

Accessory Design Guidelines for Apple Devices

Release R21

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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:

- The physical design of cases, covers, screen overlays, and camera attachments for iOS and iPadOS devices.
- The specifications for hardware accessories using USB-C to interface with iOS and iPadOS devices.
- The specifications for hardware accessories using the Bluetooth transport to communicate with iOS devices, iPadOS devices, watchOS devices, tvOS devices, and Mac computers.
- The design of AC power adapters and battery packs for iOS devices, iPadOS devices, and AirPods.
- The design of Qi wireless transmitters for iOS devices and AirPods.
- The physical design of band accessories compatible with Apple Watch.

These guidelines do not address other aspects of accessory communication. Instead, see the [Apple MFi Licensing Program](#) (page 23) and the [Accessory Interface Specification](#) (page 23).

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 22), 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 22).

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 Accessory Interface Specification

The *Accessory Interface Specification* is available to members of the [Apple MFi Licensing Program](#) (page 23).

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

3.8 Apple MFi Licensing Program

The Apple MFi licensing 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.

Accessories

4. All Accessories

Requirements in this section apply to all accessories regardless of their supported features.

4.1 Scratches and Damage

Accessories shall not scratch or damage any device.

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 Integrated USB Receptacles

Accessories incorporating a USB receptacle for the purpose of drawing power from an external USB power source shall meet the following requirements:

- USB-B receptacles shall comply with the *USB Battery Charging Specification, Release 1.2*.
- USB-C receptacles shall comply with the requirements in [Drawing Power](#) (page 244).

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 74), or [Battery Packs](#) (page 77) 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.

4. All Accessories

4.5 TDMA Noise

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.

The following devices feature optical image stabilization:

4. All Accessories

4.8 Radio Frequency (RF) Performance

- 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

This section contains RF performance requirements and recommendations for accessories.

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 253).

Accessory [Materials and Coatings](#) (page 28) 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 28) zones.
- Contain active electronic circuitry, such as:
 - Bluetooth radios.
 - Switched-mode power supplies.
 - High speed data interfaces.

All accessory configurations shall be taken into account when designing for maximum RF compatibility.

Examples include, but are not limited to:

- Accessory on/off.

4. All Accessories

4.8 Radio Frequency (RF) Performance

- Accessory open/closed.
- [Attachments](#) (page 26) 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 Licensing Program](#) (page 23).

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 28) zones.

The following devices are NFC enabled:

- 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

4. All Accessories

4.9 Thermal Management

- 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 it claims compatibility with.

4.10 Tripod Connections

Tripod connections shall comply with ISO 1222:2010. See <https://www.iso.org/standard/55918.html>.

5. Cases

Cases are accessories substantially enclosing devices.

Accessories substantially enclosing devices shall comply with the requirements stated in this chapter unless the accessory supports other features in this specification whose requirements conflict with the requirements in this chapter.

If the case has multiple user-detachable components substantially enclosing the device, the requirements shall be applied to each component separately.

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. Dimensional drawings for devices can be found in [Device Dimensional Drawings](#) (page 253).

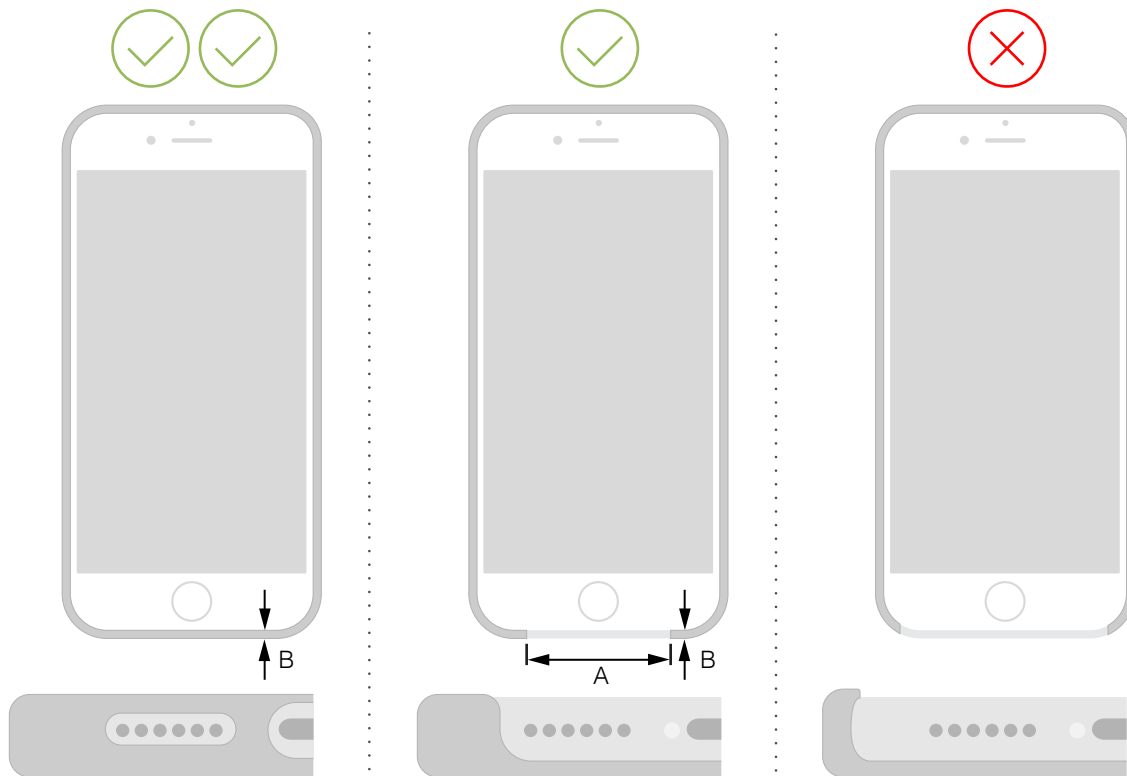
5.1.1 Device Protection

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 32).
- Be made of polycarbonate (PC) at least 1.15 mm thick, see dimension 'B' in [Figure 5-1](#) (page 32).

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.
- Ring/Silent switch.
- Action button.
- Side button.
- Home/Touch ID sensor.
- Home button.
- Sleep/Wake button.

5.1.2.2 Access to the USB-C Connector

If the case is for a device with a USB-C receptacle, the opening (that is, keep-out area):

- Shall be at least 12.35 mm by 6.50 mm.

5. Cases

5.1 Product Design

- 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 246).

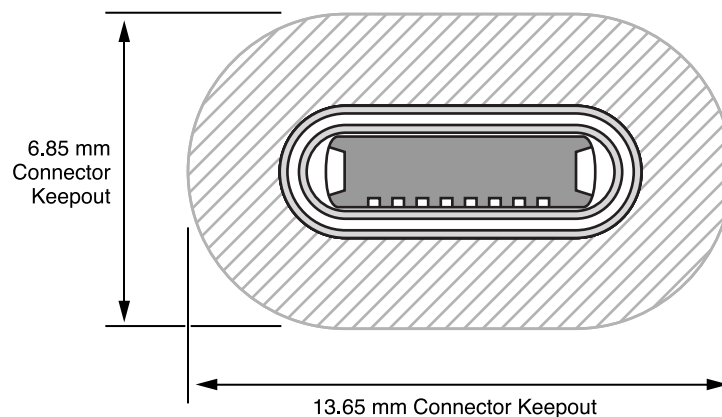
USB-C connector openings shall be designed with enough margin to compensate for shifting or dimensional changes of the case material.

5.1.2.3 Access to the Lightning Connector

If the case is for a device with a Lightning receptacle, the opening (that is, keep-out area):

- 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 5-2](#) (page 33).

Figure 5-2 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.

5.1.2.4 Access to the Headset Jack

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

The headset jack opening (that is, keep-out area):

- 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.

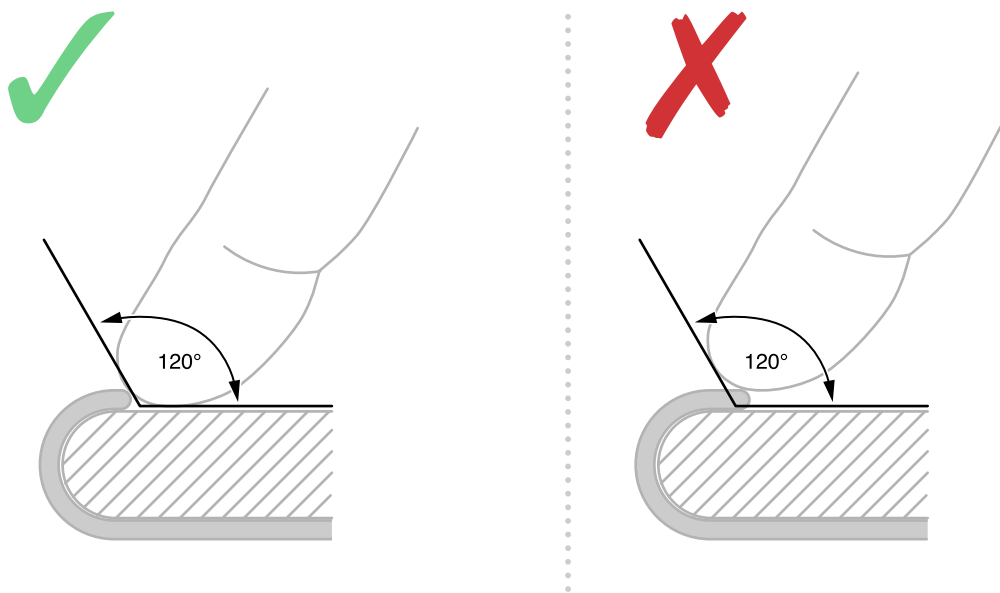
Headset jack openings shall be designed with enough margin to compensate for shifting or dimensional changes of the case material.

5.1.2.5 Touchscreen

Cases should not have any 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 5-3](#) (page 34), along the edges of a touchscreen's active area to ensure compatibility with touchscreen features. See [Device Dimensional Drawings](#) (page 253) for active areas.

Figure 5-3 Touchscreen keep-out angle



5.1.2.6 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.

The following devices make extensive use of edge swipe gestures in both portrait and landscape orientations:

- iPhone 15 Pro Max
- iPhone 15 Pro
- iPhone 15 Plus
- iPhone 15

5. Cases

5.1 Product Design

- 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
- iPad Pro 12.9-inch (6th generation)
- iPad Pro 11-inch (4th generation)
- iPad (10th generation)
- iPad Air (5th generation)
- iPad mini (6th generation)
- iPad Pro 12.9-inch (5th generation)
- iPad Pro 11-inch (3rd generation)
- iPad Air (4th generation)
- iPad Pro 12.9-inch (4th generation)
- iPad Pro 11-inch (2nd generation)
- iPad Pro 12.9-inch (3rd generation)
- iPad Pro 11-inch (1st generation)

5.1.2.7 Edge Press Gestures

Users shall be able to easily use edge press gestures.

The following devices support edge press gestures:

- iPhone 8 Plus
- iPhone 8

5. Cases

5.1 Product Design

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

An edge press gesture from the left is used to bring up the task switcher in iOS 9.0 and later.

5.1.2.8 Cover Glass Contact

Cases claiming compatibility with the following devices should not contact the cover glass as defined in their dimensional drawings:

- 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

See [Device Dimensional Drawings](#) (page 253).

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 and Rear Pockets

Cases claiming compatibility with MagSafe or Qi wireless power, see [Device Power \(Inductive\)](#) (page 138), shall 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 any distortion or echo resulting from using the case.

Cases shall not obstruct any 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 any speaker to any microphone. Such sound conduction may cause echoing in phone calls.

5.2.3 Speaker/Microphone Openings

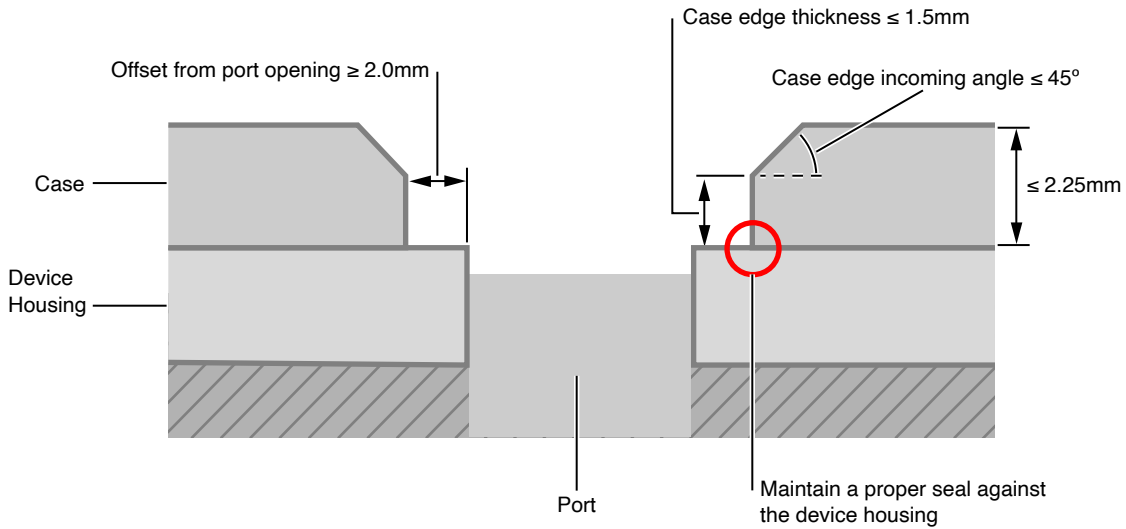
Device speaker/microphone port locations vary from model to model, see [Device Dimensional Drawings](#) (page 253).

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.

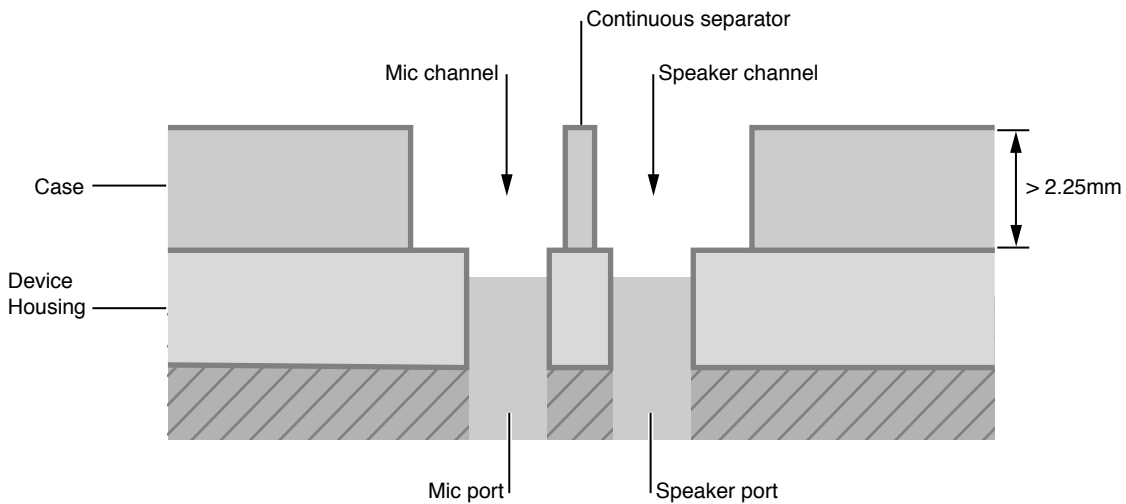
Figure 5-4 Microphone/speaker opening recommendations for thin cases



5.2.3.2 Thick Cases (>2.25 mm)

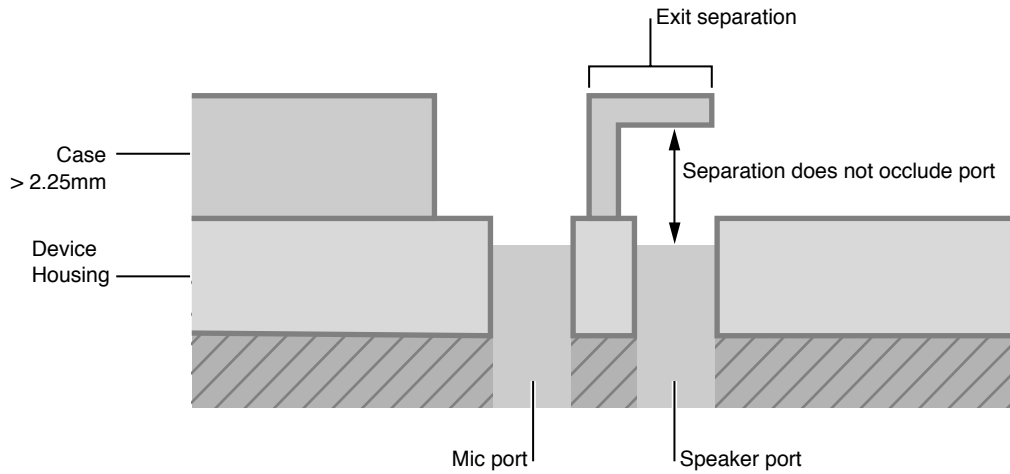
Speaker and microphone openings should be channeled independently and without interruption to/from the outside surface of a thick case.

Figure 5-5 Thick case acoustic channels



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

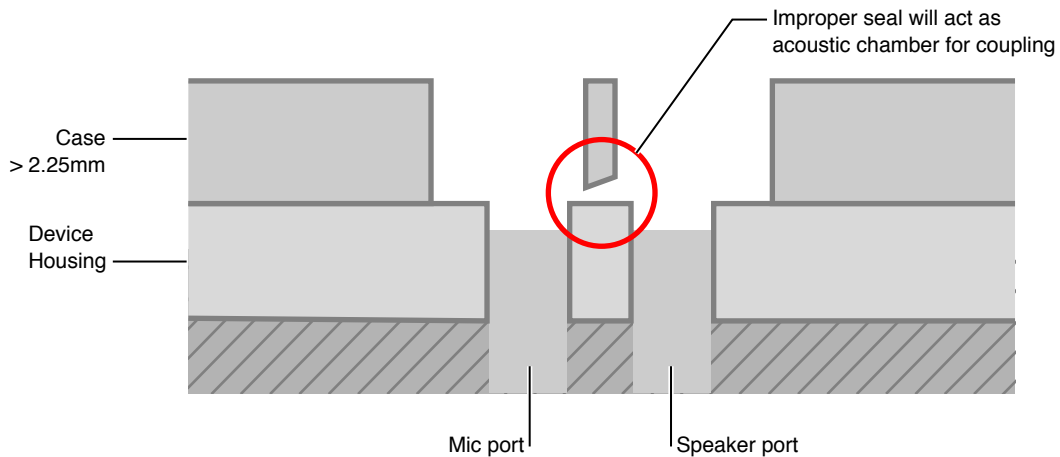
Figure 5-6 Thick case microphone and speaker exit separation



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 5-7 Improper thick case seal



5.3 Ambient Light Sensor and Proximity Sensor

The ambient light sensor and proximity sensor locations for various devices are indicated in the [Device Dimensional Drawings](#) (page 253). Some of the dimensional drawings specify a keep-out area around these sensors.

5.4 Taptic Engine

Cases should not cause substantial change in the feel of the device's Taptic Engine.

The following devices contain a Taptic Engine:

- 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 6s

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 26) for additional details.

5.6 Touch ID

Accessories shall not inhibit use of the device's Touch ID sensor. Touch ID sensor keep-outs for devices can be found in [Device Dimensional Drawings](#) (page 253).

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 device camera. It is exceptionally important manufacturers consult [Device Dimensional Drawings](#) (page 253) for each device and do not assume parameters are shared between devices.

Images from the camera may be affected by the geometry, color, and surface finish of the case.

Note:

Apple recommends a semi-gloss black material or coating around the camera and flash opening.

5.7.1 Geometry

The camera lens FOV shall not be blocked. Making an opening 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 253) for the camera keep-out.

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 a color cast. Adding a chamfer to the openings 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 artifacts. Designers should also ensure mechanical keep-outs as outlined in the [Device Dimensional Drawings](#) (page 253) are maintained with worst-case X-Y placement tolerances to minimize the risk of 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. 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.

5.7.3 Surface Finish

Semi-gloss materials may help direct reflected light away from the camera lens. Matte or diffusing materials scatter light in all directions increasing the likelihood light from a flash or a strong external light source will be reflected into a camera lens.

5.7.4 Image Degradation Examples

Figure 5-8 Sample image degradation by image blocking in an ambient condition

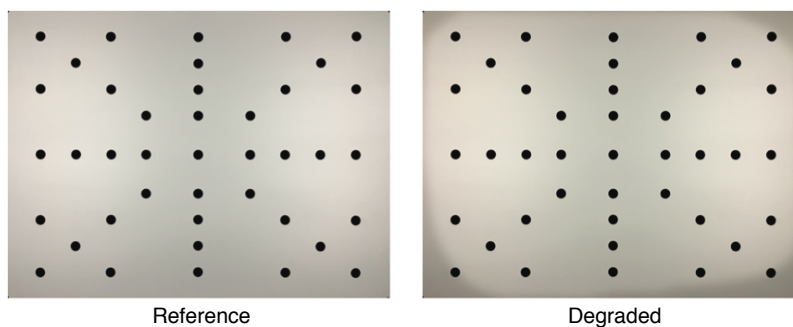


Figure 5-9 Sample image degradation by color shift through accessory with strong color

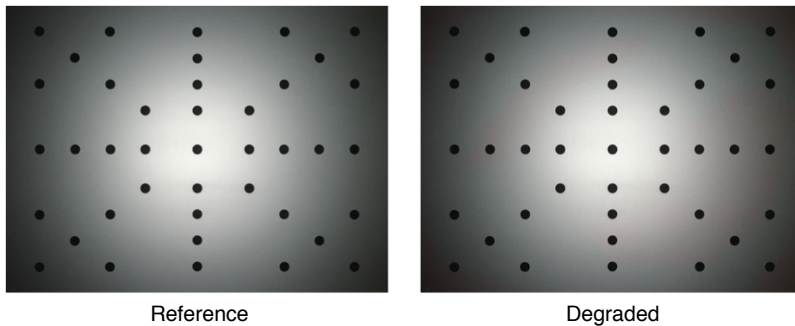
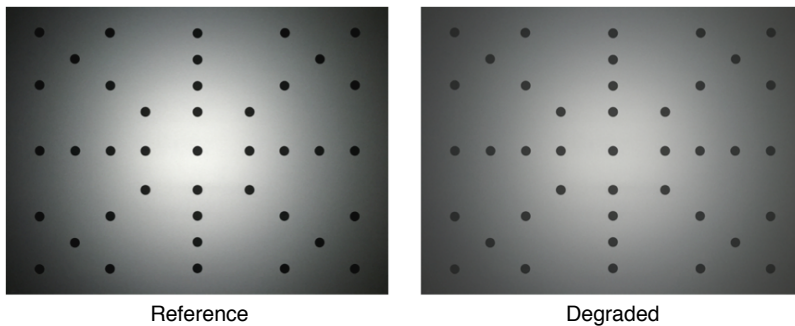


Figure 5-10 Sample image degradation by flash interference



5.8 Reliability

Cases shall be tested to verify they will withstand long-term use under typical use conditions, and will not impair or functionally degrade a device, cause damage 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 25) 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 bleed color onto either the device or its user, particularly while the case is in contact with common substances such as water or sunscreen 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 Test Procedures

5.10.1 Device Models

Case testing procedures vary depending on the device they enclose.

5.10.1.1 iPhone 15 Pro Max

Table 5-1 iPhone 15 Pro Max Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 15 Pro Max	
MagSafe Case Magnet Array (page 164)	iPhone 15 Pro Max	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 15 Pro Max	
Acoustics (page 63)	iPhone 15 Pro Max	

5. Cases

5.10 Test Procedures

5.10.1.2 iPhone 15 Pro

Table 5-2 iPhone 15 Pro Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 15 Pro	
MagSafe Case Magnet Array (page 164)	iPhone 15 Pro	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 15 Pro	
Acoustics (page 63)	iPhone 15 Pro	

5.10.1.3 iPhone 15 Plus

Table 5-3 iPhone 15 Plus Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 15 Plus	
MagSafe Case Magnet Array (page 164)	iPhone 15 Plus	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 15 Plus	
Acoustics (page 63)	iPhone 15 Plus	

5.10.1.4 iPhone 15

Table 5-4 iPhone 15 Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 15	
MagSafe Case Magnet Array (page 164)	iPhone 15	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 15	
Acoustics (page 63)	iPhone 15	

5.10.1.5 iPhone 14 Pro Max

Table 5-5 iPhone 14 Pro Max Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 14 Pro Max	
MagSafe Case Magnet Array (page 164)	iPhone 14 Pro Max	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 14 Pro Max	
Acoustics (page 63)	iPhone 14 Pro Max	

5.10.1.6 iPhone 14 Pro

Table 5-6 iPhone 14 Pro Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 14 Pro	
MagSafe Case Magnet Array (page 164)	iPhone 14 Pro	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 14 Pro	
Acoustics (page 63)	iPhone 14 Pro	

5.10.1.7 iPhone 14 Plus

Table 5-7 iPhone 14 Plus Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 14 Plus	
MagSafe Case Magnet Array (page 164)	iPhone 14 Plus	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 14 Plus	
Acoustics (page 63)	iPhone 14 Plus	

5.10.1.8 iPhone 14

Table 5-8 iPhone 14 Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 14	
MagSafe Case Magnet Array (page 164)	iPhone 14	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 14	
Acoustics (page 63)	iPhone 14	

5.10.1.9 iPhone 13 Pro Max

Table 5-9 iPhone 13 Pro Max Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 13 Pro Max	
MagSafe Case Magnet Array (page 164)	iPhone 13 Pro Max	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 13 Pro Max	
Acoustics (page 63)	iPhone 13 Pro Max	

5. Cases

5.10 Test Procedures

5.10.1.10 iPhone 13 Pro

Table iPhone 13 Pro Case Testing Matrix
5-10

Test	Using	Notes
Product Design (page 57)	iPhone 13 Pro	
MagSafe Case Magnet Array (page 164)	iPhone 13 Pro	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 13 Pro	
Acoustics (page 63)	iPhone 13 Pro	

5.10.1.11 iPhone 13

Table iPhone 13 Case Testing Matrix
5-11

Test	Using	Notes
Product Design (page 57)	iPhone 13	
MagSafe Case Magnet Array (page 164)	iPhone 13	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 13	
Acoustics (page 63)	iPhone 13	

5.10.1.12 iPhone 13 mini

Table iPhone 13 mini Case Testing Matrix
5-12

Test	Using	Notes
Product Design (page 57)	iPhone 13 mini	
MagSafe Case Magnet Array (page 164)	iPhone 13 mini	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 13 mini	
Acoustics (page 63)	iPhone 13 mini	

5.10.1.13 iPhone 12 Pro Max

Table iPhone 12 Pro Max Case Testing Matrix
5-13

Test	Using	Notes
Product Design (page 57)	iPhone 12 Pro Max	

5. Cases

5.10 Test Procedures

Test	Using	Notes
MagSafe Case Magnet Array (page 164)	iPhone 12 Pro Max	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 12 Pro Max	
Acoustics (page 63)	iPhone 12 Pro Max	

5.10.1.14 iPhone 12 Pro

Table 5-14 iPhone 12 Pro Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 12 Pro	
MagSafe Case Magnet Array (page 164)	iPhone 12 Pro	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 12 Pro	
Acoustics (page 63)	iPhone 12 Pro	

5.10.1.15 iPhone 12

Table 5-15 iPhone 12 Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 12	
MagSafe Case Magnet Array (page 164)	iPhone 12	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 12	
Acoustics (page 63)	iPhone 12	

5.10.1.16 iPhone 12 mini

Table 5-16 iPhone 12 mini Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 12 mini	
MagSafe Case Magnet Array (page 164)	iPhone 12 mini	Cases supporting MagSafe only.
Taptic Engine (page 60)	iPhone 12 mini	
Acoustics (page 63)	iPhone 12 mini	

5. Cases

5.10 Test Procedures

5.10.1.17 iPhone 11 Pro Max

Table iPhone 11 Pro Max Case Testing Matrix
5-17

Test	Using	Notes
Product Design (page 57)	iPhone 11 Pro Max	
Taptic Engine (page 60)	iPhone 11 Pro Max	
Acoustics (page 63)	iPhone 11 Pro Max	

5.10.1.18 iPhone 11 Pro

Table iPhone 11 Pro Case Testing Matrix
5-18

Test	Using	Notes
Product Design (page 57)	iPhone 11 Pro	
Taptic Engine (page 60)	iPhone 11 Pro	
Acoustics (page 63)	iPhone 11 Pro	

5.10.1.19 iPhone 11

Table iPhone 11 Case Testing Matrix
5-19

Test	Using	Notes
Product Design (page 57)	iPhone 11	
Taptic Engine (page 60)	iPhone 11	
Acoustics (page 63)	iPhone 11	

5.10.1.20 iPhone XS Max

Table iPhone XS Max Case Testing Matrix
5-20

Test	Using	Notes
Product Design (page 57)	iPhone XS Max	
Taptic Engine (page 60)	iPhone XS Max	
Acoustics (page 63)	iPhone XS Max	

5.10.1.21 iPhone XS

Table iPhone XS Case Testing Matrix
5-21

Test	Using	Notes
Product Design (page 57)	iPhone XS	
Taptic Engine (page 60)	iPhone XS	
Acoustics (page 63)	iPhone XS	

5.10.1.22 iPhone XR

Table iPhone XR Case Testing Matrix
5-22

Test	Using	Notes
Product Design (page 57)	iPhone XR	
Taptic Engine (page 60)	iPhone XR	
Acoustics (page 63)	iPhone XR	

5.10.1.23 iPhone X

Table iPhone X Case Testing Matrix
5-23

Test	Using	Notes
Product Design (page 57)	iPhone X	
Taptic Engine (page 60)	iPhone X	
Acoustics (page 63)	iPhone X	

5.10.1.24 iPhone 8 Plus/iPhone 7 Plus

Table iPhone 8 Plus/iPhone 7 Plus Case Testing Matrix
5-24

Test	Using	Notes
Product Design (page 57)	iPhone 8 Plus and iPhone 7 Plus	
Taptic Engine (page 60)	iPhone 8 Plus and iPhone 7 Plus	
Touch ID Sensor Overlays (page 60)	iPhone 8 Plus and iPhone 7 Plus	
Acoustics (page 63)	iPhone 8 Plus and iPhone 7 Plus	

5. Cases

5.10 Test Procedures

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

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

Table 5-25 iPhone SE (3rd generation)/iPhone SE (2nd generation)/iPhone 8/iPhone 7 Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone SE (3rd generation), iPhone SE (2nd generation), iPhone 8, and iPhone 7	
Taptic Engine (page 60)	iPhone SE (3rd generation), iPhone SE (2nd generation), iPhone 8, and iPhone 7	
Touch ID Sensor Overlays (page 60)	iPhone SE (3rd generation), iPhone SE (2nd generation), iPhone 8, and iPhone 7	
Acoustics (page 63)	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), only iPhone SE (2nd generation), only iPhone 8, or only iPhone 7.

5.10.1.26 iPhone 6s Plus/iPhone 6 Plus

Table 5-26 iPhone 6s Plus/iPhone 6 Plus Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 6s Plus and iPhone 6 Plus	
Taptic Engine (page 60)	iPhone 6s Plus	

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

5.10.1.27 iPhone 6s/iPhone 6

Table 5-27 iPhone 6s/iPhone 6 Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 6s and iPhone 6	
Taptic Engine (page 60)	iPhone 6s	

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

5.10.1.28 iPhone 5/iPhone 5s/iPhone SE

Table 5-28 iPhone 5/iPhone 5s/iPhone SE Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone SE	

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

5.10.1.29 iPhone 5c

Table 5-29 iPhone 5c Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPhone 5c	

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

Table 5-30 iPad Pro 12.9-inch (6th generation) and iPad Pro 12.9-inch (5th generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	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).

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

Table 5-31 iPad Pro 11-inch (4th generation) and iPad Pro 11-inch (3rd generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	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).

5.10.1.32 iPad (10th generation)

Table 5-32 iPad (10th generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPad (10th generation)	

5.10.1.33 iPad mini (6th generation)

Table 5-33 iPad mini (6th generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPad mini (6th generation)	

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

Table 5-34 iPad (7th generation)/iPad (8th generation)/iPad (9th generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	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).

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

Table 5-35 iPad Air (5th generation)/iPad Air (4th generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPad Air (5th generation)	

5.10.1.36 iPad Pro 12.9-inch (4th generation)

Table iPad Pro 12.9-inch (4th generation) Case Testing Matrix
5-36

Test	Using	Notes
Product Design (page 57)	iPad Pro 12.9-inch (4th generation)	

5.10.1.37 iPad Pro 11-inch (2nd generation)

Table iPad Pro 11-inch (2nd generation) Case Testing Matrix
5-37

Test	Using	Notes
Product Design (page 57)	iPad Pro 11-inch (2nd generation)	

5.10.1.38 iPad Air (3rd generation)

Table iPad Air (3rd generation) Case Testing Matrix
5-38

Test	Using	Notes
Product Design (page 57)	iPad Air (3rd generation)	

5.10.1.39 iPad mini (5th generation)

Table iPad mini (5th generation) Case Testing Matrix
5-39

Test	Using	Notes
Product Design (page 57)	iPad mini (5th generation)	

5.10.1.40 iPad Pro 12.9-inch (3rd generation)

Table iPad Pro 12.9-inch (3rd generation) Case Testing Matrix
5-40

Test	Using	Notes
Product Design (page 57)	iPad Pro 12.9-inch (3rd generation)	

5.10.1.41 iPad Pro 11-inch (1st generation)

Table 5-41 iPad Pro 11-inch (1st generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPad Pro 11-inch (1st generation)	

5.10.1.42 iPad Pro 10.5-inch

Table 5-42 iPad Pro 10.5-inch Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPad Pro 10.5-inch	

5.10.1.43 iPad Pro 12.9-inch (2nd generation)

Table 5-43 iPad Pro 12.9-inch (2nd generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPad Pro 12.9-inch (2nd generation)	

5.10.1.44 iPad (5th and 6th generation)

Table 5-44 iPad (5th and 6th generation) Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPad (5th generation) or iPad (6th generation)	

5.10.1.45 iPad Pro 9.7-inch

Table 5-45 iPad Pro 9.7-inch Case Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPad Pro 9.7-inch	

5.10.1.46 iPad Pro 12.9-inch (1st generation)

Table iPad Pro 12.9-inch (1st generation) Case Testing Matrix
5-46

Test	Using	Notes
Product Design (page 57)	iPad Pro 12.9-inch (1st generation)	

5.10.1.47 iPad mini 4

Table iPad mini 4 Case Testing Matrix
5-47

Test	Using	Notes
Product Design (page 57)	iPad mini 4	

5.10.1.48 iPad mini/iPad mini 2/iPad mini 3

Table iPad mini/iPad mini 2/iPad mini 3 Case Testing Matrix
5-48

Test	Using	Notes
Product Design (page 57)	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.

5.10.1.49 iPad Air 2

Table iPad Air 2 Case Testing Matrix
5-49

Test	Using	Notes
Product Design (page 57)	iPad Air 2	

5.10.1.50 iPad Air

Table iPad Air Case Testing Matrix
5-50

Test	Using	Notes
Product Design (page 57)	iPad Air	

5.10.1.51 iPad (4th generation)

Table iPad (4th generation) Case Testing Matrix
5-51

Test	Using	Notes
Product Design (page 57)	iPad (4th generation)	

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

Table iPod touch (5th generation)/iPod touch (6th generation)/iPod touch (7th generation) Case
5-52 Testing Matrix

Test	Using	Notes
Product Design (page 57)	iPod touch (7th generation)	

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

5.10.2 Product Design

5.10.2.1 Equipment

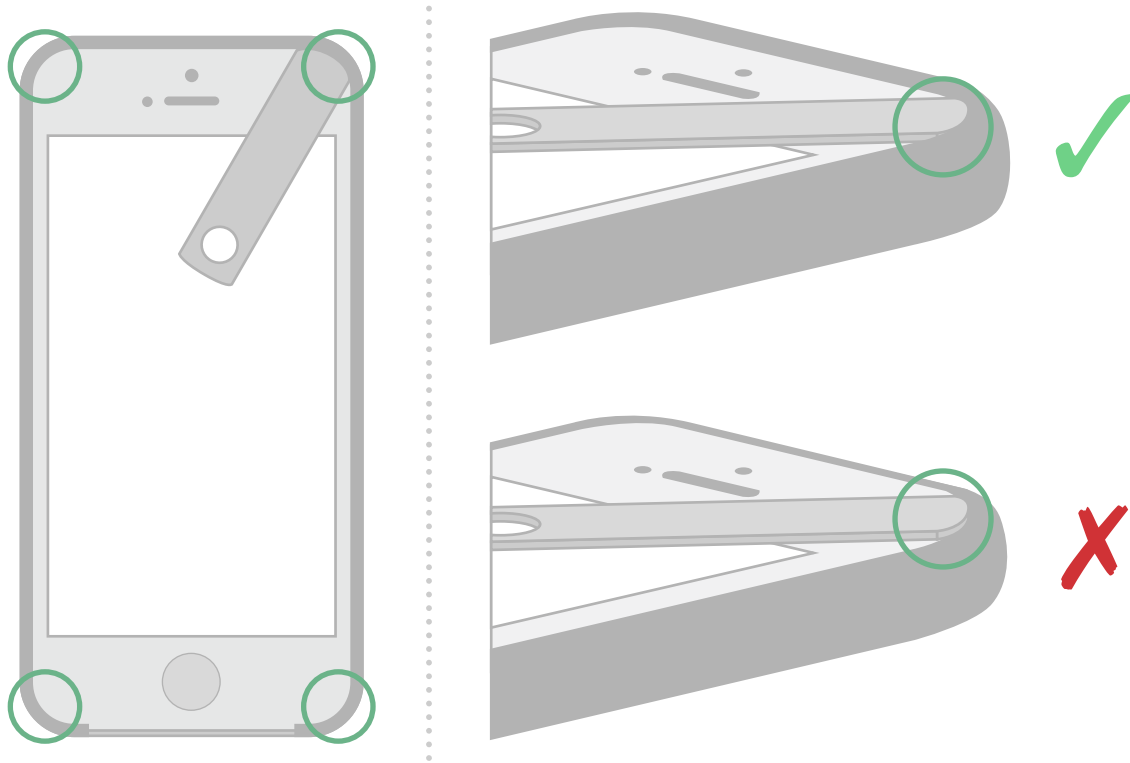
- Device
- Apple Lightning Digital AV Adapter for devices with a Lightning receptacle.
- Apple USB-C Digital AV Multiport Adapter for devices with a USB-C receptacle.
- EarPods with 3.5 mm Headphone Plug for devices with a 3.5 mm headset jack.
- Vernier calipers
- 0.85 mm plastic feeler gauge

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 Sleep/Wake 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 253).

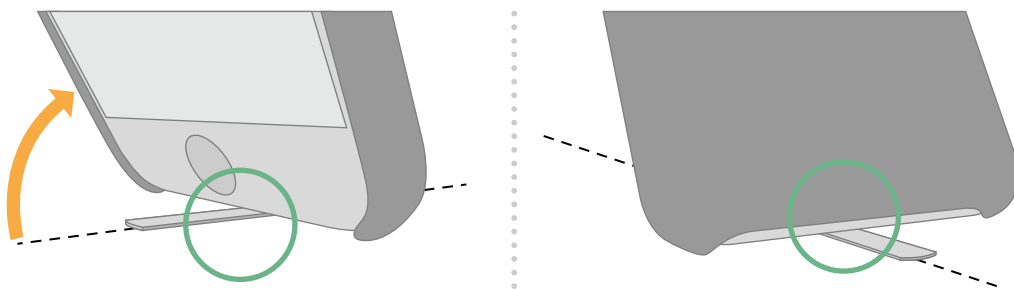
12. Verify the case is always proud of the feeler gauge when the gauge is placed at each corner of the device. See [Figure 5-11](#) (page 59).

Figure 5-11 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 5-12 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 Taptic Engine

5.10.3.1 Equipment

- Two devices A and B, same model
- Table

5.10.3.2 Procedure

1. Attach the case to device B.
2. Place device A on top of the table.
3. Place device B on top of the table next to device A.
4. Compare the Taptic Engine feedback between device A and device B for each of the following tasks:
 - a. Go to Settings > Sound & Haptics, set "Play Haptics in Ring Mode" and "Play Haptics in Silent Mode" to the on position.
 - b. Toggle the Ring/Silent switch or use the Action button.
 - c. Connect a charger, wait a few seconds, then disconnect the charger.
 - d. Go to Settings > Notifications > Phone > Sounds, select Reflection (Default).
 - e. Go to Settings > Notifications > Messages > Sounds, select Note (Default).
 - f. Go to the Home screen.
 - g. Long press the Settings app to show the Quick Actions menu, then slide your finger across the menu and release when Wi-Fi is selected.
 - h. Go to the Home screen.
 - i. Long press the Home app to show the Quick Actions menu. Release, then tap away from the menu to return to the Home screen.
 - j. Go to the Clock app and select Timers (lower right corner).
 - k. Scroll through the hours and minutes.
5. If the device has a Home button:
 - a. Go to Settings > General > Home Button, select option 2.
 - b. Press the Home button.
6. Repeat the above tasks while holding device A in the left hand and device B in the right hand.

5.10.3.3 Pass/Fail Criteria

The case does not cause substantial change in the feel of the device's Taptic Engine.

5.10.4 Touch ID Sensor Overlays

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

5.10.4.1 Equipment

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

5.10.4.2 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 sleep/wake or side 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).

5.10.4.3 Pass/Fail Criteria

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

5.10.5 Camera

5.10.5.1 Autofocus & Optical Image Stabilization

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

5.10.5.1.1 Equipment

- Device running iOS 17.0 or later or iPadOS 17.0 or later. See [Device Models](#) (page 44).
- A flat level non-ferrous test surface away from magnetic fields.
- [Accessory Developer Assistant \(ADA\)](#) (page 250).
- [Autofocus & Optical Image Stabilization Test Profile](#) (page 250).

5.10.5.1.2 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.

5.10.6 Compass

5.10.6.1 Equipment

The following equipment is necessary:

- Device running iPadOS 17.0 or later.
- [Accessory Developer Assistant \(ADA\)](#) (page 250).
- A flat level non-ferrous test surface away from magnetic fields.
- Magnetometer, such as the Meda FVM400.

5.10.6.2 Test 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.

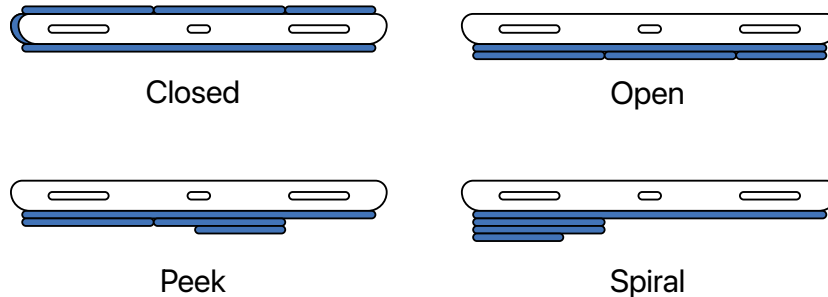
5.10.6.3 Procedure

Compass Test Procedures are outlined in this section.

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 5-13](#) (page 63).

Figure 5-13 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.

5.10.7 Acoustics

The following test procedures apply to devices with a built in speaker and/or microphone.

5.10.7.1 Speakerphone Call

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

5.10.7.1.1 Equipment and Test Setup

This procedure needs two operators in separate quiet rooms.

Room A:

- Operator A
- The device (with cellular service) used to evaluate the case.
 - The device should have 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)

5.10.7.1.2 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.

The pass/fail threshold for these two categories should be established by performing the test procedure using:

- The device (without the case) as a reference.

There should be no perceivable difference between the reference and the test conducted with the case on the device.

5.10.7.1.3 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 64).

5. Cases

5.10 Test Procedures

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

This chapter is applicable to accessories covering device displays.

6.1 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 26) for additional details.

6.2 Smart Covers

Dimensional drawings indicating magnet and Hall effect sensor locations are available for the following devices:

- [iPad Pro 12.9-inch \(6th generation\) 3 of 5](#) (page 320)
- [iPad Pro 11-inch \(4th generation\) 3 of 5](#) (page 325)
- [iPad \(10th generation\) 4 of 6](#) (page 331)
- [iPad Air \(5th generation\) and iPad Air \(4th generation\) 3 of 5](#) (page 336)
- [iPad mini \(6th generation\) 3 of 6](#) (page 341)
- [iPad mini \(6th generation\) 4 of 6](#) (page 342)
- [iPad \(9th generation\), iPad \(8th generation\) and iPad \(7th generation\) 2 of 4](#) (page 346)
- [iPad Pro 12.9-inch \(5th generation\) 3 of 5](#) (page 351)
- [iPad Pro 11-inch \(3rd generation\) 3 of 5](#) (page 356)
- [iPad Pro 12.9-inch \(4th generation\) 3 of 5](#) (page 361)
- [iPad Pro 11-inch \(2nd generation\) 3 of 5](#) (page 366)
- [iPad Air \(3rd generation\) with Wi-Fi 2 of 3](#) (page 370)
- [iPad Air \(3rd generation\) with Wi-Fi + Cellular 2 of 3](#) (page 373)
- [iPad mini \(5th generation\) with Wi-Fi 2 of 3](#) (page 376)
- [iPad mini \(5th generation\) with Wi-Fi + Cellular 2 of 3](#) (page 379)
- [iPad Pro 12.9-inch \(3rd generation\) 2 of 3](#) (page 382)

6. Covers

6.2 Smart Covers

- [iPad Pro 11-inch \(1st generation\) 2 of 3 \(page 385\)](#)
- [iPad Pro 12.9-inch \(2nd generation\) Magnet/Hall Effect Sensors 1 of 2 \(page 389\)](#)
- [iPad Pro 12.9-inch \(2nd generation\) Magnet/Hall Effect Sensors 2 of 2 \(page 390\)](#)
- [iPad Pro 10.5-inch Magnet/Hall Effect Sensors 1 of 2 \(page 393\)](#)
- [iPad Pro 10.5-inch Magnet/Hall Effect Sensors 2 of 2 \(page 394\)](#)
- [iPad \(5th and 6th generation\) Magnet/Hall Effect Sensors 1 of 2 \(page 396\)](#)
- [iPad \(5th and 6th generation\) Magnet/Hall Effect Sensors 2 of 2 \(page 397\)](#)
- [iPad Pro 9.7-inch Magnet/Hall Effect Sensors 1 of 2 \(page 400\)](#)
- [iPad Pro 9.7-inch Magnet/Hall Effect Sensors 2 of 2 \(page 401\)](#)
- [iPad Pro 12.9-inch \(1st generation\) Magnet/Hall Effect Sensors 1 of 2 \(page 404\)](#)
- [iPad Pro 12.9-inch \(1st generation\) Magnet/Hall Effect Sensors 2 of 2 \(page 405\)](#)
- [iPad mini 4 Magnet/Hall Effect Sensors \(page 408\)](#)

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 $<110^\circ$.

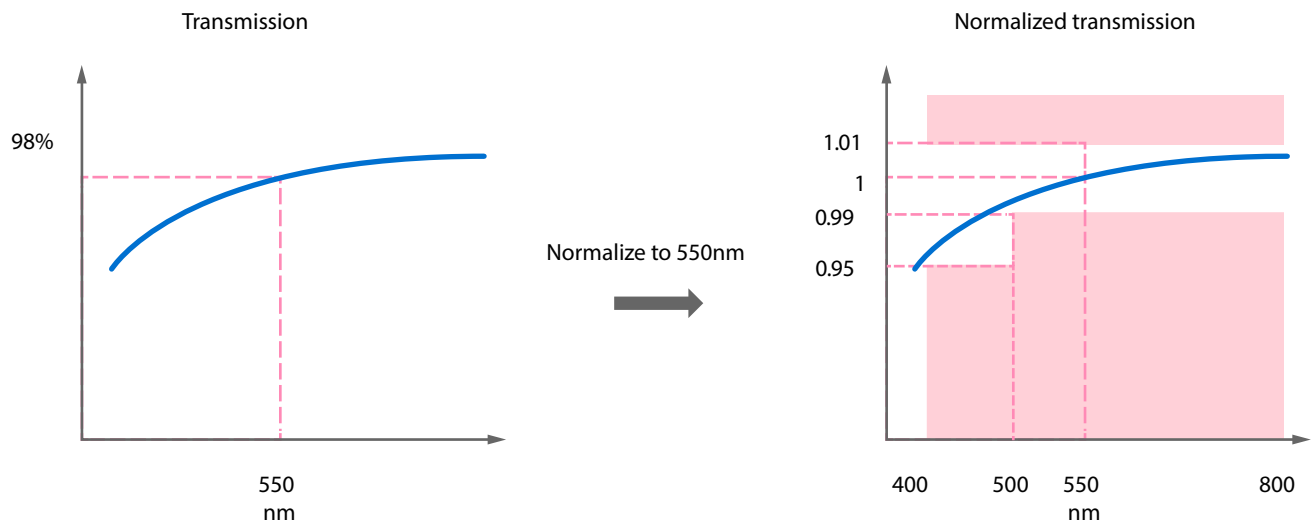
Note:

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 253).
- Remain flat as defined in [Figure 7-1](#) (page 69). 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. Transmission haze should:

- Not exceed 0.3% for the following devices:
 - 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 and Edge Press Gestures

See [Edge Swipe Gestures](#) (page 34) and [Edge Press Gestures](#) (page 35).

8. Camera Attachments

This chapter is applicable to accessories intentionally altering images captured by device cameras.

8.1 Magnetic Interference

Accessory 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 26) for additional details.

9. Adapters

An adapter accessory is a dongle or a [Built-In Cable](#) (page 22) 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 23) 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 23) 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 23) for more information.

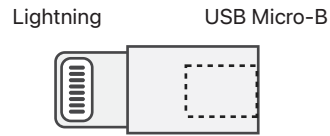
9.3 Ethernet Adapters (Lightning to RJ45)

A Lightning to Ethernet adapter is an accessory enabling a device to access a wired network. The Apple USB Ethernet Adapter is an example of a similar accessory for a Mac.

See the [Accessory Interface Specification](#) (page 23) for more information.

9.4 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 23) for more information.

10. AC Power Adapters

AC power adapters convert AC "mains" power to DC for the purpose of providing power to a device. They may provide power using one or more of the following:

- [USB-C Receptacle](#) (page 244) combined with a USB-C cable or USB-C to Lightning cable.
- [USB-A Receptacle](#) (page 239) combined with a USB-A to Lightning cable.
- [Device Power \(Inductive\)](#) (page 138).

10.1 Converter Switching Frequencies

Device touchscreen or audio functionality may be degraded if converter switching frequencies do not meet the following requirements:

- Under loads greater than 5 mA, converter switching frequencies shall be above 22 kHz.
- Under loads greater than 20 mA, converter switching frequencies:
 - Shall be above 60 kHz.
 - Should be above 450 kHz.

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 75) and Table 10-1 (page 75). 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 75) 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

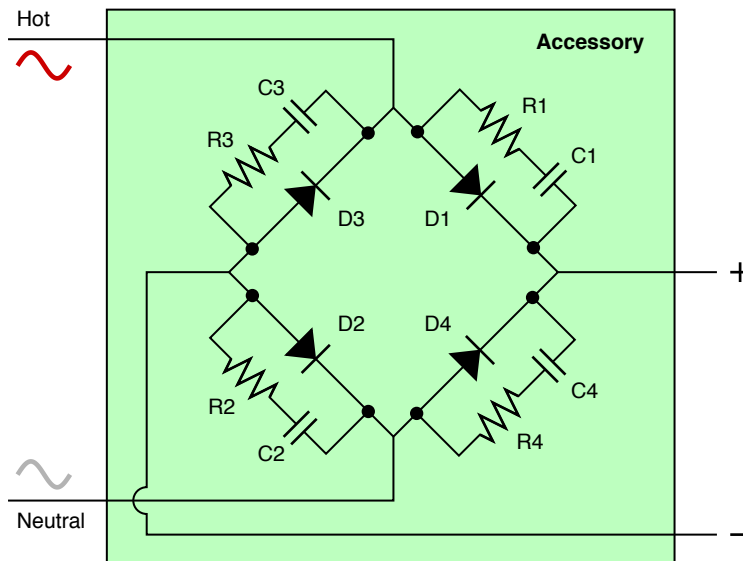


Table 10-1 Typical component values for an AC power adapter diode bridge circuit

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 one or more of the following:

- Inductive power transmitter, see [Device Power \(Inductive\)](#) (page 138).
- Integrated Lightning connector, see [Device Power \(Lightning\)](#) (page 133).
- [USB-C Receptacle](#) (page 244) combined with a USB-C cable or USB-C to Lightning cable.
- [USB-A Receptacle](#) (page 239) combined with a USB-A to Lightning cable.

12. Headsets

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

Headsets shall comply with:

- [TDMA Noise](#) (page 26) requirements.
- Applicable volume limit regulations in the regions in which they are sold.

12.1 Product Design

Headsets shall have:

- Drivers positioned on, over, or in user's ears.
- Microphone(s) positioned to primarily record user's voice.

12.2 Audio Interface

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

- [Apple USB-C Analog Headset Module](#) (page 227).
- [USB-C Plug](#) (page 240) using a USB Audio Device Class 2.0 or 3.0 compliant codec.
- [Bluetooth](#) (page 207):
 - [Hands-Free Profile \(HFP\)](#) (page 211)
 - [Advanced Audio Distribution Profile \(A2DP\)](#) (page 216)

12.3 Remote Controls

Controls shall be implemented using one of the following:

- Direct electrical connections to the [Apple Headset Remote and Microphone Transmitter](#) (page 232) when integrating an [Apple USB-C Analog Headset Module](#) (page 227).
- [HID Headset Remote](#) (page 143) when using one of the following:
 - [USB-C Plug](#) (page 240) with a USB Audio Device Class 2.0 or 3.0 compliant codec.
 - [Bluetooth](#) (page 207).
- Bluetooth [Audio/Video Remote Control Profile \(AVRCP\)](#) (page 214).

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

12.4 USB-C Headset Identification

This section applies to headsets that integrate a USB-C connector.

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).

Headsets should:

- Set the `ilInterface Playback` and `ilInterface 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.

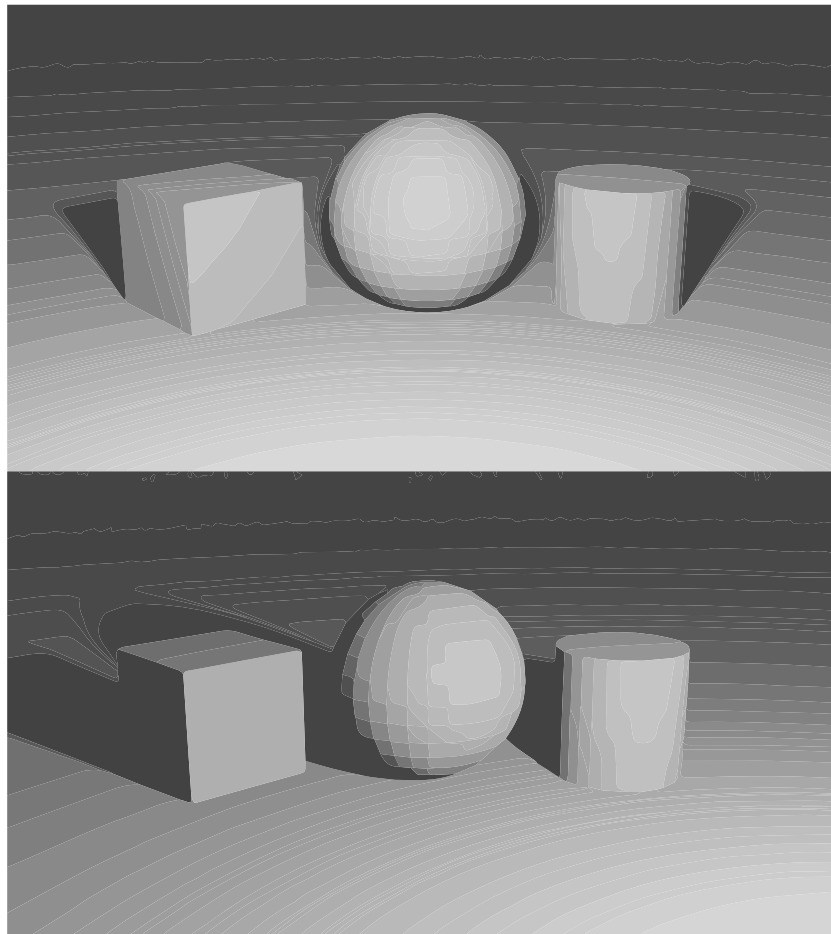
13. Strobes

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. accessory strobe (bottom)



The following devices support 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 23) 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 203) 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.

All HID usages sent from the keyboard shall occur in response to a [Direct User Action](#) (page 22).

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 88) 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 86).

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*.

14. Keyboards

14.1 Requirements

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 87) 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 #

14. Keyboards

14.1 Requirements

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:

14. Keyboards

14.1 Requirements

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

14. Keyboards

14.1 Requirements

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 86).

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 203) 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.

All HID reports sent from the accessory trackpad shall occur in response to a [Direct User Action](#) (page 22).

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 82) 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 \mathbb{A} -Tab to see the app switcher, then using the cursor to switch apps.
- Dragging an item using the trackpad, followed by pressing \mathbb{A} -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:

15. Trackpads

15.1 Requirements

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:

15. Trackpads

15.1 Requirements

- 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 $92.10/1105 = \sim 0.083$ mm) and Y (0x31) goes from 0 to 0x025F (for the same resolution of $50.60/607 = \sim 0.083$ 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

```

15. Trackpads

15.2 Examples

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

15. Trackpads

15.2 Examples

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

15. Trackpads

15.2 Examples

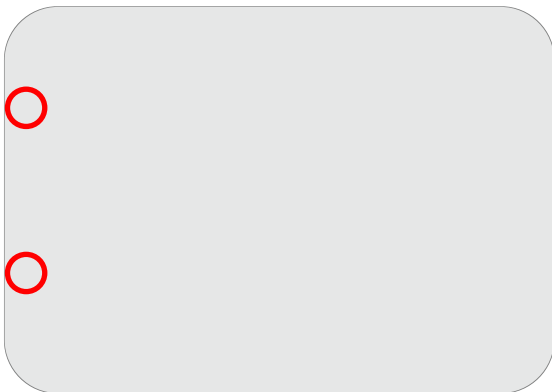
```
LOGICAL MAXIMUM (5)                25 05
REPORT SIZE (6)                    75 06
REPORT COUNT (1)                   95 01
INPUT (Data,Var,Abs)               81 02
USAGE PAGE (Generic Desktop Page)  05 01
PHYSICAL MAXIMUM (921)             46 99 03
LOGICAL MAXIMUM (1105)             26 51 04
REPORT 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 91):

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
```

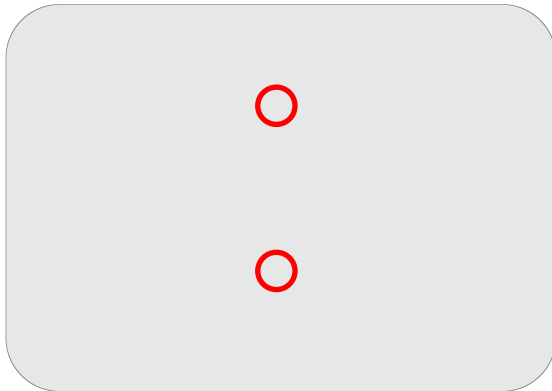
15. Trackpads

15.2 Examples



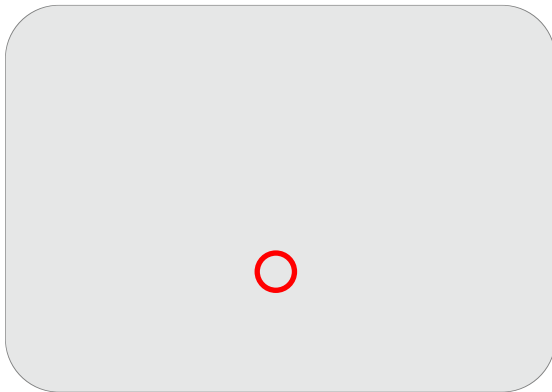
3. Two contacts continue moving until they reach the center of the digitizer surface.

```
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
```

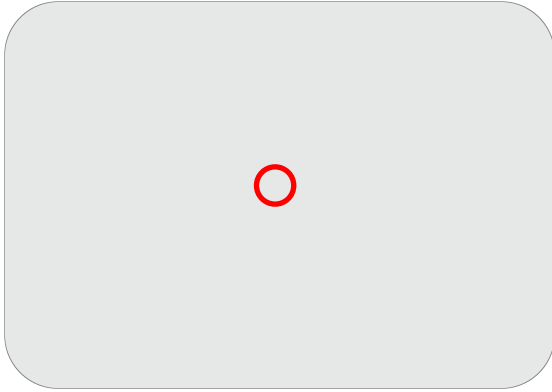


5. Remaining contact moves to the exact center of the digitizer surface. Confidence and coordinates of the removed contact are now 0.

```
039C0200 0328F212 00000000 00000000 00000000 00000000
```

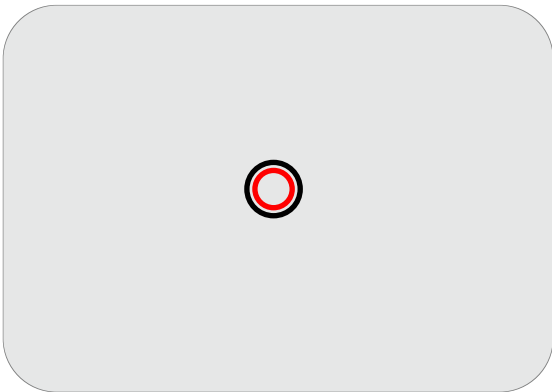
15. Trackpads

15.2 Examples



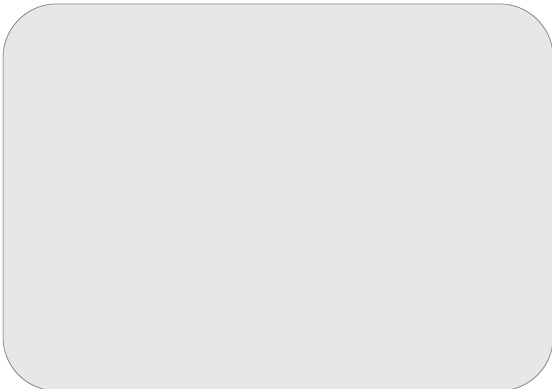
6. Button 1 is clicked.

03430301 0328F212 00000000 00000000 00000000 00000000



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. 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.

16.1 Requirements

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

- *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 142).

16.2 ProRes 4K up to 60 fps

To support ProRes capture up to 60 fps at 4K to external USB storage, the accessory shall:

- Sustain a write speed of at least 220 MB/s.
- Maintain the write speed until the USB storage is at capacity.
- Not exceed 900 mA of current draw at any point in time. See [Accessory Power \(USB-C\)](#) (page 121).

17. AirPods Accessories

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

- [AirPods Pro \(2nd generation\)](#) (page 461).
- [AirPods \(3rd generation\)](#) (page 463).
- [AirPods Pro \(1st generation\)](#) (page 465).
- [AirPods \(1st generation\) and AirPods \(2nd generation\)](#) (page 467).

17.1 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 can be found in the device dimensional drawings, see:

- [MagSafe Charging Case \(USB-C\) for AirPods Pro \(2nd generation\) 1 of 3](#) (page 455).
- [MagSafe Charging Case for AirPods Pro \(2nd generation\) 1 of 3](#) (page 458).
- [MagSafe Charging Case for AirPods \(3rd generation\)](#) (page 462).
- [Wireless Charging Case for AirPods Pro \(1st generation\)](#) (page 464).
- [Wireless Charging Case for AirPods](#) (page 466).

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

- [MagSafe Charging Case \(USB-C\) for AirPods Pro \(2nd generation\) 2 of 3](#) (page 456).
- [MagSafe Charging Case for AirPods Pro \(2nd generation\) 2 of 3](#) (page 459).

17.2 Chargers

Charging accessories shall be physically compatible with all charging cases.

Charging accessories with integrated:

- Lightning connectors shall meet the requirements for iPhone/iPod in [Device Power \(Lightning\)](#) (page 133).
- Inductive transmitters shall meet the requirements in [Device Power \(Inductive\)](#) (page 138).

17.3 Test Procedures

Test procedures for AirPods accessories.

17.3.1 Power

Power test procedures for AirPods charging case covers.

17.3.1.1 Equipment

Equipment necessary to perform the power test procedure:

- AirPods.
- AirPods charging case.
- AirPods charging case cover.
- Apple MagSafe Charger.
- Device running iOS 17.0 or later.

17.3.1.2 Test Environment and 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.

17.3.1.3 MagSafe Charging

1. Attach the accessory to the AirPods charging case.
2. Place the charging case and attached accessory 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.

18. Watch Bands

A well-designed watch band will securely attach to Apple Watch without interfering with Apple Watch operation. See [Device Dimensional Drawings](#) (page 253) for Apple Watch dimensional drawings with defined keep-out zones.

18.1 Requirements

Watch bands for Apple Watch shall integrate two lugs to mate with the [Apple Watch Band Interface](#) (page 103). 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 - 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.

18. Watch Bands

18.1 Requirements

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.

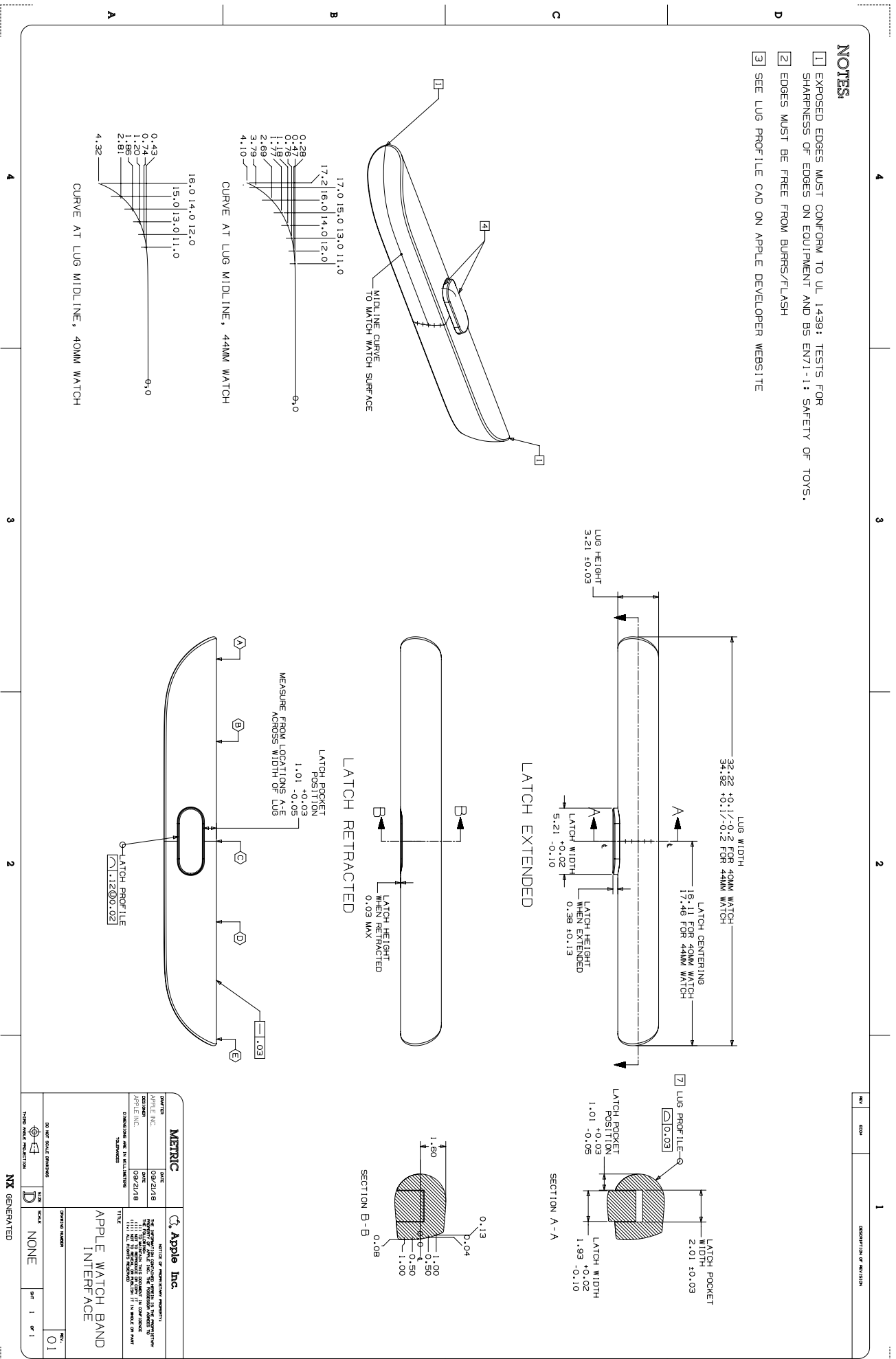
Watch bands for Apple Watch shall comply with applicable environmental regulations for the regions in which the watch bands are to be sold, and any applicable substance or material restrictions, including applicable restrictions on:

- 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).

18.2 Apple Watch Band Interface

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



METRIC		DATE		DRAWING NUMBER	
DESIGNED BY	APPLE INC.	DATE	09/21/18	SCALE	NONE
APPROVED BY	APPLE INC.	DATE	09/21/18	REV	1 OF 1
DIMENSIONS ARE IN MILLIMETERS					
TOLERANCES					
TITLE					
APPLE WATCH BAND INTERFACE					
DRAWING NUMBER					
SCALE					
NONE					
REV					
1 OF 1					

DO NOT SCALE DIMENSIONS
HARD COPY PROJECTION
NX GENERATED

18.3 Example Apple Watch Lug Assembly

Assembly instructions are based on [Example Apple Watch Lug](#) (page 106) 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.

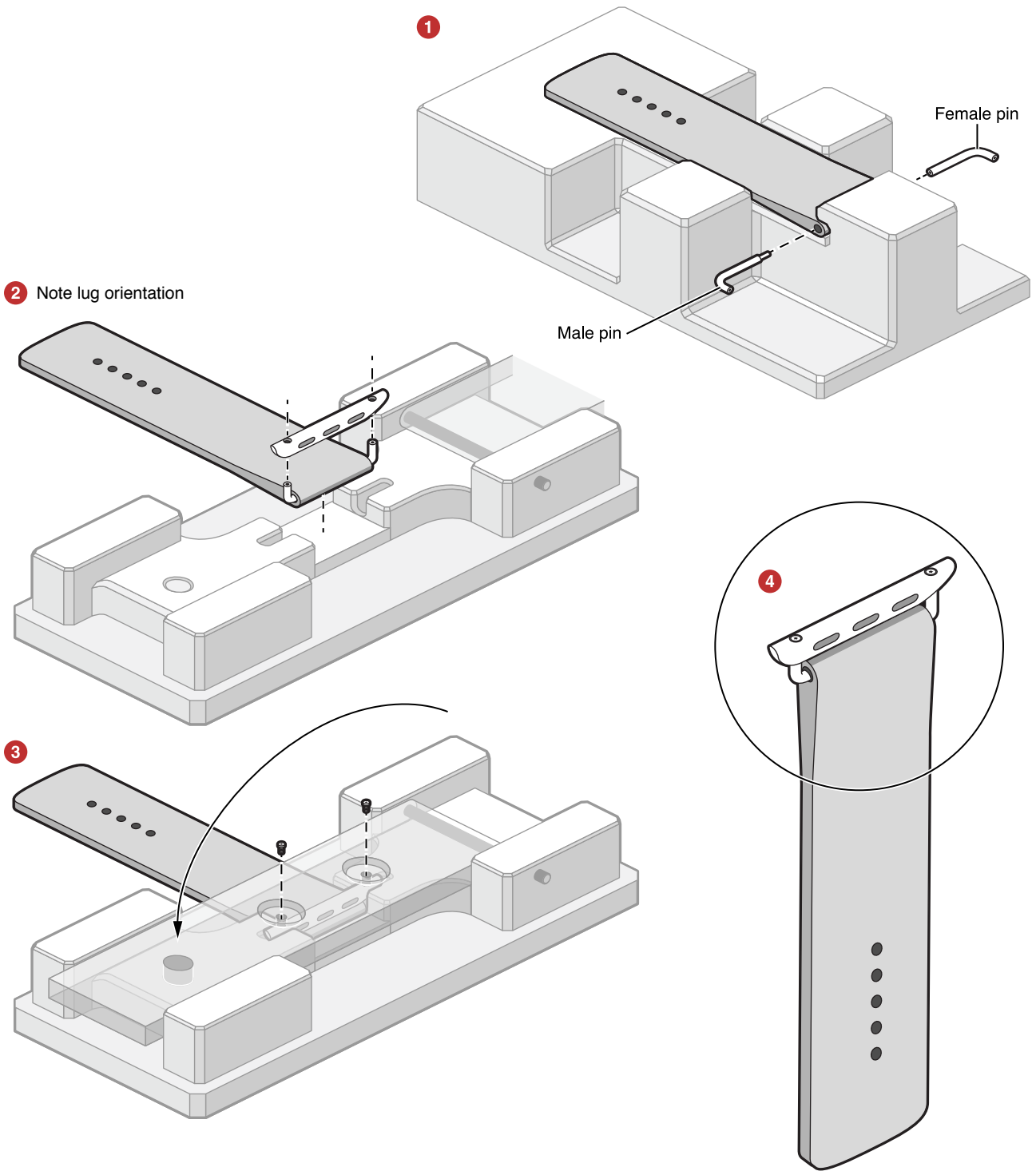
Screw threads should be secured with Loctite 435. Previously installed/used screws should not be reused.

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 18-1](#) (page 105).

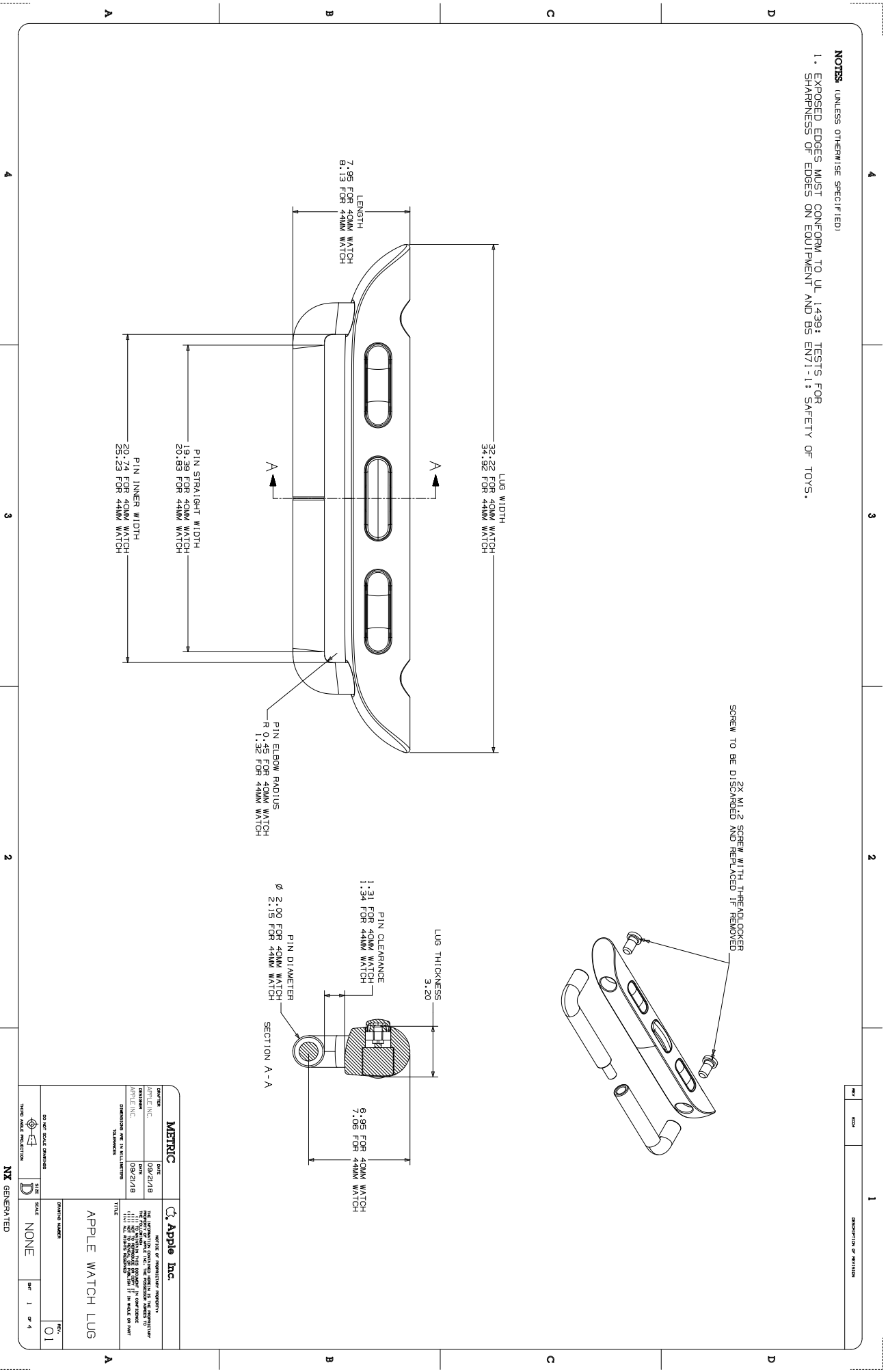
1. Lightly insert the long end of the female pin in the watch band until hard stop. Ensure there is no warping or damage in the watch band.
2. Lightly insert the long end of the male pin in the other side of the band until it interlocks with the female pin and both pins are seated together. Ensure there 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 \pm 10%
 - RPM: 120 \pm 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 18-1 Apple Watch Lug Assembly Fixture



18.4 Example Apple Watch Lug

NOTES: (UNLESS OTHERWISE SPECIFIED)
 1. EXPOSED EDGES MUST CONFORM TO UL 1439: TESTS FOR SHARPNESS OF EDGES ON EQUIPMENT AND BS EN71-1: SAFETY OF TOYS.



METRIC		Apple Inc.	
DATE	09/21/18	DATE	09/21/18
DESIGNED BY	APPLE INC.	DESIGNED BY	APPLE INC.
DATE	09/21/18	DATE	09/21/18
DIMENSIONS ARE IN MILLIMETERS		DIMENSIONS ARE IN MILLIMETERS	
TOLERANCES		TOLERANCES	
NONE		NONE	
DRAWING NUMBER		DRAWING NUMBER	
APPLE WATCH LUG		APPLE WATCH LUG	
REV. 01		REV. 01	
DO NOT SCALE DRAWING		DO NOT SCALE DRAWING	
HAND MAKE MODIFICATION		HAND MAKE MODIFICATION	
NX GENERATED		NX GENERATED	

19. 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 MagSafe.

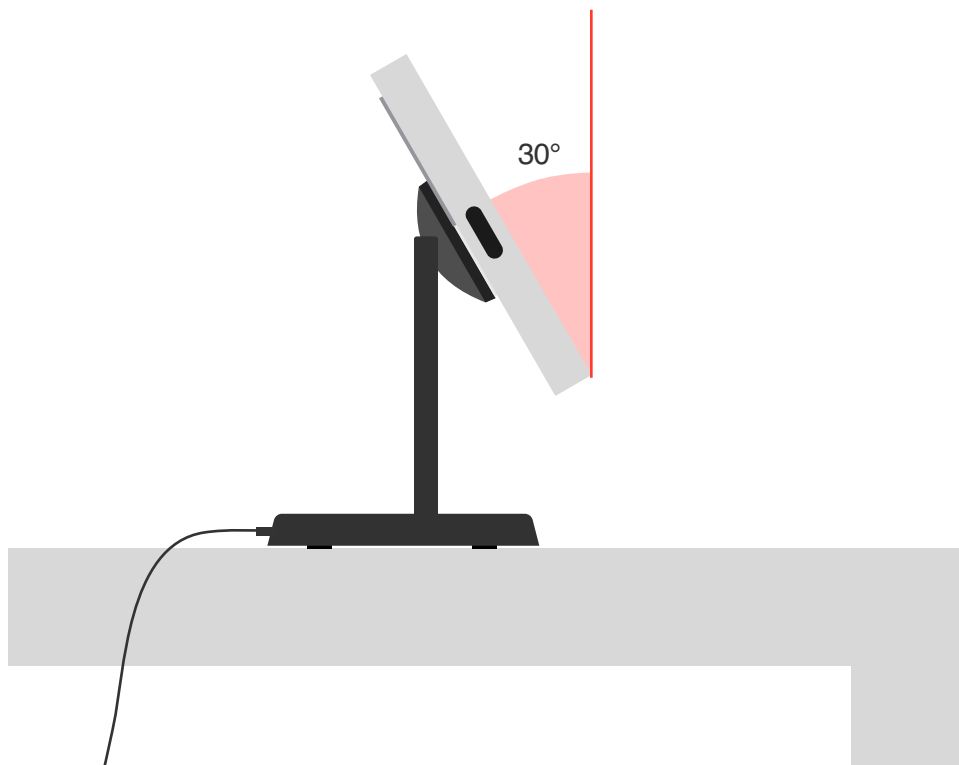
This feature is supported on iOS 17.0 or later.

Figure StandBy example
19-1



19.1 Product Design

Figure 19-2 StandBy Mount example



StandBy Mounts:

- Shall support landscape orientation.
- Shall support inductive or wired device charging.
- Shall not obstruct or touch the device cover glass or any device sensors.
- Shall not cause [Scratches and Damage](#) (page 25).
- Should prevent free rotation of the device.
- Should enable an adjustable backward tilt of at least 30° for optimal visibility.
- Should be stable to prevent unintentionally exiting StandBy.
- Should not obstruct [Access to Controls](#) (page 32).
- Should implement the [MagSafe Accessory Magnet Array](#) (page 156).

19.2 Test Procedures

19.2.1 Equipment

The following equipment is necessary:

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

19.2.2 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.

19.2.3 Product Design

Verify the StandBy Mount:

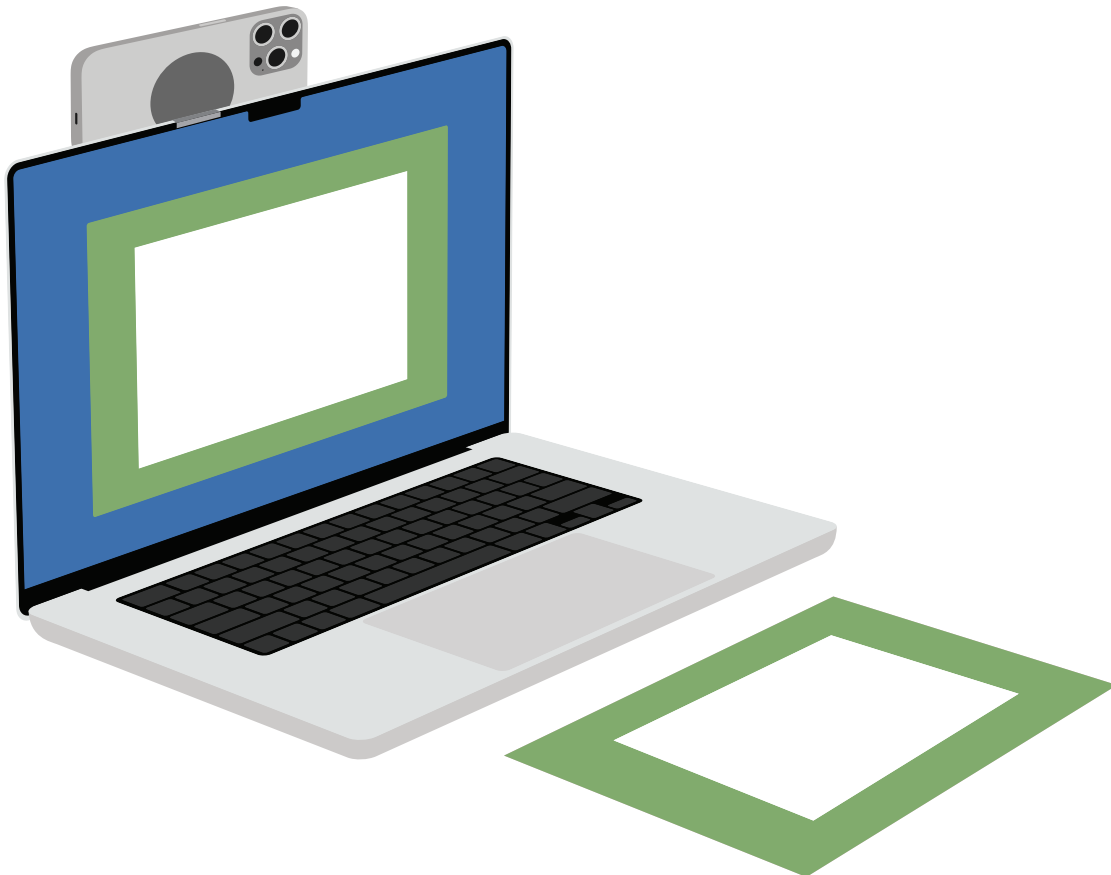
1. Supports landscape orientation.
2. Does not obstruct or touch the device cover glass or any device sensors.
3. Does not scratch or damage device.

20. Continuity Camera Mounts

Continuity Camera enables device cameras to be used with Apple TV or Mac and supports Portrait, Studio Light, Center Stage, and Desk View video effects. See <https://support.apple.com/kb/HT213244> for more information. This feature is supported on iOS 16.0, iPadOS 16.0, macOS 13.0 Ventura, tvOS 17.0, or later and Apple TV 4K (2nd generation) or later.

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

Figure 20-1 Continuity Camera MacBook Desk View example



Center Stage and Desk View are supported on the following devices:

- 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
- iPhone 11 Pro Max
- iPhone 11 Pro
- iPhone 11

Studio Light is supported on iPhone 12 or later, including iPhone SE (3rd generation).

Device as a webcam and Portrait mode are supported on iPhone XR or later.

20.1 Product Design

Continuity Camera Mounts:

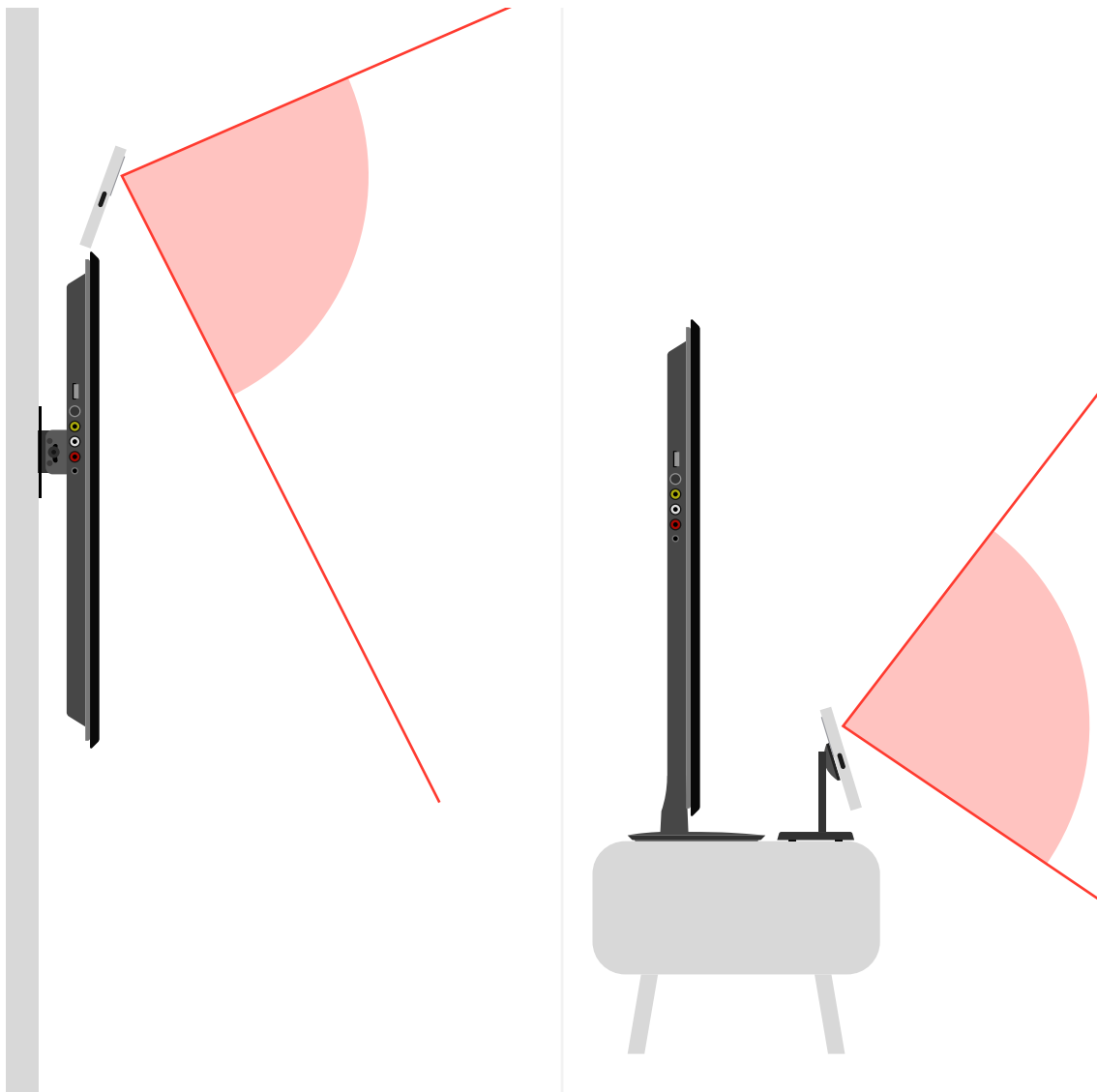
- Shall support devices in portrait and landscape orientations.
- Shall enable use of a USB-C cable or Lightning to USB charge/sync cable.
- Shall not touch the device cover glass, block any device camera field of view, or obstruct any ambient light sensors, see [Device Dimensional Drawings](#) (page 253).
- Shall not cause [Scratches and Damage](#) (page 25).
- Should prevent free rotation of the device.
- Should enable a device camera lens height of at least 228 mm to support Desk View.
- Should not obstruct [Access to Controls](#) (page 32).
- Should implement the [MagSafe Accessory Magnet Array](#) (page 156).
- Should support [Tripod Connections](#) (page 30).

Additional requirements apply to Continuity Camera Mounts used in the following scenerios:

- [Apple TV Mount](#) (page 112)
- [MacBook Mount](#) (page 113)
- [iMac or Display Mount](#) (page 114)

20.2 Apple TV Mount

Figure 20-2 Apple TV mount example

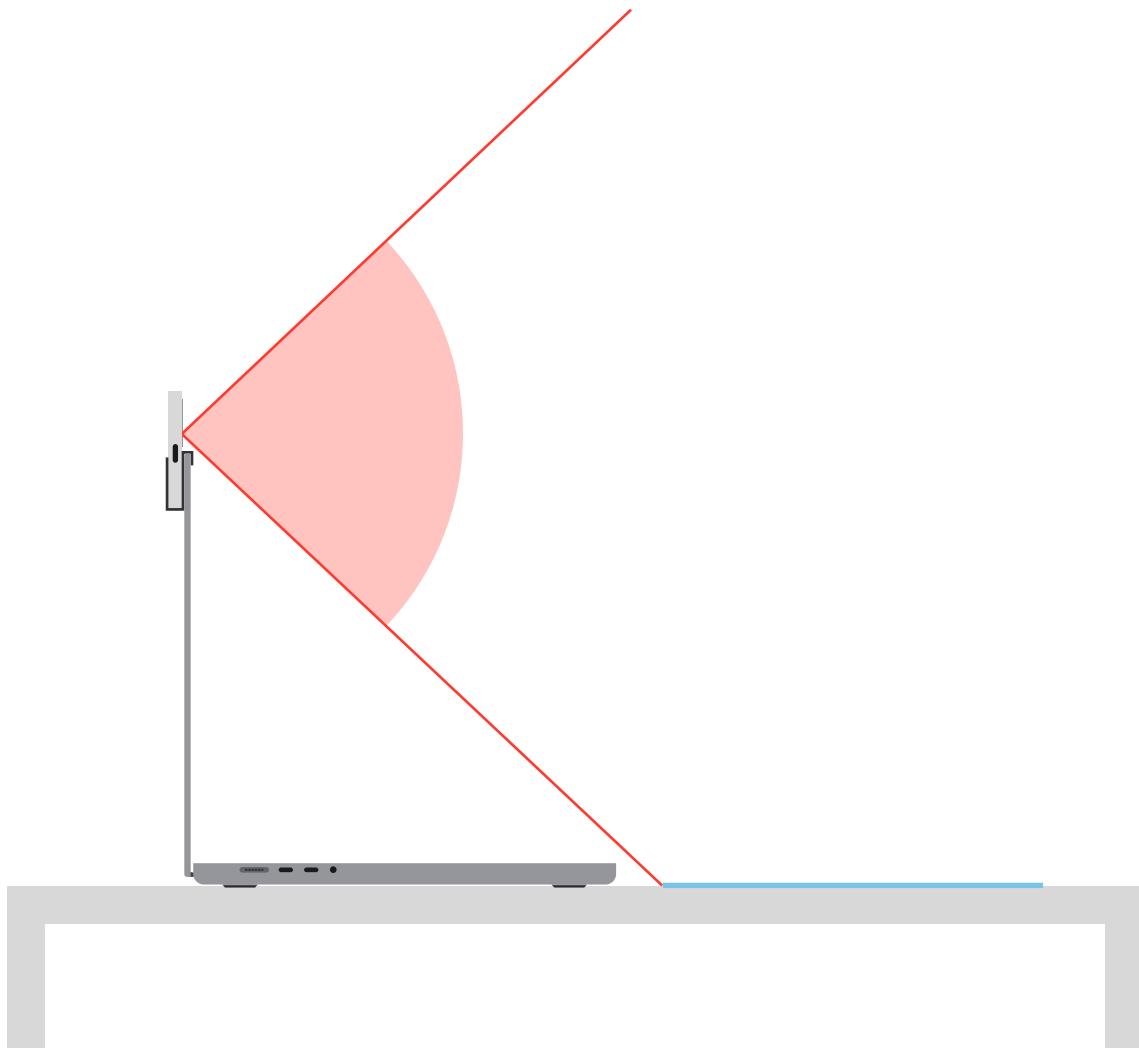


A Continuity Camera Mount designed for Apple TV:

- Shall be stable when placed on top, or in front of a TV.
- Shall not touch the display glass (active and non-active areas).
- Shall not sandwich or squeeze the TV and device together.
- Should enable upward and downward tilt.

20.3 MacBook Mount

Figure MacBook mount example
20-3



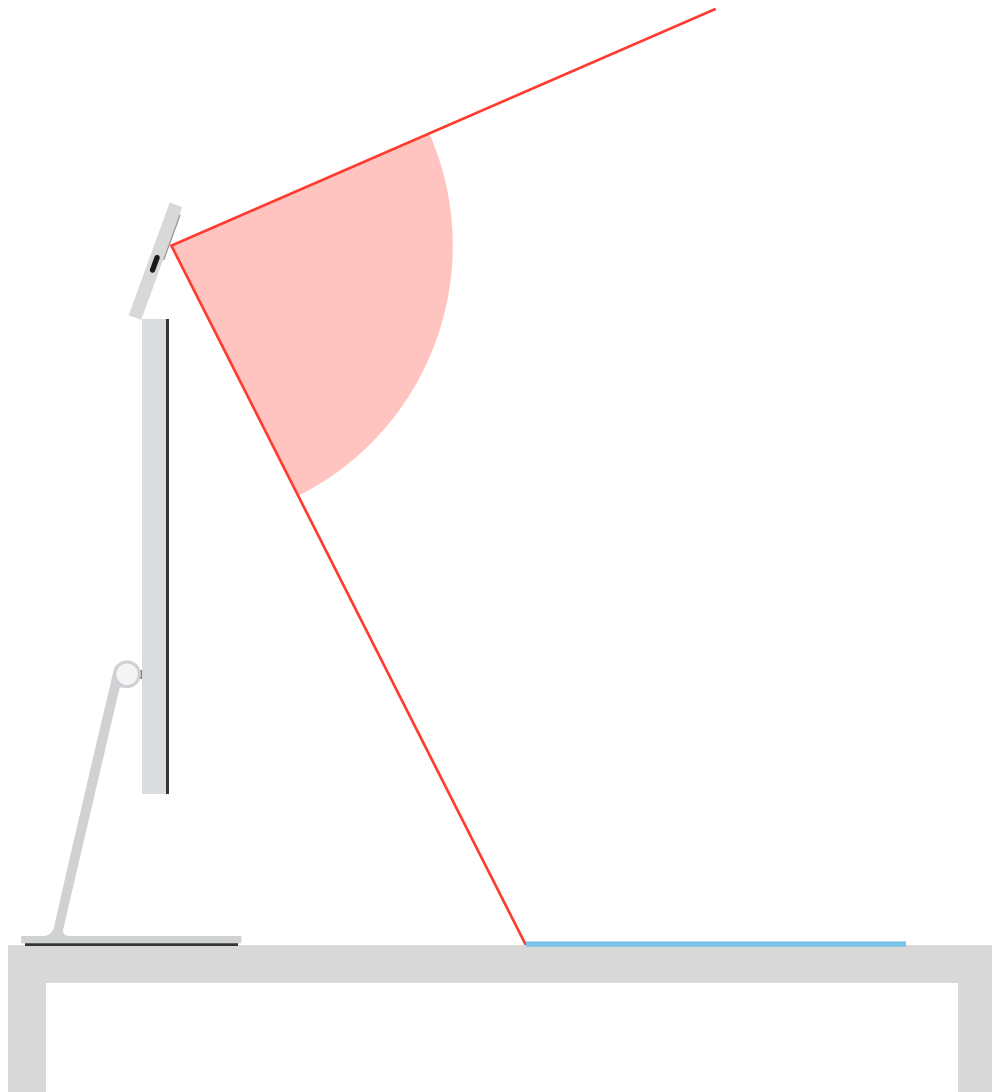
A Continuity Camera Mount designed for MacBook, MacBook Air, and MacBook Pro:

- Shall not scratch or damage the MacBook.

- Shall not touch the MacBook display glass (active and non-active areas).
- Shall not interfere with or prevent fully closing the MacBook.
- Shall not sandwich or squeeze the MacBook and device together.
- Should not cover or touch any portion of the MacBook display glass, camera, or other sensors.
- Should enable a downward tilt in portrait orientation from 0° to 12° to support Desk View.
- Should minimize the mass to maintain stability of the display.

20.4 iMac or Display Mount

Figure 20-4 Display mount example



A Continuity Camera Mount designed for iMac or displays:

- Shall not scratch or damage the iMac or display.
- Shall not touch the display glass (active and non-active areas).
- Shall not sandwich or squeeze the iMac or display and device together.
- Should not cover or touch any portion of the display glass, camera, microphones, or other sensors.
- Should enable a downward tilt from 0° to 30° to support Desk View.

20.5 Test Procedures

20.5.1 Equipment

The following equipment is necessary to perform the tests in this procedure:

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

20.5.2 Enable Continuity Camera on Apple TV

To 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 ID.
3. Using the device, select the Continuity Camera notification and select Accept.
4. Attach device to Continuity Camera Mount.
5. The Continuity Camera view will display in FaceTime.

20.5.3 Enable Continuity Camera on Mac

To 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 device to Continuity Camera 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. The Continuity Camera view will display in FaceTime.

To 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 device to Continuity Camera Mount.
4. Open FaceTime on the Mac and select Continuity Camera from the Video menu.
5. The Continuity Camera view will display in FaceTime.

20.5.4 Product Design

Verify the Continuity Camera 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 Lightning to USB charge/sync cables.

20.5.5 Center Stage

Center Stage is a video effect available in the Mac Control Center. Selecting Video Effects and enabling Center Stage will cause the video to follow people 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 in the frame.

1. Ensure the device is logged into the same Apple ID 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 Photo Booth app with and without Center Stage enabled.
 - a. Open the Photo Booth app on the Mac, use the Camera menu to select Continuity Camera.
 - b. Use the still photo mode.
4. Use the Mac Control Center menu to select Video Effects, and enable Center Stage.
5. Capture photos from different positions using Center Stage face tracking, in portrait and landscape orientation, waiting 5 seconds between each photo.
6. Use the Mac Control Center menu to select Video Effects, and disable Center Stage.
7. Capture photos in portrait and landscape orientation, waiting 5 seconds between each photo.
8. 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 visible anomalies caused by the mount in either portrait and landscape orientation.

20.5.6 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 Continuity Camera Mount and its mount 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 ID 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 Continuity Camera 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

21. Bluetooth Accessory Identification

This chapter describes Apple-specific Bluetooth commands extending accessory capabilities beyond those supported by standard Bluetooth profiles.

To enable Apple-specific features, the accessory shall support [HFP Command AT+XAPL](#) (page 119), 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 173) and [Bluetooth Headset Battery Level Indication](#) (page 130).

21.1 HFP Command AT+XAPL

Description: Enables custom AT commands from an accessory.

Initiator: Bluetooth 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)

21. Bluetooth Accessory Identification

21.1 HFP Command AT+XAPL

Response: +XAPL=iPhone,*features*

22. Accessory Power (USB-C)

This chapter applies to devices that integrate a USB-C connector.

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 2.2.*
- *USB Power Delivery Specification, Revision 3.1, Version 1.3*, if the accessory supports [USB Power Delivery](#) (page 196).

Accessories benefitting from accessory power include:

- Headsets.
- [Adapters](#) (page 72).
- [Keyboards](#) (page 82).
- [External Storage](#) (page 97).

22.1 Available Current

The following table lists the current available to an accessory.

Table 22-1 Available Current

Device	Default	USB Type-C Current (page 197)	USB Power Delivery (page 196)
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 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)

22. Accessory Power (USB-C)

22.2 Fast Role Swap (FRS)

Device	Default	USB Type-C Current (page 197)	USB Power Delivery (page 196)
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)

22.2 Fast Role Swap (FRS)

iPads with a USB-C connector support the Fast Role Swap (FRS) feature defined in the *USB Power Delivery Specification, Revision 3.1, Version 1.3*.

22.3 Test Procedures

22.3.1 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 that claims 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.

22.3.1.1 Equipment

The following equipment is necessary:


- An external USB drive in APFS format (the example accessory).
- A Mac with USB-C.
- A USB-IF certified USB-C to USB-C Full-Featured cable.
- An oscilloscope with a current probe.
- A USB-C breakout board, if necessary.

22.3.1.2 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 μ s/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.

22.3.1.3 Test Cases

22.3.1.3.1 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.

22.3.1.3.2 Idle

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

22.3.1.3.3 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.

22.3.1.3.4 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.

23. 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 23) for more information.

24. 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 127) to make use of the list.

See the [Accessory Interface Specification](#) (page 23) for more information.

25. App Launch

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

Figure 25-1 App Launch Alert



See the [Accessory Interface Specification](#) (page 23) for more information.

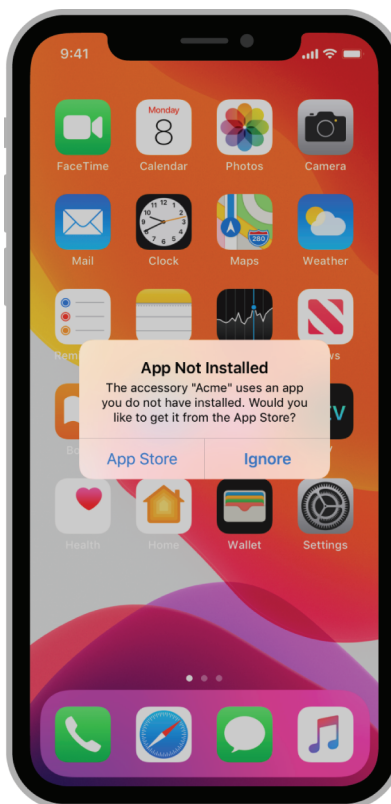
26. App Match

The App Match feature enables accessories supporting the External Accessory Protocol feature 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 by the user using *Settings > General > About > 'Accessory Name' > 'Find App for this Accessory'*.

Matched apps are listed in alphabetical order with one exception. If the accessory works with apps from multiple development teams/companies, the accessory may provide a preferred Team ID to place apps from the preferred team at the top of the list.

Figure 26-1 App Match Alert



See the [Accessory Interface Specification](#) (page 23) for more information.

27. Bluetooth Headset Battery Level Indication

Any Hands-Free Bluetooth headset accessory may display its 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 119) and [HFP Command AT+IPHONEACCEV](#) (page 130)

27.1 HFP Command AT+IPHONEACCEV

Description: Reports a headset state change.

Initiator: Headset 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

28. 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 240) or a USB-C cable.
- Use [USB Type-C Current](#) (page 197) to identify their power capability and should use [USB Power Delivery](#) (page 196) to provide higher power, see <https://support.apple.com/en-us/HT208137>.
- 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 202) protocol in conjunction with [USB Type-C Current](#) (page 197) to allow for more granular control of the available current after the initial connection. Accessories shall not use [iAP2](#) (page 202) to adjust available current in conjunction with [USB Power Delivery](#) (page 196).

Accessories providing power from a USB-C receptacle, see [Providing Power](#) (page 245).

28.1 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 74), [Integrated USB Receptacles](#) (page 25), and [User Supplied Cables and AC Power Adapters](#) (page 25) for additional requirements specific to external USB power supplies/cables.

28.2 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.
- An external power source (for example, mains electricity or battery) is connected to or disconnected from the accessory.
- The 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.

29. 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 Licensing Program](#) (page 23).

Accessories providing power to a device shall either:

- Provide direct power, see [Direct Power Source](#) (page 133).
- Manage power from external sources, see [External Power Source](#) (page 133).

Accessories without the potential for data communication with the device shall provide direct power to the device, see [Direct Power Source](#) (page 133).

29.1 Direct Power Source

Accessories providing power directly shall 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.

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

29.2 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 134).

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 74), [Integrated USB Receptacles](#) (page 25), and [User Supplied Cables and AC Power Adapters](#) (page 25) for additional requirements specific to external USB power supplies/cables.

29.3 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 192).
 - [USB D+/D- Resistor Networks](#) (page 193).
- USB-C receptacle, then:
 - It shall use one of the following to declare its power providing capability:
 - [USB Type-C Current](#) (page 197).
 - [USB Power Delivery](#) (page 196).
 - 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*.

29.4 Providing Power using USB Connectors

Accessories providing power from:

- A USB-C receptacle, see [USB-C Receptacle](#) (page 244).
- A USB-A receptacle, see [USB-A Receptacle](#) (page 239).

29.5 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.

29.6 Fast Charge for iPhone (20 W)

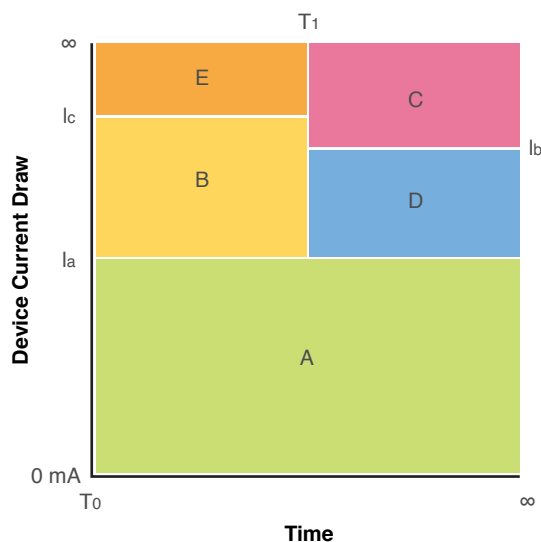
Accessories advertising "fast charge" for iPhone (<https://support.apple.com/en-us/HT208137>) shall:

- Support [USB Power Delivery](#) (page 196).
- 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.

29.7 Overcurrent and Short Circuit Protection

Figure 29-1 Overcurrent and Short Circuit Protection



Power-providing accessories shall implement overcurrent and short circuit protection for each region in [Figure 29-1](#) (page 136) according to [Table 29-1](#) (page 136), [Table 29-2](#) (page 136), and [Table 29-3](#) (page 137).

Table 29-1 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 29-2 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 $\geq T_0 + 1$ ms.

Table Overcurrent/Short Circuit Protection Behaviors
29-3

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.

29.8 Overcurrent and Short Circuit Protection Resets

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

29.9 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.
- An external power source (for example, mains electricity or battery) is connected to or disconnected from the accessory.
- The 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.

30. Device Power (Inductive)

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

- [Qi Wireless Power](#) (page 138)
- [MagSafe](#) (page 139)

30.1 Qi Wireless Power

The following devices support [Qi Wireless Power](#) (page 138):

- 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

30. Device Power (Inductive)

30.2 MagSafe

- iPhone 8
- 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 1.2.4, see <https://www.wirelesspowerconsortium.com>.

30.2 MagSafe

The following devices support MagSafe:

- 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)

See the [Accessory Interface Specification](#) (page 23) for information on MagSafe.

30.3 Electromagnetic Compatibility (EMC)

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

30. Device Power (Inductive)

30.3 Electromagnetic Compatibility (EMC)

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:

30. Device Power (Inductive)

30.3 Electromagnetic Compatibility (EMC)

- 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.

31. 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 23) for more information.

32. HID Headset Remote

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

32.1 Requirements

Accessories implementing HID headset remote controls shall:

- Connect to the device using one of the following:
 - [USB-C Plug](#) (page 240).
 - [Bluetooth](#) (page 207).

HID headset remotes shall support the [Human Interface Device \(HID\)](#) (page 203) 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 32-1](#) (page 143) and [Table 32-2](#) (page 143).

Table 32-1 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 32-2 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.

32.2 Examples

32.2.1 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

32.2.2 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

```


32. HID Headset Remote

32.2 Examples

```
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

32.2.3 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
```

32. HID Headset Remote

32.2 Examples

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

33. 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 23) for more information.

34. MagSafe Attach

The following devices support MagSafe Attach:

- 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 31) shall:

- Claim compatibility with a MagSafe-capable device.
- Integrate a [MagSafe Case Magnet Array](#) (page 149).

Other MagSafe accessories shall:

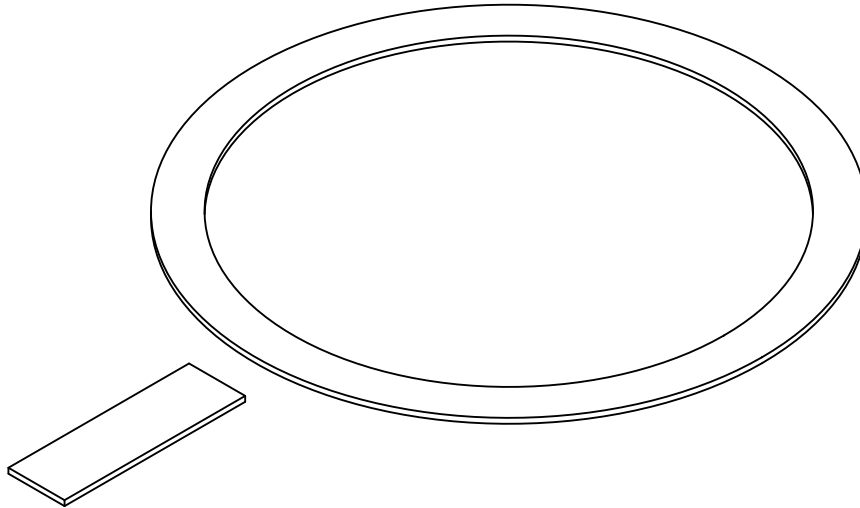
- Claim compatibility with a MagSafe-capable device.
- Integrate a [MagSafe Accessory Magnet Array](#) (page 156).

Apple recommends the following magnet array vendors:

- Ningbo Sanhuan Magsound Industry & Trade Co., Ltd. (<https://magsound.com>)
- Phone In Mag Electronics Co., Ltd. (<http://www.phonein.com.tw>)
- Quadrant Solutions, Inc. (<https://www.quadrant.us>)

34.1 MagSafe Case Magnet Array

Figure 34-1 MagSafe Case Magnet Array



34.1.1 Product Design

All 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 31).
- Work with:
 - Apple MagSafe Charger.
 - Apple MagSafe Battery Pack.
 - iPhone Leather Wallet with MagSafe.

34.1.2 Mechanical

All magnets that are part of 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.

34. MagSafe Attach

34.1 MagSafe Case Magnet Array

34.1.2.1 Magnets

All MagSafe case magnets shall be N45SH NdFeB with a 7 μm - 13 μm NiCuNi plating finish (or similar) and shall meet the requirements in [Table 34-1](#) (page 150).

Table 34-1 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

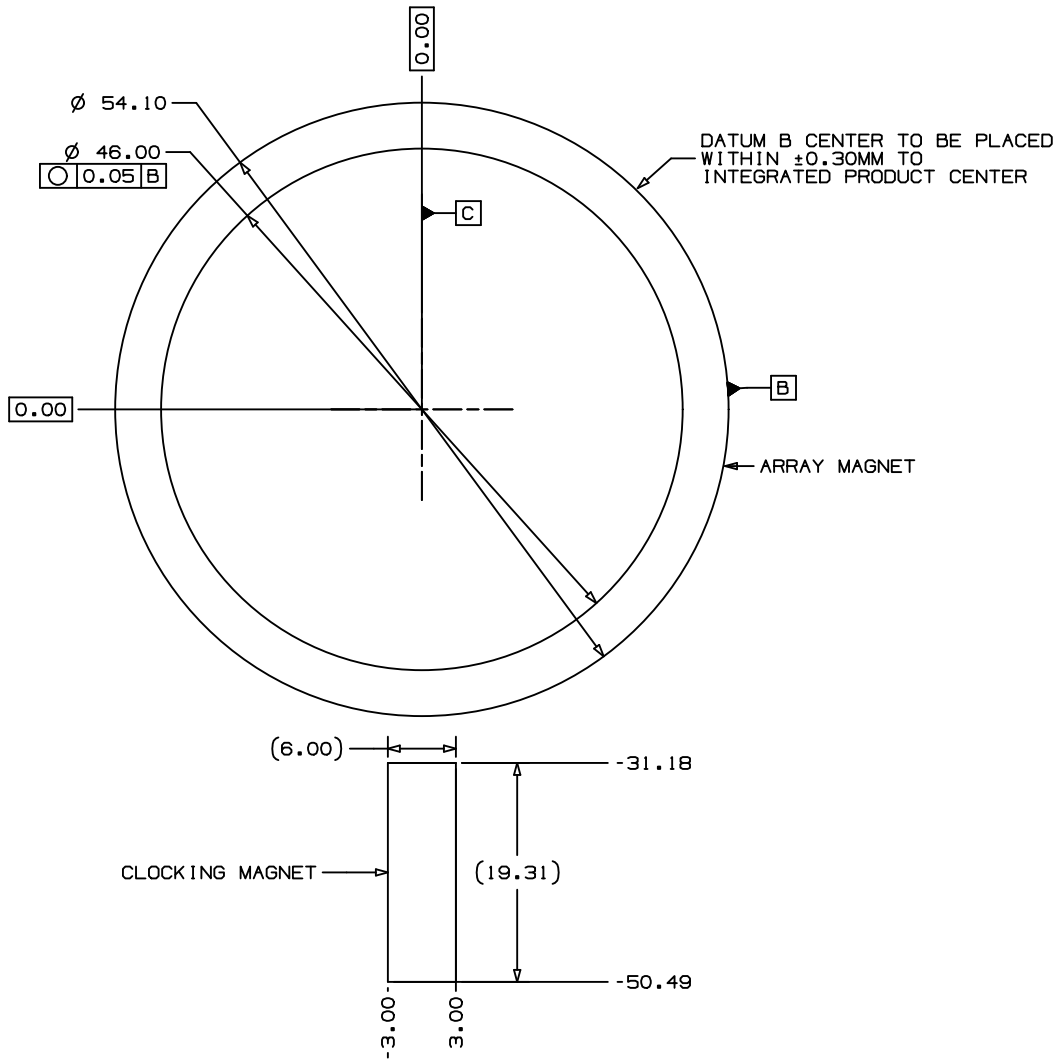
34.1.2.2 Magnet Array

The magnets shall be positioned in the case following the dimensions and polarity shown in [Figure 34-2](#) (page 151), [Figure 34-3](#) (page 152) and [Figure 34-4](#) (page 152).

34. MagSafe Attach

34.1 MagSafe Case Magnet Array

Figure 34-2 MagSafe Magnet Array Dimensions



34. MagSafe Attach

34.1 MagSafe Case Magnet Array

Figure 34-3 MagSafe Magnet Ring Dimensions and Polarity

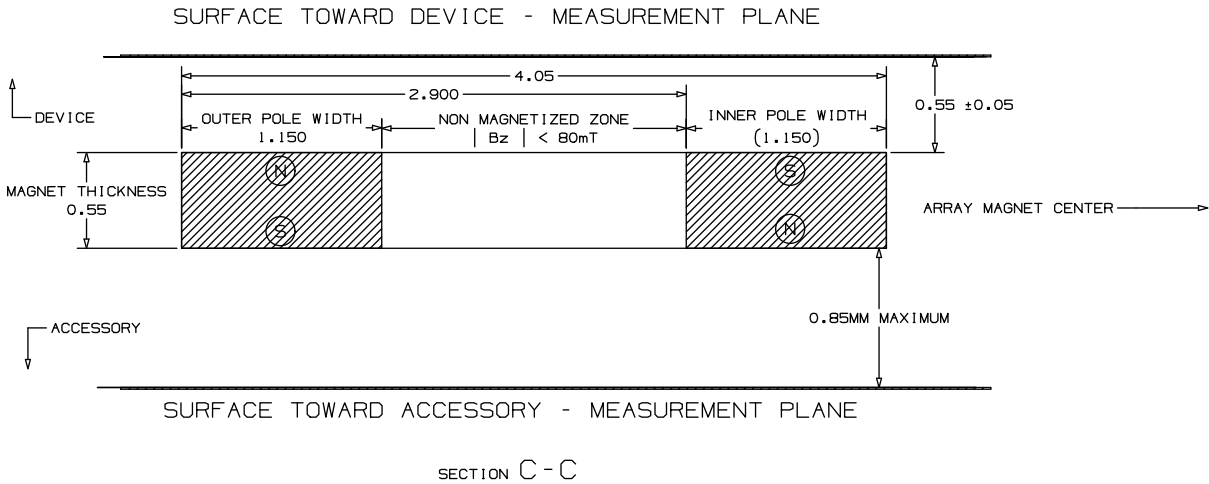
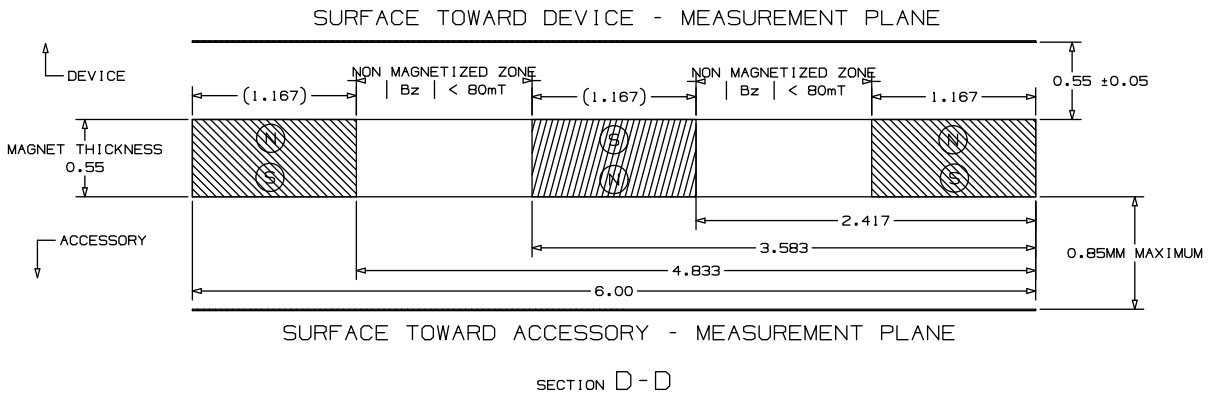


Figure 34-4 MagSafe Orientation Magnet Dimensions and Polarity



The flux density of a MagSafe case magnet ring shall comply with [Table 34-2](#) (page 153) and [Table 34-3](#) (page 154) across the 8 lines (S1 - S8) in [Figure 34-5](#) (page 153).

34. MagSafe Attach

34.1 MagSafe Case Magnet Array

Figure 34-5 MagSafe Flux Density Measurement Plane

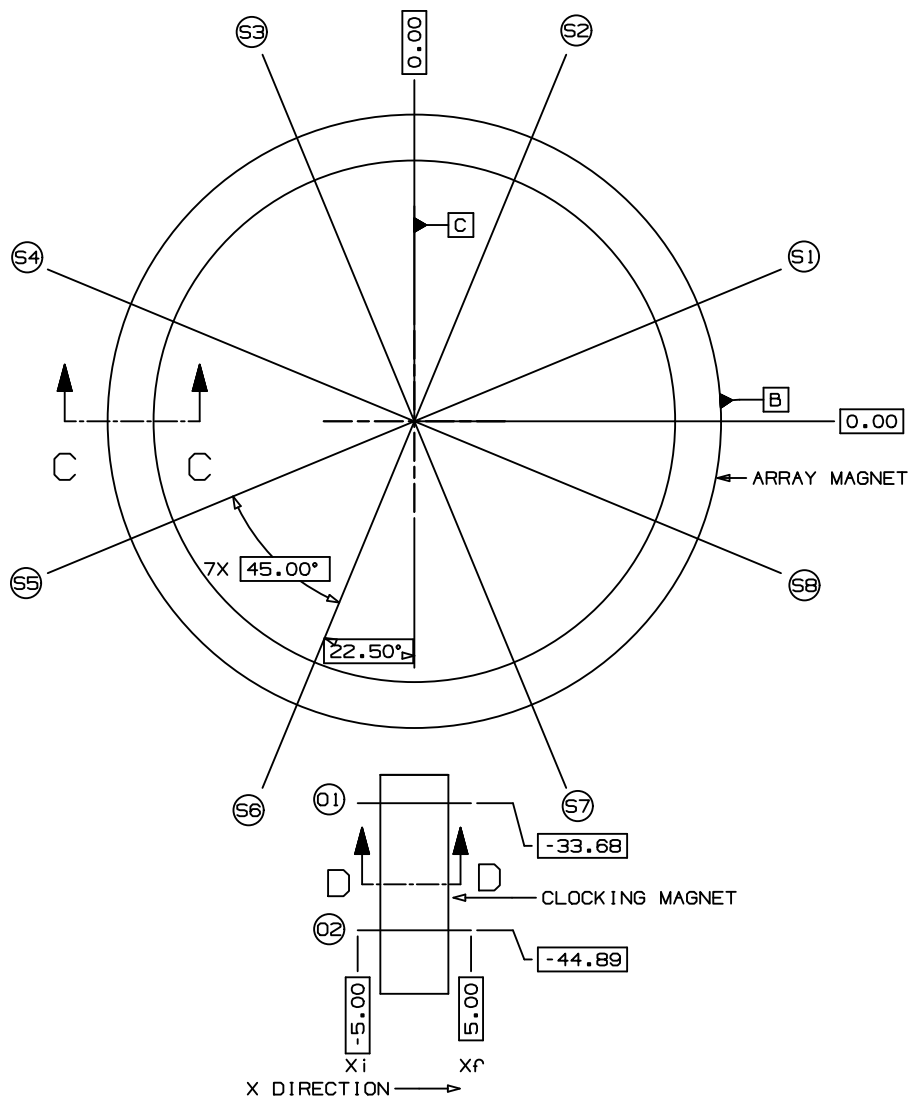


Table 34-2 Device side flux density at 0.55 mm from magnet ring surface

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

34. MagSafe Attach

34.1 MagSafe Case Magnet Array

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 34-3 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 34-4](#) (page 154) and [Table 34-5](#) (page 155) across the 2 lines (O1 and O2) in [Figure 34-5](#) (page 153).

Table 34-4 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

34. MagSafe Attach

34.1 MagSafe Case Magnet Array

Table 34-5 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

34.1.2.3 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 34-6](#) (page 155).

Table 34-6 Magnetic force

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

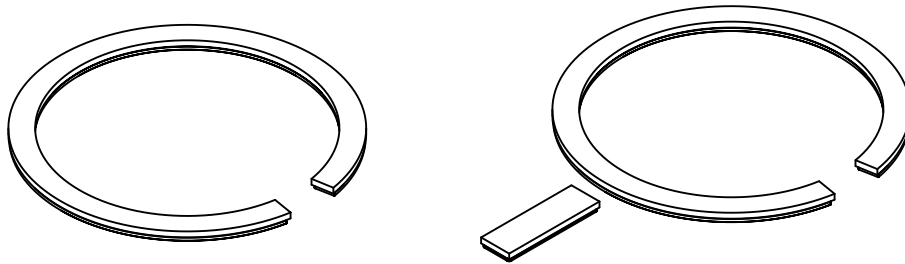
34.1.3 Magnetic Interference

All cases with an integrated MagSafe magnet array shall not interfere with:

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

34.2 MagSafe Accessory Magnet Array

Figure 34-6 MagSafe Accessory Magnet Array Options



The MagSafe accessory magnet array shall be implemented as a [Magnet Ring](#) (page 158). 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 159) as part of the array.

34.2.1 Product Design

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

34.2.2 Mechanical

The accessory shall not interfere with or cause [Scratches and Damage](#) (page 25) to the device.

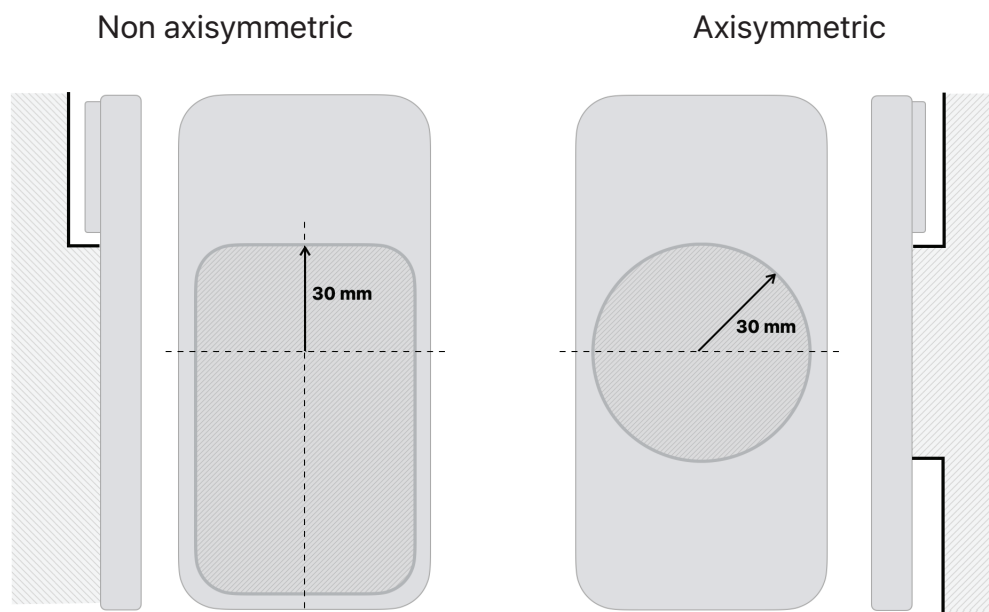
To avoid interference with devices, accessories shall:

- 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 163).

34. MagSafe Attach

34.2 MagSafe Accessory Magnet Array

Figure 34-7 MagSafe Accessory Clearance



All magnets that are part of the MagSafe accessory magnet array shall be positioned in the same plane.

The MagSafe accessory's [Magnet Ring](#) (page 158) shall magnetically self align to the device's magnet ring within a 1.55 mm radial maximum.

34.2.2.1 Magnets

All 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 34-7](#) (page 157).

Table 34-7 Magnet Properties

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

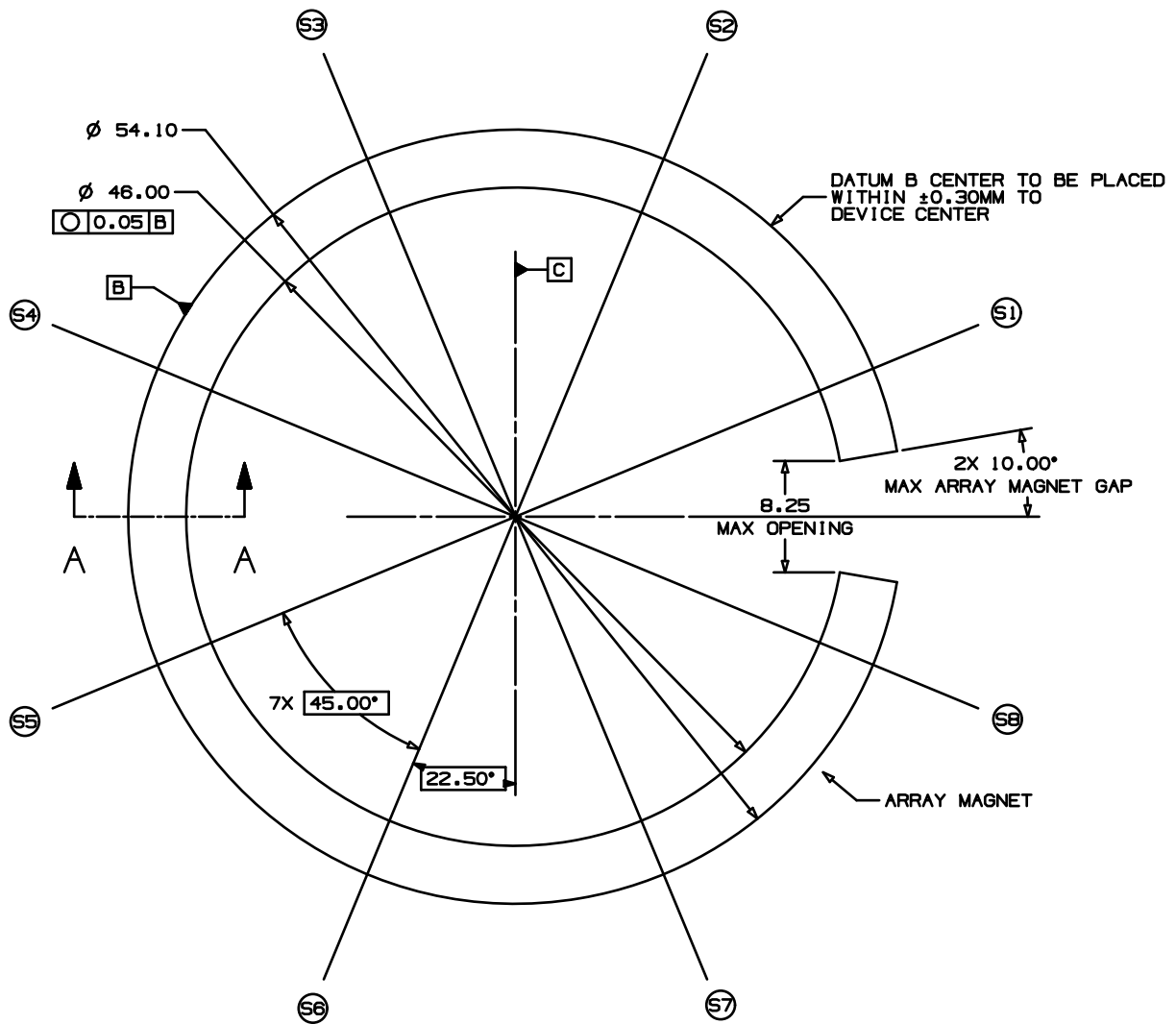
34. MagSafe Attach

34.2 MagSafe Accessory Magnet Array

34.2.2.2 Magnet Ring

The magnet ring shall be positioned in the accessory in compliance with the dimensions and polarity requirements in [Figure 34-8](#) (page 158) and [Figure 34-9](#) (page 159).

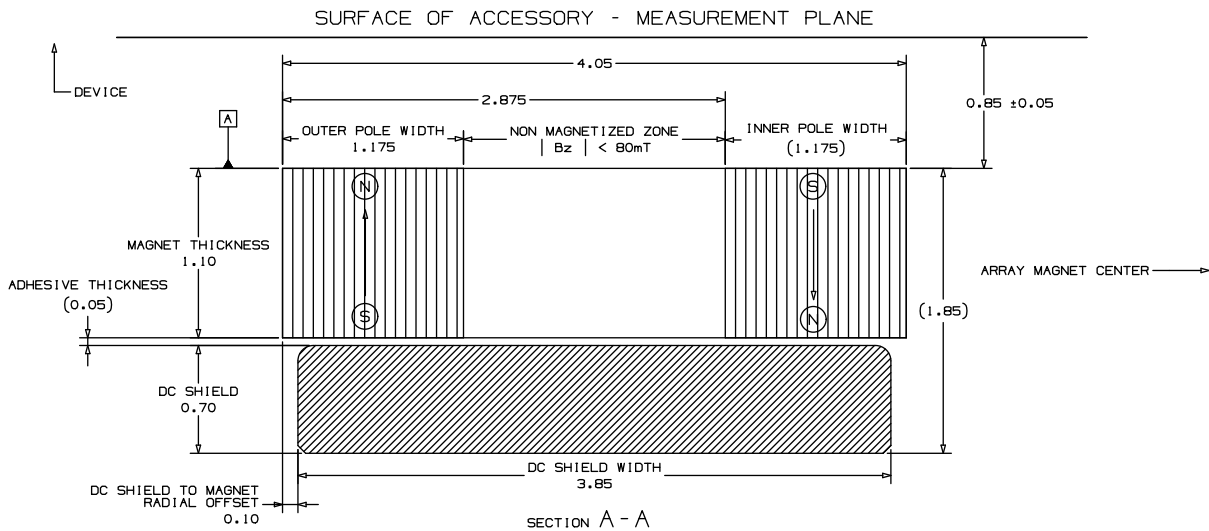
Figure 34-8 MagSafe Magnet Ring Dimensions



34. MagSafe Attach

34.2 MagSafe Accessory Magnet Array

Figure 34-9 MagSafe Magnet Ring Dimensions and Polarity



See [DC Shield](#) (page 162) for additional requirements of the DC shield specified in [Figure 34-9](#) (page 159).

The flux density of a MagSafe accessory magnet ring shall comply with [Table 34-8](#) (page 159) across the 8 lines (S1 - S8) in [Figure 34-8](#) (page 158).

Table 34-8 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

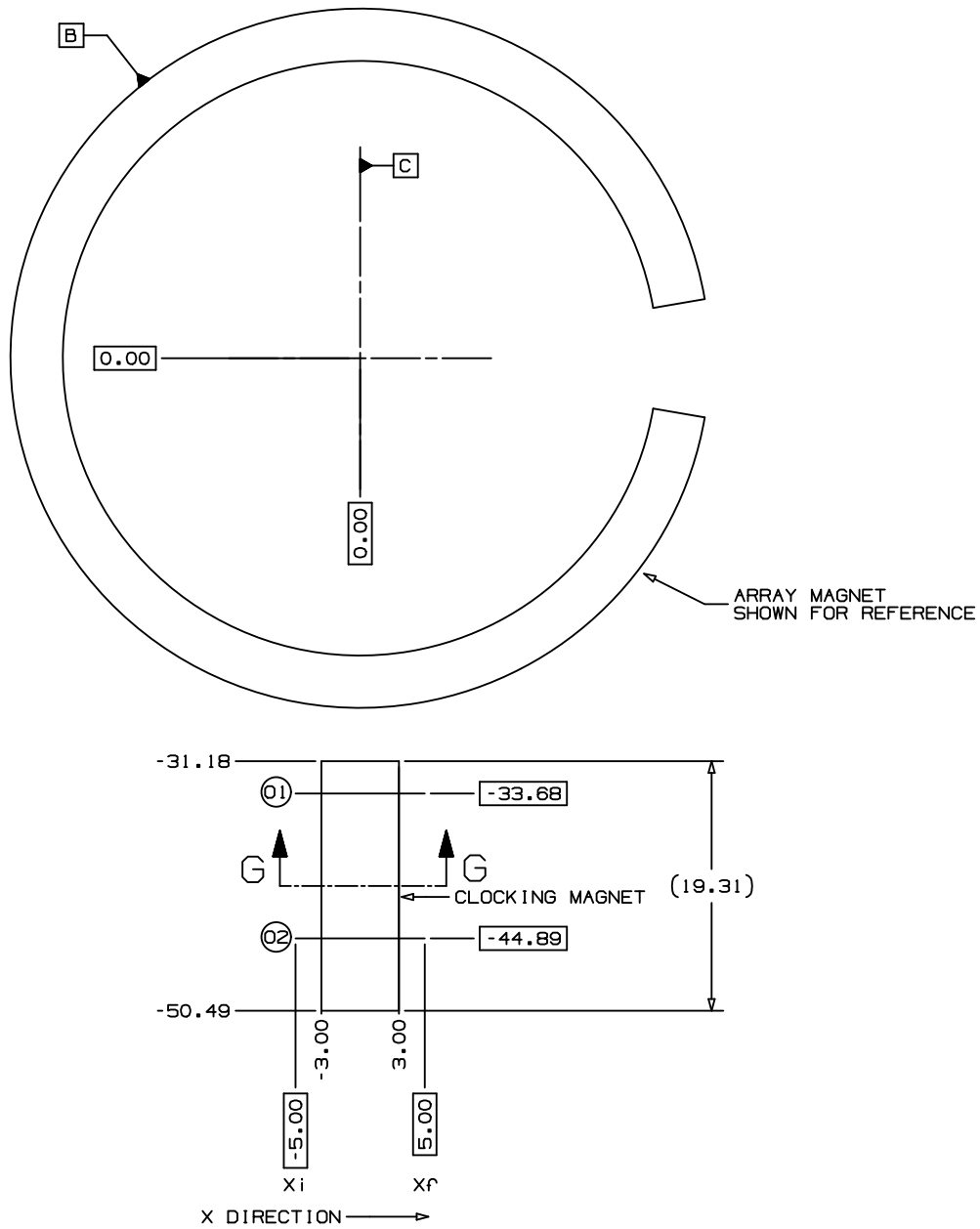
34.2.2.3 Orientation Magnet

If orientation magnets are included, the magnets shall be positioned according to [Figure 34-10](#) (page 160) and [Figure 34-11](#) (page 161).

34. MagSafe Attach

34.2 MagSafe Accessory Magnet Array

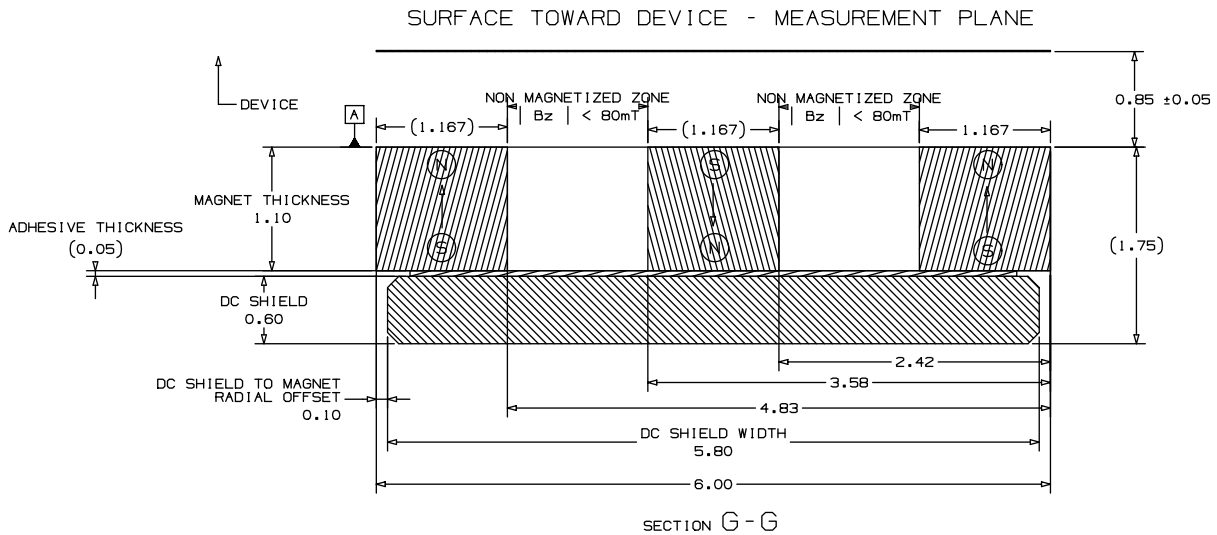
Figure 34-10 MagSafe Orientation Magnet Dimensions



34. MagSafe Attach

34.2 MagSafe Accessory Magnet Array

Figure 34-11 MagSafe Orientation Magnet Dimensions and Polarity



See [DC Shield](#) (page 162) for additional requirements of the DC shield specified in [Figure 34-11](#) (page 161).

The flux density of a MagSafe accessory orientation magnet shall comply with [Table 34-9](#) (page 161) across the 2 lines (O1 and O2) in [Figure 34-10](#) (page 160).

Table 34-9 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

34. MagSafe Attach

34.2 MagSafe Accessory Magnet Array

34.2.2.4 Magnetic Force

The force normal to the back of the device needed to dislodge the MagSafe accessory shall meet the requirements in [Table 34-10](#) (page 162).

Table 34-10 Magnetic force

Scenario	Minimum	Maximum
Accessory attached to device	650 gf	900 gf

34.2.2.5 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.

34.3 MagSafe Accessory Enclosure Geometry

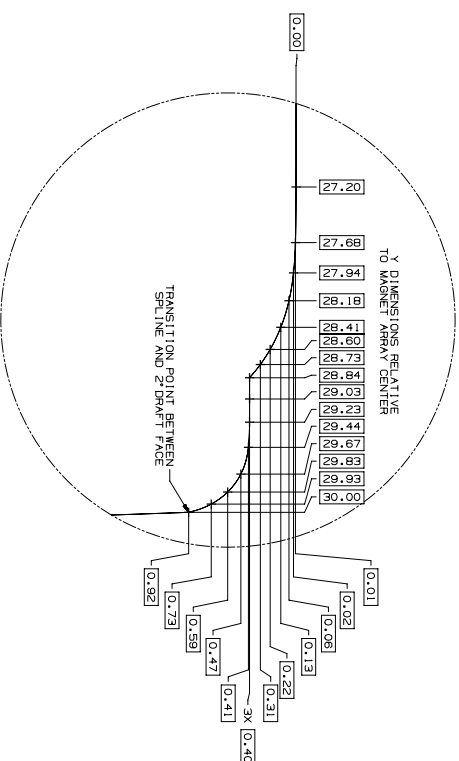
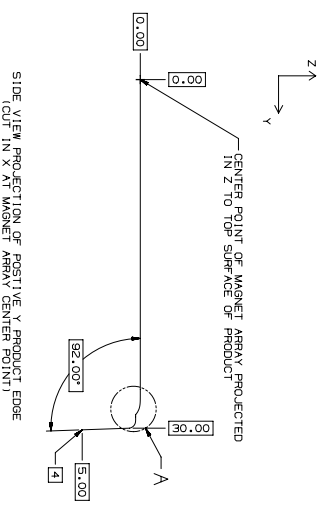
4

3

2

1

- 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



DETAIL A
SCALE 50:1

METRIC		Apple Inc.	
DATE	DATE	VERSION	DESCRIPTION
APRIL 11 2023	APRIL 11 2023	1	INITIAL RELEASE
APRIL 11 2023	APRIL 11 2023	1	INITIAL RELEASE
DIMENSIONS ARE IN MILLIMETERS		TOLERANCES	
UNLESS OTHERWISE SPECIFIED		MAGSAFE COMPATIBLE ENCLOSURE GEOMETRY	
DO NOT SCALE DIMENSIONS	SCALE	NONE	REV 01
HIDDEN AREA PROJECTION	THE	1	OF 1
NX GENERATED			

A

B

C

D

4

3

2

1

34.4 Test Procedures

34.4.1 MagSafe Case Magnet Array

34.4.1.1 Case Thickness

34.4.1.1.1 Equipment

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

34.4.1.1.2 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.

34.4.1.2 Accessory Clearance

34.4.1.2.1 Equipment

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

34.4.1.2.2 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.

34.4.1.3 Magnetic Force

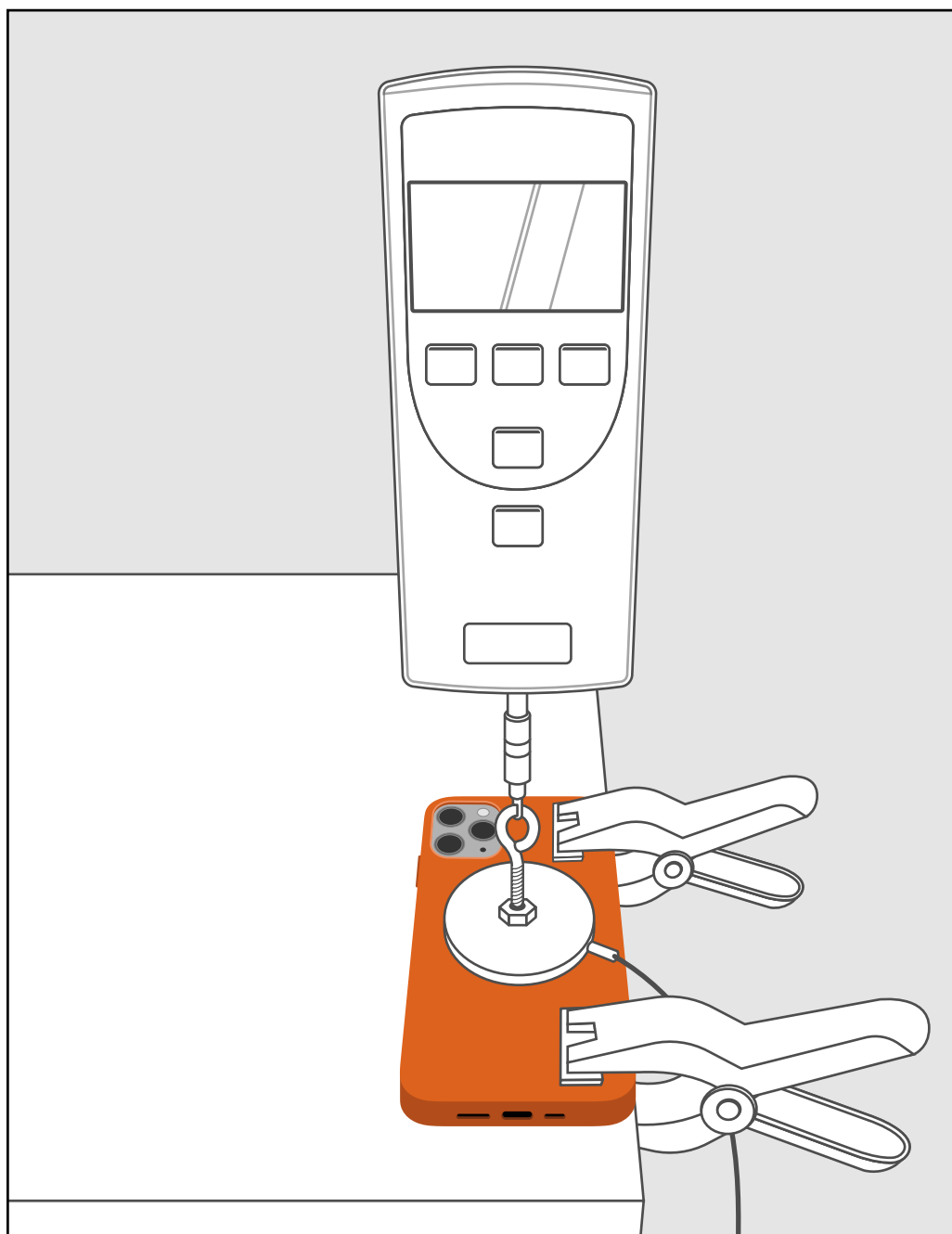
34.4.1.3.1 Equipment

- MagSafe-capable device.
- Apple MagSafe Charger with a non-magnetic eyelet screw glued firmly to its back. Pulling on the eyelet should exert a force on the center of the charger.
- Digital force gauge capable of capturing peak values, such as the Chatillon DFX II.
- Hook attachment for digital force gauge.
- Clamps.

34.4.1.3.2 Procedure

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. See [Figure 34-12](#) (page 166).
3. Repeat the following steps 5 times:
 - a. Attach the modified Apple MagSafe Charger to the back of the case, allowing the Apple MagSafe Charger to magnetically align.
 - b. Connect the force gauge hook to the eyelet. See [Figure 34-12](#) (page 166).
 - 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 force value displayed on the force gauge.
4. Calculate the average of the 5 peak force measurements.
5. Verify the average force is within the range of 800 gf to 1100 gf.

Figure 34-12 Magnetic Force Test Setup



34.4.1.4 iPhone Leather Wallet with MagSafe Detection

34.4.1.4.1 Equipment

- MagSafe-capable device.

- iPhone Leather Wallet with MagSafe.

34.4.1.4.2 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.

34.4.1.5 Magnetic Stripe Cards in iPhone Leather Wallet with MagSafe

34.4.1.5.1 Equipment

- 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.

34.4.1.5.2 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 and confirm readability.
 - b. Insert the LoCo card into the wallet with the magnetic stripe facing the magnets.
 - c. Place additional cards into the wallet to ensure a LoCo card is in contact with the magnet side of the wallet.
 - d. Attach the wallet to the accessory (attached to the device).
 - e. Wait 10 seconds.
 - f. Remove the wallet from the accessory.
 - g. Remove the LoCo card from the wallet.
 - h. Verify the LoCo card can be read and it displays the correct information.

34.4.2 MagSafe Accessory Magnet Array

34.4.2.1 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.

35. 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 23) for more information.

36. 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 making use of the Core MIDI framework, see <https://developer.apple.com/documentation/coremidi>.

36.1 Requirements

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

- *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 the following:

- *MIDI Association MIDI over Bluetooth Low Energy (BLE-MIDI), Version 1.0a*, see <https://www.midi.org/specifications-old/item/bluetooth-le-midi>.

36.2 Test Procedures

Developers should test accessory designs against macOS 14.0 Sonoma 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>.

37. 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 23) for more information.

38. 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, Lightning to USB charge/sync 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 23) for more information.

39. Siri

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

Accessories supporting Siri shall not use an icon resembling the Siri microphone icon.

The rest of this chapter is applicable to accessories supporting Siri over Bluetooth using HFP commands.

To support Siri using other transports and protocols, the accessory developer shall be a member of the [Apple MFi Licensing Program](#) (page 23).

39.1 Enabling Custom Siri Commands

Accessories supporting Siri over Bluetooth using HFP commands shall support [HFP Command AT+XAPL](#) (page 119). 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.

39.2 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.

39.2.1 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.

39.2.1.1 HFP Command AT+APLSIRI?

Description: AT 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)

39.2.2 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.

39.2.2.1 HFP Command +APLSIRI

Description: Unsolicited event indicating a change in Siri status.

Initiator: Device

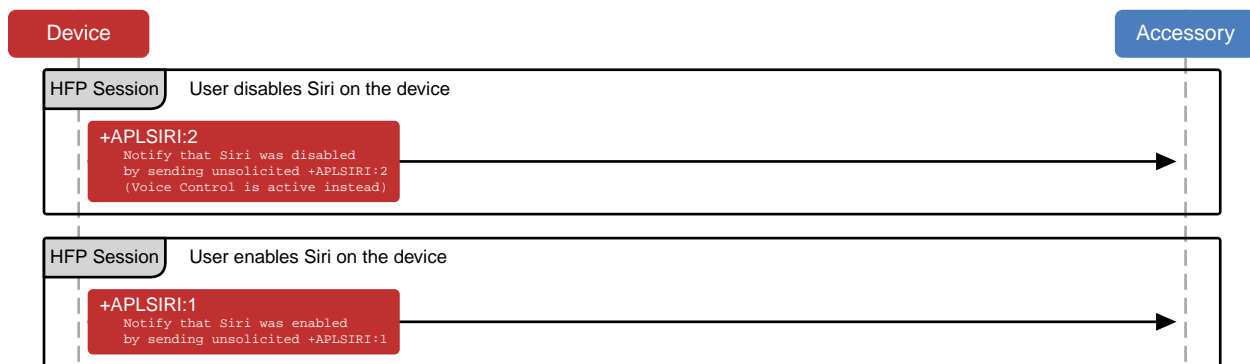
Format: +APLSIRI : *value*

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 39-1 Siri is Disabled/Enabled from the Device's Settings



39.3 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.

39.3.1 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 (*Hands-Free Profile* 1.6 profile specification, 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.

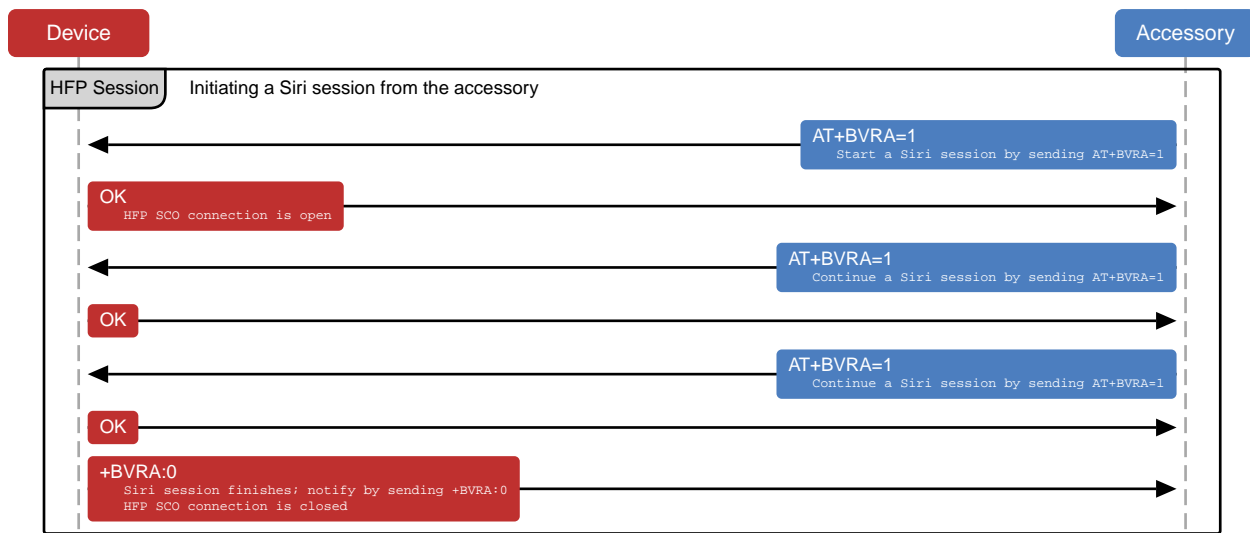
While a Siri session is active, the accessory shall let the user continue the conversation and ask follow up questions within the current context. In order to do so, the accessory shall be able to send an AT+BVRA=1 command to the device even after Siri has been already activated and before +BVRA : 0

39. Siri

39.3 Initiating a Siri Session

is received. [Figure 39-2](#) (page 176) 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 39-2 Initiating a Siri Session from the Accessory



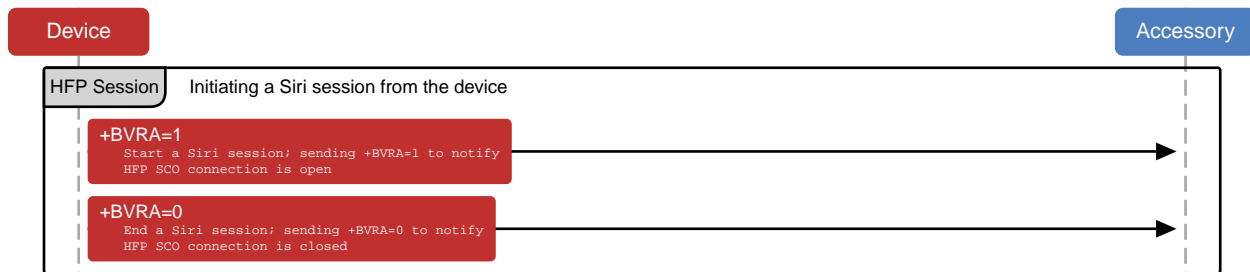
39.3.2 Initiating a Session from the Device

If the accessory supports voice recognition commands, the device sends a +BVR=1 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 1.6* specification, section 4.34.1, "Bluetooth Defined AT Capabilities." 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 +BVR: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 +BVR:0 result code to the accessory.
- The device disconnects the SCO connection.

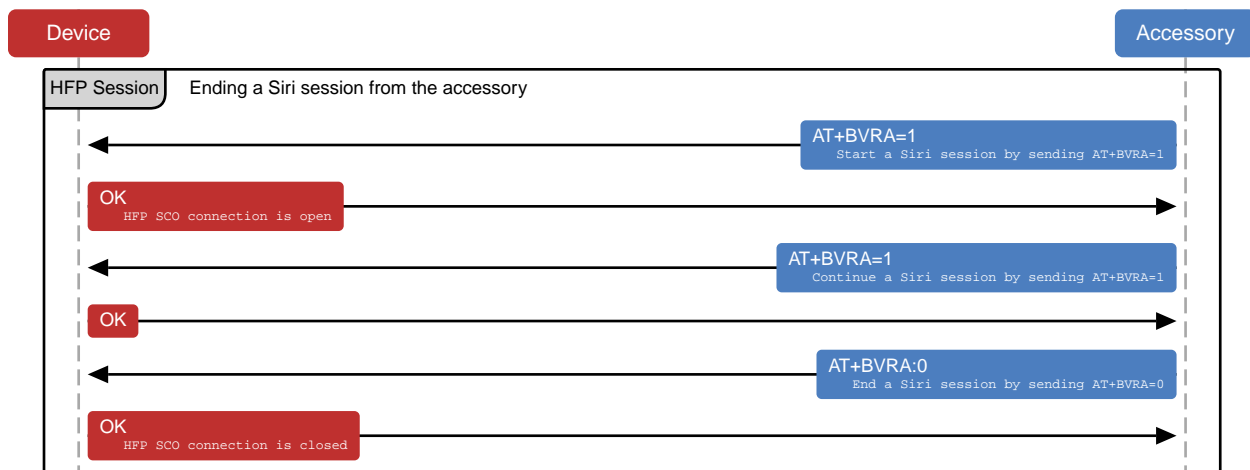
Figure 39-3 Initiating a Siri Session from the Device



39.3.3 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 39-4](#) (page 177) 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 39-4 Ending a Siri Session from the Accessory



39.4 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.

39.4.1 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

39.5 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 $-30\text{ dB} \pm 2\text{ dB}$ root-mean-square (RMS), expressed in units relative to full-scale (dBFS(A)). Alternatively, the nominal level may be $13\text{ dB} \pm 2\text{ dB}$ 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.

39.5.1 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 1.6* specification for details about wide band speech audio. Narrow band audio signal (8 kHz) is supported but not recommended.

39.6 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 that 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 that the user always hears the Siri introductory beeps.

39.7 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.

39.7.1 Initialization Procedure After Connection is Established

Figure 39-5 (page 180) 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 39-6 (page 181).

Figure 39-5 Siri Initialization Procedure

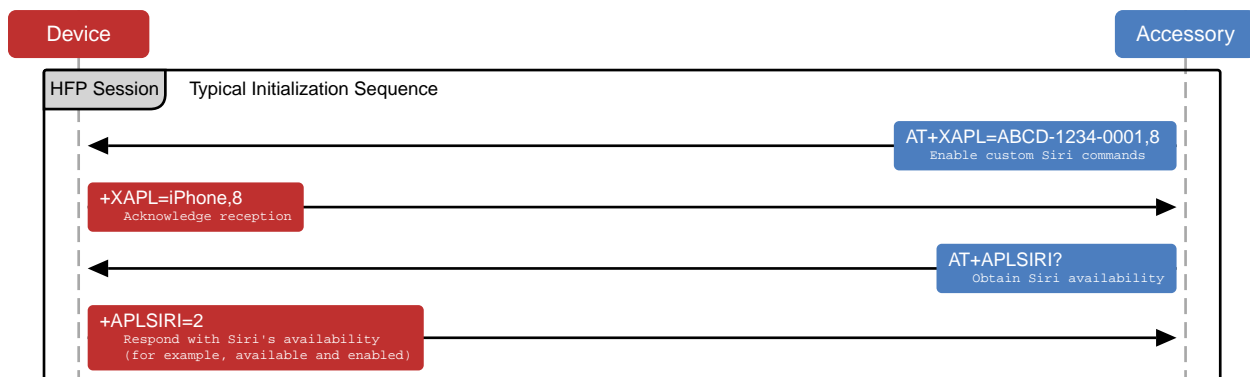
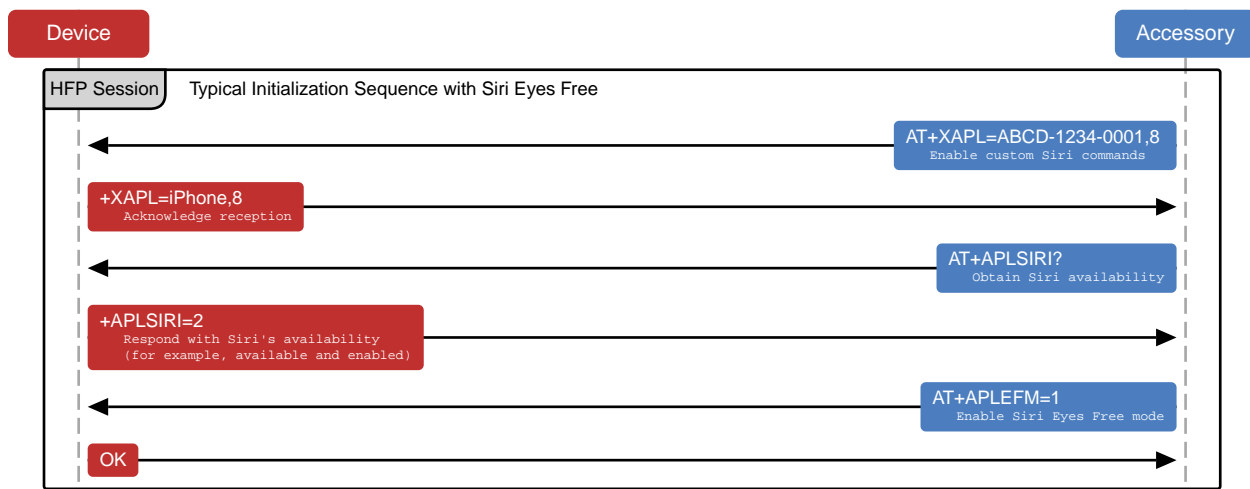


Figure 39-6 Siri Initialization Procedure with Siri Eyes Free



39.7.2 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 207). 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.

39.7.3 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 214) and [Audio Data Received using A2DP Profile](#) (page 217).
- Wired audio routes shall use iAP2.

39.7.4 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.

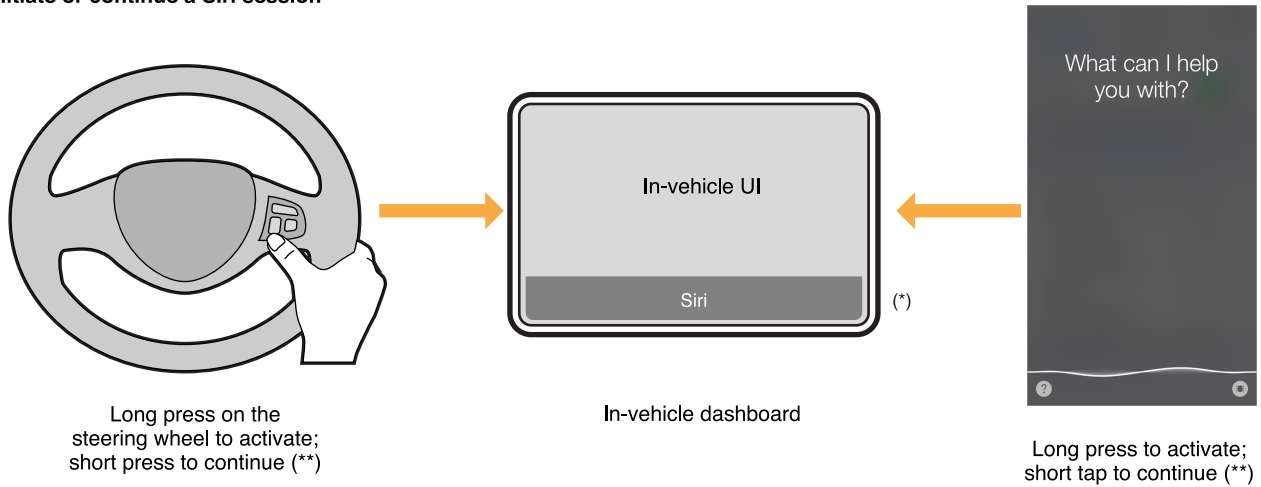
The device will notify the accessory to play turn-by-turn directions only over Bluetooth. Detailed information on how to distinguish between music playback and turn-by-turn notifications is available in [Notifications](#) (page 214).

39.8 User Interaction with Siri Eyes Free in a Vehicle

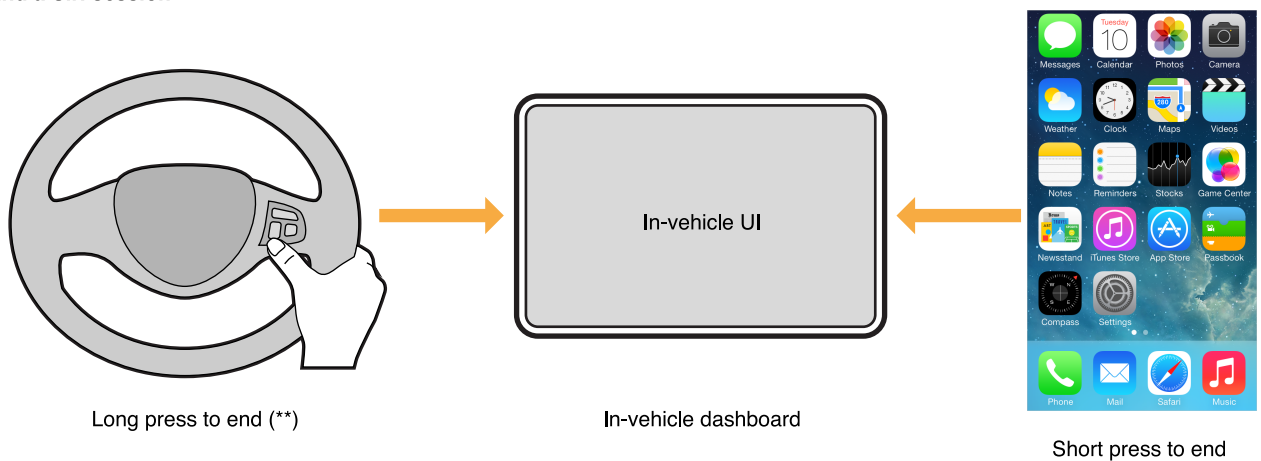
A vehicle using Siri Eyes Free mode shall integrate the Siri experience with the existing in-vehicle entertainment system and controls. The vehicle should provide a convenient interface to initiate, continue, and end a Siri session. Once a Siri session is running, the vehicle shall display a visual cue indicating voice recognition is in use. [Figure 39-7](#) (page 183) outlines how a Siri interaction should be designed.

Figure 39-7 Siri Eyes Free User Interaction

Initiate or continue a Siri session



End a Siri session



As shown in [Figure 39-7](#) (page 183):

- (*) If the accessory wishes to indicate Siri is active, it shall do one of the following:
 - 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 turn on. 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.

39.9 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 39-8](#) (page 184).
- Display a warning message and not send an activation command to the device as in [Figure 39-9](#) (page 185).

Figure 39-8 Siri is Disabled - Activating Voice Control

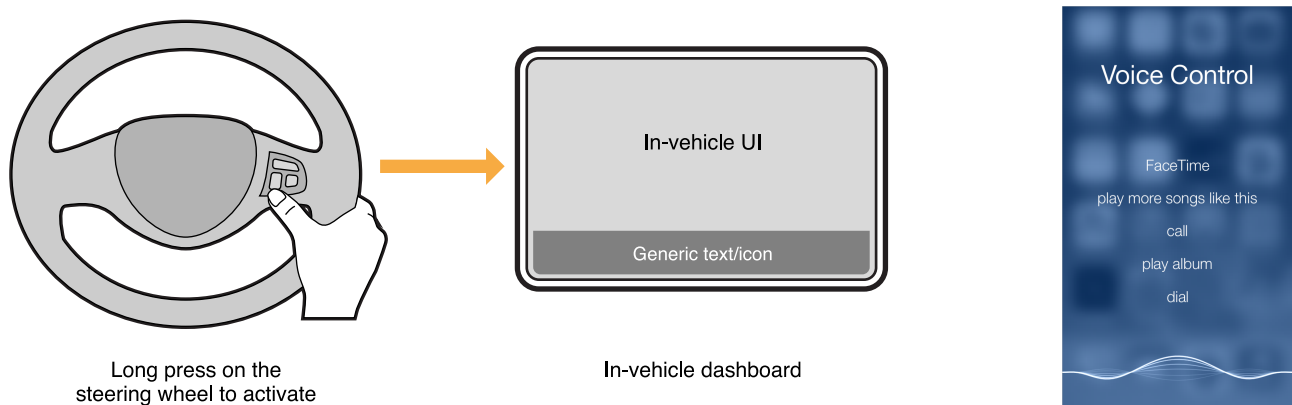
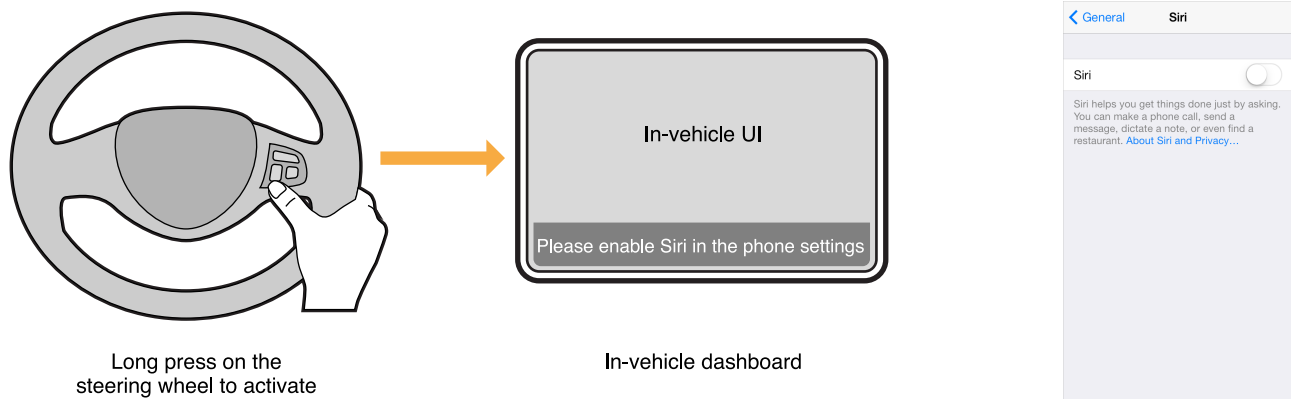


Figure 39-9 Siri is Disabled - Displaying a Warning Message



39.10 Test Procedures

39.10.1 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 to that language.

39.10.1.1 General

1. Pair and establish a Bluetooth Hands-Free Profile (HFP) connection between the iPhone and the head unit. Activate Siri from the vehicle steering wheel button (for example, by pressing and holding):
 - a. Observe the iPhone 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 iPhone 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 iPhone. 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 phone's Home button to activate Siri from the phone:
 - 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 phone's screen and ask "What's the time?".
 - c. After Siri has responded, lock the phone again to dismiss the Siri session by pressing the phone's sleep/wake or side button.
7. On the phone go to 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. On the phone go to Settings and turn Siri back on. Verify Siri can be activated/cancelled from the head unit and from the Home button on the phone.
9. Turn Bluetooth off using Settings on the phone. Verify Siri cannot be started.
10. Turn Bluetooth back on using Settings on the phone. Verify Bluetooth HFP profile reconnects and Siri can be activated/cancelled from the head unit and from the phone's Home button.
11. Confirm there is no accessory battery status level indicator icon displayed on the phone's status bar.

39.10.1.2 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 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 goes back to the 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.

39.10.1.3 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 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 goes back to its initial 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 goes back to its initial 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 iPhone 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 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 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 state.

39.10.1.4 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 iPhone music is playing, activate Siri and say "Call (*insert contact to call*)". Verify call transition is handled correctly by the head unit. Verify iPhone 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 state.
3. While iPhone music is playing, start Siri and say "Call (*insert contact to call*)". Verify call transition is handled correctly by the head unit. Verify iPhone 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 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 state.

39.10.1.5 Bluetooth + Wired iAP2

1. Connect the device to the head unit using a Lightning connector (iPhone 5). Switch to iPod music 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 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 that is (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 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 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 iPOD audio source and iPOD audio 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 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 state.
6. While iPhone music is playing, start Siri and say "Call (*insert contact to call*)". Verify call transition is handled correctly by the head unit. Verify iPhone 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 state.

7. While iPhone music is playing, start Siri and say "Call (*insert contact to call*)". Verify call transition is handled correctly by the head unit. Verify iPhone 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 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 iPhone 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 state.

40. 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 40-1 Wi-Fi Information Sharing Alert



See the [Accessory Interface Specification](#) (page 23) for more information.

Protocols

41. USB Power Capability Vendor Request

If the accessory is a USB host, and it does not implement [iAP2](#) (page 202), 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 41-1 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.

42. USB D+/D- Resistor Networks

Accessories not implementing any of the following may use USB resistor networks to identify their current capability:

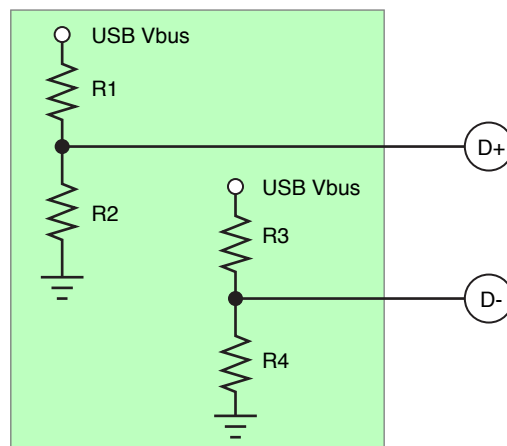
- [iAP2](#) (page 202).
- [USB Power Capability Vendor Request](#) (page 192).
- [USB Type-C Current](#) (page 197).
- [USB Power Delivery](#) (page 196).

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

42.1 Declaring Power Source Capability

Accessories shall connect the USB D+ and USB D- pins to resistor networks as shown in [Figure 42-1](#) (page 193).

Figure 42-1 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.

All resistors used to implement the networks specified in [Figure 42-1](#) (page 193) 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 42-1 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

42.2 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 42-2](#) (page 195).
6. If resistor values could not be identified, proceed to identify the power available based on the *USB Battery Charging Specification, Release 1.2*.

42. USB D+/D- Resistor Networks

42.2 Identifying Power Source Current Limit

Table USB D+/D- resistor values
42-2

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

43. USB Power Delivery

Accessories providing direct power using USB Power Delivery (USB PD) or drawing power from USB PD sources shall comply with the *USB Power Delivery Specification, Revision 3.1, Version 1.3*.

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.

44. 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 2.2*, 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.

45. Advanced Audio Distribution Profile (A2DP)

Accessories may implement the Advanced Audio Distribution Profile (A2DP) over [Bluetooth](#) (page 207) to receive audio from iOS devices and Mac computers.

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 207).

45.1 Bluetooth A2DP Specification

Accessories implementing the Advanced Audio Distribution Profile shall meet the requirements of the Bluetooth *Advanced Audio Distribution Profile* specification, Version 1.2.

45.1.1 AVDTP Transactions

Accessories shall respond to Audio/Video Distribution Transport Protocol (AVDTP) signaling transactions before the device's 5 second RTX_SIG_TIMER expires or the device will terminate the signaling channel. See Section 6.2 "Transaction Model" and section 6.4 "Signal Command Set" of the Bluetooth *Audio/Video Distribution Transport Protocol*, Version 1.3.

45.2 SubBand Codec (SBC)

The SBC Codec Specific Information Elements, defined in Section 4.3.2 of the A2DP specification, applicable to iOS devices and Mac computers are listed in [Table 45-1](#) (page 198).

Table 45-1 SubBand Codec Information Elements for iOS devices and Mac computers

Element	Value
Sampling Frequency	44,100 Hz

45. Advanced Audio Distribution Profile (A2DP)

45.3 MPEG 2/4 AAC Codecs

Element	Value
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.

45.3 MPEG 2/4 AAC Codecs

Devices support the non-mandatory codec MPEG-2/4 AAC, as defined in Section 4.5 of the *Advanced Audio Distribution Profile* specification, Version 1.2. 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 Section 4.5 of the A2DP specification, applicable to devices are listed in [Table 45-2](#) (page 199).

Table 45-2 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 45-3](#) (page 199).

Table 45-3 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 Section 4.5.4 of the A2DP specification, is formatted using LATM, as defined in Section 4 of *IETF RFC 3016*. The following notes apply to the packet fields shown in [Table 45-3](#) (page 199).

- 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 Figure 4 of RFC 3016, and is the header defined in Section 7.2.1 of the Bluetooth *Audio/Video Distribution Transport Protocol, Version 1.2*.
- The `AudioMuxElement` is the same as the RTP payload in RFC 3016. It is defined in Section 1.7.3, Table 1.41 in ISO/IEC 14496-3:2009, subpart 1. The `muxConfigPresent` argument to the `AudioMuxElement` is set to 1 (in-band mode), as recommended in Section 4.1 of RFC 3016. As recommended in Section 4.3 of RFC 3016, only one `AudioMuxElement` is put into each AVDTP packet.
- The audio payload is encoded using MPEG-4, as recommended in Section 4.5.4 of the A2DP specification.
- 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.

45.4 Test Procedures

45.4.1 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.

45.4.2 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.

45.4.3 HFP Interaction

1. Make incoming / outgoing call during A2DP.
2. Verify audio was suspended during the call and resumed after the call.

45.4.4 Siri

1. Trigger Siri during A2DP.
2. Verify audio resumed after the Siri session.

45.4.5 Video Playback

1. Stream A2DP while watching a video.
2. Verify audio / video synchronization and quality is good.

46. 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 142).
- Accessing the media library and retrieving album artwork using [Media Library Access](#) (page 169) and [Now Playing Updates](#) (page 171).
- Launching apps using [App Launch](#) (page 127).
- Discovering compatible apps using [App Discovery](#) (page 126).
- Helping users find compatible apps in the App Store using [App Match](#) (page 128).
- Providing GNSS location data using [Location Information](#) (page 147).
- Supporting connectivity with [Out-of-Band Bluetooth Pairing](#) (page 172) and [Wi-Fi Information Sharing](#) (page 190).

See the [Accessory Interface Specification](#) (page 23) for more information.

47. 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 23) for more information.

The HID protocol can be implemented over:

- USB
- Bluetooth

47.1 Requirements

Accessories supporting the HID protocol shall comply with the following 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.

47.1.1 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.

47.1.2 USB

If implementing HID over USB, the accessory shall comply with the *Device Class Definition for Human Interface Devices 1.11*, see <https://www.usb.org/hid>.

47.2 Test Procedures

47.2.1 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 usage 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

48. Bluetooth

Accessories integrating Bluetooth technology shall comply with the requirements stated in this chapter.

Accessories shall support the *Bluetooth Core Specification* Version 2.1 + EDR or later.

48.1 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.

48.2 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.

48.3 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.
- Shall accept sniff mode requests and support valid parameters from the Bluetooth specification.
- Shall support a sniff interval of 15 ms.
- Shall support sniff subrating.
- Shall not renegotiate sniff mode after it is established.
- 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 210), 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.

48.4 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.

48.5 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.

48.6 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 Volume 1, Section 5.4 in the *Bluetooth Core Specification*, Version 2.1 + EDR.

48.7 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/>.

48.8 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 Volume 3, Part C, Section 3.2.4 in the *Bluetooth Core Specification*, Version 5.0. 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'.

48.9 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.

48.10 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.

48.11 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.

48.11.1 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 Section 5.6 of the *Bluetooth Device ID Profile Specification*.
- 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 remote accessory, which is used to bridge alternate interpretations of the Bluetooth specification when communicating with a remote 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.

48.11.2 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.

48.11.3 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. Additional Apple requirements are specified in this section.

Remote accessories can use the Bluetooth *Hands-Free Profile* for phone communications. To achieve the best user experience, the remote accessory should support the following features, which are optional in the Bluetooth specification.

48.11.3.1 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 Section 4.28 in the *Bluetooth Hands-Free Profile Specification, Version 1.5*.
- 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 remote 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 Section 4.48.2 in the *Bluetooth Hands-Free Profile Specification, Version 1.5*.

48.11.3.2 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 remote 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 remote accessory should request initial status using the AT+CIND=? and AT+CIND? commands, according to the HFP specification.

48.11.3.3 Voice Recognition Activation

Accessories supporting HFP shall:

- Support Voice Recognition Activation, both AG and HF, initiated as described in Section 4.25 in the *Bluetooth Hands-Free Profile Specification, Version 1.5*.
- Set the Voice Recognition Activation bit in the "SupportedFeatures" bitmap sent with the AT+BRSF= command.

iOS devices and Mac computers support voice recognition initiated by remote (Hands-Free) accessories, and iOS (Audio Gateway) accessories.

48.11.3.4 Echo Cancellation and Noise Reduction

When echo cancellation and noise reduction are performed locally on a hands-free accessory, the accessory should turn off echo cancellation and noise reduction on the device by sending an AT+NREC command, as described in Section 4.24 in the *Bluetooth Hands-Free Profile Specification, Version 1.5*.

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.

48.11.3.5 In-Band Ringing

Accessories supporting HFP should also support In-Band Ringing as specified in Section 4.13.1 in the *Bluetooth Hands-Free Profile Specification*, Version 1.5. If the user sets a ring tone on the device, the same ring tone should sound on the hands-free accessory.

48.11.3.6 Synchronous Connection

Accessories supporting HFP shall:

- Support eSCO parameter set S2 and S3 and accept requests for these settings. See Section 5.6 of the *Bluetooth Hands-Free Profile Specification* version 1.5.
- 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.

48.11.3.7 Wide Band Speech

Accessories supporting HFP should support Wide Band Speech, as described in Section 5.7.4 of the *Bluetooth Hands-Free Profile Specification*, Version 1.6. 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.

48.11.4 Message Access Profile (MAP)

Accessories supporting Message Access Profile:

- Shall support Message Notification, as described in Section 4.1 of the *Bluetooth Message Access Profile Specification*, Version 1.1.
- Shall register for notifications immediately after the connection is established, as described in Section 4.5 in the *Message Access Profile Specification*, Version 1.1.

Devices running iOS 13.0 or later support MAP 1.1.

48.11.5 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. Additional Apple requirements are specified in this section.

48.11.5.1 Supported Operations

iOS devices and Mac computers support the following operation_IDs in passthrough commands:

- Play
- Stop
- Pause
- Fast Forward
- Rewind
- Forward
- Backward

48.11.5.2 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 Sections 6.5.4 and 6.4.3 of the *Bluetooth Audio/Video Remote Control Profile Specification*, Version 1.4.

48.11.5.3 Notifications

Accessories supporting AVRCP:

- Shall register for notifications.
- Shall not perform repetitive device status polling.

Every device in the role of an AVRCP Target supports registering for notifications, as described in Section 6.7 of the *Bluetooth Audio/Video Remote Control Profile Specification*, Version 1.4. 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

48.11.5.4 Play/Pause Button

Accessories supporting AVRCP implementing a Play/Pause control surface shall confirm the playback status of the device using AVRCP [Notifications](#) (page 214), before sending a Play or Pause command. See [Supported Operations](#) (page 214). 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.

48.11.5.5 Volume Handling

Accessories supporting AVRCP should support Absolute Volume, as described in Section 6.13 of the *Bluetooth Audio/Video Remote Control Profile Specification, Version 1.4*.

Every device in the role of AVRCP Controller supports volume handling.

48.11.5.6 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.
- Shall 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.
- Shall not reorder items (for example, alphabetically).
- Shall 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.
- Shall send the `SetBrowsedPlayer` command after receiving an `EVENT_UIDS_CHANGED` notification.
- Shall 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.

All devices running iOS 6.0 or later support AVRCP Browsing.

48.11.5.7 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.

48.11.6 Advanced Audio Distribution Profile (A2DP)

See [Advanced Audio Distribution Profile \(A2DP\)](#) (page 198).

48.12 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.

48.12.1 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.

48.12.2 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.

48.12.2.1 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 214).

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 Section 6.7.2 of the *Audio/Video Remote Control Profile Specification, Version 1.4*. 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 48-1](#) (page 217) and [Figure 48-2](#) (page 218) show the difference between notifications for music playback, and system sounds.

Figure 48-1 Initiate Audio Playback (for example, music)

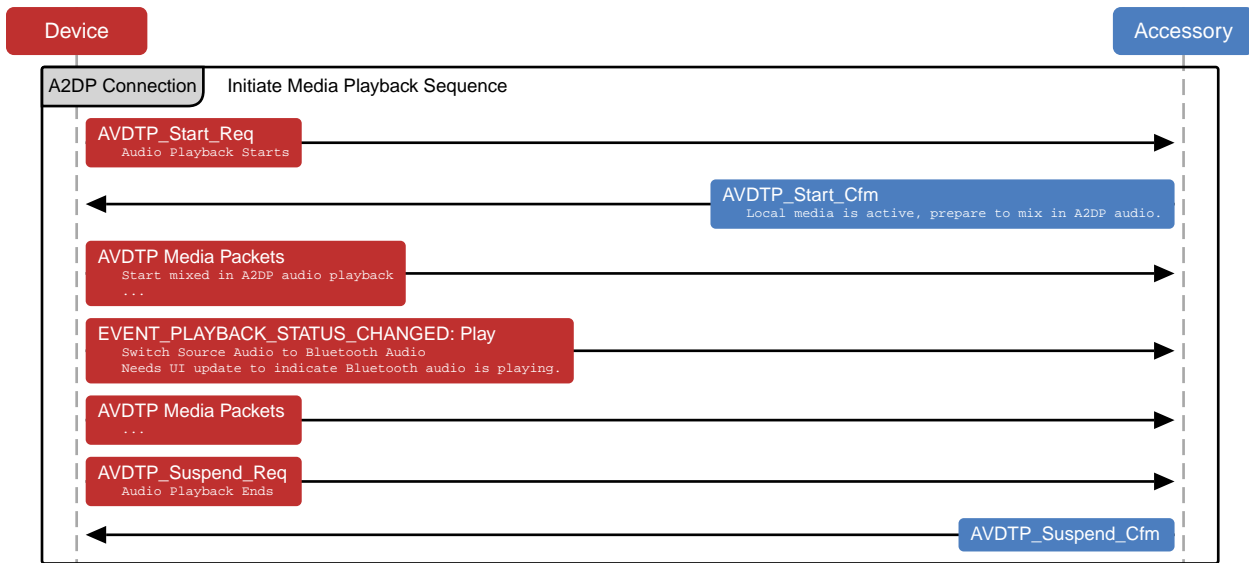
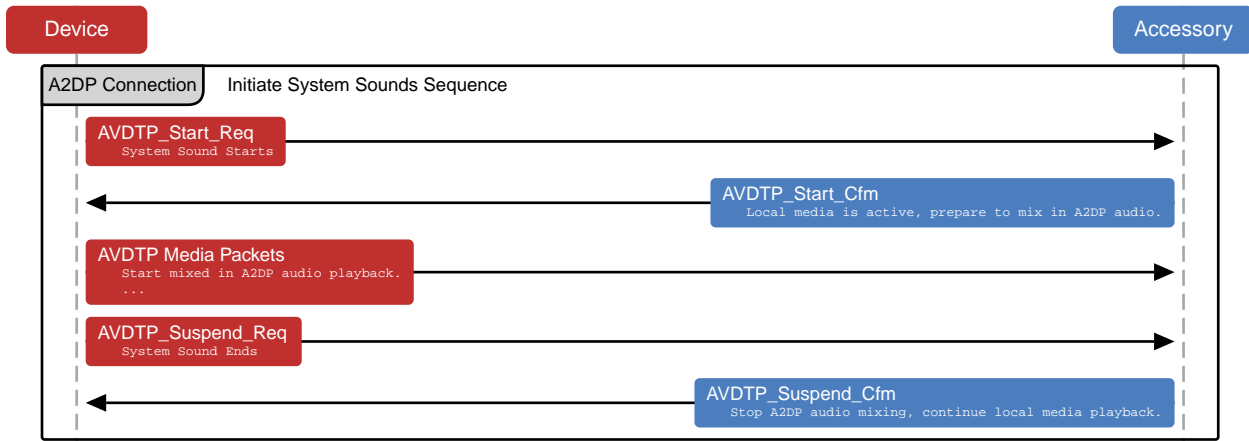


Figure 48-2 Initiate System Sound (such as, turn-by-turn directions)



48.12.2.2 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.

48.13 HID

When implementing HID over Bluetooth, the accessory:

- Should support Bluetooth HID Profile 1.1.
- Should support [Sniff Mode for Low Power Consumption](#) (page 207).
- Should use the following parameters in SDP for sniff subrating:
 - HIDSSRHostMaxLatency - 450 ms (720 slots)
 - HIDSSRHostMinTimeout - 45 ms (72 slots)
- Should 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.

49. Bluetooth Low Energy (BLE)

The *Bluetooth 4.0* specification introduces Bluetooth Low Energy (BLE), a wireless technology targeted for accessories with limited battery resources. If Bluetooth Low Energy is supported, the accessory should follow the guidelines in this section.

49.1 Role

The accessory should implement either the Peripheral role as defined in the *Bluetooth 4.0* specification, Volume 3, Part C, Section 2.2.2.3 or the Broadcaster role, as defined in Section 2.2.2.1.

49.2 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.

49.3 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.

49.4 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.

49.5 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.

49.6 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 the *Bluetooth 5.3 Specification* Volume 6, Part B, Section 5.1.1 Connection Update procedure for details.

Connection parameter requests may be rejected if they do not meet the guidelines in this section.

General connection parameter request guidelines:

- Peripheral Latency ≤ 30 connection intervals.
- Supervision Timeout from 6 seconds to 18 seconds.
- Interval Min ≥ 15 ms.
- 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.

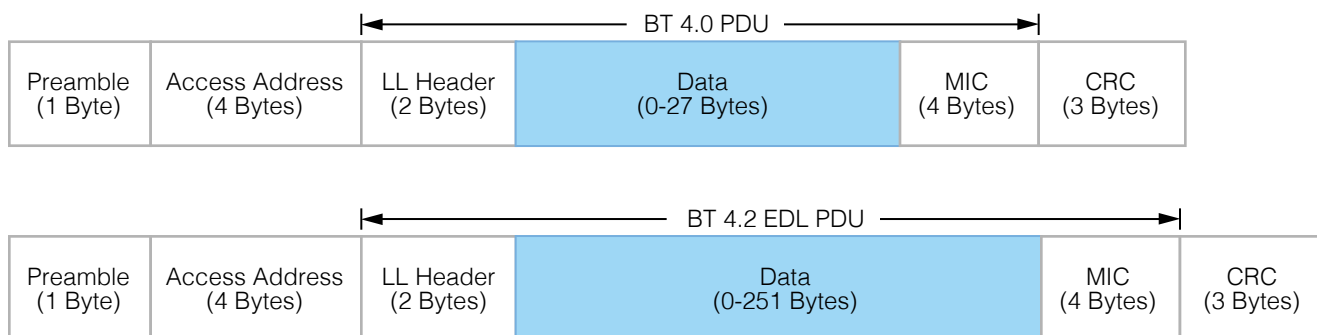
Apple Watch connection parameter request guidelines:

- 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.

49.7 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 the *Bluetooth 5.0* specification, Volume 6, Part B, Section 4.6.6 for details.

Figure 49-1 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.

49.8 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.

49.9 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.

49.10 Pairing

The accessory should not request pairing until an ATT request is rejected using the Insufficient Authentication error code. See the *Bluetooth 4.0* specification, Volume 3, Part F, Section 4 for details.

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.

49.11 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 221).

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.

49.12 Services

49.12.1 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.

49.12.2 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.

49.12.3 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

49.12.4 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.

49.13 GATT Server

With iOS 6.0, applications may contribute services and characteristics to the GATT server the device makes available to the accessory. The recommendations in this section apply to the accessory in this case.

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

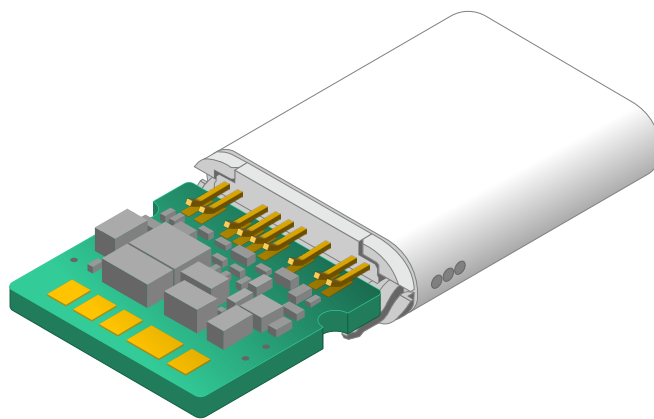
50. Apple USB-C Analog Headset Module

Note:**Developer Preview**

The following chapter is a preview and is not intended for use in the development of accessories. Although this content has been reviewed for accuracy, it is not final. Apple is supplying this content to help accessory developers plan for the adoption of the accessory interface features described herein. This information is subject to change.

The Apple USB-C Analog Headset Module (C125) may be used to create [Headsets](#) (page 78) supporting Apple Music Lossless and Hi-Res Lossless.

Figure 50-1 USB-C Analog Headset Module (C125)



50.1 Overview

C125 is a USB Audio Device Class 2.0 compliant codec with an integrated USB-C plug.

C125 supports:

- 16-bit and 24-bit samples.

- 44.1 kHz, 48 kHz mono microphone input.
- 44.1 kHz, 48 kHz, and 96 kHz (and optionally 192 kHz and 384 kHz) stereo headphone-level output.
- Volume Up, Volume Down, and Center buttons.

C125 shall not be used for USB-C to 3.5 mm headset jack adapters.

50.1.1 Additional Specifications & Support

Additional software and support for C125 is available from Cirrus Logic, Inc. Get started at <https://www.cirrus.com/support/>.

50.2 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 230) for dimensional drawing.

Unless otherwise specified in this chapter, the accessory shall meet the requirements for USB-C connector integration, see [Mechanical](#) (page 240).

C125 headsets shall:

- Encapsulate both sides of C125.
- Protect the C125 electronic components with a SUS shield.
- Laser weld the SUS shield to the C125 ground ring.

50.3 Pad Assignments

[Figure 50-2](#) (page 229) and [Table 50-1](#) (page 229) detail the layout, names, description, and assignments of the C125 pads.

Figure 50-2 C125 pads

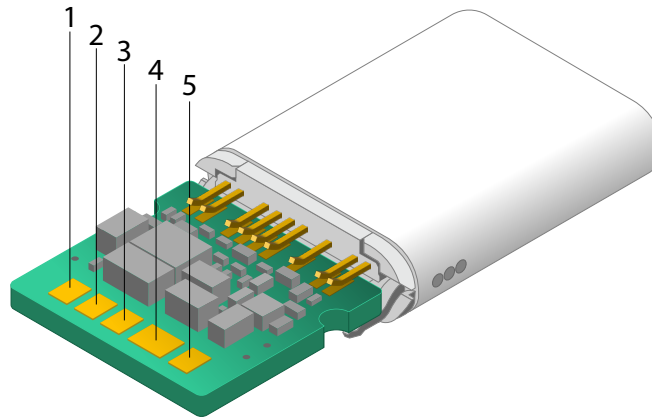


Table 50-1 C125 pad assignments

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

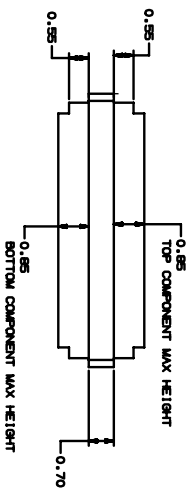
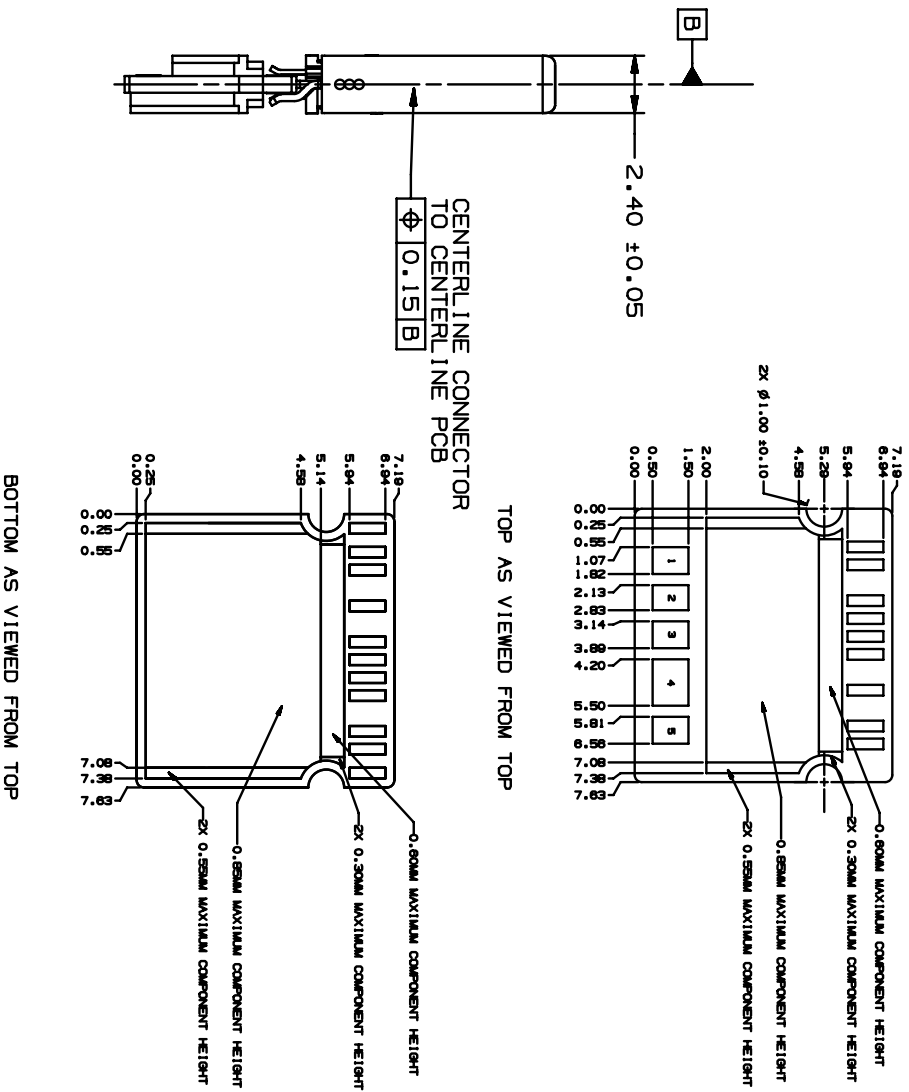
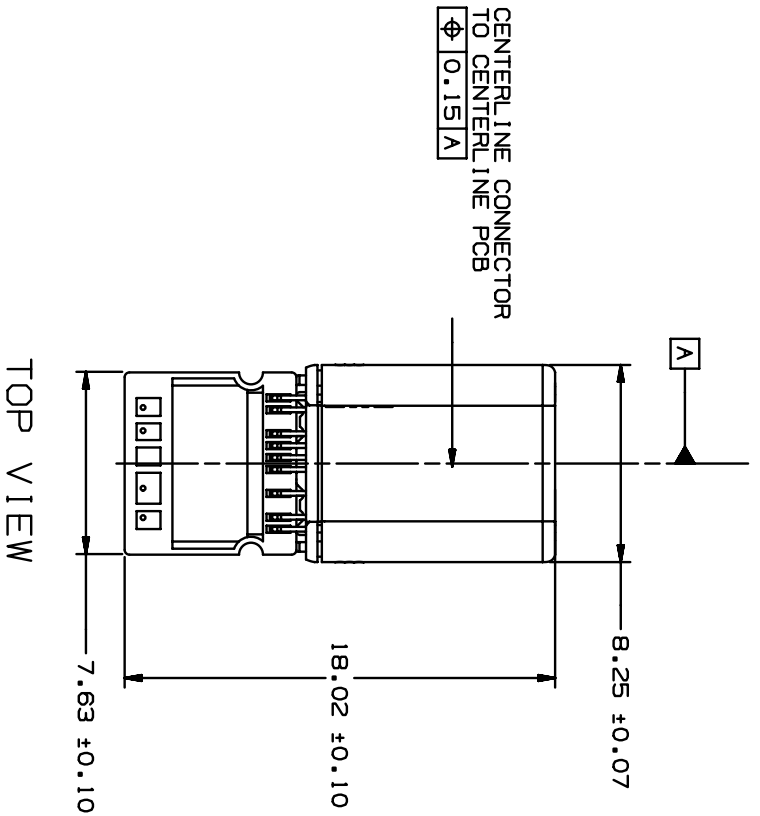
50.4 Electrical

C125 headsets shall incorporate the [Apple Headset Remote and Microphone Transmitter](#) (page 232).

The C125 shield may be treated as an electrical ground.

50.5 C125 Dimensions

NOTES: (UNLESS OTHERWISE SPECIFIED)



METRIC		Apple Inc.	
SYMBOL	UNIT	DESCRIPTION	REVISION
X.X	±0.2		
X.XX	±0.10		
X.XXX	±0.050		
ANGLES ±0.5°			
DO NOT SCALE DIMENSIONS			
TOP AND BOTTOM VIEWS			
TOTAL		DATE	
NONE		NONE	
PAGE 1 OF 1		REV. A	

Components

51. Apple Headset Remote and Microphone Transmitter

Note:**Developer Preview**

The following chapter is a preview and is not intended for use in the development of accessories. Although this content has been reviewed for accuracy, it is not final. Apple is supplying this content to help accessory developers plan for the adoption of the accessory interface features described herein. This information is subject to change.

Devices can receive button press information from [Headsets](#) (page 78) incorporating the Apple Headset Remote and Microphone Transmitter using the [Apple USB-C Analog Headset Module](#) (page 227).

51.1 Requirements

Accessories implementing the Headset Remote and Microphone Transmitter shall comply with the following requirements:

- The remote microphone shall be located 120-160 mm from the center of a headset driver when worn by the user.
- There shall be six wires originating from the plug attaching the device to the headset, corresponding to the following signals:
 - Right Driver
 - Right Return
 - Left Driver
 - Left Return
 - Microphone Bias
 - Microphone Return
- All signals shall be run separately to their respective components.
- There shall be three physical remote buttons for Volume Up, Volume Down, and Center button functions.

Headsets integrating the Headset Remote and Microphone Transmitter shall integrate a MEMS analog microphone.

Headset drivers shall have:

51. Apple Headset Remote and Microphone Transmitter

51.1 Requirements

- A minimum load impedance of 16 Ω .
- A maximum load capacitance of 150 pF.

Headsets 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 51-1 USB-C Analog Headset Module (C125) Example A

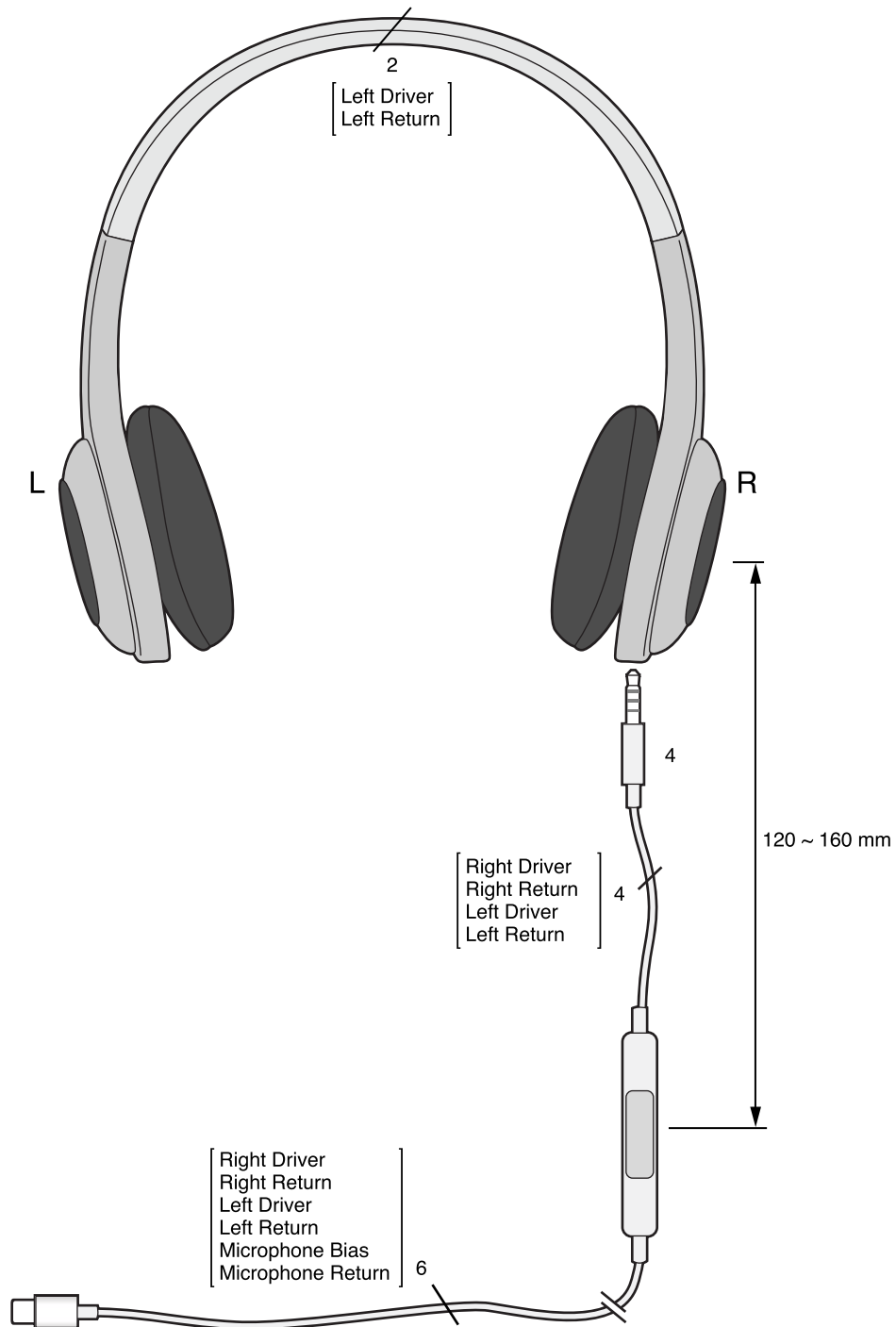


Figure 51-2 USB-C Analog Headset Module (C125) Example B

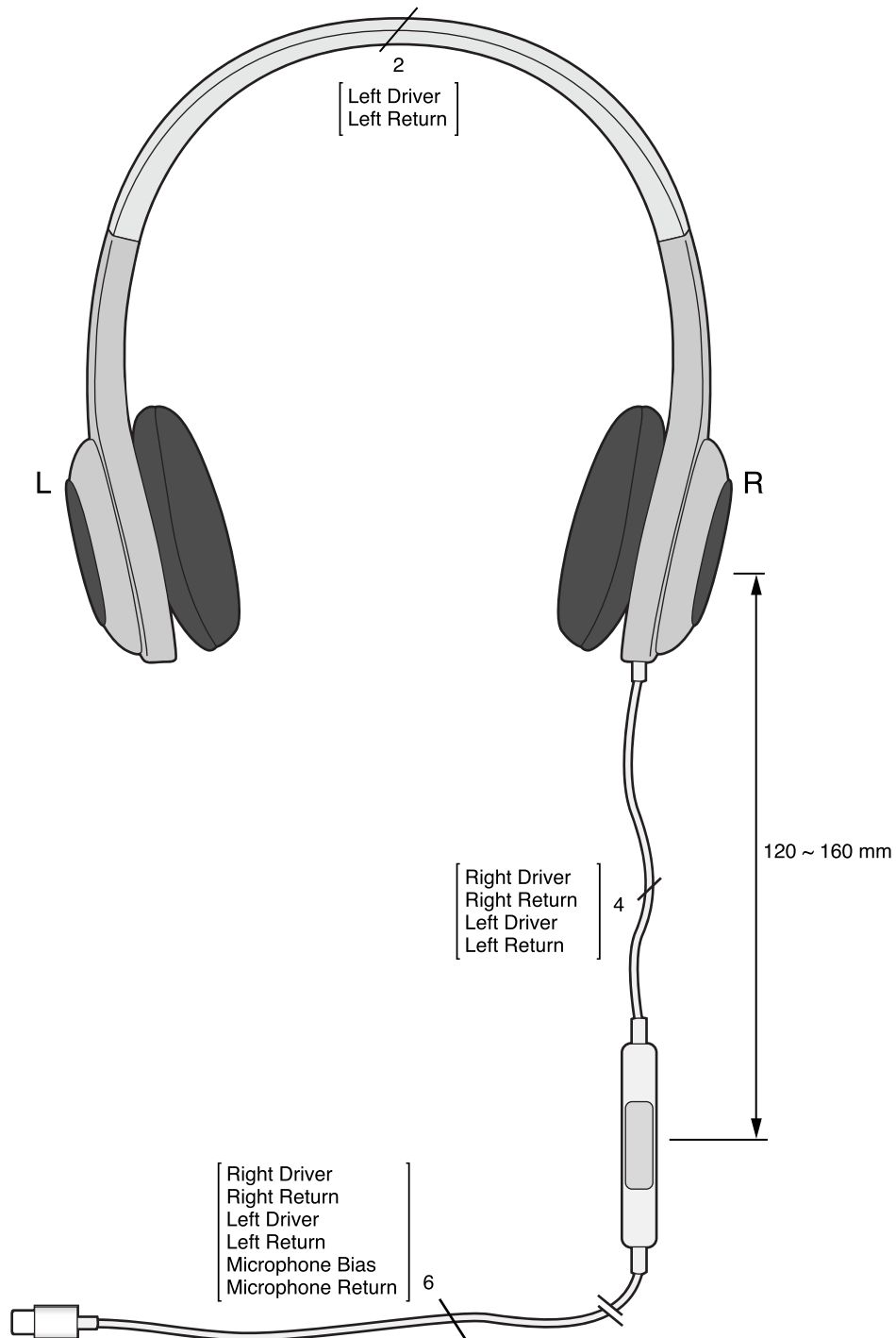


Figure 51-3 USB-C Analog Headset Module (C125) Example C

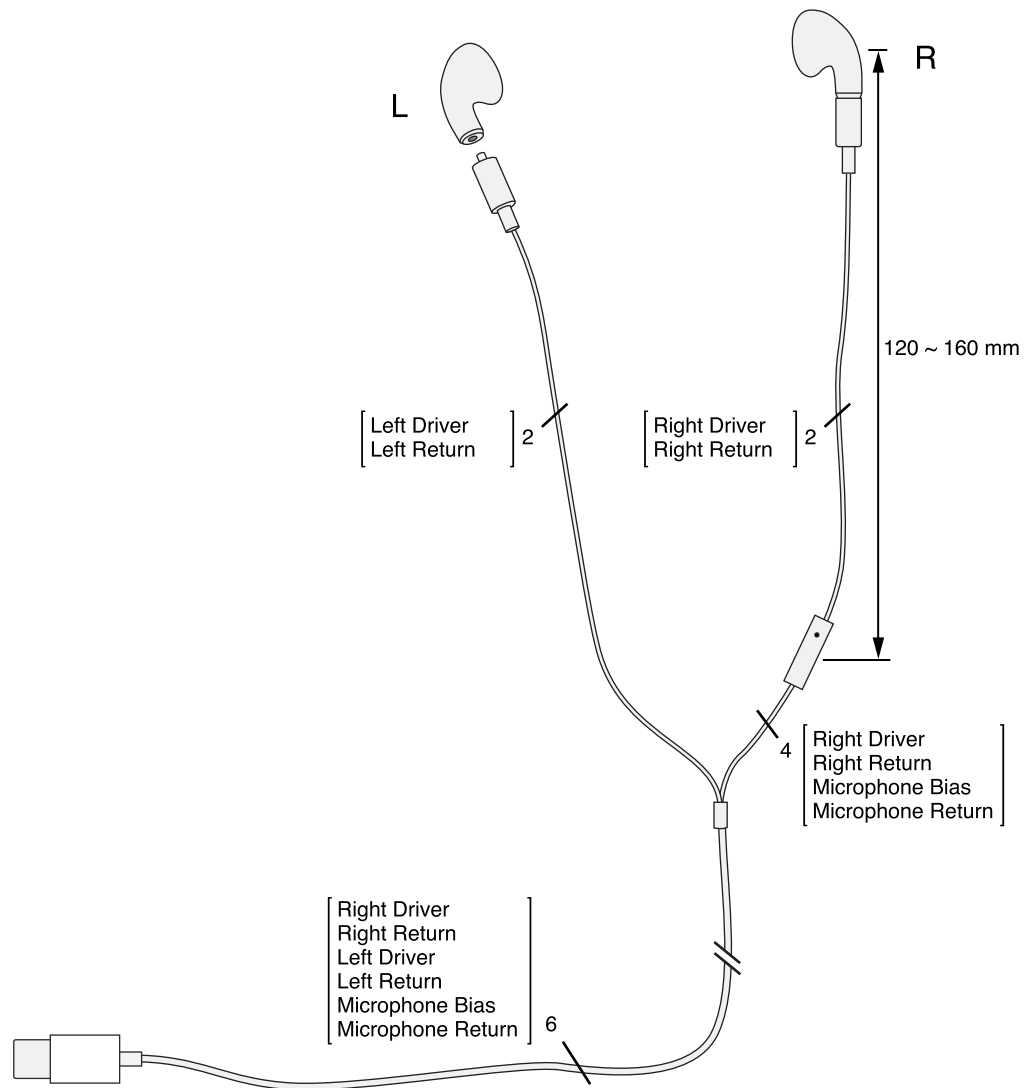
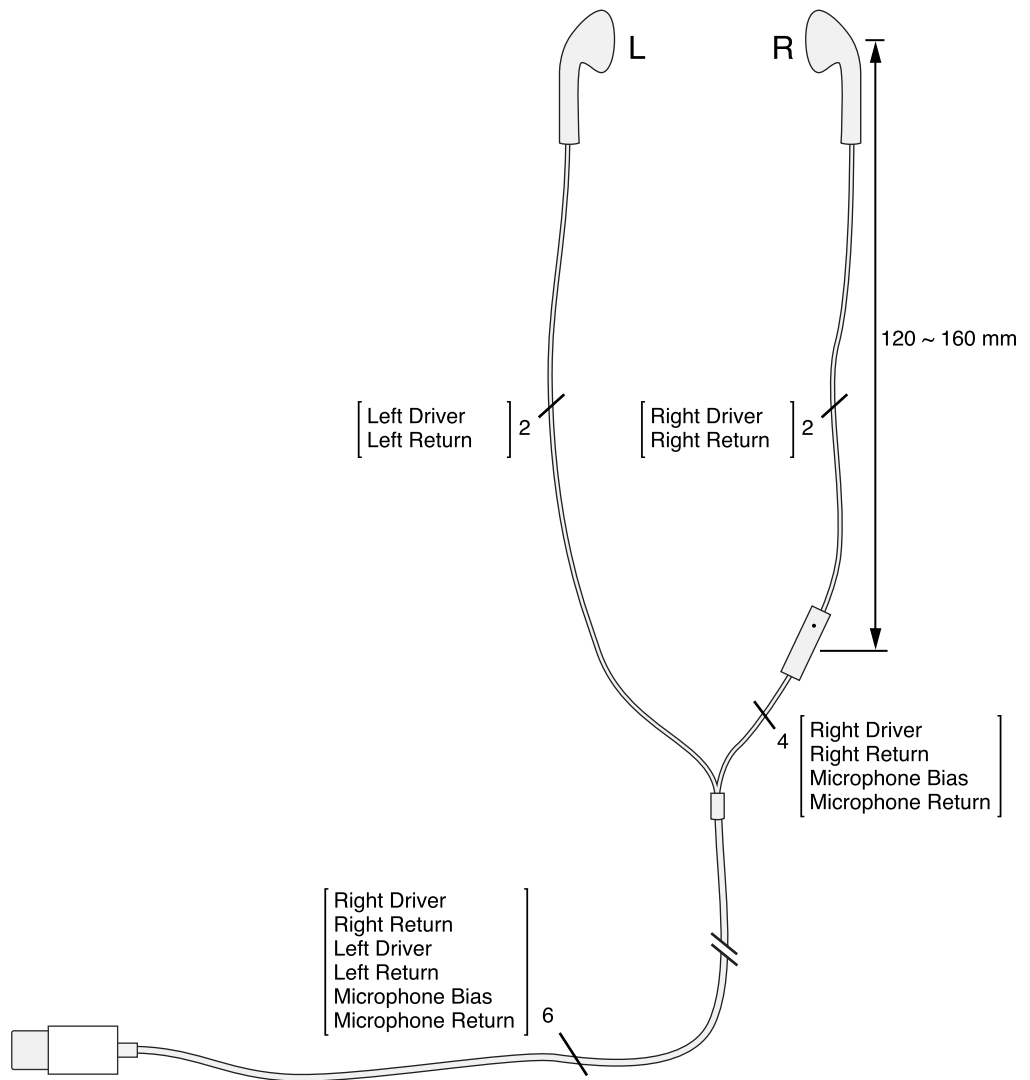


Figure 51-4 USB-C Analog Headset Module (C125) Example D



Connectors

52. USB-A Receptacle

Accessories may incorporate a USB-A receptacle to:

- Provide power to a device.

52.1 Mechanical

The USB-A receptacle shall meet or exceed all applicable USB-IF mechanical specifications.

52.2 Electrical

The USB-A receptacle shall meet or exceed all applicable USB-IF electrical specifications.

53. USB-C Plug

Accessories incorporating a USB-C plug shall comply with the *USB Type-C Cable and Connector Specification, Release 2.2*.

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.

53.1 Mechanical

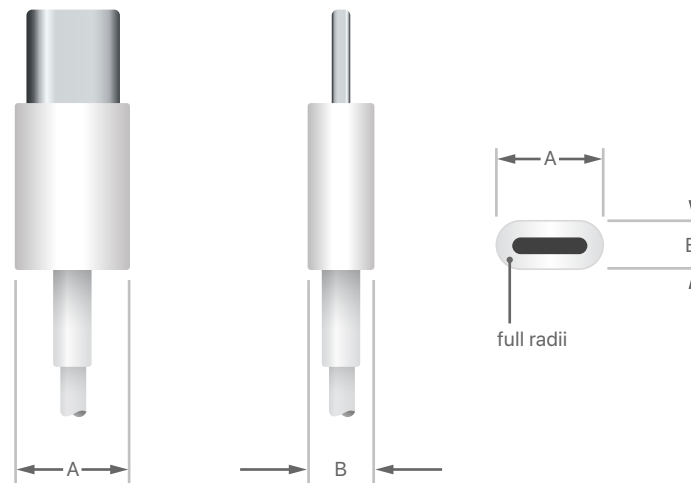
The USB-C plug shall have an assigned *Connector* Test ID from the USB-IF, see <https://www.usb.org/products>.

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 2.2*.

USB-C plug enclosures shall not exceed the following dimensions as shown in [Figure 53-1](#) (page 241):

- 'A' \leq 12.35 mm
- 'B' \leq 6.5 mm

Figure 53-1 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 246).

53.2 Electrical

53.2.1 Drawing Power

Accessories drawing power from the USB-C plug shall:

- Correctly identify all [USB Type-C Current](#) (page 197) 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](#) (page 196) sources.

Accessories drawing power from a device may do so using one of the following protocols:

- [USB Type-C Current](#) (page 197)
- [USB Power Delivery](#) (page 196)

53.2.2 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.
- Shall support [USB Type-C Current](#) (page 197).
- Should support [USB Power Delivery](#) (page 196).
- Should label the receptacle indicating how much power is supplied in watts.

53.3 Test Procedures

USB-C plug test procedures are outlined in this section.

53.3.1 Mechanical

Verify the dimensions of the USB-C plug comply with interface dimensions.

53.3.2 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>.

53.3.3 Drawing Power

This procedure applies to accessories drawing power using the USB-C plug.

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)

The following test cases apply to power source identification:

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.

54. USB-C Receptacle

Accessories incorporating a USB-C receptacle shall comply with the *USB Type-C Cable and Connector Specification, Release 2.2*.

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 74), [Battery Packs](#) (page 77), and speakers.

54.1 Mechanical

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>.

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 2.2*.

See the recommended minimum [USB-C receptacle accessory keep-out](#) (page 246).

54.2 Electrical

54.2.1 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 197) 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.

54. USB-C Receptacle

54.2 Electrical

- 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](#) (page 196) sources.

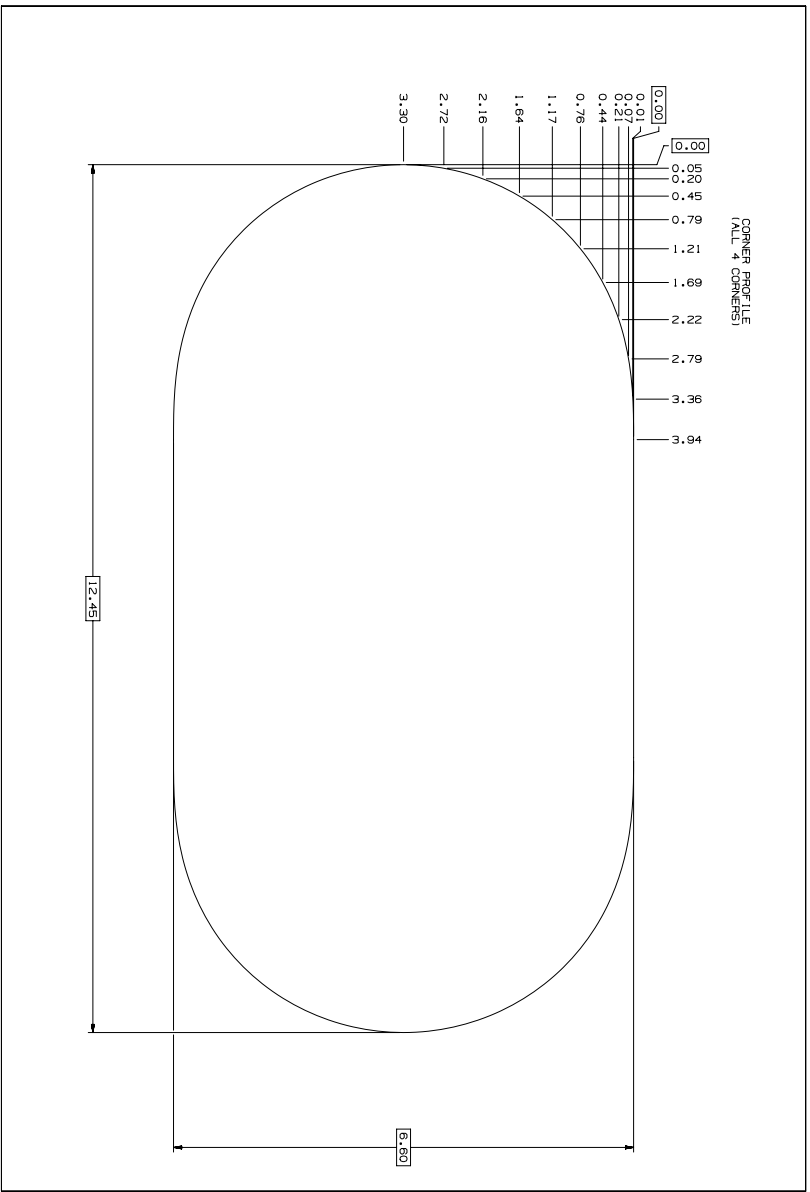
54.2.2 Providing Power

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.
- Shall support [USB Type-C Current](#) (page 197).
- Should support [USB Power Delivery](#) (page 196).
- Should label the receptacle indicating how much power is supplied in watts.

54.3 USB-C receptacle accessory keep-out

NOTES (UNLESS OTHERWISE SPECIFIED)



4 3 2 1

METRIC		Apple Inc.	
DATE	DATE	VERSION	VERSION
DESIGNED BY	NAME	APPROVED BY	NAME
<small>THE INFORMATION ON THIS DRAWING IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE. IT IS THE PROPERTY OF APPLE INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM APPLE INC.</small>			
PROPERTY		TITLE	
DRAWING NUMBER		PROFILE, USB - C	
SCALE		30 : 1	
UNIT		MM	
TOLERANCES		UNLESS SPECIFIED	
DIMENSIONS IN MILLIMETERS			
DO NOT SCALE DRAWING			
HIDDEN AREA INDICATOR			
NX GENERATED			

54.4 Test Procedures

USB-C receptacle test procedures are outlined in this section.

54.4.1 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>.

54.4.2 Drawing Power

This procedure applies to accessories drawing power using the USB-C receptacle.

54.4.2.1 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)

54.4.2.2 Test Cases

The following test cases apply to power source identification:

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.

54.4.3 Providing Power

This procedure applies to accessories providing power using the USB-C receptacle.

54.4.3.1 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)

54.4.3.2 Test Cases

The following test cases apply to power providing devices:

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

55. 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>.

Use the Accessory Developer Assistant app to ensure iPhone and iPad performance for features such as:

- [Autofocus & Optical Image Stabilization](#) (page 61)
- [Compass](#) (page 62)

55.1 Autofocus & Optical Image Stabilization Test Profile

The [Autofocus & Optical Image Stabilization](#) (page 61) 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.

55. Accessory Developer Assistant (ADA)

55.1 Autofocus & Optical Image Stabilization Test Profile

3. Go to Settings > Profile Downloaded and complete the installation.
4. Reboot the device.

References

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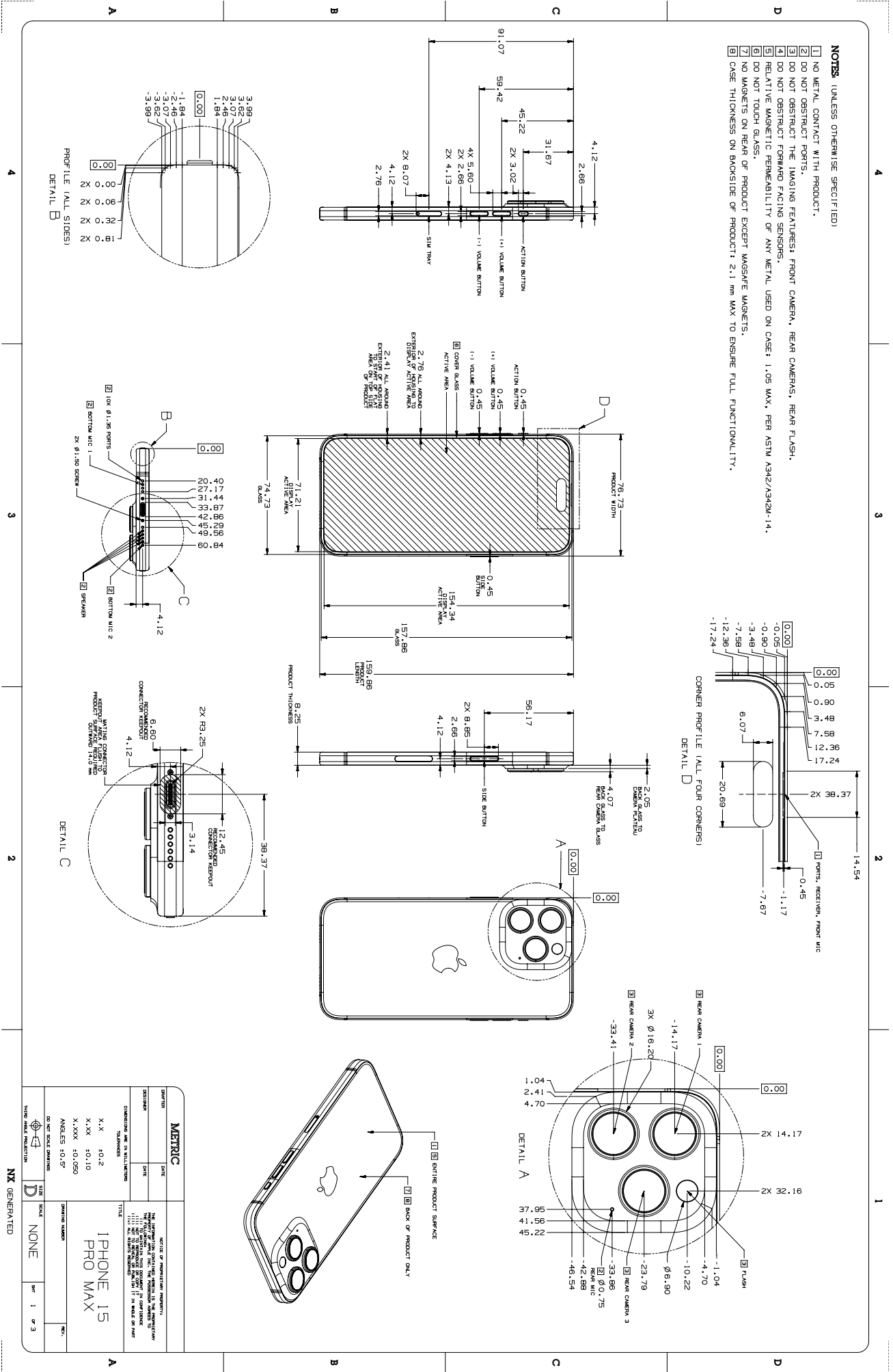
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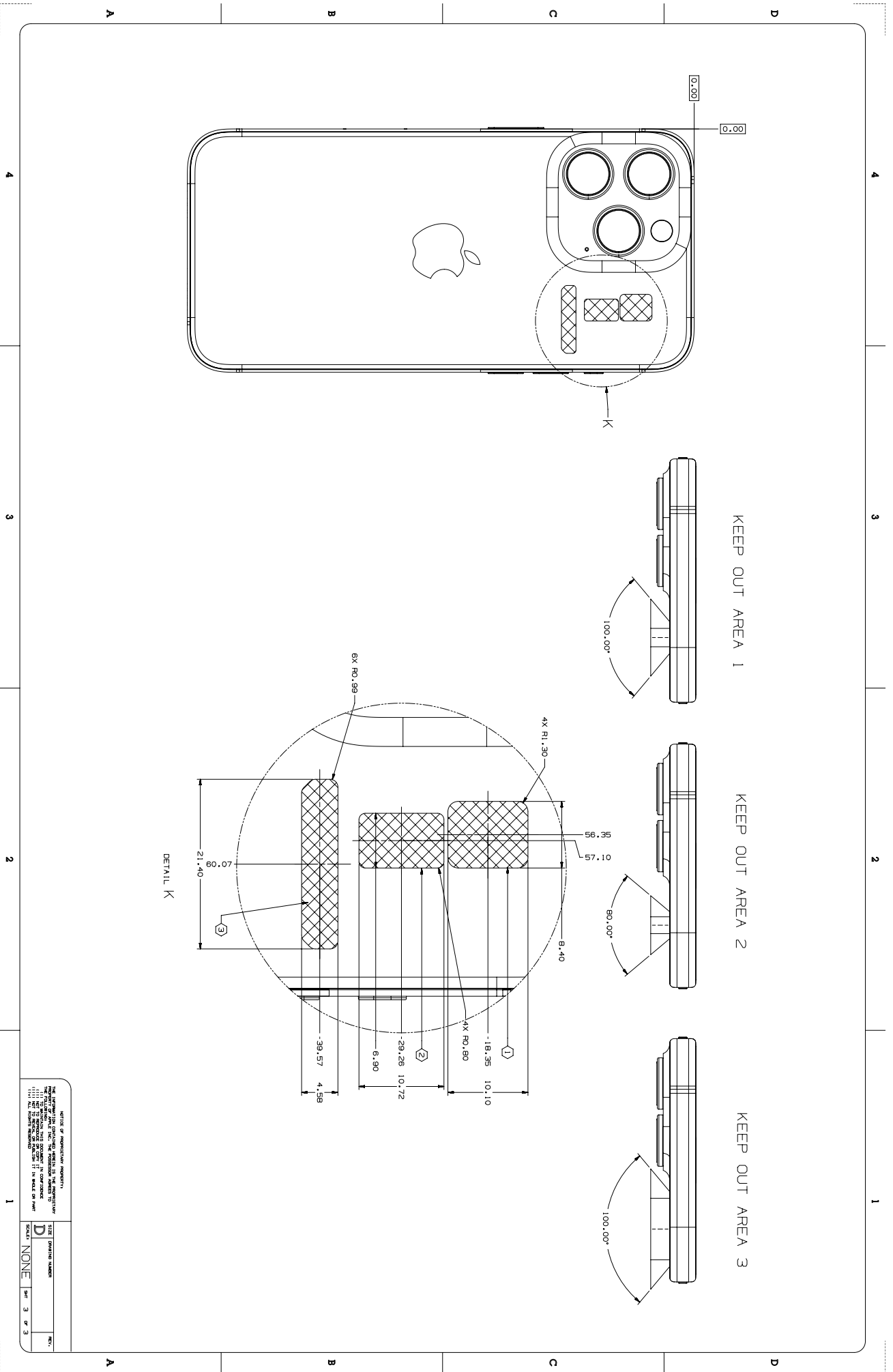
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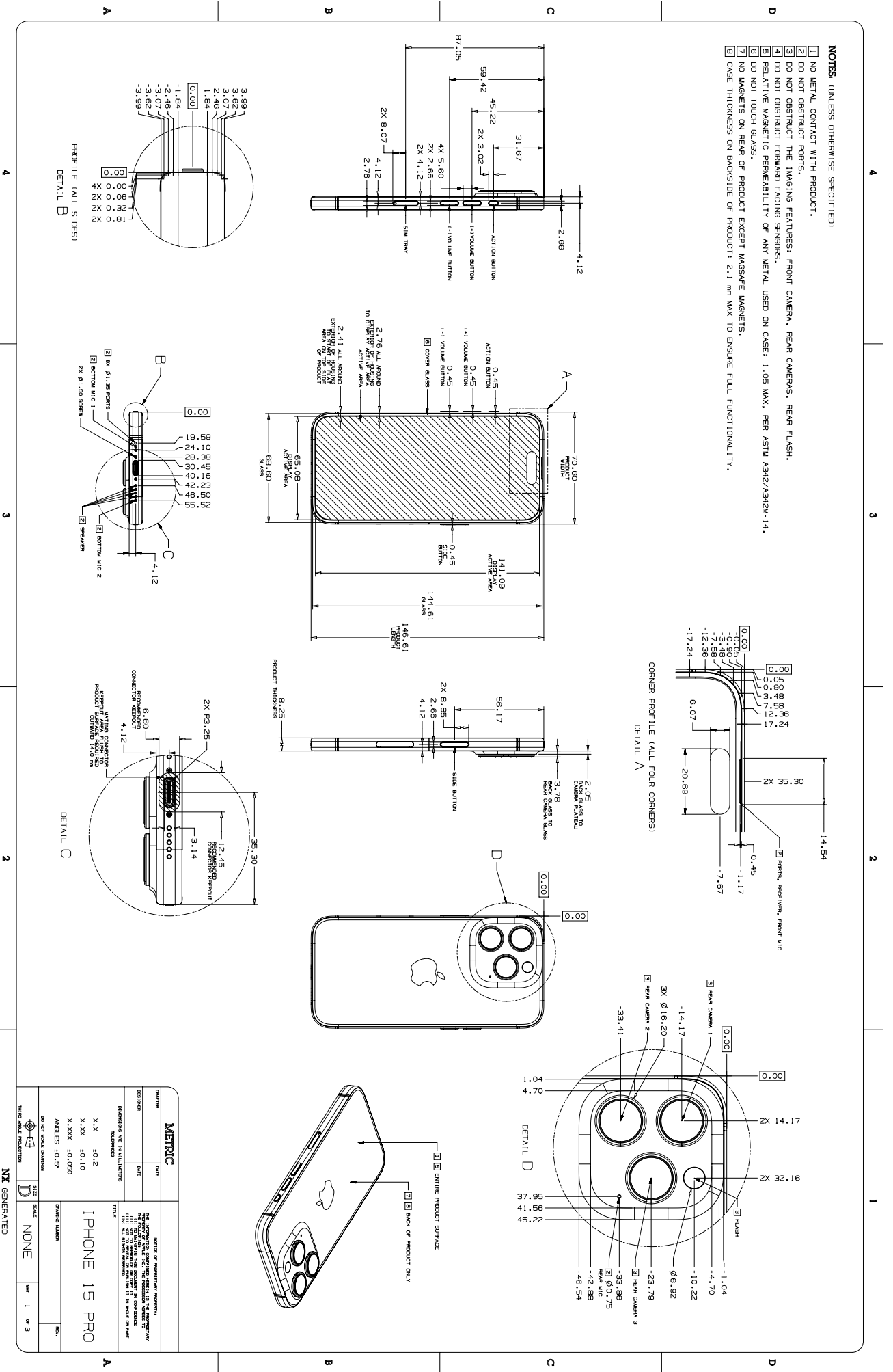
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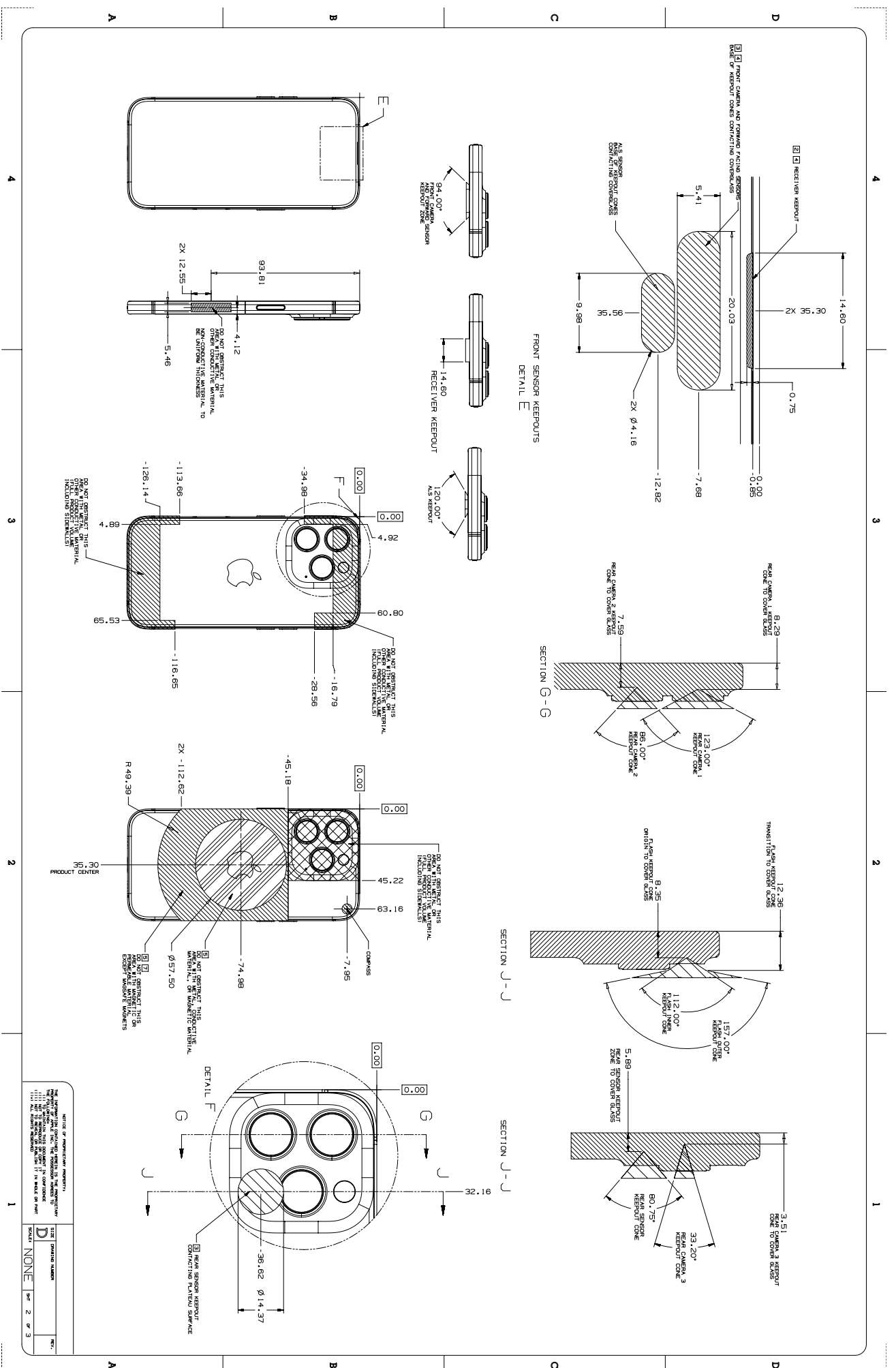
NOTES: (UNLESS OTHERWISE SPECIFIED)

- 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.



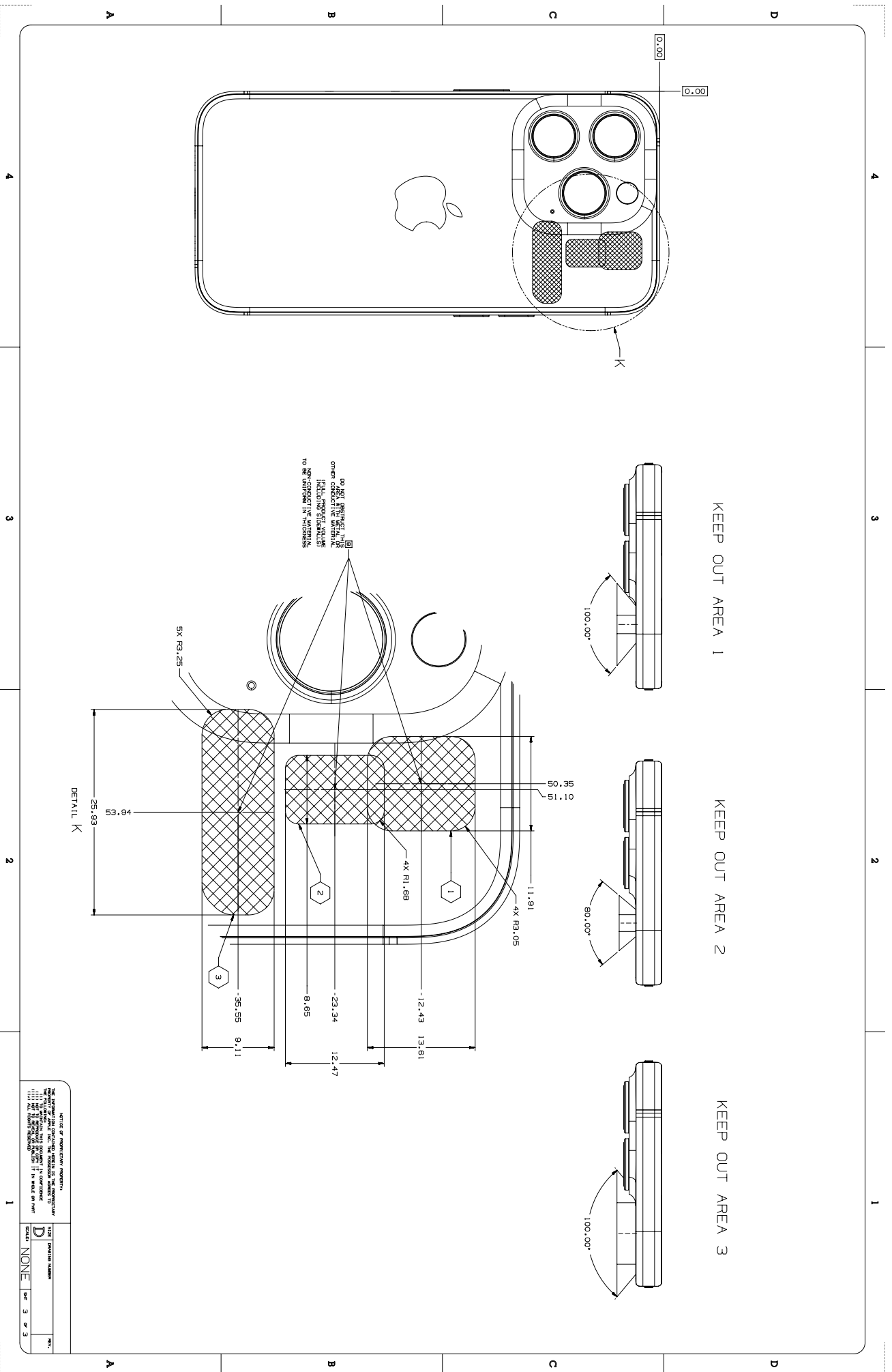
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DESIGNED	DATE	REVISED	DATE
DIMENSIONS ARE IN MILLIMETERS			
TOLERANCES			
X.X	+0.2	X.XX	+0.10
X.XXX	+0.050	ANGLES	±0.5°
DO NOT SCALE DRAWINGS			
HIDDEN AREA PROJECTION		SCALE	NONE
NONE GENERATED		SHEET	1 OF 3

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SECTION OR ORIENTATION IDENTIFIER	
SECTION	ORIENTATION
A	FRONT
B	REAR
C	FRONT
D	FRONT
E	FRONT
F	FRONT
G	FRONT
H	FRONT
I	FRONT
J	FRONT
K	FRONT
L	FRONT
M	FRONT
N	FRONT
O	FRONT
P	FRONT
Q	FRONT
R	FRONT
S	FRONT
T	FRONT
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AW	FRONT
AX	FRONT
AY	FRONT
AZ	FRONT
BA	FRONT
BB	FRONT
BC	FRONT
BD	FRONT
BE	FRONT
BF	FRONT
BF	NONE
BG	FRONT
BH	FRONT
BI	FRONT
BJ	FRONT
BK	FRONT
BL	FRONT
BM	FRONT
BN	FRONT
BO	FRONT
BP	FRONT
BQ	FRONT
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BS	FRONT
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BU	FRONT
BV	FRONT
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BX	FRONT
BY	FRONT
BZ	FRONT
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CB	FRONT
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CD	FRONT
CE	FRONT
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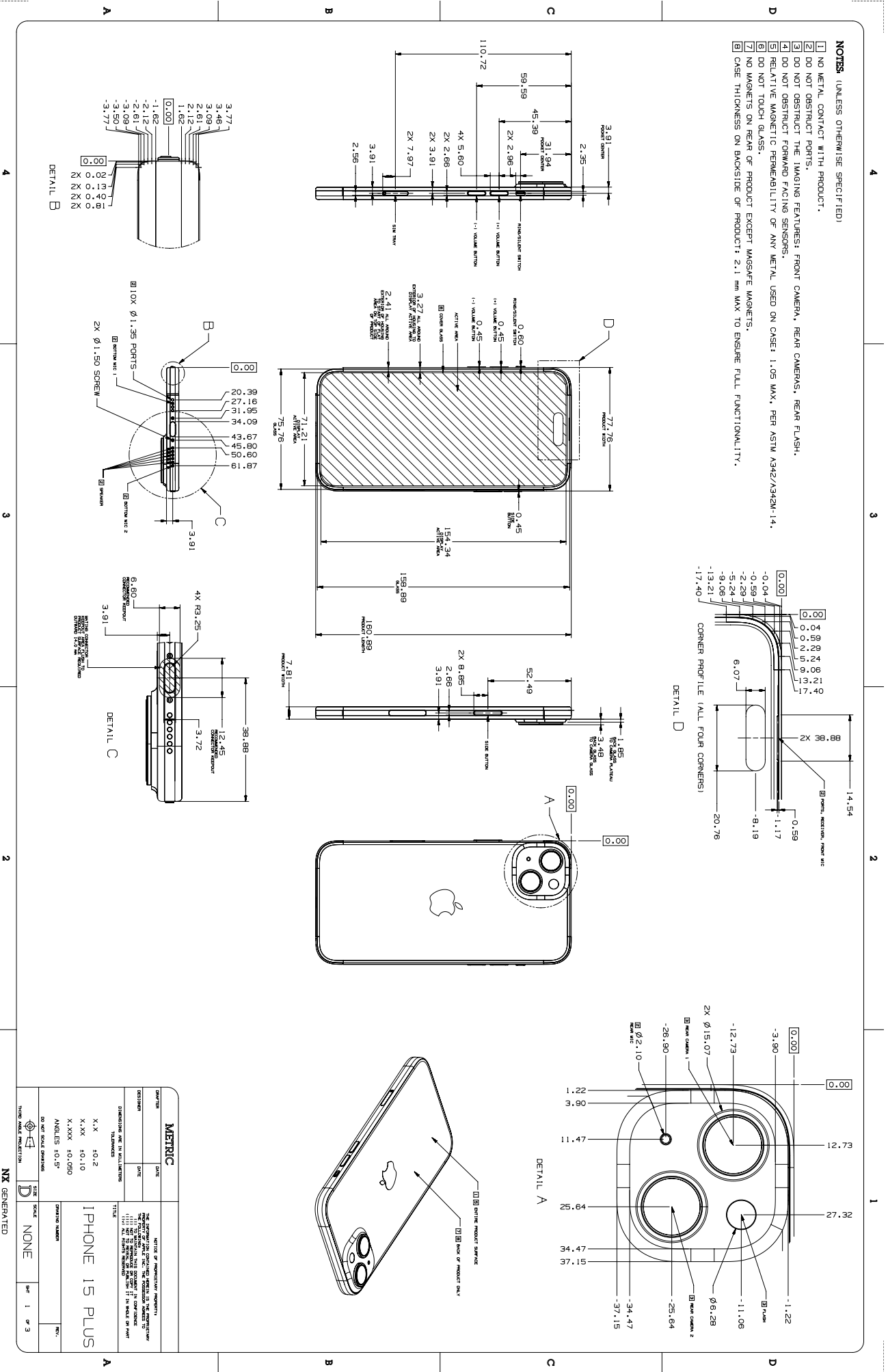
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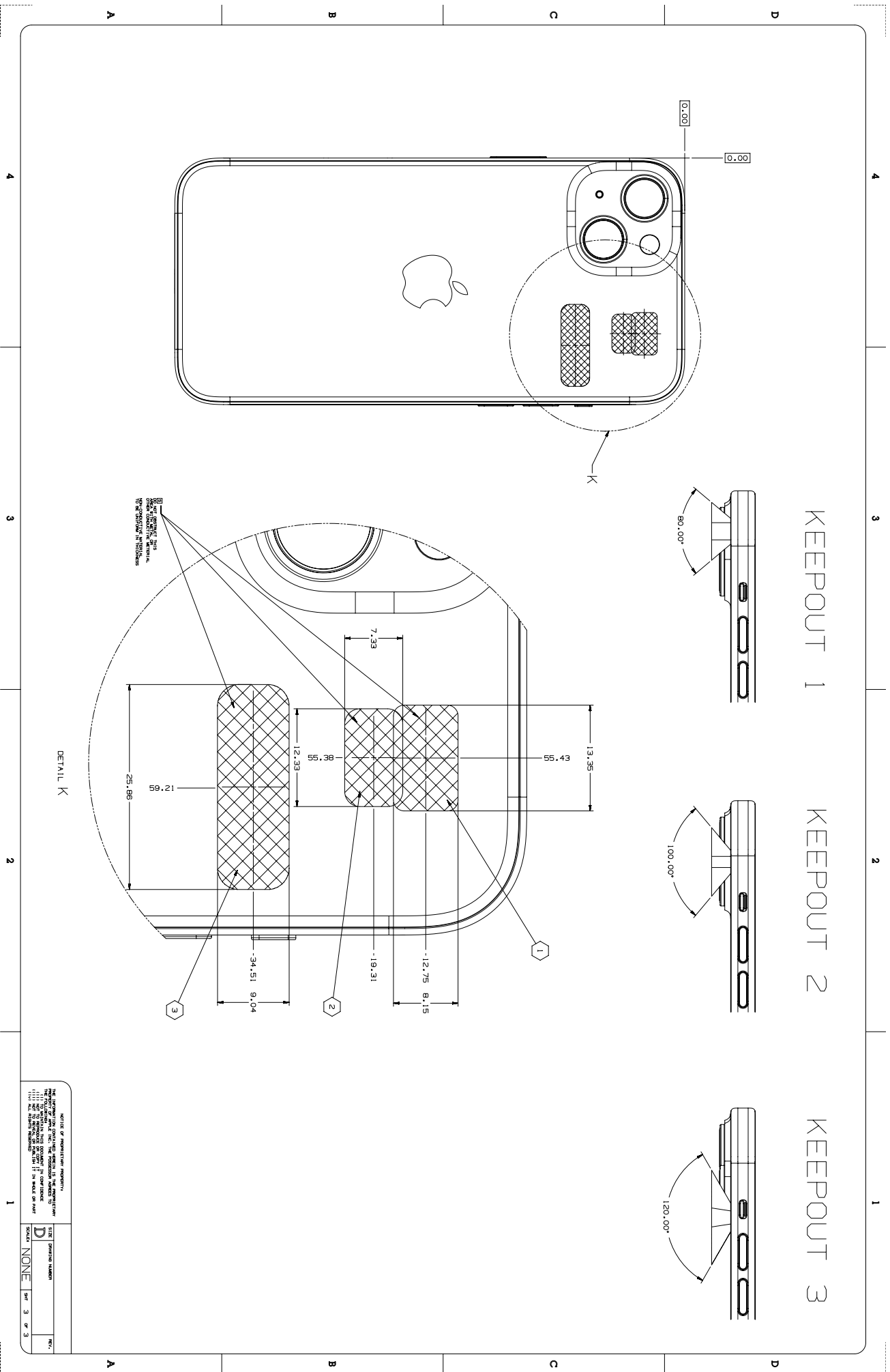
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NOTES (UNLESS OTHERWISE SPECIFIED)

- NO METAL CONTACT WITH PRODUCT.
- DO NOT OBSTRUCT PORTS.
- DO NOT OBSTRUCT THE IMAGING FEATURES! FRONT CAMERA, REAR CAMERAS, REAR FLASH.
- DO NOT OBSTRUCT THE IMAGING FEATURES! FRONT CAMERA, REAR CAMERAS, REAR FLASH.
- RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX., PER ASTM A342/A342M-14.
- DO NOT TOUCH GLASS.
- NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
- NO MAGNETS ON BACKSIDE OF PRODUCT: 2.1 mm MAX. TO ENSURE FULL FUNCTIONALITY.
- CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX. TO ENSURE FULL FUNCTIONALITY.

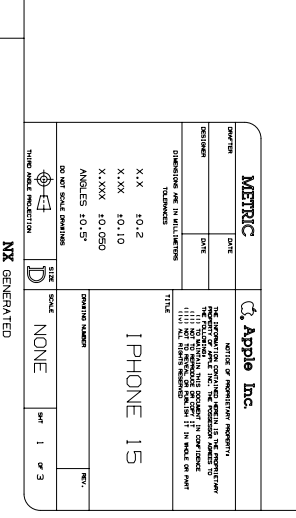
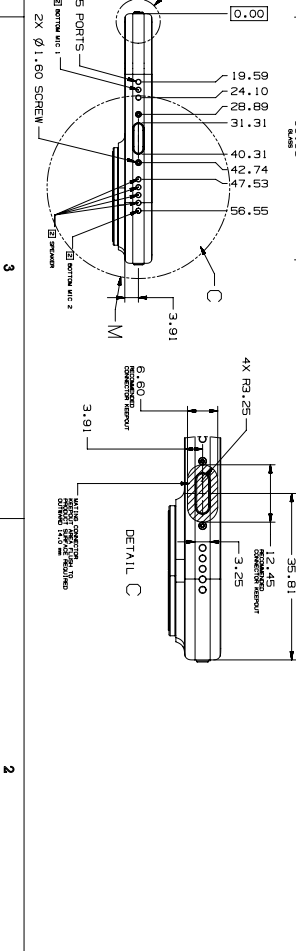
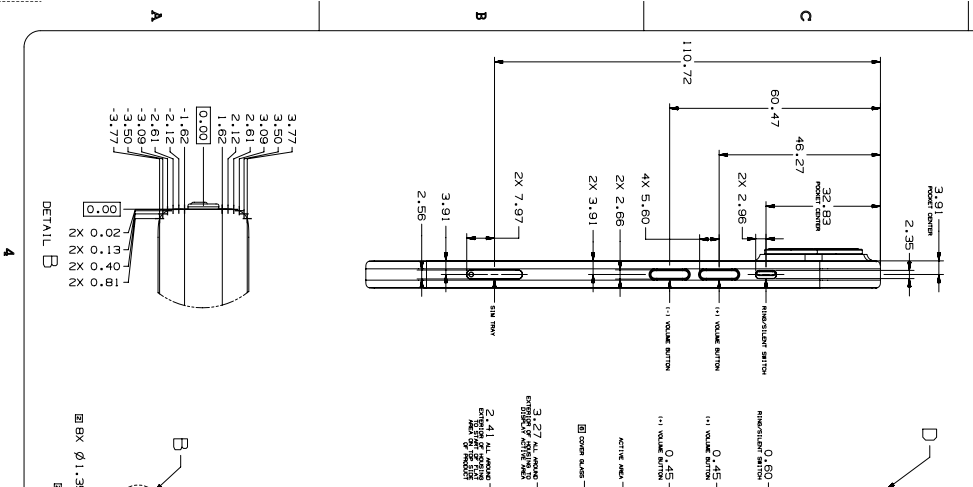
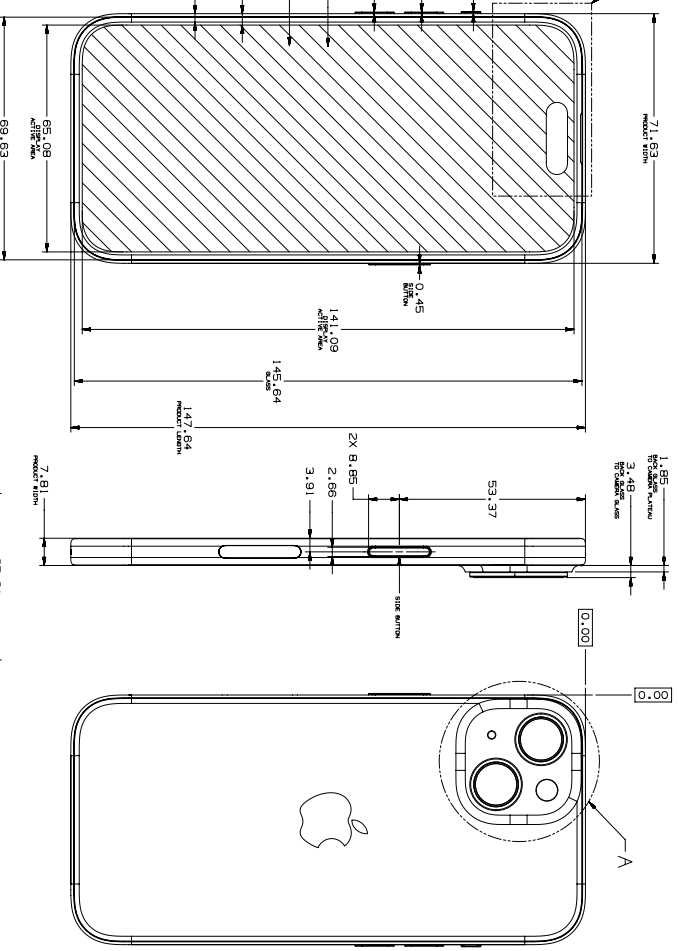
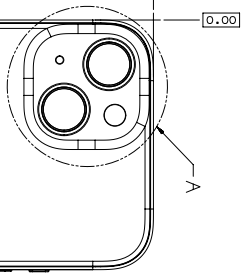
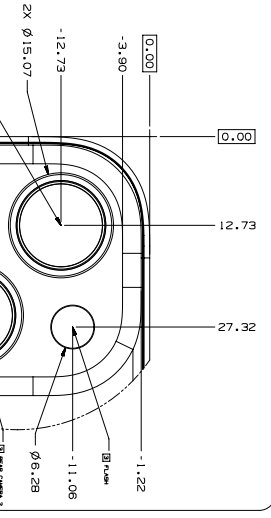
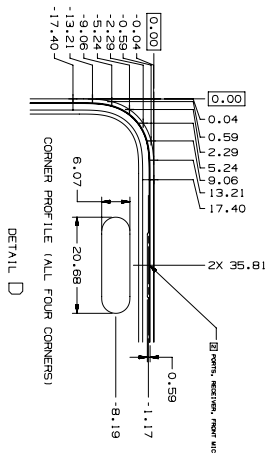


METRIC		INCH	
DESCRIPTION	UNIT	DESCRIPTION	UNIT
SIZE	MM	SIZE	INCH
DIMENSIONS ARE IN MILLIMETERS			
TOLERANCES			
X.X	+0.2	X.X	+0.10
X.XXX	+0.050	X.XXX	+0.020
ANGLES ±0.5°			
DO NOT SCALE DRAWINGS			
HIDDEN LINE REPRESENTATION		SCALE	
NONE		1 OF 3	
IPHONE 15 PLUS			
NX GENERATED			



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- NOTES (UNLESS OTHERWISE SPECIFIED)**
- NO METAL CONTACT WITH IPHONE.
 - DO NOT OBSTRUCT PORTS.
 - DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
 - DO NOT OBSTRUCT FORWARD FACING SENSORS.
 - RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
 - DO NOT TOUCH GLASS.
 - NO MARKERS ON REAR OF PRODUCT EXCEPT MASSAFE MARKERS.
 - CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 MM MAX TO ENSURE FULL FUNCTIONALITY.



SECTION	DATE	BY	CHKD
METRIC			

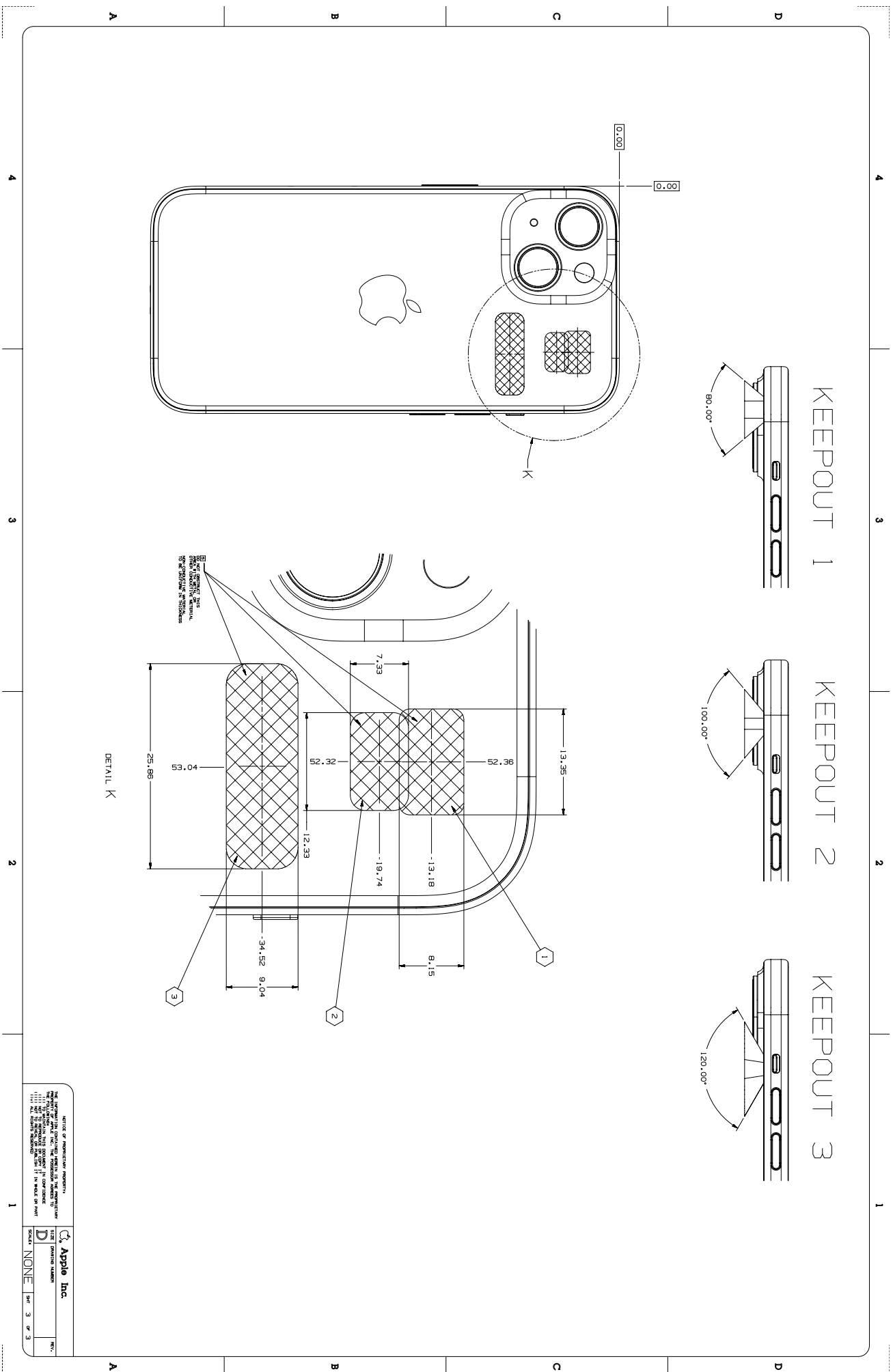
Apple Inc.

iPhone 15

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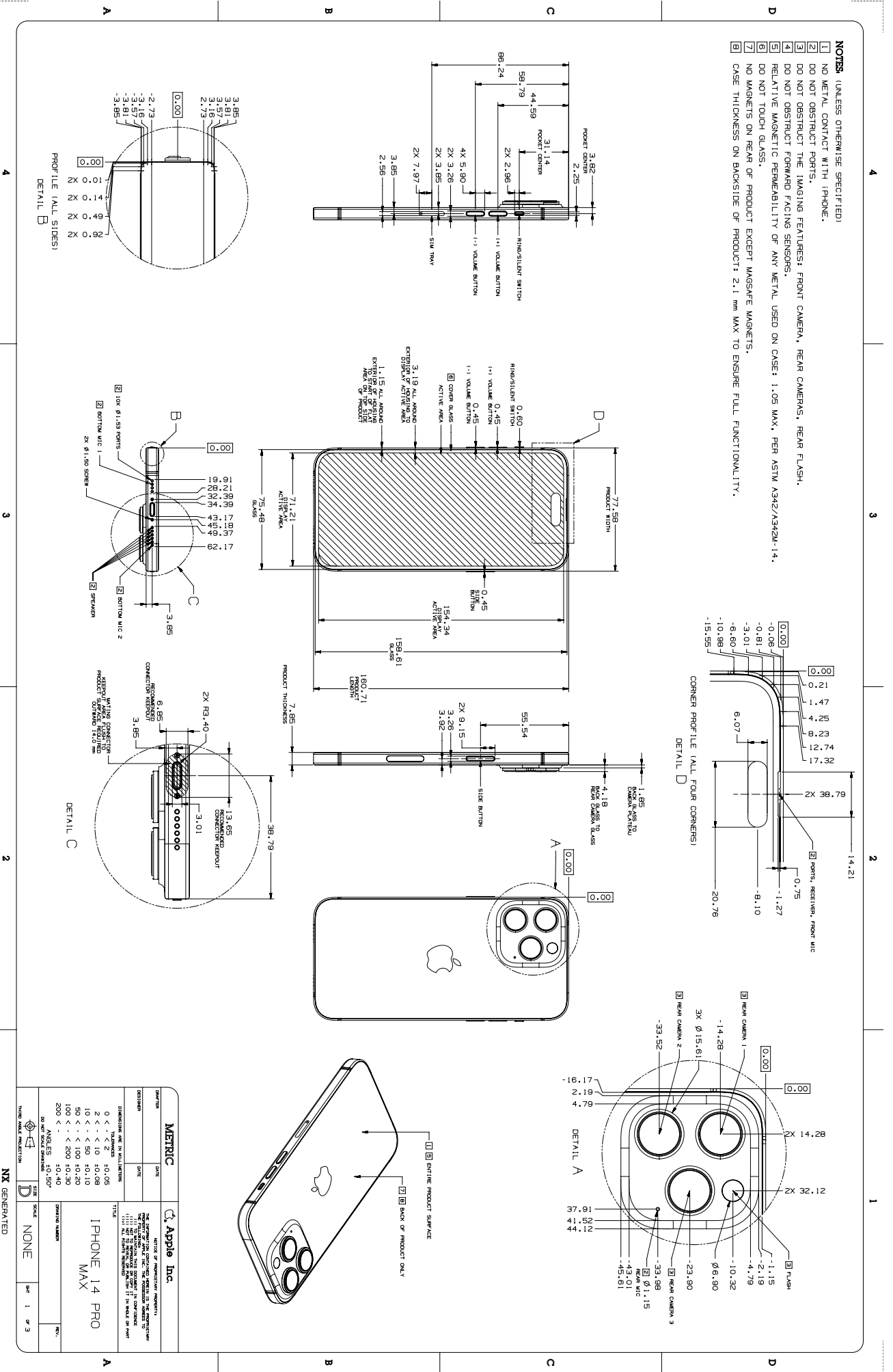


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 iPhone 15 3 of 3
 NONE

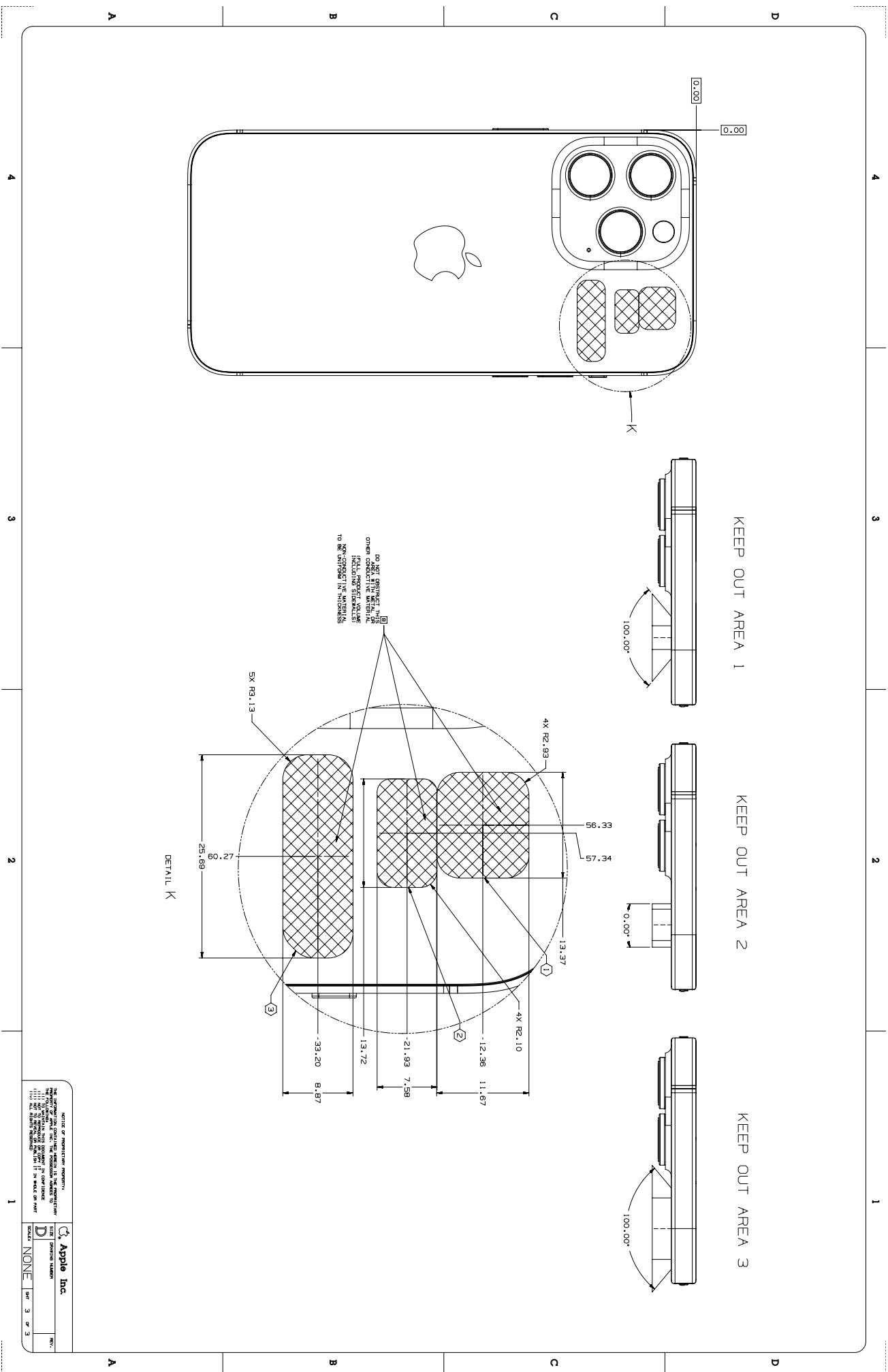
56.13 iPhone 14 Pro Max 1 of 3

- NOTES** (UNLESS OTHERWISE SPECIFIED)
- NO METAL CONTACT WITH IPHONE.
 - DO NOT OBSTRUCT PORTS.
 - DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
 - DO NOT OBSTRUCT FORWARD FACING SENSORS.
 - RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
 - DO NOT TOUCH GLASS.
 - NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
 - CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.



SECTION	DATE	BY	APPROVED
METRIC			
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DIMENSIONS ARE IN MILLIMETERS		TOLERANCES UNLESS OTHERWISE SPECIFIED	
0 < - < 2	±0.05	0 < - < 2	±0.05
2 < - < 10	±0.08	10 < - < 50	±0.10
10 < - < 50	±0.10	50 < - < 100	±0.20
100 < - < 200	±0.30	200 < - < 500	±0.50
ANGLES: ±0.25°		HOLE POSITION: ±0.10°	
DO NOT SCALE DIMENSIONS			
HIDDEN LINE PROJECTION		SCALE: NONE	
NX GENERATED		SHEET: 1 OF 3	

56.15 iPhone 14 Pro Max 3 of 3

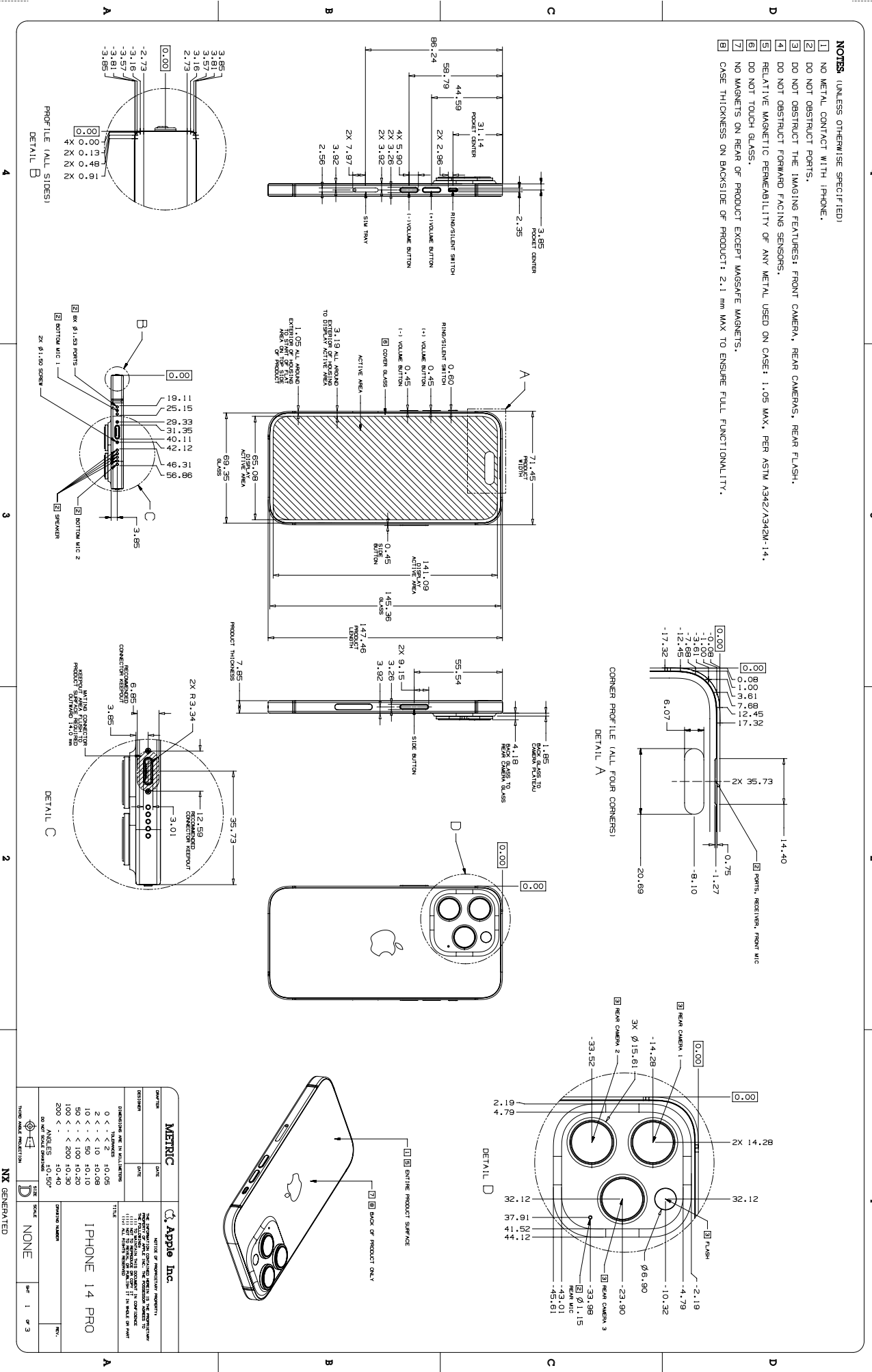


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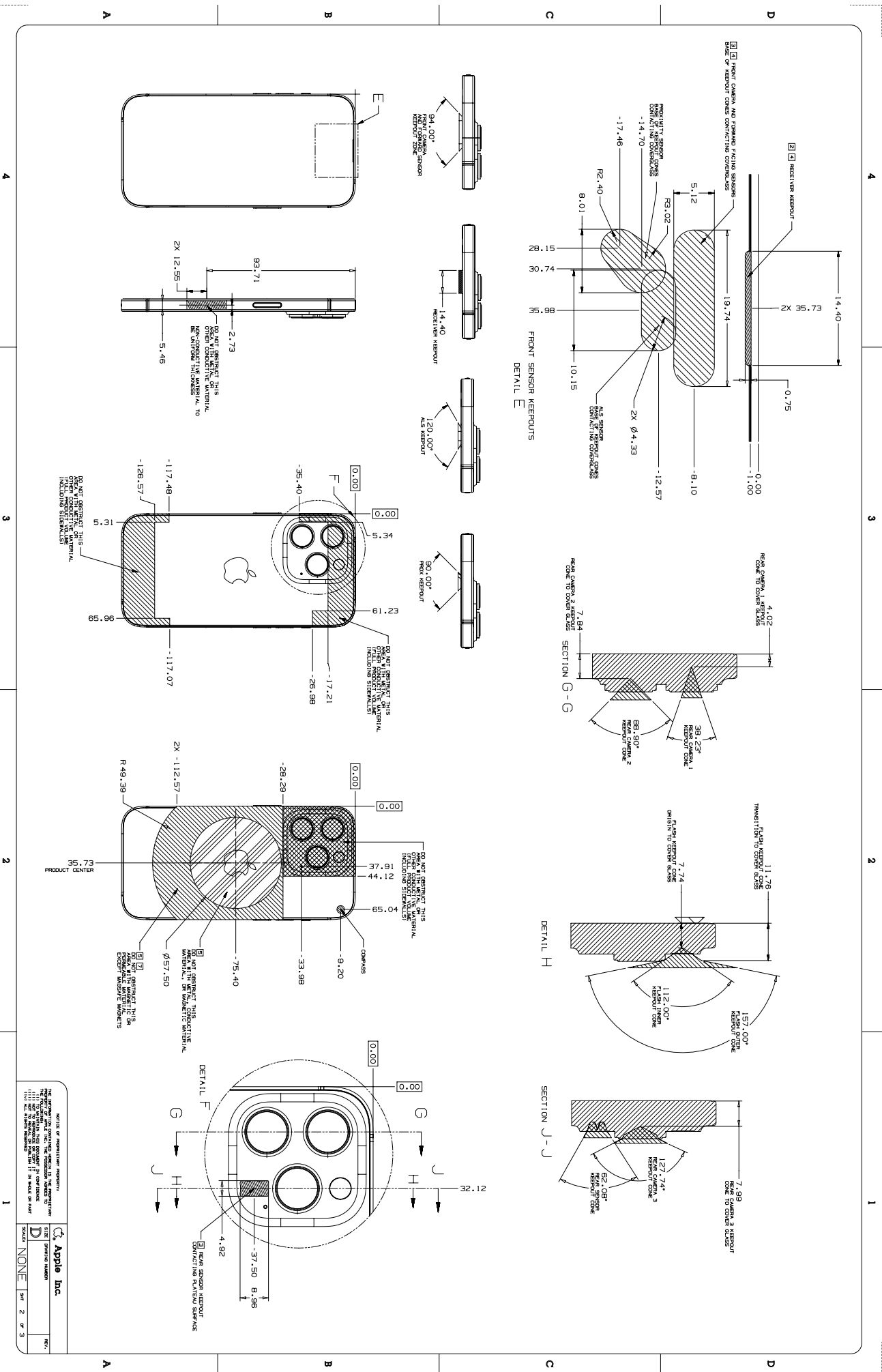
Apple Inc.
 PART NUMBER: NONE
 REVISION: 3 OF 3

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.
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- 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.



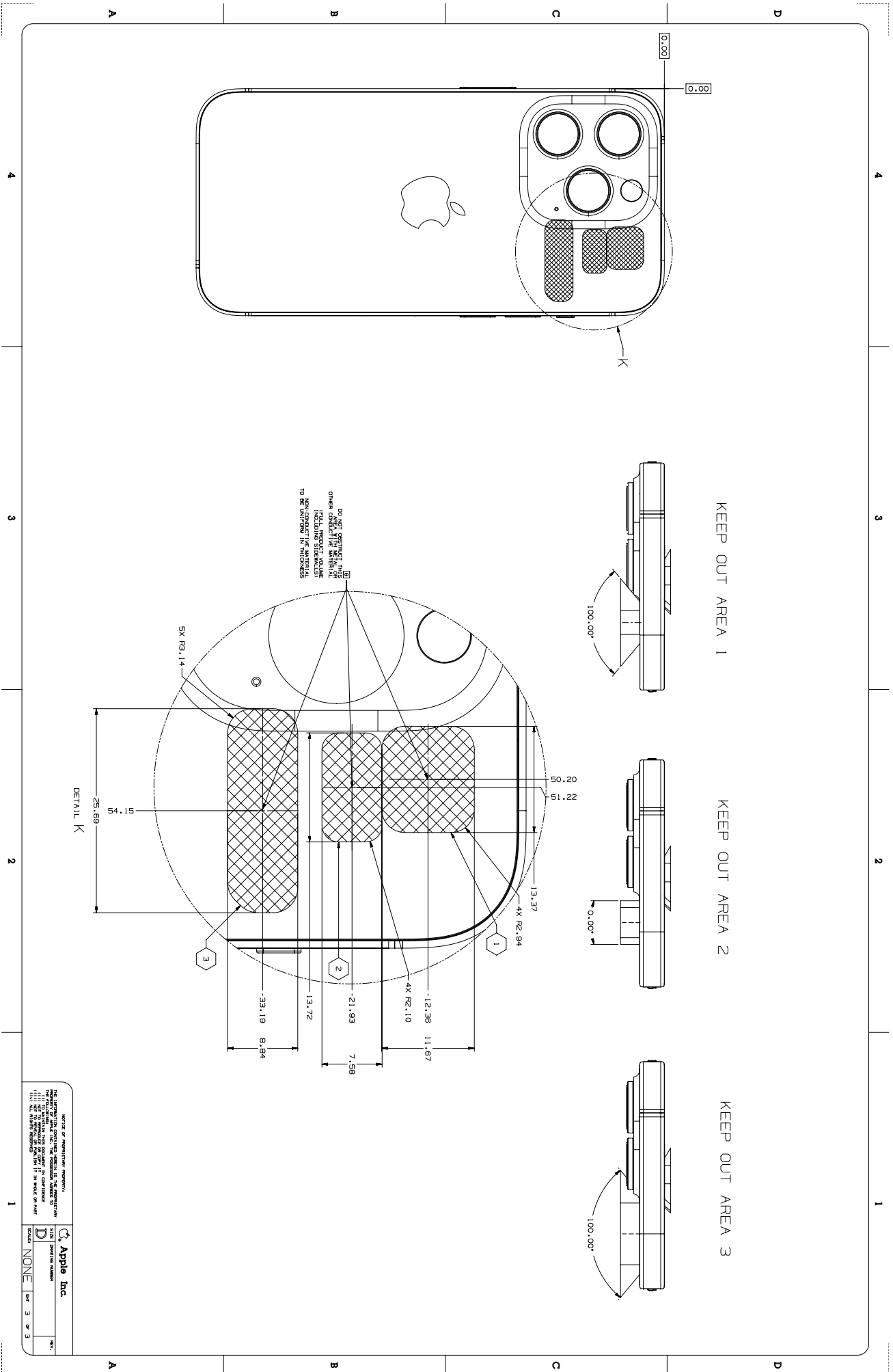
MERRUC		Apple Inc.	
SECTION	DATE	DATE OF PREVIOUS REVISION	REVISION
DESIGNED	DATE	DATE	REVISION
DIMENSIONS ARE IN MILLIMETERS			
0 < - < 2	+0.05		
2 < - < 10	+0.08		
10 < - < 50	+0.10		
50 < - < 100	+0.15		
100 < - < 200	+0.20		
200 < - < 500	+0.30		
ANGLES: 10°-150°			
DO NOT SCALE DIMENSIONS			
HARD MADE REJECTION		SCALE	SHEET 1 OF 3
NX GENERATED		NONE	



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DATE: 11/11/2023
DRAWN BY: [REDACTED]
CHECKED BY: [REDACTED]
DATE: 11/11/2023
PART: 56.17 iPhone 14 Pro 2 of 3

Apple Inc.
PART: 56.17 iPhone 14 Pro 2 of 3
REV: [REDACTED]
NONE

56.18 iPhone 14 Pro 3 of 3



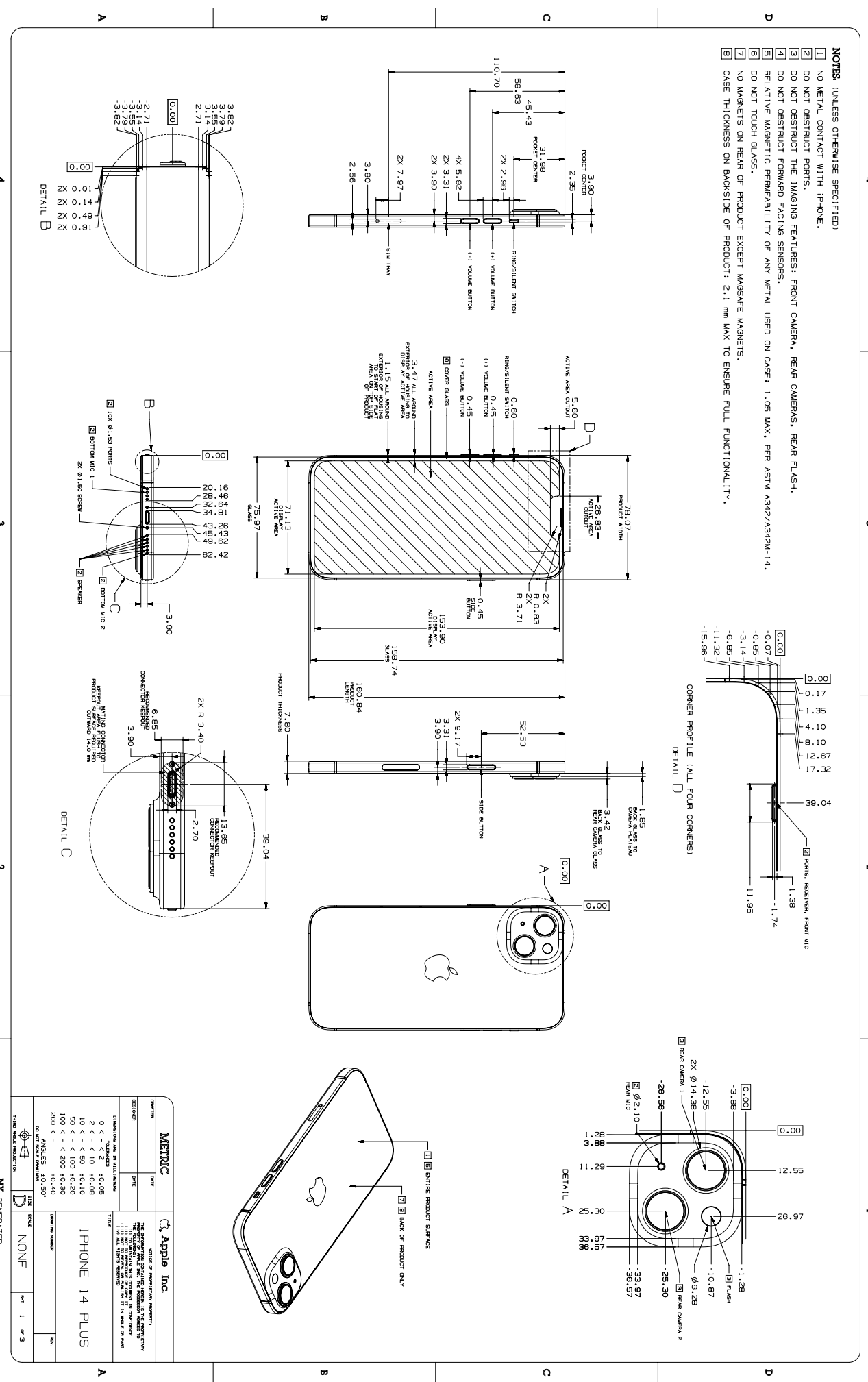
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 DATE: 2023-10-10
 DRAWING NUMBER: 56.18
 SHEET: 3 OF 3
 NONE

56.19 iPhone 14 Plus 1 of 3

NOTES (UNLESS OTHERWISE SPECIFIED)

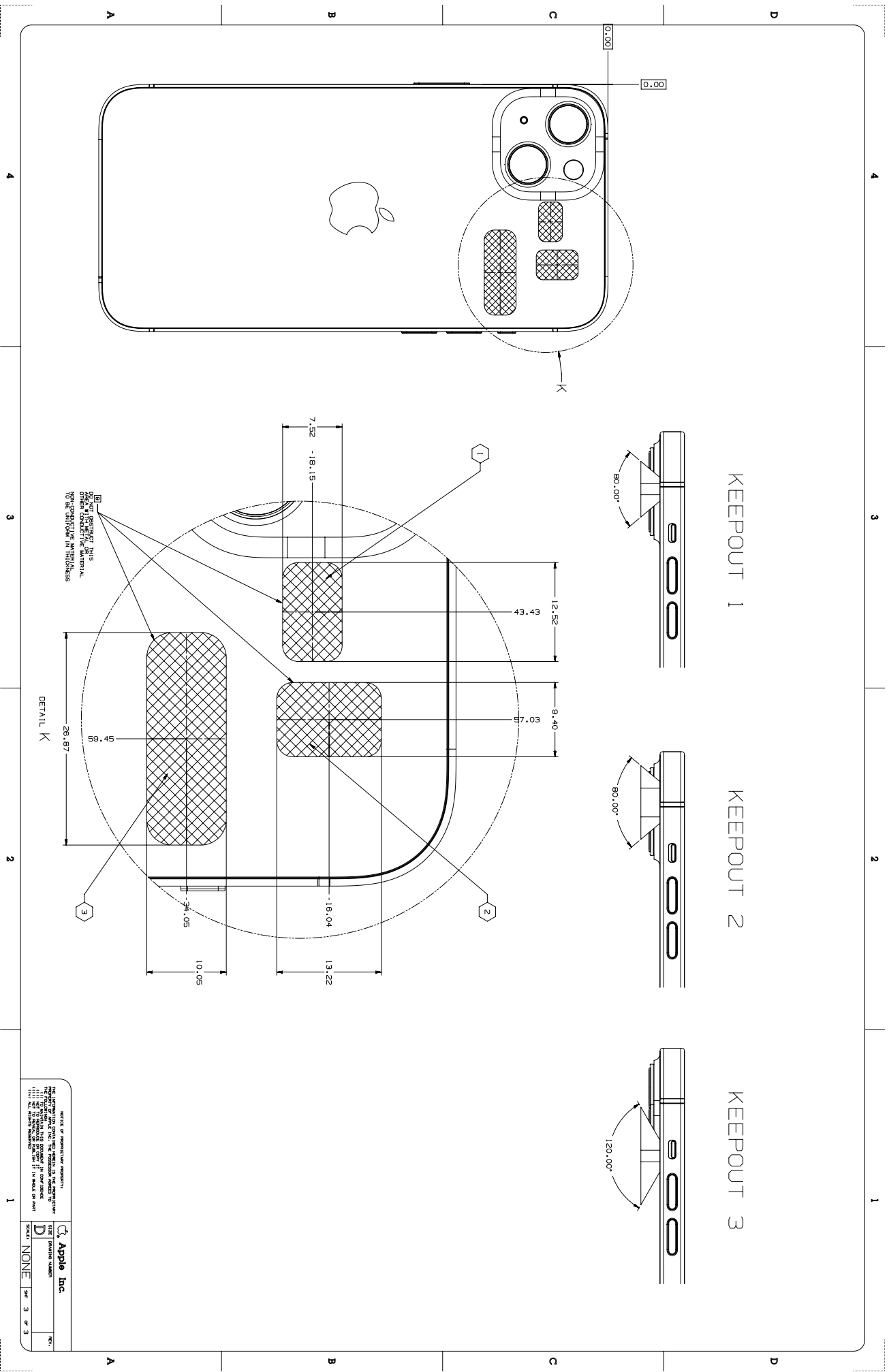
- 1 NO METAL CONTACT WITH IPHONE.
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- 4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
- 5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX., PER ASTM A362/A32M-14.
- 6 DO NOT TOUCH GLASS.
- 7 NO MAGNETS ON REAR OF PRODUCT EXCEPT MAGSAFE MAGNETS.
- 8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.



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DIMENSIONS ARE IN MILLIMETERS		TITLE	
0 < - < 2	±0.05	IPHONE 14 PLUS	
2 < - < 10	±0.08		
10 < - < 50	±0.10		
50 < - < 100	±0.15		
100 < - < 200	±0.20		
200 < -	±0.30		
ANGLES ±0.50°		DRAWN	
DO NOT SCALE DRAWING		DATE	
HIDDEN AREA INDICATION		SCALE	
NONE		SHEET 1 OF 3	

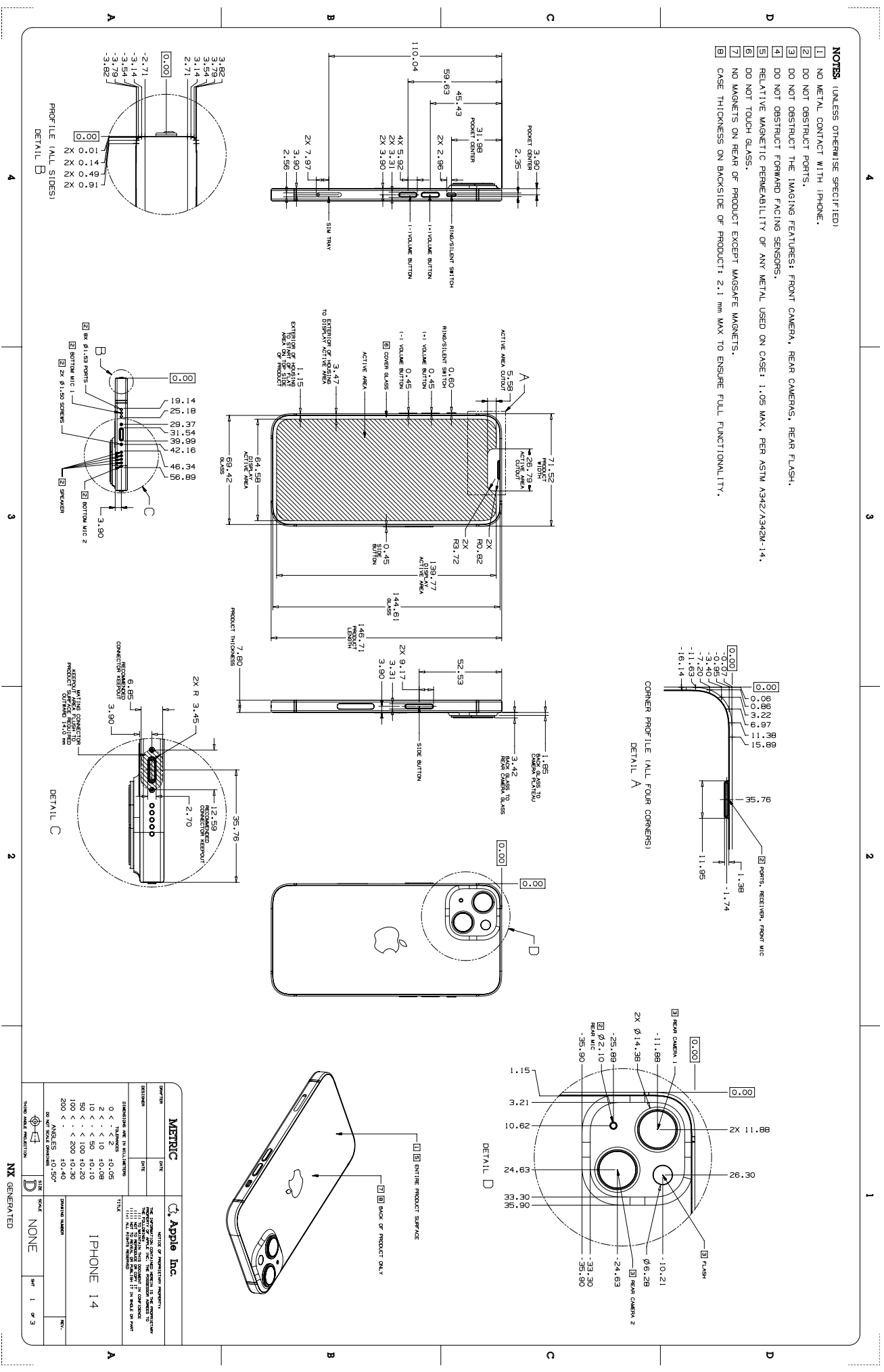
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56.21 iPhone 14 Plus 3 of 3

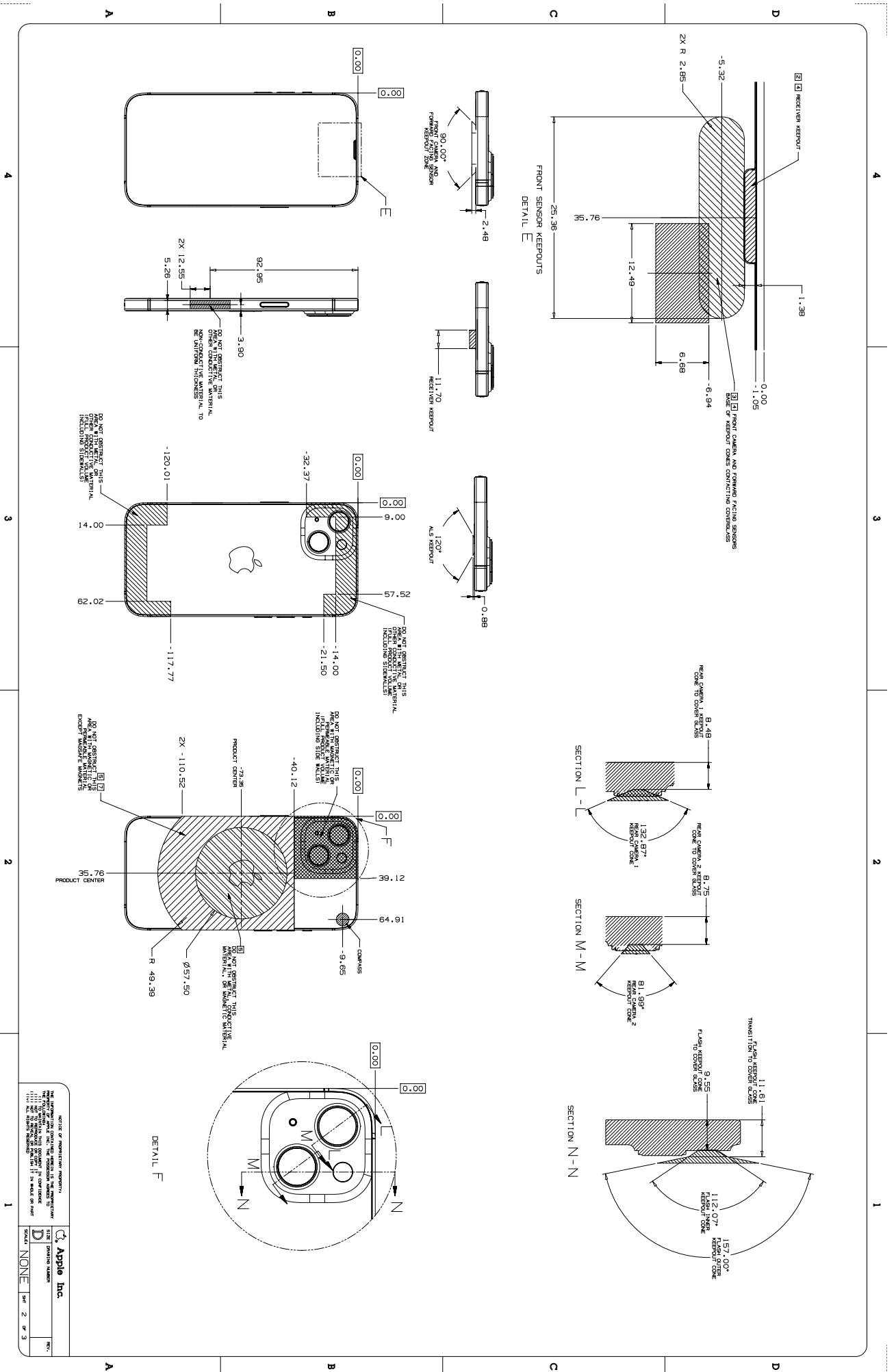


NOTES (UNLESS OTHERWISE SPECIFIED)

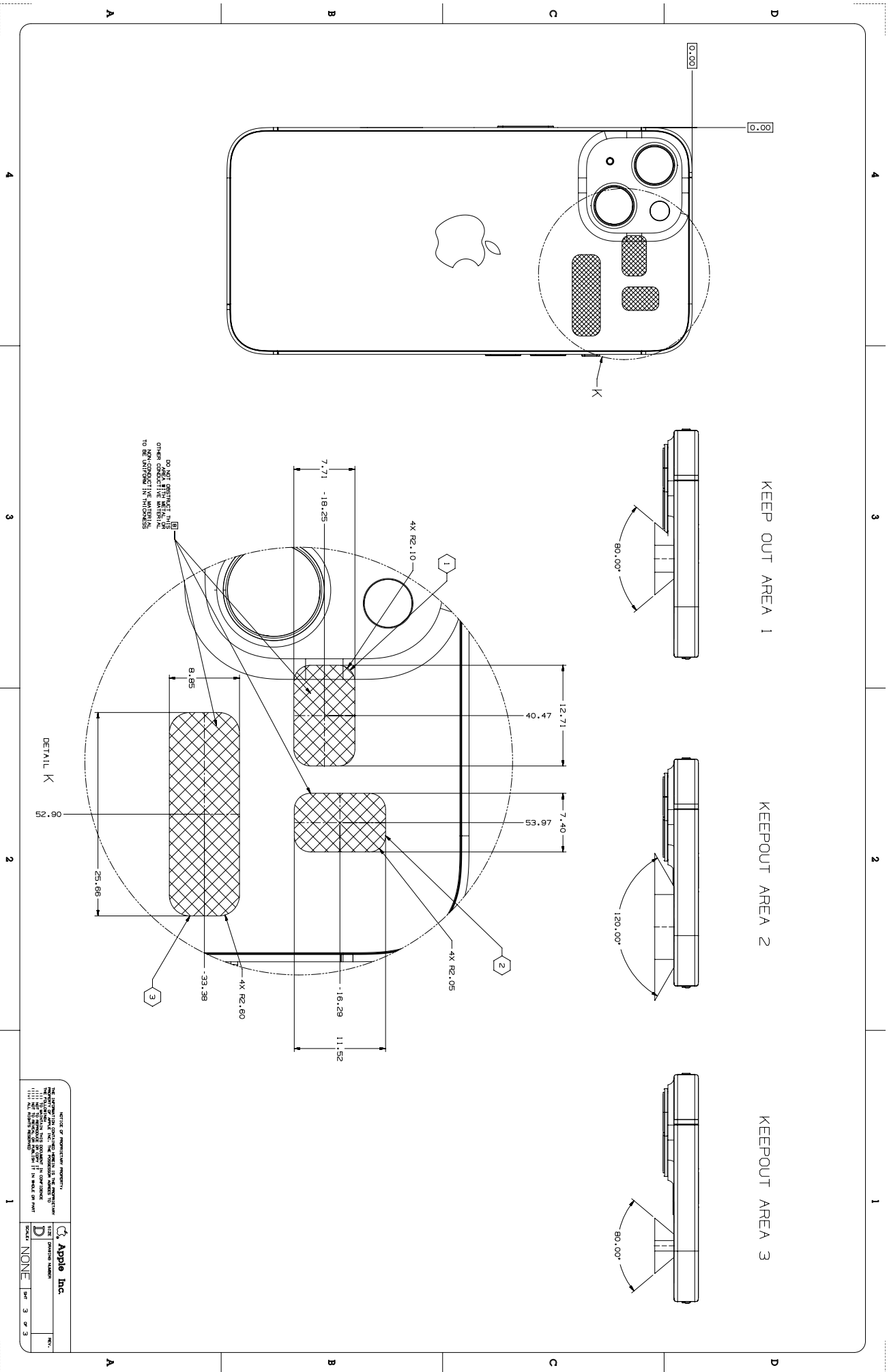
- 1 NO METAL CONTACT WITH IPHONE.
- 2 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
- 3 DO NOT OBSTRUCT FORWARD FACING SENSORS.
- 4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
- 5 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX, PER ASTM A342/A342M-14.
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MATERIAL		Apple Inc.	
DESCRIPTION	DATE	VERSION	REVISION
REVISION	DATE		
DIMENSIONS ARE IN MILLIMETERS			
0 < - < 2	±0.05		
2 < - < 10	±0.08		
10 < - < 50	±0.10		
50 < - < 100	±0.15		
100 < - < 200	±0.20		
200 < - < 500	±0.30		
ANGLES: 10°-50°			
DO NOT SCALE DIMENSIONS			
DRAWING NUMBER		SCALE	
NONE		NONE	
SHEET NUMBER		SHEET TOTAL	
1		3	

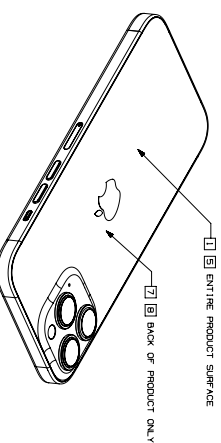
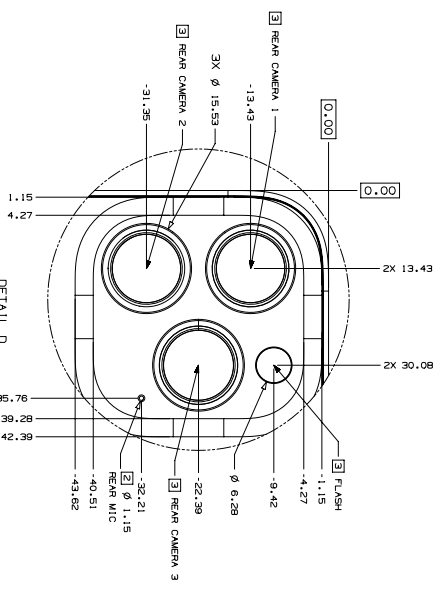
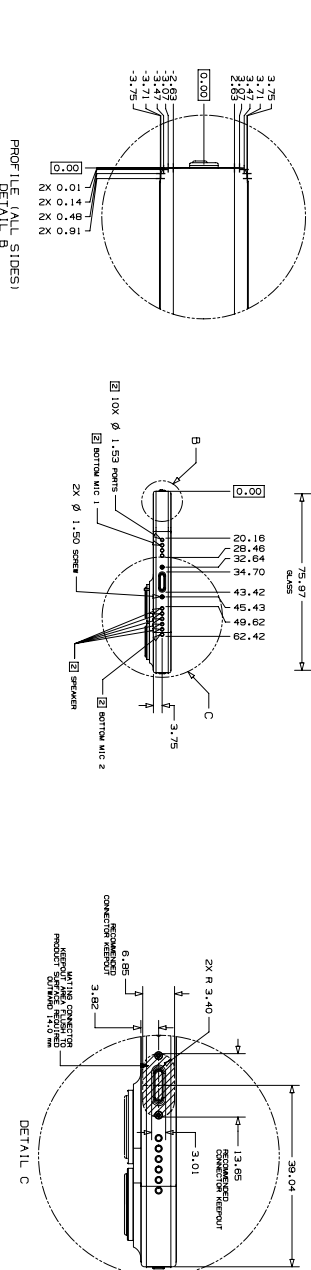
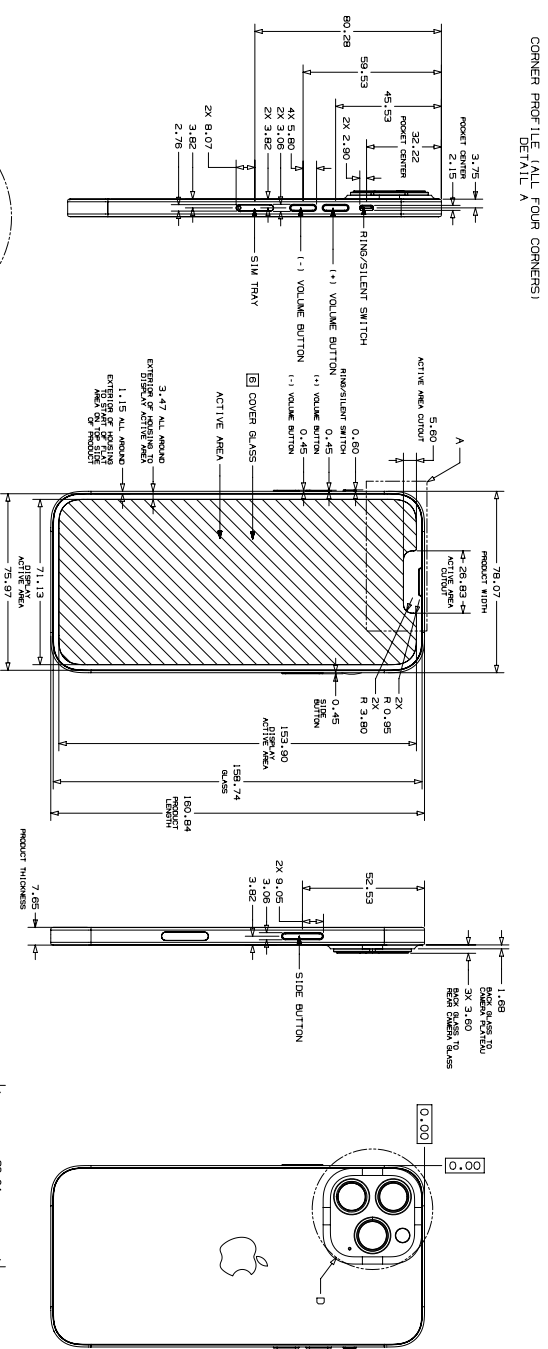
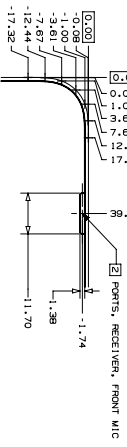


56.24 iPhone 14 3 of 3

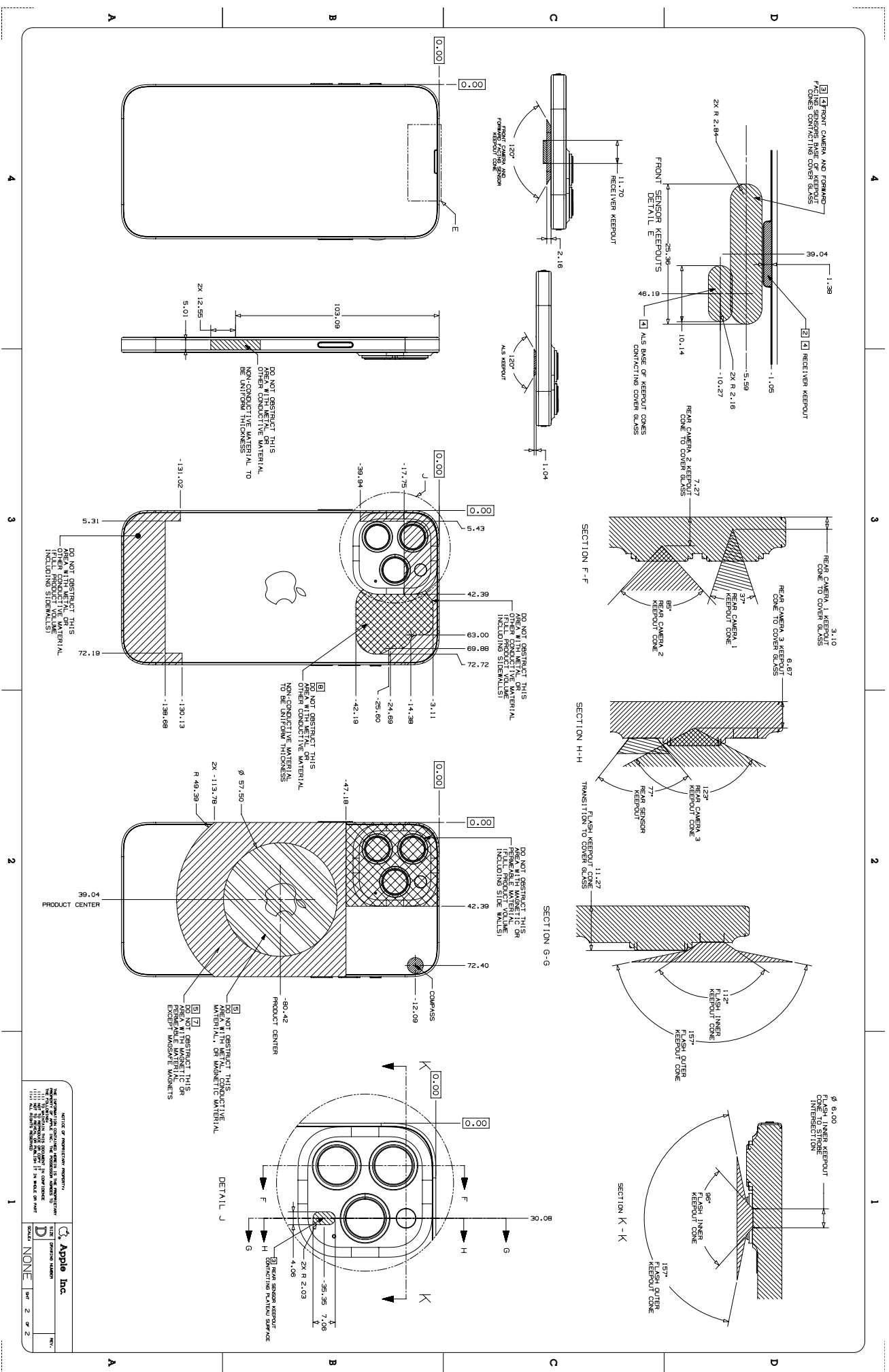


56.25 iPhone 13 Pro Max 1 of 2

- 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.
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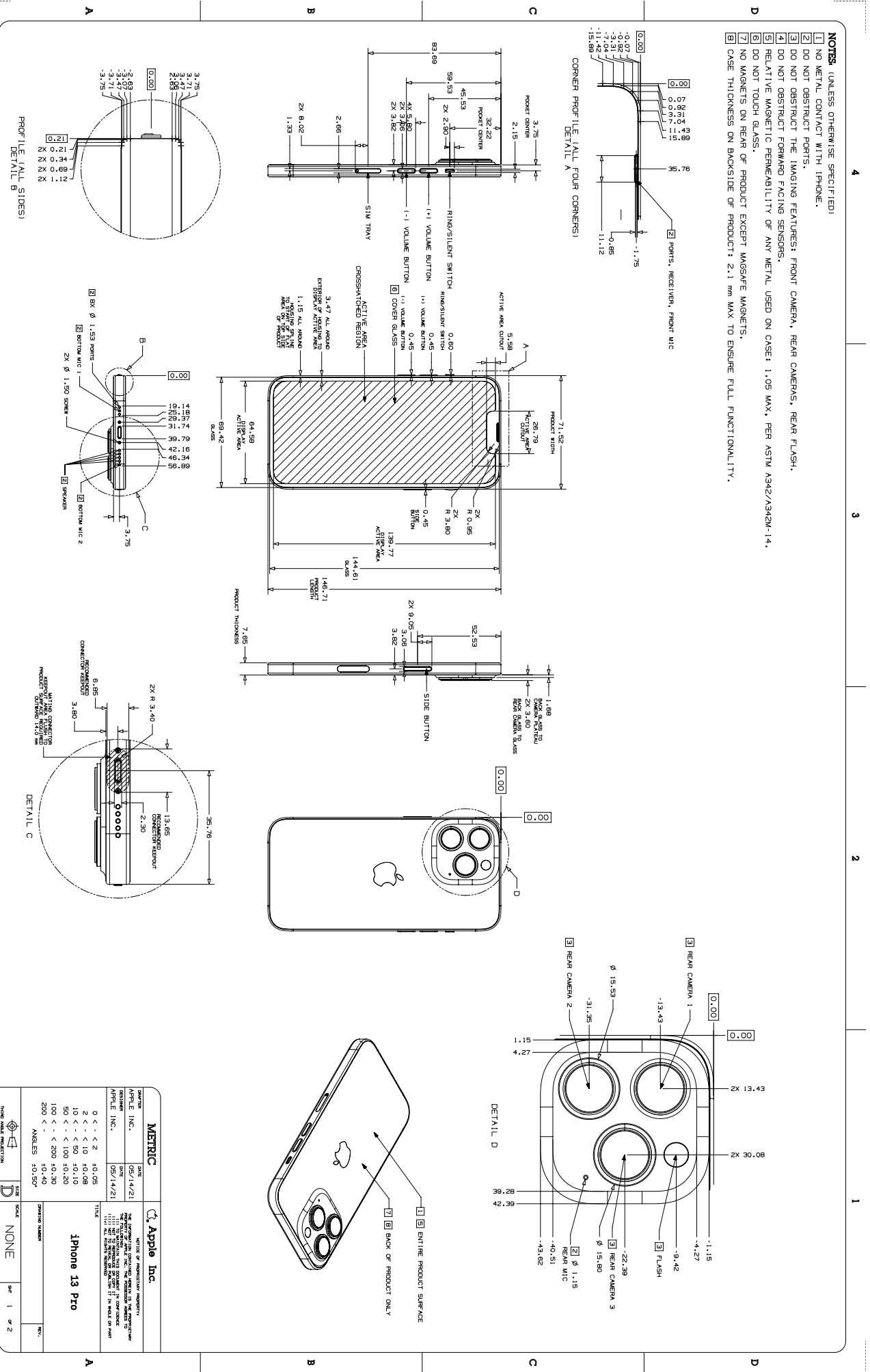
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SECTION	DATE	DESCRIPTION	REV.
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DRAWN			
CHECKED			
APPROVED			
DATE			
SCALE	NONE		
DATE			
REV.	1	OF	2



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Apple Inc.
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 SHEET: 2 OF 2

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 - [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.

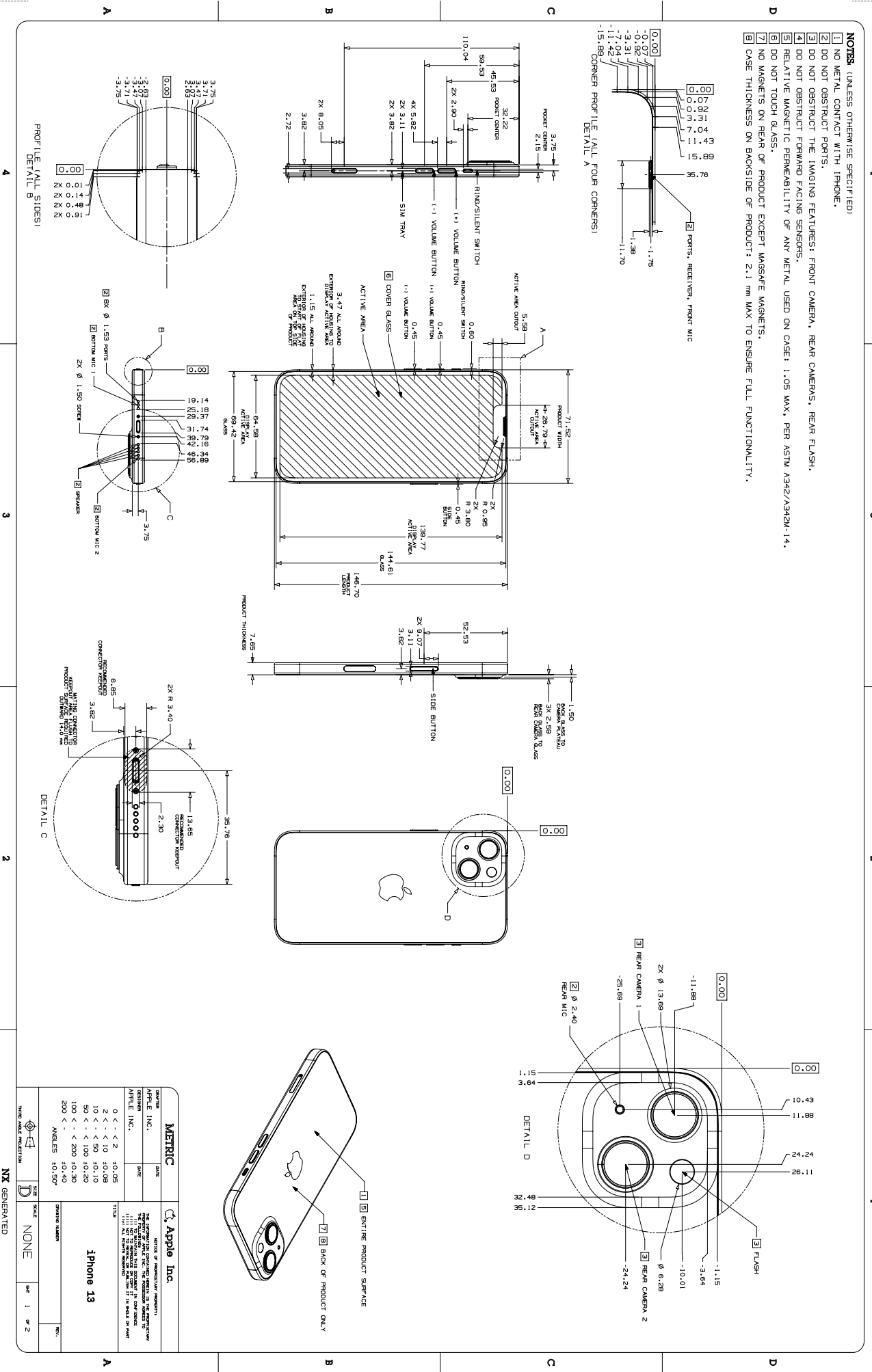


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APPLE INC.	05/14/21	8	05/14/21
APPLE INC.	05/14/21	9	05/14/21
APPLE INC.	05/14/21	10	05/14/21
APPLE INC.	05/14/21	11	05/14/21
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APPLE INC.	05/14/21	16	05/14/21
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56.29 iPhone 13 1 of 2

NOTES (UNLESS OTHERWISE SPECIFIED)

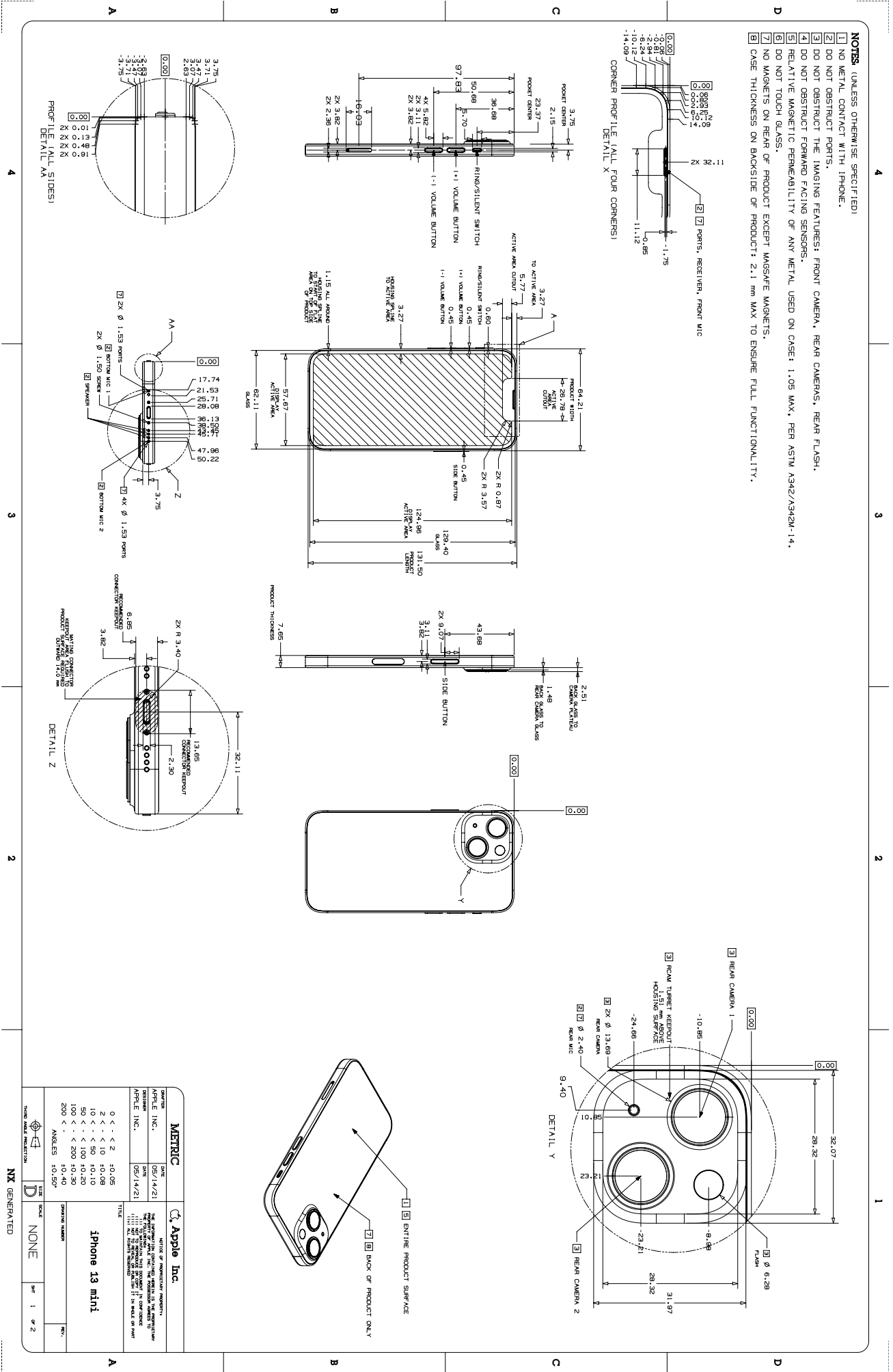
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- 8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.

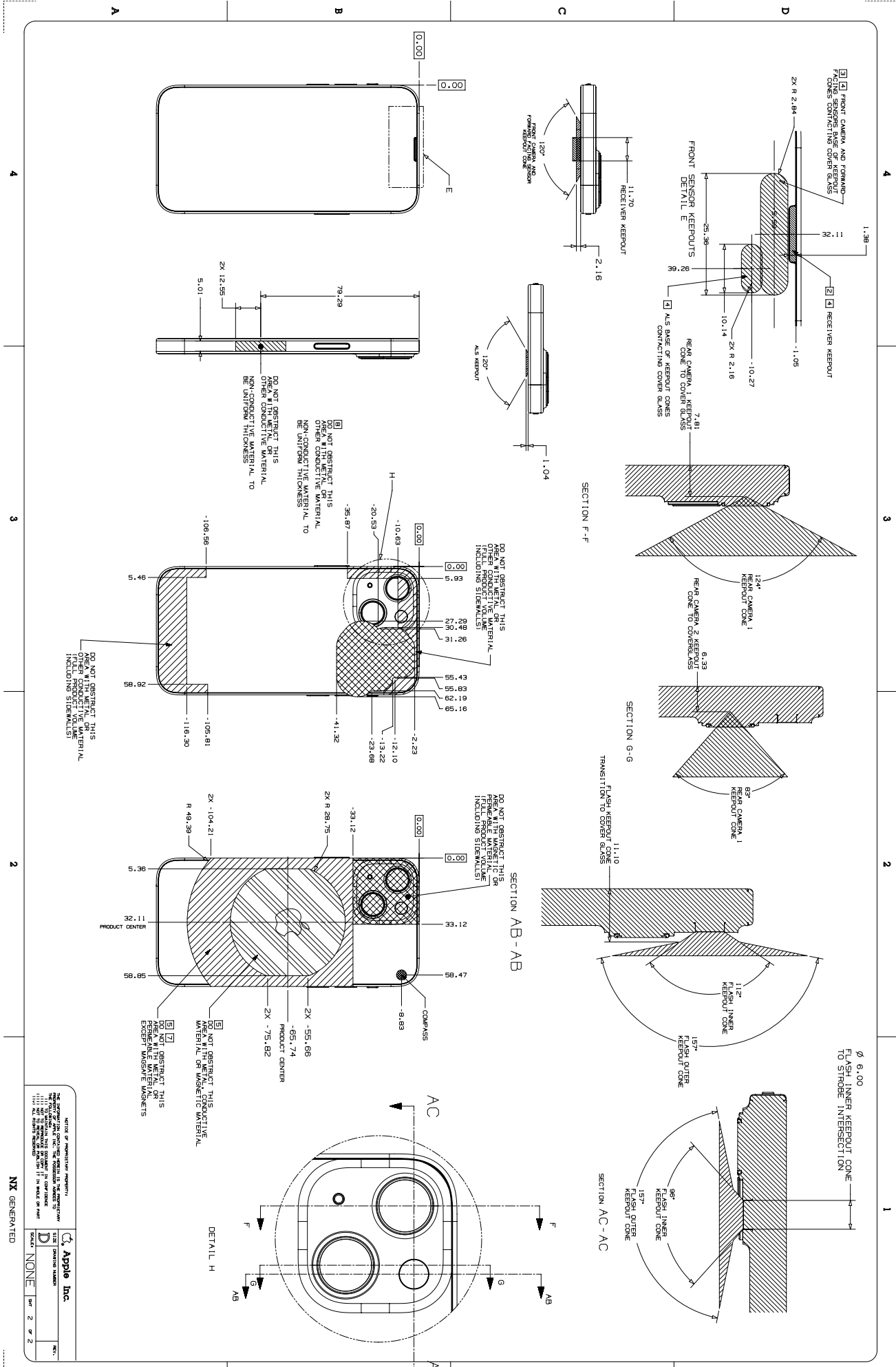


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DESCRIPTION	UNIT	DESCRIPTION	UNIT
APPLE INC.	MM	APPLE INC.	MM
RESERVED	MM	RESERVED	MM
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2 < - < 10	+0.08	2 < - < 10	+0.08
10 < - < 50	+0.10	10 < - < 50	+0.10
50 < - < 100	+0.20	50 < - < 100	+0.20
100 < - < 200	+0.30	100 < - < 200	+0.30
200 < -	+0.40	200 < -	+0.40
ANGLES	+0.50°	ANGLES	+0.50°

Apple Inc.
iPhone 13
NX GENERATED

56.31 iPhone 13 mini 1 of 2





DATE: 07/21/2021 09:21:03 AM

DESIGNER: JAMES CHANG

CHECKER: JAMES CHANG

APPROVER: JAMES CHANG

PROJECT: 56.32 iPhone 13 mini 2 of 2

DESCRIPTION: REAR CAMERA AND FORWARD-FACING SENSOR RANGE COVER GLASS

SCALE: NONE

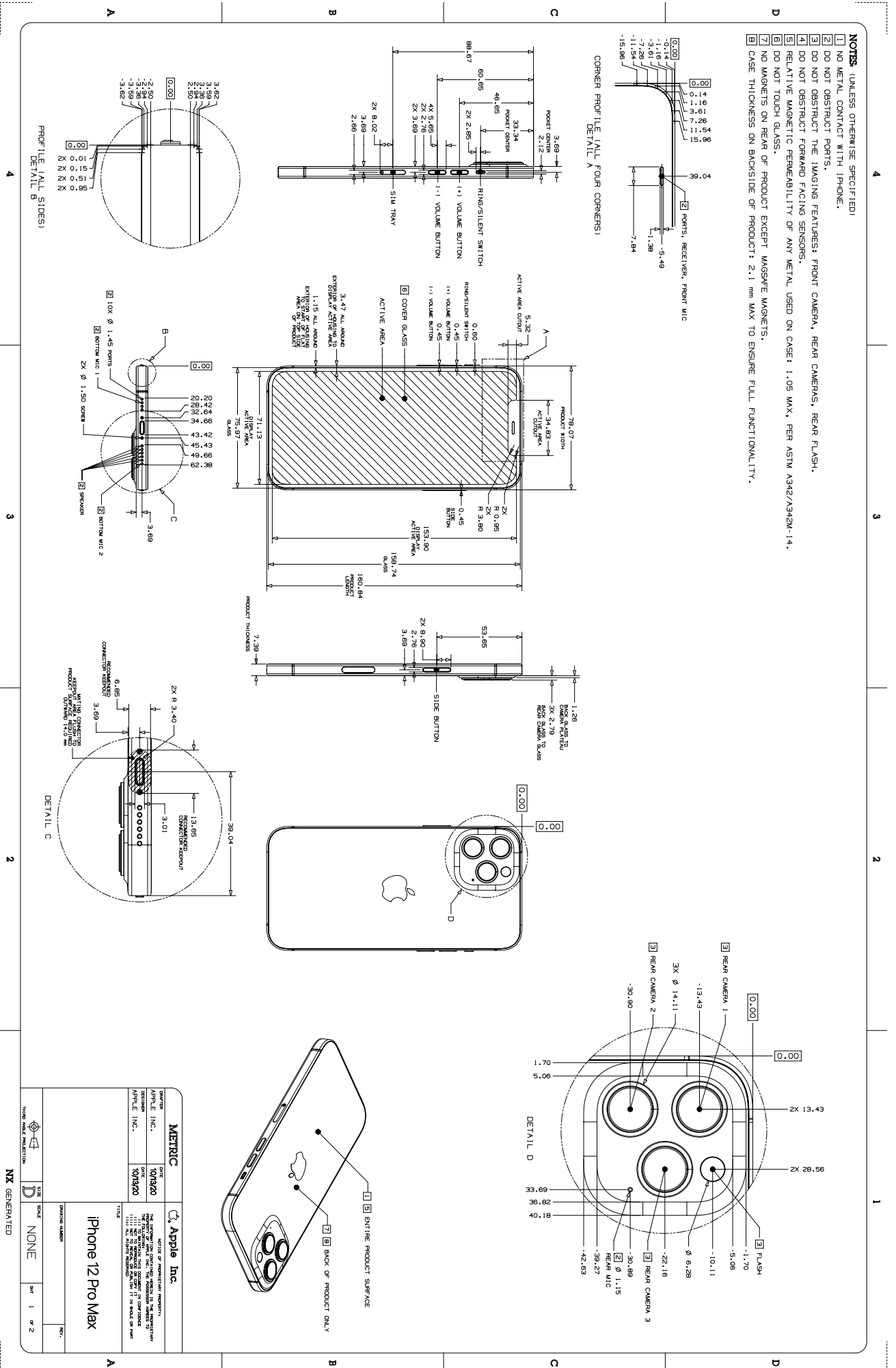
SHEET: 2 OF 2

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NX GENERATED

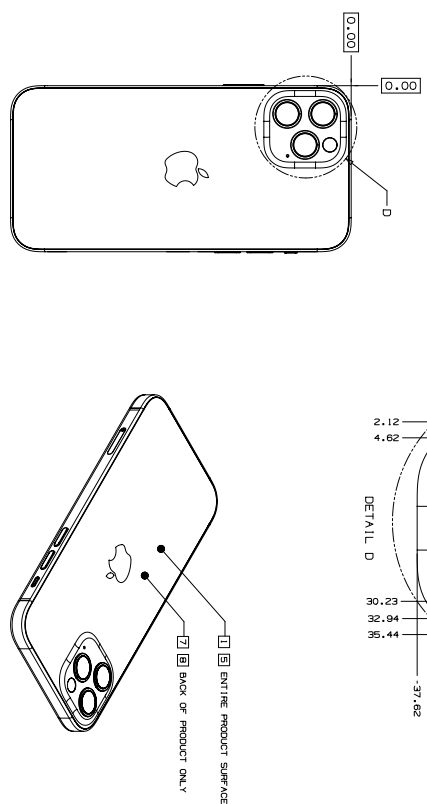
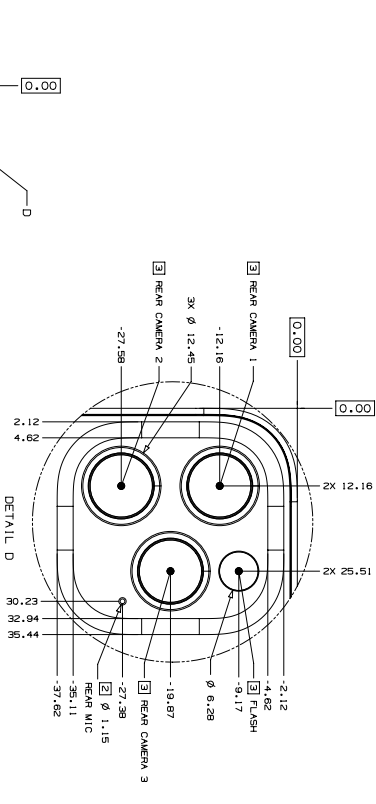
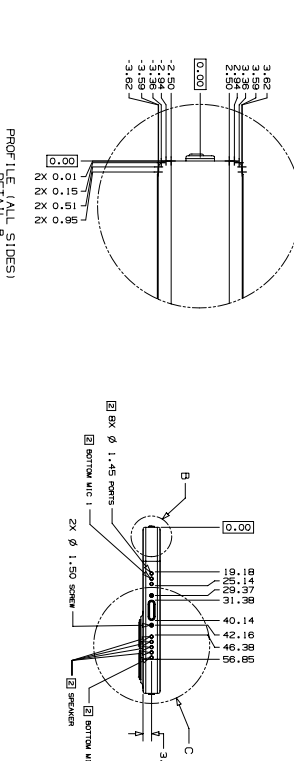
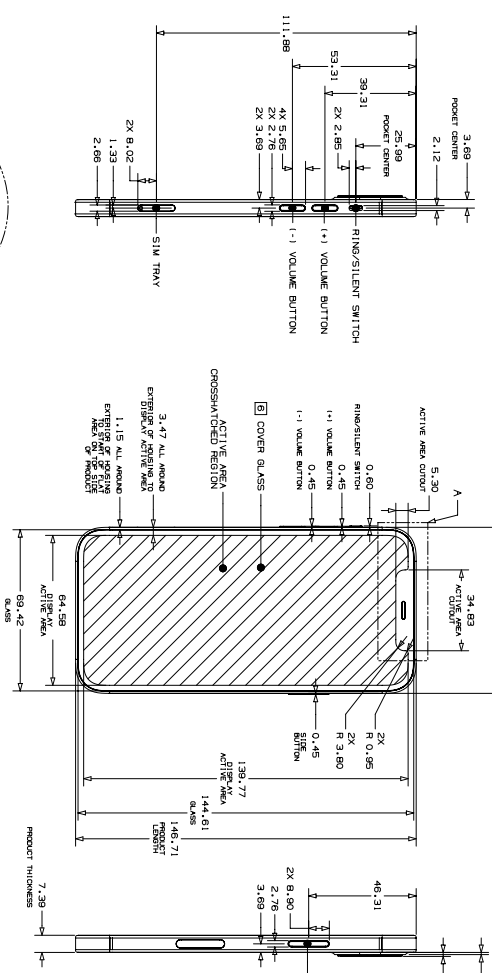
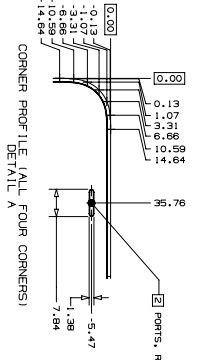
56.33 iPhone 12 Pro Max 1 of 2



56.35 iPhone 12 Pro 1 of 2

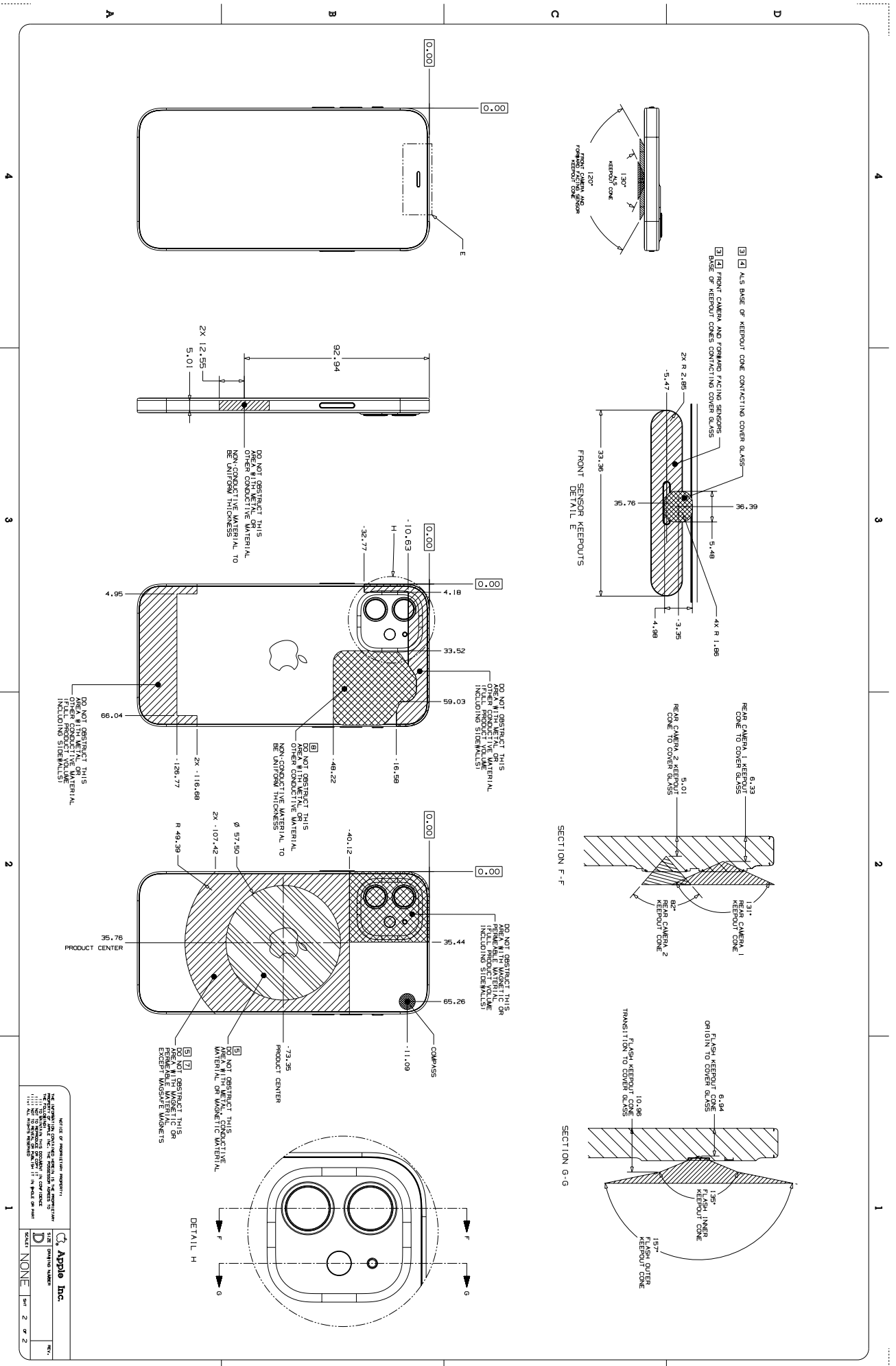
NOTES (UNLESS OTHERWISE SPECIFIED)

- 1 NO METAL CONTACT WITH IPHONE.
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- 3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERAS, REAR FLASH.
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- 8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 2.1 mm MAX TO ENSURE FULL FUNCTIONALITY.



METRIC		Apple Inc.	
DATE	10/9/20	REVISED	10/9/20
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© Apple Inc.			
iPhone 12 Pro			
SCALE NONE			
SHEET 1 OF 2			

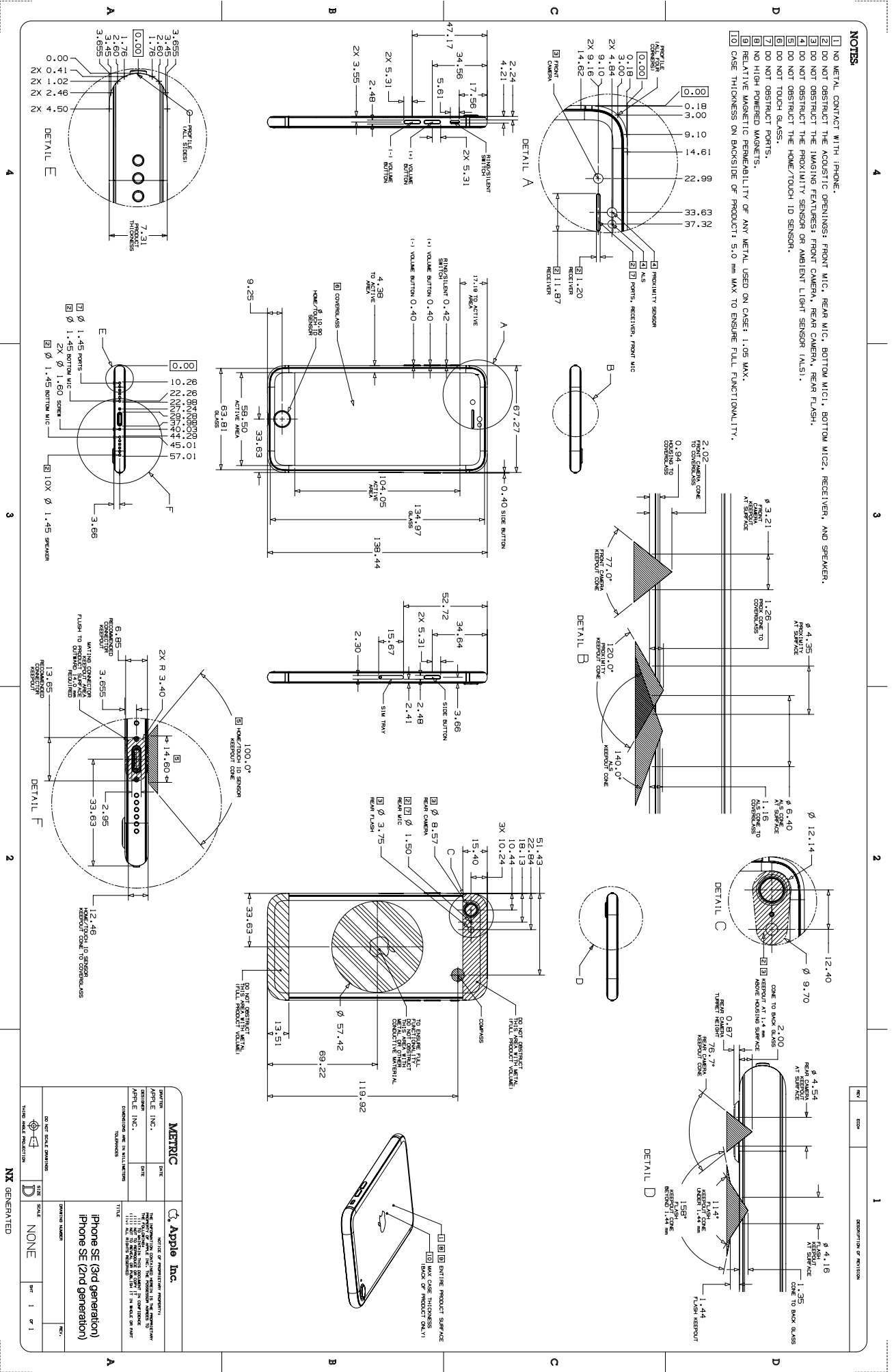
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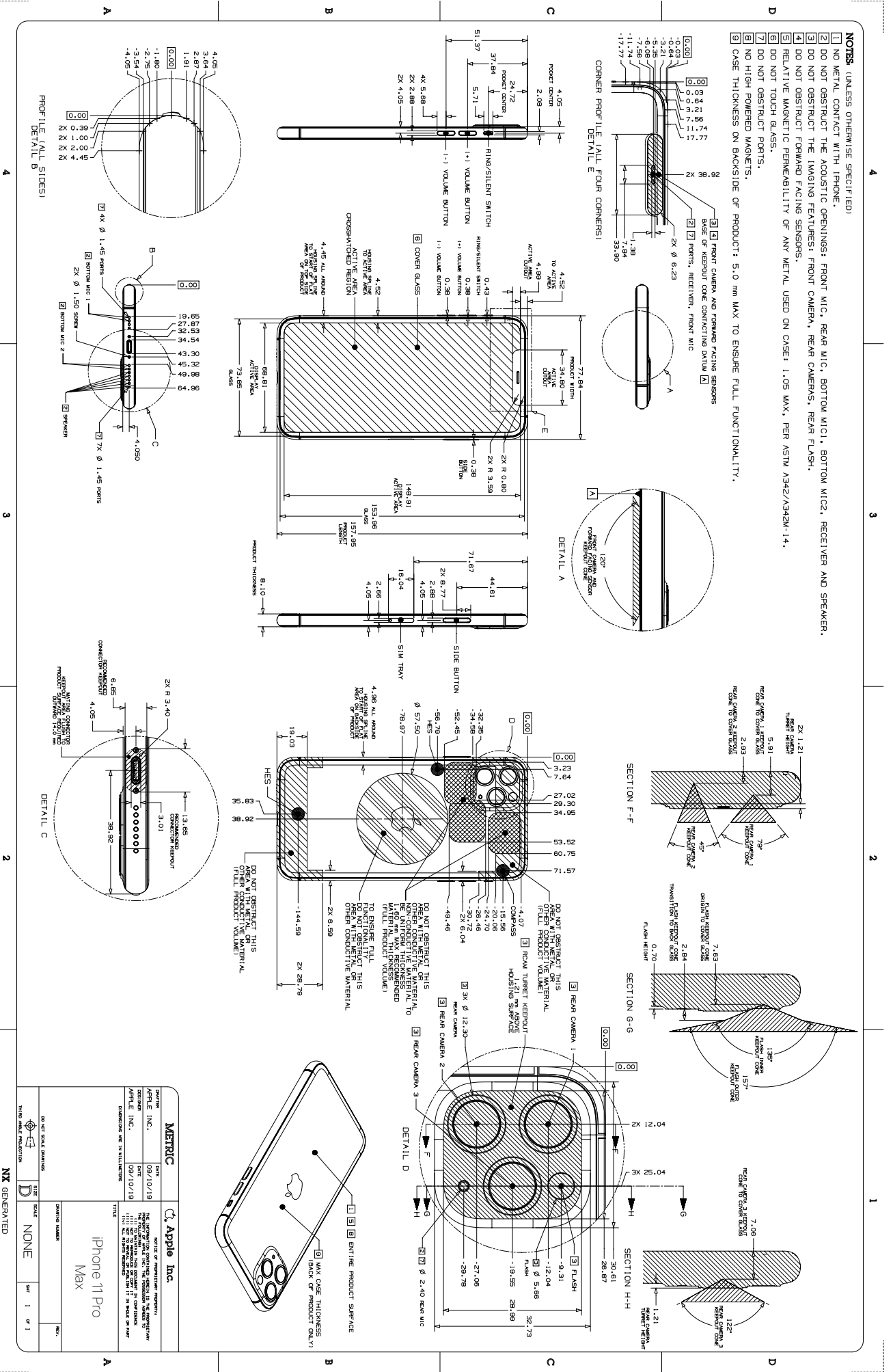
VIEW OF MANUFACTURING DIMENSIONS
ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED IN MILLIMETERS
DIMENSIONS IN PARENTHESIS ARE FOR INFORMATION ONLY
DIMENSIONS IN PARENTHESIS ARE NOT TO BE USED FOR MANUFACTURING
DIMENSIONS IN PARENTHESIS ARE FOR INFORMATION ONLY
DIMENSIONS IN PARENTHESIS ARE NOT TO BE USED FOR MANUFACTURING

Apple Inc.
Engineering Division
Product Design
Product: iPhone 12
Sheet: 2 of 2

56.41 iPhone SE (3rd generation) and iPhone SE (2nd generation)

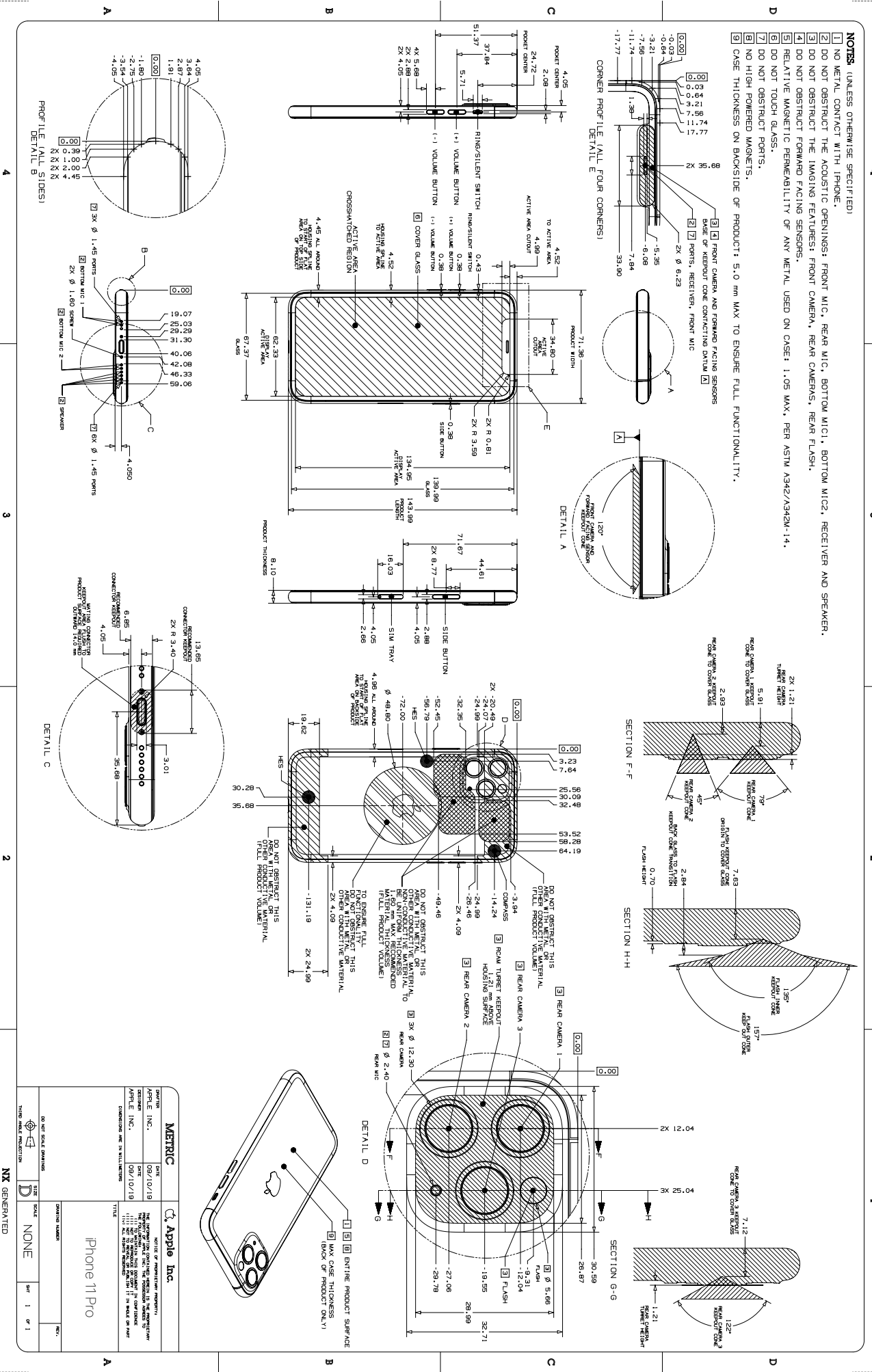


56.42 iPhone 11 Pro Max



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 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.



METRIC		Apple Inc.	
DATE	DESCRIPTION	DATE	DESCRIPTION
09/10/18	REVISION 1	09/10/18	REVISION 1
09/10/18	REVISION 2	09/10/18	REVISION 2
09/10/18	REVISION 3	09/10/18	REVISION 3
09/10/18	REVISION 4	09/10/18	REVISION 4
09/10/18	REVISION 5	09/10/18	REVISION 5
09/10/18	REVISION 6	09/10/18	REVISION 6
09/10/18	REVISION 7	09/10/18	REVISION 7
09/10/18	REVISION 8	09/10/18	REVISION 8
09/10/18	REVISION 9	09/10/18	REVISION 9
09/10/18	REVISION 10	09/10/18	REVISION 10

iPhone 11 Pro

DO NOT SCALE DIMENSIONS

SCALE: NONE

REV: 1 OF 1

DATE: 09/10/18

DESCRIPTION: iPhone 11 Pro Case

DESIGNED BY: [Name]

ENGINEERED BY: [Name]

APPROVED BY: [Name]

DATE: 09/10/18

SCALE: NONE

REV: 1 OF 1

DATE: 09/10/18

DESCRIPTION: iPhone 11 Pro Case

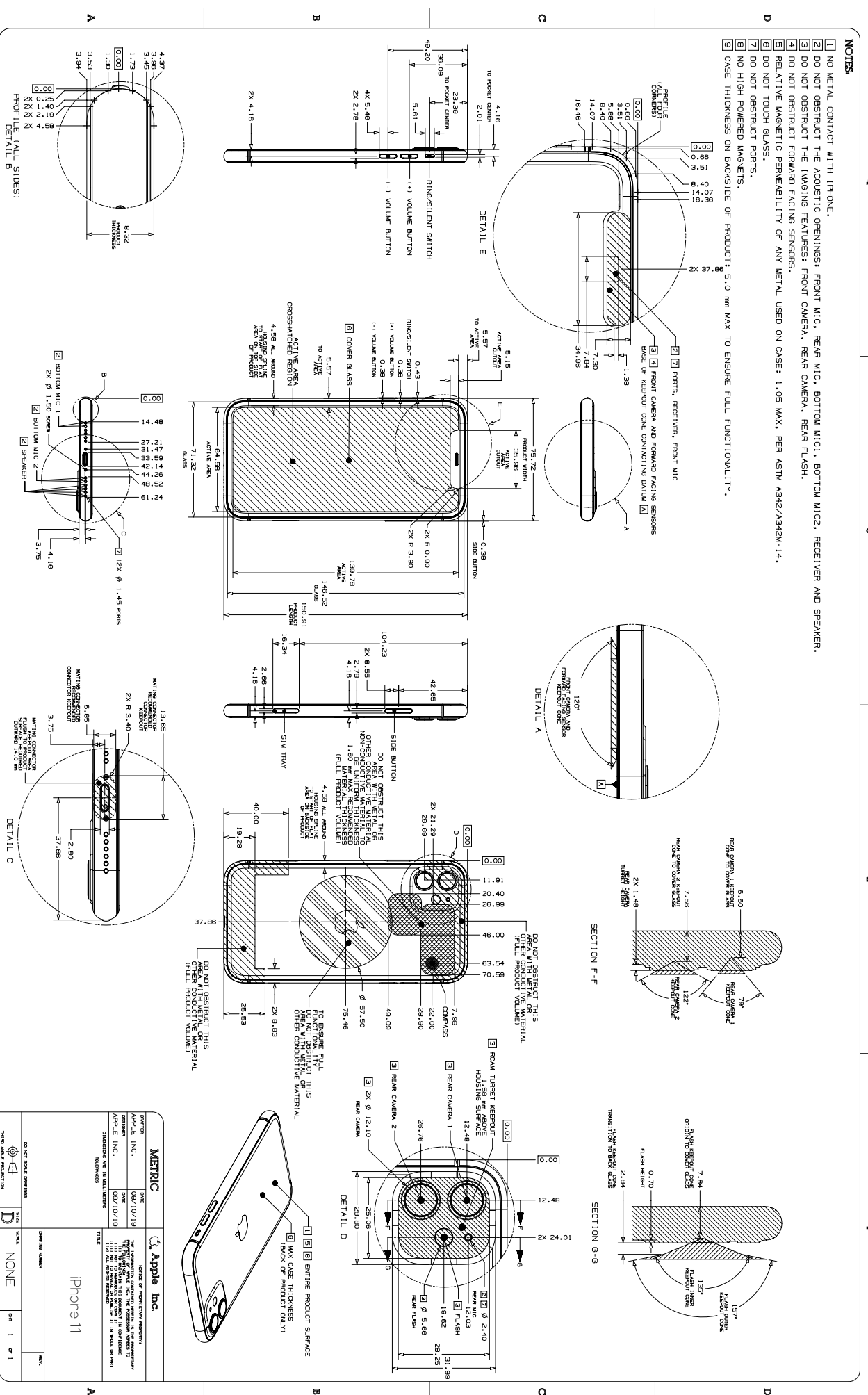
DESIGNED BY: [Name]

ENGINEERED BY: [Name]

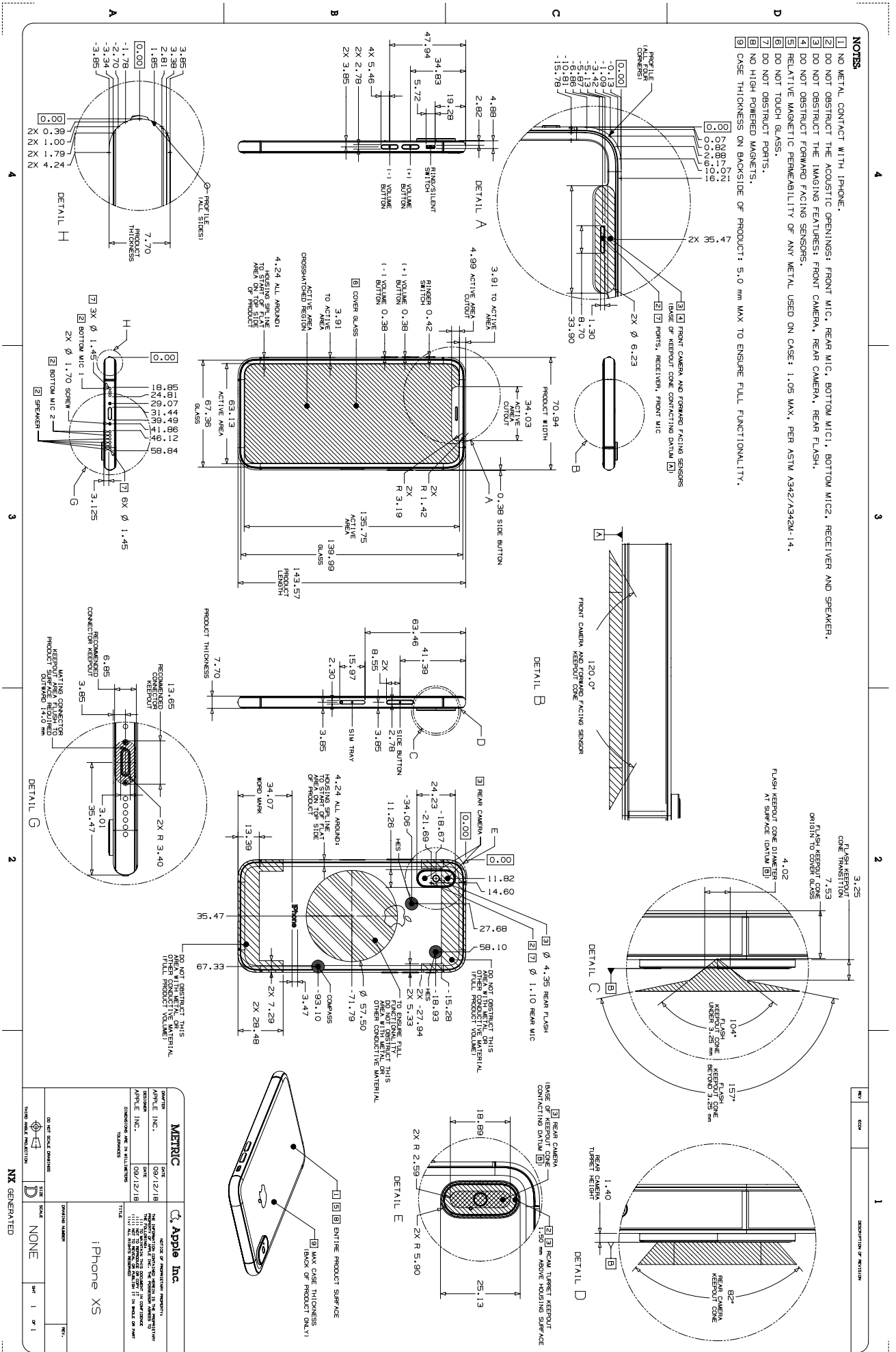
APPROVED BY: [Name]

NOTES:

- 1 NO METAL CONTACT WITH IPHONE.
- 2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, 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 TOUGH 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.



METRIC		Apple Inc.	
DATE	DATE	REV	REV
09/10/18	09/10/18	1	1
09/10/18	09/10/18	2	2
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iPhone 11			
<small> DO NOT SCALE DIMENSIONS DIMENSIONS ARE TO UNLESS NOTED OTHERWISE </small>		<small> DRAWING NUMBER: NONE SHEET: 1 OF 1 </small>	



NOTES:

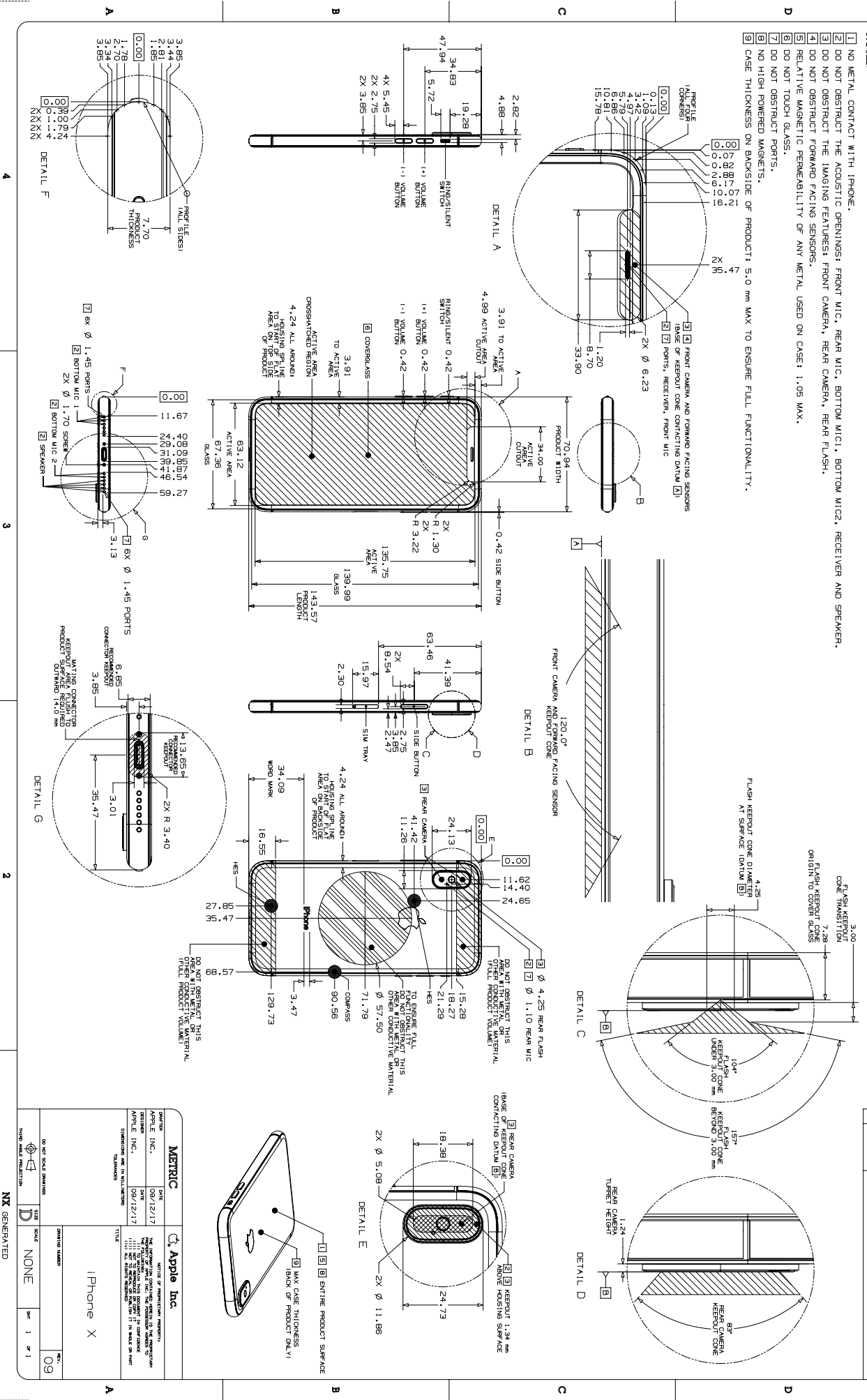
- 1 NO METAL CONTACT WITH IPHONE.
- 2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC1, BOTTOM MIC2, RECEIVER AND SPEAKER.
- 3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
- 4 DO NOT OBSTRUCT FORWARD FACING SENSORS.
- 5 RELATIVE MAGNETIC PERMEABILITY 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.

REV	CD	DESCRIPTION OF REVISION
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2		
3		
4		

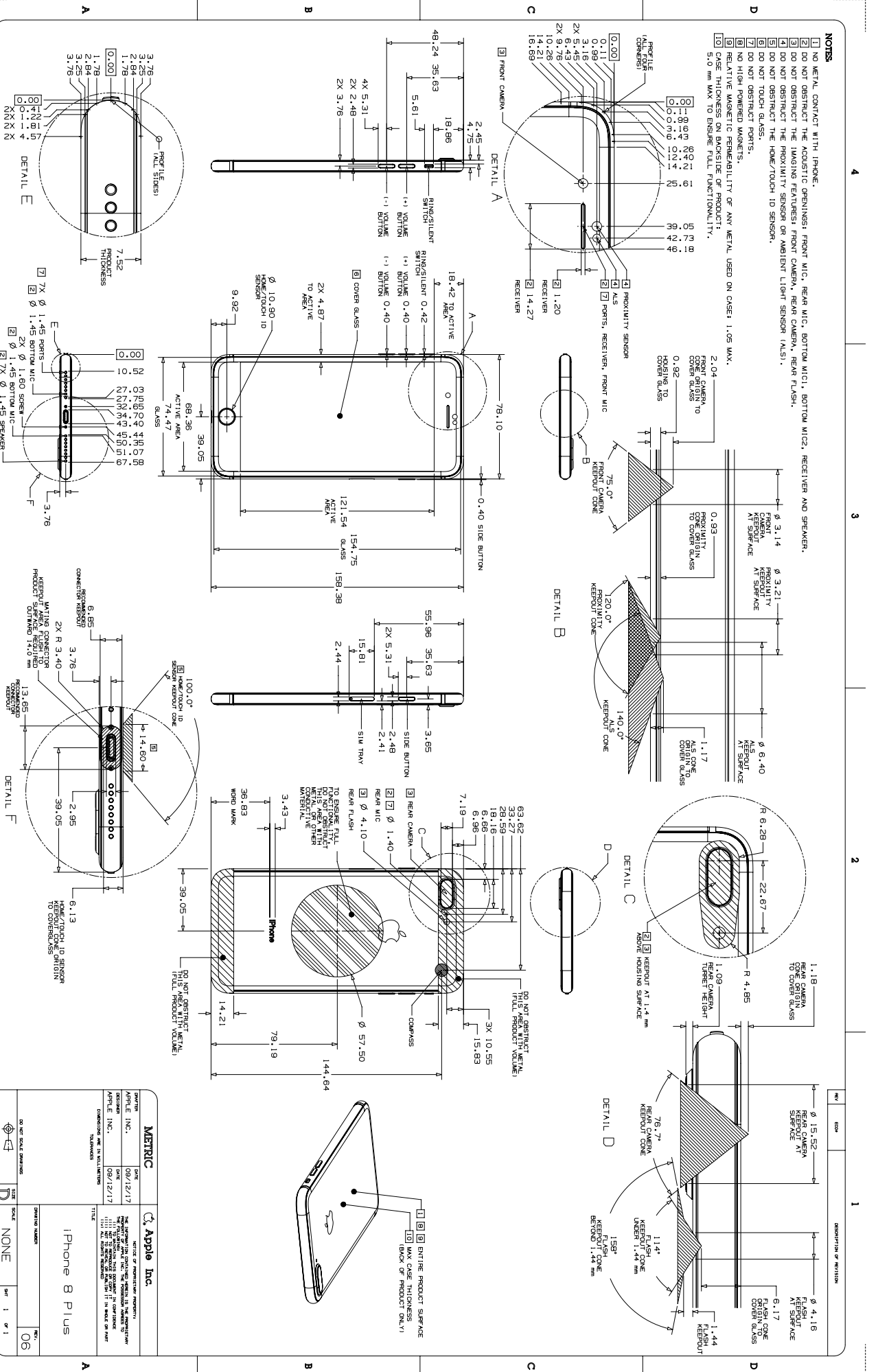
METRIC DATE: 09/12/18 DESIGNER: APPLE INC. DRAWING NO: 56.46 TITLE: iPhone XS DRAWING NUMBER: NONE SHEET NUMBER: 1 OF 1	Apple Inc. THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF APPLE INC. IT IS TO BE USED ONLY FOR THE PURPOSES SPECIFIED AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM APPLE INC. © 2018 APPLE INC. ALL RIGHTS RESERVED.
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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 MIC, 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 OBSTRUCT PORTS.
- 7 NO HIGH POWERED MAGNETS.
- 8 CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.



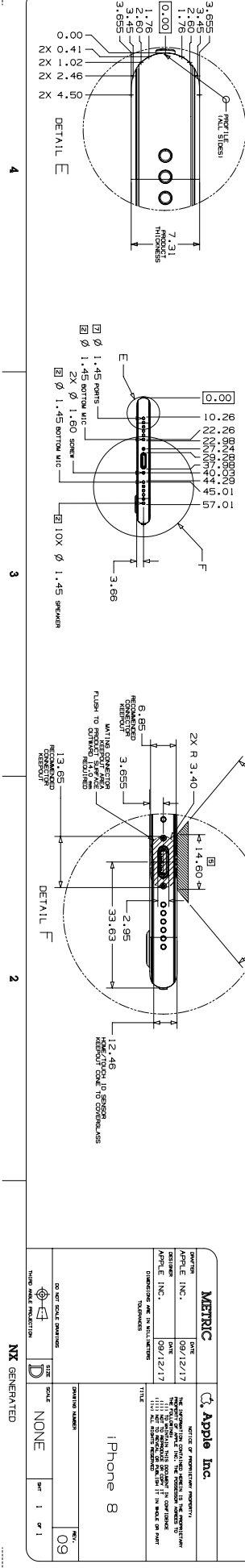
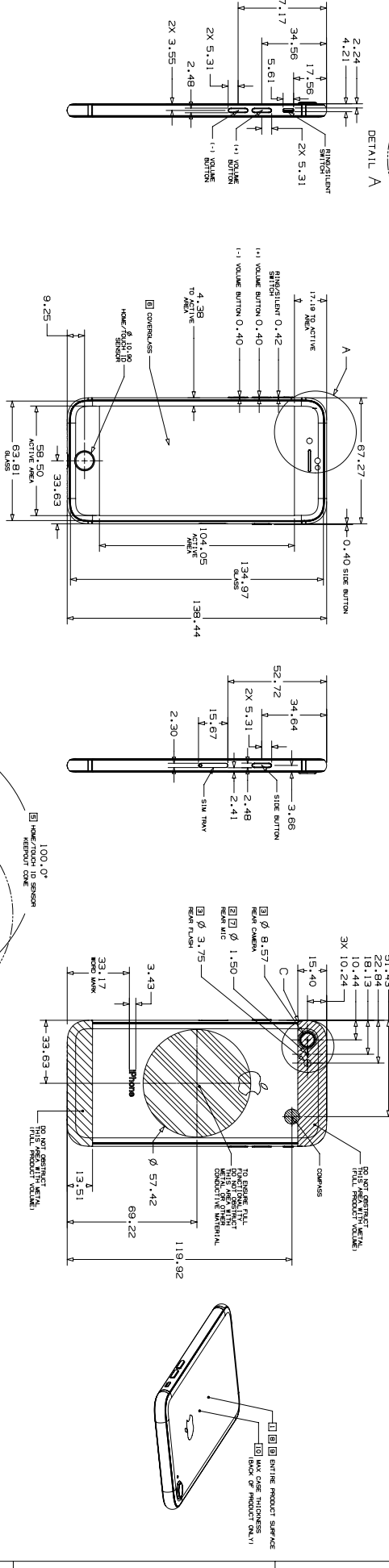
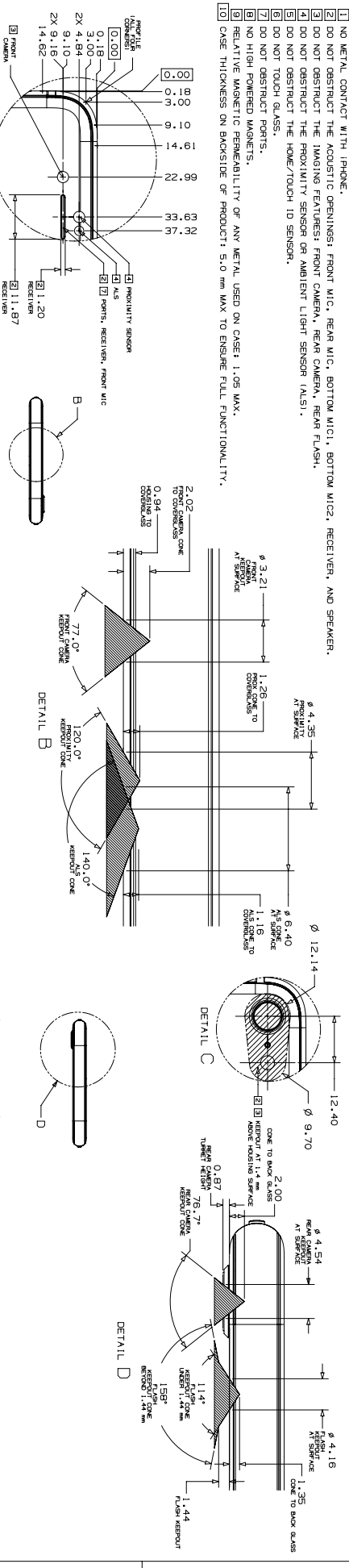
56.49 iPhone 8 Plus



NO.	ECO	DESCRIPTION OF REVISION
1		<p>1 15.52 REAR CAMERA KEYPURF AT SURFACE</p> <p>2 4.16 KEYPURF AT SURFACE</p> <p>3 6.17 FLASH CONE ORIGIN GLASS</p> <p>4 1.44 KEYPURF</p> <p>5 11.4° KEYPURF UNDER 1.44 mm</p> <p>6 1.44 KEYPURF</p> <p>7 1.44° KEYPURF</p> <p>8 1.44° KEYPURF</p> <p>9 1.44° KEYPURF</p>
2		<p>1 4.16 REAR CAMERA KEYPURF AT SURFACE</p> <p>2 1.44 KEYPURF</p> <p>3 1.44° KEYPURF</p> <p>4 1.44° KEYPURF</p> <p>5 1.44° KEYPURF</p> <p>6 1.44° KEYPURF</p> <p>7 1.44° KEYPURF</p> <p>8 1.44° KEYPURF</p> <p>9 1.44° KEYPURF</p> <p>10 1.44° KEYPURF</p>
3		<p>1 4.16 REAR CAMERA KEYPURF AT SURFACE</p> <p>2 1.44 KEYPURF</p> <p>3 1.44° KEYPURF</p> <p>4 1.44° KEYPURF</p> <p>5 1.44° KEYPURF</p> <p>6 1.44° KEYPURF</p> <p>7 1.44° KEYPURF</p> <p>8 1.44° KEYPURF</p> <p>9 1.44° KEYPURF</p> <p>10 1.44° KEYPURF</p>
4		<p>1 4.16 REAR CAMERA KEYPURF AT SURFACE</p> <p>2 1.44 KEYPURF</p> <p>3 1.44° KEYPURF</p> <p>4 1.44° KEYPURF</p> <p>5 1.44° KEYPURF</p> <p>6 1.44° KEYPURF</p> <p>7 1.44° KEYPURF</p> <p>8 1.44° KEYPURF</p> <p>9 1.44° KEYPURF</p> <p>10 1.44° KEYPURF</p>

METRIC			Apple Inc.		
DATE	09/12/17		DATE	09/12/17	
DESIGNED BY	Apple Inc. - Mechanical		DESIGNED BY	Apple Inc. - Mechanical	
DRAWN BY	Apple Inc. - Mechanical		DRAWN BY	Apple Inc. - Mechanical	
CHECKED BY	Apple Inc. - Mechanical		CHECKED BY	Apple Inc. - Mechanical	
TITLE	iPhone 8 Plus		TITLE	iPhone 8 Plus	
SCALE	NONE		SCALE	NONE	
NO. OF SHEETS	1		NO. OF SHEETS	1	
TOTAL SHEETS	1		TOTAL SHEETS	1	
DATE	09/12/17		DATE	09/12/17	
DESIGNED BY	Apple Inc. - Mechanical		DESIGNED BY	Apple Inc. - Mechanical	
DRAWN BY	Apple Inc. - Mechanical		DRAWN BY	Apple Inc. - Mechanical	
CHECKED BY	Apple Inc. - Mechanical		CHECKED BY	Apple Inc. - Mechanical	

- NOTES:**
- 1 NO METAL CONTACT WITH IPHONE.
 - 2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS; FRONT MIC, REAR MIC, 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 TOUCH GLASS.
 - 6 DO NOT OBSTRUCT PORTS.
 - 7 NO HIGH POWERED MAGNETS.
 - 8 RELATIVE MAGNETIC PERMEABILITY OF ANY METAL USED ON CASE: 1.05 MAX.
 - 9 CASE THICKNESS ON BACKSIDE OF PRODUCT: 5.0 mm MAX TO ENSURE FULL FUNCTIONALITY.
 - 10



REV	ECO	DESCRIPTION OF REVISION
1		

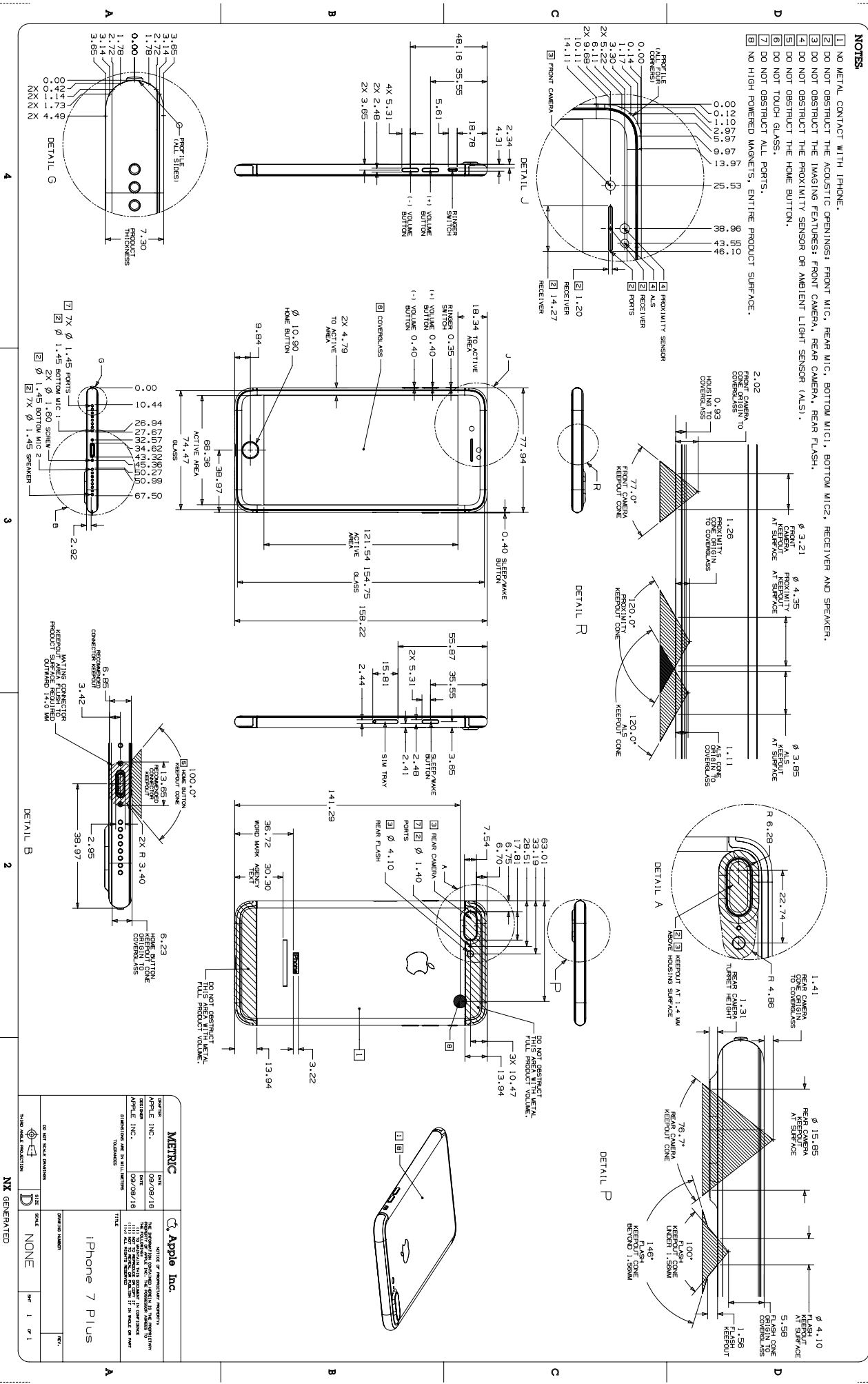
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NX GENERATED

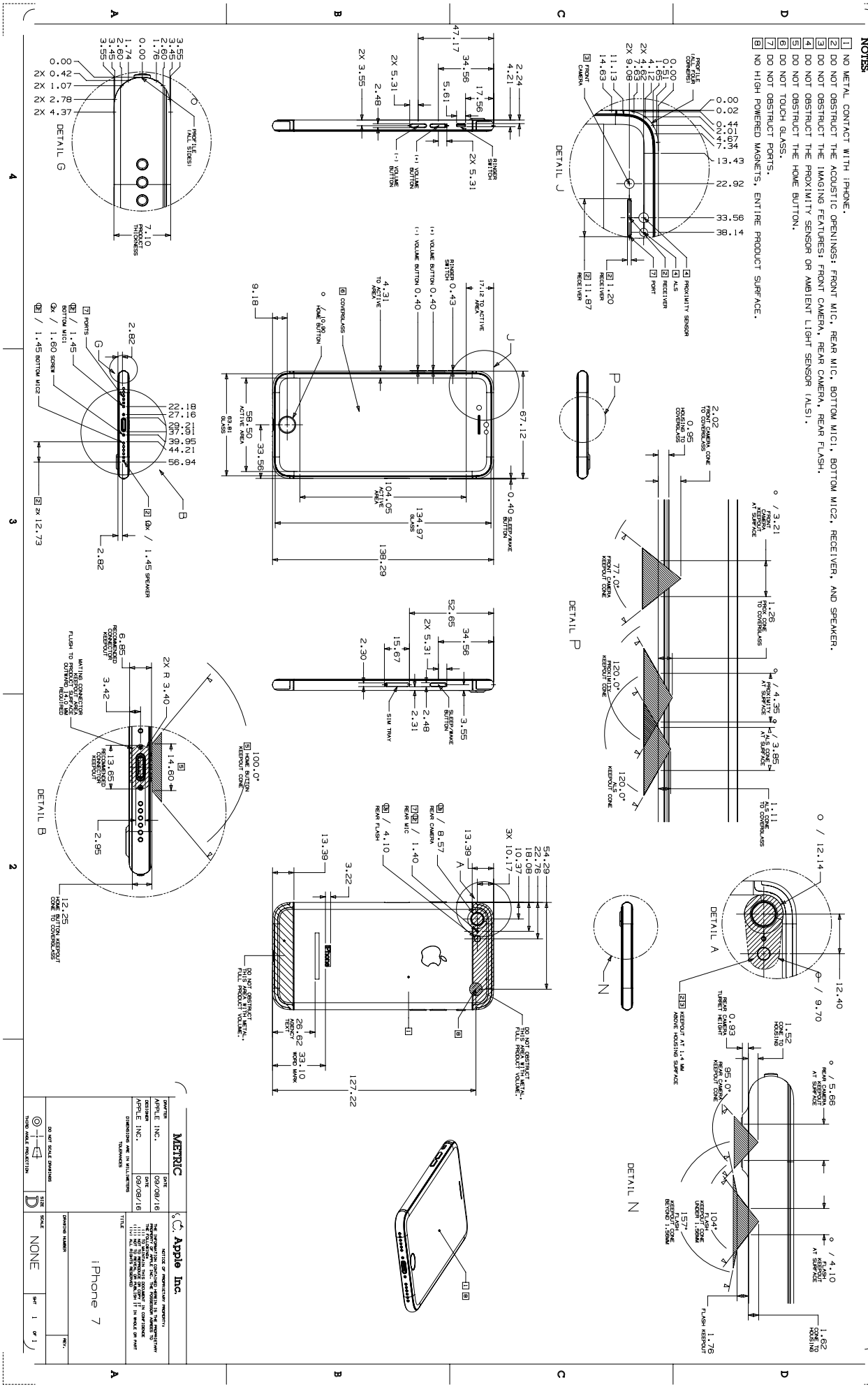
NOTES:

- 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 ALL PORTS.
- 8 NO HIGH POWERED MAGNETS, ENTIRE PRODUCT SURFACE.



METRIC		Apple Inc.	
DATE	09/08/18	REVISION	09/08/18
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DRAWN BY: [Name]		CHECKED BY: [Name]	
SCALE: NONE		SHEET: 1 OF 1	
<p>iPhone 7 Plus</p>			

- 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 TOUCH GLASS.
 - 6 DO NOT OBSTRUCT THE HOME BUTTON.
 - 7 DO NOT OBSTRUCT PORTS.
 - 8 NO HIGH POWERED MAGNETS, ENTIRE PRODUCT SURFACE.

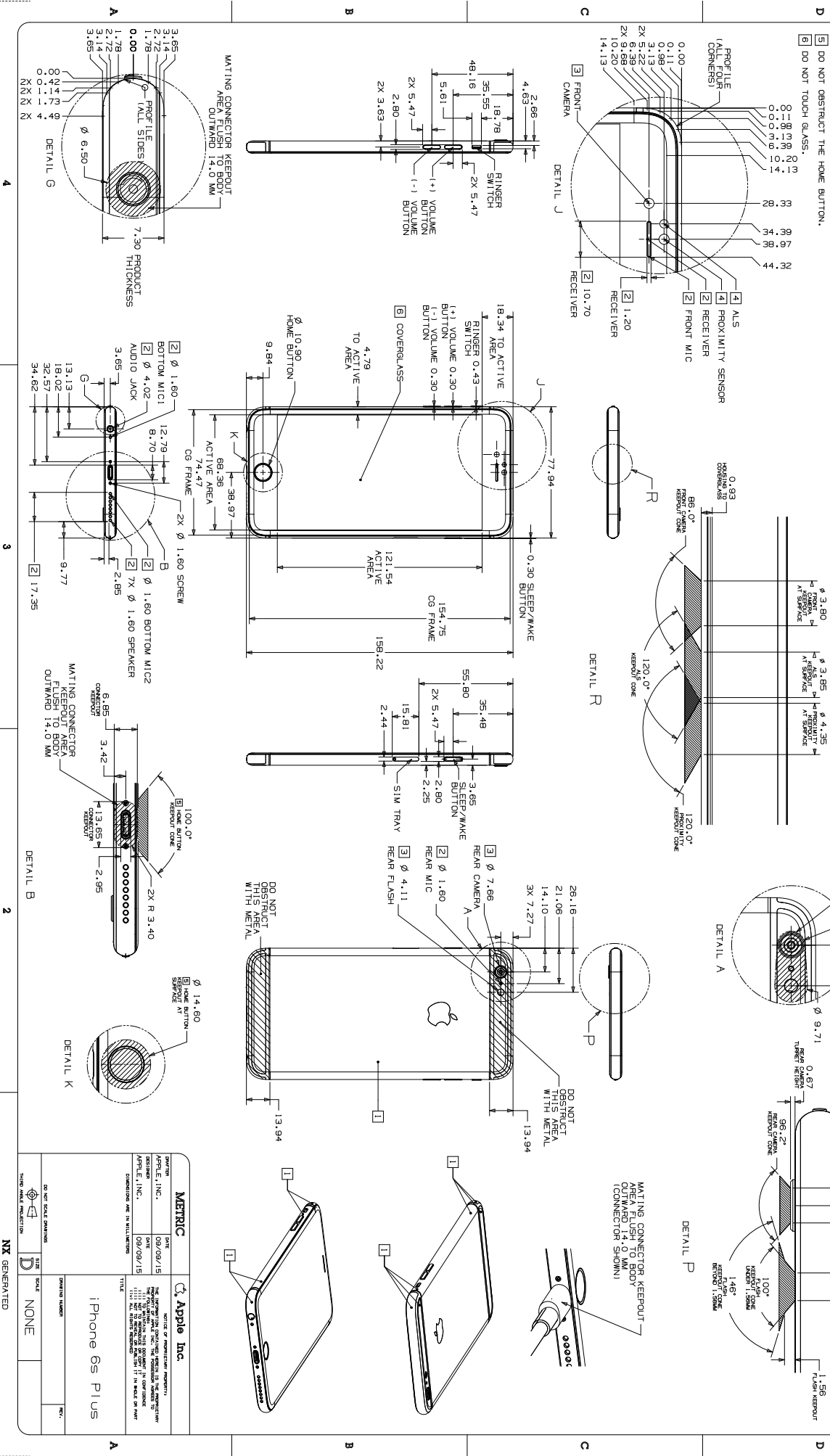


METRIC		Apple Inc.	
DATE	09/08/18	DATE	09/08/18
APPROVED BY	[Signature]	DATE	09/08/18
DESIGNED BY	[Signature]	DATE	09/08/18
TITLE iPhone 7			
SCALE NONE			
SHEET NUMBER 1 OF 1			

56.53 iPhone 6s Plus

NOTES:

- 1 NO METAL CONTACT WITH ANY IPHONE METAL.
- 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.

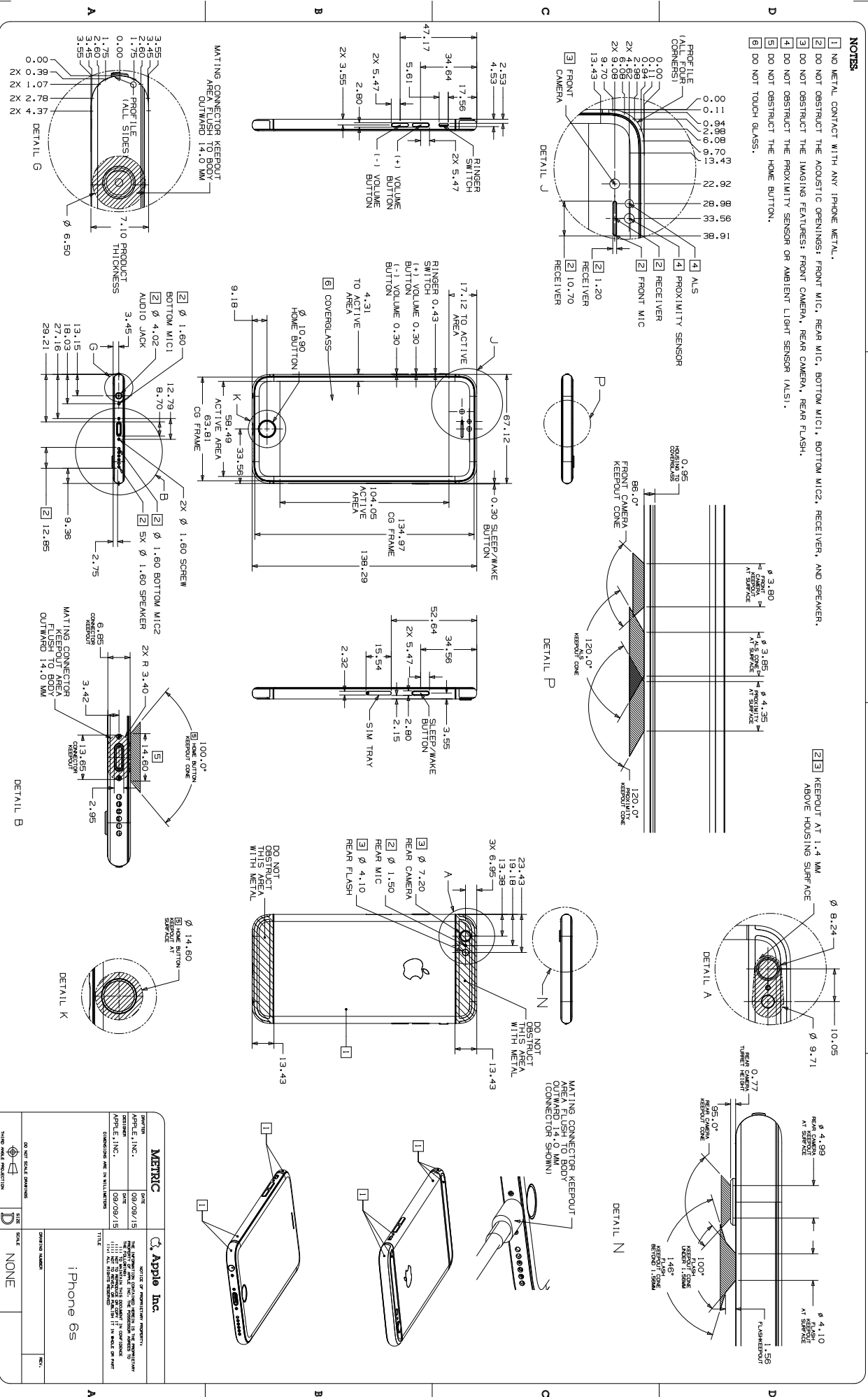


METRIC		Apple Inc.	
DATE	DATE	SCALE	REV.
09/08/15	09/08/15	NONE	
DESIGNED BY	APRILE, INC.	VOICE OF THE CUSTOMER (VOC)	
DATE	09/08/15	THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF APPLE INC. AND IS TO BE USED ONLY FOR THE PURPOSES SPECIFIED HEREIN. IT IS TO BE KEPT CONFIDENTIAL AND NOT TO BE DISCLOSED TO ANY OTHER PARTY WITHOUT THE WRITTEN PERMISSION OF APPLE INC.	
DRAWING NO.	56.53	TITLE	
		iPhone 6s Plus	

NOTES:

- 1 DO NOT METAL CONTACT WITH ANY IPHONE METAL.
- 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.

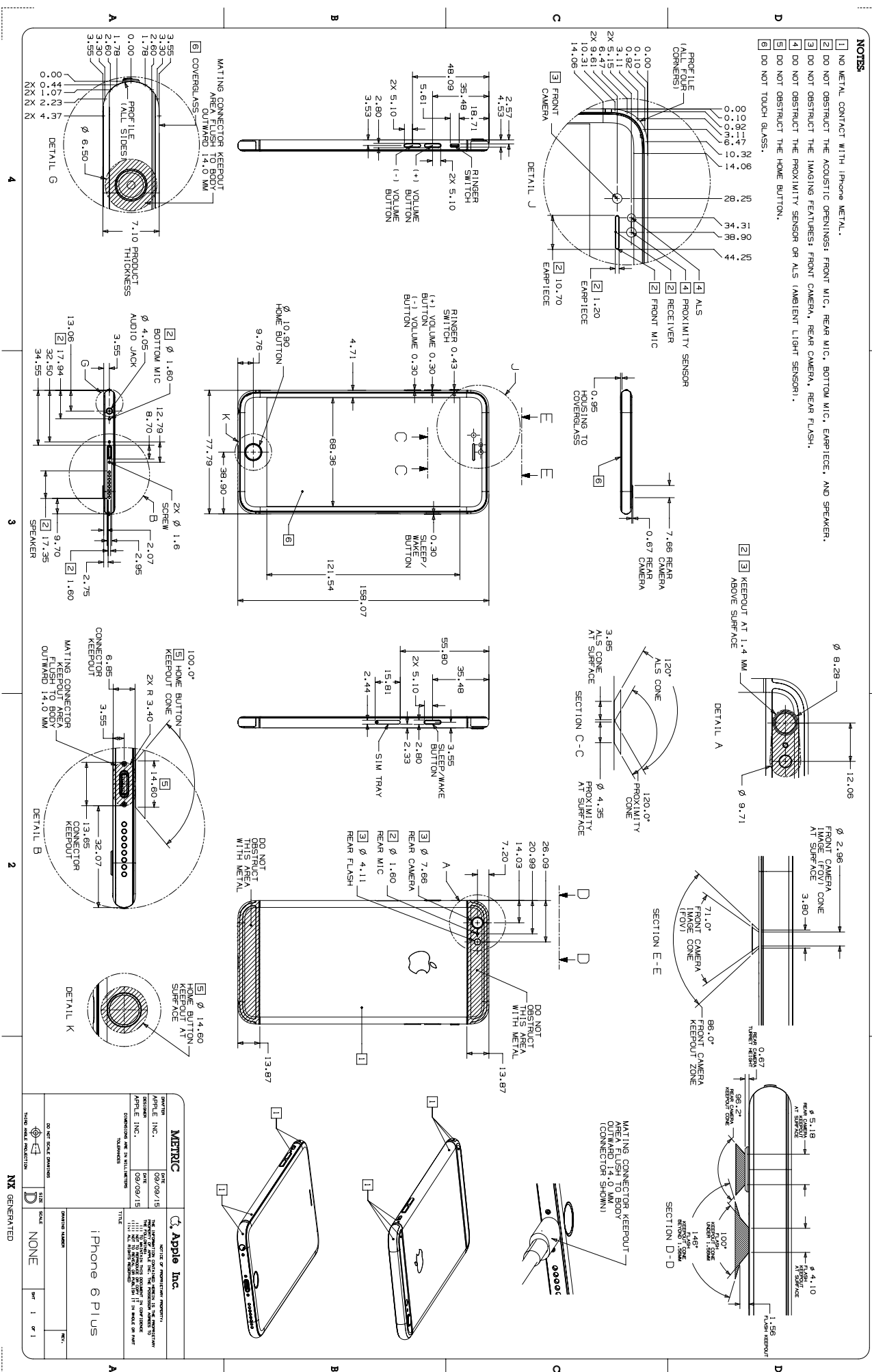
23 KEYPOUNT AT 1.4 MM ABOVE HOUSING SURFACE



METRIC		Apple Inc.	
DATE	09/09/15	DESIGNED BY	Apple Inc.
DESIGNED BY	Apple Inc.	DATE	09/09/15
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<small>CHANGING AND IN WILLIAMS</small>		<small>DO NOT SCALE DIMENSIONS</small>	
<small>TITLE</small>		<small>SCALE</small>	
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<small>DRAWING NUMBER</small>		<small>REV.</small>	
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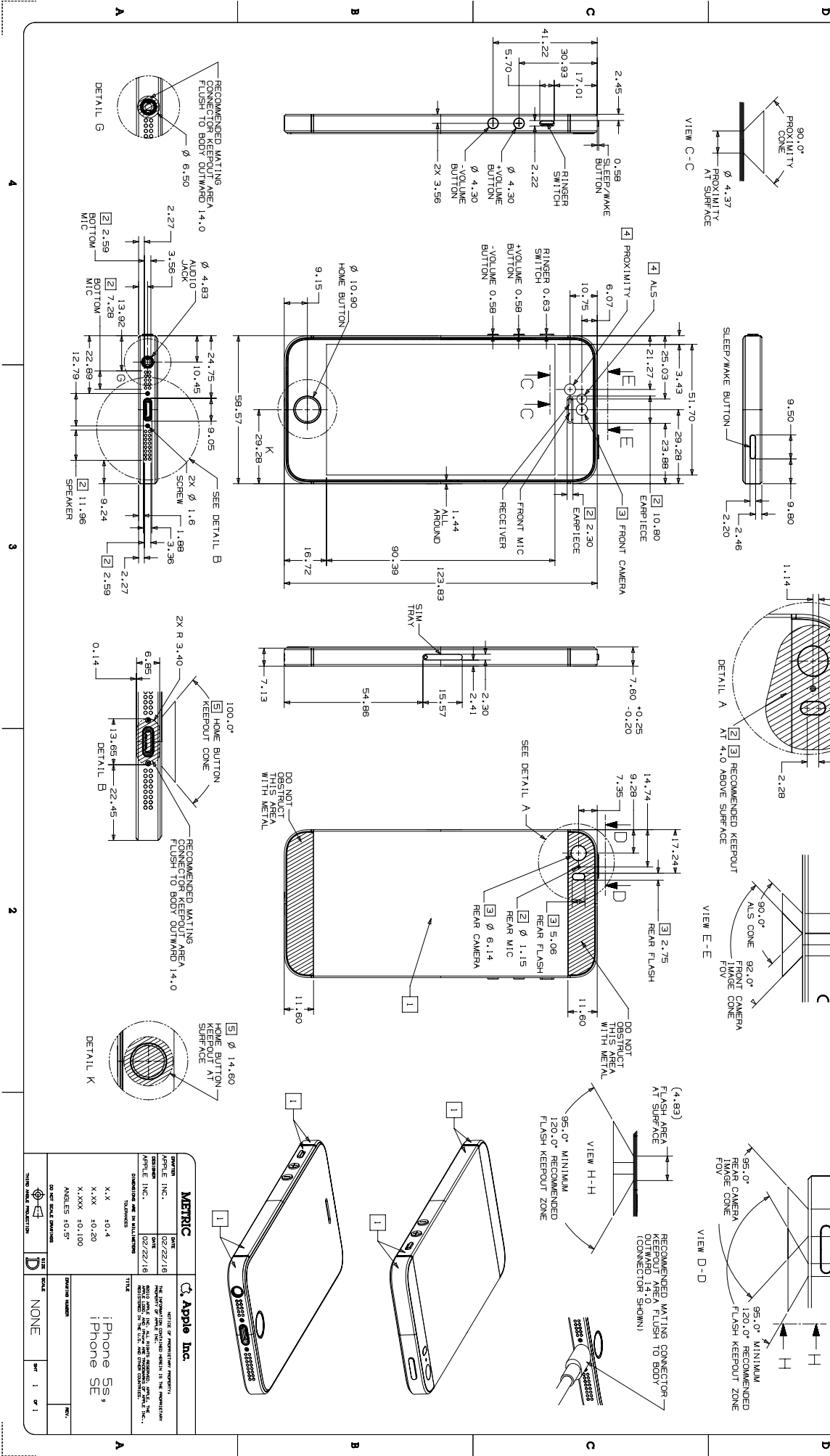
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- NOTES**
- 1 NO METAL CONTACT WITH iPhone METAL.
 - 2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR MIC, BOTTOM MIC, EARPIECE, AND SPEAKER.
 - 3 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH.
 - 4 DO NOT OBSTRUCT THE PROXIMITY SENSOR OR ALS (AMBIENT LIGHT SENSOR).
 - 5 DO NOT OBSTRUCT THE HOME BUTTON.
 - 6 DO NOT TOUCH GLASS.

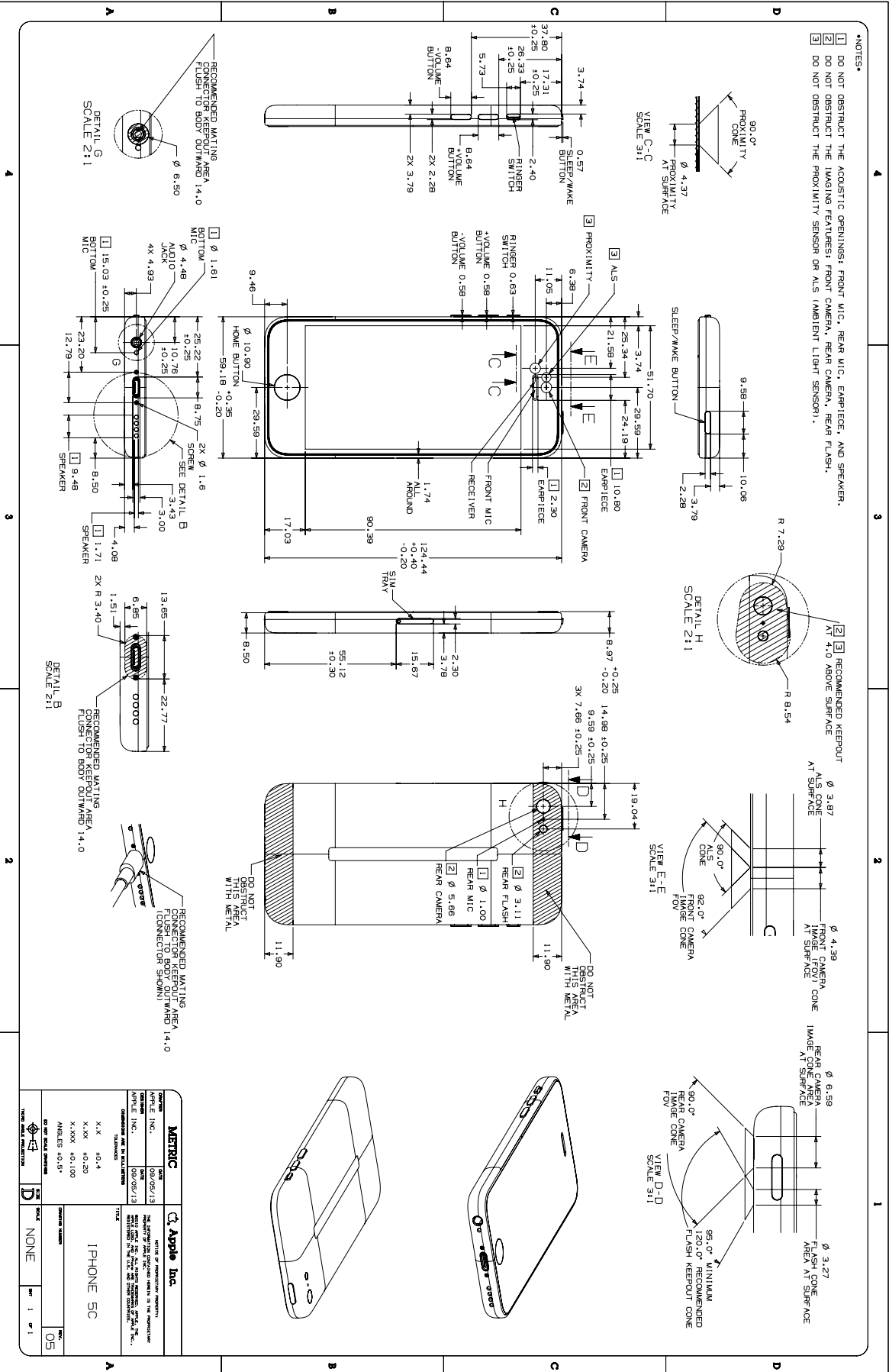


56.57 iPhone 5s and iPhone SE

- *NOTES**
- 1 NO METAL CONTACT WITH IPHONE METAL.
 - 2 DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: FRONT MIC, REAR 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.



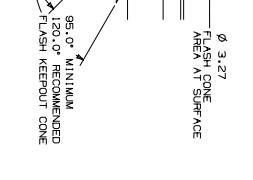
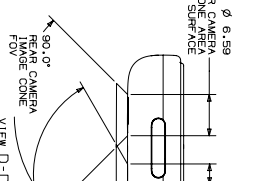
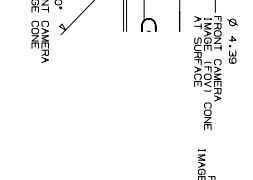
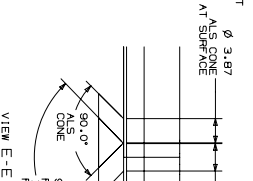
METRIC		DATE	
APPLICABLE INC.	02/22/16	DATE	02/22/16
APPLICABLE INC.	02/22/16	DATE	02/22/16
DRAWING MADE BY: [REDACTED]			
DRAWING CHECKED BY: [REDACTED]			
DRAWING APPROVED BY: [REDACTED]			
DRAWING REVISION			
TITLE		iPhone 5s, iPhone SE	
SCALE		NONE	
SHEET		1 of 1	



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).

2 3 RECOMMENDED KEEP-OUT AT 4.0 ABOVE SURFACE



RECOMMENDED MATING FLUSH TO BODY OUTWARD 14.0
DETAIL G SCALE 2:1

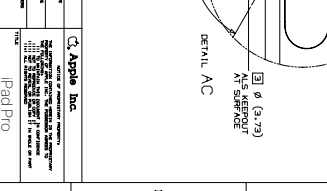
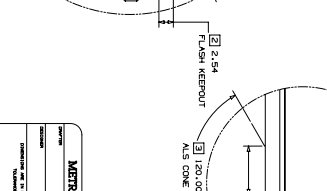
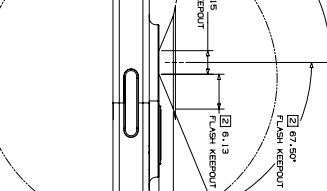
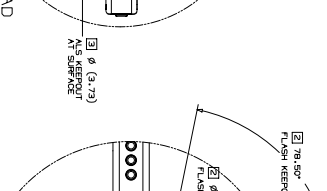
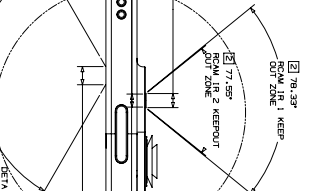
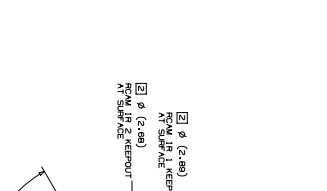
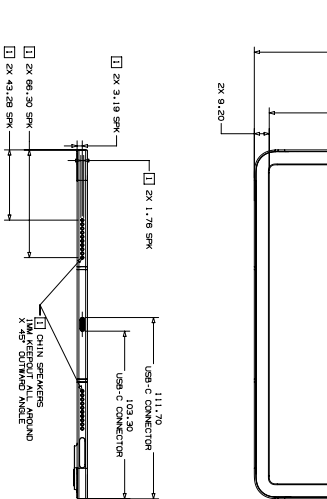
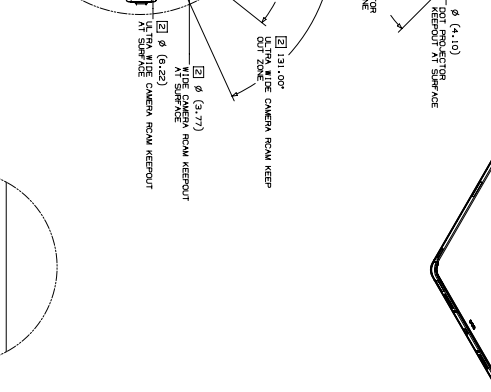
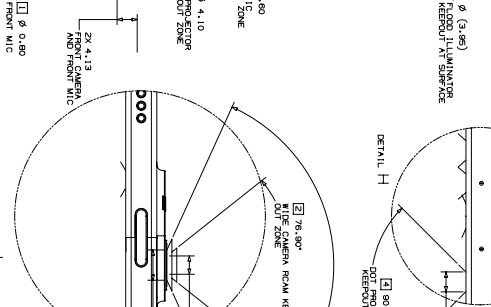
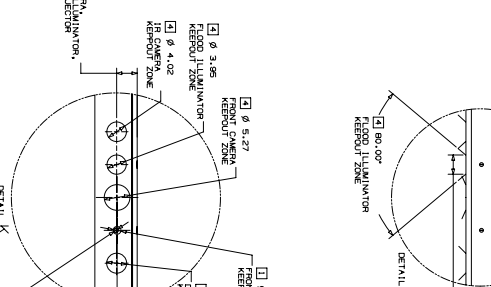
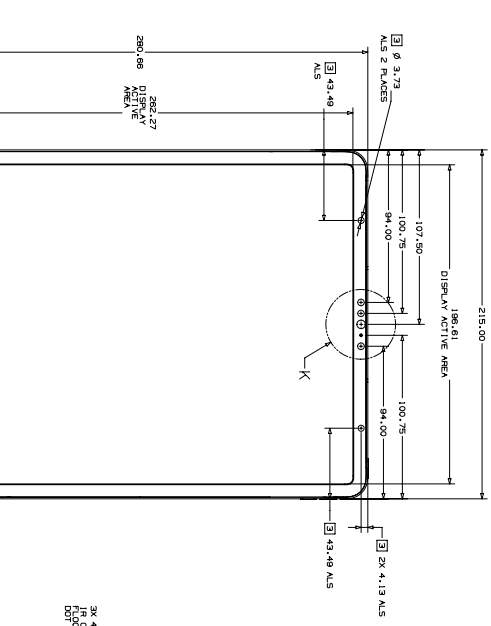
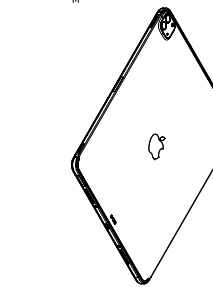
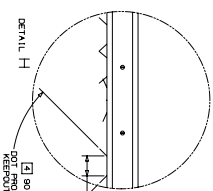
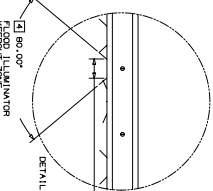
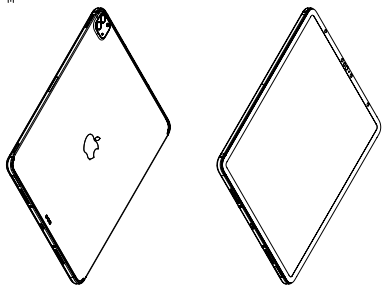
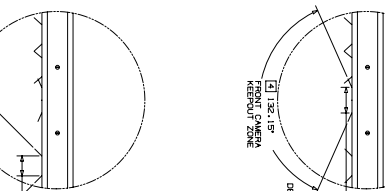
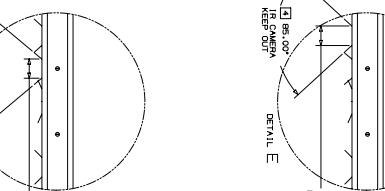
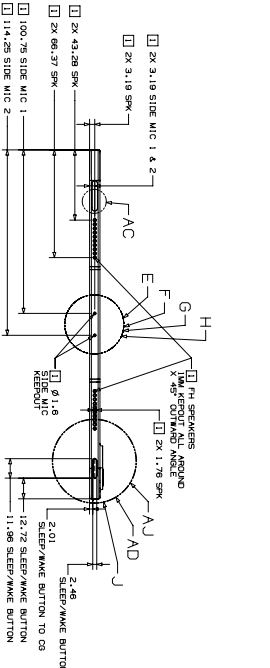
RECOMMENDED MATING FLUSH TO BODY OUTWARD 14.0
DETAIL H SCALE 2:1

RECOMMENDED MATING FLUSH TO BODY OUTWARD 14.0
DETAIL B SCALE 2:1

METRIC		Apple Inc.	
DRAWN	DATE	REVISED	DATE
J. J. W.	08/25/13		
CHECKED	DATE		
R. H. S.	08/28/13		
DESIGNED	DATE		
A. J. S.	08/28/13		
APPROVED	DATE		
J. J. W.	08/28/13		
TITLE			
IPHONE 5C			
PART NUMBER			
NONE			
REV			
05			

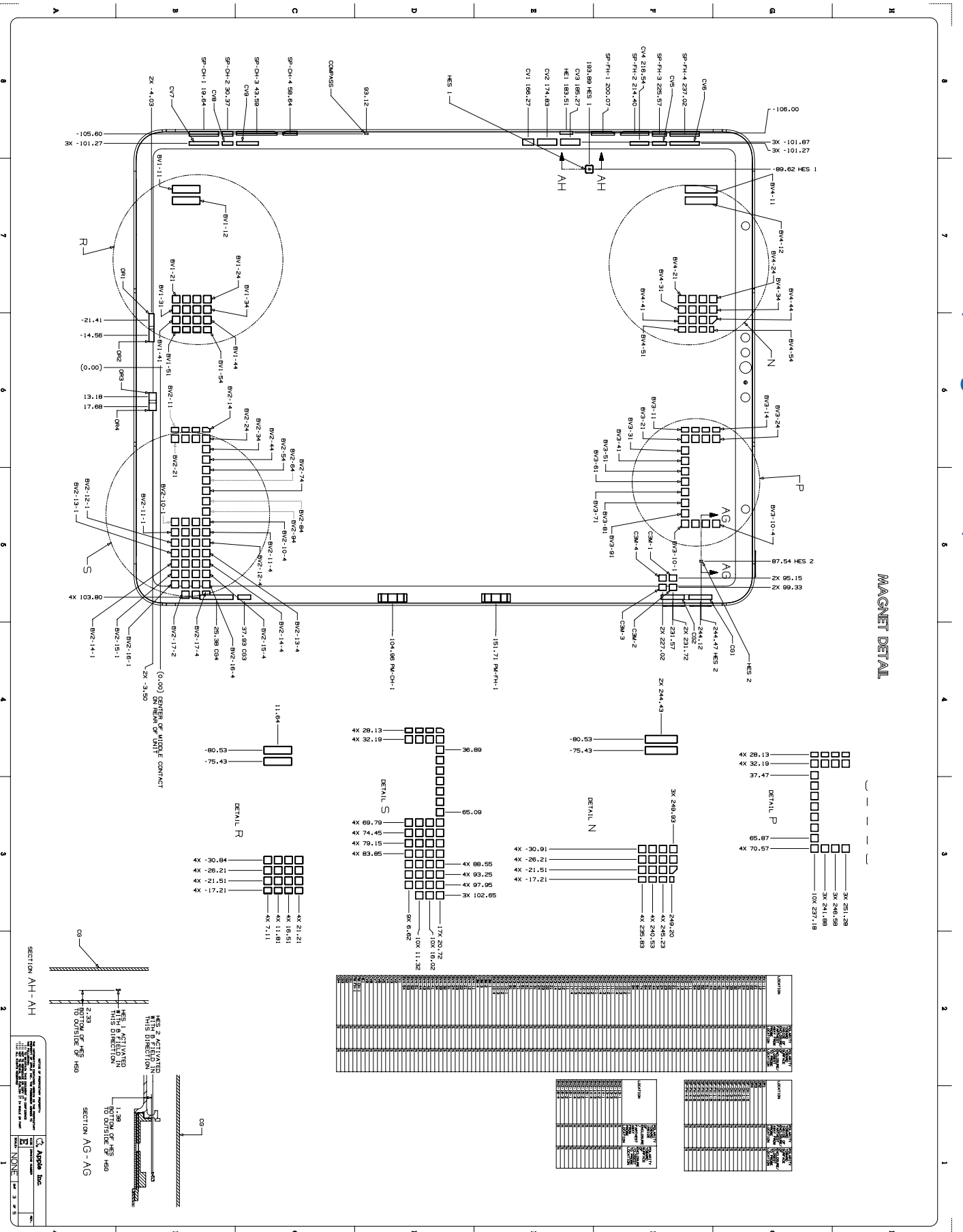
56.60 iPad Pro 12.9-inch (6th generation) 1 of 5

- NOTES** (UNLESS OTHERWISE SPECIFIED)
- 1 DO NOT OBSTRUCT ACOUSTIC PENETRATIONS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
 - 2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERAS
 - 3 DO NOT OBSTRUCT IR CAMERA, FLOOD ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
 - 4 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS

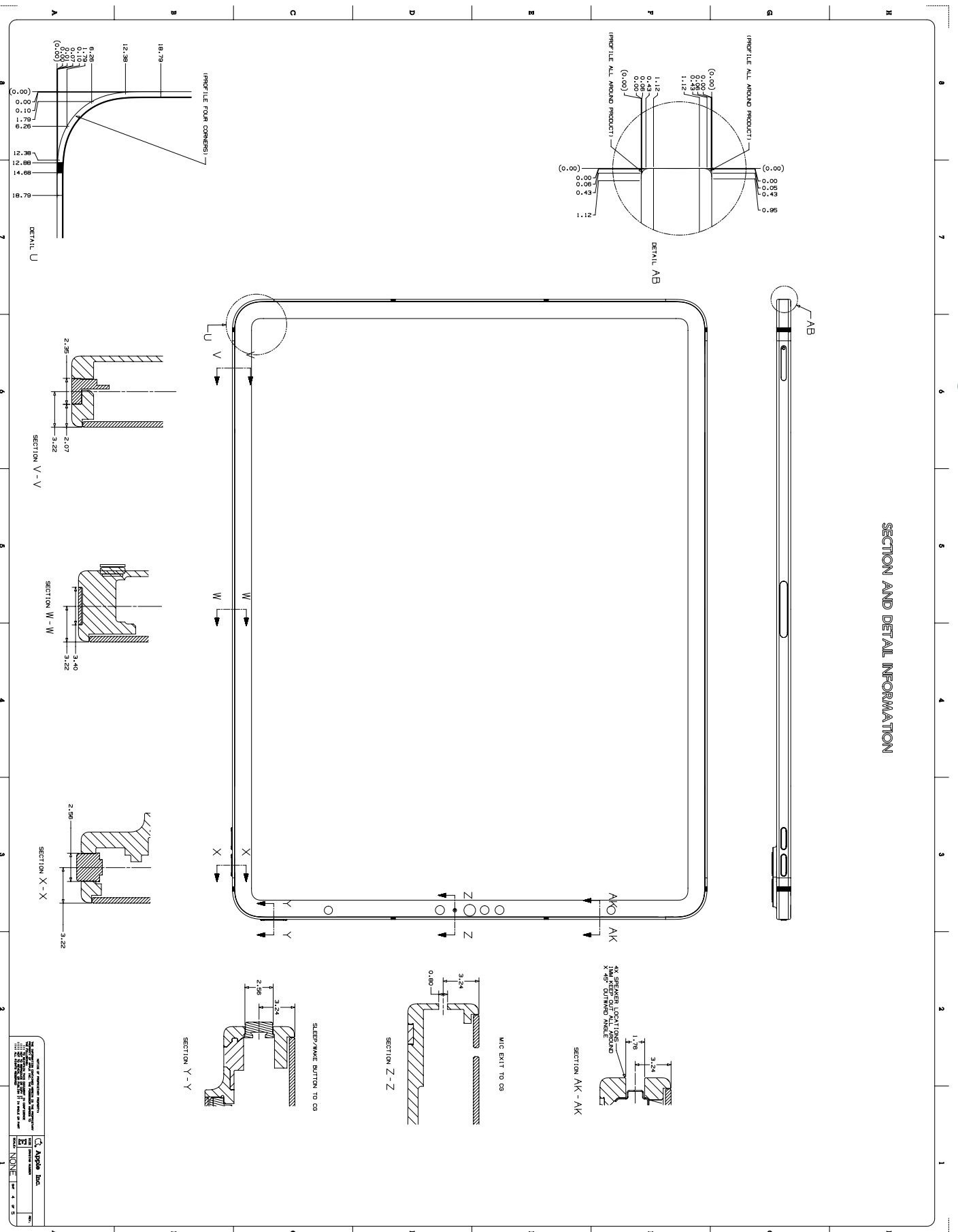


METRIC		Apple Inc.	
DATE	10/10/2023	DESIGN	56.60
REVISION	1	DESCRIPTION	56.60 iPad Pro 12.9-inch (6th generation)
APPROVED BY		DESIGNED BY	
CHECKED BY		MANUFACTURED BY	
DATE	10/10/2023	SCALE	NONE
AS SHOWN		NONE	
1 of 5		1 of 5	

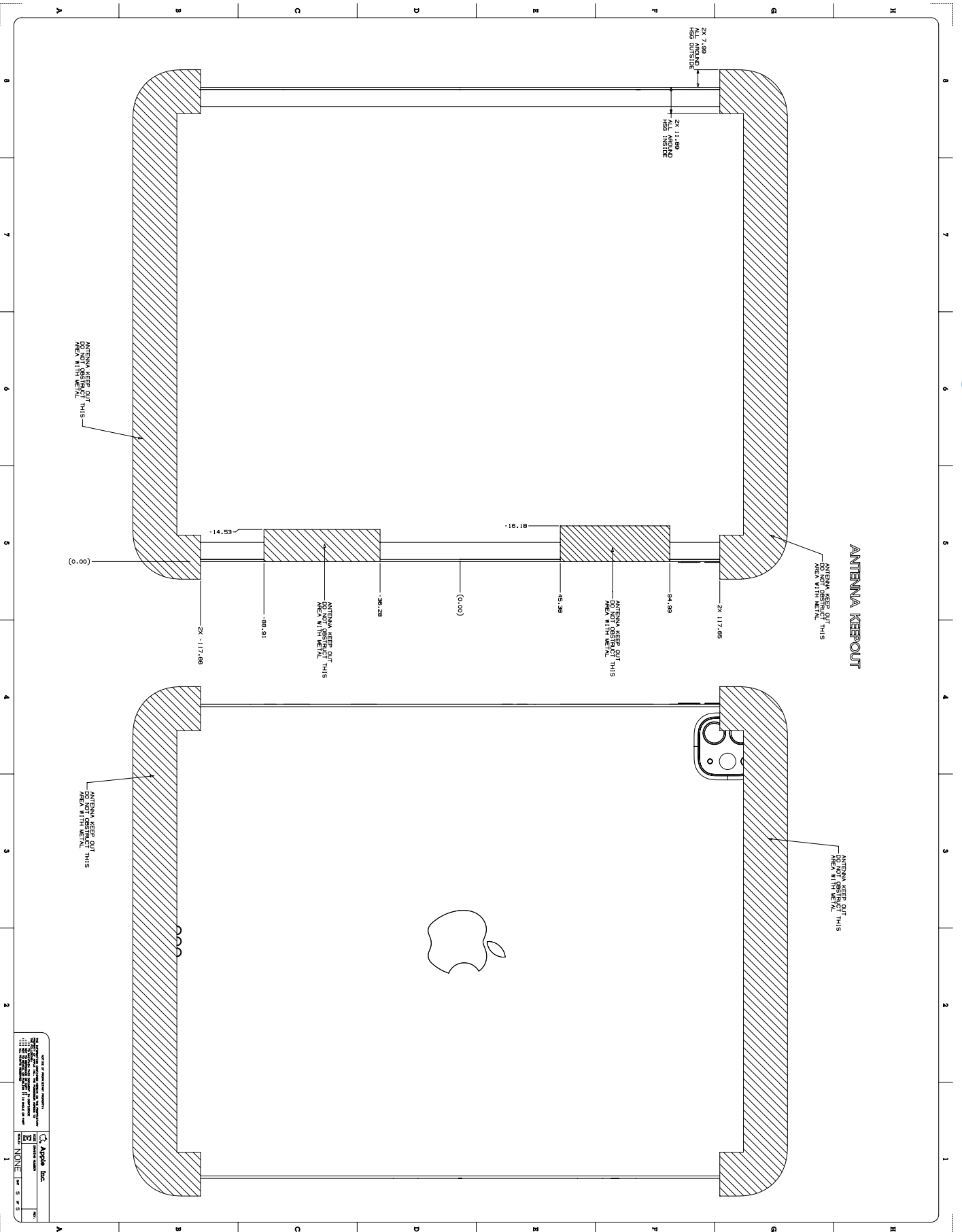
MAGNET DETAIL



SECTION AND DETAIL INFORMATION



56.64 iPad Pro 12.9-inch (6th generation) 5 of 5

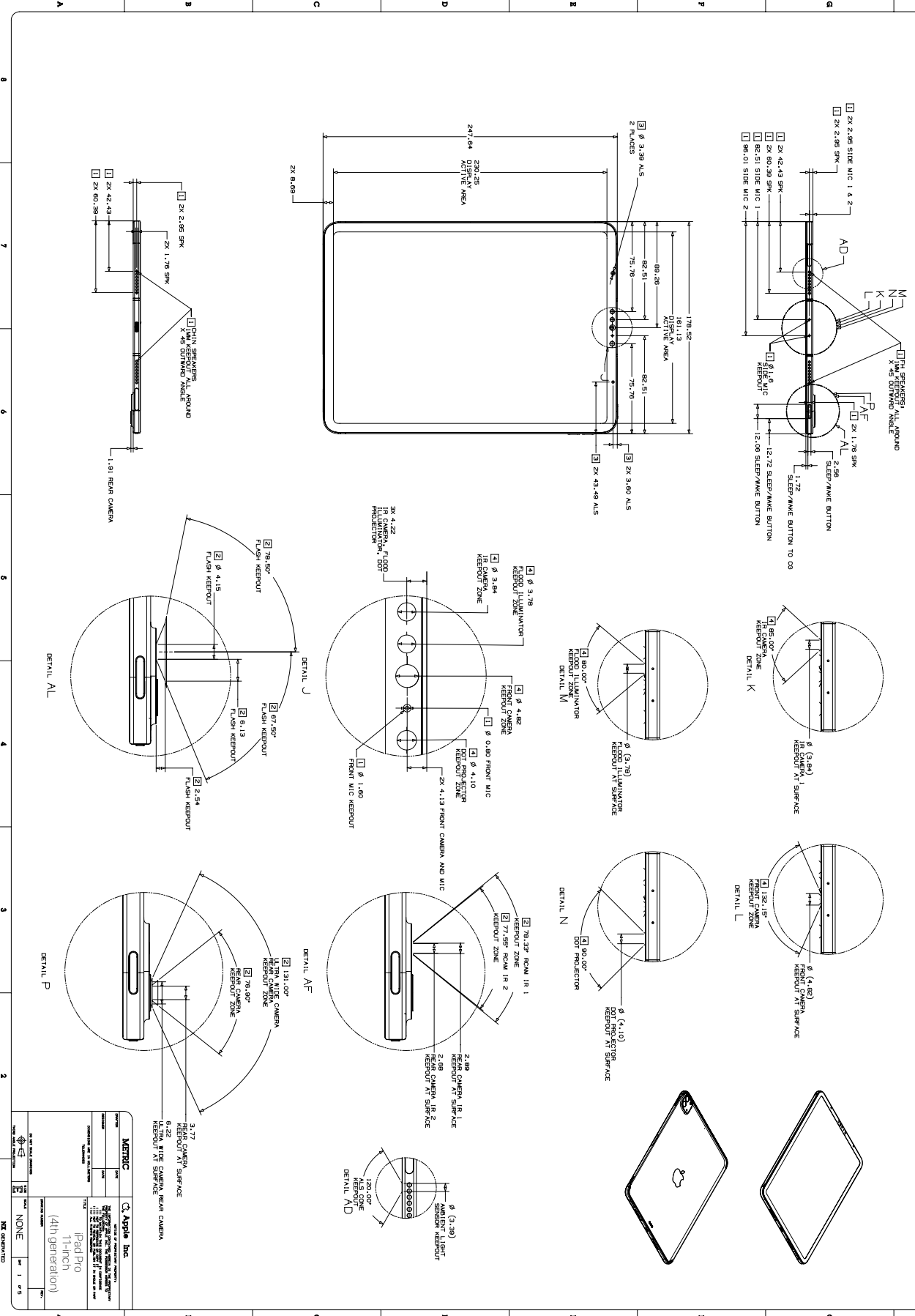


Apple Inc.	
Model	None
Part	None
Rev	1
Created	11/11/2021
By	Apple Inc.
Checked	Apple Inc.
Approved	Apple Inc.
Released	Apple Inc.

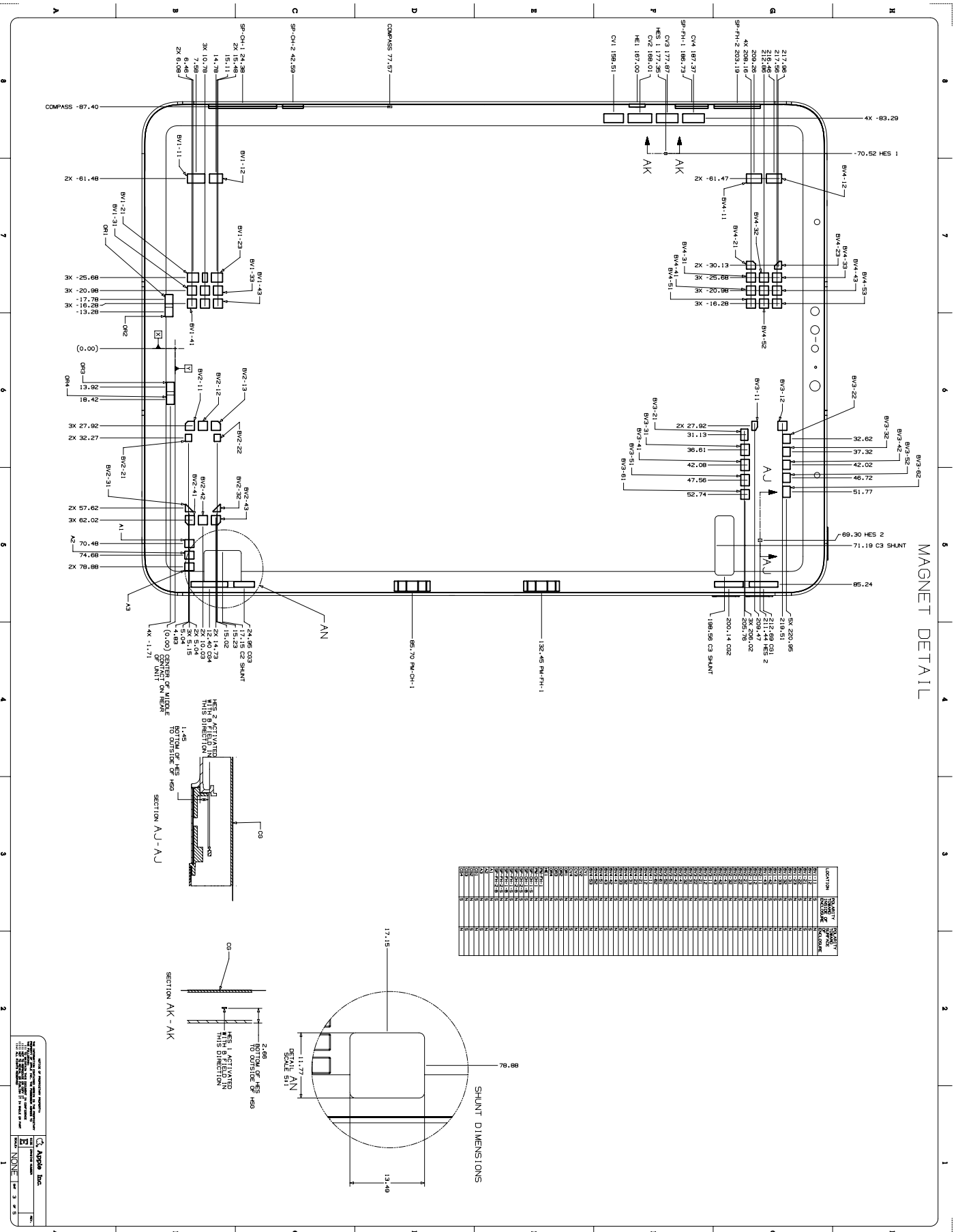
56.65 iPad Pro 11-inch (4th generation) 1 of 5

NOTES (UNLESS OTHERWISE SPECIFIED)

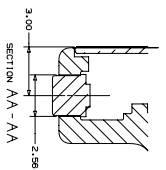
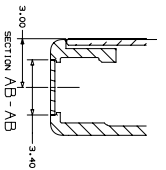
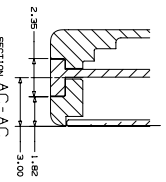
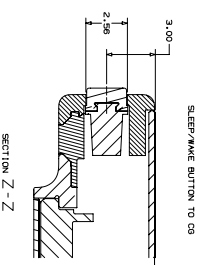
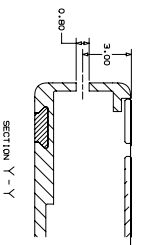
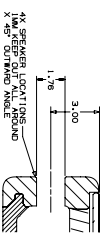
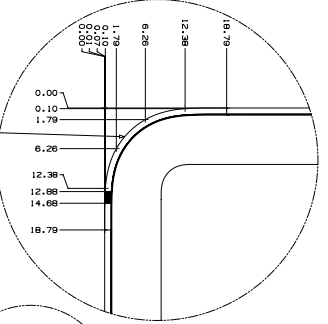
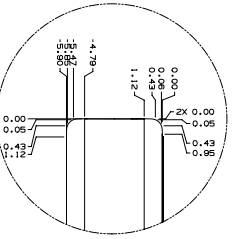
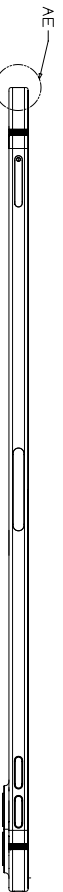
- DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
- DO NOT OBSTRUCT VISION: FLOOR ILLUMINATOR, SLEEP/WAKE BUTTON, 5 REAR IR CAMERAS
- DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
- DO NOT OBSTRUCT IR CAMERA, FLOOR ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
- DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS



MAGNET DETAIL



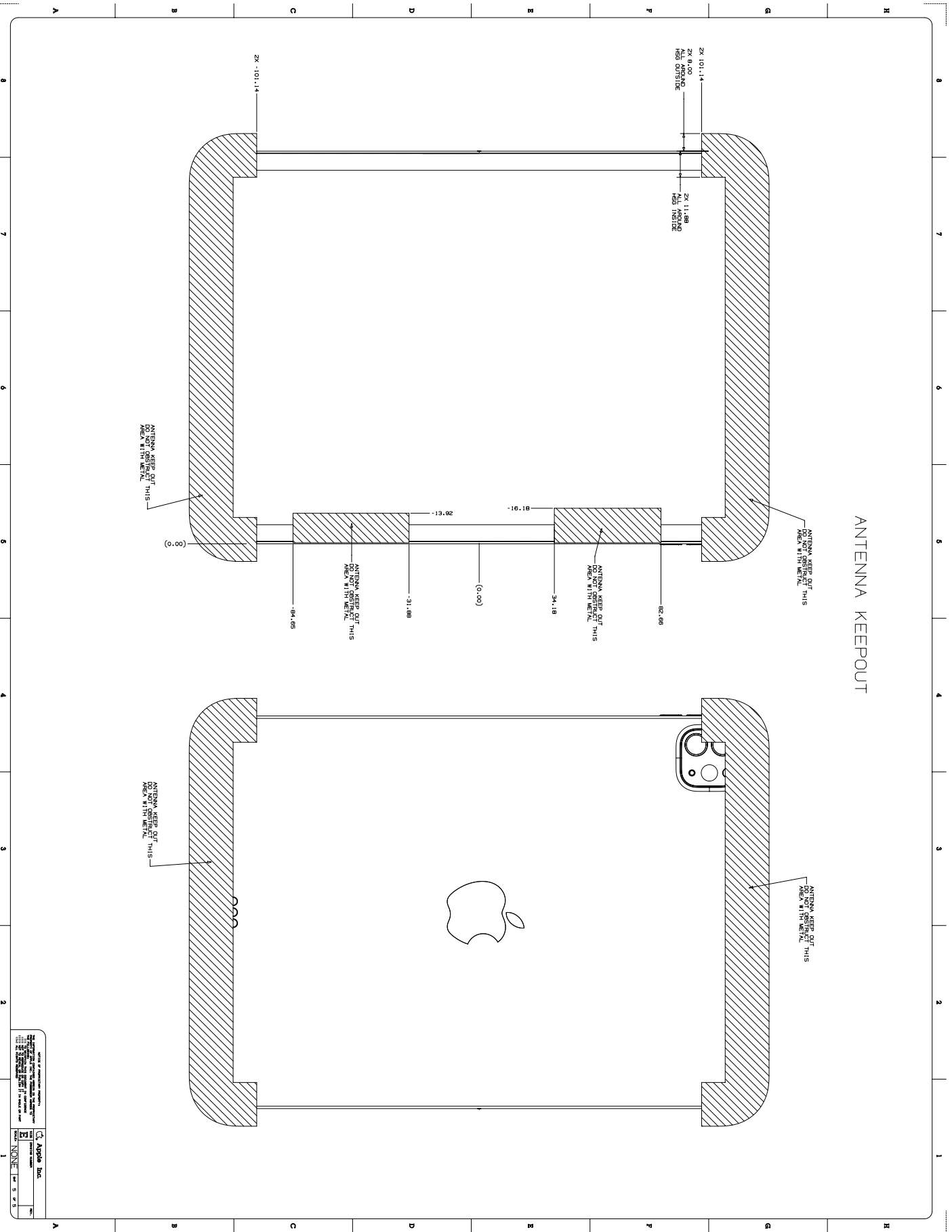
SECTION AND DETAIL INFORMATION



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Model Number	U1E42
Part Number	U1E42
Country of Origin	China
Country of Origin Code	86
Country of Origin Description	China
Country of Origin Manufacturer	Apple Inc.
Country of Origin Manufacturer Code	3168
Country of Origin Manufacturer Name	Apple Inc.
Country of Origin Manufacturer Address	One Apple Park Way, Cupertino, CA 95014
Country of Origin Manufacturer Phone	(415) 950-2400
Country of Origin Manufacturer Website	www.apple.com
Country of Origin Manufacturer Email	apple@apple.com
Country of Origin Manufacturer Fax	(415) 950-2400

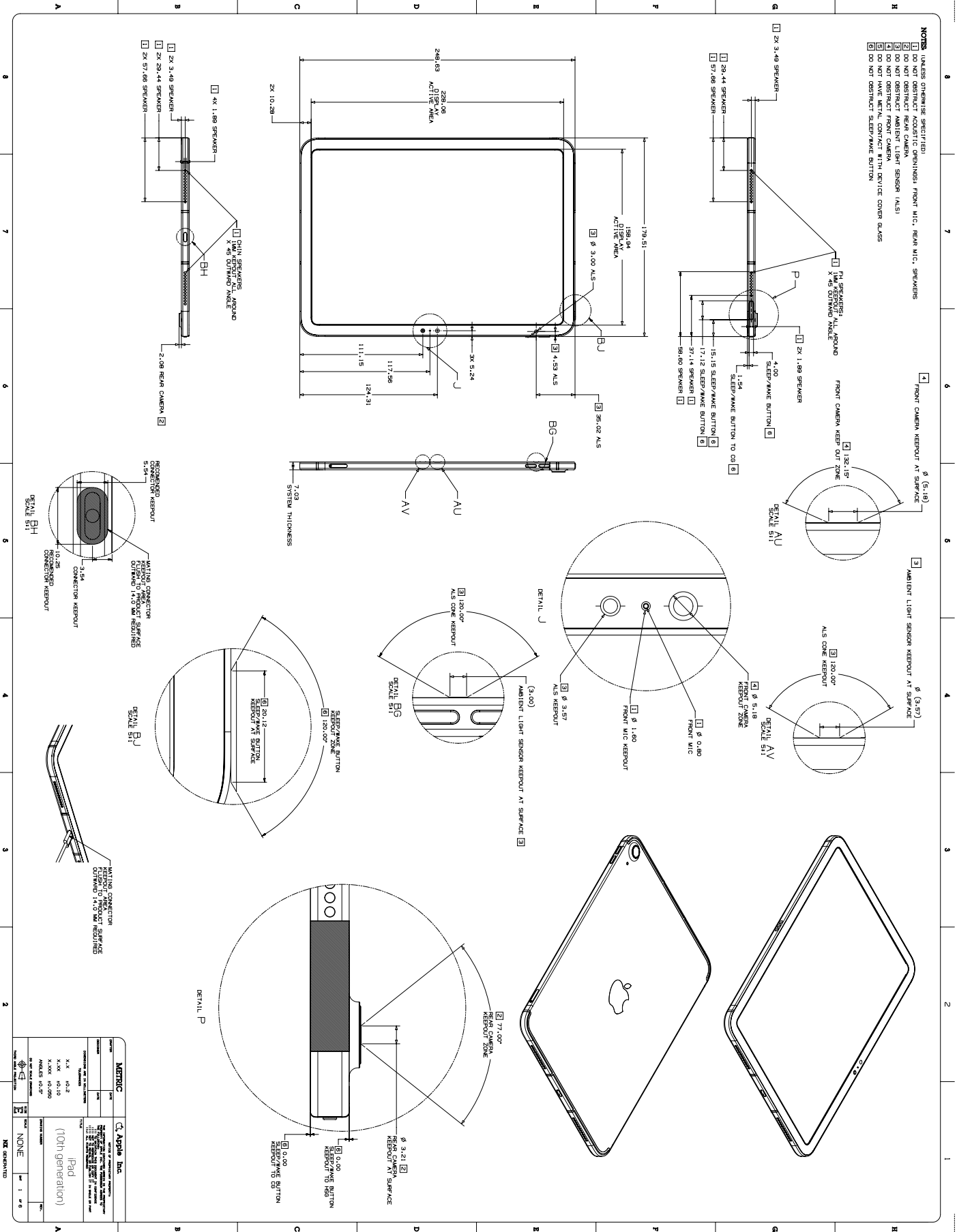
ANTENNA KEEPOUT

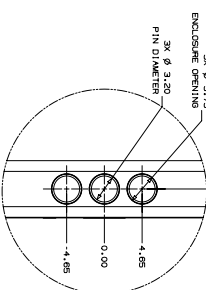
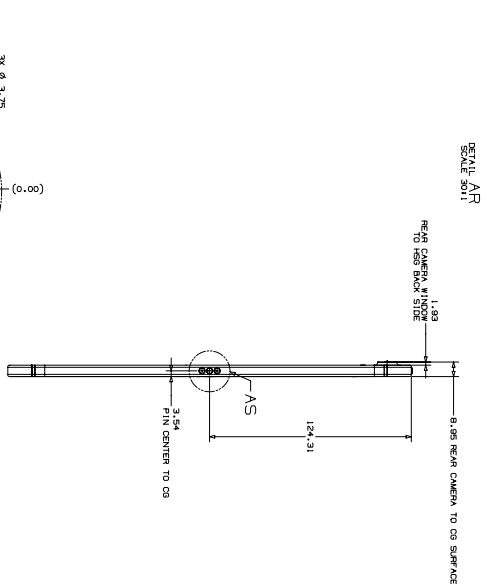
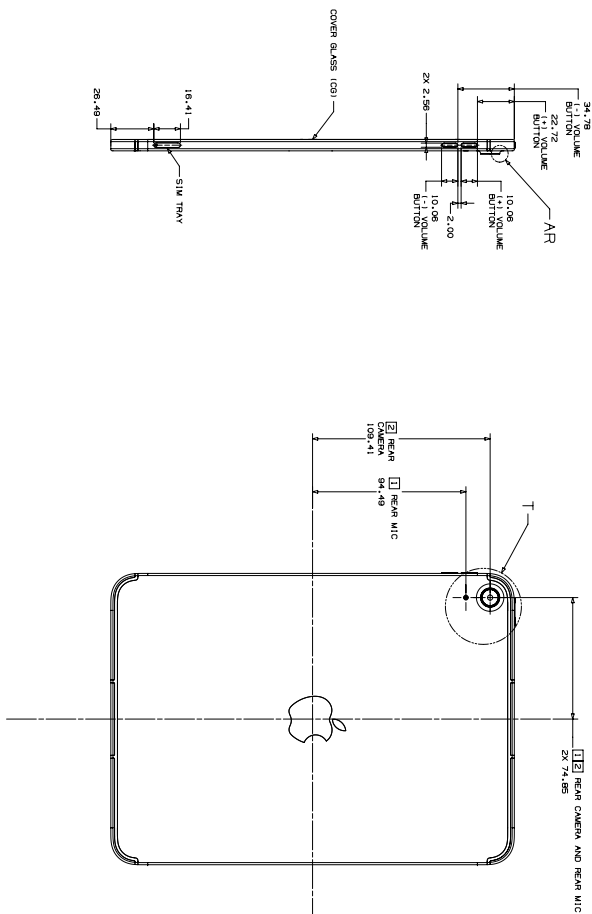
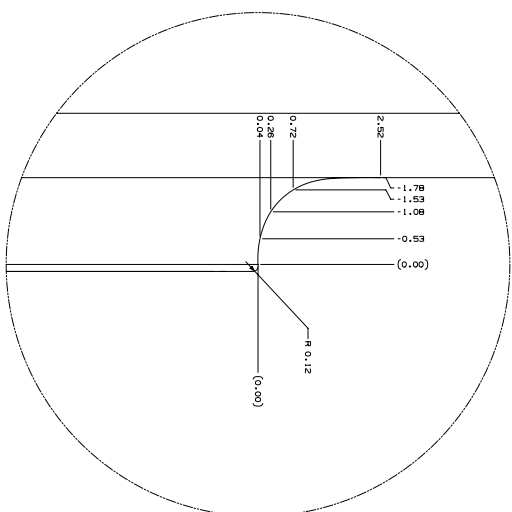
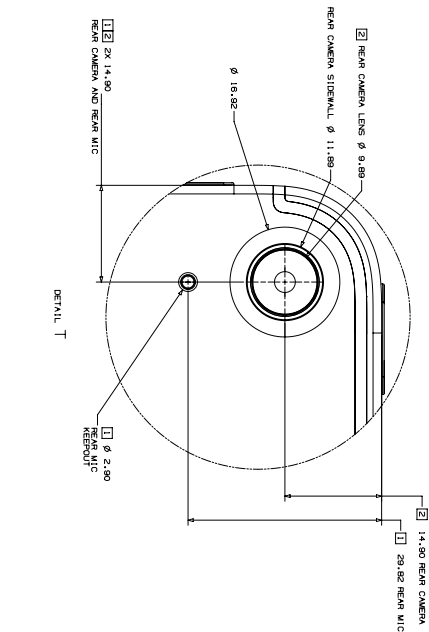


Apple Inc.	
Model	None
Part Number	56.69
Revision	1
Date	10/10/2023
Author	Apple Inc.
Checker	Apple Inc.
Apprver	Apple Inc.
Released	Apple Inc.
Released Date	10/10/2023
Released By	Apple Inc.
Released For	Apple Inc.
Released To	Apple Inc.
Released By	Apple Inc.
Released For	Apple Inc.
Released To	Apple Inc.

56.70 iPad (10th generation) 1 of 6

- NOTES:** UNLESS OTHERWISE SPECIFIED:
 1 DO NOT OBSTRUCT ACOUSTIC GRILLING: FRONT MIC, REAR MIC, SPEAKERS
 2 DO NOT OBSTRUCT REAR CAMERA
 3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
 4 DO NOT OBSTRUCT FRONT CAMERA
 5 DO NOT OBSTRUCT PROXIMITY SENSOR
 6 DO NOT OBSTRUCT SLEEP/WAKE BUTTON COVER GLASS

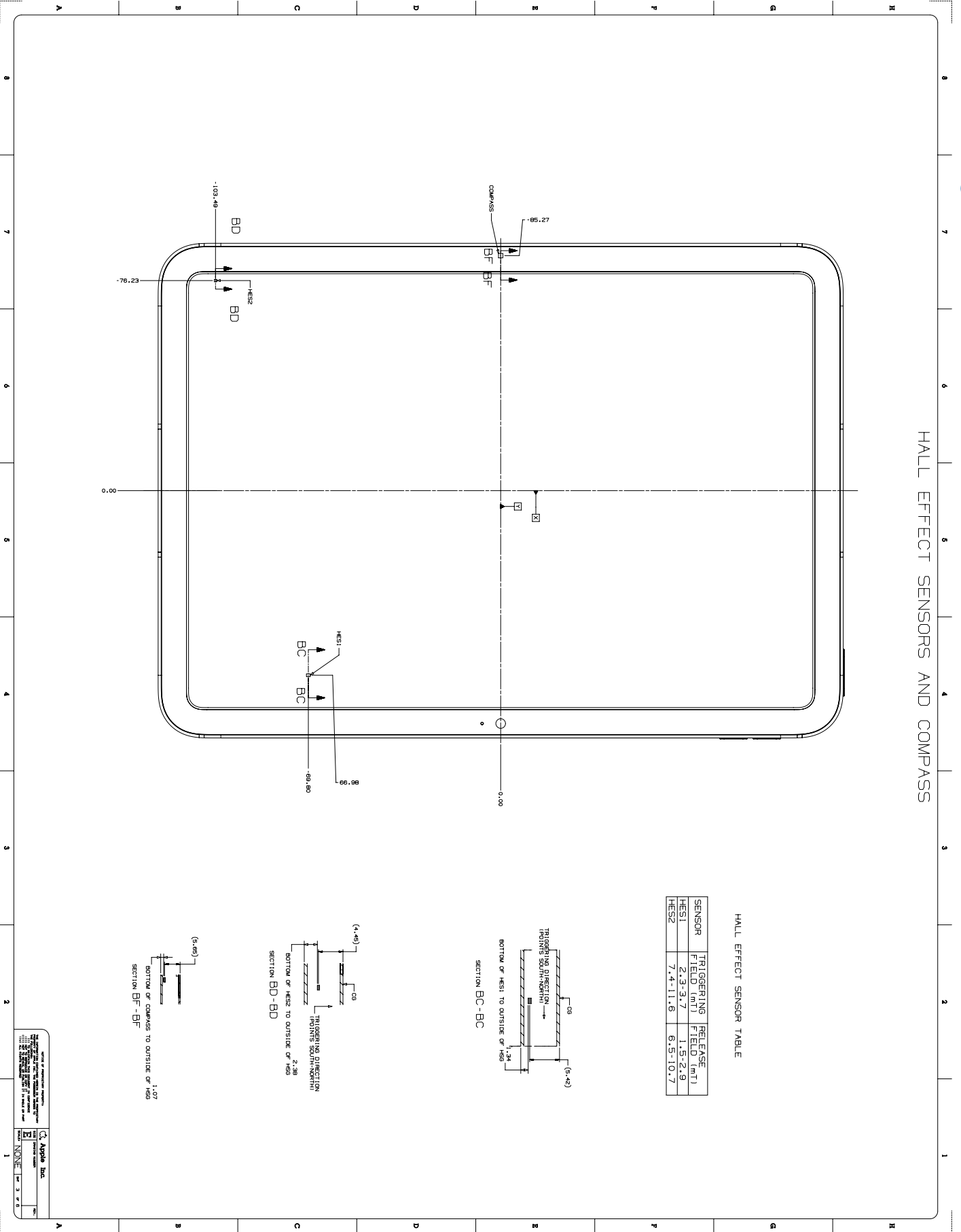




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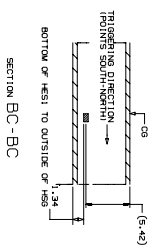
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VERSION	1
DESCRIPTION	REAR CAMERA AND REAR MIC
DESIGNED BY	XXXXXX
DESIGNED DATE	2023-10-10
APPROVED BY	XXXXXX
APPROVED DATE	2023-10-10

HALL EFFECT SENSORS AND COMPASS

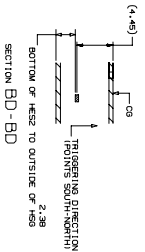


HALL EFFECT SENSOR TABLE

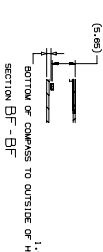
SENSOR	TRIGGERING FIELD (mT)	RELEASE FIELD (mT)
HES1	2.3-3.7	1.5-2.9
HES2	7.4-11.6	6.5-10.7



SECTION BC-BC



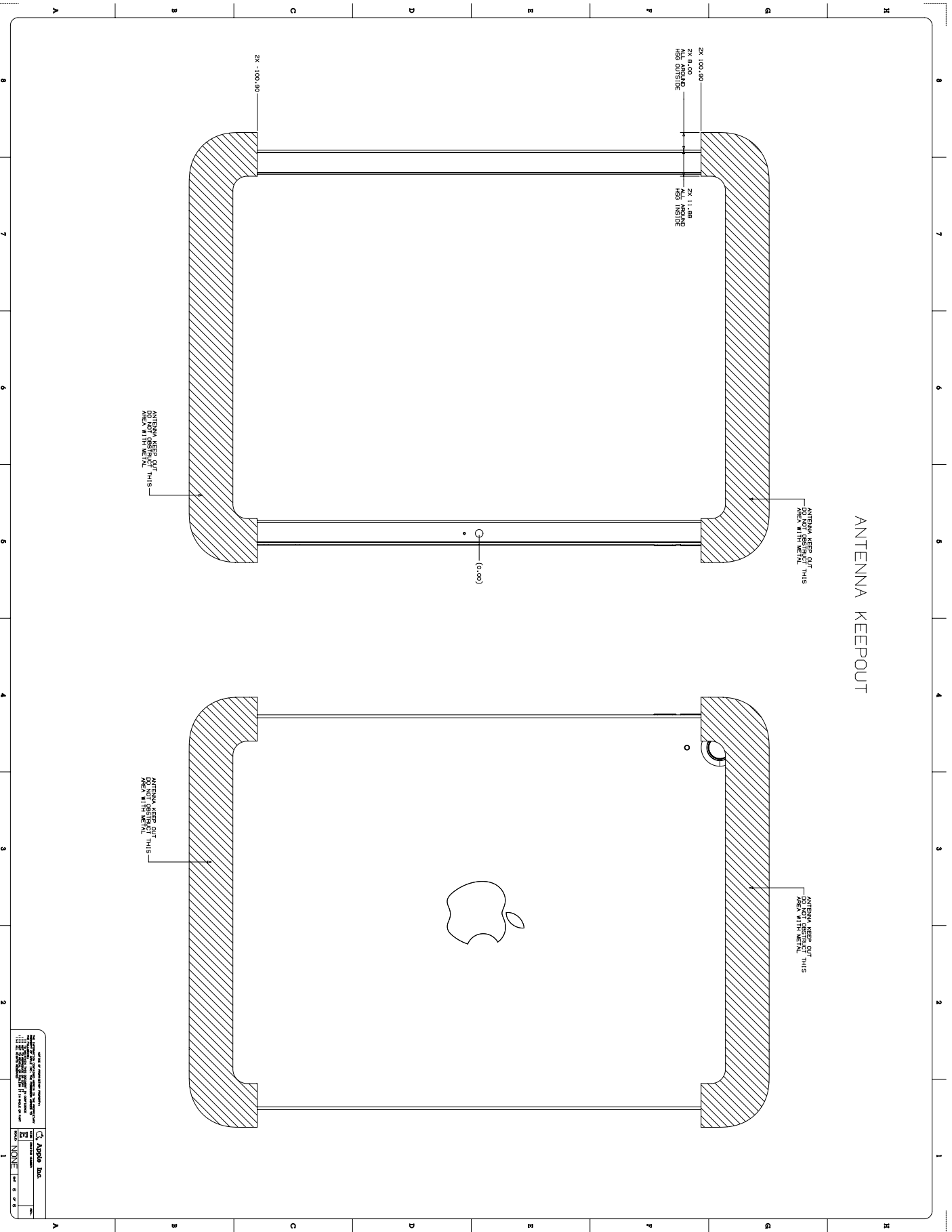
SECTION BD-BD



SECTION BF-BF

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 Cupertino, CA 95014
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 HES1 HES2 COMPASS

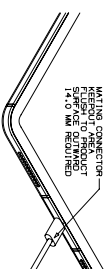
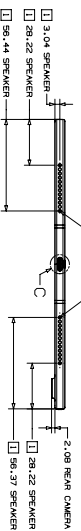
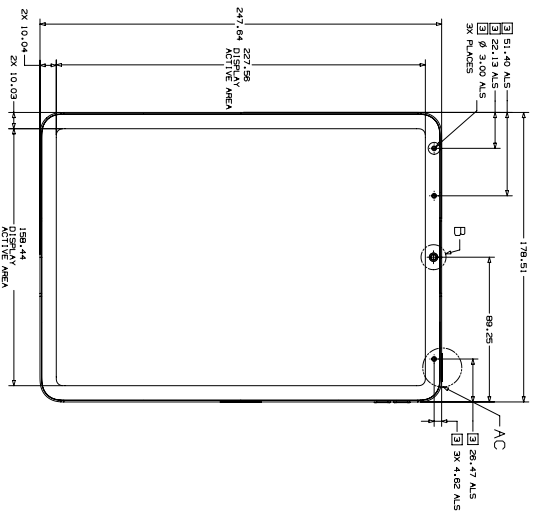
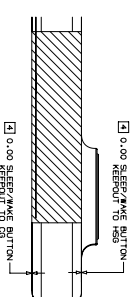
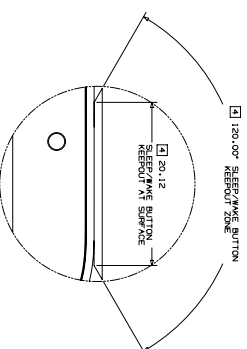
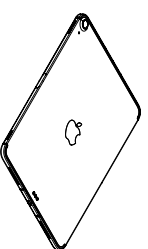
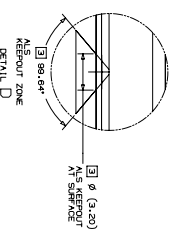
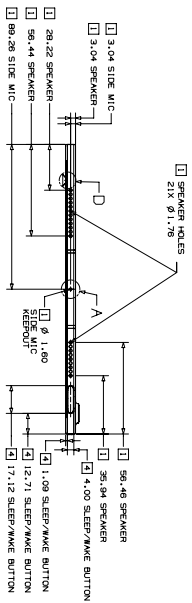
ANTENNA KEEPOUT



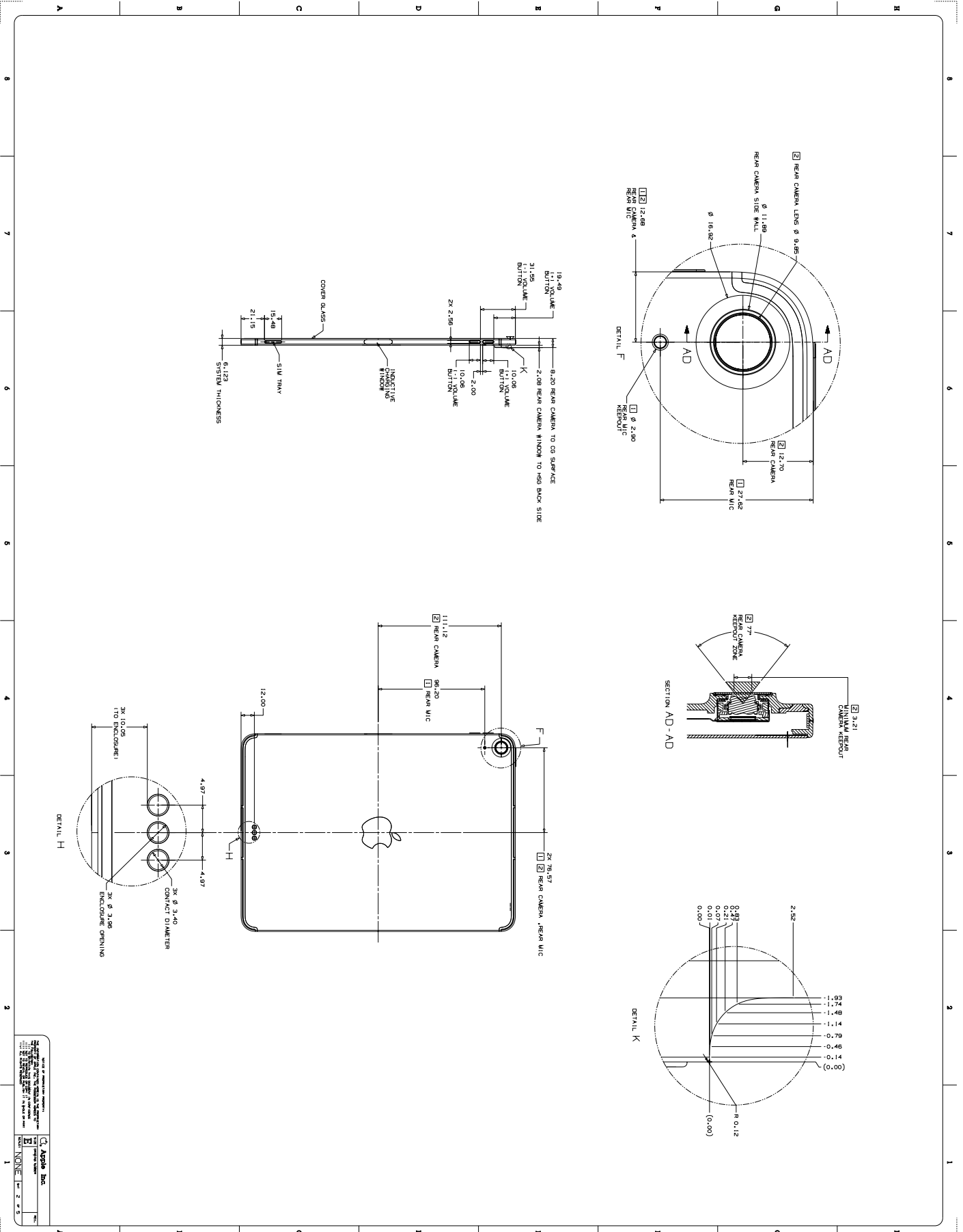
Apple Inc.	
Model Name	56.75
Part Name	ANTENNA KEEPOUT
Material	None
Color	None
Finish	None
Notes	None

56.76 iPad Air (5th generation) and iPad Air (4th generation) 1 of 5

- NOTES:** UNLESS OTHERWISE SPECIFIED:
- 1 DO NOT OBSTRUCT ACOUSTIC PENETRABILITY SIDE MIC, NEAR MIC, SPEAKERS
 - 2 DO NOT OBSTRUCT IMAGING FEATURES FRONT CAMERA, REAR CAMERA
 - 3 DO NOT OBSTRUCT IMAGING FEATURES FRONT CAMERA, REAR CAMERA
 - 4 DO NOT OBSTRUCT SLEEP/WAKE BUTTON
 - 5 DO NOT OBSTRUCT SLASIS WITH METAL
 - 6 DO NOT OBSTRUCT ENCLOSURE WITH METAL

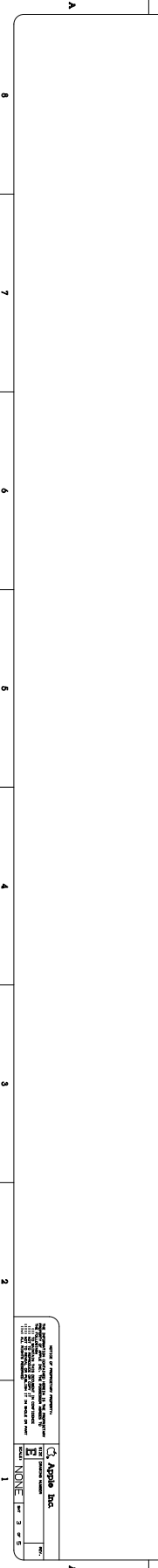
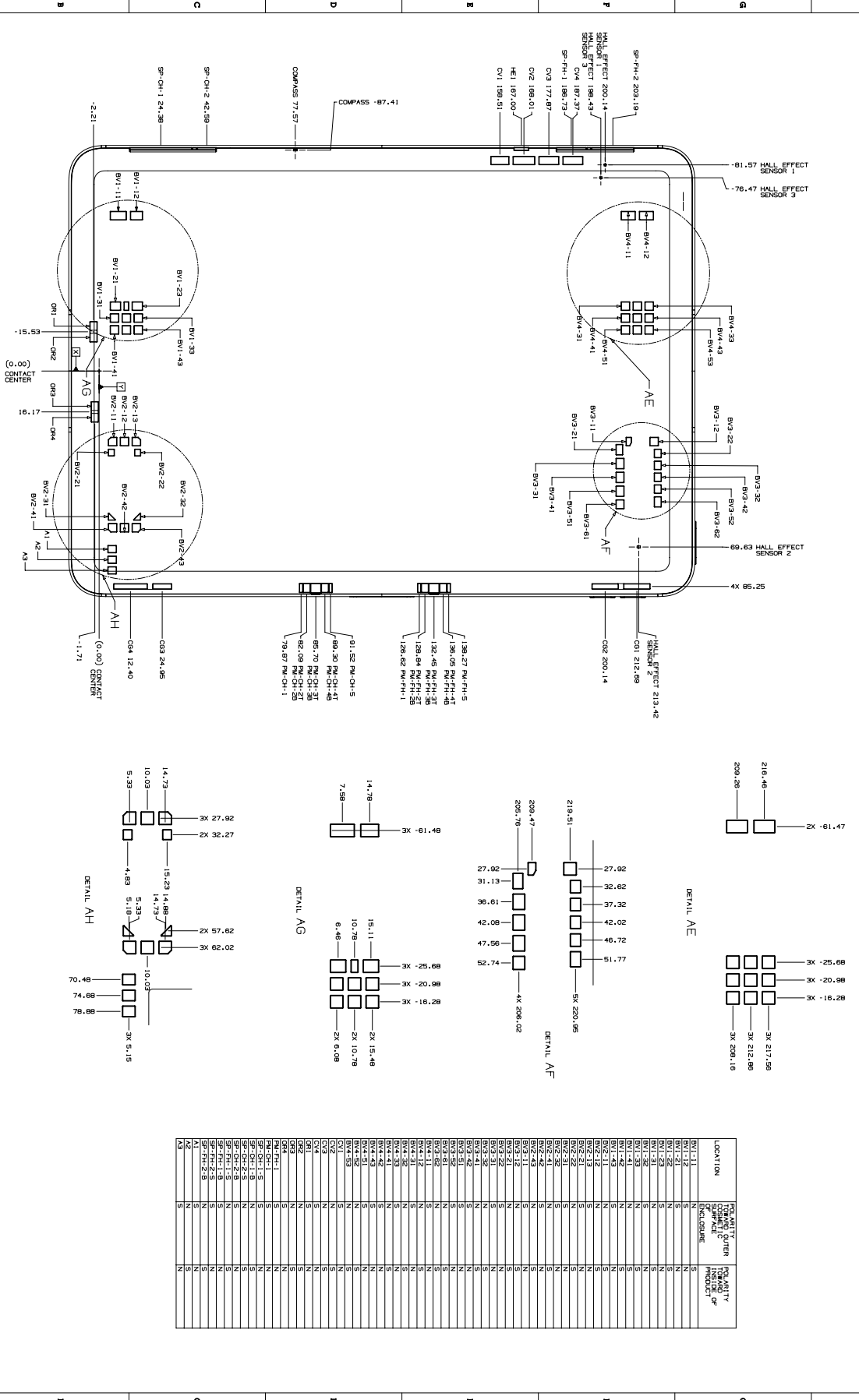


METRIC		Apple Inc.	
DATE	2023-10-10	VERSION	01
DESCRIPTION	iPad Air (5th generation) / iPad Air (4th generation)		
DESIGNED BY	Apple Inc.		
CHECKED BY	Apple Inc.		
APPROVED BY	Apple Inc.		
SCALE	NONE		
NO. OF SHEETS	1 OF 5		
NOT DIMENSIONED			

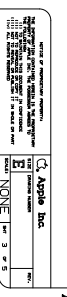


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1	INITIAL RELEASE	2022.09.14	WZ	WZ
2	REVISION	2022.09.14	WZ	WZ
3	REVISION	2022.09.14	WZ	WZ
4	REVISION	2022.09.14	WZ	WZ
5	REVISION	2022.09.14	WZ	WZ

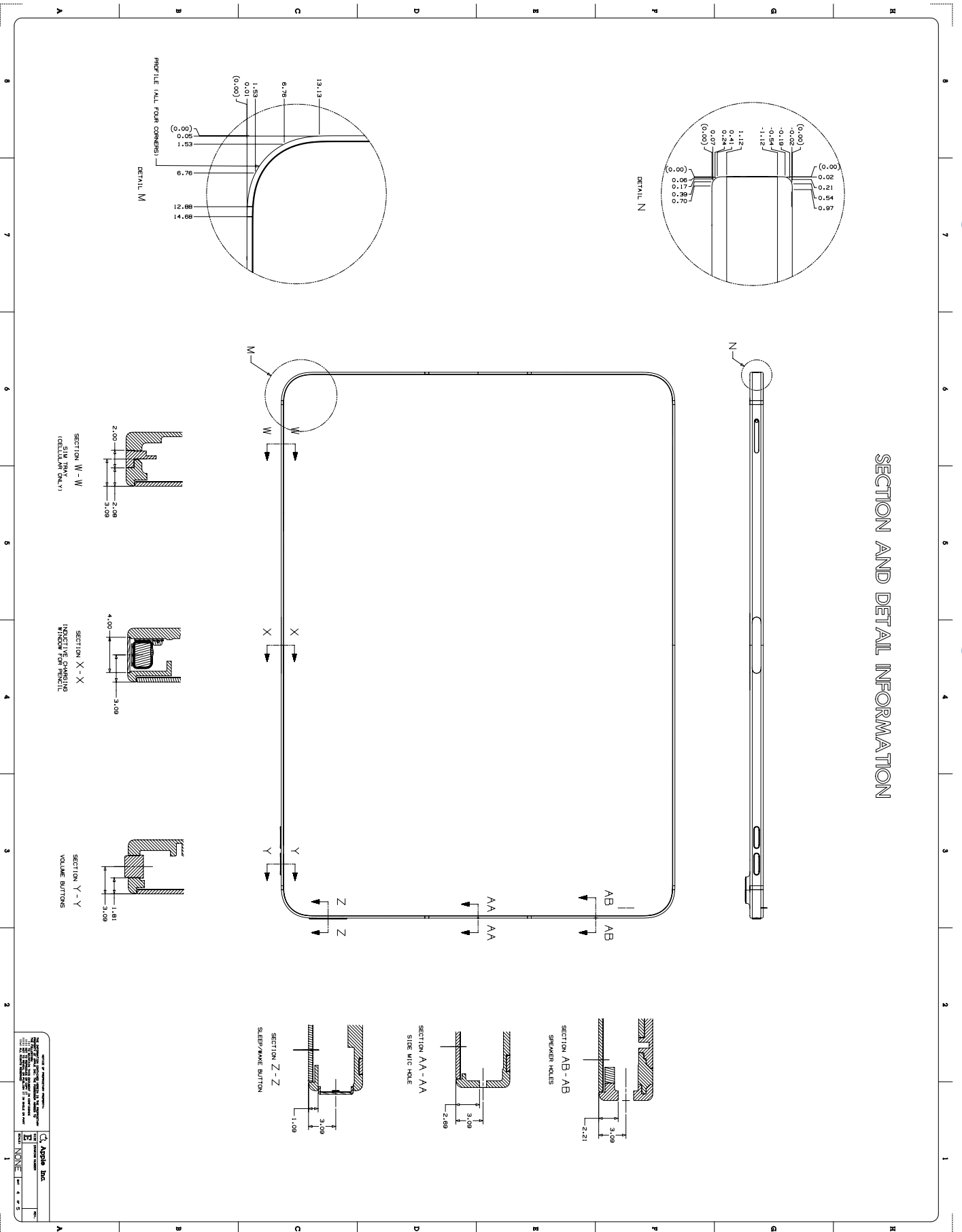
MAGNET DETAIL



LOCATION	PART NUMBER	QUANTITY	PRODUCT
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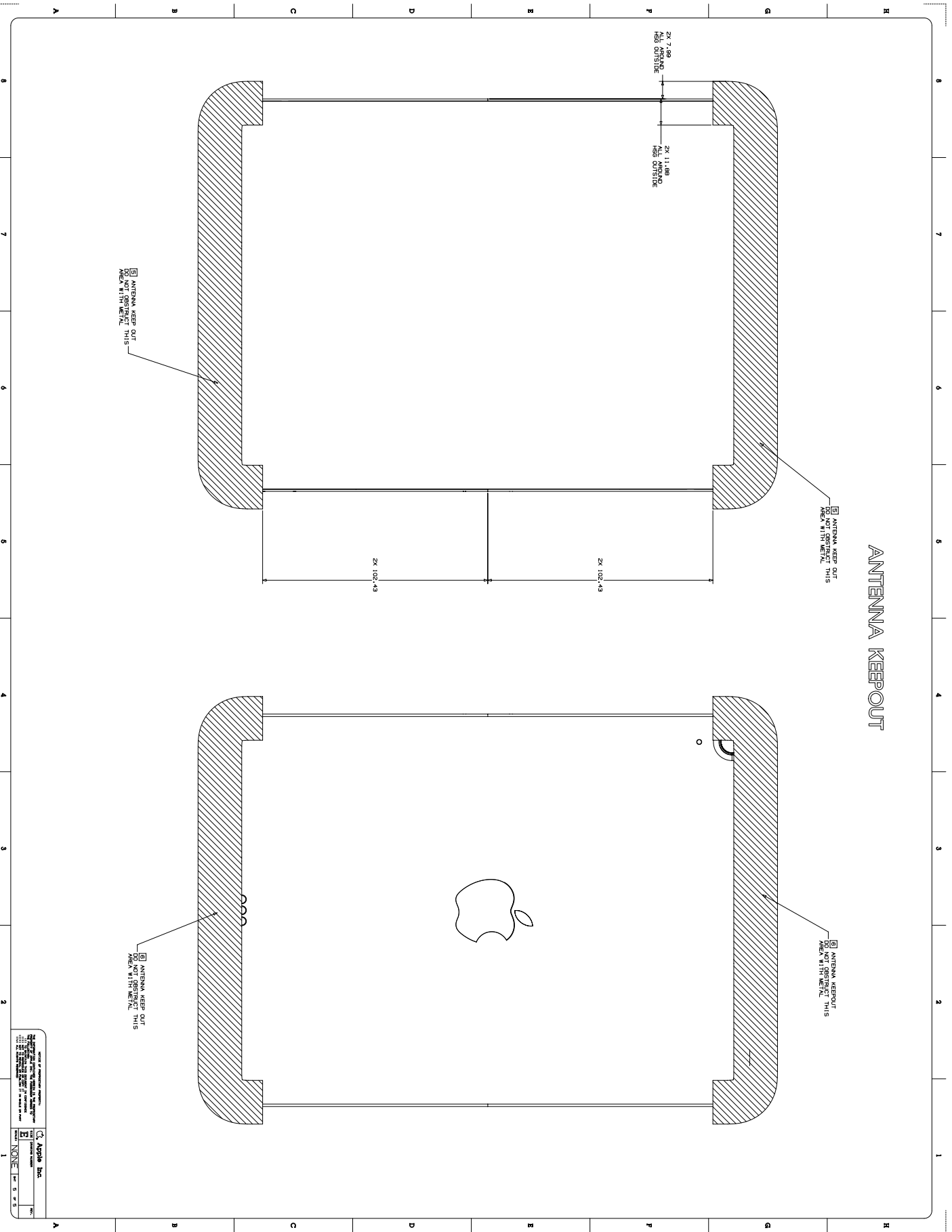


SECTION AND DETAIL INFORMATION



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DATE: 2023-10-10	REV: 1
DRAWN BY: [Name]	CHECKED BY: [Name]
APPROVED BY: [Name]	DATE: 2023-10-10

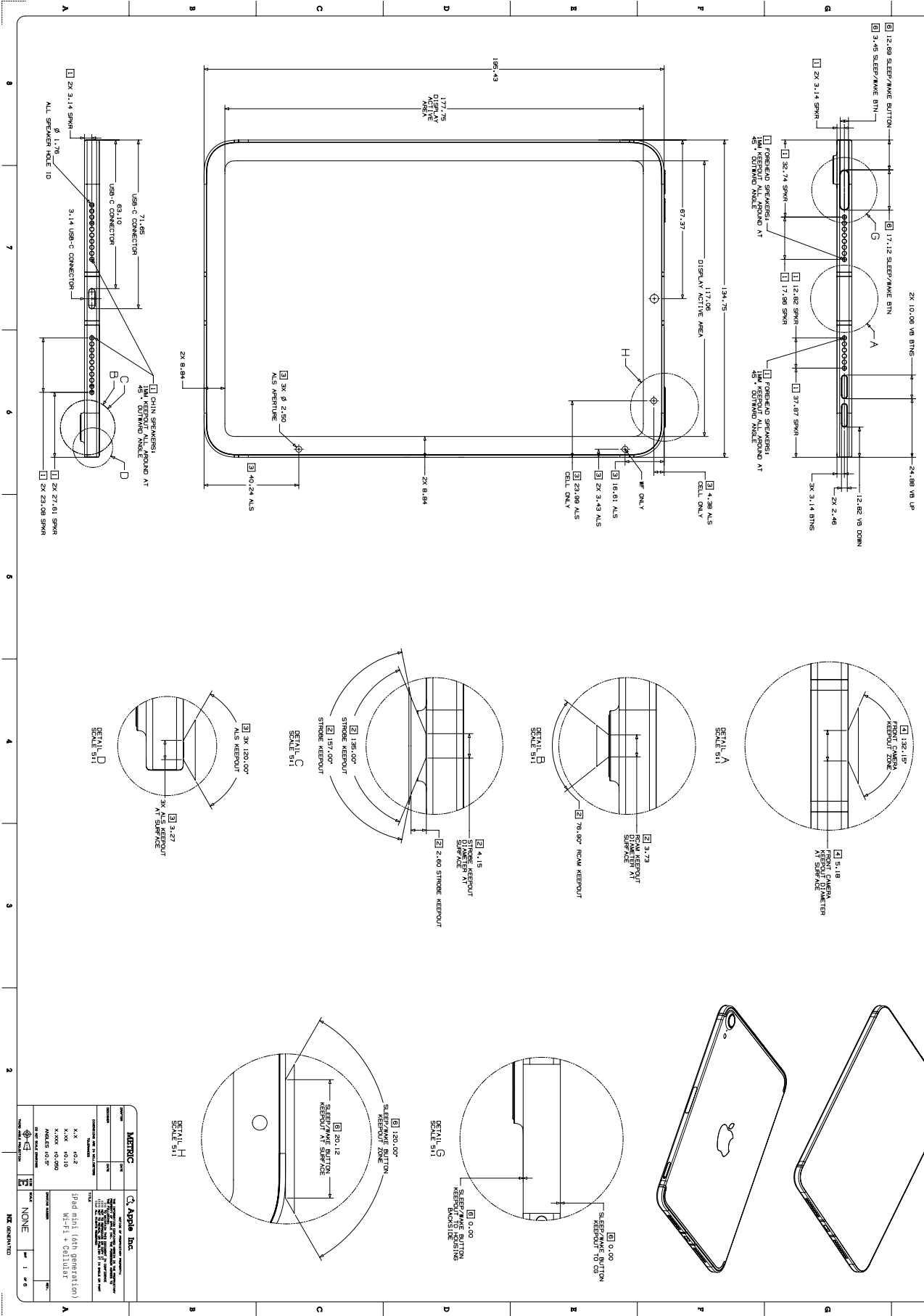
56.80 iPad Air (5th generation) and iPad Air (4th generation) 5 of 5



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<small>Model</small> A2602	<small>Apple Inc.</small>
<small>Part Name</small> NONE	<small>Rev</small> 5 of 5

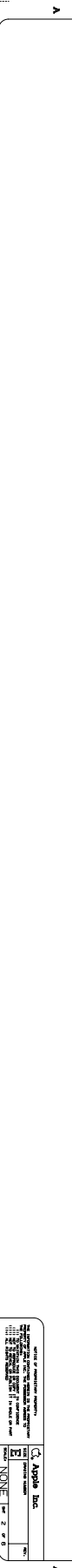
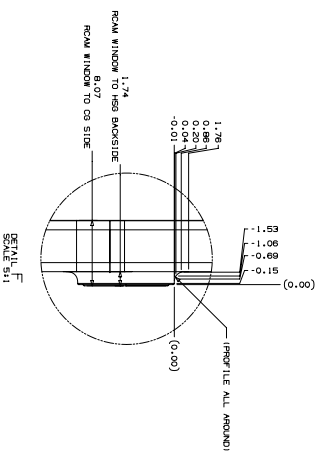
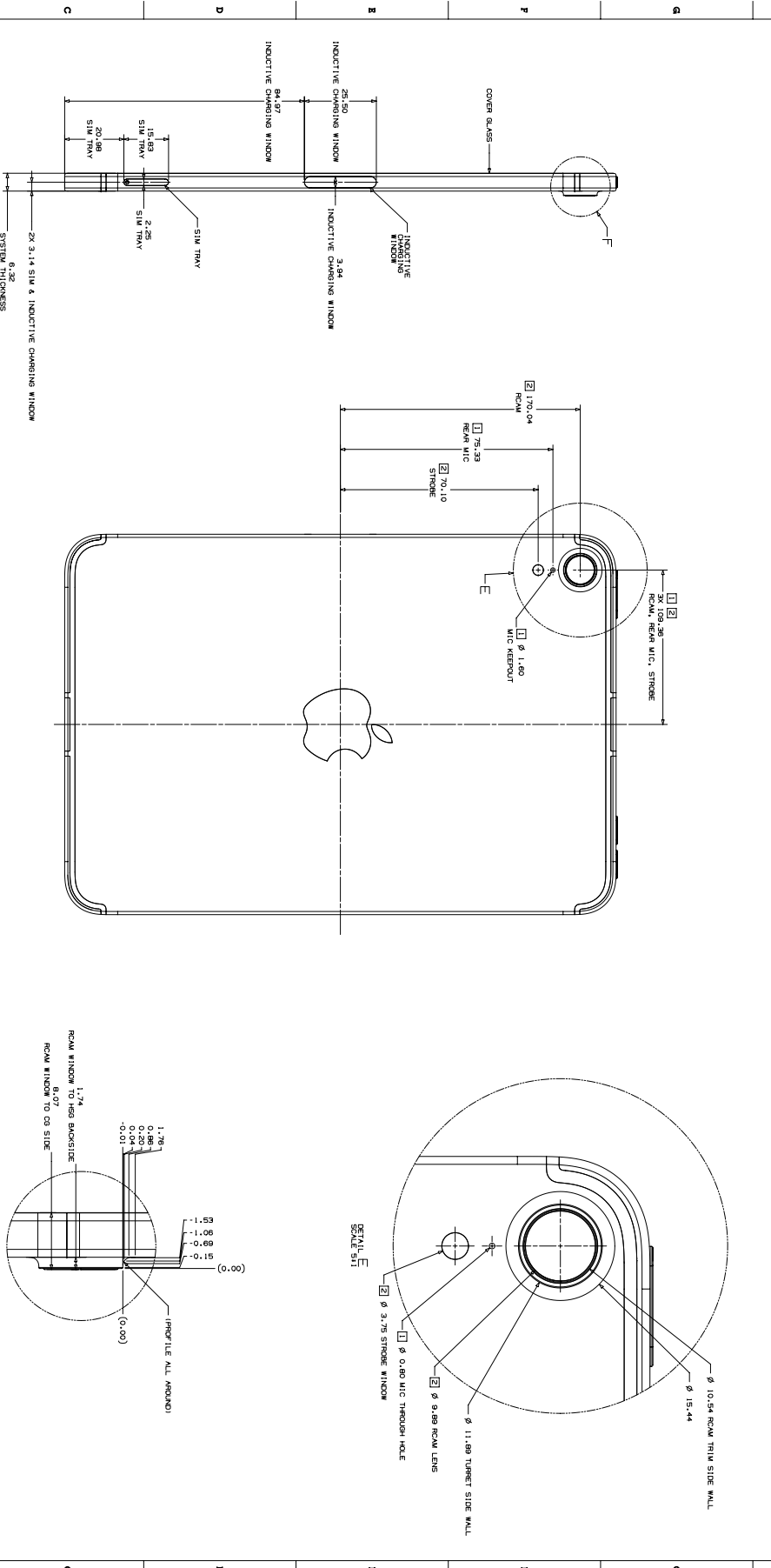
56.81 iPad mini (6th generation) 1 of 6

NOTES UNLESS OTHERWISE SPECIFIED:
 1 DO NOT OBSTRUCT AKASOIC OPENINGS REAR W/C. SPEAKERS
 2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH
 3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
 4 DO NOT OBSTRUCT FRONT CAMERA / SERVICE COVER GLASS
 5 DO NOT OBSTRUCT SLEEP/WAKE BUTTON



56.82 iPad mini (6th generation) 2 of 6

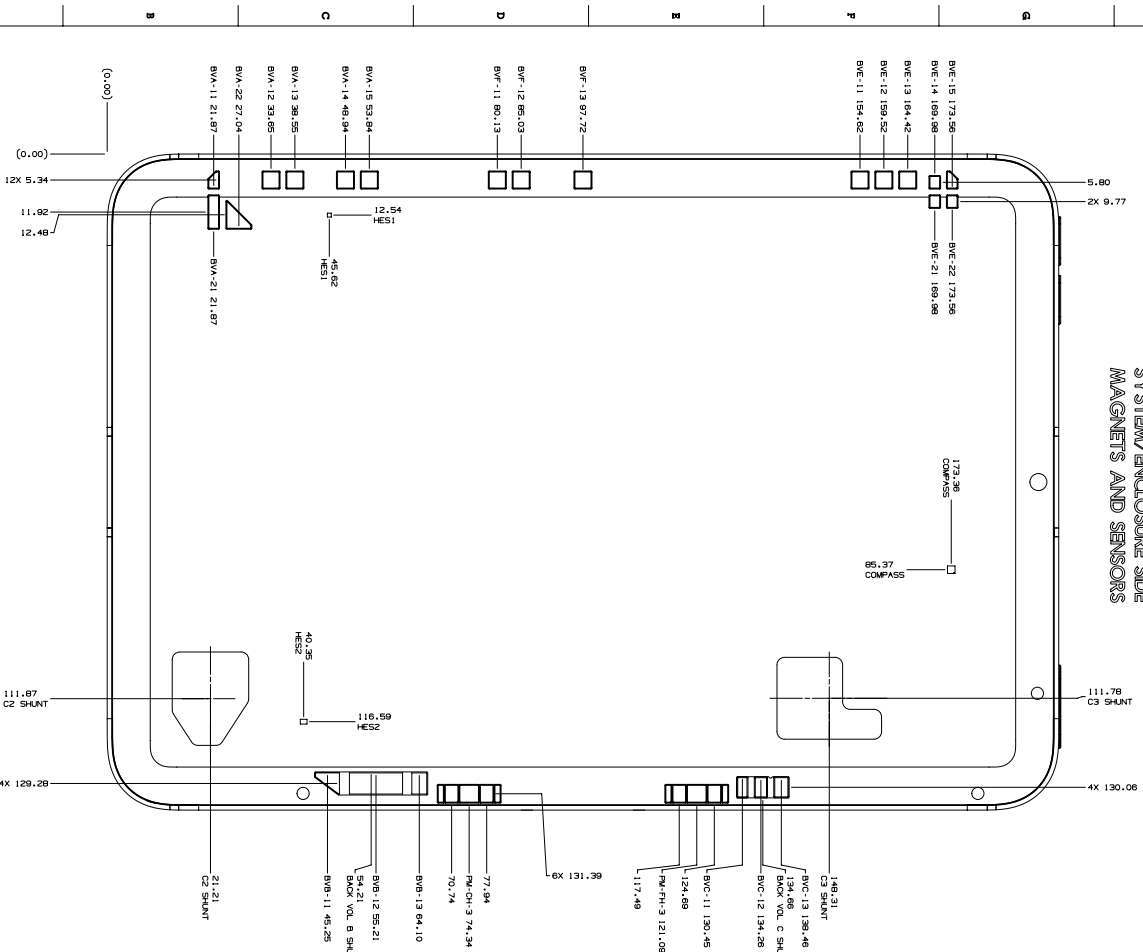
- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS! REAR MIC, SPEAKERS
- 2 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH
- 3 DO NOT OBSTRUCT FRONT CAMERA, LIGHT SENSOR
- 4 DO NOT OBSTRUCT FRONT CAMERA, LIGHT SENSOR
- 5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
- 6 DO NOT OBSTRUCT SLEEP/WAKE BUTTON



56.83 iPad mini (6th generation) 3 of 6

MAGNET, HES, COMPASS DETAIL

SYSTEM ENCLOSURE SIDE MAGNETS AND SENSORS

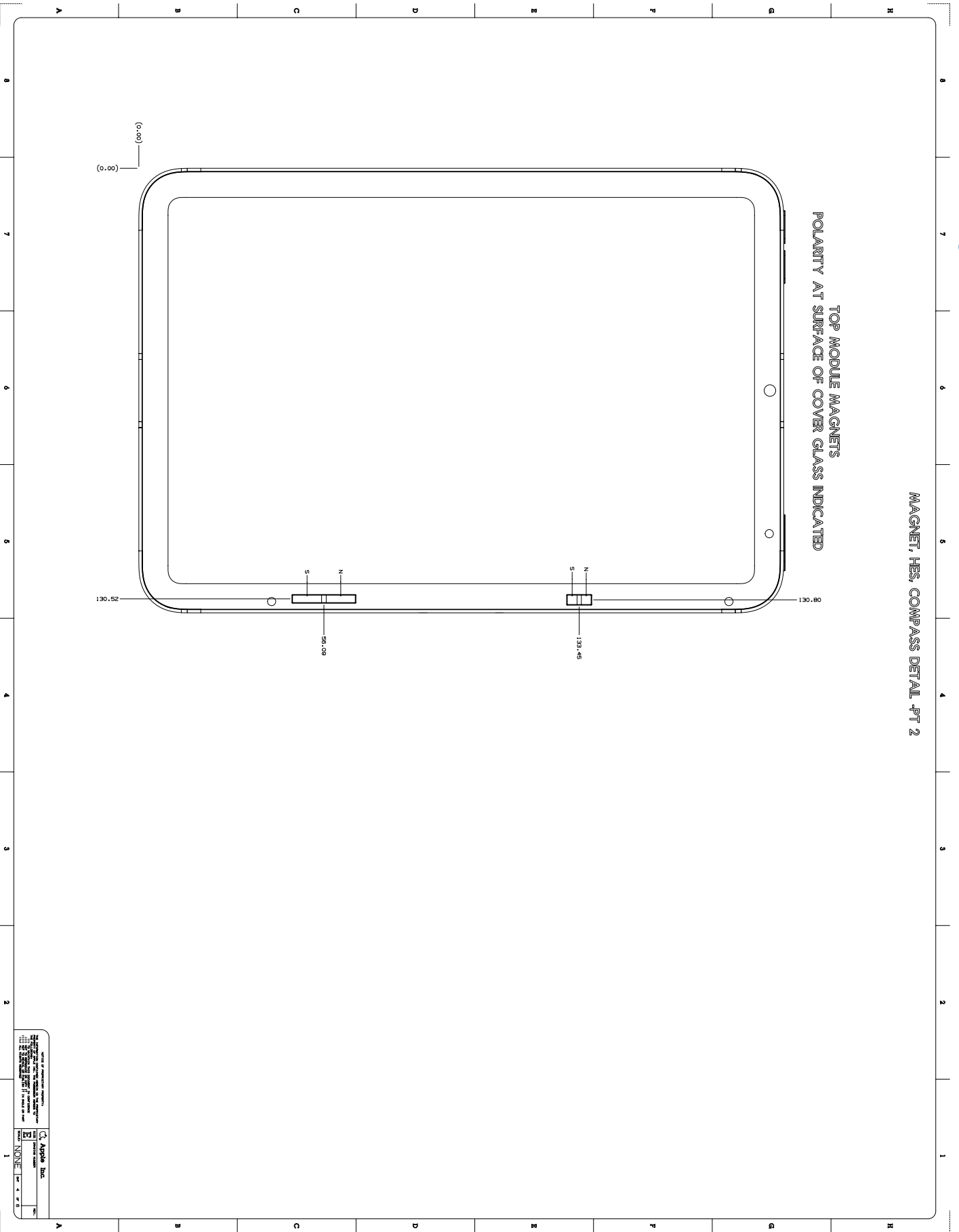


LOCATION	POLARITY TOWARD SURFACE OF ENCLOSURE
PM-FH-3	S
PM-CH-3	S
BVA-11	N
BVA-12	N
BVA-13	S
BVA-14	N
BVA-15	S
BVA-21	N
BVA-22	N
BVB-11	N
BVB-12	S
BVB-13	N
BVC-11	S
BVC-12	N
BVC-13	S
BVE-11	S
BVE-12	N
BVE-13	S
BVE-14	N
BVE-15	S
BVE-21	N
BVE-22	N
BVF-11	N
BVF-12	S
BVF-13	N

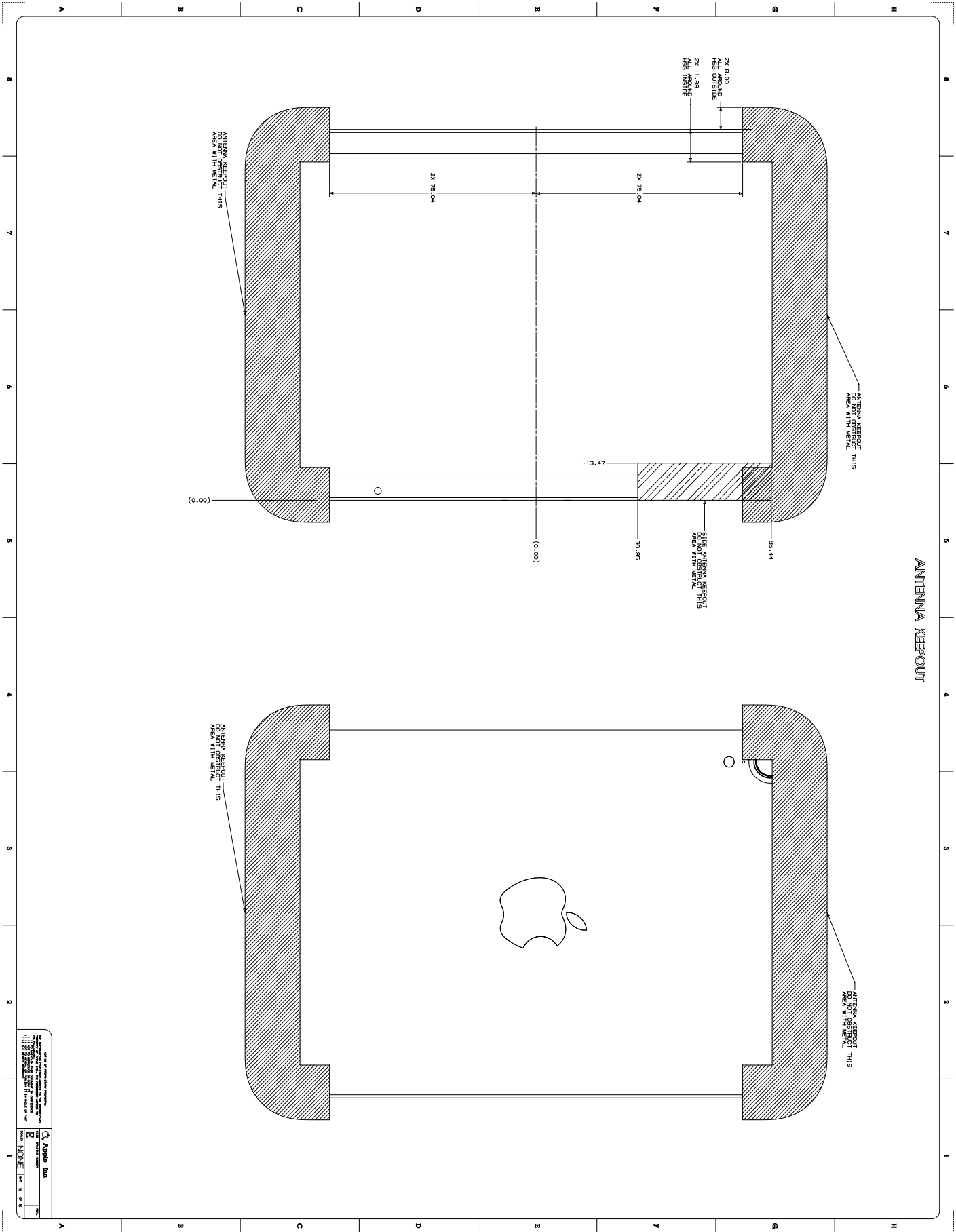
Apple logo and Apple Inc. text.

56.84 iPad mini (6th generation) 4 of 6

MAGNET, HES. COMPASS DETAIL -PT 2

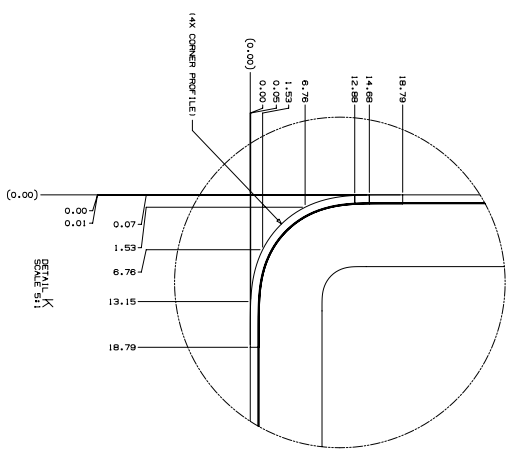
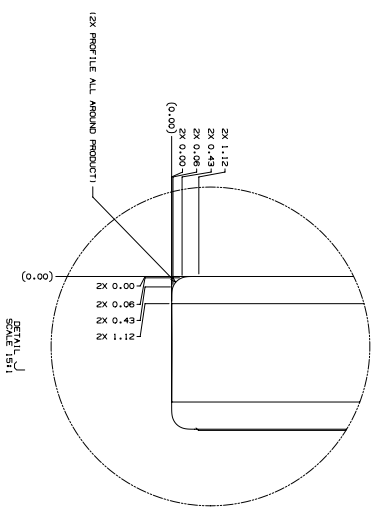
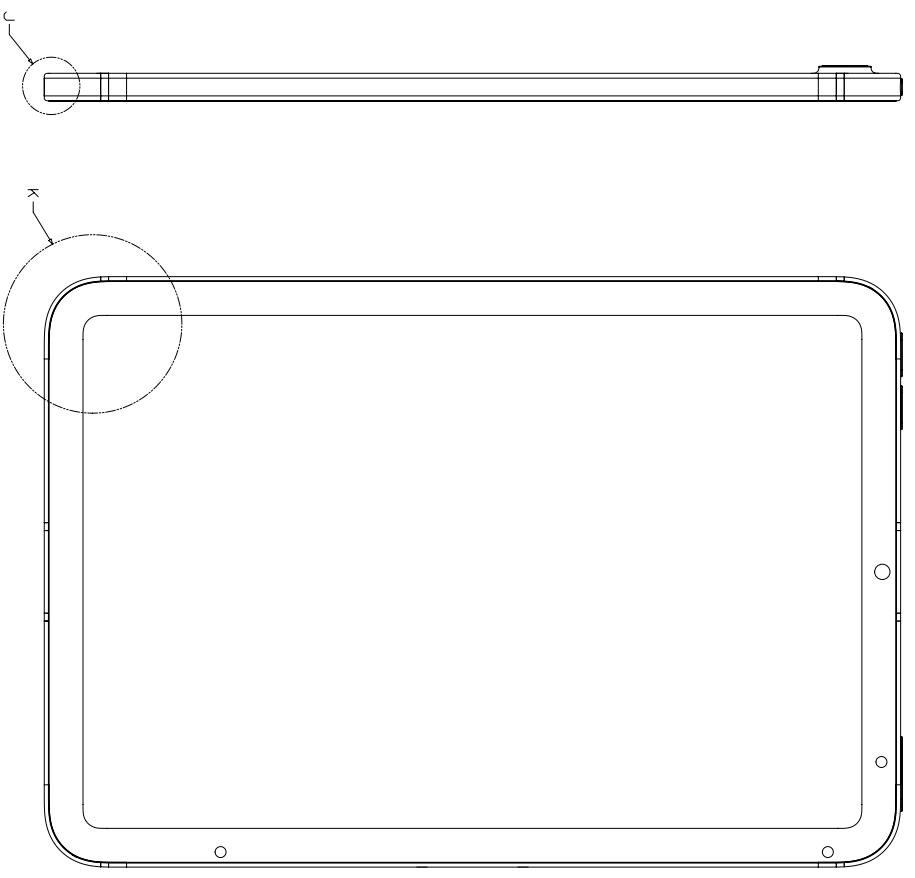


Apple Inc.	
Model Name	56.84
Part Name	MAGNET, HES. COMPASS DETAIL -PT 2
Part Number	56.84.001
Revision	1
Material	NONMET
Quantity	1
Unit of Measure	EA
Notes	1. THIS PART IS A COMPONENT OF THE PRODUCT AND IS NOT TO BE USED SEPARATELY.



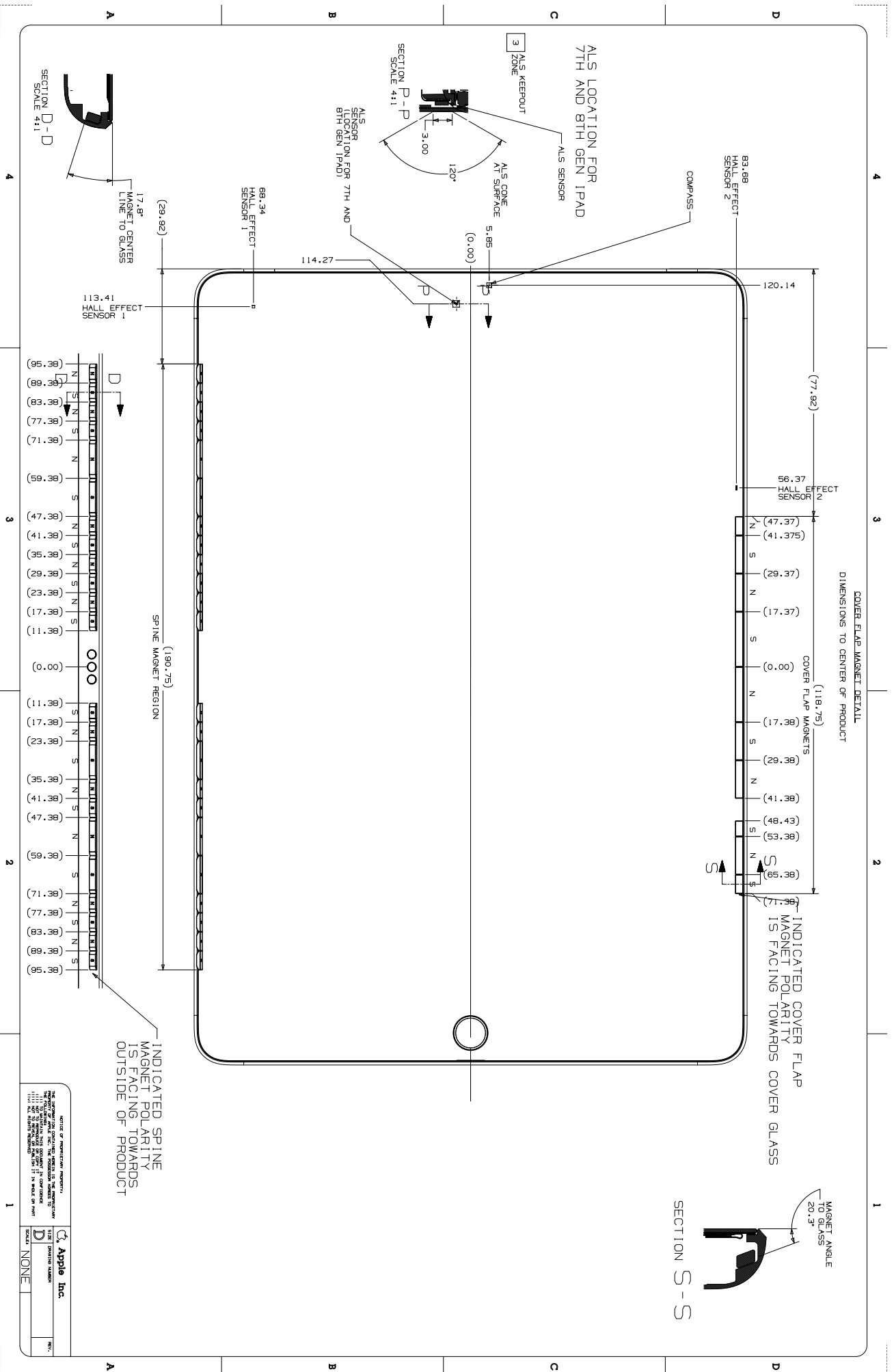
56.86 iPad mini (6th generation) 6 of 6

PROFILE DETAIL

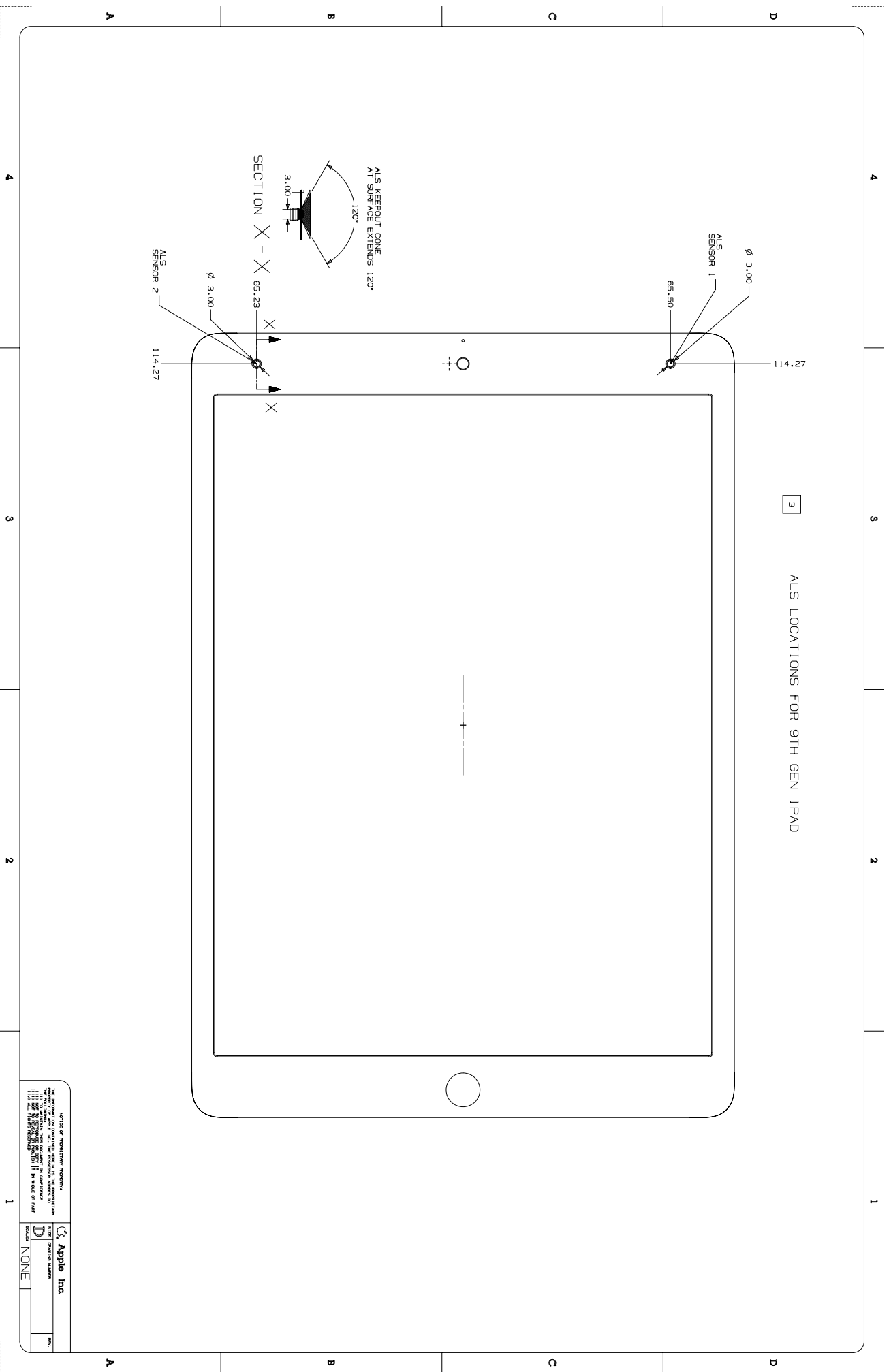


Apple Inc.	
Model	56.86
Version	1.0
Scale	19:1
Sheet	6 of 6
Date	2023-10-10

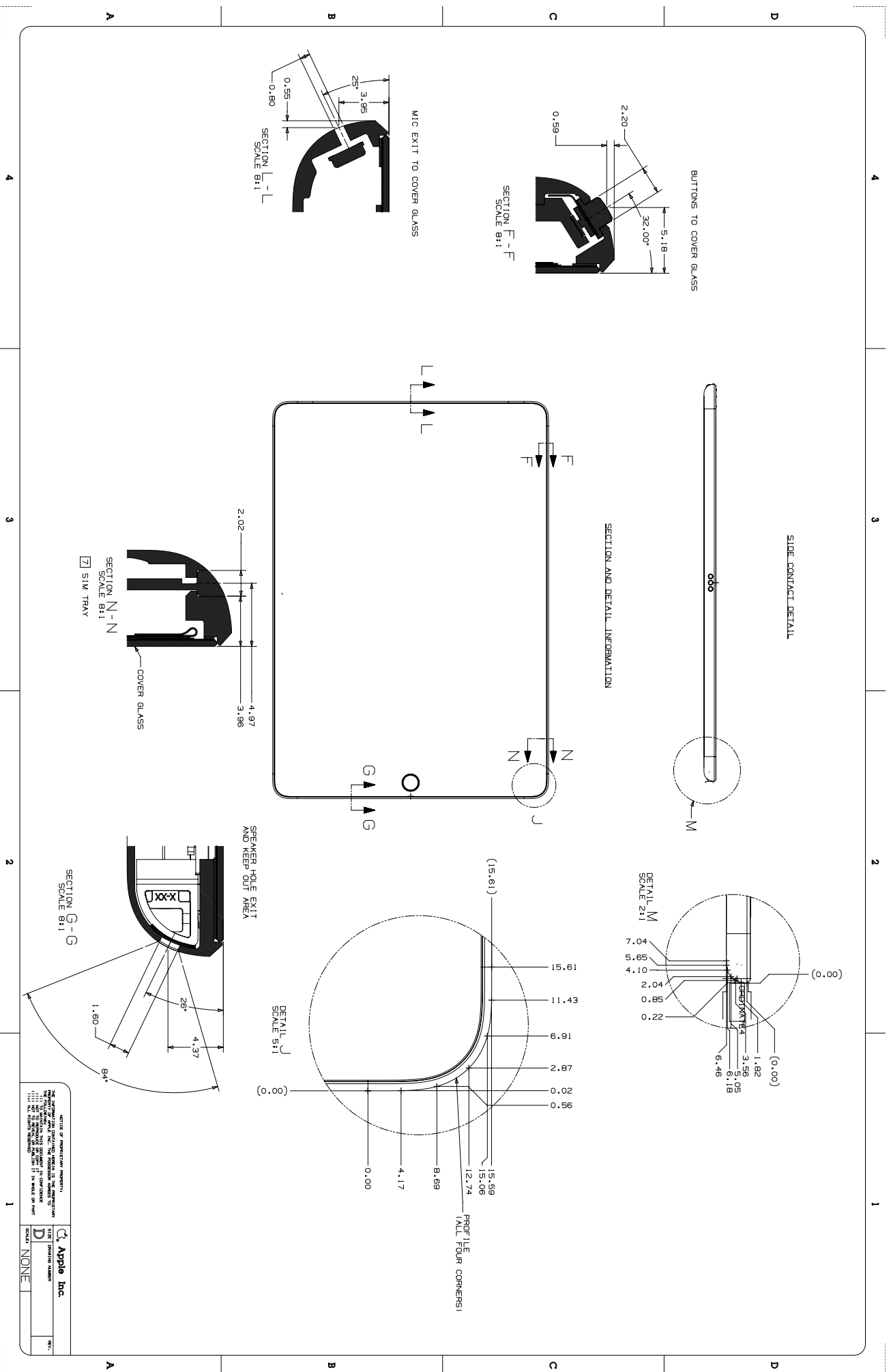
56.88 iPad (9th generation), iPad (8th generation) and iPad (7th generation) 2 of 4



56.89 iPad (9th generation), iPad (8th generation) and iPad (7th generation) 3 of 4



56.90 iPad (9th generation), iPad (8th generation) and iPad (7th generation) 4 of 4



SECTION OF REGISTERED PATENT:
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 APPLE INC. AND IS UNCLASSIFIED UNDER THE
 PROVISIONS OF EXECUTIVE ORDER 13526, WHICH
 AUTHORIZES RELEASE OF INFORMATION FROM
 THIS DOCUMENT ON THE DATE 11/11/2025.
 11/11/2025 10:28:58 AM EST BY: 60322 (JLW)

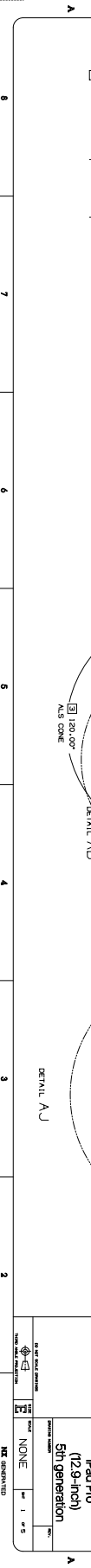
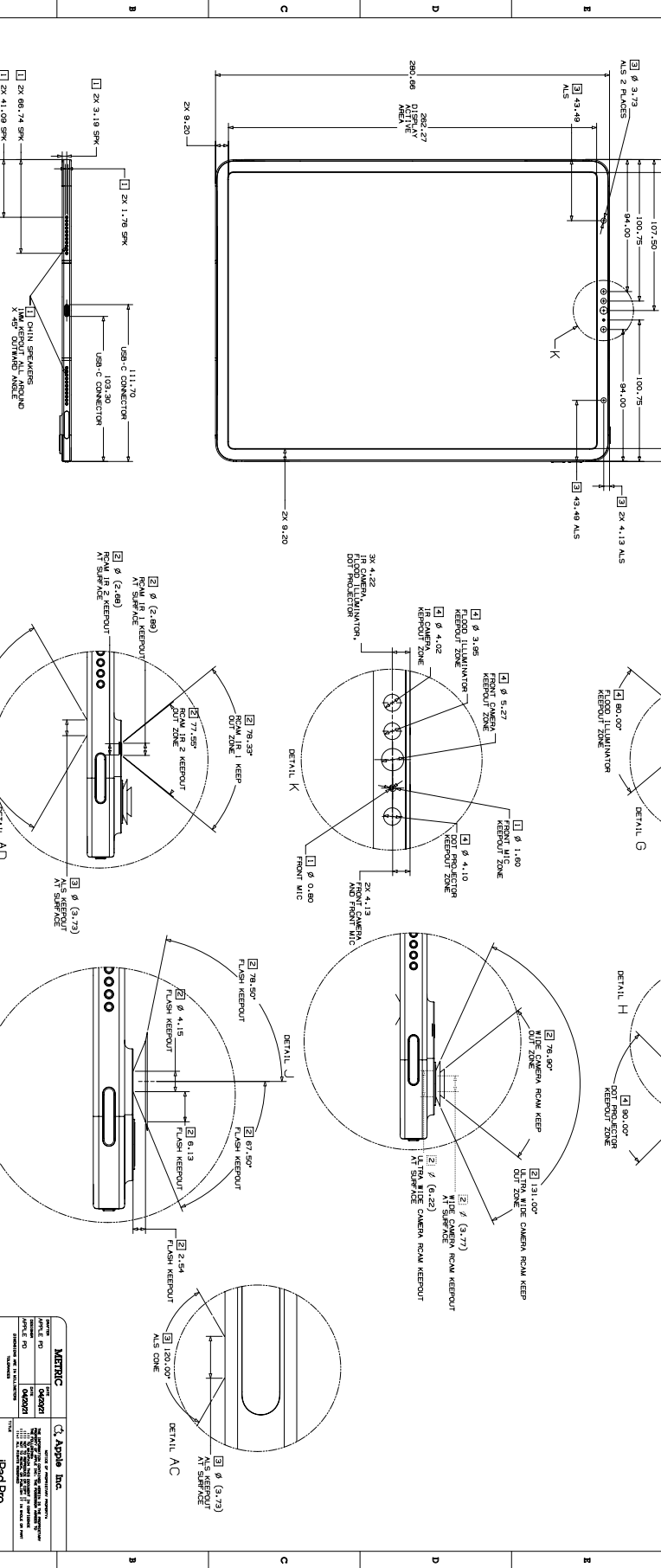
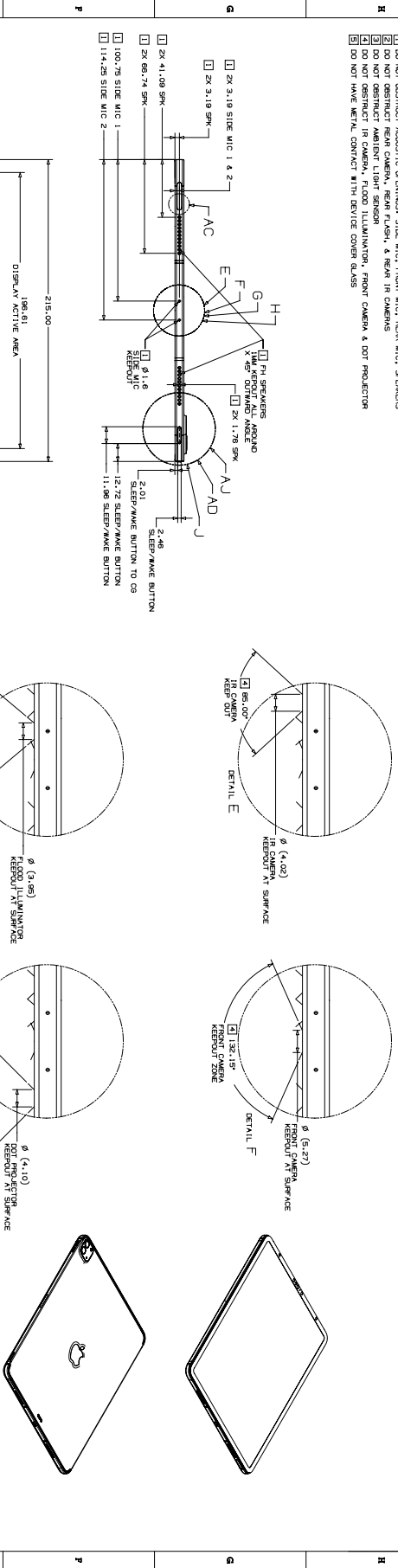
Apple Inc.
 PART NUMBER: 56.90
 DRAWING NUMBER: 56.90.001
 REVISION: 1

DATE: 11/11/2025

DESIGNED BY: NONE

56.91 iPad Pro 12.9-inch (5th generation) 1 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 REAR CAMERA, REAR FLASH, REAR IR CAMERAS & DOT PROJECTOR
 - 4 DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, REAR IR CAMERAS, FRONT CAMERA & DOT PROJECTOR
 - 5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS



METRIC		Apple Inc.	
DATE	10/10/23	DESIGNED BY	Apple Inc.
SCALE	1:1	ENGINEERED BY	Apple Inc.
PART NO	56.91	TESTED BY	Apple Inc.
REV	1	APPROVED BY	Apple Inc.

Model Name: iPad Pro (12.9-inch) 5th generation

Serial Number: [REDACTED]

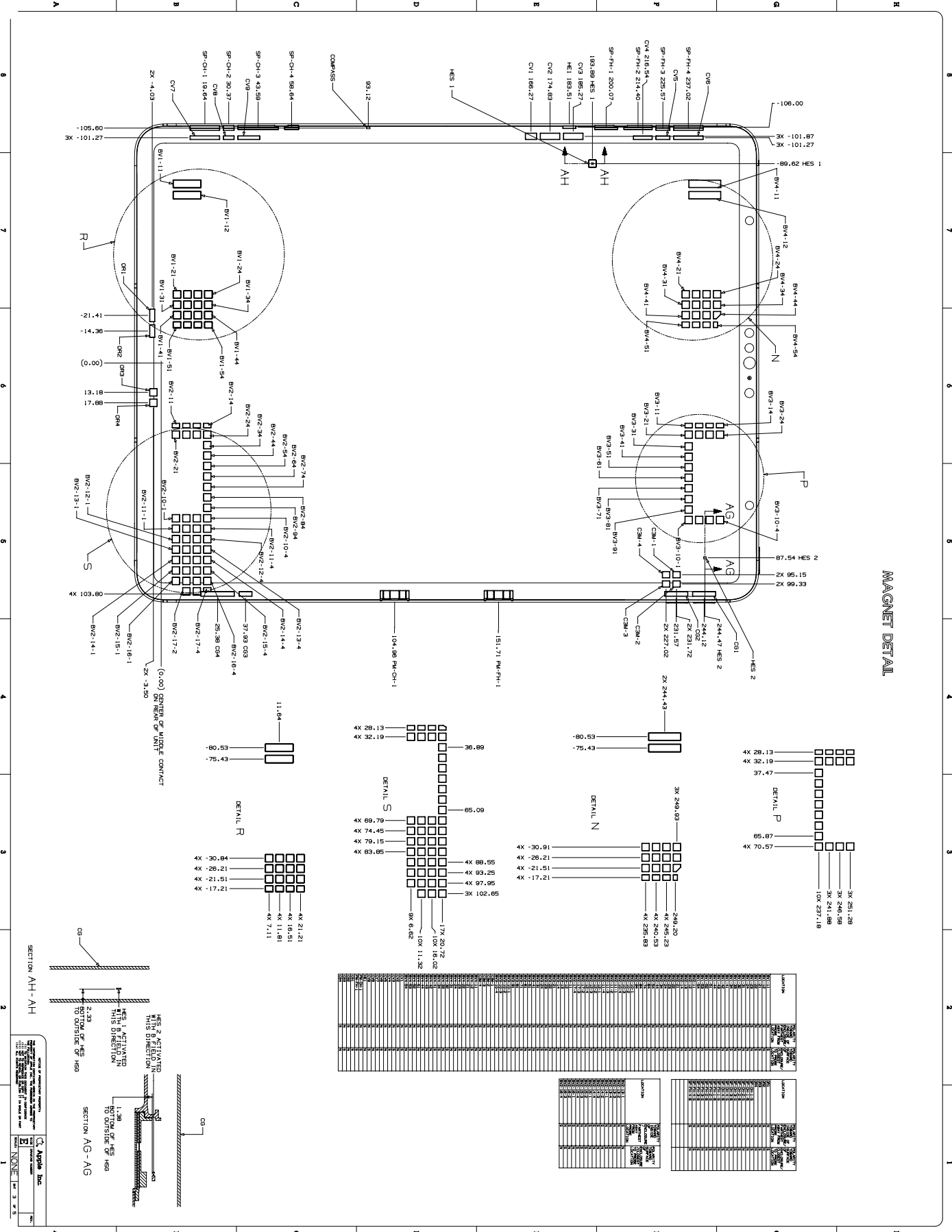
Barcode: [REDACTED]

Component: NONE

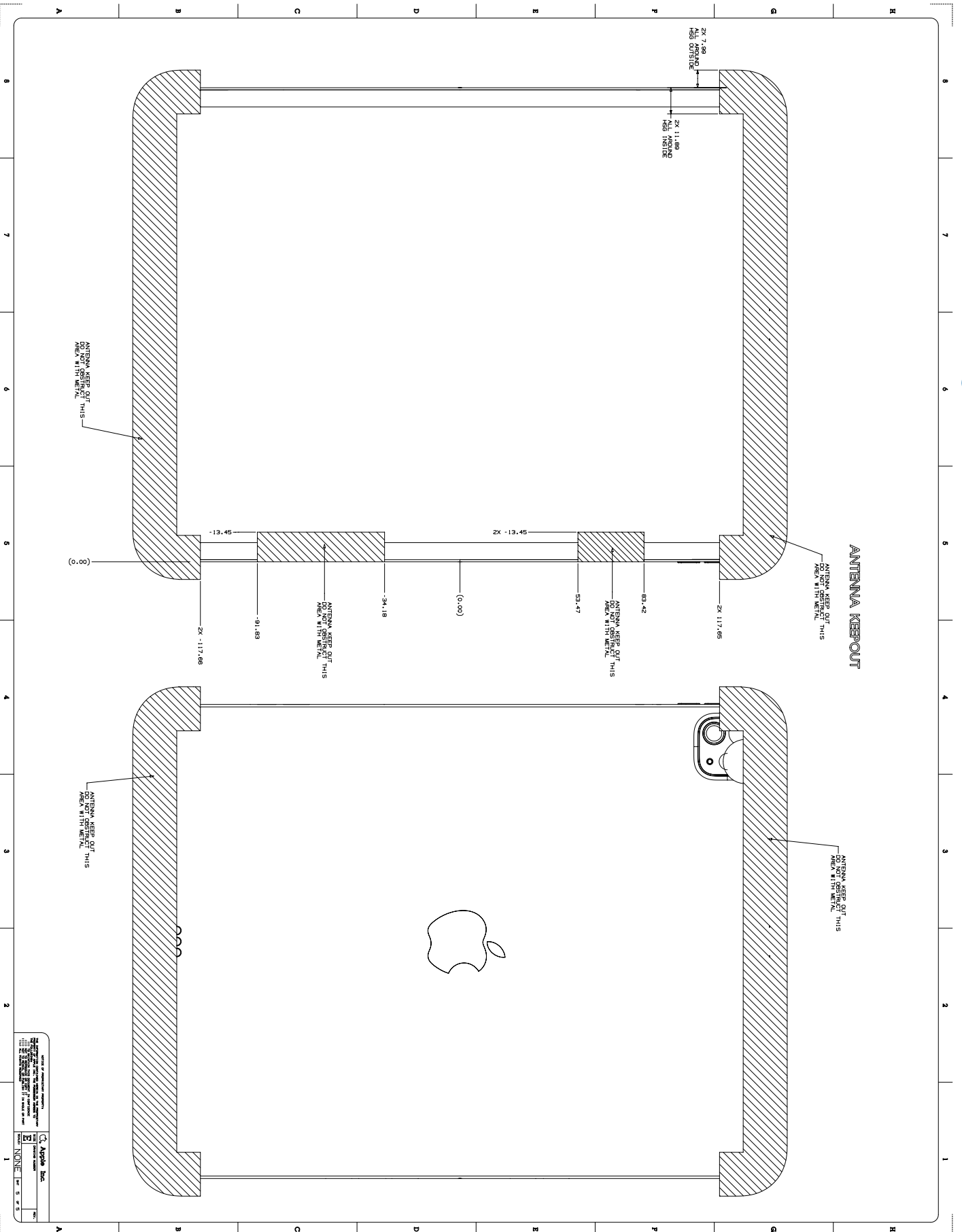
Part Number: 56.91

Revision: 1 of 5

MAGNET DETAIL



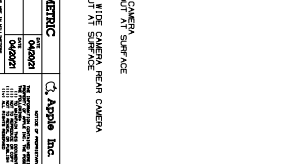
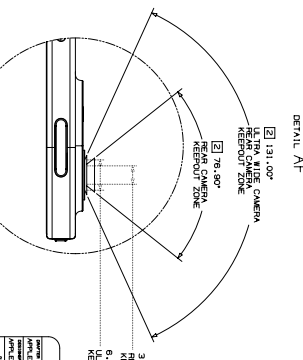
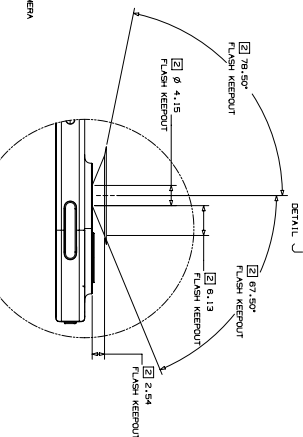
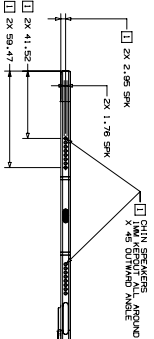
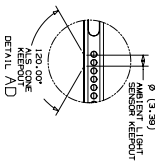
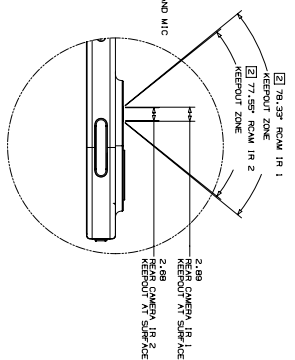
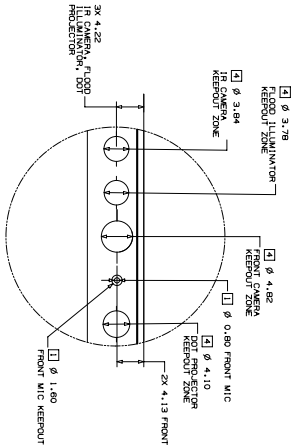
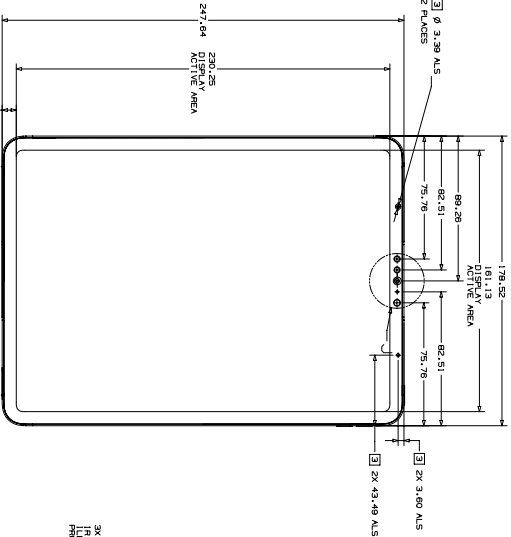
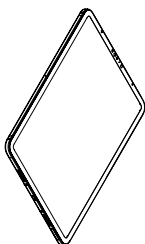
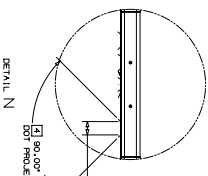
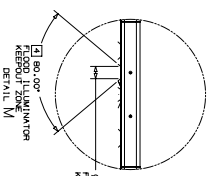
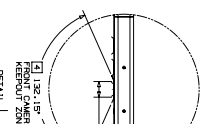
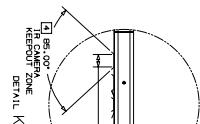
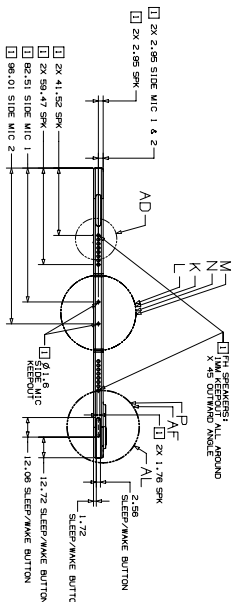
56.95 iPad Pro 12.9-inch (5th generation) 5 of 5



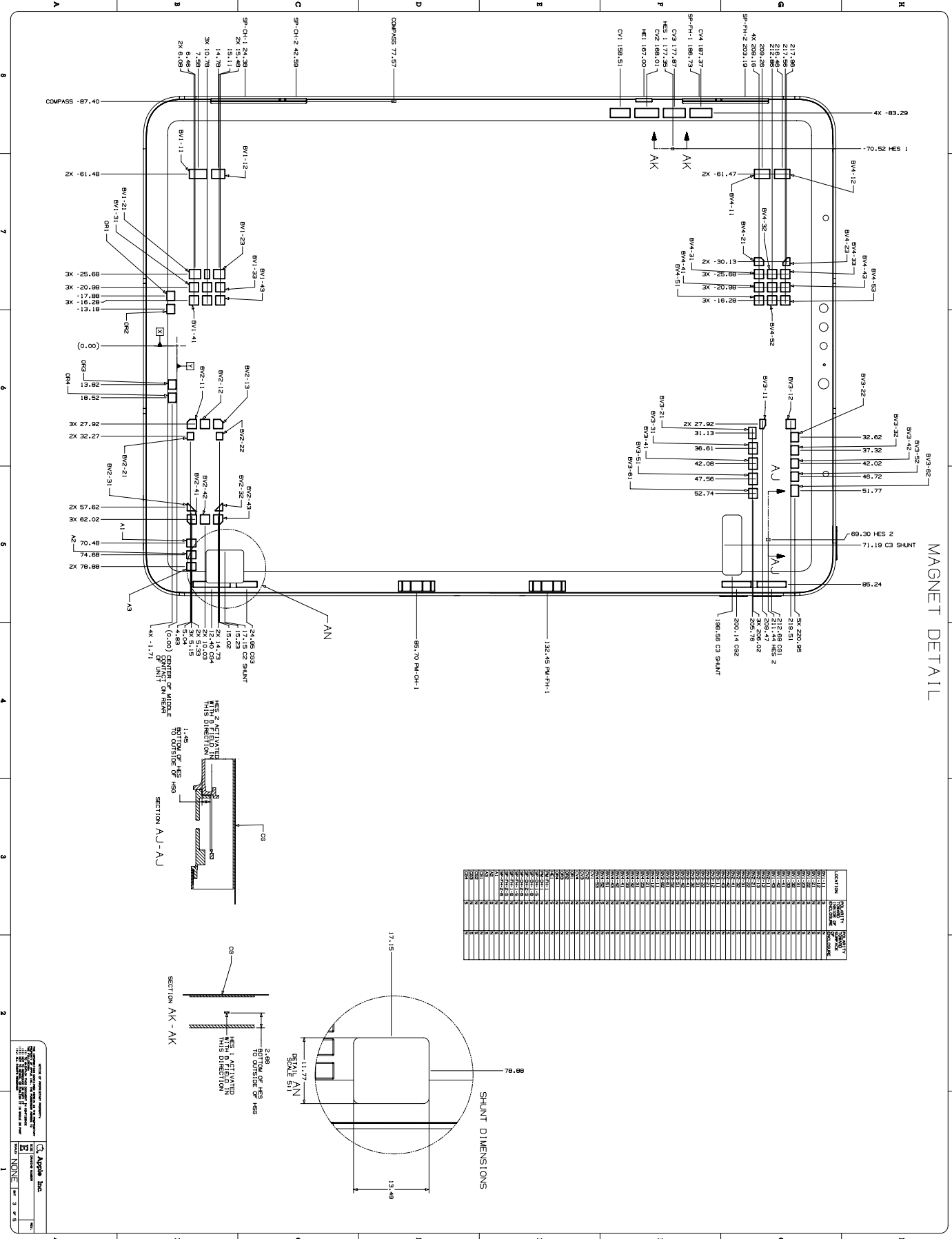
Apple Inc.	
Model	None
Part	None
Rev	1
Created	11/11/11
By	Apple Inc.
Checked	Apple Inc.
Approved	Apple Inc.
Released	Apple Inc.

56.96 iPad Pro 11-inch (3rd generation) 1 of 5

- NOTES:** UNLESS OTHERWISE SPECIFIED:
- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
 - 2 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
 - 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



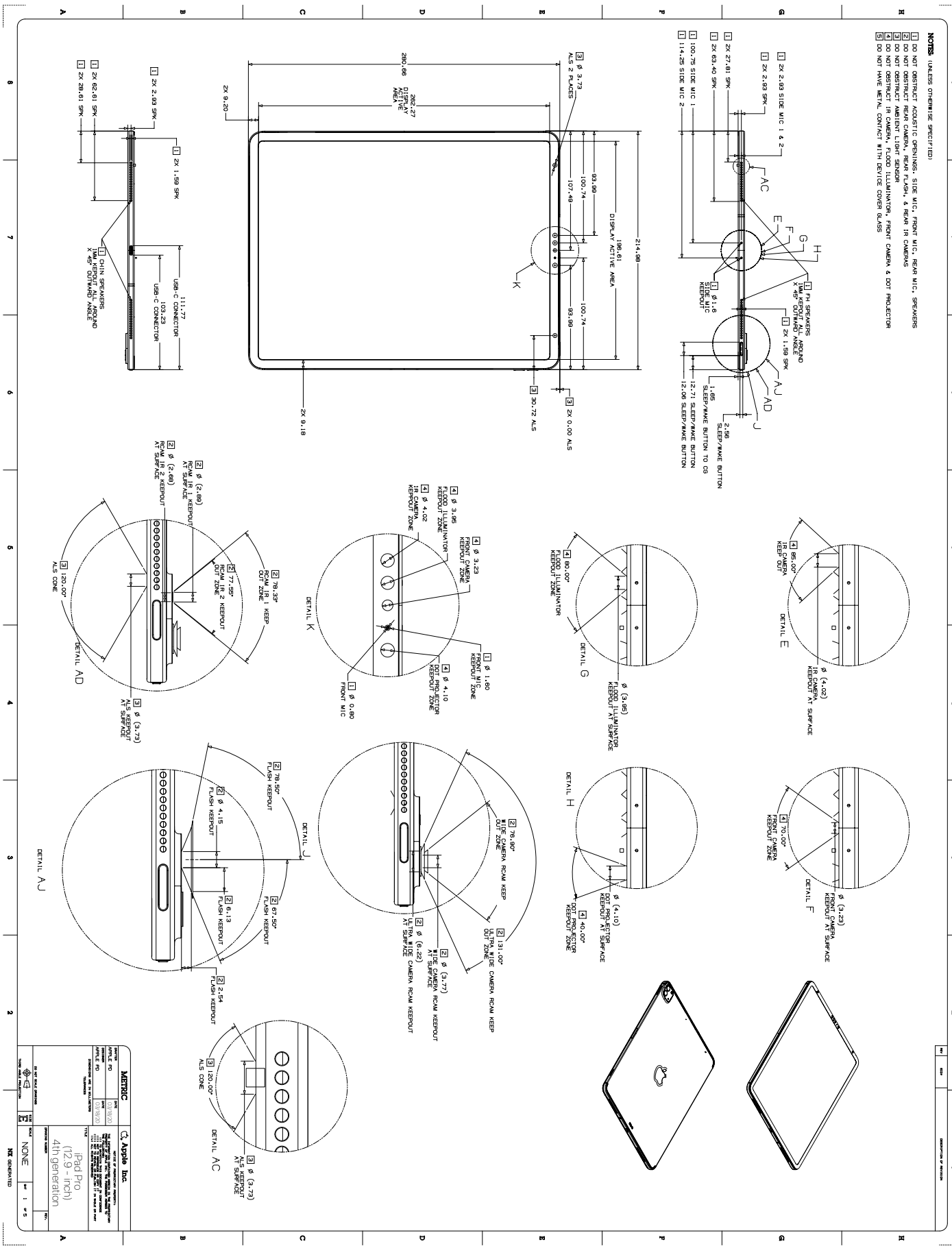
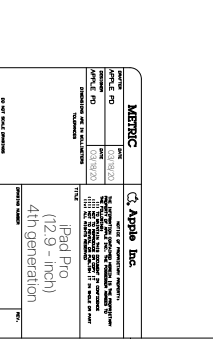
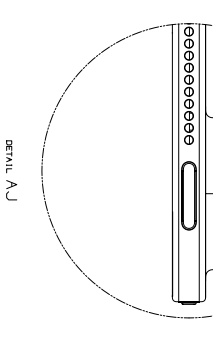
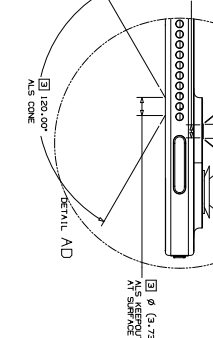
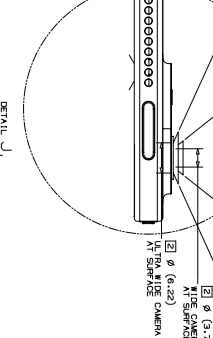
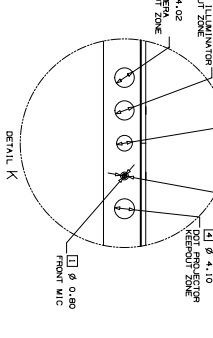
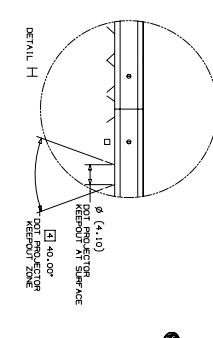
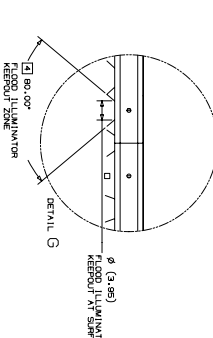
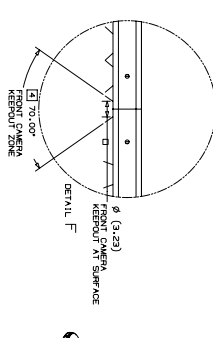
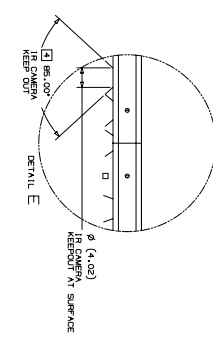
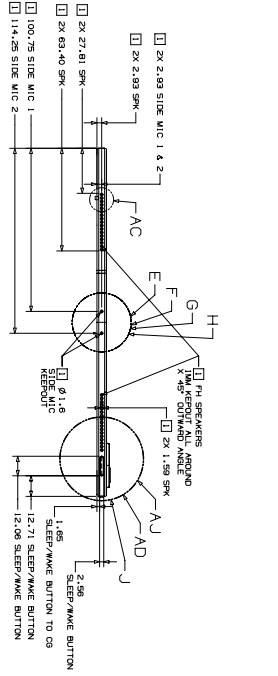
METRIC		Apple Inc.	
DESCRIPTION	REAR CAMERA	UNIT	MM
DATE	2023-10-10	SCALE	1:1
REV	1	ISSUE	1
PARTS LIST		PARTS LIST	
QTY	1	QTY	1
ASSEMBLY		ASSEMBLY	
3rd generation		3rd generation	
11-inch		11-inch	
iPad Pro		iPad Pro	
NONE		NONE	
1 of 5		1 of 5	



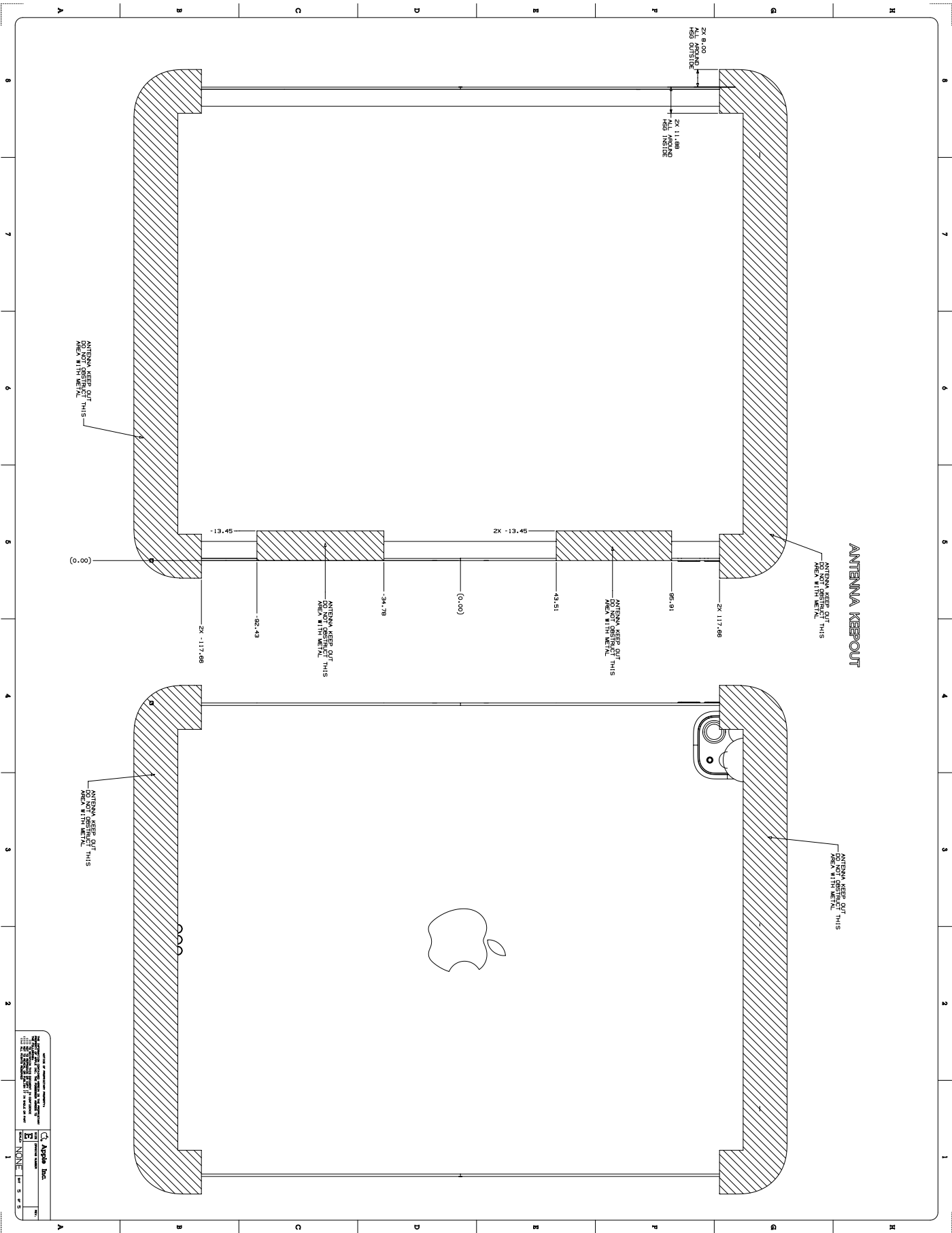
LOCATION	DESCRIPTION	UNIT	SCALE
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099	1	MM	S11
100	1	MM	S11

56.101 iPad Pro 12.9-inch (4th generation) 1 of 5

- NOTES:** DIMENSIONS SPECIFIED
- DO NOT OBSTRUCT ACOUSTIC PENETRATIONS, SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
 - DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERA
 - DO NOT OBSTRUCT REAR LIGHT SENSOR, AUTOMATICALLY, FRONT CAMERA & DOT PROJECTOR
 - DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS



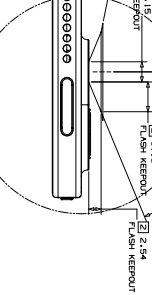
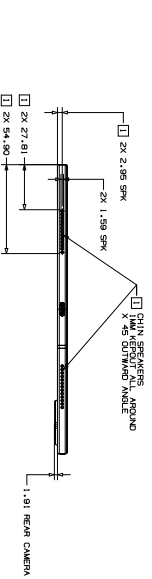
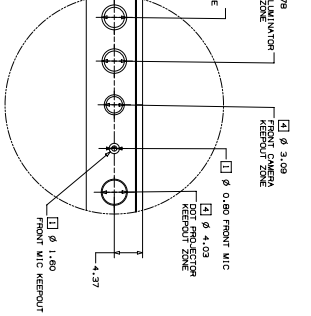
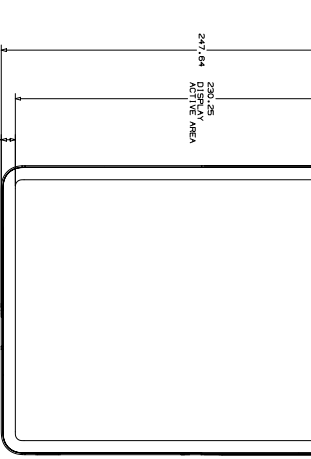
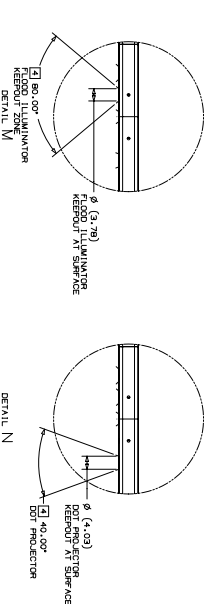
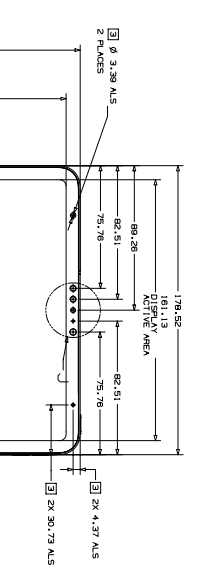
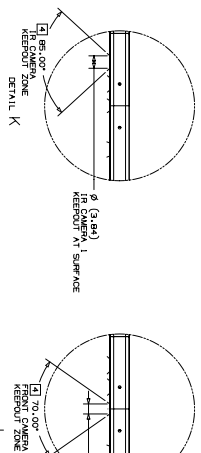
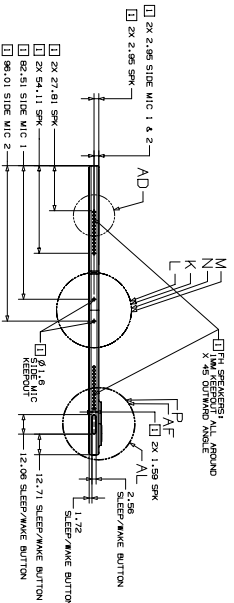
56.105 iPad Pro 12.9-inch (4th generation) 5 of 5



Apple Inc.	
Model	56.105
Version	1.0
Date	2023-10-10
Author	Apple Inc.
Checked by	Apple Inc.
Approved by	Apple Inc.
Part Name	ANTENNA KEEP OUT AREA WITH METAL
Part Number	56.105.001
Part Description	ANTENNA KEEP OUT AREA WITH METAL
Part Material	None
Part Quantity	1

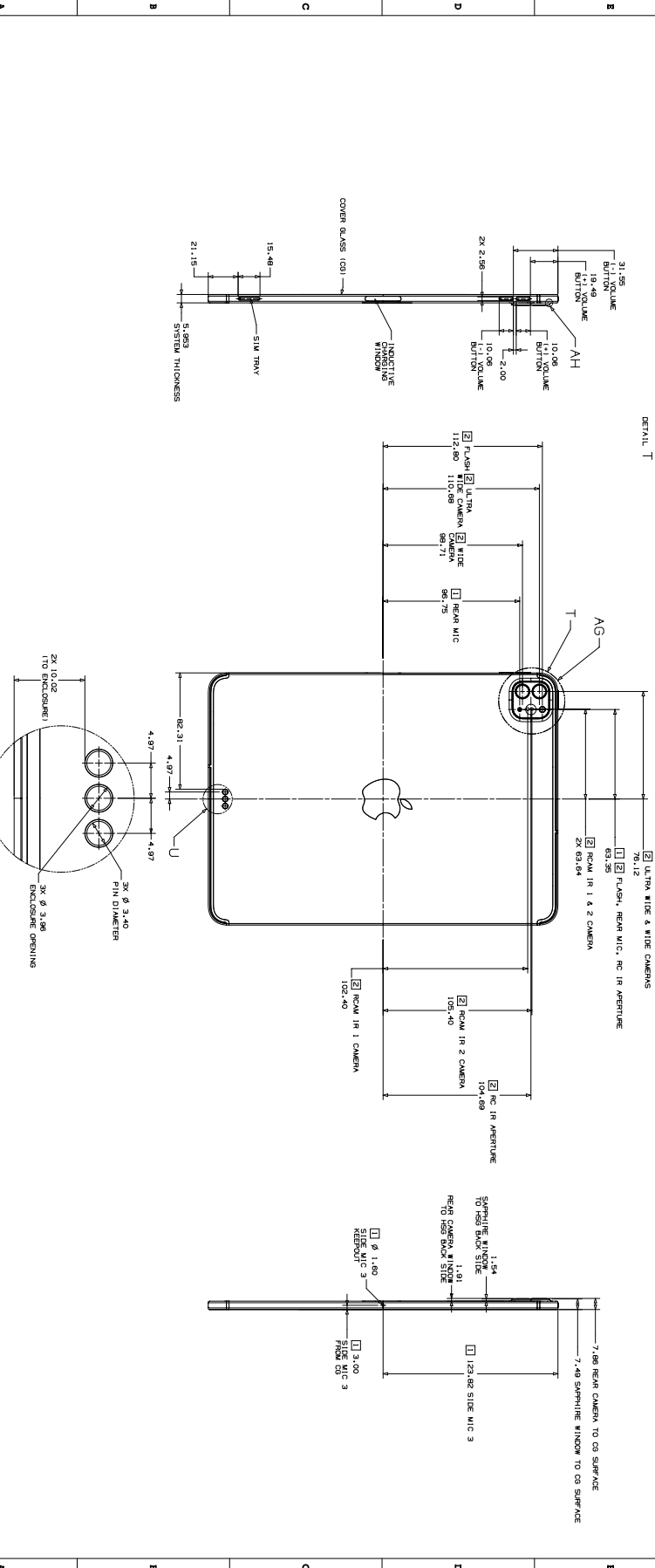
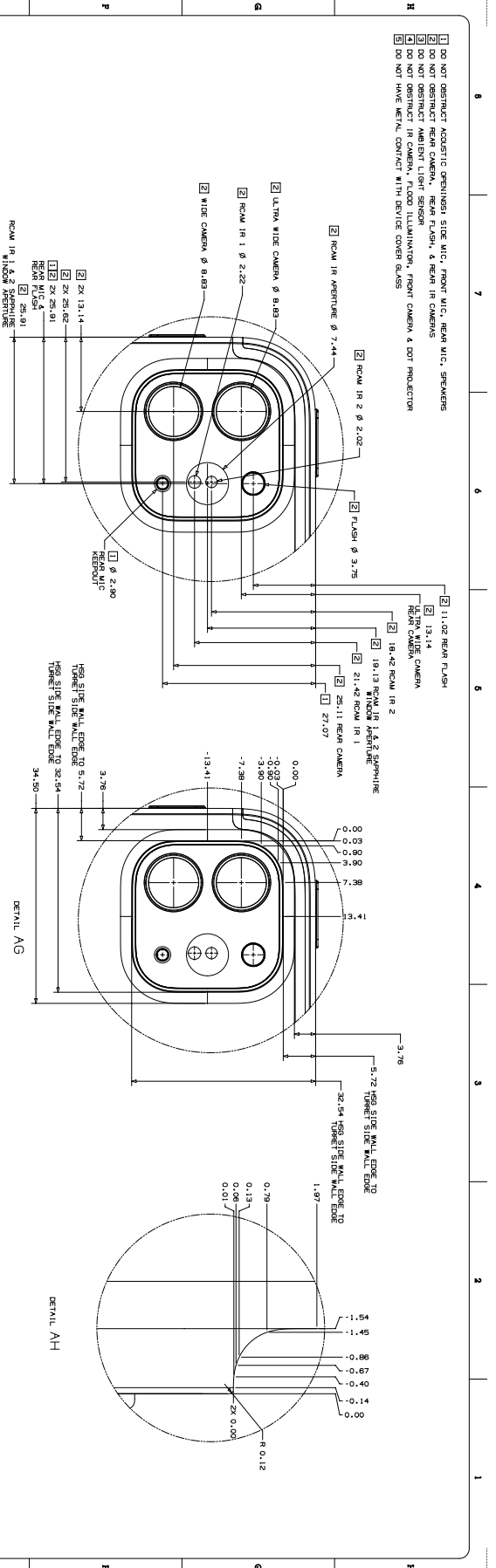
56.106 iPad Pro 11-inch (2nd generation) 1 of 5

- NOTES** UNLESS OTHERWISE SPECIFIED:
- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
 - 2 DO NOT OBSTRUCT OPTICAL OPENINGS: FRONT CAMERA, REAR CAMERA
 - 3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
 - 4 DO NOT OBSTRUCT IR CAMERA, FLOOR ILLUMINATOR, FRONT CAMERA & DOT PROJECTION
 - 5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS



<p>METRIC Apple Inc.</p> <p>11" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p>	
<p>MODEL: A2602</p> <p>PART NUMBER: A2602</p> <p>DATE: 01/23/2023</p> <p>REVISION: 001</p>	<p>11" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p>
<p>11" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p>	<p>11" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p> <p>11.1" (281.48 mm) Diagonal Length</p>

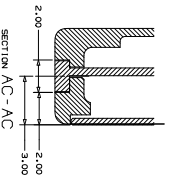
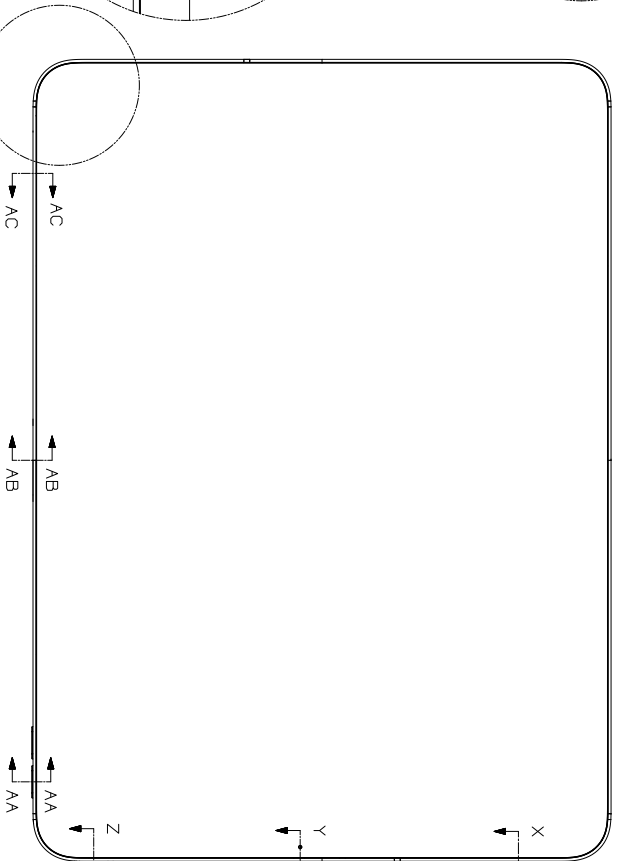
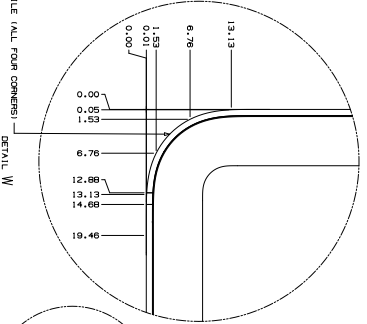
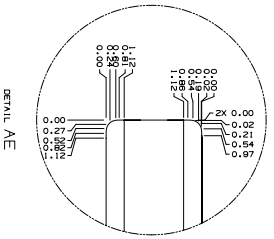
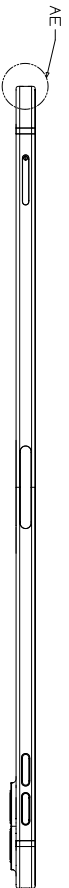
- DO NOT OBSTRUCT ACOUSTIC OPENINGS, SIDE MIC, FRONT MIC, REAR MIC, SPEAKERS
- DO NOT OBSTRUCT REAR CAMERA, REAR FLASH, & REAR IR CAMERAS
- DO NOT OBSTRUCT FRONT CAMERA, FRONT FLASH, & FRONT IR CAMERAS
- DO NOT OBSTRUCT IR CAMERA, FLUORO ILLUMINATOR, FRONT CAMERA & DOT PROJECTOR
- DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS



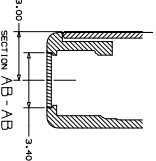
Apple Inc. 2023

Model	11,2	11,3
Part Number	11,2	11,3
Revision	1	1
Material	Aluminum	Aluminum
Color	Space Gray	Space Gray
Weight	1.58 kg	1.58 kg
Dimensions	283.5 mm x 178 mm x 7.5 mm	283.5 mm x 178 mm x 7.5 mm

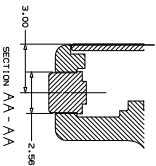
SECTION AND DETAIL INFORMATION



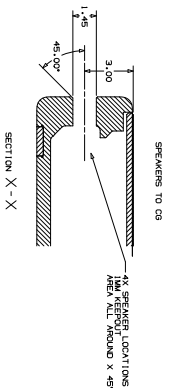
SIM TRAY



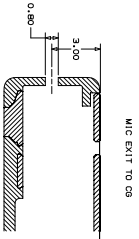
INDUCTIVE CHARGER WINDOW



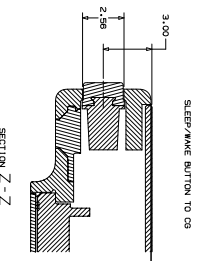
VOLUME BUTTON TO OS



SPEAKERS TO OS



MIC EXIT TO OS

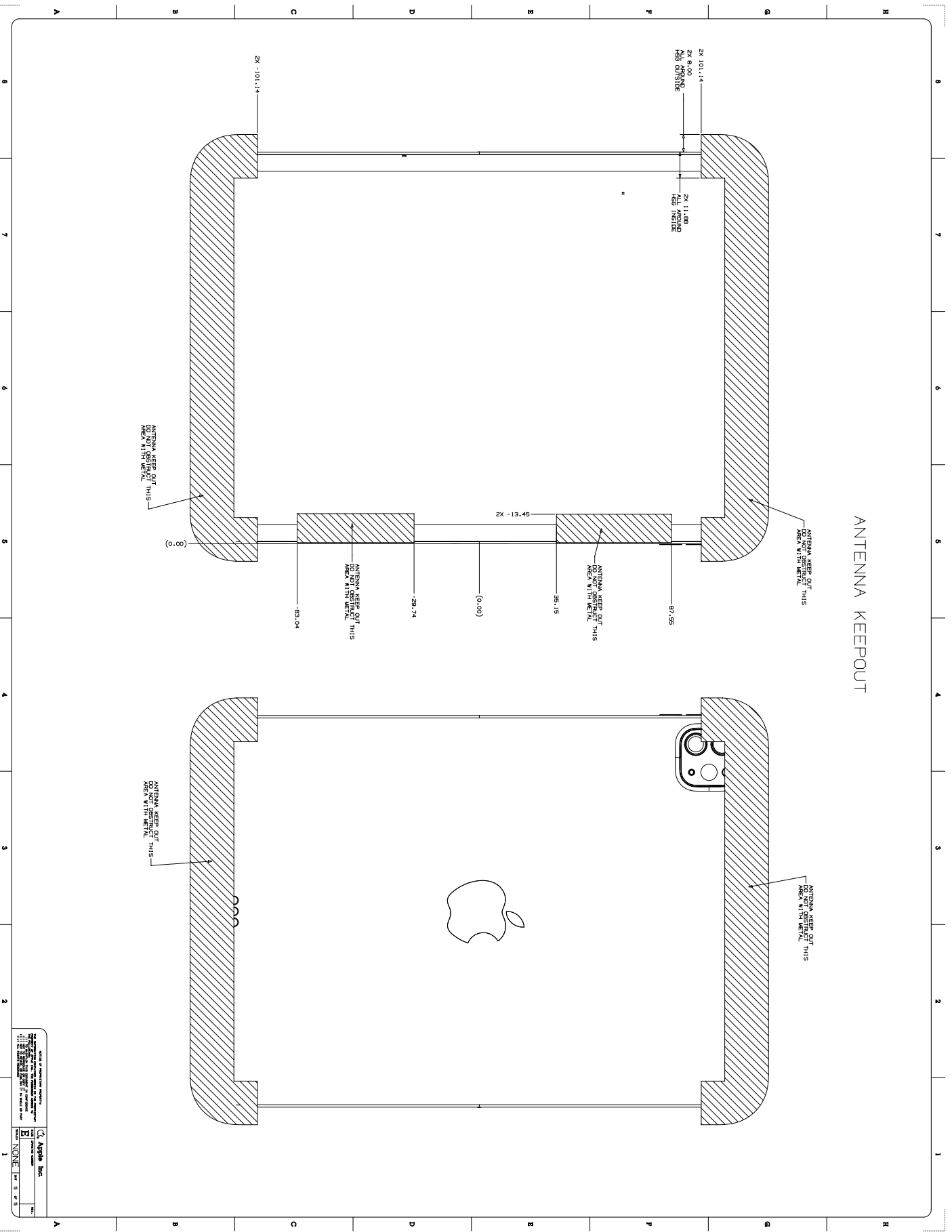


SLEEP/WAKE BUTTON TO OS

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Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 USA	Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 USA
Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 USA	Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 USA

56.110 iPad Pro 11-inch (2nd generation) 5 of 5

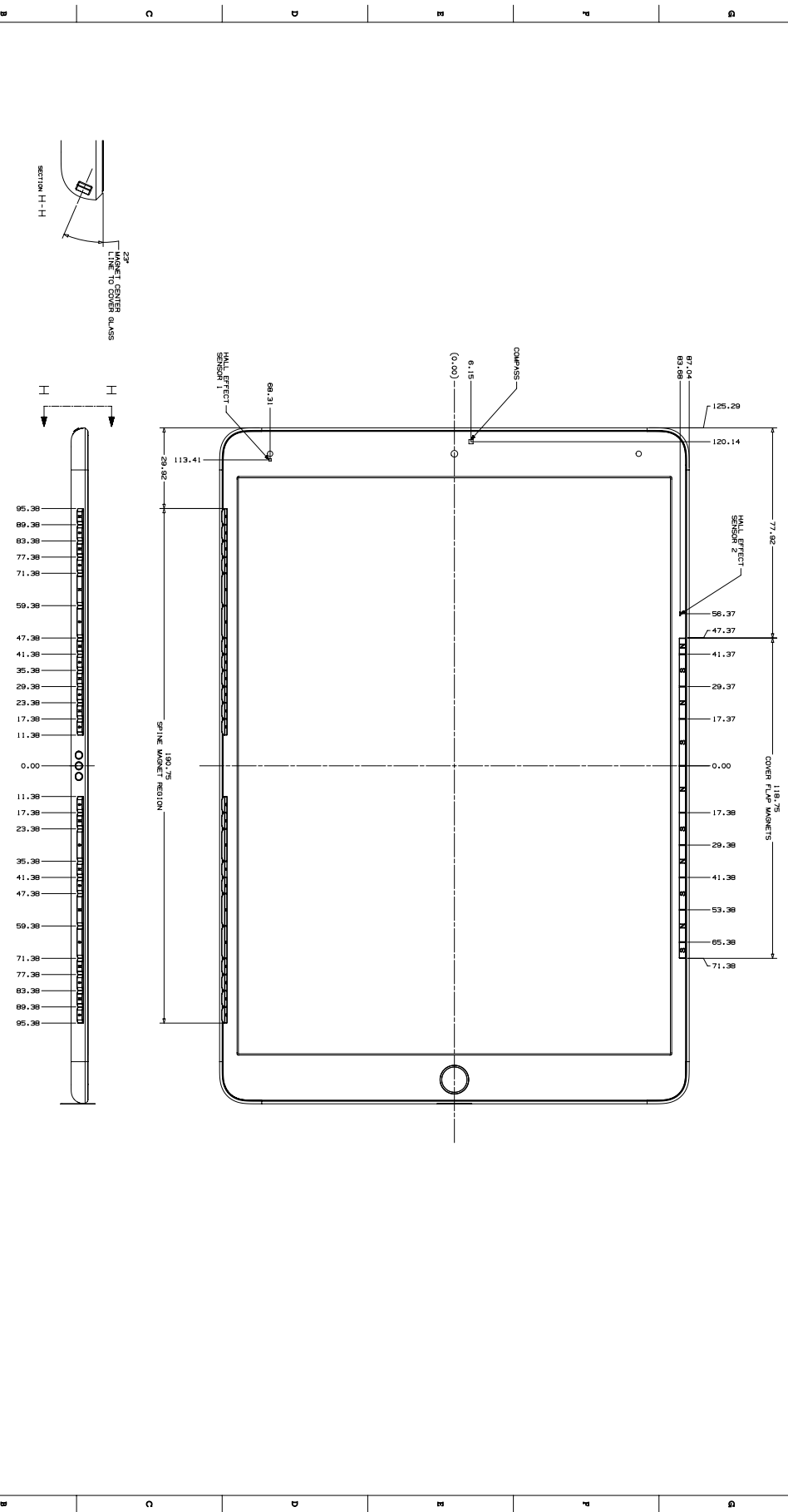
ANTENNA KEEPOUT



Apple Inc.	
Model: 56.110	Rev: 1
Created: 2023-10-10	Author: [Name]
Part Name: ANTENNA KEEPOUT	Quantity: 1
Material: NONE	Finish: NONE
Notes: [Notes]	Notes: [Notes]

56.112 iPad Air (3rd generation) with Wi-Fi 2 of 3

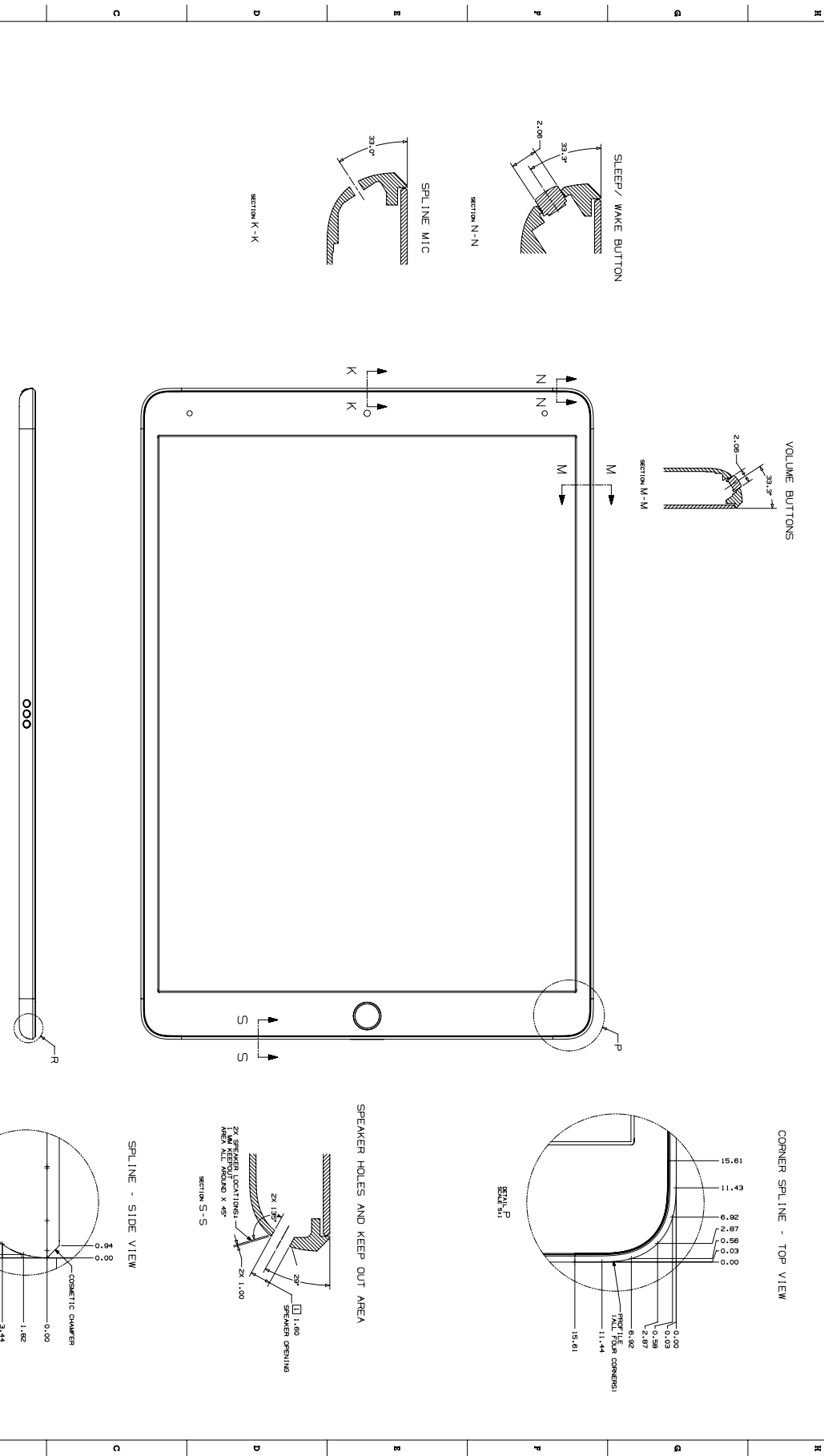
COVER FLAP MAGNET DETAIL
 POLARITY SHOWN NORMAL TO GLASS
 DIMENSIONS TO CENTER OF PRODUCT
 N = NORTH
 S = SOUTH



<small> Apple, the Apple logo, iPad, and Wi-Fi are trademarks of Apple Inc., registered in the United States and other countries. © 2023 Apple Inc. All rights reserved. </small>	
Model Name: iPad Air (3rd generation) with Wi-Fi	Model Number: A2689
Part Number: 1000000000	Revision: 1
Date of Publication: 10/10/2023	Date of Revision: 10/10/2023
Drawing Code: 56.112	Drawing Title: COVER FLAP MAGNET DETAIL
Drawing Scale: 1:1	Drawing Unit: MM
Drawing Format: PDF	Drawing Size: A4
Drawing Orientation: Landscape	Drawing Color: Black and White
Drawing Author: Apple Inc.	Drawing Date: 10/10/2023

56.113 iPad Air (3rd generation) with Wi-Fi 3 of 3

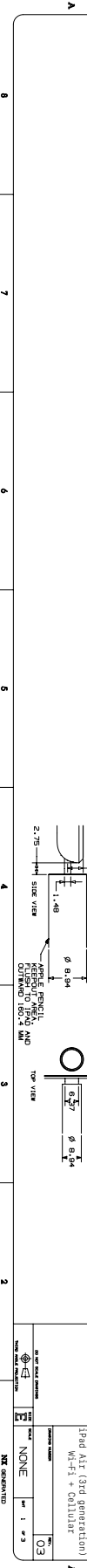
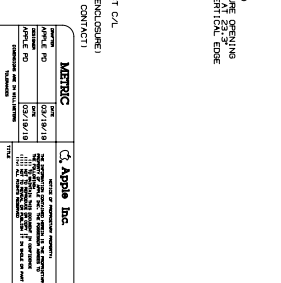
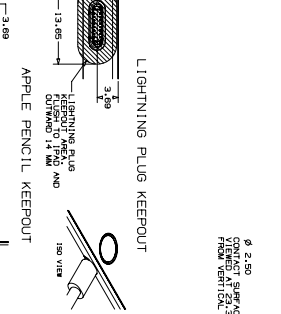
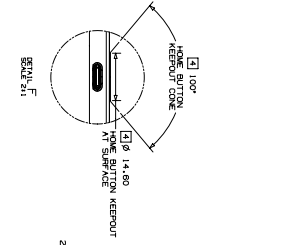
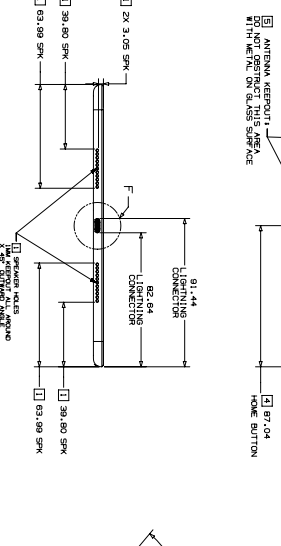
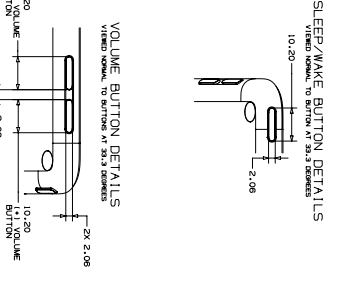
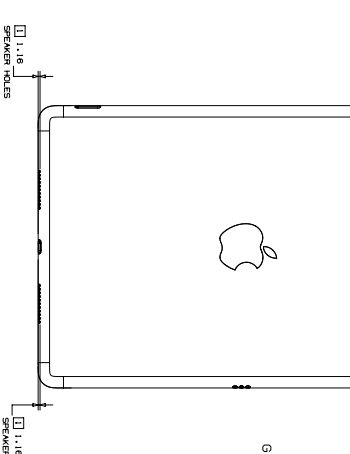
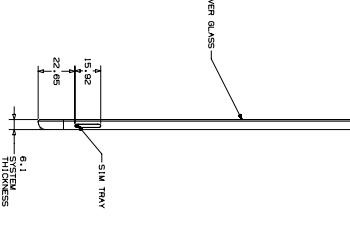
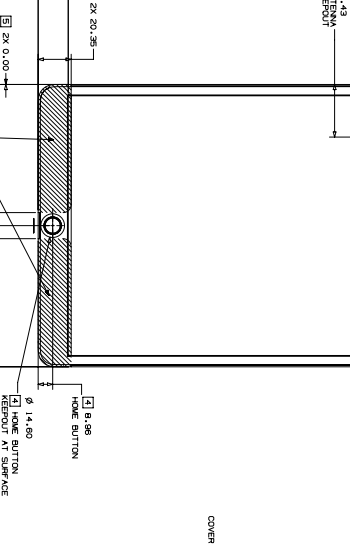
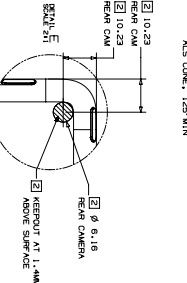
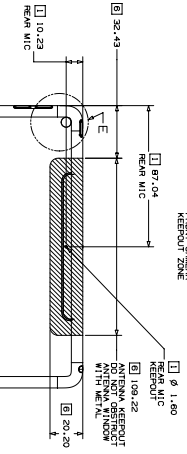
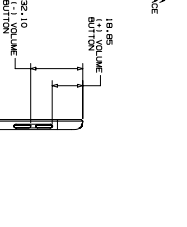
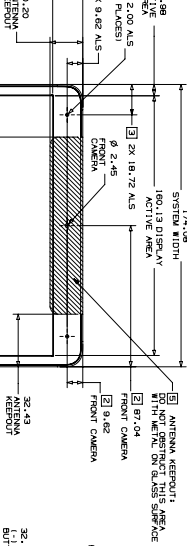
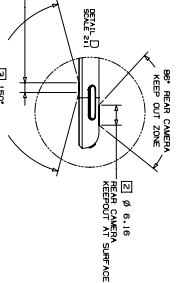
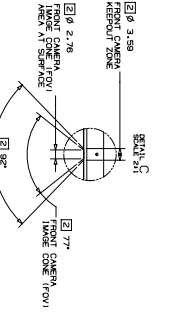
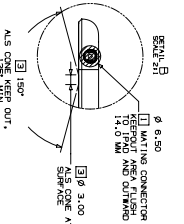
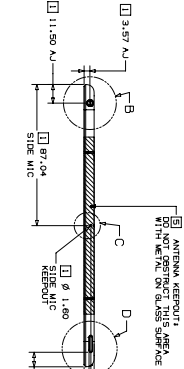
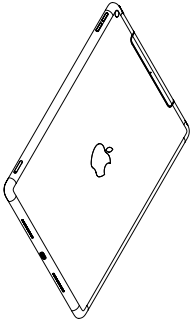
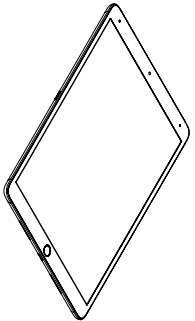
SECTION AND DETAIL INFORMATION



Apple logo Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 (415) 924-6457 www.apple.com/ipad		Apple logo Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 (415) 924-6457 www.apple.com/ipad
Apple logo Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 (415) 924-6457 www.apple.com/ipad	Apple logo Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 (415) 924-6457 www.apple.com/ipad	Apple logo Apple Inc. 1 Apple Park Drive Cupertino, CA 95014 (415) 924-6457 www.apple.com/ipad

56.114 iPad Air (3rd generation) with Wi-Fi + Cellular 1 of 3

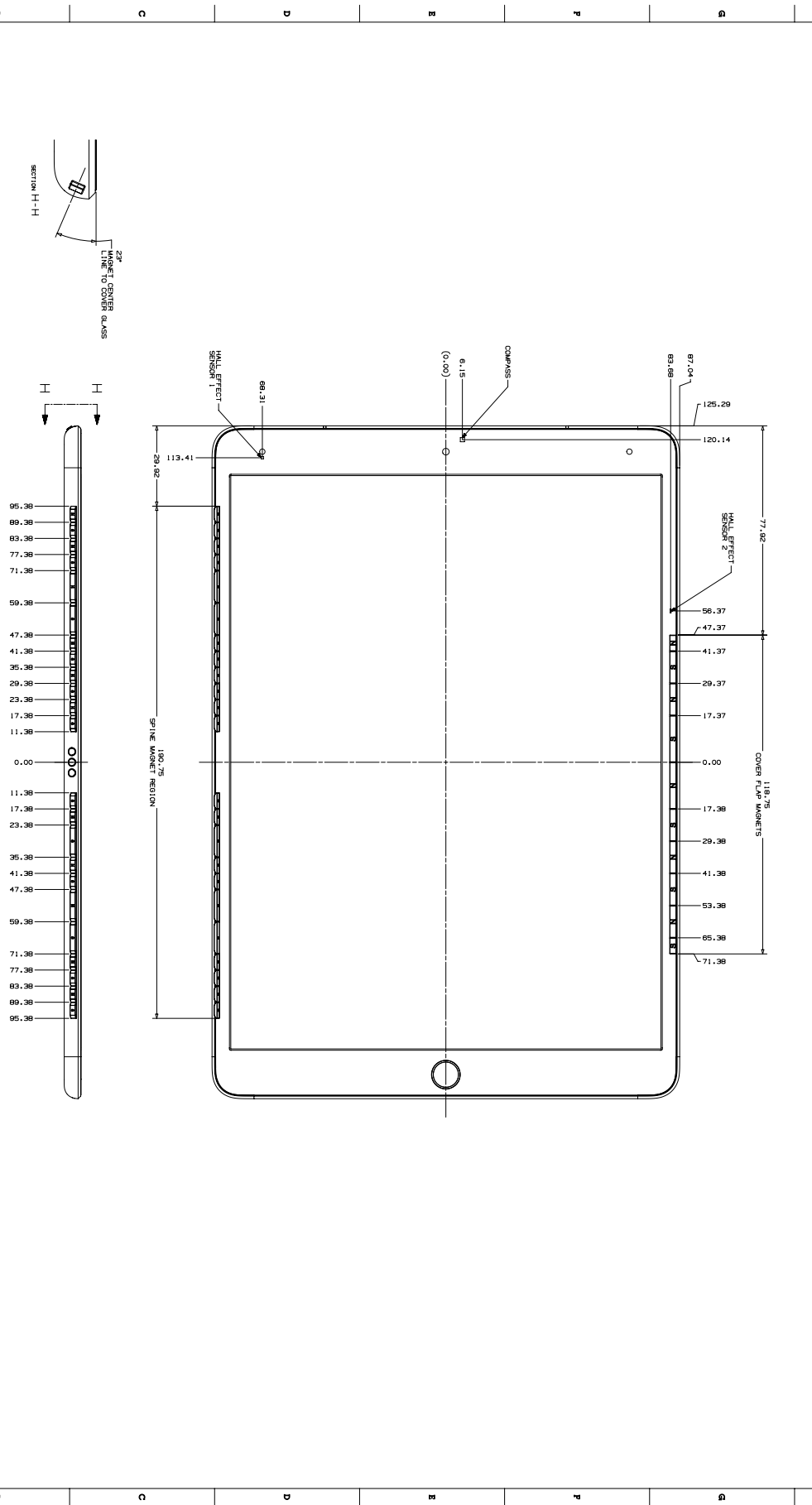
- NOTE:**
- 1 DO NOT RESTRICT ACOUSTIC GROUNDS: SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
 - 2 DO NOT RESTRICT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH
 - 3 DO NOT RESTRICT THE AMBIENT LIGHT SENSOR (ALS)
 - 4 DO NOT RESTRICT THE HOME BUTTON
 - 5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
 - 6 DO NOT HAVE METAL CONTACT WITH DEVICE ENCLOSURE



Apple Inc. 1 Apple Park Way Cupertino, CA 95014 415.974.4000 © 2023 Apple Inc. All rights reserved. www.apple.com/ipadair		03 NONE 1 of 3 NX GENERATED	
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56.115 iPad Air (3rd generation) with Wi-Fi + Cellular 2 of 3

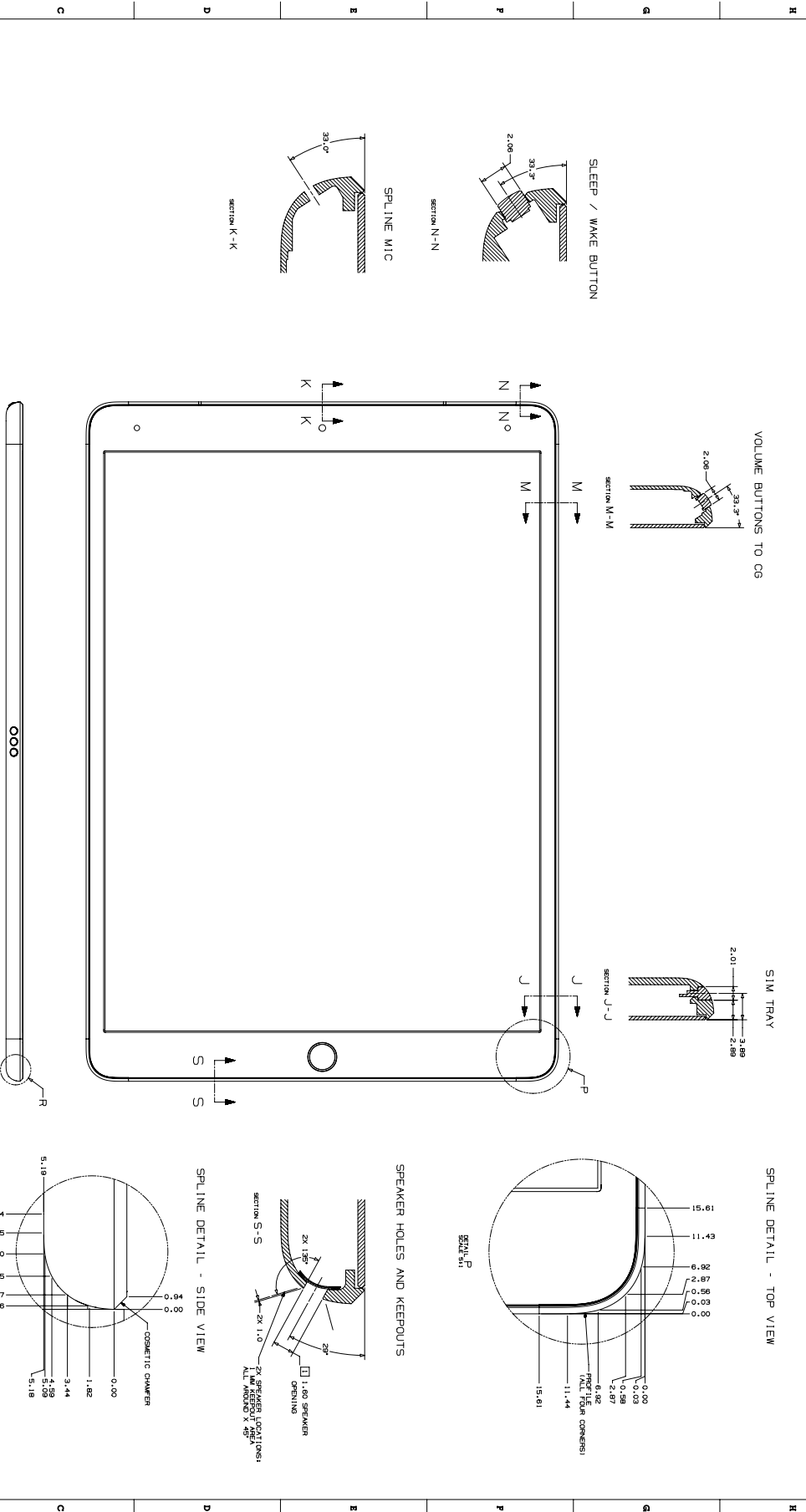
COVER FLAP MAGNET DETAIL
 POLARITY SHOWN NORMAL TO GLASS
 DIMENSIONS TO CENTER OF PRODUCT
 N = NORTH
 S = SOUTH



APPLE 10000 Apple Way Cupertino, CA 95014 (415) 922-6000 © 2023 Apple Inc. All rights reserved.	
PART NUMBER 56.115	APPLE INC.
DATE 03	NONE

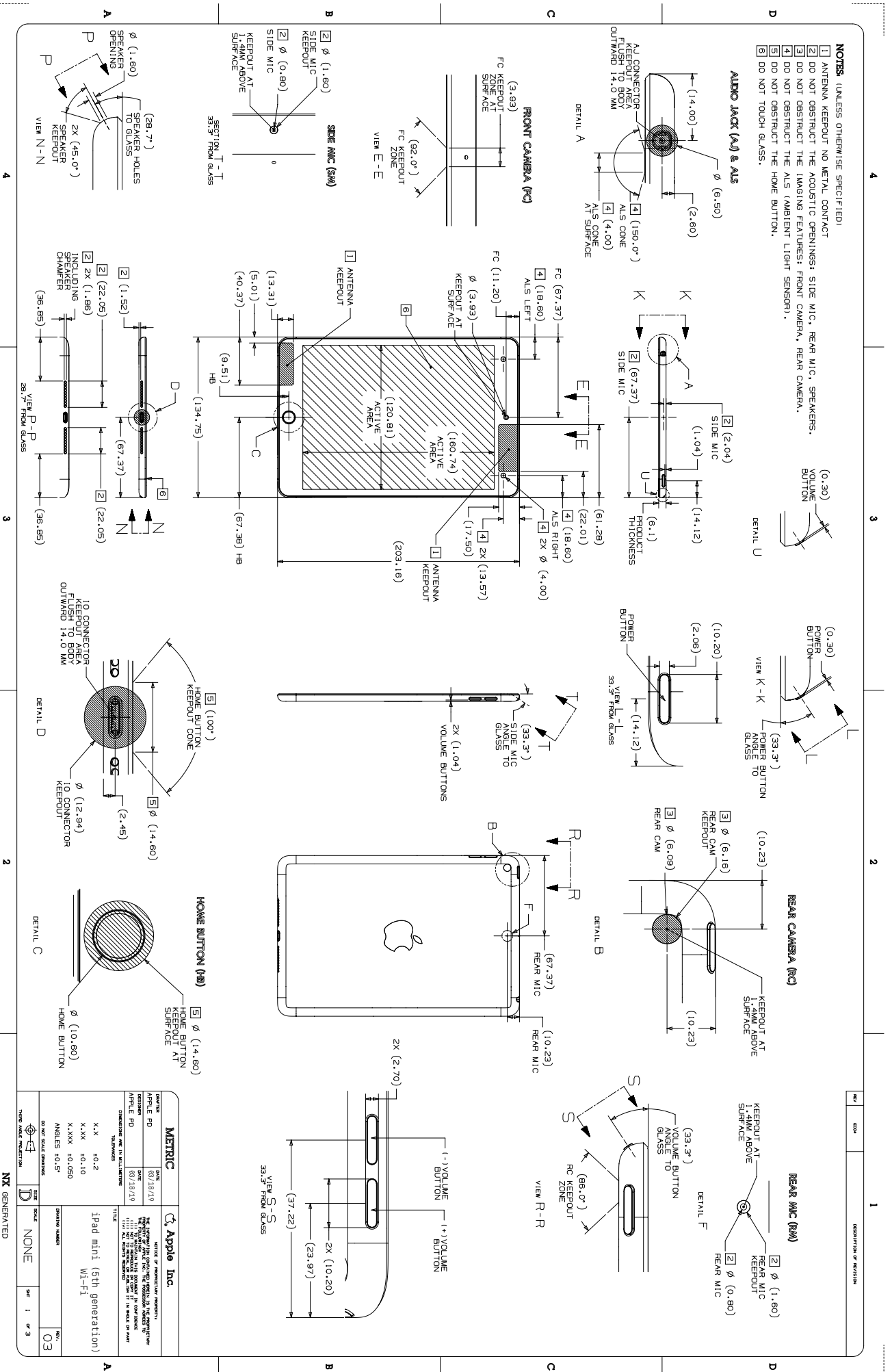
56.116 iPad Air (3rd generation) with Wi-Fi + Cellular 3 of 3

SECTION AND DETAIL INFORMATION



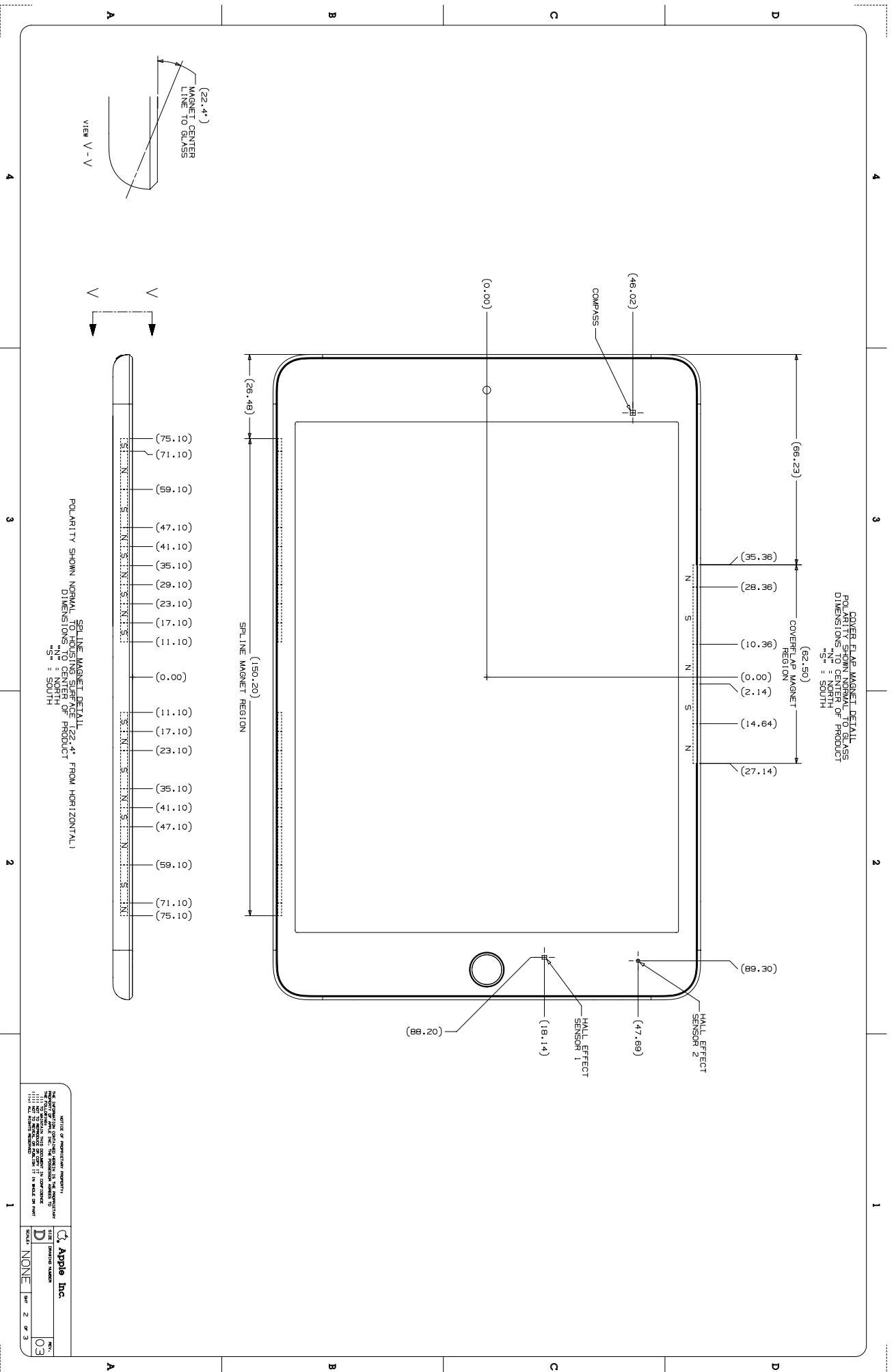
Apple Inc.	
Model	56.116
Version	3 of 3
None	None

56.117 iPad mini (5th generation) with Wi-Fi 1 of 3



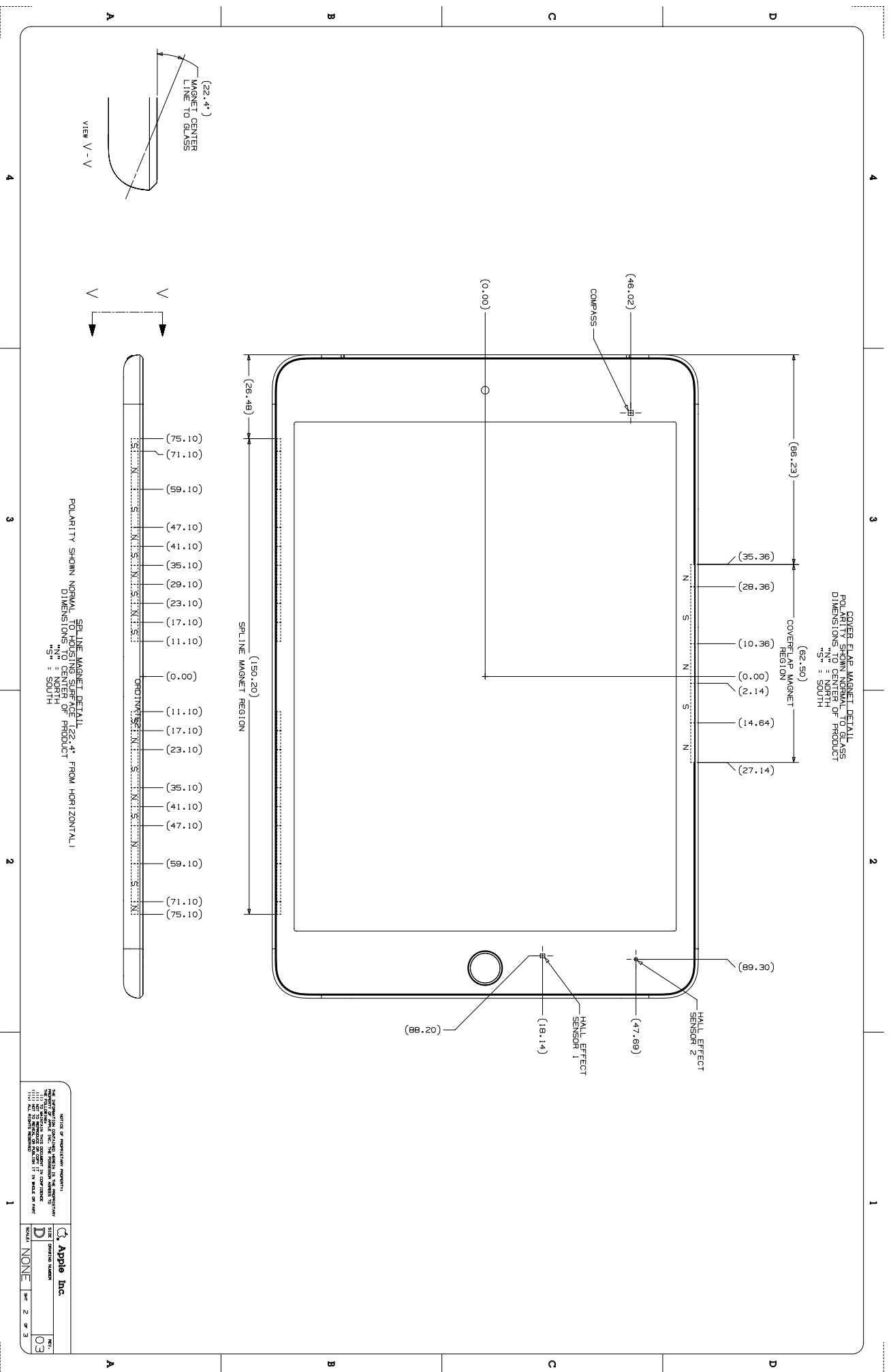
METRIC		Apple Inc.	
DATE	8/18/19	DATE	8/18/19
APPROVED BY		APPROVED BY	
DESIGNED BY		DESIGNED BY	
TITLE: iPad mini (5th generation) Wi-Fi			
PART NUMBER: 03			
SCALE: NONE			
SHEET: 1 OF 3			

56.118 iPad mini (5th generation) with Wi-Fi 2 of 3



Apple Inc.
 Apple logo
 NONE

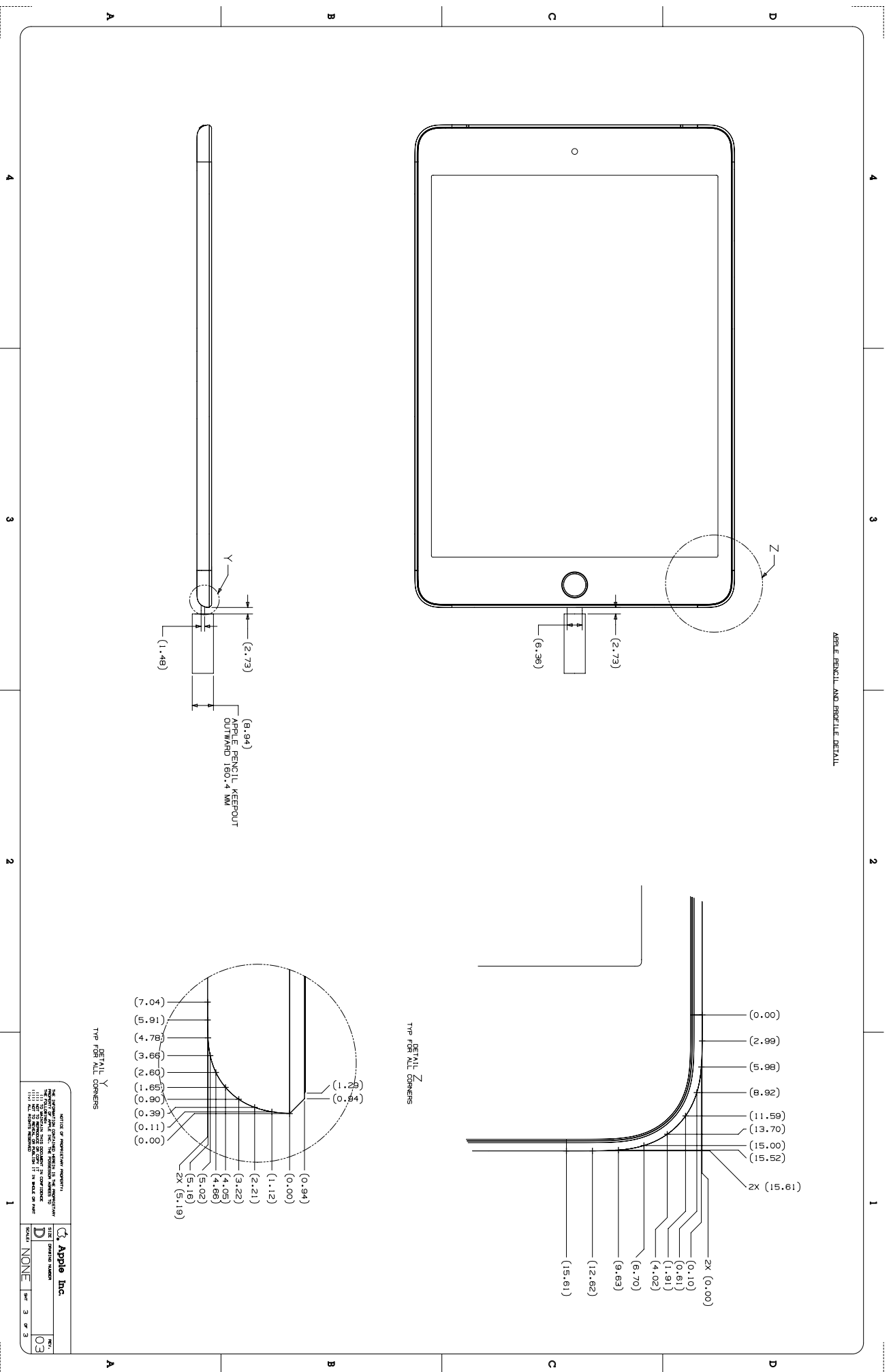
56.121 iPad mini (5th generation) with Wi-Fi + Cellular 2 of 3



Apple Inc.
 Apple logo
 Apple Inc.
 03

56.122 iPad mini (5th generation) with Wi-Fi + Cellular 3 of 3

APPLE PENCIL AND PROFILE DETAIL

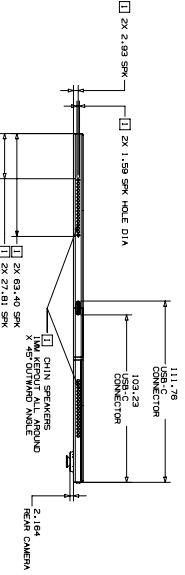
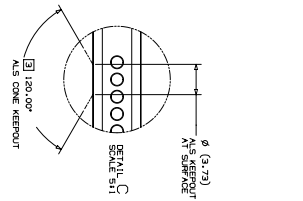
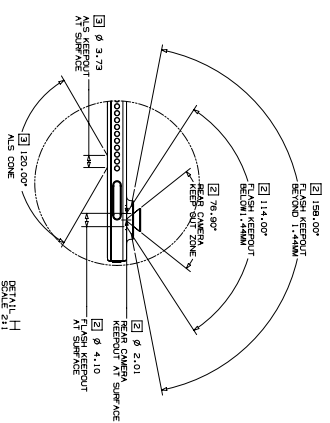
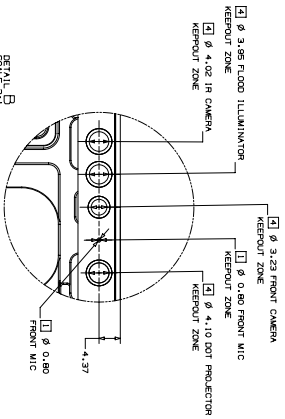
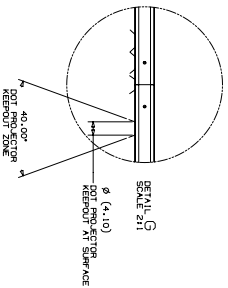
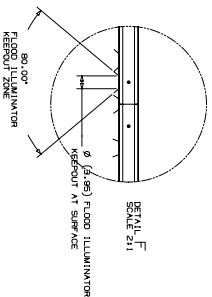
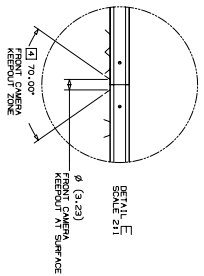
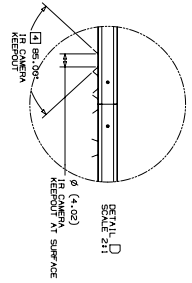
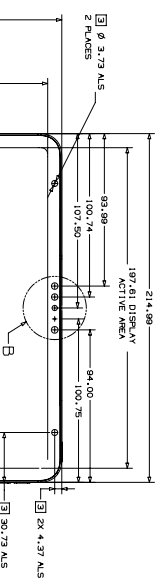
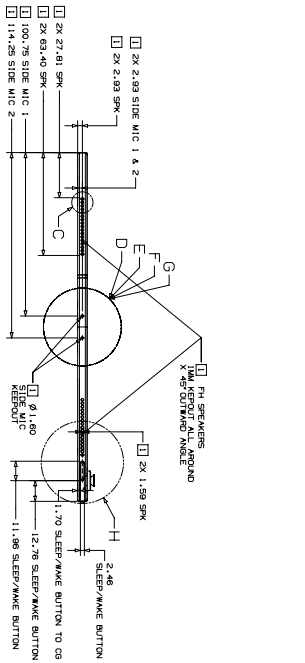


Apple Inc. logo and text: APPLE INC. 100 Apple Park Blvd. Cupertino, CA 95014. Includes a table with columns for Part Number, Revision, and Date.

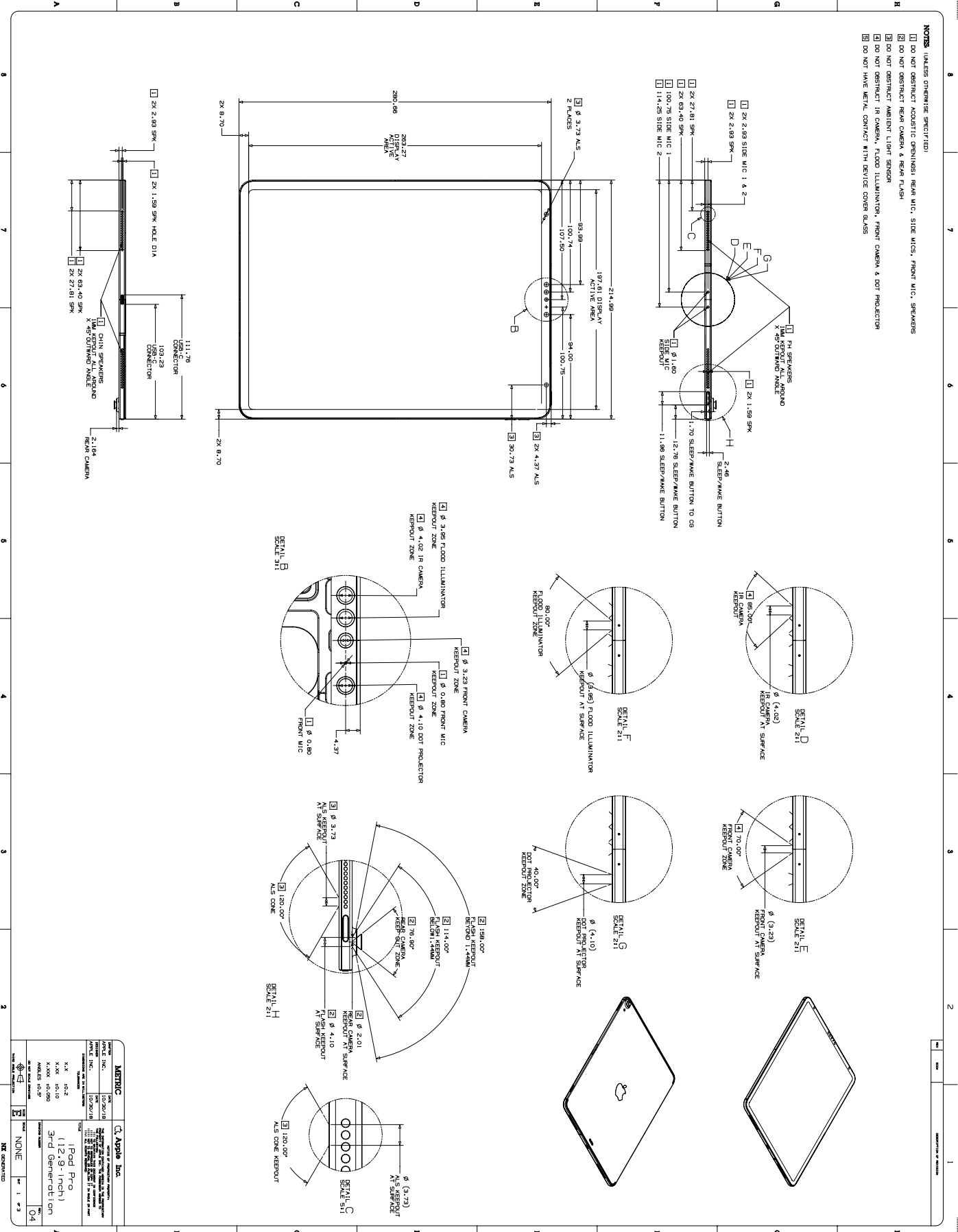
Part Number	Revision	Date
03	3	3

56.123 iPad Pro 12.9-inch (3rd generation) 1 of 3

- NOTES:** UNLESS OTHERWISE SPECIFIED:
- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: REAR MIC, SIDE MICS, FRONT MIC, SPEAKERS
 - 2 DO NOT OBSTRUCT REAR CAMERA & REAR FLASH
 - 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

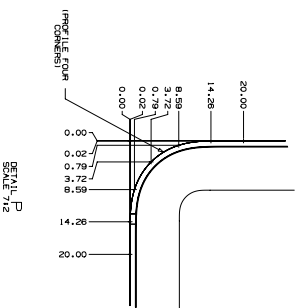
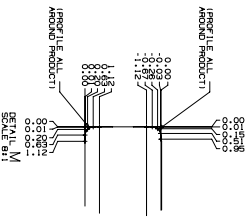


METRIC		Apple Inc.	
DATE	10/10/2021	REV	04
DESCRIPTION	iPad Pro (12.9-inch) 3rd Generation		
SCALE	1:1	UNIT	MM
DESIGNED BY	NONE		
CHECKED BY	NONE		
APPROVED BY	NONE		
DATE	10/10/2021	REV	04
DESCRIPTION	iPad Pro (12.9-inch) 3rd Generation		
SCALE	1:1	UNIT	MM
DESIGNED BY	NONE		
CHECKED BY	NONE		
APPROVED BY	NONE		
DATE	10/10/2021	REV	04
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SCALE	1:1	UNIT	MM
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CHECKED BY	NONE		
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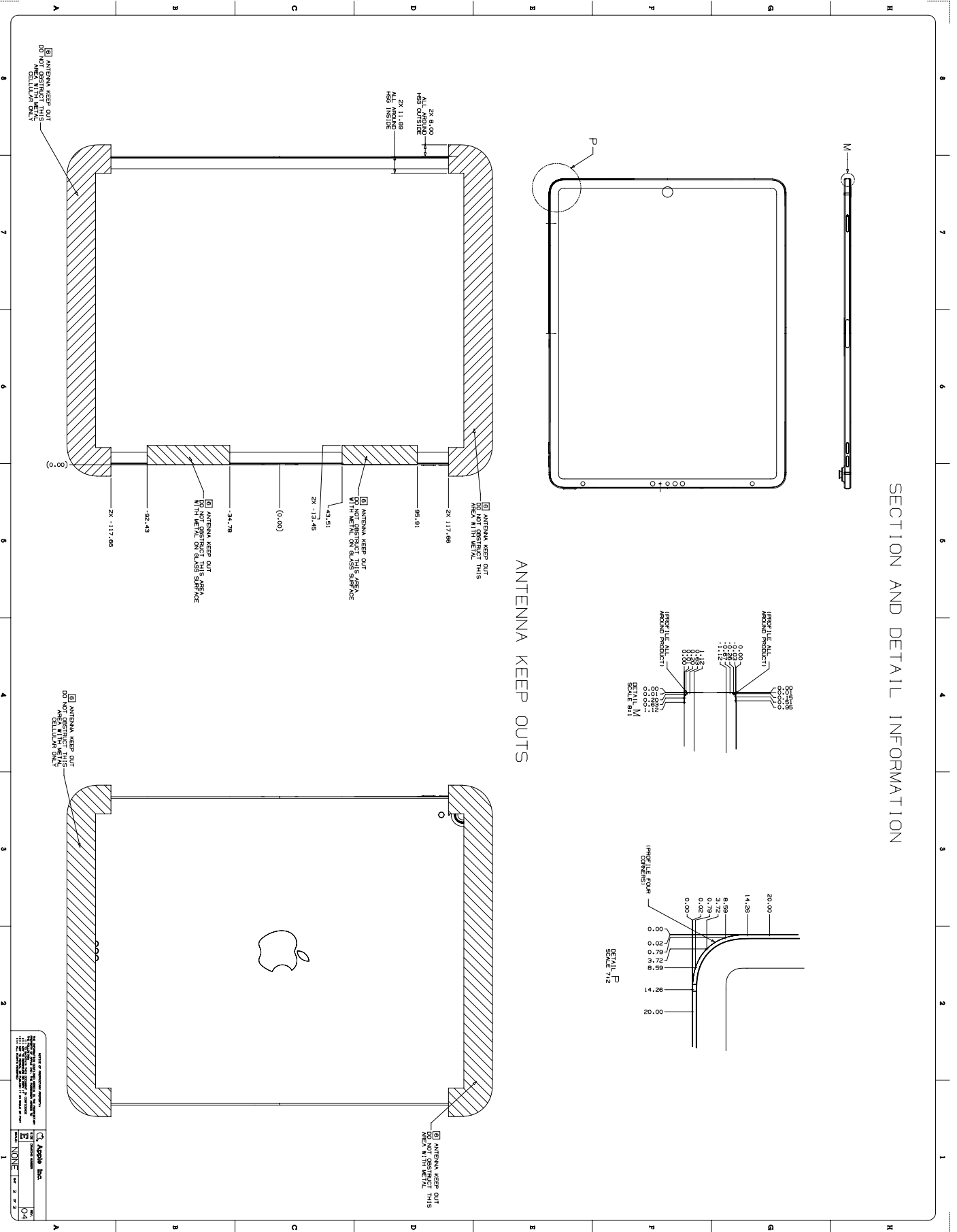


56.125 iPad Pro 12.9-inch (3rd generation) 3 of 3

SECTION AND DETAIL INFORMATION



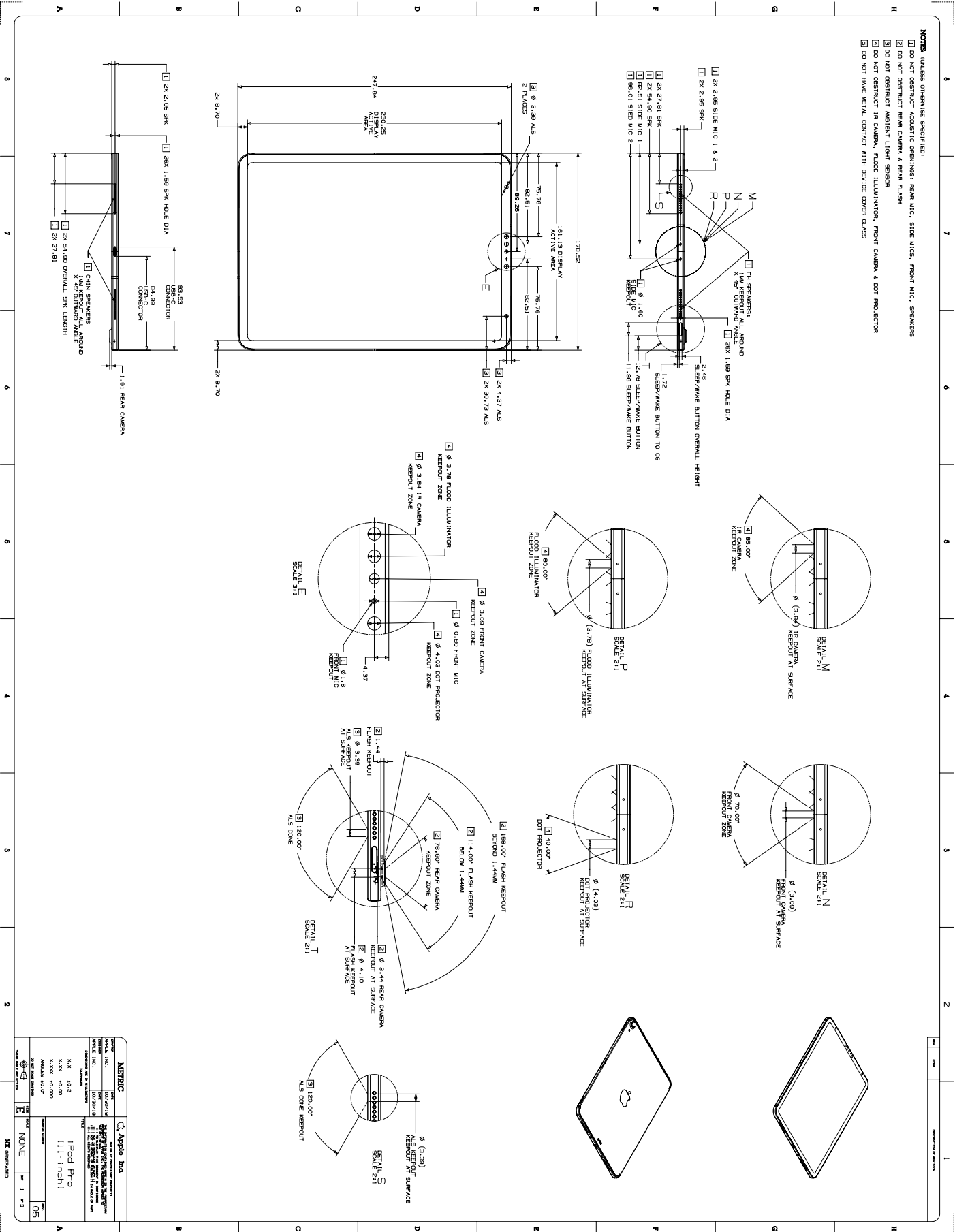
ANTENNA KEEP OUTS



56.126 iPad Pro 11-inch (1st generation) 1 of 3

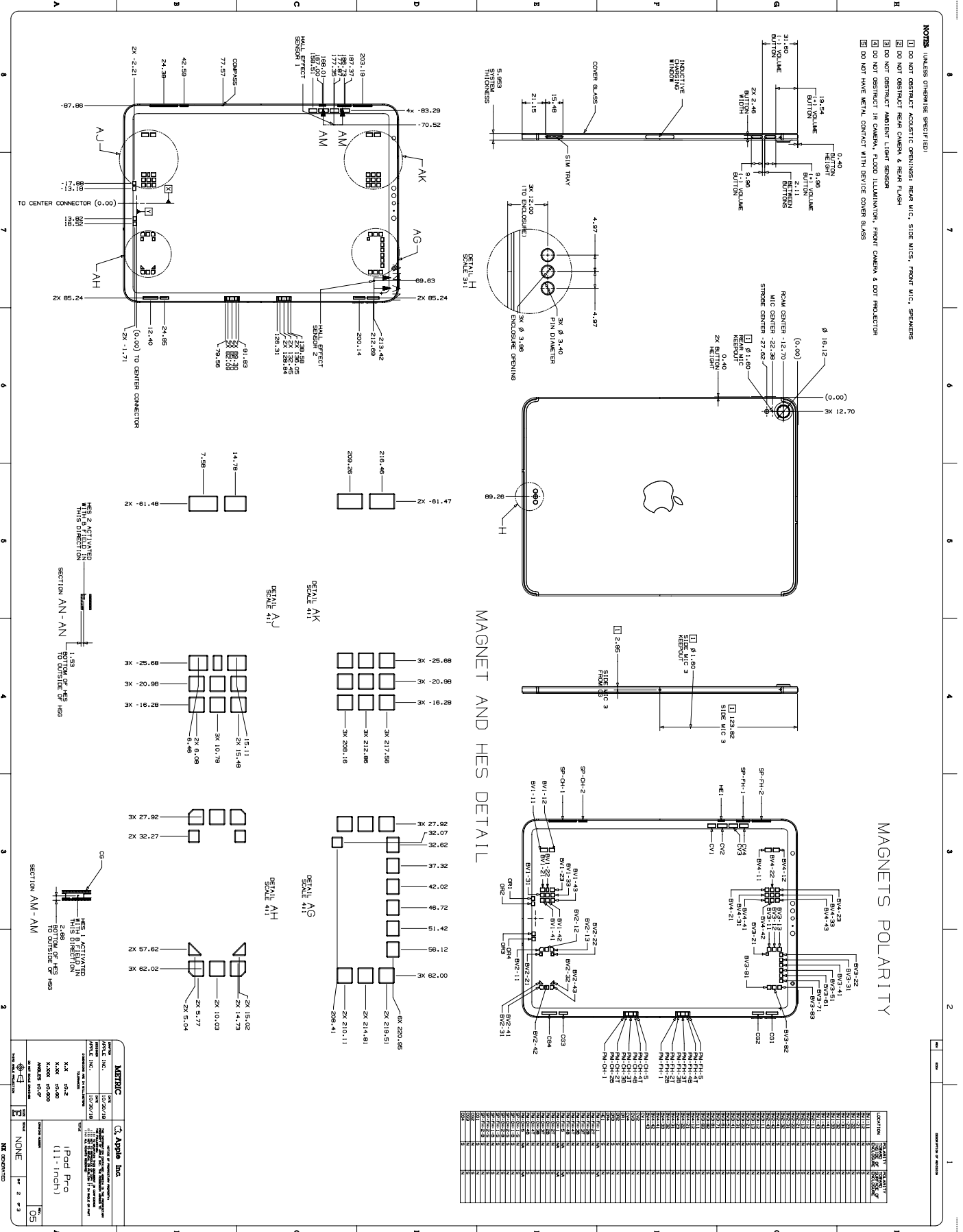
NOTES: UNLESS OTHERWISE SPECIFIED:

- 1 DO NOT OBSTRUCT ACoustic OPENINGS: REAR MIC, SIDE MICS, FRONT MIC, SPEAKERS
- 2 DO NOT OBSTRUCT REAR CAMERA & REAR FLASH
- 3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR
- 4 DO NOT OBSTRUCT IR CAMERA, FLOOD ILLUMINATOR, FRONT CAMERA & DOT PROJECTION
- 5 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS

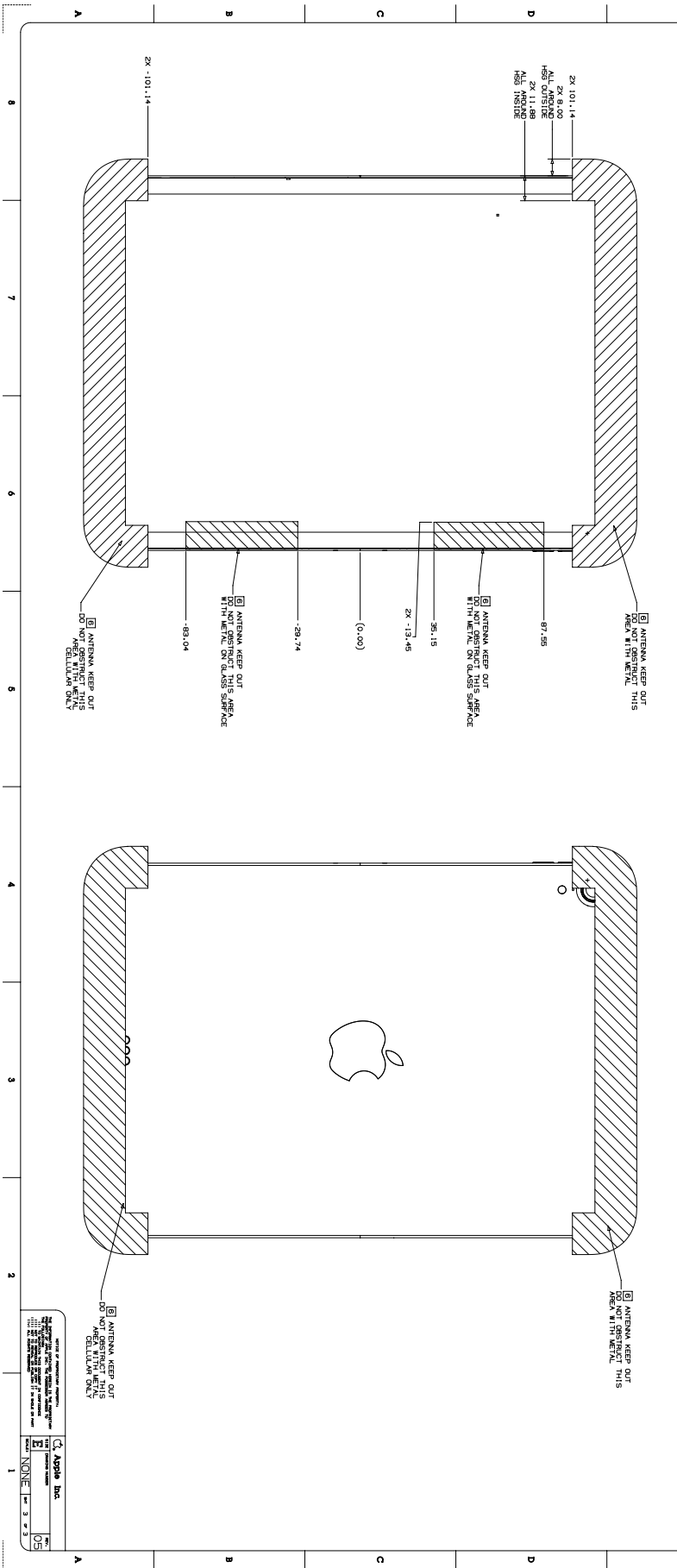
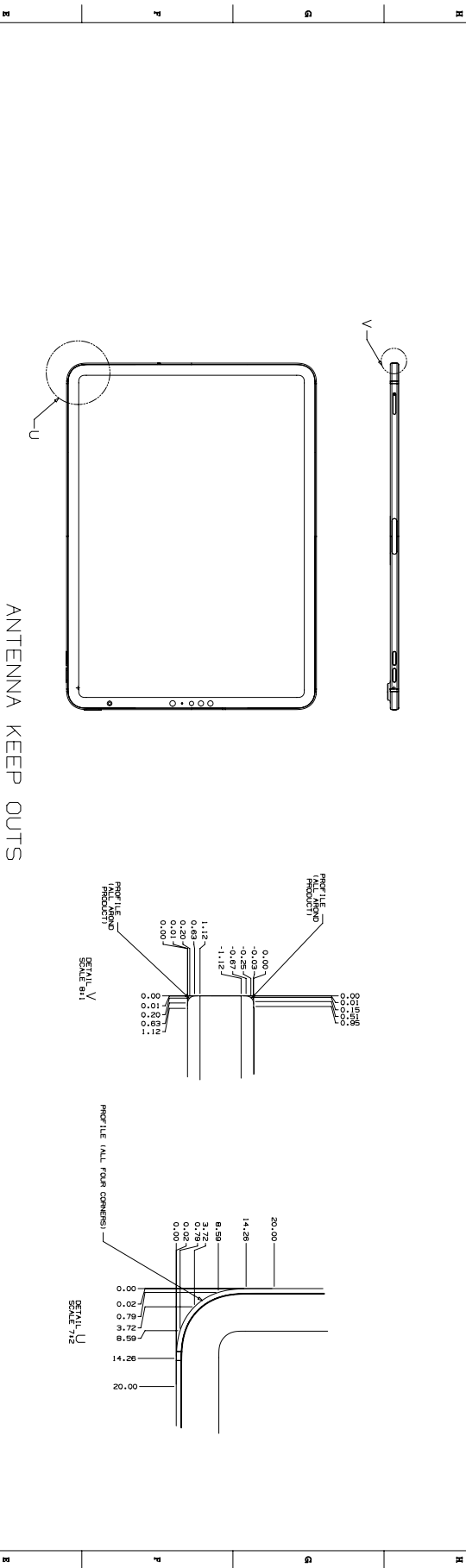


METRIC		Apple Inc.	
DATE	11/01/2019	REV	1
DESCRIPTION	iPad Pro 11-inch (1st generation)		
PART #	11027716	REV	1
DATE	11/01/2019	REV	1
DESCRIPTION	iPad Pro 11-inch (1st generation)		
DATE	11/01/2019	REV	1
DESCRIPTION	iPad Pro 11-inch (1st generation)		
DATE	11/01/2019	REV	1
DESCRIPTION	iPad Pro 11-inch (1st generation)		
DATE	11/01/2019	REV	1
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DATE	11/01/2019	REV	1
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DATE	11/01/2019	REV	1
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DATE	11/01/2019	REV	1
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DATE	11/01/2019	REV	1
DESCRIPTION	iPad Pro 11-inch (1st generation)		
DATE	11/01/2019	REV	1
DESCRIPTION	iPad Pro 11-inch (1st generation)		

56.127 iPad Pro 11-inch (1st generation) 2 of 3



SECTION AND DETAIL INFORMATION

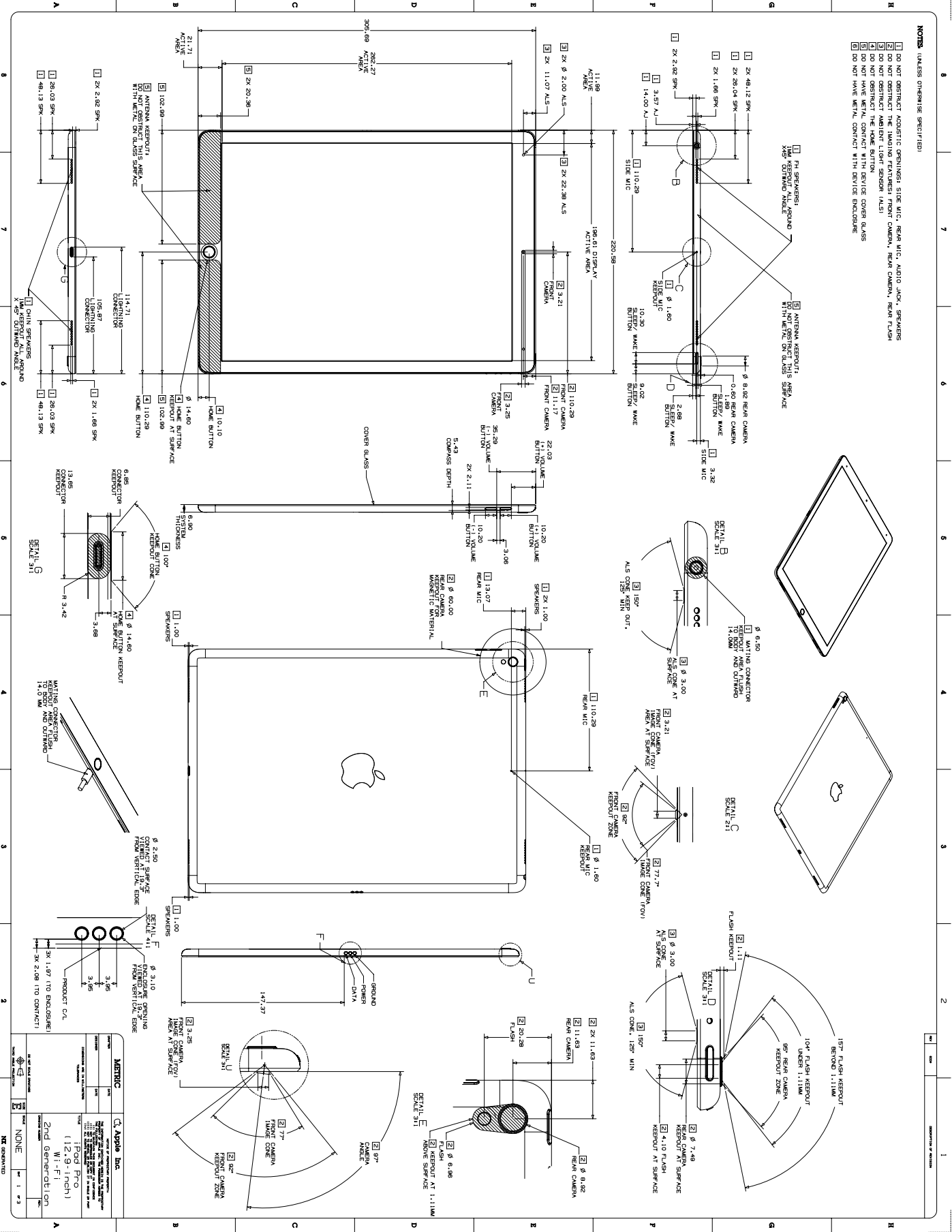


<small>DESIGNED BY</small> Apple Inc. <small>DATE</small> 05/11/16 <small>SCALE</small> NONE <small>REV</small> 05		<small>APPROVED BY</small>
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56.129 iPad Pro 12.9-inch (2nd generation) with Wi-Fi

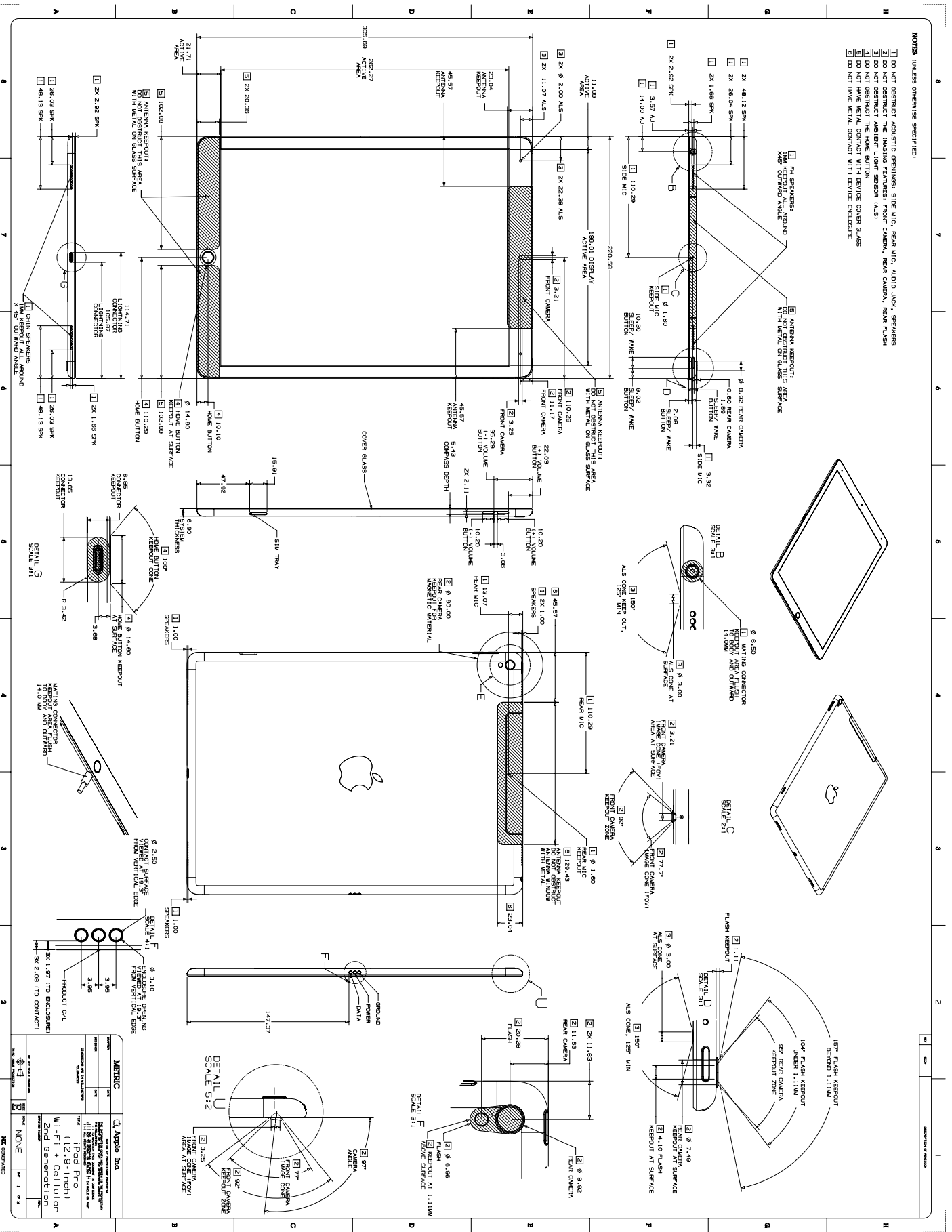
NOTES: (UNLESS OTHERWISE SPECIFIED)

- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
- 2 DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH
- 3 DO NOT OBSTRUCT THE HOME BUTTON
- 4 DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS
- 5 DO NOT HAVE METAL CONTACT WITH DEVICE ENCASEMENT



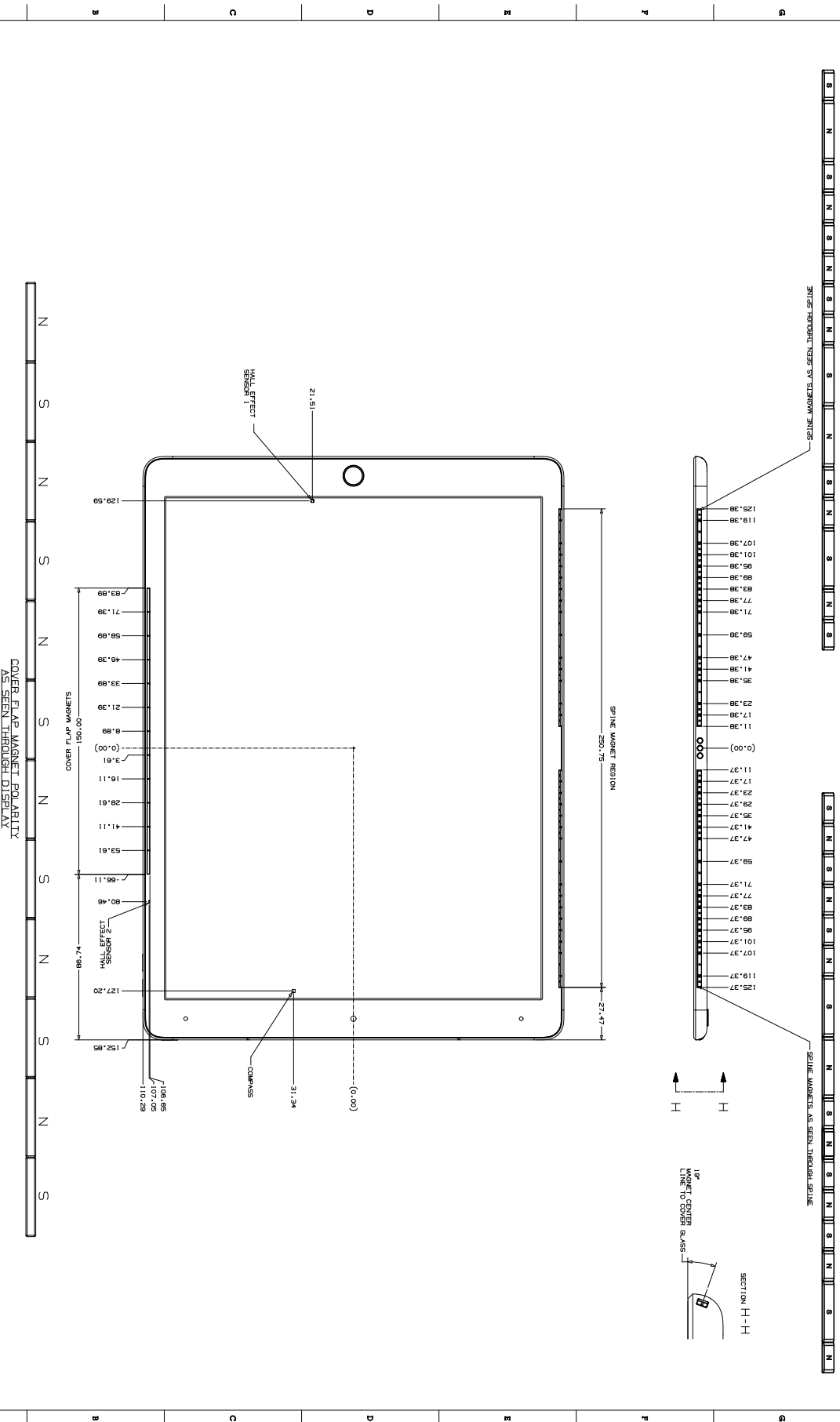
METRIC		Apple Inc.	
ITEM	UNIT	DESCRIPTION	REVISION
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2	mm	2nd Generation	1
3	mm	None	1

56.130 iPad Pro 12.9-inch (2nd generation) with Wi-Fi + Cellular



56.131 iPad Pro 12.9-inch (2nd generation) Magnet/Hall Effect Sensors 1 of 2

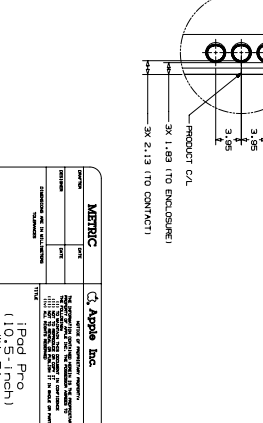
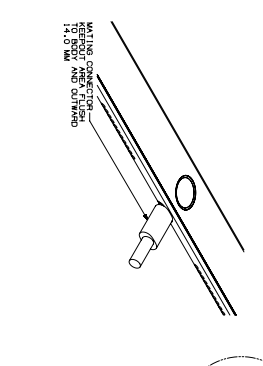
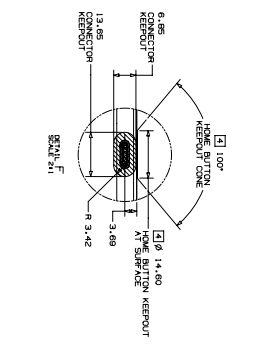
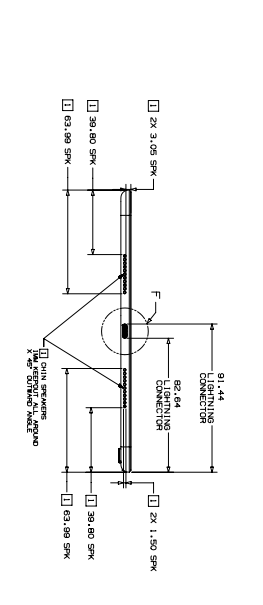
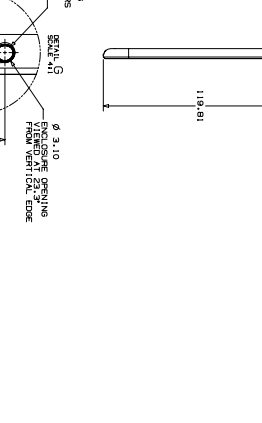
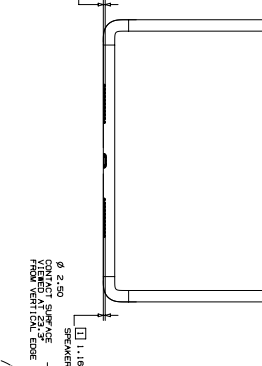
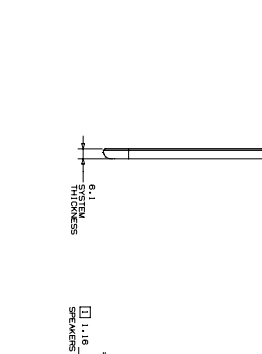
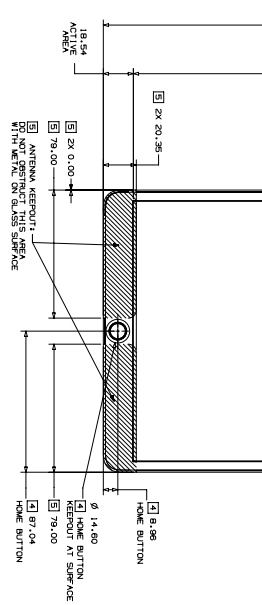
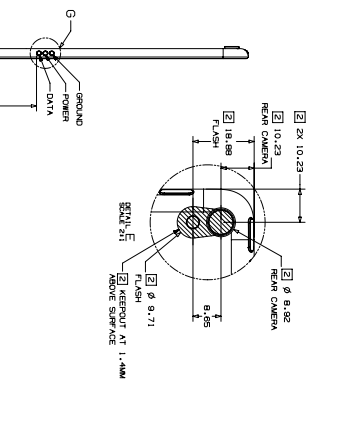
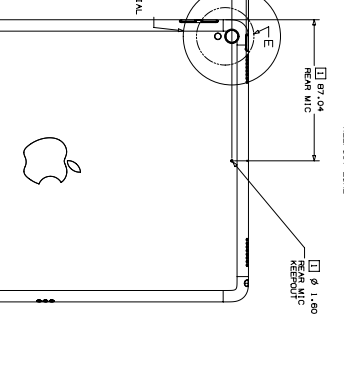
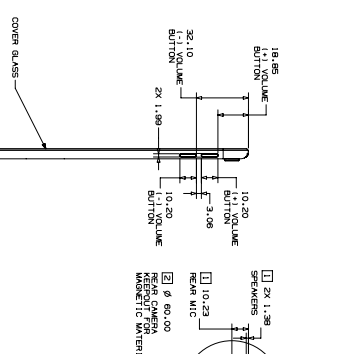
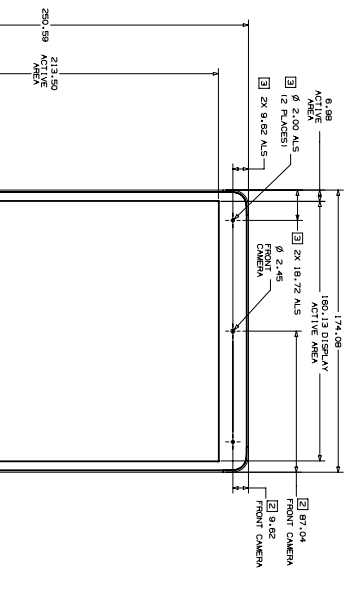
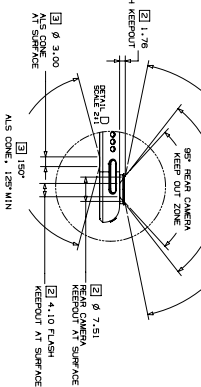
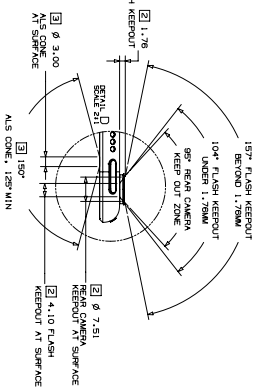
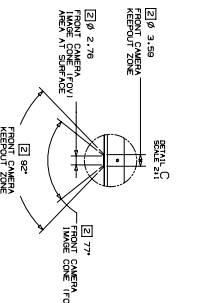
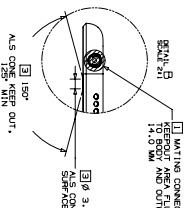
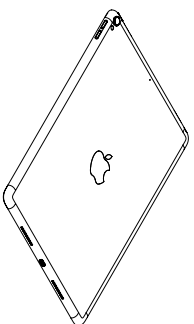
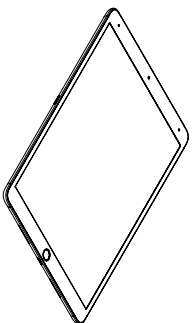
COVER FLAP MAGNET DETAIL
 POLARITY SHOWN NORMAL TO DISPLAY SURFACE
 DIMENSIONS TO CENTERLINE OF PRODUCT
 N = NORTH
 S = SOUTH



DATE OF REVISION	DESCRIPTION
03	Apple Inc.
02	Apple Inc.
01	Apple Inc.

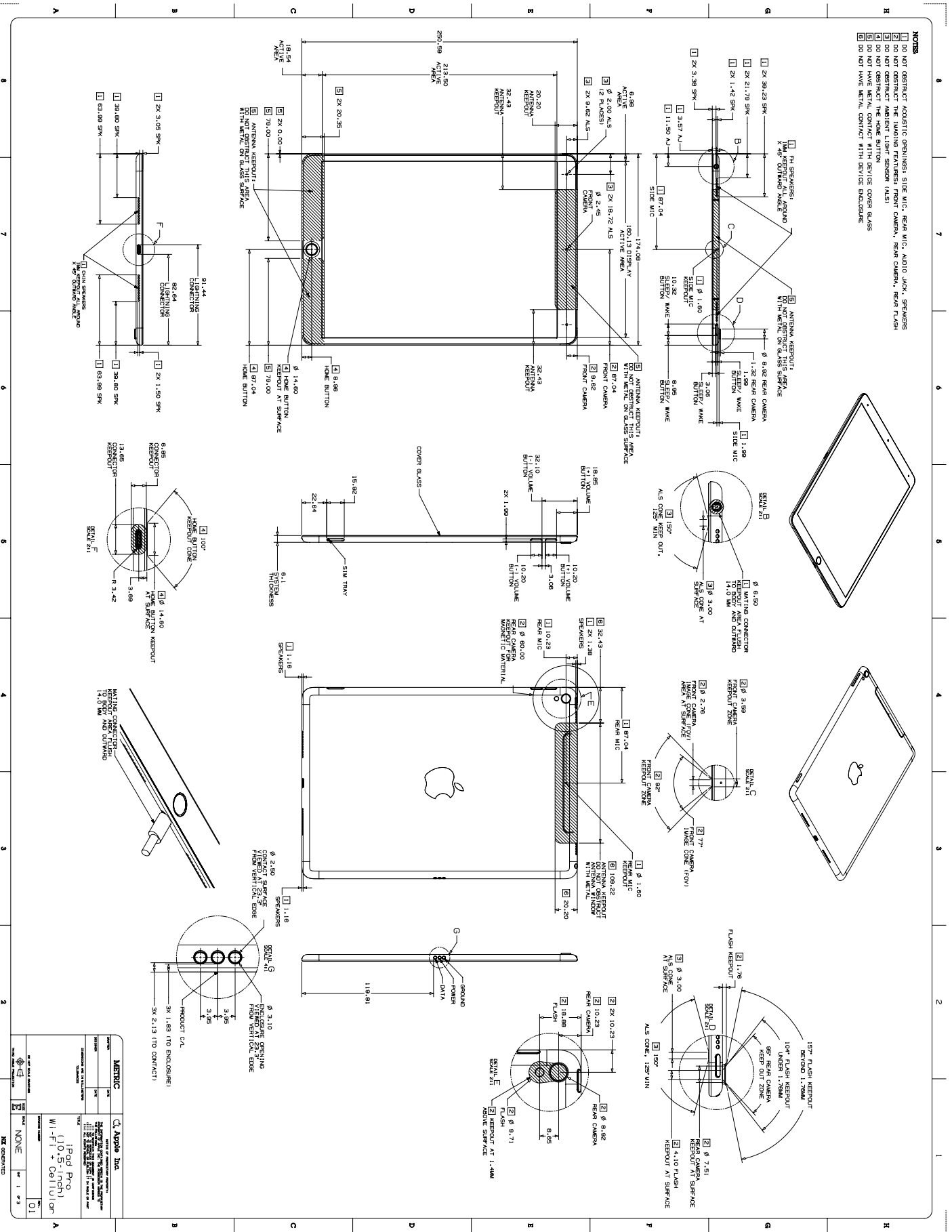
56.133 iPad Pro 10.5-inch with Wi-Fi

- NOTES**
- DO NOT OBSTRUCT ACOUSTIC OPENINGS, SIZE MIC, REAR MIC, AUDIO JACK, SPEAKERS
 - DO NOT OBSTRUCT THE IMAGING FEATURES FRONT CAMERA, REAR CAMERA, REAR FLASH
 - DO NOT OBSTRUCT THE AMBIENT LIGHT SENSOR (ALS)
 - DO NOT OBSTRUCT THE HOME BUTTON
 - DO NOT HAVE METAL CONTACT WITH DEVICE COVER GLASS



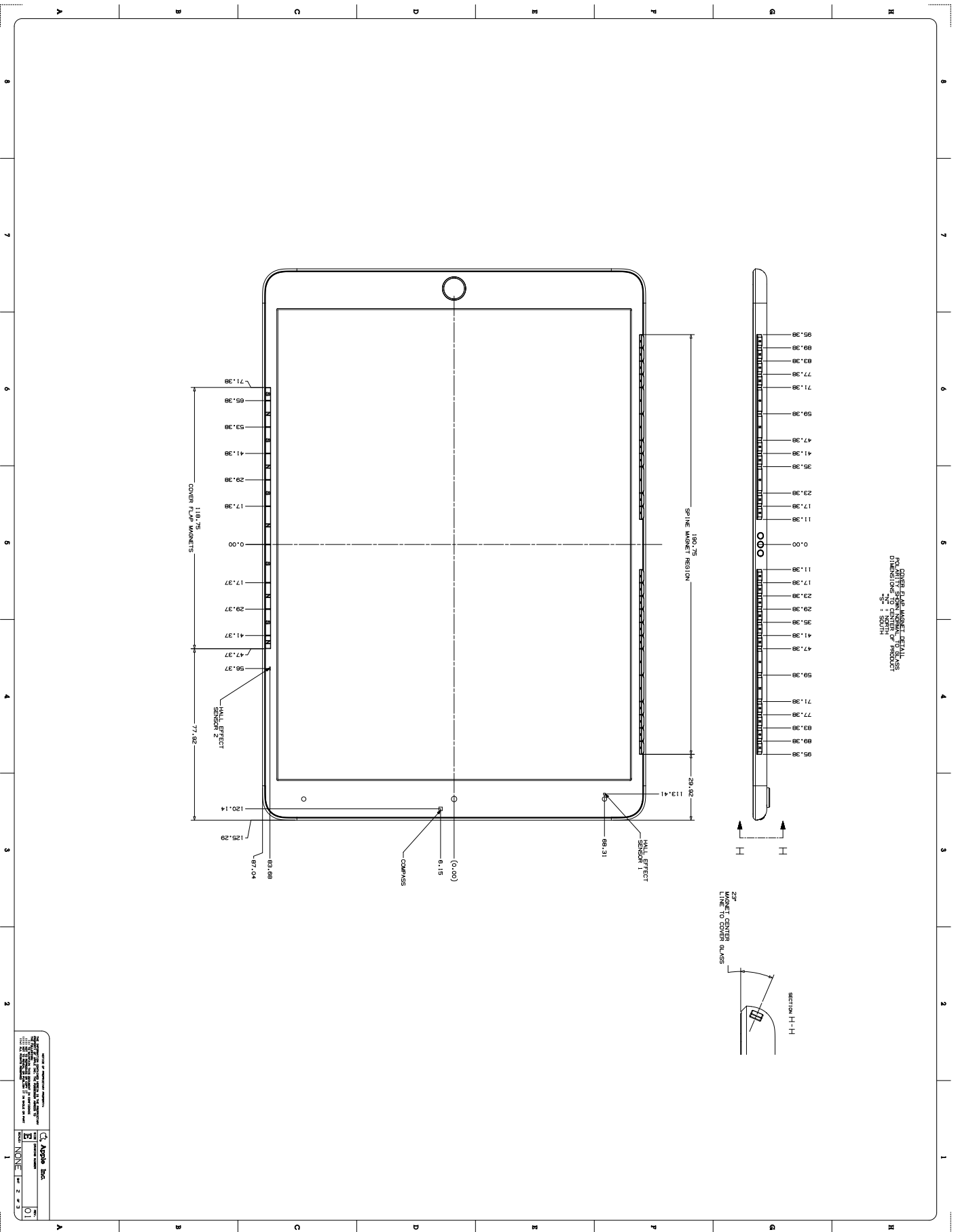
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DATE	REV	DESCRIPTION	REVISION
2013-10-10	1	Initial Design	1
PART		IPAD PRO (10.5 INCH) WITH Wi-Fi	
DRAWING		3D MODEL	
SCALE		NONE	
TOLERANCES		UNLESS OTHERWISE SPECIFIED	
DIMENSIONS		IN MILLIMETERS	
ANGLES		DEGREES	
HIDDEN DIMENSIONS		NONE	
DIMENSIONS		NONE	
DIMENSIONS		NONE	
DIMENSIONS		NONE	
DIMENSIONS		NONE	
DIMENSIONS		NONE	
DIMENSIONS		NONE	
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DIMENSIONS		NONE	

56.134 iPad Pro 10.5-inch with Wi-Fi + Cellular



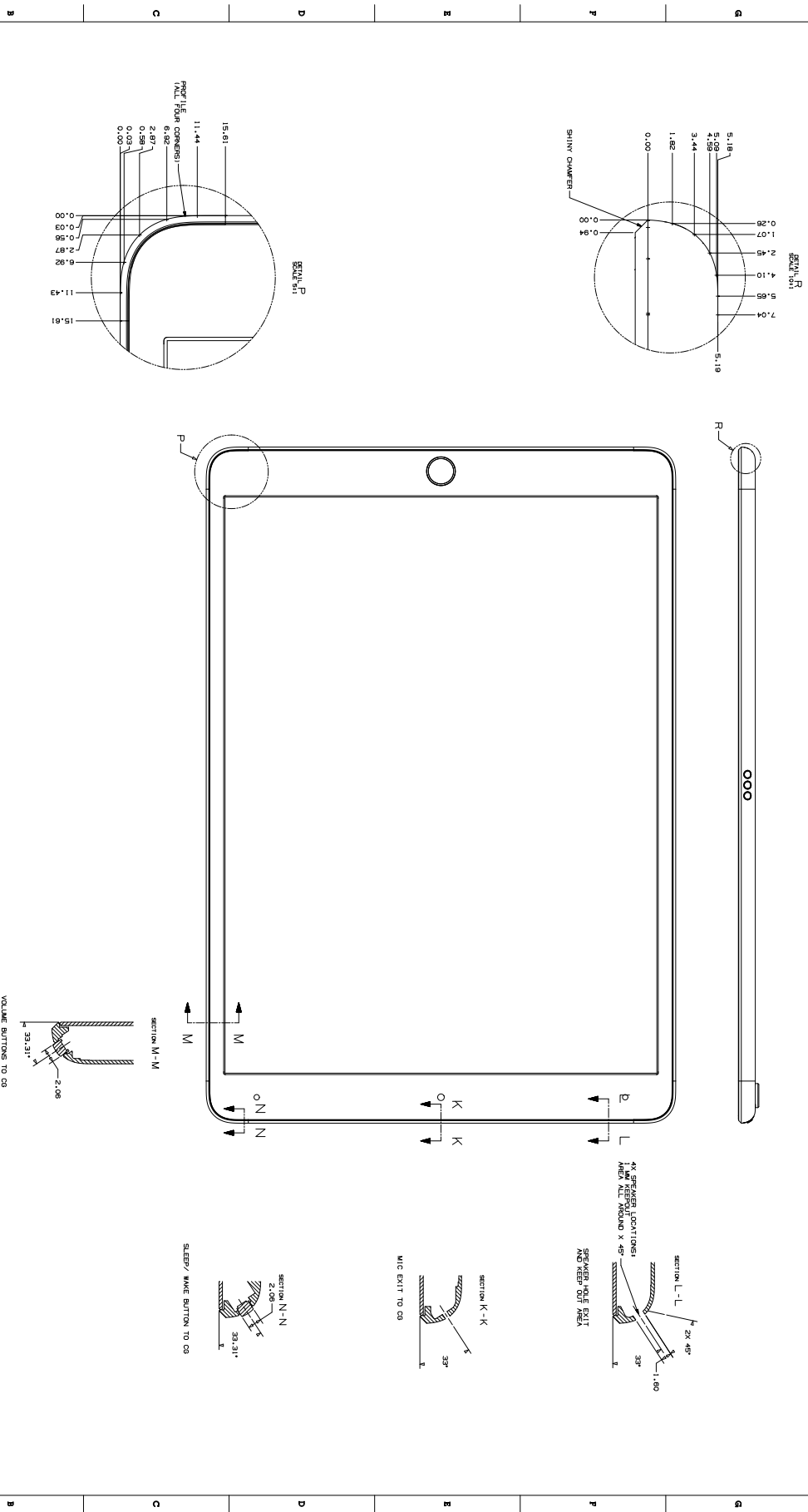
METRIC		Apple Inc.	
DATE	2023-10-10	REV	01
This drawing is the property of Apple Inc. and is not to be distributed outside of Apple Inc. without the express written permission of Apple Inc.			
DESCRIPTION	iPad Pro (10.5-inch) Wi-Fi + Cellular		
QUANTITY	NONE		
SCALE	1:1		
DRWNO	56.134		
CHKD	NONE		
APPROVED	NONE		
DATE	2023-10-10		

56.135 iPad Pro 10.5-inch Magnet/Hall Effect Sensors 1 of 2



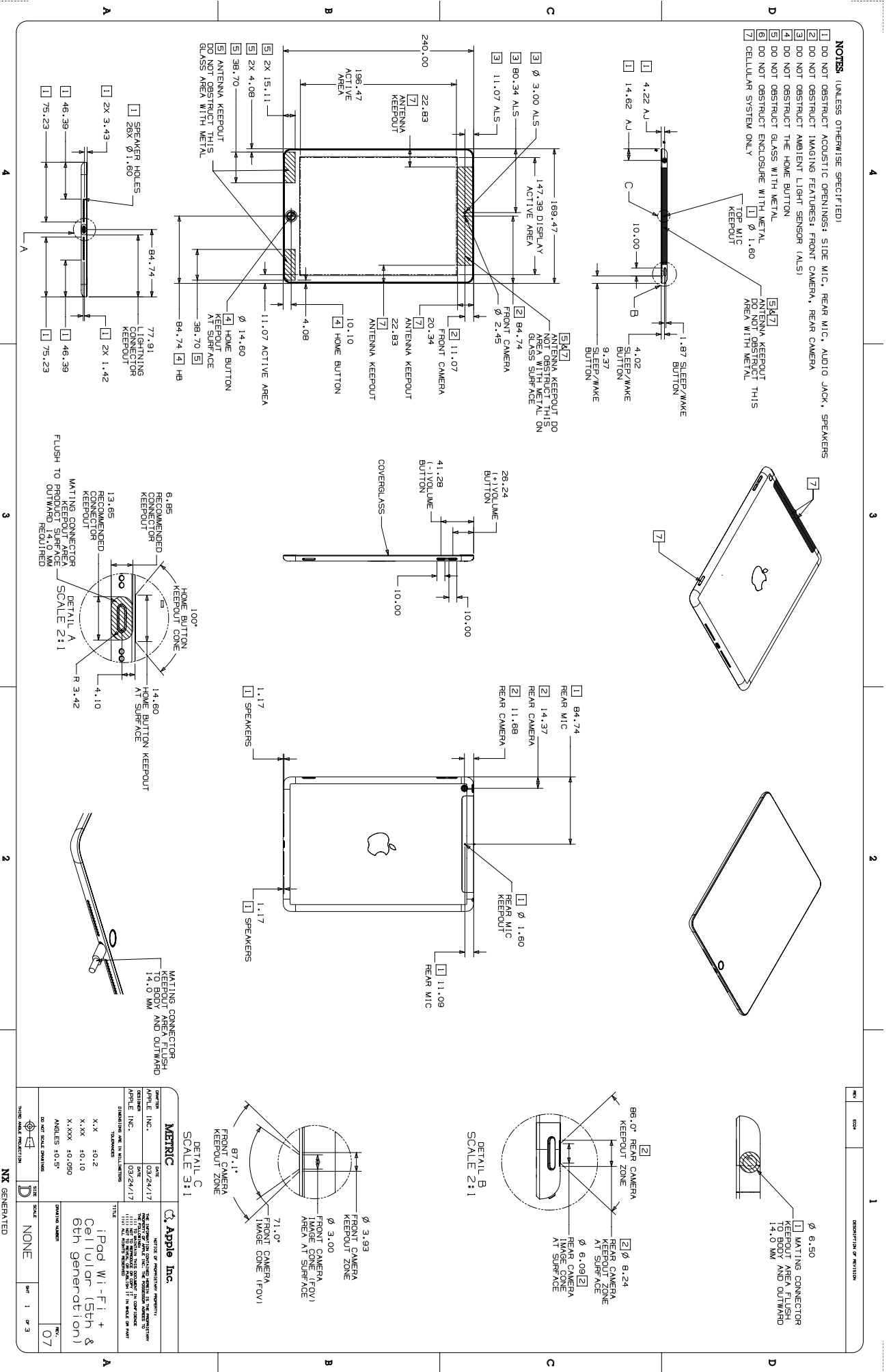
Apple Inc.	
Part Name	56.135
Part Number	101
Revision	1
Quantity	1
Material	NONE
Notes	

SECTION AND DETAIL INFORMATION



SECTION OF INFORMATION		Apple Inc.	
DATE	REV	DATE	REV
10/10/2023	01	10/10/2023	01
NONE		NONE	
1	3	2	2

56.137 iPad (5th and 6th generation) with Wi-Fi + Cellular



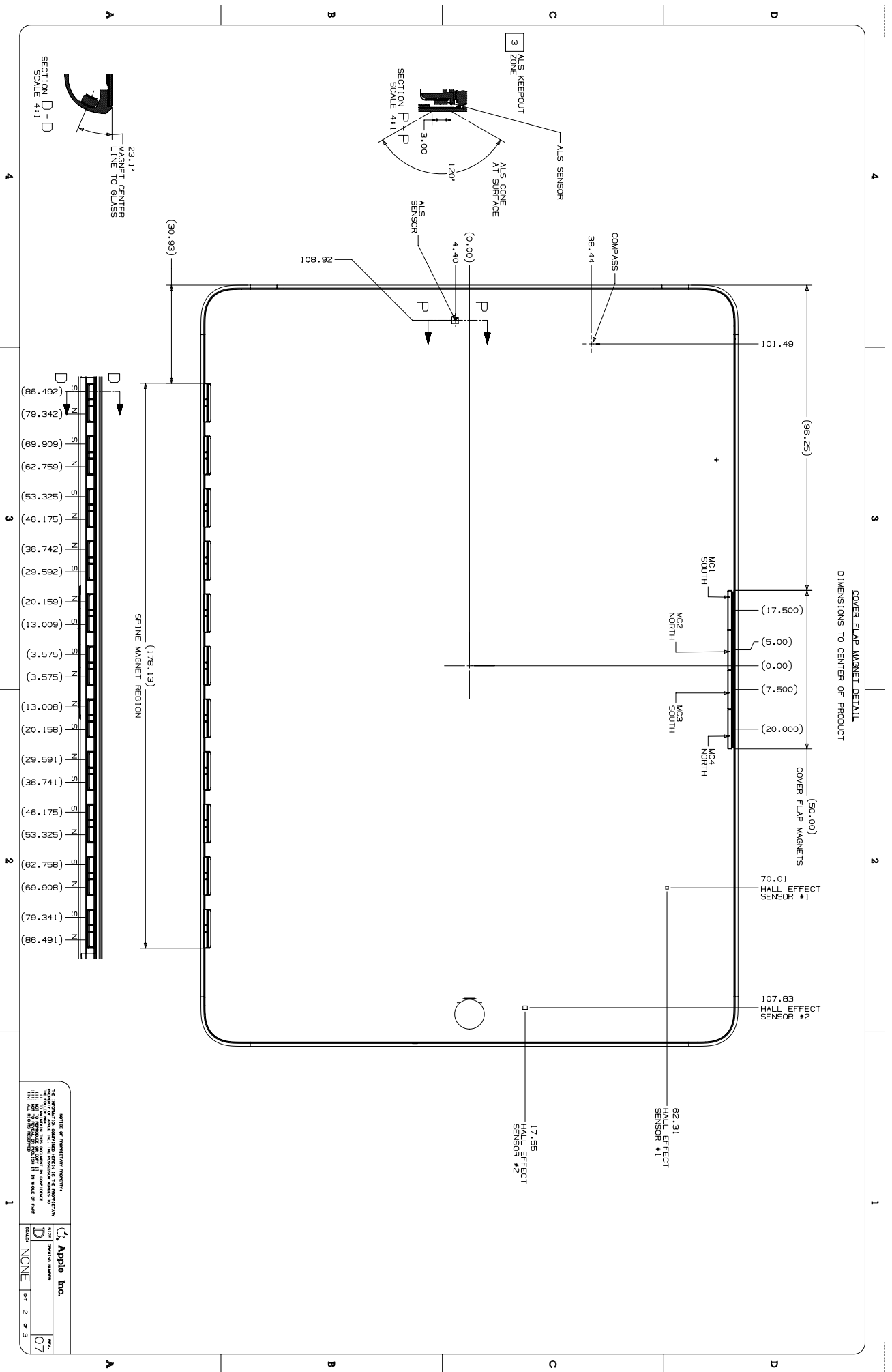
NOTES (UNLESS OTHERWISE SPECIFIED):

- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
- 2 DO NOT OBSTRUCT IMAGING FEATURES: FRONT CAMERA, REAR CAMERA
- 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
- 7 CELLULAR SYSTEM ONLY

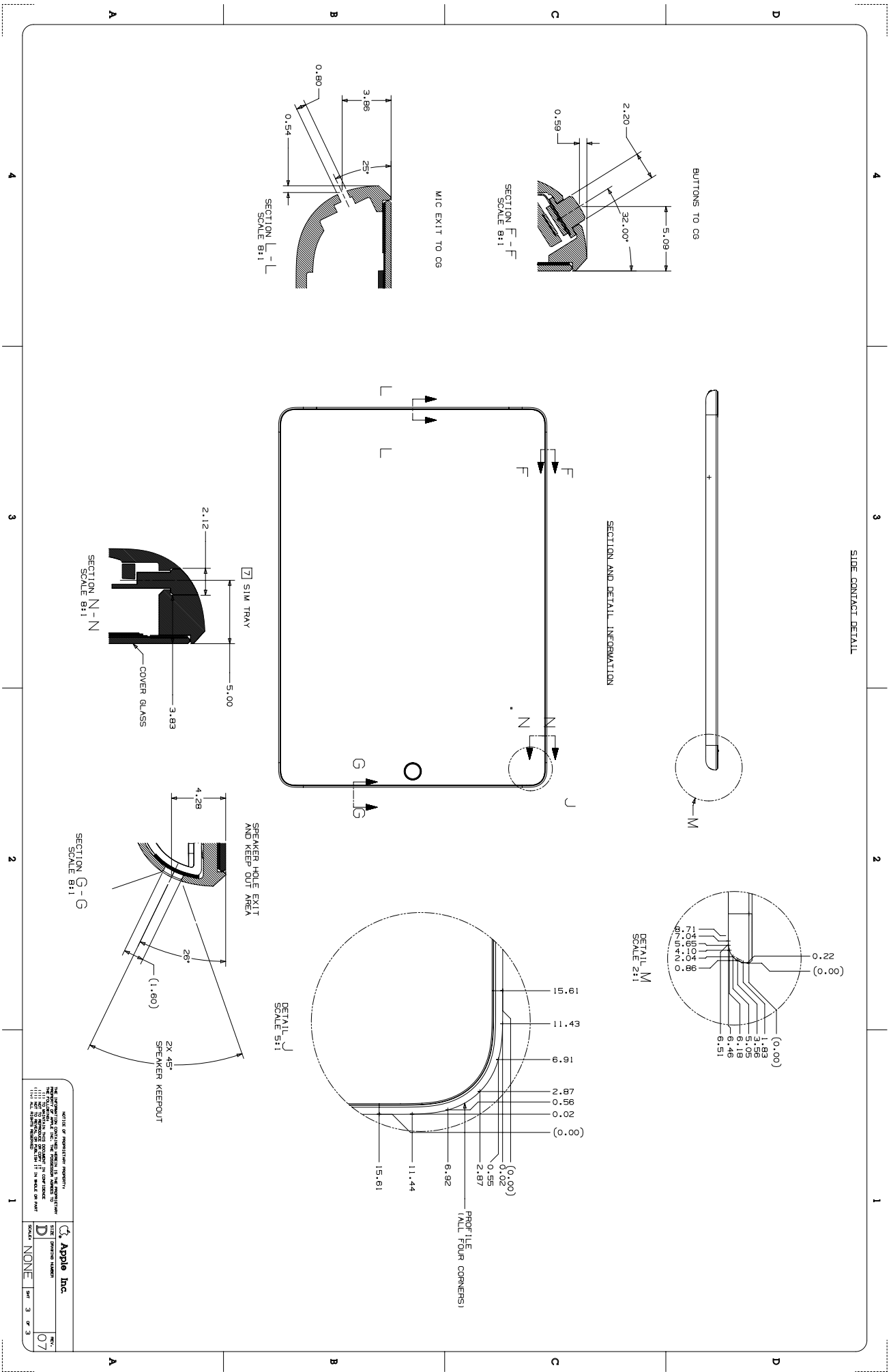
REV	DATE	DESCRIPTION OF REVISION
1		
2		
3		
4		

METRIC	Apple Inc.
DATE: 03/24/17	DESIGNED BY: [REDACTED]
APPROVED BY: [REDACTED]	DATE: 03/24/17
<small>THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF APPLE INC. IT IS TO BE USED FOR THE DESIGN AND MANUFACTURE OF APPLE PRODUCTS ONLY. IT IS TO BE KEPT IN CONFIDENTIALITY AND NOT TO BE DISCLOSED TO ANY OTHER PARTY WITHOUT THE WRITTEN PERMISSION OF APPLE INC.</small>	
DIMENSIONS ARE IN MILLIMETERS TOLERANCES X.X ±0.2 X.XX ±0.10 X.XXX ±0.050 ANGLES 10.5° DO NOT SCALE DIMENSIONS	
TITLE	iPad Wi-Fi + Cellular (5th & 6th generation)
DRAWING NUMBER	56.137
DATE	07
SCALE	NONE
REV	1 OF 3

56.138 iPad (5th and 6th generation) Magnet/Hall Effect Sensors 1 of 2



56.139 iPad (5th and 6th generation) Magnet/Hall Effect Sensors 2 of 2



VECTOR OF INVENTION INFORMATION

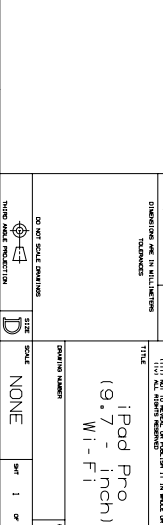
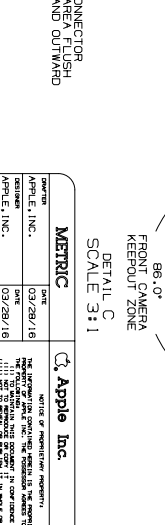
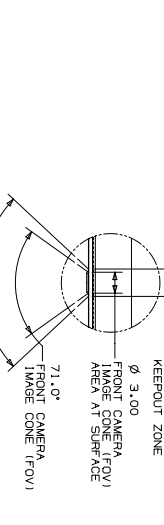
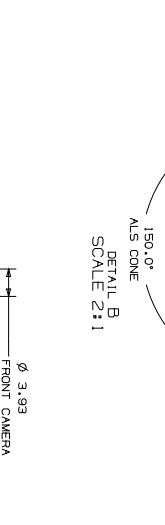
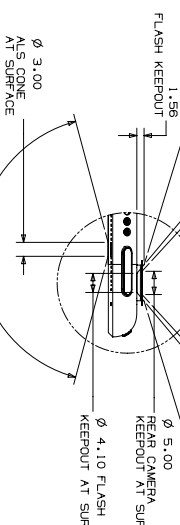
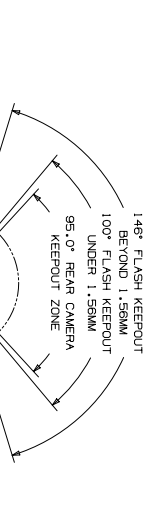
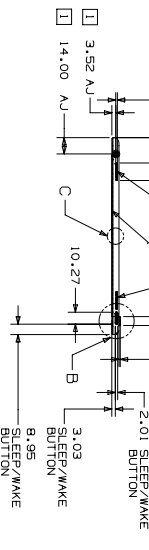
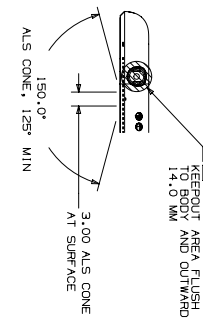
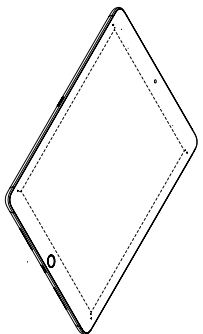
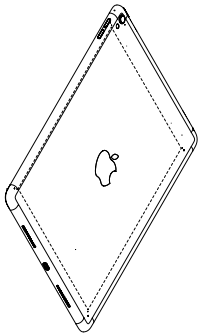
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Apple Inc.	REV
Apple Inc.	07
Apple Inc.	3 of 3

56.140 iPad Pro 9.7-inch with Wi-Fi

NOTES

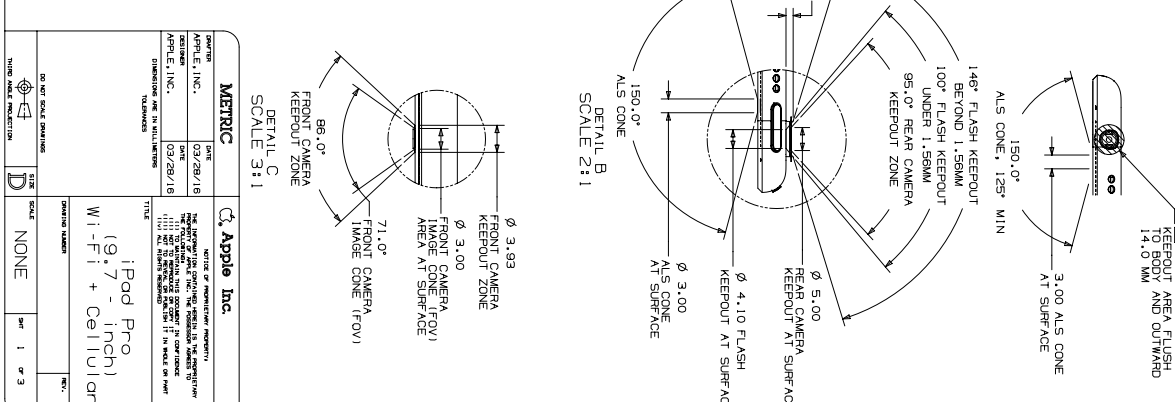
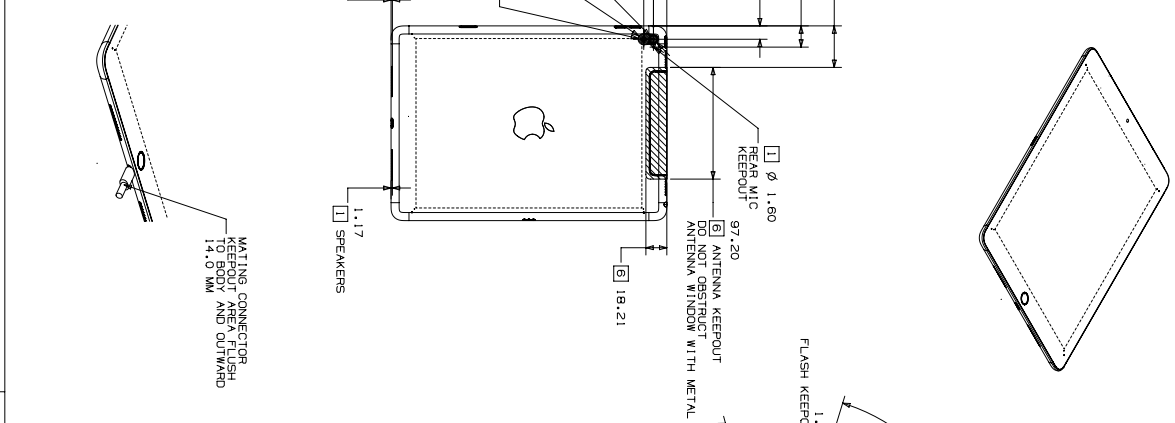
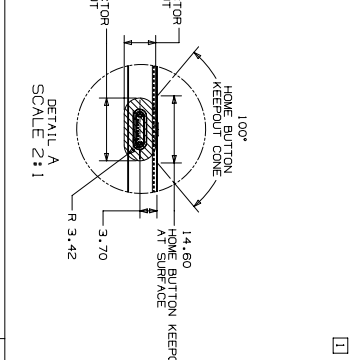
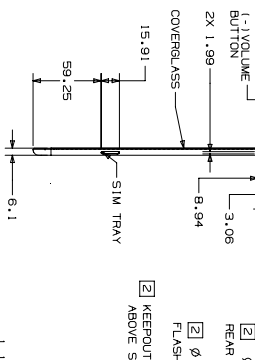
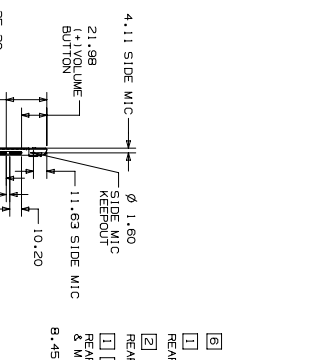
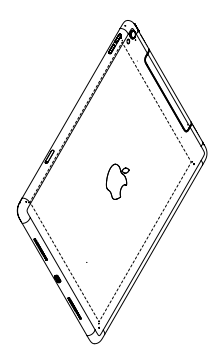
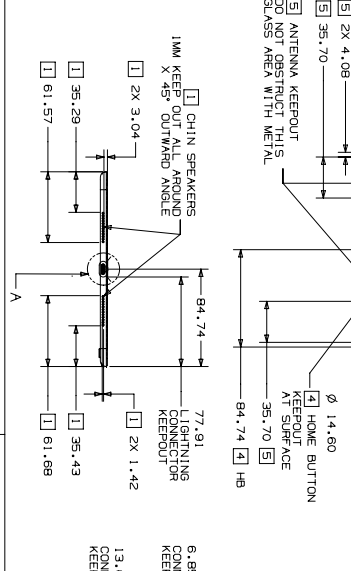
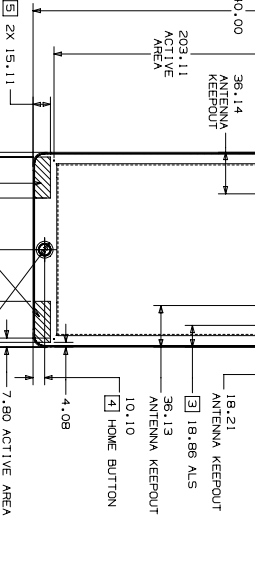
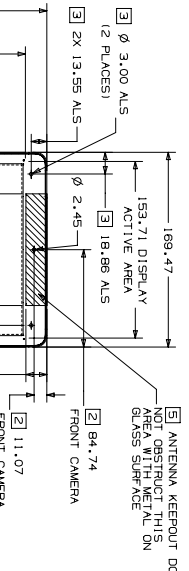
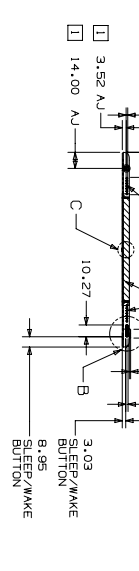
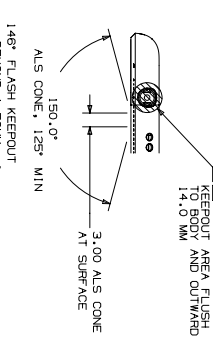
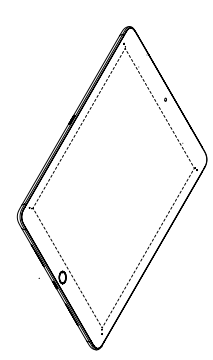
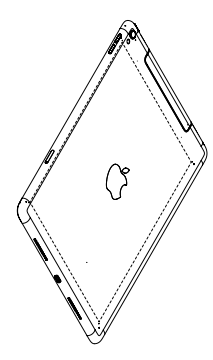
- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS; SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
- 2 DO NOT OBSTRUCT IMAGING FEATURES: FRONT CAMERA, REAR CAMERA, REAR FLASH
- 3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
- 4 DO NOT OBSTRUCT THE HOME BUTTON
- 5 DO NOT OBSTRUCT ENCLOSURE WITH METAL
- 6 DO NOT OBSTRUCT GLASS WITH METAL



MERRIC DATE: 03/28/16 DRAWN BY: [REDACTED] CHECKED BY: [REDACTED] APPROVED BY: [REDACTED] APPLE, INC. DATE: 03/28/16 DRAWING NO: 56.140.001.001 TITLE: iPad Pro (9.7-inch) Wi-Fi SCALE: NONE SHEET: 1 OF 3 NX GENERATED		Apple Inc. DATE: 03/28/16 DRAWN BY: [REDACTED] CHECKED BY: [REDACTED] APPROVED BY: [REDACTED] APPLE, INC. DATE: 03/28/16 DRAWING NO: 56.140.001.001 TITLE: iPad Pro (9.7-inch) Wi-Fi SCALE: NONE SHEET: 1 OF 3 NX GENERATED	
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56.141 iPad Pro 9.7-inch with Wi-Fi + Cellular

- 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



DATE	DESCRIPTION	BY	CHKD
03/29/16	Apple Inc.	Apple Inc.	Apple Inc.
03/29/16	Apple Inc.	Apple Inc.	Apple Inc.

Apple Inc.

Apple Inc.
12000 Apple Blvd
Cupertino, CA 95014

Apple Inc.
12000 Apple Blvd
Cupertino, CA 95014

Apple Inc.
12000 Apple Blvd
Cupertino, CA 95014

Apple Inc.
12000 Apple Blvd
Cupertino, CA 95014

Apple Inc.
12000 Apple Blvd
Cupertino, CA 95014

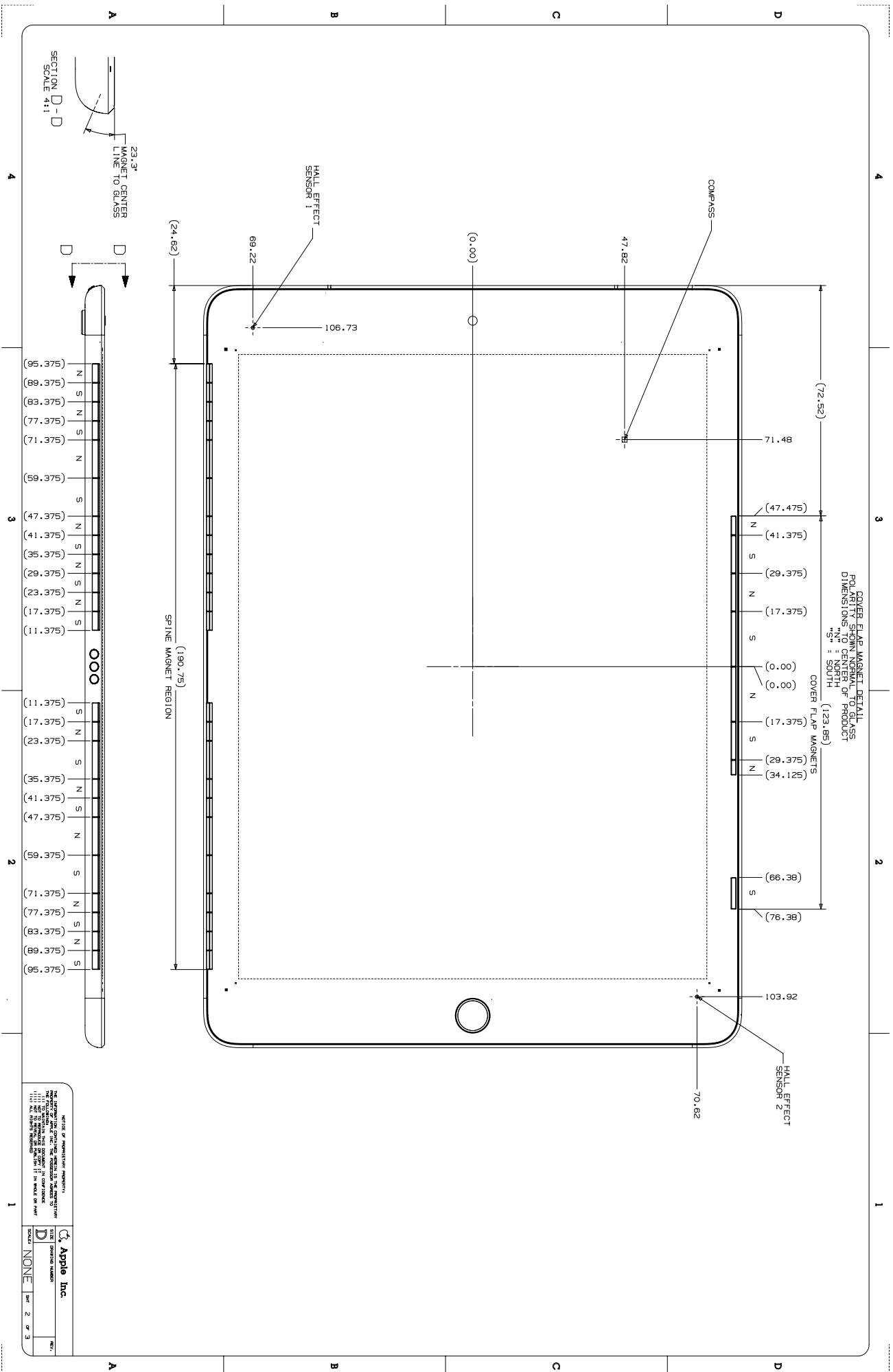
Apple Inc.
12000 Apple Blvd
Cupertino, CA 95014

Apple Inc.
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Cupertino, CA 95014

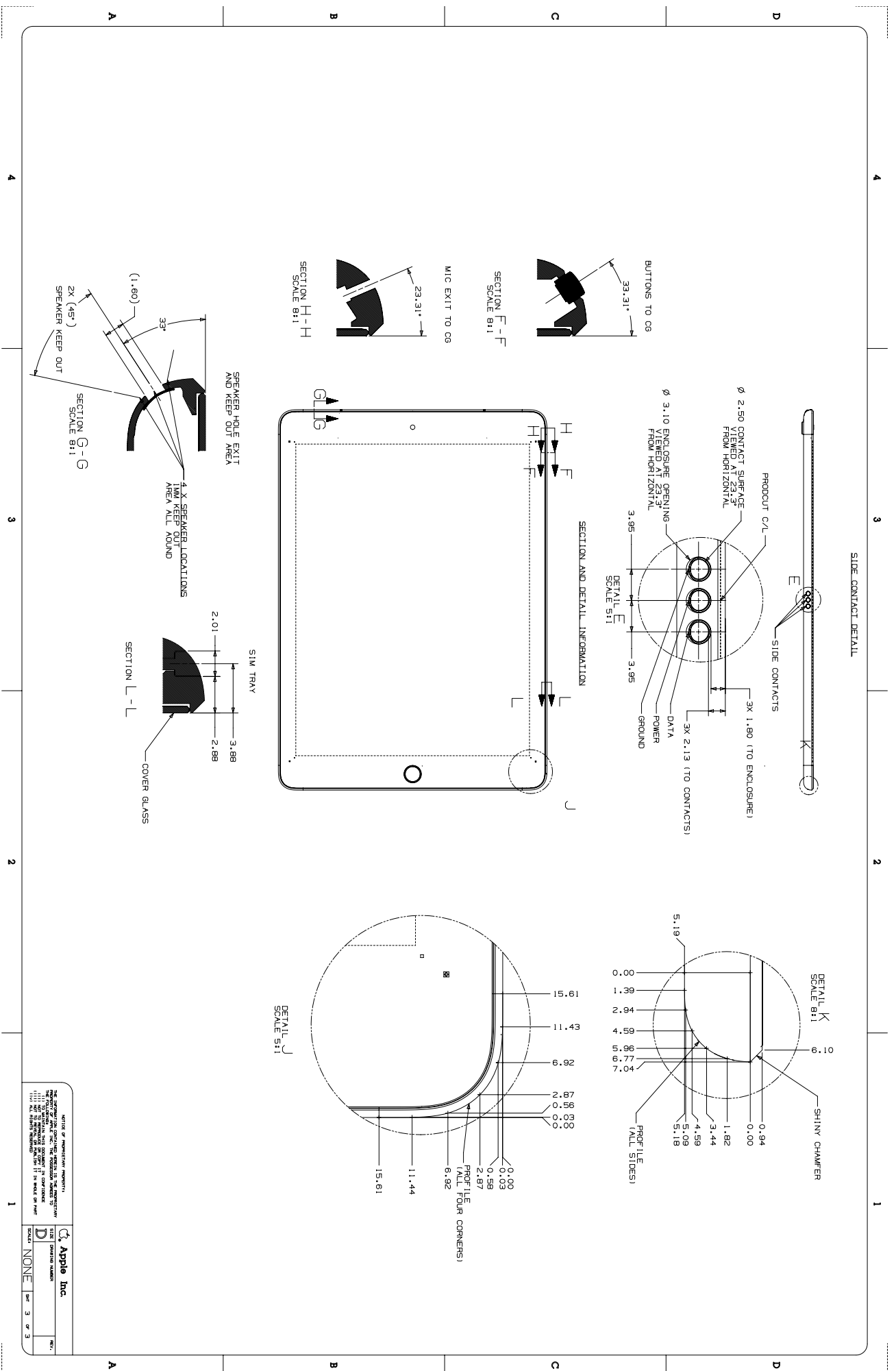
Apple Inc.
12000 Apple Blvd
Cupertino, CA 95014

Apple Inc.
12000 Apple Blvd
Cupertino, CA 95014

56.142 iPad Pro 9.7-inch Magnet/Hall Effect Sensors 1 of 2



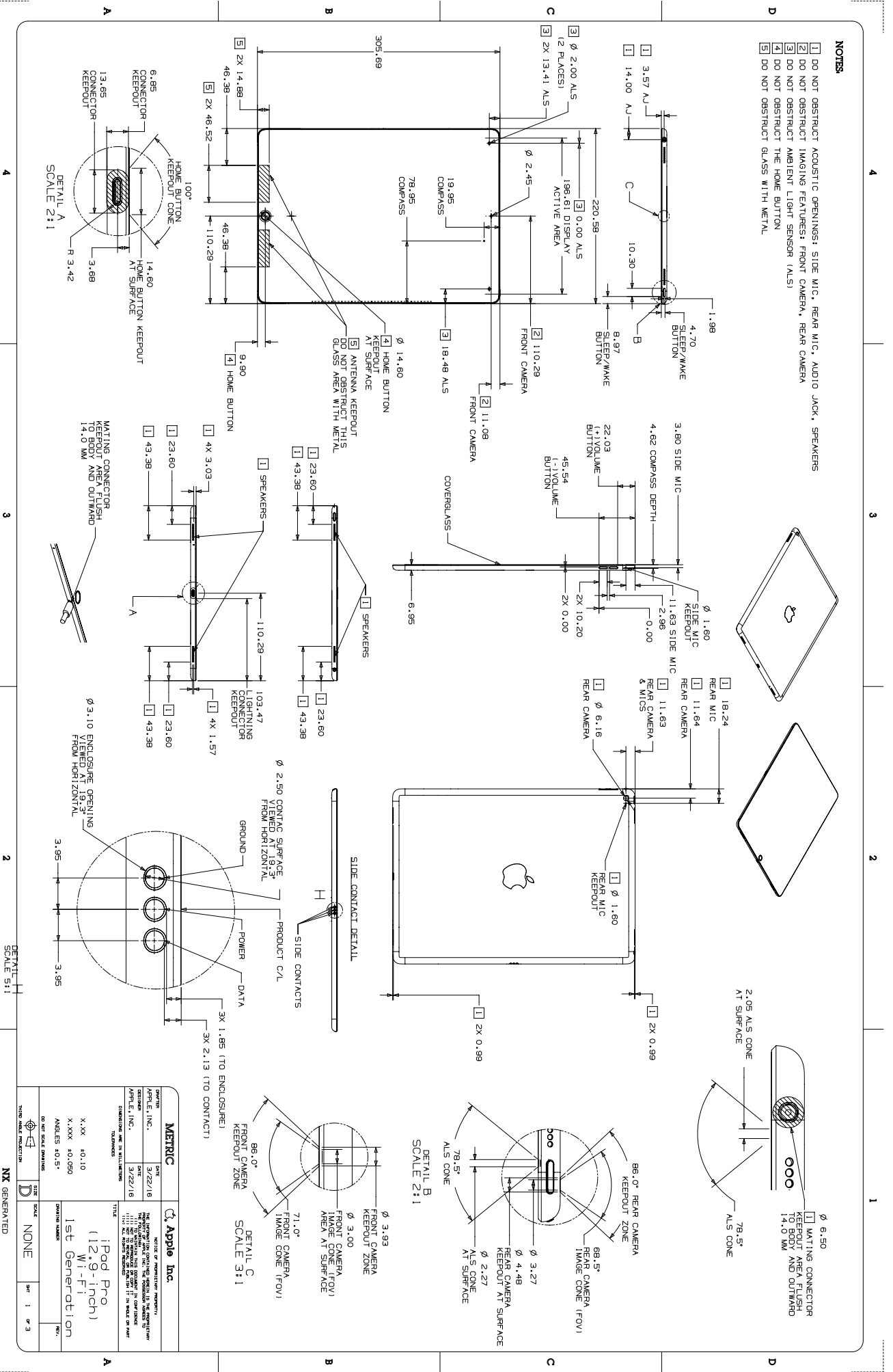
56.143 iPad Pro 9.7-inch Magnet/Hall Effect Sensors 2 of 2



Apple Inc.
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56.144 iPad Pro 12.9-inch (1st generation) with Wi-Fi

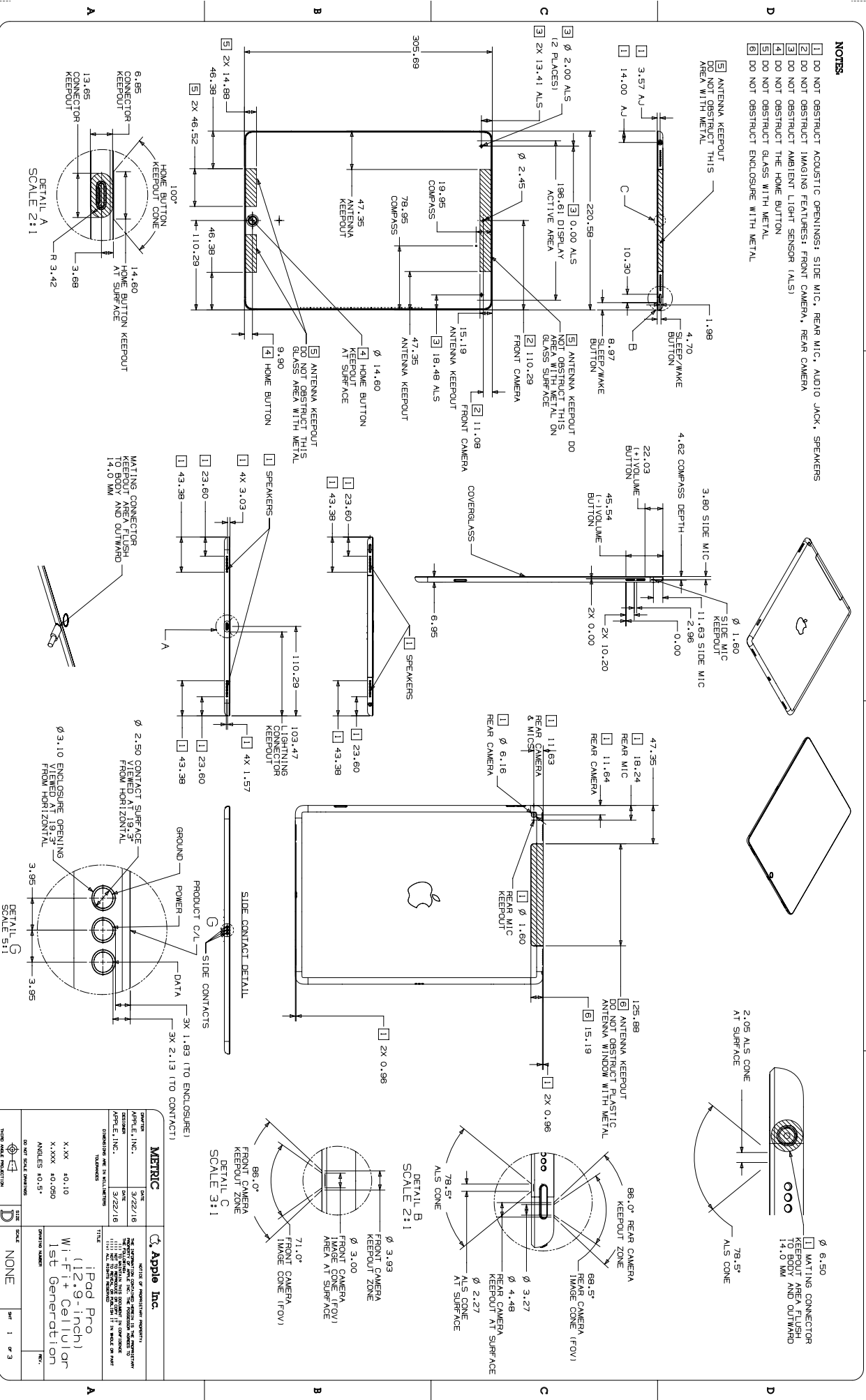
- NOTES**
- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
 - 2 DO NOT OBSTRUCT IMAGING FEATURES: FRONT CAMERA, REAR CAMERA
 - 3 DO NOT OBSTRUCT AMBIENT LIGHT SENSOR (ALS)
 - 4 DO NOT OBSTRUCT THE HOME BUTTON
 - 5 DO NOT OBSTRUCT GLASS WITH METAL



56.145 iPad Pro 12.9-inch (1st generation) with Wi-Fi + Cellular

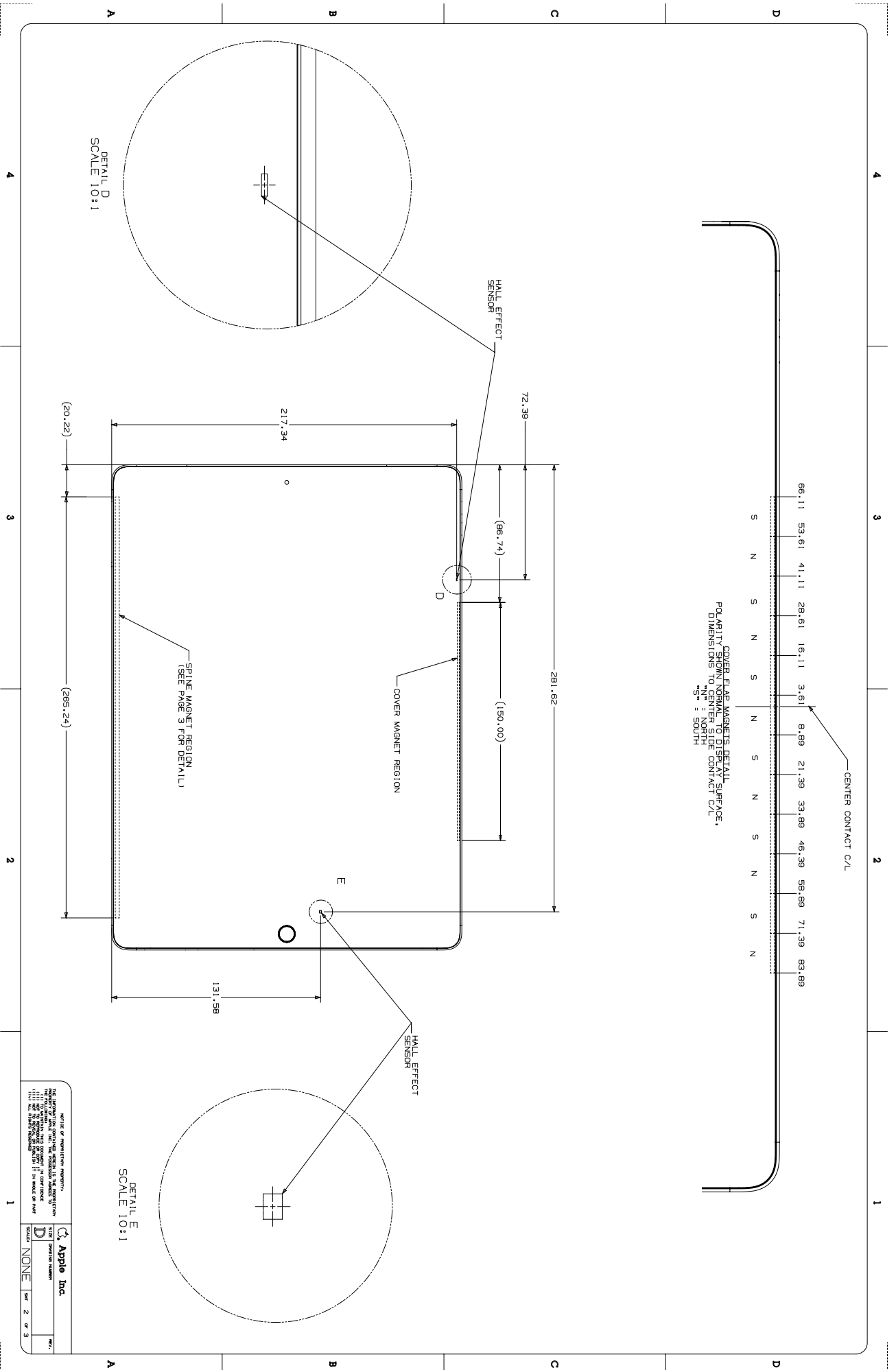
NOTES

- [1] DO NOT OBSTRUCT ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
- [2] DO NOT OBSTRUCT IMAGING FEATURES: FRONT CAMERA, REAR CAMERA
- [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



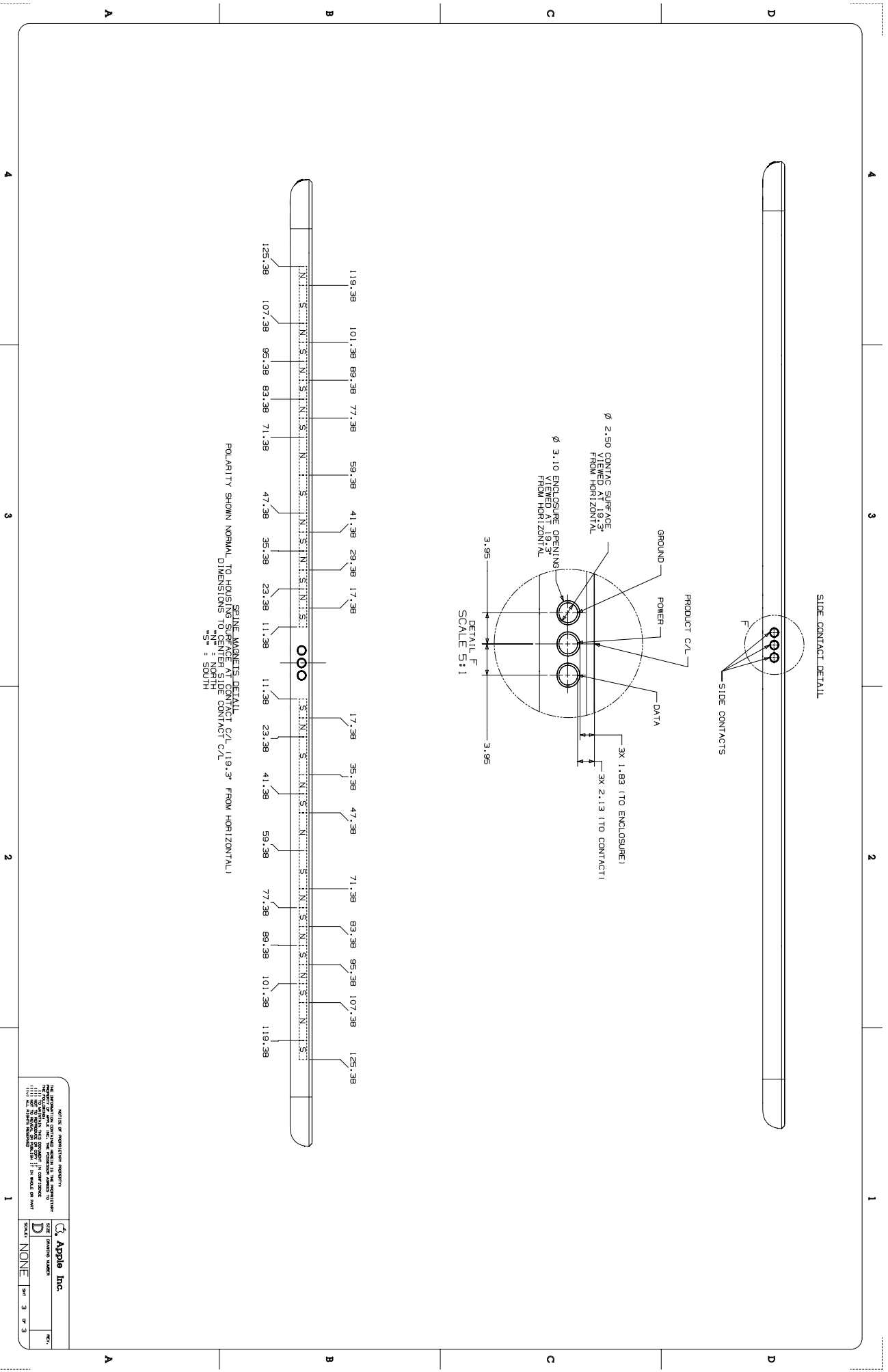
METRIC		Apple Inc.	
DATE	3/22/16	VERSION	1
<p>APRIL E. INC. THE INFORMATION CONTAINED HEREIN IS PROPRIETARY AND CONFIDENTIAL TO APPLE INC. IT IS TO BE KEPT UNDER STRICTLY CONTROLLED AND NOT TO BE DISCLOSED TO ANY OTHER PARTY WITHOUT THE WRITTEN PERMISSION OF APPLE INC.</p>			
<p>Apple Inc. (12.9-inch) Wi-Fi + Cellular 1st Generation</p>			
<p>DATE: 3/22/16</p>			
<p>SCALE: NONE</p>			
<p>GENERATED: NX</p>			

56.146 iPad Pro 12.9-inch (1st generation) Magnet/Hall Effect Sensors 1 of 2



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56.147 iPad Pro 12.9-inch (1st generation) Magnet/Hall Effect Sensors 2 of 2



APPLE INC. APPLE STORE

DATE: 2023-10-10

TIME: 10:00 AM

LOCATION: NEW YORK

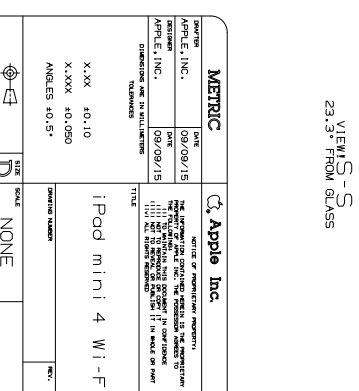
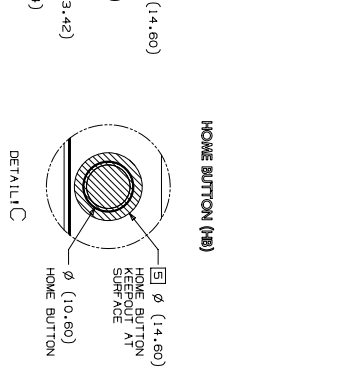
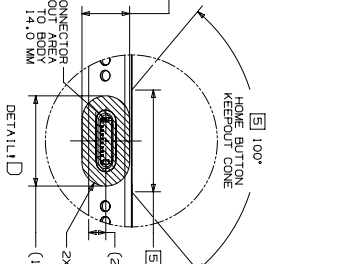
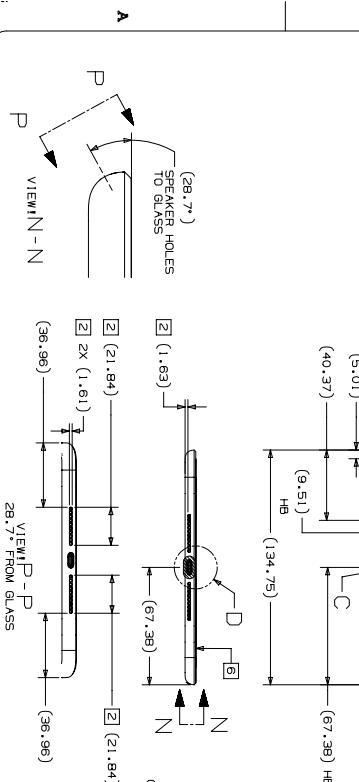
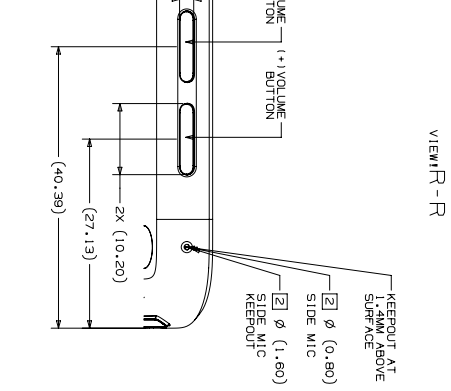
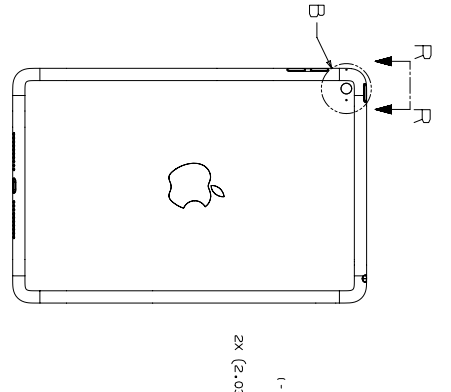
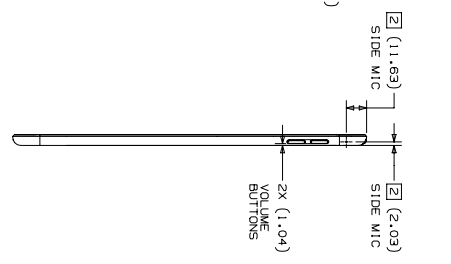
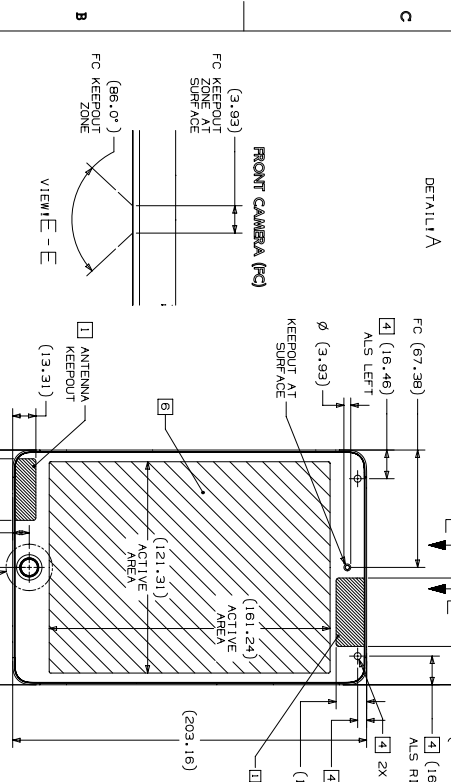
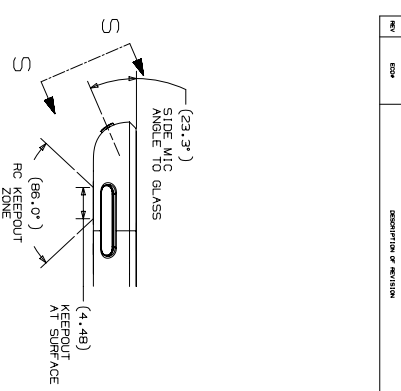
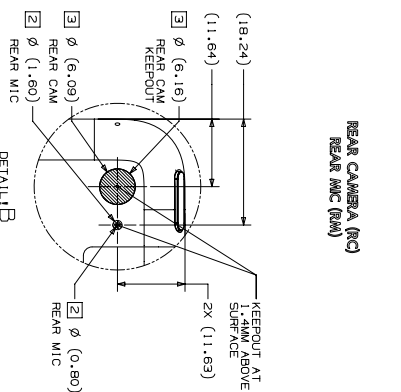
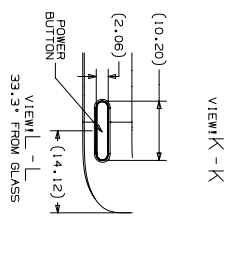
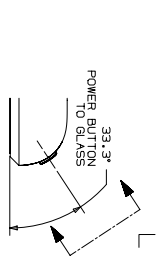
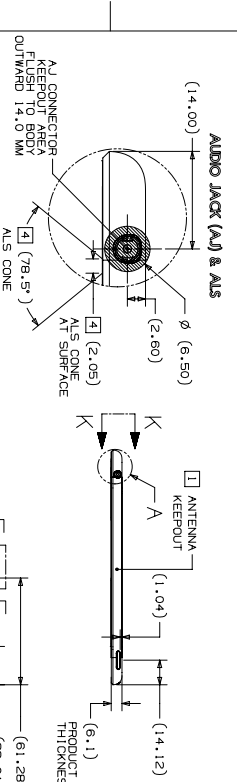
MODEL: NONE

SERIAL: 3 OF 3

56.148 iPad mini 4 with Wi-Fi

4 3 2 1

- NOTES** (UNLESS OTHERWISE SPECIFIED):
- ANTENNA KEEP-OUT NO METAL CONTACT
 - DO NOT OBSTRUCT THE ACOUSTIC OPENINGS: SIDE MIC, REAR MIC, SPEAKERS.
 - DO NOT OBSTRUCT THE IMAGING FEATURES: FRONT CAMERA, REAR CAMERA.
 - DO NOT OBSTRUCT THE ALS (AMBIENT LIGHT SENSOR).
 - DO NOT OBSTRUCT THE HOME BUTTON.
 - DO NOT TOUCH GLASS.



4 3 2 1

REV	DESC	DESCRIPTION OF REVISION
1		

DATE	DESIGNED BY	CHECKED BY	APPROVED BY	SCALE	DATE
09/08/15	APRILE, INC.			NONE	09/08/15
09/09/15	APRILE, INC.			NONE	09/09/15

DATE	DESIGNED BY	CHECKED BY	APPROVED BY	SCALE	DATE
09/08/15	APRILE, INC.			NONE	09/08/15
09/09/15	APRILE, INC.			NONE	09/09/15

DATE	DESIGNED BY	CHECKED BY	APPROVED BY	SCALE	DATE
09/08/15	APRILE, INC.			NONE	09/08/15
09/09/15	APRILE, INC.			NONE	09/09/15

DATE	DESIGNED BY	CHECKED BY	APPROVED BY	SCALE	DATE
09/08/15	APRILE, INC.			NONE	09/08/15
09/09/15	APRILE, INC.			NONE	09/09/15

DATE	DESIGNED BY	CHECKED BY	APPROVED BY	SCALE	DATE
09/08/15	APRILE, INC.			NONE	09/08/15
09/09/15	APRILE, INC.			NONE	09/09/15

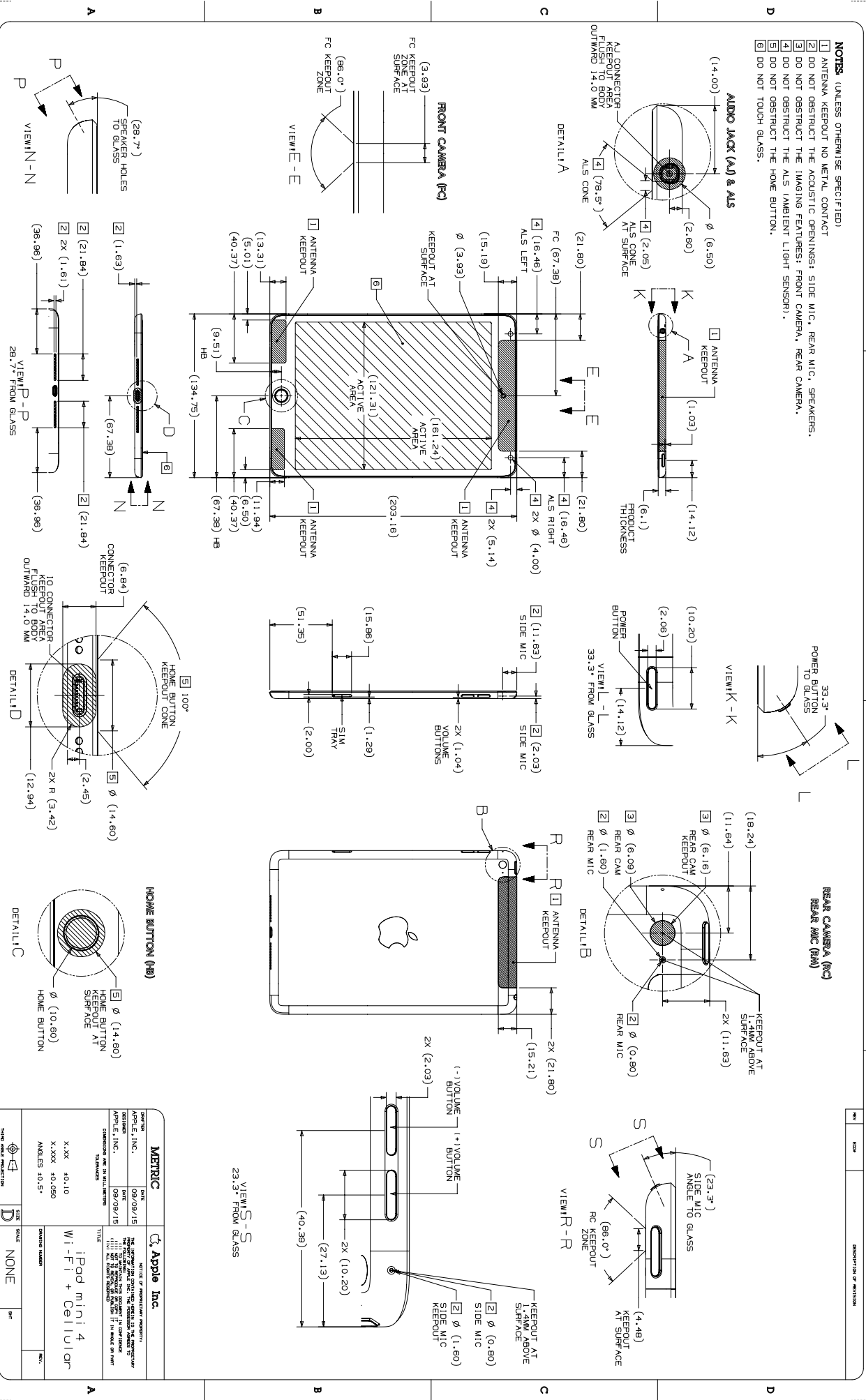
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09/09/15	APRILE, INC.			NONE	09/09/15

DATE	DESIGNED BY	CHECKED BY	APPROVED BY	SCALE	DATE
09/08/15	APRILE, INC.			NONE	09/08/15
09/09/15	APRILE, INC.			NONE	09/09/15

DATE	DESIGNED BY	CHECKED BY	APPROVED BY	SCALE	DATE
09/08/15	APRILE, INC.			NONE	09/08/15
09/09/15	APRILE, INC.			NONE	09/09/15

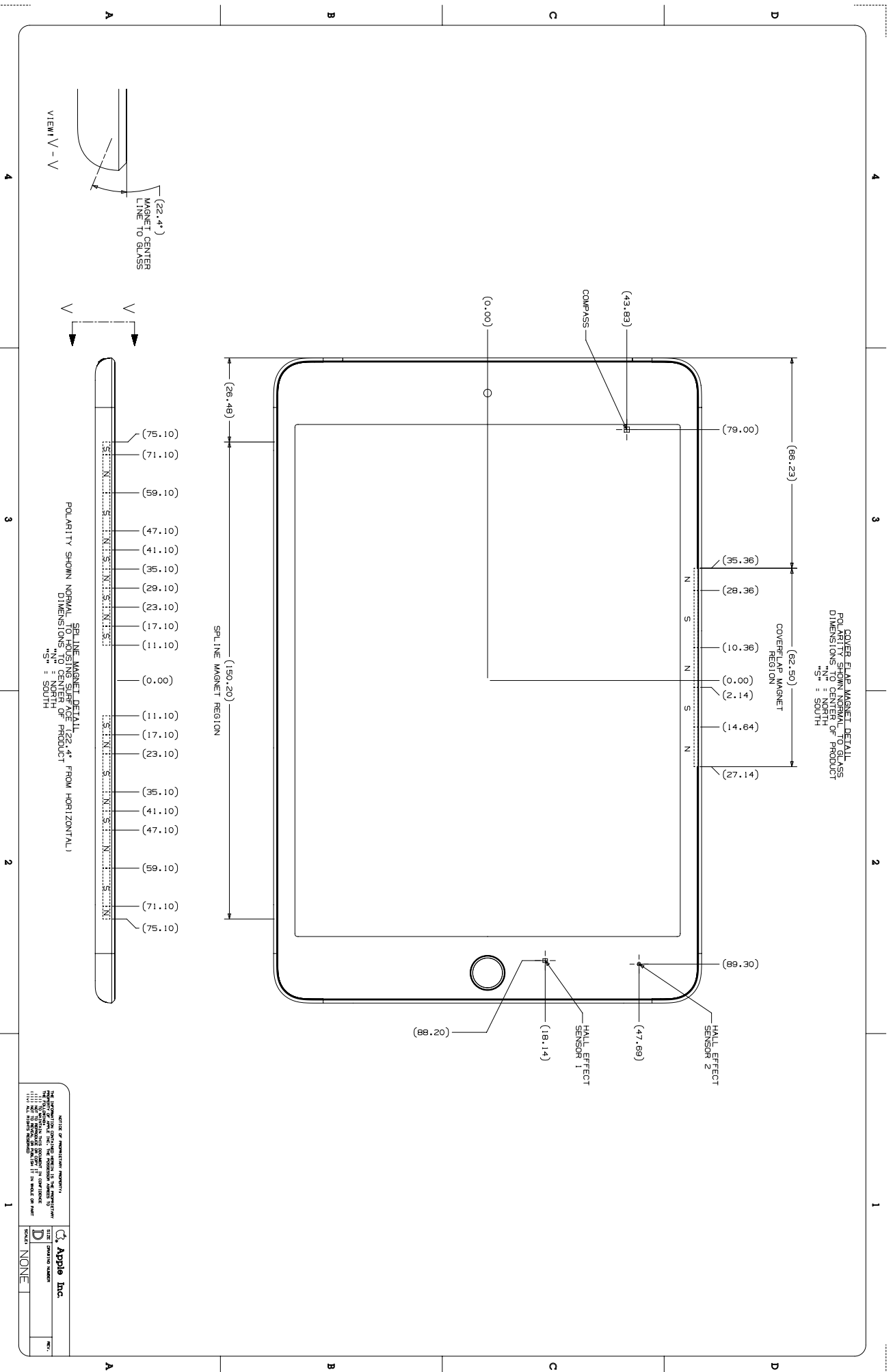
56.149 iPad mini 4 with Wi-Fi + Cellular

- NOTES** (UNLESS OTHERWISE SPECIFIED):
- 1 ANTENNA KEEP-OUT 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.



MATERIAL		DATE		Apple Inc. © Apple Inc.
APPROVED BY	DATE	APPROVED BY	DATE	
APRILE, INC.	09/08/15	APRILE, INC.	09/08/15	
APRILE, INC.	09/09/15	APRILE, INC.	09/09/15	
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DIMENSIONS ARE IN MILLIMETERS (IN PARENTHESES)				
TITLE		iPad mini 4 Wi-Fi + Cellular		
DRAWING NUMBER		NONE		
SCALE		NONE		
DATE GENERATED		NONE		

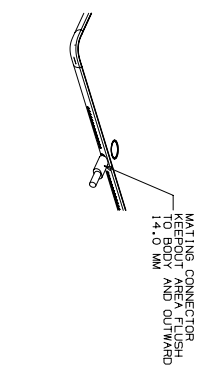
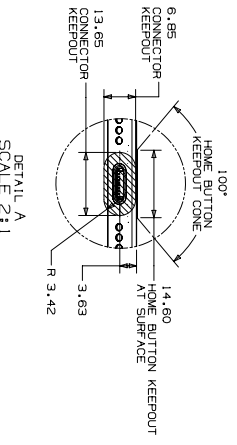
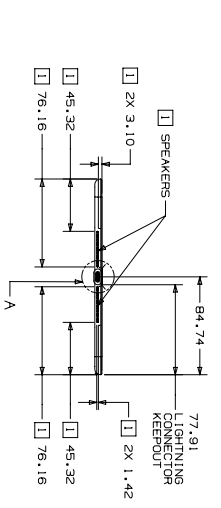
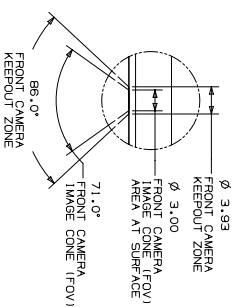
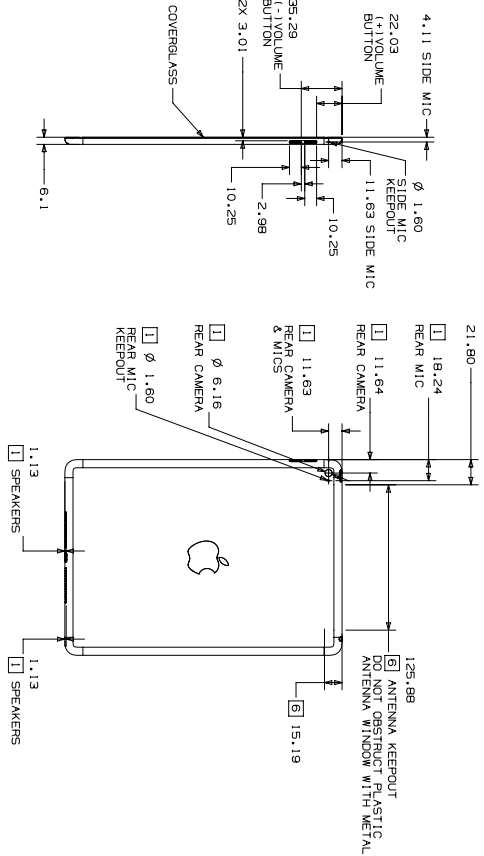
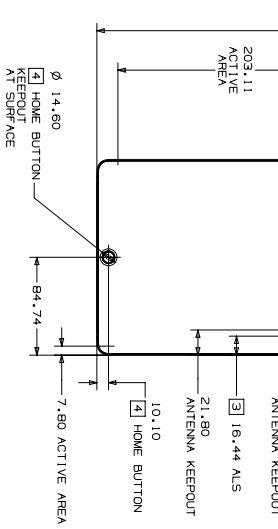
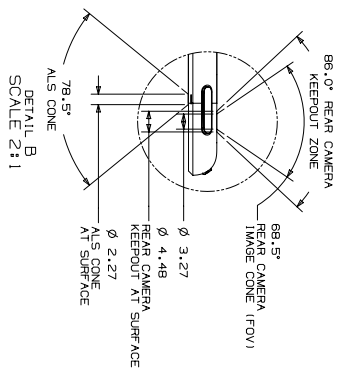
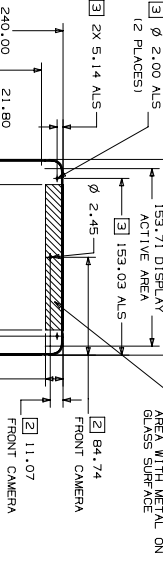
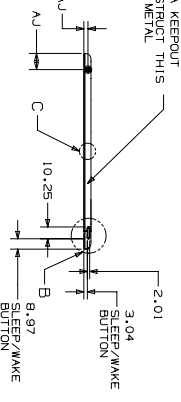
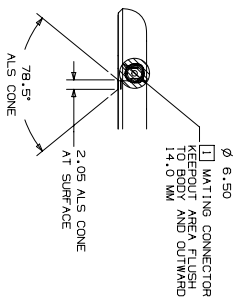
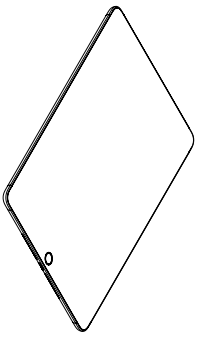
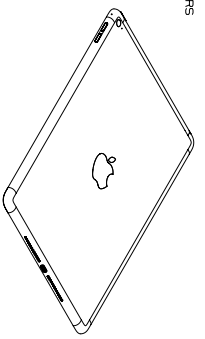
56.150 iPad mini 4 Magnet/Hall Effect Sensors



56.151 iPad Air 2 with Wi-Fi

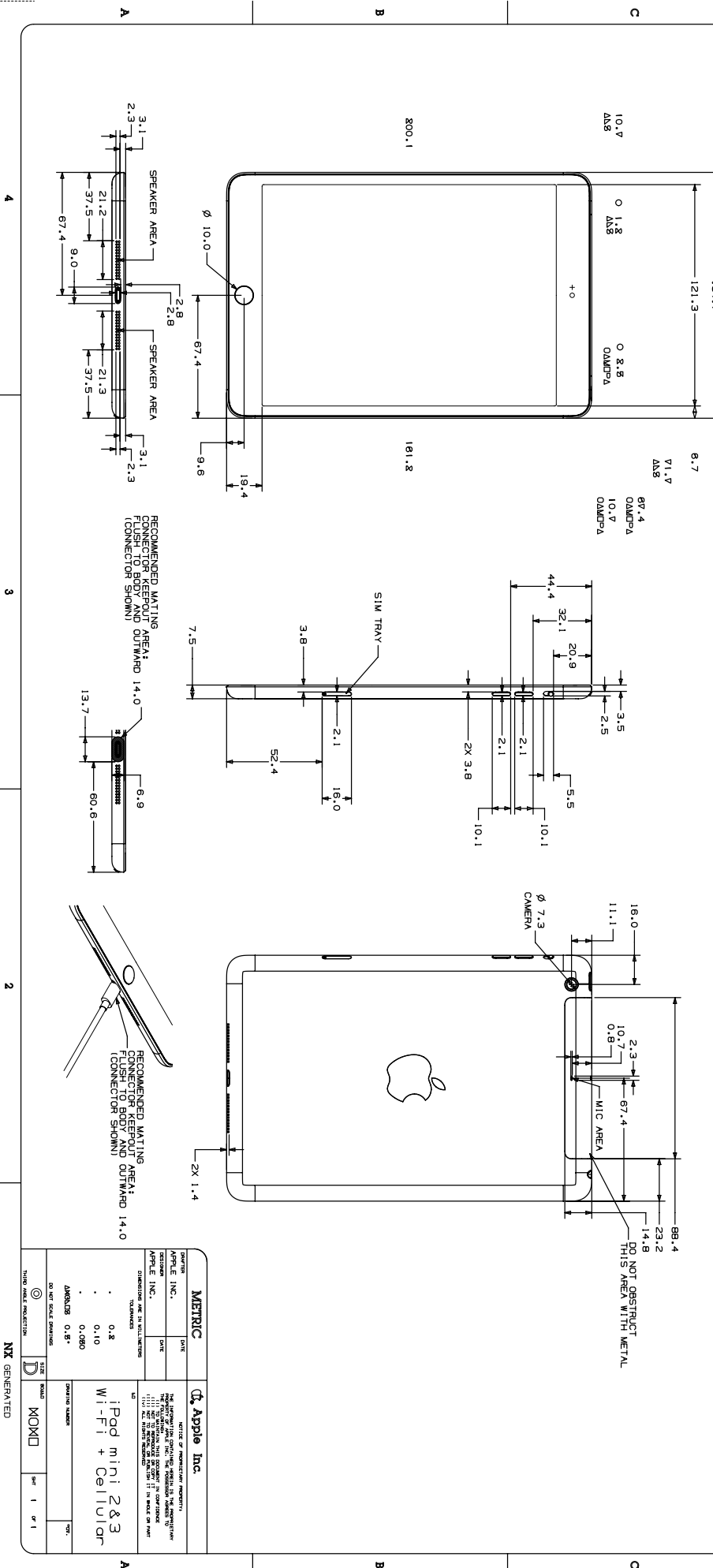
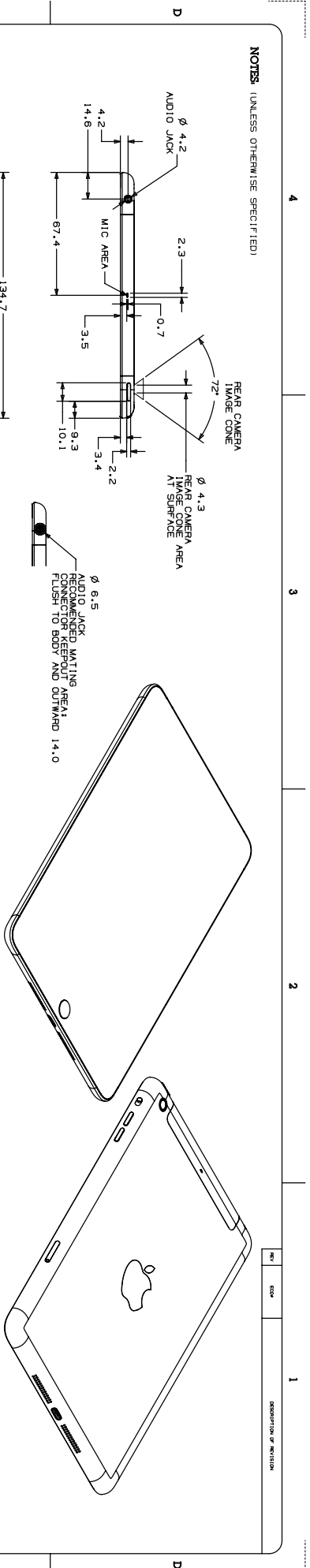
NOTES:

- 1 DO NOT OBSTRUCT ACOUSTIC OPENINGS, SIDE MIC, REAR MIC, AUDIO JACK, SPEAKERS
- 2 DO NOT OBSTRUCT IMAGING FEATURES: FRONT CAMERA, REAR CAMERA
- 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



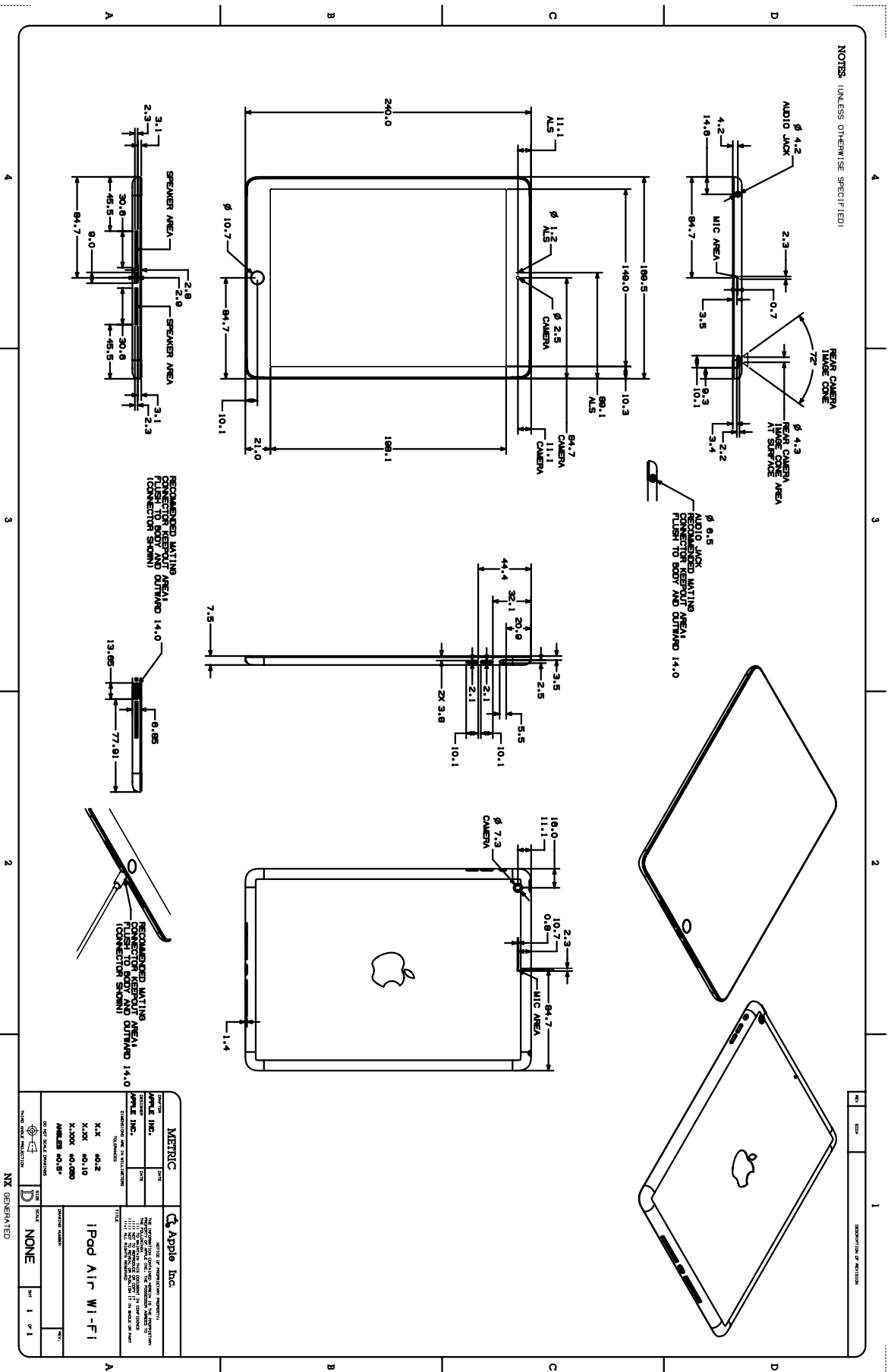
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DATE	DATE	VERSION	DESCRIPTION
APR 11, 2013	APR 11, 2013	1	NEW PRODUCT INTRODUCTION
APR 11, 2013	APR 11, 2013	2	REVISIONS
TITLE: iPad Air 2 Wi-Fi DRAWING NUMBER: 56.151 SHEET: 1 OF 1			
3D STEP FILE GENERATED BY: NX THIRD PARTY PROJECTION		SCALE: NONE UNIT: 1 OF 1	

56.154 iPad mini 2 and iPad mini 3 with Wi-Fi + Cellular



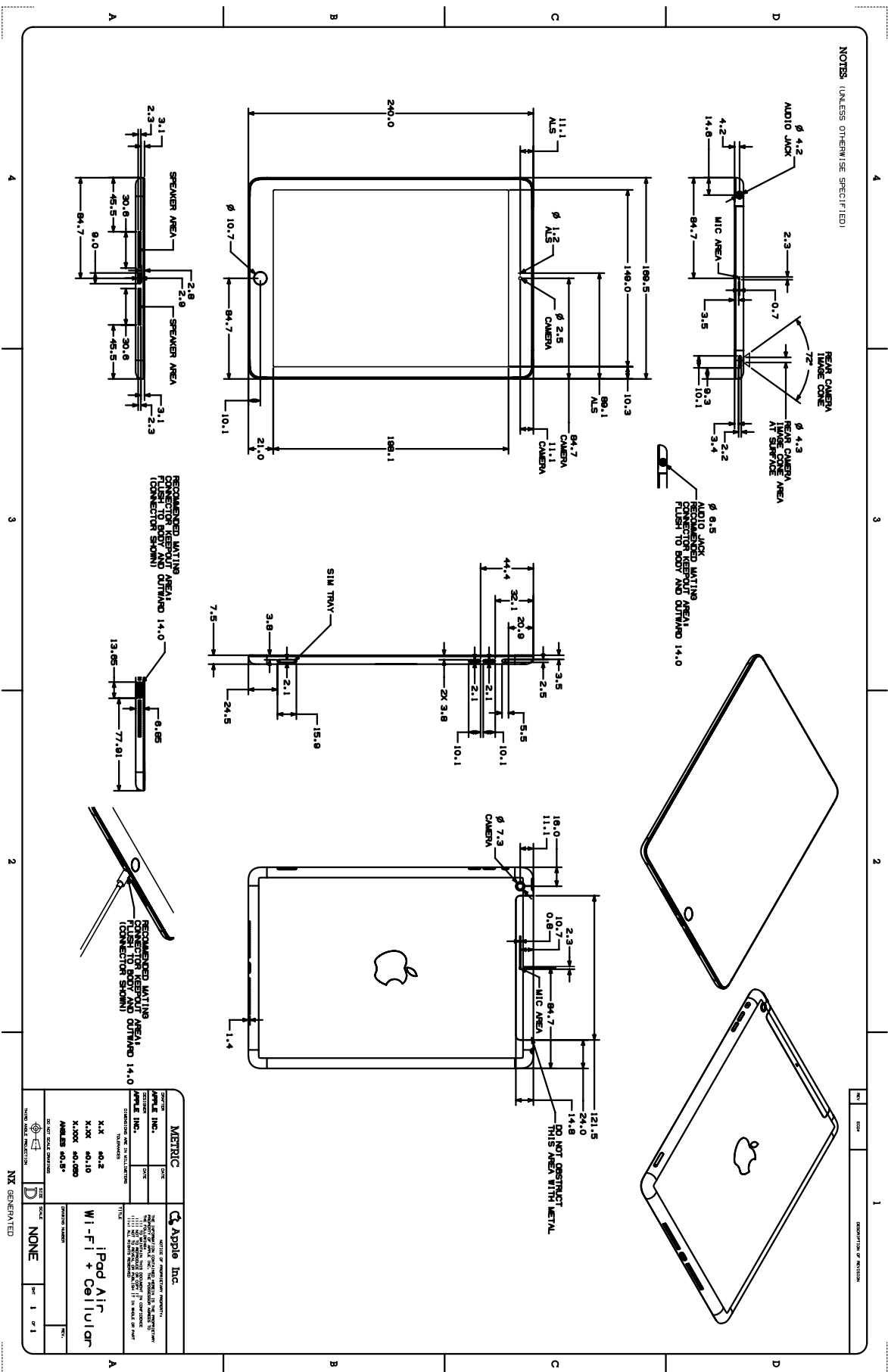
METRIC		DATE		REVISION	
DESIGNER	APPLE, INC.	DATE		DESCRIPTION	
DRAWN	APPLE, INC.	DATE		DESCRIPTION	
CHECKED	APPLE, INC.	DATE		DESCRIPTION	
APPROVED	APPLE, INC.	DATE		DESCRIPTION	
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DATE GENERATED: 2023-10-10

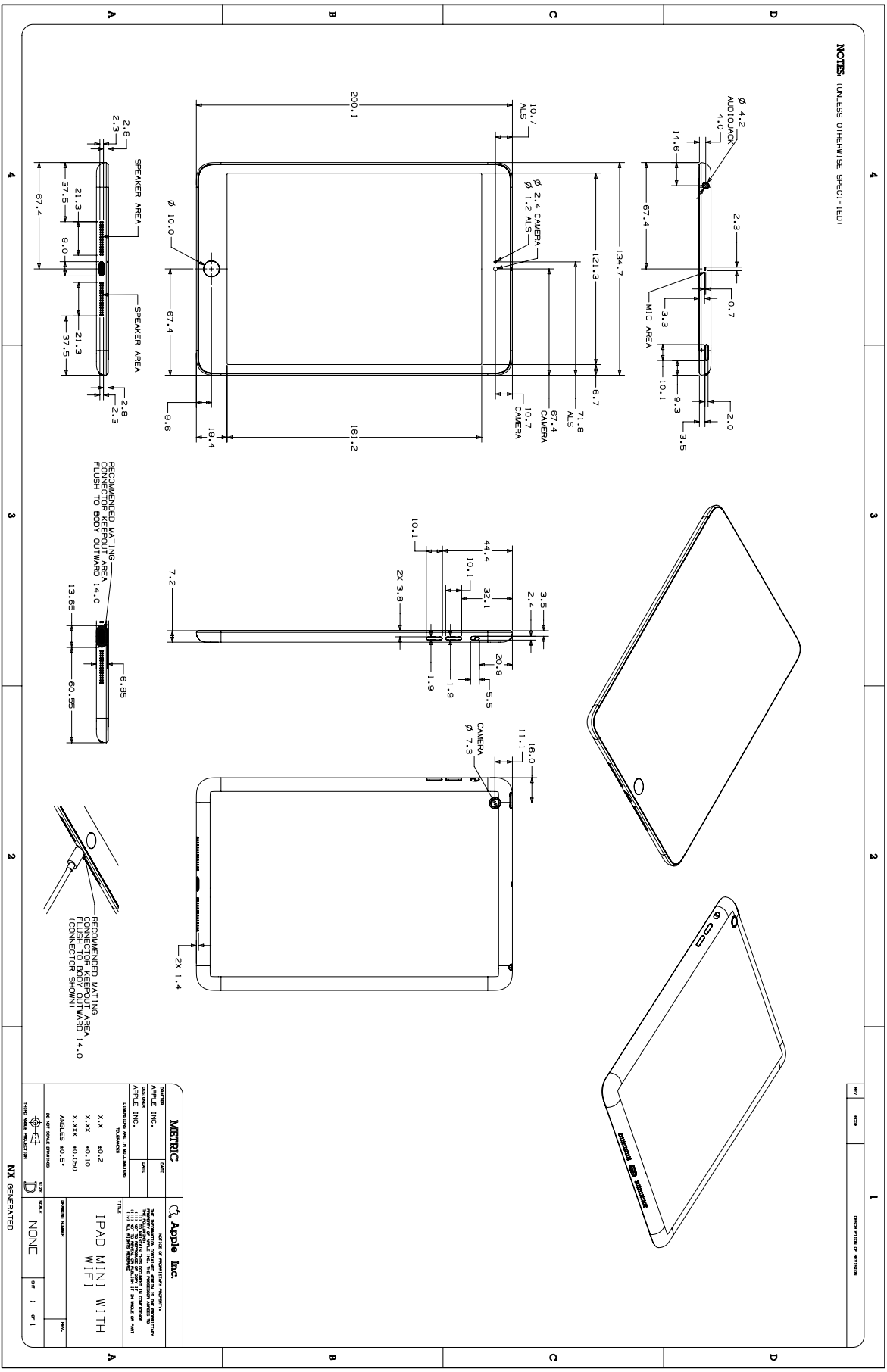


APPLE INC.	DATE	Apple Inc.	OFFICE OF PRODUCT DESIGN
APPLE INC.	REV		DATE
CHANGING MEASUREMENTS			NOTE: THIS DRAWING IS THE PROPERTY OF APPLE INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF APPLE INC.
TOLERANCES	TYPE	TITLE	
X.X 40.2		IPod Air Wi-Fi	
X.XX 40.10			
X.XXX 40.000			
ANGLES 40.8 ϕ		FORMER NUMBER	REV.
NO. OF FILE CHANGES			
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NX GENERATED			

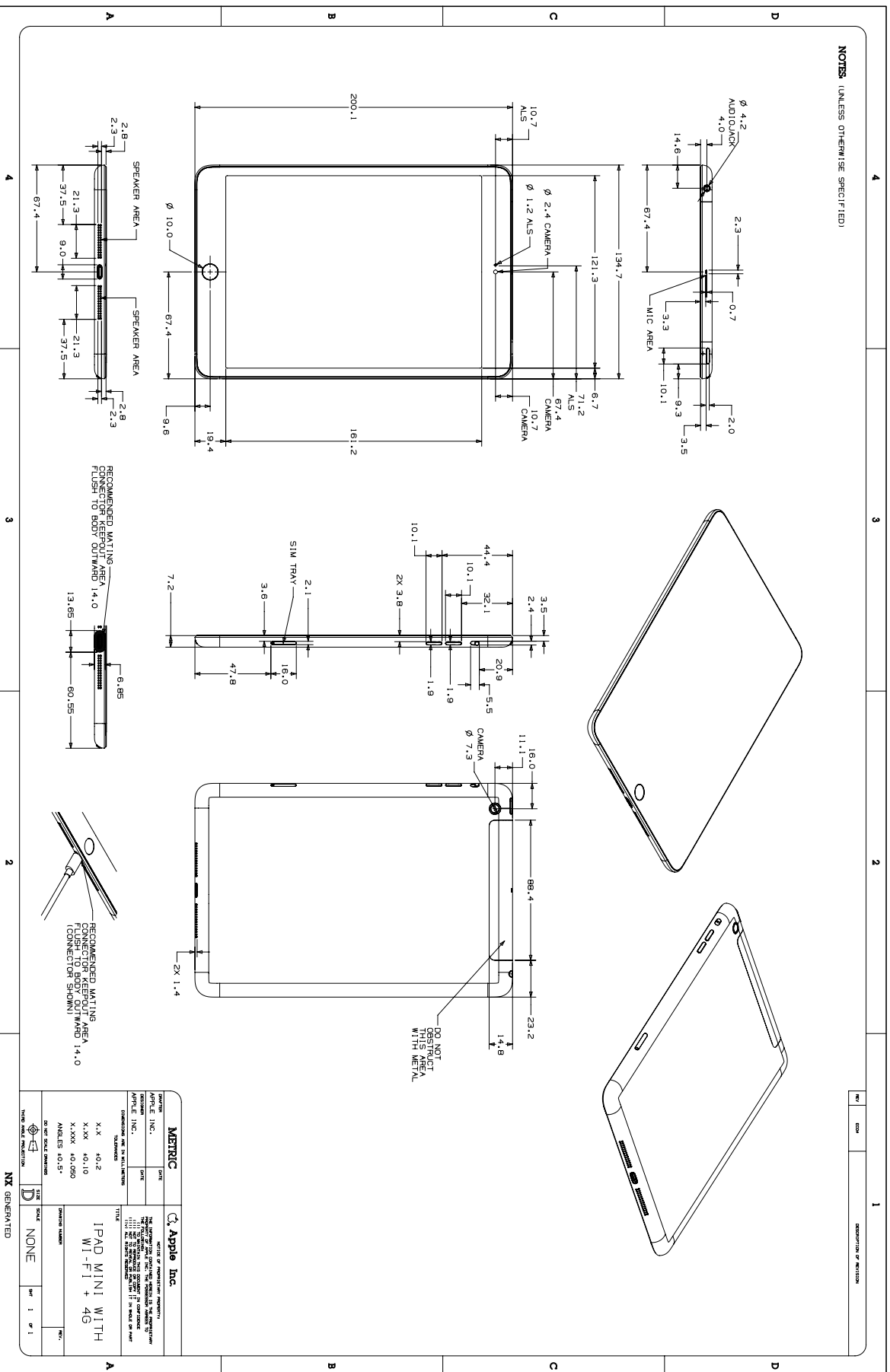
56.156 iPad Air with Wi-Fi + Cellular



56.157 iPad mini with Wi-Fi

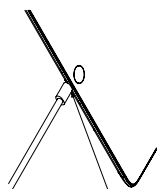
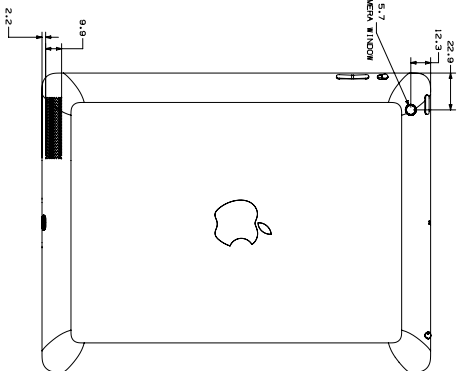
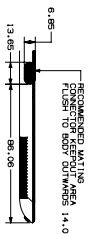
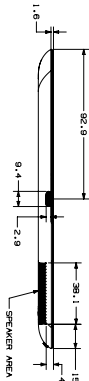
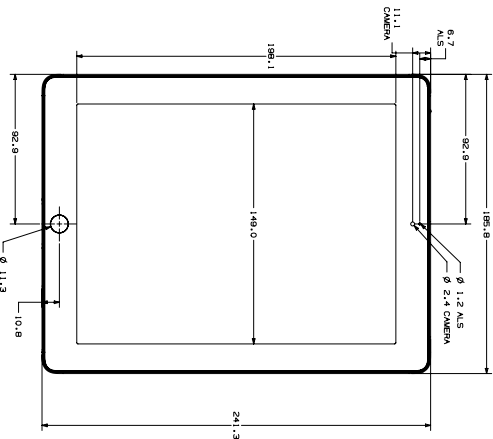
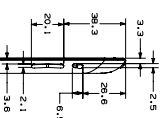
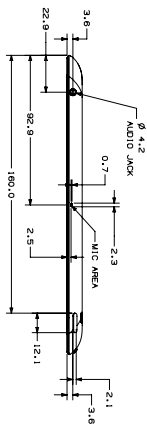
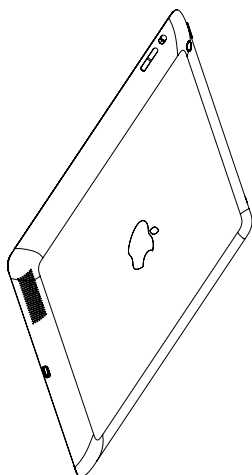
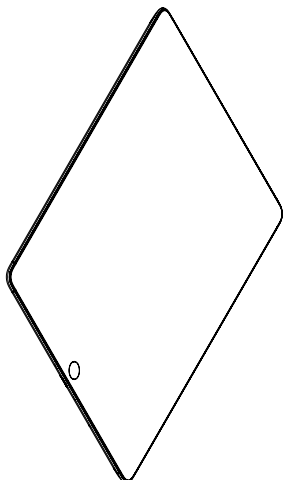


56.158 iPad mini with Wi-Fi + Cellular



56.159 iPad (4th generation) with Wi-Fi

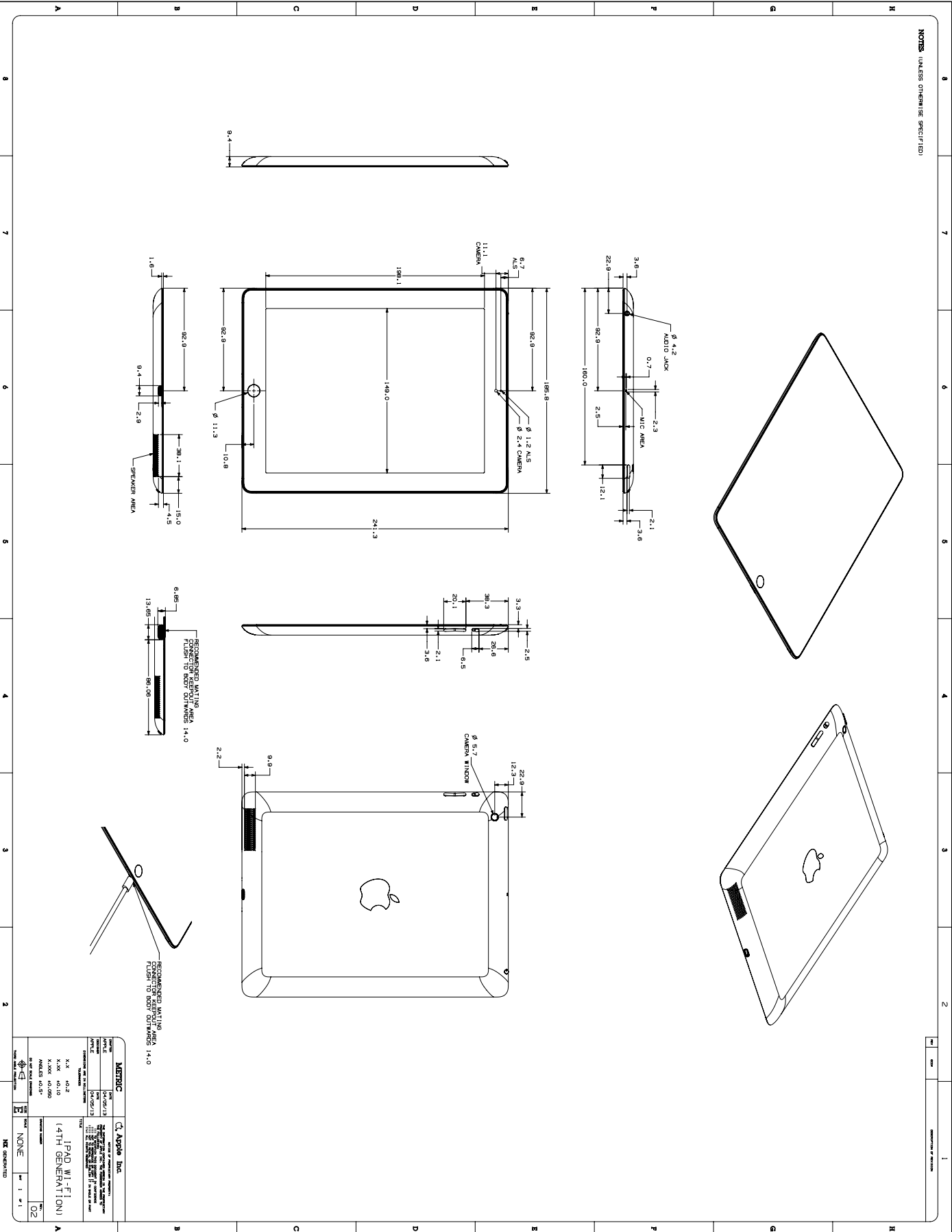
NOTES: UNLESS OTHERWISE SPECIFIED)



RECOMMENDED MATING FLANGE TO MATE OUTWARDS 14.0

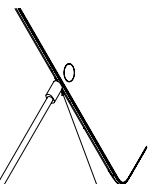
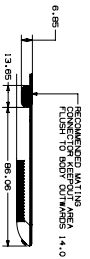
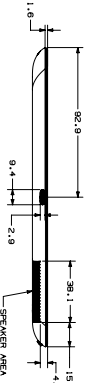
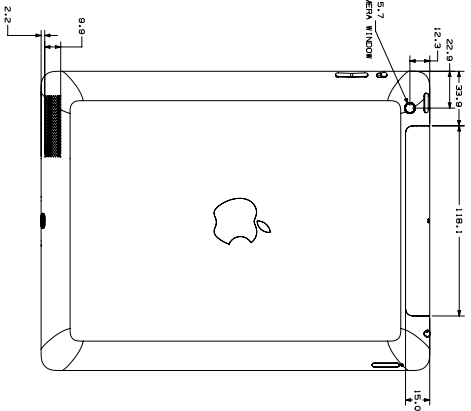
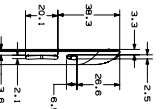
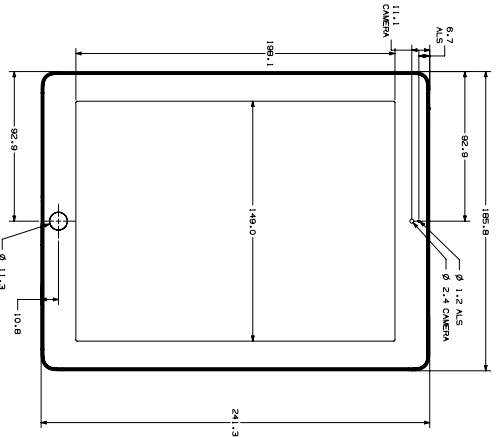
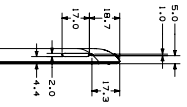
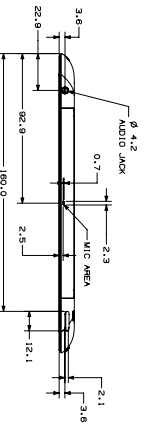
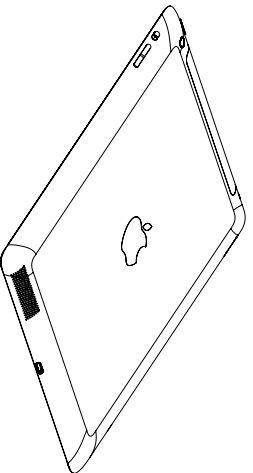
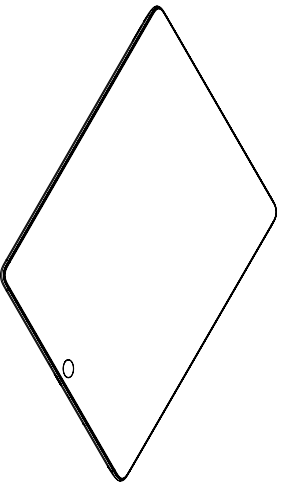
METRIC		Apple Inc.	
DATE	19/07/13	DESCRIPTION	56.159 iPad (4th generation) with Wi-Fi
REVISION	1	REVISION	1
TYPE	1	TYPE	1
SCALE	1:1	SCALE	1:1
UNIT	MM	UNIT	MM
NUMBER	02	NUMBER	02

IPAD WI-FI (4TH GENERATION)	
TYPE	IPAD WI-FI (4TH GENERATION)
SCALE	1:1
UNIT	MM
NUMBER	02



56.160 iPad (4th generation) with Wi-Fi + Cellular

NOTES: UNLESS OTHERWISE SPECIFIED



RECOMMENDED WRITING AREA FLUSH TO BODY OUTWARDS 14.0

PROPERTY	VALUE
DATE	10/23/13
REVISION	1
DESCRIPTION	56.160 iPad (4th generation) with Wi-Fi + Cellular
DESIGNER	K.K. 402
CHECKER	K.K. 402
APPROVER	K.K. 402
DATE	10/23/13

PROPERTY	VALUE
TYPE	IPAD WI-FI + CELLULAR (4TH GENERATION)
NUMBER	02

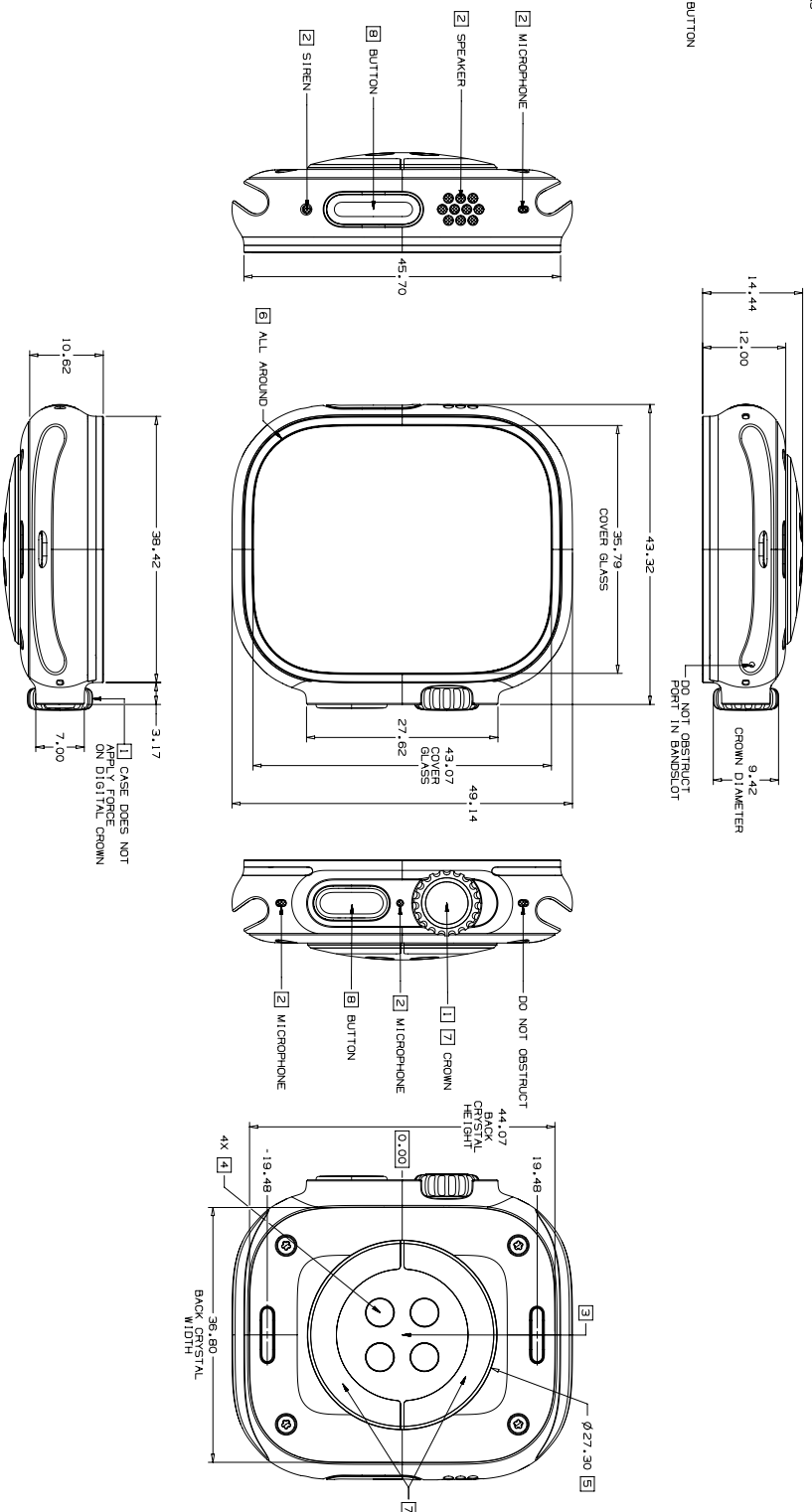
PROPERTY	VALUE
SCALE	NONE
UNIT	mm
ASSEMBLY	1 of 1
DATE	10/23/13

NOT DRAWN

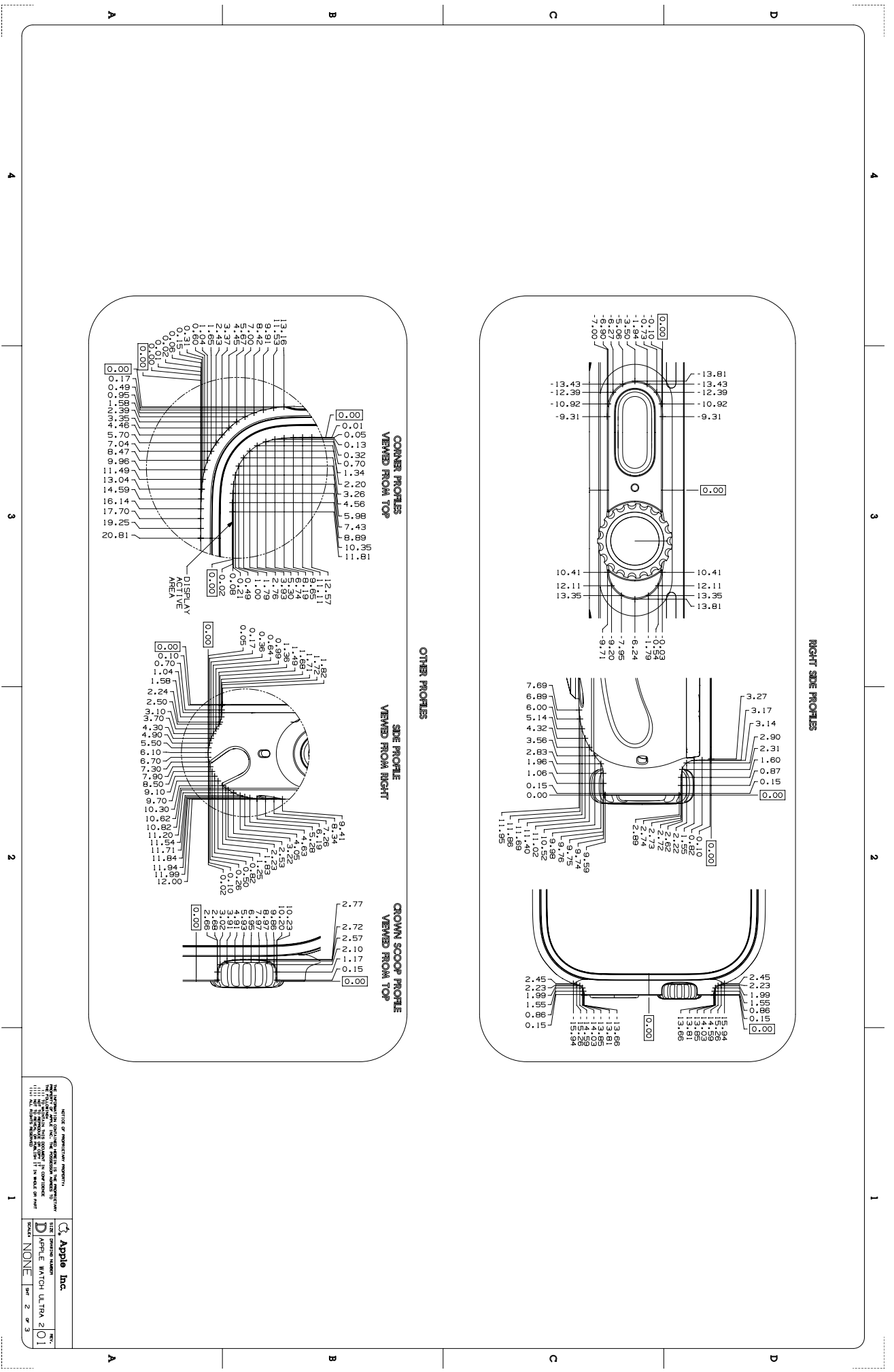
56.163 Apple Watch Ultra 2, 1 of 3

OVERALL DIMENSIONS AND CALLOUTS

- NOTES**
- 1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
 - 2 CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
 - 3 CASE DOES NOT OBSTRUCT FACE OF CROWN
 - 4 CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
 - 5 CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
 - 6 CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
 - 7 CASE DOES NOT EXTEND INTO WATCH SENSOR WINDOWS
 - 8 CASE DOES NOT CONTACT THE WATCH COVER GLASS
 - 9 CASE DOES NOT CONTACT ELECTRICAL SENSORS
 - 10 CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
 - 11 NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
 - 12 CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL

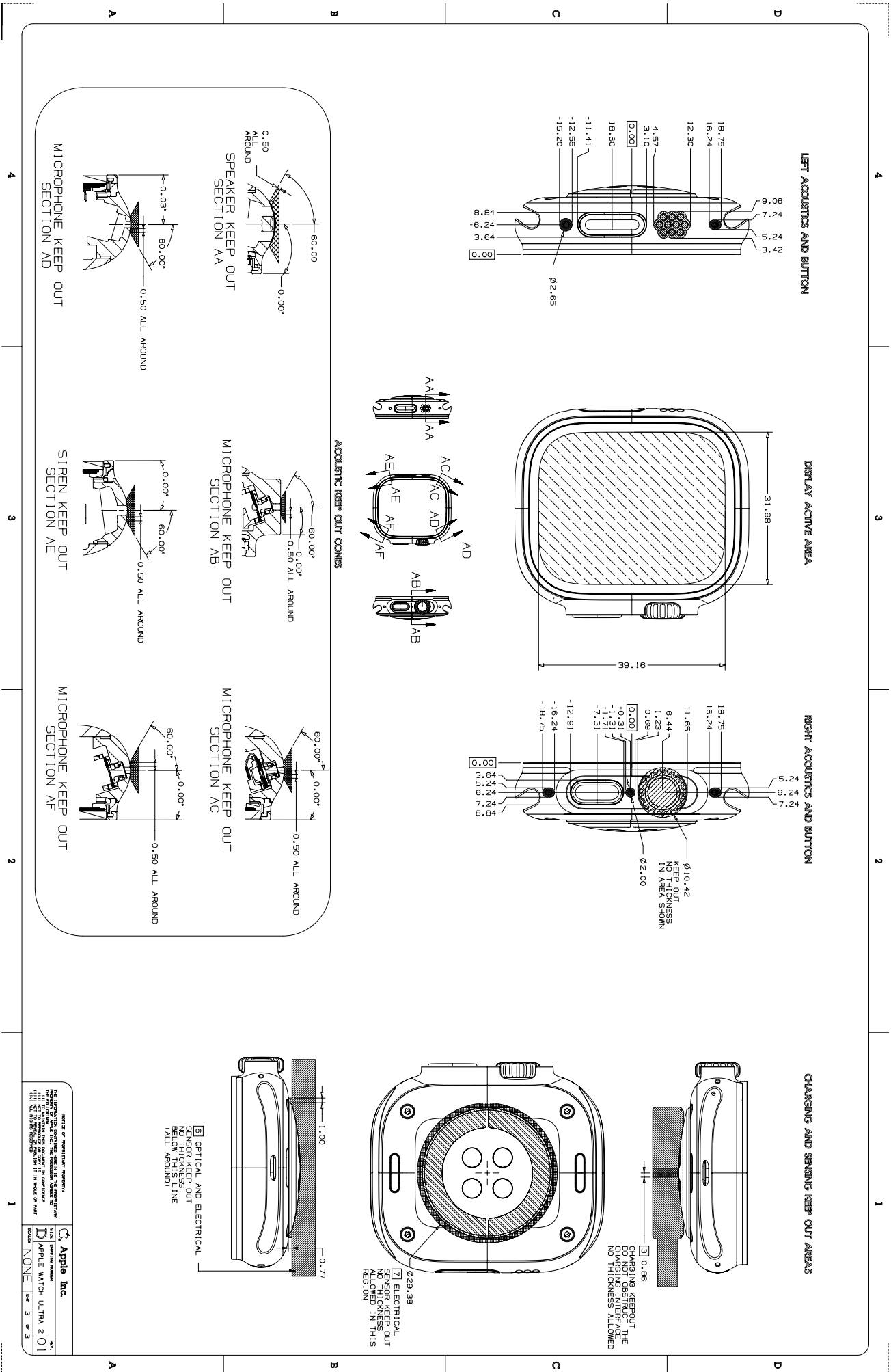


Apple Inc.
 Apple Watch Ultra 2
 Case
 NONE



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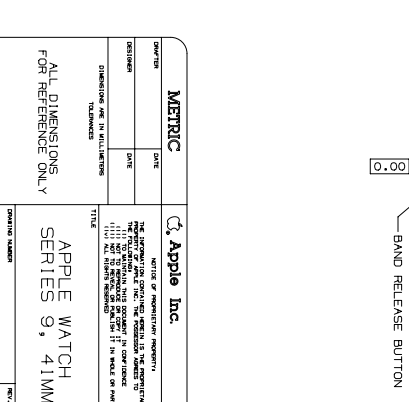
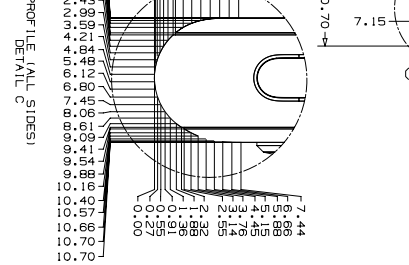
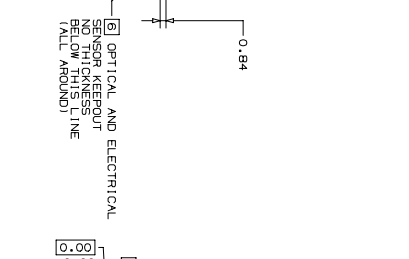
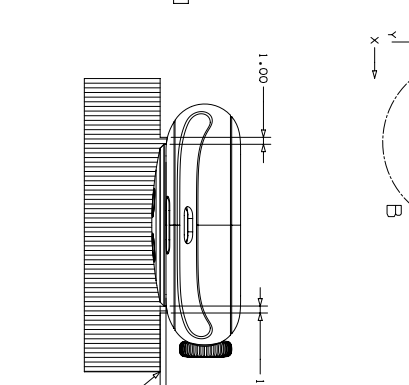
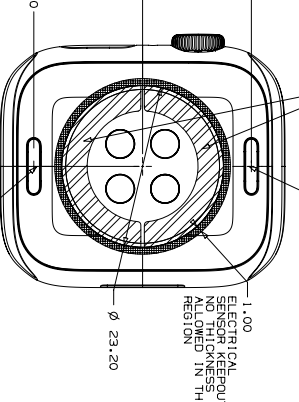
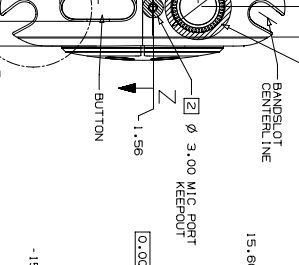
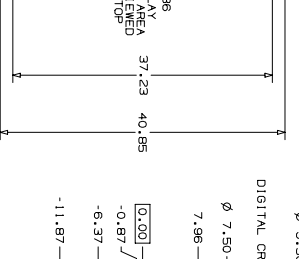
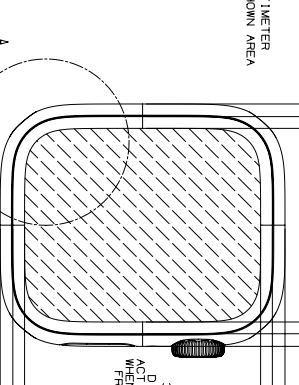
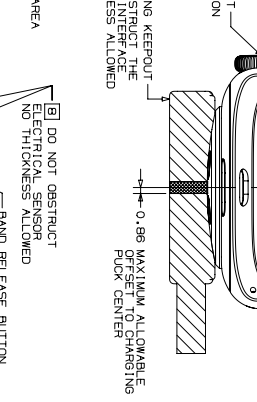
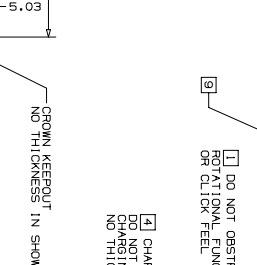
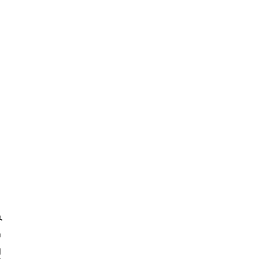
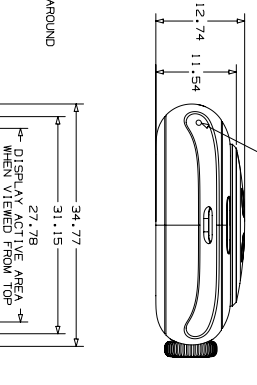
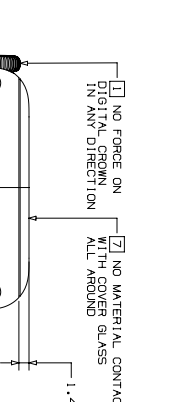
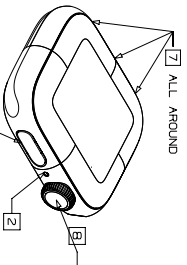
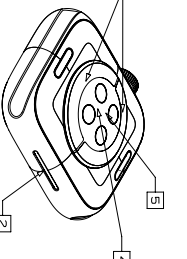
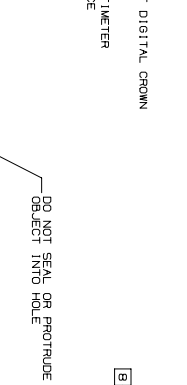
Apple Inc.
Apple Watch Ultra 2 01
NONE 2 of 3



56.167 Apple Watch Series 9, 41 mm

NOTES (UNLESS OTHERWISE SPECIFIED):

- 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
- CASE DOES NOT OBSTRUCT THE WATCH ACUSTIC OPENINGS AND ALTIMETER AND WEAR SENSORS TO MAINTAIN BEST PERFORMANCE
- DO NOT INTERFERE WITH THE WATCH CHARGING INTERFACE
- CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
- CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
- CASE DOES NOT CONTACT THE WATCH COVER GLASS
- CASE DOES NOT CONTACT ELECTRICAL SENSORS
- CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
- CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL

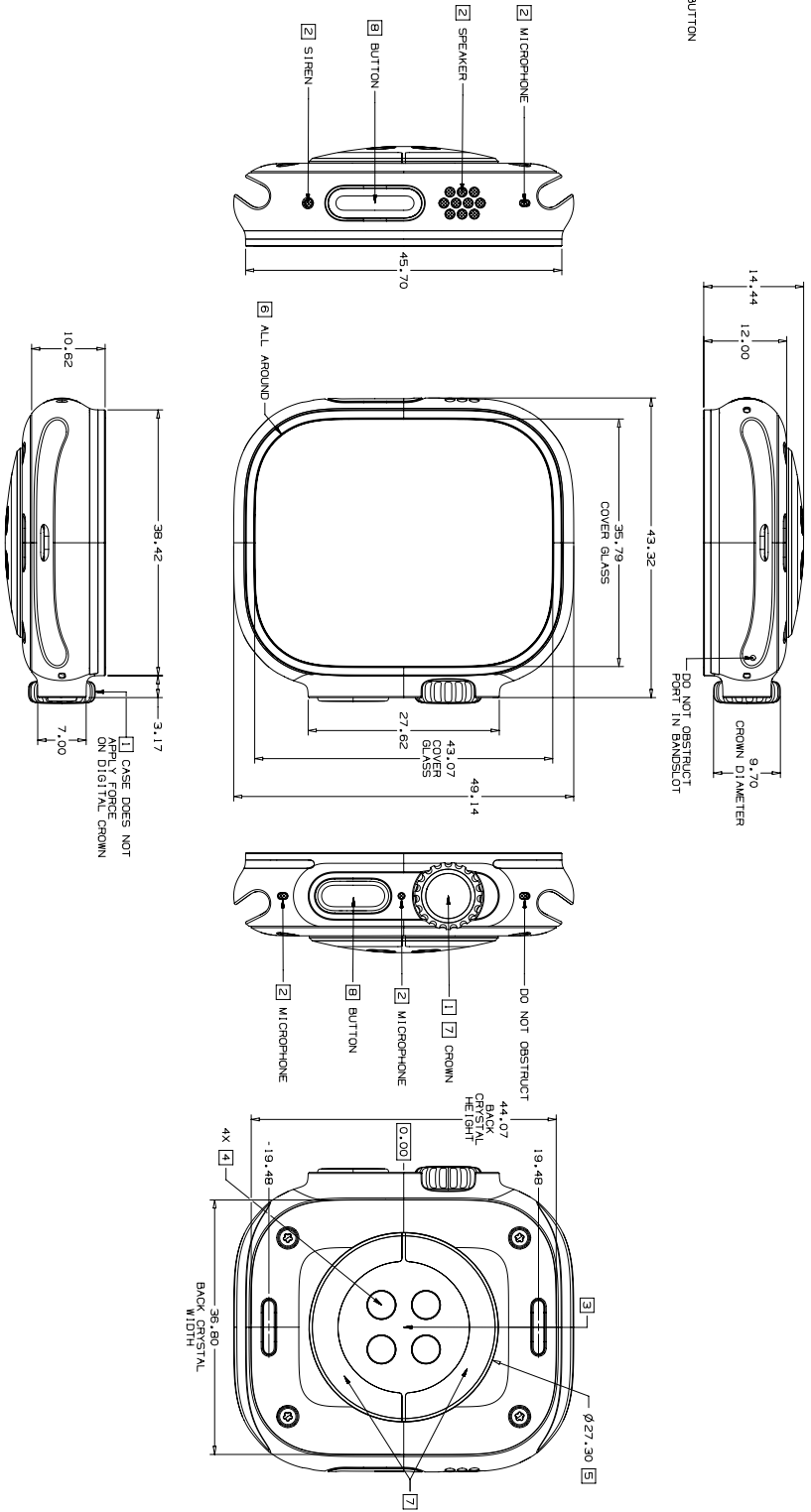


MATERIALS		FINISHES		DIMENSIONS		TOLERANCES		UNIT CONVERSIONS	
STAINLESS STEEL	316L	BRUSHED	NON-REFLECTIVE	MM	IN	MM	IN	MM	IN
ALL DIMENSIONS FOR REFERENCE ONLY		NONE		NONE		NONE		NONE	

Apple Inc.
Apple Watch Series 9, 41mm

OVERALL DIMENSIONS AND CALLOUTS

- NOTES**
- 1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
 - 2 CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
 - 3 CASE DOES NOT OBSTRUCT FACE OF CROWN
 - 4 CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTITUDE AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
 - 5 CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
 - 6 CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
 - 7 CASE DOES NOT EXTEND INTO WATCH SENSOR WINDOWS
 - 8 CASE DOES NOT CONTACT THE WATCH COVER GLASS
 - 9 CASE DOES NOT CONTACT ELECTRICAL SENSORS
 - 10 CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
 - 11 NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
 - 12 CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL



UNIT OF MEASUREMENT: MILLIMETERS

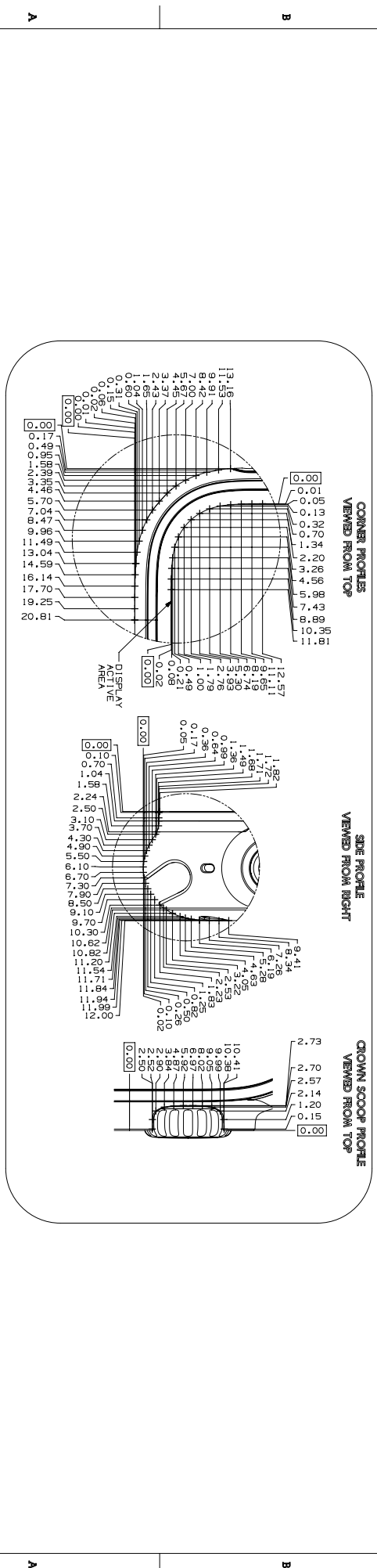
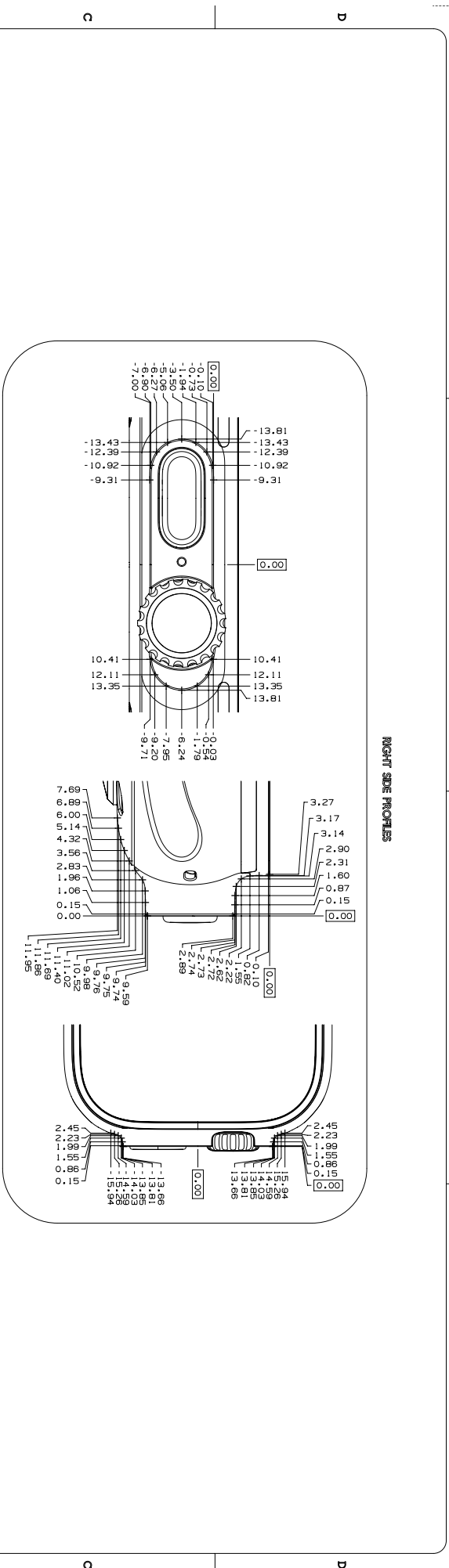
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Apple Inc.

UNIT: MILLIMETERS

NAME: APPLE WATCH ULTRA 01

CODE: NONE SH: 1 OF 3

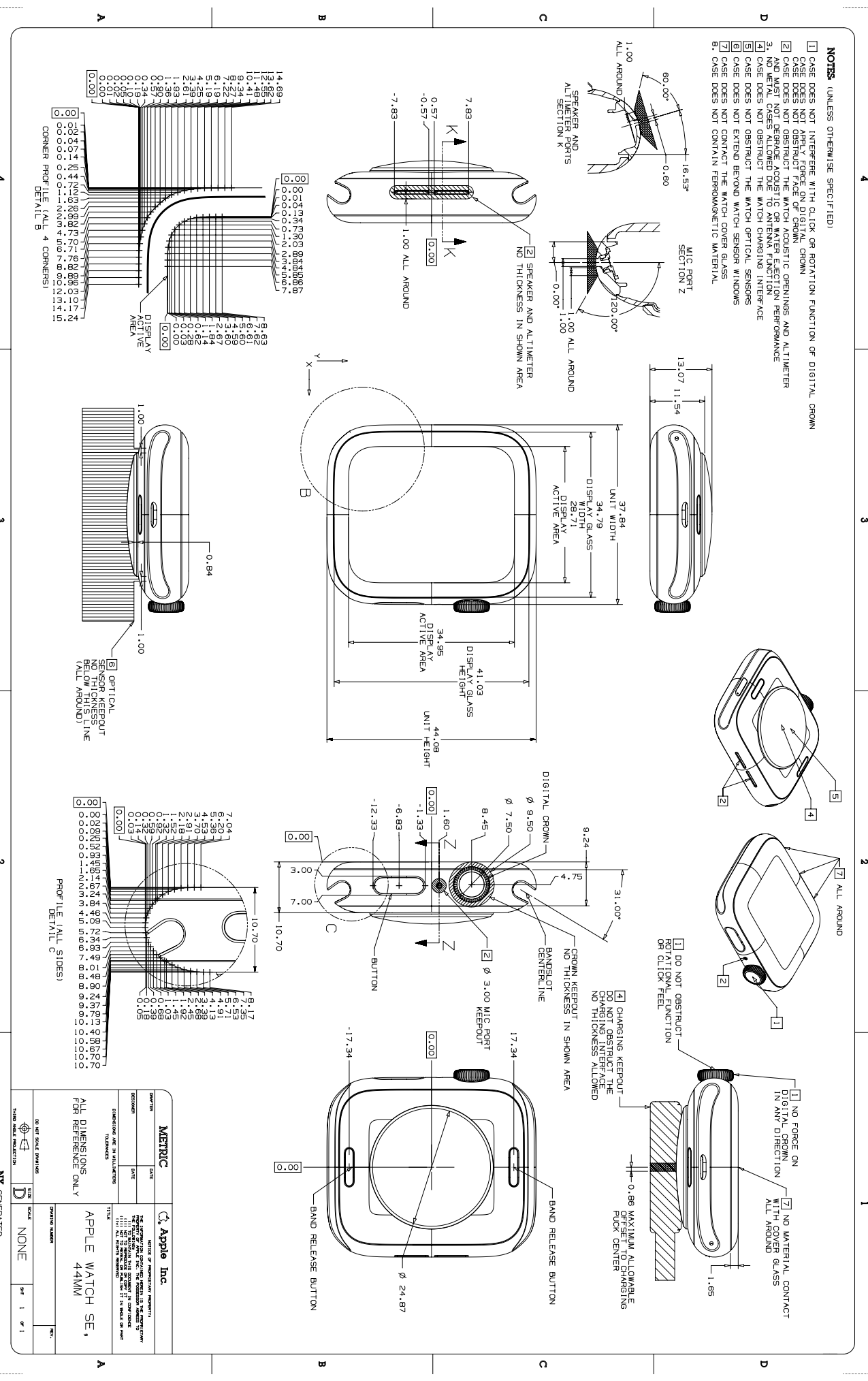


DATE OF REVISION: 08/2023
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 ALL RIGHTS RESERVED. © 2023 APPLE INC. ALL RIGHTS RESERVED.
 DRAWING NUMBER: D APPLE WATCH ULTRA 01
 SHEET: 2 OF 3

56.173 Apple Watch SE, 44 mm

NOTES (UNLESS OTHERWISE SPECIFIED)

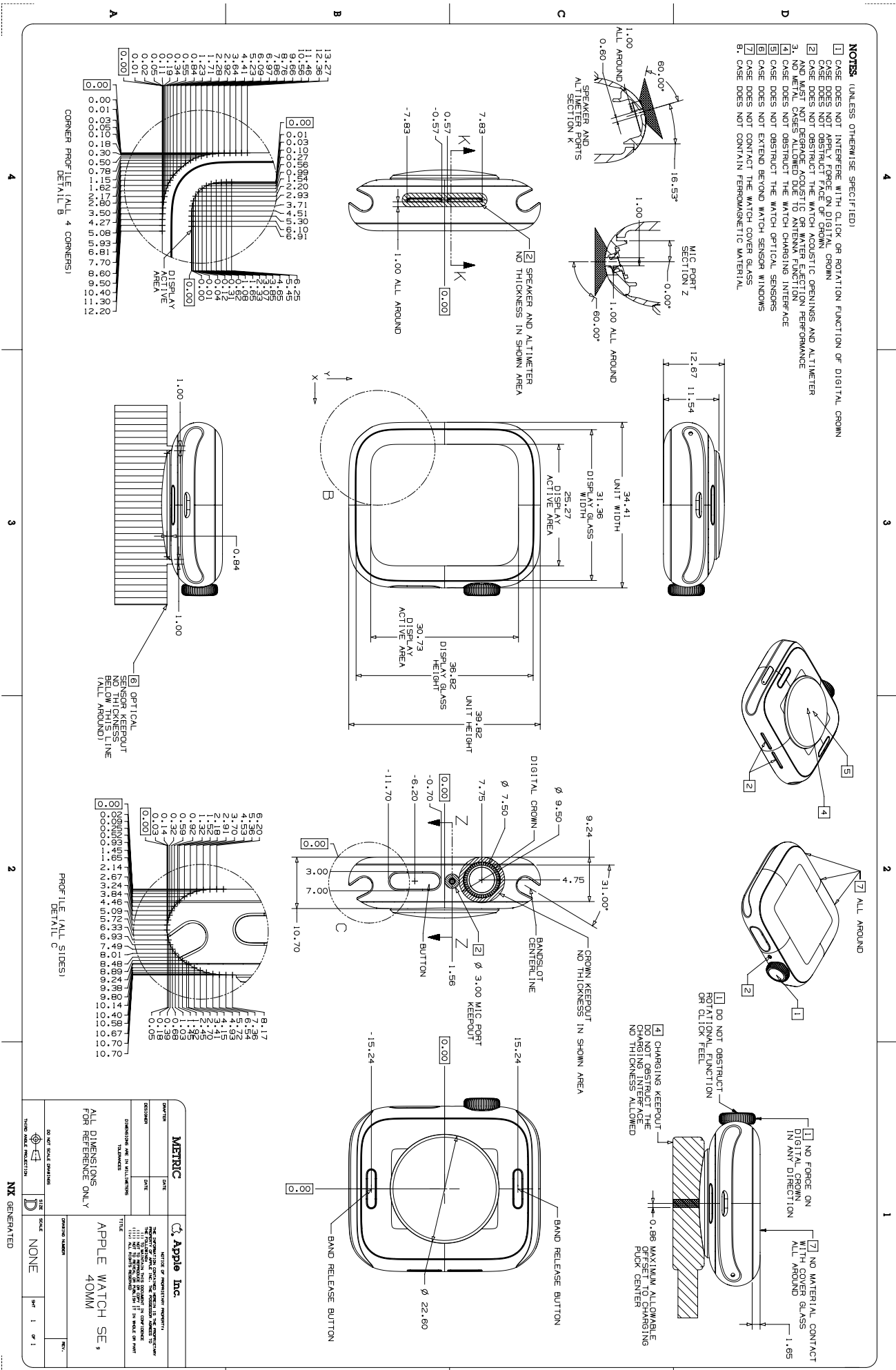
- 1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
- 2 CASE DOES NOT OBSTRUCT THE WATCH ACROUSTIC OPENINGS AND ALTIMETER
- 3.1 AND MUST NOT DEGRADE ACOUSTIC OR WATER EJECTION PERFORMANCE
- 3.2 NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION INTERFERENCE
- 4 CASE DOES NOT OBSTRUCT 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 CONTAIN FERROMAGNETIC MATERIAL



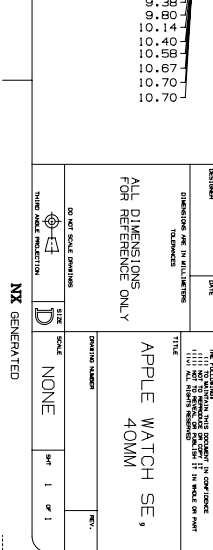
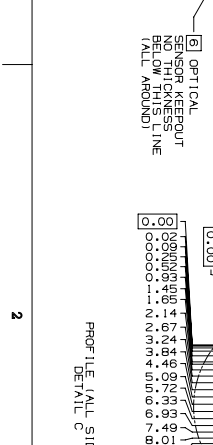
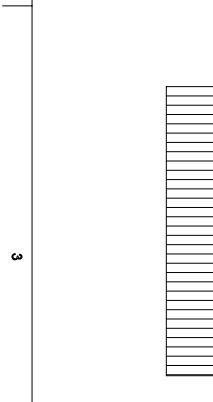
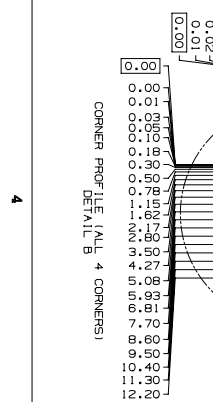
METRIC		Apple Inc.	
SYMBOL	UNIT	SYMBOL	UNIT
DISPENSE		DESIGN	
SIZE		DATE	
REVISION		DATE	
CHANGING ENG. IN BILL OF MATERIALS		TITLE	APPLE WATCH SE, 44MM
DESCRIPTION		DRAWING NUMBER	
NAME			
DATE		SCALE	NONE
		UNIT	MM
		SHEET	1 OF 1

NX GENERATED

56.174 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
 - CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER
 - [3] AND MUST NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER
 - [4] CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
 - [5] CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
 - [6] CASE DOES NOT OBSTRUCT BEYOND WATCH SENSOR WINDOWS
 - [7] CASE DOES NOT CONTACT THE WATCH COVER GLASS
 - [8] CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL



METRIC

SCALE: NONE

UNIT: MILLIMETERS

APPLE WATCH SE, 40MM

DO NOT SCALE DIMENSIONS

HIDE SHAPE REFLECTION

NX GENERATED

ALL DIMENSIONS FOR REFERENCE ONLY

APPLE Inc.

THE APPLE WATCH SE, 40MM CASE IS THE PROPERTY OF APPLE INC. © 2022 APPLE INC.

ALL DIMENSIONS FOR REFERENCE ONLY

DATE: _____

REV: 1 OF 1

DRAWING NUMBER: _____

DESIGNED BY: _____

DATE: _____

SCALE: NONE

UNIT: MILLIMETERS

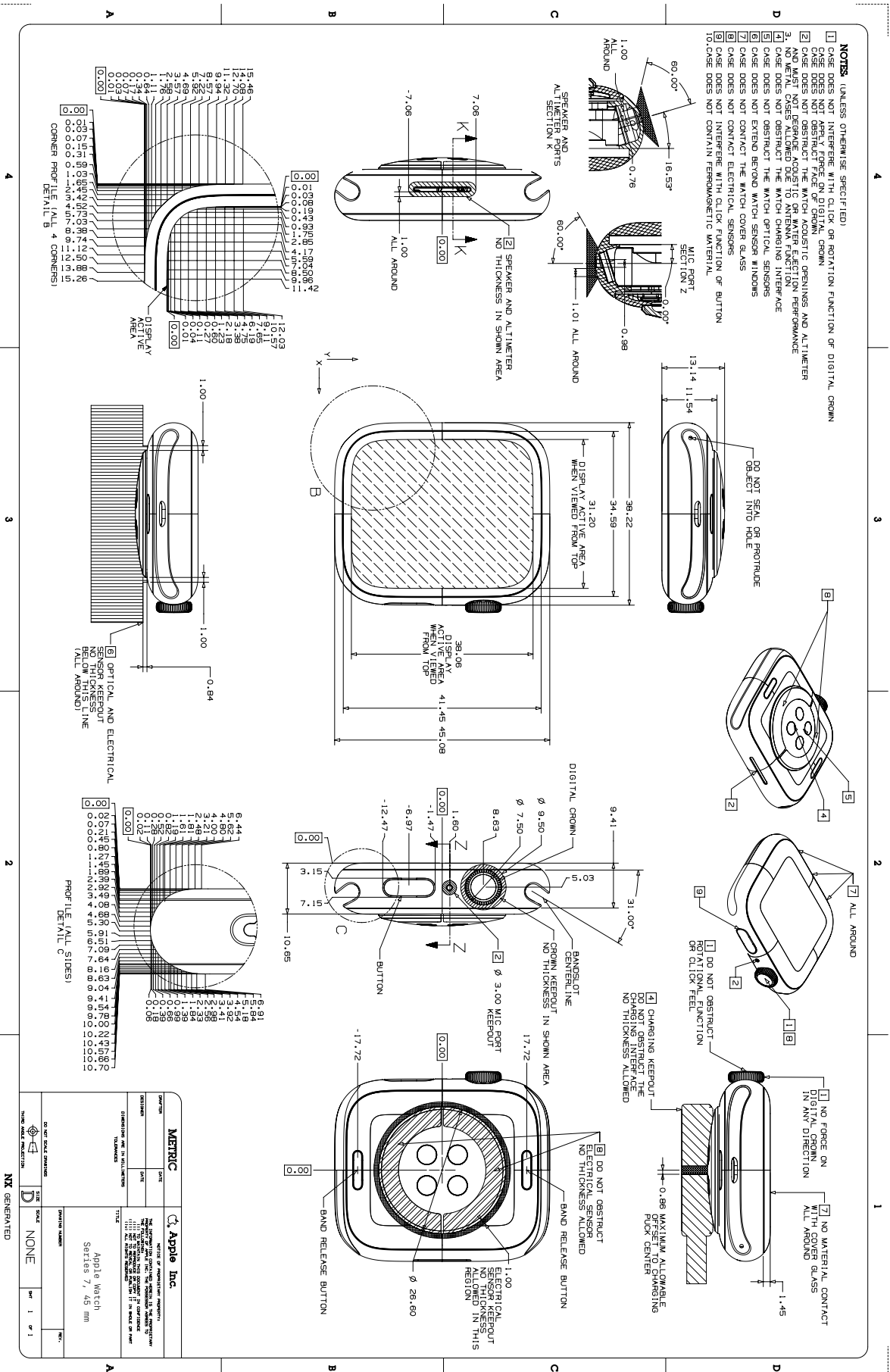
NO UNIT SCALE DIMENSIONS

HIDE SHAPE REFLECTION

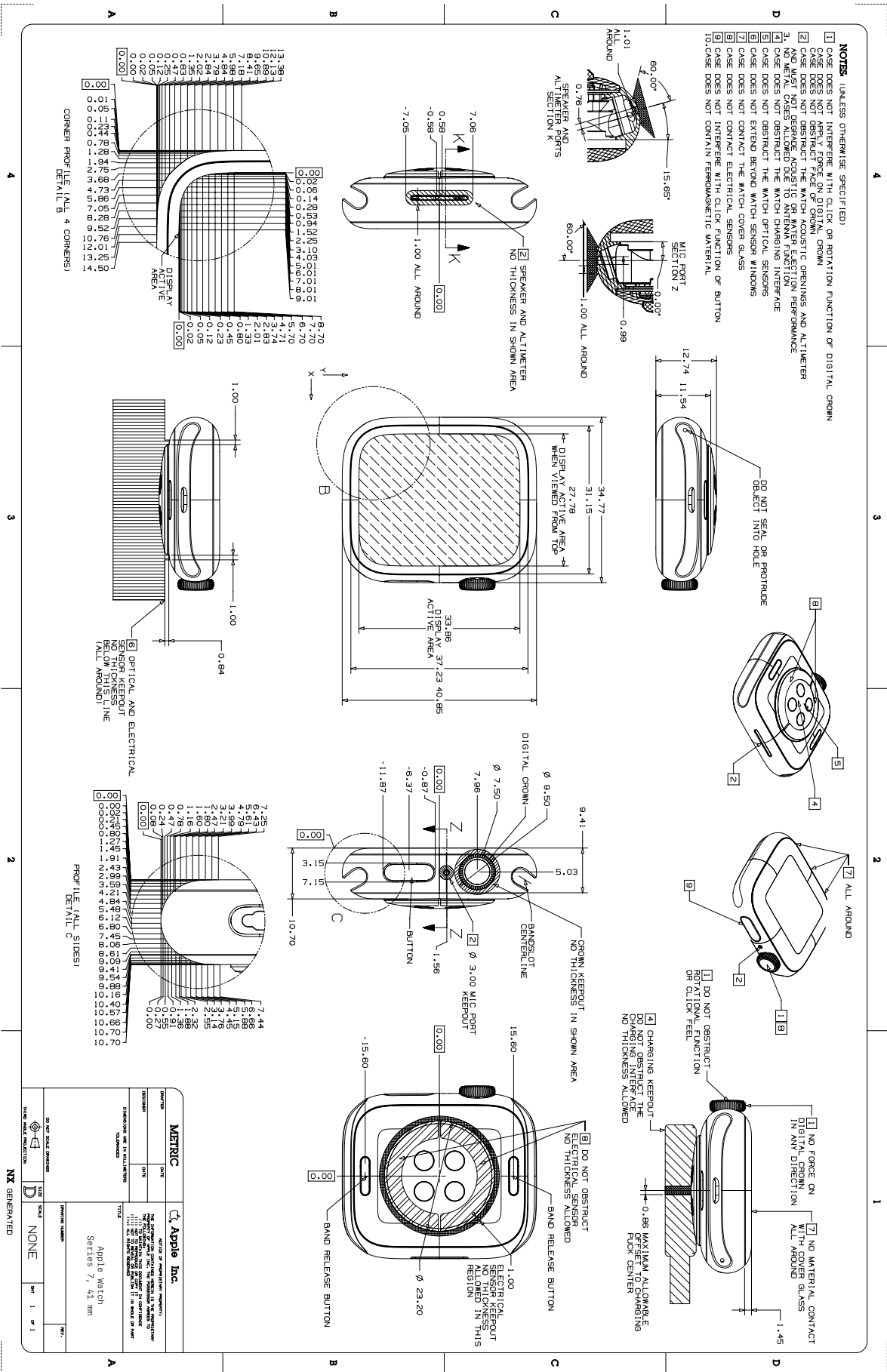
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ALL DIMENSIONS FOR REFERENCE ONLY

APPLE WATCH SE, 40MM

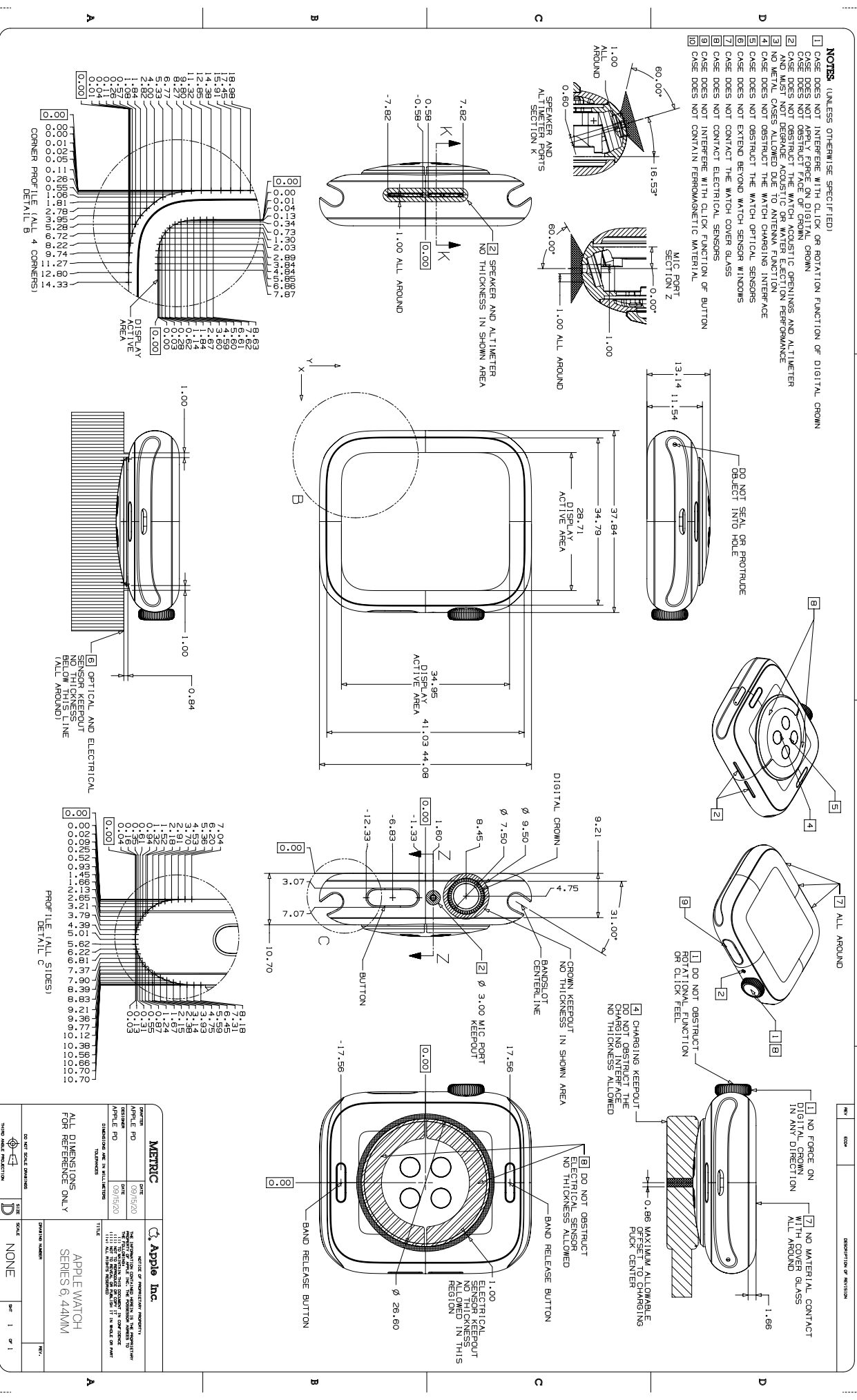


56.176 Apple Watch Series 7, 41 mm



NOTES (UNLESS OTHERWISE SPECIFIED):

- 1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
- 2 CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
- 3 CASE DOES NOT OBSTRUCT THE WATCH ADJUSTIVE OPENINGS AND ALTIMETER
- 4 CASE DOES NOT OBSTRUCT THE CHARGING PORT OR ANTENNA FUNCTION
- 5 NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
- 6 CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
- 7 CASE DOES NOT EXTEND BEYOND THE WATCH OPTICAL WINDOWS
- 8 CASE DOES NOT CONTACT THE WATCH SENSOR WINDOWS
- 9 CASE DOES NOT CONTACT ELECTRICAL SENSORS
- 10 CASE DOES NOT INTERFERE WITH CLICK FUNCTION OF BUTTON
- 11 CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL



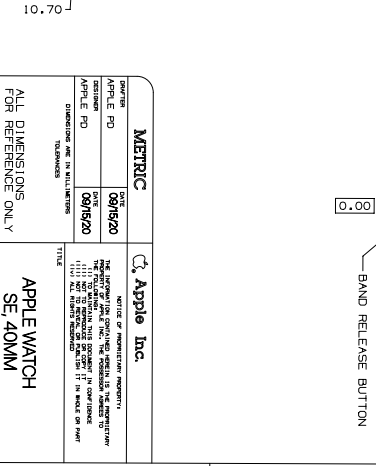
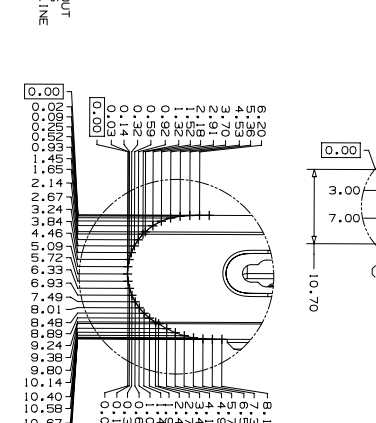
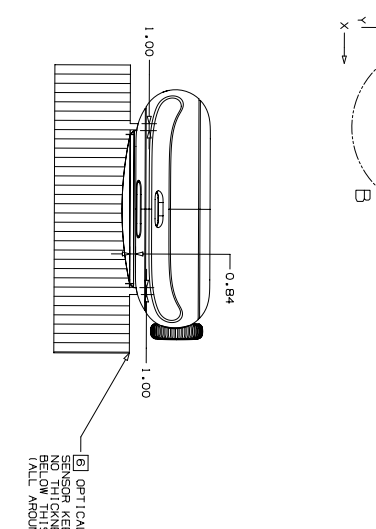
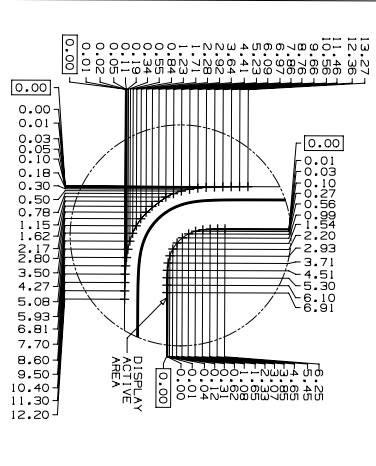
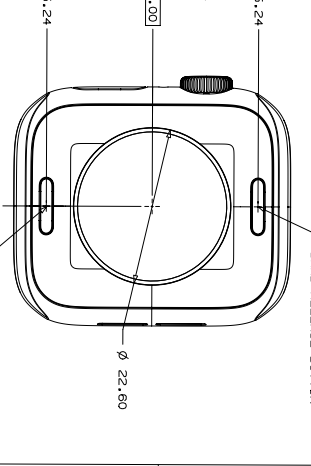
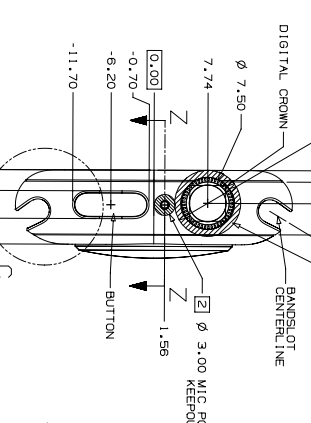
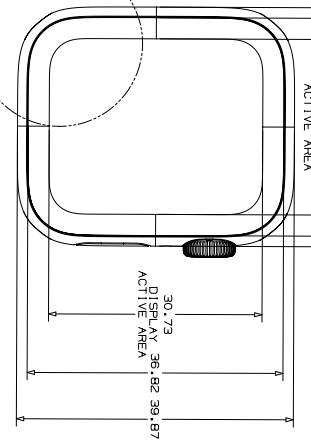
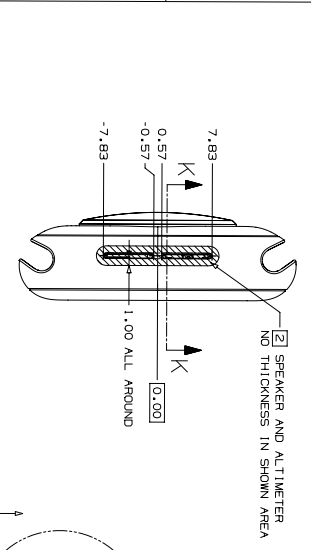
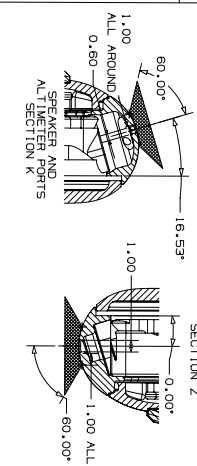
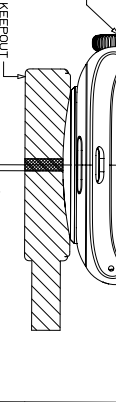
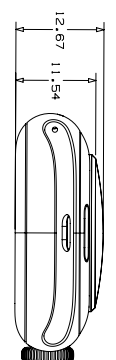
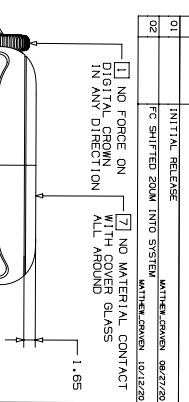
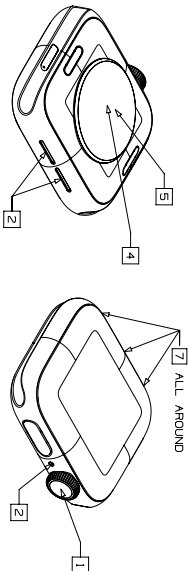
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DESIGNED BY	APPLE PD	DATE	09/15/20
CHECKED BY	APPLE PD	DATE	09/15/20

SYMBOL	DESCRIPTION
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(Symbol)	HIDE DIMENSION LINE

ALL DIMENSIONS FOR REFERENCE ONLY	
SCALE	NONE
SHEET	1 OF 1
REV.	

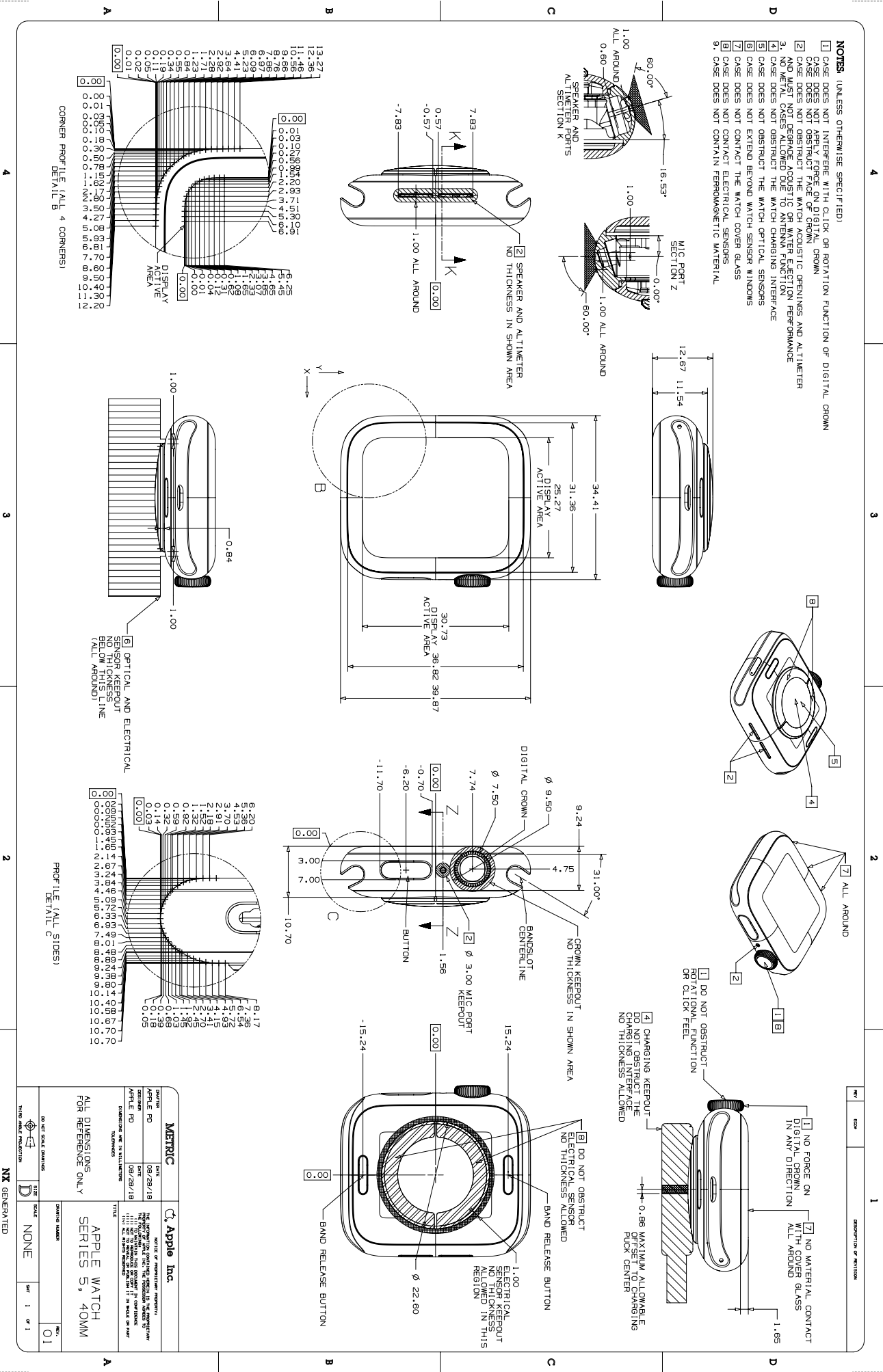
56.180 Apple Watch SE (1st generation), 40 mm

- NOTES:** UNLESS OTHERWISE SPECIFIED:
- 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
 - CASE DOES NOT OBSTRUCT WATCH ACOUSTIC OPENINGS AND ALTIMETER
 - CASE DOES NOT OBSTRUCT DIGITAL CROWN
 - NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
 - CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
 - CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
 - CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
 - CASE DOES NOT CONTACT THE WATCH COVER GLASS
 - CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL

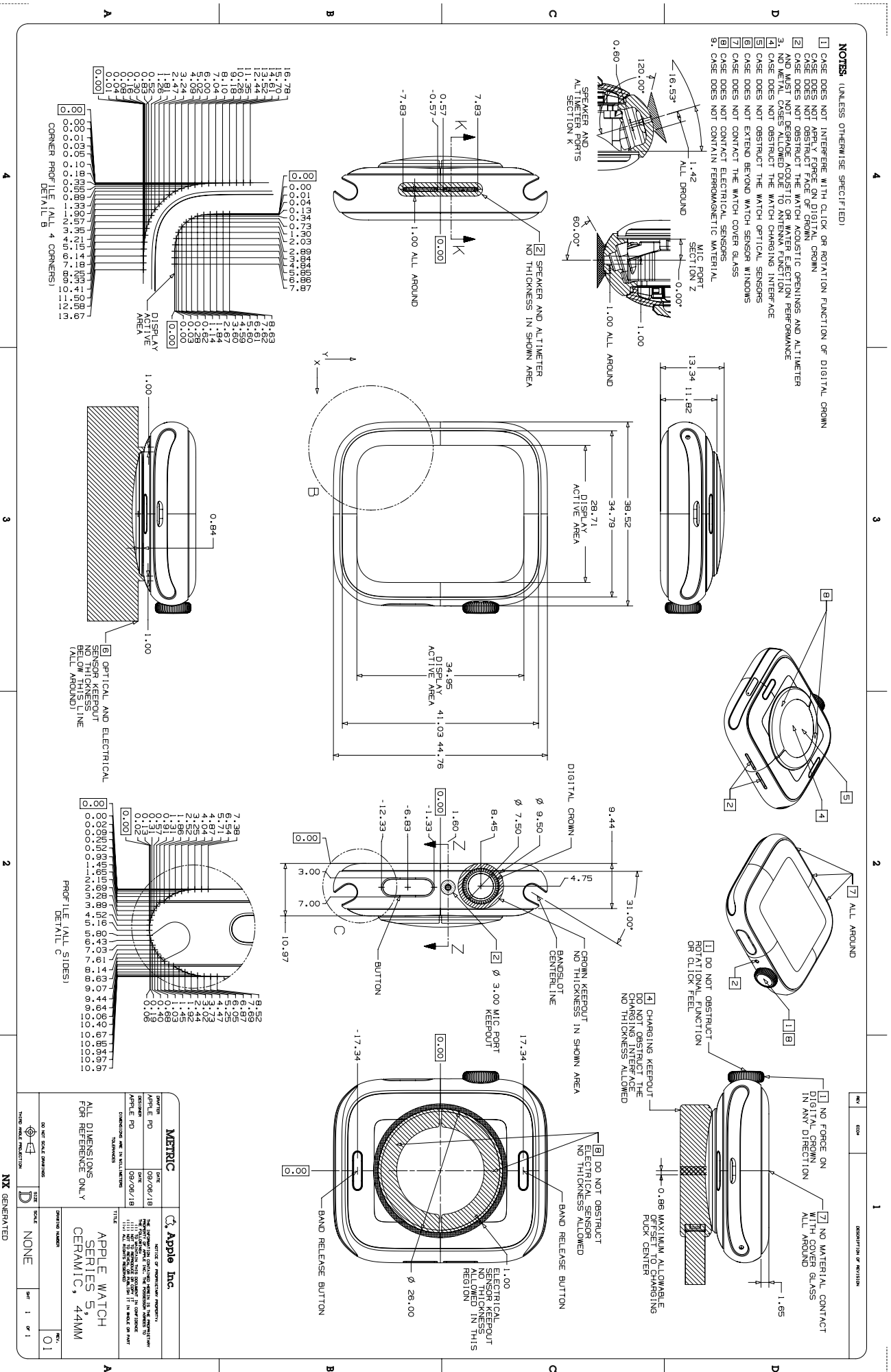


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REVISION	09/15/20	DATE	09/15/20
DESCRIPTION	APPLE I/O	DESIGNED BY	APPLE I/O
REVISION	09/15/20	DATE	09/15/20
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REVISION	09/15/20	DATE	09/15/20
DESCRIPTION	APPLE I/O	DESIGNED BY	APPLE I/O
REVISION	09/15/20	DATE	09/15/20
DESCRIPTION	APPLE I/O	DESIGNED BY	APPLE I/O
REVISION	09/15/20	DATE	09/15/20
DESCRIPTION	APPLE I/O	DESIGNED BY	APPLE I/O
REVISION	09/15/20	DATE	09/15/20

56.182 Apple Watch Series 5, 40 mm

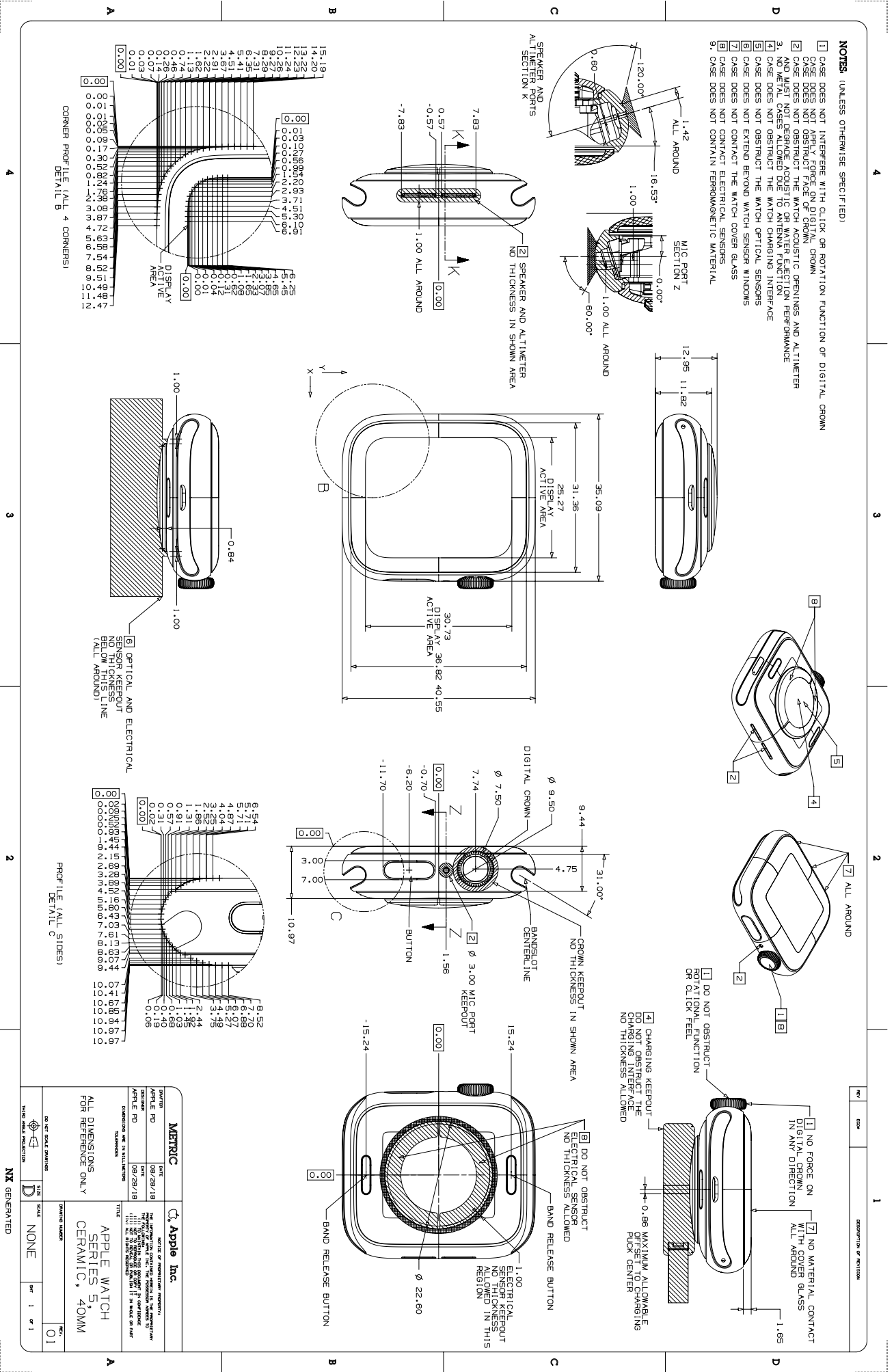


56.183 Apple Watch Series 5 Ceramic, 44 mm



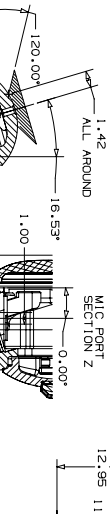
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09/06/18	APPLE PD	09/06/18	APPLE PD	56.183	D	1	1

56.184 Apple Watch Series 5 Ceramic, 40 mm

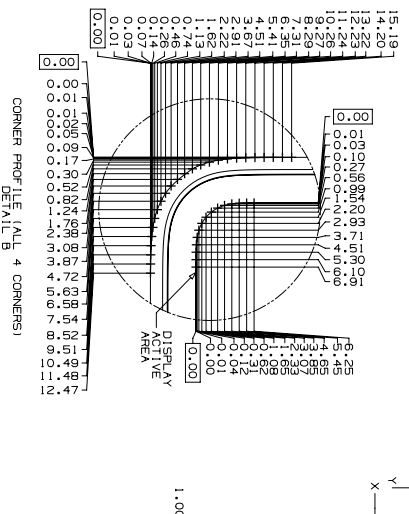
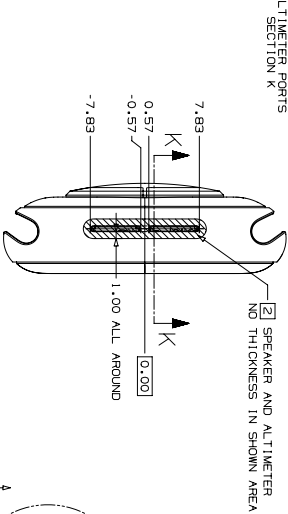


NOTES (UNLESS OTHERWISE SPECIFIED)

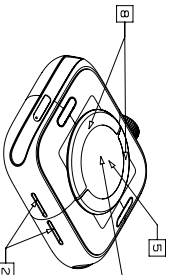
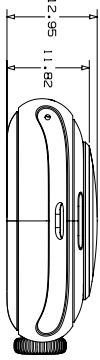
- 1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
- 2 CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
- 3 CASE DOES NOT OBSTRUCT THE WATCH ACUSTIC OPENINGS AND ALTIMETER
- 4 NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION
- 5 CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
- 6 CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
- 7 CASE DOES NOT CONTACT THE WATCH COVER GLASS
- 8 CASE DOES NOT CONTACT ELECTRICAL SENSORS
- 9 CASE DOES NOT CONTAIN FERROMAGNETIC MATERIAL



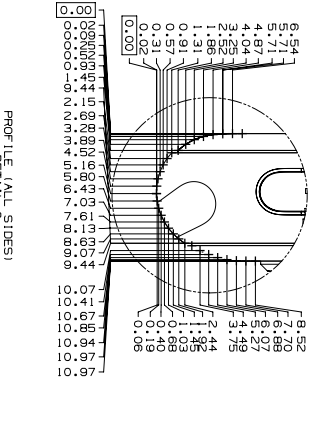
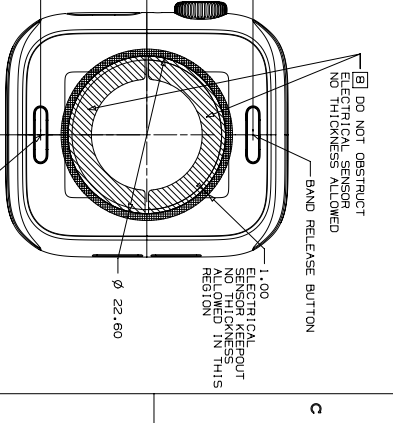
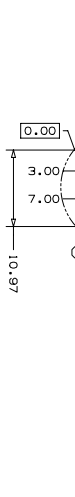
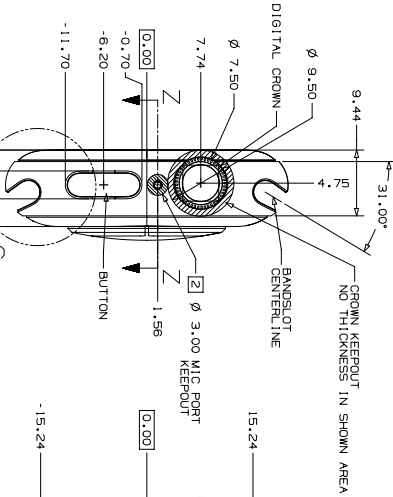
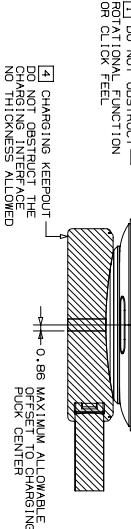
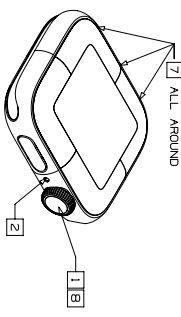
NO SPEAKER AND ALTIMETER THICKNESS IN SHOWN AREA



3



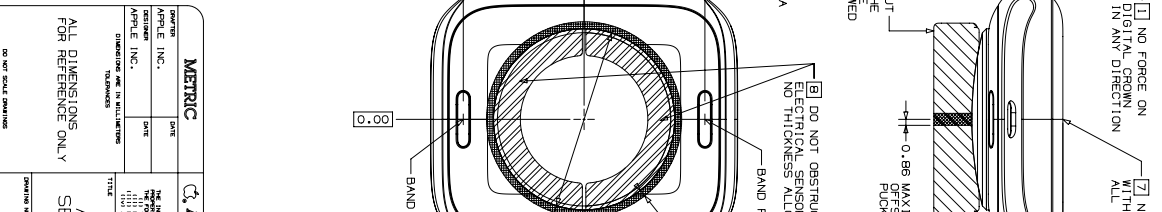
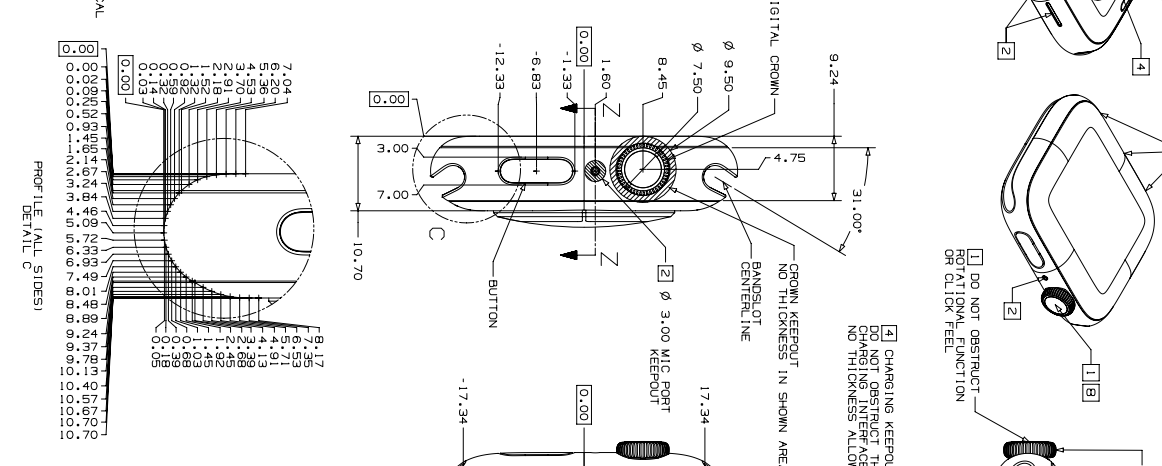
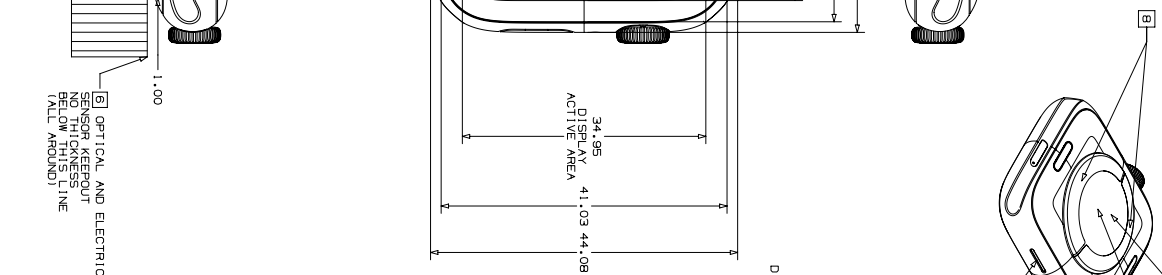
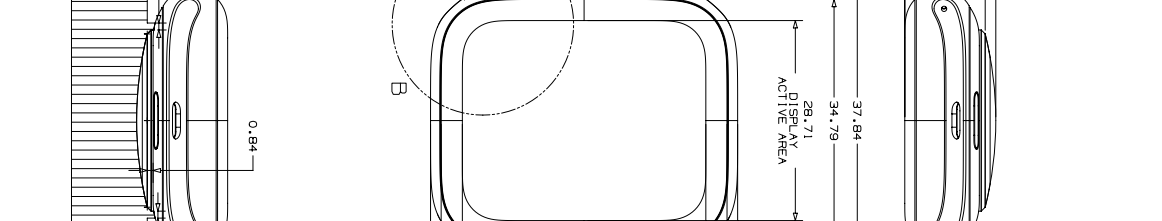
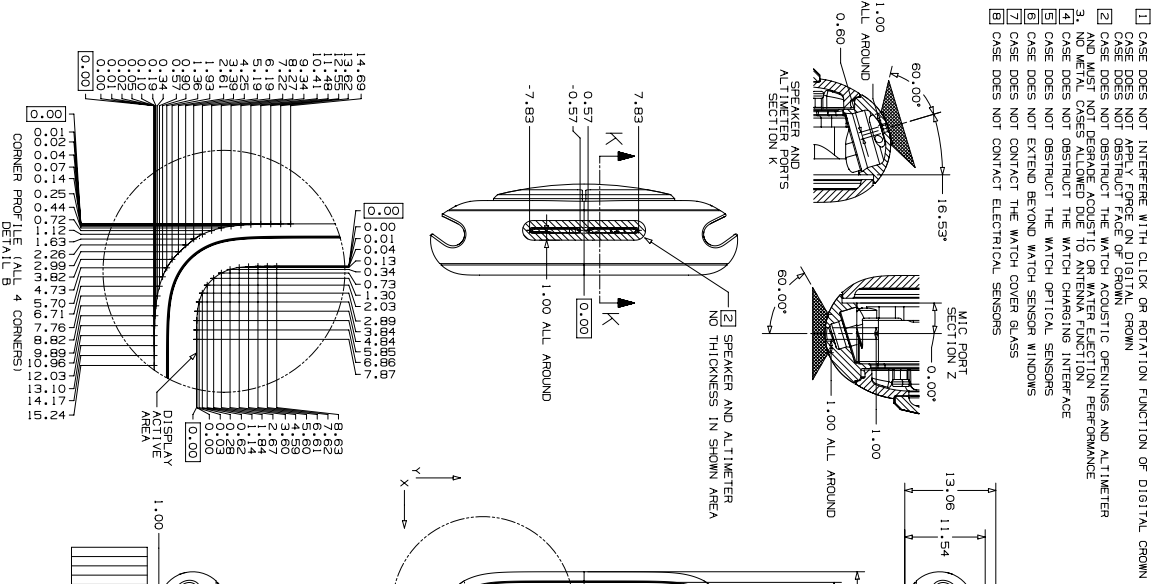
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APPROVED BY	Apple Inc.	DRWING NUMBER	01				
DATE	09/28/18	DATE	09/28/18				
APPROVED BY	Apple Inc.	DATE	09/28/18				
DESIGNED BY	Apple Inc.	DATE	09/28/18				
APPROVED BY	Apple Inc.	DATE	09/28/18				
DESIGNED BY	Apple Inc.	DATE	09/28/18				
APPROVED BY	Apple Inc.	DATE	09/28/18				
DESIGNED BY	Apple Inc.	DATE	09/28/18				
APPROVED BY	Apple Inc.	DATE	09/28/18				
DESIGNED BY	Apple Inc.	DATE	09/28/18				
APPROVED BY	Apple Inc.	DATE	09/28/18				

56.185 Apple Watch Series 4, 44 mm

- NOTES** (UNLESS OTHERWISE SPECIFIED)
- CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
 - CASE DOES NOT DEGRADE ACoustic PERFORMANCE OF MIC
 - CASE DOES NOT DEGRADE ACoustic PERFORMANCE OF WATCH ACoustic OPENINGS AND ALTIMETER
 - CASE DOES NOT DEGRADE ACoustic PERFORMANCE OF WATCH ACoustic OPENINGS AND ALTIMETER
 - NO METAL CASES ALLOWED DUE TO ANTENNA FUNCTION INTERFERENCE
 - CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
 - CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
 - CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
 - CASE DOES NOT CONTACT THE WATCH COVER GLASS
 - CASE DOES NOT CONTACT ELECTRICAL SENSORS

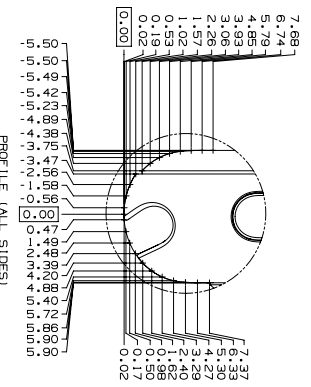
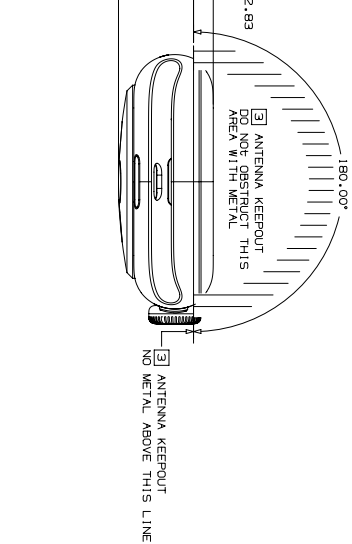
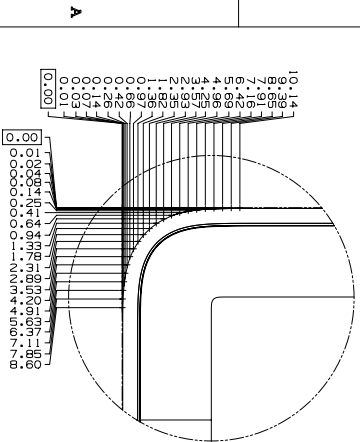
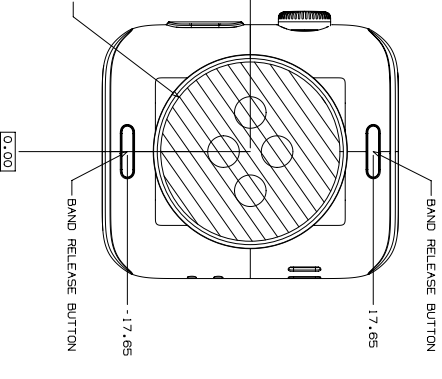
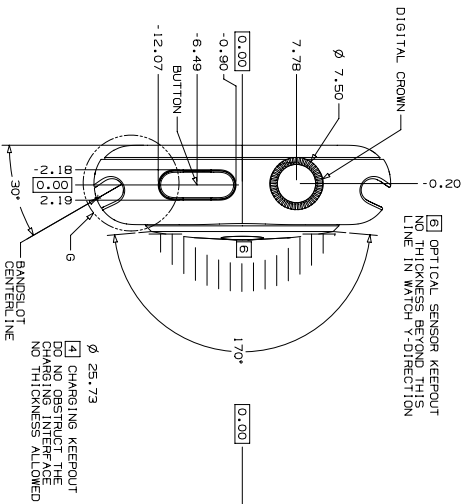
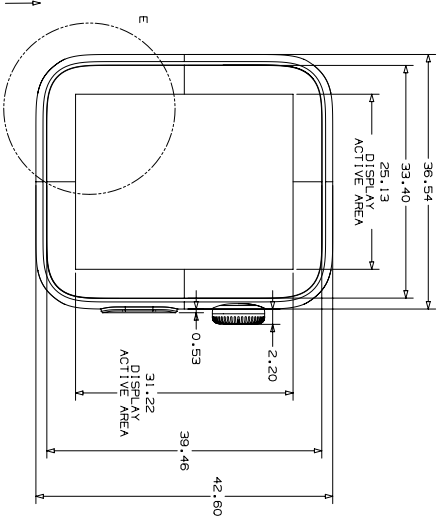
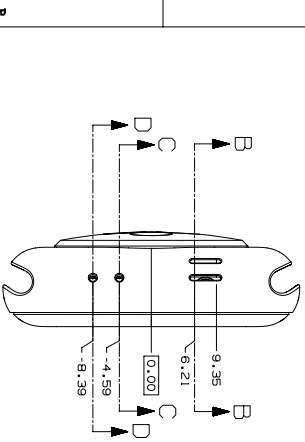
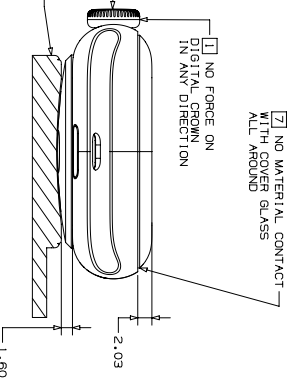
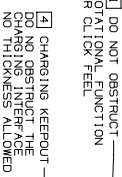
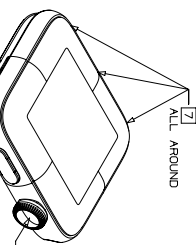
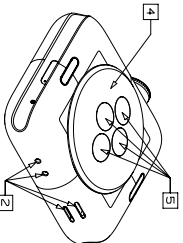
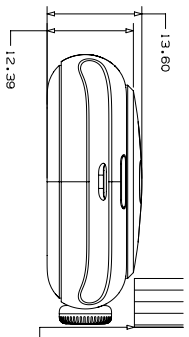
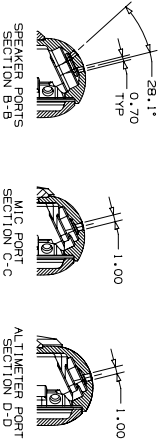


NO.	ECO.	DESCRIPTION OF REVISION
1		NO MATERIAL CONTACT WITH COVER GLASS IN ANY DIRECTION ALL AROUND
2		NO FORCE ON DIGITAL CROWN IN ANY DIRECTION
3		DO NOT OBSTRUCT ROTATIONAL FUNCTION OR CLICK FEEL
4		CHARGING KEEPOUT IN SHOWN AREA NO THICKNESS ALLOWED
5		0.868 WYTHIUM ALLOWABLE OFFSET TO CHARGING FLICK CENTER
6		DO NOT OBSTRUCT ELECTRICAL SENSOR NO THICKNESS ALLOWED
7		BAND RELEASE BUTTON NO THICKNESS ALLOWED IN THIS REGION
8		DO NOT OBSTRUCT ELECTRICAL SENSOR NO THICKNESS ALLOWED IN SHOWN AREA
9		NO THICKNESS IN SHOWN AREA
10		NO THICKNESS IN SHOWN AREA
11		NO THICKNESS IN SHOWN AREA
12		NO THICKNESS IN SHOWN AREA
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38		NO THICKNESS IN SHOWN AREA
39		NO THICKNESS IN SHOWN AREA
40		NO THICKNESS IN SHOWN AREA

56.187 Apple Watch Series 3 Ceramic, 42 mm

NOTES (UNLESS OTHERWISE SPECIFIED)

- 1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
- 2 CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
- 3 CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER
- 4 CASE DOES NOT OBSTRUCT THE WATCH ANTENNA WITH METAL
- 5 CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
- 6 CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
- 7 CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
- 8 CASE DOES NOT CONTACT THE WATCH COVER GLASS



METRIC		Apple Inc.	
DESCRIPTION	UNIT	DATE	VERSION
42MM APPLE WATCH SERIES 3 CERAMIC	MM		02
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DRAWING NAME IN ALL CAPS			
DRAWING NUMBER			
DATE			
DESIGNED BY			
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CHECKED BY			
APPROVED BY			
SCALE			
SHEET NUMBER			
TOTAL SHEETS			

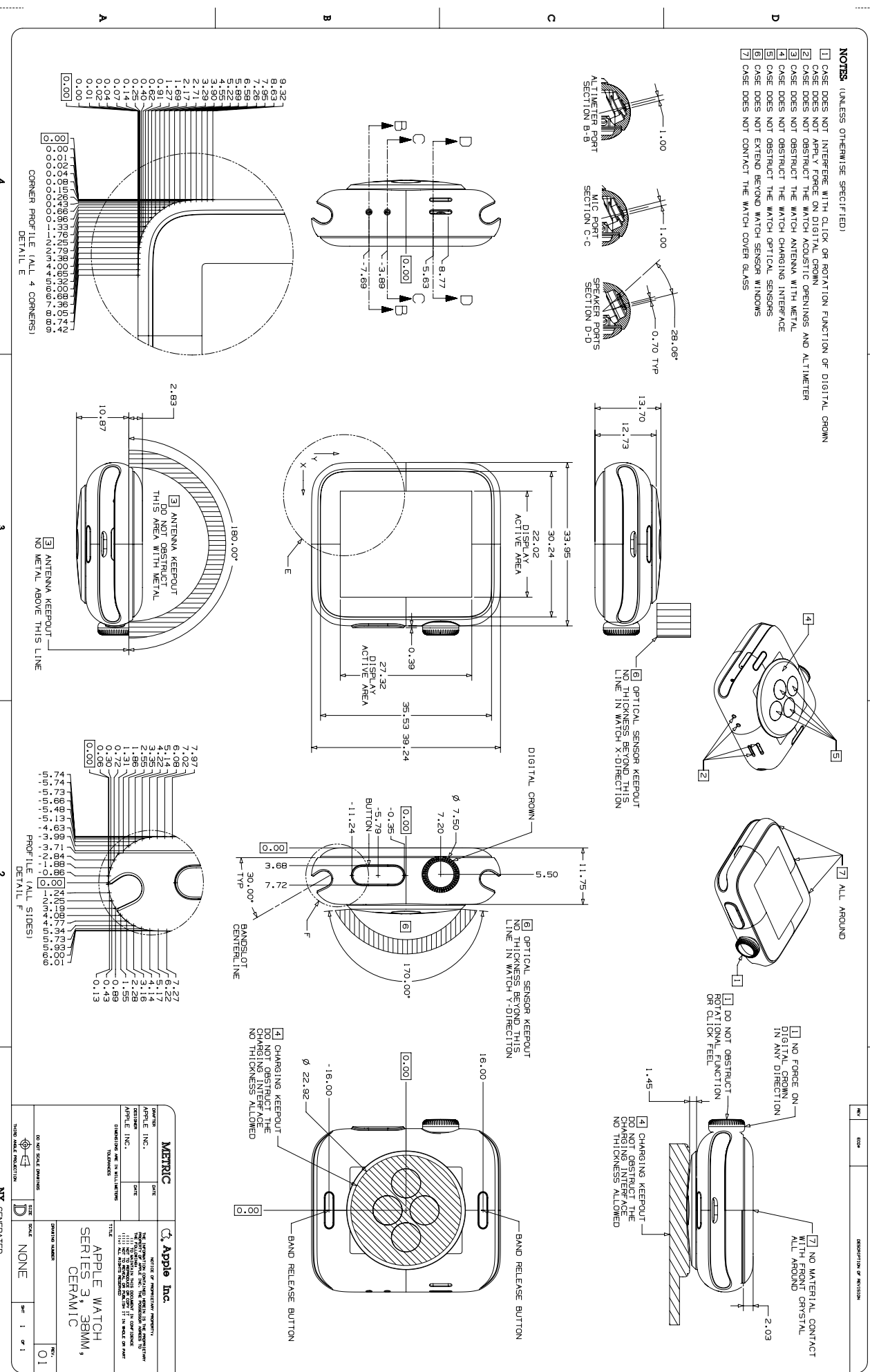
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 SHEET 1 OF 1

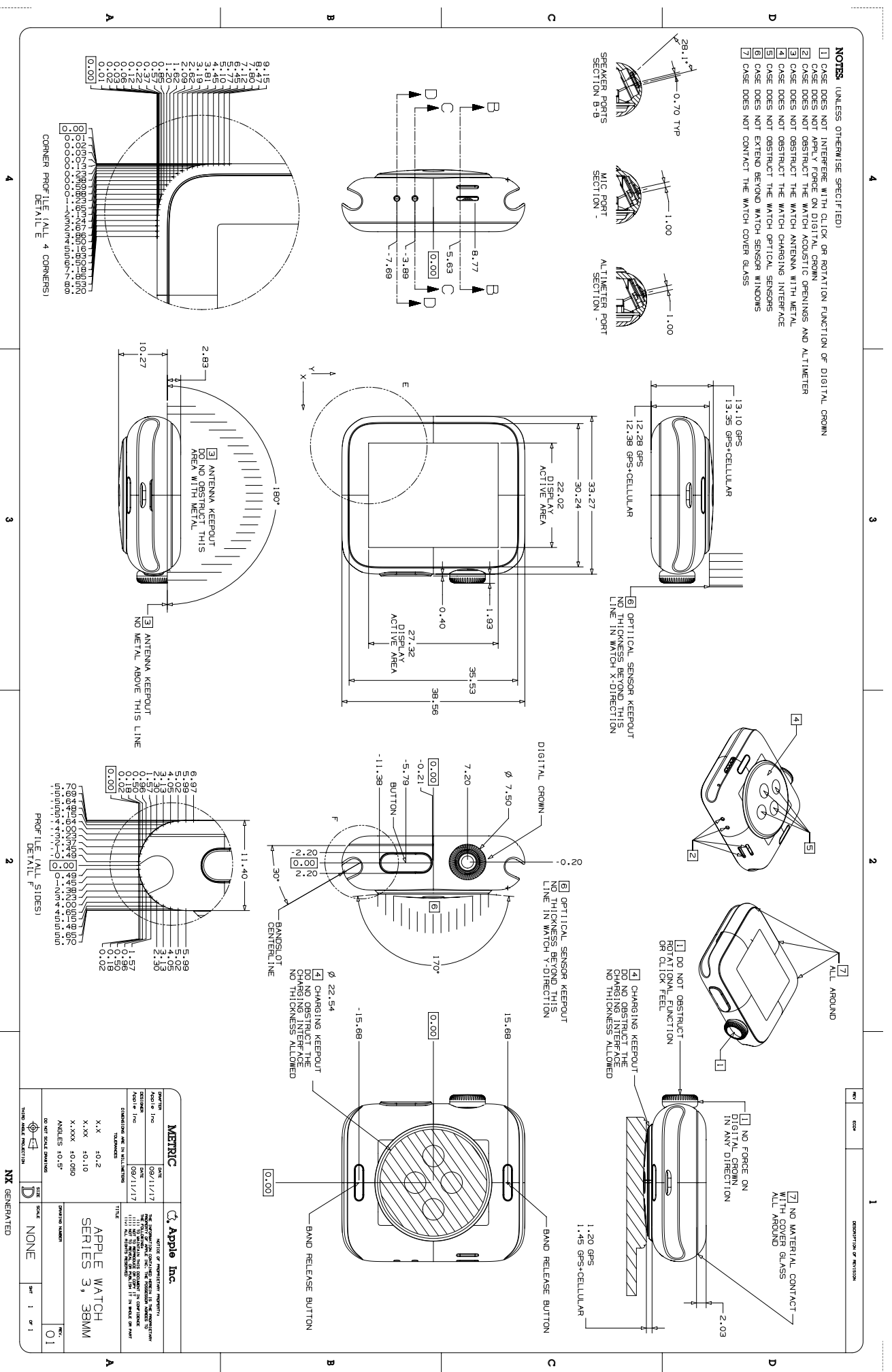
56.188 Apple Watch Series 3 Ceramic, 38 mm

NOTES (UNLESS OTHERWISE SPECIFIED)

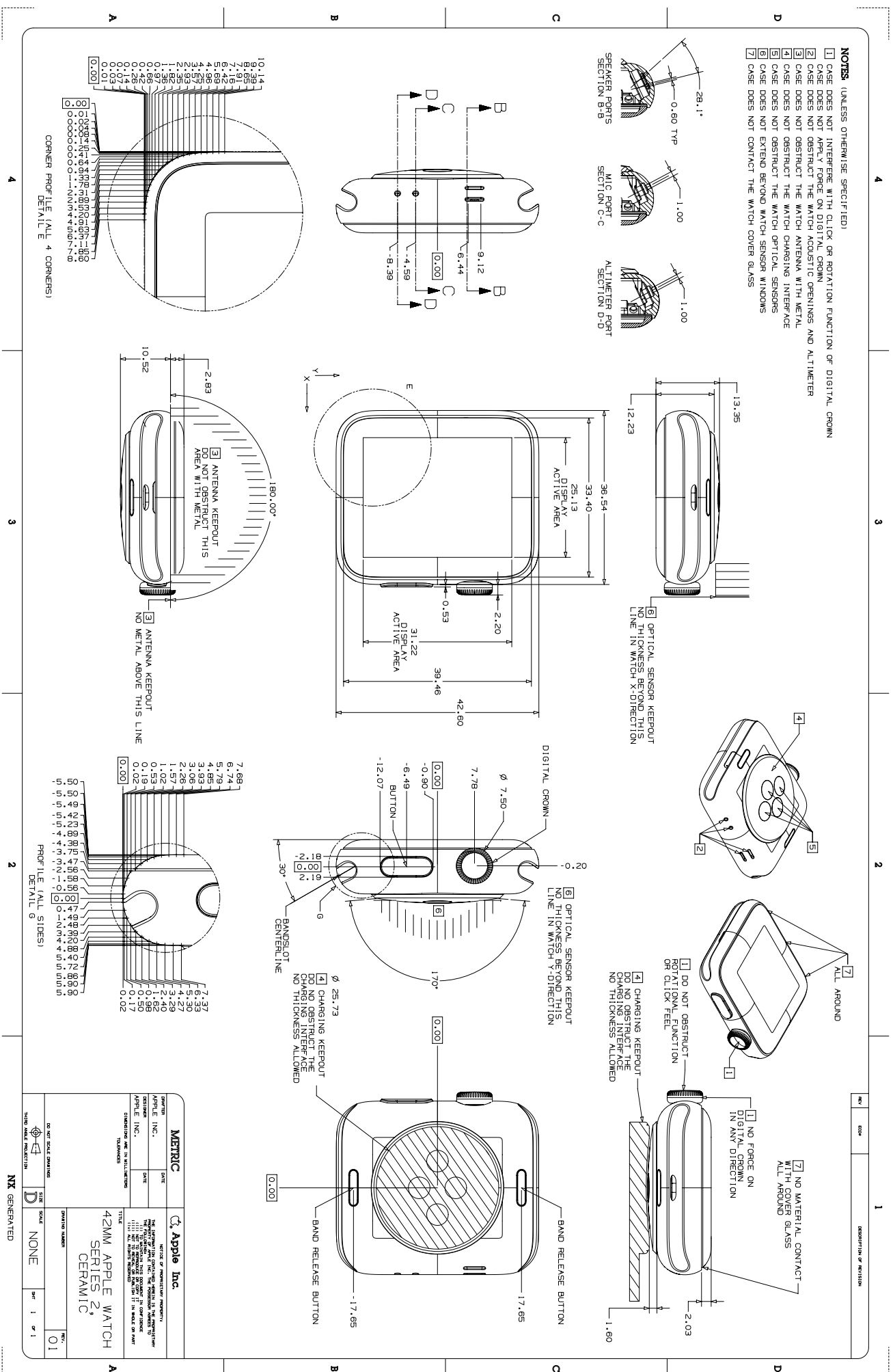
- 1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
- 2 CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
- 3 CASE DOES NOT OBSTRUCT THE WATCH ADJUSTIVE OPENINGS AND ALLIUMETER
- 4 CASE DOES NOT OBSTRUCT THE WATCH ANTENNA WITH METAL
- 5 CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
- 6 CASE DOES NOT EXTEND BEYOND THE WATCH OPTICAL SENSORS
- 7 CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
- 8 CASE DOES NOT CONTACT THE WATCH COVER GLASS

4 3 2 1



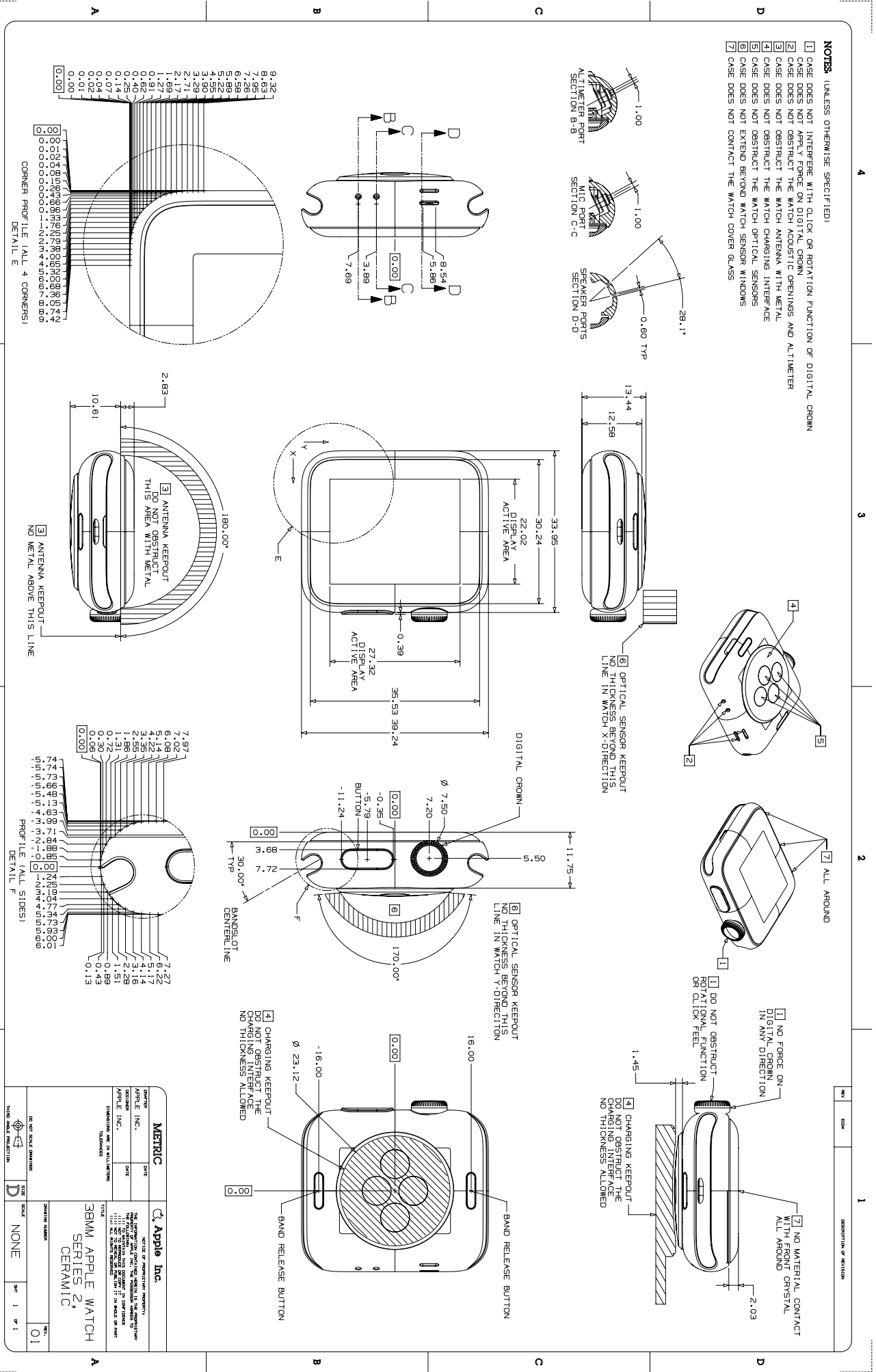


56.191 Apple Watch Series 2 Ceramic, 42 mm



56.192 Apple Watch Series 2 Ceramic, 38 mm

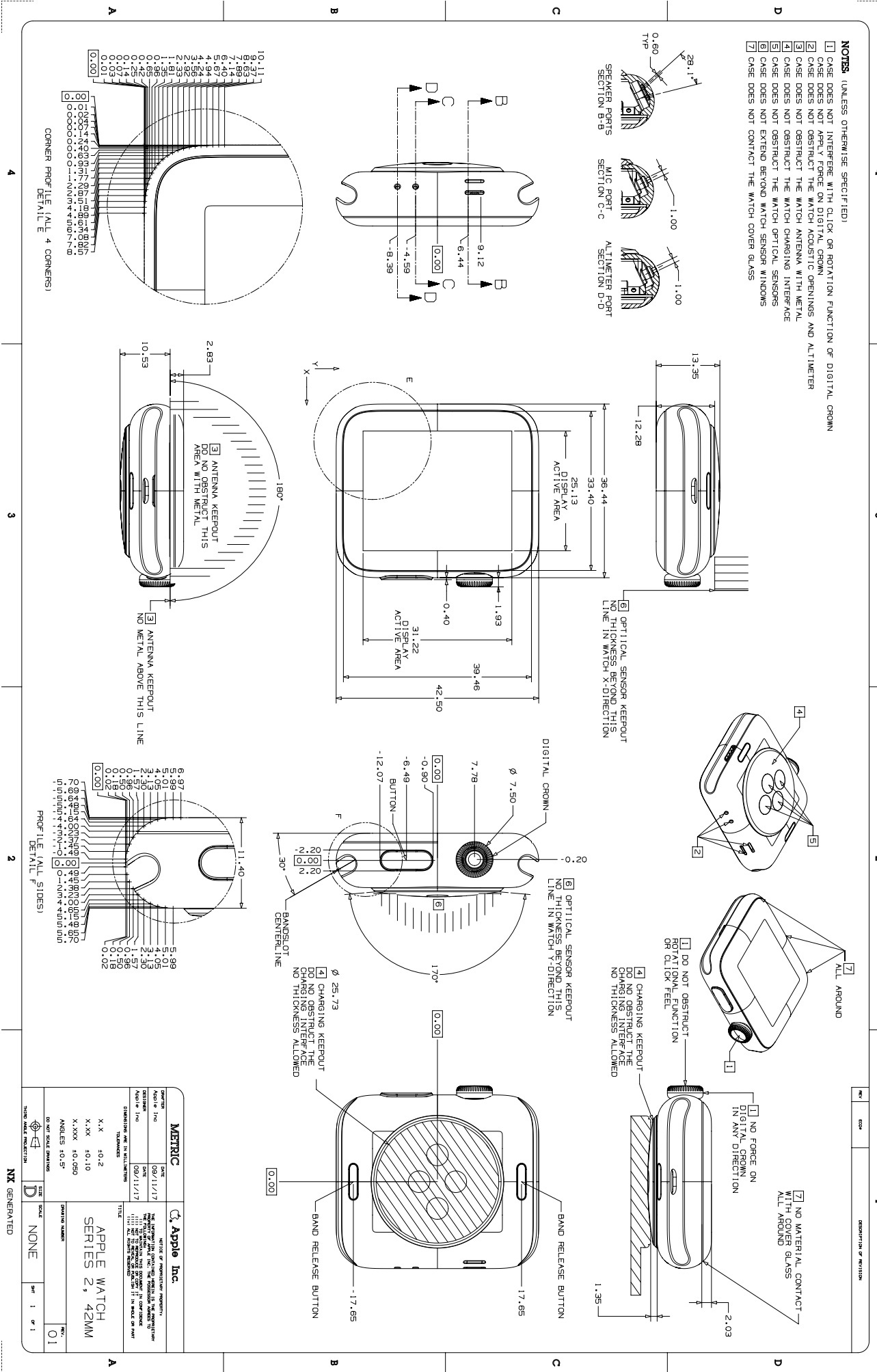
- NOTES** (UNLESS OTHERWISE SPECIFIED)
- 1 CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
 - 2 CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
 - 3 CASE DOES NOT OBSTRUCT THE WATCH ADJUSTIVE OPENINGS AND ALLIMETER
 - 4 CASE DOES NOT OBSTRUCT THE WATCH ANTENNA WITH METAL
 - 5 CASE DOES NOT OBSTRUCT THE WATCH CHANGING INTERFACE
 - 6 CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
 - 7 CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
 - 8 CASE DOES NOT CONTACT THE WATCH COVER GLASS



56.193 Apple Watch Series 2 Metal, 42 mm

NOTES (UNLESS OTHERWISE SPECIFIED):

- CASE DOES NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
- CASE DOES NOT APPLY FORCE ON DIGITAL CROWN
- CASE DOES NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS AND ALTIMETER
- CASE DOES NOT OBSTRUCT THE WATCH ANTENNA WITH METAL
- CASE DOES NOT OBSTRUCT THE WATCH CHARGING INTERFACE
- CASE DOES NOT OBSTRUCT THE WATCH OPTICAL SENSORS
- CASE DOES NOT EXTEND BEYOND WATCH SENSOR WINDOWS
- CASE DOES NOT CONTACT THE WATCH COVER GLASS

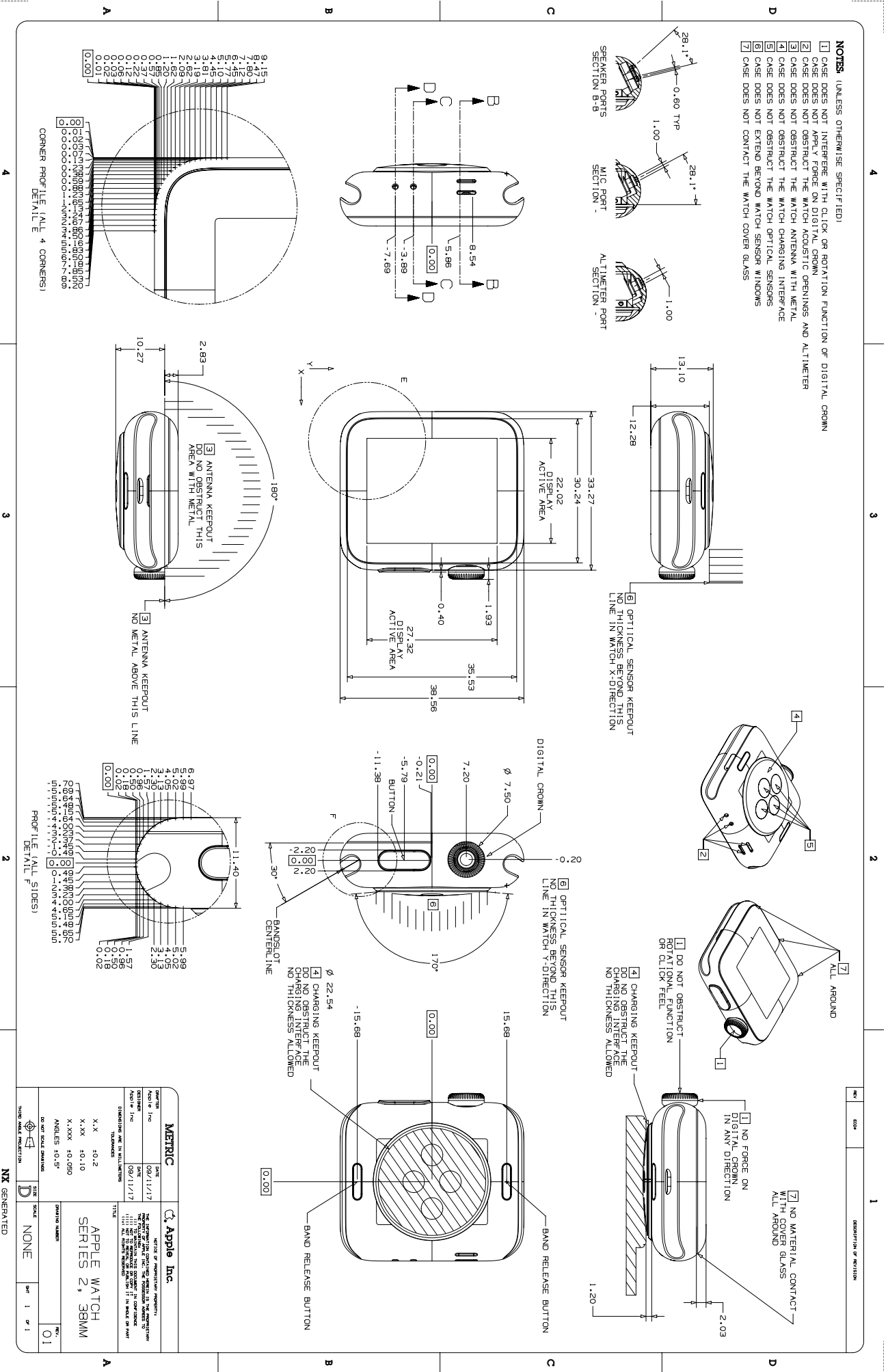


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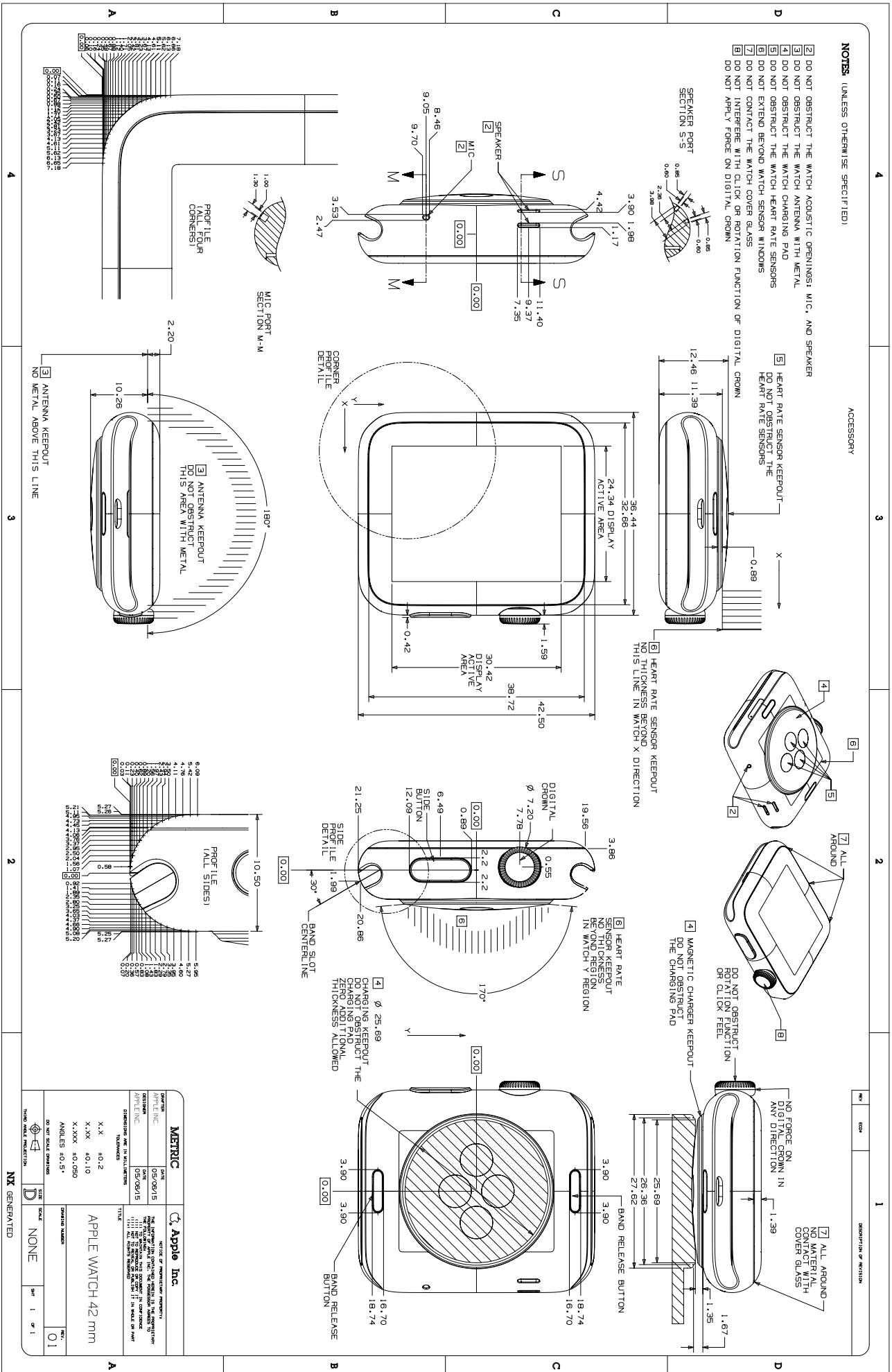
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DATE	09/11/17	DATE OF PREVIOUS REVISION	
DESIGNED BY		DESIGNED BY	
APPROVED BY		APPROVED BY	
DATE	09/11/17	DATE	
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DIMENSIONS ARE IN MILLIMETERS TOLERANCES X.X ±0.2 X.XX ±0.10 X.XXX ±0.050 ANGLES 10° 5'			
DRAWING NUMBER: APPLE WATCH SERIES 2, 42MM			
DRAWING SCALE: NONE		SHEET: 1 OF 1	

THIRD ANGLE PROJECTION
 NX GENERATED

56.194 Apple Watch Series 2 Metal, 38 mm



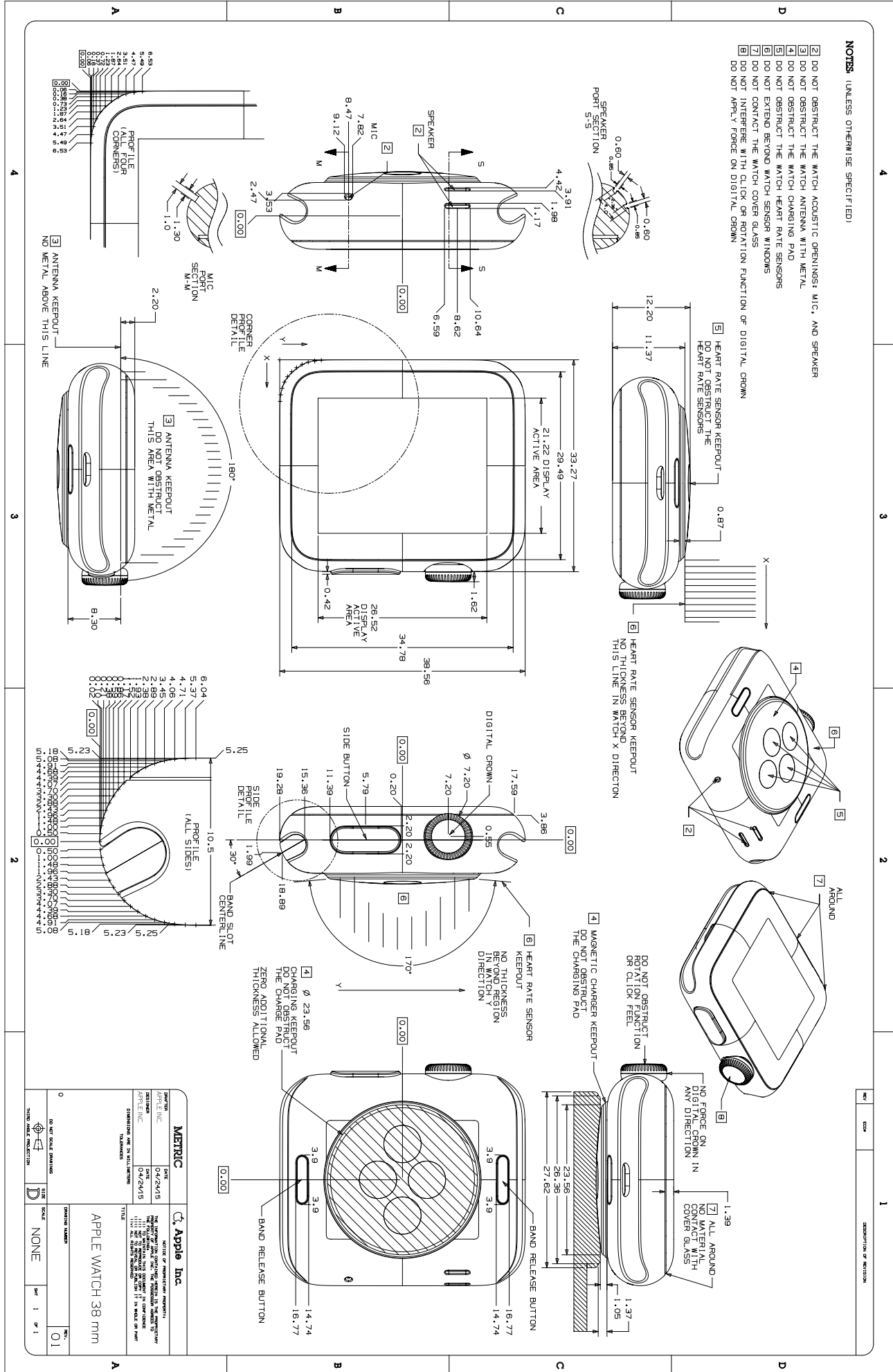
56.195 Apple Watch (1st generation) and Apple Watch Series 1, 42 mm



56.196 Apple Watch (1st generation) and Apple Watch Series 1, 38 mm

NOTES (UNLESS OTHERWISE SPECIFIED)

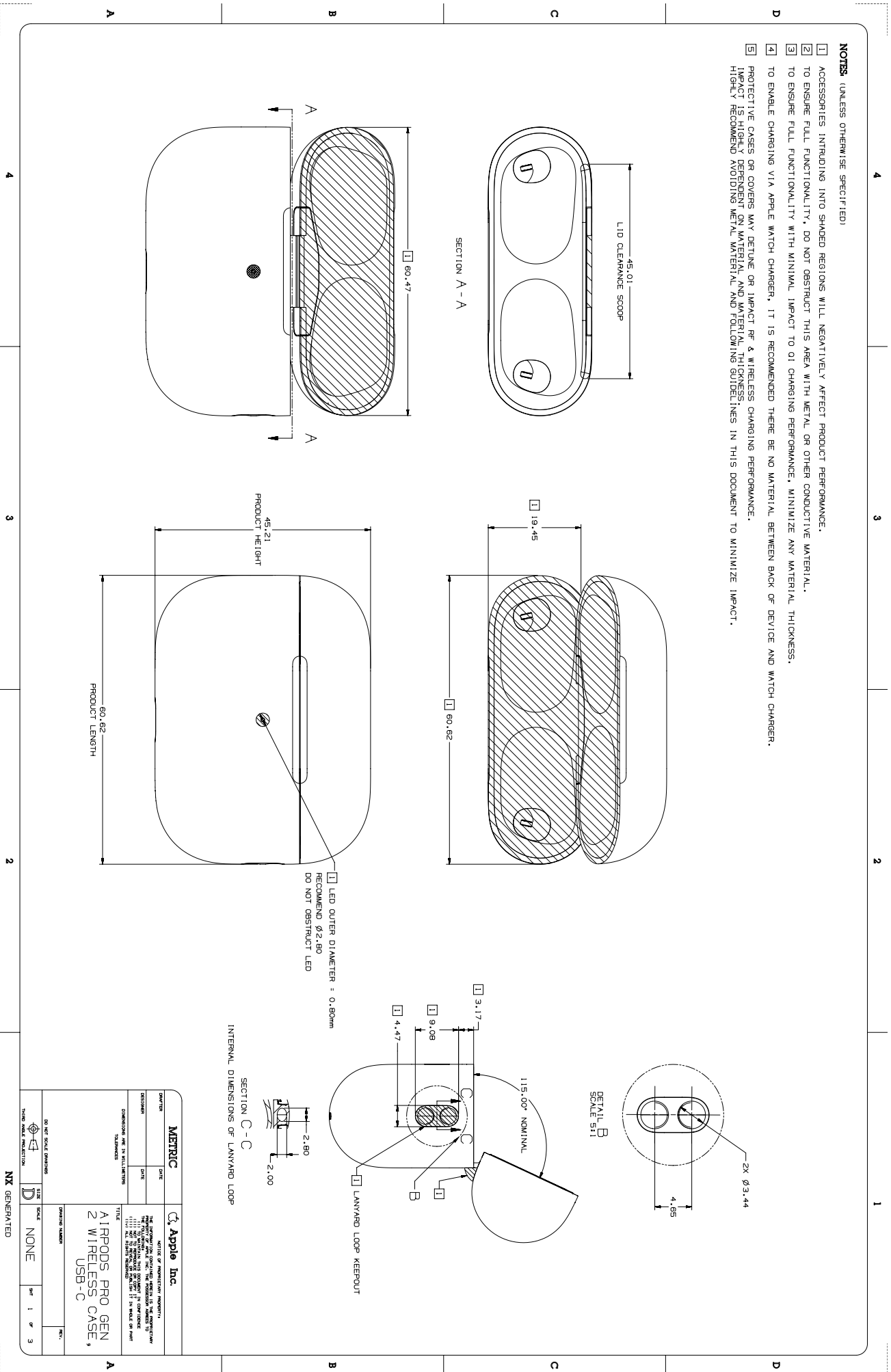
- 2 DO NOT OBSTRUCT THE WATCH ACOUSTIC OPENINGS: MIC, AND SPEAKER
- 3 DO NOT OBSTRUCT THE WATCH ANTENNA WITH METAL
- 4 DO NOT OBSTRUCT THE WATCH CHARGING PAD
- 5 DO NOT OBSTRUCT THE WATCH HEART RATE SENSORS
- 6 DO NOT EXTEND BEYOND WATCH SENSOR WINDOWS
- 7 DO NOT CONTACT THE WATCH COVER GLASS
- 8 DO NOT INTERFERE WITH CLICK OR ROTATION FUNCTION OF DIGITAL CROWN
- 9 DO NOT APPLY FORCE ON DIGITAL CROWN



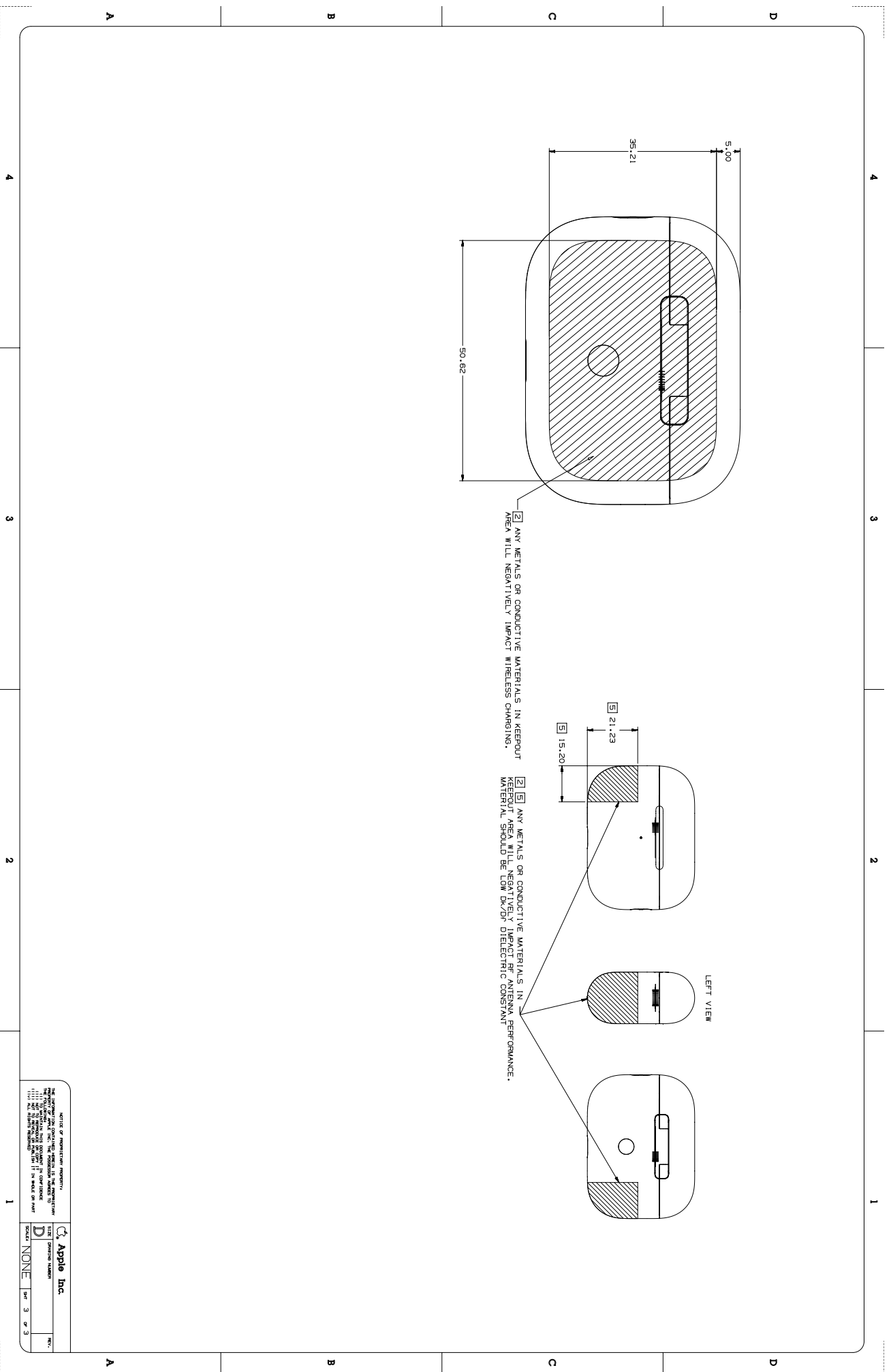
56.197 MagSafe Charging Case (USB-C) for AirPods Pro (2nd generation) 1 of 3

NOTES (UNLESS OTHERWISE SPECIFIED)

- 1 ACCESSORIES INTRODUCING 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.
- PROTECTIVE CASES OR COVERS MAY DETUNE OR IMPACT Qi & WIRELESS CHARGING PERFORMANCE. PROTECTIVE CASES OR COVERS DEPENDING ON MATERIAL AND MATERIAL THICKNESS MAY AFFECT THE HIGHLY RECOMMEND AVOIDING METAL MATERIAL AND FOLLOWING GUIDELINES IN THIS DOCUMENT TO MINIMIZE IMPACT.



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



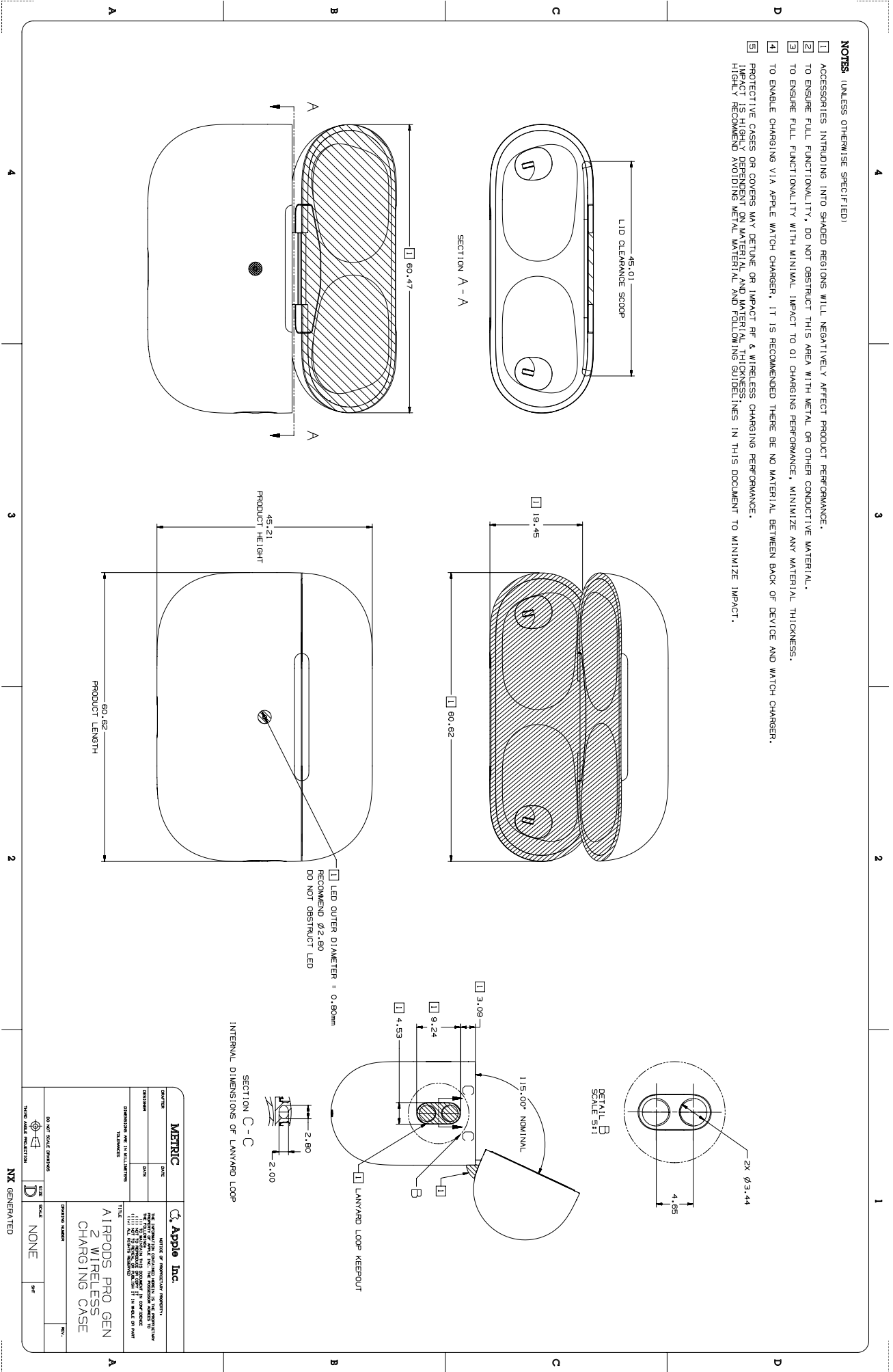
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Apple Inc.
 PART NUMBER: NONE
 SOCKET: NONE
 REV: 3 OF 3

56.200 MagSafe Charging Case for AirPods Pro (2nd generation) 1 of 3

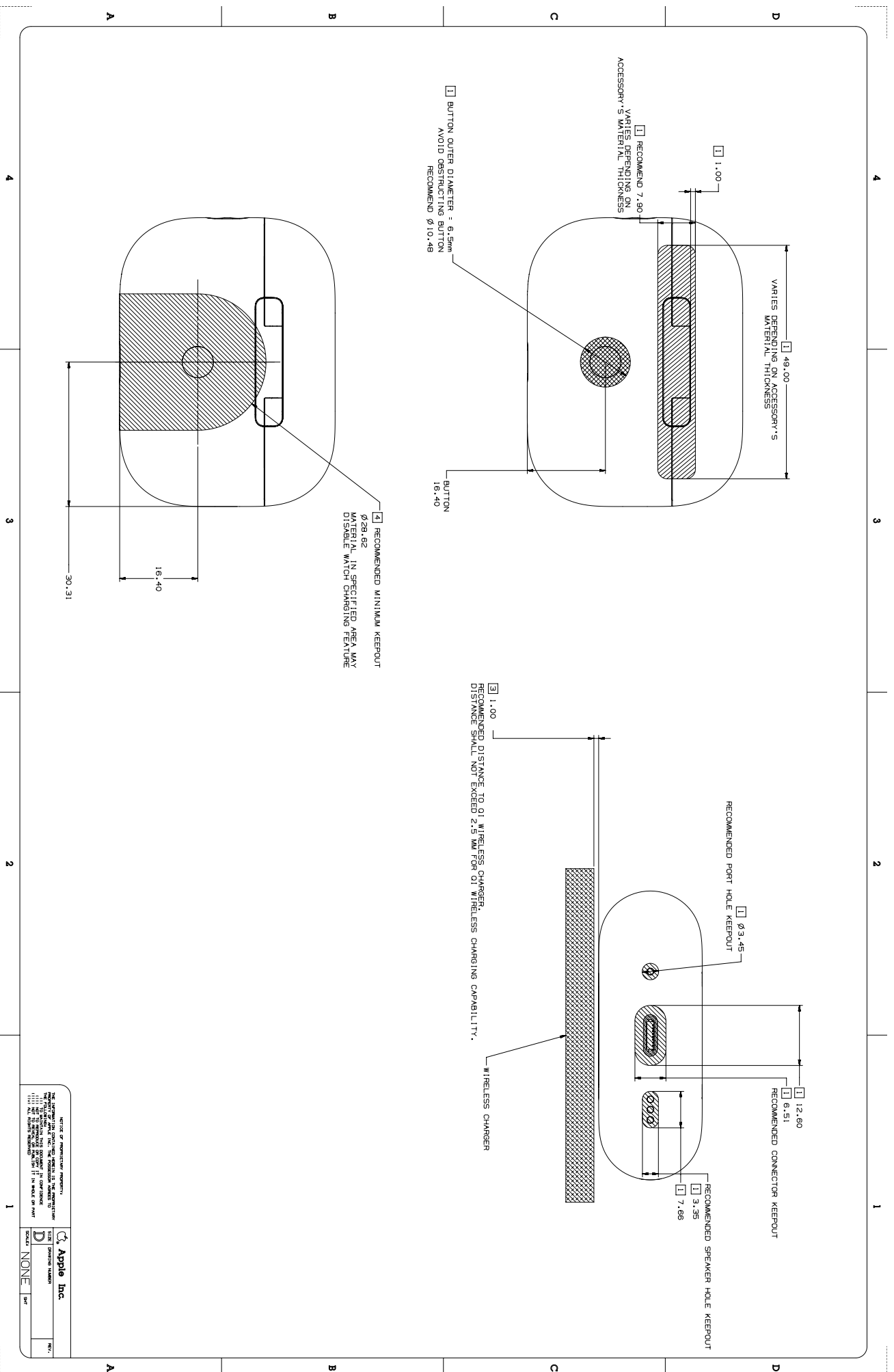
NOTES (UNLESS OTHERWISE SPECIFIED)

- 1 ACCESSORIES INTRODUCING 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.
- PROTECTIVE CASES OR COVERS MAY DETUNE OR IMPACT Qi & WIRELESS CHARGING PERFORMANCE. PROTECTIVE CASES OR COVERS DEPENDING ON MATERIAL AND MATERIAL THICKNESS MAY AFFECT THE HIGHLY RECOMMEND AVOIDING METAL MATERIAL AND FOLLOWING GUIDELINES IN THIS DOCUMENT TO MINIMIZE IMPACT.



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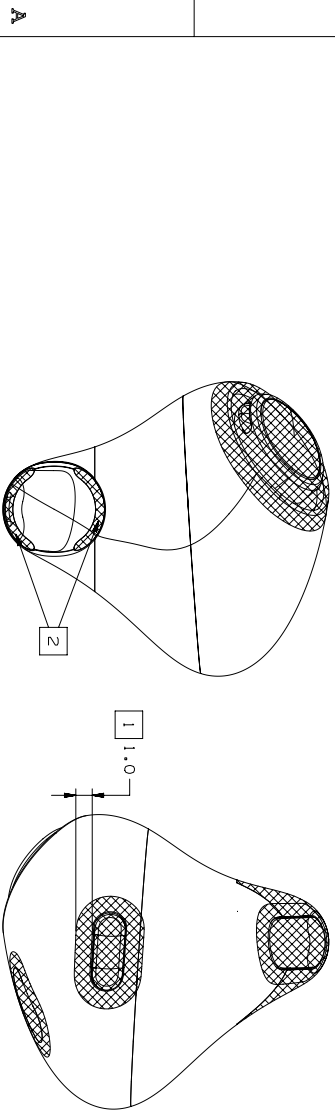
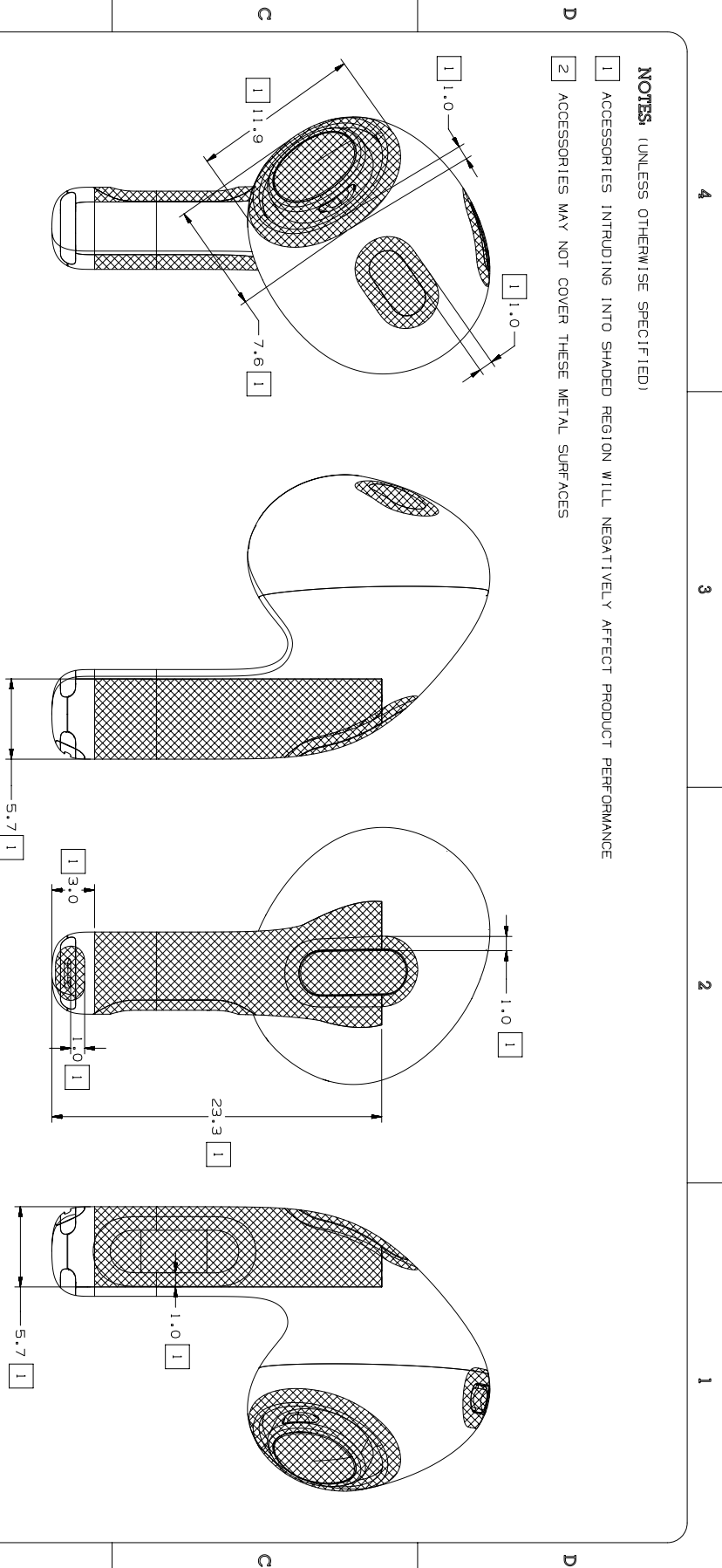
56.201 MagSafe Charging Case for AirPods Pro (2nd generation) 2 of 3



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56.203 AirPods Pro (2nd generation)

- NOTES:** (UNLESS OTHERWISE SPECIFIED)
- 1 ACCESSORIES INTRODUCING INTO SHADED REGION WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE
 - 2 ACCESSORIES MAY NOT COVER THESE METAL SURFACES



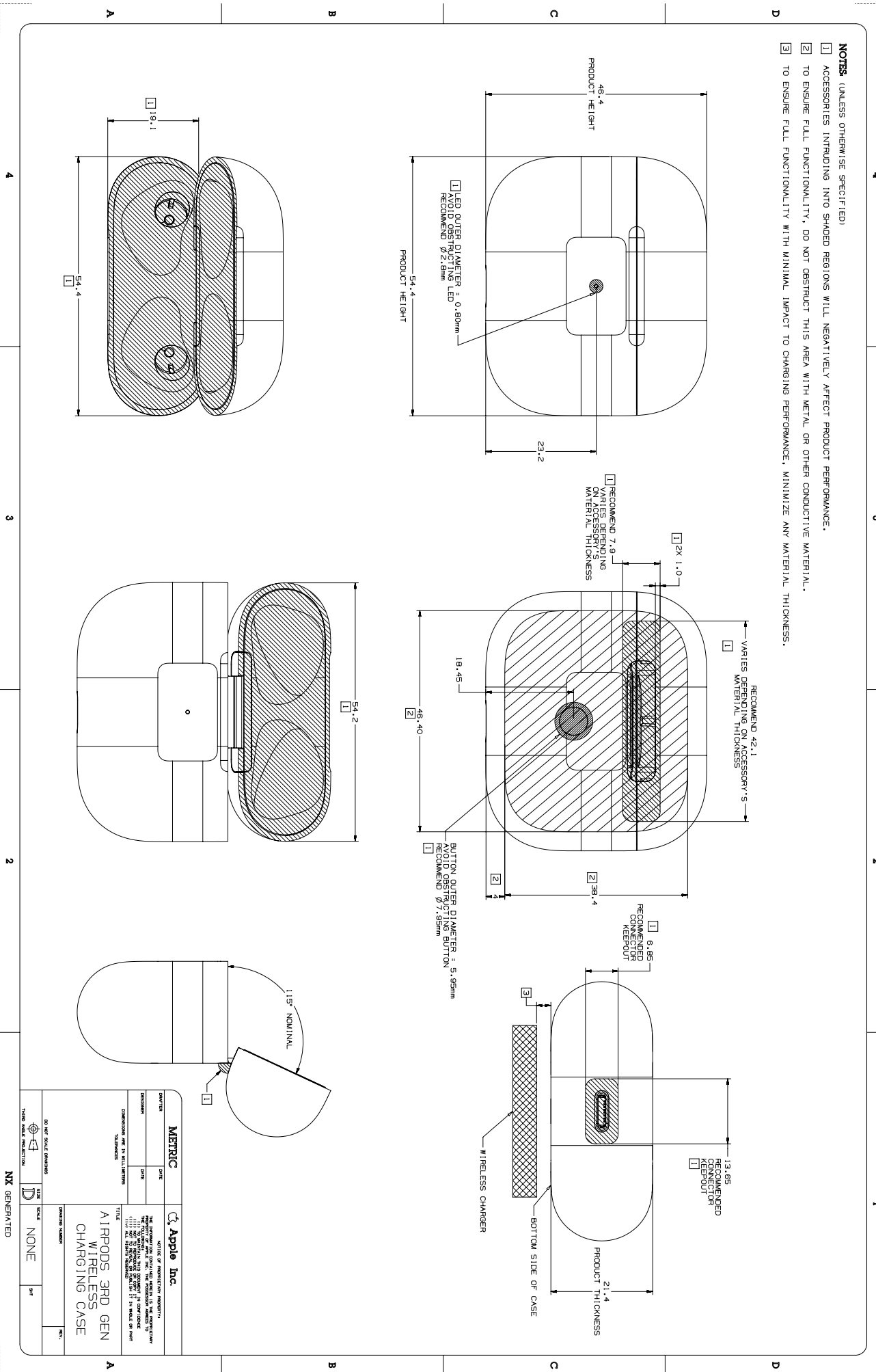
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METRIC		DATE	DATE
DRAWN			
DESIGNER			
DIVISIONS ARE IN MILLIMETERS			
TOLERANCES			
<p>NOTICE OF PROPRIETARY INTEREST:</p> <p>THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY AND CONFIDENTIAL INFORMATION OF APPLE INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE EXPRESS WRITTEN PERMISSION OF APPLE INC. ALL RIGHTS RESERVED.</p>			
TITLE			
AIRPODS PRO GEN2			
DRAWING NUMBER			
REV.			
DO NOT SCALE DRAWINGS			
THIRD ANGLE PROJECTION			
SIZE	SCALE	SHEET 1 OF 1	
NONE	NONE	NX GENERATED	

56.204 MagSafe Charging Case for AirPods (3rd generation)

NOTES (UNLESS OTHERWISE SPECIFIED)

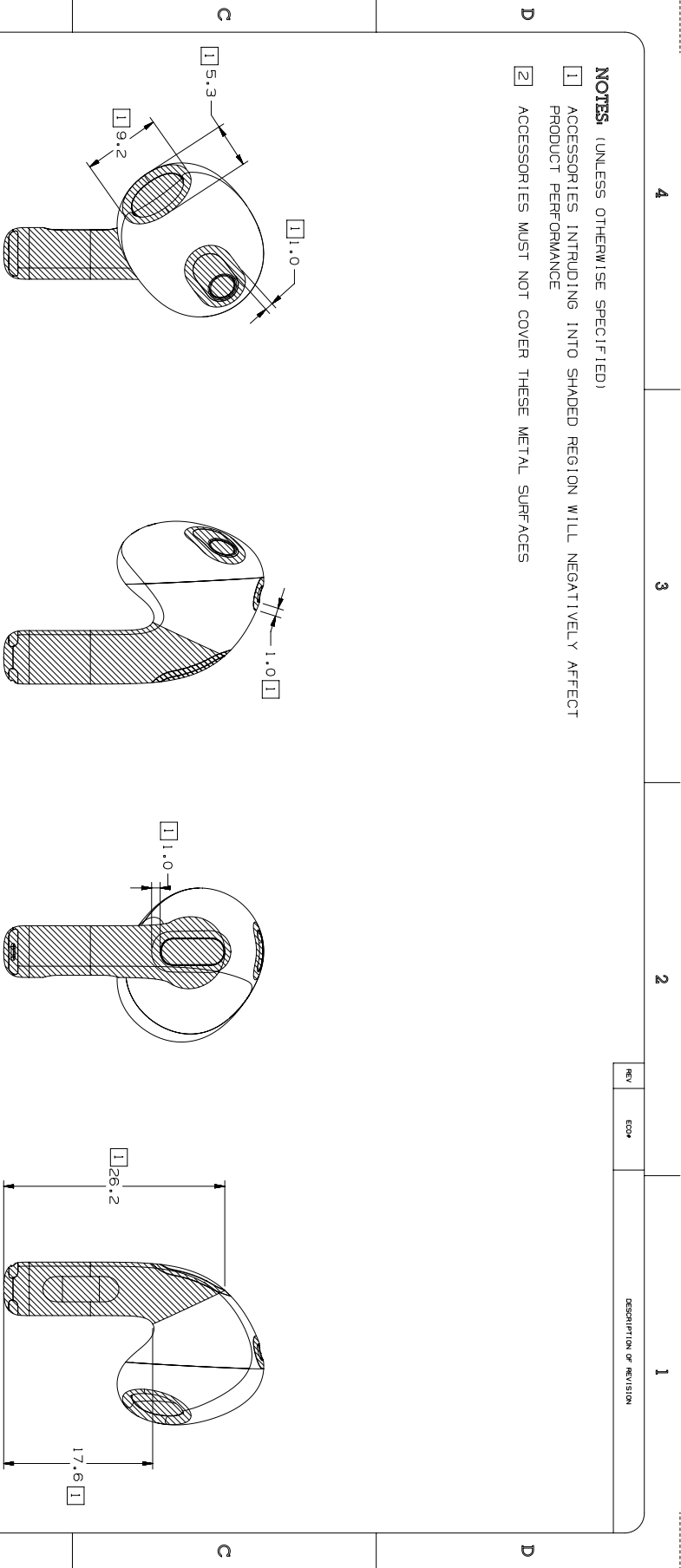
- [1] ACCESSORIES INTRODUCING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE.
- [2] TO ENSURE FULL FUNCTIONALITY, DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL.
- [3] TO ENSURE FULL FUNCTIONALITY WITH MINIMAL IMPACT TO CHARGING PERFORMANCE, MINIMIZE ANY MATERIAL THICKNESS.



METRIC		Apple Inc.	
DATE	DATE	VERSION	SCALE
DESIGNED BY	DESIGNED BY	REVISIONS	SCALE
DRAWN BY	DRAWN BY	REVISIONS	SCALE
CHECKED BY	CHECKED BY	REVISIONS	SCALE
APPROVED BY	APPROVED BY	REVISIONS	SCALE
DIMENSIONS ARE IN MILLIMETERS		TITLE	
TOLERANCES		DRAWING NUMBER	
NONE		NONE	
DO NOT SCALE DRAWINGS		SCALE	
HARD MAKE REJECTION		DATE	
NX GENERATED		REV.	

56.205 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

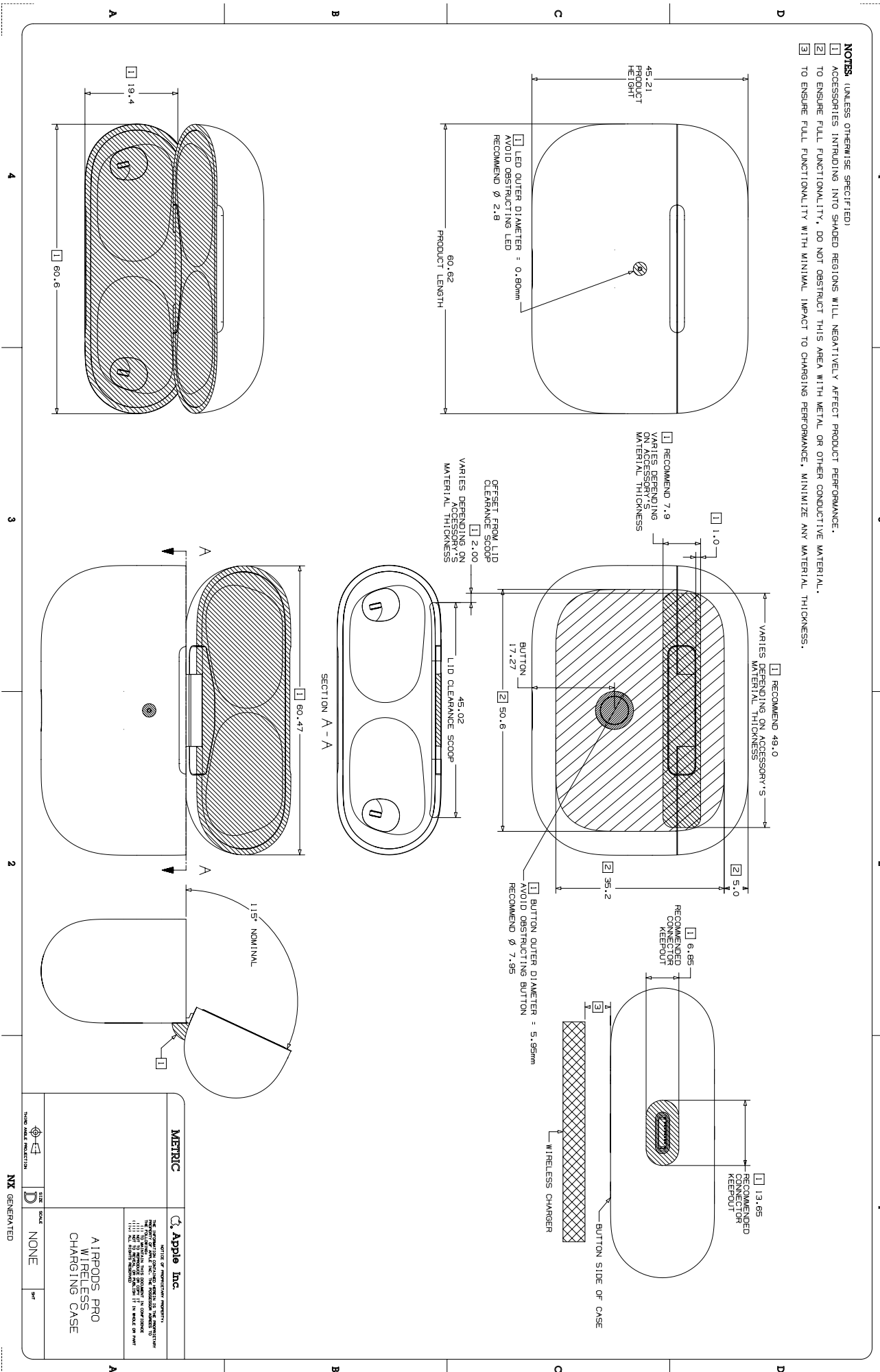


REV.	EQD#	DESCRIPTION OF REVISION
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METRIC		DATE
DRAWN	APPLE	
DESIGNED	APPLE	
DATE		
DIMENSIONS ARE IN MILLIMETERS		
TOLERANCES		
X.X	±0.2	
X.XX	±0.10	
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ANGLES	±0.5°	
DO NOT SCALE DRAWINGS		
THIRD ANGLE PROJECTION		
SIZE	SCALE	REV.
NONE	NONE	01
NX GENERATED		
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TITLE		
AirPods (3rd generation)		
DRAWING NUMBER		

56.206 Wireless Charging Case for AirPods Pro (1st generation)

- NOTES:** (UNLESS OTHERWISE SPECIFIED)
- ACCESSORIES INTRUDING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE.
 - TO ENSURE FULL FUNCTIONALITY, DO NOT OBSTRUCT THIS AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL.
 - TO ENSURE FULL FUNCTIONALITY WITH MINIMAL IMPACT TO CHARGING PERFORMANCE, MINIMIZE ANY MATERIAL THICKNESS.

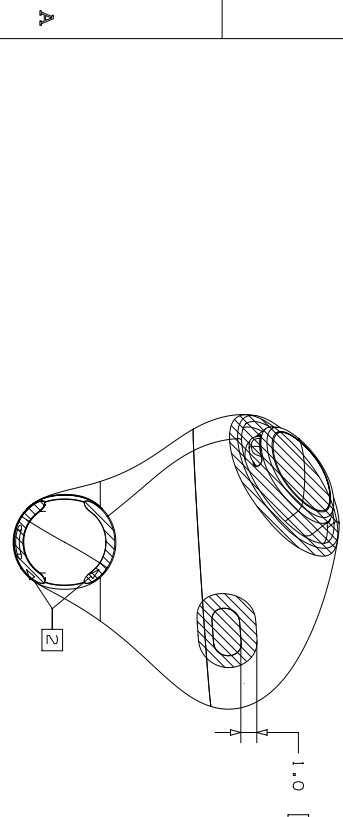
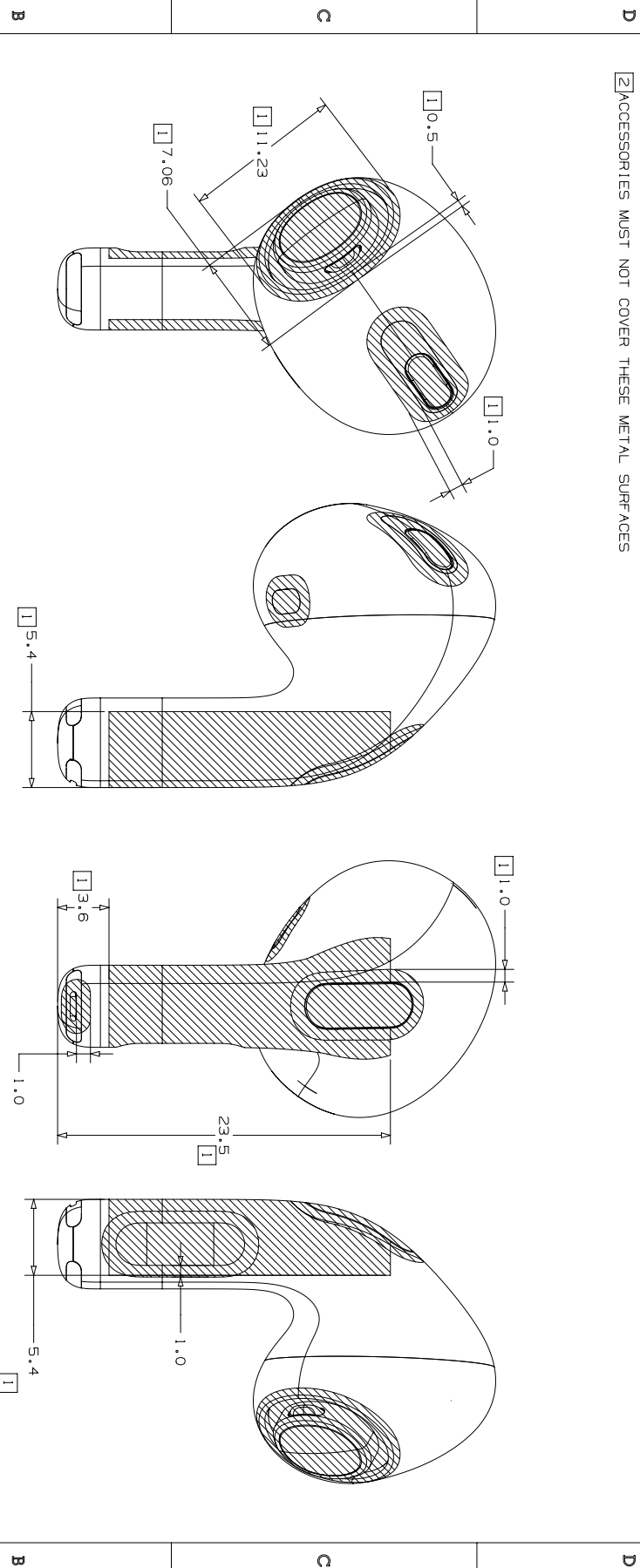


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<p>AIRPODS PRO WIRELESS CHARGING CASE</p>		<p>DATE: 2023-10-10</p>
<p>THIS DRAWING IS A 2D REPRESENTATION OF A 3D OBJECT. IT IS NOT TO BE USED FOR MANUFACTURE.</p>		<p>GENERATED BY: NX</p>

56.207 AirPods Pro (1st generation)

REV.	ESQA	DESCRIPTION OF REVISION
1		

- NOTES:** (UNLESS OTHERWISE SPECIFIED)
- [1] ACCESSORIES INTRUDING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE
 - [2] ACCESSORIES MUST NOT COVER THESE METAL SURFACES

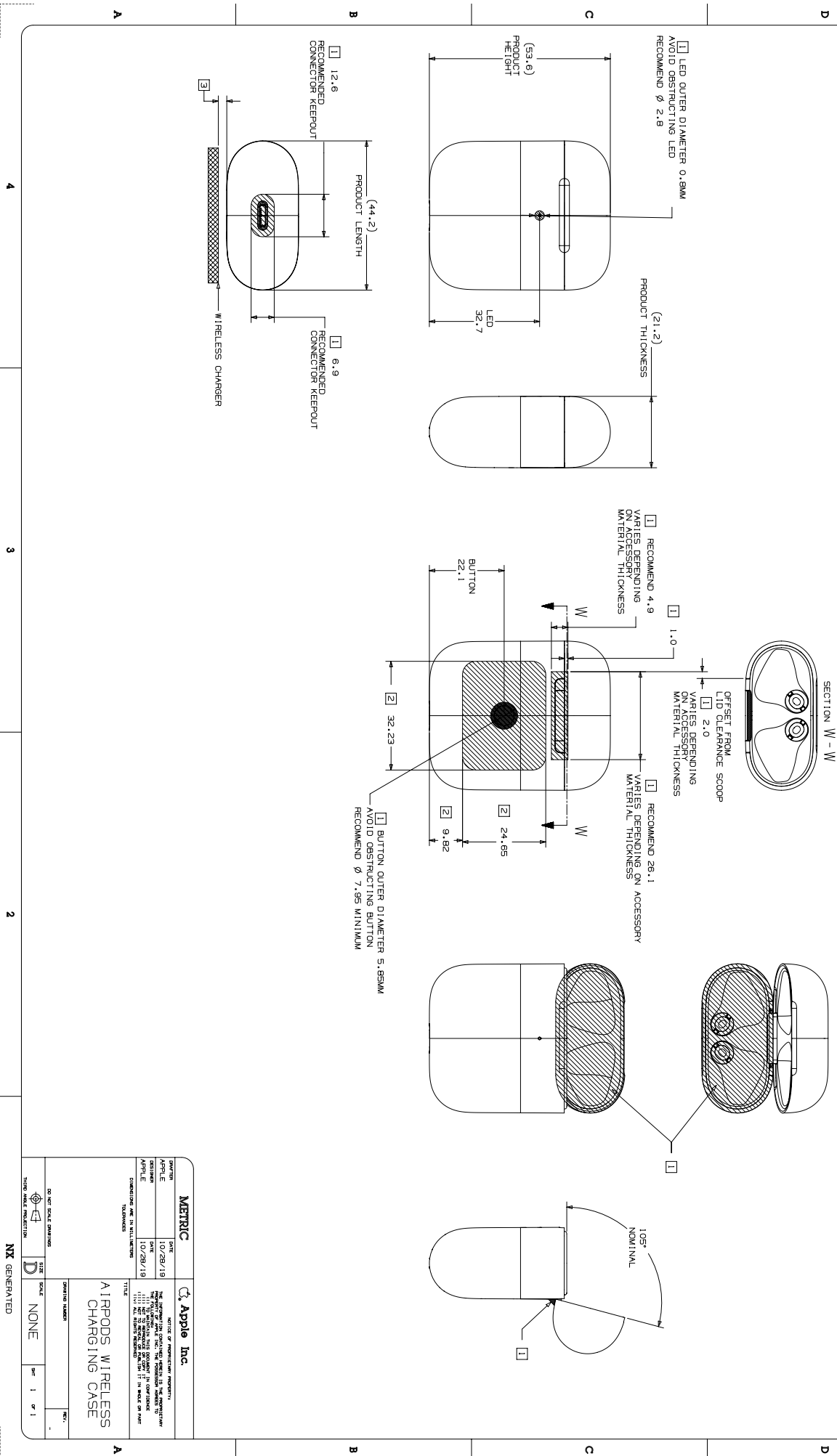


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DESIGNER	APPLE INC.	DATE	03/05/20
DESIGNER	APPLE INC.	DATE	03/05/20
DIMENSIONS ARE IN MILLIMETERS		TOLERANCES	
TITLE		AIRPODS PRO	
DRAWING NUMBER		REV. 01	
DO NOT SCALE DRAWINGS		SCALE NONE	
THIRD ANGLE PROJECTION		SHEET 1 OF 1	
NX GENERATED			

56.208 Wireless Charging Case for AirPods

NOTES (UNLESS OTHERWISE SPECIFIED)

- 1 ACCESSORIES INTRUDING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE.
- 2 TO ENSURE FULL FUNCTIONALITY, DO NOT OBSTRUCT INDICATED AREA WITH METAL OR OTHER CONDUCTIVE MATERIAL.
- 3 TO ENSURE FULL FUNCTIONALITY WITH MINIMAL IMPACT TO CHARGING PERFORMANCE, MINIMIZE ANY MATERIAL THICKNESS.



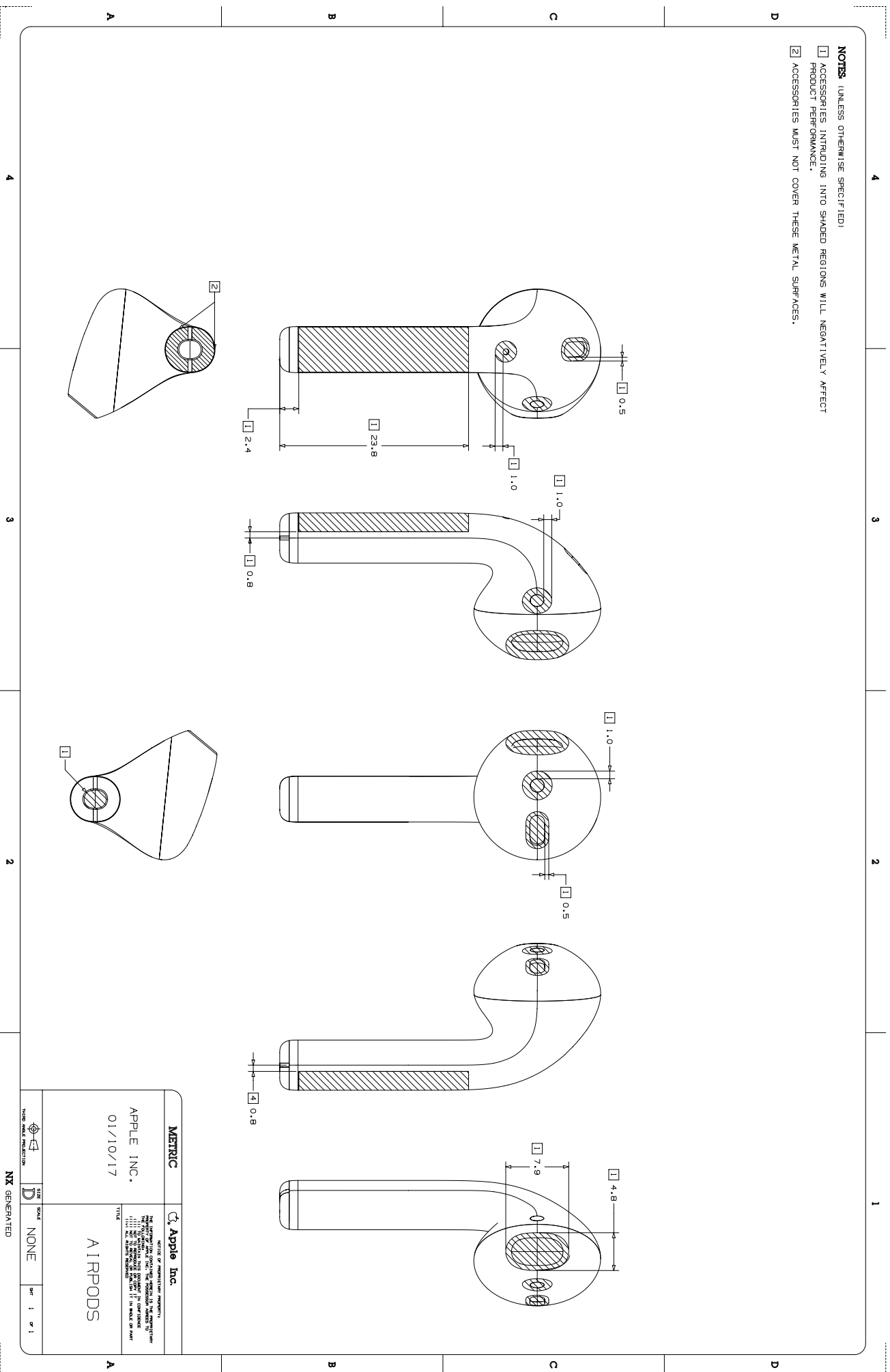
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DATE	10/28/18	DATE	10/28/18
DESIGNED BY	APPLE	DESIGNED BY	APPLE
CHANGING NAME TO BULK/UNIT		CHANGING NAME TO BULK/UNIT	
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DRAWING NUMBER		DRAWING NUMBER	
SCALE		SCALE	
NONE		NONE	
SHEET 1 OF 1		SHEET 1 OF 1	
NX GENERATED		NX GENERATED	

56.209 AirPods (1st generation) and AirPods (2nd generation)

NOTES (UNLESS OTHERWISE SPECIFIED)

[1] ACCESSORIES INTRUDING INTO SHADED REGIONS WILL NEGATIVELY AFFECT PRODUCT PERFORMANCE.

[2] ACCESSORIES MUST NOT COVER THESE METAL SURFACES.



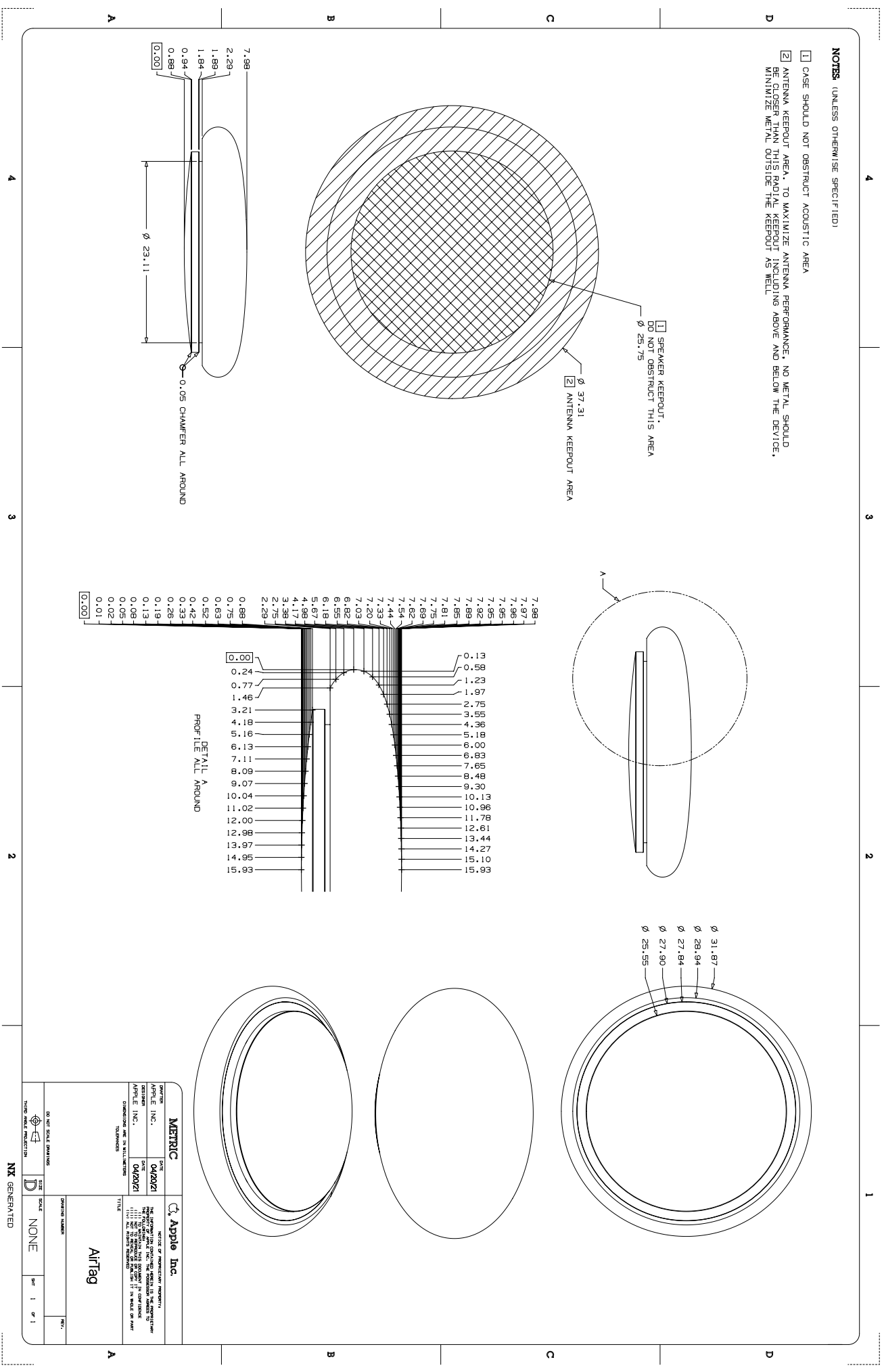
METRIC	Apple Inc.
APPLE INC. 01/10/17	<p><small>NOTICE OF REVISIONS AND OTHER INFORMATION</small></p> <p><small>THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF APPLE INC. THE DESIGN, NAMES AND LOGOS OF APPLE INC. AND ITS PRODUCTS ARE TRADEMARKS OF APPLE INC. IN THE UNITED STATES AND OTHER COUNTRIES. ALL RIGHTS RESERVED.</small></p>
TITLE	AIRPODS
THIS DRAWING REPRESENTS THE DESIGN OF THE PRODUCT AS SHOWN IN THE PHOTOGRAPH.	
DATE	01/10/17
SCALE	NONE
SHEET	1 OF 1

THIS DRAWING REPRESENTS THE DESIGN OF THE PRODUCT AS SHOWN IN THE PHOTOGRAPH. NX GENERATED

56.210 AirTag

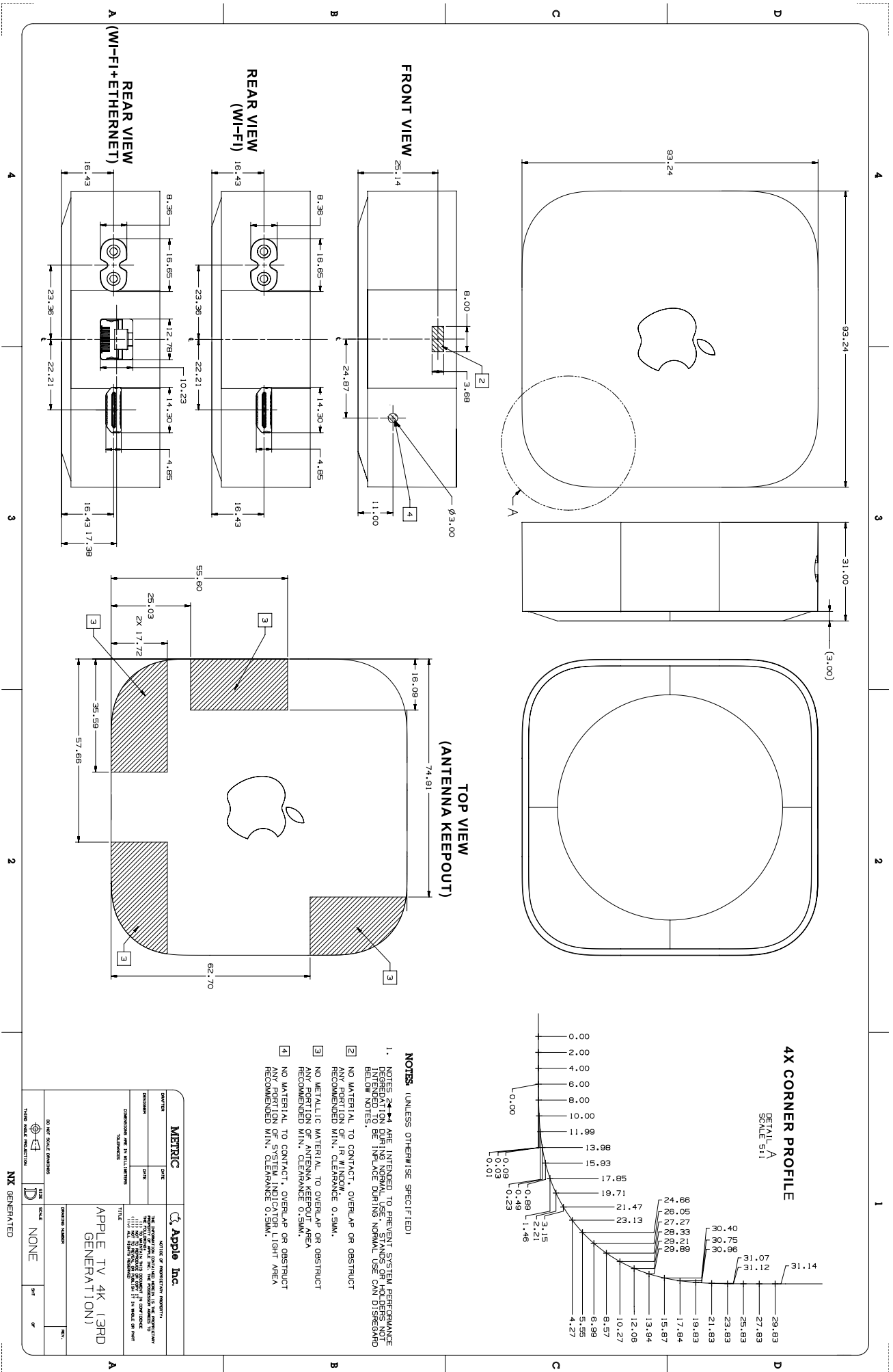
NOTES (UNLESS OTHERWISE SPECIFIED)

- 1 CASE SHOULD NOT OBSTRUCT ACOUSTIC AREA
- 2 ANTENNA KEEP-OUT AREA. TO MAXIMIZE ANTENNA PERFORMANCE, NO METAL SHOULD BE CLOSER THAN THIS RADIAL KEEP-OUT INCLUDING ABOVE AND BELOW THE DEVICE, MINIMIZE METAL OUTSIDE THE KEEP-OUT AS WELL
- 3 SPEAKER KEEP-OUT. DO NOT OBSTRUCT THIS AREA. $\varnothing 25.75$
- 4 ANTENNA KEEP-OUT AREA. $\varnothing 37.31$



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<p>PROJECT: AIRTAG</p> <p>DESCRIPTION: AIRTAG</p> <p>DATE: 04/20/21</p> <p>DESIGNED BY: [REDACTED]</p> <p>ENGINEER: [REDACTED]</p>		<p>Apple Inc.</p> <p>1000 Apple Parkway</p> <p>Cupertino, CA 95014</p> <p>TEL: 415.924.6453</p> <p>FAX: 415.924.6453</p>	
<p>SCALE: NONE</p> <p>DATE: 04/20/21</p> <p>DESIGNED BY: [REDACTED]</p> <p>ENGINEER: [REDACTED]</p>		<p>Apple Inc.</p> <p>1000 Apple Parkway</p> <p>Cupertino, CA 95014</p> <p>TEL: 415.924.6453</p> <p>FAX: 415.924.6453</p>	

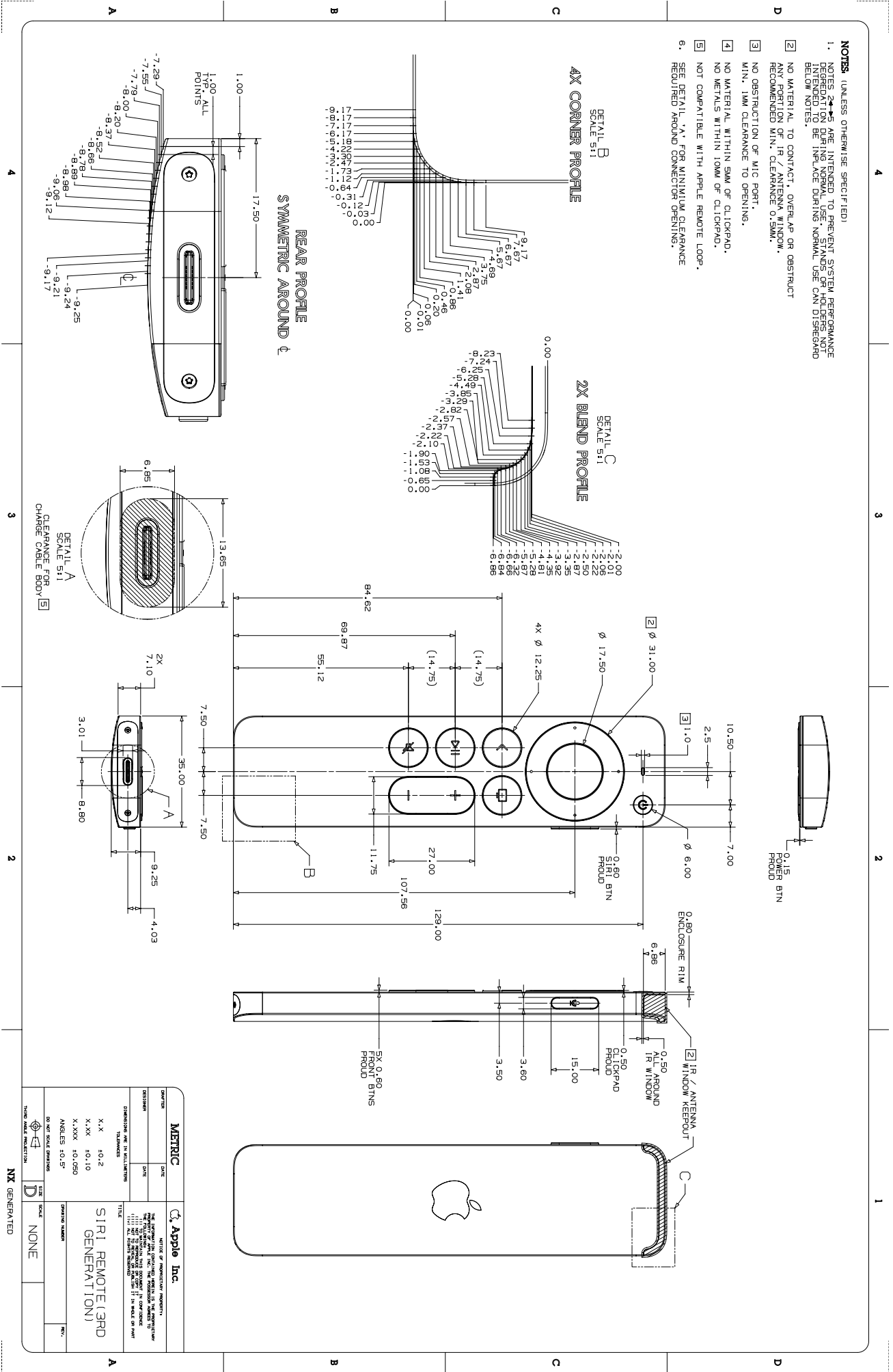
56.211 Apple TV 4K (3rd generation)



56.212 Siri Remote (3rd generation)

NOTES (UNLESS OTHERWISE SPECIFIED):

- NOTES 2, 4, 5 ARE INTENDED TO PREVENT SYSTEM PERFORMANCE DEGRADATION DURING NORMAL USE. STANDS OR HOLDERS NOT INTENDED TO BE IN PLACE DURING NORMAL USE CAN DISREGARD BELOW NOTES.
- NO MATERIAL TO CONTACT, OVERLAP OR OBSTRUCT ANY PORTION OF IR / ANTENNA WINDOW. RECOMMENDED MIN. CLEARANCE 0.5MM.
- NO OBSTRUCTION OF MIC PORT. MIN. 1MM CLEARANCE TO OPENING.
- NO MATERIAL WITHIN 5MM OF CLICKPAD.
- NO MATERIAL WITHIN 10MM OF CLICKPAD.
- NOT COMPATIBLE WITH APPLE REMOTE LOOP.
- SEE DETAIL 'A' FOR MINIMUM CLEARANCE REQUIRED AROUND CONNECTOR OPENING.



METRIC		Apple Inc.	
DATE		VERSION	
DESIGNER		DATE	
DRAWN		DATE	
CHECKED		DATE	
APPROVED		DATE	
DIMENSIONS ARE IN MILLIMETERS			
TOLERANCES			
X.X	+0.2		
X.XX	+0.10		
X.XXX	+0.050		
ANGLES 10.5°			
DO NOT SCALE DIMENSIONS			
HIDDEN LINE PRACTICE			
NONE GENERATED			
SCALE NONE			
TITLE SIRI REMOTE (3RD GENERATION)			
DRAWING NUMBER			
REV.			

Revision History

This chapter describes changes to the Accessory Design Guidelines for Apple Devices from the previous revision, excluding stylistic and editorial changes.

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- [Cases](#) (page 31) Test Procedures:
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- [Accessory Developer Assistant \(ADA\)](#) (page 250)
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