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24 GHz QRM part 2

NTMS

Oct 12, 2024

KM5PO

24 GHz QRM

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- 24 (24.050 – 24.250) GHz is shared with:
  - Part 15 “RF Devices” *Field Disturbance Sensor*
  - Part 18 “ISM Equipment”
  - Part 90 “Private Land Mobile”

eCFR :: 47 CFR Part 15 -- Radio Frequency Devices

eCFR :: 47 CFR Part 18 -- Industrial, Scientific, and Medical Equipment

eCFR :: 47 CFR Part 90 -- Private Land Mobile Radio Services

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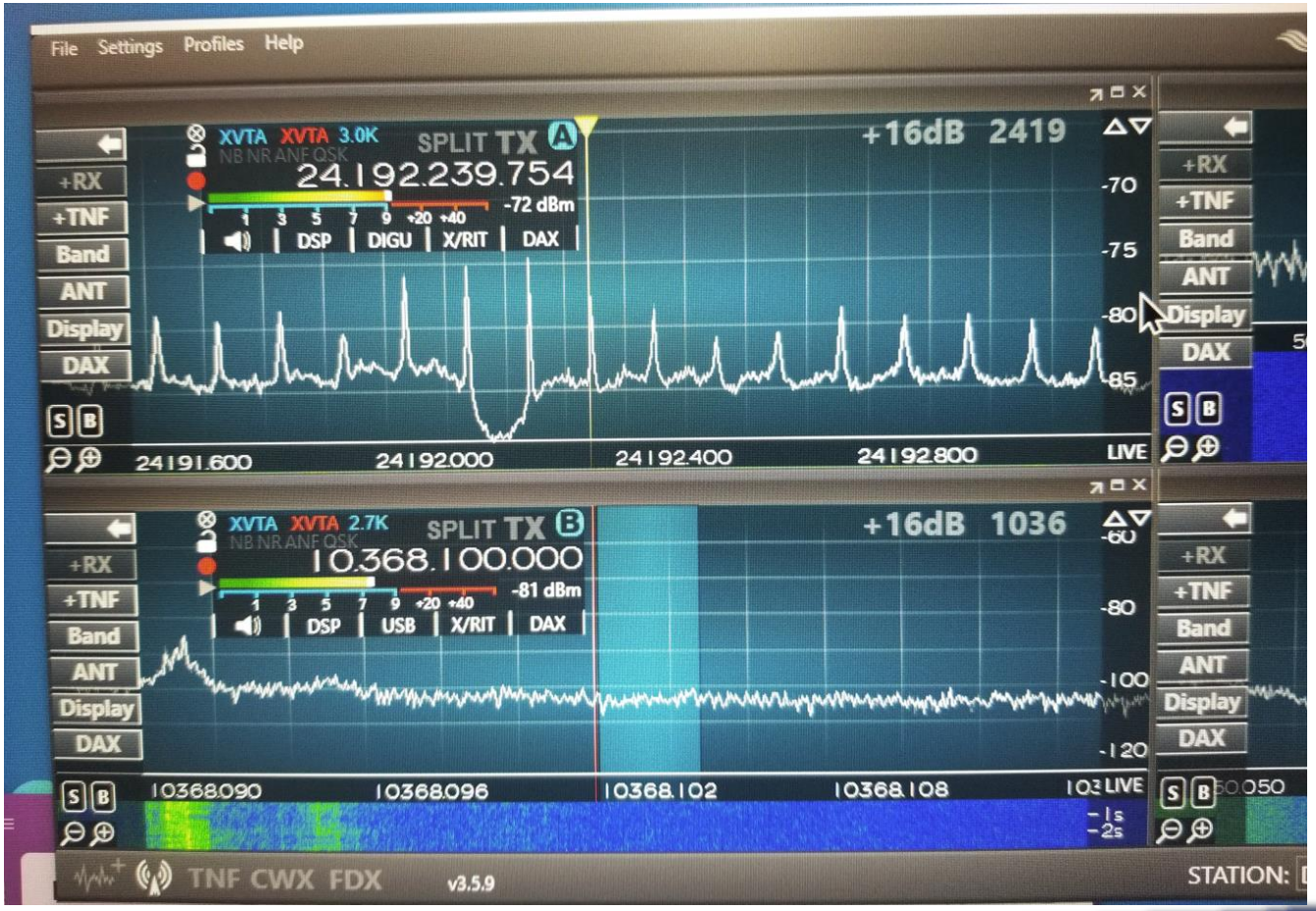
QRM at W5LUA looking 38 degrees



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The 24 GHz Dir Find team

Matthew Kube W5ZCA and Richard Burger AG5XW

24 GHz Wavelab sniffer in foreground

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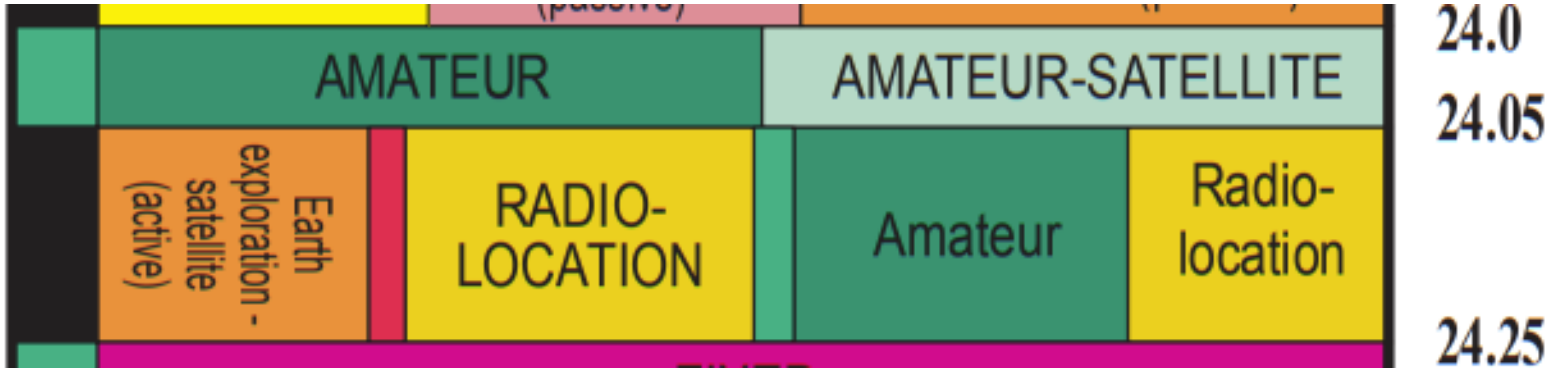
Shared 24 GHz spectrum

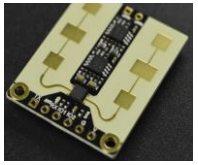
Table of Frequency Allocations	18.6-24.45 GHz (SHF)		Page 53
International Table	United States Table		FCC Rule Part(s)
24-24.05 AMATEUR AMATEUR-SATELLITE 5.150	24-24.05 5.150 US211	24-24.05 AMATEUR AMATEUR-SATELLITE 5.150 US211	 ISM Equipment (18) Amateur Radio (97)
24.05-24.25 RADIOLOCATION Amateur Earth exploration-satellite (active) 5.150	24.05-24.25 RADIOLOCATION G59 Earth exploration-satellite (active) 5.150	24.05-24.25 Amateur Earth exploration-satellite (active) Radiolocation 5.150	 RF Devices (15) ISM Equipment (18) Private Land Mobile (90) Amateur Radio (97)



Two DUTs

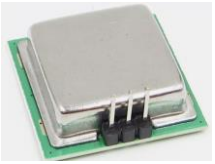
Two common 24 GHz “human presence” radar units were tested.

DfRobot SEN0395



Parameterl	Value
Freq	24.125-24.250
Oper V	3.6-5v
Oper Cur	90 mA
Modulation	FMCW,CW
Pwr output	13-15 dBm
IF	uProc serial

CDM 324



Parameter	Value
Freq	24.125-24.250
Oper V	5.5v
Oper Cur	30 mA
Modulation	CW pulse
Pwr output	16 dBm
IF	-300 to +300 mV

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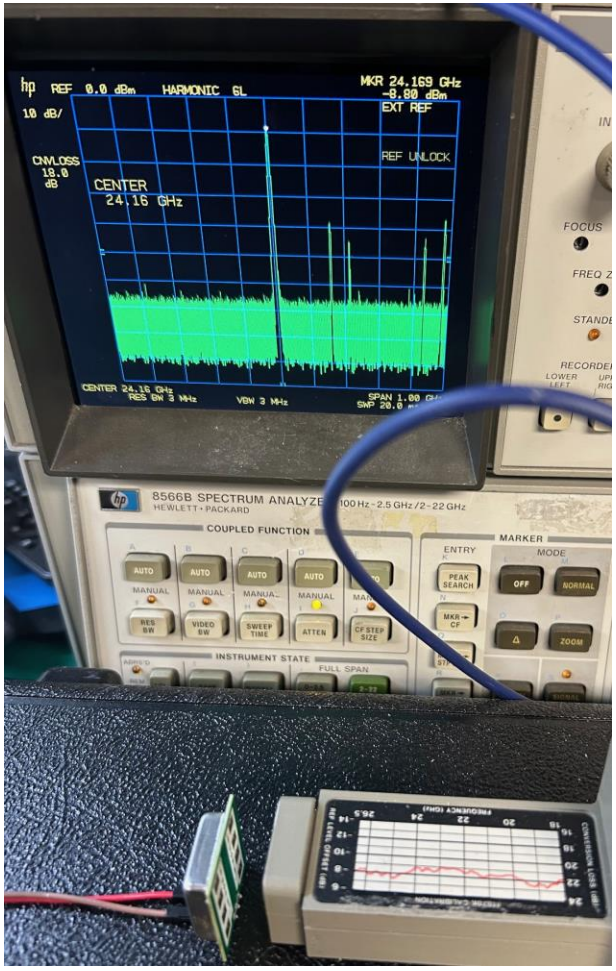
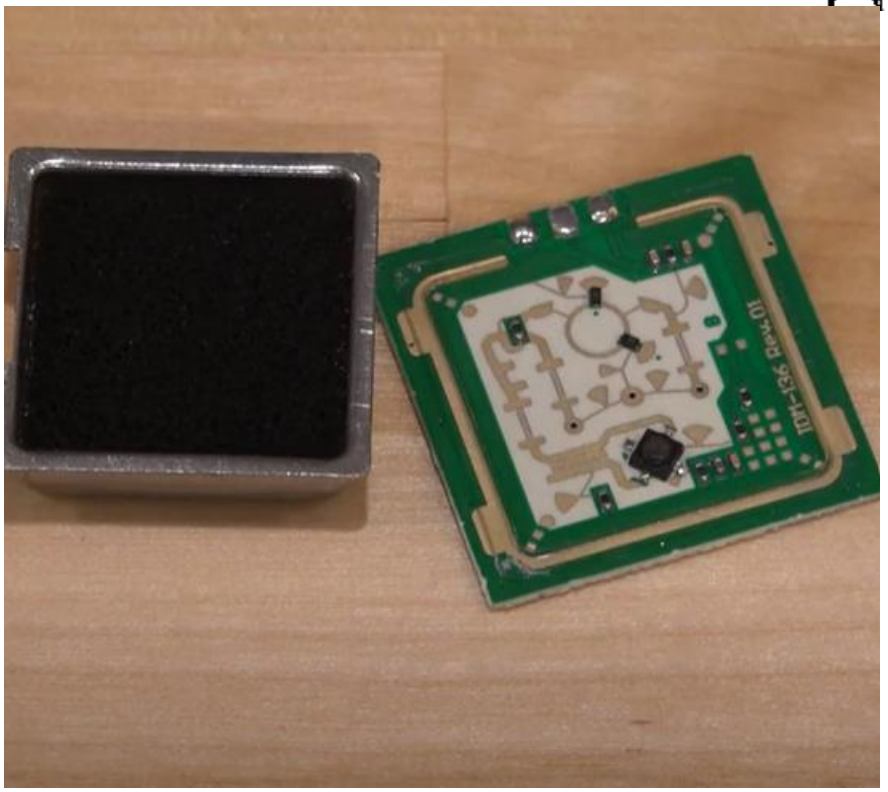
CDM 324





https://www.youtube.com/watch?v=5vqSX40seqA&t=173s

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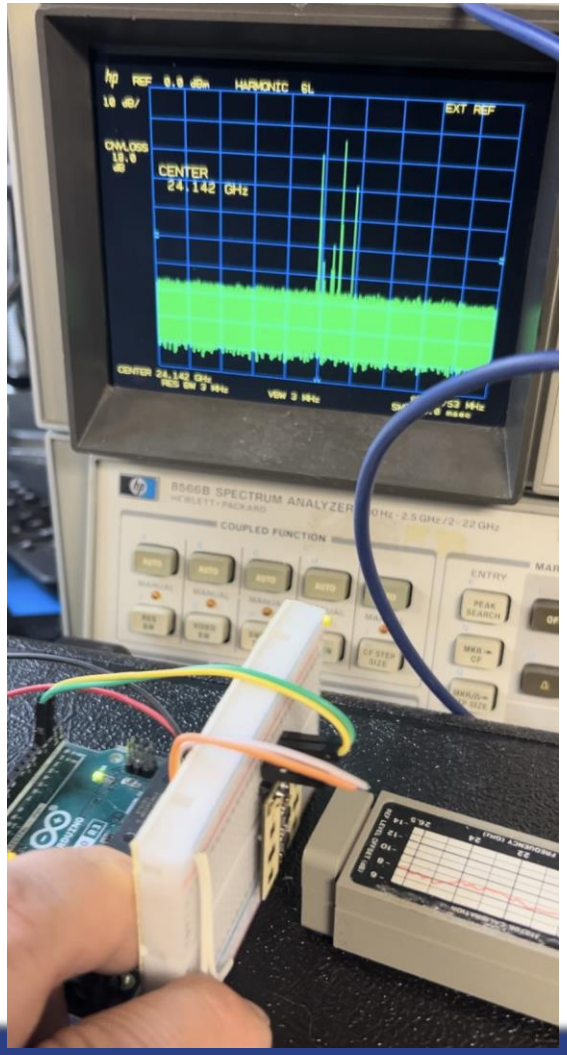
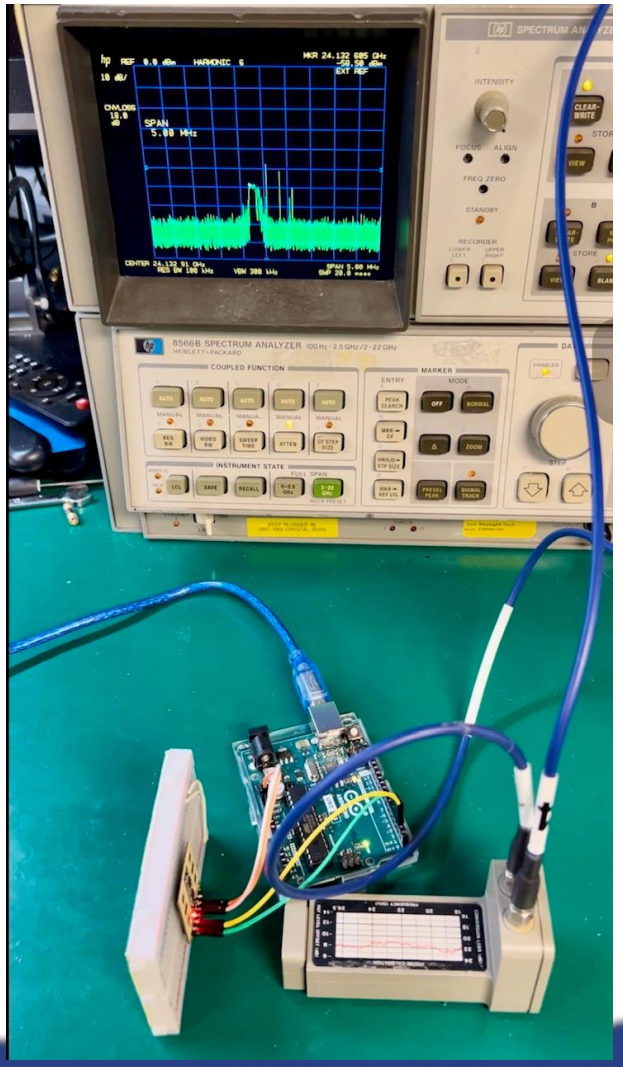
DfRobot SEN0395





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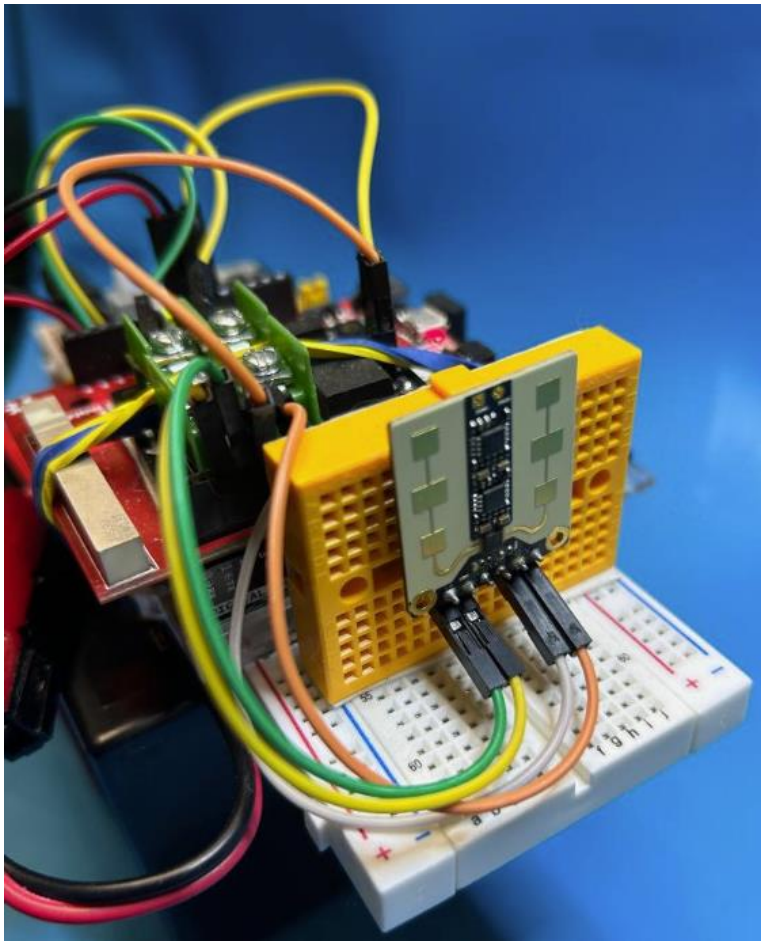
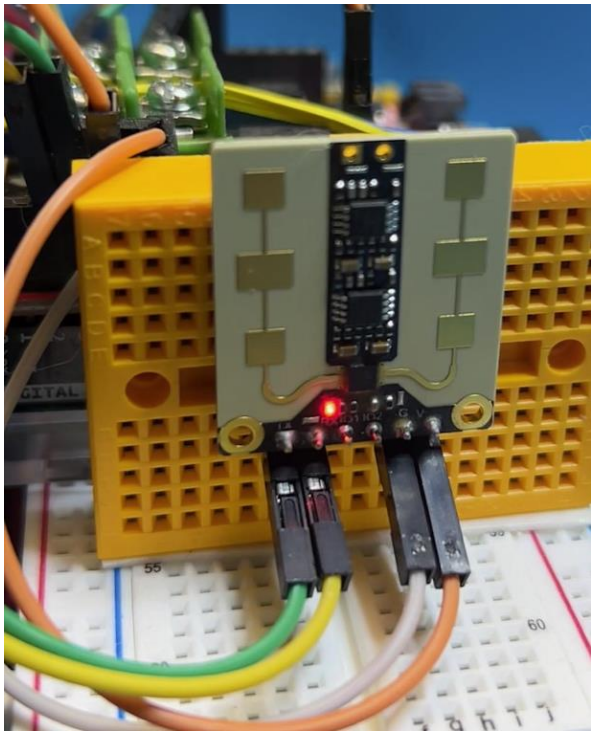
DfRobot SEN0395





QRM generator remote controlled via Halogram cell connectivity

SEN0395 Wide Band signal

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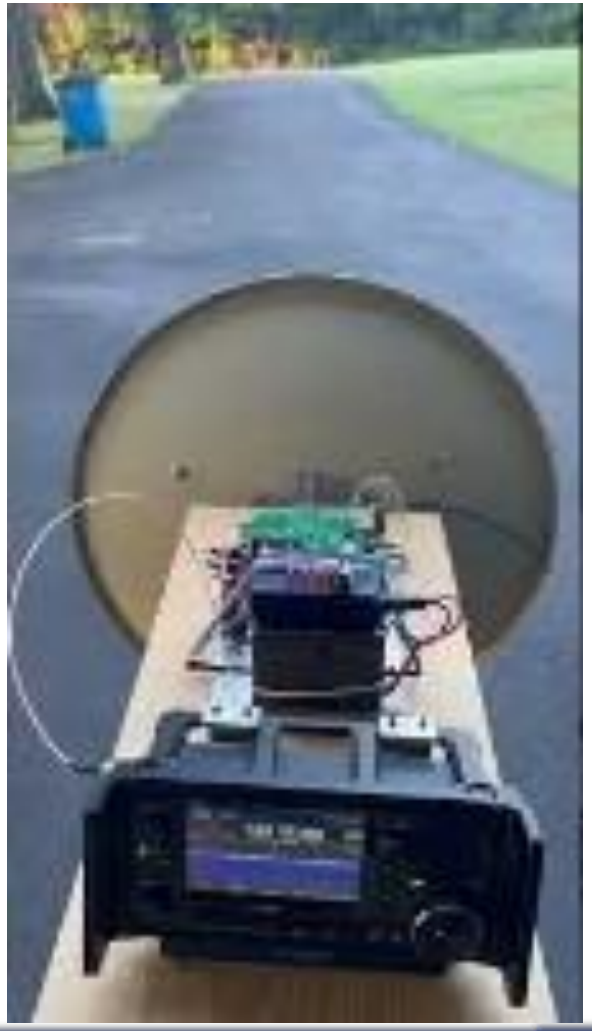

Noise blanker – Noise reducer effectivness

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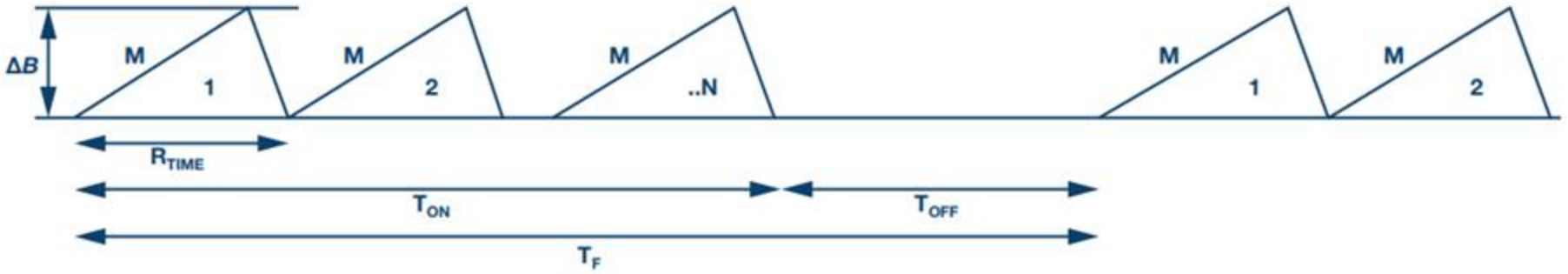
FMCW – Radar equations



$$\text{Range Resolution } \Delta R = \frac{C}{2 \times \Delta B}$$

$$\text{Velocity Resolution } \Delta V = \frac{\lambda}{2 \times N \times R_{TIME}}$$

$$\text{Angle Resolution } \Delta\theta = \frac{\lambda}{D}$$

M: FFT points for range determination
N: FFT points for velocity determination
T_{ON} (dwell time): time of transmit antenna is working
T_{OFF}: time of transmit antenna is not transmitting
R_{TIME}: total (up + down) time for each ramp
D: width of antenna receive array
λ: transmitted wavelength

[24 GHz Demorad Radar Solutions Enable New Contactless Sensors for Emerging Industrial Mass Market | Analog Devices]

24 GHz QRM

- What we know
  - 24 GHz proximity alert devices are showing up *on the doorstep*
  - 24 GHz and now 77 GHz is a multi billion dollar industry in the ADAS sector alone
  - 24 GHz also includes the ISM band from 24.0 to 24.250 (TI calls this the “narrow band”)
  - 24 GHz includes an ultra wide band which is 5 GHz wide

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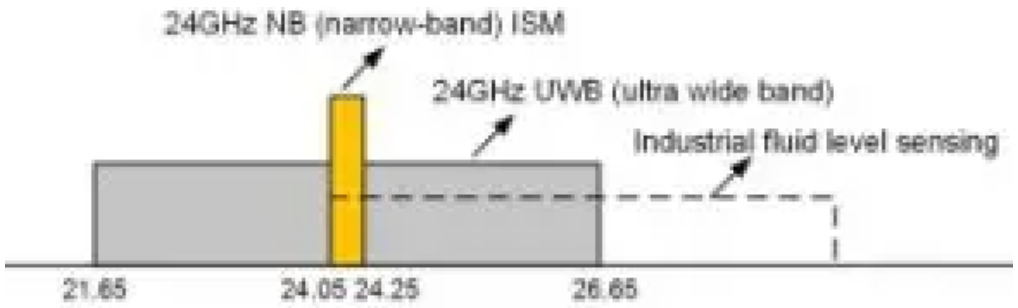
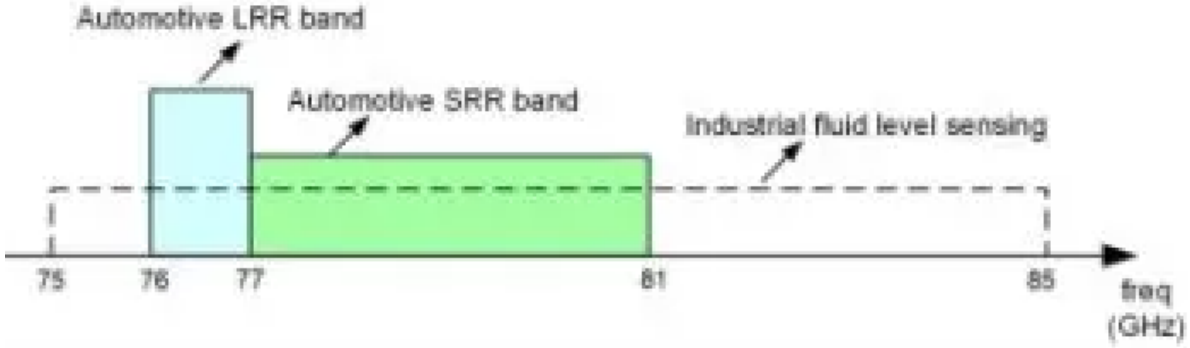
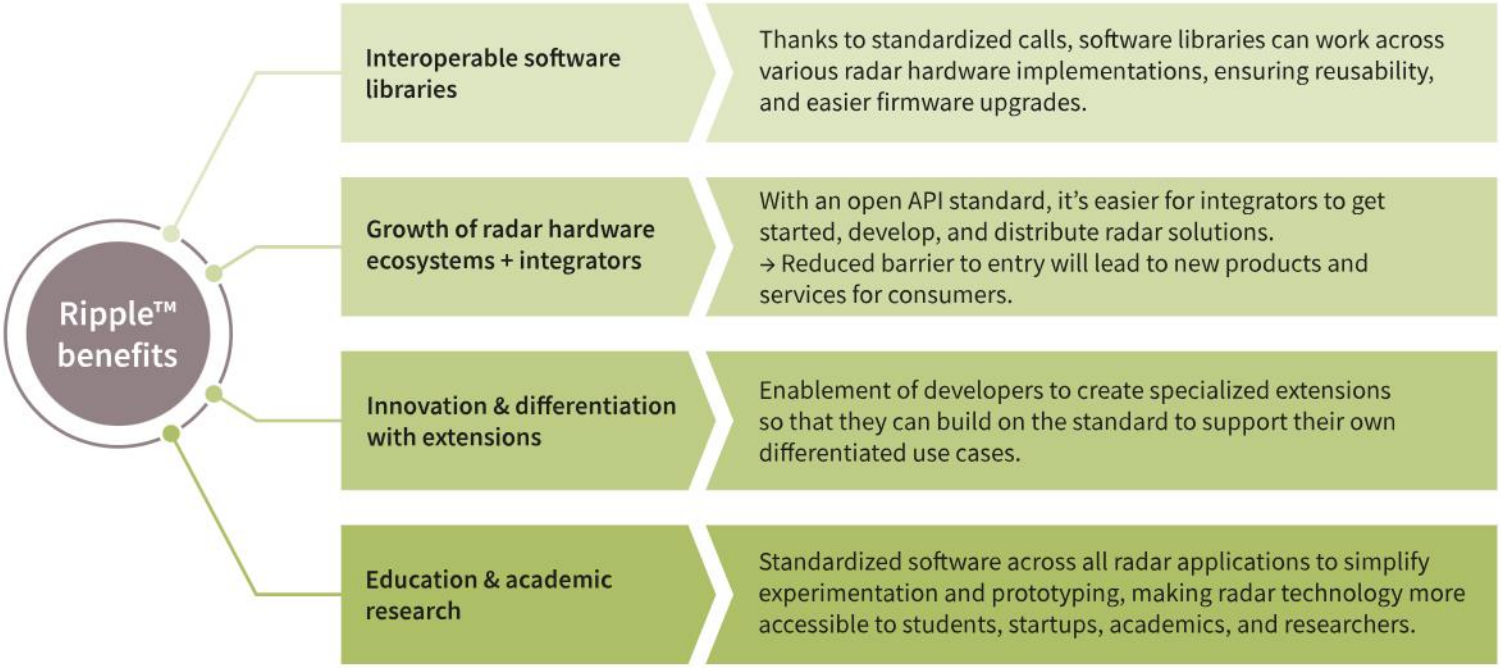




Infineon standardizing the API

Benefits of Ripple™



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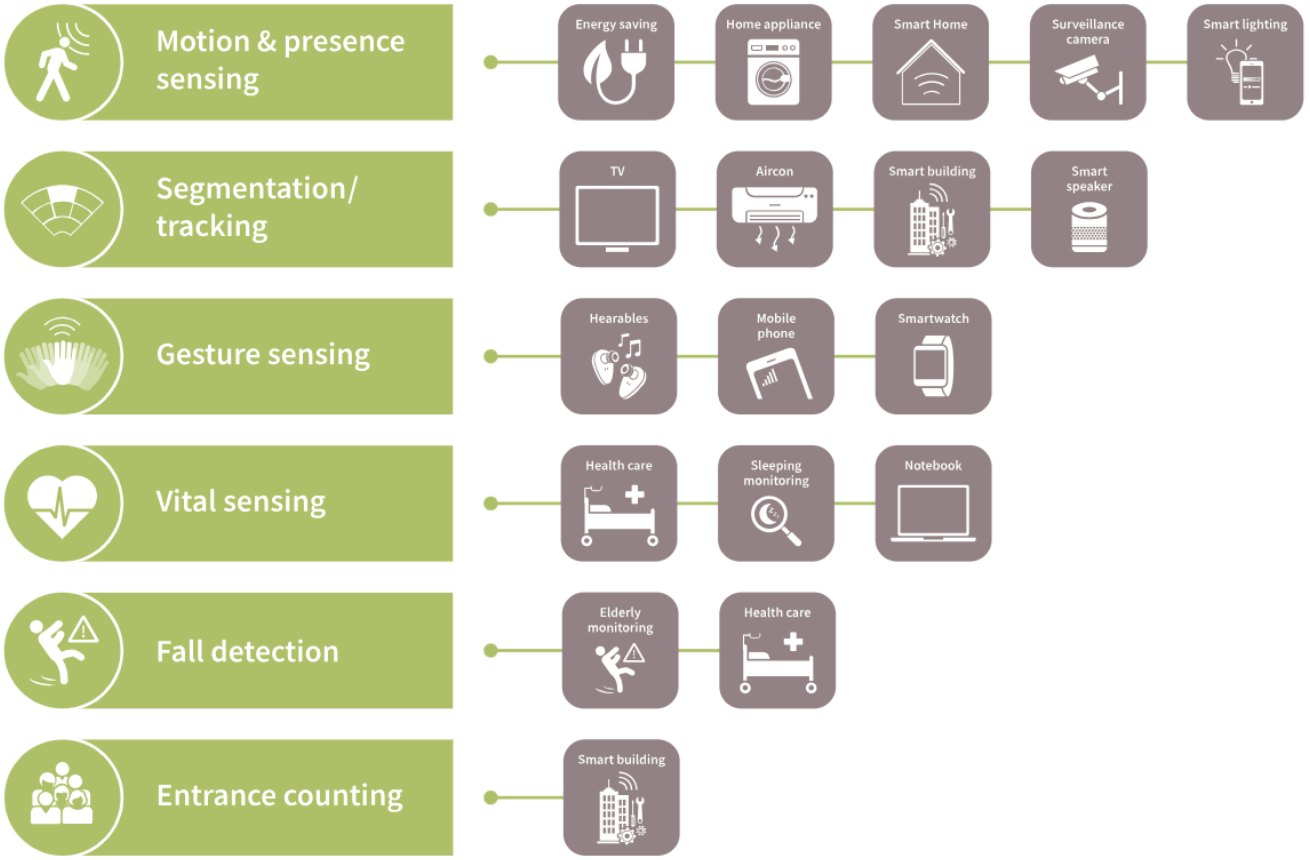
Some uses (from Infineon)



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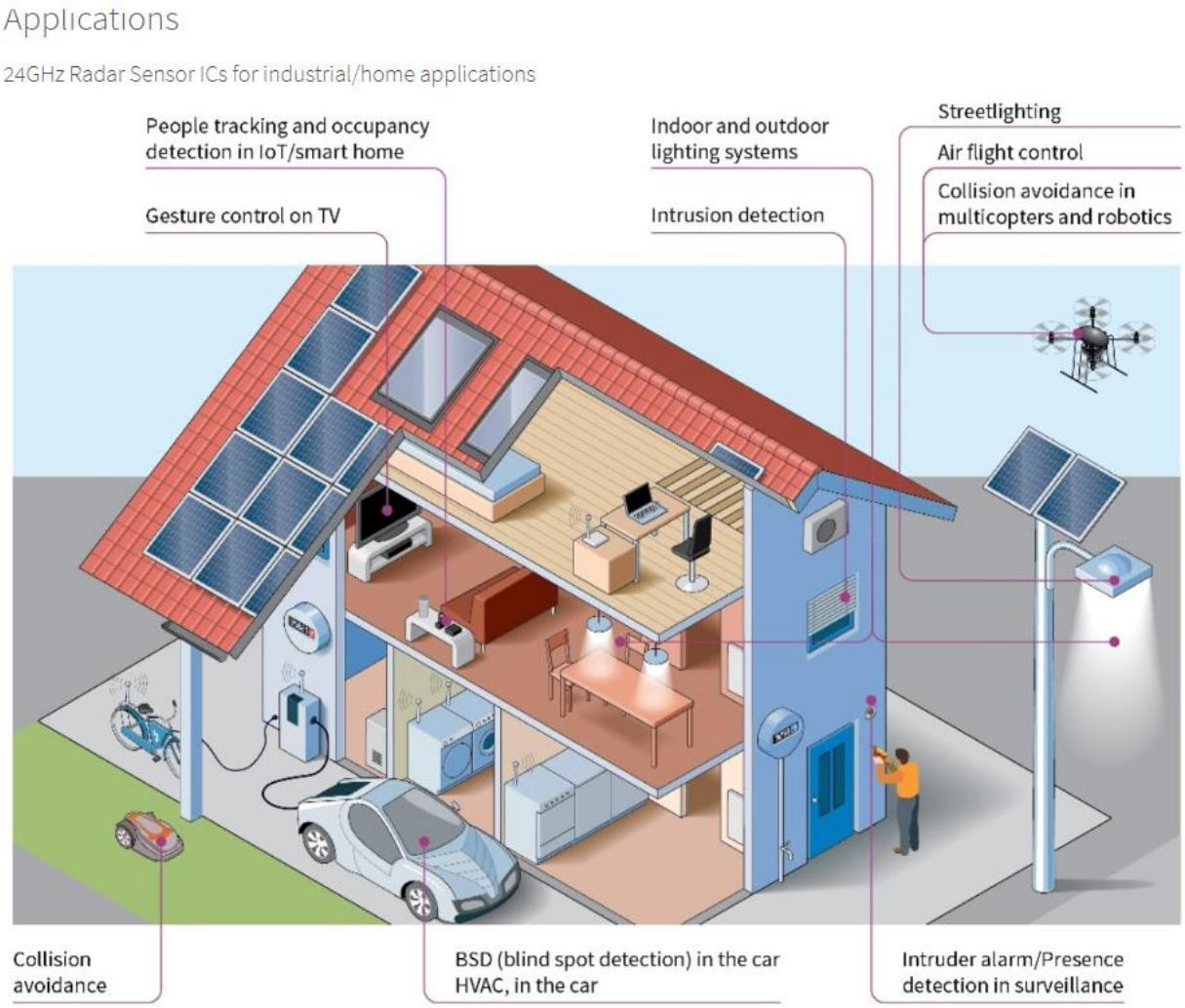
Applications



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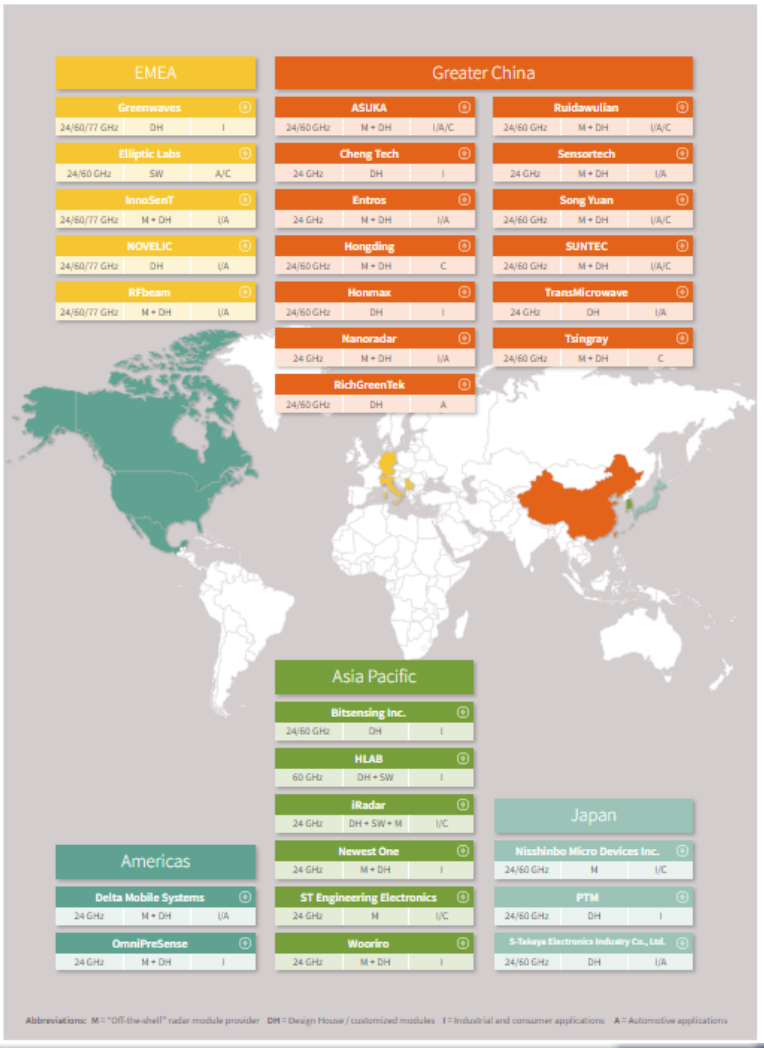
Just a few of the vendors

Radar partner ecosystem at a glance including design house partners



Few more vendors

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Manufacturer	Part	Freq	Output
Infineon Technologies	BGT24ATR11	24.0-24.25 GHz	11 dBm
Analog Devices	ADF5901	24.0-24.25 GHz	8 dBm
STMicroelectronics	STRADA431	24.0-24.25 GHz	13 dBm
AutoLiv	Various	24.5 but 1GHz UWB	10 dBm
Calterah Semiconductor	Various	Moving to 60/77 GHz for “$10B” market - 2024	

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References:

Texas Instruments (above 24 GHz) Automotive mmWave radar sensors | TI.com

Analog Devices (ADF5901) ADF5901 Datasheet and Product Info | Analog Devices

Infineon 24GHz radar sensors - Infineon Technologies

DfRobot mmWave Radar - 24GHz Human Presence Detection Sensor (9 Meters) - DFRobot

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Questions?