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# ***Wireless Audio and PSTN Monitoring System***

**INCA**

**COMPANY CONFIDENTIAL**



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## 1 Introduction to Wireless Audio Monitoring

In today's increasingly complex environment of electromagnetic signals in the radio frequency spectrum, wireless audio surveillance operations are subject to several hostile parameters, which are critical for operation success and ultimately monitored high-quality audio signal retrieval. Wireless operations are also subject to many mysterious theories, but are fairly handable if the right natural laws are implemented.

Several parameters has to be taken into consideration while using wireless audio surveillance systems versus wired systems. Convolutional and additive noise sources are the same, but other very important matters such as; frequency area, electronic interference, battery lifetime, operative range, receiving antenna, radio signal reflections, building layouts and construction techniques, are often making such operations fairly complex and require good planning along with the use of professional audio monitoring equipment designed for the task.

**Convolutional Noises** are normally related with room resonances and reverberations as major sources of this type of noise. Large rooms and lack of sound absorbing material contribute to undesired convolutional effects.

**Additive Noise** sources erupt from e.g. radio and TV audio along with a variety of noises entering from outside like mechanical movements of the microphone element, air conditioners, motors, street noise or other machinery.

**Frequency Area** is important for the operation, as concealment of the surveillance carrier in the frequency spectrum is of importance if possible, in order to avoid countermeasures or occasional interception by third party. The frequency also has to be chosen in connection with signal path loss i.e. operative distance, as to say the higher frequency the shorter operative distance and signal penetration of buildings.

**Electronic Interference** can be avoided to a certain extent but requires a selective receiver with very good input filtering, which minimizes interference from other transmitting sources. Only receivers

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### *Wireless Audio and PSTN Monitoring System INCA*

designed specially for the surveillance task, will assure the immunity and dynamic range required for optimized audio signal retrieval, easing the work for the transcriber.

**Battery lifetime/-type** is another high priority factor, often surrounded by lots of mystique but it is straight forward and can be calculated by simply dividing the transmitter current consumption (measured in mA) into the datas from the battery specifications (specified in mA/hour).

**Operative range** is an unpredictable matter mainly linked up with three major parameters; transmitting power (specified in mW), operative frequency (specified in MHz), i.e. the higher frequency the lower range due to signal attenuation in the radio frequency spectrum as well as the physical surroundings (e.g. buildings or vehicles) for the operation to be carried out.

**Receiving antenna** is as important as the radiated power from the transmitter itself. Making use of the correct antenna on the receiver side, example a narrow band directional antenna will provide a noise free amplification of several dB, extending the operative range of a concealed transmitter considerably e.g. 50 - 100 meter.

**Radio Signal Reflection** as a normal used antenna is providing a three-dimensional transmission path, another factor to be aware of is that a radio signal which has penetrated a buildings internal clutter, may often be exceeded by a signal, which has taken a more in-direct reflection route, perhaps by reflection from an adjacent building, proving a better reception at the receiver/listening post (specially in the microwave bands i.e. high frequency area).

**Building layouts and construction techniques** are other very important factors to take into consideration, where a wireless operation is to be accomplished.

The loss of the radiated signal will be high in a reinforced concrete building with internal metal partitions, that impede transmission, versus a hangar-like building which will act almost like a waveguide. The various difficulties in such operations are of disadvantage to the audio surveillance task-team. But if present handrules are taken into

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### ***Wireless Audio and PSTN Monitoring System INCA***

consideration, while planning and training for such operations and the use of high-quality professional monitoring tools designed for the task are deployed, then a maximum of parameters have been considered by the surveillance team and a successful operation should be assured.

## **2 INCA System Introduction**

Spectronic Denmark has developed a completely new generation of professional, highly advanced, micro-size modular and remote-controlled, audio/signal transmitters, which satisfy the very stringent operative requirements involved in wireless on-site target monitoring operations.

The INCA system is fully modular, assuring maximum flexibility/-expandability and is designed for applications, which range from single target operations to large scale multi target operations, incorporating an adequate number of modular INCA receivers and transmitters in order to fulfil the operative requirement.

The INCA system forms the platform of the most flexible, expandable and advanced wireless audio monitoring system available on today's world market.

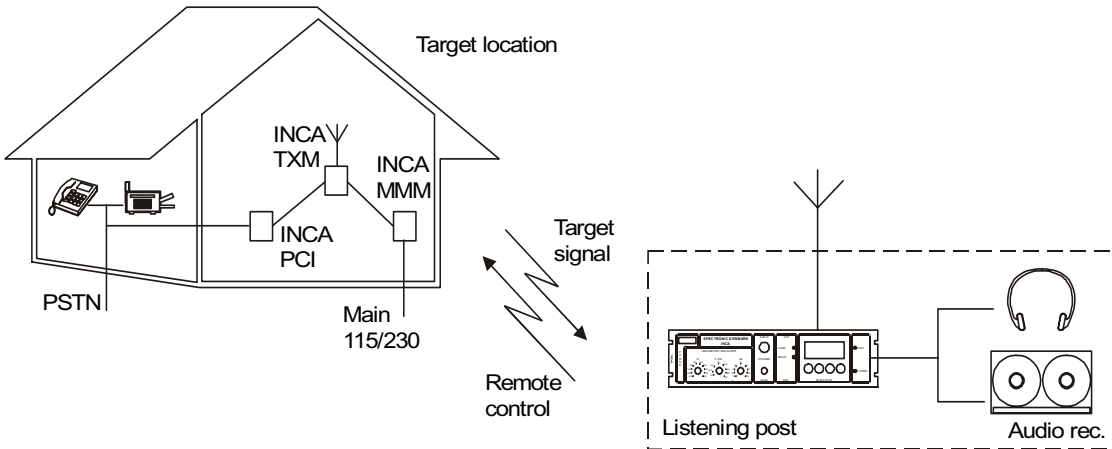
With the extensive use of the absolute latest new micro computer and SMD technology, the INCA family provides monitoring capabilities far more advanced than ever seen before, with respect to operative facilities, size, current consumption, ease of operation and reliability.

As well as having extremely advanced operating capabilities, the INCA system is designed to be both rugged and highly adaptable to the always adverse conditions in surveillance operations.

Along with highly advanced electronic performance each unit is designed to meet requirements for shock, vibration and humidity assuring perfect function after rapid deployment in contingency situations at the surveillance scenario.

## INCA SYSTEM

OPERATIONAL SET-UP





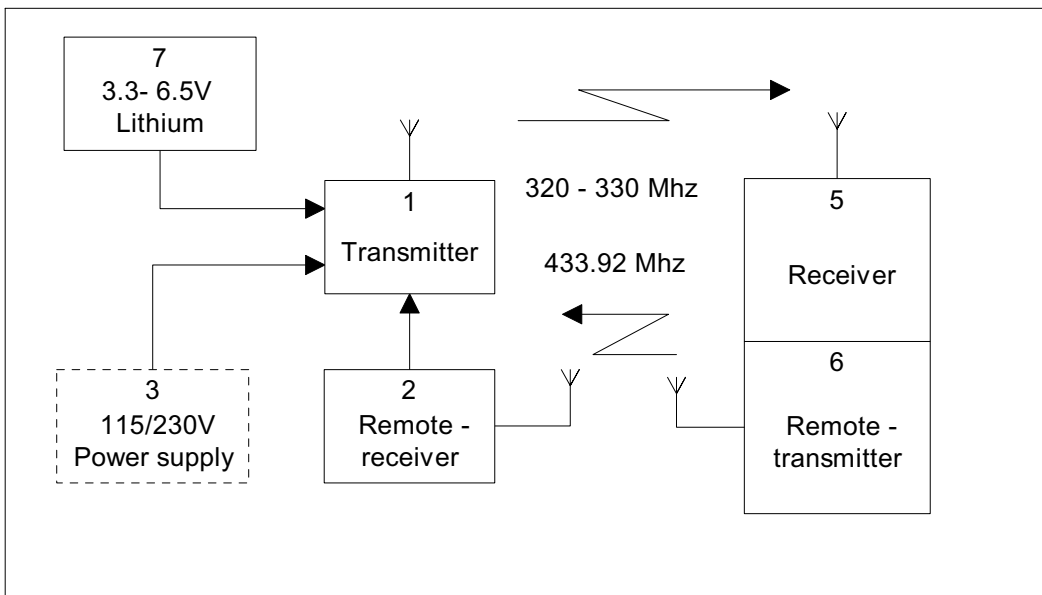
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## Wireless Audio and PSTN Monitoring System INCA

### 2.1 General

The INCA system is an advanced wireless remote controllable transmitter/receiver set. The transmitter consists of a micro SMD pieced module together with a remote - control module. The receiver is a high sensitive PLL double conversion tuner and contains a powerful remote - control transmitter.

### 2.2 The system



**FIGURE 1** Block diagram for the system

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## *Wireless Audio and PSTN Monitoring System INCA*

### **2.3 The transmitter system**

The transmitter system consists of 3 modules. A transmitter module (1) which can be used as a stand-alone transmitter, a remote - control module (2). The system is powered either from a 4 - 6V battery (7) or from the mains via a small switch - mode power supply (3). The modules (1) and (2) measure approx . 8.5 x 13 x 38 mm and module (3) 12 x 18 x 35 mm. The modules are equipped with small connectors and are connected to each other by means of flexible wires. That means that you can choose to install the whole unit as a long “train” or folded together as a compact block.

### **2.4 Transmitter**

The transmitter is very small that makes it is easy to conceal and is built of high quality miniature SMD components to obtain a high degree of reliability. It consists of a high sensitivity microphone with low vibration sensitivity succeeded by an AGC-amplifier that is feeding the FM modulation and output circuits. The AGC action of the amplifier prevents over modulation at high sound levels and in the same time makes it possible to listen to very weak conversation.

The transmitter is based on a crystal controlled PLL oscillator.

The output power is in the range from (5-30) mW depending on the chosen power supply. With the 30 mW output power the cover range will be app. 1000 meters at free sight and down to 50 - 100 meters in concrete buildings. For maximum battery lifetime and for minimising the risk to be found by “bug detectors” or “scanners” the transmitter can be switched off into “sleep - mode by means of the remote control. During the off state the transmitter is totally switched off, and as the remote receiver does not contain a local oscillator as would normally be the case, when using a heterodyne receiver, everything is totally quiet.

Also for minimum current consumption, analogue frequency modulation with an audio bandwidth of (300 - 5000) Hz has been chosen.

The scrambler, which has been added for greater security and to avoid listening in by unauthorised persons, can be switched on and off by means of a jumper. It is based on simple frequency - inversion technique due to the very low power needed for that sort of circuitry.

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## *Wireless Audio and PSTN Monitoring System INCA*

In the scramble mode the audio frequency response as well as the signal to noise ratio are somewhat degraded compared to the unscrambled mode.

### **2.5 Remote receiver / transmitter**

The remote - receiver module RCM is designed with a very small and sensitive hybrid IC for unlicensed low-power remote control.

The system uses on-off keyed (OOK) modulation from a microcontroller IC. Thus the The X-IDER remote control system can be programmed with 4096 codes and with 8 factory pre-set into the INCA receiver.

Normally such a system has a very limited coverage range due to the limited output power dictated from regulations. Therefore the output power from the remote transmitter, which is build in the main receiver, has been "boosted" up to approx. 3 W., which will give a cover range far beyond that of the main system. In free air the remote control will reach up to 1 km. But inside buildings the range will be much shorter depending on the local conditions. The remote receiver module measures approx. 8.5 x 13 x 38 mm.

### **2.6 Power supply**

The transmitter is powered by a 3.6 – 6.5V battery depending on the required output power, alternatively from a small 115/230V AC mains power supply which measures approx. 12 x 18 x 35 mm. The output voltage is 5.75 V DC, 0.4 W max. and the mains voltage can be either 115 or 230 V AC 50/60 Hz (must be specified!). This power supply is a unique switch-mode construction with sinusoidal voltages and currents. This will greatly reduce the radiation of unwanted harmonics and spurious frequencies and omit the need for bulky EMC filters and metal screening.

**Although the power supply is mains isolated to withstand a voltage of 500 VAC it is not able to fulfil international safety regulations. Therefore the power supply should only be used in professional applications and is not intended for commercial use.**

### **2.7 Receiver**

The receiver consists of a double conversion PLL tuner with very high sensitivity. The tuner functions are controlled by means of a microcontroller via a LCD - display and 4 push buttons on the front.

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### *Wireless Audio and PSTN Monitoring System INCA*

Underneath the display is placed the 4 push buttons by means of which the different functions and set-ups of the receiver can be controlled. The display will show the chosen channel number, one of eight possible channels. Besides you will see the status of the four channels, whenever they are active or not, which also can be monitored on a RSSI bar - graph display.

On the back of the receiver there are two antenna BNC - connectors; one for RF input and one for remote power output, since the remote transmitter is within the same cabinet as the receiver. You also have a switch to bypass the built in de-scrambler, in case you have chosen an unscrambled transmitter.

You will also find a relay output to switch a tape or a DAT recorder. The relay is controlled either by a VOX (voice operated switch) circuit or the RSSI level. This VOX is an advanced type of circuit that has the ability to distinguish a voice from the background noise and trigger the switch output circuit only by the voice signal. Therefore, the switching operation is highly reliable in noisy environments. The sensitivity of the switch as well as the switch-off delay of the VOX relay can also be programmed from the front by means of the pushbuttons. The activity of the VOX circuit as well as the function of the relay can be seen on LED's on the front panel. The VOX relay has an adjustable switch-off delay to avoid too many stops in the recordings during pauses in the conversation.

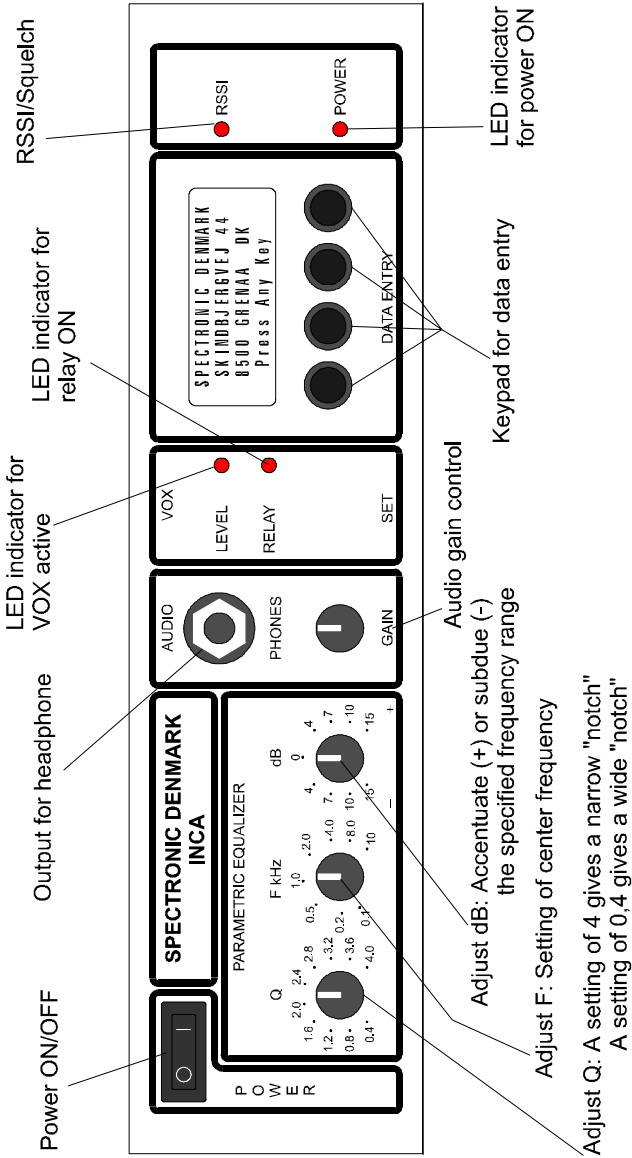
There are 2 audio outputs; one line output with phono socket and a telephone output with both 4-mm panel sockets and a standard telephone connector. The telephone has a standard 600 ohm output impedance and is equipped with an isolation transformer.

The audio signal is passed through a parametric equalizer that has a variable 12dB boost or cut in the frequency range from 100 Hz to 10 kHz as well as a variable Q (the reverse of the relative bandwidth of the boost or cut). By means of this equalizer it is possible to obtain much better audio quality in noisy environments. The receiver has a built-in loudspeaker that is automatically switched off when the headphone jack is connected to the socket.

The receiver is powered from main 115/230 V AC, alternatively from 12 -15 V DC.

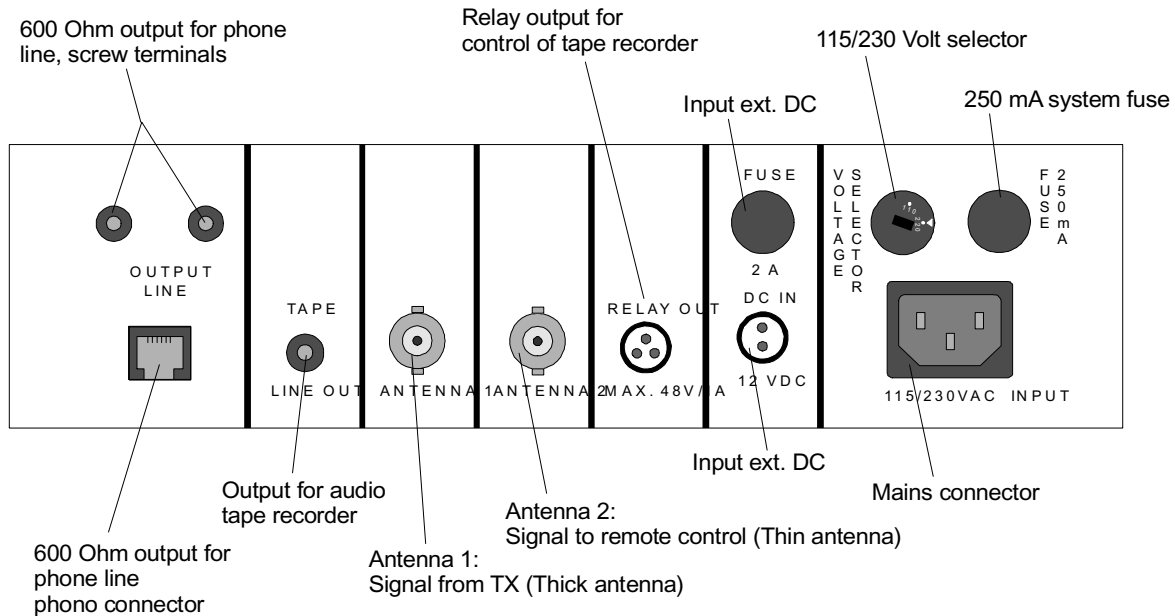
**INCA OPERATIONAL INSTRUCTION**

**Front side**

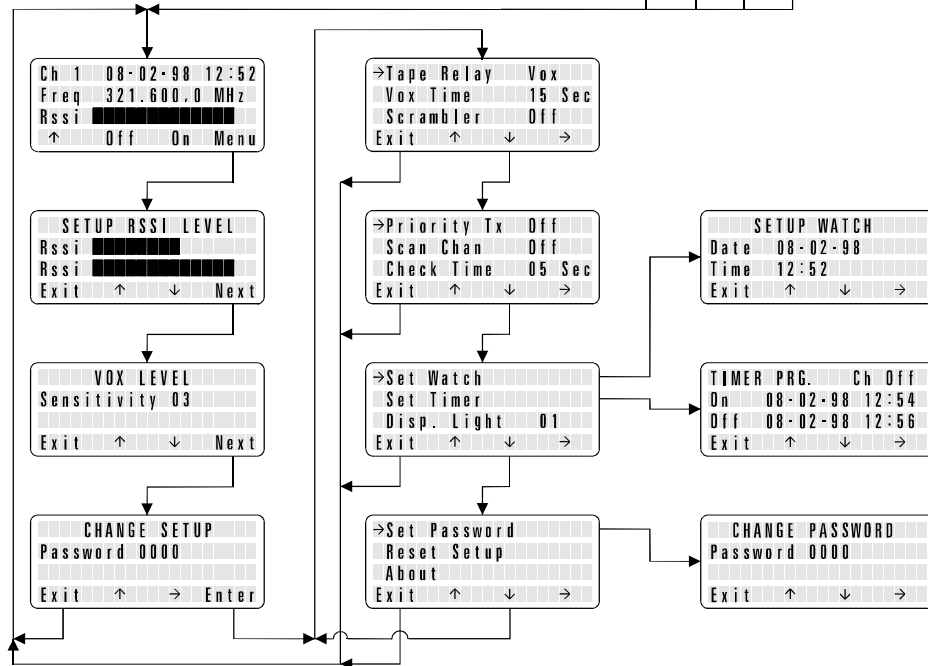
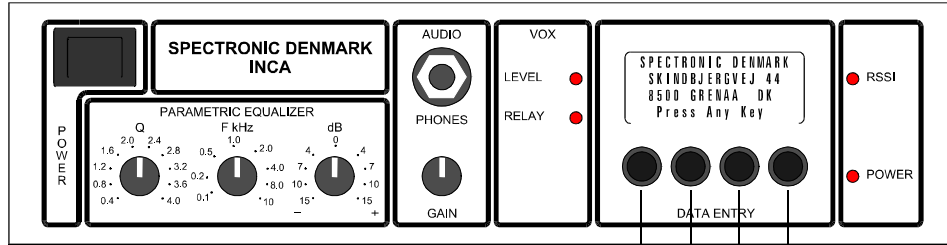


# INCA OPERATIONAL INSTRUCTION

## Rear side



# INCA OPERATIONAL INSTRUCTION



### 3 Technical Specifications

#### Receiver

##### Tuner

Frequency range 1 (standard)	(320 - 330) MHz
Frequency range 2	(160 - 170) MHz
Sensitivity (fmod. = 1kHz, deviation $\pm 3$ kHz, 20 dB SINAD)	-113 dBm (0.5 $\mu$ V)
Channel raster	12.5 kHz
Minimum channel spacing	25 kHz
Audio modulation	FM
Frequency response (input to line out)	220 Hz - 6 kHz - 3dB
AM rejection ( $V_{in} = -50$ dBm, AMmod=30 %)	45 dB
Distortion ( $V_{in} = -50$ dBm, deviation = $\pm 3$ kHz)	< 2 %, 1kHz
Input impedance	50 ohm
Audio frequency response - 3dB (line out)	220 Hz to 6 kHz
Output voltage line out (deviation= $\pm 3$ kHz)	700 mV (no load)
Output voltage tlf. out (deviation= $\pm 3$ kHz)	230 mV (600 ohm load)
Output impedance tlf. Out	600 ohm
Output impedance line out	1 kohm
Output impedance headphones out	47 ohm
Parametric equalizer frequency adjustment range	100 Hz to 10 kHz
Parametric equalizer gain adjustment range	$\pm 12$ dB
Parametric equalizer Q adjustment range	0.4 to 4
RF level meter range	(-120 to -60) dBm

##### Remote transmitter

Remote control frequency1 (standard)	433.92 MHz
Output power into 50 ohm	> 2.5 W
Modulation	OOK
Coding addresses	4096

#### General



Power supply mains feed	115/230V AC (50/60 Hz)
Power supply external DC input	12 - 15 V DC
Current consumption external DC input	< 200 mA 12 V DC
Dimensions	265 x 260 x 82 mm 10.4 x 10.2 x 3.2 inches
Weight	2.8 kg / 6.17 lbs.

**Transmitter module**

Output frequency range 1 (standard)	(320 - 330) MHz
Output frequency range 2	(160 - 170) MHz
Number of channels in the frequency range	max. 8
Minimum channel spacing	25 kHz
Channel raster	12.5 kHz
Output impedance	50 ohm
Output power into 50 ohm (Vbatt. = 6V)	30 mW min.
Max. Modulation (FM)	±3kHz
Frequency response unscrambled	100 Hz to 10 kHz - 3 dB
Frequency response scrambled	280 Hz to 4 kHz - 3 dB
Audio amplifier AGC range	50 dB
Microphone vibration sensitivity:	< 66 dB
Current consumption, active (Vbatt. = 6V)	300 mA DC typ.
Current consump., sleep mode (Vbatt. = 6V)	<2 uA DC
Supply voltage	(3.3 – 6.5) V DC
Dimensions	38 x 13.5 x 8.5 mm 1.5 x 0.5 x 0.3 inches

**Remote control module**

Remote control frequency <sup>1</sup>	433.92 MHz
Sensitivity	- 100 dBm typ.
Modulation	OOK
Coding addresses	4096
Power supply	(3.3 – 6.5) V DC
Current consumption	< 20 uA DC
Dimensions	38 x 13.5 x 8.5 mm 1.5 x 0.5 x 0.3 inches

**Power supply 6 VDC / 0.4 W**

Mains voltage	115/230 V AC
Primary current at max. load	6 mA AC

Output voltage	5.75 V DC
Output current	75 mA max.
Dimensions	38 x 18 x 12 mm 1.5 x 0.7 x 0.5 inches

**Transmitter system**

Total current consumption, switched off	<20 uA DC
Total current consumption, switched on	60 mA DC typ.
Overall unscrambled frequency response (transmitter - receiver)	250 Hz - 6 kHz
Overall scrambled frequency response (transmitter - receiver)	350 Hz - 4 kHz

**3.1 Test results for X-IDER 4096**

With new Duracell Alkaline 9V MN1604-6LR61

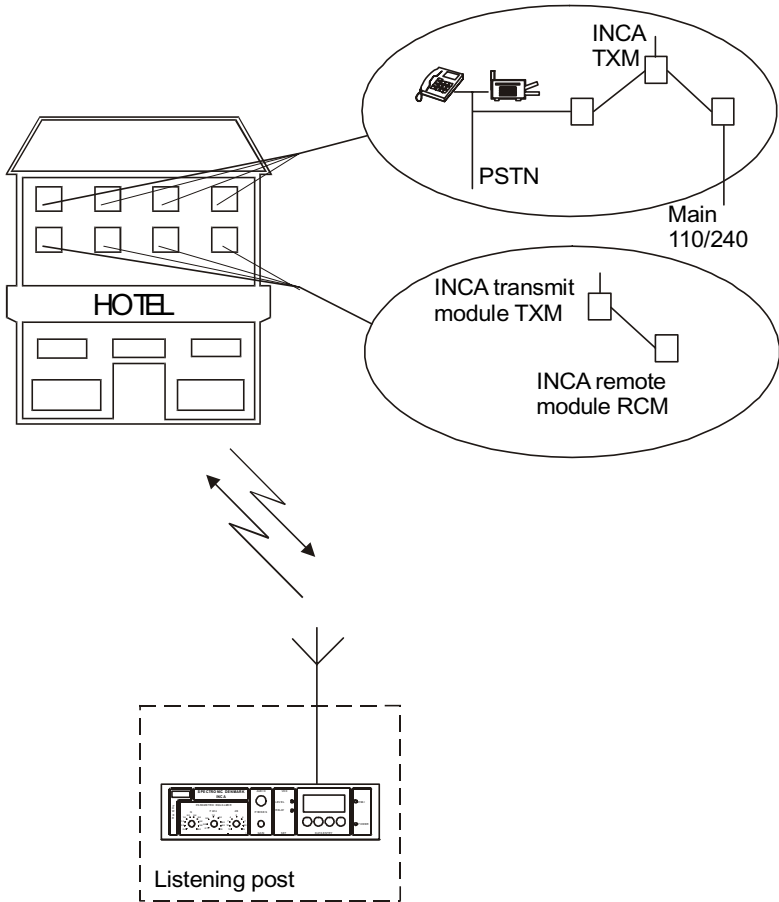
Transmitting power (Watt)	No. of transmissions	Battery power by last transmission (VDC)
Over 2.00	45	7.8
1.75 – 2.00	25	7.5
1.50 – 1.75	25	7.3
1.25 – 1.50	42	7.0
1.00 – 1.25	57	6.85
0.9 – 1.00	140	6.7
0.8 – 0.9	137	6.6 Battery LOW starts and stops.
0.7 – 0.8	93	6.5
0.6 – 0.7	85	6.4 Battery LOW on every time.
0.5 – 0.6	110	6.3
0.4 – 0.5	90	6.2

It is to be expected that the XIDER 4096 TX unit should be able to perform about 100 transmissions with a good distance by using a new good quality battery.



# INCA SYSTEM

Multi target/large scale configuration



## **4 Parts List INCA Basic Configuration 1**

<b>Pcs</b>	<b>Description</b>
1	INCA RX
1	INCA TXM Opt. 003 channel 1 + INCA RCM Opt 004
1	Antenna 1, telescope
1	Antenna 2, 70 cm band
1	Headphone
1	Elbow BNC connector
1	Extra fuse 250 mA
1	Extra fuse 2 A
1	Power cord
1	Cable for relay (Lemo to open end)
1	INCA User Guide
1	Suitcase
2	Keys

## **5 Parts List INCA Basic Configuration 2**

<b>Pcs</b>	<b>Description</b>
1	INCA RX
1	INCA TXM Opt. 003 channel 1 + INCA RCM Opt 004
1	INCA TXM Opt. 003 channel 2 + INCA RCM Opt 004
1	INCA TXM Opt. 003 channel 3 + INCA RCM Opt. 004
1	INCA TXM Opt. 003 channel 4 + INCA RCM Opt. 004
1	Antenna 1, telescope
1	Antenna 2, 70 cm band
1	Headphone
1	Elbow BNC connector
1	Extra fuse 250 mA
1	Extra fuse 2 A
1	Power cord
1	Cable for relay (Lemo to open end)
1	INCA User Guide
1	Suitcase
2	Keys

## **6 Parts List INCA Basic Configuration 3**

<b>Pcs</b>	<b>Description</b>
1	INCA RX
1	INCA TXM Opt. 003 channel 1 + INCA RCM Opt 004
1	INCA TXM Opt. 003 channel 2 + INCA RCM Opt 004
1	INCA TXM Opt. 003 channel 3 + INCA RCM Opt. 004
1	INCA TXM Opt. 003 channel 4 + INCA RCM Opt. 004
1	INCA TXM Opt. 003 channel 5 + INCA RCM Opt 004
1	INCA TXM Opt. 003 channel 6 + INCA RCM Opt 004
1	INCA TXM Opt. 003 channel 7 + INCA RCM Opt. 004
1	INCA TXM Opt. 003 channel 8 + INCA RCM Opt 004
1	Antenna 1, telescope
1	Antenna 2, 70 cm band
1	Headphone
1	Elbow BNC connector
1	Extra fuse 250 mA
1	Extra fuse 2 A
1	Power cord
1	Cable for relay (Lemo to open end)
1	LEMO plug 2-pol for DC IN
1	INCA User Guide
1	Suitcase
2	Keys



**7                    Parts List                    INCA Options**

**Pcs                    Description**

- INCA TXM Opt. 003 channel 1
- INCA TXM Opt. 003 channel 2
- INCA TXM Opt. 003 channel 3
- INCA TXM Opt. 003 channel 4
- INCA TXH Opt. 008 channel 1
- INCA TXH Opt. 008 channel 2
- INCA TXH Opt. 008 channel 3
- INCA TXH Opt. 008 channel 4
- INCA RCM Opt. 004
- INCA SXM Opt. 005
- INCA PCI Opt. 006
- INCA MMM Opt. 007

**8    INCA TX/RC PSTN Wireless Telephone Line Transmitter**

## 8.1 Introduction

This document describes the general functions and performance of the Spectronic INCA TX/RC PSTN wireless telephone line transmitter.

Information on the items of a specific delivery is to be found in a separate document, stating TX frequency and remote control address codes of the individual units.

**Note:** The special functions/upcodes will only be available, if using an X-IDER TX. Please refer to "Remote Control Upcodes 8.2.6" page 30.

## 8.2 System Concept

### 8.2.1 General

The INCA TX/RC PSTN is a series of wireless, remote controllable, minimum size VHF or UHF transmitters intended for concealed room monitoring connected in parallel to a PSTN telephone line. The input impedance is very high, so the loading of the telephone line will be negligible. The transmitters can be switched into a "sleep-mode" by means of the wireless remote control X-IDER transmitter. In this "sleep-mode" the current consumption is only app. 35  $\mu$ A, which will maximize the lifetime of the battery. Alternatively, at the expense of a little higher current consumption (approx. 90  $\mu$ A), the transmitter can be switched into an OFF-HOOK mode. In this state the transmitter is only running when the DC off-hook level of the telephone line is below a predetermined value. This OFF-HOOK circuit has three different selectable remote control turn-on levels, which are respectively 10V, 20V and 40V DC line voltage.

The transmitter also includes audio scrambler-circuit, which can be switched on and off by the remote control, just like the OFF-HOOK circuit and the sleep-mode state. The TX unit comes with flying leads for battery connection, telephone line connection and for remote RX antenna, whereas the TX antenna terminal has a female MMCX-connector. The TX unit is deliverable with either internal or external microphone.

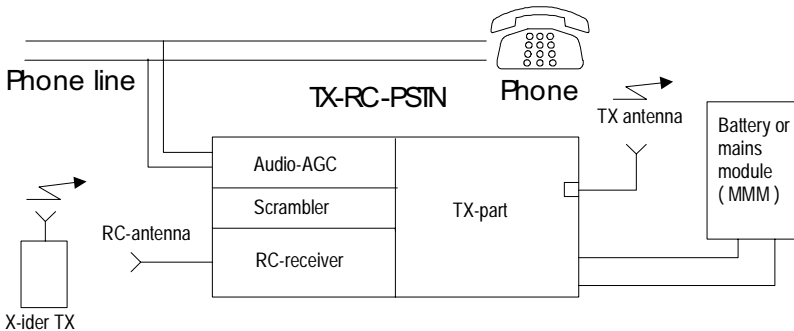
### 8.2.2 Application Note

When an antenna is in close proximity to metal surfaces, concrete walls or the human body, the efficiency of the transmitter will be

minimized due to power absorption and disturbance of the antenna radiation pattern. To achieve maximum RF range, it is therefore advisable to keep the antenna so far away from the surroundings as possible. If you let the TX run continuously, your operational time will be degraded seriously. When no monitoring is wanted or you know for sure that the target person will not be present for a certain period, it is therefore advisable to switch off the transmitter via the X-IDER remote-control transmitter to preserve the battery. Alternatively, you simply choose OFF-HOOK mode, in which case the TX only will “go in the air” every time the phone is going off-hook.

Although the transmitter will work excellently with most standard receivers or scanners, provided they have the right audio de-emphasis, you will get the best results by using the Spectronic INCA receiver. Most standard receivers and scanners have an audio bandwidth of 300-3000 Hz, whereas the INCA receiver has a bandwidth from 300-4000 Hz, even in scramble mode. Investigations at Spectronic have shown that the audio intelligibility is improved substantially by increasing the upper audio band limit from 3000 Hz to 4000 Hz. The INCA receiver also has superior selectivity and sensitivity, which will give the best possible RF range.

**8.2.3 Block Schematic**



**8.2.4 Transmitter**

The transmitter is made of high quality miniature SMD components to obtain a high degree of reliability. Since is very small, it is easy to

conceal. It consists of an AGC-amplifier that feeds both the scrambler, the FM modulation and the output circuits. The AGC action of the amplifier prevents over-modulation at high sound levels and makes it possible to listen to very weak conversation at the same time.

The transmitter is based on a crystal controlled PLL-synthesized oscillator. The frequency can be chosen in the range (320-330) MHz or (155-173) MHz.

For maximum battery lifetime and for minimizing the risk of being found by "bug detectors" or "scanners" the transmitter can be switched off into "sleep-mode" by means of the remote control.

Alternatively the transmitter can be switched off into a "OFF-HOOK mode" with the same advantages. In the "sleep-mode" the receiver only goes in the air in approx. 30 msec. for every 2.5 seconds to look for a valid code transmission

During off state, the transmitter is completely switched off. Since the remote receiver does not contain a local oscillator as would normally be the case when using a heterodyne receiver, everything is totally quiet and nothing can be traced by e.g. spectrum analyzers or scanners.

For minimum current consumption, analogue frequency modulation with an audio bandwidth of (280 - 5000) Hz (unscrambled mode) has been chosen.

The scrambler, which can be switched on and off by means of the remote control, has been added for greater security and to avoid listening-in by unauthorized persons. It is based on simple frequency-inversion techniques due to the very low power needed for that sort of circuit. In the scramble mode, the audio frequency response, as well as the signal to noise ratio, are somewhat minimized compared to the unscrambled mode.

### **8.2.5 Remote Control Receiver**

The remote-receiver is realized by a very small and sensitive hybrid IC, intended for unlicensed low-power remote control. The carrier frequency is OOK (on off keyed) modulated and the system provides up to 4096 different address codes. The Spectronic X-IDER remote-control transmitter is used to send different codes for setting up the TX. By reception of a new upcode, the TX will send an acknowledge

signal by toggling the RF on and off in three cycles of 0.6 Sec. duration.

The Address Code of the Remote Control will be Factory set, according to customer specifications or as specified for standard frequencies by Spectronic.

### **8.2.6 Remote Control Upcodes**

X-IDER left-hand HEX switch

- |   |  |
|---|--|
| 0 | TX on  |
| 1 | TX off (factory default)   |
| 4 | TX audio scrambler on  |
| 5 | TX audio scrambler off (factory default)                                     |
| A | TX OOF-HOOK defeated (factory default)                                       |
| B | TX with OFF-HOOK control, line voltage = 10V DC                              |
| C | TX with OFF-HOOK control, line voltage = 20V DC                              |
| D | TX with OFF-HOOK control, line voltage = 40V DC                              |
| E | Start up state after DC removal: TXoff                                       |
| F | Start up state after DC removal: Same as before DC removal (factory default) |

### 8.3 Technical Specifications

#### Transmitter

Output frequency range UHF (standard)	(320 - 330) MHz
Output frequency range VHF	(155 - 173) MHz
Operational temperature range	0° - +50° C / 32F – 122F
Frequency stability (above temp. range)	± 5 ppm
Minimum channel spacing	25 kHz
Channel raster	12.5 kHz
Output impedance	50 Ω
Max. Modulation: (FM)	± 4kHz
Audio frequency response unscrambled	100 Hz to 5 kHz - 3 dB
Audio frequency response scrambled	280 Hz to 4 kHz - 3 dB
Audio pre-emphasis	6dB/Octave
Audio amplifier AGC range	50 dB
Current consumption, active (Vbatt. = 6V)	<70 mA DC
Current consumption, sleep-mode	< 40 uA DC
Current consumption, OFF-HOOK (Phone ON-HOOK)	< 100 uA DC
Output power (Vbatt. = 6V)	>50 mW @ 50 Ω
DC line input impedance	>10 Meg Ω
AC line input impedance	>100 k Ω

#### Receiver

Remote control frequency	433.92 MHz
Sensitivity	< - 90 dBm
Modulation	OOK
Coding addresses	4096

### 9. INCA TX/RC VOX Wireless Transmitter

## 9.1 Introduction

This document describes the general functions and performance of the Spectronic INCA TX/RC VOX transmitter.

Information on items of a specific delivery is to be found in a separate document, stating TX frequencies and remote control address codes of the individual units.

**Note:** The special functions/upcodes will only be available, if using an X-IDER TX. Please refer to "Remote Control Upcodes 9.2.6" page 36.

## 9.2 System Concept

### 9.2.1 General

The INCA TX/RC VOX is a series of wireless, remote controllable, minimum size VHF or UHF transmitters intended for concealed room monitoring or as body transmitters. The transmitters can be switched into "sleep-mode" by means of the wireless remote control X-IDER transmitter. In this "sleep-mode" the current consumption is only app. 35 uA, which maximizes the lifetime of the battery. Alternatively, at the expense of a little higher current consumption (app. 90 uA), the transmitter can be switched into VOX-mode, meaning that the transmitter will run only when the microphone hear acoustic signals like talking or music.

This VOX is an advanced type of circuit that has the ability to distinguish voice from background noise and the power circuit is only switched on when a voice signal is present. Therefore, the switching operation is highly reliable in noisy environments. The VOX-circuit has three different, selectable remote control turn-on levels, which are respectively 2, 5 and 10 dB above background noise level.

The transmitter also includes audio scrambler-circuit, which can be switched on and off by the remote control, just like the VOX-circuit and the sleep-mode state. The TX unit comes with flying leads for both battery connection and remote RX antenna, whereas the TX antenna terminal has a female MMCX-connector. The TX unit is deliverable with either internal or external microphone.



### **9.2.2 Application Note**

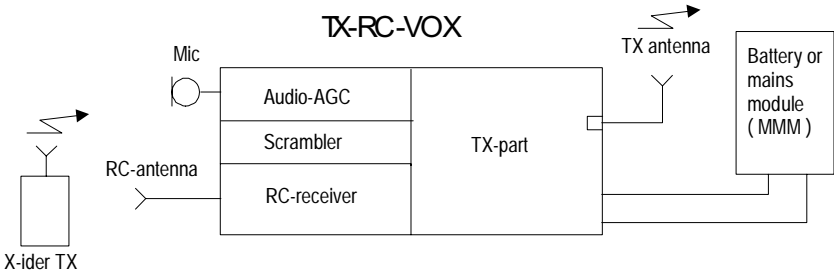
When an antenna is in close proximity to metal surfaces, concrete walls or the human body, the efficiency of the transmitter will be minimized due to power absorption and disturbance of the antenna radiation pattern. To achieve

maximum RF range it is therefore advisable to keep the antenna as far away from the surroundings as possible. If you let the TX run continuously, your operational time will be minimized seriously.

When no monitoring is wanted or you know for sure that no persons will be present in the room for a certain period, it is advisable to switch off the transmitter via the X-IDER remote-control transmitter to preserve the battery. Alternatively, simply choose VOX mode, when in doubt whether persons will be present in the room being monitored. The TX will then only go "on the air" every time conversation is detected in the room. After app. 15 sec. without conversation, the TX will go to sleep again and thus saving battery power.

Although the transmitter will work excellent with most standard receivers or scanners, provided they have the right audio de-emphasis, you will get the best results by using the Spectronic INCA receiver. Most standard receivers and scanners have an audio bandwidth of 300-3000 Hz, whereas the INCA receiver has a bandwidth from 300-4000 Hz, even in scramble mode. Investigations at Spectronic have shown that the audio intelligibility is improved substantially by increasing the upper audio band limit from 3000 Hz to 4000 Hz. The INCA receiver also has a superior selectivity and sensitivity, which will give the best possible RF range.

### **9.2.3 Block Schematic**



### 9.2.4 Transmitter

The transmitter is made of high quality miniature SMD components to obtain a high degree of reliability. Since it is very small, it is easy to conceal. It consists of a highly sensitive microphone with low vibration sensitivity succeeded by an AGC-amplifier that feeds both the scrambler, the FM modulation and the output circuits. The AGC action of the amplifier prevents over-modulation at high sound levels and makes it possible to listen to very weak conversation at the same time.

The transmitter is based on a crystal controlled PLL-synthesized oscillator. The frequency can be chosen in the range (320-330) MHz or (155-173) MHz.

For maximum battery lifetime and for minimizing the risk of being found by "bug detectors" or "scanners", the transmitter can be switched off into "sleep-mode" by means of the remote control. Alternatively the transmitter can be switched off into "VOX-mode" with the same advantages. In "sleep-mode" the receiver only goes on the air in app. 30 msec. for every 2.5 seconds to look for a valid code transmission

During off state, the transmitter is completely switched off, and as the remote receiver does not contain a local oscillator as would normally be the case, when using a heterodyne receiver, everything is totally quiet and nothing can be found by e.g. spectrum analyzers or scanners.

For minimum current consumption, analogue frequency modulation with an audio bandwidth of (280 - 5000) Hz (unscrambled mode) has been chosen.

The scrambler, which can be switched on and off by means of the remote control, has been added for greater security and to avoid listening-in by unauthorised persons. It is based on simple frequency-inversion techniques due to the very low power needed for that sort of circuit. In the scramble mode, the audio frequency response, as well as the signal to noise ratio, are somewhat minimized compared to the unscrambled mode.

**9.2.5 Remote Control Receiver**

The remote-receiver is realized by a very small and sensitive hybrid IC, intended for unlicensed low-power remote control. The carrier frequency is OOK (on off keyed) modulated and the system provides up to 4096 different address codes. The Spectronic X-IDER remote-control transmitter is used to send the different codes for setting up the TX. By reception of a new upcode the TX will send an acknowledge signal by toggling the RF on and off in three cycles of 0.6 Sec. duration.

The Address Code of the Remote Control is Factory set, according to customer specifications, or as specified for standard frequencies by Spectronic.

**9.2.6 Remote Control Upcodes**

X-IDER left-hand HEX switch

- 0 TX on
- 1 TX off (factory default)
- 4 TX audio scrambler on

- 5 TX audio scrambler off (factory default)
- A TX with VOX defeated (factory default)
- B TX with VOX, level 2 dB above noise
- C TX with VOX, level 5 dB above noise
- D TX with VOX, level 10 dB above noise
- E Start up state after DC removal: TX off
- F Start up state after DC removal: Same as before DC removal (factory default)

### **9.3 Technical Specifications**

#### **Transmitter**

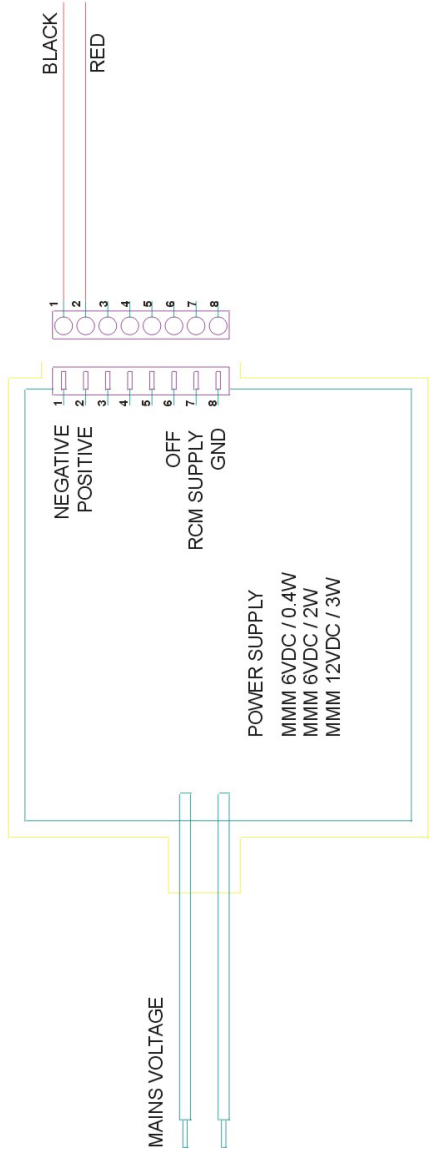
Output frequency range UHF (standard)	(320 – 330) MHz
Output frequency range VHF	(155 – 173) MHz
Operational temperature range	0°- +50° C / 32F – 122F
Frequency stability (above temp. range)	± 5 ppm
Minimum channel spacing	25 kHz
Channel raster	12.5 kHz

Output impedance	50 $\Omega$
Max. Modulation (FM)	$\pm$ 4kHz
Audio frequency response unscrambled	100 Hz to 5 kHz – 3 dB
Audio frequency response scrambled	280 Hz to 4 kHz – 3 dB
Audio pre-emphasis	6dB/Octave
Audio amplifier AGC range	50 dB
Microphone vibration sensitivity	< 66 dB
Current consumption, active (Vbatt. = 6V)	<70 mA DC
Current consumption, sleep-mode	< 40 $\mu$ A DC
Current consumption, VOX-mode (silent room)	< 100 $\mu$ A DC
Output power (Vbatt. = 6V)	>50 mW @ 50 $\Omega$
Size	33 x 24 x 7 mm 1.3 x 0.9 x 0.3 inches

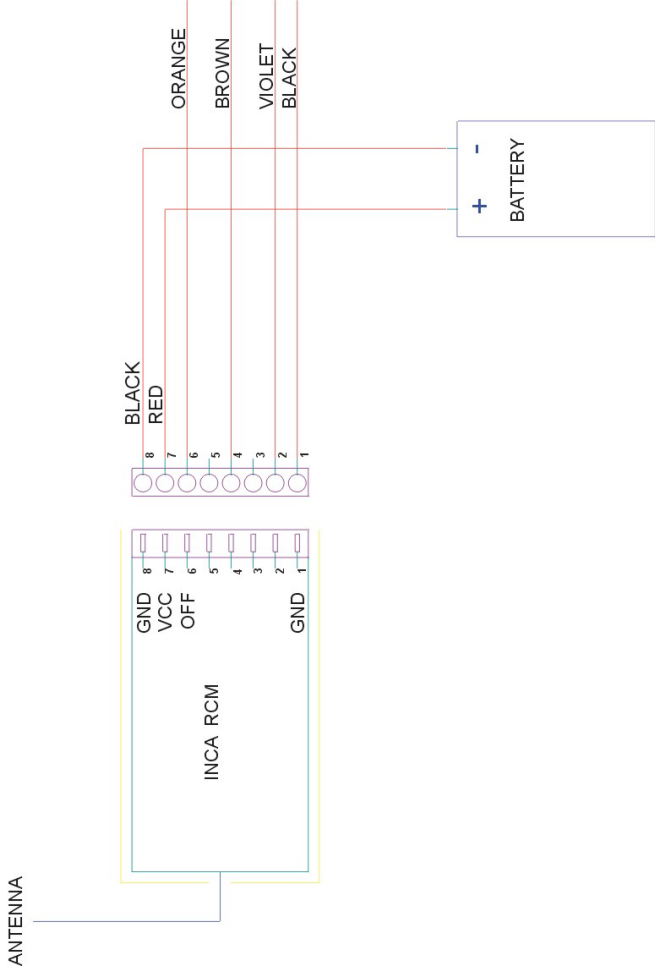
**Receiver**

Remote control frequency	433.92 MHz
Sensitivity	< - 90 dBm
Modulation	OOK
Coding addresses	4096

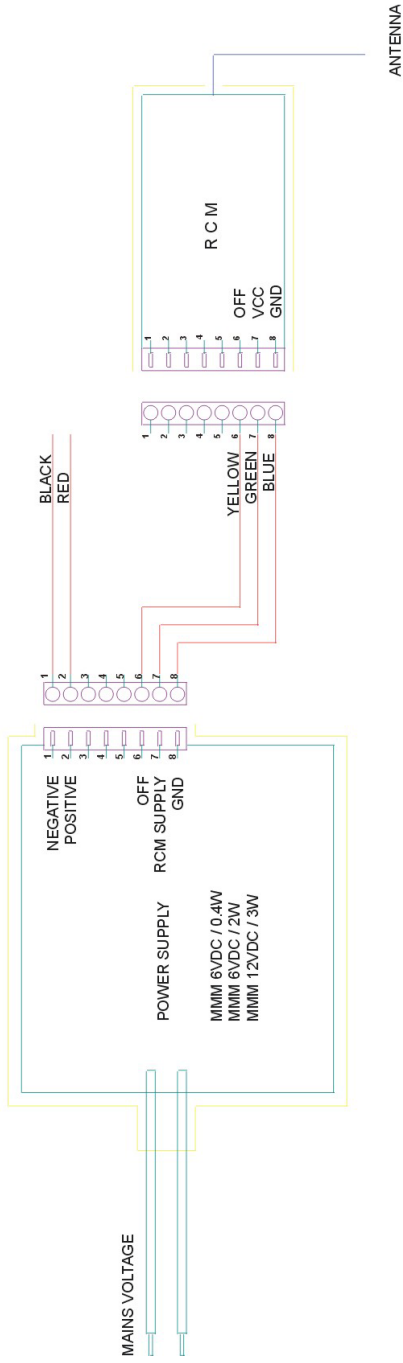
# WIRE CONNECTIONS FOR MMM



# WIRE CONNECTIONS FOR RCM AND BATTERY

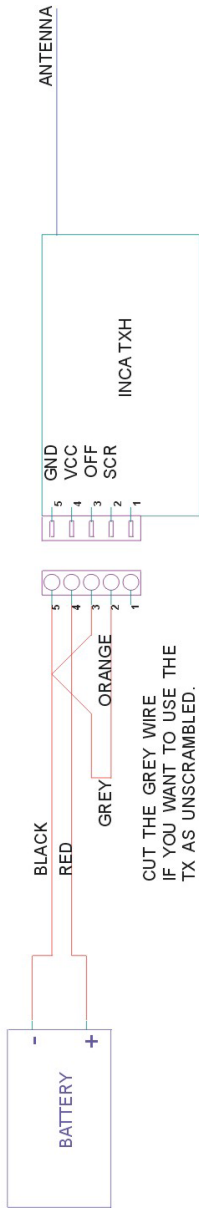


# WIRE CONNECTIONS FOR MMM AND RCM

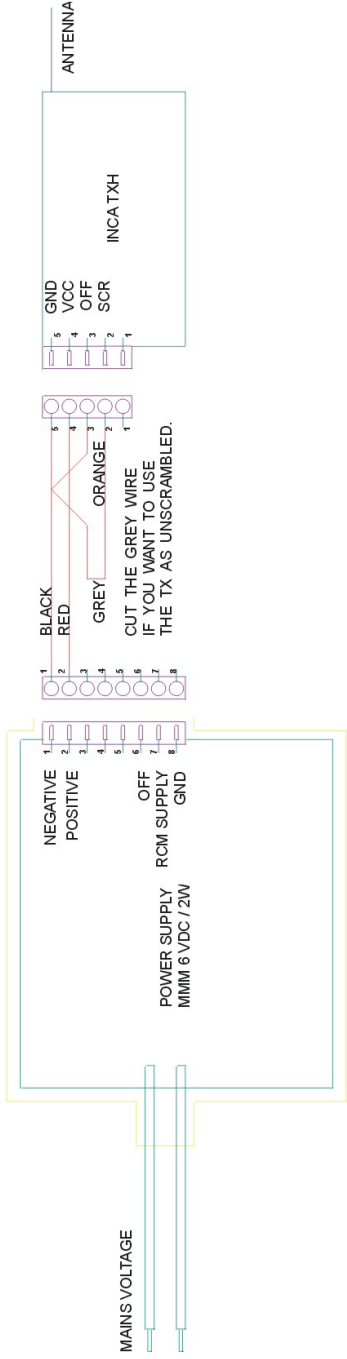




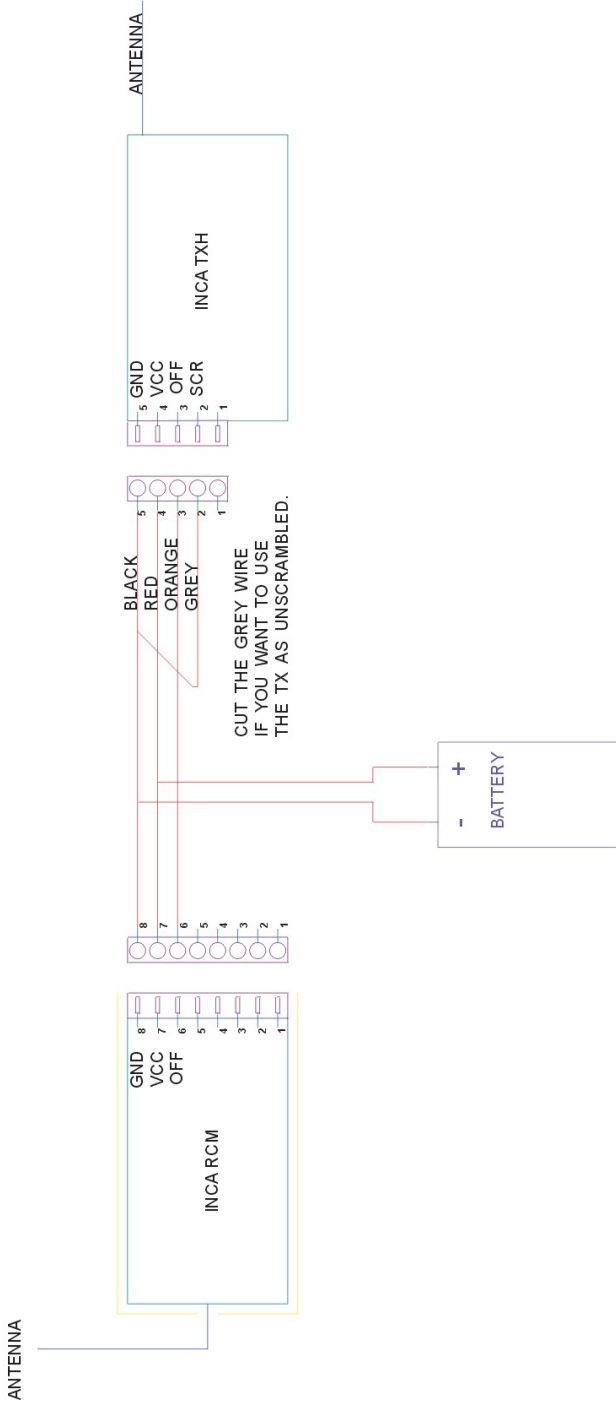
# WIRE CONNECTIONS FOR TXH WITH BATTERY



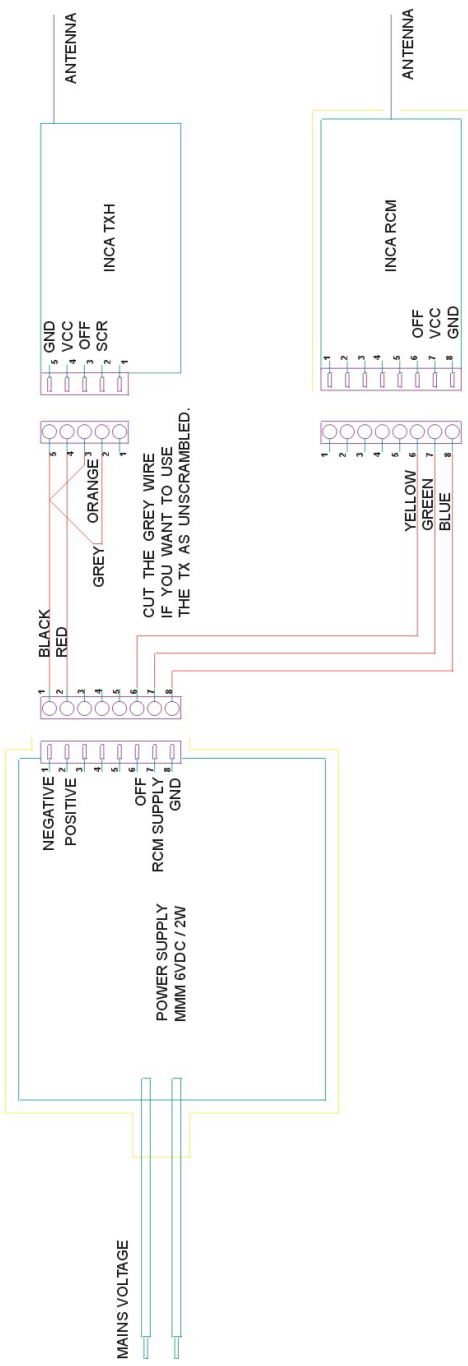
# WIRE CONNECTIONS FOR MMM AND TXH



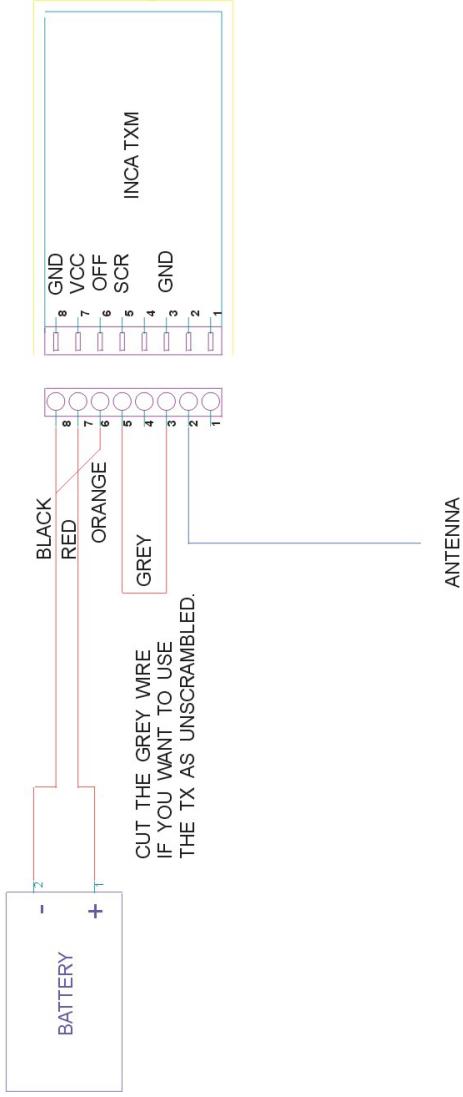
# WIRE CONNECTIONS FOR RCM AND TXH WITH BATTERY



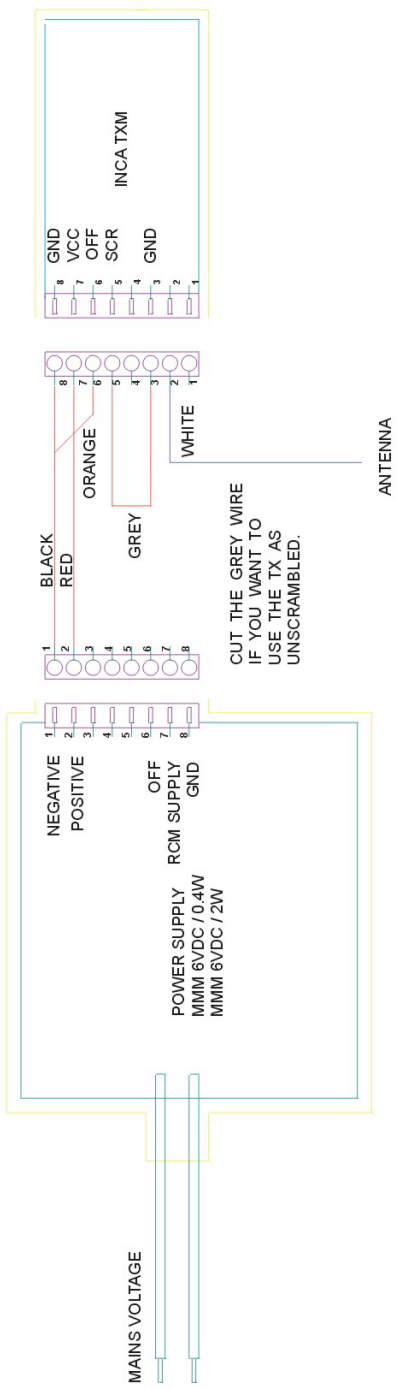
# WIRE CONNECTIONS FOR MMM PLUS TXH AND RCM



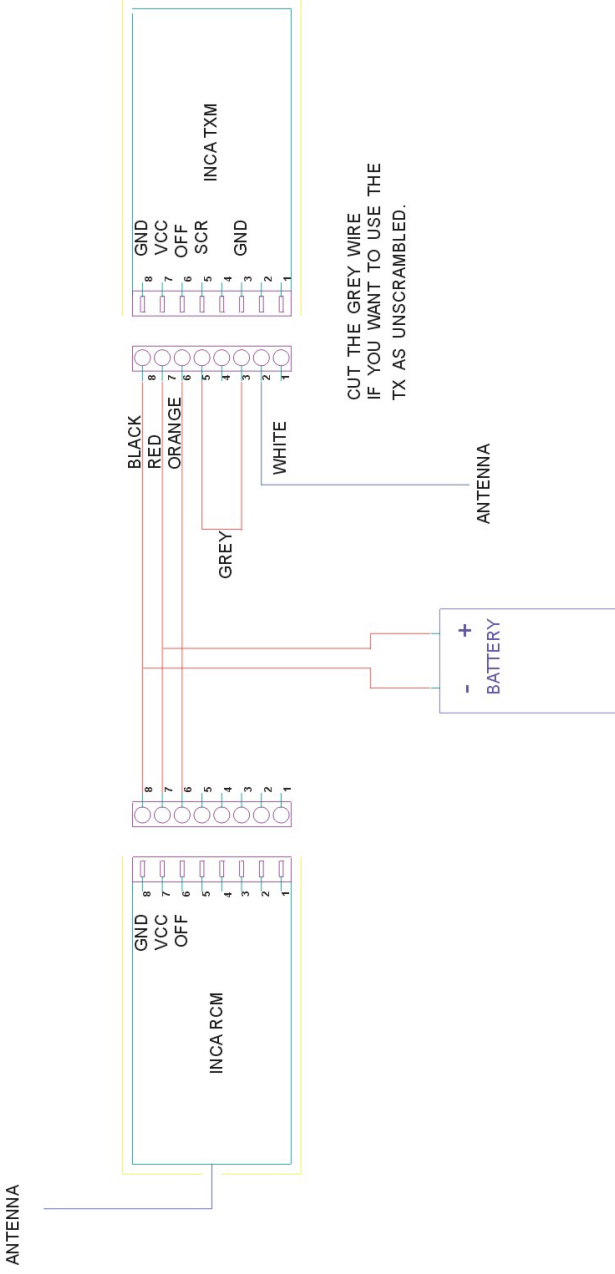
# WIRE CONNECTIONS FOR TXM WITH BATTERY



# WIRE CONNECTIONS FOR MMM AND TXM



# WIRE CONNECTIONS FOR RCM AND TXM WITH BATTERY



# WIRE CONNECTIONS FOR MMM PLUS TXM AND RCM

