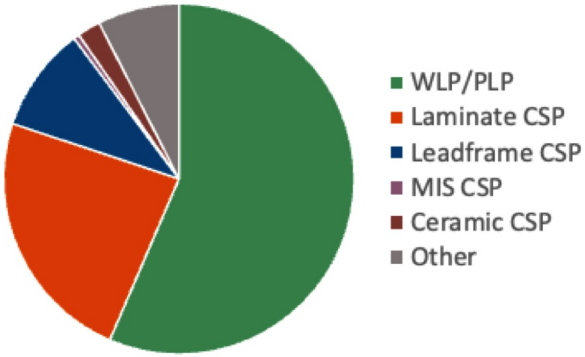
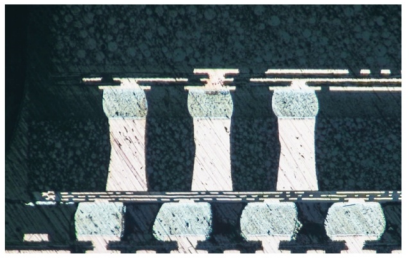
Apple iPhone 15 Pro

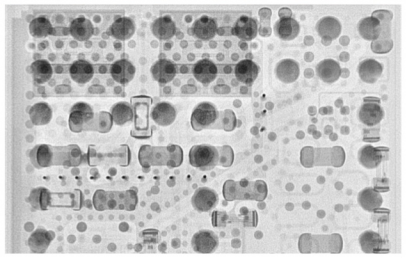
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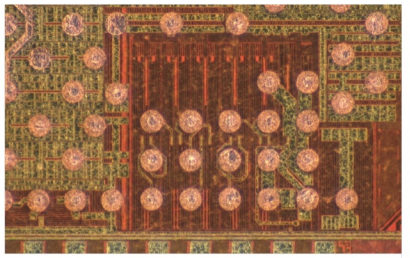




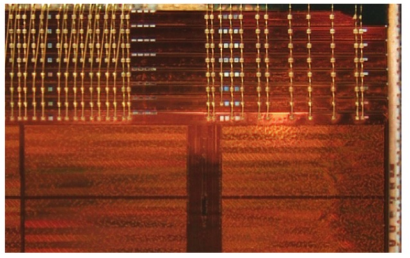












Contents and Highlights

- 246-page report with package quantity summaries, high-resolution photos and x-rays, package dimensions, thermal management analysis
- 39 additional slides with extra details including PoP and main board cross sections, advanced packaging technology characteristics, and interesting finds
- Every package in the phone examined, including decapsulation and analysis of the die contained within
- Deep analysis of Apple's A17 Pro application processor in FO-WLP, including layer and Cu stud metrics from cross sections
- The phone features some brand new sensors such as a combined Face ID and proximity sensor module and redesigned LiDAR sensor module

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 iPhone 15 Pro

A2848

category Smartphone (high-end)

released Sep 2023

Package quantities (by package type)

WLP/PLP	
Laminate CSP	
Leadframe CSP	
MIS CSP	
Ceramic CSP	
Other	
TOTAL	186

Die quantities (by die interconnect type)

RDL/WLP	
Flip chip	
Wire bond	
Clip	
Ribbon	
TOTAL	

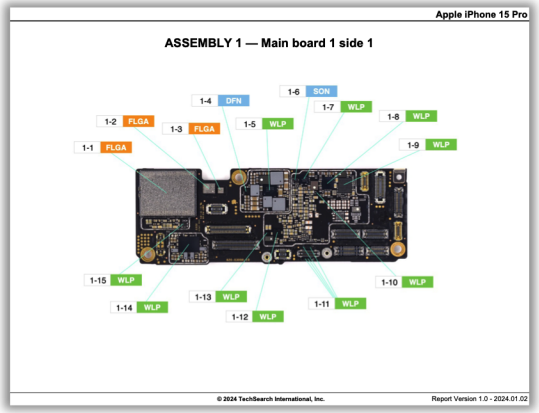
Total area (mm²)	Bare die solutions included	Bare die solutions excluded
Package area		
Die area		
Die / package	%	%

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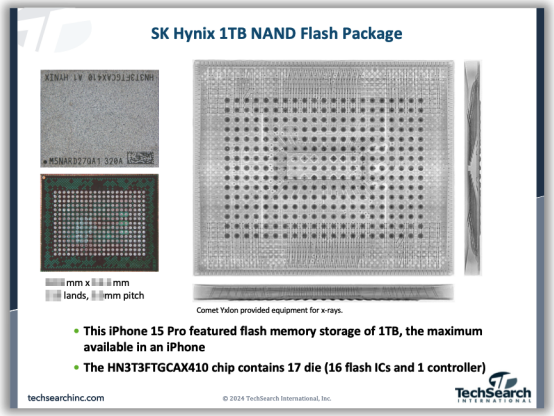
Package = Any device that has completed final packaging steps; includes all board-level packaged devices as well as finished packages mounted inside other packages/modules. *Camera modules not counted as packages.*
Bare die solutions = Finished devices mounted directly on boards or flex circuits (e.g.,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

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ASSEMBLY 1 — Main board 1 side 1

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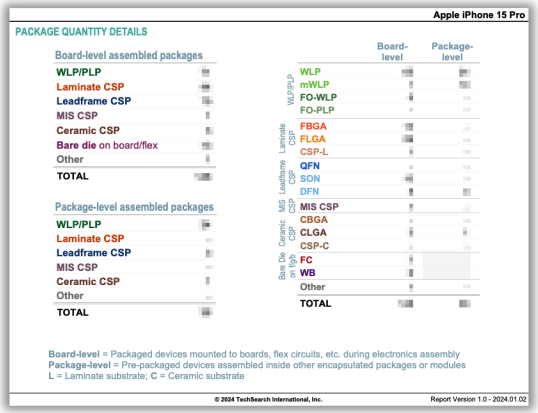

SK Hynix 1TB NAND Flash Package

mm x mm
lands, mm pitch

Comet Yxlon provided equipment for x-rays.

- This iPhone 15 Pro featured flash memory storage of 1TB, the maximum available in an iPhone
- The HN3T3FTGCAX410 chip contains 17 die (16 flash ICs and 1 controller)

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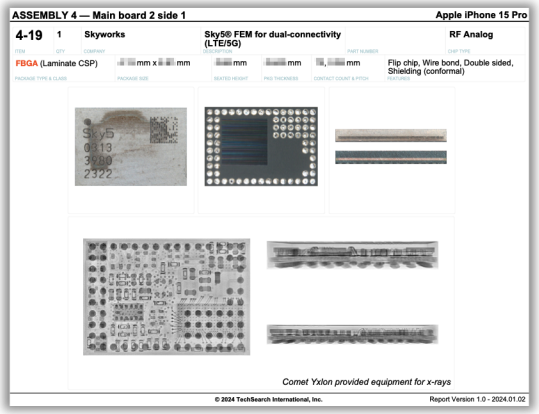


PACKAGE QUANTITY DETAILS

	Board-level	Package-level
WLP/PLP		
WLP		
mWLP		
FO-WLP		
FO-PLP		
Laminate CSP		
FBGA		
FLGA		
CSP-L		
Leadframe CSP		
QFN		
SON		
DFN		
MIS CSP		
MIS CSP		
Ceramic CSP		
CBGA		
CLGA		
CSP-C		
Bare Die or SiP		
FC		
WB		
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

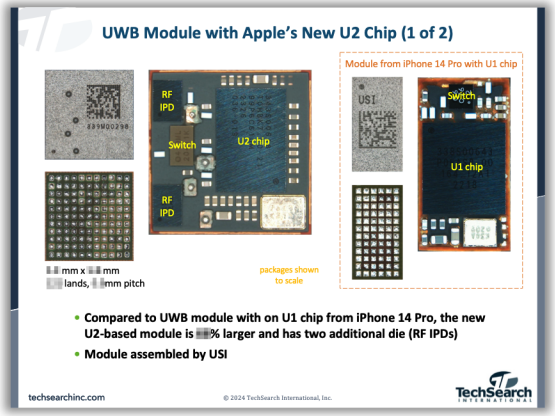
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4-19	1	Skyworks	Sky5® FEM for dual-connectivity (LTE/5G)	RF Analog
FBGA (Laminate CSP)		mm x mm	mm	mm, mm	Flip chip, Wire bond, Double sided, Shielding (conformal)

Comet Yxlon provided equipment for x-rays

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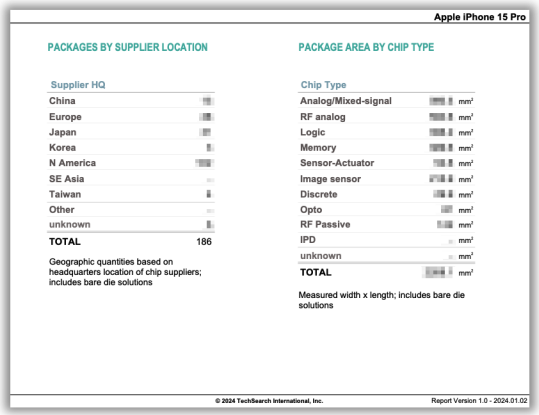

UWB Module with Apple's New U2 Chip (1 of 2)

mm x mm
lands, mm pitch

packages shown to scale

- Compared to UWB module with on U1 chip from iPhone 14 Pro, the new U2-based module is % larger and has two additional die (RF IPDs)
- Module assembled by USI

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PACKAGES BY SUPPLIER LOCATION

Supplier HQ	
China	
Europe	
Japan	
Korea	
N America	
SE Asia	
Taiwan	
Other	
unknown	
TOTAL	186

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

PACKAGE AREA BY CHIP TYPE

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

Measured width x length; includes bare die solutions

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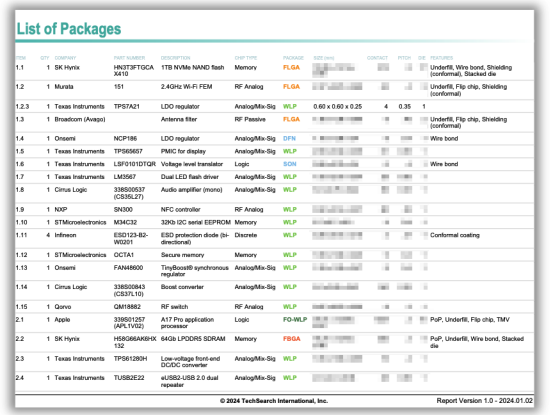
Component Details Die count: 3

4-1-1	1	Qualcomm	Baseband processor
Flip chip		mm x mm	Cu pillars, µm pitch, µm width

4-1-2	2	Samsung Semiconductor	DRAM
Wire bond		mm x mm	Cu wires, µm pitch, µm width

Additional Images

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List of Packages

		Company	Part Number	Description	Chip Type	Package	Body (mm)	Contact	Pitch	Die	Die Features
1.1	1	SK Hynix	HN3T3FTGCA X410	1TB NVMe NAND flash	Memory	FLGA					Underfill, Wire bond, Shielding (conformal), Stacked die
1.2	1	Murata	151	2.4GHz Wi-Fi FEM	RF Analog	FLGA					Underfill, Flip chip, Shielding (conformal)
1.2.3	1	Texas Instruments	TPS7A21	LDO regulator	Analog/Mix-Sig	WLP	0.60 x 0.60 x 0.25	4	0.35	1	
1.3	1	Broadcom (Avago)		Antenna filter	RF Passive	FLGA					Underfill, Flip chip, Shielding (conformal)
1.4	1	Onsemi	NCP186	LDO regulator	Analog/Mix-Sig	DFN					Wire bond
1.5	1	Texas Instruments	TPS65657	PMIC for display	Analog/Mix-Sig	WLP					
1.6	1	Texas Instruments	LSF0101DTQR	Voltage level translator	Logic	SON					Wire bond
1.7	1	Texas Instruments	LM3567	Dual LED flash driver	Analog/Mix-Sig	WLP					
1.8	1	Cirrus Logic	338S00537 (CS35L27)	Audio amplifier (mono)	Analog/Mix-Sig	WLP					
1.9	1	NXP	SN300	NFC controller	RF Analog	WLP					
1.10	1	STMicroelectronics	M34C32	32Kb I2C serial EEPROM	Memory	WLP					
1.11	4	Infineon	ESD123-B2-W0201	ESD protection diode (bi-directional)	Discrete	WLP					Conformal coating
1.12	1	STMicroelectronics	OCTA1	Secure memory	Memory	WLP					
1.13	1	Onsemi	FAN48600	TinyBoost® synchronous regulator	Analog/Mix-Sig	WLP					
1.14	1	Cirrus Logic	338S00843 (CS37L10)	Boost converter	Analog/Mix-Sig	WLP					
1.15	1	Qorvo	QM18862	RF switch	RF Analog	WLP					
2.1	1	Apple	339S01257 (APL1V02)	A17 Pro application processor	Logic	FO-WLP					PoP, Underfill, Flip chip, TMV
2.2	1	SK Hynix	H9JG66AK6HX 132	64Gb LPDDR5 SDRAM	Memory	FBGA					PoP, Underfill, Wire bond, Stacked die
2.3	1	Texas Instruments	TPS61280H	Low-voltage front-end DC/DC converter	Analog/Mix-Sig	WLP					
2.4	1	Texas Instruments	TUSB2E22	eUSB2-USB 2.0 dual repeater	Analog/Mix-Sig	WLP					

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