

TESLA

SOLAR ROOF

FREQUENTLY ASKED QUESTIONS
FOR BUILDING AND FIRE OFFICIALS



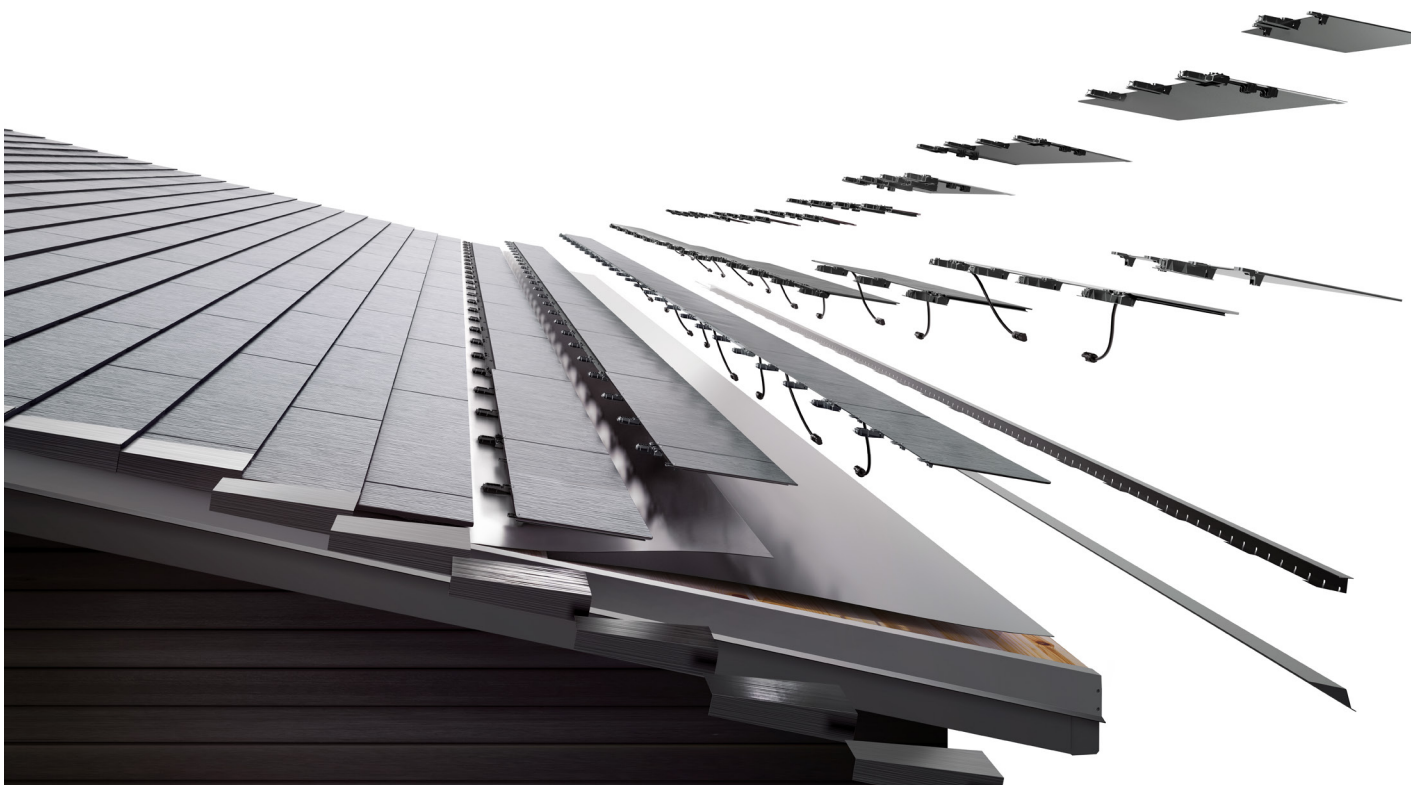
SOLAR ROOF OVERVIEW

Tesla Solar Roof combines roofing and photovoltaics (PV) into one product. As shown in the cover photo, it is different from other products that integrate photovoltaic roofing with existing roofing. Solar Roof replaces all existing roofing with materials that allow the roof to produce electricity.

The roofing components are tested to standards specific to roofing, including fire, wind, rain, and impact resistance. Likewise, the PV and electrical components are tested to applicable standards, including fire, electrical, mechanical, and rapid shutdown.

A complete list of certifications for each part may be found under **System Certifications**. **Certificates of Compliance** may be found at the end of this document.

We would like to answer any questions you have. Please feel free to email codecompliance@tesla.com.



SYSTEM CERTIFICATIONS

Q: TO WHAT STANDARDS HAS SOLAR ROOF BEEN EVALUATED?

A: Because Solar Roof must perform as both a roof covering and a solar array, it has been tested to standards that apply to each. The table under **System Certifications** shows those standards, and where applicable, the rating each component has achieved.

- UL 61730 for PV Modules
- UL 790 for Roof Fire Classification (Class A rated)
- ASTM D3161 for Wind Resistance of Steep Slope Roofing (Class F rated)
- TAS 100 for Wind-driven Rain

COMPONENT	PART #	FIRE CLASSIFICATION	WIND RESISTANCE	WIND DRIVEN RAIN
PV MODULE	SR60T1	UL 790 Class A	ASTM D3161 Class F	TAS 100
ROOFING MODULE	SRNFT1/6, SRNFT1/3, SRNFT1/2, SRNFT2/3, SRNFT5/6, SRNFT1			

COMPONENT	PART #	FIRE CLASSIFICATION	WIND RESISTANCE	WIND DRIVEN RAIN
FOOTLAP	SR-FOOTLAP	UL 790 Class A	ASTM D3161 Class F	TAS 100
FOOT WITH SUPPORT	SR-FOOTSUP			

- UL 9703 for Distributed Generation Wiring Harnesses
- UL 1741 for Interconnection System Equipment with Distributed Energy Resources

COMPONENT	PART #	WIRING HARNESSES
DIODE HARNESS	SRDTH	UL 703
JUMPER	SR-BJMINI, SR-BJ2X, SR-BJ3X, SR-BJ4X	

COMPONENT	PART #	SYSTEM EQUIPMENT
RAPID SHUTDOWN DEVICE	Delta MCI GPI00010110	UL 1741
PV RAPID SHUTDOWN ARRAY	SYSTEM	UL QIJR / UL 1741, NEC Article 690.12
PASS THROUGH BOX	SRPTB-4	UL 1741

Q: TO WHAT BUILDING CODES DOES SOLAR ROOF COMPLY?

A: Solar Roof complies with the applicable sections of IBC, IRC, IFC, NFPA 70 (NEC), and NFPA 1 (FIRE CODE) when installed in accordance with the installation instructions.

PVRSR MODEL | SOLARGLASS ROOF RAPID SHUTDOWN ARRAY

CATEGORY QIJR, REPORT DATE: 2020-05-01

TABLE OF ESSENTIAL ELEMENTS				
Function	Manufacturer	Model No.	Firmware Versions and Checksums	Certification Standard
PVRSE Mid Circuit Interrupter (MCI)	Delta Electronics	GPI00010114 ²	2.1.6	UL 1741 PVRSE
Inverter	Delta Electronics	M4, M5, M6, M8, M10	Sys: 2.2.11 Pwr: 1.4.9 Safety: 1.4.3	UL 1741
PV Module	Tesla	SR60T1	N/A	UL 61730
Diode Harness	Tesla	SRDTH	N/A	UL 9703
PV Wire Jumper(s)	Tesla	SR-BJ2X, SR-BJ3X, SR-BJ4X, SR-BJMini	N/A	UL 9703
Pass-Through Box	Tesla	SRPTB-4	N/A	UL 1741
PVRSR Initiator ¹ (See installation req. below)	Non-Specific	N/A	N/A	N/A

1 Dedicated PV system AC circuit breaker or AC disconnect switch, labeled per NEC 690.12 requirements.

2 Applies to variations of this part number, e.g. suffixes.

Note: PVRSA installation requirements may reduce the effective equipment and component ratings below the individual equipment and component PVRSE ratings in order to achieve PVRSA shock hazard reduction requirements.

PVRSA INSTALLATION REQUIREMENTS	
Max System Voltage	600 Vdc
Max Array Internal Voltage After Actuation	165 Vdc (cold weather open circuit)
Max Series-Connected Panels between MCI Output Connections:	10
Max Series-Connected Panels Connected to MCI Inputs:	5

OTHER INSTALLATION INSTRUCTIONS
1. MCIs shall be positioned at a slight angle during installation on roof deck to assist with water shedding.
2. An MCI must be connected to one end of each series string or mounting plane sub-array string.
3. Verification that MCIs are installed with 10 or fewer modules between MCI output connections shall be documented for inspection, by voltage measurement logs and/or as-built string layout diagrams.
4. The dedicated PV system AC circuit breaker or PV system AC disconnect switch shall serve as the PVRSA initiator and shall be sized and installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings.



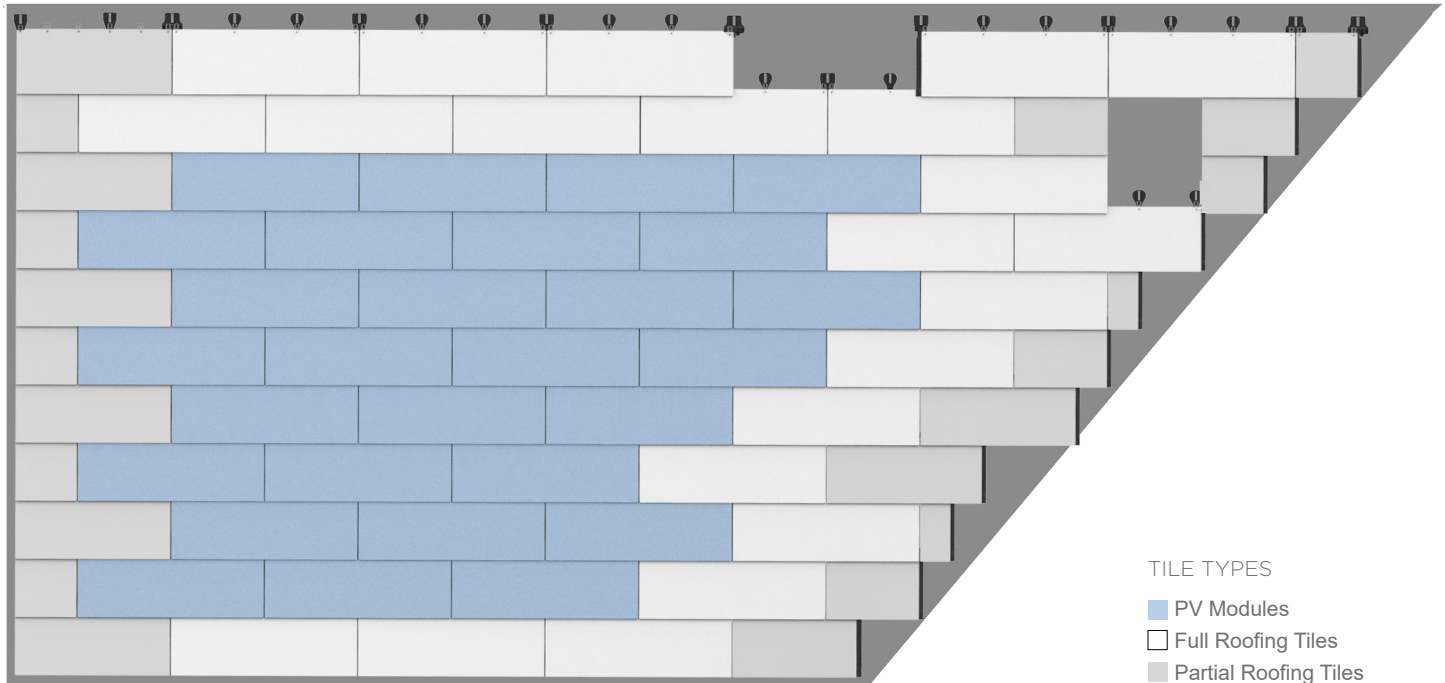
Certification Mark of UL on the installation instructions is the only method provided by UL to identify products manufactured under its Certification and Follow-Up Service. The Certification Mark for these products includes the UL symbol, the words "CERTIFIED" and "SAFETY", the geographic identifier(s), and a file number.

FREQUENTLY ASKED QUESTIONS

Q: DOES EVERY PART OF THE ROOF COVERING MAKE ELECTRICITY?

A: No. While much of the roof is made up of PV Modules, parts of the roof are covered with Roofing Modules or other typical roof details that do not produce electricity.

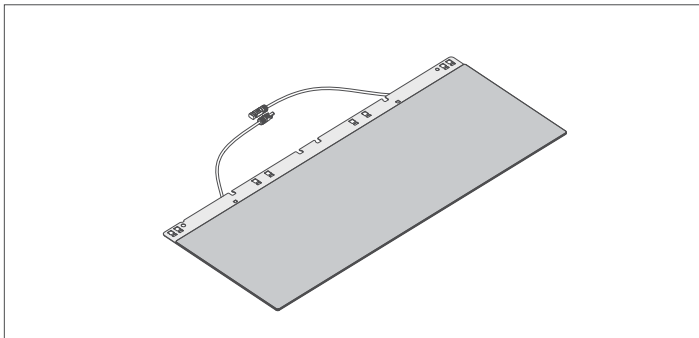
SAMPLE MOUNTING PLANE



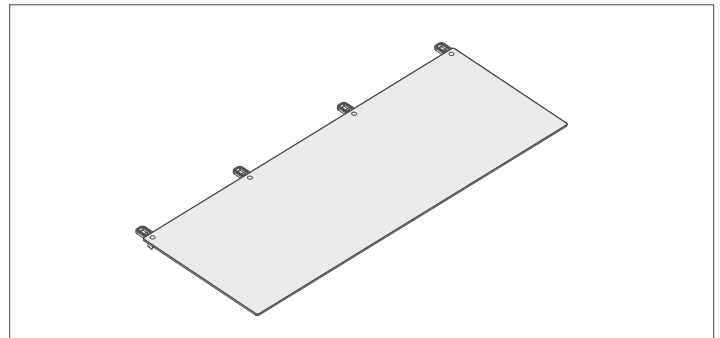
Q: IS SOLAR ROOF A TILE OR A SHINGLE?

A: While Solar Roof has an appearance similar to both tiles and shingles, it is unique. A typical Solar Roof Module consists of a factory-built assembly with integral fasteners. Accordingly, resistance to wind loads has been evaluated through multiple test methods applicable to both roof covering types as well as PV mounting methods, including UL 1897, ASTM D3161 and UL 61730 (Mechanical).

PV MODULE

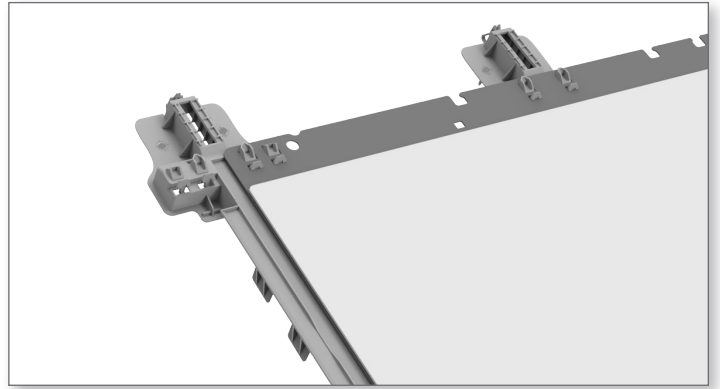
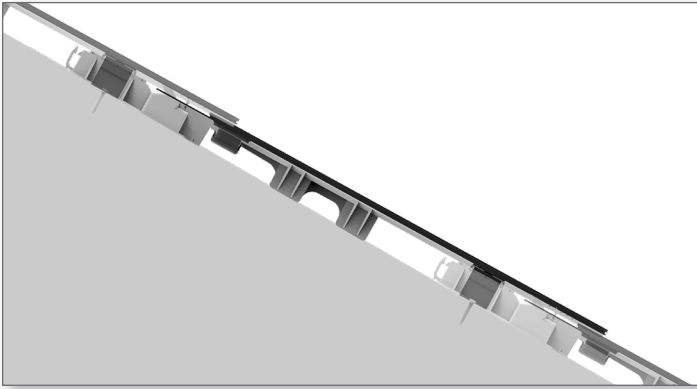


ROOFING MODULES



Q: HOW IS SOLAR ROOF ATTACHED?

A: Each PV Module and Roofing Module is secured with traditional fasteners and recloseable fasteners. This attachment method has been evaluated to requirements in UL 1897, ASTM D3161 and UL 61730 (Mechanical).



Q: HOW MUCH DOES SOLAR ROOF WEIGH?

A: Solar Roof's complete assembly weighs approximately 3.4 psf for textured tile. These figures include all elements above the roof sheathing, including underlayment and roof covering components.

Q: WHAT IS THE MAXIMUM WIND SPEED THAT SOLAR ROOF CAN WITHSTAND?

Solar Roof is rated "Class F", the highest attainable wind rating under ASTM D3161. Refer to IRC 2015 Section R905.16.7, IRC 2018 Section R905.16.6, IBC 2015 Section 1507.17.8, and/or IBC 2018 Section 1507.17.8; for applicability of wind ratings.

Q: IS SOLAR ROOF CERTIFIED CLASS "A" UNDER UL 790?

A: Yes. The roof assembly (including the PV Modules, Roofing Modules, and underlayment) have been evaluated to the requirements of UL 790 and has a Class "A" fire rating when installed in accordance with the installation instructions.

Q: CAN SOLAR ROOF BE INSTALLED IN A HIGH FIRE HAZARD SEVERITY ZONE (HFHSZ) OR WILDLAND-URBAN INTERFACE (WUI)?

A: Yes. Solar Roof has a UL 790 Class A fire rating and complies with the applicable sections of IRC and IWUIC for installation in areas of elevated fire risk when installed according to the manufacturer's instructions using code-compliant flashings and accessory components.

Q: DOES SOLAR ROOF COMPLY WITH THE “COOL ROOF” RATING REQUIREMENTS OF CALIFORNIA TITLE 24?

A: Yes. Solar Roof complies with the CEC Building Energy Efficiency requirements of Section 150.2(b)11 (a) (sometimes called the “cool roof” requirement) through its incorporation of an airspace between the roof deck and roof covering.

Q: CAN YOU WALK ON SOLAR ROOF?

A: Yes. Solar Roof is engineered to safely withstand applicable live loads required by the building code for steep slope applications. However, to ensure safety and maintain maximum roof life, walking should be avoided except by first responders and trained Solar Roof installation professionals. This is a common recommendation for other high-end roof types, including slate, clay, concrete, and composite tile products.

Q: HOW IS SOLAR ROOF WIRED? IS IT DIFFERENT FROM TYPICAL PV INSTALLATIONS?

A: Solar Roof wiring is similar in most respects to traditional PV systems. It uses the same industry standard, UL-certified wire and PV connectors to combine modules in series strings. UL certified wiring harnesses, called Diode Harnesses, aggregate series-connected PV Modules. 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. The combined circuits exit the roof via a listed assembly, called the Pass Through Box. The strings then connect to a conventional DC-AC inverter.

The wire routing and installation methods of the system have also been evaluated by UL.

Q: HOW MUCH VOLTAGE AND CURRENT ARE PRODUCED BY A SOLAR ROOF PV MODULE?

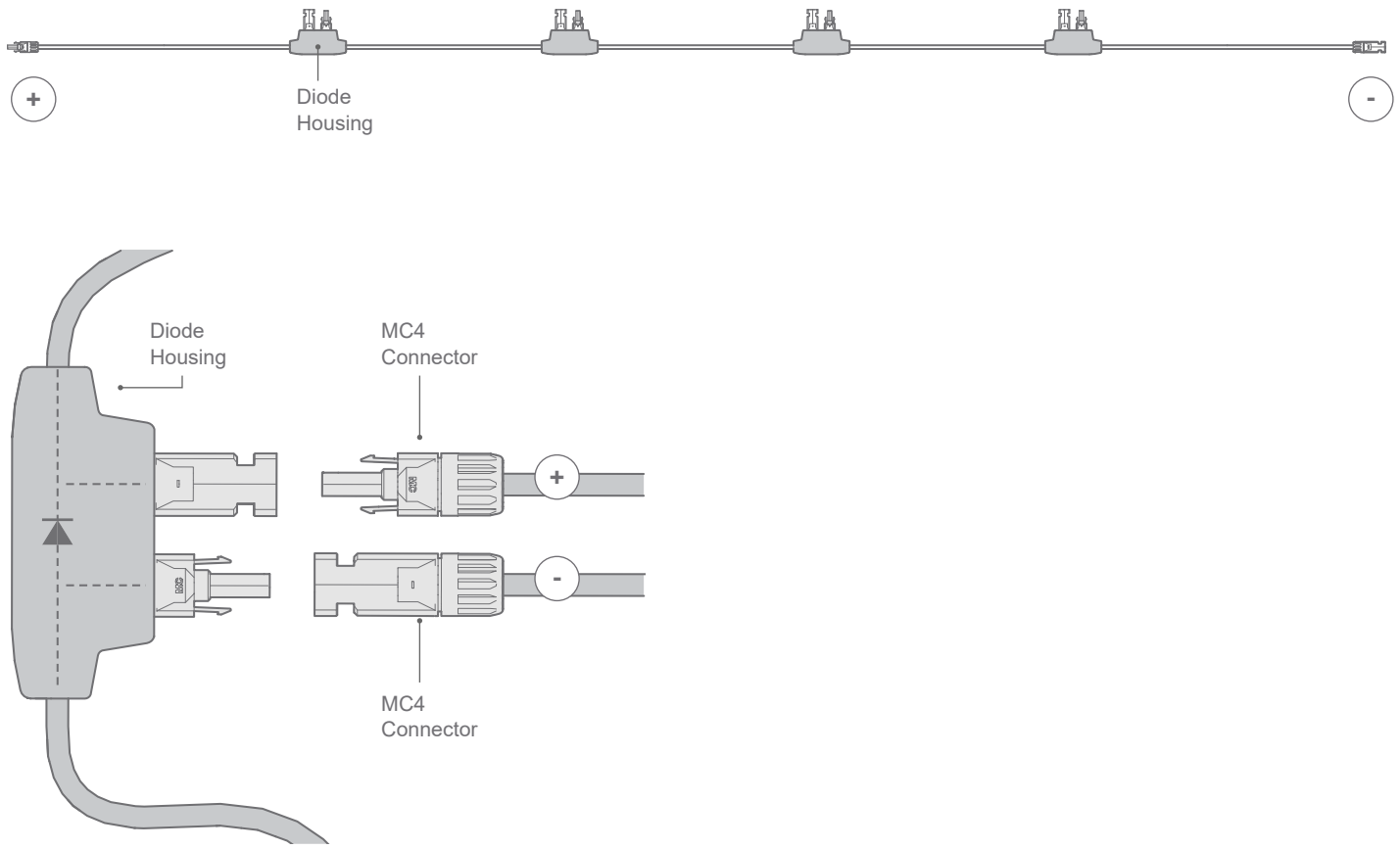
A: One PV Module produces about 10.99 Volts and 5.32 Amps with a nominal power output of approximately 58 Watts.



Q: WHAT IS THE FUNCTION OF THE DIODE HARNESS?

A: The Diode Harness is a UL listed, pre-manufactured cable assembly that connects PV Modules together in series and provides shading protection.

In traditional solar panels, bypass diodes are housed in junction boxes on the back of each module. In Solar Roof, the bypass diodes are in the Diode Harness. Under partially shaded conditions, the diode diverts current away from the shaded PV Modules. The diode also diverts current if a connector opens in the series.



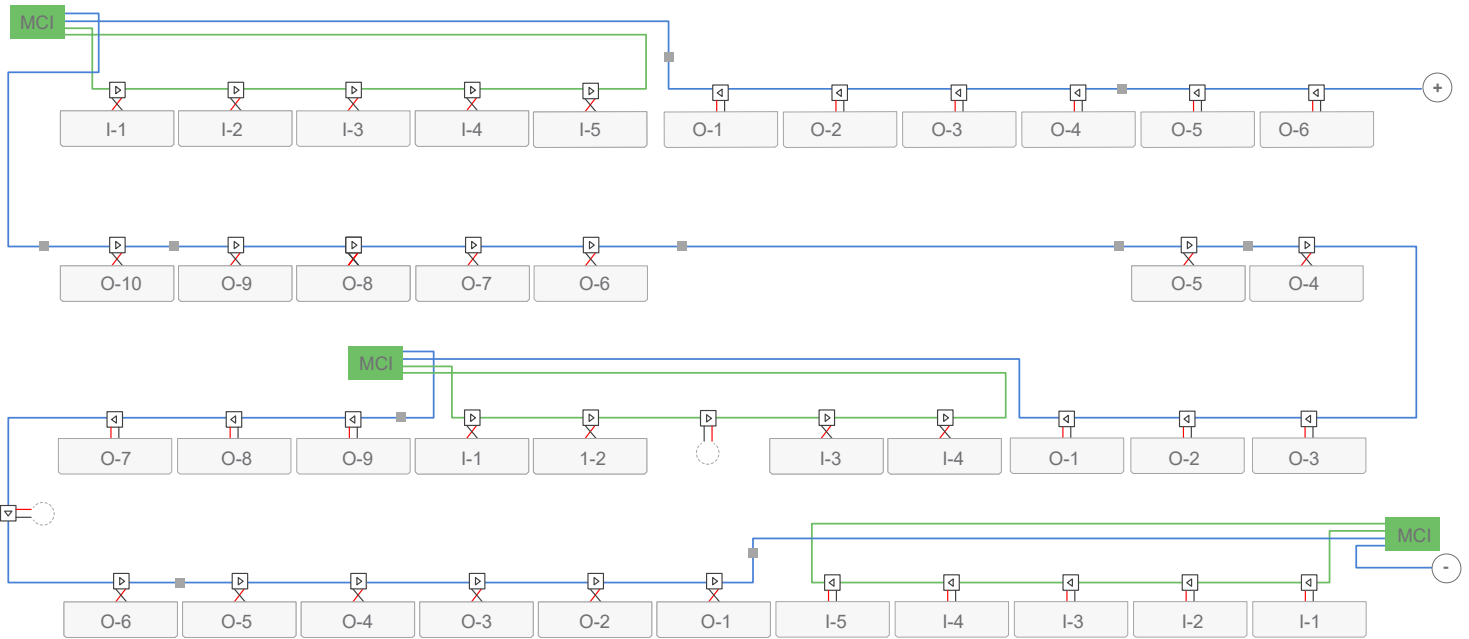
Q: WHAT IS THE MAXIMUM VOLTAGE AND CURRENT PRODUCED BY ANY SOLAR ROOF CONDUCTOR?

A: Maximum voltage and current on any conductor beneath Solar Roof is less than 600 V and 10 A.

Q: HOW ARE SOLAR ROOF PV MODULES CONNECTED?

A: Solar Roof modules are wired in series to the input and output Diode Harness assemblies. The Input Harness is a 5 diode bundle (< 80 V) which powers the Mid-Circuit Interrupter. The Output Harness is a bundle of 10 or fewer modules (< 160 V) connected between MCI Units. As Solar Roof modules are installed along the mounting plane, the harness wiring of the PV array weaves back and forth in a serpentine pattern.

EXAMPLE PV ARRAY WITH 3 MCI UNITS



Q: WHAT IS THE MAXIMUM NUMBER OF PV MODULES THAT CAN BE CONNECTED IN SERIES WITH DIODE HARNESSES?

A: The maximum number of PV Modules connected in a single string is 39.

TERM	DEFINITION
BYPASS DIODE	Housed in the Diode Harness, a bypass diode protects a shaded PV Module by diverting current.
DIODE HARNESS	A UL listed, pre-manufactured cable assembly that connects strings of PV Modules together in series using MC4 connectors. The Harness houses 1 bypass diode per module.
PV MODULE	A UL listed roofing and DC power-producing assembly of six high-efficiency, mono-crystalline cells with a nominal power rating of 58 Watts.
ROOFING MODULE	A UL listed roofing assembly that is aesthetically similar to the PV Module, but produces no power.

Q: HOW IS THE SYSTEM GROUNDED?

A: Unlike traditional PV modules and racking systems, Solar Roof PV and Roofing Modules do not incorporate any accessible metal components. By eliminating accessible metal on the roof that might become energized in the event of a fault, Solar Roof does not require connection to an Equipment Ground Conductor (EGC) until the array wiring exits the roof.

Q: WHAT OTHER ELECTRICAL SAFETY FEATURES HAVE BEEN INCORPORATED INTO SOLAR ROOF?

A: Wire management features built into Solar Roof support all wiring to protect it from anything that might cut or abrade its insulation. Because the system is enclosed, the wiring is protected from vermin and contact by people.

Q: HOW DOES SOLAR ROOF COMPLY WITH RAPID SHUTDOWN REQUIREMENTS?

A: Solar Roof meets 2014 and 2017 NEC Rapid Shutdown requirements by incorporating automatic disconnecting devices within the arrays. Rapid shutdown is initiated by disconnecting the home from the utility, or by opening the PV system's main AC disconnect. The rapid shutdown components are certified to UL 1741, and the system as a whole has been certified by UL as a PV System Rapid Shutdown Array in accordance with 690.12 (B) (2) (1) of the 2017 NEC.

Q: DOES SOLAR ROOF REQUIRE A SPECIAL INVERTER OR OTHER ELECTRONICS?

A: Solar Roof uses conventional DC-AC inverters. PV Modules are wired into series strings to achieve a target DC voltage below 600 V. For systems installed in accordance with the 2017 NEC, MCI devices are installed in the arrays to provide rapid shutdown functionality.

Q: HOW DOES SOLAR ROOF DEAL WITH ROOF OBSTRUCTIONS SUCH AS VENTS, SKYLIGHTS, DORMERS, VALLEYS, RIDGES, ETC.?

A: Solar Roof uses conventional flashing details and practices employed by all roofers to seamlessly integrate with ordinary roof obstructions. Solar Roof uses a dedicated metal ridge cap.

Q: IN AREAS SUBJECT TO "ICE DAMMING", WHAT UNDERLAYMENTS ARE USED?

A: To prevent ice damming, Solar Roof uses an underlayment that complies with ASTM D1970 and is approved nationwide as a self-adhering ice and water barrier.

Q: WHO IS QUALIFIED TO INSTALL SOLAR ROOF?

A: Solar Roof can only be installed by Tesla-trained technicians. Solar Roof will not be distributed to, or installed by, conventional roofing contractors.

Q: CAN SOLAR ROOF BE ACCESSED FOR SERVICE?

A: Yes. The Modules may be removed for servicing. No special tools are required.

CERTIFICATES OF COMPLIANCE

CERTIFICATE OF COMPLIANCE

Certificate Number	20191115-E491360
Report Reference	E491360-201911108
Issue Date	2019-NOVEMBER-15

Issued to: TESLA INC
3500 DEER CREEK RD
PALO ALTO CA 94304

This certificate confirms that representative samples of BUILDING-INTEGRATED PHOTOVOLTAIC MODULES AND PANELS
USL – “Tesla Solarglass Roof” BIPV Roofing Modules, model numbers SR60T1, the associated “non-functional” Roofing Modules, Tesla model numbers SRNFT1/6, SRNFT1/3, SRNFT1/2, SRNFT2/3, SRNFT5/6 and SRNFT1, and their Roof Mounting System elements, which serve as part of the installed system.

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.


Standard(s) for Safety: ANSI/UL 61730-1, Photovoltaic (PV) Module Safety Qualification - Part 1: Requirements for Construction, nd ANSI/UL 61730-2, Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements for Testing.

Additional Information: See the UL Online Certifications Directory at <https://iq.ulprospector.com> for additional information.

This Certificate of Compliance does not provide authorization to apply the UL Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.



Bruce Mahanobis, Director North American Certification Program
UL LLC
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Page 1 of 1

CERTIFICATE OF COMPLIANCE

Certificate Number	20170512-E491361
Report Reference	E491361-20170509
Issue Date	2017-MAY-12

Issued to: Tesla Inc
3500 Deer Creek Rd
Palo Alto CA 94304


This is to certify that representative samples of DISTRIBUTED GENERATION WIRING SYSTEMS AND HARNESSES
Photovoltaic Wiring Harness: Tesla Solar Roof “Diode Trunk Harness” - Tesla Part No. 1122020-00-A.

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL Subject 9703, Distributed Generation Wiring Harnesses.
Additional Information: See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

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Page 1 of 1

CERTIFICATE OF COMPLIANCE

Certificate Number	20180627-E318357
Report Reference	E318357-20180625
Issue Date	2018-JUNE-27

Issued to: TESLA INC
3500 Deer Creek Rd
Palo Alto CA 94304

This is to certify that representative samples of DISTRIBUTED GENERATION POWER SYSTEMS ACCESSORY EQUIPMENT
Photovoltaic Pass Through box, Model SRPTB-4


Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 1741, Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources

Additional Information: See the UL Online Certifications Directory at www.ul.com/database for additional information

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Page 1 of 1

CERTIFICATE OF COMPLIANCE

Certificate Number	20180608-E491361
Report Reference	E491361-20170718
Issue Date	2018-JUNE-08

Issued to: Tesla Inc
3500 Deer Creek Rd
Palo Alto, CA 94304

This is to certify that representative samples of DISTRIBUTED GENERATION WIRING SYSTEMS AND HARNESSES
Photovoltaic Wiring Harness Products for installation of the Tesla Solar Roof System.


Solar Roof, Branch Jumpers, 1x, 2x, 3x, 4x, mini
Part Nos. 1121897-01-A, -02-A, -03-A, -04-A, -05-A
Part Nos. 1467674-01-A, -02-A, -03-A, -04-A, -05-A

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL Subject 9703, Distributed Generation Wiring Harnesses.
Additional Information: See the UL Online Certifications Directory at www.ul.com/database for additional information

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Page 1 of 1

CERTIFICATE OF COMPLIANCE

Certificate Number E515336
Report Reference E515336-20200501
Issue Date 2020-MAY-08

Issued to: Tesla Inc
 3500 Deer Creek Rd
 Palo Alto CA 94304

This certificate confirms that representative samples of PHOTOVOLTAIC RAPID SHUTDOWN ARRAYS
 Please see addendum page

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: Please see addendum page
Additional Information: See the UL Online Certifications Directory at <https://iq.ulprospector.com> for additional information.

This Certificate of Compliance does not provide authorization to apply the UL Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.



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CERTIFICATE OF COMPLIANCE

Certificate Number E515336
Report Reference E515336-20200501
Issue Date 2020-MAY-08

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Models/ Product

Certified, Photovoltaic Rapid Shutdown Array (PVRSA). When installed in accordance with its instructions, this PVRSA is intended to reduce electrical hazards for firefighters performing fire fighting work in the vicinity of the array. Fire Fighters are required to wear inspected and serviceable PPE. The instructions require that the PVRSA is to be configured with mid circuit interruption PV Rapid Shutdown Equipment (PVRSE) such that the highest internal PV array voltage is no more than 165VDC, 30 seconds after a rapid shutdown event is initiated. The Photovoltaic Rapid Shutdown Array was evaluated to comply with the requirement within UL 1741.

Product Names:
 ZS Rapid Shutdown Array
 (Applicable to ZS Comp, ZS Span, ZS Ramp, and ZS Seam)
 Solarglass Roof Rapid Shutdown Array

Standard(s) for Safety:

Standard	Title
UL 1741	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
IEEE 1547	IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
IEEE 1547.1	IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems



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EVALUATION REPORTS

Report prepared for public access on 2/8/2021 12:06:48 PM

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LISTING INFORMATION

Tesla Solarglass Roof is a BIPV roof covering.

This listing applies to the Solarglass Roof BIPV module/tile model No. SR60T-1 and the non-energy producing Solarglass Roof Tile models, SRNFT 1, SRNFT 1/6, SRNFT 1/3, SRNFT 1/2, SRNFT 2/3, and SRNFT 5/6

The Tesla Solarglass BIPV Tiles and non-energy producing Solarglass Roof Tiles are supported and attached by snap engagement to plastic mounting components that are mechanically fastened to prepared roofing. The mounting components are fastened to roof with two 1-1/2 in. ring shank roofing nails with 3/8-in. heads and 1/8-in. shanks.

Assemblies are intended for use in steep slope roof applications with roof slope equal to or greater than 2:12, installed over minimum 15/32-in. thick exterior grade plywood roof decks covered with two layers of underlayment.

WIND RESISTANCE

Test Standard	Rating	Assembly Details
ASTM D3161-12	CLASS F Rating	1. Deck: 15/32 in. plywood 2. Underlayment: 2a. Two layers of Firestone Class "A" CLAD GARD SA-FR underlayment Or 2b. One layer of FT Synthetics Cobalt Ultra followed by one layer of GAF VersaShield SOLO Or 2c. One layer of FT Synthetics Cobalt FR Self-Adhered Underlayment Or 2d. One layer of Tesla Solar Roof Self-Adhered Roofing Underlayment 3. Tesla SolarGlass Roof System (with SR60T-1 or SRNFT models) Eave and rake flashing conditions and attachment per Tesla Installation instructions.

WIND DRIVEN RAIN

Test Standard	Rating	Assembly Details & Rating
TAS 100-95	PASS - No leakage	1. Deck: 15/32 in. plywood 2. Underlayment: 2a. Two layers of Firestone Class "A" CLAD GARD SA-FR underlayment Or 2b. One Layer of FT Synthetics Cobalt Ultra followed by one

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layer of of GAF VersaShield SOLO Or 2c. One layer of FT Synthetics Cobalt FR Self-Adhered Underlayment Or 2d. One layer of Tesla Solar Roof Self-Adhered Roofing Underlayment 3. Tesla SolarGlass Roof System (with SR60T-1 or SRNFT models) Eave, Valley, and rake flashing conditions and attachment per Tesla installation instructions.

FIRE ROOF CLASSIFICATION: CLASS A - UL 790

Assembly No.	E108-RFU-52115-01
Slope:	Qualifies for use with roof slopes ≥ 2:12
Deck Type:	Combustible Deck 15/32 in. plywood
Details:	1. Underlayment: 1a. Two Layers of Firestone Class "A" CLAD GARD SA-FR underlayment Or 1b. One Layer of FT Synthetics Cobalt Ultra followed by one layer of of GAF VersaShield SOLO Or 1c. One layer of FT Synthetics Cobalt FR Self-Adhered Underlayment Or 1d. One layer of Tesla Solar Roof Self-Adhered Roofing Underlayment 2. Tesla Solarglass Roof System (with SR60T-1 or SRNFT models) Attachment and installation per Tesla Installation instructions.

Note: the component materials of each system must be applied in the order in which they are listed above.

Report No.	Product Covered
FL No. 31342	Tesla Solarglass Roof

Attribute	Value
Code Reports	Yes
Criteria	ASTM D3161/D3161M (2012)
Criteria	UL 790 (2014)
Criteria	TAS 100 (1995)
CSI Code	07 32 00 Roof Tiles

EVALUATION REPORTS CONTINUED

Report prepared for public access on 2/8/2021 12:06:48 PM

SpecDIRECT™ POWERED BY intertek

Intertek Services	Certification
Listed or Inspected	LISTED
Listing Section	ROOF COVERING SYSTEMS
Spec ID	52115

Tesla Inc. | 52115 | Rev: Feb 5 2021 5:11PM | Uncontrolled Copy

Page 4 of 4