Development and Application of an Energy Harvesting Power Factor and Apparent Power Sensor


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Benefits of electricity monitoring

Visualization of electricity usage

- Machine operation monitoring
- Reduce electricity usage
- CO2 emissions monitoring
- Compliance with ISO 14001

▼

There are many benefits
to be gained by power monitoring

Monitoring power factor

Power factor varies with load

- Monitoring machine load status
- Measure the precise amount of electricity usage

Power factor monitoring provides more information about machine

Power factor monitoring has been attracting much attentions

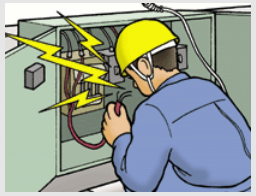
Needs for individual PF monitoring

PF measurement equipment

The commercially available ones are

Cumbersome to install

Expensive



Invasive

There is no wireless monitoring device that can easily measure the PF

Purpose of this study

- Development of a Non-contact, Low-cost, non-invasive Wireless PF and Apparent Power sensor

Visualization of true power usage contributes to reduction of electricity usage, visualization of CO_2 emissions, etc

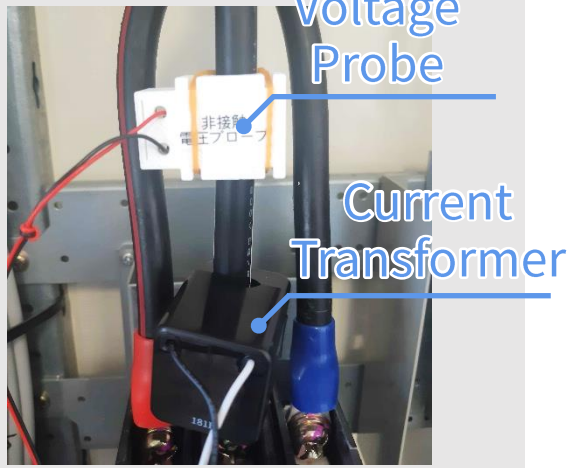
Development of an unprecedented non-contact sensor with energy harvesting

Appearance of the fabricated sensor

Fabricated sensor can measure power factor without contact

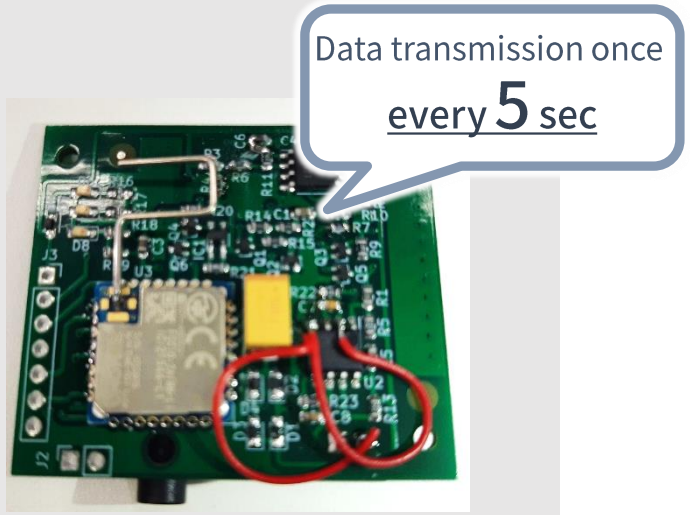
Probe

Voltage Probe
(LDT0-028K)



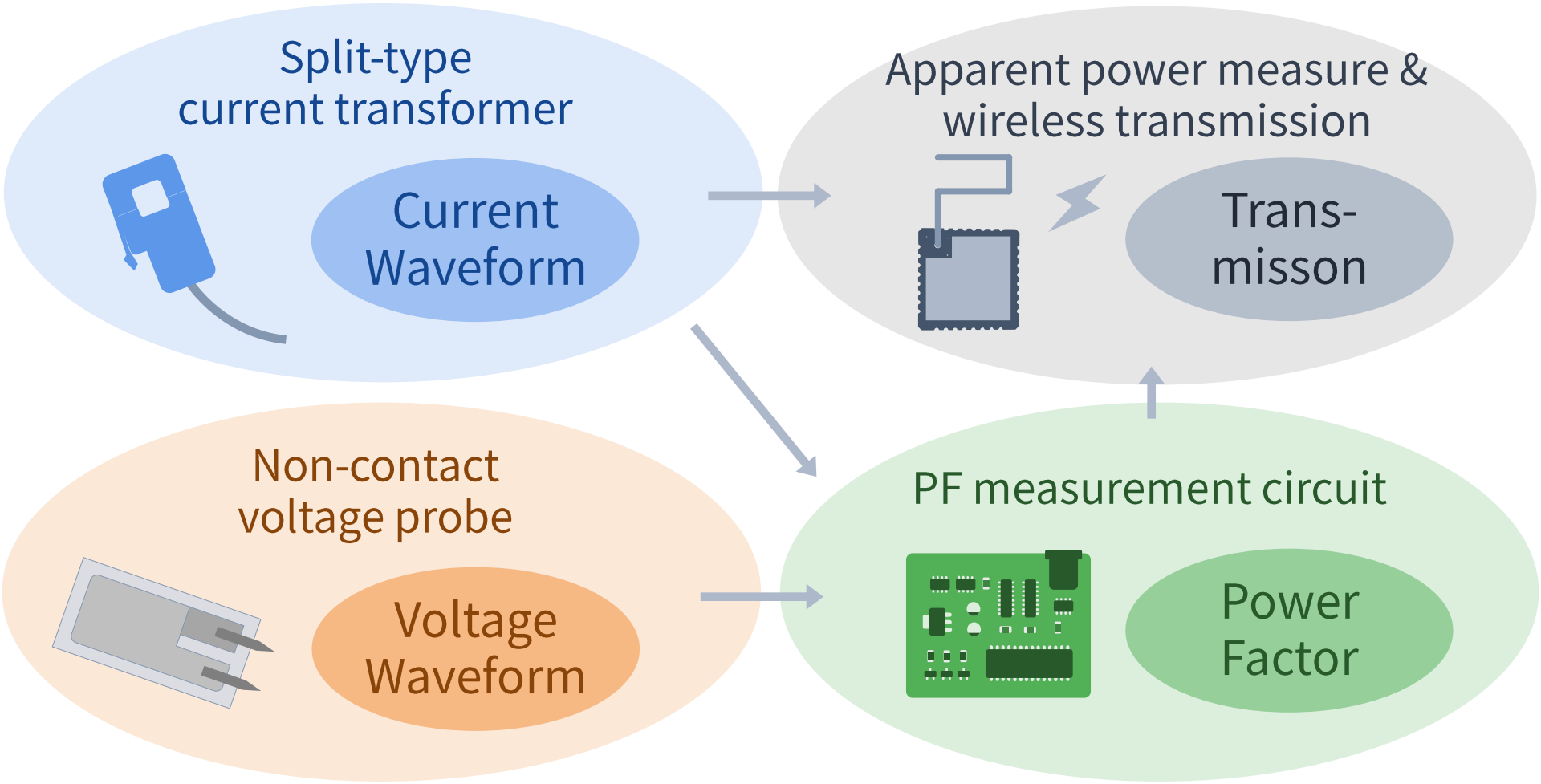
Probes at installation

Sensor board



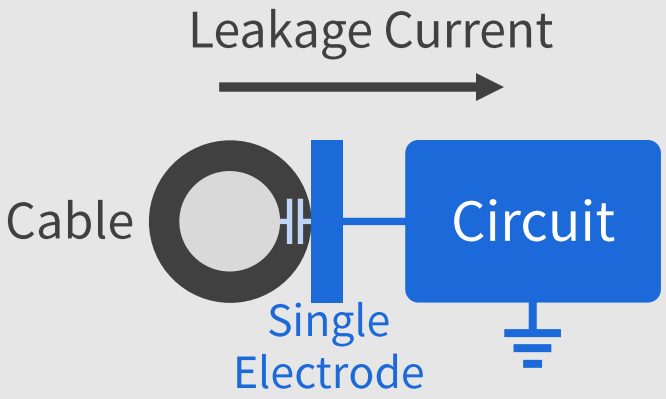
Printed circuit board

Overview of the PF and apparent power sensor



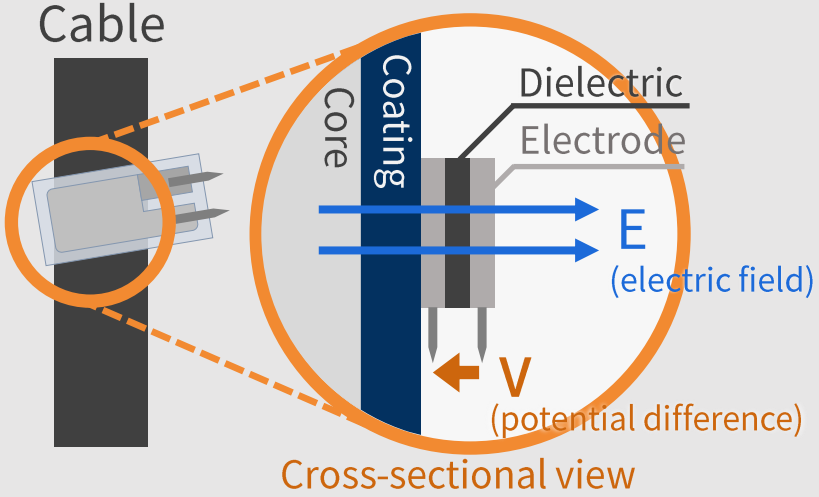
Non-metal-contact voltage measurement

Typical commercial products



Measure leakage current by putting a conductor on the coating

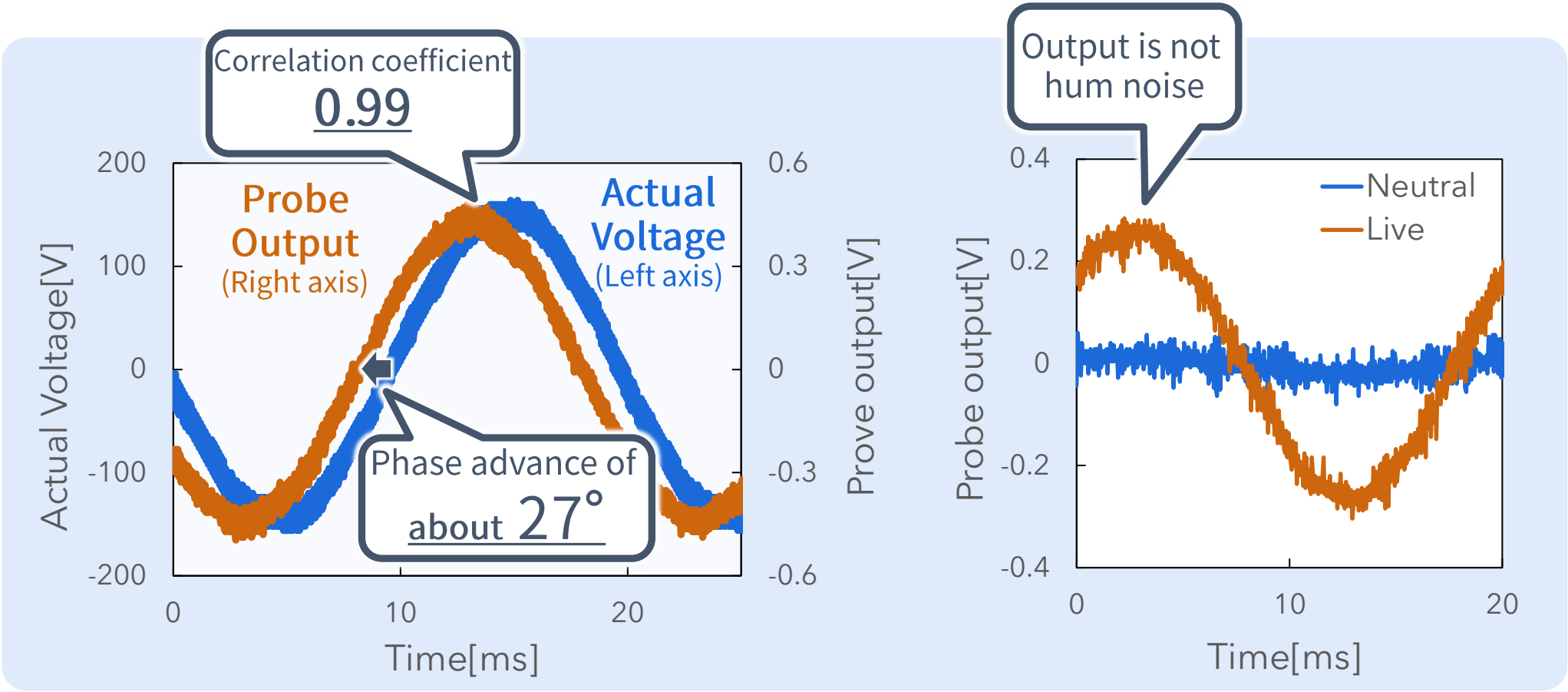
Proposed method



Converting electric field into potential difference

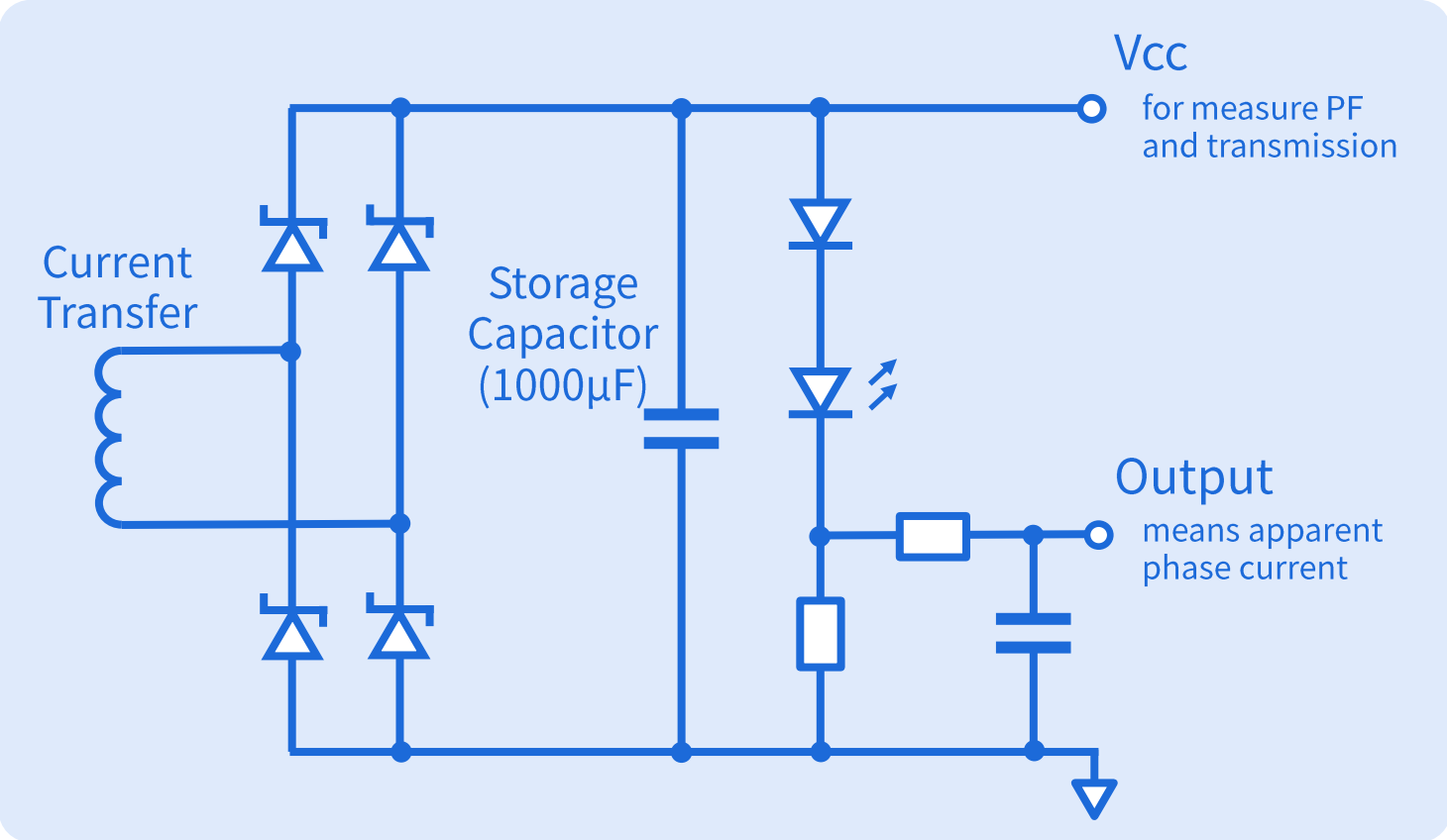
Attempted non-contact measurement of voltage with piezoelectric film

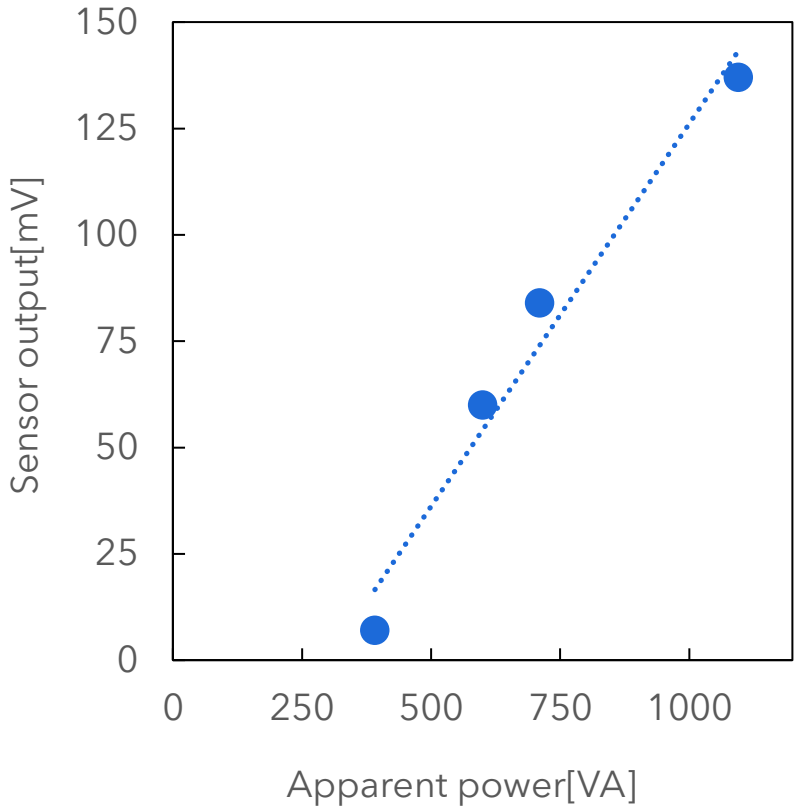
Measured waveform with piezo film



A single probe measured voltage waveform contactless

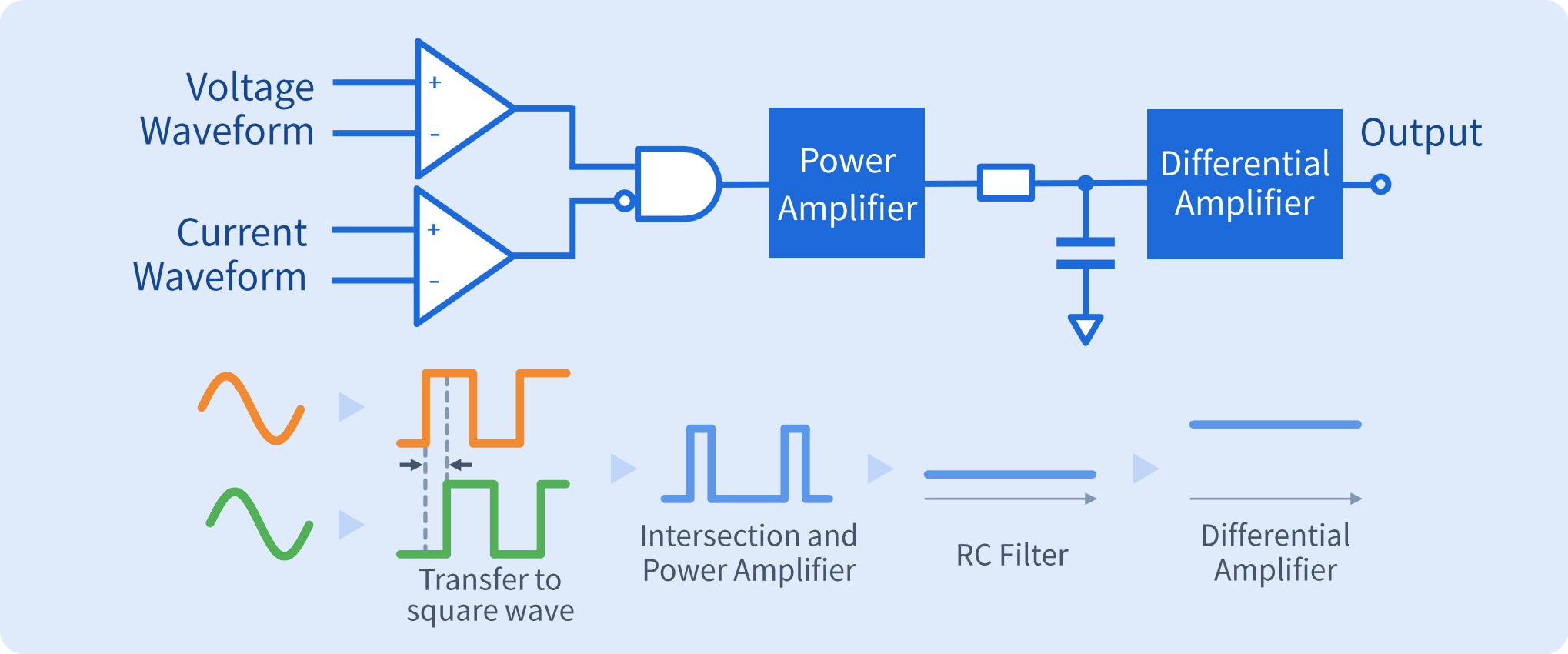
Apparent power measurement and power management





Power management and measurement

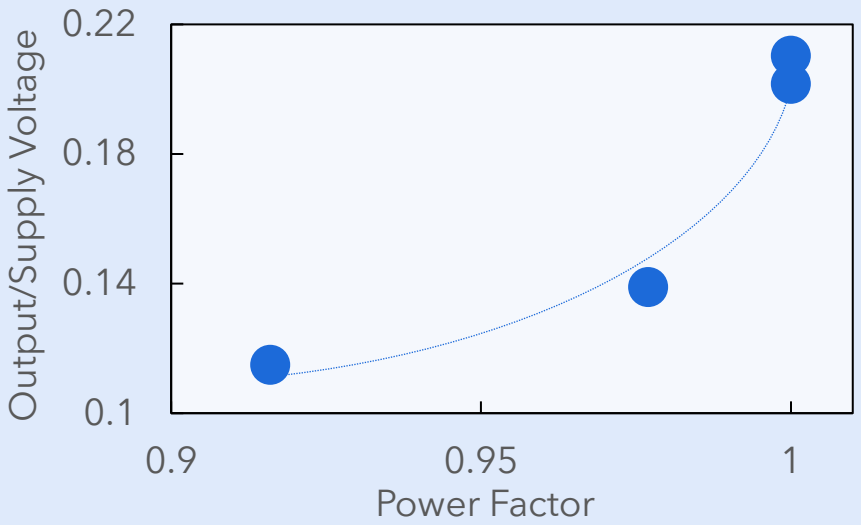
Power factor measurement circuit



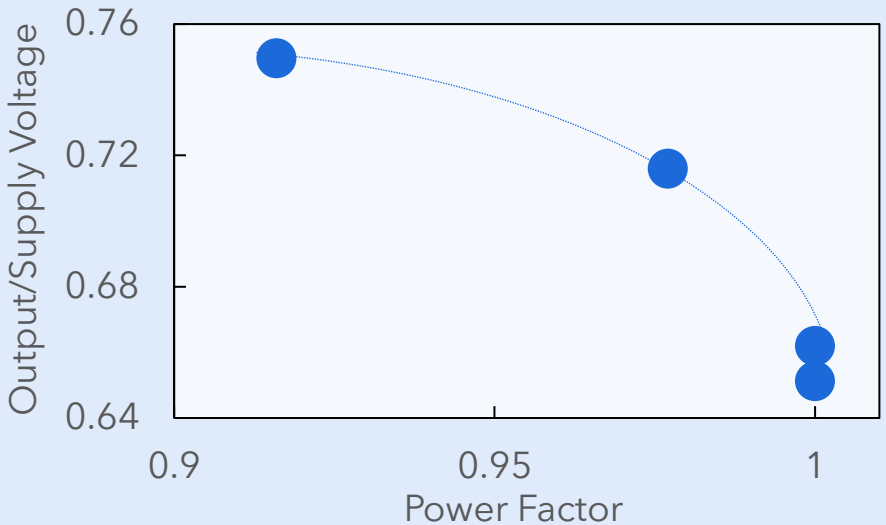
Current consumption is about 10μA

Result of PF measurement

Output of the developed circuit with the piezo prove



Install current transformer in **forward direction**



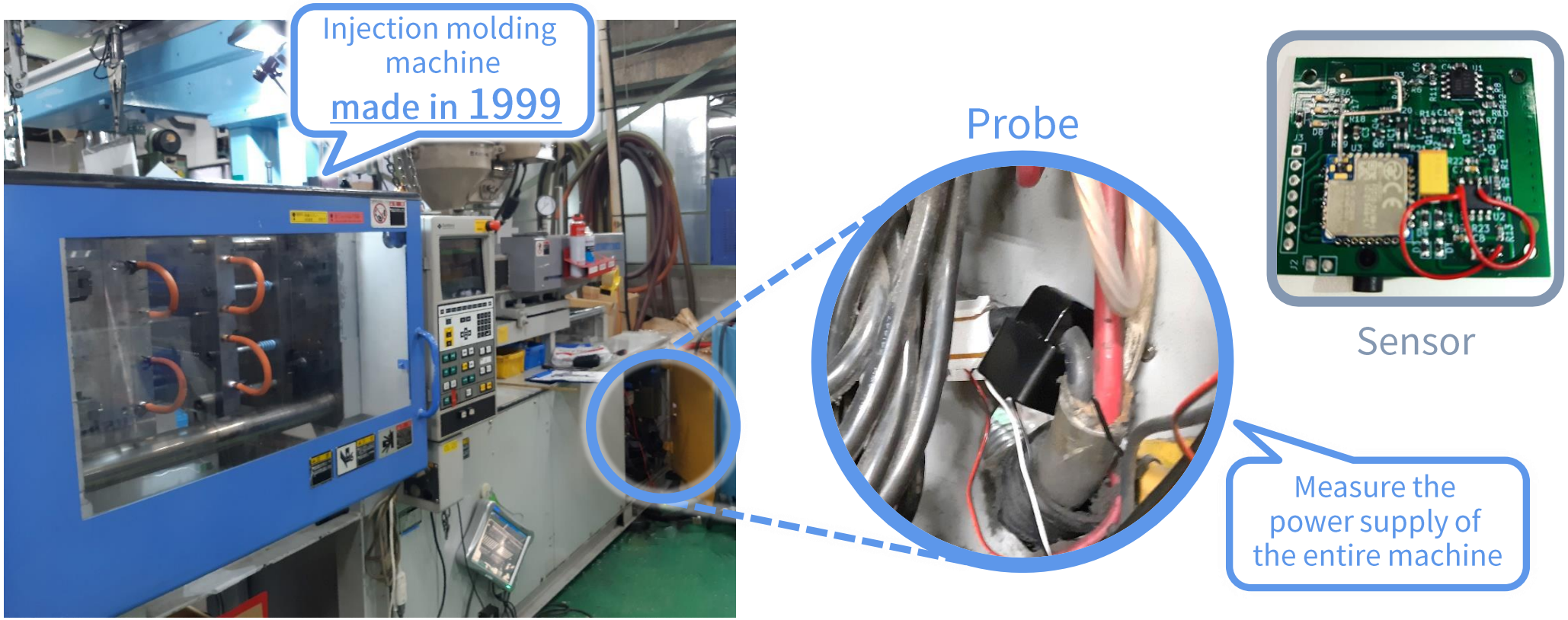
Install current transformer in **reverse direction**

※Theoretical value: ACOS(PF)

The sensor could measure the power factor without contact

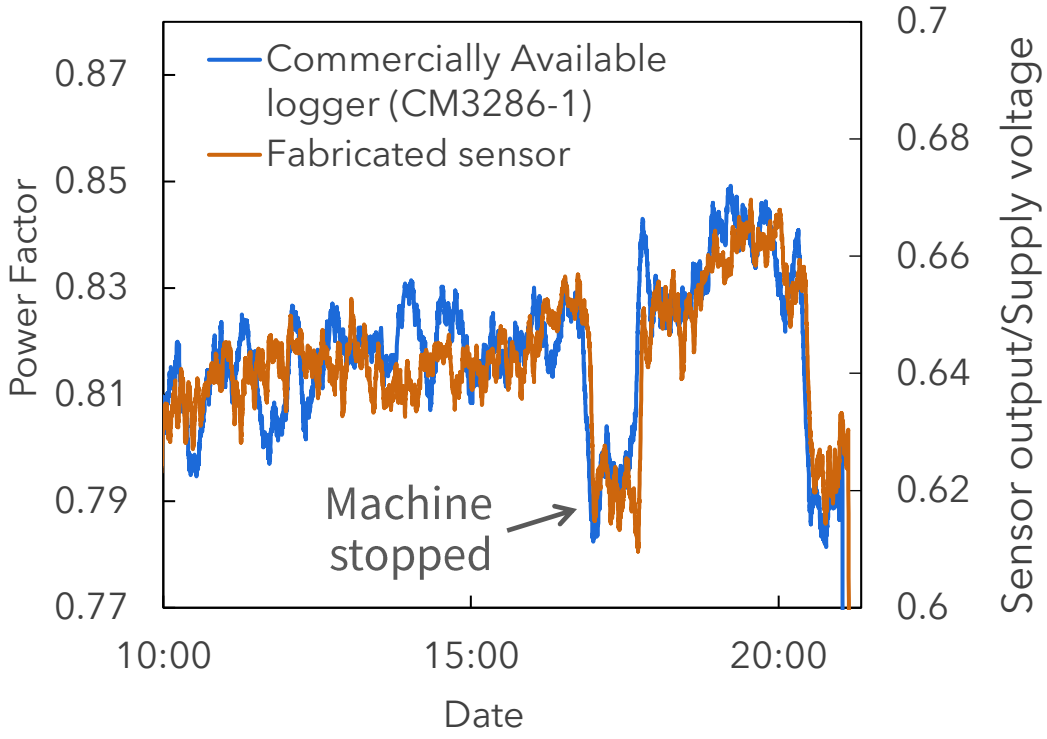
Field test

Sensor installed on injection molding machine at factory for field test

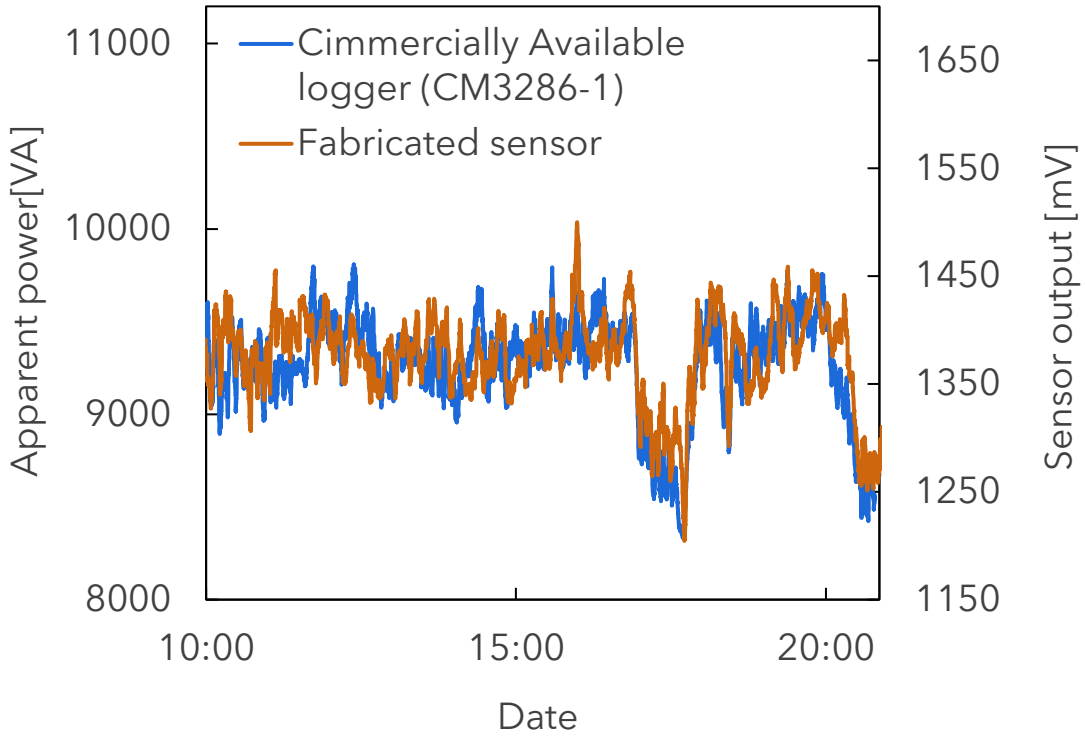


Place: Tycoh Bussan Corporation (Tachikawa, Tokyo)

Result of field test



Power Factor



Apparent power

Correlation coefficients were 0.80 for PF and 0.73 for apparent power

※Data is a moving average of 50 points

Conclusion

Conclusion

- Confirmed that voltage waveform can be measured without contact
- Confirmed that power factor can be measured with low power consumption
- The fabricated wireless sensor had a correlation with PF and apparent power

Applications and Challenges

- Fabricated sensors are expected to be applied in many industries.
- The sensor need to be placed in many locations to determine the impact.

Please contact us!

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