

## **BWS-T2 SERIES**

Multiray safety barrier, level 2,  
1 ... 2 pairs of photocells

## **INSTRUCTION MANUAL**

We

**DATASENSOR S.p.A.**  
Via Lavino, 265  
40050 Monte San Pietro  
Bologna - Italy

declare under our sole responsibility that the product(s)

**BWS-T2 SAFETY CONTROLLER (TYPE 2)**

to which this declaration relates in conformity with the following standard(s) or other normative document(s)

**CEI EN 55022, JUNE 1997:**

LIMITS AND METHODS OF MEASUREMENTS OF RADIO DISTURBANCE OF INFORMATION TECHNOLOGY EQUIPMENT

**CEI EN 61000-4-2, SEPTEMBER 1996:**

ELECTROMAGNETIC COMPATIBILITY (EMC). PART 4: TESTING AND MEASUREMENT TECHNIQUES. SECTION 2: ELECTROSTATIC DISCHARGE IMMUNITY TEST

**CEI EN 61000-4-3, NOVEMBER 1997:**

ELECTROMAGNETIC COMPATIBILITY (EMC). PART 4: TESTING AND MEASUREMENT TECHNIQUES. SECTION 3: RADIATED, RADIO-FREQUENCY, ELECTROMAGNETIC FIELD IMMUNITY TEST

**CEI EN 61000-4-4, SEPTEMBER 1996:**

ELECTROMAGNETIC COMPATIBILITY (EMC). PART 4: TESTING AND MEASUREMENT TECHNIQUES. SECTION 4: ELECTRICAL FAST TRANSIENT/BURST IMMUNITY TEST

**CEI EN 61000-4-5, JUNE 1997:**

ELECTROMAGNETIC COMPATIBILITY (EMC). PART 4: TESTING AND MEASUREMENT TECHNIQUES. SECTION 5: SURGE IMMUNITY TEST

**CEI EN 61000-4-6, NOVEMBER 1997:**

ELECTROMAGNETIC COMPATIBILITY (EMC). PART 4: TESTING AND MEASUREMENT TECHNIQUES. SECTION 6: IMMUNITY TO CONDUCTED DISTURBANCES, INDUCED BY RADIO-FREQUENCY FIELDS

**CEI IEC 61496-2, NOVEMBER 1997:**

SAFETY OF MACHINERY - ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT - PART 2: PARTICULAR REQUIREMENTS FOR EQUIPMENT USING ACTIVE OPTO-ELECTRONIC PROTECTIVE DEVICES (AOPDs)

Following the provision of the Directive(s):

**89/336 CEE AND SUCCESSIVE AMENDMENTS**

Monte San Pietro, 02/01/2001

Gianni Stradiotti



Quality Assurance Manager



DECLARATION OF CONFORMITY

**WARRANTY**

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DATASENSOR S.p.A. will repair or replace, free of charge, any product found to be defective during the warranty period of 36 months from the manufacturing date.

This warranty does not cover damage or liability deriving from the improper application of DATASENSOR products.

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La garanzia non copre danneggiamenti o responsabilità dovute ad un uso non corretto del prodotto.

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826190024 Rev.E

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### GENERAL VIEW

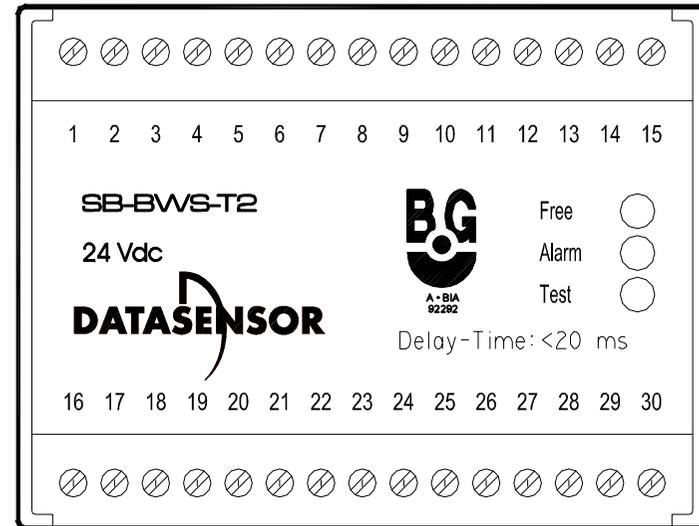


Figure A

## 1. INTRODUCTION

The BWS-T2 is an essential part of a photoelectric installation whose purpose is to maintain a safe environment in potentially dangerous areas where electrical machinery or equipment is in operation. It performs this task by not allowing such machinery to start up unless the dangerous area is clear of any persons or objects.

The product is designed to satisfy the following specifications (German normatives):

The BWS-T2 can be used in the below listed industrial sectors. We inform that eventually other normatives and rules of local bodies for safety at work have to be respected.

- **Cold treatment of metals**

prEN692    Mechanic presses

prEN693    Hydraulic presses

- **Machinery for plastics and rubber**

prEN201    Injection presses - moulding machinery

prEN289    Shape- and moulding presses

prEN1114   Rail- and extruding presses

prEN1417   Equipment for mixing with 2 cylinders

prEN422    Blow- shaping machinery

- **Machinery for packaging**

prEN415-2   Machinery for packaging of rigid prechaped goods

prEN415-3   Machinery for packaging, filling and enclosure

prEN415-4   Equipment for palleting and un palleting

prEN415-5   Machinery for wrapping

prEN415-6   Group packing machinery

prEN415-7   Machinery for arrangements

- **Machinery for wood treatment**

- prEN691 General requirements
- prEN859 Planing and straightening machinery with manual transport
- prEN860 Single sided machinery for planing
- prEN861 Machinery for combined planing and straightening
- prEN1807 Band- saws
- prEN848 Table milling machinery
- prEN940 Combined Machinery
- prEN1218 Double profile machinery

- **Paper- and printing machinery**

- prEN1010 Printing machinery
- prEN1034 Machinery for paper production

- **Machinery for tanning**

- prEN972 Alternative machinery with movable rolls
- prEN1035 Machinery with movable slats
- prEN931 Machinery for scratching, grinding, polishing, folding and nailing

- **Other machinery**

- prEN11553 Safety of Laser machinery for treating materials
- EN775 Safety of handling automation
- prEN1525 Driverless transport systems and their systems

Further normatives to be applied:

**EN 292 Part 1: November 1991**

Safety of machinery- Basic concepts, general principles for design:  
Part 1: Basic terminology , methodology

**EN 292 Part 2: November 1991**

Safety of machinery - Basic concepts, general principles for design:  
Part 2: Technical principles and specifications

**EN 294: Juni 1992**

Safety of machinery - Safety distances to prevent danger zones being reached  
by the upper limbs

**EN 811: Oktober 1992**

Safety of machinery - Safety distances to prevent danger zones being reached by the lower limbs

**EN 999: Januar 1995**

Safety of machinery - The positioning of protective equipment in respect of approach of parts of the human body

**EN 954 Part 1: März 1997**

Safety of machinery; Safety related parts of control systems  
- General principles for design

**EN 60204 Part 1 Safety of machinery, electrical equipment of machines - General requirements**

Draft prEN 1050: April 1996  
Safety of machinery; risk assessment

**FINAL DRAFT IEC 61496-1/Ed. 1.0: Safety of machinery - electro - sensitive equipment,**

Part 1: General requirements and tests.  
Documents 44/206/FDIS and 44/206A/FDIS: 1997-03-28

**FINAL DRAFT IEC 61496-2/Ed. 1.0: Safety of machinery - electro - sensitive equipment,**

Part 2: Particular requirements for equipment using active opto-electronic protective devices.  
Documents 44/208/FDIS and 44/206A/FDIS: 1997-0530

The BWS-T2 can be used in conjunction with our line of photoelectric sensors as shown in the Technical Specifications.

The BWS-T2 has been designed so that one (1) or two (2) Emitter-Receiver pairs can be connected to it.

The operating voltage is: 24VDC  $\pm$ 10%.

The status of the system is indicated by 3 visible LEDs:

- FREE green
- ALARM red
- TEST yellow

The BWS-T2 is rated as a type 2 ESPD (Electro Sensitive Protective Device) according to the EUROPEAN STANDARD. A type 2 ESPD is a device which relies on the correct response to external tests to maintain its safety integrity. The device may not detect failures in system integrity between tests.

## 1.1 OPERATING DESCRIPTION

The BWS-T2 features the following functions:

### **START INTERLOCK:**

A start interlock is a means for preventing automatic starting after the BWS-T2 is switched on.

### **INITIAL TEST:**

A test which is performed via the start switch, after the BWS-T2 has been powered, in order to test the complete safety related control system before the first operation is initiated.

### **RESTART INTERLOCK:**

A means for preventing automatic re-starting of a machine after the optical beam(s) was (were) interrupted.

### **CYCLE TEST:**

A test which can be performed at any time while the BWS-T2 is in the active operating mode in order to test the complete safety related control system.

The flow chart on the following page can be used to describe the operation of the BWS-T2:

**BWS-T2 OPERATION**

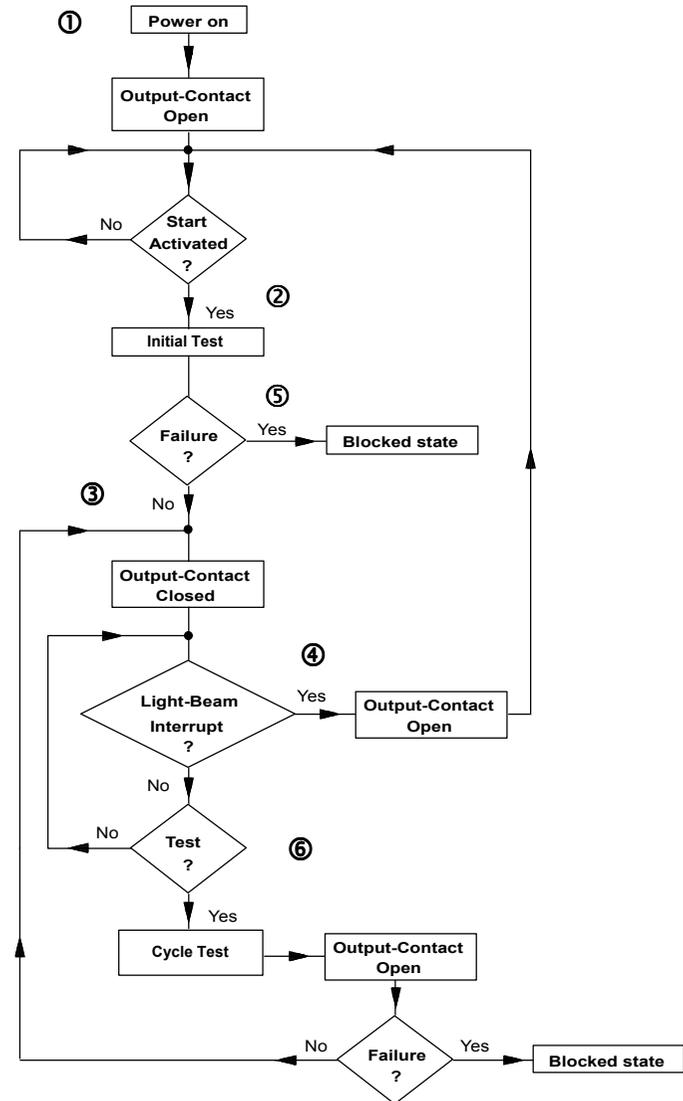


Figure 1

- ① Upon application of power, the red ALARM LED lights up and the START INTERLOCK function will prevent the operation of the output contacts.
- ② The active operation mode can be initiated only with a N.O. (normally open) start switch. After closing the start switch, the INITIAL TEST function will be activated automatically. The red ALARM LED goes off and the yellow TEST LED lights up.
- ③ After the start switch is released, and only if no fault is detected, both N.O. output contacts will switch to the active operation mode. In this case the yellow TEST LED goes off and the green FREE LED lights up.
- ④ Thereafter, any interruption of the optical beam(s) will cause the RESTART INTERLOCK to prevent automatic re-activation and force the operator to re-initiate with the start switch.
- ⑤ If a fault is detected, after the start switch is released, the yellow TEST LED goes off and the red ALARM LED lights up; the output contacts remain open (preventing machine start up).
- ⑥ During the active operating mode, the CYCLE TEST can be performed by means of 2 N.C. contacts: Test 1 and Test 2 (see figure 2). This procedure is normally used to detect the status of the BWS-T2 periodically.

By opening the Test 1 contact, the CYCLE TEST is started; the output contacts are OPEN for the duration of the test and will CLOSE after the test is completed only if the BWS-T2 has detected no fault. The test is completed when the Test 2 contact is opened and then closed.

The CYCLE TEST is such that any short-circuit, open, or component malfunction will be instantly recognized.

The LED indicators for the CYCLE TEST have the same function as in the INITIAL TEST.

There are two ways to connect the Test 1 and Test 2 contacts:

a) CYCLE TEST procedure using 2 N.C. contacts.

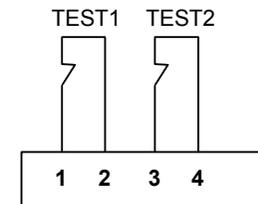


Figure 2

When the Test 1 contact opens, the test procedure begins.

When the Test 2 contact opens and closes again, the test procedure ends.

This type of connection allows to detect short-circuits at the test cables.

b) CYCLE TEST procedure using 1 N.C. contact.

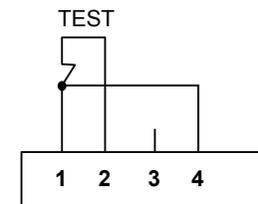


Figure 3

When the Test contact opens, the test procedure begins; when it closes, the test procedure ends.

## 2. INSTALLATION

### 2.1 MOUNTING THE BWS-T2

The BWS-T2 must be mounted in an enclosure with at least an IP54 rating. The dimensions of the BWS-T2 are given in the following diagram for mounting purposes:

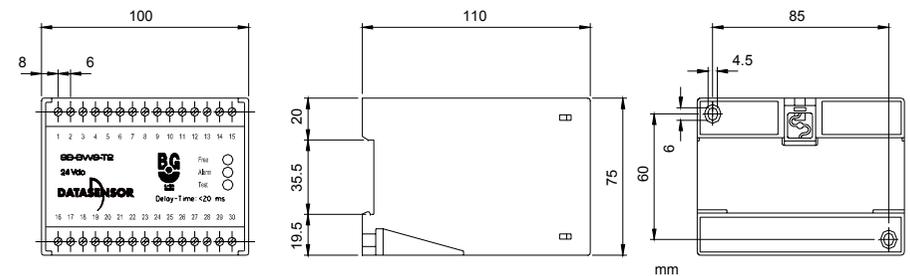


Figure 4

### 2.2 START SWITCH

The external start switch, which allows the enabling of the active operating mode, must be installed in such a way that an unobstructed view of the danger area is provided.

**IT MUST NOT BE POSSIBLE TO ACTIVATE THE START SWITCH FROM INSIDE THE DANGER AREA !**

By-passing the start switch in order to eliminate the START INTERLOCK and the RESTART INTERLOCK functions is not allowed. Therefore the start switch must be closed and then opened again to begin the INITIAL TEST.

### 2.3 SENSORS

The photoelectric sensors must be mounted in front of the danger area (as per EN 999) so as to protect the entire danger area.

The sensors must be installed in the vicinity of the operating equipment in such a way as to allow ENTRY or OPERATION of the machine ONLY THROUGH the safety barrier. The possibility of reaching the danger area from below, above or from around the safety barrier must be prevented. It must not be possible to move or alter the installation in any way.

In addition, it must not be possible to be inside of the danger area behind the safety barrier. This must be detected by the safety barrier.

The electrical connection from the BWS-T2 box to the sensors is done via shielded cables. The possible lengths are listed in the sensor datasheets. If using sensors with connectors, be sure that your cable is shielded.

### 2.4 SAFETY DISTANCE (SD)

The photoelectric sensors must be mounted at a "safety distance" (S) in front of the machine or danger area. It must be assured that the dangerous movement is stopped before a person is able to touch the dangerous moving parts.

This safety distance (S) depends upon the reaction time of the BWS-T2, the speed of the person or object penetrating the "guarded" area (approx. value:  $v=1.6\text{m/s}$ ) and the lagtime of the machine. See figure 5.

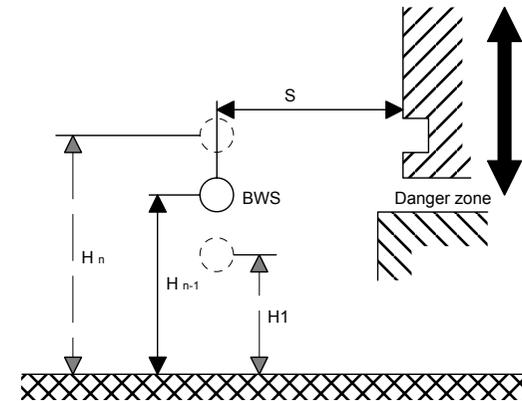


Figure 5

$$S = V * T + C \quad C = 8(d - 14\text{mm})$$

- S: Minimum distance - safety distance
- V: Approaching speed
- T: Delay time of the complete system
- C: Supposed length of a part of a body with  $\varnothing <$  resolution of photocell array, that exceeds the protecting area without a guaranteed detection.
- d: Detection capability (see table characteristics of photocells) -  
Fingerresolution:  $\varnothing \leq 14\text{mm}$ ; handresolution:  $\varnothing \leq 40\text{mm}$ ;  
armresolution:  $\varnothing \leq 70\text{mm}$ .
- H: Vertical position of the protecting area above the floor

#### 2.4.1. Protection of danger zones with BWS-T2 for protection of fingers and hands

**Condition:**  $14\text{mm} < d \leq 40\text{mm}$ ;  $C \geq 0$

For  $100\text{mm} < S \leq 500\text{mm}$  is valid:

$$S = 2000 * T + C$$

For  $S \leq 500\text{mm}$  is valid:

$$S = 1600 * T + C$$

**Must not be applied if also children have to be protected!**

**2.4.2. Protection of access with BWS-T2 - 1- or more beams for arm and body protection**

**Condition:**  $40\text{mm} < d \leq 70\text{mm}$ ;  $C \leq 0$   
 $S = 1600 * T + 850\text{mm}$

**Mounting height of the emitter(s) and receiver(s):**

1 Pair E/R:	750mm		
2 Pairs E/R:	400mm,	900mm	
3 Pairs E/R:	300mm,	700mm,	1100mm
4 Pairs E/R:	300mm,	600mm,	900mm, 1200mm

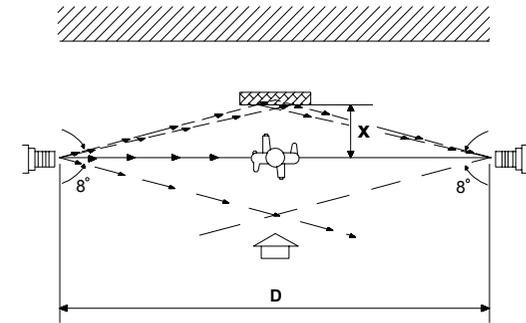
**Criterion:** No limbs passing below the lowest beam  
 No limbs passing below the highest beam  
 No limbs passing between 2 beams  
 No passage between 2 beams  
 Highest beam  $\leq 900\text{mm}$ , lowest beam  $\leq 300\text{mm}$

## 2.5 UNWANTED BEAM REFLECTIONS

Specular reflections from shiny surfaces in proximity or within the beam envelope (cone) can reflect light, thus affecting the ability to detect an intrusion into the guarded area.

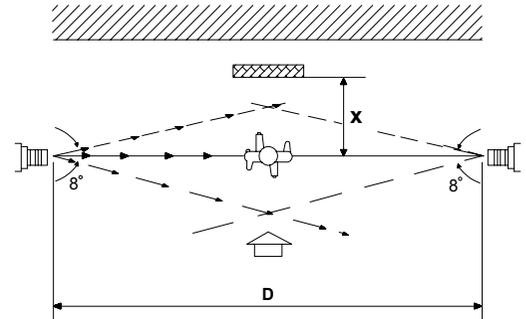
The minimum distances shown in figures 7a and 7b must be respected to satisfy the arrangement shown in figure 6b (figure 6a is not correct).

**INCORRECT  
INSTALLATION**

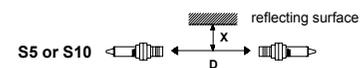
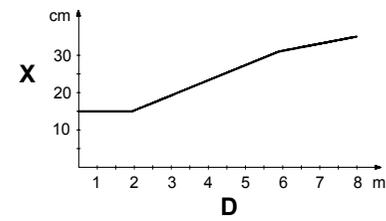


**Figure 6a**

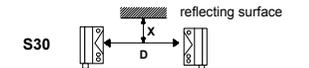
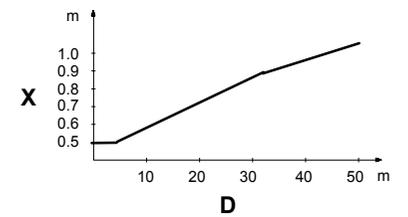
**CORRECT  
INSTALLATION**



**Figure 6b**



**Figure 7a**



**Figure 7b**

### 2.6 PHOTOELECTRIC SENSOR INSTALLATION

When mounting the sensors (emitter(E)/receiver(R) pairs) to the BWS-T2, care must be taken to position these components in such a way as not to interfere with each other. (including with the help of a mirror, see figure 8b and 8c). The layouts in figures 8a-8d are bad examples NOT to follow because they are unreliable.

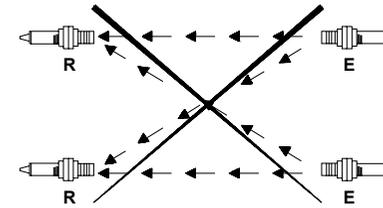


Figure 8a

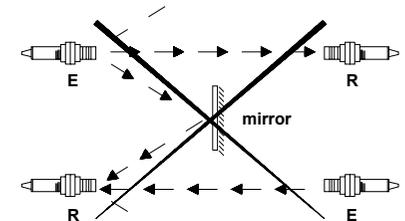


Figure 8b

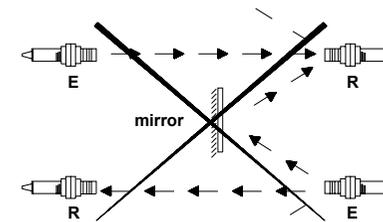


Figure 8c



Figure 8d

Figures 9a-9b show the proper disposition of these elements.

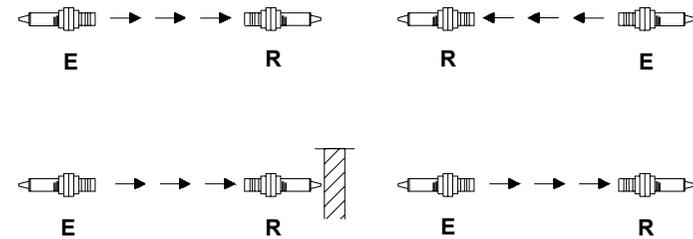


Figure 9a

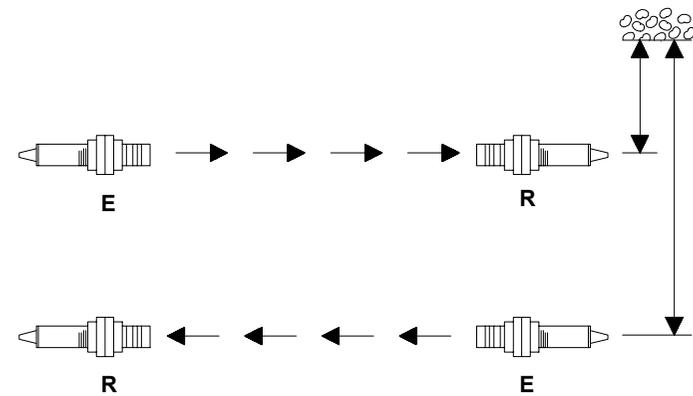


Figure 9b

## 2.7 ALIGNMENT OF THE SENSOR(S)

To align the sensor(s), you have to bridge the start switch from terminal 19 to terminal 20. Using the Receiver output LED of the photoelectric sensor(s) you can align the light barrier.

If the sensors are correctly positioned, the yellow TEST LED lights up.

If beam 1 or 2 is interrupted, the ALARM LED at the BWS-T2 lights up and the TEST LED turns off.

When the alignment is completed, disconnect the bridge between Terminal 19 and Terminal 20.

### 3. ELECTRICAL CONNECTIONS

The BWS-T2 controller provides for the following connections:

Signal	Terminal
Output 1	14; 29
Output 2	15; 30
Start	19; 20
Test 1	1;2
Test 2	3;4
Emitter 1	5;6;7;8
Receiver 1	21;22;23;24
Emitter 2	25;26;27;28
Receiver 2	9;10;11;12
Input +24 VDC	16
GND	18
Earth GND	17

See the individual diagrams (figures 10 - 13) for wiring details.

#### CAUTION

**Supply only the photocells from this device!**

Always use shielded cables to wire the emitter and receiver pairs.

One (1) or two (2) emitter-receiver pair(s) can be connected to the BWS-T2. If using only one Emitter-Receiver pair, the cables of the Emitter must be connected to the EMITTER 1 terminals and the cables of the Receiver must be connected to the RECEIVER 2 terminals. The EMITTER 2 and RECEIVER 1 terminals remain free.

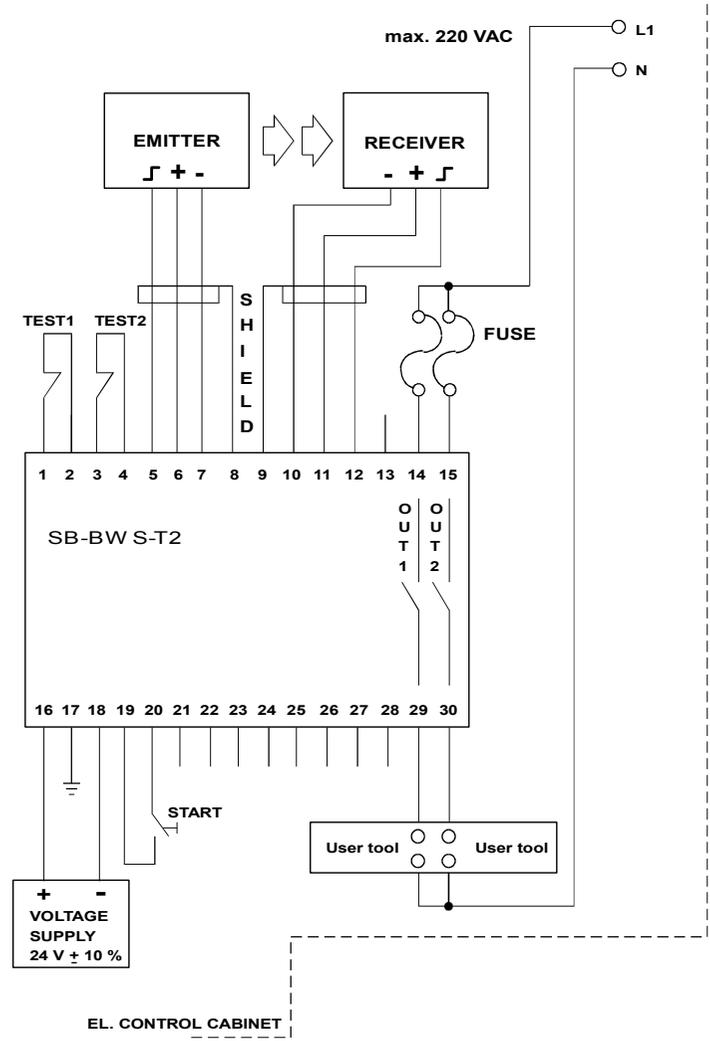


Figure 10 - One Emitter/Receiver pair

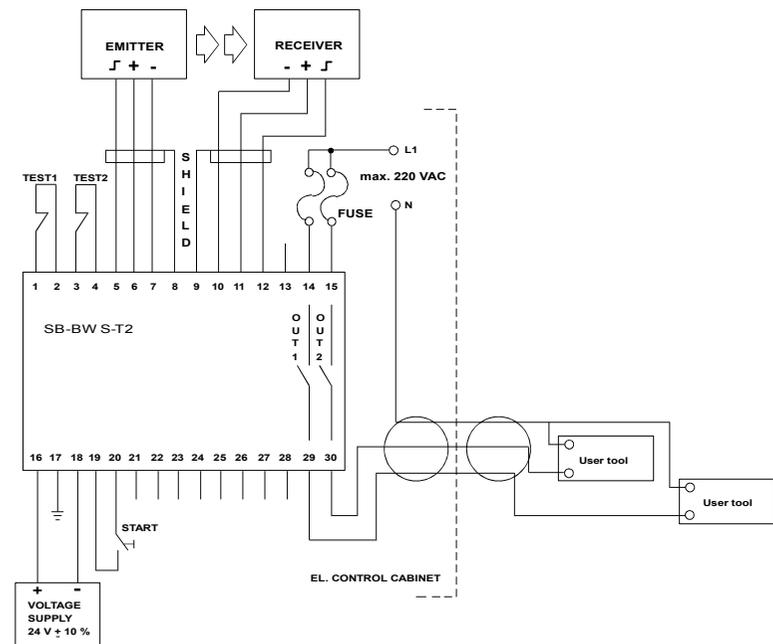


Figure 11 - One Emitter/Receiver pair

**NOTE**

*Be sure that L1 is switched by the 2 output contacts and not N.*

If only one User Tool is used, the output contacts can be tied together.

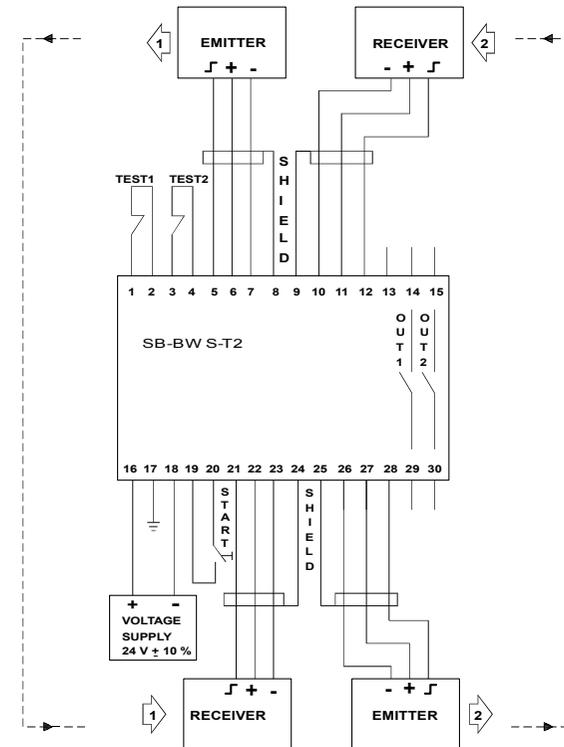


Figure 12 - Two Emitter/Receiver pairs

When operating with 2 E-R pairs, the wiring configuration shown in figure 12 must be respected. It must be made certain, that EMITTER 1 directs its beam only to RECEIVER 1 and EMITTER 2 directs its beam only to RECEIVER 2.

### CAUTION

Make sure that EMITTER 1 never directs to RECEIVER 2. To satisfy this demand, verify that the BWS-T2 switches from GREEN to RED status, when beam one OR beam two are interrupted separately.

The maximum specified rating of the BWS-T2 output contacts must not be exceeded.

With inductive loads, arc suppression or switching as described below should be utilized. For user tools that require load currents that exceed the BWS-T2 contact rating, auxiliary power operated switches must be used (see figure 13).

The N.O. contacts of the auxiliary power operated switches H1/H2 are used to wire directly to the machine control itself. The N.C. contacts of H1/H2 insure that in case of a defective switch the machine will not restart.

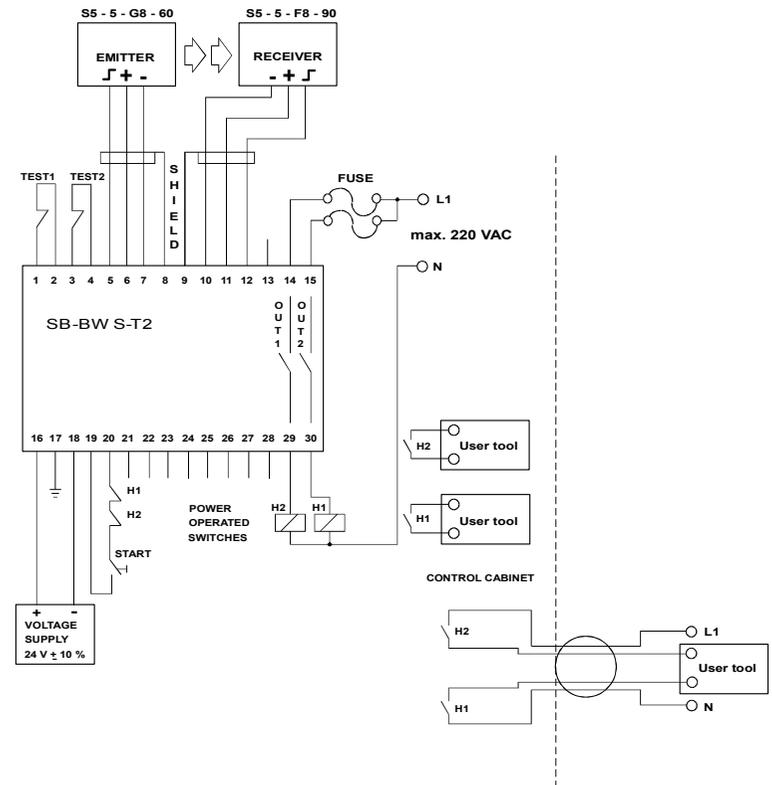


Figure 13 - If load current exceeds I<sub>max</sub>

## 4. TECHNICAL DATA

<b>Voltage:</b>	24 Vdc $\pm$ 10%, reverse polarity protection
<b>Max Power Consumption:</b> (1 Emitter-Receiver pair) (2 Emitter-Receiver pair)	3.4 W 3.8 W
<b>Weight:</b>	510 g. (without sensors)
<b>Operating Temperature:</b>	0...50 °C
<b>Output:</b> (SDS safety relay) V max 220 V AC I <sub>max</sub> 220 V AC 30 V DC	4 A AC (load life 100000 ops) 2 A AC (load life 500000 ops) 2 A DC
<b>Fuse Rating:</b>	60% of I <sub>max</sub>
<b>Input Signals:</b> Start: N.O. contact One-way wire length: Test 1/2: N.C. One way wire length:	contact close time > 40 ms < 10 m contact open time > 40 ms < 10 m
<b>Reaction Time:</b>	< 20 ms
<b>Initial Test Time:</b>	150 ms + contact close time
<b>Cycle Test Time:</b>	150 ms + test contact time
<b>Sensing Distance and Background Suppression:</b>	Depends on type of Emitter-Receiver used
<b>Enclosure Protection:</b>	IP20 when mounted in control enclosure with at least a IP54 rating

## Specifications related to the photoelectric sensors

Type	S5	S10	S30
Emitter	S5-5-G8-60-ST2 S5-5-G8-62-ST2	S10-5-G8-60-ST2 S10-5-G8-62-ST2	S30-5-G50-1-ST2 S30-5-G50-2-ST2
Receiver (Light pulse PNP output)	S5-5-F8-90-ST2 S5-5-F8-92-ST2	S10-5-F8-90-ST2 S10-5-F8-92-ST2	S30-5-F50-1-ST2 S30-5-F50-2P-ST2 select light pulse!
Max. sensing distance	8 m		50 m
Min. object class	Ø 15 mm		Ø 20 mm
Protection class	IP67		
Length of the shielded cable	30m		