# Annex A - Functional Specifications of the Alarm

*(please do NOT include this annex in your report)*

The Alarm has three main modes of operation, OFF, Presence Detector and Active. The three modes are selected by a three positions switch. The three modes operate as detailed next:

**(Mode 1) OFF** – this mode deactivates the alarm completely.

**(Mode 2) PRESENCE DETECTOR** – the infrared sensor is used to detect the movement on the room/space, that be signalized resorting both to a lamp and to the buzzer on the panel. The lamp should be on for 5 seconds, upon the detection of each person, and an acoustic signal with the duration of 1 second should be emitted.

**(Mode 3) ACTIVE** – in this mode the alarm is to be used.

Detailed specifications for mode 3, **ACTIVE**, are the following:

a) When requested for activation, a period of 30 seconds of inactivity is set to allow the user to abandon the space, and afterwards remains permanently activated.

b) Upon intrusion detection, by the infrared sensor or the window switch, the alarm evolves to the warning phase.

c) The alarm lights a warning on the panel and after 5 seconds the buzzer must be activated. The warning must be a periodic signal with 1 second on and 2 seconds off.

d) The alarm can be deactivated pressing the # key on the command panel.

**Advanced Characteristics of the Alarm:**

An advanced alternative for the alarm activation/deactivation consists on the use of a code previously set by the human owner (e.g. 9887). To implement the activation function, the following procedure must be implemented:

a) switch the alarm mode to ACTIVE.

b) introduce the activation code (e.g. 9887).

c) press #, and wait for 30 seconds to allow the user to abandon the space.

d) start the intrusion detection function, i.e. the alarm is fully operational.

To deactivate the alarm, upon intrusion detection or to allow the use of the space, the following instructions must be accomplished:

a) Introduce the secret code (the same as the activation one, e.g. 9887).

b) Press #

c) Change the alarm mode to a mode other the ACTIVE.

**Special Characteristics of the Alarm:**

A safer mode of operation for the intrusion detection alarm is to allow the user to change the activation/deactivation code. The code 1234 is initially used, as a factory preset. To change the code, the following operations must be done:

a) Press \*, followed by the pre-programmed code.

b) Introduced the new code to be used, finished by \*

In the case where a mistake occurs, press the code \*\*\*\* to reset the code to the factory default.

**Available Material**

In the laboratory there are six different working places, all with similar PLCs but different consoles. All workplaces have a PLC Schneider model P57. All of them have a power supply with 24V and/or 12V and a desktop PC, with the Unity Pro v6 development software and the PLC manuals, in PDF format.

In each workplace there will be also an alarm console with the following components:

|  |  |
| --- | --- |
| 1 three positions switch  1 two positions switch  3 LEDs  1 keyboard (4x3 buttons)  1 buzzer (12V) |  |

The solution for this automation problem must be based on the languages described on the IEC-61131-3 standard, i.e. ladder diagrams, instruction list and structured text.

# Annex B - 4x3 Keyboard

*(please do NOT include this annex in your report)*

The keyboards[[1]](#footnote-1) that are used in the laboratory have 12 keys arranged in a 4x3 matrix (see the next figure). The terminology to be used in the laboratory is the following: the three columns are named by the digits 1,2,3 and the four lines by the letters a,b,c,d.

 

The next image shows the inside of a keyboard. Notice that keyboards can be made simply of contacts which are short circuited when someone presses a button. For example, pressing key "eight" shorts the circuit of column 2 with line c. Most 4x3 keyboards have 4+3 wires. Some, as the one shown in the figure bellow, can have also an 8th wire which will not be used in the project.



In this picture the pads with holes for wiring the keyboard to a terminal (or a PLC) are marked, from left-to-right, 3,2,1,a,b,c,d. This sorting is not standard among manufacturers. In most cases columns and lines are mixed and unsorted as the base printed circuit boards are simpler. Every 4x3 keyboard must be tested to identify the pads corresponding to the 3 columns and the 4 lines.

A possible algorithm for identifying the 3 pads that can act the columns and the 4 pads that can read the lines is the following:

- Choose 2 of the 7 pads of the keyboard and use the multimeter (ohmmeter) to verify that, after pressing all keys, the 2 chosen pads (i) can or (ii) cannot be short circuited.

- If the two chosen pads can be short circuited by a pressed key, i.e. case (i), then press another key in the same column and change one of the two selected pads to the other 5 positions. If the novel key is not identified, then return the changed pad to its original location and do the same 5 tests with the other pad. This procedure allows naming a pad as column 1, 2 or 3.

- If case (ii), then the two chosen pads connect to two lines or to two columns, not one line and one column. Need to reselect one pad of the selected pair. Repeat this until a pair of pads is in accordance with case (i).

- After identifying the pad defining one column, it is easy to identify 4 pads corresponding to the 4 lines, as pressing keys in the right column must always do a short circuit to another pad.

- Having identified 1+4 pads, the remaining two pads are connected to the two other columns. Pressing a key in one column or the other makes a short circuit to one of the four lines.

1. The keyboards used in the laboratory in essence show just digits and therefore are more commonly known as numerical keypads or, simply, keypads. [↑](#footnote-ref-1)