

City of Houston Permit Center



Plan Review
Solar PV Systems

1. Solar Code Requirements

2017 National Electrical Code N.E.C.

City of Houston Electrical Amendments

2012 International Building Code I.B.C

2012 International Residential Code I.R.C

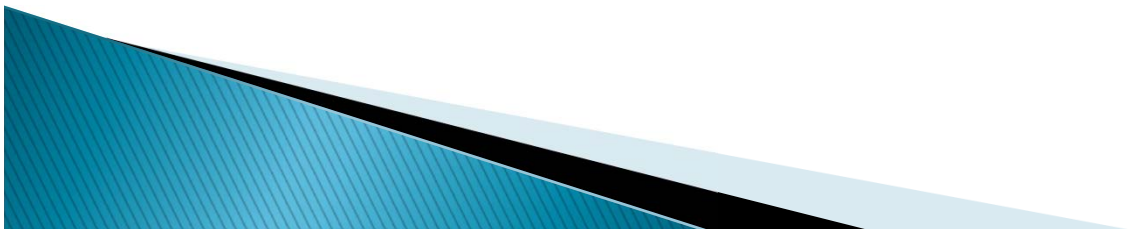
City of Houston Building or Residential
Amendments

2015 International Energy Conservation Code
IECC



2. Permit Requirements

- ▶ Prepared Plans and Permit Application
- ▶ Declaration Support of Application
- ▶ Deed Restrictions
- ▶ Building Permit & Electrical Permit
- ▶ Plan Review And Approval
- ▶ Construction of Solar System
- ▶ Site Inspection



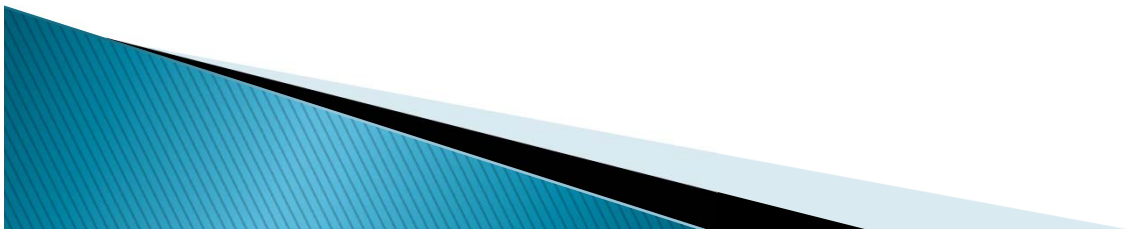
3. Recommendations For Solar Permitting

Submitted Plans (Two Sets)

Engineered Structural Design

Engineered or Master Electrician Design

Permit Applications Completed



4. Solar Code Requirements

Structural Design

Engineered Design

Live and Dead Load

International Building Code (IBC 2012)

International Residential Code (IRC 2012)

International Fire Code (IFC 2012)



Electrical Design Codes

City of Houston Electrical Code

National Electrical Code 2017)

Article 690 Solar Photovoltaic (PV) Systems

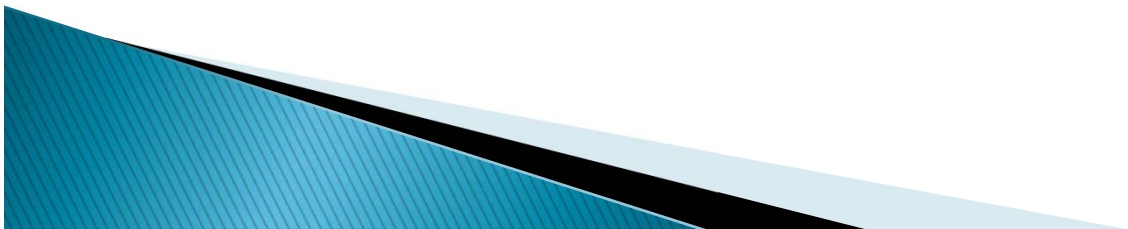
Article 705 Interconnected Electric Power
Productions Sources

International Energy Conservation Code (IECC
2015)



City of Houston Electrical Code Requirements

- ▶ Chapter 3 PERMITS AND INSPECTIONS
- ▶ SECTION 301—PERMITS
- ▶ 301.1 Permits Required. It shall be unlawful for any person to install, alter, repair, replace or remodel any electrical system or equipment regulated by this code, except as specified in Section 301.2, or cause the same to be done, unless the person has a current permit for the work or is working under the supervision of a person who has a permit.



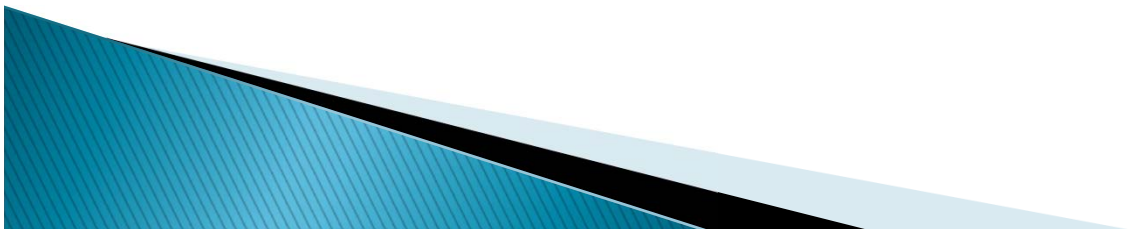
City of Houston Electrical Code Requirements

- ▶ SECTION 302—ELECTRICAL PERMITS
- ▶ SECTION 302.1 Application.
- ▶ 302.1 Application. To obtain an electrical permit, the applicant shall first file an application on a form furnished by the Building Inspection Division for that purpose. Each application shall:
 - ▶ 4. Be accompanied by plans, diagrams, computations and other data as required in Section 302.2.



City of Houston Electrical Code Requirements

- ▶ **302.2 Plans and Specifications.** Plans, calculations, diagrams and other data shall be submitted in two or more sets with each application for a permit. The building official may require all plans, computations and specifications to be prepared by a master electrician of record and/or prepared and sealed by a professional engineer licensed in the State of Texas in compliance with The Texas Engineering Practice Act (*Texas Occupations Code*, Chapter 1001).



Professional Engineer Seal Signed and Dated

- ▶ **Engineer Seal**
- ▶ Drawings are required to be sealed, signed and dated by a State of Texas Registered Professional Engineer in accordance with the State of Texas Engineer Practice Act.
- ▶ **Engineer Firm Name and Registration Number**
- ▶ All engineering documents released, issued, or submitted by or for a registered State of Texas engineering firm, including preliminary documents, must clearly indicate the firm name and registration number. Section 302.2 City of Houston Electrical Code
- ▶ Engineer's License Number
- ▶ Engineer's Firm Number

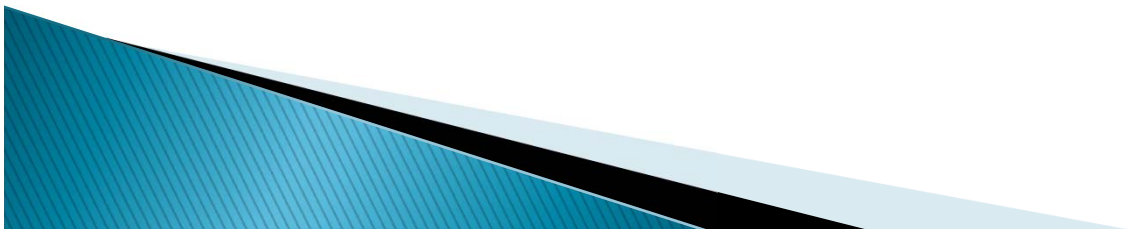


State of Texas Master Electrician Signed and Dated with State License Number



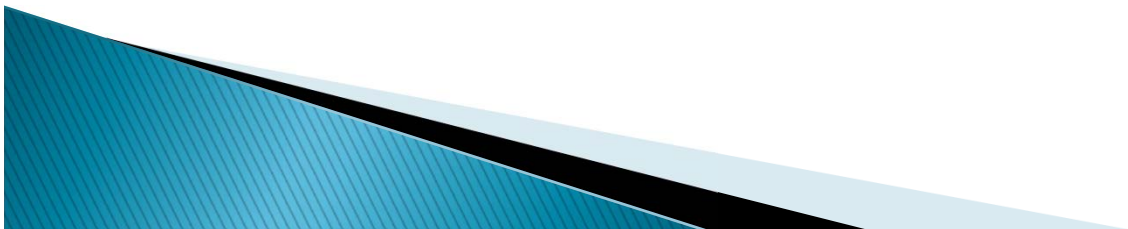
City of Houston Electrical Code

- ▶ SECTION 508—ELECTRICAL MATERIAL AND EQUIPMENT
- ▶ All electrical materials and equipment shall be listed and labeled for intended use and shall be included in a list published by an approved agency.



Approved Equipment

- ▶ Solar Module
- ▶ Combiner Boxes
- ▶ Inverter
- ▶ Charge Controller
- ▶ All associated electrical equipment.



Typical Registered Certification Marks



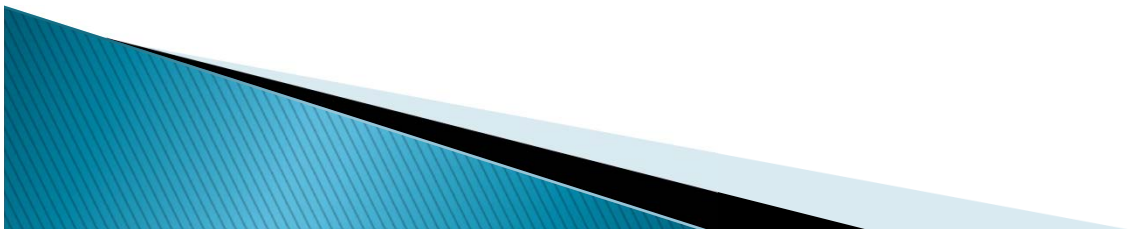
<https://www.osha.gov/dts/otpca/nrtl/nrtlmrk.html#1>



Typical Registered Certification Marks



C U.S.



► Solar Panel Spec Sheet








CS6K-285 | 290MS-SD

Canadian Solar's SmartDC module features an innovative integration of Canadian Solar's SuperPower module technology and SolarEdge's power optimization for grid-tied PV applications. By replacing the traditional junction-box with a power optimizer, the SmartDC module optimizes power output at module-level. With this feature, the SmartDC module can eliminate module-level mismatch and decrease shading losses. Furthermore, the SmartDC module provides module-level monitoring that allows effective system management and minimizes operational costs.

KEY FEATURES

- 
Harvests up to 25% more energy from each module
 - Maximizes power from each individual module against potential mismatch risk
 - Decreases shading losses
- 
Easy installation, simple system design
 - Integrated smart solution, no need to add other accessories
 - Enhances the shading tolerance
- 
Reduces BoS Costs
 - Up to 11.25 kW ~ 12.75 kW per string allows for more modules to be based on different inverters
- 
Free module-level monitoring system
 - Full visibility of system performance with a free smartphone app
- 
Safety
 - Automatic drop of DC current and voltage when inverter or grid power is shut down


linear power output warranty


product warranty on materials and workmanship

MANAGEMENT SYSTEM CERTIFICATES*

ISO 9001:2008 / Quality management system
 ISO/TS 16949:2009 / The automotive industry quality management system
 ISO 14001:2004 / Standards for environmental management system
 OHSAS 18001:2007 / International standards for occupational health & safety

PRODUCT CERTIFICATES*

IEC 61215 / IEC 61730: VDE/CE
 UL 1703: CSA



*As there are different certification requirements in different markets, please contact your Canadian Solar sales representative for the specific certificates applicable to the products.

CANADIAN SOLAR INC. is committed to providing high quality solar products, solar system solutions and services to customers around the world. As a leading manufacturer of solar modules and PV project developer with over 14 GW of premium quality modules deployed around the world since 2001, Canadian Solar Inc. (NASDAQ: CSIQ) is one of the most bankable solar companies worldwide.

► Solar Inverter Spec Sheet

solaredge
Single Phase Inverter
with HD-Wave Technology
for North America
SE3000H-US / SE3800H-US / SE5000H-US /
SE6000H-US / SE7600H-US / SE10000H-US / SE11400H-US

INVERTERS



Optimized installation with HD-Wave technology

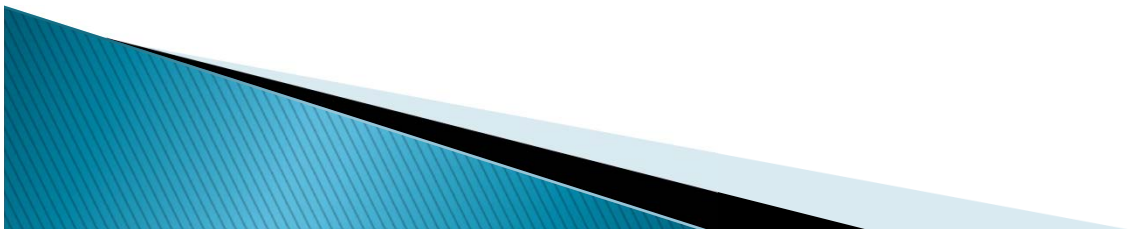
- Specifically designed to work with power optimizers
- Record-breaking efficiency
- Fixed voltage inverter for longer strings
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Extremely small
- High reliability without any electrolytic capacitors
- Built-in module-level monitoring
- Outdoor and indoor installation
- Optional: Revenue grade data, ANSI C12.20 Class 0.5 (0.5% accuracy)

HD
wave

www.solaredge.us

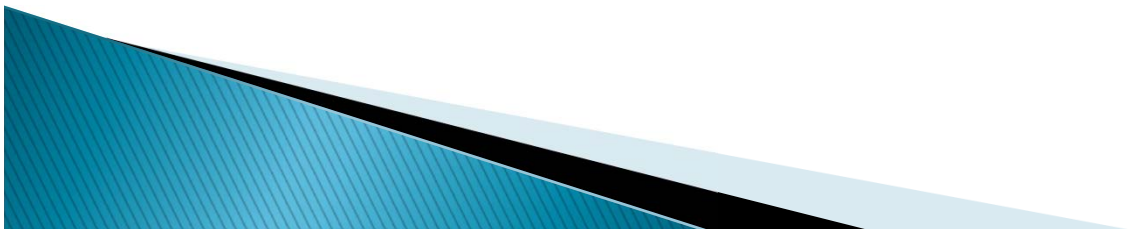
2017 National Electrical Code N.E.C.

- ▶ All solar installations shall be submitted for review.
- ▶ All Applicable Provisions of the NEC Shall Apply
- ▶ Solar Photovoltaic (PV) Systems Article 690



2017 National Electrical Code

- ▶ Voltage And Wiring Sizing Calculations
- ▶ DC System Voltage
- ▶ DC System Current
- ▶ DC run from combiner to inverter.
- ▶ AC Output Current
- ▶ AC run from inverter to combiner panel
- ▶ AC Overcurrent Protection



2017 National Electrical Code

One-Line Diagram



TAG	DESCRIPTION
1	SOLAR PV MODULE
2	DC PV SOURCE CIRCUIT
3	COMBINER BOX (if installed), refer to item 14 on page 3
4	DC PV OUTPUT CIRCUIT
5	DC EQUIPMENT GROUNDING CONDUCTOR per 690.43 NEC
6	INVERTER DC DISCONNECT
7	DC TO AC INVERTER WITH ISOLATION TRANSFORMER
8	GROUND FAULT DETECTION INTERRUPTER
9	AC DISCONNECT
10	SOLAR LOAD CENTER (If installed)
11	UTILITY PERFORMANCE METER (If installed)
12	UTILITY SAFETY SWITCH (If installed)
13	INVERTER DC GROUNDING ELECTRODE CONDUCTOR (MIN #8 AWG COPPER)
14	ELECTRICAL SERVICE PANEL

STANDARD PV PLAN FOR SINGLE FAMILY DWELLING CENTRAL INVERTER

MAXIMUM 10 KW
MAXIMUM 225 AMP SERVICE

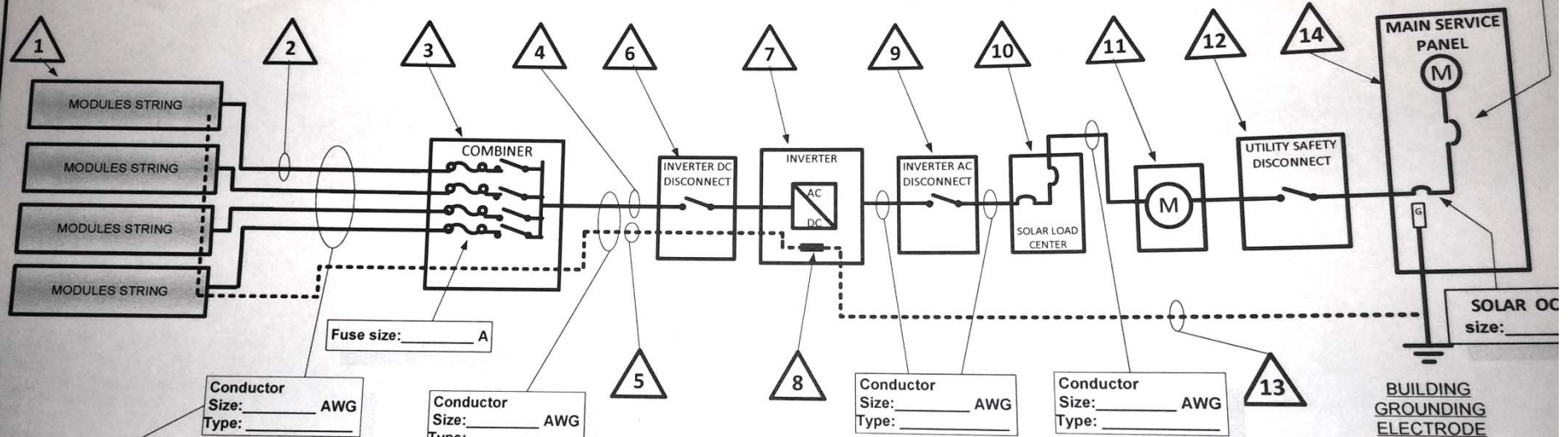
THIS PLAN MUST BE PROVIDED TO THE FIELD INSPECTOR

MAIN BREAKER / FUSE Size: _____ A

SOLAR BREAKER/ FUSE Size: _____ A

MAIN PANEL BUS Size: _____ A

MAIN OVERCURRENT
PROTECTIVE DEVICE
size: _____ A

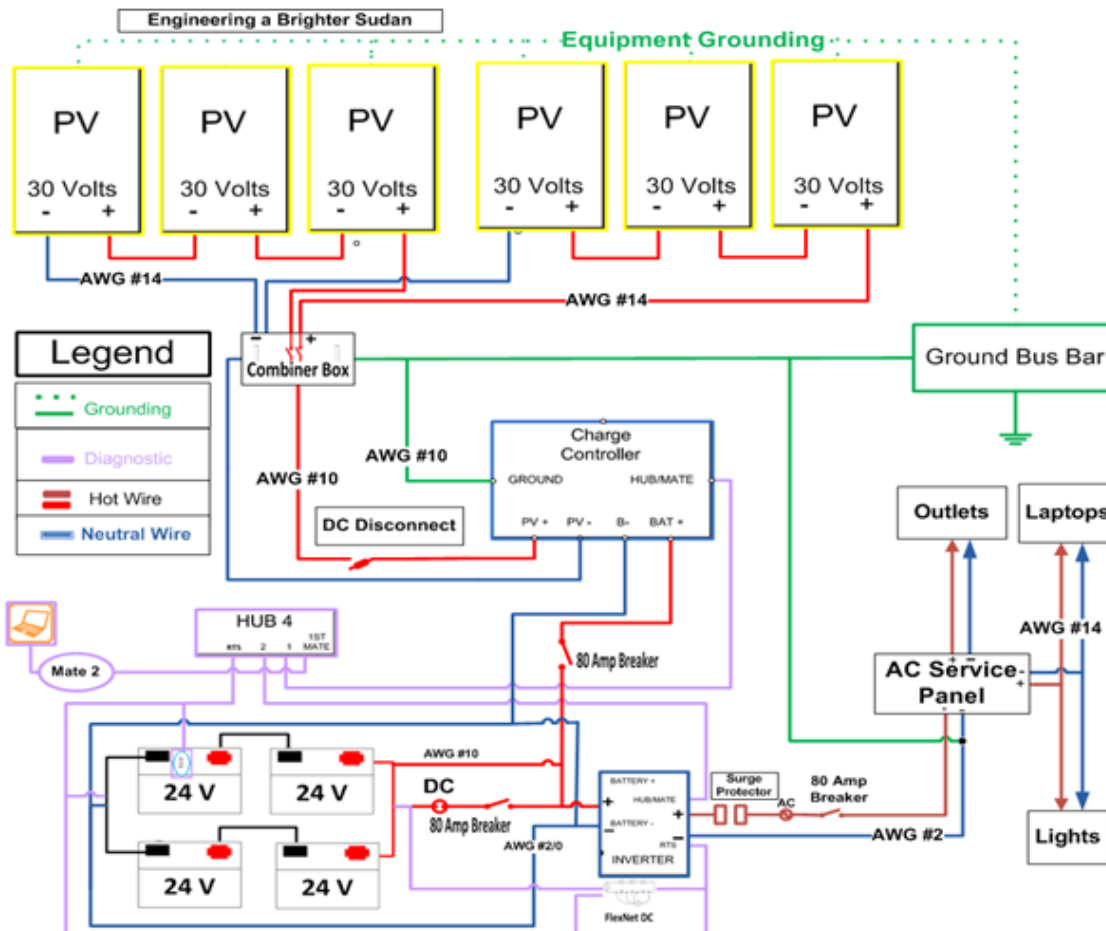


Provide required information in these boxes

Note: This plan is Not intended to be used with micro inverters or transform inverters. Permitted DC conductor types are USE-2, PV Wire or equivalent cables. Conductors for DC and AC circuits, where installed in raceways or shall be "W" rated and have an insulation rating of 90 degrees Centigrade.

Project Address: _____

Permit Number: _____



2017 National Electrical Code

- ▶ **Solar Equipment Location**
- ▶ Locate all solar and associated electrical equipment on the electrical site plan. Label each item and show each item's exact location on the floor plan
- ▶ In compliance with Working Spaces Article 110.26, Tap Rules Article 240.21,
- ▶ PV Systems Article 690 N.E.C.



Pathway per 2012 IFC

~320) SOLAR MODULES, 8,100 kW DC STC
 1 = 41.2" X 61.4" X 1.51"
 JS) PV INVERTERS @ 7.88 kW AC
 1 OUTPUT = 7.88 kW AC.
 EET SUNPOWER INVISIMOUNT
 ATTACHMENTS
 SOLUTION

180"

ROOF RIDGE

1" PATHWAY FROM
 RIDGE PROVIDED
 PER NFPA 1 [11.12.2.2.2.1]

36" PATHWAY FROM
 GUTTER TO RIDGE PROVIDED
 PER NFPA 1 [11.12.2.2.2.1]

36" SETBACK FROM RIDGE
 PER NFPA 1 [11.12.2.2.2.2]
 36" SETBACK FROM RIDGE



SOLAR PV SYSTEM:
 (25) SUNPOWER E19-320 MODULES ON
 (25) ENPHASE IQ7X-96-2-US INVERTERS
 (9) INVERTERS IN PARALLEL ON BRANCH #1
 (9) INVERTERS IN PARALLEL ON BRANCH #2
 (7) INVERTERS IN PARALLEL ON BRANCH #3

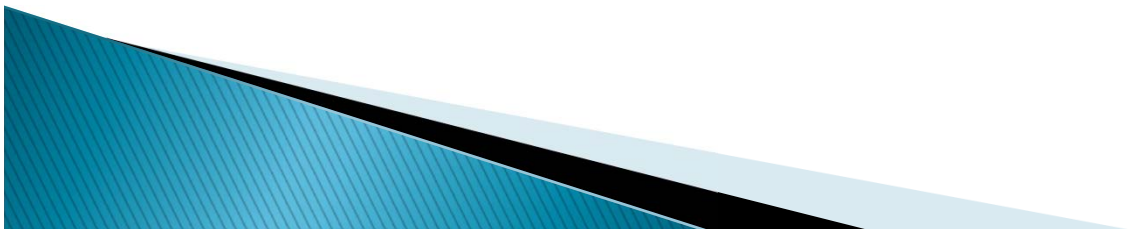
PRECAUTION: MAX 12 INVERTERS PER BRANCH

GROUNDING ELECTRODE
 CENTERPOINT ENERGY METER
 MAIN DISTRIBUTION PANEL
 MONITORING
 PV AC DISCONNECT
 (VISIBLE, LOCKABLE, LABELED)
 SOLAR LOAD CENTER

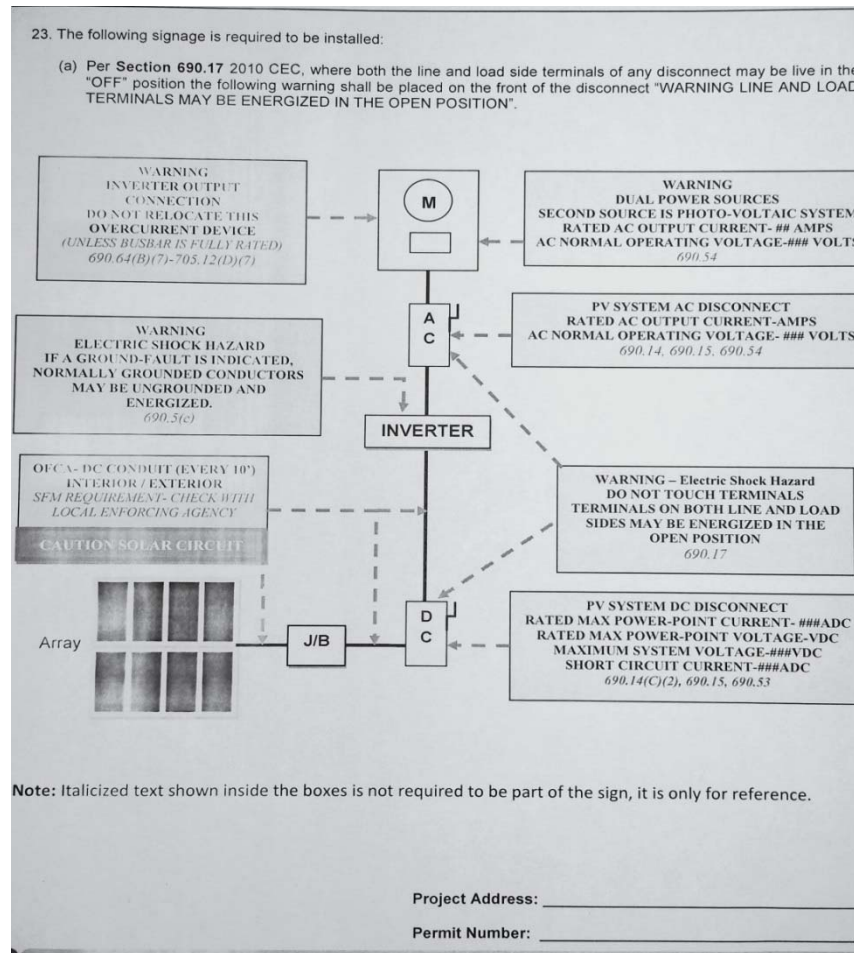
1 ACCORDANCE WITH THE
 JOINTS,
 1/8" TIGHT WITH MINIMUM NEMA 3R RATING,
 1 REQUIRE FIELD VERIFICATION,
 6-4" MAX FOR LAG BOLT TYPE ROOF ATTACHMENTS ANCHORED TO RAFTERS,
 6-4" MAX FOR 5-61 CLAMPS ANCHORED TO STANDING SEAM ROOF PANELS

Center Point Energy & Solar Interconnection

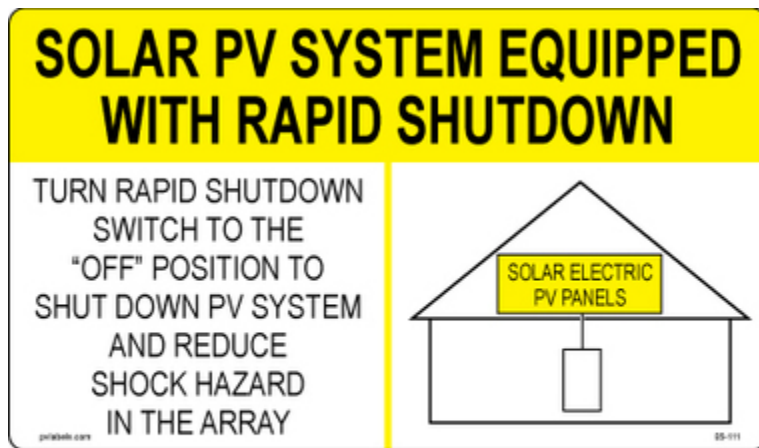
- ▶ Comply with Center Point Energy requirements for interconnection and approval.



2017 National Electrical Code



2017 N.E.C. Solar Warning Signs



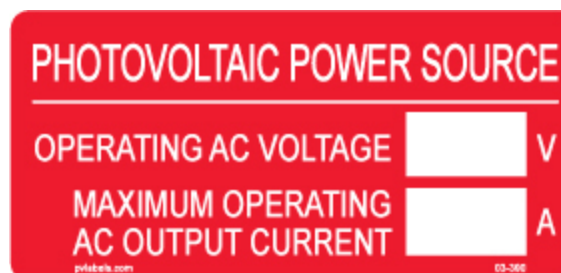
6" X 3½"



4" X 1"



4" X 3"



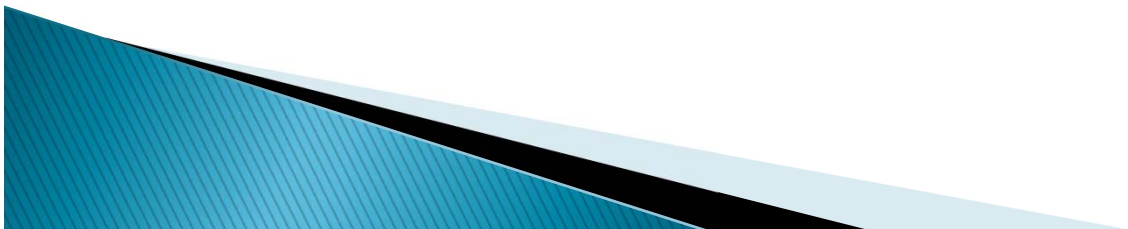
4" X 2"

Structural and Electrical Inspections

The inspection requirements for residential solar panels will be based on the approved plans.

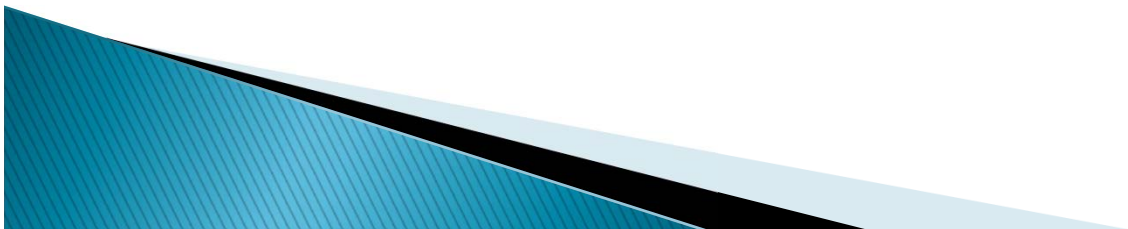
The approved plans shall remain on site during the construction and inspection process.

Applicant shall provide access for inspectors to review plans and the installation at all locations of the work.



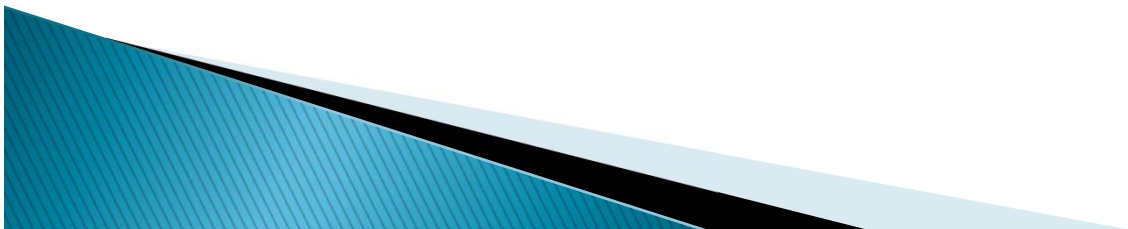
Structural Inspections

The structural engineer must provide a special inspection letter certifying that the installation conforms to his/her design. This may be submitted to the Structural Inspection Office at 1002 Washington Avenue 4th Floor, Houston, TX 77002 in lieu of calling for a structural inspection to accept the letter (minimizing the inspections to electrical only).



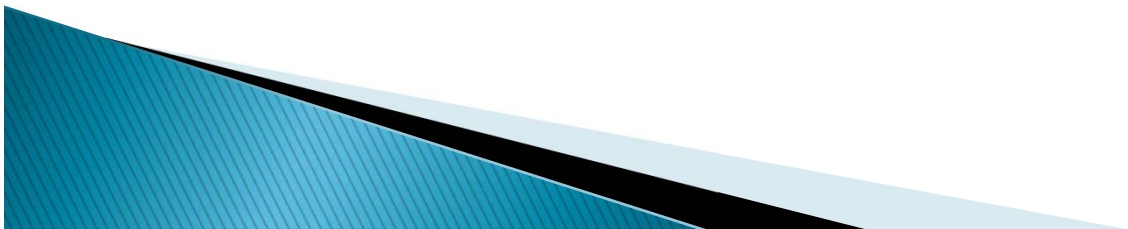
Electrical Inspections

- ▶ PV Module Listings
- ▶ Mechanical Attachment
- ▶ Grounding
- ▶ Conductors
- ▶ Overcurrent Protection
- ▶ Electrical Connections
- ▶ Disconnects
- ▶ Inverters



Department of Public Works & Engineering eDocument Center

- ▶ Form 1198
- ▶ Residential Solar Panel Permit and Inspection Guide
- ▶ <https://edocs.publicworks.houstontx.gov/all-documents/division-files/planning-and-development-services-division/enforcement/forms-and-publications/plan-review-handouts-guidelines/2439-1198-residential-solar-panel-permit-and-inspection-guide.html>





RESIDENTIAL SOLAR PANEL PERMIT & INSPECTION GUIDE

PURPOSE

This is a guide to assist in the plan review, permit, and inspection process for the installation of a residential solar panel system. Listed below are the required components to be included in drawings to obtain permits, and the items that the city inspectors will be verifying in the field during the inspection process.

PERMIT REQUIREMENTS

A [Building](#) permit and a single trade [Electrical](#) permit are required for the installation. A licensed electrician will be required to pull the Electrical permit. As part of the permit application process, the owner will be required to sign a [Deed Restriction Affidavit](#) and have it notarized. Properties located in the Flood Plain will be subject to additional requirements. Prior to application verify your [deed restrictions](#) with your civic association or county real property records regarding the placement of solar panels on your property.

NOTE: In addition to City of Houston requirements, an application for interconnection to Center Point Energy for approval and subsequent inspection approval must be accomplished. For further information visit <http://www.centerpointenergy.com/services/electricity/business/generation/>.

DRAWING PACKAGE CONTENTS

When equipment is installed on an existing structure, include a letter from a structural engineer indicating that the existing structure is sufficient to support the new loads associated with the additional weight and wind resistance (minimum 110 mph wind speed design).

Structural plans designed and sealed by a Texas Professional Engineer for securing the panels to the existing structure, or to a new foundation or structure shall be submitted.

Electrical solar panel work shall comply with NEC Article 690, and the panels shall comply with UL Standard 1703.

At minimum, the following shall be indicated on the plans (including a site or roof plan) to be confirmed during inspection:

- | | | |
|---|--|---|
| <input type="checkbox"/> Panel Layout | <input type="checkbox"/> Conductor Size & Type | <input type="checkbox"/> Disconnect Size & Type |
| <input type="checkbox"/> Mounting Structure & Anchors | <input type="checkbox"/> Conductor Insulation Type | <input type="checkbox"/> Inverter Size & Type |
| <input type="checkbox"/> Roof Penetrations | <input type="checkbox"/> Over Current Protection | <input type="checkbox"/> Battery(ies) Size & Type |
| <input type="checkbox"/> Grounding Points | <input type="checkbox"/> Charge Controllers | <input type="checkbox"/> One-Line Diagram |

INSPECTION PACKAGE CONTENTS

The manufacturer's installation manual and the permit drawings must remain on the jobsite at all times during the inspection process. The structural engineer must provide a [special inspection letter](#) certifying that the installation conforms to his/her design. This may be submitted to the Structural Inspection Office at 1002 Washington Avenue 4th Floor, Houston, TX 77002 in lieu of calling for a structural inspection to accept the letter (minimizing the inspections to electrical only). The inspection requirements for residential solar panels will be based on the approved plans, the manufacturer's installation manual, and the Houston Construction Code, whichever is more restrictive. Applicant shall provide access for inspectors to review the installation at all locations of the work.

CONTACT INFORMATION

Structural Inspections – (832) 394-8840

Electrical Inspections – (832) 394-8860

For Plan Review Questions, please call (832) 394-8810

Department of Public Works & Engineering eDocument Center

2018 Building Code Enforcement Permit Fee Schedule

NOTE: All permit fees are subject to the minimum and administrative fees.

VALUATION TABLE	
Use this table to determine fees when noted in the fee schedule	
Valuation (rounded to the nearest dollar)	Permit Fee (NOTE: The minimum permit fee is \$72.59)
\$0.01 - \$7,000	\$37.46
\$7,001 - \$150,000	\$37.46 for the first \$7,000 plus \$4.27 for every additional \$1000 in valuation or fraction thereof
\$150,001 - \$200,000	\$649.79 for the first \$150,000 plus \$4.01 for every additional \$1000 in valuation or fraction thereof
\$200,001 - \$300,000	\$850.50 for the first \$200,000 plus \$3.74 for every additional \$1000 in valuation or fraction thereof
\$300,001 - \$500,000	\$1,225.18 for the first \$300,000 plus \$3.47 for every additional \$1000 in valuation or fraction thereof
\$500,001 - \$1,000,000	\$1,921.01 for the first \$500,000 plus \$3.21 for every additional \$1000 in valuation or fraction thereof
\$1,000,001 - \$5,000,000	\$3,526.76 for the first \$1,000,000 plus \$2.93 for every additional \$1000 in valuation or fraction thereof
\$5,000,001 to \$50,000,000	\$15,302.31 for the first \$5,000,000 Plus \$1.60 for every additional \$1,000 in valuation or fraction thereof
\$50,000,001 and up	\$87,561.32 for the first \$50,000,000 Plus \$1.07 for every additional \$1,000 in valuation or fraction thereof

Department of Public Works & Engineering eDocument Center

2018 Building Code Enforcement Permit Fee Schedule

Electrical Permit Including \$26.75 Admin Fee

	CHARGES				
	Quantity	Item Description	Fee Amount	Total	Cost
		Meter Loop & Service Up to and including 50 kW @	\$74.92		
		51kW through 250 kW @	\$80.28		
		Over 250 KW @	\$85.63		
		Sub Panels with 8 or more circuits (each) @	\$ 7.48		
		Outlets @	\$ 1.06		
		Lighting Fixtures @	\$ 1.06		
		Range Receptacle @	\$ 3.74		

Green Building Resource Center

