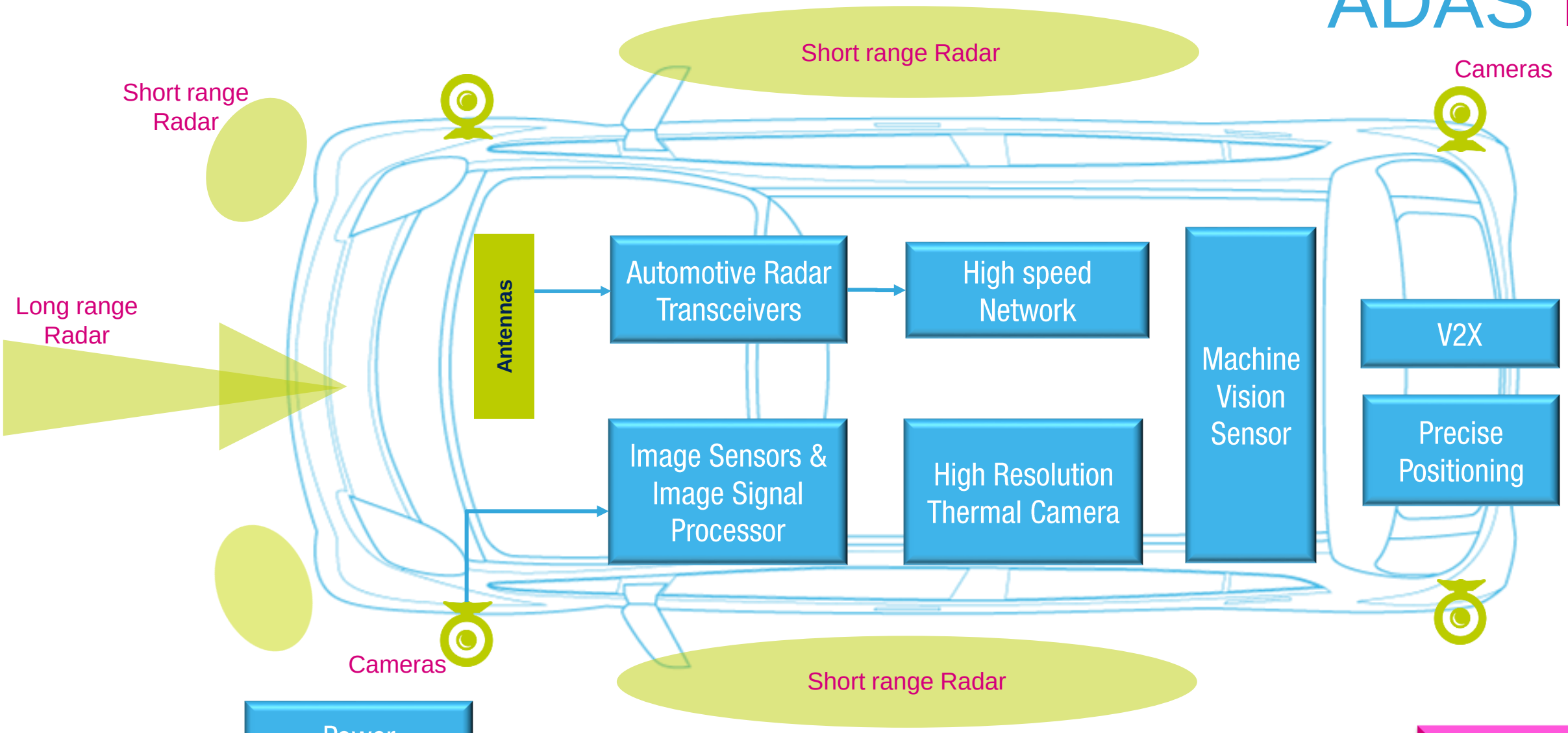
ADAS



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Product Information

Machine Vision System

Multiple ST Dev. Increase Silicon Content in ADAS Systems

Leading Vision-based system with Mobileye

MOBILEYE® An Intel Company

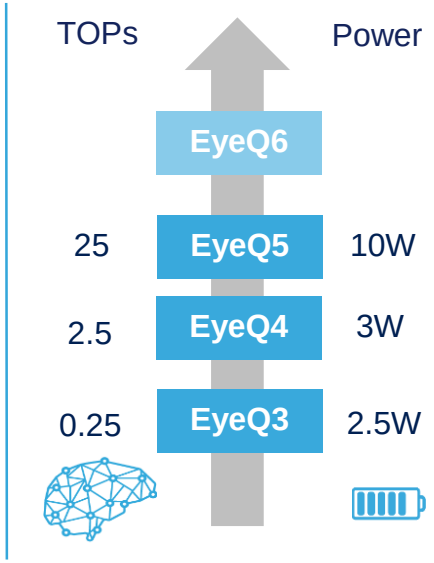
78#
2018 new car models launched

32M
Mobileye EyeQ systems delivered to OEMs globally

EyeQ5

- 1st product designed for Automotive in 7nm FinFET suitable for both ADAS and Autonomous Driving market
- Functional samples delivered to customer in Dec 2018
- High volume business already acquired with car makers

Today under field test



Moving towards autonomous vehicles with Auto-parking ability

Panasonic

- Advanced solution for mobility and Autonomous Parking
- Co-development leveraging ST Expertise in designing safe and secure Automotive SoCs and Panasonic leadership in image manipulation and system design
- 16nm technology samples delivered

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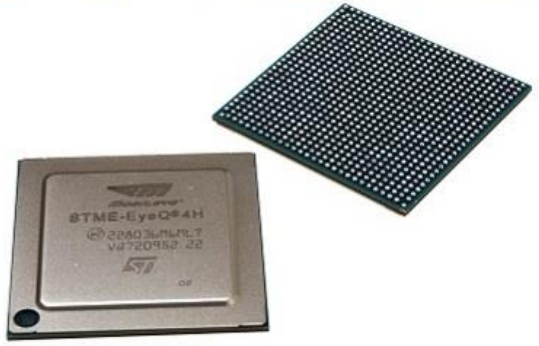
Machine Vision System



MOBILEYE
An Intel Company

- The evolution of Advanced Driver Assistance Systems (ADAS) technologies represents a significant step towards the realisation of fully connected and autonomous driving vehicles. These rely heavily on **machine vision systems** that run sophisticated algorithms in order to reach a surroundings perception level, equivalent to or exceeding that of a human being.
- In the long-standing cooperation between MobilEye and STMicroelectronics, ST provides extensive design resources as well as expertise in automotive quality and reliability standards compliance.
- Further information about Mobileye can be found at: https://www.mobileye.com/

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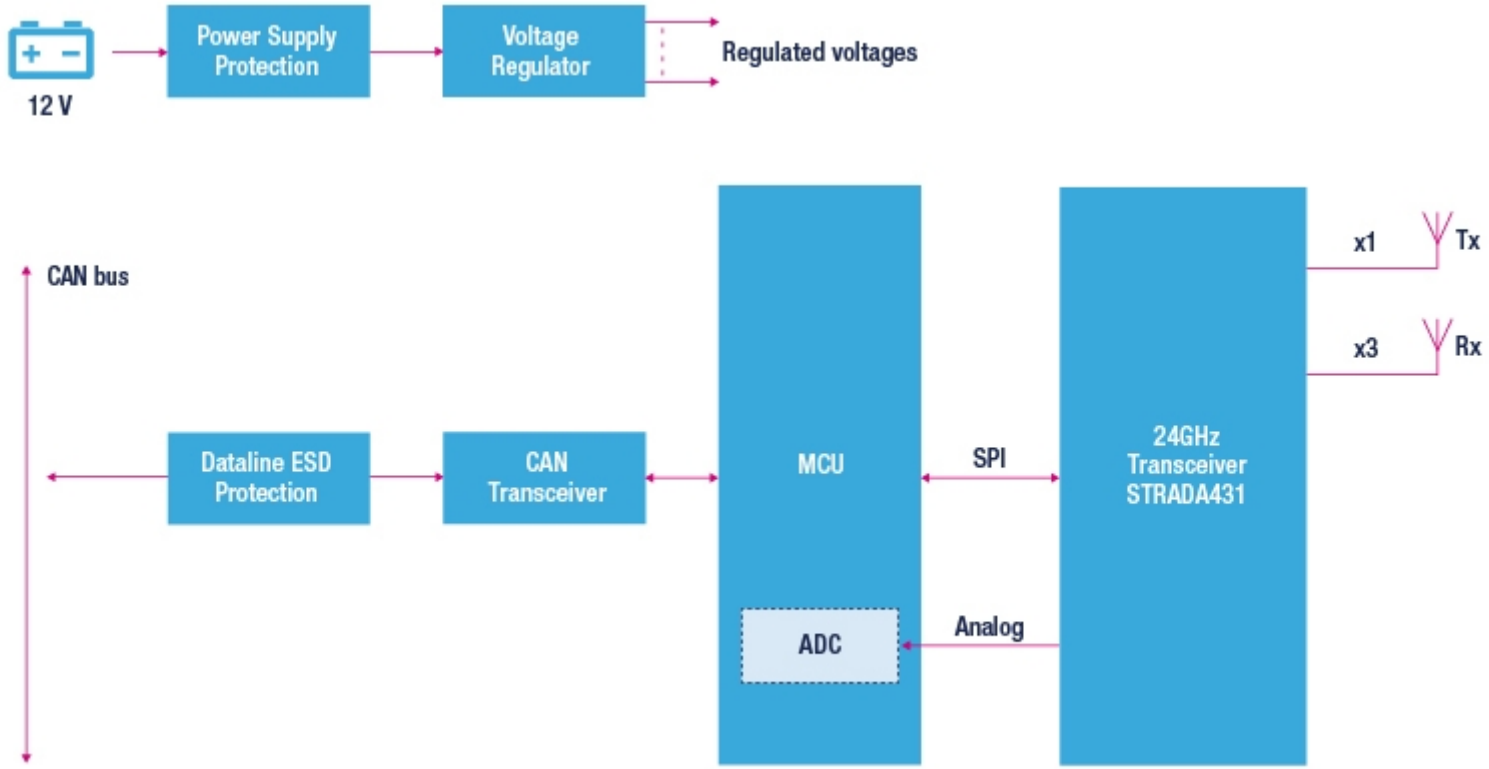
24 GHz Radar System



Automotive Radar Transceivers

24GHz

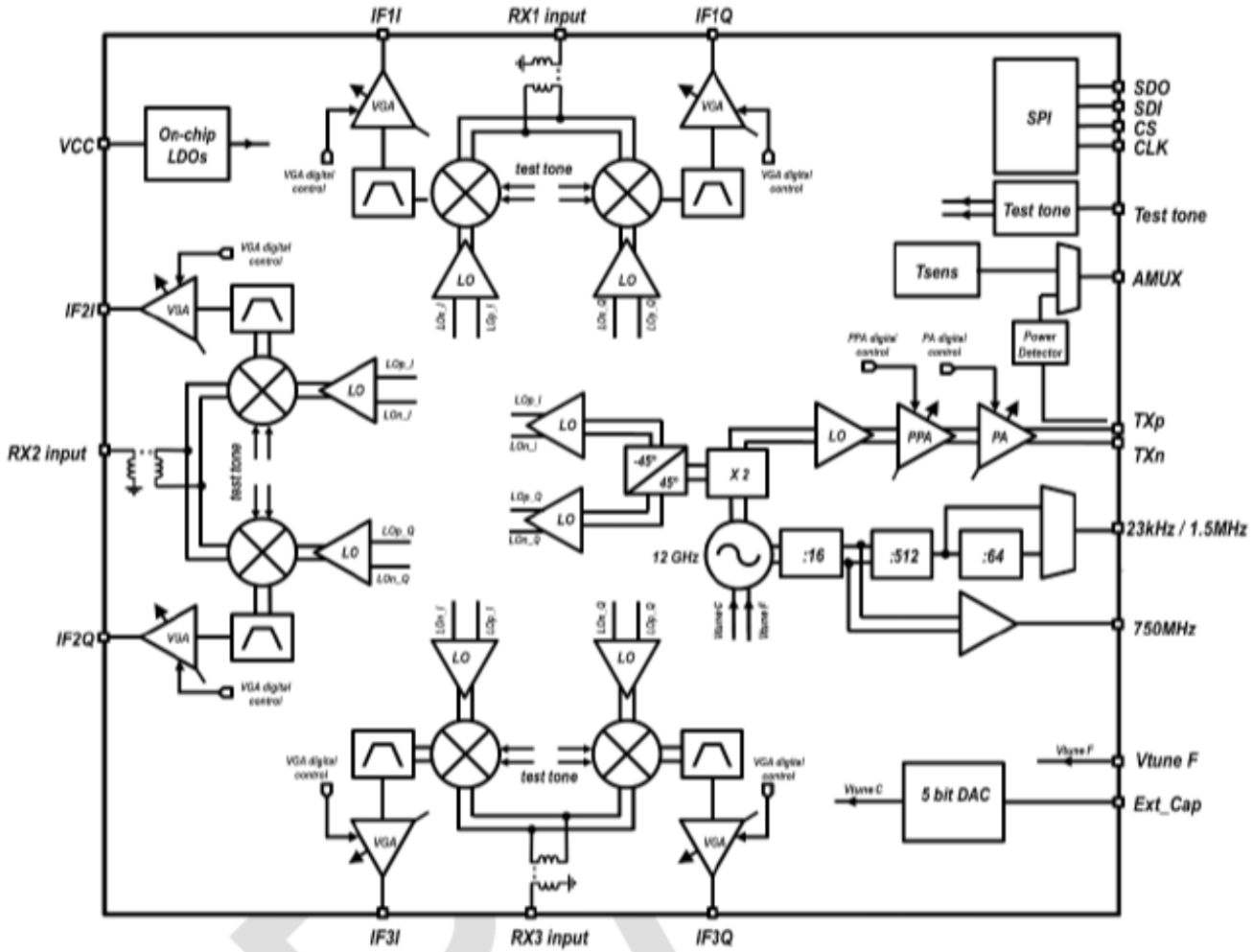


Figure 1.1.1 A431 simplified block diagram.

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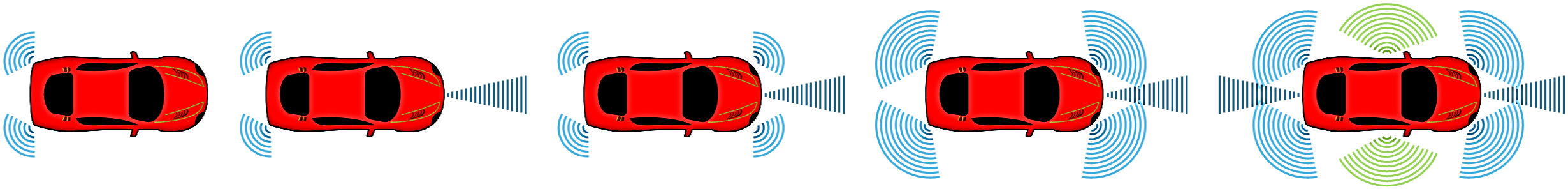
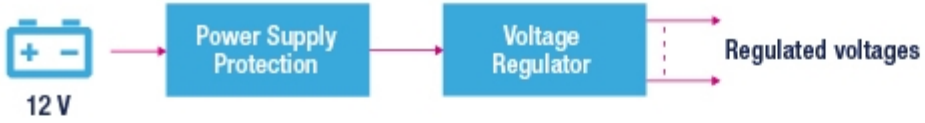
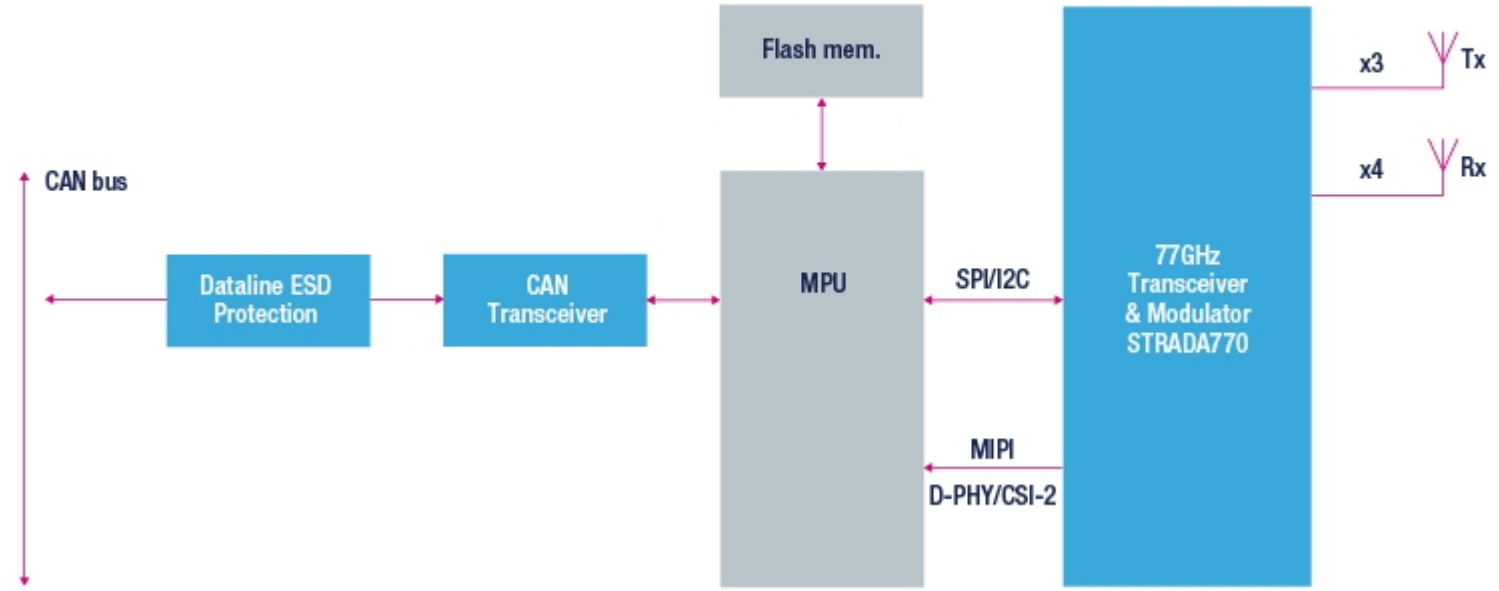
77 GHz Radar System







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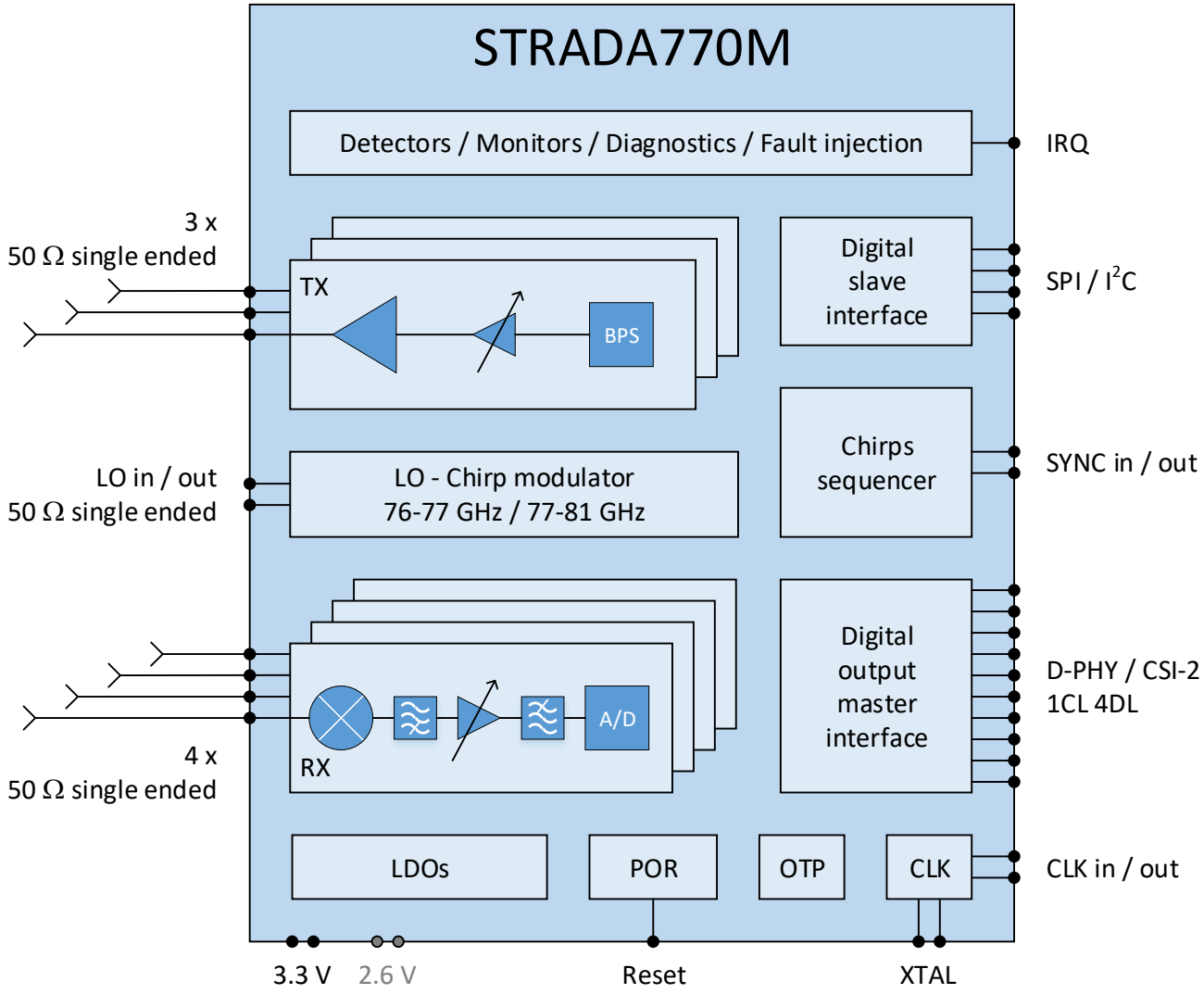
Automotive Radar Transceivers

77GHz



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TESEO V & TESEO APP
for Precise Positioning

Absolute Precise Location for Assisted and Autonomous Driving

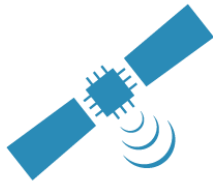
Full Production

MultiConstellation*
Single-Band (L1)

Sub-meter positioning

Production Q3 2020

MultiConstellation*
MultiBand (L1, L2, L5)
ASIL-B



* GPS, Galileo, Glonass, Beidou, IRNSS (NAVIC), QZSS, SBAS

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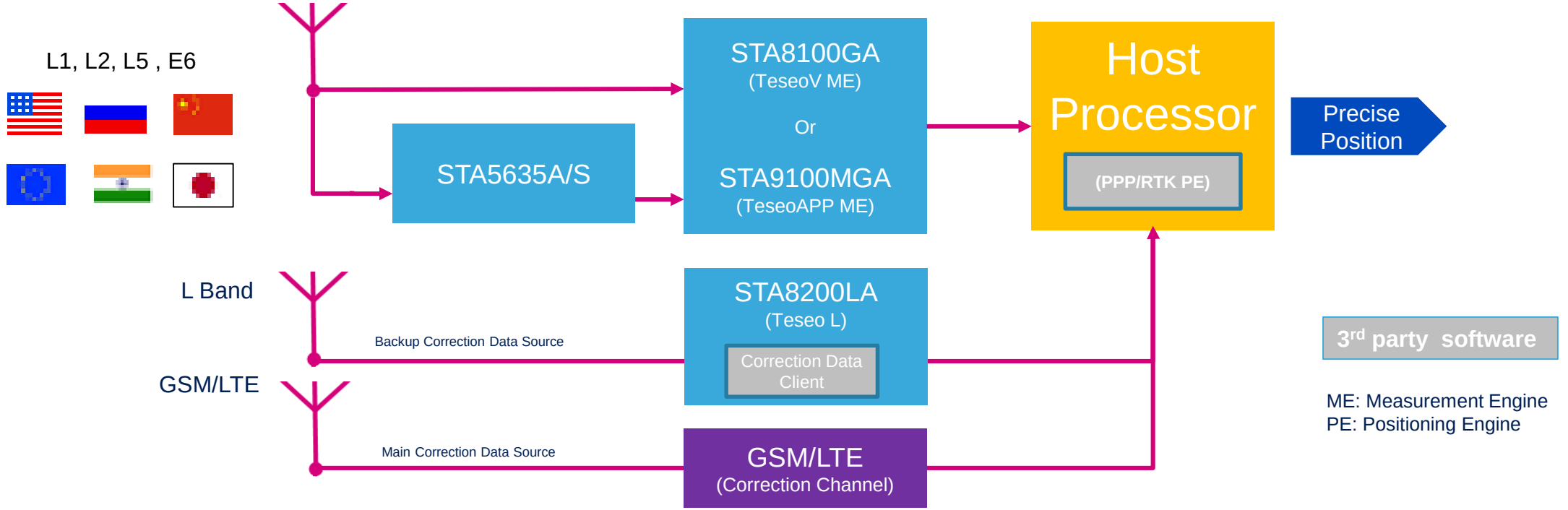
TeseoV / TeseoAPP ME



		GPS / QZSS			GLONASS		BEIDOU			GALILEO				IRNSS	SBAS
		L1C/A	L2C	L5	L1OF	L2OF	B1I / B1C	B2I	B2a	E1	E5a	E5b	E6	L5	L1
case1	Dual Band L1/L5 (without STA5635A) *	I		I			I		I	I	I			I	I
case2	Dual Band L1/L5 *	I		E	I		I		E	I	E			E	I
case3	Dual Band L1/L2 *	I	E		I	E	I	E		I		E			I
case4	Triple Band L1/L5/E6*	I		I						I	I		E		I
case5	Triple Band L1/L2/L5 *	I	E	I			I	E	I	I	I	E			I

>> I => when using internal tuner
>> E => when using external STA5635A
* Max 72 satellites tracked simulatenosly

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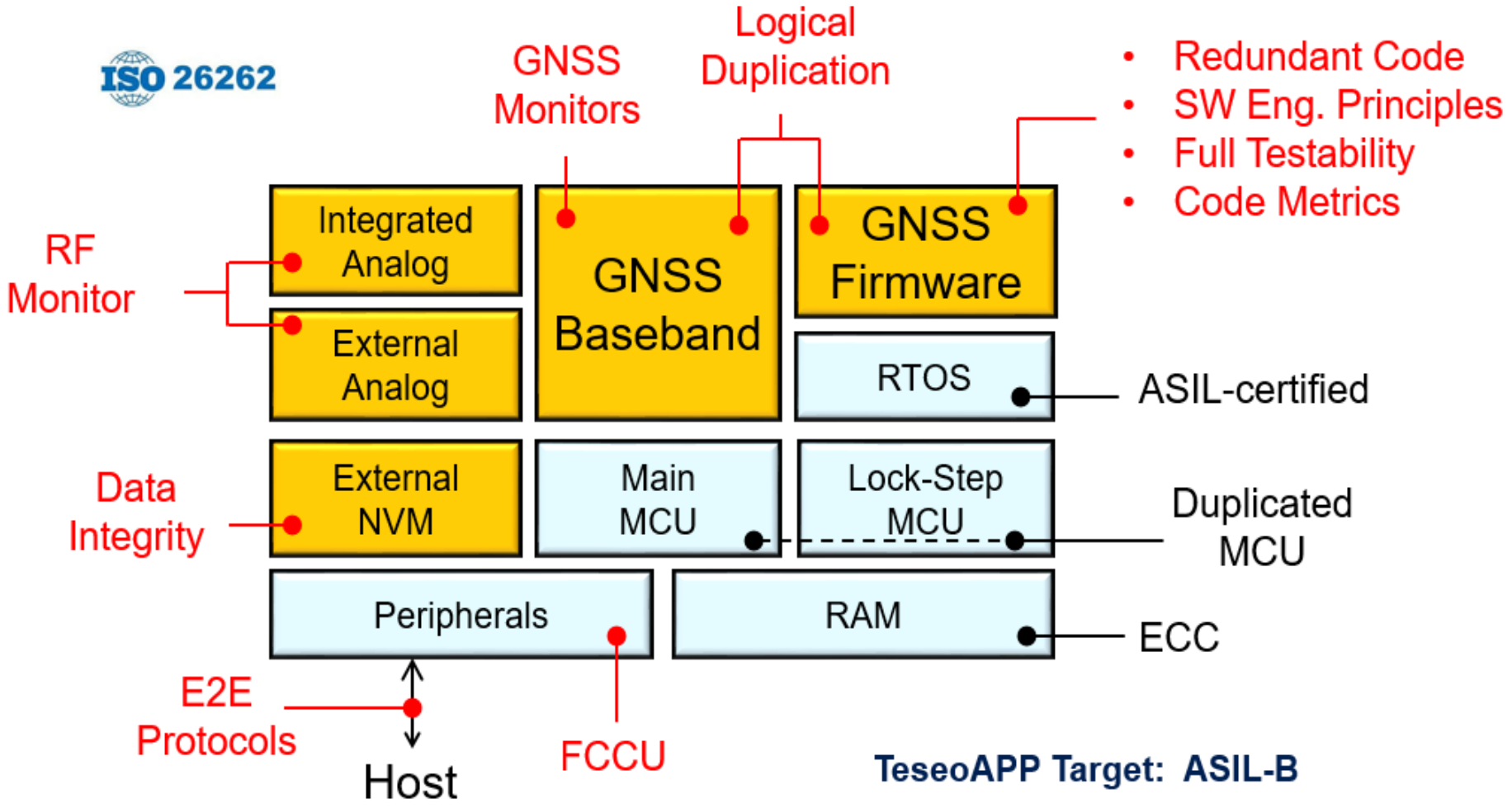
TeseoAPP Functional Safety



ASM330LHH 6-axis Inertial Module

for Accurate Navigation

Temperature Features

Extended Temp. Range: up to **+105°C**

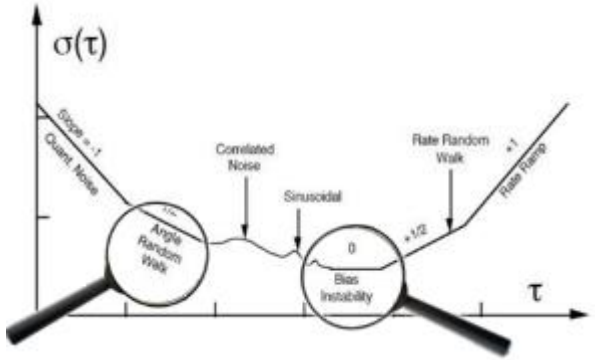
High Resolution: **256 LSB/°C**

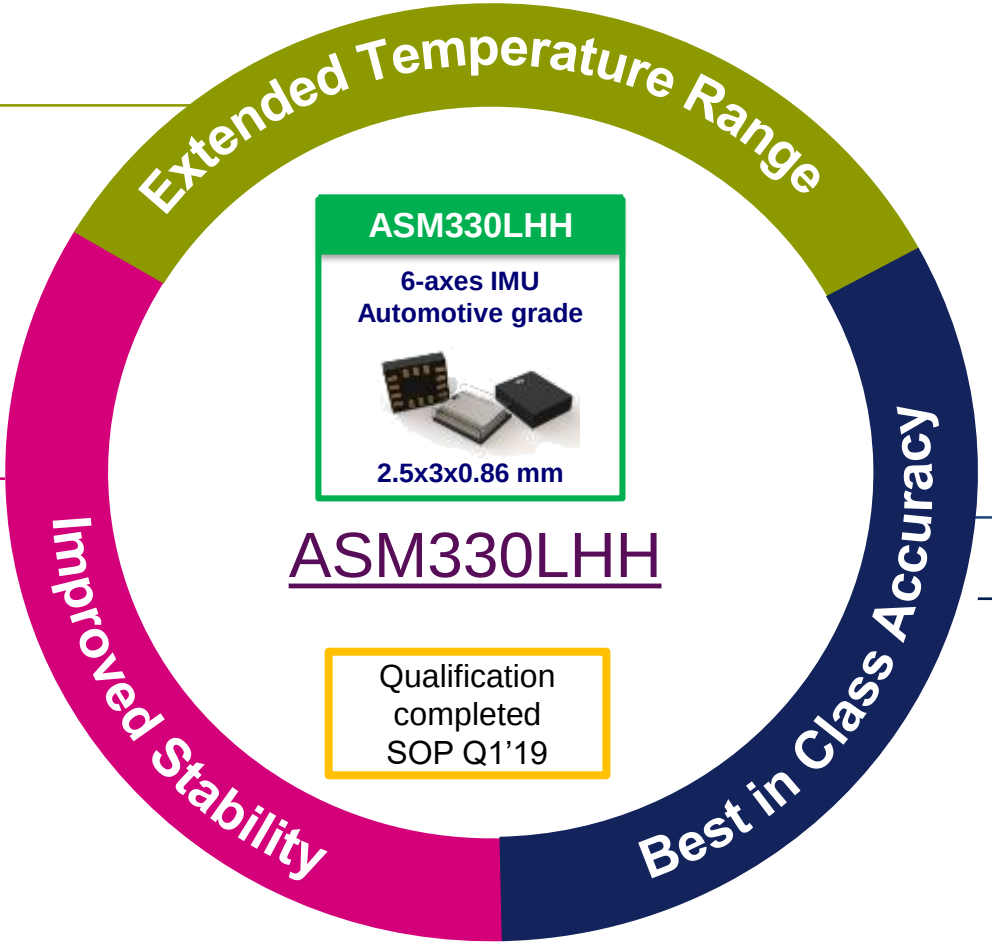
Stability Features

Typ. Angular Random Walk (ARW): **0.21 deg/√h**

Typ. Bias Instability (BI): **3°/hr (High accuracy)**

Stability: **Over time & Temperature**





Accuracy 1st

Accelerometer range	2/4/8/16 g
Gyroscope range	125 dps to 4000 dps
Typ current	1.3 mA (6 axis)
FIFO	3kb
Accelerometer noise density	60 ug/√Hz
Gyroscope noise density	5 mdps/√Hz

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AIS2IH: High Performance Low Power

Automotive Grade Accelerometer

Features

- #3 axis
- Selectable FS ±2/ ±4/ ±8/ ±16 g
- Low noise (90µg/√Hz)
- Ultra low power: 120µA in HP mode
- ODR up to 1600 Hz
- 2 independent programmable interrupt
- FIFO 32 level

Benefits

- Flexibility between High performance and Low power in the same device
- Motion and acceleration detection embedded
- Data storage (FIFO)
- LGA wettable flanks

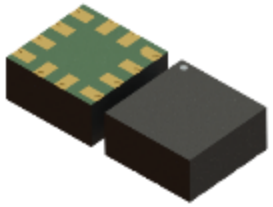
Applications

- Anti-theft device / Car Alarm
- Inclination/orientation detection
- In-dash car navigation
- Telematics and black boxes
- Motion-activated functions

Status: Under Development

AEC-Q100 compliant

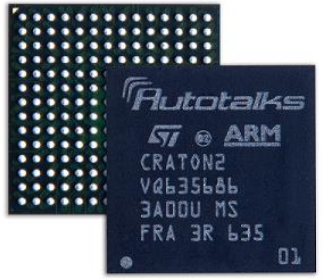
PPAP level-3



LGA-12
2x2x0.93 mm³

Vehicle-to-Everything (V2X)

Market 1st dual-mode solution supporting 5G Cellular V2X



Single IC Solution

5G

Wi Fi

Cellular
(Automotive low latency 5G)

&

Wi-Fi 11.p
(for Automotive)

life.augmented | Autotalks

Autotalks solution awarded for production:

- 4 of the top 10 automakers deploy Autotalks V2X solution
- > 10 Tier1s selected the chipset
- Volume production by 2020

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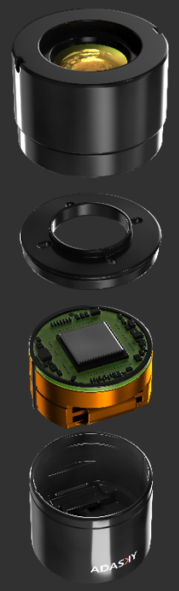
Hi-Res Thermal Camera : ST & ADASKY

Based on micro-bolometric thermal imaging technology (FIR)

- Complete solution – Camera to Computer Vision
- Passive technology
- Shutterless technology
- VGA @ 60fps
- Lowest power consumption (<750mW)
- Unique sunburn protection algorithms
- Dedicated ISP for superior image quality (ADA1)
- Built for automotive - ISO 26262 ASIL-B ready
- Scalable solution enables cost reduction
- State of the art Computer Vision algorithms
- Large annotated data sets for machine learning



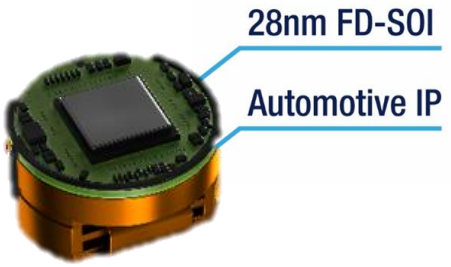
System description

- Thermal imagery based Advanced Driver Assistance System (ADAS) for avoidance of forward collisions with 3d party objects: Pedestrians, bicyclists, animals, general objects, moving and static vehicles.

- The system will detect and warn about obstacles up to 130 meters, 24/7 in all weather conditions. Main advantage in night time and extreme weather.

Silicon implementation

- 28nm FD-SOI
- 12x12 250pin, 0.65pitch FlipChip BGA
- ISO-26262 ASIL-B ready
- AEC-Q100 grade 2 (-40c to 105c)



Powered by ST

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ADASKY
Driven to save lives

ST Automotive Imaging Solutions

Driving innovation in Emerging Automotive Applications

Viewing & Sensing Camera
E-Mirror, Rear & Surround View, Front-Facing

In-Cabin Optical Sense
Driver monitor, Gesture control, Occupancy Detection

Digital LiDAR
Autonomous Driving through Sensor Fusion

Highest Imaging Technology
To Cope with Adverse Imaging Conditions

Platform and System Support
To Ease Imaging Sensor Integration

Automotive Ecosystem
To Meet with Automotive Regulations

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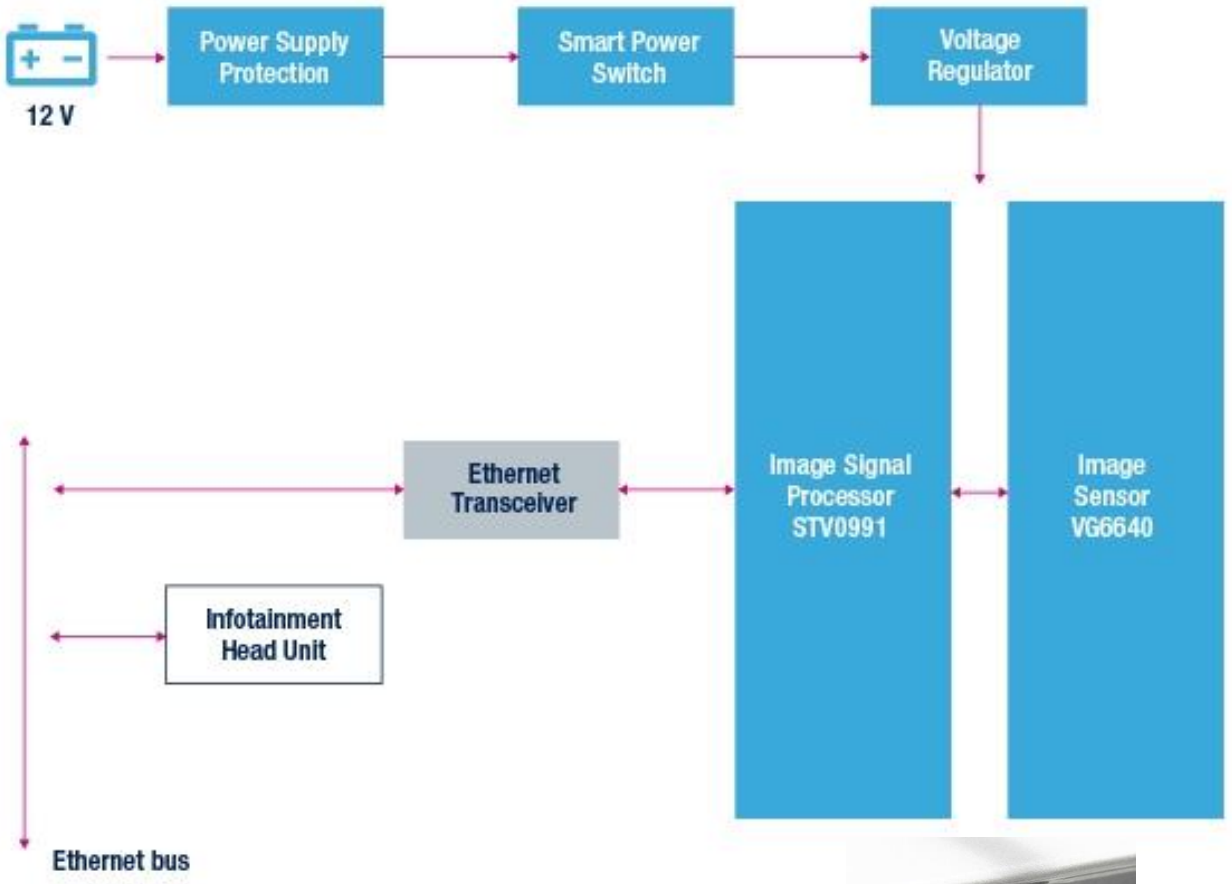
Smart Automotive Cameras



ST Image Sensors & ISP Solutions:

- **STV0991+VG6640**: 1.3Mpx (with Video Compression) : Ethernet rear Camera
- **STV0971 + VG6640**: 1.3Mpx: LVDS rear camera, and low resolution viewing camera
- **STV0971 + VG6768** : 2.5Mpx: LVDS e-mirror camera (HDR Led Flicker-Free)
- **Global shutter VG5661**: 1.6Mpx for Driver Monitoring System
- **Global shutter VG5761**: 2.3Mpx for DMS and Occupancy Monitoring System

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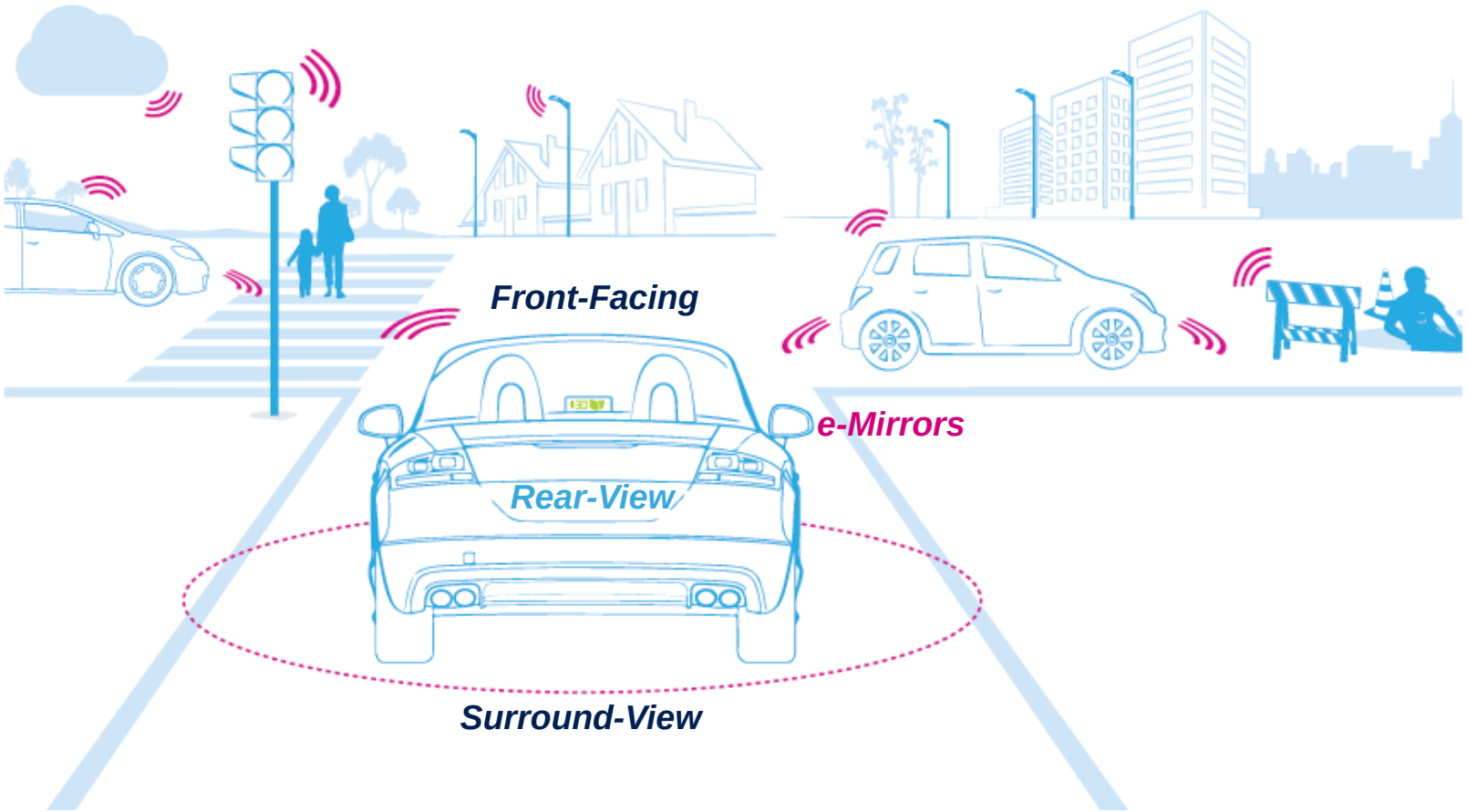
Viewing Camera Systems for ADAS

LED lighting is present everywhere in our driving environment



Perfect Solution Fit

- ✓ E-Mirror
- ✓ Any Display-Vision RVC/SVC application
- ✓ Front-Facing Machine Vision
- ✓ ST Supply-Chain & Quality excellence

Disruptive Sensor Technology

- ✓ 2.5Mpixels Rolling Shutter sensor
- ✓ 145dB Dynamic Range (highest on market)
- ✓ New LED Flicker-FREE pixel
- ✓ Up to 60fps in full HD resolution
- ✓ ASIL-B & AEC-Q100 Grade 2

Fully Flexible System Offer

- ✓ Advanced HDR ISP Companion Chip
- ✓ Standalone or combined sensor/ISP options
- ✓ LVDS automotive applications

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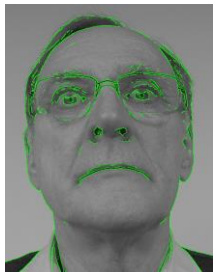
In-Cabin Smart Optical Sensors

Perfect Solution Fit

- ✓ Head pose detection
- ✓ Eyelids analysis
- ✓ Accurate gaze direction
- ✓ Immune to ambient
- ✓ ASIL-B & AEC-Q100 Grade 2

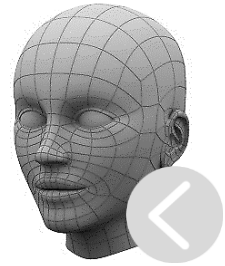


Disruptive Sensor Technology

- ✓ 1.6Mpixels & 2.3Mpixels Global Shutter Sensors
- ✓ 96dB High Dynamic Range with Dual Memory Nodes
- ✓ High Effective Resolution and Contrast @ 940nm
- ✓ Very Low Noise at High Temperature
- ✓ Background Removal

Compatible with 3D Sensing Systems

- ✓ Using Stereo or Structured Light
- ✓ Robust Driver Identification
- ✓ Head Distance to Dashboard
- ✓ Head Position Confirmation



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ST Automotive Imaging Portfolio

Building on our Differentiated Imaging Technology Portfolio

Viewing & Sensing Camera

Rolling Shutter

- **FSI, 3.75um**
- **132dB**
- Staggered HDR
- Low Noise
- High Sensitivity

NEW

- **BSI, 3.2um**
- **145dB**
- No Memory
- Low Noise
- High Sensitivity
- **Flicker Free**

- **BSI, 2.4um**
- **120dB**
- **3D Stack**
- Low Noise
- High Sensitivity
- **Flicker Free**

Dev

In-Cabin Optical Sense

Global Shutter

NEW

- **FSI, 3.2um**
- **96dB**
- HDR
- Low Noise
- High MTF
- Multi-ROI / expo

- **BSI, <3um**
- **96dB**
- **3D Stack**
- HDR
- Low Noise
- High MTF

Dev

Digital LiDAR

Foundry Business

No Product available, indirect business with LIDAR partners

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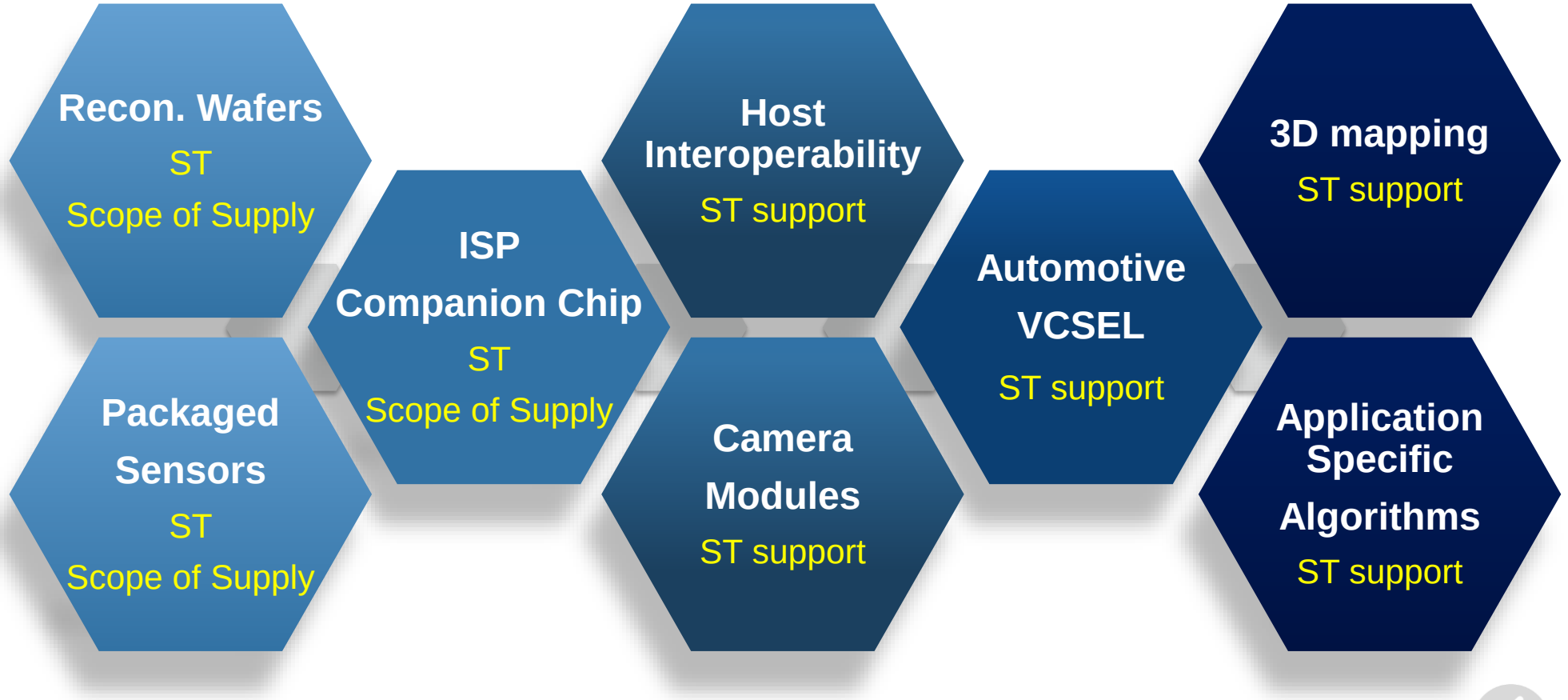
ST Automotive Imaging Solutions

Platform and System support



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High Speed Network: ST & VALENS

Valens and ST join forces to revolutionize in-car connectivity.

Unprecedented Bandwidth

- Tunneling of up to 6Gbps of simultaneous streams of high-definition video & audio, data, USB, and power, over a 15m (50ft) single, unshielded twisted pair (UTP) cable.

Designed for Networking

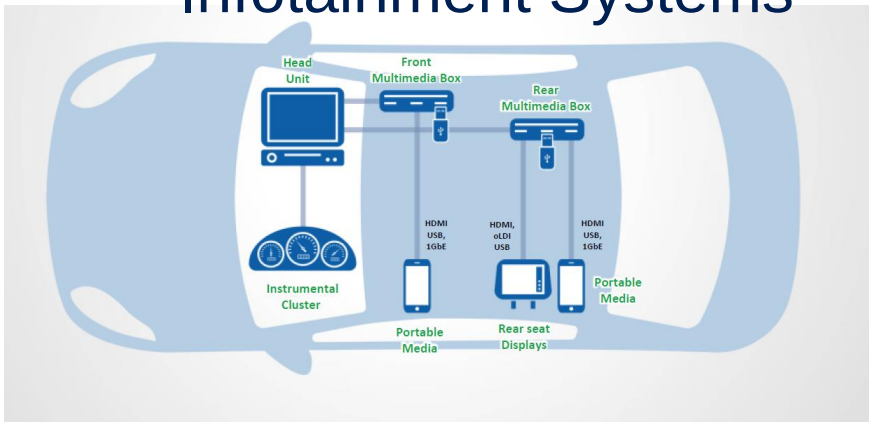
- Multistream & multi-hop capabilities for the whole-car backbone network infrastructure, for optimized sensor fusion, ADAS and infotainment.

EMC - Resistant Solution

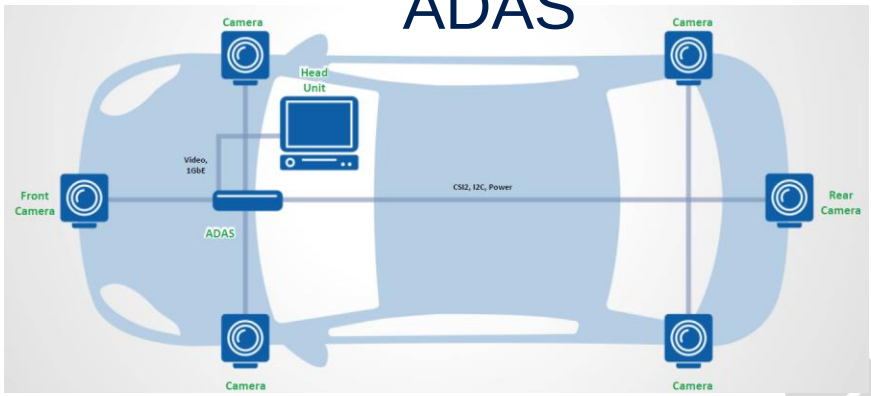
- Highly robust, with adaptive mechanism to deal with EMC, cable aging, temperature changes, and more, with no need for cable grounding.

HDBT

Infotainment Systems



ADAS



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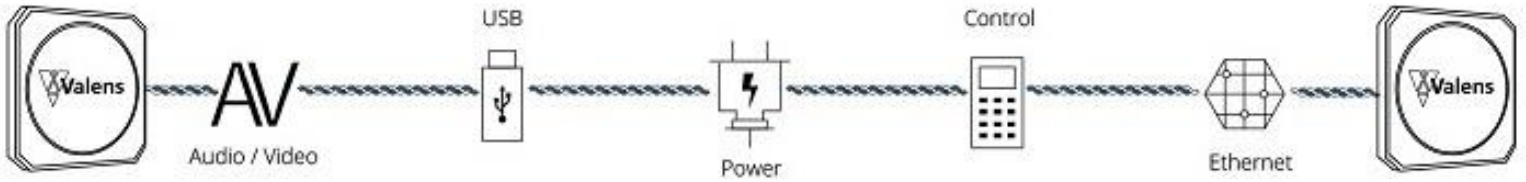
Valens

High Speed Network: ST & VALENS



Valens

Further information about Valens can be found at: www.valens.com

System content

- 6Gbps full-duplex link on UTP cable
- Gigabit Ethernet
- USB 2.0, I2S, I2C protocols

Silicon implementation

- 28nm CMOS bulk
- 20M logic gates
- 13x13 225pin FlipChip BGA
- Max Total power < 7W
- -40°C < Tj < 125°C

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Valens

Power Management

PMICs

VREGs

SBCs

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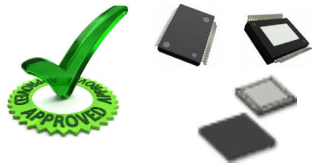
Infotainment and ADAS Power Supplies

L5963

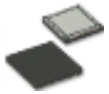
Dual monolithic switching regulator with LDO and HSD (3A x 2 + 250mA)

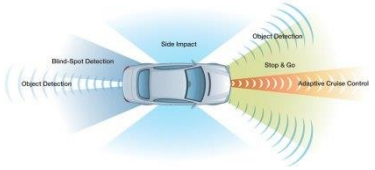


2016

ADAS L5965

Multiple power management for automotive **vision and radar** systems ISO26262

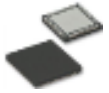




2018

L5964

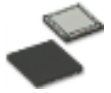
Dual monolithic switching regulator with LDO and **watchdog, reset** (3.5A x 2 or 7A + 250mA)



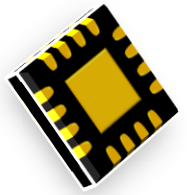
2019

NEW ADAS PMIC

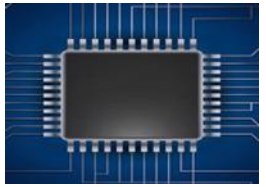
Second generation ADAS PMIC



2020



Multiple power management for automotive **cameras** (ADAS) Targeting QFN flip-chip package



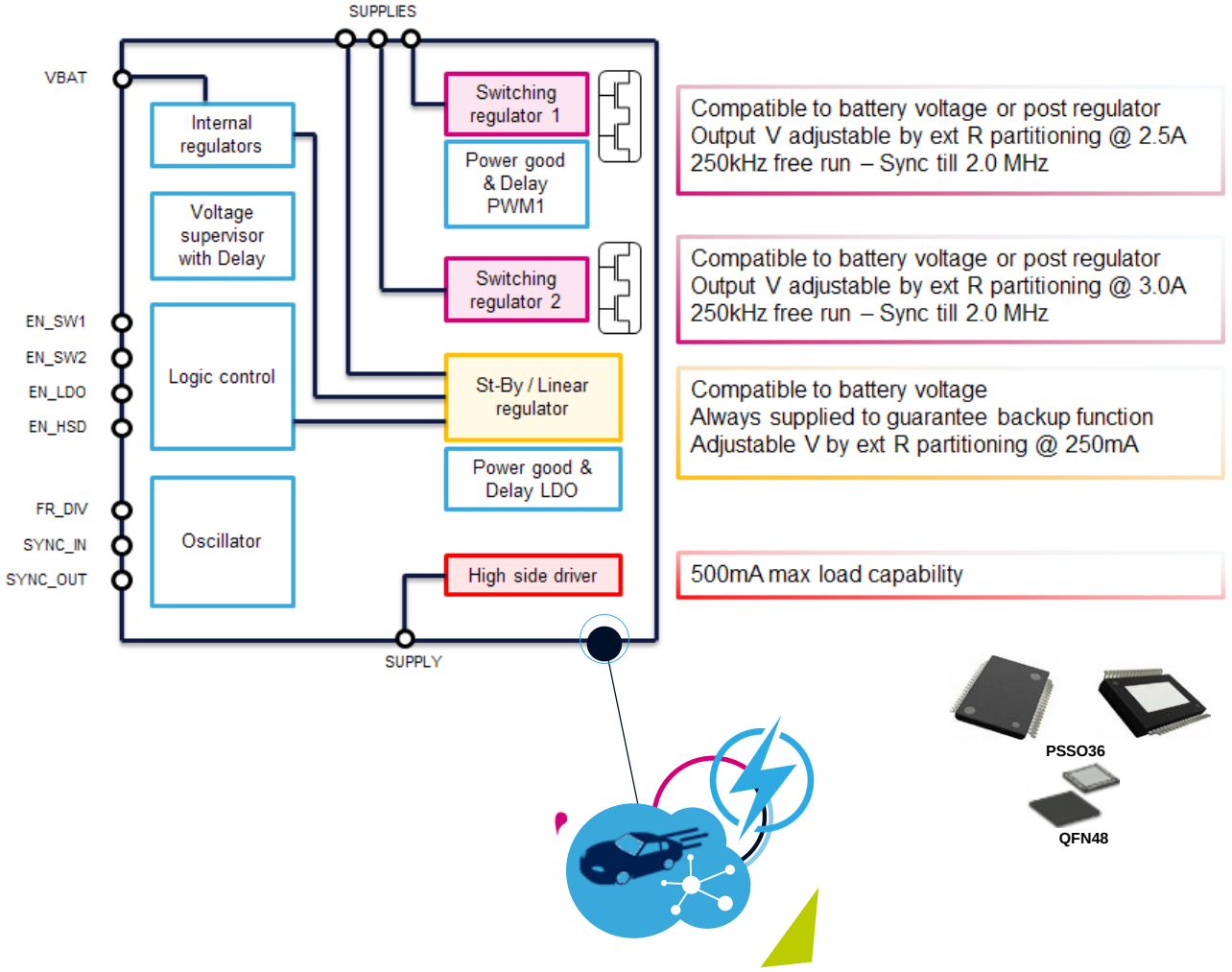
ASICs
Adopting all IPs developed for ADAS PMICs

Multiple buck-boost power management for Audio and USB Type-C power delivery

Type-C

L5963

Dual Monolithic Switching Regulator with LDO and HSD



MAIN FEATURES

- Compact solution in a small package
- Every regulator is battery compatible
- High switching frequency, up to 2MHz
- High current capability, up to 3A
- Extremely low quiescent current in st-by (25uA typ)
- Possibility of synchronization
- Voltage monitoring and power goods
- 180° phase shift between dc-dc

BENEFITS

- Use of just a single device with 3 outputs
- Flexibility
- High integration level
- Small external components
- Master slave configuration and customized power up sequences without any external control
- Low EMI emissions
- Automotive qualified AEC Q100

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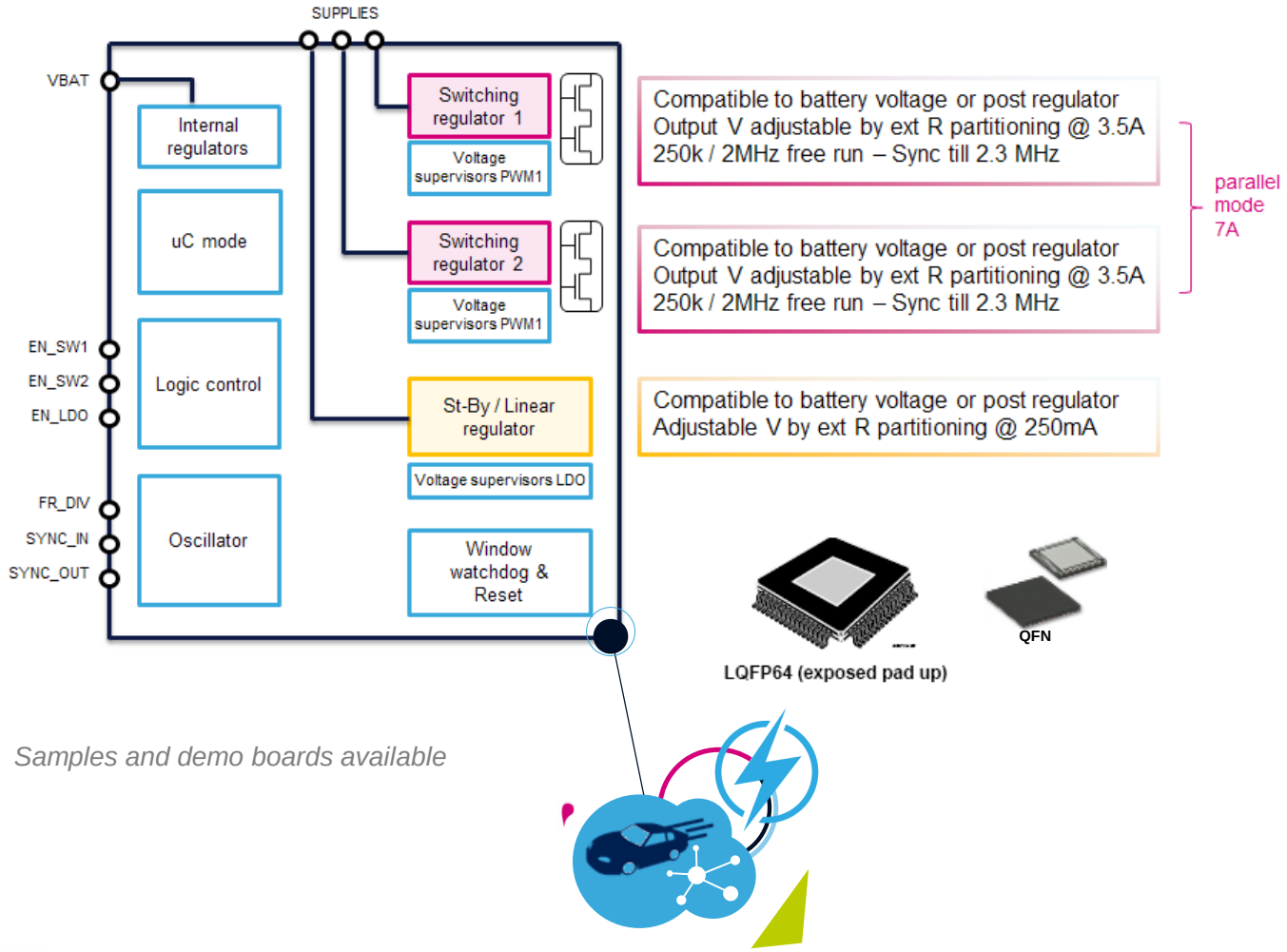
L5964

Dual Switching Regulator with LDO and UC Power Mgmt



LQFP64 (exposed pad up)

QFN

Samples and demo boards available

MAIN FEATURES

- Compact solution in a small package
- Current mode
- Every regulator is battery compatible
- High switching frequency, up to 2.3MHz
- High current capability, up to 7A multi-phase
- Possibility of synchronization
- Voltage supervisors and power goods
- Phase shift between regulators
- Microcontroller management

BENEFITS

- Few external components
- Flexibility of use and high integration level
- Internal oscillator or external synch
- Use of small inductors
- Can be used as high current pre-regulator
- Master slave configuration and customized power up sequences without any external control
- Low EMI emissions
- Automotive qualified AEC Q100

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L5965

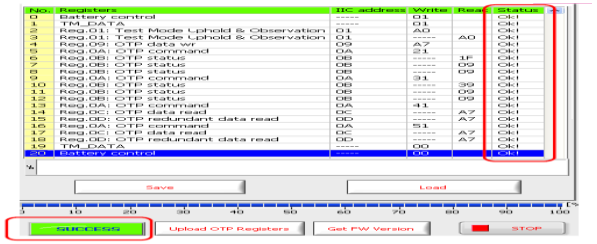
PMIC for Cameras and Radars

L5965 is a multiple voltage regulator including pre and post regulators, 7 output voltages with the target to supply ADAS systems and to be compatible to ST ICs:

- Vision processors (EyeQ3, EyeQ4, … (Vision-System-on-Chip))
- Radar sensors (STRADA431 - 24GHz Transceiver, …)
- Microcontrollers (SPC58NE84E7, SPC58NE84C3 - 32bit microcontroller for automotive ASIL-D applications, …)

An SPI interface is present

OTP for programming

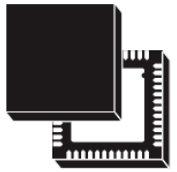


Designed with reference to

CERTIFIED FUNCTIONAL SAFETY JQA

Certification for Products
in accordance with
ISO 26262

VFQFPN-48



VFQFPN-48 (7x7x1.0mm)
Very Fine Quad Flat Package No lead

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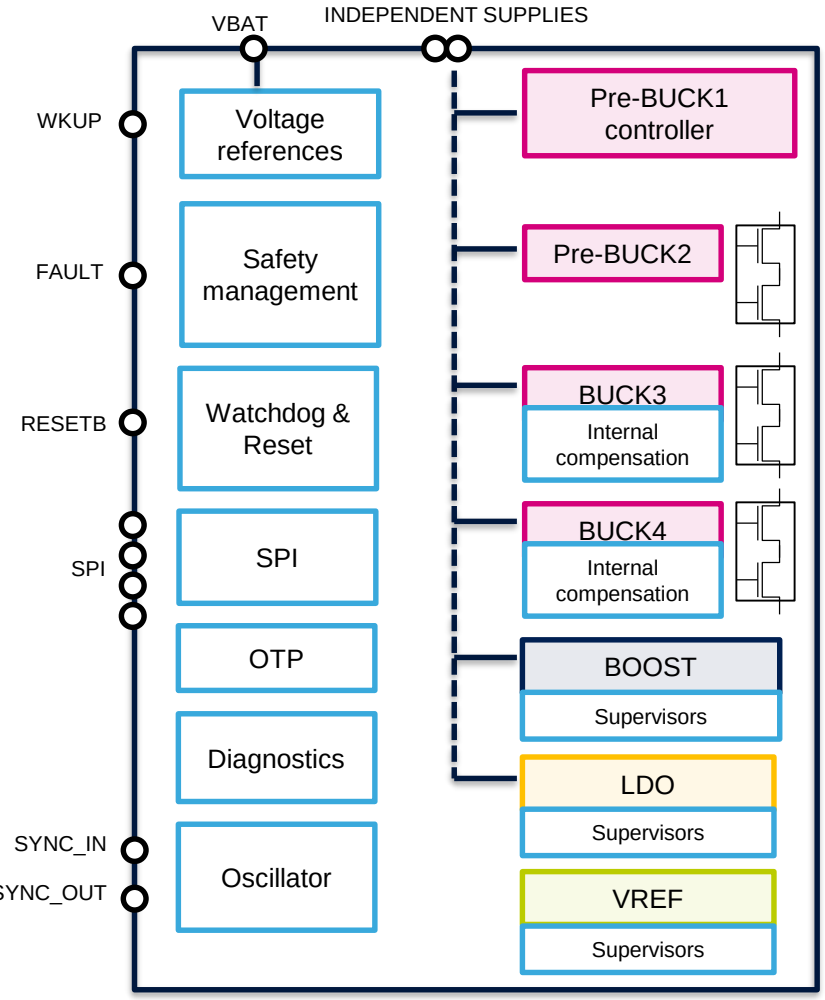
L5965

Multiple Power Mgmt IC for Vision and Radar Systems



Buck pre/post controller compatible to battery V
5-3.8-3.3-1.8-1.2-1.1-1.0-0.8 V @ 0.4 MHz

Buck pre/post regulator compatible to battery V
5.0-3.6-3.3-1.5-1.35-1.2-1.1-1.0 V @ 1-2 A ● 0.4 - 2.4 MHz

Buck post regulator compatible to 5.5V max
3.3-2.5-2.3-2.0-1.8-1.35-1.2-1.0 V @ 1.2 A ● 2.4 MHz

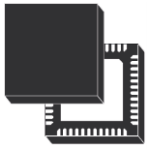
Buck post regulator compatible to 5.5V max
3.3-1.8-1.35-1.3-1.25-1.2-1.12-1.1 V @ 0.9 A ● 2.4 MHz

Boost post regulator compatible to 5.5V max
7 – 5 V @ 0.3 A ● 2.4 MHz

Linear post regulator compatible to 5.5V max
5-3.3-2.8-2.5-1.8-1.3-1.25-1.2 V @ 300/600 mA

Internally connected to the battery
4.1 - 3.3 – 2.5 – 1.8 V @ 20 mA

OTP programmable!



VFQFPN

Samples and demo boards available

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ISO26262 - ASIL Compliance

ISO26262 ASIL compliance

- VIN/VOUT monitors
- Two independent Band-gaps: one for reference and one for monitor
- Ground loss monitors
- Internal compensation network and resistor divider
- Digital BIST on internal logic
- Analog BIST:
    - Voltage comparator toggle
    - Temperature comparators toggle
    - Reset assertion check
- Fault pin to Microcontroller

OTP programmable parameters

- BUCK1 output values
- BUCK2 output values
- BUCK2 current limit value
- BUCK2 free running frequency
- BUCK3 output values
- BUCK4 output values
- LDO output values
- LDO output current limitation
- BOOST output voltage
- VREF output voltage
- Main BUCK selection (to decide which regulator between BUCK1 and BUCK2 is the main pre-regulator)
- Power up sequence

Second Generation ADAS PMIC

- Pre Buck1 controller, OTP V, battery compatible
- Buck2 controller OTP V
- Buck3 converter OTP V, 3A
- Buck4 converter OTP V, 3A
- Buck5 converter OTP V, 1.25A
- Boost converter / controller
- LDO1 OTP V, 0.75A
- LDO2 OTP V, 0.75A
- LDO3 OTP V, 0.75A
- LDO4 OTP V, 0.75A
- LDO5 OTP V, 0.75A
- LDO6 OTP V, 0.25A
- LDO7 OTP V, 0.25A
- FD CAN interface, SPI, protections, OTP, safety

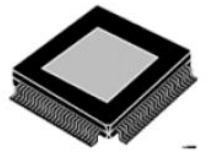
Powerful power management IC offering a full set of features to support applications that need to fulfill functional safety requirements as defined by Automotive Safety Integrity Level (ASIL) A-B-C-D.

Evolution of L5965 with improved functionalities, higher current capability, higher number of power rails and controller, higher voltage precision.

Complete programmability by OTP

ST has all IPs to provide PMICs for ADAS and, in general, for the automotive environment

- First engineering samples in H1’19
- Final samples in H2 2020
- Production H2 2021



TQFP128L
(Exposed pad up)

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VREGs – New Product Line-up

L99VR01S

CONFIGURABLE FOR 8 FIXED VOUT

ENABLE | RESET

SO-8

200 mA

L99VR01J

CONFIGURABLE FOR 8 FIXED VOUT

ENABLE | RESET

WD | Thermal Warning

Ishort CTRL

POWERSSO-12

200 mA

L99VR02J

CONFIGURABLE FOR 8 FIXED VOUT

ENABLE | RESET

WD | Thermal Warning

Ishort CTRL

POWERSSO-12

500 mA

L99VR02XP

LDO1 8 CONF. FIXED VOUT | LDO2 8 CONF. FIXED VOUT

ENABLE | CONF. RESET

WD | Thermal Warning

Ishort CTRL | Thermal Clusters

POWERSSO-36

2x250 mA

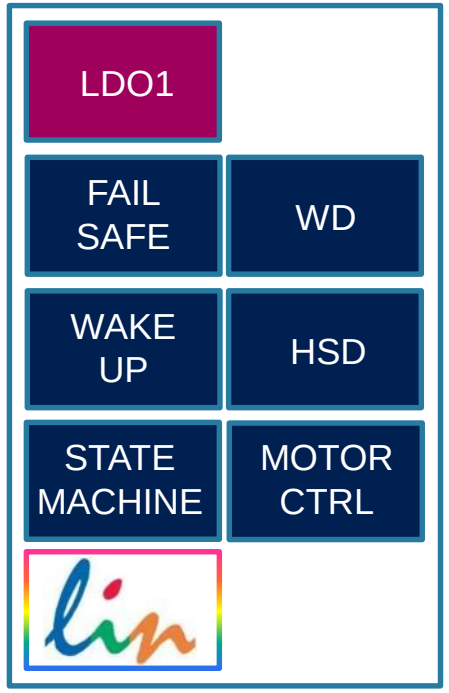
Output Current

Automotive Power Management ICs

Power Management Line up

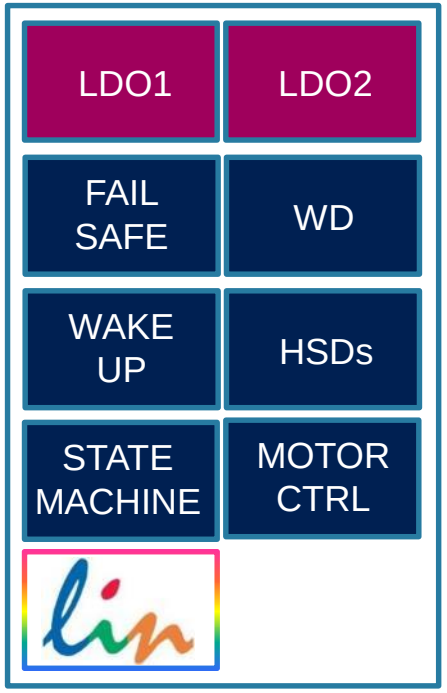
L99PM60J

Motor Control, LIN, Vreg, HSDs



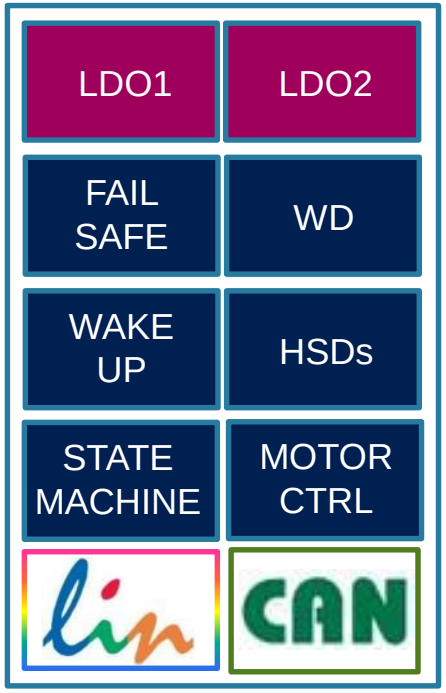
L9952GXP

Motor Control, LIN, Vregs, HSDs Wakeup, Opamps, etc



L99PM62GXP

Motor Control, LIN, CAN, Vregs, HSDs Wakeup, Opamps, etc



L99PM72GXP

Motor Control, LIN, CAN-PN, Vregs, HSDs, Wakeup, Opamps, etc