DOCUMENT ISSUE

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GENERAL DESCRIPTION

INTRODUCTION

Twenty five years experience in the electronic security industry, coupled with the production of around 5,000 **"GPS"** systems, is the base which has allowed **GPS Standard spa** to develop a new detection system for external detection: the "RFC".
It constitutes the most advanced answer to the requirements of an external perimeter system. The equipment is based on solid field experience in the application of electronic security systems and a profound technical understanding of the most advanced electronic components and systems.
The fundamental characteristic is the complete camouflage of the system: most of today's external protection systems are easily avoided and damaged.
The RFC system will detect human intrusions, silently and invisibly, ignoring small animals, birds and other weather related disturbances which can cause alarms on other systems.
The RFC system, using the buried radio frequency cables, detects variations in the electromagnetic field generated by the target crossing the sensitive area.

The RFC System (perimeter protection by buried electromagnetic cables)

The RFC system, using two buried cables (one for Transmit, one for Receive), creates a sensitive electromagnetic field sensitive to movement of a target in the protected area. **It is insensitive to vibrations in the ground**.
The target generates a variation in permeability inside the electromagnetic field, which is detected by a comparison between the radio frequency energy transmitted and the energy received.
The signal obtained is sent to the **Concentrator Analyzer** where it is analyzed and then an appropriate signal is sent to the **Universal Communications Processor** (Pre-alarm RFC, Alarm RFC, ..etc.).

- The **RFC** system does not alter the aesthetics of the protected area.

- Does not allow identification of the protection zone.

The **RFC** system is modular and allows the protection of any length of perimeter and it is particularly useful for applications in: military sites, airports, industrial sites, refineries, nuclear centers and many others.

Areas Of Application For The RFC System

The **RFC**, adaptable to any shape of perimeter, is particularly suitable to the type of site that requires a high level of security and detection.

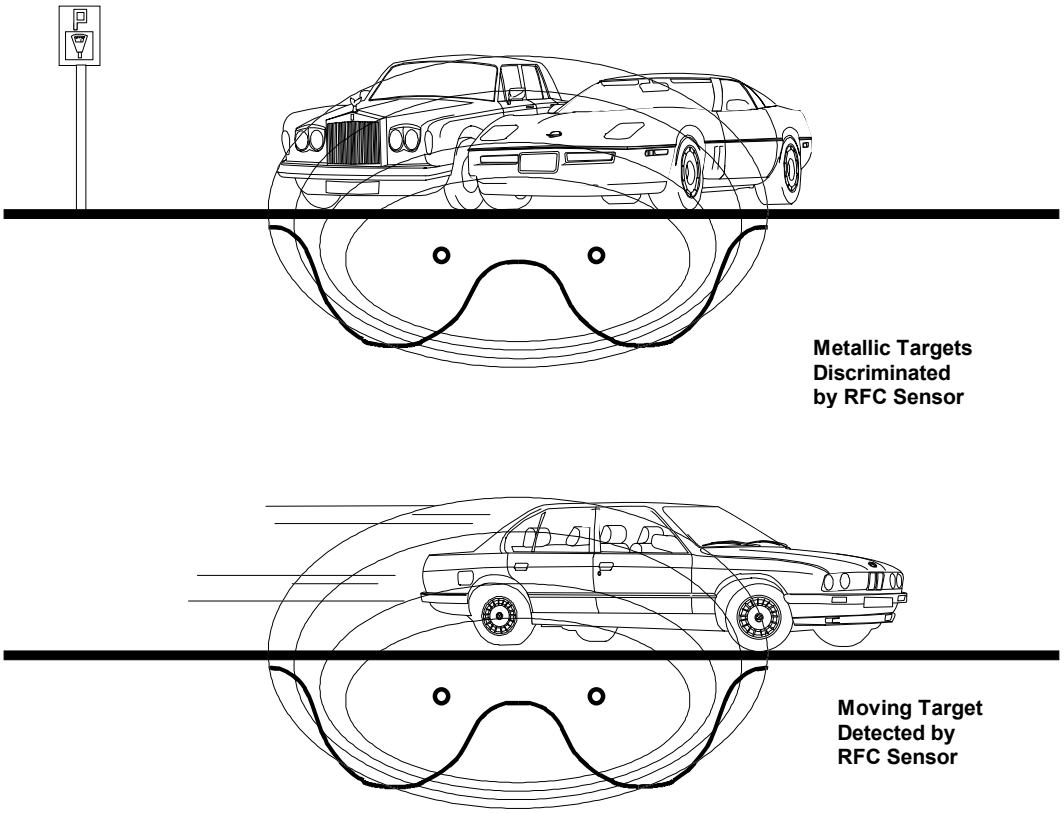


Figure 1

The **RFC** system is designed to identify “moving” targets with a high dielectric constant or with a large enough electromagnetic cross-section. It is designed to detect the human body (which has a high water content) or metallic objects of sufficient size (cars, trucks, bicycles, etc...).
It makes discrimination between small and large objects (e.g. small animals, such as dogs and cats will not be detected) and between moving and stationary metallic objects in the protected area.

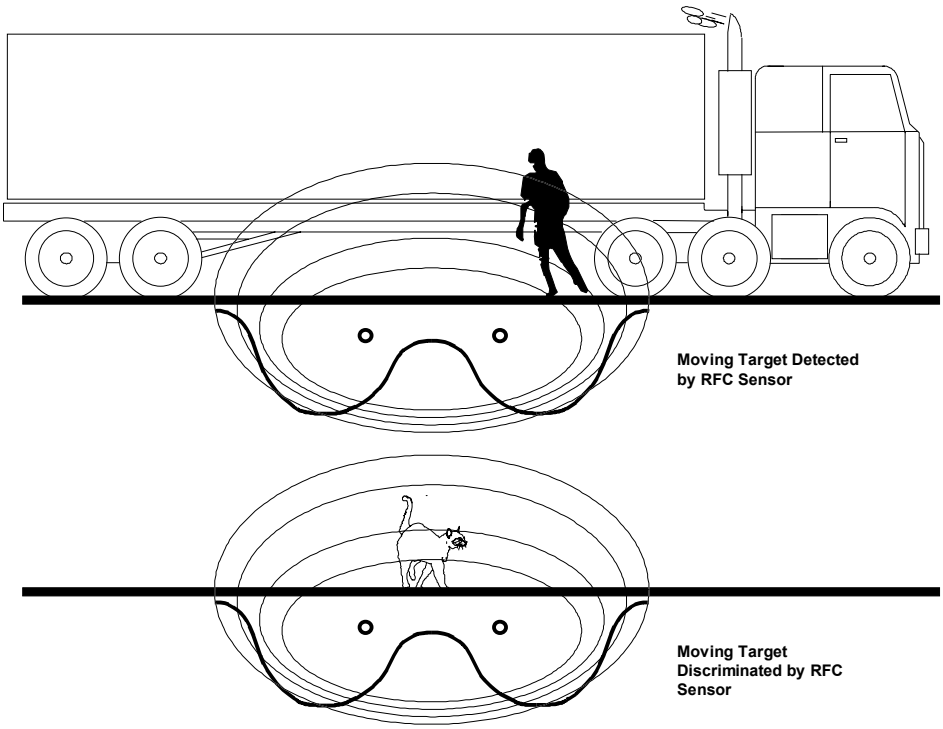


Figure 2

Structure of the RFC System

RFC system is subdivided into two principal parts:

a) The **Sensor** in the **Field**;

b) The **U**niversal **C**ommunications Processor (**UCP**).

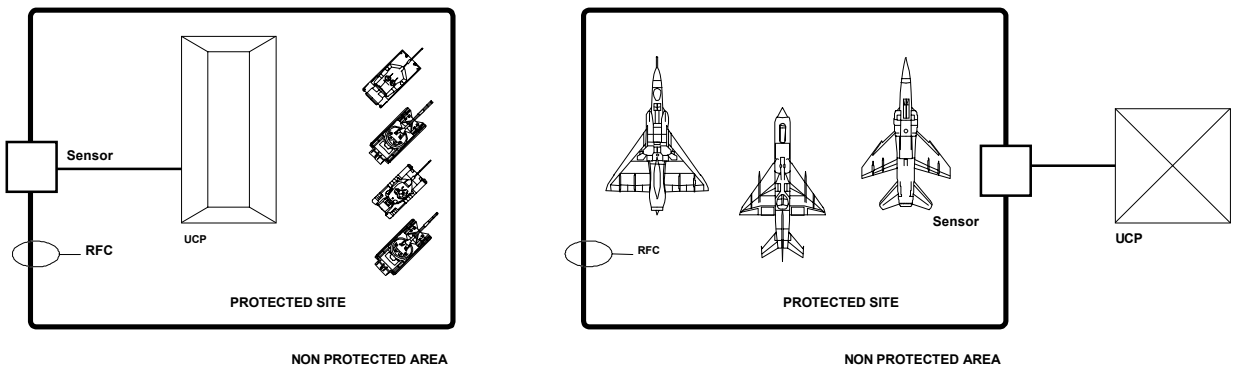


Figure 3

a) The Field

This comprises the "***sensor***" part of the system, with the capacity to detect the events generated by a violation of the protected perimeter.
The parts are: the **RFC Sensor**, the **RFC Cables**, the **Transmit and Receive System**.
This represents the **intelligence** of the system, with the capability to analyze, discriminate and signal all the events detected along the perimeter.
There is a board containing a Digital Signal Processor which permits the analysis of all the system events.
It defines the sensitive zone delimiting the area to be protected.

b) Universal Communications Processor (UCP)

Comprises: the **Group Power Supply**, **Analyzer Unit**, and the **Relay Cards**.
Allows the collection of the alarm signals and is usually installed within the area to be protected, but it is also possible to install it remotely.
The **Multiplex 2000** system can manage up to 64 peripherals (**Sensors**) all connected to a single cable. At each sensor is connected a Receiver which together with the transmitters and the cables, creates a sensitive zone **3m** wide and up to **300m** long (2 x 150m zones).

RFC SYSTEM

RFC SYSTEM LAYOUT

The two cables must be buried at different depths, depending on the type of ground under which they are buried and at a distance of about 1.2m apart.

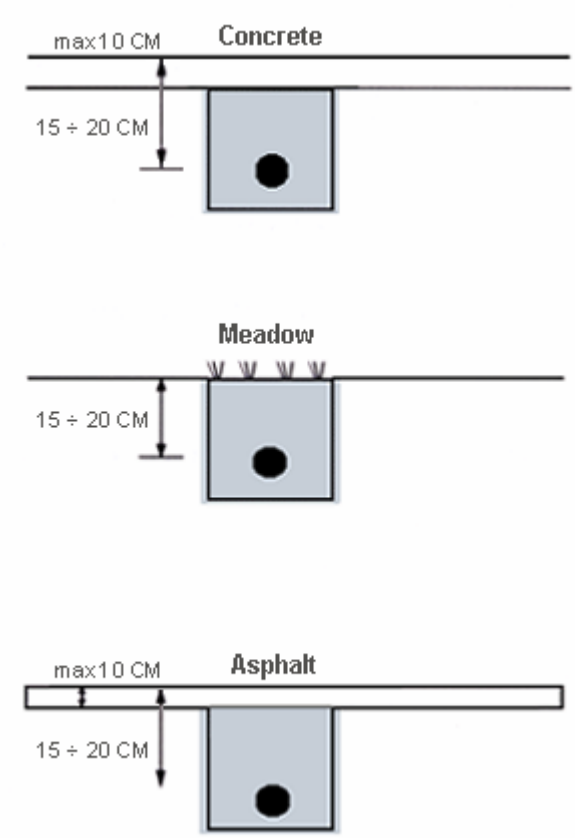


Figure 4

The surface must be constant throughout the whole zone. The two cables can be installed in whatever mode shown route. Change of direction must have radius of curvatures less 6m.

If there is a transition between neadow or soft ground and hard ground (asphalt, concrete) it is necessary follow this figure:

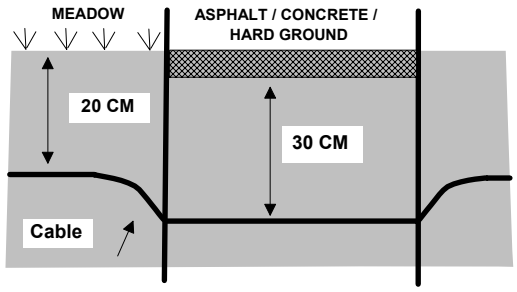


Figure 5

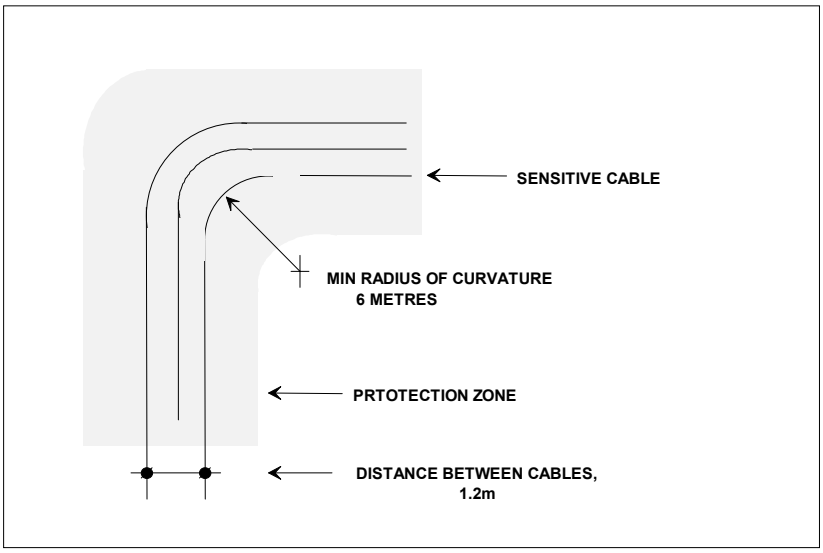


Figure 6

If the curve is to be in concrete or asphalt, it should be laid out as shown below:

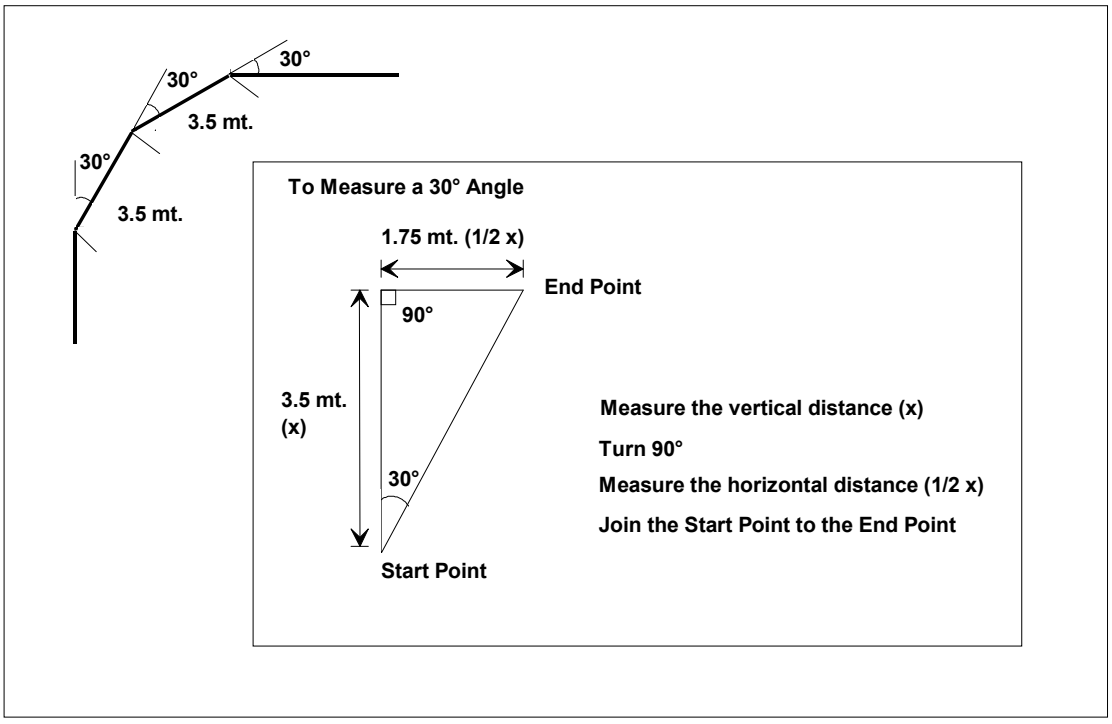


Figure 7

Distance From Obstacles

Objects that can constitute a false alarm risk are:

1. Fixed metal objects (e.g. fences, lamp standards);
2. Buildings
3. Moving objects;
4. Temporary objects;
5. Surface water (puddles, streams);
6. Underground tubes and conductors;
7. Power lines

When defining the route for the RFC cables, ensure these objects are removed.

1. Fixed Metal Objects

The RFC must not be installed close to objects like metallic fences or light poles.
The distance will depend on the type of object and the type of ground.
The objects which cause the most false alarms are those subjected to oscillations (metallic mesh, specially if not plasticized).
Rigid structures are less dangerous and it is possible to install the cables closer, whilst always maintaining a minimum distance.

The following table establishes the minimum distances from various types of significant objects.

TYPE Of OBJECT	**SURFACE**		
	Soft (sand)	*Asphalt*	*Hard (soil or concrete)*
Very rigid structure, intermittent electrical switching (e.g. *Metallic fence with concrete posts, metallic lamps and pillars).*	3 meters	2.5 meters	2.5 meters
Rigid structure that moves less than 1.3cm at a height of 2.5m above the ground in strong winds (*tensioned structure at a tension of 13.6kg like a welded mesh fence).*	3.5 meters	3 meters	3 meters
Other categories of rigid structure (e.g. *Chain link fences, metallic and plastic coated).*	5.5 meters	4.5 meters	3.5 meters

2. Buildings

If the cables are installed too close to a building all the movements inside the building may be detected. The RF field can pass through all types of wall except metallic panels. Metallic objects inside the building may cause false alarms.

If the cables are parallel to the building it is possible to apply the same considerations as used for the rigid structures.
If the cables are perpendicular to the building allow at least 7 meters.

The integrity of the RFC field cannot be guaranteed when the sensitive zone is too close to an object, when the object can cause interference and generate false alarms.

3. Moving Objects

The distance will depend on the type of ground.

TYPE Of OBJECT	SURFACE		
	Soft (sand)	*Asphalt*	*Hard (soil or concrete)*
Moving Metal Object (e.g. *cars, bicycle, trucks)*	5.5 meters	5.5 meters	5 meters

4. Temporary Objects

Objects such as cable drums, piles of wood, wires and tubes are a probable cause of false alarms.
It is possible that they will distort the shape of the RFC field and generate an irregular sensitive area.
It is therefore advisable to position any such objects at least 1.5m from the RFC cables.

5. Surface Water

Standing water (puddles, swimming pools, ponds) also constitute a false alarm risk. Make sure there is adequate drainage throughout the area where the cables are to be installed and that the water cannot accumulate along the length of the cable. Maintain a distance of at least 1.5m from all standing water.

6. Underground Tubes and Cables

Buried tubes, cables and conductors can distort the sensitive field if adequate distance is not maintained between them and the RFC cables.
Suitable distances are shown in the following table:

TYPE of TUBE or CABLE	SECTION	MINIMUM DISTANCE
Metallic	Up to 10 cm	30 cm if parallel to the RFC cables
	Above 10 cm	5 cm if perpendicular to the RFC cables
Non metallic containing flowing water	Up to 10 cm	50 cm
	Above 10 cm	1 meter
Non metallic containing pressurized water	Up to 10 cm	15 cm if parallel to the RFC cables
		5 cm if perpendicular to the RFC cables

The distance specified applies to a tube or cable situated above or below the RFC cables.

7. Very Hard Ground

In very hard ground it is advisable to contact CENTRAL CUSTOMER SUPPORT at GPS (Tel: +39 0125.96.86.11 Fax: +39 0125.96.60.43)
e-mail: gpscom@gps-standard.com for an analysis of the situation and a personalized solution for each problem.

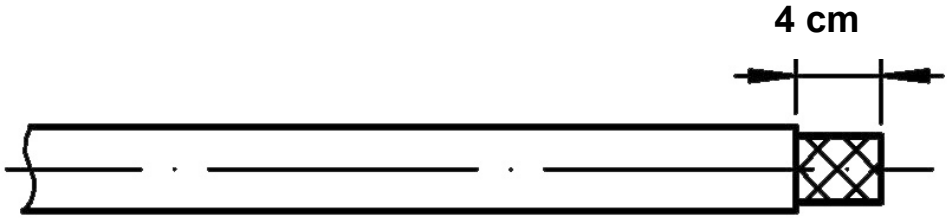
Sensitive Cable PRFC2001

Joint Kit PRFC2007

In order to maintain a constant distance between the two sensitive cables at the end where they arrive at the transmitter/receiver **PRFC2005**, it is necessary to make a joint between the sensitive cable **PRFC2001**and the non-sensitive cable **PDPS2120**.

1) Place the heat-shrink tubing on one of the two cables.

2) Strip the cable for 4 cm. As shown in the following figure:



3) On the RFC cable fold back the braid and remove the aluminium foil screen.

4) On the non-sensitive cable fold back the first braid, remove the aluminium screen, fold back the second braid and remove the second aluminium screen.

5) Strip the central conductor of the two cables for 2 cm.

6) Solder the two central cores together as shown in the following photograph.

7) Insulate the soldering with the vulcanised tape to the same diameter as the insulation.

8) First replace the first braid of the non-sensitive cable so that it covers the uniformly the whole of the joint area.

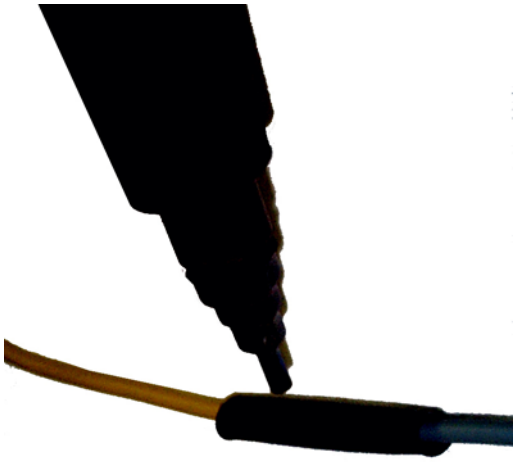
9) Cut any excess length of the braid and replace the braid of the sensitive cable over the first braid of the non-sensitive cable.

10) Replace the second braid of the non-sensitive cable over the two previous braids (see photo).

11) Link the various braids using solder, avoiding overheating with the iron.

12) Re-cover, with the aluminium foil removed from the cable, the braid area of the two cables and cover with vulcanised tape, overlapping at least half the tape width on each turn.

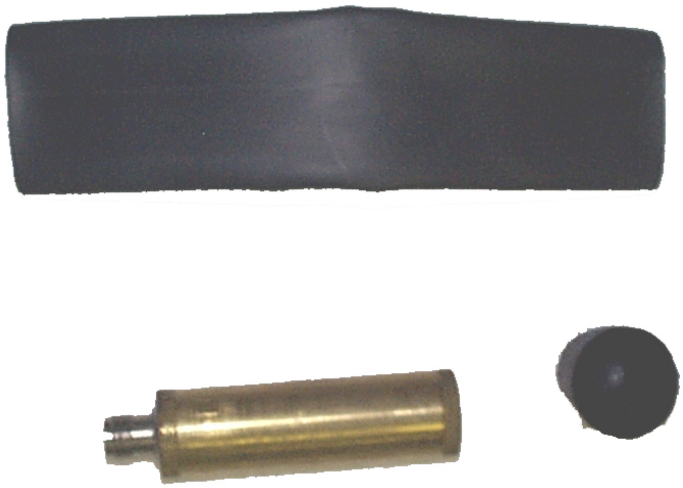
13) After positioning the heat-shrink over the joint, heat it until it is completely shrunk on to the joint.



14) The result should look similar to that shown in the following photo:

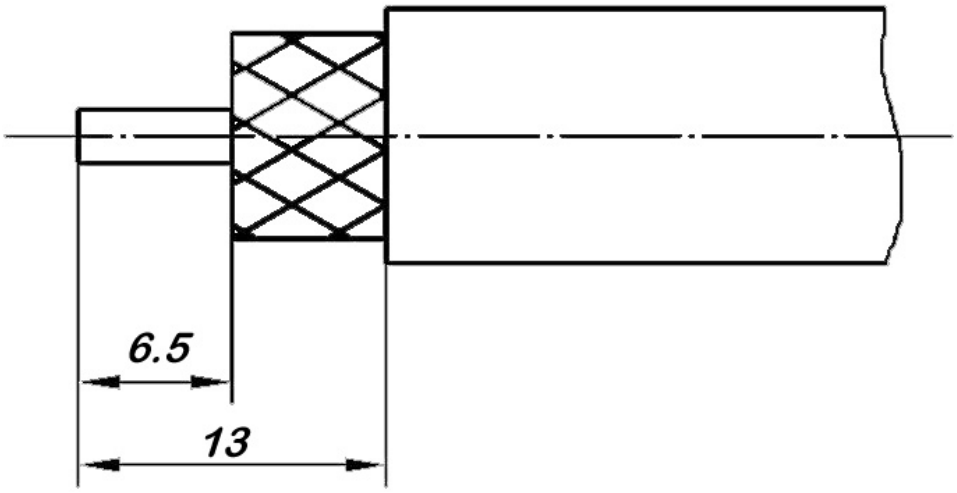
Termination Kit PRFC2006

To ensure correct operation of the completed system each zone (max 100m of sensitive cable) must be terminated with the appropriate kit PRFC2006.



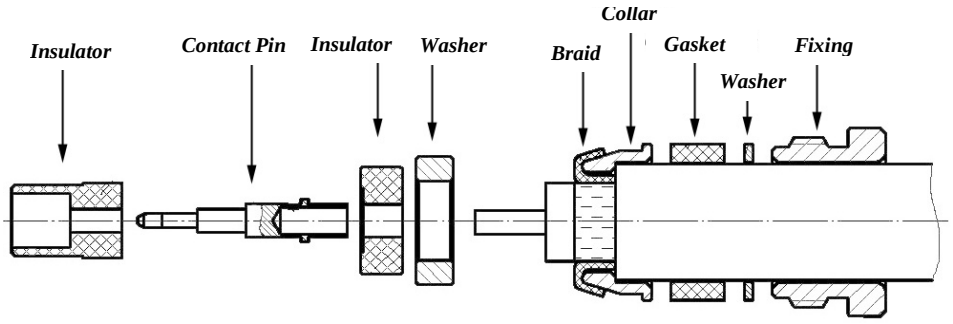
1. Mounting connectors on the sensitive cable PRFC2001 and on the non-sensitive cable PDPS2120

   a. Strip the cable for **13mm** as shown in the following figure:



b. Place the components of the connector in the following order:
   - Fixing;
   - Washer;
   - Gasket;
   - Collar;

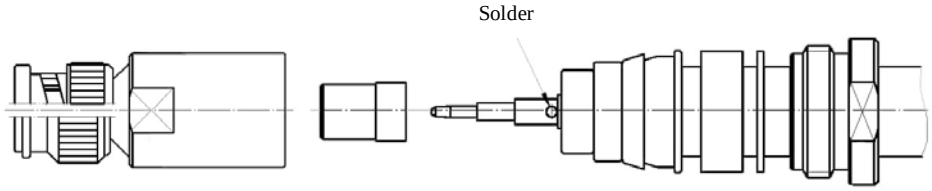
   Pull back the braid behind the collar as shown in the figure:



c. Solder the braid to the collar making sure that the overall dimensions are not increased too much.

d. Place the two washers on the central contact of the connector.

e. Solder the connector contact pin to the central core of the cable.



f. Place the insulator on the central contact.

g. Place the cable inside the body of the connector and screw the fixing until it is tight.

h. Check that there is no short circuit between the central contact and the external body of the connector.

1. Place the heat shrink on the cable.

2. Lock the termination on the cable connector.

3. Cover the termination and connector with vulcanised tape, overlapping at least half the tape width on each turn:

4. After positioning the heat shrink over the termination heat it until it is completely shrunk:

5. The result should look similar to that shown in the following photo:

RFC Multiplex SYSTEM (art. PRFC2002)

The **RFC Multiplex** Sensor is designed to be integrated into a **Multiplex 2000** system, an interconnection system which, using a single Data Cable (art. **PUCP2115**), can connect up to 64 Sensors to a single **Universal Communications Processor** (**UCP**) which can manage and output the signals provided by the sensors using the Relay Cards (art. **PUCP2005** and **PUCP2006**). In this system the management of the sensors, up to 5km from the **UCP**, is by a software package running in the **Windows® 95/98/2000/NT** environment (art. **PUCP2000SW**). It is possible to control all of the sensor parameters as well as monitoring and recording the signals generated by the sensor and updating sensor firmware.
The board is designed to accommodate an optional board, which can provide local inputs and outputs (art. **PCPS2002**).
The **Multiplex 2000** System, because of the distance from the UCP to the sensors, uses a power supply of **48** Vdc (minimum). The **RFC** sensor has an internal board, which generates the 12vdc required for normal operation.
The Dip-Switch **DSW1** (1÷6) assigns the unique address used to communicate with the UCP to which it is connected (see Table 2).

The Leds **1**, **2**, **3**, **4**, **6** and **7** provide indications as described below and dependent on the setting of switches 7 and 8 of Dip-Switch **DSW1**, as shown in Table 2, Leds 1, 2, 3, 4 **DO NOT** give alternative indications, whereas leds 6 and 7 can give indications of the communications traffic to and from the PC.
All of the operating parameters can be altered using the management software while the factory default parameters can be reset by closing link P1 for at least one second.

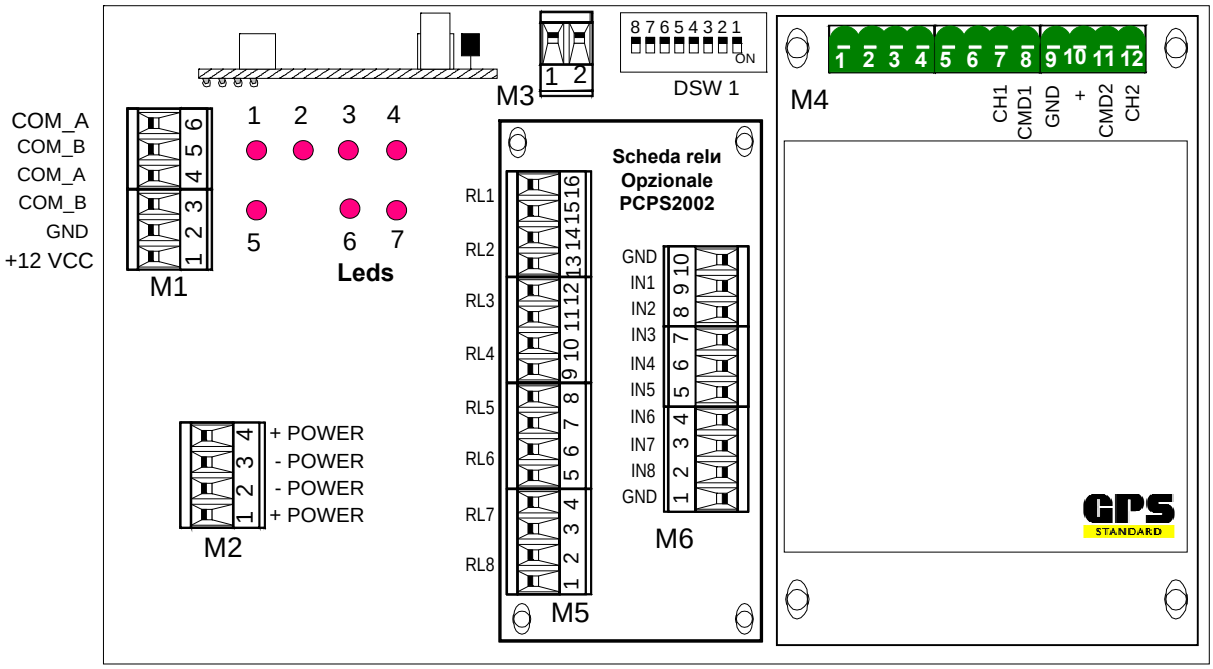


Figure 8

Terminals M1 (Serial Communication Line)

6 = [**COM_A**] Serial Communications (COM115) to UCP
5 = [**COM_B**] Serial Communications (COM115) to UCP
4 = [**COM_A**] Serial Communications (COM115) to Next Sensor
3 = [**COM_B**] Serial Communications (COM115) to Next Sensor
2 = [**GND**] Screen
1 = [**+12VDC**] Auxiliary power supply

Terminals M2 (Power Supply)

4 = [**+48V**] Positive Power Supply Input 48Vdc)
3 = [**–**] Negative Power Supply Input (48Vdc)
2 = [**–**] Negative Power Supply Input (48Vdc)
1 = [**+48V**] Positive Power Supply Input (48Vdc)

Terminals M3 (Tamper Input)

1 = [**–**] Negative
2 = [**TAMPER**] Tamper Input N.C.

Terminals M4 (Signal Input)

1 = [ ] N.U.
2 = [ ] N.U.
3 = [ ] N.U.
4 = [ ] N.U.
5 = [ ] N.U.
6 = [ ] N.U.
7 = [**Ch1**] CH1 RFC Signal input
8 = [**Cmd1**] Command 1 RFC
9 = [**-**] Negative Power supply
10 = [**+**] Positive Power supply
11 = [**Cmd2**] Command 2 RFC
12 = [**Ch2**] CH2 RFC Signal input.

Link P1 (Set to default)

Leds (Indicators)

1 = Pre-alarm channel **A**
2 = Alarm channel **A**
3 = Alarm channel **B**
4 = Pre-alarm channel **B**
5 = Power supply
6 = Pressure low channel **A** / transmitted data line COM115
7 = Pressure low channel **B** / received data line COM115

Communication "COM115" Line Termination

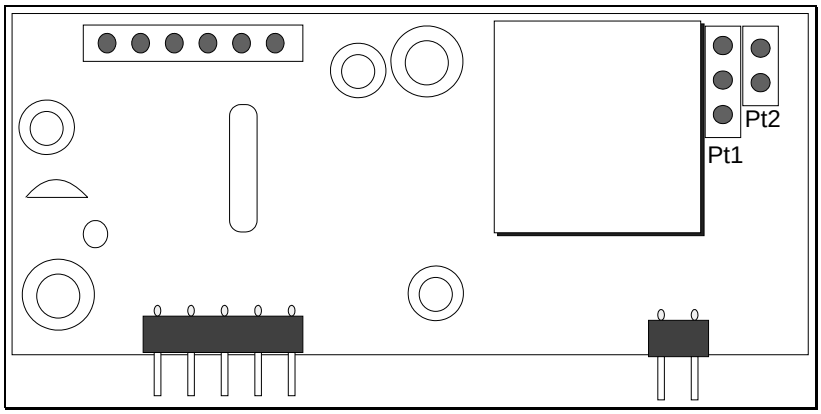
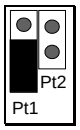


Figure 9

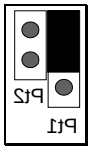
To ensure reliable operation of the COM115 communications it is necessary to terminate the line using links PT1 and PT2 on the small communications board located close to M1.

There are two possible scenarios:

1. The sensor is located between 0 and 3 Km from the UCP and it is the last one in the line: terminate PT1 and PT2 as shown in the following figure:



2. The sensor is located between 3 and 5 Km from the UCP and it is the last one in the line: terminate PT1 and PT2 as shown in the following figure:



For more details see the *UCP Installation Manual*

GPS "Communication 115" (COM115) Serial Line

The high speed communication line, called "Communication 115", between the peripherals and the UCP has allowed an increase in the number of sensors that can be managed and gives a very quick system response in the event of an Alarm or Pre-alarm.

The presence of two seperate communication ports means that the maximum distance covered by the system can be increased to 10 Km (5Km + 5Km)

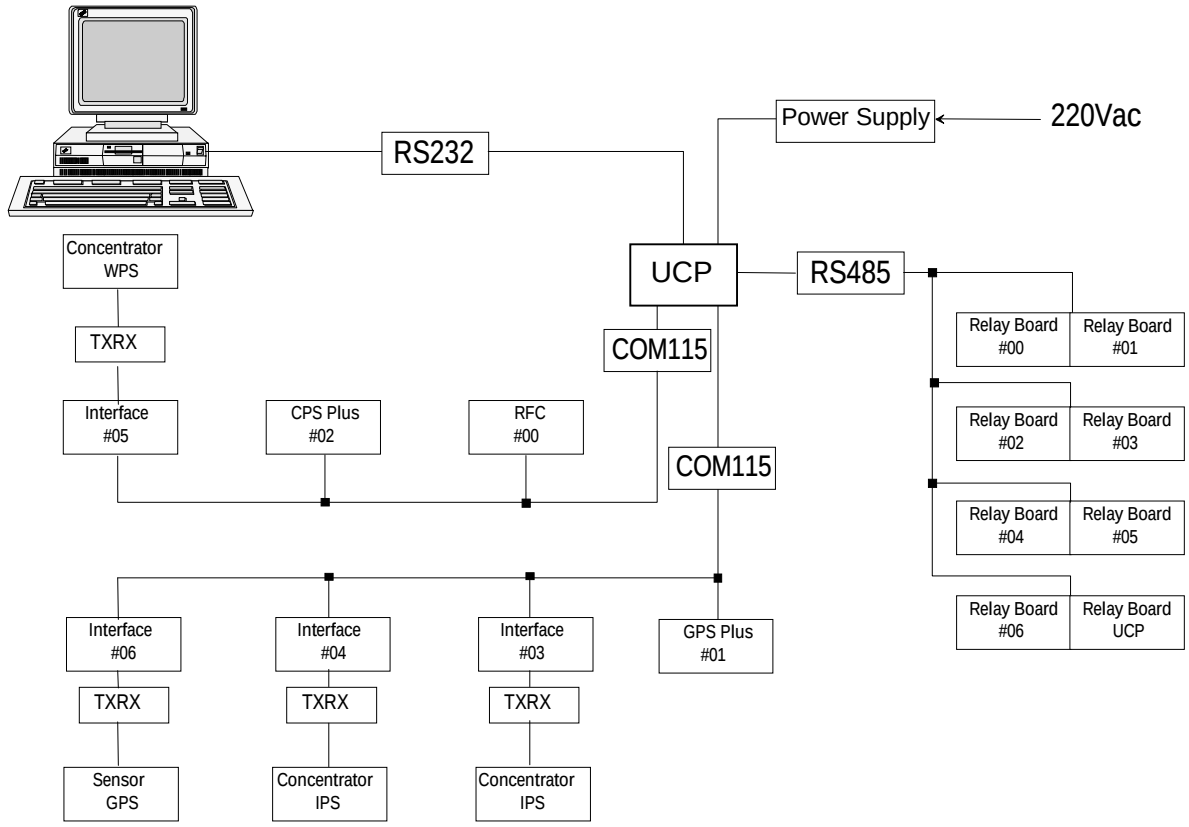


Figure 10

Example of a **Multiplex 2000** system with one UCP, Relay Boards, two COM115 connected to CPS Plus sensors, RFC Sensors, GPS Plus Sensors and, using an interface, to IPS, WPS and GPS sensors.

Dip-Switch Sensor Address Selection

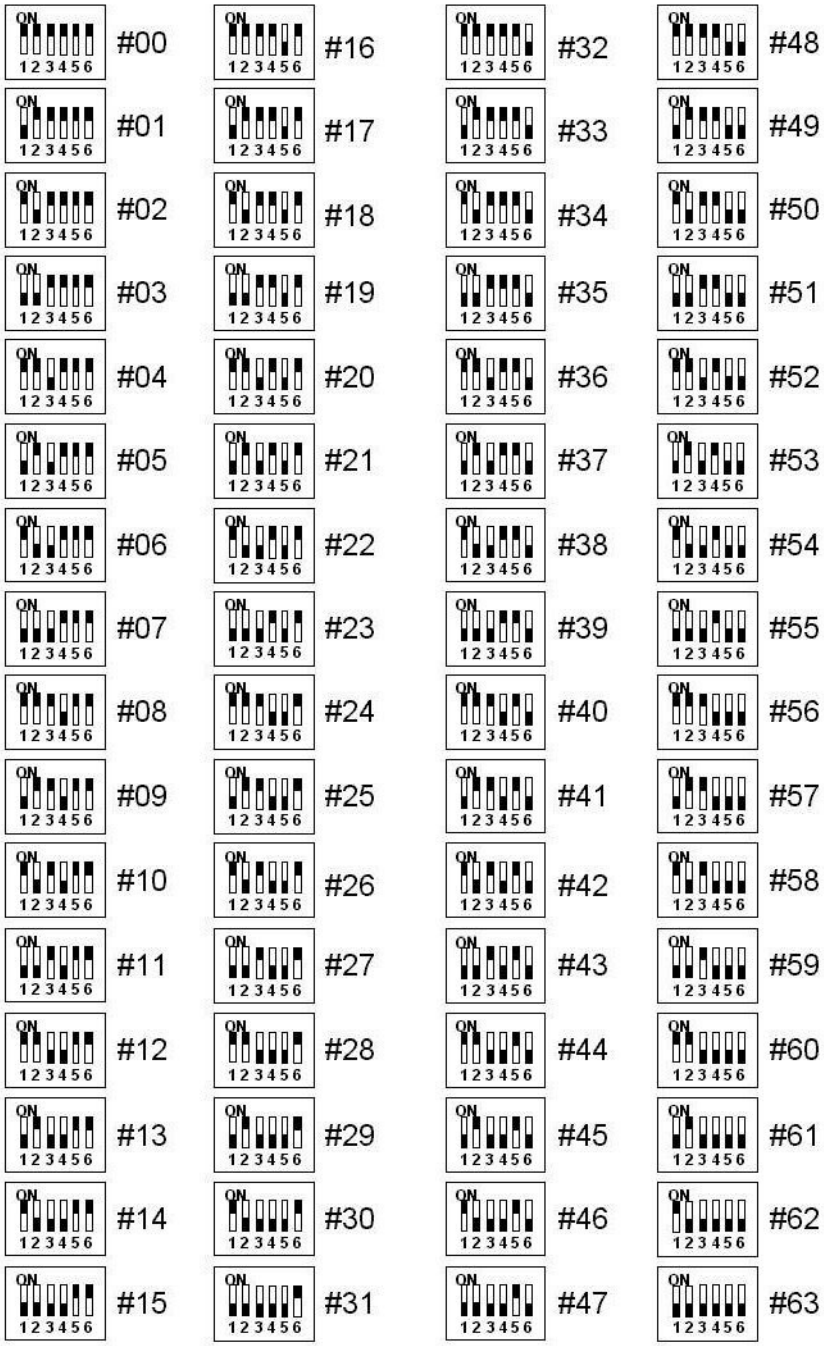
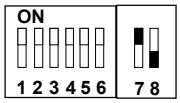


Table 1



Selecting the switches 7 & 8 on the Dip – Switch as shown in the figure make it possible to view the data traffic on the COM115 line connected to the sensor:

Led n°6 = Transmit Data **Led n° 7 = Receive Data**

System Connections (RFC * 12 VDC Stand Alone Version*)

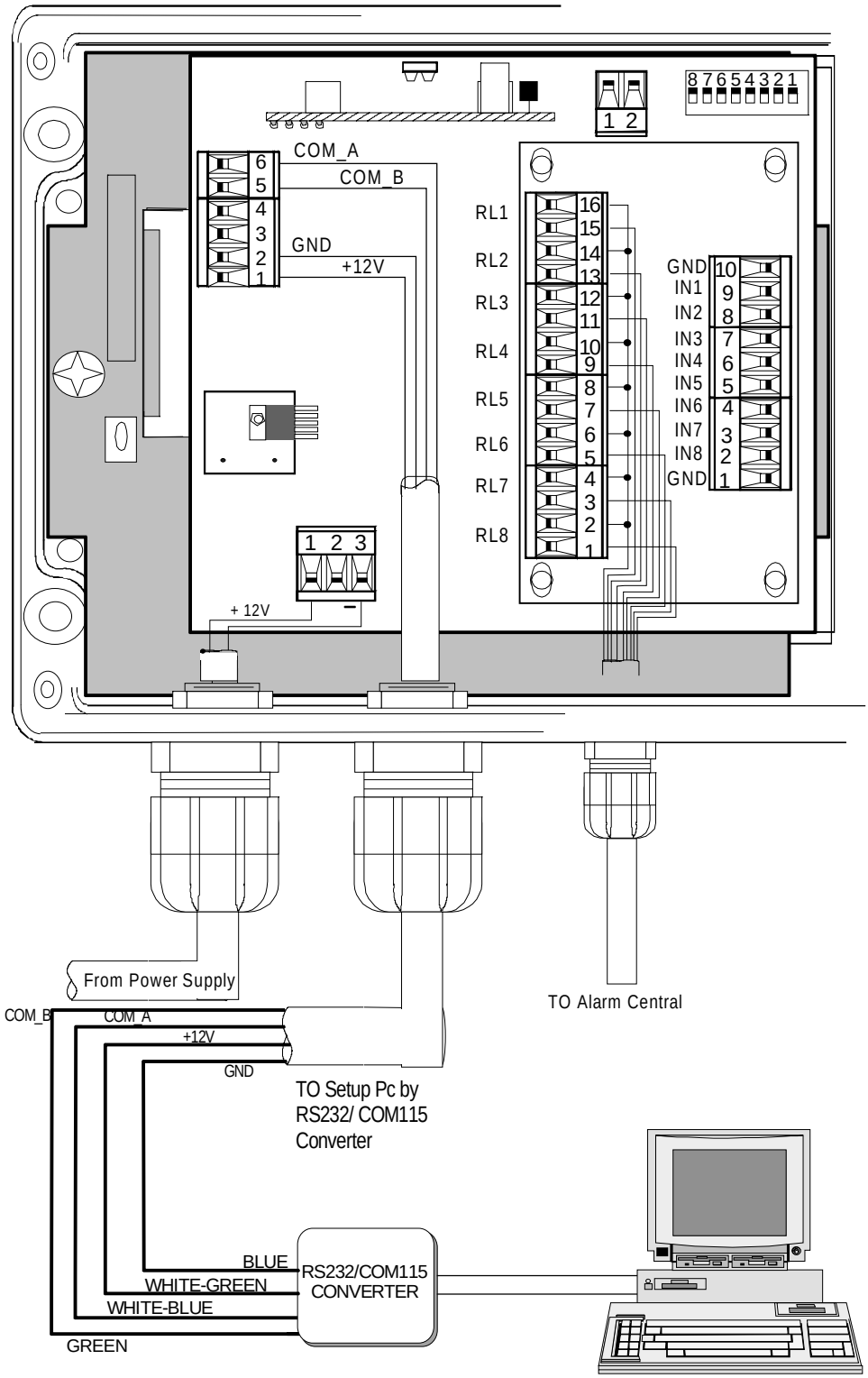


Figure 11

Terminals M1 (PC Connections)

6 = [**COM_A**] Serial Communications (COM115) – Green wire
5 = [**COM_B**] Serial Communications (COM115) – White-blue wire
4 = [**COM_A**] Serial Communications (COM115)
3 = [**COM_B**] Serial Communications (COM115)
2 = [**GND**] Screen – Blu wire
1 = [**+12 VDC**] Auxiliary power supply 12 VDC - White-green wire

Terminals M2 (Power Supply)

1 = [**+12V**] Positive Power Supply Input (nominal 12Vdc)
2 = [**N.U.**] Not Used
3 = [**–**] Negative Power Supply Input (nominal 12Vdc)

Terminals M3 (Tamper Input)

1 = [**–**] Negative
2 = [**TAMPER**] Tamper Input N.C.

Terminals M4 (Signal Input and power supply for GPS sensor)

1 = [**N.U.**] Not Used
2 = [**N.U.**] Not Used
3 = [**N.U.**] Not Used
4 = [**N.U.**] Not Used
5 = [**N.U.**] Not Used
6 = [**N.U.**] Not Used
7 = [**Ch1**] CH1 RFC Signal input
8 = [**Cmd1**] Command 1 RFC
9 = [**-**] Negative Power supply
10 = [**+**] Positive Power supply
11 = [**Cmd2**] Command 2 RFC
12 = [**Ch2**] CH2 RFC Signal input

Terminals M5 (Local Relay Output)

15 – 16 = [**RL1**] NC Contact with 22 Ohm series resistance
13 – 14 = [**RL2**] NC Contact with 22 Ohm series resistance
11 – 12 = [**RL3**] NC Contact with 22 Ohm series resistance
9 – 10 = [**RL4**] NC Contact with 22 Ohm series resistance
7 – 8 = [**RL5**] NC Contact with 22 Ohm series resistance
5 – 6 = [**RL6**] NC Contact with 22 Ohm series resistance
3 – 4 = [**RL7**] NC Contact with 22 Ohm series resistance
1 – 2 = [**RL8**] NC Contact with 22 Ohm series resistance

Terminals M6 (Logical Local Input)

10 = [**–**] Negative
9 = [**IN1**] Logical Input **1** (NC)
8 = [**IN2**] Logical Input **2** (NC)
7 = [**IN3**] Logical Input **3** (NC)
6 = [**IN4**] Logical Input **4** (NC)
5 = [**IN5**] Logical Input **5** (NC)
4 = [**IN6**] Logical Input **6** (NC)
3 = [**IN7**] Logical Input **7** (NC)
2 = [**IN8**] Logical Input **8** (NC)
1 = [**–**] Negative

System Connections

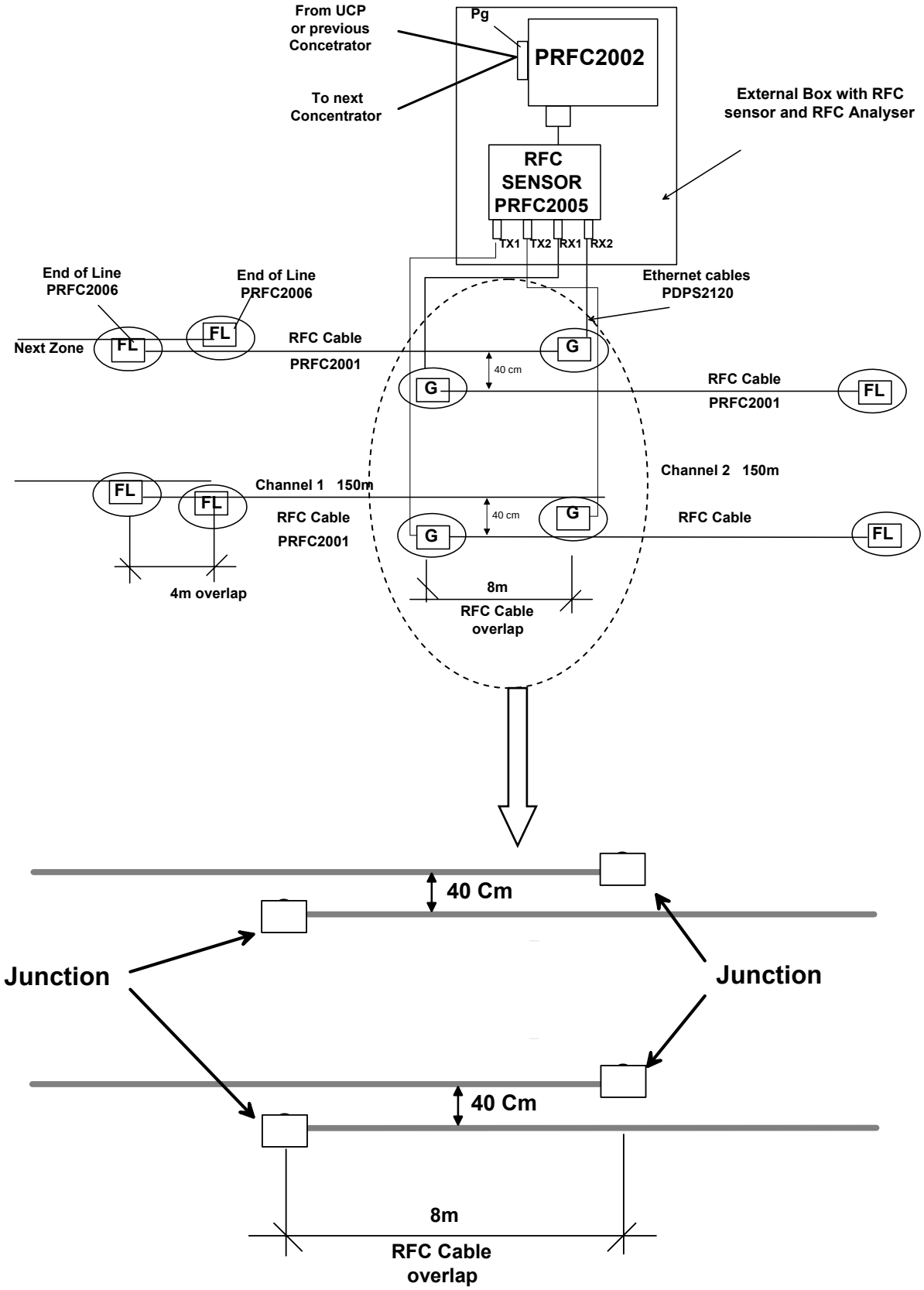


Figure 12

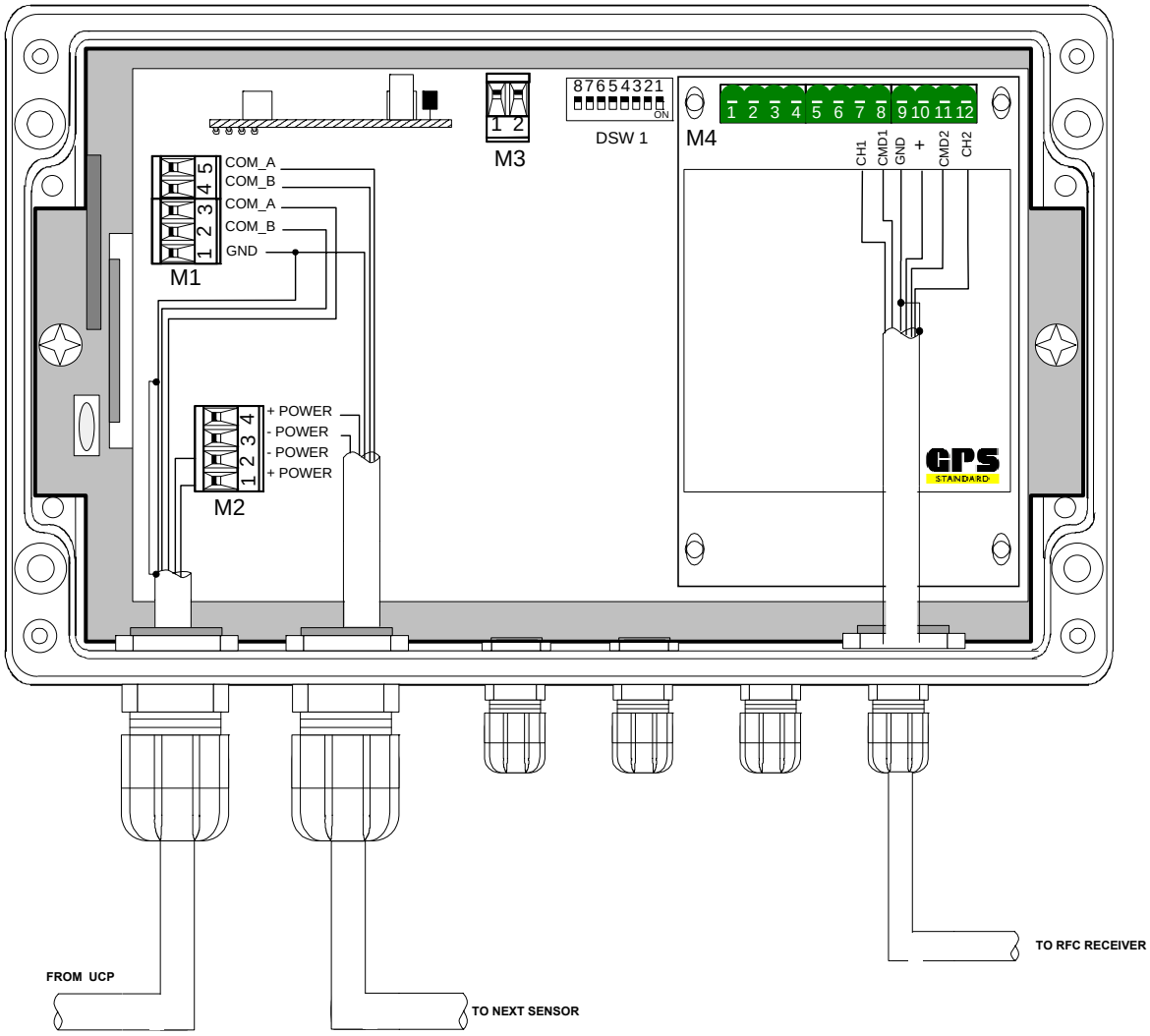

M1
COM_A
COM_B
COM_A
COM_B
GND
M2
+ POWER
- POWER
- POWER
+ POWER
M3
1 2
DSW 1
87654321
ON
M4
1 2 3 4 5 6 7 8 9 10 11 12
CH1
CMD1
GND
+
CMD2
CH2
GPS
STANDARD
FROM UCP
TO NEXT SENSOR
TO RFC RECEIVER

Figure 13

RFC Receiver (Art. PRFC2005)

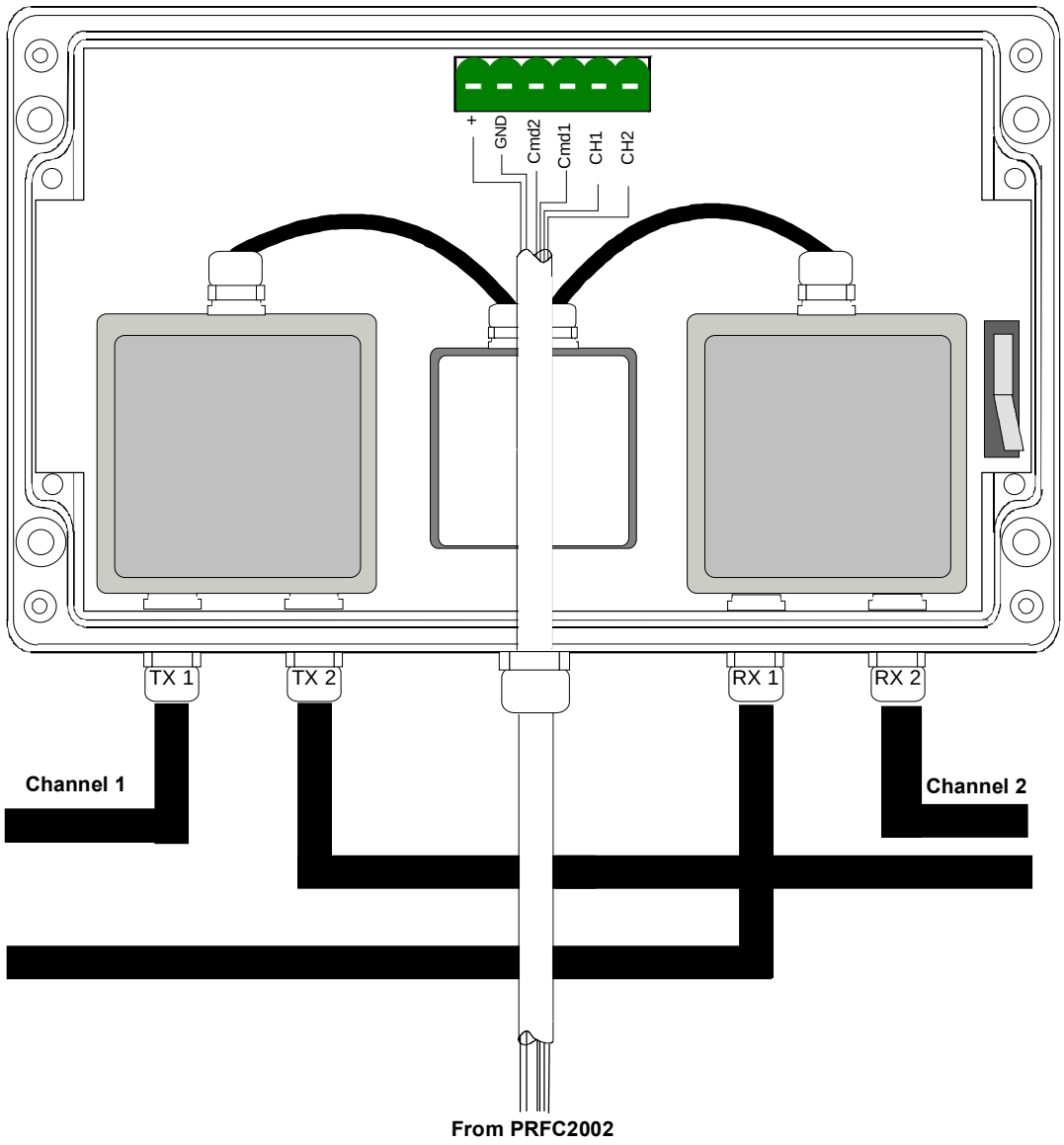


Figure 14

Connection Details (Power and Signal **RFC**)

1 =	[**+**]	Positive Power Supply for **RFC** Sensor
2 =	[**-**]	Negative Power Supply for **RFC** Sensor
3 =	[**CMD2**]	Command **RFC** zone **2**
4 =	[**CMD1**]	Command **RFC** zone **1**
5 =	[**CH1**]	**RFC** zone **1** Signal
6 =	[**CH2**]	**RFC** zone **2** Signal

To connect the **RFC Sensor** to the Concentrator uses the special cable PUCP2116. Ensure that the screen is continuous throughout the length and that it is connected to negative at the concentrator and left free at the sensor.

System Commissioning

Once all the system has been installed and connected, the initial system commissioning can commence.

After powering up the UCP the system carries out an automatic configuration of the sensors connected and initiates the monitoring of the signals provided by the sensors.

For correct operation it is necessary to set all of the system parameters using the Multiplex 2000 management software.

To do this it is necessary to make a temporary connection between the UCP and a computer, as described in the Multiplex 2000 Software Manual, to evaluate the signals provided by each sensor and to adjust the parameters following the guidelines shown in the manual. This phase is best conducted with the support of the GPS Technical Support Network.

For more information on setting up and commissioning the RFC systems refer to the **On-Line Help** in the MX2000 Management Software (art. **PUCP2000SW**).

- Conclusions.
  - The notes in this manual are designed to support the installation of the **RFC** system in it most common applications.
  - It is true that poor installation of the system (poorly selected cable routes, etc...) can compromise and limit the performance of the system.

For difficult situations, or for specific advice contact GPS Technical Support.

Initialisation Of The System

1) Connect the output of the power supply (Art. PUCP2004) to the UCP and then connect the AC mains supply to the power supply. The UCP initiates an automatic acquisition of all the sensors connected to the communication line(s). This activity is indicated by the “General Fault” and “Communication Fault” led flashing. When this is finished the “Power” indicator on the front panel comes on.

2) Check that the “Fault” indicator is off and not flashing.

3) Press and release the system “Test” switch.

4) All the control unit indicators will flash, once for each sensor detected by the system.

5) Set the Sensitivity switch to mid position.

6) Connect the service computer as per the UCP manual and load the Multiplex 2000 software as described.

7) After the system acquisition check that the table displayed on the PC monitor corresponds to the number and type of sensors actually installed.

8) Select “Monitoring” e check that the signals provided by the sensors are displayed on the screen.

9) Proceed to set the parameters.

N.B. In case of Stand-Alone Unit, connect the service computer as in the manual description and see previous step from 9.

In Case Of Incorrect Operation

Check the power supply connections and confirm the power supply output voltage.

Check the protection fuse for the UCP, the sensor cable connections and the correct setting of the sensor addresses.

Check the connection between the computer and the UCP.

Check for correct end of line terminations.

Check the pressure on the appropriate sensors using the installation pump.

Check the battery voltage.

Parameter Setting

The operating parameters for each sensor are initially set by a simple walk test and analyzing the resultant signal.

This process is repeated for each sensor on the system.

Sensitivity

The quiescent signals from the sensor in quiet, should be below 500 millivolts and one person should then walk at normal walking pace across the system at approximately 10 meters intervals, while a second person monitors the 'Monitoring' screen.

The peak signals generated by this should be between 4 - 5 volts.

Using the parameter setting screen the sensitivity of each sensor can be adjusted to ensure the correct level of signal.

It may be necessary to repeat this process a few times to obtain the optimum settings.

Start Analysis Threshold Level

The default settings for the start analysis thresholds are suitable for initial set up.
These can be set so that they are above the fundamental noise level of the system such that the frequency domain analysis of the signals only starts when the signal generated by a zone is different from the normal noise of the system.

The **Fast Analysis Threshold** levels must be set so that they are above the fundamental noise level of the system, shown with 1 Hz high pass filter, and below the crossing signal, shown in the same mode.

The **Slow Analysis Threshold** levels must be set so that they are above the fundamental noise level of the system, shown with 1 Hz low pass filter, and below the crossing signal, shown in the same mode.

Auto setup

After setting the sensitivity and the start threshold level, selecting auto setup will start the auto acquisition of the crossing signals. After selecting the channel and the type of crossing to be acquired the system waits for the selected type of crossing to be attempted. Clicking the 

button will cause the program to wait while the selected number of attempts are carried out. As soon as the number of attempts have been completed the program calculates the resultant average of the attempts.

After the attempt is completed clicking the  button will send the average to the sensor being programmed.

After acquiring the different attempts to be detected, make a series of tests at crossing the sensitive zone at different points and confirm that each attempt generates an alarm.

FINAL CONSIDERATIONS

Summary Of The Principal Installation Steps.

- Make the system connections:
  - as per all of the instructions in the **SYSTEM CONNECTIONS** section;
  - ensure they are all correct to prevent system malfunction.

- Commission the system:
  - The definition of the parameters is possible by connecting to the serial line and using a personal computer running the management software (**PUCP2000SW**) in a **Windows® 95/98/2000/NT** environment. The **RFC** Multiplex system (Art. **PRFC2001**) has a COM115 type serial interface and it is necessary to use the optional converter **RS232 - COM115** (with the PUCP2000SW software) to interconnect between the sensor and the Personal Computer.

SYSTEM CHARACTERISTICS

GENERAL DATA

General Data

➢ Versions Available	**Art. PRFC2002**	RFC Multiplex System
➢ Options	**Art. PCPS2002**	Local relay Board and Logic Inputs for RFC Multiplex System (**Art. PRFC2001**)
➢ System Applications	External	
➢ Maximum System Coverage	**300 m** approx (two 150 meter zones)	
➢ System Parameter Setting	Via serial port **COM115**, using Personal Computer	
➢ Parameter Memory	On **EEPROM** (non volatile RAM)	
➢ Firmware	Resident on Flash upgradeable via Serial line	

Mechanical Data

➢ Cabinet	Metallic Container (tamper protected) completely weatherproof to **IP65** Dimensions: [L] **260**x [H] **160**x [D] **90mm** Weight: **2 Kg** Color: **gray**

Environmental

➢ Operating Temperature	**- 30°C** - **+ 70°C** Relative Humidity 90**%**

Electrical Data

➢ Power Supply	**Art. PRFC2002** **Art. PRFC2002/SA**	**24** - **55 Vdc** (48 Volt nominal) **10.5** - **16 Vdc** (12 Volt nominal)
➢ Current	**Art. PRFC2002**	**100 mA** (max) @ **48 Vdc** **400 mA** (max) @ **12 Vdc**
➢ Outputs	**Art. PRFC2002** **Art. PRFC2002/SA**	**8** relay contacts **NC** (optional) **8** relay contacts **NC**
➢ Relay rating	**12 V** (max), **100 mA** (contact **NC**, **22 Ohm** in series)	
➢ Inputs	**Art. PRFC2002** **Art. PRFC2002/SA**	**8 NC** / **NO** (optional) **8 NC / NO**
➢ Input/Output Circuit Protection	Using Varistors	
➢ Auto-protection in case of atmospheric interference	Using **Watch – Dog** (External/ Internal)	