BPU4 Blanking Programming Unit
Instruction Manual

WARNING

Tapeswitch photo-electric safety systems are intended to protect operators working at or near dangerous machinery. They can only perform this function if they are correctly fitted to a suitable machine. It is essential that the full contents of this manual and all the authoritative documents referred to herein are fully understood before any attempt at installation is made. If in doubt contact Tapeswitch Corporation.

IMPORTANT

This manual must accompany the product throughout its working life. Those persons responsible for the product must ensure that all persons involved in the installation, commissioning, operation, maintenance and servicing of the product have access to all the information supplied by the manufacturers of the machine and its safety system.

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Note: This manual must be used with all GS140 Light Curtains and B-Series Light Curtains with serial numbers ending with D01 and above

1. INTRODUCTION

1.1 GENERAL

WARNING

Incorrect use of blanking and/or failure to correctly address the implications of using blanking on the management of a machine is potentially very dangerous. It is therefore vital that the requirements for the use of blanking specified in this manual be fully understood and complied with.

The BPU4 Programming Unit is used to set up the blanking function on a Tapeswitch light curtain. This includes the GS140 Series light curtain product line.

Blanking is sometimes confused with other light-curtain-related functions, for example muting, and therefore, it helps to start with an explanation of exactly what blanking is.

First consider the normal operation of a light curtain without blanking. A light curtain typically consists of a grid of parallel beams of infra-red light, each beam consisting of an emitter device at one end and a receiver device at the other (see Figure 1).

If any single beam is obscured, the light curtain will generate a stop signal.

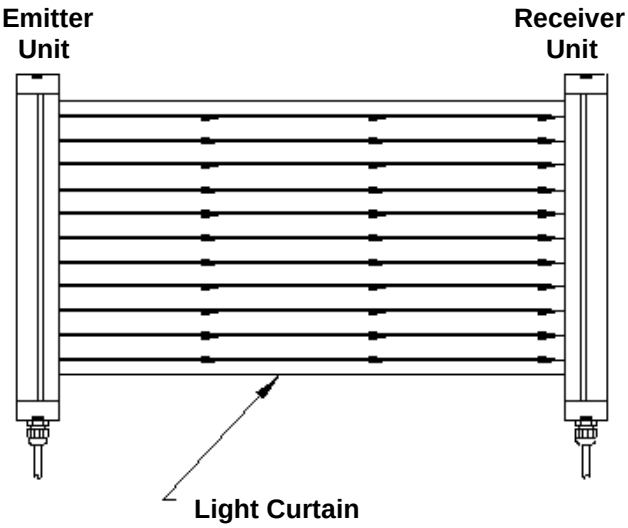

Figure 1

The decision process within the light curtain logic is a relatively simple one, as shown in Figure 2.

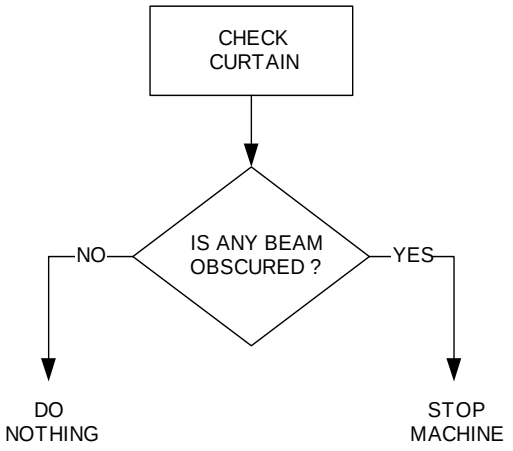

Figure 2

Now consider the operation of a light curtain that is using blanking. With blanking, the unit is able to:

- determine the state of each individual beam
- compare this information with previously programmed requirements
- based on this comparison, decide whether to send a stop signal to the machine.

The light curtain decision process is now a more complex one as shown in Figure 3.

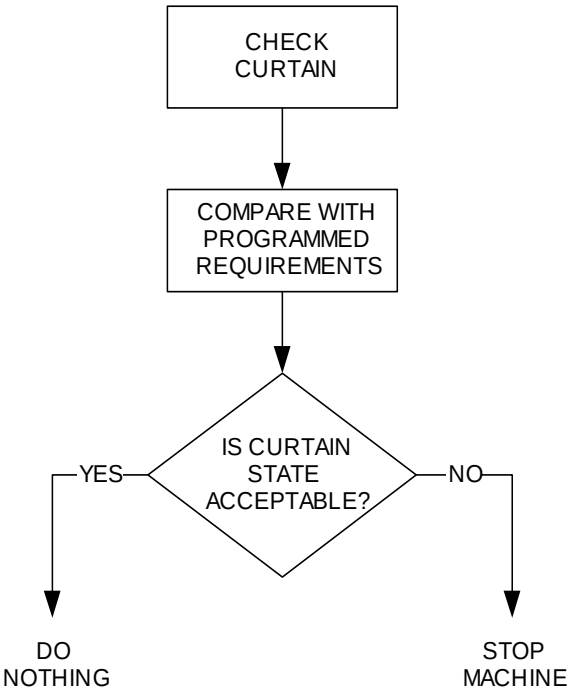

Figure 3

Blanking therefore modifies the basic instinct of the light curtain to stop the machine when any beam is obscured, and makes its response conditional.

Safe use of this modified behavior obviously makes special demands on the design of the light curtain, but equally important are the demands made on the installation, programming, operation and maintenance of the machine/light curtain combination.

Notice that the light curtain can only consider the question:

'Has this state of the curtain been programmed as acceptable?'

It cannot consider the question:

'Is this a safe state for the curtain to be in?'

This is the responsibility of those involved in the use of the machine, and can only be achieved with very careful consideration of all implications of the use of blanking as described in this manual and careful analysis of the application.

1.2 TYPES OF BLANKING

1.2.1 GENERAL

There are basically two types of blanking: fixed and floating. The two types can be used independently or in combination. The operation, purpose and implications of independent and combined use are considered below.

1.2.2 FIXED BLANKING

In fixed blanking, one or more selected beams, at particular positions in the curtain, are allowed to be obscured without a stop signal being generated.

NOTE: The behavior of a fixed blanked beam can be further modified by the use of fixed and floating blanking in combination. This is explained in section 1.2.4.

Fixed blanking is used where correct positioning of the light curtain dictates that some necessary fixtures on a machine, for example sheet supports on a press brake, will obscure some beams during normal operation.

These beams can be selected for fixed blanking so that the presence of the fixture does not cause the curtain to send a stop signal and the machine can be used normally. The curtain ignores the obstruction.

In the GS140 Series light curtain, once a beam has been specified as 'fixed blanked' it is monitored in 'opposite mode'. If a fixed blanked beam becomes unobscured, the light curtain will generate a stop signal, just as if a normal, non-blanked beam had been obscured.

The GS140 Series light curtain has positive blanking, which means, once the light curtain is programmed to expect an obstruction, it will ignore this obstruction. However, the light curtain will constantly verify this obstruction is present. If the obstruction is removed, the light curtain views this as a contradiction to how it has been programmed and it will issue a stop signal.

If a fixed blanked beam is not monitored in this way, removal of the fixture would leave an unprotected area in the curtain.

In the GS140 Series system the programming of fixed blanked beams is achieved by means of a learning function.

Using the BPU4, the light curtain is instructed to learn the state of the curtain, i.e., which beams are clear and which are obscured. This state is recorded in non-volatile memory. For this reason, fixed blanking is also referred to as learned blanking later in this manual.

After programming, the current state of the curtain is continually compared with the recorded state and any deviations will result in a stop signal being generated.

1.2.3 FLOATING BLANKING

Floating blanking allows a number of beams, usually one or two, to be obscured without a stop signal being generated. The term floating blanking is used because an obstruction can move or 'float' within the detection zone without a stop signal being generated, providing that the obstruction does not obscure more than the specified number of beams.

Floating blanking is used to allow an obstruction to move within the detection zone, for example where flexible cables or pipes pass through the detection zone and can move while the machine is operating.

The GS140 Series light curtain can be programmed for 1-beam floating blanking or 2-beam floating blanking.

The maximum size of an object which will be ignored by the curtain, at any range, is given in Table 1.

Basic Detection Capability	Type of Floating Blanking Used		
	None	1 Beam	2 Beam
14mm	2mm	8mm	17mm
30mm	5mm	15mm	32mm
70mm	5mm	38mm	88mm

Table 1 - Ignored Object Diameter

1.2.4 FIXED AND FLOATING BLANKING IN COMBINATION

When fixed and floating blanking are used in combination, the floating blanking modifies the fixed blanking. Recall that floating blanking, used independently, allows a number of beams to be blocked without generating a stop signal. It allows a number of beams which would normally need to be clear to be obscured. In other words, it allows a number of curtain discrepancies.

This is how floating blanking works with fixed blanking. When a light curtain has been programmed for fixed blanking, some beams need to be clear and all other beams need to be obscured, otherwise a stop signal will be generated. The floating blanking allows a number of curtain discrepancies. So, beams which would normally need to be clear can be obscured, and beams which would normally need to be obscured can be clear.

In the case of the GS140 Series light curtain, the maximum number of allowed curtain discrepancies can be set at 1 or 2.

This would allow a fixed blanked object, for example feedstock, to move slightly during machine operation. The maximum allowable movement of a fixed blanked object is given in Table 2.

Basic Detection Capability	Maximum Allowed Object Movement
14mm	9mm
30mm	17mm
70mm	50mm

Table 2

1.3 IMPLICATIONS OF BLANKING

1.3.1 EFFECT OF BLANKING ON DETECTION CAPABILITY

WARNING

Beam blanking changes the detection characteristics of the light curtain and should be used with caution. When blanking is used, always ensure that the safety distance is still sufficient with the modified detection capability.

Blanking of any kind increases the detection capability of a light curtain. The detection capability of a light curtain is the smallest diameter of opaque object which the system can reliably detect.

NOTE: An increase in detection capability is not an improvement. It means that the curtain is less sensitive to intrusions.

The **effective detection capability**, D_e, of the light curtain which is blanked can be calculated using the following formula:

Formula 1: $D_e = D_b + I\,(N_{fx} + N_{ft})$

where:

- I = beam increment (see Table 3)
- N_{fx} = number of beams in largest contiguous block of fixed blanked beams
- N_{ft} = number of floating blanked beams

Basic Detection Capability	Increment, I
14mm	9mm
30mm	17mm
70mm	50mm

Table 3

Note: Read sections 1.3.2 and 1.3.3 for guidance before using this formula.

1.3.2 EFFECT OF BLANKING ON SEPARATION DISTANCE

As previously explained, the use of any type of blanking increases the detection capability of the light curtain. Detection capability is one of a number of factors used to calculate the separation distance, i.e., the distance at which the light curtain is positioned from the dangerous parts of the machine. (See the light curtain manual for further details).

Normally the greater the detection capability the greater the separation distance, all other factors being equal. Certainly, the use of floating blanking always requires an increase in separation distance.

However, when using fixed blanking, although fixed blanking always increases the detection capability of the light curtain, it is not always necessary to increase the separation distance. This depends entirely on the nature of the obstruction.

Figures 4 and 5 show two obstruction possibilities: complete obstruction and incomplete obstruction.

In the case of incomplete obstruction it is possible for a person to gain access to the dangerous parts, between and on either side of the obstructions, through the area which would have been covered by the fixed blanked beams.

Therefore, in the case of incomplete obstruction, the **effective** detection capability has been increased and the separation distance must be calculated using this increased value.

In the case of complete obstruction, it is not possible for a person to gain access to the dangerous parts of the machine through the area of the curtain which would have been covered by the fixed blanked beams. When the light curtain/obstruction is considered as a whole, the detection capability in the unobscured areas of the curtain is not **effectively** increased.

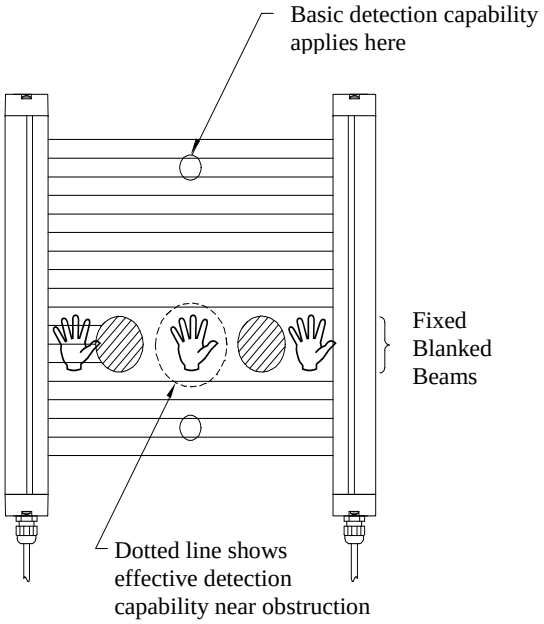

Figure 4 - Incomplete Obstruction

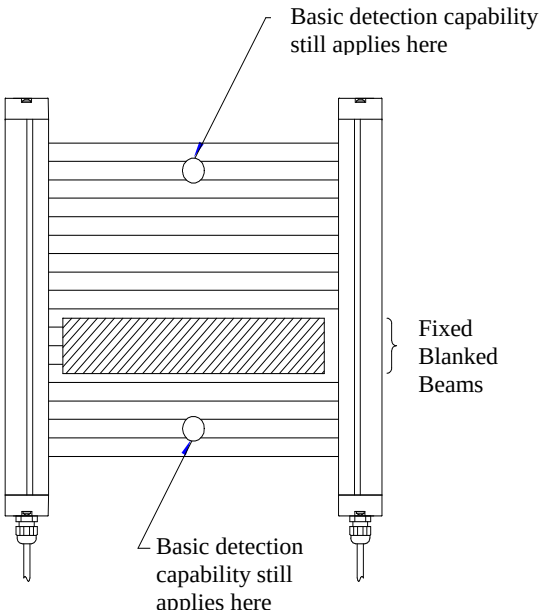

Figure 5 - Complete Obstruction

Therefore, the separation distance can be calculated using the **basic** detection capability value.

It is important that an obstruction originally considered as complete is not modified at a later date such that the use of the basic detection capability value is no longer valid. If this cannot be assured, it is recommended that the application is treated as an incomplete obstruction from the outset and the separation distance calculated accordingly.

NOTE: Any gaps between a complete obstruction and the light curtain units must not exceed the values recommended in EN294.

Figure 6 shows a combined obstruction where, due to the shape of the obstruction, part of the curtain is completely obstructed and part of the curtain is incompletely obstructed. In this case the complete and incomplete parts of the obstruction should be treated separately.

In all cases, if the obstruction is removed, the opposite mode monitoring will take effect and will cause a stop signal to be generated.

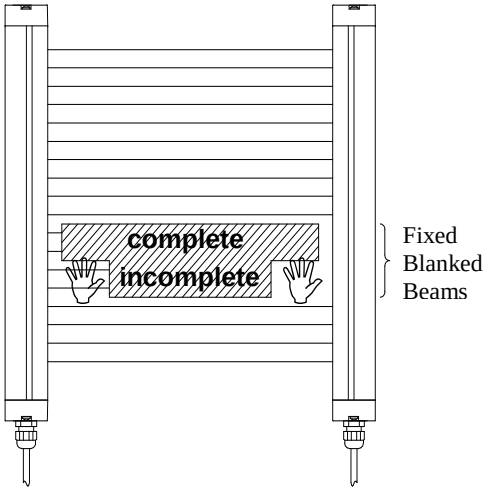

Figure 6 - Combined Obstruction

1.3.3 CALCULATION OF EFFECTIVE DETECTION CAPABILITY

The effective detection capability to be used for the purpose of calculating the separation distance can be determined as follows:

Case 1 Fixed blanking with complete obstruction: Basic detection capability applies.

Case 2 Fixed blanking with incomplete obstruction: Formula 1 applies.

Case 3 One or two beam floating blanking only: Formula 1 applies (see table 4 below).

Case 4 Fixed blanking with one or two beams floating blanking and complete obstruction: Formula 1 applies with $N_{fx} = 0$.

Case 5 Fixed blanking with one or two beam floating blanking and incomplete obstruction: Formula 1 applies.

NOTE: If there are a number of obstructions in the same curtain the calculation must be made for each obstruction and the largest value found should be used in the calculation of separation distance.

Basic Detection Capability	1 beam floating	2 beam floating
14mm	23mm	32mm
30 mm	47mm	64mm
70mm	120mm	170mm

Table 4

Full details of the calculation of separation distance can be found in the technical manual for the light curtain and in the ANSI Standard B11.19-1990.

For cases 2 and 5, if the number of beams which are fixed blanked (N_{fx}) is not clear the following procedure can be used:

1. Measure the largest obstruction, where it obscures the curtain.
2. Divide the measurement by the appropriate increment, I, shown in Table 3.
3. Add 0.25 to the answer **then** round up to the next integer.
4. Use this value for the term N_{fx}.

Example: A vertical light curtain with a basic detection capability of 30mm is incompletely obstructed by horizontal sheet supports with section 48mm x 48mm.

The value of I for a curtain with basic detection capability of 30mm is 17mm (from table 3).

48 divided by 17 gives 2.82
Adding 0.25 gives 3.07
Rounding up to next integer gives 4.
Using $N_{fx} = 4$ in Formula 1 gives:

$$D_e = 30 + 17\ (4 + 0)$$

$$= 98\text{mm}$$

Use this value for detection capability when calculating separation distance.

2. BPU4 PROGRAMMING UNIT

2.1 UNIT DESCRIPTION

The BPU4 programming unit is required to program the blanking function of a GS140 Series system.

The receiver unit of the GS140 Series system must have an 8-pin male connector.

The BPU4 unit has two 3 foot cables. One cable has an 8-pin male connector and the other has an 8-pin female connector. The unit is designed to be connected in line with the receiver/machine interface cable as illustrated in figure 7 and described below:

Step 1 Remove the orange receiver cable female from the receiver unit.

Step 2 Connect this cable to the male cable on the hand held blanking (programming) unit.

Step 3 Connect the female cable of the hand-held blanking (programming) unit to the receiver.

The BPU4 is now ready to program the light curtain. Once the blanking is complete, remove the hand-held (programmer) from the system.

The BPU4 has five indicators and two buttons. The front panel of the BPU4 is shown in figure 8.

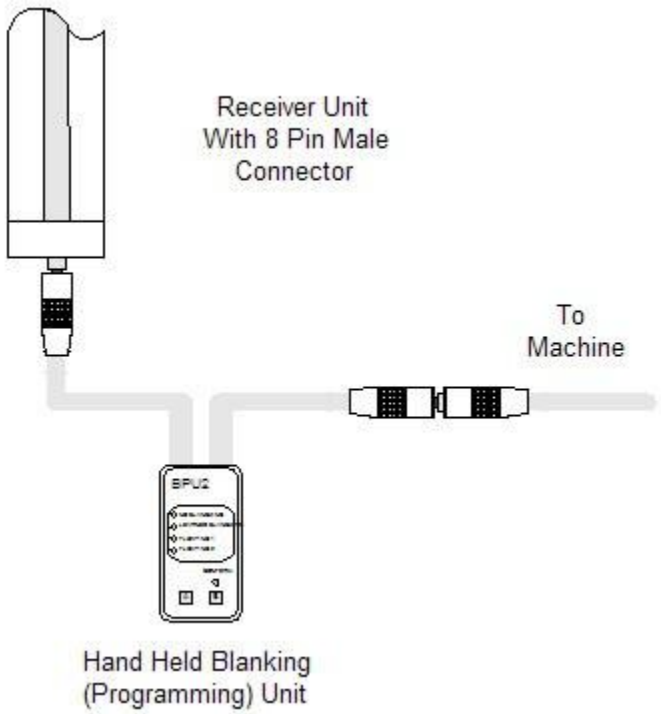

Figure 7

Four of the indicators are associated with the four types of blanking:

- no blanking
- learned (fixed) blanking
- 1 beam floating blanking
- 2 beam floating blanking

Because these can be used in combination there are six possible programmed modes:

- no blanking
- learned (fixed) blanking
- 1 beam floating blanking
- 2 beam floating blanking
- learned with 1 beam floating blanking
- learned with 2 beam floating blanking

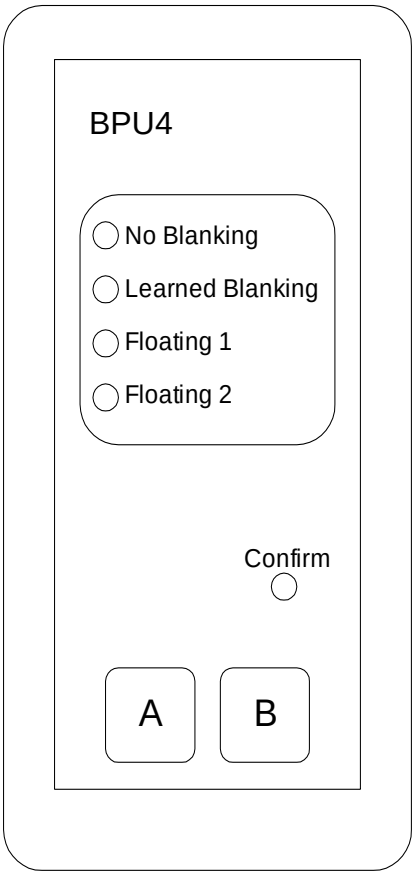

Figure 8

2.2 PROGRAMMING INSTRUCTIONS

The basic programming sequence is described below and illustrated in Figure 9:

1. Connect the BPU4 in line with the GS140 Series receiver unit. All the mode indicators will come ON with the current mode indicator(s) flashing.

2. To enter programming mode, press buttons A and B together for 3 seconds. The mode indicators will go OFF. Once the mode indicators go OFF, release both buttons and after a short period the confirm indicator will come ON and then go OFF. Button B must be pressed within 1 second of the confirm indicator coming ON and released within 1 second of the confirm indicator going OFF.

3. If step 2 is followed correctly the indicators for the current mode will be ON steady. Pressing button A repeatedly will cycle the indicators through the possible blanking modes.

4. To program a particular mode, press buttons A and B together for at least 3 seconds when the desired mode indicators are ON.

5. While the light curtain is programming the selected mode, the selected mode indicator(s) will flash. Once the selected mode has been programmed the other indicators will come ON steady and the programmed mode indicators will flash.

6. After a short period, providing the curtain is in an acceptable state, the outputs will come ON. The system is now in the initial state. Disconnect the BPU4 unit from the light curtain.

KEY: = ON = FLASHING = OFF

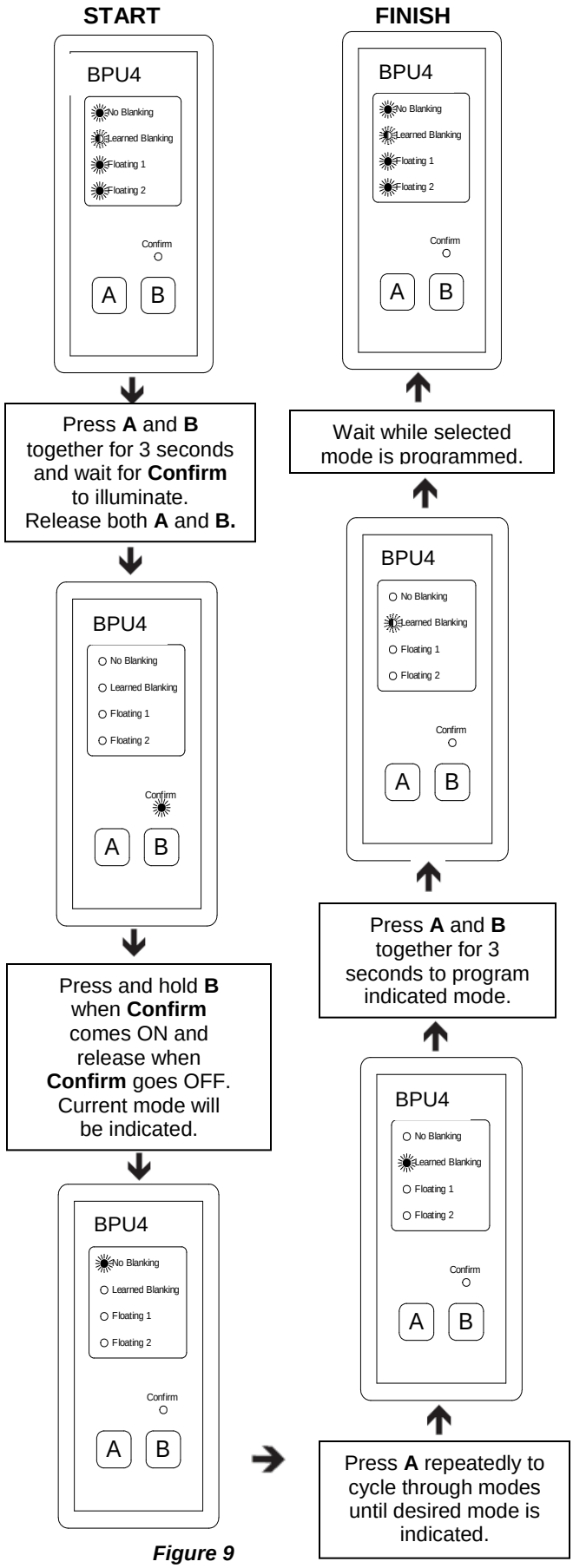

Figure 9

2.3 OPERATING CONSIDERATIONS

2.3.1 BPU4 OPERATION

1. Beam 1, the beam nearest the connector end of the emitter and receiver units, cannot be blanked in any way. If beam 1 is obscured, the outputs will go OFF.

2. When the BPU4 unit is attached to the light curtain initially, check that all the mode indicators illuminate.

3. Once programming mode has been entered, if no buttons are pressed for a period of ten seconds, programming will automatically abort and the previously programmed mode will be resumed. Similarly, if an inappropriate sequence of button operations is performed the programming will automatically abort. Automatic aborting will be indicated by all the mode indicators illuminating for a period of five seconds.

4. The machine cannot be operated with the BPU4 connected to the light curtain. It is recommended that the BPU4 unit be held by a responsible person when not in use.

5. If no beams are obstructed, learned blanking will not program. If the selected mode **is** learned blanking or **includes** learned blanking, the light curtain will default to the selected mode **minus** learned blanking. For example, if learned blanking only is selected, the light curtain will default to no blanking; if learned blanking with 2 beam floating blanking is selected the light curtain will default to 2 beam floating blanking only.

6. If the light curtain is in test mode (indicated by the red indicator on the emitter unit being lit steady) the programming unit will not function.

7. If the communication link between the light curtain and the BPU4 unit is not functioning all the mode indicators will flash while the BPU4 is connected.

2.3.2 CURTAIN OPERATION

When a light curtain is programmed for blanking of any type, the yellow indicator on the light curtain receiver unit will be steadily lit. This confirms that the light curtain has been programmed for some mode other than no blanking.

3. MANAGEMENT ISSUES

3.1 BLANKING TEST PROCEDURE

Immediately prior to programming the light curtain for learned (fixed) blanking (with or without floating blanking), it is essential that the light curtain be tested as follows:

1. With the light curtain in its intended position on the machine but with no obstruction in place, program the light curtain for “NO BLANKING”. Check that all the indicators of the BPU4 unit illuminate when the programming unit is initially attached to the light curtain. A faulty indicator could lead to programming of the wrong mode.

If any indicator does not illuminate, **DO NOT USE THE PROGRAMMING UNIT UNTIL IT HAS BEEN REPAIRED.**

2. Perform the daily test on the light curtain system, as detailed in the light curtain technical manual, using the test piece supplied with the light curtain (i.e., the test piece with a diameter which is the same as the detection capability marked on the light curtain unit labels).

If this test fails, **DO NOT USE FIXED BLANKING UNTIL THE LIGHT CURTAIN HAS BEEN REPAIRED.**

3. If the test is passed, without moving the light curtain, fit the obstructions in place and program the desired blanking mode.

This test ensures that faulty beams, which may not be obscured by the obstruction, are not inadvertently blanked.

3.2 DETECTION CAPABILITY - TEST AND INDICATION

When blanking is in use, the detection capability can be affected such that the detection capability marked on the light curtain units is not correct. This also means that the test piece supplied with the light curtain is no longer suitable for performing the daily tests.

Previous sections of this manual describe how to determine the effective detection capability for any blanking situation.

A test piece will need to be obtained or produced to suit the effective detection capability, in order to perform the daily tests.

Also it is recommended that the current effective detection capability of a system be recorded and clearly displayed at the machine.

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