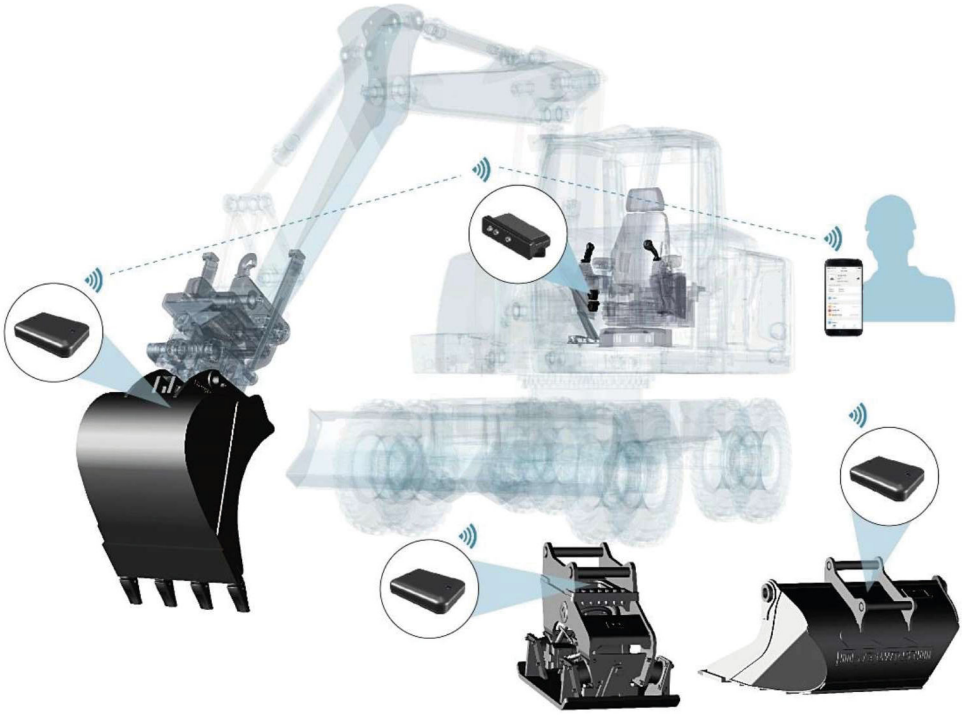
SVAB
Excavator Control Systems



Quantum

Installation instruction

DOC-0001404
2020-12-02

Table of Contents

Introduction

General

Quantum Tool Recognition is a system for wireless toolrecognition on excavators. This is the only usage intended for this product. All other usages of this machine, without written permission from SVAB, are strictly prohibited.

This document gives instructions how to do installation work on a Quantum Tool Recognition system. SVAB reserves the right to change the contents of this instruction at any time without further notice.

SVAB develops and produces their products in accordance to european legislation and teh macinery directive 2006/42/EG. The CE marking shows that the system fulfills the directive of electromagnetic compatibility EMC, RoHS and radiodirective RED.

This installation instruction shall be used in the technical file which will be the base for the final CE marking of the machine. Therefore, the checklist in this instruction shall be thouroughly performed, completely filled out and signed by responsible fitter. Save this instruction in the technical file.

The installation of the system referred to in this document is to be performed by experienced personnel. If there's unclarities regarding the use, installation, understanding of the system or regarding this document - disengage the installation work and contact the system provider for information. By using common sense you can avoid accidents from happening yourself.

FCC and ISED

To comply with FCC/IC RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. Changes or modifications to the equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1) this device may not cause harmful interference

2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: -- Reorient or relocate the receiving antenna. -- Increase the separation between the equipment and receiver. -- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. -- Consult the dealer or an experienced radio/TV technician for help.

RSS Standard

This equipment is exempt from the routine RF exposure evaluation requirement of RSS-102. This equipment should be installed and operated with a minimum distance of 20 cm between the antenna and the user or bystanders. This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1) This device may not cause interference.

RSS Standard
2) This device must accept any interference, including interference that may cause undesired operation of the device. Ce matériel n'est pas sujet à l'évaluation habituelle d'exposition RF selon RSS102. Ce matériel devrait être installé et exploité en gardant une distance minimale de 20 cm entre l'antenne et l'utilisateur ou les spectateurs. L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radioexempts de licence. L'exploitation est autorisée aux deux conditions suivantes : 1) L'appareil ne doit pas produire de brouillage 2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement. CAN ICES-3 (B)/NMB-3(B)

Support

Contact SVAB at:

SVAB, Ulvsättersgatan 2SE-694 35 Hallsberg

Phone: +46 (0)582 152 30 (main) +46 (0)0582 152 33 (Support)

On our website www.svab.se you will find additional information.

Environment

As part of our environmental commitment, we strive for our products to have as little environmental impact as possible throughout the lifecycle. This means there are things to consider during the installation.

- All assembly / disassembly must be done according to national requirements and local regulations.
- Recycle waste ccording to national requirements and local regulations.

Certificate of compliance

SVAB
Precision Control Systems

Declaration of Conformity

The manufacturer assures that this product complies with the essential requirements and provisions in

EMC Directive 2014/30/EU
RoHS Directive 2011/65/EU
RED Direktiv 2014/53/EU

This declaration is based on the following applied specifications:

EN 13309:2010	Construction machinery – Electromagnetic compatibility of machines with internal power supply
ISO 13766:2006	Earth-moving machinery - EMC
EN 50581:2012	Restriction of hazardous substances
EN 300328 v2.1.1	Wideband transmission systems
EN 301489-1 v2.1.1	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1
EN 301489-17 v3.1.1	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17
IEC 60950-1:2005	Information technology equipment – Safety

Article number: P-0001441

Product description: Quantum Tool Recognition kit

The manufacturer's name and address:
SVAB Hydraulik AB
Ulvsättersgatan 2
69435 Hallsberg
Sweden

Hallsberg 2018-04-0–5

_____

Fredrik Eriksson, CEO

Safety

General safety

Please read the installation instruction carefully before starting any assembly work. Follow the directions and local regulations.

The system may only be handled by personnel trained for the machine.

Never perform assembly work when the excavator is running.

Make sure that the electric system is powerless before any work on the system commences.

Make sure that the machine's ROPS structure is not altered, it may affect the CE marking of the machine.

Only use SVAB original parts. Damage or malfunction caused by parts other than SVAB original parts are not covered by warranty or product liability.

Warning signs

In our step-by-step instructions, there are warning signs that indicate dangerous situations that may occur when work is performed when installing our system. It is also explained what the consequences of the dangerous situation may be.

You who work with the assembly must make a risk assessment in each work situation and follow the warning that is described on the warning sign to avoid dangerous situations.

Levels of risks

There are three risk levels to take into account:

DANGER

DANGER

Indicates an upcoming hazardous situation which, if not avoided, will result in serious injury or a fatal accident.

WARNING

WARNING

Indicates a potentially dangerous situation which, if not avoided, can result in serious injury or fatal accident.

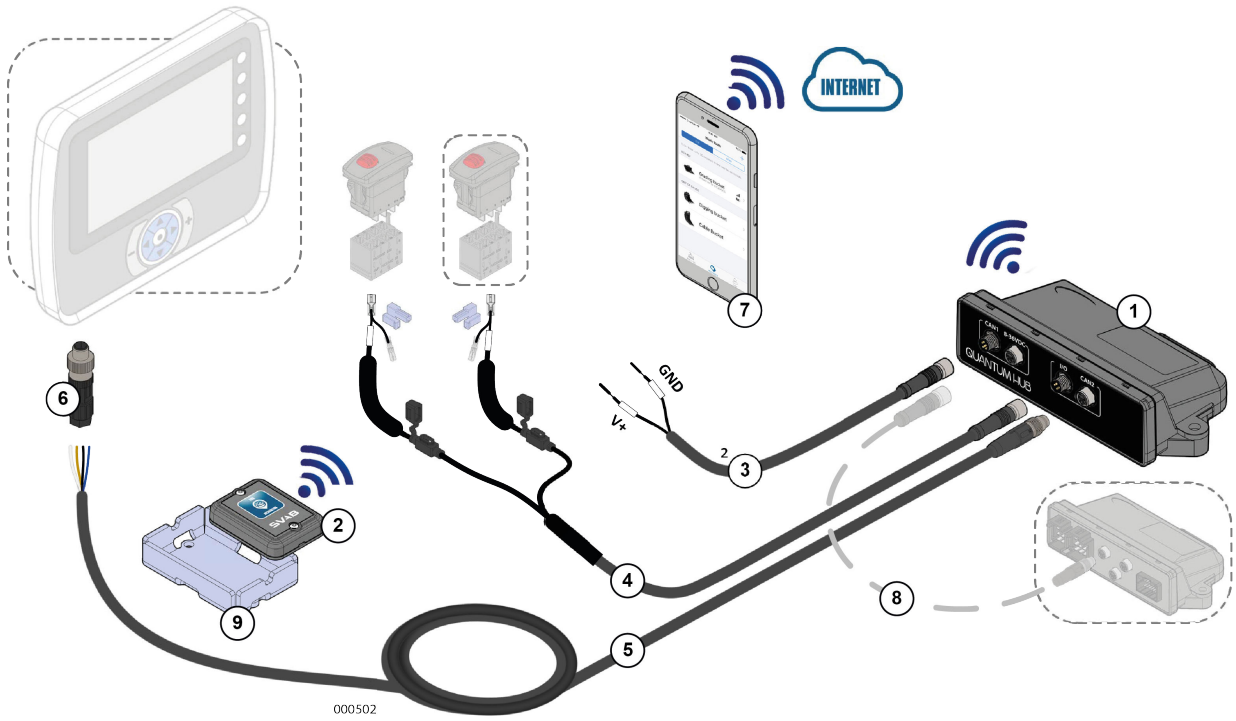
CAUTION
CAUTION

Indicates a potentially dangerous situation which, if not avoided, can result in less serious to moderate injuries.

IMPORTANT
NOTE!

This symbol is used when we want to you to pay extra attention or point out things that can enhance or impair the functionality of your product.

System overview



Pos	Part no	Description
1	P-0000963	Quantum Hub
2	P-0000966	TRM
3	P-0001345	Cable supply Quantum Hub
4	P-0001346	Cable Quick coupler signal Quantum Hub
5	P-0000585	Connecting cable Digging system
6	P-0000723	M12 Connector male, straight 5 - pole
7	n/a	Quantum App (Google play / App store)
8a	200586	Jumper cable M8, 0.3 m
8b	149209	Jumper cable M8, 1 m
8c	149207	Jumper cable M8, 2 m
9	P-0001304	Cover TRM

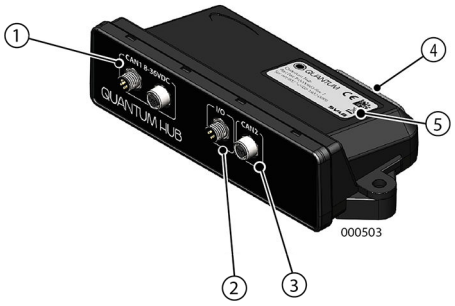
Technical description

Main parts

This is also a test page

Quantum Hub

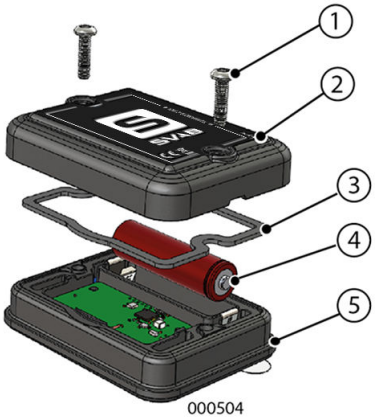
The hub consists of following main parts:



1. CAN1 / 8-36 VDC
2. I / O
3. CAN2
4. Diodes
5. Name plate

TRM (Tool Recognition Module)

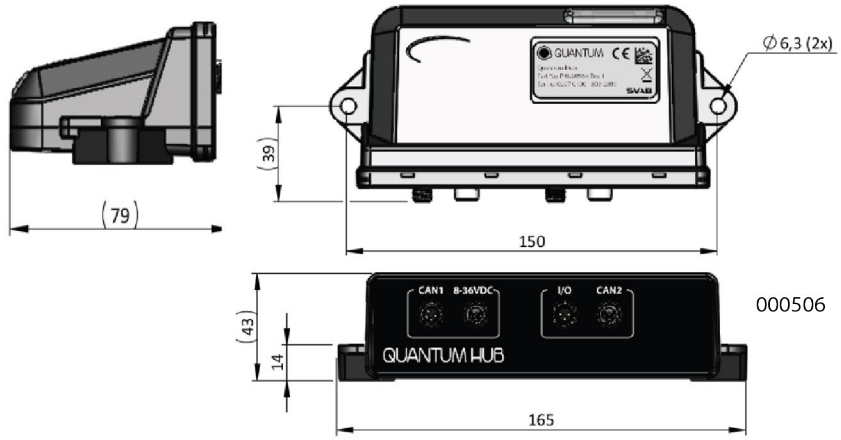
The TRM consists of following main parts:



1. Screw
2. Cover
3. Seal
4. BAttery
5. Lower part

Technical data Quantum Hub

Dimensions



				Unit	Remark
	Min	**Nom**	**Max**	-	-
Mass	-	180	-	g	-
Material	-	PA6	-	-	-
Operating temp	- 20		+ 70	C	-
Storage temp	- 20		+ 85	C	-
Voltage feed	7.5	12/24	36	V	-
CAN resistance	-	-	-	-	Software selectable 120 Ω, 600 Ω, not terminated
IP rating	-	IP50	-	-	-
Humidity	-	-	-	-	IEC60068-2-30 IEC60068-2-78
Vibration	-	-	-	-	IEC60068-2-64
Shock	-	-	-	-	IEC60068-2-27, 500 m/s2 - 6 msec
Drops	-	-	-	-	IEC60068-2-31

Certifications

Compliance	**Remark**
WEEE	2012/19/EU
RED (Radio equipment directive)	2014/53/EU
RoHS directive	2011/65/EU

Standards	**Remark**
EMC (electromagnetic radiation)	2004/108/EU

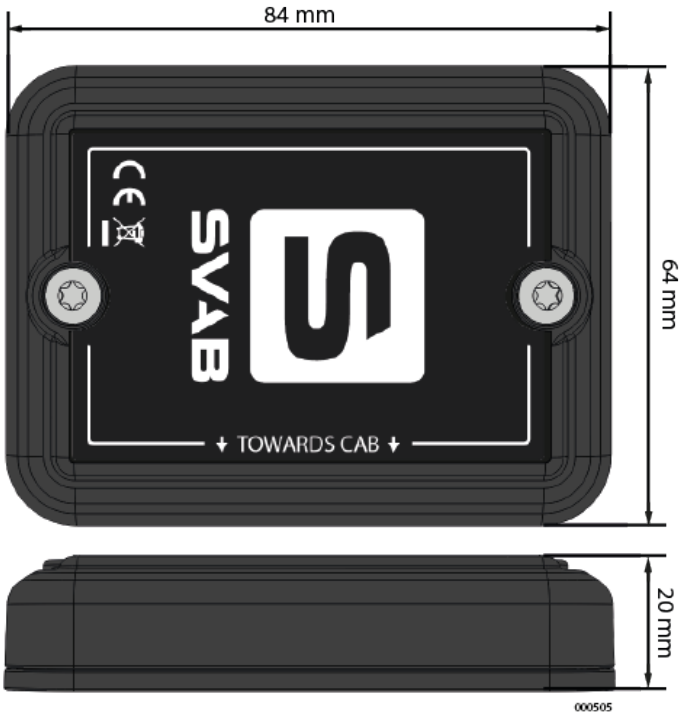
Radio	ETSI EN 300 328 V2.1.1 ETSI EN 301 489 V2.1.1 ETSI EN 301 489 V3.1.1
EMI	ISO 13766-1:2018
RoHs	EN 50581:2012
LVD	EN 60950-1

Bluetooth

Description	**Remark**
Bluetooth	Bluetooth 4.1
Frequence	From 2.4 GHz to 2.4835 GHz (ISM band)
Range	up to 30 m

Technical data TRM

Dimensions



System

				Unit	Remark
	Min	Nom	Max		
Mass		90		g	
Material		PC/PBT			
Operating temp	-40		+ 70	C	
Storage temp	- 40		+ 85	C	
Voltage feed	1.8	3.6	3.9	V	
Battery time			5	years	Up to 5 years, depending on degree of use and environment
IP rating		IP67/IP69K			
Humidity	-	-	-	-	IEC60068-2-30 IEC60068-2-38 IEC60068-2-78
Vibration	-	-	-	-	Field tested to withstand tough environments (such as a hydraulic hammer)
Shock	-	-	-	-	IEC62262, IK09, 10 joule
Drops	-	-	-	-	IEC60068-2-31

Certifications

Compliance	Remark
RED	2014/53/EU

WEEE	2012/19/EU
RoHS directive	2011/65/EU

Standards	Remark
EMC (electromagnetic radiation)	2004/108/EU
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Bluetooth

Description	Remark
Bluetooth	Bluetooth 4.1
Frequence	From 2.4 GHz to 2.4835 GHz (ISM band)
Range	up to 30 m

Function

Tool recognition

ToolRec is a system for wireless tool recognition on excavators. The system identifies which tool is connected to the excavator’s attachment or to the tiltrotator’s attachment. Quantum is based on each tool being equipped with a compact and robust battery-powered device (TRM) that communicates wirelessly with a controller in the cabin (cabin module).

The tiltrotator and / or machine quick coupler is connected to the system to detect when a change of tools occurs. In cases where the machine is equipped with a Quantum or MACS RT based tiltrotator control system, the information is shared when a tool change under the tiltrotator through the CAN bus. When initiating a change, the system starts scanning for moving tools. The system uses several smart conditions to identify the correct tools.

CAN-bus - interface towards external systems

The cabin module can transmit the information to other control systems in the excavator via CAN bus. This way, these systems can adapt to each tool.

GPS/3D machine control system

An example of function is to automatically indicate the correct tool for the machine’s GPS / 3D machine control system without the operator having to manually enter it. This input can be used to automatically change theMachine Control System settings to the connected work tool. This provides quicker tool-changes and eliminates potential error sources and expensive rework. The Tool RecognitionModules (TRMs) can also store information on the work tool’s unique measurements anddimensions if local work tool data storage is preferred.

Tiltrotator control systems

ToolRec in combination with tiltrotatorcontrol systems developed by SVAB, each ToolRec module can be configured with custom tiltrotator speeds. This helps the operator to always get the optimum performance of his/her tiltrotator and ensures minimal fuel consumption. With ToolRec's open CAN bus interface the system can also be integrated with external tiltrotator control systems.

Tracking of tools and machine

The system stores the user's smartphone GPS position in the cloud and connects it to the tool and machine shown on a map in the app, provided that the user has:

- Downloaded the Quantum app to his/her smarthphone
- Approved that the app has access to location information
- Bluetooth connection with cabin module and/or TRM devices
- Internet Access

The information about the position of a tool or machine is also shared by other users who have a Bluetooth connection with any cabin module or TRM device. It is enough for someone who has the Quantum app installed on their smartphone to pass a cabin module or TRM and get connected via Bluetooth to update the location in the cloud. The information is sent anonymously and is displayed only for those users who registered the current machine or device in their app.

Operating time and service intervals

Quantum Tool Recognition together with the Quantum app also keeps track of the machine and tool's operating time. The machine's operating time is measured in time as the hub has been powered, the tool's operating time is measured in time as the TRM unit has been connected to the cabin module and at the same time been in motion.

In the app, you can define multiple service intervals for both the machine and the tool, the app will then notify via notifications to it when it's time for service.

Installation

Read the section about safety before starting installation. Check that the delivery is complete before the assembly begins.

Check of delivery

The kit consists of:

- TRM
- Cover for the TRM (Option)
- Quantum Hub
- Mounting plate
- Cabling, quick coupler
- Feed cable, Quantum Hub
- Cabling, connection external system 5 m
- Connector, M12
- Cabling, tiltrotator system

Check the delivery agianst the packing list to make sure no parts are missing.

Install the Quantum hub

WARNING
WARNING

When installing the hub, it is not allowed to use areas that affects the emergency exits.

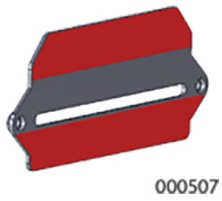
1. Look for a free space in the cab for the Quantum hub. The hub should be in sight of the TRM for good reception. Therefore, it's recommended to place the hub on a window.
2. Clean the surface thouroughly where the hub is placed.

NOTE
Please direct the cloth in one direction, not in circles

3. Mount the hub on the mounting plate with 2 screws.

000508

4. Remove the red protective film on the mounting plate.



5. Press the mounting plate onto the clean surface. Press for at least 30 sec.

NOTE
Do not use screws when mounting the plate. It may affect the machine's ROPS structure.

6. Let the glue harden for a couple of minutes.

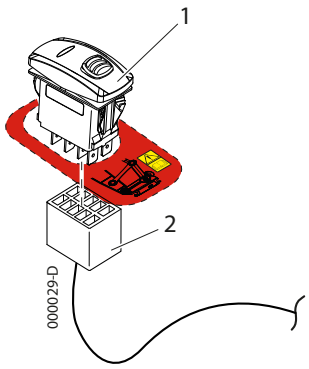
NOTE
Please note that it can take up to 8 hours until the glue has hardened and reached full strength.

Install quick coupler switch

The machine must be equipped with a switch that can be locked in the off position. The quick coupler switch is mounted in a spare location in the instrument panel, easily accessible to the machine operator. The panel switch for the quick coupler lock switch must be located so that it is not confused with other similar switches or switches with similar functions.

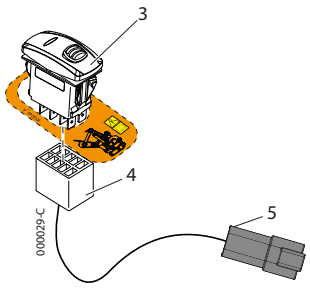
The buzzer for indication of open quick coupler lock may not be plugged or removed. The signal must be clearly audible when normal work is underway. Clearly mark this switch in the panel by placing the sticker enclosed between the switch and socket. If the machine has an existing tool attachment the switch for it must be marked with sticker.

1. Remove original quick coupler switch and place the red sticker (upper) between the button [1] and the socket [2].



Note: Image above shows an example of a switch.

2. Place the yellow sticker (lower) between the quick coupler [3] and the socket [4].



3. Install the switch [3] into the instrument panel.

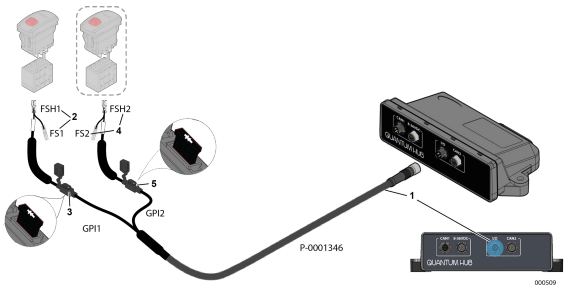
Connecting quick coupler; original and tiltrotator-system

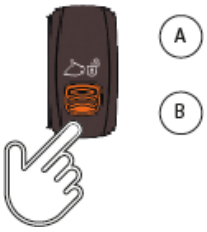
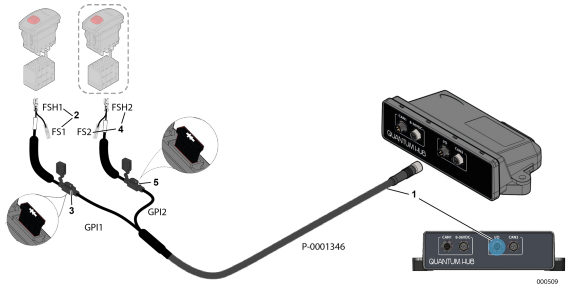
WARNING

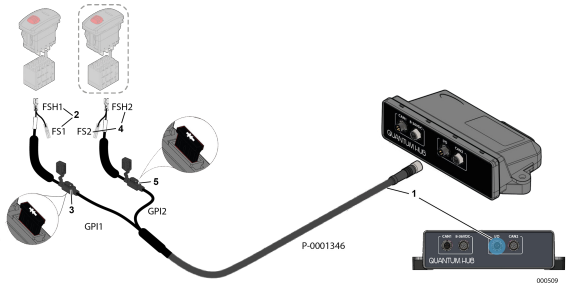
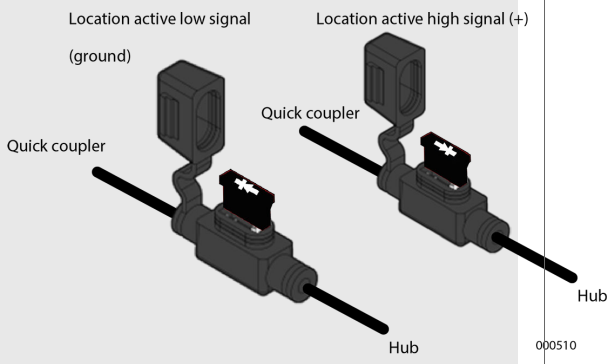
Place the tool on the ground before testing the quick coupler.

Take care when connecting the cable. An incorrect installation may affect the upper / lower quick coupler function.

The signal for breaking the hydraulic functions is directly connected to the machine's original circuit breaker with a diode in series to protect it from incorrect reverse voltage. See the electrical diagram for further information. DO NOT REPLACE THE DIODS WITH FUSES.

Connect quick coupler	
1. Connect the signal cable 802626 [1] to output marked I/O on the hub.	
2. Identify signal from external upper quick coupler and tiltrotator (active high / active low):	
a) Turn the ignition on and start up the machine. Activate the safety gate and place the tool on the ground.	
b) Switch position on the quick couplers between open/close. Measure the connections of the couplers. The signal is found where there is an alteration between open/close. [A] Coupler locked/closed [B] Coupler open	
c) Measure this connection.	

Connect quick coupler	
d) Active high signal: Start with coupler in closed mode [A]. Measure between connection and ground(GND). The value should be 0 V. Switch to open mode [B] When the signal is active high, the value should be between 8-36 V.	
e) Active low signal: Start with coupler in closed mode [A]. Measure between connection and ground(GND). The value should be 8-36 V. Switch to open mode [B]. The value should be 0 V.	
3. Remove existing cable from the machine's original quick coupler.	
4. Connect cable end marked GPI1, flat pin FSH1, to the machine original quick coupler[2].	
5. Connect existing cable to flat pin FS1[2].	
6. Place enclosed diode in the holder for GPI1 [3].	**IMPORTANT** Place the diode in correct direction with respect to the poles, active high signal and acitve low signal respectively. See image below.
7. If quick coupler for TR-system does not exist, please ignore steps 8 - 12.	
8. Identify signal from the tiltrotator quick cuopler (active high/active low).	
9. Remove existing cable from the quick coupler.	

Connect quick coupler	
10. Connect cable end marked GPI2, flat pin FSH2, to the machine original quick coupler [4].	
11. Connect existing cable to flat pin t FS2 [4].	
12. Place enclosed diode in the holder for GPI2 [5].	**IMPORTANT** Place the diode in correct direction with respect to the poles, active high signal and acitve low signal respectively: 

Connect feed and external excvatator system (when applicable)

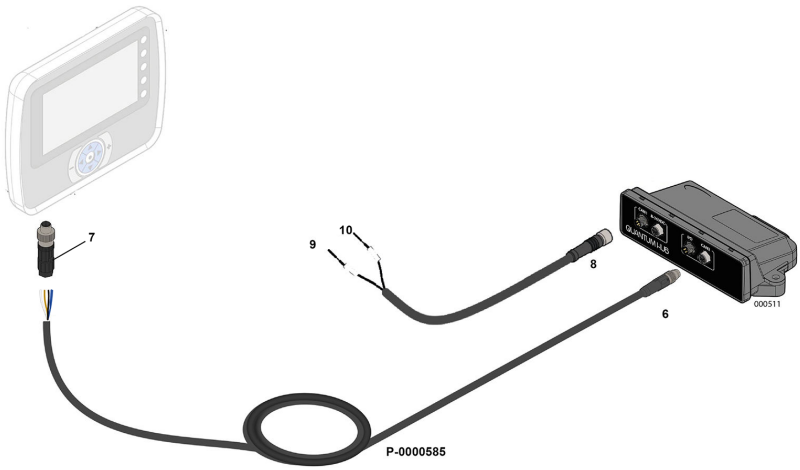
Connect to external system (when applicable)

1. Connect the cable P-0000585 to external system, such as an excavator system. Connect the cable [6] to output marked CAN2 on the hub.
2. Connect connector P-0000723 [7] to external system.

Connect the feed

1. Connect the feed cable P-0001345 [8] to output marked 8 - 36 VDC / CAN1 on the hub.
2. Connect + feed [9] to suitable power supply (12 - 24 V). Fuse with 5 A fuse
3. Connect GND [10] to ground.

> **NOTE**
> The hub shall only be powered up when ignition is turned on (connection 15)



Connecting to tiltrotatorsystem (MACS-RT, XCG2)

1. Connect the quick couplers according to sections *Connecting quick coupler, original and Tr-system* and *Connect external excavator system*.

> **NOTE**
> Please note that feed cable is not installed since the feed is obtained through CAN.

2. Connect CAN cable 801062 from Quantum hub to the control unit.

Mount the TRM

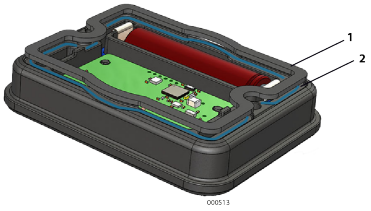
The TRM-module should be mounted on the tool in room temperature for best result. The temperature may not go under - 10 grader C.

The module is delivered with the battery, seal and screws on the side.

1. Remove the cover on the module and install the battery.

2. Install the seal.

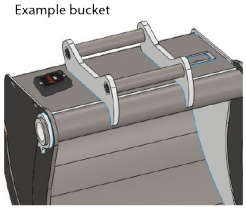
> **NOTE**
> Make sure the seal[1] is placed correctly in the groove [2].



3. Remount the cover and tighten the screws at 0.8 Nm.
4. Find a protected surface for the module. On top of the tool, close to the attachement is one good placement, se examples below.

Exemple Steelwrist TR

Example bucket



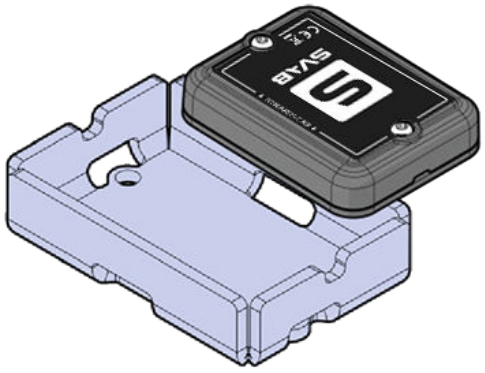
5. Clean the surface where the module is placed.

> **NOTE**
> The surface needs to be clear from dirt and should be dry. Use some kind of lipo-soluble spray for the task. Avoid circling movements, keep one direction if possible.

6. For optimal function, make sure that the module is rotated correctly before mounting. Follow the directions on the module cover:

7. Installation with protection cover: Weld or screw the protection cover to the clean surface. Remove the tape underneath the module and press the module to the bottom of the cover.

> **CAUTION**
> Make sure that the hub is powerless by disconnecting the power cable before any welding is started.



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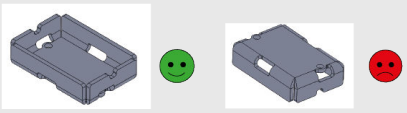
NOTE
For best performance, mount the cover bottom down towards the surface.



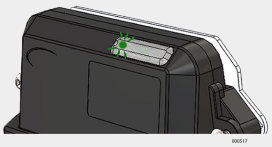
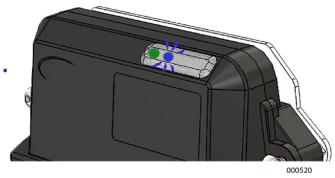
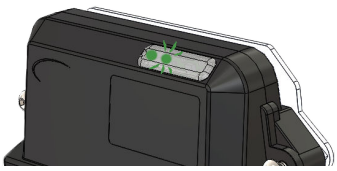
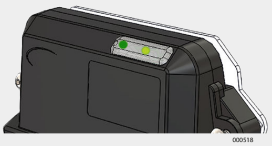
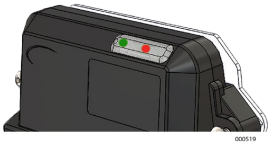
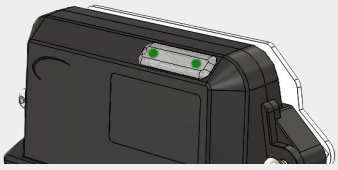
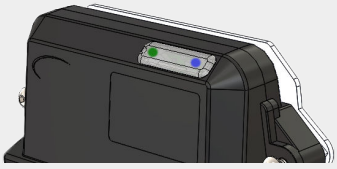
8. Installation without protection cover: Remove the tape underneath the module and press the module to the clean surface.
9. Do not throw the protective tape put. Place the protective tape on a paper or similar. The TRM is labeled with a MAC-adress and this number will show up in the app later on. It will make it easier to find the tool in the app.

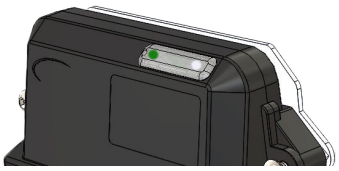
Start up

Start up the system

Quantum starts when the machines electronics is activated by the ignition.

Start the Quantum hub

1. Power up the machine. Quantum hub will start and the diodes will start to flash. The LEDs are called (from the left): LED 1, LED 2, LED 3, LED 4. LED 1 (Heartbeat), LED 2(TOOLREC-searching), LED 3 (quickcoupler), LED 4 (TOOLREC-status)		-
2. Check that LED 1 is flashing green. As long as the hub is running, the led will flash.		-
3. LED 2 flashes blue when searching for a tool. If LED 2 flashes green, it searches for a tiltrotator. If LED 2 flashes blue and green respectively, it searches for both tiltrotator and tools.		
4. Check lower coupler function by activating it. LED 3 lights up with a green steady light.		-
5. Check upper coupler function by activating it. LED 3 lights up with a red steady light.		If both couplers are open, LED 3 lights up with a yellow light.
6. When a tiltrotator has been identified, LED 4 lights up with a green steady light. When a tool has been identified, LED 4 lights up with a blue steady light.		

7. LED 4 lights up with a steady white light when both tiltrotator and a tool has been idenftified.		-

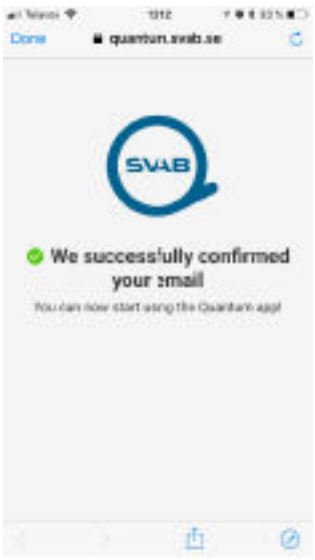
Register user

Download the SVAB Quantum app from App Store or Google Play.

1. Start by creating a new user.
2. Enter user information and password. Click ”Next”.

> **NOTE**
> You need to accept the licence agreeent in order to get to the next step in the registration.

3. Wait for a confirmation mail and follow the instructions in the mail.
4. Your registration will be confirmed

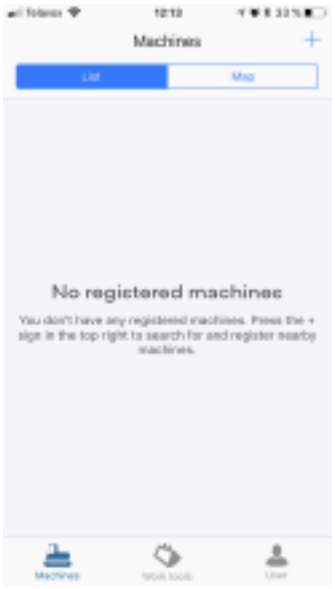


Register new machine

1. Go to ”Machines” to register a new machine.

NOTE
Please note that the machine must be running in order for the system to function.

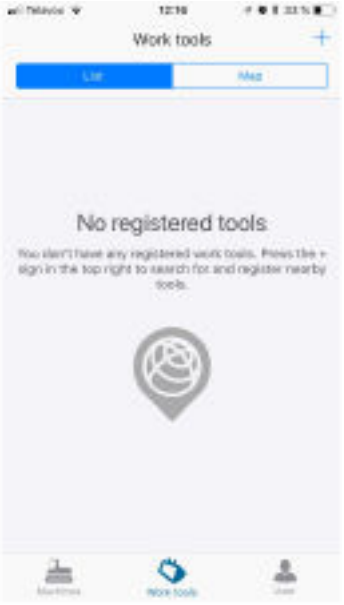
2. Press the + sign to scan for and register machines.



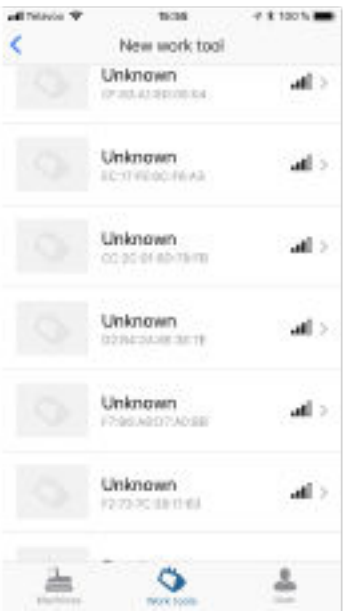
3. The machine will show up as unknown machine. Click on the machine to register. Name the machine and add a picture if desired.
4. Press ”Save” when you are done. The machine is added to your list.

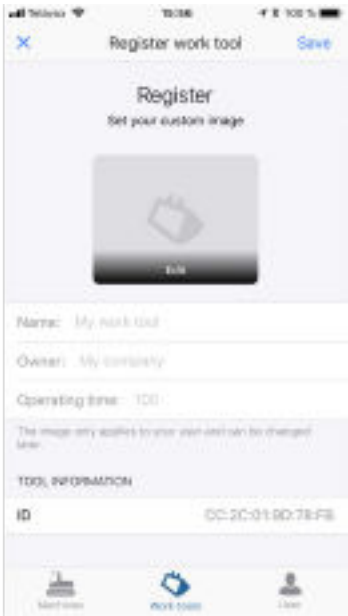
Register a new tool

1. Go to ”Tools” to register a tool.
2. Press the + sign to scan for and register tools.



3. The tool will show up as unknown, ”Unknown” , with a MAC-adress. Compare the numbers on the insatlled TRM-module.
4. Select the tool to be registered. Name the tool and add a picture if desired.
5. Press ”Save” when you are done. The tool is added to your list.



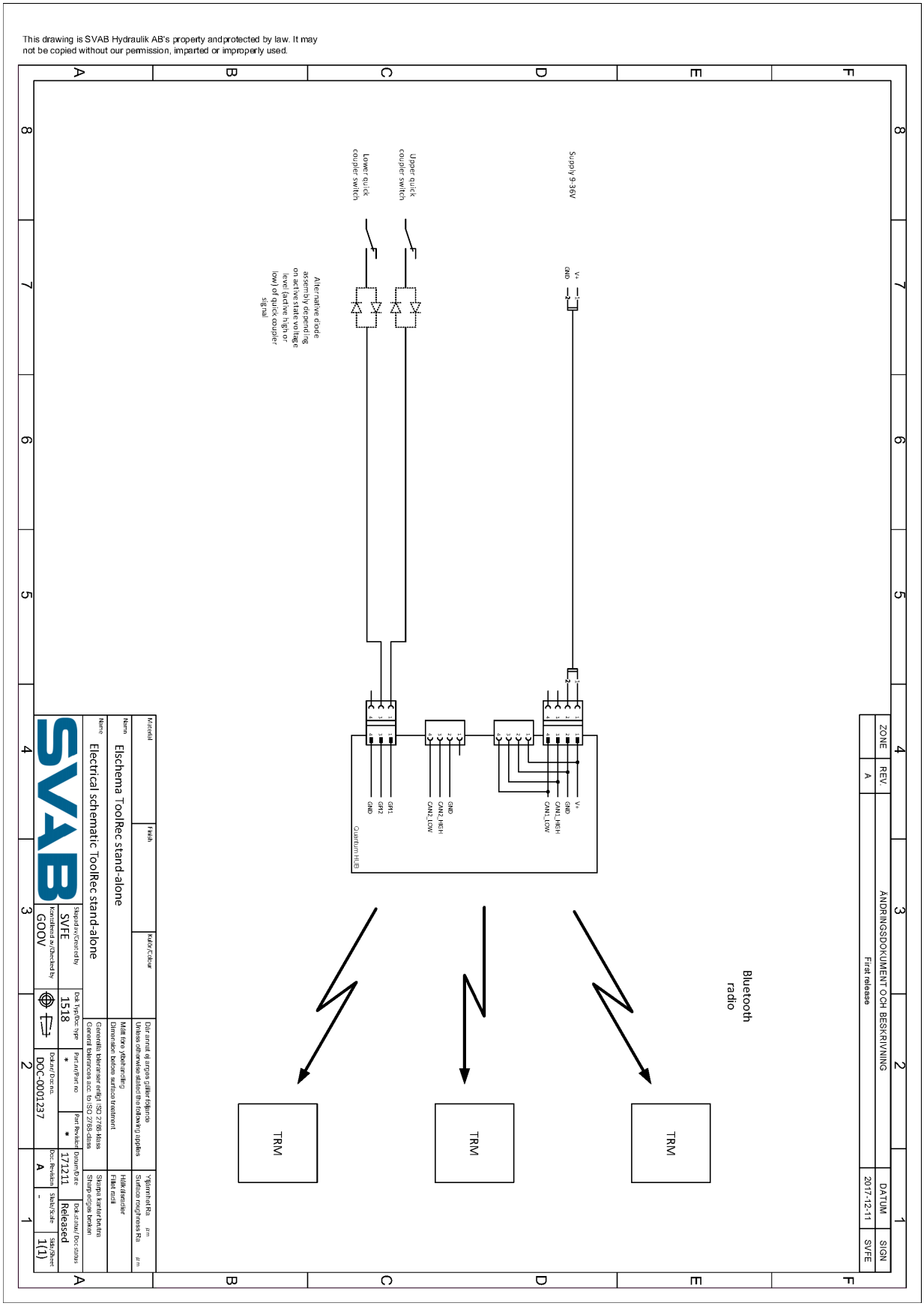


Tiltrotator TRM

The Tiltrotator TRM is predifined from factory and will show up on the screen.

Basic settings for Quantum ToolRec are now made.

Electric diagram



Checklist

NOTE
Be extra observant of the machine's movements when starting for the first time after installation! A safety distance of at least 10 m around the machine is recommended.

Before going through the checklist, ensure that the machine:

- has been started
- the safety gate is closed
- is in excavation mode (not in transport mode)

Checklist			
General testing/adjustment(macine not running		Sign	Sign
1	Check that cables are correctly routed and properly secured, and that cable protection is mounted where cables can be subjected to wear.		
2	Check that the system is correctly connected according to the electrical diagram.		
3	Check that the system is correctly fused.		
4	Check that no holes or other modifications are made on the shovel boom or on the cab's ROPS structure.		
5	Check that the user manual accompanies the machine upon delivery to the end-user.		
Safety functions (These must always be checked and approved by a person other than the installation technician).		Sign	sign
1	Check that the upper tool lock interlock functions correctly, according to user manual of the machine		
2	Check that the lower tool lock functions correctly, according to the user manual of the machine		
Testing/adjustment (machine running)		Sign	Sign
1	Check that the app starts and starts to scan for tools within range.		
2	Check that it is possible to connect a tool.		
3	Check that LED 3 lights up with a red light when upper tool lock is activated		
4	Check that LED 3 lights up with a green light when the lower tool lock is activated.		

Machine model:	Serial number:
Signature:	Date:
Signature(safety functions):	Date: