



# **Safety Interlock Cable (Voltech Part Number 250-030)**

## **for Banner EZAC-R9-QE8**

### **Installation Guide**

#### **Voltech Instruments Inc.**

12851 Banyan Creek Drive  
Fort Myers, FL 33908, USA  
Tel : +1 239 437 0494

#### **Voltech Instruments Ltd.**

66 Innovation Drive  
Milton Park  
Abingdon, Oxfordshire OX14 4RQ, U.K.  
Tel: +44 (0) 1235 861173

[www.voltech.com](http://www.voltech.com)  
[sales@voltech.com](mailto:sales@voltech.com)

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## **DANGER OF ELECTRIC SHOCK**

Only qualified personnel should install this equipment, after reading and understanding this user manual. If in doubt, consult your supplier.

## **RISQUE D'ELECTROCUTION**

L'installation de cet équipement ne doit être confiée qu'à un personnel qualifié ayant lu et compris le présent manuel d'utilisation. Dans le doute, s'adresser au fournisseur.

## **GEFAHR VON ELEKTRISCHEM SCHOCK**

Nur entsprechend ausgebildetes Personal ist berechtigt, diese Ausrüstung nach dem Lesen und Verständnis dieses Anwendungshandbuches zu installieren. Falls Sie Zweifel haben sollten, wenden Sie sich bitte an Ihren Lieferanten.

## **RISCHIO DI SCARICHE ELETTRICHE**

Solo personale qualificato può installare questo strumento, dopo la lettura e la comprensione di questo manuale. Se esistono dubbi consultate il vostro rivenditore.

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# 1 INTRODUCTION

## 1.1. INTRODUCTION

Many of the tests available with the AT series testers can generate high voltages, which could cause operator injury unless proper safety precautions are taken.

The rear panel of the AT5600 and some AT accessories have been designed with a safety interlock connector, which is described in the user manual of those products. Unless the three safety interlock signals on this connector are properly made, the tester will not execute test programs.

You **must** have a safety system operating the safety interlocks.

The details of any safety system installation could vary depending on where the tester is being used. In a robotic production line, for example, the tester could be in an enclosed area, and the safety switches could be mounted in the door.

With manual production, the safety system could be based on physical barrier, for example, a 'lid' fitted with safety interlock switches. However, the requirement to open and close such a barrier will give a slower speed of test, and often the reduced production throughput that follows from this may not be acceptable.

This Safety Interlock Cable is available from Voltech as an optional accessory for your tester and requires the Banner EZ-Screen Safety Light Curtain System. It is designed so that it will not compromise the speed of test and your throughput in production. It is based on a 'light curtain' of infrared beams positioned in front of the tester.

Once the operator has placed a transformer on the test fixture, and removed his or her hand, the light curtain can signal that the situation is safe within a few tens of milliseconds. However, if the operator tries to touch the transformer during program execution, the safety system will open the safety interlocks (also within a few tens of milliseconds) and stop any test that is running.

The infrared safety system is easy to install with no special tools or knowledge. Once installed, it will be operational immediately, and will require the minimum of operator training

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## 1.2. RECOMMENDED INFRA-RED SAFETY SYSTEM

For optimum safety, ease of use and test speed, Voltech recommends the use of a safety light curtain with the AT5600 and other Voltech products that can generate dangerous voltages during routine production testing.

This provides a 'light curtain' of infrared beams positioned in front of the tester.

Once the operator has placed a transformer on the test fixture, and removed his or her hand, the light curtain can signal that the situation is safe within a few tens of milliseconds.

However, if the operator tries to touch the transformer during program execution, the safety system will open the safety interlocks (also within a few tens of milliseconds), so that the tests with dangerously high voltages will not be run.

The Safety Interlock Cable is an accessory that makes connection between the AT5600 and a safety light curtain as safe and easy as possible.

The cable has been optimized for use with the 'Banner' safety light curtain described below, but safety light curtains from other manufacturers may also be suitable.

To construct a complete safety system, you will need:

### From Voltech

250-030 Safety Interlock Cable

### From Banner

1 off 'EZ-Screen' safety light curtain.

This comprises of 5 parts from BANNER ENGINEERING

1 off <b>EZAC-R9-QE8</b>	Light Curtain Interface Box Input Voltage: 100-250V ac Input Frequency: 50-60Hz Input Current: typical 0.37A @ 100V ac in typical 0.23A @ 200V AC input
1 off <b>SLPE14550AP8</b>	Emitter Beam 550mm high with 100mm to 7.0m range.
1 off <b>SLPR14-550P8</b>	Receiver Beam 550mm high with 100mm to 7.0m range.
1 off <b>CSB-M1281M1281</b>	"Y" Splitter Cord Set
1 off <b>DEE2R-88D</b>	Male to Female Extender Cord Set

Source: [www.bannerengineering.com](http://www.bannerengineering.com)

### NOTES:

The Banner part numbers were correct in 2016

You are strongly advised to consult with your safety system supplier before making purchase decisions.

Similar safety systems are available from many other manufacturers and may be suitable.

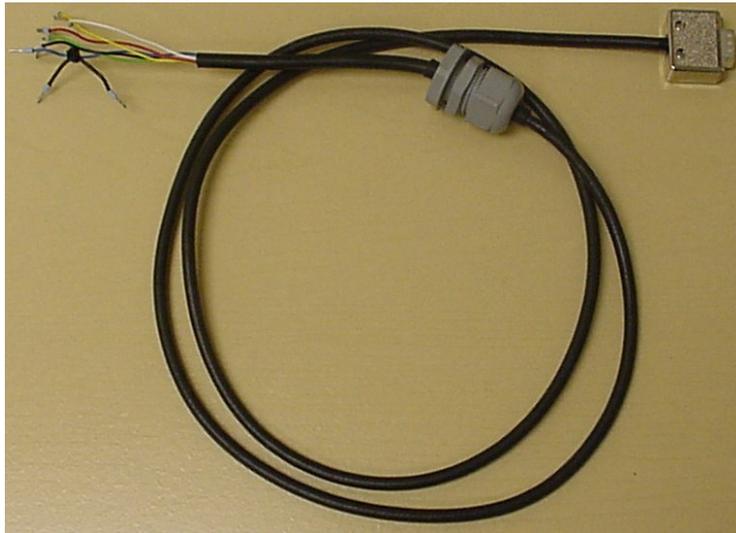
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## 2 DESCRIPTION

### 2.1. GENERAL DESCRIPTION

The Safety Interlock Cable is a robust and convenient way of connecting the AT5600 and other Voltech products to a safety interlock system.

Although other safety systems may be suitable, the cable has been optimized for direct and quick connection to the Banner product described in the previous chapter.



Length	1.75 meters
Construction	High-quality shielded cable and terminations.
AT5600 Termination	Slimline 9-way d-type plug
Safety System Termination	Color-coded wires with bootlace ferrules. 20mm cable gland to secure the cable to the light curtain control box case.
Voltech Part Number	250-030

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## 2.2 PRINCIPLE OF OPERATION

The cable carries 3 pairs of color-coded wires.

Each pair must be linked together by the safety system before the AT5600 will operate a high voltage test.

If any one of the three pairs become un-linked during a test, the AT5600 very quickly switches off any high voltage that is being produced.

There are three pairs of wires to provide the multiple redundancies required by various international safety standards.

### Yellow and Blue

The primary control (MPCE) elements of the AT5600.

The primary generator power is passed through the yellow and blue leads.

The contacts used to connect yellow to blue must be rated 230V ac, 2A or more.

As this is the HV drive source signal, it provides a failsafe independent of the unit firmware.

### Red and White

This is the secondary control element (MSCE) of the AT5600.

If this pair is open-circuited, prime power will also be removed from the AT5600 high power generator.

This action is independent of the MPCE above and thus provides fail-safe operation of the complete safety system.

**A 6k8 resistor is fitted in series with this pair, as required by the AT5600's electrical control system. This is already fitted into the 250-030 cable for you.**

### Green and Black

This is a monitoring pair, used by the AT5600 to confirm the status of the safety system.

## 2.3 CABLE SCHEMATIC

Function	AT5600 9-pin d-type		Safety Light Curtain	Connection to safety system.
Primary power to the high voltage generators is passed through pins 3 and 7	3	—	<b>Yellow</b>	Main power-breaking relays (Final Switching Device) of the safety system.
	7	—	<b>Blue</b>	
Secondary control logic.	5	—	<b>Green</b>	Monitoring or auxiliary relay.
	6	—	<b>Black</b>	
Secondary switching device. (A 6k8 resistor is fitted in series with pin 2 – it is already included in the cable for you).	2	—	<b>Red</b>	Secondary Control Element.
	9	—	<b>White</b>	
Screen	Screen		No Connection	

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## 3 INSTALLING THE IR SAFETY SYSTEM

### 3.1. POSITIONING THE LIGHT CURTAIN

The light curtain should be positioned in front of the tester, extending well beyond the width of the tester so that the operator is not impeded when he/she must load and unload the transformer under test.

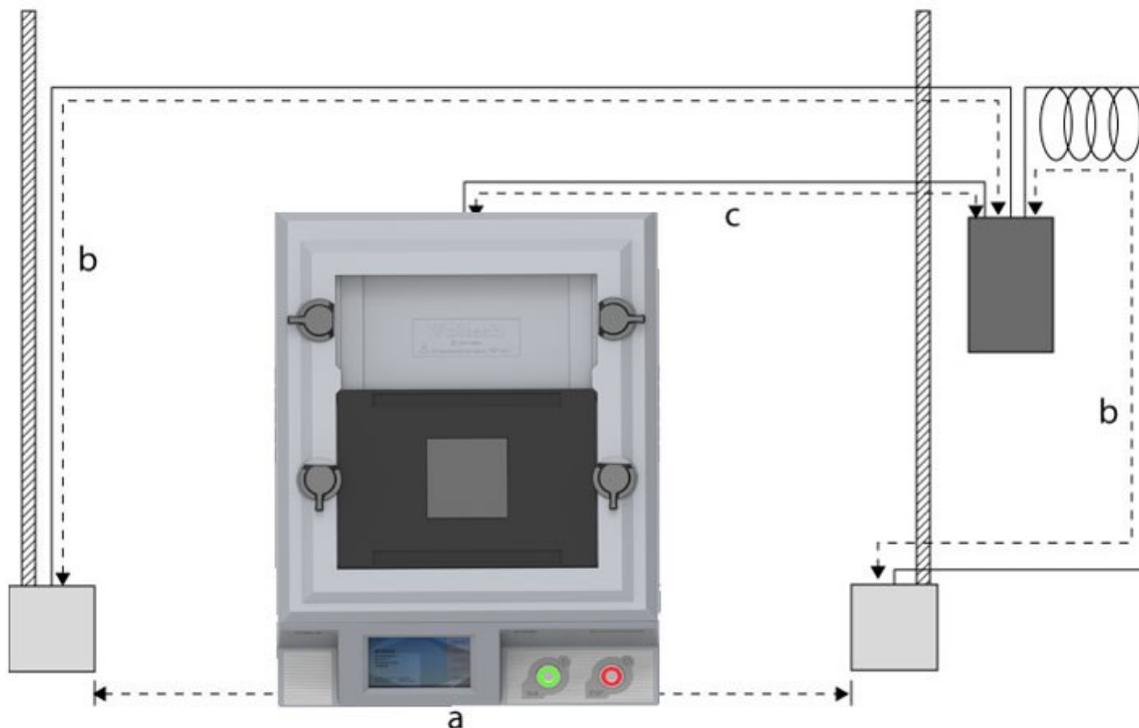
The interconnection between each of the modules is via simple multi-way cables, which are easy for you to install.

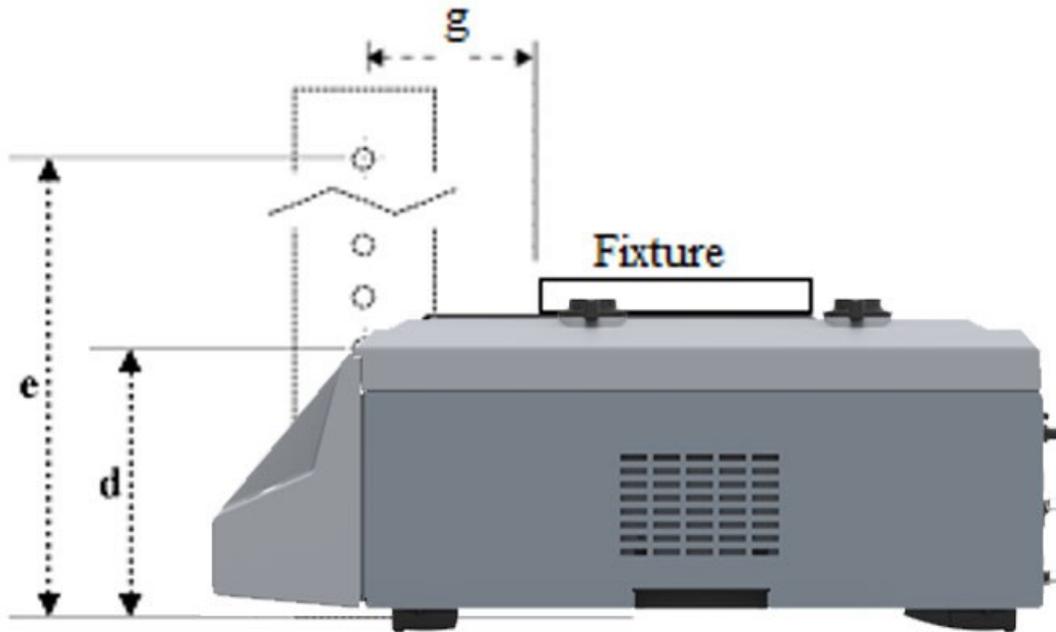
Finally, the AT Safety Interlock cable connects between the BANNER control box and the AT Safety Interlock socket.

This document gives an overview of the Banner EZ-Screen functions when used with the AT5600. It describes how to connect the cable to the BANNER control box.

**The user must refer to the BANNER documentation for details of assembly and operation of the Micro Screen**

The following shows a suggested installation.





The dimensions are as follows

a =Width of the light curtain	1.8m to 2.0m
b =Banner cable length from control box to vertical columns	b1 = 0.9m / b2 = 3.4m
c =Voltech cable length from control box to AT tester	1.5m
d =Lowest beam in light curtain	130mm minimum
e =Highest beam in light curtain	630mm maximum
g =Beam to edge of fixture	100mm minimum

The two vertical columns are equipped with suitable mounting brackets, making it easy for you to secure them to the work surface in the correct positions either side of the AT series tester.

The length of the cables is sufficient to allow you to position the control box outside the safety enclosure either under or on top of the work surface.

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## 3.2. OPERATOR SAFETY

It is the responsibility of the user's organization to ensure that the AT5600 and its associated safety systems are installed, maintained, and operated in accordance with all safety guidance and legislation that may be in force locally.

The BANNER EZ-Screen (light curtain) will provide only part of the complete safety function that is required. The AT5600 and light curtain must be installed by a designated, qualified safety person who will conduct an overall assessment of the risks involved and provide operator training, safety notices, and further safety equipment as well as install the AT5600 and light curtain in accordance with local regulations.

When conducting a risk assessment and providing operator training and notices, it should be noted that the first safety feature of the AT5600 is the yellow indicating light on its front panel.

This light will be lit when the AT5600 is running a test and may be generating dangerous voltages. (External indicating devices can also be used to show that the AT5600 is in a hazardous condition. See the 'Remote Port' description in the AT5600 user manual.)

The operator should not attempt to touch the part under test or enter the safety enclosure when the yellow light is illuminated.

The light curtain then provides supplementary safety protection against accidental entry into the safety enclosure by the operator.

## 3.3. THE SAFETY ENCLOSURE

Clearly, any safety system should be thought of providing a total 'safety enclosure' which prevents access from all sides to the dangerous voltages on the transformer under test.

It is also clear that the infrared safety system can only provide one side of this safety enclosure - that which faces the operator.

If there is a danger that an operator or any other person could touch the transformer under test from either the side or the rear of the tester, then you must also take steps to prevent this, either by installing suitable physical barriers, or for example, by positioning the tester in the corner of the room so that existing walls prevent access to the transformer from the side and rear.

The two vertical columns of the IR safety system would then normally be placed touching the physical barriers, which form the sidewalls of the safety enclosure.

Additionally, it should be noted that highest beam in the light curtain of the IR safety system is approximately 550mm above the work surface.

If there is any danger that the operator could reach over this height, or could touch the transformer under test from above, then further precautions should be taken to provide physical barriers to guard against this.

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### 3.4. CONNECTING THE SAFETY INTERLOCK CABLE TO A BANNER LIGHT CURTAIN

The following instruction has been written specifically for the BANNER EZ-Screen, Model Number EZAC-R9-QE8 AC Interface Box

**Caution:**

**Ensure that the light curtain and the AT5600 are disconnected from the mains supply line before opening the control box. Failure to do so could result in personal injury. Consult the user manual supplied with the light curtain for up-to-date information.**

- 1) Voltech Safety Interlock Cable (250-030) preparation:
  - a) Cut the plastic tie-wrap joining the Blue wire and the Black jumper wire. The Black jumper wire is not required for Banner Model Number EZAC-R9-QE8 installation. Refer to Figure 1

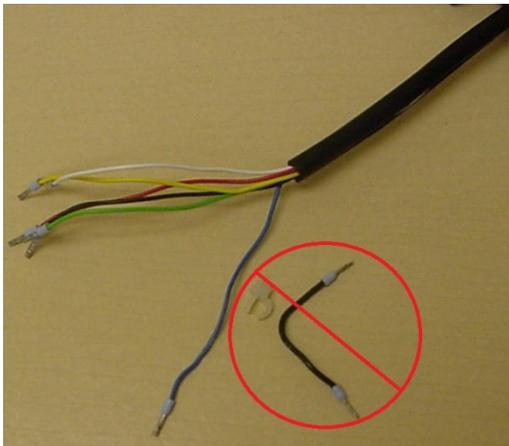


Figure 1

- b) Remove the Cable Gland supplied with the Safety Interlock Cable and replace with the cable gland supplied with the Banner AC Interface Box. Do not tighten at this point. Refer to Figure 2.

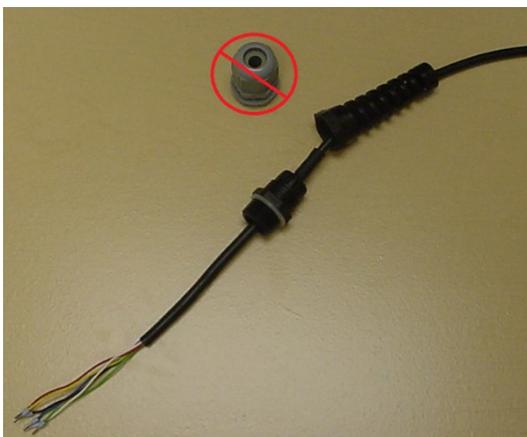


Figure 2

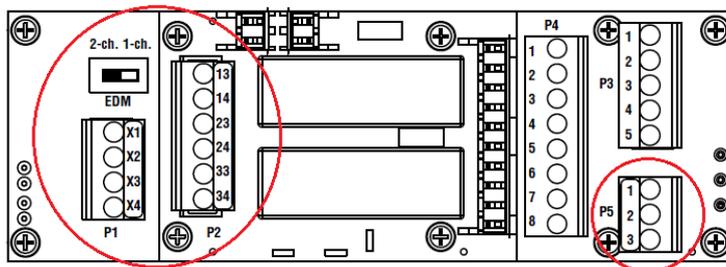
2 Fit an AC Power Cord with the second cable gland supplied with the Banner AC Interface Box. Do not tighten at this point. Refer to Figure 3



Figure 3

3) Remove the lid from the Banner AC Interface Box.

4) Identify the terminal block, P1, P2, and P5, inside the Banner AC Interface Box. Also identify the EDM slide switch.

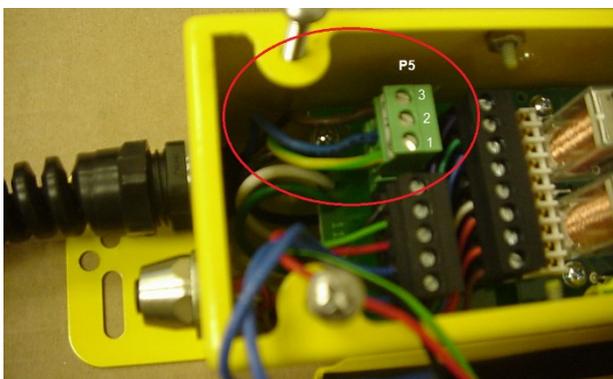


Model Number EZAC-R9-QE8.

5) Fit the cable gland for the AC Power Card onto the bottom hole of the Banner AC Interface Box. Connect the flying leads of the AC Power Cord to terminal block P5 inside the AC Interface Box. Tighten the cable gland after connections are made. Refer to Figure 4

AC Power	Terminal Block P5	AC Power Cord Wire Color
Earth	1	Green-Yellow or Green
Neutral	2	Blue or White
Line	3	Brown or Black

Figure 4



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6) Fit the two Shorting Links provided with the Banner AC Interface Box into terminal block P1 as followed; Refer to figure 5B

a.) short X1 to X2

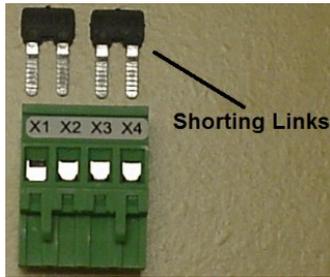


Figure 5A

b.) short X3 to X4

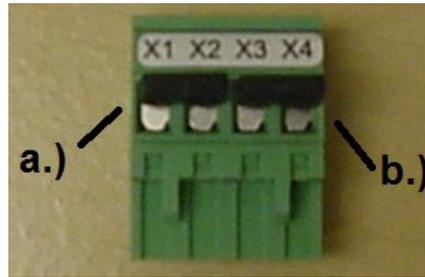


Figure 5B

7) Set the EDM Slide Switch to 2-CH EDM position. Refer to figure 6.

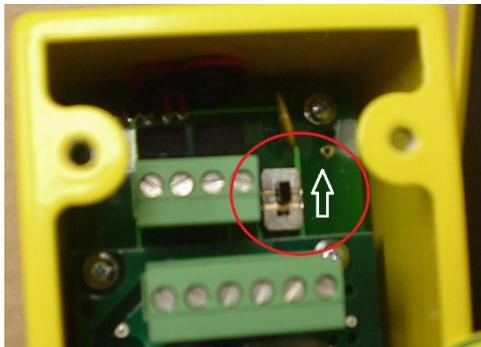


Figure 6

8) Fit the cable gland for the Safety Interlock Cable onto the top hole of the Banner AC Interface Box.  
Connect the flying leads of the Safety Interlock Cable to terminal block P2 of the AC Interface Box.  
Tighten the cable gland after connections are made.  
Refer to Figure 7

Terminal Block P2	Safety Interlock Cable Wire Color
13	Yellow
14	Blue
23	Green
24	Black
33	Red
34	White

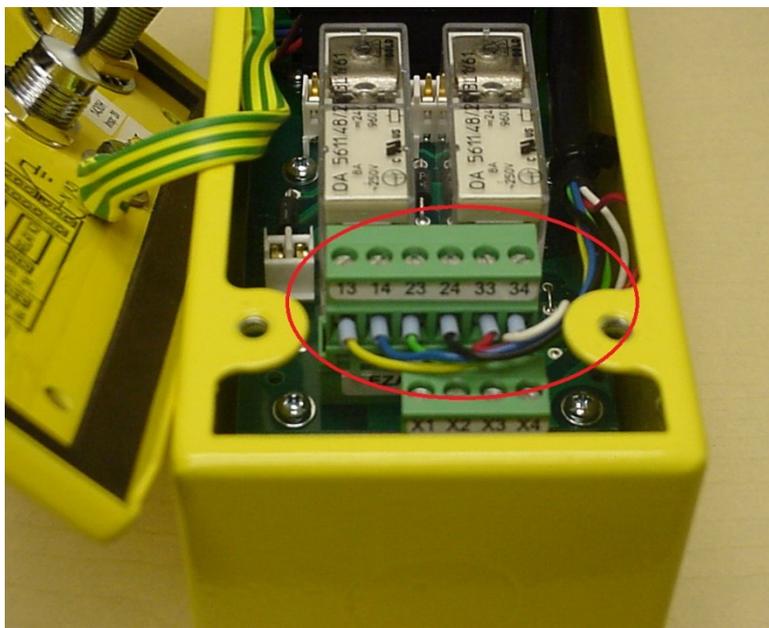


Figure 7

9) Replace the lid on the Banner AC Interface Box.

10) Connect the d-type connector to the AT5600's interlock port (see Figure 8).

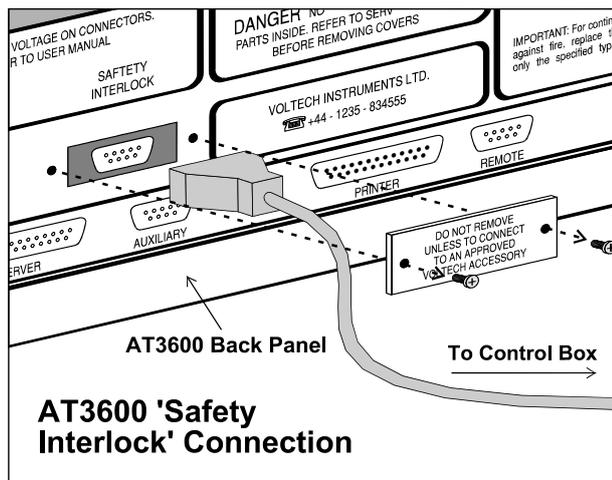


Figure 8

- 11) Position the AT5600, light curtain beams, control box and cables as described previously
- 12) Apply power to the light curtain control box and follow the manufacturer's instructions for test and use.
- 13) Apply power to the AT5600 and test the safety system as described in the next chapter.
14. Banner AC Interface Box, POWER light.



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# 4 TESTING THE SAFETY SYSTEM

## 4.1. RECOMMENDED DAILY CHECK

Testing of the safety system, which may include checking any physical barriers in the total safety enclosure surrounding the tester, should be supervised by your designated, qualified person responsible for operator safety.

The following tests must be carried out during installation of the light curtain and at periodic intervals, normally daily, as determined by the designated safety person:

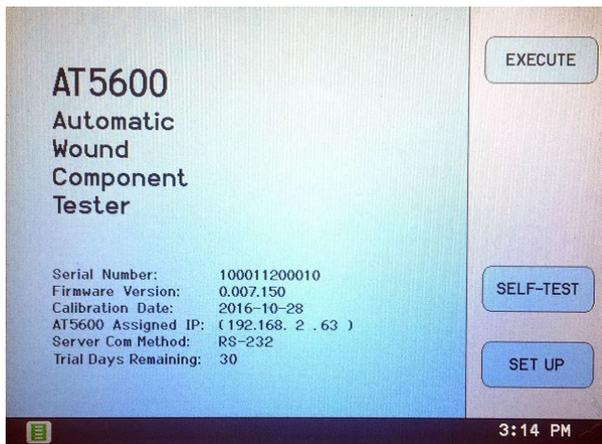
1. Check the integrity of the complete safety enclosure including warning notices and physical barriers.
2. Check that the light curtain columns, AC Interface Box, and cables are securely mounted and free from damage.
3. Check that the inside faces of the two columns is clean and free from dust. If necessary, wipe the beam windows with a clean, soft, damp cloth, taking care not to scratch the surface. Do not use organic solvents or thinners to clean the windows.
4. Switch on the power to your safety system, making sure there is nothing between the two columns. After a few seconds, the Banner AC Interface Box should be showing a green POWER light, indicating that the light curtain is ready for use. If the Banner AC Interface Box shows a red POWER light, then the light curtain must not be used. Perform the following checks in sequence, checking for a green light each time:
  - Clean the inside faces of the columns as above.
  - Make sure there are no obstructions between the columns during switch on.
  - Check that the columns have not moved out of alignment.
  - Check for changes in the lighting environment - reflective surfaces, dust or very strong sunlight can disrupt the beams.
5. When the Banner AC Interface Box is showing a green POWER light, then the IR beam detectors should be tested to be fully functional:
  - Use the test rod to break the infrared beams between the two columns. Insert the test rod at 90° to the beams and move it slowly from top to bottom in three places: midway between the columns and close to each vertical column. The POWER indicator on the Banner AC Interface Box will show red at all points while the test rod is in the beams.
  - Repeat the same procedure with the test rod inserted at 45 degrees to the beam.

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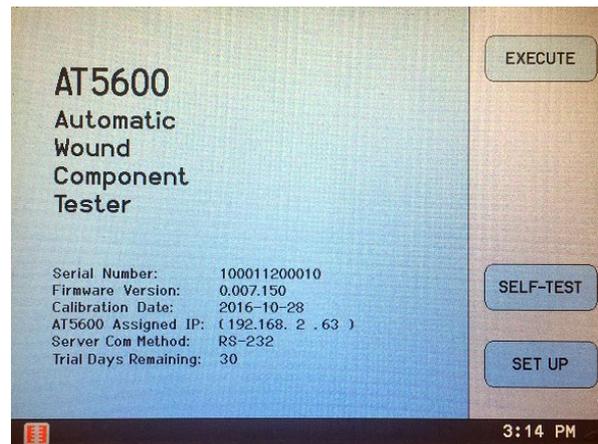
## 4.2. QUICK CHECK – COMPLETE SYSTEM

The above process will check the action of the light curtain on its own.  
To check the operation of the complete system (i.e. to confirm that the interlock signals are correctly understood by the AT5600) you can use the interlock icon on the display of the AT5600.

Repeat the above tests with the rod and observe the Icon on the front panel of the AT5600.



Light Beam NOT INTERRUPTED  
AT5600 Interlock icon is GREEN  
Test programs WILL execute



Light Beam IS INTERRUPTED  
AT5600 Interlock icon is RED  
Test programs WILL NOT execute

If any part of the operation is not correct, or if you suspect that the safety system is not operating properly for any reason, stop working and carry out detailed checks as described in this and the safety system manuals.

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## 5 OPERATING THE AT5600 WITH THE IR SAFETY SYSTEM

For a description of the use of the Light Curtain with the AT5600, please see the AT5600 user manual (98-119) chapter 6.

Chapter 6.5 describes the operating and warning messages that may be observed on the AT5600 when it is being used with a safety light curtain.

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## 6 CONSTRUCTING SAFE FIXTURES

As described in the previous section, when the light curtain of the safety system is broken, the tester will stop the execution of a high voltage test, and remove the dangerous voltages, to protect the operator from the dangers of electric shock.

This may sound a simple operation, but in fact it is not.

Firstly, there must be a certain amount of signal processing within the vertical columns to detect that the IR beams have been broken.

Secondly, the control box must signal this to the tester.

Thirdly, the tester must ramp-down the test source.

This final operation has to be done carefully, because if there is current flowing through the inductance of a winding and it is suddenly switched off, rather than creating a safe situation, it could produce a dangerously high 'back EMF'.

Clearly this means that, after the light curtain has been broken, there must be a finite amount of time to switch off and safely ramp down the potentially dangerous voltage. With the IR Safety System, this time could be up to 50msec.

This time must be born in mind when you are designing your test fixtures. It is essential that any high voltage point on the transformer under test is set far enough back from the light curtain so that it cannot be touched by the operator's hand within 50msec of breaking the beams.

Note that the high voltage points on the transformer could include the body or core (as well as terminals) if your program contains Hi Pot tests for core isolation.

The normally assumed value for the speed of an operator's hand is 2m/sec.

This speed implies that the distance from the beams of the light curtain to the dangerous point on the transformer should be at least 100mm.