

Murata solution for ADAS and V2X application

Murata Mfg. Co., Ltd.



Products for Powertrain & ADAS

Powertrain



Lead Type Ceramic Capacitors for Fuel Injection

RPF Series

Metal Terminal Capacitors

KCM/KC3 Series

Radial Lead Type Ceramic Capacitors

150°C compatible Type: RH Series

125°C Compatible Type: RCE Series

Lead Type Ceramic Capacitors (Safety Standard Satisfied Cap)

DE6 Series

Large CurrentvCommon Mode

PLT10H Series

Monolithic Ceramic Capacitors

GC3 Series (High ripple resistance)

GCD Series (2-element array)

GCE Series (2-element array and resin electrode)

GCG Series (Conductivity adhesive)

GCJ Series (Resin electrode)

GGD Series (Water repellent and 2-element array)

GGM Series (Water repellent)

Chip Ferrite Beads

BLM_SH Series

Power Inductors

LQM/LQH Series

EMI Suppression Filters EMIFIL®

NFM/NFA/NFL/NFE Series

Thermistors

PRF/PRG Series

Ceramic Resonators(CERAROCK®)

CSTNE/CSTNR Series

Crystal Units

XRCHA-F-A Series

XRCGB-F-A Series

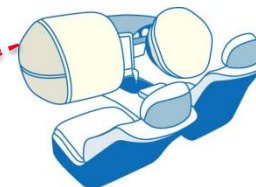
Low Temperature Co-fires

Ceramics(LTCC)

Ceramic Multilayer Substrated

LFC®

Safety



Accelerometers

SCA Series

Inclinometers

SCA Series

Shock Sensors

RKGS Series

Combined Gyro Sensors

SCC/SCR Series

Ultrasonic Sensors

MA Series

Piezoelectric Sounders

PKLCS Series

Products for Infotainment & Comfort

Infotainment



SAW Filters/Resonators

SF/RF/RO series



Polymer Aluminu Electroytic Capacitors

ECAS Series

Connectivity Module

Wi-Fi® Bluetooth®



Ceramic ESD Protection Devices

LXES Series



DC-DC converters

MY Series



Chip Multilayer LC Filters **

LFB18/LFB21_V Series

LFL18/LFL21_V Series

Chip Multilayer Baluns **

LDB21_V/LDM18_V Series

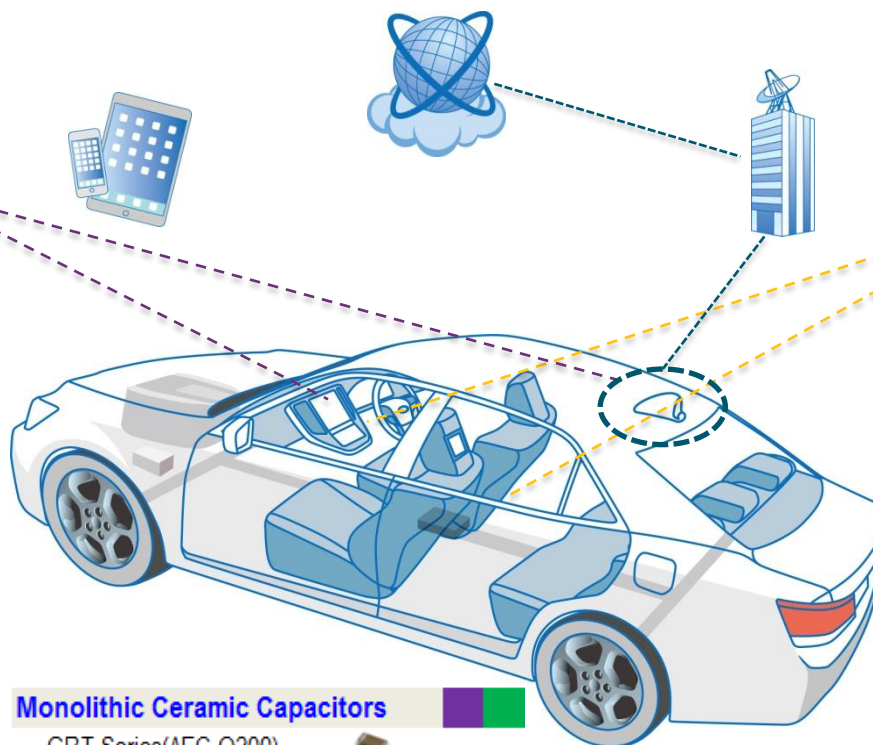
Chip Multilayer Hybrid Dividers **

LDD18_V/LDD21_V Series

Chip Multilayer Couplers **

LDC18_V/LDC21_V Series

****Consumer Grade & Available
for consumer grade use only**



Monolithic Ceramic Capacitors

GRT Series(AEC-Q200)



Chip Ferrite Beads

BLM_SZ Series



Power Inductors

LQM/LQH Series

RF Inductors

LQW/LQG/LQP Series



EMI Suppression Filters EMIFIL®

NFM/NFA/NFL/NFE Series



Chip Common Mode Choke Coils

DLW Series



Comfort / LAN



Ceramic Filters CERAFIL®

SFECF Series



Rotary Position Sensors

SV Series



Thermistors

PRF/PRG Series



Ceramic Resonators(CERAROCK®)

CSTNE/CSTNR Series



Crystal Units

XRCHA-F-A Series



XRCGB-F-A Series

Piezoelectric Sounders

PKLCS/PKMCSSeries



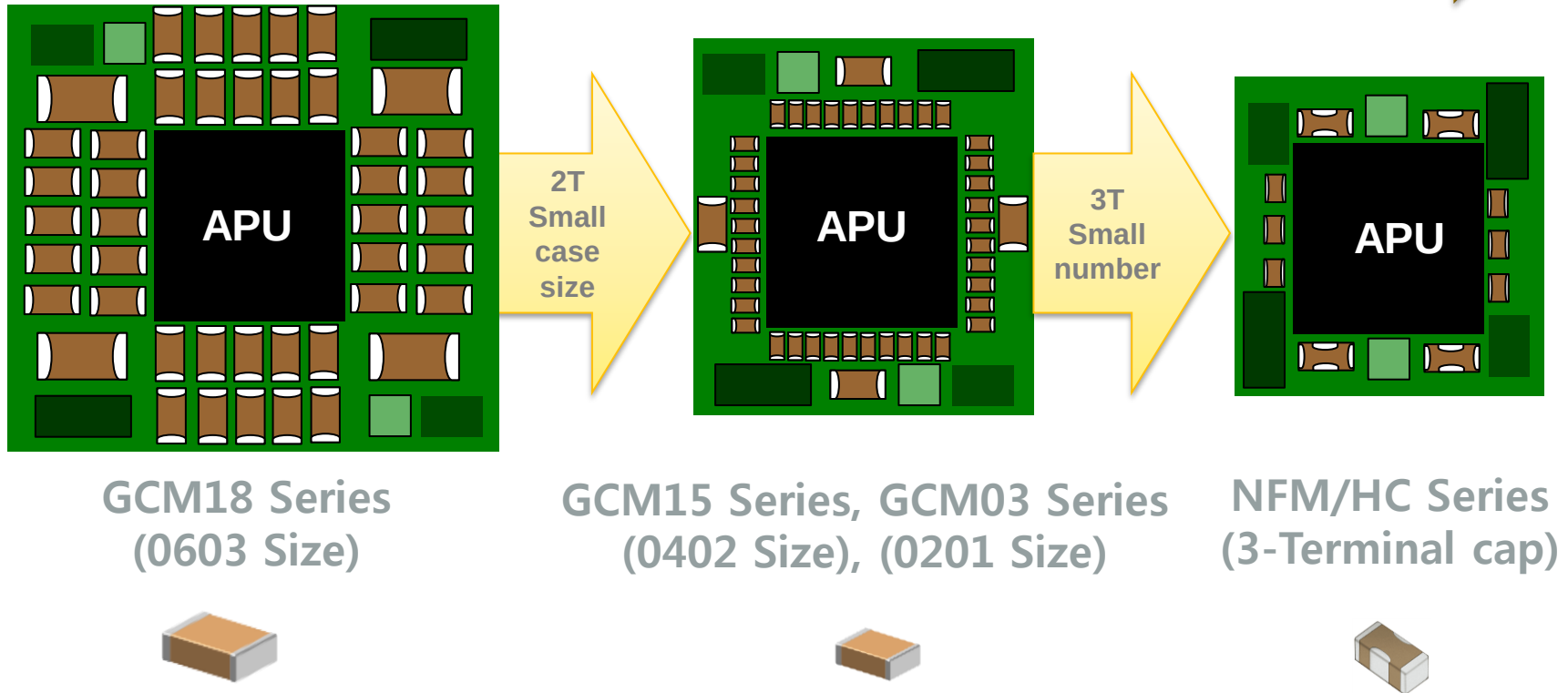
Cap Value Trend for Automotive Grade MLCC

Higher Capacitance can be achieved Murata cutting-edge technology!!



Design trend of decoupling capacitors for ADAS application

MPU Freq. has been Higher >> Power Line Capacitance continuously increasing



- We recommend AEC-Q200 (Grade 1) Capacitor for ADAS application.
 - 2-Terminal cap : GCM series
 - 3-Terminal cap : NFM/HC series

Key Applications



Camera



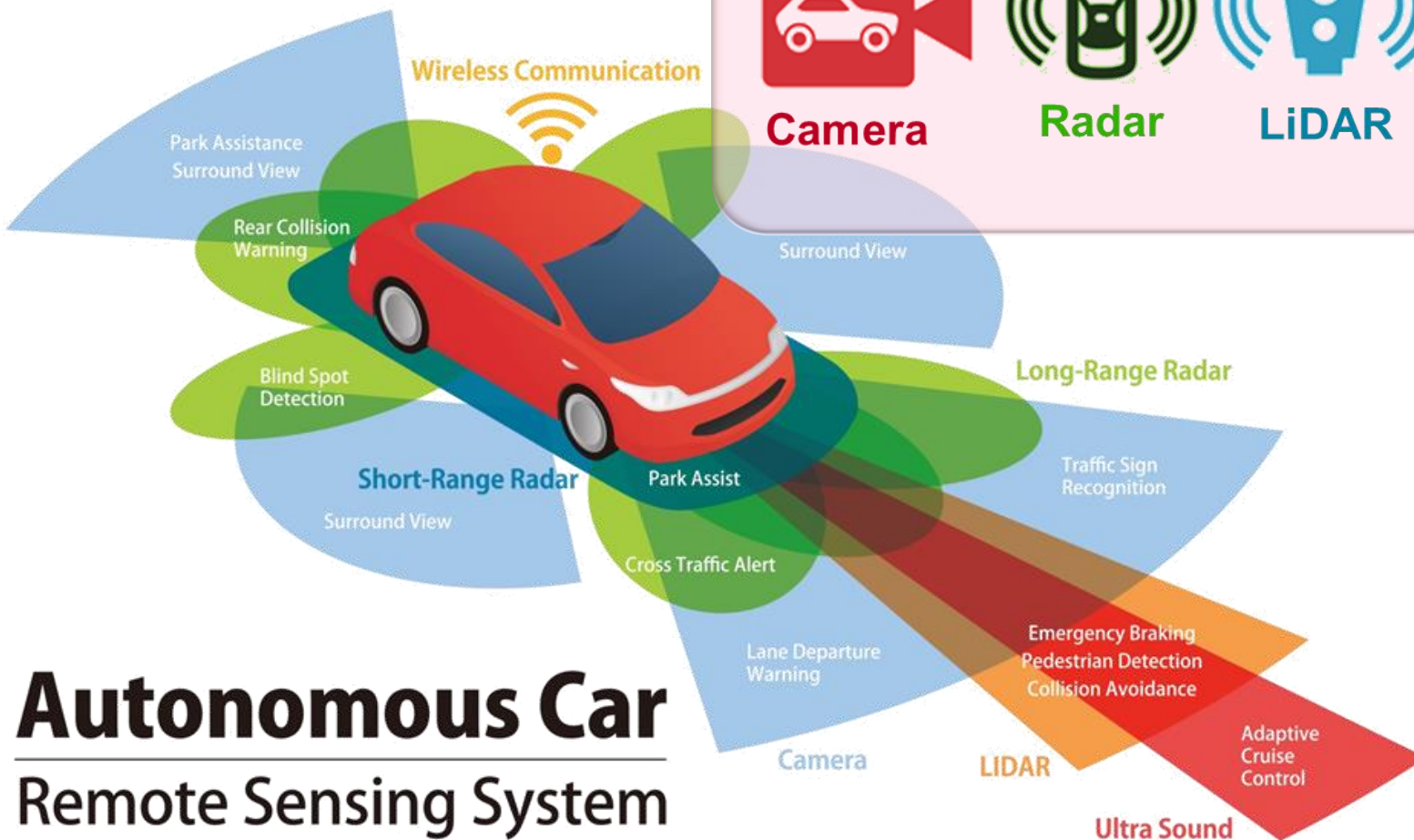
Radar



LiDAR

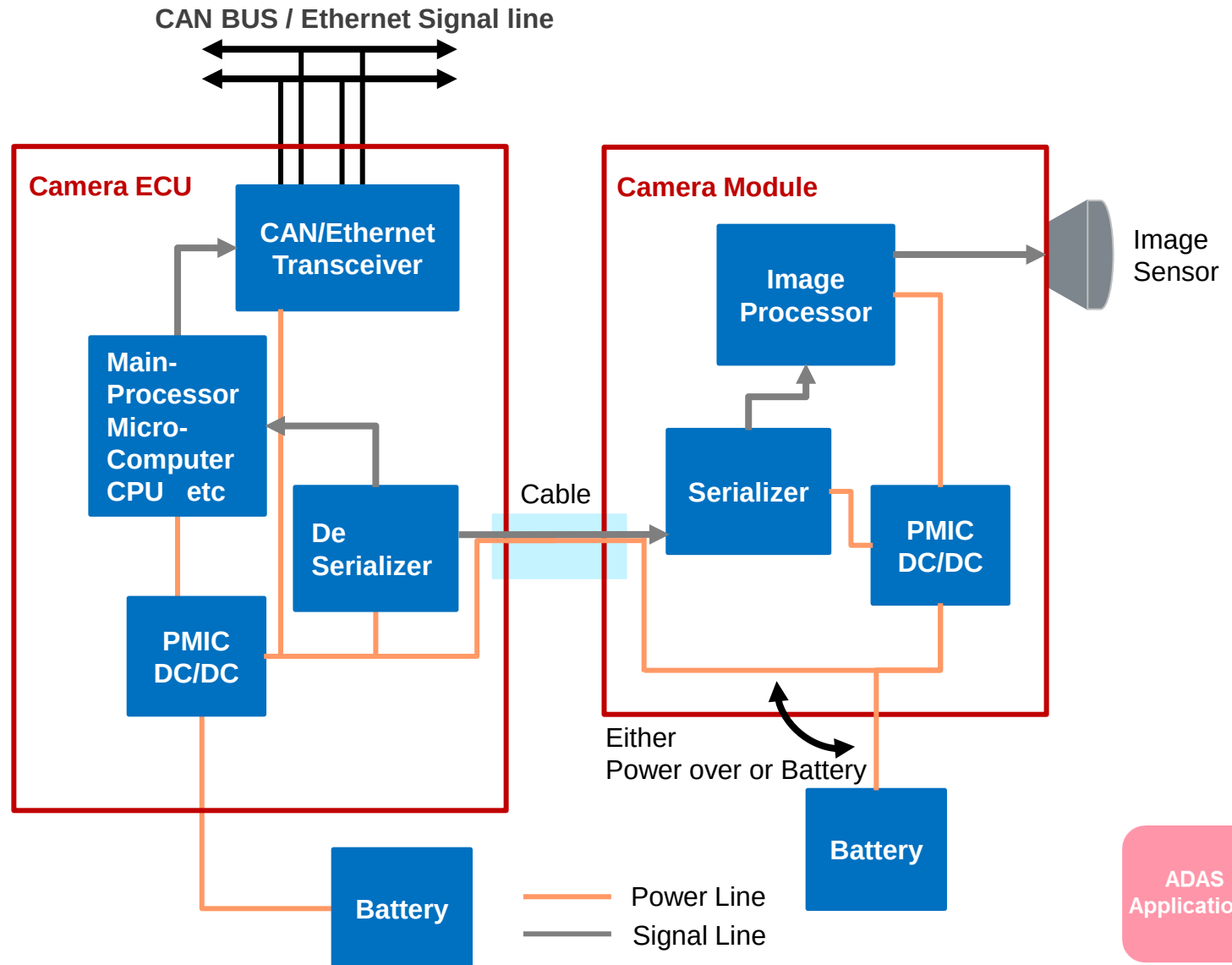


ADAS ECU



Autonomous Car Remote Sensing System

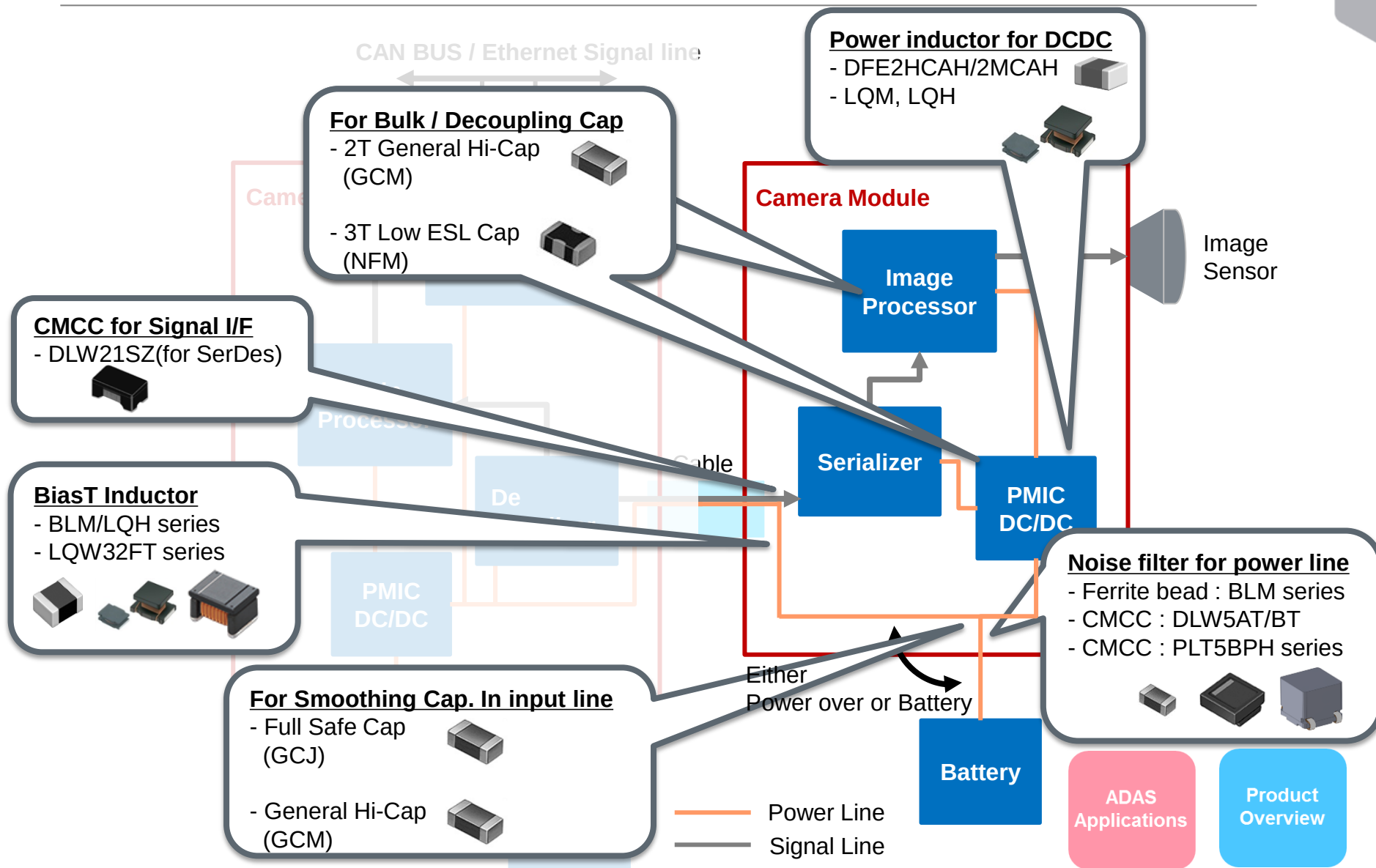
Camera Block Diagram



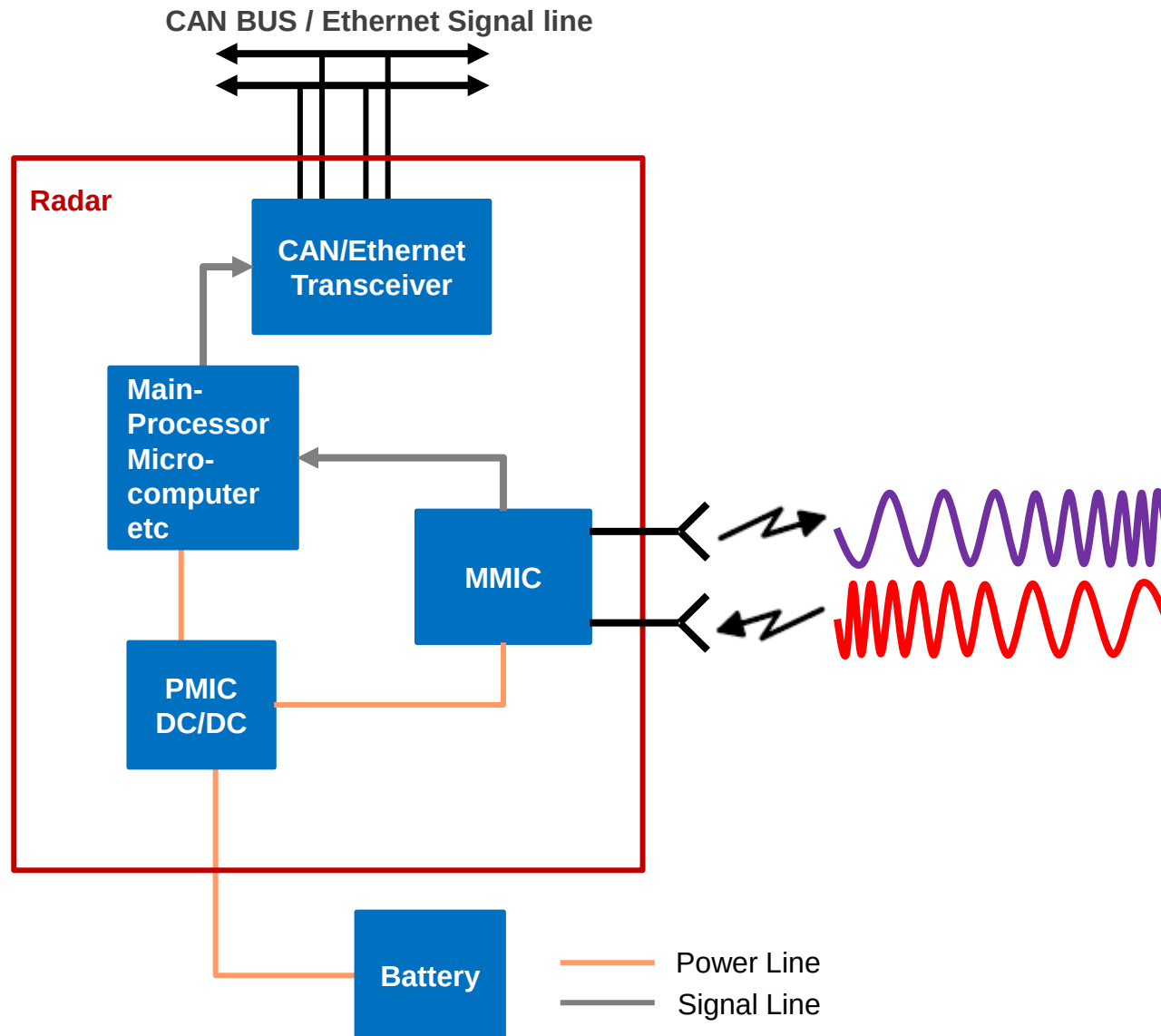
muRata
INNOVATOR IN ELECTRONICS



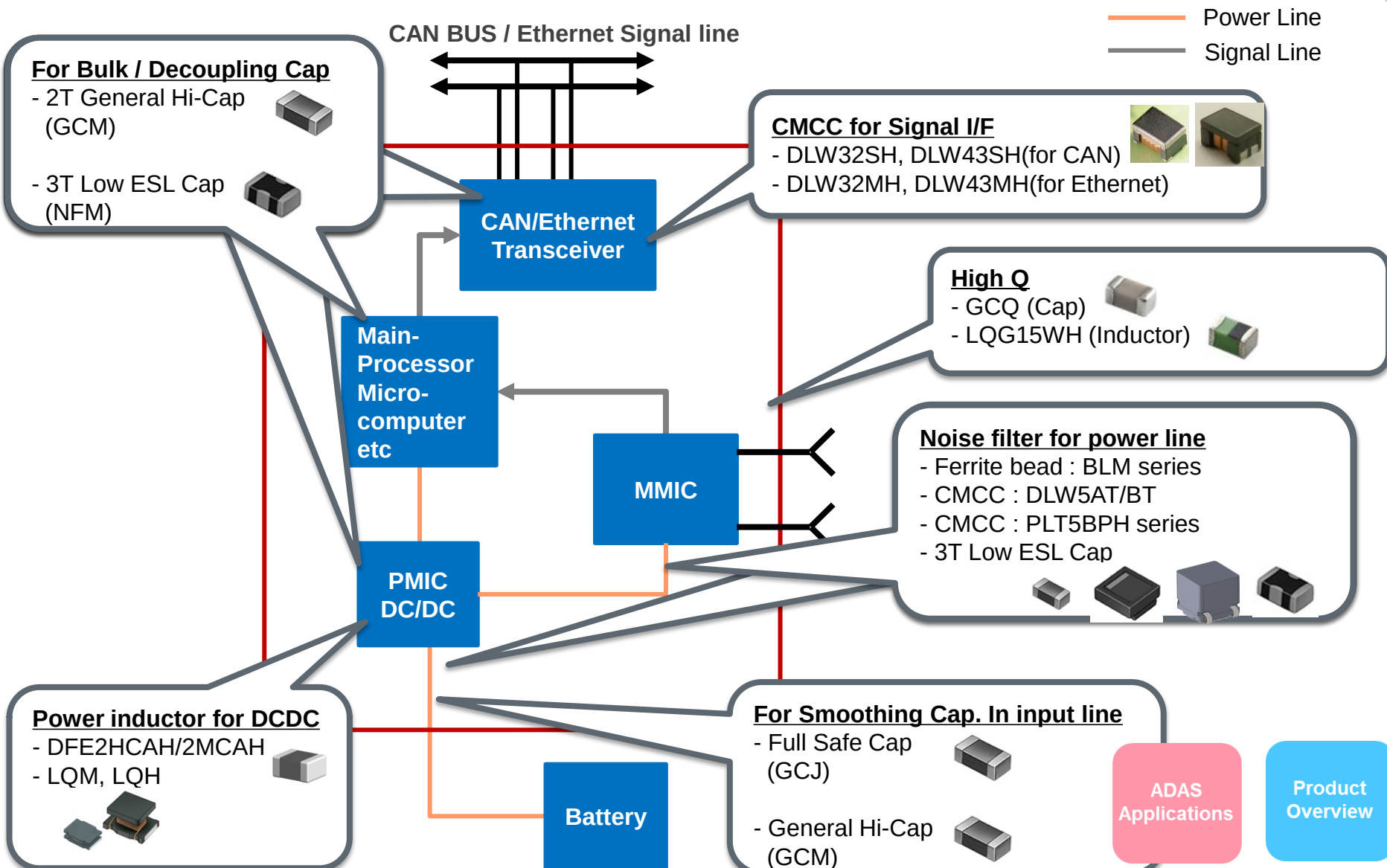
Camera Block Diagram (Module)



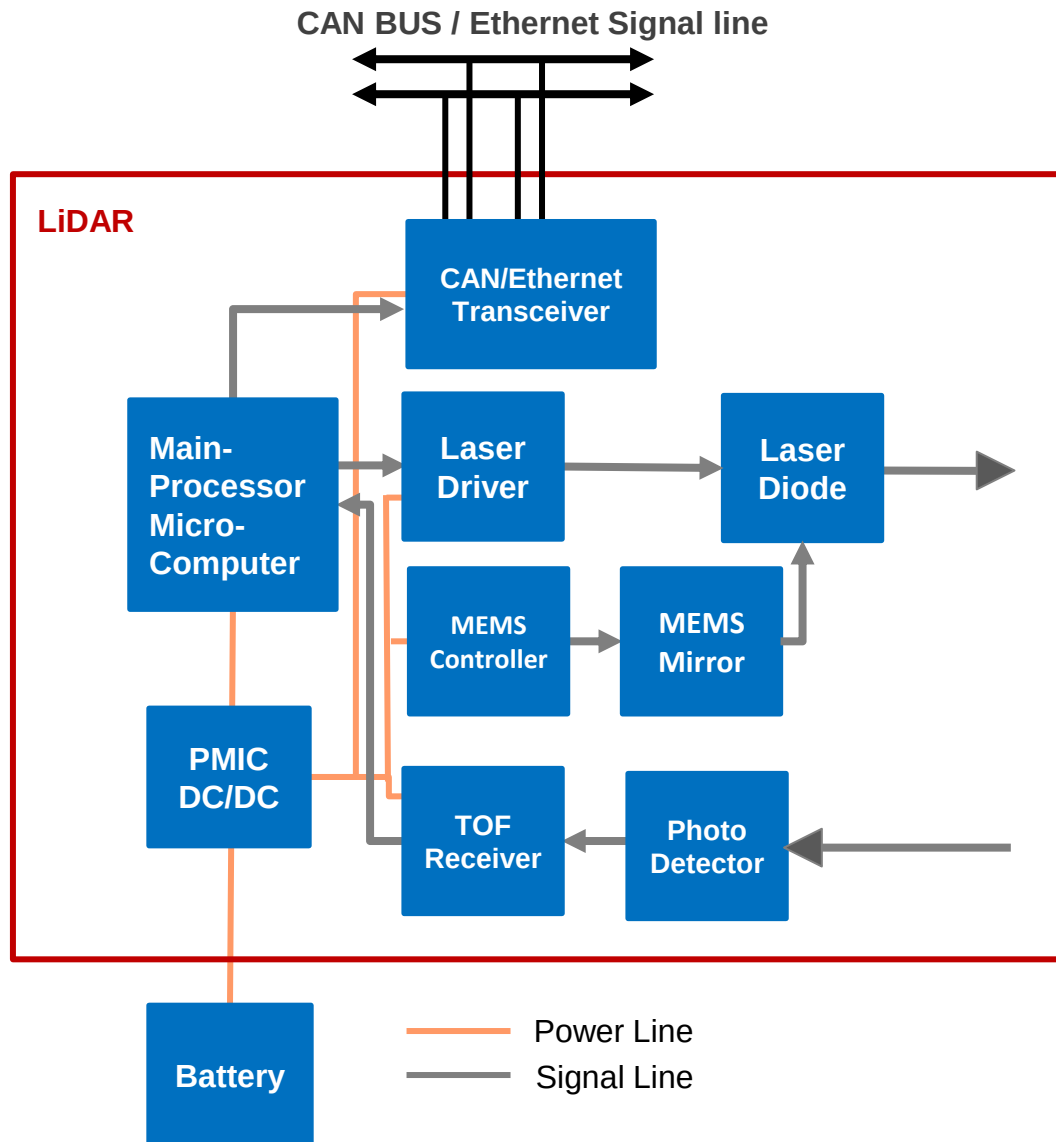
Radar Block Diagram



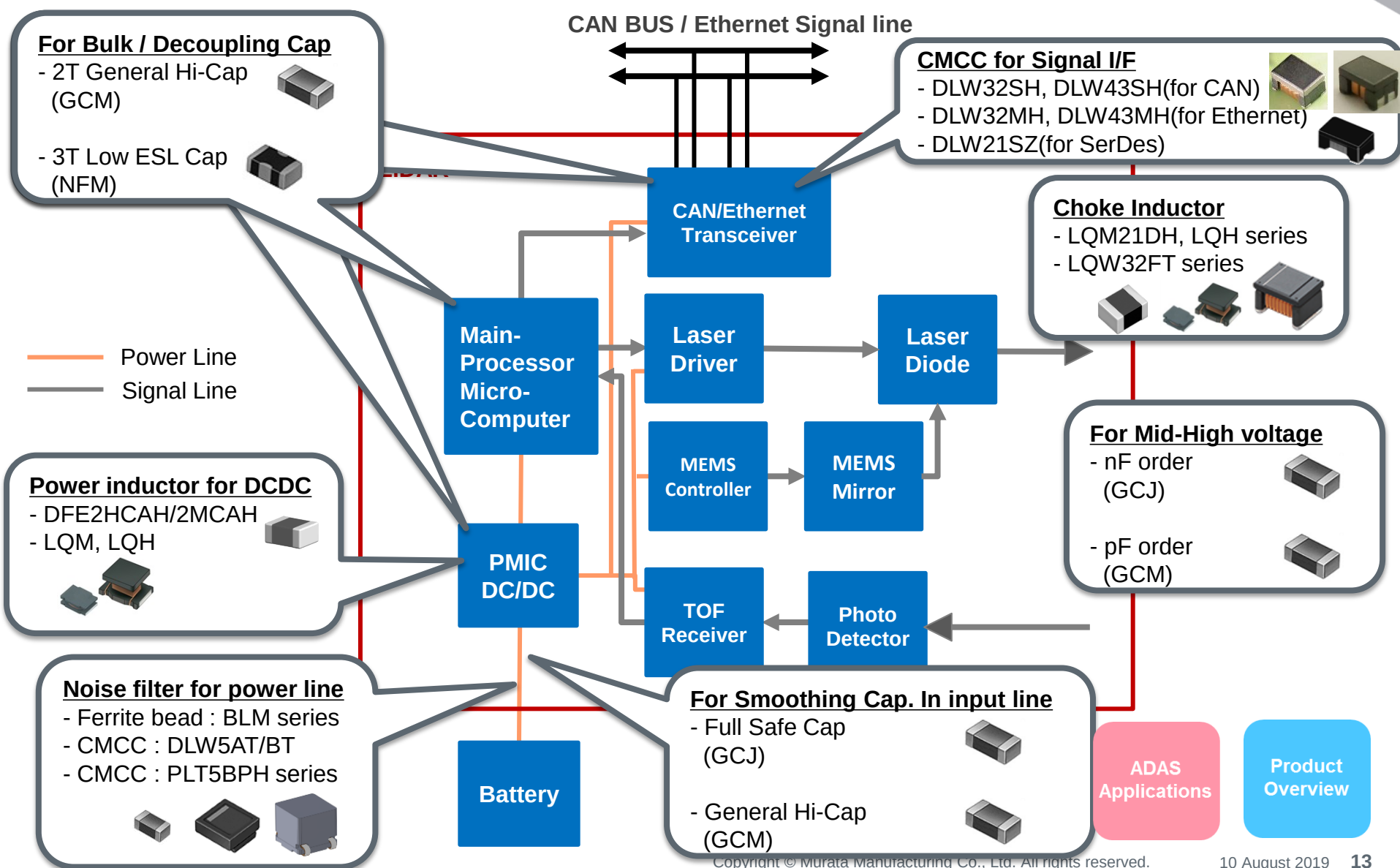
Radar Block Diagram



LiDAR module Block Diagram (MEMS)

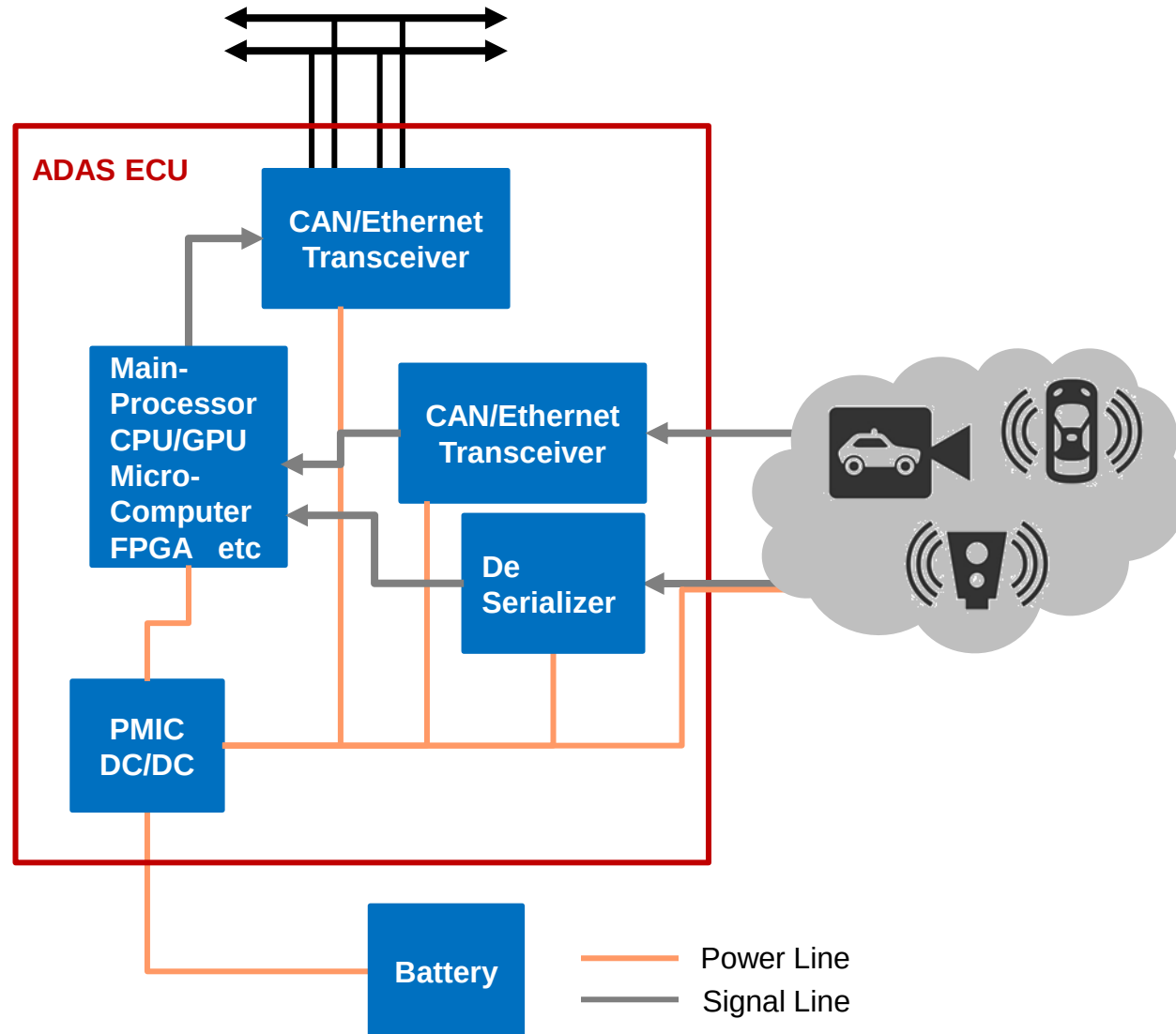


LiDAR module Block Diagram (MEMS)

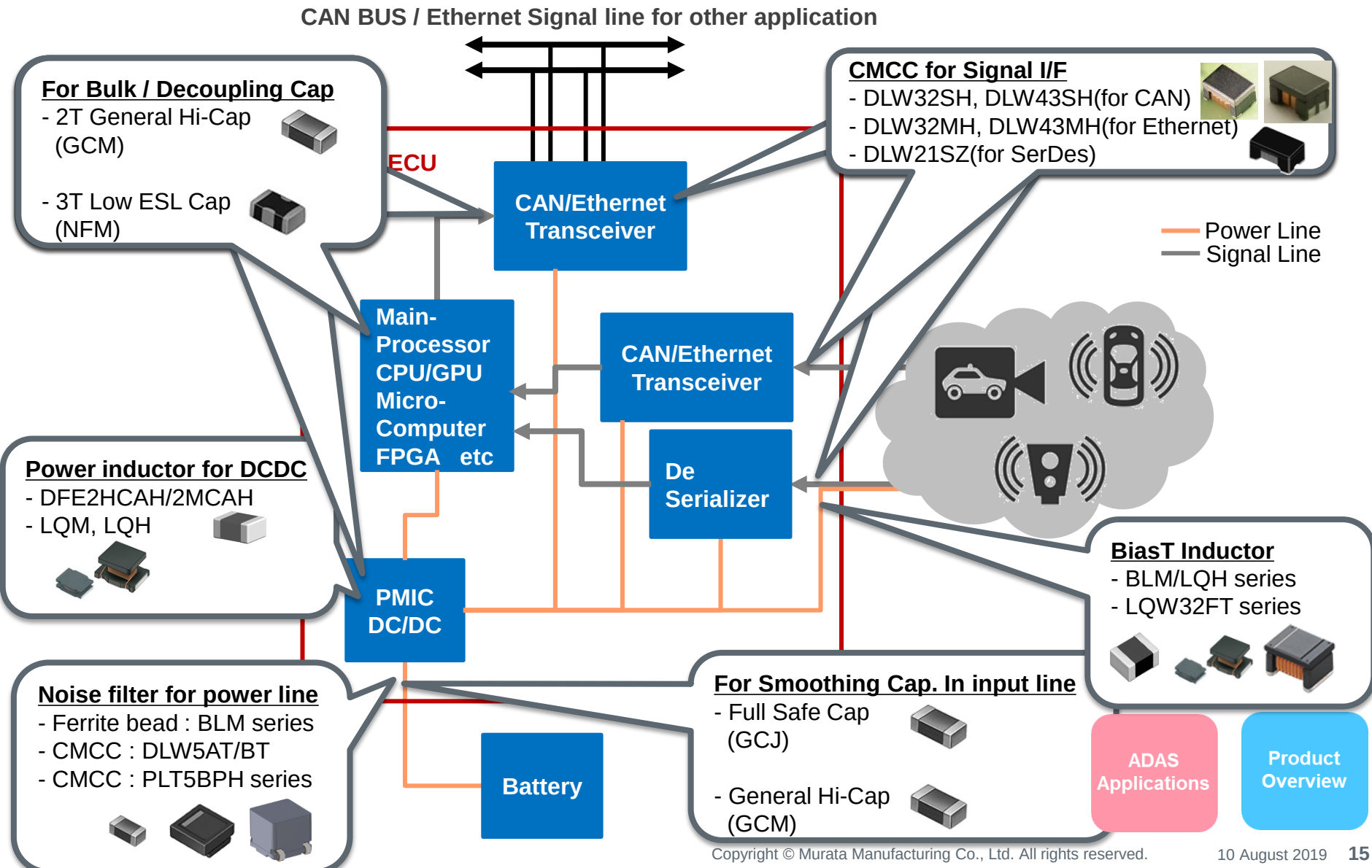


ADAS ECU Block Diagram

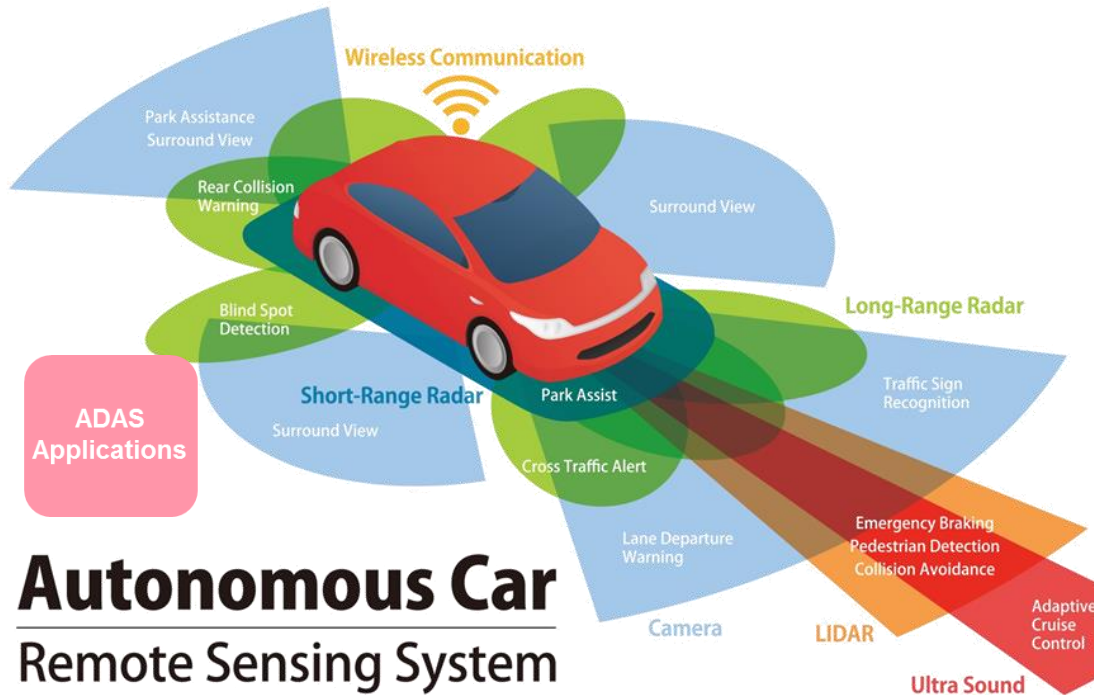
CAN BUS / Ethernet Signal line for other application



ADAS ECU Block Diagram



ADAS and V2X application



V2X : RF Transceiver (IEEE802.11p)



Proposal for DC cut and RF matching

GCQ series / High Q capacitor



ADAS



1.Proposal for filter in 12V batt. line

GCM/GCJ series

/ Small case size, high cap



2.Proposal for Filter in DC-DC and Decoupling in Processor, RFIC

GCM series (2-Terminal cap)

/ Small case size, high cap and low voltage



NFM series (3-Terminal cap)

/ Reduction of number of components with Low ESL capacitor

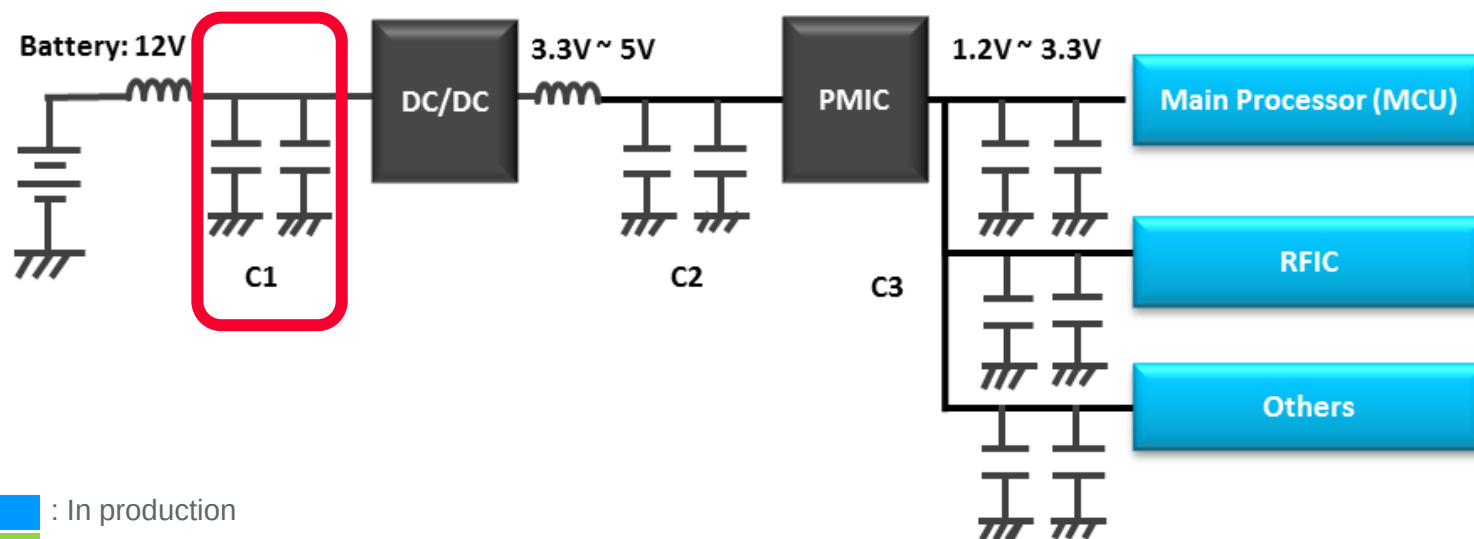


3.Proposal for Lager generator Si-cap

/ Low profile, wire bondable, and low inductance



Proposal for 12V battery line



■ : In production

■ : Under development (Sample is available.)

Type/Size	RV	Cap					Murata PN (14digit)	Description
		105	225	475	106	226		
GCM18, GCJ18 (0603 case size)	25V	X7R					GCM188R71E105K	0603, X7R, 25V, 1uF
							GCJ188R71E105K	0603, X7R, 25V, 1uF, Soft term.
GCM18, GCJ18 (0805 case size)	50V	X7R					GCM21BR71H105K	0805, X7R, 50V, 1uF
							GCJ21BR71H105K	0805, X7R, 50V, 1uF, Soft term.
	25V		X7R				GCM21BR71E225K	0805, X7R, 25V, 2.2uF
							GCJ21BR71E225K	0805, X7R, 25V, 2.2uF, Soft term
GCM31 & GCJ31	50V			X7S			GCM31CC71H475K	1206, X7S, 50V, 4.7uF
							GCJ31CC71H475K	1206, X7S, 50V, 4.7uF, Sft term
	25V				X7S		GCM31CC71E106K	1210, X7S, 25V, 10uF
							GCJ31CC71E106K	1210, X7S, 25V, 10uF, Soft term
GCM32 & GCJ32	50V				X7S		GCM32EC71H106K	1210, X7S, 50V, 10uF
							GCJ32EC71H106K	1210, X7S, 50V, 10uF, Soft term
	25V					X7S	GCM32EC71E226K	1210, X7S, 25V, 22uF
							GCJ32EC71E226K	1210, X7S, 25V, 22uF, Soft term

**Product
Overview**

Down-sizing proposal for filter in 12V batt. line



Recommend 0201 0402 0603 0805

GCM【X7*】

unit : inch

Type	Rated Voltage [V]	Capacitance											
		pF			nF								
		100	220	470	1	2.2	4.7	10	22	47	100	220	470
GCM	100		0402	0402	0805 0603 ↓ 0402	0805 0603 ↓ 0402	0805 0603 ↓ 0402	0805 ↓ 0603	0805 ↓ 0603	0805	0805		
	50		0402	0402	0603 ↓ 0402	0603 ↓ 0402	0603 ↓ 0402	0603 ↓ 0402	0603 ↓ 0402	0805 0603 ↓ 0402	0805 0603 ↓ 0402	0805 0603	0805
	25	0201	0201	0201	0603 ↓ 0201	0603 ↓ 0201	0603 ↓ 0402	0603 ↓ 0402	0603 ↓ 0402	0603 ↓ 0402	0805 0603 ↓ 0402	0805 ↓ 0603	0805 0603
	16					0201				0402	0603 ↓ 0402	0603 ↓ 0402	0805 ↓ 0603
	10					0201	0201	0201			0402		0402 (C7)
	6.3												

Product
Overview

Comparison of ESD characteristics

ESD test condition : 150pF/2kΩ, Level method

Type	Rataed Voltage [V]	Case size [inch]	unit	Capacitance														
				102	152	222	332	472	682	103	153	223	333	473	683	104	154	224
				1nF	1.5nF	2.2nF	3.3nF	4.7nF	6.8nF	10nF	15nF	22nF	33nF	47nF	68nF	100nF	150nF	220nF
GCM	100	0402	ESD[kV]	2	2	2	4	4	No product line-up (Under consideration)									
		0603	ESD[kV]	4	4	6	6	8	8	8	8	16						
	50	0402	ESD[kV]	2	2	2	4	4	No data	8	8	8	8	16	16	25		
		0603	ESD[kV]							8	8	16	25	25	25	25	25	25

1. Same ESD performance can be achieved with small case size.

e.g. : 0603 / 50V / 223 → 0402 / 50V / 473

0603 / 50V / 333 – 104 → 0402 / 50V / 104

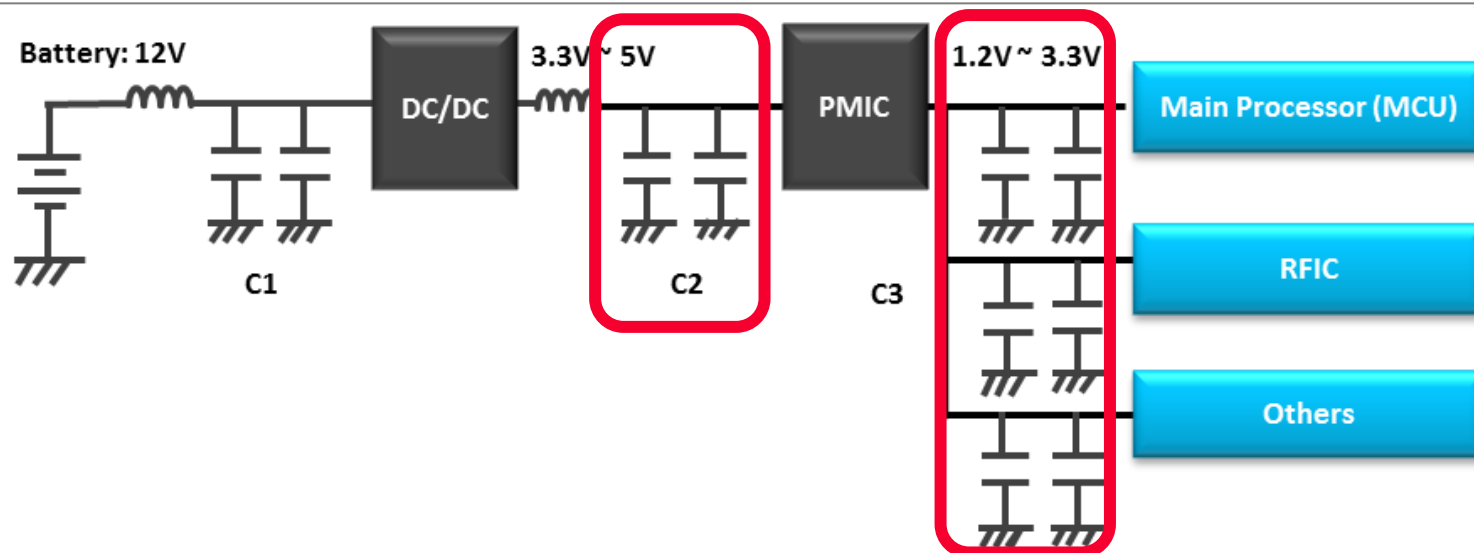
2. No concern about the other electrical parameters (same as D/S of low cap)

3. 100V product line up will be expanded as high priority.

4. Need to consider OEM requirement → Murata can support it.

Product
Overview

Proposal of 2-Terminal for Filter in DC-DC and Decoupling in Processor, RFIC

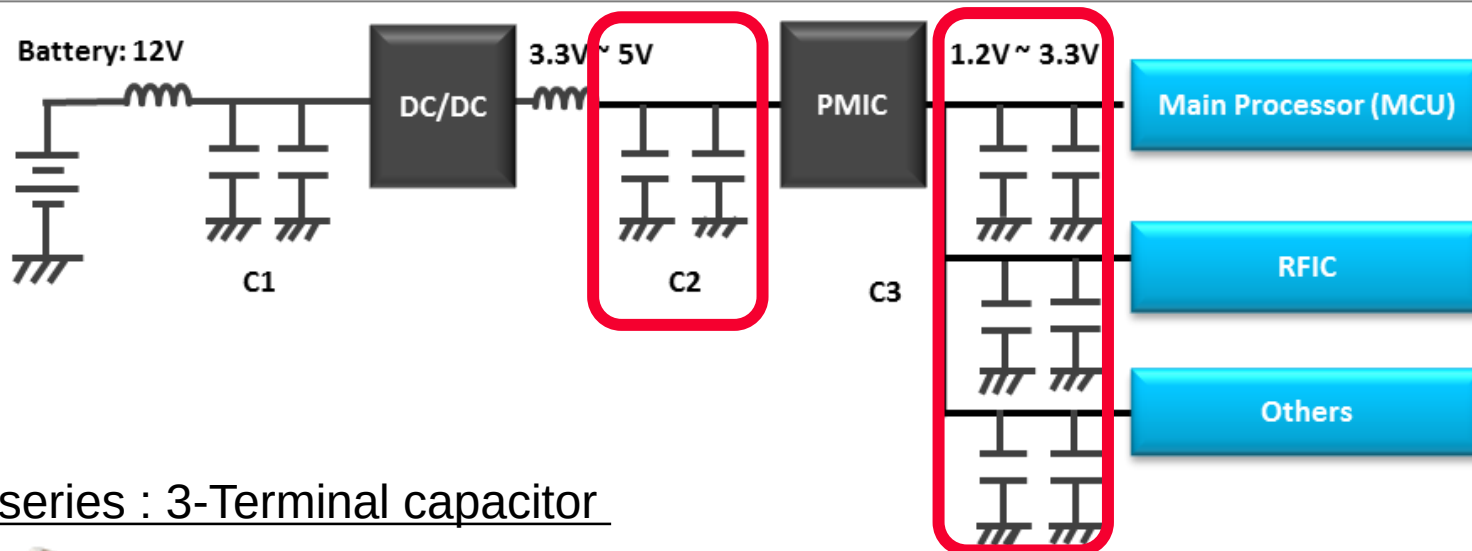


Type/Size	RV	Cap						Murata PN 14digit	Description
		104	105	106	226	476	107		
GCM03	6.3V	X7S						GCM033C70J104K	0201, X7S, 6.3V, 100nF
GCM15	10V		X7S					GCM155C71A105K	0402, X7S, 10V, 1uF
GCM18	6.3V			X7T				GCM188D70J106M	0603, X7T, 6.3V, 10uF
GCM21	6.3V				X7T			GCM21BD70J226M	0805, X7T, 6.3V, 22uF
GCM31	4V					X7T		GCM31CD70G476M	1206, X7T, 4V, 47uF
GCM32	4V						X7T	GCM32ED70G107M	1210, X7T, 4V, 100uF

■ : In production
■ : Under development (Sample is available.)

Product
Overview

Proposal of 3-Terminal capacitor for Decoupling cap in Processor/RFIC



NFM series : 3-Terminal capacitor



Type/Size	RV	Cap						Murata PN 14digit
		R10	R20	6R8	470	105	106	
NFM15	4V					X7*		NFM15HC105*0G*
NFM18	16V					X7S		NFM18HC105C1C3
NFM18	4V						X7*	NFM18HC106*0G*

■ : In production
■ : Under development (Sample is available.)

Product
Overview

What is Low ESL Capacitor ?

The structure is different from Conventional MLCC.

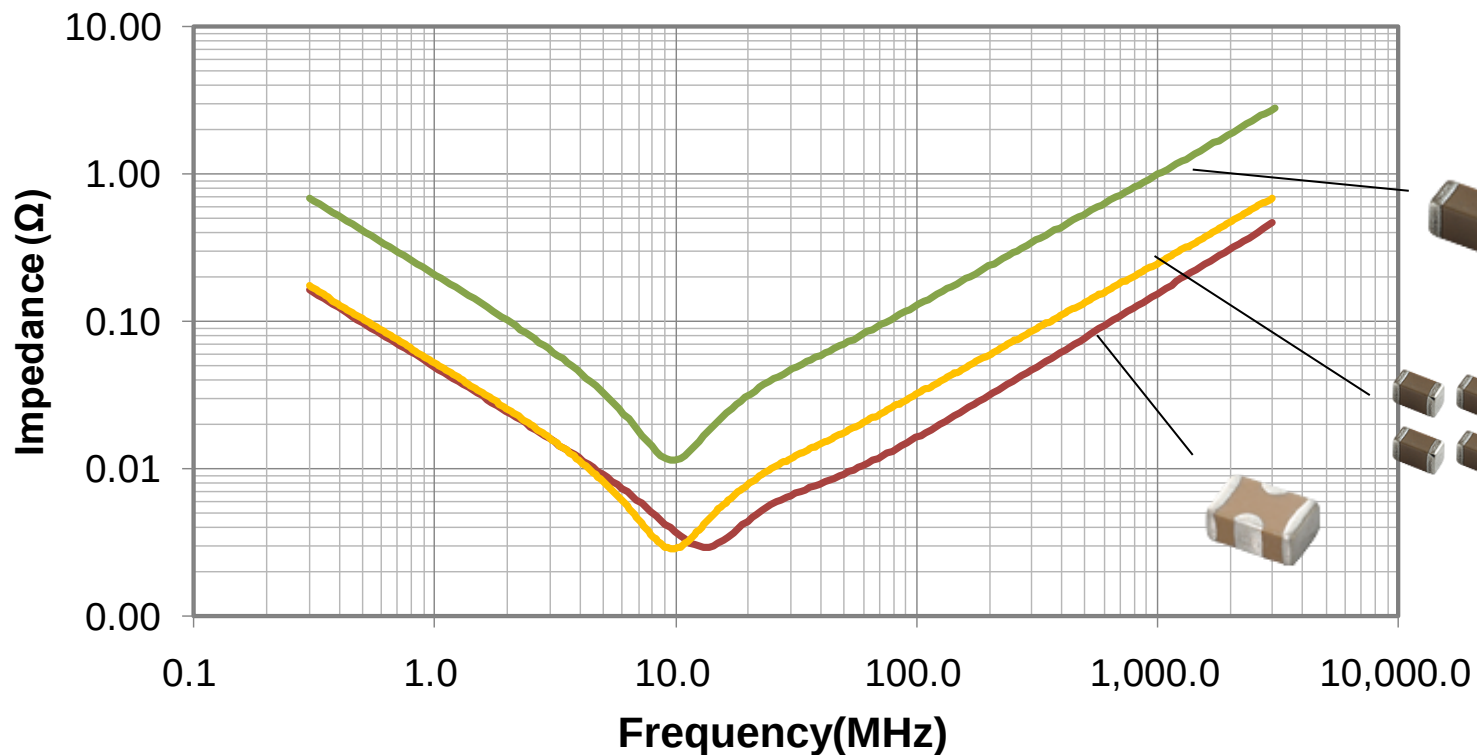


Std. MLCC
(2-Terminal)



Low-ESL
(3-Terminal)

Impedance of Low-ESL cap at high frequency is low due to its low ESL.

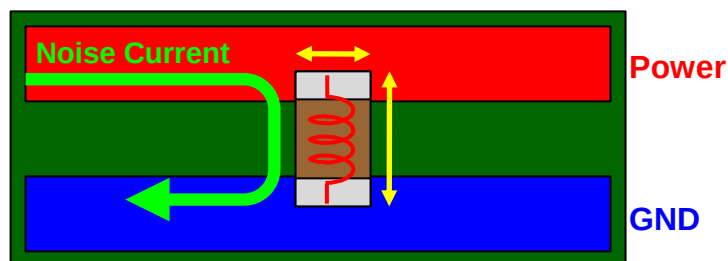
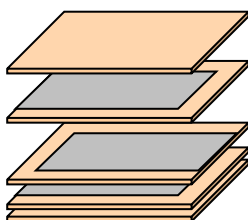


Product
Overview

Low ESL Capacitor Structure

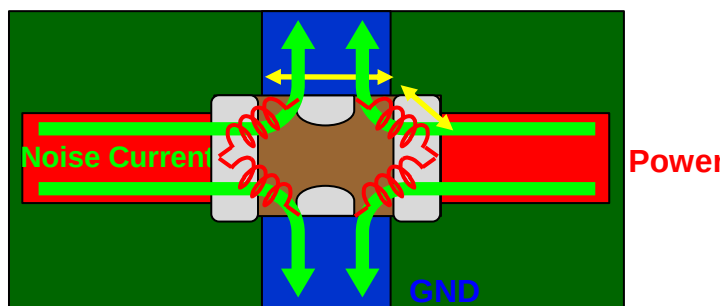
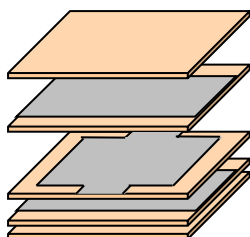
Comparison of structure between standard MLCC and Low-ESL cap.

<2-Terminal cap>



Bad : Long current path
Bad : Small sectional area for current path

<3-Terminal cap>

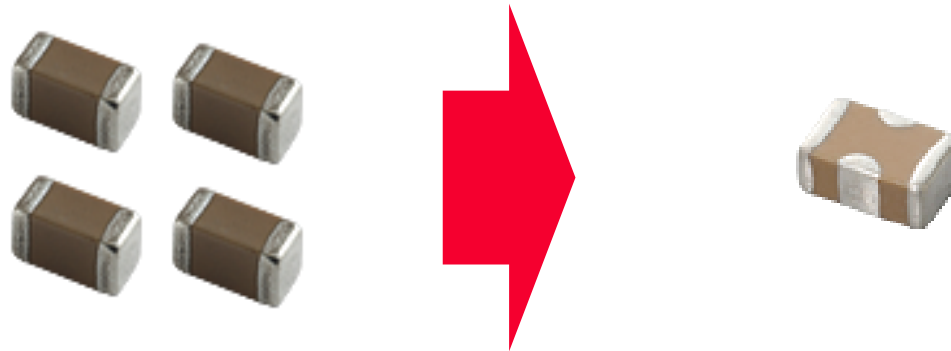


Good : Short current path
Good : Large sectional area for current path
Good : Multiple current path

Product
Overview

Selection of 3-Terminal capacitor

Example of replacement from 2-Terminal cap to 3-Terminal cap



Quantity reduction :

4pcs of 2-Terminal cap → 1pcs of 3-Terminal cap

*This is an image based on the design of products. The actual reduction of number of quantity is depending on target impedance and PCB design.

Capacitance :

0.22uF*4pcs (2-Terminal cap) → 1uF*1pcs 3-Terminal cap

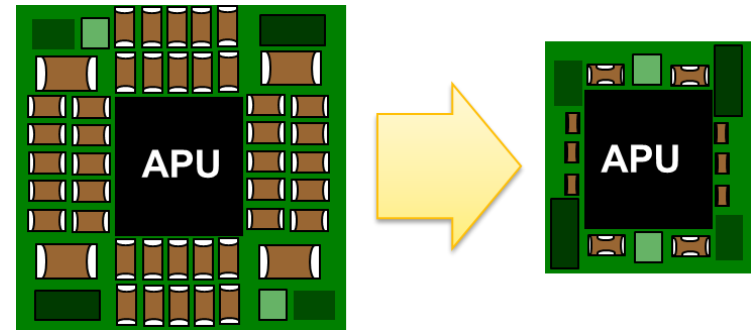
Total capacitance of Low ESL-cap should be same or bigger than that of 2-terminal caps.

Product
Overview

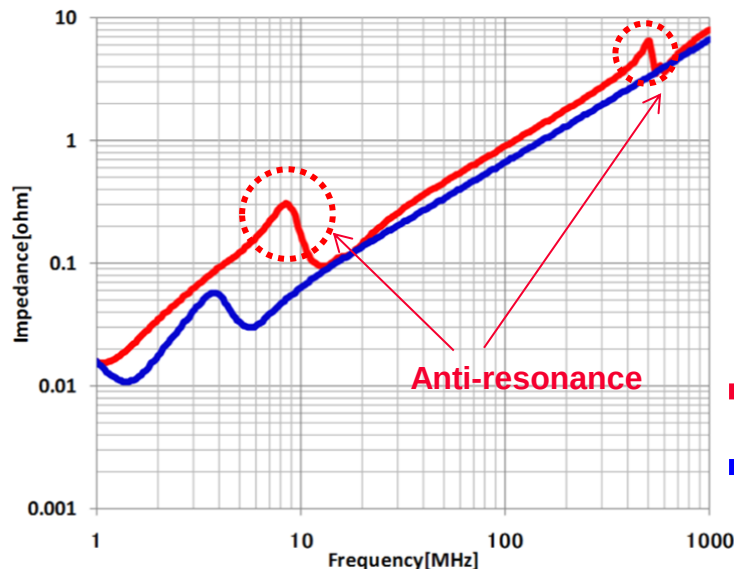
Design optimization with 3-Terminal capacitor

Advantage 1. Reduction of number of MLCC

Advantage 2. Space saving of PCB



Advantage 3. Compatible or better impedance design



Good impedance in system



Improvement of Anti-resonance

— : Design with 2-Terminal cap

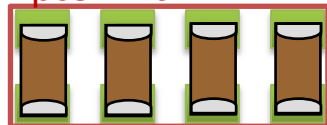
— : Design with 3-Terminal cap



Product
Overview

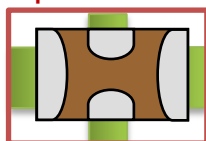
Effectiveness of PCB Space Reduction

4pcs:1.49mm²

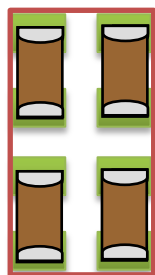


-32.2%

1pc:1.01mm²

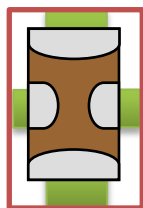


4pcs:1.51mm²

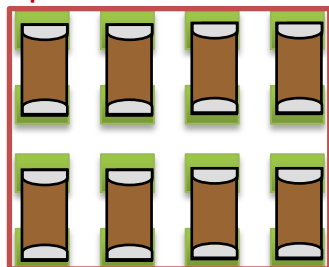


-33.1%

1pc:1.01mm²

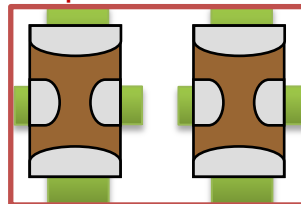


8pcs:3.35mm²



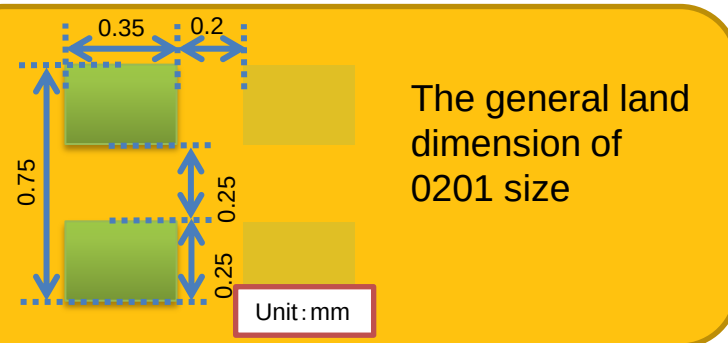
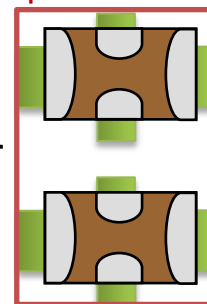
-31.9%

2pcs:2.28mm²



or

2pcs:2.28mm²



Product
Overview

Example of technical solution service

■ Optimum cap design for power line

Input

- CAD data
- Structure info.
- Circuit diagram

Design

- Cap design
- Structure design

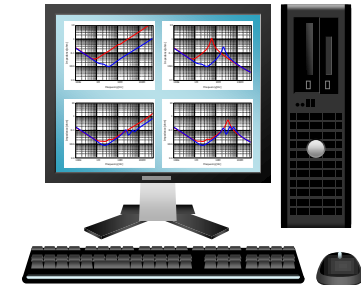
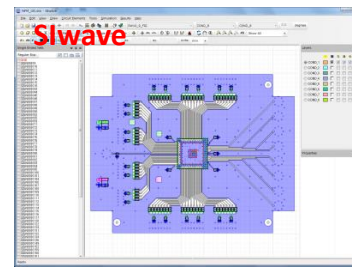
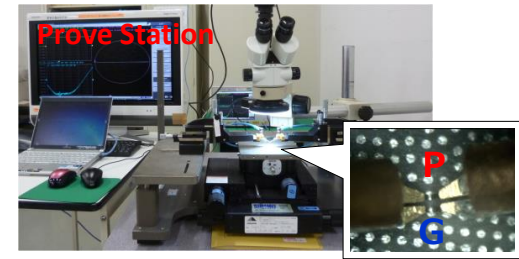
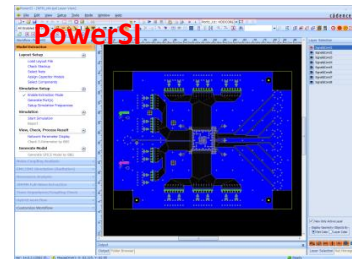
Analysis (Check)

- Simulation
- Measurement

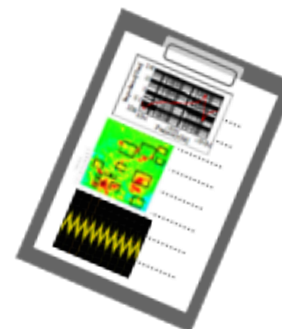
Output

- Recommended parts
- Optimized Layout
- Evaluation data

Analysis for optimization



Report optimized layout and parts



- Can be evaluated also,
- ✓ Voltage change
 - ✓ Near field distribution
 - ✓ Radiation noise

Product
Overview

Technical support for design optimization

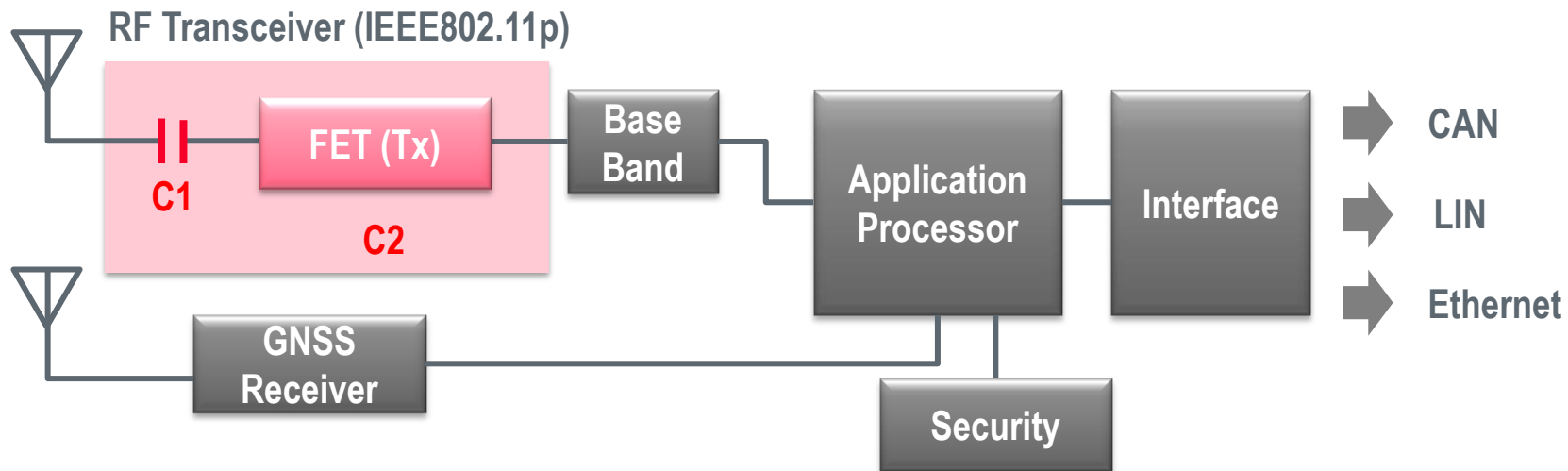
Necessity Information for Free Engineering Support

- CAD data (".pcb/.rul" format / ".brd" format)
 - PCS property (Layer count/ Layer thickness/ Dielectric material/ Er/ metal material)
 - Schematic
 - Bills of material
 - Assy. cost
- Need but not necessary if it is included in CAD data.**
- Need if cost estimation including Assy cost is required**

CAD Software	Ver.	File Format
ZUKEN CR-5000	Rev.12 and Higher	.pcb and .rul
Cadence Allegro	16.0 , 16.1 , 16.2 , 16.3	.brd
Mentor Graphics PADS	PADS PowerPCB v5.2a, V2005 , v2007	.pcb or .asc
	9.4 , 9.5	ODB++
Mentor Graphics Expedition	EE7.9.x	ODB++
	V2005 , V2007.1 ~ EE7.9	ODB++

Product
Overview

Proposal for DC cut and RF matching in V2X application



■ : In production

■ : Under development (Sample is available.)

Type/Size	RV	Cap						Murata PN 14digit	remark
		R10	R20	6R8	470	105	106		
GCQ03	25V		C0G	C0G				GCQ0335C1E****	Cap:R20-6R8 available
GCQ15	50V	C0G	C0G	C0G	C0G			GCQ1555C1H****	Cap:R10-470 available

Capacitance tolerance

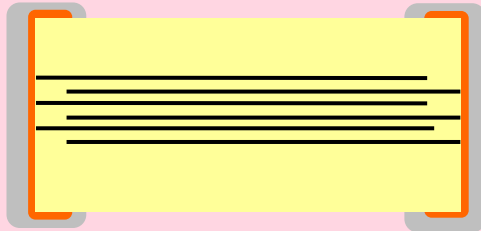
Code	Cap. Tol.	Cap. Range
W	+/-0.05pF	≤ 5.0pF
B	+/-0.1pF	< 10pF
C	+/-0.25pF	< 10pF
D	+/-0.5pF	5.1 ~ 9.9pF

Code	Cap. Tol.	Cap. Range
F	+/-1%	≥ 10pF
G	+/-2%	≥ 10pF
J	+/-5%	≥ 10pF

The narrow capacitance step and tight tolerance are available. Please contact to Murata.

**Product
Overview**

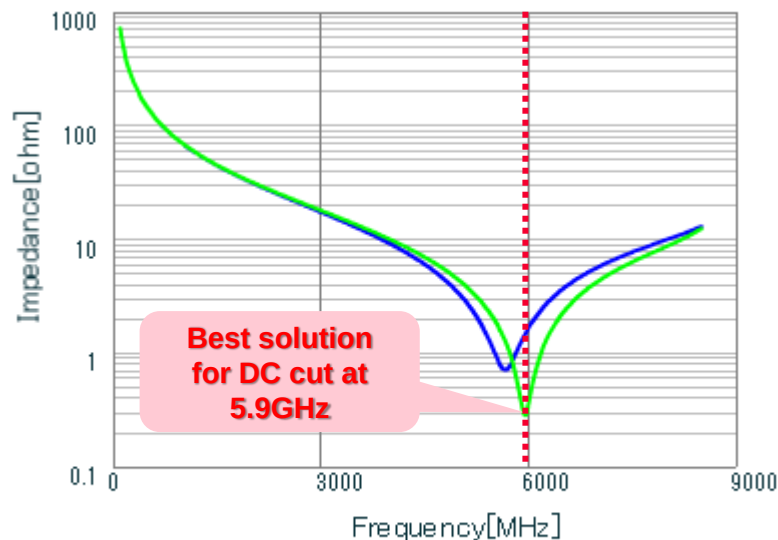
Good performance for V2X application



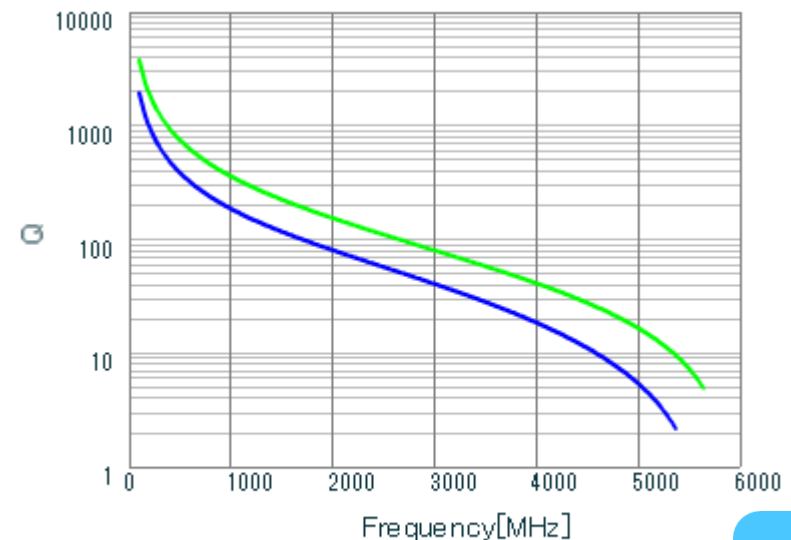
Ceramic
Cu Internal Electrodes
Cu Electrode Layer
Ni/Sn Plated Layer

**Low loss type ceramic material
&
Cu inner electrode
→ High Q characteristics!!**

Impedance characteristics



Q-frequency

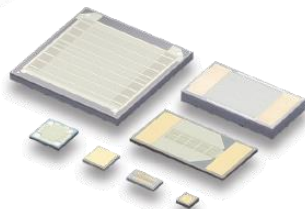


- GCM (Standard) / C0G / 50Vdc / 2.2pF
- GCQ (High Q type) / C0G / 50Vdc / 2.2pF

Product
Overview

Murata started New solution

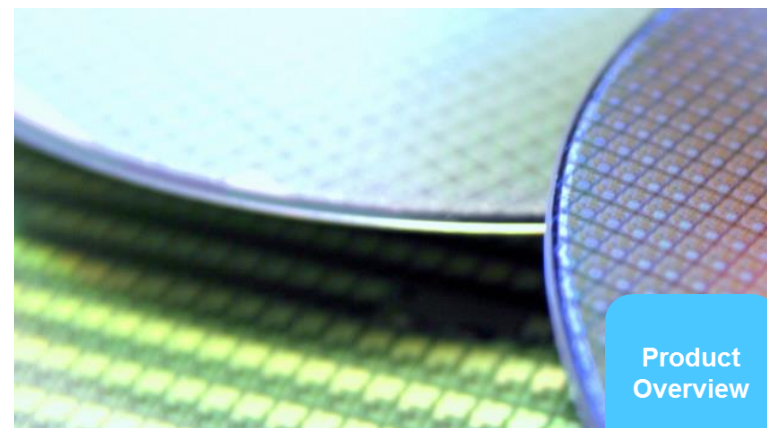
ipdia
The 3D Silicon Leader



muRata
INNOVATOR IN ELECTRONICS



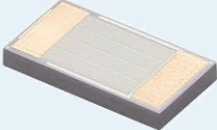
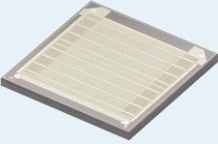
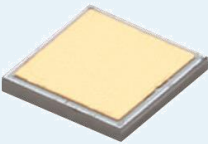
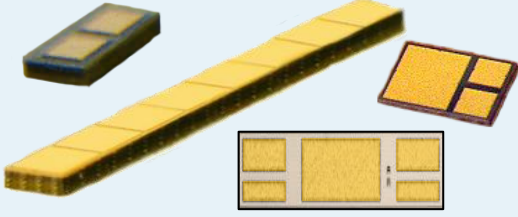
Company Name	Murata Integrated Passice Solutions S.A.
Location	2, rue de la Girafe, 14000 Caen, France
Incorporation Date	2009 (Murata acquired at Oct 2016)
Business Description	Silicon Capacitor, IPD solution
Number of Employees	130



Product
Overview

What is Si-capacitor?

➤ Si Capacitor - Product Type

Off-the-Shelf			Customized Solution	
Solder mounting	Wire-bonding / Embedded	Wire-bonding	Capacitor Array Binary Capacitor	IPD (Integrated Passive Device)
				 Capacitor + Resistor + Inductor
2 terminal	4 terminal	Vertical		

➤ Key Feature

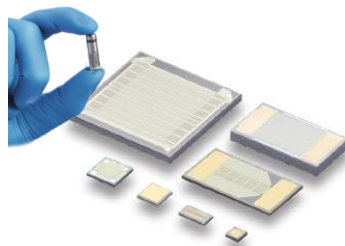
❖ **Up to 250°C**

High Reliability
Stable Life



❖ **500 nF/mm²**

Miniaturization
No cap degradation



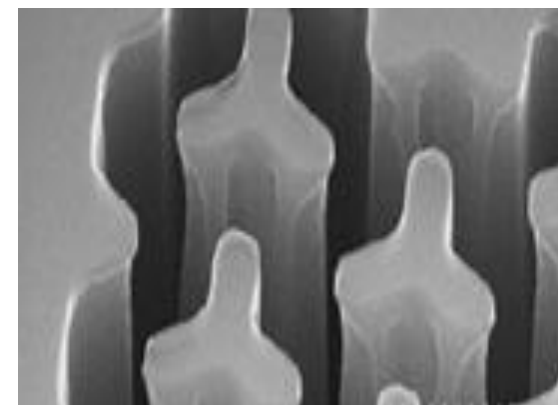
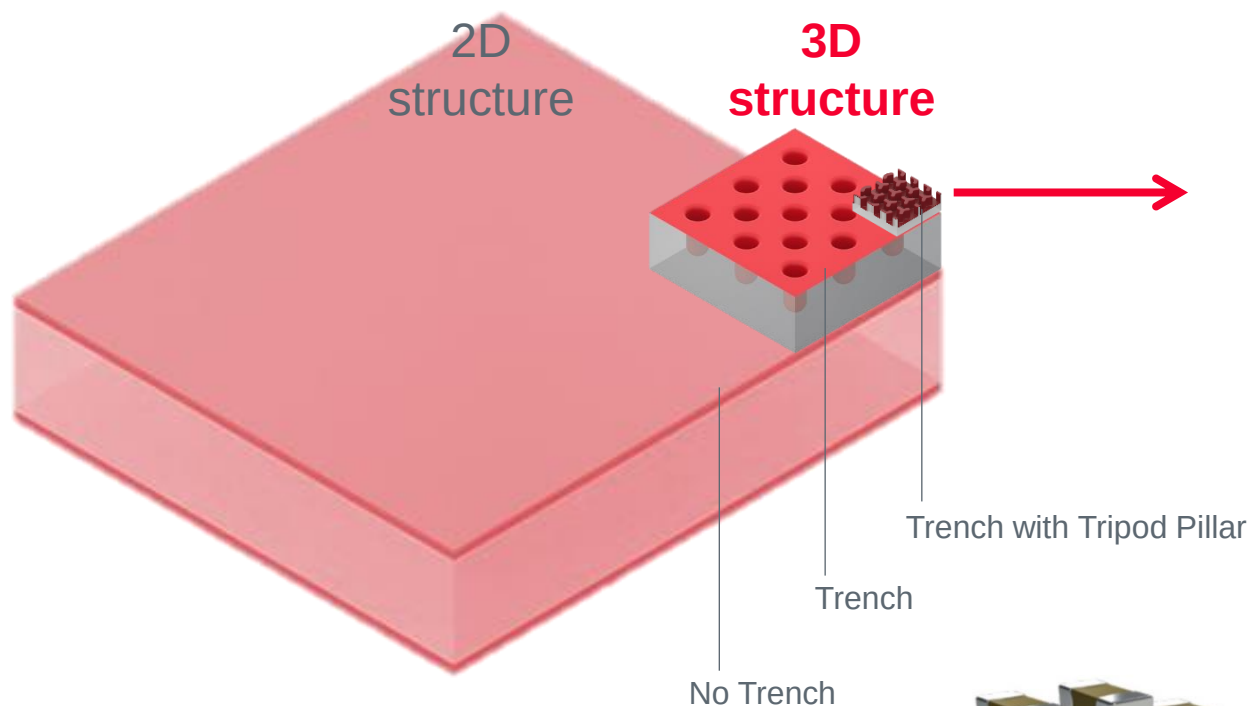
❖ **80 μm**

Ultra low profile



Product
Overview

Murata Si-Cap Advantage



3D capacitor by using semiconductor processes

Deep Trench and Tripod Pillar

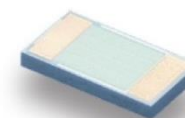


500nF/mm²



Class 1 dielectric COG
10 x 10 nF 0603 400 μ m thick

=



Murata SiCap
1x 100 nF 0402 100 μ m thick

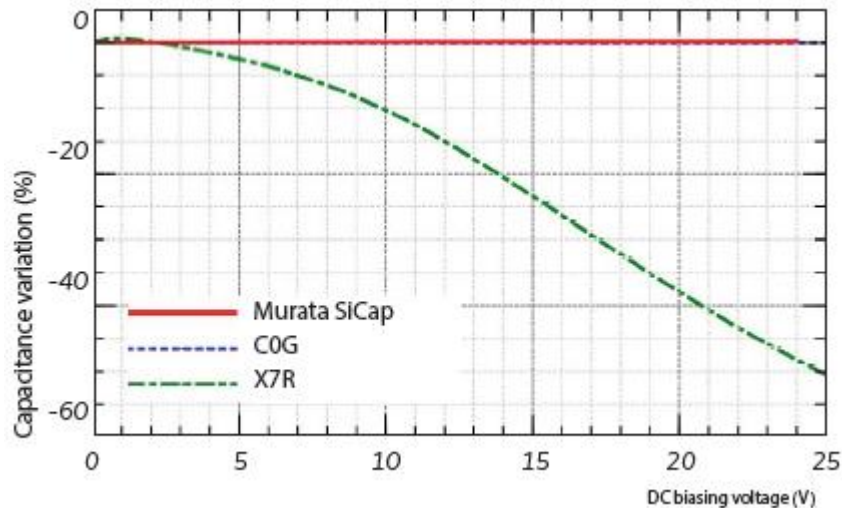
**Very effective to reduce the components !
Very easy to miniaturize the application !**

Product
Overview

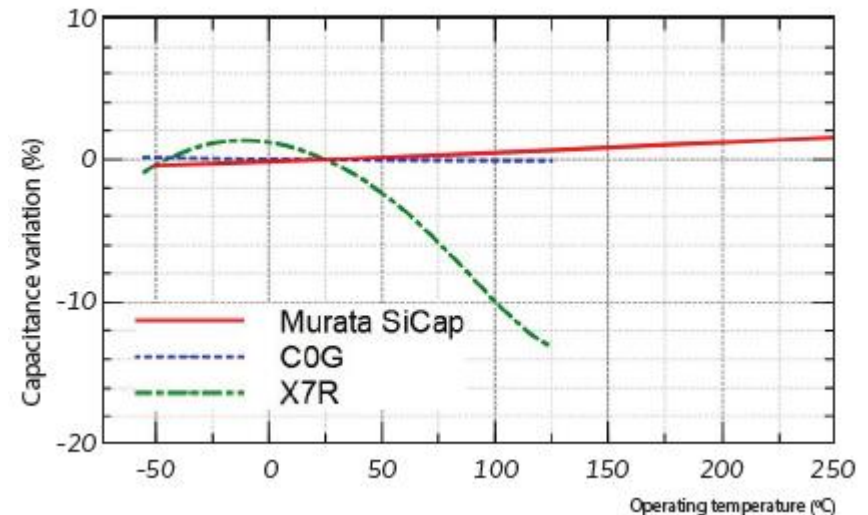
Basic Electrical Characteristics

- ✓ High Cap Stability
- ✓ No Cap Degradation

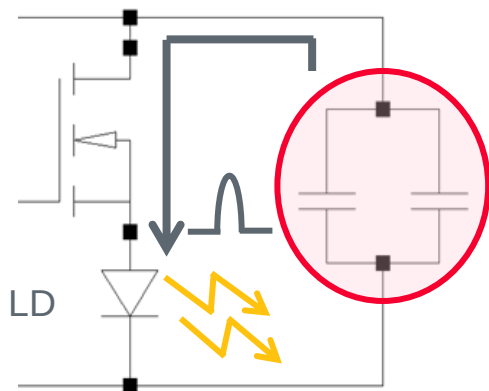
➤ Temperature Characteristics



➤ DC Bias Characteristics



Minimum requirements



Stable pulse

-> Capacitance stability

High peak pulse

-> Appropriate capacitance

-> Resistance to voltage

Automotive grade

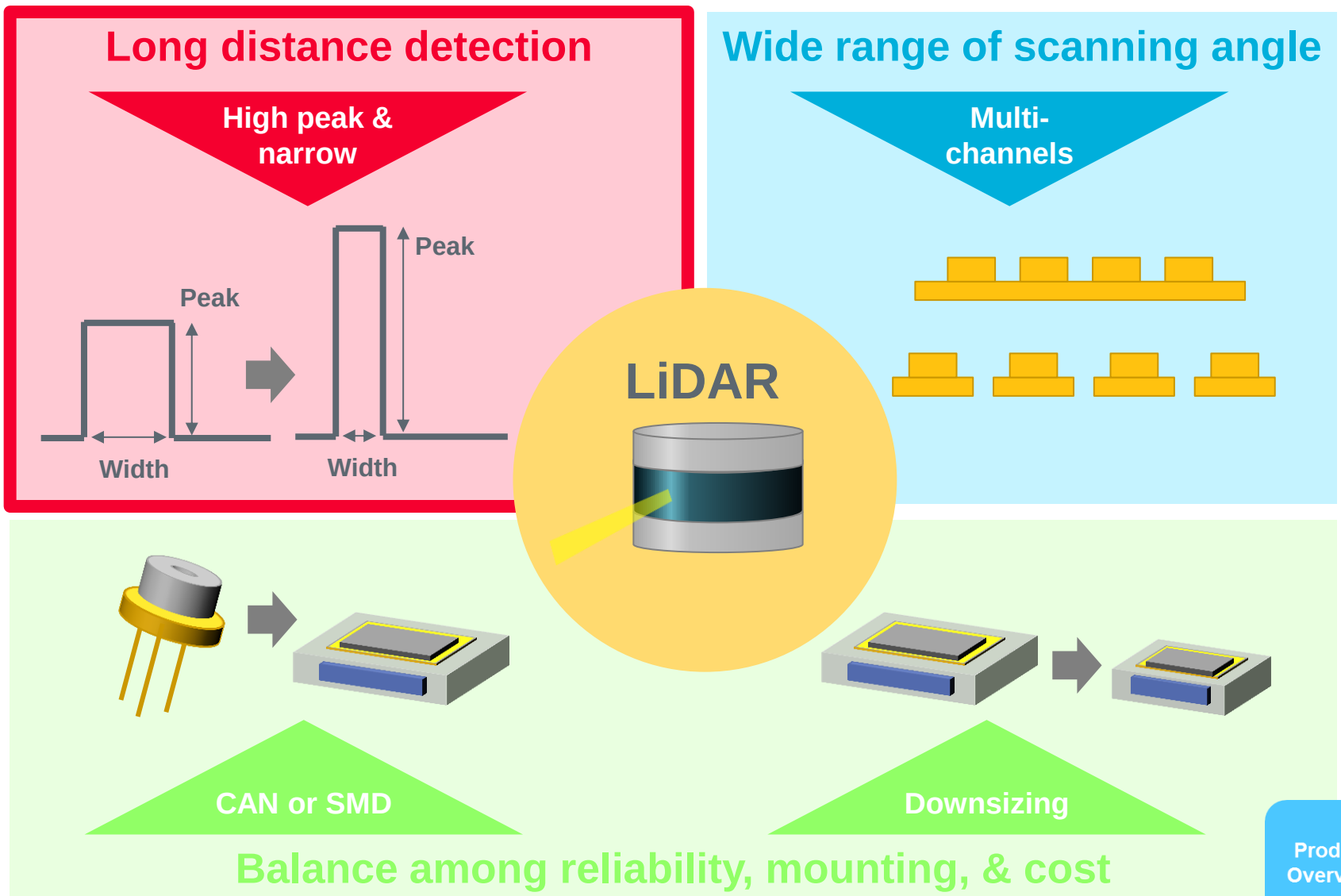
-> AEC-Q100/200 compliance

	Automotive MLCC GCM0335C1H	Automotive MLCC GCM155R72A	SI-Cap WBSC 0302 BV450V
1. Capacitance stability	+/-60ppm/°C, Independent of voltage	+/-15%, Dependent on voltage	+/-60ppm/°C, 0.02%/V
2. Appropriate capacitance (470pF-1nF)	~100pF	1nF	470pF
3. Resistance to voltage	50V	100V	~150V
4. AEC-Q100/200 compliance	AEC-Q200 (Compliant)	AEC-Q200 (Compliant)	AEC-Q100 (Available)

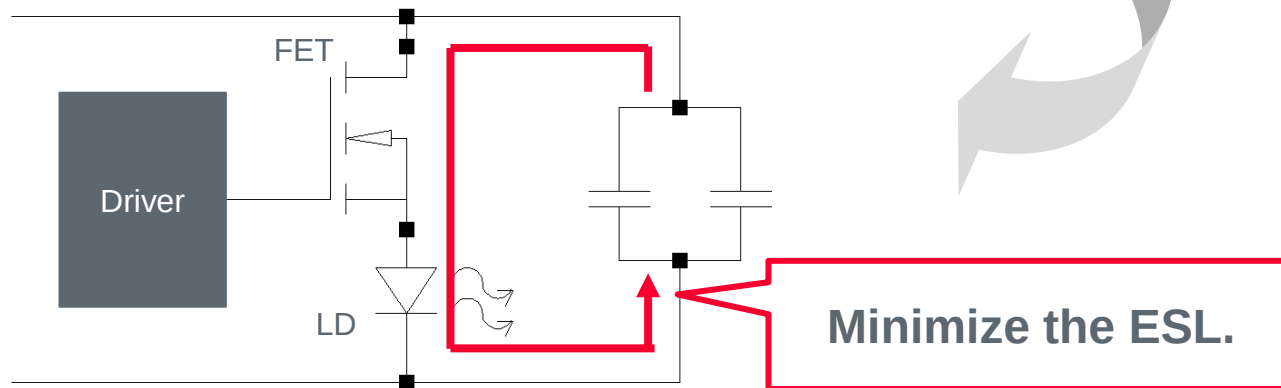
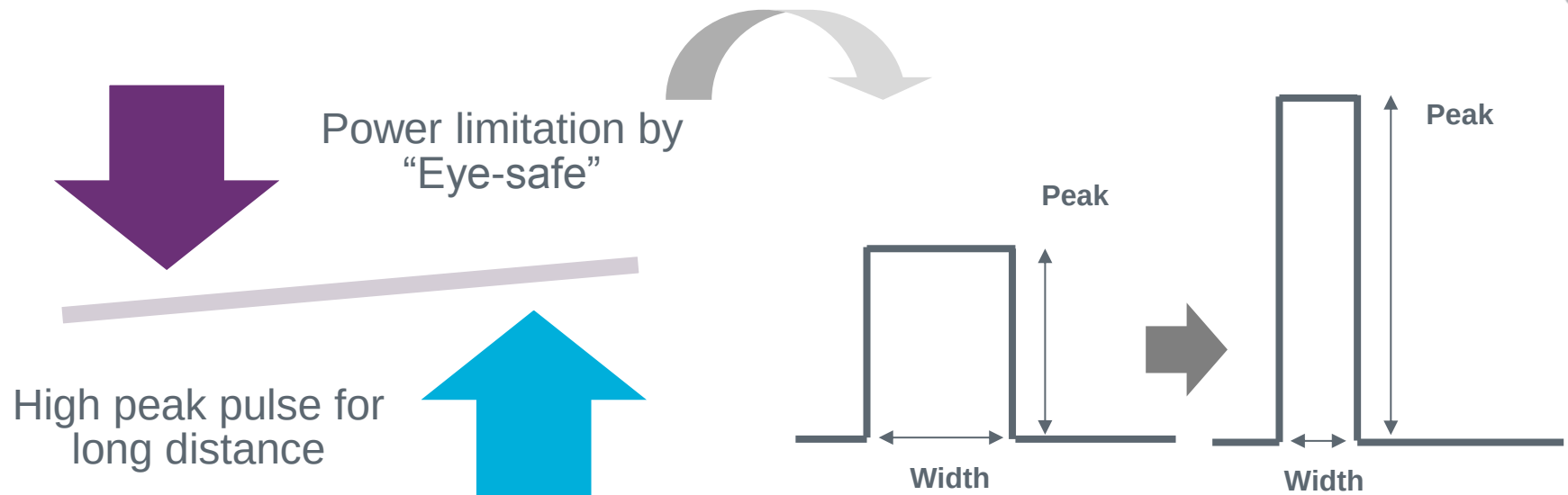
Si-cap can meet the all requirement

Product
Overview

Where LiDAR to go



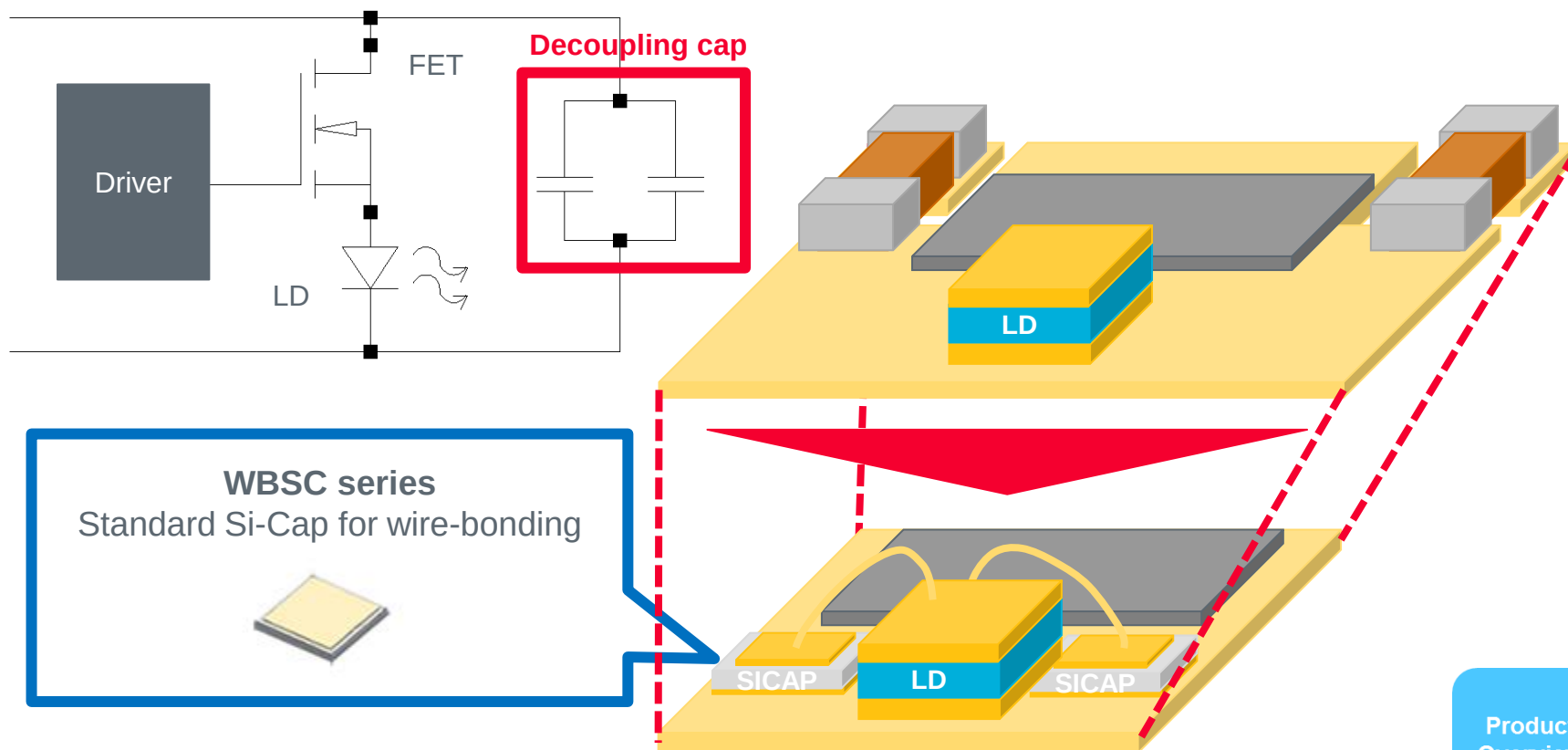
High peak & narrow pulse



Product
Overview

1st solution ; Vertical Si-Cap

Design optimization for lower loop ESL & miniaturization.



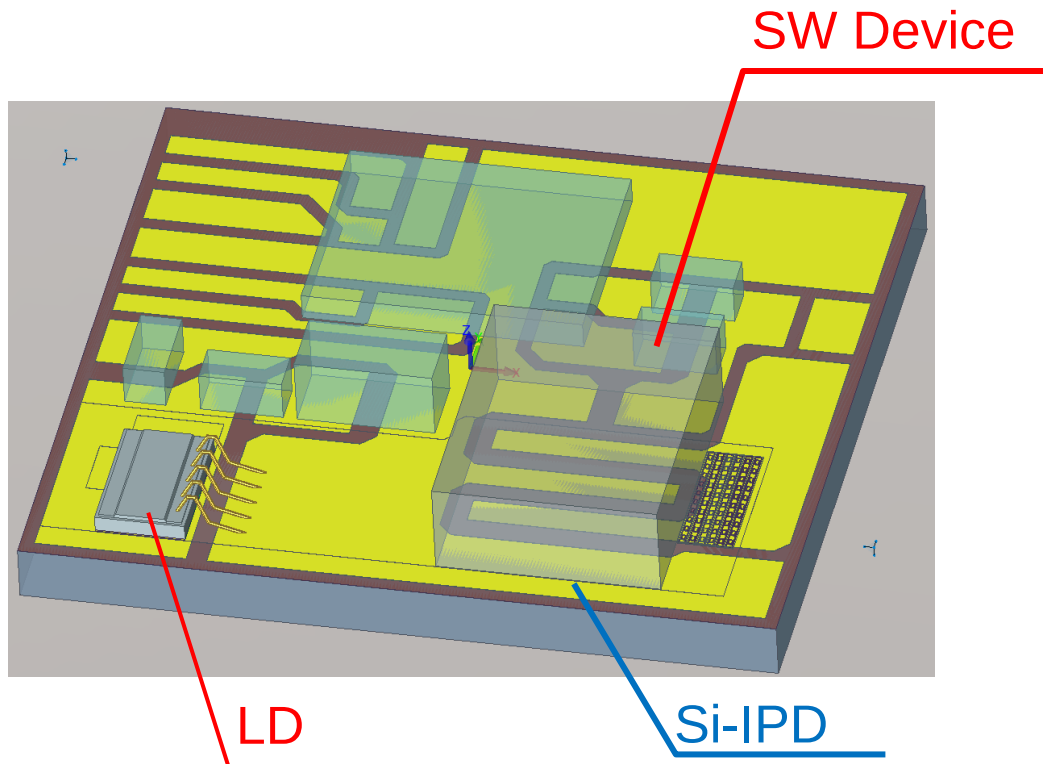
Product
Overview

2nd solution ; Si-IPD

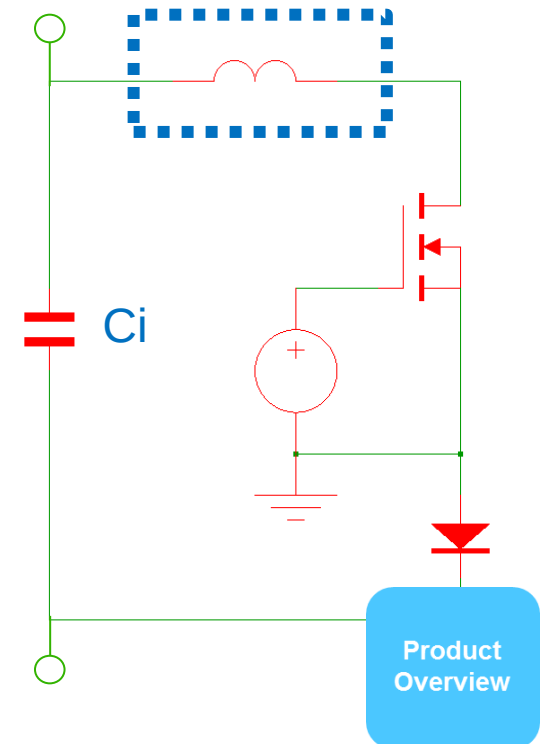
More advanced solution by Si-IPD

S-IPD = Si-Interposer + Passive components

Ultra minimized ESL



Reduce the parasitic inductance as much as possible



Thank you very much for your attention !!

