



Rapid Shutdown System (RSS) for Fire Safety

Installation Manual TS4-A-F/2F and Transmitters



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Overview

The Tigo Rapid Shutdown System (RSS) for Fire Safety uses TS4-A-F/2F MLPE and transmitter components to enable a UL-certified and NEC-compliant PV rapid shutdown system (PVRSS) for new and existing PV systems. Upon shutdown, the components, applicable for residential through large commercial systems, reduce voltage to $0.6V_{DC}$ per TS4 and string voltage to less than $30V_{DC}$.

- A TS4-A-F can stop output from one module while a TS4-A-2F controls two modules. They are otherwise identical in function and may be used interchangeably in a string.
- The TS4-A-F/2Fs rely on a continuous powerline communication (PLC) keep-alive signal from an RSS transmitter to enable module output. Upon signal loss, module and string voltages drop to safe levels.
- The legacy Tigo RSS Transmitter accommodates single-transmitter systems. Current RSS transmitters include Tigo Pure Signal Technology™ to serve complex, multi-transmitter installations by mitigating crosstalk and other signal interference.

WARNING - THIS PHOTOVOLTAIC RAPID SHUTDOWN EQUIPMENT (PVRSE) DOES NOT PERFORM ALL OF THE FUNCTIONS OF A COMPLETE PHOTOVOLTAIC RAPID SHUTDOWN SYSTEM (PVRSS). THIS PVRSE MUST BE INSTALLED WITH OTHER EQUIPMENT TO FORM A COMPLETE PVRSS THAT MEETS THE REQUIREMENTS OF NEC (NFPA 70) SECTION 690.12 FOR CONTROLLED CONDUCTORS OUTSIDE THE ARRAY. OTHER EQUIPMENT INSTALLED IN OR ON THIS PV SYSTEM MAY ADVERSLY AFFECT THE OPERATION OF THE PVRSS. IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE COMPLETED PV SYSTEM MEETS THE RAPID SHUT DOWN FUNCTIONAL REQUIREMENTS. THIS EQUIPMENT MUST BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.

AVERTISSEMENT - CET ÉQUIPEMENT D'ARRÊT RAPIDE PHOTOVOLTAÏQUE (PVRSE) N'EXÉCUTE PAS TOUTES LES FONCTIONS D'UN SYSTÈME D'ARRÊT RAPIDE PHOTOVOLTAÏQUE COMPLET (PVRSS). CE PVRSE DOIT ÊTRE INSTALLÉ AVEC D'AUTRES ÉQUIPEMENTS POUR FORMER UN PVRSS COMPLET QUI RÉPOND AUX EXIGENCES DE LA SECTION 690.12 DE NEC (NFPA 70) POUR LES CONDUCTEURS CONTRÔLÉS EN DEHORS DU SYSTÈME. D'AUTRES ÉQUIPEMENTS INSTALLÉS DANS OU SUR CE SYSTÈME PV PEUVENT AFFECTER LE FONCTIONNEMENT DU PVRSS. IL EST DE LA RESPONSABILITÉ DE L'INSTALLATEUR DE S'ASSURER QUE LE SYSTÈME PV TERMINÉ RÉPOND AUX EXIGENCES FONCTIONNELLES D'ARRÊT RAPIDE. CET ÉQUIPEMENT DOIT ÊTRE INSTALLÉ SELON LES INSTRUCTIONS D'INSTALLATION DU FABRICANT.

This Manual

This manual provides instructions for installing and commissioning the following components of a Tigo Rapid Shutdown System for Fire Safety:

- TS4-A-F
- TS4-A-2F
- RSS Transmitter
- RSS Transmitter with Tigo Pure Signal Technology™

Safety

Tigo equipment must be installed and maintained by qualified personnel in accordance with the National Electrical Code and ANSI/NFPA 70 wiring methods. In addition:

- Components must operate within the technical specifications listed in their [datasheets](#). Failure to follow instructions herein may cause equipment damage not covered by the warranty.
- Always wear appropriate PPE and use insulated tools.
- Connectors from different manufacturers cannot be mated with each other.
- This product could expose the user to chemicals known to the State of California to cause cancer. For more information refer to www.P65Warnings.ca.gov.

These safety symbols may appear in the manual:



A hazardous situation which could result in serious injury or loss of life.



A hazardous situation which could result in injury or damage to the product.



An important operational note.

These symbols appear on Tigo enclosures:



Risk of electrical shock.



Risk of burns.



Tigo Fire Safety series equipment.



Check the operating instructions.



Caution, the inverter may retain high voltage for up to five minutes after disconnection.



Avoid tampering.



Observe caution.



Grounding connection.

PV Conductor Layout and RSS Signal Integrity

Tigo RSS transmitters use powerline communications (PLC) over PV conductors to communicate with TS4s. To mitigate interfering crosstalk from other conductors and other electrical interference, Tigo developed Pure Signal Technology™ (PST).



Tigo RSS transmitters must be installed in systems that conform with Tigo design and installation requirements that minimize crosstalk in PV conductor layouts.

Required Practices

To maintain PLC signal integrity:

- Limit the round-trip (positive-to-negative) length of a PV conductor to 300m/985ft. Runs up to 500m/1640ft may be possible using multiple cores – contact Tigo [Sales Engineering](#).
- Do not cross current-carrying conductors over any PV conductor used in the RSS.
- Run all conductors that use the same transmitter together in one conduit.



- Maintain at least 20cm/8in between conductors that use different transmitters.
- Keep individual +/- conductors either twisted or adjacent one another except when the negative conductor passes through a core.



- Use separate cable trays for conductors using different transmitters with a minimum 20cm/8in spacing between trays. Open cable trays do not protect signals from crosstalk.
- If using up to 10 transmitters with PST to create a pure signal group, combine all the group's conductors in one conduit.
- If using multiple pure signal groups (>10 transmitters or with multiple inverters using transmitters), maintain at least 20cm/8in between groups.

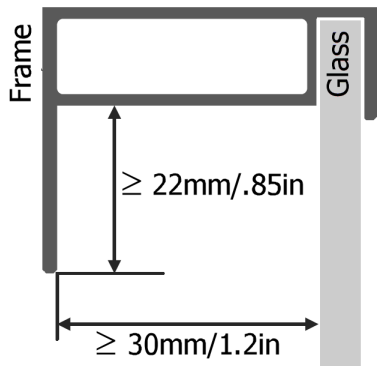
Install TS4s

TS4-A-F and TS4-A-2F devices have identical functionality, however the TS4-A-F controls one module while TS4-A-2F controls two modules. Each module in a string must have its own TS4-A-F or share a TS4-A-2F with another module. You may connect a TS4-A-2F to a single module if needed.

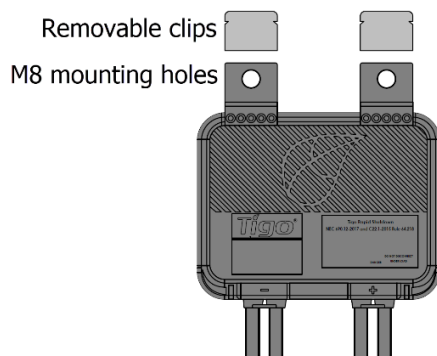


- Do not install TS4s if they have been physically damaged or with damaged or substandard wiring or connectors.
- Do not connect or disconnect TS4s under load.
- Do not apply an external voltage source to a module/string equipped with TS4s.

TS4s mount directly onto module frames with spring clips where the frame edge extends $\geq 22\text{mm}/.85\text{in}$ and the clearance between the frame edge and the module glass is $\geq 30\text{mm}/1.2\text{in}$. Frame thickness should be $1.8\text{mm}/.07\text{in} - 2.2\text{mm}/.085\text{in}$.

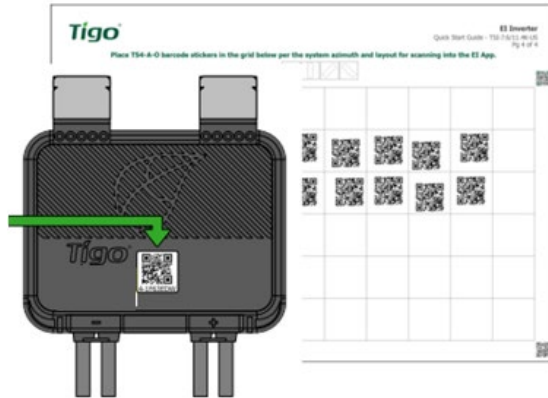


If using frameless modules, remove the clips and bolt the TS4 directly to the PV rail with M8 bolts and torque to 10.2Nm. No additional grounding is required.



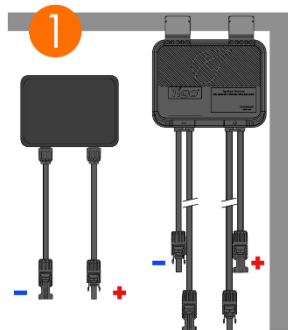
To install a TS4-A-F:

1. Remove the QR/barcode sticker and affix it to a suitable map of the solar array.

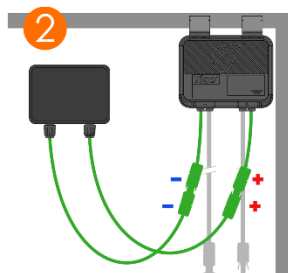


Try to match the physical layout of modules in the array.

2. Attach the TS4 to the top of the PV module frame with the cable glands facing down. The TS4 and its cables, cable glands, and connectors must not touch a roof surface.

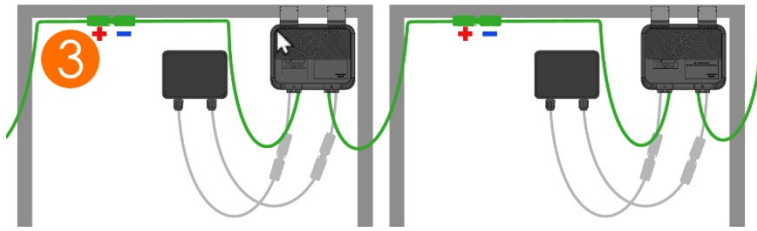


3. Connect the shorter TS4 input leads to the PV modules.



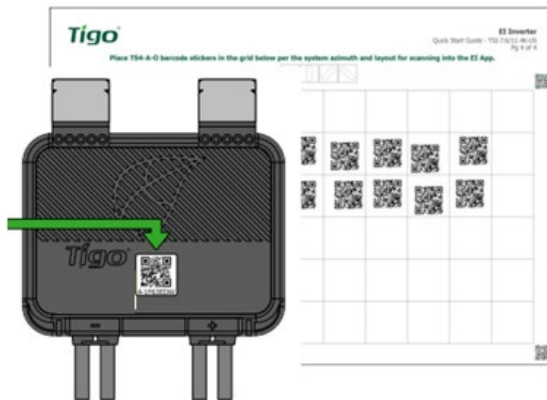
You must connect the shorter TS4 input leads to the PV modules before connecting to neighboring TS4s. Failure to do so can damage the TS4 units.

4. Connect the longer set of TS4 output cables to the neighboring TS4 to create a string.



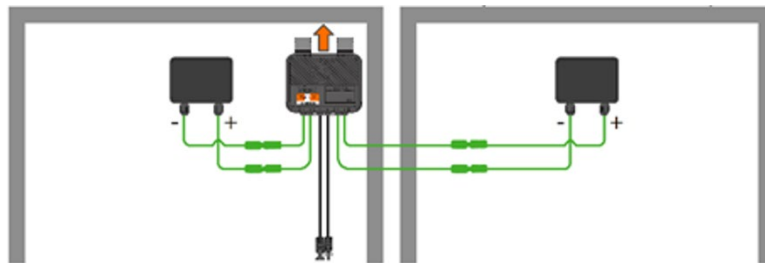
To install a TS4-A-2F:

1. Remove the QR/barcode sticker and affix it to a suitable map of the solar array.



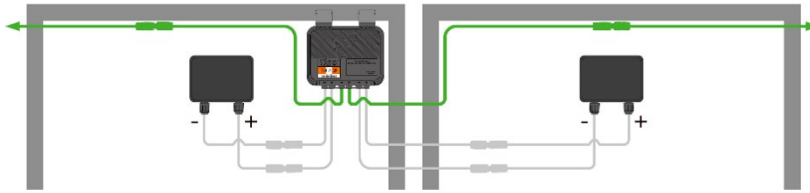
Try to match the physical layout of modules in the array.

2. Attach a TS4-A-2F to the top of a PV module frame with the cable glands facing down. The TS4 and its cables, cable glands, and connectors must not touch a roof surface.
3. Connect the shorter TS4 input leads to two PV modules.

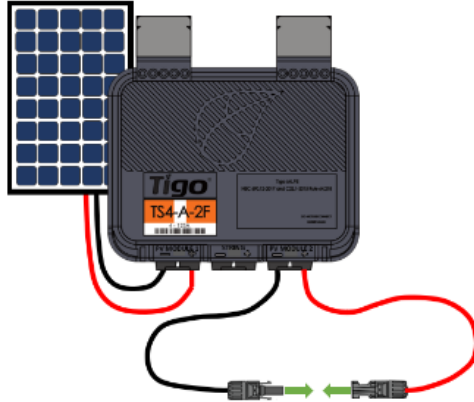


You must connect the shorter TS4 input leads to the PV modules first. Failure to do so can damage the TS4 unit.

4. Connect the longer set of TS4 output cables to the next TS4-A-2F in the string.



5. If connecting a TS4-A-2F to a single PV module, connect the unused input cables together.



To disconnect a TS4:

- Activate rapid shutdown by turning off the RSS transmitter and inverter or by using the designated PV rapid shutdown system (PVRSS) initiator.
- Wait 30 seconds after a rapid shutdown activation before disconnecting DC cables.
- Disconnect individual TS4 output cables from a string before disconnecting the TS4 input cables from the module junction box.



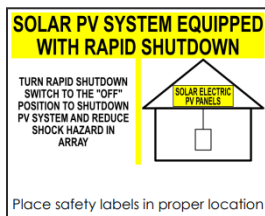
Always assume that TS4 units are in an ON state.

Install a Transmitter Enclosure

Install a transmitter on the same AC branch circuit as the inverter. Additionally:

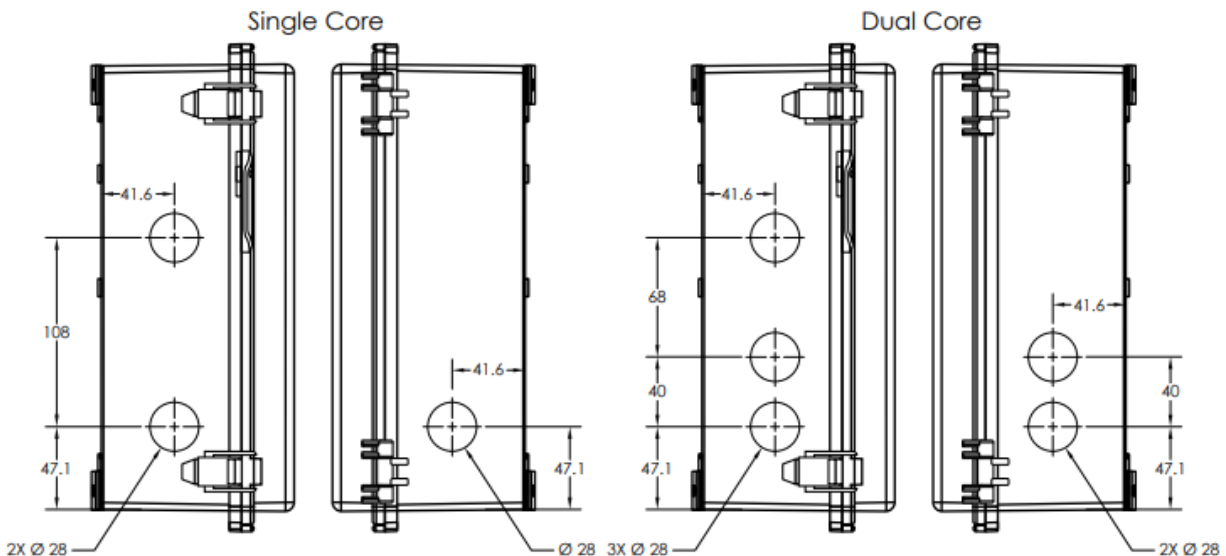
- Transmitters are NEMA 1 (indoor) rated and require an enclosure with a 35mm DIN rail and 12V_{DC} power supply. Tigo kits include NEMA 4-rated enclosures, transmitters, and power supplies.
- Multiple-transmitter systems require a signal connection between transmitters.

After installing TS4s and transmitters, place the RSS label within 1m/3ft of the Tigo E-Stop switch or other approved RSS initiator (Refer to 690.12(C)).

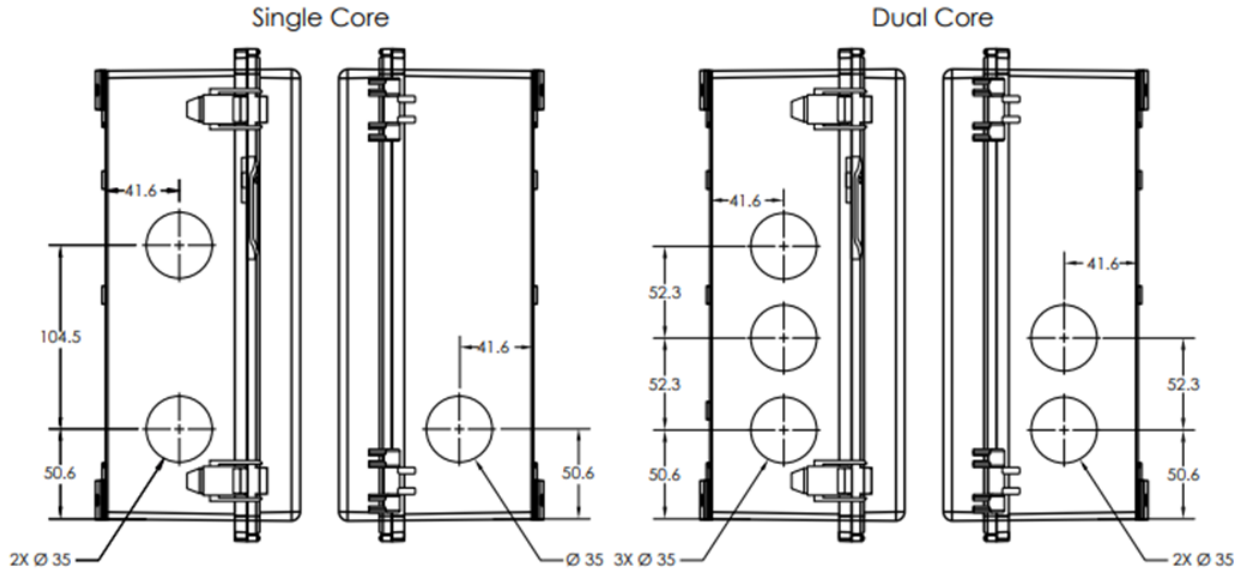


If installing a Tigo enclosure, use the guide below for locating conduit openings.

For 21mm/3/4in conduit:



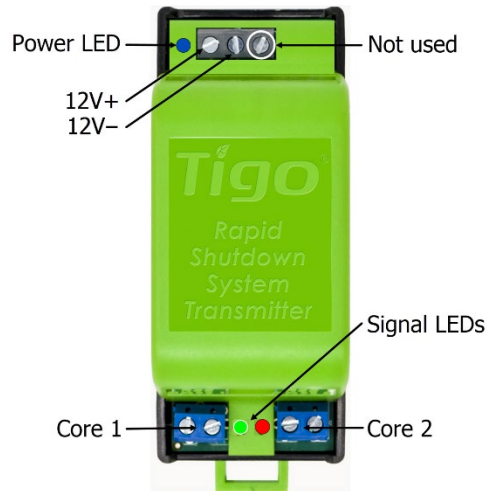
For 27mm/1in conduit:



Install Transmitters

RSS Transmitter without PST

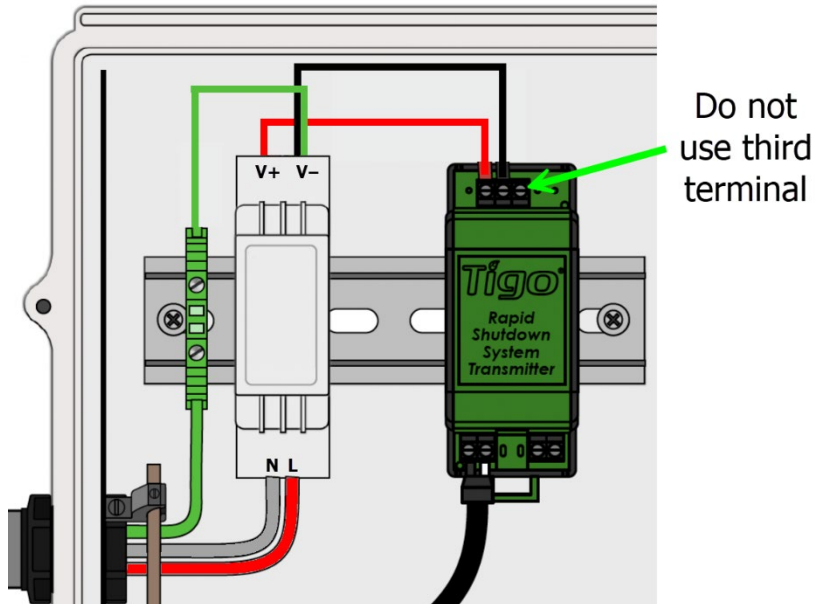
Legacy RSS transmitter LEDs and terminals include:



To install a legacy, pre-PST RSS transmitter, you will:

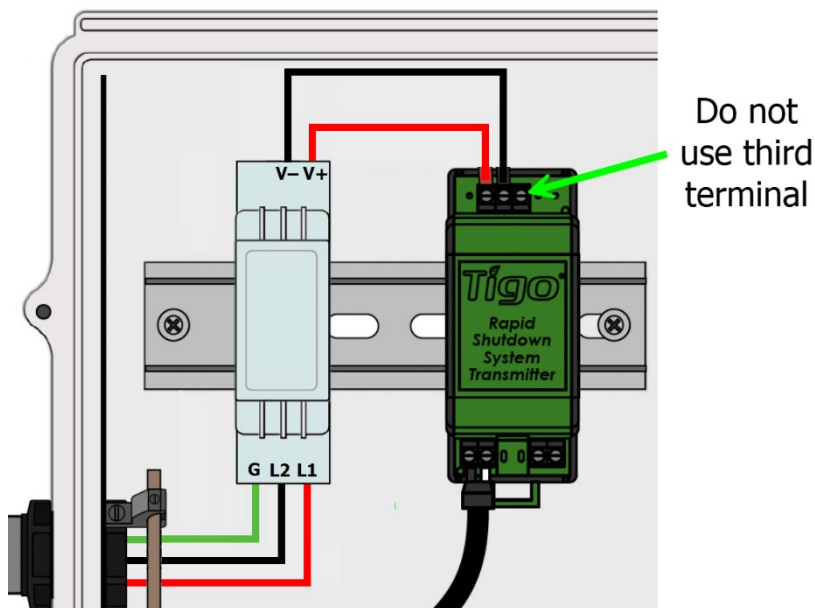
1. Turn off all AC power sources.
2. Connect the power supply and ground terminal to the transmitter on the enclosure's DIN rail.
3. Connect a core to the transmitter.
4. Route negative PV conductors through the core.

To connect a standard 100-240V_{AC} power supply to a transmitter:



- Connect the supplied DIN rail ground to the power supply V- output terminal.
- Connect neutral and L1 AC conductors as shown.
- Use ferruled leads to connect 12V output to the transmitter terminals as shown.

To connect a commercial 180-550VAC power supply to a transmitter:



- Connect ground, L2, and L1 AC conductors as shown. The power supply cover is metal and grounds the DIN rail.
- Use ferruled leads to connect 12V output to the transmitter terminals as shown.

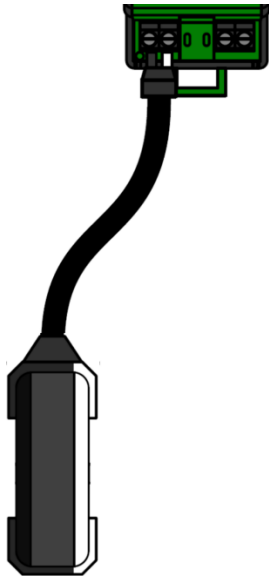


Ensure power supplies output 12V_{DC}. Do not use a 24V_{DC} power supply designed for the Tigo CCA.

Tigo power supplies meet ride-through interconnection requirements such as California's Electric Rule 21.

To connect a core to the transmitter:

1. Insert the core wire with a white ferrule into the transmitter white *Core 1* input. Torque to 0.5Nm.



2. Insert the core wire with the black ferrule into the black terminal. Torque to 0.5Nm.

A single core must be connected to the left input. The right input is only powered when the left input is connected to a core.

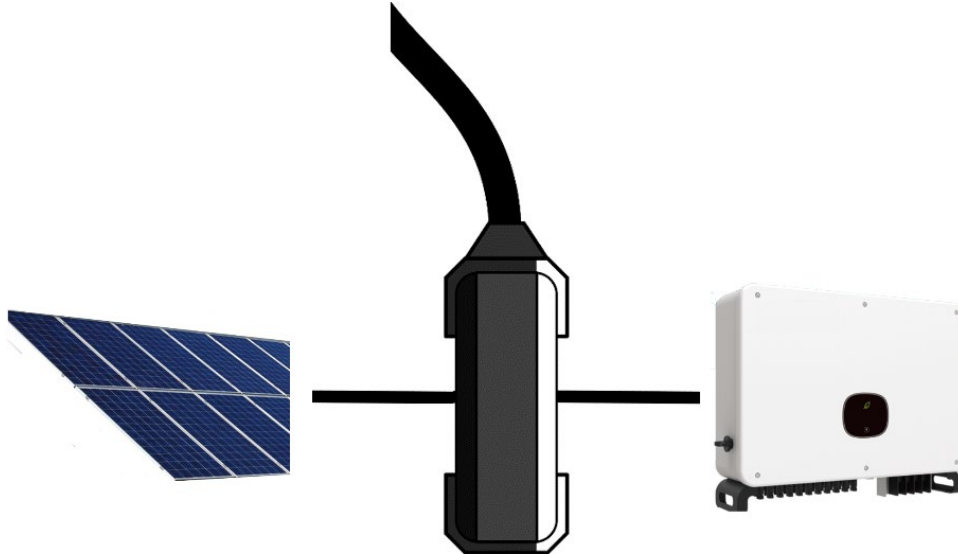
3. Repeat the procedure at the *Core 2* input for two-core applications.



Do not modify or extend the wires between a transmitter and its core.

To route PV conductors:

1. Route PV conductors into the enclosure.
2. Pass up to ten negative conductors through a transmitter core. The black side of the core must face the PV array.



3. Route PV conductors out to the inverter.

RSS Transmitter with PST

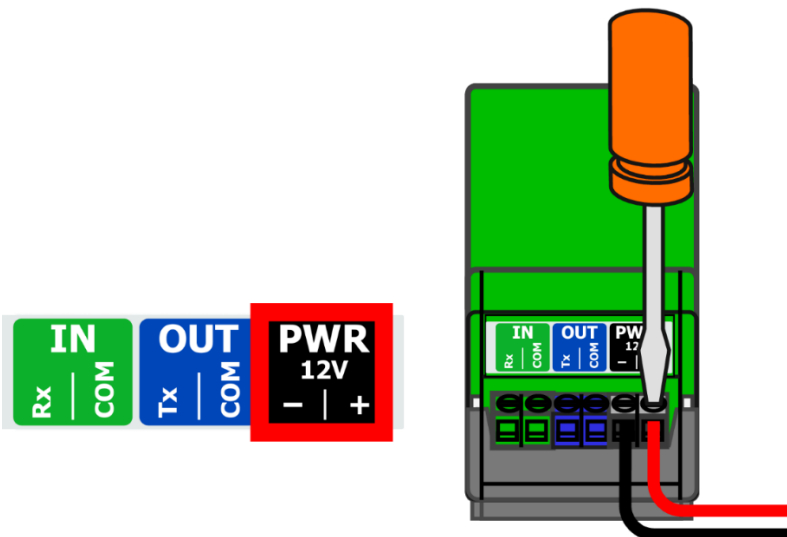
RSS transmitters with PST LEDs and connections include:



1. 12V +
2. 12V -
3. COM ground
4. Transmit signal (Tx)
5. COM ground
6. Receive signal (Rx)
7. Core 1 input
8. Signal LEDs (green/red)
9. Core 2 input

To install up to 10 transmitters with PST in series, first follow the procedure for installing a transmitter without PST.

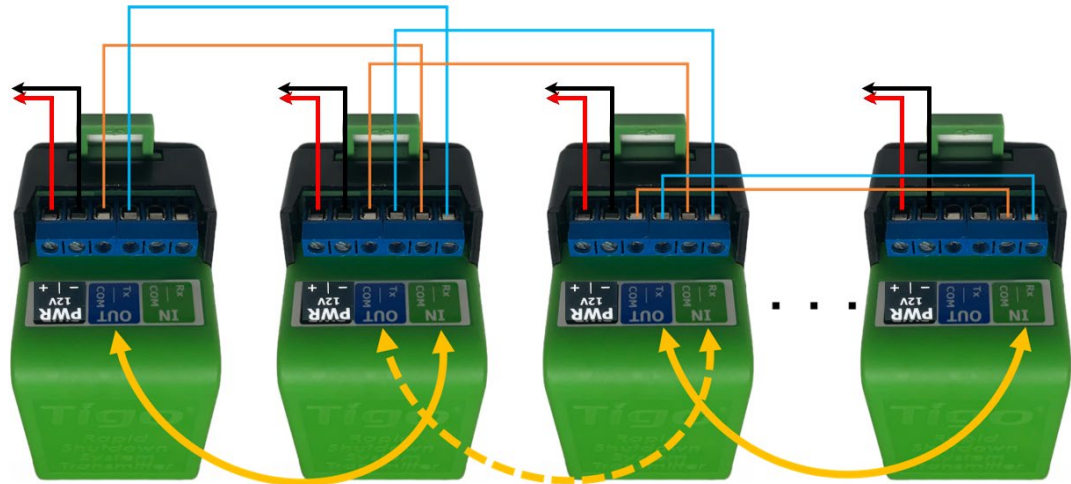
Transmitters connect to 12+ and 12V- leads only. There is no ground terminal and all transmitters require their own power connection:



Connecting power leads improperly will destroy the transmitter.

In addition:

1. Connect signal wiring to all transmitters using 14 – 22 AWG shielded twisted pair. Torque to 0.4Nm.



Maximum signal wiring length is 30m/100ft.

The first transmitter is the "leader." Subsequent transmitters are "followers."

2. As shown above, ensure power is connected to each transmitter from one or more power supplies.

Each transmitter requires 12V_{DC} ($\pm 2\%$) 1A current and fusing is recommended.

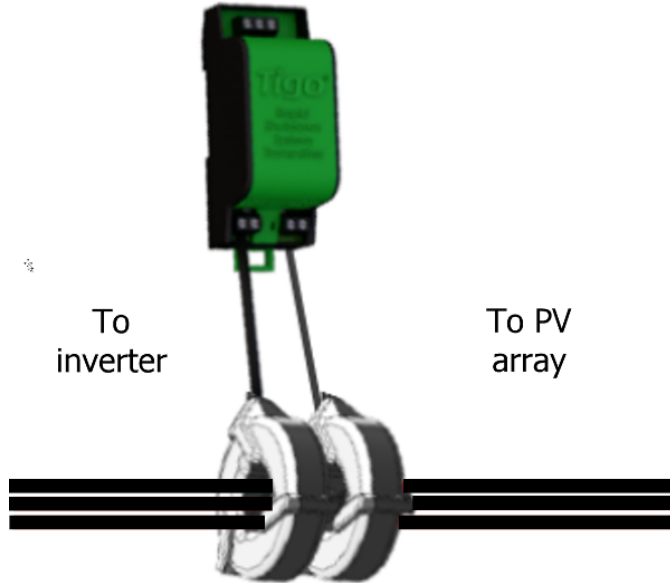
Status LEDs

If connected correctly:

- The red signal LED in the leader (first transmitter in the series) emits a continuous red.
- The green signal LEDs in all transmitters blink simultaneously.

Transmitters on Long Strings

For a single transmitter and home run strings between 300m/1000ft and 500m/1650ft, two cores may be used in series to amplify the transmitter signal. Contact [Tigo Sales Engineering](mailto:sales@tigoenergy.com) for more information.



Testing

Before powering-on the solution, first ensure all of the following conditions are met:

- ✓ All PV modules are connected to a TS4-A-F/2F.
- ✓ The black sides of all RSS cores face the PV array.
- ✓ Only negative conductors (≤ 10) run through a single RSS core.
- ✓ PV conductor home run length is $\leq 300\text{m}/985\text{ft}$ with one core and $\leq 500\text{m}/1650\text{ft}$ with two cores.
- ✓ Multiple transmitters with PST are wired from IN to OUT on each transmitter and connections are secure.
- ✓ The power supply is wired correctly.
- ✓ All conduit attachments are secure.
- ✓ Cable ties are secured evenly and have no sharp edges and the enclosure and installation area are clean and accessible.
- ✓ String voltage is $\leq 0.6\text{V} \times$ the number of TS4-A-F/2Fs in the string.
- ✓ The PVRSS label is within 3ft of the Tigo E-Stop switch or other initiation device.
- ✓ All transmitters are connected to the same AC branch circuit as the inverter.

To power-on the system, turn on the breaker supplying power to the transmitter. Using a multimeter, confirm all strings carry full voltage at their inverter terminals.

To test RSS functionality:

1. Verify the RSS transmitter control power supply is on the same AC branch circuit as its inverter.
2. Verify the test string is operating normally and that all modules are generating expected voltage.

The Tigo [RSS Signal Transmitter](#) verifies that all TS4s are receiving a keep-alive signal from their respective RSS transmitters.

3. Turn off power to the transmitter or its inverter or activate the string's RSS initiator.

If the string voltage drops to less than .6V times the number of TS4s in the string, RSS is functioning.



Wait 60 seconds after rapid shutdown activation before disconnecting DC cables.

Troubleshooting

Troubleshooting must be performed by qualified personnel.

- When powering off the transmitter, wait one minute before disconnecting any TS4 cables from the string.
- After disconnecting any TS4 output cables from the string, wait at least one minute before reconnecting the cables.
- Do not use insulation-resistance or I-V curve test equipment with a TS4-A-F/2F.

RSS Signal Detector

Tigo's RSS Signal Detector is a functionality testing device that senses the PLC keep-alive signal at the TS4s.

To operate the detector:

1. Turn on the detector.
2. Place the detector sensor area within 5cm/2" of a TS4. When the keep-alive signal is detected, the LED will change from blue to yellow and you will hear an audible alert.
3. If the signal is not detected, the LED will remain blue and there will be no sound. Contact Tigo [technical support](#).

Possible Issues

String Has No V_{DC}

A TS4 should pass 0.6V when the string is not connected to an active transmitter. A string output voltage of zero indicates an open circuit.

- Verify all strings are disconnected from the inverter and in free air before measuring individual string voltage.
- Perform a visual inspection of the modules, TS4 units, wiring, and connectors. Verify all equipment is connected properly.
- Apply standard electrical tests such as testing insulation resistance with a mega ohmmeter to localize the potential open circuit condition.
- If the TS4 is suspected, see the next section.

TS4 Has No V_{DC}

A TS4-A-F/2F should pass 0.6V when connected to a module (or two) and the string is not connected to an active transmitter. A TS4 output voltage of 0V can indicate a wiring, TS4, or module issue.

1. Shut down the system, wait 60 seconds, and disconnect the longer output leads (string) of the unit.
 - Measure the voltage of the disconnected TS4. If the reading is 0.6V, the unit is working correctly.
 - If the output is still 0V, proceed to step 2.
2. If there are no visible issues with the unit, rewire it and test the TS4 output voltage. Then test the module output voltage.
 - If the TS4 output voltage is 0.6V when connected to the module, the issue has been resolved.
 - If the TS4 output voltage is 0V but the module voltage is between 16V and V_{OC} , the issue may be the TS4. Proceed to step 3.
3. Swap the suspected TS4 with a known functioning unit. Wait 60 seconds after shutdown before disconnecting output leads.
 - If the functional unit's output is 0V, there is an issue with the module output.
 - If the functional unit's output is .6V when connected to the module, then the first TS4 has an issue. Contact Tigo [technical support](#).

TS4 with Active Transmitter Not Passing Full Voltage

The transmitter is turned on and appears active but the TS4 is not passing full module output voltage to the string. This is most often caused by the transmitter's signal being interrupted. The interruption may be related to improper installation of the transmitter, transmitter failure, or improper string/inverter wiring.

1. Confirm the following:
 - The TS4 and inverter are listed as compatible on the [tigoenergy.com Compatibility](http://tigoenergy.com/Compatibility) page.
 - No more than 10 strings run through the core.
 - No more than 30 modules are connected per string.
 - A maximum current of 150A passes through a single core.
 - The core is properly connected to the bottom terminals of the transmitter.
 - String lengths are $\leq 300\text{m}/1000\text{ft}$ from the positive to the negative home run at the inverter.

- Only negative PV conductors run through the core.
 - The Tigo RSS Signal Detector indicates the transmitter signal is present at each TS4.
2. Verify the transmitter is working correctly.
 - Check that the transmitter signal LEDs are powered. If not, check wiring to and from the transmitter power supply.
 3. Confirm that strings have been properly wired from the core to the inverter:
 - Remove all strings from the core. Replace one string and turn on the transmitter to verify proper operation.
 - Repeat the process for each string.
 - If the issue persists, contact Tigo [technical support](#).

Reduced Performance

The performance of the array shows a visible reduction in production within a short period of time that is not related to changing environmental factors such as weather.

1. Prior to troubleshooting system components, rule out external factors such as dirt, debris, and other foreign objects.

2. Check the string voltage with an active transmitter at V_{OC} .

If the voltage is less than the module V_{OC} multiplied by the number of modules, ensure the transmitter is correctly installed and the PLC keep-alive signal is present. Visually inspect the modules, TS4s, and wiring for signs of damage.

3. Check the string voltage without an active transmitter. If the voltage is less than 0.6V multiplied by the number of TS4s, there may be a connection issue with one or more TS4s. Locate the units with no voltage.

Follow the TS4 troubleshooting steps listed earlier in this section. Begin with one string and turn on the transmitter. Repeat with other strings.

4. If the TS4 provides the correct voltages with and without an active transmitter, the performance issue cannot be attributed to Tigo components.

Transmitter with PST Status LED Indicators

Observation	Cause	Corrective Actions
Green LEDs not blinking in unison on all transmitters.	Transmitter interconnection wiring not installed, reversed, or disconnected.	<p>Check for wiring inconsistencies with product documentation.</p> <p>Check the torque on interconnection wiring terminals.</p>
A follower green LED is not blinking but all other followers blink green in unison.	<p>Incorrect wiring to transmitters.</p> <p>Possible malfunction with the follower that is not blinking.</p> <p>Single-core install: the core is incorrectly connected to transmitter terminals.</p> <p>Dual-core install: one core may not be facing the right direction (white side towards inverter).</p>	<p>Check interconnection wiring. Ensure the Com and Tx wires connect to the Com and Rx terminals on the next transmitter in the chain.</p> <p>Ensure the black and white ends of the core leads are in the proper transmitter terminals.</p> <p>Ensure both cores have the white side facing towards the inverter. If not, disconnect the leads and reposition.</p>
No LEDs on any transmitters.	No power to devices.	<p>Check power supplies to transmitters.</p> <p>Check power wiring to each transmitter.</p>
LEDs on transmitters look correct/normal, yet all strings are not coming up to full voltage and a safety voltage of 0.6V per TS4 is observed.	<p>Cores are not properly oriented (one or more are reversed).</p> <p>Core leads are not in the correct transmitter terminals.</p> <p>Core cable connector(s) are loose or broken.</p>	<p>Test for presence of a transmitter signal using the RSS Signal Detector.</p> <p>Verify and correct core alignment: ensure white side of core faces towards the inverter.</p> <p>Ensure core leads to transmitter terminals are in the correct position.</p> <p>Repair or replace loose or broken transmitter core leads.</p>

Transmitter without PST Operation Check

When AC power is connected to the transmitter power supply, the transmitter should be turned on and the PLC keep-alive signal should be activated. The TS4s will then provide full voltage to their string. When powered up, the transmitter power LED is blue and the signal LED is green.



Verify that the transmitter is working correctly:

LED States	Condition	Actions
Power LED continuous Signal LEDs flashing	Transmitter is on and generating a PLC keep-alive signal.	None
Power LED red	Error in power connection.	Ensure top terminals are wired 12V+ followed by 12- and that the third terminal is not used.
Power LED off Signal LEDs off	Transmitter is off or not powered.	Check power to and from power supply and connections.
Power LED continuous Signal LEDs off	Transmitter is not functioning.	Power cycle the unit. If still off, contact Tigo technical support .

Verify the transmitter is connected to the power supply and that core(s) are installed with correct polarity with the black side facing the PV array.

Use the Tigo RSS Signal Detector to verify that the PLC keep-alive signal from the transmitter is present along the string of TS4s.

- If a PLC signal cannot be detected along the string, there is likely an open circuit. Review wiring connections and check for string-level issues.
- If the transmitter LEDs indicate proper functioning but the signal is not received by any TS4s, contact Tigo [technical support](#).

Specifications

Download comprehensive specifications for all Tigo products from the Tigoenergy.com [Downloads](http://www.tigoenergy.com/downloads) (www.tigoenergy.com/downloads) page.

Warranty

Download comprehensive warranty information from the Tigoenergy.com [Downloads](http://www.tigoenergy.com/downloads) (www.tigoenergy.com/downloads) page.

Support

If you have any questions about installing the Tigo RSS for Fire Safety solution, please contact a Tigo sales engineering team:

Australia	+61 413 251-081
China	+86 512 6587-4600
Europe WhatsApp (English, Italian, Spanish)	+39 342 67 92 285
Japan	+81 3 4567-6199
Middle East WhatsApp (English, Hebrew)	+972 50 687-8618
North America	+1 480 402-0802 ext. 4
South America	+55 21-991045050
Taiwan	+866 919 743-749

If an issue persists after following the troubleshooting steps listed in this manual, visit the [Tigo Help Center](#). If you open a support ticket, include the following information:

- A summary of tests you've performed
- System name or ID, owner, address, and installer
- Serial number(s) of the affected MLPE/transmitters.
- Number of strings per inverter MPPT
- Number of modules per string
- Length of each string from the positive to the negative home run at the inverter
- If available, inverter production, current, and voltage graphs

If a TS4 or transmitter appears damaged, please take pictures of the unit showing damage and a legible serial number.