

POWER LOSS PHOTOVOLTAIC MODULE DETECTION METHOD BY TWO STEPS

Kazumi Takano¹, Yusuke Toda¹, Masaru Yamashita¹, Katsuhiko Shirasawa²

¹ITES, Japan, ²National Institute of Advanced Industrial Science Technology, Japan

Solar panel manufactures offer their customers the power warranty for 25 years. New Japanese FIT law obliges electricity utility to do a periodical inspection of a photovoltaic module (PVM) by a licensed electrical engineer. But the maintenance guideline that supplied from Japan Photovoltaic Energy Association doesn't include the inspection method to detect a power loss PVM.

The most frequent failures of the crystalline silicon type PVM are disconnection of internal circuit and increase of resistance. When these failures occur, at least 33 % of electric generating capacity is lost (Figure 1). The method to detect this power loss PVM was experimentally studied. As a narrow down step, measure the impedance instead of resistance and open circuit voltage of the PVM string. The impedance of the string containing the power loss PVM is higher than the other strings (Figure 2). The open-circuit voltage of the string contains interconnect disconnection decreases by about 10 V. As a single out step, check magnetic field intensity emitted by current flow in internal circuit. The magnetic field intensity does not appear from the interconnector in the open state. This detection method was carried out at a photovoltaic power plant that had been operating for 15 years (Table 1). Every PVM that were determined as a power loss PVM has come out losing power generation capacity under the evaluation of a solar simulator. 13 power loss PVMs of 30 can be early detected by checking the magnetic field intensity near interconnectors on the cover glass of PVM (Figure 3). As the result of cross section analysis, solder layer between interconnector and cell has fatigue fracture (Figure 4). Disconnection and increase of resistance failures are caused by the degradation of solder connection.

Solar simulator must be accurate at data of output power, but only solar panel manufactures have it. However, a power loss PVM because of disconnection or increase of resistance can be found by this easily detection method in the field without removing a PVM.

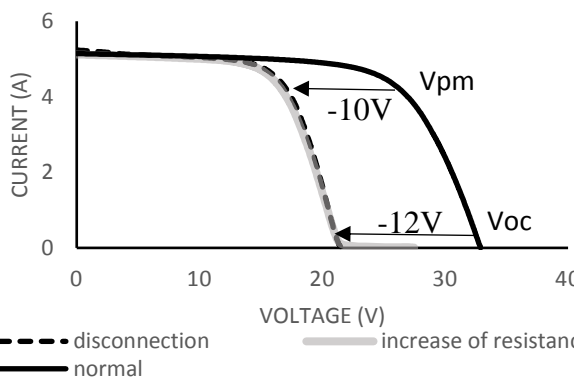


Figure 1: Photo IV of false failure in Module
If disconnection occurs, open circuit Voltage goes down about 12V. If increase of resistance occurs, power max voltage goes down about 10V. Both failures lose at least 33% of output power.

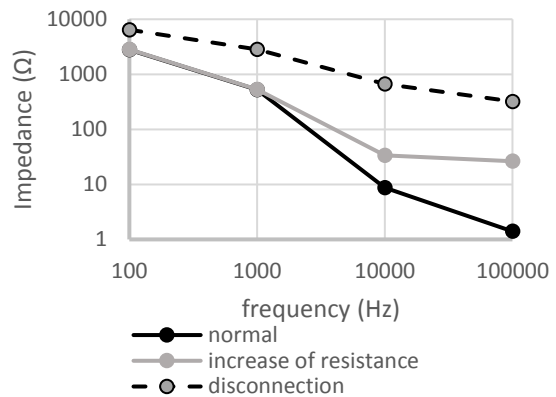


Figure 2: Impedance of false failure in Module
Impedances under 1kHz of the false failure modules have no major differences. But Impedances over 100kHz of them have difference of more than ten times. It is easy parameter to detect these failures.

Table 1: Impedance & Voc of Strings

string	Z(Ω)	Voc(V)
#1	33	146
#2	>1000	0
#3	610	141
#4	>1000	0
#5	160	141
#6	7	155

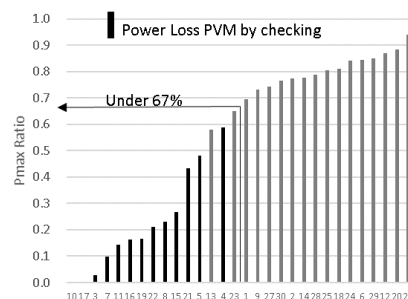


Figure 3: Power loss PVM and Pmax ratio

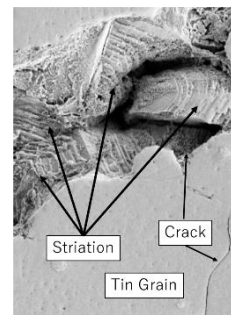


Figure 4: Striation in crack