

# Togami

## Super LINE CHECKER

Type:TLC-C-Y1



**Circuit breaker or route detection can be carried out  
on the live lines by a single operator!**

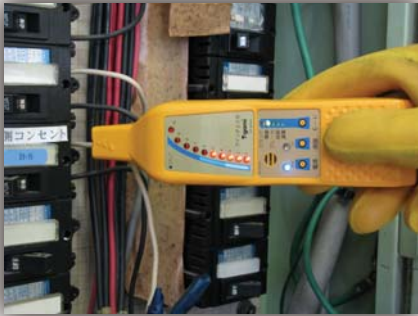
**Togami Electric Mfg.Co.,Ltd.**

Catalog No C0251  
2016 January

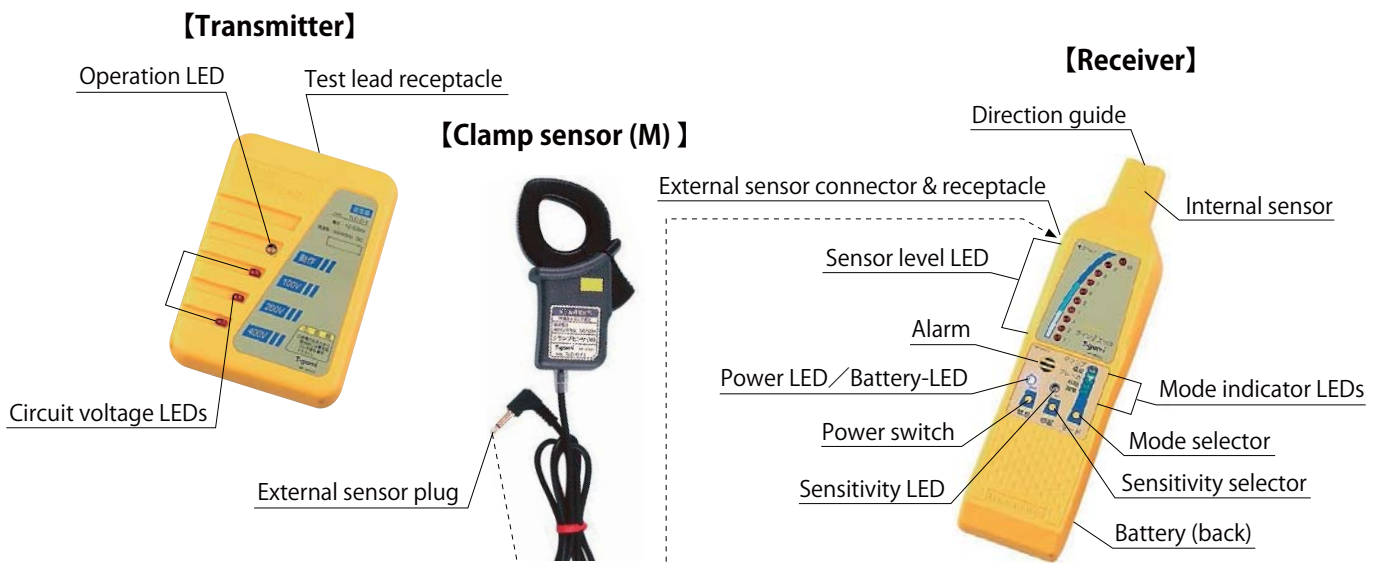
Super Line Checker is suitable for wiring check prior to installation and repair work and at maintenance and failure occurred.

## Features

- ◆Earth leakage point detection
- ◆Breaker and route detection either live or de-energized wires
- ◆Circuit voltage indication
- ◆Easy judgment by sound and LED lights
- ◆More accurate detection by using clamp sensor
- ◆Prevent signal leak to the line you are not detecting



## Part names



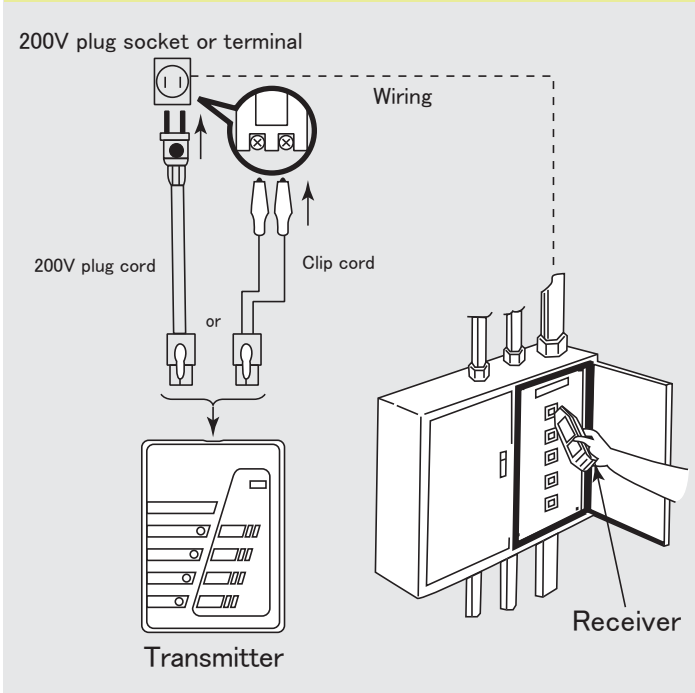
## Contents of standard set



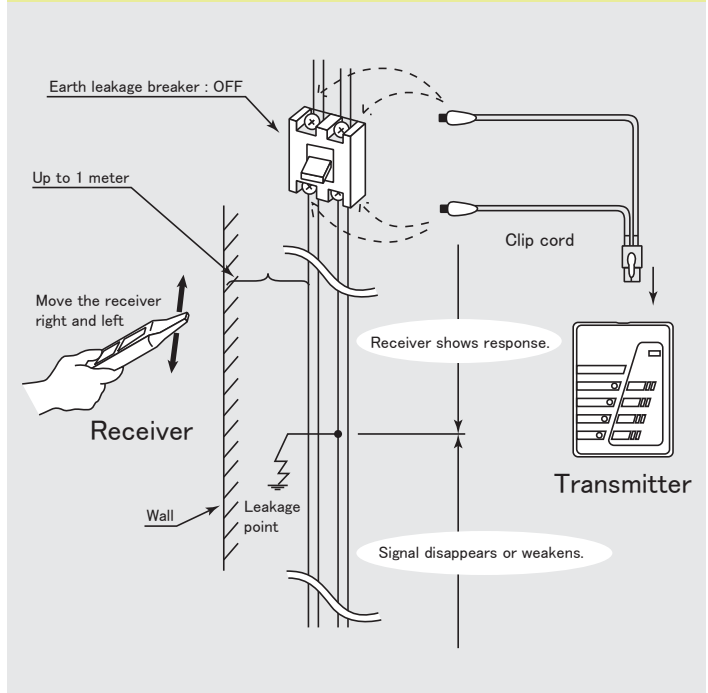
Transmitter× 1  
 Receiver× 1  
 Clamp sensor (M) × 1  
 Cord with 200V plug× 1  
 Clip cord× 1  
 Cord with battery clip× 1  
 9V manganese battery× 1  
 Carrying case× 1  
 Instruction manual× 1

# Usage

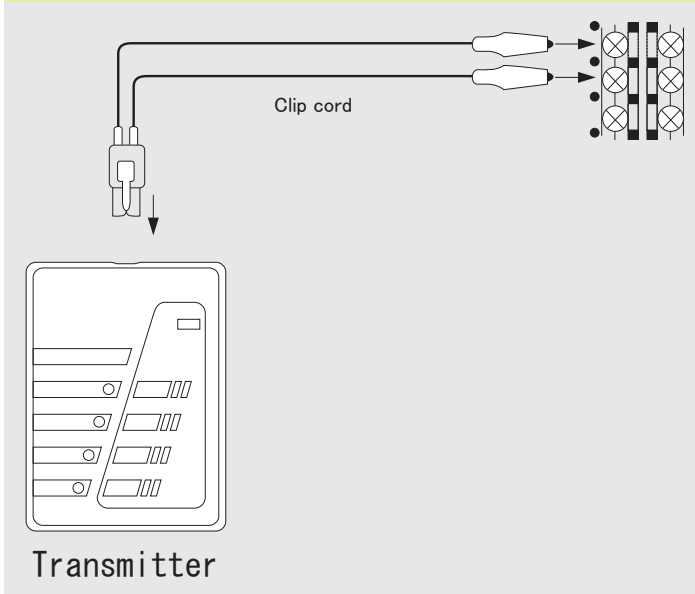
## 1. Energized breaker detection



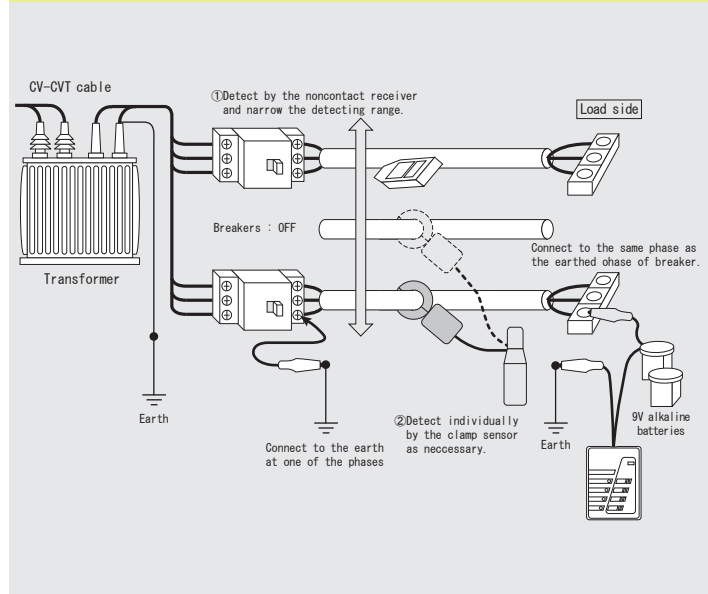
## 2. Earth leakage point detection (De-energized)



## 3. Circuit voltage check



## 4. De-energized cable detection



# Options



Signal leakage prevention unit  
(SBU-A-5K)



Clamp sensor (S)  
(inner dia.  $\phi$  8)  
(TLC-C-F3)



Clamp sensor (L)  
(inner dia.  $\phi$  40)  
(TLC-C-F2)



Clamp sensor (LL)  
(inner dia.  $\phi$  68)  
(TLC-C-F7)

# Specifications

## Receiver (Type : TLC-C-R)

Detection theory	Detection the magnetic field generated by the signal current
Detection frequency	5kHz
Built-in sensor	2 coil sensors ( coils for wire detection and breaker detection )
External sensor	Clamp sensor ( plug connecting type )
Judgment criterion	10 LEDs ( red ) blink ( receiving level indication ) and alarm sound
Sensitivity selection	5 mode selection ( Clamp, Wire, Breaker, Route, and E.Leakage) and Low/High sensitivity selection ( common to each mode )
Condition of earth leakage detection	Ground fault resistance = 2k $\Omega$ or less Earth capacitance = 0.01 $\mu$ F or less
Power	9V battery ( manganese or alkaline )
Battery life	About 8 hours ( manganese battery, 20°C, continuous receive )
Battery life display	Battery-LED ( blue ) ( Battery remaining : lighting = 40% or more, blinking = 40% or less, extinction = 0% )
Auto power off	Auto power off after 10 minutes of non-operation
Auto power off alarm sound	1.5 sec ( ON ) → 5 sec ( OFF ) → 1.5 sec ( ON ) → 5 sec ( OFF ) → 5 sec ( ON ) → Power off
Applicable clamp sensor	Clamp sensor ( M ) ( internal diameter $\phi$ 24 ) ( standard ) Clamp sensor ( LL ) ( internal diameter $\phi$ 68 ) ( option ) Clamp sensor ( L ) ( internal diameter $\phi$ 40 ) ( option ) Clamp sensor ( S ) ( internal diameter $\phi$ 8 ) ( option )
Dimensions	193 ( H ) × 51 ( W ) × 33 ( D ) mm
Weight	About 135g ( including a battery )

## Transmitter (Type : TLC-C-T)

Applicable voltage range	AC50/60Hz and DC : 12-528V
Type	Current consumption
Signal frequency	5kHz
Signal current	200mA <sub>p</sub>
Signal time	30ms
Signal cycle	500ms
Operation indication	LED ( yellow )
Voltage indication	LED ( red ) ( 100V/200V/400V )
Dimensions	112 ( H ) × 82 ( W ) × 30 ( D ) mm
Weight	About 111g

## Clamp sensor (M) (Type : TLC-C-F1)

Applicable voltage range	AC50/60Hz and DC : max. 528V
Applicable current	AC50/60Hz and DC : 100A
Internal diameter of clamp	$\phi$ 24
Applicable clamping point	Insulating coating of LV insulated conductor ( Never clamp the bare conductors. )
Length of signal cable	About 90cm
Dimensions	100 ( L ) × 60 ( W ) × 26 ( D ) mm
Weight	About 81g

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※Appearance, dimensions, etc., are subject to change without prior notice.

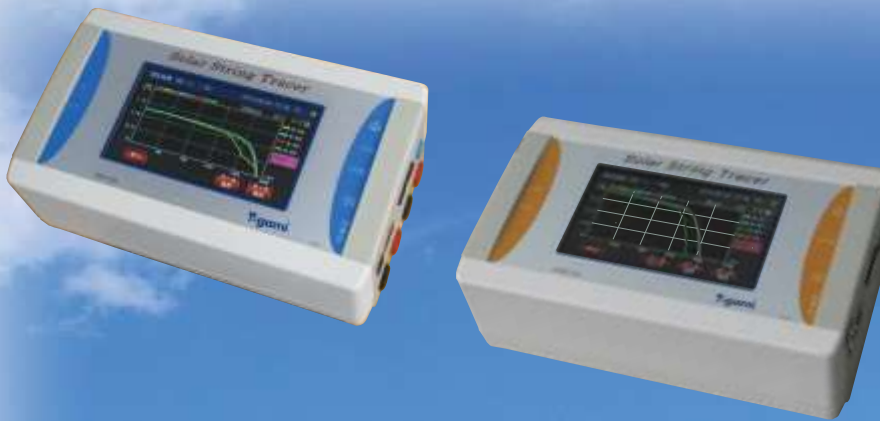


**PV Doctor**

**Togami**

For the inspection and fault location of the photovoltaic modules

# *Photovoltaic Module Fault Detectors*



**String Tracer** (I-V curve tracer)



**Cell Line Checker** (Fault module detector)

Feb. 2016

Catalog No. C0234c

**Togami Electric Mfg. Co., Ltd.**





Do you have any of the following issues in your PV system?

I don't know how to investigate the cause of declining the power output.

I don't know which tool is suitable for the detailed module inspection.

There is no tool to check the photovoltaic module condition.

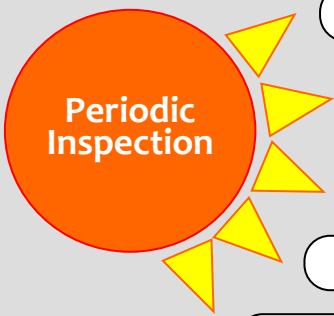
I'm looking for a tool which is cheap and easy to use.



If you have these issues and leave them unsolved, you may have the unexpected troubles, such as...

- ◆ Unexpected decline of power output which may lead to the compensation issue of electricity sales to the grid.
- ◆ Accidents, such as fire, caused by photovoltaic module, etc.

Japan Photovoltaic Energy Association <Guideline for maintenance and inspection of small-scale photovoltaic generation system>



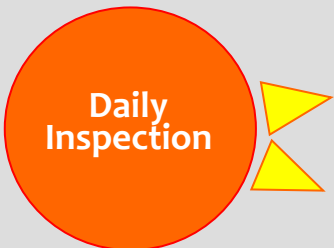
Visual check (breakage, etc.)

Power output check (Inverter monitoring)

Measurement of open-circuit voltage (Voc)

Measurement of short-circuit current (Isc)

Measurement of insulation resistance

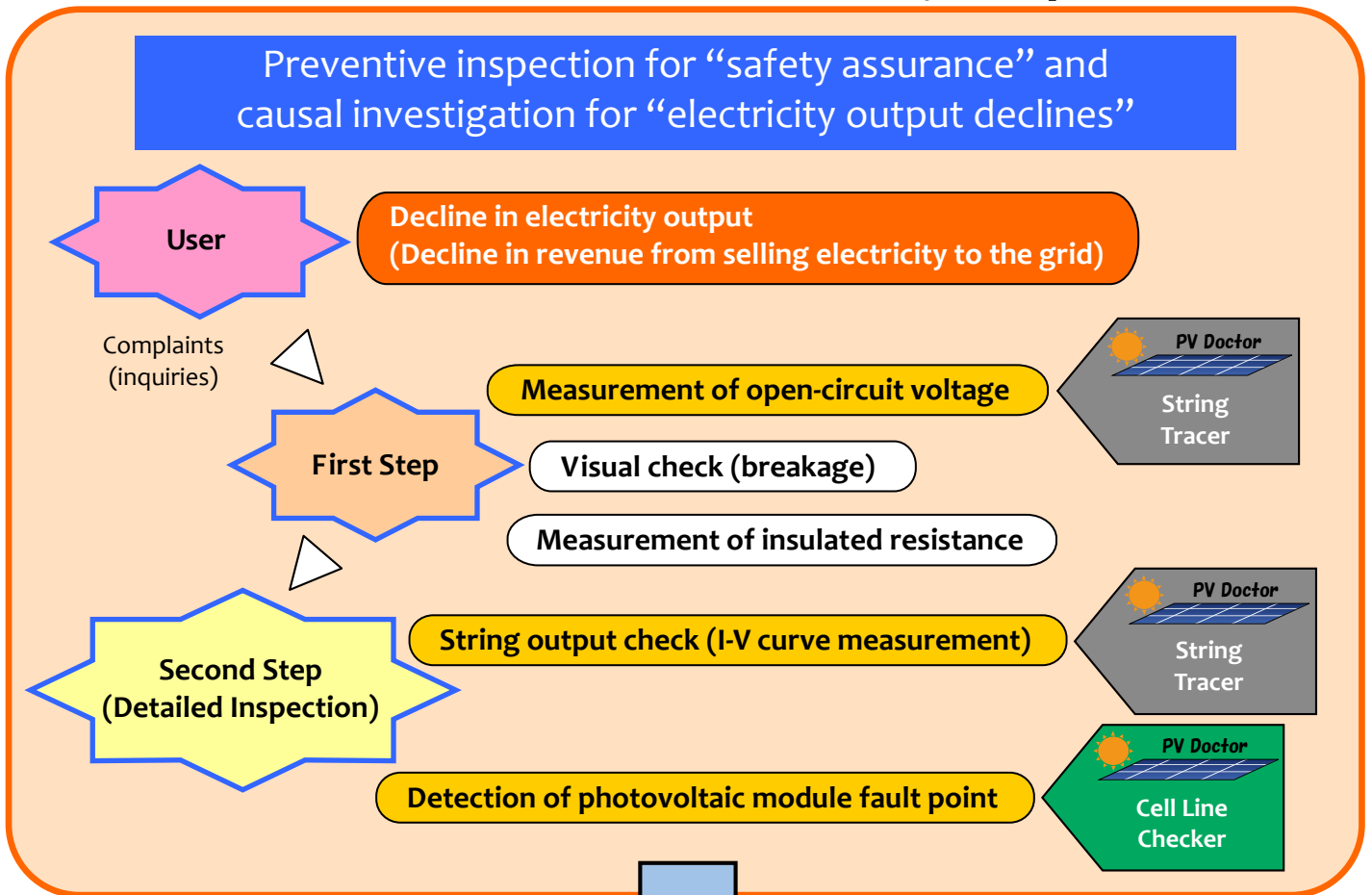


Visual check (breakage, etc.)

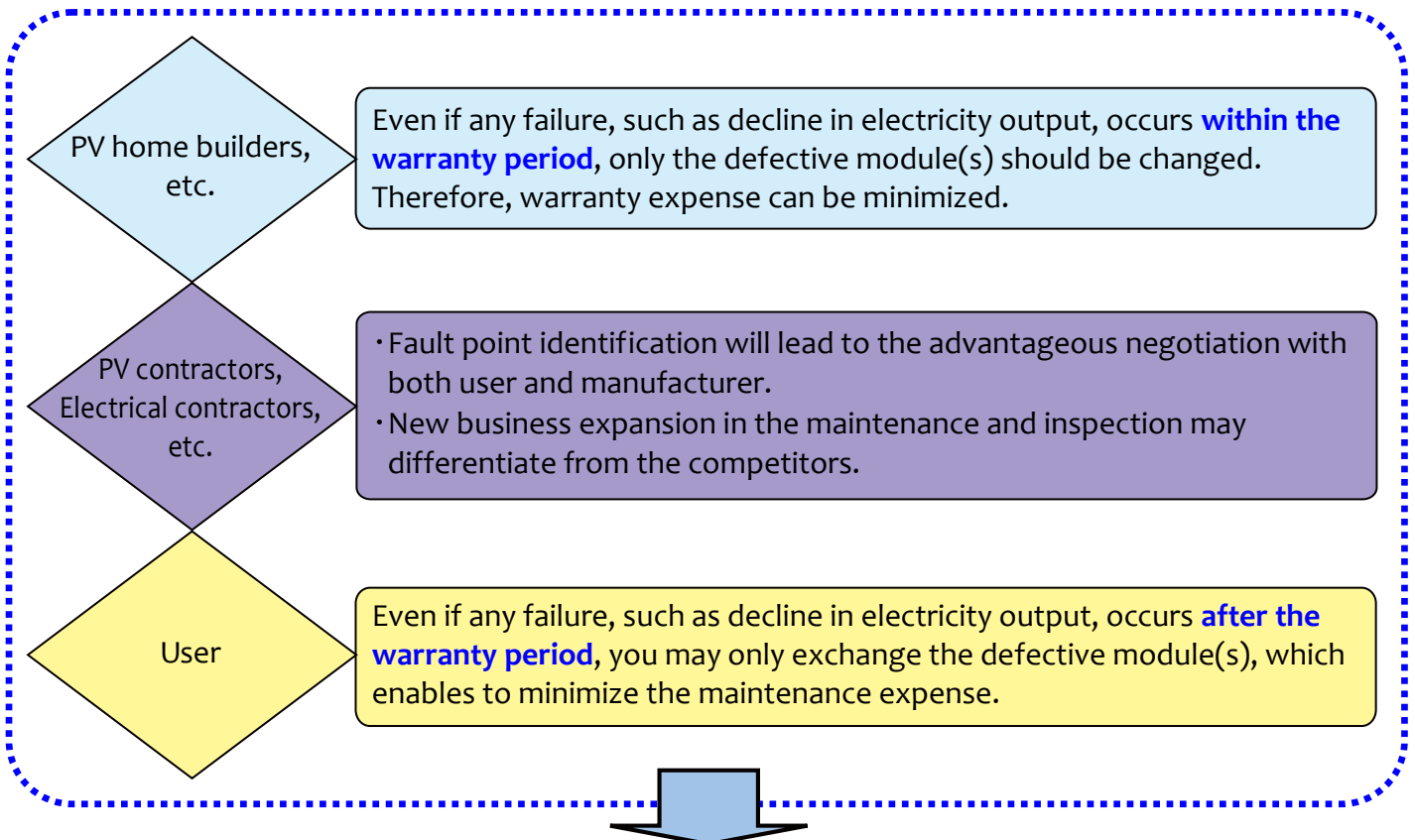
Power output check (Inverter monitoring)

Guideline recommends the I-V curve measurement by the curve tracer other than Voc measurement.

# PV Doctor Series solve your problem!

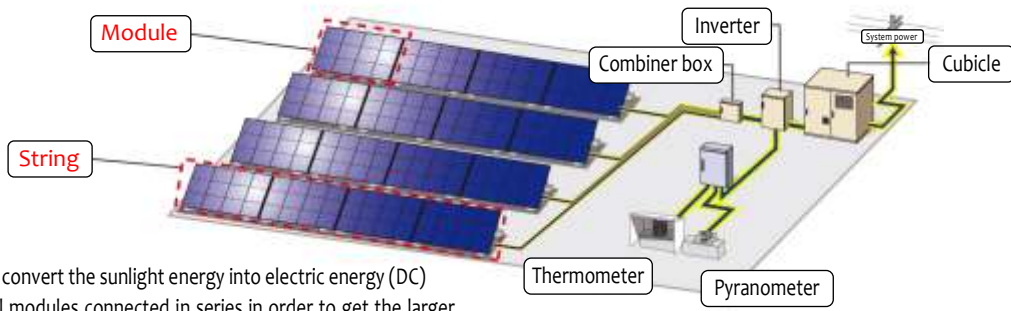


Causal investigation will bring the following benefits to each party!



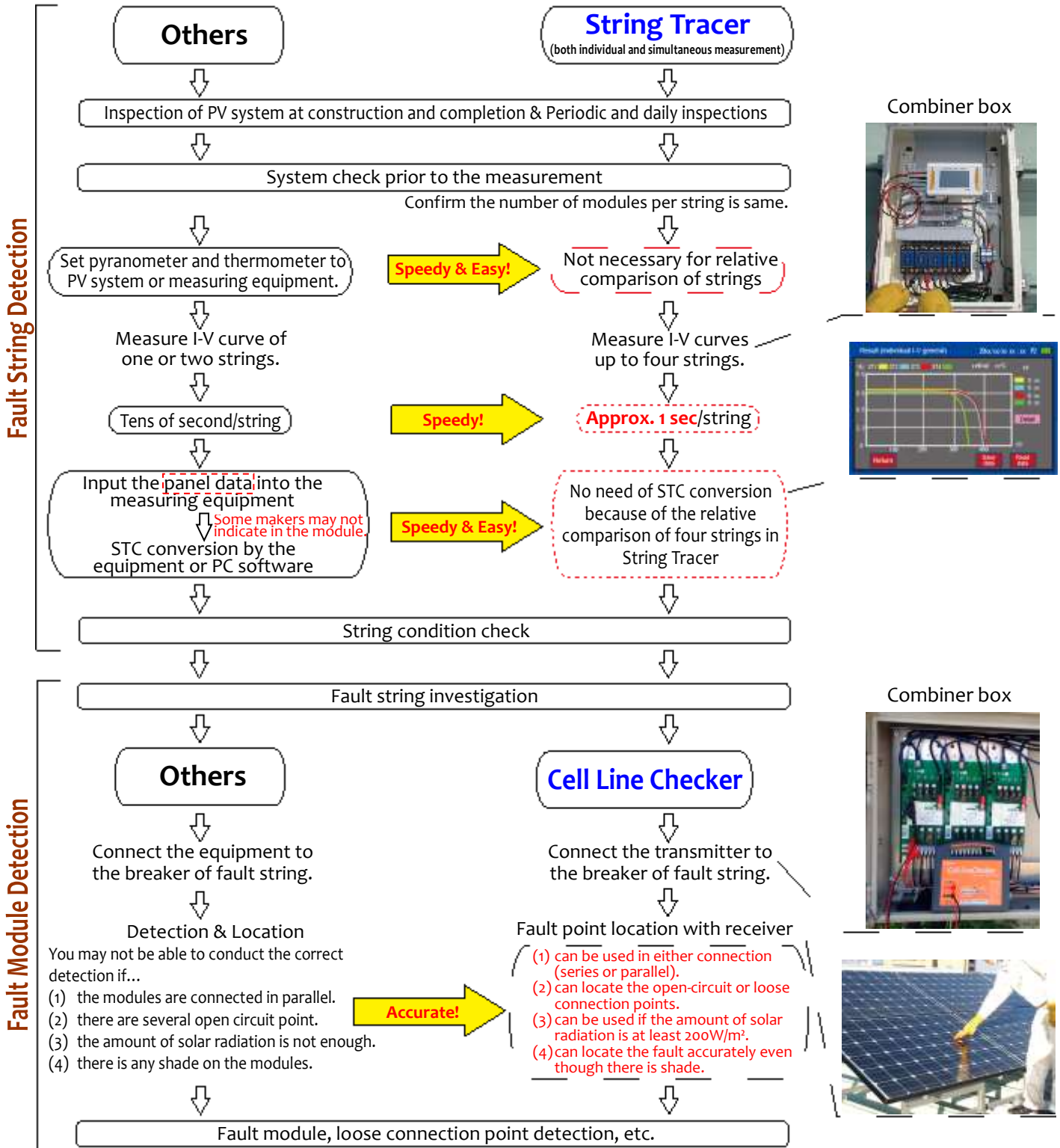
“Enhance safety” and “maintain relevant power output” as power generation system.

# Photovoltaic power generation system



**Module**: Panel to directly convert the sunlight energy into electric energy (DC)  
**String**: A unit of several modules connected in series in order to get the larger power output

## Features of PV Doctor from Tgami and comparison with other equipment



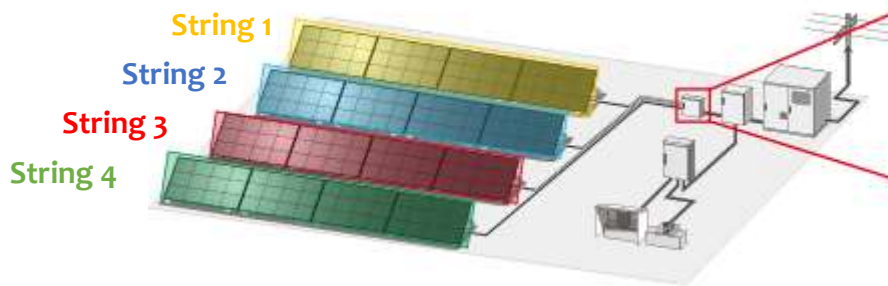


## String Tracer

(I-V curve tracer)

[Function] Fault module can be detected by the relative comparison of up to 4 strings in a screen.

[Feature] Easy operation. The measuring speed is approximately 1 second per string.

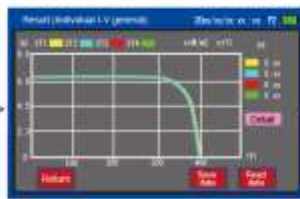


Contact the probes to the breaker terminals.

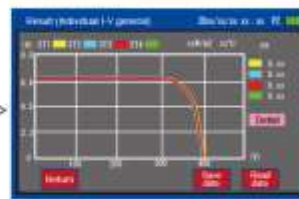
[Screen]



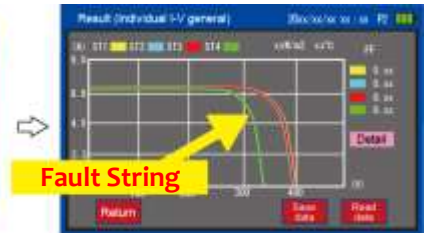
String 1



String 2



String 3



String 4

## Cell Line Checker

(Fault module detector)

[Function] (1) Module configuration per string

(2) Fault point location

[Feature] Fault module can be identified.

(1) Checking the module configuration per string

<p>Connect the transmitter to the breaker terminal of the string.</p>	<p>On the surface of modules connected to the signal input string, receiver detects the signal and shows response by light and sound.</p>	<p>Confirm the module configuration of the string.</p>



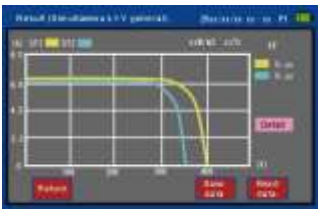

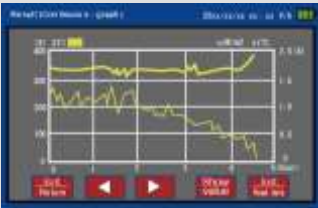


(2) Locating the fault point

<p>Connect the transmitter to the breaker terminal of the fault string.</p>	<p>Conduct the fault location on the fault string.</p>	<p>Confirm the fault module.</p>
		<p>On the surface of normal module, receiver detects and shows the signal input from transmitter by light and sound. However, on the fault point, no signal can be detected. * For bypass diode open-circuit check, you need a special procedure.</p>



## String Tracer (I-V curve tracer)



Type	SPST-A1-Y1		SPST-A2-Y1	
Voltage measuring Range	[General (c-Si, CIS, etc.)] 20.0Vdc to 700.0Vdc		[General (c-Si, CIS, etc.)] [Hybrid (Si-HJT)] 20.0Vdc to 1000.0Vdc	
	[Hybrid (Si-HJT)] 20.0Vdc to 600.0Vdc			
Current measuring Range	[General (c-Si, CIS, etc.)] 0.5Adc to 10.0Adc		[General (c-Si, CIS, etc.)] [Hybrid (Si-HJT)] 0.5Adc to 10.0Adc	
	[Hybrid (Si-HJT)] 0.5Adc to 7.0Adc			
Power measuring Range	[General (c-Si, CIS, etc.)] 10W to 4900W		[General (c-Si, CIS, etc.)] [Hybrid (Si-HJT)] 10W to 8000W	
	[Hybrid (Si-HJT)] 10W to 2900W			
Rated power voltage	[AC adpoter] 100V to 240Vac, 50/60Hz [Size AA batteryx4] 6.0Vdc (Range: 4.8 to 7.2Vdc)			
Accuracy	Voltage:±1%rdg ±5dgt Current:±1%rdg ±5dgt Power:±2%rdg ±5dgt			
Dimensions	195×115×70mm			
Weight	690g (excl. batteries)		600g (excl. batteries)	
Measuring speed	Approx. 100ms (per string)			
Functions	Individual I-V curve measurement	 <p style="text-align: center;">Measure and display up to 4 strings</p>		
	Simultaneous I-V curve measurement	 <p style="text-align: center;">Measure and display up to 4 strings</p>	 <p style="text-align: center;">Measure and display up to 2 strings</p>	
		 <p style="text-align: center;">Measure up to 4 strings</p>	 <p style="text-align: center;">Measure up to 2 strings</p>	
	String voltage/current Measurement * Clamp CT is necessary for the measurement.	 <p style="text-align: center;">Measure up to 4 strings</p>		
	Voltage test	 <p style="text-align: center;">(Voc measurement)</p>		
STC conversion *1	N/A (Accompanied PC software can conduct STC conversion.)		String Trace main unit can conduct STC conversion.	
Detailed specification page	7 to 10			

\*1 Pyranometer and thermometer (optional) is necessary for STC conversion.



# Cell Line Checker (Fault module detector)



Type		SPLC-B-Y													
Transmitter	Rated power voltage	9.0Vdc(Range: 6.5 to 9.0Vdc)													
	Applicable voltage range	Magnetic field mode	15.0Vdc to 1000.0Vdc												
		Electric field mode	0V to 1000.0Vdc (0V for open-circuit fault detection)												
	Detecting method	Current consumption (Magnetic field mode) Signal input (Electric field mode)													
	Signal frequency	5kHz													
	Dimensions	205 x 222 x 80mm													
	Weight	Approx. 1000g (with battery)													
Receiver	Rated power voltage	9.0Vdc (Range: 6.5 to 9.0Vdc)													
	Receiver sensitivity level	Select from 5 levels. Each level has 5 level adjust from -20% to +20%.													
	Receiver display	Receiving level display: Flashing 10 green LEDs Alarm sound synchronized with LED flash													
	Dimensions	235 x 60 x 30mm													
	Weight	Approx. 160g (with battery)													
Functions	Phenomenon	Function	Procedure												
	No system map and no information on configuration per string	[Magnetic field mode] Configuration check of the string	<table border="1"> <thead> <tr> <th>CB</th> <th>Transmitter</th> <th>Response of receiver</th> </tr> </thead> <tbody> <tr> <td>On</td> <td> <p>Connect to breaker for string configuration check.</p> </td> <td> <p>Receiver shows response by sound and LED.</p> </td> </tr> <tr> <td>Off</td> <td> <p>Connect to breaker of fault string.</p> </td> <td> <p>Flow of signal (red arrow) No response part (yellow arrow) The fault may be caused by the interconnector open circuit or cluster failure.</p> </td> </tr> <tr> <td>Off</td> <td> <p>Connect plus terminal to breaker and minus terminal to earth.</p> </td> <td> <p>Flow of signal (red arrow) Area showing response by receiver (red area) No response part (yellow area) &lt;Open circuit or loose connection&gt;</p> </td> </tr> </tbody> </table>	CB	Transmitter	Response of receiver	On	<p>Connect to breaker for string configuration check.</p>	<p>Receiver shows response by sound and LED.</p>	Off	<p>Connect to breaker of fault string.</p>	<p>Flow of signal (red arrow) No response part (yellow arrow) The fault may be caused by the interconnector open circuit or cluster failure.</p>	Off	<p>Connect plus terminal to breaker and minus terminal to earth.</p>	<p>Flow of signal (red arrow) Area showing response by receiver (red area) No response part (yellow area) &lt;Open circuit or loose connection&gt;</p>
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Off	<p>Connect plus terminal to breaker and minus terminal to earth.</p>	<p>Flow of signal (red arrow) Area showing response by receiver (red area) No response part (yellow area) &lt;Open circuit or loose connection&gt;</p>													
Output drop e.g.) cluster failure e.g.)interconnector open-circuit	[Magnetic field mode] Fault point location	Off	<p>Flow of signal (red arrow) No response part (yellow arrow) The fault may be caused by the interconnector open circuit or cluster failure.</p>												
Voc=0 by I-V curve tracer or tester	[Electric field mode] Open-circuit between modules and loose connection, etc.	Off	<p>Flow of signal (red arrow) Area showing response by receiver (red area) No response part (yellow area) &lt;Open circuit or loose connection&gt;</p>												

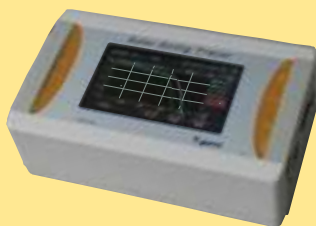
Detailed specification page

11 to 14





SPST-A1-Y1



SPST-A2-Y1

- ★ Displaying 4-string I-V curves in a screen
- ★ Easy determination of faulty module by the relative comparison of strings
- ★ Usable at the installation inspection

## ■ Purpose

Electrical failure of module at string level can be detected in the residential, industrial, and utility-scale PV power generation systems. Installation inspection and maintenance check can be conducted effectively.

## ■ Features

- **Four measuring modes:** Individual I-V measurement, simultaneous I-V measurement, string voltage/current measurement, and voltage test
- **Relative comparison** of I-V curves of each string makes the performance check quick and easy.
- Measured data can be saved on **SD card** and used on **PC**.  
\*The data management software is Windows 7 compatible.
- For relative comparison among strings, **pyranometer and thermometer are not necessary**.
- For **STC conversion**, **pyranometer and thermometer (options)** are necessary.

## ■ Functions

Function	Detail of function
<b>Individual I-V curve measurement</b> CB in the combiner box shall be "OFF".	String I-V curve can be measured by 1 channel at a time. Measured results, up to 4 strings, can be displayed in a graph, and each string condition can be compared relatively. Needle type probes for 1 channel shall be contacted with the terminals of a string at a time; therefore, there is no need to clamp the leads to the terminals.
<b>Simultaneous I-V curve measurement &amp; String condition check</b> CB in the combiner box shall be "OFF".	String I-V curves up to 4 strings for SPST-A1-Y1 and 2 strings for SPST-A2-Y1 can be measured at a time, and measured data can be saved. All measured results (max. 4 strings for SPST-A1-Y1 and 2 strings for SPST-A2-Y1) can be displayed in a graph, and strings can be compared relatively to check the conditions. Voc is measured to judge whether the relative comparison of I-V curves is effective by checking the string circuit failure, number of string modules, etc.
<b>String voltage/current measurement</b> CB in the combiner box shall be "ON", and inverter shall be under operation.	In a certain intervals, voltage and current of the strings (max. 4 strings for SPST-A1-Y1 and 2 strings for SPST-A2-Y1) can be measured at a time, and the data can be saved. <ul style="list-style-type: none"> <li>• Measuring item (voltage/current) and strings can be selected.</li> <li>• Continuous measurement up to 7 days is possible.</li> </ul> Results can be displayed in either "numerical data" or "graphs" in the screen. * When continuous measurement mode is selected, make sure to use the accompanied AC adapter.
<b>Voltage test (Voc measurement)</b>	Open circuit voltage of a string can be measured.

## Specifications

Voltage measuring range	SPST-A1-Y1	[General (c-Si, CIS, etc.)] *1 20.0V to 700.0Vdc [Hybrid (Si-HJT)] *1 20.0V to 600.0Vdc	Accuracy	Voltage: $\pm 1\%$ rdg $\pm 5$ dgt Current: $\pm 1\%$ rdg $\pm 5$ dgt Power: $\pm 2\%$ rdg $\pm 5$ dgt	
	SPST-A2-Y1	20.0V to 1000.0Vdc		Measuring points	100 points (per string)
Current measuring range	SPST-A1-Y1	[General (c-Si, CIS, etc.)] *1 0.5A to 10.0Adc [Hybrid (Si-HJT)] *1 0.5A to 7.0Adc	Measuring time	Approx. 100ms (per string) *4	
	SPST-A2-Y1	0.5A to 10.0Adc	Max. continuous use (LCD brightness set: +10) *5	- LCD display on: Approx. 9 hours - Touch screen operation: Approx. 6 hours - I-V measurement: Approx. 4 hours	
Power measuring range	SPST-A1-Y1	[General (c-Si, CIS, etc.)] *1 10W to 4900W [Hybrid (Si-HJT)] *1 10W to 2900W	Savable data	500 files/day x 100 days = Max. 50,000 files Manage the data with the software in case the number of files exceeds the above. Delete the data in the SD card.	
	SPST-A2-Y1	10W to 8000W	Other functions	Automatic power off (5 minutes)	
Rated power voltage	[AC adopter] 100V to 240Vac, 50/60Hz [Size AA batteryx4] 6.0Vdc (Range: 4.8 to 7.2Vdc) *2, *3		Dimensions	195x115x70mm	
			Weight	SPST-A1-Y1	690g (excl. batteries)
				SPST-A2-Y1	600g (excl. batteries)
			Accessories	Clamp probe, Needle probe: 1set, I-V test lead, SD card *6, AC adapter, Instruction manual, Shoulder belt, Size AA battery: 4, and Carrying case	

\*1 Measuring ranges are different depending on the module types.

\*2 If battery level is decreased, measurement will stop because the inrush current causes the instant voltage drop.

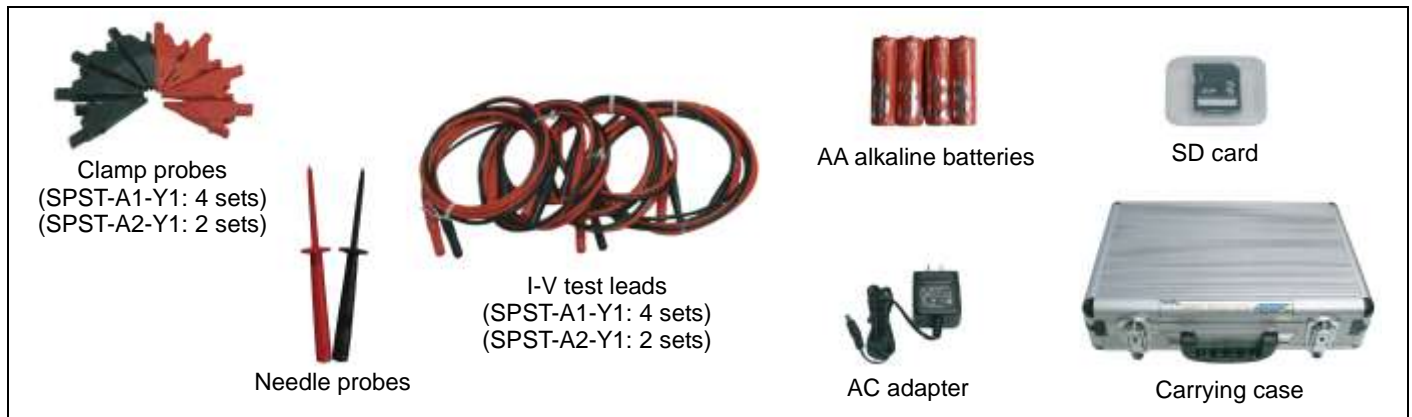
\*3 Battery can be NiMH rechargeable battery or alkaline battery.

\*4 I-V curve measurement (individual mode) takes 3.1 sec to measure a string: 1sec for probe contact check + 100ms for I-V measurement + 2 sec for the interval until the next measurement  
I-V curve measurement (simultaneous mode) needs 5 sec interval between measurements. Within 5 sec after a string measurement, start selection button will not be shown on the screen.




\*5 Hours are based on the continuous use of full charged four(4) 1900mAh NiMH batteries.

\*6 SD card contains the data management software and software installation manual.

## Accessories



## Options

 <p>Clamp sensor</p>		 <p>Pyranometer &amp; thermometer</p>		 <p>Magnetic test probe</p>	
Type	SPST-A-F1	Type	SPST-A-F2	Type	SPST-A-F4
Measuring range (accuracy)	0 to 10.0A ( $\pm 1\%$ rdg $\pm 5$ dgt)	Measuring range (accuracy)	0 to 1200W/m <sup>2</sup> ( $\pm 5\%$ rdg $\pm 5$ dgt) -20 to 100°C( $\pm 1\%$ rdg $\pm 2$ dgt)	Length of cable	1.5 meters
Length of cable	1.5 meters	Length of cable	10 meters	Withstand voltage	1000V CATIII
Weight	80g/unit	Dimensions	Pyranometer: 40x100x80(mm) Thermometer: 50x70x6(mm)		
		Weight	Pyranometer: 700g Thermometer & cable: 720g		

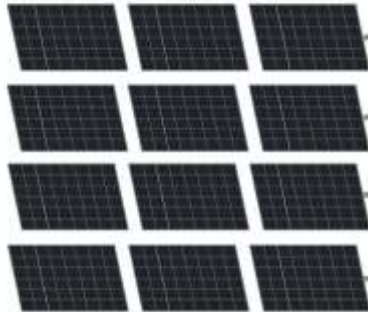


# I-V curve measurement modes

## (1) Individual mode (CB in combiner box: OFF)

If alligator clamps are difficult to connect to CB terminals, use the needle type probes for shortening the measurement time.

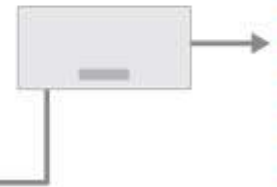
PV modules (4 strings)



Combiner box



Inverter



A pair of needle type probes is used to measure.



\*If solar radiation is unstable, current level may change in a short time.

\*Four strings I-V curves are shown in a graph.

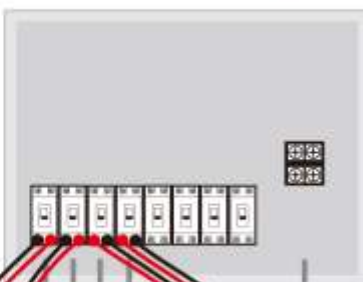
If **Detail** is selected, measured results:  $V_{oc}$  (V) open-circuit voltage,  $I_{sc}$  (A) short-circuit current,  $P_{max}$  (W) Maximum power, and FF value are shown.

## (2) Simultaneous mode (CB in combiner box: OFF)

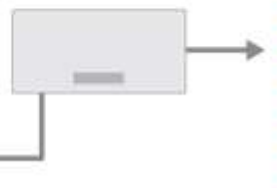
PV modules (4 strings)



Combiner box



Inverter



Use Clamp probes.  
(SPST-A1-Y1: 8 pieces)  
(SPST-A2-Y1: 4 pieces)



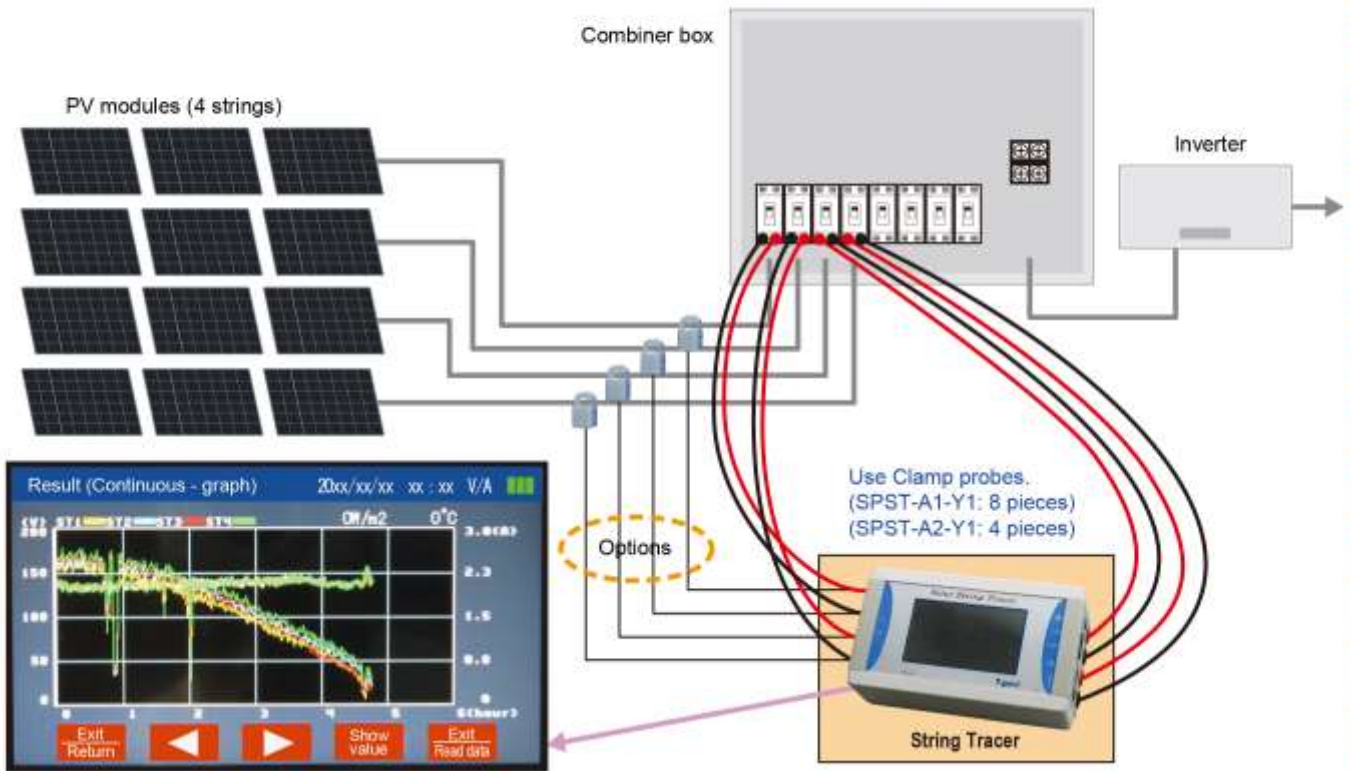
\*No need of pyranometer and thermometer for relative comparison of strings. For STC conversion, pyranometer and thermometer are necessary.

\*4 strings (SPST-A1-Y1) or 2 strings (SPST-A2-Y1) I-V curves are shown in a graph.

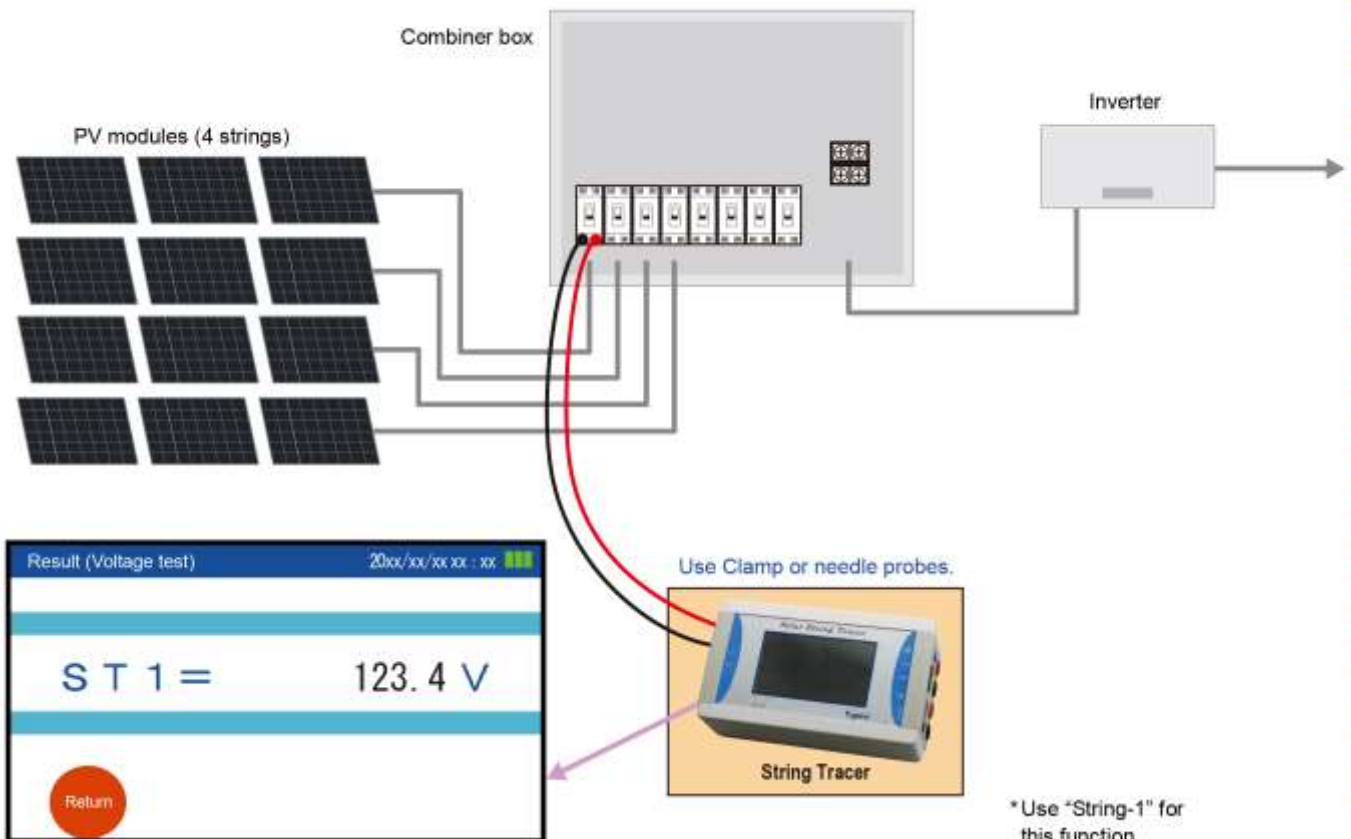
If **Detail** is selected, measured results:  $V_{oc}$  (V) open-circuit voltage,  $I_{sc}$  (A) short-circuit current,  $P_{max}$  (W) Maximum power, and FF value are shown.

### (3) String voltage/current measurement (CB in combiner box: ON & Inverter: operation)

In a certain intervals, voltage and current of the strings (max. 4 strings for SPST-A1-Y1 and 2 strings for SPST-A2-Y1) can be measured at a time, and the data can be saved for maximum 7 days. \* Clamp CT sensors (option) are necessary.



### (4) Voltage test (Open-circuit voltage measurement)





- ☆String configuration can be identified.
- ☆Fault point (wiring failure) can be detected.
- ☆Shadow on the module will not affect the results.
- ☆Installation inspection is effectively conducted.
- ☆Detection can be conducted on the rear surface of modules.

## ■ Purpose

Detect the string configuration and fault module and cell at the time of PV systems maintenance.

## ■ Features

- Cluster failure and bypass diode open circuit can be easily detected. [Magnetic field mode]
- Open circuit or loose connector between modules can be detected. [Electric field mode]
- Detection can be conducted under the cloudy weather.
- Cell interconnector failure can be detected; therefore, module power output reduction is possibly predicted. [Magnetic field mode]

[Magnetic field mode]

- Identification of a string configuration
- Detection of fault modules, clusters, and cells
- Detection of the fault bypass diode in a module

[Electric field mode]

- Detection of the broken/disconnected wire between modules
- Detection of the connector between modules having fault continuity

**Quality of installation of PV system can be enhanced because Cell Line Checker can detect the wiring and connector failures between modules.**



## ■ Detailed functions depending on module fault causes

Phenomenon	Details of failure phenomenon	Causes	Applicable functions
Decline of power output	<b>No output from the string</b> *Series circuit in a string is disconnected.	(1) Broken/loose connector or disconnected wire between modules (2) Damaged bypass diode and disconnected busbar, disconnected interconnector, or damaged cell	[Magnetic field mode] • Detection of fault module • Detection of wiring failure between modules [Electric field mode] • Detection of connector having defective continuity or wiring disconnection
	<b>Declined output from the string</b> *Series circuit in module is disconnected.	(1) Fault busbar (2) Complete interconnector disconnection (3) Cell damage (severe)	[Magnetic field mode] • Detection of fault module • Detection of fault cluster in the fault module • Detection of fault cell in the fault module • Detection of fault bypass diode
	<b>Declined output from the string</b> *Part of series circuit in module is damaged.	(1) Disconnection of one of interconnectors (2) Cell damage (light)	

## ■ Specifications

### 【Transmitter】

Rated power voltage	9.0Vdc (Range: 6.5 to 9.0Vdc) *1	
Applicable voltage range	Magnetic field mode	15.0Vdc to 1000.0Vdc
	Electric field mode	0V to 1000.0Vdc (0V for connection fault detection)
Detecting method	Current consumption (Magnetic field mode) Signal input (Electric field mode)	
Signal frequency	5kHz	
Display	Green or Blue LED by flashing or ON	
Dimensions	205 x 120 x 50mm	
Weight	Approx. 1000g (with battery)	
Other functions	Auto-power off *2	

### 【Receiver】

Rated power voltage	9.0Vdc (Range: 6.5 to 9.0Vdc) *1	
Receiver sensitivity level	Select from 5 levels. Each level has 5 level adjust from -20% to +20%.	
Receiver display	Receiving level display: Flashing 10 green LEDs Alarm sound synchronized with LED flash	
Built-in sensor	Coil sensor: 1 Electrode sensor: 1	
Dimensions	235 x 60 x 30mm	
Weight	Approx. 160g (with battery)	
Other functions	Auto-power off and Silent mode *3	

\*1 One 9V battery is used. (Manganese or alkaline battery)


\*2 [Magnetic field mode] The power is automatically turned off when input voltage gets less than 10V and non-operated duration exceeds 10min.  
[Electric field mode] The power is automatically turned off when non-operated duration exceeds 2hr.

\*3 The power is automatically turned off when no signal input and non-operated duration continues 10min.

## ■ Accessories




## ■ Options




Rod sensor

Type	SPLC-B-F1Y
Built-in sensor	2 coil sensors (horizontal & vertical)
Rod length when detecting	Max. 2meters (0.92meter when storing)
Dimensions when storing	920(H)×70(W)×60(D) (mm)
Weight	Approx. 850g (without receiver)
Other function	Angle adjustable sensor head
Accessories	Storage bag and shoulder belt



Needle probe

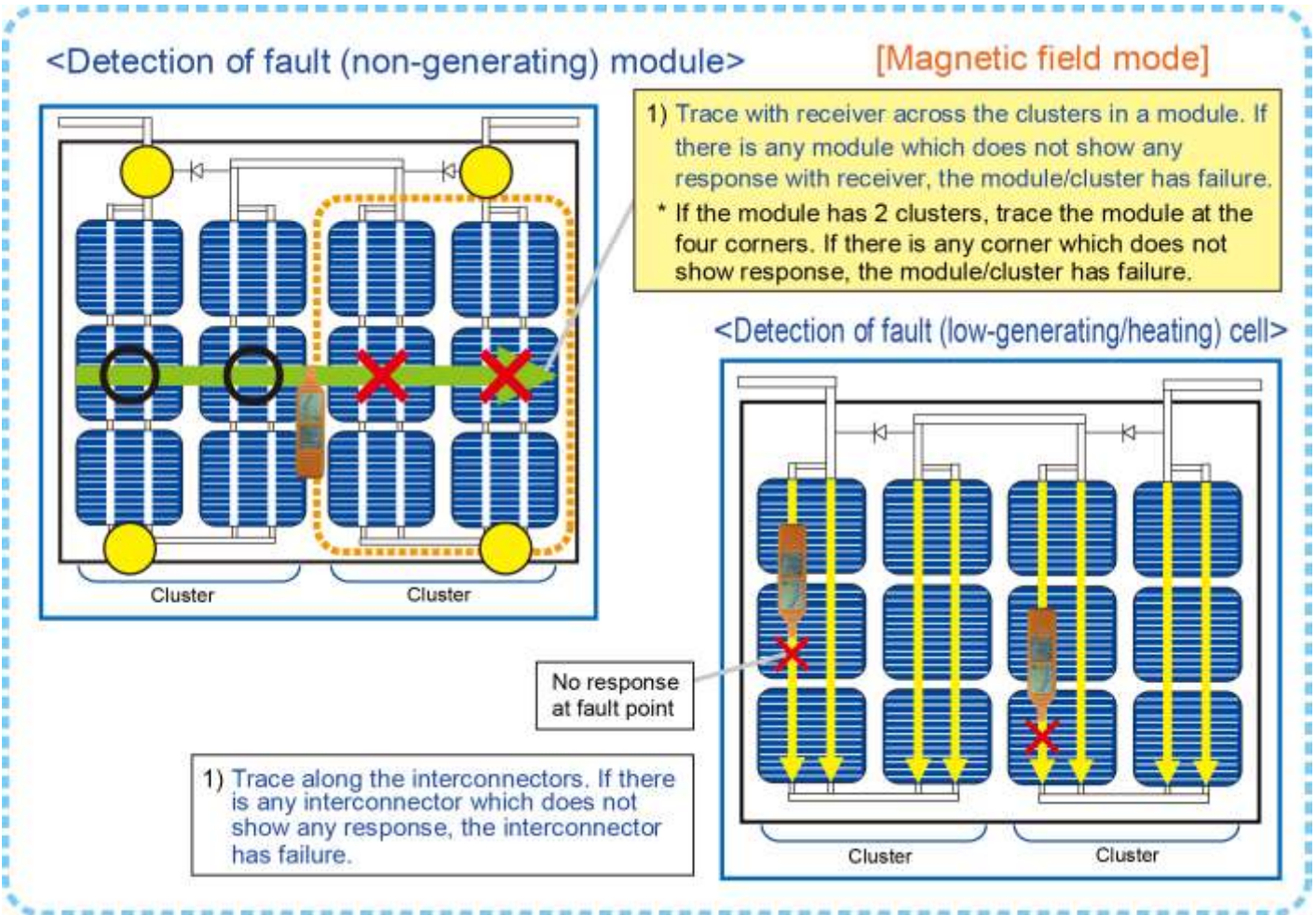
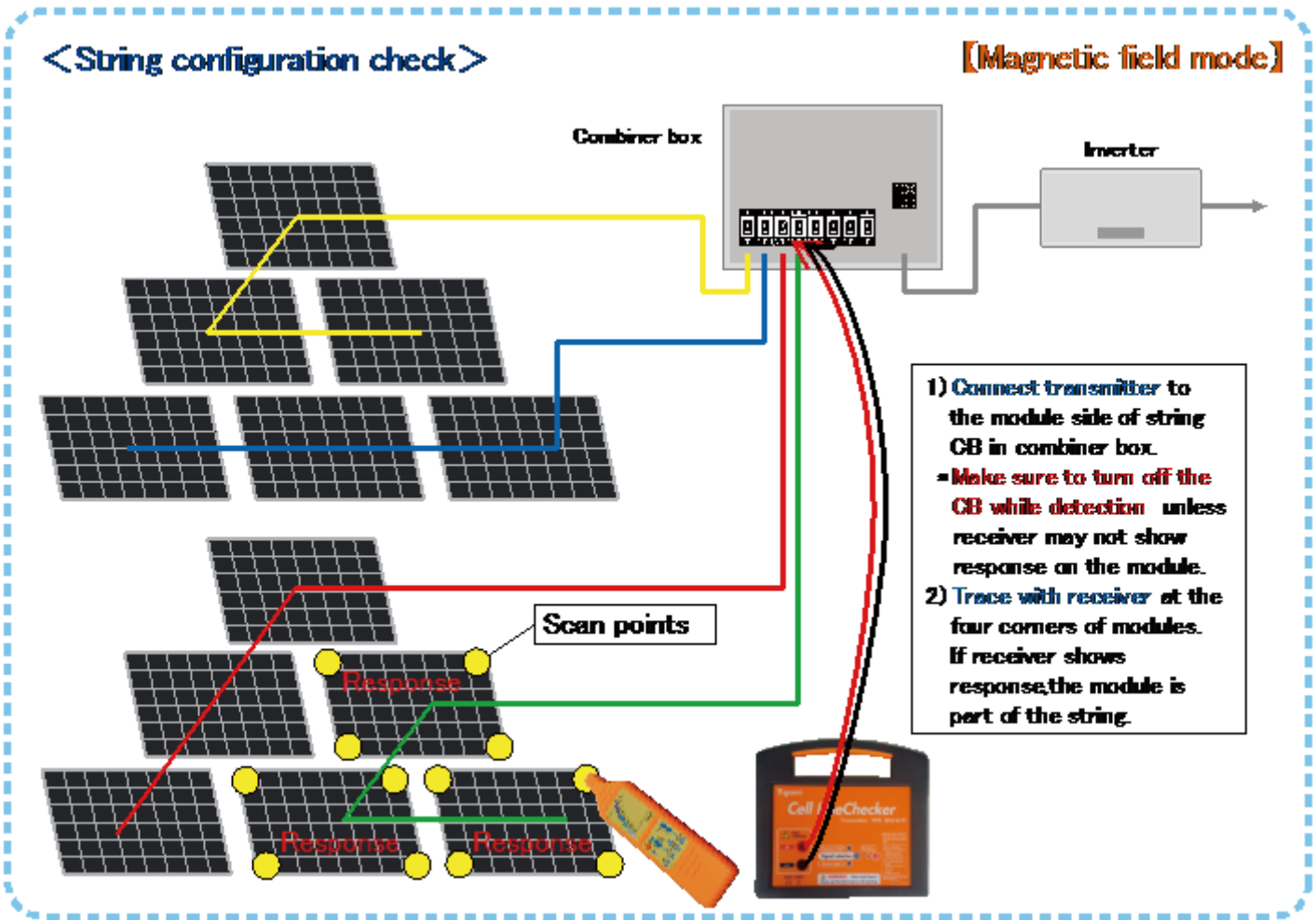
Type	SPST-A-F3
Withstand voltage	1000V CATIII



Magnetic test probe

Type	SPST-A-F4
Length of cable	1.5 meters
Withstand voltage	1000V CATIII

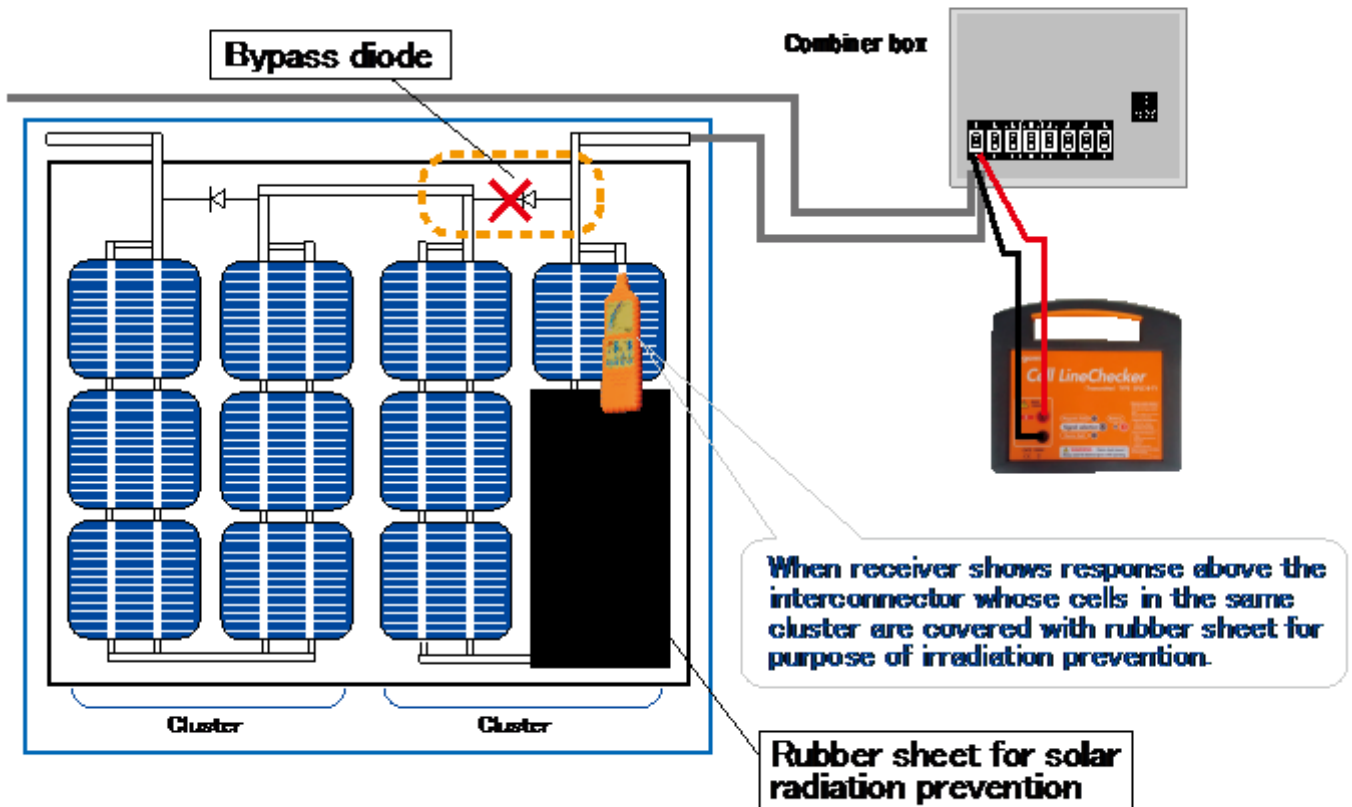
# Example of detection





<Detection of fault module (bypass diode open circuit failure)>

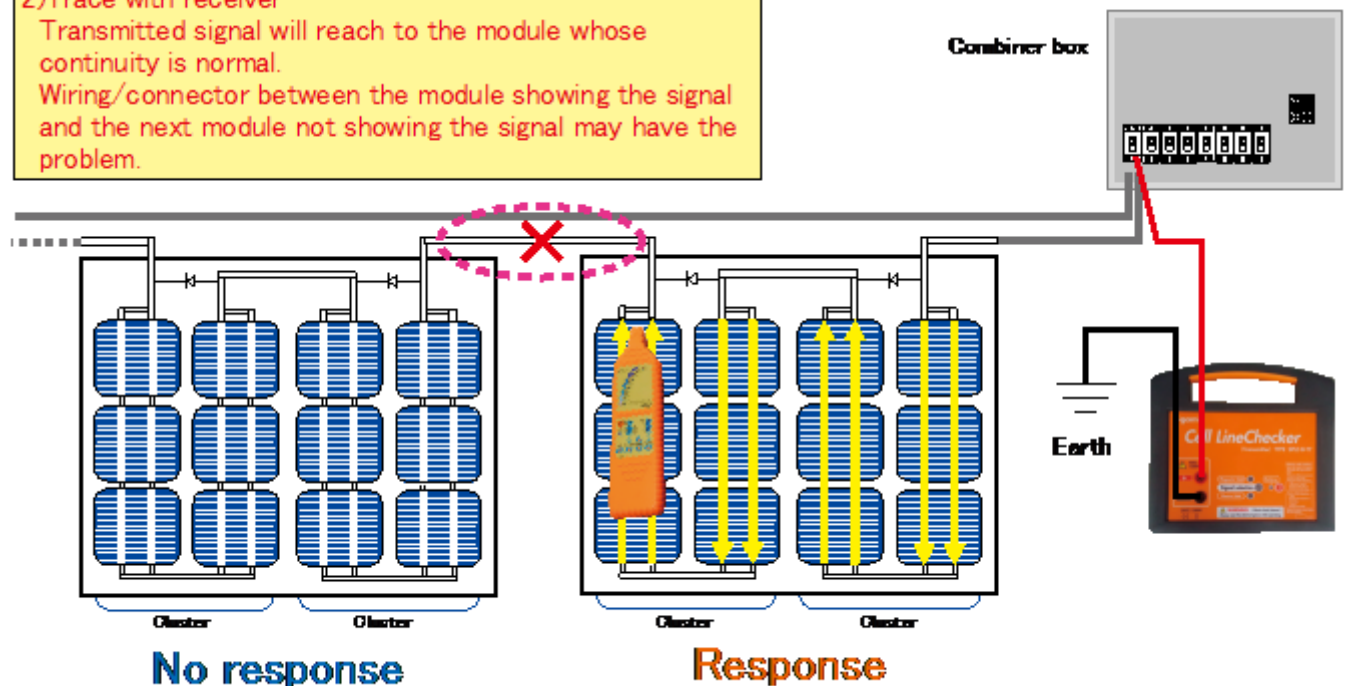
[Magnetic field mode]



<Detection of wiring/connector failure between modules>

[Electric field mode]

- 1) Connect transmitter  
Connect the plus terminal of transmitter to one of the string CB terminals and the minus terminal to the earth.
- 2) Trace with receiver  
Transmitted signal will reach to the module whose continuity is normal.  
Wiring/connector between the module showing the signal and the next module not showing the signal may have the problem.



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# Cell LineChecker



Fault module detector  
Type: SPLC-B-Y



Transmitter



Receiver

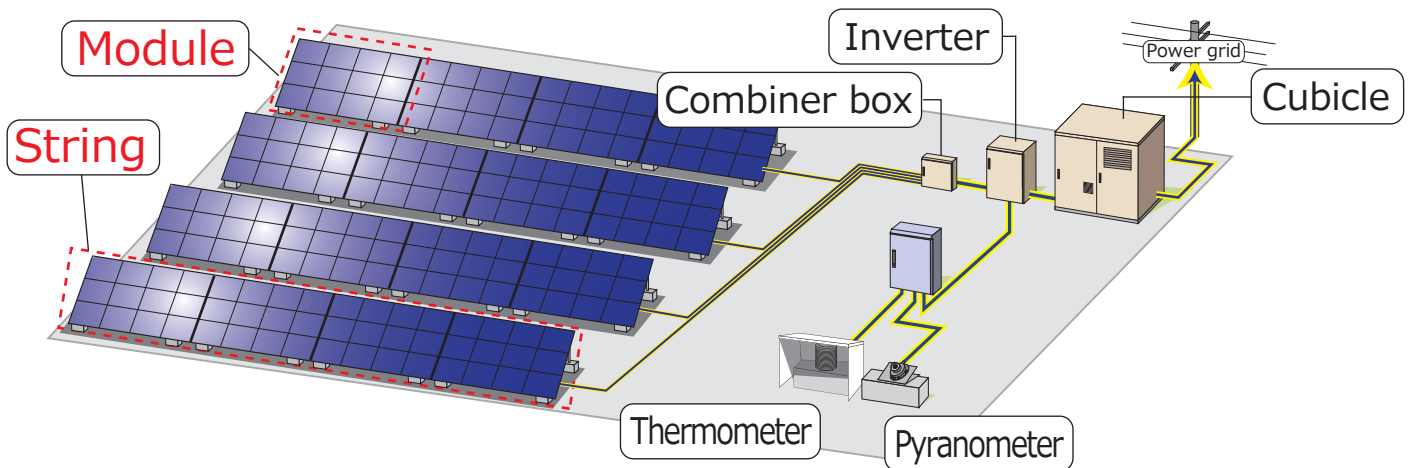




# Present situation of photovoltaic (PV) power generation systems

Currently, the environmental problems, such as climate change, are worldwide concerns. In many countries, the laws and regulations related to the environmental issues are established, and expectation on the clean energy becomes higher than before. One of the clean energies deployed globally is **the photovoltaic power**.

## ■ PV power generation system (example)



**Module** : A panel directly converting the sunlight energy into electric energy (DC)

**String** : A unit of several modules connected in series in order to get the larger power output

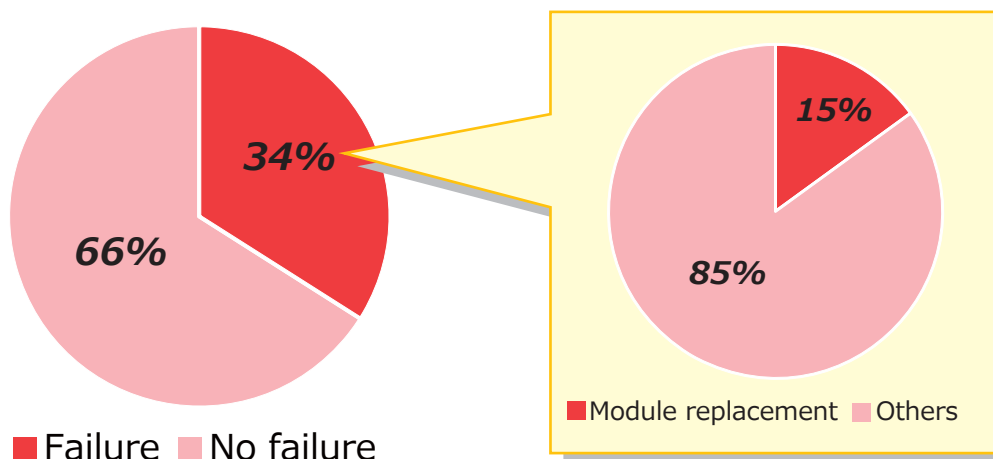
## ■ Is maintenance on PV system necessary?

For years, PV system was considered as maintenance-free power generation. However, there are several causes to lower the power output because of the severe outdoor installation environment, such as...

- Dirt on the module,
- Wiring failure/open-circuit caused by the heat generation, soldering defect, animal intrusion, natural disaster, etc.,
- Rust,
- Aged deterioration,
- Hot spot, etc.



**[Reference]** PV power generation system failure investigation adapted from "PV Generation System Failure Files" by Kazuhiko Kato



**Periodic maintenance is necessary** because the judgment by visual and hearing is very difficult for no sound is generated and no operation is necessary while the system is under operation.

Moreover, the power output changes from moment to moment in accordance with the surrounding environment and weather conditions. Therefore, **measurement by the measuring device is essential** for PV system in order to find any failure.

The first step is to find a fault string having a lower power output by I-V curve tracer or monitoring system.

Then, find one or more fault modules by using

# Cell LineChecker

Type: SPLC-B-Y



## Cell LineChecker users

Installers, O&M companies, EPC companies, contractors, system integrators, training organizations, technical colleges, and research institutions



## Benefit

- Manufacturer** ... Even if any failure, such as decline in output, occurs **within the warranty period**, only the defective module(s) should be changed, which can minimize the warranty expenses.
- Contractors** ... A fair negotiation with both user and manufacturer can be reached.
- Owner** ... Even if any failure, such as decline in output, occurs **after the warranty period**, you may only exchange the defective module(s), which enables to minimize the maintenance expense.



## Features

Detect the string configuration and fault module and cell at the time of PV systems installation and O&M.

- String configuration can be identified.
- Faults can be identified at module level.
- Multiple fault modules can be identified in a string.
- Cluster failure and opened bypass diode open circuit can be easily detected.
- Open circuit or loose connector between modules can be detected.
- Detection can be conducted under the cloudy weather.

### Commonly used method

Disconnect the connectors between modules and measure the values module by module.

Improve work efficiency

Shorten working hours

### Cell LineChecker

Connect transmitter to combiner box by strings, and find a fault module by contacting receiver above the modules.

## Detailed functions depending on module fault causes

Phenomenon	Details of failure phenomenon	Causes	Applicable functions
Decline of power output	No output from a string *Series circuit in a string is opened.	Broken/loose connector or disconnected wire between modules	[Electric field mode] • Detection of connector having defective continuity or wiring disconnection
	Declined output from a string *Series circuit in module is opened. (cluster failure)	(1) Opened busbar (2) Completely opened interconnector (3) Cell damage (severe)	[Magnetic field mode] • Detection of fault module • Detection of fault cluster in the fault module • Detection of fault cell in the fault module
	Declined output from a string *Part of series circuit in module is damaged.	(1) Open-circuit of one of interconnectors (2) Cell damage (light)	• Detection of opened bypass diode

# Specifications

## ■ Condition of use

Item	Condition of use
Environment	Avoid using in the rain
Temperature range	-10°C to 50°C (14°F to 122°F)
Humidity range	Relative humidity: 80% or less (No condensation)
Storage temperature range	-20°C to 60°C (-4°F to 140°F)

## ■ Ratings of transmitter

Item	Description
Rated power voltage	9.0Vdc:Operation range 6.5Vdc to 9.0Vdc Using one 9Vdc battery Either manganese or alkaline
Applicable voltage range	Magnetic field mode 15.0V to 1000.0Vdc Electric field mode 0V to 1000.0Vdc
Detection method	-Current consumption with magnetic field mode -Signal input with electric field mode
Signal frequency	5kHz
Operation display	Green or blue LED(ON or flash)
Dimensions	205(H)×222(W)×80(D)mm (8.07×8.74×3.15inch)
Weight	Approx.1000g (2.2lb)(including a battery)
Other functions	Auto power off • Mg.field mode:A condition of input voltage less than 10V and no operation continues 10 minutes. • Elec.field mode:After non-operation for 2 hours

## ■ Ratings of receiver

Item	Description
Rated power voltage	9.0Vdc:Operation range 6.5Vdc to 9.0Vdc Using one 9Vdc battery Either manganese or alkaline
Receiver sensitivity selector	Select from 5 levels. Each level has 5 level adjust from -20% to +20%.
Receiver display	Receiving level display:Flashing 10 green LEDs Alarm sound synchronized with LED flash
Built-in sensor	Coil sensor:1 Electrode sensor:1
Dimensions	235(H)×60(W)×30(D)mm (9.25×2.36×1.18inch)
Weight	Approx.160g (5.64oz) (including a battery)
Other functions	Auto power off and silent mode Power off after 10 minutes of no signal input and no operation

## ■ Safety standard

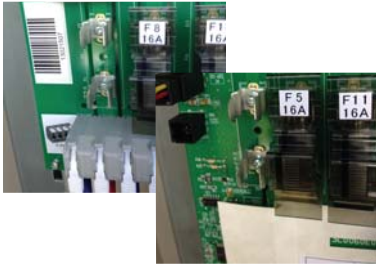
- IEC61010-1 & 61010-2-030
- CAT II,1000V

# How to locate faults

**After installation** ... locate an open-circuit or connection failure between modules.

## Electric field mode

①



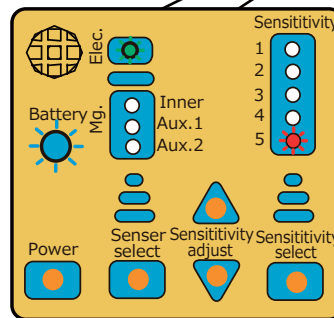
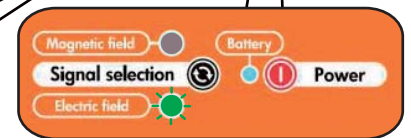
Turn off the CB or remove fuses of the string to be measured.

②

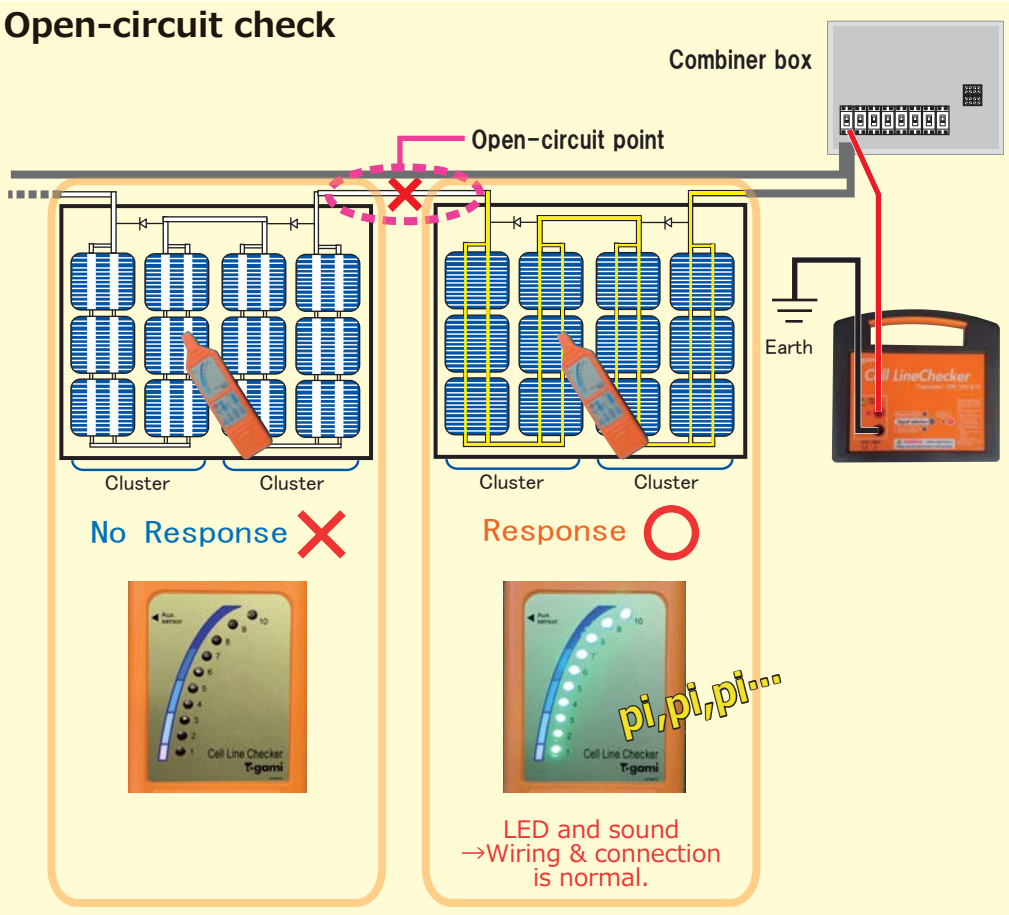


Connect the **RED** lead to the minus terminal and **BLACK** to the earth.

③



## Open-circuit check



## During inspection and maintenance

- locate a fault modules having lower power output or opened bypass diode, etc.

### ■ Magnetic field mode

①



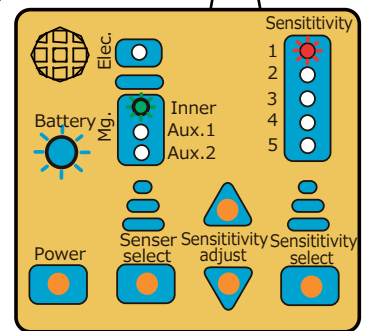
Turn off the CB or remove fuses of the string to be measured.

②



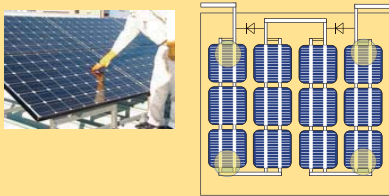
Connect the lead to the terminals of module side.

③



**First, check the module configuration in a string!**

#### (1) String configuration check

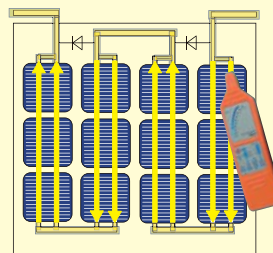


Scan at the four corners of module.

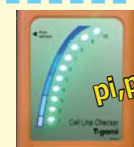
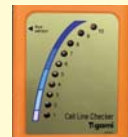


LED and sound  
→ The module is a part of the string.

#### (2)-1 Busbar & Interconnector failure

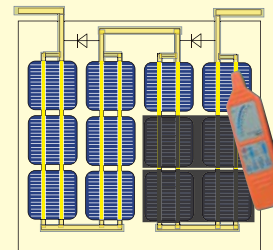


Scan on the busbar or Interconnector of module surface.

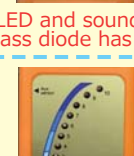


LED and sound  
→ The module is normal.

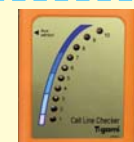
#### (2)-2 Bypass diode failure (open-circuit)



Cover cells with rubber sheets and scan over the module.



LED and sound  
→ Bypass diode has failure.





## Accessories



*Rubber sheet*

### *Clamps and test leads*



*Carrying bag*

## Options



### *Rod sensor*

Type: SPLC-B-F1Y  
Weight: Approx. 850g (without receiver)  
Rod length when detecting: Max. 2meters  
(0.92meter when storing)

### *Magnetic test probe*

Type: SPST-A-F4  
Length of cable: 1.5meters



### *Needle probe*

Type: SPST-A-F3

# Togami

— Let's make society, the earth and the future affluent. —

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