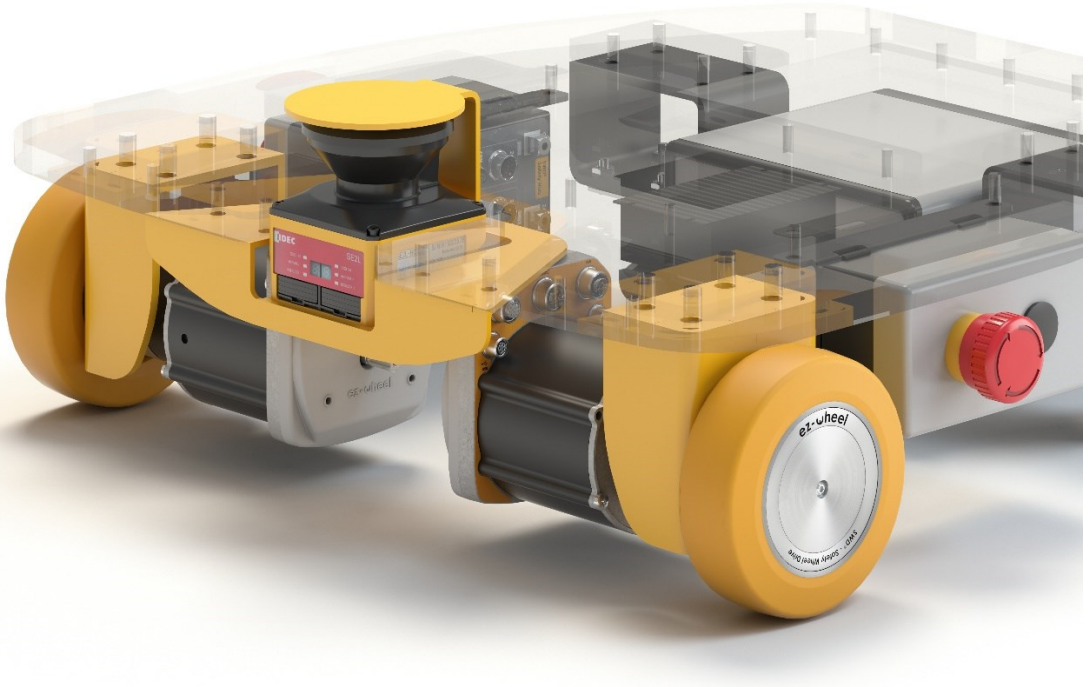
SWD® Starter Kit

For AGV & AMR

Instruction manual

Version 6-b - Original version



ez-Wheel®
A brand of the **IDEC Corporation Group**

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⚠ **This document should be read carefully before the first use of the product.**

1. Preamble

1.1. Who is this manual for?

This manual is intended for skilled robotics integrators.

The ***SWD® Starter Kit*** saves a lot of development time, but needs competencies in:

- Automation, functional safety, and robotics
- Embedded Linux, Python and C++
- ROS development environment

1.2. Terminology

The terms used in this manual are related to the technical field of industrial machinery and more particularly to driverless industrial trucks and drive systems controlled by the field bus.

For a precise reading of the manual, a good knowledge of the following standards is recommended:

- Machinery Directive (2006/42/EC)
- Safety requirements for driverless industrial trucks and their systems (ISO 3691-4)
- Variable speed power electric drives (EN 61800-5)
- CANopen Application Profile for Motor Drives (CiA 402)

Dictionary of acronyms:

AGV:	Automatic Guided Vehicle
AGC:	Automatic Guided Cart
AMR:	Autonomous Mobile Robot
CAN:	Controller Area Network
LiDAR:	Light Detection And Ranging
OSSD:	Output Signal Switching Device
SBC:	Safe Brake Control
SBU:	Safe Brake Unlock
SDI[p/n]:	Safe Direction Indication [positive/negative]
SLAM:	Simultaneous Localization And Mapping
SLS:	Safety Limited Speed
SLSa:	Safety Limited speed asymmetric
SMS:	Safe Maximum
SRDO:	Speed Safety-Relevant Data Objects
STO:	Safe Torque Off

1.3. Additional resources

The ***SWD® Starter Kit*** uses ***SWD®*** safety drives, the following ***SWD®*** documents are available from ez-wheel.com:

- ***SWD®*** datasheets
- ***SWD® Full Range Brochure*** Safety Wheel Drive Series Overview
- 2D and 3D mechanical plans of the ***SWD®***
- ***SWD® Safety Hub*** manual instruction

1.4. Declarations of conformity

SWD® products are developed in accordance with legal requirements applicable in the European Union.
SWD® declarations of conformity (DoC) are established by IDEC.

1.5. Important information about the manual

⚠	Important information – Read carefully
📝	Parameterizable value
ℹ	Additional information

1.6. Disclaimer

The technical information included in this manual is subject to change without prior notice. No responsibility is assumed for the completeness, up-to-date or accuracy of the data and illustrations provided.
The textual and visual data included in this manual are the property of ***APEM SAS*** *company of* ***IDEC Corporation***.
The trademarks ez-Wheel and SWD Safety Wheel Drive are registered.
Designations may be trademarks and/or copyrights of their respective manufacturers, the use of which by third parties for their own purposes could infringe the rights of such owners.

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IDEC Mobility Solutions division
LE MOULIN DE L'ABBAYE - 135 ROUTE DE BORDEAUX
16400 LA COURONNE - FRANCE

2. Safety Instructions – *SWD® Starter Kit* Precautions

⚠	Do not open. Do not expose to a heat source. Do not expose to fire. Do not insert metal parts into the connectors. Under no circumstances should the product receive any modifications not authorized by IDEC. Do not attempt to modify the technical performance of the product. The product must not be used for use beyond the technical performance specified by IDEC. Inappropriate use results in the cancellation of the warranty. Opening the product results in the cancellation of the warranty.

3. Description

3.1. A toolkit for robot developers

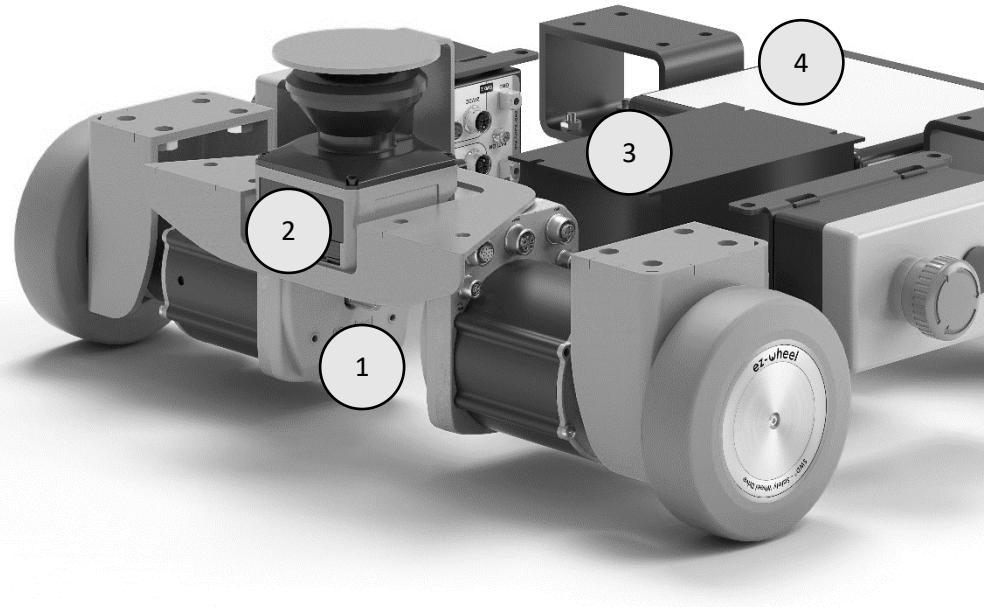
The ***SWD® Starter Kit*** is made of combinable, modular devices for mobile robotics.

The ***SWD® Starter Kit*** introduces key technologies for mobile robots' development.

- ***SWD® Safety Wheel Drive***: the world's first drive with embedded safe motion control
- Safety Laser Scanner: the smallest laser scanner for safety critical applications
- ROS Robot Operating System: the reference middleware for robotics

SWD Safety Wheel Drive

ROS Robot Operating System

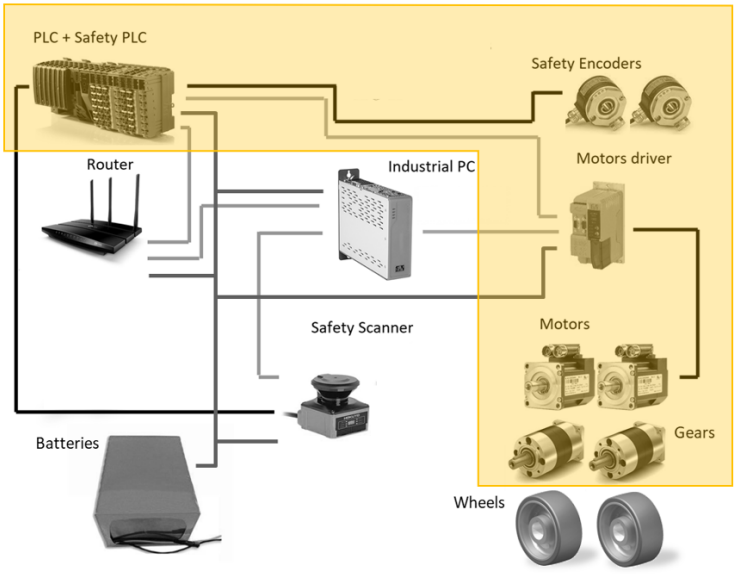


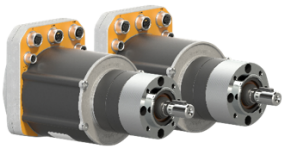
1	***SWD®*** safety drives
2	Safety laser scanner
3	Embedded PC with ROS
4	Battery

3.2. Integrated Safety

The ***SWD® Starter Kit*** provides the simplest AGV/AMR safety architecture ever:

- ***SWD®*** integrates motor drivers.
- Unique, fully certified safe motion features
- Safety encoder integrated into ***SWD®***

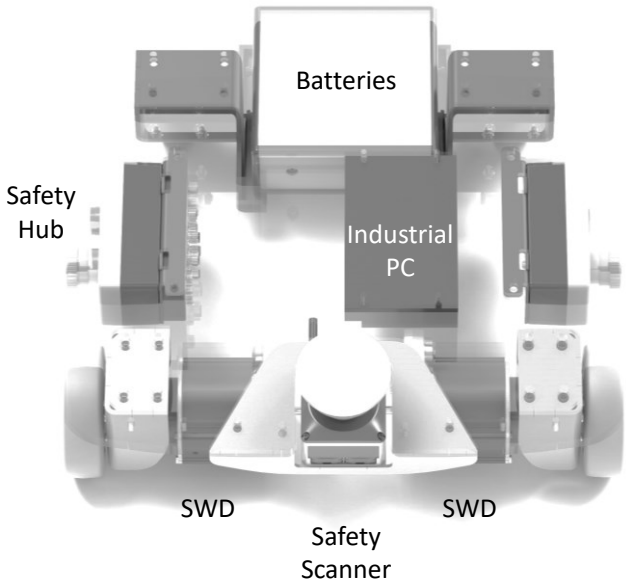




SWD® Safety Wheel Drive
Drives with integrated Safety.

The robot architecture is therefore extremely simplified compared to conventional AGVs or AMRs:

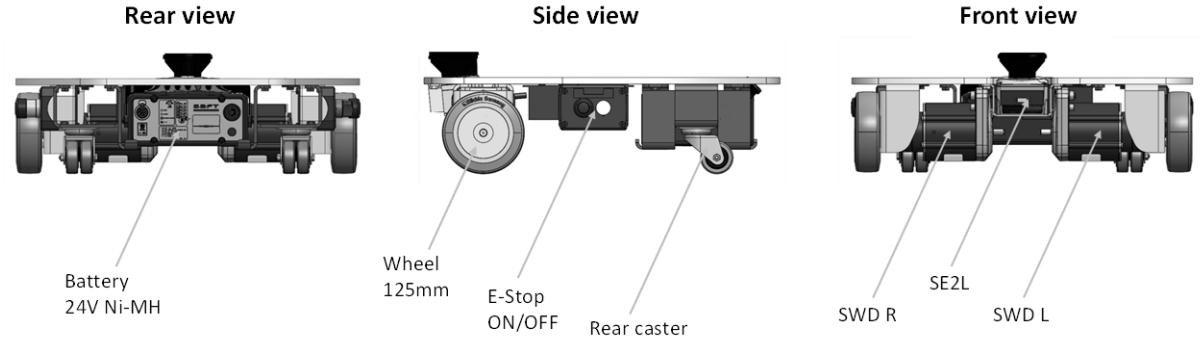
- ✓ Drives interfaced directly with safety laser scanners.
- ✓ Replaces safety encoders, PLCs, and motor drivers.



3.3. Specificities of the *SWD® Starter Kit*

The ***SWD® Starter Kit*** is a demonstration platform based on AMR use case, including:

- One safety laser scanner in front/center position
- Two ***SWD®*** safety drives with 125mm wheels
- An ARM PC controller with Linux OS and ROS drivers for ***SWD®*** wheel drives
- A 24 VDC 9 Ah Ni-MH rechargeable battery
- A chassis and complete wiring with two E-Stops



⚠ The ***SWD® Starter* Kit** is not a complete, functional AMR:

- No navigation system provided.
- No fleet management software.

3.4. SIL2/PLd Safety features

Motor disconnection	STO with E-Stops buttons
Motion control	SMS (Safe Maximum Speed), SLS (Safe Limited Speed), SLSa (Safe Limited Speed asymmetric),

	SDI (Safe Direction)
Braking	SBC (Safe Brake Control), SBU (Safe Brake Unlock, i.e. free wheel mode)

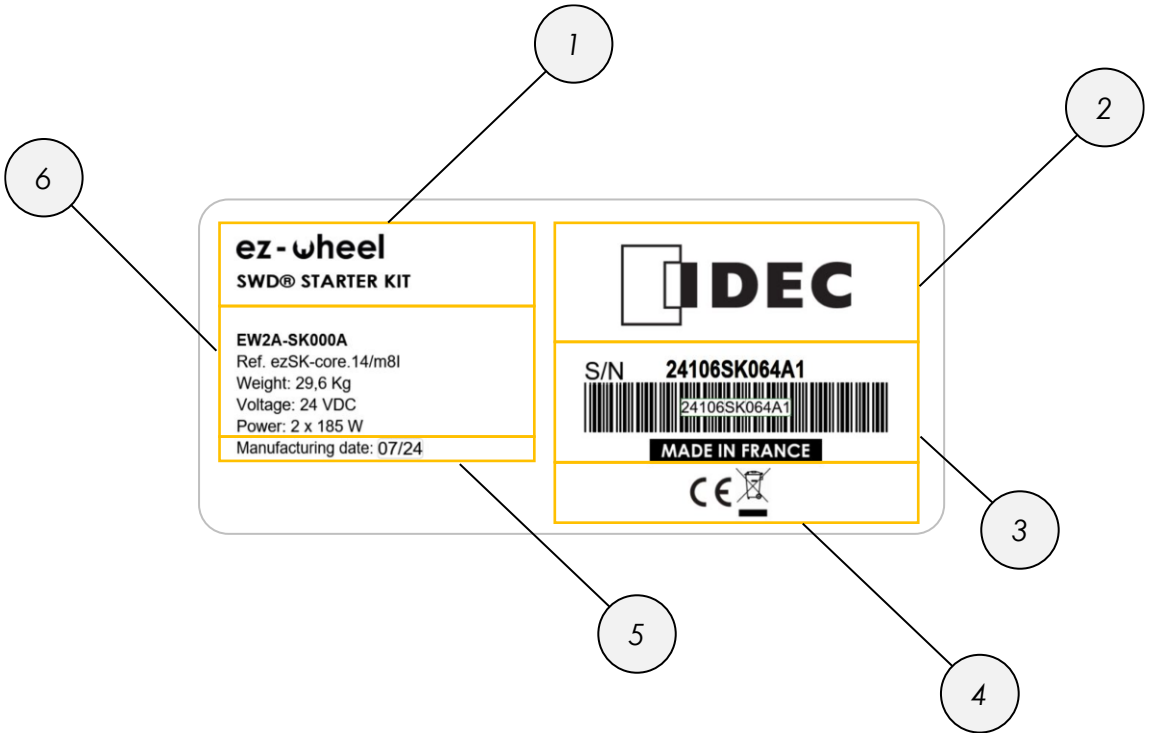
3.5. Conditions of Use

Temperatures	0 to +40°C
IP index	IP66 for ***SWD®*** electronic unit, IP65 for safety laser scanner, IP54 for battery, NC for others
Maintenance period	5 years

3.6. Weight

Total weight	29,5 Kg

3.7. Product Label



1	Product Family and Range Identification
2	Manufacturer and trademark identification
3	Serial Number / Item code Geographical origin of the product
4	Regulatory pictogram
5	Manufacturing date

6	Commercial reference Product information Product performance

3.8. Applications

The ***SWD® Starter Kit*** is intended for the development of mobile robotics applications such as:

- Industrial AGVs, AGCs and AMRs
- Logistics AGVs, AGCs and AMRs
- Cobots and mobile robot arms
- Mobile platforms

4. Synoptic

Safety and Control synoptics of the product

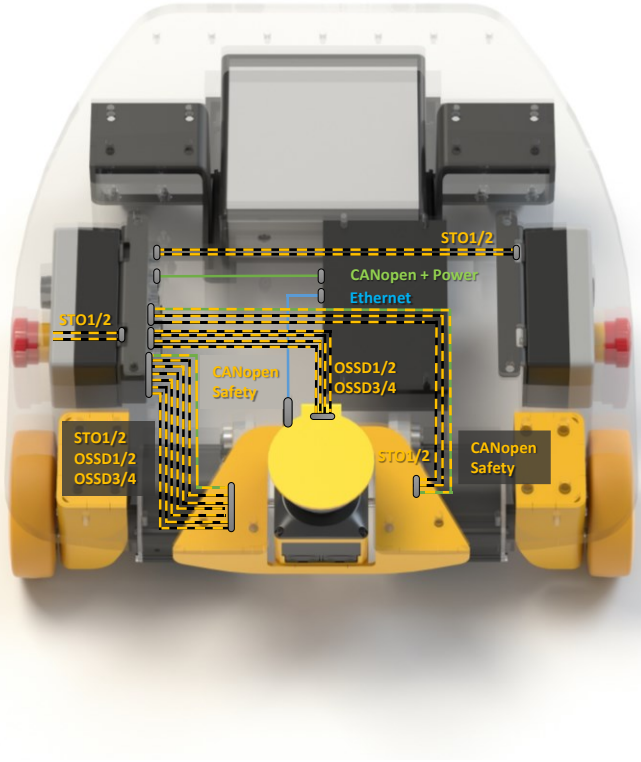


Figure 1 - Wiring synoptic

ℹ The pinout of the adapter for 12/17 points wiring is available on the appendix.

Safety

Direct connection of safety sensors and switches to ***SWD®*** safe inputs:

- Emergency Stop Left ➔ ***SWD®*** Left - STO inputs.
- Emergency Stop Right ➔ ***SWD®*** Right - STO inputs.
- Safety laser scanner OSSD outputs ➔ SWD® left - Safety inputs

ℹ CANopen Safety communication between ***SWD®*** Left and Right is used to give the information of the safety inputs triggered from one ***SWD®*** to the other one.

Control

ℹ CANopen from IPC to ***SWD®*** Left and Right, uses CiA 402 velocity control mode for speed and direction control. Ethernet from safety laser scanner to IPC, is used to get data for SLAM and ROS-based algorithms.

ℹ CANopen and CANopen Safety frames are transmitted on the same physical CAN bus.

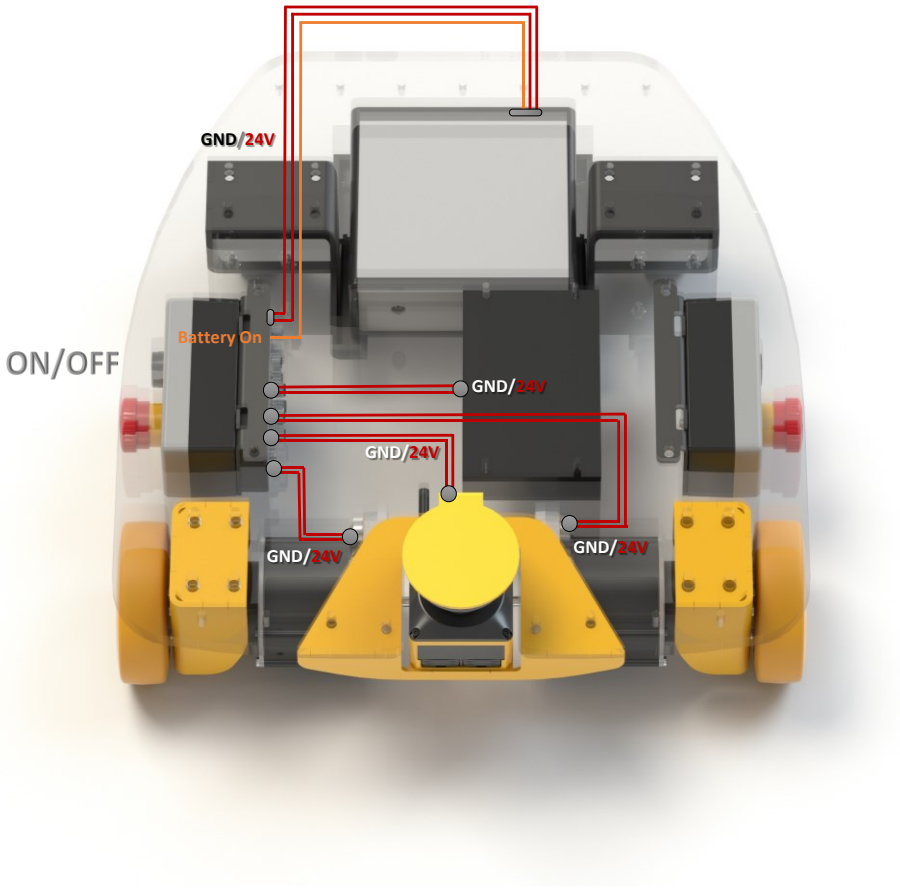


Figure 2 - Power Supply synoptic of the product

Power supply

- All devices powered by Ni-MH 24V / 9Ah battery.
- Battery to junction box
- Junction box to ***SWD®*** Left, ***SWD®***Right, safety laser scanner and IPC
- Activation signal, from the ON/OFF button to the activation input of the battery

Charging

The external charger can be directly connected to the battery panel connector:

5. Interfaces

5.1. Overview

The ***SWD® Starter Kit*** is using the ***SWD® Safety Hub*** interface to centralize the connections of all devices and facilitate the overall wiring.

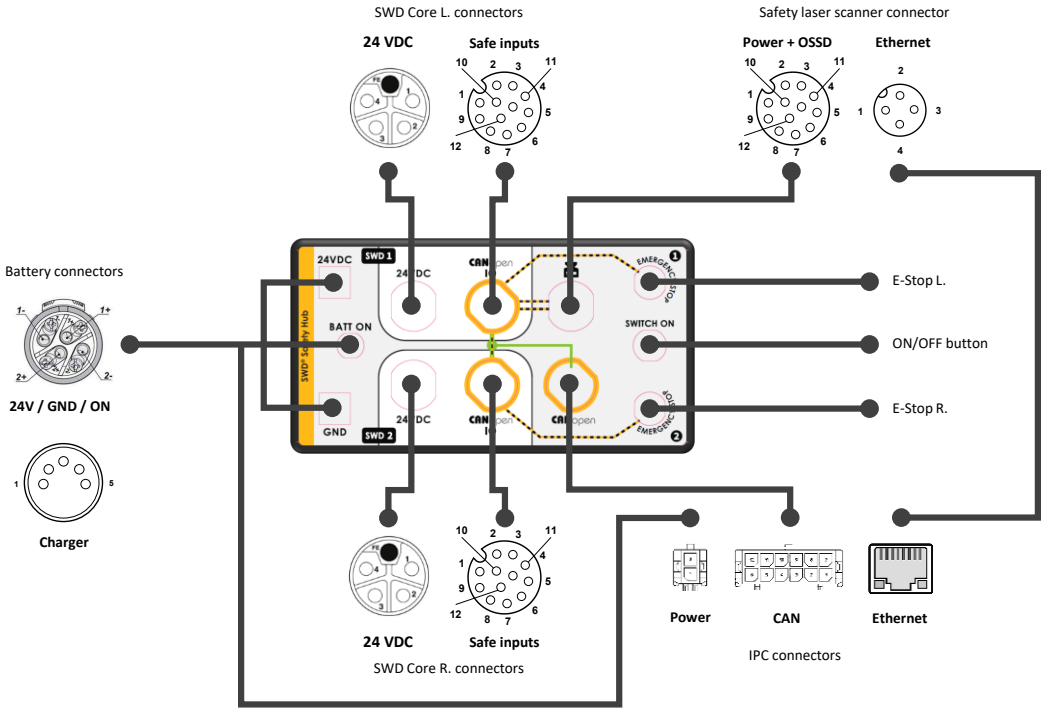


*Figure 3 - Wiring synoptic, **SWD® Safety Hub** before July 2022*

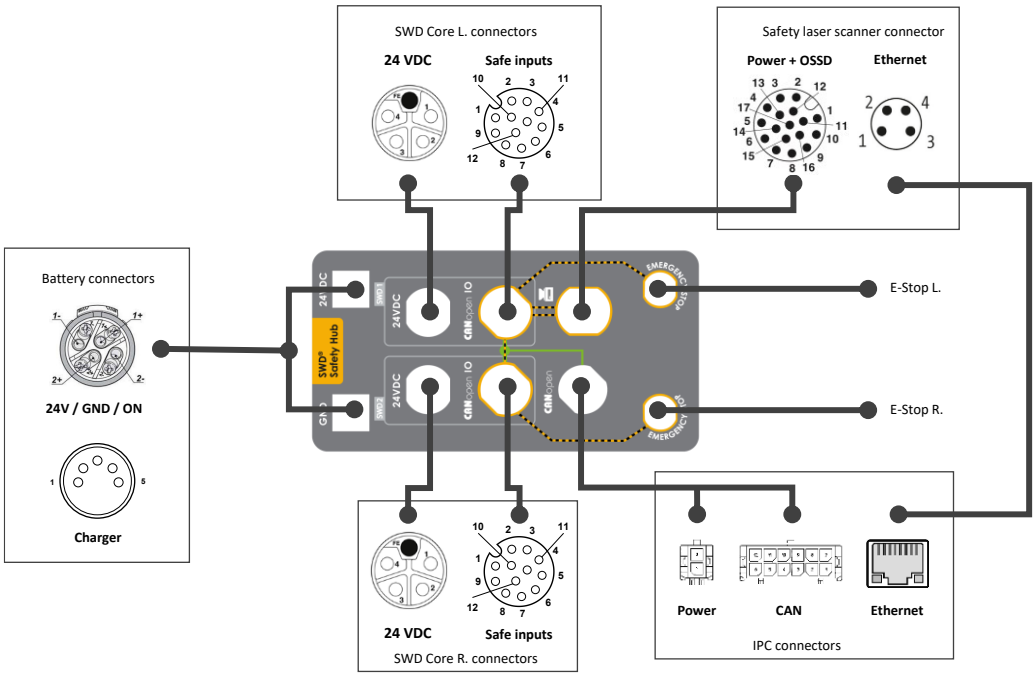


*Figure 4 - Wiring synoptic, **SWD® Safety Hub** after July 2022*

5.2. *SWD®* connectors

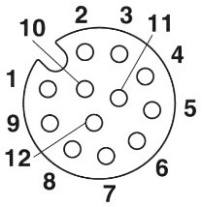
The I/O connector and 24 VDC connector of the ***SWD®*** are used in the ***SWD® Starter Kit.***
The other connectors (CAN, USB, Ethernet, and Brake) are not used, please refer to the Instruction Manual of the ***SWD®*** for details on the complete connections of the product.

ℹ The same connector types and pin numbers are used in the ***SWD®***, and the associated connection featured on the ***SWD® Safety Hub***. The following pinout description is therefore valid for both.

5.2.1. SWD® I/O connector

The I/O connector is type M12 - 12 pin A-coded.
It is used for the CAN interface between the drives and the IPC, and for the safety loops coming from the safety laser scanner and E-Stops.

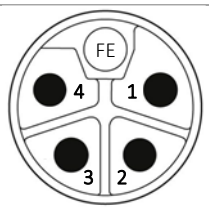
Pin #	Designation	ℹ
1	CAN High	*CANopen Safety*
2	INSafe_4	*OSSD from SE2L on SWD® left*
3	CAN Low	*CANopen Safety*
4	Power supply output 24 VDC	*2A max*
5	STO_1	*E-Stop*
6	GND Power Supply output	-
7	INSafe_1	*OSSD from SE2L on SWD® left*
8	STO_2	*E-Stop*
9	INSafe_3	*OSSD from SE2L on SWD® left*
10	INSafe_2	*OSSD from SE2L on SWD® left*
11	GND	*unused*
12	ON	*unused*



5.2.2. SWD® 24 VDC connector

The 24 VDC power connector is of type M12 Power - 5-pin L-coded (4 pin + FE).
It is used to distribute the battery power on the drives.

Pin #	Designation	ℹ
1	+ Power supply 24 VDC	*16A max*
2	+ Power supply 24 VDC	*16A max*
3	GND Power Supply	-
4	GND Power Supply	-
FE	Mechanical ground	*Connected to the chassis*



5.3. Safety Laser Scanner connectors

The Power+OSSD connector and Ethernet connector of the safety laser scanner are used in the ***SWD® Starter Kit.***
Please refer to the safety laser scanner User Manual for details on the complete connections of the product.

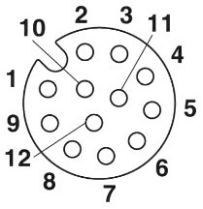
⚠ The original connector of the safety laser scanner has been replaced by an M12 Power + OSSD connector to get homogeneous connections with the ***SWD® products***.

ℹ The same connector types and pin numbers are used in the safety laser scanner, and the associated connection featured on the ***SWD® Safety Hub***. The following pinout description is therefore valid for both.

5.3.1. Power + OSSD adapter (if any)

After July 2022, an adapter might be used for Power + OSSD of the safety scanner. The connector is of type M12 - 12 pin A-coded. It is used for safety loops going to the ***SWD®***.

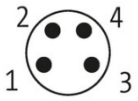
Pin #	Designation
1	24 VDC
2	GND
3	OSSD1
4	OSSD2
5	*NC*
6	*NC*
7	*NC*
8	*NC*
9	OSSD3
10	OSSD4
11	*NC*
12	*NC*



5.3.2. Ethernet connector

The Ethernet connector is an M8 4-pin A-coded. It is used to exchange non-safe data between the safety laser scanner and the IPC.

Pin #	Designation
1	TD+
2	RD+
3	RD-
4	TD-



5.4. IPC connectors

The Power connector, CAN connector and Ethernet connector of the embedded IPC are used in the ***SWD® Starter Kit.***

For the **iMX6 version**: Please refer to the TEK3-IMX6 BOX PC Product Manual for details on the complete connections of the product.

For the **iMX8 version**: Please refer to the COMPULAB IOT-GATE-iMX8 Reference guide for details on the complete connections of the product.

5.4.1. Power connector

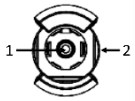
It is used to bring power to the IPC.

For the iMX6 version, the connector is a Molex 43025-0200 (2-pin Micro-Fit 3.0).

Pin #	Designation
1	GND
2	DC Voltage input (8-36 VDC)

For the iMX8 version, the connector is a DC Power Jack.

Pin #	Designation
1	DC Voltage IN (8-36 VDC)
2	GND

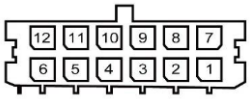


5.4.2. CAN connector

It is used to connect the CANopen interface between the drives and the IPC.

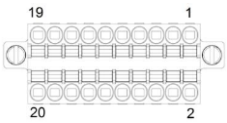
For the iMX6 version, the connector is a Molex 43025-1200 (12-pin Micro-Fit 3.0).

Pin #	Designation
1	Ground for CAN
2	*NC*
3	CAN Bus 1A high
4	CAN Bus 1A low
5	*NC*
6	*NC*
7	*NC*
8	*NC*
9	*NC*
10	*NC*
11	*NC*
12	*NC*



For the iMX8 version, the connector is a Kunacon PDFD25420500K (20-pin dual-raw plug with push-in spring connections).

Pin #	Designation
1	*NC*
2	ISO GND A
3	*NC*
4	*NC*
5	*NC*
6	*NC*
7	CAN High
8	ISO GND B
9	CAN Low
10	*NC*
11	*NC*
12	*NC*
13	*NC*

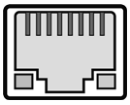


14	*NC*	
15	*NC*	
16	*NC*	
17	*NC*	
18	*NC*	
19	*NC*	
20	ISO GND C	

5.4.3. Ethernet

It is used to exchange non-safe data between the safety laser scanner and the IPC. This data is processed by the PC to create a map of the environment and perform SLAM for instance.

The Ethernet connector is a standard RJ45 for 10/100 Mbps transmission.
The 100 / 1000Mbps Ethernet ports are RJ45 connectors.
ETH1 (1000 Mbps port) is used to exchange non-safe data between the safety laser scanner and the iMX8.

Pin #	Designation	
1	TD+	
2	TD-	
3	RD+	
4	*NC*	
5	*NC*	
6	RD-	
7	*NC*	
8	*NC*	

5.4.4. Serial Debug connector (iMX8 only)

The serial debug console via UART-to-USB bridge is a micro-USB connector.
It can be used to open a serial connection between your local PC (e.g. laptop) and the iMX8.

NB: Baud Rate speed is 115200.

5.4.5. USB

An additional Wi-Fi USB dongle is provided with the iMX8 ***SWD®*** StarterKit, thus it is possible to connect the Kit to a Guest Wi-Fi for example. Consequently you can access and download resources from the internet, directly from the Wi-Fi.

A USB-A female connector is mounted on the side of the ***SWD® Starter Kit***, next to the emergency button.

NB: You can use the second Ethernet port of the iMX8, to connect the robot to your own network.

5.5. Battery connectors

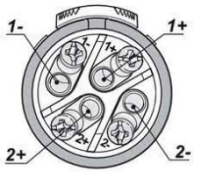
The Power connector and Charger connector of the Mobility Module battery are used in the ***SWD® Starter Kit.***

⚠ Please refer to the Mobility Module User Manual for details on the complete connections of the product.

5.5.1. Power connector

The Power connector is a Neutrik Speakon 4-pin. It is used to power the kit and to turn ON and OFF the battery.

Pin #	Designation
1+	24 VDC
2+	GND
1-	RD+ / BPCI*
2-	ON signal

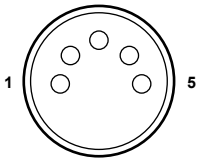


*BPCI = Battery Protection & Communication Interface

5.5.2. Charger connector

The Charger connector is a Neutrik XLR 5-pin. It is used to connect the charger to the battery.

Pin #	Designation
1	Charger+
2	*NC*
3	*NC*
4	*NC*
5	GND



6. Mechanical assembly

6.1. Dimensions of the packaging and contents of the pack

The ***SWD® Starter Kit*** is packed within its original cardboard box and is protected by a half-pallet size wood box.

cardboard box dimensions	555 (l) x 545 (p) x 220 (h) mm
half-pallet size wood box dimensions	800 (l) x 600 (p) x 380 (h) mm

⚠ For all logistics operations on the gearmotor alone, preferably use the original packaging.

⚠ Countersunk wood screws 4mm x L 30mm were used to close the box cover
Please use a screwdriver PZ2 for screwing

6.2. Overall dimensions

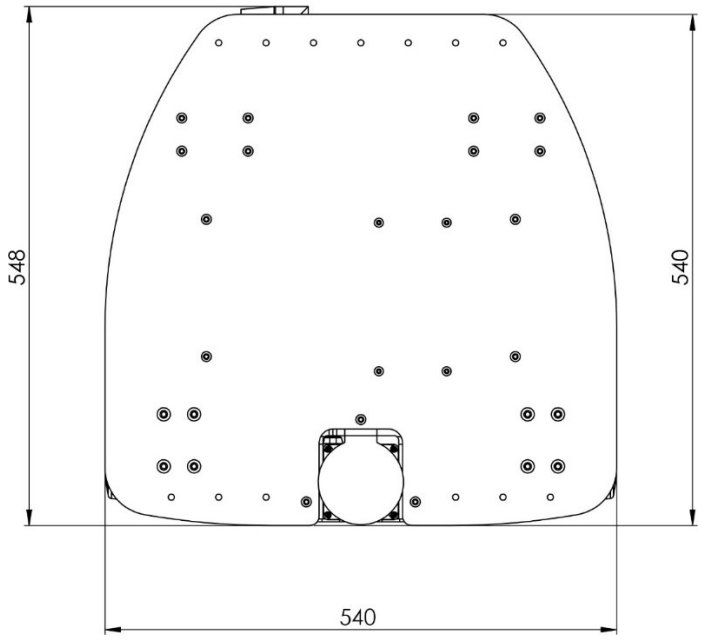


Figure 5 - Overall dimensions, top view

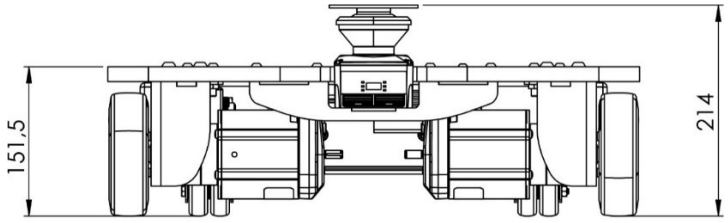
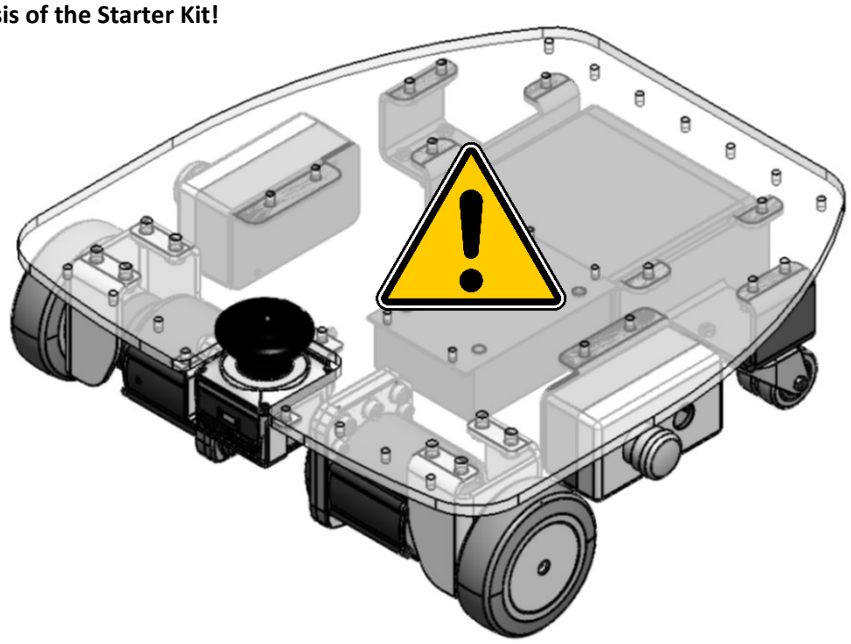


Figure 6 - Overall dimensions, front view

6.3. Mechanical specifications

The casters are designed to support a maximum load of 40 kg per caster, but the plastic chassis, for demonstration purposes only, is not designed to carry load.

⚠ **Do not step or put loads on the chassis of the Starter Kit!**



7. Safety features

7.1. Overview of safety features

7.1.1. Safety features available from SWD® safety drives

The ***SWD®*** includes safe engine shutdown features, as well as advanced safe speed monitoring features. This exclusive integrated solution simplifies the machine architecture by avoiding the need for external supervisory system and safety logics.

The engine shutdown functions include:

- STO (Safe Torque Off): safe disconnection of motor torque
- SBC (Safe Brake Control): safe braking engagement
- SBU (Safe Brake Unlock): safe disengaging braking.

Speed monitoring functions are based on a safety encoder integrated into the product and include:

- SDI (Safe Direction): safe control of the direction of rotation
- SLS (Safely Limited Speed): safe rotational speed limitation
- SLSa (Safely Limited Speed asymmetric): safe rotational speed limitation with independent thresholds according to the sense of rotation
- SMS (Safe Maximum Speed): maximum speed limit independently from safety functions activated.

These safety functions are implemented in accordance with IEC 61800-5-2 (functional safety requirements for the development of safety drives) and according to the CiA/DS 402-4 profile for the safety functions of motor controllers.

	Safety features	**Possible settings**
STO	Safe disconnection of engine torque	Rearmament: ▪ automatic ▪ by request for acquittal Braking configuration associated with the STO (Cf. SBC)
SBC	Safe braking engagement	Joint activation of the STO: ▪ from internal braking to ***SWD®*** ▪ an external electromechanical brake ▪ of both brakes simultaneously
SBU	Safe brake Unlock	-
SDI	Safe control of the direction of rotation	Prohibition of the direction of rotation: ▪ positive or negative ▪ with two tolerance thresholds levels
SLS	Safe rotational speed limitation	Prohibition of speeding: ▪ eight switchable throttling thresholds ▪ an adjustable trigger time

SLSa	Safe rotational speed limitation asymmetric	Prohibition of speeding: ▪ eight switchable throttling thresholds ▪ an adjustable trigger time
SMS	Maximum speed limit independently from activated safety functions	Prohibition of excessing speed limit ▪ Threshold for positive maximum speed ▪ Threshold for negative maximum speed

ℹ Refer to the Instruction Manual of the ***SWD®*** to get all details on the operation and configuration of available safety features.

7.2. Use of safety features in the *SWD® Starter Kit*

Emergency Stops

E-Stops on each side of the kit, for stopping the motors (STO: Safe Torque Off function)

STO

When one ***SWD®*** reads the STO signal from an E-Stop button, it sends the STO message to the other drive through the CANopen Safety

Safety fields and Safe Motion

Close obstacle: when the safety laser scanner detects an obstacle in the close range (<1m forward), the speed limit (SLS: Safely Limited Speed function) is engaged on the ***SWD®***, limiting the speed at 0.3 m/s.

SLS

Collision risk: when the safety laser scanner detects an immediate risk of collision (<50cm forward), the direction limit (SDI: Safe Direction function) is engaged on the ***SWD®***, prohibiting forward direction.

SDI

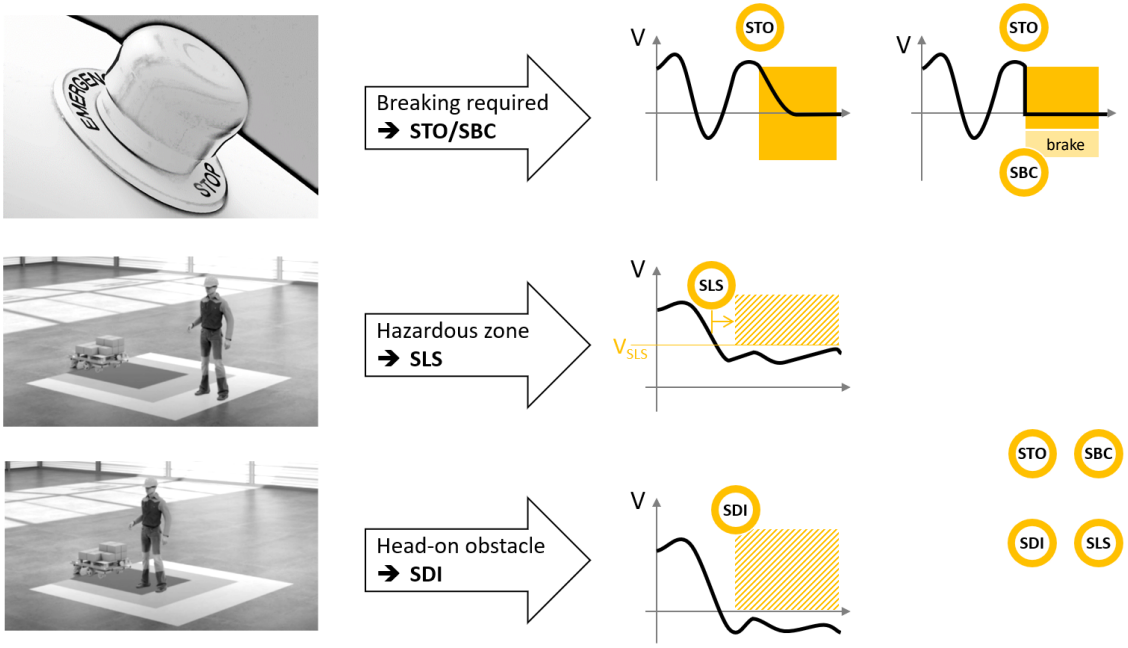
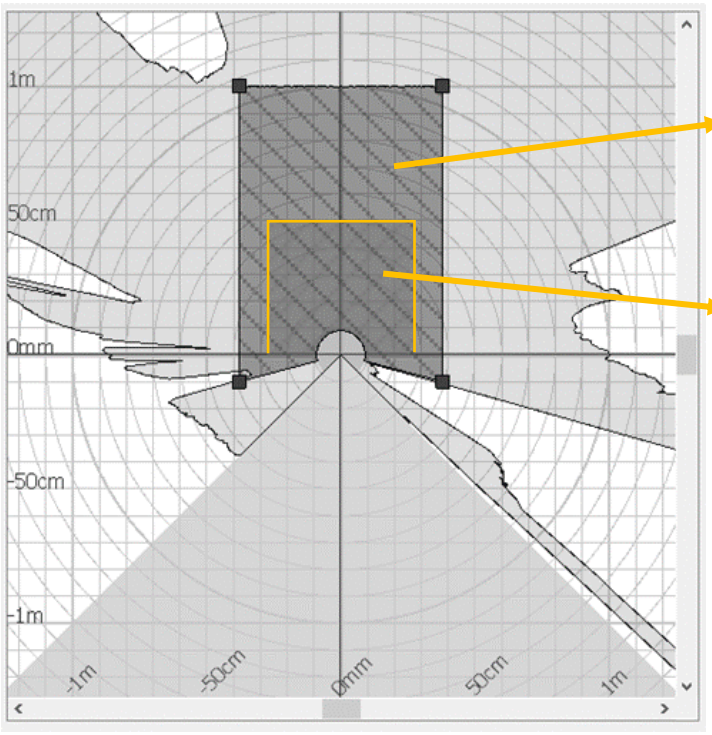


Figure 7 - Use of Safety Features

7.3. Safety fields configuration

The default configuration of safety fields in the safety laser scanner is set as follows:



Close obstacle

- Area 70cm width x 1m forward
- Routed to OSSD 3/4 outputs of safety laser scanner.

Collision risk

- Area 50cm width x 50cm forward
- Routed to OSSD 1/2 outputs of safety laser scanner.

Figure 8 - Safety fields of the safety laser scanner

ℹ To edit and customize the safety fields of the SE2L, use the software provided by IDEC laser scanner:
- SLS Project Designer software available from the website .
- Video tutorial available online

NB: For updating the configuration of the laser, disconnect its ethernet cable.

ℹ Any safety laser scanner is compliant with ***SWD® Starter Kit*** as long as it has OSSDs output signals.

7.4. Safety loops configuration

The safety loops of the ***SWD® Starter Kit*** are set up as follows:

- Emergency Stop Left ➔ ***SWD®*** Left - STO inputs.
- Emergency Stop Right ➔ ***SWD®*** Right - STO inputs.
- Safety laser scanner OSSD outputs ➔ SWD® left - Safety inputs
- CANopen Safety communication between ***SWD®*** Left and Right is used to give the information of the safety inputs triggered from one ***SWD®*** to the other one.

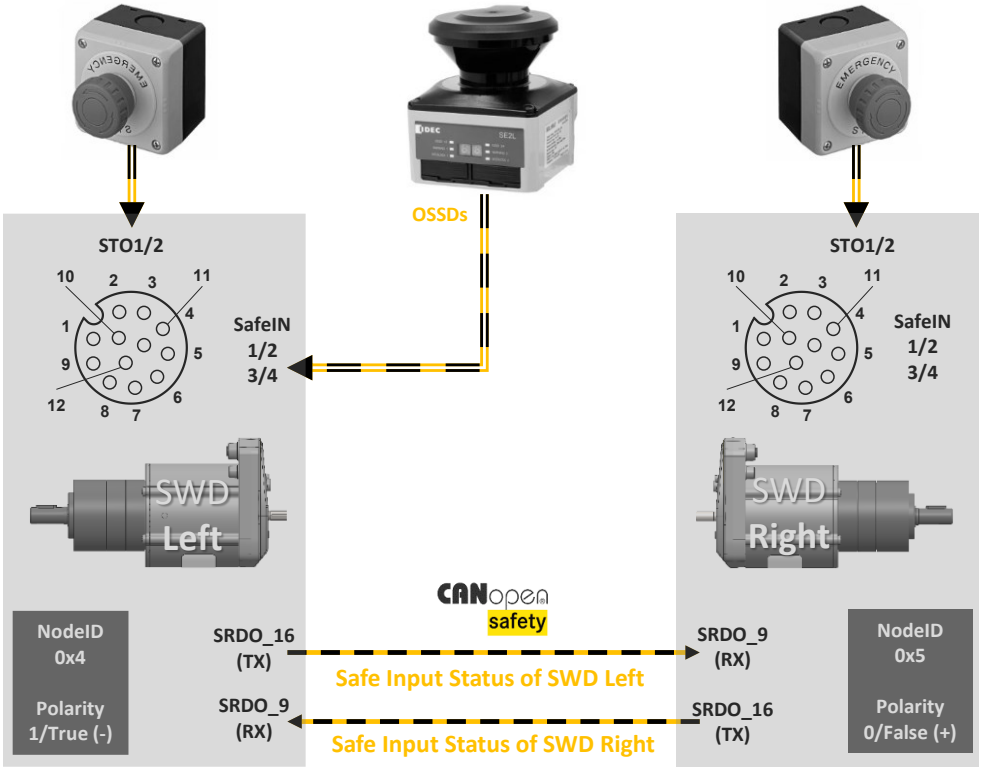


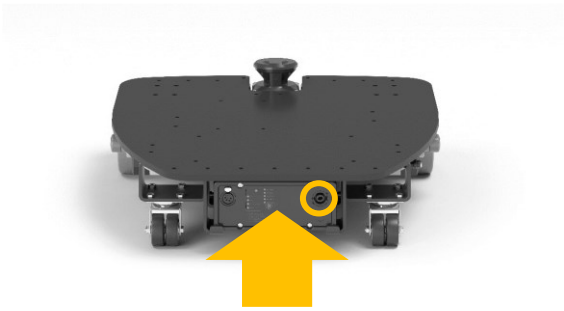
*Figure 9 - Synoptic of safety with **SWD®***

ℹ The drives configuration is done by CANopen messages. Scripts are available to commission the drives on IDEC ez-Wheel GitHub: IDEC-ezWheel/swd-starter-kit-config.

8. Starting the *SWD® Starter Kit*

8.1. Power on

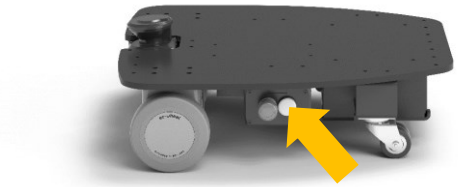
Setting up the kit
Put the kit on the floor on a stable and flat surface.



Battery
Install and plug the battery power connector onto the rear side of the robot.

Start button
Press the white ON/OFF button on the side of the robot, near the Emergency Stop.
The IPC and safety laser scanner lights turn on, and the kit starts booting for a few ten seconds.

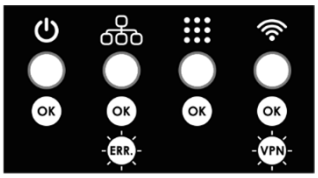
Emergency Stops
To start safely, you can engage one of the Emergency Stops while the robot is powering on.



8.2. Display and status

8.2.1. iMX6 version

When powered, the embedded PC shows the status of each service started on the side 4-LED display.



- Power LED: green when the battery power is available.
- Devices LED: green when the connection to the ***SWD®*** and to the safety laser scanner is active, flashing if the connection cannot be established.
- ROS LED: green when the ROS environment is active.
- Wi-Fi LED: green when the internet connection is established, flashing when the VPN connection is activated (only for support).

8.2.2. iMX8 version

The LEDs are off.

8.3. Connection to Control Page

Once started, the ***SWD® Starter Kit*** generates its own Wi-Fi access point to connect third-party devices. Any device with a navigator can connect to the ***SWD® Starter Kit***, to access the web Control Page, hosted on the embedded IPC.

To connect to the Wi-Fi hotspot, the SSID and initial password are indicated on the front plate beside the safety laser scanner. It is also available on the 'Quick Start' leaflet.

Upon MAC address of each hardware kit

SSID: SWD-StarterKit-880756
Password: swd_starterkit

Once a PC or a tablet connects to the ***SWD® Starter Kit*** Wi-Fi access point, a web page is accessible with any navigator by typing the page's address.

http://10.10.0.1

The ***SWD® Starter Kit*** generates a web Control Page for the user to monitor the real time activity.

The page is used to check the status of the safety features set up with the ***SWD®*** safety drives and the safety laser scanner and shows an example of map built thanks to a ROS open-source SLAM algorithm using the data from the safety laser scanner.

ℹ The SLAM algorithm used by default is Hector Slam available under ROS Noetic, but other algorithms such as LaMa or Gmapping could be used.

8.4. Connection to the IPC

8.4.1. SSH

HostName	10.10.0.1
User	swd_sk
Password	swd_sk

8.4.2. USB Serial (Only for iMX8 version)

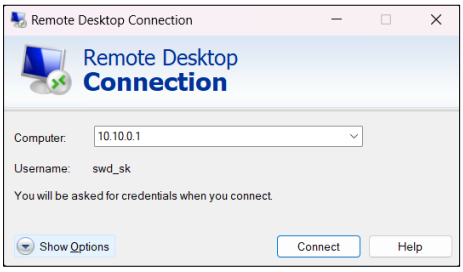
You can open a serial connection using a micro-USB cable (not provided), with PuTTY for example with the following parameters:

Baud Rate	Data Bits	Stop Bits	Parity	Flow Control
115200	8	1	none	none

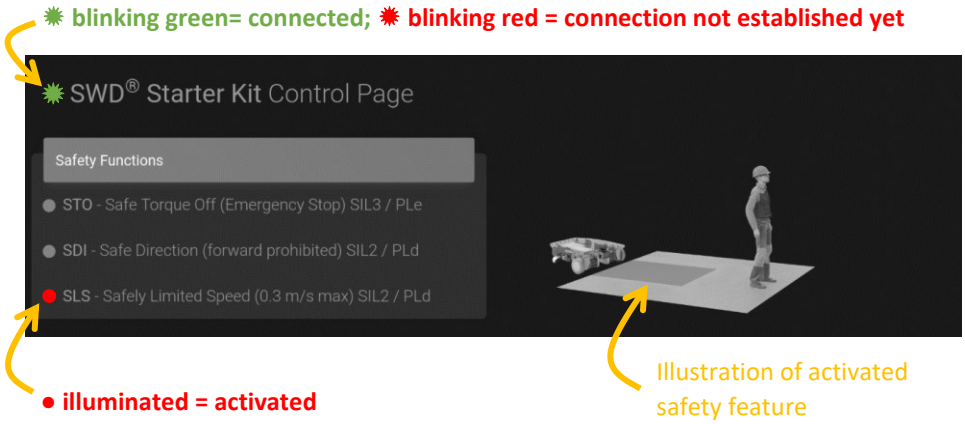
ℹ Windows OS: you might have to download CP211x driver to see the serial port (COMx) on your host PC.

8.4.3. Remote Desktop protocol (Only for iMX8 version)

You can use the remote Desktop Protocol for graphical usage on your local PC:



8.5. Safety features monitoring



Once the control page of the connected Starter Kit is active and displayed, the status of the safety features can be monitored:

- **STO** status is RED when one of the two Emergency Stops is engaged, the motors are stopped (Safe Torque Off).
- **SDI** status is RED when the safety laser scanner detects an obstacle in the short perimeter (<50cm), the motors cannot go forward (Safe Direction).
- **SLS** status is RED when the safety laser scanner detects an obstacle in the nearby perimeter (<1m), the robot cannot exceed 0,3 m/s (Safely Limited Speed).

8.6. Hand control for teleoperation

The ***SWD® Starter Kit*** is delivered with a consumer type console joystick, for demonstration purposes only. The wireless joystick is directly connected to the embedded IPC and allows manual teleoperation of the machine.

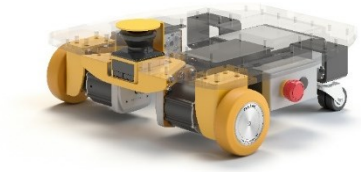
ℹ The ***SWD® Starter Kit*** uses standard ROS Noetic packages (using *joy* and *teleop_twist_joy*) providing interfaces with a standard console joystick.

ⓘ To activate the hand controller, ROS packages must be started (It can take a few minutes at start-up).
ⓘ The status of the ROS LED can be checked to confirm that ROS is active.

⚠ If the motion control becomes jerky, the joystick might be discharged. Joy's LEDs should be blinking.
⚠ If you unconfigured the original controller settings, you can press the 'Reset' button, on its rear.

Appendices

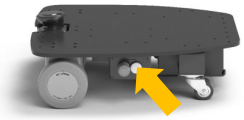
1. **Quick Start**



QUICK START

1 Power on

Put the kit on the floor on a stable and flat surface.
Install and plug the battery power connector onto the rear side of the robot.
Press the white ON/OFF button on the side of the robot, near the Emergency Stop.

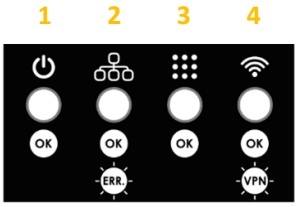


- ℹ The IPC and safety laser scanner lights turn on, and the kit starts booting for a few ten seconds.
- ℹ To start safely, you can engage one of the Emergency Stops while the robot is powering ON.

2 Display and status

iMX6 version

Display of the 4 LEDs - when the embedded IPC is powered:

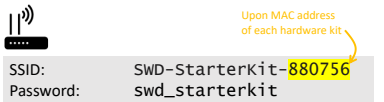


1	**Power**	●	The battery power is available
2	**Devices**	●	The connection to the ***SWD®*** and to the safety laser scanner is active
		✹	The connection cannot be established
3	**ROS**	●	The ROS environment is active
4	**Wi-Fi**	●	The Internet connection is established
		✹	The VPN connection is activated (only for support)

iMX8 version

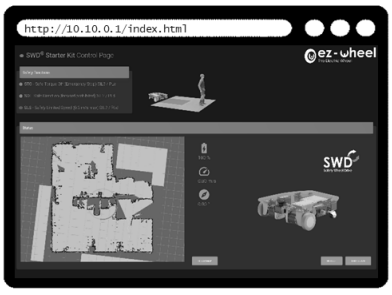
		iMX8 ON
Power Led State	Yellow	✓

3 Connection to the web Control Page hosted on the embedded PC



Connect a third-party device to the Starter Kit thanks to its own Wi-Fi access point

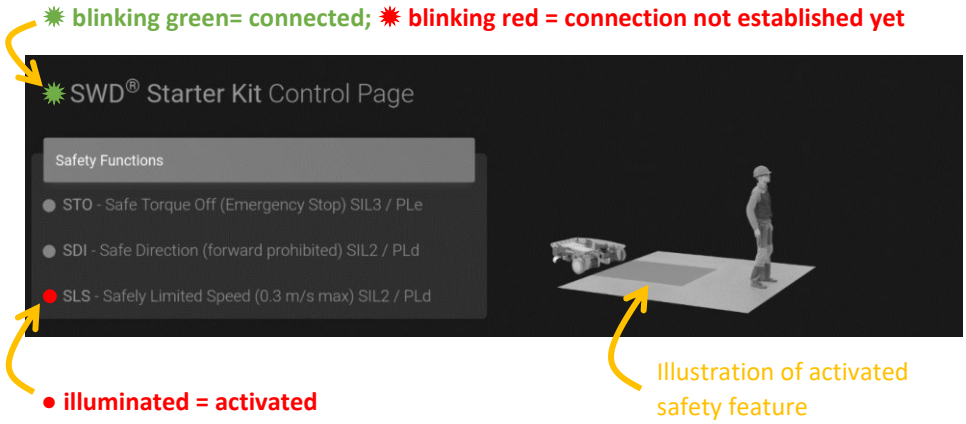
- ℹ SSID and initial password are indicated on the front plate beside the safety laser scanner or on the leaflet.
- ℹ Once a PC or tablet connected to the ***SWD® Starter Kit*** Wi-Fi access point, a web page is accessible with any navigator by typing the page's address: **http://10.10.0.1.**



- ℹ **The SLAM algorithm used by default is Hector Slam available under ROS Noetic, but other algorithms such as LaMa or Gmapping could be used.**

4 Safety features monitoring

ℹ The page is used to check the status of the safety features set up with the ***SWD®*** safety drives and the safety laser scanner and shows an example of map built thanks to a ROS open-source SLAM algorithm using the data from the safety laser scanner.



STO	●	when one of the two Emergency Stops is engaged, the motors are stopped (Safe Torque Off)
SDI	●	when the safety laser scanner detects an obstacle in the short perimeter (<50cm), the motors cannot go forward (Safe Direction)
SLS	●	when the safety laser scanner detects an obstacle in the nearby perimeter (<1m), the robot cannot exceed 0,3 m/s (Safely Limited Speed)

5 Hand control for teleoperation (for demonstration)

ℹ The wireless joystick is directly connected to the embedded IPC and allows manual teleoperation of the machine.

ℹ The ***SWD® Starter Kit*** uses standard ROS Noetic packages (using *joy* and *teleop_twist_joy*) providing interfaces with a standard console joystick.

To activate the hand controller, ROS packages must be started.

ℹ The status of the ROS LED can be checked to confirm that ROS is active.

ℹ Make sure you have released the emergency buttons.

ℹ If the motion control becomes jerky, then the joystick might be discharged. You should see joy's LEDs blinking.

2. M12 Adapter 12 <-> 17 pin.

Pinout of the M12 connectors between the safety laser scanner (12 pin) and the *Safety Hub (17 pin):*

M12 male 17-pin, A-coded	Designation	Wire colour	M12 female 12-pin, A-coded
1	+24	Brown	1
2	GND	Blue	2
3	SWD1_SAFE_IN_1	White	3
4	SWD1_SAFE_IN_2	Green	4
5	-	-	5
6	SWD2_SAFE_IN_1	Yellow	6
7	SWD2_SAFE_IN_2	Black	7
8	-	-	8
9	SWD1_SAFE_IN_3	Red	9
10	SWD1_SAFE_IN_4	Violet	10
11	SWD2_SAFE_IN_3	Grey/Pink	11
12	SWD2_SAFE_IN_4	Red/Blue	12
13	-	-	-
14	-	-	-
15	-	-	-
16	-	-	-
17	-	-	-

3. Modification History

Revision	Release date	Changes
V0	19/11/2021	First Release First Development
V1	20/07/2022	Minor changes. Add Glossary and Quick Start procedure. Add joy documentation, ***SWD®*** safety certified.
V2	20/10/2022	Minor updates. Update Safety Hub's front panel. Add safety synoptic for 17 pin commissioning.
V3	10/01/2023	Minor updates. Update of the kit boxing. Add documentation for both types of commissioning (12 and 17 pin). Add documentation of adapter 12-17 pin. Add documentation of Safety Hub connectors. Fix mistake, STO activates SBC by default. Fix pinout and adapter wiring.
V4	31/10/2023	- Mention ***SWD®*** - Update Power Supply synoptic - Add release note - Add IPC version IMX8 - Add safety functions according to FW version 2.0
V5	04/04/2024	- Remove SICK scanner links - Fix inverted safe inputs no. 2 and 9 - Add button to hold for moving - Add indicative time before being able to run Starter Kit at startup
V6	16/12/2024	- Add link to Windows driver USB serial for iMX8 - Pins on iMX8 power jack connector specified - Illustration added for the RDP connection program - Document naming update - Update legal entity and trademark
V6-b	24/06/2025	- Remove Safety Hub connector doc, cf. dedicated documentation from this version - Remove commissioning 17 pin (same as 12 pin) - Rearrange connectors paragraphs and numeration - Formatting for adapter 12 <-> 17 pin