Multiple ST Dev. Increase Silicon Content in ADAS Systems

Leading Vision-based system with Mobileye

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

- 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
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/
24 GHz Radar System
Automotive Radar Transceivers

24GHz

Figure 1.1.1 A431 simplified block diagram.
77 GHz Radar System
Automotive Radar Transceivers

STRADA770M

Detectors / Monitors / Diagnostics / Fault injection

LO - Chirp modulator
76-77 GHz / 77-81 GHz

Chirps sequencer

Digital slave interface

Digital output master interface

3 x 50 Ω single ended

LO in / out 50 Ω single ended

4 x 50 Ω single ended

TX

BPS

D-PHY / CSI-2

1CL 4DL

CLK in / out

3 x 50 Ω single ended

TX

BPS

D-PHY / CSI-2

1CL 4DL

CLK in / out

3.3 V 2.6 V

Reset

XTAL

4 x 50 Ω single ended

RX

A/D

Digital output master interface

Digital slave interface

Detectors / Monitors / Diagnostics / Fault injection

3.3 V 2.6 V

Reset

XTAL

3.3 V 2.6 V

Reset

XTAL

77GHz
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
TeseoV / TeseoAPP ME

- L1, L2, L5, E6
- GPS / QZSS
- GLONASS
- BEIDOU
- GALILEO
- IRNSS
- SBAS

- L1C/A
- L2C
- L5
- L1OF
- L2OF
- B1I / B1C
- B2I
- B2a
- E1
- E5a
- E5b
- E6
- L5
- L1

- Case 1: Dual Band L1/L5 (without STA5635A) *
- Case 2: Dual Band L1/L5 *
- Case 3: Dual Band L1/L2 *
- Case 4: Triple Band L1/L5/E6*
- Case 5: Triple Band L1/L2/L5 *

- STA8100GA (TeseoV ME)
- STA9100MGA (TeseoAPP ME)

- Host Processor
  - (PPP/RTK PE)

- STA8200LA (Teseo L)

- Backup Correction Data Source
- Main Correction Data Source

- L Band
- GSM/LTE

- STA5635A/S
- STA8100GA
- STA9100MGA
- STA8200LA

- ME: Measurement Engine
- PE: Positioning Engine

- 3rd party software

- Precise Position

- **I** => when using internal tuner
- **E** => when using external STA5635A

- **Max 72 satellites tracked simultaneously**

- Teseo: ME
- TeseoAPP: ME

- GPS / QZSS: GLONASS
- GPS / QZSS: BEIDOU
- GPS / QZSS: GALILEO
- GPS / QZSS: IRNSS
- GPS / QZSS: SBAS

- GSM/LTE: Main Correction Data Source
- GSM/LTE: Backup Correction Data Source

- STA8200LA (Teseo L)
- STA8100GA (TeseoV ME)
- STA9100MGA (TeseoAPP ME)

- ME: Measurement Engine
- PE: Positioning Engine

- Precision Positioning

- Correction Data
- STM32F407ZET6
- STM32F407ZIT6
- STM32L073CGT6

- 3rd party software

- **I** => when using internal tuner
- **E** => when using external STA5635A

- **Max 72 satellites tracked simultaneously**

- Case 1: Dual Band L1/L5 (without STA5635A) *
- Case 2: Dual Band L1/L5 *
- Case 3: Dual Band L1/L2 *
- Case 4: Triple Band L1/L5/E6*
- Case 5: Triple Band L1/L2/L5 *

- **L1C/A**
- **L2C**
- **L5**
- **L1OF**
- **L2OF**
- **B1I / B1C**
- **B2I**
- **B2a**
- **E1**
- **E5a**
- **E5b**
- **E6**
- **L5**
- **L1**

- **Case 1**
- **Case 2**
- **Case 3**
- **Case 4**
- **Case 5**

- **I** => when using internal tuner
- **E** => when using external STA5635A

- **Max 72 satellites tracked simultaneously**
TeseoAPP Functional Safety

- Redundant Code
- SW Eng. Principles
- Full Testability
- Code Metrics

TeseoAPP Target: ASIL-B
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

**Extended Temperature Range**

**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 μg/√Hz
- Gyroscope noise density 5 mdps/√Hz

ASM330LHH
6-axes IMU
Automotive grade
2.5x3x0.86 mm

Qualification completed
SOP Q1’19
# 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

Cellular
(Automotive low latency 5G)

&

Wi-Fi 11.p
(for Automotive)

Autotalks solution awarded for production:
• 4 of the top 10 automakers deploy Autotalks V2X solution
• > 10 Tier1s selected the chipset
• Volume production by 2020
Hi-Res Thermal Camera : ST & ADASKY

Based on micro-bolometric thermal imaging technology (FIR)

System description
- Thermal imagery based Advanced Driver Assistance System (ADAS) for avoidance of forward collisions with 3rd 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)
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
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
Viewing Camera Systems for ADAS

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

LED lighting is present everywhere in our driving environment.
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
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
  - Flicker Free

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

In-Cabin Optical Sense
- Global Shutter
  - FSI, 3.2um
  - 96dB
  - HDR
  - Low Noise
  - High MTF
  - Multi-ROI / expo

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

  No Product available, indirect business with LiDAR partners

Digital LiDAR
- Foundry Business

Dev
Dev
ST Automotive Imaging Solutions

Platform and System support

Recon. Wafers
ST
Scope of Supply

ISP
Companion Chip
ST
Scope of Supply

Host
Interoperability
ST support

Automotive
VCSEL
ST support

3D mapping
ST support

Application
Specific
Algorithms
ST support

Camera
Modules
ST support

Packaged
Sensors
ST
Scope of Supply
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.
High Speed Network: ST & VALENS

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

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

PMICs

VREGs

SBCs
Infotainment and ADAS Power Supplies

**L5963**
Dual monolithic switching regulator with LDO and HSD (3A x 2 + 250mA)

**ADAS L5965**
Multiple power management for automotive vision and radar systems ISO26262

**L5964**
Dual monolithic switching regulator with LDO and watchdog, reset (3.5A x 2 or 7A + 250mA)

**NEW ADAS PMIC**
Second generation ADAS PMIC

- **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**

Timeline:
- **2016**
- **2018**
- **2019**
- **2020**
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 standby (25uA typ)
- Possibility of synchronization
- Voltage monitoring and power good
- 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
Dual Switching Regulator with LDO and UC Power Mgmt

**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 sync
- 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
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

Certification for Products in accordance with ISO 26262

VFQFPN-48 (7x7 x 1.0mm) Very Fine Quad Flat Package No lead

OPT for programming

Designed with reference to
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 5.5V max**
  - 3.3-2.5-2.3-2.0-1.8-1.35-1.2-1.1 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!**

- **Samples and demo boards available**
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

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
VREGs – New Product Line-up

- **L99VR01S**: CONFIGURABLE FOR 8 FIXED VOUT
  - ENABLE
  - RESET
  - WD
  - Thermal Warning
  - Ishort CTRL
  - SO-8

- **L99VR01J**: CONFIGURABLE FOR 8 FIXED VOUT
  - ENABLE
  - RESET
  - WD
  - Thermal Warning
  - Ishort CTRL
  - POWERSSO-12

- **L99VR02J**: CONFIGURABLE FOR 8 FIXED VOUT
  - ENABLE
  - RESET
  - WD
  - Thermal Warning
  - Ishort CTRL
  - POWERSSO-12

- **L99VR02XP**: LDO1 8 CONF. FIXED VOUT
  - LDO2 8 CONF. FIXED VOUT
  - ENABLE
  - CONF. RESET
  - WD
  - Thermal Warning
  - Ishort CTRL
  - Thermal Clusters
  - POWERSSO-36

- Output Current:
  - 200 mA
  - 200 mA
  - 500 mA
  - 2x250 mA
Automotive Power Management ICs

Power Management Line up

**L99PM60J**
- Motor Control, LIN, Vreg, HSDs
- Wakeup, Opamps, etc

**L9952GXP**
- Motor Control, LIN, Vreg, HSDs
- Wakeup, Opamps, etc

**L99PM62GXP**
- Motor Control, LIN, CAN, Vreg, HSDs
- Wakeup, Opamps, etc

**L99PM72GXP**
- Motor Control, LIN, CAN-PN, Vreg, HSDs, Wakeup, Opamps, etc