## GENERAL NOTES

1.1.1 **PROJECT NOTES:**

1.1.2 THIS PHOTOVOLTAIC (PV) SYSTEM SHALL COMPLY WITH THE NATIONAL ELECTRIC CODE (NEC) ARTICLE, ALL MANUFACTURERS'S LISTING AND INSTALLATION INSTRUCTIONS, AND THE RELEVANT CODES AS SPECIFIED BY THE AUTHORITY HAVING JURISDICTION'S (AHJ) APPLICABLE CODES.

1.1.3 THE UTILITY INTERCONNECTION APPLICATION MUST BE APPROVED AND PV SYSTEM INSPECTED PRIOR TO PARALLEL OPERATION

1.1.4 GROUND FAULT DETECTION AND INTERRUPTION (GFDI) DEVICE IS INTEGRATED WITH THE MICROINVERTER IN ACCORDANCE WITH NEC 690.5(A)

1.1.5 ALL PV SYSTEM COMPONENTS; MODULES, UTILITY-INTERACTIVE INVERTERS, AND SOURCE CIRCUIT COMBINER BOXES ARE IDENTIFIED AND LISTED FOR USE IN PHOTOVOLTAIC SYSTEMS AS REQUIRED BY NEC 690.4 & NEC 690.60:
PV MODULES: UL1703, IEC61730, AND IEC61215, AND NFPA 70 CLASS C FIRE
INVERTERS: UL 1741 CERTIFIED, IEEE 1547, 929, 519
COMBINER BOX(ES): UL 1703 OR UL 1741 ACCESSORY

1.1.6 MAX DC VOLTAGE CALCULATED USING MANUFACTURER PROVIDED TEMP COEFFICIENT FOR VOC. IF UNAVAILABLE, MAX DC VOLTAGE CALCULATED ACCORDING TO NEC 690.7.

1.1.7 ALL INVERTERS, PHOTOVOLTAIC MODULES, PHOTOVOLTAIC PANELS, AND SOURCE CIRCUIT COMBINERS INTENDED FOR USE IN A PHOTOVOLTAIC POWER SYSTEM WILL BE IDENTIFIED AND LISTED FOR THE APPLICATION PER 690.4 (D). SHALL BE INSTALLED ACCORDING TO ANY INSTRUCTIONS FROM LISTING OR LABELING [NEC 110.3].

1.1.8 ALL SIGNAGE TO BE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE. IF EXPOSED TO SUNLIGHT, IT SHALL BE UV RESISTANT. ALL PLAQUES AND SIGNAGE WILL BE INSTALLED AS REQUIRED BY THE NEC AND AHJ.

1.2.1 **SCOPE OF WORK:**

1.2.2 PRIME CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND SPECIFICATIONS OF THE GRID-TIED PHOTOVOLTAIC SYSTEM RETROFIT. PRIME CONTRACTOR WILL BE RESPONSIBLE FOR COLLECTING EXISTING ONSITE REQUIREMENTS TO DESIGN, SPECIFY, AND INSTALL THE EXTERIOR ROOF-MOUNTED PORTION OF THE PHOTOVOLTAIC SYSTEMS DETAILED IN THIS DOCUMENT.

1.3.1 **WORK INCLUDES:**

1.3.2 PV ROOF ATTACHMENTS - ECOLIBRIUM ECOX

1.3.3 PV RACKING SYSTEM INSTALLATION - RAILLESS

1.3.4 PV MODULE AND INVERTER INSTALLATION - CANADIAN SOLAR CS6K-280M / ENPHASE M250-60-2LL-S22 (-ZC) (-NA) (240V)

1.3.5 PV EQUIPMENT GROUNDING

1.3.6 PV SYSTEM WIRING TO A ROOF-MOUNTED JUNCTION BOX

1.3.7 PV LOAD CENTERS (IF INCLUDED)

1.3.8 PV METERING/MONITORING (IF INCLUDED)

1.3.9 PV DISCONNECTS

1.3.10 PV GROUNDING ELECTRODE & BONDING TO (E) GEC

1.3.11 PV FINAL COMMISSIONING

1.3.12 (E) ELECTRICAL EQUIPMENT RETROFIT FOR PV

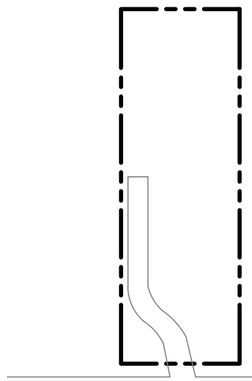
1.3.13 SIGNAGE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE

# NEW PV SYSTEM: 7.84 kWp
# EXAMPLE RESIDENCE

## 111 EXAMPLE DR.
## DETROIT, MI 11111 ASSESSOR'S #: 01010101010101

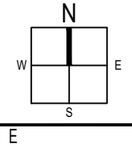
01 AERIAL PHOTO

NOT TO SCALE




02 PLAT MAP

NOT TO SCALE




## SHEET LIST TABLE


| SHEET NUMBER | SHEET TITLE |
|---|---|
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| G-001 | NOTES |
| A-101 | SITE PLAN |
| A-102 | ELECTRICAL PLAN |
| A-103 | SOLAR ATTACHMENT PLAN |
| E-601 | LINE DIAGRAM |
| E-602 | DESIGN TABLES |
| E-603 | PLACARDS |
| S-501 | ASSEMBLY DETAILS |
| R-001 | RESOURCE DOCUMENT |
| R-002 | RESOURCE DOCUMENT |
| R-003 | RESOURCE DOCUMENT |


## PROJECT INFORMATION

**OWNER**
NAME: EXAMPLE RESIDENCE

**PROJECT MANAGER**
NAME: EXAMPLE MANAGER
PHONE: 123 456 7890

**CONTRACTOR**
NAME: EXAMPLE CONTRACTOR
PHONE: 123 456 7890

**AUTHORITIES HAVING JURISDICTION**
BUILDING: DETROIT
ZONING: DETROIT
UTILITY: DTE

**DESIGN SPECIFICATIONS**
OCCUPANCY: II
CONSTRUCTION: SINGLE-FAMILY
ZONING: RESIDENTIAL
GROUND SNOW LOAD: 25 PSF
WIND EXPOSURE: C
WIND SPEED: 115 MPH

**APPLICABLE CODES & STANDARDS**
BUILDING: IBC 2015 IRC 2015
ELECTRICAL: NEC 2014
FIRE: IFC 2015

**CONTRACTOR**


EXAMPLE CONTRACTOR

**PHONE:** 123-456-7890
**ADDRESS:** 111 EX DRIVE
DETROIT, MI 11111


**LIC. NO.:** 01010101010
**HIC. NO.:**
**ELE. NO.:**



NEW PV SYSTEM: 7.84 kWp

**EXAMPLE RESIDENCE**

111 EXAMPLE DR
DETROIT, MI 11111 APN: 01010101010101

**ENGINEER OF RECORD**

PAPER SIZE: 11" x 17" (ANSI B)

COVER PAGE

**DATE:** 11.30.2016

**DESIGN BY:**

**CHECKED BY:**

REVISIONS

T-001.00

(SHEET 1)

2.1.1 **SITE NOTES:**

2.1.2 A LADDER WILL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.

2.1.3 THE PV MODULES ARE CONSIDERED NON-COMBUSTIBLE AND THIS SYSTEM IS A UTILITY INTERACTIVE SYSTEM WITH NO STORAGE BATTERIES.

2.1.4 THE SOLAR PV INSTALLATION WILL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS.

2.1.5 PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND PROPOSED ELECTRICAL EQUIPMENT WILL BE PROVIDED AS PER SECTION NEC 110.26.

2.1.6 ROOF COVERINGS SHALL BE DESIGNED, INSTALLED, AND MAINTAINED IN ACCORDANCE WITH THIS CODE AND THE APPROVED MANUFACTURER'S INSTRUCTIONS SUCH THAT THE ROOF COVERING SERVES TO PROTECT THE BUILDING OR STRUCTURE.

2.2.1 **EQUIPMENT LOCATIONS:**

2.2.2 ALL EQUIPMENT SHALL MEET MINIMUM SETBACKS AS REQUIRED BY NEC 110.26.

2.2.3 WIRING SYSTEMS INSTALLED IN DIRECT SUNLIGHT MUST BE RATED FOR EXPECTED OPERATING TEMPERATURE AS SPECIFIED BY NEC 690.31 (A),(C) AND NEC TABLES 310.15 (B)(2)(A) AND 310.15 (B)(3)(C).

2.2.4 JUNCTION AND PULL BOXES PERMITTED INSTALLED UNDER PV MODULES ACCORDING TO NEC 690.34.

2.2.5 ADDITIONAL AC DISCONNECT(S) SHALL BE PROVIDED WHERE THE INVERTER IS NOT WITHIN SIGHT OF THE AC SERVICING DISCONNECT.

2.2.6 ALL EQUIPMENT SHALL BE INSTALLED ACCESSIBLE TO QUALIFIED PERSONNEL ACCORDING TO NEC APPLICABLE CODES.

2.2.7 ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR OUTDOOR USAGE WHEN APPROPRIATE.

2.3.1 **STRUCTURAL NOTES:**

2.3.2 RACKING SYSTEM & PV ARRAY WILL BE INSTALLED ACCORDING TO CODE-COMPLIANT INSTALLATION MANUAL. TOP CLAMPS REQUIRE A DESIGNATED SPACE BETWEEN MODULES, AND RAILS MUST ALSO EXTEND A MINIMUM DISTANCE BEYOND EITHER EDGE OF THE ARRAY/SUBARRAY, ACCORDING TO RAI MANUFACTURER'S INSTRUCTIONS.

2.3.3 JUNCTION BOX WILL BE INSTALLED PER MANUFACTURERS' SPECIFICATIONS. IF ROOF-PENETRATING TYPE, IT SHALL BE FLASHED & SEALED PER LOCAL REQUIREMENTS.

2.3.4 ROOFTOP PENETRATIONS FOR PV RACEWAY WILL BE COMPLETED AND SEALED W/ APPROVED CHEMICAL SEALANT PER CODE BY A LICENSED CONTRACTOR.

2.3.5 ALL PV RELATED ROOF ATTACHMENTS TO BE SPACED NO GREATER THAN THE SPAN DISTANCE SPECIFIED BY THE RACKING MANUFACTURER.

2.3.6 WHEN POSSIBLE, ALL PV RELATED RACKING ATTACHMENTS WILL BE STAGGERED AMONGST THE ROOF FRAMING MEMBERS.

2.4.1 **WIRING & CONDUIT NOTES:**

2.4.2 ALL CONDUIT AND WIRE WILL BE LISTED AND APPROVED FOR THEIR PURPOSE. CONDUIT AND WIRE SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING.

2.4.3 CONDUCTORS SIZED ACCORDING TO NEC 690.8, NEC 690.7.

2.4.4 VOLTAGE DROP LIMITED TO 1.5%.

2.4.5 DC WIRING LIMITED TO MODULE FOOTPRINT. MICROINVERTER WIRING SYSTEMS SHALL BE LOCATED AND SECURED UNDER THE ARRAY W/ SUITABLE WIRING CLIPS.

2.4.6 AC CONDUCTORS COLORED OR MARKED AS FOLLOWS:

PHASE A OR L1- BLACK
PHASE B OR L2- RED, OR OTHER CONVENTION IF THREE PHASE
PHASE C OR L3- BLUE, YELLOW, ORANGE**, OR OTHER CONVENTION
NEUTRAL- WHITE OR GREY

IN 4-WIRE DELTA CONNECTED SYSTEMS THE PHASE WITH HIGHER VOLTAGE TO BE MARKED ORANGE [NEC 110.15].

4.5.1 **GROUNDING NOTES:**

2.5.2 GROUNDING SYSTEM COMPONENTS SHALL BE LISTED FOR THEIR PURPOSE, AND GROUNDING DEVISES EXPOSED TO THE ELEMENTS SHALL BE RATED FOR SUCH USE.

2.5.3 PV EQUIPMENT SHALL BE GROUNDED ACCORDING TO NEC 690.43 AND MINIMUM NEC TABLE 250.122.

2.5.4 METAL PARTS OF MODULE FRAMES, MODULE RACKING, AND ENCLOSURES CONSIDERED GROUNDED IN ACCORD WITH 250.134 AND 250.136(A).

2.5.5 EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO NEC 690.45 AND MICROINVERTER MANUFACTORERS' INSTRUCTIONS.

2.5.6 EACH MODULE WILL BE GROUNDED USING WEEB GROUNDING CLIPS AS SHOWN IN MANUFACTURER DOCUMENTATION AND APPROVED BY THE AHJ. IF WEEBS ARE NOT USED, MODULE GROUNDING LUGS MUST BE INSTALLED AT THE SPECIFIED GROUNDING LUG HOLES PER THE MANUFACTURERS' INSTALLATION REQUIREMENTS.

2.5.7 THE GROUNDING CONNECTION TO A MODULE SHALL BE ARRANGED SUCH THAT THE REMOVAL OF A MODULE DOES NOT INTERRUPT A GROUNDING CONDUCTOR TO ANOTHER MODULE.

2.5.8 GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLORED GREEN OR MARKED GREEN IF #4 AWG OR LARGER [NEC 250.119]

2.5.9 THE GROUNDING ELECTRODE SYSTEM COMPLIES WITH NEC 690.47 AND NEC 250.50 THROUGH 250.106. IF EXISTING SYSTEM IS INACCESSIBLE, OR INADEQUATE, A GROUNDING ELECTRODE SYSTEM PROVIDED ACCORDING TO NEC 250, NEC 690.47 AND AHJ.

2.5.10 GROUND-FAULT DETECTION SHALL COMPLY WITH NEC 690.5 IN GENERAL AND NEC 690.5 (A)(1) SPECIFICALLY.

2.6.1 **DISCONNECTION AND OVER-CURRENT PROTECTION NOTES:**

2.6.2 DISCONNECTING SWITCHES SHALL BE WIRED SUCH THAT WHEN THE SWITCH IS OPENED THE CONDUCTORS REMAINING ENERGIZED ARE CONNECTED TO THE TERMINALS MARKED "LINE SIDE" (TYPICALLY THE UPPER TERMINALS).

2.6.3 DISCONNECTS TO BE ACCESSIBLE TO QUALIFIED UTILITY PERSONNEL, BE LOCKABLE, AND BE A VISIBLE-BREAK SWITCH

2.6.4 RAPID SHUTDOWN OF ENERGIZED CONDUCTORS BEYOND 10 FT OF PV ARRAY OR 5 FT INSIDE A BUILDING WITHIN 10 SECONDS. CONTROLLED CONDUCTORS ≤30V AND ≤240VA [NEC 690.12]. LOCATION OF LABEL ACCORDING TO AHJ.

2.6.5 ALL OCPD RATINGS AND TYPES SPECIFIED ACCORDING TO NEC 690.8, 690.9, AND 240.

2.6.6 MICROINVERTER BRANCHES CONNECTED TO A SINGLE BREAKER OR GROUPED FUSES IN ACCORDANCE WITH NEC 110.3(B).

2.6.7 IF REQUIRED BY AHJ, SYSTEM WILL INCLUDE ARC-FAULT CIRCUIT PROTECTION ACCORDING TO NEC 690.11 AND UL1699B.

2.7.1 **INTERCONNECTION NOTES:**

2.7.2 LOAD-SIDE INTERCONNECTION SHALL BE IN ACCORDANCE WITH [NEC 690.64 (B)]

2.7.3 THE SUM OF THE UTILITY OCPD AND INVERTER CONTINUOUS INPUT MAY NOT EXCEED 120% OF BUSBAR RATING [NEC 705.12(D)(2)(3)].

2.7.4 WHEN SUM OF THE PV SOURCES EQUALS >100% OF BUSBAR RATING, PV DEDICATED BACKFFED BREAKERS MUST BE LOCATED OPPOSITE END OF THE BUS FROM THE UTILITY SOURCE OCPD [NEC 705.12(D)(2)(3)].

2.7.5 AT MULTIPLE PV OUTPUT COMBINER PANEL, TOTAL RATING OF ALL OVERCURRENT DEVICES SHALL NOT EXCEED AMPACITY OF BUSBAR. HOWEVER, THE COMBINED OVERCURRENT DEVICE MAY BE EXCLUDED ACCORDING TO NEC 705.12 (D)(2)(3)(C).

2.7.6 FEEDER TAP INTERCONECTION (LOAD SIDE) ACCORDING TO NEC 705.12 (D)(2)(1)

2.7.7 SUPPLY SIDE TAP INTERCONNECTION ACCORDING TO NEC 705.12 (A) WITH SERVICE ENTRANCE CONDUCTORS IN ACCORDANCE WITH NEC 230.42

2.7.8 BACKFEEDING BREAKER FOR UTILITY-INTERACTIVE INVERTER OUTPUT IS EXEMPT FROM ADDITIONAL FASTENING [NEC 705.12 (D)(5)].

**CONTRACTOR**

EXAMPLE CONTRACTOR

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**ELE. NO.:**



NEW PV SYSTEM: 7.84 kWp

# EXAMPLE RESIDENCE

111 EXAMPLE DR
DETROIT, MI 11111 APN:
01010101010101

**ENGINEER OF RECORD**

PAPER SIZE: 11" x 17" (ANSI B)

NOTES

**DATE:** 11.30.2016
**DESIGN BY:**
**CHECKED BY:**

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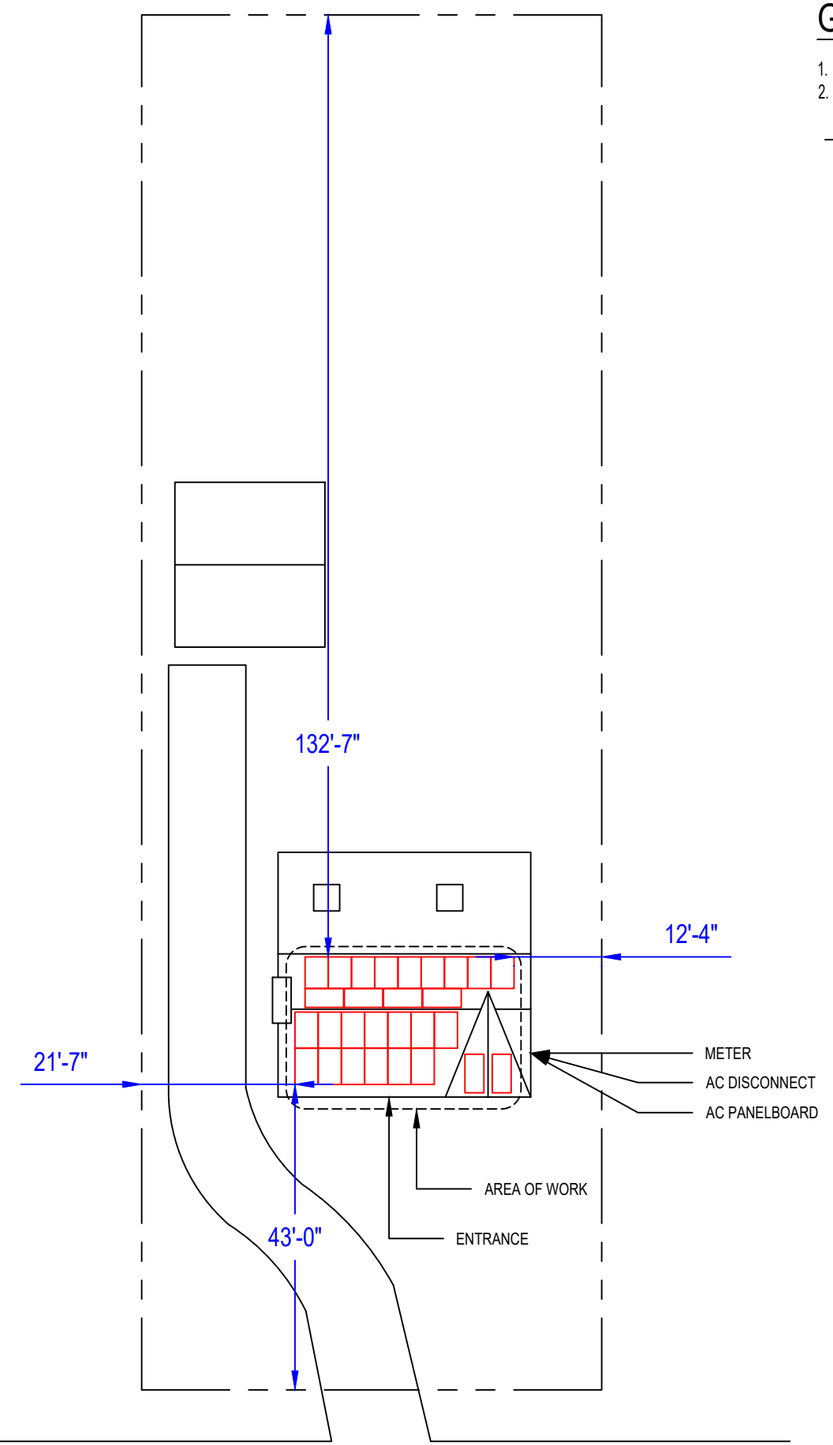
(SHEET 2)

# GENERAL NOTES

1. FIELD VERIFY ALL MEASUREMENTS
2. ITEMS BELOW MAY NOT BE ON THIS PAGE

PROPERTY LINE




01 SITE PLAN

3/64" = 1'-0"

0 10'-8" 21'-4"

## CONTRACTOR


EXAMPLE CONTRACTOR

**PHONE:** 123-456-7890
**ADDRESS:** 111 EX DRIVE
DETROIT, MI 11111

**LIC. NO.:** 01010101010
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**ELE. NO.:**




NEW PV SYSTEM: 7.84 kWp

# EXAMPLE RESIDENCE

111 EXAMPLE DR
DETROIT, MI 11111 APN:
01010101010101

## ENGINEER OF RECORD

PAPER SIZE: 11" x 17" (ANSI B)

SITE PLAN

**DATE:** 11.30.2016
**DESIGN BY:**
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(SHEET 3)

# GENERAL NOTES

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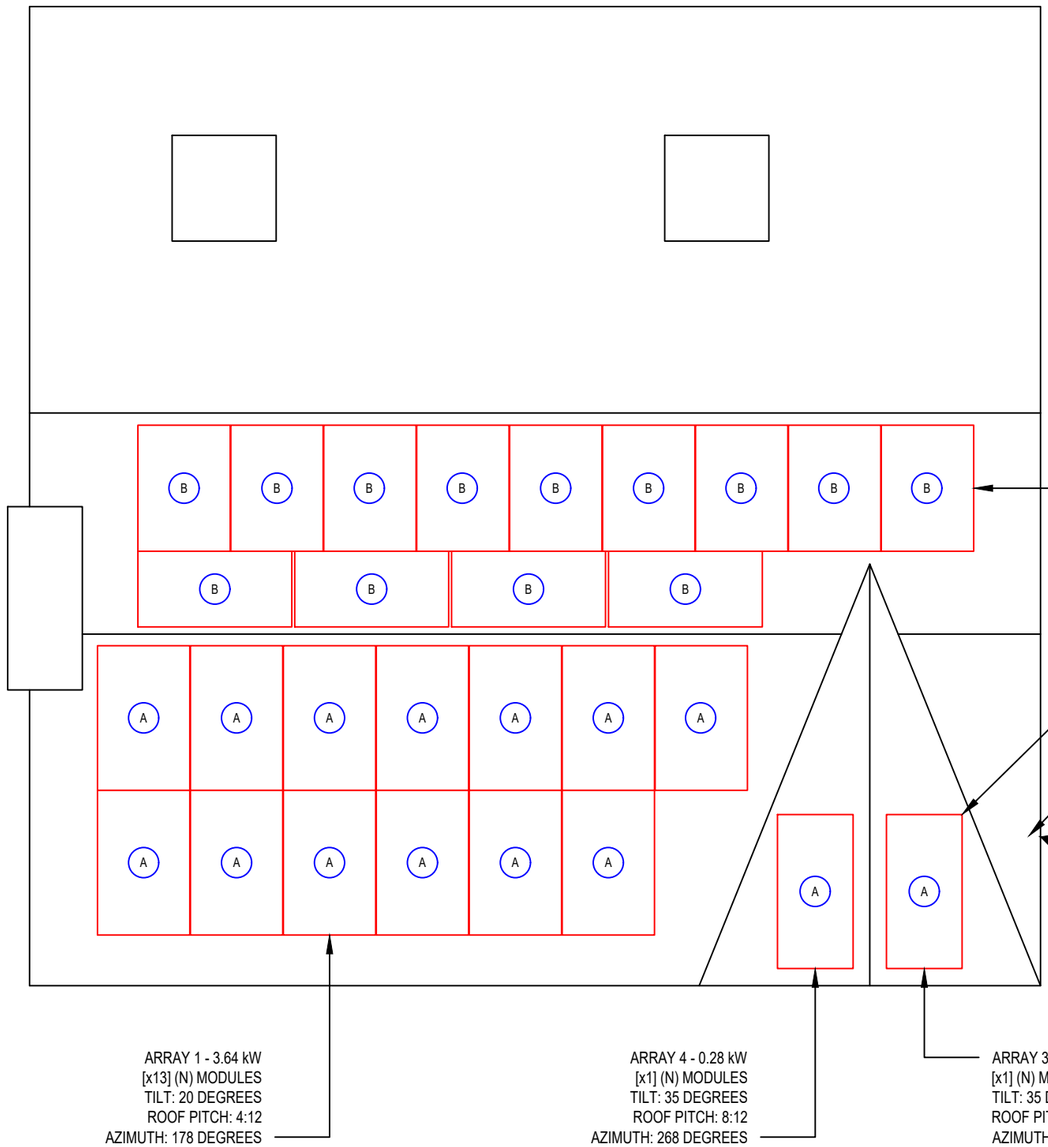
2. ITEMS BELOW MAY NOT BE ON THIS PAGE




EQUIPMENT GROUND

CONDUIT

A MODULE STRINGING

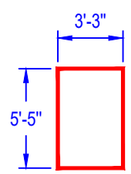
B MODULE STRINGING

01 ELECTRICAL PLAN

3/16" = 1'

0 2'-8" 5'-4"

N W E S




MODULE:
CANADIAN SOLAR
CS6K-280M
280 WATTS

## CONTRACTOR


EXAMPLE CONTRACTOR

**PHONE:** 123-456-7890
**ADDRESS:** 111 EX DRIVE
DETROIT, MI 11111

**LIC. NO.:** 01010101010
**HIC. NO.:**
**ELE. NO.:**




## ENGINEER OF RECORD

PAPER SIZE: 11" x 17" (ANSI B)

ELECTRICAL PLAN

**DATE:** 11.30.2016

**DESIGN BY:**

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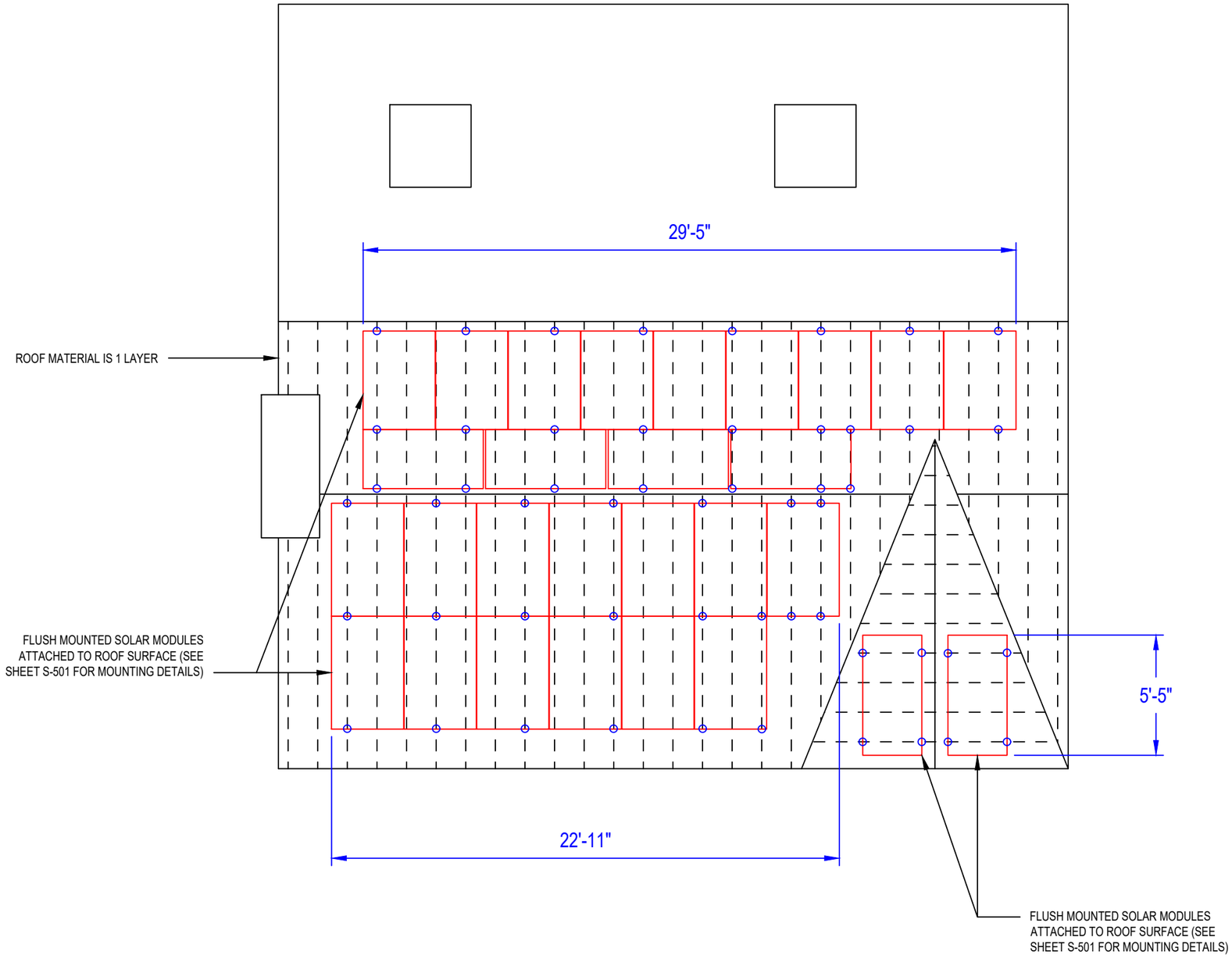
(SHEET 4)

# GENERAL NOTES

1. FIELD VERIFY ALL MEASUREMENTS
2. ITEMS BELOW MAY NOT BE ON THIS PAGE

_ _ _ _ ROOF RAFTERS

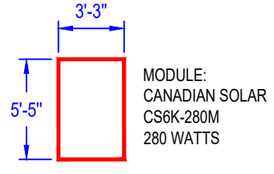



01 SOLAR ATTACHMENT PLAN

3/16" = 1'

0 2'-8" 5'-4"

N W E S




MODULE:
CANADIAN SOLAR
CS6K-280M
280 WATTS

## CONTRACTOR

EXAMPLE CONTRACTOR

**PHONE:** 123-456-7890
**ADDRESS:** 111 EX DRIVE
DETROIT, MI 11111

**LIC. NO.:** 01010101010
**HIC. NO.:**
**ELE. NO.:**



NEW PV SYSTEM: 7.84 kWp

# EXAMPLE RESIDENCE

111 EXAMPLE DR
DETROIT, MI 11111 APN:
01010101010101

## ENGINEER OF RECORD

PAPER SIZE: 11" x 17" (ANSI B)

SOLAR ATTACHMENT PLAN

**DATE:** 11.30.2016

**DESIGN BY:**

**CHECKED BY:**

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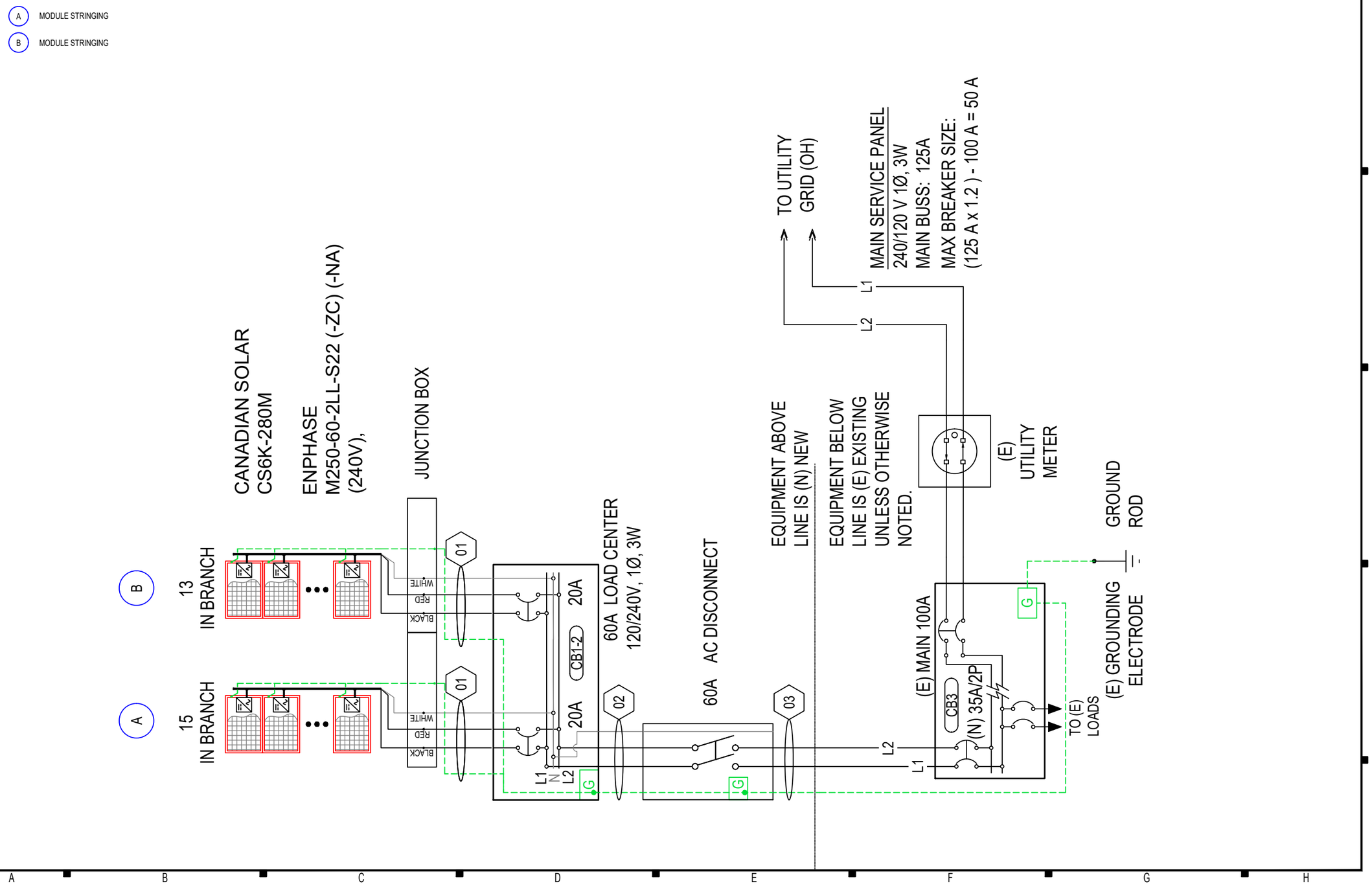
A-103.00

(SHEET 5)

## CONDUCTOR AND CONDUIT SCHEDULE W/ELECTRICAL CALCULATIONS

| ID | TYPICAL | CONDUCTOR | CONDUIT | CURRENT-CARRYING CONDUCTORS IN CONDUIT | OCPD | EGC | TEMP. CORR. FACTOR | CONDUIT FILL FACTOR | CONT. CURRENT | MAX. CURRENT (125%) | BASE AMP. | DERATED AMP. | TERM. TEMP. RATING | AMP. @ TERMINAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 8 AWG THWN-2, COPPER | 1" DIA. PVC-40 | 4 | 20A | 6 AWG THWN-2, COPPER | 0.76 (55°C) | 0.8 | 15A | 18.75A | 55A | 33.44A | 75°C | 50A |
| 2 | 1 | 8 AWG THWN-2, COPPER | 0.75" DIA. PVC-40 | 2 | N/A | 6 AWG THWN-2, COPPER | 0.96 (33°C) | 1.0 | 28A | 35A | 55A | 52.8A | 75°C | 50A |
| 3 | 1 | 8 AWG THWN-2, COPPER | 0.75" DIA. PVC-40 | 2 | 35A | 6 AWG THWN-2, COPPER | 0.96 (33°C) | 1.0 | 28A | 35A | 55A | 52.8A | 75°C | 50A |





**CONTRACTOR**

EXAMPLE CONTRACTOR

**PHONE:** 123-456-7890
**ADDRESS:** 111 EX DRIVE
DETROIT, MI 11111

**LIC. NO.:** 01010101010
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NEW PV SYSTEM: 7.84 kWp

# EXAMPLE RESIDENCE

111 EXAMPLE DR
DETROIT, MI 11111 APN:
01010101010101

**ENGINEER OF RECORD**

PAPER SIZE: 11" x 17" (ANSI B)

LINE DIAGRAM

**DATE:** 11.30.2016
**DESIGN BY:**
**CHECKED BY:**

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(SHEET 6)

| SYSTEM SUMMARY | | |
|---|---|---|
| | BRANCH #1 | BRANCH #2 |
| INVERTERS PER BRANCH | 15 | 13 |
| MAX AC CURRENT | 15A | 13A |
| MAX AC OUTPUT POWER | 3,750W | 3,250W |
| ARRAY STC POWER | 7,840W | |
| ARRAY PTC POWER | 7,109W | |
| MAX AC CURRENT | 28A | |
| MAX AC POWER | 7,000W | |
| DERATED (CEC) AC POWER | 6,860W | |

| DESIGN TEMPERATURES | |
|---|---|
| ASHRAE EXTREME LOW | -16°C (3°F), SOURCE: MCGUIRE AFB (KWRI) 40.02°, -74.6° |
| ASHRAE 2% HIGH | 33°C (91°F), SOURCE: MCGUIRE AFB (KWRI) 40.02°, -74.6° |

| MODULES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| REF. | QTY. | MAKE AND MODEL | PMAX | PTC | ISC | IMP | VOC | VMP | TEMP. COEFF. OF VOC | FUSE RATING |
| PM1-28 | 28 | CANADIAN SOLAR CS6K-280M | 280W | 254W | 9.43A | 8.89A | 38.5V | 31.5V | -0.119V/°C (-0.31%/°C) | 15A |

| INVERTERS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| REF. | QTY. | MAKE AND MODEL | AC VOLTAGE | GROUND | MAX OCPD RATING | RATED POWER | MAX OUTPUT CURRENT | MAX INPUT CURRENT | MAX INPUT VOLTAGE | CEC WEIGHTED EFFICIENCY |
| I1-28 | 28 | ENPHASE M250-60-2LL-S22 (-ZC) (-NA) (240V) | 240V | FLOATING | 20A | 250W | 1.0A | 9.8A | 48V | 96.5% |

| DISCONNECTS | | | | |
|---|---|---|---|---|
| REF. | QTY. | MAKE AND MODEL | RATED CURRENT | MAX RATED VOLTAGE |
| SW1 | 1 | SQUARE D DU222RB OR EQUIV. | 60A | 240VAC |

| OCPDS | | | |
|---|---|---|---|
| REF. | QTY. | RATED CURRENT | MAX VOLTAGE |
| CB1-2 | 2 | 20A | 240VAC |
| CB3 | 1 | 35A | 240VAC |

| BILL OF MATERIALS | | | | | | | |
|---|---|---|---|---|---|---|---|
| CATEGORY | MAKE | MODEL NUMBER | REF | QTY | UNIT | QTY/UNIT | DESCRIPTION |
| MODULE | CANADIAN SOLAR | CS6K-280M | PM1-28 | 28 | PIECES | 1 | CANADIAN SOLAR CS6K-280M 280W, 60 CELLS, MONOCRYSTALLINE SILICON |
| INVERTER | ENPHASE | M250-60-2LL-S22-IG | I1-28 | 28 | PIECES | 1 | ENPHASE M250-60-2LL-S22-IG 250W MICROINVERTER |
| DISCONNECT | SQUARE D | DU222RB | SW1 | 1 | PIECE | 1 | SQUARE D DU222RB DISCONNECT SWITCH, 2-POLE, 60A, 240VAC, OR EQUIVALENT |
| MISC ELECTRICAL EQUIPMENT | | GEN-AC-PANEL | EP1 | 1 | PIECE | 1 | AC SUBPANEL |
| MISC ELECTRICAL EQUIPMENT | | GEN-CABLE-CLIP | HDWR6-145 | 140 | PIECES | 1 | GENERIC CABLE CLIP |
| WIRING | ENPHASE | ET17-240-40 | EN1-2 | 2 | PIECES | 1 | ENPHASE ENGAGE (TM) TRUNK CABLE FOR LANDSCAPE LAYOUT |
| WIRING | ENPHASE | ET-TERM-10 | EN3 | 1 | BUNDLE | 10 | ENPHASE ENGAGE (TM) BRANCH TERMINATOR |
| WIRING | ENPHASE | ET-SEAL-10 | EN4 | 1 | BUNDLE | 10 | ENPHASE ENGAGE (TM) WATERTIGHT SEALING CAP |
| WIRING | | GEN-8-AWG-THWN-2-CU-WH | WR1-3 | 110 | FEET | 1 | 8 AWG THWN-2, COPPER, WHITE (NEUTRAL) |
| WIRING | | GEN-8-AWG-THWN-2-CU-BLK | WR1-3 | 110 | FEET | 1 | 8 AWG THWN-2, COPPER, BLACK (LINE 1) |
| WIRING | | GEN-8-AWG-THWN-2-CU-RD | WR1-3 | 110 | FEET | 1 | 8 AWG THWN-2, COPPER, RED (LINE 2) |
| WIRING | | GEN-6-AWG-THWN-2-CU-GR | WR1-3 | 110 | FEET | 1 | 6 AWG THWN-2, COPPER, GREEN (GROUND) |
| WIREWAY | ENPHASE | ET-SPLK-05 | EN5 | 1 | BUNDLE | 5 | ENPHASE ENGAGE (TM) ENGAGE COUPLER |
| WIREWAY | | GEN-JBOX | JB1 | 1 | PIECE | 1 | JUNCTION BOX |
| WIREWAY | | GEN-PVC-40-1DIA | WW1 | 45 | FEET | 1 | PVC_40 CONDUIT, 1 DIA. |
| WIREWAY | | GEN-PVC-40-0_75DIA | WW2-3 | 20 | FEET | 1 | PVC_40 CONDUIT, 0.75 DIA. |
| OCPD | GENERIC MANUFACTURER | GEN-CB-20A-240VAC | CB1-2 | 2 | PIECES | 1 | CIRCUIT BREAKER, 20A, 240VAC |
| OCPD | GENERIC MANUFACTURER | GEN-CB-35A-240VAC | CB3 | 1 | PIECE | 1 | CIRCUIT BREAKER, 35A, 240VAC |


**CONTRACTOR**

EXAMPLE CONTRACTOR

**PHONE:** 123-456-7890
**ADDRESS:** 111 EX DRIVE
DETROIT, MI 11111

**LIC. NO.:** 01010101010
**HIC. NO.:**
**ELE. NO.:**




NEW PV SYSTEM: 7.84 kWp

# EXAMPLE RESIDENCE

111 EXAMPLE DR
DETROIT, MI 11111 APN:
01010101010101

**ENGINEER OF RECORD**

PAPER SIZE: 11" x 17" (ANSI B)

DESIGN TABLES

**DATE:** 11.30.2016
**DESIGN BY:**
**CHECKED BY:**

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E-602.00
(SHEET 7)

! WARNING !

ELECTRIC SHOCK HAZARD
IF A GROUND FAULT IS INDICATED, NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED.

**LABEL 1**
AT EACH INVERTER
[NEC 690.5]

! WARNING !

ELECTRIC SHOCK HAZARD
DO NOT TOUCH TERMINALS.
TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.

**LABEL 2**
AT EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT
[NEC 690.17]

**PHOTOVOLTAIC AC DISCONNECT**

OPERATING CURRENT: 28.0 A AC
OPERATING VOLTAGE: 240 V AC

**LABEL 4**
AT POINT OF INTERCONNECTION, MARKED AT DISCONNECTING MEANS
[NEC 690.54]

! WARNING !

DUAL POWER SOURCES.
SECOND SOURCE IS PV SYSTEM

! CAUTION !

PHOTOVOLTAIC SYSTEM CIRCUIT IS BACKFED

INTERACTIVE PHOTOVOLTAIC SYSTEM CONNECTED

**LABEL 5**

**LABEL 6**

**LABEL 7**
AT UTILITY METER
[NEC 690.56(B)]

AT POINT OF INTERCONNECTION; LABEL, SUCH AS LABEL 5 OR LABEL 6 MUST IDENTIFY PHOTOVOLTAIC SYSTEM
[NEC 705.12(D)(4)]

WARNING: PHOTOVOLTAIC POWER SOURCE

**LABEL 10**
AT EXPOSED RACEWAYS, CABLE TRAYS, AND OTHER WIRING METHODS; SPACED AT MAXIMUM 10 FT SECTION OR WHERE SEPARATED BY ENCLOSURES, WALLS, PARTITIONS, CEILINGS, OR FLOORS.
[NEC 690.31(G)]
LETTERS AT LEAST 3/8 INCH; WHITE ON RED BACKGROUND; REFLECTIVE
[IFC 605.11.1.1]

**PHOTOVOLTAIC AC DISCONNECT**

**LABEL 11**
AT EACH AC DISCONNECTING MEANS
[NEC 690.13(B)]

! WARNING !

INVERTER OUTPUT CONNECTION.
DO NOT RELOCATE THIS OVERCURRENT DEVICE

**LABEL 12**
AT POINT OF INTERCONNECTION OVERCURRENT DEVICE
[NEC 705.12(D)(7)]

INTERACTIVE PHOTOVOLTAIC SYSTEM CONNECTED
PHOTOVOLTAIC SYSTEM DISCONNECT LOCATED EAST SIDE OF THE HOUSE

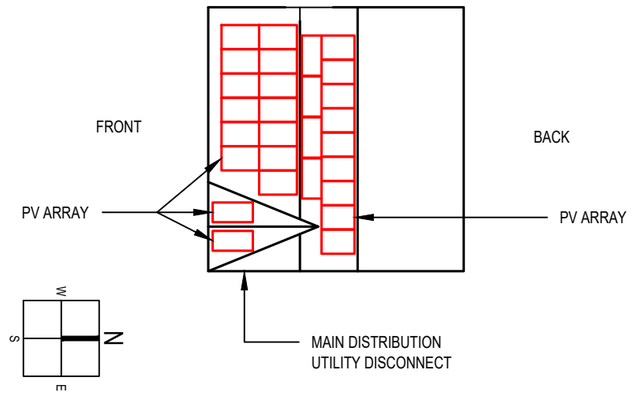
**PLAQUE**

**DIRECTORY**
PERMANENT PLAQUE OR DIRECTORY PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS IF NOT IN THE SAME LOCATION
[NEC 690.56(B)]
WHERE THE INVERTERS ARE REMOTELY LOCATED FROM EACH OTHER, A DIRECTORY IN ACCORDANCE WITH 705.10 SHALL BE INSTALLED AT EACH DC PV SYSTEM DISCONNECTING MEANS, AT EACH AC DISCONNECTING MEANS, AND AT THE MAIN SERVICE DISCONNECTING MEANS SHOWING THE LOCATION OF ALL AC AND DC PV SYSTEM DISCONNECTING MEANS IN THE BUILDING.
[NEC 690.4(H)]

**LABELING NOTES**:
1.1 LABELING REQUIREMENTS BASED ON THE 2014 NATIONAL ELECTRICAL CODE, INTERNATIONAL FIRE CODE 605.11, OSHA STANDARD 1910.145, ANSI Z535
1.2 MATERIAL BASED ON THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
1.3 LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.
1.4 LABELS TO BE A MINIMUM LETTER HEIGHT OF 3/8" AND PERMANENTLY AFFIXED.
1.5 ALERTING WORDS TO BE COLOR CODED. "DANGER" WILL HAVE RED BACKGROUND; "WARNING" WILL HAVE ORANGE BACKGROUND; "CAUTION" WILL HAVE YELLOW BACKGROUND. [ANSI Z535]

# !CAUTION!

POWER TO THIS BUILDING IS ALSO SUPPLIED FROM ROOF MOUNTED SOLAR ARRAYS WITH SAFETY DISCONNECTS AS SHOWN:




## CONTRACTOR


EXAMPLE CONTRACTOR

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NEW PV SYSTEM: 7.84 kWp

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PAPER SIZE: 11" x 17" (ANSI B)

PLACARDS

**DATE:** 11.30.2016
**DESIGN BY:**
**CHECKED BY:**

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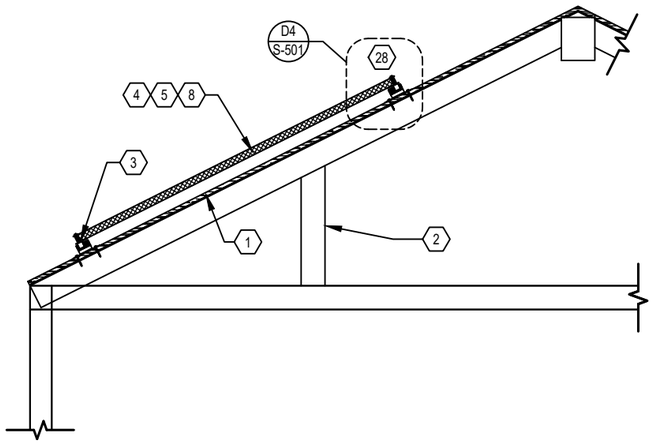
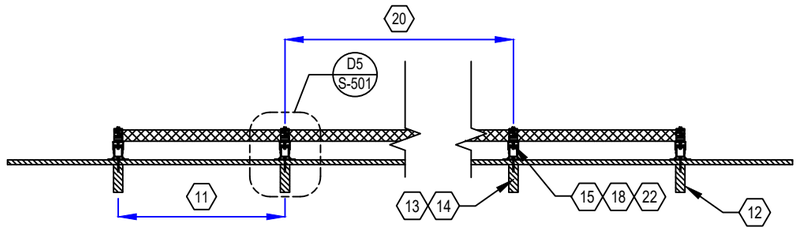
E-603.00
(SHEET 8)



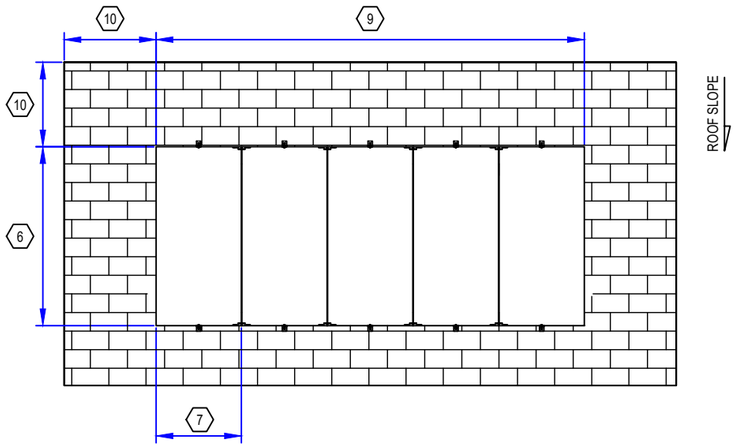




## D2 RACKING DETAIL (LONGITUDINAL)

NOT TO SCALE

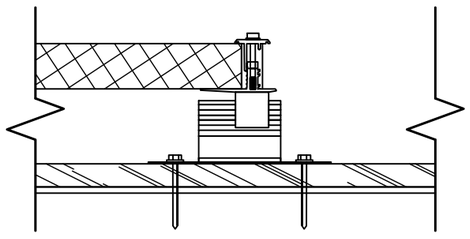
## D1 RACKING DETAIL (TRANSVERSE)

NOT TO SCALE



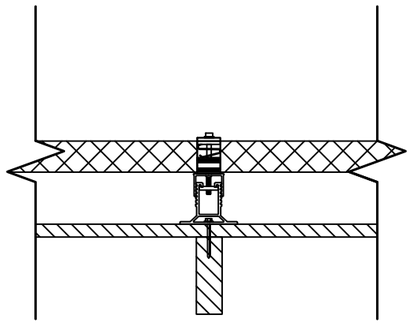

## D3 RACKING DETAIL (TOP)

NOT TO SCALE



## D4 DETAIL (TRANSVERSE)

NOT TO SCALE



## D5 DETAIL (LONGITUDINAL)

NOT TO SCALE

## GENERAL NOTES

1. FIELD VERIFY ALL MEASUREMENTS

## SHEET KEYNOTES

1. ROOF MATERIAL: ASPHALT SHINGLE
2. ROOF STRUCTURE: KNEE WALL
3. ATTACHMENT TYPE: ECOLIBRIUM ECOX
4. MODULE MANUFACTURER: CANADIAN SOLAR
5. MODULE MODEL: CS6K-280M
6. MODULE LENGTH: 5'-5"
7. MODULE WIDTH: 3'-3"
8. MODULE WEIGHT: 40.1 LBS.
9. SEE SHEET A-2 FOR DIMENSION(S)
10. MIN. FIRE OFFSET: NO FIRE CODE ENFORCED
11. RAFTER SPACING: 16 IN. O.C.
12. RAFTER SIZE: 2X6 NOMINAL
13. LAG BOLT DIAMETER: 3/8 IN.
14. LAG BOLT EMBEDMENT: 4 IN.
15. TOTAL # OF ATTACHMENTS: 53
16. TOTAL AREA: 508.2 SQ. FT.
17. TOTAL WEIGHT: 1122.8 LBS.
18. WEIGHT PER ATTACHMENT: 21.18 LBS.
19. DISTRIBUTED LOAD: 2.2 PSF.
20. MAX. HORIZONTAL STANDOFF: 48 IN.
21. MAX. VERTICAL STANDOFF: LANDSCAPE: 26 IN., PORTRAIT: 33 IN.
22. STANDOFF STAGGERING: NO
23. MAX. RAFTER SPAN: 13 FT.
24. MODULE CLEARANCE: 3 IN. MIN., 6 IN. MAX.

**CONTRACTOR**

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NEW PV SYSTEM: 7.84 kWp

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**ENGINEER OF RECORD**

PAPER SIZE: 11" x 17" (ANSI B)

ASSEMBLY DETAILS

**DATE:** 11.30.2016

**DESIGN BY:**

**CHECKED BY:**

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S-501.00

(SHEET 9)

# CS6K-275|280|285M

The high quality and reliability of Canadian Solar's modules is ensured by 15 years of experience in module manufacturing, well-engineered module design, stringent BOM quality testing, an automated manufacturing process and 100% EL testing.

*Black frame product can be provided upon request.

## KEY FEATURES

- Excellent module efficiency of up to 17.41 %
- High PTC rating of up to 90.7%
- Outstanding low irradiance performance: 96.5 %
- IP67 junction box for long-term weather endurance
- Heavy snow load up to 5400 Pa, wind load up to 2400 Pa

**25 years** linear power output warranty

**10 years** 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 / IEC 61215 performance: CEC listed (US)
UL 1703: CSA / IEC 61701 ED2: VDE / IEC 62716: VDE / Take-e-way

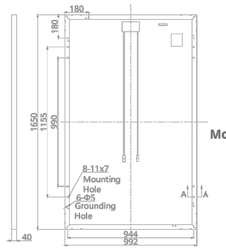
* As there are different certification requirements in different markets, please contact your local Canadian Solar sales representative for the specific certificates applicable to the products in the region in which the products are to be used.

**CANADIAN SOLAR INC.** is committed to providing high quality solar products, solar system solutions and services to customers around the world. As a leading PV project developer and manufacturer of solar modules with over 15 GW deployed around the world since 2001, Canadian Solar Inc. (NASDAQ: CSIQ) is one of the most bankable solar companies worldwide.

**CANADIAN SOLAR INC.**
545 Speedvale Avenue West, Guelph, Ontario N1K 1E6, Canada, www.canadiansolar.com, support@canadiansolar.com

## ENGINEERING DRAWING (mm)

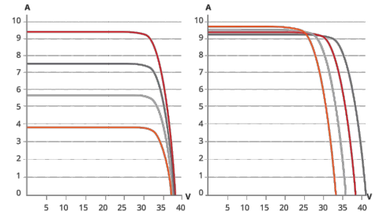
Rear View




Frame Cross Section A-A


Mounting Hole


## CS6K-280M / I-V CURVES




## ELECTRICAL DATA / STC*

| CS6K | 275M | 280M | 285M |
|---|---|---|---|
| Nominal Max. Power (Pmax) | 275 W | 280 W | 285 W |
| Opt. Operating Voltage (Vmp) | 31.3 V | 31.5 V | 31.7 V |
| Opt. Operating Current (Imp) | 8.80 A | 8.89 A | 8.98 A |
| Open Circuit Voltage (Voc) | 38.3 V | 38.5 V | 38.6 V |
| Short Circuit Current (Isc) | 9.31 A | 9.43 A | 9.51 A |
| Module Efficiency | 16.80 % | 17.11 % | 17.41 % |
| Operating Temperature | -40°C ~ +85°C | | |
| Max. System Voltage | 1000 V (IEC) or 1000 V (UL) | | |
| Module Fire Performance | TYPE 1 (UL 1703) or CLASS C (IEC 61730) | | |
| Max. Series Fuse Rating | 15 A | | |
| Application Classification | Class A | | |
| Power Tolerance | 0 ~ + 5 W | | |

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m², spectrum AM 1.5 and cell temperature of 25°C.

## MECHANICAL DATA

| Specification | Data |
|---|---|
| Cell Type | Mono-crystalline, 6 inch |
| Cell Arrangement | 60 (6×10) |
| Dimensions | 1650×992×40 mm (65.0×39.1×1.57 in) |
| Weight | 18.2 kg (40.1 lbs) |
| Front Cover | 3.2 mm tempered glass |
| Frame Material | Anodized aluminium alloy |
| J-Box | IP67, 3 diodes |
| Cable | 4 mm² (IEC) or 4 mm² & 12 AWG 1000 V (UL), 1000 mm (39.4 in) |
| Per Pallet | 26 pieces, 520 kg (1146.4 lbs) (quantity & weight per pallet) |
| Per container (40' HQ) | 728 pieces |

## ELECTRICAL DATA / NOCT*

| Electrical Data CS6K | 275M | 280M | 285M |
|---|---|---|---|
| Nominal Max. Power (Pmax) | 199 W | 202 W | 206 W |
| Opt. Operating Voltage (Vmp) | 28.5 V | 28.7 V | 28.9 V |
| Opt. Operating Current (Imp) | 6.95 A | 7.04 A | 7.12 A |
| Open Circuit Voltage (Voc) | 35.1 V | 35.3 V | 35.4 V |
| Short Circuit Current (Isc) | 7.54 A | 7.63 A | 7.70 A |

* Under Nominal Operating Cell Temperature (NOCT), irradiance of 800 W/m², spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

## TEMPERATURE CHARACTERISTICS

| Specification | Data |
|---|---|
| Temperature Coefficient (Pmax) | -0.41 % / °C |
| Temperature Coefficient (Voc) | -0.31 % / °C |
| Temperature Coefficient (Isc) | 0.053 % / °C |
| Nominal Operating Cell Temperature | 45±2 °C |

## PERFORMANCE AT LOW IRRADIANCE

Outstanding performance at low irradiance, average relative efficiency of 96.5 % from an irradiance of 1000 W/m² to 200 W/m² (AM 1.5, 25°C).

The specification and key features described in this datasheet may deviate slightly and are not guaranteed. Due to on-going innovation, research and product enhancement, Canadian Solar Inc. reserves the right to make any adjustment to the information described herein at any time without notice. Please always obtain the most recent version of the datasheet which shall be duly incorporated into the binding contract made by the parties governing all transactions related to the purchase and sale of the products described herein.
Caution: For professional use only. The installation and handling of PV modules requires professional skills and should only be performed by qualified professionals. Please read the safety and installation instructions before using the modules.

## PARTNER SECTION



## CONTRACTOR

EXAMPLE CONTRACTOR

**PHONE:** 123-456-7890
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**LIC. NO.:** 01010101010
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NEW PV SYSTEM: 7.84 kWp

# EXAMPLE RESIDENCE

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DETROIT, MI 11111 APN:
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## ENGINEER OF RECORD

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RESOURCE DOCUMENT

**DATE:** 11.30.2016
**DESIGN BY:**
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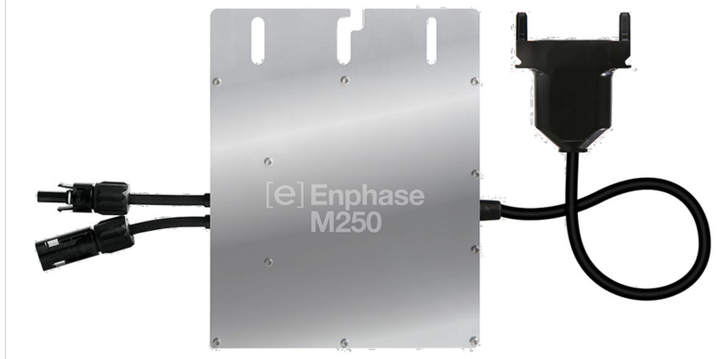
REVISIONS

R-001.00

SHEET 10

Enphase® **Microinverters**

# Enphase® **M250**




The **Enphase® M250 Microinverter** delivers increased energy harvest and reduces design and installation complexity with its all-AC approach. With the M250, the DC circuit is isolated and insulated from ground, so **no Ground Electrode Conductor (GEC) is required for the microinverter.** This further simplifies installation, enhances safety, and saves on labor and materials costs.

The Enphase M250 integrates seamlessly with the Engage® Cable, the Envoy® Communications Gateway™, and Enlighten®, Enphase's monitoring and analysis software.

### PRODUCTIVE

- Optimized for higher-power modules
- Maximizes energy production
- Minimizes impact of shading, dust, and debris

### SIMPLE

- No GEC needed for microinverter
- No DC design or string calculation required
- Easy installation with Engage Cable

### RELIABLE

- 4th-generation product
- More than 1 million hours of testing and millions of units shipped
- Industry-leading warranty, up to 25 years

[e] enphase® ENERGY

C SP US

Enphase® **M250** Microinverter // DATA

| **INPUT DATA (DC)** | **M250-60-2LL-S22, M250-60-2LL-S25** | |
|---|---|---|
| Recommended input power (STC) | 210 - 310 W | |
| Maximum input DC voltage | 48 V | |
| Peak power tracking voltage | 27 V - 39 V | |
| Operating range | 16 V - 48 V | |
| Min/Max start voltage | 22 V / 48 V | |
| Max DC short circuit current | 15 A | |
| **OUTPUT DATA (AC)** | **@208 VAC** | **@240 VAC** |
| Peak output power | 250 W | 250 W |
| Rated (continuous) output power | 240 W | 240 W |
| Nominal output current | 1.15 A (A rms at nominal duration) | 1.0 A (A rms at nominal duration) |
| Nominal voltage/range | 208 V / 183-229 V | 240 V / 211-264 V |
| Nominal frequency/range | 60.0 / 57-61 Hz | 60.0 / 57-61 Hz |
| Extended frequency range* | 57-62.5 Hz | 57-62.5 Hz |
| Power factor | >0.95 | >0.95 |
| Maximum units per 20 A branch circuit | 24 (three phase) | 16 (single phase) |
| Maximum output fault current | 850 mA rms for 6 cycles | 850 mA rms for 6 cycles |
| **EFFICIENCY** | | |
| CEC weighted efficiency | 96.5% | |
| Peak inverter efficiency | 96.5% | |
| Static MPPT efficiency (weighted, reference EN50530) | 99.4 % | |
| Night time power consumption | 65 mW max | |
| **MECHANICAL DATA** | | |
| Ambient temperature range | -40°C to +65°C | |
| Dimensions (WxHxD) | 171 mm x 173 mm x 30 mm (without mounting bracket) | |
| Weight | 1.6 kg (3.4 lbs) | |
| Cooling | Natural convection - No fans | |
| Enclosure environmental rating | Outdoor - NEMA 6 | |
| Connector type | M250-60-2LL-S22: MC4<br>M250-60-2LL-S25: Amphenol H4 | |
| **FEATURES** | | |
| Compatibility | Compatible with 60-cell PV modules | |
| Communication | Power line | |
| Integrated ground | The DC circuit meets the requirements for ungrounded PV arrays in NEC 690.35. Equipment ground is provided in the Engage Cable. No additional GEC or ground is required. Ground fault protection (GFP) is integrated into the microinverter. | |
| Monitoring | Enlighten Manager and MyEnlighten monitoring options | |
| Compliance | UL1741/IEEE1547, FCC Part 15 Class B, CAN/CSA-C22.2 NO. 0-M91, 0.4-04, and 107.1-01 | |

* Frequency ranges can be extended beyond nominal if required by the utility

To learn more about Enphase Microinverter technology, visit **enphase.com**

[e] enphase® ENERGY



MKT-00070 Rev 1.0

## CONTRACTOR

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## ENGINEER OF RECORD

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RESOURCE DOCUMENT

**DATE:** 11.30.2016

**DESIGN BY:**

**CHECKED BY:**

REVISIONS

R-002.00

SHEET 11

# EcoX

The new EcoX is an innovative, rail-less racking system, proven to organize the installation process. The flexible design offers a clean aesthetic, simplified logistics, and delivers a higher quality installation at a lower cost per watt.



## Fast.

Modules drop in from above and there is never a need to reach over or walk on modules. Pre-assembled components and quick connections make EcoX easy to install.



## Simple.

Universal components mount to standard framed modules. With a single socket size and a wide range of adjustment, it is quick and easy to install any array with a clean, finished look.



## Supported.

The Ecolibrium field support team offers on-site installation training and ongoing technical support. And from project planning to logistics to installation, we are dedicated to customer service.

sales@ecolibriumsolar.com | US: 740-249-1877 | www.ecolibriumsolar.com

EcolibriumSolar

## Aesthetic Design

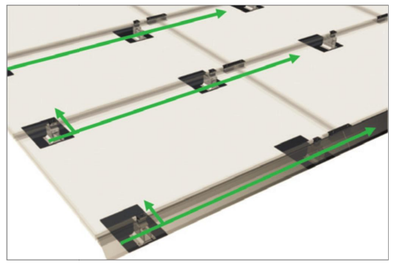
A wide range of adjustment makes it easy to install a straight, level system. Components are designed to blend into the array, and the aesthetic skirt creates a finished look. Alternatively, a skirt free option is available to provide a more traditional look.

## Cable Management

Whether installing with Microinverters, Power Optimizers, or String Inverters, EcoX provides wire management provisions to both prep the modules, and to route homerun or trunk cables throughout the array.


## Flexible System Design

The EcoX Estimator is a powerful racking system design tool. The user inputs all site conditions and can layout multiple roof surfaces. The EcoX Estimator outputs a site specific design package with engineering specs and bill of materials.



## Single Point Grounding

EcoX and approved modules create a continuously bonded system. The installer can connect a finished array to ground with a single bonding lug.

| Technical Specifications | |
|---|---|
| Materials | Racking components: Aluminum, stainless hardware, dark bronze anodized upper surface, mill finish lower surfaces<br>Flashings: Aluminum, black powder coated finish |
| Grounding/Bonding Validation | UL2703 - *see installation manual for specific module approvals* |
| Fire Resistance Validation | UL2703 - Class A, Type 1 and Type 2 modules |
| Mechanical Load Validation | UL2703 - *see installation manual for specific module approvals* |
| Flashing Validation | ICC-ES AC286/UL441 Rain Test for Roof Flashing |
| Adjustability | 1" vertical range, 3.5" North/South range, connect anywhere in East/West direction |
| Warranty | 15 years |

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EcolibriumSolar

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REVISIONS

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SHEET 12