

**Attn:** Sean McDonald, CEO IronRidge Inc.

**Date:** September 28<sup>th</sup>, 2023

**Re:** Structural Certification for QuickMount *Halo UltraGrip™* Roof Attachment - Deck Attached

This letter certifies the structural capacity of the *QuickMount Halo UltraGrip™* (*HUG*) for use as a roof attachment with flush mounted PV solar systems, when attached to a roof deck. *HUG* consists of a cast aluminum base with a 2" long vertical open-end slot for connection of a rail system. An UltraGrip™ Flashing Technology is affixed to the underside of the *HUG* base. *HUG* is secured to the roof deck sheathing using six (6) No. 14 x 3" structural wood screws. Screws shall be installed in accordance with the *QuickMount Halo UltraGrip™* installation manual. Full assembly details are shown in Exhibit EX-0023.

The structural capacities of *HUG* are reviewed along four respective load directions including uplift, compression, lateral parallel to the rafter, and lateral perpendicular to the rafter for base orientations that represent rail running cross-slope or up slope in relation to roof pitch. The capacity ratings are based on structural load tests performed using a Universal Instron Test Unit according to ASTM D1761-20 "*Standard Test Methods for Mechanical Fasteners in Wood and Wood Based Materials*". For each load test a *HUG* was installed onto a sample roof deck constructed from 2x4 rafters and OSB roof deck sheathing with the following thicknesses: 7/16", 15/32", or 19/32", as shown in Figure 1. Deck sheathing was installed onto the roof rafters using 0.131" x 2.5" nails. The nailing schedules applied for the various sheathing thicknesses are as follows: 7/16" and 15/32" sheathing used 6" edge and 12" field spacing, and 19/32" sheathing used 6" edge and 6" field spacing, following guidelines from the *Florida Residential Building Code* Table R803.2.3.1. The moisture content and the specific gravity of the rafters were measured per ASTM D2395-17 "*Standard Test Methods for Density and Specific Gravity (Relative Gravity) of Wood and Wood-Based Materials*". The recorded moisture content of the rafters among all sample roof decks was between 12% and 14% and the specific gravity was 0.42. The tested *HUG* was affixed to the roof deck structure via 3" long No. 14 stainless steel structural wood screws per the requirements specified by the *QuickMount Halo UltraGrip™* installation manual. For each load test, the point load was placed at the highest position allowed in the open-end slot. The tested *HUG* was installed to the roof deck with four (4) screws to account for stripped screws or screws installed into sheathing joints.

The failure observed during uplift load testing was a mixture of wood screw withdrawal from the OSB deck, nail withdrawal from the rafter, and OSB rupture for all tested roof sheathing thicknesses. The wood screw withdrawal failure with a worst-case safety factor of 3.0 per ASTM D7147 is applied to the uplift peak load. For 7/16" and 15/32" OSB deck sheathing the peak failure load was 585 lbs., which provides an **allowable uplift capacity of 195 lbs.** For 19/32" OSB deck sheathing the peak failure load was 819 lbs., which provides an **allowable uplift capacity of 273 lbs.**

The failure observed during compression load testing was rupture of the OSB deck under the *HUG* for all tested roof sheathing thicknesses. For the deck rupture failure, a safety factor of 2.54 per NDS 2018 is applied to the peak load. For a 7/16" thick OSB deck the peak failure load was 582 lbs., which provides an **allowable compression capacity of 229 lbs.** For a 15/32" thick OSB deck the peak failure load was 627 lbs., which provides an **allowable compression capacity of 247lbs.** For a 19/32" thick OSB deck the peak failure load was 764lbs., which provides an **allowable compression capacity of 301 lbs.**

For each lateral load direction, the *HUG* was tested in the worst-case condition installed onto a roof deck with minimum sheathing thickness of 7/16" and with the load placed at the highest position allowed in the vertical slot. The lowest peak lateral load recorded from all tests including both lateral directions and base orientations was used to determine the allowable lateral capacity. The failure observed was fastener withdrawal from the OSB sheathing at the peak load of 352 lbs. For the fastener withdrawal failure, a safety factor of 3.0 per ASTM D7147 applied to the lateral peak load which provides an **allowable lateral capacity of 117 lbs.**

Please note the provided test investigation and its associated results described herein were based on load tests performed on the *HUG* as a stand-alone roof attachment. It is not the intention of this letter to rate or certify structural components other than those specifically delineated in this letter. This evaluation excludes the structural adequacy of the chosen PV modules and underlying roof supporting members. For those, it shall be the responsibility of the designated system designer or project engineer to verify the structural capacity and adequacy regarding the applied or resultant loads of the chosen array configuration.

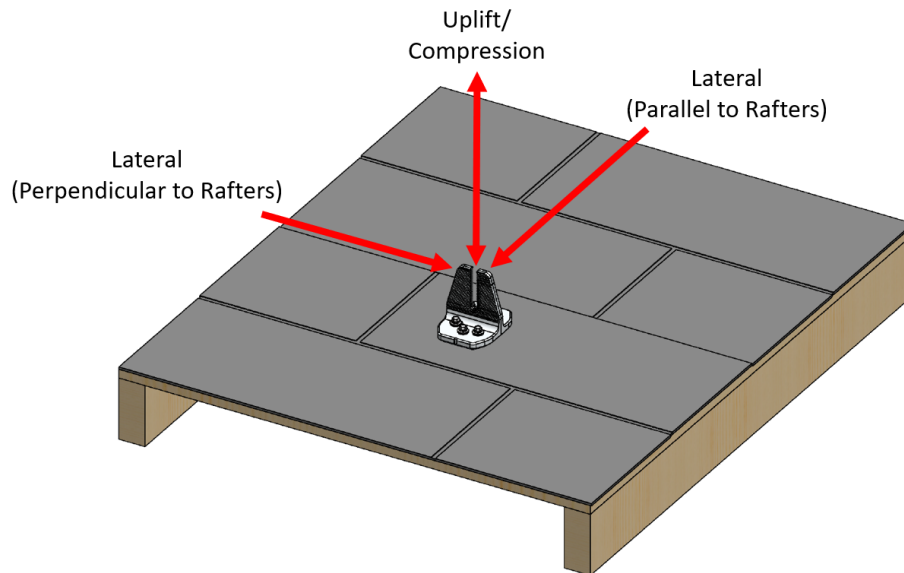


Figure 1: QuickMount Halo UltraGrip™ and Applied Loading Directions

Table 1: QuickMount HUG Deck Attachment Allowable Capacities <sup>(1)</sup>							
Load Direction	Minimum Sheathing Thickness (in) <sup>(7)</sup>	Test Quantity	Critical Failure Mode	Safety Factor <sup>(5)</sup>	Avg Ultimate Capacity (lbs.)	Max deviation from mean <sup>(4)</sup>	Allowable Capacity (lbs) <sup>(6)</sup>
Uplift <sup>(2)</sup>	7/16	8	Fastener Withdrawal	3.0	585	21.4%	195
	19/32	8	Fastener Withdrawal	3.0	819	17.6%	273
Compression <sup>(3)</sup>	7/16	8	OSB Deck Rupture	2.54	582	21.0%	229
	15/32	5	OSB Deck Rupture	2.54	627	5.6%	247
	19/32	8	OSB Deck Rupture	2.54	764	14.6%	301
Lateral <sup>(8)</sup>	7/16	8	Fastener Withdrawal	3.0	352	14.3%	117

Table 1 Notes:

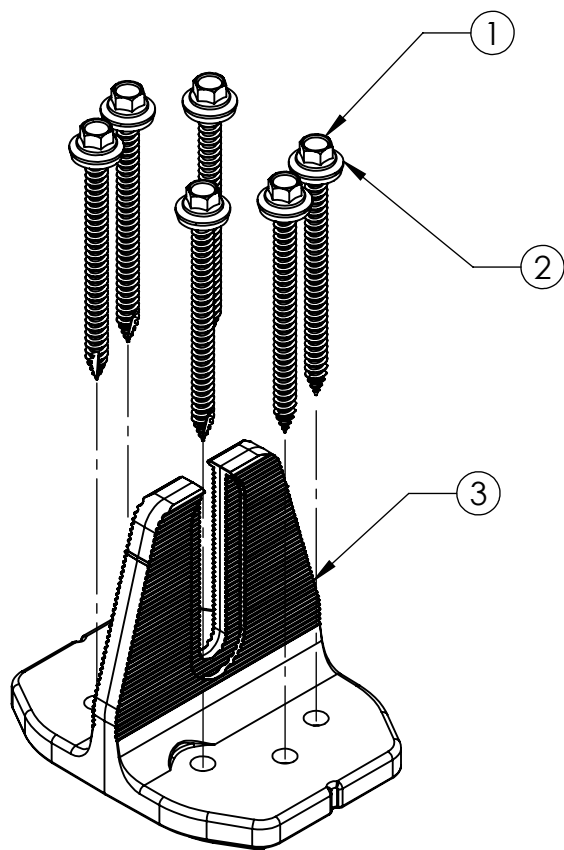
- (1) Capacities apply to a minimum deck thickness of 7/16", 15/32", and 19/32" on rafters spaced no greater than 24" O.C. using 3" long No. 14 wood screws installed per the *QuickMount Halo UltraGrip™* installation manual. Rafters and roof deck should be in sound structural conditions with no sign of rot, decay, previous installation, or pre-existing damages.
- (2) The uplift direction is upward perpendicular to the roof surface.
- (3) The compression direction is downward perpendicular to the roof surface.
- (4) Deviation reflects the variance of the highest or the lowest test value from the group mean for the respective load direction. For load directions where deviation was larger than 10% after 5 tests, 3 additional tests are added per *ADM-2020* Appendix 1.
- (5) Safety Factor is based on the respective failure mode recorded and determined per *NDS 2018*, and *ASTM 7147-21*.
- (6) Allowable Capacity is equal to Average Ultimate Capacity divided by its associated Safety Factor.
- (7) Minimum Sheathing Thickness is applicable for either OSB or Plywood deck construction.
- (8) Allowable Lateral Capacity apply to sheathing that has a minimum thickness of 7/16" and is applicable to all lateral load directions and *HUG* orientations.

Sincerely,

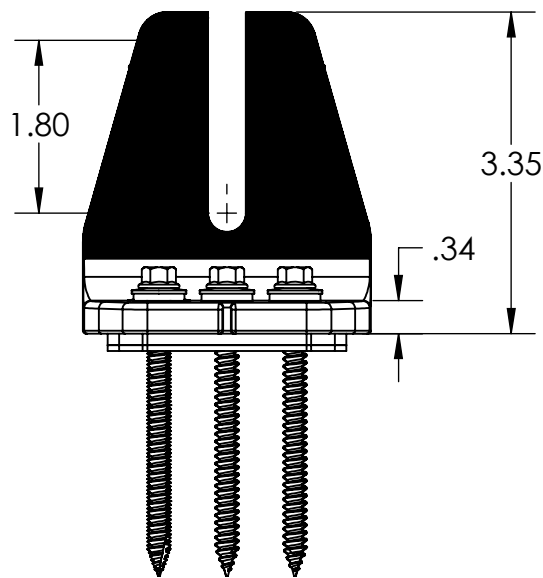
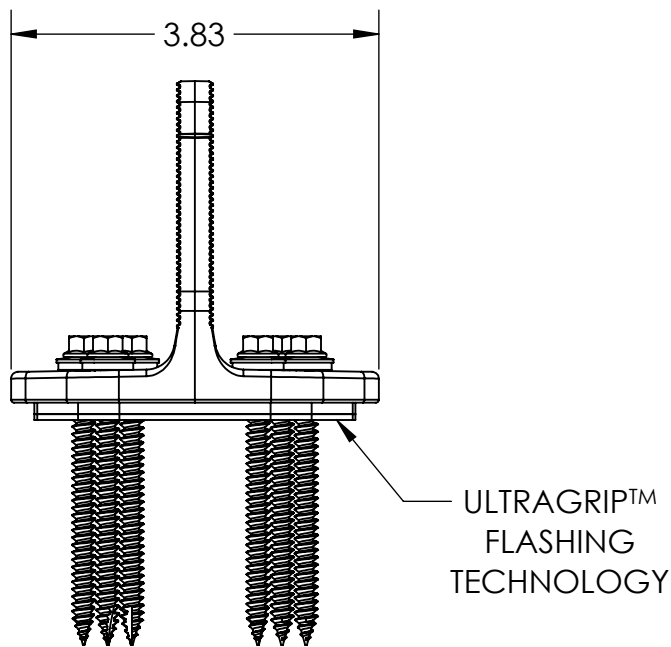
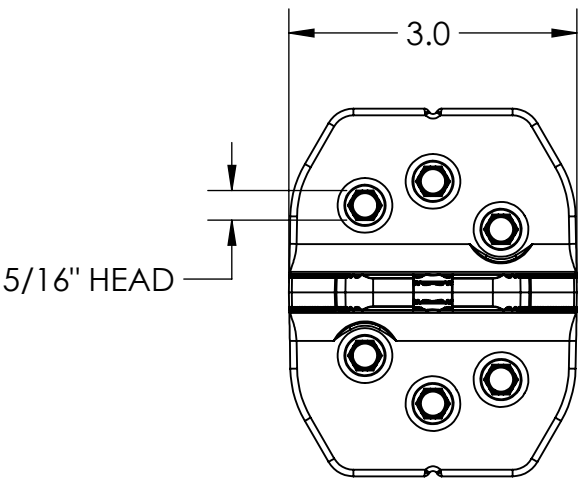


Matthew Kuzila, PE  
Professional Engineer

Digitally Sealed 9.28.2023



6 RD STRUCTURAL WOOD SCREWS SHOWN FOR REFERENCE. REFER TO HALO ULTRAGRIP™ INSTALLATION MANUAL FOR REQUIRED NUMBER OF FASTENERS FOR DECK ATTACHED APPLICATIONS.



ITEM NO.	DESCRIPTION
1	RD STRUCTURAL WOOD SCREW, #14 X 3"
2	EPDM SEALING WASHER, #14 SCREW
3	HALO ULTRAGRIP™ (HUG)

**IRONRIDGE**

ASSY, HALO ULTRAGRIP™,  
DECK ATTACHED

DWG. NO. EX-0024