life.augmented

Products and solutions for Medical Ultrasound

Contents

Introduction

Medical ultrasound systems are among the most used diagnostic and disease identification equipment in gynecology, obstetrics, cardiology and other hospital wards.

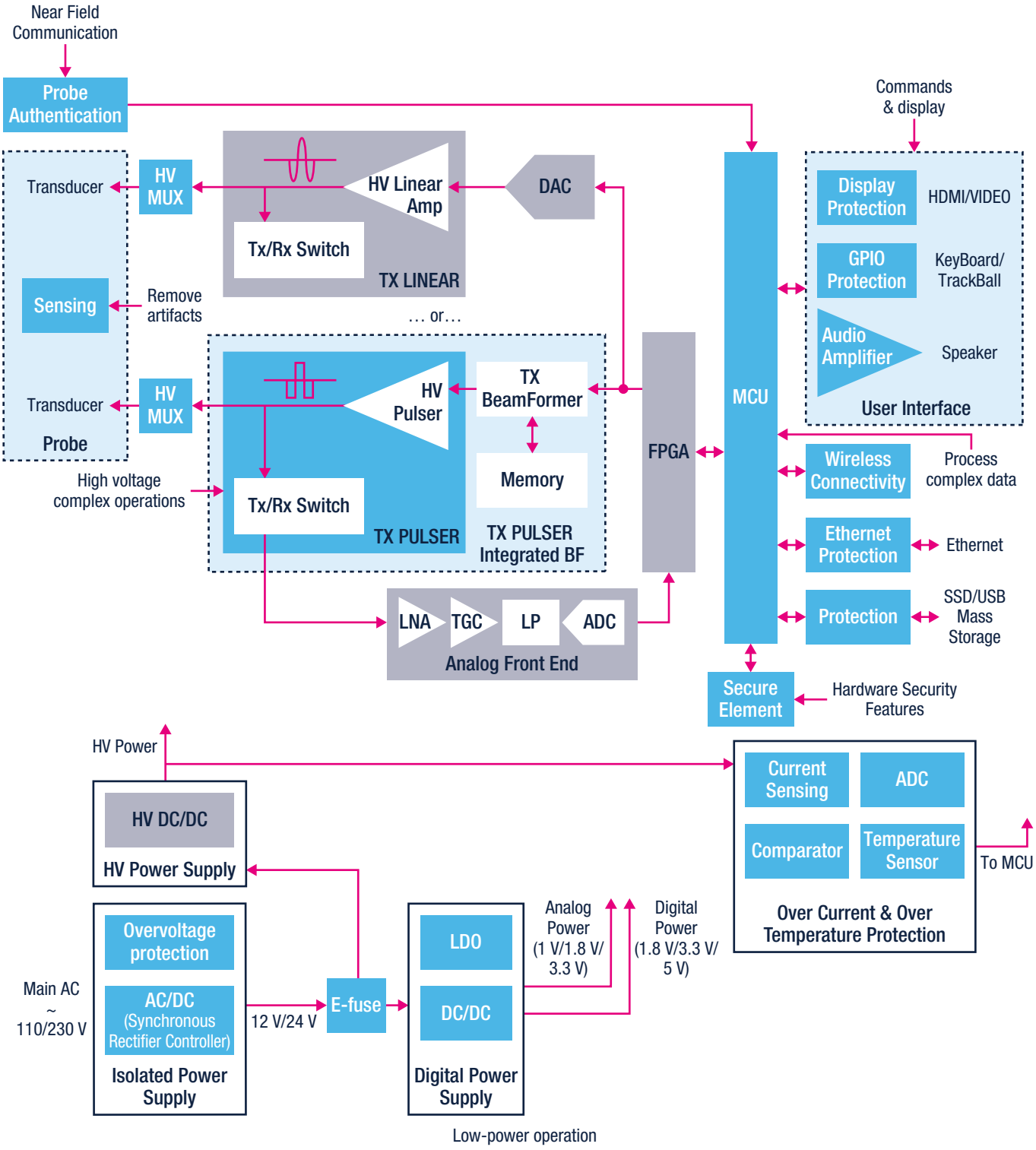
Ultrasound machines emit inaudible, high frequency sound waves and capture the reflected echoes that bounce off their target. From these echoes, an image based on the acoustic impedance of different body tissues is generated.

These systems consist of a probe with the acoustic transmitter and receiver stages, and a cart where the doctor can view the images and adjust the focus of the acoustic beam, as well as set all the parameters associated with a particular diagnosis.

Portable solutions based on computer laptops are now also readily available.

The probe is one of the most important elements in medical ultrasound systems, containing 48 to 512 micro-coaxial cables ending in transducer elements.

Ultrasound echography block diagram



Key Products

HIGH VOLTAGE MULTIPLEXER

ST's Medical Ultrasound Imaging IC Solutions include the most highly integrated **STHV64SW** **64-channel high voltage analog independent switches.** These low harmonic distortion ICs are designed for use in applications such as medical ultrasound imaging and other piezoelectric transducer drivers, where high voltage switching is controlled by low voltage control signals.

The **STHV64SW** comprises a shift register for serial communication, self-biased high voltage MOSFET gate drivers, and high-power N-channel MOSFETs for each switch. The switches can provide up to ±3 A peak output current, and are suitable for various combinations of high voltage supplies, such as -100 V/+100 V, 0 V/200 V, -200 V/0 V, etc.

How to evaluate the product?

BOARD FEATURES

- Switch input and output header connectors
- High voltage and low voltage connectors to power the STHV64SW
- Digital input and output header connector
- Optional standard probe connector footprint

Order Code: **STEVAL-IME015V1**
(available under NDA)

ULTRASOUND PULSER ICs

The TX Pulser integrates a controller logic interface circuit, level translators, MOSFET gate drivers, noise-blocking diodes, and high-power P-channel and N-channel MOSFETs as the output stage for each channel. It can also integrate the beamforming process to enable phase delay generation.

The **STHV748S** is composed of a controller logic interface circuit, level translators, MOSFET gate drivers, noise blocking diodes, and high-power P-channel and N-channel MOSFETs as the output stage for each channel. It also includes clamping-to-ground circuitry, anti-leakage, anti-memory effect block, thermal sensor, and a T/R switch which guarantees effective decoupling during the transmission phase. The STHV748S also includes self-biasing and thermal shutdown blocks.

The **STHV800** is an octal, monolithic, high-voltage & high-speed pulse generator. The device integrates a controller logic interface circuit (compatible with 1.8 V and 3.3 V input signals), level translators, MOSFET gate drivers, noise blocking diodes, and high-power P-channel and N-channel MOSFETs as the output stage for each channel. These MOSFETs can provide more than 2 A of peak output current. Each channel has a dedicated bridge to reduce power dissipation and jitter during continuous wave mode (peak current is limited to 0.3 A). This CW bridge has dedicated power supplies (HV_CW) which are fully independent on the main HV supplies.

The **STHV1600** features 16 independent channels and integrates a 16-channel beamformer. A purely analog section provides each channel with voltage level translators, a noise blocking diode function, and two identical high voltage P- and N-channel MOSFETs. Its digital core logic is responsible for managing channel delay transmission used in the beamformer, waveform generation and compression algorithms, configuration and data storage, as well as managing all the device operation sequences.

The latest **STHVUP64*** is the first device of pulsers designed for ultra-portable applications for medical ultrasound tools. On the PCB, it's designed to be next to the piezoelectric material element to be effective.

The **STHVUP64** features 64 independent channels and integrates a beamformer function. The analog section provides with each channel with voltage level translators, noise-blocking diode function, and two identical high-voltage P- and N-channel MOSFETs. Its digital core logic is responsible for managing channel delay transmission used in the beamformer, waveform generation, compression algorithms, configuration and data storage, and all the device operation sequences.

Part Number	Number of Channels	Output Voltage (V)	Output Current (A)	Output Levels	Package (size in mm)
STHV748S	4	±90	±2	3/5	VFQFPN2 64 (9 x 9 x 1)
STHV800	8	±90	±2	3 RTZ	TFLGA-56LD (8 x 8 x 0.9)
STHV1600	16	±100	±2/4	3/5 RTZ	LFBGA144 (10 x 10 x 1.4)
STHVUP64*	64	±100	±0.2-0.4	3/5 RTZ	FCBGA196 (10 x 10 x 1.4)

Note: * available by Q4 2022

How to evaluate the product?

BOARD FEATURES
- Designed around STHV800
- 8-channel outputs: high voltage and low voltage BNC connectors
- Load simulator using signal equivalent circuits
- 4 MB serial Flash memory to host FPGA code and waveforms, 16 preset waveforms
- Memory expansion connector to add external serial Flash

Order Code: **STEVAL-IME009V1**

BOARD FEATURES
- Designed around STHV748
- 4-ch outputs: high voltage and low voltage BNC connectors
- Up to 4 memory locations to store own designed waveforms
- USB connector to download on the board own waveforms
- Dedicated connectors to supply high voltage and low voltage to the STHV748 output stage
- 4 key button to select quickly the preferred program

Order Code: **STEVAL-IME011V2**

BOARD FEATURES
- Cost effective ultrasound pulser IC evaluation board based on the STHV800

Order Code: **STEVAL-IME013V1**

BOARD FEATURES
- Designed around STHV1600
- Typical load connected on high voltage outputs (100 Ω / 300 pF); can be easily removed
- Four preset programs and waveforms
- USB interface to change programs and waveforms
- Button interface to control waveform generation
- Included Power Supply board (STEVAL-IME014V1D):
  - Four high voltage and one low voltage supply lines
  - All other necessary low voltage supplies generated on-board

Order Code: **STEVAL-IME014V1B**
(available under NDA)

CUSTOM IC SERVICE

ST provides a complete ASIC design and turnkey manufacturing services for companies that develop SoC for ultrasound medical imaging applications. Experienced in digital and analog mixed-signal technologies, we offer SoC solutions based on advanced BDC process nodes from 4 µm down to 110 nm technologies, and large voltage ranges spanning from 5 V to 800 V.

ST offers a broad spectrum of HV and mixed-signal IP to complete the value chain for customer design targets.

ST recently released ASIC solutions to support the most advanced Trans-Esophageal Echocardiography (TEE) probes and Intracardiac Echography (ICE) probes for cardiovascular imaging. The adoption of SOI-BCD technology offers best-in-class HV devices with large CMOS integration tailoring TX/RX functions to enable multichannel integration in a single-chip.

Contact ST Sales for further Information

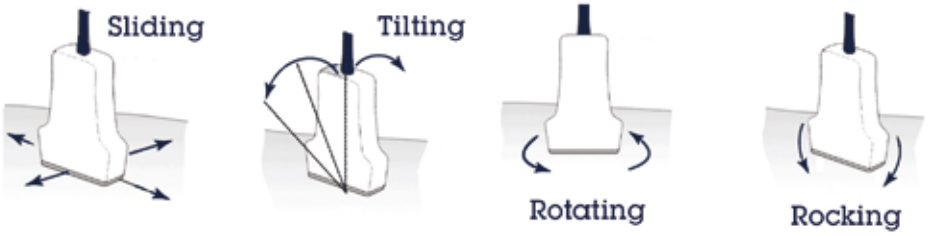
The flexibility that ST brings to any project allows customers to optimize required resources and services. We offer the following different business models and can adapt each model to fit specific customer requirements

ASIC	COT	FOUNDRY
• Customer defines the specification for own product • ST designs the product and is in charge of whole supply chain	• Customer designs own products • ST in charge of whole supply chain	• ST provides wafers to customer
ONE STOP SHOP	Foundry ++	

SENSING

Inertial sensors

The inertial sensors can be used in probes to detect their spatial movement and rotation.



Part Number	Description	Movement able to retrieve
IIS2DLPC	3-axis accelerometer ultra-low-power high performance	Sliding, Tilting, Rocking*
ISM303DAC	e-Compass with 3D digital linear acceleration sensor, 3D digital magnetic sensor	Sliding, Tilting, Rotating*, Rocking*
ISM330DHCX	High performance 6-axis IMU with MLC**	Sliding, Tilting, Rocking, Rotating speed*, Attitude***, Movement Timings****, Context awareness***, Orientation***

Notes: * Sensor Fusion Algorithm will improve the performances of the single sensor
** Machine Learning Core
*** Thanks to embedded Machine Learning Core (MLC)
**** Thanks to embedded Finite State Machine (FSM)

How to evaluate the product?

Order Code: **STEVAL-MKI109V3**
+ **STEVAL-MKI191V1** (IIS2DLPC)
+ **STEVAL-MKI184V1** (ISM303DAC)
+ **STEVAL-MKI207V1** (ISM330DHCX)

Software Algorithm with: **UNICLEO-GUI and AlgoBuilder**

MEMS Microphone

ST MEMS microphones offer small size, high sound quality, reliability and affordability. Our MEMS microphones are suitable for medical ultrasound application requiring high SNR and wide acoustic dynamic range. Very tight sensitivity matching allows to optimize beamforming and noise cancelling algorithms for multi-microphone arrays. Low power consumption allows for an extended battery life.

Part Number	Description	Acoustic Overload Point	Sensitivity
IMP34DT05	MEMS audio sensor omnidirectional digital microphone	122.5 dBSPL	-26 dBFS ±3 dB
IMP23ABSU	Analog bottom port microphone with frequency response up to 80 kHz	130 dBSPL	-38 dBV ±1 dB

How to evaluate the product?

STM32 Open Development Environment

SENSORTILE WIRELESS INDUSTRIAL NODE DEVELOPMENT KIT FOR INDUSTRIAL APPLICATIONS BOARD FEATURES

- Multi-sensing wireless platform implementing vibration monitoring and ultrasound detection
- Industrial grade digital MEMS microphone (IMP34DT05) analog MEMS microphone with frequency response up to 80 kHz (IMP23ABSU)

Order Code: **STEVAL-STWINKT1B**

BOARD FEATURES

- 4 x IMP34DT05 top port digital MEMS microphones
- Daughterboard to be used with X-NUCLEO-CCA02M1

Order Code: **STEVAL-MIC003V1**

BOARD FEATURES

- 4 x IMP23ABSU bottom port analog MEMS microphones
- Daughterboard to be used with X-NUCLEO-CCA02M1

Order Code: **STEVAL-MIC007V1**

Pressure

As human activities are affected by environmental conditions, knowing the actual value of certain physical variables such as temperature, pressure, humidity, light and sound, or the presence of chemicals, are crucial to providing greater comfort and the lowest possible energy consumption.

Part Number	Description	Features
ILPS22QS	Dual full-scale, 1.26 bar and 4 bar, absolute digital output barometer in full-mold package	Absolute pressure accuracy: 0.5 hPa Low pressure sensor noise: 0.34 Pa

How to evaluate the product?

Order Code: **STEVAL-MKI109V3** + **STEVAL-MKI228A** (ILPS22QS)

STM32 Open Development Environment

Order Code: **X-NUCLEO-IKS01A3**

Proximity sensors

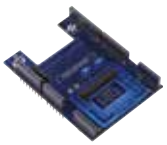
ST time-of-flight proximity and ranging sensors provide accurate distance measurements and can be used to determine the distance of probes from the patient.

Part Number	Description	Features
VL53L4CD	Time-of-Flight high accuracy proximity sensor	• Provides very accurate distance measurements from only 1 mm up to 1200 mm within 18° FoV • Package size: 4.4 x 2.4 x 1 mmFoV: 18° • Max distance: 120 cm • Single zone

Short distance linearity

Low Power mode available

How to evaluate the product?

Item	Picture	Commercial Product (= Order Code)	Comments
VL53L4CDNucleo™ Expansion board		X-NUCLEO-53L4A1	To go along with STM32F401 Nucleo board.Comes with cover-glass holder, 2x cover-window samples
Pack: VL53L4CD Nucleo™ Expansion board + STM32F401 NUCLEO		P-NUCLEO-53L4A1*	X-NUCLEO-53L4A1 expansion board delivered together with STM32F401 NUCLEO board
VL53L4CD Breakout boards		SATEL-VL53L4CD	2x Breakout boards delivered

Note: * coming soon

STM32 Open Development Environment

PROBE AUTHENTICATION

Near Field Communication

ST offers a comprehensive portfolio of products operating at 13.56 MHz and based on NFC and ISO standards suitable for:

- **Ultrasound Probe:** Dynamic NFC tag, featuring a reliable EEPROM memory with data protection, an ISO15693/ NFC Type 5 contactless interface and an I^2C interface to connect to an embedded MCU
- **Ultrasound Cart:** NFC/RFID Readers, which support multiple NFC protocols in Reader, Writer and Peer-to-Peer modes, accessed by SPI interface and able to cope with the most challenging environment

Part Number	Mode	Protocol	Usage
ST25R3911B **ST25R3912**	Reader/Writer P2P	ISO14443A/B ISO15693 FeliCa	Cart
ST25R3916 **ST25R3918**	Reader/Writer Card Emulation P2P	ISO14443A/B ISO15693 FeliCa	Cart
ST25DV04KC **ST25DV16KC** **ST25DV64KC**	Dynamic NFC Tag	ISO15693	Probe

How to evaluate the product?

Boards	Order code
• ST25R3911B Discovery board (105x52mm 2 turns antenna)	ST25R3911B-DISCO
• ST25R3911B Nucleo shield (47x34mm 4 turns antenna)	X-NUCLEO-NFC05A1
• ST25R3916 Discovery board (66x66mm 2 turns antenna)	ST25R3916-DISCO
• ST25R3916 Nucleo shield (47x34mm 4 turns antenna)	X-NUCLEO-NFC06A1
• ST25DVxxKC Discovery board (40x24mm 10 turns antenna)	ST25DV64KC-DISCO
• ST25DVxxKC Nucleo shield (Ø54mm 8 turns antenna)	X-NUCLEO-NFC07A1
• ST25DVxxKC tiny board (14x14mm dual layer antenna)	ANT7-T-25DV64KC

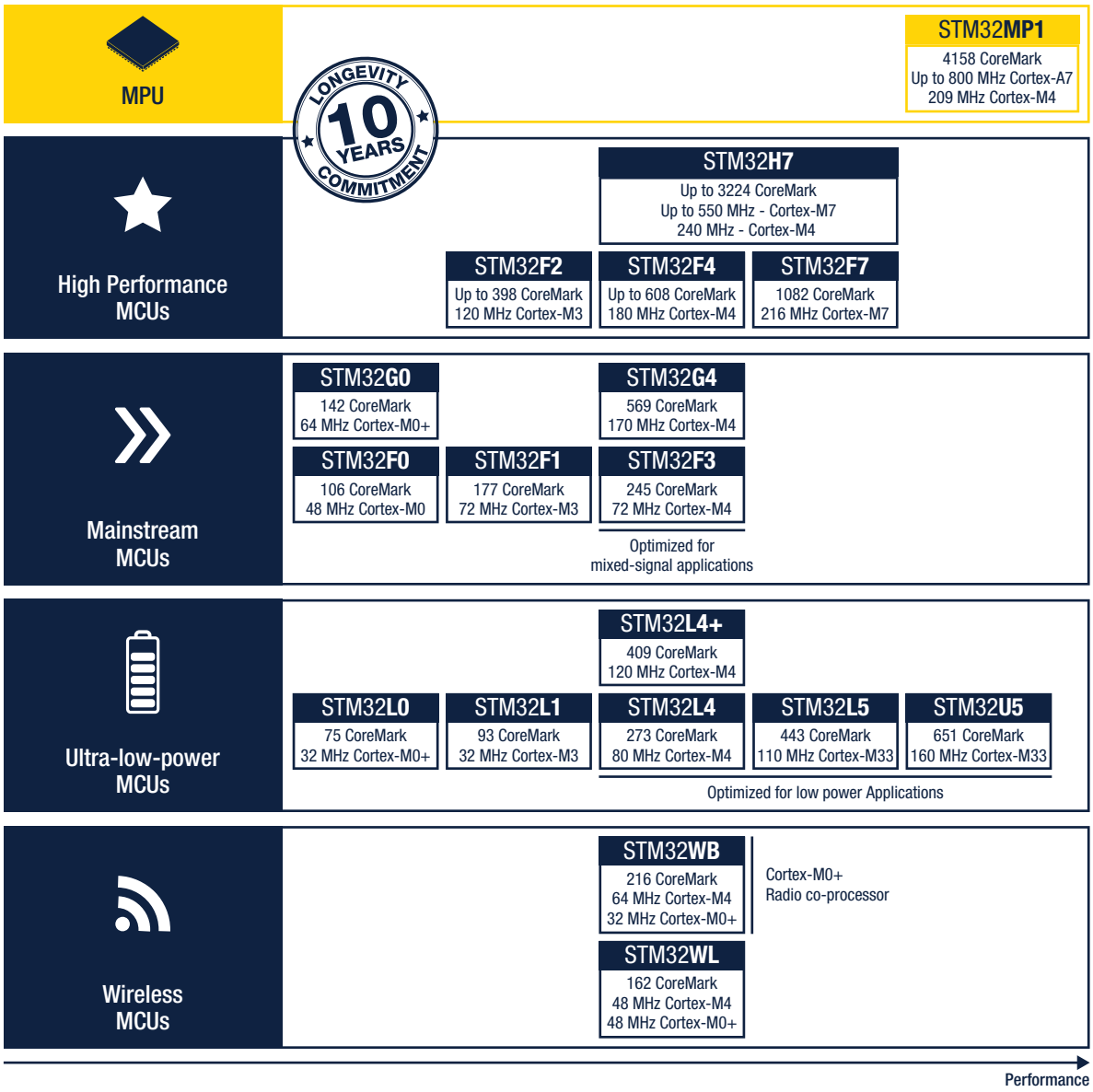
STM32 Open Development Environment

MICROCONTROLLER AND MICROPROCESSOR

ST's wide-ranging MCU product portfolio spans from robust, low-cost 8-bit MCUs up to 32-bit Arm®-based Cortex®-M microcontrollers with a comprehensive choice of peripherals. Its breadth ensures that design engineers will find the mix of performance, power efficiency and security that is required by their application.

With the addition of the STM32 MPU and its heterogeneous architecture combining Arm® Cortex®-A and Cortex®-M Cores, embedded system engineers are given new design possibilities and access to open-source Linux and Android platforms. This flexible architecture allows the advanced digital and analog peripherals to be allocated to either core, while achieving the best power efficiency depending on processing and real-time execution requirements.

To help engineers reduce application development time, a fully mainlined open-source Linux distribution and a new-generation system toolset from ST and 3rd parties are now available for STM32 MPUs.



STM32H7 series

The best choice for controls, indicators, and interfaces of ventilators.

STM32H7

New performance record
Up to 2424 + 800 CoreMark (Cortex©-M7 @480 MHz + Cortex©-M4 @240 MHz) in Dual core
Up to 2778 CoreMark (Cortex©-M7 @550 MHz) in Single core

Dual-core flexible architecture for industrial, security or AI applications
Accelerated graphics, fast data transfer, advanced peripherals

Advanced security feature
Crypto Hash, Cortex©-M7 Security services

Rich eco-system to speed-up your design
SW tools, HW boards, community and partners

STM32MP1 Microprocessor

The best choice for HMI control combined with sensors aggregation.

Boosting performances
3040 + 260 DMIPS (2x Cortex©-A7 @800 MHz + Cortex©-M4 @209 MHz)

Flexible architecture for a wide range of applications
2x Cortex-A7 for high speed I/F & processing, Cortex-M4 for real time & low power

Advanced HMI with graphics & video combined with real time
Advanced 3D GPU, HD video decode with 2x Cortex-A7, Cortex-M4 for sensors

A broader STM32 MPU ecosystem to reduce development time and cost
Linux mainlined, SW tools, HW boards, community and partners

STPMIC1 High-performance power management IC for STM32MP1 MPUs

The **STPMIC1** is a fully integrated power management IC specifically tailored for products based on highly integrated application processor designs requiring low power and high efficiency.

Fully programmable, the STPMIC1 is designed to supply power to the application processor as well as to the external system peripherals such as DDR, flash memories and other system devices. It is the ideal companion chip for STM32MP1 MPUs and other application microprocessors.

The STPIMC1 is available in three different versions which are factory pre-programmed and meant to meet different I/O voltage requirements. All versions can be easily customized later during the design stage, meaning that the I/O voltage levels are reprogrammable, offering a high level of flexibility to users.

An STPMIC1 evaluation board (STEVAL-PMIC1K1) with a user friend GUI (STSW-PMIC1GUI) is also available to monitor and configure the STPMIC1's main parameters.

Order Code	NVM Status	Package
STPMIC1APQR	Factory pre-programmed to support VIO at 3.3 V	WFQFN 44L (5 x 6 x 0.8)
STPMIC1BPQR	Factory pre-programmed to support VIO at 1.8 V	
STPMIC1CPQR	Not factory pre-programmed	

How to evaluate the product?

Order Code: **STEVAL-PMIC1K1**

BOARD FEATURES:

- Single device MPU supply solution embedding:
  - 5 LDOs
  - 5 high efficiency DC/DC converters
  - 1 termination for DDR memory
  - 1 voltage reference for DDR memory
  - 2 power switches
- Programmable voltage outputs and protection parameters
- Programmable power-on and power-off sequences
- Single supply input from 3.1 V to 5.5 V
- I^2C control and non-volatile memory configuration storage

WIRELESS CONNECTIVITY

Bluetooth Low Energy

ST's offers an extensive variety of RF solutions covering most of the key standards as well as proprietary radio solutions.

ST's portfolio includes a variety of RF transceivers, wireless application processors, network co-processors and fully certified modules for key wireless connectivity technologies including Bluetooth LE®, Thread and Zigbee for point-to-point device connection, ultra-wideband for precise positioning and 60 GHz for contactless connectivity.

In Ultrasound Machines, Bluetooth is one of the main standard to connect Mobile Devices with Equipment to have an easy configuration and parameter setting, moreover it could be used for user identification.

Two main product families

Dual-core ARM Cortex™-M0/M4
Processing intensive applications

New LP devices extend multi-protocol
BLE, Zigbee & Thread wireless MCUs

Single core ARM Cortex™-M0
Lightweight applications

Bluethooth® LE 5.2-Certified SoC
safe, efficient, scalable connectivity

STM32WB

The **STM32WB** Series is the only dual-core MCU in the industry with an Arm® Cortex®-M4 for the applicative code, and a Cortex-M0+ for the wireless communication and security management. It comes with Bluetooth LE 5.2 certified stack with various options, proprietary possibilities and other short-range technologies depending on the model.

The **STM32WB15** offers the benefits of a dual-core MCU in a smaller-sized product with up to 320 Kbytes of Flash memory and a variety of peripherals like Touch sensing. Available in UQFN48 and WLCSP49 package that features up to 37 GPIOs.

STM32WB products can address a broad spectrum of possibilities with the flexibility to target markets from high-end device types to cost-sensitive products.

How to evaluate the product?

STM32WB55 MULTI-PROTOCOLS WIRELESS MCU DEVELOPMENT PLATFORM

- 1 MB of Flash, 256 KB of RAM, and large peripherals for engineers working on high end applications
- Bluetooth LE 5.2, Zigbee 3.0 and OpenThread certified

Order Code: **NUCLEO-WB55RG**

STM32WB15 DEVELOPMENT BOARD
BRINGING BLE AND TOUCH SENSORS TO MORE DEVELOPERS

- 320 KB of Flash, 48 KB of RAM, and suitable peripherals for engineers working on simple applications.
- Bluetooth LE 5.2 with certified stacks to reduce a product's time to market

Order Code: **NUCLEO-WB15CC**

BlueNRG

BlueNRG portfolio allows to easily untether traditionally wired devices thanks to its robust, reliable and extended range capabilities. BlueRNG portfolio is offered either as a System-on-Chip for adoption in new designs as well as in a conveniently pre-certified RF module for quick adaptation of pre-existing solutions

The flagship BlueNRG-LP SoC supports advanced BLE features such as Long Range, 2 Mbps transfers and LE power control. Both radio and SoC architectures have been highly optimized to achieve the lowest power consumption yet offering uncompromised RF performance and a stunning 112 dBm dynamic range for robust and reliable RF link.

ST WiSE Studio IDE and the BlueNRG SDK, both free of charge, allows to jump-start development in just few minutes.

How to evaluate the product?

BOARD FEATURES:
- BLUENRG-LP (QFN48) based development board
- On-board MEMS sensors (axl/gyro, press/temp and mic)
- Arduino R3 expansion connector
- Greatly simplifies product evaluation and shorten development time

Order Code: STEVAL-IDB011V2

BOARD FEATURES:
- BLUENRG-M2SA (certified BLE module) based development board
- On-board MEMS sensors (axl/gyro, press/temp)
- Arduino R3 expansion connector and free SDK/IDE (STWise)

Order Code: STEVAL-IDB008V1M

SPIRIT modules

SPIRIT module portfolio comes as a fully pre-certified Sub-1GHz wireless solution suitable for the worldwide ISM band. The ultra-low-power architecture and excellent RF performance allow to easily implement robust and reliable wireless link for point-to-point, multipoint or mesh networking applications. The portfolio includes, besides modules, SPIRIT1 and S2-LP chipset for chip-on-board designs. All tools, free-of-charge software and evaluation kits support different frequency ISM bands

SPSGRFC-433
SPSGRFC-868
SPSGRFC-915

- Up to **+11.6 dBm** output power
- **-118 dBm** Rx sensitivity
- 4-wires **SPI interface** to external host
- Shutdown line
- 4 programmable GPIOs
- Included AES-128 security co-processor
- Modulation schemes: 2-FSK, GFSK, MSK, GMSK, OOK, ASK
- **Small** form factor: 13.5 x 11.5 x 2 mm
- **Industrial** temperature range: **-40 °C to +85 °C**
- Power supply voltage from **1.8 V to 3.6 V**

How to evaluate the product?

BOARD FEATURES:

- Sub-1GHz (860-940 MHz) transceiver development kit, ISM band
- Based on the S2-LP sub-1GHz +16 dBm radio for ISM bands
- Powered by a NUCLEO-L053R8 STM32 programmable motherboard
- Air data-rate up to 500 Kbps via SPI interface

Order Code: **STEVAL-FKI868V2**

BOARD FEATURES:

- Based on the SPIRIT1 RF module SPSGRF-868
- Operates in the 868 (-A4)/915 (-A5) MHz ISM band, ETSI certified
- Equipped with Arduino UNO R3 connectors

STM32 Open Development Environment

Order Code: **X-NUCLEO-IDS01A4**

ST4SIM solutions

The connection with hospital database is fundamental to manage the Electronic Medical Record. Portable Ultrasound Systems could benefit by the wide range **SIM/eSIM** solutions based on basic, cryptographic and GSMA SGP.02 configurations.

- GSMA eSIM certified and interoperable with MNOs & Subscription Management platform
- Complete ecosystem with trusted partners for connectivity & Subscription Management Platform
- Industrial & automotive grade solutions (T° & reliability)
- Multiple packages format (4FF, MFF2, WLCSP, TSSOP20)

TRUPHONE ARKESSA arm connected with SORACOM

How to evaluate the product?

BOARD FEATURES:

- All-in-One Module powered by STM32 to design Cellular IoT Devices. B-L462-CELL1 discovery kit with an Highly integrated tiny Module powered by STM32L4 MCU, ST4SIM eSIM and LTE Modem, and onboard sensors, simplifies ...
- Customers just need to design a PCB with all-in-one module and the peripherals (eg: sensor) needed
- Customer benefits Worldwide coverage out-of-the-box (with LTE-M TRUPHONE network)
- ST customers can integrate their application easily (thanks to X-CUBE-CELLULAR SW Package)

Order Code: **B-L462E-CELL1**

AUTHENTICATION AND EMBEDDED SECURITY

STSECURE offers solutions to ensure medical equipment authenticity and to bring integrity, confidentiality and availability of Electronic Medical Record (EMR). With STSAFE family, ST delivers certified secure elements bringing best in class hardware security that can be easily integrated with few security expertise.

- Strict Authentication of medical equipment, probes or consumables
- Medical equipment pre-attachment to clouds services using personalized X509 device Certificate
- Secured and simplified medical equipment configuration at manufacturing by mounting a pre-personalized secure element
- Integrity, confidentiality and availability of patient data exchange with data digital signature and data encryption

How to evaluate the product?

BOARD FEATURES:

- On-board STSAFE-A110 customized with a standard evaluation profile
- HE10 extension connector to mount additional STSAFE devices
- STM32Cube Software package

STM32 Open Development Environment

Order Code: X-NUCLEO-SAFEA1A

ELECTRONIC FUSE (eFuse)

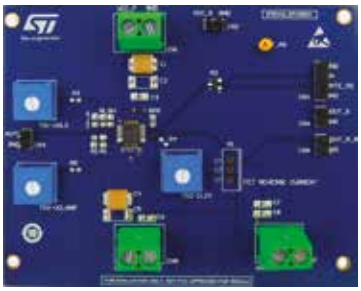
eFuses, or electronic fuses, are integrated circuits that enable a smart protection of the DC lines. Housed in small plastic packages, such as SO, SOT, DFN and Flip-chip, they integrate a control circuit and a power switch with low on-resistance, connecting the input port to the load.

eFuse

Part Number	Description	Output Voltage
STPW12	Monolithic, programmable electronic 15 W power breakers	12 V
STEF12S	4 A monolithic electronic fuse (eFuse)	12 V
STEF01	4 A fully programmable high-voltage eFuse	8 V to 48 V

Connected in series to the power rail, an eFuse operates like a standard fuse with the ability of detecting and quickly reacting to overcurrent and overvoltage conditions. When such an event happens, the device limits the output current/voltage to a safe value defined by the user. If the anomalous overload condition persists, the eFuse opens the power path and disconnects the load from the power supply.

How to evaluate the product?



BOARD FEATURES:

- Input voltage from 8 to 48 V
- Peak output current up to 6 A
- Enable/Disable/Fault flag pin
- Adjustable undervoltage lockout
- Adjustable output voltage clamp
- Programmable VOUT slew rate control
- Power good monitoring flag

Order Code: STEVAL-EFUSE01

LOW DROPOUT VOLTAGE REGULATOR

An LDO is a linear voltage regulator designed to operate with a very low input-to-output voltage differential (dropout voltage). It aims to minimize the power dissipated as heat on the device and increase conversion efficiency.

LDO

Part Number	Description	Features
LD56100	1 A very low dropout fast transient ultra-low noise linear regulator	1 A, 13 µV RMS noise, Low drop
LDBL20	200 mA very low quiescent current regulator in (0.47x0.47) mm^2 package	20 0mA very low Iq, Ultra Tiny package
LD39130S	300 mA very low quiescent current Linear regulator IC with automatic Green mode	300 mA, Low Iq, Green mode, CSP
LD39200	2 A high PSRR ultra low drop linear regulator with reverse current protection	2 A, High PSRR, ultra low drop
LD56050	500 mA ultra-low dropout linear regulator with bias supply	500 mA, Ultra low drop with bias
LD57100	1 A ultra low-dropout LDO with bias	1 A, Ultra low drop with bias
LD56020	200 mA ultra low dropout linear regulator	200 mA, Low input, High PSRR
ST730/2	300 mA low dropout linear regulator	5 µA quiescent current, 0.5% accuracy

How to evaluate the product?

QUAD HIGH PERFORMANCE LDO EVALUATION BOARD BASED ON LDBL20, LDLN025, LD39130S AND STLQ020 BOARD FEATURES:

- Low operating input voltage (from 1.4 V to 5.5 V)
- Current capability from 200 mA to 300 mA
- Low dropout (down to 160 mV typ.)
- Ultra-low quiescent current (down to 500 nA typ.)
- Low noise (down to 6.5 µVRMS typ.)
- High PSSR (up to 80 dB)

Order Code: **STEVAL-LDO001V1**

DC/DC CONVERTERS

A DC-DC switching converter is used to locally supply any component or part of a system with the desired DC voltage and current. Depending on the application's relationship between the input and output voltage, engineers have to choose the best power topology – buck (step down), boost (step-up), buck-boost or inverting.

Part Number	Description	Output Voltage
L7983	60 V 300 mA synchronous step-down switching regulator with 10 µA quiescent current	Adj,3.3 V, 5 V
L6983	38 V, 3 A synchronous step-down converter with 17 µA quiescent current	Adj,3.3 V, 5 V
L6982	38 V, 2 A synchronous step-down converter with low quiescent current	Adj
L6981	38 V, 1.5 A synchronous step-down converter with low quiescent current	Adj
L3751	Wide 6 V to 75 V input voltage synchronous buck controller	Adj

How to evaluate the product?

BOARD FEATURES:
- 12 V to 60 V operating input voltage
- Step-down (buck) conversion
- 12 V output voltage
- 300 mA DC max. output current

Order Code: STEVAL-L7983ADJ

BOARD FEATURES:
- 3.5 V to 38 V operating input voltage
- Programmable VOUT from 0.85 V to VIN
- 3.3 V and 5 V fixed output voltage versions
- 2 A DC output current

Order Code: STEVAL-L6982CDR/L6982NDR

BOARD FEATURES (L6983):
- 3.5 V to 38 V operating input voltage
- Output voltage from 0.85 V to VIN
- 3.3 V and 5 V fixed VOUT versions
- 3 A DC output current
- 17 µA operating quiescent current

Order Code: STEVAL-ISA208V1/209V1

BOARD FEATURES:
- 3.5 V to 38 V operating input voltage
- Output voltage from 0.85 V to VIN
- 1.5 A DC output current
- 2 µA shutdown current

Order Code: STEVAL-L6981CDR/L6981NDR

CURRENT SENSING

Current sensing solutions add valuable safety and protection features to system designs. They provide information to control current in systems avoiding overheating and short circuits. Current sensing is also an essential part of energy metering to ensure power-efficiency and minimize environmental impact.

Part Number	Description	Features
TSC210 **TSC211** **TSC212** **TSC213** **TSC214** **TSC215**	Low/High side bidirectional, zero-drift, current sense amplifiers (-0.3 to 26 V)	• x50 (TSC213) • x75 (TSC215) • x100 (TSC214) • x200 (TSC210) • x500 (TSC211) • x1000 (TSC212)
TSC2010 **TSC2011** **TSC2012**	High voltage (-20 to +70 V), precision, bidirectional current sense amplifiers	• x20 (TSC2010) • x60 (TSC2011) • x100 (TSC2012)

How to evaluate the product?

Evaluation kit for high voltage bidirectional current sense amplifier (TSC2010, TSC2011, TSC2012)

Order Code: **STEVAL-AETKT1V2**

Quick Reference Guide
Current Sensing

COMPARATOR

Reduced supply leakage for a longer battery lifetime with the TS88 series. The TS881, TS882 and TS884 are respectively single, dual and quad comparators featuring ultra-low supply current with rail-to-rail input and push-pull output capabilities. The series of nanopower comparators also includes a single version (TS880) and a dual version (TS883) with open-drain output. The performance of these comparators allows them to be used in a wide range of portable applications.

Part Number	Description	Features
TS880 **TS881** **TS882** **TS883** **TS884**	Nanopower, low voltage, rail to rail Comparators, open-drain (TS880, TS883) and Push-Pull (TS881, TS882, TS884) outputs	• From 0.9 V to 5.5 V (TS880, TS881, TS883) • From 1.1 V to 5.5 V (TS882, TS884)

How to evaluate the product?

Quick Reference Guide
Operational Amplifiers

Part Number	Single	Dual	Quad	Std-by
TS880	x			x
TS881	x			
TS882		x		
TS883		x		x
TS884			x	

ANALOG TO DIGITAL CONVERTER

ST's high performance converters combine high-speed with ultra-low power consumption by using 0.25 µm and 130 nm high-end proven technology in high volume.

The ADC120 is a low-power, eight-channel pure CMOS 12-bit analog-to-digital converter specified for conversion from 50 ksps to 1 Msps, tested at 1 Msps. The architecture is based on a successive-approximation register with an internal track-and-hold cell. The ADC120 features 8 single ended multiplexed inputs. The output serial data is straight binary and is SPI™ compatible. The analog and digital power supplies operate from 2.7 V to 3.6 V. The power consumption at 3.3 V nominal supply is as low as 6.6 mW. The ADC120 comes plastic TSSOP-16, and can operates from -40 °C to +125 °C ambient temperature.

How to evaluate the product?

The STEVAL-AKI001V1 evaluation board has several on-board sources and can accept external signals to allow measurement and evaluation of the ADC120 conversion performance. The board is supplied ready-to-use in standalone mode, or it can be plugged onto a NUCLEO-L476RG board with SMT32 microcontroller, which enables further signal processing and PC communication.

Order Code: STEVAL-AKI001V1

TEMPERATURE SENSORS

ST's temperature sensor portfolio includes both analog and digital temperature sensor ICs. The analog temperature sensors feature low power consumption, good linearity, and high accuracy across the whole operating range. The digital temperature sensors feature low power consumption as low as 20 µA with up to 12-bit resolution able to digitize temperatures to a resolution up to 0.0625 °C to ensure high accuracy flat across the whole operating range.

Part Number	Description	Interface	Accuracy (°C) typ	Current Consumption (µA) Normal Mode	Current Consumption (µA) Power Down Mode
STLM20	Analog temperature sensor, ultra-low current, high precision	Analog	0.5	4.8	0.02
STTS22H	Low-voltage, ultra-low power, I²C/SMBUS 3.0 temperature sensor	Digital (16 bit nom.)	0.5	1.75	0.5

How to evaluate the product?

Order Code: STEVAL-MKI109V3
+ STEVAL-MKI199V1K (STLM20)
+ STEVAL-MKI200V1K (STTS22H)

PROTECTIONS AND FILTERS IN ULTRASOUND

ST's Protection and EMI filter portfolio offers a unique and comprehensive choice of high-performance components to ensure safe electronic system operation and immunity from electromagnetic interference (EMI).

Our rich portfolio protects integrated circuits against all types of electrical stress including:

- Power surges thanks to our **high power-density Transient Voltage Suppressor (TVS) series**
- Electromagnetic noise thanks to our **application-specific integrated products (ASIP)** including common-mode filters (CMF) with integrated ESD protection and EMI suppression mechanisms using low-pass filters
- Electrostatic discharge (ESD) surges thanks to our **low clamping ESD technologies**

Produced with ST's technologies, they ensure the best protection and filtering performance for demanding systems.

GPIO

Family	Part numbers
ESD prot.	ESDZL5-1F4

Keyboard/Trackball

Family	Part numbers
ESD prot.	ESDALC6V1-5P6

LCD & touchscreen

Family	Part numbers
EMIF **ESD prot.**	EMIF08-VID1F3 ESDALC6V1-5P6

HDMI

Family	Part numbers
TMDS: EMIF **Control lines**	ECMF4-2450A60N10 (> 1.485 Gbps) HDMI2C4-5F2

HV MUX, TX PULSER , TX LINEAR ESD protection 2 or 3 in series

Family	Part numbers
ESD prot.	ESDU401-1BF4

MOSFET protection in flyback snubber

Family	Part numbers
400 W TVS	SMAJ

Speaker

Family	Part numbers
EMIF	EMIF02-SPK03F2

Wireless

RF matching filter
MLPF-WB55-01E3

DC Power rail TVS

Family	Part numbers
600 W TVS	SMA6J

SD card

Family	Part numbers
ESD prot.	HSP053-4M5

Ethernet 1G/10G

Family	Part numbers
Surge Prot.at secondary	HSP053-4M5 HSP031-1BM6

USB Type C

Family	Part numbers
ESD prot **ASIP** **ECMF** **ECMF**	Vbus:ESDA25P35-1U1M CC lines: TCPP01-M12 DP/DM: ECMF02-2AMX6 SSTx/Rx: ECMF4-2450A60N10

USB 2.0

Family	Part numbers
ECMF	ECMF02-4CMX8

DISCLAIMER FOR CRITICAL APPLICATIONS

- Product(s) indicated in this presentation are sold under ST terms and conditions and they are not designed, intended or authorized for use as a critical component in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body.
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