

Typhoon HIL User Guides and Documentation
Universal HIL Connect User Guide
Aug 24, 2021

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Chapter 1

Universal HIL Connect

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Information about the Universal HIL Connect, a variant of the HIL Connect interface devices with part number 20010, designed to adapt HIL IO signal levels to those most commonly used in the industry.



Note: This documentation applies only to legacy HIL Connect devices with part number 20010. For other HIL Connect devices, please refer to the latest version of the [HIL Connect documentation](#).

Table 1: Universal HIL Connect Table of Contents

Chapter	Description of Content
Overview on page 6	Overview of the purpose of the Universal HIL Connect.
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Overview

Overview of the purpose of the Universal HIL Connect.

The Universal HIL Connect is a rack-mount signal conditioning device, designed to convert HIL voltage levels (e.g. +/-10V HIL analog outputs) to levels commonly used in the power electronics, or power systems industry (e.g. 130V RMS). It is designed to be used with any HIL device, and has a capacity to condition one row of HIL I/O (up to: 32 x AO, 16 x AI, 32 x DO, 32 x DI).

The Universal HIL Connect enables seamless integration with a wide variety of devices, most commonly:

- Protective relays
- Diesel Genset controllers
- Power electronic controllers
- Industrial automation equipment

The front of the device features connectors to interface with a single row of HIL I/O, while the rear panel provides connection points for external equipment.

The Universal HIL Connect is powered via mains, and it is compatible with all mains voltages around the world.



Warning: Connectors X21, X22, X23, and X24 can output voltages of up to ~200V AC. Do not touch exposed pins, or short with metal objects.

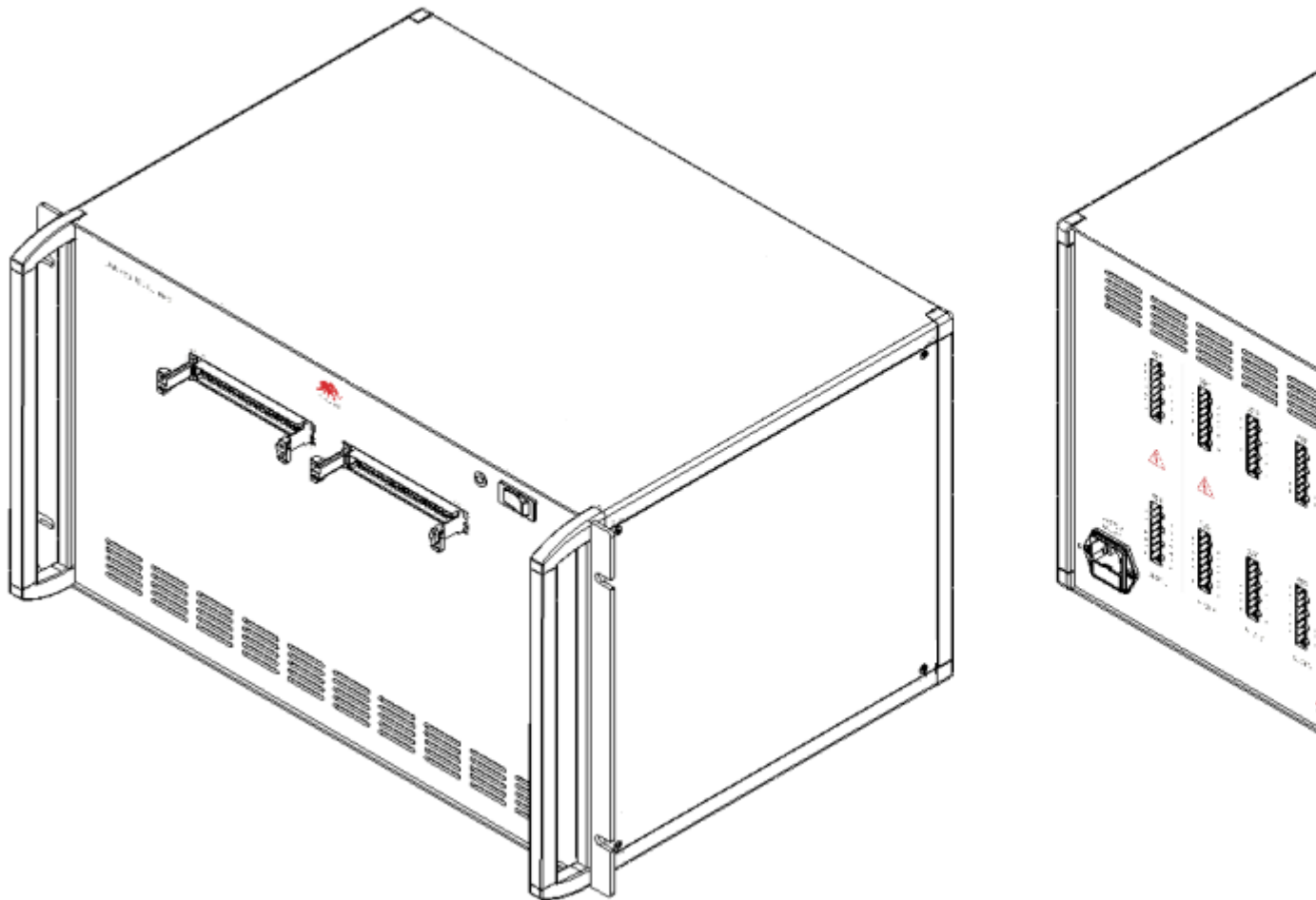


Figure 1: Universal HIL Connect isometric view

Detailed description

Detailed description of the functionality of the Universal HIL Connect.

As the block diagram in [Figure 1](#) shows, the Universal HIL Connect has the following sections:

- Digital outputs (driven by HIL DO1..32)
- Digital inputs (routed to HIL DI1..32)
- Analog outputs (driven by HIL AO1..32)
- Analog inputs (routed to HIL AI1..16)

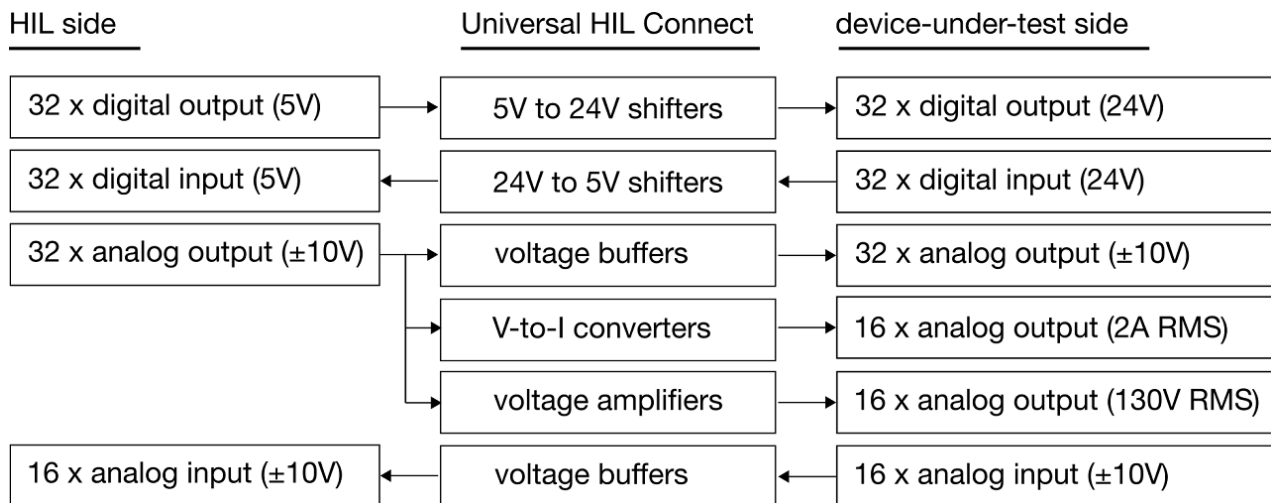


Figure 2: Universal HIL Connect block diagram

I/O specification

Detailed specification of the Universal HIL Connect I/O stage.

Analog outputs

Analog output-type signals are driven via HIL Analog Outputs, with a maximum of 32 channels. To increase the flexibility of the device, HIL analog outputs are:

1. Buffered and routed to the output (AO1-32)
2. Amplified to high voltage, and routed to output connectors (AO1-16)

3. Converted from voltage to current, and routed to output connectors (AO17-AO32)

Table 2: Analog output specification

Type	Range (peak)	Conditioned channels	Bandwidth	Accuracy	Comment
Analog Output	± 10 V (~7.071 V [rms])	32 (AO1..AO32)	DC-100 kHz	0.1% + 0.5 mV	Load range: > 500 Ω
High voltage	± 183.3 V	16 (AO1..AO16)	DC-10 kHz	1% + 10 mV	1 mA output current
Current Output	± 2.82 A	16 (AO17..AO32)	DC-120 kHz	0.1% + 0.6 mA	± 2 V compliance

Analog inputs

The analog input stage is an opamp buffer stage, with all 16 channels routed through the Universal HIL Connect.

Table 3: Analog input specification

Type	Range (peak)	Conditioned channels	Bandwidth	Accuracy	Comment
Voltage	± 10 V (~7.071 V [rms])	16 (AI1..16)	DC-100 kHz	1% + 10 mV	± 24 V continuous external voltage protection

Digital outputs

The digital output stage is implemented via push-pull gate drivers. The driving signal comes from HIL DO1..32 channels. Essentially, the whole section is behaving as a level shifter, converting 5V logic signals from HIL to the industry-standard 24V logic.

Table 4: Digital output specification

Type	Logic	Conditioned channels	Output resistance	Rating	Comment
Voltage	Push-pull	32 (DO1..32)	~ 22 Ω	24 V	$I_{MAX} = 50$ mA

Digital inputs

Digital input stage is implemented with all logic levels in mind, thus enabling connection of any controller digital output signal to any of the 32 HIL DI channels.

Table 5: Digital input specification

Type	Logic	Conditioned channels	Input resistance	Rating	Comment
Voltage	Fast I/O	32 (DI1..32)	~ 100 k Ω	Logic High: 2.5..28 V Logic Low: 0..0.8 V	

Connector Layout

Universal HIL Connect connector layout and type.

Front panel

The front panel of the Universal HIL Connect features two 96-pin DIN41612 connectors, designed to be connected to a single row of HIL I/O, via the provided 96pin HIL I/O cables.

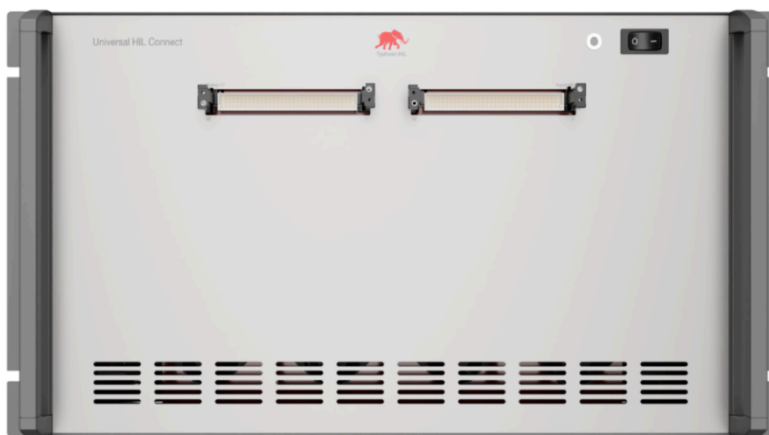


Figure 3: Universal HIL Connect front panel

Rear panel

The rear panel of the Universal HIL Connect features connectors for interfacing with external equipment.

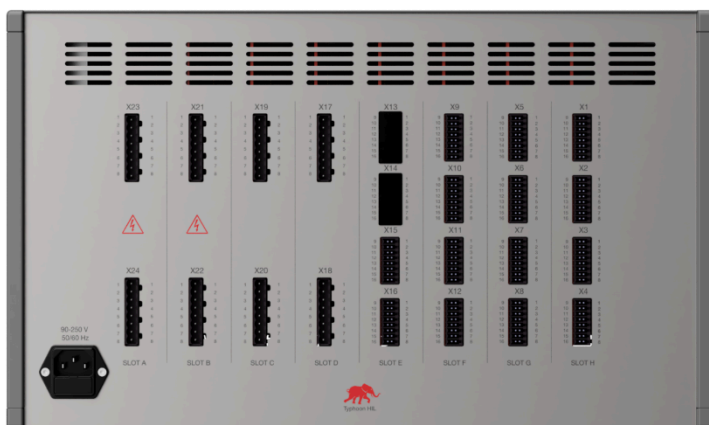


Figure 4: Universal HIL Connect rear panel

Table 6: Rear panel connectors

Section	Connector part number	Mating connector part number
AO, AI, DO, DI	1289320000	B2CF 3.50/16/180 SN BK BX
Current Outputs, High Voltage outputs	1780240000	BLF 5.08HC/08/180 SN BK BX

Pinouts

Pinouts for the connectors for interfacing with external equipment.

Digital outputs

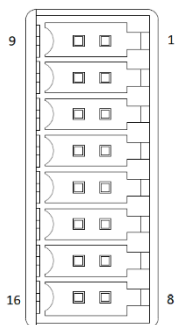


Figure 5: Connector outline

Table 7: X1

Connector	Pin	Rating	Related HIL channel
X1	1	24 V logic	DO1
X1	2	24 V logic	DO2
X1	3	24 V logic	DO3
X1	4	24 V logic	DO4
X1	5	24 V logic	DO5
X1	6	24 V logic	DO6
X1	7	24 V logic	DO7
X1	8	24 V logic	DO8
X1	9..16	GND	HIL GND

Table 8: X2

Connector	Pin	Rating	Related HIL channel
X2	1	24 V logic	DO9
X2	2	24 V logic	DO10
X2	3	24 V logic	DO11
X2	4	24 V logic	DO12
X2	5	24 V logic	DO13
X2	6	24 V logic	DO14
X2	7	24 V logic	DO15
X2	8	24 V logic	DO16
X2	9..16	GND	HIL GND

Table 9: X3

Connector	Pin	Rating	Related HIL channel
X3	1	24 V logic	DO17
X3	2	24 V logic	DO18
X3	3	24 V logic	DO19
X3	4	24 V logic	DO20
X3	5	24 V logic	DO21
X3	6	24 V logic	DO22
X3	7	24 V logic	DO23
X3	8	24 V logic	DO24
X3	9..16	GND	HIL GND

Table 10: X4

Connector	Pin	Rating	Related HIL channel
X4	1	24 V logic	DO25
X4	2	24 V logic	DO26
X4	3	24 V logic	DO27
X4	4	24 V logic	DO28
X4	5	24 V logic	DO29
X4	6	24 V logic	DO30
X4	7	24 V logic	DO31
X4	8	24 V logic	DO32
X4	9..16	GND	HIL GND

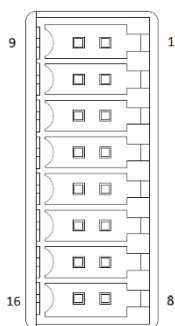
Digital inputs**Figure 6: Connector outline**

Table 11: X5

Connector	Pin	Rating (logic LOW / logic HIGH)	Related HIL channel
X5	1	0..0.8 V / 2.5..24 V	DI1
X5	2	0..0.8 V / 2.5..24 V	DI2
X5	3	0..0.8 V / 2.5..24 V	DI3
X5	4	0..0.8 V / 2.5..24 V	DI4
X5	5	0..0.8 V / 2.5..24 V	DI5
X5	6	0..0.8 V / 2.5..24 V	DI6
X5	7	0..0.8 V / 2.5..24 V	DI7
X5	8	0..0.8 V / 2.5..24 V	DI8
X5	9..16	GND	HIL GND

Table 12: X6

Connector	Pin	Rating	Related HIL channel
X6	1	0..0.8 V / 2.5..24 V	DI9
X6	2	0..0.8 V / 2.5..24 V	DI10
X6	3	0..0.8 V / 2.5..24 V	DI11
X6	4	0..0.8 V / 2.5..24 V	DI12
X6	5	0..0.8 V / 2.5..24 V	DI13
X6	6	0..0.8 V / 2.5..24 V	DI14
X6	7	0..0.8 V / 2.5..24 V	DI15
X6	8	0..0.8 V / 2.5..24 V	DI16
X6	9..16	GND	HIL GND

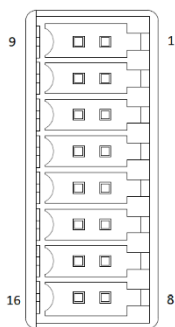
Table 13: X7

Connector	Pin	Rating	Related HIL channel
X7	1	0..0.8 V / 2.5..24 V	DI17
X7	2	0..0.8 V / 2.5..24 V	DI18
X7	3	0..0.8 V / 2.5..24 V	DI19
X7	4	0..0.8 V / 2.5..24 V	DI20
X7	5	0..0.8 V / 2.5..24 V	DI21
X7	6	0..0.8 V / 2.5..24 V	DI22
X7	7	0..0.8 V / 2.5..24 V	DI23
X7	8	0..0.8 V / 2.5..24 V	DI24
X7	9..16	GND	HIL GND

Table 14: X8

Connector	Pin	Rating	Related HIL channel
X8	1	0..0.8 V / 2.5..24 V	DI25
X8	2	0..0.8 V / 2.5..24 V	DI26
X8	3	0..0.8 V / 2.5..24 V	DI27
X8	4	0..0.8 V / 2.5..24 V	DI28
X8	5	0..0.8 V / 2.5..24 V	DI29
X8	6	0..0.8 V / 2.5..24 V	DI30
X8	7	0..0.8 V / 2.5..24 V	DI31
X8	8	0..0.8 V / 2.5..24 V	DI32
X8	9..16	GND	HIL GND

Analog Outputs

**Figure 7: Connector outline****Table 15: X9**

Connector	Pin	Rating	Related HIL channel
X9	1	±10 V	AO1
X9	2	±10 V	AO2
X9	3	±10 V	AO3
X9	4	±10 V	AO4
X9	5	±10 V	AO5
X9	6	±10 V	AO6
X9	7	±10 V	AO7
X9	8	±10 V	AO8
X9	9..16	GND	HIL GND

Table 16: X10

Connector	Pin	Rating	Related HIL channel
X10	1	±10 V	AO9
X10	2	±10 V	AO10
X10	3	±10 V	AO11
X10	4	±10 V	AO12
X10	5	±10 V	AO13
X10	6	±10 V	AO14
X10	7	±10 V	AO15
X10	8	±10 V	AO16
X10	9..16	GND	HIL GND

Table 17: X11

Connector	Pin	Rating	Related HIL channel
X11	1	±10 V	AO17
X11	2	±10 V	AO18
X11	3	±10 V	AO19
X11	4	±10 V	AO20
X11	5	±10 V	AO21
X11	6	±10 V	AO22
X11	7	±10 V	AO23
X11	8	±10 V	AO24
X11	9..16	GND	HIL GND

Table 18: X12

Connector	Pin	Rating	Related HIL channel
X12	1	±10 V	AO25
X12	2	±10 V	AO26
X12	3	±10 V	AO27
X12	4	±10 V	AO28
X12	5	±10 V	AO29
X12	6	±10 V	AO30
X12	7	±10 V	AO31
X12	8	±10 V	AO32
X12	9..16	GND	HIL GND

Analog inputs

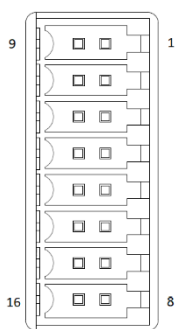


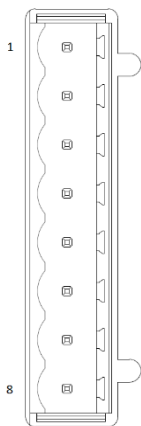
Figure 8: Connector outline

Table 19: X15

Connector	Pin	Rating	Related HIL channel
X15	1	± 10 V	AI1
X15	2	± 10 V	AI2
X15	3	± 10 V	AI3
X15	4	± 10 V	AI4
X15	5	± 10 V	AI5
X15	6	± 10 V	AI6
X15	7	± 10 V	AI7
X15	8	± 10 V	AI8
X15	9..16	GND	HIL GND

Table 20: X16

Connector	Pin	Rating	Related HIL channel
X16	1	± 10 V	AI9
X16	2	± 10 V	AI10
X16	3	± 10 V	AI11
X16	4	± 10 V	AI12
X16	5	± 10 V	AI13
X16	6	± 10 V	AI14
X16	7	± 10 V	AI15
X16	8	± 10 V	AI16
X16	9..16	GND	HIL GND

Current outputs**Table 21: X17**

Connector	Pin	Rating	Related HIL channel
X17	1	±2.82 A	AO1
X17	2	-	GND
X17	3	±2.82 A	AO2
X17	4	-	GND
X17	5	±2.82 A	AO3
X17	6	-	GND
X17	7	±2.82 A	AO4
X17	8	-	GND

Table 22: X18

Connector	Pin	Rating	Related HIL channel
X18	1	±2.82 A	AO5
X18	2	-	GND
X18	3	±2.82 A	AO6
X18	4	-	GND
X18	5	±2.82 A	AO7
X18	6	-	GND
X18	7	±2.82 A	AO8
X18	8	-	GND

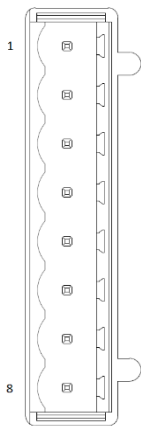
Figure 9: Connector outline**Table 23: X19**

Connector	Pin	Rating	Related HIL channel
X19	1	±2.82 A	AO9

Connector	Pin	Rating	Related HIL channel
X19	2	-	GND
X19	3	± 2.82 A	AO10
X19	4	-	GND
X19	5	± 2.82 A	AO11
X19	6	-	GND
X19	7	± 2.82 A	AO12
X19	8	-	GND

Table 24: X20

Connector	Pin	Rating	Related HIL channel
X20	1	± 2.82 A	AO13
X20	2	-	GND
X20	3	± 2.82 A	AO14
X20	4	-	GND
X20	5	± 2.82 A	AO15
X20	6	-	GND
X20	7	± 2.82 A	AO16
X20	8	-	GND

Voltage outputs**Table 25: X21**

Connector	Pin	Rating	Related HIL channel
X21	1	± 183.3 V	AO17
X21	2	-	GND
X21	3	± 183.3 V	AO18

Connector	Pin	Rating	Related HIL channel
X21	4	-	GND
X21	5	± 183.3 V	AO19
X21	6	-	GND
X21	7	± 183.3 V	AO20
X21	8	-	GND

Table 26: X22

Connector	Pin	Rating	Related HIL channel
X22	1	± 183.3 V	AO21
X22	2	-	GND
X22	3	± 183.3 V	AO22
X22	4	-	GND
X22	5	± 183.3 V	AO23
X22	6	-	GND
X22	7	± 183.3 V	AO24
X22	8	-	GND

Figure 10: Connector outline**Table 27: X23**

Connector	Pin	Rating	Related HIL channel
X23	1	± 183.3 V	AO25
X23	2	-	GND
X23	3	± 183.3 V	AO26
X23	4	-	GND
X23	5	± 183.3 V	AO27
X23	6	-	GND
X23	7	± 183.3 V	AO28
X23	8	-	GND

Table 28: X24

Connector	Pin	Rating	Related HIL channel
X24	1	± 183.3 V	AO29
X24	2	-	GND
X24	3	± 183.3 V	AO30
X24	4	-	GND
X24	5	± 183.3 V	AO31

Connector	Pin	Rating	Related HIL channel
X24	6	-	GND
X24	7	± 183.3 V	AO32
X24	8	-	GND

Mechanical

Mechanical dimensions of the Universal HIL Connect.

Table 29: Universal HIL Connect mechanical information

Width (without 19" rackmount handles)	W1	448 [mm]
Width (including 19" rackmount handles)	W	482.4 [mm]
Height	H	266 [mm] - 6U
Depth (without 19" rackmount handles)	D1	308.4 [mm]
Depth (including 19" rackmount handles)	D	347.4 [mm]
Weight		12 [kg]

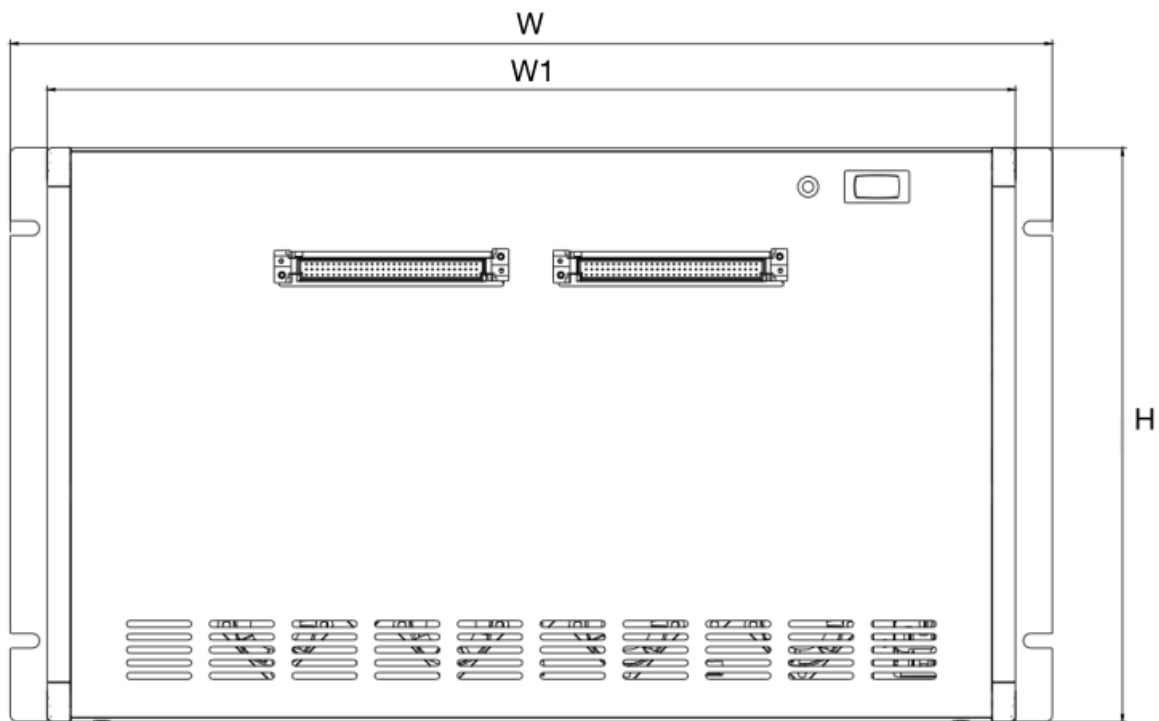


Figure 11: Universal HIL Connect dimensions [mm] - front view

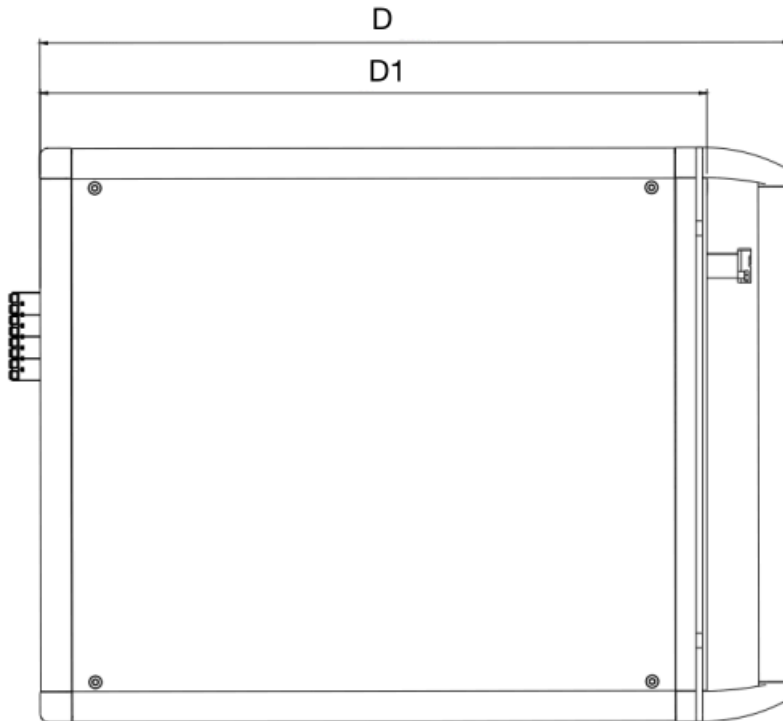


Figure 12: Universal HIL Connect dimensions [mm] - side view

Scope of delivery

Scope of delivery of the Universal HIL Connect package.

Table 30: Scope of delivery

Item	Typhoon HIL part number	Quantity
Universal HIL Connect	20010	1
HIL Interface cable set, 30 cm	21143	1
Connector set, containing 8 pcs 8-pin and 14 pcs 16-pin spring cage connectors	21828	1
Country-specific C14 power cord	20039 (EU) , 20460 (US), 20044 (CH) or 20045 (UK)	1

Revision History

Update history of the Universal HIL Connect documentation.

Table 31: Revision History

Date	Version	Revision
28-04-2021	1.0	Initial release.
24-08-2021	1.1	Added warning related to high voltages on certain connectors.