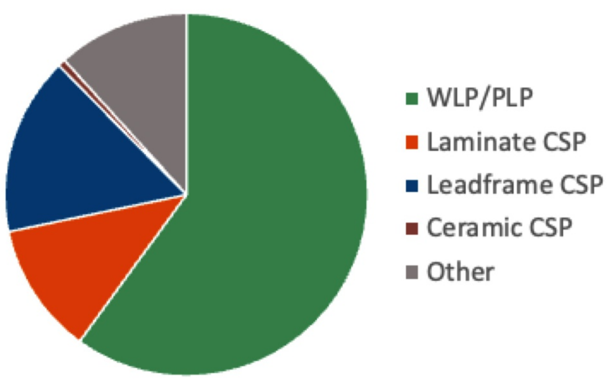
Apple Watch Series 10 (GPS+LTE)

Teardown from TechSearch International, Inc.

145 Packages Examined



Contents and Highlights

- 133-page report with package quantity summaries, high-resolution photos and X-rays, package dimensions, part numbers and descriptions, as well as analysis of packaging and assembly technologies discovered from package decapsulation
- Each of the 35 packages encapsulated inside the S10 highly integrated module were extracted and analyzed individually
- 25 additional slides with construction analysis details for packages such as:
  - InFO-PoP assembly with the bottom package as a two-die FO-WLP consisting of application processor and PMIC and the top package containing DRAM and NAND die
  - RF FEMs such as Broadcom AFEM-8089, Skyworks SKY78278-18, USI 339M00473 UWB module
  - Touchcreen control module with reduced size compared to previous generation

Teardowns backed by 38 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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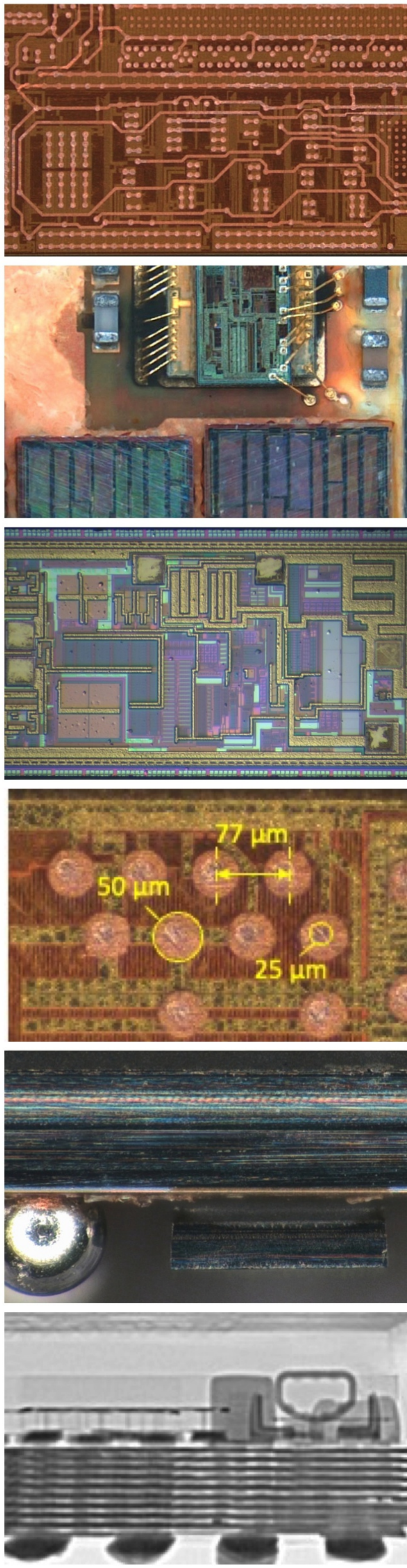
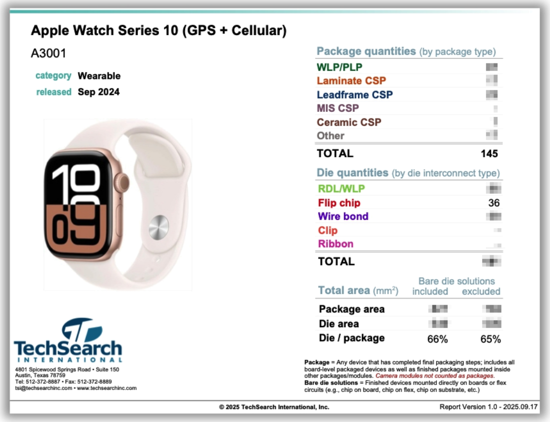


Sample pages from the report and slides



Apple Watch Series 10 (GPS + Cellular)

A3001

category **Wearable**
released **Sep 2024**

Package quantities (by package type)	
WLP/PLP	[redacted]
Laminate CSP	[redacted]
Leadframe CSP	[redacted]
MIS CSP	[redacted]
Ceramic CSP	[redacted]
Other	[redacted]
TOTAL	145

Die quantities (by die interconnect type)	
RDL/WLP	[redacted]
Flip chip	36
Wire bond	[redacted]
Clip	[redacted]
Ribbon	[redacted]
TOTAL	[redacted]

Total area (mm²)	Bare die solutions included	Bare die solutions excluded
Package area	[redacted]	[redacted]
Die area	[redacted]	[redacted]
Die / package	66%	65%

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Package = Any device that has completed final packaging steps; includes all board-level packaged devices as well as finished packages mounted inside other packages/modules. *Camera modules not counted as packages.*
Bare die solutions = Finished devices mounted directly on boards or flex circuits (e.g., chip on board, chip on flex, chip on substrate, etc.)

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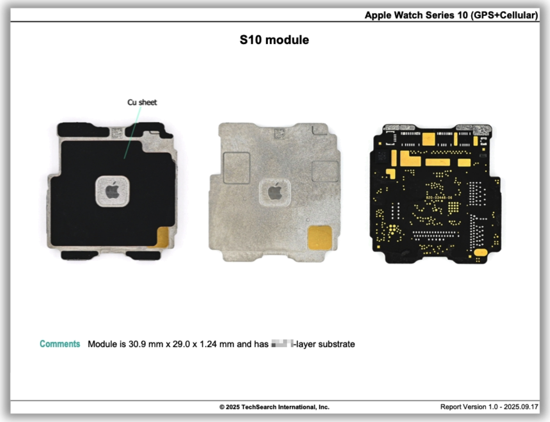

Apple Watch Series 10 (GPS+Cellular)

S10 module

Comments Module is 30.9 mm x 29.0 x 1.24 mm and has [redacted]-layer substrate

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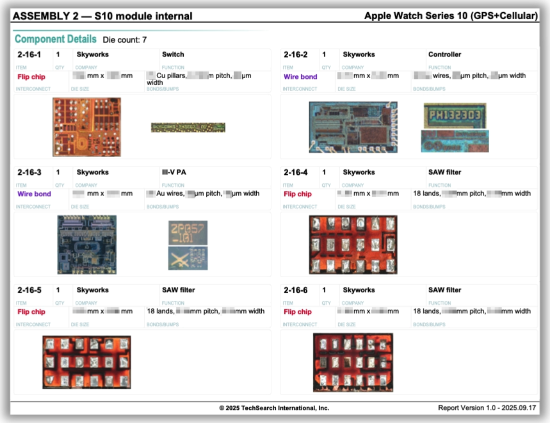

ASSEMBLY 2 — S10 module internal Apple Watch Series 10 (GPS+Cellular)

Component Details Die count: 7

ITEM	QTY	COMPANY	FUNCTION	INTERCONNECT	DIE SIZE	BONDS/BUMPS
2-16-1	1	Skyworks	Switch	Flip chip	[redacted] mm x [redacted] mm	[redacted] Cu pillars, [redacted]m pitch, [redacted] µm width
2-16-2	1	Skyworks	Controller	Wire bond	[redacted] mm x [redacted] mm	[redacted] wires, [redacted] µm pitch, [redacted] µm width
2-16-3	1	Skyworks	III-V PA	Wire bond	[redacted] mm x [redacted] mm	[redacted] Au wires, [redacted] µm pitch, [redacted] µm width
2-16-4	1	Skyworks	SAW filter	Flip chip	[redacted] mm x [redacted] mm	18 lands, [redacted] mm pitch, [redacted] mm width
2-16-5	1	Skyworks	SAW filter	Flip chip	[redacted] mm x [redacted] mm	18 lands, [redacted] mm pitch, [redacted] mm width
2-16-6	1	Skyworks	SAW filter	Flip chip	[redacted] mm x [redacted] mm	18 lands, [redacted] mm pitch, [redacted] mm width

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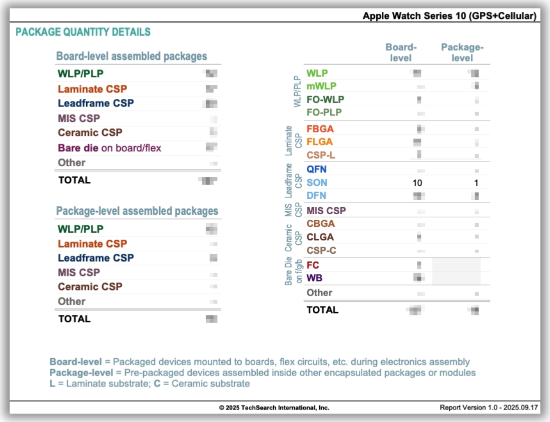

Apple Watch Series 10 (GPS+Cellular)

PACKAGE QUANTITY DETAILS

Board-level assembled packages	
WLP/PLP	[redacted]
Laminate CSP	[redacted]
Leadframe CSP	[redacted]
MIS CSP	[redacted]
Ceramic CSP	[redacted]
Bare die on board/flex	[redacted]
Other	[redacted]
TOTAL	[redacted]

Package-level assembled packages	
WLP/PLP	[redacted]
Laminate CSP	[redacted]
Leadframe CSP	[redacted]
MIS CSP	[redacted]
Ceramic CSP	[redacted]
Other	[redacted]
TOTAL	[redacted]

		Board-level	Package-level
WLP/PLP	WLP	[redacted]	[redacted]
	mWLP	[redacted]	[redacted]
	FO-WLP	[redacted]	[redacted]
	FO-PLP	[redacted]	[redacted]
Laminate CSP	FBGA	[redacted]	[redacted]
	FLGA	[redacted]	[redacted]
	CSP-L	[redacted]	[redacted]
Leadframe CSP	QFN	[redacted]	[redacted]
	SON	10	1
	DFN	[redacted]	[redacted]
MIS CSP	MIS CSP	[redacted]	[redacted]
Ceramic CSP	CBGA	[redacted]	[redacted]
	CLGA	[redacted]	[redacted]
	CSP-C	[redacted]	[redacted]
Bare Die on f/g/b	FC	[redacted]	
	WB	[redacted]	
	Other	[redacted]	[redacted]
	TOTAL	[redacted]	[redacted]

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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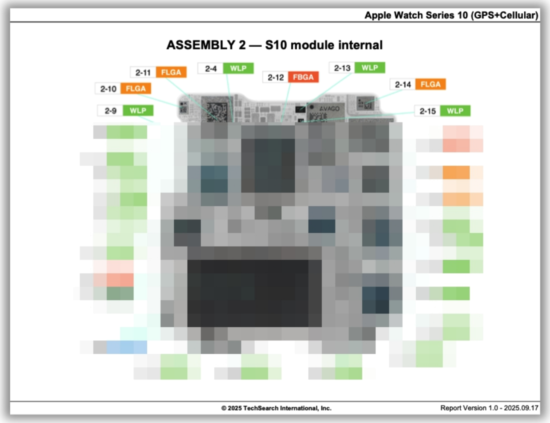

Apple Watch Series 10 (GPS+Cellular)

ASSEMBLY 2 — S10 module internal

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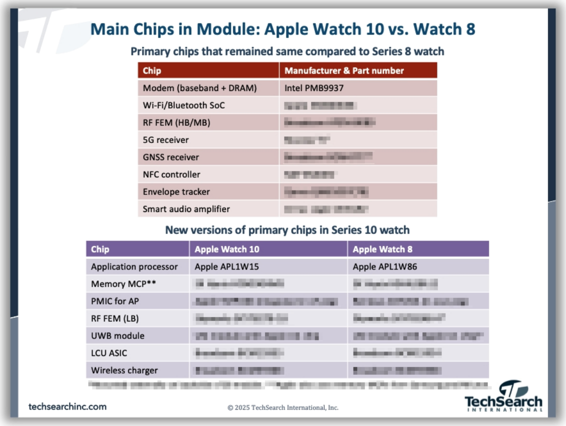

Main Chips in Module: Apple Watch 10 vs. Watch 8

Primary chips that remained same compared to Series 8 watch

Chip	Manufacturer & Part number
Modem (baseband + DRAM)	Intel PMB9937
Wi-Fi/Bluetooth SoC	[redacted]
RF FEM (HB/MB)	[redacted]
5G receiver	[redacted]
GNSS receiver	[redacted]
NFC controller	[redacted]
Envelope tracker	[redacted]
Smart audio amplifier	[redacted]

New versions of primary chips in Series 10 watch

Chip	Apple Watch 10	Apple Watch 8
Application processor	Apple APL1W15	Apple APL1W86
Memory MCP**	[redacted]	[redacted]
PMIC for AP	[redacted]	[redacted]
RF FEM (LB)	[redacted]	[redacted]
UWB module	[redacted]	[redacted]
LCU ASIC	[redacted]	[redacted]
Wireless charger	[redacted]	[redacted]

[redacted]

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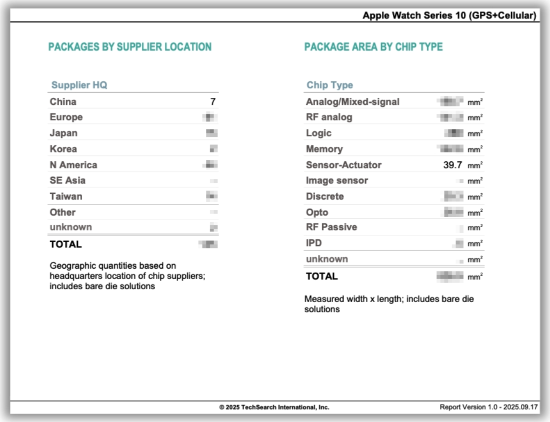

Apple Watch Series 10 (GPS+Cellular)

PACKAGES BY SUPPLIER LOCATION

Supplier HQ	
China	7
Europe	[redacted]
Japan	[redacted]
Korea	[redacted]
N America	[redacted]
SE Asia	[redacted]
Taiwan	[redacted]
Other	[redacted]
unknown	[redacted]
TOTAL	[redacted]

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

PACKAGE AREA BY CHIP TYPE

Chip Type	
Analog/Mixed-signal	[redacted] mm²
RF analog	[redacted] mm²
Logic	[redacted] mm²
Memory	[redacted] mm²
Sensor-Actuator	39.7 mm²
Image sensor	[redacted] mm²
Discrete	[redacted] mm²
Opto	[redacted] mm²
RF Passive	[redacted] mm²
IPD	[redacted] mm²
unknown	[redacted] mm²
TOTAL	[redacted] mm²

Measured width x length; includes bare die solutions

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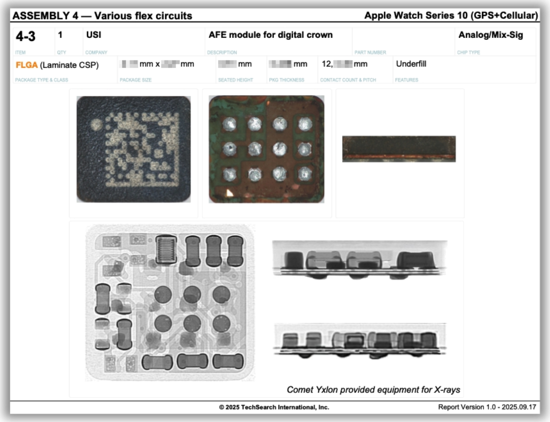

ASSEMBLY 4 — Various flex circuits Apple Watch Series 10 (GPS+Cellular)

ITEM	QTY	COMPANY	DESCRIPTION	PART NUMBER	CHIP TYPE
4-3	1	USI	AFE module for digital crown		Analog/Mix-Sig

PACKAGE TYPE & CLASS	PACKAGE SIZE	SEATED HEIGHT	PKG THICKNESS	CONTACT COUNT & PITCH	FEATURES
FLGA (Laminate CSP)	[redacted] mm x [redacted] mm	[redacted] mm	[redacted] mm	12, [redacted] mm	Underfill

Comet Yxlon provided equipment for X-rays

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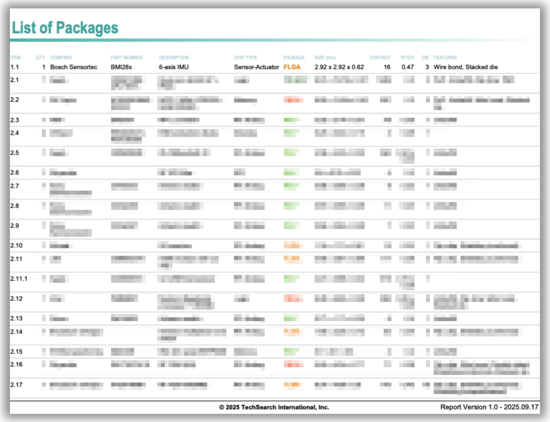

List of Packages

ITEM	QTY	COMPANY	PART NUMBER	DESCRIPTION	CHIP TYPE	PACKAGE	SIZE (mm)	CONTACT	PITCH	DIE	FEATURES
1.1	1	Bosch Sensortec	BMI28x	6-axis IMU	Sensor-Actuator	FLGA	2.92 x 2.92 x 0.62	16	0.47	3	Wire bond, Stacked die
2.1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
2.5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.6	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.10	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.11.1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
2.12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.14	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2.17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

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