

Design Criteria for Span Tables:

Values in the maximum allowable rail span tables provided herein are subject to the following general criteria and additional criteria shown on individual span tables sheets. Values in span tables are based on the same engineering methodology and calculation algorithms used for U-Builder and are provided here for reference.

Building Assumptions

- Building Risk Category: II
- Mean Roof Height: 30 ft
- Roof Pitch: 0°-45°
- Site Elevation: 0 ft

Wind Design Assumptions

- Wind loads used are based on ASCE 7-16 Sec 29.4.4 with Provisions from SEAOC PV2-2017
- Exposure Category B, C, or D
- Basic Wind Speed = 90 – 180 mph
- Level terrain. Topographic factor, $k_{zt} = 1.0$
- $\gamma_E = 1.0$ for 'Interior' spans, $\gamma_E = 1.5$ for 'Exposed' spans (ASCE 7-16, Fig. 29.4-7)

Snow Design Assumptions

- Ground Snow Load = 0-100 psf
- Exposure Factor coefficients of Partially Exposed condition
- Thermal Factor = 1.0
- Results based on uniform snow load

Seismic Design Assumptions

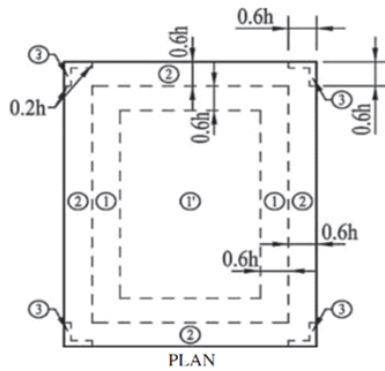
- 0.2-s Spectral Response Acceleration, $S_S \leq 3$
- $S_S = 1.25$ and 3 per criteria shown on individual span tables sheets.
- $S_1 = 0.5$
- Seismic site class D

Array Assumptions

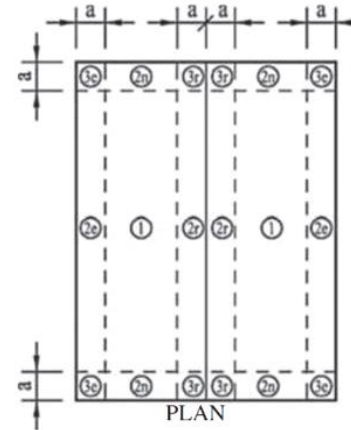
- Module orientation and Rail direction per criteria shown on individual span tables sheets.
- Maximum module dimensions of 40.1" x 67" (~19 sq.ft, 47.65 lbs) and 41" x 80" (~23 sq.ft, 58.6 lbs) per criteria shown on individual span tables sheets.
- Minimum distance between modules and roof edge is at least twice the module height above roof surface.
- Modules are parallel to roof surface and maximum height above roof surface is 5" to 10" depending on attachment type.
- Gaps between module rows and columns is 0.25" in to 1" depending on clamp type.
- The most restrictive of all roof zone spans shall be used when any part of the module is attributed to that span.
- 'Exposed' spans as defined in ASCE 7-16 sec. 29.4.4 shall be used when any part of an exposed module or panel as is attributed to that span.

Span Tables

Zone should be considered as per ASCE 7-16, Fig. 30.3-2A to 30.3-2D



Gable Roofs $\theta \leq 7^\circ$

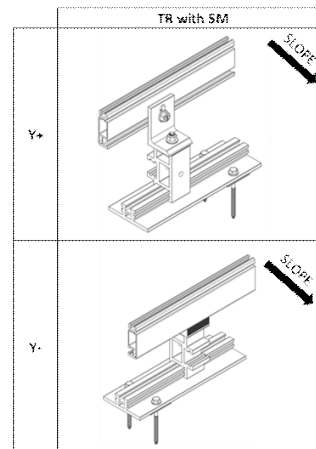


Gable Roofs $7^\circ < \theta \leq 45^\circ$

Grouping of ASCE 7-16 Roof Zones (Gable and Flat)

- **Roof Tilt 0° - 7°**
 - Roof Zone 1 = 1
 - Roof Zone 2 = 2
 - Roof Zone 3 = 3
- **Roof Tilt 7° - 27°**
 - Roof Zone 1 = 1, 2e
 - Roof Zone 2 = 2n, 2r, 3e
 - Roof Zone 3 = 3r
- **Roof Tilt 27° - 45°**
 - Roof Zone 1 = 1, 2e, 2r
 - Roof Zone 2 = 2n, 3r
 - Roof Zone 3 = 3e

Rails can be installed in these possible orientations.



Highlighted cell with strikethrough indicate 3-rail system span and module clamp allowable capacity exceeds with 3-rails. 4-Rail system required. Contact Unirac Engineering Services for support.

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[illegible]

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Maximum Allowable Rail Spans for Rooftop Solar Panels Parallel to the Roof Surface (inches)

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0	B	0-7	Interior	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	149	150	150	142	150	149	130	150	137	120	150	128	78	141	120	60	132	98	53	124	67	47											
			Exposed	150	150	150	150	150	147	150	150	139	150	150	131	150	143	125	150	136	119	150	130	98	141	120	60	131	91	52	122	63	45	109	55	39	69	49	35	59	43	46									
		Exposed	150	150	150	150	150	150	150	141	150	147	132	150	138	125	150	131	118	150	124	63	150	64	53	144	55	46	79	48	40	64	42	53	56	37	46	50	49	41											
		Exposed	151	151	151	151	151	151	151	151	151	151	151	151	151	148	151	143	139	151	136	131	150	124	68	137	74	52	127	58	43	118	50	36	85	44	31	68	39	41											
		Exposed	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	139	152	149	132	152	135	121	147	125	70	133	116	55	122	63	47	62	56	40	55	49	35											
		Exposed	150	148	129	150	140	122	150	132	115	149	126	69	141	120	60	135	115	55	129	82	50	119	60	42	81	51	36	61	44	48	53	39	42	47	34	37	42	46	33										
		Exposed	150	144	130	150	134	121	150	126	65	150	119	58	150	64	53	150	58	48	137	53	44	72	45	37	59	39	48	51	34	42	45	44																	

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Highlighted cell with strikethrough indicate 3-rail system span and module clamp allowable capacity exceeds with 3-rails. 4-Rail system required. Contact Unirac Engineering Services for support.

[illegible]

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10 Highlighted cell indicate 3-rail system span. Contact Unirac Engineering Services for support.

34 Highlighted cell with strikethrough indicate 3-rail system span and module clamp allowable capacity exceeds with 3-rails. 4-Rail system required. Contact Unirac Engineering Services for support.

Ground Snow Load (psf)	Wind Exposure Category	Roof Tilt Angle (deg)	Panel Exposure	Basic Wind Speed (mph)																																															
				Roof Wind Zone																								130				140				150				160				170				180			
				90			95			100			105			110			115			120			130			140			150			160			170			180											
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3													
0	B	0-7	Interior	120	120	120	120	120	120	120	120	120	120	117	120	120	101	120	120	84	120	117	72	120	91	53	117	70	41	95	56	34	75	45	30	61	37	26	51	33	23										
			Exposed	120	120	100	120	120	120	81	120	114	66	120	95	56	120	80	47	116	69	41	102	60	35	76	46	30	59	36	26	47	29	33	24	26	29	21	23												
		7-20	Interior	120	120	120	120	120	120	120	120	120	120	116	120	120	94	120	115	75	120	93	62	120	64	45	97	48	35	63	37	30	53	32	26	45	28	23	38	25	20										
			Exposed	120	120	93	120	109	71	120	84	57	120	67	47	119	55	39	89	46	34	67	40	31	54	32	26	44	27	23	36	24	20	32	21	26	28	28	23	25	24	20									
		20-27	Interior	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	119	109	121	93	70	121	67	50	107	51	38	82	40	31	66	34	26	57	30	23												
			Exposed	121	121	121	121	121	117	121	116	97	121	97	74	121	79	60	120	65	49	115	55	41	84	41	32	65	33	26	53	29	21	45	25	18	38	22	23	33	20	20									
	C	0-7	Interior	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	116	122*	119*	86	122*	98	64	115	74	50	82	58	40	62	47	33	48	39	29										
			Exposed	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	122*	116	122*	119*	86	122*	98	64	115	74	50	82	58	40	62	47	33	48	39	29										
		7-20	Interior	120	120	115	120	120	92	120	118	75	120	108	63	120	90	53	120	77	46	115	67	39	86	51	32	66	41	27	53	34	24	43	29	21	35	26	28	31	23	25									
			Exposed	120	90	53	118	74	44	108	62	37	90	53	76	46	30	65	40	27	56	35	25	44	30	21	35	25	27	30	22	24	26	29	21	23	26	18	21	23	16										
		20-27	Interior	120	120	111	120	117	84	120	99	66	120	78	54	120	64	44	118	53	37	80	45	33	59	34	28	48	29	24	40	25	21	34	22	28	30	20	24	26	26	22									
			Exposed	120	63	44	116	51	36	70	42	32	61	35	29	53	32	26	47	29	24	42	26	22	34	22	28	29	29	24	25	25	21	22	22	16	30	19	16												

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10 Highlighted cell with strikethrough indicate 3-rail system span and module clamp allowable capacity exceeds with 3-rails. 4-Rail system required. Contact Unirac Engineering Services for support.

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[illegible]

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ASCE 7-16
Design Standard

II
Risk Category

30 ft
Roof Height

Ss = 3.00
Seismic

19 sq.ft
Module Area

LANDSCAPE
Orientation

CROSS-SLOPE
Rail Direction

SM
Rail Type

UAF
Clamp

Tile Replacement
Attachment

SPAN TABLES

Maximum Allowable Rail Spans for Rooftop Solar Panels Parallel to the Roof Surface (inches)

Ground Snow Load (psf)	Wind Exposure Category	Roof Tilt Angle (deg)	Panel Exposure	Basic Wind Speed (mph)																																															
				Roof Wind Zone																																															
				90			95			100			105			110			115			120			130			140			150			160			170			180											
				1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3									
0	B	0-7	Interior	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	149	150	150	142	150	149	130	150	137	120	150	128	78	141	120	60	132	98	53	124	67	47										
			Exposed	150	150	150	150	150	150	147	150	150	139	150	150	131	150	143	125	150	136	119	150	130	98	141	120	60	131	91	52	122	63	45	109	55	39	69	49	35	59	43	46								
		7-20	Interior	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	145	150	145	130	150	132	119	150	121	60	150	64	53	150	56	46	86	50	41									
			Exposed	150	150	150	150	150	150	150	150	141	150	147	132	150	138	125	150	131	118	150	124	63	150	64	53	144	55	46	79	48	40	64	42	35	56	37	46	50	49	41									
		20-27	Interior	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*								
			Exposed	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*								
	27-45	Interior	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*									
		Exposed	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*									
	C	0-7	Interior	150	150	150	150	150	150	150	150	144	150	150	136	150	149	129	150	141	123	150	135	118	147	124	65	133	116	55	126	72	48	118	59	42	86	52	37	63	46	89									
			Exposed	150	148	129	150	140	122	150	132	115	149	126	69	141	120	60	135	115	55	129	82	50	119	60	42	81	51	36	61	44	48	53	39	42	47	34	37	42	46	89									
		7-20	Interior	150	150	150	150	150	150	150	150	150	148	150	150	138	150	145	130	150	137	123	150	129	117	150	118	57	150	59	49	91	51	42	71	45	37	60	40	49	53	35	44								
			Exposed	150	144	130	150	134	121	150	126	65	150	119	58	150	64	53	150	58	48	137	53	44	72	45	37	59	39	48	51	34	42	45	44	37	40	39	89	35	35	29									
		20-27	Interior	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*								
			Exposed	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*								
	27-45	Interior	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*									
		Exposed	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*									
	D	0-7	Interior	150	150	148	150	150	139	150	150	131	150	143	124	150	136	118	150	129	88	146	124	64	134	112	54	124	66	46	116	57	40	74	50	35	60	44	47	53	39	42									
			Exposed	150	135	118	150	128	78	143	121	61	136	116	55	129	84	50	123	65	46	118	59	42	76	50	36	59	43	46	51	37	40	45	49	35	39	43	84	35	39	27									
7-20		Interior	150	150	150	150	150	142	150	147	132	150	138	124	150	130	117	150	123	62	150	117	57	150	58	48	86	50	41	66	43	36	57	38	47	51	50	42	45	45	37										
		Exposed	150	129	117	150	121	60	150	68	54	150	59	49	138	54	45	83	49	41	71	45	37	58	38	48	50	49	41	43	43	35	38	37	84	50	89	27	45	29	24										
20-27		Interior	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*	150*									
		Exposed	150*	142	137	150*	133	127	150*	125	119	143	118	57	135	65	50	129	59	45	123	54	40	90	46	32	68	39	41	58	34	35	51	45	31	45	40	27	40	35	24										
27-45	Interior	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*										
	Exposed	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*	146*										
10	B	0-7	Interior	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134									
			Exposed	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134									
		7-20	Interior	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134							
			Exposed	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134								
		20-27	Interior	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*								
			Exposed	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*	143*								
	27-45	Interior	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*									
		Exposed	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*	139*									
	C	0-7	Interior	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134									
			Exposed	134	134	129	134	134	122	134	132	115	134	126	69	134	120	60	134	115	55	129	82	50	119	60	42	81	51	36	61	44	48	53	39	42	47	34	37	42	46	89									
		7-20	Interior	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134																													

[illegible]

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Ground Snow Load (psf)	Wind Exposure Category	Roof Tilt Angle (deg)	Panel Exposure	Basic Wind Speed (mph)																																		
				Roof Wind Zone																								170				180						
				90			95			100			105			110			115			120			130			140			150			160			170	
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3			
90	B	0-7	Interior	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	
			Exposed	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	
		7-20	Interior	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	
			Exposed	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	
		20-27	Interior	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	
			Exposed	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	
	27-45	Interior	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*		
		Exposed	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*	32*		
	C	0-7	Interior	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	
			Exposed	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38		
		7-20	Interior	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*		
			Exposed	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*	27*		
20-27		Interior	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*		
		Exposed	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*	34*		
27-45	Interior	32*	32*	32*	32*	32*																																

* Cells with an asterisk indicates that the L-foot must be oriented in the Y- direction as indicated in the image.

Highlighted cell with strikethrough indicate 3-rail system span and module clamp allowable capacity exceeds with 3-rails. 4-Rail system required. Contact Unirac Engineering Services for support.

Highlighted cell with strikethrough indicate 3-rail system span and module clamp allowable capacity exceeds with 3-rails. 4-Rail system required. Contact Unirac Engineering Services for support.

[illegible]

* Cells with an asterisk indicates that the L-foot must be oriented in the Y- direction as indicated in the image.

[illegible]

* Cells with an asterisk indicates that the L-foot must be oriented in the Y- direction as indicated in the image.

10 Highlighted cell indicate 3-rail system span. Contact Unirac Engineering Services for support.

40 Highlighted cell with strikethrough indicate 3-rail system span and module clamp allowable capacity exceeds with 3-rails. 4-Rail system required. Contact Unirac Engineering Services for support.