



**OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT
FACILITIES DEVELOPMENT DIVISION**

**APPLICATION FOR OSHPD SPECIAL SEISMIC
CERTIFICATION PREAPPROVAL (OSP)**

OFFICE USE ONLY

APPLICATION #: OSP-0706

OSHPD Special Seismic Certification Preapproval (OSP)

Type: New Renewal

Manufacturer Information

Manufacturer: MegaResistors

Manufacturer's Technical Representative: Daljeet Cheema

Mailing Address: 2439 Lucknow Drive #15, Mississauga, ON L5S1V3

Telephone: (905) 908-2376 Email: dcheema@megaresistor.com

Product Information

Product Name: Power Isolation and Correction Systems

Product Type: Grounding Systems

Product Model Number: MegaResistor's Neutral Grounding Resistors (NGR) and High Resistance Grounding Systems (HRG)

General Description: Neutral Grounding Resistors (NGR) and High Resistance Grounding Systems (HRG) are equipment that protect power system equipment and personnel by limiting and lowering the magnitude of ground-fault currents to a predetermined value by safely dissipating the electrical energy as heat. An NGR or HRG becomes the only current path between the Neutral of power transformers or generators and Ground.

Mounting Description: Rigid, See Certified Product Tables

Tested Seismic Enhancements: None

Applicant Information

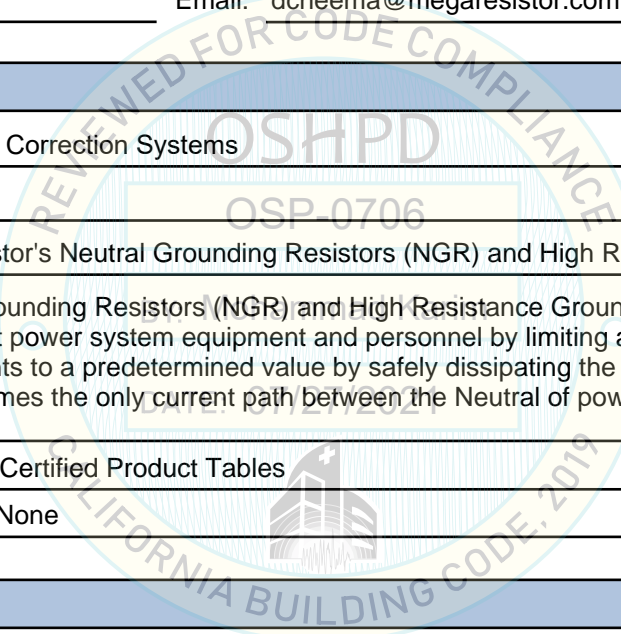
Applicant Company Name: Forell/Elsesser Engineers

Contact Person: Christopher Tung

Mailing Address: 160 Pine Street, 6th Floor, San Francisco, CA 94111

Telephone: (415) 827-0700 Email: c.tung@forell.com

Title: Engineer





OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT
FACILITIES DEVELOPMENT DIVISION

California Licensed Structural Engineer Responsible for the Engineering and Test Report(s)

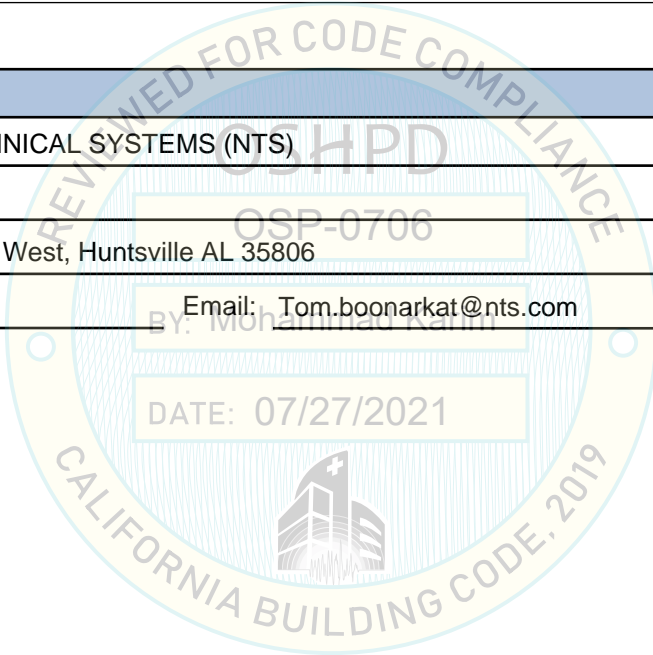
Company Name: FORELL / ELSESSER ENGINEERS, INC.
Name: Marco Scanu California License Number: S4454
Mailing Address: 160 Pine Street, Suite 600, San Francisco, CA 94111
Telephone: (415) 837-0700 Email: scanu@forell.com

Certification Method

GR-63-Core [X] ICC-ES AC156 IEEE 344 IEEE 693 NEBS 3
Other (Please Specify):

Testing Laboratory

Company Name: NATIONAL TECHNICAL SYSTEMS (NTS)
Contact Person: Tom Boonarkat
Mailing Address: 7800 Highway 20 West, Huntsville AL 35806
Telephone: (256) 716-4520 Email: Tom.boonarkat@nts.com





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Seismic Parameters

Design Basis of Equipment or Components (F_p/W_p) = See Attachments

SDS (Design spectral response acceleration at short period, g) = See Attachments

a_p (Amplification factor) = 2.5

R_p (Response modification factor) = 6.0

Ω_0 (System overstrength factor) = 2.0

I_p (Importance factor) = 1.5

z/h (Height ratio factor) = 1

Natural frequencies (Hz) = See Attachment

Overall dimensions and weight = See Attachment

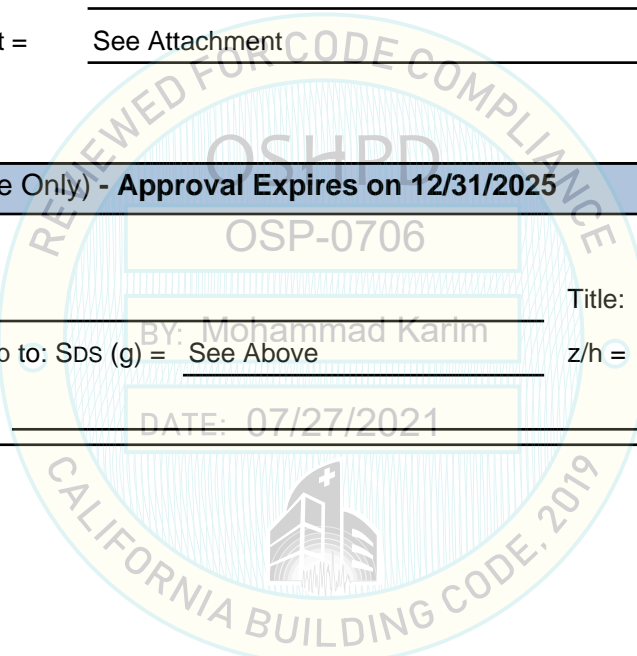
OSHPD Approval (For Office Use Only) - Approval Expires on 12/31/2025

Date: 7/27/2021

Name: Mohammad Karim Title: Supervisor, Health Facilities

Special Seismic Certification Valid Up to: SDS (g) = See Above z/h = 1

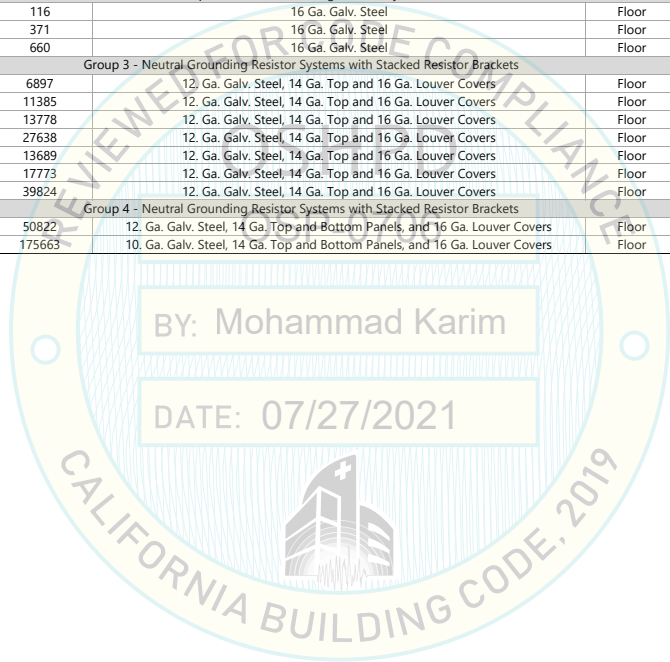
Condition of Approval (if applicable): DATE: 07/27/2021



MegaResistors - Certified Product Table													
Unit	Test Status	Width (in)	Depth (in)	Height (in)	Weight (lbs)	Center of Gravity Height (in.)	Overturing Moment (lb-in)	Construction Material ¹	Mounting	Enclosure Protection Grade	Model Number	Notes	Tension (100% + 30%) (in.)
Group 1 - High Resistance Grounding Systems													
HR1	UUT-1	25.02	12.1	29.37	70.5	15.28	1077	16 Ga. Mild Steel	Wall	Type 3R	HRG - ENHR=1-3R	2	101.9
HR1	UUT-2	25.02	12.1	29.37	70.5	15.28	1077	16 Ga. Mild Steel	Wall	Type 3R	HRG - ENHR=1-3R	2	101.9

MegaResistors - Certified Product Table													
Unit	Test Status	Width (in)	Depth (in)	Height (in)	Weight (lbs)	Center of Gravity Height (in.)	Overturing Moment (lb-in)	Construction Material ¹	Mounting	Enclosure Protection Grade	Model Number	Notes	Tension (100% + 30%) (in.)
Group 1 - High Resistance Grounding Systems													
HR2	UUT-3	26	12.1	54.74	126.14	24.84	3133	16 Ga. Mild Steel, 12 Ga. Bottom Mount Pads and Lifting Lugs	Floor	Type 3R	HRG - ENHR=2-3R	2	295.1
HR3	Interpolated	22	16	66.12	128.48	32.44	4168	16 Ga. Mild Steel, 12 Ga. Bottom Mount Pads and Lifting Lugs	Floor	Type 3R	HRG - ENHR=3-3R	2	317.3
HR4	UUT-4	26	18	80.73	200.02	37.87	7575	16 Ga. Mild Steel, 12 Ga. Bottom Mount Pads and Lifting Lugs	Floor	Type 3R	HRG - ENHR=4-3R	2	508.2
Group 2 - Neutral Grounding Resistor Systems													
N1	UUT-5	22	18	8.06	23.745	4.88	116	16 Ga. Galv. Steel	Floor	Type 3R	NGR - ENNG=1-3R	2	8
N2	Interpolated	22	22	12.43	50	7.41	371	16 Ga. Galv. Steel	Floor	Type 3R	NGR - ENNG=2-3R-L	2	21.9
N2L	UUT-6	22	30.75	12.43	90	7.33	660	16 Ga. Galv. Steel	Floor	Type 3R	NGR - ENNG=2L-3R	2	36.4
Group 3 - Neutral Grounding Resistor Systems with Stacked Resistor Brackets													
N6A	UUT-7	46	38	32.25	416	16.58	6897	12 Ga. Galv. Steel, 14 Ga. Top and 16 Ga. Louver Covers	Floor	Type 3R	NGR - CPD-0111-F-1	2	226.5
N6B	Interpolated	45	37	39.37	550	20.7	11385	12 Ga. Galv. Steel, 14 Ga. Top and 16 Ga. Louver Covers	Floor	Type 3R	NGR - ENNG=6B-3R-L	2	383.6
N6C	Interpolated	45	37	48.28	550	25.05	13778	12 Ga. Galv. Steel, 14 Ga. Top and 16 Ga. Louver Covers	Floor	Type 3R	NGR - ENNG=6C-3R-L	2	464.2
N6D	Interpolated	45	37	72	750	36.85	27638	12 Ga. Galv. Steel, 14 Ga. Top and 16 Ga. Louver Covers	Floor	Type 3R	NGR - ENNG=6D-3R-L	2	931.2
N9A	Interpolated	50	45	39.28	650	21.06	13689	12 Ga. Galv. Steel, 14 Ga. Top and 16 Ga. Louver Covers	Floor	Type 3R	NGR - ENNG=9A-3R-L	2	386.3
N9B	Interpolated	50	45	47.79	700	25.39	17773	12 Ga. Galv. Steel, 14 Ga. Top and 16 Ga. Louver Covers	Floor	Type 3R	NGR - ENNG=9B-3R-L	2	501.6
N9C	UUT-8	51	46	72.07	1074	37.08	39824	12 Ga. Galv. Steel, 14 Ga. Top and 16 Ga. Louver Covers	Floor	Type 3R	NGR - CPD-0128-F-1	2	1100
Group 4 - Neutral Grounding Resistor Systems with Stacked Resistor Brackets													
N12	UUT-9	84	59.79	63.87	1420	35.79	50822	12 Ga. Galv. Steel, 14 Ga. Top and Bottom Panels, and 16 Ga. Louver Covers	Floor	Type 3R	NGR - CPD-0141-F-1	2	1031.5
N20	UUT-10	130.56	78	88.18	3665	47.93	175663	10 Ga. Galv. Steel, 14 Ga. Top and Bottom Panels, and 16 Ga. Louver Covers	Floor	Type 3R	NGR - CPD-0145-F-1	2	2655.7

Notes
1. CFS= cold-formed carbon steel
2. Mounting Hardware details provided on UUT Drawings
3. All units are NEMA 3R



MEGARESISTORS NEUTRAL GROUNDING RESISTORS AND HIGH RESISTANCE GROUNDING SYSTEMS									
Unit	Test Status	Width (in)	Depth (in)	Height (in)	Weight (lbs)	z/h	SDS (g)	Fp/Wp	IEEE-693 Seismic Level
Group 1 - High Resistance Grounding Systems (Wall Mounted)									
HR1	UUT-1	25.02	12.1	29.37	70.5	1.0	2.5	1.88	High
HR1	UUT-2	25.02	12.1	29.37	70.5	1.0	2.5	1.88	High

MEGARESISTORS NEUTRAL GROUNDING RESISTORS AND HIGH RESISTANCE GROUNDING SYSTEMS									
Unit	Test Status	Width (in)	Depth (in)	Height (in)	Weight (lbs)	z/h	SDS (g)	Fp/Wp	IEEE-693 Seismic Level
Group 1 - High Resistance Grounding Systems									
HR2	UUT-3	26	12.1	54.74	126.14	1.0	2.5	1.88	High
HR3	Interpolated	22	16	66.12	128.48	1.0	2.5	1.88	High
HR4	UUT-4	26	18	80.73	200.02	1.0	2.5	1.88	High
Group 2 - Neutral Grounding Resistor Systems									
N1	UUT-5	22	18	8.06	23.745	1.0	2.5	1.88	High
N2	Interpolated	22	22	12.43	50	1.0	2.5	1.88	High
N2L	UUT-6	22	30.75	12.43	90	1.0	2.5	1.88	High
Group 3 - Neutral Grounding Resistor Systems with Stacked Resistor Brackets									
N6A	UUT-7	46	38	32.25	416	1.0	2.5	1.88	High
N6B	Interpolated	45	37	39.37	550	1.0	1.25	0.94	High
N6C	Interpolated	45	37	48.28	550	1.0	1.25	0.94	High
N6D	Interpolated	45	37	72	750	1.0	1.25	0.94	High
N9A	Interpolated	50	45	39.28	650	1.0	1.25	0.94	High
N9B	Interpolated	50	45	47.79	700	1.0	1.25	0.94	High
N9C	UUT-8	51	46	72.07	1074	1.0	1.25	0.94	High
Group 4 - Neutral Grounding Resistor Systems with Stacked Resistor Brackets									
N10	Extrapolated	62	45	52.66	1000	1.0	1.25	1.88	High
N12	UUT-9	84	59.79	63.87	1420	1.0	2.5	1.88	High
N18	Interpolated	82.15	72.84	62.8	2000	1.0	1.25	0.94	High
N20	UUT-10	130.56	78	88.18	3665	1.0	1.25	0.94	High

Notes									
1. All tested UUT's contain all of their respective subcomponents during testing and do not rely on any other tested unit to interpolate or extrapolate subcomponent performance									
2. HR3 contains only subcomponents that were tested in UUT-3 or UUT-4, and is similar build to UUT-3 and UUT-4									
3. N2 contains only subcomponents that were tested in UUT-5 or UUT-6, and is similar build to UUT-5 and UUT-6									
4. N10 contains only subcomponents that were tested in UUT-9 and is of similar build to UUT-9									

**Subcomponent Table
MegaResistors - OSP**

Category	Display Name	Manufacturer	Part Number	Vendor Code	Group Usage	Testing Status
Fuse	Fuse Holder Disconnecter CCP-3-30CC	Eaton	SPFU=HO-D	CCP-3-30CC	Group 1	UUT-4
Bonding Lug	SLU-70	IlSCO	TEBL=70	SLU-70	Group 1	UUT-5 to UUT-10
Current Transformer	CT20-2-005	GE	INCT=20D2-5-5	20-2-005	Group 1 and 2	UUT-4
Zig-Zag Transformer	480V 5A Zig-Zag Transformer	MegaResistors	INZZ=480V-5A	n/a	Group 1 and 2	UUT-6
Zig-Zag Transformer	600V 5A Zig-Zag Transformer	MegaResistors	INZZ=600V-5A	n/a	Group 1 and 2	UUT-6
Terminal Block	Terminal Block 14002-3	Eaton	TETB=115-T3	14002-3	Group 1 and 2	UUT-5 to UUT-6
Terminal Block	Shorting Terminal Block	Ideal	TETB=SH-60-T4	Model 89-505	Group 1 and 2	UUT-5 to UUT-6
Terminal Block	Terminal Block 14002-2	Eaton	TETB=115-T2	14002-2	Group 2	UUT-5 to UUT-6
Insulator	15kV standoff insulator	MegaResistors	IRPS=15	n/a	Group 3 and 4	UUT-9
Insulator	23kV standoff insulator	MegaResistors	IRPS=23	n/a	Group 3 and 4	UUT-10
Insulator	5kV standoff insulator	MegaResistors	IRPS=5	n/a	Group 3 and 4	UUT-7
Insulator	8.7kV standoff insulator	MegaResistors	IRPS=8P7	n/a	Group 3 and 4	UUT-8
NEMA Pad	15kV terminal	MegaResistors	TENP=15	n/a	Group 3 and 4	UUT-9
NEMA Pad	5kV terminal	MegaResistors	TENP=5	n/a	Group 3 and 4	UUT-7
NEMA Pad	8.7kV terminal	MegaResistors	TENP=8P7	n/a	Group 3 and 4	UUT-8
Resistor Element	Edgewound resistor	MegaResistors	REEM=XXA-XX	n/a	Groups 1 to 4	UUT-5 to UUT-10
Resistor Element	Wirewound resistor	MegaResistors	REWW=XX	n/a	Groups 1 to 4	All UUTs
Controls and Indication	95db Buzzer	Mallory	IDHO=95	SC110N	Group 1	UUT-1 and UUT-2
Controls and Indication	2POS Selector Switch	ABB	SPSS=01	C2S52-10B-10	Group 1	UUT-1 and UUT-2
Control Relay	SE-330	Littelfuse Startco	ELCR=SE330-00-00	SE-330	Group 1	UUT-3
Input-Output Module	I/O Module for M-T-M	Automation Direct	ELIO=24VACDC-8DI8DO	P1-16CDR	Group 1	UUT-3
Power Supply	Power Supply 120VAC/125VDC M-T-M	Automation Direct	ELPS=120VACDC-20W-48VA	P1-01AC	Group 1	UUT-3
Controls and Indication	Crompton 3 1/2" Analog Panel Meter	Crompton Instruments	MEAM=3P5	016-02AA-LSMT-C7-S2-MG	Group 1	UUT-3
Controls and Indication	Crompton 3 1/2" Analog Panel Meter	Crompton Instruments	MEVM=3P5	016-02VA-SFSF-C7-S2-MG	Group 1	UUT-3
Auxiliary Relay	ABB Relay 2NO-2NC	ABB	ELAR=2NO-2NC	NF22E-13	Group 1	UUT-4
Auxiliary Relay	IDEC, FL1F-H12RCC, 100-240 VAC/DC	Idec	ELAR=FL1F	FL1F-H12RCC	Group 1	UUT-4
Auxiliary Relay	Interface Relay Base Socket for CR Relay	ABB	ELAR=IRBS	1SVR405660R0000	Group 1	UUT-4
Auxiliary Relay	CR Type, 3C/O, 11PIN	ABB	ELAR=IRCR	1SVR405622R2100	Group 1	UUT-4
Auxiliary Relay	Relay Module	Phoenix Contact	ELAR=R0-24VDC-1	2903361	Group 1	UUT-4
Auxiliary Relay	Relay Module	Phoenix Contact	ELAR=R1-24VDC-1	2903334	Group 1	UUT-4
Auxiliary Relay	Power relay	Idec	ELAR=RJ2S-120V	RJ2S-CL-A120	Group 1	UUT-4
Auxiliary Relay	Power relay base socket	Idec	ELAR=RJ2S-BS	RJ2S-CL-A120-BS	Group 1	UUT-4
Control Relay	ILC 131 ETH System Controller	Phoenix Contact	ELCO=ILC-131ETH	2700973	Group 1	UUT-4
Control Relay	Logic Control Client - M-T-M	Automation Direct	ELCO=P1-540ETH	P1-540	Group 1	UUT-4
Control Relay	COM465IP	Bender	ELCR=COM465	B95061065	Group 1	UUT-4
Control Relay	NGRM500	Bender	ELCR=NGRM500	B94013500	Group 1	UUT-4
Control Relay	NGRM700	Bender	ELCR=NGRM700	B94013700	Group 1	UUT-4
Control Relay	RCM420	Bender	ELCR=RCM420	B94014002	Group 1	UUT-4
Control Relay	RCMS490	Bender	ELCR=RCMS490	B94053006	Group 1	UUT-4
Control Relay	SE-701	Littelfuse Startco	ELCR=SE701	SE-701	Group 1	UUT-4
Input-Output Module	I/O Module 8 DI	Phoenix Contact	ELIO=24VDC-8DI	2702792	Group 1	UUT-4
Input-Output Module	I/O Module 8 DO	Phoenix Contact	ELIO=24VDC-8DO	2702793	Group 1	UUT-4
Input-Output Module	I/O Module 4 AI	Phoenix Contact	ELIO=4AI	2702495	Group 1	UUT-4
Power Supply	Power Supply 24Vdc 1.25A	Phoenix Contact	ELPS=24VDC-30W	2902991	Group 1	UUT-4
Power Supply	Power Supply 24VDC 60W	Phoenix Contact	ELPS=24VDC-60W	2902992	Group 1	UUT-4
Power Supply	Power Supply 24Vdc 1.75A	Phoenix Contact	ELPS=STEP-24V-1P75A	2868648	Group 1	UUT-4
Touchscreen Panel	Touchscreen Operator Panel 4"	Phoenix Contact	ELTO=BTP-2043W	1050387	Group 1	UUT-4
Touchscreen Panel	Touchscreen Operator Panel	Automation Direct	ELTO=EA1-S3MLW	EA1-S3MLW-N	Group 1	UUT-4

Subcomponent Table
MegaResistors - OSP

Category	Display Name	Manufacturer	Part Number	Vendor Code	Group Usage	Testing Status
Heater	Enclosure Heater w/Thermostat	Stego	ENHE=50W	060010-00	Group 1	UUT-4
Controls and Indication	ABB Pilot Light	ABB	IDLA=G120	CL-513G	Group 1	UUT-4
Control Power Transformer	Control Power Transformer SP100ACP	Hammond	INPT=SP100ACP	SP100ACP	Group 1	UUT-4
Ethernet Switch	Ethernet Switch 5 Port	Phoenix Contact	SPES=ETHSW5P	2891001	Group 1	UUT-4
Fuse	Fuse	Mersen	SPFU=600V-6A	ATMR6	Group 1	UUT-4
Disconnect Switch	Socomec 600V, 16A, 3P	Socomec	SPLD=16A-SOCO	22003000	Group 1	UUT-4
Disconnect Switch	Disconnect	ABB	SPLD=40A	OT40F3P	Group 1	UUT-4
Controls and Indication	Push Button N/O	ABB	SPPB=10	CP1-10B-10	Group 1	UUT-4
Pulsing Contactor	Solid State Relay	Crydom	SPPC=24VDC-10A-NC	D2410-B	Group 1	UUT-4
Pulsing Contactor	Solid State Contactor 600V	Phoenix Contact	SPPC=24VDC-20A	1032919	Group 1	UUT-4
Terminal Block	DIN-Rail Terminal Block	ABB	TEDI=25	ABB 011511607	Group 1	UUT-4
Terminal Block	DIN-Rail Terminal Block	ABB	TEDI=55	ABB 011511811	Group 1	UUT-4
Terminal Block	DIN-Rail End Stop	ABB	TEDI=END	1SNK900001R0000	Group 1	UUT-4
Current Transformer	CS10-2.5	Littelfuse Startco	INCT=CS10-2P5	SE-CS10-2,5	Group 1 and 2	UUT-4
Current Transformer	ELCT5-31	Littelfuse Startco	INCT=ELCT5-31	ELCT5-31	Group 1 and 2	UUT-4
Sensing Resistor	CD1000	Bender	INSR=CD1000	B98039010	Group 2	UUT-4
Sensing Resistor	ER-600VC Sensing Resistor	Littelfuse Startco	INSR=ER600VC	ER-600VC	Group 2	UUT-4
Current Transformer	5SFT	Crompton Instruments	INCT=5SFT	5SFT-101	Group 3 and 4	UUT-4
Current Transformer	CTUB103-CTBC35	Bender	INCT=UB-RCMS-103-35	B98120003	Group 1	UUT-3 and UUT-4
Cooling Fan	Multicomp Axial Cooling Fan	Multicomp	ENCF=HR	MC19694	Group 1	UUT-1 to UUT-4
Fuse	Fuse Holder	Littelfuse Startco	SPFU=HO-LF	LPSC0001	Group 1	UUT-4
Fuse	Fuse Holder	Mersen	SPFU=HO-ME	USCC1	Group 1	UUT-4
Pulsing Contactor	Definite Purpose Contactor	ABB	SPPC=DP20C2P-1	DP20C2P-1	Group 1	UUT-1
Sensing Resistor	MR Resistance Monitor Electronics	MegaResistors	X1	n/a	Group 1	UUT-3
Current Transformer	MR Resistance Monitor Transformers	MegaResistors	X2	n/a	Group 1	UUT-3
Sensing Resistor	MR Resistance Monitor Sensors	MegaResistors	X3	n/a	Group 1	UUT-3
NEMA Pad	23kV terminal	MegaResistors	TENP=23	n/a	Group 3 and 4	UUT-10



MegaResistors – Neutral Grounding Resistors and High Resistance Grounding System Equipment Sheets

Test Report PR117621-TR-21 – UUT 1

High Resistance Grounding System

Model Number: HRG – ENHR=1-3R

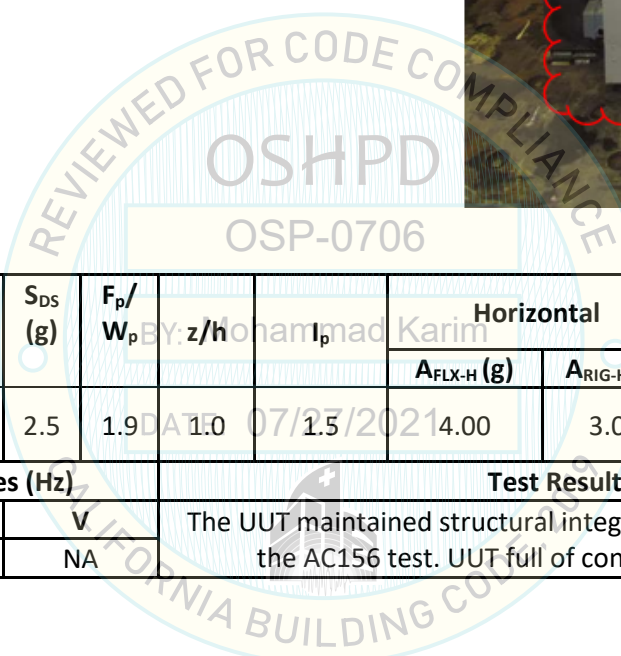
16 ga. Cold Formed Carbon Steel

25.02"W x 12.1"D x 29.37"H, 70.5 lbs

Rigidly Wall mounted using: (6) - 1/4" -20 stainless steel bolts

UUT-1 is shown in the bottom of the picture

Attached to a steel backing



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	z/h	I _p	Horizontal		Vertical	
						A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2019	ICC-ES AC 156	2.5	1.9	1.0	1.5	14.00	3.00	1.675	0.675
Natural Frequencies (Hz)				Test Results					
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
NA	NA	NA							

Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Pulsing Contactor	ABB	SPPC=DP20C2P-1
Controls and Indication	Mallory	IDHO=95
Controls and Indication	ABB	SPSS=01
Cooling Fan	Multicomp	ENCF=HR

MegaResistors – Neutral Grounding Resistors and High Resistance Grounding System
Equipment Sheets

Test Report PR117621-TR-21 – UUT 2

High Resistance Grounding System

Model Number: HRG – ENHR=1-3R

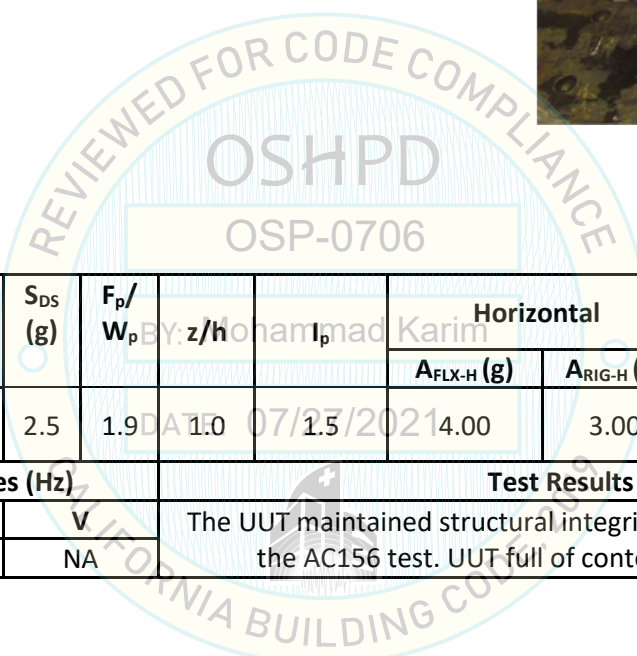
16 ga. Cold Formed Carbon Steel

25.02"W x 12.1"D x 29.37"H, 70.5 lbs

Rigidly Wall mounted using: (6) - 1/4" -20 stainless steel bolts

Attached to a steel backing

UUT-2 is shown in the top of the picture



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	I _p	Horizontal		Vertical		
					A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)	
CBC 2019	ICC-ES AC 156	2.5	1.9	1.0	1.5	14.00	3.00	1.675	0.675
Natural Frequencies (Hz)					Test Results				
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
NA	NA	NA							

Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Controls and Indication	Mallory	IDHO=95
Controls and Indication	ABB	SPSS=01
Cooling Fan	Multicomp	ENCF=HR

Test Report PR117621-TR-21 – UUT 3

High Resistance Grounding System
 Model Number: HRG – ENHR=2-3R
 16 ga. Cold Formed Carbon Steel
 26"W x 12.1"D x 24.74"H, 126.14 lbs
 Rigidly Floor mounted using: (6) – 1/2" Grade 5 bolts
 Attached to a steel base



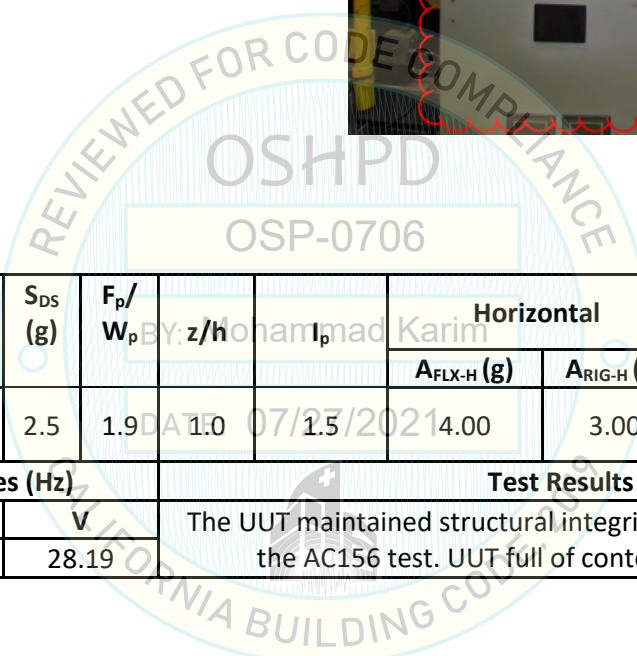
Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	z/h	I _p	Horizontal		Vertical	
						A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2019	ICC-ES AC 156	2.5	1.9	1.0	1.5	4.00	3.00	1.675	0.675
Natural Frequencies (Hz)					Test Results				
F-B	S-S	V			The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.				
17.33	26.66	27.90							

Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Cooling Fan	Multicomp	ENCF=HR
Control Relay	Littelfuse Startco	ELCR=SE330-00-00
Input-Output Module	Automation Direct	ELIO=24VACDC-8DI8DO
Power Supply	Automation Direct	ELPS=120VACDC-20W-48VA
Controls and Indication	Crompton Instruments	MEAM=3P5
Controls and Indication	Crompton Instruments	MEVM=3P5
Sensing Resistor	MegaResistors	X1
Current Transformer	MegaResistors	X2
Sensing Resistor	MegaResistors	X3
Current Transformer	Bender	INCT=UB-RCMS-103-35

MegaResistors – Neutral Grounding Resistors and High Resistance Grounding System
Equipment Sheets

Test Report PR117621-TR-21 – UUT 4

High Resistance Grounding System
Model Number: HRG – ENHR=4-3R
16 ga. Cold Formed Carbon Steel
26”W x 18”D x 80.73”H, 200.02 lbs
Rigidly Floor mounted using: (6) – 1/2” Grade 5 bolts
Attached to a steel base



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	z/h	I _p	Horizontal		Vertical	
						A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2019	ICC-ES AC 156	2.5	1.9	1.0	1.5	14.00	3.00	1.675	0.675
Natural Frequencies (Hz)			Test Results						
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
11.92	13.42	28.19							

Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Cooling Fan	Multicomp	ENCF=HR
Fuse	Eaton	SPFU=HO-D
Current Transformer	GE	INCT=20D2-5-5
Auxiliary Relay	ABB	ELAR=2NO-2NC
Auxiliary Relay	Idec	ELAR=FL1F
Auxiliary Relay	ABB	ELAR=IRBS
Auxiliary Relay	ABB	ELAR=IRCR
Auxiliary Relay	Phoenix Contact	ELAR=R0-24VDC-1
Auxiliary Relay	Phoenix Contact	ELAR=R1-24VDC-1
Auxiliary Relay	Idec	ELAR=RJ2S-120V
Auxiliary Relay	Idec	ELAR=RJ2S-BS
Control Relay	Phoenix Contact	ELCO=ILC-131ETH
Control Relay	Automation Direct	ELCO=P1-540ETH

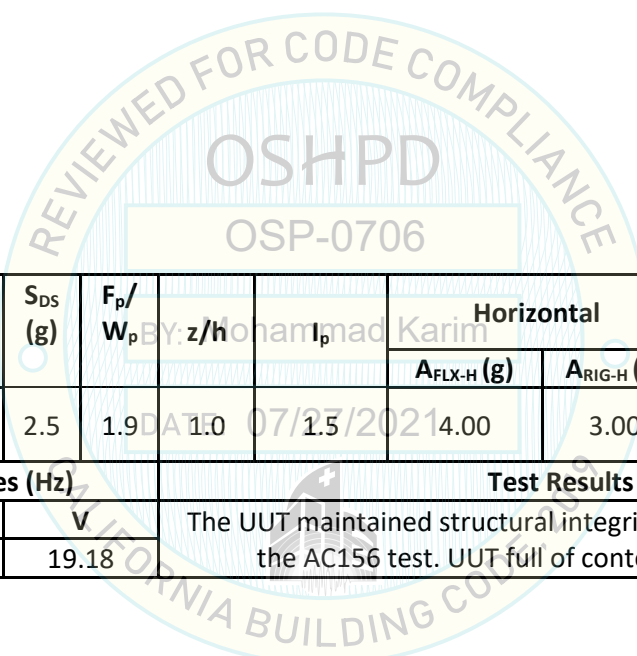
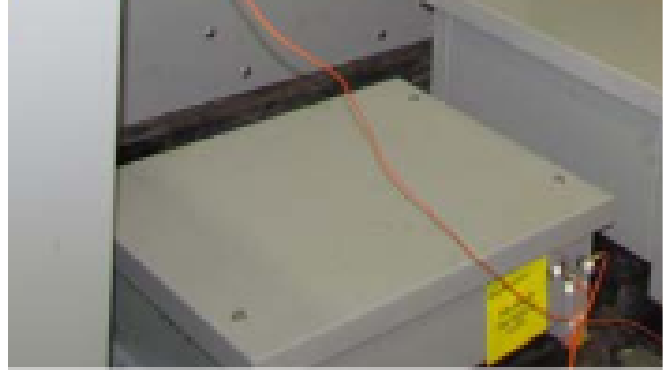
MegaResistors – Neutral Grounding Resistors and High Resistance Grounding System
Equipment Sheets

Subcomponents (Contd.)	Manufacturer	Part #
Control Relay	Bender	ELCR=COM465
Control Relay	Bender	ELCR=NGRM500
Control Relay	Bender	ELCR=NGRM700
Control Relay	Bender	ELCR=RCM420
Control Relay	Bender	ELCR=RCMS490
Control Relay	Littelfuse Startco	ELCR=SE701
Input-Output Module	Phoenix Contact	ELIO=24VDC-8DI
Input-Output Module	Phoenix Contact	ELIO=24VDC-8DO
Input-Output Module	Phoenix Contact	ELIO=4AI
Power Supply	Phoenix Contact	ELPS=24VDC-30W
Power Supply	Phoenix Contact	ELPS=24VDC-60W
Power Supply	Phoenix Contact	ELPS=STEP-24V-1P75A
Touchscreen Panel	Phoenix Contact	ELTO=BTP-2043W
Touchscreen Panel	Automation Direct	ELTO=EA1-S3MLW
Heater	Stego	ENHE=50W
Controls and Indication	ABB	IDLA=G120
Control Power Transformer	Hammond	INPT=SP100ACP
Ethernet Switch	Phoenix Contact	SPES=ETHSW5P
Fuse	Mersen	SPFU=600V-6A
Disconnect Switch	Socomec	SPLD=16A-SOCO
Disconnect Switch	ABB	SPLD=40A
Controls and Indication	ABB	SPPB=10
Pulsing Contactor	Crydom	SPPC=24VDC-10A-NC
Pulsing Contactor	Phoenix Contact	SPPC=24VDC-20A
Terminal Block	ABB	TEDI=25
Terminal Block	ABB	TEDI=55
Terminal Block	ABB	TEDI=END
Current Transformer	Littelfuse Startco	INCT=CS10-2P5
Current Transformer	Littelfuse Startco	INCT=ELCT5-31
Sensing Resistor	Bender	INSR=CD1000
Sensing Resistor	Littelfuse Startco	INSR=ER600VC
Current Transformer	Crompton Instruments	INCT=5SFT
Fuse	Littelfuse Startco	SPFU=HO-LF
Fuse	Mersen	SPFU=HO-ME

MegaResistors – Neutral Grounding Resistors and High Resistance Grounding System
Equipment Sheets

Test Report PR117621-TR-21 – UUT 5

Neutral Grounding Resistor Systems
Model Number: NGR – ENNG=1-3R
16 ga. Galvanized Steel
22"W x 18"D x 8.06"H, 23.745 lbs
Rigidly Floor mounted using: (4) – 5/16" bolts
Attached to a steel base



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	I _p	Horizontal		Vertical		
					A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)	
CBC 2019	ICC-ES AC 156	2.5	1.9	1.0	1.5	14.00	3.00	1.675	0.675
Natural Frequencies (Hz)				Test Results					
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
11.92	9.969	19.18							

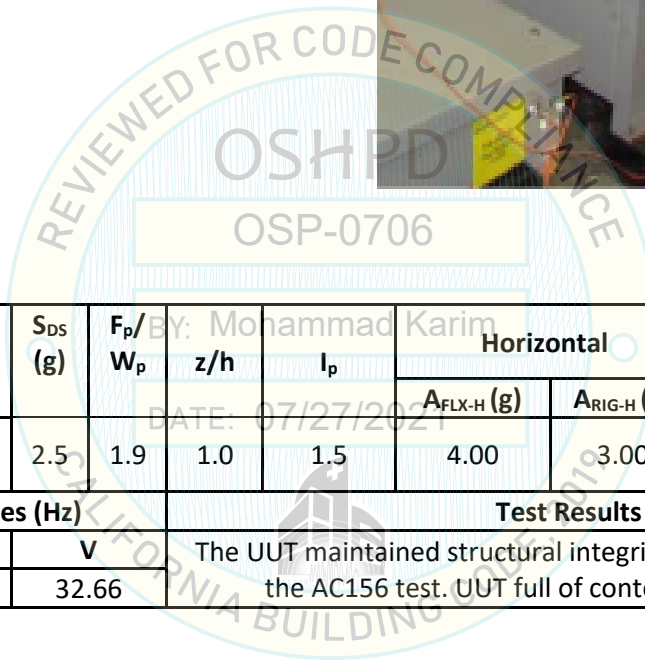
Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Bonding Lug	IlSCO	TEBL=70
Resistor Element	MegaResistors	REEM=XXA-XX
Terminal Block	Eaton	TETB=115-T3
Terminal Block	Ideal	TETB=SH-60-T4
Terminal Block	Eaton	TETB=115-T2

OSP APPLICATION
 MegaResistors – Neutral Grounding Resistors and High Resistance Grounding System
 Equipment Sheets

Date: 7/26/2021

Test Report PR117621-TR-21 – UUT 6

Neutral Grounding Resistor Systems
 Model Number: NGR – ENNG=2L-3R
 16 ga. Galvanized Steel
 22"W x 30.75"D x 12.434"H, 90 lbs
 Rigidly Floor mounted using: (4) – 3/8" bolts
 Attached to a steel base



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	z/h	I _p	Horizontal		Vertical	
						A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2019	ICC-ES AC 156	2.5	1.9	1.0	1.5	4.00	3.00	1.675	0.675
Natural Frequencies (Hz)					Test Results				
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
11.92	17.70	32.66							

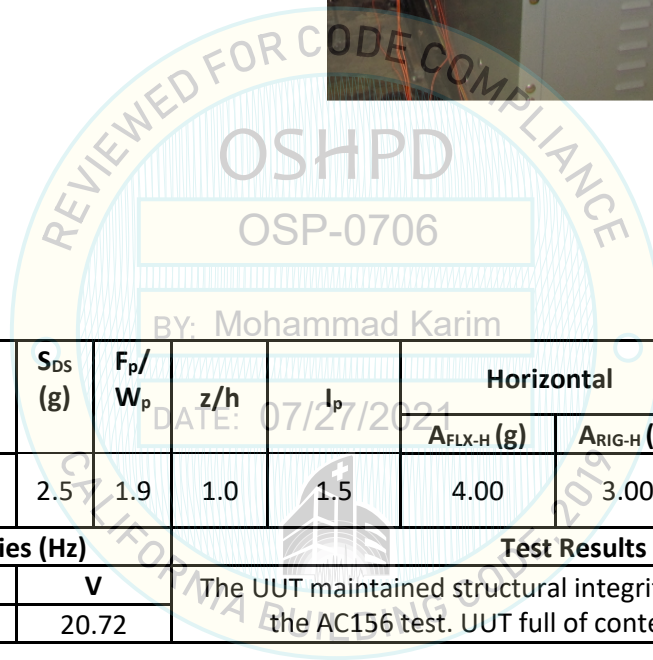
Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Bonding Lug	IlSCO	TEBL=70
Resistor Element	MegaResistors	REEM=XXA-XX
Terminal Block	Eaton	TETB=115-T3
Terminal Block	Ideal	TETB=SH-60-T4
Terminal Block	Eaton	TETB=115-T2
Zig-Zag Transformer	MegaResistors	INZZ=480V-5A
Zig-Zag Transformer	MegaResistors	INZZ=600V-5A

OSP APPLICATION
 MegaResistors – Neutral Grounding Resistors and High Resistance Grounding System
 Equipment Sheets

Date: 7/26/2021

Test Report PR117621-TR-21 – UUT 7

Neutral Grounding Resistor System with stacked Resistor Brackets
 Model Number: NGR – CPD-0111-F-1
 12 ga. Galvanized Steel and 14 ga. top louver cover and 16 ga. louver cover
 46”W x 38”D x 32.25”H, 416 lbs
 Rigidly Floor Mounted using: (6) -1/2” Grade 5 Bolts Attached to a steel base



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	z/h	I _p	Horizontal		Vertical	
						A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2019	ICC-ES AC 156	2.5	1.9	1.0	1.5	4.00	3.00	1.675	0.675
Natural Frequencies (Hz)					Test Results				
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
11.92	17.51	20.72							

Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Bonding Lug	IlSCO	TEBL=70
Resistor Element	MegaResistors	REEM=XXA-XX
Terminal Block	Eaton	TETB=115-T3
Insulator	MegaResistors	IRPS=5
NEMA Pad	MegaResistors	TENP=5

MegaResistors – Neutral Grounding Resistors and High Resistance Grounding System
Equipment Sheets

Test Report PR117621-TR-21 – UUT 8

Neutral Grounding Resistor System with stacked Resistor Brackets

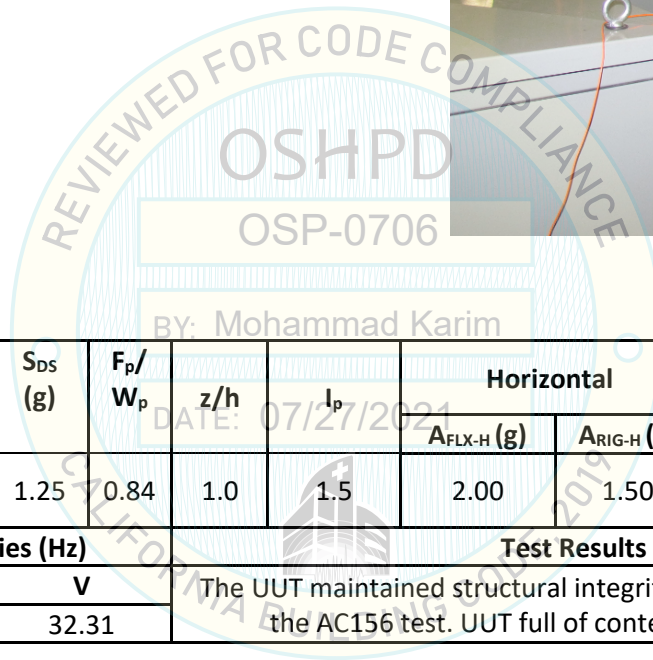
Model Number: NGR – CPD-0128-F-1

12 ga. Galvanized Steel and 14 ga. top louver cover and 16 ga. louver cover

51”W x 46”D x 72.07”H, 1074 lbs

Rigidly Floor Mounted using: (6) -1/2” Grade 5 bolts

Attached to a steel base



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	z/h	I _p	Horizontal		Vertical	
						A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2019	ICC-ES AC 156	1.25	0.84	1.0	1.5	2.00	1.50	0.8375	0.3375
Natural Frequencies (Hz)					Test Results				
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
28.19	18.39	32.31							

Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Bonding Lug	IlSCO	TEBL=70
Resistor Element	MegaResistors	REEM=XXA-XX
Insulator	MegaResistors	IRPS=8P7
NEMA Pad	MegaResistors	TENP=8P7

Test Report PR117621-TR-21 – UUT 9

Neutral Grounding Resistor System with stacked Resistor Brackets

Model Number: NGR – CPD-0141-F-1

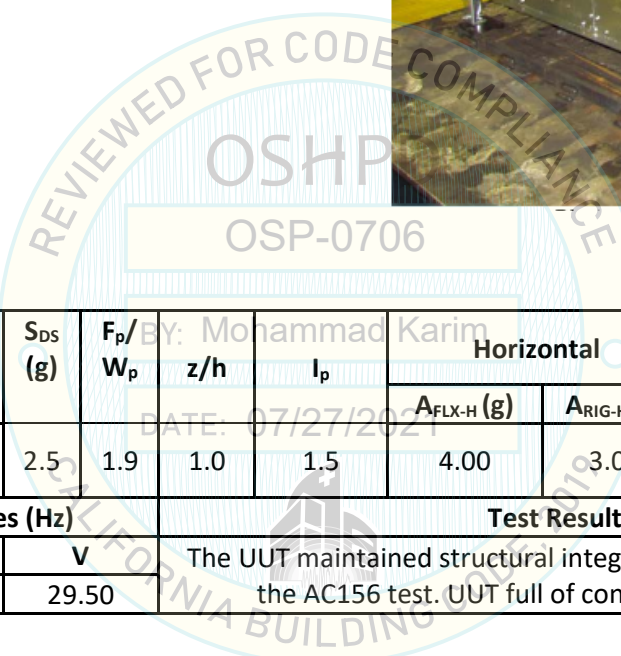
12 ga. Galvanized Steel Top and Bottom Panels

16 ga Cold Formed Carbon Steel Louver Covers

84”W x 59.79”D x 63.87”H, 1420 lbs

Rigidly Floor Mounted using: (4) -1/2” Grade 5 bolts

Attached to a steel base



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	z/h	I _p	Horizontal		Vertical	
						A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2019	ICC-ES AC 156	2.5	1.9	1.0	1.5	4.00	3.00	1.675	0.675
Natural Frequencies (Hz)					Test Results				
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
10.54	17.89	29.50							

Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Bonding Lug	IlSCO	TEBL=70
Resistor Element	MegaResistors	REEM=XXA-XX
Insulator	MegaResistors	IRPS=15
NEMA Pad	MegaResistors	TENP=15

Test Report PR117621-TR-21 – UUT 10

Neutral Grounding Resistor System with stacked Resistor Brackets

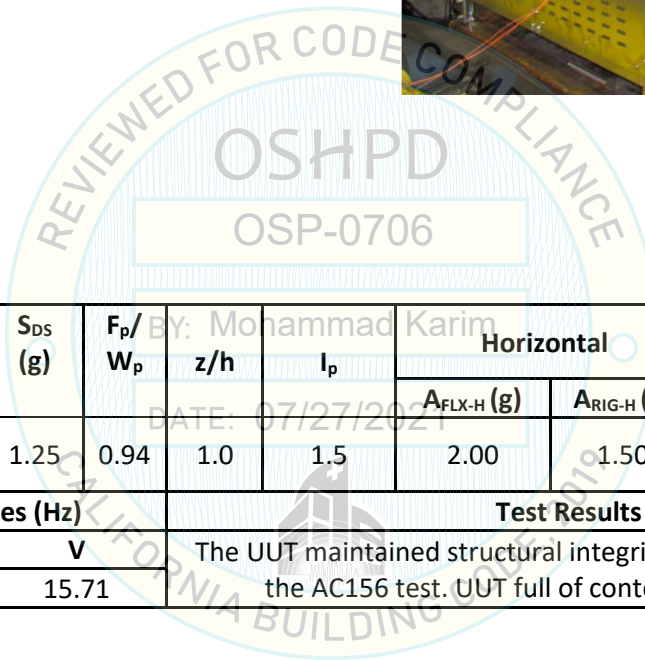
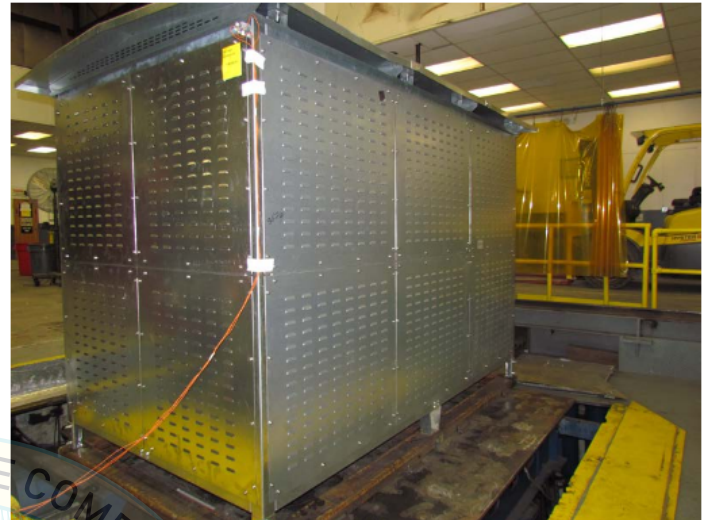
Model Number: NGR – CPD-0145-F-1

10 ga. Cold Formed Carbon Steel Top and Bottom Panels

16 ga Cold Formed Carbon Steel Louver Covers

130.56”W x 78”D x 88.18”H, 3665 lbs

Rigidly Floor Mounted using: (6) – ½” Grade 5 bolts attached to tube steel framing.



Building Code	Test Criteria	S _{DS} (g)	F _p /W _p	z/h	I _p	Horizontal		Vertical	
						A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2019	ICC-ES AC 156	1.25	0.94	1.0	1.5	2.00	1.50	0.8375	0.3375
Natural Frequencies (Hz)					Test Results				
F-B	S-S	V	The UUT maintained structural integrity and functionality after the AC156 test. UUT full of contents during testing.						
7.225	6.807	15.71							

Subcomponents	Manufacturer	Part #
Resistor Element	MegaResistors	REWW=XX
Bonding Lug	IlSCO	TEBL=70
Resistor Element	MegaResistors	REEM=XXA-XX
Insulator	MegaResistors	IRPS=23
NEMA Pad	MegaResistors	TENP=23