

Title: Sharp Photovoltaic (PV) Module Alternate Grounding Addendum

Document ID: PCMAN- Alternate Grounding Addendum- n.9.1.1

Date: 01/07/2011

I) Scope

This addendum defines alternative grounding methods for SHARP PV modules referenced in this document. This addendum applies to the SHARP module installation manuals listed in Section III) Referenced documents. These methods are certified to be compliant with applicable grounding requirements of UL 1703, the standard for Safety for Flat-Plate, Photovoltaic Modules and Panels, By Underwriters Laboratories, Inc.

II) Compliance

All SHARP PV modules are evaluated to the requirements of UL 1703, the Standard for Safety for Flat-Plate, Photovoltaic Modules and Panels. They are additionally evaluated to the Canadian Other Recognized Document (ORD), ULC/ORD-C1703-01, Flat-Plate Photovoltaic Modules and Panels. Currently, all SHARP PV modules are listed by UL. As part of the UL 1703 listing process as described in Section 11: “Bonding and Grounding”, PV modules are tested with specific grounding hardware and installation methods.

Additional grounding methods have been evaluated and approved as described in this addendum. For rooftop installation, Installation must be over fire resistant roof covering materials.

Testing was performed and certified by INTERTEK per UL 1703 (3rd edition; issued 2002/03/15 Rev 2008/04/08) Standard for Safety of Flat-Plate Photovoltaic Modules and Panels. The following sections of UL 1703 are applicable: Construction Evaluation and Report (all sections), Temperature Testing Section 35, and Humidity Testing Section 36. The applicable sections pertaining to grounding were evaluated and tested for specific alternate approaches listed in the “Approved Alternate Grounding Methods” section.

III) Referenced documents

- UL 1703 Standard for Safety of Flat-Plate Photovoltaic Modules Sharp File # 160673
- ULC/ORD-C1703-01, the Canadian Other Recognized Document (ORD), Flat-Plate Photovoltaic Modules and Panels
- National Electrical Code (NEC) 2008 articles 250 (grounding and bonding) and article 690 (Solar Photovoltaic Systems)
- CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1 (CEC) 2009 section 10 (grounding and bonding) and section 50 (Solar Photovoltaic Systems)
- Installation and user manuals for applicable Sharp Photovoltaic modules
 - MDMAN-TINSEA089MNZZ-5.0 60 cell ND_NU Install manual 10-20-10
 - MDMAN-TINSEA085MNZZ-1.0 60 cell ND-U/L-230/235Q1 manual 10-7-10
 - MDMAN-TINSEA082MNZZ-1.0 60 cell NU-U240/245P1 manual 8-24-10
- Wiley Electronics LLC's WEEB® Washer Documentation
 - UniRac® Document Number 104-0404-000010-011
 - ProSolar® Document Number 104-0404-000008-008
 - DPW® Document Number 104-0404-000036-004
- ILSCO®
 - *See Manufacturer Recommendations*

IV) Approved Alternate Grounding Methods

A) Intentionally left blank

B) ILSCO® Lug:

An ILSCO Lug (GBL-4DBT) can be attached to SHARP module frames with a standard #10 machine stainless steel screw, spring lock washer and nut to allow an EGC to be installed. The module ground hole must be expanded with a #9 (Ø0.196 inch) drill bit. Mark expanded hole with the “ground symbol” (UL listed label).

C) Expanding Existing Ground Hole Instructions

D) WEEB®:

WEEB (Washer, Electrical Equipment Bond made by Wiley Electronics LLC) can be installed in accordance with the applicable Wiley Electronics installation manual to provide a bond between SHARP module frames and specific, approved racking systems instead of a module-module EGC. Note that NEC AND CEC guidelines requiring a continuous ground must be followed.

D.1 WEEB – UniRac®

This drawing shows installation of WEEB products on UniRac® Solar Mount rails.

D.2 WEEB – ProSolar®

This drawing shows how to install WEEB products on ProSolar® RoofTrac and GroundTrac rails.

D.3 WEEB – DPW®

This drawing shows how to install WEEB products on DPW® Power rails.

E) Aluminum Member:

An aluminum member, used for the mounting of Sharp PV modules, can be attached to SHARP module frames via existing 9 mm mounting holes using a 1/4", 5/16", or M8 bolt and nut in conjunction with two star washers; where one washer is in contact with SHARP frame and the other contacts the aluminum member. At least one connection per member is required. The aluminum member must be resistant to atmospheric corrosion as well as other sources of corrosion present at the site. The aluminum member material must be a 6000 series alloy (includes 6061, 6063 and all 6XXX alloys). Anodized aluminum members are allowed and are preferred for increased corrosion resistance. This aluminum member must then be properly grounded per NEC AND CEC requirements to provide a continuous equipment grounding conductor for the system.


F) Galvanized Steel Member:

A steel member, used for the mounting of Sharp PV modules, can be attached to SHARP module frames via existing 9 mm mounting holes using a 1/4", 5/16", or M8 bolt and nut in conjunction with two star washers; where one washer is in contact with SHARP frame and the other contacts steel member. At least one connection per member is required. The galvanized steel member must be resistant to atmospheric corrosion as well as other sources of corrosion present at the site. The galvanized steel member must be galvanized to a minimum of G90 specification (ASTM standard A525;

specifies 0.90 grams of zinc per square foot of steel). Please note that many locations require higher levels of corrosion protection and it is the responsibility of the designer or installer to specify an appropriate thickness of galvanization for proper corrosion protection. This galvanized steel member must then be properly grounded per NEC AND CEC requirements to provide a continuous equipment grounding conductor for the system.

G) Intentionally left blank

V) Installation Guidelines

- Follow all applicable NEC AND CEC guidelines and local requirements when installing SHARP modules.
SHARP modules come with grounding holes labeled with a “G” or ground symbol  on the aluminum frame.
- Use stainless steel hardware ONLY.
- All components must be free from dirt and debris before assembling.
- Minimize galvanic corrosion by avoiding contact between dissimilar metals.
- Refer to ‘*UL document i1703_3_20070509 Grounding of Dissimilar Metals*’
 - Aluminum should never be in direct contact with copper.
 - Bonding and Grounding (UL 1703, section 11) requires a ferrous metal part in the grounding path shall be protected against corrosion by metallic or nonmetallic coatings, such as painting, galvanizing, or plating. Stainless steel is acceptable without additional coating.
 - In order to avoid galvanic corrosion dissimilar metals in direct contact should have an electrochemical potential difference of 0.6 V or less. Refer to Fig. 11.1 Electrochemical potentials, (UL Document) subject i1703_3_20070509.
 - The hardware (such as a star washer) must score the frame surface to make a positive electrical contact with the frame.
- WEEB are intended for single use only; they must not be reused after removal or loosening for any reason.
- Properly torque all grounding connections to ensure longevity of the connection.
- All Racking structures must be grounded per NEC AND CEC.

- All rack structures must be designed to withstand wind & snow loading per ASCE 7-05, IBC (International Building Code) and local building requirements.
- Warranty will be void if modules are damaged during any of these procedures described in section: (IV) Approved Alternate Grounding Methods.
- Installation for wiring and grounding method shall be in accordance with the NEC and CEC guidelines and the relevant instructions provided in this document.
- Care must be taken to arrange the system ground so that the removal of one module from the circuit will not interrupt the grounding of other modules.

VI) Tables and Figures

Table I shows the frame types used for SHARP PV modules. It references the approved grounding methods for specific SHARP modules. Refer to Figure I to identify frame profiles referenced in Table I

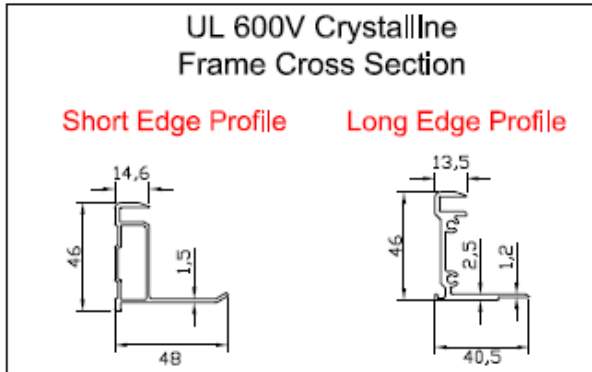
Table I. Alternate Grounding Selection Guide

Model Description	Frame Type	Alternate Grounding Configuration Type	Maximum Fuse Rating
ND-208UC1, 216UC1, U216C1, 220UC1, 224UC1, U224C1, 230UC1	600V Crystalline	B thru F	15 A
ND-L230Q1, U230Q1, L235Q1, U235Q1	600V Crystalline	B thru F	15 A
NU-U230F3, U235F3, U235F1, U240F1	600V Crystalline	B thru F	15 A
NU-U240P1, U245P1	600V Crystalline	B thru F	15 A

Table II lists the alternate grounding procedure documents. These documents illustrate each approved method and identify approved materials, and parts.

Table II. Alternate Grounding Procedure Documents

Configuration Type	Description	Document Name	Page #
A	Intentionally left black	TBD	7 of 15
B	ILSCO Lug	PCDWG-MANB-LAY-IN LUG-n.6.1	8 of 15
C	Expanding existing Ground Hole	PCDWG-MANC-GND HOLE-n.6	9 of 15
D.1	WEEB - UniRac	PCDWG-MAND.1-WEEB-UNI-n.4	10 of 15
D.2	WEEB - ProSolar	PCDWG-MAND.2-WEEB-PRO-n.4	11 of 15
D.3	WEEB - DPW	PCDWG-MAND.3-WEEB-DPW-n.4	12 of 15
E	ALUMINUM MEMBER	PCDWG-MANE-ALUM MEMBER-n.6	13 of 15
F	GALVANIZED STEEL MEMBER	PCDWG-MANF-GAL STEEL MEMB-n.5	14 of 15
G	Intentionally left black	TBD	15 of 15



NOTES:

- Frame material is ALUM 6063-T5
- Dimensions in millimeters

Figure 1. This figure identifies the SHARP PV module frame types for the thin film and applicable crystalline modules. Use this figure with Table I to identify the approved grounding methods that pertain to the frame type of the specific product being used.

	0	SHARP	TBD	
PROPRIETARY AND CONFIDENTIAL THIS INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SHARP ELECTRONICS. ANY REPRODUCTIONS IN PART OR AS A WHOLE WITHOUT WRITTEN PERMISSION OF SHARP ELECTRONICS IS PROHIBITED.	CHECKED NAME	SIZE A	DRAWN BY NAME	
SHARP	APPROVED NAME	ALTERNATE GROUNDING ADDENDUM DOCUMENT SHARP DESCRIPTION		REV n.0
	APPROVAL SIGNATURE / DATE	SCALE = NTS	DATE: TBD	DN: PCDWG-MANG-TBD-n.0

Figure 2. Intentionally left blank

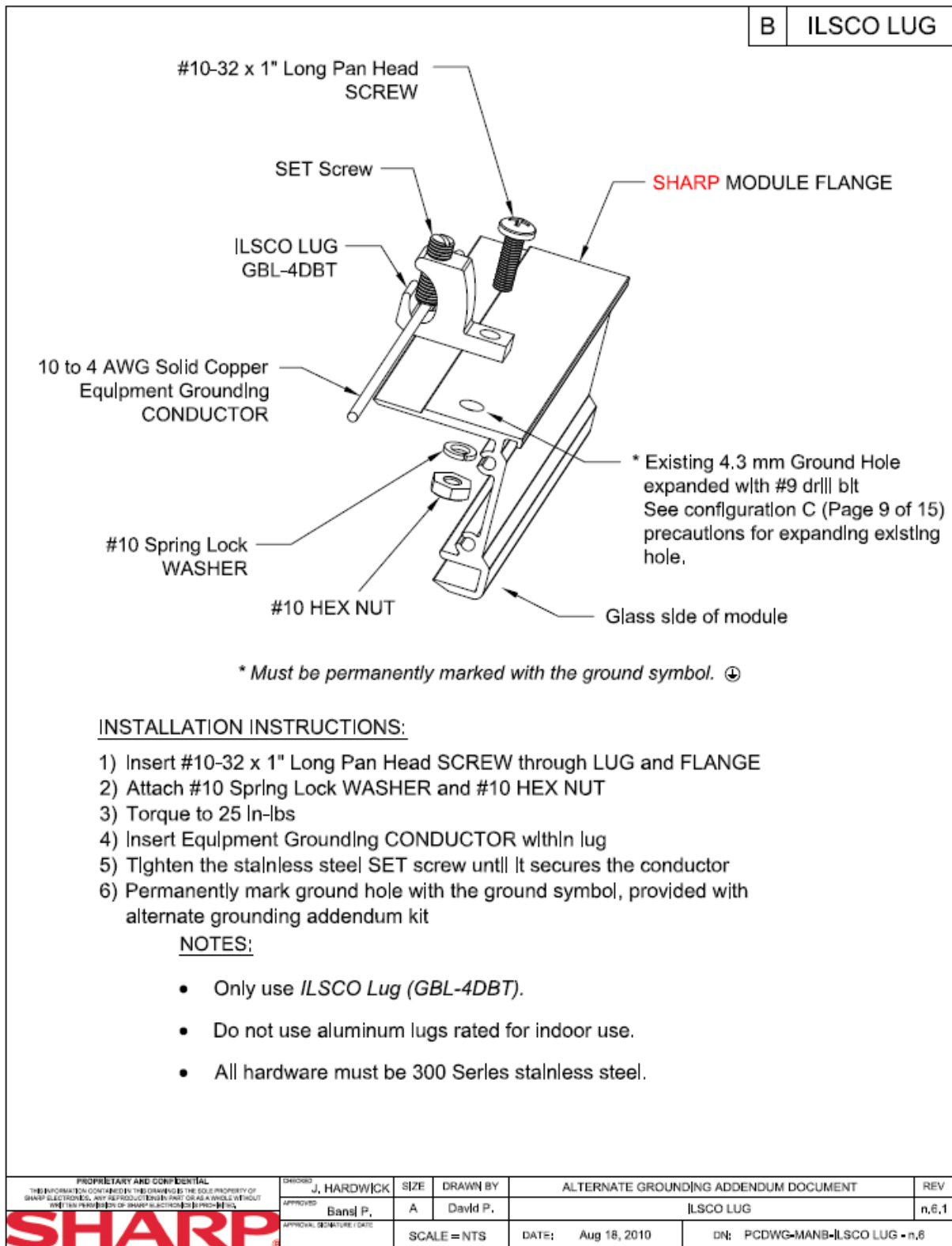
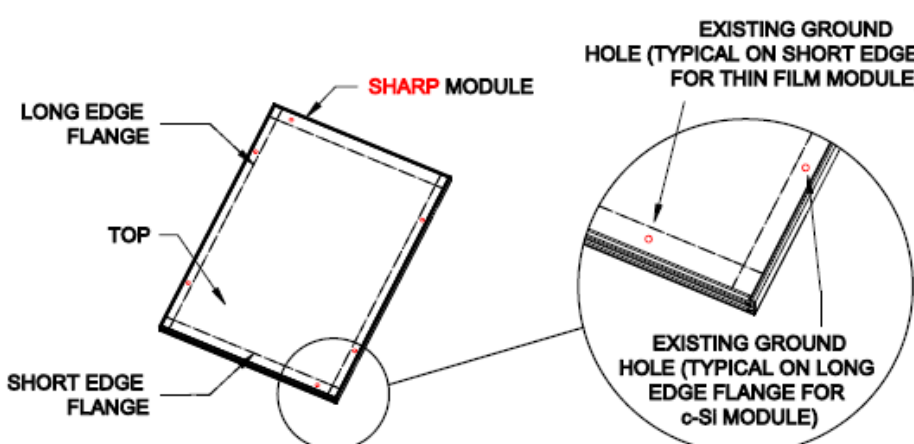
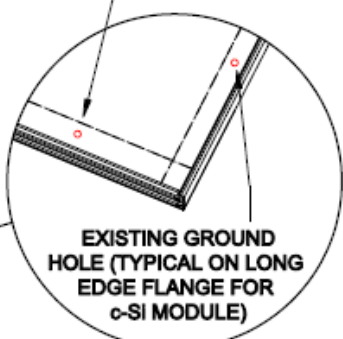


Figure 3. ILSCO Lug Grounding method

	C Expanding Existing Ground Hole
--	---





INSTALLATION INSTRUCTIONS:

- 1) Place MODULE on a clean, flat surface and secure from moving
- 2) Use a smooth, padded board and a drill stop to avoid damaging the module backsheet and glass when expanding existing Ground Hole. The board will capture any metal shards and stop the drill bit from hitting the backsheet.
- 3) For method B, Install #10 screw through ILSCO Lug through the Frame see Figure 3, (ILSCO Lug Grounding method)

NOTES:

- Do not hit the MODULE backsheet or glass when expanding existing Ground HOLE.

WARNING:
Warranty will be void if module is damaged during this process. Module backsheet can be easily damaged and must be carefully protected during any frame drilling procedure.

<small>PROPRIETARY AND CONFIDENTIAL THIS INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SHARP ELECTRONICS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT WRITTEN PERMISSION OF SHARP ELECTRONICS IS PROHIBITED.</small>	CHECKED J. HARDWICK	SIZE A	DRAWN BY D. Pastore	ALTERNATE GROUNDING ADDENDUM DOCUMENT EXPANDING EXISTING GROUND HOLE	REV n.9
SHARP	APPROVAL SIGNATURE / DATE	SCALE = NTS	DATE: JAN 05, 2011	DN: PCDWG-MANC-GND HOLE - n.9	

Figure 4. Expanding existing ground hole

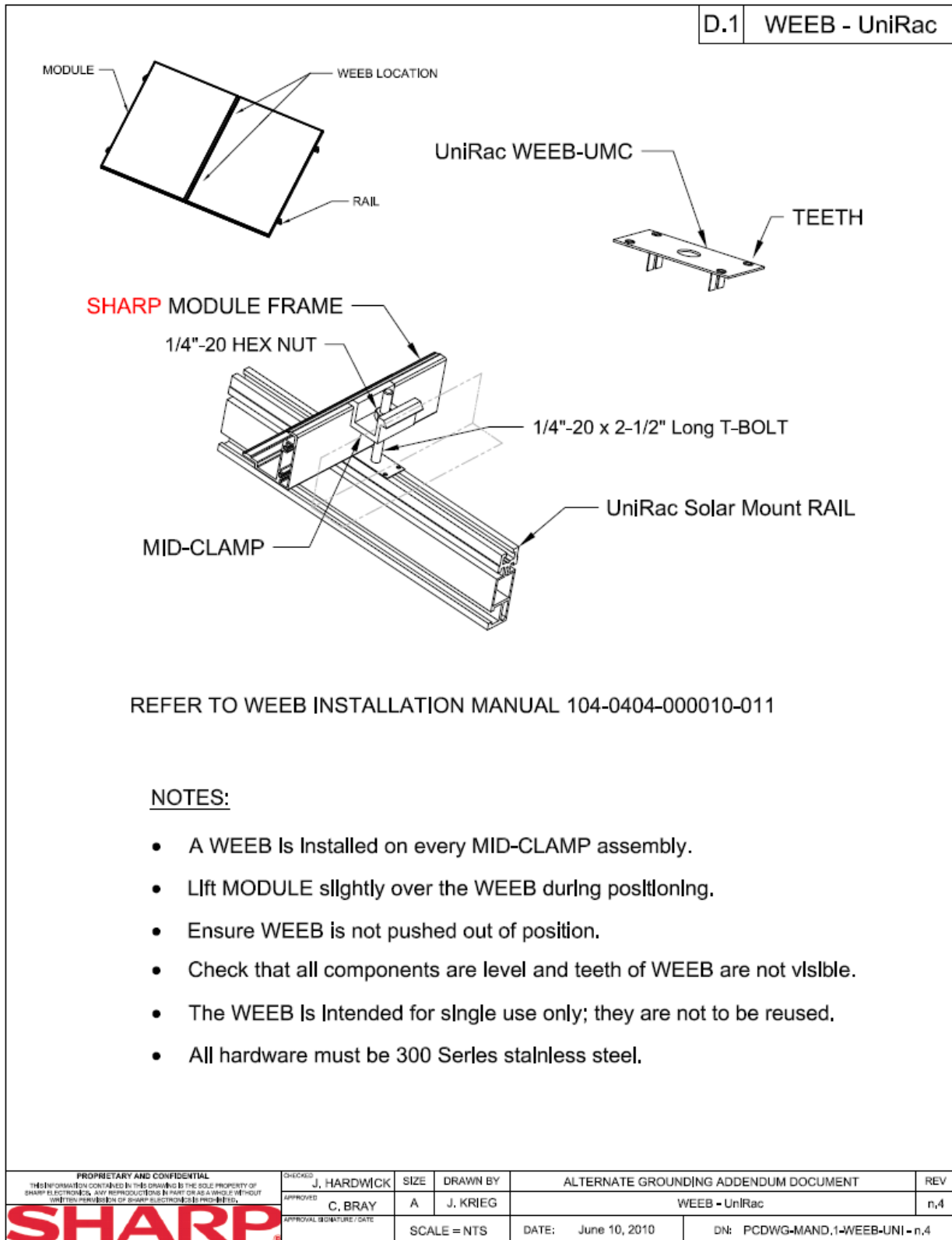


Figure 5. WEEB with UniRac structure grounding method

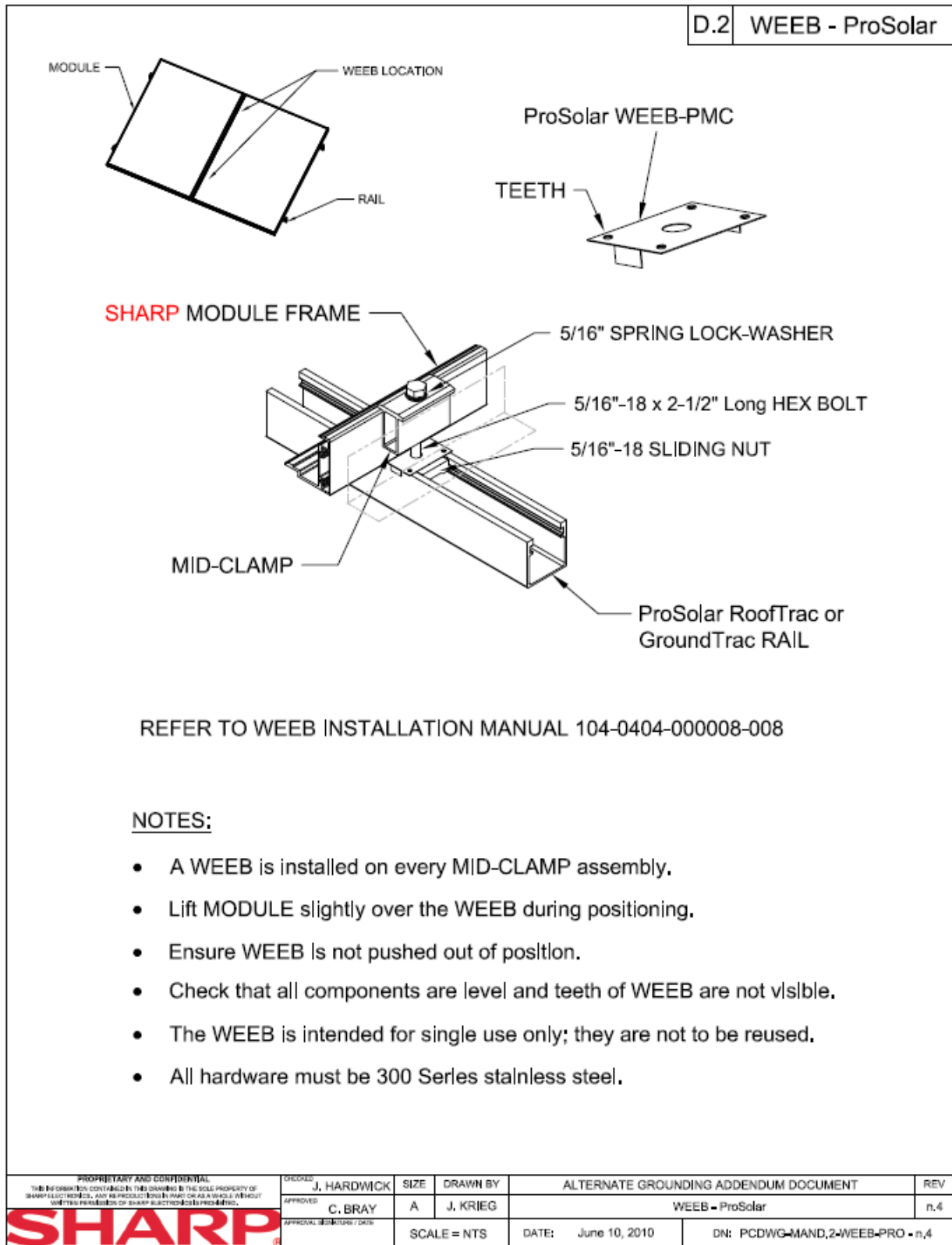


Figure 6. WEEB with ProSolar structure grounding method

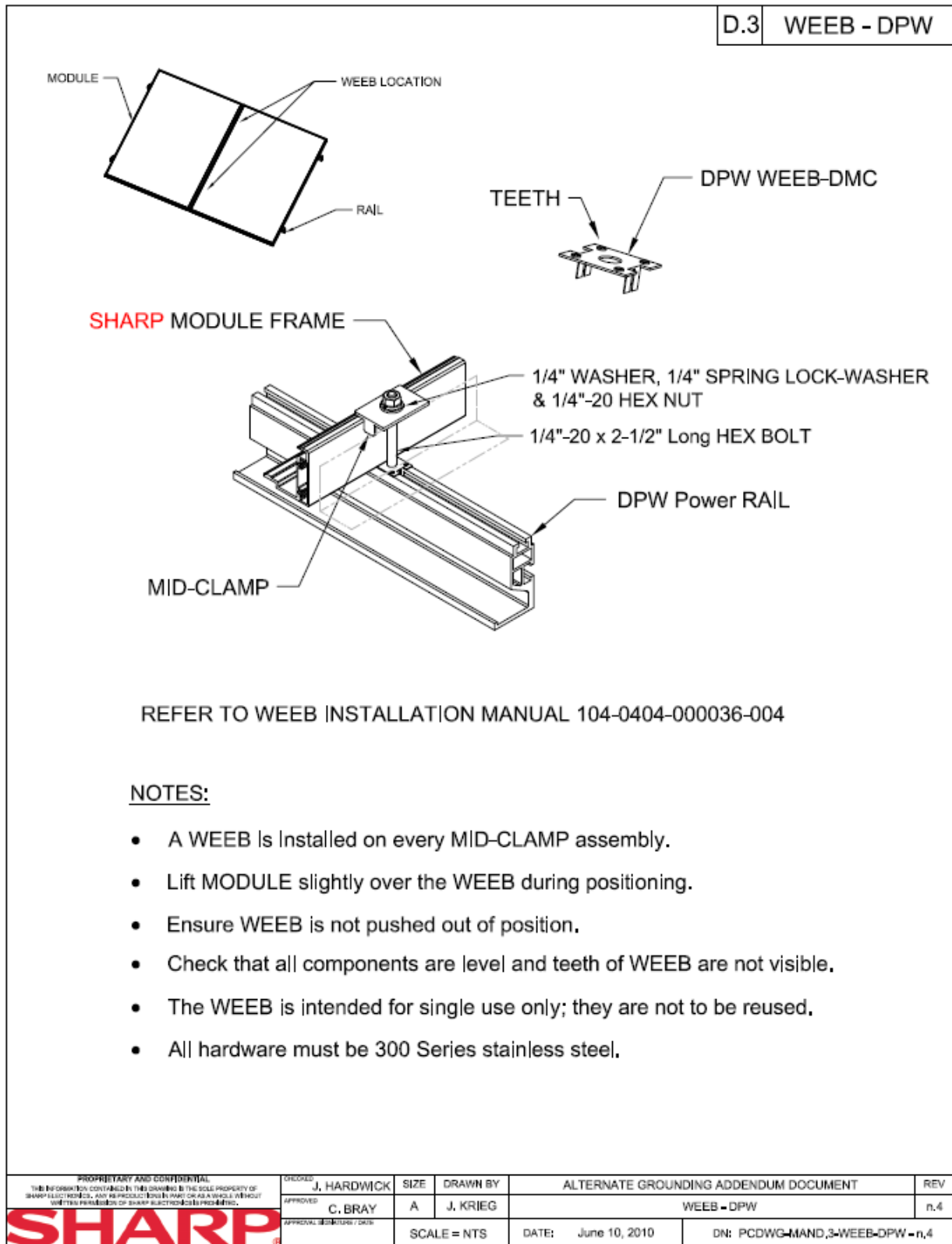


Figure 7. WEEB with DPW structure grounding method

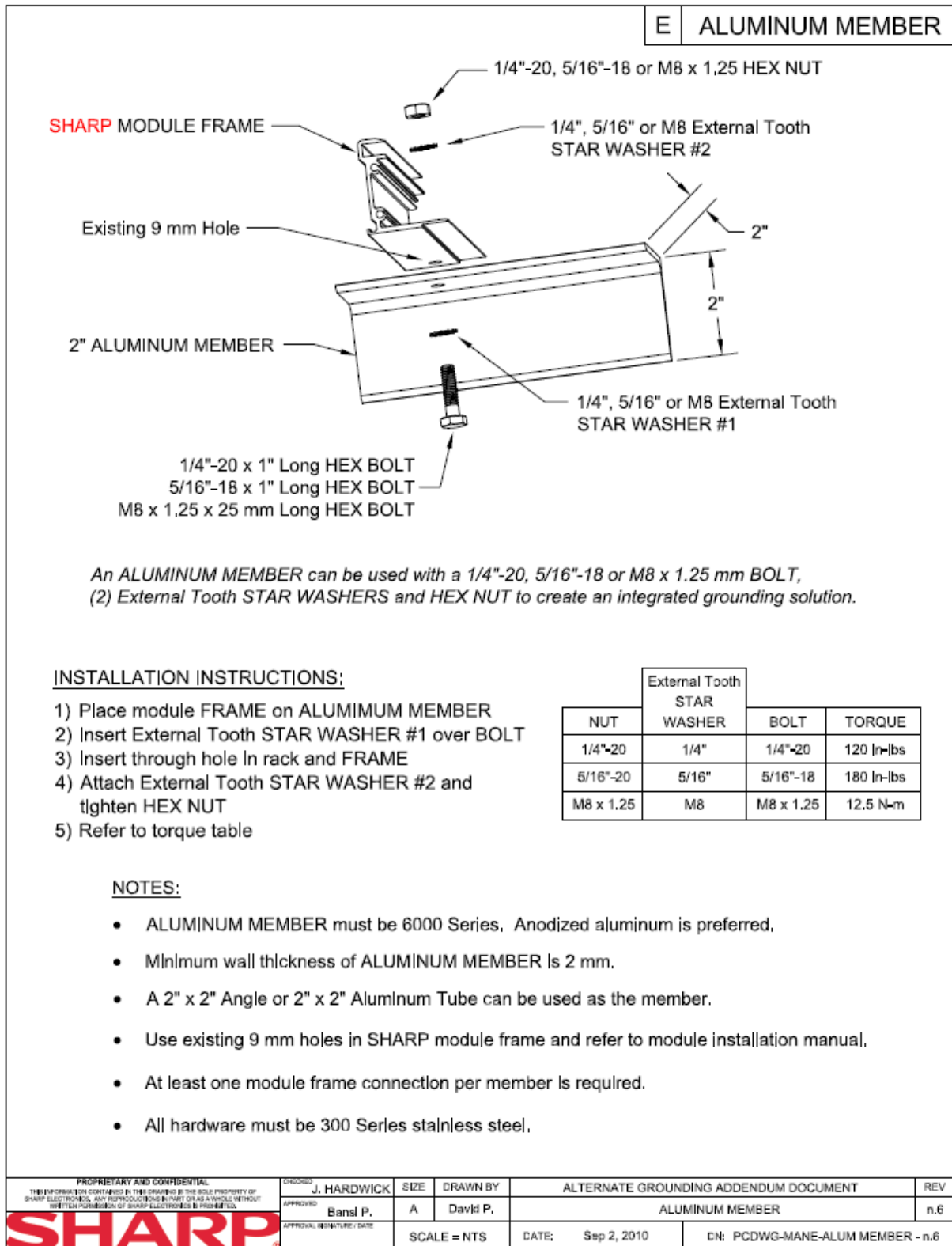


Figure 8. Aluminum member grounding method

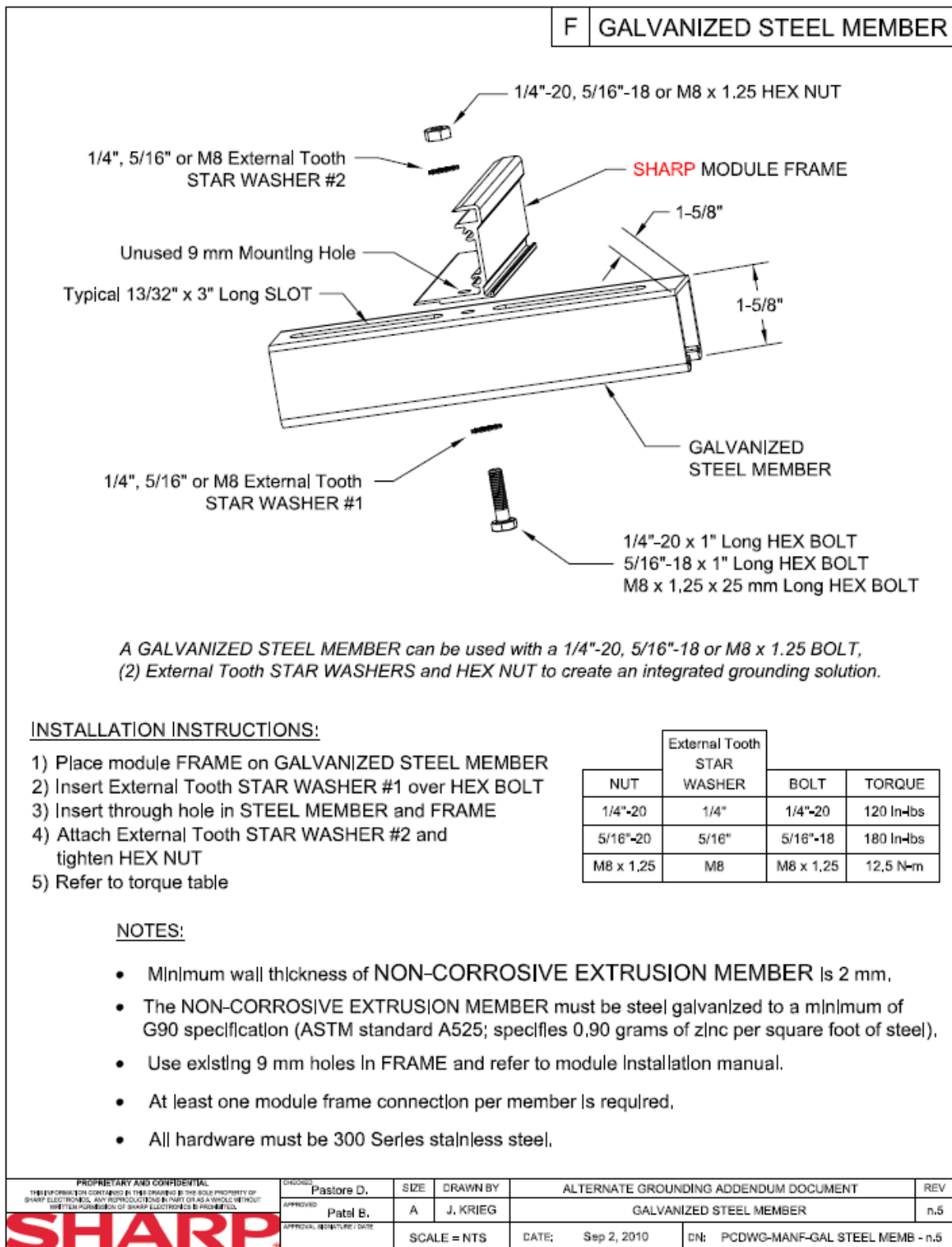


Figure 9. Galvanized steel member grounding method

	0	SHARP	TBD
PROPRIETARY AND CONFIDENTIAL THIS INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SHARP ELECTRONICS. ANY REPRODUCTIONS IN PART OR AS A WHOLE WITHOUT WRITTEN PERMISSION OF SHARP ELECTRONICS IS PROHIBITED.	CHECKED NAME APPROVED NAME APPROVAL SIGNATURE / DATE	SIZE A SCALE = NTS	DRAWN BY NAME DATE: TBD DN: PCDWG-MANG-TBD-n.0
ALTERNATE GROUNDING ADDENDUM DOCUMENT SHARP DESCRIPTION n.0			

Figure 10. Intentionally left blank