

**Tigo**<sup>®</sup>

# Installation Manual

TS4 UHD-Core with TAP and CCA

# IMPORTANT SAFETY INSTRUCTIONS

## LETHAL VOLTAGE MAY BE PRESENT IN ANY PV INSTALLATION

### SAVE THESE INSTRUCTIONS

- This manual contains important instructions for installation and maintenance of the Tigo Energy® product models TS4-L, TS4-O, TS4-S, TS4-M, TS4-R-O, TS4-R-S, TS4-R-M, TS4-R-O-Duo, TS4-R-S-Duo, TS4-R-M-Duo, ES-GTWY-020, Tigo Access Point (TAP), Cloud Connect Advanced (CCA), and related Tigo Energy software and mobile applications.
- Risk of electric shock, do not remove cover, disassemble, or repair, no user serviceable parts inside. Refer servicing to qualified service personnel.
- Before installing or using the Tigo Energy® System, please read all instructions and warning markings on the Tigo Energy products, appropriate sections of your inverter manual, photovoltaic (PV) module installation manual, and other available safety guides.
- Failure to adhere to these instructions may result in injury or death, damage to the system or voiding the factory warranty.
- To reduce risk of fire and shock hazard, install this device with strict adherence to National Electric Code (NEC) ANSI/NFPA 70 and/or local electrical codes. When the photovoltaic array is exposed to light, it supplies a DC voltage to the Tigo Energy® TS4 units. The TS4 units start in the "ON" state and their output voltage may be as high as the PV module open circuit voltage ( $V_{OC}$ ) when connected to the module. The installer should use the same caution when handling electrical cables from a PV module with or without the Tigo Energy Module Maximizer attached.
- Installation must be performed by trained professionals only. Tigo Energy does not assume liability for loss or damage resulting from improper handling, installation, or misuse of products.
- Remove all metallic jewelry prior to installing the Tigo Energy TS4 units to reduce the risk of contacting live circuitry. Do not attempt to install in inclement weather.
- Do not operate the Tigo Energy TS4 units if they have been physically damaged. Check existing cables and connectors, ensuring they are in good condition and appropriate in rating. Do not operate Tigo Energy TS4 units with damaged or substandard wiring or connectors. Tigo Energy TS4 units must be mounted on the high end of the PV module backsheet or racking system, and in any case above ground.
- Do not connect or disconnect under load. Turning off the Inverter and/or the Tigo Energy products may not reduce this risk. Internal capacitors within the inverter can remain charged for several minutes after disconnecting all power sources. Verify capacitors have discharged by measuring voltage across inverter terminals prior to disconnecting wiring if service is required.
- Always assume TS4 units are in "ON" state, or may turn on when restarting.

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# 1. TIGO SYSTEM OVERVIEW

Module Level Power Electronics:



## TS4

Modular smart electronics platform

Communication Accessories:



## Access Point (TAP)

Wireless communication device for monitoring and safety features



## Cloud Connect Advanced (CCA)

Data logger and rapid shutdown control

# 1.1 TS4 FLEX MLPE VERSIONS



## TS4-B

- Module electronics are contained in the junction box, installed at the PV module factory.
- Connected in series like regular modules
- No additional wiring connections to make



## TS4-R

- Bracket clips to module frame without tools
- TS4-R outputs are connected in series to form a string
- No additional grounding required



## TS4-R-Duo

- Bracket clips to module frame without tools
- Designed to fit two 60 cell modules in series to one TS4-R-Duo
- TS4-R-Duo outputs are connected in series to form a string
- No additional grounding required

# 1.1 TS4 FLEX MLPE FUNCTIONS

The TS4 versions are the bases on top of which functional covers are installed. These covers contain the module-level electronics and determine its functionality.

**TS4-M: MONITORING:** The TS4-M provides continuous system-wide monitoring to make customer support and fleet workflow on track



**TS4-S: SAFETY:** The TS4-S provides the necessary safety and monitoring services to satisfy NEC 690.12 Rapid Shutdown requirements for 2014 and 2017



**TS4-O: OPTIMIZATION:** In addition to safety, monitoring, and PV2.0 synchronization, TS4-O optimizes each PV module when its performance is affected by shade or mismatch



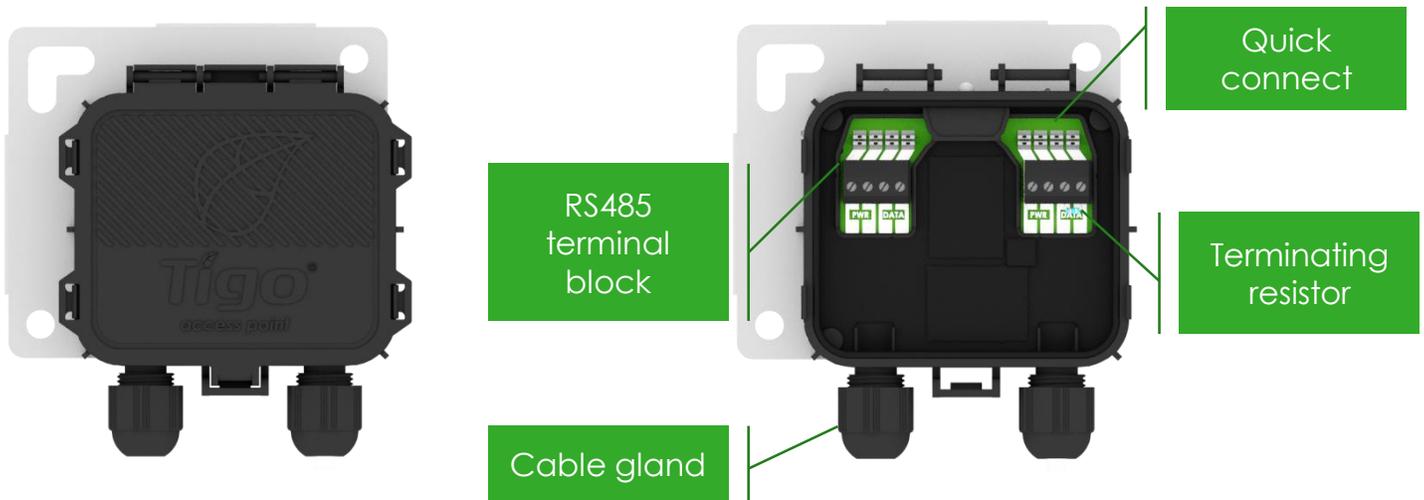
**TS4-L: LONG STRINGS:** The TS4-L is the complete Smart Module solution. It is ideal for systems requiring fully optimized performance at the module level, monitoring, safety, and longer strings [click here](#) to see the TS4-L string sizing info



For the **TS4-F (Fire Safety)** manual, [click here](#)

# 1.2 COMMUNICATION ACCESSORIES

## TIGO ACCESS POINT (TAP)



### Mesh configuration:

- 300 TS4 units per TAP
- 900 TS4 units per CCA
- 7 TAPs per CCA
- 33ft (10m) max between TAP and closest TS4 unit
- 115ft (35m) max between TAP and farthest TS4 unit using mesh

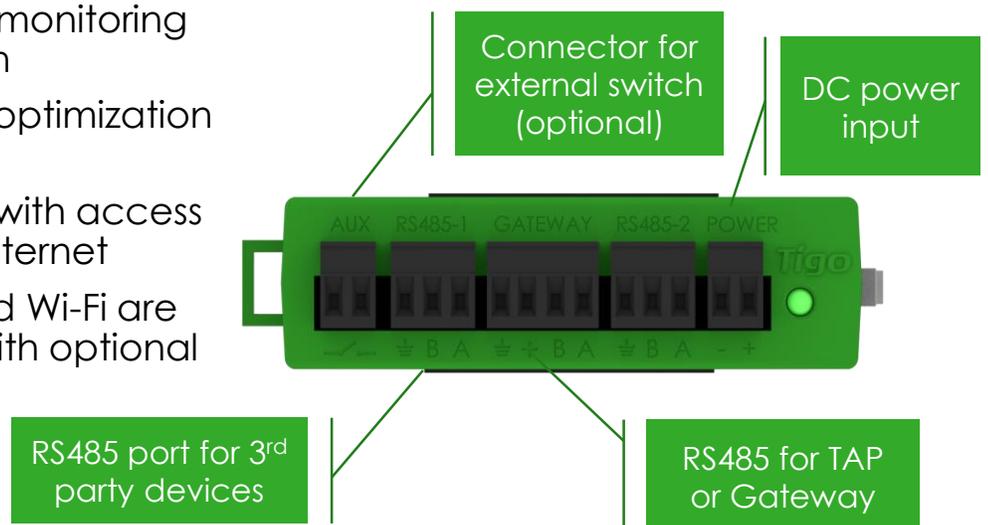
### Legacy configuration:

- 120 TS4 units per TAP
- 360 TS4 units per CCA
- 7 TAPs per CCA
- 50ft (15m) radius

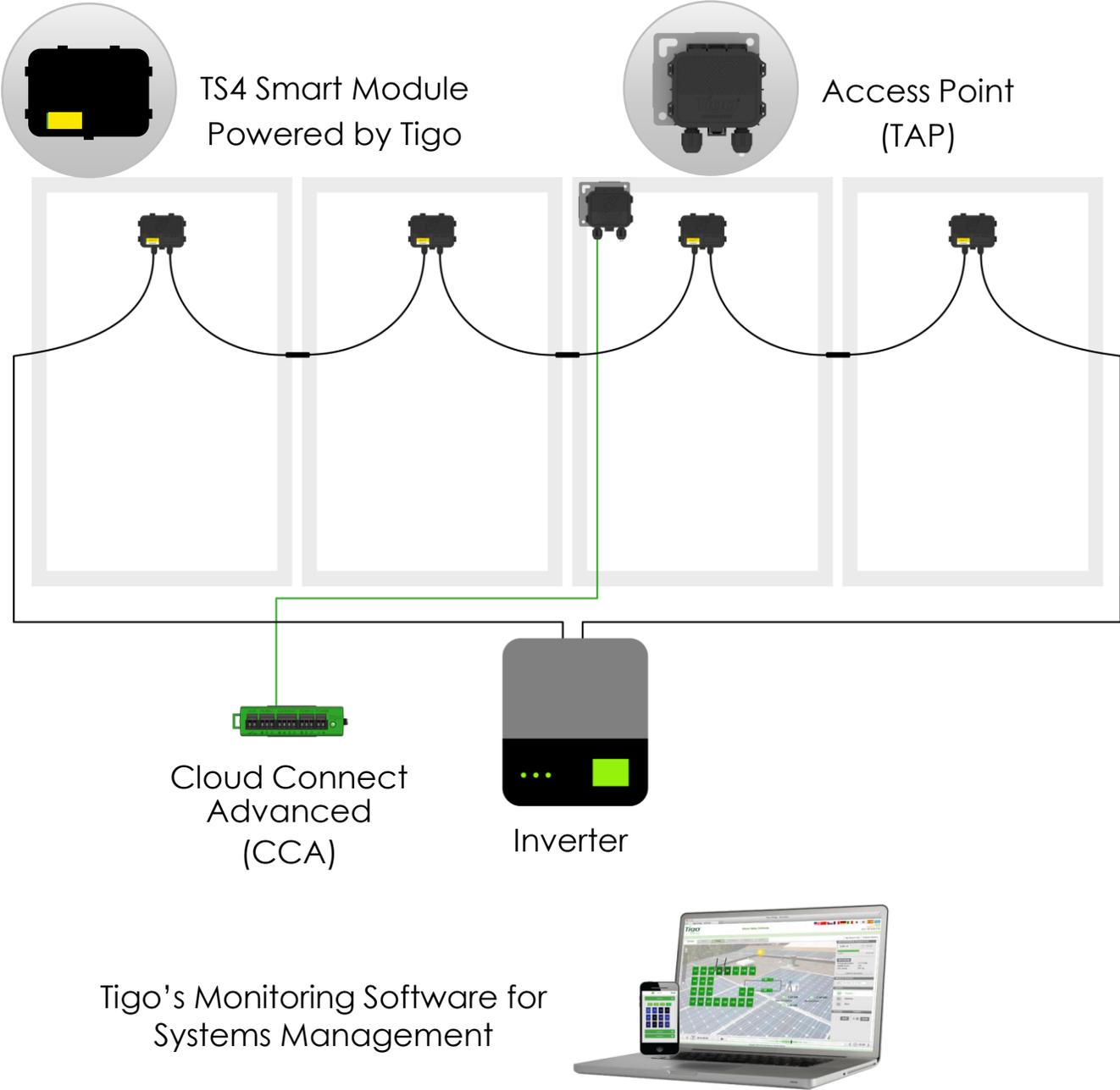
Same as Gateway, see appendix 3 for more details

## CLOUD CONNECT ADVANCED (CCA)

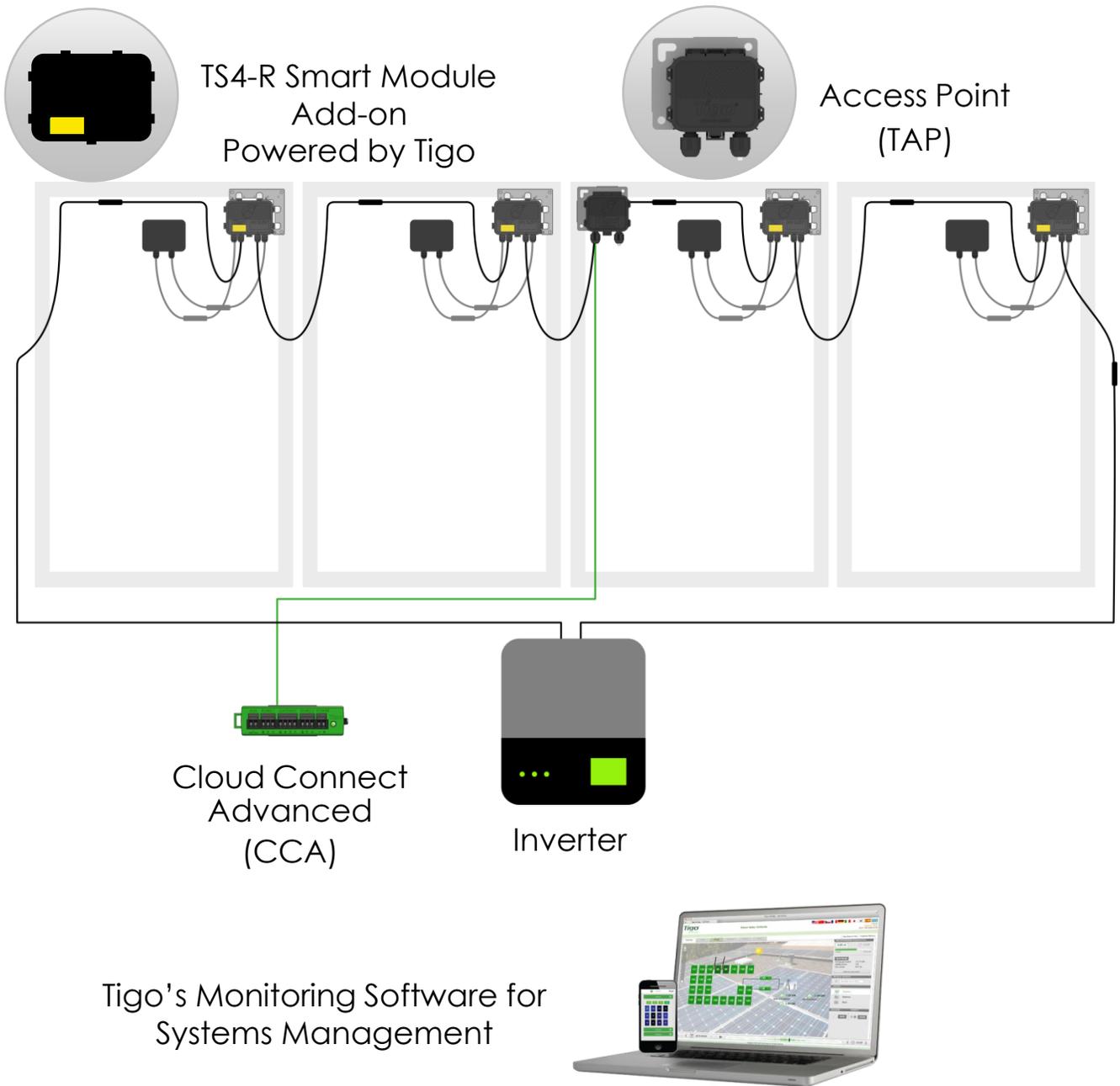
- CCA is required for monitoring and rapid shutdown
- CCA is optional for optimization and long strings
- Install near inverter with access to AC power and internet
  - Ethernet and Wi-Fi are standard, with optional cellular



# 1.3 SYSTEM OVERVIEW: TS4-B



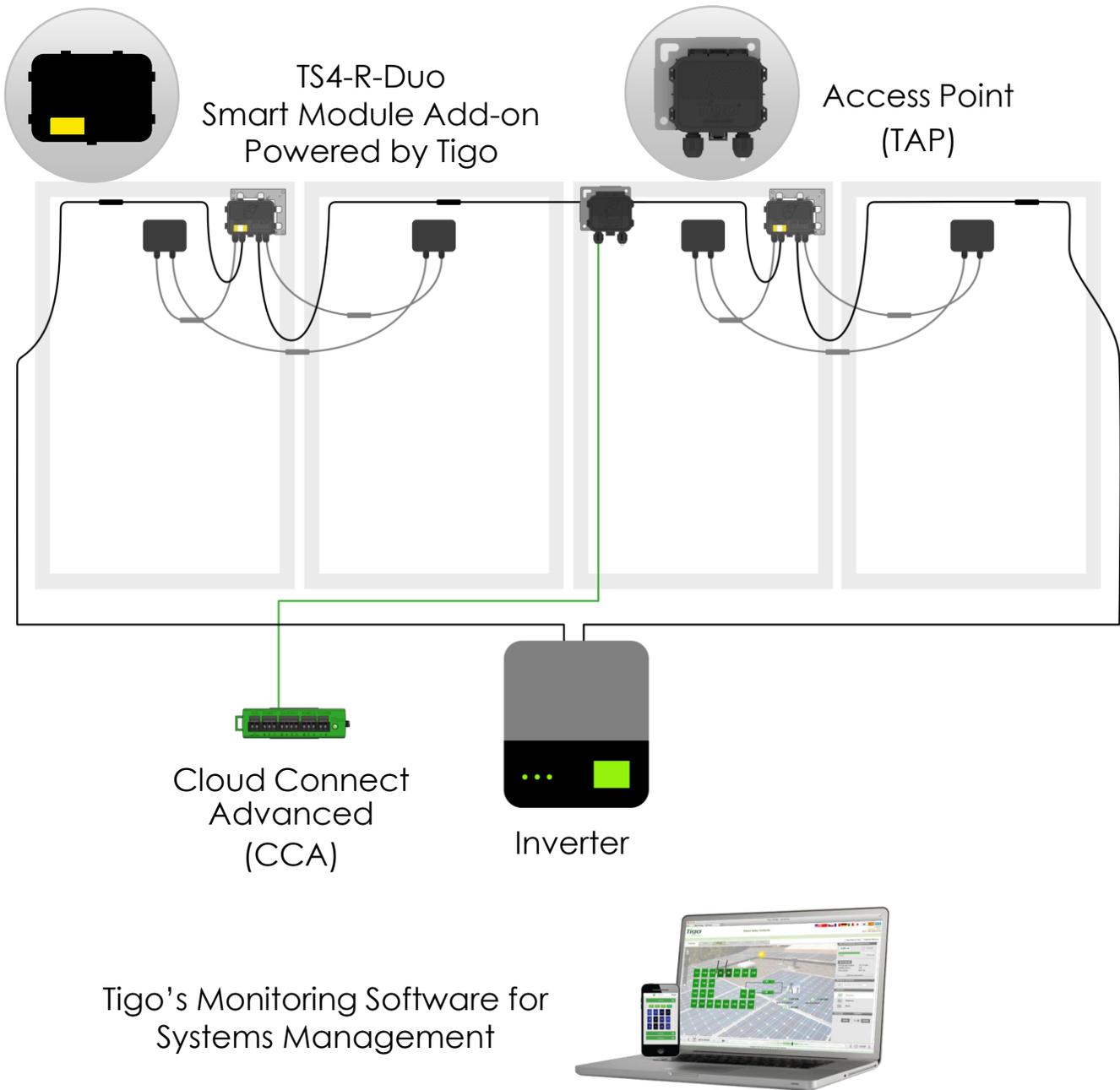
# 1.3 SYSTEM OVERVIEW: TS4-R



**Note: connect modules to TS4-R inputs before connecting outputs**

- TS4-R mounting is recommended on the upper right as shown, but can be placed on upper left if needed (due to racking constraints, etc.)
- TS4-R cable glands must not be facing up
- Allow clearance between PV module and mounting surface for air circulation around TS4-R
- Do not drill additional mounting holes in the frame or metal bracket

# 1.3 SYSTEM OVERVIEW: TS4-R-DUO



**Note: connect modules to TS4-R-Duo inputs before connecting outputs**

- TS4-R-Duo mounting is recommended on the upper right as shown, but can be placed on upper left if needed (due to racking constraints, etc.)
- TS4-R-Duo cable glands must not be facing up
- Allow clearance between PV module and mounting surface for air circulation around TS4-R-Duo
- Do not drill additional mounting holes in the frame or metal bracket

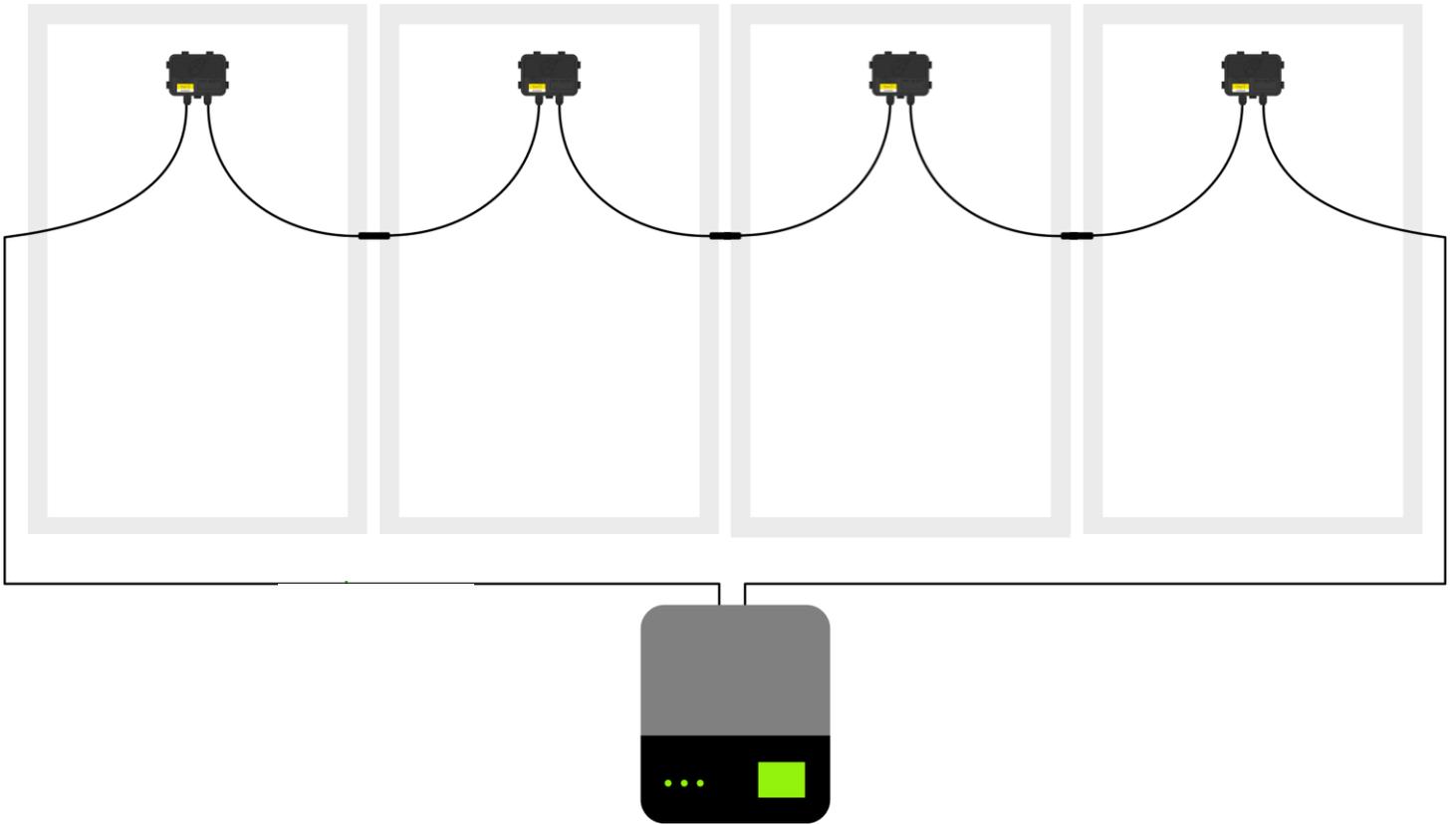
## 2. MLPE INSTALLATION

- Note: The following TS4 products are shipped in the ON position:
  - TS4-M, TS4-S, TS4-O, TS4-L
  - TS4-R-M, TS4-R-S, TS4-R-O
  - TS4-R-M-Duo, TS4-R-S-Duo, TS4-R-O-Duo
- Upon exposure of the PV module to sunlight high voltage is present. Handle with the appropriate precaution measures.
- Optimization and Long Strings features don't require communication accessories in order to work.
- To enable Monitoring and Safety features:
  - Collect the TS4 removable barcode label from the PV module junction box.



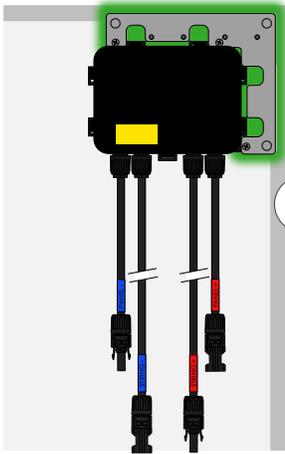
- Install and commission communication accessories.
- With add-on / retrofit units, failing to follow the sequence of installation steps may result in TS4 damage not covered under warranty.

## 2.1 TS4-B INSTALLATION

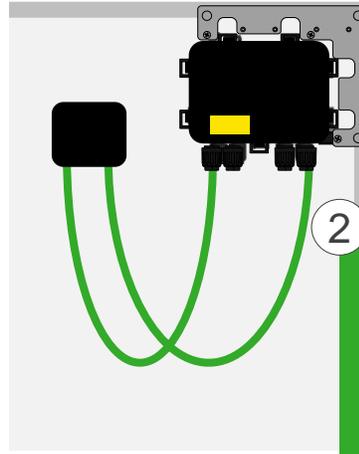


Smart Modules with Integrated TS4 Junction box are installed just like standard PV-Modules.

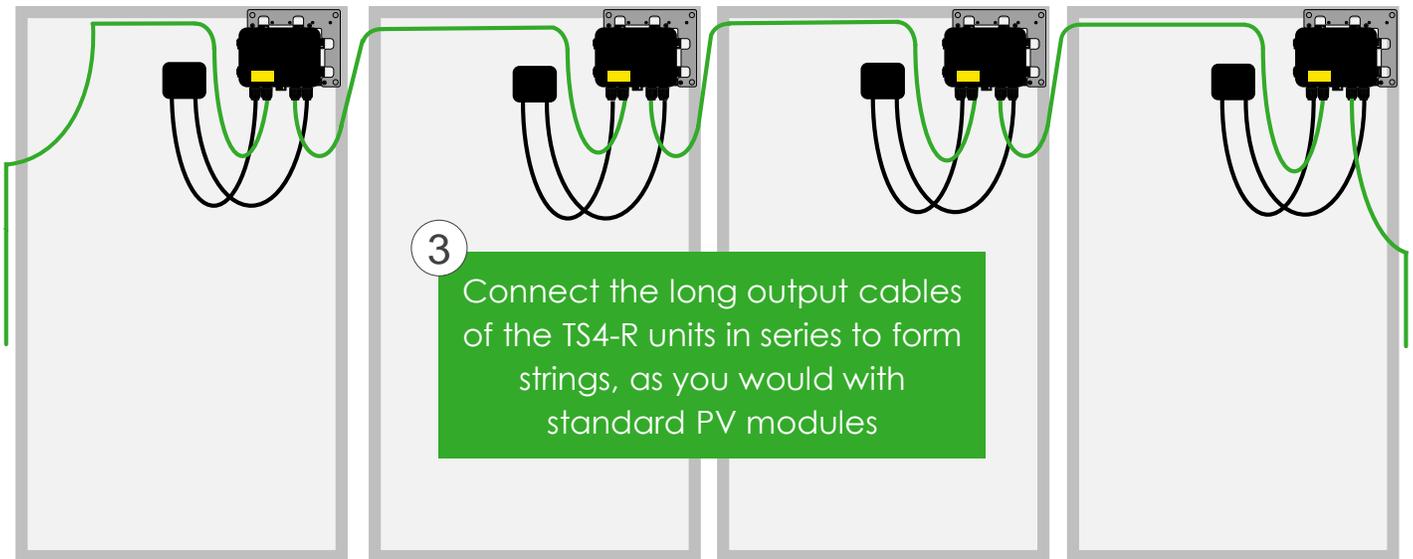
## 2.2 TS4-R INSTALLATION



1  
Mount the TS4-R on  
the top right corner  
of a PV module



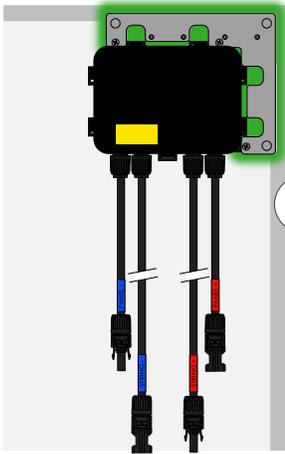
2  
Connect the PV  
cables from the  
module to the short  
leads of the TS4-R



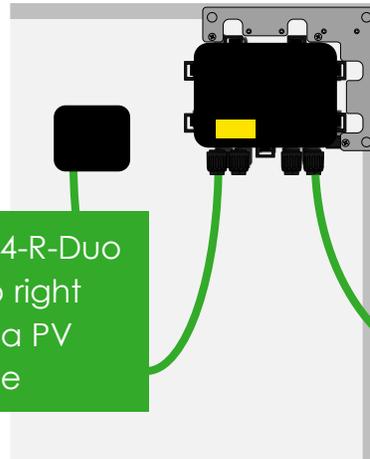
3  
Connect the long output cables  
of the TS4-R units in series to form  
strings, as you would with  
standard PV modules

Note: connect modules to TS4-R inputs before connecting outputs

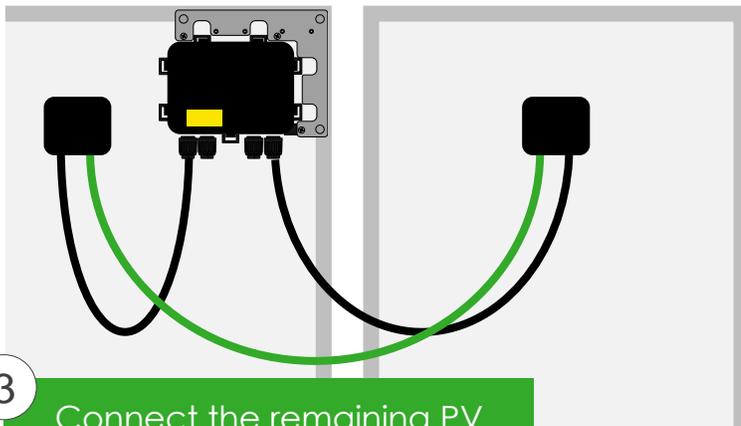
## 2.3 TS4-R-Duo INSTALLATION



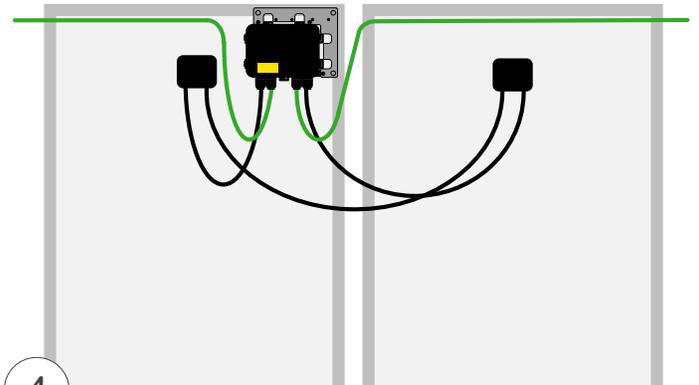
1 Mount the TS4-R-Duo on the top right corner of a PV module



2 Connect the PV cables from the modules to the short leads of the TS4-R-Duo



3 Connect the remaining PV cables from the modules to complete the series connection



4 Connect the long output cables of the TS4-R-Duo units in series to form strings, as you would with standard PV modules

Note: connect modules to TS4-R-Duo inputs before connecting outputs

# 3. COMMUNICATION INSTALLATION

## COMMUNICATION DESIGN RULES

- MESH CONFIGURATION
  - 300 TS4 units per TAP
  - 900 TS4 units per CCA
  - 7 TAPs per CCA
  - 33ft (10m) max between TAP and closest TS4 unit
  - 115ft (35m) max wireless range using mesh
    - No more than 10m between TS4 units on same TAP
- LEGACY CONFIGURATION
  - 120 TS4 units per TAP
  - 360 TS4 units per CCA
  - 7 TAPs per CCA
  - 50ft (15m) radius

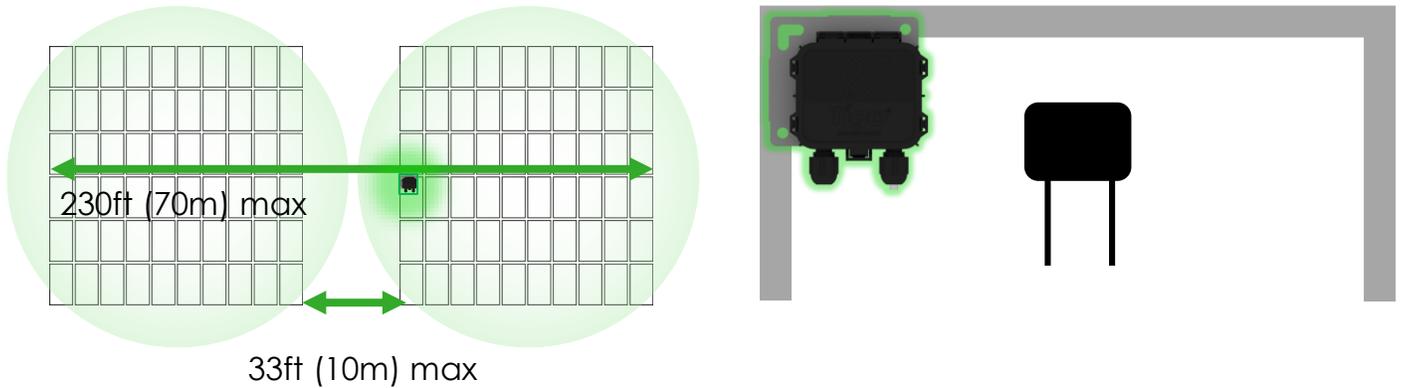
## NOTES

- All TS4 units in the same string must be assigned to the same CCA.
- For further design information, [click here](#).

## CCA and TAP CALCULATOR

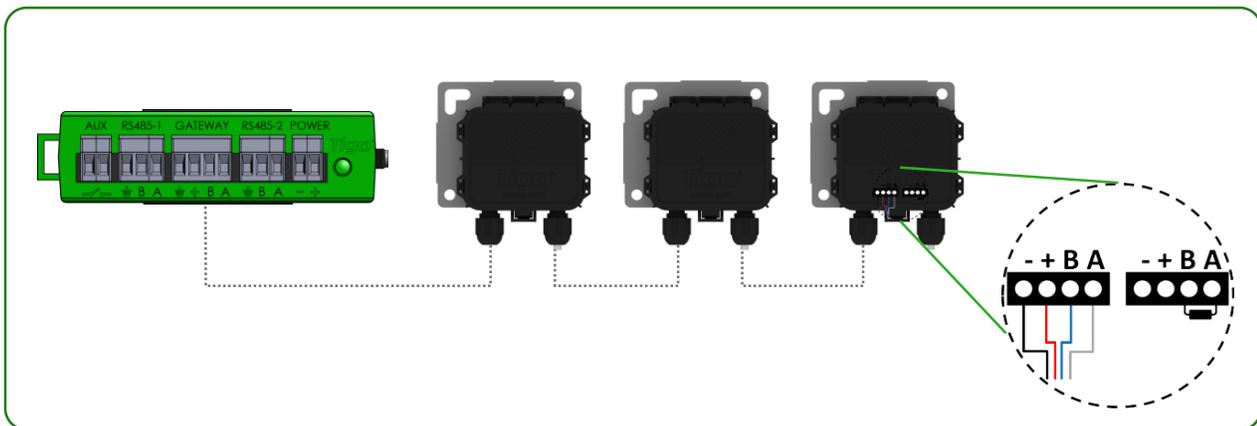
- For the number of CCAs and TAPs required for your project, [click here](#).

# 3.1 TAP PLACEMENT - MESH CONFIGURATION



Place TAP within 10m of any TS4 unit in the array, with a maximum distance of 10m between TS4 units and 35m from TAP to farthest TS4.

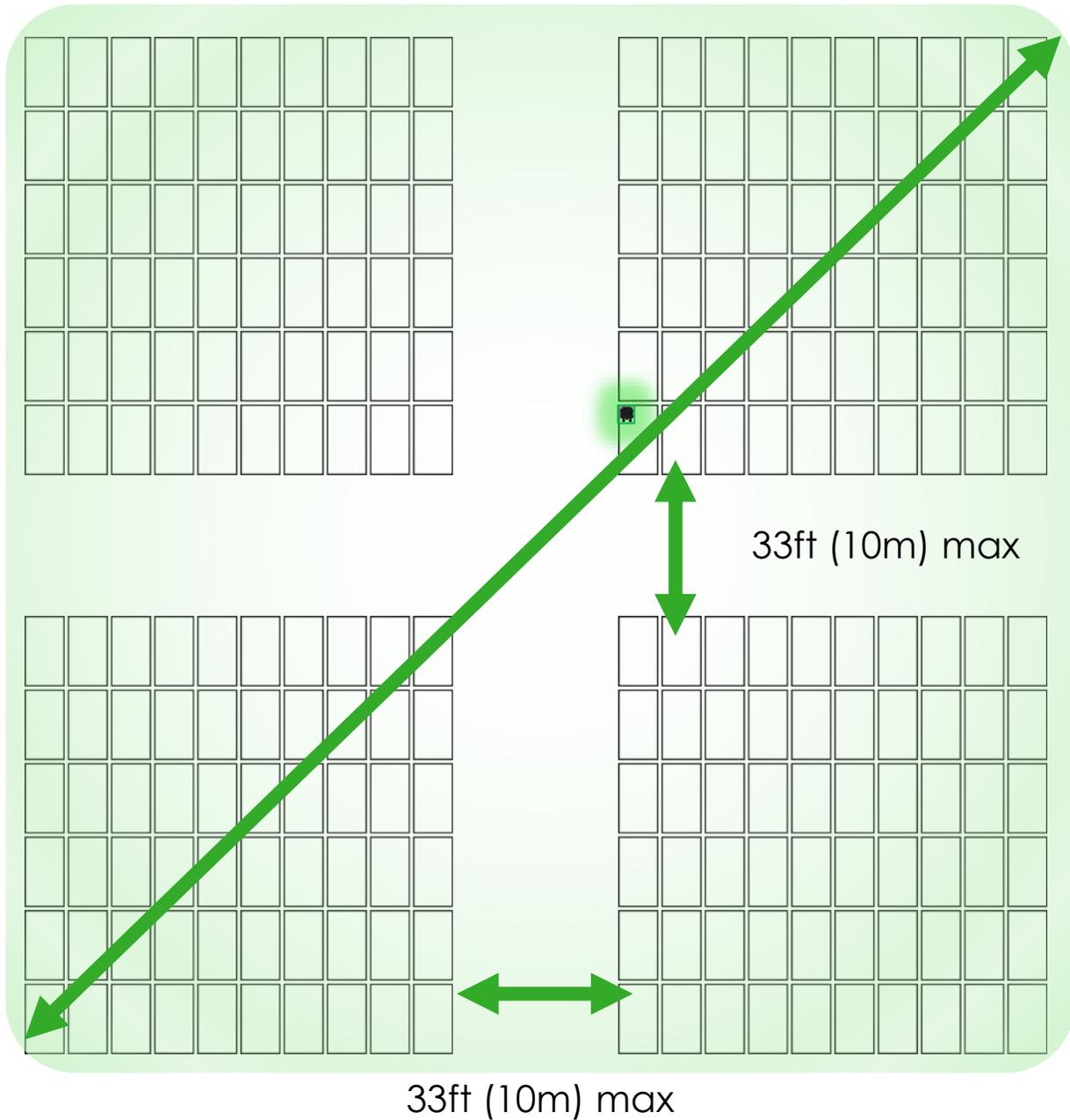
TAP attaches to module frame using built-in bracket. Mounting holes are also available in case of frameless modules.



Connect multiple TAP units in series and leave terminating resistor only in final TAP only.

# 3.1 MESH PLACEMENT EXAMPLE

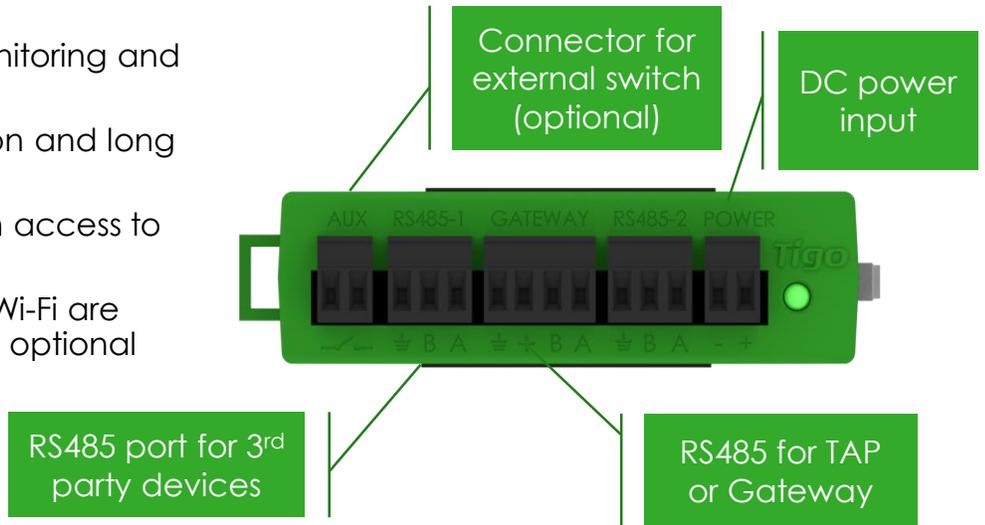
230ft (70m) max



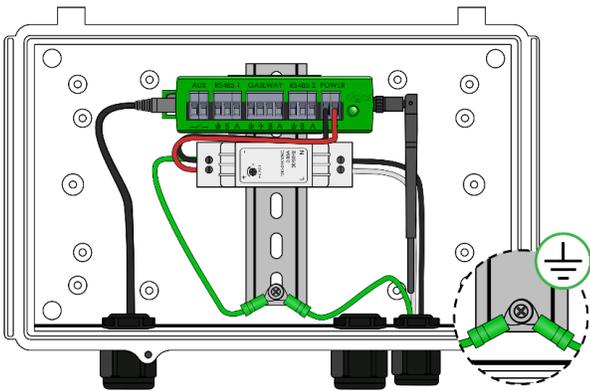
- Place TAP within 10m of any TS4 unit in the array
- Maximum distance of 10m between TS4 units that belong to a single TAP
- Maximum distance of 35m (115ft) between TAP and farthest TS4 unit
- Connect multiple TAPs in series for larger arrays

# 3.2 CCA INSTALLATION

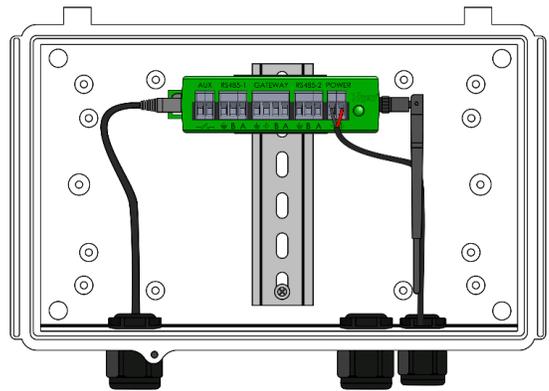
- CCA is required for monitoring and rapid shutdown
- Optional for optimization and long strings
- Install near inverter with access to AC power and internet
  - Ethernet and Wi-Fi are standard, with optional cellular



**CCA and TAP are required for Rapid Shutdown control**  
 Install CCA on same AC main service as inverter for automatic activation in case of AC grid loss



CCA with DIN rail power supply



CCA with DC transformer

- Connect DC leads from power supply to CCA
- Connect AC and DC ground wires to DIN rail
- Connect AC power input to power supply

- Connect DC leads from power supply to CCA

**Complete TAP wiring connections before powering on Cloud Connect**

# 3.2 CCA LED STATUS GUIDE

Auto PV Safe 

- A blinking red and yellow LED indicates that the system automatically entered PV-Off mode.

User PV Safe 

- A blinking green and yellow LED indicates that PV-Off mode was activated manually.

SMART App activity 

- A blinking green LED indicates that the mobile app is connected to the CCA and is actively in use.

Discovery 

- A blinking yellow LED indicates that the CCA is scanning for Gateways and smart modules (part of the commissioning process).

Error 

- A solid red LED indicates that the Discovery process failed or that the CCA is not able to connect to the Tigo server. In case of errors, connect to the CCA using the mobile app for more details.

Warning 

- A solid yellow LED indicates that: Discovery has not been run, Discovery completed but did not find all expected Gateways or modules, or CCA is not able to upload data. Connect to the CCA using the mobile app for more details.

System OK 

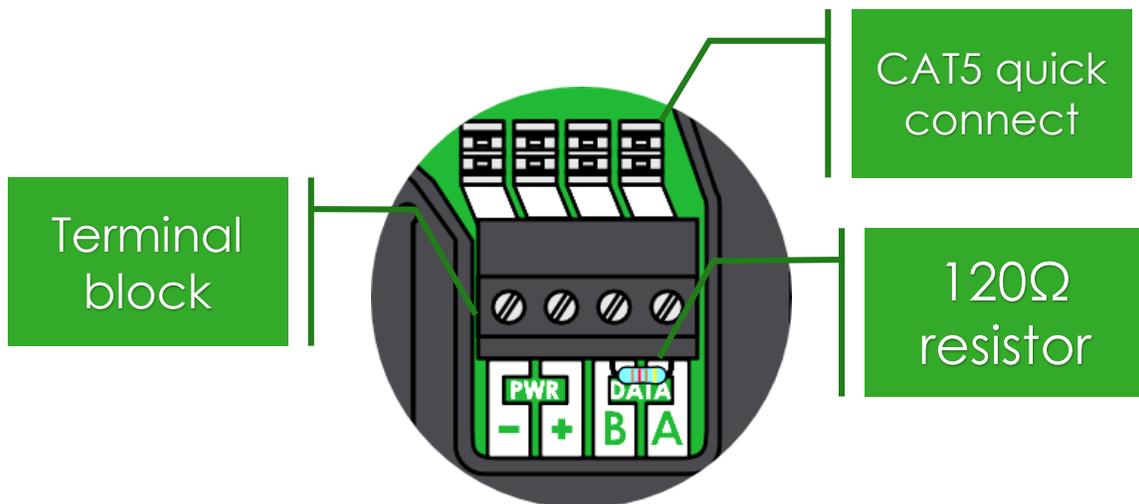
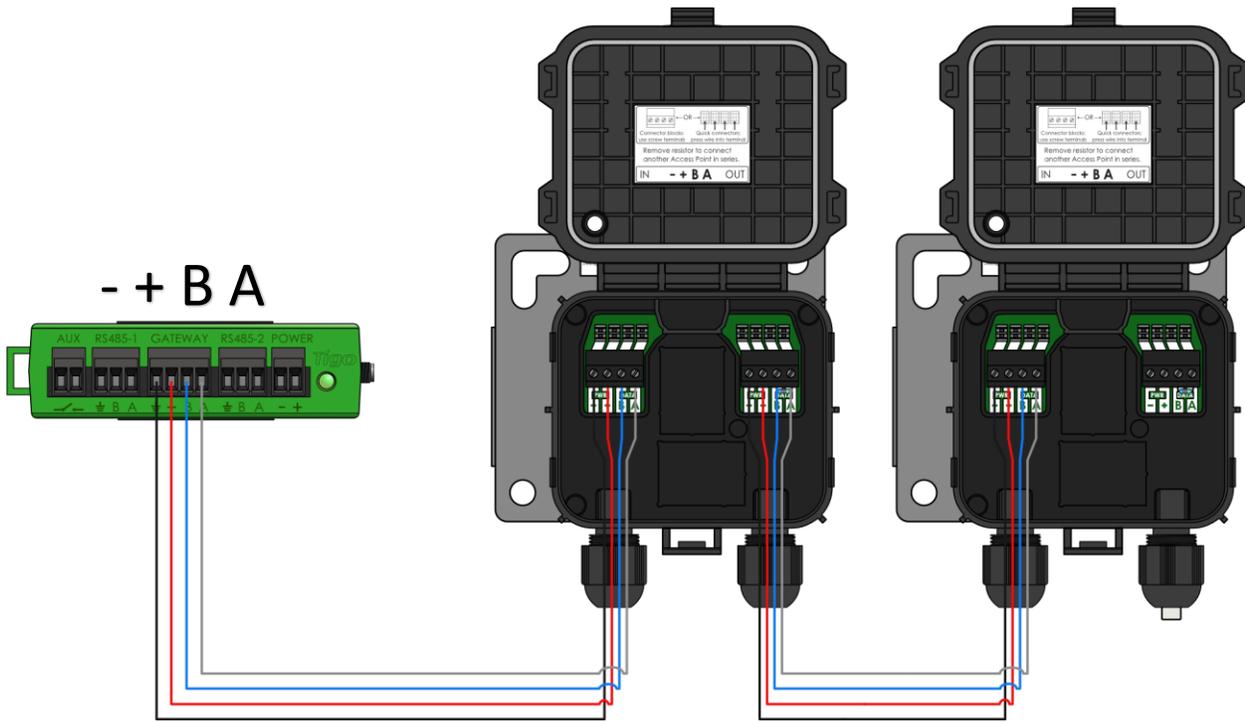
- A solid green LED indicates that Discovery is complete and found all expected Gateways and smart modules, and CCA is able to connect to the Tigo server.

Power Off / No Status 

- An unlit LED indicates that the CCA is powered off.



# 3.2 CCA & TAP WIRING



Connect multiple TAP units in series and leave terminating resistor only in final TAP.

If using the quick connectors, remove the terminal block from the TAP and strip approximately 3cm of insulation from the end of the cable.

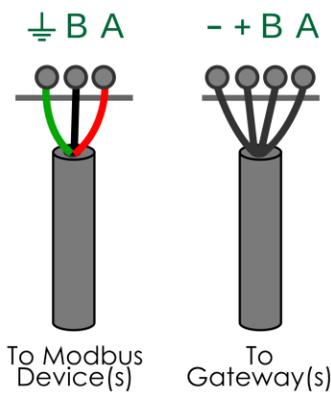
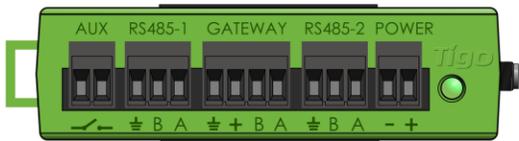
Use a small flathead screwdriver to press the conductors into the quick connectors. The individual conductors do not require stripped ends.

**Connect all communication cables before powering on CCA**

# 3.3 MODBUS RS-485 WIRING DIAGRAM AND CONFIGURATION TEMPLATE

- Up to 32 Modbus RS-485 devices can be connected to a single Cloud Connect/CCA
- All devices must have a unique Modbus address
- All devices connected in series must have the same baud rate, parity, and stop bit settings
- Check device manual for Modbus settings

Tigo Energy  
Cloud Connect Advanced  
(CCA)



Modbus Device #1	
Manufacturer:	_____
Model:	_____
Type of Device:	_____
Electrical Voltage:	_____
Single or 3 Phase:	_____
CT Rating:	_____
Modbus Address:	_____
Baud Rate:	_____
Parity:	_____
Stop Bits:	_____
RS-485 Modbus terminal	
G	+ -

Modbus Device #2	
Manufacturer:	_____
Model:	_____
Type of Device:	_____
Electrical Voltage:	_____
Single or 3 Phase:	_____
CT Rating:	_____
Modbus Address:	_____
Baud Rate:	_____
Parity:	_____
Stop Bits:	_____
RS-485 Modbus terminal	
G	+ -

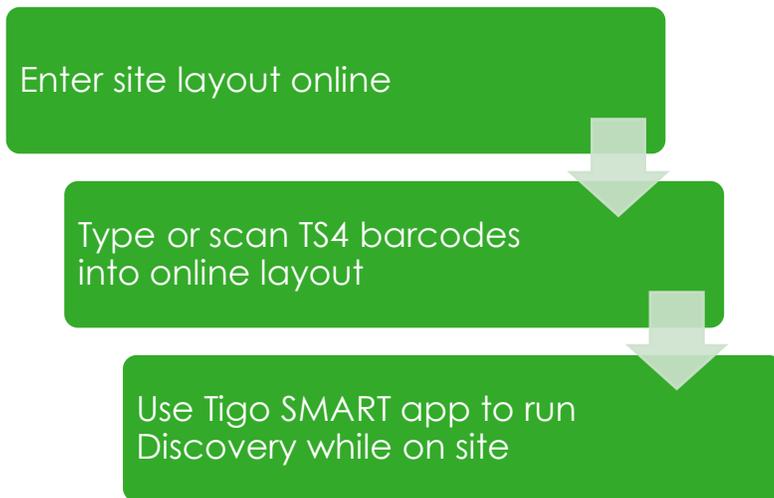


↑  
RS-485 communication cable with shield

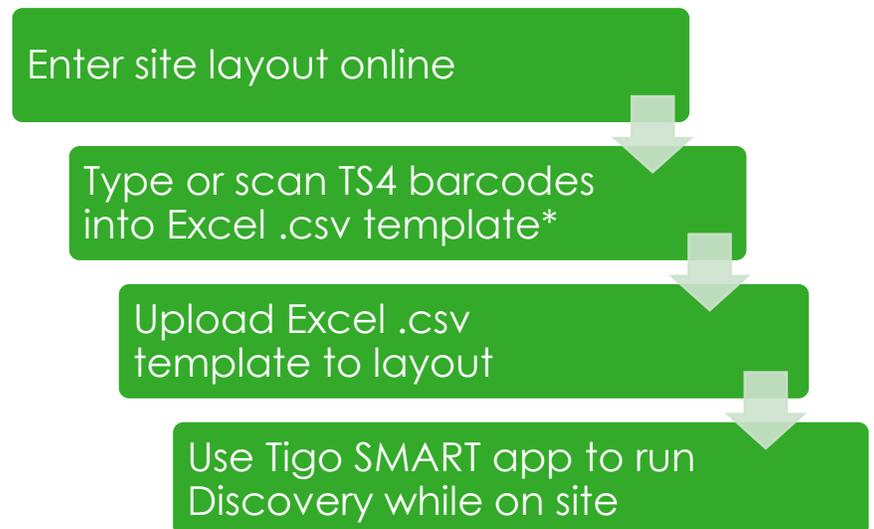
↑  
120Ω resistor across + and - terminals on the last Modbus device in series

# 4. CONFIGURATION, REGISTRATION AND COMMISSIONING

- Non-residential systems should perform site configuration online at <https://installations.tigoenergy.com>.
- Residential systems can perform configuration, registration, and commissioning via the Tigo SMART App.



OR



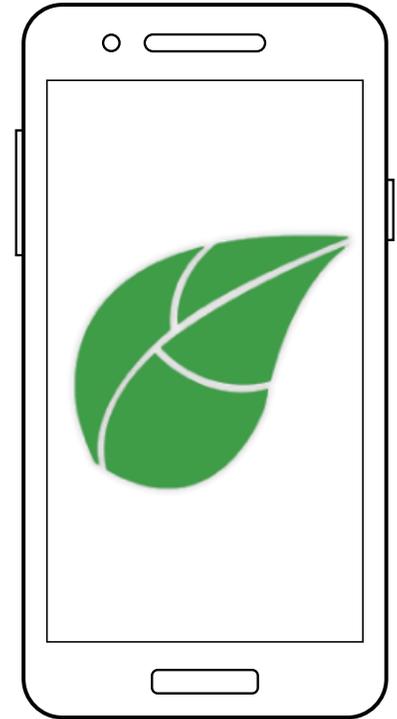
\* Download the pre-formatted .csv template from the Layout step of the site builder

# TIGO SMART APP

*Commissioning a new system using the Tigo App 3.0*

Use the Tigo SMART app to:

- Create a system
- Input owner info
- Enter inverter & module types
- Configure layout and scan barcodes
- Configure network
- Commission Tigo hardware
- Monitor production



Install 'Tigo SMART' from the App Store or Google Play



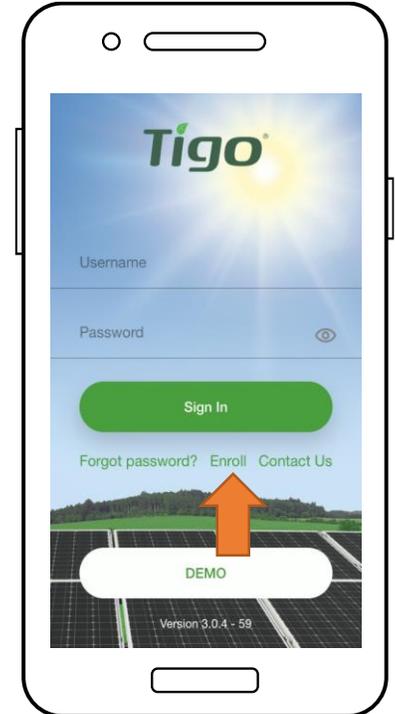
# GETTING STARTED

*Requires active mobile data connection*

If you do not have an installer account, tap **'Enroll'** to create a new account. All system data can also be accessed and edited here: <https://installations.tigoenergy.com>

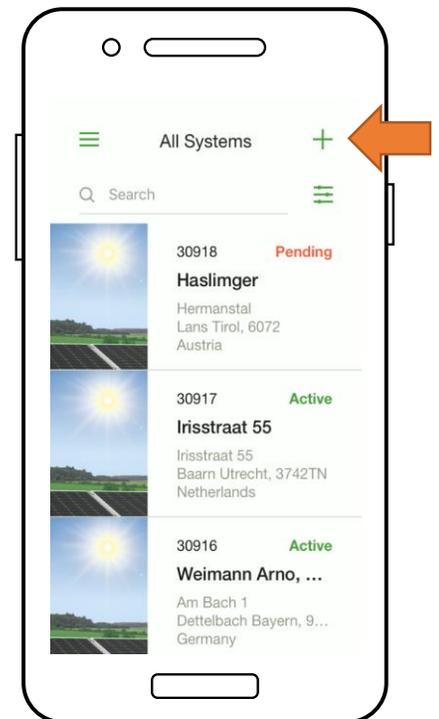


<https://installations.tigoenergy.com/>



To proceed with a new installation, tap **'+'** at the top right of the display

To service or monitor an existing system that has already been configured, tap on that system in your list

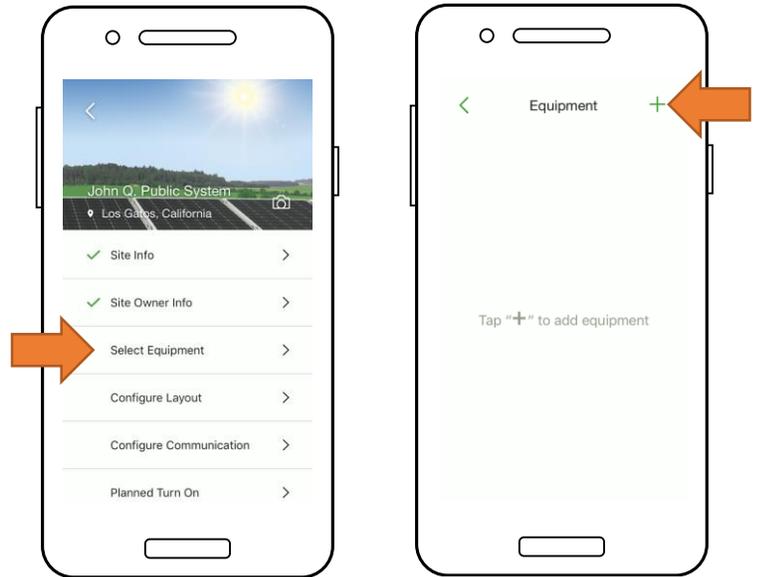


# SELECT EQUIPMENT

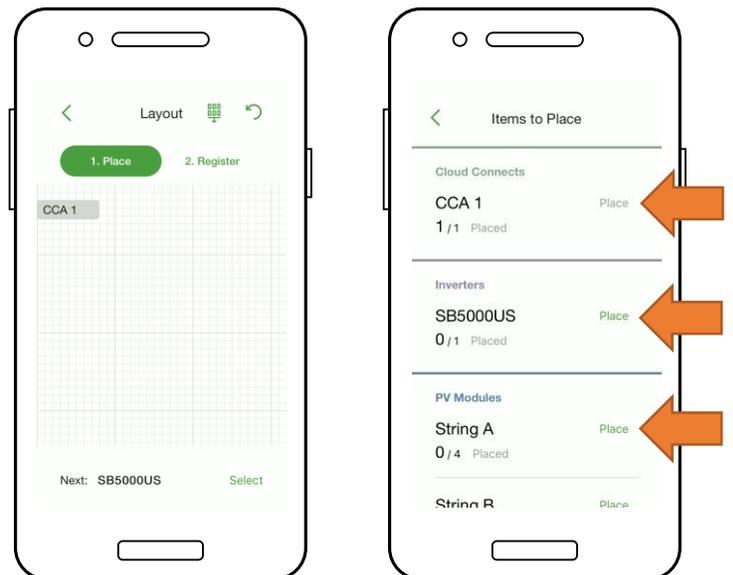
*Requires active mobile data connection*

- Go to 'Select Equipment'
- Tap '+' at the top right of the display to add equipment
- Choose the inverter model, the number of MPPTs, and the associated CCA
- Select the manufacturer and model of the PV modules

**Note:** If using an inverter or module not in the list, click the '+' sign at the top right corner



- Place the CCA by tapping on a position on the Layout grid
- Tap 'Place' next to an equipment type to place it on the grid
- Repeat for all CCAs and inverters



# CONFIGURE MODULE LAYOUT

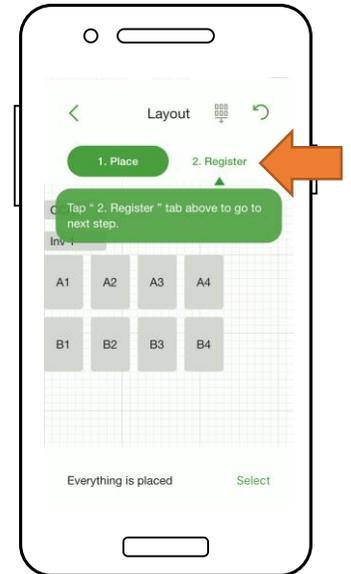
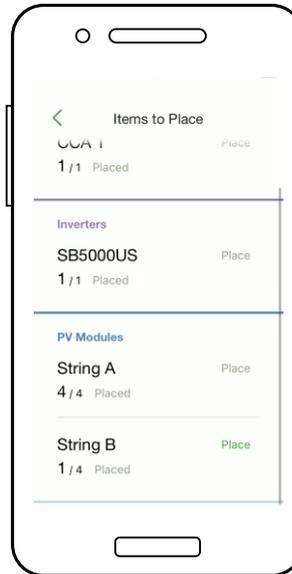
*Requires active mobile data connection*

- Place modules in the Layout grid according to their physical placement on site

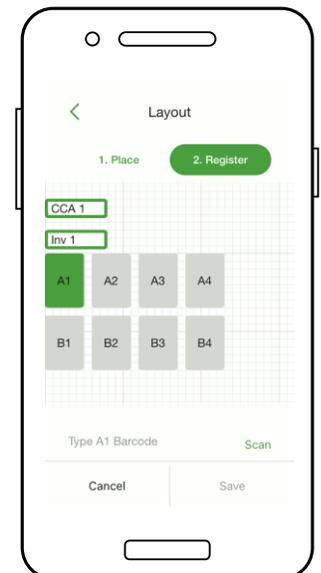
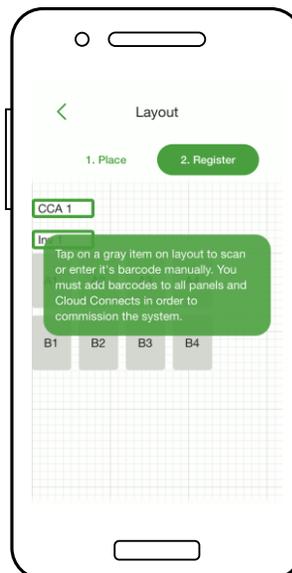


**Note:** Matching the physical map of the system is optional but improves its appearance in the monitoring portal and makes maintenance easier

- Tap and drag to change the position of a placed item
- Tap 'Register' to begin entering the TS4 barcodes



- Select a gray module in the layout to register it by typing or scanning in its TS4 barcode
- Register all TS4 barcodes



# CONNECT CCA TO SMARTPHONE

*No mobile data connection required*

You can use either a Wi-Fi or Bluetooth connection to connect the smartphone to the CCA



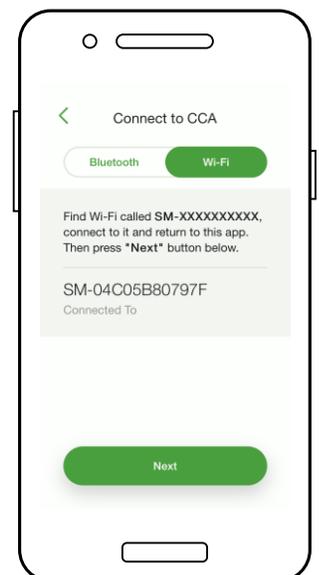
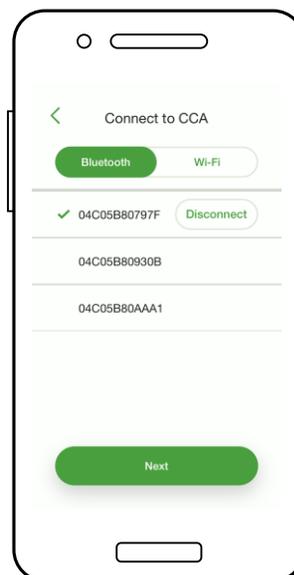
To connect the Smartphone to the CCA via **Bluetooth**, tap the serial number of the CCA you wish to connect with

- **Note:** Use the Tigo Smart App to pair with the CCA, instead of the phone's Bluetooth pairing screen
- Once connected to the CCA, tap 'Next' to continue



To connect the smartphone to the CCA via **Wi-Fi**, choose the CCA's Wi-Fi connection in the phone's settings

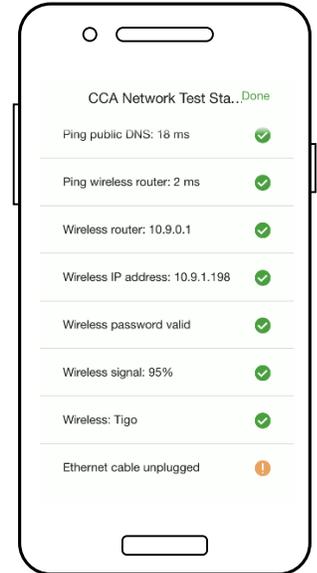
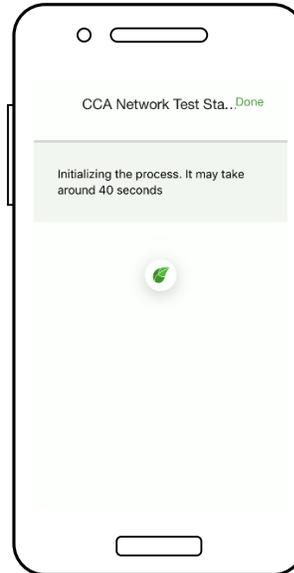
- **Note:** Using the Wi-Fi connection disconnects the smartphone from the local Wi-Fi
- Once connected to the CCA, tap 'Next' to continue



# CONFIGURE NETWORK SETTINGS – CONNECT CCA TO INTERNET

*Requires smartphone – CCA connection*

- The Network Test checks the Internet connection of the CCA
- The test performs a series of checks that can be used for troubleshooting the network connection
- Tap 'Done' to continue



# COMMISSION THE TS4 UNITS – RUN DISCOVERY

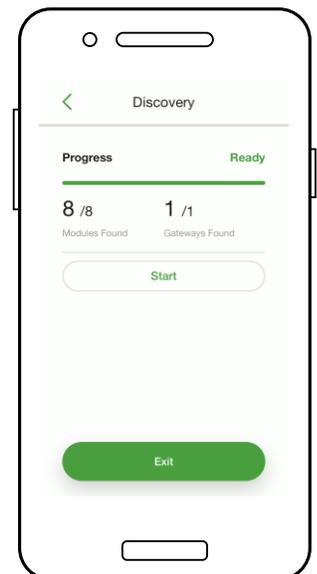
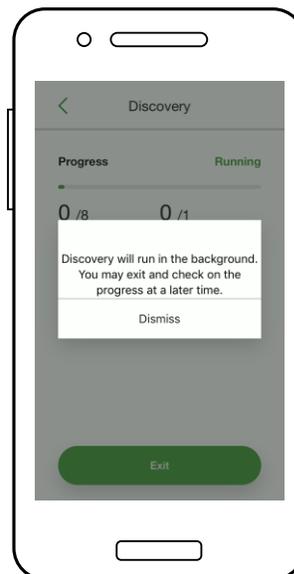
*Requires smartphone – CCA connection*

- Tap 'Next' in the 'CCA Network Settings' to go to 'Discovery'



**Note:** Before starting Discovery, all site equipment and TS4 barcodes should be input into the app. Begin the process no later than an hour before sunset.

- Tap 'Start' to run Discovery





**Tigo**<sup>®</sup>

## **APPENDIX**

A. Mechanical specifications

B. Rapid Shutdown

C. String Sizing with TS4-L



# TECHNICAL SPECIFICATIONS – SMART MODULE WITH TS4-B BASE

## TS4 COVERS



DIODES  
TS4-D



MONITORING  
TS4-M



SAFETY  
TS4-S



OPTIMIZATION  
TS4-O



LONG STRINGS  
TS4-L

### ELECTRICAL RATINGS

INPUT					
Rated DC Input Power		475W	475W	475W	475W
Maximum Input Voltage	N/A	90V	90V	90V	90V
Max Continuous Input Current ( $I_{MAX}$ )	12.5A	12A	12A	12A	12A
Maximum $V_{OC}$ @ STC		75V	75V	75V	75V
Minimum $V_{MP}$	N/A	16V	16V	16V	16V
OUTPUT					
Output Power Range	0 - 375W	0 - 475W	0 - 475W	0 - 475W	0 - 475W
Output Voltage Range	0 - $V_{OC}$	0 - $V_{OC}$	0 - $V_{OC}$	0 - $V_{OC}$	0 - $V_{MAX}$
Communication Type	N/A	802.15.4 2.4GHz	802.15.4 2.4GHz	802.15.4 2.4GHz	802.15.4 2.4GHz
Rapid Shutdown UL Listed (NEC 2014 & 2017 690.12)	Need additional RS device	Need additional RS device	Yes	Yes	Yes
Impedance Matching Capability	No	No	No	Yes	Yes
Output Voltage Limit	No	No	No	No	Yes
Maximum System Voltage	1500V	1500V	1500V	1500V	1500V

All TS4 covers are 1500V compatible. Specify system voltage when ordering (1000V / 1500V) for appropriate cables & connectors.

Rapid shutdown requires TS4-S or higher, installed with CCA and TAP.

# TECHNICAL SPECIFICATIONS – RETROFIT UNIT WITH TS4-R BASE

## TS4-R



**MONITORING**  
TS4-R-M



**SAFETY**  
TS4-R-S



**OPTIMIZATION**  
TS4-R-O

### ELECTRICAL RATINGS

INPUT			
Rated DC Input Power	475W	475W	475W
Maximum Input Voltage	90V	90V	90V
Max Continuous Input Current ( $I_{MAX}$ )	12A	12A	12A
Maximum $V_{OC}$ @ STC	75V	75V	75V
Minimum $V_{MP}$	16V	16V	16V
OUTPUT			
Output Power Range	0 - 475W	0 - 475W	0 - 475W
Output Voltage Range	0 – $V_{OC}$	0 - $V_{OC}$	0 - $V_{OC}$
Communication Type	802.15.4 2.4GHz	802.15.4 2.4GHz	802.15.4 2.4GHz
Rapid Shutdown UL Listed (NEC 2014 & 2017 690.12)	Need additional RS device	Yes	Yes
Impedance Matching Capability	No	No	Yes
Output Voltage Limit	No	No	No
Maximum System Voltage	1500V	1500V	1500V

All TS4 covers are 1500V compatible. Specify system voltage when ordering (1000V / 1500V) for appropriate cables & connectors.

Rapid shutdown requires TS4-R-S or higher, installed with CCA and TAP.

# TECHNICAL SPECIFICATIONS – RETROFIT DUO UNIT WITH TS4-R BASE

## TS4-R-DUO



**MONITORING**  
TS4-R-M-Duo



**SAFETY**  
TS4-R-S-Duo



**OPTIMIZATION**  
TS4-R-O-Duo

### ELECTRICAL RATINGS

INPUT			
Maximum DC Input Power	700W	700W	700W
Total Max Input Voltage ( $V_{OC}$ @ Lowest Temperature)	90V	90V	90V
Total PV Module $V_{OC}$ @ STC <sup>1</sup>	75V	75V	75V
Max Continuous Input Current ( $I_{MAX}$ )	12A	12A	12A
OUTPUT			
Output Power Range	0 - 700W	0 - 700W	0 - 700W
Output Voltage Range	0 - $V_{OC}$	0 - $V_{OC}$	0 - $V_{OC}$
Communication Type	802.15.4 2.4GHz	802.15.4 2.4GHz	802.15.4 2.4GHz
Rapid Shutdown UL Listed <sup>2</sup> (NEC 2014 & 2017* 690.12)	Need additional RS device	Yes	Yes
Impedance Matching Capability <sup>3</sup>	No	No	Yes
Output Voltage Limit	No	No	No
Maximum System Voltage	1500V	1500V	1500V

<sup>1</sup> Approximate  $V_{OC}$  of 90V at -40°C.

<sup>2</sup> Cloud Connect Advanced (CCA) and TAP/Gateway required for rapid shutdown compliance.

<sup>3</sup> Install TS4-R-X-Duo on strings of identical length with identical PV modules.

All TS4 covers are 1500V compatible. Specify system voltage when ordering (1000V / 1500V) for appropriate cables & connectors.

Rapid shutdown requires TS4-R-S-Duo or higher, installed with CCA and TAP.

# TECHNICAL SPECIFICATIONS

## MECHANICAL SPECIFICATIONS – TS4-B and TS4-R

### Mechanical

Operating Temperature Range -40°C to +85°C (-40°F to +185°F)

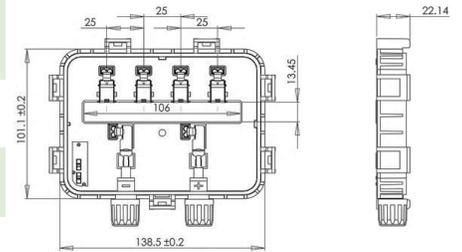
Storage Temperature Range -40°C to +85°C (-40°F to +185°F)

Cooling Method Natural Convection

Dimensions (TS4-R with cover) 178.5mm x 134mm x 25.5mm

Weight (base without cover) 270g

Outdoor Rating IP67/IP68, NEMA 3R



### Cabling

Type H1Z2Z2-K

Output Cable Length Standard 1.0m, other lengths on request

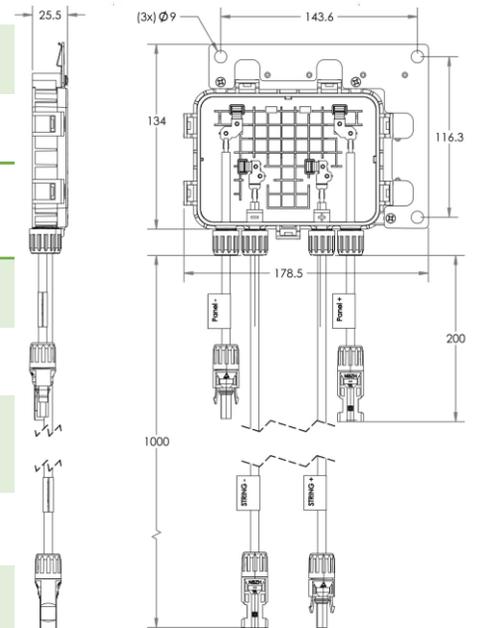
Rating Options 1000V rated  
1500V rated

Cable Cross-Section 6.3 ± 0.3mm

Connectors MC4, MC4 compatible, EVO2

UV Resistance 500hr with UV light between 300-400nm @ 65C

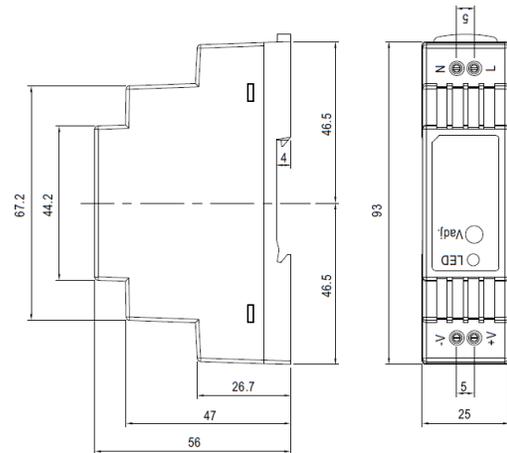
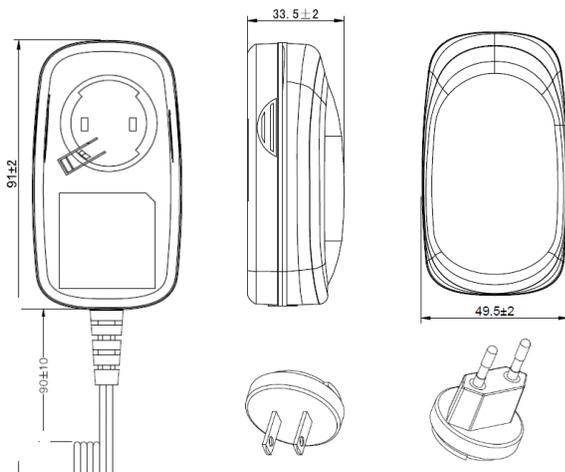
Maximum String Voltage 1500V UL/IEC<sup>1</sup>



<sup>1</sup> All TS4 covers are 1500V compatible. Specify max system voltage when ordering modules with TS4 bases for appropriate cables & connectors.

# CCA POWER SUPPLY OPTIONS

Wall Outlet Plug (DC Transformer)		DIN Rail	
Tigo Power supply only P/N	983-00070-00	Tigo Power supply only P/N	983-00054-00
Tigo CC Kit P/N	333-00000-10	Tigo CC Kit P/N	333-00000-00
Manufacturer, P/N	Click, CPS024240100*	Manufacturer, P/N	Mean Well, DR-15-24
Input	85-264VAC 47Hz-63Hz	Input	100-240VAC 50Hz/60Hz
Output	24VDC 0.63A	Output	24VDC 1A
Temperature rating	0°C to +45°C	Temperature rating	-20°C to +60°C



# RAPID SHUTDOWN

TS4-L, TS4-O, and TS4-S with Cloud Connect/Cloud Connect Advanced and TAP are a solution to meet NEC 2014 & 2017 690.12 Rapid Shutdown requirements, when combined with a DC disconnect at the inverter.

When Rapid Shutdown is initiated, the voltage across PV conductors will drop below 30V within 10 seconds at the module level.

## To activate rapid shutdown:

1. Switch off DC disconnect to disconnect capacitors.
2. Switch OFF AC main to deactivate system.

In the inverter's box you'll find 2 red labels to mark the Rapid Shutdown equipment. Place one sticker next to the inverter's DC switch and the other on the AC main breaker. **Both labels must be visible!**

Only a properly installed, configured, and tested system will perform Rapid Shutdown properly.

[CLICK HERE](#) for more info about Rapid Shutdown

# STRING LENGTH AND DESIGN WITH TS4

## TS4-M: MONITORING:

Standard rules for string length and design.  
*Requires CCA and TAP for monitoring.*



## TS4-S: SAFETY:

Standard rules for string length and design.  
*Requires CCA and TAP for monitoring and rapid shutdown.*



## TS4-O: OPTIMIZATION:

Standard rules for string length  
Flexible design (mixed orientations, unequal length strings in parallel)  
Tolerant of shade and mismatch



## TS4-L: LONG STRINGS:

Increased maximum string length, no derating for cold temperature  
Flexible design (mixed orientations, unequal length strings in parallel)  
Tolerant of shade and mismatch



# STRING SIZING WITH TS4-L

TS4-L has a state of the art technology designed to reduce balance of system costs by allowing longer strings. This can reduce the number of strings by up to 30%, which directly correlates to a 30% reduction in combiner boxes, wiring, fuses, and hardware overhead costs, as well as reducing the labor requirement for installation.

## By code:

Traditional String Design:			
Max. string Voc	÷	Temp corrected Voc	= # of modules per string

Example Calculation (based on a 260W module):

Max. Voc for code: 600V  
VMPP range: 190-510V  
Module Voc: 38.2V  
Module Vmp: 30.6V  
Temp. Corrected Voc:  $38.2 * 1.25 = 47.75V$   
Max. string:  $600V \div 47.75V = \mathbf{12 \text{ modules}}$

Smart Module String Design:			
Max. string Voc	÷	Reduced Voc	= # of modules per string

Max. Voc for code: 600V  
Inverter VMPP range: 190-510V  
Reduced Voc: **35V**  
Module Vmp: 30.6V  
Temp. Corrected Voc:  $35V * 1 = 35V$   
Max. string:  $600V \div 35V = \mathbf{17 \text{ modules}}$

## By inverter:

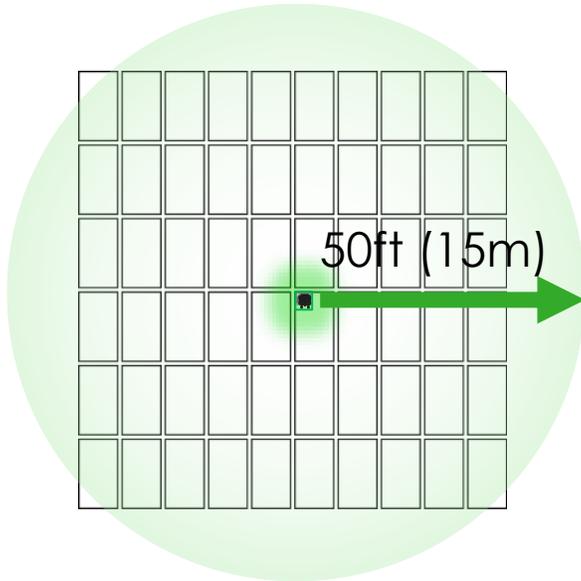
Verify maximum string length according to inverter parameters			
Inverter MPP Voltage Max	÷	Module Vmp	= # of modules per string

Verify string Vmp limits by dividing inverter max MPP voltage range by the Smart Module's Vmp.

From the example above:  $510V \div 30.6V = \mathbf{16 \text{ modules per string by inverter}}$

In case of discrepancy between the code requirement and the inverter voltage requirement pick the lower number of the two. Therefore, this example results in a **maximum of 16 panels per string, a 33% increase** in string power, with a corresponding reduction in electrical BOS costs.

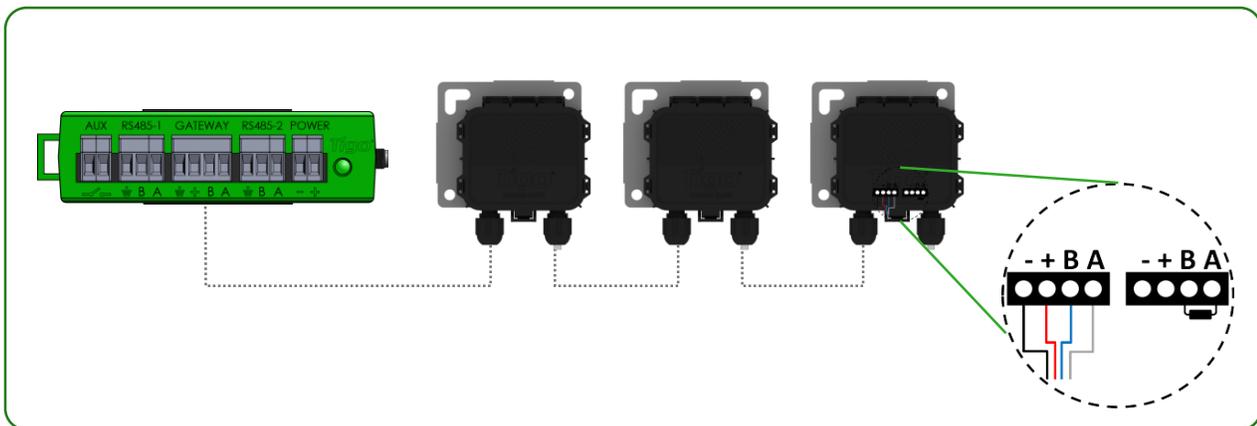
# TAP PLACEMENT - LEGACY (non-UHD-Core TS4)



Place TAP near center of array or each sub-array



TAP attaches to module frame using built-in bracket. Mounting holes are also available in case of frameless modules.



Connect multiple TAP units in series and leave terminating resistor only in final TAP only.

Legacy configuration (same as Gateway):

- 120 TS4 units per TAP
- 360 TS4 units per CCA
- 7 TAPs per CCA
- 50ft (15m) radius

# INSTALLATION COMPLETE

For more details on designing and installing solutions powered by Tigo, please visit:

- [Tigo Academy](#)
- [Resource Center](#)

Or contact us at:

- [training@tigoenergy.com](mailto:training@tigoenergy.com)

