Navistar E95 Camera RFQ

Far-range Satellite Camera (FSC)

Surround View Camera (SVC)

Requested Infrared camera currently not in Continental portfolio

Agenda

Navistar E95 Camera RFQ

RFQ Documents received Summary

› Continental is responding E95 Camera RFQ with camera information as follows:

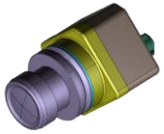
Sourcing Number	Part description	Continental Camera name	Design Requirement Document
F GT C 21 43 001	Infrared camera- long range	No quote yet	EEARCH-55_(Infrared_Camera)_v1pdf
F GT C 21 43 002	Camera sensor- fish eye	SVC220	EEARCH-71_(Fisheye_Camera)_v1.pdf
F GT C 21 43 003	Camera sensor- short range	FSC232/FSC230	EEARCH-56_(Camera_Sensors)_v1.pdf
F GT C 21 43 004	Camera sensor- medium range	FSC231	EEARCH-56_(Camera_Sensors)_v1.pdf
F GT C 21 43 005	Camera sensor- long range	FSC231	EEARCH-56_(Camera_Sensors)_v1.pdf
F GT C 21 43 006	Camera sensor- fisheye interior	No quote yet	EEARCH-71_(Fisheye_Camera)_v1.pdf

› *Functional Requirements*
› *Electrical Requirements*
› *Communication Requirements*
› *Communication Requirements*
› *Reference _Documents*

Navistar E95 Camera RFQ

Off-the-shelf offer: key requirements

Achieved
Over-achieved
Deviation to be discussed
Clear deviation

Technical Parameters	Camera - fish eye exterior F GT C 21 43 002 EEARCH-71		Camera - short range F GT C 21 43 003 EEARCH-56		Camera - medium range F GT C 21 43 004 EEARCH-56		Camera - long range F GT C 21 43 005 EEARCH-56	
	requirement	SVC220	requirement	FSC232	requirement	FSC231	requirement	FSC231
Resolution	≥ 1280x720	1620x1280	≥ 1920x1200	3840 x 2160	≥ 1920x1200	3840 x 2160	≥ 1920x1200	3840 x 2160
Dynamic range [dB]	TBD	≥ 100	≥ 120	≥ 120	≥ 120	≥ 120	≥ 120	≥ 120
LFM	TBD	limited	required	limited	required	limited	required	limited
Framerate [Hz]	10	30	20	30	20	30	20	30
CFA	RGGB	RGGB	RGGB	RGGB	RGGB	RGGB	RGGB	RGGB
HFoV [°]	185	195	≥ 50	70	>25 & <50	30	≤ 25	30
F#	4.0	2.0	1.6±5%	1.6	2.2±5%	1.6	1.7 +/- 5%	1.6
IP class	IP6K9K	IP6K9K	IP6K9K	IP6K9K	IP6K9K	IP6K9K	IP6K9K	IP6K9K
SerDes	GMSL2	GMSL2	GMSL2	GMSL2	GMSL2	GMSL2	GMSL2	GMSL2
ASIL level	TBD	QM	B	B	B	B	B	B
Security	yes	no	yes	with different imager version	yes	with different imager version	yes	with different imager version
Operating voltage	9.0 ≤ V < 18.0	5.0 ≤ V ≤ 10.0	9.0 ≤ V < 18.0	6.0 ≤ V ≤ 12.0	9.0 ≤ V < 18.0	6.0 ≤ V ≤ 12.0	9.0 ≤ V < 18.0	6.0 ≤ V ≤ 12.0

Agenda

Smart Camera

Continental´s History & Future

2005
- **BLIS**
  Camera based
  Blind Spot Detection

  (in cooperation
  with Schefenacker)

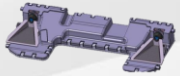
2007
- **LWCS**
  Lane Warning
  Camera System

2008
- **TLC**
  Time to Line Crossing

  Front camera with
  LDW, HLA, TSA
  (ex. Siemens VDO)

2011
- **CSF200**
  LDW, HLA, TSA

2013
- **MFC300**
  Stereo Camera



  LDW, HLA, TSA,
  OD, EBA, Preview

  Truck

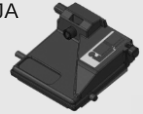
  Mono

2015
- **MFS420**
  Stereo Camera
  LDW, LKA, HLA, TSA, SOD,
  Preview, EBA-Ped,
  Freespace detection

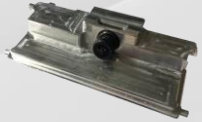
2015
- **MFL420**
  LDW, HLA, EBA, TSA

2017
- **MFC430**
  LDW, HLA, TSA, OD

2019
- **MFC431**
  NCAP2018
  TJA

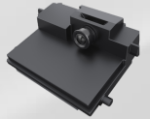


2021
- **MFC525**
  Neural Network,
  Fusion host,
  Video out



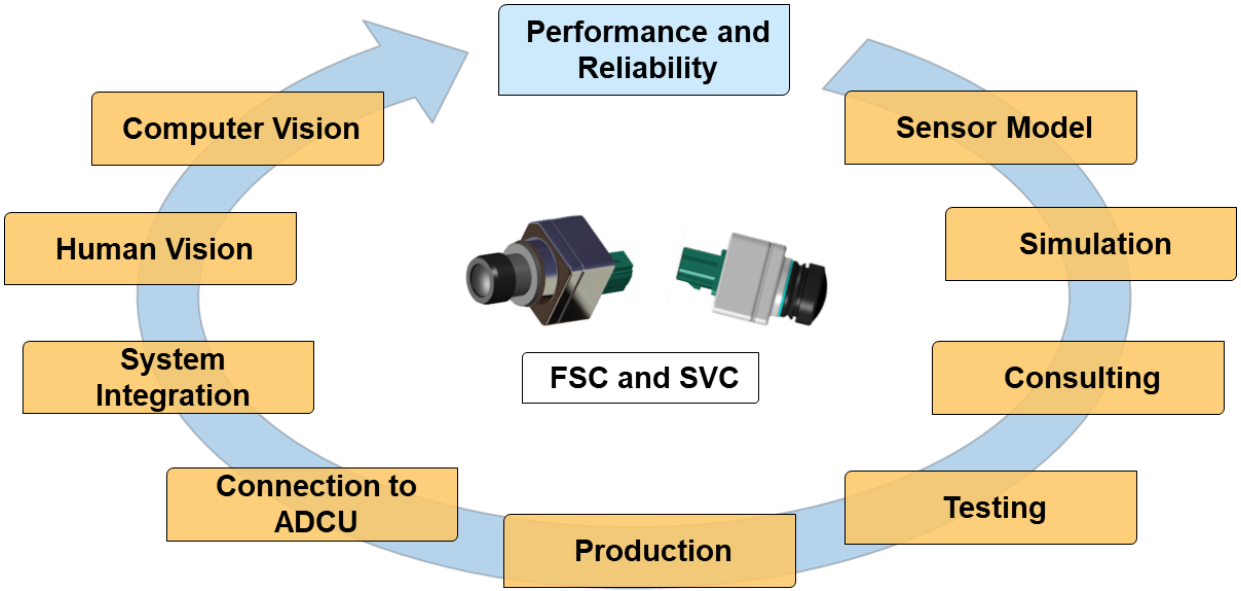
2022
- **MFC526**
  Truck Version

2023
- **MFC521 & MFC527**
  Roll-out



2025

Continental's Satellite Cameras



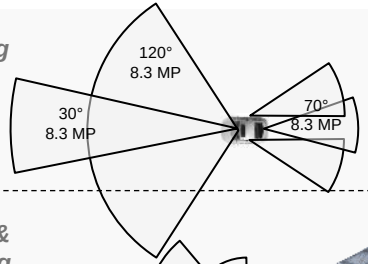
→ *Continental combines full system know-how with excellent sensor products.*

ADAS Satellite Camera Family

SVC / FSC / RVS – Scalable from Entry to Premium

Premium

Automated Driving

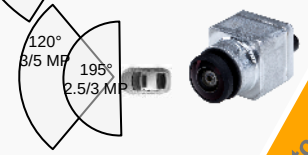


FSC33x *2nd Gen. Camera Belt with 120°, 70°, 30° in 8.3MP*

FSC23x *AD Camera Belt with 120°, 70°, 30° in 8.3MP*

Premium / Stand.

Assisted Driving & Automated Driving



FSC3x0 *Front View with 120° and 3/5MP*

SVC22x *Surround View, AD Camera Belt & AR and 2.5/3MP*

RVS23x *Smart Rear View Camera with 195° and 1.3/2.5MP*

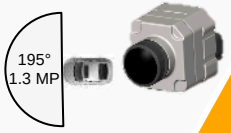
Stand.

Surround View & Assisted Driving

SVC310 *Surround View Camera with 195° and 3MP*

Stand. / Entry

Surround View & Assisted Driving



SVC21x *Surround View Camera with 195° and 1.3MP*

RVS217 *Rear View and overlays with 195° and 1.3MP*

SVC301 *Best Cost Surround View Camera.*

8.3 MPix

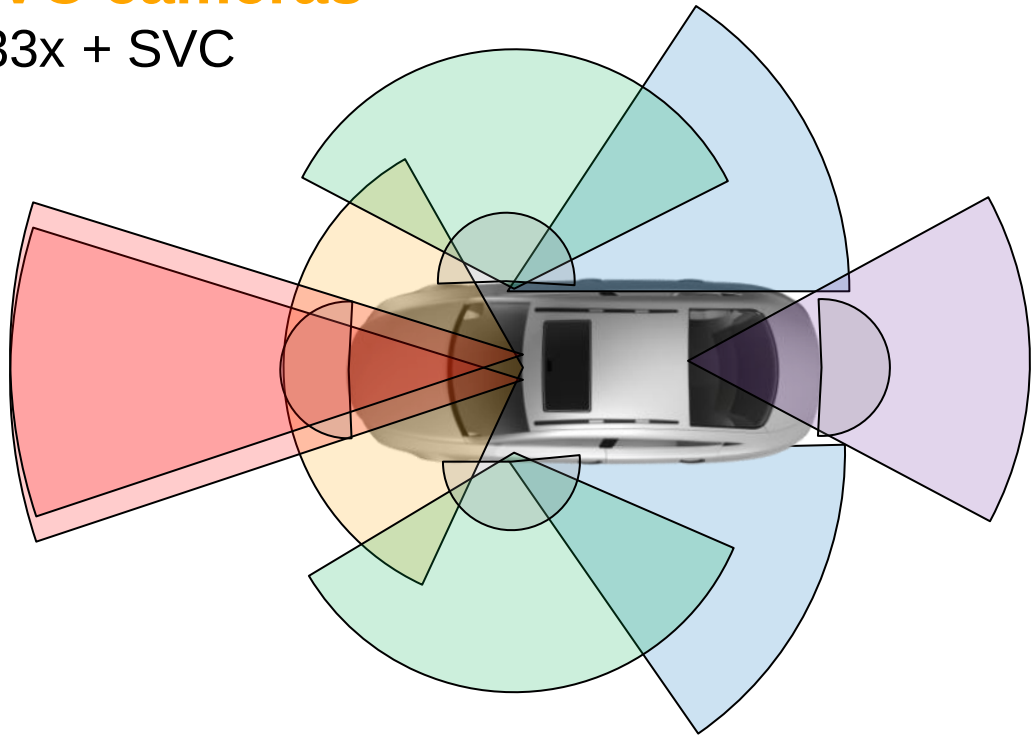
5 MPix

up to 1.3 MPix

Legend:
AD – Automated Driving
AR – Augmented Reality
FSC – Far-looking Satellite Camera
RVS – Rear View System
SVC – Surround View Camera

FSC / SVC cameras

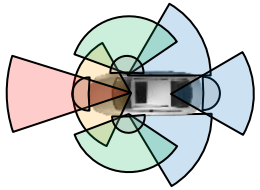
FSC23x/33x + SVC



Continental cameras
FSC230/330/335
FSC231/331
FSC230/330
FSC232/332
FSC232/332
SVC225/310/320

Overview

Next generation SVC and FSC cameras for AD

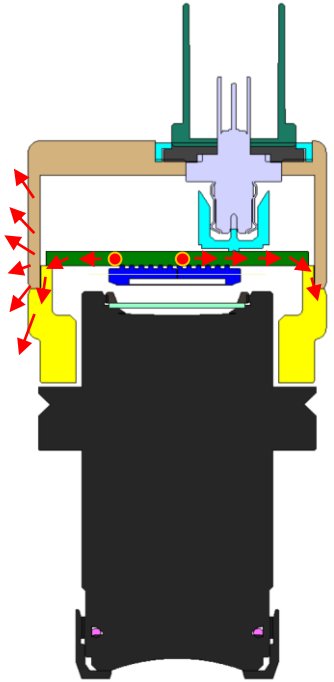


Camera	SVC310	FSC310	SVC320	FSC320	SVC225	FSC333	FSC336	FSC331	FSC332	FSC335
	Volume SVC	Entry FSC	Premium SVC	Volume FSC	Premium SVC	Premium FSC	Premium FSC	Premium FSC	Premium FSC	Premium FSC
Mounting location										
hFoV	195°	120°	195°	120°	200°	36°	120°	30°	70°	120°
resolution	3.0MP	3.0MP	5.0MP	5.0MP	3.0MP	3.0MP	8.3MP	8.3MP	8.3MP	8.3MP
Pixel size	2.1µm	2.1µm	2.1µm	2.1µm	3.0µm	3.0µm	2.1µm	2.1µm	2.1µm	2.1µm
Lens heater	no	no	no	no	optional	optional	optional	optional	optional	no
ASIL	B	B	B	B	B	B	B	B	B	B
Cyber security support	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Target SOP	2024	2024	2025	2025	2024	2024	2024	2024	2024	2024
Predecessor product					**SVC220**		**FSC230**	**FSC231**	**FSC232**	

ADAS Satellite Camera

Evolutionary Camera Design Benefits

- Excellent thermal dissipation to metal housing
- Benchmark EMC/ESD - proven in simulation, component and vehicle measurements by Continental and OEMs
- Proven watertight design (no issues in the field)
- Stable optical performance over temperature
- Latest imager technology
- High quality lens
- Mounting concept for minimal tolerances

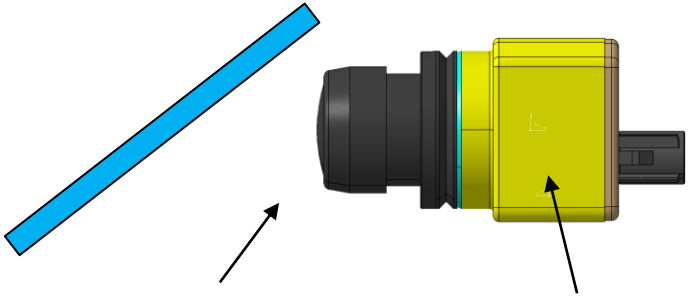


→ Holistic design concept for best possible performance.

Agenda

Camera Sensor Technology

World class automotive imaging team



Windscreen

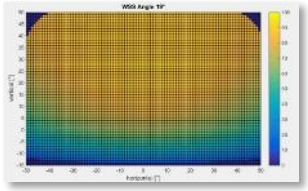
Lens

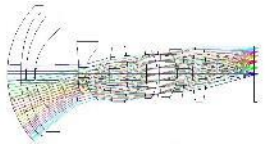
Image sensor

+ image quality testing and tuning

+ module design

+ simulation



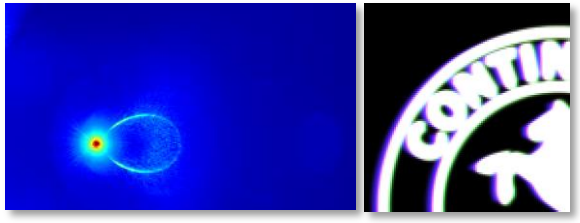


→ *Full component and system know-how leads to excellent products.*

Camera Sensor Technology

Optics for FSC and SVC cameras

- Low F# and constant MTF, RI and low color aberration over the full field of view
- Low glare and ghosting enabling high dynamic range imaging
- High stability against temperature and environmental influences
- Simulation and testing capabilities for all relevant parameters



Mechanics

- Metal barrel for optimized stability
- Full sealing for exterior applications
- Optimized appearance (black color / small retainer)

Features

- Broadband AR coating on all lens elements
- Coating with hydrophobic properties on front lens element for exterior cameras
- Optional: lens heating

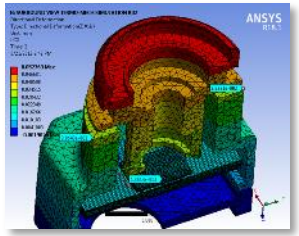
→ *High-performance optics are specifically designed for Continentals cameras.*

Camera Sensor Technology

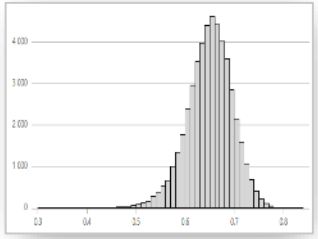
Optical performance over temperature

Lenses and camera housing are designed to complement each other in terms of focus shift providing stable performance over temperature.

- Detailed simulation using ANSYS, ZEMAX and Monte-Carlo tools
- Optimized module design and production concept (test/alignment positions)
- Introduction of new test setups (lens / module) at lens suppliers and Continental

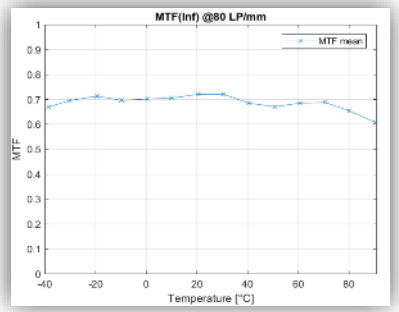


Simulation

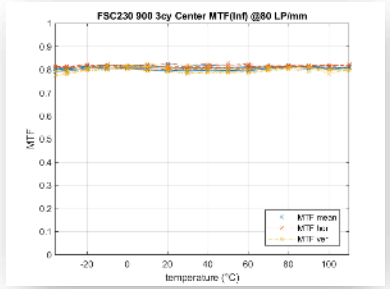


Monte-Carlo analysis

Testing



Sharpness vs. temperature (example of 2MPix SVC design)

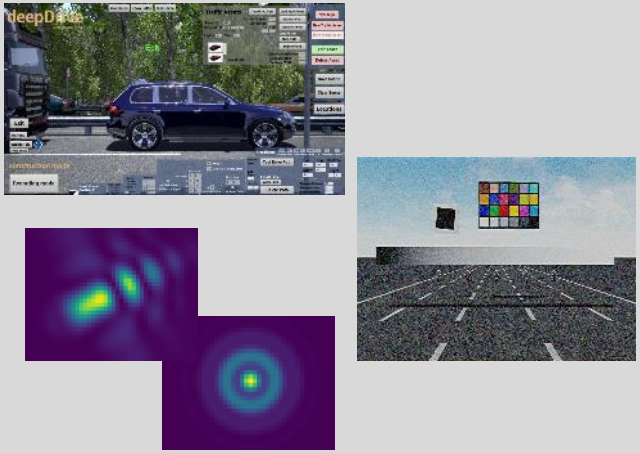


Sharpness vs. temperature (example of 8MPix FSC design)

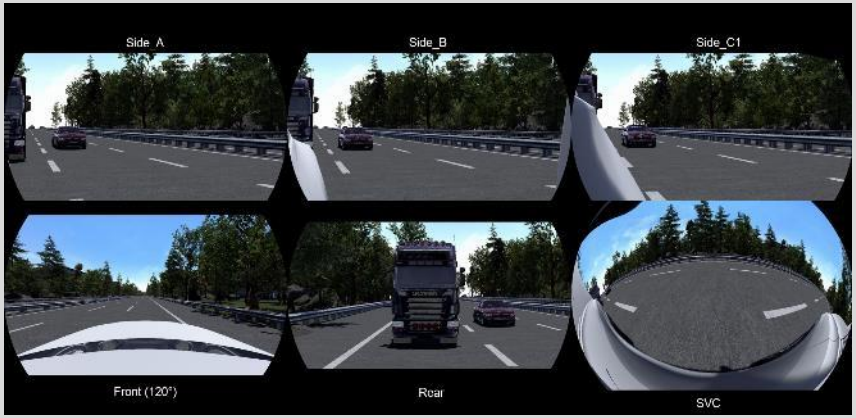
→ *Result: Stable optical parameters over full operating range*

Continental Simulation

Building Blocks…



Physics based simulation



Multi-Camera Field of View and Use Cases Analyses using Continentals Deep-Drive

→ *Extensive simulation capabilities for development and system integration/validation.*

Camera Sensor Technology

FSC cameras – B-sample images from FSC23x 8.3MPix cameras

→ *Continental is developing 8.3MPix satellite cameras in two generations.*

Camera Sensor Technology

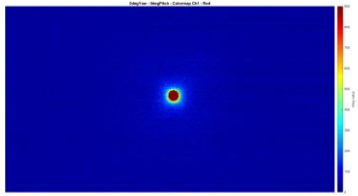
FSC cameras – B-sample images from FSC23x 8.3MPix cameras

70° FoV cropped – ca. 15m distance

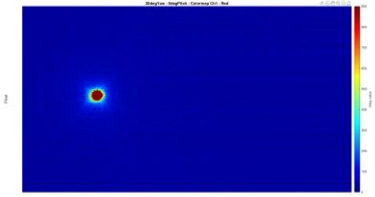
→ *Continental is developing 8.3MPix satellite cameras.*

Camera Sensor Technology

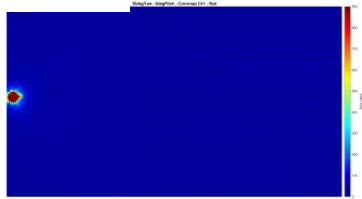
Ghost performance



0°



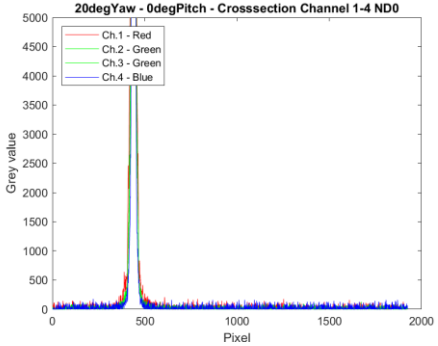
20°



35°

Example:
FSC232 70° 8.3MPix

Special test setup



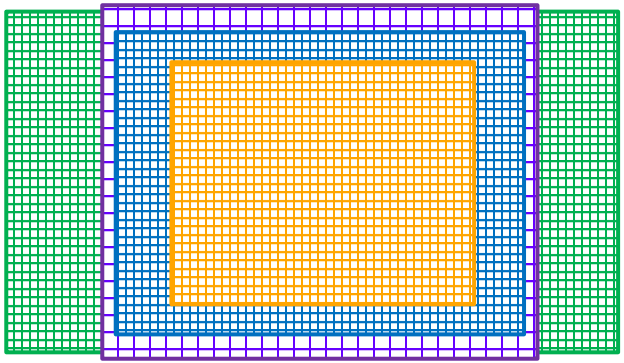
Cross-section

→ *Extensive test capabilities in order to achieve best performance (>120dB ghost rejection ratio).*

Camera Sensor Technology

Next generation image sensors for FSC33x and SVC225/SVC3xx cameras

- ***Main features:***
  - HDR CMOS stacked sensors with BSI pixel technology
  - Sensor design optimized for computer and human vision
  - Excellent low light performance
  - Dynamic range >120 dB
  - **LED flicker mitigation feature on Pixel Level included**
  - ASIL B / **Cyber Security** support features included
  - Flexible output formats (RAW, PWL compressed, YUV optionally)



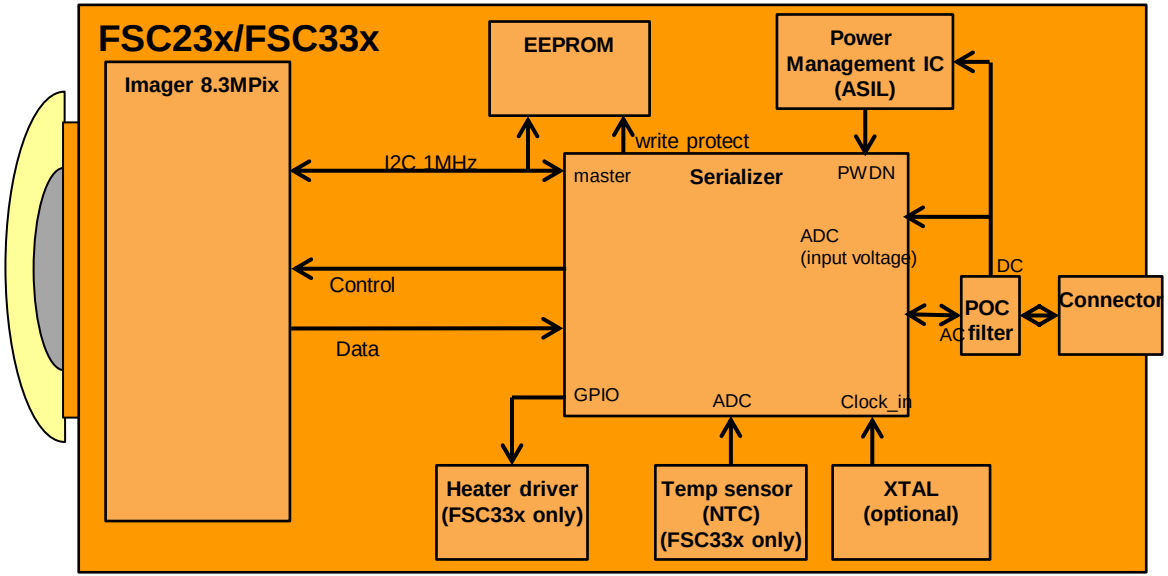
3 Mpix (1920 x 1536)	3.0µm
8 Mpix (3840 x 2160)	2.1µm
5 Mpix (2560 x 1920)	2.1µm
3 Mpix (1920 x 1536)	2.1µm

→ *Continentals next generation cameras will include the latest generation of high-performance image sensors*

Agenda

HW Block Diagram

FSC23x/FSC33x



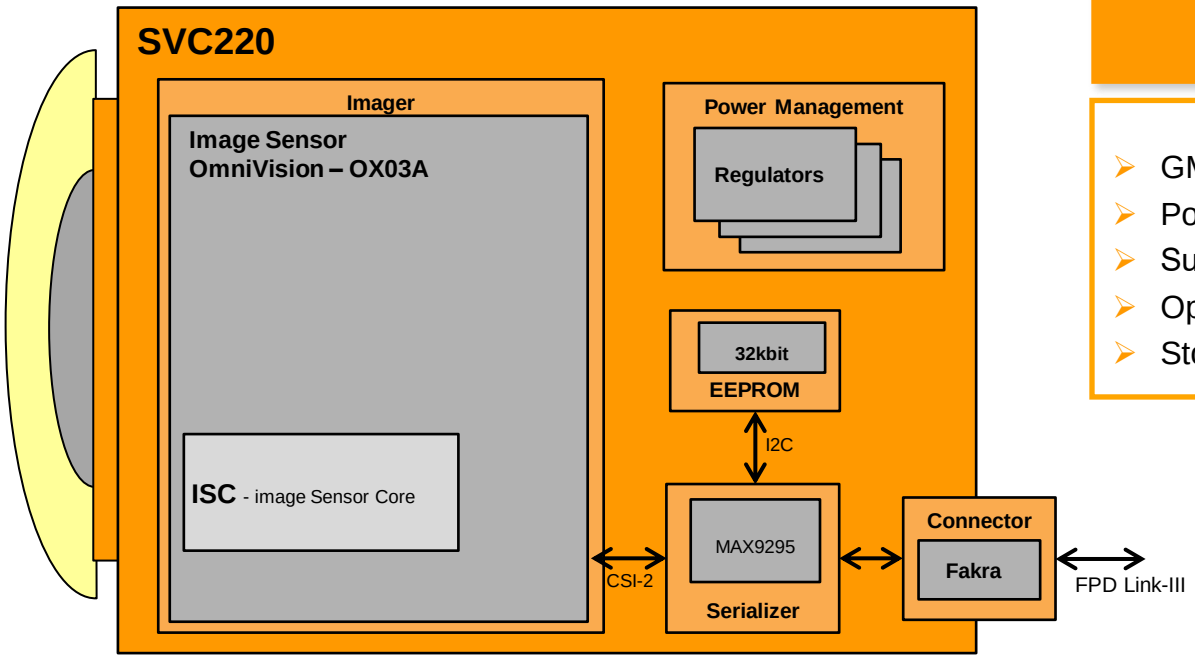
Key Figures

- GMSL2 SERDES IF
- Internal voltage monitoring for ASIL-B
- Power-over-Coax power supply
- Operating temp range: -40 … +85°C
- Storage temp range: -40 … +105°C

→ *Designed for high environmental temperatures with temperature sensing on PCB*

Electronic Design

Block Diagram



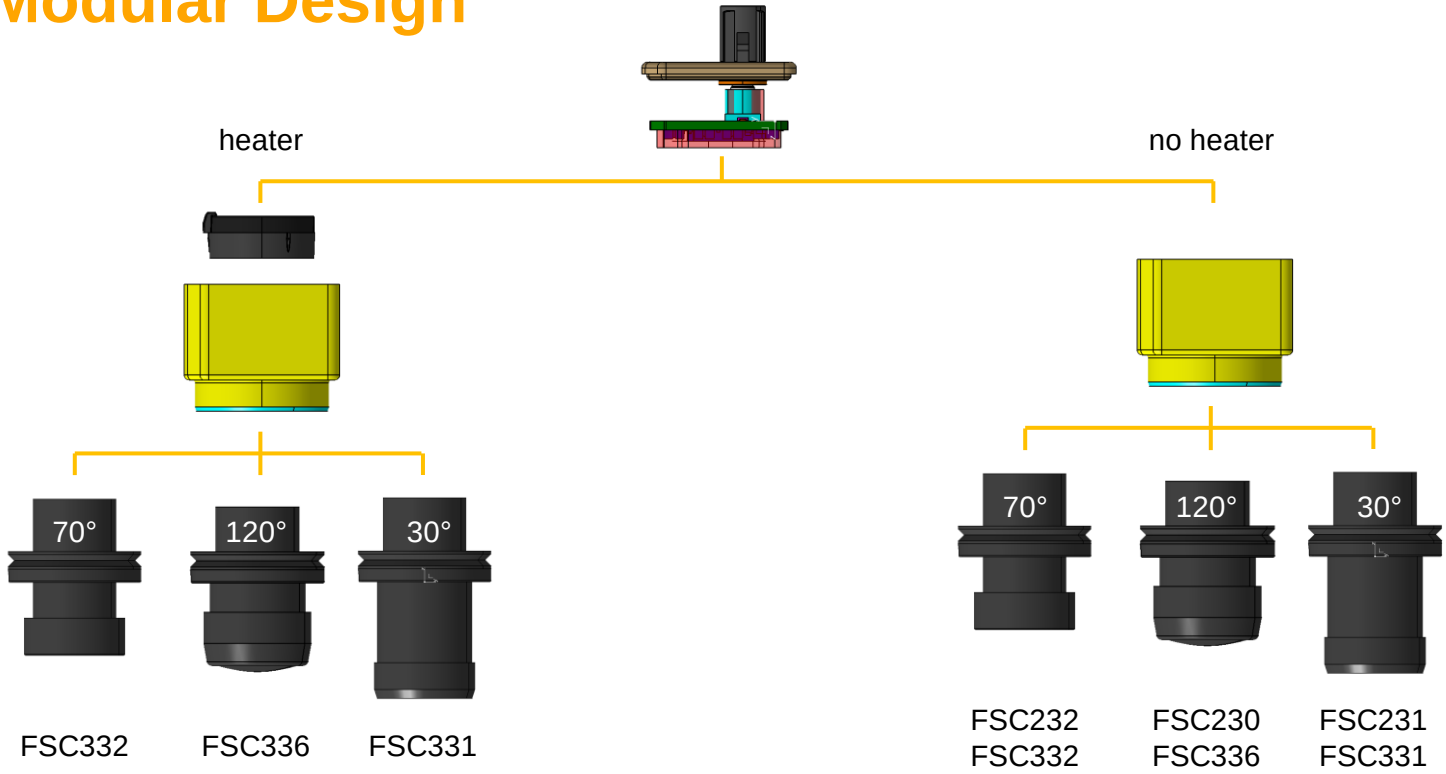
Key Figures

- GMSL2 SERDES IF
- Power-over-Coax power supply
- Supply voltage range: +5 … 10V
- Operating temp range: -40 … +85°C*
- Storage temp range: -40 … +105°C

*qualified until 80°C but design is capable up to 85°C

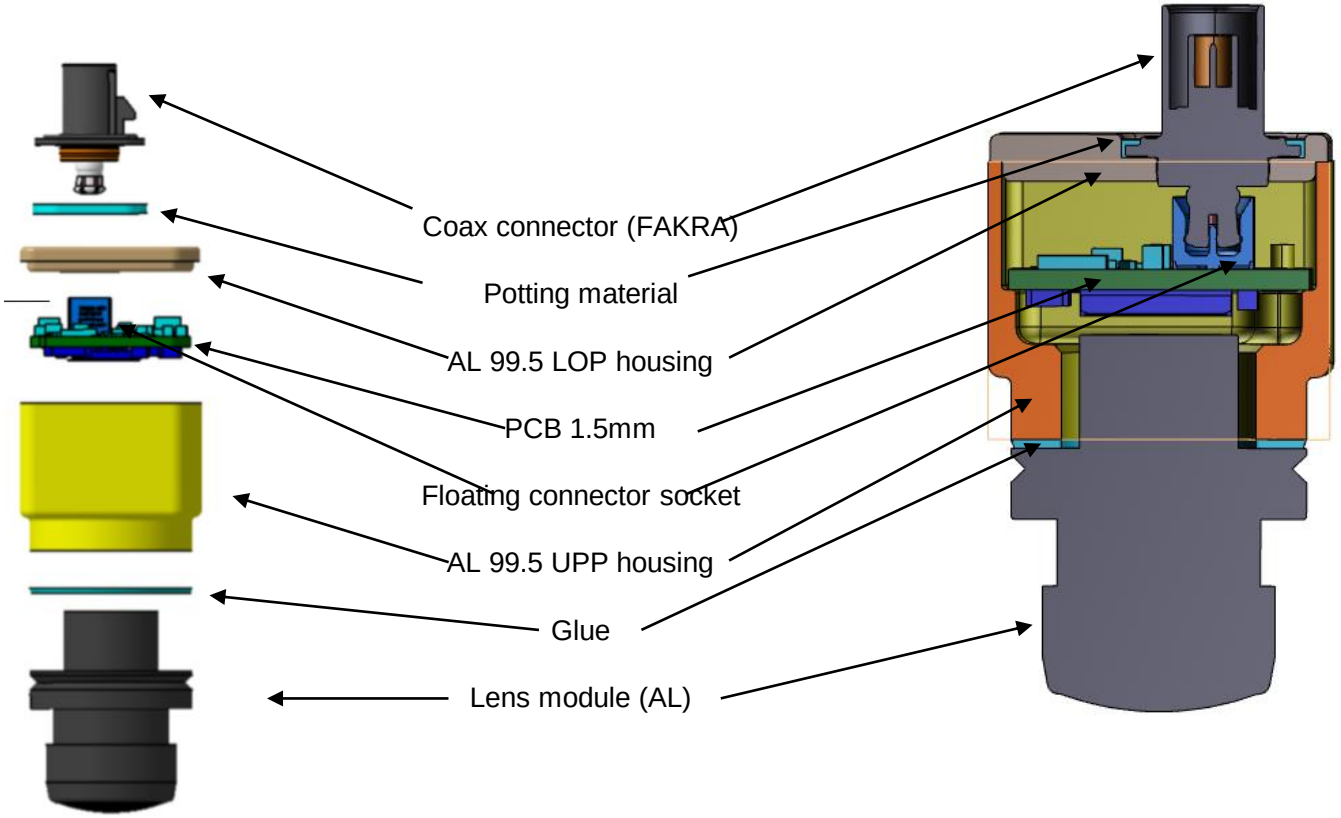
Agenda

FSC Modular Design



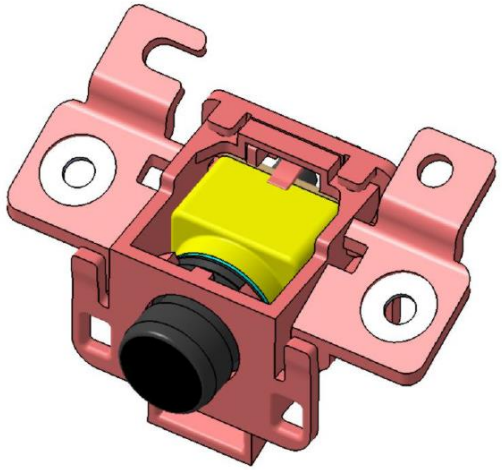
FSC23x

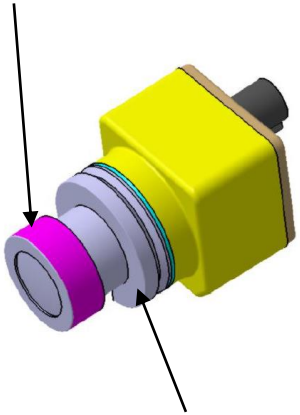
Exploded view



FSC Mounting concept proposal

Example

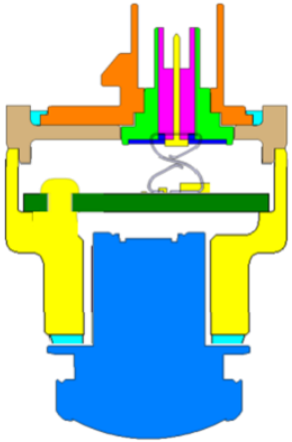




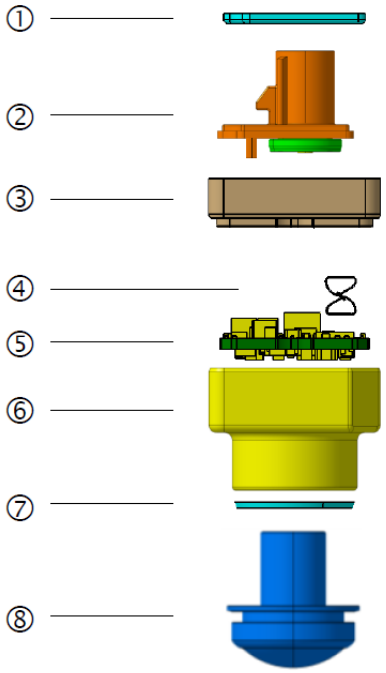
Mounting feature on lens barrel for minimum tolerances

SVC220

Exploded view



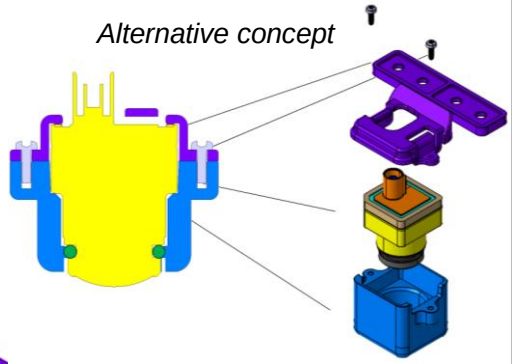
Pos.	Part name
1	Potting glue
2	Coax connector (incl.FAKRA interface)
3	Housing LOP
4	C-Clip
5	Imager PCB
6	Housing UPP
7	Lens Glue
8	Lens



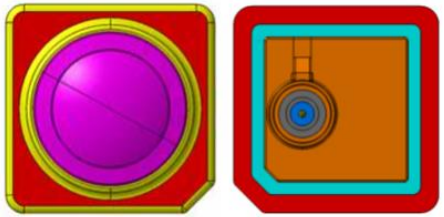
SVC Mounting concept proposal

Example

Alternative concept

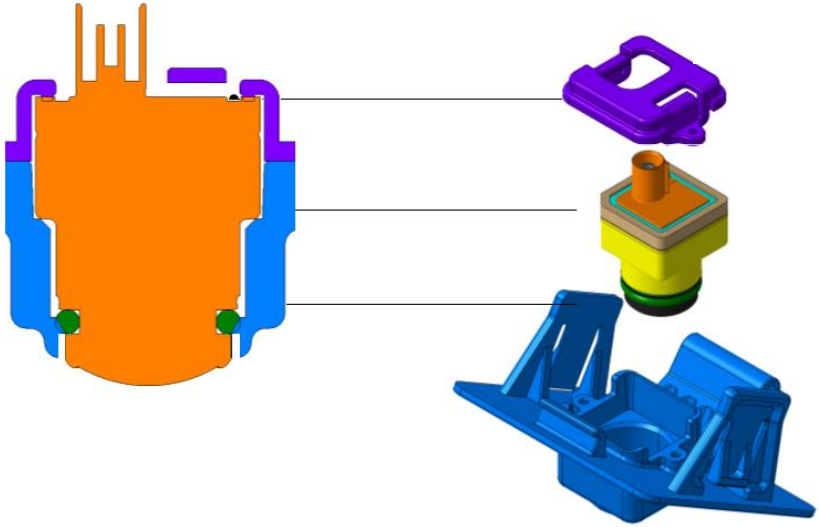


The camera fixation shall be as follows: Camera clamped to te marked areas in red in the drawing below:



Imager reference surface at front housing

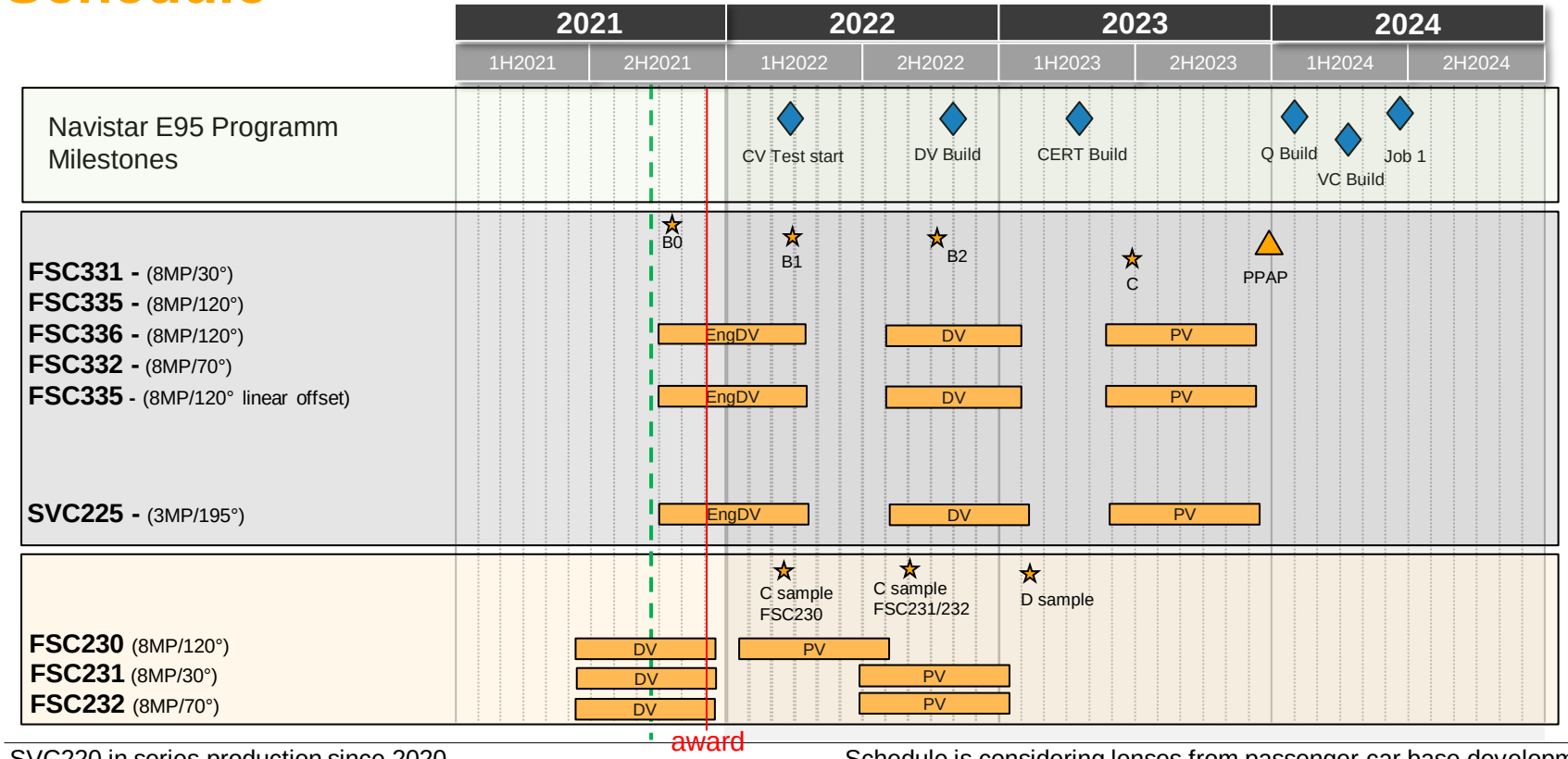
Clamping reference surface at back housing



Agenda

Schedule

Preliminary



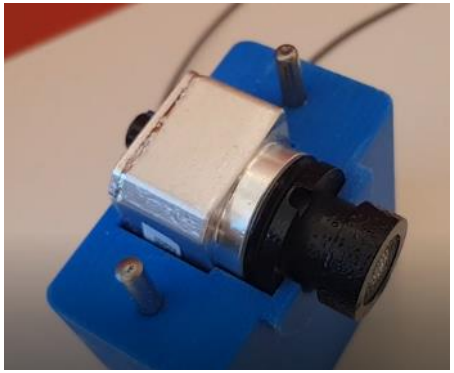
SVC220 in series production since 2020

Schedule is considering lenses from passenger car base development

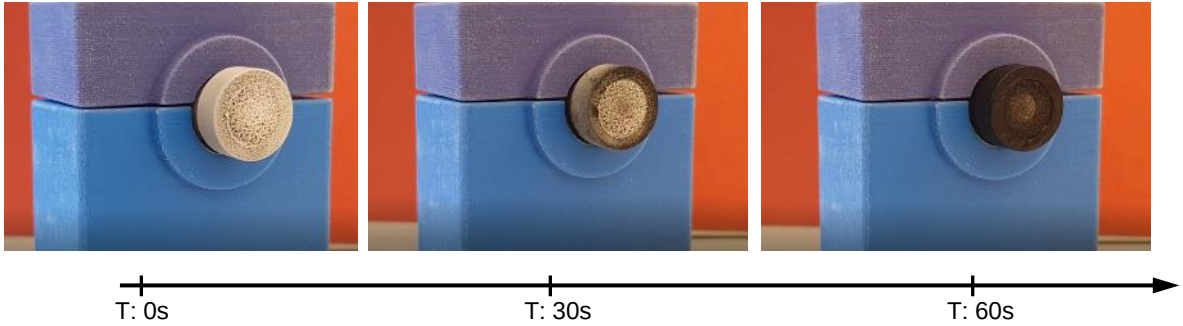
Agenda

Integrated heating solution

Test run with Prototype V2



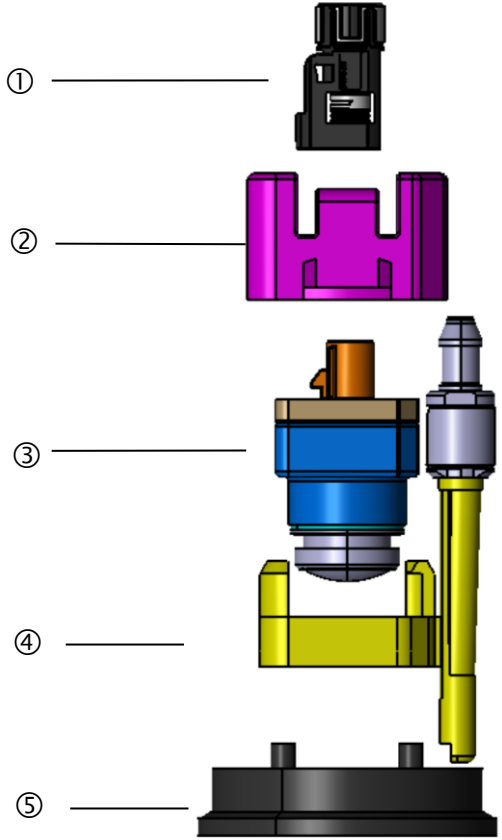
- Latest Prototype and Heater Module
  - Mechanically fully integrated
  - Camera temp @-15°C
  - Heater Power: 1,6W
  - Camera: OFF
    (only heater module running)
  - Test condition:
    preconditioned for 2h



Washing concept

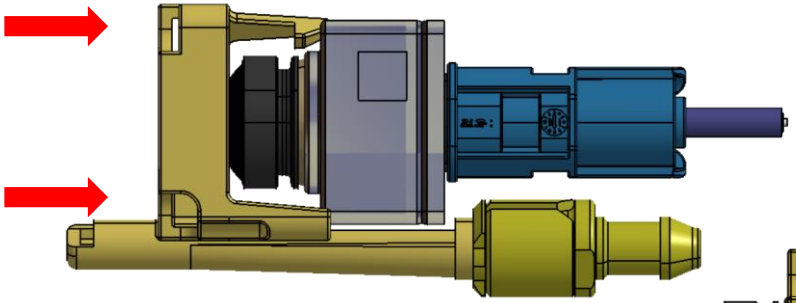
Mechanics washer tube

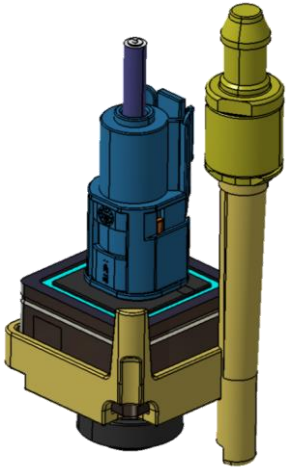
Pos.	Part name
1	Cable connector
2	Locking clamp
3	Camera module
4	Washer tube
5	Decorative Emblem

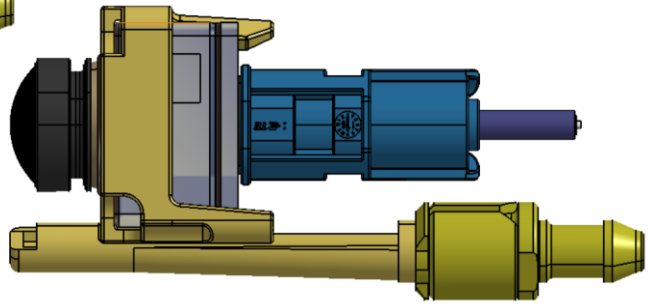


Washing concept

Mechanics washer tube







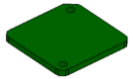
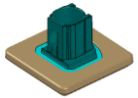
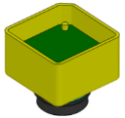
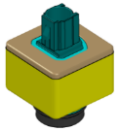
Tube size and position needs to be adapted and optimized during development phase to support a better assembly and connecting process.

Agenda

FSC23x / FSC33x / SVC220
Production concept

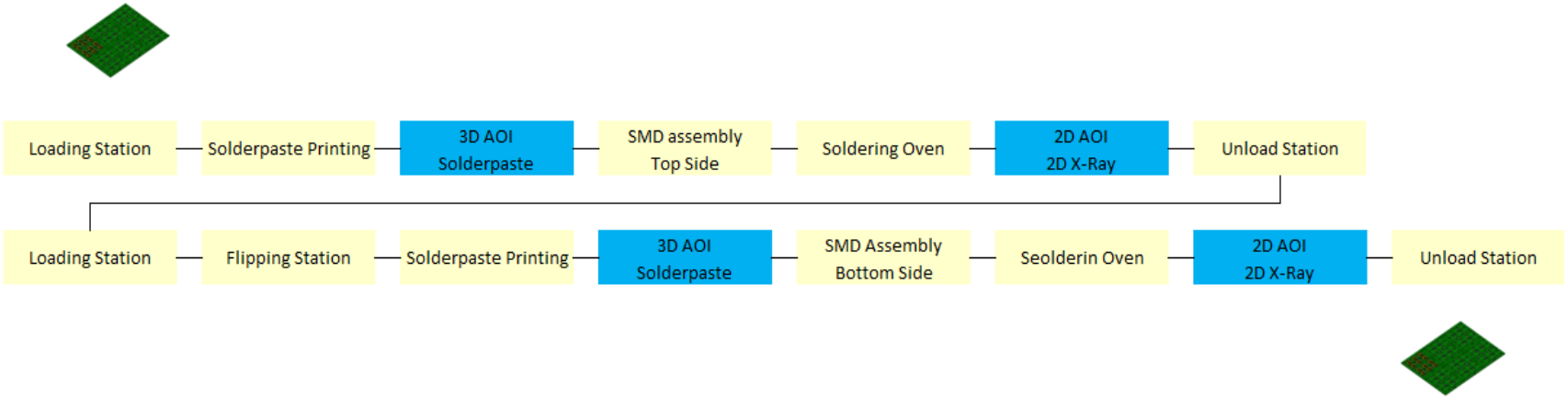
Production is generally divided into four lines:

- PCB handling
- LOP preassembly
- UPP preassembly
- Final Assembly

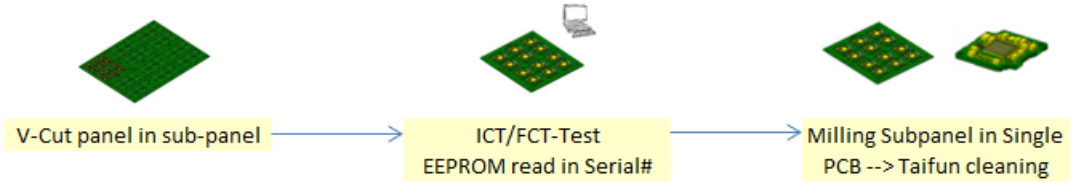





FSC23x / FSC33x / SVC220

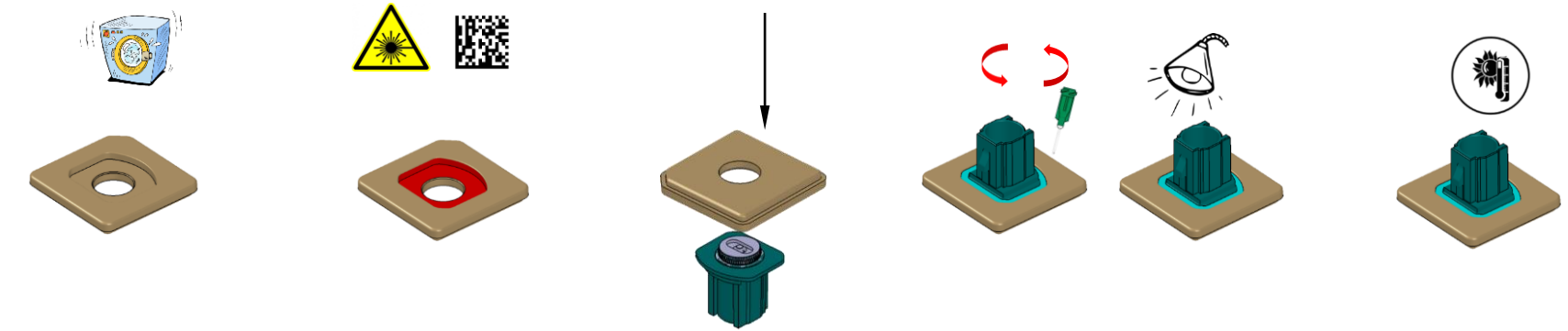
PCB Front-End Page – PCB Assembly



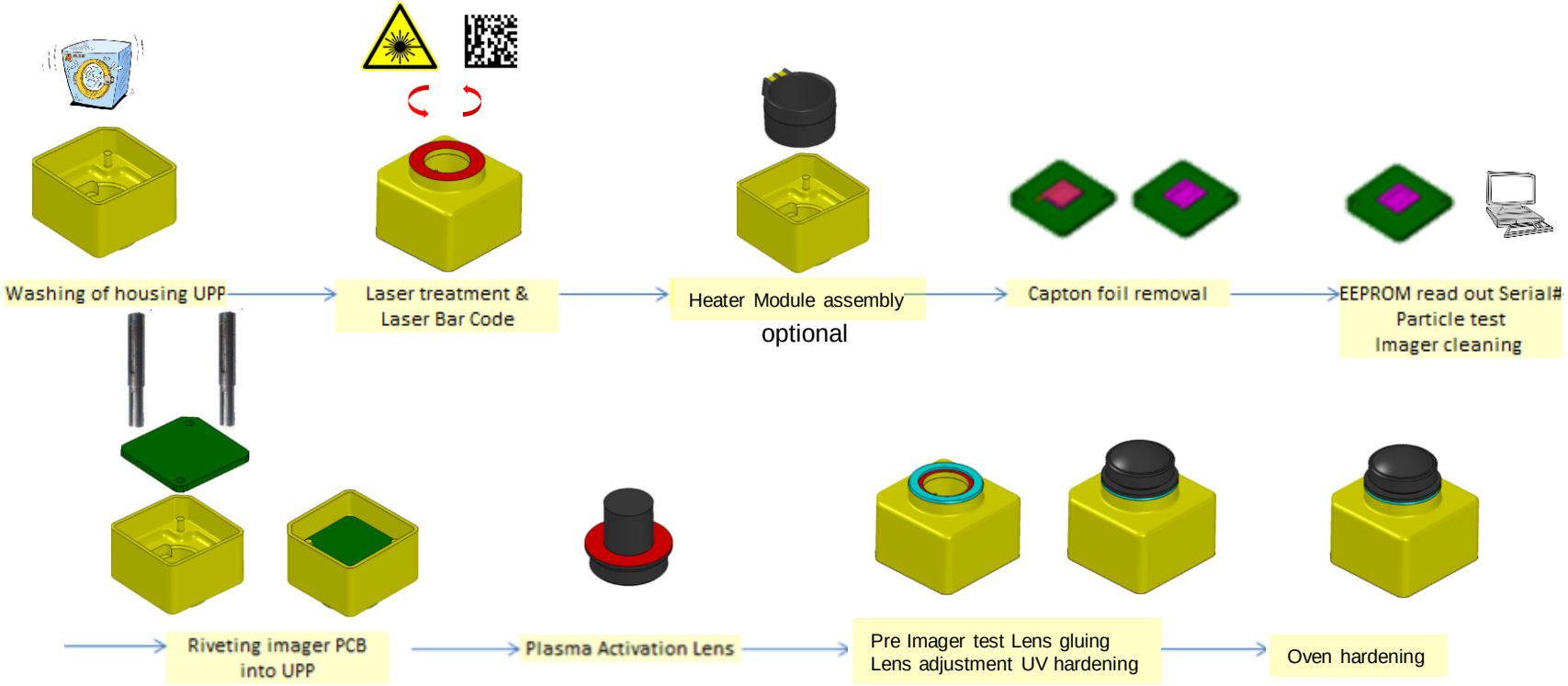
Process Flow – PCB handling



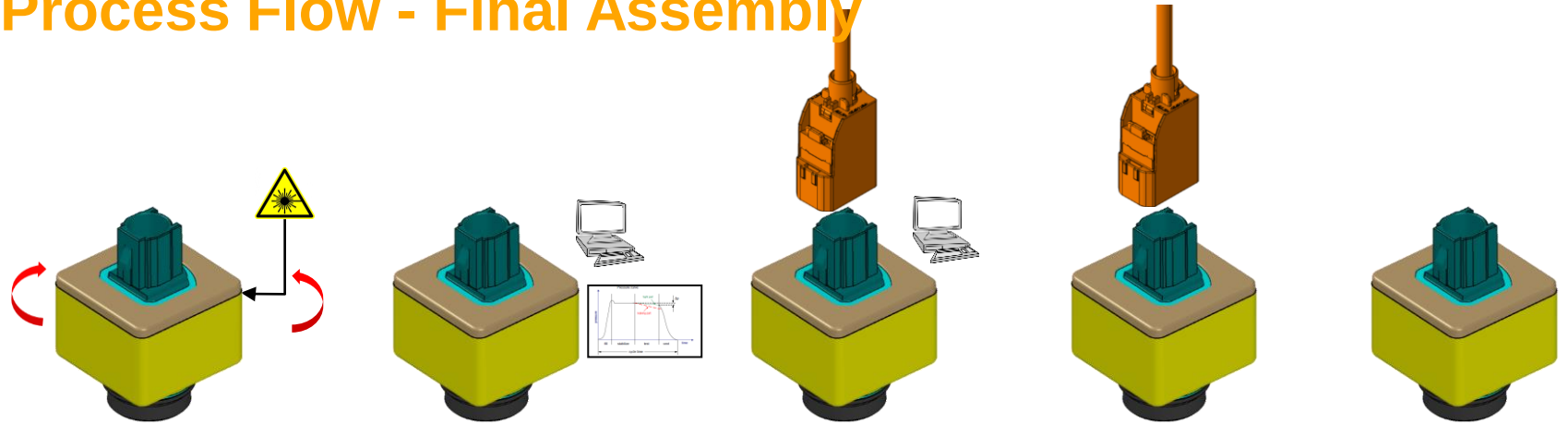
Process Flow – LOP preassembly



Process Flow – UPP preassembly



Process Flow - Final Assembly



Agenda

SVC220 Product Data Sheet

Application

Features:

- Surround View Satellite camera for human and machine vision application

Functional Safety:

- QM

Hardware

Imager	2.5 MPix RGGB CFA
Coax	GMSL2 @ 3Gbps
Lens	195°hFoV, 147°vFoV lens module Anti-Reflective+Hydrophobic coating
Housing	Aluminium forged (laser welded)
Connector	FAKRA

Mech. & Electr. Interfaces.

Interface

- 2-wire coax connection – Power + data + communication
- SERDES GMSL2 @ 3Gbps
- Data format: Raw 16bit(DCG) +12bit(VS)
- Communication via SERDES backchannel

Mounting:

- Mounted externally (side/front/rear)
- Lens exposed to surrounding environment

Characteristics:

- Resolution: 1620x1280 (of 1920x1280)
- Dynamic range ≥ 100 dB
- Target power dissipation < 1.25 W
- Operating Voltage: Pre-regulated 5-10 V
- Target operating temp range -40 … +85°C
- Storing temp range -40 … +105°C
- Dimensions ≤ 23 x 23 x 40 mm (Including lens and Coax connector)
- IP classification
  - IPX9K - lens part
  - IP6K7 - housing + connector part
- Mass < 35 g

Design

Mounting Position

Navistar E95 Camera RFQ

FSC232 (short and medium range) design drivers and features

Application

Features:

- Satellite camera platform for Passenger Cars

Functional Safety:

- ASIL B

Hardware

Imager	ONSEMI AR0820
Coax	GMSL2 @ 6Gbps
Lens	70°FoV F#1.6 FoV = 70° (H) x 39° (V)
Housing	Aluminum forged (laser welded)
Connector	FAKRA

Mech. & Electr. Interfaces

Interface

- 2-wire coax connection – Power + data + communication
- GMSL 2 @ 6Gbps
- Data format: 12bit RAW
- Video Datarate @ 30fps: ~ 5000 Mbps
- Communication via SERDES backchannel

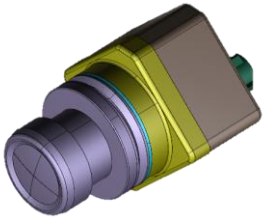
Mounting:

- External mounting. E.g. in mirrors
- Lens exposed to surrounding environment

Characteristics:

- Resolution: 3840 x 2160 px
- Power dissipation target ≤ 2W
- Supply voltage range: +6 ... 12 V pre regulated (nom)
- Operating temp range -40 … +85°C (tbc)
- Storing temp range -40 … +105°C (tbc)
- Dimensions ≤ 25 x 25 x 50 mm (including connector)
- IP classification – IP6K9K (lens part), IP6K7 (housing & connector part)
- Mass < 60 g

Design



Navistar E95 Camera RFQ

FSC231 (long range) design drivers and features

Application

Features:

- Satellite camera platform for Passenger Cars

Functional Safety:

- ASIL B

Hardware

Imager	ONSEMI AR0820
Coax	GMSL2 @ 6Gbps
Lens	30°FoV F#1.6 FoV = 30° (H) x 16° (V)
Housing	Aluminum forged (laser welded)
Connector	FAKRA

Mech. & Electr. Interfaces

Interface

- 2-wire coax connection – Power + data + communication
- GMSL 2 @ 6Gbps
- Data format: 12bit RAW
- Video Datarate @ 30fps: ~ 5000 Mbps
- Communication via SERDES backchannel

Mounting:

- External mounting. E.g. in mirrors
- Lens exposed to surrounding environment

Characteristics:

- Resolution: 3840 x 2160 px
- Power dissipation target ≤ 2W
- Supply voltage range: +6 ... 12 V pre regulated (nom)
- Operating temp range -40 … +85°C (tbc)
- Storing temp range -40 … +105°C (tbc)
- Dimensions ≤ 25 x 25 x 50 mm (including connector)
- IP classification – IP6K9K (lens part), IP6K7 (housing & connector part)
- Mass < 80 g

Design

Navistar E95 Camera RFQ

FSC230 design drivers and features

Application

Features:

- Satellite camera platform for Passenger Cars

Functional Safety:

- ASIL B

Hardware

Imager	ONSEMI AR0820
Coax	GMSL2 @ 6Gbps
Lens	120°FoV F#1.6 FoV = 120° (H) x 65° (V)
Housing	Aluminum forged (laser welded)
Connector	FAKRA

Mech. & Electr. Interfaces

Interface

- 2-wire coax connection – Power + data + communication
- GMSL 2 @ 6Gbps
- Data format: 12bit RAW
- Video Datarate @ 30fps: ~ 5000 Mbps
- Communication via SERDES backchannel

Mounting:

- External mounting. E.g. in mirrors
- Lens exposed to surrounding environment

Characteristics:

- Resolution: 3840 x 2160 px
- Power dissipation target ≤ 2W
- Supply voltage range: +6 ... 12 V pre regulated (nom)
- Operating temp range -40 … +85°C (tbc)
- Storing temp range -40 … +105°C (tbc)
- Dimensions ≤ 25 x 25 x 50 mm (including connector)
- IP classification – IP6K9K (lens part), IP6K7 (housing & connector part)
- Mass < 60 g

Design