V. 08/20

Whitepaper
What Do i.MX 8M Mini and Nano Offer?

Highest flexibility based on a new CPU generation

Alcom electronics
Singel 3 | B-2550 Kontich | Belgium | Tel. +32 (0)3 458 30 33 | info@alcom.be | www.alcom.be
Rivium 1e straat 52 | 2909 LE Capelle aan den IJssel | The Netherlands | Tel. +31 (0)10 288 25 00 | info@alcom.nl | www.alcom.nl

Content

1. Where do Mini and Nano belong in the i.MX 8M family?

With the i.MX 8M Mini/Nano family, NXP offers a CPU family within the i.MX8 series for a reduced price and with scaled-back functions. The main difference between this CPU and its more powerful 'brother' i.MX 8M in terms of graphics and video interfaces is that there is only one display interface (MIPI-DSI) and one serial camera interface. The Mini and Nano have the same core architecture and are pin-compatible, but differ in their basic functions.

1.1 i.MX 8M Mini

The i.MX 8M Mini uses the Cortex A53 core with up to 1.8 GHz. A Cortex-M4F with 400MHz is available to support real-time applications as well as security tasks of the CPU. The memory interface is 32 bit wide and supports LPDDR4, DDR4 and DDR3L.

In addition to the extended audio functions with 5x I²S (SAI), 20x 32-bit up to 384KHz with DSD512 and TDM support, 8-channel PDM microphone inputs, the processor offers comprehensive graphics capabilities. These include 2D and 3D graphics thanks to GCNanoUltra (GPU) as well as video decoding (1080p60 H.265, H.264, VP8, VP9) and encoding (1080p60 H.264, VP8) as hardware acceleration. It also features extensive security functions.

There are six CPU variants available. These range from single core and dual core to quad core, and include lite versions without video decoding and encoding.

In addition to the extensive audio functions, the main interfaces are available as follows:

- 1x MIP DSI (Display Sensor Interface)
- 1x MIPI CSI (Display Sensor Interface)
- 1x PCIe 2.0
- 3x SDIO/eMMC
- 2x USB 2.0
- 1x Gigabit Ethernet

1.2 i.MX 8M Nano

The i.MX 8M Nano is essentially different in that it integrates a 750MHz Cortex-M7 with more power to support the CPU for real-time applications or security tasks. In addition, the memory interface is 16 bits wide, enabling a maximum memory expansion of two gigabytes. The GC7000UL serves as the Nano's GPU.

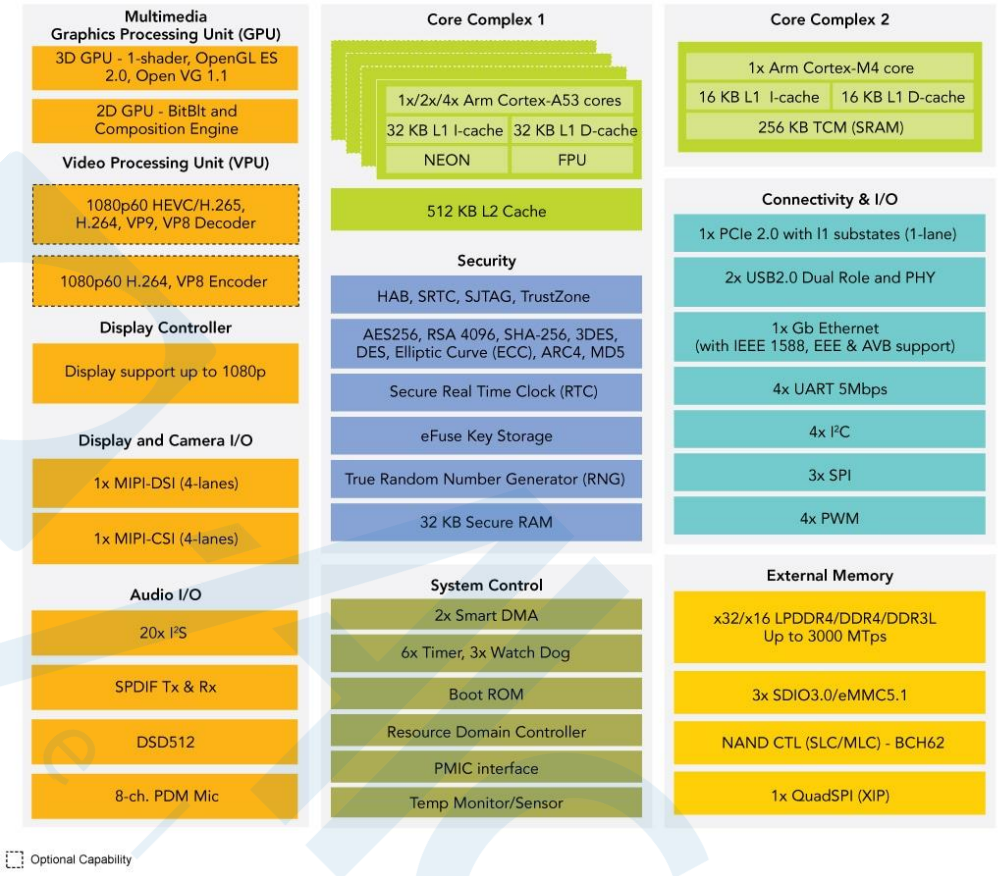
To reduce costs, the design omits the video hardware acceleration and PCI. The Nano CPU was designed primarily for mobile applications. There are also six CPU variants as mentioned above, but the GPU is missing in the three lite versions.

	Product Family	i.MX 8M Mini Embedded Consumer and Industrial Applications	i.MX 8M Nano Embedded Consumer and Industrial Applications
CPU, GPU, and DSP	Cortex®-A72	-	-
	Cortex®-A53	4	4
	Cortex®-A35	-	-
	Cortex®-M4F	1	-
	Cortex®-M7	-	1
	Cortex®-DSP	-	-
	Cortex®-GPU	1	1
HMI & Multimedia	Display Resolution and Interfaces: MIPI-DSI / Parallel / HDMI	1080p 1 / 0 / 0	1080p 1 / 0 / 0
	Camera Interfaces: MIPI-CSI / Parallel / HDMI	1 / 0 / 0	1 / 0 / 0
	Video Decode Resolution (Top Codecs)	-	-
	Video Encode Resolution (Top Codecs)	1080p60 (h.264)	-
Interfaces	PCIe	1	-
	Gigabit Ethernet	1x	1x
CPU Performance / Power	Performance	3450 bis 13800 DMIPS	3450 bis 13800 DMIPS
	CPU Power	1–4W	1–4W

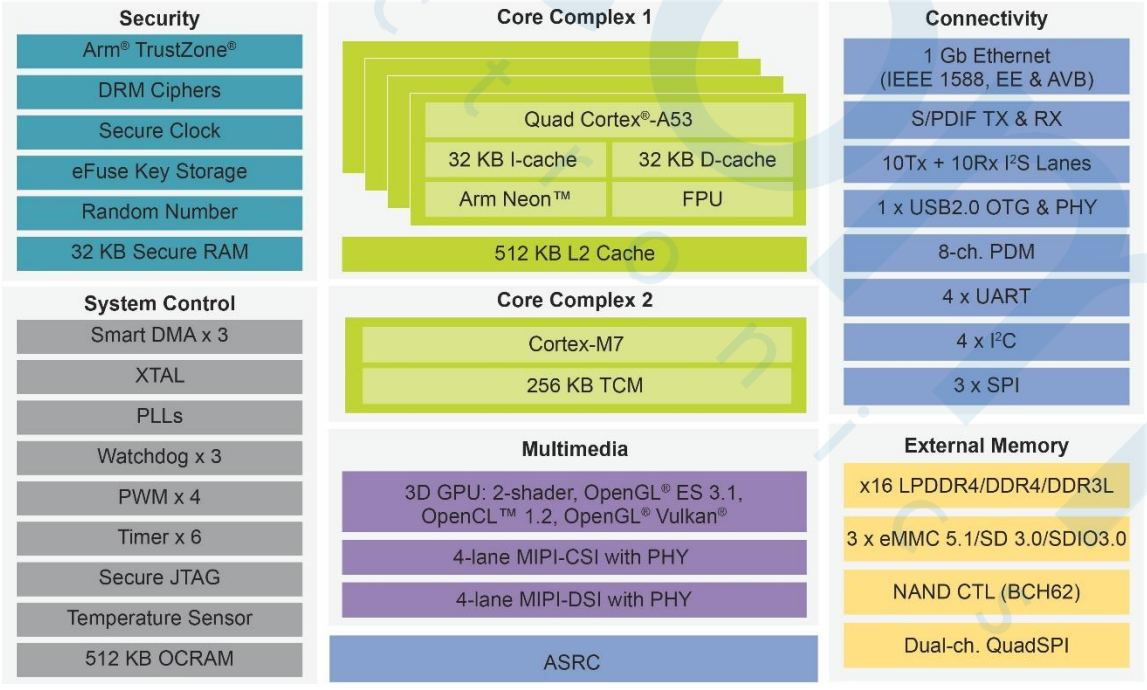
Graphic 1: Comparison i.MX 8M Mini and Nano (Image: TQ-Systems)

All interfaces function depending on the availability of pin multiplexing. This results in a very high flexibility when designing mainboards, and thus the ability to achieve high efficiency and utilization of the CPU.

TQ-Embedded has developed a module design that is compatible with both the i.MX 8M Mini and i.MX 8M Nano, despite their technical differences.



Graphic 2: Overview i.MX 8M Mini (Image: NXP)



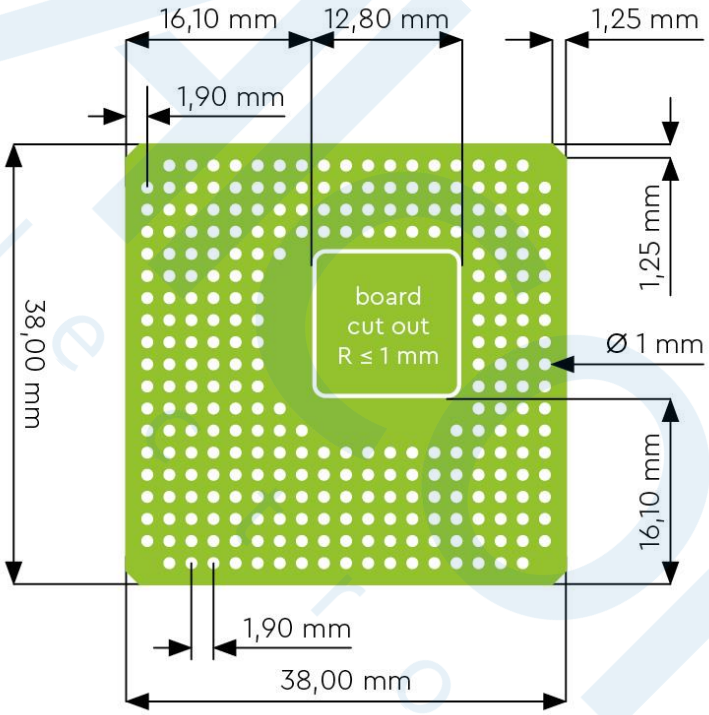
Graphic 3: Overview i.MX 8M Nano (Image: NXP)

2. Module design i.MX 8M Mini/Nano

Measuring only 38x38mm, the TQ module performs in demanding industrial applications as well as flexible mobile applications. All relevant signal pins are available to the user for the realization of an own mainboard. This enables a very high degree of fulfillment, especially when pin multiplexing is an option for the interfaces provided by the CPU.

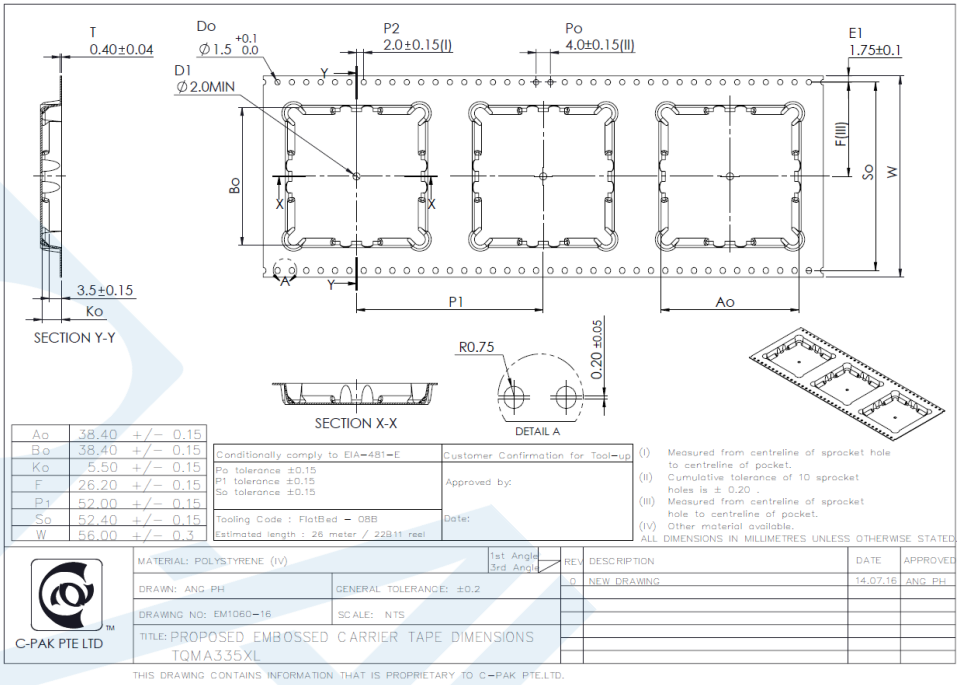
The TQ module was realized using proven LGA technology (Land Grid Array). The LGA module connects directly to the mainboard via soldering without plug connection. For this purpose, a matching solder profile comes with the module. This offers an enormous cost advantage, since no expensive connectors are required.

For the LGA modules from TQ, a pin arrangement of 1.9mm (design) was selected, which allows the baseboard design to be implemented cost-effectively while taking into account design specifications such as impedances and line lengths for interfaces. The soldering reflects the demand for high robustness, offering resistance to shock, vibration or temperature variation on the module.



Graphic 4: Pin placement of TQ modules (Image: TQ-Systems)

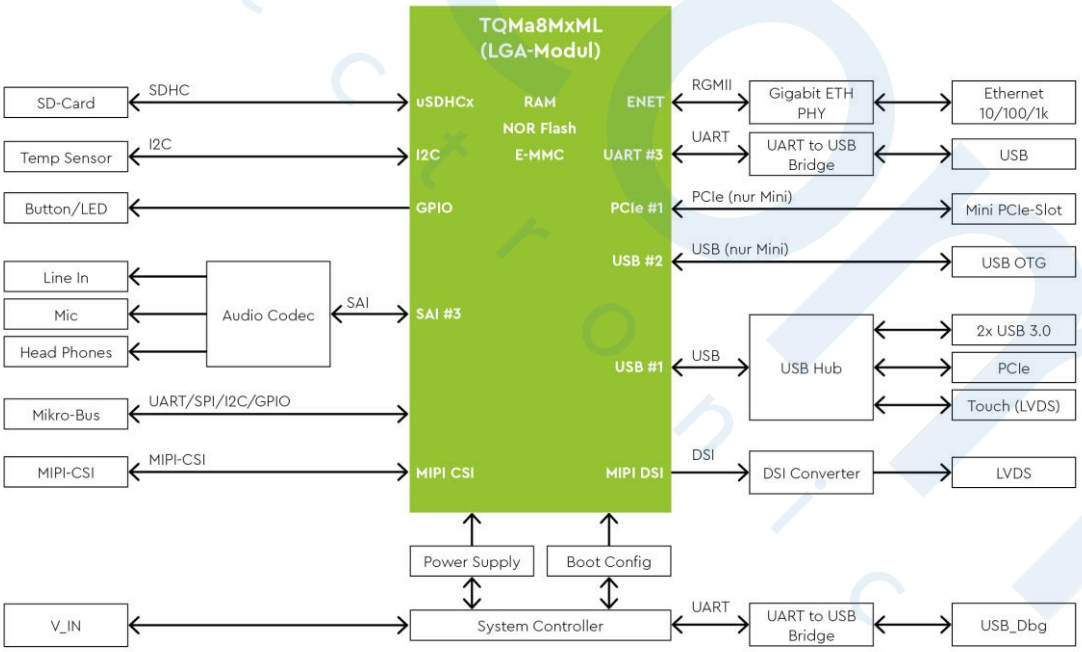
LGA modules from TQ are generally suitable for pick-and-place machines, thus further reducing costs. Mini and Nano are available in up to twelve CPU variants; this underscores the great scalability. This serves as the basis for highly individual expansion stages for devices.



Graphic 5: Examples of pick-and-place options (Image: C-PAK)

3. Mainboard design

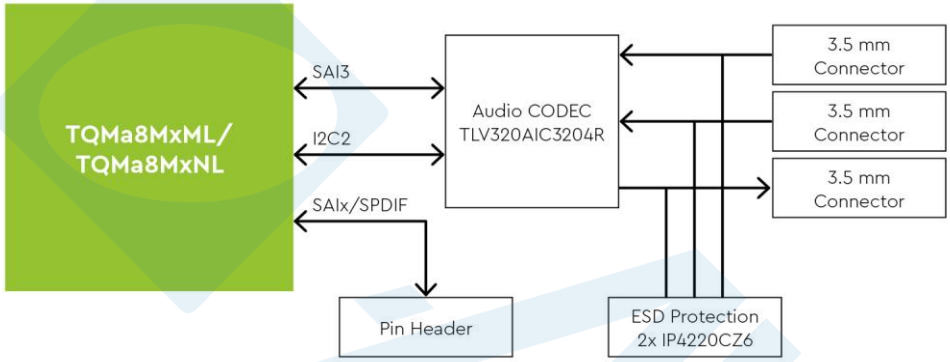
TQ offers a baseboard as a reference platform. The interfaces that have already been implemented provide a sound basis, saving valuable development time and bringing about a considerable cost saving. The following graphic details the supported interfaces.



Graphic 6: Baseboard MBa8Mx from TQ-Systems for i.MX 8M Mini/Nano module (Image: TQ-Systems)

3.1 Audio

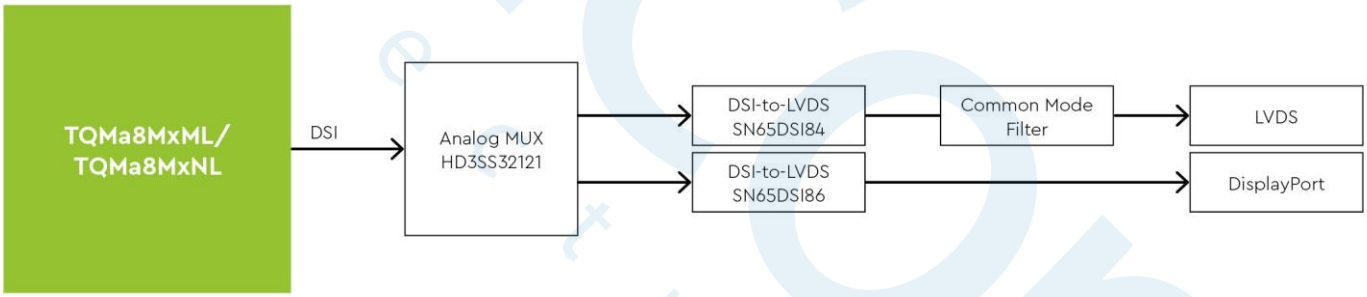
The CPU provides up to five SAI audio ports. It supports the protocols I²S, AC97 and TDM. The largest audio path with 16 channels (8Rx / 8TX) is SAI1. The baseboard reference design only uses SAI3 (1Rx / 1Tx). The TLV320AIC3204 from Texas Instruments is the chosen audio codec. Its configuration via SAI is I²S, and it connects with the module via I2C2. The audio codec provides microphone, line in and line out signals. 3.5 mm connectors tap into the signals.



Graphic 7: Audio interface (Image: TQ-Systems)

3.2 Graphics

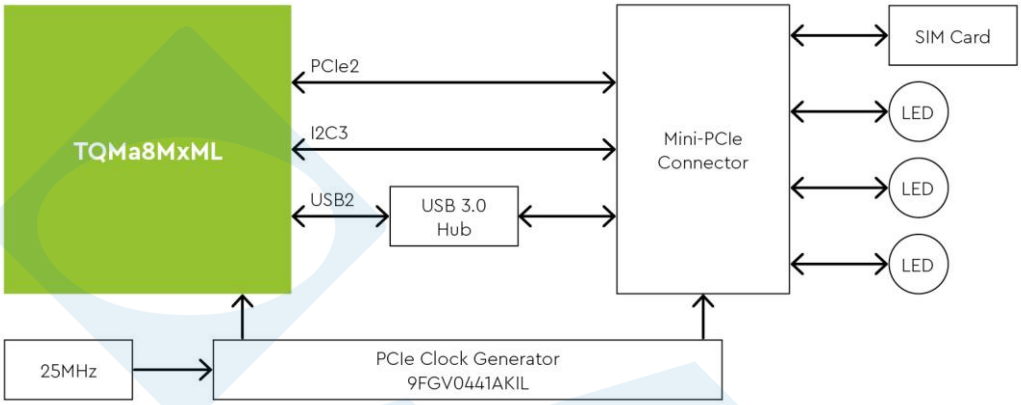
Depending on which graphic interfaces the user requires on the baseboard, a simple switch can select the physical interface. This does not result in any other restrictions or violations of the design guidelines. The following graphic shows two possibilities to use MIPI DSI.



Graphic 8: Graphics interface (Image: TQ-Systems)

3.3 PCIe / Mini PCIe

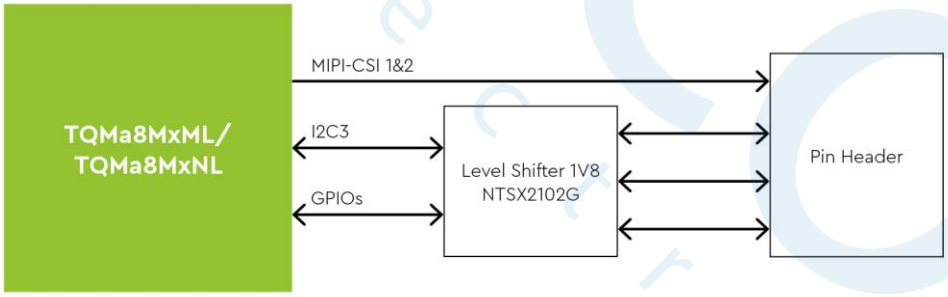
The PCIe interface is Mini PCIe to enable the use of wireless solutions. Cellphone modules fit in the available SIM card reader.



Graphic 9: PCIe-/Mini PCIe interface (Image: TQ-Systems)

3.4 CSI

The Camera Serial Interface (CSI) signals are available on a high-speed connector. Many manufacturers have different requirements for the design of the camera interface, and the availability of camera modules can change very quickly. Depending on the requirements, the cameras connects via a simple adapter board. This allows using the CSI interface without direct changes to the baseboard or any restrictions.



Graphic 10: CSI interface (Image: TQ-Systems)

4. Available TQ modules with i.MX 8M Mini and i.MX 8M Nano

TQ currently offers two modules based on the two CPU families. The optimized technical properties of both modules allow for use in harsh environmental conditions. This results in hardly any restrictions when it comes to use in robust applications.

4.1 TQMa8MxML

Image 1: TQMa8MxML (Image: TQ-Systems)

The TQMa8MxML with the i.MX 8M Mini processor based on a Cortex-A53 core offers 1 to 4 GB LPDDR4 memory and eMMC sizes ranging from 8 to 64 GB in the extended temperature range. The graphics integrated into the CPU enable a screen resolution up to Full HD with 3D video processing as well as high video encoding and decoding performance. In the Mini, a Cortex-M4 supports the Cortex-A53.

4.2 TQMa8MxNL

Image 2: TQMa8MxNL (Image: TQ-Systems)

The TQMa8MxNL with the i.MX 8M Nano processor based on a Cortex A53 core offers memory ranging from 512 MB to 2 GB LPDDR4 and eMMC sizes ranging from 8 to 64 GB in the extended temperature range. With the graphics integrated in the CPU, a screen resolution up to Full HD with 3D video processing is possible. In the Nano, a Cortex-M7 supports the Cortex-A53.

TQ-Systems offers extensive design support for the design of a customer-specific mainboard, such as current diagram and layout testing, ESD consulting and more. If requested, TQ can offer complete design services, from concept through to certification and product approval.

4.3 Software

For each of the modules there is a separate BSP to match the architecture. For these two modules, Linux is the focus. In addition to Linux, support for Android is available on request.

4.4 Possible areas of application

Both TQ modules are particularly suitable for solutions in the following areas:

- Industry (machine learning, camera technology)
- Private and commercial building automation
- Image processing
- Robotics
- Infotainment and audio
- Medical
- Measurement
- Transportation

(Images: 123rf.com/pixinoo; istockphoto.com/de/mikkelwilliam; stock.adobe.com/de/terovesalainen; 123rf.com/Kittipong Jirasukhanont; 123rf.com/Andrey Popov; istock.com/maska82)