

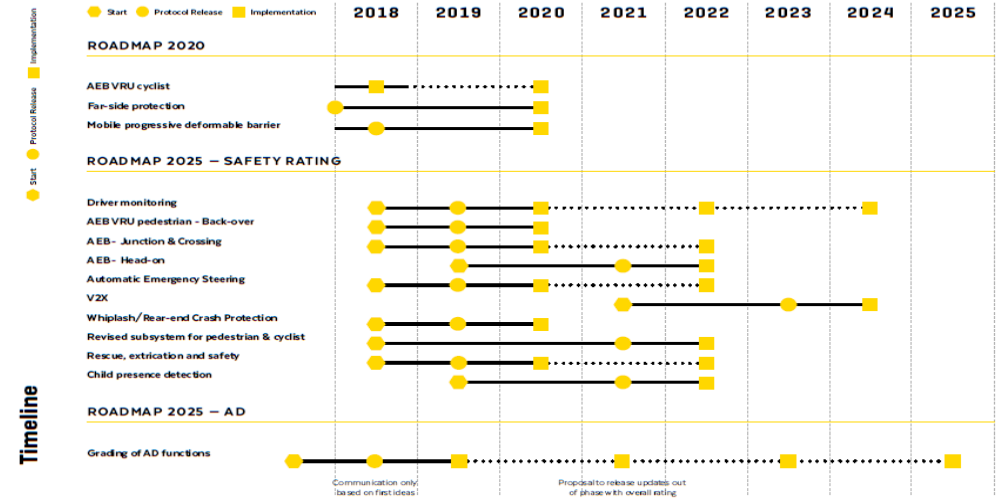
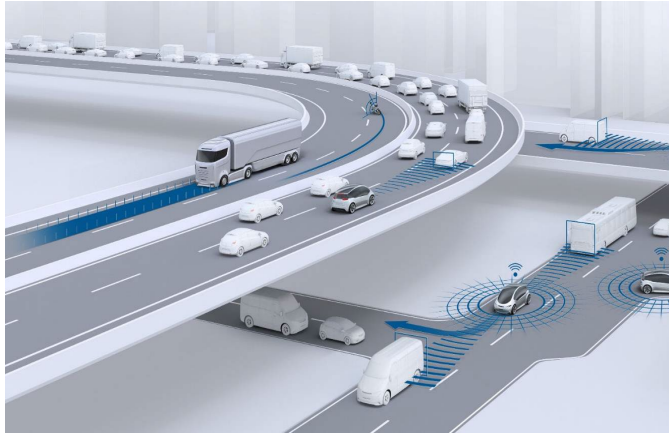
# RADAR REGULATION 76-77GHZ IN JAPAN

PRESENTATION AT WORKING GROUP  
INTERNATIONAL HARMONIZATION

2022.02.16  
(REVISED VERSION)

# Radar regulation 76-77GHz in JAPAN

## Teaching the vehicle how to drive

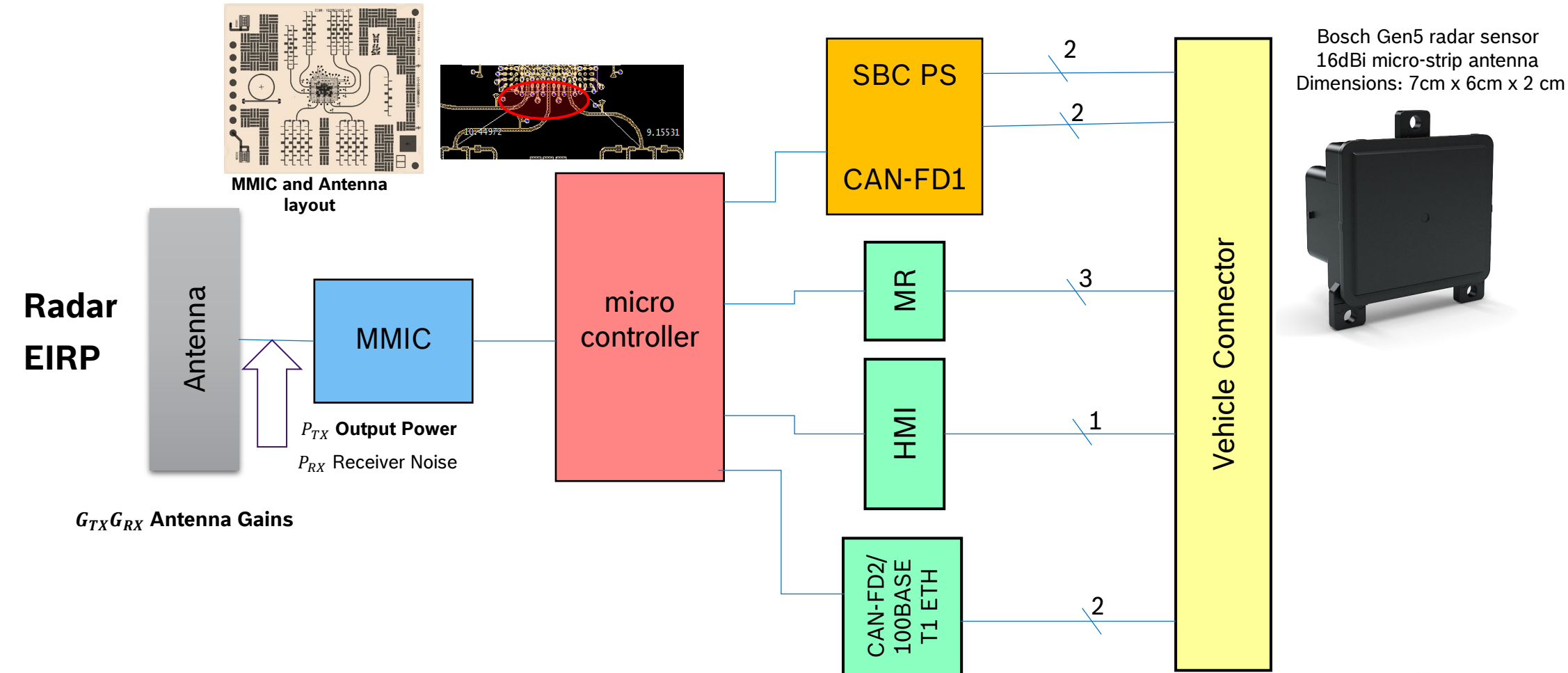


Motorcycle 76GHz front radar equipped

- Safety function requirement to ADAS system in market is becoming more advanced to be safer road environment. A lot of functions are with lowest RCS objects(cyclist, pedestrian...)
- Both larger Field of View and high detection range are demanded
- Radar size is demanded to be smaller and covered by bumper/emblem w/ attenuation.

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## Typical Sensor Top Level Diagram



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## Global Automotive radar regulations (extract in 76-77GHz)

	Standard	Band	Limit
Japan	ARIB STD-T48 Version 2.2	76GHz 77GHz	The antenna power shall be 10 mW <sup>1</sup> or less.
European Union	ETSI EN 301 091-1 V2.1.1	76GHz 77GHz	The mean power (EIRP) shall not be greater than 50 dBm.
United States	FCC CFR 47 Part 95, Subpart M	76GHz 81GHz	The maximum power (EIRP) shall not exceed 50 dBm.

<sup>1</sup> According to Notification of Ministry of Internal Affairs and Communications No.88 “Testing method for the characteristics examination”, duty cycle must be considered in calculation of conducted power

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## Impact of regulation limits on radar performance

For Bosch front radar Gen. 5 device, maximum allowed average EIRP can be calculated as follows:

$$EIRP = P_{TX} + G_{TX} - L_{DC}$$

ARIB limit on conducted power:  $P_{TX} = 10dBm$

Antenna gain of Bosch front radar :  $G_{TX} = 16,6dBi$

Duty cycle correction factor:  $L_{DC} = 5,9dB$

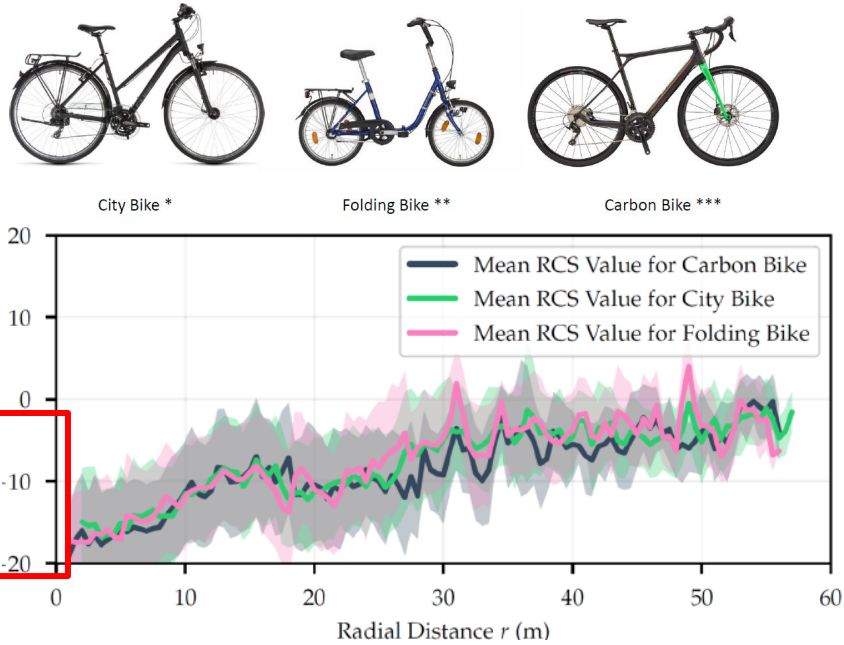
$$EIRP = 10dBm + 16,6dBi - 5,9dB = \mathbf{20,7dBm}$$

**The maximum average EIRP permitted by ARIB standard is significantly lower than ETSI and FCC regulations.** In order to comply with the ARIB standard BOSCH must reduce conducted power of the Bosch front radar Gen.5 MMIC devices. This leads to significantly reduced performance (less sensitivity) of this device in Japan as shown on next pages.

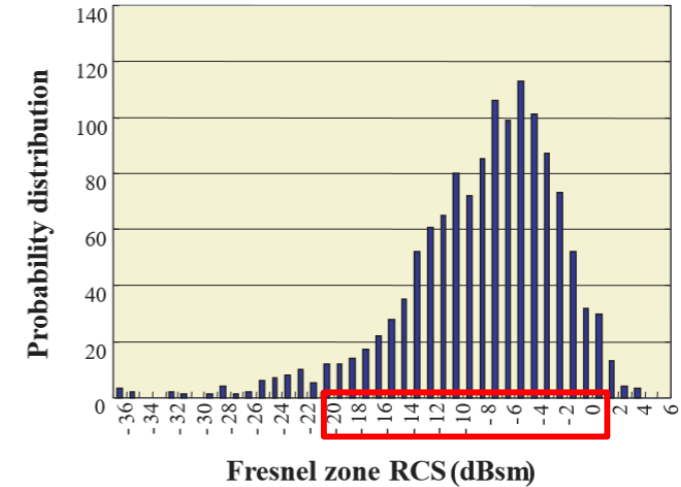
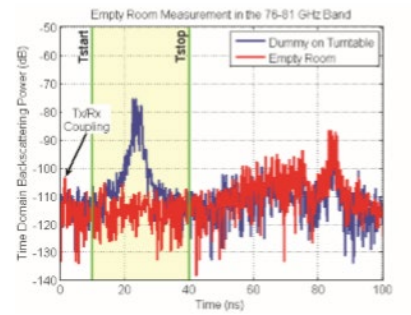
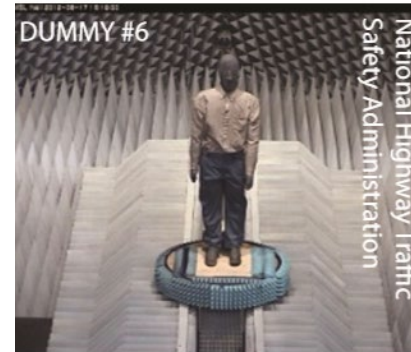
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## RCS considerations for small objects

### Bicycle



### Pedestrian



Vulnerable objects such as Pedestrians and Bicycles have very small RCS

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## Antenna gain discussion

- ▶ EIRP can be derived as a sum of transmitter output power  $P_{TX}$  and transmitter antenna gain  $G_{TX}$ .
- ▶ Japanese regulation allows  $P_{TX} \leq 10\text{dBm}$  and  $G_{TX} \leq 40\text{dBi}$ . This enables total EIRP=50dBm, which is comparable to ETSI and FCC regulations. However, a 40 dBi antenna gain is impractical in automotive application. It requires large 3D structures like horn or parabolic, with minimum diameter of 18cm and such radar could not be easily integrated in a vehicle.
- ▶ Additionally beam of such antenna is **very narrow**, **limiting field of view** of the radar and its general performance to an unacceptable level.



40dBi, 76,5GHz parabolic antenna  
20cm diameter



40dBi, 76,5GHz horn antenna  
18cm diameter



Bosch Gen5 radar sensor  
16dBi micro-strip antenna  
Dimensions: 7cm x 6cm x 2 cm

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## Impact of regulation limits on radar performance

- ▶ Table below presents possible detection range of various objects by mid range front radar device under ARIB, ETSI and FCC regulations based on ETSI TR 103 593 V1.1.1 Table C.5.

Standard	Maximum detection range [m]				
	Small child	Pedestrian	Bicycle	Motorcycle	Car
ARIB STD-T48 <sup>1)</sup>	25	30	39	53	94
ETSI EN 301 091-1 or FCC CFR 47 Part 95 <sup>2)</sup>	33	39	53	70	125

- ▶ ETSI and FCC regulations allow higher EIRP output enabling larger detection range. Therefore vehicle driver or vehicle system has more time available for reaction. Higher output power leads to better safety on road.

1) Example of  $P_{TX}$ : 10dBm, EIRP: 25dBm.

2) Example of  $P_{TX}$ : 15dBm, EIRP: 30dBm.



# Radar regulation 76-77GHz in JAPAN

## Summary

- ▶ The maximum average EIRP permitted by ARIB standard is significantly lower than ETSI and FCC regulations. In order to comply with the ARIB standard, Bosch must reduce conducted power of the Front Radar MMIC devices. This leads to significantly reduced performance (less sensitivity) of this device in Japan.
- ▶ The performance reduction affects detection range of vulnerable objects (Motorcycle, Bicycle, Pedestrian) with low RCS and reaction timing for crash avoidance.
- ▶ International harmonization of radar regulation enhances further utilization of radar, which may enhance safety in roads and advanced driving assistance for drivers.