

350INVCHGT150-120-240-8G

Utility Interactive Bi-Directional Inverter/Charger

The Bel Power Solutions 350INVCHGT150-120-240-8G is a 15 kW inverter/charger that converts AC to DC voltages in charge mode and converts DC voltages to pure sine wave AC in standalone or utility mode. In the standalone mode the inverter/charger could supply some AC accessories and in the utility mode is able to push energy back to the grid. The liquid cooled inverter/charger operates at 250-435 VDC and 120/240 VAC (50/60 Hz) split-phase.

The inverter charger powers up to 15 kW in either direction. Features include very high efficiency, high reliability, low total harmonic distortion (AC), low output voltage noise (DC), and excellent dynamic response to load/input changes.



Key Features & Benefits

- Up to 15 kW Power in Charge, 14.4 kVA in Standalone and 13.2 kVA in Utility Mode
- 90 % Typical Efficiency
- Charge Mode Output 250-435 VDC
- Standalone Mode Output 120/240 VAC - 50/60 Hz (split-phase) overload capability 200% of rated power during 10 sec.
- Utility Mode Output 208 VAC-60 Hz, UL1741/IEEE1547 certified
- J1939 Compliant CAN Control and Monitoring
- Over-temperature, Output Over-voltage and Over-current Protections
- SAE 1455 Complaint Environmental Standards
- IP65 and IP67 Rating

Applications

- Hybrid Electric Vehicles, Buses, Trucks
- Storage Energy Systems



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350INVCHGT150-120-240-8G

1. MODEL SELECTION

MODEL	DESCRIPTION
350INVCHGT150-120-240-8G	Inverter/Charger
350INVCHGT150-CON-KIT-8G	Connector Kit with DC mating connector, including HV DC cable (3 m)
350INVCHGT150-CON-KIT-9G	Connector Kit with DC mating connector, excluding HV DC cable

2. CHARGE MODE INPUT

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Input Voltage	Nominal Operating Range	100	230	240	VAC
	Absolute Operating Range	90		264	
Input Current	Charge Mode:			70	Arms
		@ 195 – 265 VAC @ 90 – 195 VAC		16	
Frequency		47	50 / 60	63	Hz
Input Line Under-voltage	Charge Mode: Inverter Shutdown	83	85	88	VAC
Input Capacitance				100	μF
Leakage Current	@ 265 VAC, 60 Hz			10	mA
Line Harmonic Current	EN 61000-3-12				
Inrush Current	Pre-charge Mechanism				
Power Factor	@ Vin = 240 VAC, Poset = 250 VDC*40 ADC and 435 VDC*34 ADC	0.98			

3. CHARGE MODE OUTPUT

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Output Type	DC current source with 120 Hz sine wave ripple component				
Output Voltage	Not regulated; depends on battery voltage	250	375	435	VDC
Output Current	Average output current adjustable via CAN			40	ADC
Output Power	@ 240 VAC / 250 VDC			10	kW
	@ 240 VAC / >375 VDC			15	
Efficiency	@ Vin = 240 VAC, Vo = 375 VDC Io = 40 ADC	88	90		%
Static Regulation	Charge Mode: Set Point Accuracy @ Idcset = 30 A, Load in voltage Mode, Tcoolant = 25°C Thermal Drift after 15 min warm up period	- 1		+ 1	ADC %/°C
		- 0.05		+ 0.05	
Turn-On/Off Delay	Charge Mode: Turn-On Delay Turn-Off Delay			3	s
				1	

4. STANDALONE MODE INPUT

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Input Voltage		250	375	435	VDC
Input Current	Average Input current			40	ADC
Input Line Under-voltage	Standalone Mode: Inverter shutdown			240	VDC
Inrush Current	External pre-charging circuit is required as part of battery management system.				
Input Capacitance				400	μF

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5. STANDALONE MODE OUTPUT

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT	
Output Voltage	Split-phase 120 / 240 VAC	2x 112	2x 120	2x 128	VAC	
Output Current	Export Mode: Phase - L1, L2 Neutral - N			60 40	Arms	
Output Power	@ >375 VDC / 240 VAC			14.4	kVA	
Frequency	CAN selectable 50 or 60 Hz	Mode: 50 Hz Mode: 60 Hz	49.9 59.9	50 60	50.1 60.1	Hz
Efficiency	@ 250 VDC, 435 VDC, IAC1 = IAC2 = 60 Arms	88	90		%	
Load Regulation	Export Mode: @ 250 VDC, 435 VDC	- 8	0	+ 8	VAC	
Load Step Response	Load step 30 Arms IAC1 = IAC2 Minimum IAC1 = IAC2 = 6 Arms	Voltage deviation Response time	- 30%	0	+ 30% 4	VAC ms
Periodic and Random Deviation	Export Mode: @ 120 VAC / 60 Arms	- 3.5		+ 3.5	Vpk	
Total Harmonic Distortion	@ 250, 435 VDC; Load 0 – 60 Arms			3	%	
GFCI	Leakage current threshold @ 120 VAC, 60 Hz Reaction time		25	30 30	mA ms	
Turn-On/Off Delay	Export Mode: Turn-On Delay Turn-Off Delay			3 1	s	

6. UTILITY INTERACTIVE MODE INPUT

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Input Voltage		250	375	435	VDC
Input Current	Average Input current			40	ADC
Input Line Under-voltage	Utility Mode: Inverter shutdown			240	VDC
Inrush Current	External pre-charging circuit is required as part of battery management system.				
Input Capacitance				400	μF

7. UTILITY INTERACTIVE MODE OUTPUT

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Output Voltage		183	208	229	VAC
Operating Frequency		59.3	60	60.5	Hz
Maximum Continuous Output Power	@ >375 VDC / 208 VAC			13.2	kVA
Efficiency	@ 250 VDC, 435 VDC, IAC = 63 Arms	88	90		%
Maximum Continuous Output Current	@ >375 VDC / 208 VAC			63	Arms
Maximum Output Overcurrent protection				100	A
Maximum Output Fault Current	duration 1.73ms, 188Arms duration 50ms			518 19	pkA Arms
Number of the phases			1		-
Output Power Factor Rating			1		-

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8. UTILITY INTERCONNECTION DEFAULT VOLTAGE, FREQUENCY TRIP LIMITS & TRIP TIMES

CONDITION	SIMULATED UTILITY SOURCE		MAXIMUM TIME (sec) BEFORE CESSATION OF CURRENT TO THE SIMULATED UTILITY
	VOLTAGE (V)	FREQUENCY (Hz)	
A	$< 0.50 V_{nor}$	Rated	0.16 (Default)
B	$0.50 V_{nor} \leq V < 0.88 V_{nor}$	Rated	2 (Default)
C	$1.10 V_{nor} < V < 1.20 V_{nor}$	Rated	1 (Default)
D	$1.20 V_{nor} \leq V$	Rated	0.16 (Default)
E	Rated	$f > 60.5$ (Default)	0.16 (Default)
F	Rated	$f < 59.3$ (Default)	0.16 (Default)
G	Reconnect Time 300 s (Default) Field Adjustable 10 s to 300 s		

NOTE: The trip limit & trip time accuracy is +/-3 V and +/-0.15 Hz.

9. PROTECTION SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Output Over-Current Protection	Standalone Mode: 10s Over-Load Phase - L1, L2 Neutral - N			120 60	Arms
Short Circuit Survival - Operating	Self-protecting; Hiccup mode				
Output Over-Voltage Protection	Charge Mode: Latch type, CAN adjustable, max. OV Duration 1ms Standalone Mode: Latch type, max. OV Duration 8.33 ms	250		435	VDC
Output Under-Voltage Protection	Charge Mode: Latch type, CAN adjustable, max. UV Duration 1.0 s Standalone Mode: UV Duration 1.0 s	250		435	VDC
Over-Temperature Protection	Converter shutdown at T_coolant higher than	85		95	VAC
Input Overvoltage Protection	Charge Mode: Standalone Mode:	65		272 432	°C VDC

10. MONITORING AND CONTROL SIGNALS

PARAMETER	DESCRIPTION / CONDITION
IGN (Key Switch)	CAN communication enable Level High = Enable
Control Pilot	Function and levels according to SAE J1772
Proximity Detection	Function and levels according to SAE J1772
LED1	PWM current source max 50mA. Supplied from battery voltage input (VBAT 12V) PWM controlled with CAN bus.
LED2	PWM current source max 50mA. Supplied from battery voltage input (VBAT 12V) PWM controlled with CAN bus.
VBAT	12V battery voltage input. Used to supply CAN bus communication
EVSE_WAKE_OUT	Energy taken from VBAT. Voltage level is approximately 1.5V below connected VBAT. High side output wake VCU and other vehicle control modules and/or relay coils. Wake output goes high when control pilot is active and goes low when CAN command from VCU is received or in sleep Mode.
LCD_SCL / LCD_SDA	I ² C for communication with display; 5V logic level; max 100kHz
GFCI_LED	PWM current source max 50mA for supply of LED (GFCI status)
GFCI_RST	If signal is pulled up to 12V for >5ms GFCI will reset
CAN_BAUD_RATE	CAN bus speed; Open – 500 kBit / Grounded – 250 kbit

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11. SAFETY, REGULATORY AND EMI SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	CRITERION
Insulation	Signals to AC	Basic 2250 VDC
	Signals to DC	Basic 2500 VDC
	AC to DC	Reinforced 2500 VDC
	Signals RTN to PE	Electrically connected *
Radiated Emission	FCC15	Class A
Conducted Emission	FCC15, CISPR 22, EN 55022	Class A
Electrostatic Discharge	IEC 61000-4-2	Performance Criterion B
Radiated Electromagnetic Field	IEC 61000-4-3, SAE J1113/21	Performance Criterion B, Status 2
Electrical Fast Transient (EFT) /Burst	IEC 61000-4-4; Level 2 (+/-2 kV, 5 kHz)	Performance Criterion B
Surge Immunity	IEC 61000-4-5; Level 3 surge (+/-1 kV DM and +/-2 kV CM)	Performance Criterion B
RF Conducted Immunity	IEC1000-4-6; Level 3 (10V, 0.15...80 MHz, AM 80%, 1 KHz)	Performance Criterion A
Flicker Tests	IEC 61000-3-3	
Electrical Transient Conduction along Supply Lines	ISO 7637-2, ISO 16750-2	

* Due to referencing of Control Pilot and Proximity against PE/chassis (SAE J1772)

12. ENVIRONMENTAL SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Altitude	Non-Operating:18.6 kPa absolute pressure			12200	m
Operating Temperature	Liquid cooled:				
	T_coolant	-40		+60	°C
	T_ambient	-40		+85	°C
Storage Temperature		-40		+95	°C
Humidity	SAE J1455				
Shock	SAE J1455, GMW-3172				
Vibration	SAE J1455, GMW-3172				
Protection	IP65 and IP67 (4X) / when all matting connectors are installed				

13. CONNECTORS

13.1 AC INPUT CONNECTOR

Inverter / Charger side: MFG: Deutsch; PN: HDP24-24-7PN-C038

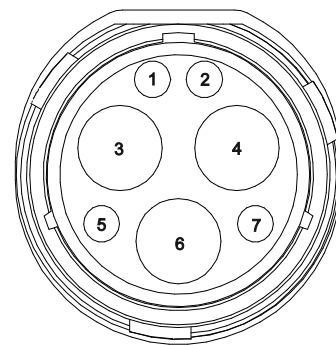
Mating connector: MFG: Deutsch; PN: HDP26-24-7SN-C038

Use copper conductors only with an insulation rating of 120 °C.

NOTE: Follow connector MFG instructions for correct connector assembly.

PIN	FUNCTION	WIRE SIZE	DEUTCH MATTING TERMINAL P/N
1	Control-Pilot*	AWG 16-20	0462-201-16141
2	Proximity*	AWG 16-20	0462-201-16141
3	L1 - Input	AWG 4	5962-203-04141
4	L2 or N - Input	AWG 4	5962-203-04141
5	Not Used	N/A	N/A
6	PE*	AWG 4	5962-203-04141
7	Not Used	N/A	N/A

* Functions and levels according SAE J1772; Insulated from AC side; Referenced to 12V_RTN



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13.2 AC OUTPUT CONNECTOR

Inverter / Charger side: MFG: Deutsch; PN: HDP24-24-9SE

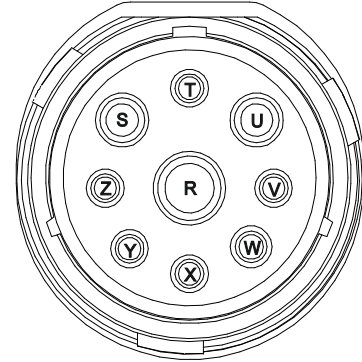
Mating connector: MFG: Deutsch; PN: HDP26-24-9PE-L015

Use copper conductors only with an insulation rating of 120 °C.

NOTE: Follow connector MFG instructions for correct connector assembly.

PIN	FUNCTION	WIRE SIZE	DEUTCH MATTING TEMINAL P/N
R	N - Output	AWG 6	0460-204-0490
S	L1 - Output	AWG 8 - 10	0460-204-08141
T	PE*	AWG 12 - 14	0460-204-12141
U	L2 - Output	AWG 8 - 10	0460-204-08141
V	PE*	AWG 12 - 14	0460-204-12141
W	PE*	AWG 12 - 14	0460-204-12141
X	PE*	AWG 12 - 14	0460-204-12141
Y	PE*	AWG 12 - 14	0460-204-12141
Z	PE*	AWG 12 - 14	0460-204-12141

* All PE terminals (T, V, W, X, Y, Z) shall be connected together to keep safety rating requirements.



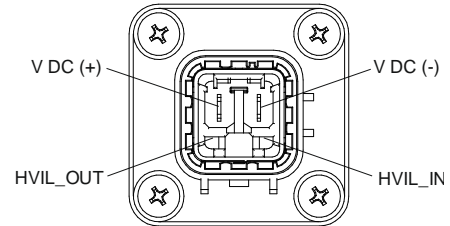
13.3 DC INPUT / OUTPUT CONNECTOR

Inverter / Charger side: MFG: TE Connectivity; PN: 8-2141272-1 (HVA-630)

Mating connector: MFG: TE Connectivity; PN: 2177140-2

HV cable: MFG: Coroplast; PN: 9-2641

NOTE: HVIL_IN and HVIL_OUT signals are connected directly to SIGNAL 2 connector. Signals are insulated from HV DC side. Signals are insulated from 12V_RTN up to 60 VDC basic insulation. Current rating is 2 A.

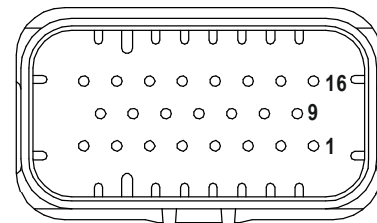


13.4 SIGNAL 1

Inverter / Charger side: MFG: TE Connectivity; PN: 776087-5

Mating connector: MFG: TE Connectivity; PN: 770680-5

PIN	NAME	FUNCTION	AMPS PER PIN
1	LCD_SCL	I ² C_SCL for Display	2 (AWG20)
2	LCD_SDA	I ² C_SDA for Display	2 (AWG20)
3	GFCI_LED	GFCI status signal	2 (AWG20)
4	GFCI_RST	Pin to connect external GFCI reset button (Button connected to +12V)	2 (AWG20)
5	12V_BAT	Connected to connector 2 pin 3	2 (AWG20)
6	12V_RTN	Return for 12V battery and signals Connected with connector 2 pin 10	2 (AWG20)
7	SWITCH_IN	Loop to connector 2 pin 14	2 (AWG20)
8	ALARM_OUT	Loop from connector 2 pin 13	2 (AWG20)
9	IGN	Loop from connector 2 pin 12	2 (AWG20)
10 - 23	NA		



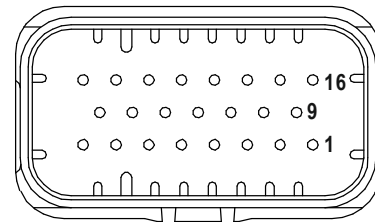
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13.5 SIGNAL 2

Inverter / Charger side: MFG: TE Connectivity; PN: 776087-1

Mating connector: MFG: TE Connectivity; PN: 770680-1

PIN	NAME	FUNCTION	AMPS PER PIN
1	LED_1	Charger status LED1	2 (AWG20)
2	LED_2	Charger status LED2	2 (AWG20)
3	VBAT	12V battery voltage input	2 (AWG20)
4	CANH_1	CAN Bus H	2 (AWG20)
5	CANL_1	CAN Bus L	2 (AWG20)
6	HVIL_1	HVIL from DC connector (HVIL_IN)	2 (AWG20)
7	HVIL_2	HVIL from DC connector (HVIL_OUT)	2 (AWG20)
8	CANH_2	CAN Bus H (connected to pin 4)	2 (AWG20)
9	CANL_2	CAN Bus L (connected to pin 5)	2 (AWG20)
10	12V_RTN	Return for 12V battery and signals	2 (AWG20)
11	EVSE_WAKE_OUT	Signal to wake up Vehicle Control Unit (VCU module)	2 (AWG20)
12	IGN	(Key Switch) Supply of CAN and Bias convertor enable.	2 (AWG20)
13	ALARM_IN	Loop to connector 1 pin 8	2 (AWG20)
14	SWITCH_OUT	Loop from connector 1 pin 7	2 (AWG20)
15	EVSE_WAKE_OUT	Connected to pin 11	2 (AWG20)
16	NA		2 (AWG20)
17	CAN_BAUD_RATE	Open – 500 kBit; Grounded – 250 kbit	2 (AWG20)
18 -23	NA		

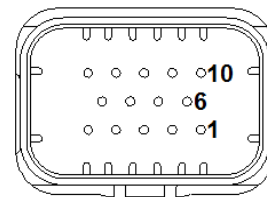


13.6 SIGNAL 3

Inverter / Charger side: MFG: TE Connectivity; PN: 776267-1

Mating connector: MFG: TE Connectivity; PN: 776273-1

PIN	NAME	FUNCTION	AMPS PER PIN
1	CANH_3	CAN Bus H (connected to connector Signal 2 / pin 4)	2 (AWG20)
2	CANL_3	CAN Bus L (connected to connector Signal 2 / pin 5)	2 (AWG20)
3	VBAT	Connected to connector Signal 2 / pin 3	2 (AWG20)
4	12V_RTN	Return for 12V battery and signals Connected to connector Signal 2 / pin 10	2 (AWG20)
5	EVSE_WAKE_OUT	Connected to connector Signal 2 / pin 11	2 (AWG20)
6	Control Pilot	Connected to AC Input connector / pin 1	2 (AWG20)
7	Proximity	Connected to AC Input connector / pin 2	2 (AWG20)
8	KEY_SWITCH	Connected to connector Signal 2 / pin 12	2 (AWG20)
9 -14	NC		



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14 COOLING SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION
Cooling Type:	Liquid cooling
Coolant Medium/Mixture:	50/50 Glycol/Water
Coolant Flow:	Min.11.4 LPM
Max. coolant pressure:	15 psi
Max. pressure drop:	3 psi
Inlet/Outlet Coolant Connection:	SAE fittings with outer thread 1-14UNS for internal hose size $\geq 5/8"$ (e.g. Parker p/n: 10F5OMLOSS)
Material of fittings:	Stainless steel
Fittings provided with inverter charger:	2pcs Parker p/n: 10F5OMLOSS or equivalent

15 MECHANICAL SPECIFICATIONS

PARAMETER	CONDITIONS / DESCRIPTION
Dimensions (W x H x D)	605 x 170 x 394 mm
Weight	38.5 kg
Enclosure Material	Aluminum alloy

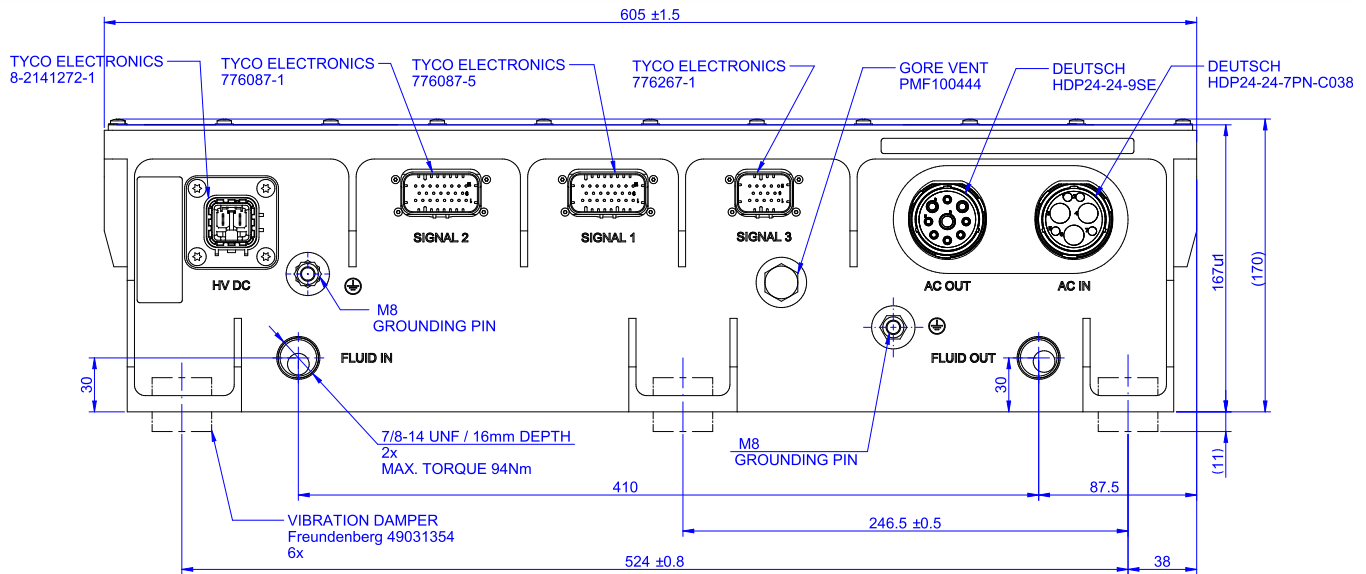


Figure 1. Mechanical Dimensions – Front View

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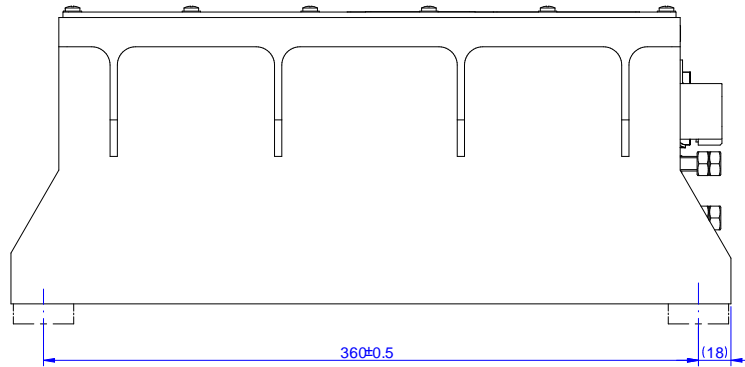


Figure 2. Mechanical Dimensions – Side View

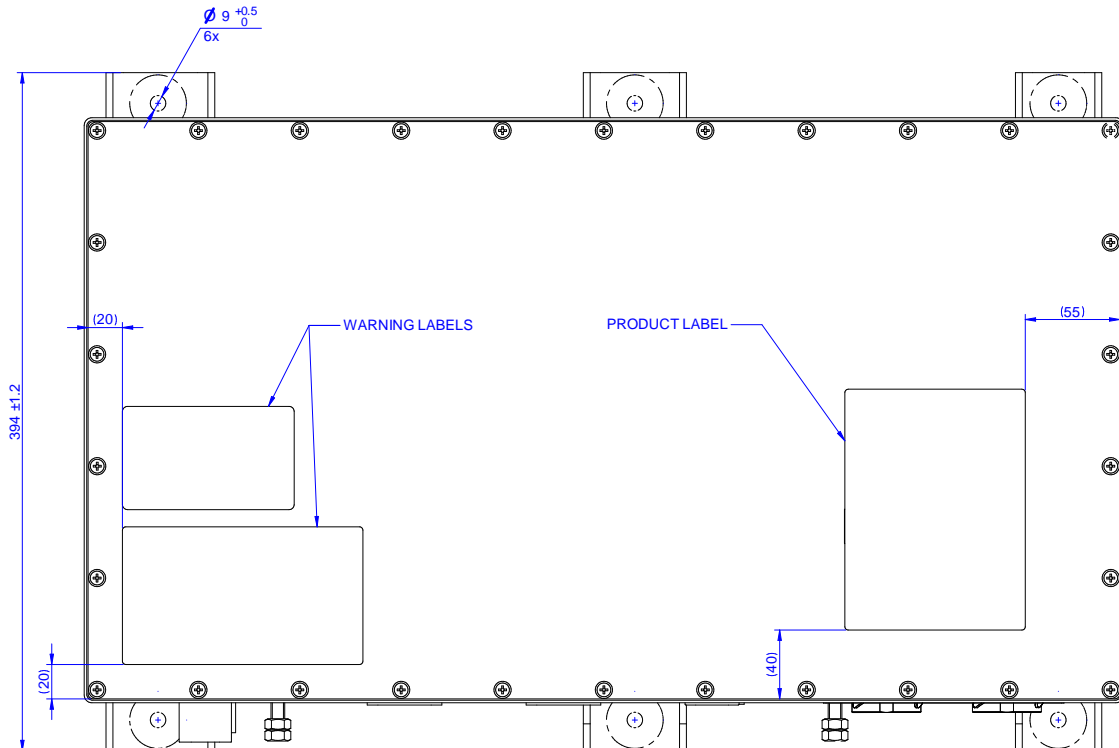


Figure 3. Mechanical Dimensions – Top View

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