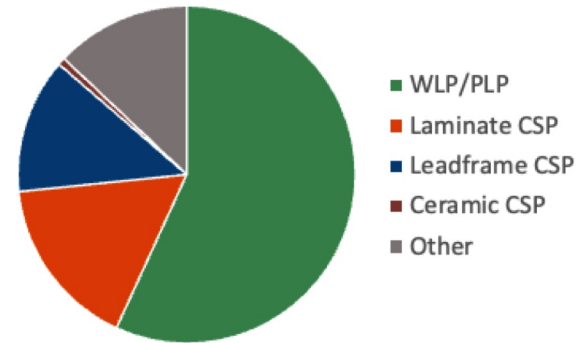


Apple Watch Series 8 (GPS + Cellular)

Teardown from TechSearch International, Inc.



139 Packages Examined



Contents and Highlights

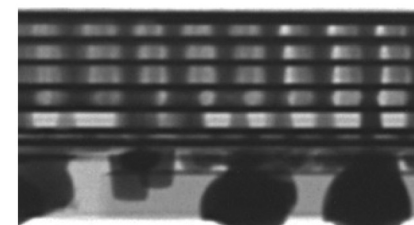
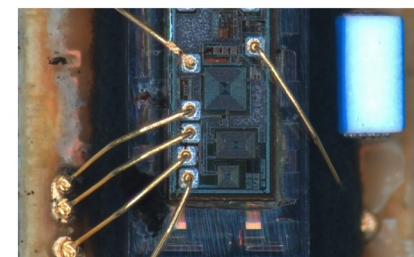
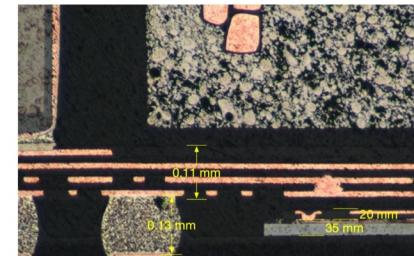
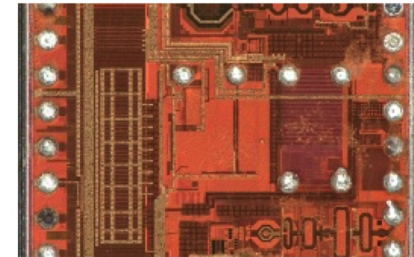
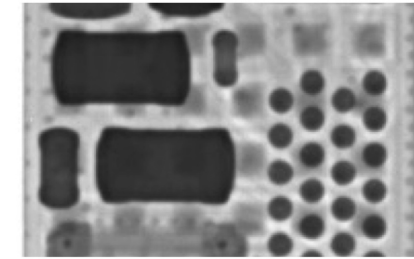
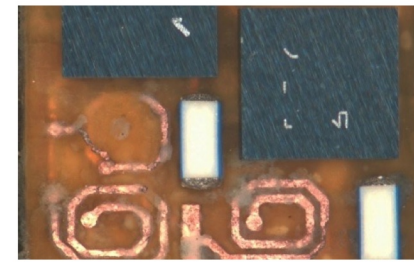
- 145-page report with photos of packages (before and after decapsulation), x-rays, package dimensions, and die metrics and images
- 22 slides with extra details covering advanced packaging technology characteristics and interesting finds
- The watch and the wireless charger that ships with it contain a total of 139 packaged chips, of which 57% are wafer-level packages (WLPs); there are a total of 172 die and of those 33% use wire bond interconnect
- S8 highly integrated module contains 38 packaged devices encapsulated within and each of these were extracted from the module for further examination

Teardowns backed by 36 years serving as the industry's trusted source for semiconductor packaging trend analysis

- Examination of all chips with emphasis on assembly and packaging technologies
- Superb quality photographs and x-ray images
- Both the packages and the die within are identified and characterized
- Detailed construction analysis of key chips and packages



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Sample pages from the report and slides

Apple Watch Series 8 (GPS + Cellular)

A2772

category Wearable
released Sep 2022



Package quantities (by package type)

WLP/PLP	
Laminate CSP	
Leadframe CSP	
MIS CSP	
Ceramic CSP	
Other	
TOTAL	

Die quantities (by die interconnect type)

RDL/WLP	
Flip chip	
Wire bond	
Clip	
TOTAL	

Package area Bare die solutions included excluded

Die area

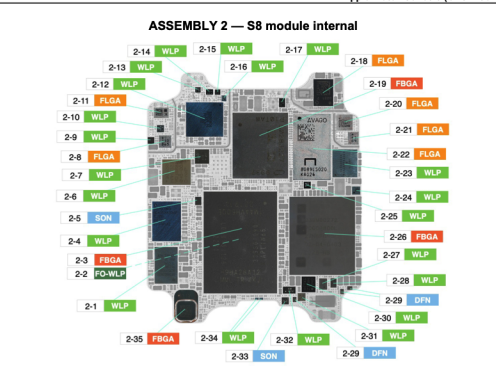
Die / package

Package = Any device that has completed final packaging steps, includes all interconnect packages as well as finished packages mounted inside other packages/modules. Content includes not covered in packages. Bare die solutions = Finished devices received directly on boards or flex circuits (e.g., chip on board, chip on flex, chip on substrate, etc.)

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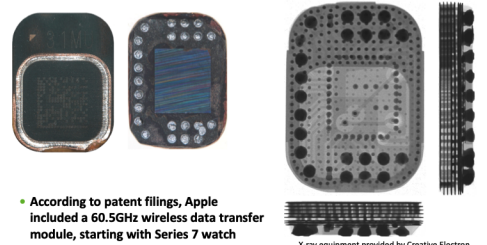
ASSEMBLY 2 — S8 module internal

Apple Watch Series 8 (GPS + Cellular)



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60.5GHz Antenna & Transmitter Module



- According to patent filings, Apple included a 60.5GHz wireless data transfer module, starting with Series 7 watch
 - Module only activated when the watch is placed on a proprietary magnetic dock with a corresponding 60.5GHz module
 - Module appears to be only for use by Apple for diagnostic purposes
- Antenna-in-package (AIP) design with transmitter IC flip chip attached to bottom
- Assembled by USI

X-ray equipment provided by Creative Electron.

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PACKAGE QUANTITY DETAILS

Apple Watch Series 8 (GPS + Cellular)

Board-level assembled packages

WLP/PLP	
Laminate CSP	
Leadframe CSP	
MIS CSP	
Ceramic CSP	
Bare die on board/flex	
Other	
TOTAL	

Package-level assembled packages

WLP/PLP	
Laminate CSP	
Leadframe CSP	
MIS CSP	
Ceramic CSP	
Other	
TOTAL	

Board-level = Packaged devices mounted to boards, flex circuits, etc. during electronics assembly
Package-level = Pre-packaged devices assembled inside other encapsulated packages or modules
L = Laminate substrate; C = Ceramic substrate

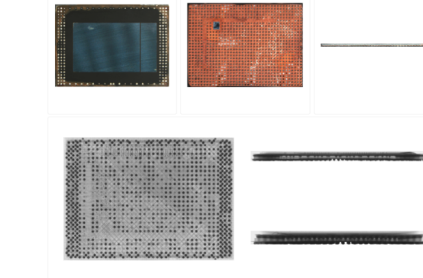
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ASSEMBLY 2 — S8 module internal

Apple Watch Series 8 (GPS + Cellular)

2-2 1 Apple Dual-core 64-bit AP 339801090 APL1W86 Logic

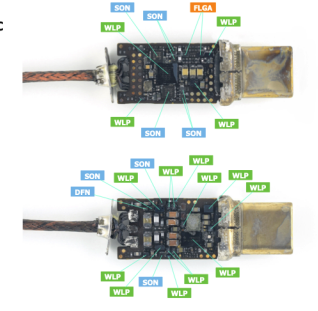
FO-WLP (WLP/PLP)



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Wireless Charger Cable with USB-C Connector

- Wireless charger with USB-C connector has total of 29 packages inside
- For comparison, the wireless charger with lightning connector that shipped with Apple Watch Series 6 contained 18 packages



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PACKAGES BY SUPPLIER LOCATION

Supplier HQ

China	
Europe	
Japan	
Korea	
N America	
SE Asia	
Taiwan	
Other	
unknown	
TOTAL	

Geographic quantities based on headquarters location of chip suppliers; includes bare die solutions

PACKAGE AREA BY CHIP TYPE

Chip Type

Analog/Mixed-signal	
RF analog	
Logic	
Memory	
Sensor-Actuator	
Image sensor	
Discrete	
OpIc	
RF Passive	
IPD	
unknown	
TOTAL	

Measured width x length; includes bare die solutions

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ASSEMBLY 4 — Sensors flex circuits

Apple Watch Series 8 (GPS + Cellular)

Component Details Pre-packaged chip count: 5

4-1-1 1 Analog Devices Analog front-end IC	4-1-2 1 Nexperia ESD protection diode
4-1-3 1 Infineon TVS diode for ESD protection	4-1-4 1 Infineon TVS diode for ESD protection
4-1-5 1 Infineon TVS diode for ESD protection	

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List of Packages

QTY	REF ID	MANUFACTURER	DESCRIPTION	PACKAGE	HEIGHT	CONTACT	REF ID	QTY	REF ID	DESCRIPTION
11	1	Skyworks	SKY73244-4 RF PAM (LB)	RF Analog	FLGA	4.52 x 4.13 x 0.77	63	4	7	Flip Chip die, Wire Bond die, Double side, Stacking (conformal), Stacked die, Stacking (conformal)
12	1	USI	GNSS receiver module with Broadcom BCM4777	RF Analog	FLGA					Shielding (conformal)
12	1	Broadcom	BCM4777 GPS/Bluetooth receiver	RF Analog	WLP					
13	1	Bosch Sensortec	BMG28x 6-axis IMU	Sensor-Actuator	FLGA					Wire Bond die, Stacked die
14	1	USI	UWB module with U1 chip	RF Analog	FLGA					Shielding (conformal)
14	1	Apple	33850641 U1 UWB receiver IC	RF Analog	WLP					
15	2	unknown supplier	ESD protection diode	Discrete	WLP					
21	1	Broadcom	BCM5936 Wireless charger	Analog/Mix-Sig	WLP					Underfill
22	1	Apple	339801090 APL1W86 Dual-core 64-bit AP	Logic	FO-WLP					Underfill, Flip Chip die
23	1	SK Hynix	HK42BA12M MCF (12Gb LPDDR4X ML) (8GB NAND)	Memory	FBGA					Underfill, Wire Bond die, Stacked die
24	1	Broadcom	BCM1524 Custom analog/digital control unit (ECC) ASIC	Logic	WLP	4.95 x 3.57 x 0.37	95	0.4	1	Underfill
25	1	Texas Instruments	LSF0101Q1QR Video lens transmitter	Logic	SON					Wire Bond die
26	1	NXP	SN230 NFC controller	RF Analog	WLP					Underfill
27	1	STMicroelectronics	V484148 PMIC	Analog/Mix-Sig	WLP					Underfill
28	1	Skyworks	RF FEM	RF Analog	FLGA					Flip Chip die, Shielding (conformal)
29	1	Renesas (S8eq)	SL6509M series Power switch	Analog/Mix-Sig	WLP					Underfill
29	1	Sony Semiconductor	CXA4502 Antenna switch	RF Analog	WLP					Underfill
211	1	Murata	SG receiver	RF Analog	FLGA					Flip Chip die, Shielding (conformal)
212	1	Apple	33850638 Wi-Fi/Bleutooth IC	RF Analog	WLP					Underfill
213	1	Sony Semiconductor	CXA4503 Antenna switch	RF Analog	WLP					Underfill

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