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SetupRobotics ToolBase Screwdriver

USER MANUAL

Preface

Congratulations with your SetupRobotics ToolBase screwdriver with vacuum pickup (option).

Most robot screwdrivers have an external power cable supplying the screwdriver motor with enough energy, much more than a typical tool interface can supply. Especially at end when torque builds the motor demands a high energy supply. At other times the energy demand is zero e.g. the robot moves around picking up the next screw etc. The SetupRobotics screwdriver uses this fact and stores energy at all time has an internal energy storage being prepared to deliver the high energy when needed.

Features:

- Mount on SetupRobotics patented ToolBase.
- No need for extra power cables
- Military standard LIFePO4 batteries (safe alternative to Li-Ion type)
- Vacuum pickup option. Pick also nonmagnetic screws as stainless steel and brass.
- Setup the screwing task via push buttons/display
- Torque setting with feedback to robot.
- 2 speed gear.
- Detailed feedback using Tool communication.
- Single IO mode for robots without tool communication.
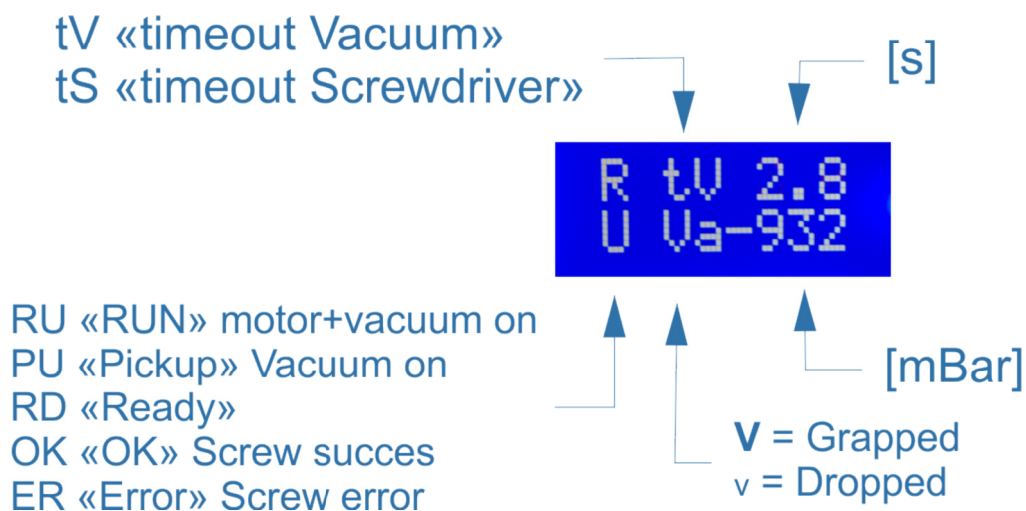
Screwdriver modes

To be able to store energy into the screwdriver batteries the motor running times should be minimized.

To do this the screwdriver is operated as followed.

- Activate screwdriver. Motor and vacuum goes on. Pick-up screw from screw feeder.

- Deactivated screwdriver. Motor stops but vacuum continuous. The picked-up screw stays secured using vacuum. Screwdriver charges while robot moves to screw in location.

- At screw in location activate screwdriver and mount the screw.

- At end status is signaled back to robot. Motor and vacuum stops.

- A cleaning blow is performed when screwdriver is deactivated.

On the screwdriver display process status is showed.

tV «timeout Vacuum»
tS «timeout Screwdriver»   [s]

R tV 2.8
U Va-932

RU «RUN» motor+vacuum on
PU «Pickup» Vacuum on
RD «Ready»
OK «OK» Screw succes
ER «Error» Screw error

[mBar]

V = Grapped
v = Dropped

P tV 1.7
U Va-929

PU = Pickup

1.7s to vacuum timeout

V = Screw grapped, pressure -929mBar

R b1 100
D b2 100
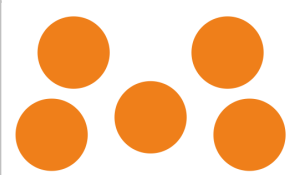
RD = Ready
Both batteries 100% charged

O TORQUE
K DETECT

OK
Screw in success

E   TIME
R   OUT

ER=ERROR
Timeout

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Status after screwing

OK Success	Screw in Torque OK	Torque switch detected
ER Timeout	Screw time to long	Increase screwing timeout
ER LOW B1	Bat 1 discharged	If possible optimize robot program to charge more
ER LOW B2	Bat 2 discharged	Same as above
ER HI-CUR	Motor current to high	Internal protection circuit
ER HITEMP	Temperature to high	Let screwdriver cool more
ER E LO-Vin	Robot voltage to low	To high load on robot power.

Setup screwdriver

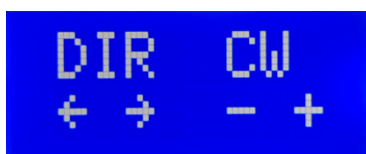The screwdriver is setup using the push button interface.

At power on the following screens are showed.
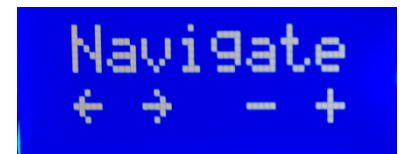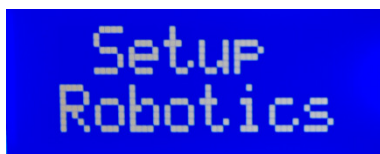
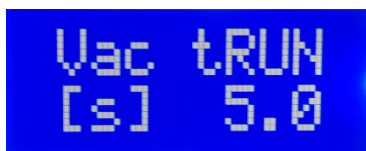After SetupRobotics intro, version is showed and lastly how to navigate.

Press ← and → to scroll through pages of settings.

Press + and – to change values.

Direction CW / CCW.

Press -/+ to change

tRUN. Time vacuum stays activated when screwdriver is activated.

At timeout physical feedback changes. See later.

tPickup. Time vacuum stays activated after screwdriver is deactivated.

At timeout screwdriver returns to ready mode.

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Screwing timeout. Should be a little longer than screw mounting time.

Actual vacuum level. Press + / - to activate / deactivate ToolBase vacuum pump.

Vacuum threshold. Press + / - to adjust. When vacuum level is below threshold screw grab is feedback to robot. On display **V** is capital when grabbed and **v** lowercase if not. See later how adjusting suction cup influence the threshold.

Speed. Press + / - to adjust speed. Normally set to 100%

Acceleration. Press + / - to adjust acceleration. Normally set to 100% but to achieve a soft start set it to a lower value.

Physical IO and feedback

The screwdriver is controlled and provides feedback using a IO as all other SetupRobotics ToolBase tools.
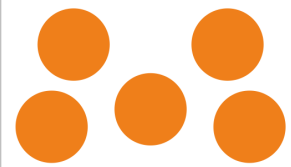
- The output (oWhite or oBlack) activates/deactivates the screwdriver.
- The input (iWhite or iBlack) reports both if screw is grabbed and if the screw is mounted correctly. To do this the physical feedback changes from screw grab to screw success/failure when tRUN expires. When using this method it should be adjusted so the screw has started entering the thread before vacuum stops.

    It is recommended to use MODBUS feedback whenever possible. See below.
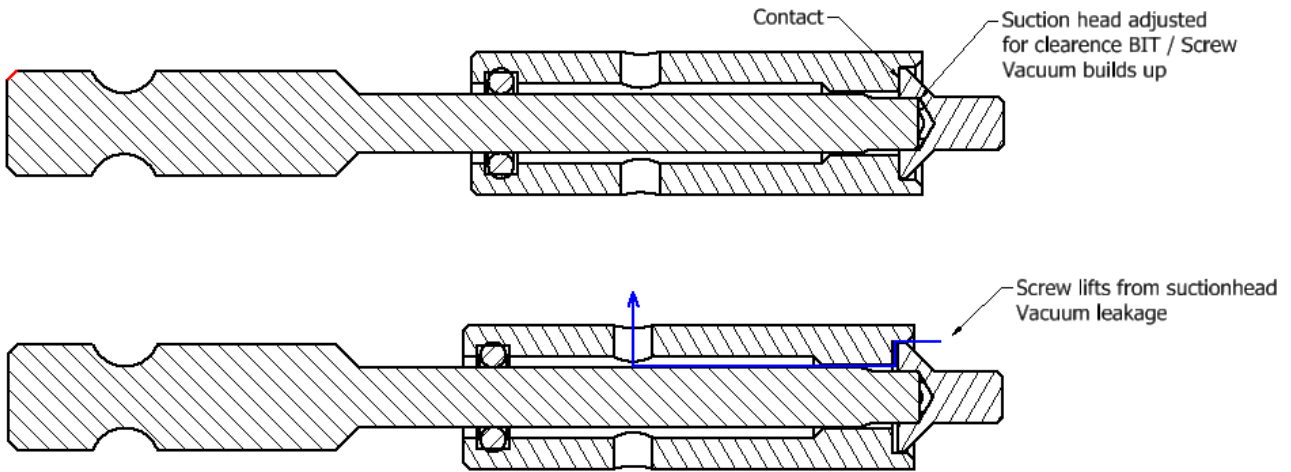
MODBUS feedback

When using MODBUS, the screwdriver reports 4 status signals simultaneously.

- iWhiteFeedBack / iBlackFeedBack: High if vacuum level is below threshold.
- iBlackOK / iBlackOK: High if screwing session ended successful
- iWhiteNOK / iBlackNOK : High if screwing session ended with an error
- WhiteVacuum / BlackVacuum the current vacuum pressure in mBar

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Suction head adjustment

The suction head is adjusted to a small clearance between BIT and screw so vacuum can build up.

Contact — Suction head adjusted for clearence BIT / Screw Vacuum builds up

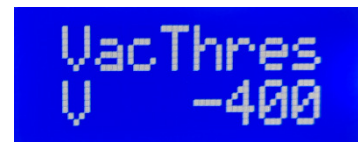Screw lifts from suctionhead Vacuum leakage

Turn on vacuum via push buttons and turn adjust ring to a stable vacuum level but also sufficient BIT insertion into screw. It is possible to adjust +/- 2mm from nominal position

VacLevel
-924 On
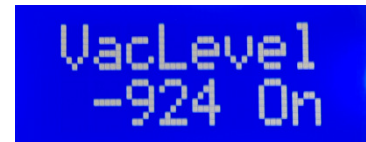
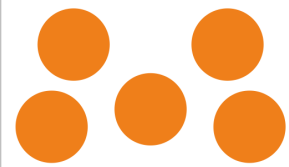⚠ When the red dot appears, the ring is at its maximum. If unscrewed further make sure the 3 internal push springs are in place when reassemble.

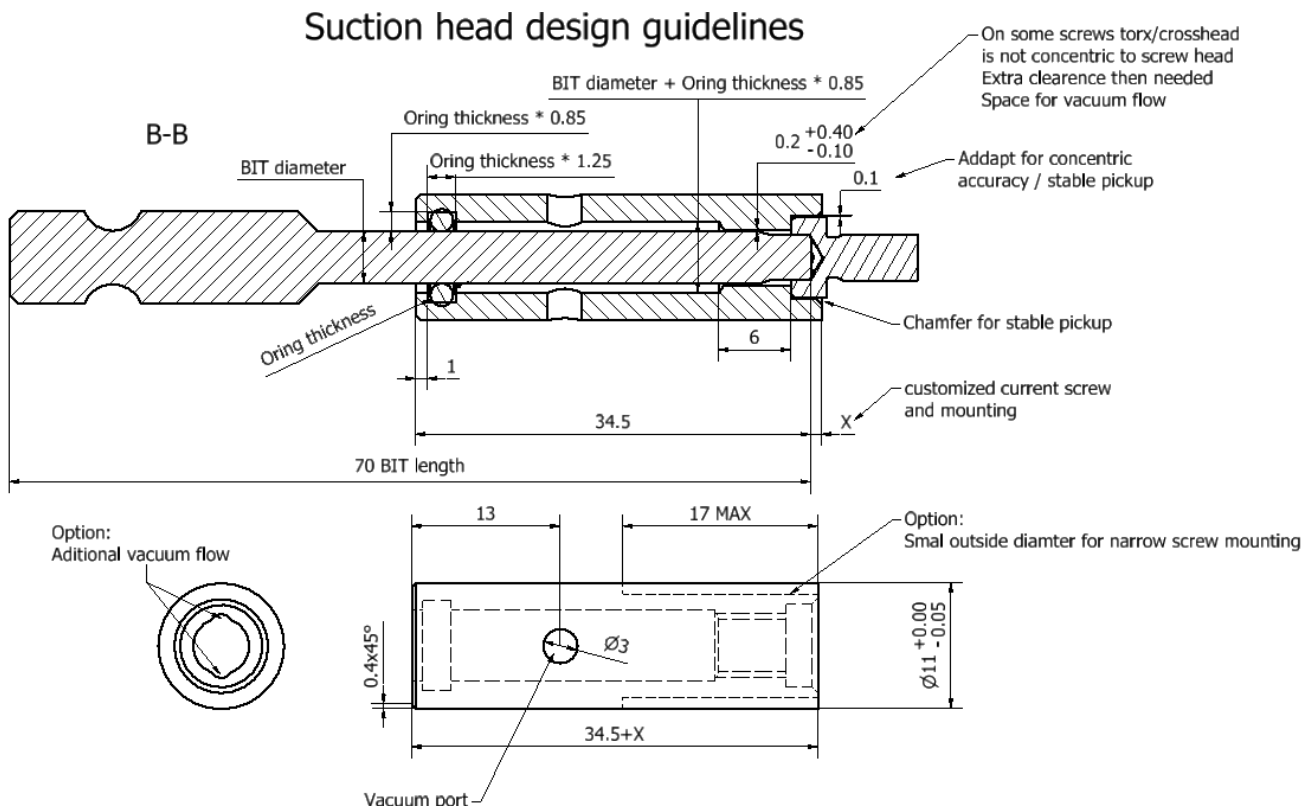2 NOMINEL

Adjust ring

0 MIN

4 MAX

Red dot
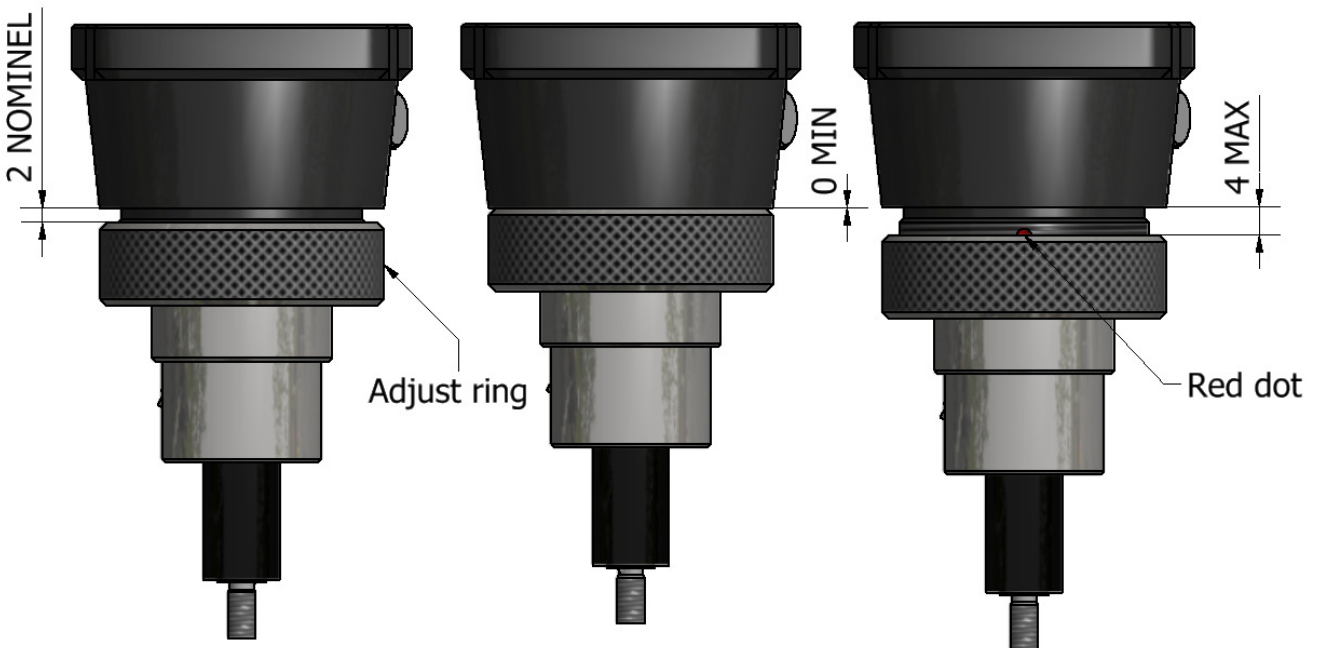
Adjust vacuum threshold in the middle of the vacuum level when is screw mounted and dismounted.

VacThres
V   -400

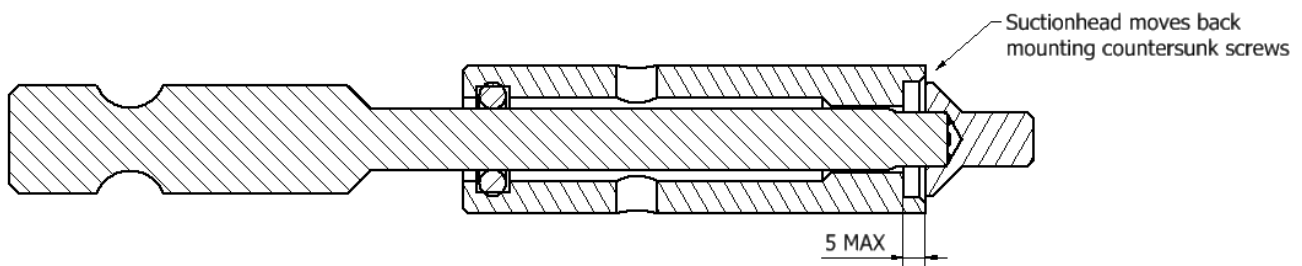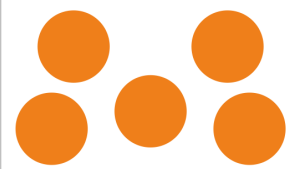| **SD1** | Version: 1.00 |
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Suction head preparations

SetupRobotics can deliver ready to use suction heads for the current application however the integrator might want to make a customized suction head or other adjustments. The following design criteria should be considered. Drawing below is at nominal position.

Suction head design guidelines

B-B

On some screws torx/crosshead is not concentric to screw head
Extra clearence then needed
Space for vacuum flow

Addapt for concentric accuracy / stable pickup

BIT diameter + Oring thickness * 0.85

Oring thickness * 0.85

Oring thickness * 1.25

BIT diameter

$0.2 ^{+0.40}_{-0.10}$

0.1

Oring thickness

Chamfer for stable pickup

6

1

customized current screw and mounting

34.5

X

70 BIT length

Option: Aditional vacuum flow

13

17 MAX

Option: Smal outside diamter for narrow screw mounting

0.4x45°

Ø3

$\varnothing 11 ^{+0.00}_{-0.05}$

34.5+X

Vacuum port

The suction head can move back up to 5mm when mounting countersunk screws.

Suctionhead moves back mounting countersunk screws

5 MAX

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BITS

The SetupRobotics screwdriver is based on DIN ISO 1173-F 6.3 1/4" hexagon holder.
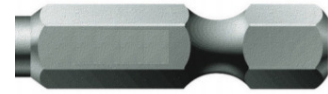
The vacuum pickup unit uses 70mm length BITS with cylindrical shaft e.g. from WERA

Below list of compatible WERA BITS and recommended vacuum head O-rings.

WERA NUMBER	TYPE	LENGTH	DIAMETER	O-RING
5134740001	TX 6	70	3.0	3 x 3
5345047001	TX 7	70	3.0	3 x 3
5060098001	TX 8	70	3.0	3 x 3
5319835001	TX 9	70	3.0	3 x 3
5060100001	TX 10	70	4.0	4 x 2.5
5060105001	TX 15	70	4.0	4 x 2.5
5060110001	TX 20	70	4.5	4.5 x 2
5060115001	TX 25	70	6.0	6 x 1.5
5060120001	TX 27	70	6.0	6 x 1.5
5060125001	TX 30	70	6.0	6 x 1.5
5134906001	PH 0	70	3.0	3 x 3
5134370001	PH 1	70	4.5	4.5 x 2
5134371001	PH 2	70	6.0	6 x 1.5
5134913001	PH 3	70	8.0	6 x 1.5
5059755001	PH 1	70	4.5	4.5 x 2
5059770001	PH 2	70	6.0	6 x 1.5
5060027001	PZ 1	70	4.5	4.5 x 2
5060033001	PZ 2	70	6.0	6 x 1.5

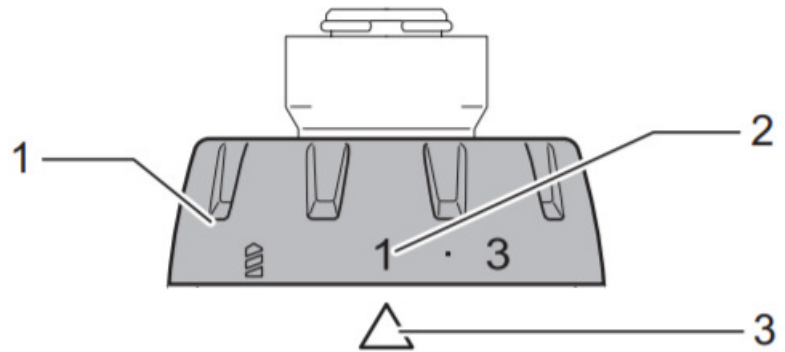| SD1		Version: 1.00
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Torque setting

The fastening torque can be adjusted in 22 levels by turning the adjusting ring. Align the graduations with the arrow on the tool body.

1. Adjusting ring 2. Graduation 3. Arrow

When the torque clutch slips the screwdriver stops operation.

Gear / Torque selecting

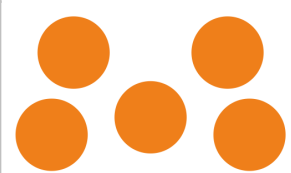| Gear	Speed	Torque setting	Approx torque
2	650 RPM	1	0.3 Nm
2	650 RPM	5	0.82 Nm
2	650 RPM	9	1.35 Nm
1	200 RPM	13	1.88 Nm
1	200 RPM	17	2.41Nm
1	200 RPM	21	2.9 Nm

To know the precise torque an external torque test should be used.

The drilling torque setting should not be used as the torque will not slip and therefore the motor will only stop after timeout.

Specifications

2-speed design (200 RPM and 650 RPM) for high or low torque applications

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Important message.

The Screwdriver is part of a partly completed machinery. A risk assessment is required for each usage.

It is the responsibility of the integrator to make the risk assessment and that all safety requirements and local regulations are complied with.

Special precautions must be taken but not limited to:

Never use a damaged screwdriver or defect components.

The Screwdriver is intended to be used for screwdriving mounted as tool on a SetupRobotics ToolBase in a clean and dry industrial environment. It is not to be used in potentially explosive environments or in life support applications.

Uffe Safeldt
COO, CTO
Hillerød 2020.01.01