TESLA

SOLAR ROOF

EMERGENCY RESPONSE GUIDE

This guide is intended only for use by trained and certified rescuers and first responders. It assumes that readers have a comprehensive understanding of how safety systems work and have completed the appropriate training and certification required to safely handle rescue situations. Therefore, this guide provides only the specific information necessary to help identify a Solar Roof installation, its key components and features. This guide provides an overview of Tesla Solar Roof operation and any safety considerations specific to Tesla Solar Roof.

IMPORTANT SAFETY INSTRUCTIONS

This document contains important safety information and warnings that must be followed when handling Tesla Solar Roof in an emergency situation.

WARNING: Regardless of the disabling procedure you use, always follow standard electrical safety procedures, and wear appropriate personal protection equipment to avoid shock hazard.

WARNING: To avoid a shock hazard, do not contact or touch electrically charged, accessible live parts.

WARNING: Tesla Solar Roof does not include any structural components (for example battens or rails) that support bodyweight if the underlying roof structure is compromised. **ALWAYS** confirm roof integrity before rooftop operations. Failure to follow this procedure can result in serious injury or death.

WARNING: Tesla Solar Roof cannot be sounded through the tiles. **ALWAYS** remove Solar Roof tiles before sounding. Failure to follow this procedure can result in serious injury or death.

WARNING: Solar Roof tiles are always slippery especially when soiled or wet. **ALWAYS** use appropriate fall protection equipment when working from heights. Failure to follow this instruction can lead to serious injury or death.

WARNING: **ALWAYS** wear suitable personal protection equipment to prevent the risk of electrical hazards when interacting with any Solar Roof components. Failure to do so can result in serious injury or death.

WARNING: Do not walk or stand on gutters, rakes, hips, or ridges. Doing so is a fall hazard that can lead to serious injury or death.

CONTACT INFORMATION

For more information, email **FIRSTRESPONDERS**@tesla.com.

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OVERVIEW OF TESLA SOLAR ROOF

Tesla Solar Roof combines roofing and photovoltaics (PV) into one product. It is different from other products that integrate photovoltaic roofing with existing roofing because a Solar Roof installation replaces all existing roofing with materials that allow most of the roof to produce electricity.

The roofing components are tested to standards specific to roofing, including fire, wind and impact resistance. Likewise, the PV and electrical components are tested to applicable standards, including fire, electrical and mechanical standards. A complete list of certifications for Solar Roof is available on request.

DIFFERENCES FROM TRADITIONAL PV

- From a distance, the roofing and power-producing modules look very similar
- Modules are much lower voltage than traditional standard-format PV modules, less than 14 V_{DC}
- Short strings of modules are combined with a UL-listed cable called a Diode Harness
- The metal frame found on traditional solar panels is removed eliminating a potential fault path

SIMILARITIES TO TRADITIONAL PV

- Modules produce DC electricity, just as traditional PV modules do
- The panels are made from tempered glass
- Like traditional PV systems, Solar Roof uses silicon PV cells
- Solar Roof modules use junction boxes, PV wire and listed connectors
- Standard string inverters are used

PRE-PLANNING - KNOW YOUR RESPONSE AREA

As with traditional PV systems, emergency response agencies may choose to work with local permitting offices to identify the locations of PV system installations in your response area. If special operations are deemed necessary for Tesla Solar Roof by your emergency response agency, it is recommended that installation locations be added to your CAD (Computer Aided Design) database or forwarded to your dispatch provider.

HOW TO IDENTIFY SOLAR ROOF TILES

Tesla Solar Roof has been designed to improve the aesthetics of a customer's home. Solar Roof tiles, made of tempered glass and fiberglass, are easily distinguishable from conventional roofing materials (like composition shingle, concrete tile, clay tile, slate, metal, etc.) as well as other building-integrated solar products. A visual inspection will show the following tell-tale signs that a roof is Solar Roof:

FORMAL IDENTIFIERS:

Tesla Solar Roof contains many of the same formal identifiers of traditional PV systems such as:

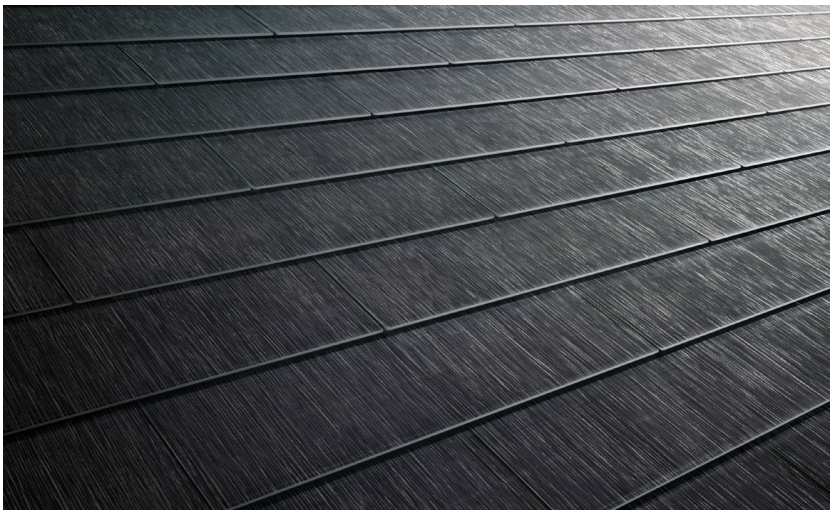
- Placards and signage, typically white lettering on red background
- Inverters and additional electronics
  (e.g., Rapid Shutdown initiation devices and Energy Storage Systems (ESS))
- External disconnects where required by the local AHJ or Utility

INFORMAL IDENTIFIERS:

- The tile is glossy, reflective & mostly smooth in appearance
- Solar Roof tiles are reflective during daylight under all lighting conditions, and at night will reflect a flashlight or other artificial light unlike asphalt composition shingle
- Solar Roof tiles are generally black or dark gray in color
- Solar Roof tiles cover the ENTIRE roof

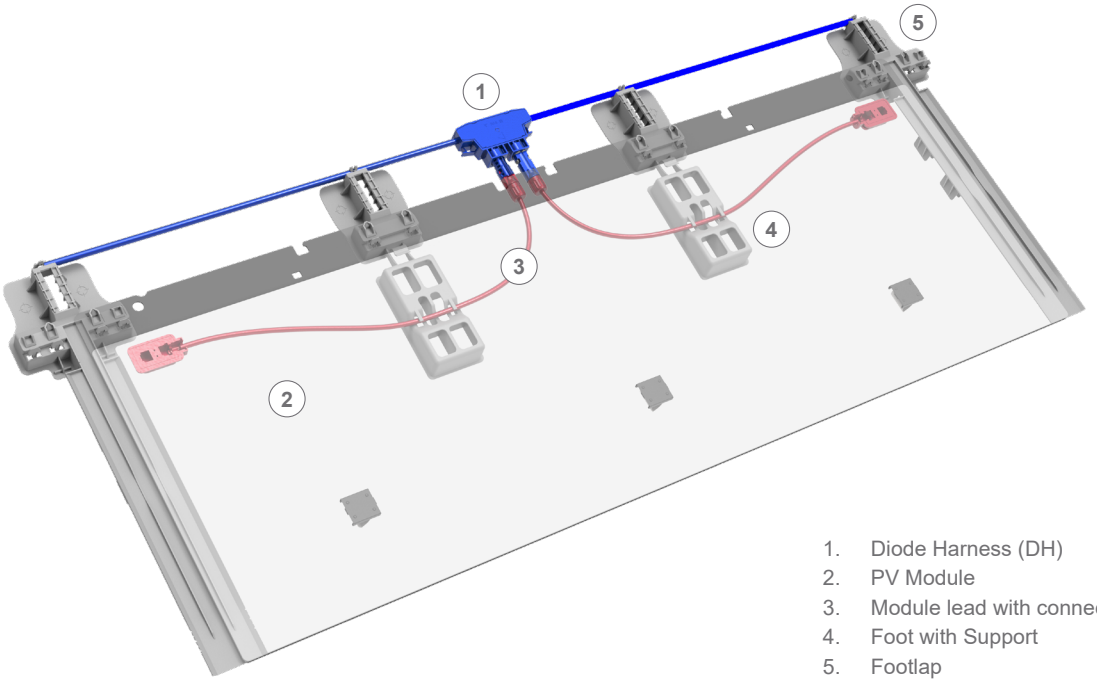
WARNING: There is little to no visible difference between Solar Roof PV Tiles (power-producing) and Solar Roof Roofing Tiles (non-power-producing). Always assume the entire roof is Solar Roof PV Tiles and take the following precautions to avoid serious injury or death:

- **ALWAYS** wear appropriate Personal Protection Equipment (PPE) to prevent the risk of electrical hazards; and
- **ALWAYS** use appropriate fall protection equipment and techniques to prevent fall hazards.

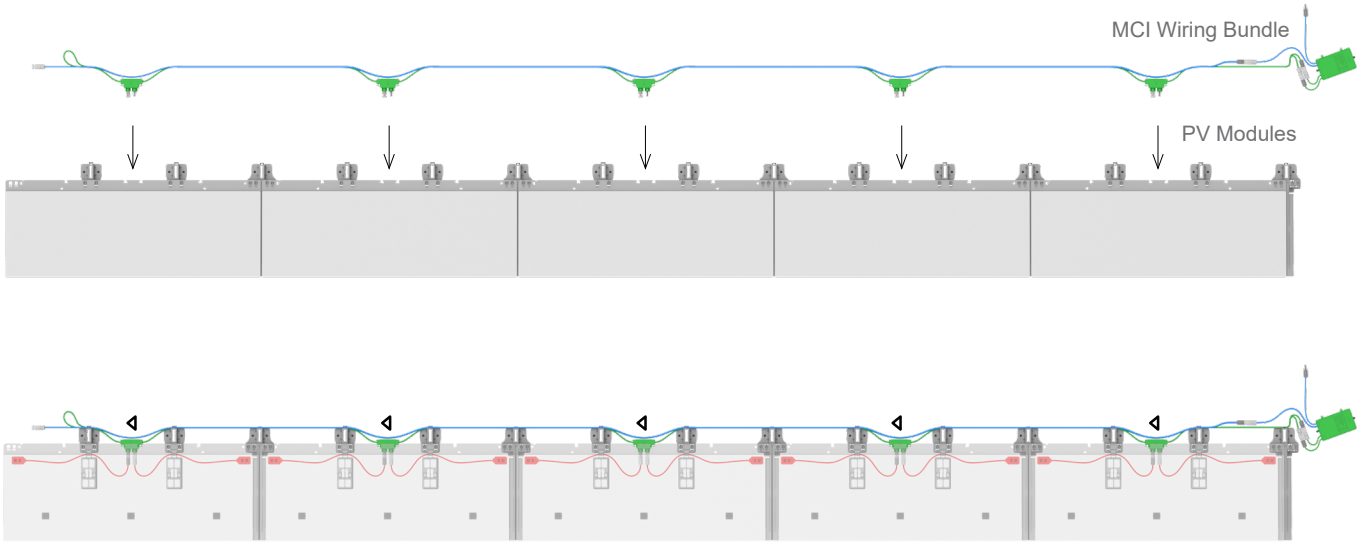


HOW TESLA SOLAR ROOF WORKS

A Solar Roof functions in fundamentally the same way as traditional roof-mounted PV systems. Sunlight is converted to DC electricity at each individual module. Individual modules are connected in series using diode harnesses to form a complete PV “string.” One or more strings connect in parallel at a typical string inverter to convert power to AC.



1. Diode Harness (DH)
2. PV Module
3. Module lead with connector
4. Foot with Support
5. Footlap



Note: Color differences in the illustration above do not reflect actual product.
Color and appearance of Roofing Modules and PV Modules will be nearly identical.

ELECTRICAL ARCHITECTURE

Each Solar Roof module produces approximately 14 V_{DC} at maximum power output. Array current is limited to approximately 6 A_{DC}.

Power originates at each modules and is collected by the Diode Harness.

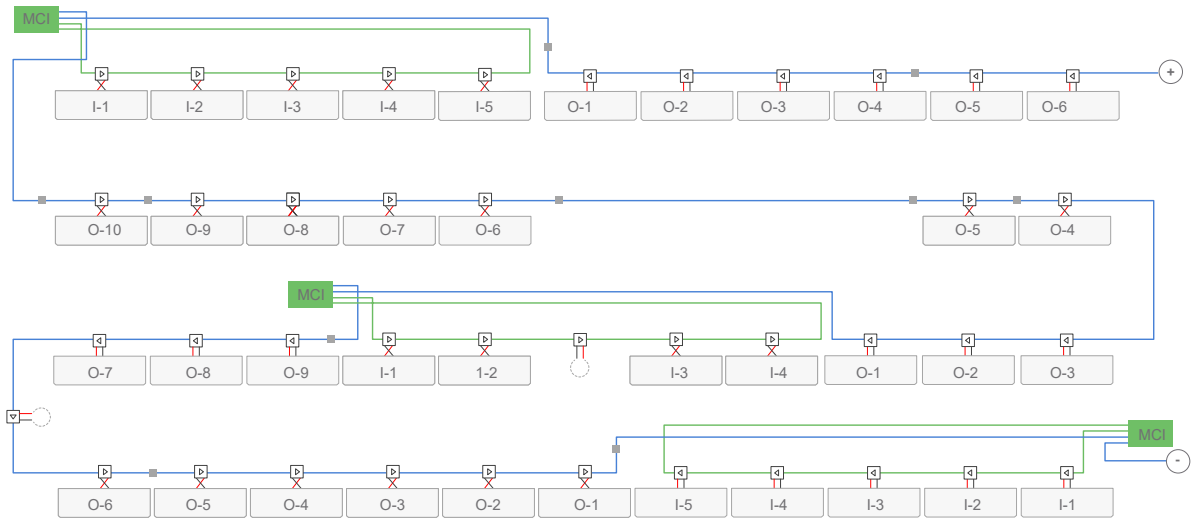
Voltage in the Diode Harness is limited to a maximum of 600 V_{DC} between conductors under all conditions. Voltage potential between each conductor and earth ground is 0 V_{DC} (nominal) under normal operating conditions.

MODEL #SR60T1 14-CELL MODULE

Irradiance (W/m^2)	Temp. (Celsius)	Voc (V)	Vmp (V)	Isc (A)	Imp (A)	Pmax (W)
1000	25	13.34	10.99	5.65	5.32	58.47

These electrical characteristics are within ± 5% of the indicated values of Isc, Voc, and Pmax under standard test conditions (irradiance of 1000 W/m^2, AM 1.5 spectrum, and a cell temperature of 25 °C or 77 °F).

Example PV Array with 3 MCI Units



IDENTIFICATION OF HAZARDS

STRUCTURAL HAZARDS

A complete Tesla Solar Roof assembly weighs less than 4 PSF. These figures include all elements above the roof sheathing, including underlayment and roof covering components. This is comparable to two (2) layers of asphalt composition shingle, and is considerably lighter than concrete or clay tile.

WARNING: Always confirm roof integrity before rooftop operations. Roof integrity cannot be confirmed by visual cues alone. Although a Solar Roof system can support live loads in accordance with local and national codes, it is installed directly onto the existing roof's structure. Solar Roof tiles must be removed prior to sounding. Solar Roof does not include any structural components (for example battens or rails) that can support bodyweight if the underlying roof structure is compromised.

PHYSICAL HAZARDS

Tesla Solar Roof is primarily composed of tempered glass and will break under extreme impact or pressure. Tempered glass will break into small, blunt pieces. PV Modules also contain a power-producing cell and laminate which may hold the broken fragments together much like an automotive windshield.

Metal flashings are used at edge conditions to seal the Solar Roof system (rakes, valleys, obstructions like chimneys/ vents/skylights, etc.). Cut resistant gloves are recommended when handling metal flashings.

WARNING: Solar Roof Roof tiles and underlayment are slippery, especially when weather, such as rain, snow, or ice, is a factor. There is very little slip resistance, especially as the pitch of the roof increases. If rooftop access is deemed necessary, operating on roof ladders or from an aerial platform is always recommended.

WARNING: When Solar Roof tiles are physically damaged, or when tiles have been partially removed, the underlying supports and wiring may pose a tripping hazard.

THE ELECTRICAL SYSTEM *SHOCK RISK ASSESSMENT*

WARNING: Electrical hazards may be present when physical damage not specifically addressed by UL 1741 Rapid Shutdown functionality has occurred, such as:

- Direct exposure of components to fire
- Direct exposure of components to the high-pressure hose spray
- Major systemic physical damage such as roof collapse

WARNING: Do not touch exposed or damaged components without proper Firefighter Personal Protection Equipment in serviceable condition. Failure to do so can lead to serious injury or death.

Select PPE in compliance with article 130.2 of NFPA 70E, Standard for Electrical Safety in the Workplace, and 29 CFR 1910 (OSHA) as adopted by reference in section 7.1.1.2 of NFPA 1500, Standard on Fire Department Occupational Safety, Health, and Wellness Program.

The majority of the array wiring's maximum voltage potential is less than 20 V_{DC}, which is considered an "electrically safe work condition" in accordance with NFPA 70E. No electrical specific PPE is required for this wiring.

THE ELECTRICAL SYSTEM *RAPID SHUTDOWN*

All Tesla Solar Roof installations are compliant with system level PV Rapid Shutdown Array requirements to UL QIJR and to Article 690.12 of the National Electric Code. Rapid Shutdown components are certified to UL 1741.

The Mid-Circuit Interrupter functions as a Rapid Shutdown Device and is installed to be within in compliance with NEC 2017 and NEC 2020 where conductors are within 1' of the PV array. When activated this device limits the voltage of conductors leaving the array to no more than 30 V_{DC} between any two conductors, or any conductor and earth ground.

Conductors within the array are limited to no more than 80 V_{DC} between any two conductors, or any conductor and earth ground.

FIREFIGHTING MEASURES

Traditional methods of extinguishment for structure fires may be employed on buildings with Tesla Solar Roof with full structural firefighting PPE including SCBA.

OVERHAUL

Power to the structure should remain shut down during overhaul operations.

ADDITIONAL RESOURCES

Tesla Customer Care 888-765-2489

https://tesla.com/FIRSTRESPONDERS

NFPA 70E, Standard for Electrical Safety in the Workplace

29 CFR 1910 (OSHA)

NFPA 1500, Standard on Fire Department Occupational Safety, Health, and Wellness Program

Visit https://tesla.com/**FIRSTRESPONDERS** to find additional resources

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