E50 Smart Tool US Version | P/N: 81401264

Featuring Variable Field Output (VFO) technology, this automation-ready magnetic gripper can be controlled using CANopen protocols to de-stack and pick single or multiple sheets. Adjustability of magnetic strength between 0 and 100% allows use of this magnet on both thin and thick sheets of varying sizes and material type. CANopen communication allows integration of multiple tools on the same CANopen bus, controlled simultaneously.

Specifications

Nominal Maximum Breakaway Force [1,2]	464.5	lb	210.7	kg
Nominal Maximum Shear Force [1,2]	160.9	lb	73.0	kg
Nominal Supply Voltage	24 V DC			
Peak Power Draw	3 A @ 24 V DC			
Net Weight	6.50	lb	2.95	kg
Connector Type	Male M12x1.0 – 5 Pin – A-coded			
Mounting Options	TOP: Ø6-M8-Ø6 NAAMS pattern (x2)			
	TOP: M8-Ø6-M8 NAAMS pattern (x4)			

De-stack Settings [3]		0.5 (0.020)	1 (0.039)	2 (0.079)	7 (0.276)
	Minimum Thickness for De-stack - mm (in)	0.5 (0.020)	1 (0.039)	2 (0.079)	7 (0.276)
	Partial Actuation	15%	20%	35%	100%

Material Thickness - mm (in)	0.5 (0.020)	1 (0.039)	2 (0.079)	3 (0.118)	4 (0.157)	5 (0.197)	6 (0.236)	7 (0.276)	12.7 (0.500)	50 (1.969)
Maximum Force [1, 2, 5] **- kg (lbs)**	14.60 (32.19)	37.83 (83.41)	70.10 (154.5)	110.47 (243.5)	153.40 (338.2)	182.90 (403.2)	194.47 (428.7)	202.67 (446.8)	210.50 (464.1)	210.70 (464.5)

$$SWL\ (Safe\ Working\ Load) = \frac{Maximum\ Force^5}{Safety\ Factor\ (\geq 5)}$$

[1] Determined in laboratory environment on SAE1018 Steel with surface roughness 63 micro inches with optimized pole shoes. Many factors contribute to the actual breakaway force and safe working load in each application. Consult a Magswitch Applications Engineer and test the Magswitch in each application before deployment.

[2] All data applies to unit with flat pole shoes installed.

[3] Determined with SAE1018 Steel L=200mm W=200mm.

[4] Values may vary by +/- 5%.

[5] Maximum forces listed above are not safe lifting forces. Designer must take into account safety factor when specifying tool. Magswitch recommends SWL = 5:1 for most applications.

![magswitch®]

Pole shoes required for operation
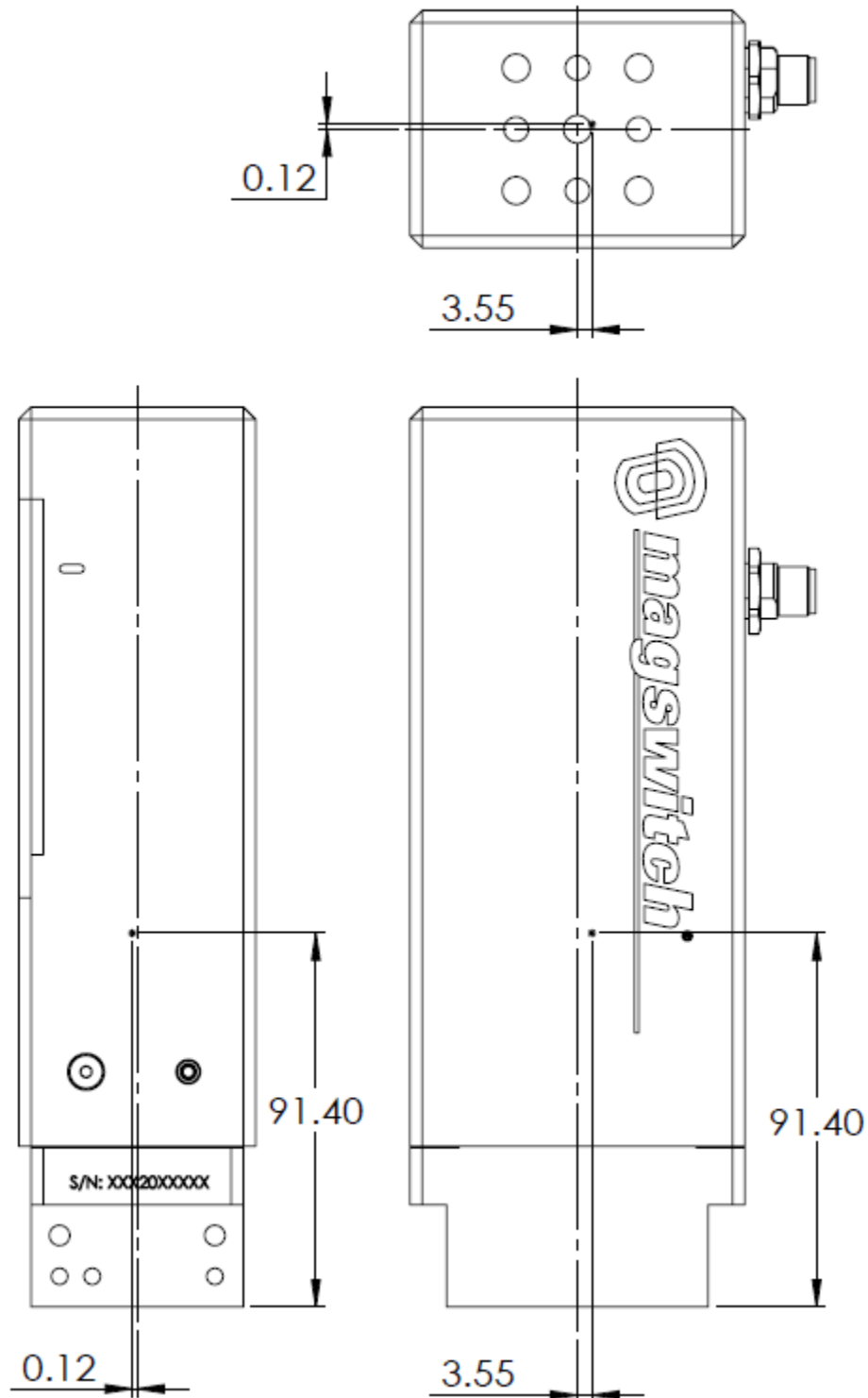
Standard Kits Available:

Standard Flat Pole Shoe Kit	8800837
MagMaster: Communication Module for E Series	8800826

WARNING!
Do Not Operate Unless In Contact With Ferrous Target!
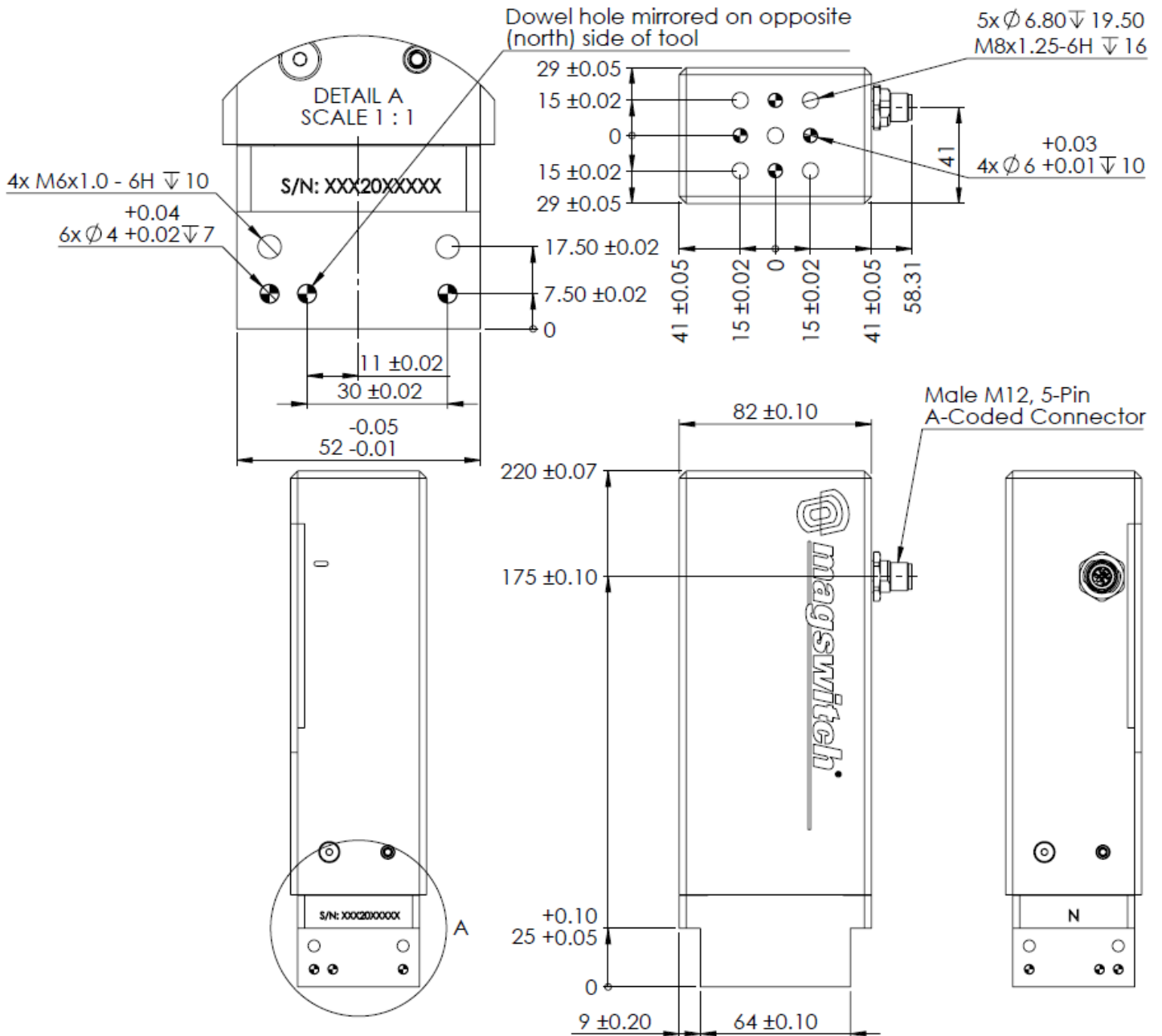
Center of Mass (COM) Information

General Electrical Characteristics

| Parameter	Value
Input Voltage Range	24±5% V DC
Rated Current Draw (Continuous and Peak)	3 A DC @ 24 V DC
Connection to tool	Rigid horizontal M12 Connector
Connector Style	Male M12 – 5 Pin – A-Coded

Ambient Conditions

Parameter	Range
Ambient Temperature (Operation)	-10 to +40 Degrees Celsius
Ambient Temperature (Storage)	-25 to +80 Degrees Celsius
Relative Humidity (non-condensing)	0 to 95%

LED Color Codes

Function/State	Blue LED State	Green LED State
No power to tool	OFF	OFF
Waiting to home magnet	Blinking	Blinking
Magnet actuated OFF	ON	OFF
Magnet actuated ON 100% (Fail-Safe)	ON	ON
Magnet partially actuated	ON	Blinking
Standard calibration routine	Blinks when calibration mode is entered Blinks when steps 1-4 are confirmed	OFF/ON depending on magnet state
Auto-calibration routine	Blinks on entry and exit/confirmation	OFF/ON depending on magnet state

Connector Pinout

Pin #	Function	Logic
1	Signal Shield	-
2	Vin (V+)	+24 VDC
3	GND (V-)	GND
4	CANopen bus high	TX/RX high line (D1) (CAN H)
5	CANopen bus low	TX/RX low line (D0) (CAN L)
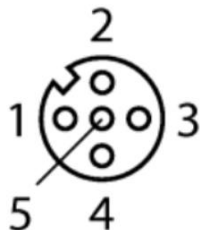
Cable Side: Pin Assignment M12, 5-pin, A-coded, Female Connector (socket-side)
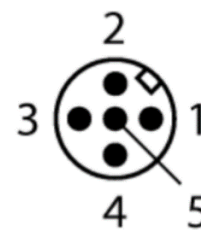
Tool side: Pin Assignment M12, 5-pin, A-coded, Male Connector (pin-side) View

CANopen Configuration Information

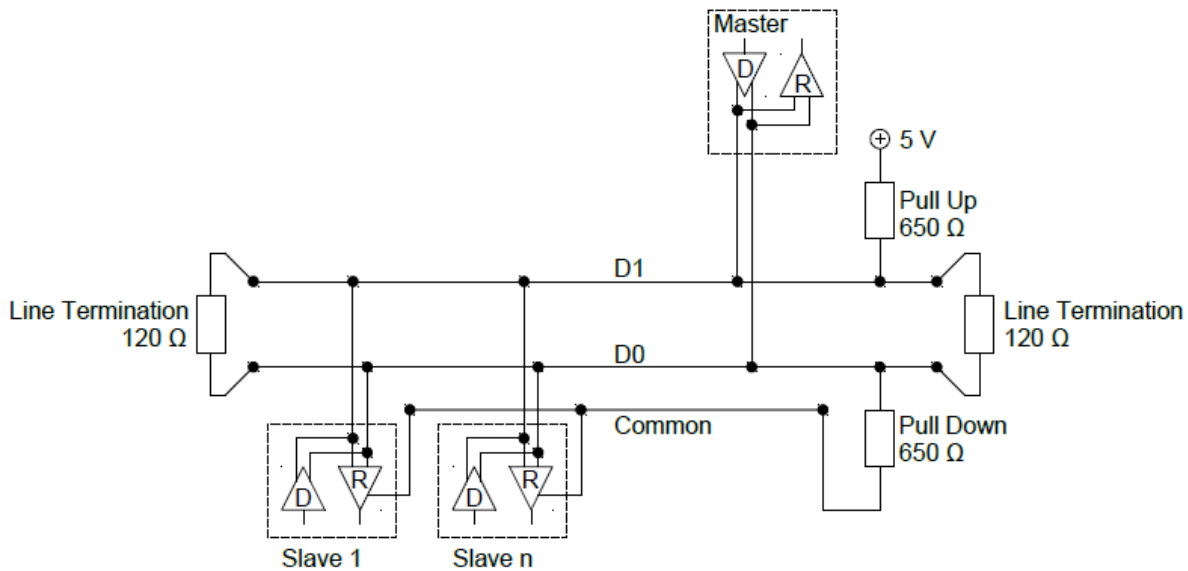| CAN Baud Rate	250 kBaud (Note software version on Page 8)
Default CAN Node ID	$14_d = E_h$, See 2a and 2b below for details
Device Terminating Resistor	120 Ω **NOT** enabled
Master Device Termination	Master device must have line polarization/termination OR: Apply 450-650 Ω pull-up to +5V on high line (D1) (CAN_H) Apply 450-650 Ω pull-down to GND on low line (D0) (CAN_L)

Changing CANopen NodeID

1. Check object 2009_h for current CANopen NodeID.
   a. Default NodeID $= 14_d = E_h$ (Node ID range in Step 2-a)
2. Write desired NodeID value to 2009_h.
   a. Software Version 3 & above: Acceptable NodeID value range $= 1_d$-23_d (Defaults to 14_d if node ID is out of range)
   b. Software Version 2 & below: Acceptable NodeID value range $= 1_d$-127_d
3. To save, write to object 1010_h sub-index 02_h the value 1702257011_d (65766173_h).
4. Wait until object 1010_h sub-index 02_h is equal to 1.
5. Disconnect and reconnect power.
6. The device NodeID will now be changed.

Changing CANopen Baud Rate (Not configurable for software version 3 and above)

For changing tool CANopen baud rates, please consult integration/assembly manual 1101334. Available baud rates are 10, 20, 50, 125, 250, 500, and 1000 kBaud.

CANopen I/O Service Data Objects (SDO's) and Functionality

Type	Object (hex)	Sub Index (hex)	Short Name	Description
Inputs	2400	01	Move Enable	1 = home magnet 2 = move to position set in 2400:02 **0 =reset trigger after each move**
	2400	02	Set Position	Position 0-100% (increments of 1)
	2400	03	Calibration Trigger	Standard Calibration: 1 = trigger (must be reset to 0 after each trigger in standard calibration) Auto Calibration: 1 = start (with Calibration Mode already set to 1) 999 = exit & don't save **0 = reset trigger after setting 1 or 999**
	2400	04	Calibration Select	Select calibration storage options 0-3 (4 possible calibrations)
	2400	05	Sensitivity	default = 0 more sensitive = -x less sensitive = x typical x values = 5, 10, 20
	2400	06	Calibration Mode	0 = standard calibration procedure (good for bin picking, etc) 1 = auto calibrate
Outputs	2500	01	Magnet Position	0-100% (<=2 is considered 0)
	2500	02	Magnet State	0 = OFF 1= Partial ON 2 = Magnet ON 100% (Fail-Safe)
	2500	03	Calibration State	0 = no South Pole, no North Pole, and no part present in range 1 = only North pole on 2 = only South Pole on 3 = both poles on, but no part present 4 = North, South, part present all within Range
	2500	04	In Calibration	0 = not in Calibration 1 = In Standard Calibration 2 = In Auto Calibration
	2500	05	Calibration Step	0 = not in calibration 1 = waiting for best circuit 2 = waiting for worst circuit 3 = waiting for South Pole 4 = waiting for North pole
	2500	06	Cycle Count	Number of times the tool has been turned on to full power
	2500	07	Home Status	0 = not properly homed 1= Properly homed
	2500	08	Move Status	0 = not complete 1 = Last set move complete
	2500	09	Serial Number	Magswitch Tool Serial Number
	2500	0A	Magnet Software Version	Magswitch Software Version
	2500	0B	Tool Type	30 for E30, 50 for E50
	2005		CANopen Baud Rate	$85_h = 133_d = 250$ kBaud by default. Consult configuration manual 1101334 before changing
	2009		CANopen Node ID	Refer to Pg.5: Step 2a and 2b for more details on NodeID range $E_h = 14_d$ by default

4-Step Calibration Procedure   See setup manual 1101340 for more detail.

Step 1
Limiting Position 1 for Calibration Match Signal
Step 2
Limiting Position 2 for Calibration Match Signal
Step 3
South Pole Position for South Pole Signal
Step 4
North Pole Position for North Pole Signal

Object **CalState (2500:03$_h$)** will return 4 when the contact quality between both poles and the part lie within the zone created by bounding Limiting Position 1, Limiting Position 2, and North and South Pole calibration signals.

Object **CalState (2500:03$_h$)** will return 2, 3, or 4 if contact quality is equal to or better than the stored South Pole signal.

Object **CalState (2500:03$_h$)** will return 1, 3, or 4 if contact quality is equal to or better than the stored North Pole signal.

Limiting Position 1

Limiting Position 2

0.2mm air gap if applicable

Target Part

Target Part

North Pole Signal

South Pole Signal
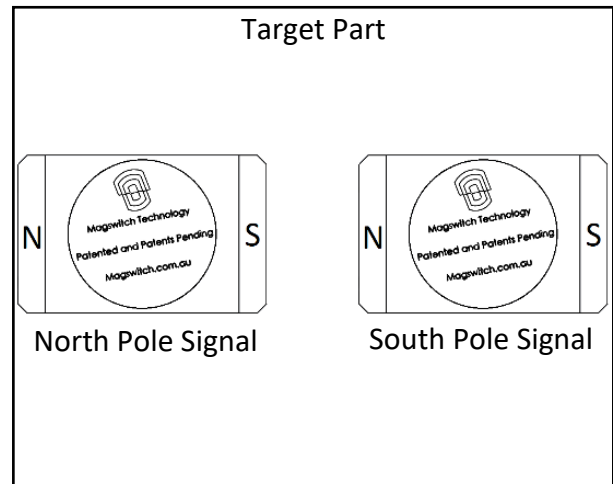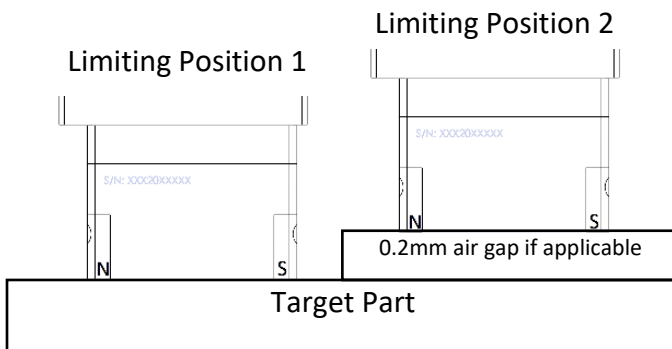
The following flowchart shows the proper CANopen signaling required to enter and set calibrations 0-4. Note that all "output" objects can be polled at any time to determine the current state of the calibration process.

It is critical that the magnet be fully actuated (setPosition / OutPos = 100) at each calibration step to guarantee proper field values are stored. **The tool will not allow you to confirm calibration steps 1 through 4 unless the magnet is ON and the green light is lit.**

The supplementary document 1101340 can be provided by Magswitch if additional information regarding calibration procedure is needed.

Auto-Calibration Procedure

Actuate tool OFF and enter auto-calibration mode by setting object 2400:04=1$_d$ and then writing 2400:03=1$_d$. Position the tool on the desired part. Once the tool is actuated ON and the green light is lit, the tool records magnetic field strengths in the current configuration and stores them as allowable Part Present boundaries. Add or adjust parts and fixtures to widen the allowable range of field strengths. By writing 2400:03=0$_d$, auto-calibration parameters are saved and standard operation resumes. Tool should NOT be actuated OFF until auto-calibration is exited and saved otherwise calibration values will be skewed. Tool should not be actuated off-target or calibration range will exceed practical usage and part present functionality will be inaccurate.

E-Series Operational Flowchart

Required actions in black
Optional actions in yellow

power on

2400:01=1 → move home on command delay 5 seconds to finish homing procedure → Blue LED blinking / Green LED blinking

2500:07 → Properly homed? — N → returns 0 / returns 1 → Blue LED solid/ON

2400:01=0 → Reset MoveEnable — Y

Tool is Homed

Standby

2400:04=0-3 → Select calibration preset 0,1,2,3

2400:06=1 / 2400:03=1 → Auto-calibration Triggered?

2400:06=0 / 2400:03=1 → Calibration Triggered? — Y

2400:03=0 → Reset CalTrigger to 0 — N

2400:05 → Read Sensitivity → returns value

2400:05=value → Set Sensitivity

Actuation

2400:01=0 → Reset MoveEnable

2400:02=0-100 → Set Position 0-100%

2400:01=2 → Move to Position

2500:08 → Move Complete? — N → returns 0 / returns 1 — Y

2400:01=0 → Reset MoveEnable

2500:01 → Actuation Position → returns 0-100

2500:02 → Magnet State → returns 0,1,2

Y - magnet is OFF → magnet OFF → green light OFF — N

Y - magnet partially actuated → magnet partially actuated → green light blinking — N

magnet ON → green light solid — Y - magnet is ON

2500:03 → Calibration State → returns 0,1,2,3,4

2500:04 → Not In Calibration → returns 0

2500:06 → Cycle Count → returns count

2500:09 → Serial Number → returns SN

2500:0A → Software Version → returns version

2500:0B → E-series Tool Type → returns 30,50,70

Calibration Mode

2400:03=0 → Reset CalTrigger to 0

2500:05 → Verify in calibration mode → returns 1

Actuation allowable

STEP 1
Position magnet on best part configuration:
- best surface contact
- least air gap (no coatings)
- most ferromagnetic material

2400:03=1 / 1 second min → Set "best circuit" calibration

2400:03=0 → Reset CalTrigger to 0

Actuation allowable

STEP 2
Position magnet on worst part configuration:
- rough surface contact
- max air gap (coatings)
- least ferromagnetic material

2400:03=1 / 1 second min → Set "worst circuit" calibration

2400:03=0 → Reset CalTrigger to 0

Actuation allowable

STEP 3
Position south pole with worst allowable part contact. e.g. south pole should be closest to the edge of the part or have the greatest south pole air gap.

2400:03=1 / 1 second min → Set south pole calibration

2400:03=0 → Reset CalTrigger to 0

Actuation allowable

STEP 4
Position north pole with worst allowable part contact. e.g north pole should be closest to the edge of the part or have the greatest north pole air gap.

2400:03=1 / 1 second min → Set north pole calibration

2400:03=0 → Reset CalTrigger to 0

Calibration complete

2400:03=999 → Exit calibration without saving

2500:04 → Verify in calibration mode → returns 1

blue light flashes when calibration steps are set

Calibration steps 1-4 MUST be completed when magnet state is ON. MagState 2500:02 must be equal to 2.

Auto-Calibration Mode

2500:04 → Verify in auto-calibration → returns 2

(Actuation Allowable) → POSITION TOOL ON PART BEFORE TURNING MAGNET ON

Magnet ON? — N — Y

Tool records magnetic flux profile while magnet is turned ON.

Make all necessary part additions while magnet is ON.

DO NOT TURN OFF MAGNET UNTIL AUTO-CALIBRATION MODE IS EXITED.

2400:03=0 → Reset CalTrigger to 0 Save and exit auto-calibration

2400:03=999 → Exit calibration without saving

blue light flashes when auto-calibrate mode is entered and exited