



W4005V46-SYSx /B (BÜHLER) Elevator Monitoring System OPERATION MANUAL



INSTALLATION INSTRUCTIONS

**MODELS: W4005V46-SYS1 /B
W4005V46-SYS2 /B
Hardware Version: R2
Software Versions - Main Processor: 1.2.0**

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1. Abbreviations and Notations Used

Abbreviation	Meaning
SUD	Start Up Delay
HBS	Hot Bearing Temperature Sensor
ETH	Ethernet
NTC	Negative Temperature Coefficient – temperature bead type
PPM	Pulses per Minute (Speed)
RPM	Revolutions per Minute (Speed)
BYTE	8-bit wide variable
WORD	16-bit wide variable

Table 1 – Document Abbreviations

2. Warnings



DANGER: EXPOSED BUCKETS AND MOVING PARTS WILL CAUSE SERIOUS INJURY OR DEATH. THE OPERATOR MUST ALWAYS LOCKOUT POWER BEFORE REMOVING COVER OF THE INSPECTION DOOR OF THE ELEVATOR OR PERFORMING ANY INSTALLATION OR MAINTENANCE WORK.

DANGER: ALL ELECTRICAL POWER TO THE SYSTEM AND WIRING MUST BE ISOLATED PRIOR TO STARTING ANY INSTALLATION OR MAINTENANCE WORK. WORKING ON OPEN LIVE CIRCUITS IN ATEX ZONES IS PROHIBITED AND CAN LEAD TO AN EXPLOSION.

3. System Introduction

The W4005V46-SYSx /B is a fully automated elevator dust explosion hazard prevention system. All the major elevator explosion hazard conditions are constantly monitored and the elevator is stopped when it is unsafe to carry on the operation. No PLC or other control intervention is needed to provide the safety of operation.

4. System Approvals and Compliance

Approvals information may change due to the standards changing from time to time and due to 4B constantly expanding the portfolio of international certifications that the system components are approved to. The information given below is correct at the time of release of this manual it may become out of date from time to time though. Please refer to an approvals information addendum sheet (if one has been included in this manual) for the latest information.

4.1 W4005V46-SYS1 /B Declaration of Conformity

**DECLARATION
OF CONFORMITY**



I, the undersigned, on behalf of Don Electronics Limited, hereby declare that the Assembly listed below conforms to the relevant provisions of the **94/9/EC ATEX (Atmosphères Explosibles) Directive, 2006/42/EC Machinery Directive** and other normative documents mentioned herein.

ASSEMBLY: **W4005V46-SYS1**

TYPE OF PRODUCT: **SENSOR MONITORING SYSTEM**

INTENDED USE: **ELEVATOR MONITORING**

DIRECTIVE: **94/9/EC ATEX and 2006/42/EC Machinery (Article 12, 3 (a))**

W4005V46-SYS1 SYSTEM

Qty	Equipment Code	Equipment Description	Manufactured By	Certificate No's
1	W4005NV46AI	W400 Elite 24V Controller	Don Electronics Ltd	IECEX BAS11.0018X / Baseefa11ATEX0033X
4	TS1V4AI	Cable Entry Touchswitch 24V	Don Electronics Ltd	IECEX BAS13.0116X / Baseefa14ATEX0015X
1	P300V34AI	P300 30mm Sensor	Synatel Ltd	IECEX BAS 12.0118X / Baseefa12ATEX0226X
1	WG4A-BR	Whirligig Pulse Generator	Synatel Ltd	Baseefa03ATEX0676

We declare that we have followed the ATEX Guidelines on the Application of Directive 94/9/EC concerning equipment and protective systems intended for use in potentially explosive atmospheres (4th Edition). As per section 3.7.5 (Assemblies) of the above guidelines, we declare that we have carried out an ignition risk assessment of this system and state that this assembly has not altered the explosion characteristics of the products with respect to the Essential Health & Safety requirements of the above Directive.

Name: David Wheat
 Position: Managing Director
 Date: 17th April 2014

Don Electronics Ltd
 Westfield Industrial Estate
 Kirk Lane, Yeadon LS19 7LX,
 United Kingdom

4.2 W4005V46-SYS2 /B Declaration of Conformity

**DECLARATION
OF CONFORMITY**



I, the undersigned, on behalf of Don Electronics Limited, hereby declare that the Assembly listed below conforms to the relevant provisions of the **94/9/EC ATEX (Atmosphères Explosibles) Directive, 2006/42/EC Machinery Directive** and other normative documents mentioned herein.

ASSEMBLY: **W4005V46-SYS2**

TYPE OF PRODUCT: **SENSOR MONITORING SYSTEM**

INTENDED USE: **ELEVATOR MONITORING**

DIRECTIVE: **94/9/EC ATEX and 2006/42/EC Machinery (Article 12, 3 (a))**

W4005V46-SYS2 SYSTEM

Qty	Equipment Code	Equipment Description	Manufactured By	Certificate No's
1	W4005NV46AI	W400 Elite 24V Controller	Don Electronics Ltd	IECEX BAS11.0018X / Baseefa11ATEX0033X
4	TS1V4AI	Cable Entry Touchswitch 24V	Don Electronics Ltd	IECEX BAS13.0116X / Baseefa14ATEX0015X
4	ADB910V3AI	100mm Adjustable NTC Bearing Sensor	Don Electronics Ltd	IECEX BAS 09.0111X / Baseefa09ATEX0231X
1	P300V34AI	P300 30mm Sensor	Synatel Ltd	IECEX BAS 12.0118X / Baseefa12ATEX0226X
1	WG4A-BR	Whirligig Pulse Generator	Synatel Ltd	Baseefa03ATEX0676

We declare that we have followed the ATEX Guidelines on the Application of Directive 94/9/EC concerning equipment and protective systems intended for use in potentially explosive atmospheres (4th Edition). As per section 3.7.5 (Assemblies) of the above guidelines, we declare that we have carried out an ignition risk assessment of this system and state that this assembly has not altered the explosion characteristics of the products with respect to the Essential Health & Safety requirements of the above Directive.

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5. Transportation

The system is securely packaged in a specially designed carton box with custom inserts. Nevertheless care must be taken during the transportation of the system as the carton contains sensitive electronic components. If any mechanical or water damage is noticed the electronics inside the box should not be used and the end user must contact the seller immediately to arrange for a replacement.

6. System Components

System Component	Qty	Description
W4005NV46AI /B	1	W400 Series Elevator Controller
TS1V4AI /B	4	TouchSwitch Belt Alignment Sensor
P300V34AI /B	1	Speed Sensor
WG4A-BR /B	1	Whirligig Speed Sensor Mount
ADB910V3AI /B *	4*	Adjustable Depth Bearing Temperature Sensor

Table 2 - System Components

* NB! This item is only included in the W4005V46-SYS2 /B system model. These can be added at a later date, please contact your local 4B representative.

6.3 System Components Introduction

6.3.1. W4005NV46AI /B – W400 Series Elevator Controller

The W4005NV46AI /B is a standalone controller unit which operates by reading up-to: four NTC Temperature inputs, two Misalignment Zones (possible to add more than two sensors, see Belt Alignment Sensor section). It can operate in a single speed mode or with two speed inputs, i.e. differential speed mode. It also has a Motor Interlock input. When the motor interlock signal is applied to the W4005NV46AI /B, it monitors all its sensor inputs for any fault conditions and can act on alarms to cause an alarm and shutdown of the elevator/conveyor when any of the fault conditions are detected. The unit is fitted with MUTE and TEST buttons. The unit is equipped with an Ethernet port and supports ProfiNet protocol for easy integration with the Siemens PLCs. Ethernet /IP and Hazardmon.com connectivity will become available via a future software update.

6.3.2. TS1V4AI /B – Touchswitch™ Alignment Sensor

The Touchswitch™ is an electronic limit switch with no moving parts. When a belt misaligns or a pulley moves over and contacts the sensor, the built in solid-state electronic circuitry detects the lateral force of the belt or pulley and activates a voltage free relay contact. This relay contact is used to immediately generate an alarm. The face of the sensor is made from hardened stainless steel, so that there is virtually no wear when a belt contacts it. The sensor is not affected by dust or material build up and will still work when completely covered by material. Four sensors are provided in the kit and are expected to be installed in pair – two sensors near the top and two near the bottom pulleys.

6.3.3. P300V34AI /B – Proximity Speed Sensor

P300 is an inductive proximity sensor which is used to detect the speed of an elevator shaft. This sensor gives an opto-isolated pulsed transistor output, which the W4005NV46AI /B controller uses to calculate the current shaft speed. P300 sensor is designed to be mounted on to the shaft using the Whirligig mounting bracket (WG4A-BR /B).

6.3.4. WG4A-BR /B – Whirligig® Speed Sensor Mounting

The Whirligig® is a fully guarded target for easy mounting of motion sensors. It is a target, bracket and guard designed for the P300V34AI /B sensor included in the System. P300V34AI /B sensor is bolted to the Whirligig® and the complete assembly either bolts to the machines shaft through a M12 tapped hole, or is connected magnetically using 4B's patented Mag-Con™ adaptor (*not included in the System kit). Shaft or machine vibration does not affect the performance of the sensor, as the whole assembly moves with the shaft. With the Whirligig, installation of speed sensors is simple, safe and reliable.

6.3.5. ADB910V3AI /B * - Adjustable Depth Bearing Temperature Sensor

The ADB910V3AI /B bearing sensors are manufactured to screw directly into a bearing housing. Each sensor is fitted with a grease nipple to allow lubrication of the bearing without the need for removal of the sensor. The sensor is fitted with a mechanism to allow the temperature probe to set at variable depth to suit your application. The temperature bead is of NTC (Negative Temperature Coefficient) response type. The ADB910V3AI /B sensor cable has two cores. The connections are not polarity sensitive therefore special connection requirements are eliminated. It is advisable however to connect all sensors in an identical manner, this will reduce the risk of shorting.

7. Specifications

7.1 Overall Packaging

Overall Packaging Dimensions

Dimensions	640mm x 430mm x 220mm (L x W x H)
Weight	7.2kg

Table 3 - System Packaging Dimensions

7.2 Airborne Noise

This system is electronic with no major moving parts. The airborne noise of the system is below 70dB(A). When a siren is connected to the alarm relay, it is up to the end user to make sure that the noise levels of the selected siren comply with the Machinery Directive.

7.3 W4005NV46AI /B – W400 Series Elevator Controller

Controller Specifications	
Supply Voltage:	24V _{DC} OR 100-240V _{AC} ±10% 50/60Hz
Power Dissipation:	25W Max
Alarm Relay Contacts:	1 Pole normally open 8A@ 250VAC AC1
Stop Relay Contacts:	Guided Relay Category B, 1 Pole normally open 8A@ 250VAC AC1
Sensor Supply:	24VDC; Current 800mA maximum (combined over F1 and F2)
Interlock Input:	24V _{DC}
Power Terminals:	4mm ² 14 AWG max
Signal Terminals:	2.5mm ² 16 AWG max
Protection:	IP66
Height:	246mm (9.7")
Width:	188mm (7.4")
Depth:	102mm (4")
Fixing Centres:	222mm x 102mm (8.75" x 4") (AutoCAD Drawing available)
Cable Entry:	2 x M25 DIA Holes
Weight:	1.3kg (3lbs)

Table 4 – W4005NV46AI /B Controller Specifications

7.3.1. W4005NV46AI /B Controller Fuses

The W400 series controller has three replaceable fuses. Please use the information below when ordering new fuses.

Fuse Reference	Fuse Value	Fuse Type	4B Part Number
F1, F2, F6	2A; 250V	TR5,Time Delay	FUSE-ELITE-2
F5	200mA	TR5,Time Delay	FUSE-ELITE-200

Table 5 – W4005NV46AI /B Fuse Ratings

7.4 TS1V4AI /B – Touchswitch™ Alignment Sensor

TouchSwitch Specifications	
Supply Voltage:	24V _{DC} (TS1V4AI)
Power Consumption:	50mA
Indication:	Red LED indicates when powered up and relay is energized.
Adjustment:	Force Sensitivity is factory set to 3.6 Kg (8 lb) approx.
Output:	Voltage free changeover relay contact rated at 5A 250vac; Non-inductive.
Body Construction:	Pressed seamless steel, powder coated.
Face Construction:	Hardened stainless steel.
Cable Length:	3 meters (9ft)
Conductors:	6 core; 22AWG
Weight:	1.36 Kg (3 lb)
Protection:	IP 66
Dimensions:	86mm (3.5") Diameter x 44mm (1.75") Deep (AutoCAD Drawing Available)

Table 6 - TS1V4AI /B Specifications

7.5 P300V34AI /B – Proximity Speed Sensor

P300 Specifications

Supply Voltage:	10-30V _{DC}
Sensor Output Type:	Opto-Isolated Transistor (NPN or PNP use)
Sensor Output Ratings:	100mA @ 30V _{DC} MAX
Maximum Detectable Speed:	200Hz (3000 RPM shaft speed with WG4A-BR mount)
Cable Length:	3m
Conductors:	4 core; 22AWG
Detection Range:	12mm
Protection:	IP65
Dimensions:	30mm Diameter x 92mm Long (AutoCAD Drawing Available)
Weight:	0.2kg

Table 7 - P300V34AI /B Specifications

7.6 WG4A-BR /B – Whirligig® Speed Sensor Mounting

Whirligig Specifications

Shaft Material:	Stainless Steel
Body Material:	Polypropylene
Bearing Type:	Sealed Stainless Steel
Mounting Thread Size:	M12
Maximum Speed:	1500 RPM
Number of Targets:	4
Protection:	IP40
Dimensions:	AutoCAD drawing available
Weight:	0.25kg

Table 8 - WG4A-BR /B Specifications

7.7 ADB910V3AI /B - Adjustable Depth Bearing Temperature Sensor

ADB910 Specifications

Thermistor Type:	NTC
Response Curve:	Exponential (Please contact 4B for more details)
Conductors:	2 Core + Shield; 22AWG; Polarity Independent
Probe length:	100mm
Body Mounting Thread:	1/8" Rc (BSPT)
Dimensions:	AutoCAD drawing available
Protection:	IP65
Weight:	0.25kg

Table 9 - ADB910V3AI /B Specifications

8. Mechanical Installation

DANGER: EXPOSED BUCKETS AND MOVING PARTS WILL CAUSE SERIOUS INJURY OR DEATH. THE OPERATOR MUST ALWAYS LOCKOUT POWER BEFORE REMOVING COVER OF THE INSPECTION DOOR OF THE ELEVATOR OR PERFORMING ANY INSTALLATION OR MAINTENANCE WORK.

8.1 TS1V4AI /B – Touchswitch™ Alignment Sensor

The Touchswitch™ hole should be cut into the housing with a 55mm diameter hole saw (Figure 2), centered on the edge of the belt. The hole should be cleaned and de-burred to avoid the Touchswitch™ puck binding and giving false misalignment alarms. You can mount the Touchswitch™ with 2 of the 4 flange holes, provided they are diagonal from one another (Figure 1). The enclosed flange shims can be used as a template to properly place the flange holes. The Touchswitch™ needs to be mounted on a flat surface, preferably with the cable entrance between the 3 to 9 o'clock.



Figure 2 – TouchSwitch Mounting Hole Drill



Figure 1 – TouchSwitch Mounting Hole

The Touchswitch™ can be mounted using one of the following three methods:

- Drill and tap the machine casing for M6 threaded bolts. Make sure that the bolts used to secure the Touchswitch™ are short enough that they do not interfere with the operation of the machine
- Use threaded rivet nuts for M6 threads. The length of the rivet nut will depend on the thickness of the machine's casing. Make sure that the bolts used to secure the Touchswitch™ are short enough that they do not interfere with the operation of the machine
- CD weld M6 x 30mm threaded welding studs to the machine casing

When placing flange shims on Touchswitch™ make certain belt and or pulley contacts the Touchswitch™ face before it can contact any internal surface of leg or conveyor housing. It is best not to be any further away from the pulley than 30mm to 40mm to the face of the Touchswitch™.

When mounting on the head section of an elevator try to catch the belt and the pulley. On an elevator, mount the Touchswitch™ above the center line of the head shaft on the discharge side of the pulley when possible. Sometimes this is not possible due to an inspection door or other obstruction. In this case, the Touchswitch™ can be mounted on the top or up side of the head pulley. Try to mount Touchswitches so they are accessible from the head section walkway. Be sure to mount Touchswitches straight across from one another. For typical mounting positions on a bucket elevator, see Figure 4, Figure 5 and Figure 6.

On an elevator boot, mount the Touchswitch™ on the up side of the tail pulley if there are no obstructions. If obstructions are encountered, use the down side of the pulley, but be sure to have the Touchswitches mounted directly across from one another. Mount the Touchswitch™ above the center line of the boot shaft at the shaft's highest possible position (Figure 6).

8.1.1. TouchSwitch Dimensions

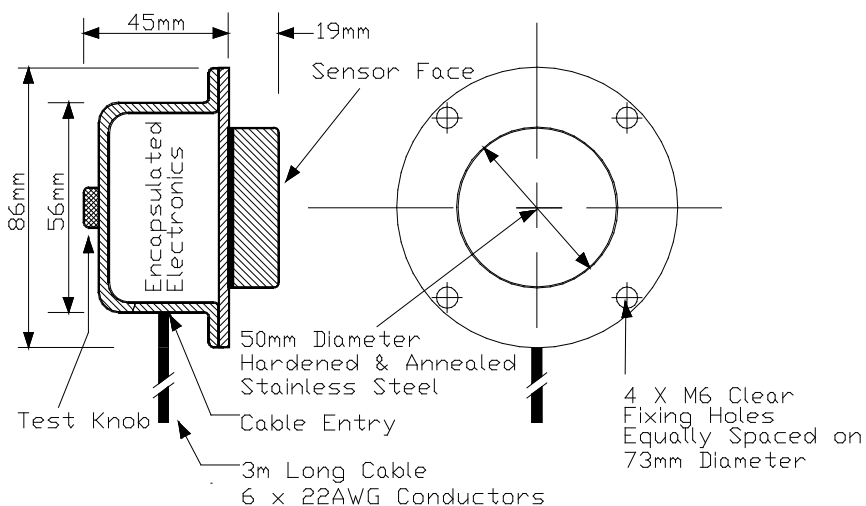
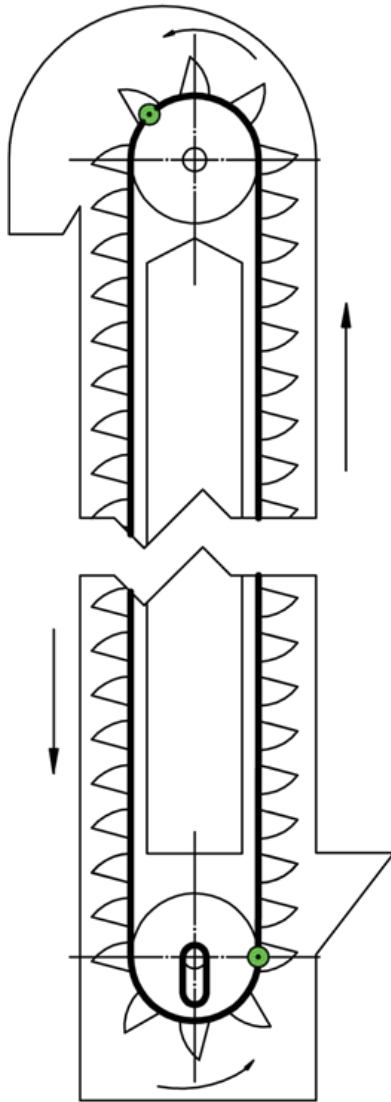


Figure 3 – TouchSwitch Mechanical Dimensions

8.1.2. TouchSwitch Mounting Diagrams

8.1.2.1. Determining LEFT and RIGHT side of Bucket elevator

VIEW OF LEFT SIDE



VIEW OF RIGHT SIDE

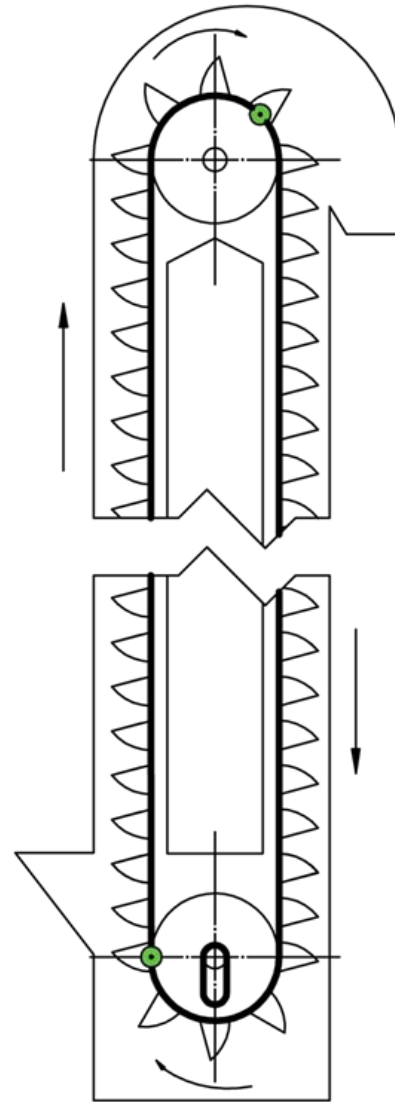


Figure 4 – TouchSwitch Mounting Positions – Elevator Left and Right

Note: left and right sides are determined when facing the direction that the bucket elevator discharges. Touchswitch™ placement on the left side will mirror the right side.

8.1.2.2. Typical Mounting Positions on a Bucket Elevator

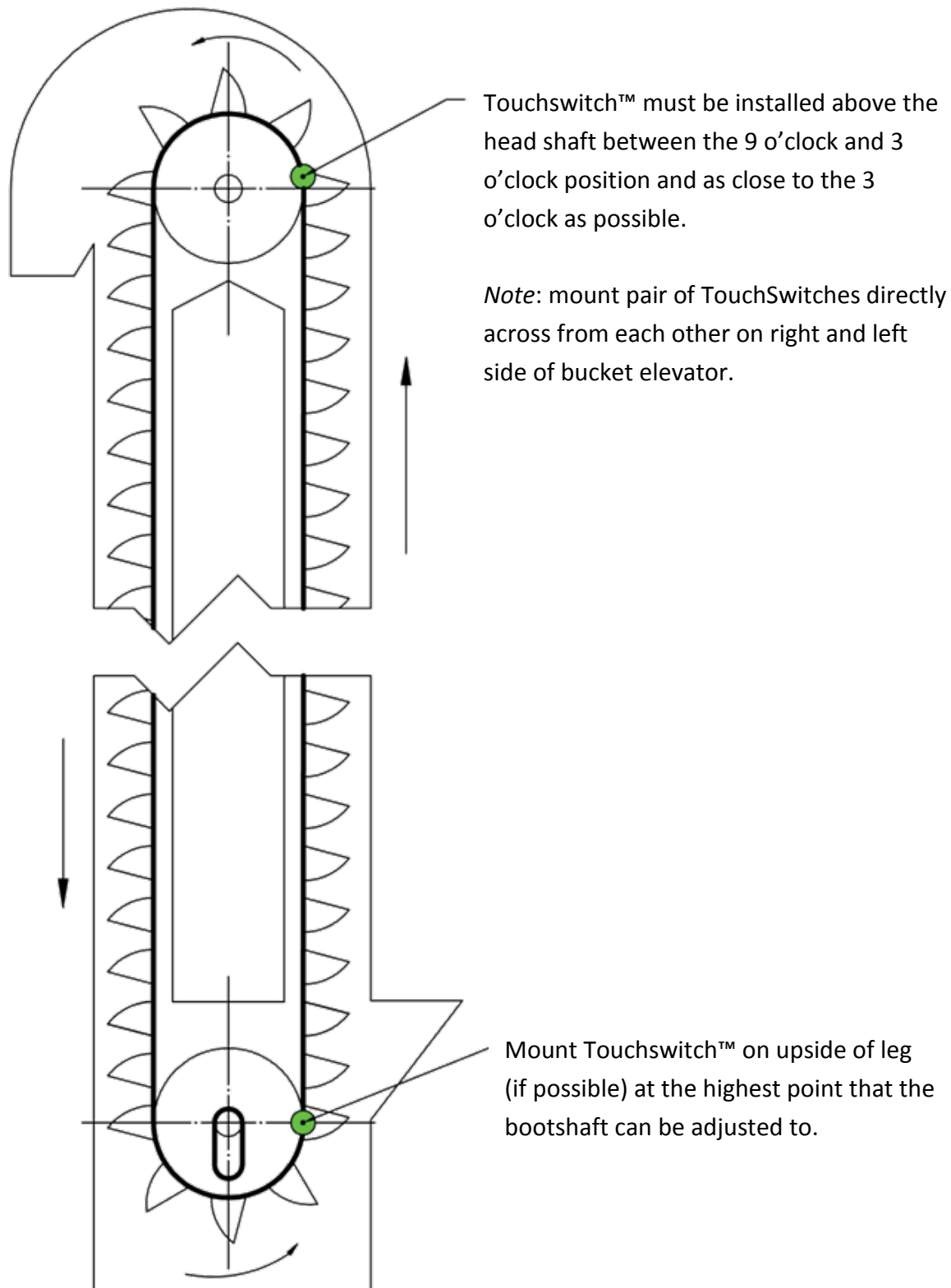


Figure 5 – Touchswitch Mounting Positions – Elevator Leg

8.1.2.3. Typical Mounting Positions On Tail/Boot Section Of Bucket Elevator

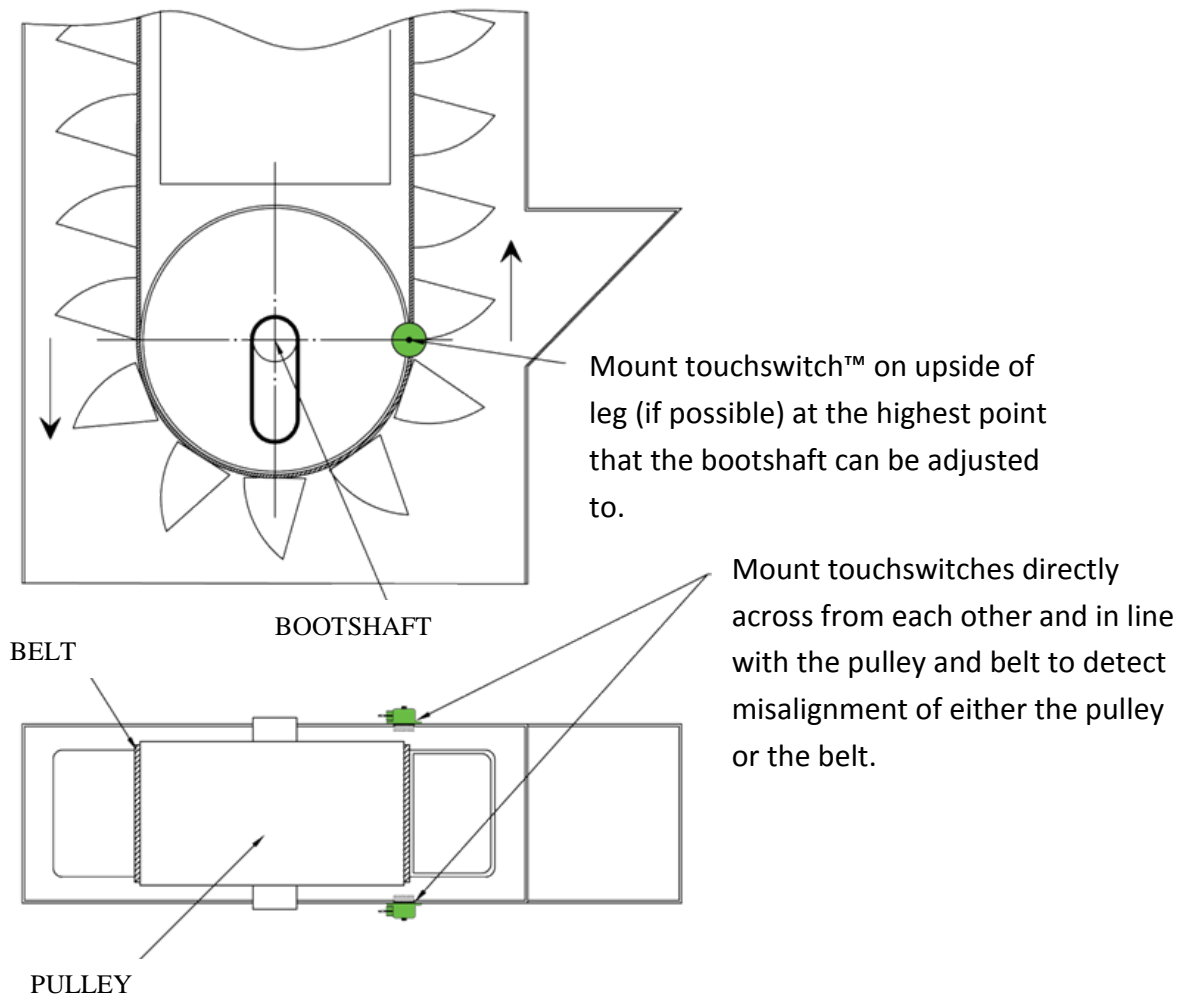


Figure 6 – Touchswitch Mounting Position – Bottom Pulley

8.2 WG4A-BR /B and P300V34AI /B – Proximity Speed Sensor and Bracket Installation

- Install the sensor to the base plate; leave a 2 mm (approximate) gap between the sensor face and the target guard cover. Use the supplied universal bracket and screws to mount the P300 sensor
- There are two options to attach the Whirligig® to the machine's shaft:
 - Option 1 - Drill and tap the center of the machine shaft for M12 x 15mm deep thread. Thread the Whirligig® onto the machine shaft with a M16 open ended spanner using suitable thread locking adhesive (Loctite or similar)
 - Option 2 - Use Mag-Con™ magnetic connector. Thread the Mag-Con™ onto the Whirligig® using a suitable thread locking adhesive (Loctite or similar) and attach the unit onto the machine shaft
- Wire the sensor in accordance with the manufacturer's instructions while observing all relevant electrical regulations and according to IEC 60079-14, IEC 60079-10
- Fix the white flexible strap to a solid structure
- Please refer to Figure 7 for an illustration of the installation process



Figure 7 – P300 and Whirligig Mounting Bracket Mechanical Installation

IMPORTANT: DO NOT REMOVE THE WHIRLIGIG® TARGET GUARD COVER. THE ROTATING COMPONENTS UNDER THE COVER COULD CAUSE SERIOUS INJURY.

8.3 ADB910V3AI/B - Adjustable Depth Bearing Temperature Sensor

- a) Remove the existing grease nipple from the bearing sensor
- b) Drill out and tap to 1/8"Rp (BSPT) x 6mm deep
- c) Slacken the olive nut and remove the sensor probe
- d) Screw the sensor body in to the new tapped hole in the bearing housing
- e) Re-insert the temperature probe in to the olive nut adjusting the depth to suit the bearing depth
- f) Tighten the olive nut using an appropriate spanner
- g) The maximum recommended torque for the olive nut is 2N-m (18 lb-in). Please do not exceed.

8.4 W4005NV46AI /B – W400 Series Elevator Controller

8.4.1. W4005NV46AI /B Enclosure Installation

- a. The IP66 rating of the enclosure must be maintained. You must use the correct cable, glands and sealing arrangement and in accordance with the installation codes detailed in EN 60079.
- b. Where other certified components are used as part of the assembly or installation procedure, the user must take in to account any limitations which might be listed on the relevant certificates.
- c. The box is supplied with 2 x M25 pre drilled holes in the bottom face. All unused entry apertures must be sealed using component certified stopping plugs as specified in EN 60079-14. The end user must install component or apparatus certified stopping plugs and cable glands in strict accordance with the manufacturer's instructions.
- d. All wiring must be carried out in accordance with relevant codes of practice and/or instructions (IEC 60079-14, IEC 60079-10).
- e. The electronics inside the enclosure should not be modified. No new components can be added. The W4005NV46AI /B is approved only with the electronics supplied by the manufacturer. Any modifications will void the approvals and warranty.
- f. Bare wires must not extend beyond 1mm of the metal face of the terminals.
- g. All wires must be insulated and rated for the appropriate voltage.
- h. Not more than one cable with a maximum cross section as detailed in Table 4 – W4005NV46AI /B Controller Specifications is to be connected to any terminal unless multiple conductors have previously been joined in a suitable manner (e.g. boot lace ferrule) such that they present a single connection point to the terminal.
- i. A parallel shaft screwdriver of the correct size should always be used when tightening terminals. Maximum torque is 0.51 N-m.

9. Electrical Installation and Wiring

DANGER: ALL ELECTRICAL POWER TO THE SYSTEM AND WIRING MUST BE ISOLATED PRIOR TO STARTING ANY INSTALLATION OR MAINTENANCE WORK. WORKING ON OPEN LIVE CIRCUITS IN ATEX ZONES IS PROHIBITED AND CAN LEAD TO AN EXPLOSION.

9.5 Warnings

- **Shield the sensors' cabling and keep sensor wiring separate from high voltage cables if cable lengths of more than 10 meters are used**
- **Never run sensor cables in the same conduit as 3-phase motor cables**
- **Never weld near or around the supplied system components**
- **Track belts and commission plant prior to installing TouchSwitches**

All Wiring Must Be In Accordance With Local and National Electrical Codes and Should Be Undertaken By an Experienced and Professional, Qualified Electrician. In order to comply with the ATEX regulations, the installation design and process must also comply with the latest IEC 60079 range of standards.

9.6 TS1V4AI /B – Touchswitch™ Alignment Sensor

Mount a suitable junction box within 3m of the sensor and make the necessary wiring connections inside this junction box. A 3m long PVC coated cable connected to the sensor contains the following 22 AWG wires:

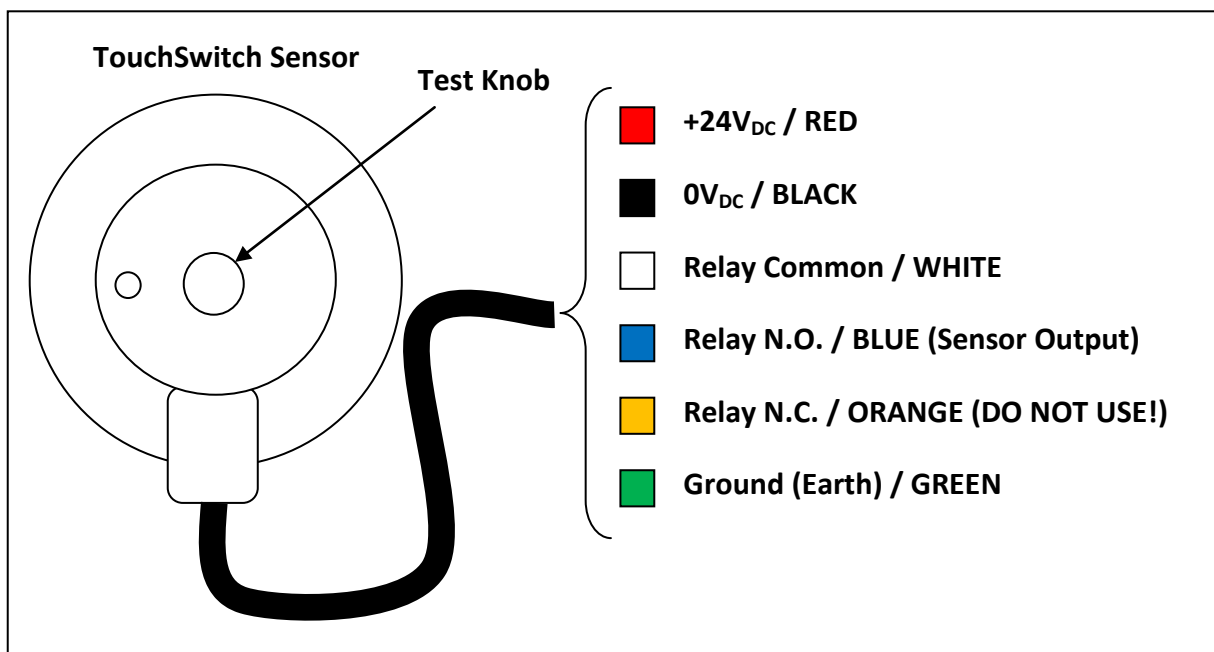


Figure 8 – TouchSwitch™ Electrical Connection

Wire Color	Function
Red	+24V _{DC}
Black	0V _{DC}
Green	Ground (Earth)
White	Relay Common Connection
Blue	Relay Contact, N.O. (Sensor Output to Controller or PLC)
Orange	Relay Contact, N.C. (DO NOT USE!) – Make sure this conductor is isolated

Table 10- TouchSwitch™ Electrical Sensor Wiring

9.6.1. Sensor Operation

This is an electronic limit switch. The sensor reacts to pressure applied to the sensor face. If the **pressure is higher than 3.6kg**, then the sensor switches the relay to an **alarm condition** (see Figure 10). If the sensor is correctly powered, working and no pressure is applied to the sensor face then the sensor will energise the relay and indicate the healthy state by a lit up LED (see Figure 9).

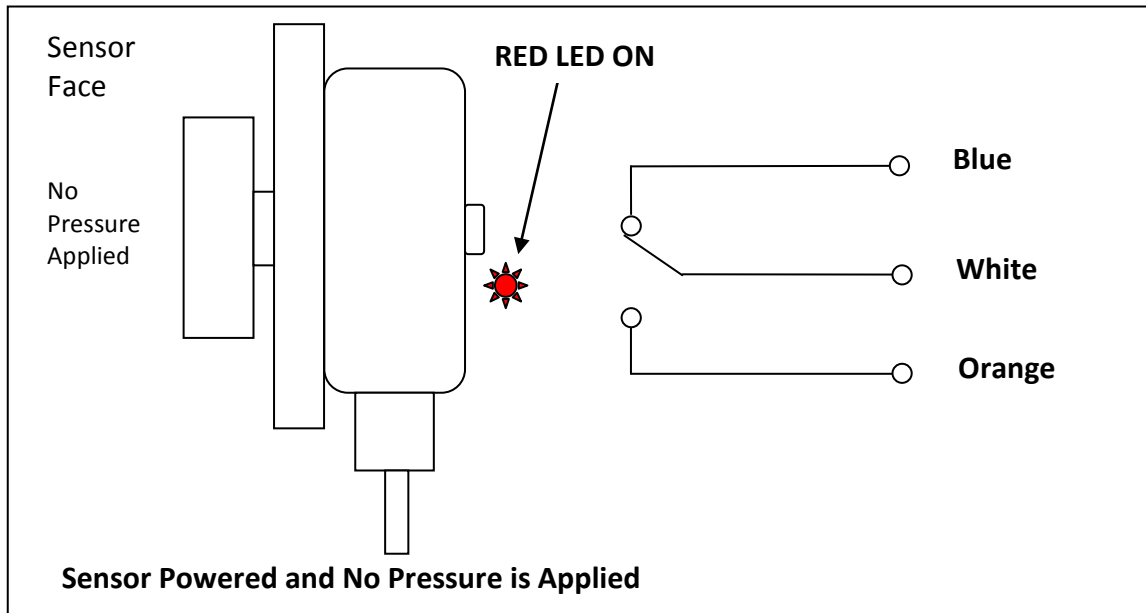


Figure 9 - TouchSwitch in Healthy Condition

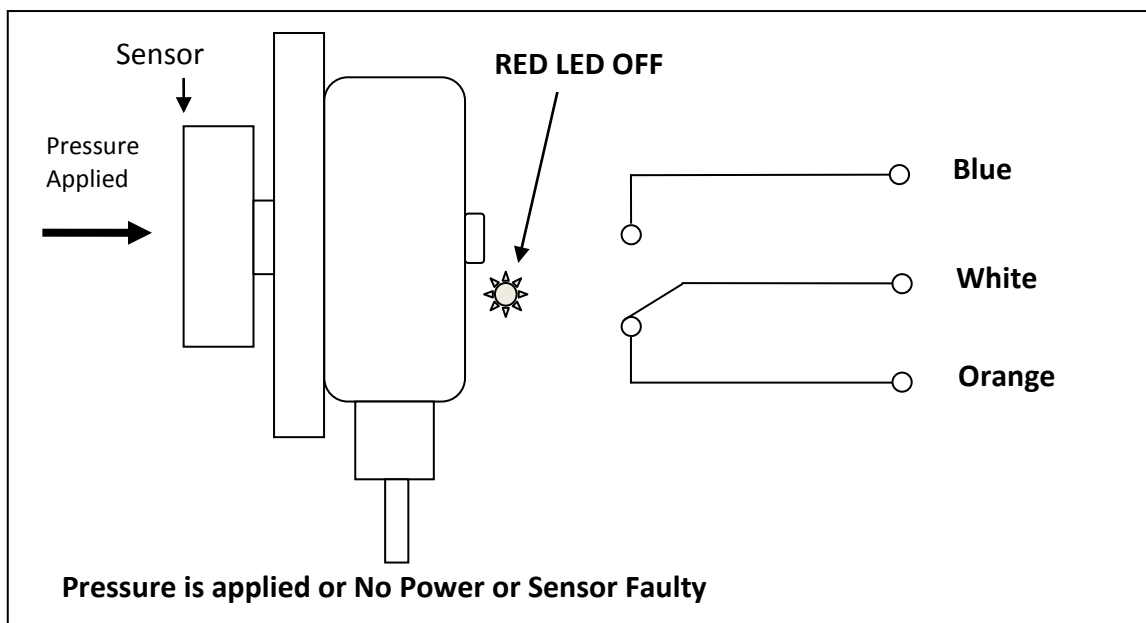


Figure 10 - TouchSwitch in Alarm Condition

NOTE: TouchSwitch™ is delivered factory pre-calibrated and no sensitivity adjustment is possible. The sensor is calibrated to switch to the alarm state when pressure exceeds 3.6kg. Should you require adjusting this value, please contact your 4B Representative for more information.

9.6.2. Testing and Commissioning

TouchSwitch™ has a unique self-test feature which allows verifying that the system wiring is correct without the need of removing the sensor. The system has an active self-checking mechanism between the sensors and the controller; however 4B would still recommend checking if the Stop signal from the W4005NV46AI /B controller shuts down the elevator and that the Alarm relay signal is visible to the operators at least annually. The test procedure is given below.

- 1) Observe that the red output LED on the sensor housing (see Figure 9) is ON and the belt or pulley are not touching the sensor
- 2) Slowly turn the test knob (see Figure 8) clockwise by hand, until the LED goes OFF
- 3) Check that the alarms and shutdowns of the overall system work as expected (see Figure 10)
- 4) Once completely satisfied that the system can be stopped and that the alarm is processed correctly turn the test knob back to its original position (about 1 turn) and make sure that it is loose
- 5) Observe that the LED is now ON

9.6.3. TouchSwitch Electrical Wiring

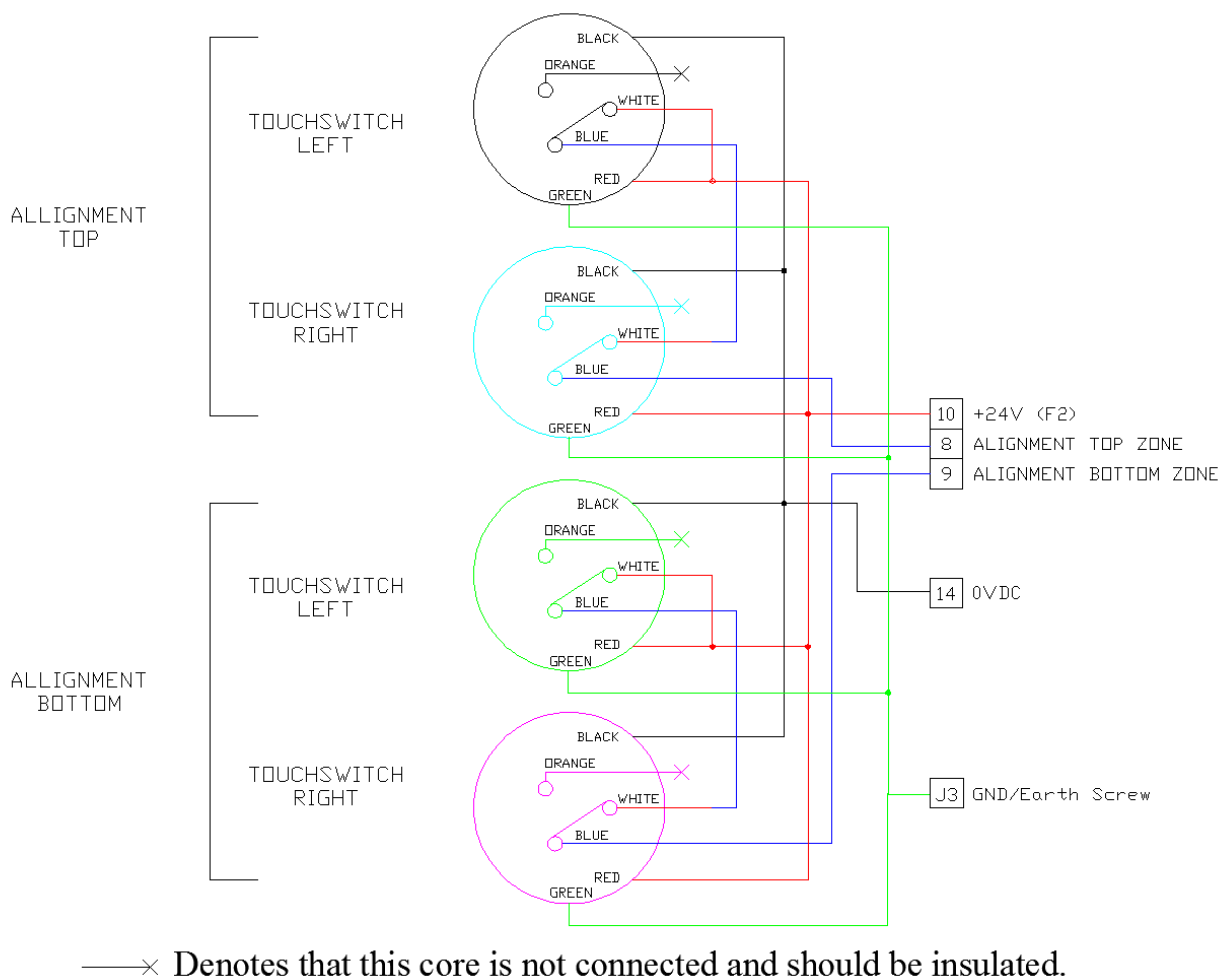


Figure 11- TouchSwitch Wiring Diagram

9.7 P300V34AI /B – Proximity Speed Sensor

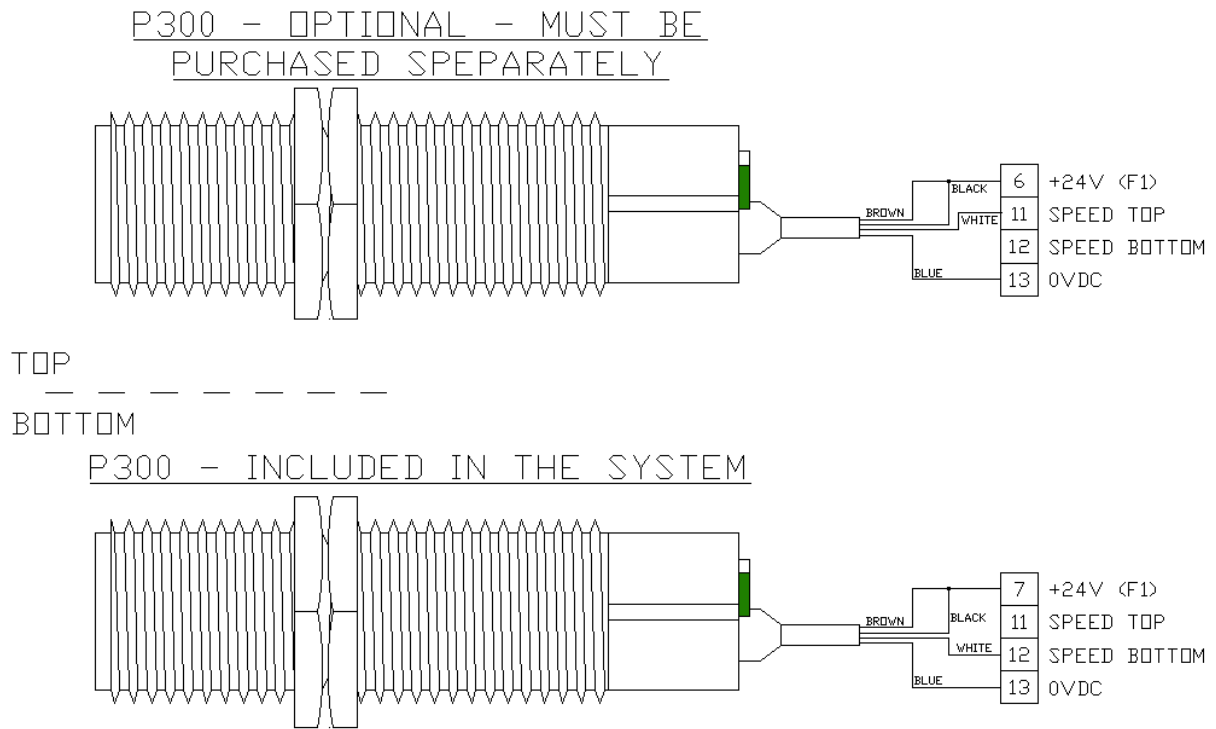


Figure 12 - Speed Sensor Wiring Diagram

9.8 ADB910V3AI /B - Adjustable Depth Bearing Temperature Sensor

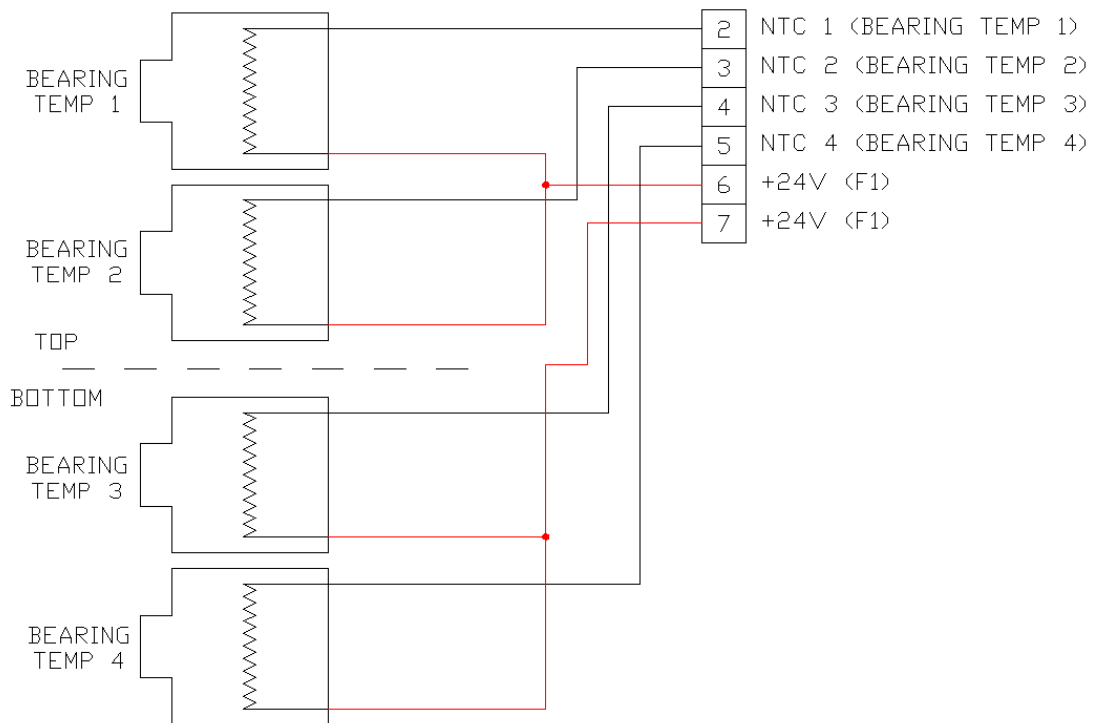


Figure 13 - HBS Wiring Diagram

9.9 W4005NV46AI /B – W400 Elevator Controller

9.9.1. Overall System Wiring Schematics

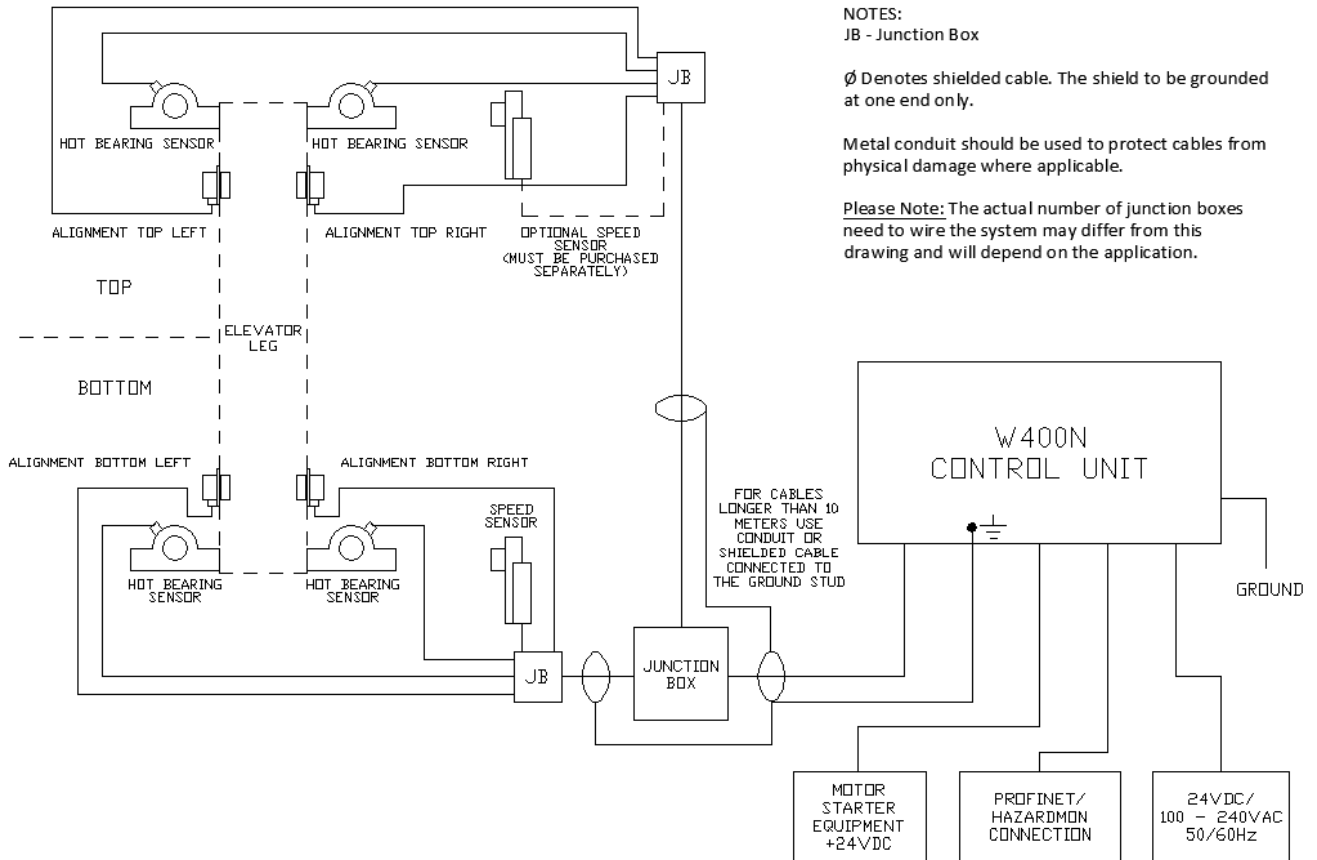


Figure 14 – Overall System Wiring Diagram

9.9.2. Motor Interlock and Start / Stop Circuit Wiring Diagram

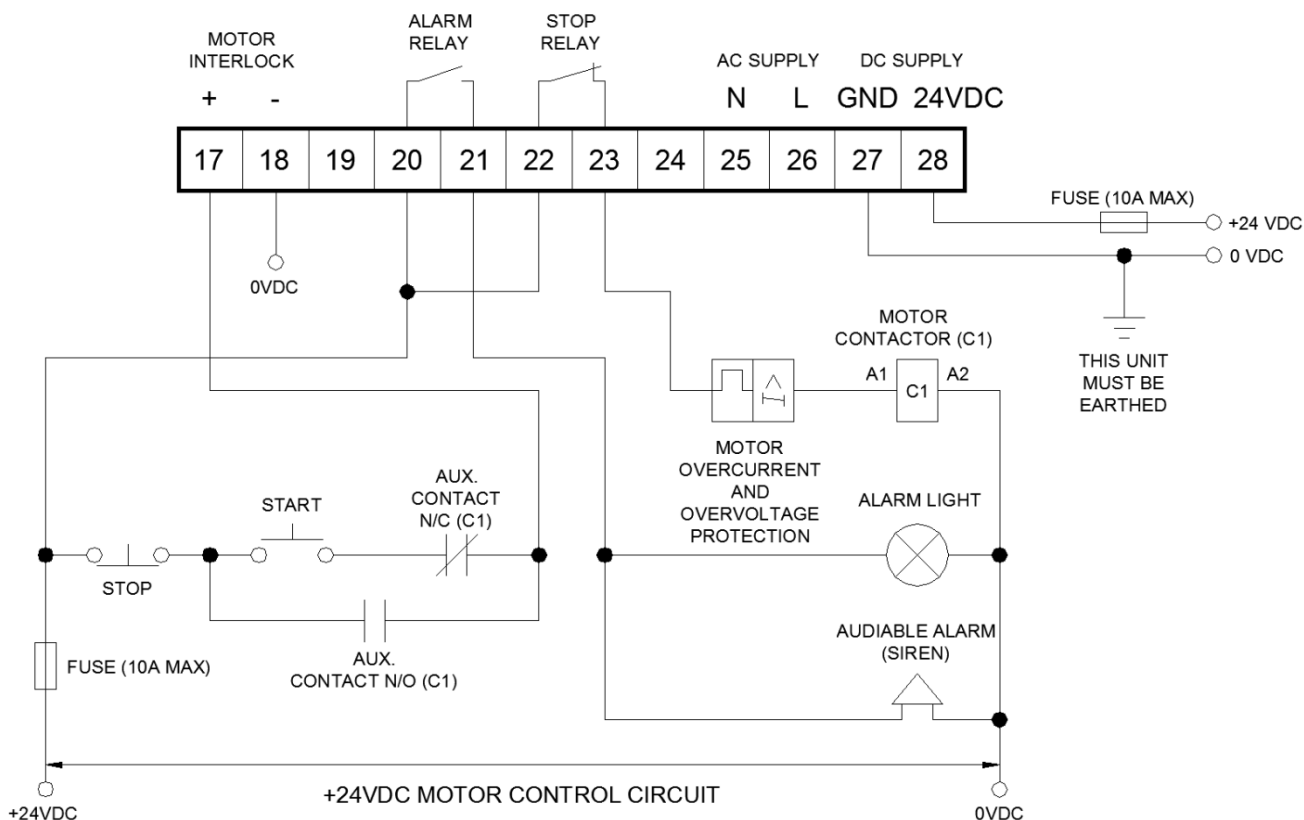


Figure 15 - Motor Interlock and Start / Stop circuit wiring; 24VDC power supply

Warning: Interlock signal across pins 17 and 18 must be 24Vdc only! Mains AC voltage will damage this circuit and should not be used!

Note: Please see section 7.3 - W4005NV46AI /B – W400 Series Elevator Controller for information on the relays Voltage and Current ratings.

Note: Alarm and Stop relays are shown in normal machine running states.

Please contact 4B for additional wiring diagrams.

10. W4005NV46AI /B Controller Operation Description

10.10 Overall Operation Description

The W4005NV46AI /B controller provides a fully automated elevator dust explosion hazard prevention system. All the major elevator explosion hazard conditions are constantly monitored and the elevator is stopped when it is unsafe to carry on the operation. No PLC or other control intervention is needed to provide the safety of operation.

10.11 W4005NV46AI /B Controller LEDs

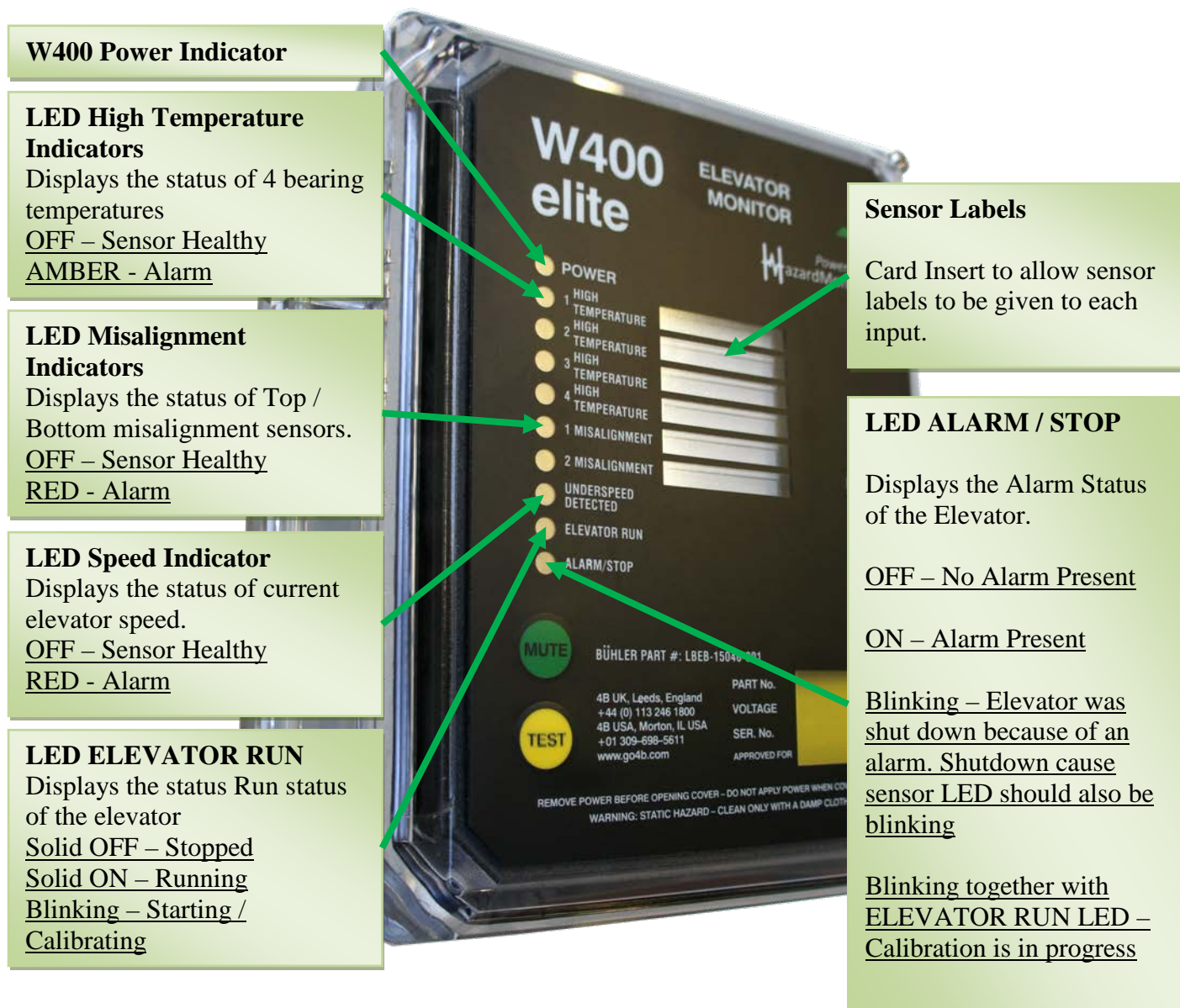


Figure 16 – W400 Controller LEDs

10.12 W4005NV46AI /B Controller Buttons

MUTE Button

Short Press – This will open the Alarm Relay if an alarm is present.

New alarms will close the alarm relay

The alarm MUTE will not stop the shutdown process.

Elevator will still be stopped if the alarm condition stays present

Long Press (5s) – Controller Fault Reset after an alarm shutdown

It is not possible to re-start the elevator after an alarm shutdown without first resetting the fault by long press on the MUTE button

Alarm relay will open after the controller fault was reset



TEST Button

Short Press – Simple Controller Test

All LEDs blink once

Two Short Presses – Full System Test

Must press second time within 1 second of the first press

Simple Test + Alarm and Stop Relays toggled. THIS WILL STOP THE ELEVATOR

Long Press (5s) – Start Calibration Command

In Single Speed mode the rotation speed is saved

In Differential Speed mode the bottom speed is divided by top speed and the ratio of speeds is saved

Calibration can be initiated on a Stopped or Running elevator

Figure 17 – W400 Controller Buttons

10.13 Settings Switches

The W4005NV46AI /B has all the adjustable settings available via the two switches on the PCB – SW1 is a rotary switch and SW2 is a DIP switch. Please see Figure 18 for the location of the two switches.

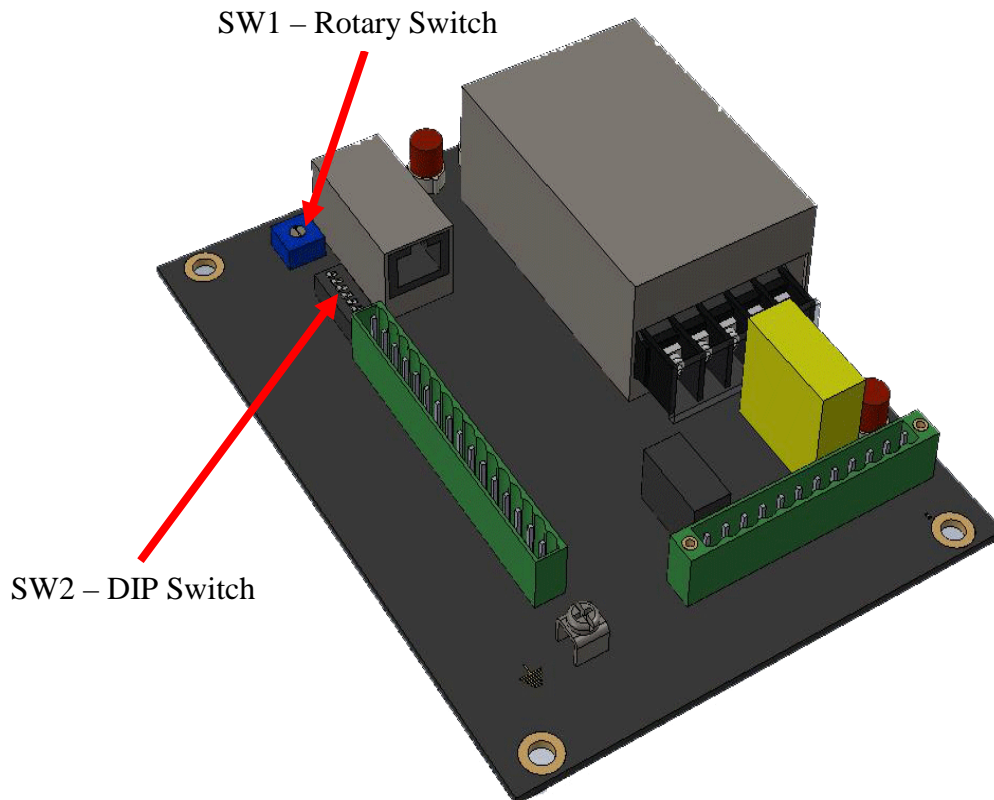


Figure 18 – W4005N Switch Locations

Note: The W4005NV46AI /B unit will only read the switch states during **power up**. If any changes to the settings are needed, then the unit must be powered down, the switch states changed and then the W4005NV46AI /B can be powered up again and the new settings will take effect.

10.13.1. Rotary Switch (SW1)

SW1 rotary switch is used to configure the W4005NV46AI /B controller temperature alarm level. See Table 11 below.

Switch Position	Alarm °C
0	55
1	60 - Default
2	65
3	70
4	75
5	80
6	85
7	90

Table 11 – SW1 Temperature Alarm Levels

10.13.2. DIP Switches (SW2)

These switches are used to set the following settings:

Switch Number	Description	Left Position	Right Position
1	Speed Detection Mode	Single Speed Mode	Differential Speed Mode
2	Start Up Delay	10s	30s
3	HBS Top Enabled	OFF	ON
4	HBS Bottom Enabled	OFF	ON
5	Not Used	-	-
6	Not Used	-	-
7	PLC Protocol Selection	ProfiNet	Ethernet/IP
8	Settings Override by PLC	OFF	ON

Table 12 – SW2 W4005NV46AI /B Settings

10.13.2.1. Speed Detection Mode

The W4005NV46AI /B controller supports two speed modes: Single and Differential.

In single speed mode (this is the default mode) only one P300 speed sensor is used to monitor the bottom shaft of the elevator. The W4005NV46AI /B is calibrated to a normal elevator running speed and an alarm is raised if in normal running state the speed changes as explained in paragraph 10.15.1 - *Underspeed Alarm – Belt Slipping*.

In differential speed mode it is required for the user to install two P300 sensors*. The W4005NV46AI /B will be calibrated to a ratio between the top and bottom shaft speeds. The running speed of the elevator can vary since the W4005NV46AI /B doesn't have a normal running speed saved, but instead the ratio of the top and bottom speeds must stay constant. If the bottom shaft becomes slower than the top shaft, then an alarm will be raised.

***Note:** Only one P300 sensor is supplied in the package as standard. The second sensor must be purchased separately. Please see the end of this manual for contacts around the world.

10.13.2.2. Start Up Delay

This is a time delay from when the elevator is started. During this time any speed alarms are ignored. This gives the elevator time to reach normal running speed.

10.13.2.3. HBS Top/Bottom Enabled

This switch gives an option to enable/disable temperature monitoring. This can only be done in Top and Bottom sensor pairs.



When temperature monitoring is enabled, the bearing temperature sensors must be wired in to the W4005NV46AI /B, otherwise an Open/Circuit Alarm will be constantly present and the W4005NV46AI /B will not allow for the elevator to start.

10.13.2.4. PLC Protocol Selection

The W4005NV46AI /B is intended to support two of the industry's major Industrial Ethernet protocols: ProfiNet and Ethernet/IP. Currently this feature is not operational. This section will be updated at a later date. This feature will become available via a software update to the W4005NV46AI /B controller.

10.13.2.5. Settings Override by PLC

This feature is currently not implemented and has not effect on the product operation. This section will be updated at a later date. This feature will become available via a software update to the W4005NV46AI /B controller.

10.13.3. Fixed Settings

There are a number of settings that are fixed within the unit and cannot be changed. These settings are very important to know when operating the product. Please refer to the Alarms and Shutdown section for more information.

10.14 W4005NV46AI /B Calibration

The W4005NV46AI /B unit is delivered in a Non-Calibrated state. This is distinguished by both the Alarm LED and Relay toggling every 1 second. The W4005NV46AI /B **MUST** be calibrated before it can be used to control the elevator. This procedure is exactly the same for both Single and Differential speed modes

The following steps must be executed in order to calibrate the W4005NV46AI /B controller:

- a) Press and hold the TEST button for 5 seconds – This will start the calibration process and the W4005NV46AI /B will now be waiting for the interlock voltage to be applied. In this state the W4005NV46AI /B Alarm/Stop LED will carry on toggling, but the Alarm relay will Open
- b) Operate the START button on the motor starter. This provides an interlock signal to the W4005NV46AI /B (terminals 17 and 18) which will cause the Stop relay to be energised and allow the machine to start. ALARM/STOP and ELEVATOR RUN LEDs will be flashing.
- c) The Calibration procedure takes 20 seconds plus the start up delay (see paragraph 10.13.2.2 for more details).
- d) When the Calibration procedure is complete the unit will go into normal operation. Any change of speed or misalignment or temperature beyond the allowed levels will now cause the appropriate ALARM and STOP action

If it is necessary to re-calibrate the W4005NV46AI /B just repeat the steps above.

10.15 Alarms and Shutdown

Each Alarm Source (sensor) has its own alarm and stop delay timer. As soon as the alarm condition is detected, the corresponding LED is lit immediately on the front of the unit. The Alarm Relay will close after the alarm delay timeout and the stop relay will open after the stop delay. All timers are cumulative, so that if an alarm condition is repeatedly detected and cleared (belt wandering) the elevator will eventually be stopped if the sensor is staying in an alarm state more than in healthy state.

10.15.1. Underspeed Alarm – Belt Slipping

This condition is detected by constantly measuring the speed of the bottom shaft (single speed mode) or by comparing the speeds of top and bottom shafts (differential speed mode). The behaviour is different depending on the speed mode selected.

Detected Speed	Condition	Alarm Relay Delay	Stop Relay Delay
Single Speed Mode			
<90% of calibrated speed (PPM)	Underspeed Alarm	1s	5s
<80% of calibrated speed (PPM)	Severe Underspeed Alarm	1s	1s
>110% of calibrated speed (PPM)	Overspeed Alarm	1s	5s
>120% of calibrated speed (PPM)	Severe Overspeed Alarm	1s	1s
Differential Speed Mode			
<90% of calibrated speeds fraction	Underspeed Alarm	1s	5s
<80% of calibrated speeds fraction	Severe Underspeed Alarm	1s	1s
>110% of calibrated speeds fraction	Overspeed Alarm	1s	5s
>120% of calibrated speeds fraction	Severe Overspeed Alarm	1s	1s

Table 13 – Speed Alarm and Stop Delays

Speed Start Up Delays	
Speed Start Up Delay	10s/30s (switch selectable)
Jam Detection	>25% of calibrated speed reached after 5s /10s, depending on Start Up Delay selected

Table 14 – Speed Start Up Delays

A switch selectable start up delay is used for speed monitoring. During this start up delay the speed is not monitored. Additionally elevator Jam/Block detection is implemented in the W4005NV46AI /B controller. If after the delays specified in Table 14 – Speed Start Up Delays, the speed of the elevator has not reached at least 25% of the calibrated speed, the W4005NV46AI /B will assume that the elevator is jammed and will stop the elevator immediately without waiting for the start up delay to elapse.

10.15.2. Belt Misalignment Alarm

The W4005NV46AI /B has two belt alignment zone inputs designed to be used for top and bottom elevator belt misalignment detection. The system comes with four Touchswitch sensors included in the package. If additional belt alignment monitoring is needed, then additional sensors can be wired in series to the existing ones. There is a start-up delay during which the misalignment alarms are ignored by the W4005NV46AI /B. After this period, the Alarm relay delay and the Stop relay delay will be as detailed in Table 15.

Misalignment Conditions	Time [s]
Misalignment Start Up Delay	20s
Misalignment Alarm Relay Delay	5s
Misalignment Stop Relay Delay	15s

Table 15 – Misalignment Alarm Delays

10.15.3. Hot Bearing Temperature Alarm

Four NTC type bearing temperature sensors can be connected to the W4005NV46AI /B controller as shown in Figure 13. The inputs will be constantly monitored for the following conditions:

- a) Open Circuit
- b) Short Circuit
- c) High Temperature Alarm

The temperature value above which the alarm will be detected is configured as described in paragraph 10.13.1. The high temperature condition will not allow the elevator to start if detected when elevator is stopped. If the elevator is running and a high temperature alarm is detected the following Alarm and Stop relay delays will apply:

Temperature Alarm Delays	Time [s]
Alarm Relay Delay	5s
Stop Relay Delay	30s

Table 16 – Temperature Alarm Delays

10.15.4. Alarm Muting

It is possible to acknowledge the alarm by pressing the MUTE button briefly. This will open the Alarm relay. The W4005NV46AI /B will continue to countdown to the Stop condition even if the alarm is muted and unless the alarm source condition is cleared, the elevator will stop. A new alarm will re-enable the Alarm relay.

10.16 Test Functionality

In order to test that the W4005V46-SYSx /B system is correctly wired to control the elevator, users can press the Test button on the front lid. There are two types of tests available:

10.16.1. Simple Test

In order to test the correct functionality of the microprocessor and LEDs, a simple test can be performed. This test can be performed when the system is either running or stopped. When the TEST button is pressed and released all the LEDs will toggle.

10.16.2. Extended Test

An extended test can be performed to test all the relays, LEDs and microprocessor operation. This test can be performed by pressing the TEST button **twice** in quick succession. Make sure to press and release the second time while the LEDs are lit from the first press, i.e. when the simple test is running. All the LEDs will toggle after which the Alarm relay will turn ON and then OFF after 1 second. The Stop relay will open and the elevator should stop if the W4005V46-SYSx /B system is wired in correctly.

If this test is performed when the system is stopped, the Alarm relay will be activated but the STOP RELAY will have no effect on the equipment. If this test is performed when the equipment is running, the Alarm relay will be activated and the STOP RELAY will stop the equipment.



The Extended Test can only be started when the W4005NV46AI /B controller has been previously calibrated and the elevator is running normally without any alarms. In any other states or if at least one alarm is present, only the Simple Test will be performed.



Make sure that the machine is empty of material prior to performing an extended test!

10.17 Normal Machine Start / Stop

Under normal conditions the elevator should be started by the operator pressing a start button on the control panel. The run signal (+24Vdc) must be constantly provided across the interlock terminals 17 and 18 of the W4005NV46AI /B controller throughout the duration of the elevator running state.

The operator should stop the Elevator by pressing the Stop button on the control panel. This should remove the run signal or remove the +24Vdc from appearing across the terminals 17 and 18 of the W4005NV46AI /B.

10.18 Alarm Shutdown Restart

If the elevator was stopped by the W4005NV46AI /B controller because of an alarm, then the cause of shutdown LED as well as the ALARM/STOP LED will be blinking and the Alarm relay will stay ON until the fault has been acknowledged. The fault can only be acknowledged by pressing and holding the MUTE button for 5 seconds. It will not be possible to restart the elevator until the user has acknowledged the fault. Depending on the type of alarm the condition may also need to be cleared before it is possible to restart the elevator again.

11. Common Misuse Warnings



Never operate the machine (elevator) when the W4005V46-SYSx /B system is known to be in bypass, i.e. it is not able to stop the elevator, because of a manual override in external circuitry. The machine must be taken out of service until the problem is resolved.



It is prohibited to open the lid of the W4005NV46AI /B controller or any junction boxes used in wiring of the system when electrical power is applied. Please isolate the power before opening the enclosures of any live circuits. Sparking on live contacts can lead to an explosion when equipment is used in ATEX environment.



All the system wiring is 24Vdc. Make sure that no main AC or high-voltage AC signals are wired into the system (apart from powering the W4005NV46AI /B controller itself). Applying incorrect voltage may lead to equipment failure and/or injury.

12. Communication Options

The unit comes with a standard RJ45 Ethernet Socket on-board. This is currently inactive. Support for a number of field bus interfaces will be added in the near future.

13. Maintenance Procedure

DANGER: EXPOSED BUCKETS AND MOVING PARTS WILL CAUSE SERIOUS INJURY OR DEATH. THE OPERATOR MUST ALWAYS LOCKOUT POWER BEFORE REMOVING COVER OF THE INSPECTION DOOR OF THE ELEVATOR OR PERFORMING ANY INSTALLATION OR MAINTENANCE WORK.

DANGER: ALL ELECTRICAL POWER TO THE SYSTEM AND WIRING MUST BE ISOLATED PRIOR TO STARTING ANY INSTALLATION OR MAINTENANCE WORK. WORKING ON OPEN LIVE CIRCUITS IN ATEX ZONES IS PROHIBITED AND CAN LEAD TO AN EXPLOSION.

Even though this system conforms to ISO13849 Cat 2 PLd, 4B recommends that the system and all of its components are inspected at least once every 6 months. Below is the procedure that the end user must adhere to in order to maintain the system in a safe state.

- 1) Inspect that all the cabling is in good state and that all the electrical connections, including the terminal blocks in the junction boxes are secure and in good order
- 2) Make sure there is no water damage to the inside of the controller or any junction boxes used
- 3) Verify that the Touchswitch sensors are operational by following the procedure stated in 9.6.2 - Testing and Commissioning
- 4) It is advisable to also verify that the Bearing temperature sensor accuracy is within the specified range. A test device with product code ADBT1 (ADB Tester) is required for this and therefore this point is advisable, but not mandatory. Please contact your system supplier or 4B representative for more information on the ADBT1 testing device
- 5) Verify that the speed sensor and the Whirligig are securely mounted on the shaft
- 6) Verify that the speed sensor is operational by observing that the LED on the sensor blinks four times per shaft revolution
- 7) Verify that the configuration switches of the W4005NV46AI /B controller are set as intended. Please refer to 10.13 - Settings Switches for more information.
- 8) Perform the W4005NV46AI /B controller simple test to check that all the LEDs are in working state. Please refer to 10.16.1 - Simple Test for the explanation of this procedure.
- 9) Perform the W4005NV46AI /B controller extended test while elevator is running to verify that the W4005NV46AI /B can stop the elevator. This is needed to make sure that the control wiring is correct and has not been modified since the last test. Please refer to 10.16.2 - Extended Test for the explanation of this procedure.



IF THE SYSTEM DOES NOT ALARM AND SHUTDOWN AS REQUIRED, THEN REMOVE THE MACHINE FROM SERVICE UNTIL THE PROBLEM HAS BEEN DIAGNOSED AND CORRECTED.

14. Commissioning

DANGER: EXPOSED BUCKETS AND MOVING PARTS WILL CAUSE SERIOUS INJURY OR DEATH. THE OPERATOR MUST ALWAYS LOCKOUT POWER BEFORE REMOVING COVER OF THE INSPECTION DOOR OF THE ELEVATOR OR PERFORMING ANY INSTALLATION OR MAINTENANCE WORK.

DANGER: ALL ELECTRICAL POWER TO THE SYSTEM AND WIRING MUST BE ISOLATED PRIOR TO STARTING ANY INSTALLATION OR MAINTENANCE WORK. WORKING ON OPEN LIVE CIRCUITS IN ATEX ZONES IS PROHIBITED AND CAN LEAD TO AN EXPLOSION.

- 1) Please follow steps 1 to 7 of the 13 - Maintenance Procedure section of this manual
- 2) Calibrate the W4005NV46AI /B controller as explained in section 10.14 - W4005NV46AI /B Calibration
- 3) Perform the normal machine start / stop sequence as explained in section 10.17 - Normal Machine Start / Stop
- 4) Perform the alarm shutdown sequence as explained in section 10.18 - Alarm Shutdown Restart of this manual

15. System Breakdown Procedure

In the event of the W4005V46-SYSx /B system or any part of it not operating correctly, the machine must be stopped immediately and the system repaired or replaced. The system must then be re-commissioned and verified to be working correctly. Please refer to 13 - Maintenance Procedure for the details.

If the user decides to bypass the W400 system and operate without protection, the machinery is not protected against explosion risks and the end user takes all the responsibility for this action.

16. Manufacturer Information

System Component	Manufacturer	Authorised Reseller
W4005NV46AI /B	Don Electronics	4B Group
TS1V4AI /B	Don Electronics	4B Group
P300V34AI /B	Synatel	4B Group
WG4A-BR /B	Synatel	4B Group
ADB910V3AI /B	Don Electronics	4B Group

Table 17 - Manufacturer Information

16.19 Manufacturer Detailed Information

Don Electronic Ltd
Westfield Industrial Estate
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UK

Synatel Instrumentation Ltd.
Walsall Road, Norton Canes
Cannock, Staffordshire
WS11 9TB
UK

17. Revision History

Revision	Date	Modifications
1	25 October 2013	Initial Document Release
2	27 January 2014	<ol style="list-style-type: none"> 1) Added ProfiNet Support Section 2) Updated Warranty and Legal information 3) Minor change to +24V terminal numbers in the sensor wiring section 4) Minor changes to the TS commissioning and testing section
3	18 February 2014	<ol style="list-style-type: none"> 1) ProfiNet section temporarily removed 2) Updated the Interlock and Power wiring diagrams 3) Updated Calibration section: Press TEST for 5 seconds to start calibration 4) Updated the Test section: Full test characteristics changed 5) Updated the configurable settings (10/30 start up delay instead of 10/60s) 6) Added Elevator Jam detection description 7) Added Manual alarm reset after alarmed shutdown (long press of the MUTE button) 8) Removed the approvals information from the manual. This will be supplied as an addendum sheet, included with each product. 9) Removed safe use conditions. These will be supplied as an addendum sheet, included with each product.
4	11 May 2014	<ol style="list-style-type: none"> 1) Added Hardware and Software version numbers 2) Updated the power LED colour to Green 3) Updated the Temperature Alarm LED colour to Amber 4) Added the ProfiNet section 5) Added various other sections in accordance with the machinery directive
5	14 May 2014	<ol style="list-style-type: none"> 1) Added Manufacturer information 2) Made all references within the manual to the full part numbers to avoid ambiguity 3) Added more prominent warnings
6	14 May 2014	<ol style="list-style-type: none"> 1) Minor typos and grammatical errors corrected
6.1	23 May 2014	<ol style="list-style-type: none"> 1) Removed the Profinet section temporarily
6.2	03 June 2014	<ol style="list-style-type: none"> 2) Cleared an error in the Declaration of Conformity section

Table 18 – Revision History

With subsidiaries in North America, Europe, Asia, Africa and Australia along with a worldwide network of distributors, 4B can provide practical solutions for all your applications no matter the location.



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