ARMIDOR

Digital Doppler detector
for external protection
General installation manual
Edition 1.0

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INDEX

1) GENERAL DESCRIPTION

The Armidor is a volumetric microwave detector, for external protection that uses the Doppler principle and digital signal analysis.

The size and shape of the detection field make it particularly useful for protection of both completely open areas and areas with irregular shapes and obstacles. Armidor is especially suitable for situations difficult to protect with other devices: for example the dead zone near the cross-over or overlap of microwave barriers. Furthermore, thanks to a particular feature of the planar antenna that creates an aperture angle of 90° on the horizontal plane and 22° on the vertical plane, Armidor can produce a "Curtain" of protection. This is particularly suitable to cover the front of buildings, ensuring effective protection against intrusion. The interface with the MW transmitter-receiver has been created using a special thick film hybrid circuit, that generates the transmitter modulation signal and demodulates and pre-amplifies the received signal.

This special circuit, combined to the new generation MW transmitter-receiver, produces a great improvement in the signal to noise ratio, particularly at the lowest frequencies, that are consistant with slow and transverse movements through the protection field.   This produces a drastic reduction in the difference in sensitivity between the longitudinal and transverse movements, usually a feature of Doppler devices.

The performance is further enhanced by the analysis of the signal which, after amplification, is sampled by three Analog to Digital converters and the different "samples" selected are passed to the on-board microprocessor. These samples are analysed step by step as received, through complex algorithms, using "Fuzzy" logic.

This state of the art analysis, avoids the problems with external environments that normally affect mono-static microwave devices (i.e. with transmitter and receiver in the same head).

The Fuzzy analysis of the signal greatly improves, compared with traditional signal analysis, the ability to discriminate between the signal noise, signals produced by various interference factors, for example the rain, and those produced by the movement of an intruder.

The the on-board microprocessor also analyses the operation of the microwave and can detect faults and attempts to mask the device.

Furthermore it has a global, self-diagnostic test of all the circuit components that generates specific fault alarms for the device.

It is also possible to make a remote functional test, from the control panel.
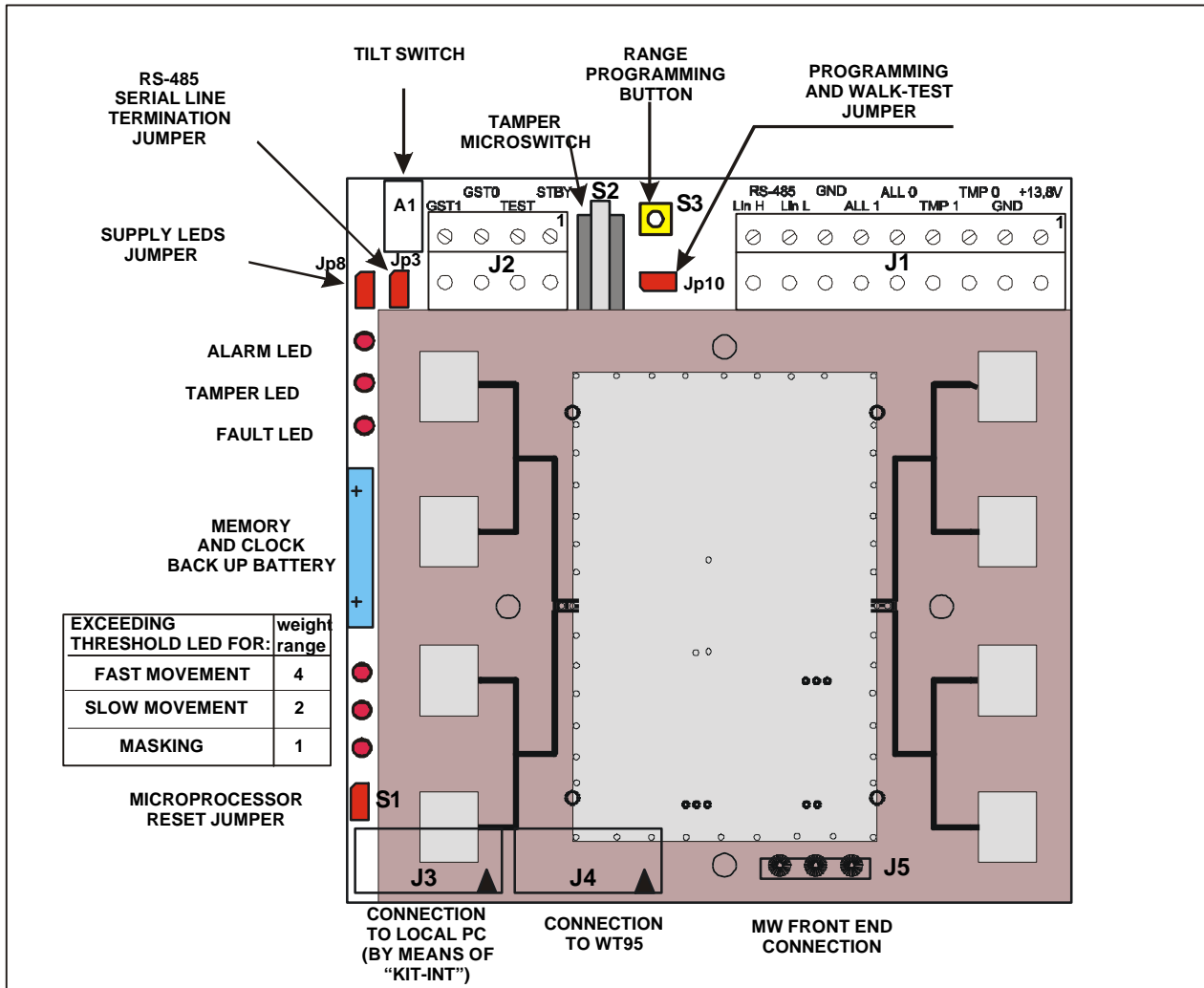
2) BLOCK DIAGRAM AND LED LAYOUT, JUMPERS, TERMINAL-BLOCKS

The following two figures show the Block Diagram and led layout, jumpers, connectors, terminal-blocks and push buttons of the Armidor detector.
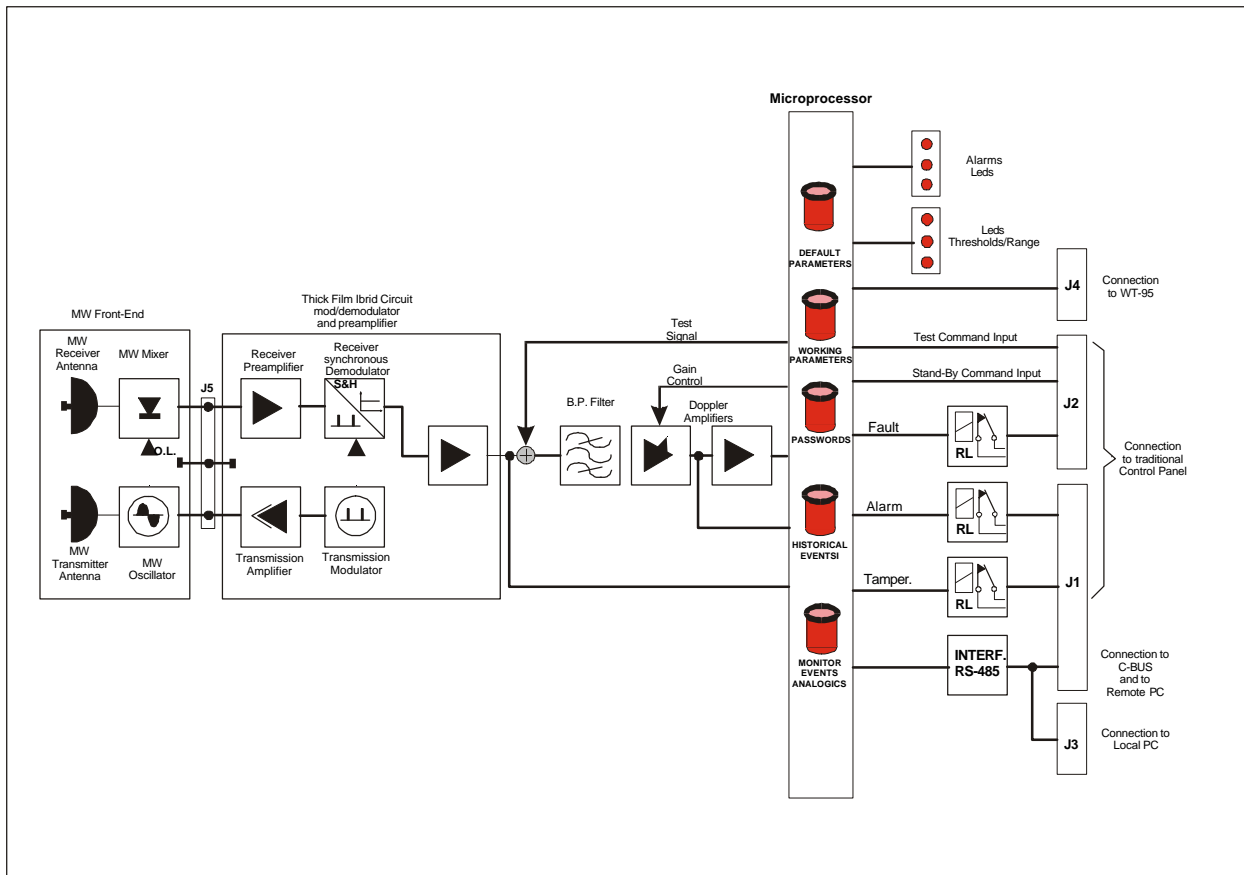
- Fig. 1 -

Armidor Block Diagram

- Fig. 2 -
Layout and function of Leds, Jumpers, connectors, Terminal-Blocks.

3) **TECHNICAL CHARACTERISTICS**

The following table shows the technical/operational features of the Armidor detector.

### **Technical/Operational Features**

1)	Analysis	Of the Doppler signal using Behaviour Models for detection of slow, quick, longitudinal, transverse movements, using algorithms designed according to the "Fuzzy" logic (Fuzzy Behaviour Models or **FBM**) models.
2)	Analysis	Of the absolute value of the received signal for detection of Masking attempts and to detect possible faults in the MW components.
3)	Analysis	Of the signal state, in order to avoid the noise due to the rain (Fuzzy Rain Filter or **FRF**)
4)	Analysis	Of the signal state, in order to avoid the general noise (Fuzzy Constant False Alarm Rate or **FCFAR**)
5)	Analysis	Of the DC power supply (High or Low)
6)	Analysis	Of the environmental temperature to detect possible faults and to compensate signal differences due to temperature changes.
7)	Analysis	Of the cover opening (Radome).
8)	Analysis	Of a Stand by command input, for inhibiting the recording of Historical and Monitor events in Armidor.
9)	Analysis	Of a Test command input, that enables a test signal inside Armidor and if the result is positive produces an alarm through the alarm relay and the serial line (connection with interface or control panel **"C-BUS"**)
10)	Activation	Of three solid state relays for Alarm, Tamper, Fault.
11)	Activation	On RS-485 serial line, after polling of the three alarm states, alarm, tamper, and fault (connection with interface or control panel **"C-BUS"**)
12)	Activation	Of three leds indicating alarm, tamper, fault (can be disabled)
13)	Availability	Of a lithium battery that keeps the historical, monitor and clock calendar data during power supply failure.
14)	Availability	Of a clock-calendar (2000 compliant) that marks the events that are stored inside Armidor (Historical and analogue monitor events.
15)	Availability	Of Historical files inside Armidor for the last 256 events, with the indication of the date, hour, and type of event and further possible values. This data can be downloaded, using software called Armidor Test and stored on the hard disc from where they can be viewed and printed.
16)	Availability	Of the last 100 records of 2.5 sec. each, of the detected analogue signal, when it passes the Monitor threshold, set up by the installer.
17)	Availability	Of default parameters, used whenever Armidor has not been set up or when a self-check finds a corrupted value.
18)	Availability	Of a connector for the set-up instrument WT-95
19)	Availability	Of a connector to use a PC on serial line RS-485, which allows, using the SW Armidor-Test, setting, testing and management of the detector.
20)	Availability	Of a single RS-485 line to collect all the alarms, initiate the Stand-by and Test commands, and all the commissioning and management of each device.

The table is a list of the technical characteristics of the **ARMIDOR.**

TECHNICAL CHARACTERISTICS	Min	Nom	Max	Note
Operating Frequency (meets the requirements of the different countries)	9,47 GHz	9,9 GHz	10,58 GHz	
RF Power (meets the requirements of the different countries)	-	500 mW PIRE	-	
Modulation	-	-	-	on/off
Duty-cycle	-	1/10	-	
Range	4 m	-	20 m	
Current consumption in normal state with Leds (mA --):	-	57	-	
Current consumption in alarm state with Leds (mA --):	-	53	-	
Current consumption in normal state **(mA --):**	**-**	**51**	**-**	
Current consumption in alarm state (mA --):	-	47	-	
Intrusion alarm contact (Static Relay)	-	-	100mA	C-NC
Tamper contact (Static Relay)	-	-	100mA	C-NC
Fault contact (Static Relay)			100mA	C-NC
Red Led for intrusion alarm	-	-		on
Red Led for Tamper	-	-		on
Red Led for Fault	-	-		on
Red Led for exceeding fast movements threshold	-	-		on
Red Led for exceeding slow movements threshold	-	-		on
Red Led for exceeding masking threshold	-	-		on
Threshold setting	-	-	-	SW
Range setting: 8 steps of 2m each (Step 1 - 4m)	4 m	-	20 m	SW or WT95
Weight	-	1000 g	-	
Diameter	-	-	120 mm	
Depth including clamps	-	-	120 mm	
Working temperature	-20 °C	-	+60 °C	
Case protection level	IP55			

4) DIMENSIONS AND SHAPE OF PROTECTION FIELD

ARMIDOR creates a protection field whose shape is asymmetric: the horizontal plane has an aperture angle of 90° and the vertical plane an aperture angle of 20°. The protection field is shown below:

Protection field
HORIZONTAL PLANE

Protection field
VERTICAL PLANE
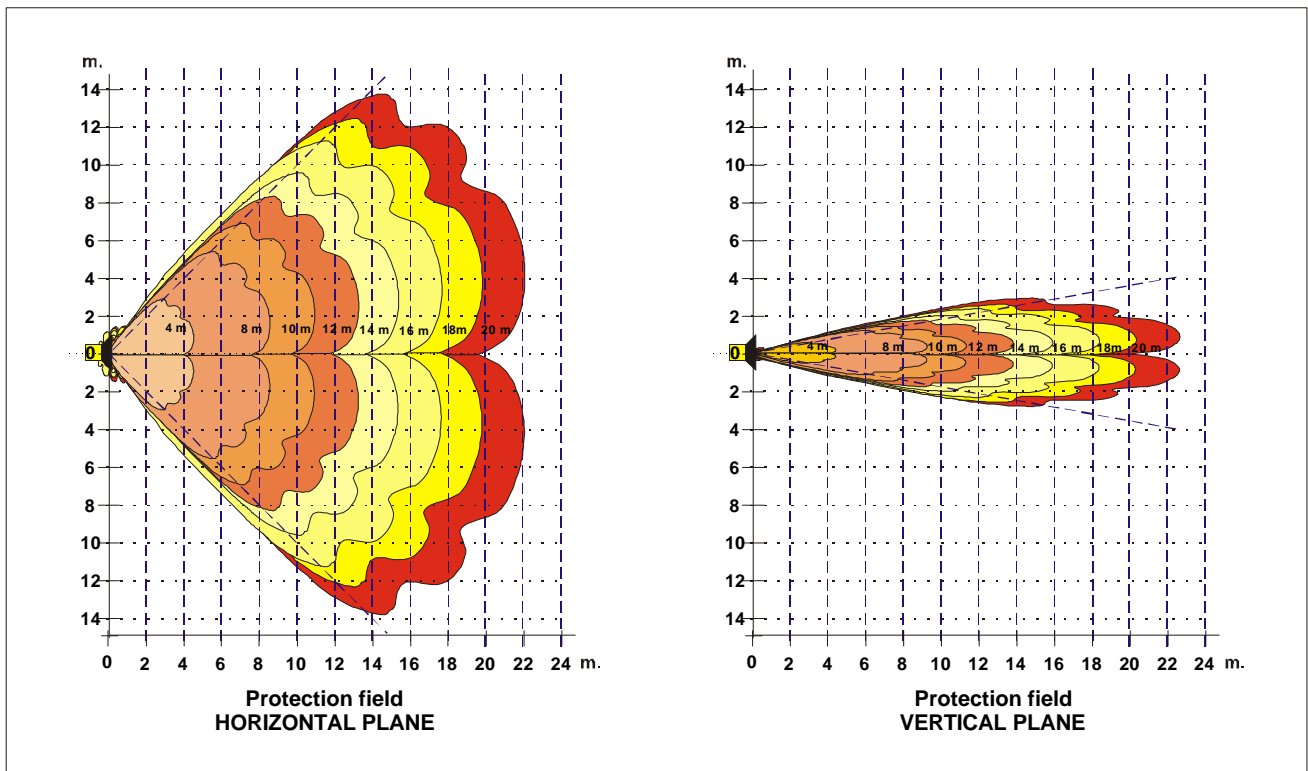
In the above figure it is possible to see how the protection field changes when the different ranges are set. These ranges can be set by the installer and go from 4m to 20m in steps of 2m each, except for the first step that goes from 4m to 8m.

**Protection field
HORIZONTAL PLANE**

**Protection field
VERTICAL PLANE**
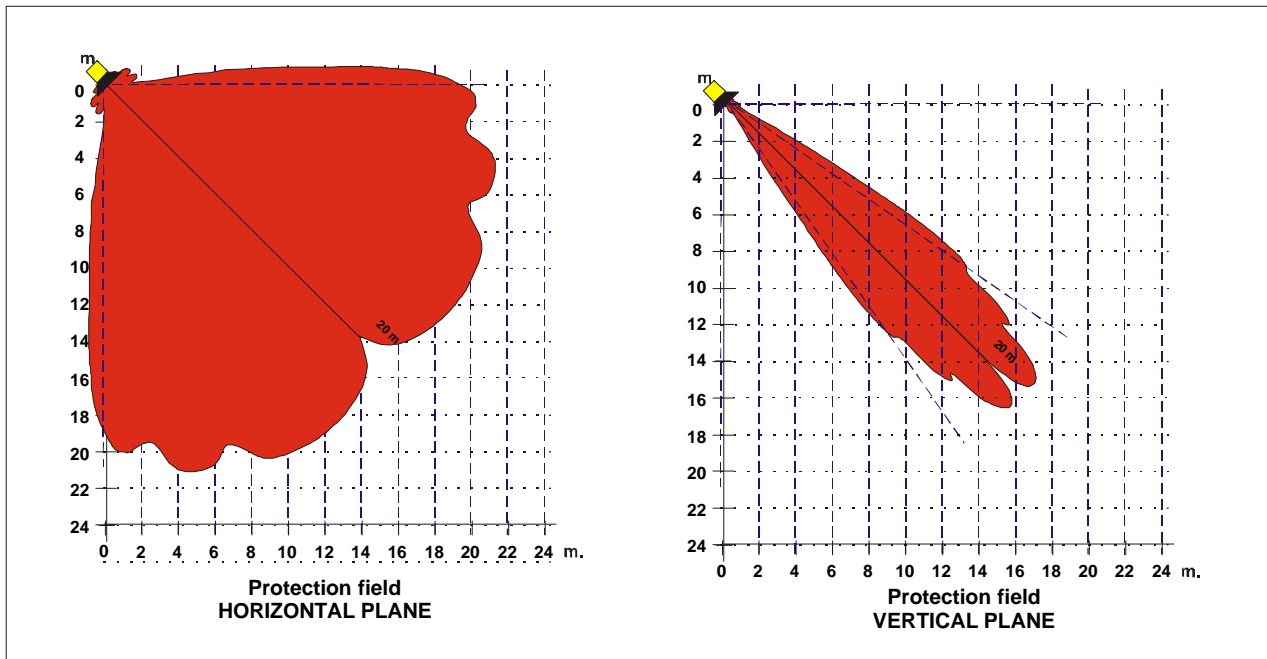
The above figure shows both planes of the protection field at maximum range only, for a better understanding of how the microwave field is shaped.

5) SYSTEM COMPONENTS

ARMIDOR is an external detector and therefore the housing is waterproof. All the electronic and MW components are inside. An aluminium plate with a joint is fitted to the back of the housing, to mount the device, using an optional bracket, to a 60mm external diameter pole or to the wall. The incoming cable is fed through a flexible conduit union (also water-proof) fitted on the aluminium plate.

6) **ACCESSORIES**

The accessories available for the ARMIDOR are as follows:

- Wall fixing bracket   10 cm.
- Wall fixing bracket   30 cm.
- Pole fixing bracket   10 cm.
- Small metallic rain-shield
- Walk Test instrument "WT 95"
- Interface converter RS-485/RS-232 "Kit Int"
- Commissioning and management software "Armidor-Test"

- The choice of the first three accessories depends on the installation requirements.

- The rain-shield is necessary in all the cases where ARMIDOR will be subject to driving rain, which hits directly on the face of the device and could give nuisance alarms. In all the other cases, the rain is recognised and discriminated through a special filter (**FRF** Fuzzy Rain Filter) that allows correct operation without false alarms even with heavy rain. The use of the rain shield is only to avoid rain drops directly on the front of the detector.

- The WT-95 instrument is shown below:

This allows range setting and "Walk-Testing" of the ARMIDOR. It is supplied with a flat cable (10 wires), to link it to the connector on the ARMIDOR. Range setting is by closing jumper JP10 on the ARMIDOR, and pushing the "install" button repeatedly on the WT-95 instrument. The three leds named "Down", "Function" and "Up", nominated 1-2-3 respectively, will display the selected range as per the following table:

N° of step	Range	Leds status		
	[meters]	1	2	3
1	4	Off	Off	Off
2	8	On	Off	Off
3	10	Off	On	Off
4	12	On	On	Off
5	14	Off	Off	On
6	16	On	Off	On
7	18	Off	On	On
8	20	On	On	On

When the JP10 jumper on ARMIDOR is closed the audible "Walk-Test" function is also enabled. This function uses the buzzer inside the WT-95, which will sound in pulse mode, with a repetition frequency proportional to the intensity of the doppler signal received, produced by the movement in the protection field. The sound becomes continuous in case of alarm, allowing the installer to perform an effective check and set-up of the device single handed. Using this instrument it is also possible to check if there are any hidden sources of interference: without movement there should not be any sound from the instrument.

The interface connection RS-485/RS-232 "Kit-Int" has a flat cable with 10 conductors for connection to the J3 connector of the ARMIDOR. This interface converter allows the ARMIDOR to be connected to a PC installed with the commissioning and management software "Armidor-Test". The features of this SW are described in the software manual.

Note that the RS 232 (V 24) interface that this device presents is DCE type and is physically one female connector (25 pins: ISO DIS 2110). The conductors used are as follows:

Circuit CCITT V24	CONNECTOR PIN	FUNCTION DTE $\rightarrow$ DCE
C102	7	Signal Ground
C103	2	Transmitted Data
C104	3	Received Data

7) INSTALLATION

7.1) Site Preparation

ARMIDOR is a detector that, thanks to its operating principle (Doppler Effect), does not require any particular site preparation; on the contrary it can be used in those situations where other devices would experience significant and difficult to solve problems.

For instance, ARMIDOR can be used to cover dead zones in a MW barrier systems, where there is not enough space to allow for correct cross-overs or overlaps. Another practical use is to protect balconies, terraces, and the front of buildings. In these cases, thanks to the special shape of the beam, it is possible to create very efficient protection, without false alarms. It is only necessary to ensure that the brackets are well fixed, that Armidor will not be subject to direct rainfall (use the small rain shield), that Armidor does not look directly at fluorescent lamps and that it is not placed in front of moving fan blades (especially metallic) such that the vanes could cause false alarms.

Armidor can work together with all CIAS Bi-static detectors (MW barriers Minermo, Ermusa, Ermo) without any special precautions; the operation of the Armidor or of the barriers will not be affected, even if the Armidor is placed near the barrier transmitter or receiver.

7.2) Equipment connections to the alarm control panel

Armidor has three normally closed, voltage free relay contacts. These relays will open in the following situations:

Alarm
Tamper
Fault

The alarm relay opens every time there is an intrusion into the protected field.
The tamper relay opens when the cover is removed or when the position of Armidor is changed (this operates a mercury tilt switch).
The fault relay opens when the supply voltage is outside the range +11.5 Vdc to +14.8 Vdc, or when the inside temperature is outside the range –20°C to +60°C or if the detector is masked.

Therefore is easy to connect Armidor to any type of existing control panel, as a star connection, normally closed or balanced type.

Armidor stores in memory (Zero Power RAM memory) two files, one historical and one monitor file. The historical file holds all events that the detector produces (the last 256 events, both alarms and set-up operations), while the monitor file holds the analogue signals (the last 100: 2.5 seconds each) that pass a certain threshold (monitor threshold) or that have given an alarm.

These two files are very useful to the installer, especially during the initial field test period and then during normal operation because they allow a very detailed examination (using the Armidor Test software) of what really happens during the operation of the device. Therefore when the detector is disabled (for example during the day) the recording of events or monitor files must also be disabled, otherwise they will become full of irrelavent details, with the risk of loosing important data that was stored when the detector was enabled. The **"Stand-By"** input of Armidor is used for this purpose. This input, when linked to 0V (Ground), disables the recording of events and monitors, while keeping the detector active so that it continues to open the alarm relay in case of intrusion, but without storing it. The tamper and fault alarm continue to work as normal, opening the respective relays and storing the events in the files in the device.

Armidor also has a "TEST" input. Linking this input to 0V (Ground) for at least 10 seconds will initiate a series of self checks. If these checks are positive (i.e. if the detector functions normally), the alarm relay opens for at least 2 seconds, allowing the control panel that requested the test to ensure the complete operation of the detector, including the ability to communicate an alarm when it occurs (long loop test).

The connection of Armidor to the control panel can also be via an RS-485 multidrop serial line. Armidor has a protocol (C-BUS) that allows it to communicate the events and to receive the Stand-By and Test commands, also via the serial line. In this case it is necessary to assign to each linked detector (with the Armidor-Test software) a "device number" from 0 to 95. The communication that takes place on this serial line is by means of a cyclical query (polling) of the line itself from the interface manager (COM –BUS).

This interface (see details in the specific manual) can serve as a control panel, or simply control the serial communication with the detectors and give the alarms from them as relay outputs, voltage free, in the configuration for interface to any type of control panel. At the same time this serial line (C-BUS) can also manage the ERMO 482X MW barriers (directly linked to the serial line as per Armidor) or any other type of detector (not made by CIAS) by adding a very small identifier called IDE-B99 (max N° of detectors for each line is 96).

Where the alarms are collected by the control panel using the normal relays and a balanced line connection, it is however useful link all the Armidor via the RS-485 serial line so that all the detector functions (downloading Historical and monitor files, setting the parameters, viewing operational status.…) can be managed from a central control room without moving or opening the detectors.

8) CALIBRATION AND TESTING

8.1) Start up

After fixing the device on the pole or wall bracket, and connecting it to the control panel, in star or serial mode, connect the DC power supply to the detector. After that, point it in the desired direction, bearing in mind the shape of the protection field. Then set the maximum distance (range) to be covered. The range programming can be carried out on the device directly, without using of any other instrument. Proceed as follows:

1. **Close the Jumper J10.** This enables the programming status (Installation status) of the detector, and enables the "Walk-Test" function as well. In this case the leds near the microprocessor reset button (S1), show the current value of the range as in the following table:

N° of step	Range [meters]	Leds status		
		1	2	3
1	4	Off	Off	Off
2	8	On	Off	Off
3	10	Off	On	Off
4	12	On	On	Off
5	14	Off	Off	On
6	16	On	Off	On
7	18	Off	On	On
8	20	On	On	On

2. **Push the range-programming button S3** until the desired range is represented on the leds.

3. **Carry out a detection test by moving in the protection field** and observe how the alarm led works. Without alarm this led must be on, and it is turned off when an alarm occurs. It is important to note that the only setting to do on ARMIDOR is the range. With this detector is not necessary to set any integration time (delay). This is because ARMIDOR analyses the received Doppler signal using an analysis algorithm based on "Fuzzy" logic methods (Fuzzy Behaviour Models or FBM) that allow it to distinguish the different behaviour of the intruder (slow, fast, longitudinal, transverse) from interference or from environmental noises.

4. **Open the Jumper J10**. From this moment the leds that previously indicated the range setting, now indicate when the different thresholds are exceeded: Masking (Led 1), Slow movement (Led 2), Fast movement (Led 3). Without movement, interference or masking, these three leds must be off.

5. **The masking threshold** is pre-set to a default value by the factory. It is only possible to change this value by means of Armidor-Test SW. This must be changed only if the operation of this function is clearly understood and if necessary in the field.

6. **The field level** that ARMIDOR continuously checks to ensure that no masking attempts are made is automatically acquired when the cover is closed (tamper micro switch) without exceeding the thresholds (masking, slow movement, fast movement) and the protected field is quiet for at least 10 seconds (leds off).

Note: before closing the cover of ARMIDOR it is recommended that Jumper J8 is opened, to disable the leds completely, and reduce the current consumption.

8.2) Calibration using the WT-95 instrument

Calibration using the WT-95 instrument is exactly the same as above. In this case the range button and leds function is available on the instrument as seen in the paragraph 6. The advantage in using the WT-95 is the integral buzzer, the sound of which indicates movement during Walk Test.