

Trade in ICT goods statistics: Impacts of the 2022 update to the Harmonized Commodity Description and Coding System

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Summary

Merchandise imports and exports data classified according to the World Customs Organisation (WCO) Harmonized Commodity Description and Coding System - generally referred to as "Harmonized System" or simply "HS" – are the building blocks for statistics on trade in ICT goods. Each HS product code must be considered against the definition of ICT goods to identify those included when compiling ICT goods trade. The HS nomenclature is updated periodically to reflect changes in the nature of products – including rapid advances in products incorporating digital technologies. The 2022 edition (HS22) introduced various changes to the HS structure, including additional product breakdowns within ICT goods product codes, deletion of codes that had formerly been recorded as ICT goods, and the addition of substantive new classes of product codes which need to be assessed against the definition. This technical note sets out the relevant changes and identifies their implications for measuring ICT goods trade.

1. Introduction: statistics on the trade in ICT goods

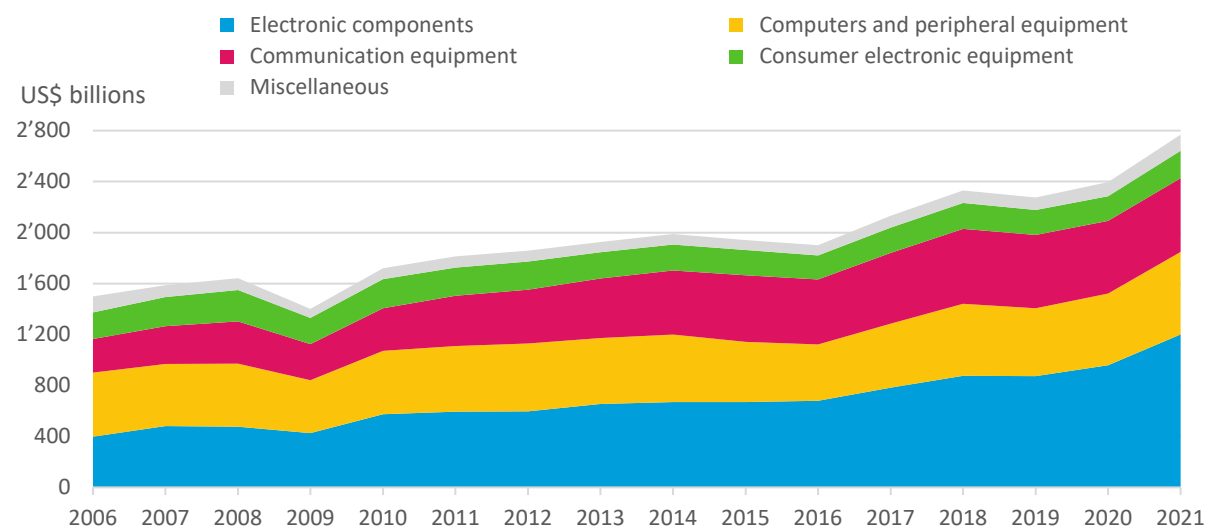
Information and communications technologies (ICTs) play a fundamental enabling role in the on-going digital transformation of economies and societies. Statistics on the trade in ICT goods and services provide a key means of assessing, analysing, and illustrating patterns of digitalisation worldwide. ICT goods are a crucial element because having the hardware needed to construct, maintain, and access computer networks – most notably the Internet – is a prerequisite for being able to consume or produce ICT services and other forms of digitally delivered services. Furthermore, because the production of ICT goods is heavily concentrated in a relatively small number of economies, statistics on imports of these products can reveal insights into the extent of digitalisation in different countries.

Exports of ICT goods reached almost US\$ 2.8 trillion worldwide in 2021 (Figure 1). Electronic components, which are used as inputs both to products themselves recorded as ICT goods and to other electronic goods such as household appliances, accounted for over two-fifths of this total. Computers and peripheral equipment and Communication equipment were the other major elements, accounting for around one fifth of ICT goods exports each.

* Mention of any firm or licensed process does not imply the endorsement of the United Nations. This document has not been formally edited.

Figure 1. Exports of ICT goods, worldwide, 2006 – 2021

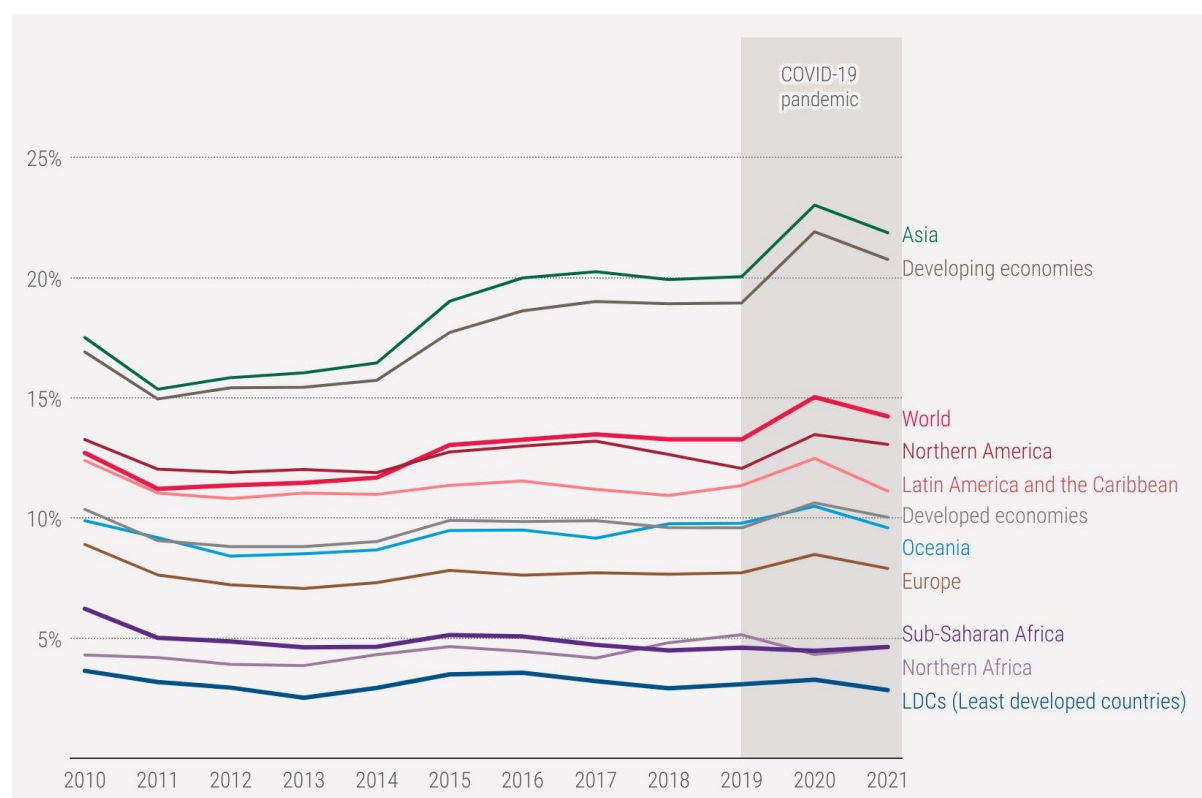
US\$ billions, current prices



Source: UNCTAD digital economy database (available at: <https://unctadstat.unctad.org/wds>)

ICT goods account for around 15 per cent of merchandise imports worldwide (Figure 2), a share that increased as the disruption of the COVID-19 pandemic provided a sudden need for more businesses and individuals to get online. The share is especially high on average across developing economies, at around 21 per cent - though this is dominated by those in Asia, with much lower shares seen in Latin America and the Caribbean (11 per cent), Africa (5 per cent), and the least developed countries (LDCs; 3 per cent).

Figure 2: ICT goods as a share of merchandise imports, by region, 2010 - 2021



Source: UNCTAD digital economy database (available at: <https://unctadstat.unctad.org/wds>)

2. HS 2022 creates a need to (re)assess which categories of merchandise should be classed as ICT goods

Data from customs declarations are the main source for International Merchandise Trade Statistics. As such, they also underpin the UN Comtrade Database, the UNCTAD International Merchandise Trade database, and the UNCTAD ICT goods trade statistics in the UNCTAD Stats database.

For 2022, the World Customs Organisation (WCO) revised its Harmonized Commodity Description and Coding System, generally referred to as "Harmonized System" or simply "HS". The 2022 edition (HS22) brought the number of commodity codes to 7,710, up from 7,437 in 2017 (HS17). Many of the changes impact product categories included in measures of trade in ICT goods. Furthermore, HS22 also introduced several substantive new categories of products, many of which are products integrating digital technologies and therefore merit some consideration against the definition of ICT goods.

It is necessary to decide which of the product codes set out in the HS22 classifications meet the definition of ICT goods. Furthermore, it is necessary to consider how codes introduced in HS22 should be mapped to classes in HS17 to facilitate the compilation of back-series for ICT goods trade.

3. What are ICT goods?

ICT products – whether goods or services - were defined by the OECD (2011): “ICT products **must** primarily be intended to fulfil or enable the function of **information processing** and **communication** by electronic means, **including transmission and display**”.

This definition establishes several clear criteria, which a good must meet in order to be classified as an ICT good. Firstly, it must not only “fulfil or enable” information processing by electronic means but also communication by electronic means. Furthermore, that communication must include both transmission and display.

Strictly speaking, any good that does not have all these features does not meet this definition. However, the list of HS17 products included as ICT goods[†] yields various such products which do not meet all of these conditions simultaneously. For example, while most products in HS 851810 “Microphones and stands therefor” can presumably capture sound waves and process them into an electronic signal which is then transmitted onward these products do not generally fulfil or enable the electronic display of information. Therefore, the definition appears to be interpreted and applied somewhat flexibly in practice.

Additionally, the wording “primarily intended to fulfil” is challenging. Whose intention matters? That of the inventor? The producer? The purchaser? And how can it be determined what their intention actually was or is? Or whether the eventual use is a primary or secondary intention of these parties? The Harmonized System, as a general rule, arranges goods in order of their degree of manufacture: raw materials, unworked products, semi-finished products, and finished products without reference to the end-use.

Putting this together, the interpretation by UNCTAD and UNSD of the definition in practice when determining the HS product codes to be treated as ICT goods can be phrased as follows:

“ICT goods ~~must primarily be intended to~~ fulfil or enable the function of information processing and/or communication by electronic means, **including such as** transmission **and** **or** display”.

[†] https://unctadstat.unctad.org/en/Classifications/DimHS2017Products_Ict_Hierarchy.pdf

The products identified are grouped into the following categories:

- ICT01 – Computers and ICT peripheral equipment
- ICT02 – Communication equipment
- ICT03 – Consumer electronic equipment
- ICT04 – Electronic components
- ICT05 – Miscellaneous ICT goods (not elsewhere classified)

The following sections examine various HS codes within these classes as well as new codes introduced in HS22 which might qualify for treatment as ICT goods. These new classes reflect the development and growing importance of new kinds of products, but also raise questions:

Is having the capacity to process and/or transmit information in electronic form sufficient for a good to be regarded as an ICT good?

Or, to put it another way:

Does an ICT good not only have (or enable) these capacities but they must be the “primary purpose” of the good in question?

Until relatively recently, there was no major tension between these two factors. The goods which had these capabilities were generally clearly primarily intended for information processing and/or communication because the processing and/or communication of information in electronic form was an end in itself for items with those capabilities.

Today, the capabilities to process and transmit information electronically are found in an ever-increasing range of goods. For example, household and commercial robot vacuum cleaners have advanced sensors and information processing capabilities; they are also connected to the Internet and use this to transmit information (position, status updates, etc.) to an associated software application. If information processing and/or transmission are sufficient defining characteristics, these are clearly ICT goods – and the same can be said of other products such as autonomous vehicles, industrial robots, 3D printers, industrial robots and smart/connected household appliances (e.g. light bulbs, washing machines and fridges).

However, the processing and transmission of information in electronic form is not the primary purpose in any of these cases. The primary purpose of a robot vacuum cleaner is to clean; information processing and communication are a means to that end. Thus, it can also be argued that none of the goods mentioned should be regarded as ICT goods.

This paper takes the position that an ICT good must have the capability to fulfil or enable (e.g. in combination with other ICT goods) information processing and/or transmission in electronic form. However, this alone is not sufficient to lead to classification as an ICT good; information processing and or transmission must also be a primary function of the good in question.

4. Identifying ICT goods in HS22

3.1 Direct matches from HS17 to HS22

A practical starting point is to expect that the 88 codes that were classed as ICT goods under HS17 and which remain identical in HS22 would likely still be considered ICT goods. Nevertheless, in view of the discussion above, a number of questions arise:

ICT01 – computers and ICT peripheral equipment

- ICT01 includes item 8470.50 cash registers. One justification is that (modern) cash registers have input devices, sensors, processing power, displays, etc. so are essentially just a specialized form of computer. Furthermore, cash registers are designed primarily to process information including identifying products based on barcodes being scanned and calculating the total to be charged. However, cash registers are the only item within 84.70 included in the scope of ICT goods even though the other items in the class have similar features e.g., calculating (i.e. information processing functions), and the ability to display and/or transmit information. [A more consistent treatment is therefore recommended, whereby all items under this heading are recorded as ICT goods.](#)

Heading	H.S. Code	
84.70		Calculating machines and pocket-size data recording, reproducing and displaying machines with calculating functions; accounting machines, postage-franking machines, ticket-issuing machines and similar machines, incorporating a calculating device; cash registers.
	8470.10	- Electronic calculators capable of operation without an external source of electric power and pocket-size data recording, reproducing and displaying machines with calculating functions
		- Other electronic calculating machines :
	8470.21	-- Incorporating a printing device
	8470.29	-- Other
	8470.30	- Other calculating machines
	8470.50	- Cash registers
	8470.90	- Other

Examining countries which reported all components of this breakdown once or more during the period 2017-2022 (284 country-year sets), cash registers accounted for 73 per cent of exports under heading 84.70 whereas the other classes comprised 27 per cent.

- ICT01 includes item 8472.90 office machines; not elsewhere classified. Given the overall description of Heading 84.72 it appears that this code would comprise “addressing machines, automatic banknote dispensers, coin-sorting machines, coin-counting or wrapping machines, pencil sharpening machines, [and] perforating or stapling machines]”. Examining countries which reported all components of this breakdown once or more during the period 2017-2022 (266 country-year sets), 8472.90 Other office machines not elsewhere classified (counted as ICT goods) comprised 92 per cent of exports under heading 8472 whereas the other classes (not counted as ICT goods) comprised 8 per cent.

Nevertheless, some of the products covered by 8472.90 clearly do not have information processing or communication capabilities and would not meet the definition of ICT goods - namely machines for pencil sharpening, perforating, or stapling. Many machines for handling coins may also lack such capabilities. At the same time, this category would also cover automatic teller machines (ATMs) which are a specialised form of computer terminal. However, they cannot be separated from the other items covered. As such, the inclusion or exclusion of this HS category requires a judgement call. [As the strong majority of products recorded under 8472.90, by value, would be likely to meet the definition of ICT goods, it is recommended that this treatment is maintained.](#)

84.72	Other office machines (for example, hectograph or stencil duplicating machines, addressing machines, automatic banknote dispensers, coin-sorting machines, coin-counting or wrapping machines, pencil-sharpening machines, perforating or stapling machines).
8472.10	- Duplicating machines
8472.30	- Machines for sorting or folding mail or for inserting mail in envelopes or bands, machines for opening, closing or sealing mail and machines for affixing or cancelling postage stamps
8472.90	- Other

ICT01 includes 8473.40 “Parts and accessories (other than covers, carrying cases and the like) suitable for use solely or principally with machines of heading 84.72”. This treatment appears appropriate given that over 90 per cent of the value of exports under 84.72 are classed as ICT goods.

- ICT01 includes 852842 and 852852 which are CRT (cathode ray tube) or “non-CRT” monitors “capable of directly connecting to and designed for use with an automatic data processing machine of heading 84.71 [i.e. computers]”. However, 852862 “Projectors: Capable of directly connecting to and designed for use with an automatic data processing machine of heading 84.71” are treated instead as consumer electronic equipment (ICT03). Such variation in recording, which is based only on display technology, does not appear to have a clear rationale. Against this background, [it is recommended that 852862 is recorded within ICT01 rather than ICT03](#).

ICT03 – Consumer electronic equipment

ICT03 includes 9504.30 “games operated by coins, banknotes, bank cards, tokens, or by any other means of payment, other than automatic bowling alley equipment”. It does not appear obvious why these are not included as ICT goods. Not only does this category include arcade video games (which are capable of information processing and display) but today most amusement arcade machines have some ability to process and/or display information (e.g. calculate and present a score, number of tokens won, etc.). [It is therefore recommended that these products be included in measures of ICT goods trade](#).

ICT04 – Electronic components

As electronic components are intermediate inputs rather than final products, it is often the case that they do not, on their own, have the key characteristics of ICT goods – namely the ability to process, transmit or display information. Nevertheless, such components have crucial applications in ICT goods in which they enable these functions.

However, some electronic components are also widely used in non-ICT applications, i.e. in electronic goods that are not ICTs such as household appliances and other electronic items (e.g. light dimmers, dishwashers, washing machines, fridges, microwave ovens, vacuum cleaners, power tools, toys). It is therefore not always clear whether these components “primarily fulfil or enable the function of information processing and/or communication by electronic means, such as transmission or display”. This suggests a need to consider what criterion should be used to qualify an electronic component as an ICT good.

The simplest approach is to take the position that *if an electronic component is used in ICT applications at all, it should be considered as an ICT good*. A key merit is that this is easy to apply. On the other

hand, it is a rather blunt approach. As an example, thyristors, diacs and triacs are currently treated as ICT goods and they are used in certain ICT applications. However, most of their main applications are in products that would not be classified as ICT goods. These include motors, fans, light dimmers, power inverters and control circuits in appliances such as washing machines, fridges and ovens. If simply being used in ICT applications is a sufficient qualifier, then many other products should also be included as ICT goods. For example, and as discussed further below, LEDs have crucial applications in flat panel screens. Nevertheless, the primary uses of LEDs are for lighting (space illumination) and as indicator lights in products from cars to toys. To continue, glass plays a crucial role “enabling information processing and communication” by being used in smart phone and television screens – even though these are clearly not the main applications of glass by volume or value. Under this criterion, a case could be made that glass (or at least some types of glass) should be regarded as “ICT components”. Similar arguments could be made for certain types of aluminium, steel, plastic, etc.

An alternative is to *include only those components for which the “primary” applications are in products which would themselves be considered ICT goods*. This can be interpreted as evidence that these components “primarily fulfil or enable the function of information processing and/or communication by electronic means”.

Specific consideration may be warranted for components that act as **sensors** (e.g. of light, temperature, movement, presence of smoke, chemicals, etc). These are used in an extensive range of electronics items and equipment. Some of these are in ICT applications but many (likely the majority) are not. In all cases, the role of a sensor is essentially to generate information – most often in the form of an electrical current or signal which can be measured and acted upon (processed) in some way, such as by sounding a siren in the case of a smoke or burglar alarm or displaying (and possibly recording) the temperature in the case of a digital thermometer. *Because sensors are used to generate information for processing (in some way or another) it is reasonable to assert that they should always be regarded as ICT components, even if they are not primarily used in products which would not be regarded as ICT goods.*

The following products especially stand out as cases where such considerations may be relevant, though there may be others; for example, 853400 printed circuits are widely used in household appliances, electronic toys, etc. as well as being components in ICT goods.

- 8541.10 diodes (other than photosensitive and LEDs).
“A diode is a semiconductor device that essentially acts as a one-way switch for current. It allows current to flow easily in one direction, but severely restricts current from flowing in the opposite direction”.[‡] “The most common and important application of a diode is the rectification of AC power to DC power”. Diodes are also used in other applications related to power control such as voltage multiplication, reverse polarity protection and voltage spike protection.

These are not inherently “ICT applications”, nor are they applications as sensors. That said, diodes are used in certain specific ICT-related applications to moderate noise peaks in FM transmitters (i.e. an application “intended to enable the communication of information by electronic means”) and can be used in (basic) logic gates (i.e. an application in which they are used to process information).[§]

[‡] <https://www.fluke.com/en/learn/blog/electrical/what-is-a-diode>.

[§] <https://www.electronicshub.org/applications-of-diodes/>

Overall, the main applications of diodes are in power conversion and management including in transformers. This includes those supplied with ICTs, such as laptop computers, but also with or in any powered appliance where it is necessary to convert between AC and DC current such as in water heaters, washing machines, tumble driers, lights, refrigerators, ovens, dishwashers, e-bikes and scooters, electric cars, etc.**

It is likely that most diodes do not end up in items classed as ICT goods and therefore appears difficult to make the case that diodes “primarily fulfil or enable information processing [and/or] communication”. *It is recommended that diodes should not be recorded as ICT goods.*

- 8541.30 thyristors, diacs, and triacs.
These are types of semiconductor switches. The most widely used thyristors are “Silicon controlled rectifiers” (SCRs). “SCRs are used in switching circuits, DC motor drives, AC/DC static switches and inverting circuits.”
TRIACs are the second most common form of thyristor. They are “used as light dimmers, speed controls for electric fans and other electric motors, and in computerized control circuits of household appliances”. DIACs are mainly used in conjunction with TRIACs and “are found in light bulb dimmers”.^{††}
Given that most of these uses are in non-ICT applications (motors, fans, light dimmers, power inverters, control circuits in appliances such as washing machines, fridges, ovens), and they are not acting as sensors, *it is recommended that thyristors, diacs and triacs as a whole are not classified as ICT goods.*
- 8541.60 piezoelectric crystals.
These are crystals which generate an electric charge when subjected to pressure. The “top uses of piezoelectricity in everyday applications” include: engine knock sensors, pressure sensors, sonar equipment, diesel fuel injectors, fast response solenoid valves, optical adjustment, ultrasonic cleaning, ultrasonic welding, ultrasound imaging, dot matrix and inkjet printers, piezoelectric speakers found in mobile phones, ear buds, sound-producing toys, musical greetings cards, etc., electronic toothbrushes, piezoelectric igniters (e.g. on gas stoves), and in tennis racquets, among others.^{‡‡}
Again, although piezoelectric crystals have some important applications in a range of ICT use cases, it appears unlikely that the majority of piezoelectric crystals end up incorporated in ICT goods. Nevertheless, their major use is as sensors for pressure, regardless of the item they are incorporated in. It is therefore recommended to continue to include them as ICT goods.

Examining countries which reported all components of this breakdown once or more during the period 2017-2021 (285 country-year sets), the three classes counted as ICT goods comprised 19 per cent of exports under heading 8541 whereas the other classes (not counted as ICT goods) comprised 81 per cent with 8541.40 photovoltaic cells being the largest other component (49 per cent). Together, these items comprised around 2.4 per cent of exports of ICT components (ICT04) between 2017 and 2021.

Overall, this section has recommended several changes compared to the list of ICT goods.

The following codes are recommended for inclusion as ICT goods:

- All codes under heading 84.70 calculating machines (including 8470.50 cash registers, which were already treated as ICT goods)

** <https://dewwool.com/uses-of-rectifiers>.

†† <https://mdesemiconductor.com/what-is-a-thyristor-types-of-thyristors-and-their-uses>

‡‡ <https://www.americanpiezo.com/blog/top-uses-of-piezoelectricity-in-everyday-applications/>

- 9504.30 “games operated by coins, banknotes, bank cards, tokens, or by any other means of payment, other than automatic bowling alley equipment”

The following codes, previously included as ICT goods, are recommended to be excluded from the list:

- 8541.10 diodes (other than photosensitive and LEDs).
- 8541.30 thyristors, diacs, and triacs.

The following code is transferred from ICT03 to ICT01 to ensure recording consistent with similar products:

- 852862 “Projectors: Capable of directly connecting to and designed for use with an automatic data processing machine of heading 84.71”

3.2 changes in HS22 to codes considered as ICT goods under HS17

Various product categories that were recorded as ICT goods under HS17 have been changed in HS22. These changes arise for various reasons but most often result from a breaking down of a single HS17 category into multiple HS22 codes offering greater product detail. These changes are outlined below in approximate order of complexity.

Telephone answering machines

Up until HS17, telephone answering machines were recorded under a separate product code and included within ICT03 consumer electronic equipment. Given their decline, the separate code was deleted in HS22. Any remaining trade is expected to be recorded under a code that has been maintained from HS17 to HS22 and is also within ICT03 when compiling ICT trade.

HS17	HS22
851950 Sound recording or reproducing apparatus; telephone answering machines	851981 Sound recording or reproducing apparatus; using magnetic, optical or semiconductor media, n.e.c. in item no 8519.20 [jukeboxes], 8519.30 [turntables] or 8519.50 [amplifiers].

Mobile phones

The HS17 category covering mobile phones was split in HS22 to distinguish between smartphones and other mobile phones. Both of these should be regarded as ICTs (specifically ICT02 – communication equipment).

HS17	HS22
851712 Telephones for cellular networks or for other wireless networks	851713 Telephone sets; smartphones for cellular or other wireless networks 851714 Telephone sets; other than smartphones, for cellular or other wireless networks

Parts for telephone sets

This category was split in HS22 to differentiate between “aerials and aerial reflectors” (aka. satellite dishes) and “other parts for telephone sets”. Aerials and satellite dishes are clearly used for the transmission (but not processing) of information and would therefore be considered as ICT goods.

The parts covered by the second HS22 category might cover parts such as replacement handsets for corded telephones, replacement power cables, etc. It is likely that this class would include replacement bodywork (e.g. the plastic or metal shell of a fixed or mobile phone). It is not clear, however, whether replacement parts that are essentially electronic components such as replacement screens, speakers, microphones or circuit boards would be recorded here or in electronic components. In practice recording may vary between countries (or even between customs officials). In any case, as all the parts recorded here are for communication apparatus they can reasonably be assumed to *fulfil or enable* the electronic communication of information and therefore to be ICT goods (ICT02 – communication equipment).

HS17	HS22
851770 Telephone sets and other apparatus for the transmission or reception of voice, images or other data, via a wired or wireless network; parts	851771 Communication apparatus; parts, aerials and aerial reflectors of all kinds, parts suitable for use therewith 851779 Communication apparatus; parts, other than aerials and aerial reflectors of all kinds

Television cameras, digital cameras and video camera recorders

The single HS17 category for these items has been deleted and replaced with multiple categories distinguishing cameras with different features.

The subheadings mentioned specify the meanings of “high speed”, “radiation hardened/tolerant”, and “night vision” as well as specifying that thermal imaging cameras are to be recorded under “other”.

It is clear that these items have information processing features (being able to process light landing on optical sensors into digital images) and thereby “fulfil or enable information transmission and/or display”. They should, therefore, be regarded as ICT goods, maintaining the recording that was applied to the previous single HS17 class 8525.80, in ICT03 – Consumer electronic equipment.

HS17	HS22
8525.80 Television cameras, digital cameras and video camera recorders	Television cameras, digital cameras and video camera recorders: 852581 - High-speed goods as specified in Subheading Note 1 to this Chapter 852582 - Other, radiation-hardened or radiation-tolerant goods as specified in Subheading Note 2 to this Chapter 852583 - Other, night vision goods as specified in Subheading Note 3 to this Chapter 852589 - Other

Semiconductor devices including LEDs, solar cells and other photosensitive semiconductor devices

Under HS17, all components of Heading 85.41 were included as ICT goods:

85.41		Diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LED); mounted piezo-electric crystals.
	8541.10	- Diodes, other than photosensitive or light-emitting diodes (LED)
		- Transistors, other than photosensitive transistors :
	8541.21	-- With a dissipation rate of less than 1 W
	8541.29	-- Other
	8541.30	- Thyristors, diacs and triacs, other than photosensitive devices
	8541.40	- Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LED)
	8541.50	- Other semiconductor devices
	8541.60	- Mounted piezo-electric crystals
	8541.90	- Parts

HS22 reconfigures the structure within this heading:

85.41		Semiconductor devices (for example, diodes, transistors, semiconductor-based transducers); photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LED), whether or not assembled with other light-emitting diodes (LED); mounted piezo-electric crystals.
	8541.10	- Diodes, other than photosensitive or light-emitting diodes (LED)
		- Transistors, other than photosensitive transistors :
	8541.21	-- With a dissipation rate of less than 1 W
	8541.29	-- Other
	8541.30	- Thyristors, diacs and triacs, other than photosensitive devices
		- Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LED) :
	8541.41	-- Light-emitting diodes (LED)
	8541.42	-- Photovoltaic cells not assembled in modules or made up into panels
	8541.43	-- Photovoltaic cells assembled in modules or made up into panels
	8541.49	-- Other
		- Other semiconductor devices :
	8541.51	-- Semiconductor-based transducers
	8541.59	-- Other
	8541.60	- Mounted piezo-electric crystals
	8541.90	- Parts

While questions can be raised about the extent to which any of these sub-products should be regarded as ICT components if their main areas of application are in non-ICT goods, the changes in HS22 lead in particular to the deletion of two product codes present up to HS17 and their replacement with multiple more specific categories.

HS17	HS22
854140 Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LED)	854141 light emitting diodes (LEDs). 854142 photovoltaic cells not assembled in modules or made up into panels. 854143 photovoltaic cells assembled in modules or made up into panels. 854149 "other" [photosensitive semiconductor devices].
854150 Other semiconductor devices	854151 [other] semiconductor-based transducers 854159 "other" [semiconductor devices not elsewhere classified]

Each of these new categories merits some analysis. As a starting point, though, it is useful to note the definition of a semiconductor and of semiconductor devices:

"A semiconductor is a material which has an electrical conductivity value falling between that of a conductor, such as copper, and an insulator, such as glass." ^{§§}

"Semiconductor devices" are devices the operation of which depends on variations in resistivity on the application of an electric field or semiconductor-based transducers. Semiconductor devices may also include assembly of plural elements, whether or not equipped with active and passive device ancillary functions.


Additionally, it is relevant to understand the meaning of the term "transducer". Transducers are devices that convert energy from one form to another, for example, from electrical energy to light (i.e. as in a light bulb) or from light to electricity (as in a photovoltaic cell).^{***} There are two main types:

- An **input transducer**, or sensor, responds to a change in the environment and converts it into an electrical signal which can be read. For example, a microphone takes physical sound waves and turns those into an electrical signal which is transferred through wires.
- **Output transducers**, or actuators, do the opposite of an input transducer. They take electrical signals and convert them into another form of energy. For example, a motor that converts electricity into motion.

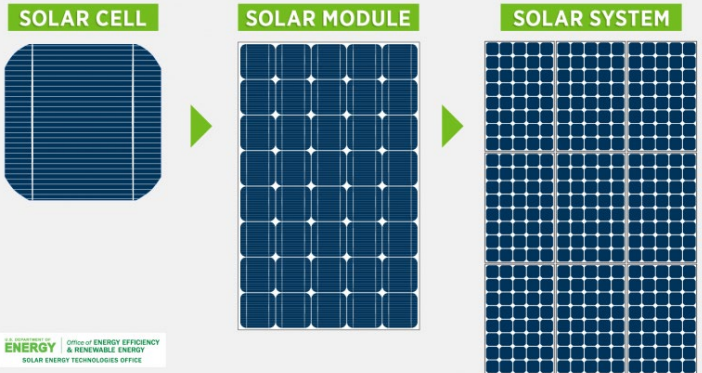
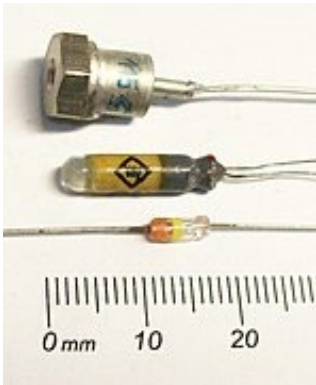
The items covered by the above codes are all various forms of semiconductor-based transducers. However, LEDs and photosensitive transducers are recorded separately from other semiconductor-based transducers.

^{§§} <https://en.wikipedia.org/wiki/Semiconductor>

^{***} <https://gmw.com/transducers/>

Product	What is it?	Features	Notes
854141 light emitting diodes (LEDs)	 <p>The WCO documentation for HS 2022¹⁰ provides the following details and clarifications:</p> <p>“Light-emitting diodes (LED)” are semiconductor devices based on semiconductor materials which convert electrical energy into visible, infra-red or ultra-violet rays, whether or not electrically connected among each other and whether or not combined with protective diodes. Light-emitting diodes (LED) of heading 85.41 do not incorporate elements for the purposes of providing power supply or power control; For the purposes of heading 85.39, the expression “light-emitting diode (LED) light sources” covers:</p> <p>(a) “Light-emitting diode (LED) modules” which are electrical light sources based on light-emitting diodes (LED) arranged in electrical circuits and containing further elements like electrical, mechanical, thermal or optical elements. They also contain discrete active elements, discrete passive elements, or articles of heading 85.36 or 85.42 for the purposes of providing power supply or power control. Light-emitting diode (LED) modules do not have a cap designed to allow easy installation or replacement in a luminaire and ensure mechanical and electrical contact.</p> <p>(b) “Light-emitting diode (LED) lamps” which are electrical light sources containing one or more LED modules containing further elements like electrical, mechanical, thermal or optical elements. The distinction between light-emitting diode (LED) modules and light-emitting diode (LED) lamps is that lamps have a cap designed to allow easy installation or replacement in a luminaire and ensure mechanical and electrical contact</p>	<ul style="list-style-type: none"> ✗ Information processing ✗ Information transmission ✓ Information display (but individual LEDs can display basic information only – the same as any light bulb!) 	<p>Primary uses of LEDs are <i>illumination and indication</i>. <i>Illumination</i>, i.e. lighting, is not clearly related to information processing/communication except in the case of LED arrays used as backlighting in flat panel displays etc. <i>Indication</i> is a form of information display but only very basic information can be displayed this way because LEDs can only be on, off, flashing, variable brightness etc. (individual LEDs can’t change colour). Examples include on/off, charging/not charging, etc. Before LEDs were invented, other types of bulbs were used as indicator lights in a wide array of applications. This seemingly was not judged sufficient to class them as ICTs.</p> <p>LEDs do perform certain key functions in ICTs, most notably LED arrays are used in flat panel screens and individual LEDs as indicator lights (e.g. for charging). But LEDs are also widely used in domestic and commercial lighting, car headlights and dashboards, all kinds of electronics, toys, etc.</p> <p>Given the wide range of uses, it seems hard to make a case that that LEDs as a whole are “primarily intended to [...] enable information processing [and/or] communication”.</p>

¹⁰ https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/nomenclature/instruments-and-tools/hs-nomenclature-2022/2022/1685_2022e.pdf?la=en

854142 photovoltaic cells not assembled in modules or made up into panels	 <p>The diagram illustrates the hierarchy of solar energy components. It starts with a single 'SOLAR CELL' (a small blue square with a grid pattern). An arrow points to a 'SOLAR MODULE' (a larger rectangle composed of many small cells). Another arrow points to a 'SOLAR SYSTEM' (a large rectangle composed of many modules). The source is cited as 'U.S. DEPARTMENT OF ENERGY Office of ENERGY EFFICIENCY & RENEWABLE ENERGY SOLAR ENERGY TECHNOLOGIES OFFICE'.</p>	<ul style="list-style-type: none"> ✗ Information processing ✗ Information transmission ✗ Information display 	<p>Solar cells' primary purpose is power generation not information processing or communication.¹¹</p>
854143 photovoltaic cells assembled in modules or made up into panels			
854149 "other" [photosensitive semiconductor devices]	 <p>Photodiodes are also used for light measurement, as in camera light meters, or to respond to light levels, as in the switch on street lighting after dark. They are often combined with a light emitting component such as in infrared obstruction sensors¹².</p>	<ul style="list-style-type: none"> ✗ Information processing (but can act as a light sensor to generate information that may be processed in electronic form) ✗ Information transmission (in some cases) ✗ Information display 	<p>Like photovoltaic cells, photodiodes produce an electrical current when exposed to light. A difference, however, is that they are not designed and optimised for the purpose of electricity production. They are not in themselves capable of information processing, display, or transmission but can act as a source of information. "A photodiode is usually combined into a single component with an emitter of light, either to detect the presence of a mechanical obstruction to the beam or to couple two digital or analogue devices"⁶.</p> <p>Some of the applications of photodiodes fulfil or enable information processing or transmission, such as in optical disk players and as a receiver for signals sent from an infrared remote control. Another key application is as a light meter for digital cameras, including in mobile phones – both of which are classed as ICT goods.</p> <p>Nevertheless, photodiodes are also widely used in non-ICT applications, such as ambient light or motion sensors used to activate street or toilet lights, obstruction sensors on automatic doors and barriers, and in medical devices. Because the primary role of photodiodes is as sensors for light, they can be regarded as ICT components.</p>

¹¹ Image reproduced from <https://www.energy.gov/eere/solar/articles/pv-cells-101-primer-solar-photovoltaic-cell>. Other

¹² <https://eduinput.com/what-is-photodiode/>

854151 [other] semiconductor-based transducers	<p>The WCO documentation for HS 2022¹³ provides the following details and clarifications⁸:</p> <p>“Semiconductor-based transducers” are, for the purposes of this definition, semiconductor-based sensors, semiconductor-based actuators, semiconductor-based resonators and semiconductor-based oscillators, which are types of discrete semiconductor-based devices, which perform an intrinsic function, which are able to convert any kind of physical or chemical phenomena or an action into an electrical signal or an electrical signal into any type of physical phenomenon or an action.</p> <p>All the elements in semiconductor-based transducers are indivisibly combined, and may also include necessary materials indivisibly attached, that enable their construction or function.</p> <p>“Semiconductor-based” means built or manufactured on a semiconductor substrate or made of semiconductor materials, manufactured by semiconductor technology, in which the semiconductor substrate or material plays a critical and unreplaceable role of transducer function and performance, and the operation of which is based on semiconductor properties including physical, electrical, chemical and optical properties.</p> <p>“Physical or chemical phenomena” relate to phenomena, such as pressure, acoustic waves, acceleration, vibration, movement, orientation, strain, magnetic field strength, electric field strength, light, radioactivity, humidity, flow, chemicals concentration, etc.</p> <p>Four types of semiconductor-based transducers are identified in the HS2022 documentation. These, “consists of microelectronic or mechanical structures that are created in the mass or on the surface of a semiconductor and that have the function of”:...</p> <p>i) “detecting physical or chemical quantities and converting these into electric signals” (“semiconductor-based sensor”).</p> <p>ii) “converting electric signals into physical movement” (“semiconductor-based actuator”).</p> <p>iii) “generating a mechanical or electrical oscillation of a predefined frequency that depends on the physical geometry of these structures in response to an external input” (“semiconductor-based resonator” i.e. in a speaker or buzzer)</p> <p>iv) “generating a mechanical or electrical oscillation of a predefined frequency that depends on the physical geometry of these structures” (“semiconductor-based oscillator” i.e. in a microphone).</p>	<p>✗ Information processing (but in some applications act as a sensor generating information that may be processed in electronic form)</p> <p>✓ Information transmission (in applications as speakers or</p> <p>✗ Information display</p>	<p>Semiconductor-based transducers are used in a wide range of applications. Some of these are clearly in the ICT domain, including as components in microphones or speakers. However, they are also used for many other applications that seem unlikely to take place primarily in the context of ICTs, including as sensors for:</p> <ul style="list-style-type: none"> - Temperature (e.g. in ovens, fryers, washing machines, water heating systems, etc, etc.) - Pressure (e.g. in vehicle tyres) - Presence of chemicals, gasses, etc. (e.g. in manufacturing processes) - Movement, acceleration, vibration, orientation (e.g. in vehicles) - Strain (e.g. in - Radioactivity - Magnetic fields - Humidity (e.g. in <p>It appears that these semiconductor-based transducers are predominantly used in non-ICT applications. Nevertheless, their primary role is as sensors for different phenomena and so they can be regarded as ICT components.</p>
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¹³ https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/nomenclature/instruments-and-tools/hs-nomenclature-2022/2022/1685_2022e.pdf?la=en

One of the first applications of solar cells in consumer products was in pocket calculators and so at one point they could have been considered as enabling information processing and display (notwithstanding the fact, noted above, that calculators have not previously been recorded as ICT goods). Nevertheless, it is clear that the main uses of solar cells are not in ICT applications and so **it is recommended not to classify solar panels as ICT goods.**

LEDs are a less clear-cut case. LEDs cannot process information. However, an LED can display basic information (e.g. on/off) and arrays of LEDs are the core technology in flat panel screens. Nevertheless, LEDs are most widely used in non-ICT applications, especially for lighting in domestic, commercial, and automotive settings. **It is therefore recommended not to classify LEDs as ICT goods.**

Photodiodes (i.e. “other photosensitive semiconductor devices”) act as sensors to facilitate the capturing and transmission of information and play a variety of important roles in both ICT and non-ICT applications. Against this background, **it is recommended to treat photodiodes as ICT goods recorded within ICT04 electronic components.**

On average, from 2017 to 2021, HS17 854140 “Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LEDs)” accounted for about six per cent of exports of electronic components (ICT04).

Based on the available data classified by HS22, which have been submitted to Comtrade by 40 economies, in 2022, exports of products under heading 85414 comprised:

- LEDs: 17%
- Solar cells: 75%
- Other photosensitive semiconductor devices (photosensors): 8%

It therefore appears that the strong majority of the single predecessor HS17 category consisted of items not considered to be ICT goods.

From 2017 to 2021, HS17 854150 “Other semiconductor devices” accounted for around 0.4 per cent of exports of ICT components on average. This is a much smaller share, though this may not be representative of what the share will be under HS22 as the introduction of the sub-code for semiconductor-based transducers is framed by the WCO as an expansion in scope.¹⁴ The available HS22 data show that in 2022, “semiconductor-based transducers” comprised 30 per cent of the total of these two items.

Semiconductor-based transducers are used extensively as sensors in both ICT and non-ICT applications. **It is recommended that semiconductor-based transducers should be recorded as ICT goods within ICT04 electronic components.**

However, neither the WCO notes to chapter 85 of HS17 nor HS22 give any detail of what products are included under code “854159 “other” [semiconductor devices not elsewhere classified]. In the absence of the information needed to assess whether these products would meet the definition of ICT goods and considering also the very limited volume of trade recorded under the single HS17 predecessor heading, **it is recommended that this code should not be recorded as ICT goods.**

¹⁴ https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/nomenclature/instruments-and-tools/hs-nomenclature-2022/table-i_en.pdf?la=en

This section has generally recommended that where HS22 has introduced multiple product codes offering more product detail in place of a single HS17 product code that was treated as ICT goods, these successor products should also be treated as ICT goods. There is one key exception where the greater product detail allows certain products do not meet the definition of ICT goods – LEDs and solar cells – to be excluded from measures of ICT goods trade.

3.3 Substantive categories introduced in HS22

In addition to the above changes, HS22 also introduces a number of entirely new product categories that merit consideration against the definition of ICT goods.

Flat panel display modules

HS22 introduced new product codes for flat panel display modules. This brings the treatment of flat panel modules, a type of electronic component, into line with that for components of non-flatscreen products such as cathode ray tubes (CRTs) in that they are now placed in a separate category.

The purpose of these modules is to fulfil the display of information so it is clear that they meet the definition of ICT goods. It is recommended that they are recorded, alongside components for other display technologies, in ICT04 – electronic components.

85.24	Flat panel display modules, whether or not incorporating touch-sensitive screens.
	- Without drivers or control circuits :
8524.11	-- Of liquid crystals
8524.12	-- Of organic light-emitting diodes (OLED)
8524.19	-- Other
	- Other :
8524.91	-- Of liquid crystals
8524.92	-- Of organic light-emitting diodes (OLED)
8524.99	-- Other



3D Printers

Conventional (i.e. 2D) printers are recorded in several separate HS categories depending on the features the printer unit has (for example, it may combine printing with copying and scanning). These are treated as ICT goods.

Prima facie, this appears unremarkable – printers are, after all, common computer peripherals. However, it is clear that 2D printers “primarily fulfil or enable the function of [...] communication” not by electronic means but by physical means. This would appear not to meet the definition of ICT goods set out in Section 3.

Clearly, though, this has not prevented the treatment of 2D printers as ICT goods up until now. A possible justification may be that printers have the information processing capability needed to process digital instructions to produce those physical outputs (printed pages). Many printers also incorporate screens enabling them to communicate some information digitally (though this is not their “primary” function) and some have the ability to take and send images (i.e. scan/copy functionality).

As 3D printers (also known as additive manufacturing machines) have similar features and capabilities (though not scan/copy), it can be argued that they should, by extension, be considered as ICT goods. In many cases they can also essentially be regarded as a form of “computer peripheral”; like a 2D

printer they must be loaded with a file from a computer (through a wired or wireless connection, or directly using media such as an SD card) which is processed by on board software to produce a physical output. This is the case whether the machine is a desktop 3D printer or a large-scale machine used to print buildings.

However, having information processing capabilities alone is not sufficient for classification as an ICT good. Furthermore, there are various other machines which processing a digital input file along with feedstock to produce a physical output which already existed in HS2017 or earlier and have not been treated as ICT goods. Examples include the several categories for computer numerically controlled (CNC) machines such as those used for cutting parts from sheet wood or metal according to a template given in a digital input file (within HS 84.58/59) and category 8479.50 Industrial robots¹⁵, such as those used on assembly lines for vehicles and many other goods.

A key difference between 2D and 3D printers is that the former are a *communications technology*; the objects they produce are intended to carry and communicate information in textual or visual form. By contrast, 3D printers exist to produce physical objects which are not vehicles for information and communications, but which have other uses. **It is therefore recommended that 3D printers should not be treated as ICT goods** because information processing and/or communication are not their primary purpose.

84.85

8485.10

8485.20

8485.30

8485.80

8485.90

Machines for additive manufacturing.

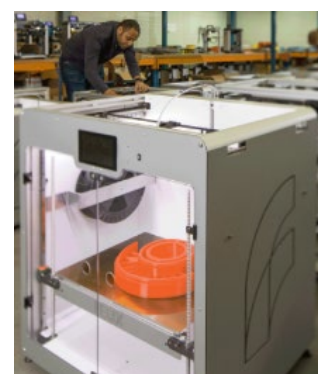
- By metal deposit

- By plastics or rubber deposit

- By plaster, cement, ceramics or glass deposit

- Other

- Parts



Aerial drones

Drones, also known as unmanned aircraft, are essentially “a flying robot that can be remotely controlled or fly autonomously using software-controlled flight plans in its embedded systems, that work in conjunction with onboard sensors and a global positioning system (GPS).”¹⁶ There are two over-arching use cases for drones: i) using cameras and other sensors to electronically record and transmit video and other information, and ii) carrying payloads for delivery.

Typical features of drones are the ability to receive commands (information) electronically and the ability to transmit video, sound, etc. Furthermore, drones process information from on-board sensors to automate some (or even all) aspects of flight. As such, drones can meet both the information processing and communication criteria for treatment as ICTs.

¹⁵ HS 2022 introduced the additional code 8428.70 Industrial robots for lifting, handling, loading or unloading.
¹⁶

[https://www.techtarget.com/iotagenda/definition/drone#:~:text=Essentially%2C%20a%20drone%20is%20a,global%20positioning%20system%20\(GPS\).](https://www.techtarget.com/iotagenda/definition/drone#:~:text=Essentially%2C%20a%20drone%20is%20a,global%20positioning%20system%20(GPS).)

However, for drones designed and used to carry physical payloads, it is not unreasonable to assert that these capabilities are ancillary to the primary purpose of delivering those payloads. It can therefore be argued that, although they have these capabilities, these drones do not “primarily fulfil or enable information processing and/or communication”. By contrast, for the other use case, the primary purpose is the collection, processing and transmission of information. To put it another way, these are essentially video cameras (which are recorded as ICTs) but are able to fly.

Regrettably, the HS2022 does not make a distinction along these lines and so the case for treatment as ICT goods (or not) rests on whether information processing capabilities is viewed as a sufficient criterion. [It is therefore recommended that unmanned aircraft are not recorded as ICT goods.](#)

88.06	Unmanned aircraft.
8806.10	- Designed for the carriage of passengers
	- Other, for remote-controlled flight only :
8806.21	-- With maximum take-off weight not more than 250 g
8806.22	-- With maximum take-off weight more than 250 g but not more than 7 kg
8806.23	-- With maximum take-off weight more than 7 kg but not more than 25 kg
8806.24	-- With maximum take-off weight more than 25 kg but not more than 150 kg
8806.29	-- Other
	- Other :
8806.91	-- With maximum take-off weight not more than 250 g
8806.92	-- With maximum take-off weight more than 250 g but not more than 7 kg
8806.93	-- With maximum take-off weight more than 7 kg but not more than 25 kg
8806.94	-- With maximum take-off weight more than 25 kg but not more than 150 kg
8806.99	-- Other

This section has recommended one of the new classes of products introduced in HS22 for inclusion within the scope of ICT goods – flat panel display modules. Although the other products considered all have information processing and communications capabilities, these are not their primary function (with the exception of drones used to record and transmit video footage, which are excluded for practical reasons due to being combined with all other unmanned aircraft). **Annex A** presents a table listing all of the HS 2022 codes considered as ICT goods.

However, this is only the first step; the second is to decide how differences between HS22 and HS17 should be handled when compiling back-series.

5. Correlation and conversion tables

Over time, the most prominent trend in successive editions of the HS has been the addition of greater product detail in the form of more product classes. This supports more detailed and insightful analyses but new editions of the HS also create challenges for the compilation of statistics. Some economies take time to implement the latest HS edition. There can, therefore, be a (potentially lengthy) period over which trade classified by HS22 is not available for all economies. For the purpose of international comparisons, it is necessary to have data for all economies classified according to the same HS edition.

The same is true when performing time-series analysis: to make meaningful comparisons over time it is necessary to have data classified according to the same HS for the whole period of interest.

Because the latest edition of the HS typically contains more detailed product codes, trying to re-compile data reported according to previous editions of the HS to align with the latest HS would involve imputing these additional break downs. While this may be feasible in principle, doing so for multiple years, almost 200 economies, and across thousands of products would require substantial computing and human resources and ultimately result in a dataset in which a high proportion of values are imputed. Therefore, the practice implemented by UNSD is to establish a mapping by which data reported according to the latest HS can be re-compiled to be as consistent as possible with the previous edition.

The UN Comtrade database (<https://comtrade.un.org/>), the central dissemination channel for data classified by HS, offers users a choice between:

- Data in the original classification in which it was submitted by reporting economies.
- Data converted to earlier versions of the HS (as well as to other trade classifications).

Underpinning this is a decision on how each HS22 product code should be handled when re-compiling into HS17. A starting point is the HS22 “correlation tables”.

To facilitate implementation of the new nomenclature, the WCO produces tables “correlating” HS22 codes against the previous edition (HS17) i.e. for each HS22 product code, the table identifies under which code(s) those products would have been recorded if HS17 had remained in force. UNSD compiles the available correlation tables to create a master correlation table. This is a first step in working out how the product breakdown in HS22 should be mapped backward onto previous editions of the HS in order to compile time-series.

In the correlation table between HS 2022 and any previous HS edition, four types of relationships are possible:

HS22	HS17	
1:	1	The HS 2022 subheading is correlated with one and only one subheading in the previous HS.
n:	1	The HS 2022 subheading is a result of a split of one subheading in the previous classification into several subheadings.
1:	n	The HS 2022 subheading is the result of merging several subheadings in the previous classification.
n:	n	The subheading is the result of a split and merge of several subheadings in the previous classification.

In the first case (1:1) no specific action is needed; the given HS22 code can be treated as directly equivalent to the same HS17 code. In the second case (n:1), re-compiling into HS17 is a simple matter of adding up the relevant multiple codes from HS22.

The remaining two relationships are more problematic. In the third case there is greater product detail in HS17 than there is in HS22. While this is relatively unusual, it can arise because of the declining relevance (and resulting trade) in certain products – as in the case for telephone answering machines noted above. As it is not possible to robustly estimate how the single HS22 category could be split across multiple HS17 categories, the practice is to “flatten” the relationship by identifying a single HS17 code that the HS22 code should be mapped with (i.e. a 1:1 relationship). For example, for the HS22 code that now includes telephone answering machines (851981), a choice must be made

between mapping that code in whole to the HS17 code for answering machines (851950) or the other HS17 code with which it was combined (also 851981)

In the final situation, multiple HS22 codes essentially arise from multiple HS17 codes being broken down and components from each being re-combined. For these, UNSD practice is to “flatten” the relationship to either 1:1 or n:1 so that each HS17 code in its entirety is mapped only to one HS22 code or to several HS22 codes which are added together. The principles applied are set out in detail in a UNSD paper on “Correlation and conversion tables used in UN Comtrade”¹⁷. The result is a “**conversion table**” of only 1:1 and n:1 type relationships.

6. HS22 conversion table for ICT goods

Identifying how each individual HS22 code should be mapped back onto HS17 product codes can be challenging. However, such a mapping is not the primary task at hand here. Our main aim is to measure trade in ICT goods, both in total and broken down into:

- ICT01 – Computers and ICT peripheral equipment
- ICT02 – Communication equipment
- ICT03 – Consumer electronic equipment
- ICT04 – Electronic components
- ICT05 – Miscellaneous ICT goods (not elsewhere classified)

As such, for each HS22 code identified as meeting the definition of ICT goods, it is necessary to also consider if the HS17 code it is mapped to can, in entirety, be considered as ICT goods and furthermore whether they both appear under the same ICT goods heading.

For the majority of ICT goods, the HS22 code has a direct match in HS17 (i.e. a 1:1 relationship). Of the 108 HS22 codes listed in Annex A, 92 are identical to codes in HS17. For a further 8 codes, there is a straightforward n:1 relationship where new detail was introduced in HS22 and these codes can be summed to match the category available in HS17.

This leaves several more challenging situations relating to products that were discussed above.

Photosensitive semiconductor devices (1 HS22 code)

The application of other photosensitive semiconductor devices is as sensors for light. While it is not likely that the primary use of these sensors is in products regarded as ICT goods, the case has been made that sensors of all types should be regarded as ICT components because their intrinsic role is the gathering of information (e.g. the presence of light) and the “transmission” of that information in the form of an electrical current or signal to be processed in some way.

However, an issue arises when considering the mapping from HS22 back to HS17 because the HS22 code 854149 “other” [photosensitive semiconductor devices], was introduced alongside codes for LEDs and solar cells as a break down of a single code that existed in HS17. LEDs and solar cells are not treated as ICTs because they are not used for information processing and transmission but for illumination and indication (LEDs) and power generation (solar cells).

These codes collectively have a n:1 relationship with that single HS17 code: 854140 Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up

¹⁷ <https://unstats.un.org/unsd/classifications/Econ/corr-notes/HS2022%20conversion%20to%20earlier%20HS%20versions%20and%20other%20classifications%20%20-%20v.1.0.pdf>

into panels; light-emitting diodes (LED). It is, therefore, necessary to decide whether this code should be included or excluded in its entirety when calculating ICT goods trade based on HS17 (or earlier). Either will lead to some degree of discontinuity in time-series. However, because the detail available in HS22 appears to suggest that the great bulk (over 90 per cent) of the products that were recorded within this HS17 code were LEDs or solar cells, the discontinuity can be minimised by omitting code 854140 when compiling ICT goods trade based on data classified by HS17. Accordingly, [it is recommended that HS17 code 854140 is not included when compiling ICT goods statistics.](#)

[other] semiconductor-based transducers (1 HS22 code)

In Section 4, it was noted that semi-conductor based transducers are used extensively as sensors and, therefore that HS 22 code 854151 [other] semiconductor-based transducers should be included within the scope of ICT goods.

Similar to photosensitive semiconductor devices, this code was introduced as part of a split of a single predecessor HS17 code. It was noted above that the other code introduced - 854159 “other” [semiconductor devices not elsewhere classified] – could not be assessed as meeting the definition of ICT goods. This, coupled with explanation in the WCO table correlating the HS22 and HS17 versions which notes that the inclusion of a code for semiconductor-based transducers is an “expansion” and this code is expected to be populated with products transferred from an extensive list of other codes, leads to the [recommendation that HS17 code 854140 “other semiconductor devices is not included when compiling ICT goods statistics.](#)

In considering the impact of this recommendation, it can be noted that the above code accounted for around 0.4 per cent of exports of electronic components on average between 2017 and 2021.

Flat panel display modules (6 HS22 codes)

HS22 introduced a separate set of codes for flat panel display modules, with the following explanation:

7.- For the purposes of heading 85.24, “flat panel display modules” refer to devices or apparatus for the display of information, equipped at a minimum with a display screen, which are designed to be incorporated into articles of other headings prior to use. Display screens for flat panel display modules include, but are not limited to, those which are flat, curved, flexible, foldable or stretchable in form. Flat panel display modules may incorporate additional elements, including those necessary for receiving video signals and the allocation of those signals to pixels on the display. However, heading 85.24 does not include display modules which are equipped with components for converting video signals (e.g., a scaler IC, decoder IC or application processor) or have otherwise assumed the character of goods of other headings.

For the classification of flat panel display modules defined in this Note, heading 85.24 shall take precedence over any other heading in the Nomenclature.

This brings their treatment into line with other display technologies. However, **there is no single category in HS17 which would clearly be the antecedent to the codes introduced in HS22.** Indeed, the WCO table¹⁸ correlating HS22 to the HS17 version states that the new heading 85.24 for flat panel display modules entails the possible transfer of products covered by other headings in the HS17 nomenclature and identifies 81 product headings (each containing multiple HS product codes) where flat panel display modules may have been recorded under HS17.

¹⁸ https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/nomenclature/instruments-and-tools/hs-nomenclature-2022/table-i_en.pdf?la=en

In developing the master conversion table between HS22 and HS17¹⁹, UNSD has set an n:1 mapping for 8524 flat panel display modules to 851712 Telephones for cellular networks or for other wireless networks. While it is the case that some of the products recorded under HS22 8524 would have been recorded under 851712 under HS17, and furthermore that this is judged to be the HS17 category contributing the largest share to the new HS22 category, this alone does not account for the majority of products found under HS22 8524. It is therefore likely that this mapping (or any of the available alternatives) would result in some degree of discontinuity when comparing 851712 compiled under HS17 to the total for HS22 products mapped to that code in the conversion table.

When it comes to measuring trade in ICT goods, though, this is not the only issue to consider. Of the 81 HS17 product headings identified as potential donors in the WCO correlation table, only 9 headings contain one or more codes that were treated as ICT goods under HS17. Some products that were previously not recorded as ICT goods will therefore now be delineated from the product codes where they would have been recorded under HS17 and included in the HS22 class for flat panel display modules. This will create some degree of discontinuity in the measure of total ICT goods.

Furthermore, it is clear that flat panel display modules should be recorded under ICT04 electronic components, consistent with the treatment of other display technologies. However, the ICT goods codes within all 9 of the HS17 headings noted above are recorded elsewhere within ICT goods classification (i.e. ICT01, 02, 03 and 05). For example, HS17 code 851712 - Telephones for cellular networks or for other wireless networks – are recorded within ICT02. As such, some products that were previously recorded as ICT goods within ICT01, 02, 03, and 05 will now be delineated from the product codes where they would have been recorded if HS17 had remained in force and included in the HS22 class for flat panel display modules. While this should not result in any discontinuity in the measure of total ICT goods, it will cause some discontinuity in the various sub-headings.

It is not possible to estimate the extent to which the value recorded under the HS22 codes for flat panel display modules consists of products “redistributed” from other headings classed as ICT goods vs from headings not classed as ICT goods. Nevertheless, the overall size of this category relative to total ICT goods trade should give some indication of how material the impact of introducing these codes is likely to have been. [It is recommended that these discontinuities are clearly communicated to users of ICT goods trade statistics through metadata and supporting documentation.](#)

7. Summary and conclusions

This paper has detailed various changes made to the HS structure in 2022, setting out their impacts for the compilation of statistics on exports and imports of ICT goods. The most material impact arises from the ability to exclude LEDs and solar cells, which had previously been included but do not meet the definition of ICT goods. New product details added in HS22 allow these to be excluded. Other things equal, this can be expected to reduce the level of trade in ICT components (ICT 04), the largest element of ICT goods trade by around five per cent. On its own, this might translate through to a fall in total ICT goods trade of around two per cent. However, other changes introduced in HS22 – notably the introduction of a new class for flat panel modules – might be expected to partially offset this impact.

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<https://unstats.un.org/unsd/classifications/Econ/tables/HS2022toHS2017ConversionAndCorrelationTables.xls>
[x](#)

The changes set out in this technical note will be implemented at the point when the statistics on ICT goods trade in 2022 are compiled.

Annex A. HS 2022 products classed as ICT goods

HS2022 code	Description	Notes
ICT01 – computers and ICT peripheral equipment		
844331	Printing, copying, and facsimile machines; machines which perform two or more of the functions of printing, copying or facsimile transmission, capable of connecting to an automatic data processing machine or to a network	Retained from HS17
844332	Printing, copying, and facsimile machines; single-function printing, copying or facsimile machines, capable of connecting to an automatic data processing machine or to a network	Retained from HS17
847010	Calculating machines; electronic calculators capable of operation without an external source of electric power and pocket-size data recording, reproducing and displaying machines with calculating functions	Addition to scope of ICT goods
847021	Calculating machines; electronic, incorporating a printing device, needing an external source of power	Addition to scope of ICT goods
847029	Calculating machines; electronic, (not incorporating a printing device), needing an external power source	Addition to scope of ICT goods
847050	Cash registers	Retained from HS17
847090	Machines incorporating a calculating device; n.e.c. in heading no. 8470	Addition to scope of ICT goods
847130	Automatic data processing machines; portable, weighing not more than 10kg, consisting of at least a central processing unit, a keyboard and a display	Retained from HS17
847141	Automatic data processing machines; comprising in the same housing at least a central processing unit and an input and output unit, whether or not combined, n.e.c. in item no. 8471.30	Retained from HS17
847149	Automatic data processing machines; presented in the form of systems, n.e.c. in item no. 8471.30 or 8471.41	Retained from HS17
847150	Units of automatic data processing machines; processing units other than those of item no. 8471.41 or 8471.49, whether or not containing in the same housing one or two of the following types of unit: storage units, input units or output units	Retained from HS17
847160	Units of automatic data processing machines; input or output units, whether or not containing storage units in the same housing	Retained from HS17
847170	Units of automatic data processing machines; storage units	Retained from HS17
847180	Units of automatic data processing machines; n.e.c. in item no. 8471.50, 8471.60 or 8471.70	Retained from HS17
847190	Magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data, not elsewhere specified or included	Retained from HS17
847290	Office machines; not elsewhere classified	Retained from HS17
847330	Machinery; parts and accessories (other than covers, carrying cases and the like) of the machines of heading no. 8471	Retained from HS17
847340	Machinery; parts and accessories (other than covers, carrying cases and the like) of the machines of heading no. 8472	Retained from HS17
847350	Machines; parts and accessories (other than covers, carrying cases and the like) equally suitable for use with machines of two or more of the headings 8470 to 8472	Retained from HS17
852842	Monitors; cathode-ray tube, capable of directly connecting to and designed for use with an automatic data processing machine of heading 84.71	Retained from HS17
852852	Monitors; other than cathode-ray tube; capable of directly connecting to and designed for use with an automatic data processing machine of heading 84.71	Retained from HS17
852862	Projectors; capable of directly connecting to and designed for use with an automatic data processing machine of heading 84.71	Moved from ICT03
ICT02 – Communication equipment		
851711	Line telephone sets with cordless handsets	Retained from HS17

851713	Telephone sets; smartphones for cellular or other wireless networks	Breakdown replacing HS17 category 851712
851714	Telephone sets; other than smartphones, for cellular or other wireless networks	
851718	Telephone sets n.e.c. in item no. 8517.1	Retained from HS17
851761	Base stations	Retained from HS17
851762	Communication apparatus (excluding telephone sets or base stations); machines for the reception, conversion and transmission or regeneration of voice, images or other data, including switching and routing apparatus	Retained from HS17
851769	Communication apparatus (excluding telephone sets or base stations); machines for the transmission or reception of voice, images or other data (including wired/wireless networks), n.e.c. in item no. 8517.6	Retained from HS17
851771	Communication apparatus; parts, aerials and aerial reflectors of all kinds, part suitable for use therewith	Breakdown replacing HS17 category 851770
851779	Communication apparatus; parts, other than aerials and aerial reflectors of all kinds	
852550	Transmission apparatus for radio-broadcasting or television, whether or not incorporating sound recording or reproducing apparatus, not incorporating reception apparatus	Retained from HS17
852560	Transmission apparatus for radio-broadcasting or television, whether or not incorporating sound recording or reproducing apparatus, incorporating reception apparatus	Retained from HS17
853110	Signalling apparatus; electric, sound or visual, burglar or fire alarms and similar, other than those of heading no. 8512 or 8530	Retained from HS17
ICT03 – Consumer electronic equipment		
851810	Microphones and stands therefor	Retained from HS17
851821	Loudspeakers; single, mounted in their enclosures	Retained from HS17
851822	Loudspeakers; multiple, mounted in the same enclosure	Retained from HS17
851829	Loudspeakers; not mounted in their enclosures	Retained from HS17
851830	Headphones and earphones, whether or not combined with a microphone, and sets consisting of a microphone and one or more loudspeakers	Retained from HS17
851840	Amplifiers; audio-frequency electric	Retained from HS17
851850	Amplifier sets; electric sound	Retained from HS17
851890	Microphones, headphones, earphones, amplifier equipment; parts of the equipment of heading no. 8518	Retained from HS17
851920	Sound recording or reproducing apparatus; operated by coins, banknotes, bank cards, tokens or by other means of payment	Retained from HS17
851930	Sound recording or reproducing apparatus; turntables (record-decks)	Retained from HS17
851981	Sound recording or reproducing apparatus; using magnetic, optical or semiconductor media, n.e.c. in item no 8519.20, 8519.30 or 8519.50	Retained from HS17
851989	Sound recording or reproducing apparatus; n.e.c. in heading no 8519	Retained from HS17
852110	Video recording or reproducing apparatus; magnetic tape-type	Retained from HS17
852190	Video recording or reproducing apparatus; other than magnetic tape-type	Retained from HS17
852210	Sound recording or reproducing apparatus; parts and accessories thereof, pick-up cartridges	Retained from HS17
852290	Sound or video recording or reproducing apparatus; parts and accessories thereof, other than pick-up cartridges	Retained from HS17
852581	Television cameras, digital cameras and video camera recorders; high-speed goods as specified in subheading note 1 to this chapter	Breakdown replacing HS17 category 852580
852582	Television cameras, digital cameras and video camera recorders; radiation-hardened or radiation-tolerant goods as specified in subheading note 2 to this chapter	
852583	Television cameras, digital cameras and video camera recorders; night vision goods as specified in subheading note 3 to this chapter	
852589	Television cameras; n.e.c. in item no 8525.8	
852712	Radio broadcast receivers capable of operating without an external power source; pocket-size radio cassette-players	Retained from HS17
852713	Radio broadcast receivers capable of operating without an external power source; apparatus (other than pocket-size radio cassette-players), combined with sound recording or reproducing apparatus	Retained from HS17

852719	Radio broadcast receivers capable of operating without an external power source; n.e.c. in item no. 8527.1	Retained from HS17
852721	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles; combined with sound recording or reproducing apparatus	Retained from HS17
852729	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles; not combined with sound recording or reproducing apparatus	Retained from HS17
852791	Radio-broadcast receivers n.e.c. in heading no. 8527; combined with sound recording or reproducing apparatus	Retained from HS17
852792	Radio-broadcast receivers n.e.c. in heading no. 8527; not combined with sound recording or reproducing apparatus but combined with a clock	Retained from HS17
852799	Radio-broadcast receivers n.e.c. in heading no. 8527; not combined with sound recording or reproducing apparatus and not combined with a clock	Retained from HS17
852849	Monitors; cathode-ray tube, n.e.c. in subheading 8528.42, whether or not colour	Retained from HS17
852859	Monitors other than cathode-ray tube; n.e.c. in subheading 8528.52, whether or not colour	Retained from HS17
852862	Projectors; capable of directly connecting to and designed for use with an automatic data processing machine of heading 84.71	Retained from HS17
852869	Projectors; n.e.c. in subheading 8528.62, whether or not colour	Retained from HS17
852871	Reception apparatus for television, whether or not incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus; not designed to incorporate a video display or screen	Retained from HS17
852872	Reception apparatus for television, whether or not incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus; incorporating a colour video display or screen	Retained from HS17
852873	Reception apparatus for television, whether or not incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus; incorporating a monochrome video display or screen	Retained from HS17
950430	Games; operated by coins, banknotes, bank cards, tokens or by other means of payment, other than billiard articles and accessories, and automatic bowling alley equipment	Addition to scope of ICT goods
950450	Games; video game consoles and machines, other than those of subheading 9504.30	Retained from HS17
ICT04 – Electronic components		
852321	Magnetic media; cards incorporating a magnetic stripe, whether or not recorded, excluding products of Chapter 37	Retained from HS17
852352	Semiconductor media; smart cards, whether or not recorded, excluding products of Chapter 37	Retained from HS17
852411	Flat panel display modules, whether or not incorporating touch-sensitive screens; of liquid crystals, without drivers or control circuits	Category introduced in HS22.
852412	Flat panel display modules, whether or not incorporating touch-sensitive screens; of organic light-emitting diodes (OLED), without drivers or control circuits	
852419	Flat panel display modules, whether or not incorporating touch-sensitive screens; of other than liquid crystals or organic light-emitting diodes (OLED), without drivers or control circuits	
852491	Flat panel display modules, whether or not incorporating touch-sensitive screens; of liquid crystals, with drivers or control circuits	
852492	Flat panel display modules, whether or not incorporating touch-sensitive screens; of organic light-emitting diodes (OLED), with drivers or control circuits	
852499	Flat panel display modules, whether or not incorporating touch-sensitive screens; of other than liquid crystals or organic light-emitting diodes (OLED), with drivers or control circuits	
853400	Circuits; printed	Retained from HS17
854011	Tubes; cathode-ray television picture tubes, including video monitor cathode-ray tubes, colour	Retained from HS17
854012	Tubes; cathode-ray television picture tubes, including video monitor cathode-ray tubes, monochrome	Retained from HS17

854020	Tubes; television camera tubes, image converters and intensifiers, other photo-cathode tubes	Retained from HS17
854040	Tubes; data/graphic display tubes, monochrome; data/graphic display tubes, colour, with a phosphor dot screen pitch smaller than 0.4mm	Retained from HS17
854060	Tubes; cathode ray, n.e.c. in heading no. 8540	Retained from HS17
854071	Tubes; microwave, magnetrons, excluding grid-controlled tubes	Retained from HS17
854079	Tubes; microwave (for example klystrons, travelling wave tubes, carlinotrons), excluding magnetrons and grid-controlled tubes	Retained from HS17
854081	Valves and tubes; receiver or amplifier	Retained from HS17
854089	Valves and tubes; n.e.c. in heading no. 8540	Retained from HS17
854091	Tubes; parts of cathode-ray tubes	Retained from HS17
854099	Valves and tubes; parts of the valves and tubes of heading no. 8540, excluding parts of cathode-ray tubes	Retained from HS17
854121	Electrical apparatus; transistors, (other than photosensitive), with a dissipation rate of less than 1W	Retained from HS17
854129	Electrical apparatus; transistors, (other than photosensitive), with a dissipation rate of 1W or more	Retained from HS17
854149	Electrical apparatus; photosensitive semiconductor devices, diodes other than light emitting diodes and photovoltaic cells whether or not assembled in modules or made up into panels	Introduced as part of a breakdown replacing HS17 category 854140.
854151	Semiconductor-based transducers	Introduced as part of a breakdown replacing HS17 category 854140.
854160	Crystals; mounted piezo-electric	Retained from HS17
854190	Electrical apparatus; parts for diodes, transistors and similar semiconductor devices and photosensitive semiconductor devices	Retained from HS17
854231	Electronic integrated circuits; processors and controllers, whether or not combined with memories, converters, logic circuits, amplifiers, clock and timing circuits, or other circuits	Retained from HS17
854232	Electronic integrated circuits; memories	Retained from HS17
854233	Electronic integrated circuits; amplifiers	Retained from HS17
854239	Electronic integrated circuits; n.e.c. in heading no. 8542	Retained from HS17
854290	Parts of electronic integrated circuits	Retained from HS17
ICT05 – Miscellaneous ICT goods (not elsewhere classified)		
852351	Semiconductor media; solid-state non-volatile storage devices, whether or not recorded, excluding products of Chapter 37	Retained from HS17
852359	Semiconductor media; other than smart cards, whether or not recorded, excluding products of Chapter 37	Retained from HS17
852380	Media n.e.c. in heading 8523, whether or not recorded, excluding products of Chapter 37	Retained from HS17
852910	Reception and transmission apparatus; aerials and aerial reflectors of all kinds and parts suitable for use therewith	Retained from HS17
852990	Reception and transmission apparatus; for use with the apparatus of heading no. 8524 to 8528, excluding aerials and aerial reflectors	Retained from HS17
901320	Lasers; other than laser diodes	Retained from HS17

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