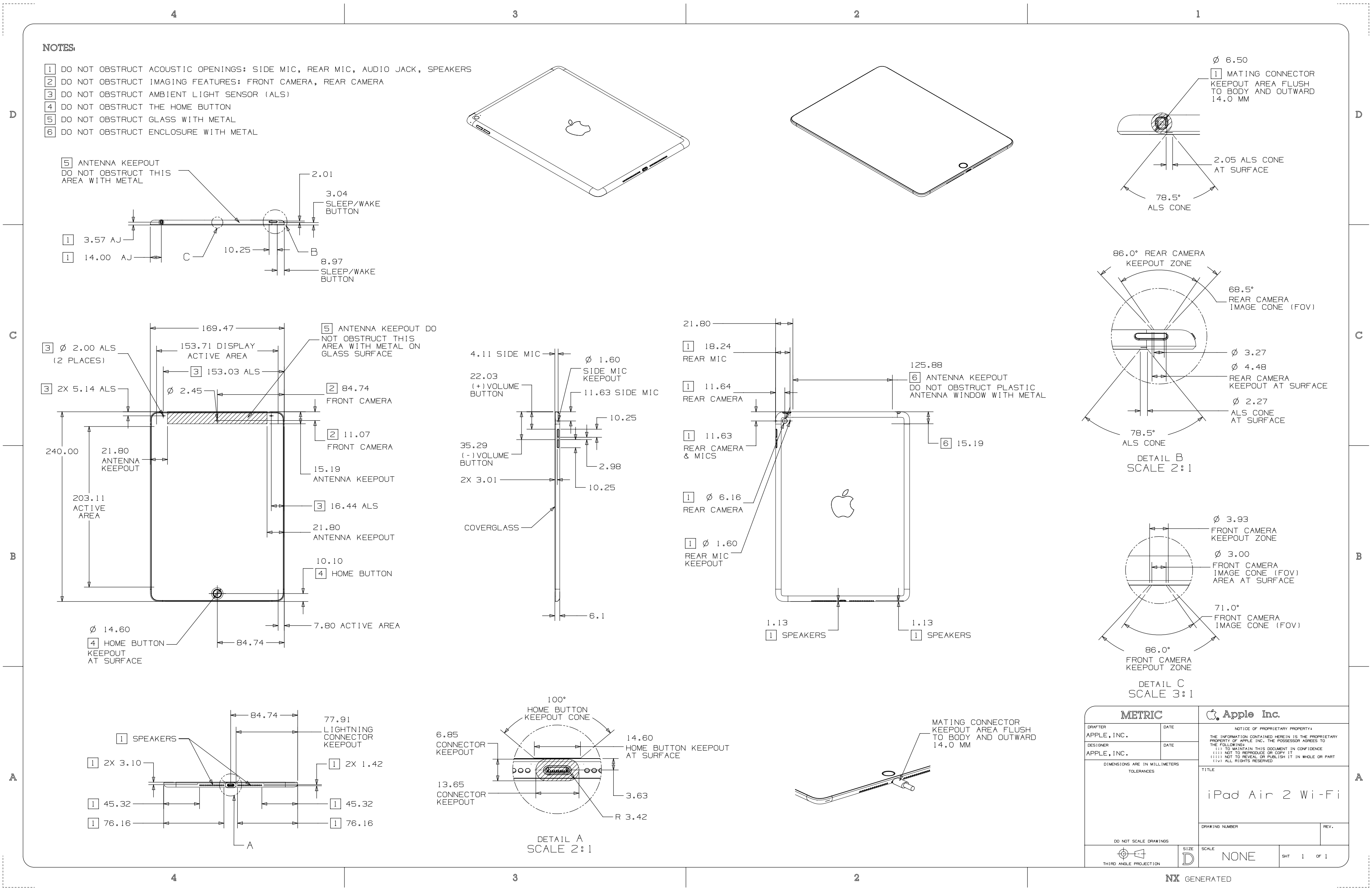
60.194 iPad mini 4 with Cellular



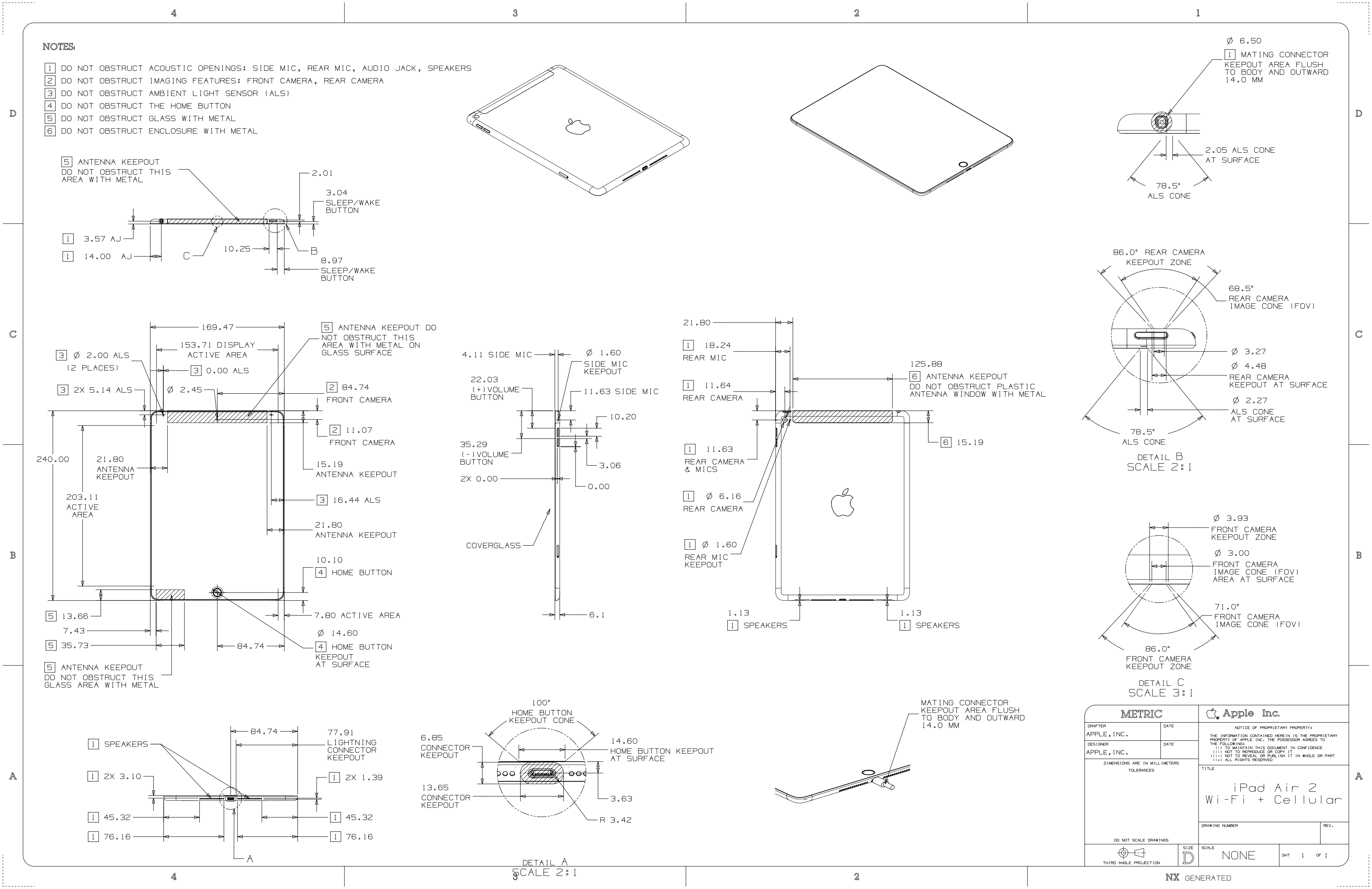
60.195 iPad mini 4 Magnet/Hall Effect Sensors



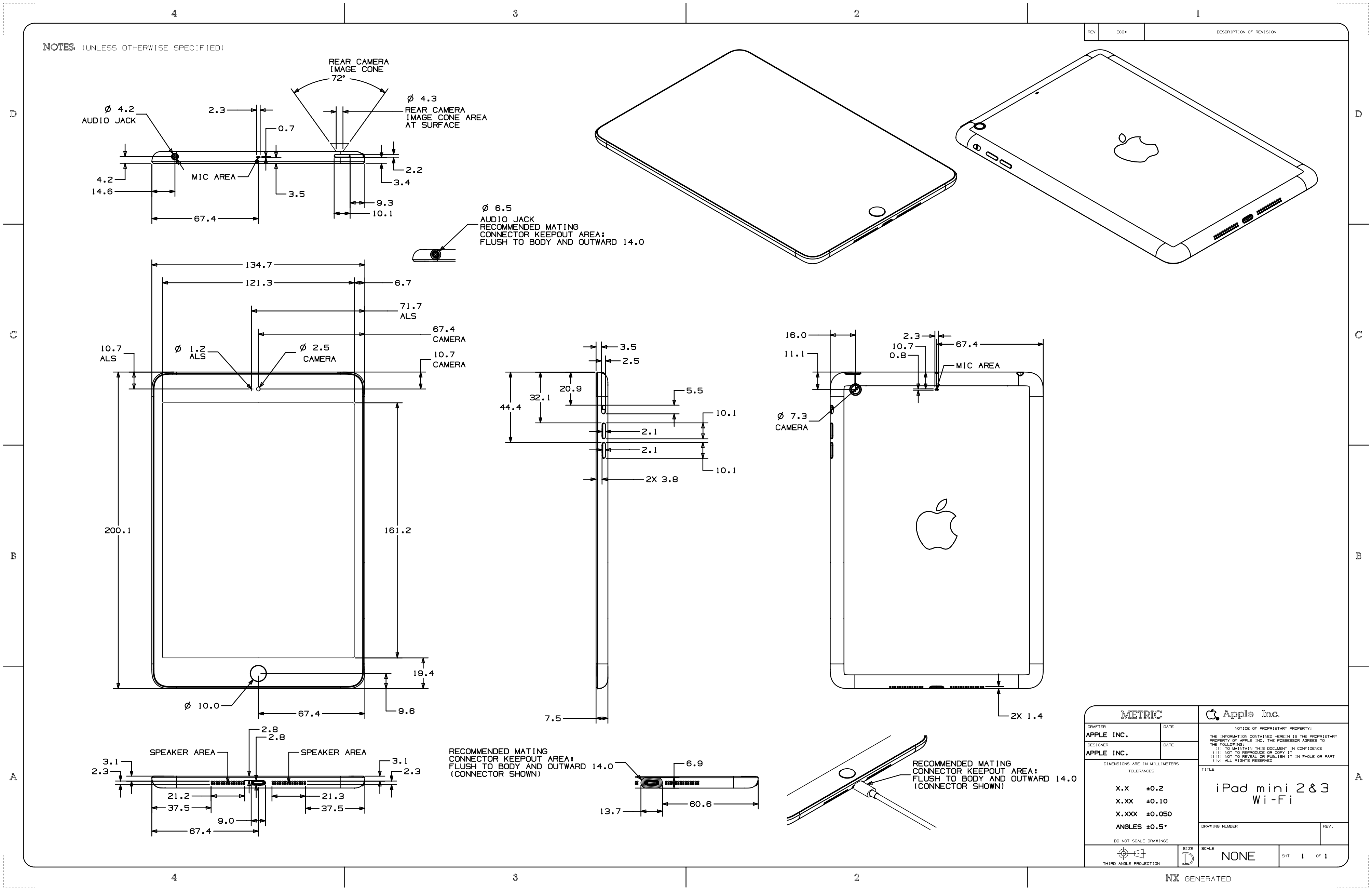
60.196 iPad Air 2



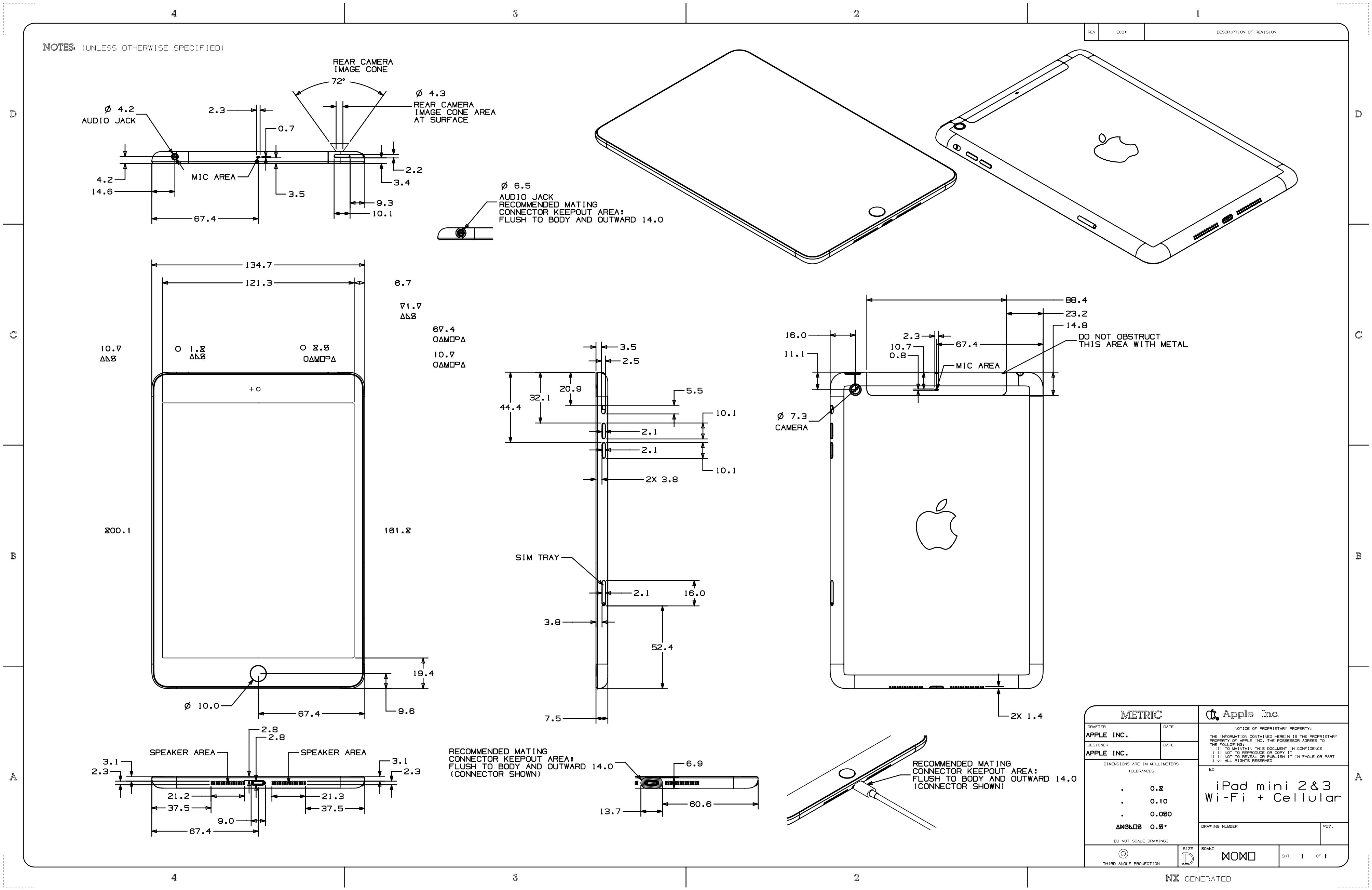
60.197 iPad Air 2 with Cellular

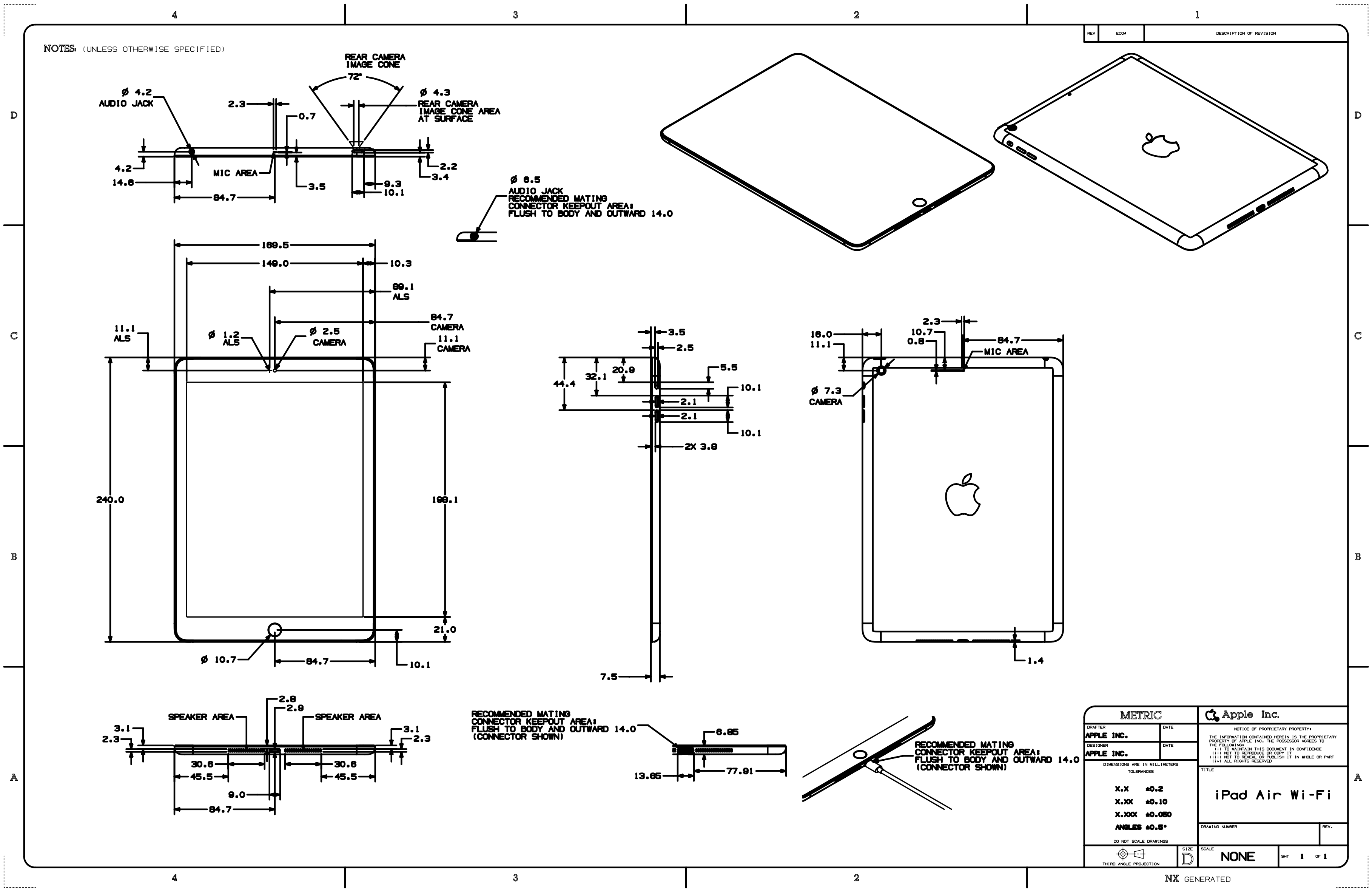


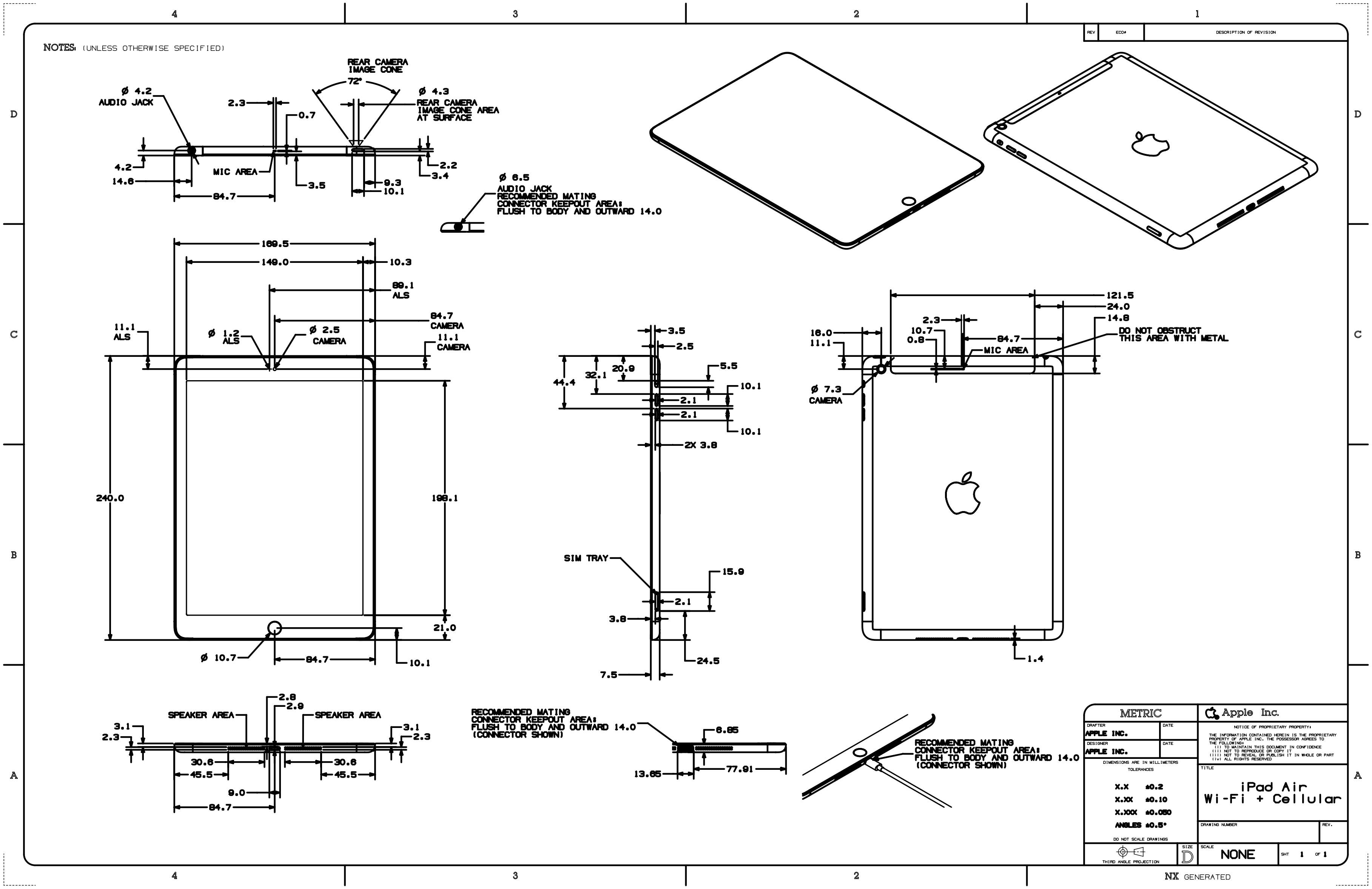
60.198 iPad mini 3 and iPad mini 2

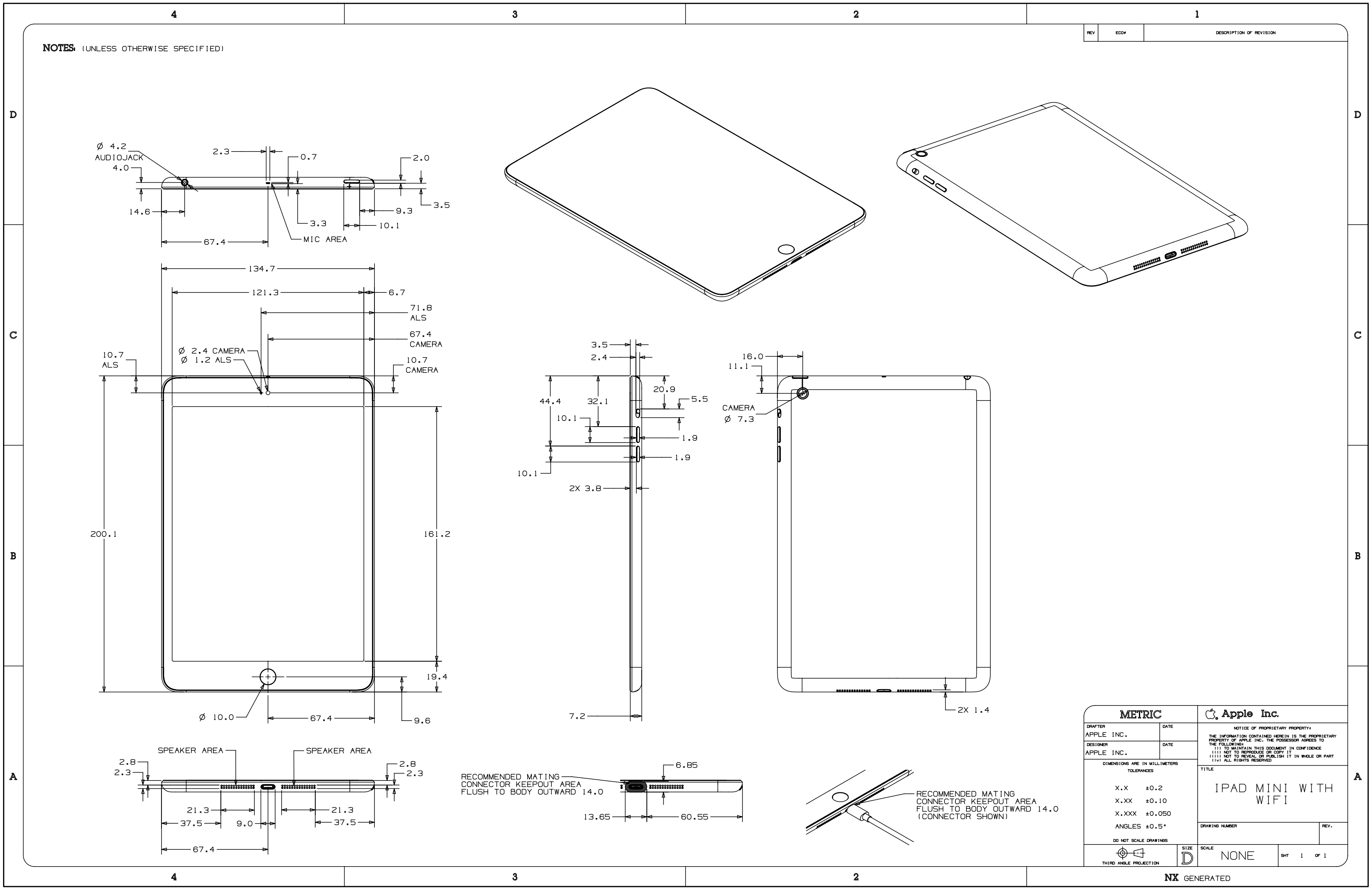


60.199 iPad mini 3 and iPad mini 2 with Cellular

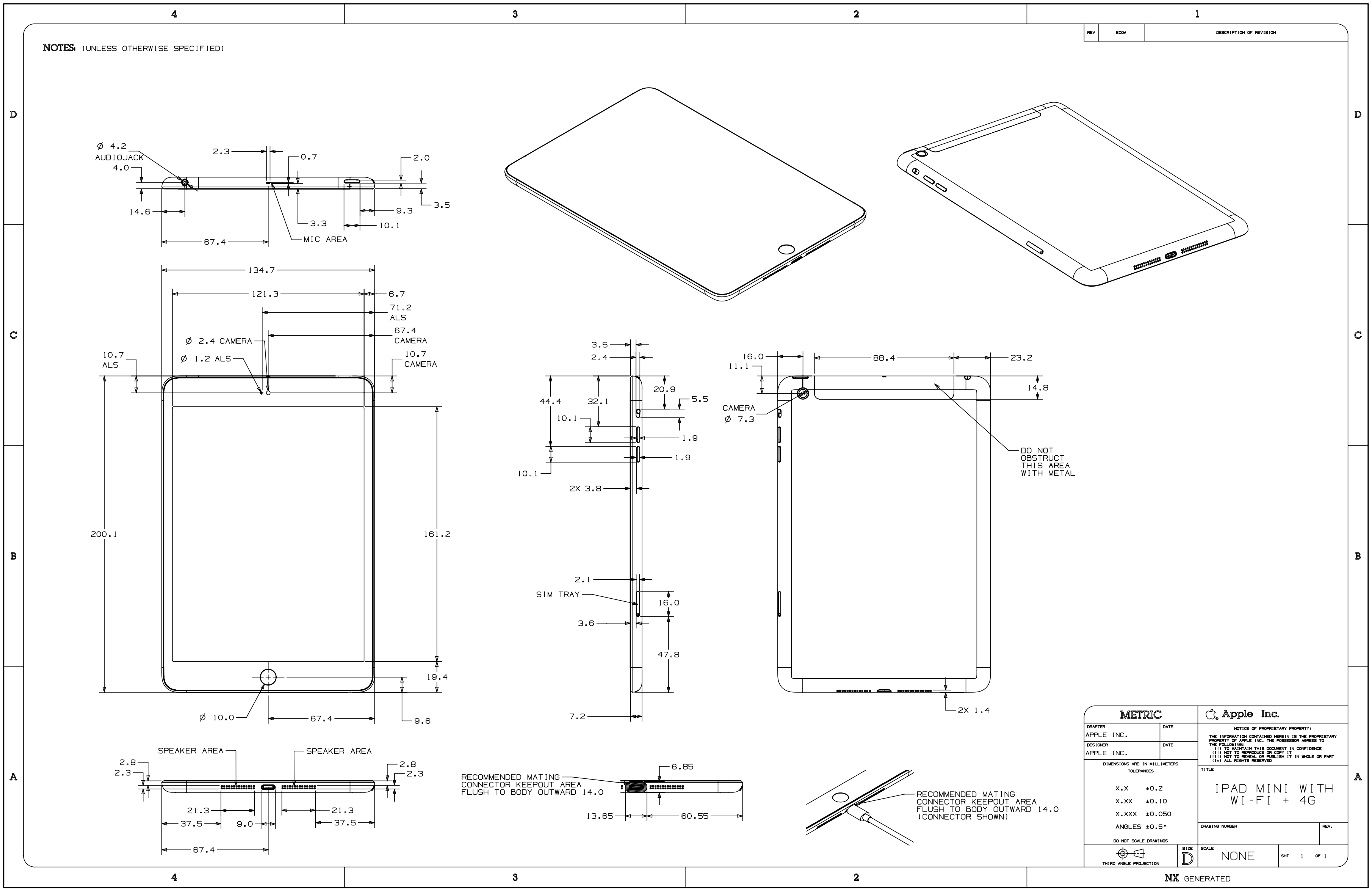



NOTES: (UNLESS OTHERWISE SPECIFIED)
REAR CAMERA IMAGE CONE
72°
Ø 4.2 AUDIO JACK
Ø 4.3 REAR CAMERA IMAGE CONE AREA AT SURFACE
MIC AREA
Ø 6.5 AUDIO JACK RECOMMENDED MATING CONNECTOR KEEPOUT AREA: FLUSH TO BODY AND OUTWARD 14.0
ALS
CAMERA
Ø 1.2 ALS
Ø 2.5 CAMERA
Ø 10.7
Ø 7.3 CAMERA
SPEAKER AREA
RECOMMENDED MATING CONNECTOR KEEPOUT AREA: FLUSH TO BODY AND OUTWARD 14.0 (CONNECTOR SHOWN)
METRIC
APPLE INC.
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
X.X ±0.2
X.XX ±0.10
X.XXX ±0.050
ANGLES ±0.5°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
iPad Air Wi-Fi
SCALE NONE
SHT 1 OF 1
NX GENERATED

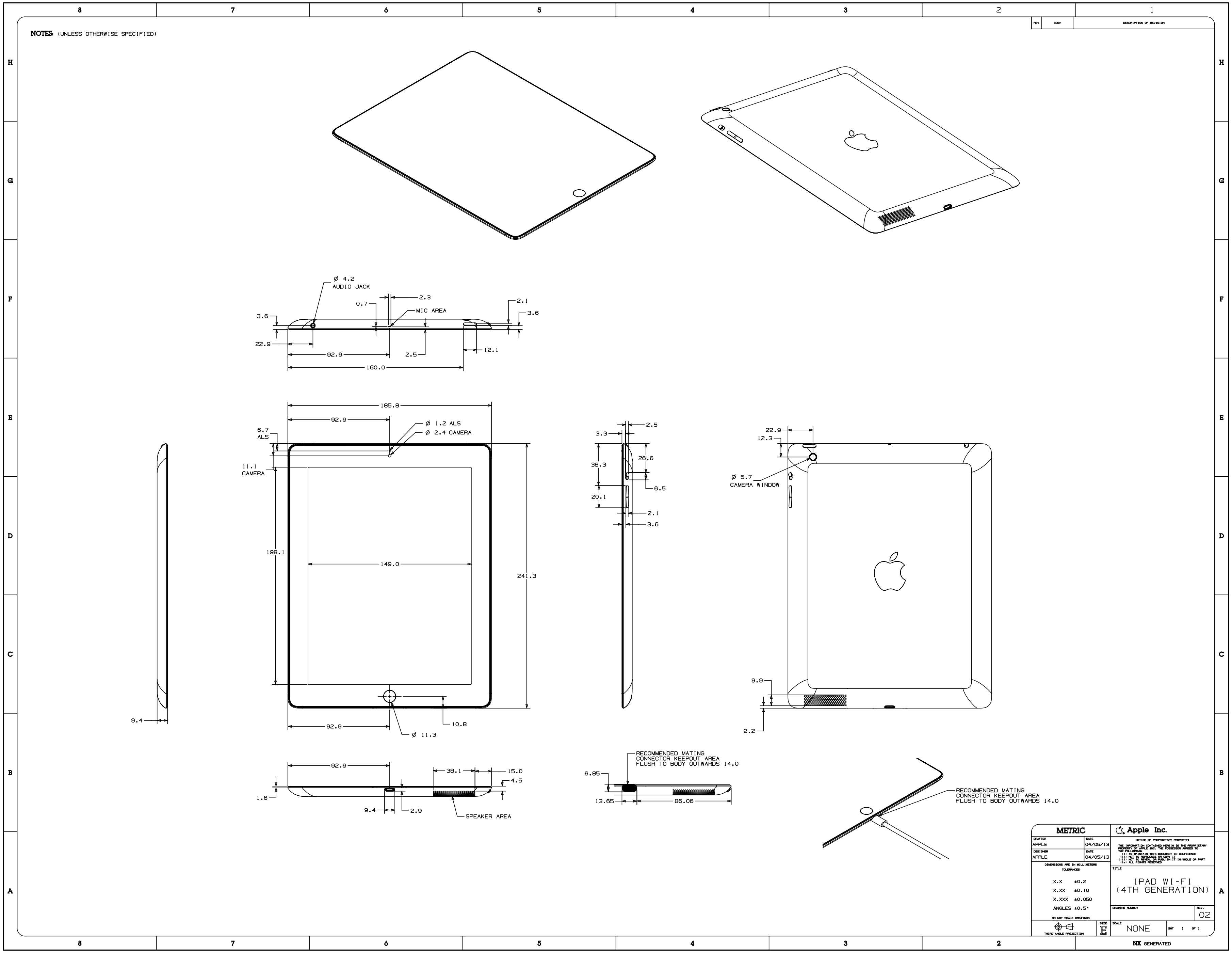

NOTES: (UNLESS OTHERWISE SPECIFIED)
REAR CAMERA IMAGE CONE
72°
Ø 4.2 AUDIO JACK
Ø 4.3 REAR CAMERA IMAGE CONE AREA AT SURFACE
MIC AREA
Ø 6.5 AUDIO JACK RECOMMENDED MATING CONNECTOR KEEPOUT AREA: FLUSH TO BODY AND OUTWARD 14.0
11.1 ALS
Ø 1.2 ALS
Ø 2.5 CAMERA
89.1 ALS
84.7 CAMERA
11.1 CAMERA
240.0
169.5
149.0
198.1
Ø 10.7
SIM TRAY
2X 3.8
Ø 7.3 CAMERA
DO NOT OBSTRUCT THIS AREA WITH METAL
SPEAKER AREA
SPEAKER AREA
RECOMMENDED MATING CONNECTOR KEEPOUT AREA: FLUSH TO BODY AND OUTWARD 14.0 (CONNECTOR SHOWN)
RECOMMENDED MATING CONNECTOR KEEPOUT AREA: FLUSH TO BODY AND OUTWARD 14.0 (CONNECTOR SHOWN)
METRIC
Apple Inc.
DRAFTER APPLE INC.
DESIGNER APPLE INC.
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
X.X ±0.2
X.XX ±0.10
X.XXX ±0.050
ANGLES ±0.5°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
TITLE
iPad Air
Wi-Fi + Cellular
SIZE D
SCALE NONE
SHT 1 OF 1
NX GENERATED


NOTES: (UNLESS OTHERWISE SPECIFIED)
REV
ECO#
DESCRIPTION OF REVISION
Ø 4.2
AUDIOJACK
4.0
2.3
0.7
2.0
3.5
9.3
10.1
3.3
MIC AREA
14.6
67.4
134.7
121.3
6.7
71.8
ALS
67.4
CAMERA
10.7
CAMERA
Ø 2.4 CAMERA
Ø 1.2 ALS
10.7
ALS
200.1
161.2
19.4
Ø 10.0
67.4
9.6
3.5
2.4
44.4
32.1
20.9
5.5
10.1
1.9
1.9
10.1
2X 3.8
7.2
16.0
11.1
CAMERA
Ø 7.3
2X 1.4
SPEAKER AREA
SPEAKER AREA
2.8
2.3
2.8
2.3
21.3
21.3
37.5
9.0
37.5
67.4
RECOMMENDED MATING
CONNECTOR KEEPOUT AREA
FLUSH TO BODY OUTWARD 14.0
6.85
13.65
60.55
RECOMMENDED MATING
CONNECTOR KEEPOUT AREA
FLUSH TO BODY OUTWARD 14.0
(CONNECTOR SHOWN)
METRIC
DRAFTER
APPLE INC.
DATE
DESIGNER
APPLE INC.
DATE
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
X.X ±0.2
X.XX ±0.10
X.XXX ±0.050
ANGLES ±0.5°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
SIZE
D
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
TITLE
IPAD MINI WITH
WIFI
DRAWING NUMBER
REV.
SCALE
NONE
SHT 1 OF 1
NX GENERATED

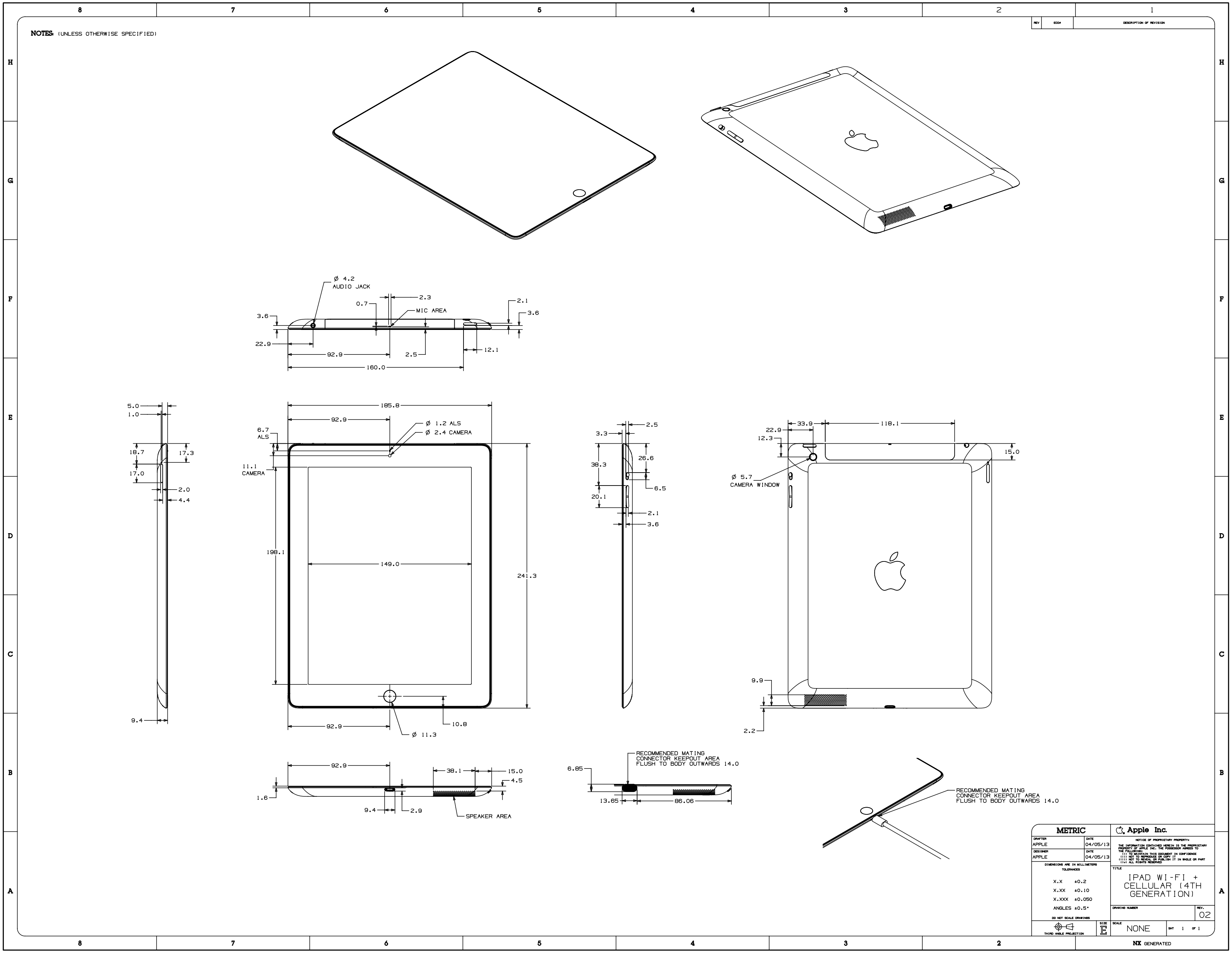
60.203 iPad mini with Cellular



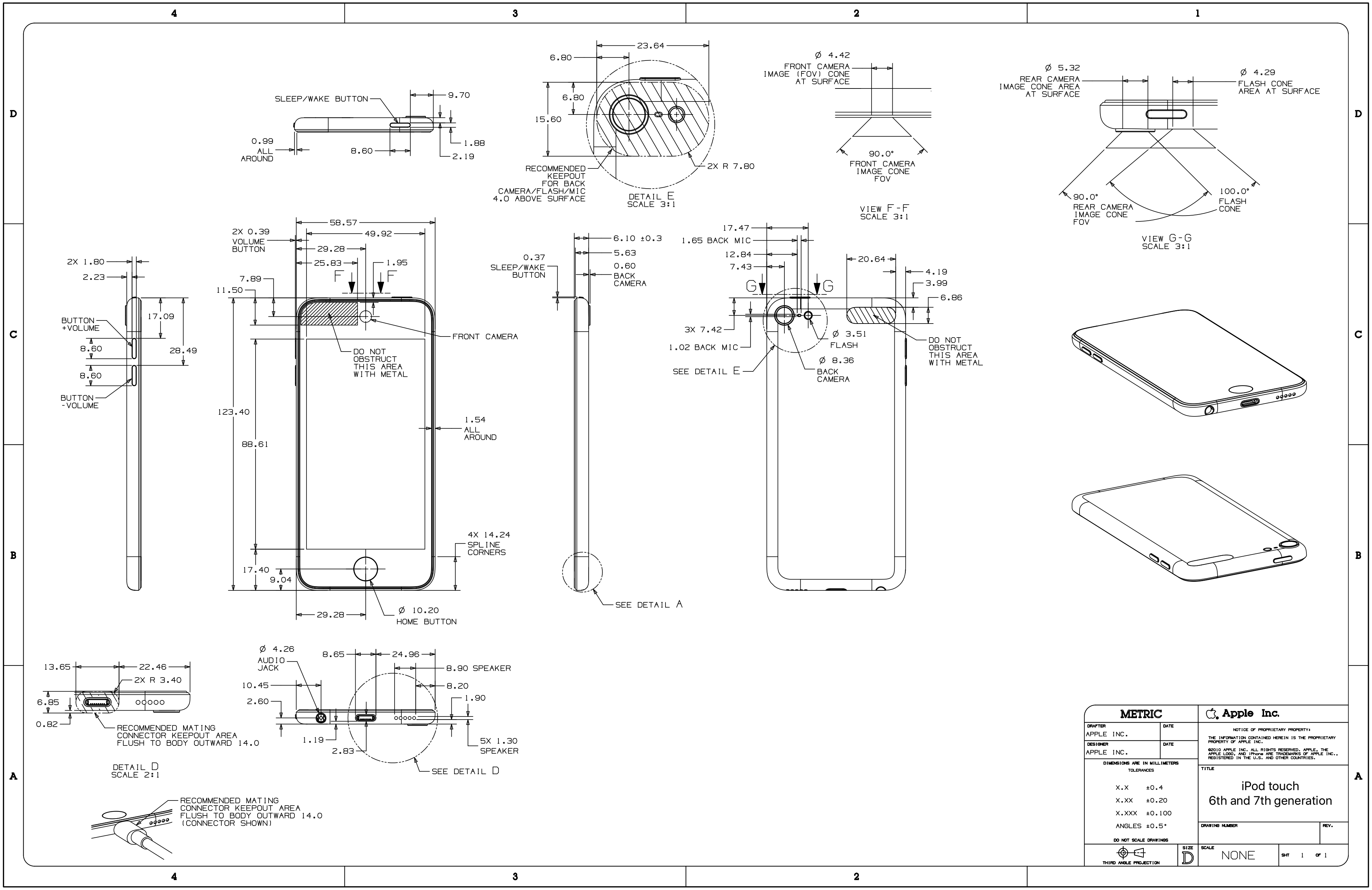
60.204 iPad (4th generation)

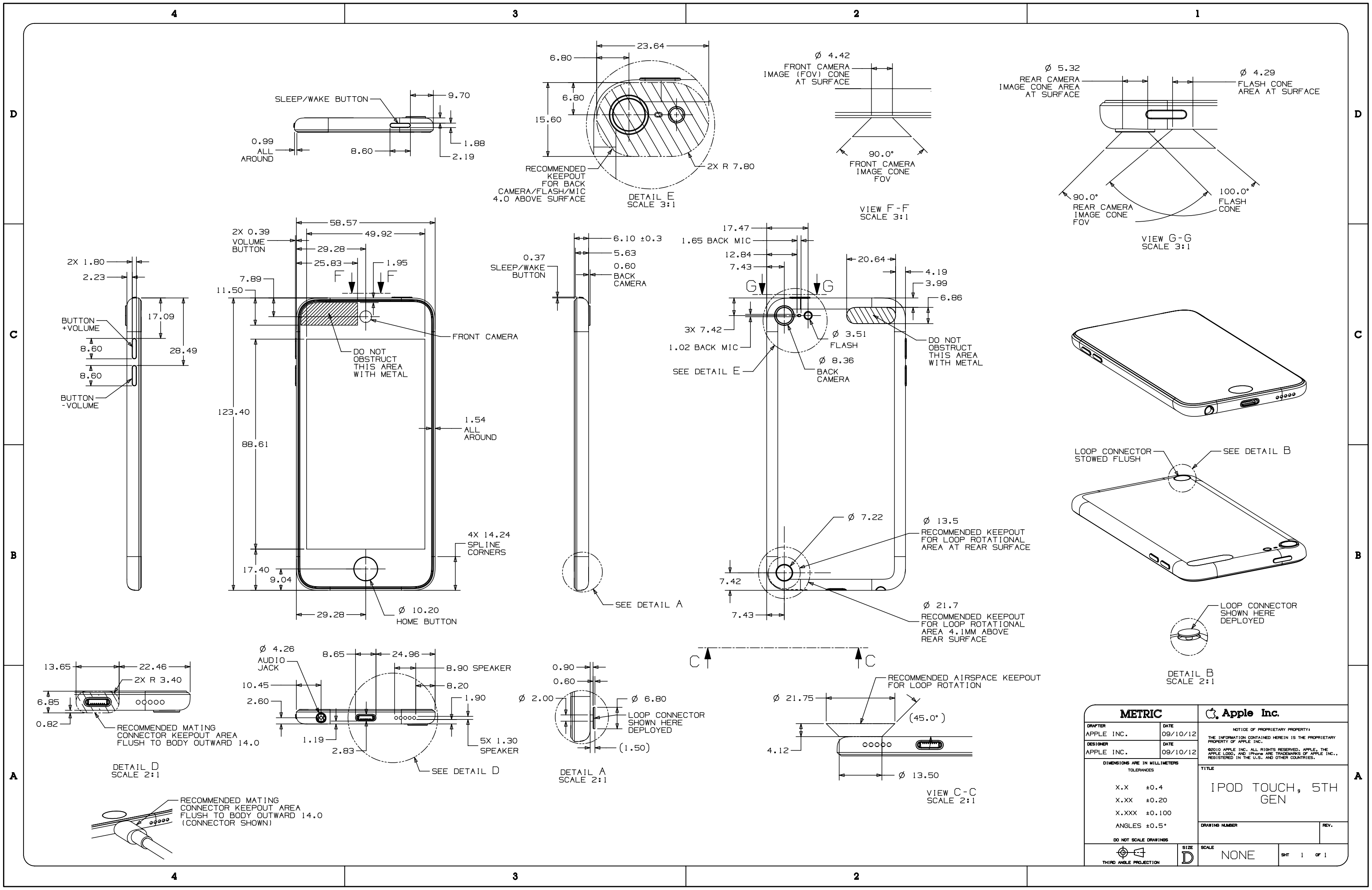


60.205 iPad (4th generation) with Cellular

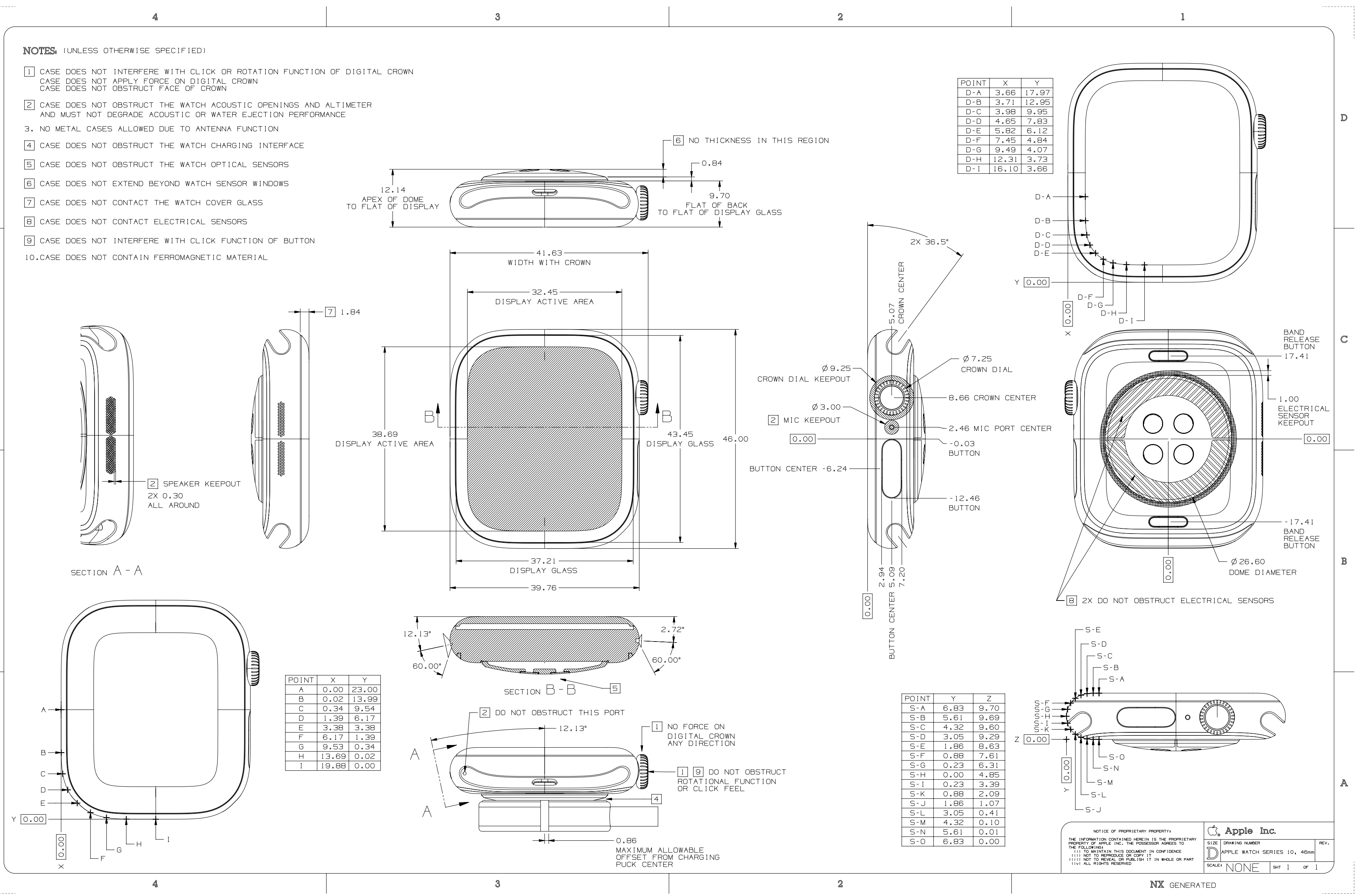


60.206 iPod touch (7th generation) and iPod touch (6th generation)




SLEEP/WAKE BUTTON
9.70
0.99 ALL AROUND
8.60
1.88
2.19
23.64
6.80
6.80
15.60
RECOMMENDED KEEPOUT FOR BACK CAMERA/FLASH/MIC 4.0 ABOVE SURFACE
2X R 7.80
DETAIL E SCALE 3:1
Ø 4.42 FRONT CAMERA IMAGE (FOV) CONE AT SURFACE
90.0° FRONT CAMERA IMAGE CONE FOV
VIEW F-F SCALE 3:1
Ø 5.32 REAR CAMERA IMAGE CONE AREA AT SURFACE
Ø 4.29 FLASH CONE AREA AT SURFACE
90.0° REAR CAMERA IMAGE CONE FOV
100.0° FLASH CONE
VIEW G-G SCALE 3:1
2X 1.80
2.23
BUTTON +VOLUME
17.09
8.60
28.49
8.60
BUTTON -VOLUME
58.57
49.92
2X 0.39 VOLUME BUTTON
29.28
25.83
1.95
7.89
11.50
F
F
FRONT CAMERA
DO NOT OBSTRUCT THIS AREA WITH METAL
123.40
88.61
1.54 ALL AROUND
4X 14.24 SPLINE CORNERS
17.40
9.04
29.28
Ø 10.20 HOME BUTTON
6.10 ±0.3
5.63
0.37 SLEEP/WAKE BUTTON
0.60 BACK CAMERA
SEE DETAIL A
17.47
1.65 BACK MIC
12.84
7.43
20.64
4.19
3.99
6.86
G
G
3X 7.42
Ø 3.51 FLASH
1.02 BACK MIC
DO NOT OBSTRUCT THIS AREA WITH METAL
Ø 8.36 BACK CAMERA
SEE DETAIL E
Ø 7.22
Ø 13.5 RECOMMENDED KEEPOUT FOR LOOP ROTATIONAL AREA AT REAR SURFACE
7.42
7.43
Ø 21.7 RECOMMENDED KEEPOUT FOR LOOP ROTATIONAL AREA 4.1MM ABOVE REAR SURFACE
LOOP CONNECTOR STOWED FLUSH
SEE DETAIL B
LOOP CONNECTOR SHOWN HERE DEPLOYED
DETAIL B SCALE 2:1
13.65
22.46
2X R 3.40
6.85
0.82
RECOMMENDED MATING CONNECTOR KEEPOUT AREA FLUSH TO BODY OUTWARD 14.0
DETAIL D SCALE 2:1
RECOMMENDED MATING CONNECTOR KEEPOUT AREA FLUSH TO BODY OUTWARD 14.0 (CONNECTOR SHOWN)
Ø 4.26 AUDIO JACK
8.65
24.96
8.90 SPEAKER
10.45
8.20
2.60
1.90
1.19
2.83
5X 1.30 SPEAKER
SEE DETAIL D
0.90
0.60
Ø 2.00
Ø 6.80
LOOP CONNECTOR SHOWN HERE DEPLOYED
(1.50)
DETAIL A SCALE 2:1
C
C
RECOMMENDED AIRSPACE KEEPOUT FOR LOOP ROTATION
Ø 21.75
(45.0°)
4.12
Ø 13.50
VIEW C-C SCALE 2:1
METRIC
Apple Inc.
DRAFTER APPLE INC. DATE 09/10/12
DESIGNER APPLE INC. DATE 09/10/12
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC.
©2010 APPLE INC. ALL RIGHTS RESERVED. APPLE, THE APPLE LOGO, AND iPhone ARE TRADEMARKS OF APPLE INC., REGISTERED IN THE U.S. AND OTHER COUNTRIES.
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
X.X ±0.4
X.XX ±0.20
X.XXX ±0.100
ANGLES ±0.5°
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
TITLE
IPOD TOUCH, 5TH GEN
DRAWING NUMBER
REV.
SIZE D
SCALE NONE
SHT 1 OF 1

60.208 Apple Watch Series 10, 46 mm



NOTES: (UNLESS OTHERWISE SPECIFIED)

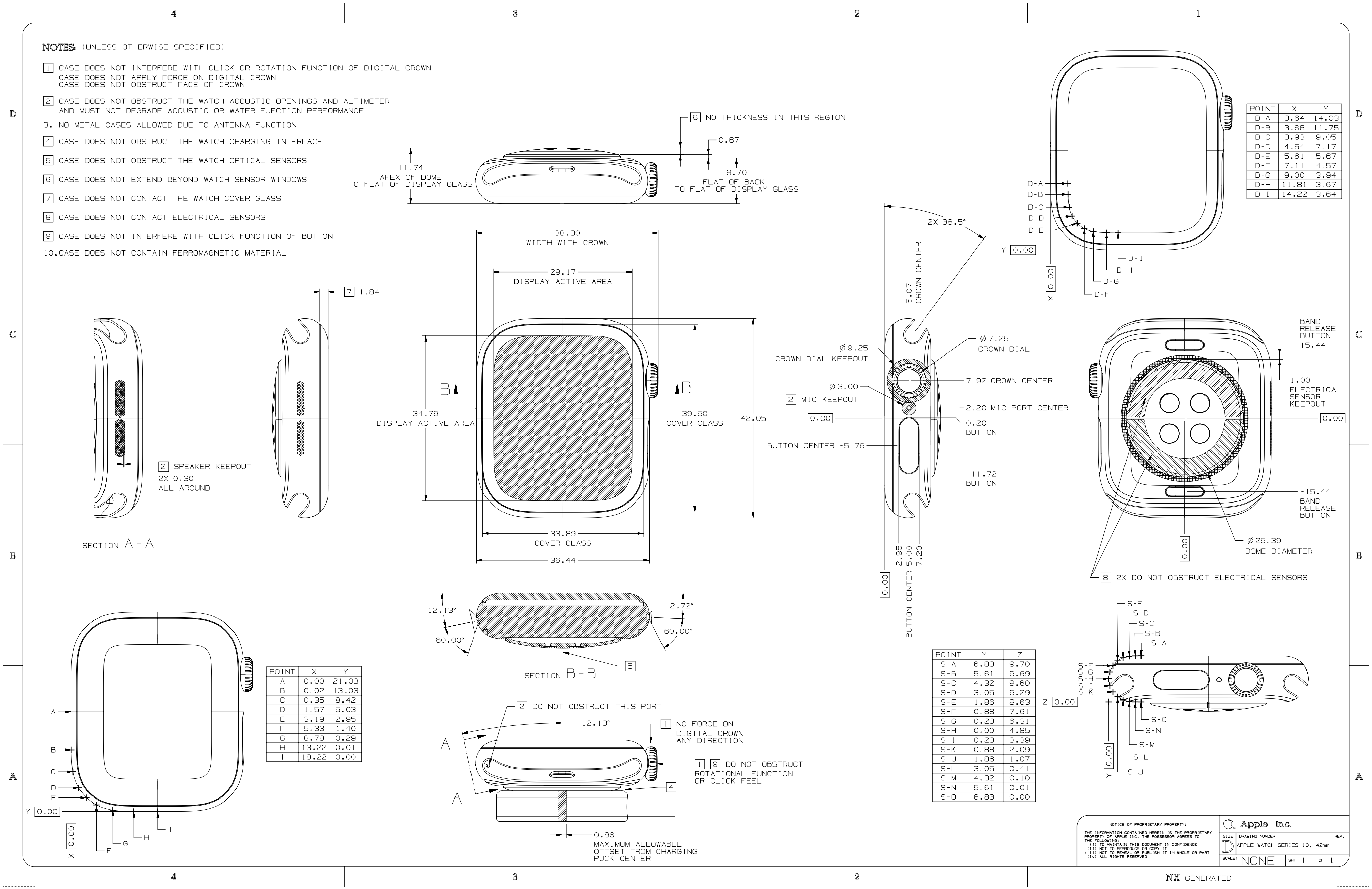
1. CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
CASE DOES NOT OBSTRUCT FACE OF CROWN
2. CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
3. NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
4. CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
5. CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
6. CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
7. CASE DOES NOT CONTACT THE WATCH COVER GLASS
8. CASE DOES NOT CONTACT ELECTRICAL SENSORS
9. CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
10. CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL

POINT	X	Y
D-A	3.66	17.97
D-B	3.71	12.95
D-C	3.98	9.95
D-D	4.65	7.83
D-E	5.82	6.12
D-F	7.45	4.84
D-G	9.49	4.07
D-H	12.31	3.73
D-I	16.10	3.66

POINT	X	Y
A	0.00	23.00
B	0.02	13.99
C	0.34	9.54
D	1.39	6.17
E	3.38	3.38
F	6.17	1.39
G	9.53	0.34
H	13.69	0.02
I	19.88	0.00

POINT	Y	Z
S-A	6.83	9.70
S-B	5.61	9.69
S-C	4.32	9.60
S-D	3.05	9.29
S-E	1.86	8.63
S-F	0.88	7.61
S-G	0.23	6.31
S-H	0.00	4.85
S-I	0.23	3.39
S-K	0.88	2.09
S-J	1.86	1.07
S-L	3.05	0.41
S-M	4.32	0.10
S-N	5.61	0.01
S-O	6.83	0.00

60.209 Apple Watch Series 10, 42 mm



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
   CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
   CASE DOES NOT OBSTRUCT FACE OF CROWN
2. CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
3. NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
4. CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
5. CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
6. CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
7. CASE DOES NOT CONTACT THE WATCH COVER GLASS
8. CASE DOES NOT CONTACT ELECTRICAL SENSORS
9. CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
10. CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL

POINT	X	Y
D-A	3.64	14.03
D-B	3.68	11.75
D-C	3.93	9.05
D-D	4.54	7.17
D-E	5.61	5.67
D-F	7.11	4.57
D-G	9.00	3.94
D-H	11.81	3.67
D-I	14.22	3.64

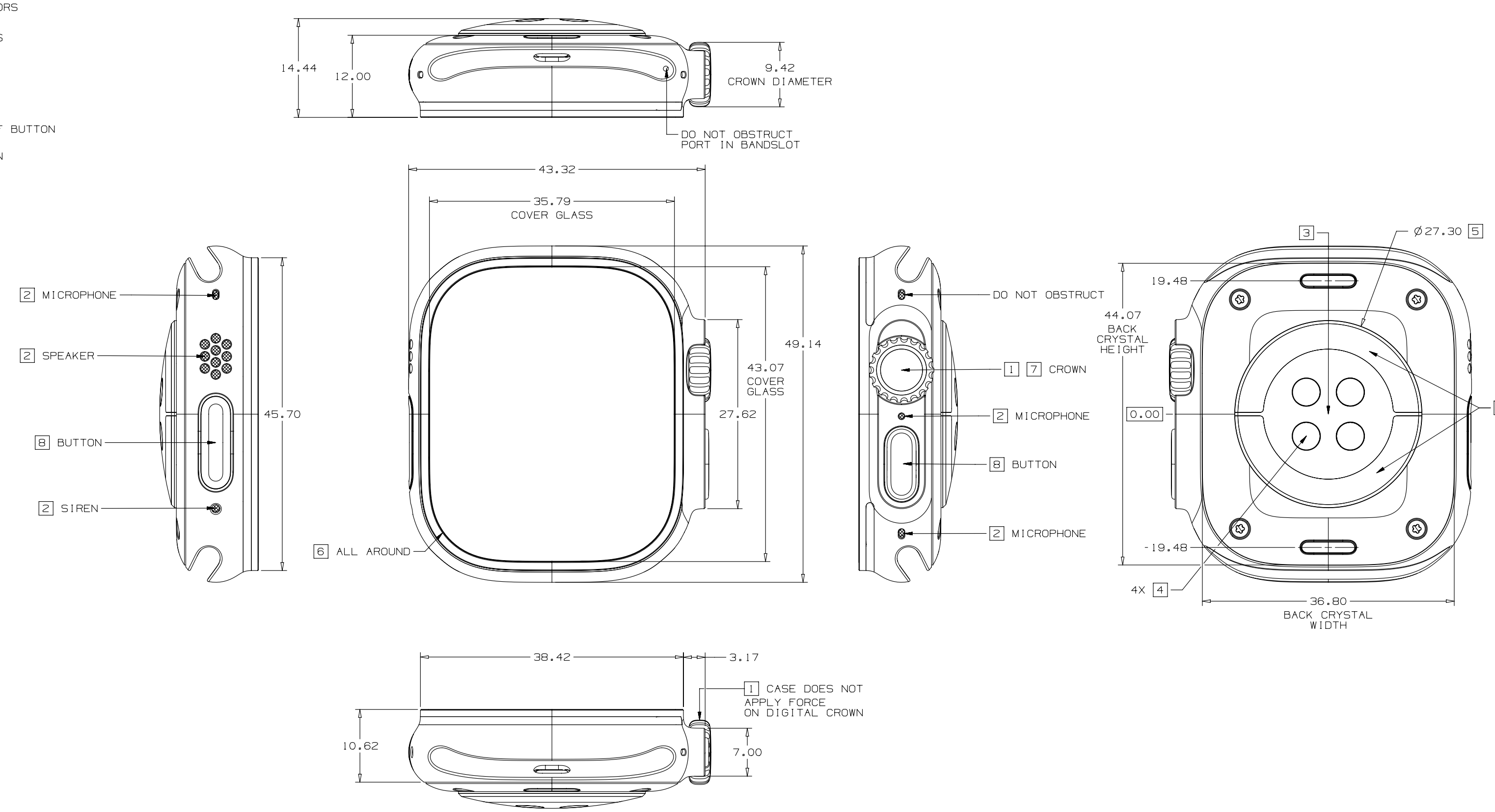
POINT	X	Y
A	0.00	21.03
B	0.02	13.03
C	0.35	8.42
D	1.57	5.03
E	3.19	2.95
F	5.33	1.40
G	8.78	0.29
H	13.22	0.01
I	18.22	0.00

POINT	Y	Z
S-A	6.83	9.70
S-B	5.61	9.69
S-C	4.32	9.60
S-D	3.05	9.29
S-E	1.86	8.63
S-F	0.88	7.61
S-G	0.23	6.31
S-H	0.00	4.85
S-I	0.23	3.39
S-K	0.88	2.09
S-J	1.86	1.07
S-L	3.05	0.41
S-M	4.32	0.10
S-N	5.61	0.01
S-O	6.83	0.00

OVERALL DIMENSIONS AND CALLOUTS

NOTES:

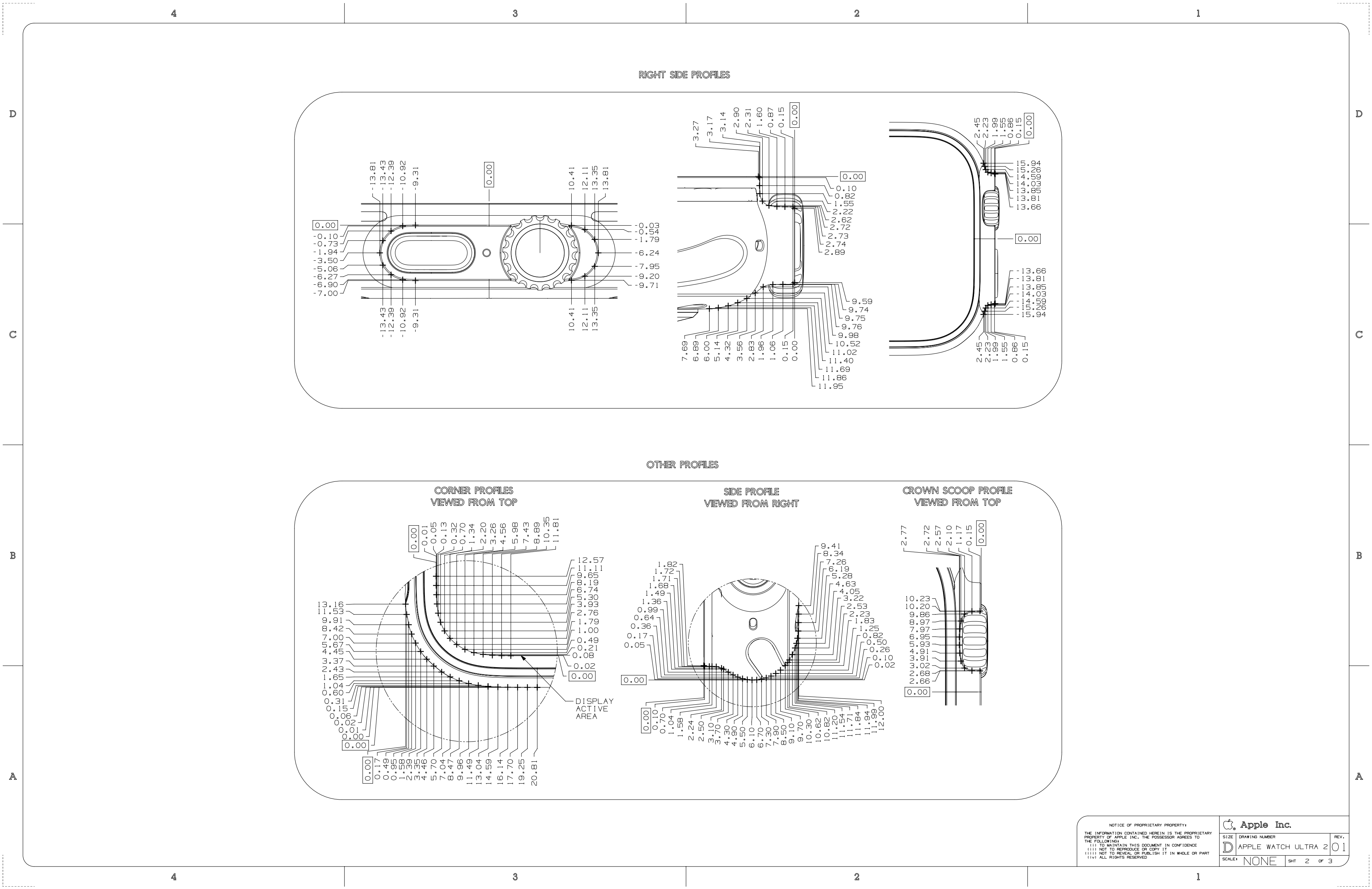
1. CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
   CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
   CASE DOES NOT OBSTRUCT FACE OF CROWN
2. CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
3. CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
4. CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
5. CASE DOES NOT EXTEND INTO WATCH SENSOR WINDOWS
6. CASE DOES NOT CONTACT THE WATCH COVER GLASS
7. CASE DOES NOT CONTACT ELECTRICAL SENSORS
8. CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
9. NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
10. CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL



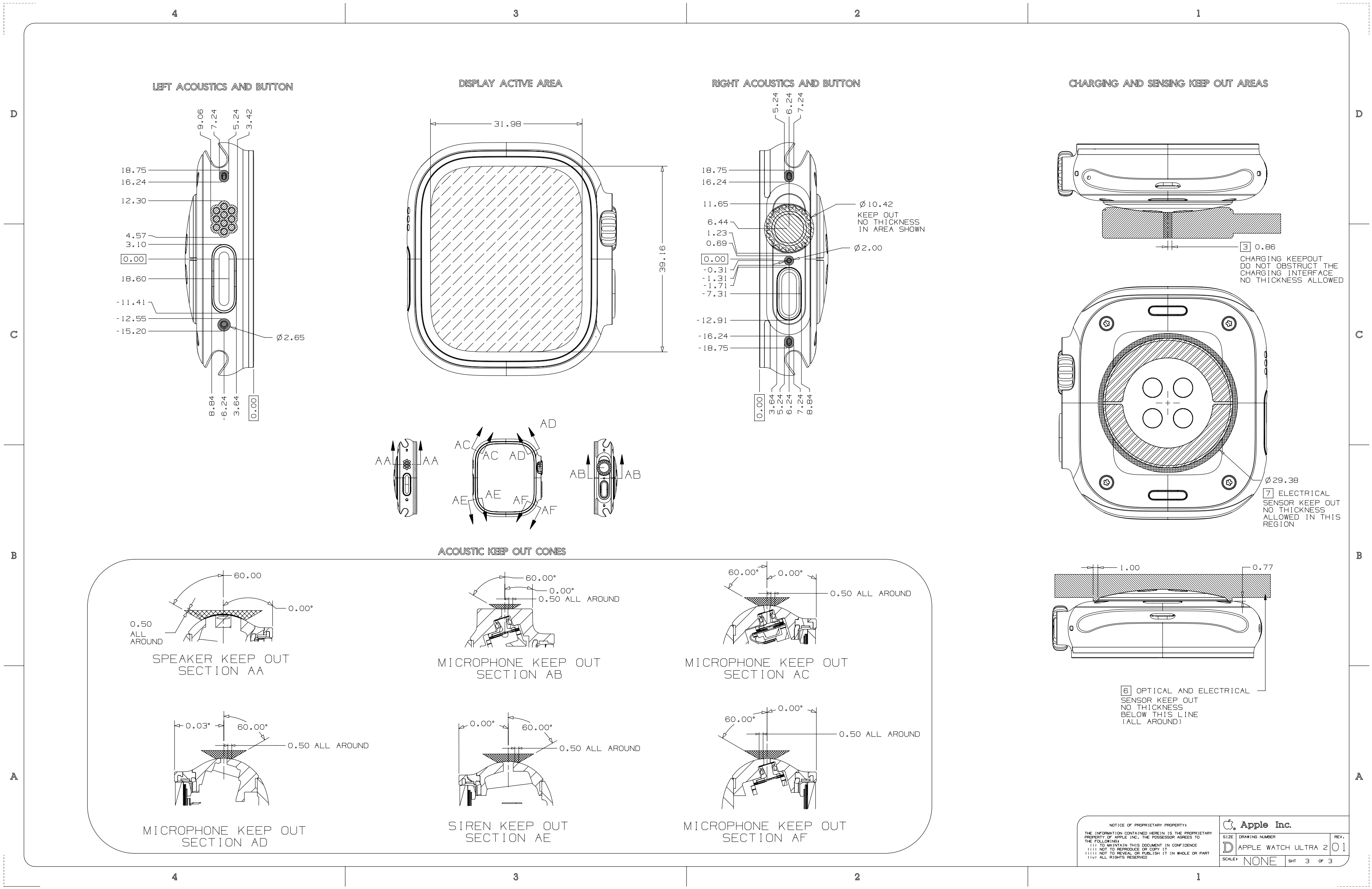
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED

Apple Inc.

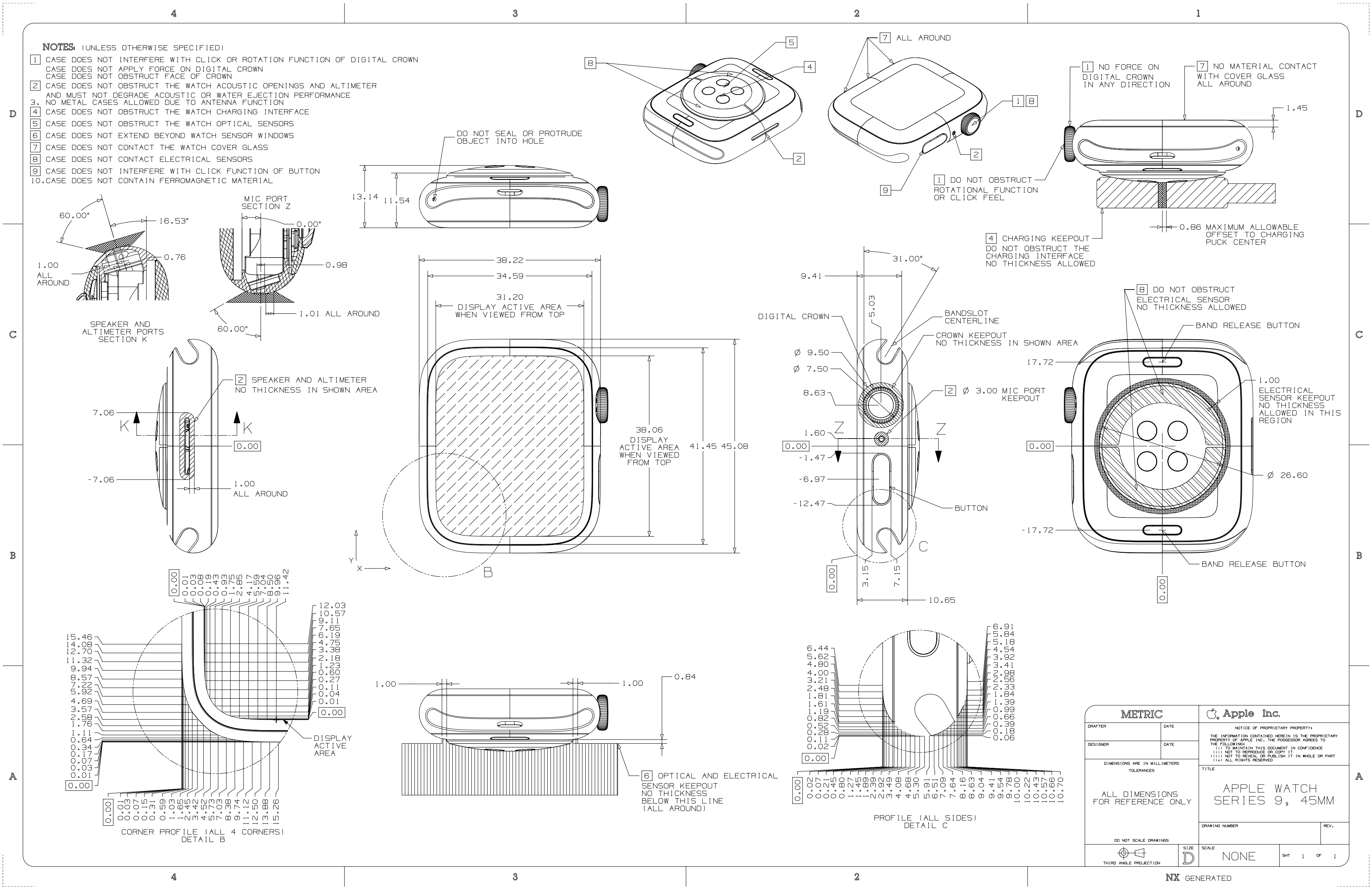
SIZE	DRAWING NUMBER	REV.
D	APPLE WATCH ULTRA 2	01
SCALE: NONE	SHT 1 OF 3	

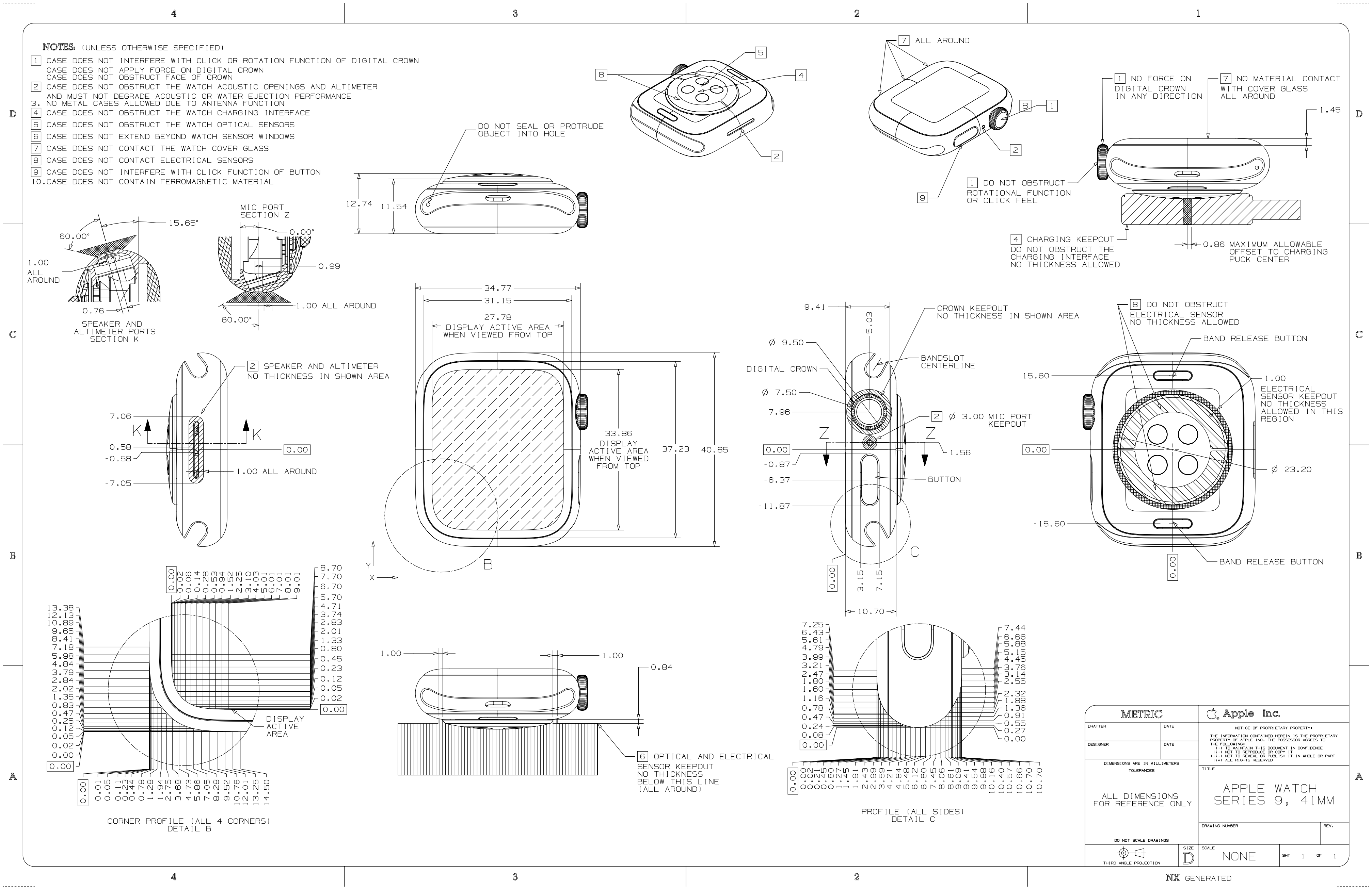

RIGHT SIDE PROFILES
OTHER PROFILES
CORNER PROFILES
VIEWED FROM TOP
SIDE PROFILE
VIEWED FROM RIGHT
CROWN SCOOP PROFILE
VIEWED FROM TOP
DISPLAY
ACTIVE
AREA
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE
DRAWING NUMBER
REV.
D
APPLE WATCH ULTRA 2
01
SCALE:
NONE
SHT 2 OF 3

60.212 Apple Watch Ultra 2, 3 of 3



60.213 Apple Watch Series 9, 45 mm

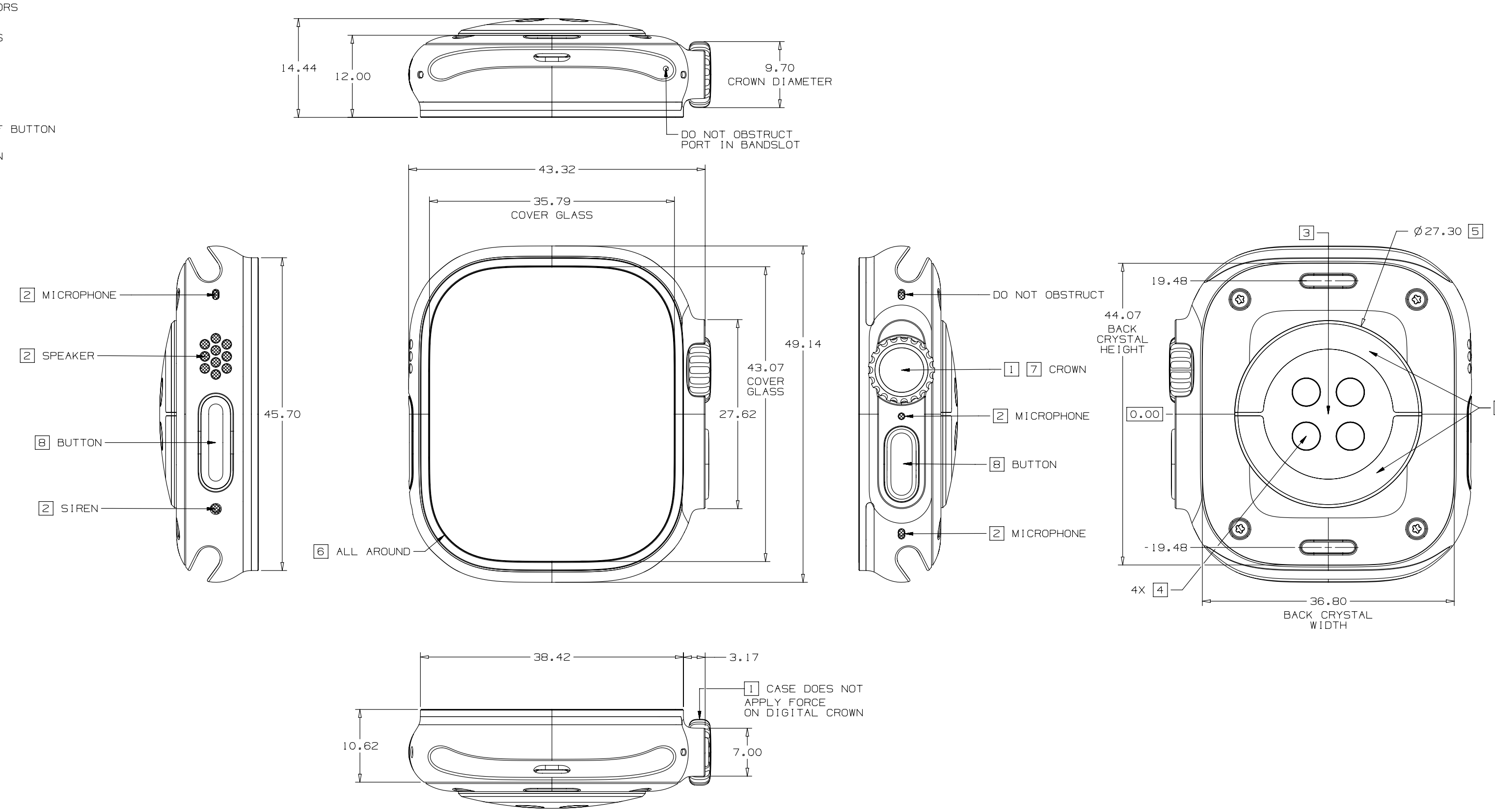



NOTES: (UNLESS OTHERWISE SPECIFIED)
1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
CASE DOES NOT OBSTRUCT FACE OF CROWN
2 CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER
AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
3. NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
4 CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
5 CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
6 CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
7 CASE DOES NOT CONTACT THE WATCH COVER GLASS
8 CASE DOES NOT CONTACT ELECTRICAL SENSORS
9 CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
10. CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL
7 ALL AROUND
DO NOT SEAL OR PROTRUDE OBJECT INTO HOLE
1 DO NOT OBSTRUCT ROTATIONAL FUNCTION OR CLICK FEEL
1 NO FORCE ON DIGITAL CROWN IN ANY DIRECTION
7 NO MATERIAL CONTACT WITH COVER GLASS ALL AROUND
4 CHARGING KEEPOUT DO NOT OBSTRUCT THE CHARGING INTERFACE NO THICKNESS ALLOWED
0.86 MAXIMUM ALLOWABLE OFFSET TO CHARGING PUCK CENTER
SPEAKER AND ALTIMETER PORTS SECTION K
MIC PORT SECTION Z
1.00 ALL AROUND
2 SPEAKER AND ALTIMETER NO THICKNESS IN SHOWN AREA
27.78 DISPLAY ACTIVE AREA WHEN VIEWED FROM TOP
33.86 DISPLAY ACTIVE AREA WHEN VIEWED FROM TOP
CROWN KEEPOUT NO THICKNESS IN SHOWN AREA
DIGITAL CROWN
BANDSLOT CENTERLINE
2 Ø 3.00 MIC PORT KEEPOUT
BUTTON
8 DO NOT OBSTRUCT ELECTRICAL SENSOR NO THICKNESS ALLOWED
BAND RELEASE BUTTON
ELECTRICAL SENSOR KEEPOUT NO THICKNESS ALLOWED IN THIS REGION
Ø 23.20
DISPLAY ACTIVE AREA
CORNER PROFILE (ALL 4 CORNERS) DETAIL B
6 OPTICAL AND ELECTRICAL SENSOR KEEPOUT NO THICKNESS BELOW THIS LINE (ALL AROUND)
PROFILE (ALL SIDES) DETAIL C
METRIC
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
DIMENSIONS ARE IN MILLIMETERS
ALL DIMENSIONS FOR REFERENCE ONLY
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
TITLE
APPLE WATCH SERIES 9, 41MM
SIZE D
SCALE NONE
SHT 1 OF 1
NX GENERATED

NOTES:

1. CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
CASE DOES NOT OBSTRUCT FACE OF CROWN
2. CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
3. CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
4. CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
5. CASE DOES NOT EXTEND INTO WATCH SENSOR WINDOWS
6. CASE DOES NOT CONTACT THE WATCH COVER GLASS
7. CASE DOES NOT CONTACT ELECTRICAL SENSORS
8. CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
9. NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
10. CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL

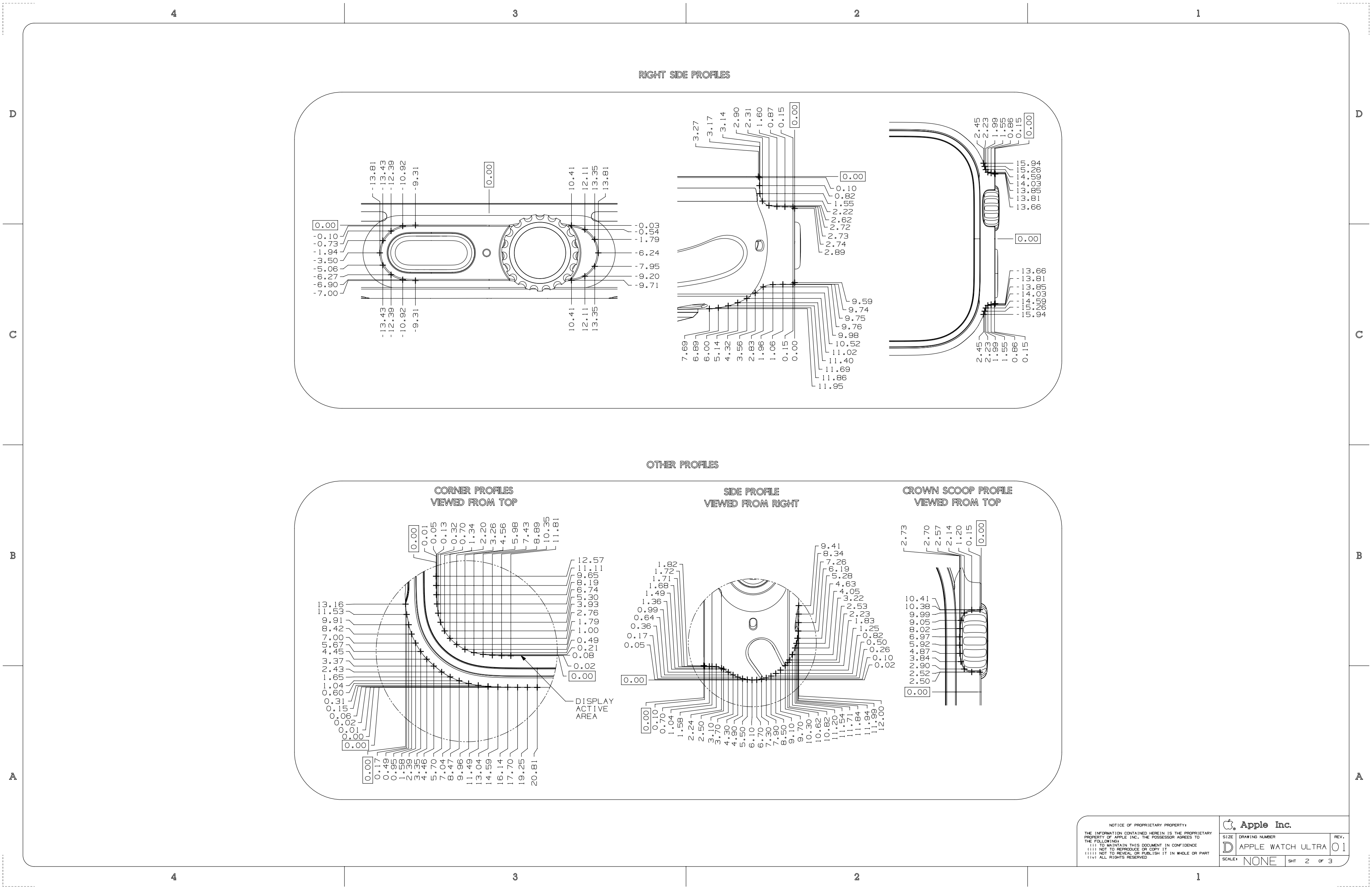
OVERALL DIMENSIONS AND CALLOUTS



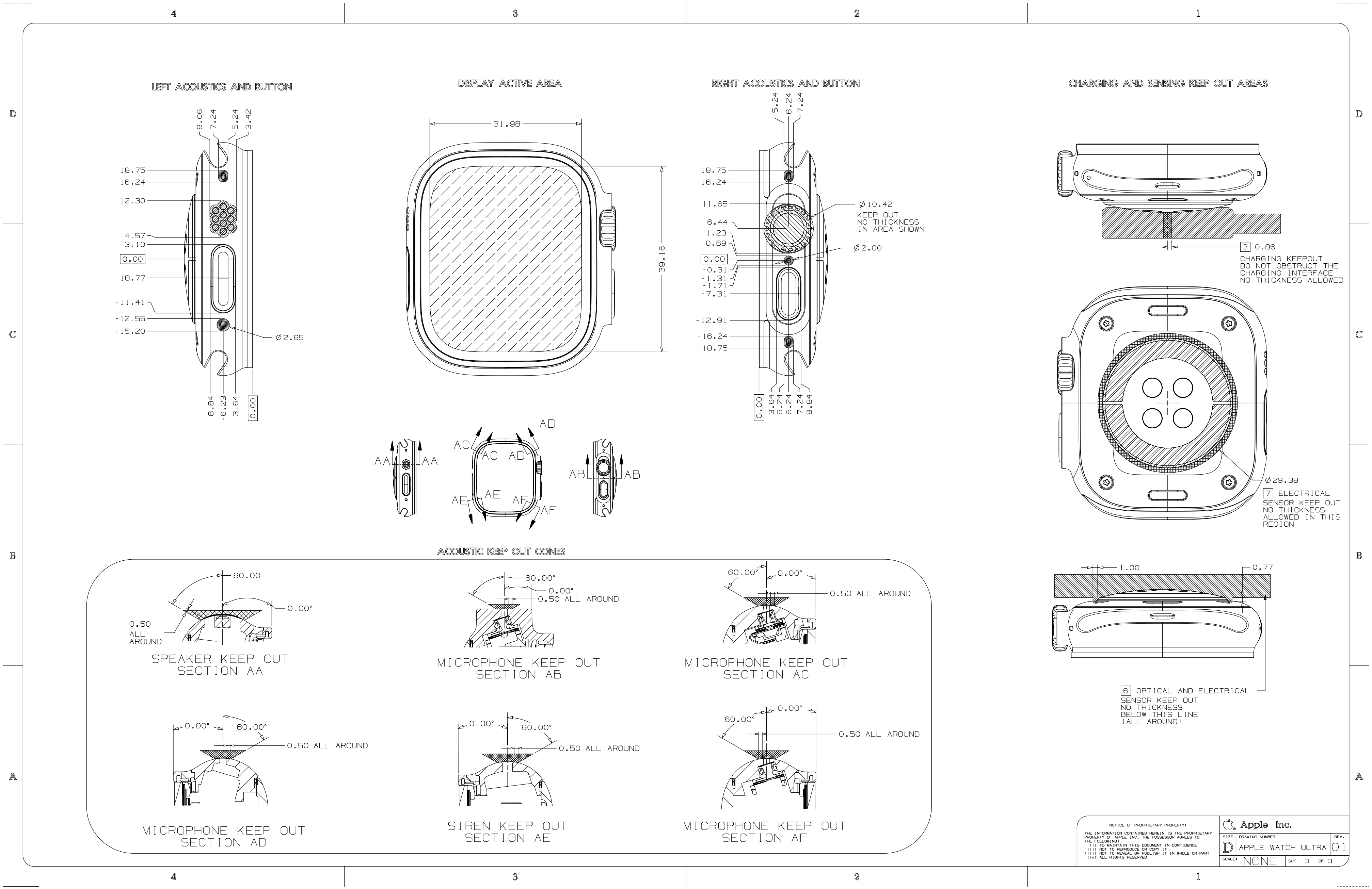
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED

Apple Inc.

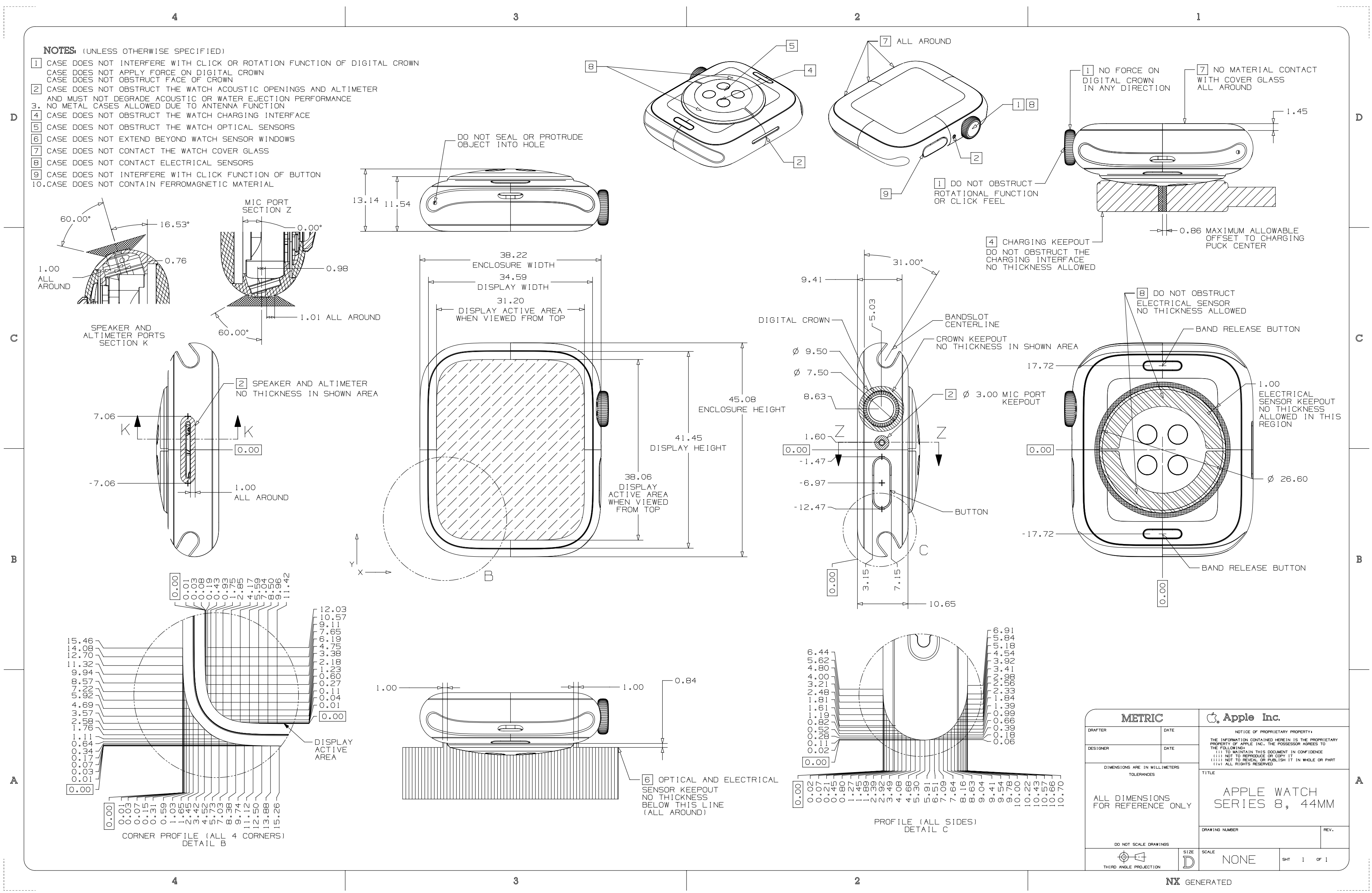
SIZE	DRAWING NUMBER	REV.
D	APPLE WATCH ULTRA	01
SCALE: NONE	SHT 1 OF 3	


RIGHT SIDE PROFILES
OTHER PROFILES
CORNER PROFILES
VIEWED FROM TOP
SIDE PROFILE
VIEWED FROM RIGHT
CROWN SCOOP PROFILE
VIEWED FROM TOP
DISPLAY
ACTIVE
AREA
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
APPLE WATCH ULTRA
REV. 01
SCALE: NONE
SHT 2 OF 3

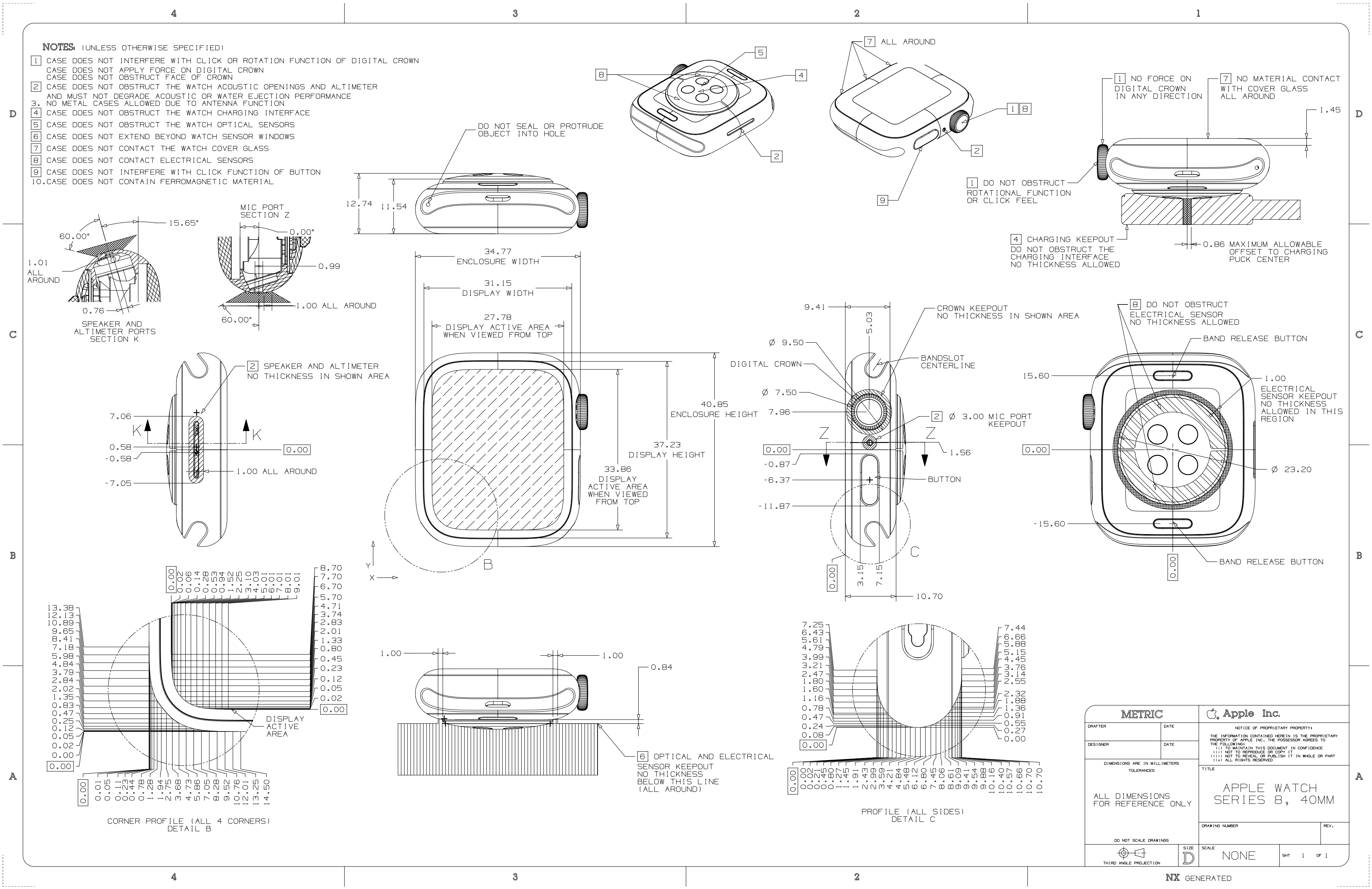
60.217 Apple Watch Ultra, 3 of 3



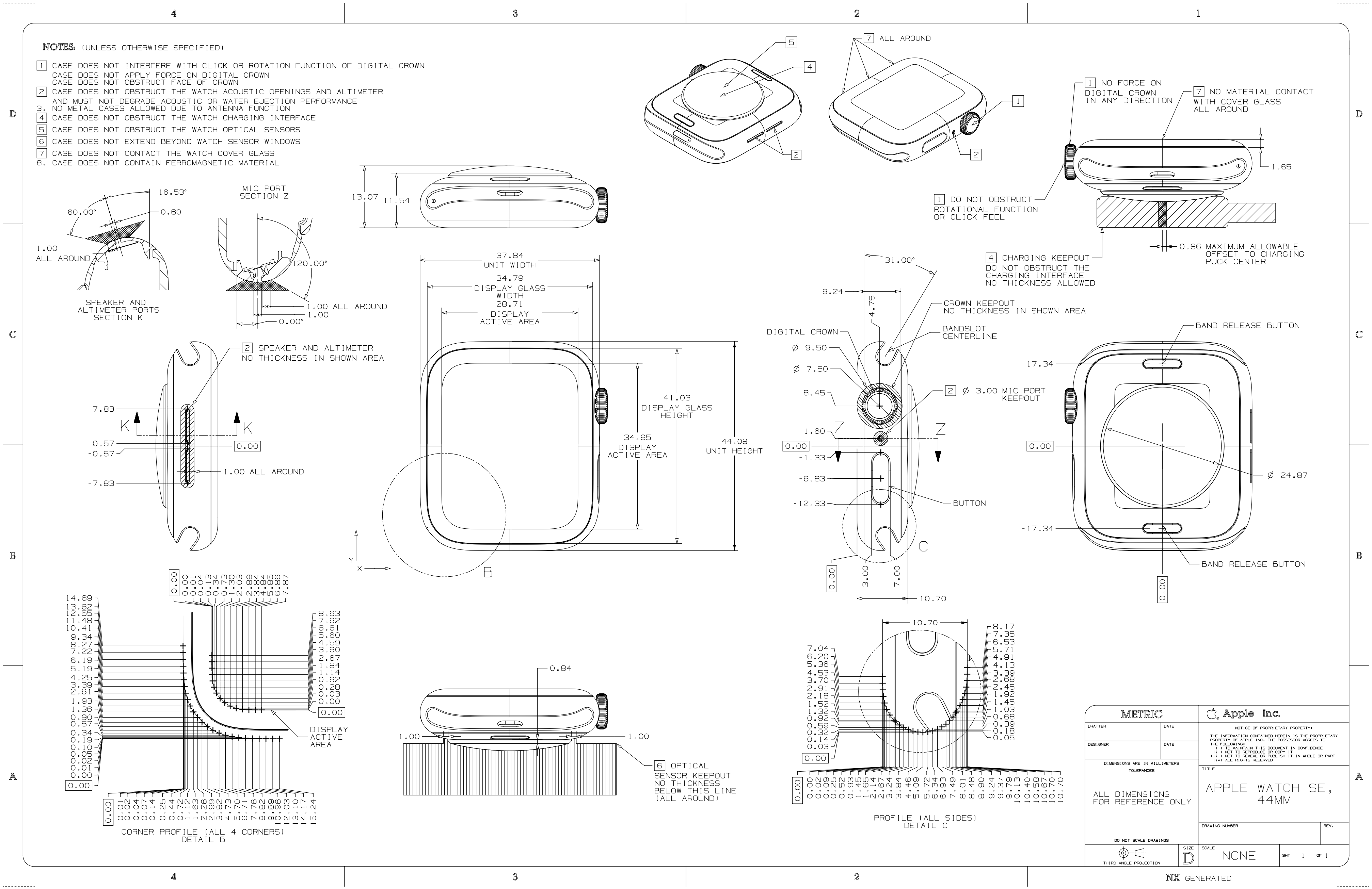
60.218 Apple Watch Series 8, 45 mm



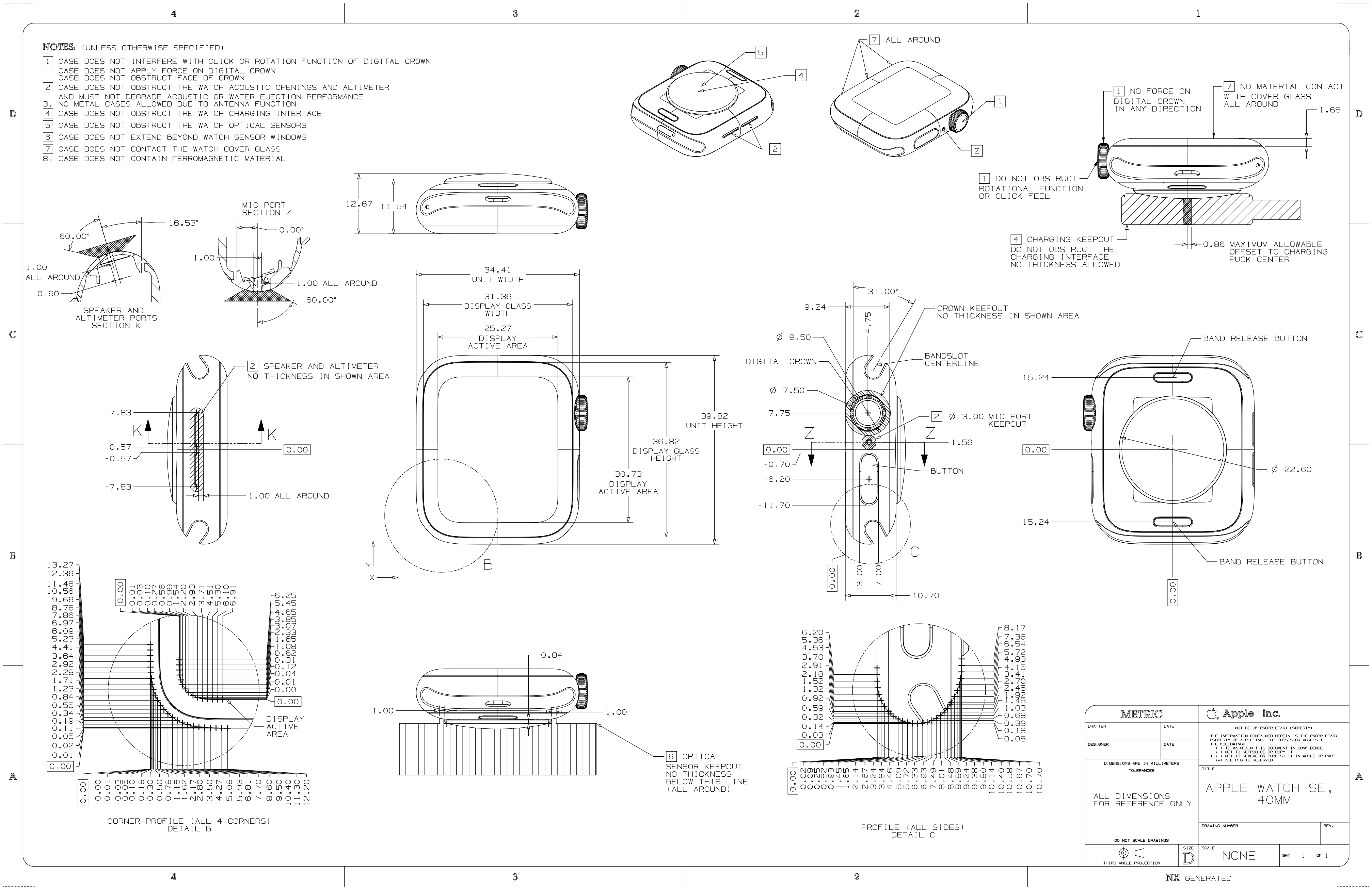
60.219 Apple Watch Series 8, 41 mm

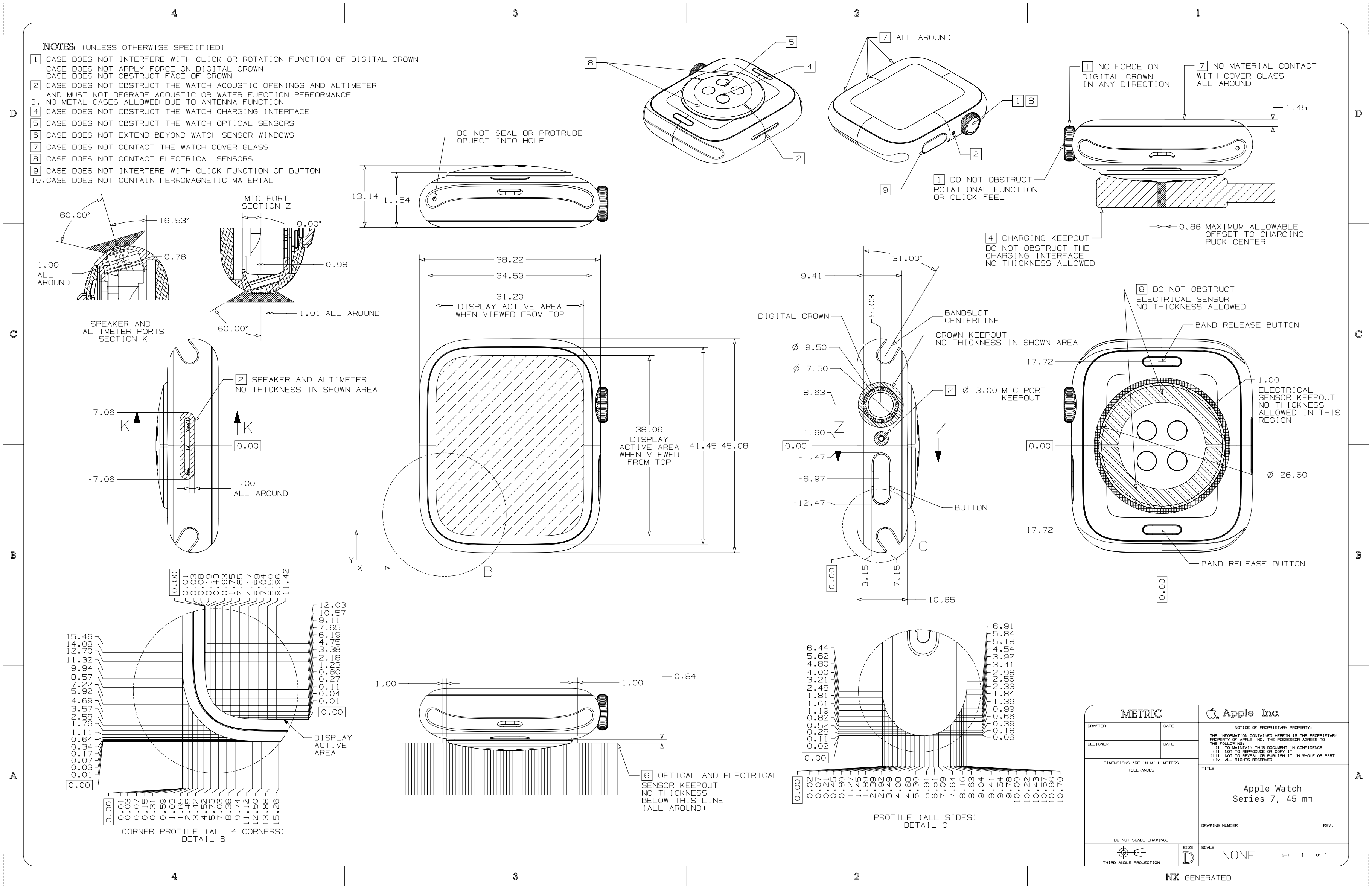


60.220 Apple Watch SE, 44 mm

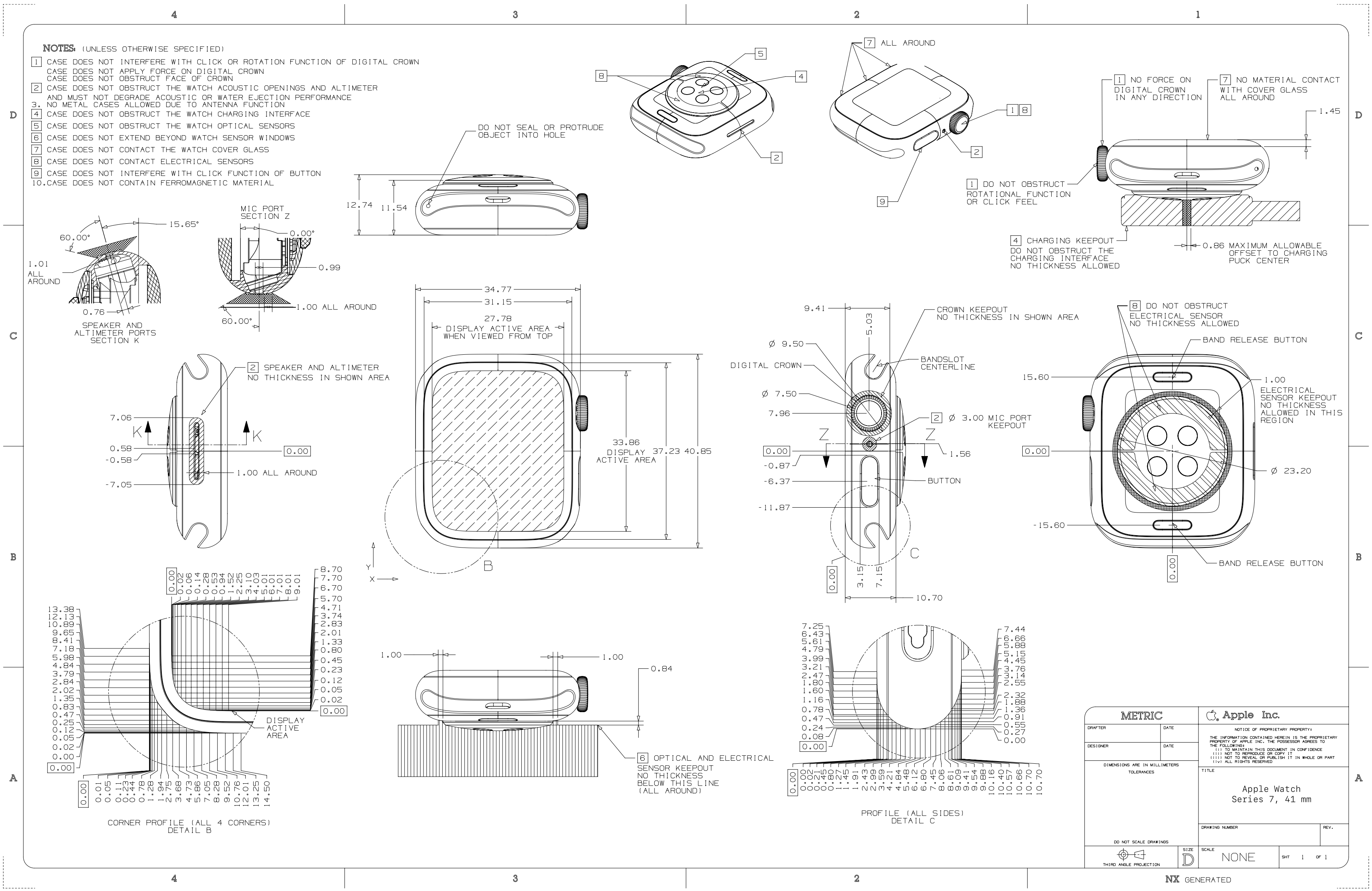


60.221 Apple Watch SE, 40 mm

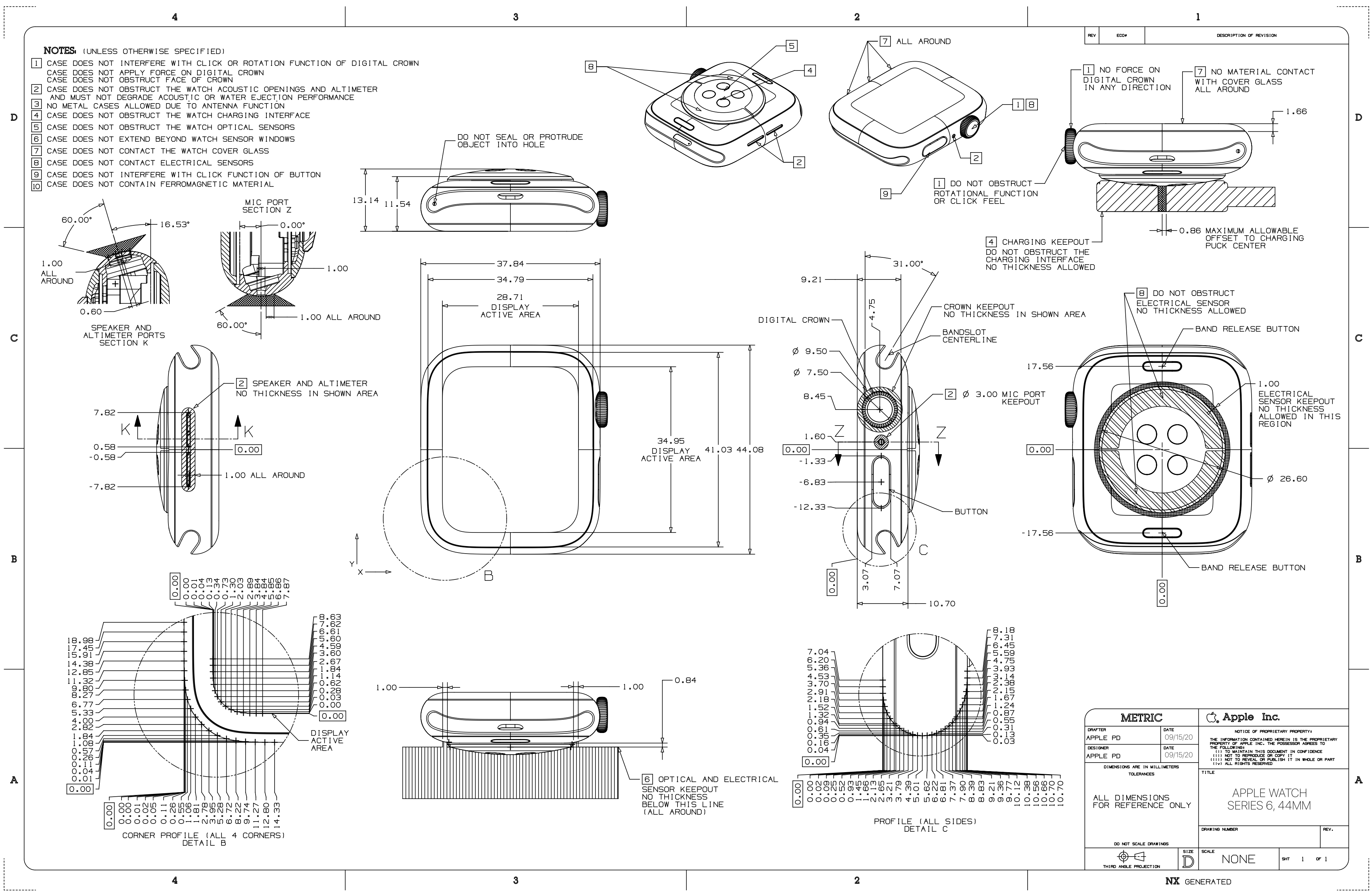



NOTES: (UNLESS OTHERWISE SPECIFIED)
1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
CASE DOES NOT OBSTRUCT FACE OF CROWN
2 CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER
AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
3. NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
4 CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
5 CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
6 CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
7 CASE DOES NOT CONTACT THE WATCH COVER GLASS
8 CASE DOES NOT CONTACT ELECTRICAL SENSORS
9 CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
10. CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL
7 ALL AROUND
1 NO FORCE ON DIGITAL CROWN IN ANY DIRECTION
7 NO MATERIAL CONTACT WITH COVER GLASS ALL AROUND
1 DO NOT OBSTRUCT ROTATIONAL FUNCTION OR CLICK FEEL
DO NOT SEAL OR PROTRUDE OBJECT INTO HOLE
4 CHARGING KEEPOUT DO NOT OBSTRUCT THE CHARGING INTERFACE NO THICKNESS ALLOWED
0.86 MAXIMUM ALLOWABLE OFFSET TO CHARGING PUCK CENTER
MIC PORT SECTION Z
SPEAKER AND ALTIMETER PORTS SECTION K
1.00 ALL AROUND
1.01 ALL AROUND
2 SPEAKER AND ALTIMETER NO THICKNESS IN SHOWN AREA
DISPLAY ACTIVE AREA WHEN VIEWED FROM TOP
DIGITAL CROWN
BANDSLOT CENTERLINE
CROWN KEEPOUT NO THICKNESS IN SHOWN AREA
2 Ø 3.00 MIC PORT KEEPOUT
BUTTON
8 DO NOT OBSTRUCT ELECTRICAL SENSOR NO THICKNESS ALLOWED
BAND RELEASE BUTTON
1.00 ELECTRICAL SENSOR KEEPOUT NO THICKNESS ALLOWED IN THIS REGION
Ø 26.60
DISPLAY ACTIVE AREA
CORNER PROFILE (ALL 4 CORNERS) DETAIL B
6 OPTICAL AND ELECTRICAL SENSOR KEEPOUT NO THICKNESS BELOW THIS LINE (ALL AROUND)
PROFILE (ALL SIDES) DETAIL C
METRIC
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY
DIMENSIONS ARE IN MILLIMETERS
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
TITLE
Apple Watch Series 7, 45 mm
SCALE NONE
SIZE D
NX GENERATED

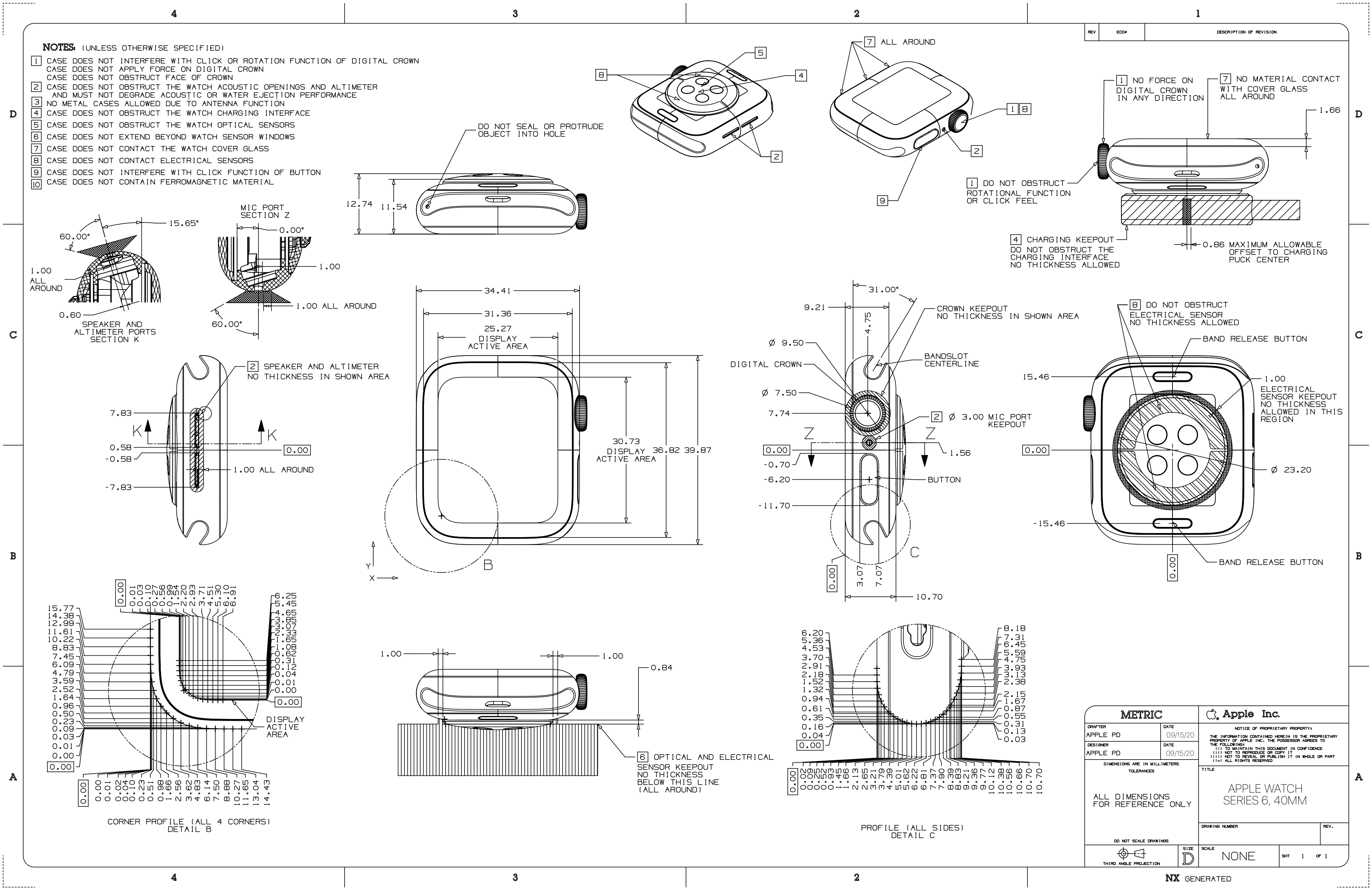
60.223 Apple Watch Series 7, 41 mm



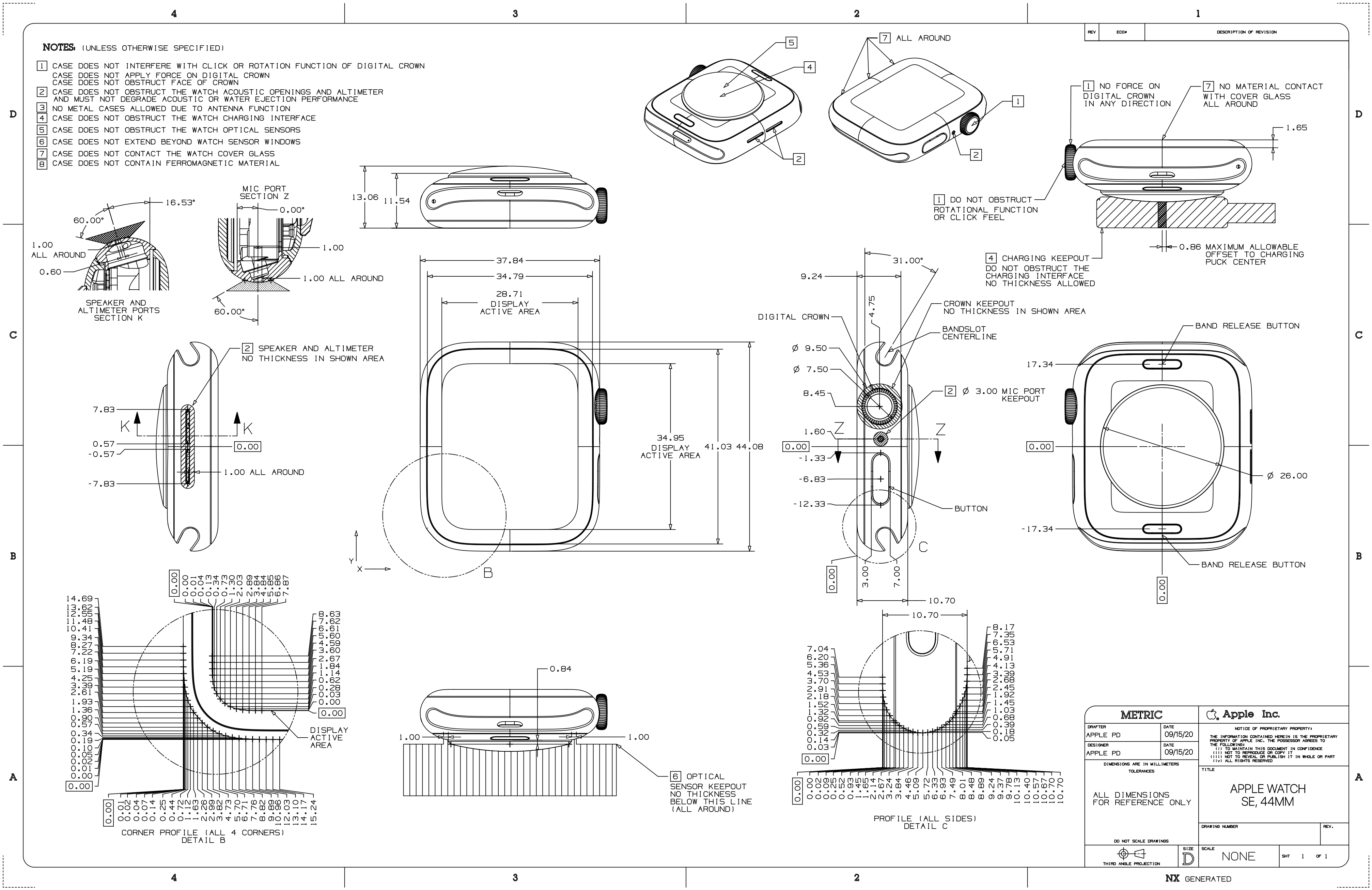
60.224 Apple Watch Series 6, 44 mm



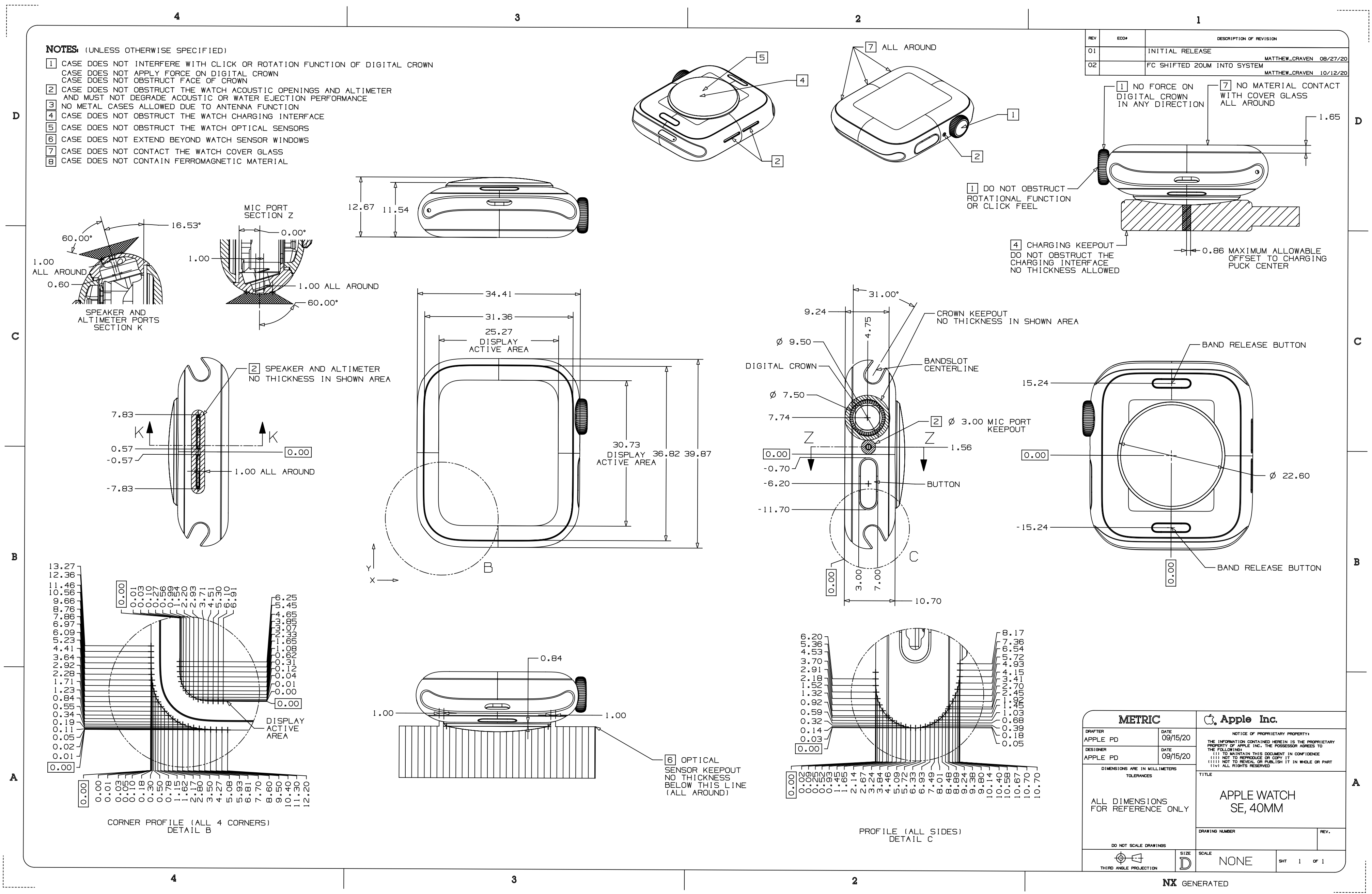
60.225 Apple Watch Series 6, 40 mm



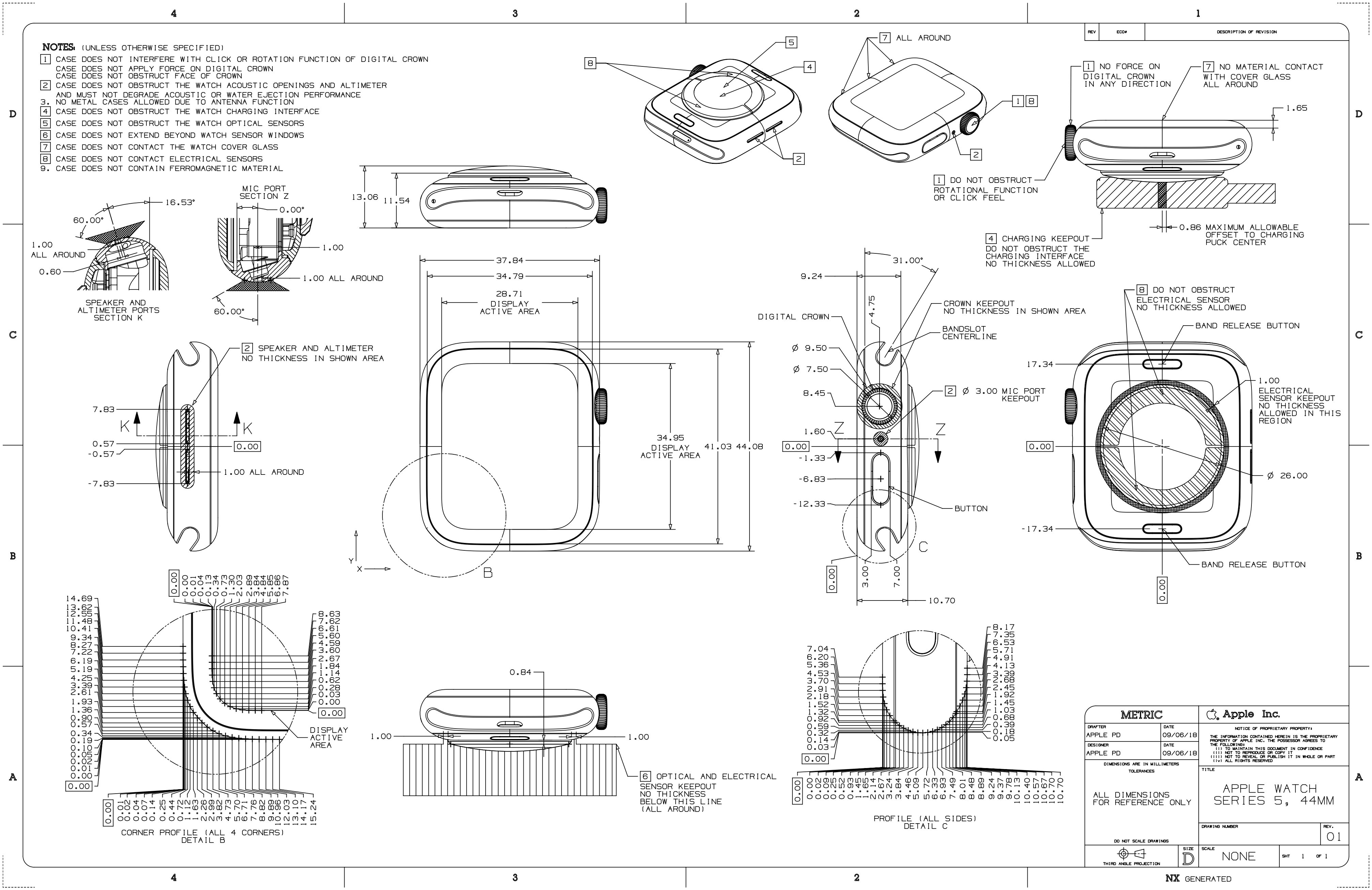
60.226 Apple Watch SE (1st generation), 44 mm



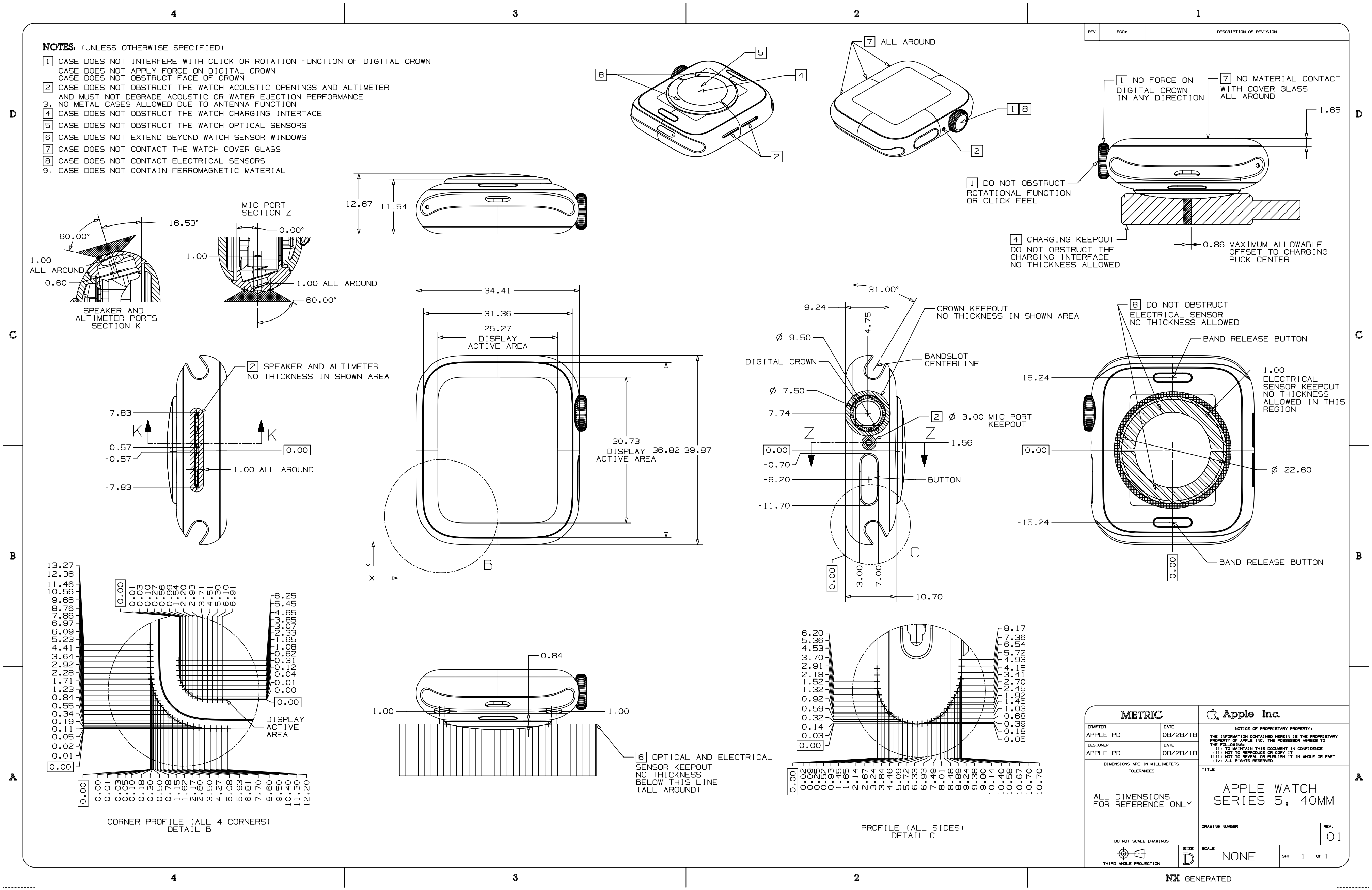
60.227 Apple Watch SE (1st generation), 40 mm



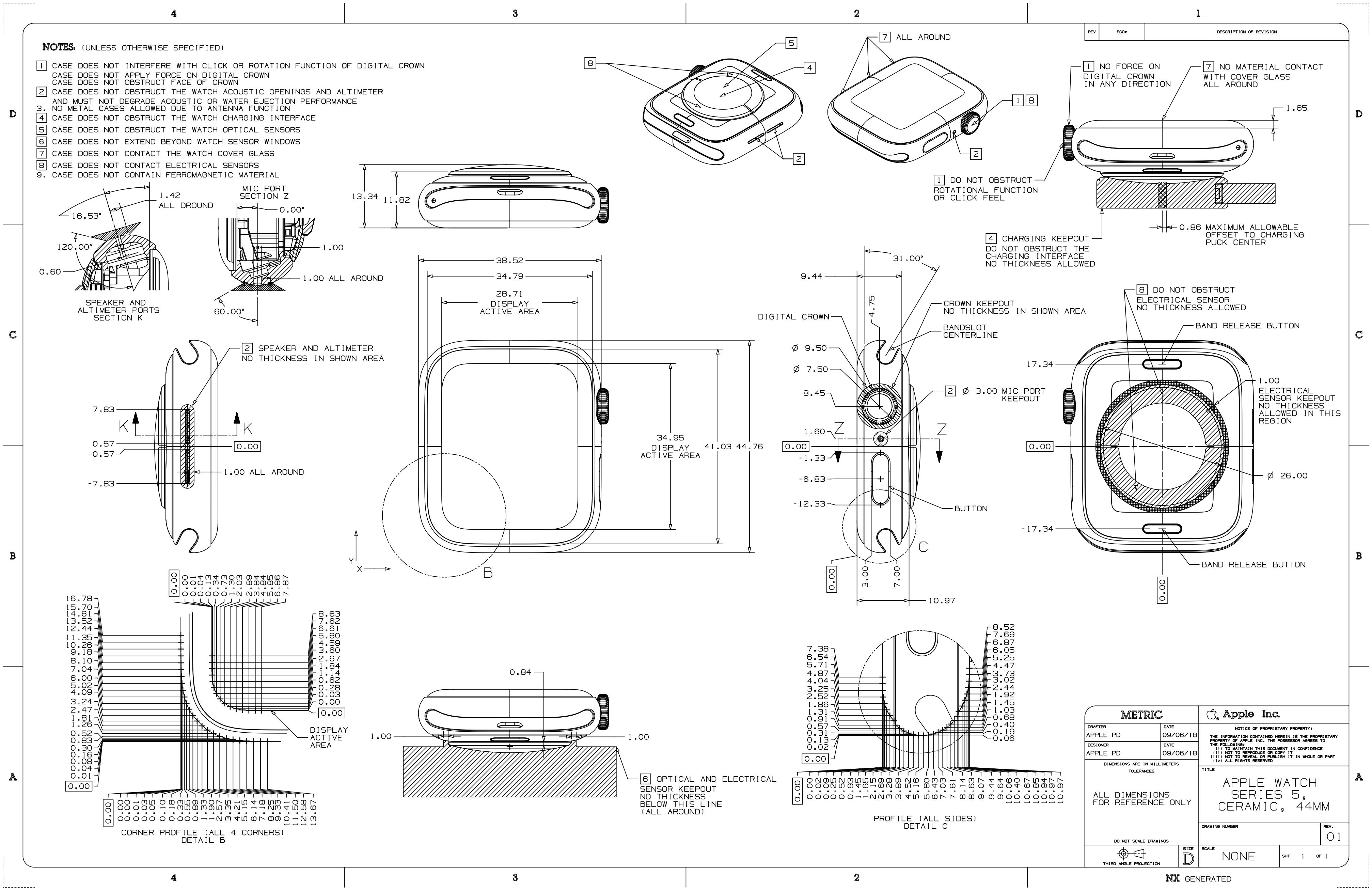
60.228 Apple Watch Series 5, 44 mm



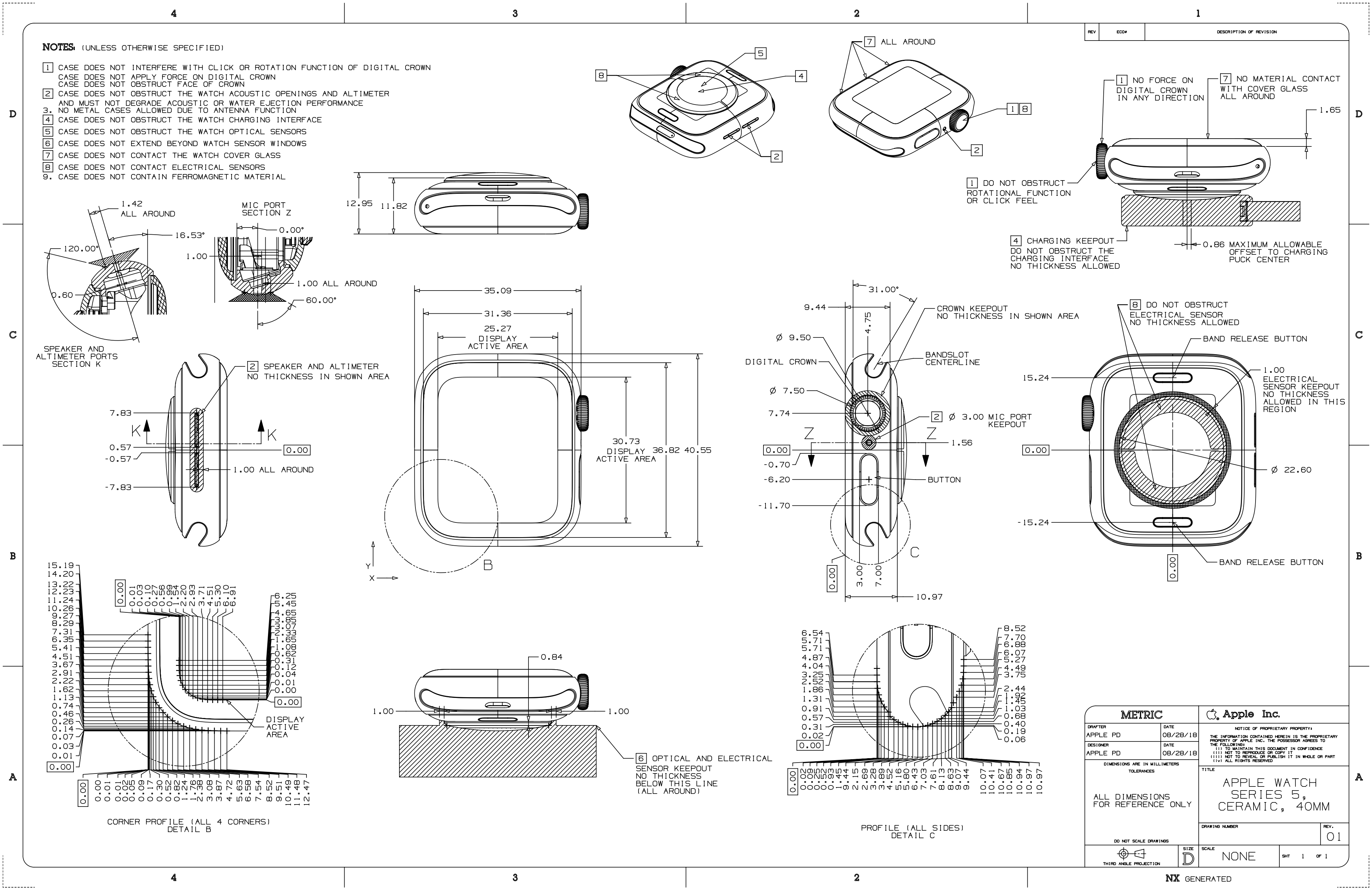
60.229 Apple Watch Series 5, 40 mm



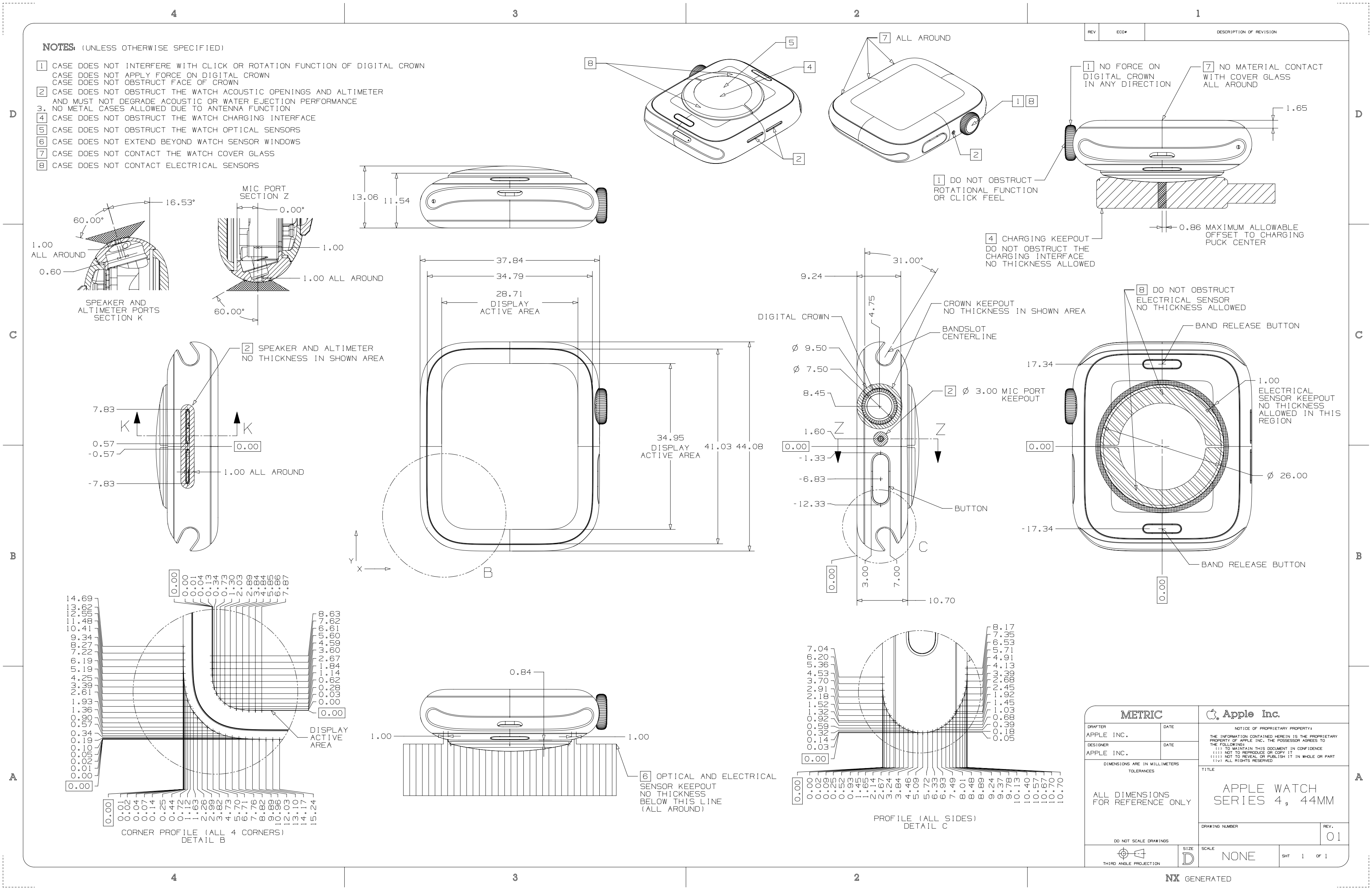
60.230 Apple Watch Series 5 Ceramic, 44 mm



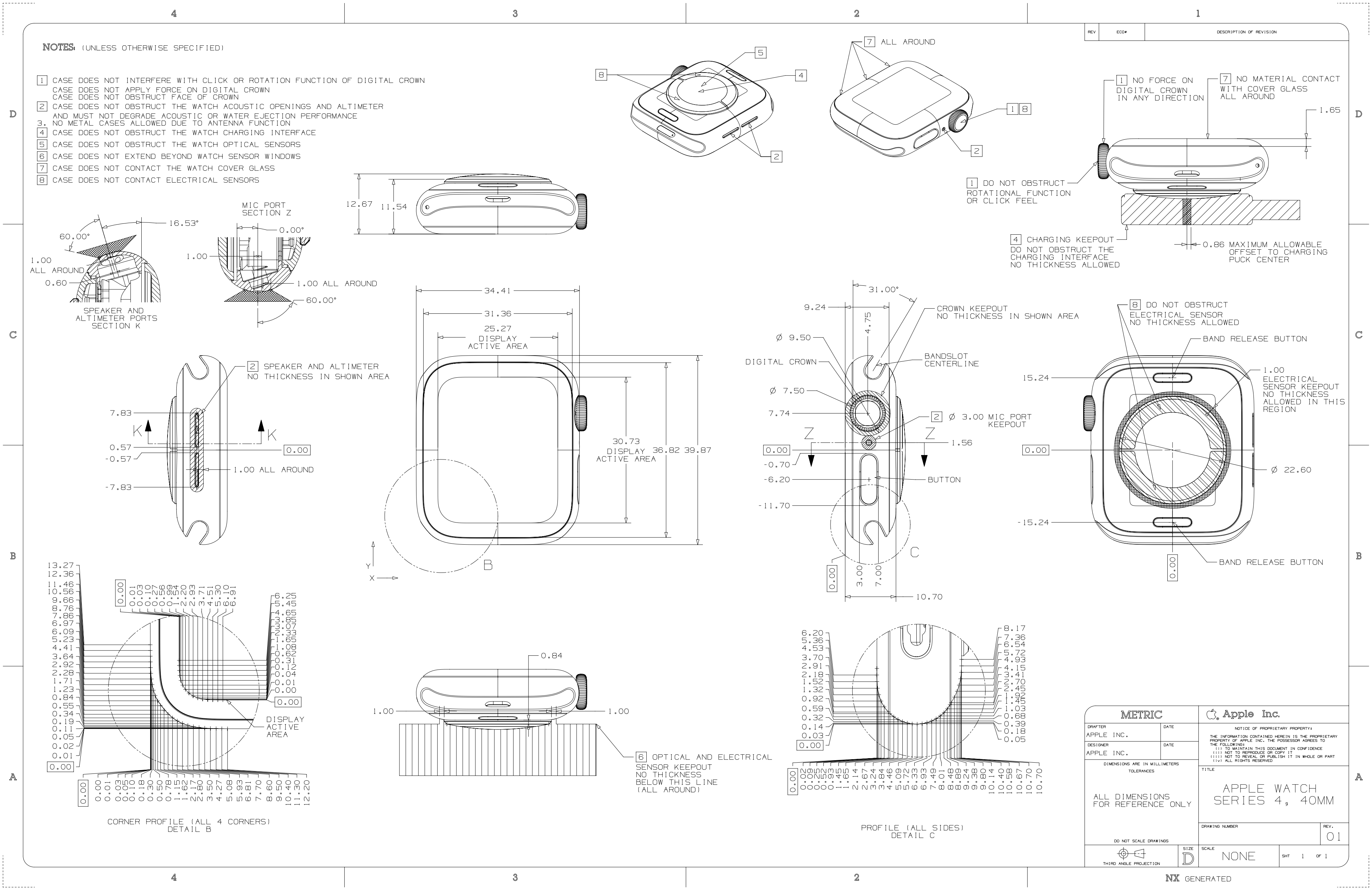
60.231 Apple Watch Series 5 Ceramic, 40 mm



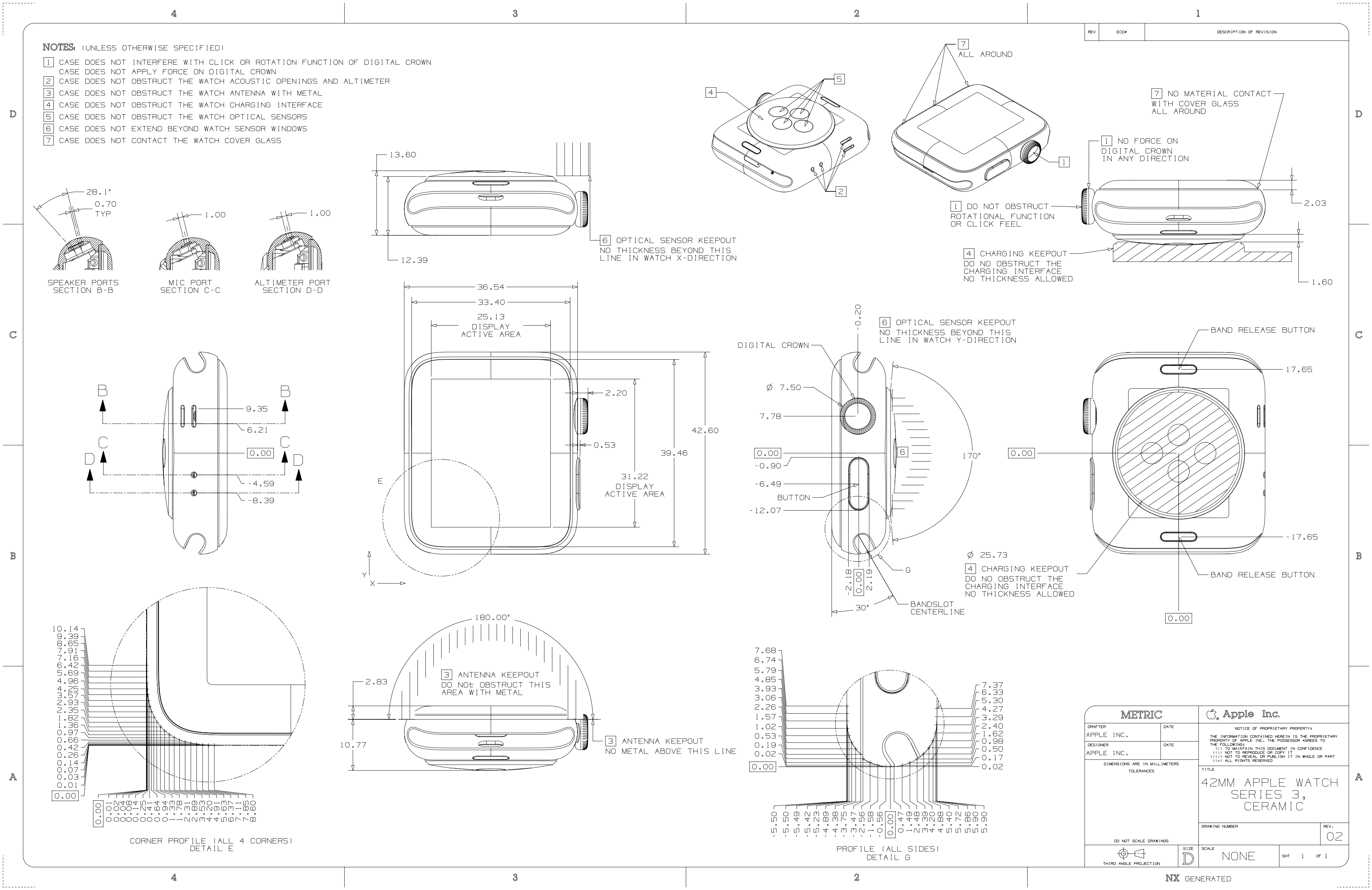
60.232 Apple Watch Series 4, 44 mm



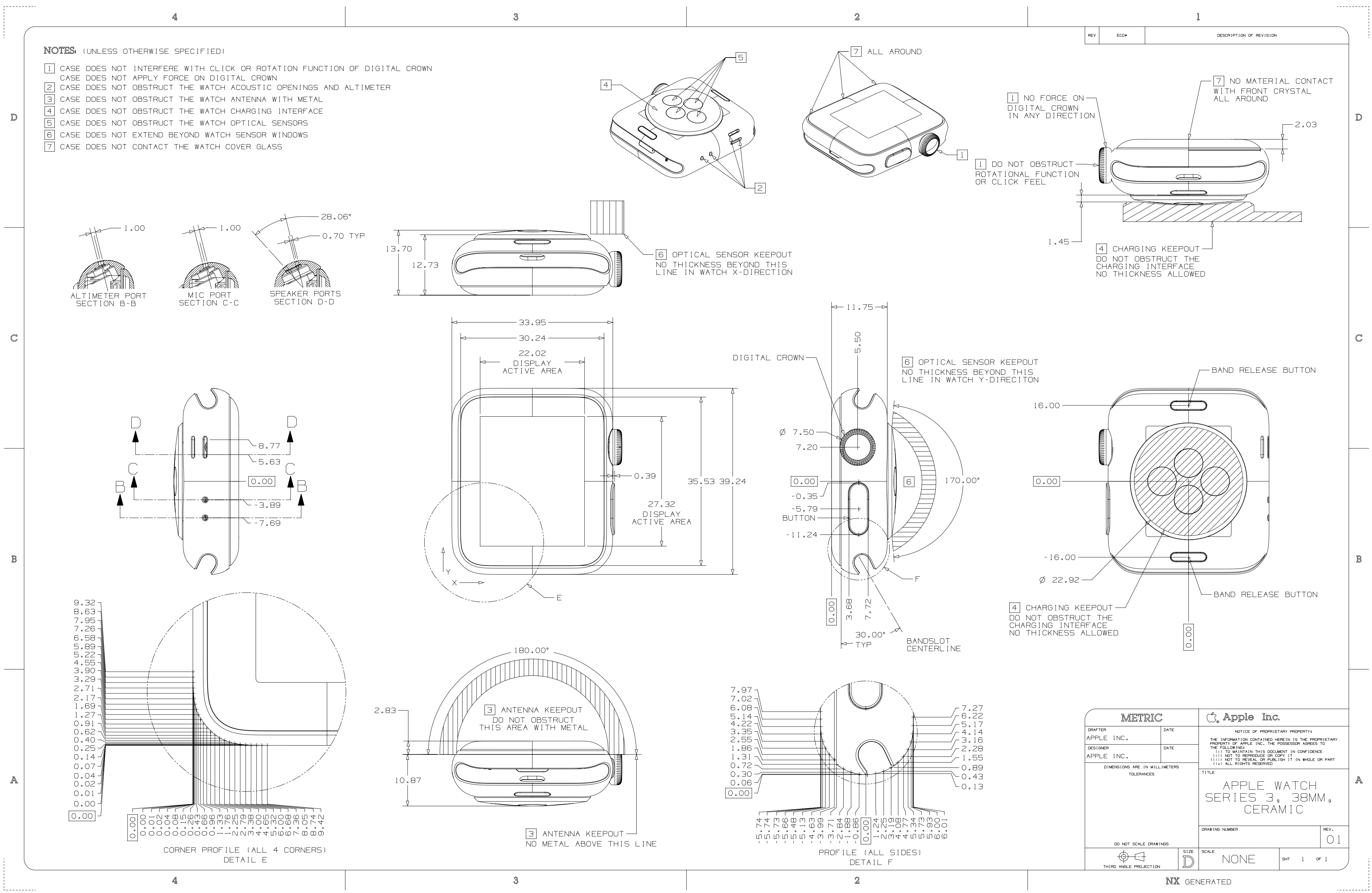
60.233 Apple Watch Series 4, 40 mm



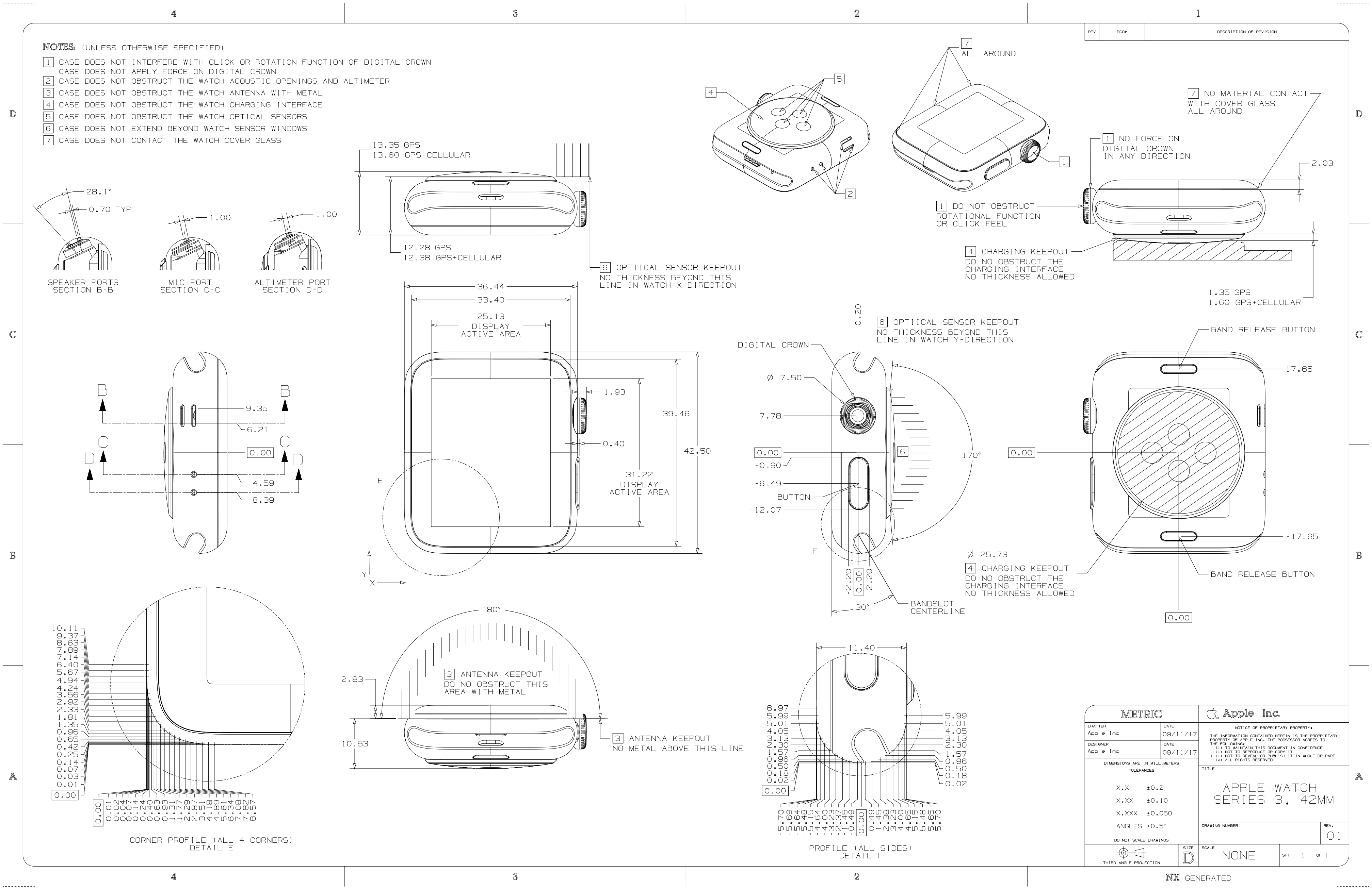
60.234 Apple Watch Series 3 Ceramic, 42 mm



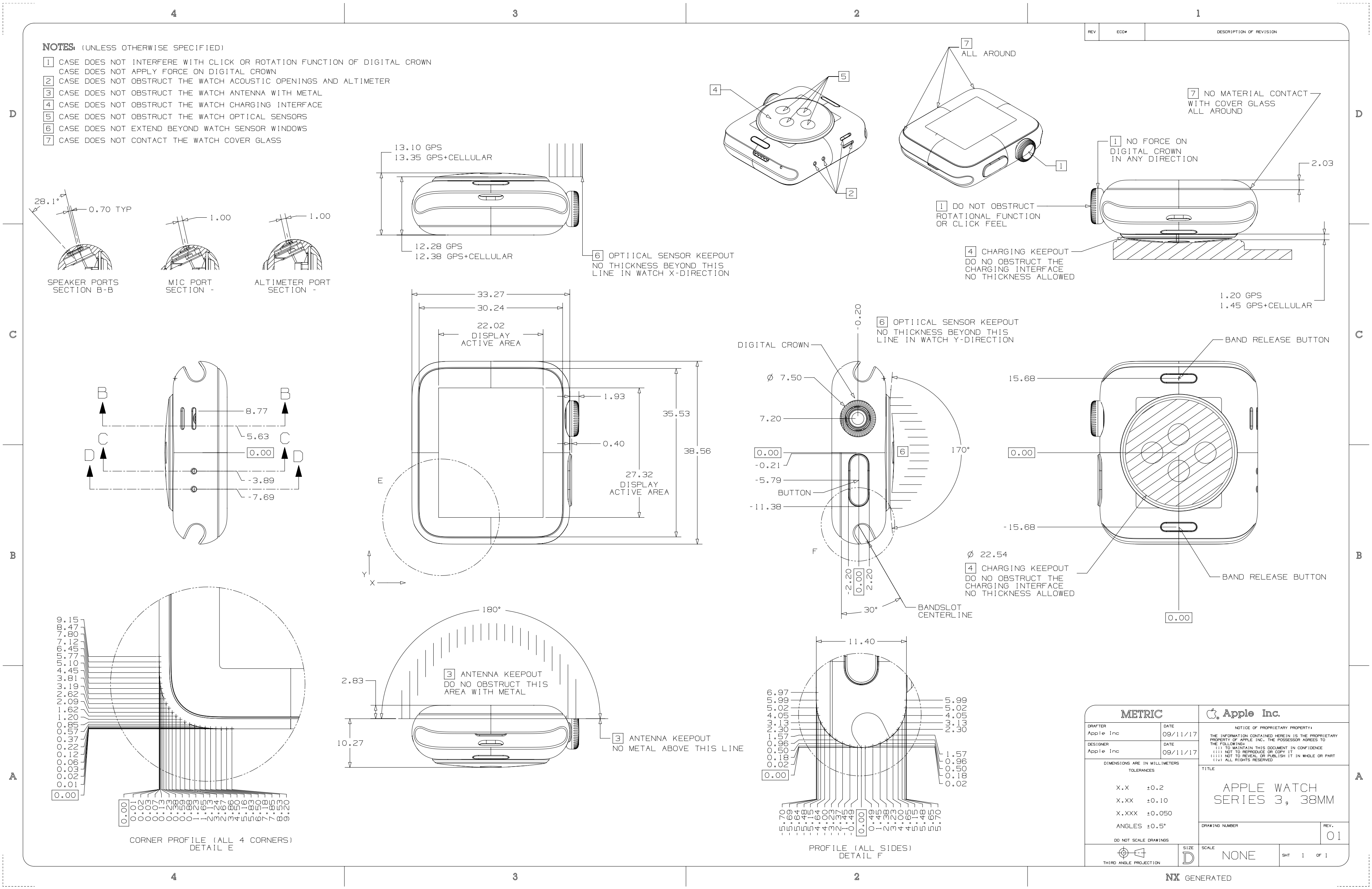
60.235 Apple Watch Series 3 Ceramic, 38 mm



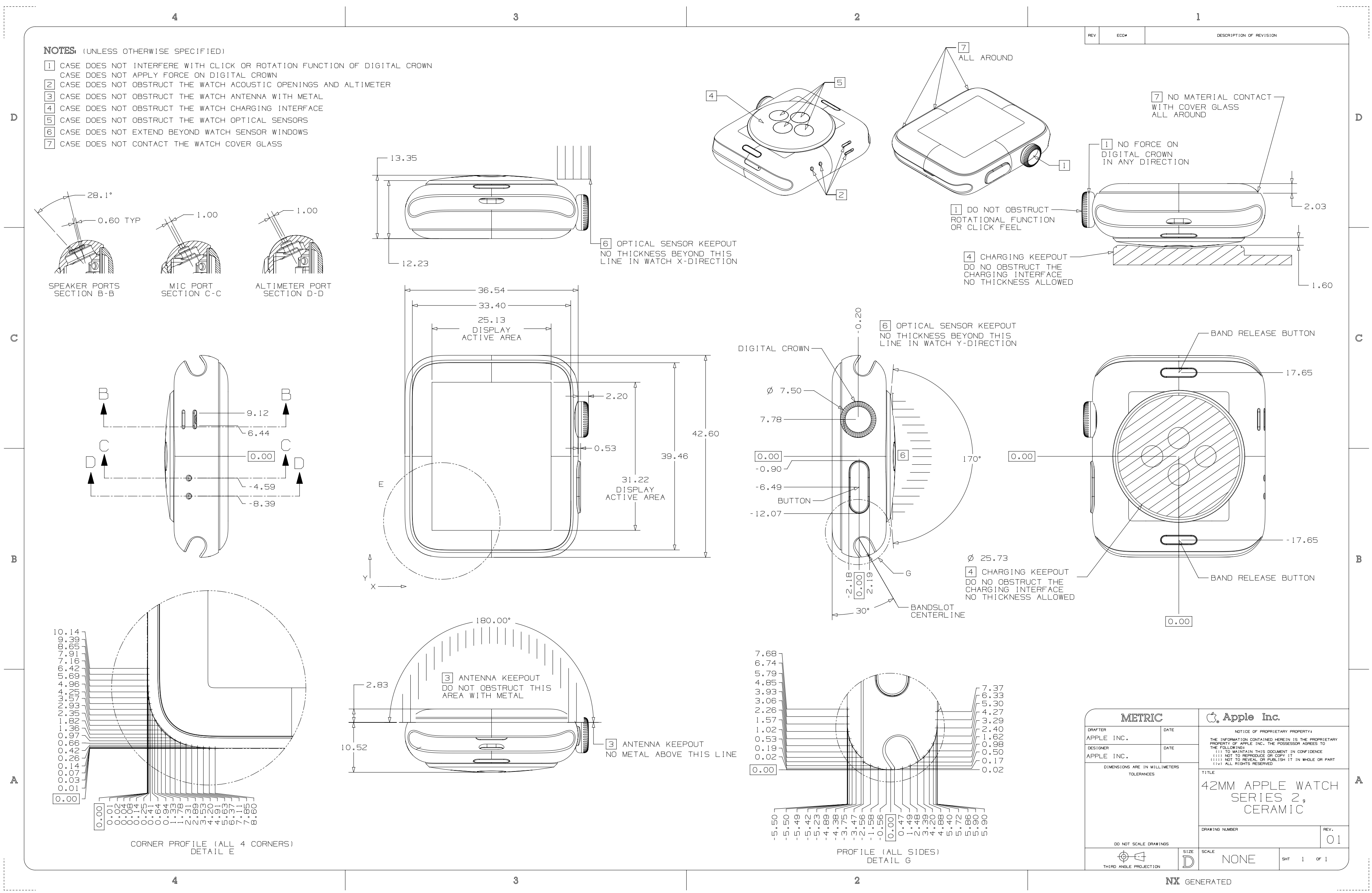
60.236 Apple Watch Series 3 Metal, 42 mm



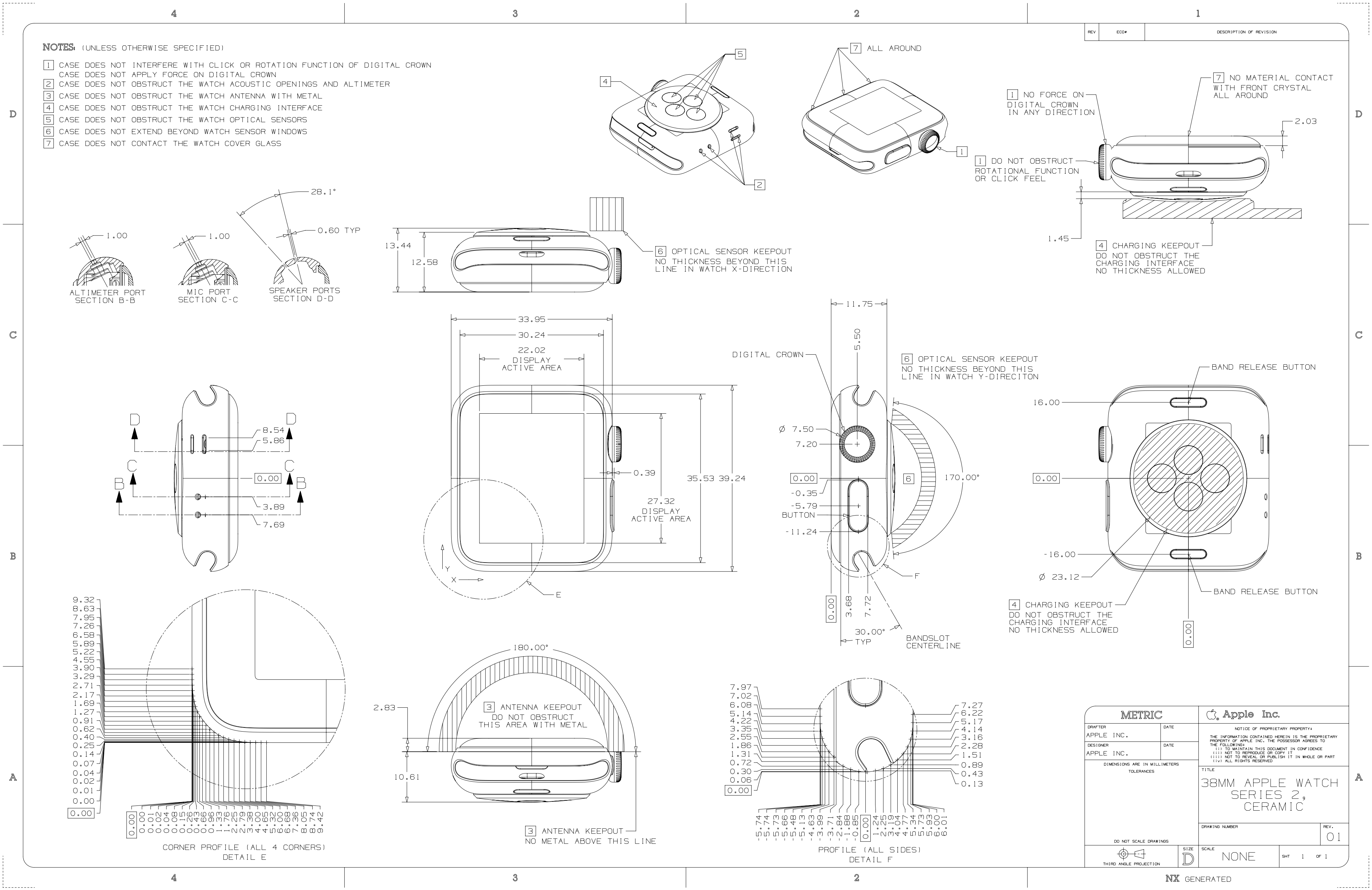
60.237 Apple Watch Series 3 Metal, 38 mm



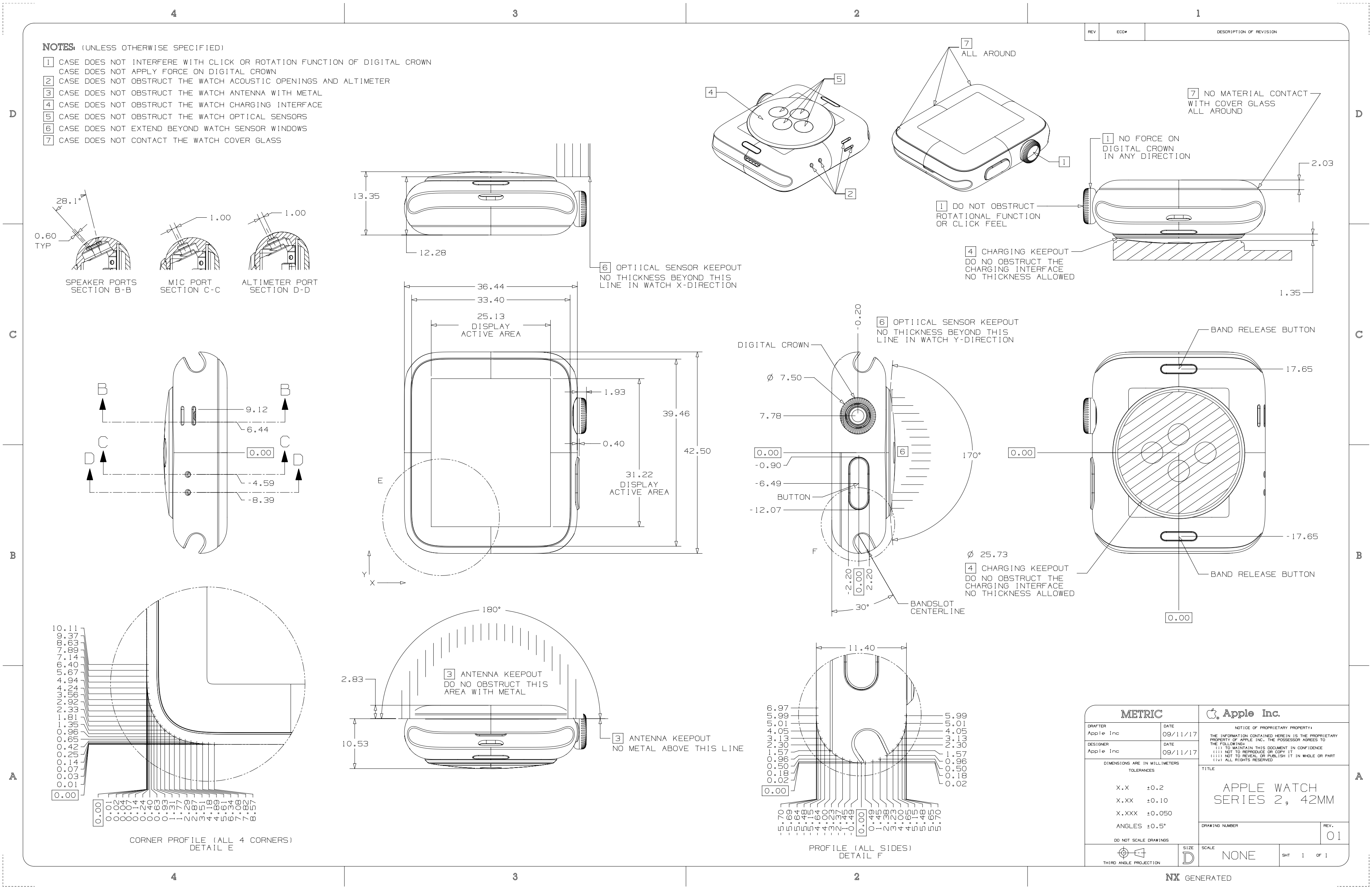
60.238 Apple Watch Series 2 Ceramic, 42 mm



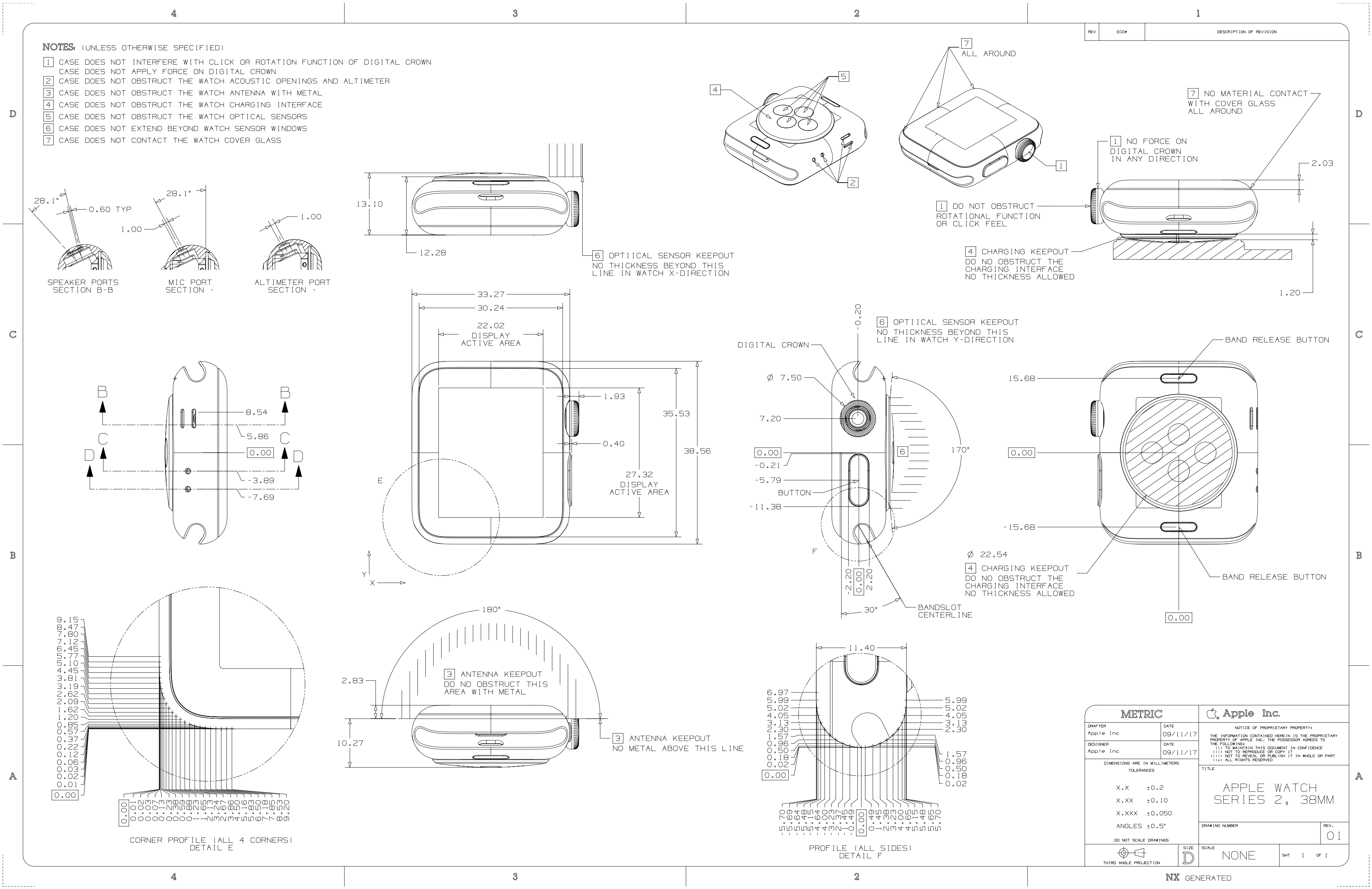
60.239 Apple Watch Series 2 Ceramic, 38 mm



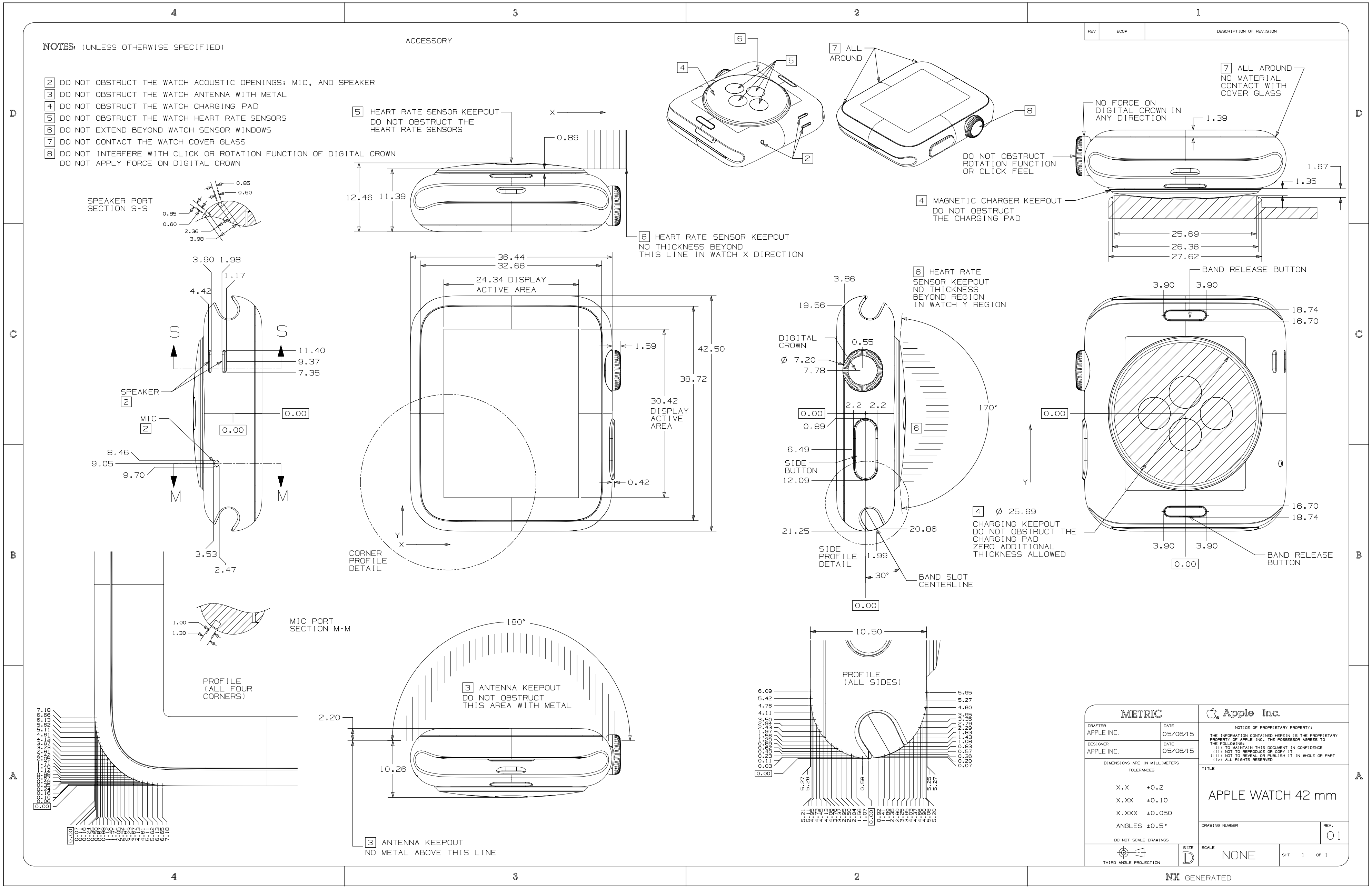
60.240 Apple Watch Series 2 Metal, 42 mm

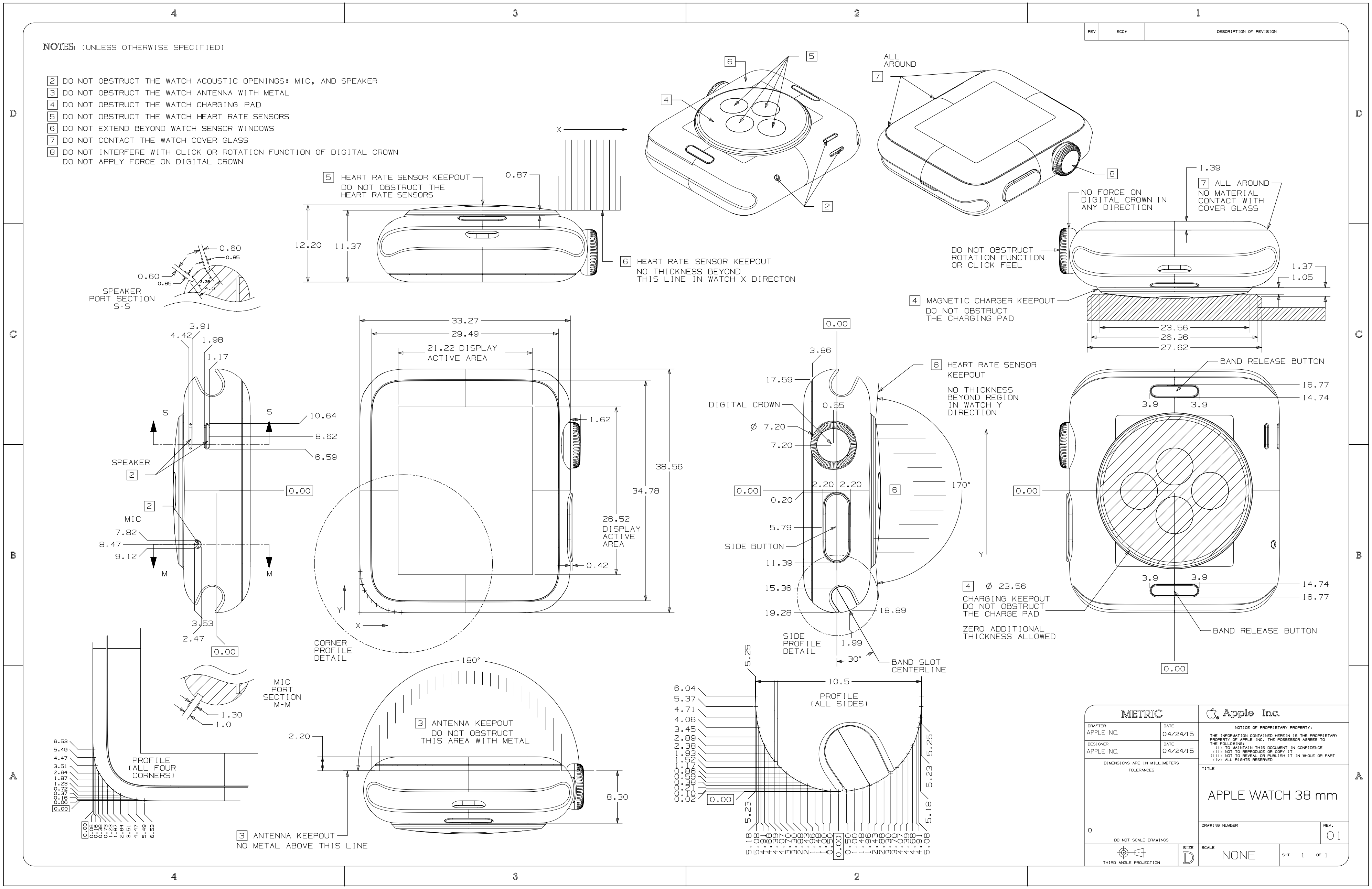


60.241 Apple Watch Series 2 Metal, 38 mm



60.242 Apple Watch Series 1 and Apple Watch (1st generation), 42 mm

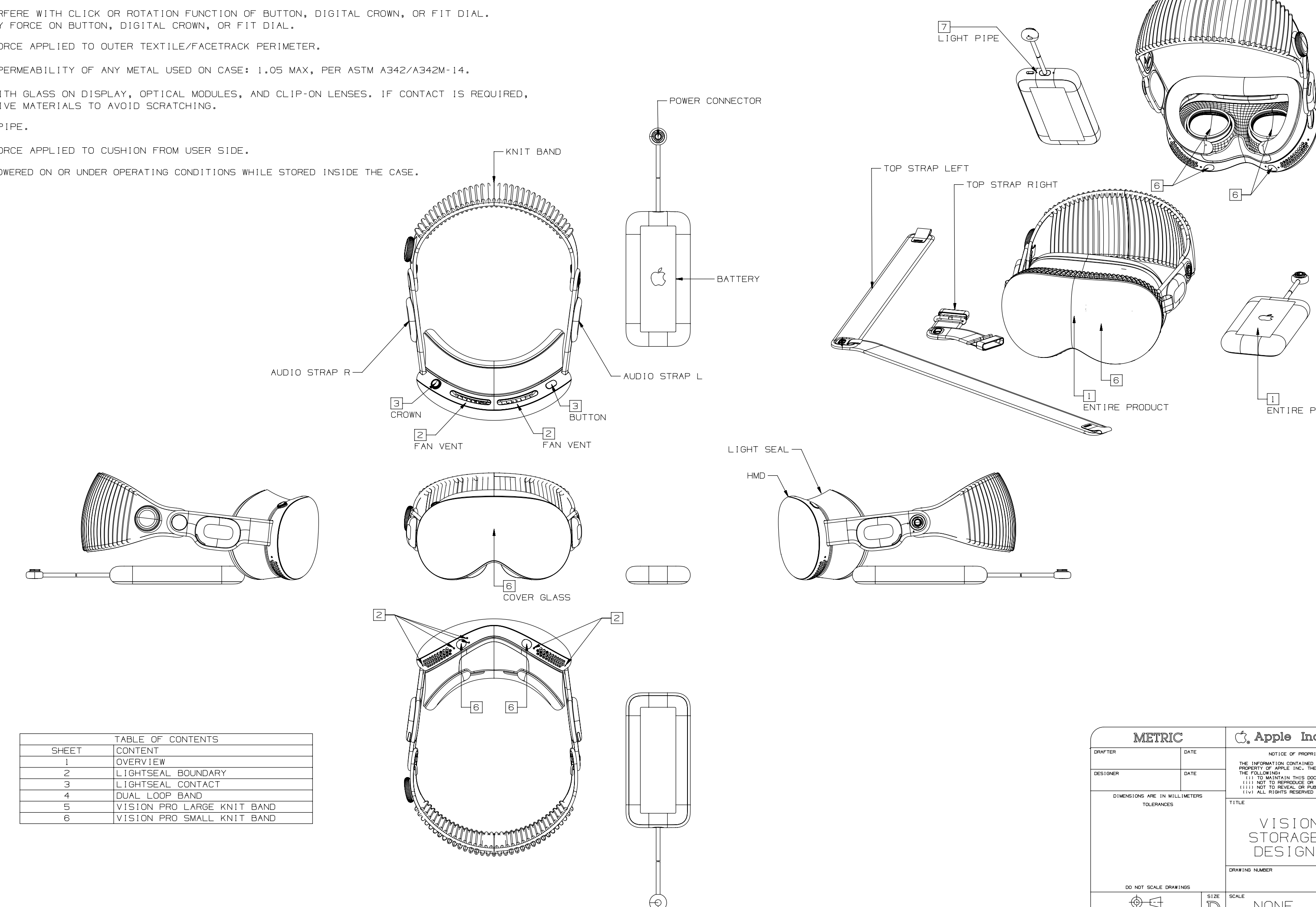



NOTES: (UNLESS OTHERWISE SPECIFIED)
2 DO NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS: MIC, AND SPEAKER
3 DO NOT OBSTRUCT THE WATCH ANTENNA WITH METAL
4 DO NOT OBSTRUCT THE WATCH CHARGING PAD
5 DO NOT OBSTRUCT THE WATCH HEART RATE SENSORS
6 DO NOT EXTEND BEYOND WATCH SENSOR WINDOWS
7 DO NOT CONTACT THE WATCH COVER GLASS
8 DO NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
DO NOT APPLY FORCE ON DIGITAL CROWN
5 HEART RATE SENSOR KEEPOUT DO NOT OBSTRUCT THE HEART RATE SENSORS
6 HEART RATE SENSOR KEEPOUT NO THICKNESS BEYOND THIS LINE IN WATCH X DIRECTON
ALL AROUND
NO FORCE ON DIGITAL CROWN IN ANY DIRECTION
7 ALL AROUND NO MATERIAL CONTACT WITH COVER GLASS
DO NOT OBSTRUCT ROTATION FUNCTION OR CLICK FEEL
4 MAGNETIC CHARGER KEEPOUT DO NOT OBSTRUCT THE CHARGING PAD
SPEAKER PORT SECTION S-S
SPEAKER
MIC
21.22 DISPLAY ACTIVE AREA
26.52 DISPLAY ACTIVE AREA
CORNER PROFILE DETAIL
DIGITAL CROWN
SIDE BUTTON
6 HEART RATE SENSOR KEEPOUT NO THICKNESS BEYOND REGION IN WATCH Y DIRECTION
4 Ø 23.56 CHARGING KEEPOUT DO NOT OBSTRUCT THE CHARGE PAD
ZERO ADDITIONAL THICKNESS ALLOWED
BAND RELEASE BUTTON
SIDE PROFILE DETAIL
BAND SLOT CENTERLINE
MIC PORT SECTION M-M
PROFILE (ALL FOUR CORNERS)
3 ANTENNA KEEPOUT DO NOT OBSTRUCT THIS AREA WITH METAL
3 ANTENNA KEEPOUT NO METAL ABOVE THIS LINE
PROFILE (ALL SIDES)
METRIC
Apple Inc.
DRAFTER APPLE INC. DATE 04/24/15
DESIGNER APPLE INC. DATE 04/24/15
DIMENSIONS ARE IN MILLIMETERS
TITLE APPLE WATCH 38 mm
REV. 01
SCALE NONE
SIZE D
SHT 1 OF 1
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. NO METAL CONTACT WITH PRODUCT.
2. DO NOT OBSTRUCT PORTS.
3. CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF BUTTON, DIGITAL CROWN, OR FIT DIAL. CASE DOES NOT APPLY FORCE ON BUTTON, DIGITAL CROWN, OR FIT DIAL.
4. 2N MAX ALLOWABLE FORCE APPLIED TO OUTER TEXTILE/FACETRACK PERIMETER.
5. RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
6. MINIMIZE CONTACT WITH GLASS ON DISPLAY, OPTICAL MODULES, AND CLIP-ON LENSES. IF CONTACT IS REQUIRED, USE SOFT NON-ABRASIVE MATERIALS TO AVOID SCRATCHING.
7. DO NOT TOUCH LIGHTPIPE.
8. 4N MAX ALLOWABLE FORCE APPLIED TO CUSHION FROM USER SIDE.

UNIT SHALL NOT BE POWERED ON OR UNDER OPERATING CONDITIONS WHILE STORED INSIDE THE CASE.



SHEET	TABLE OF CONTENTS CONTENT
1	OVERVIEW
2	LIGHTSEAL BOUNDARY
3	LIGHTSEAL CONTACT
4	DUAL LOOP BAND
5	VISION PRO LARGE KNIT BAND
6	VISION PRO SMALL KNIT BAND

METRIC
DRAFTER | DATE
DESIGNER | DATE
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES
DO NOT SCALE DRAWINGS
THIRD ANGLE PROJECTION
SIZE D

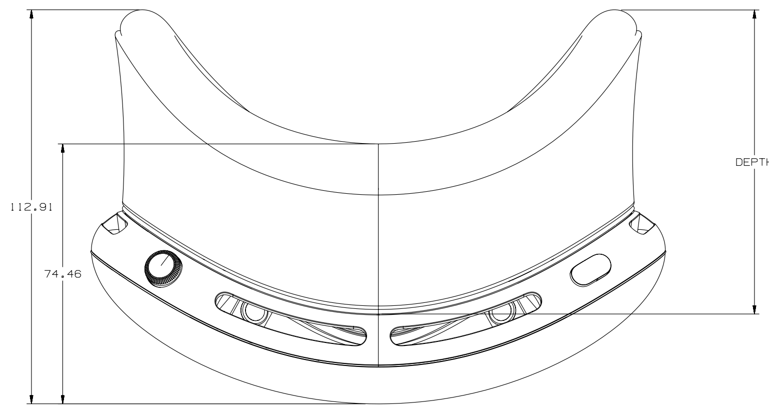
Apple Inc.
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED

TITLE: VISION PRO STORAGE CASE DESIGN GUIDE
DRAWING NUMBER | REV.
SCALE NONE | SHT | OF

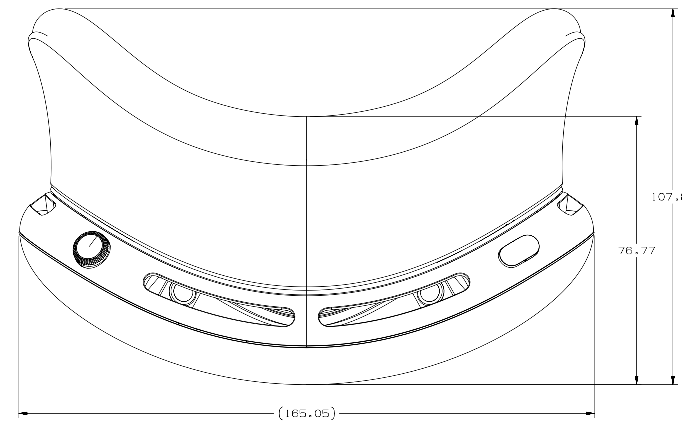
REV | ECO# | DESCRIPTION OF REVISION

NX GENERATED

LIGHT SEAL BOUNDARY REQUIREMENTS

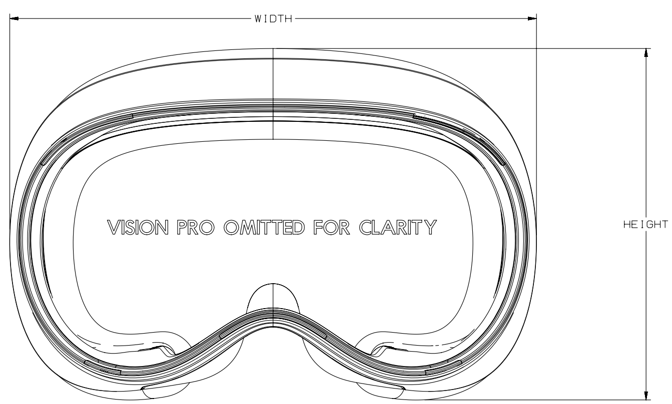


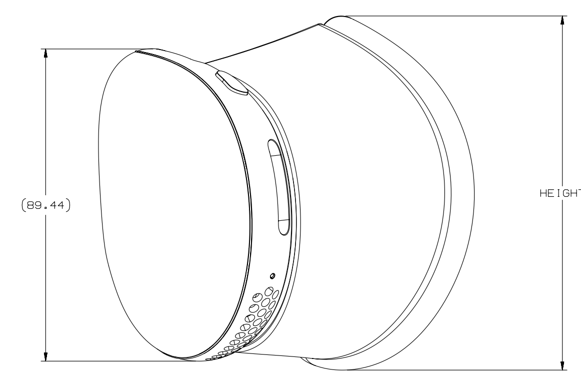
DEEPEST LIGHT SEAL



WIDEST • TALLEST LIGHT SEAL

DESCRIPTION	LIGHTSEAL + FACE CUSHION (mm)		
	WIDTH	DEPTH	HEIGHT
LARGEST IN ALL DIMESIONS	161.35 MMC	98.4 MMC	104.26 MMC
SMALLEST IN ALL DIMESIONS	147.57 LMC	72.38 MMC	94.07 LMC

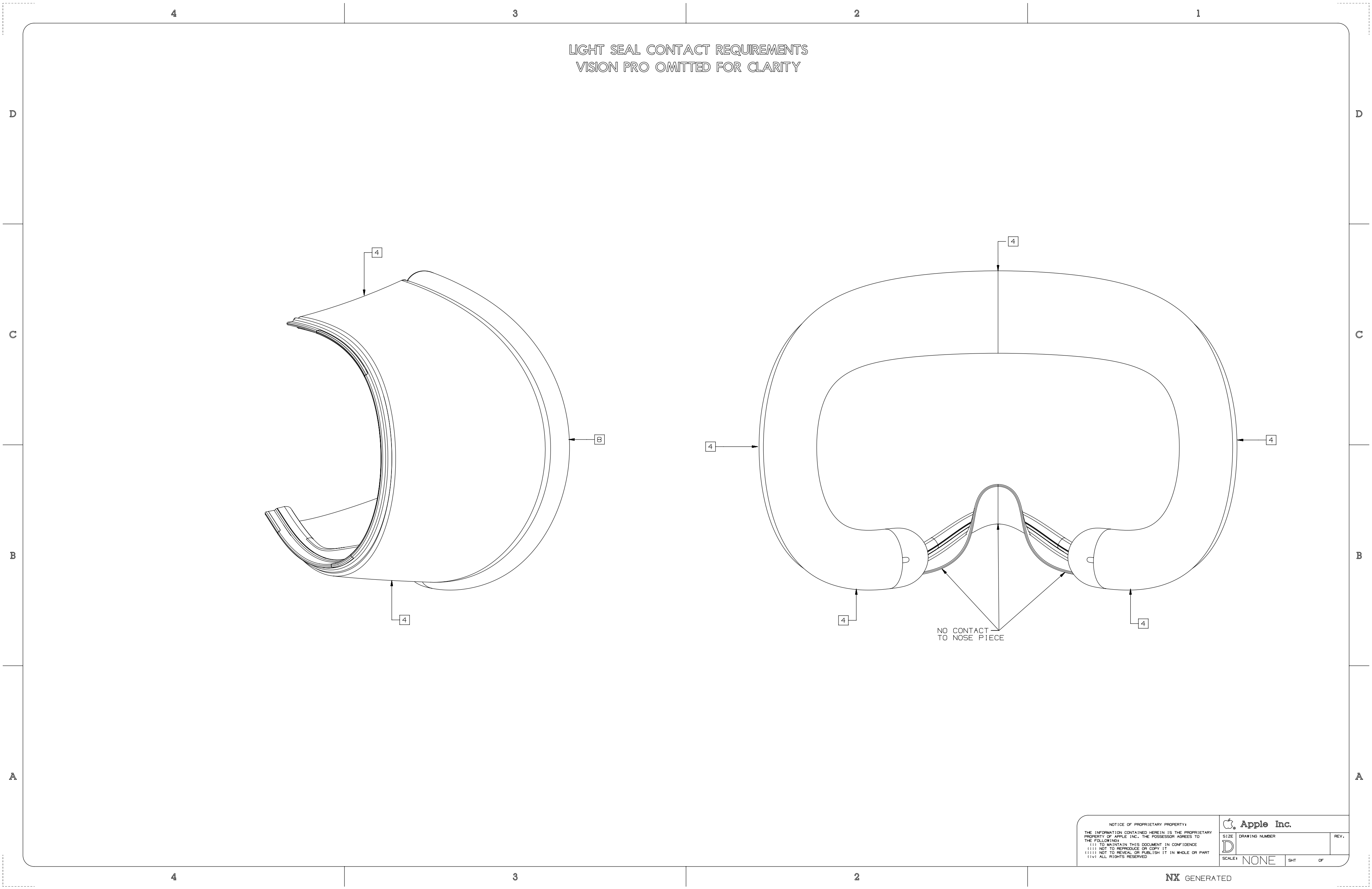


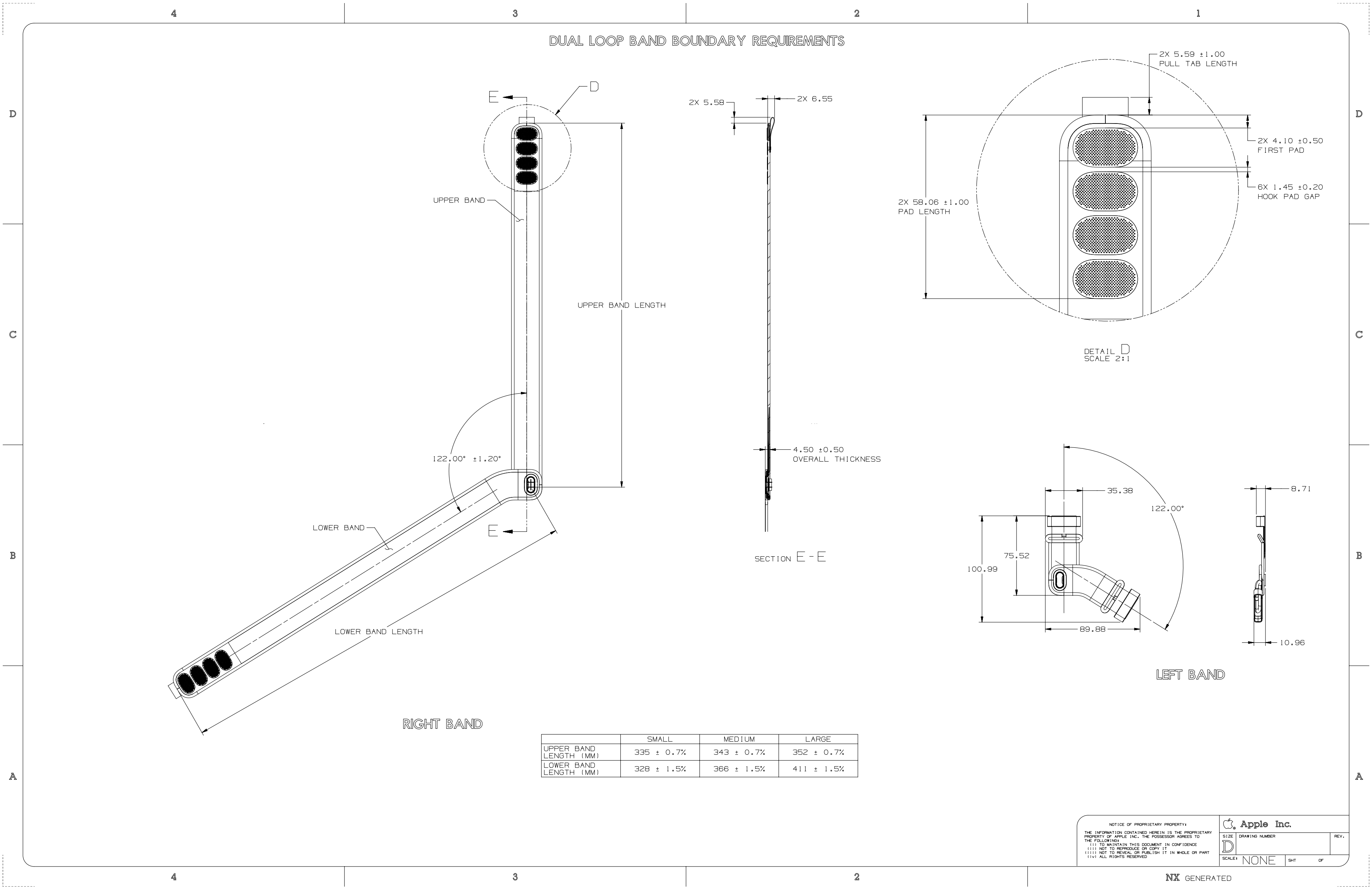


NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED

Apple Inc.
SIZE D | DRAWING NUMBER | REV.
SCALE: NONE | SHT | OF

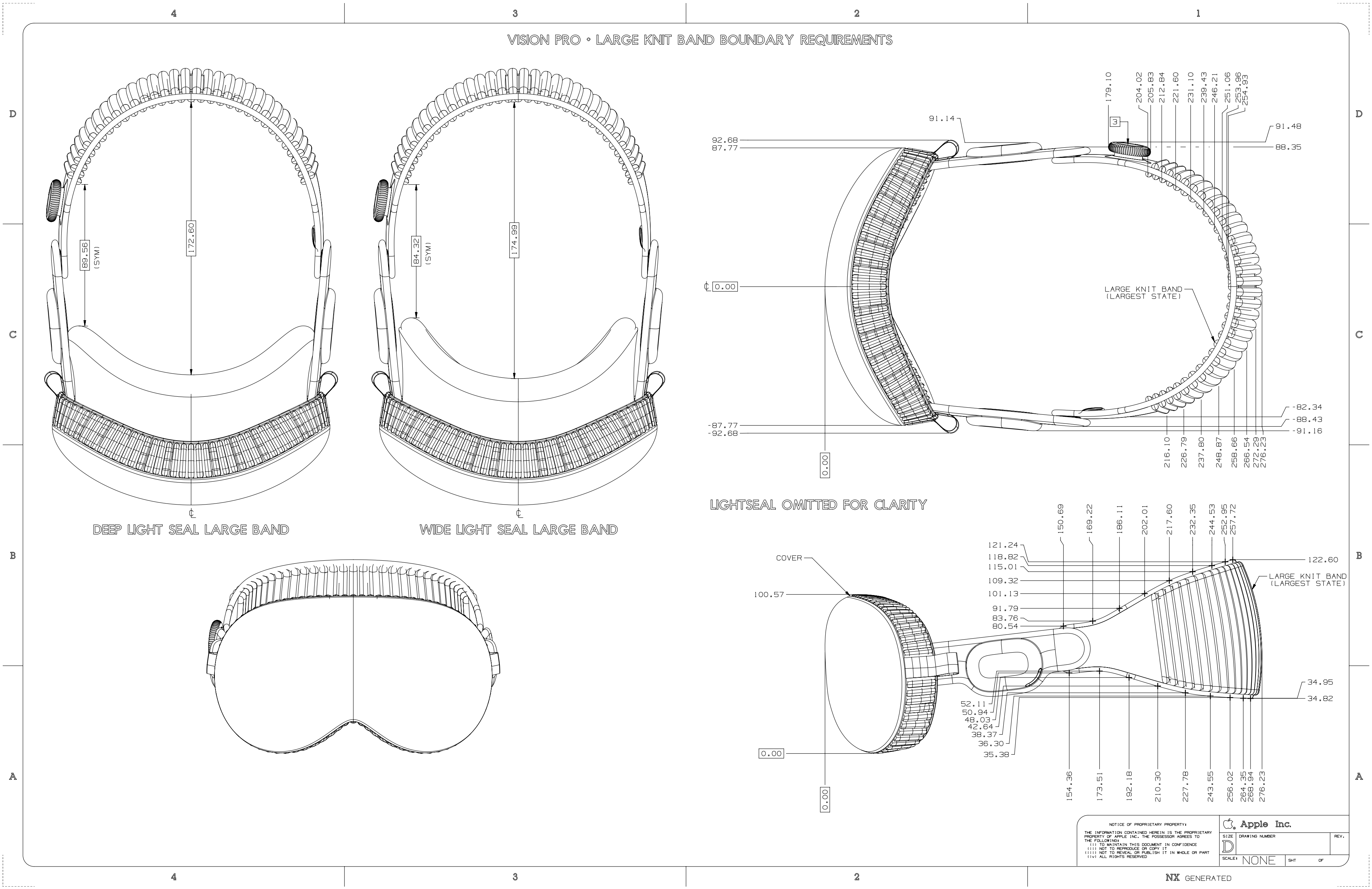
NX GENERATED

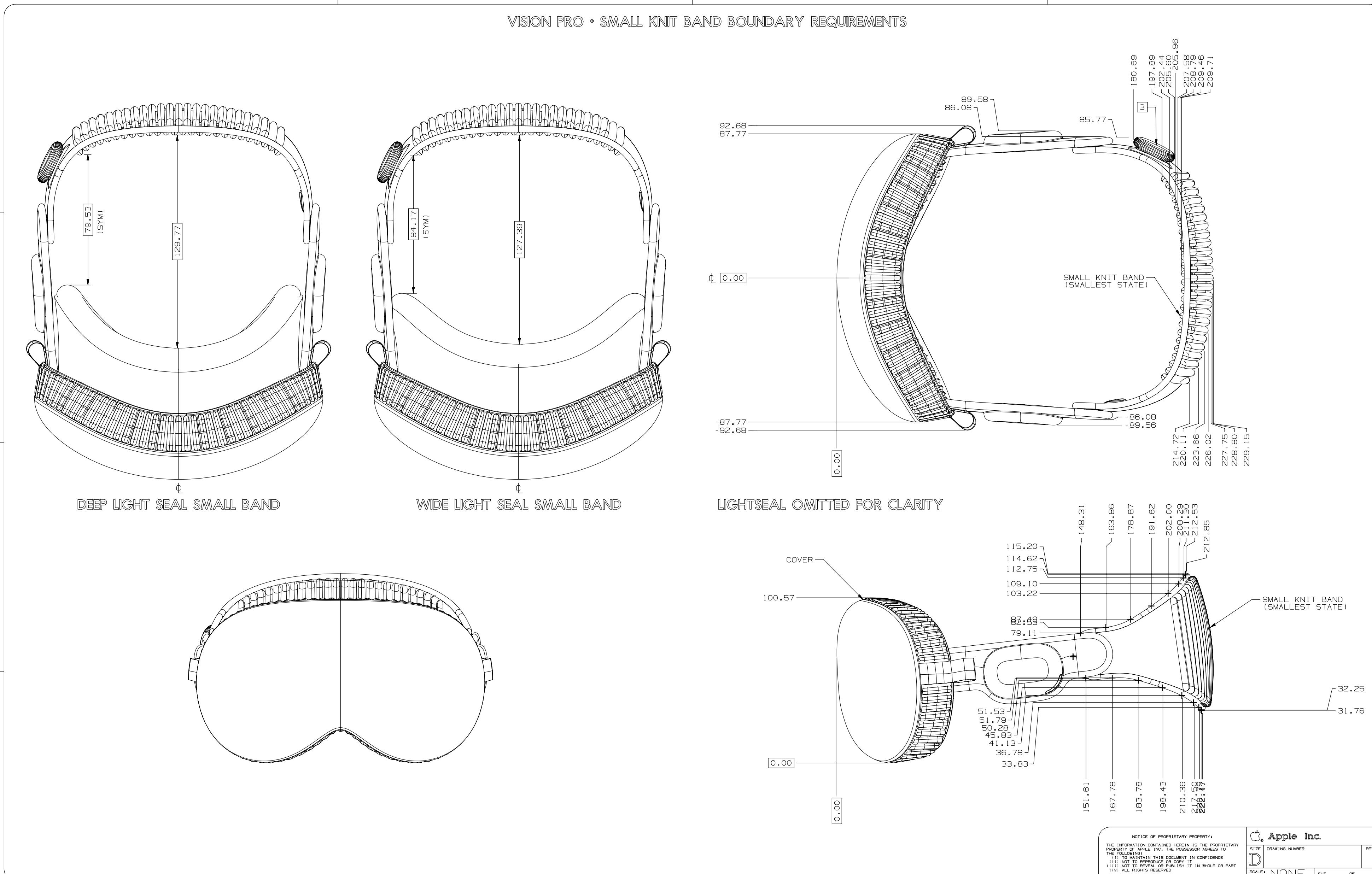

LIGHT SEAL CONTACT REQUIREMENTS
VISION PRO OMITTED FOR CLARITY
4
8
NO CONTACT TO NOSE PIECE
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT OF
NX GENERATED



	SMALL	MEDIUM	LARGE
UPPER BAND LENGTH (MM)	335 ± 0.7%	343 ± 0.7%	352 ± 0.7%
LOWER BAND LENGTH (MM)	328 ± 1.5%	366 ± 1.5%	411 ± 1.5%

60.248 Apple Vision Pro, 5 of 6

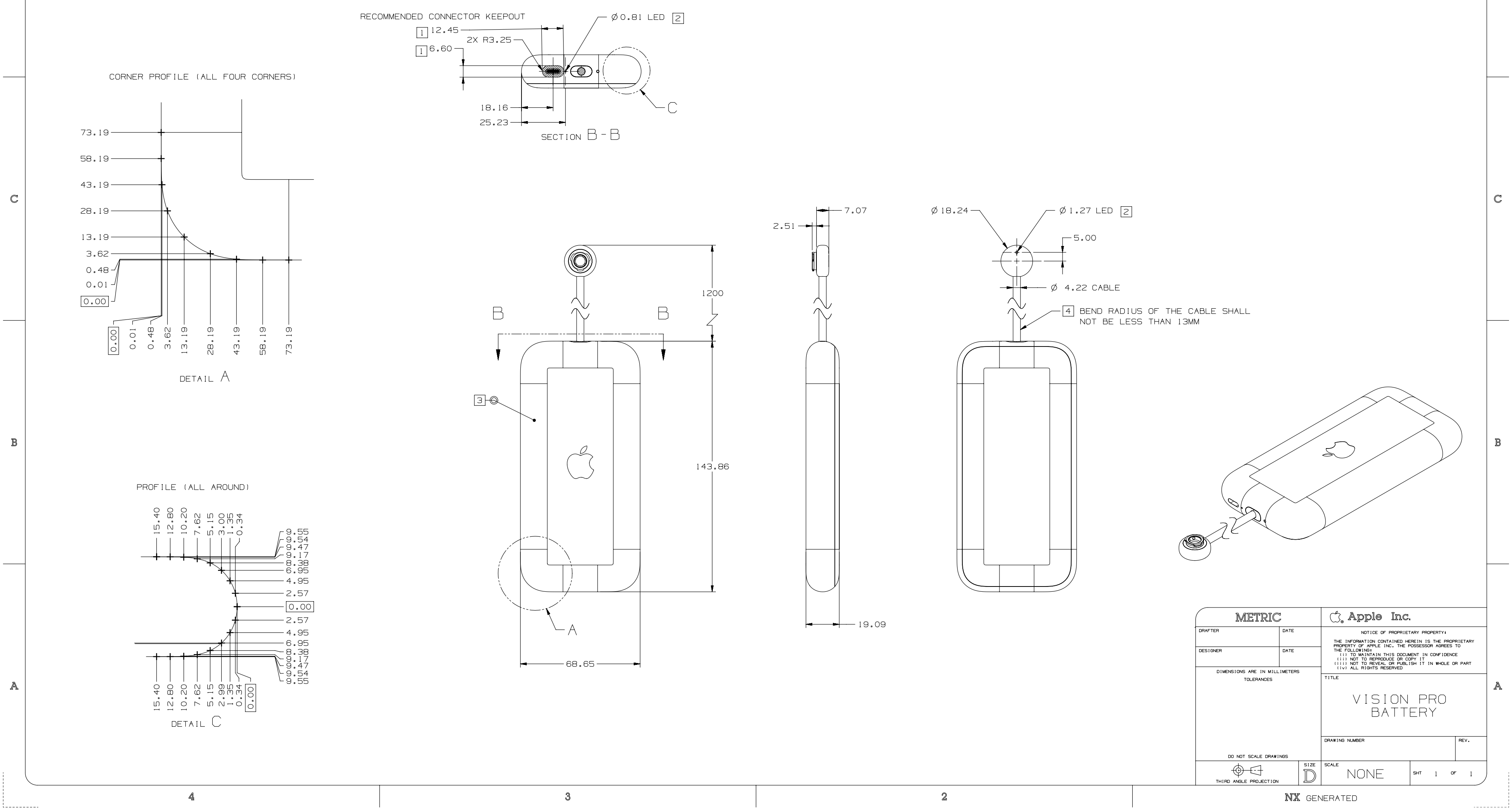



VISION PRO • SMALL KNIT BAND BOUNDARY REQUIREMENTS
79.53 (SYM)
129.77
84.17 (SYM)
127.39
DEEP LIGHT SEAL SMALL BAND
WIDE LIGHT SEAL SMALL BAND
LIGHTSEAL OMITTED FOR CLARITY
92.68
87.77
89.58
86.08
85.77
3
180.69
197.89
202.44
205.60
205.96
207.58
208.79
209.46
209.71
0.00
SMALL KNIT BAND (SMALLEST STATE)
-87.77
-92.68
-86.08
-89.56
214.72
220.11
223.66
226.02
227.75
228.80
229.15
COVER
100.57
115.20
114.62
112.75
109.10
103.22
82.53
79.11
148.31
163.86
178.87
191.62
202.00
208.29
211.30
212.53
212.85
51.53
51.79
50.28
45.83
41.13
36.78
33.83
151.61
167.78
183.78
198.43
210.36
217.50
32.25
31.76
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT OF
NX GENERATED

60.250 Apple Vision Pro Battery

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. DO NOT OBSTRUCT PORT.
2. DO NOT OBSTRUCT LED.
3. NO METAL CONTACT.
4. BEND RADIUS REQUIREMENT.
5. RECOMMEND TO MAINTAIN AT LEAST 25% SURFACE EXPOSURE FOR HEAT DISSIPATION.



60.251 Apple Vision Pro Audio Strap

NOTES: (UNLESS OTHERWISE SPECIFIED)

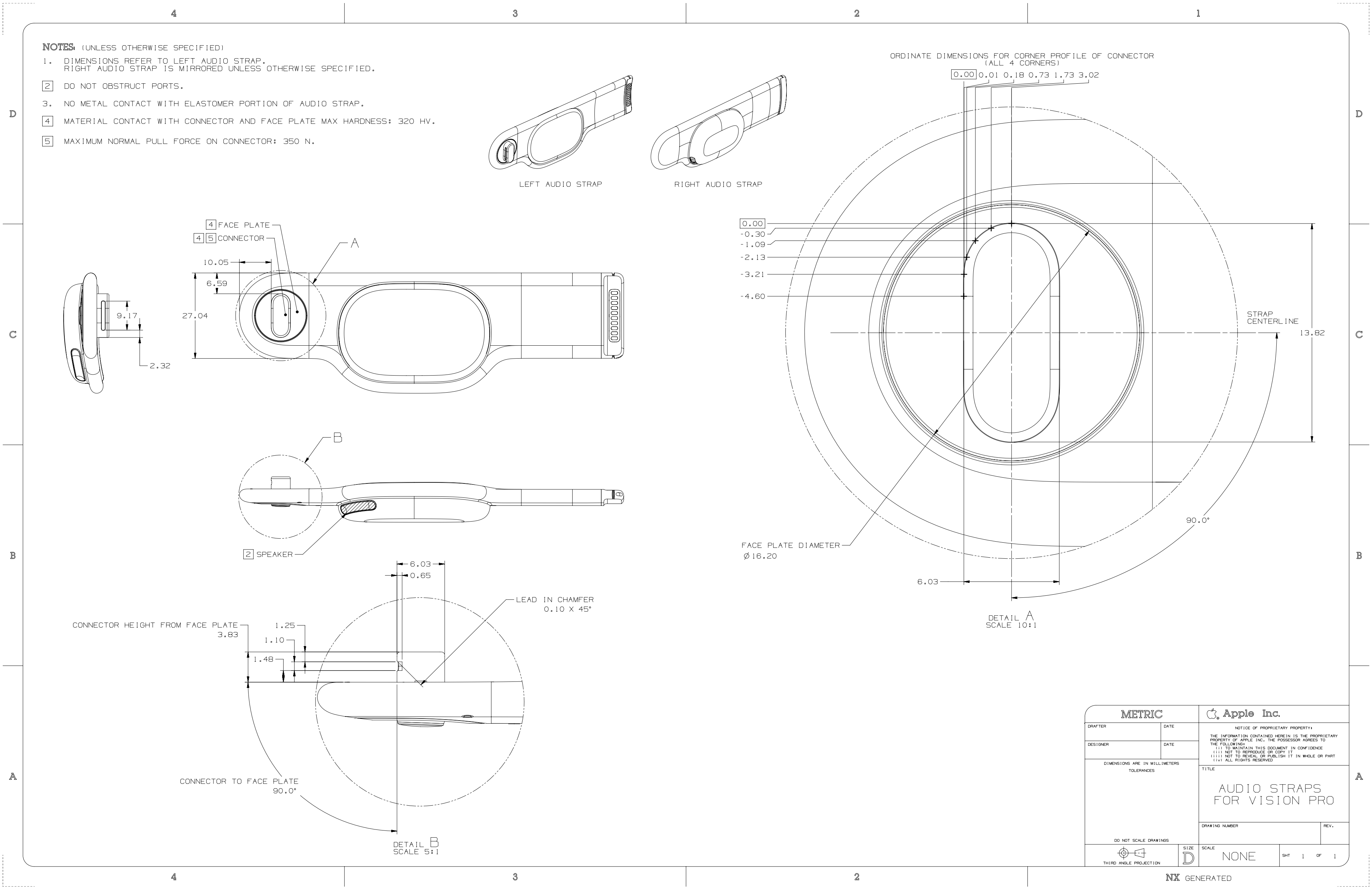
1. DIMENSIONS REFER TO LEFT AUDIO STRAP. RIGHT AUDIO STRAP IS MIRRORED UNLESS OTHERWISE SPECIFIED.

[2] DO NOT OBSTRUCT PORTS.

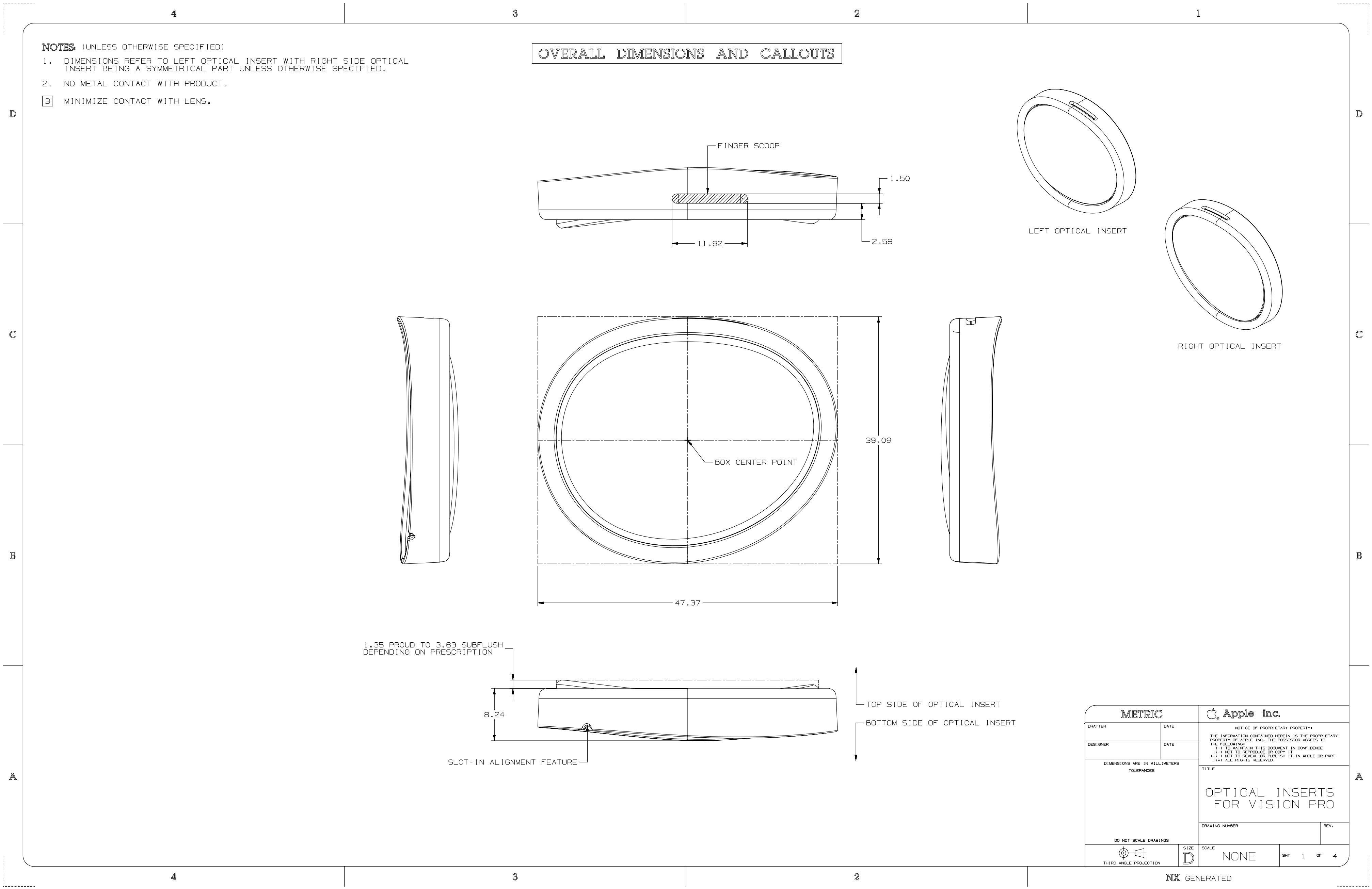
3. NO METAL CONTACT WITH ELASTOMER PORTION OF AUDIO STRAP.

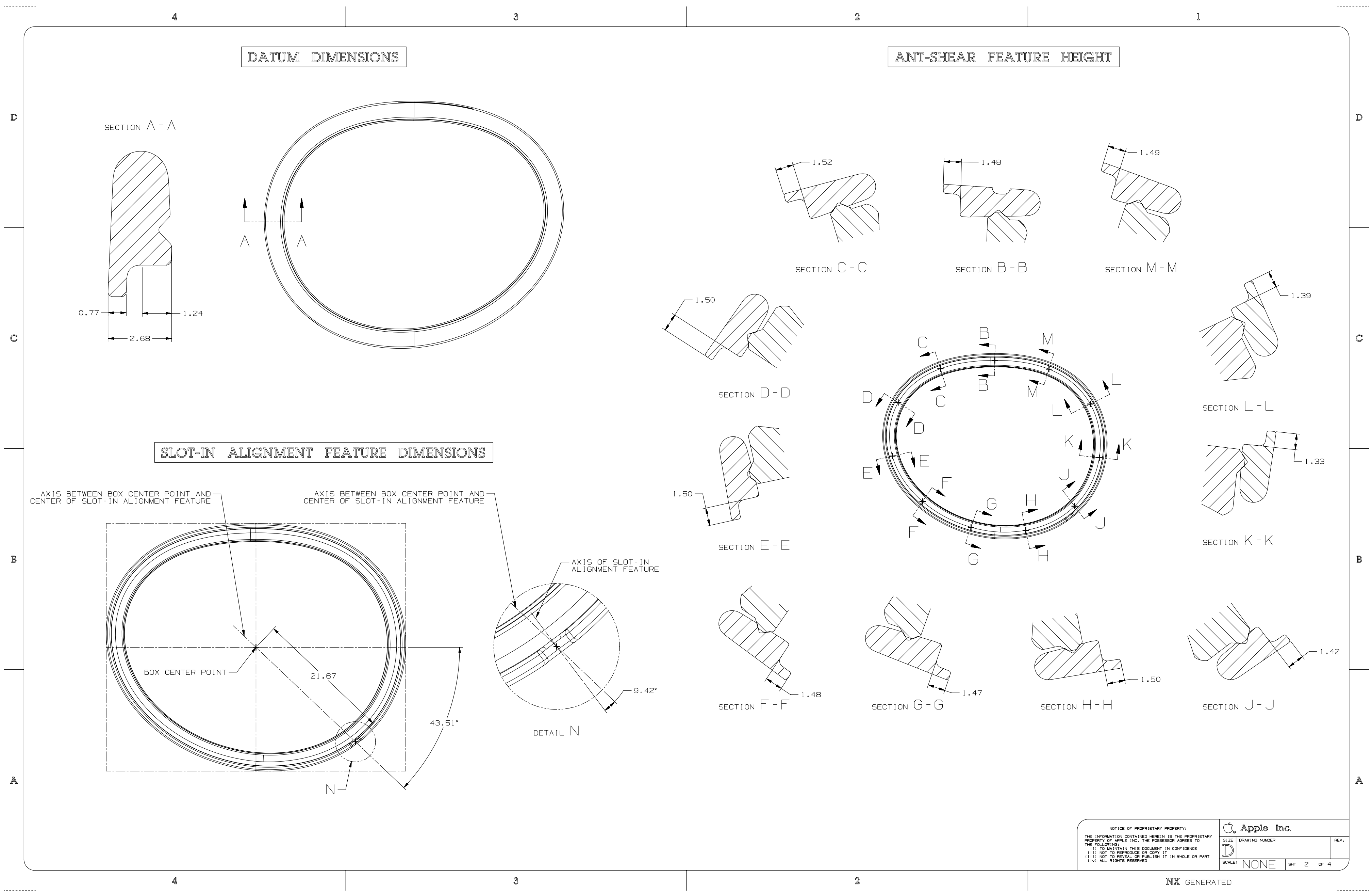
[4] MATERIAL CONTACT WITH CONNECTOR AND FACE PLATE MAX HARDNESS: 320 HV.

[5] MAXIMUM NORMAL PULL FORCE ON CONNECTOR: 350 N.

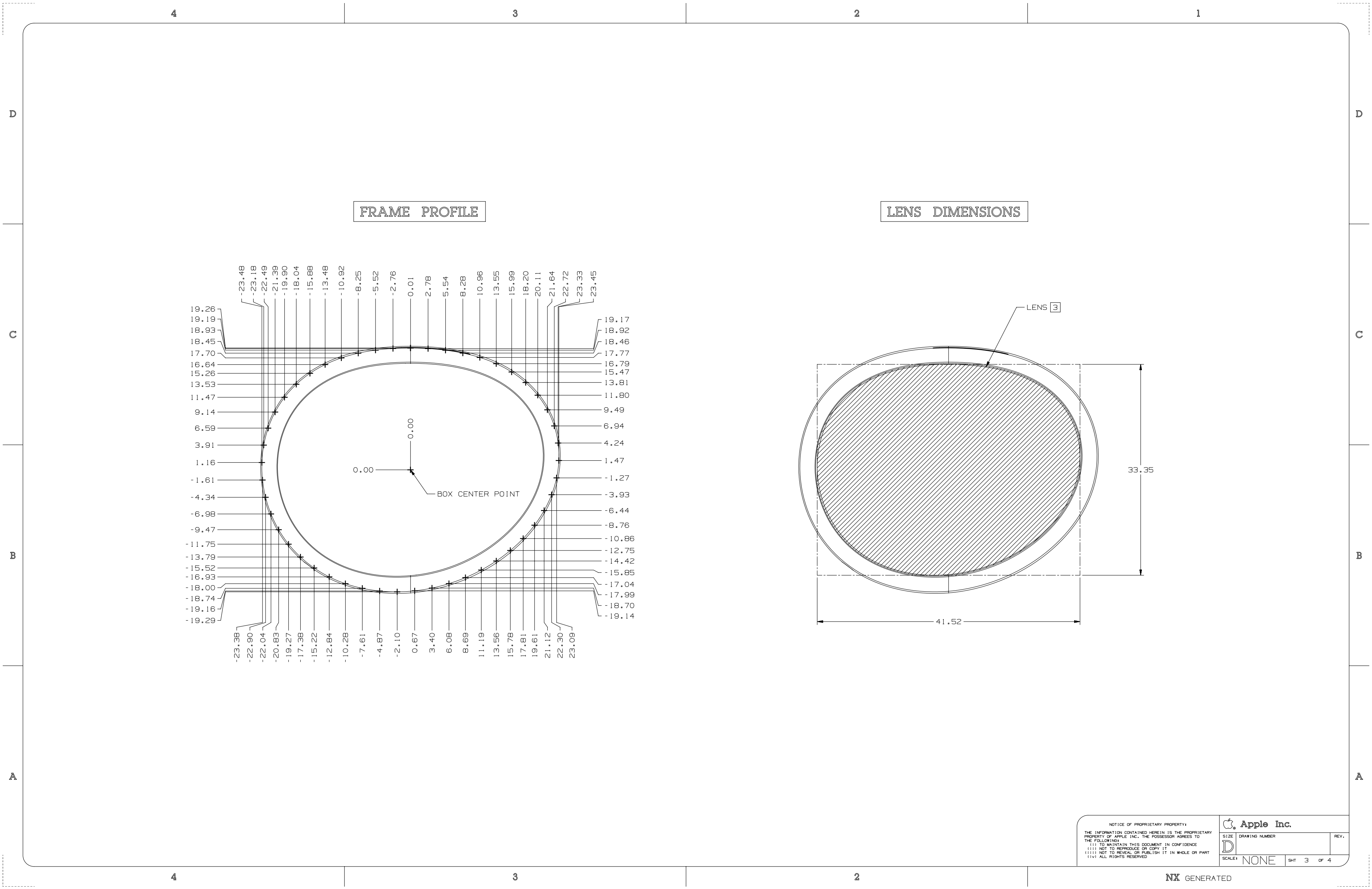


60.252 ZEISS Optical Inserts, 1 of 4



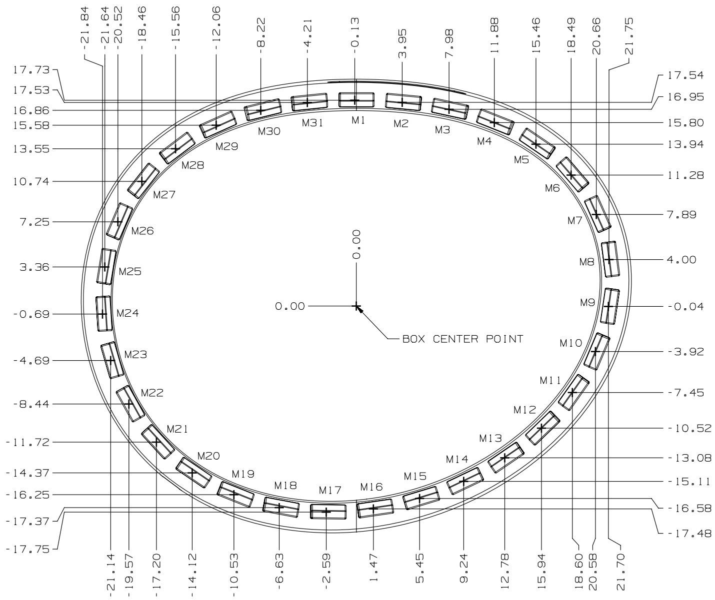


DATUM DIMENSIONS
SECTION A - A
0.77
2.68
1.24
A
A
ANT-SHEAR FEATURE HEIGHT
SECTION C - C
1.52
SECTION B - B
1.48
SECTION M - M
1.49
SECTION D - D
1.50
SECTION E - E
1.50
SECTION F - F
1.48
SECTION G - G
1.47
SECTION H - H
1.50
SECTION J - J
1.42
SECTION K - K
1.33
SECTION L - L
1.39
SLOT-IN ALIGNMENT FEATURE DIMENSIONS
AXIS BETWEEN BOX CENTER POINT AND CENTER OF SLOT-IN ALIGNMENT FEATURE
BOX CENTER POINT
21.67
43.51°
N
AXIS OF SLOT-IN ALIGNMENT FEATURE
9.42°
DETAIL N
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 2 OF 4
NX GENERATED

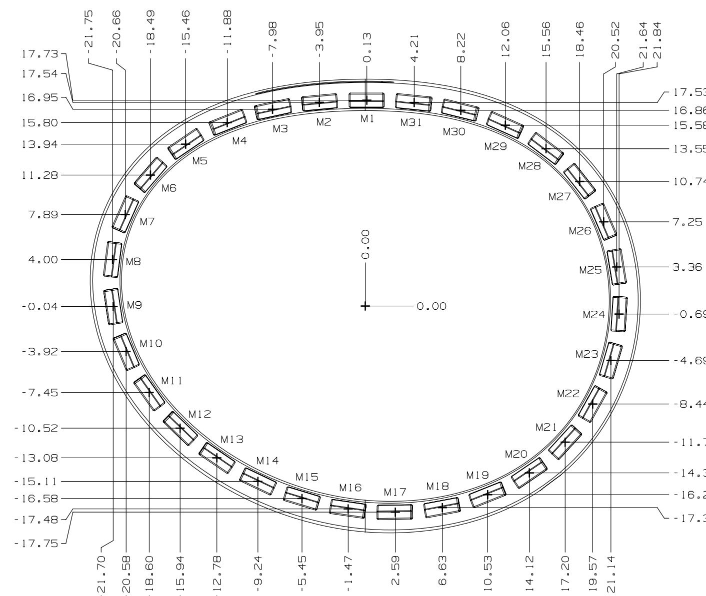

FRAME PROFILE
LENS DIMENSIONS
0.00
0.00
BOX CENTER POINT
-23.48 -23.18 -22.49 -21.39 -19.90 -18.04 -15.88 -13.48 -10.92 -8.25 -5.52 -2.76 0.01 2.78 5.54 8.28 10.96 13.55 15.99 18.20 20.11 21.64 22.72 23.33 23.45
19.26 19.19 18.93 18.45 17.70 16.64 15.26 13.53 11.47 9.14 6.59 3.91 1.16 -1.61 -4.34 -6.98 -9.47 -11.75 -13.79 -15.52 -16.93 -18.00 -18.74 -19.16 -19.29
19.17 18.92 18.46 17.77 16.79 15.47 13.81 11.80 9.49 6.94 4.24 1.47 -1.27 -3.93 -6.44 -8.76 -10.86 -12.75 -14.42 -15.85 -17.04 -17.99 -18.70 -19.14
-23.38 -22.90 -22.04 -20.83 -19.27 -17.38 -15.22 -12.84 -10.28 -7.61 -4.87 -2.10 0.67 3.40 6.08 8.69 11.19 13.56 15.78 17.81 19.61 21.12 22.30 23.09
LENS 3
33.35
41.52
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 3 OF 4
NX GENERATED

60.255 ZEISS Optical Inserts, 4 of 4

LEFT MAGNET ARRAY



RIGHT MAGNET ARRAY



MAGNET POLARITY FOR EACH MAGNET (Left)

MAGNET	POLARITY TOWARD TOP SIDE	POLARITY TOWARD BOTTOM SIDE
M1	N	S
M2		
M3		
M4		
M5		
M6		
M7		
M8	S	N
M9		
M10		
M11		
M12		
M13		
M14		
M15		
M16		
M17		
M18	N	S
M19		
M20		
M21		
M22	S	N
M23		
M24		
M25		
M26		
M27		
M28		
M29	N	S
M30		
M31		

MAGNET POLARITY FOR EACH MAGNET (Right)

MAGNET	POLARITY TOWARD TOP SIDE	POLARITY TOWARD BOTTOM SIDE
M1	S	N
M2		
M5		
M8		
M9		
M12		
M15		
M18	N	S
M19		
M22		
M23		
M26		
M29		
M30		
M15		
M16		
M17		
M18	S	N
M19		
M20		
M21		
M22	N	S
M23		
M24		
M25		
M26		
M27		
M28		
M29	S	N
M30		
M31		

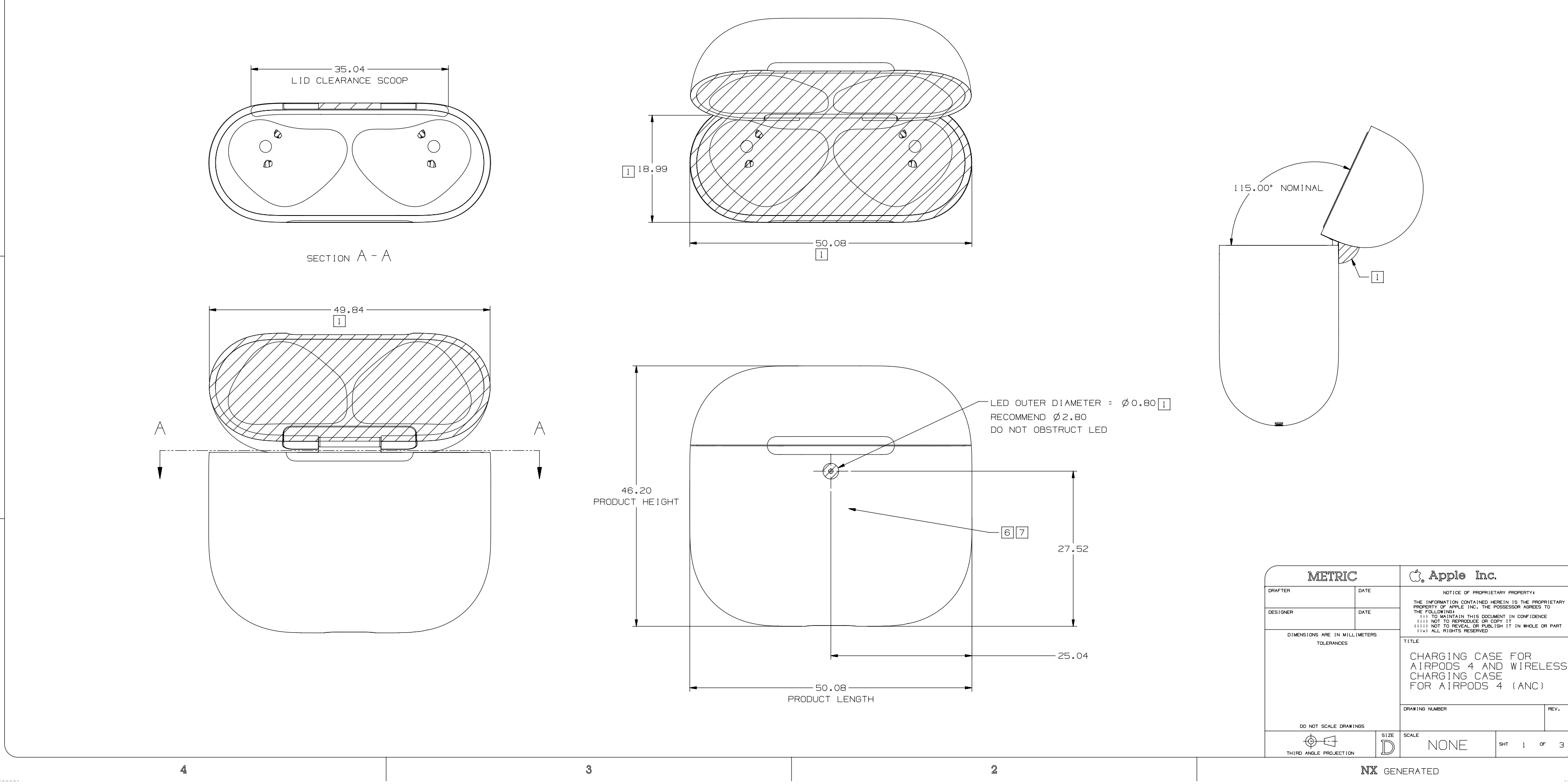
Apple Inc.
SIZE D | DRAWING NUMBER | REV.
SCALE: NONE | SHT 4 OF 4

NX GENERATED

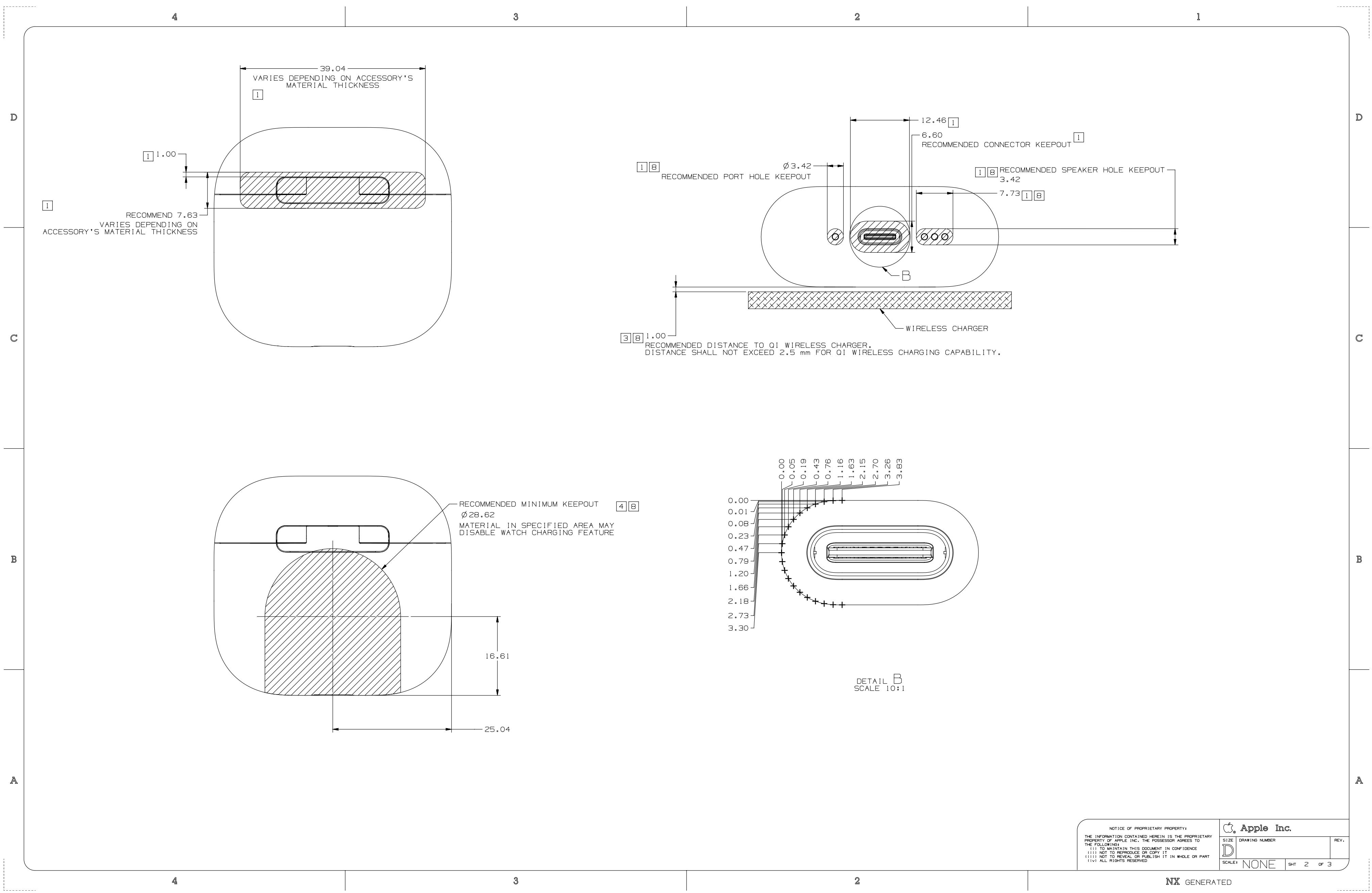
60.256 Wireless Charging Case (USB-C) for AirPods 4, 1 of 3

NOTES: (UNLESS OTHERWISE SPECIFIED)

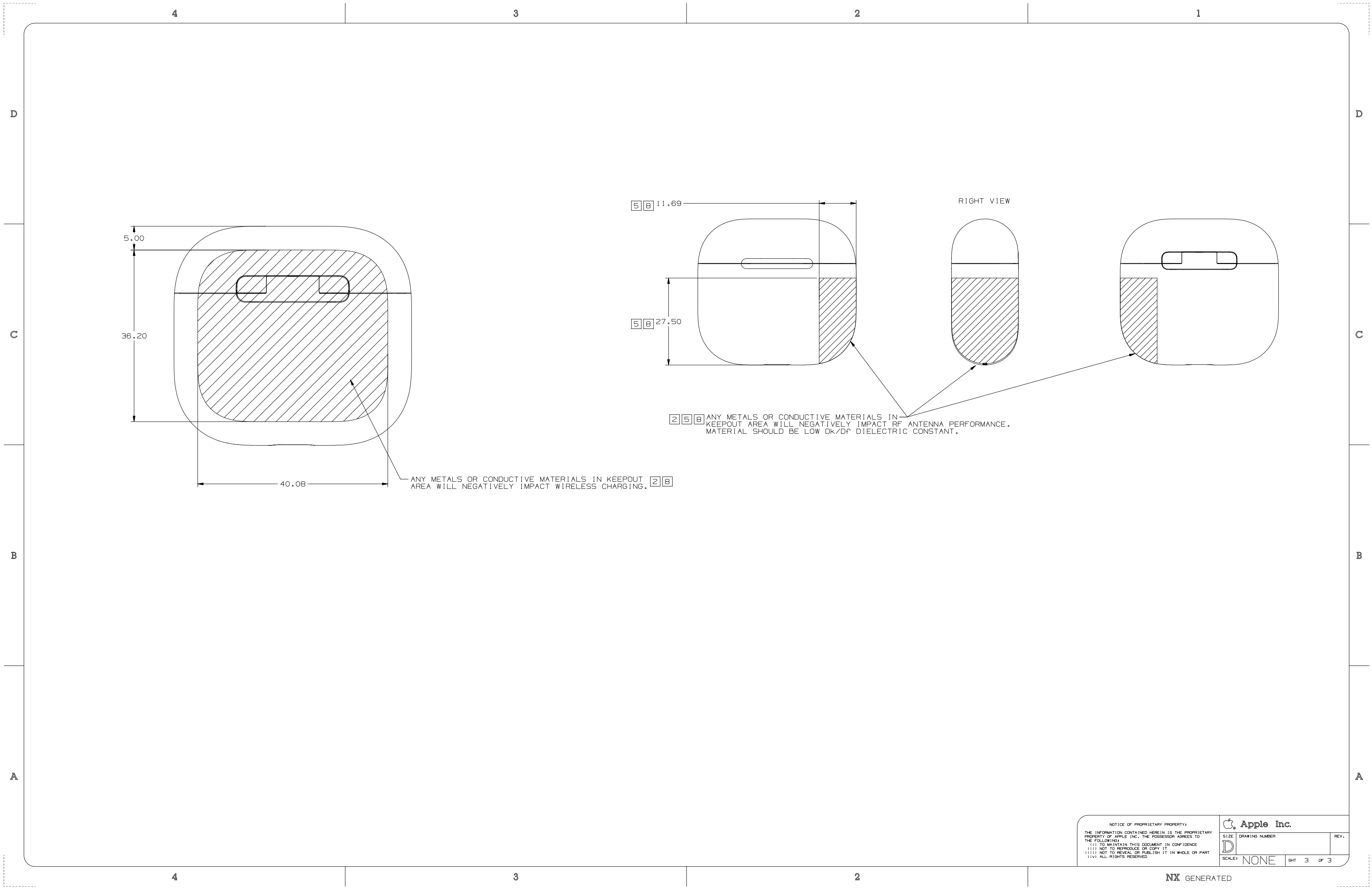
1. ACCESSORIES INTRUDING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE.
2. TO ENSURE FULL FUNCTIONALITY, DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL.
3. TO ENSURE FULL FUNCTIONALITY WITH MINIMAL IMPACT TO QI CHARGING PERFORMANCE, MINIMIZE ANY MATERIAL THICKNESS.
4. TO ENABLE CHARGING VIA APPLE WATCH CHARGER, IT IS RECOMMENDED THERE BE NO MATERIAL BETWEEN BACK OF DEVICE AND WATCH CHARGER.
5. PROTECTIVE CASES OR COVERS MAY DETUNE OR IMPACT RF & WIRELESS CHARGING PERFORMANCE. IMPACT IS HIGHLY DEPENDENT ON MATERIAL AND MATERIAL THICKNESS. HIGHLY RECOMMEND AVOIDING METAL MATERIAL AND FOLLOWING GUIDELINES IN THIS DOCUMENT TO MINIMIZE IMPACT.
6. PROTECTIVE CASES OR COVERS MAY IMPACT PAIRING AND FACTORY RESET FUNCTIONS ON CHARGING CASE FOR AIRPODS 4.
7. PROTECTIVE CASES OR COVERS MAY IMPACT PAIRING, FACTORY RESET, AND SERIAL NUMBER LOOKUP FUNCTIONS ON WIRELESS CHARGING CASE FOR AIRPODS 4 (ANC).
8. ONLY APPLICABLE TO WIRELESS CHARGING CASE FOR AIRPODS 4 (ANC).



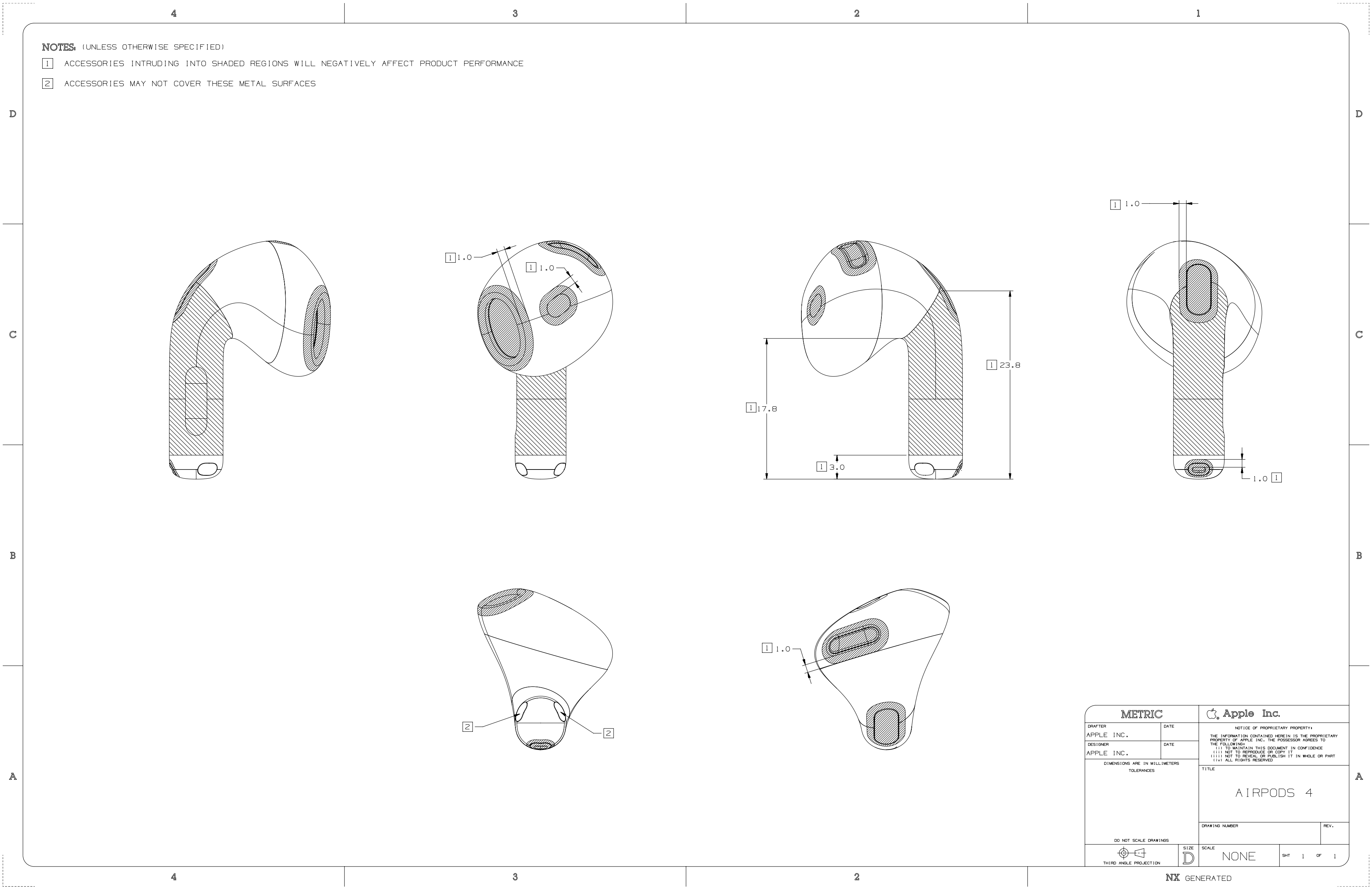
60.257 Wireless Charging Case (USB-C) for AirPods 4, 2 of 3



60.258 Wireless Charging Case (USB-C) for AirPods 4, 3 of 3



60.259 AirPods 4



NOTES: (UNLESS OTHERWISE SPECIFIED)

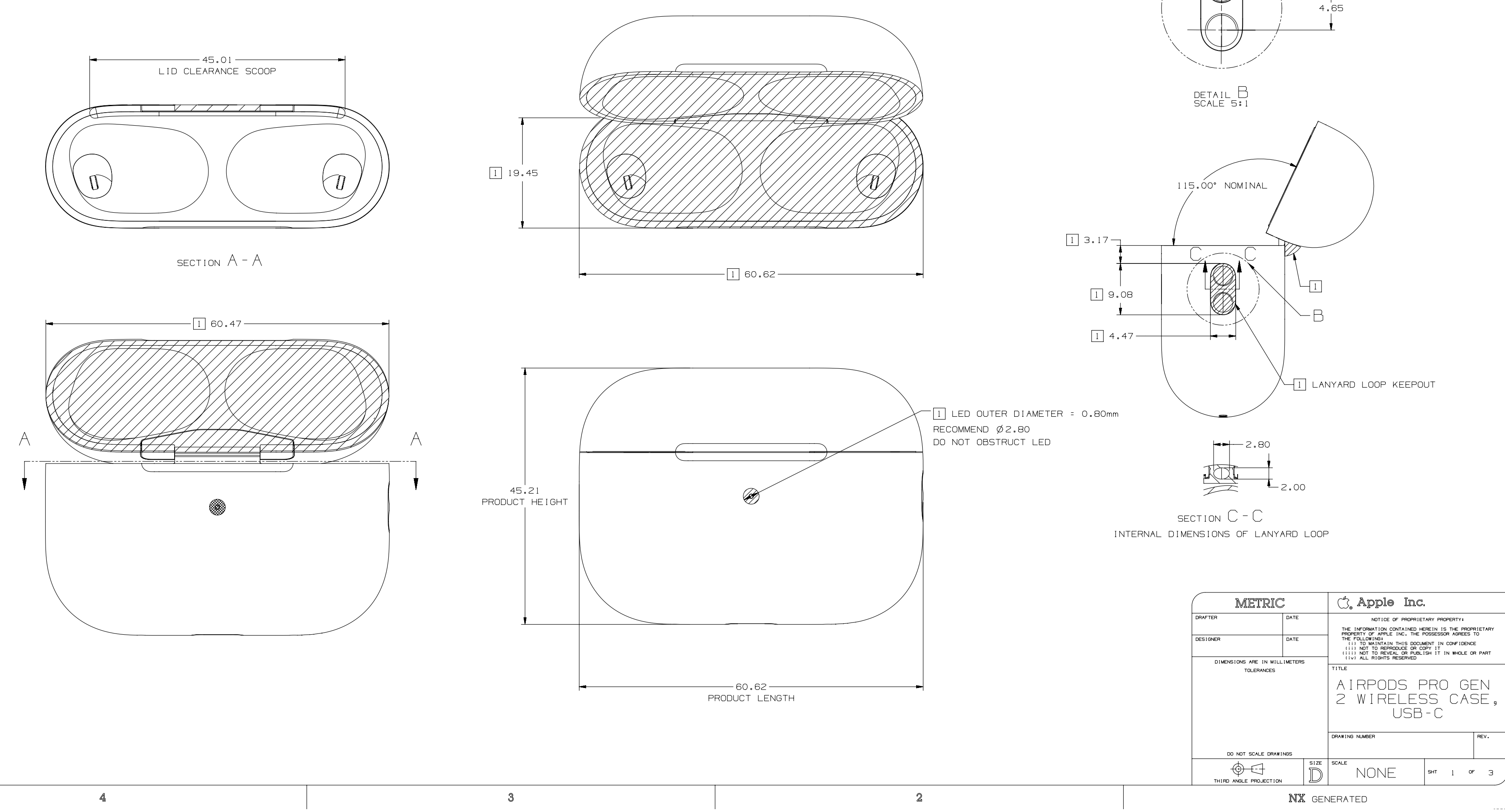
1 ACCESSORIES INTRUDING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE.

2 TO ENSURE FULL FUNCTIONALITY, DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL.

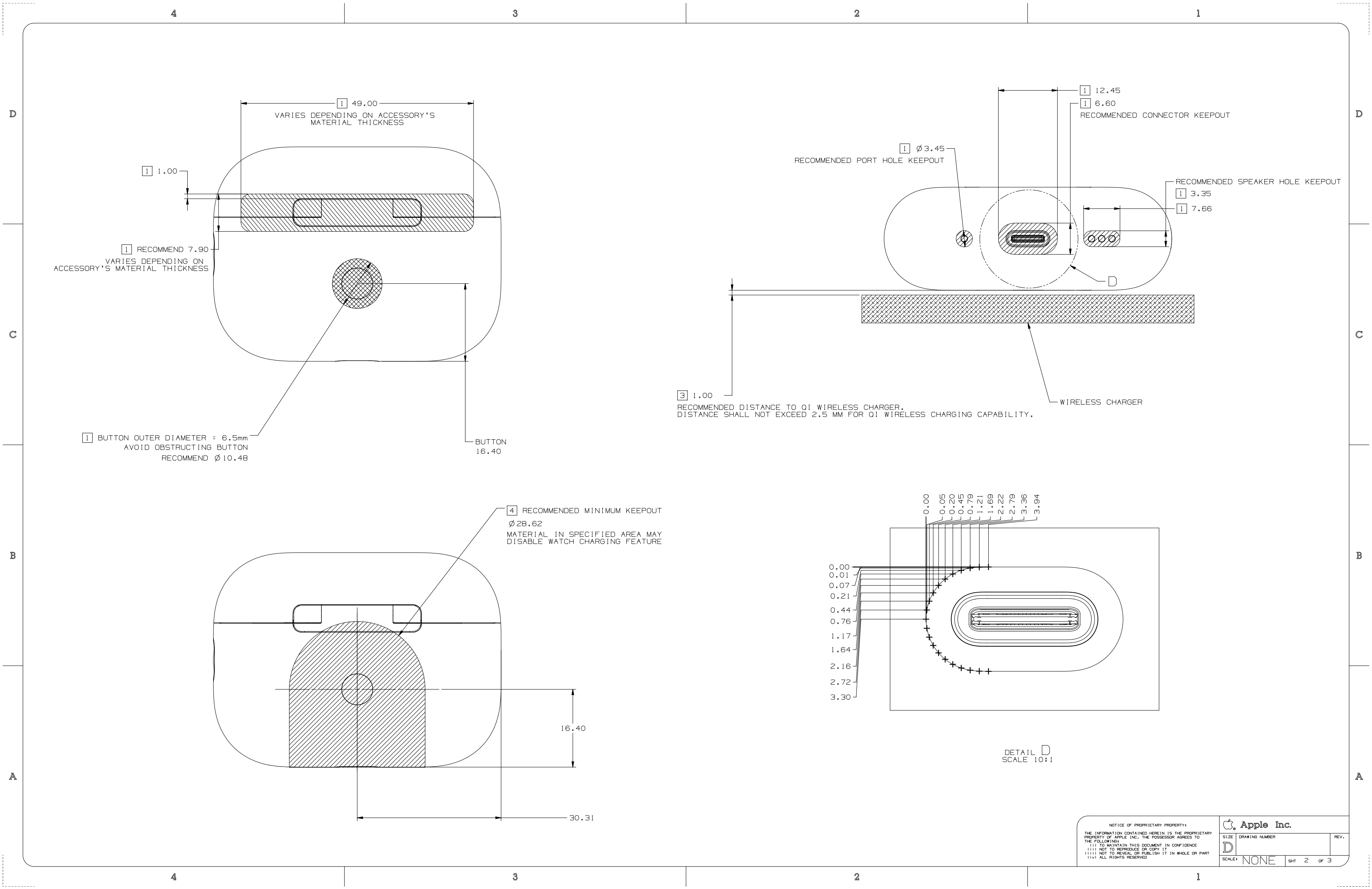
3 TO ENSURE FULL FUNCTIONALITY WITH MINIMAL IMPACT TO QI CHARGING PERFORMANCE, MINIMIZE ANY MATERIAL THICKNESS.

4 TO ENABLE CHARGING VIA APPLE WATCH CHARGER, IT IS RECOMMENDED THERE BE NO MATERIAL BETWEEN BACK OF DEVICE AND WATCH CHARGER.

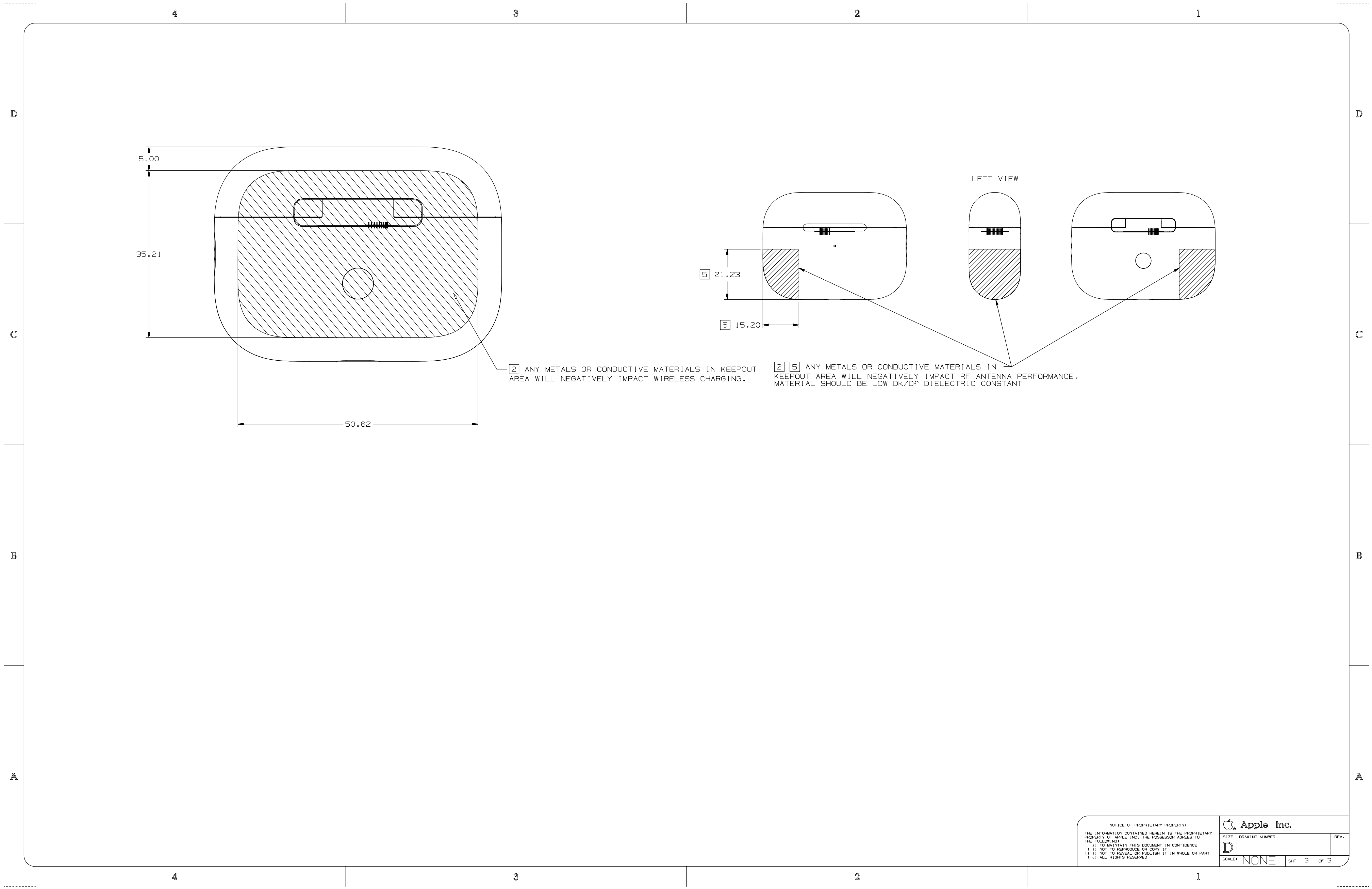
5 PROTECTIVE CASES OR COVERS MAY DETUNE OR IMPACT RF & WIRELESS CHARGING PERFORMANCE.
IMPACT IS HIGHLY DEPENDENT ON MATERIAL AND MATERIAL THICKNESS.
HIGHLY RECOMMEND AVOIDING METAL MATERIAL AND FOLLOWING GUIDELINES IN THIS DOCUMENT TO MINIMIZE IMPACT.



60.261 MagSafe Charging Case (USB-C) for AirPods Pro (2nd generation), 2 of 3



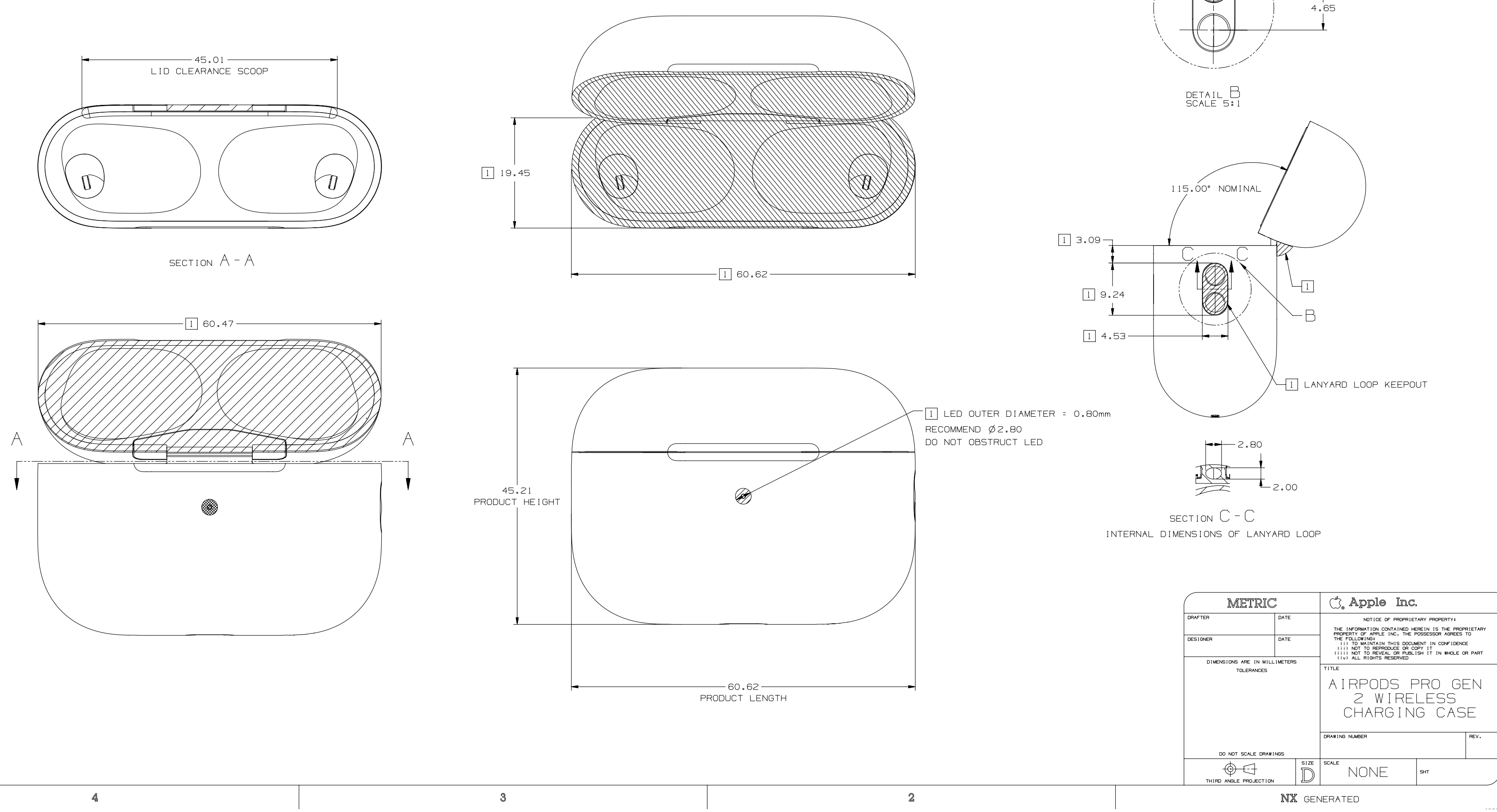
60.262 MagSafe Charging Case (USB-C) for AirPods Pro (2nd generation), 3 of 3



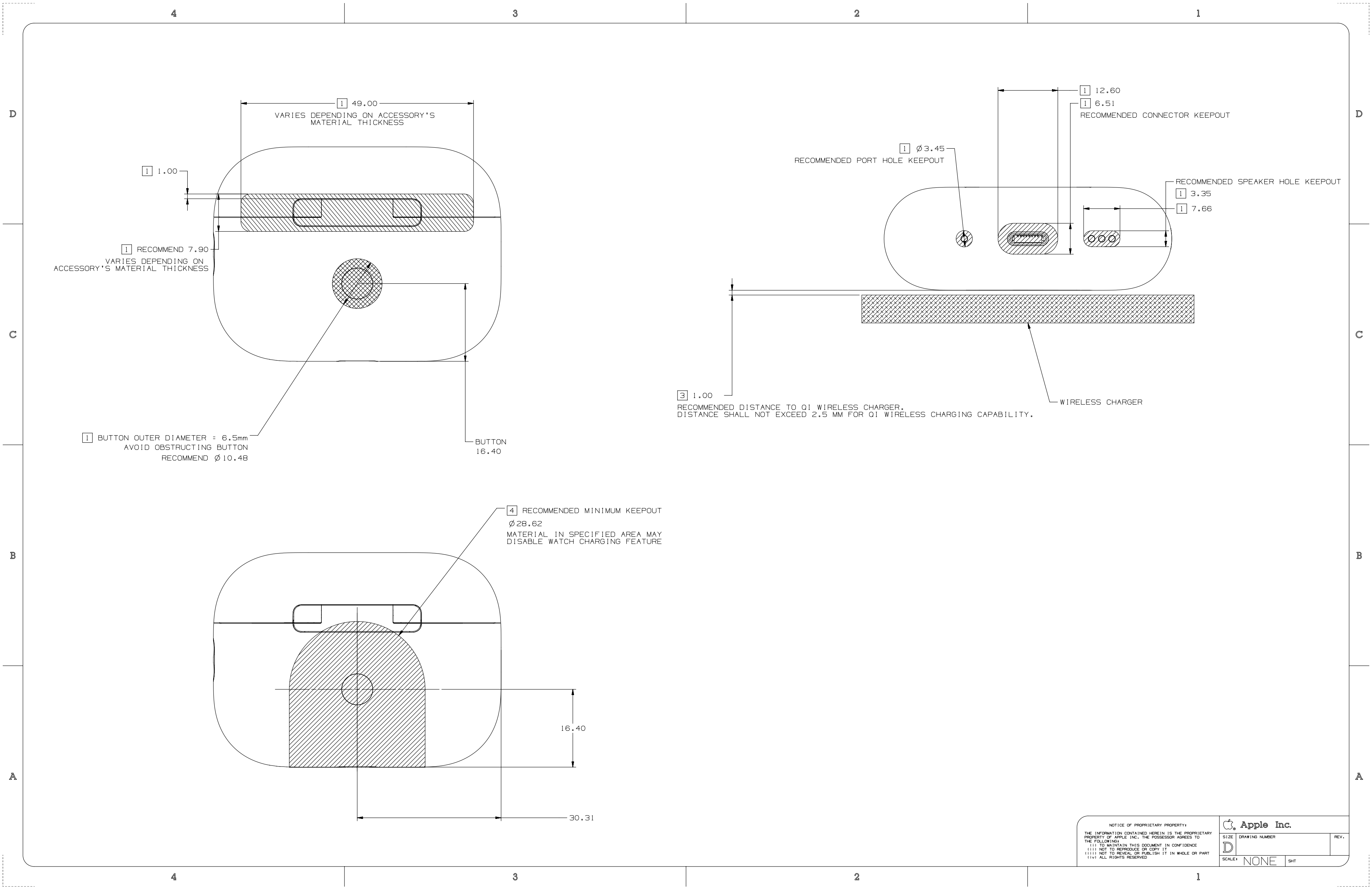
60.263 MagSafe Charging Case for AirPods Pro (2nd generation), 1 of 3

NOTES: (UNLESS OTHERWISE SPECIFIED)

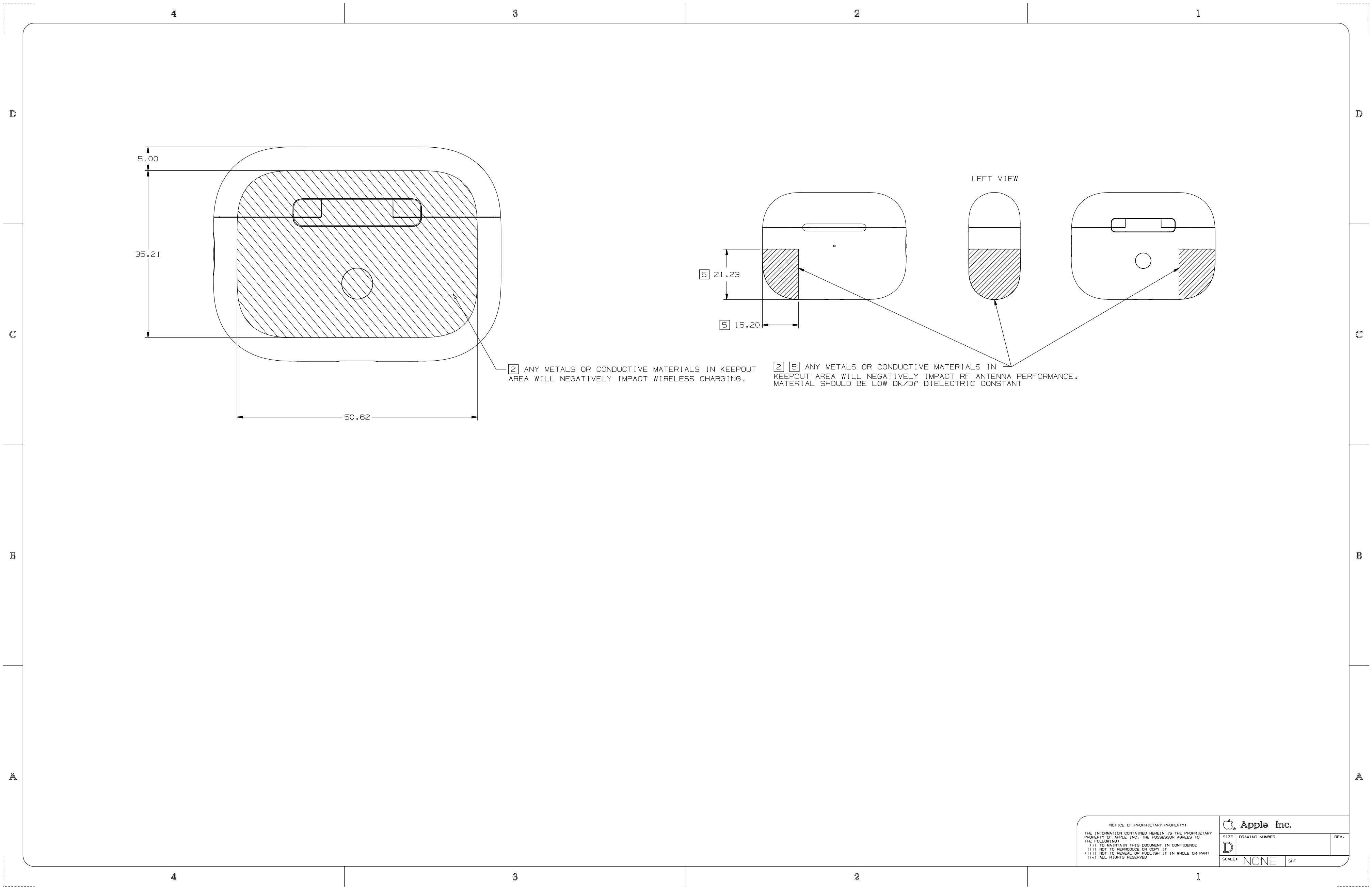
1. ACCESSORIES INTRUDING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE.
2. TO ENSURE FULL FUNCTIONALITY, DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL.
3. TO ENSURE FULL FUNCTIONALITY WITH MINIMAL IMPACT TO QI CHARGING PERFORMANCE, MINIMIZE ANY MATERIAL THICKNESS.
4. TO ENABLE CHARGING VIA APPLE WATCH CHARGER, IT IS RECOMMENDED THERE BE NO MATERIAL BETWEEN BACK OF DEVICE AND WATCH CHARGER.
5. PROTECTIVE CASES OR COVERS MAY DETUNE OR IMPACT RF & WIRELESS CHARGING PERFORMANCE.
IMPACT IS HIGHLY DEPENDENT ON MATERIAL AND MATERIAL THICKNESS.
HIGHLY RECOMMEND AVOIDING METAL MATERIAL AND FOLLOWING GUIDELINES IN THIS DOCUMENT TO MINIMIZE IMPACT.



60.264 MagSafe Charging Case for AirPods Pro (2nd generation), 2 of 3



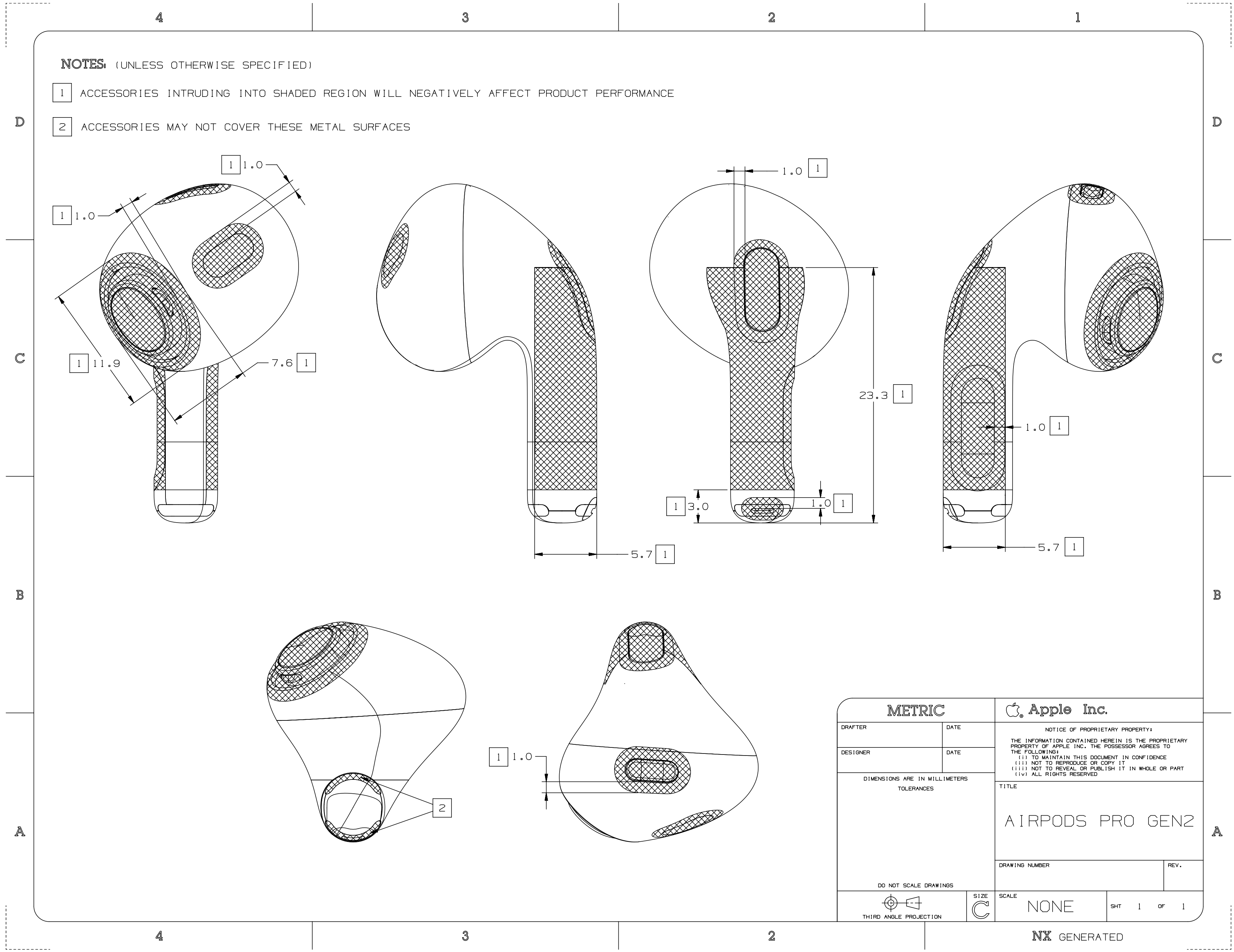
60.265 MagSafe Charging Case for AirPods Pro (2nd generation), 3 of 3



60.266 AirPods Pro (2nd generation)

NOTES: (UNLESS OTHERWISE SPECIFIED)

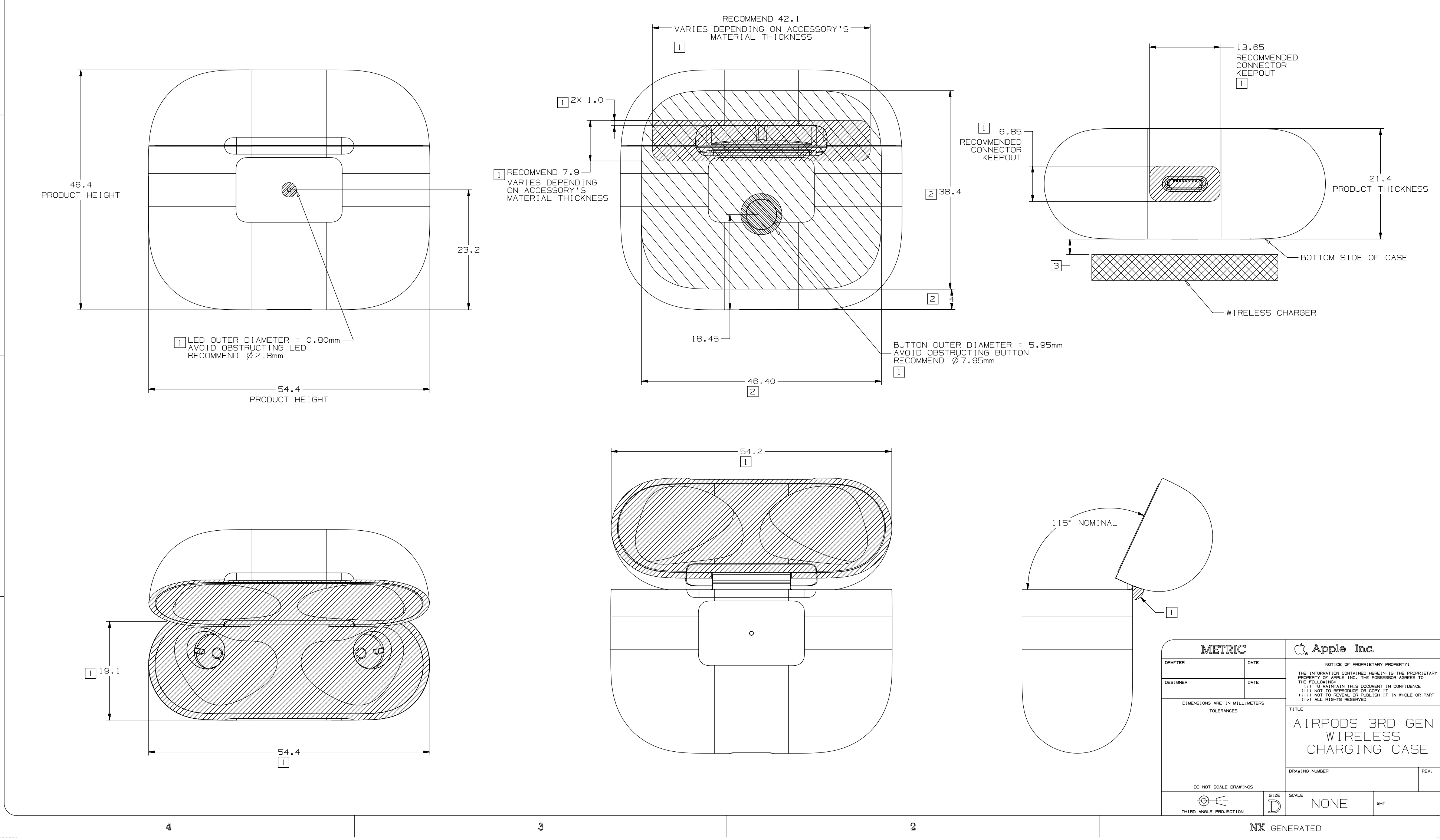
1. ACCESSORIES INTRUDING INTO SHADED REGION WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE
2. ACCESSORIES MAY NOT COVER THESE METAL SURFACES



60.267 MagSafe Charging Case for AirPods (3rd generation)

NOTES: (UNLESS OTHERWISE SPECIFIED)

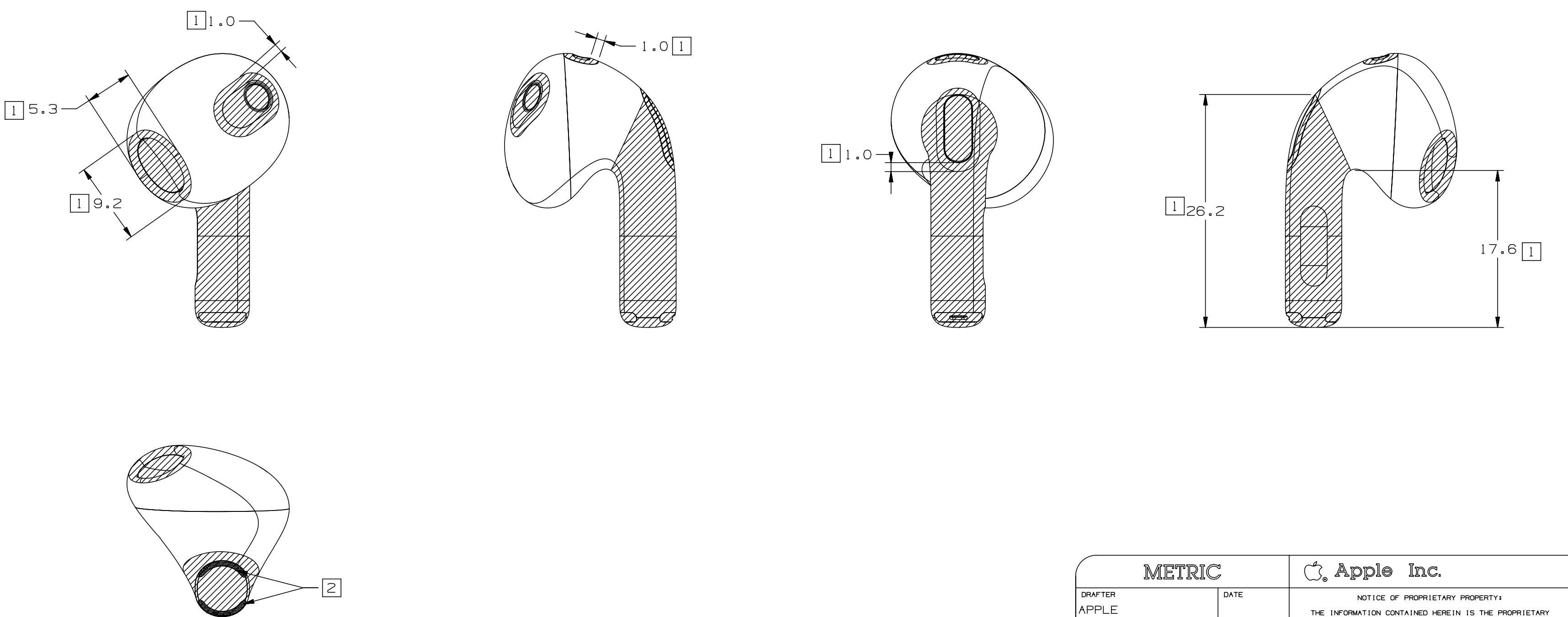
1. ACCESSORIES INTRUDING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE.
2. TO ENSURE FULL FUNCTIONALITY, DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL.
3. TO ENSURE FULL FUNCTIONALITY WITH MINIMAL IMPACT TO CHARGING PERFORMANCE, MINIMIZE ANY MATERIAL THICKNESS.



60.268 AirPods (3rd generation)

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ACCESSORIES INTRUDING INTO SHADED REGION WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE
2. ACCESSORIES MUST NOT COVER THESE METAL SURFACES



REV	ECO#	DESCRIPTION OF REVISION

METRIC

DRAFTER APPLE — DATE

DESIGNER APPLE — DATE

DIMENSIONS ARE IN MILLIMETERS
TOLERANCES

X.X ±0.2
X.XX ±0.10
X.XXX ±0.050
ANGLES ±0.5°

DO NOT SCALE DRAWINGS

THIRD ANGLE PROJECTION

SIZE C

Apple Inc.

NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED

TITLE
AirPods (3rd generation)

DRAWING NUMBER — REV. 01

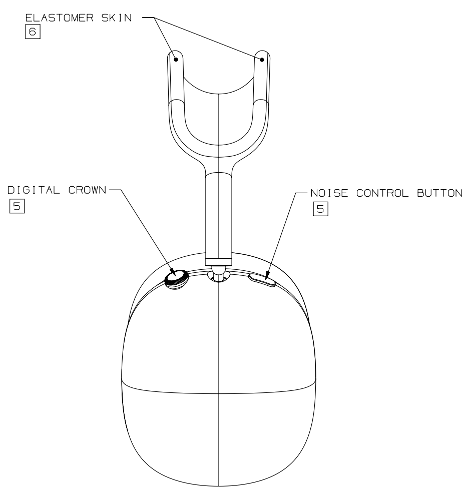
SCALE NONE — SHT 1 OF 1

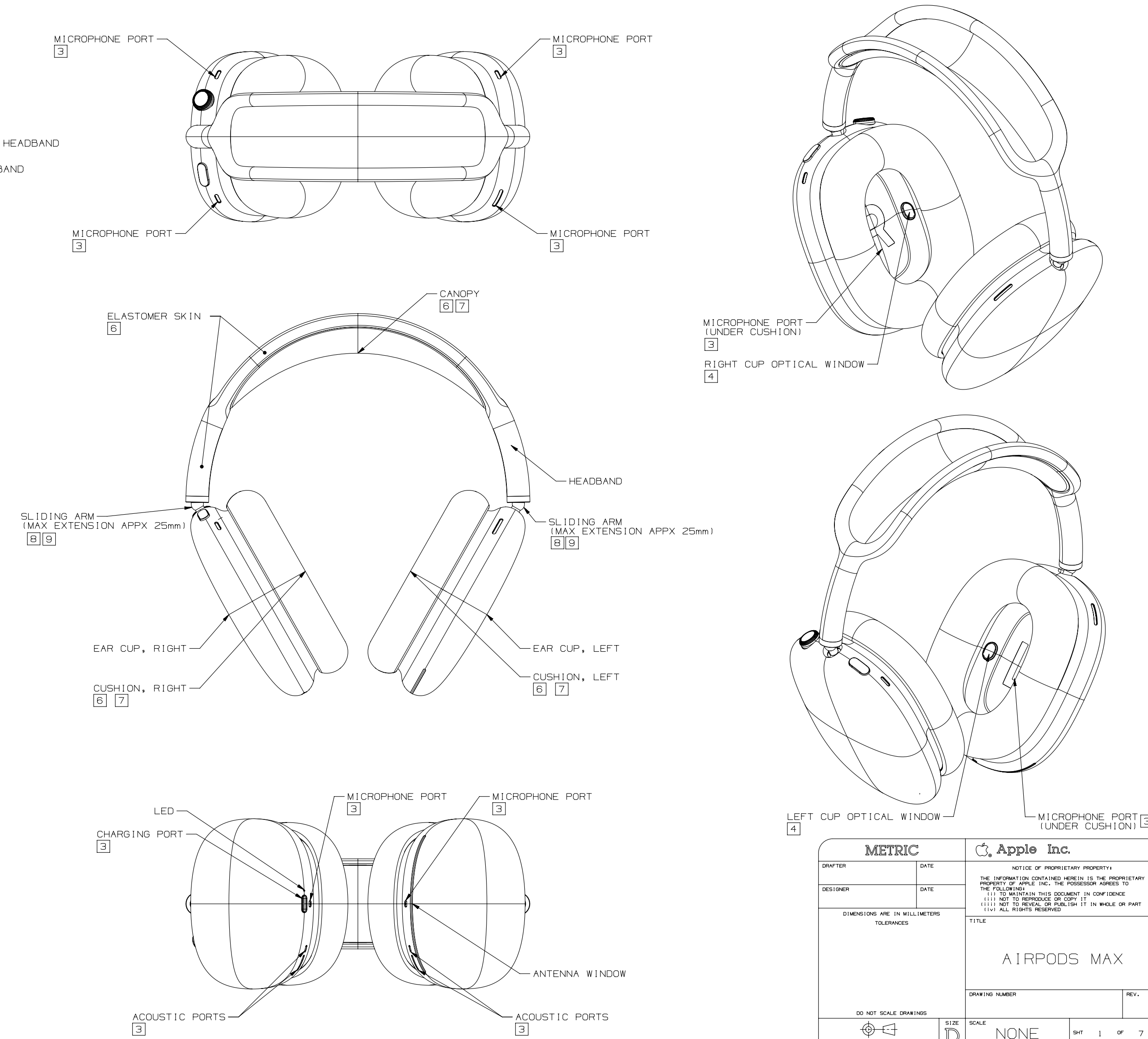
NX GENERATED

COMPONENT DEFINITION

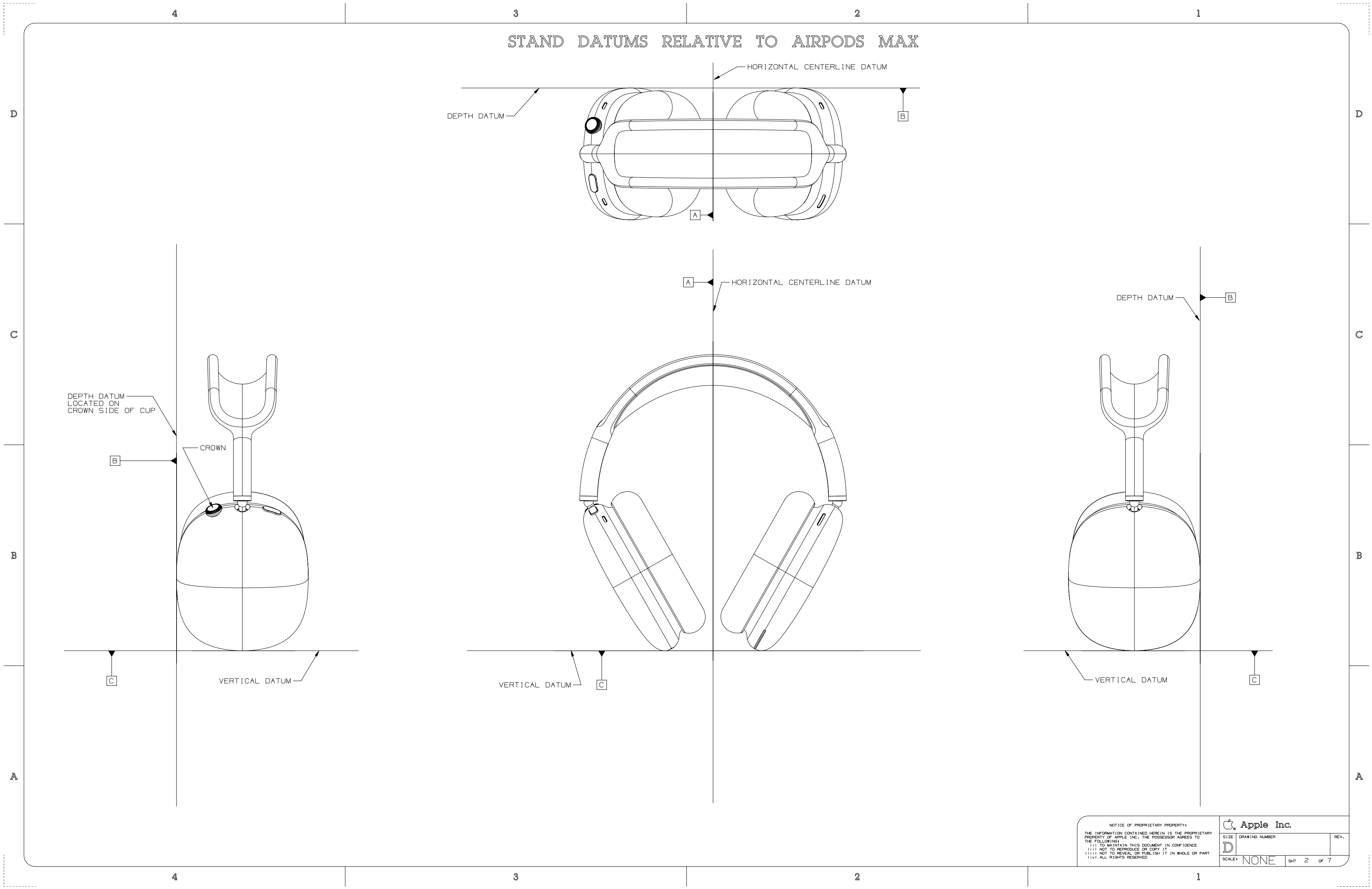
NOTES: (UNLESS OTHERWISE SPECIFIED)

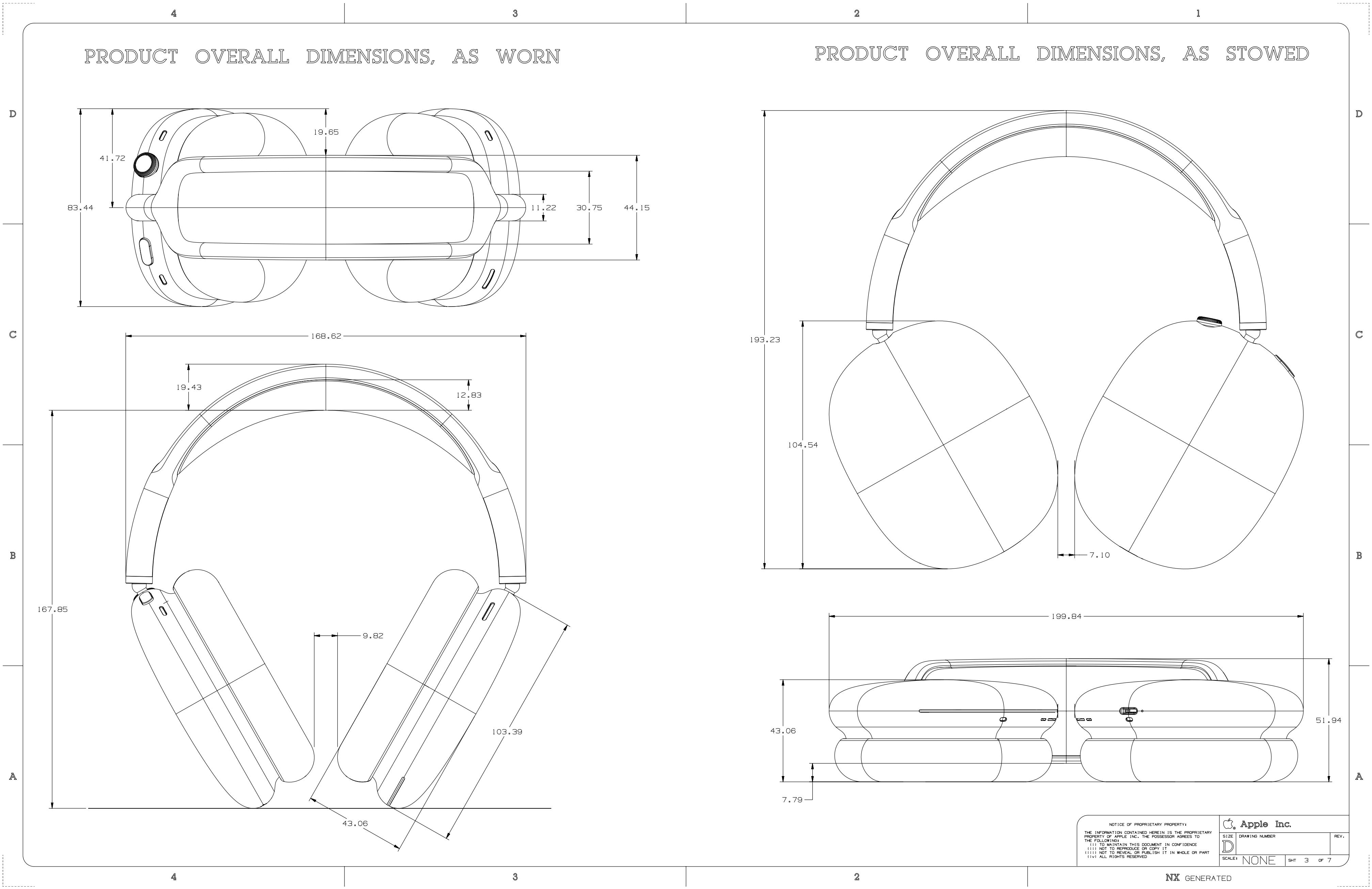
1 MEASURE MAGNETIC FLUX USING FLUX PROBE WITH CUPS ROTATED TO 'ON-HEAD' POSITION (AS SHOWN)
2. NO METAL CONTACT WITH PRODUCT
3 DO NOT OBSTRUCT PORTS
4 DO NOT OBSTRUCT OPTICAL WINDOWS
5 DO NOT APPLY PERSISTENT FORCE TO NOISE CONTROL BUTTON OR DIGITAL CROWN
6 DO NOT APPLY PERSISTENT FORCE TO CANOPY, CUSHION, OR ELASTOMER SKIN ON HEADBAND
7 DO NOT APPLY POINT LOADS TO CANOPY, CUSHION, OR ELASTOMER SKIN ON HEADBAND
8 DO NOT RESTRICT MOTION OF EAR CUP WITH RESPECT TO HEADBAND
9 DO NOT RESTRICT MOTION OF SLIDING ARMS ON HEADBAND

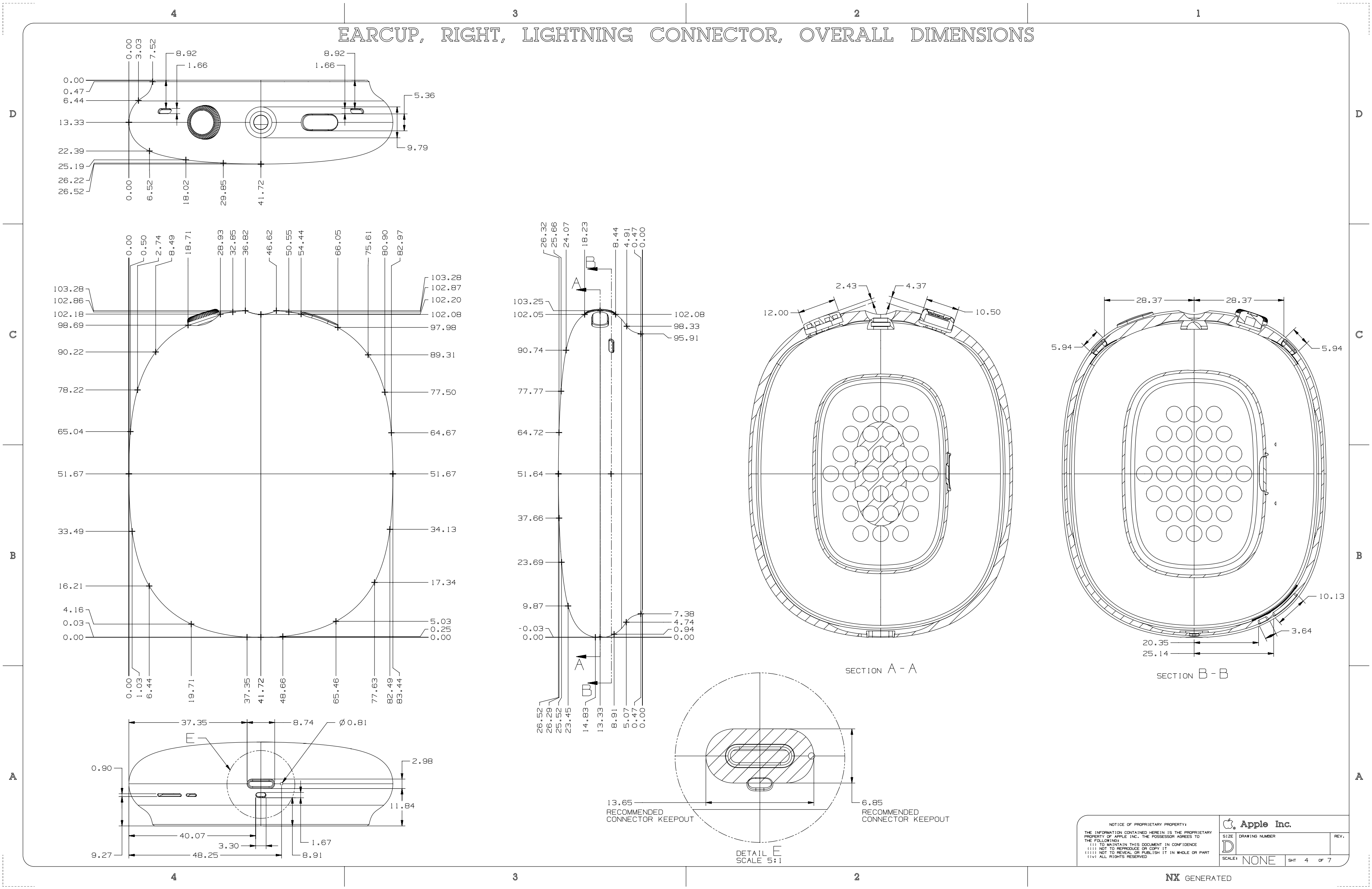


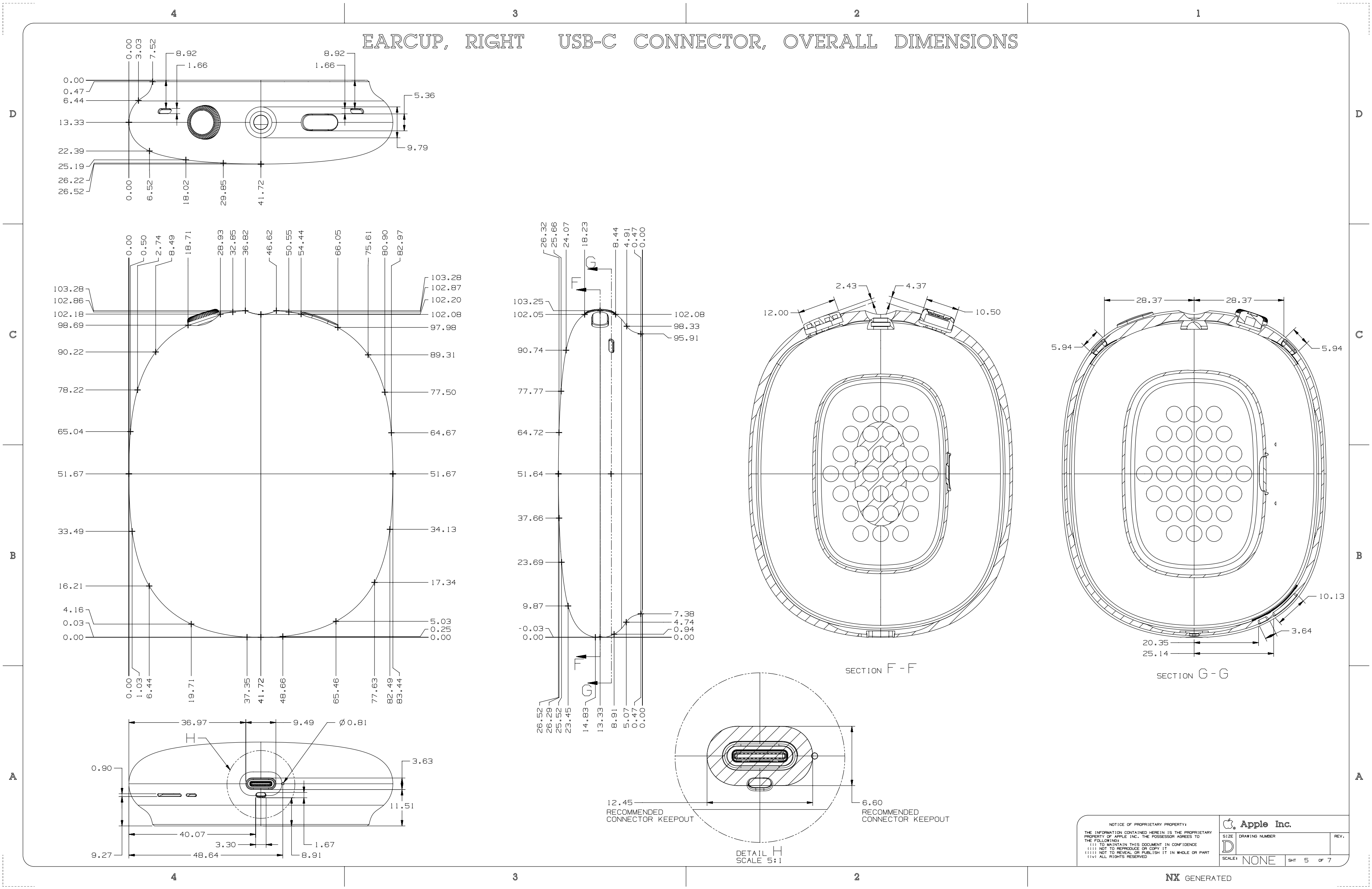


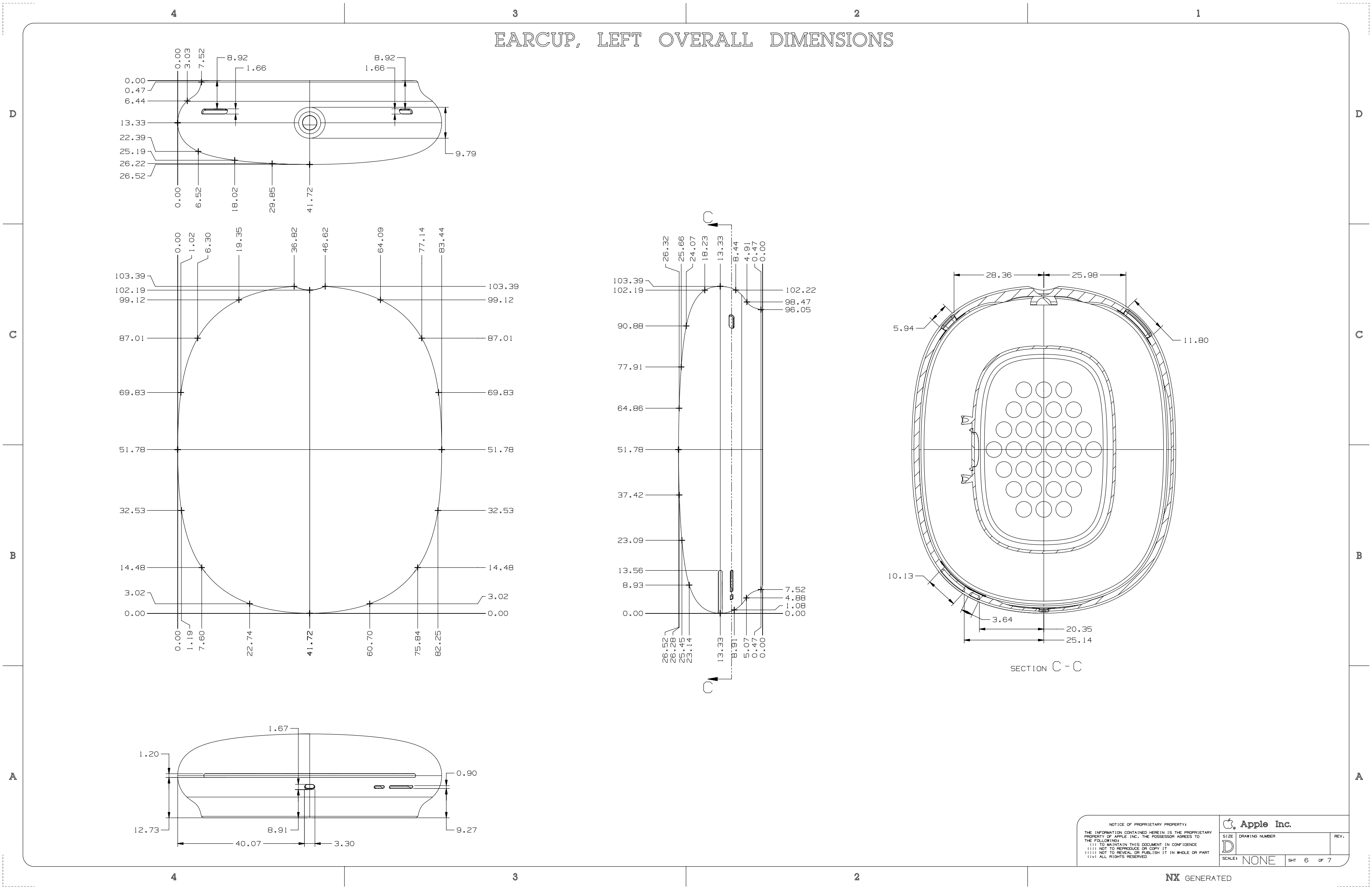
NX GENERATED


STAND DATUMS RELATIVE TO AIRPODS MAX
HORIZONTAL CENTERLINE DATUM
DEPTH DATUM
B
A
A
HORIZONTAL CENTERLINE DATUM
DEPTH DATUM
B
DEPTH DATUM
LOCATED ON
CROWN SIDE OF CUP
CROWN
B
C
VERTICAL DATUM
VERTICAL DATUM
C
VERTICAL DATUM
C
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE
D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 2 OF 7

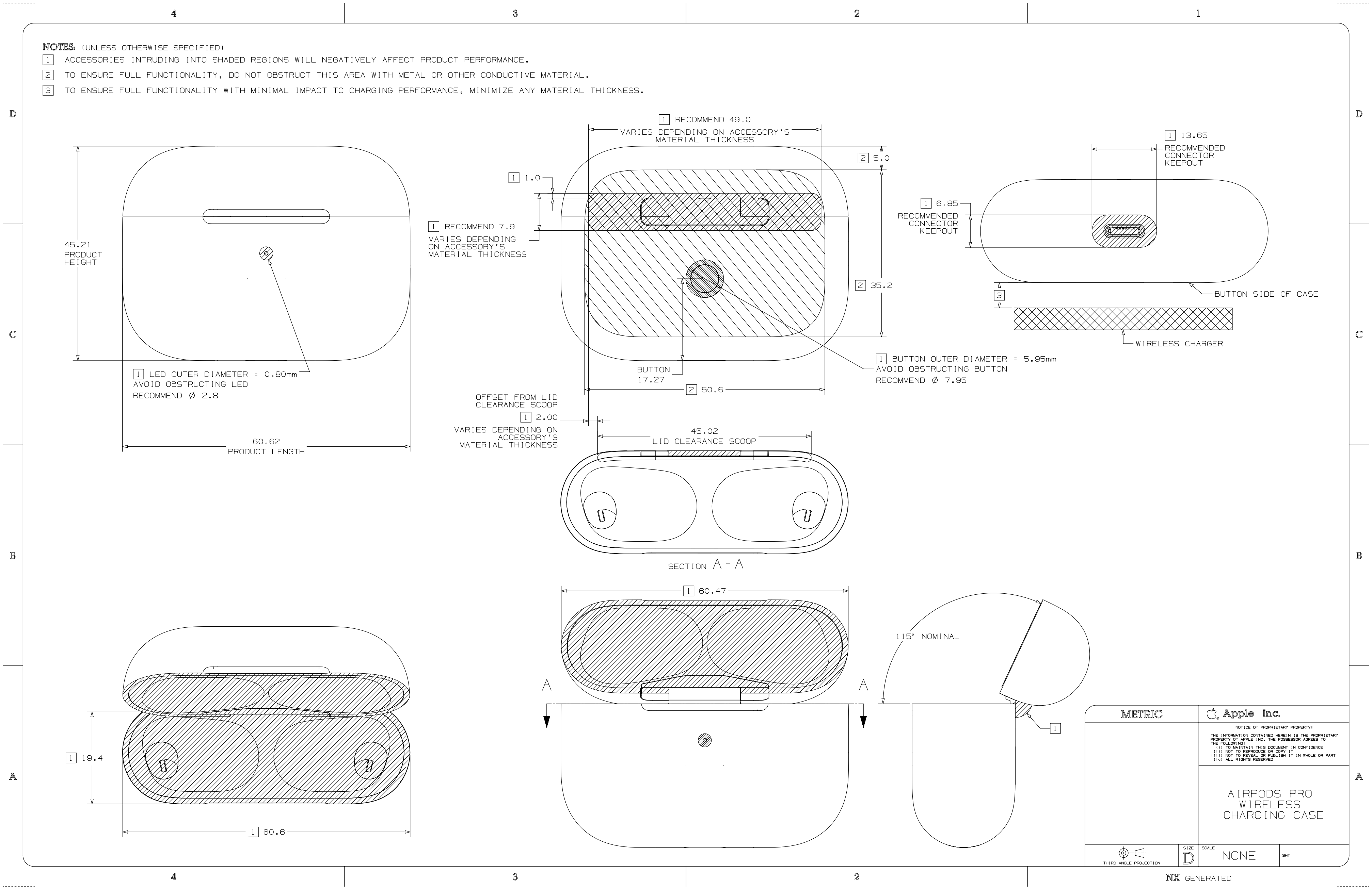

4
3
2
1
D
C
B
A
PRODUCT OVERALL DIMENSIONS, AS WORN
PRODUCT OVERALL DIMENSIONS, AS STOWED
19.65
41.72
83.44
11.22
30.75
44.15
168.62
19.43
12.83
167.85
9.82
103.39
43.06
193.23
104.54
7.10
199.84
43.06
51.94
7.79
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(i) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(ii) NOT TO REPRODUCE OR COPY IT
(iii) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(iv) ALL RIGHTS RESERVED
Apple Inc.
SIZE
D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 3 OF 7
NX GENERATED


EARCUP, RIGHT, LIGHTNING CONNECTOR, OVERALL DIMENSIONS
SECTION A - A
SECTION B - B
DETAIL E
SCALE 5:1
13.65
RECOMMENDED
CONNECTOR KEEPOUT
6.85
RECOMMENDED
CONNECTOR KEEPOUT
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 4 OF 7
NX GENERATED

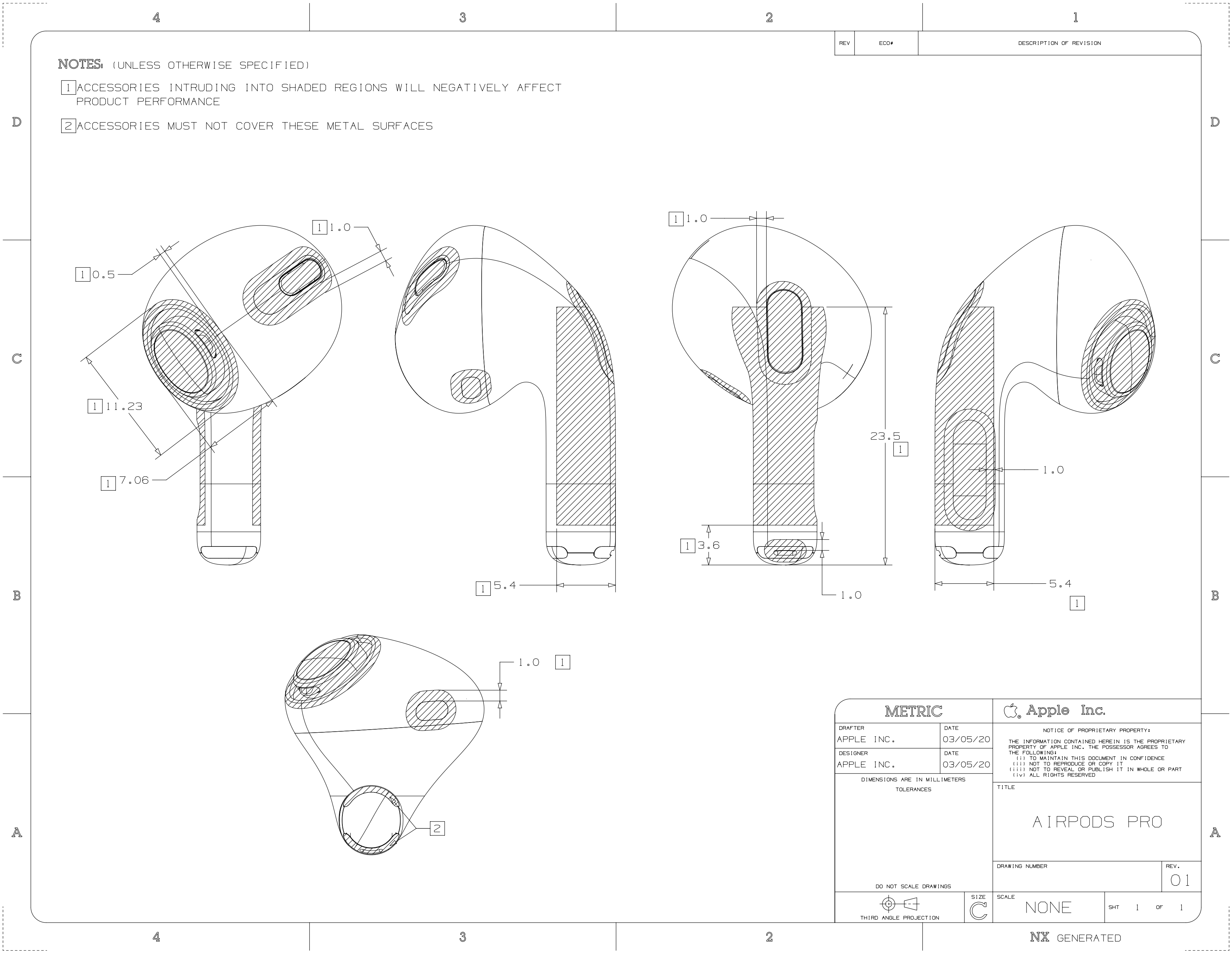

EARCUP, RIGHT USB-C CONNECTOR, OVERALL DIMENSIONS
SECTION F-F
SECTION G-G
DETAIL H
SCALE 5:1
12.45
RECOMMENDED
CONNECTOR KEEPOUT
6.60
RECOMMENDED
CONNECTOR KEEPOUT
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 5 OF 7
NX GENERATED


EARCUP, LEFT OVERALL DIMENSIONS
SECTION C - C
NOTICE OF PROPRIETARY PROPERTY:
THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF APPLE INC. THE POSSESSOR AGREES TO THE FOLLOWING:
(I) TO MAINTAIN THIS DOCUMENT IN CONFIDENCE
(II) NOT TO REPRODUCE OR COPY IT
(III) NOT TO REVEAL OR PUBLISH IT IN WHOLE OR PART
(IV) ALL RIGHTS RESERVED
Apple Inc.
SIZE D
DRAWING NUMBER
REV.
SCALE: NONE
SHT 6 OF 7
NX GENERATED

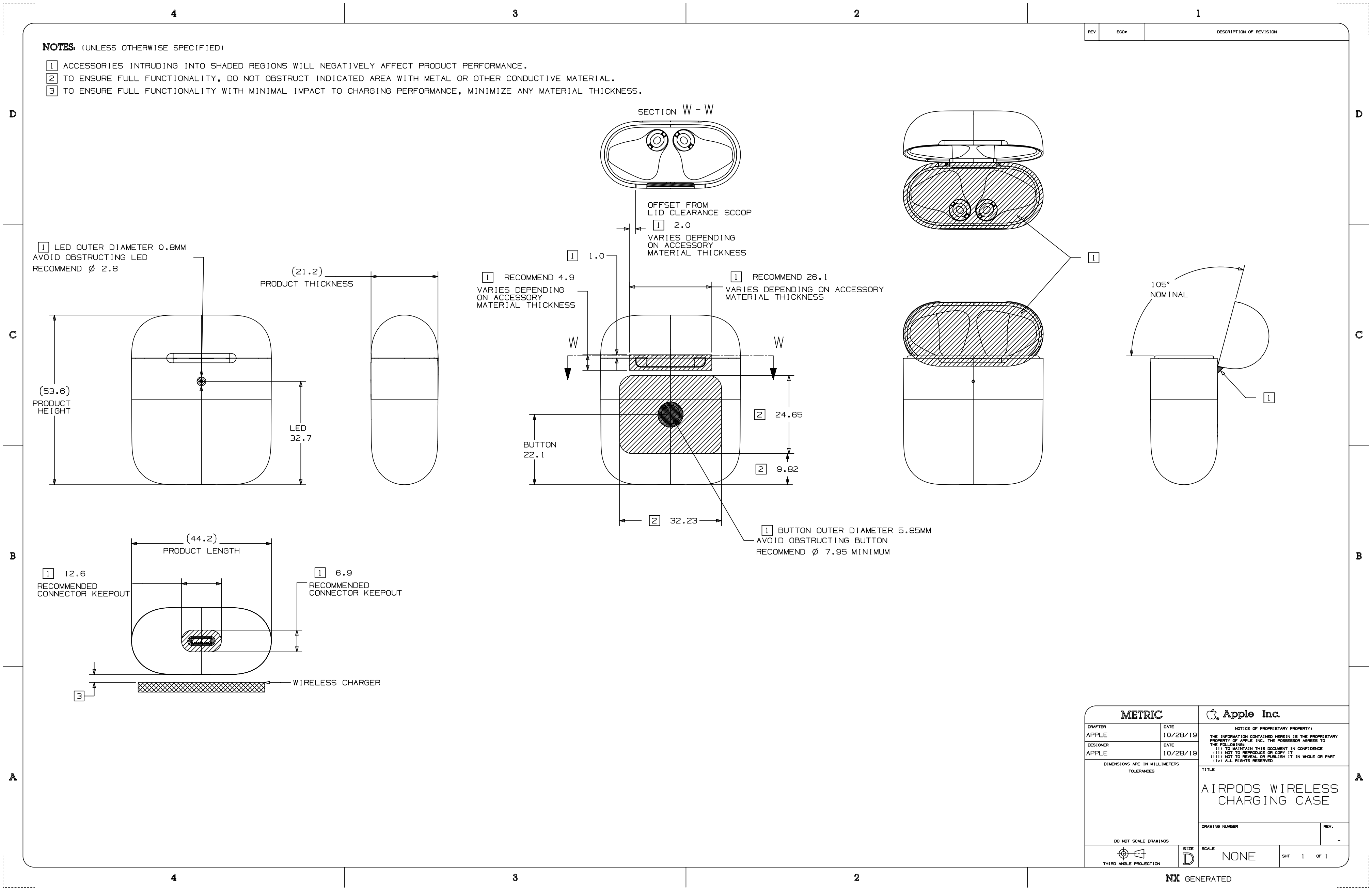
60.275 Wireless Charging Case for AirPods Pro (1st generation)



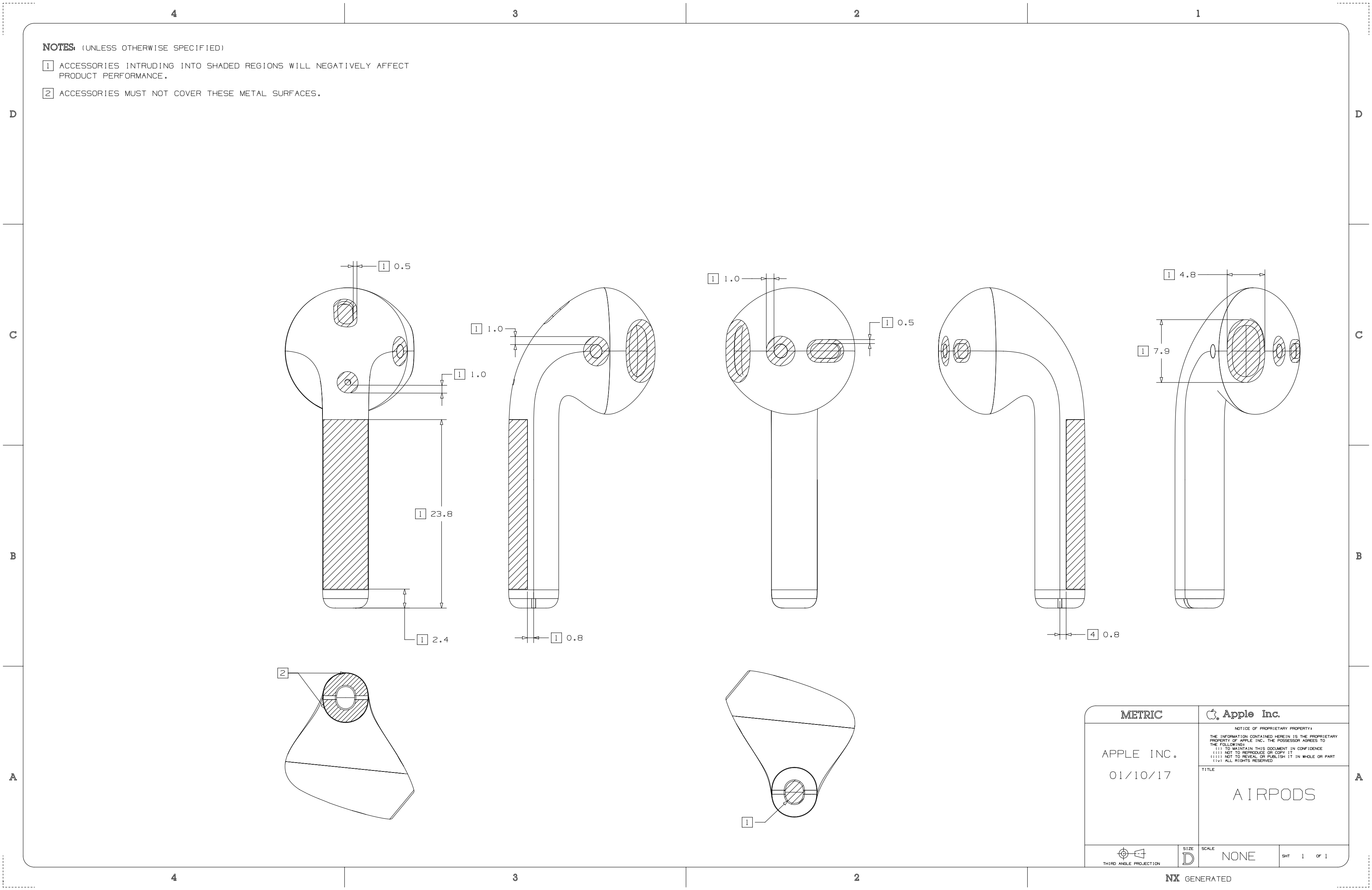
60.276 AirPods Pro (1st generation)



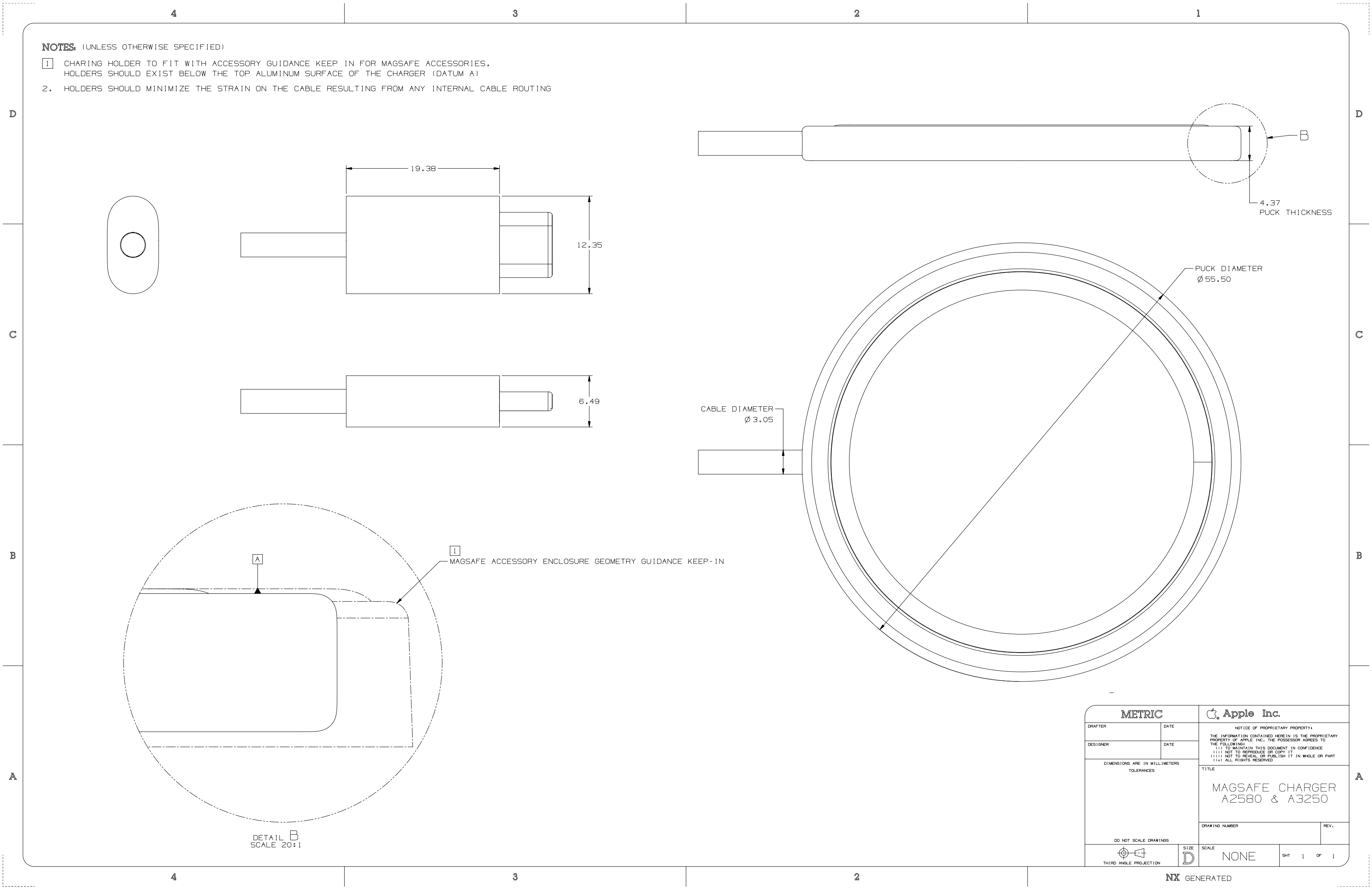
60.277 Wireless Charging Case for AirPods



60.278 AirPods (2nd generation) and AirPods (1st generation)



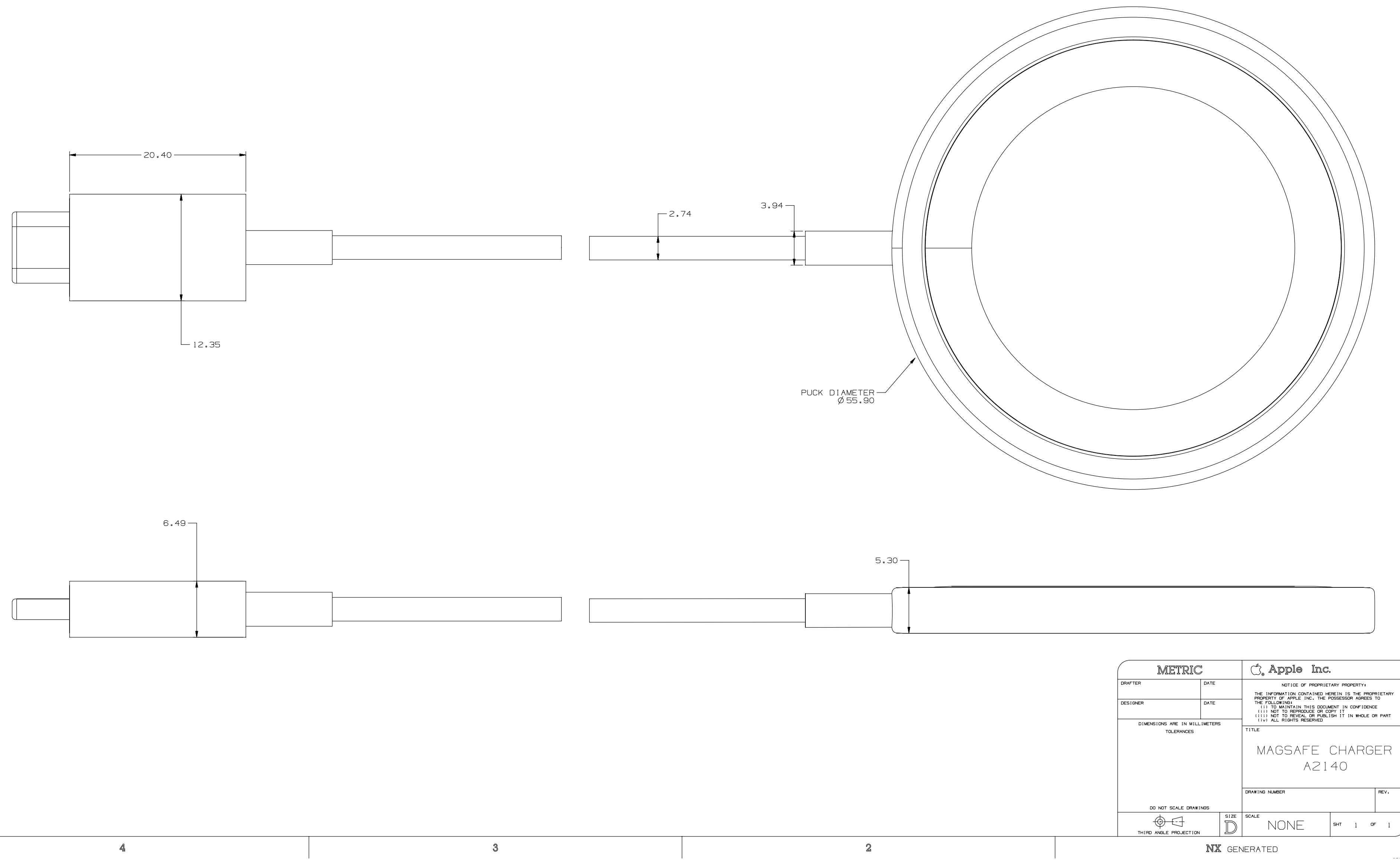
60.279 Apple MagSafe Charger (1 m) and Apple MagSafe Charger (2 m)



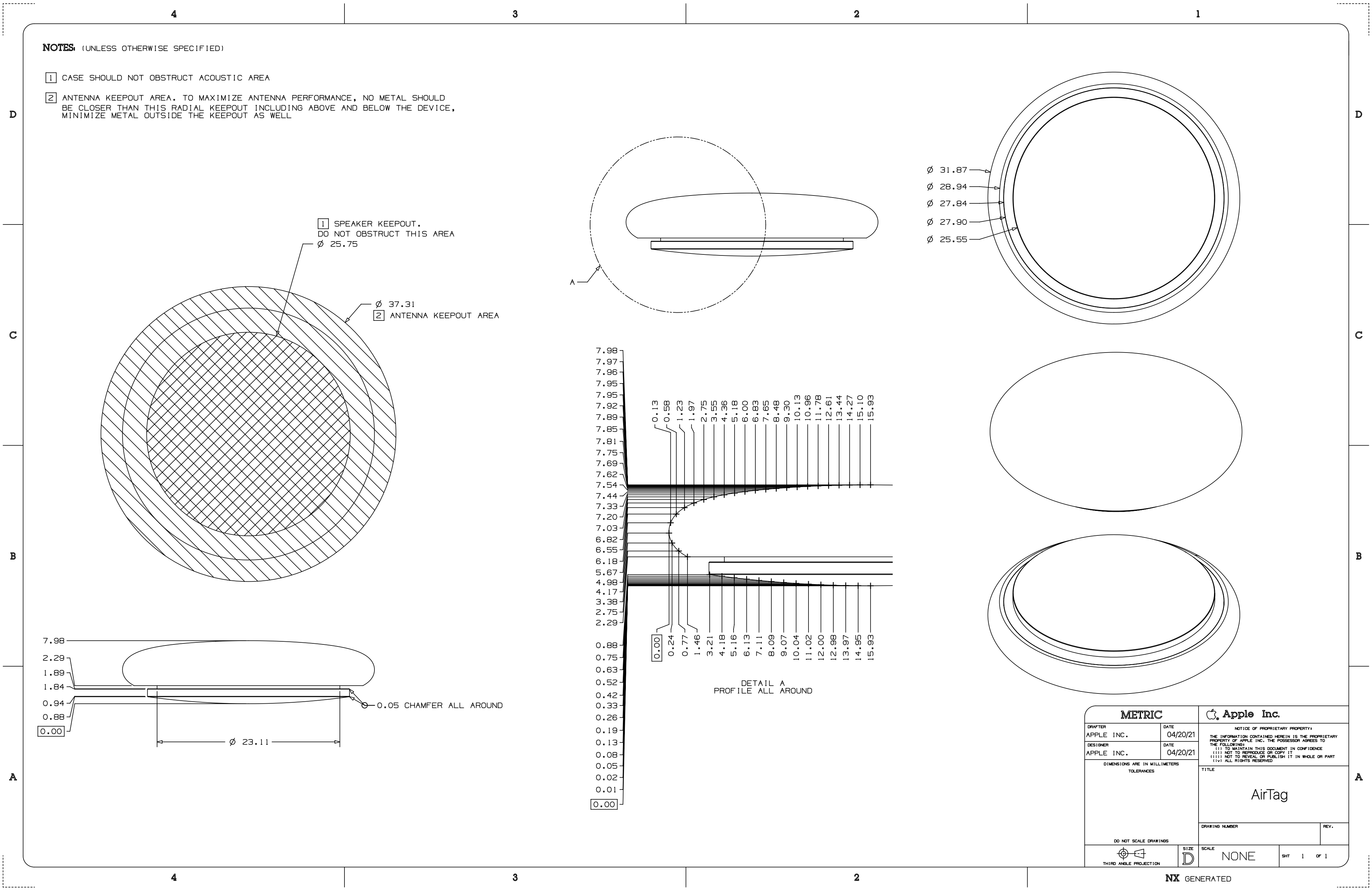
60.280 Apple MagSafe Charger

NOTES: (UNLESS OTHERWISE SPECIFIED)

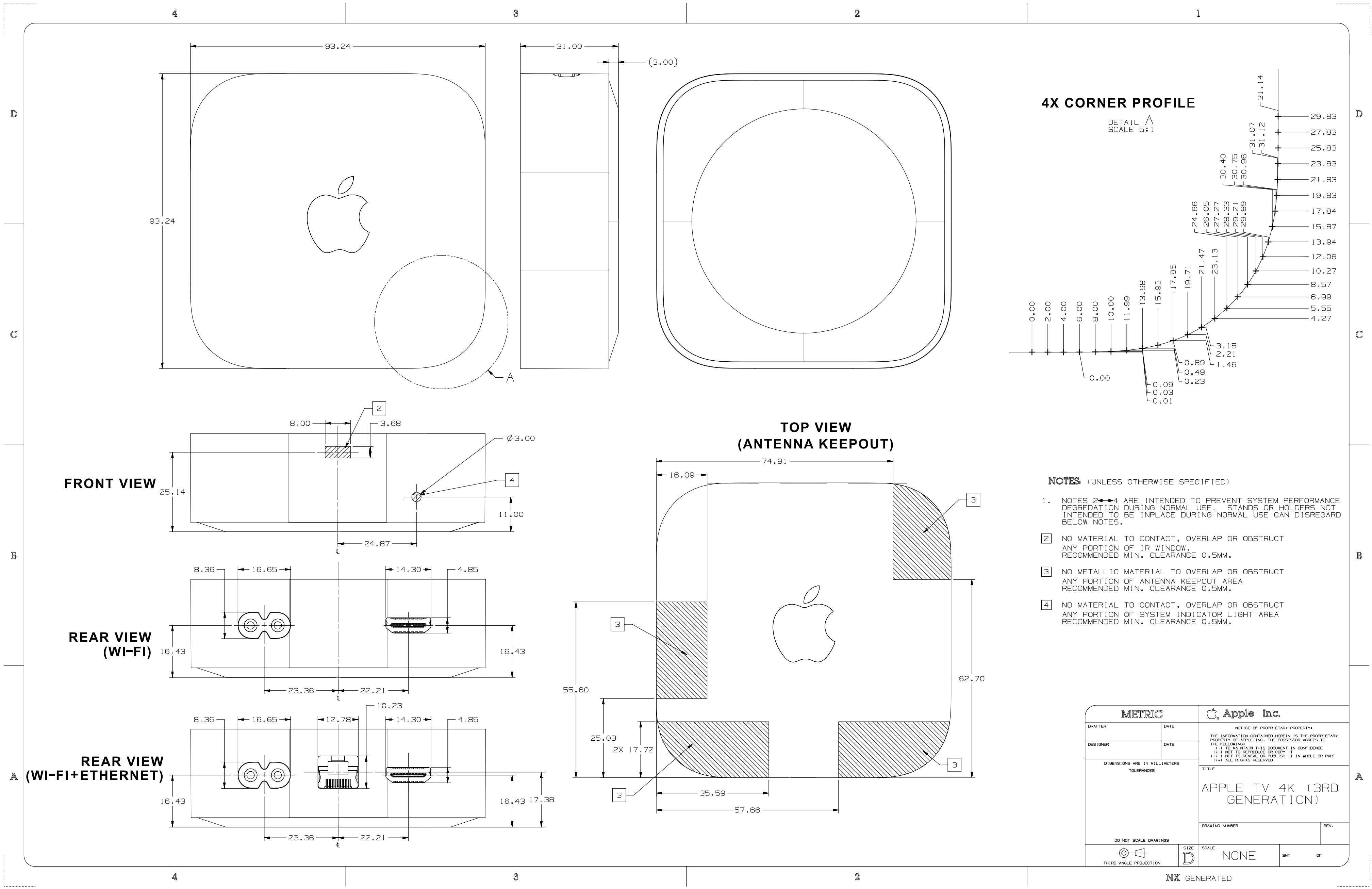
1. CHARING HOLDER TO FIT WITH ACCESSORY GUIDANCE KEEP IN FOR MAGSAFE ACCESSORIES. HOLDERS SHOULD EXIST BELOW THE TOP ALUMINUM SURFACE OF THE CHARGER (DATUM A)
2. HOLDERS SHOULD MINIMIZE THE STRAIN ON THE CABLE RESULTING FROM ANY INTERNAL CABLE ROUTING



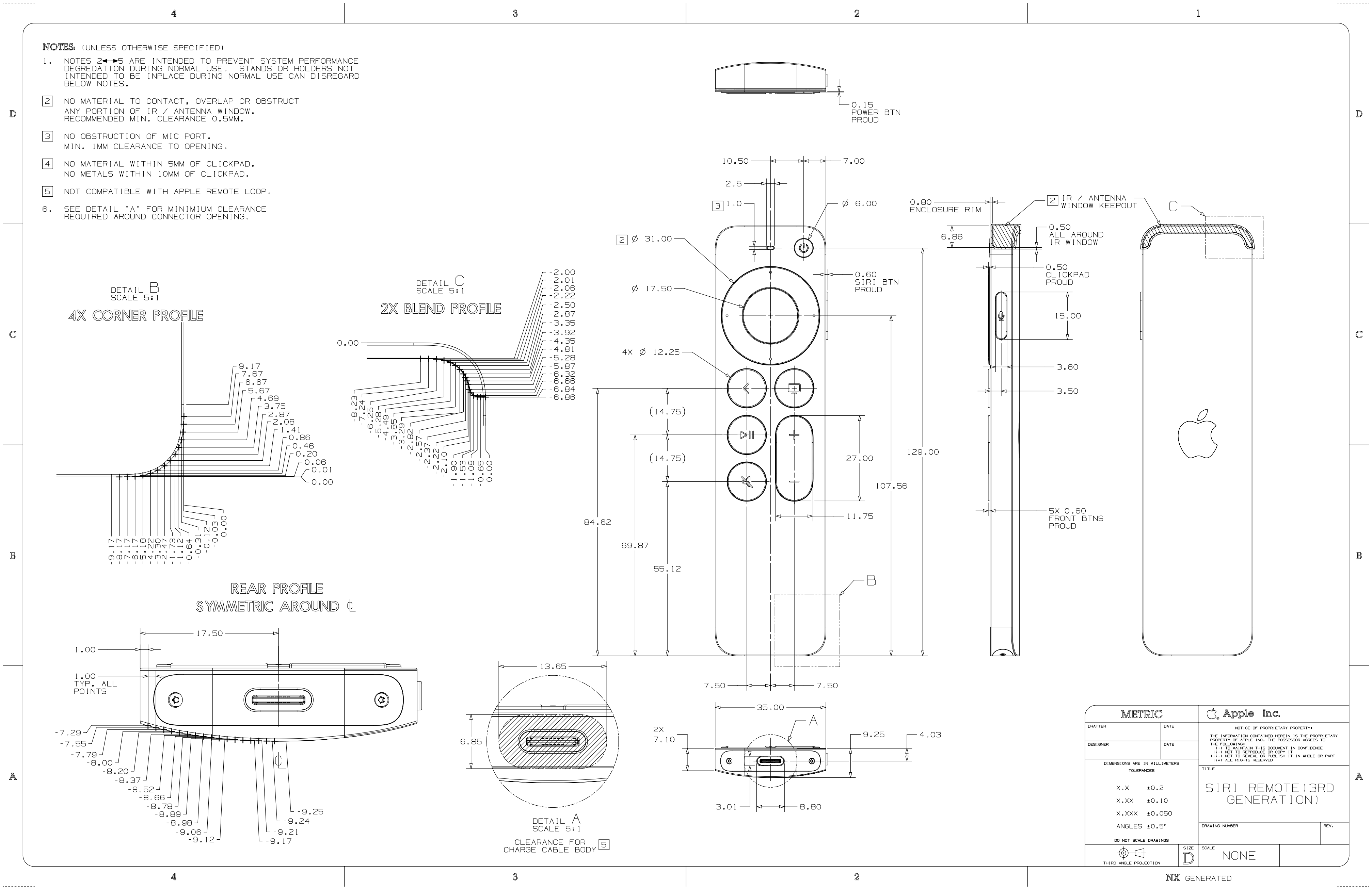
60.281 AirTag



60.282 Apple TV 4K (3rd generation)



60.283 Siri Remote (3rd generation)



Revision History

Added Content

- Braille Displays and Keyboards (page 108)
- iPhone 16e, 1 of 2 (page 298)

Updated Content

- Access to the Camera Control (page 36)
- MagSafe Case Magnet Array (page 177)
  - Magnets (page 178)
- iPad Air 13-inch (M3) and iPad Air 13-inch (M2), 1 of 5 (page 375)
- iPad Air 11-inch (M3) and iPad Air 11-inch (M2), 1 of 5 (page 380)
- iPad (A16) and iPad (10th generation), 1 of 7 (page 385)

Terms and Conditions (“Terms”)

These Guidelines are made available to you for informational purposes only. If you make or distribute any accessory for an Apple device based on or in connection with these Guidelines (“Accessories”), you agree to the following covenants, terms and conditions:

All intellectual property rights in and to the Guidelines, and all technology described therein, are retained by Apple Inc. (“Apple”). You acknowledge and agree that Apple is not granting you, and nothing contained herein shall constitute or be construed or interpreted as a grant, by implication, estoppel or otherwise, of any license, covenant, immunity, release or right under or with respect to any intellectual property rights of Apple, including without limitation any rights to make, use, have made, sell, import, or otherwise relating in any way to any Apple device or technology described in or relating to the Guidelines.

You agree to follow Apple’s Guidelines For Using Apple Trademarks and Copyrights as published on Apple’s website at www.apple.com/legal/guidelinesfor3rdparties.html (“IP Guidelines”) and as may be modified from time to time. You agree not to use the marks “Apple,” the Apple Logo, “Mac”, “iPhone,” “iPod touch,” “iPad,” “Apple Watch,” “ WATCH” or any other marks belonging or licensed to Apple in any way except as expressly authorized in writing by Apple in each instance or as permitted in the IP Guidelines. You agree that all goodwill arising out of your authorized use of Apple’s marks shall inure to the benefit of and belong to Apple.

You agree to indemnify, hold harmless, and, at Apple’s option, defend, Apple against any claims, causes of action, losses, liabilities, damages, fines, settlements, costs, fees, and expenses (including attorney and other professional fees and expenses) arising out of: (i) your use of the Guidelines, including without limitation, any claims that any Accessory, or the combination of any Accessory with any software, technology, intellectual property, device, apparatus or assembly not supplied by Apple, infringes any patent, copyright, trade secret or other intellectual property right; (ii) the manufacture, use, promotion, distribution, sale, offer for sale, import, other distribution or exploitation or performance of any product, case, cover, band, charging stand, or other Accessory or product incorporating any Accessory, including any personal injury or product liability claims; or (iii) any failure to comply with any of the Guidelines. You will not, without Apple’s prior written consent, make any admissions of liability, enter into any settlement that imposes any obligation on Apple, or publicize any settlement details relating to Apple. In addition, for any claims related to these Terms where you do not have an indemnification obligation, you shall provide all reasonable assistance to Apple and/or its counsel in connection with the defense, remedy or mitigation of such claims.

Applicable laws or regulations may impose additional restrictions or requirements on Accessories or products that incorporate the Accessories. You represent and warrant that you are in full compliance with all applicable laws, regulations, and policies in the United States and in any other location in which you engage, in whole or in part, in any activity related to the design, manufacture, marketing, sale or offer for sale, use, or other distribution of Accessories or products that incorporate the Accessories. You agree to promptly notify Apple of any complaints or threats of complaints regarding products that incorporate the Accessories with respect to any such regulatory requirements, in which case Apple may limit or terminate your ability to make, sell or purchase additional Accessories.

You expressly acknowledge and agree that access to the Guidelines is at your sole and entire risk and that you are solely responsible and liable for any harm or damage to any Apple product arising out of any breach by you of these covenants, terms and conditions. THE GUIDELINES ARE PROVIDED “AS IS” AND WITHOUT REPRESENTATION, WARRANTY, UPGRADES OR SUPPORT OF ANY KIND. APPLE AND APPLE’S DISTRIBUTORS, AFFILIATES, LICENSOR(S) AND SUPPLIER(S) (“APPLE PARTIES”) EXPRESSLY DISCLAIM ALL REPRESENTATIONS, WARRANTIES AND CONDITIONS, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES AND CONDITIONS OF MERCHANTABILITY, OF SATISFACTORY QUALITY, OF FITNESS FOR A PARTICULAR PURPOSE, OF NON-INFRINGEMENT AND OF ACCURACY. NONE OF THE APPLE PARTIES WARRANTS THAT THE GUIDELINES OR ANY ACCESSORY WILL MEET YOUR REQUIREMENTS, THAT DEFECTS IN THEM WILL BE CORRECTED OR THAT THEY WILL BE COMPATIBLE WITH FUTURE APPLE PRODUCTS. NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY ANY APPLE PARTY OR AN APPLE AUTHORIZED REPRESENTATIVE WILL CREATE A WARRANTY.

EXCEPT TO THE EXTENT SUCH A LIMITATION IS PROHIBITED BY LAW, IN NO EVENT WILL ANY APPLE PARTY BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, CONSEQUENTIAL, EXEMPLARY OR PUNITIVE DAMAGES, INCLUDING LOST PROFITS, LOST REVENUES OR BUSINESS INTERRUPTIONS, ARISING OUT OF OR RELATING TO THE GUIDELINES UNDER A THEORY OF CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE), PRODUCTS LIABILITY OR OTHERWISE, EVEN IF ANY APPLE PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, AND NOTWITHSTANDING THE FAILURE OF ESSENTIAL PURPOSE OF ANY REMEDY. IN NO EVENT WILL THE APPLE PARTIES’ TOTAL LIABILITY TO YOU FOR ALL DAMAGES AND CLAIMS UNDER OR RELATED TO THE GUIDELINES EXCEED THE AMOUNT OF US$50.00.

These Terms will be governed by and construed and enforced under the laws of the United States and the State of Delaware, except that the arbitration clause and any arbitration hereunder shall be governed by the Federal Arbitration Act, Chapters 1 and 2. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to these Terms. All disputes arising out of or in connection with these Terms shall be finally settled under the Rules of Arbitration of the International Chamber of Commerce by one arbitrator appointed in accordance with such rules, and shall be conducted according to the International Bar Association Rules on the Taking of Evidence in International Arbitration. The arbitration shall take place in San Francisco, California. The arbitration shall be conducted in English. The award shall be rendered within six months of the commencement of the arbitration, unless the arbitrator determines that the interest of justice requires that such limit be extended.