



SmartSonic™

High-Performance Ultrasonic
Time-of-Flight Sensors

ICU-10201 & ICU-20201

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Director of Product Marketing

January 6, 2022

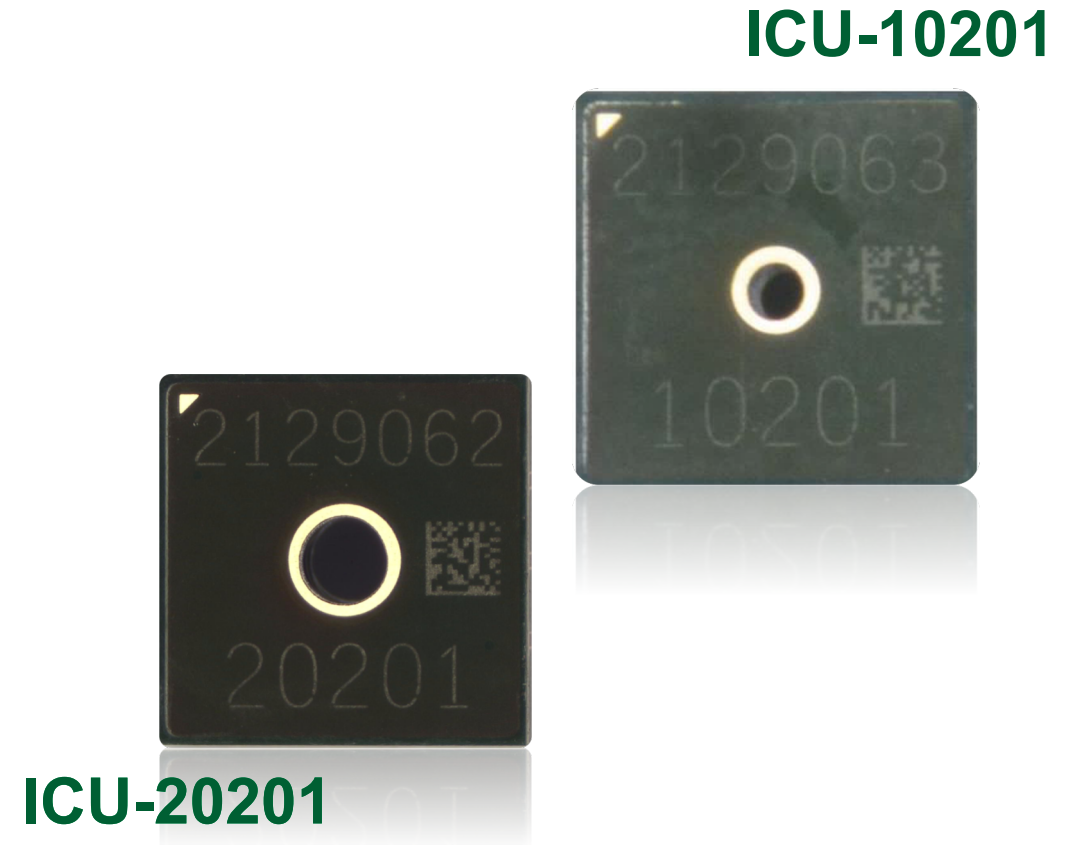
Attracting Tomorrow



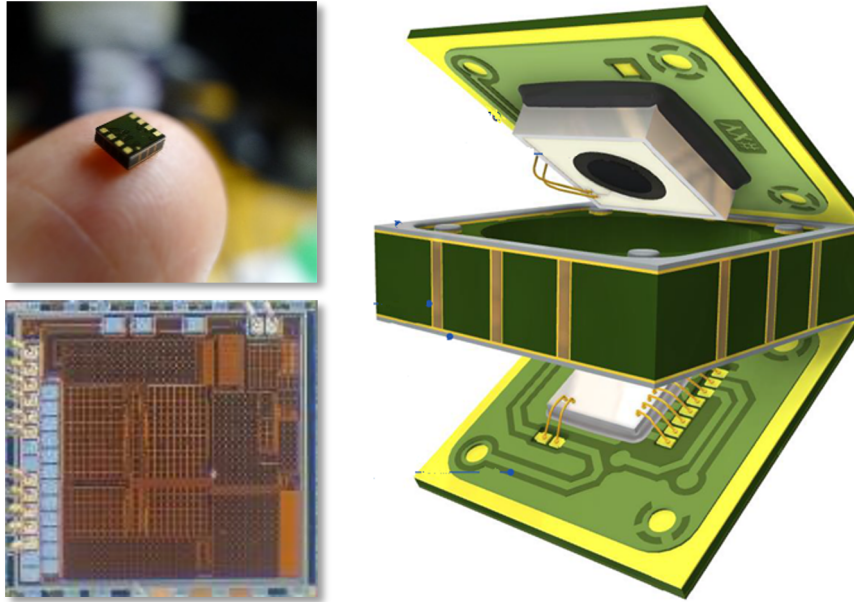
TDK InvenSense introduces the second generation of **Ultrasonic Time-of-Flight** sensor technology.

Enhanced on-chip processing allows for higher computational power inside an ultra-compact package

- **10x** faster DSP w/ HW multiplier
- **3x** code space - **2x** data space
- High speed host interface
- Small footprint: **3.5 × 3.5 mm²**



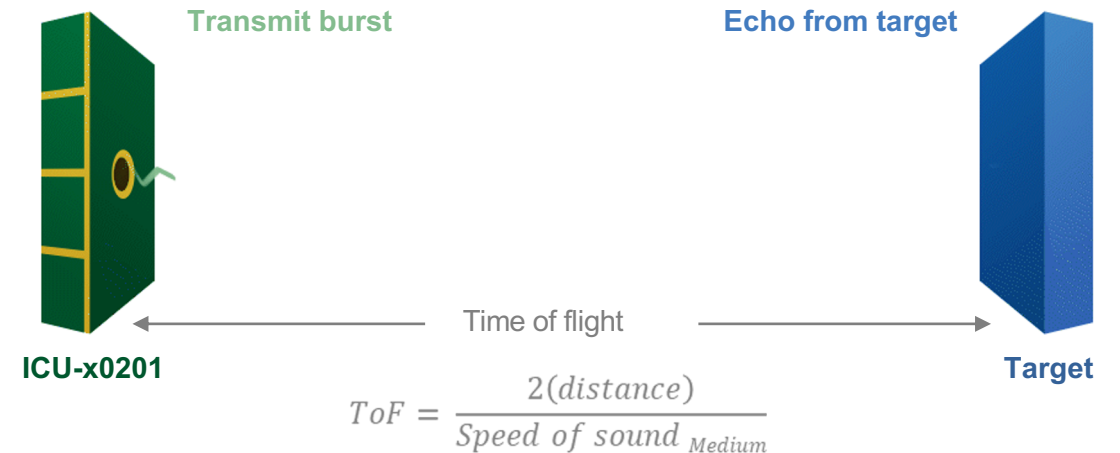
ICU-x0201 Ultrasonic Sensor



Integrated ultrasonic transceiver

- Piezoelectric MEMS ultrasonic transducer (PMUT)
- Ultrasound SoC

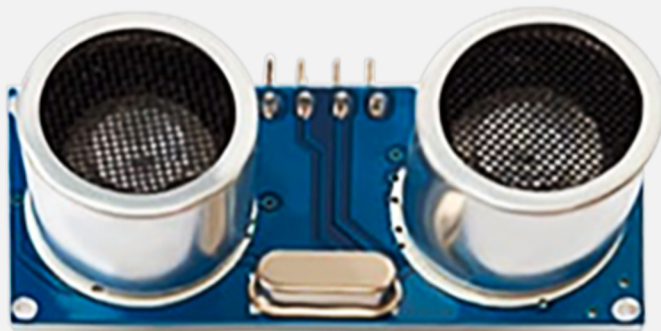
On-chip Sensing Algorithm



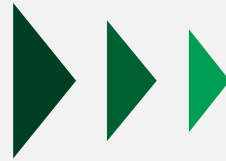
Embedded DSP

- Provides high-accuracy time-of-flight (ToF) digital output
- Multiple ToF measurements enable 3D location-finding

Chirp Sonar-on-a-Chip beats conventional ultrasound on size, weight, and power



Conventional product



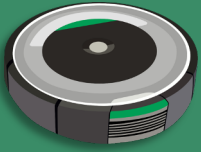
Today's Ultrasonic Rangefinders

- Conventional manufacturing
- Lots of discrete electronics
- Too bulky for consumer applications
- Great solution for range-finding

TDK InvenSense's SmartSonic

- Sonar on a chip
- Integrated DSP chip – 100x lower power
- Millimeter-sized sensor – 1000x smaller
- Best range-finding performance in the market

Ultrasonic Applications



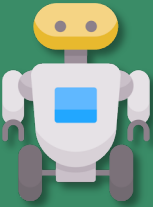
ROBOT VACUUMS

Floor Identification, Cliff Detection, Collision Avoidance



SMART LOCK

Ultra-low power presence detection and customizable field of view



ROBOTICS

Collision avoidance in any lighting condition



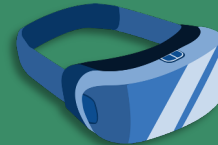
SOAP DISPENSERS

Ultra-low power presence detection in any lighting condition



INFOPOINTS / KIOSKS

Concealed wide field-of-view, ultra-low power presence detection



AR, VR, GAMING

6DoF Controller, full 360° controller tracking, gesture recognition



SMOKE DETECTORS

Ultra-low power, wide field-of-view presence detection



WATER DISPENSERS

Touchless operation, glass recognition, automatic filling – level detection



LIGHT SWITCHES, MOTION SENSORS

Concealed ultra-low power, wide field-of-view presence detection



MOBILE PHONES

Screen lock, gesture recognition, camera autofocus

2nd Generation Ultrasonic ToF

New Features & Improvements

SPEC	CHx01 (1 st Gen ToF)	ICU-x0201 (2 nd Gen ToF)	Improvement	Comments
MCU Frequency	4MHz	40MHz	10x faster	Higher Performance Enhanced processing capabilities enabling to fit and to run on-chip a wide range of application offloading completely the system MCU This is combined with extended data buffering (>10min as opposed to <5min of CHx01) to master more complex use cases
Program Memory	α	3 α	3x code space	
Data Memory	β	2 β	2x data space	
DSP capability	Bit-shift & add	HW Multiplier	Efficient SW execution	
NVM	None	32x16b OTP	Adds electronic serial number and trim	Quality and Repeatability e-ID for sensor traceability and device calibration
Serial interface	400kHz I ² C	13MHz SPI up to 3.3V	Streams out IQ data at full speed and removes the need of level shifters	Faster communication, simpler system, lower power Serial interface changed to SPI with support of 1.8 to 3.3V on the I/Os for maximum interoperability with all major MCU. No need for level shifters in the system
DMA controller	Basic	Integrated with MCU	Arbitration of data memory between SPI, PMUT transceiver, and CPU with no data loss	
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High-Performance Ultra-Compact Ultrasonic Time of Flight Sensor

Solution Features

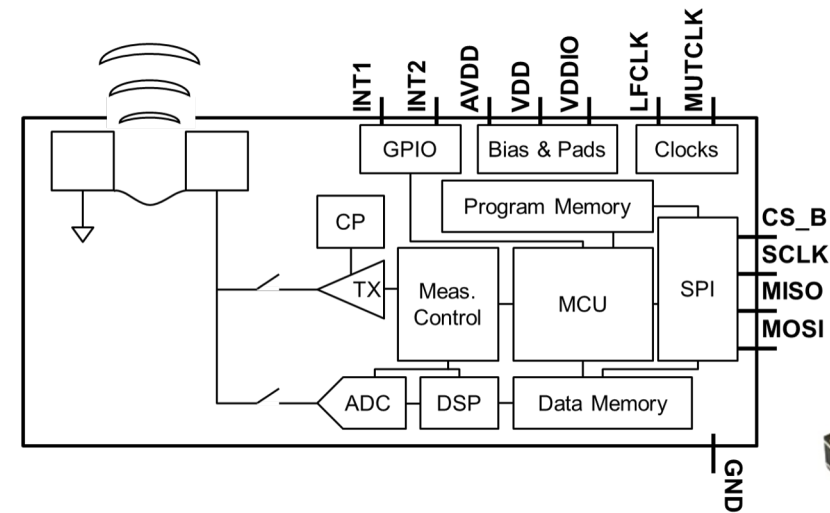
- Operating range: 20cm to 5m
- Sample rate: 150 samples/sec @ 1m
32 samples/sec @ 5m
- Ultra-low current consumption:
 - 1 sample/sec: 26 μ A (5m max range)
 - 25 samples/sec: 300 μ A (5m max range)
- Operating Temp: -40°C÷85°C,
- Operation voltage: Core 1.8V \pm 5%,
I/Os 1.8÷3.3V \pm 5%
SPI 13MHz
- Integrated DSP for signal processing
- Customizable field of view up to 180°
- 3.5 x 3.5 x 1.26mm LGA package

Applications

- Robotics and Drones
- Obstacle avoidance
- Mobile and Computing Devices
- Proximity/Presence sensing
- Home/Building automation
- Water/Liquid dispenser - level sensing & shelf inventory monitoring

Solution Benefits

- Ideal for long range applications
- Ultra-low power consumption extends battery life
- Integrated high performances DSP runs ultrasonic firmware freeing up system micro-controller resources
- High flexibility - large embedded program/data memory
- Works in any lighting conditions and can detect transparent surfaces
- Available in modules as well



ICU-10201

High-Performance Ultrasonic Time of Flight Sensor

Solution Features

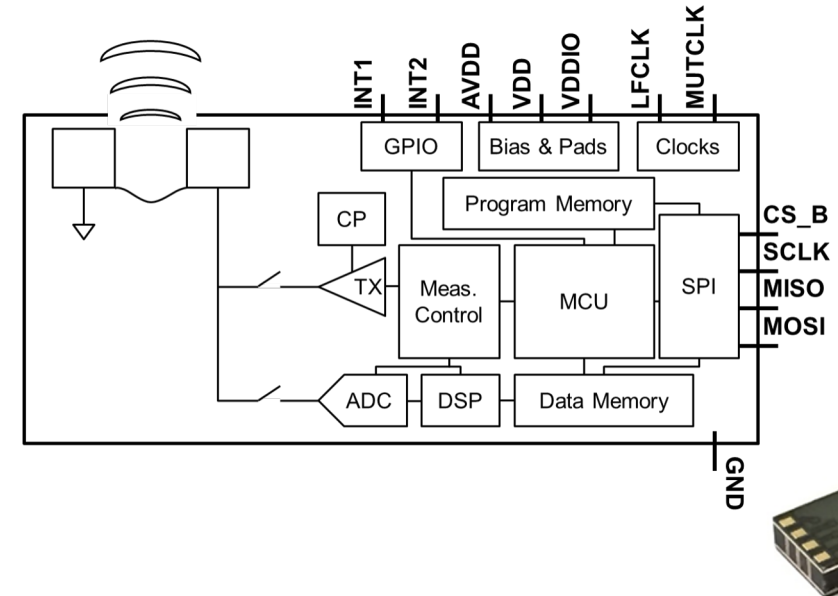
- Operating range: 10cm to 1.2m
- Sample rate: 250 samples/sec @ 0.3m
130 samples/sec @ 1m
- Ultra-low current consumption:
 - 1 sample/sec: 17 μ A (1.2m max range)
 - 50 samples/sec: 320 μ A (1.2m max range)
- Operating Temp: -40°C÷85°C,
- Operation voltage: 1.8V \pm 5%,
I/O 1.8÷3.3V \pm 5%
- Host Interface: SPI 13MHz
- Integrated DSP for signal processing
- Customizable field of view up to 180°
- 3.5 x 3.5 x 1.26mm LGA package

Applications

- Augmented/Virtual Reality and Gaming
- Gesture control
- Robotics and Drones
- Obstacle avoidance
- Floor type and cliff detection for robotic vacuums
- Mobile and Computing Devices
- Ultra-low power remote presence-sensing nodes

Solution Benefits

- Ideal for short-range applications that require low range detection
- Ultra-low power consumption extends battery life
- Integrated high performances DSP runs ultrasonic firmware freeing up system micro-controller resources
- High flexibility - large embedded program/data memory
- Pitch-catch ranging between wireless nodes
- Works in any lighting conditions and can detect transparent surfaces



Attracting Tomorrow



Questions?