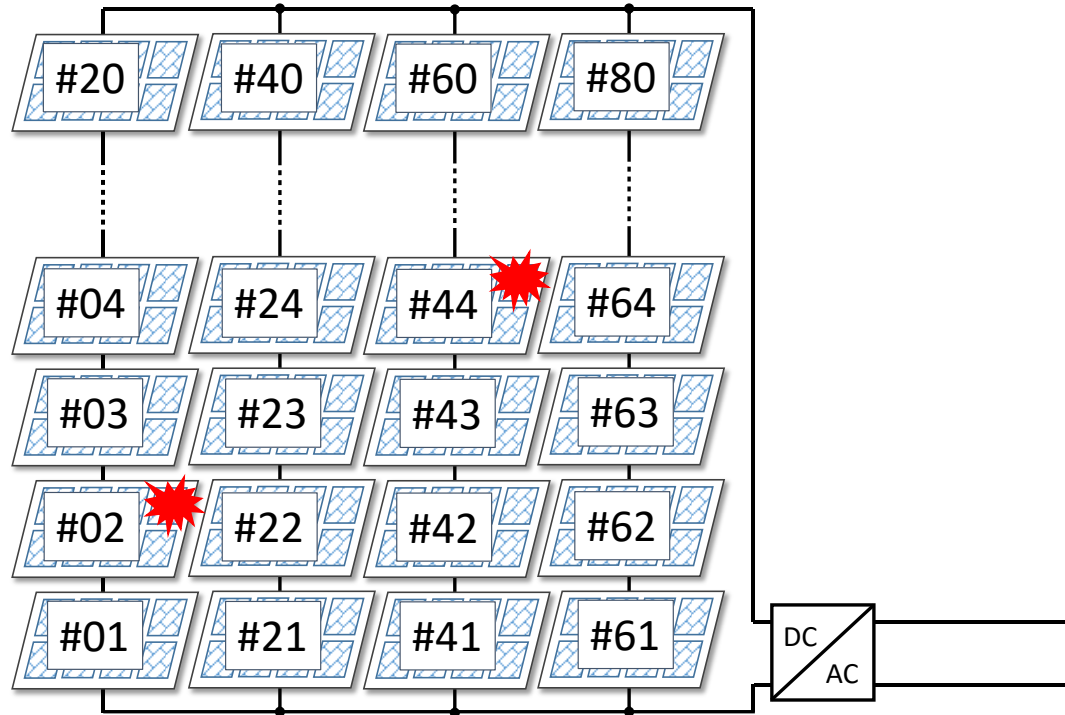


PPLC-PV: A Pulse Power Line Communication for Series-Connected PV Monitoring

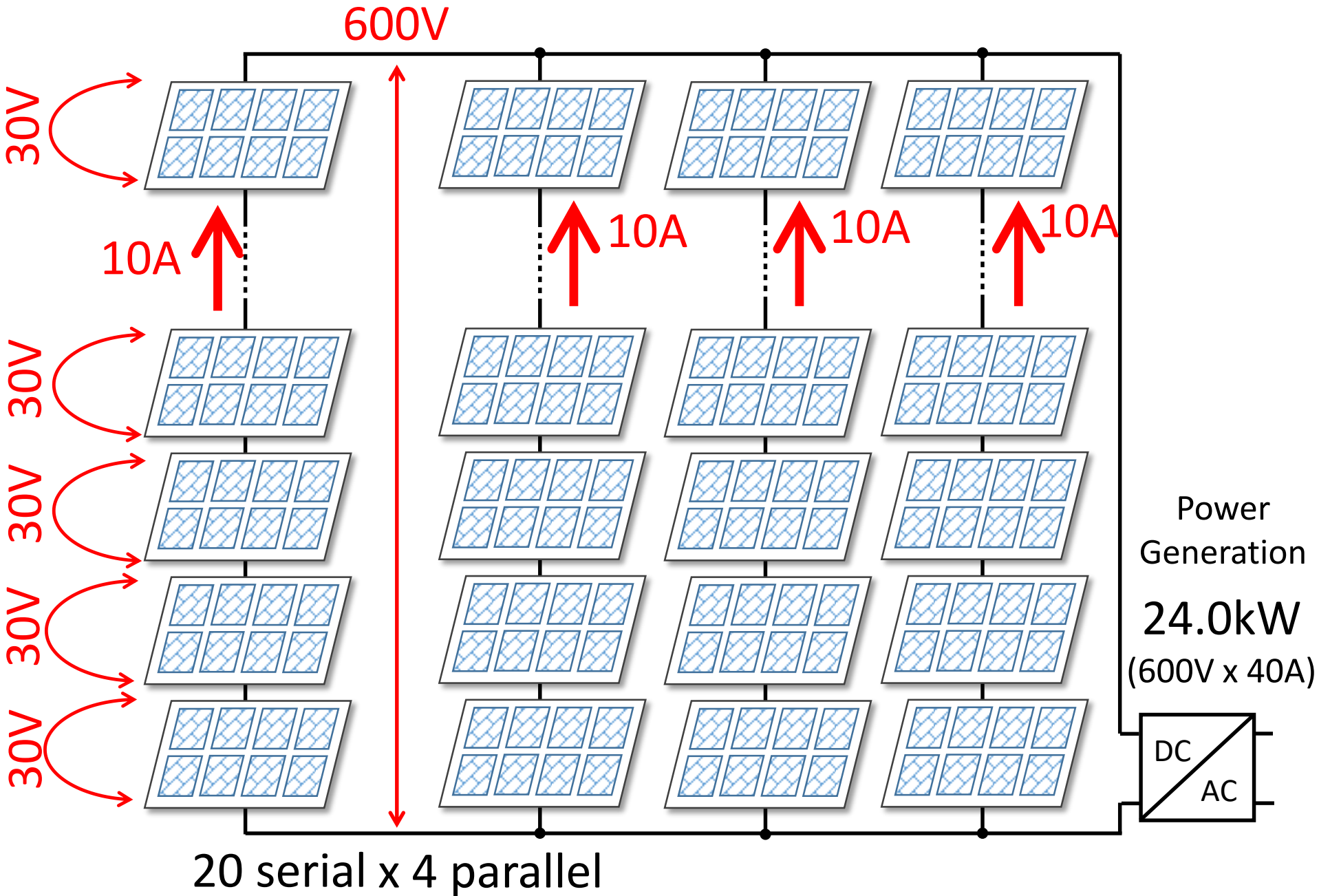


Hideya Ochiai, Ph.D.

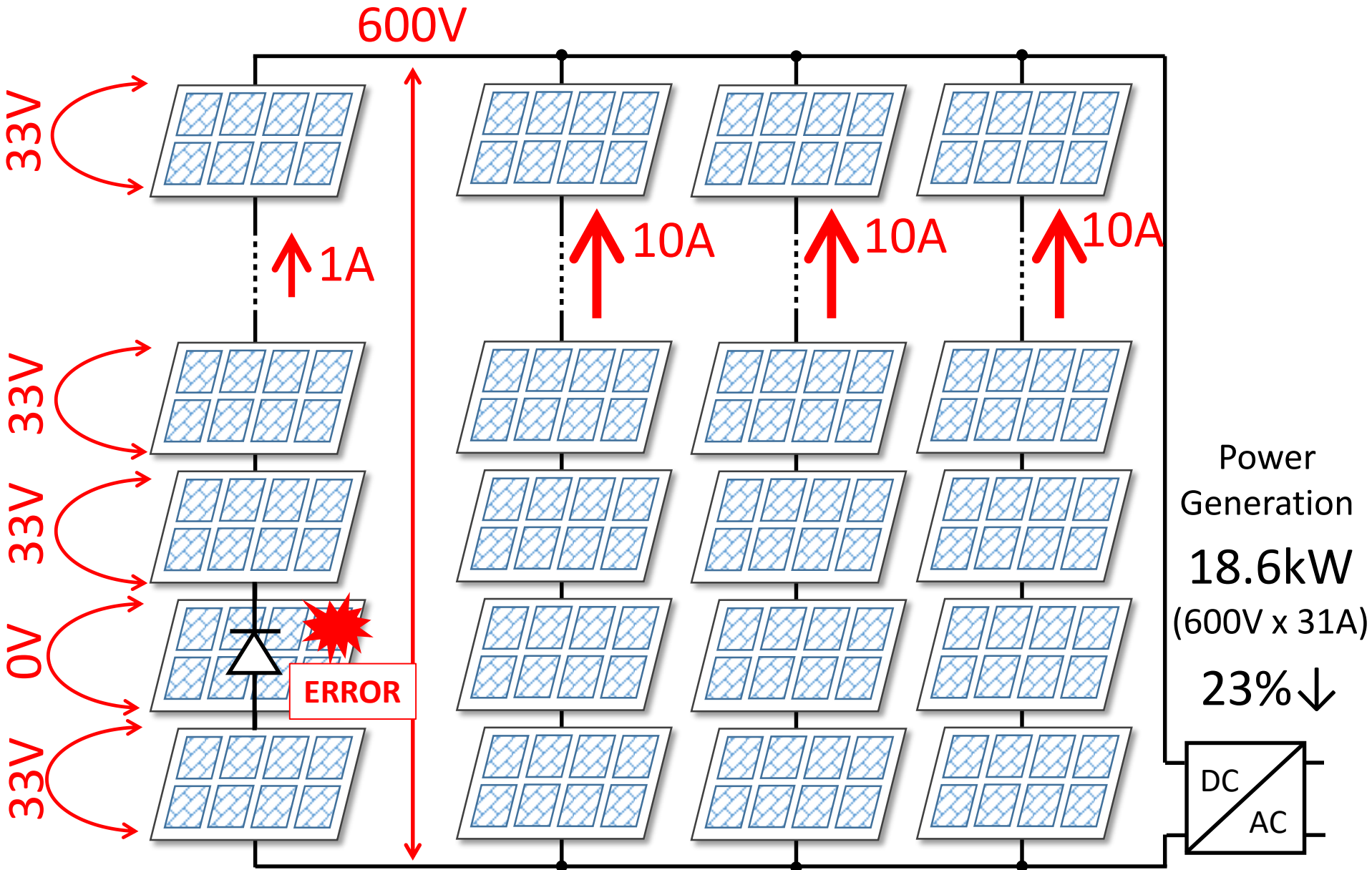
Hiroyuki Ikegami

The University of Tokyo, JAPAN

Background: Vulnerability of PV System

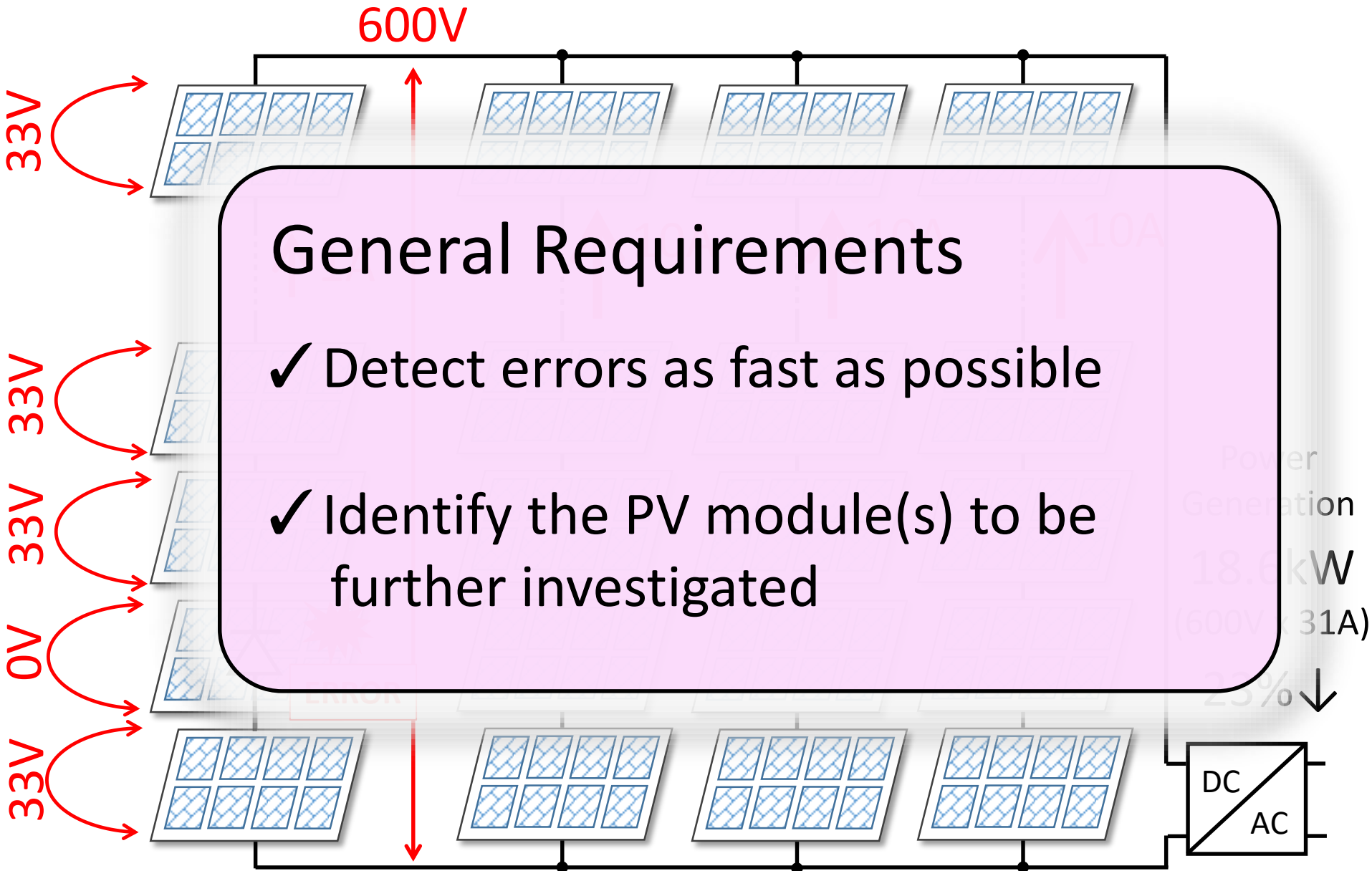


Background: Vulnerability of PV System

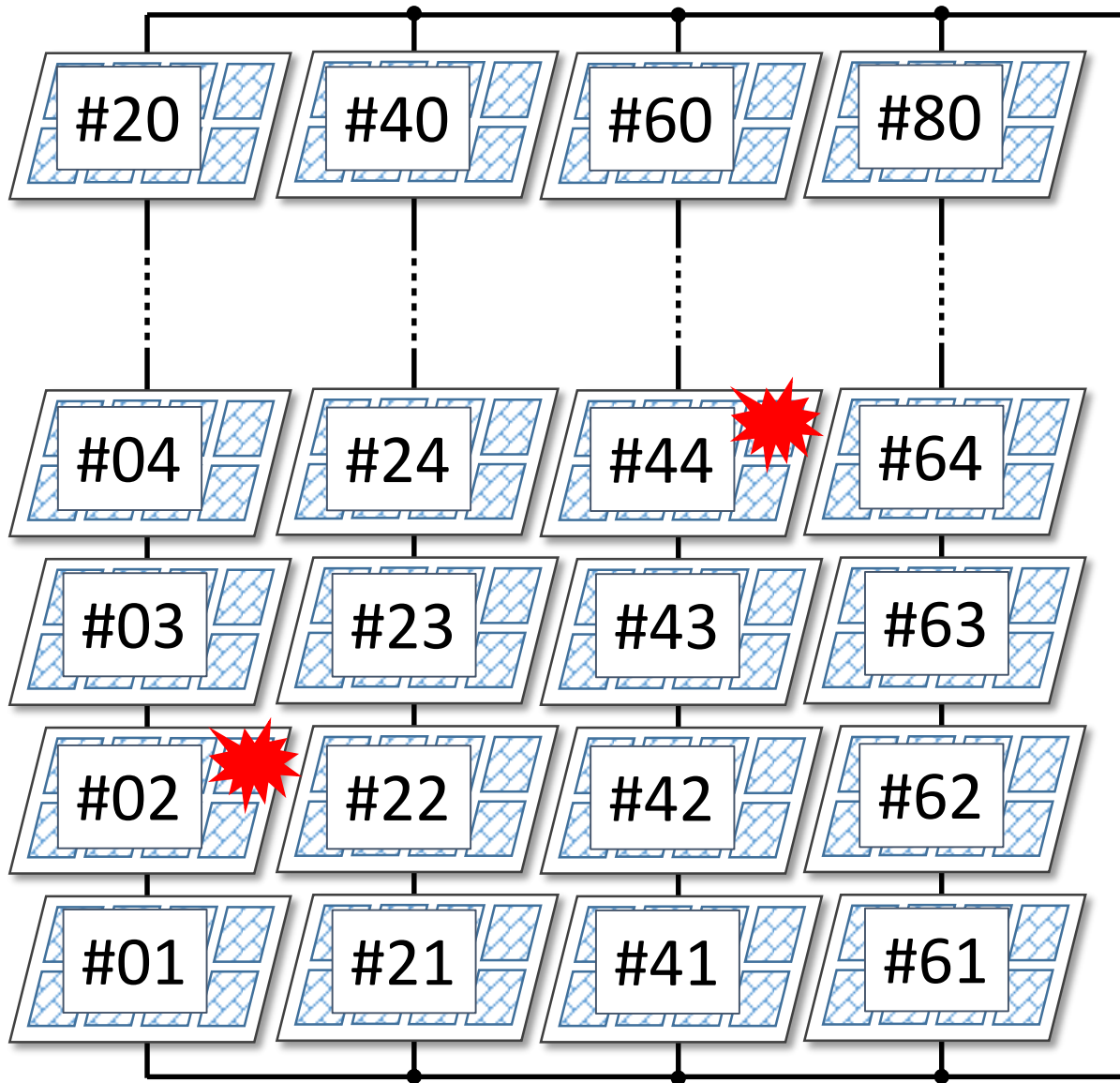


ERROR may shadow or invisible internal disruption.

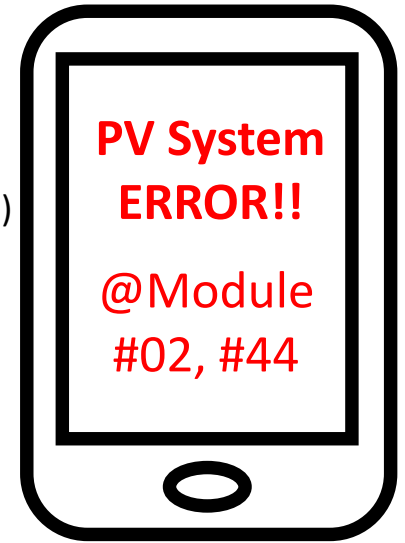
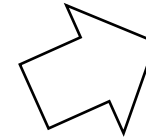
Background: Vulnerability of PV System



Monitoring of PV Modules



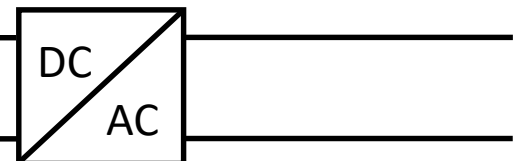
LTE+Cloud
(not our focus)



How to collect ?

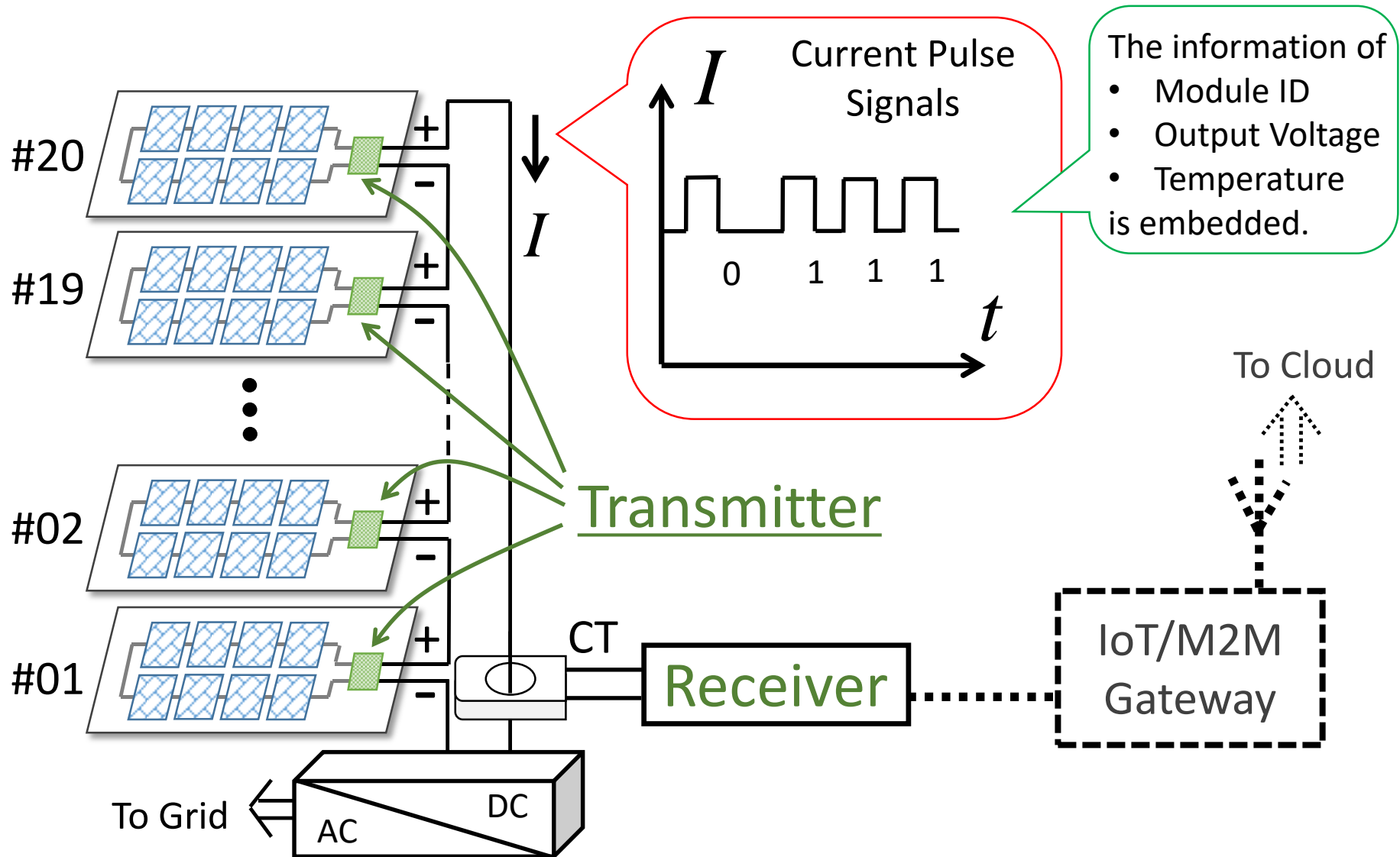
PPLC-PV

- No additional wire
- No radio communication
- Use “power line” for communication



Proposal : PPLC-PV

A Pulse PLC for Series-Connected PVs



A Pulse PLC for Series-Connected PVs



顔を合わせて内容をご説明したいため、スライドの一部をぼかしています。詳細を知りたい方は、落合までコンタクトをお願いします。

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PV (#04)



$D_{forward}$

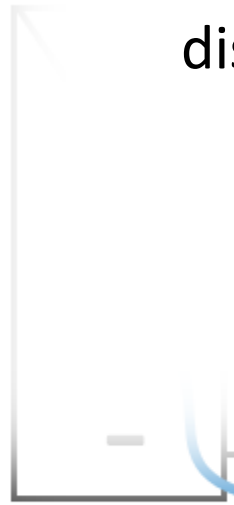
Constant Current
by PVs

顔を合わせて内容をご説明したいため、スライドの一部をぼかしています。詳細を知りたい方は、落合までコンタクトをお願いします。

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PV (#03)

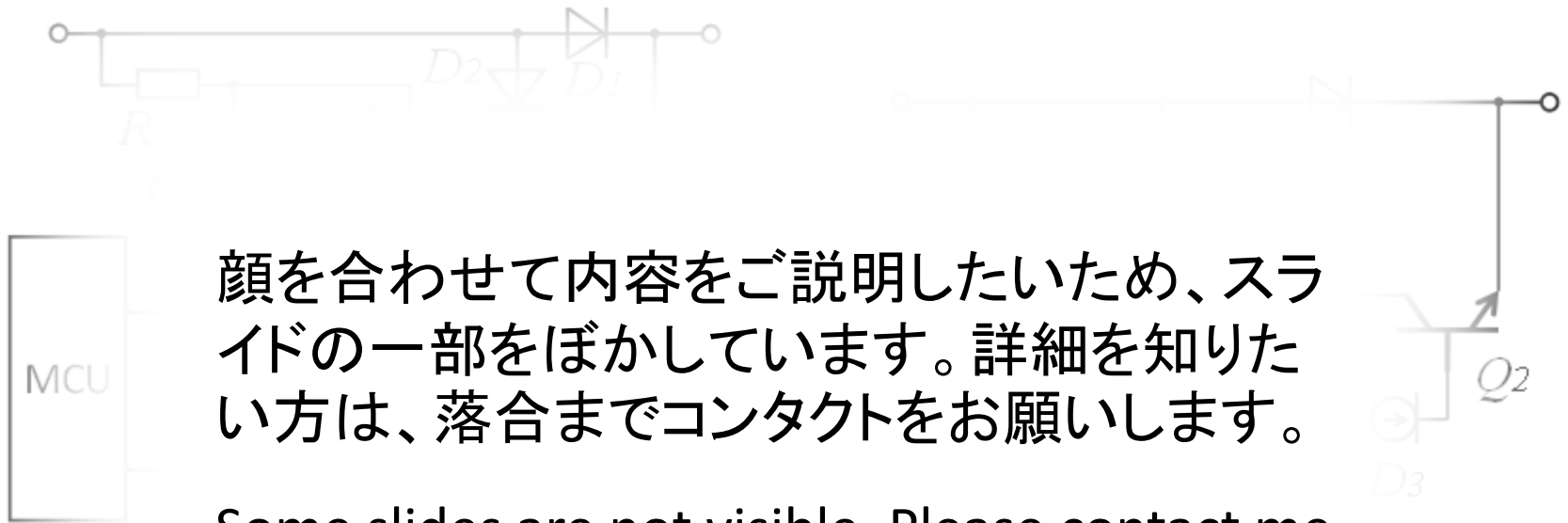


Current
bypass
!!)

"t"

use!!

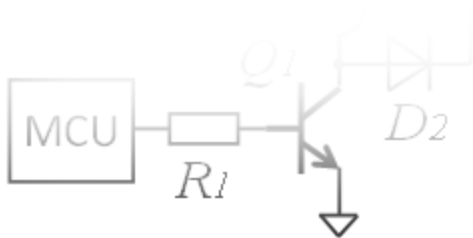
Designed Transmitters (4 Types)



顔を合わせて内容をご説明したいため、スライドの一部をぼかしています。詳細を知りたい方は、落合までコンタクトをお願いします。

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(c) Inductor Direct Transmitter



(d) Reverse Current Transmitter

How “(c) Inductor Direct Transmitter” generate a pulse.

(3) Current diminishes
1000 μ sec

顔を合わせて内容をご説明したいため、スライドの一部をぼかしています。詳細を知りたい方は、落合までコンタクトをお願いします。

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om L.

(1) Q1=ON (e.g., 200 μ sec)

→ Charge Current into L.

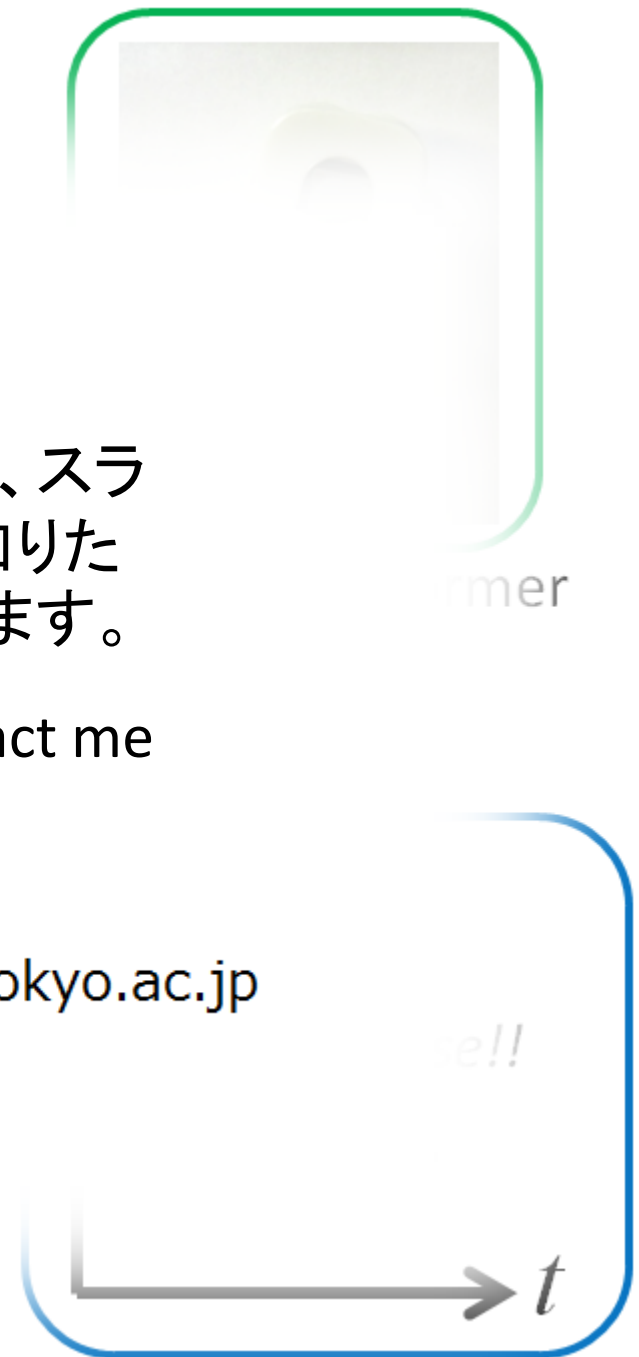


PPLC-PV Receiver

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Experiment

(to study the features of PPLC-PV)

- PV Module



SY-M12W-12

(SUNYOOO Solar Limited)

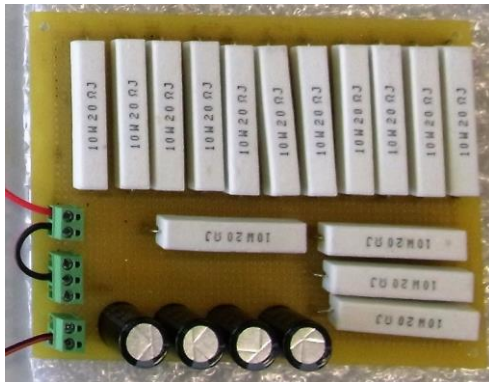
Pmax: 17.4V 0.69A (12W)

Open Voltage: 21.8V

Short Current: 0.73A

× 20

- Load (as Inverter)



Resister: 0 – 600Ω

Input Capacitance: 190uF

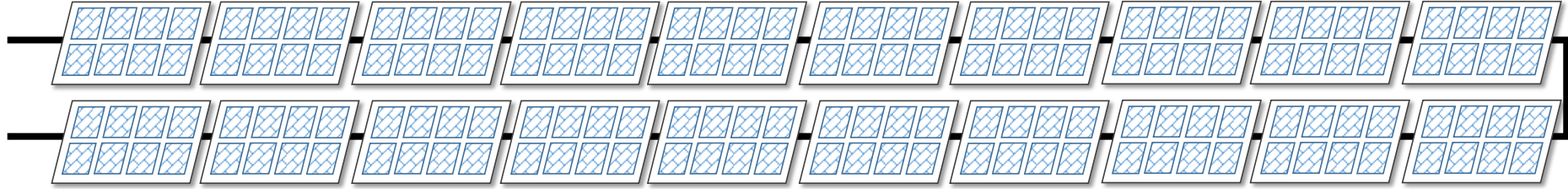
- Receiver CT



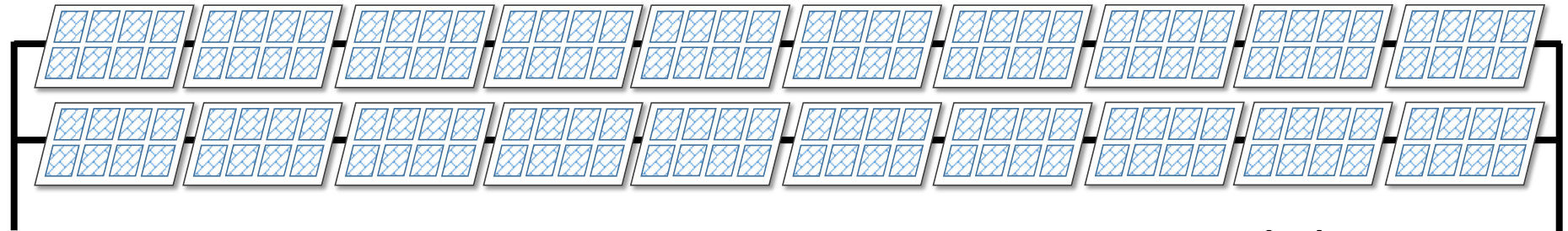
CTL-10-CLS (u-RD)

N : 1 = 3000 : 1
with 30kΩ resister

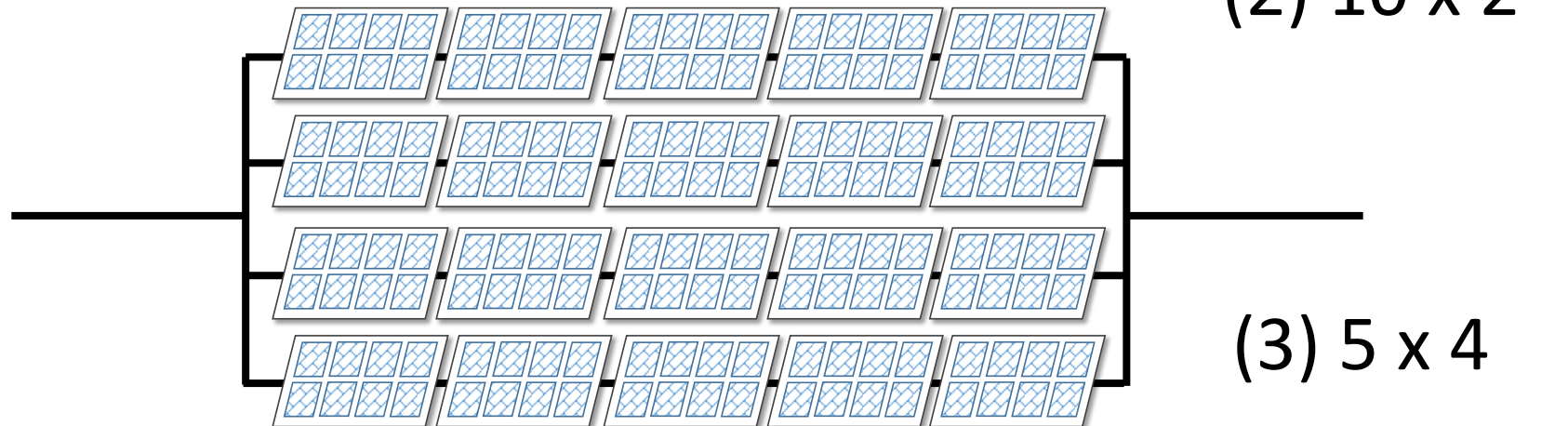
PV Module Configurations for Testing



(1) 20 x 1



(2) 10 x 2



(3) 5 x 4

Pulse Form Observation

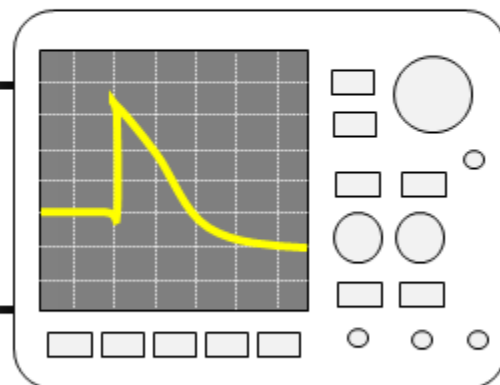
Observation Method

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Voltage



Oscilloscope: Tektronix MDO3014

much larger than others!!

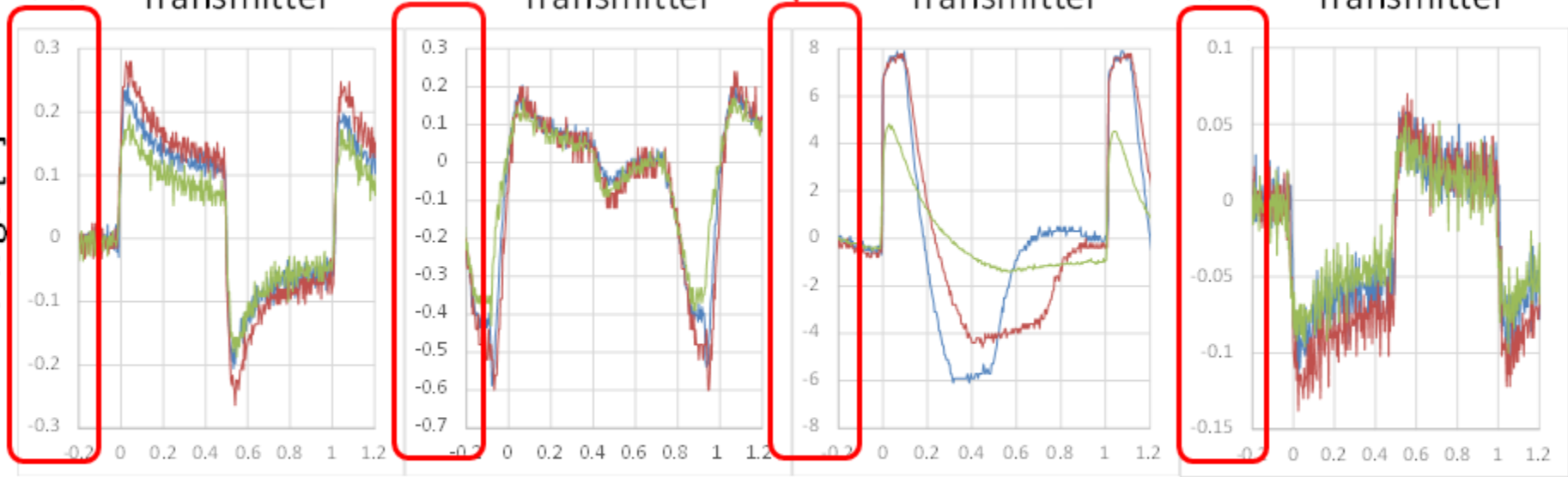
(a) Capacitor Pump Transmitter

(b) Inductor Pump Transmitter

(c) Inductor Direct Transmitter

(d) Reverse Current Transmitter

Voltage [V]



— 20x1 — 10x2 — 5x4

Time[msec]

Pulses generated by inductor direct transmitter

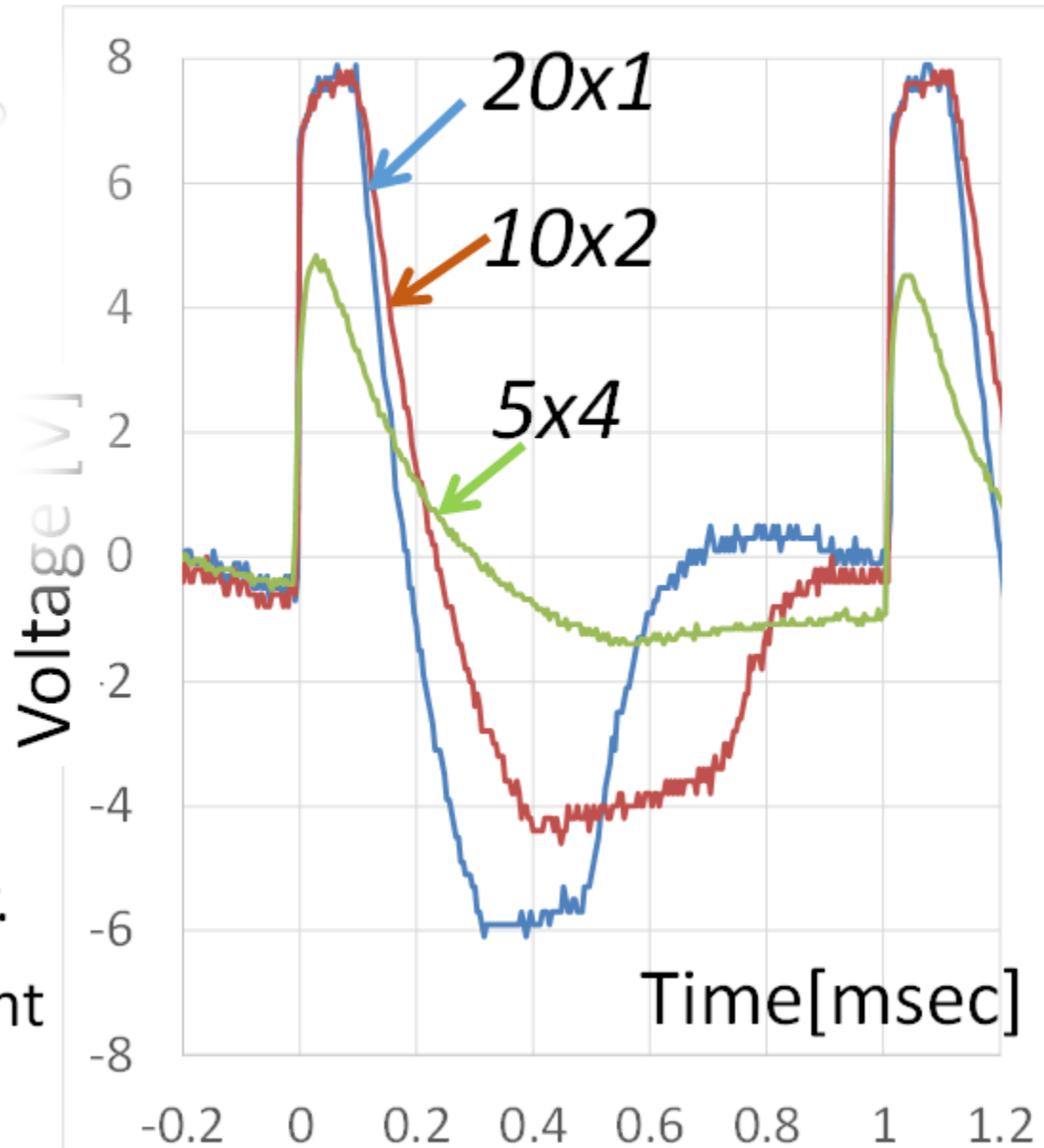
顔を合わせて内容をご説明したいため、スライドの一部をぼかしています。詳細を知りたい方は、落合までコンタクトをお願いします。

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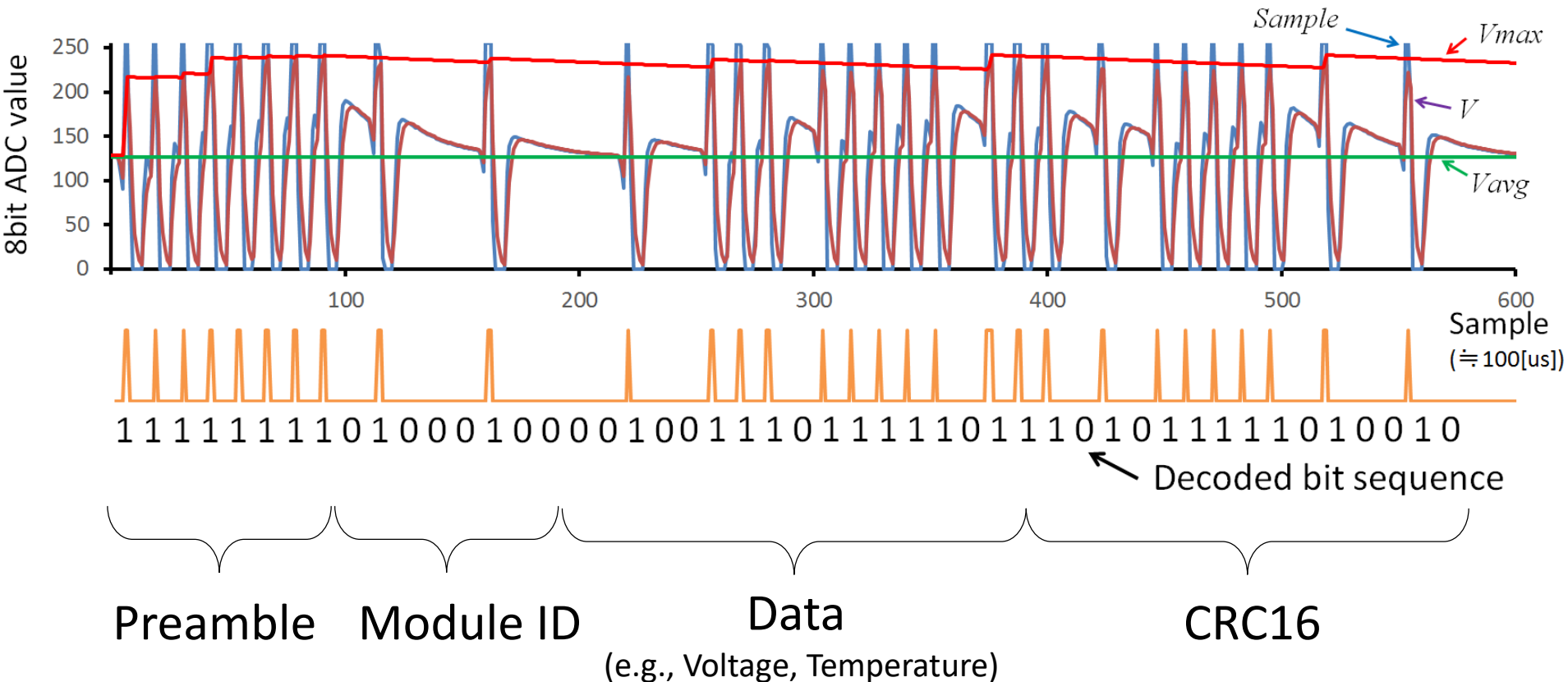
Contact: ochiai@elab.ic.i.u-tokyo.ac.jp

Schematics

Very strong pulses were detected at the receiver.
-- expected to be tolerant to potential noises.



Data Transmission Example: Decoding data at the receiver (Inductor Direct Transmitter's case)



➔ Not only single pulse, PPLC-PV can send some basic data frames !!

Conclusion

- PV module-level monitoring is required.
 - to detect ERRORS caused by shadow or invisible internal faults.
 - to recover the failed PV system as fast as possible.
- A Pulse PLC for series-connected PV monitoring:
 - Proposed simple schematics that makes strong pulse signals
- Experiment
 - Inductor direct transmitter is the best.
 - It can send some basic data frames.
- Others
 - Several updates after the paper submission.
 - Calling for Research Collaborators for further research on this.