Research topics

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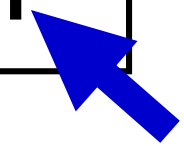
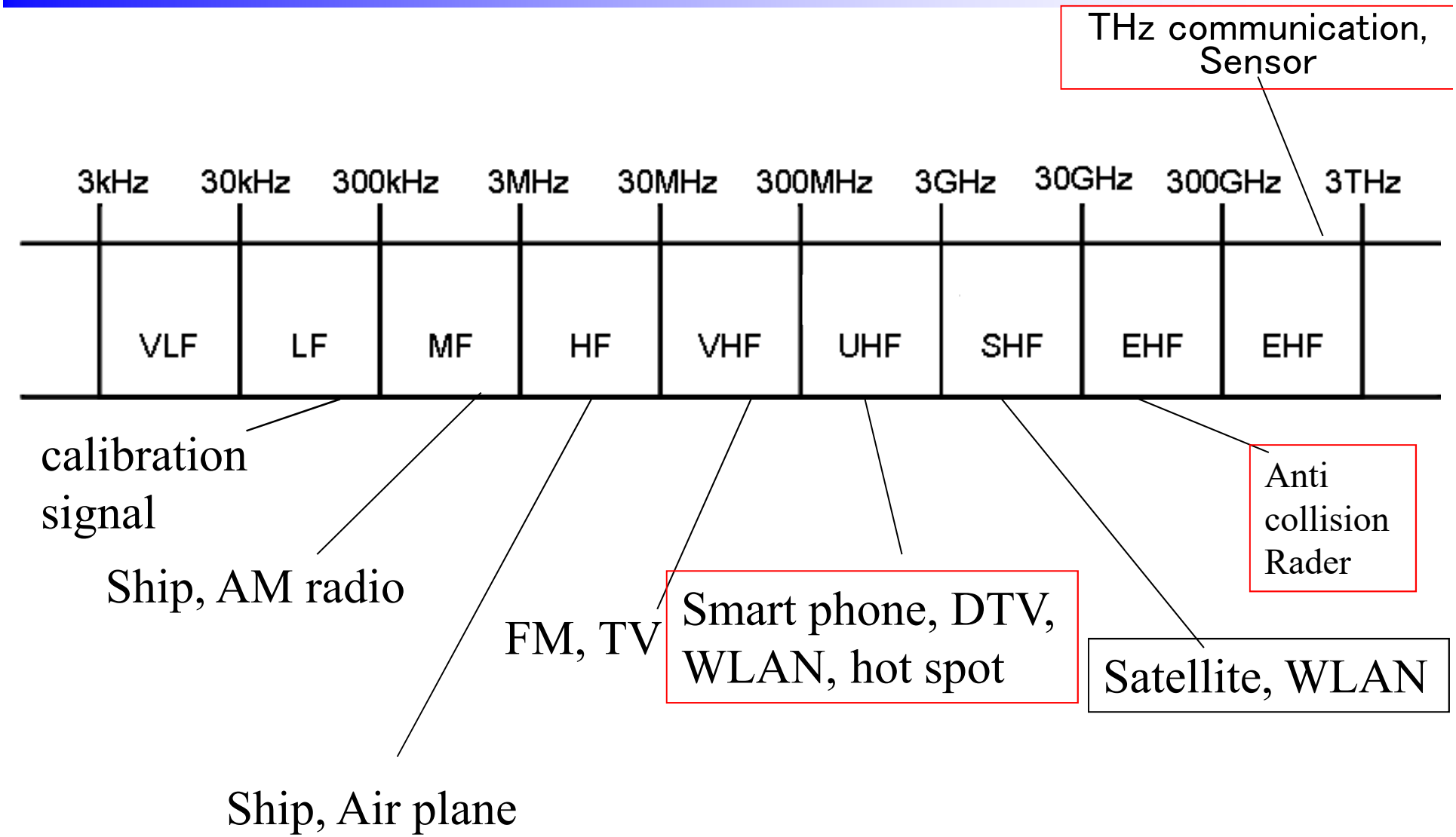
RFIC Japan



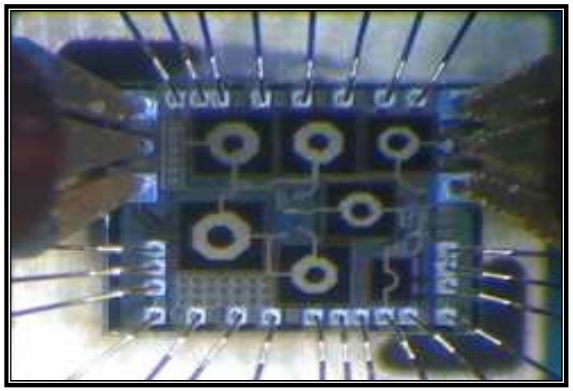
Frequency allocation

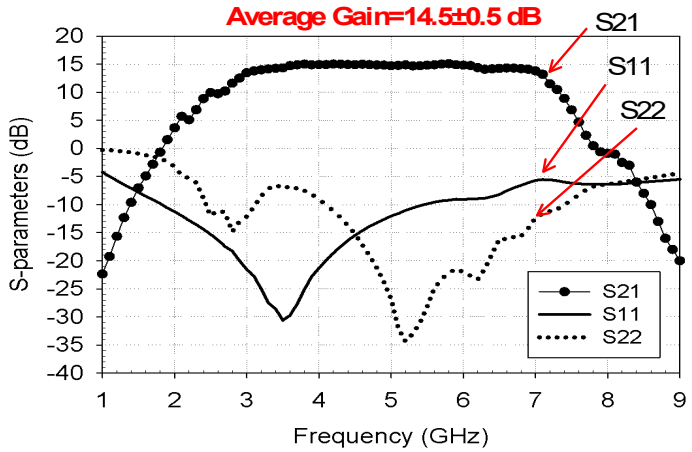


UWB Amplifiers

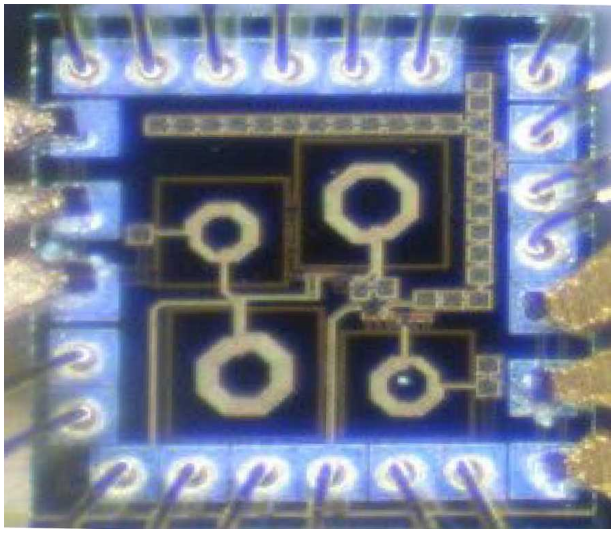
TSMC 0.18um CMOS

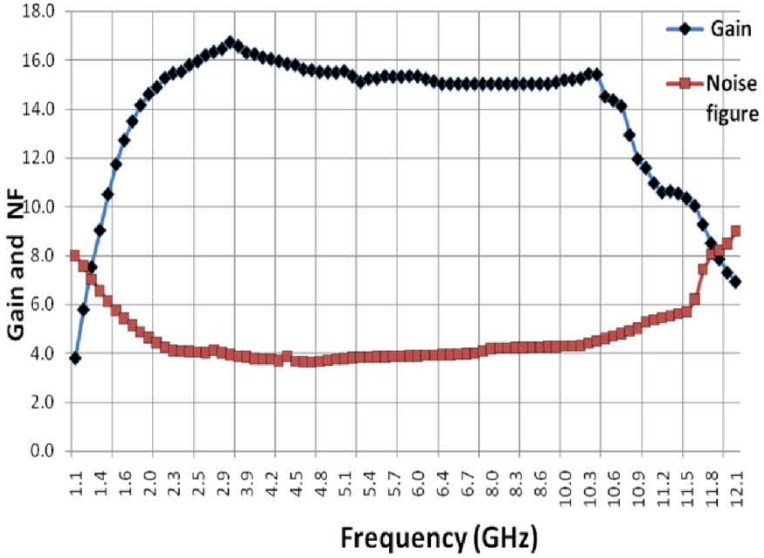
UWB Power Amplifier



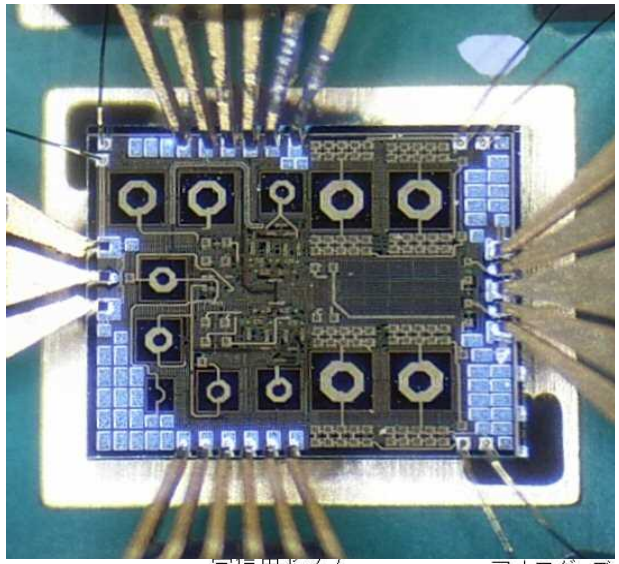


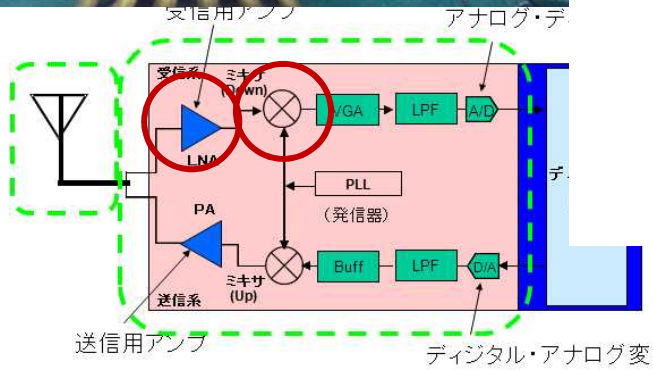
UWB Low Noise Amplifier



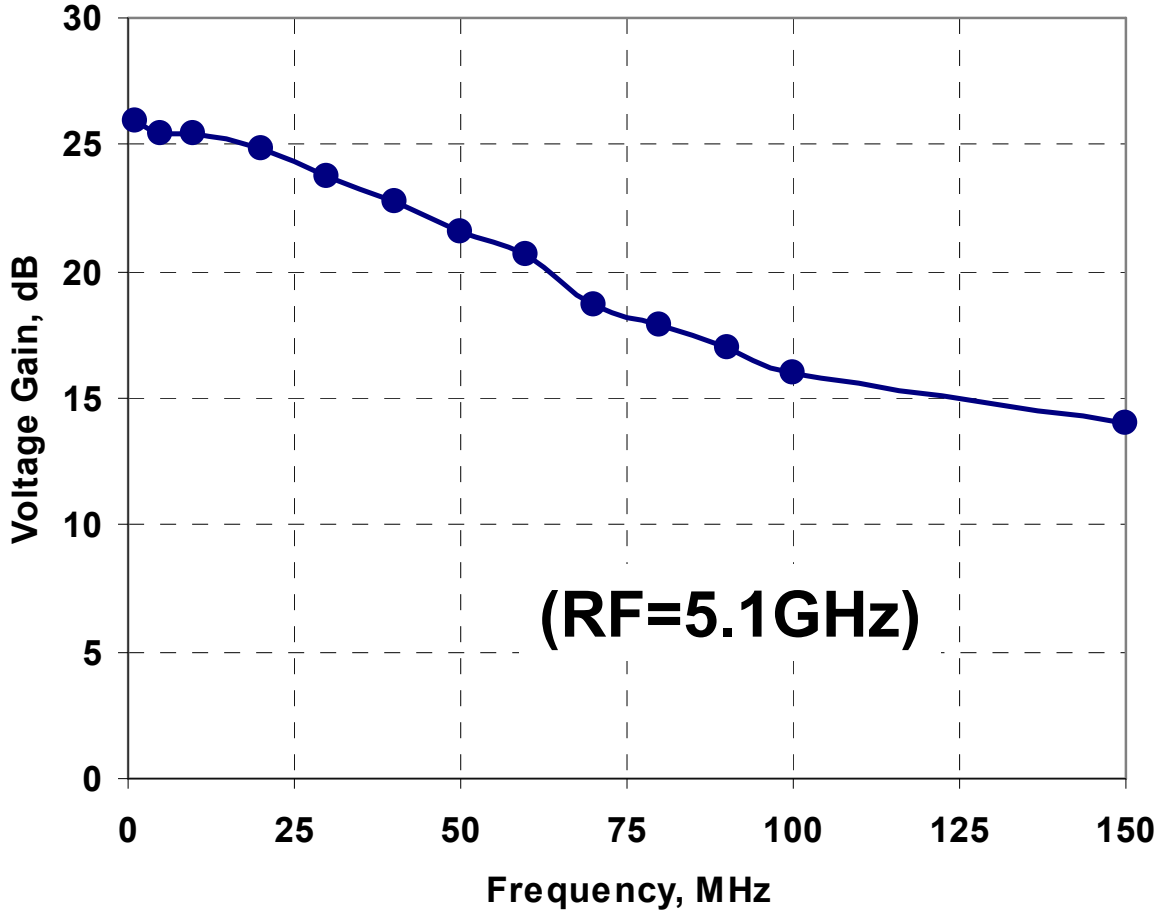


LNA-Mixer　(Down converter)



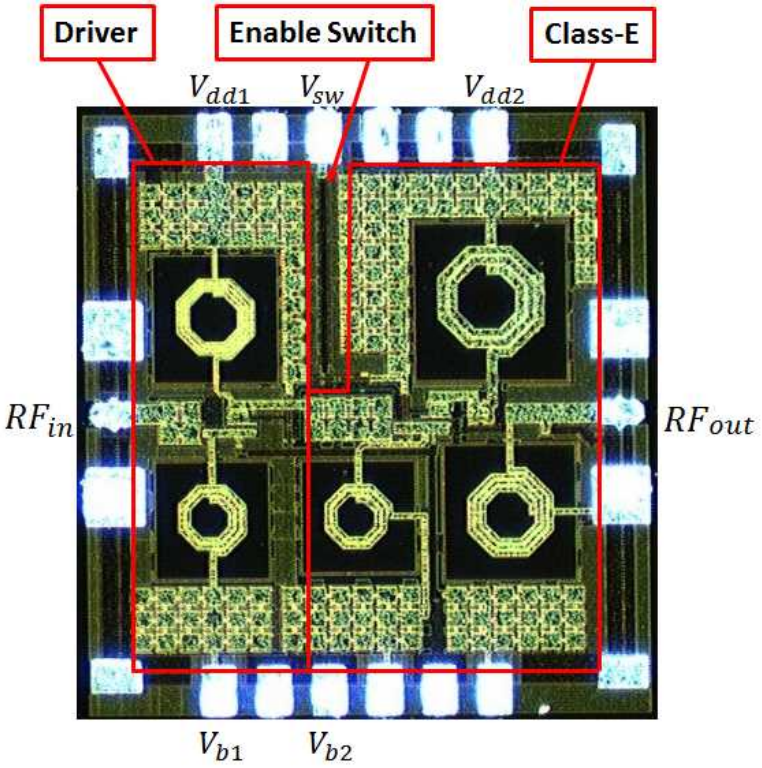


Measured Voltage Gain vs. IF frequency

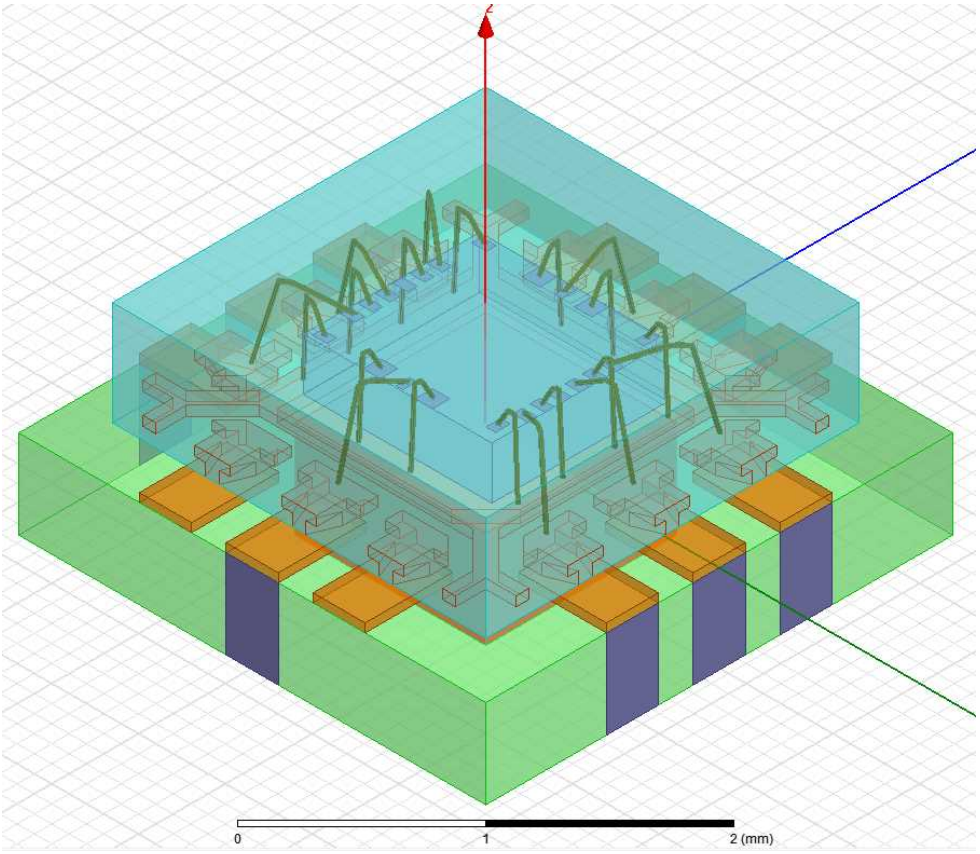


5GHz power amplifier module

Chip photo



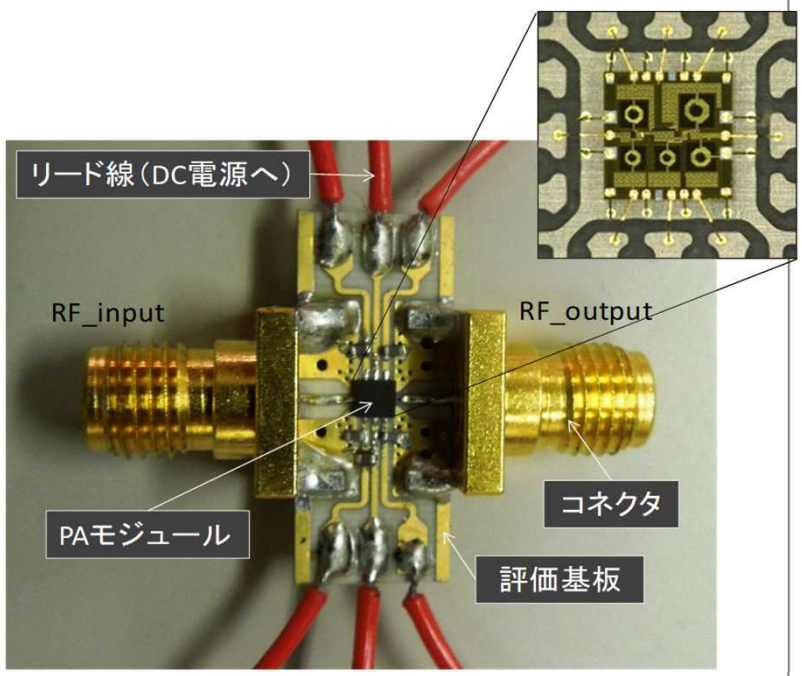
Packaging

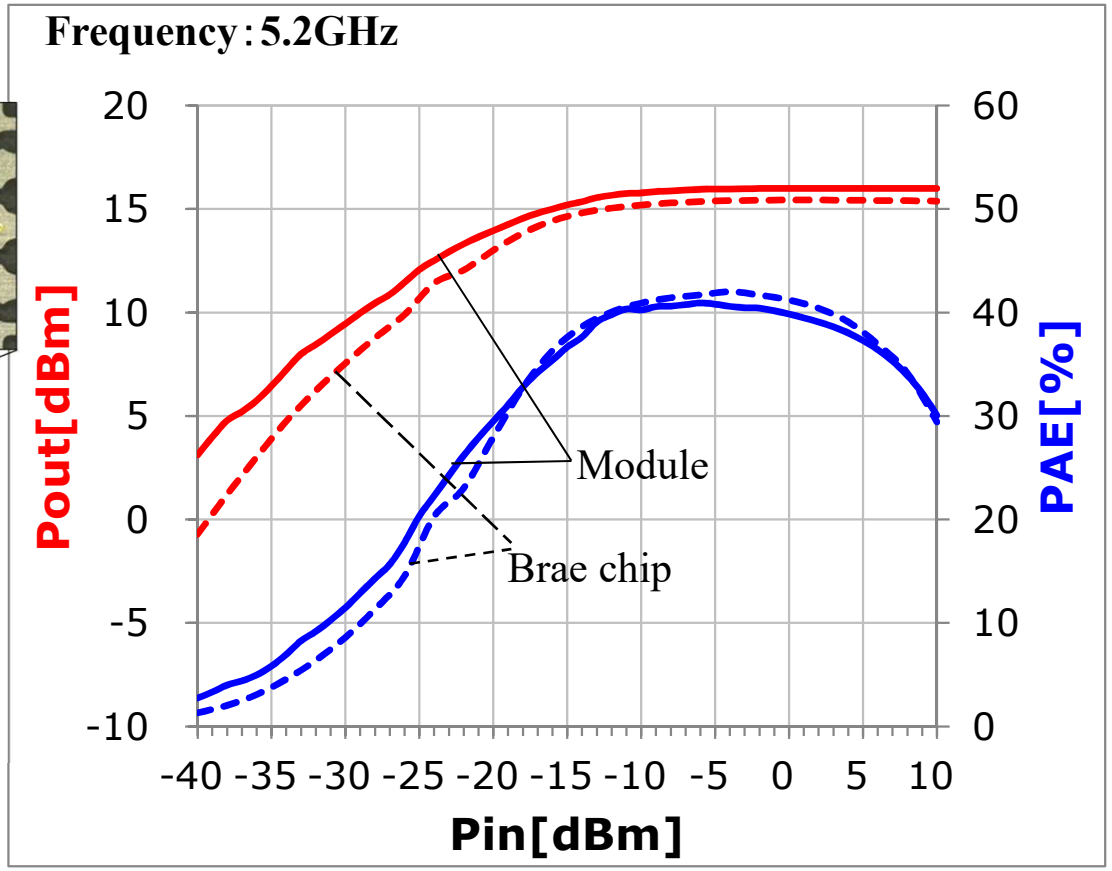


Chip size：0.9×0.9mm

CAD tools： ADS ， Vioruoso
Technorogy： TSMC 0.18μm CMOS

Measured results





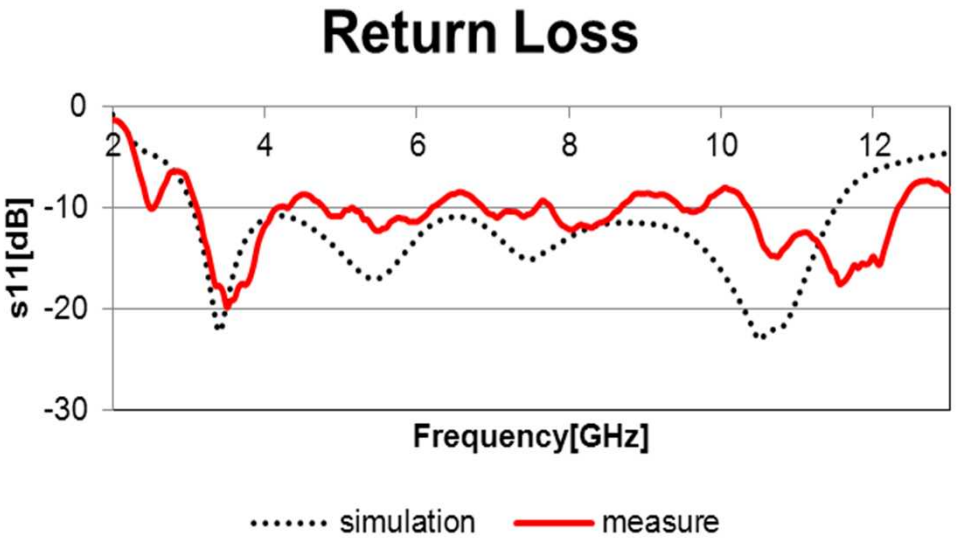
Input-output comparison

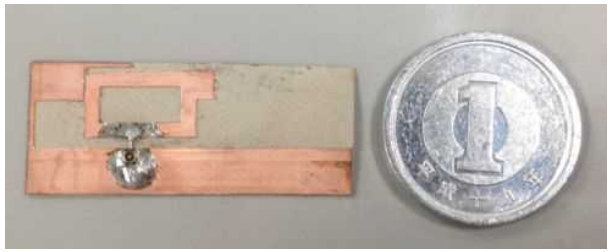
	Bare chip	Module
Pout[dBm]	15.4	15.9
PAE[%]	42.0	41.0

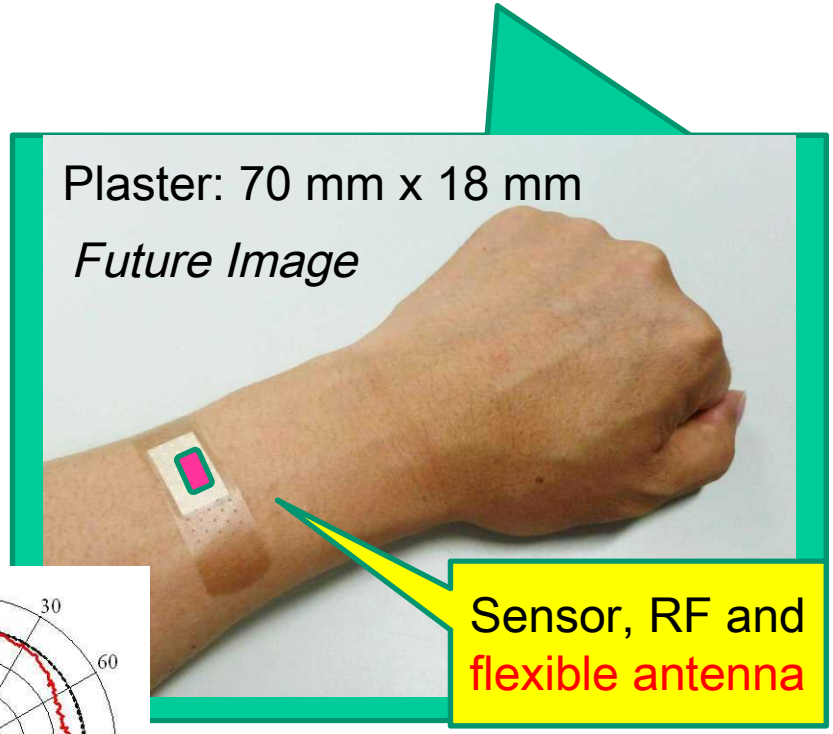
No performance degradation

Antenna design

UWB Full band antenna on flexible substrate

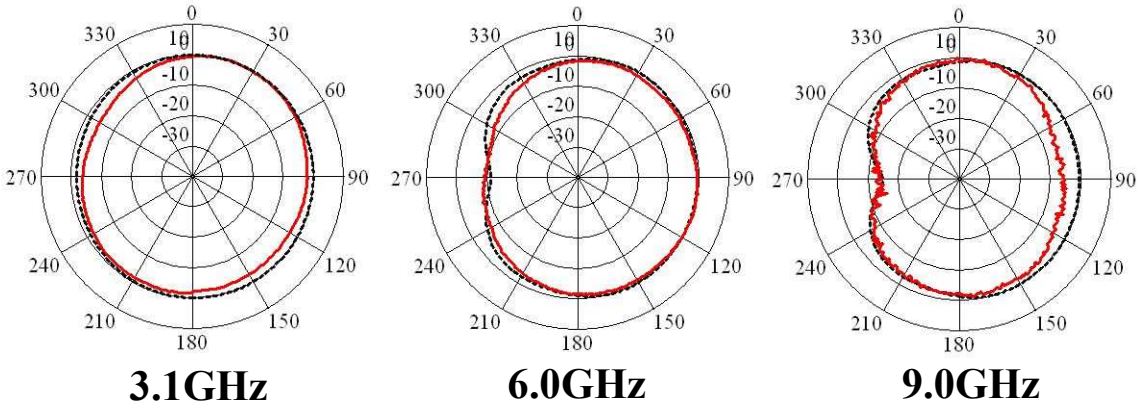






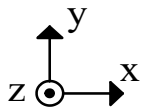
Bandwidth : 3.1~11.4GHz

Radiation patterns (yz plane)



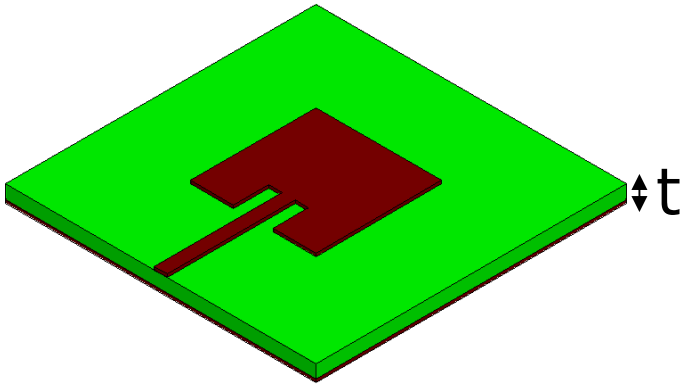
--- simulation

— measure

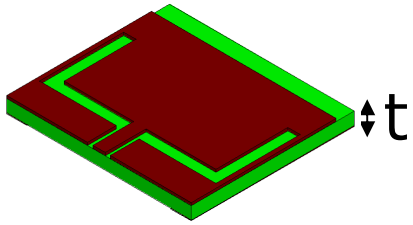


Comparison table

Patch antenna



One-sided directional slot antenna



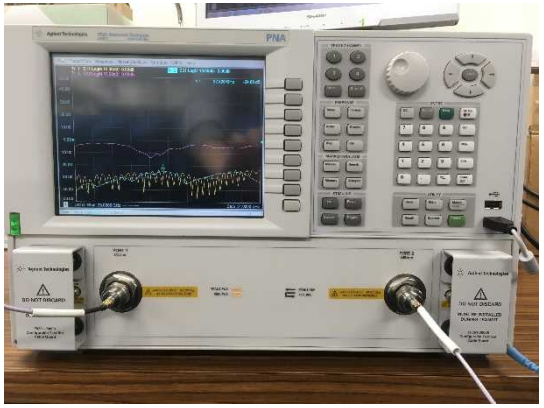
Size reduction (No large GND)
Thin substrate

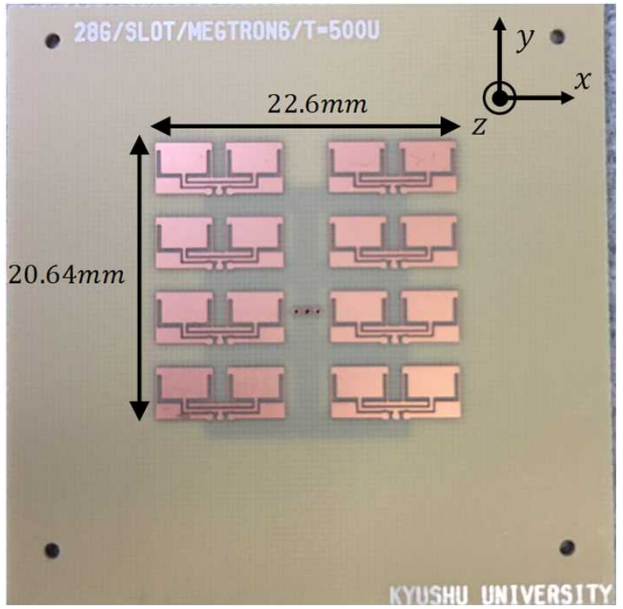
	Thickness t [μm]	100	150	200	300
One-sided directional slot	Gain [dBi]	3.35	3.73	5.29	5.62
Patch		-1.41	2.47	4.73	5.85

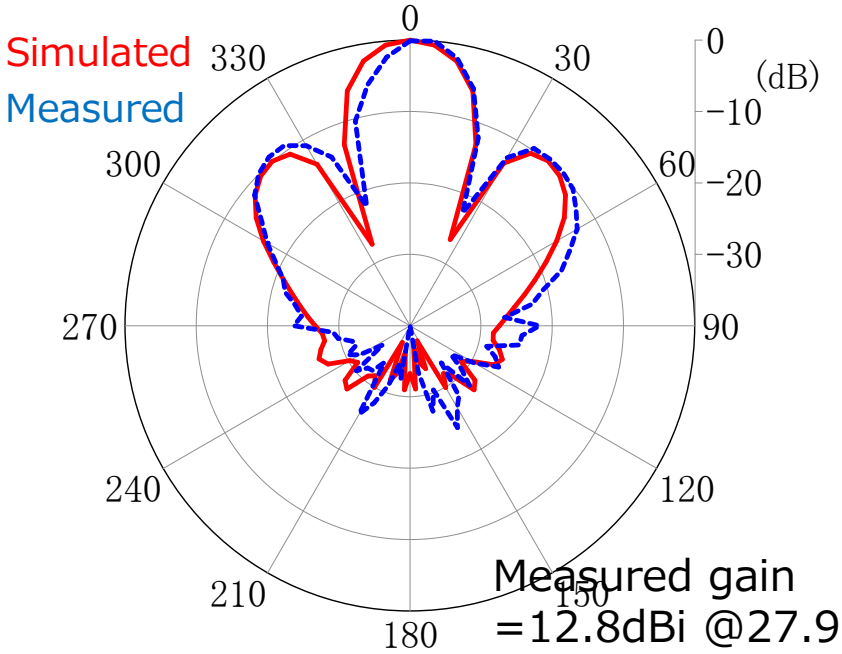
@28GHz

5G/beyond 5G 4x4 array antenna

5G







Measured gain
=12.8dBi @27.9 GHz

NTT docomo M2M system and Watching security system

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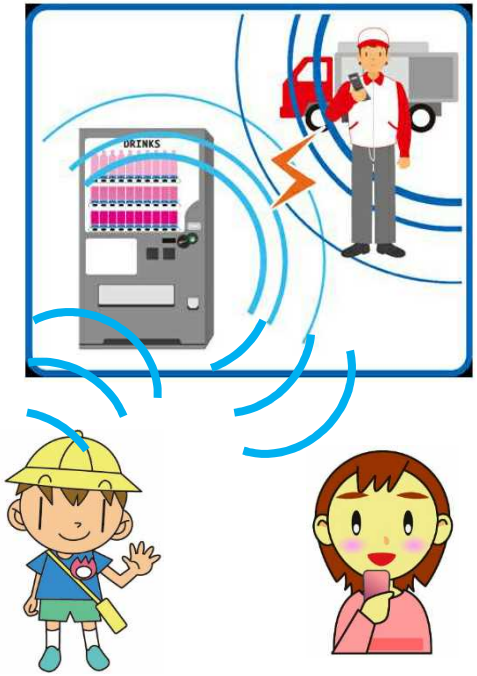
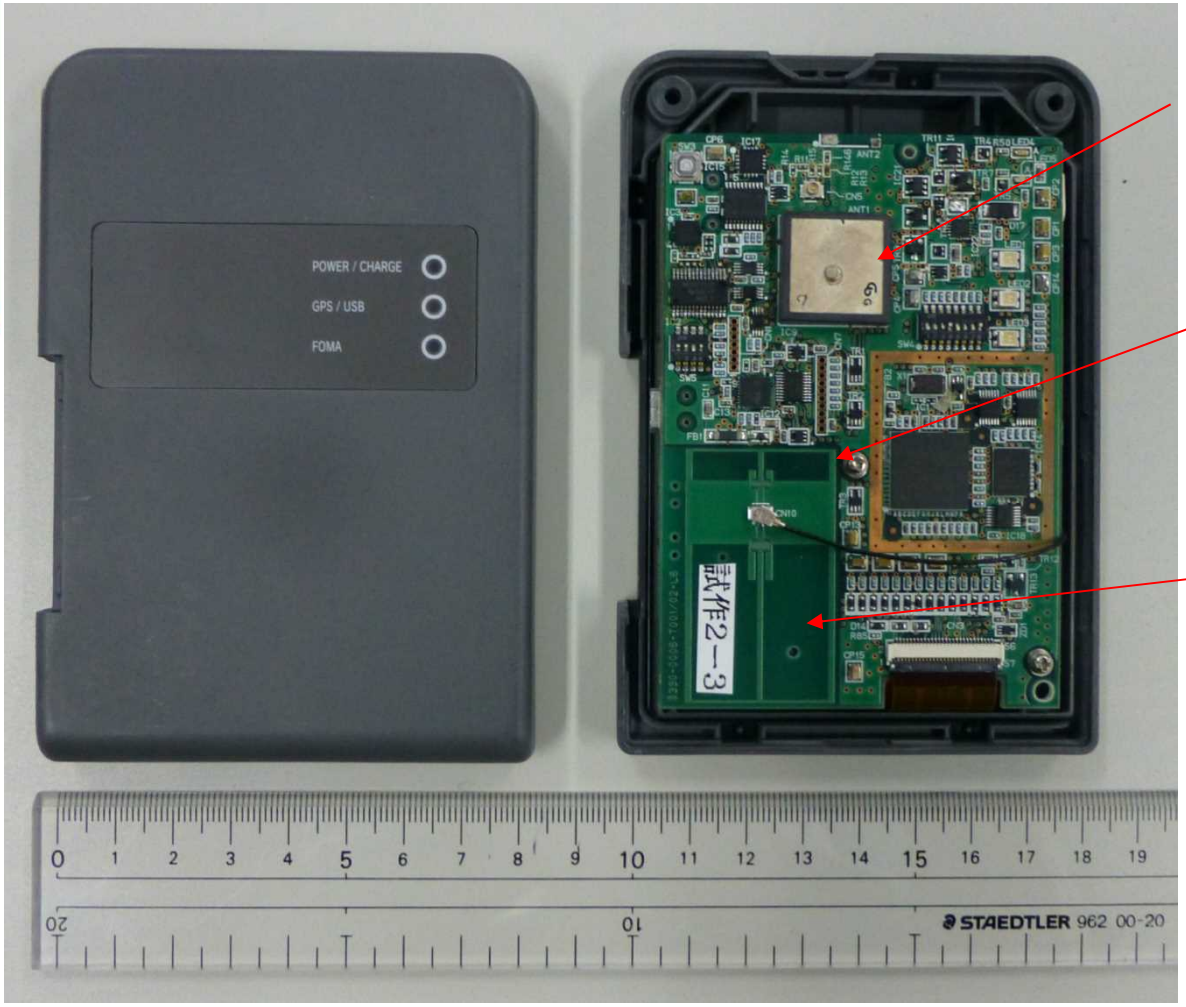
M2M

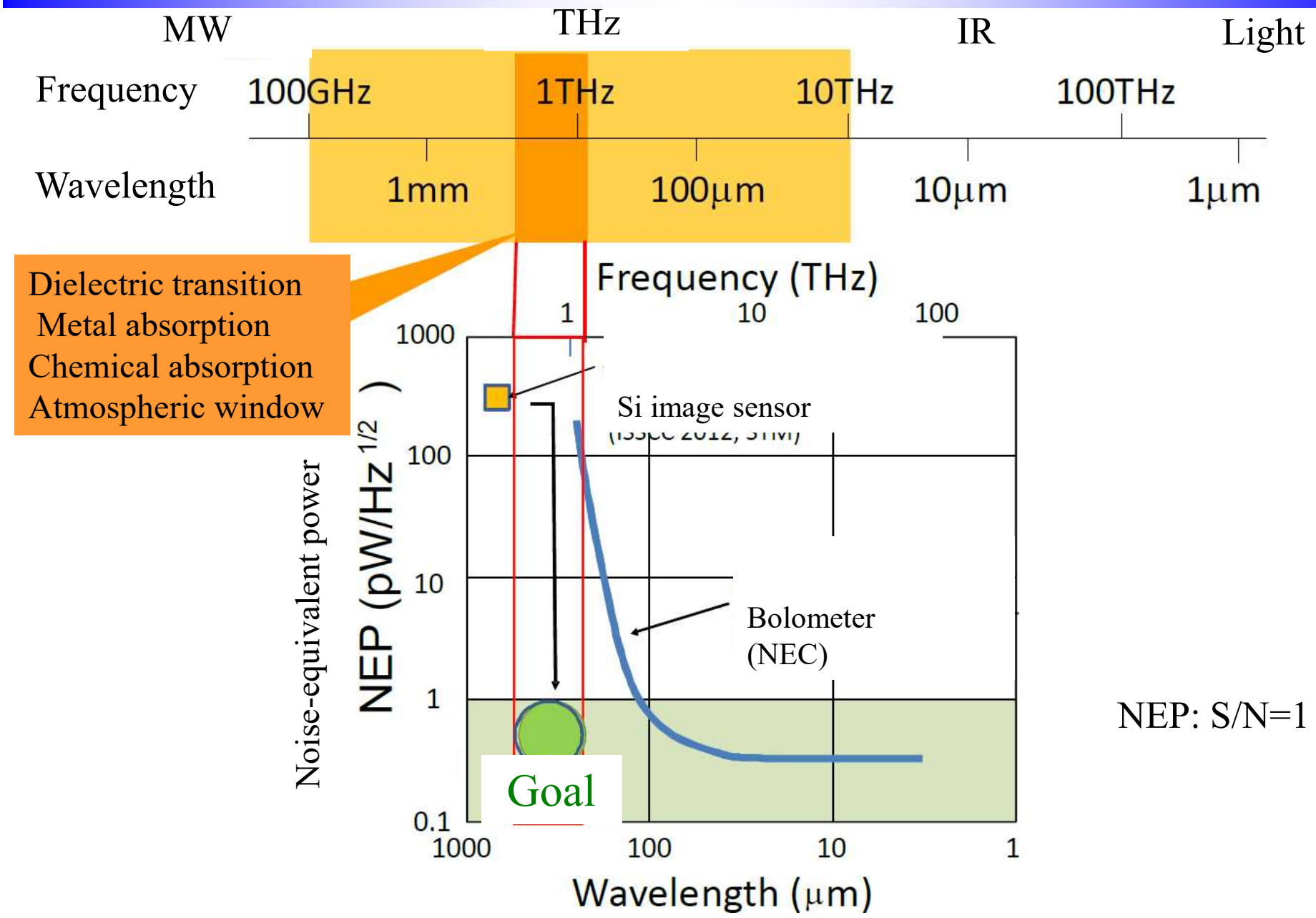


Watching
security system



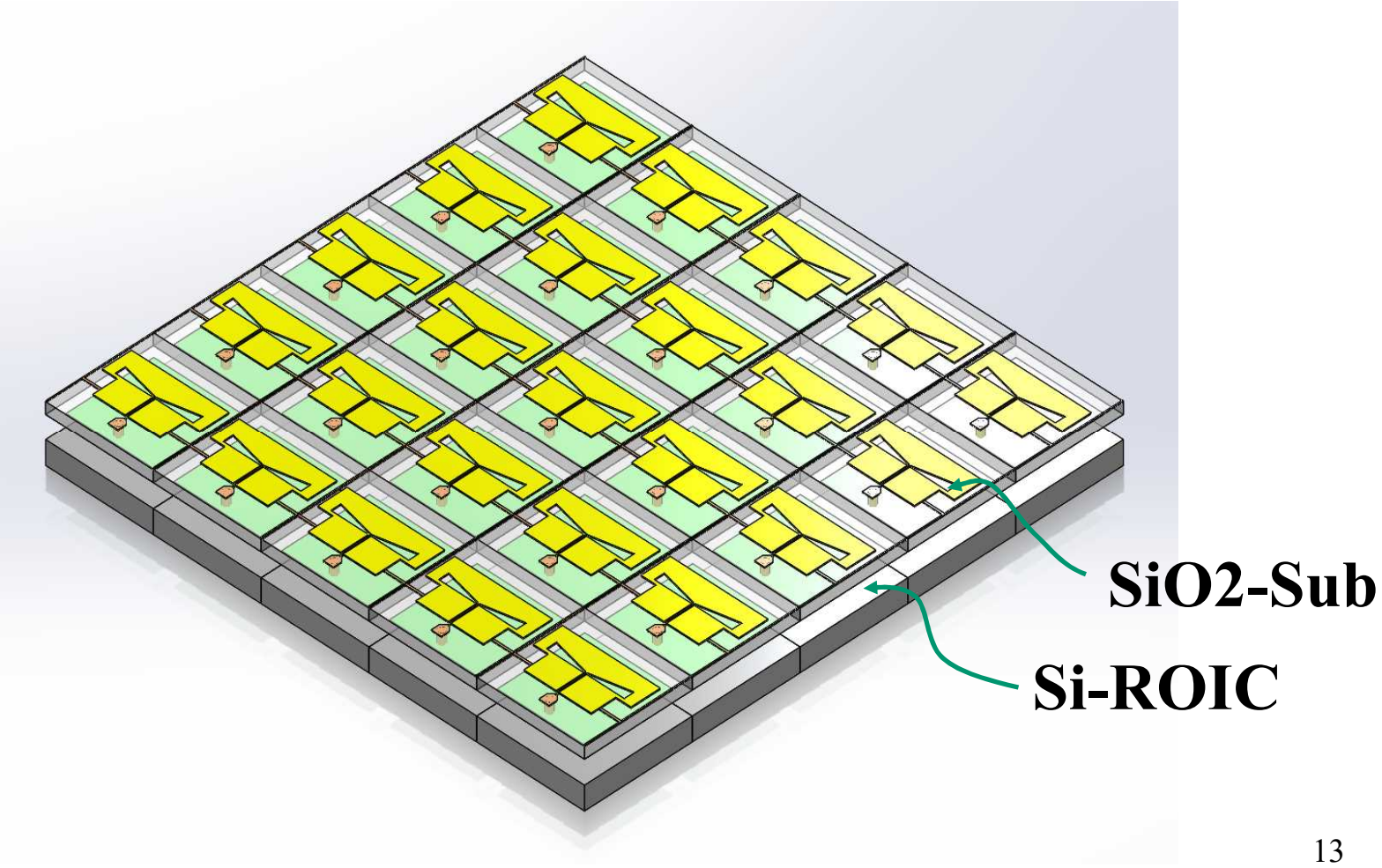
M2M: Machine to machine

Antenna on chip for 1THz imaging



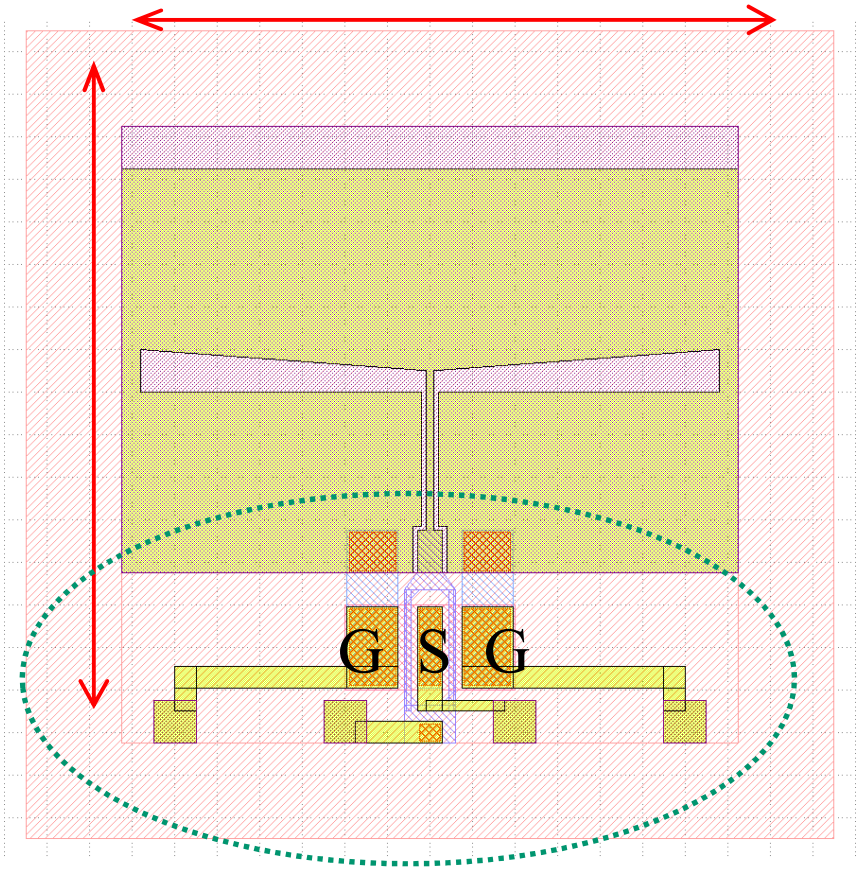
NEP: S/N=1

THz image sensor

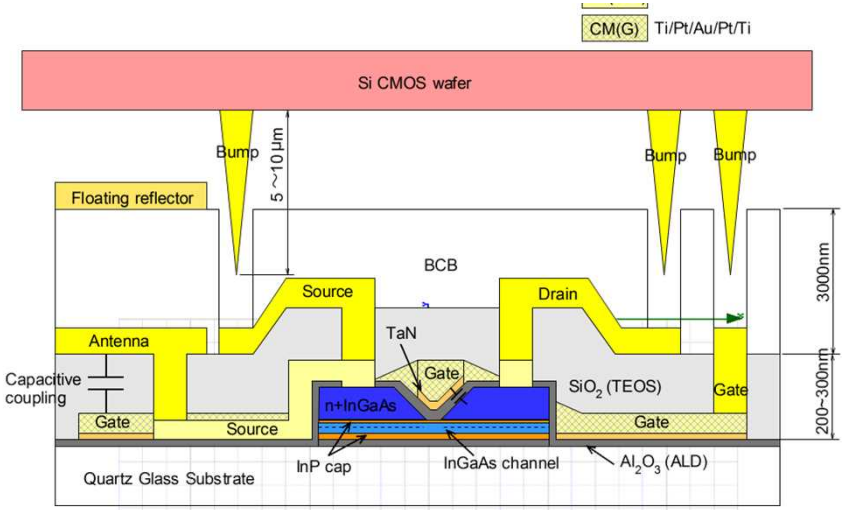


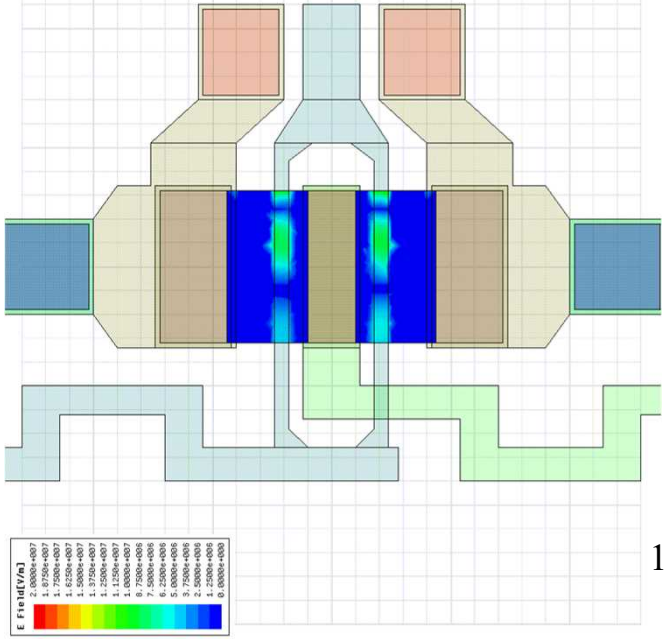
Antenna on quartz for 1THz imaging

290μm□

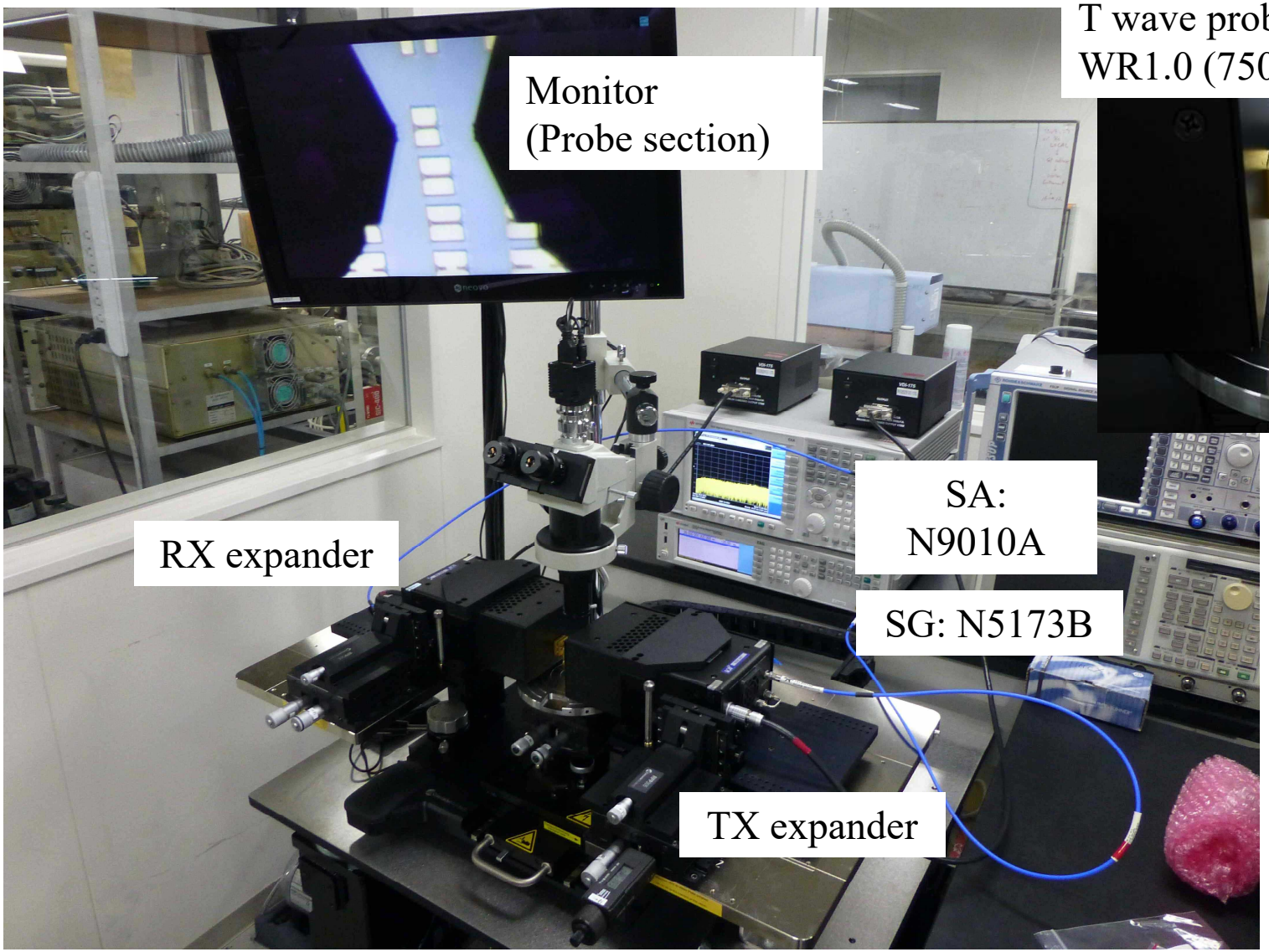


InAs MOS HEMT on quartz glass

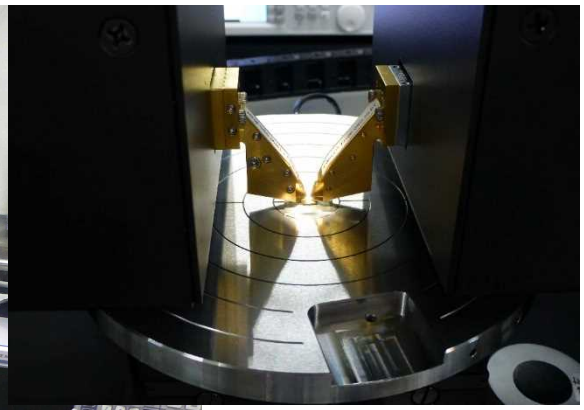




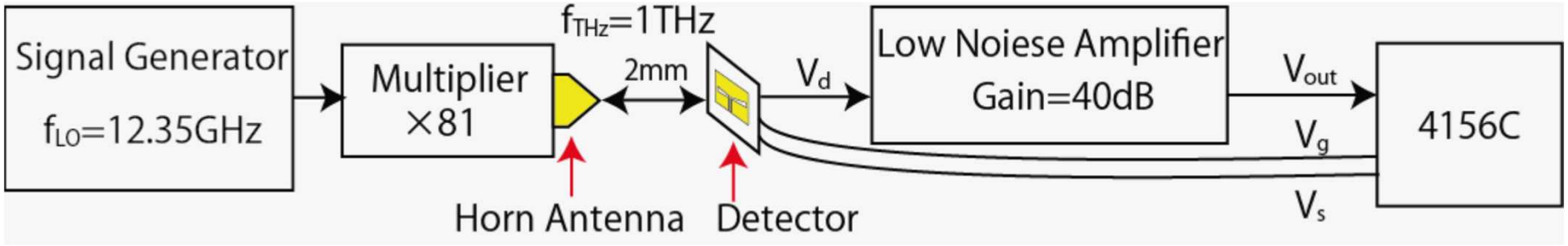
1THz Measured setup

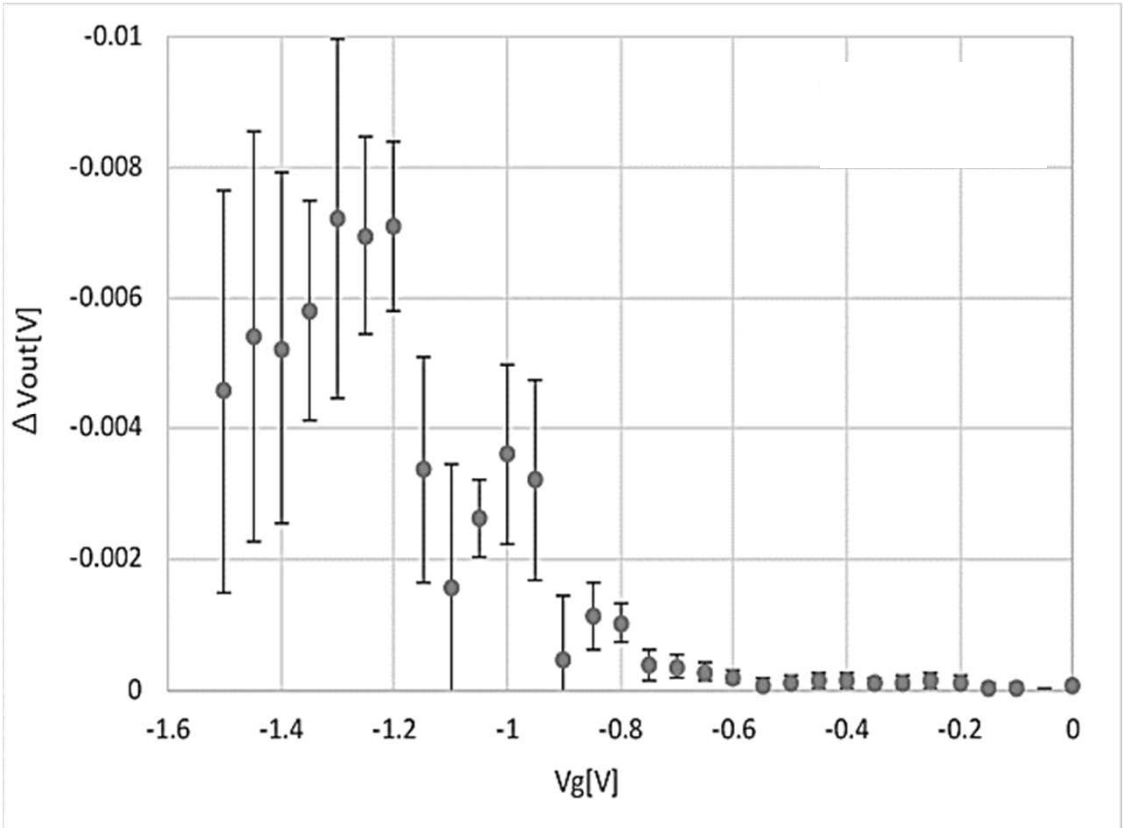


T wave probe, T1100-GSG-25,
WR1.0 (750 GHz – 1.1THz)



Antenna measurement

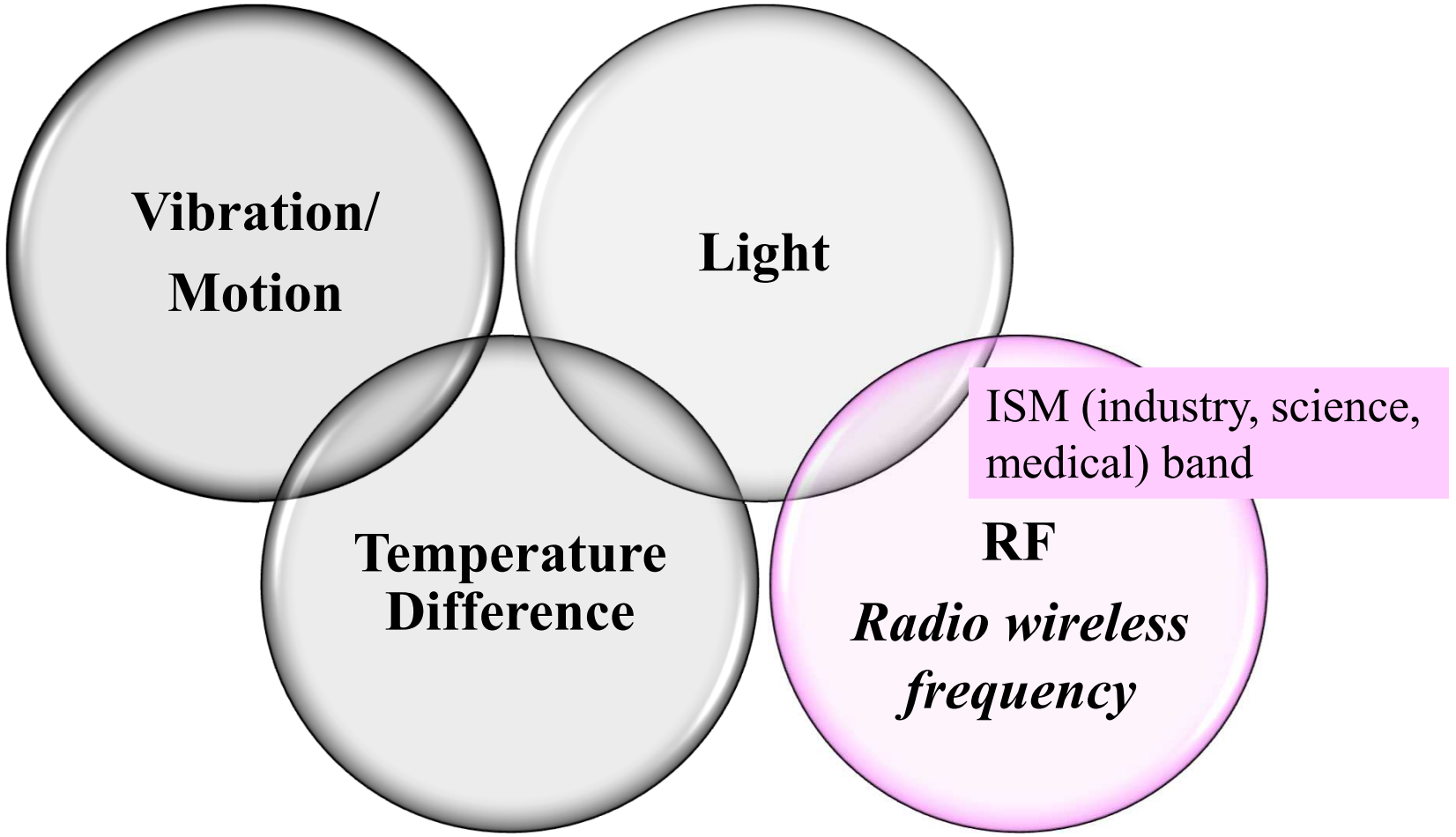




Energy harvesting

Numerous unused energy sources exist for producing sufficient electrical power to run low-power embedded systems.

Different technologies of energy harvester



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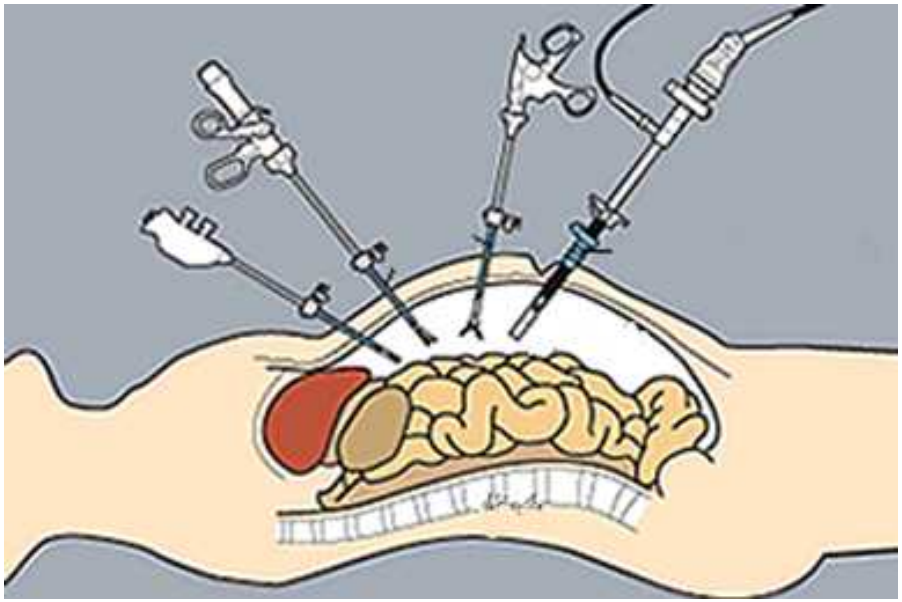
Medical application

Endoscopic surgery



Radiography system

exposure

protective clothing

Camera

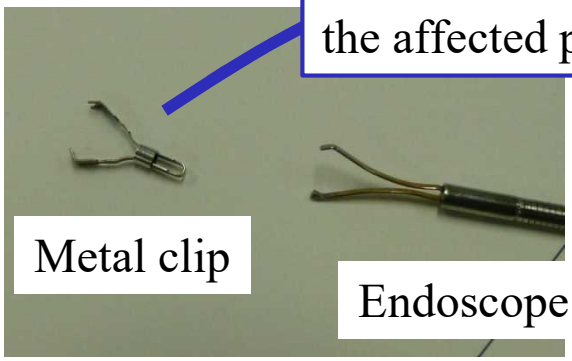
Out side of the stomach and intestines

Radiograpy

In side of the stomach and intestines

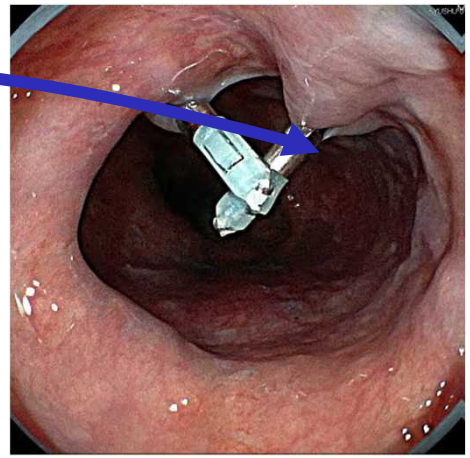
Medical application

Before operation



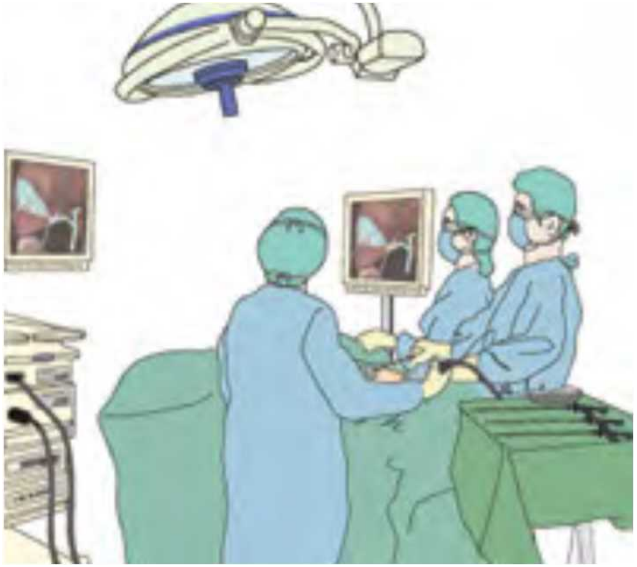
Clip for endoscope

Remove affected part



Clip attached

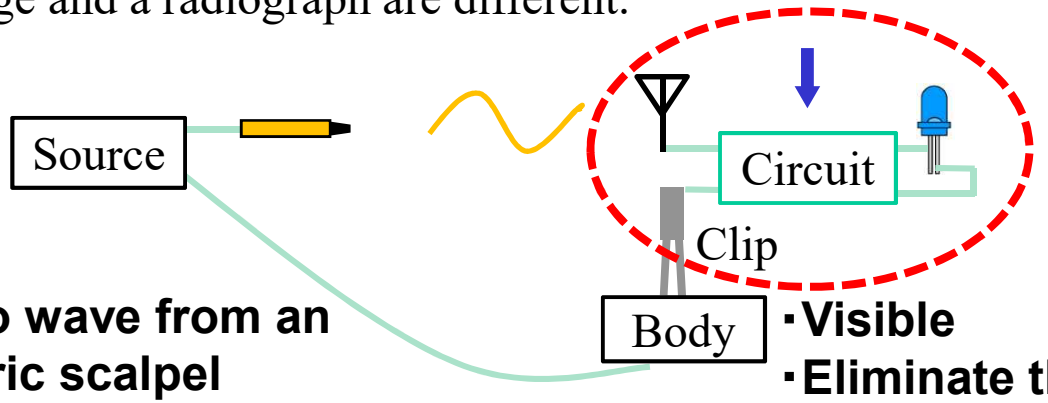
In side of the stomach



Endoscopic surgery

Radiography system should be needed.
A laparoscopic image and a radiograph are different.

Radio wave from an electric scalpel



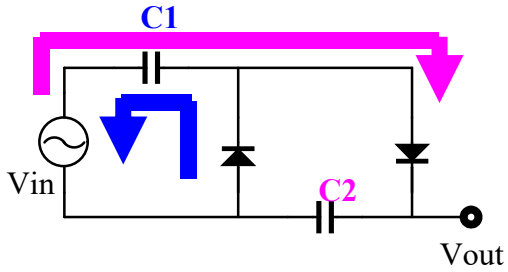
- **Visible**
- **Eliminate the radiograph equipment**

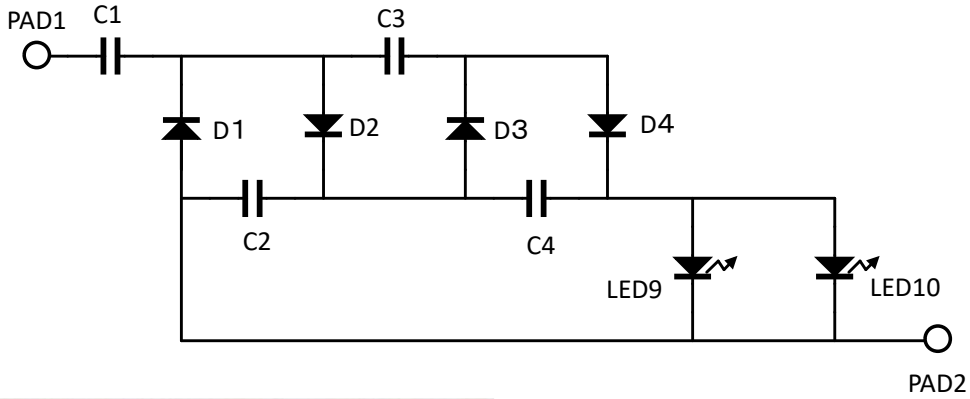
Miniaturization for imprint application

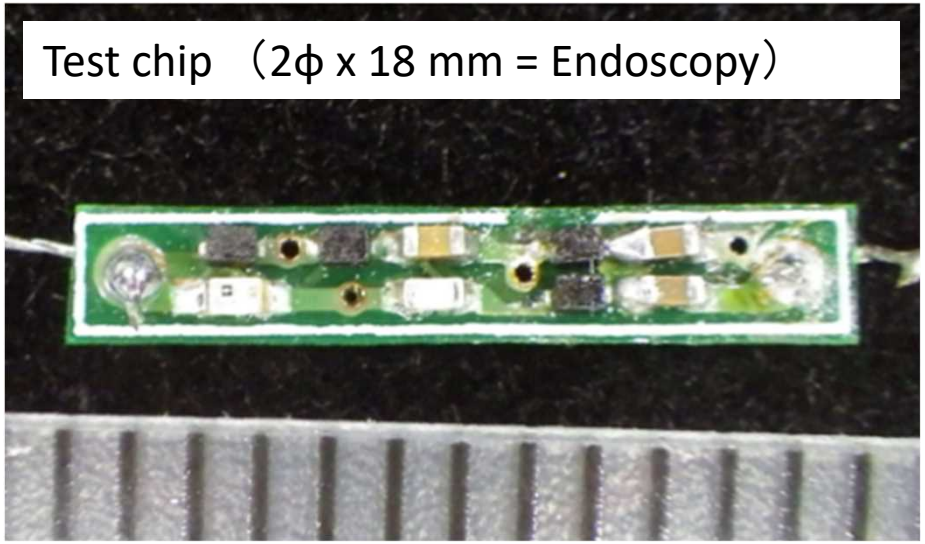
- Electro magnetic wave circuit
- Size reduction
- Medical equipment

LED marker without any batteries for Endoscopic surgery
Source: electric scalpel

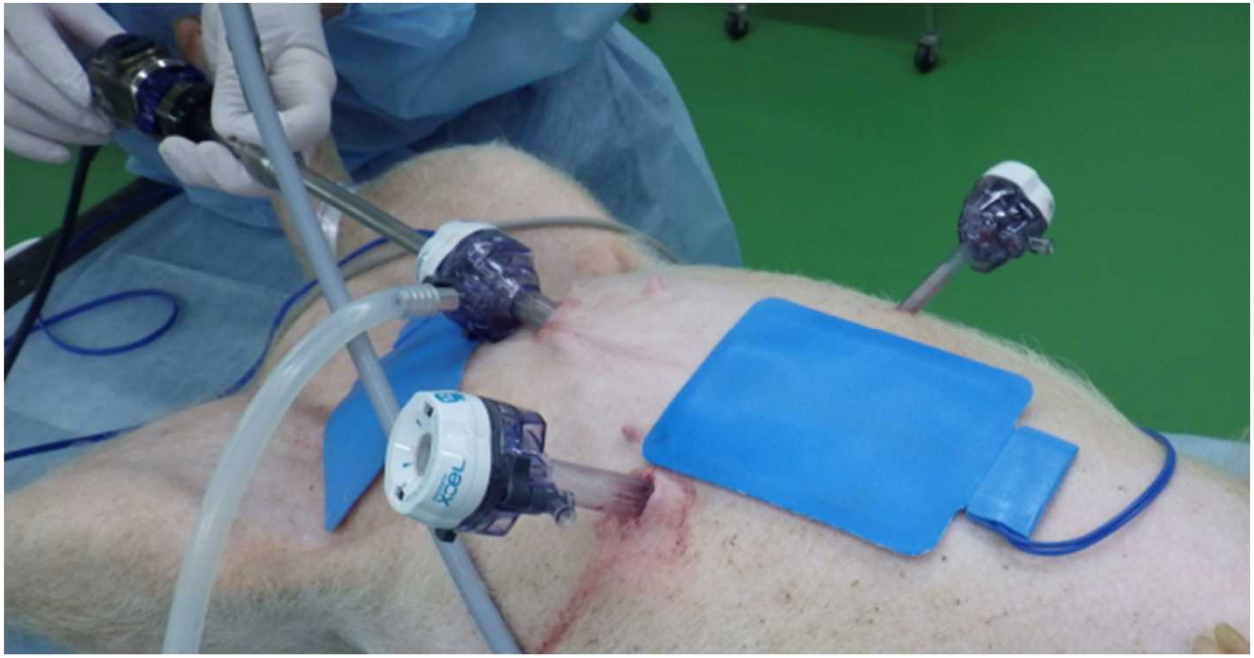
Circuit model



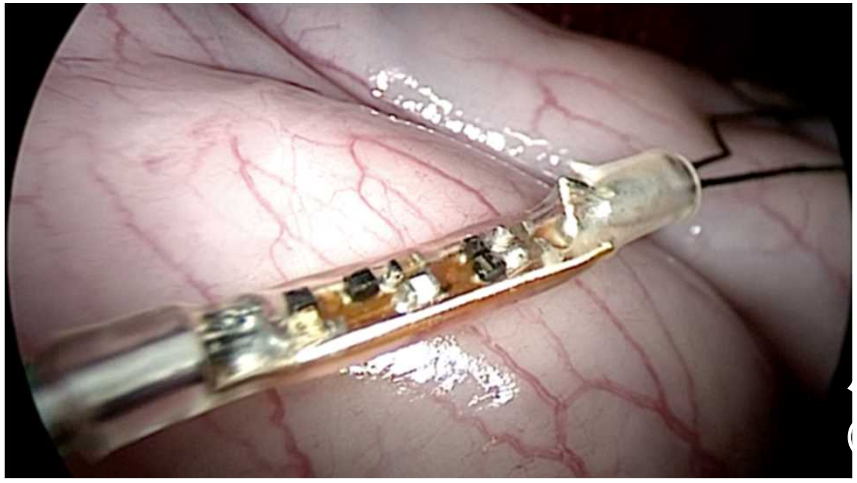




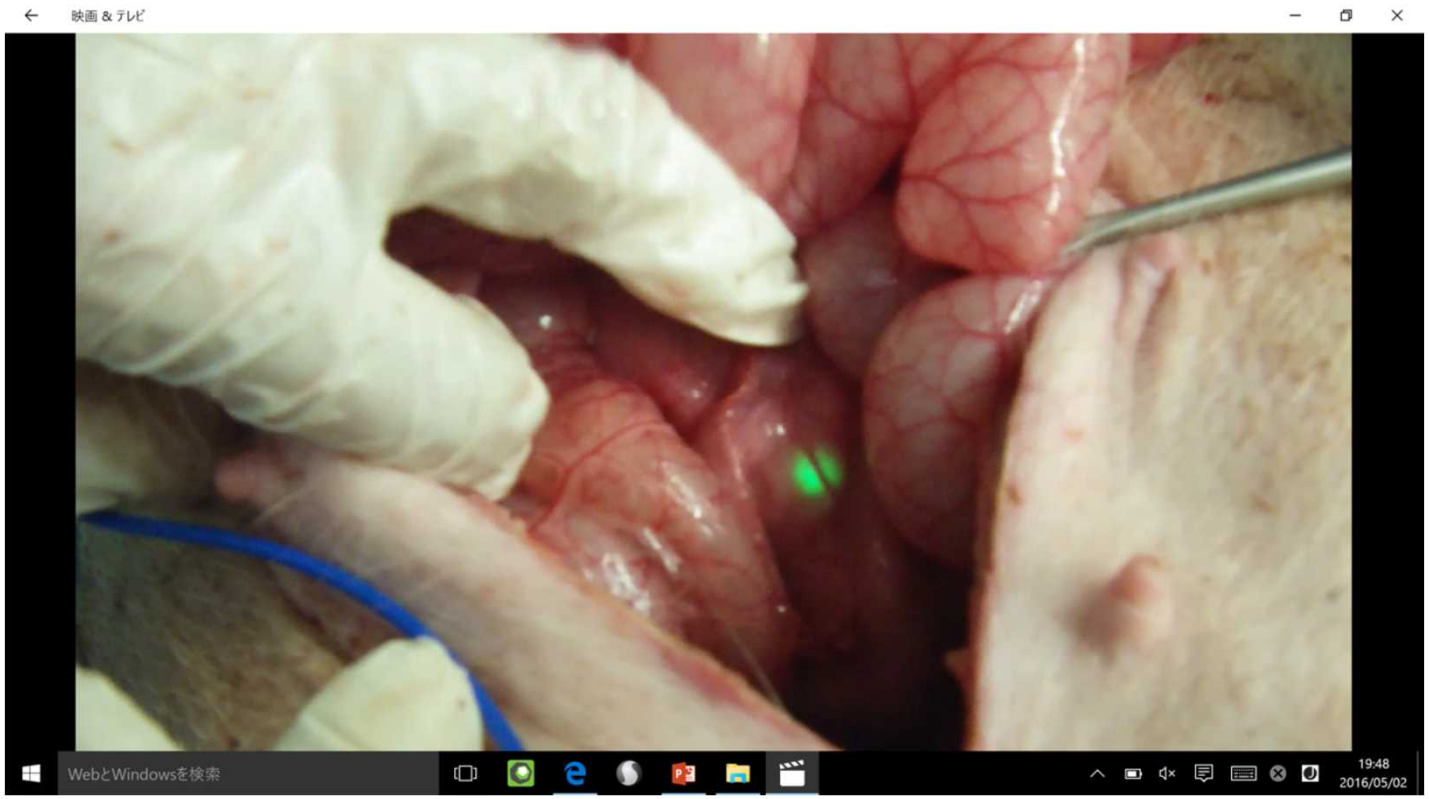
Experiment with pig (weight =30kg)



LED was clipped on the Stomach anterior wall.

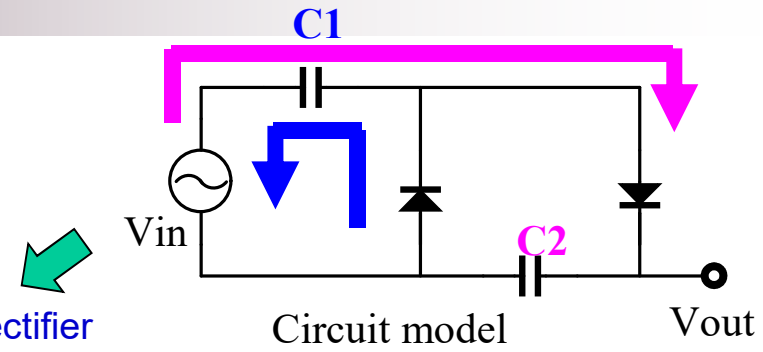


LED lightning (Inside the stomach)



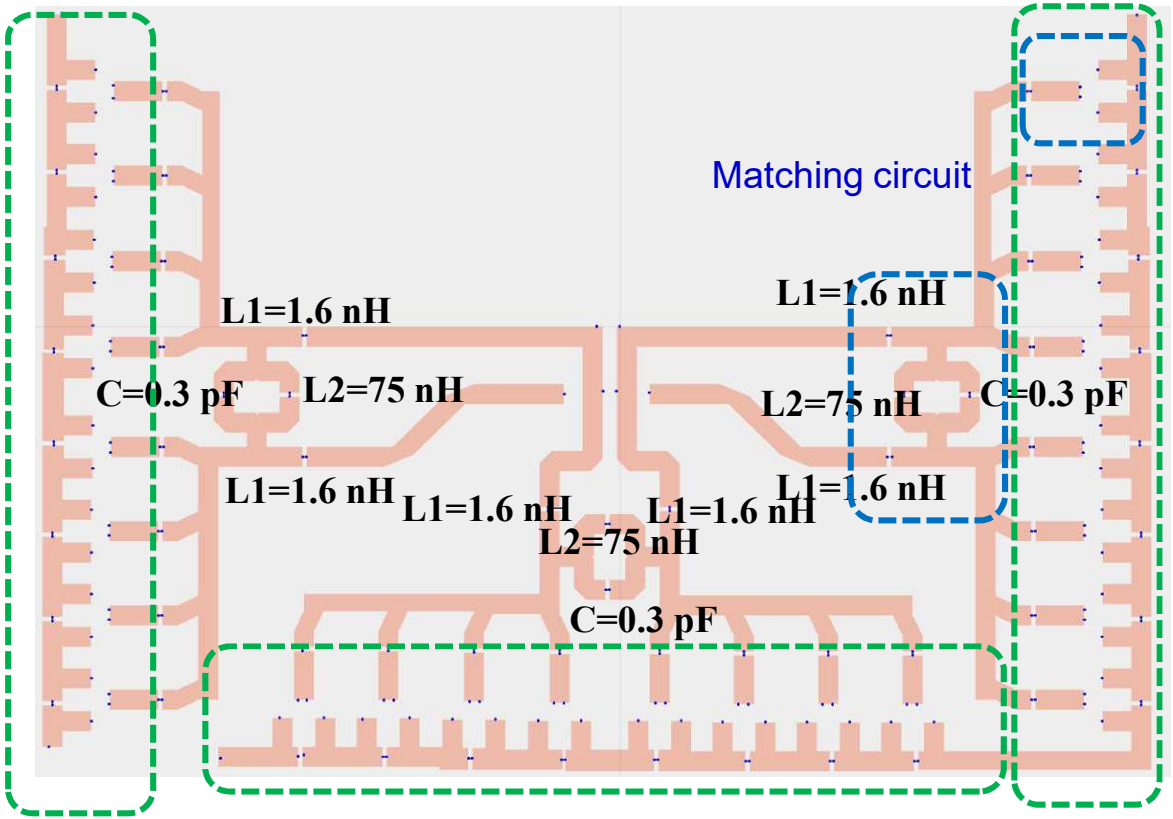
Energy Harvesting Circuit with Planar Antenna

Dr. M. Mansour

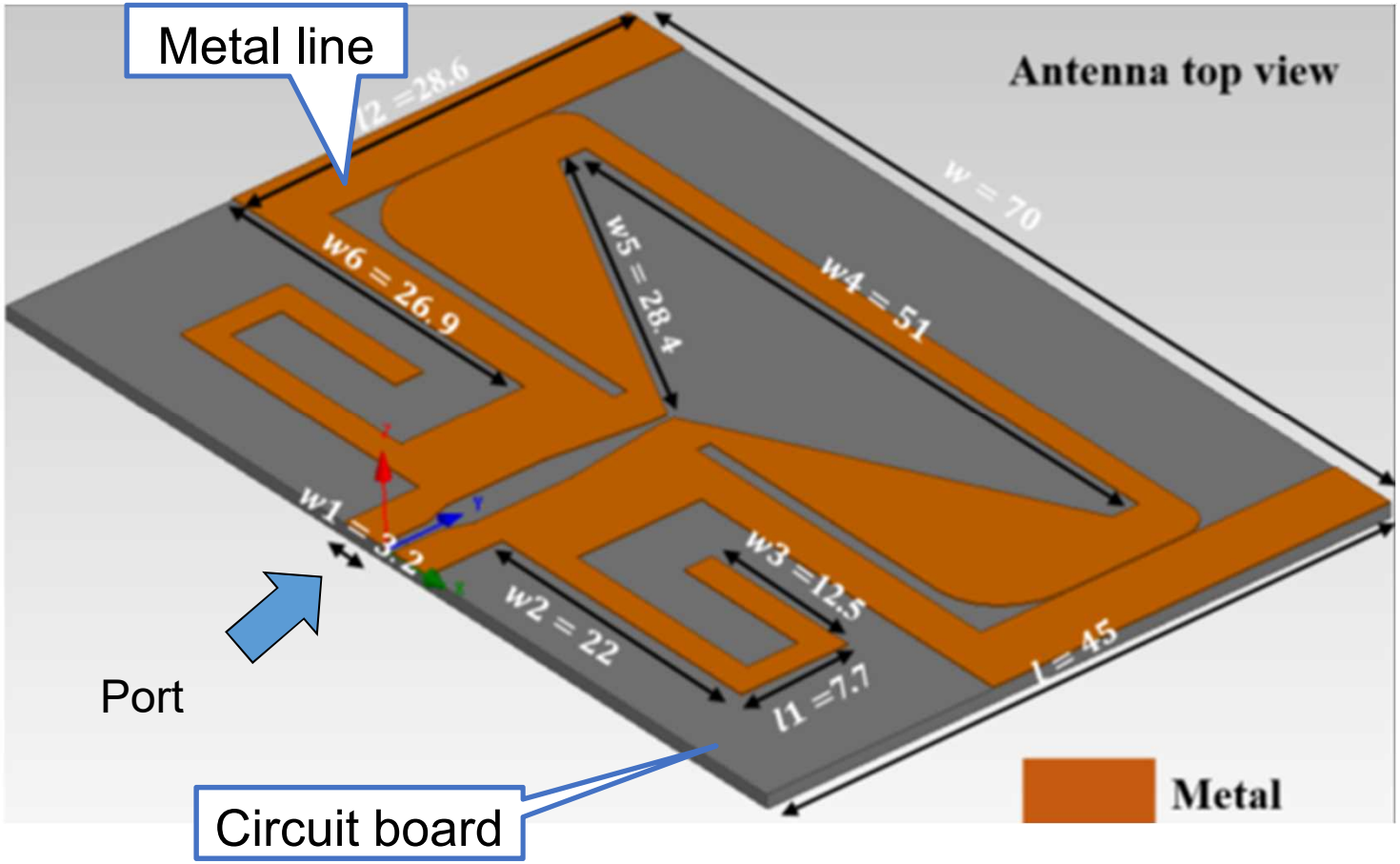


Rectifier unit cell

8 stage x 3 cets

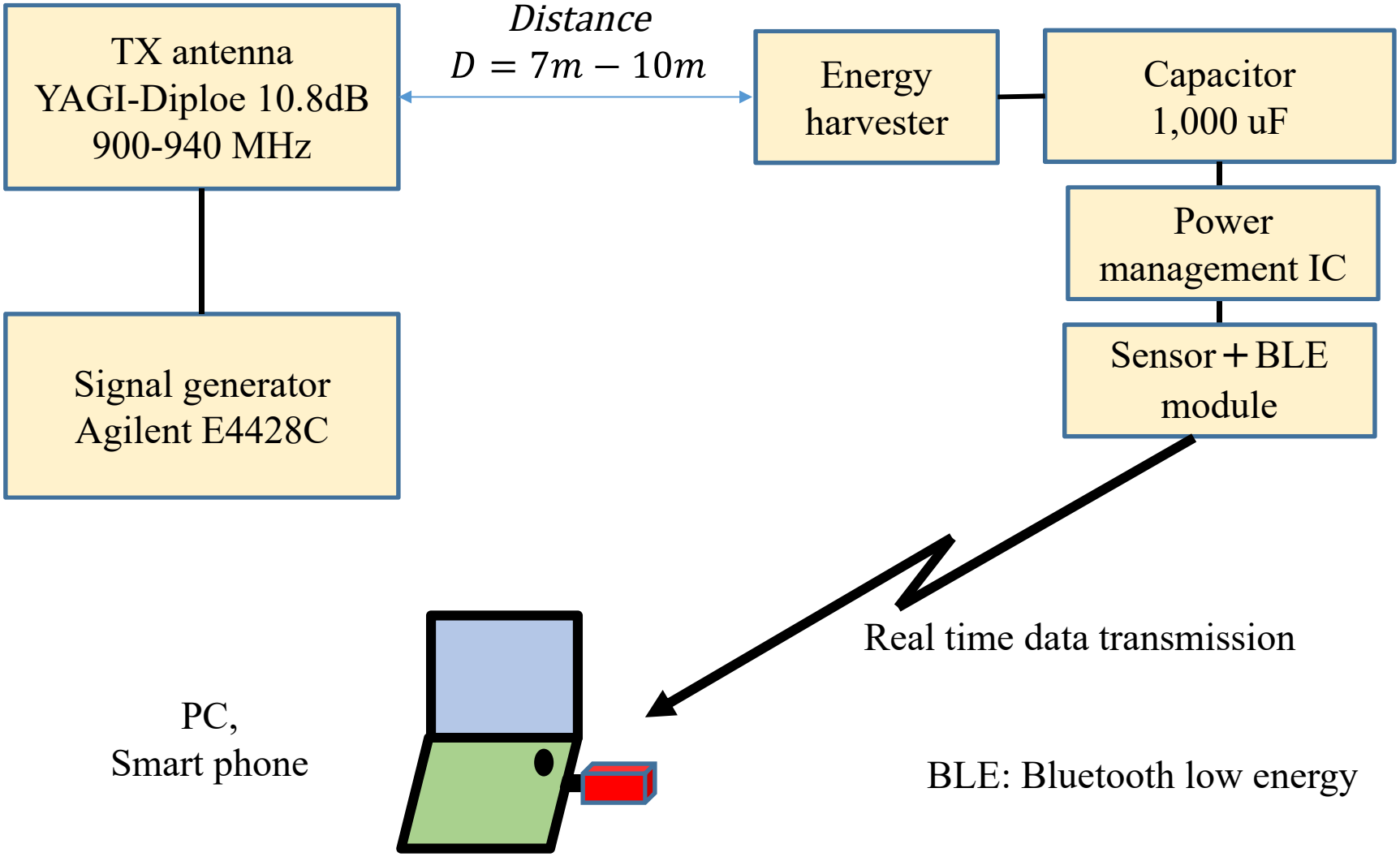


Antenna layout

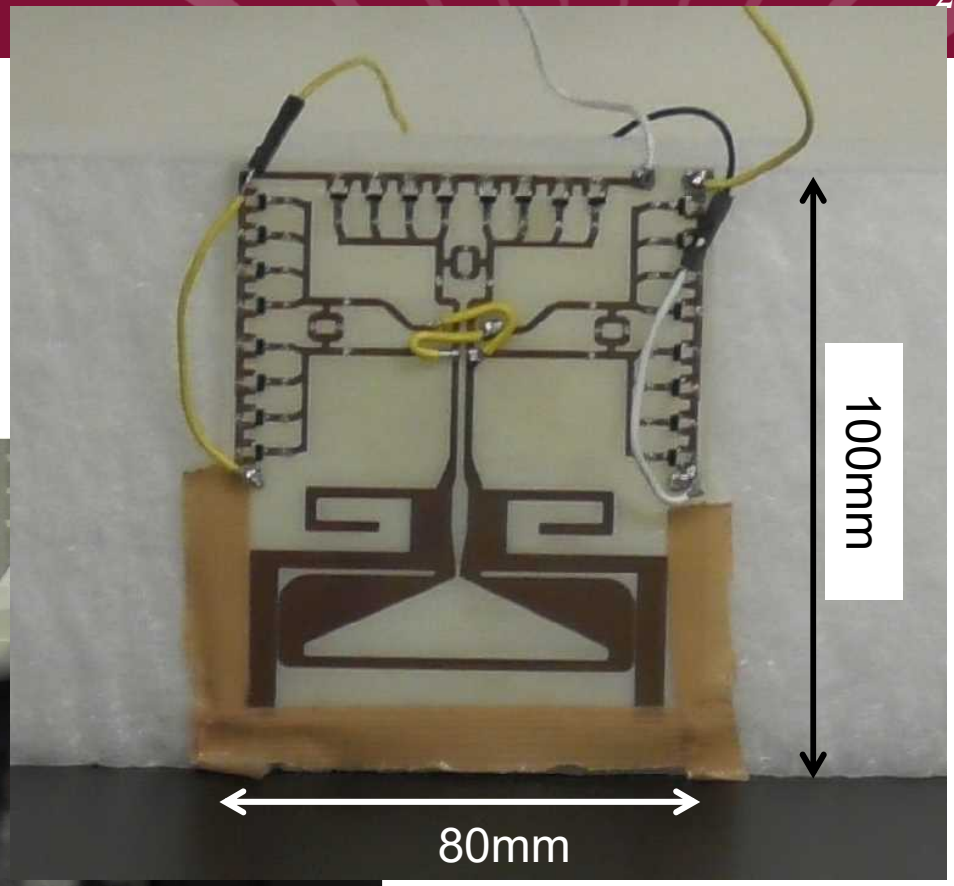


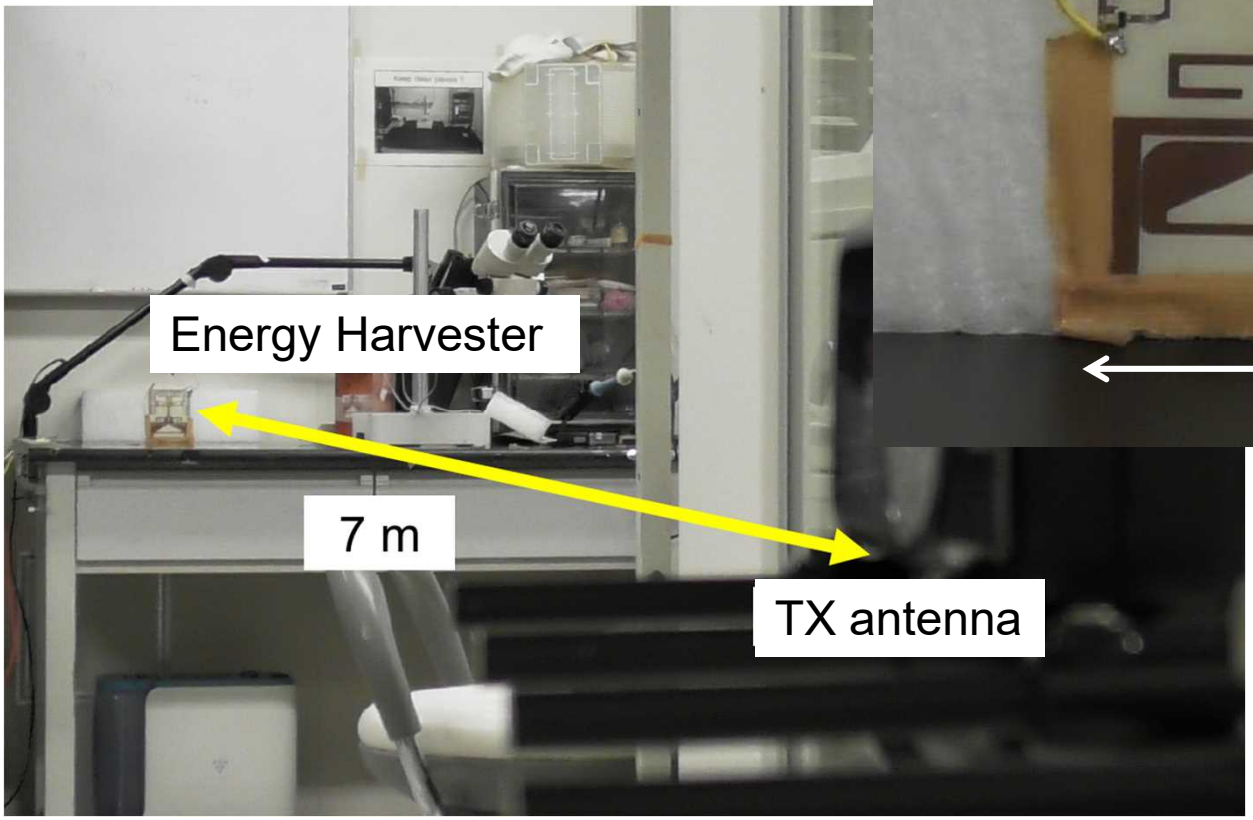
M. Mansour, K. Sultan, and H. Kanaya, IEEE AP-S 2020

Block diagram (Field test)



Experimental setup

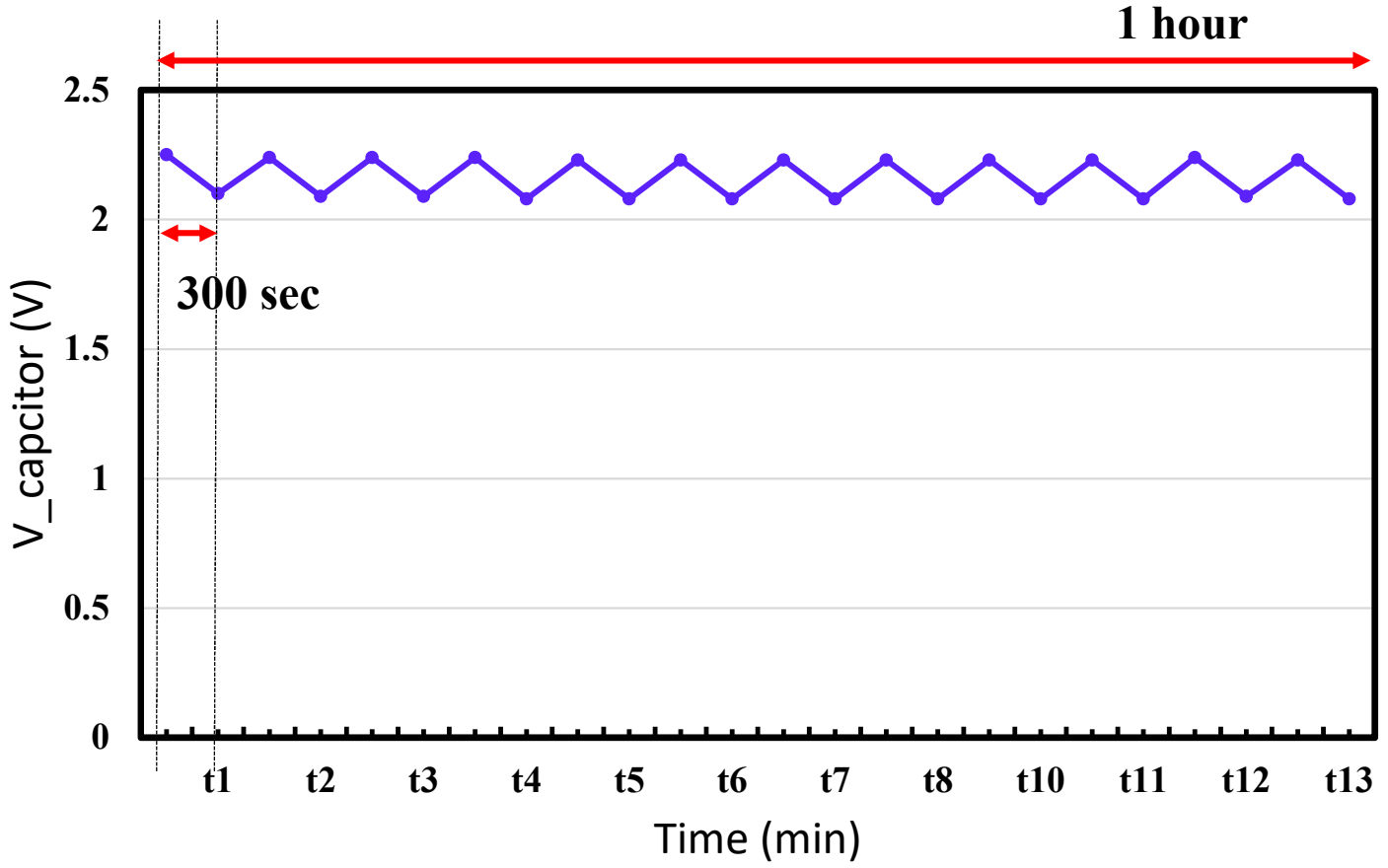




22dBm@920MHz（IMS band）

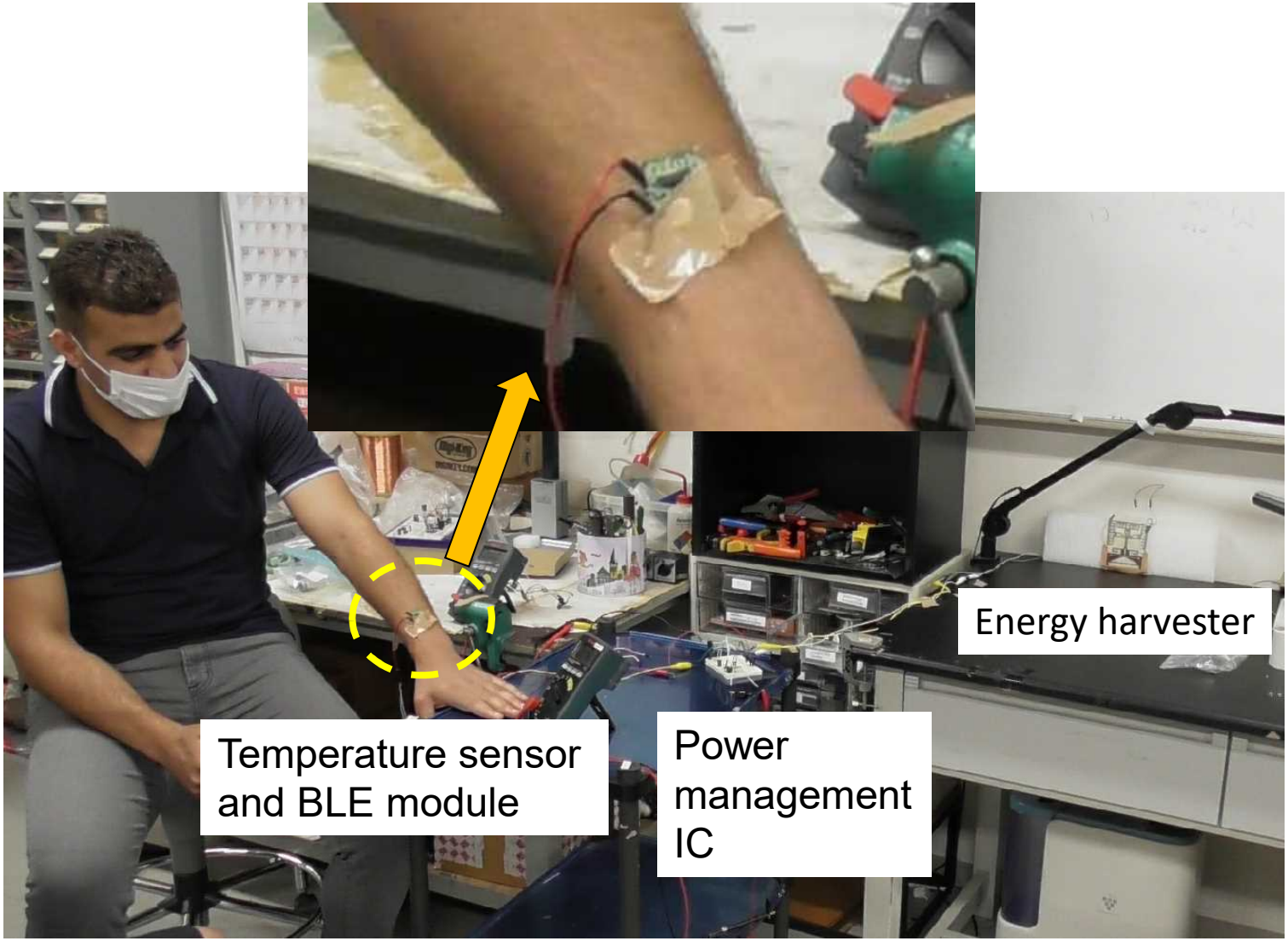
Measured results

Voltage drop by the sensing and BLE data transmission



Measured results

Body surface temperature measurement



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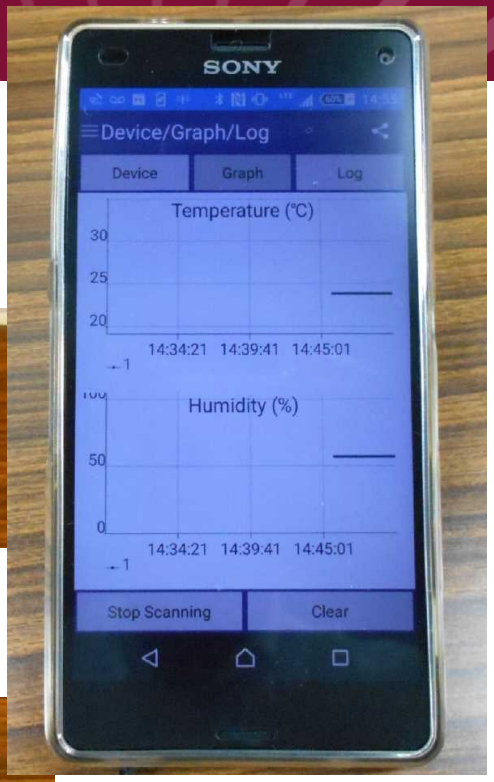
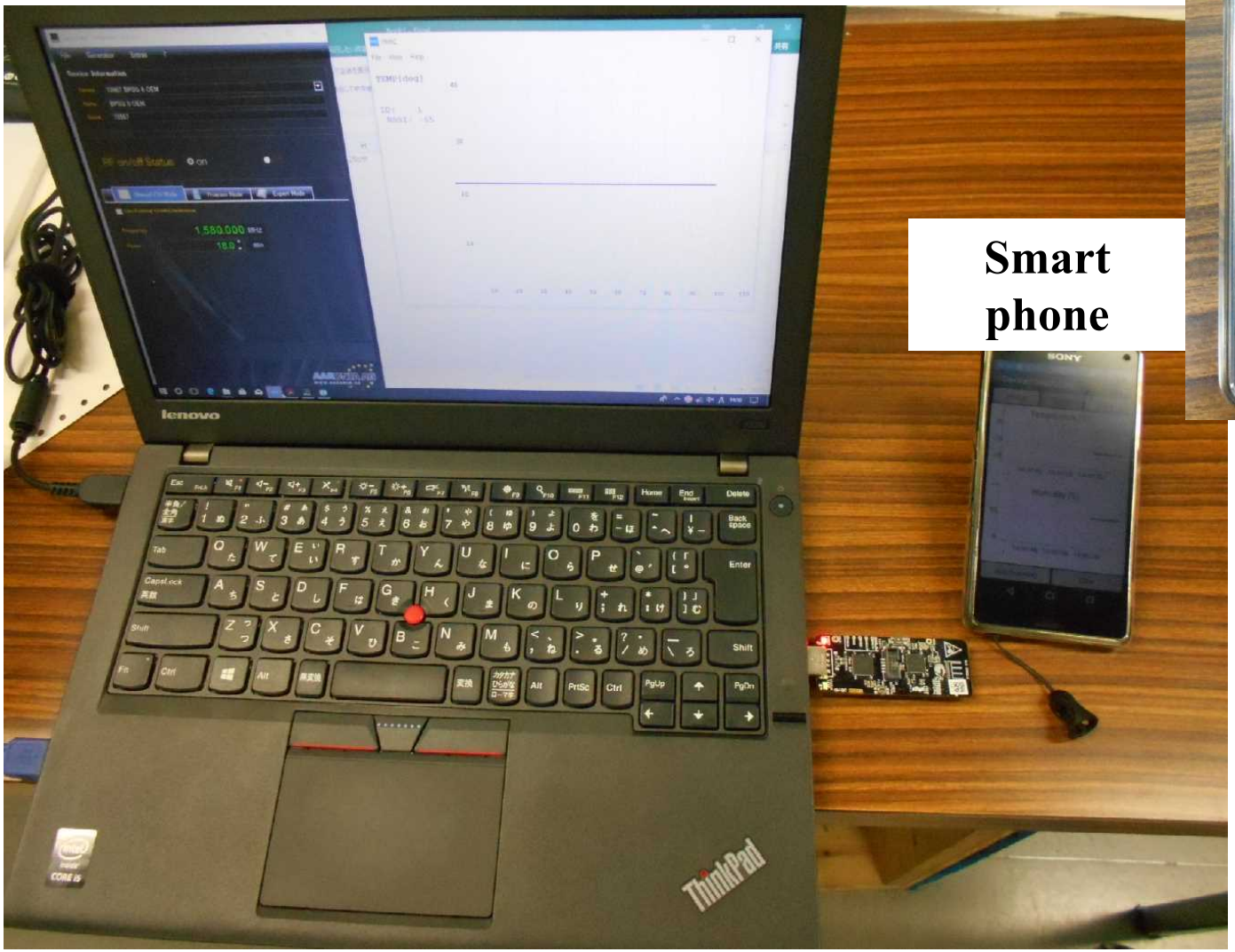
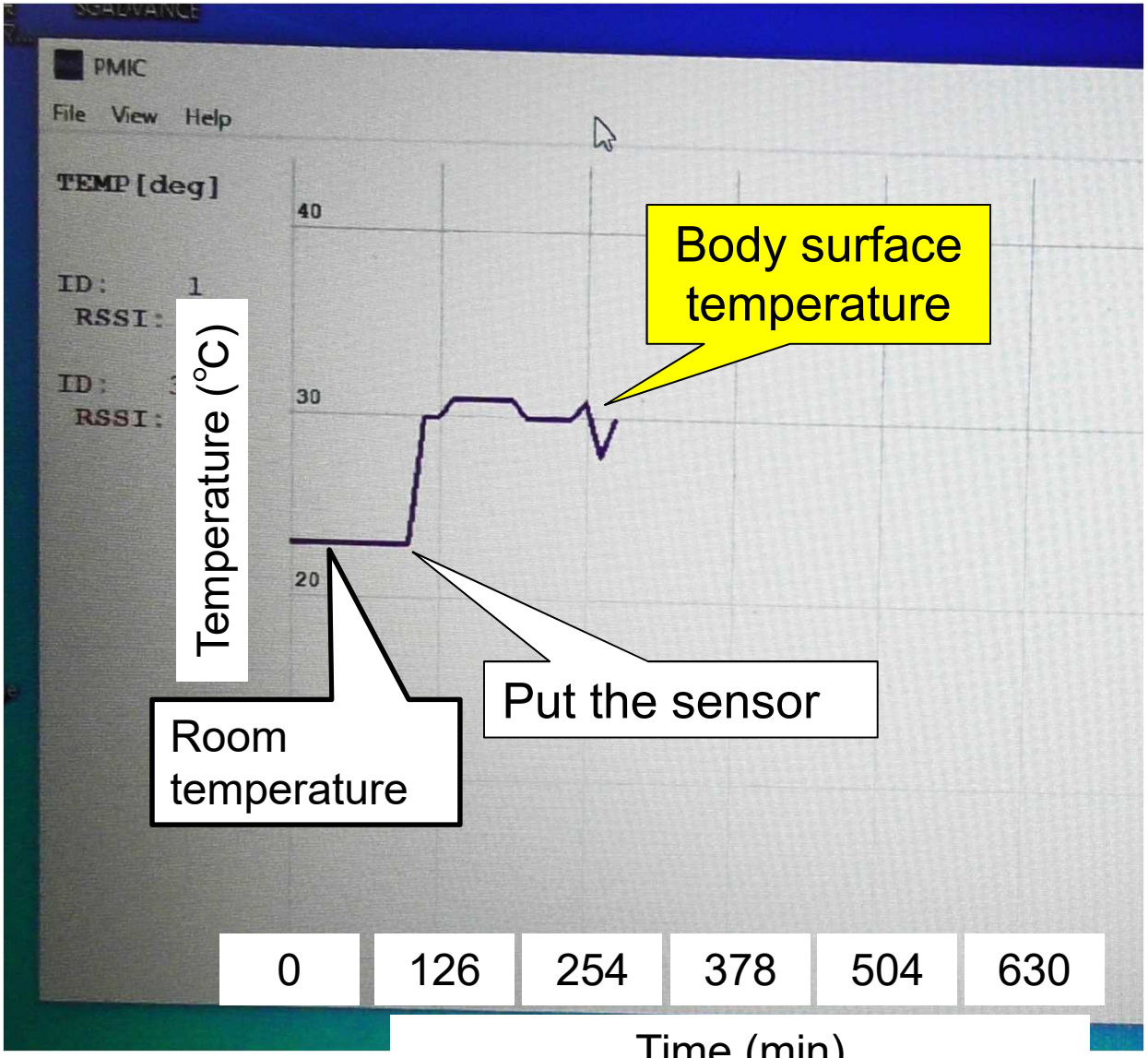
Data receiving (BLE)





Smart phone

Measured data



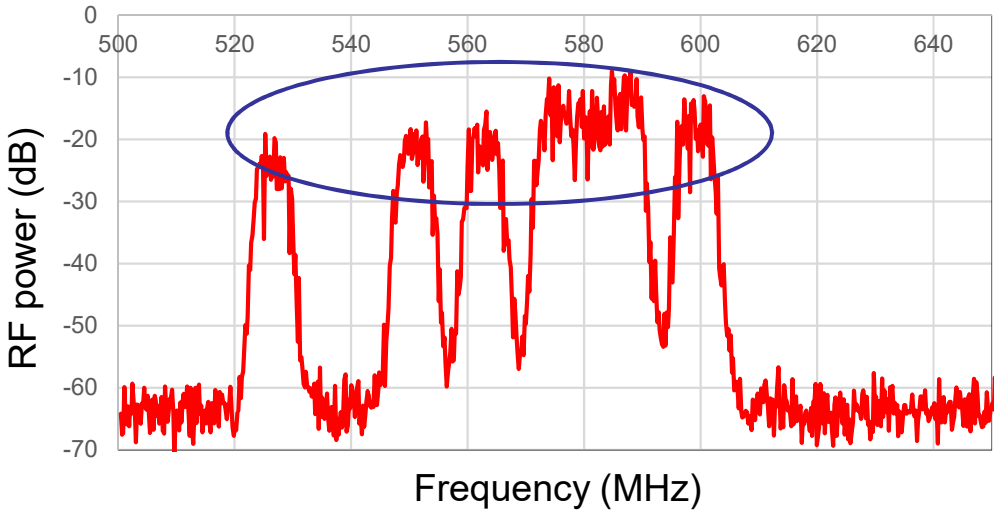
Extend the distance using RF from DTV station

Fukuoka Tower

Fukuoka Tower is one of the TV transmission towers.
500MHz to 600MHz, radiating power of 6.0kW to 7.2kW

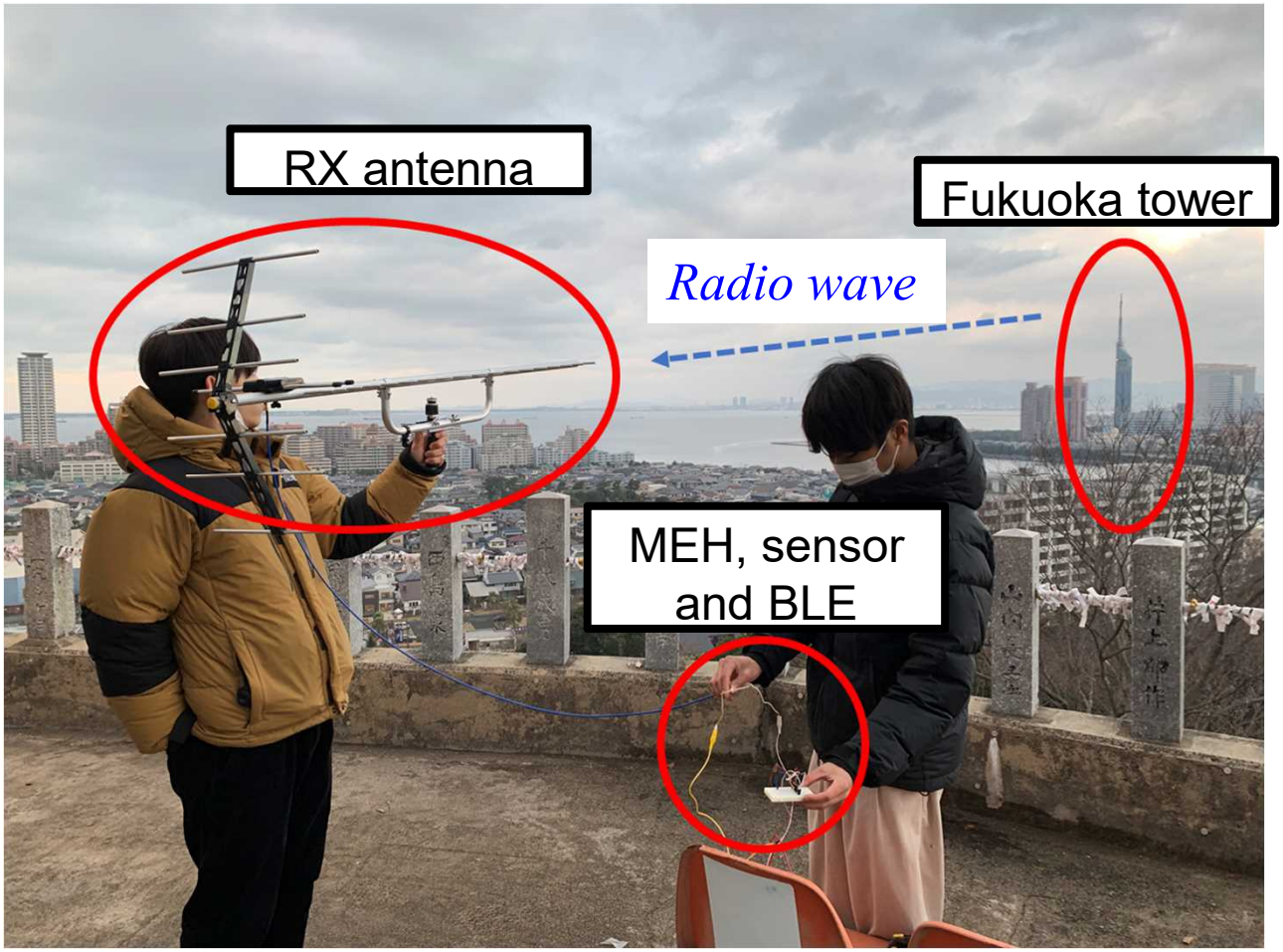
Fukuoka Tower, 234m Hight.

⇒ **Multi band transmitter**



Measurement powers around
400m from Fukuoka Tower

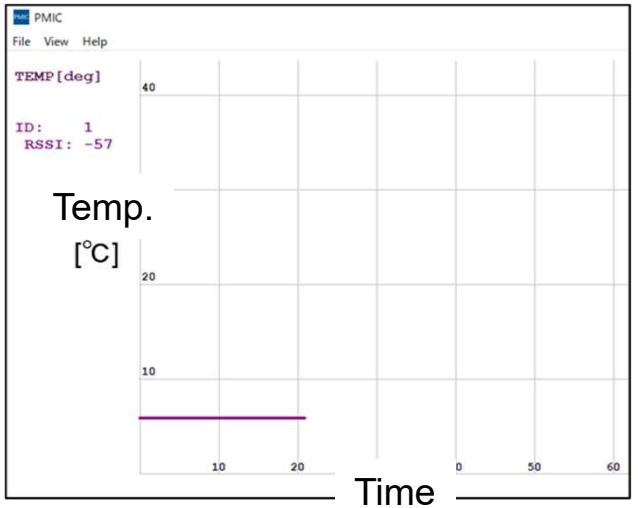
MEH measurement



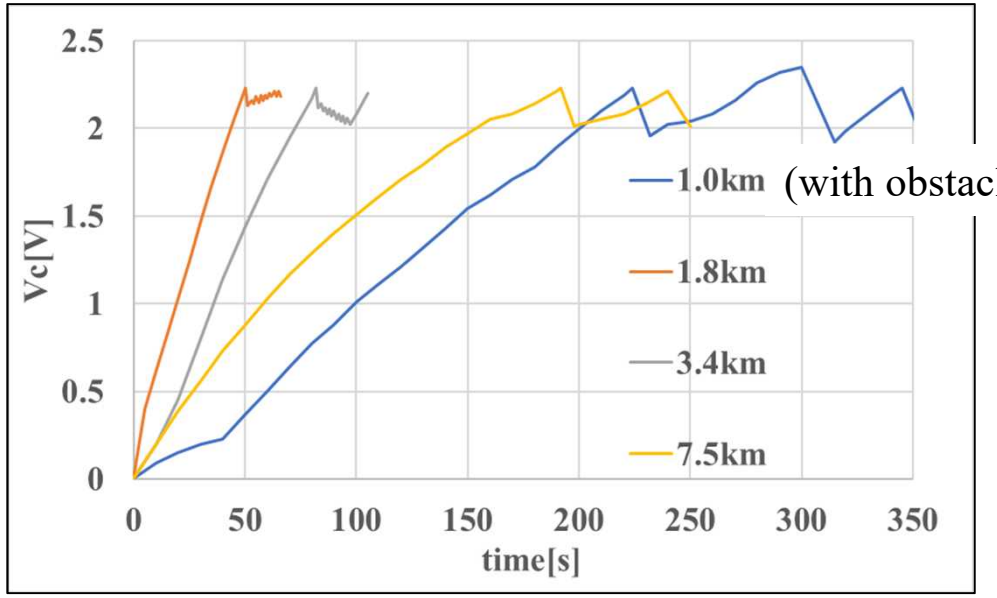
Experiment at Atago Shrine (1.8km point)

Measured results

Distance from Fukuoka tower	Output open circuit DC voltage	Time taken for first communication
1.0km (with obstacles)	5.1V	220 s
1.8km	10V	50 s
3.4km	9.6V	82 s
7.5km	6.0V	192 s



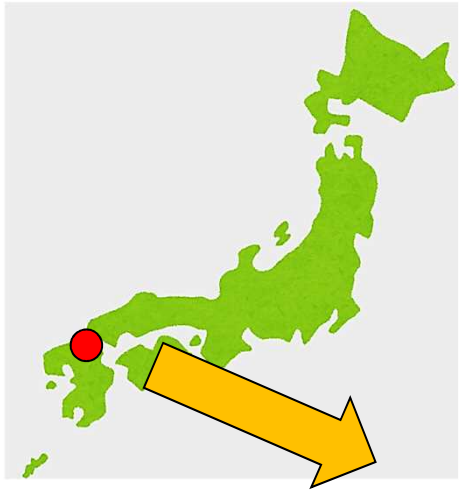
Temperature receiving data

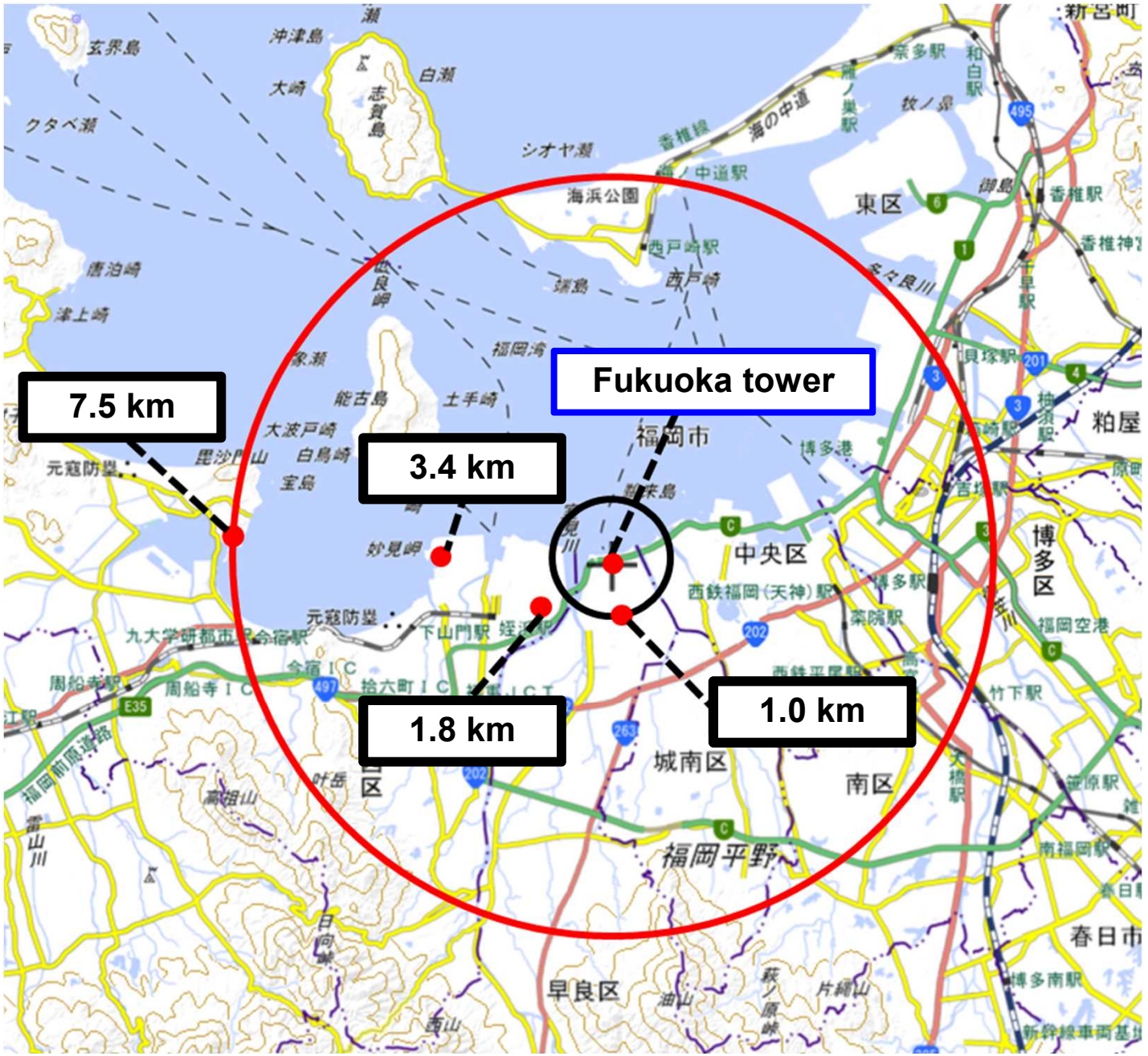


Capacitor voltage

Successful continuous communication using radio waves emitted from Fukuoka Tower.

Operable area (estimated)





COLLABORATORS

Vital sensing project:

- ALSENS Inc.
- University Farm, Kyushu University
- Livestock Research Division, Oita Prefectural Agriculture, Forestry and Fisheries Research Center
- Oita Prefectural Agriculture, Forestry and Fisheries Research Center
- Kamiens Technology, Inc.

Implant sensing project:

- Fukuoka Dental College Medical & Dental Hospital
- Kyushu University Hospital
- Section of Oral Rehabilitation, Kyushu University
- LOGICAL PRODUCT Co.

Infrastructure sensing project:

- Geodisaster Prevention Engineering Laboratory, Kyushu University
- Universiti Teknologi Malaysia, Malaysia
- Nahda University, Egypt
- NRIAG, , Egypt

COLLABORATORS Cont.

Wireless communication project:

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