



Apple iPad 4 LTE A1459

Quad-Band GSM/EDGE

W-CDMA/HSPA+ (850 / 900 / 1900/ 2100 MHz)

LTE (700 / 1700 MHz)

[Sample Report](#)

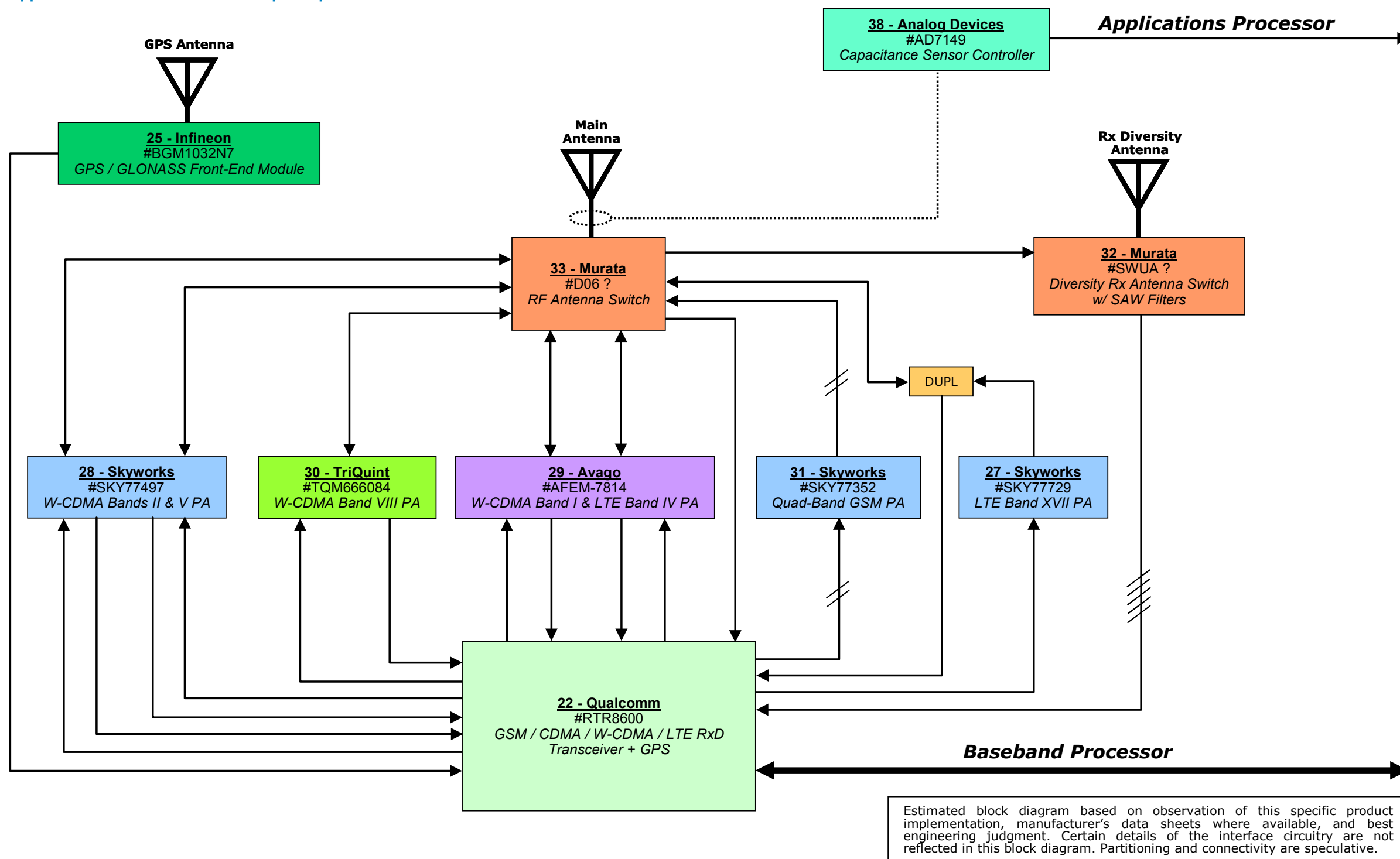
Product Description

The Cellular Apple iPad 4 A1459 tablet, which Apple officially calls the “iPad with Retina Display,” is the company’s fourth-generation model in this family. It features a 9.7-in. LED-backlit TFT-LCD Retina Display with QXGA (2048 x 1536) resolution, 16M colors, and multitouch capacitive touchscreen with Gorilla Glass overlay. It runs the iOS 6.0 operating system on a dual-core 1.4 GHz Apple A6X SoC with quad-core graphics and 1 GB RAM. It also features 32 GB of internal memory (16 GB and 64 GB models also available) but lacks a memory card slot for external storage. There are also two cameras: a rear-facing 5 MP BSI CMOS “iSight” camera with autofocus, LED flash, and HD (1080p) video capability; and a front-facing 1.2 MP “Facetime HD” camera with HD (720p) video capability. Connectivity is provided by WiFi 802.11a/b/g/n, Bluetooth 4.0, GPS, microUSB 2.0, and a USB “Lightning” port (in place of the previous Dock Connector port). Sensors include an accelerometer, gyroscope, compass, and ambient light sensor. The iPad 4 A1459 is powered by a large-capacity 3.7 V, 11,560 mAh Li-Polymer battery that supplies a listed 10 hours of use time and 720 hours of standby.

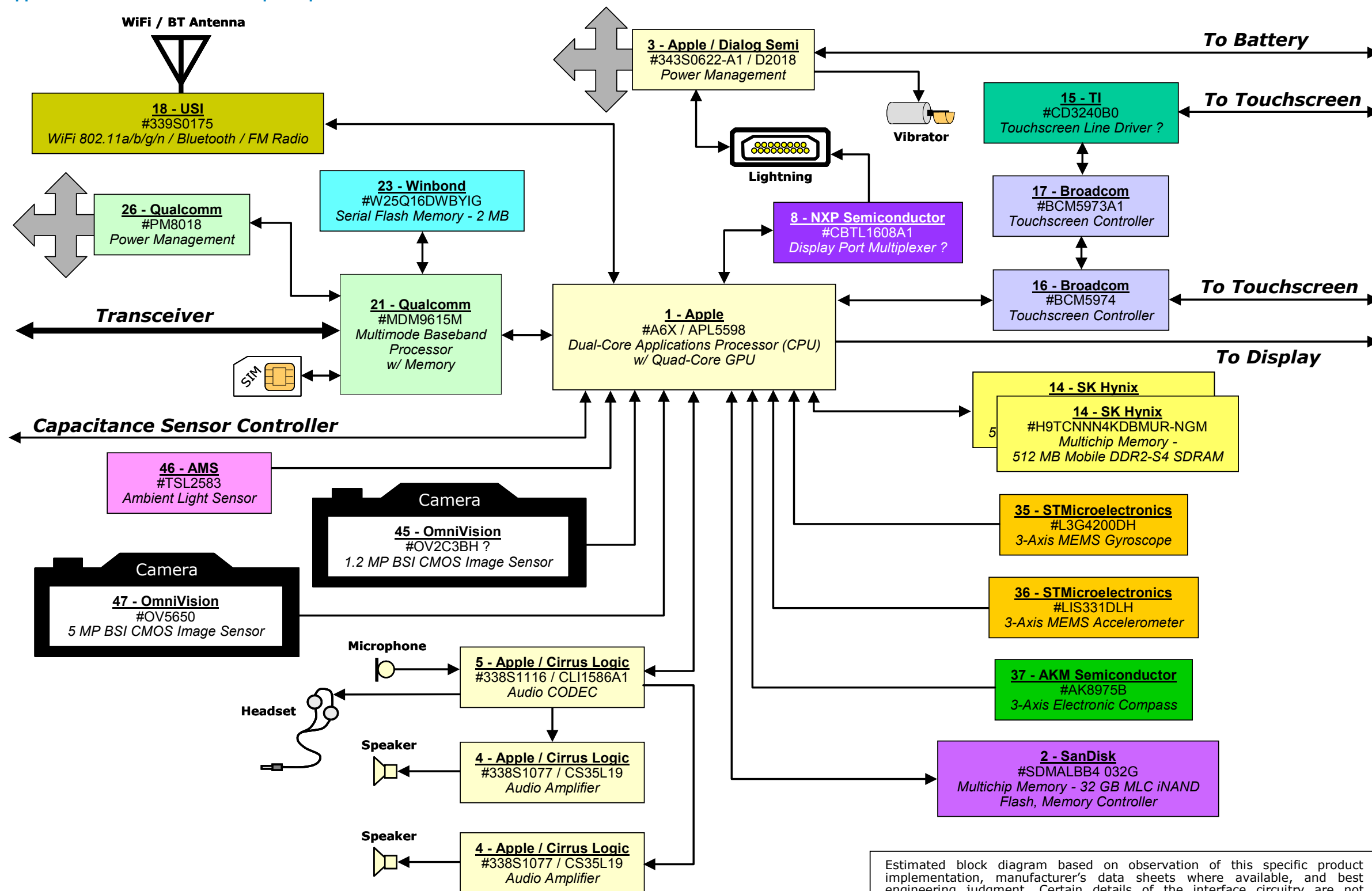
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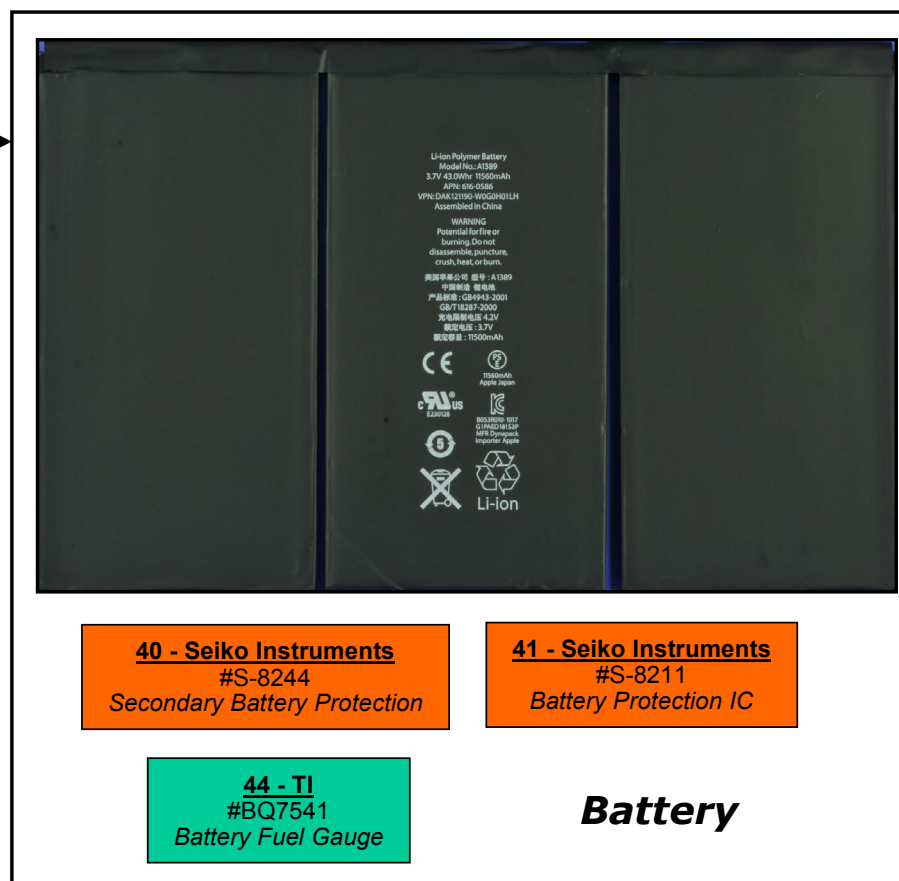
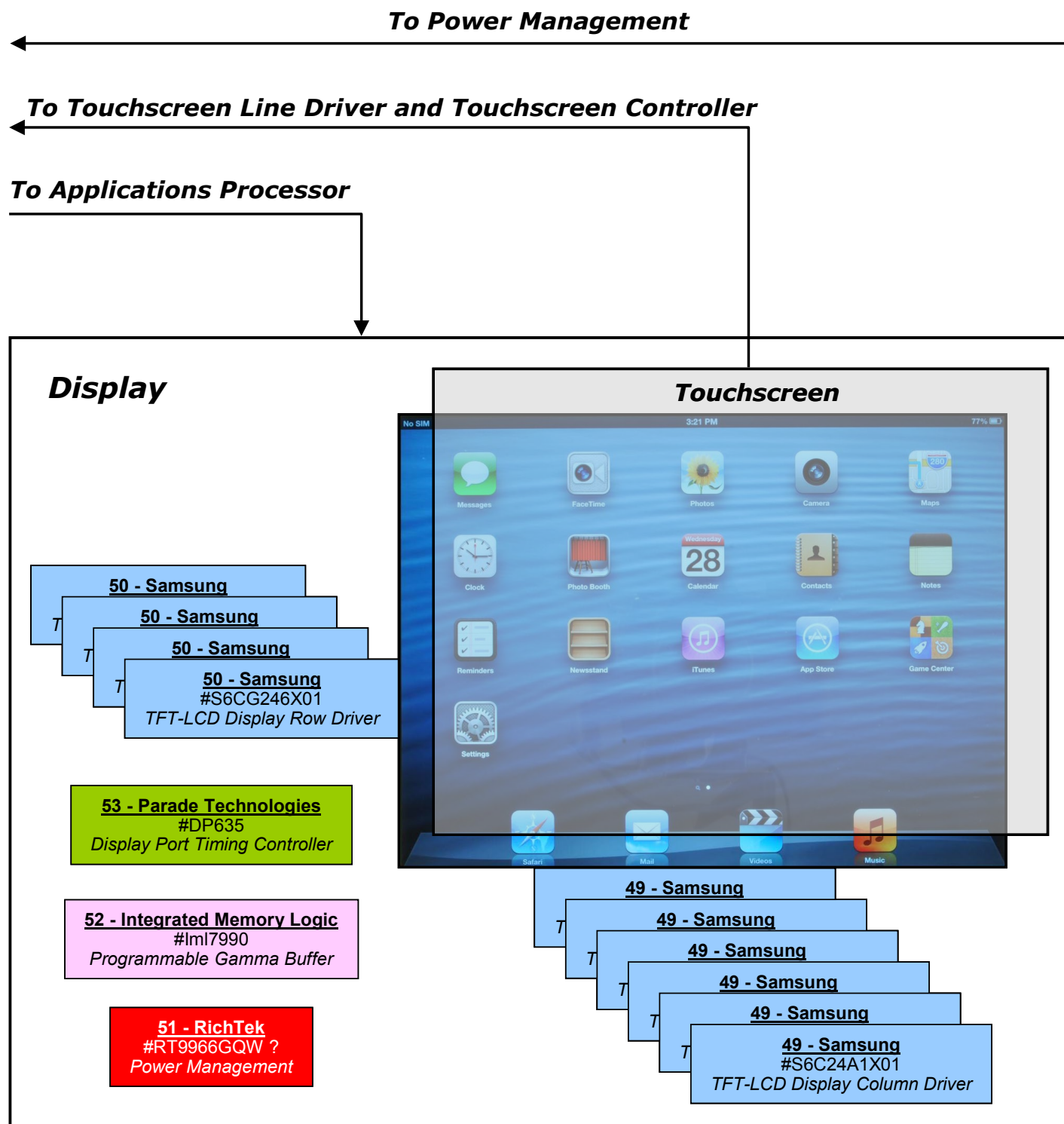
Product Description		Integrated Circuit Metrics		
Product Type	Tablet	IC Die Count**	85	
Brand	Apple	IC Package Count**	64	
Product Name & Model #	iPad 4 LTE A1459	Cost Metrics		
Official Release Date	11/16/2012			
Weight (grams)	662	Retail Price	\$729.00	
Product Dimensions (mm)	242 x 186 x 9.4	Total Manufacturing Cost*	\$326.27	
Product Features		Electronics Cost**	\$216.29	
		Manufacturing Cost Breakdown		
Operating System	iOS 6.0	Integrated Circuits	\$117.09	35.9%
Communications	Quad-Band GSM/EDGE; Quad-Band W-CDMA/HSPA+; LTE (700 MHz-Band XVII/1700 MHz-Band IV)	Modules, Discretes & Connectors	\$17.73	5.4%
		Substrates	\$12.35	3.8%
Connectivity	WiFi 802.11n, Bluetooth 4.0, GPS, microUSB 2.0, "Lightning" Port	Component Insertion	\$8.14	2.5%
		Card Test	\$0.65	0.2%
Battery Life	Use Time: 10 hours Standby: 720 hours	Battery Subsystem	\$20.27	6.2%
		Display / Touchscreen Subsystem	\$112.73	34.6%
Processor	Dual-Core 1.4 GHz A6X SoC w/ Quad-Core Graphics & 1 GB RAM	Camera Subsystems	\$16.31	5.0%
Interface	Multitouch Capacitive Touchscreen; Home Key; Up/Down Keys; Mute Key	Non-Electronic Parts	\$17.75	5.4%
		Final Assembly & Test	\$3.25	1.0%
Storage	Internal: 32 GB External: N/A	Total	\$326.27	100.0%
Sensors	Accelerometer; Gyroscope; Compass; Ambient Light	*Excluding Supporting Materials' Cost **Including Subsystems		
Key Subsystems				
Battery	3.7 V, 11,560 mAh, Li-Polymer			
Display	9.7" TFT-LCD; 2048 x 1536 Pixels (264 ppi); 16,777,216 Colors; Gorilla Glass			
Main Camera	5.0 MP BSI CMOS, Autofocus, LED Flash, "iSight" HD Video (1080p)			
Secondary Camera	1.2 MP BSI CMOS, "Facetime HD" Video (720p)			



Deep Dive Teardown
Apple iPad 4 LTE A1459 32 GB Sample Report



Estimated block diagram based on observation of this specific product implementation, manufacturer's data sheets where available, and best engineering judgment. Certain details of the interface circuitry are not reflected in this block diagram. Partitioning and connectivity are speculative.



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Total Estimated
Cost of Supporting Materials: \$5.20

Packaging - \$0.90



Documentation - \$0.10



SIM Card Extractor - \$0.05



AC Adapter - \$2.40



USB / Lightning Cable - \$1.75



Supporting Materials

Label

iPad

Designed by Apple in California Assembled in China

Model A1459 Complies with the Canadian ICES-003 Class B specifications.

FCC ID: BCGA1459 and IC: 579C-A1459 Serial: DMPJN8R4F18F



Ambient
Light Sensor

Front
Camera

Capacitive
Touchscreen

Home Key

Top

Bottom

Backlights

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Product Packaging

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Teardown

Antenna

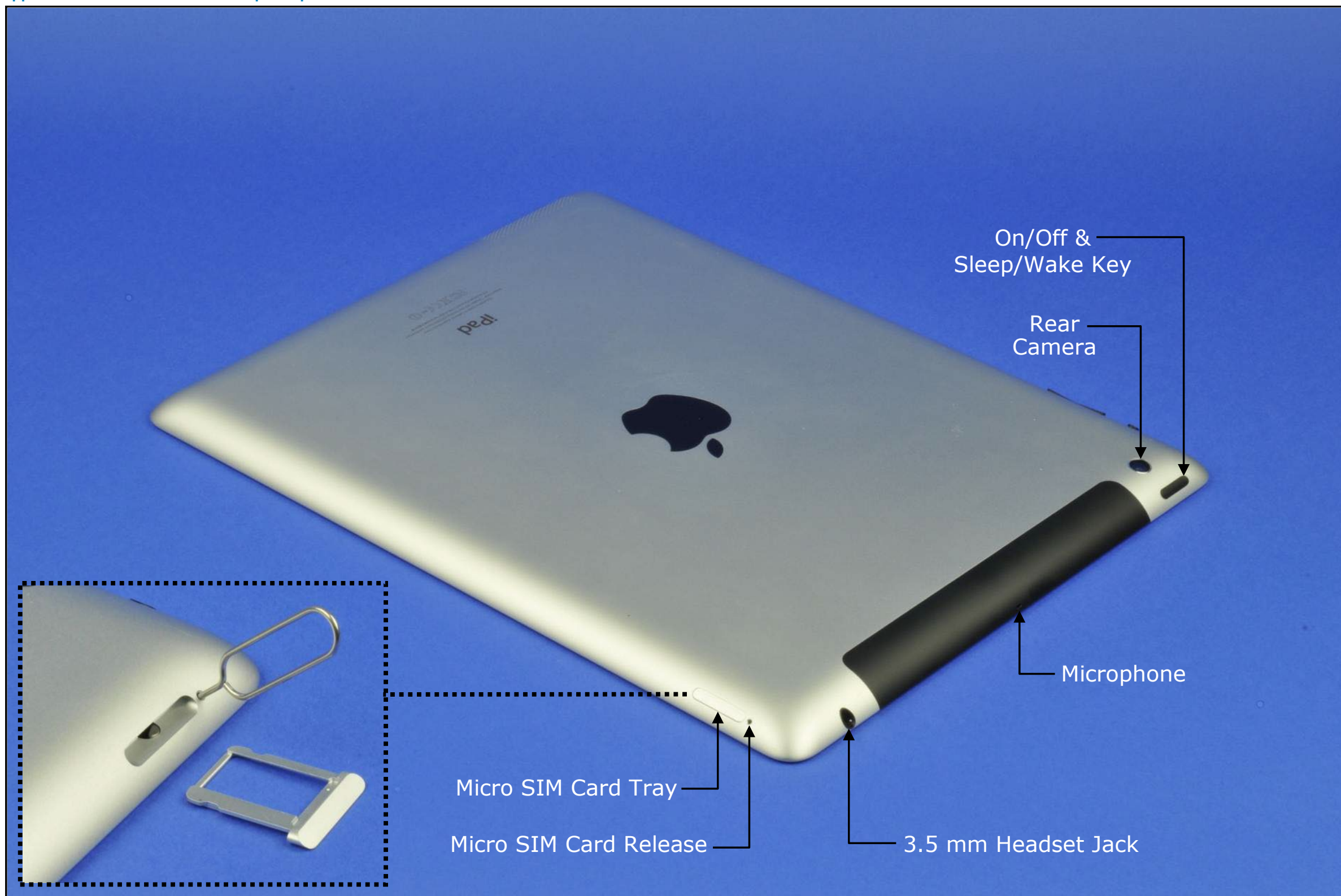
Subsystems

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Other Substrates

Costs and Metrics

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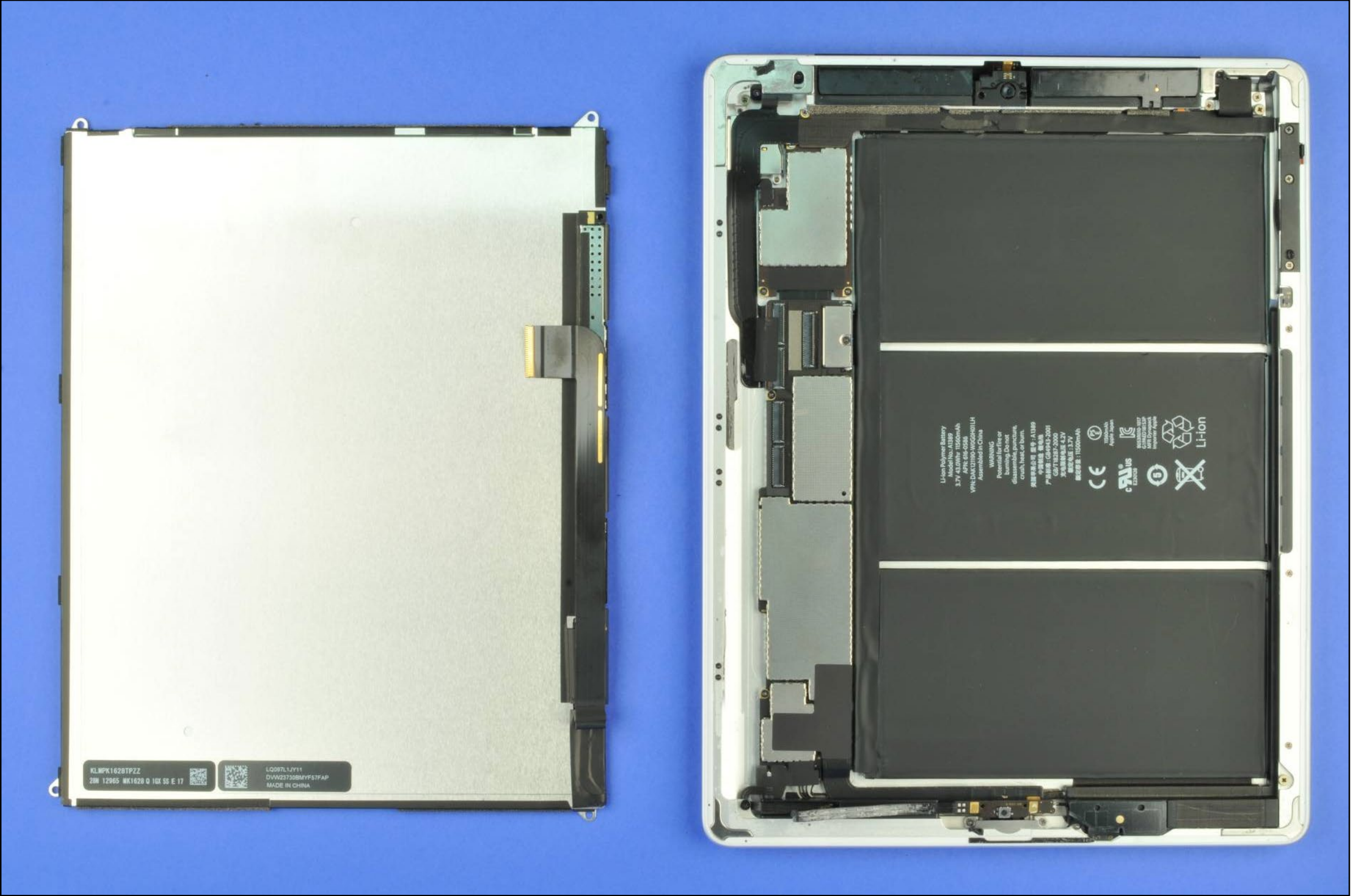
[Main Board](#)

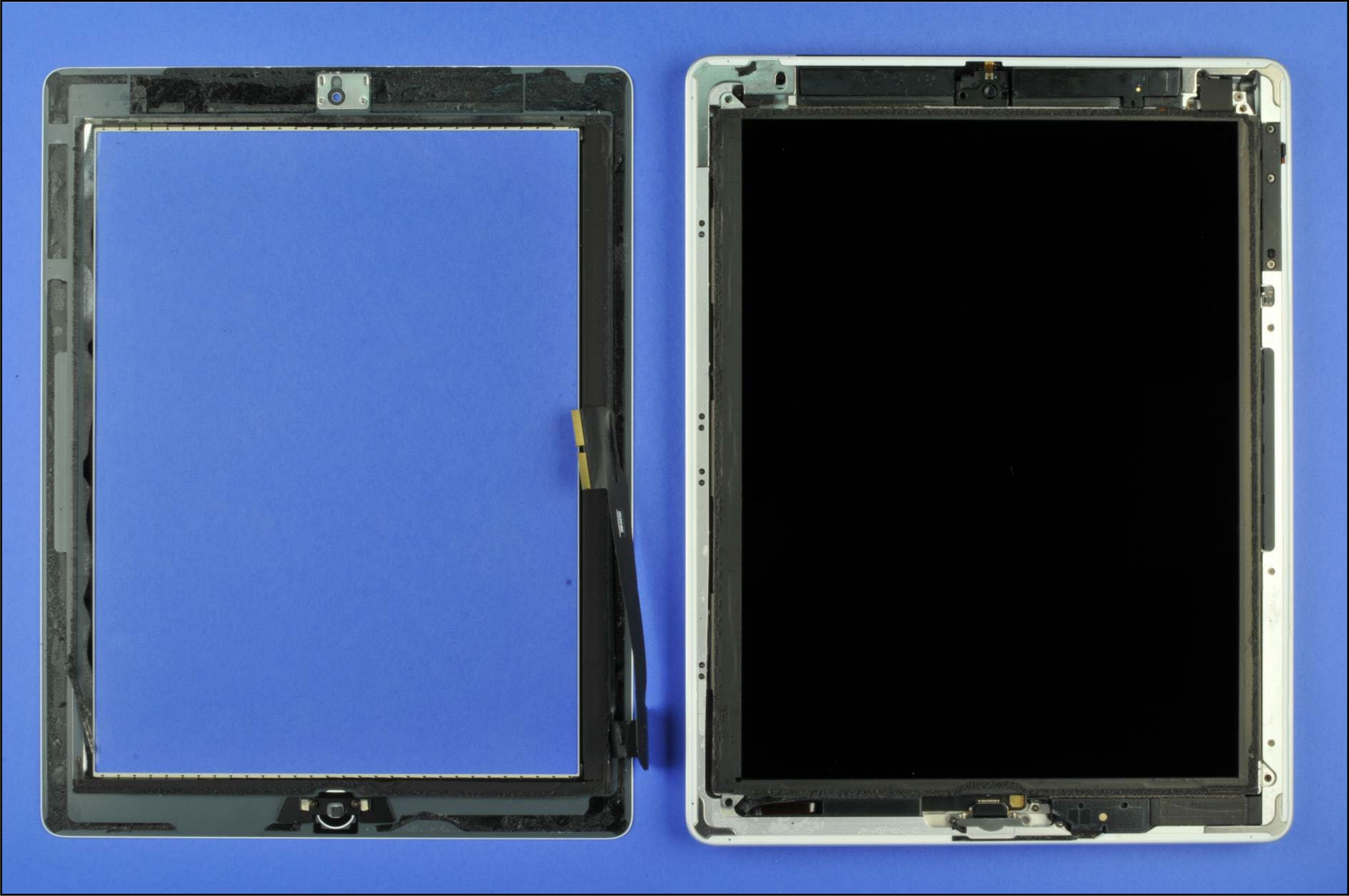
[Other Substrates](#)

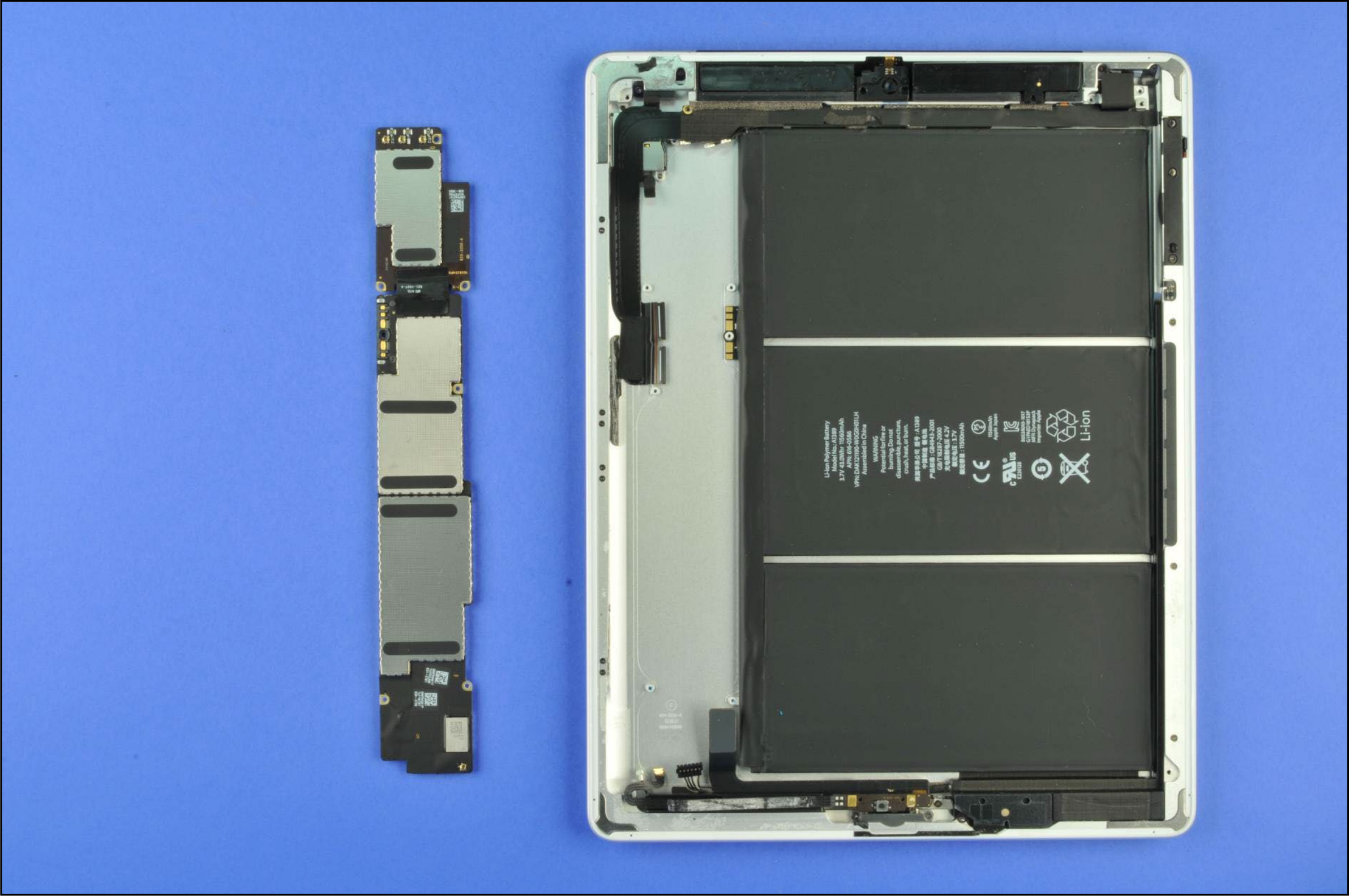
[Costs and Metrics](#)

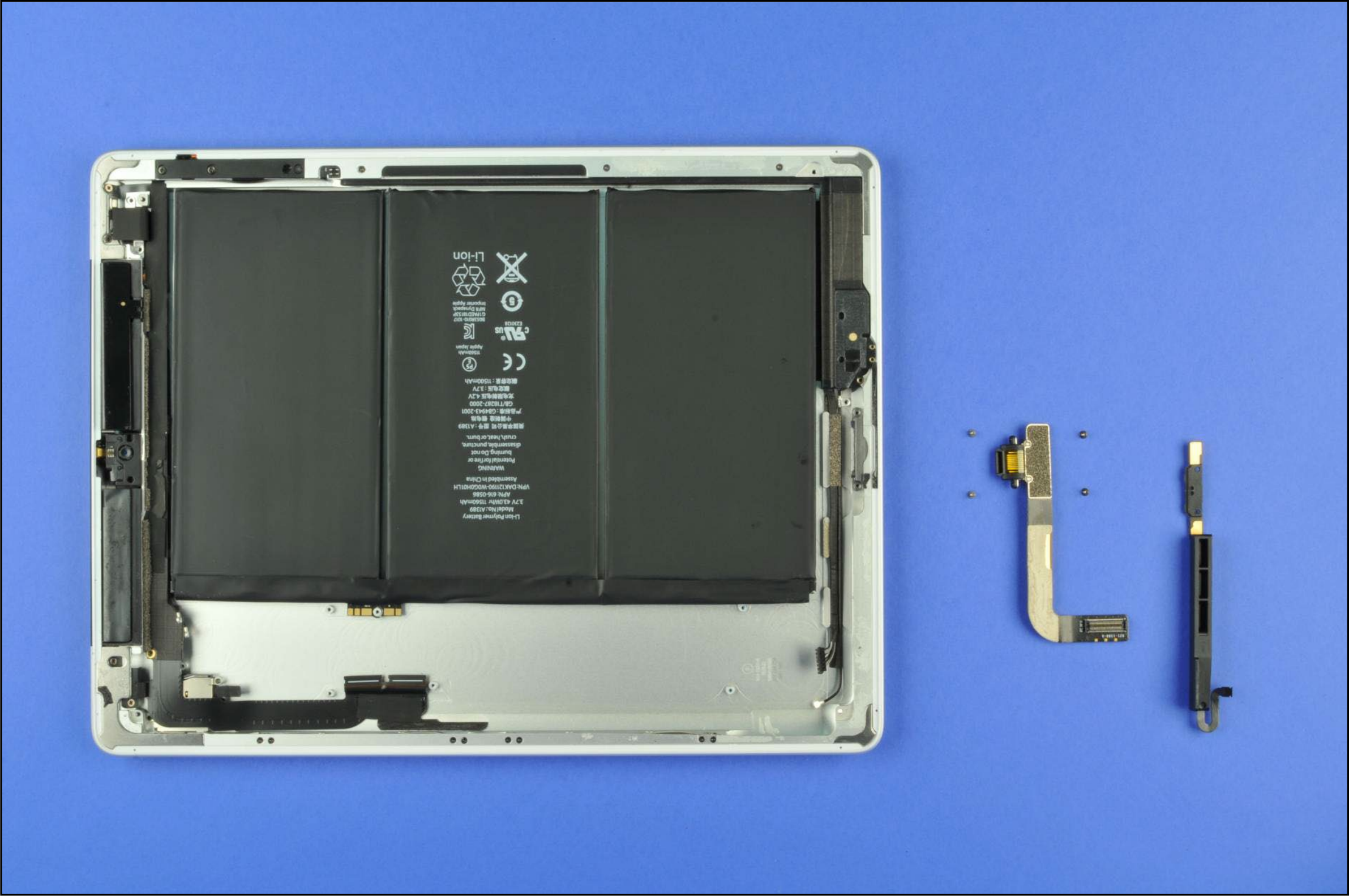
[Overview & Discussion](#)



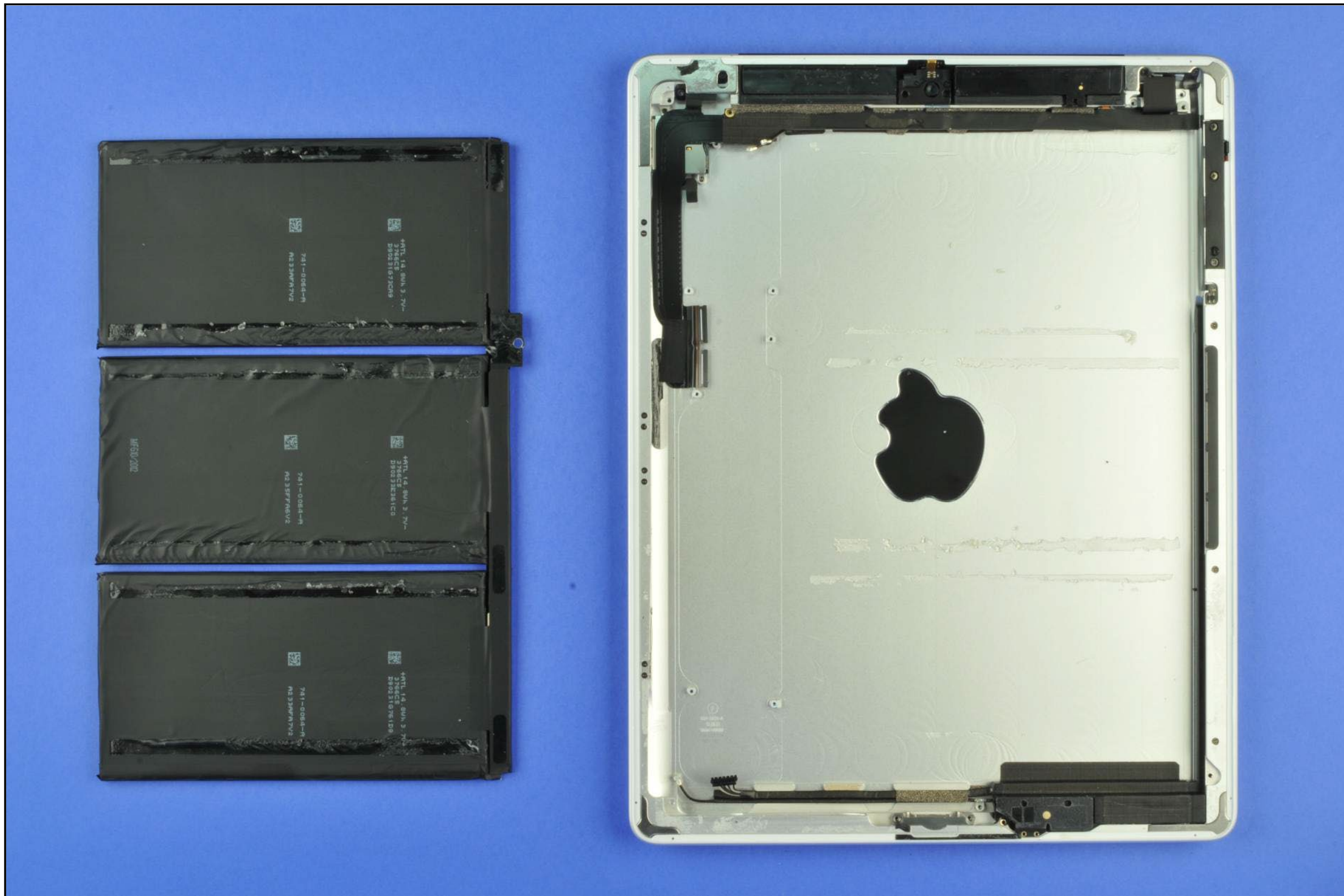








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Step 2

Step 3

Step 4

Step 5

Step 6

Step 7

Step 8

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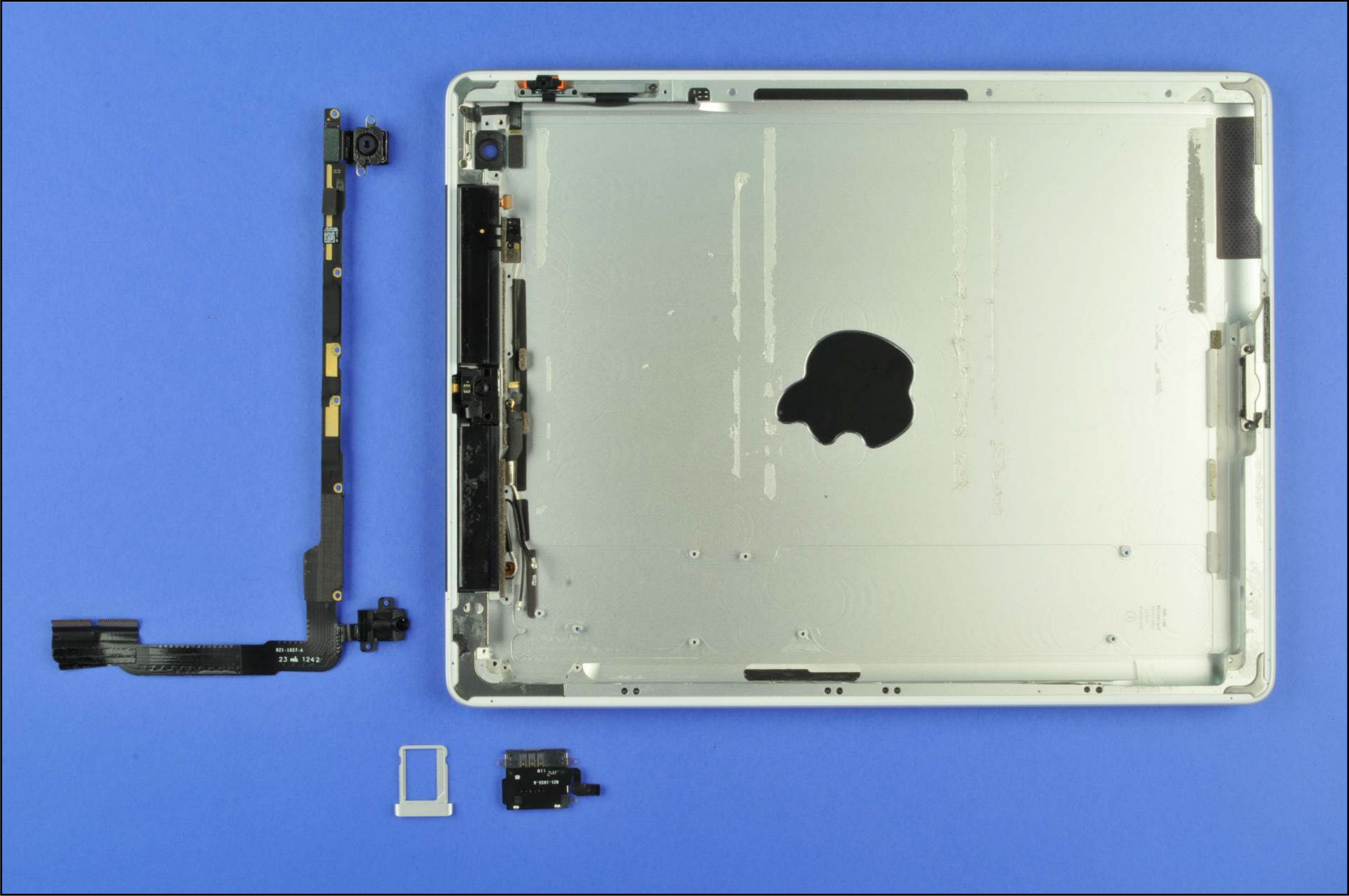
Subsystems

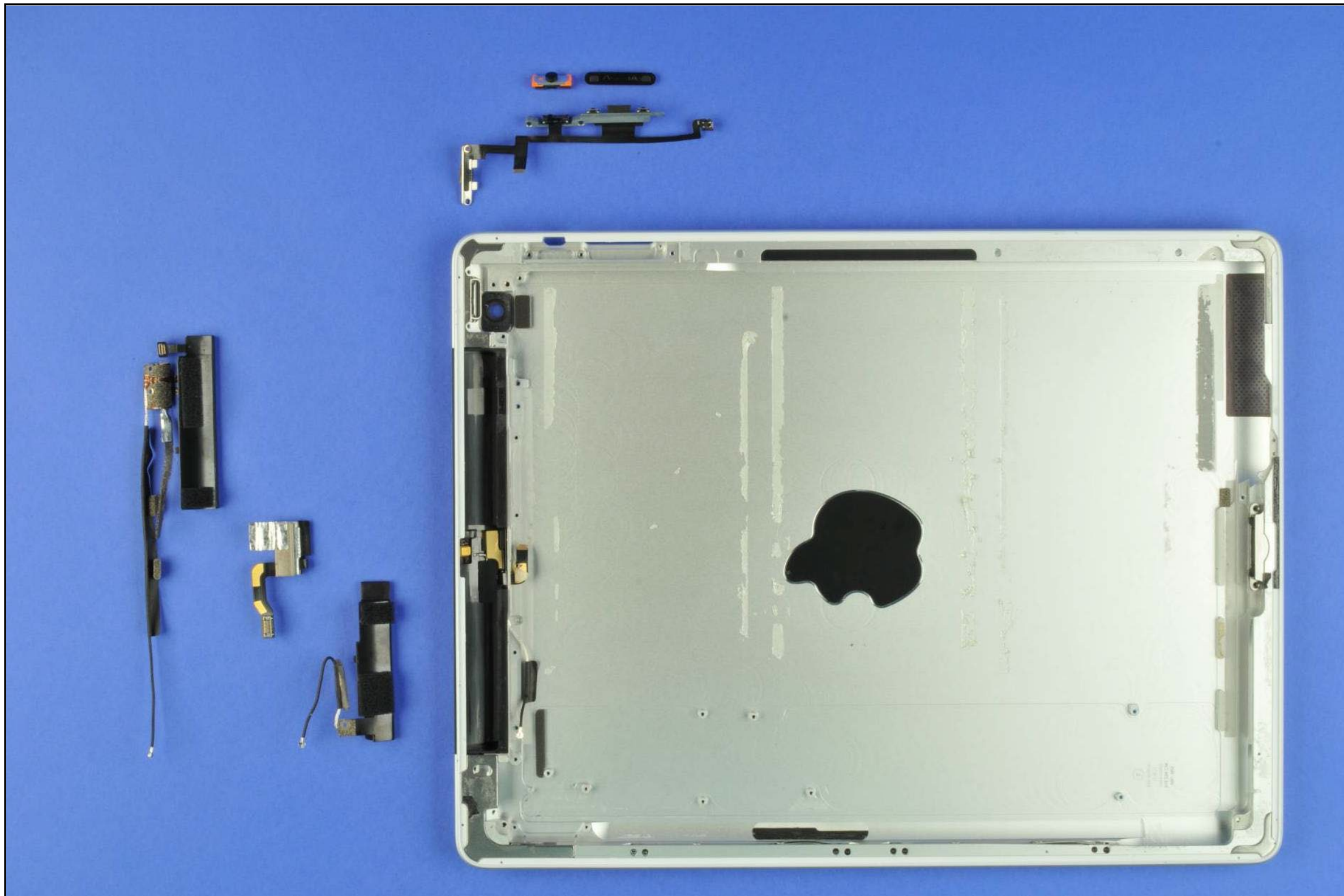
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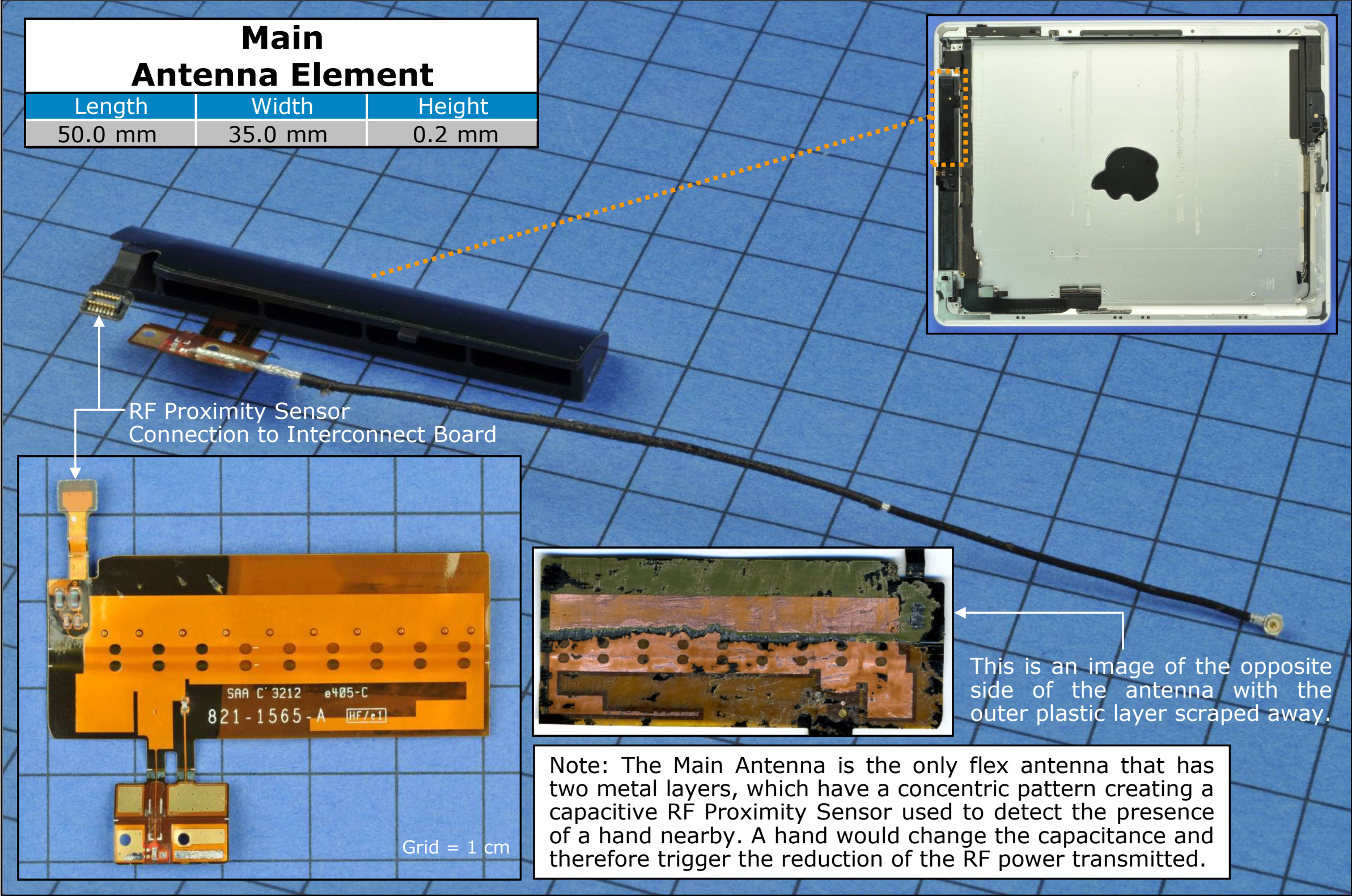
Subsystems

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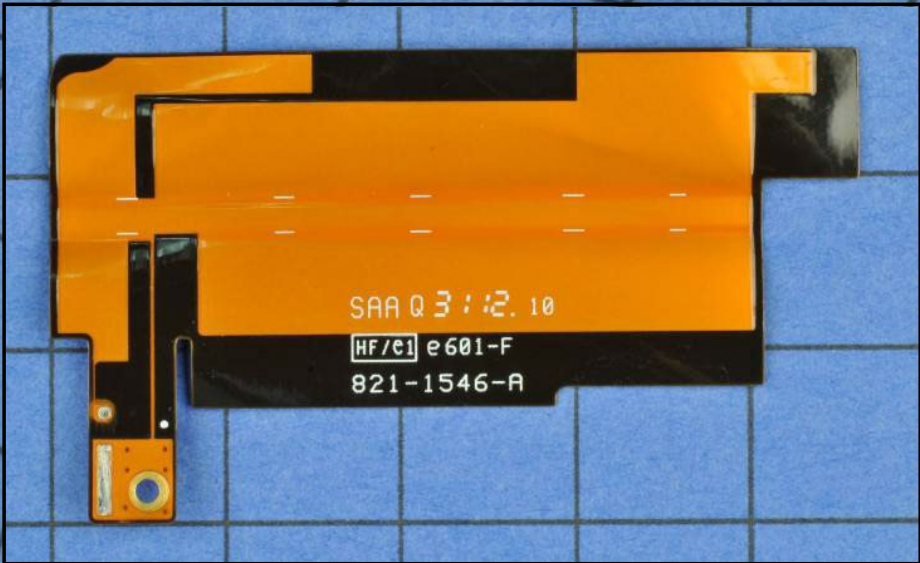
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Rx Diversity
Antenna Element

Length	Width	Height
20.5 mm	46.2 mm	0.2 mm



Grid = 1 cm

Main Antenna

Diversity Antenna

WiFi & Bluetooth Antenna

GPS Antenna

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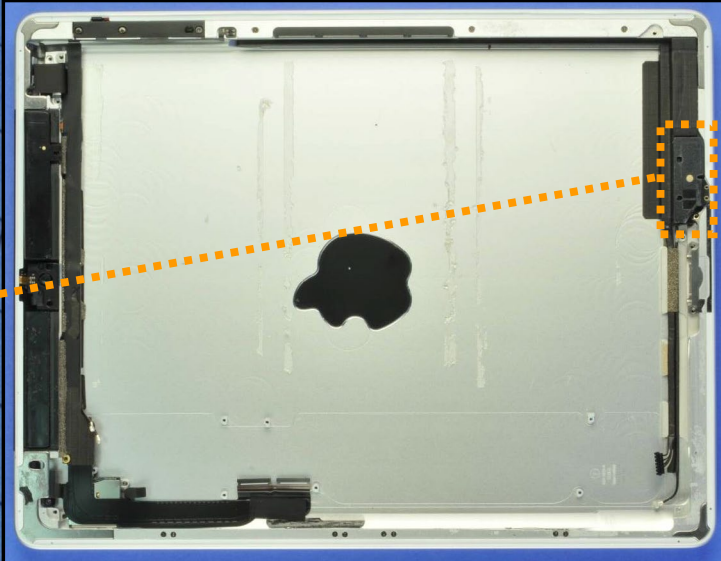
Other Substrates

Costs and Metrics

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WiFi/Bluetooth
Antenna Element

Length	Width	Height
30.0 mm	11.0 mm	0.2 mm



Grid = 1 cm

Main Antenna

Diversity Antenna

WiFi & Bluetooth Antenna

GPS Antenna

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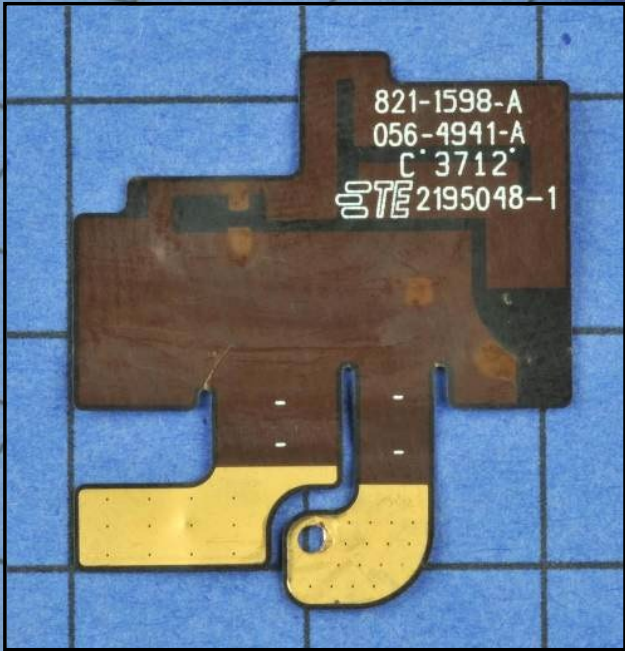
Other Substrates

Costs and Metrics

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GPS
Antenna Element

Length	Width	Height
21.4 mm	23.6 mm	0.2 mm



Grid = 1 cm

Main Antenna

Diversity Antenna

WiFi & Bluetooth Antenna

GPS Antenna

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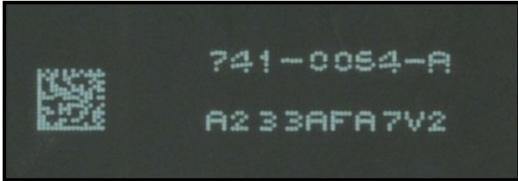
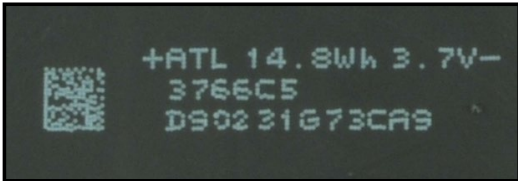
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Battery Pack

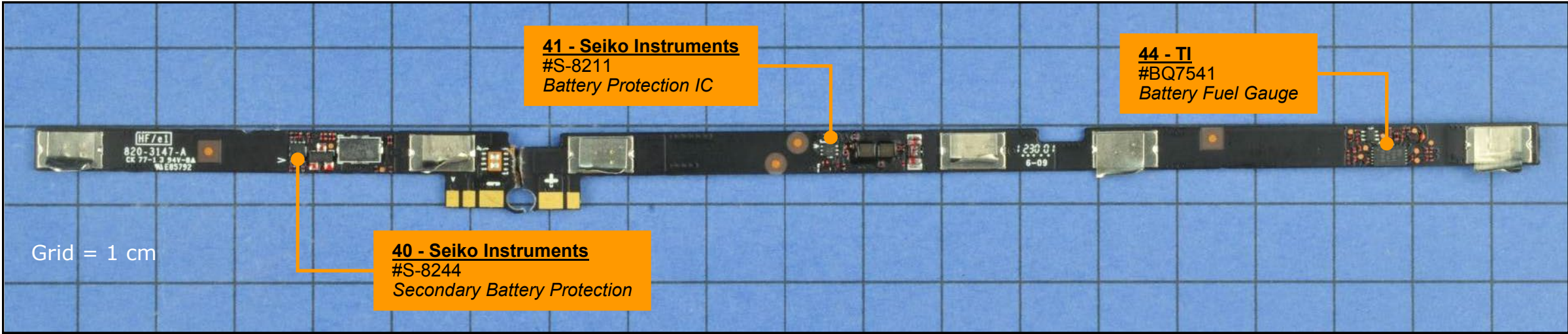
Battery

Camera

Display / Touchscreen

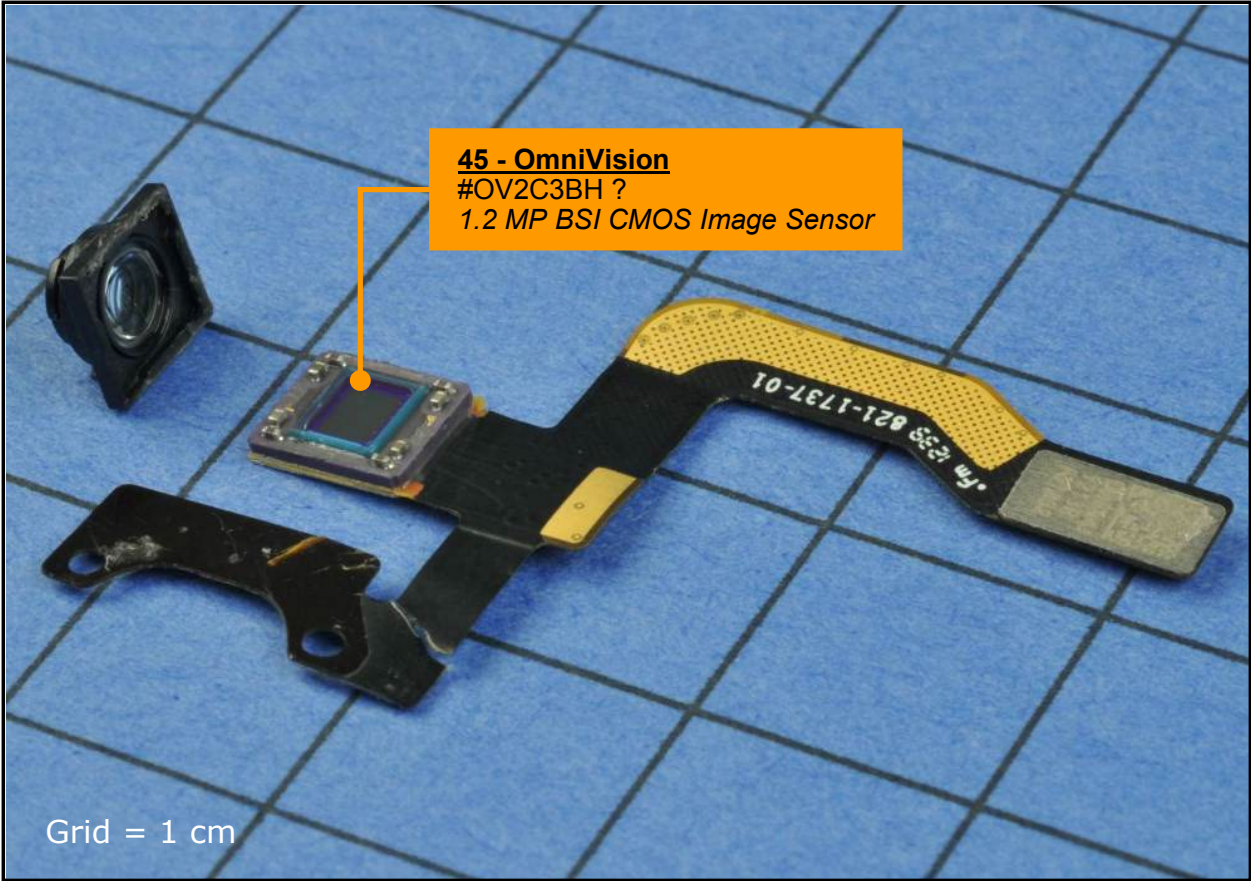


Battery Pack		
Pack Brand		Apple
Pack Part Number		A1389
Pack Voltage		3.7
Cell Type		Lithium Polymer
Pack Rating (mAhrs)		11560
Pack Size (mm)		198 x 126 x 4
Vol. Energy Density (mWHrs/cc)		428.6
Pack Weight (grams)		209.0
Wt. Energy Density (mWHrs/g)		204.7
Cell Brand		ATL
Estimated Costs	Cell(s)	\$11.76
	Electronic Parts	\$1.70
	Non-electronic Parts	\$0.09
	Assembly	\$0.54
	Test	\$0.10
	Markup	\$6.08
Estimated Pack Price		\$20.27





Secondary Camera		
Brand	Unknown	
Part Number	Unknown	
Subsystem Size (mm)	15.8 x 10.6 x 3.9	
Camera Size (mm)	15.8 x 10.6 x 3.7	
Subsystem Weight (grams)	0.6	
Camera Weight (grams)	0.5	
Type	CMOS	
Resolution	1 MP	
Optical Size	1/5	
Lens Elements	4	
Optical Zoom	1	
Estimated Costs	Electronic Parts	\$2.54
	Non-Electronic Parts	\$1.07
	Assembly	\$0.18
	Test	\$0.10
	Markup	\$1.67
Estimated Module Price		\$5.55

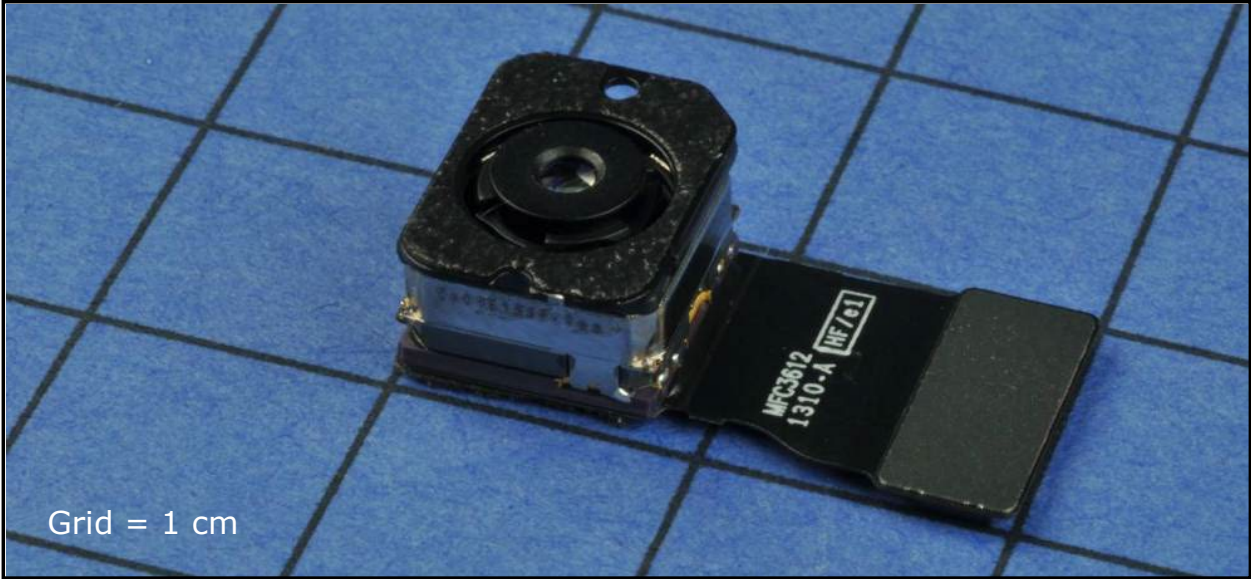


Front

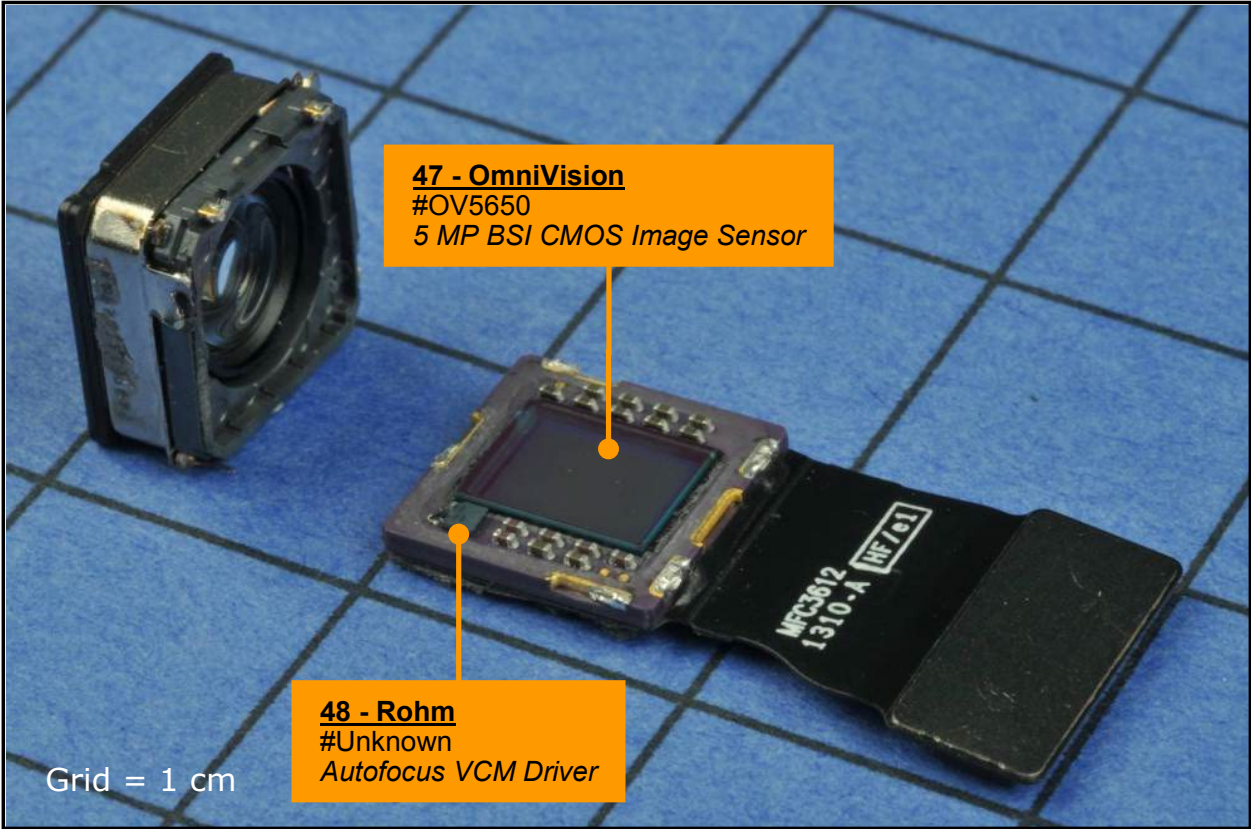
Battery

Camera

Display / Touchscreen



Main Camera		
Brand		Unknown
Part Number		MFC3612
Subsystem Size (mm)		8.6 x 8.5 x 5.3
Camera Size (mm)		8.5 x 8.5 x 6.8
Subsystem Weight (grams)		0.9
Camera Weight (grams)		1.4
Type		CMOS
Resolution		5 MP
Optical Size		1/3.2
Lens Elements		5
Optical Zoom		1
Estimated Costs	Electronic Parts	\$5.74
	Non-Electronic Parts	\$1.36
	Assembly	\$0.28
	Test	\$0.15
	Markup	\$3.23
Estimated Module Price		\$10.76



47 - OmniVision
#OV5650
5 MP BSI CMOS Image Sensor

48 - Rohm
#Unknown
Autofocus VCM Driver

Rear

Battery

Camera

Display / Touchscreen

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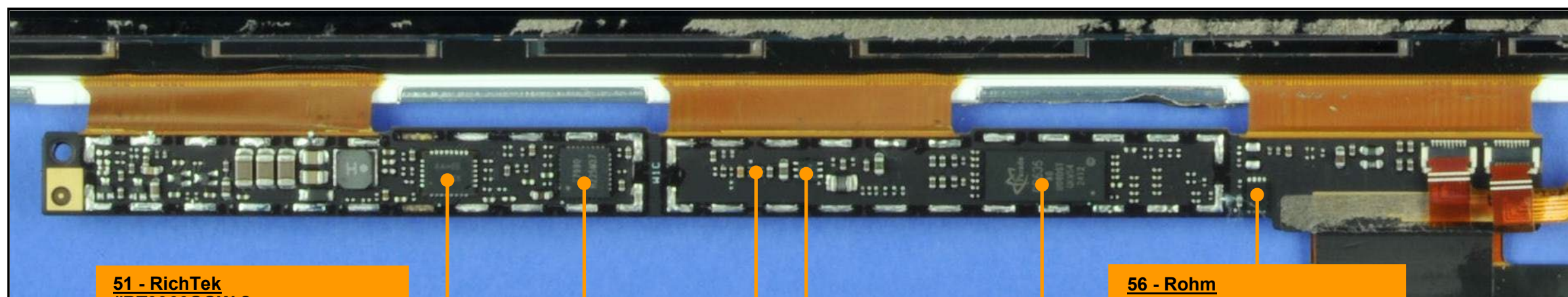
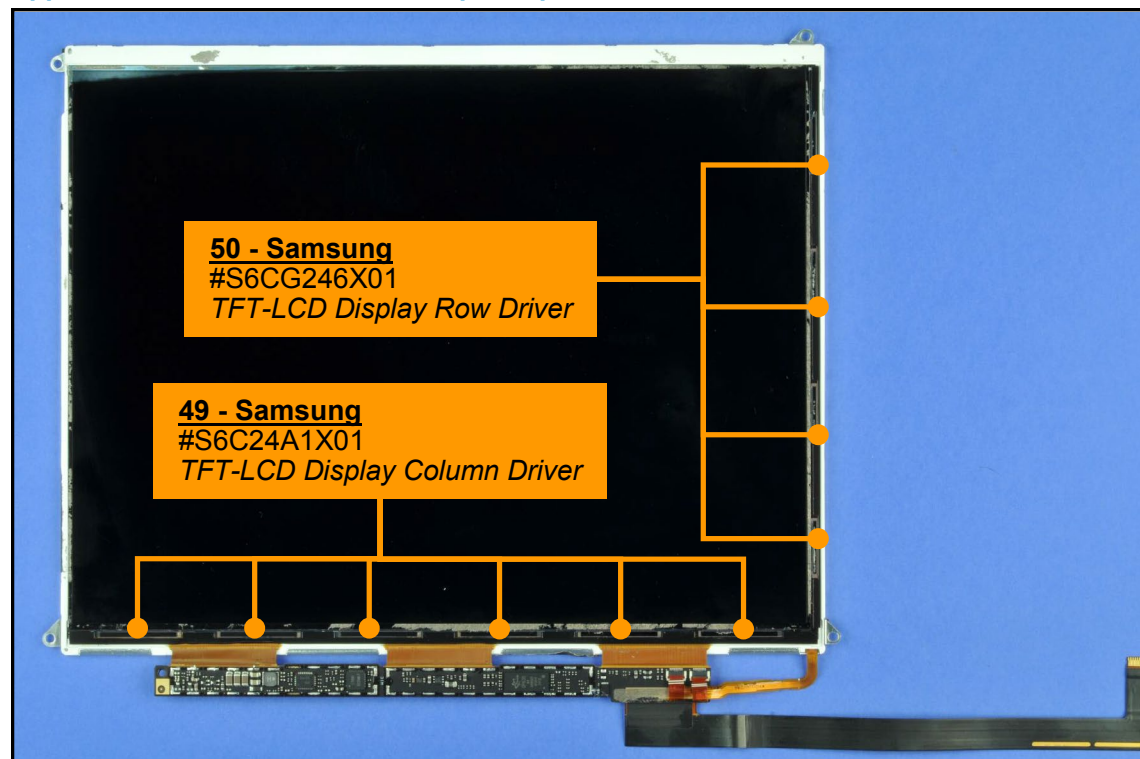
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51 - RichTek
#RT9966GQW ?
Power Management (3-Die Pkg.)

52 - Integrated Memory Logic
#iML7990
Programmable Gamma Buffer

54 - Ricoh
#RP111L071D
500 mA / 0.7 V LDO Regulator

56 - Rohm
#BR24T16-W
Serial EEPROM Memory - 2 KB

53 - Parade Technologies
#DP635
Display Port Timing Controller

55 - TI
#TPS62260
600 mA Step-Down DC-DC Converter

IC Identification

Estimated Cost

Battery

Camera

Display / Touchscreen

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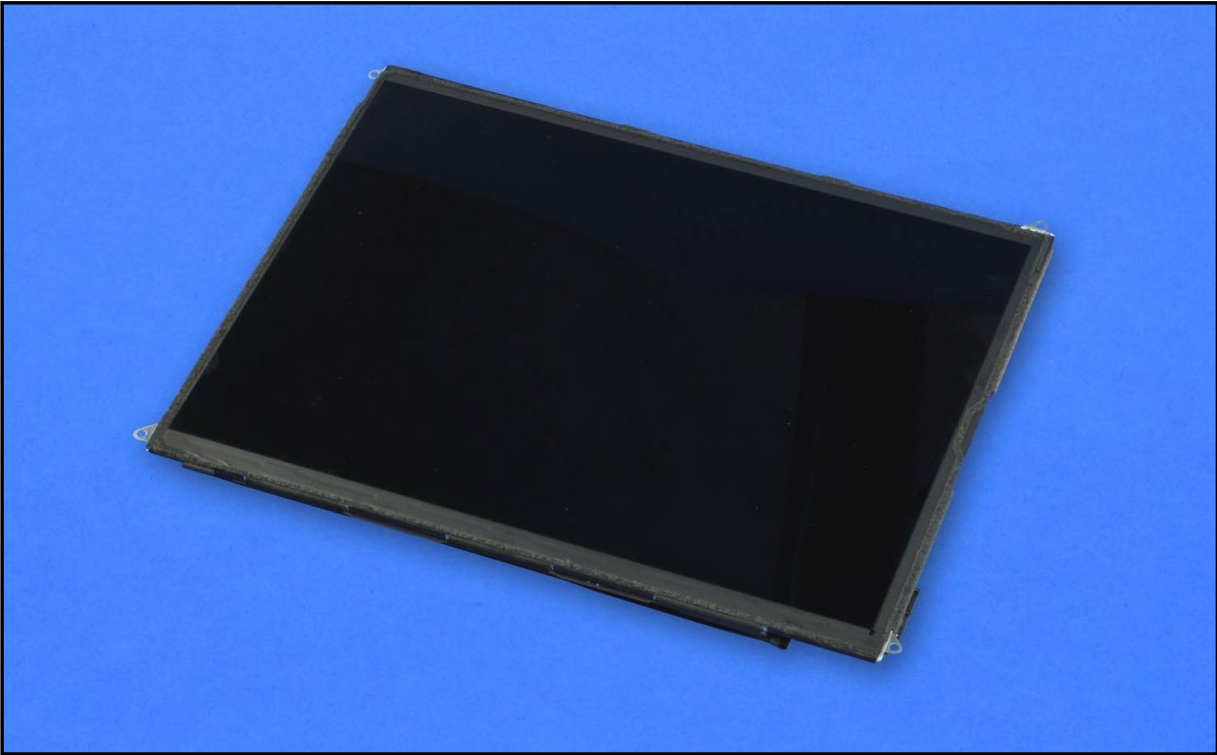
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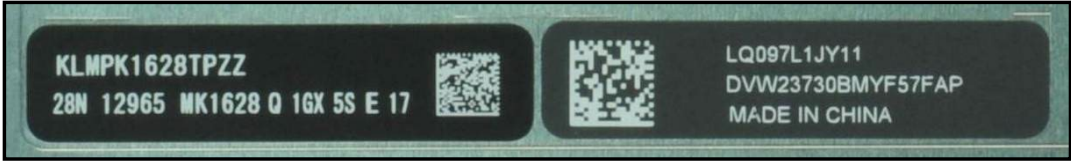
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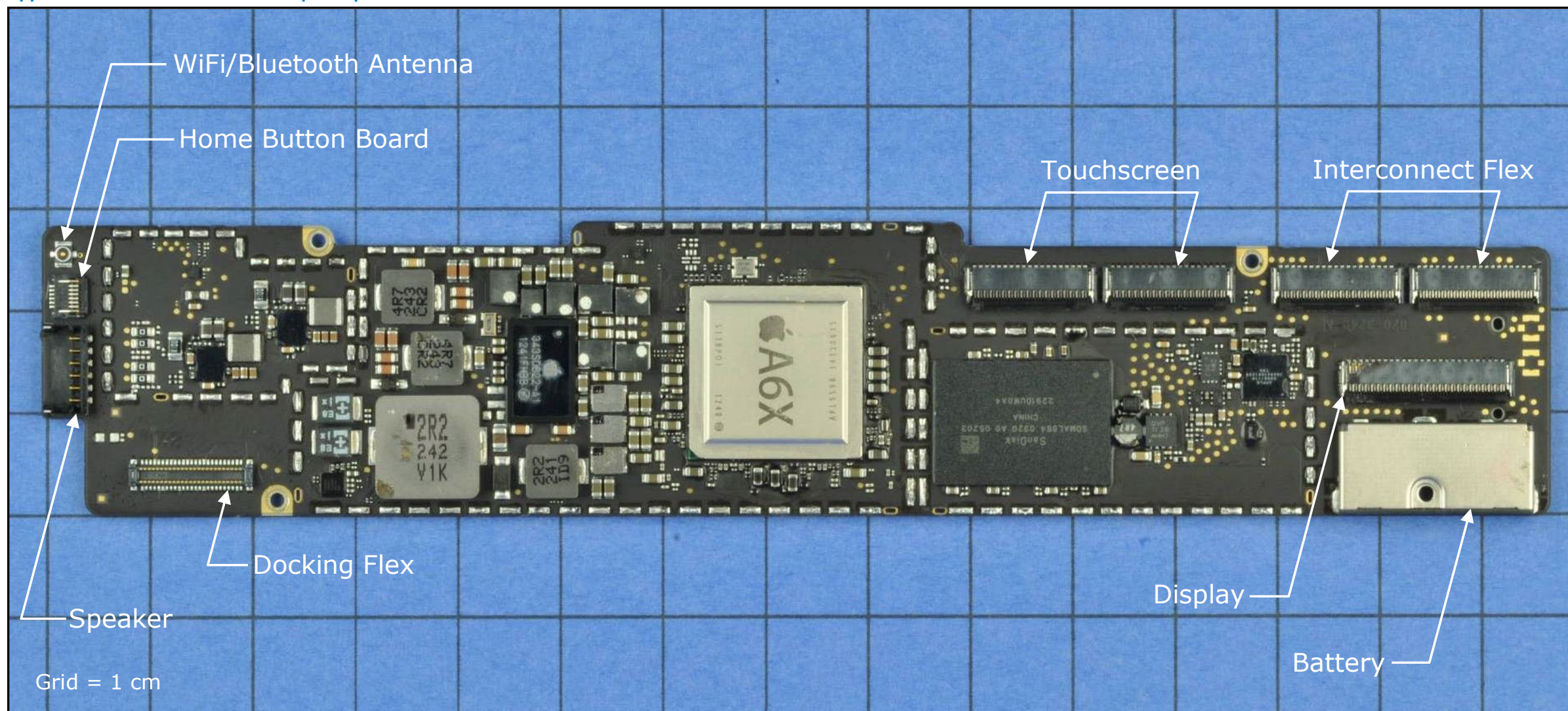
Display / Touchscreen Module		
Brand		Samsung
Part Number		LQ097L1JY11
Module Dimensions		238.2 x 182.7 x 3.69
Weight (grams)		240.60
Panel Metrics	View Size (mm)	197.104 x 147.828
	Type	TFT
	Colors	16777216
	Rows / Columns	1536 / 2048
	Backlighting Scheme	84 White LEDs
Estimated Costs	Panel(s)	\$12.12
	Electronic Parts	\$47.25
	Circuit Assembly	\$1.87
	Non-Electronic Parts	\$11.40
	Final Assembly	\$0.28
	Test	\$0.35
	Markup	\$39.57
Estimated Module Price		\$112.73



Note: The Display / Touchscreen cost includes the Cover Glass. The original report was posted with the Display and Touchscreen as separate subsystems; the Cover Glass was originally categorized as part of the Main Non-Electronics. The original overall cost will differ from this revised report.

Per today's teardown techniques we now group the Display, Touchscreen, and Cover Glass as one subsystem.

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Side 1

Side 1 IC Identification

Side 1 X-Ray & Die Photos

Side 2

Side 2 IC Identification

Side 2 X-Ray & Die Photos

Cross-Section

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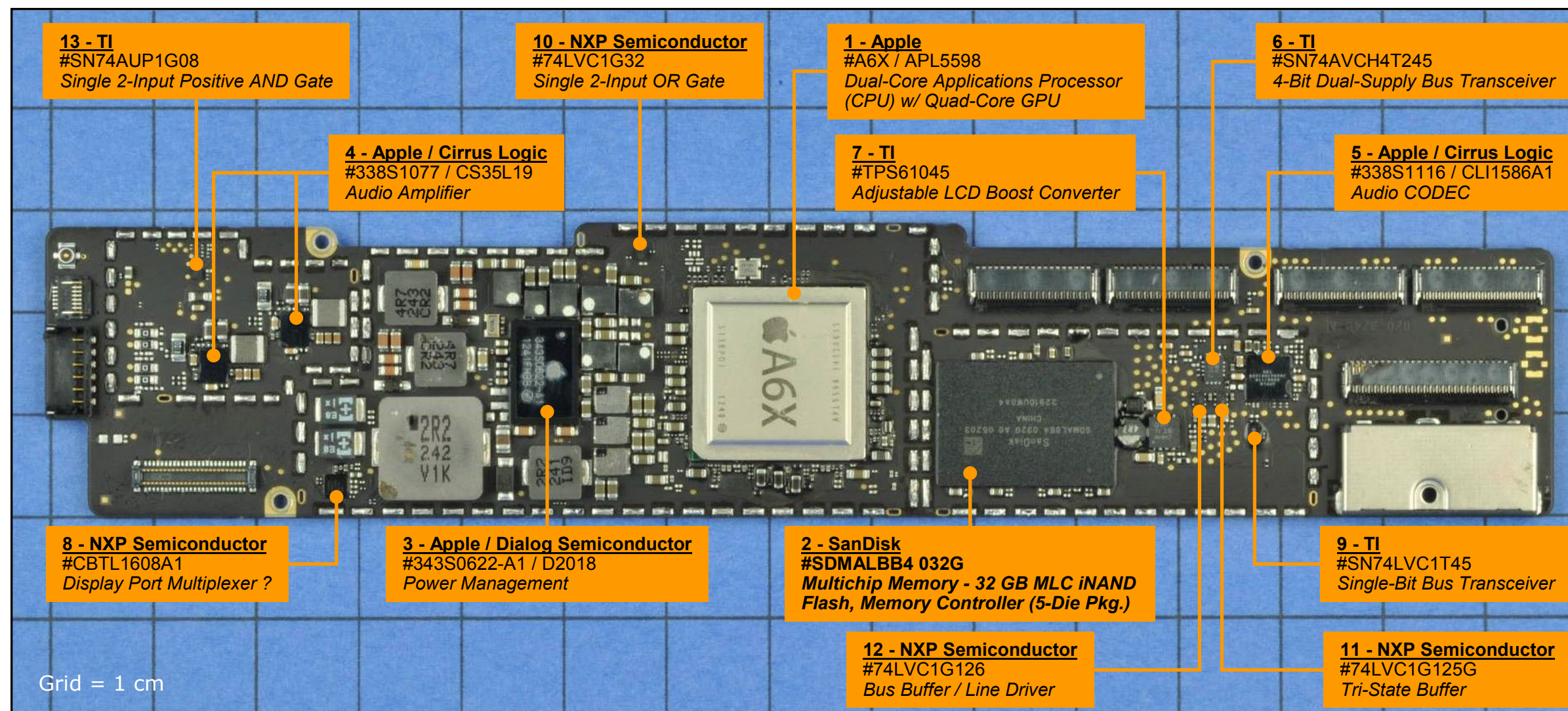
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Side 1 IC Identification

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Side 2 X-Ray & Die Photos

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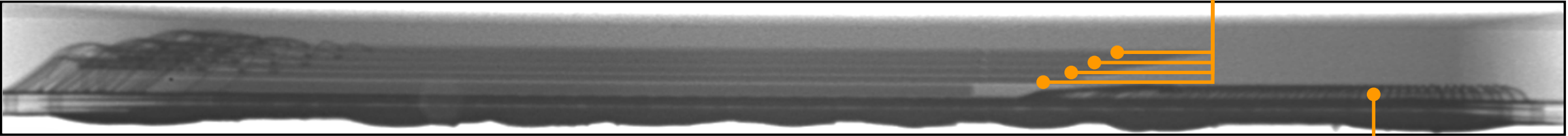
Other Substrates

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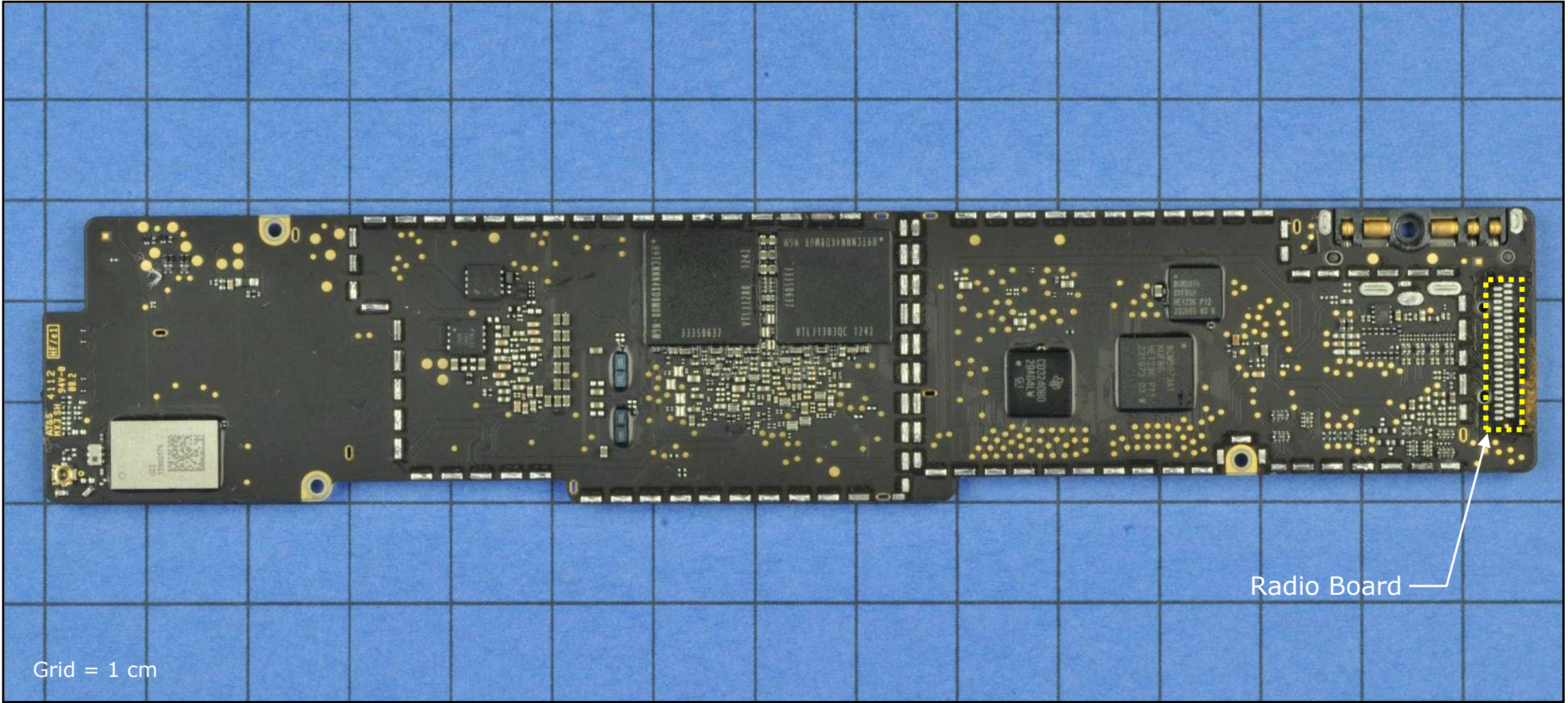
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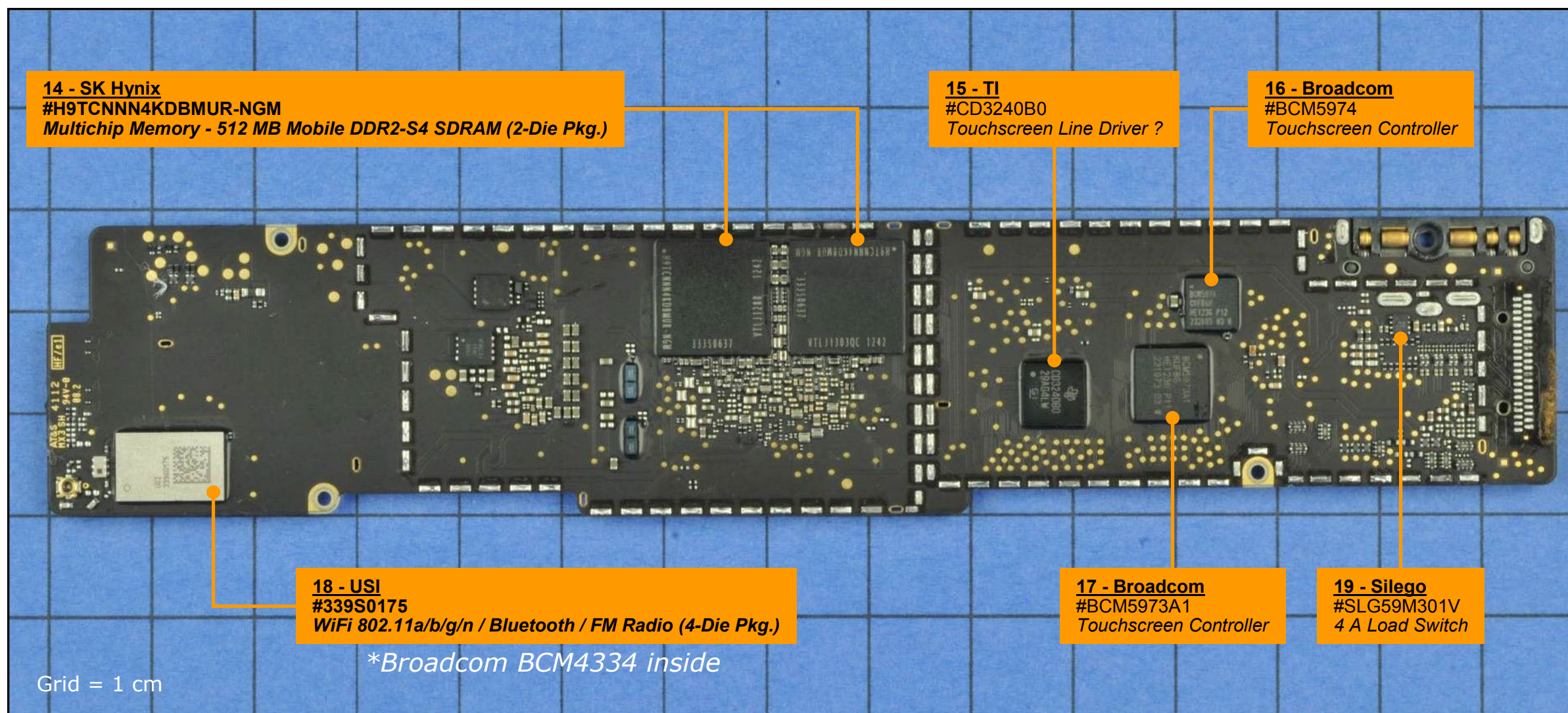
2 - SanDisk
#SDMALBB4 032G
Multichip Memory - 32 GB MLC iNAND Flash, Memory Controller (5-Die Pkg.)
Pkg Size: 17 x 12 mm

2.2 - SanDisk
#EHL9-64G
MLC iNAND Flash Memory - 8 GB
Die Size: 15.87 x 7.83 mm



2.1 - SanDisk
#ANOBIT
Memory Controller
Die Size: 5.6 x 2.81 mm





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Side 1 IC Identification

Side 1 X-Ray & Die Photos

Side 2

Side 2 IC Identification

Side 2 X-Ray & Die Photos

Cross-Section

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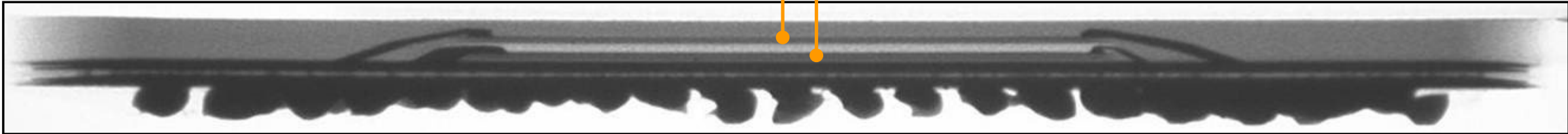
Other Substrates

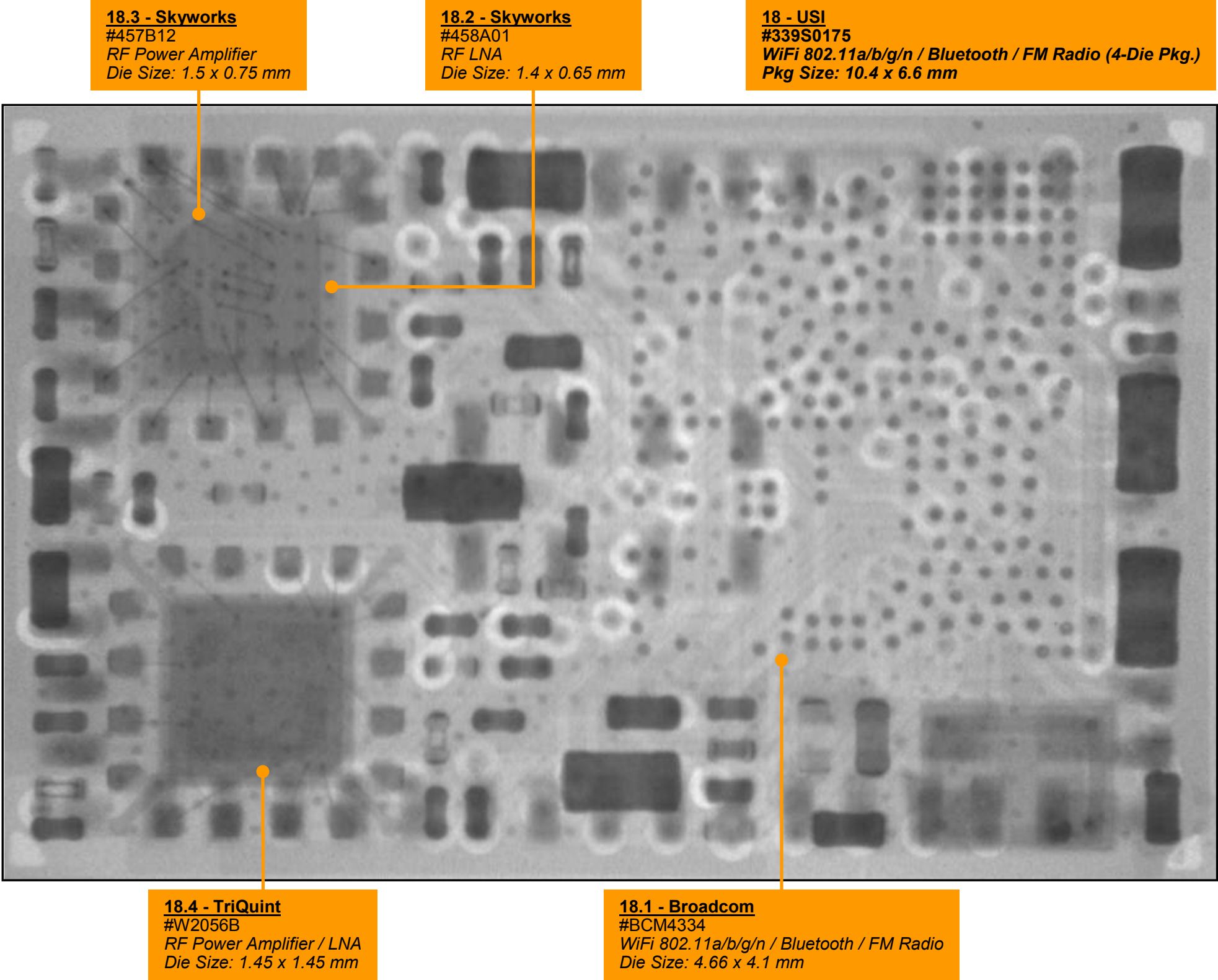
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14 - SK Hynix
#H9TCNNN4KDBMUR-NGM
Multichip Memory - 512 MB Mobile DDR2-S4 SDRAM (2-Die Pkg.)
Pkg Size: 11 x 11 mm

14.1 - SK Hynix
#H5LR2D23AFR
Mobile DDR2-S4 SDRAM Memory - 256 MB
Die Size: 7.75 x 4.94 mm

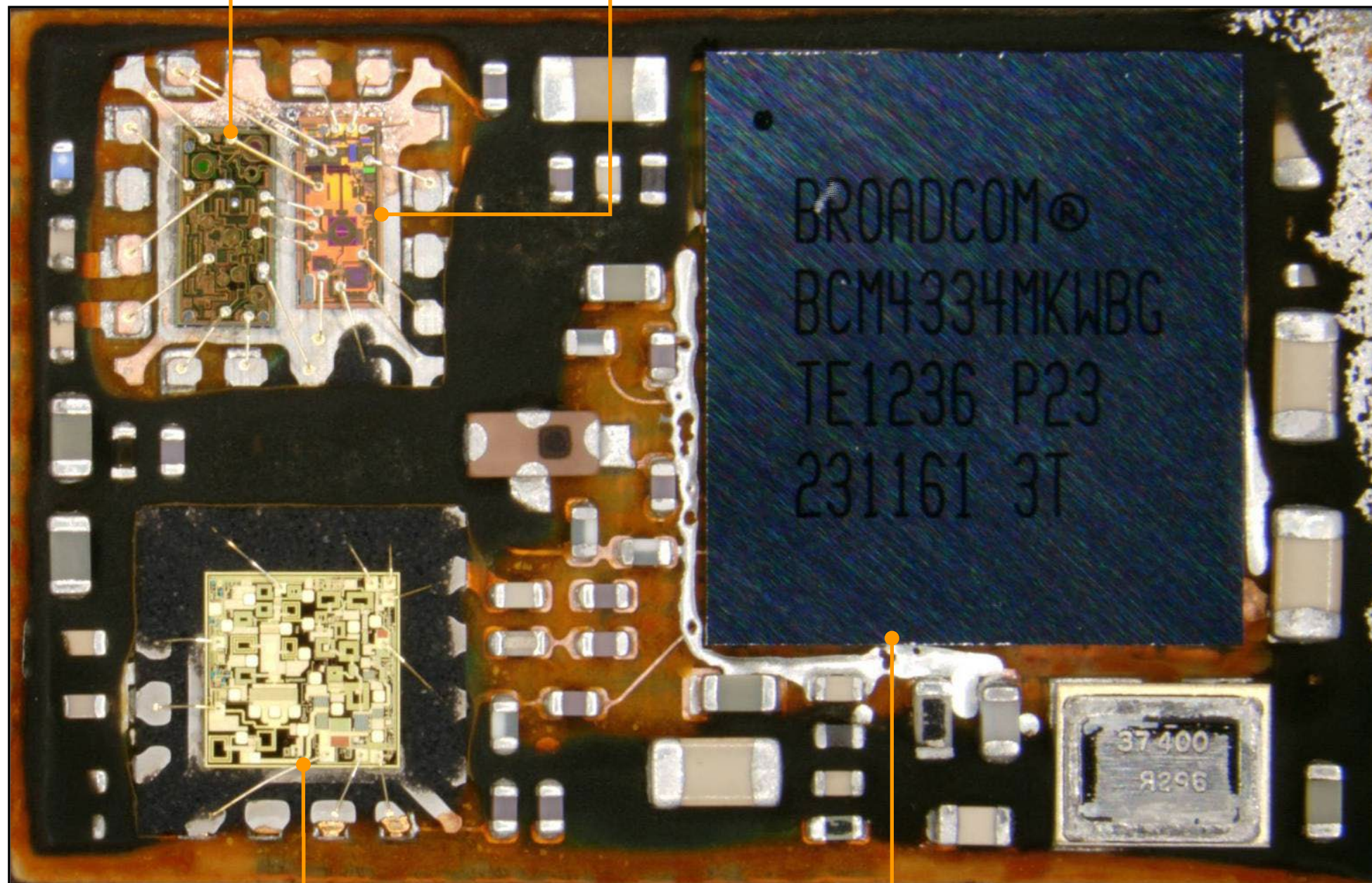




18.3 - Skyworks
#457B12
RF Power Amplifier
Die Size: 1.5 x 0.75 mm

18.2 - Skyworks
#458A01
RF LNA
Die Size: 1.4 x 0.65 mm

18 - USI
#339S0175
WiFi 802.11a/b/g/n / Bluetooth / FM Radio (4-Die Pkg.)
Pkg Size: 10.4 x 6.6 mm



18.4 - TriQuint
#W2056B
RF Power Amplifier / LNA
Die Size: 1.45 x 1.45 mm

18.1 - Broadcom
#BCM4334
WiFi 802.11a/b/g/n / Bluetooth / FM Radio
Die Size: 4.66 x 4.1 mm

Image 1

Image 2

Image 3

Side 1

Side 1 IC Identification

Side 1 X-Ray & Die Photos

Side 2

Side 2 IC Identification

Side 2 X-Ray & Die Photos

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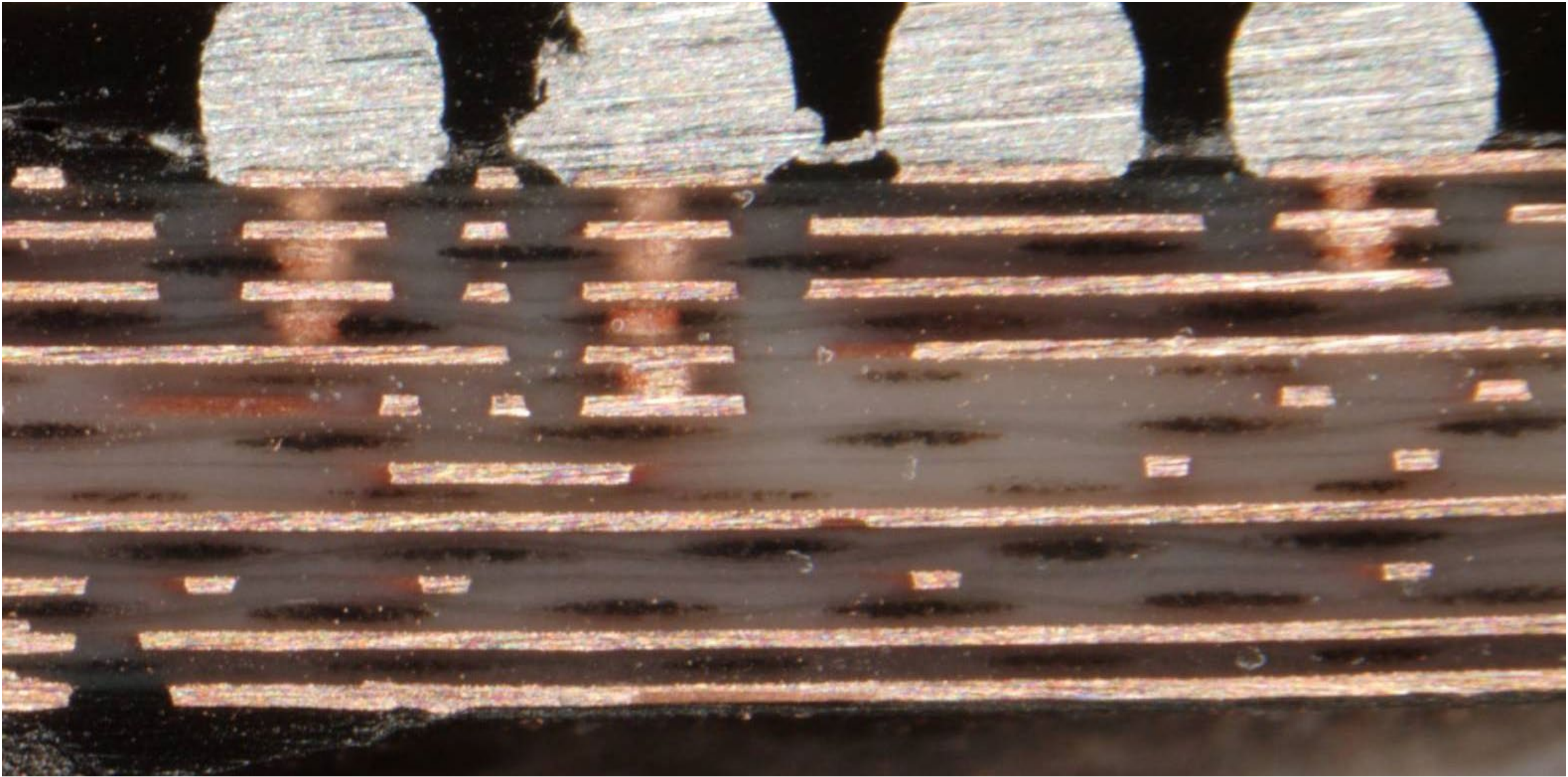
Subsystems

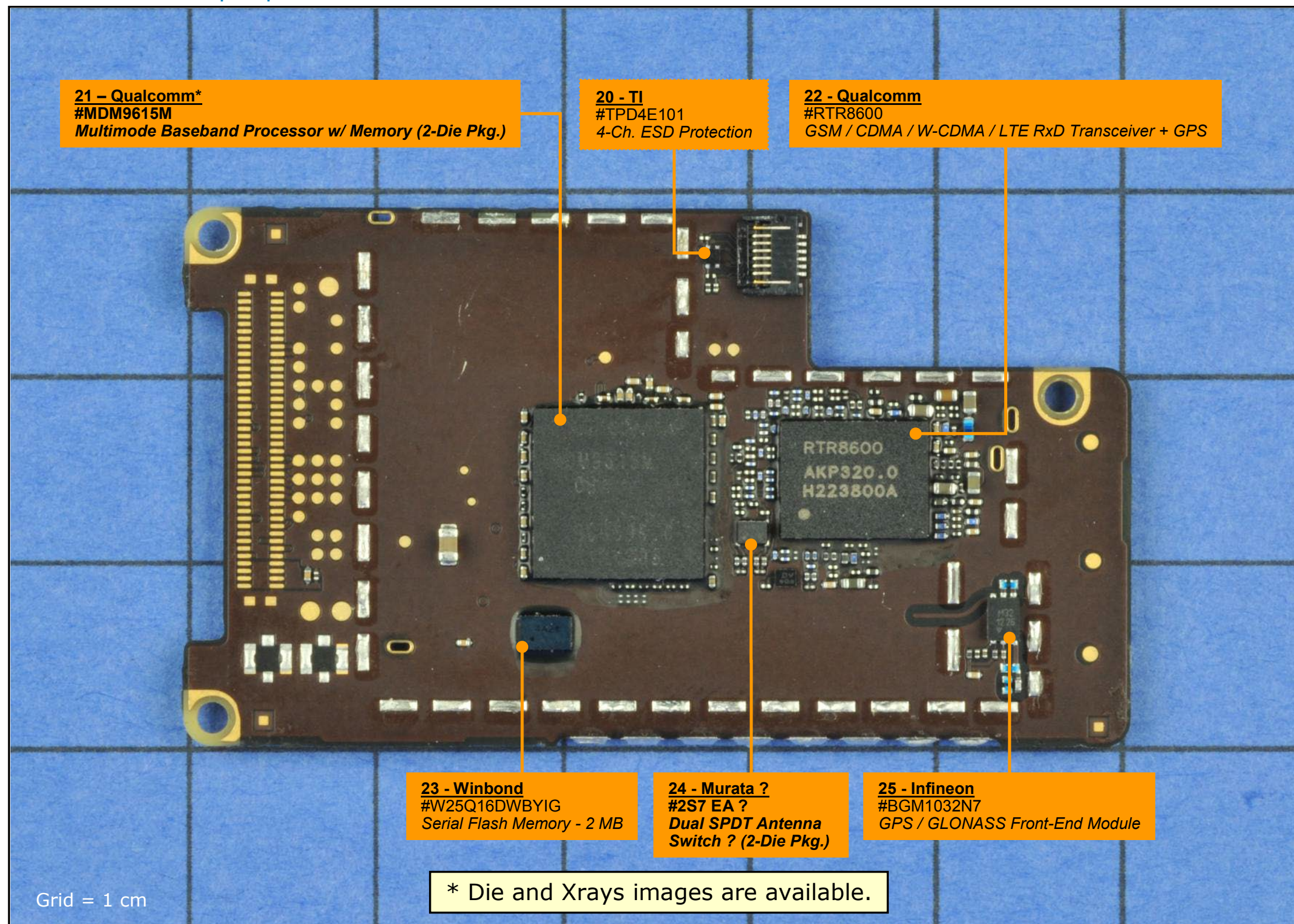
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Radio Board

Interconnect Board

Side Key Flex

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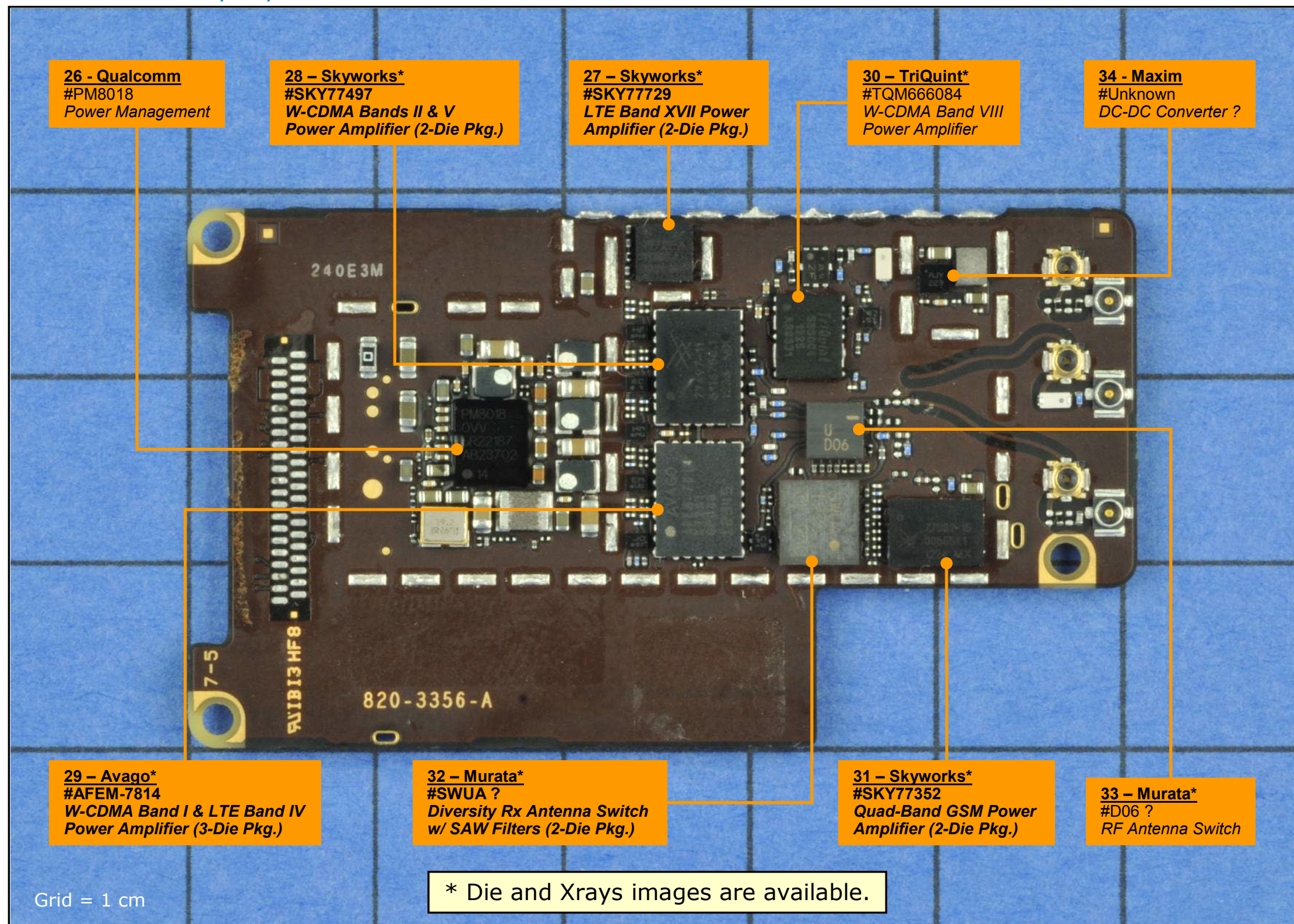
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Radio Board

Interconnect Board

Side Key Flex

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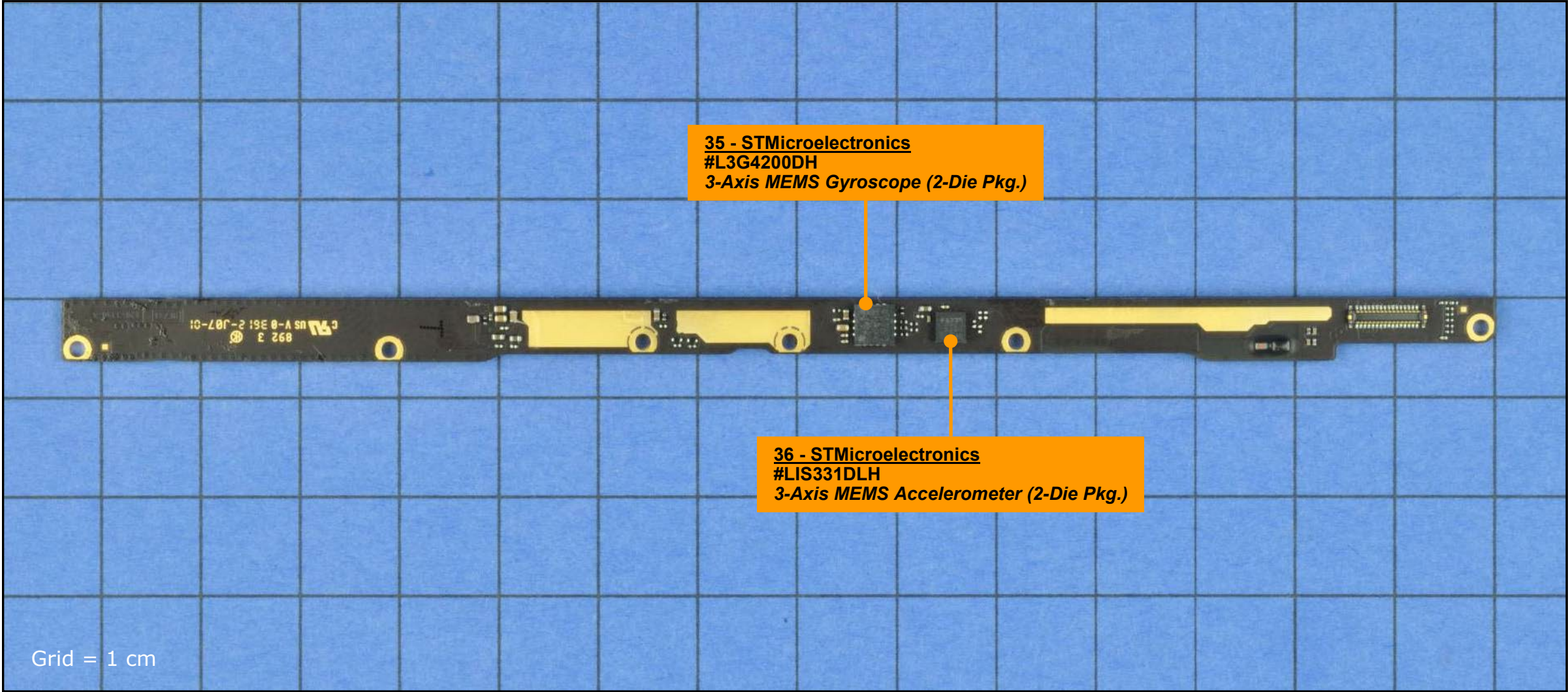
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Costs and Metrics

Overview & Discussion



Side 1

Radio Boad

Interconnect Board

Side Key Flex

Product Overview

Block Diagram

Product Packaging

Exterior Features

Major Components

Component Arrangement

Teardown

Antenna

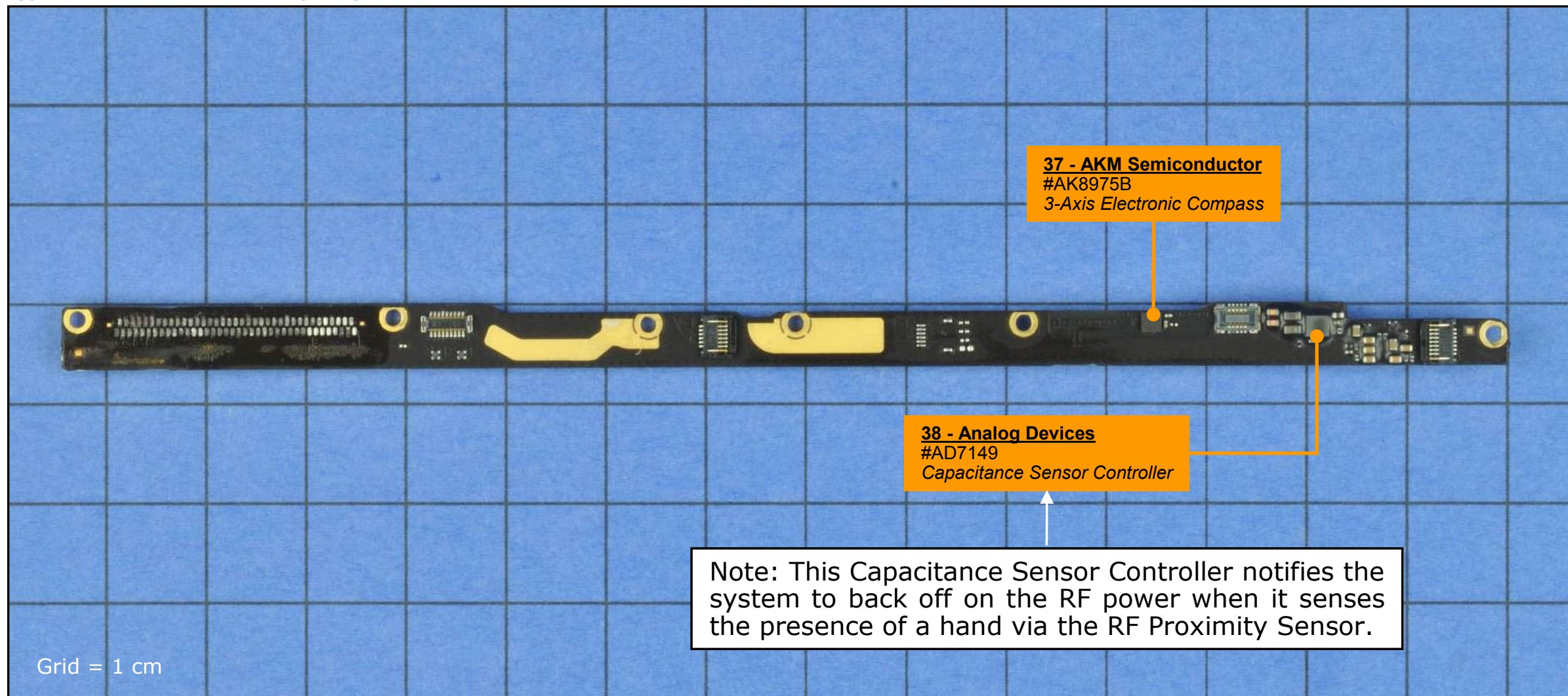
Subsystems

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Side 2

Radio Board

Interconnect Board

Side Key Flex

Product Overview

Block Diagram

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Exterior Features

Major Components

Component Arrangement

Teardown

Antenna

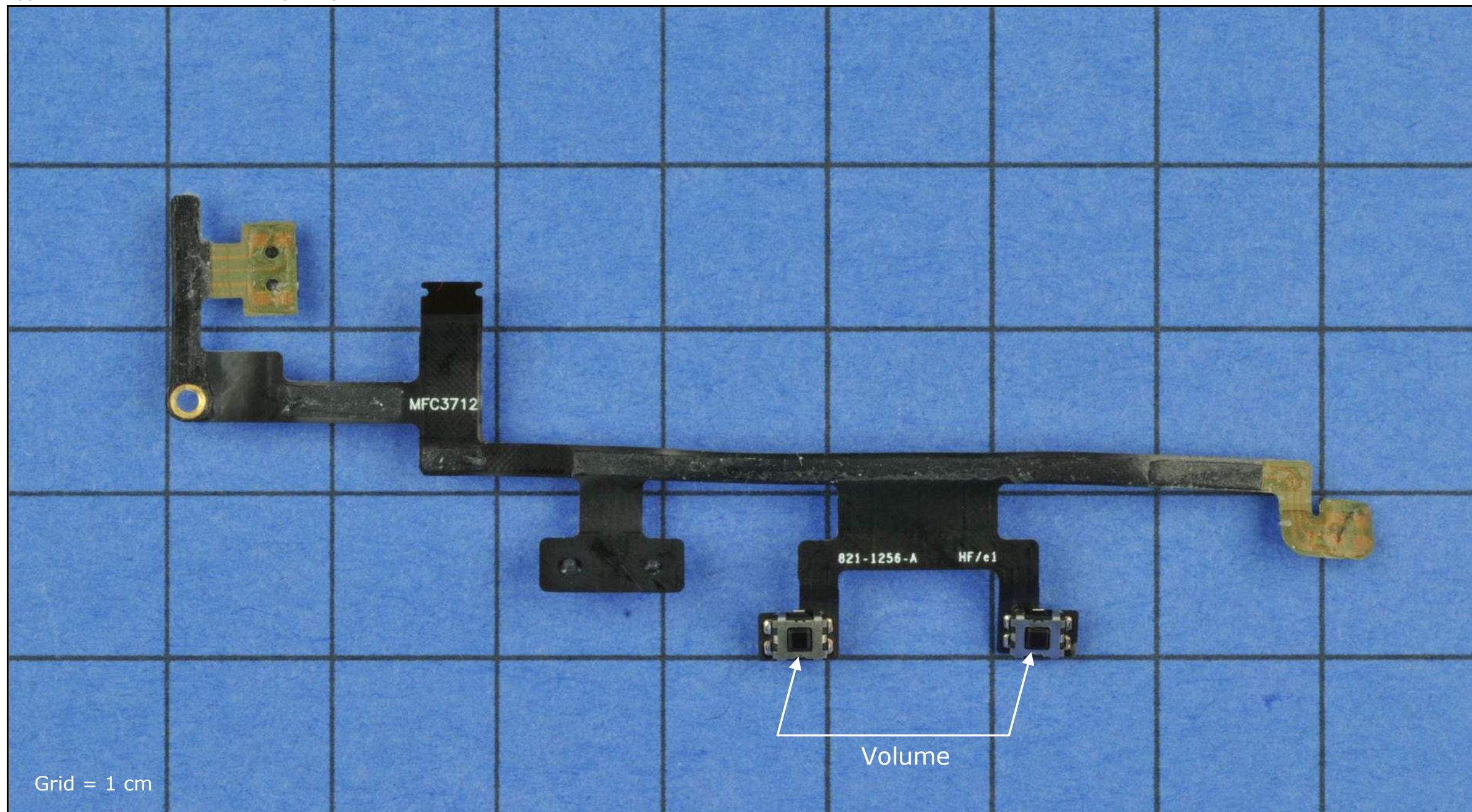
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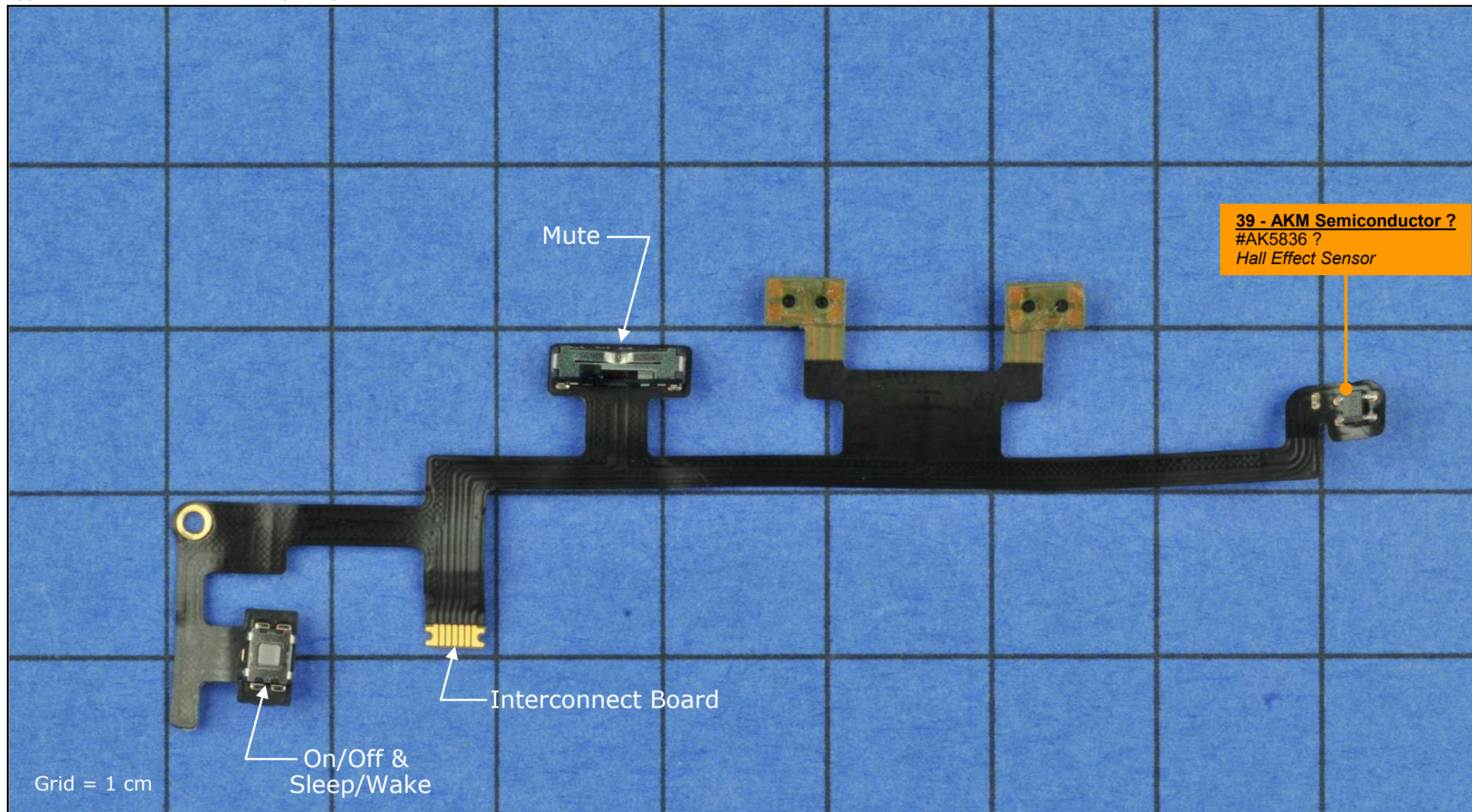
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Note: Additional Substrate images were made available in the original report.

Side 2

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Substrates														
Assembly Name	Manufacturer	Core Material	Mfg. Technology	Layers	Area (cm²)	Min. Trace Pitch (mm)	Min. Trace Width (mm)	ThruVia Land Dia (mm)	ThruVia Hole Dia (mm)	BlindVia Land Dia (mm)	BlindVia Hole Dia (mm)	Thickness (mm)	Routing Density	Estimated Costs
Docking Flex	Unknown	Polyimide	4 Layer flex w/vias	4	6.6	0.40	0.20	0.40	0.20			0.3	41.6	\$ 1.66
Home Button Board	Unknown	FR4	2 Layer conventional FR4 / HF	2	1.6	0.40	0.20	0.50	0.20			0.2	16.4	\$ 0.02
Interconnect Board	Multek Hong Kong	FR4	10 Layer buildup FR4 / HF	10	9.1	0.20	0.10	0.50	0.25	0.30	0.10	0.8	32.6	\$ 0.85
Interconnect Flex	Nippon Mektron	Polyimide	4 Layer flex w/vias	4	13.5	0.15	0.08	0.30	0.15			0.3	5.5	\$ 3.39
Main Board	AT&S	FR4	10 Layer buildup FR4 / HF	10	39.0	0.20	0.10	0.50	0.25	0.25	0.10	0.8	75.5	\$ 3.63
Microphone Flex	Unknown	Polyimide	2 Layer flex w/vias	3	1.8	0.15	0.08	0.30	0.10			0.2	12.0	\$ 0.37
Radio Board	Ibiden	FR4	10 Layer buildup FR4 / HF	10	13.0	0.15	0.08			0.25	0.10	0.7	69.3	\$ 1.21
Side Key Flex	Multi-Fineline Electronix	Polyimide	2 Layer flex w/vias	2	2.6	0.20	0.10	0.50	0.20			0.1	18.2	\$ 0.42
SIM Card Flex	Unknown	Polyimide	2 Layer flex w/vias	3	3.9	0.20	0.10	0.50	0.25			0.2	9.2	\$ 0.81

Deep Dive Teardown

Apple iPad 4 LTE A1459 32 GB Sample Report

Location	Package Info										Die Info							Estimated Costs	
	Pkg Ref. #	Pkg Qty	Brand Name	Part Number	Pkg Description	Form	Pin Count	Length (mm)	Width (mm)	Height (mm)	Die Ref #	Die Qty	Brand Name	Part Number	Description	Length (mm)	Width (mm)	Each	Total
Main Board, Side 1	1	1	Apple	A6X / APL5598	Dual-Core Applications Processor (CPU) w/ Quad-Core GPU	BGA (UF)	1089	16.90	16.90	1.20	1.1	1	Apple	A6X / APL5598	Dual-Core Applications Processor (CPU) w/ Quad-Core GPU	12.30	10.80	\$ 39.540	\$ 39.540
	2	1	SanDisk	SDMALBB4 032G	Multichip Memory - 32 GB MLC iNAND Flash, Memory Controller	BGA Stacked 5 (UF)	60	17.00	12.00	1.06	2.1	1	SanDisk	ANOBIT	Memory Controller	5.60	2.81	\$ 0.950	\$ 0.950
											2.2	4	SanDisk	EHL9-64G	MLC iNAND Flash Memory - 8 GB	15.87	7.83	\$ 3.510	\$ 14.040
	3	1	Apple	343S0622-A1 / D2018	Power Management	Flip Chip, Solder (UF)	296	8.94	5.55	1.10	3.1	1	Dialog Semiconductor	343S0622-A1 / D2018	Power Management	8.94	5.55	\$ 3.320	\$ 3.320
	4	2	Apple	338S1077 / CS35L19	Audio Amplifier	Flip Chip, Solder (UF)	42	3.20	2.73	0.80	4.1	1	Cirrus Logic	338S1077 / CS35L19	Audio Amplifier	3.20	2.73	\$ 0.600	\$ 1.200
	5	1	Apple	338S1116 / CL11586A1	Audio CODEC	Flip Chip, Solder (UF)	100	4.30	4.30	0.80	5.1	1	Cirrus Logic	338S1116 / CL11586A1	Audio CODEC	4.30	4.30	\$ 1.510	\$ 1.510
	6	1	TI	SN74AVCH4T245	4-Bit Dual-Supply Bus Transceiver	QFN	16	2.60	1.80	0.90	6.1	1	TI	SN74AVCH4T245	4-Bit Dual-Supply Bus Transceiver	1.28	1.15	\$ 0.160	\$ 0.160
	7	1	TI	TPS61045	Adjustable LCD Boost Converter	DFN	8	3.00	3.00	1.10	7.1	1	TI	TPS61045	Adjustable LCD Boost Converter	1.41	1.17	\$ 0.140	\$ 0.140
	8	1	NXP Semiconductor	CBTL1608A1	Display Port Multiplexer ?	Flip Chip, Solder (UF)	36	2.10	2.09	0.80	8.1	1	NXP Semiconductor	CBTL1608A1	Display Port Multiplexer ?	2.10	2.09	\$ 0.330	\$ 0.330
	9	1	TI	SN74LVC1T45	Single-Bit Bus Transceiver	Flip Chip, Solder (UF)	6	1.40	0.91	0.90	9.1	1	TI	SN74LVC1T45	Single-Bit Bus Transceiver	1.40	0.91	\$ 0.100	\$ 0.100
	10	1	NXP Semiconductor	74LVC1G32	Single 2-Input OR Gate	DFN	6	1.00	1.00	0.90	10.1	1	NXP Semiconductor	74LVC1G32	Single 2-Input OR Gate	0.51	0.34	\$ 0.040	\$ 0.040
	11	1	NXP Semiconductor	74LVC1G125G	Tri-State Buffer	DFN	6	1.40	1.00	0.90	11.1	1	NXP Semiconductor	74LVC1G125G	Tri-State Buffer	0.56	0.38	\$ 0.040	\$ 0.040
	12	1	NXP Semiconductor	74LVC1G126	Bus Buffer / Line Driver	DFN	6	1.40	1.00	0.90	12.1	1	NXP Semiconductor	74LVC1G126	Bus Buffer / Line Driver	0.56	0.38	\$ 0.040	\$ 0.040
	13	1	TI	SN74AUP1G08	Single 2-Input Positive AND Gate	BGA	6	1.00	1.00	0.90	13.1	1	TI	SN74AUP1G08	Single 2-Input Positive AND Gate	0.56	0.38	\$ 0.040	\$ 0.040
Main Board, Side 2	14	2	SK Hynix	H9TCNNN4KDBMUR-NGM	Multichip Memory - 512 MB Mobile DDR2-S4 SDRAM	BGA Stacked 2 (UF)	225	11.00	11.00	0.70	14.1	2	SK Hynix	H5LR2D23AFR	Mobile DDR2-S4 SDRAM Memory - 256 MB	7.75	4.94	\$ 1.210	\$ 4.840
	15	1	TI	CD3240B0	Touchscreen Line Driver ?	BGA (UF)	121	6.00	6.00	0.50	15.1	1	TI	CD3240B0	Touchscreen Line Driver ?	3.25	3.19	\$ 1.080	\$ 1.080
	16	1	Broadcom	BCM5974	Touchscreen Controller	BGA (UF)	81	5.00	5.00	0.57	16.1	1	Broadcom	BCM5974	Touchscreen Controller	3.25	3.19	\$ 1.230	\$ 1.230
	17	1	Broadcom	BCM5973A1	Touchscreen Controller	BGA (UF)	119	7.00	7.00	0.56	17.1	1	Broadcom	BCM5973A1	Touchscreen Controller	4.83	4.34	\$ 2.180	\$ 2.180
	18	1	USI	339S0175	WiFi 802.11a/b/g/n / Bluetooth / FM Radio	MCP - 4 Chips (UF)	52	10.40	6.60	0.75	18.1	1	Broadcom	BCM4334	WiFi 802.11a/b/g/n / Bluetooth / FM Radio	4.66	4.10	\$ 3.960	\$ 3.960
											18.2	1	Skyworks	458A01	RF LNA	1.40	0.65	\$ 0.200	\$ 0.200
											18.3	1	Skyworks	457B12	RF Power Amplifier	1.50	0.75	\$ 0.260	\$ 0.260
											18.4	1	TriQuint	W2056B	RF Power Amplifier / LNA	1.45	1.45	\$ 0.460	\$ 0.460
	19	1	Silego	SLG59M301V	4 A Load Switch	DFN	8	2.00	1.50	1.10	19.1	1	Silego	SLG59M301V	4 A Load Switch	1.59	0.98	\$ 0.120	\$ 0.120
Radio Board, Side 1	20	1	TI	TPD4E101	4-Ch. ESD Protection	DFN	4	0.80	0.80	0.35	20.1	1	TI	TPD4E101	4-Ch. ESD Protection	0.35	0.35	\$ 0.030	\$ 0.030
	21	1	Qualcomm	MDM9615M	Multimode Baseband Processor w/ Memory	BGA Stacked 2 (UF)	383	9.00	9.00	0.95	21.1	1	Micron	M100ACD ?	Mobile DDR SDRAM Memory - 128 MB ?	7.57	3.66	\$ 0.780	\$ 0.780
											21.2	1	Qualcomm	HG11-N3877	Multimode Baseband Processor	7.28	5.80	\$ 21.490	\$ 21.490
	22	1	Qualcomm	RTR8600	GSM / CDMA / W-CDMA / LTE Rx/D Transceiver + GPS	BGA (UF)	196	7.80	6.20	0.90	22.1	1	Qualcomm	HG11-VF535-220	GSM / CDMA / W-CDMA / LTE Rx/D Transceiver + GPS	6.59	3.99	\$ 3.910	\$ 3.910
	23	1	Winbond	W25Q16DWBYIG	Serial Flash Memory - 2 MB	Flip Chip, Solder (UF)	8	2.70	1.76	0.80	23.1	1	Winbond	W25Q16DWBYIG	Serial Flash Memory - 2 MB	2.70	1.76	\$ 0.160	\$ 0.160
	24	1	Murata ?	2S7 EA ?	Dual SPDT Antenna Switch ?	MCP - 2 Chips (UF)	10	1.50	1.10	0.80	24.1	2	Murata ?	25SJ ?	SPDT Antenna Switch	0.33	0.33	\$ 0.050	\$ 0.100
	25	1	Infineon	BGM1032N7	GPS / GLONASS Front-End Module	DFN	6	2.26	1.68	0.90	25.1	1	Infineon	BGM1032N7	GPS / GLONASS Front-End Module	1.00	0.53	\$ 0.210	\$ 0.210
Radio Board, Side 2	26	1	Qualcomm	PM8018	Power Management	Flip Chip, Solder (UF)	106	4.46	3.90	0.80	26.1	1	Qualcomm	HG11-VU756-210	Power Management	4.46	3.90	\$ 1.190	\$ 1.190
	27	1	Skyworks	SKY77729	LTE Band XVII Power Amplifier	MCP - 2 Chips	10	3.00	3.00	0.95	27.1	1	Skyworks	31087_01	Bias Control	0.70	0.40	\$ 0.030	\$ 0.030
											27.2	1	Skyworks	94031_34	RF Power Amplifier	1.00	0.90	\$ 0.210	\$ 0.210
	28	1	Skyworks	SKY77497	W-CDMA Bands II & V Power Amplifier	QFN Stacked 2	30	6.00	4.50	0.95	28.1	1	Skyworks	RP1629_1	Bias Control	0.71	0.31	\$ 0.070	\$ 0.070
											28.2	1	Skyworks	94040_01	RF Power Amplifier	1.95	0.90	\$ 1.450	\$ 1.450
	29	1	Avago	AFEM-7814	W-CDMA Band I & LTE Band IV Power Amplifier	MCP - 3 Chips	30	6.00	4.50	0.81	29.1	1	Avago	4DT7A	Bias Control	0.77	0.57	\$ 0.190	\$ 0.190
											29.2	1	Avago	PBS1	RF Power Amplifier	0.95	0.88	\$ 0.990	\$ 0.990
											29.3	1	Avago	PBS3	RF Power Amplifier	0.87	0.72	\$ 0.730	\$ 0.730
	30	1	TriQuint	TQM666084	W-CDMA Band VIII Power Amplifier	QFN	14	4.50	3.50	1.00	30.1	1	TriQuint	TQM666084	W-CDMA Band VIII Power Amplifier	1.53	0.99	\$ 0.980	\$ 0.980
	31	1	Skyworks	SKY77352	Quad-Band GSM Power Amplifier	MCP - 2 Chips	14	5.00	3.50	1.00	31.1	1	Skyworks	31531_02	Power Amplifier Controller	0.98	0.98	\$ 0.120	\$ 0.120
											31.2	1	Skyworks	94030_01	RF Power Amplifier	1.20	0.80	\$ 0.310	\$ 0.310
	32	1	Murata	SIWUA ?	Diversity Rx Antenna Switch w/ SAW Filters	MCP - 2 Chips	24	4.50	4.20	1.40	32.1	1	Peregrine	C9941_1	RF Antenna Switch	1.21	1.16	\$ 1.020	\$ 1.020
Interconnect Board, Side 1	33	1	Murata	D06 ?	RF Antenna Switch	QFN	20	3.00	3.00	1.10	33.1	1	Peregrine	XM0825SX	RF Switch ?	1.20	0.80	\$ 0.380	\$ 0.380
	34	1	Maxim	Unknown	DC-DC Converter ?	Flip Chip, Solder	9	1.57	1.56	0.90	34.1	1	Peregrine	C9930_2	RF Antenna Switch	1.98	1.25	\$ 0.880	\$ 0.880
												1	Maxim	Unknown	DC-DC Converter	1.57	1.56	\$ 0.170	\$ 0.170
Interconnect Board, Side 1	35	1	STMicroelectronics	L3G4200DH	3-Axis MEMS Gyroscope	QFN Stacked 2	16	4.00	4.00	1.00	35.1	1	STMicroelectronics	V854A	Gyroscope Processor	2.56	2.56	\$ 0.430	\$ 0.430
	36	1	STMicroelectronics	LIS331DLH	3-Axis MEMS Accelerometer	QFN Stacked 2	16	3.00	3.00	0.98	35.2	1	STMicroelectronics	GK10A	MEMS Sensor	3.10	3.00	\$ 2.930	\$ 2.930
											36.1	1	STMicroelectronics	V583A	Accelerometer Processor	2.19	1.52	\$ 0.240	\$ 0.240
Interconnect Board, Side 2	37	1	AKM Semiconductor	AK8975B	3-Axis Electronic Compass	Flip Chip, Solder	14	2.00	2.00	0.80	37.1	1	AKM Semiconductor	AK8975B	3-Axis Electronic Compass	2.00	2.00	\$ 0.470	\$ 0.470
	38	1	Analog Devices	AD7149	Capacitance Sensor Controller	Flip Chip, Solder (UF)	25	2.20	2.00	0.80	38.1	1	Analog Devices	AD7149	Capacitance Sensor Controller	2.20	2.00	\$ 0.410	\$ 0.410
Side Key Flex, Side 2	39	1	AKM Semiconductor ?	AK5836 ?	Hall Effect Sensor	SOP	4	2.11	1.20	0.80	39.1	1	AKM Semiconductor ?	AK5836 ?	Hall Effect Sensor	0.76	0.71	\$ 0.050	\$ 0.050
Totals		41					3489					60							\$117.09

(UF) = Underfilled

Note: Supplemental information, such as IC package & die markings, is included in the Excel Bill of Materials (BOM) spreadsheet.

Note: The ICs listed below are for reference only.
Their costs are integrated into the cost of the individual subsystems.

Location	Package Info										Die Info							Estimated Costs	
	Pkg Ref. #	Pkg Qty	Brand Name	Part Number	Pkg Description	Form	Pin Count	Length (mm)	Width (mm)	Height (mm)	Die Ref #	Die Qty	Brand Name	Part Number	Description	Length (mm)	Width (mm)	Each	Total
Battery Pack: Battery Board	40	1	Seiko Instruments	S-8244	Secondary Battery Protection	DFN	8	2.10	1.90	0.90	40.1	1	Seiko Instruments	S-8244	Secondary Battery Protection	1.24	1.18	\$ 0.120	\$ 0.120
	41	1	Seiko Instruments	S-8211	Battery Protection IC	DFN	6	1.50	1.50	0.90	41.1	1	Seiko Instruments	S-8211	Battery Protection IC	1.14	0.78	\$ 0.080	\$ 0.080
	44	1	TI	BQ7541	Battery Fuel Gauge	DFN	12	4.00	2.50	0.90	44.1	1	TI	BQ7541	Battery Fuel Gauge	2.39	1.92	\$ 0.320	\$ 0.320
Secondary Camera: Secondary Camera Flex	45	1	OmniVision	OV2C3BH ?	1.2 MP BSI CMOS Image Sensor	Other - Surface Mount	16	5.90	5.40	1.10	45.1	1	OmniVision	OV2C3BH ?	1.2 MP BSI CMOS Image Sensor	4.32	4.15	\$ 2.010	\$ 2.010
	46	1	AMS	TSL2583	Ambient Light Sensor	DFN	6	1.90	1.90	0.80	46.1	1	AMS	TSL2583	Ambient Light Sensor	1.65	1.10	\$ 0.140	\$ 0.140
Main Camera: Main Camera Flex	47	1	OmniVision	OV5650	5 MP BSI CMOS Image Sensor	Other - Surface Mount	31	8.60	8.50	1.00	47.1	1	OmniVision	OV5650	5 MP BSI CMOS Image Sensor	6.54	6.06	\$ 4.520	\$ 4.520
	48	1	Rohm	Unknown	Autofocus VCM Driver	Flip Chip, Solder	6	1.30	0.95	0.80	48.1	1	Rohm	Unknown	Autofocus VCM Driver	1.30	0.95	\$ 0.110	\$ 0.110
Display / Touchscreen Module:	49	6	Samsung	S6C24A1X01	TFT-LCD Display Column Driver	Flip Chip, Adhesive	1225	20.90	1.30	0.22	49.1	1	Samsung	S6C24A1X01	TFT-LCD Display Column Driver	20.90	1.30	\$ 1.510	\$ 9.060
	50	4	Samsung	S6CG246X01	TFT-LCD Display Row Driver	Flip Chip, Adhesive	668	14.30	0.80	0.12	50.1	1	Samsung	S6CG246X01	TFT-LCD Display Row Driver	14.30	0.80	\$ 0.690	\$ 2.760
Display / Touchscreen Module: Display Board	51	1	RichTek	RT9966GQW ?	Power Management	MCP - 3 Chips	28	5.00	4.00	0.70	51.1	1	RichTek	Unknown	MOSFET ?	0.59	0.51	\$ 0.030	\$ 0.030
											51.2	1	RichTek	RT436D2	DC-DC Converter ?	1.65	0.75	\$ 0.100	\$ 0.100
											51.3	1	RichTek	RT248F	DC-DC Converter ?	2.49	1.74	\$ 0.350	\$ 0.350
	52	1	Integrated Memory Logic	IML7990	Programmable Gamma Buffer	QFN	32	5.00	5.00	0.80	52.1	1	Integrated Memory Logic	IML7990	Programmable Gamma Buffer	2.98	2.95	\$ 0.650	\$ 0.650
	53	1	Parade Technologies	DP635	Display Port Timing Controller	BGA	119	12.00	5.00	1.00	53.1	1	Parade Technologies	DP635	Display Port Timing Controller	4.83	3.01	\$ 1.440	\$ 1.440
	54	1	Ricoh	RP111L071D	500 mA / 0.7 V LDO Regulator	DFN	6	1.20	1.20	0.70	54.1	1	Ricoh	RP111L071D	500 mA / 0.7 V LDO Regulator	0.73	0.56	\$ 0.050	\$ 0.050
	55	1	TI	TPS62260	600 mA Step-Down DC-DC Converter	DFN	6	2.00	2.00	0.80	55.1	1	TI	TPS62260	600 mA Step-Down DC-DC Converter	1.44	0.85	\$ 0.090	\$ 0.090
	56	1	Rohm	BR24T16-W	Serial EEPROM Memory - 2 KB	DFN	8	3.00	2.00	0.80	56.1	1	Rohm	BR24T16-W	Serial EEPROM Memory - 2 KB	1.17	0.77	\$ 0.100	\$ 0.100
Totals		23					10306					25							\$21.93

Note: Supplemental information, such as IC package & die markings, is included in the Excel Bill of Materials (BOM) spreadsheet.

Deep Dive Teardown

Apple iPad 4 LTE A1459 32 GB Sample Report

Location	Qty	Brand Name	Part Number	Description	Package			Estimated Costs	
					Pin Count	Length (mm)	Width (mm)	Each	Total
Main Board, Side 1	1	Unknown	Unknown	Shielding: Large	1	38.50	18.20	\$ 0.040	\$ 0.040
	1	Unknown	Unknown	Shielding: Large	1	24.50	17.00	\$ 0.040	\$ 0.040
	1	Unknown	A238L	Crystal: Ceramic	2	2.00	1.10	\$ 0.200	\$ 0.200
	1	Unknown	T240	Crystal: Ceramic	4	2.00	1.50	\$ 0.200	\$ 0.200
	1	Unknown	Unknown	Speaker: Dual Assembly w/ Acoustic Chamber	6	74.00	16.00	\$ 1.600	\$ 1.600
	1	Unknown	821-1728	Antenna: Film - WiFi/Bluetooth w/ Coax Cable	1	30.00	11.00	\$ 0.200	\$ 0.200
	1	Unknown	Unknown	Shielding: Large	1	62.40	28.40	\$ 0.040	\$ 0.040
Main Board, Side 2	1	Unknown	Unknown	Shielding: Large	1	55.00	28.00	\$ 0.040	\$ 0.040
	1	Unknown	Unknown	Shielding: Large	1	55.00	26.00	\$ 0.040	\$ 0.040
Radio Board, Side 1	1	Murata	Unknown	Filter: SAW	5	1.00	0.92	\$ 0.070	\$ 0.070
	1	Unknown	Unknown	Shielding: Large	1	36.50	26.90	\$ 0.040	\$ 0.040
Radio Board, Side 2	1	Unknown	Unknown	Shielding: Large	1	36.50	20.20	\$ 0.040	\$ 0.040
	1	Sawtek	Unknown	Crystal: Ceramic	4	2.60	2.10	\$ 0.200	\$ 0.200
	1	Unknown	821-1546-A	Antenna: Film - Rx Diversity w/ Support & Cable	1	20.50	46.20	\$ 0.250	\$ 0.250
	1	Shanghai Amphenol Airwave (SAA)	821-1565-A	Antenna: Film - Main w/ Support & Cable (RF Prox.)	1	50.00	35.00	\$ 0.350	\$ 0.350
	1	Murata	Unknown	Filter: SAW	5	1.00	0.90	\$ 0.070	\$ 0.070
	1	Murata	Unknown	Filter: SAW	5	1.00	0.90	\$ 0.070	\$ 0.070
	1	Murata	Unknown	Filter: SAW	5	1.00	0.90	\$ 0.070	\$ 0.070
	1	Murata	Unknown	Filter: SAW	5	1.00	0.90	\$ 0.070	\$ 0.070
	1	Murata	Unknown	Filter: SAW	5	1.00	0.90	\$ 0.070	\$ 0.070
	1	Murata	Unknown	Filter: SAW	5	1.00	0.90	\$ 0.070	\$ 0.070
	1	Murata	Unknown	Filter: SAW	5	1.00	0.90	\$ 0.070	\$ 0.070
	1	Murata	Unknown	Filter: SAW - Duplexer	9	1.75	1.39	\$ 0.290	\$ 0.290
	1	Tyco Electronics	821-1598-A	Antenna: Film - GPS w/ Cable	1	21.40	23.60	\$ 0.200	\$ 0.200
Home Button Board, Side 1	1	Unknown	Unknown	Switch: SMT - Home Button	4	3.90	3.80	\$ 0.070	\$ 0.070
Side Key Flex, Side 1	2	Unknown	Unknown	Switch: SMT - Volume	4	3.20	2.80	\$ 0.070	\$ 0.140
Side Key Flex, Side 2	1	Unknown	Unknown	Switch: SMT - On/Off & Sleep/Wake	4	3.20	2.80	\$ 0.070	\$ 0.070
	1	Unknown	Unknown	Switch: SMT - Slide - Mute	6	8.00	2.20	\$ 0.100	\$ 0.100
Microphone Flex, Side 1	1	Knowles	SPK0833LM4H-B	Microphone: MEMS	4	3.90	2.90	\$ 0.270	\$ 0.270
TOTALS	30				102				\$4.98

Location	Qty	Functional Description	Package					Estimated Costs	
			Form	Top Marking	Pin Count	Length (mm)	Width (mm)	Each	Total
Main Board, Side 1	1	Small Active	Diode, SMT	BF t28	2	2.60	1.60	\$0.015	\$0.015
	2	Small Active	Diode, SMT	JH	2	1.40	1.00	\$0.015	\$0.030
	1	Small Active	Diode, SMT	SD	2	2.00	1.50	\$0.015	\$0.015
Main Board, Side 2	4	Small Active	MOSFET - Flip Chip	58874 34047	6	1.40	0.97	\$0.090	\$0.360
	4	Small Active	Diode, SMT		2	1.00	0.60	\$0.015	\$0.060
	8	Small Active	Diode, SMT		2	0.60	0.30	\$0.015	\$0.119
Interconnect Board, Side 1	2	Small Active	Diode, SMT	V	2	0.50	0.30	\$0.015	\$0.030
Interconnect Flex, Side 1	7	Small Active	Diode, SMT		2	0.60	0.30	\$0.015	\$0.104
TOTALS	29				74				\$0.73

Location	Qty	Functional Description	Package		Estimated Costs	
			Form	Pin Count	Each	Total
Main Board, Side 1	3	Coil	SMT, Small	2	\$0.050	\$0.150
	1	Coil	SMT, Small	2	\$0.080	\$0.080
	10	Coil	SMT, Small	2	\$0.050	\$0.500
	1	Coil	SMT, Small	2	\$0.050	\$0.050
	2	Capacitor	Tantalum / Niobium, Small	2	\$0.050	\$0.100
	356	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$1.424
Main Board, Side 2	427	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$1.708
	12	Small Passive	Cap, Res, Ferrite Array	4	\$0.007	\$0.089
	8	Small Passive	Cap, Res, Ferrite Array	10	\$0.007	\$0.059
	1	Filter	Ceramic, Small	6	\$0.065	\$0.065
Radio Board, Side 1	39	Small Passive	Coil, Inductor	2	\$0.008	\$0.312
	142	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$0.568
Radio Board, Side 2	30	Small Passive	Coil, Inductor	2	\$0.008	\$0.240
	5	Coil	SMT, Small	2	\$0.050	\$0.250
	2	Filter	Ceramic, Small	2	\$0.065	\$0.130
	144	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$0.576
Interconnect Board, Side 1	44	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$0.176
	2	Small Passive	Coil, Inductor	2	\$0.008	\$0.016
Interconnect Board, Side 2	26	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$0.104
	5	Small Passive	Cap, Res, Ferrite Array	4	\$0.007	\$0.037
	4	Small Passive	Coil, Inductor	2	\$0.008	\$0.032
Home Button Board, Side 1	1	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$0.004
Docking Flex, Side 1	1	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$0.004
Side Key Flex, Side 2	1	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$0.004
Microphone Flex, Side 1	4	Small Passive	Cap, Res, Ferrite	2	\$0.004	\$0.016
TOTALS	1271			2644		\$6.69

Substrates	Integrated Circuits	Subsystem ICs	Modules	Active Discretes	Passive Discretes	Connectors
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Electronic Assembly Metrics	Electronic Costs Breakdown	Vendor IC Cost Distribution	Non-Electronic Cost Estimate	Final Ass'y Labor & Test Cost	Cost Summary
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Product Overview	Block Diagram	Product Packaging	Exterior Features	Major Components	Component Arrangement	Teardown	Antenna	Subsystems	Main Board	Other Substrates	Costs and Metrics	Overview & Discussion
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Location	Qty	Form	Package			Estimated Costs	
			Pin Count	Length (mm)	Width (mm)	Each	Total
Docking Flex, Side 1	1	Port: Lightning	10	14.50	8.50	\$0.500	\$0.500
Docking Flex, Side 2	1	Bd to Bd: Main Board	50	13.20	3.70	\$0.270	\$0.270
Home Button Board, Side 1	1	Cable: Flex - Home Button Board to Main Board	6	107.50	11.76	\$0.620	\$0.620
Interconnect Board, Side 1	1	Bd to Bd: Main Camera	32	7.80	1.30	\$0.180	\$0.180
Interconnect Board, Side 2	1	Connector: ZIF - Microphone Flex	6	4.35	3.20	\$0.092	\$0.092
	1	Bd to Bd: RF Proximity Sensor / Main Antenna	10	4.40	2.40	\$0.070	\$0.070
	1	Bd to Bd: Secondary Camera	18	5.00	1.60	\$0.110	\$0.110
Interconnect Flex, Side 1	1	Jack: Headphone	5	14.60	15.80	\$0.150	\$0.150
Main Board, Side 1	1	Connector: ZIF - Home Button Flex	6	4.30	3.20	\$0.092	\$0.092
	1	Connector: Speaker	6	8.91	5.10	\$0.080	\$0.080
	1	Connector: Antenna Coax - WiFi/Bluetooth	2	2.56	1.65	\$0.040	\$0.040
	1	Connector: Battery Module	5	19.00	9.20	\$0.120	\$0.120
	1	Bd to Bd: Docking Flex	50	12.00	2.20	\$0.270	\$0.270
	4	Connector: ZIF - Touchscreen/Interconnect Flex	37	12.80	4.10	\$0.309	\$1.236
	1	Connector: ZIF - Display	51	17.10	4.00	\$0.407	\$0.407
Main Board, Side 2	1	Cable: Flex - Main to Radio Board	42	13.30	16.00	\$0.350	\$0.350
	1	Connector: External Test Antenna	2	2.00	2.00	\$0.070	\$0.070
Radio Board, Side 1	1	Connector: ZIF - SIM Card Flex	6	4.20	3.30	\$0.092	\$0.092
Radio Board, Side 2	3	Connector: External Test Antenna	2	2.00	2.00	\$0.070	\$0.210
	3	Connector: Antenna Coax - Main, Rx Diversity, GPS	2	1.60	1.60	\$0.040	\$0.120
SIM Card Flex, Side 1	1	Socket: Micro SIM	6	18.10	17.40	\$0.230	\$0.230
TOTALS	28		473				\$5.31

Electronic Assembly Metrics by Assembly											
General Area	Assembly Name	Substrate Area (sq.cm)	Metal Layers	Circuit Area (sq.cm)	Routing Density (cm of routing per sq.cm of substrate)	Number of Components	Number of Connections	Component Density (Components/sq.cm)	Connection Density (Connections/sq.cm)	Avg. Pin Count	Assembly Weight (grams)
Main Electronics	Docking Flex	6.6	4	26.4	41.6	3	62	0.5	9.4	20.7	1.80
Main Electronics	Home Button Board	1.6	2	3.2	16.4	3	12	1.9	7.5	4.0	0.30
Main Electronics	Interconnect Board	9.1	10	91.0	32.6	91	313	10.0	34.4	3.4	2.10
Main Electronics	Interconnect Flex	13.5	4	54.0	5.5	8	19	0.6	1.4	2.4	1.30
Main Electronics	Main Board	39.0	10	390.0	75.5	883	4670	22.6	119.7	5.3	34.80
Main Electronics	Microphone Flex	1.8	3	5.4	12.0	5	12	2.8	6.7	2.4	0.10
Main Electronics	Radio Board	13.0	10	130.0	69.3	399	1664	30.7	128.0	4.2	4.40
Main Electronics	Side Key Flex	2.6	2	5.2	18.2	6	24	2.3	9.2	4.0	0.20
Main Electronics	SIM Card Flex	3.9	3	11.7	9.2	1	6	0.3	1.5	6.0	0.70
Main Electronics Totals		91.1	48	716.9		1399	6782	15.4	74.4	4.8	45.70
Subsystem Electronics	Battery Pack: Battery Board	10.4	8	83.2	18.2	69	163	6.6	15.7	2.4	3.70
Subsystem Electronics	Secondary Camera: Secondary Camera Flex	1.7	2	3.4	53.1	3	40	1.8	23.5	13.3	0.20
Subsystem Electronics	Main Camera: Main Camera Flex	1.7	2	3.4	81.6	4	71	2.4	41.8	17.8	0.50
Subsystem Electronics	Display / Touchscreen Module: Backlight Flex - Bottom	10.4	2	20.8	12.1	42	84	4.0	8.1	2.0	0.50
Subsystem Electronics	Display / Touchscreen Module: Backlight Flex - Top	14.4	2	28.8	10.3	42	84	2.9	5.8	2.0	0.70
Subsystem Electronics	Display / Touchscreen Module: Display Board	20.3	10	203.0	30.0	153	629	7.5	27.3	4.1	5.40
Subsystem Electronics Totals		58.9	26	342.6		313	1071	5.3	18.2	3.4	11.00
	System Totals	150.0	74	1059.5		1711	7779	11.4	51.9	4.5	56.70

Electronics Costs by Assembly										
General Area	Assembly Name	Total	Integrated Circuits	Modular & Odd Form Components	Small Active Components	Passive Components	Connector Components	Substrates	Insertion	Card Test
Main Electronics	Docking Flex	\$ 2.53	\$ -	\$ -	\$ -	\$ 0.00	\$ 0.77	\$ 1.66	\$ 0.04	\$ 0.05
Main Electronics	Home Button Board	\$ 0.77	\$ -	\$ 0.07	\$ -	\$ 0.00	\$ 0.62	\$ 0.02	\$ 0.03	\$ 0.02
Main Electronics	Interconnect Board	\$ 8.15	\$ 5.86	\$ -	\$ 0.03	\$ 0.37	\$ 0.45	\$ 0.85	\$ 0.55	\$ 0.05
Main Electronics	Interconnect Flex	\$ 3.72	\$ -	\$ -	\$ 0.10	\$ -	\$ 0.15	\$ 3.39	\$ 0.05	\$ 0.02
Main Electronics	Main Board	\$ 94.62	\$ 75.78	\$ 2.40	\$ 0.60	\$ 4.22	\$ 2.66	\$ 3.63	\$ 5.07	\$ 0.25
Main Electronics	Microphone Flex	\$ 0.70	\$ -	\$ 0.27	\$ -	\$ 0.02	\$ -	\$ 0.37	\$ 0.02	\$ 0.02
Main Electronics	Radio Board	\$ 43.54	\$ 35.40	\$ 1.93	\$ -	\$ 2.08	\$ 0.42	\$ 1.21	\$ 2.31	\$ 0.20
Main Electronics	Side Key Flex	\$ 0.85	\$ 0.05	\$ 0.31	\$ -	\$ 0.00	\$ -	\$ 0.42	\$ 0.05	\$ 0.02
Main Electronics	SIM Card Flex	\$ 1.07	\$ -	\$ -	\$ -	\$ -	\$ 0.23	\$ 0.81	\$ 0.01	\$ 0.02
Main Electronics Totals		\$ 155.95	\$ 117.09	\$ 4.98	\$ 0.73	\$ 6.69	\$ 5.31	\$ 12.36	\$ 8.14	\$ 0.65
Subsystem Electronics	Battery Pack	\$ 2.25	\$ 0.52	\$ -	\$ 0.30	\$ 0.35	\$ 0.15	\$ 0.38	\$ 0.45	\$ 0.10
Subsystem Electronics	Display / Touchscreen Module	\$ 49.43	\$ 14.63	\$ 15.81	\$ 4.34	\$ 0.59	\$ 4.68	\$ 7.21	\$ 1.83	\$ 0.35
Subsystem Electronics	Main Camera	\$ 5.96	\$ 4.63	\$ 0.65	\$ -	\$ -	\$ 0.18	\$ 0.28	\$ 0.07	\$ 0.15
Subsystem Electronics	Secondary Camera	\$ 2.70	\$ 2.15	\$ -	\$ -	\$ -	\$ 0.11	\$ 0.28	\$ 0.06	\$ 0.10
Subsystem Electronics Totals		\$ 60.34	\$ 21.93	\$ 16.46	\$ 4.64	\$ 0.94	\$ 5.12	\$ 8.15	\$ 2.40	\$ 0.70
	System Totals	\$ 216.29	\$ 139.02	\$ 21.44	\$ 5.37	\$ 7.64	\$ 10.42	\$ 20.51	\$ 10.55	\$ 1.45

NOTE: Occasional inconsistencies in totals may be present due to rounding error.

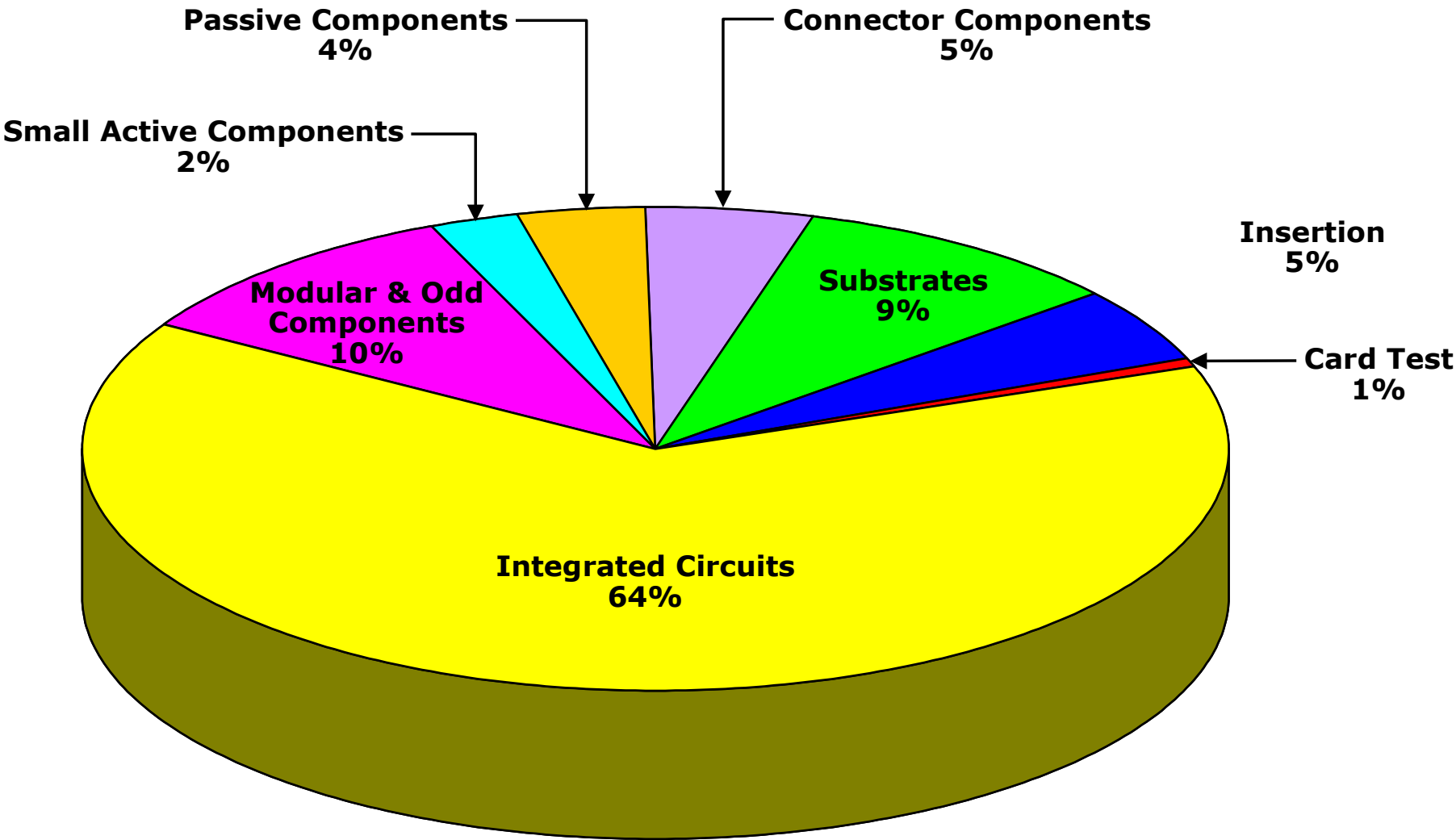
Counts by Assembly													
General Area	Assembly Name	IC Package Count	IC Connections	Modular/Odd Form Components	Modular/Odd Form Component Connections	Small Active Components	Small Active Component Connections	Passive Components	Passive Component Connections	Connectors	Connector Connections	Subsystem IOs	Opportunities
Main Electronics	Docking Flex	0	0	0	0	0	0	1	2	2	60	0	65
Main Electronics	Home Button Board	0	0	1	4	0	0	1	2	1	6	0	15
Main Electronics	Interconnect Board	4	71	0	0	2	4	81	172	4	66	0	404
Main Electronics	Interconnect Flex	0	0	0	0	7	14	0	0	1	5	0	27
Main Electronics	Main Board	21	2550	9	18	20	56	821	1734	12	312	0	5553
Main Electronics	Microphone Flex	0	0	1	4	0	0	4	8	0	0	0	17
Main Electronics	Radio Board	15	864	15	58	0	0	362	724	7	18	0	2063
Main Electronics	Side Key Flex	1	4	4	18	0	0	1	2	0	0	0	30
Main Electronics	SIM Card Flex	0	0	0	0	0	0	0	0	1	6	0	7
Main Electronics Totals		41	3489	30	102	29	74	1271	2644	28	473	0	8181
Subsystem Electronics	Battery Pack	3	26	0	0	8	25	52	106	6	6	5	237
Subsystem Electronics	Display / Touchscreen Module	16	10221	3	76	89	182	136	272	3	68	51	11116
Subsystem Electronics	Main Camera	2	37	1	2	0	0	0	0	1	32	32	107
Subsystem Electronics	Secondary Camera	2	22	0	0	0	0	0	0	1	18	18	61
Subsystem Electronics	Touchscreen Module	0	0	1	74	0	0	0	0	0	0	74	149
Subsystem Electronics Totals		23	10306	5	152	97	207	188	378	11	124	180	11670
	System Totals	64	13795	34	180	126	281	1459	3022	39	597	180	19777

NOTE: Occasional inconsistencies in totals may be present due to rounding error.

IC Metrics											
General Area	Assembly Name	IC Die Count	IC Package Count	Number of Package Connections	Die Area (sq.mm)	Substrate Tiling Density (die area / substrate area)	Package Area (sq.mm)	Die Area/Package Area Ratio	Package Connections per sq.cm of Package Area	Volatile Memory (KBytes)	Non-Volatile Memory (KBytes)
Main Electronics	Interconnect Board	6	4	71	31.7	0.03	33.4	0.95	212.6	0	0
Main Electronics	Main Board	30	21	2550	960.4	0.25	1023.0	0.94	249.3	1048576	33554432
Main Electronics	Radio Board	23	15	864	135.0	0.1	284.2	0.48	304.0	131072	2048
Main Electronics	Side Key Flex	1	1	4	0.5	0	2.5	0.21	158.0	0	0
Main Electronics Totals		60	41	3489	1127.7		1343.1	0.84	259.8	1179648	33556480
Subsystems	Battery Pack	3	3	26	6.9		16.2	0.43	1.6	0	0
Subsystems	Display / Touchscreen Module	18	16	10221	240.5		325.2	0.74	31.4	0	8
Subsystems	Main Camera	2	2	37	40.9		74.3	0.55	0.5	0	0
Subsystems	Secondary Camera	2	2	22	19.7		35.5	0.56	0.6	0	0
Subsystem Electronics Totals		25	23	10306	308.1		451.3	0.68	2283.8	0	8
	System Totals	85	64	13795	1435.7		1794.4	0.80	768.8	1179648	33556488

NOTE: Occasional inconsistencies in totals may be present due to rounding error.

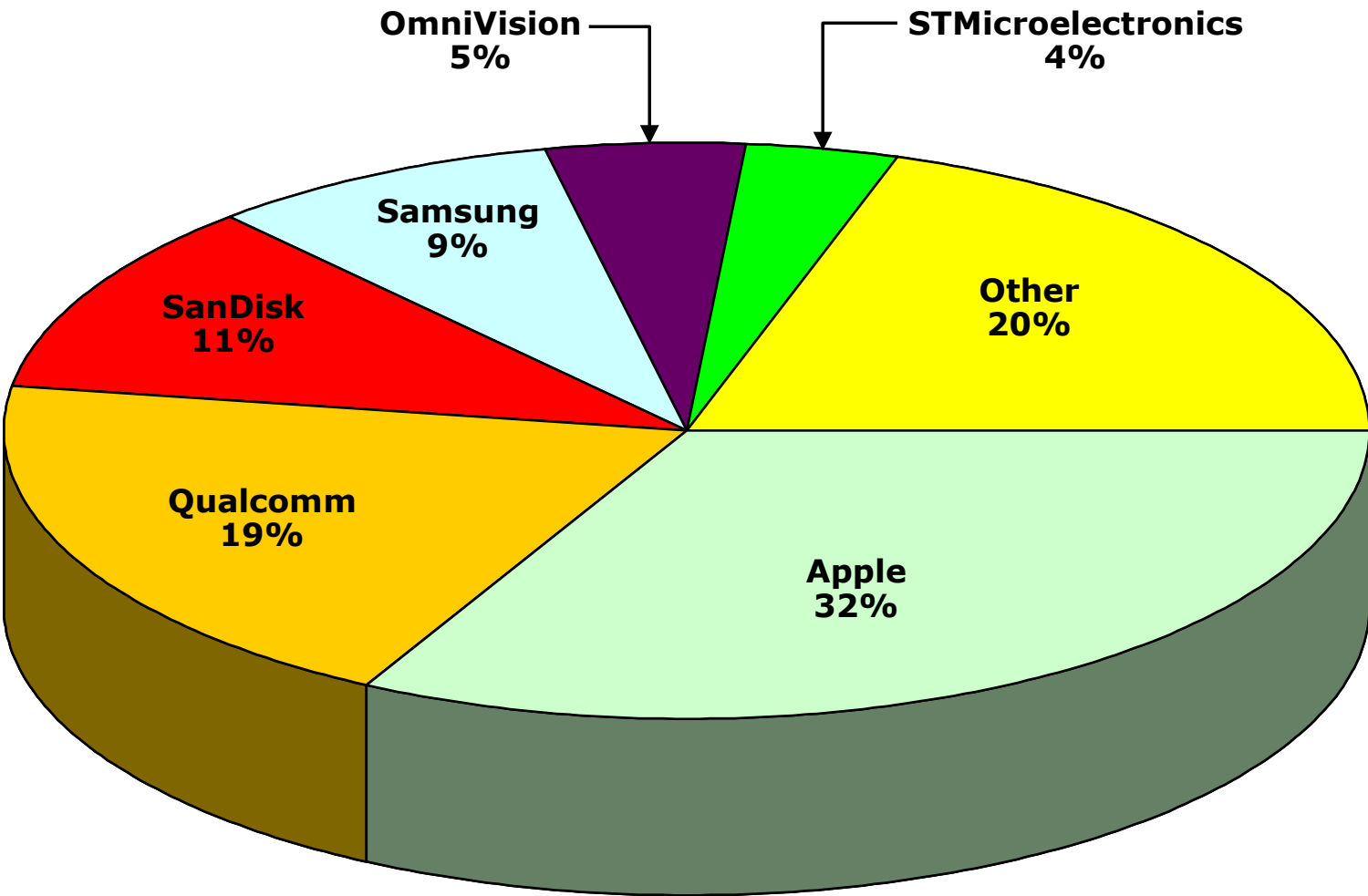
Estimated Cost
of Electronics
(Includes Subsystem Electronics)
\$216.29



NOTE: Occasional inconsistencies in totals may be present due to rounding error.

* Includes Subsystem Vendors & Associated Costs

Pkg. Brand	Cost
Apple	\$45.57
Qualcomm	\$27.37
SanDisk	\$14.99
Samsung	\$11.82
OmniVision	\$6.53
STMicroelectronics	\$4.98
Other	
USI	\$4.88
SK Hynix	\$4.84
Broadcom	\$3.41
Murata	\$2.38
Skyworks	\$2.19
TI	\$1.96
Avago	\$1.91
Parade Technologies	\$1.44
TriQuint	\$0.98
Integrated Memory Logic	\$0.65
AKM Semiconductor	\$0.52
RichTek	\$0.48
NXP Semiconductor	\$0.45
Analog Devices	\$0.41
Rohm	\$0.21
Infineon	\$0.21
Seiko Instruments	\$0.20
Maxim	\$0.17
Winbond	\$0.16
AMS	\$0.14
Silego	\$0.12
Ricoh	\$0.05



NOTE: Occasional inconsistencies in totals may be present due to rounding error.

Deep Dive Teardown

Apple iPad 4 LTE A1459 32 GB Sample Report

Subsystem	Part ID No.	Qty	Description	Fabrication Process	Material	Dimensions (mm)	Weight (grams)	Est'd Cost Each	Est'd Extended Cost
Enclosures	1	1	Enclosure	Cast + Machined + Anodized + Printed	Aluminum	241.2 x 185.8 x 8.9	122.30	13.000	13.000
	3	1	Bezel	Molded	Plastic + Adhesive	240 x 184 x 1	1.20	0.200	0.200
	4	1	Antenna Well	Molded + Pulls	Plastic + Adhesive	120 x 16.5 x 8.6	4.80	0.270	0.270
Miscellaneous	5	59	Screw	Machined	Metal	x	0.59	0.007	0.413
	6	2	Strong Magnet + Spring	Cast + Stamped + Assembled	Metal	50 x 3.6 x 3	4.40	0.400	0.800
	7	4	Weak Magnet	Cast	Metal	13 x 3.2 x 0.7	0.80	0.050	0.200
	8	1	Micro SIM Holder	Machined + Anodized	Aluminum	20.6 x 16.8 x 1.9	0.30	0.200	0.200
	9	1	Lightning Connector Support	Cast + Machined + Anodized	Aluminum	25.6 x 8 x 4.9	2.00	0.250	0.250
	10	1	Micro SIM Holder Lever	Cast	Metal	12.6 x 2.7 x 3.2	0.05	0.100	0.100
	11	4	Corner Plates	Cast	Metal	x	6.40	0.100	0.400
	12	1	Side Key Bracket	Cast	Metal	40.8 x 5 x 2.9	1.00	0.050	0.050
	13	1	Bracket	Cast	Metal	18.2 x 4.8 x 0.9	0.05	0.030	0.030
	14	1	Secondary Camera Bracket	Stamped + Press Fit	Metal	15.8 x 10.9 x 2.1	0.05	0.070	0.070
	15	1	Power Button	Molded + Extruded	Plastic + Metal	12.3 x 3.7 x 2.8	0.05	0.100	0.100
	16	1	Home Key Cover w/ Spring	Molded + Painted + Printed + Stamped + Assembled	Plastic + Metal + Adhesive	13.6 x 13.4 x 1.1	0.20	0.180	0.180
	17	1	Home Key Bracket	Cast + Painted	Metal	36.1 x 7.9 x 1.9	1.30	0.100	0.100
	18	1	Bracket	Molded	Plastic	21.2 x 7.4 x 1.7	0.05	0.020	0.020
	19	1	Camera Lens Cover	Molded + Stamped + Painted	Plastic + Metal	10.9 x 8 x 1.3	0.05	0.080	0.080
	20	1	Camera Bezel	Molded	Plastic	11.3 x 8.2 x 1.6	0.05	0.020	0.020
	21	1	Apple Logo	Molded	Plastic	40 x 32 x 0.7	1.20	0.100	0.100
	22	1	Magnet Bracket	Molded	Plastic	61.9 x 3.2 x 1.1	0.05	0.030	0.030
	23	4	Magnet Brackets	Molded	Plastic	8 x 5.1 x 2.5	0.20	0.020	0.080
	24	1	Bracket	Molded	Plastic	54.3 x 6.6 x 5.4	1.10	0.050	0.050
	25	1	Bracket	Stamped + Painted	Aluminum	45.6 x 7 x 1.1	1.30	0.040	0.040
	26	1	Mute Button	Co-Molded + Painted	Plastic + Aluminum	11.2 x 4.8 x 4.4	0.05	0.150	0.150
	27	1	Side Keys	Molded + Painted	Plastic	20 x 3.7 x 1.7	0.05	0.050	0.050
	28	1	Speaker Screen	Die-Cut	Plastic + Adhesive	41.6 x 14.9 x 0.04	0.01	0.010	0.010
	29	4	Foam	Die-Cut	Foam + Adhesive	x	0.04	0.005	0.020
	30	19	Conductive Gasket	Die-Cut	Conductive Foam + Adhesive	x	0.19	0.005	0.095
	31	7	Grounding Tape	Die-Cut	Conductive Fabric + Adhesive	x	0.07	0.020	0.140
	32	4	Label	Die-Cut + Printed	Plastic + Adhesive	x	0.04	0.010	0.040
	33	37	Tape	Die-Cut	Plastic + Adhesive	x	0.37	0.005	0.185
	34	5	Gasket	Die-Cut	Foam + Adhesive	x	0.05	0.005	0.025
	35	4	Gasket	Die-Cut	Plastic + Adhesive	x	0.04	0.010	0.040
	36	8	Thermal Pad	Die-Cut	Thermal Elastomer	x	0.08	0.020	0.160
	37	1	Tape	Die-Cut	Plastic + Adhesive	203 x 7.7 x 0.03	1.00	0.010	0.010
	38	2	Gasket	Die-Cut	Plastic + Adhesive	75 x 1 x 0.8	0.10	0.010	0.020
	39	1	Gasket	Die-Cut	Plastic + Adhesive	222 x 165 x 0.05	0.80	0.020	0.020
Total		187	Estimated Cost						\$17.75

Final Assembly & Test		
Made in	China	
Number of parts	229	
Est'd number of steps	779	
Est'd time (seconds)	2959	
Est'd final assembly cost	\$	1.64
Est'd final test cost	\$	1.60

Estimated Cost Totals		
Main Electronic Assemblies	\$	155.95
Battery Pack	\$	20.27
Display / Touchscreen	\$	112.73
Cameras	\$	16.31
Non-Electronic Parts	\$	17.75
Final Assembly & Test	\$	3.25
Total	\$	326.27

Note: Because the Touchscreen and Cover Glass were included in the Display costs, there is a difference in the final cost from the original report.

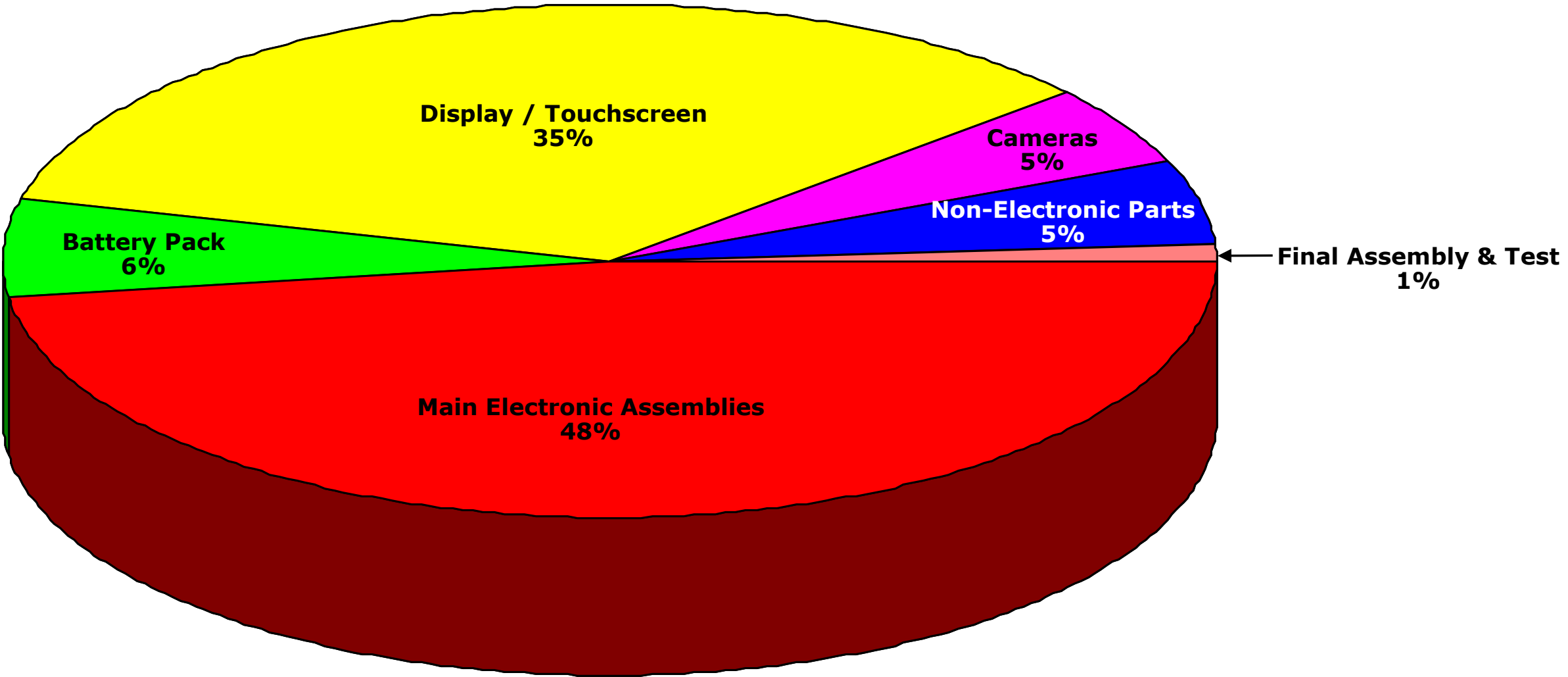
Note: An additional \$5.20 estimated for accessories and supporting materials

Cost Total Notes:

Estimated final assembly cost includes labor only.

Total cost does not include Non-recurring, R&D, G&A, IP licensing fees/royalties, software, sales & marketing, distribution.

Assumes fully scaled production.



Substrates	Integrated Circuits	Subsystem ICs	Modules	Active Discretes	Passive Discretes	Connectors
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Electronic Assembly Metrics	Electronic Costs Breakdown	Vendor IC Cost Distribution	Non-Electronic Cost Estimate	Final Ass'y Labor & Test Cost	Cost Summary
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Product Overview	Block Diagram	Product Packaging	Exterior Features	Major Components	Component Arrangement	Teardown	Antenna	Subsystems	Main Board	Other Substrates	Costs and Metrics	Overview & Discussion
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COST ESTIMATION PROCESS

Overview and Discussion

Cost modeling is tricky business. Multiple variables affect the actual production costs a manufacturer will experience, including development expenses, unit volumes, supply-and-demand in component markets, die yield-curve maturity, OEM purchasing power, and even variations in accounting practices. Different cost modeling methods employ different assumptions about how to handle these and other variables, but we can identify two basic approaches: that which seeks to track short-term variations in the inputs to the production process, and that which strives to maintain comparability of the output of the model across product families and over time.

TechInsights’ philosophy in cost modeling is to emphasize consistency across products and comparability over time, rather than to track short-term fluctuations. During the past eight years, we have developed an estimation process that, while necessarily lacking an insider’s knowledge of the cost factors that impact any one manufacturer, is reasonably accurate in its prediction of unit costs in high-volume production environments. We do not claim that the model will produce the "right" answer for your firm’s environment. However, TechInsights does give customers a key analytical tool with a complete set of data in our Bill of Materials (BOM). The BOM allows readers to 1) scrutinize the assumptions behind our cost model and 2) modify the results based on substitution of their own component cost estimates where they have better information based on inside knowledge.

Our estimation process decomposes overall system cost into three major categories: Electronics, Mechanical, and Final Assembly. We begin by creating a complete electronics bill-of-materials (BOM). Each component from the largest ASIC to the smallest discrete resistor is entered into a BOM table with identifying attributes such as size, pitch, I/O count, package type, manufacturer, part number, estimated placement cost, and die size (if the component is an IC). Integrated circuit costs are calculated from measured die area. Using assumptions for wafer size, process type, number of die per wafer, defect density, and profit margin in combination with die area, an estimate of semiconductor cost is derived. Costs for discrete components and interconnect are derived from assumption tables which relate BOM line items to specific cost estimates by component type and estimates for part placement costs are included. For LCD display costs, we employ a model which tabulates expected cost from measurements of glass area, LCD type, and total pixel resolution. When market costs are available from alternative sources, LCD panel costs are taken from and referenced to these sources.

Costs of non-electronic components such as molded plastic enclosures and metallic components are measured in terms of weight, size, thickness, type of material, and complexity to arrive at their estimated cost. Other system items such as optics, antennas, batteries and displays are costed from a set of assumption tables derived from a combination of industry data, average high volume costs, and external sources. For final assembly, we re-build the torn-down product, tabulating stepwise assembly times as the reconstruction proceeds, to reach a total assembly time. Using a labor rate assumption for the country of origin, we then calculate final assembly cost.

The three major categories for system cost contributors can be broken down into the subcategories of ICs, other electronics parts, displays, batteries (as appropriate), camera modules, electronics assembly, non-electronic elements, and final assembly. By adding the cost estimates for each of these subcategories, an overall estimated cost is derived for the system under evaluation. Product packaging and accessories (CDs, cables, etc.) are also documented and estimated for their contribution to total cost as appropriate.

We believe our cost estimates generally fall within 15 percent of the "right answer," which itself can vary depending on the market and OEM-specific factors mentioned earlier. While the TechInsights cost model is imperfect, it yields important insights into technology and business dynamics along with good first-order contributions to system cost by component type. Additionally, the consistency of approach and gradual modification to assumptions (smoothing out frequently-shifting pricing factors) hopefully yields a credible, but user-modifiable, view of OEM high volume cost-to-produce.

Please feel free to contact us at support@techinsights.com with any comments, questions, or proposed corrections with respect to our cost estimates. We welcome your input.

Metrics

Overview and Discussion

In our product teardowns, we gather a series of metrics for product profiling and comparison. Some metrics focus on system characteristics such as total silicon area, total system semiconductor storage capacity, and total connection count. Other metrics reflect more subtle aspects of electronics assembly such as connection density, average component I/O count, and silicon tiling density. Taken as a whole, the metrics allow deeper comparison and benchmarking across multiple disciplines and multiple products. Key metrics we gather on products are described below along with their definitions and what they tend to say about the system under study. Most metrics can be used both in comparing similar products for benchmarking purposes or for quantifying differences in levels of complexity between dissimilar product types. Data fall into two categories; either "raw" measured data or ratios of these measured data sets.

Total Silicon Area : This metric describes the total area of silicon as measured from X-ray or direct measurement of ICs. The area is an expression of the enclosed bare die area and excludes packaging area. The aggregate silicon area is a good benchmark to show how integrated a design might be when making comparisons to similar systems. Total silicon area also reflects the major cost driver for most systems we examine.

Silicon Tiling Density : Ratio of Total Silicon Area to total printed circuit board "projected" area (i.e. the simple board area and not the cumulative surface area of both sides of the board). This metric directly reflects the level of efficiency and aggressiveness in integrated circuit packing and placement. Single digit Silicon Tiling Density is typical but silicon coverage of 10% - 20% has been seen in some of the most advanced products we have examined. Higher Tiling Densities often correspond with the use of chip scale packaging (CSPs) or other small form-factor IC packaging technologies. High density circuit boards are also often a supporting technology.

Number of Parts : Total component count including ICs, passives, modules, connectors, etc., each separated out in our reporting.

Number of Connections : The total number of connections corresponds to the total number of interconnects introduced by the aggregate component set and reflects any electrical connection observed (solder joints, adhesive interconnect, or connector terminal interfaces).

Opportunity Count : Opportunity Count is the total number of parts plus the total number of connections; the name reflects that each of these constituent elements represents an opportunity for failure. A high opportunity count means more complex and riskier electronics assembly.

Average Pin Count (APC) : Ratio of total number of component terminals to total number of parts, at the system level. This metric reflects the 'average' terminal complexity of the components and often provide a signature of integration level and/or "digital-ness" of the overall product. Low APCs reflect a high number of discretes or other low-pincount devices often characteristic of analog circuitry. Conversely, high APCs are characteristic of highly integrated, high-pincount assemblies, often those composed largely of digital integrated circuits.

Connection Density : This metric is a ratio of the total Number of Connections to total printed circuit board assembly area, in units of connections per sq. inch. The metric provides data related to the Silicon Tiling Density above, but with an emphasis on complexity of I/O interconnect. For example, with a fixed Connection Density, high tiling density of low-pincount memory chips is more readily achieved than comparable silicon tiling of high pincount logic.

Part Density : This metric is a ratio of the total Number of Parts to total printed circuit board assembly area, in units of components per sq. inch. The metric provides data related to the Silicon Tiling Density and Connection Density as described above, but with an emphasis on density and complexity of component packing efficiency. For example, low Part Density of high-pincount devices can pose an equal challenge in Connection Density to high Part Density of low-pincount devices. High Part Density does reflect challenges in surface mount assembly in terms of (typically) precision of placement, number of placements, and engineering of part clearances.

Routing Density (heuristic estimate) = $3 * (\text{Average Pin Count}) * \sqrt{\text{Part Density}}$. The Routing Density metric is an empirically derived relationship that characterizes the wiring density of the interconnect used to support the interconnection of components in a planar electronic assembly (i.e. the circuit board). Architectural issues such as bussing or other factors affecting the regularity of wiring impact the actual Routing Density needed to support a given application, but the metric provides a ready measure of wiring complexity.