

Semiconductor solutions for healthcare applications



STMicroelectronics

At STMicroelectronics, we have developed our healthcare product and service portfolio based on long-term research. We are involved in government-funded programs, collaborate with international universities and are a member of acknowledged healthcare consortia, such as the Continua Health Alliance.

Healthcare market segments and application examples

Portable, telehealth monitoring	Wellness, fitness, assisted living	Clinical, diagnostics and therapy	Medical imaging
Blood pressure monitors Temperature meters Blood glucose meters Blood oximeters Hearing aids Portable ECG	Pedometers Heart rate monitors Fall detection Wheelchairs Hospital beds Drug dispensers	Patient monitoring Respirators Infusion pumps Automated external defibrillators (AED) Electrocardiograms (ECG)	Ultrasound Magnetic resonance imaging (MRI) Positron emission tomography (PET) Endoscopes

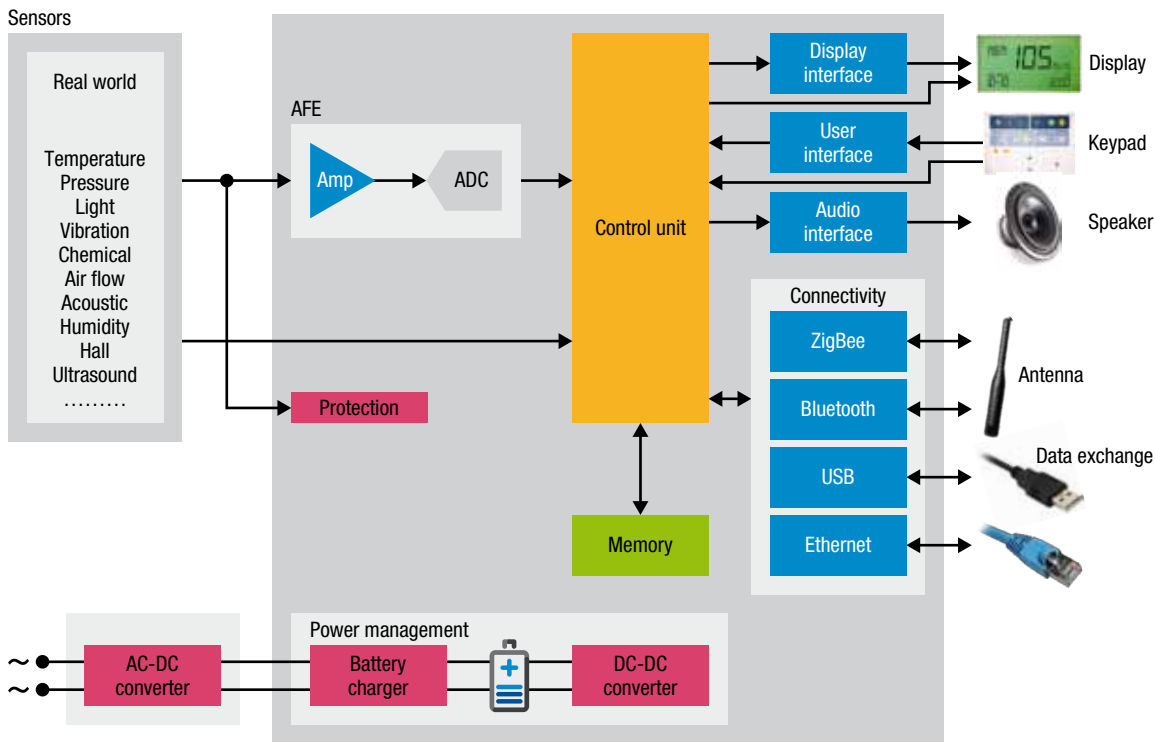
Our position among the top-ranked semiconductor manufacturers, combined with strong cooperation with global healthcare leaders, enables us to develop optimized process technology and to design semiconductor devices with best-fit characteristics.

We are addressing the healthcare market with a broad portfolio of devices, such as discrete devices, low-power microcontrollers, image sensors, memories, MEMS (micro-electro-mechanical systems), thin-film batteries and analog, digital and mixed-signal ICs.

In addition to our standard products, ST offers our customers the possibilities of application-specific devices and access to our leading-edge silicon processes and package technologies for customer-designed products to give added performance and value to the end product.

Let STMicroelectronics’ experience in the healthcare and medical markets help you meet your customers’ needs.

Typical healthcare application diagram



Featured products

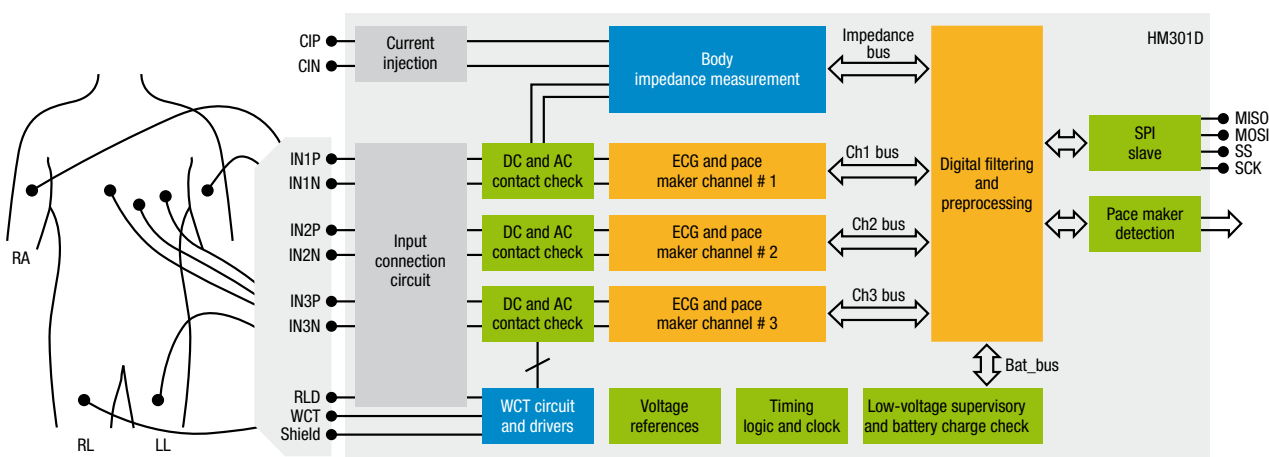
HMx01¹

Integrated diagnostic-quality bio-potential acquisition IC with 1, 2 or 3 differential channels

The HMx01D devices are fully integrated, diagnostic-quality bio-potential acquisition systems with 1, 2 or 3 differential channels. A fully-integrated high-pass filter removes the half-cell DC value so the channels work with the AC component only. Each channel provides high resolution and low-noise conversion of bio-potential signals up to 10 kHz. The input connection circuit matrix guarantees maximum flexibility in terms of electrodes, cables and connectors. The D versions include a dedicated impedance measurement channel that can be used to measure both body impedance average value and body impedance variation due to respiration. This channel delivers both the real and the imaginary parts of the body and the breathing impedances.

Key features

- 1, 2 or 3 bio-potential acquisition channels with integrated analog high-pass filters
- 1 bio-impedance measurement channel (D version) with 2- or 4-wire measurement
- Integrated configurable digital filtering and preprocessing
- Multi master/slave configuration to support up to 16 channels (12 bio-potential acquisitions and 4 bio-impedance channels)
- SPI serial interface
- Low supply voltage: 1.7 to 3.6 V
- CMRR: -126 dB
- Maximum data rate: 10 KSPS
- Less than 2 mW per channel at full bandwidth and resolution
- Internal or external clock



Note: 1. For the complete part number list, refer to the ECG unit product table at the end of the brochure.

STHV748

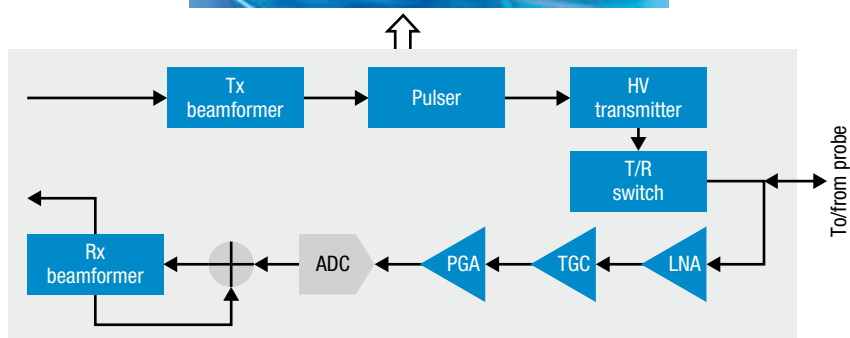
Integrated high-performance ultrasound pulse controller

The STHV748 is a quad, high-voltage fully-monolithic pulser IC mainly intended for medical ultrasound imaging applications.

An ultrasound imaging system transmits ultrasound waveforms generated from a piezoelectric transducer. As soon as the transmission ends, the same transducer is then switched to receive mode and the echoes, are then converted into low-voltage signals. These signals are further conditioned, followed by post processing, to give the final image. The STHV748 correctly drives the piezoelectric transducer during the transmission phase and routes the received echoes to the receiving chain by means of an integrated T/R switch. The excellent STHV748 pulse symmetry (5 levels), while exciting the piezoelectric transducer, delivers low second-order distortion resulting in better image quality.

Key features

- 0 to ± 90 V output voltage
- Up to 20 MHz operating frequency
- Embedded low-power, floating high-voltage drivers
- ± 2 A source and sink current in PW and CW modes
- Greater than 42 dB second-harmonic suppression
- Dedicated half bridge for continuous wave operations
- Fully-integrated clamping-to-ground function
- Fully-integrated T/R switch and noise blocking diodes
- Latch-up free using HV Sol technology



8/32-bit ultra-low-power MCUs

STMicroelectronics' ultra-low-power portfolio includes a full range of 8-bit and 32-bit MCUs. It addresses most healthcare applications requiring reduced current consumption, from ultra-simple, cost-optimized feature needs to complex, high-performance requirements.

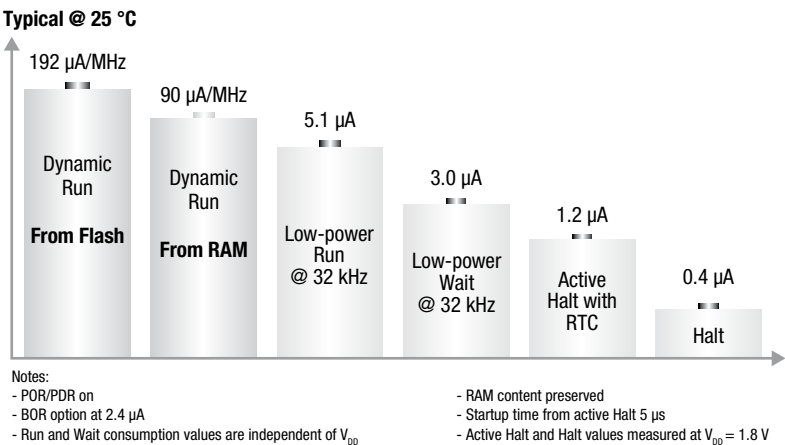
Key features

- Platform for 8-bit STM8L and 32-bit STM32L MCUs
- ST's 130 nm ultra-low-leakage process technology – speed and power consumption are independent of MCU power supply
- Ultra-low voltage supply: 1.65 to 3.6 V
- Advanced analog functions down to 1.8 V
- Fast wake up
- On-board security and safety features for critical applications

STM8L

- 8-bit MCU: up to 16 MIPS at 16 MHz
- 2 to 64 Kbytes of embedded Flash, up to 4 Kbytes of SRAM and up to 2 Kbytes of EEPROM
- Up to four ultra-low-power modes: down to 350 nA with SRAM and context retention
- Run mode dynamic consumption down to 150 $\mu\text{A}/\text{MHz}$
- Free touch-sensing library

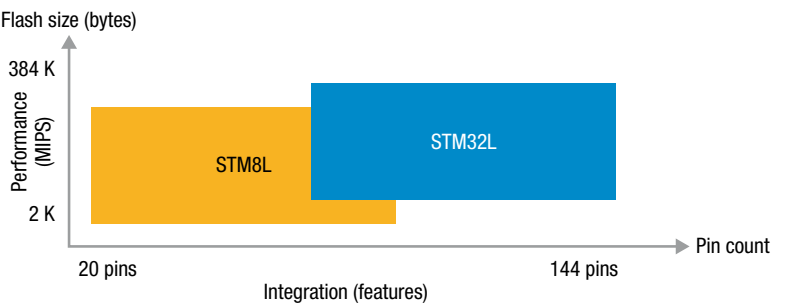
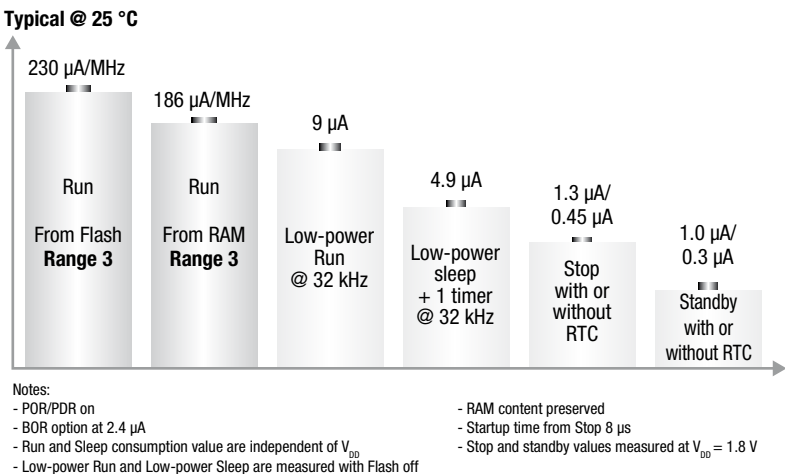
STM8L15x consumption values



STM32L

- 32-bit ARM Cortex™-M3: up to 33 DMIPS at 32 MHz
- Pin-to-pin compatibility with STM32F series (except V_{BAT})
- 32 to 384 Kbytes of embedded Flash, up to 48 Kbytes of SRAM and up to 12 Kbytes of data EEPROM
- Six ultra-low-power modes: down to 300 nA
- Ultra-low-power dynamic modes: low-power run down to 9 μA ; low-power sleep down to 4.9 μA with one timer
- Economical run mode consumption down to 230 $\mu\text{A}/\text{MHz}$ from Flash at zero-wait state with dynamic voltage scaling (3 ranges)

STM32L consumption values



INEMO-M1

The smallest 9-axis inertial system of the iNEMO® SoB family

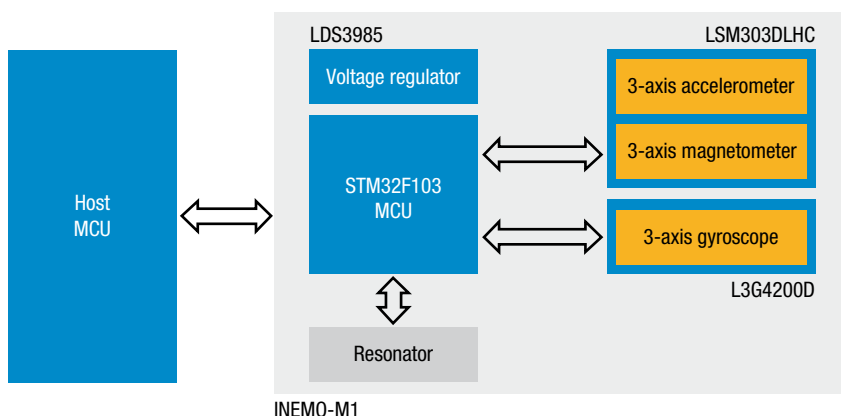
INEMO-M1 is the first member of the iNEMO system on board (SoB) family. It integrates multiple sensors with a powerful computational core and provides reliable, drift-free 3D orientation estimation (roll, pitch and yaw, quaternions, rotation matrix), as well as sensor data.

This 9 degrees-of-freedom inertial system represents a fully integrated solution that can be used in numerous applications such as virtual reality, augmented reality, image stabilization, human machine interfaces, robotics and inertial body tracking.

A complete set of communication interfaces in a very small size form factor (13 x 13 x 2 mm) make the INEMO-M1 system on board a flexible solution for effortless orientation estimation in embedded applications.

Key features

- Flexible interfaces: CAN, USART, SPI and I²C serial interfaces; full-speed USB 2.0
- Two power supply options: internal regulator (3.6 to 6 V), external regulated voltage (2.4 to 3.6 V)
- Embedding real-time algorithm to calculate attitude and heading (roll, pitch and yaw angles, quaternions or rotation matrix)
- In application programming interfaces for firmware upgrading



LIS3DH

Ultra-low-power accelerometer

The LIS3DH is an ultra-low-power, high-performance 3-axis linear accelerometer belonging to the nano family, with a digital I²C/SPI serial interface standard output. The device features ultra-low-power operating modes that allow advanced power saving and smart embedded functions. The LIS3DH has dynamically selectable full scales of $\pm 2g/\pm 4g/\pm 8g/\pm 16g$ and is capable of measuring accelerations with output data rates from 1 Hz to 5 kHz. The self-test capability allows the user to check the functioning of the sensor in the final application.

Key features

- Ultra-low power consumption: down to 2 μA
- $\pm 2g/\pm 4g/\pm 8g/\pm 16g$ dynamically selectable full scale
- Embedded 96-level FIFO of 16-bit data output
- Embedded temperature sensor and ADC converter
- 6D/4D orientation detection
- Wide supply voltage range: 1.7 to 3.6 V
- Fully programmable interrupt generator
- Wake-up and free-fall detection
- Click and double-click recognition



MP34DT01

High-performance, low-power digital MEMS microphone with 63 dB SNR

The MP34DT01 is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface. The sensing element that detects the acoustic waves is manufactured using a special silicon micromachining process dedicated to produce audio sensors. The IC interface is manufactured using a CMOS process so that a dedicated circuit may be designed to provide a digital signal externally in PDM format. The MP34DT01 has an acoustic overload point of 120 dB SPL with a 63 dB signal-to-noise ratio and -26 dBFS sensitivity.

Key features

- Single supply voltage
- Low power consumption
- 120 dB SPL acoustic overload point
- 63 dB signal-to-noise ratio
- Omnidirectional sensitivity
- -26 dBFS sensitivity
- PDM output
- HCLGA package
- Top port design
- SMD compliant
- EMI shielded



LPS331AP

High-resolution digital pressure sensor

The LPS331AP is an ultra compact absolute piezoresistive pressure sensor. It includes a monolithic sensing element and an IC interface to take the information from the sensing element and to provide a digital signal to the external world.

The sensing element consists of a suspended membrane formed inside a single mono-silicon substrate. It is capable of detecting pressure and is manufactured using a dedicated process developed by ST, VENSENS.

Key features

- 260 to 1260 mbar absolute pressure range
- High-resolution mode: 0.020 mbar RMS
- Low power consumption:
 - Low-resolution mode: 5.5 μ A
 - High-resolution mode: 30 μ A
- High overpressure capability: 20x full scale
- Embedded temperature compensation
- Embedded 24-bit ADC
- Selectable ODR from 1 Hz to 25 Hz
- SPI and I²C interfaces
- Supply voltage: 1.71 to 3.6 V
- High shock survivability: 10000 g



LDCL015XX

150 mA capless ultra-low-drop linear regulator simplifies power management designs

The LDCL015XX provides 150 mA from an input voltage ranging from 1.8 to 5.5 V, with a typical dropout voltage of 50 mV. It is stable with no input or output capacitor. Low quiescent current, low noise and capless operation make it suitable for low-power battery-powered applications and reduces the board size required. Typical power supply rejection ratio is 52 dB at low frequencies, and starts to roll off at 10 kHz. The enable logic control function puts the LDCL015XX in shutdown mode, reducing the total current consumption to less than 1 μ A. The device also includes short-circuit constant-current limit and thermal protection.

Key features

- No input or output capacitor required
- Input voltage: 1.8 to 5.5 V
- Very low drop: 50 mV at 100 mA load
- $\pm 2\%$ output voltage accuracy
- Output voltage tolerance: $\pm 3\%$
- Low noise
- 150 mA guaranteed output current
- Available in fixed and adjustable output voltages, from 0.8 V in 100 mV steps
- Internal current and thermal limit



M24LR16E and M24LR64E

Dual Interface EEPROM

The M24LR16E and M24LR64E feature both an I²C and an RF interface, and so provide the flexibility to remotely program or update electronic products anytime during their lifetime and anywhere in the supply chain. RFID and NFC compatible, they are used to read measurements from portable healthcare applications and update the configuration data of clinical devices without powering on the device. They also feature an innovative energy harvesting function which can enable battery-less designs or greatly improve battery lifetime.

Key features

- I²C interface
 - 1.8 to 5.5 V wide operating voltage
 - 400 kHz across the entire voltage range
- 13.56 MHz RF interface
 - ISO 15693 industry standard: passive RF technology – no power needed to operate in RF
 - NFC compatible
- Memory
 - User memory: 4-Kbit, 16-Kbit or 64-Kbit EEPROM
 - Reliability: 40-year data retention and 1 million erase-write cycles
 - Data protection: unique and flexible 32-bit password protection scheme
- Energy harvesting
 - V_{OUT} pin providing the energy harvested from the RFID reader



STAC3932B/F, STAC4932B/F

100 V RF power MOSFETs in STAC[®] package for 1.5T and 3T MRI

A new generation of 100 V RF power MOSFETs housed in STAC[®] air-cavity packages and capable of delivering an output power up to 1.2 kW for industrial, scientific and medical applications such as 1.5T and 3T magnetic resonance imaging.

The new air-cavity technology enables lower thermal resistance, lower weight and reduced cost compared to devices in ceramic packages.

Key features

- Frequency: 61.5 MHz (1.5T MRI), 123 MHz (3T MRI)
- Supply voltage: 100 V
- Output power: Up to 1.2 kW
- Gain: > 23 dB
- Efficiency: > 60%
- 25% lower thermal resistance (R_{THJA})
- 4 times higher MTTF
- Cost-effective solution versus ceramic packages
- Available in two mounting configurations:
 - Bolt-down
 - Surface mount with AgSnCu back solder finishing



EMI filtering and signal conditioning

Integrated EMI filtering and ESD protection:

- EMIF¹: Strong attenuation of 900 MHz and higher frequencies for different sockets including keypads and touch pads, memory cards, audio lines
- ECMF¹: High-performance common-mode noise filtering with integrated ESD protection for high-speed serial interfaces for display and camera/imaging systems with serial interfaces, High Speed USB 2.0

IPD for RF front-end: integrated passive device (IPD) solutions based on glass substrate can offer a low parasitic and high-Q solution suitable for RF applications including:

- Matched balun for 2.4 GHz applications such as Bluetooth or WLAN (using 50/50, 50/100 or custom matching)
- Diplexers for applications sharing the same antenna for 2.4 and 5 GHz WLAN
- Band-pass filter for 5 GHz WLAN



ESD/EOS protection devices

Protection devices come in 2 families:

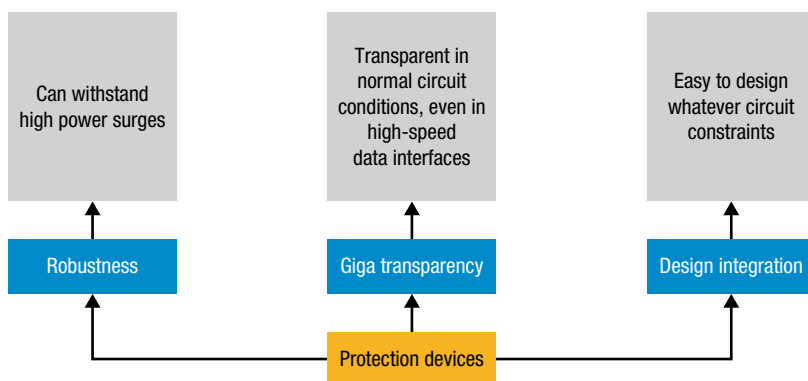
- Transient voltage suppressors (TVS or Transil™)
- Crowbar diodes (Trisil™)

These devices protect circuits against:

- Electrostatic discharge (ESD) generated by contact with a person or a machine (IEC 61000-4-2)
- Electrical overstress (EOS) generated by lightning strikes or AED generated overvoltages (IEC 61000-4-5)

Key features

- Wide portfolio
 - TVS from 100 W to 5000 W
 - ESD array – including low capacitive arrays
 - Crowbar diodes
 - Crowbar diode arrays
- Wide range of applications
 - Airway clearance
 - Glucometers
 - Blood pressure
 - Monitoring stations



Microcontrollers	
STM8L	Ultra-low-power 8-bit MCUs, 1.65 to 3.6 V, up to 6 MIPS, 2 to 64 Kbytes
STM32L	Ultra-low-power 32-bit MCUs, 1.65 to 3.6 V, up to 33 DMIPS, 32 to 384 Kbytes
STM32F	32-bit MCUs, 1.7 to 3.6 V, up to 68 DMIPS, 16 Kbytes to 1 Mbyte
SPEAR3x0	32-bit MPU based on ARM926EJ-S™ core with up to 400 DMIPS

Dual Interface EEPROM	
M24LR16E-R	16-Kbit Dual Interface EEPROM with password protection, energy harvesting and RF status functions
M24LR64-R	64-Kbit Dual Interface EEPROM with password protection

MEMS and sensors	
LIS331DLx	Digital-output motion sensors, low-power and high-performance 3-axis accelerometer
LIS3DH	MEMS digital-output motion sensor, ultra-low-power, high-performance 3-axis nano accelerometer
LIS344ALH	MEMS inertial sensor, high-performance 3-axis $\pm 2g/\pm 6g$ ultra-compact linear accelerometer
L3G4200D	Digital-output, low-power and high-stability 3-axis gyroscope
LSM303DLHx	Sensor modules, 3-axis accelerometer and 3-axis magnetometer
L3GD20	3-axis digital gyroscope
LSM330DL	Inertial module (3 accelerometers, 3 gyroscopes)
MP45DT02	Omnidirectional digital MEMS microphone, 58 dB signal-to-noise ratio and -26 dB sensitivity
MP34DB01	Omnidirectional digital MEMS microphone, 62 dB signal-to-noise ratio and -26 dB
LPS001WP	MEMS pressure sensor, 300 to 1100 mbar absolute digital output barometer
LPS331AP	MEMS pressure sensor, 260 to 1260 mbar absolute digital output barometer
STMT04/5/7	S-Touch® - FingerTip, multi-touch capacitive touchscreen controllers from 4 to 7 inch
STMPE812A	S-Touch® - FingerTip, multi-touch capacitive touchscreen controllers from 4 to 7 inch
STMT14x	STMTouch - Proximity or single touch key touch controllers
STTS751	2.25 V low-voltage local digital temperature sensor
STLM20	Ultra-low current, 2.4 V precision analog temperature sensor

Pulser ICs	
STHV748	5-level, ± 90 V, 2 A high-speed pulser with four independent channels and integrated Tx/Rx switch

EMI filtering and signal conditioning	
EMIF01-1003M3	1-line EMI filter with ESD protection for keypads
EMIF04/06/08-1005Mx	4/6/8-line EMI filters with ESD protection
EMIF02-SPK02F2	2-line EMI filter and ESD protection
EMIF06-mSD03F3	6-line EMI filter and ESD protection
ECMF06-6AM16	6-line common-mode filter with ESD protection
ECMF02-2BF3	2-line common-mode filter with ESD protection
ECMF04-4CMX8	2-line CMF including ID and V_{BUS} ESD protection
EMIF08-LCD04M16	8-line LC filter and ESD protection
BAL2690D3U	2.4 GHz matched balun for STLC2690
DIP2450-01D3	Diplexer for 2.4 and 5 GHz
BPF50-01D3	Band-pass filter for 5 GHz WLAN

Connectivity ICs	
SPZB32W1xx	IEEE 802.15.4 modules
SPBT2532C2	Bluetooth module
ST802RT1	10/100 real-time Ethernet 3.3 V transceiver
STM32W	STM32 with embedded 2.4 GHz IEEE 802.15.4 radio, low-cost wireless network implementation

ECG unit	
HM301	3-channel integrated diagnostic quality ECG analog front end
HM201	2-channel integrated diagnostic quality ECG analog front end
HM101	1-channel integrated diagnostic quality ECG analog front end

Amplifiers and comparators

TSV85x	Micropower op-amps, 180 μ A/1.3 MHz with shutdown
LMV82x	Standard low-power op-amps, 400 μ A/5.5 MHz with shutdown
TS33x	Micropower low-voltage rail-to-rail comparators
LMV3x	Low-cost, low-power rail-to-rail input/output op-amps
TS302x	Rail-to-rail 1.8 V high-speed micropower comparators
TS3011	Rail-to-rail high-speed comparator
TSV6x	Rail-to-rail input/output CMOS op-amps

Power management

STLA02	White LED driver/backlighting
STLD41	White LED driver/backlighting
STPxCMP	Driver/backlighting
STLD20D/40D	White LED driver/backlighting
L6924D	Lithium battery charger
L6924U	USB compatible lithium battery charger
STw4102	Dual input Li-ion battery charger with gas gauge
STC3100	Battery monitor for gas gauge applications
L6920DB	0.8 A step-up, low IQ, down to 0.6 V _{IN}
L6920D	1 A step-up, low IQ, down to 0.6 V _{IN}
ST8R00	1 A step-up, DFN8 (4 x 4 mm) package
L6928	Sync step-down converter, 95 % 2 to 5.5 V _{IN}
STLQ50	50 mA, 3 μ A supply current, low drop linear regulator
STLQ015	150 mA, 1.7 μ A supply current, low drop linear regulator
ST715	85 mA, very low quiescent current LDO regulator
LD39115J	150 mA, miniature high-performance LDO regulator
LD59015	150 mA, very high PSRR, low-noise LDO regulator
LDLN015	150 mA ultra-low noise LDO
LDCL015	150 mA capless LDO
LM4041	0.1% low consumption shunt voltage reference
STBB2J	800 mA, high-efficiency buck-boost converter in CSP package
ST1S15J	500 mA, high-efficiency buck converter in CSP package
STBB1	Dual-mode, 1 A I _{OUT} buck-boost voltage regulator
VIPERxx	VIPerPlus family of high-performance offline high-voltage converters

ASSP for motor control

L639x	MOSFET IGBT smartDRIVE gate drivers integrating advanced current sensing, comparator and operational amplifier
L62xx	powerSPIN – monolithic motor-driver platform for DC, BLDC and stepper motors
L6470	dSPIN – monolithic digital microstepping motor driver for stepper motors
L6460	flexSPIN – monolithic multi-motor driver with microstepping for stepper and DC motors
L6474	Monolithic microstepping driver with SPI and diagnostics

Protection devices

DSILC6-4xx	Ethernet, LVDS, USB 2.0 15 kV ESD protection
ESDA14V2BP6	8 V and 12 V keyboard/button/audio ESD protection
ESDALC5-1BM2	1-line bidirectional ESD protection, 8 pF
ESDAVLC8-1BM2	1-line bidirectional ESD protection, 4 pF
SMM4F	2.5 kW, flat package, ESD overvoltage reverse polarity protection Transil™
ESDALCL - xxx	ESD array, low leakage (1 nA), low capacitance (1.5 pF), 1 to 4 lines
USBULC6	USB 2.0 high-speed 15 kV ESD protection
ESDA-1K	450 W EOS protection in SOD-523 package
HSP061-4NY8	High-speed protection, 2 x 1 mm flow-through package
SLVU2.8	Gigabit Ethernet protection

Interface ICs

STUSB02E/03E	USB transceivers
STOTG04	USB On-The-Go
STMPE1801	18-bit enhanced port expander with keypad controller
STMPE2403	24-bit enhanced port expander with keypad and PWM controller

Power transistors

STL120N2VH5	20 V, n-channel, super logic level, power MOSFET in PowerFLAT 5x6
ST14N3LLH5D1	30 V, n-channel, logic level power MOSFET in die form
STS10DN3LH5	30 V, dual n-channel, logic level power MOSFET in S0-8
STL65DN3LLH5	30 V, dual n-channel, logic level power MOSFET in PowerFLAT 5x6
STL15DN4F5	40 V, dual n-channel power MOSFET in PowerFLAT 5x6
STD30NF60LT4	60 V, n-channel logic level power MOSFET in DPAK
STB9NK60ZT4	600 V, n-channel power MOSFET in D ² PAK
STY139N65M5	650 V, n-channel power MOSFET in Max247
ST1NK80D2	800 V, n-channel power MOSFET in die form
ST1N105K3D2	1050 V, n-channel power MOSFET in die form
STGW45HF60WD	45 A, 600 V, n-channel advanced planar PT IGBT in TO-247
STGW30N120KD	N-channel 30 A, 1200 V short circuit rugged IGBT with ultrafast diode
STGW30NC120HD	N-channel 30 A, 1200 V IGBT with ultra-fast diode
SD293x/393x	N-channel RF power MOSFETs
STAC3932B/F	1 kW, 100 V RF power MOSFET in STAC® package for 1.5T and 3T MRI
STAC4932B/F	STAC® package for 1.5T and 3T MRI

Clocks and timing circuits

M41T62LC6F	World's smallest RTC with embedded crystal in LCC8 3.2 x 1.5 mm package
M41T6X	Low-power I ² C RTC with alarm, 32 kHz output or programmable watchdog functions, 1.3 to 4.4 V operation
M41T83/93	I ² C/SPI RTC with analog calibration, alarm, watchdog, 32 kHz and reset functions
M41ST85	3.0/3.3 V I ² C combination serial RTC, NVRAM supervisor and microprocessor supervisor
M41ST87	I ² C RTC and NVRAM supervisor with anti-tamper detection function
M48Txx	Non-volatile SRAM, 3 to 5.5 V with alarm, watchdog timer

Level translators and analog switches

ST1G3236	1-bit level shifter general purpose, 1.2 to 3.6 V, DFN6 1.0 x 1.2 mm
ST2329B	2-bit level shifter for I ² C, 1.65 to 5.5 V, QFN8 1.2 x 1.4 mm
ST2129B	2-bit general-purpose level shifter, 1.65 to 5.5 V, QFN8 1.2 x 1.4 mm
ST2149B	4-bit level shifter general purpose, 1.65 to 5.5 V, QFN12 2.0 x 1.7 mm
STG719	Ultra-low leakage current (0.35 nA max at 85 °C) SPDT switch

EEPROM

M24128-BFCS6TP/A	128-Kbit I ² C in WLCSP form
M24256-BRCS6TP/A	256-Kbit I ² C in WLCSP form
M95256-RCS6TP/A	256-Kbit SPI in WLCSP form
M24M01-RAW21/90	1-Mbit I ² C in wafer form
M24M02-DR	2-Mbit serial I ² C bus EEPROM



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