# WRP-600

## Microprocessor-Controlled Wireless Repeater

**Visonic Ltd**

## Installation Instructions

## 1. INTRODUCTION

The WRP-600 is a microprocessor controlled wireless repeater, designed to relay digital data between wireless transmitters and a target receiver. Repeater links are required when the target receiver is beyond the range of at least some of the wireless transmitters and is therefore incapable of receiving transmissions directly (refer to Figure 1).

As a communication range extender for all Visonic Ltd. low-power wireless transmitters, this repeater is compatible with the standard line (WT/WR series) that uses 12-bit DIP-switch programmable codes and the new "PowerCode" family (MCT/MCR series) that uses 16,000,000 self-learning codes. **A WRP-600 repeater can simultaneously serve both 12-bit and PowerCode networks that coexist in the same area.**

If the distance between the transmitters and the destination receiver is too large to be covered with one repeater, several auxiliary repeaters may be added along the communication path. This way, a multi-level network is created (see Figure 2).

Up to 16 auxiliary repeaters can be interposed between the farthest group of transmitters and the target receiver.
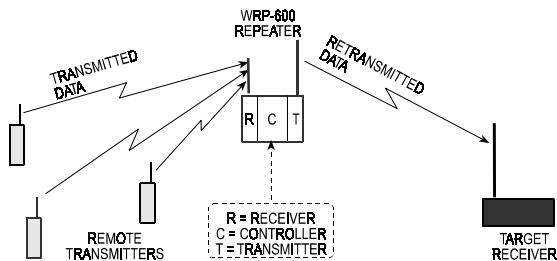
Each repeater must be assigned a correct LEVEL TAG for the system to operate properly.

The repeater closest to the target receiver is at LEVEL 0, and level numbers go up with each added repeater, up to LEVEL 15.

A receiver module, a transmitter module and a controller motherboard are the building blocks of the WRP-600. All three units are packaged in a small-size, easy-to-install plastic housing. Both receiver and transmitter use short, down-hanging wire antennas. The WRP-600 repeater is powered by 13 to 20 VDC supply or 11-16 VAC. A 9-Volt nickel-cadmium rechargeable battery provides backup in case of mains power failure.

The battery is recharged by a built-in charger. A fully charged 110 mA/h battery will provide about 5 hours of emergency operation at 1:1 receive/transmit ratio.
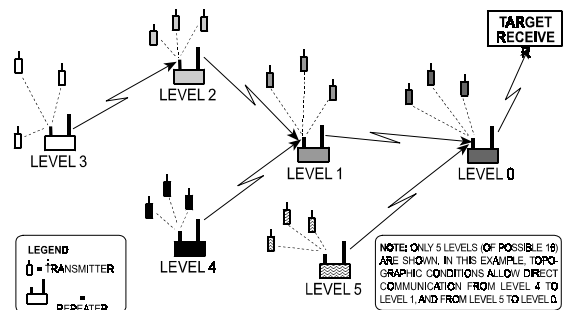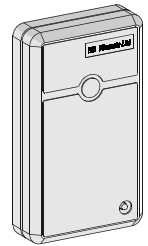


*Figure 1.* Single -Level Repeater Configuration



*Figure 2.* Multi-Level Repeater Configuration

## 2. SPECIFICATIONS

**Operating Frequencies:** Any one of 315, 404, 418, 433.9 MHz, or other frequencies in accordance with local requirements.
**Receiver Type:** Super-regenerative.
**Modulation Type:** 100% ASK.
**System Codes:** (in 12-bit systems): 8-bit digital word, 256 combinations, pulse width modulation.
**PowerCode ID:** One of 16,000,000 possible 24-bit codes
**Power Input Ranges**:13 - 20 Volts DC, or 11-16 Volts AC, 100 mA min.
**Backup Battery:** 9 V (8.4 V), 110 mA/h rechargeable Ni-Cd type.
**Current Consumption @ 14 VDC**:
- With Rechargeable Battery: 17.5 mA.
- Without Battery: 5.5 mA.

*Note: There is no change in current consumption between the receive and transmit modes.*
**Battery Backup Duration:** Approx. 5 hours with a fully charged 110 mA/h Ni-Cd battery and 1:1 standby/transmit ratio.
**LED indicator:** Lights during transmission.
**Compliance with Standards**: 418 & 433.92 MHz units European Council Directive EMC 89/336/EEC & 92/31/EEC, and bear the CE mark and certification.
Meets FCC Part 15, ETS 300-220 and MPT 1340.
**Operating Temperature:** 0 °C to 49°C (32° F to 120° F).
**Dimensions (H x W x D):** 110 x 63 x 25 mm (4-5/16 x 2-1/2 x 1in.).
**Weight:** 73 gr (2.6 oz).

## 3. FUNCTIONALITY

### 3.1 Interfacing with 12-Bit Systems

In 12-bit systems that do not employ WRP-600 repeaters, 8 bits are used for the system code, and all transmitters as well as the target receiver are set to the same 8-bit code.

With WRP-600 repeaters in use, it is sometimes required to determine which transmitter will take advantage of the repeater and which transmitter will send its data directly to the target receiver without repeater intervention.

To make this possible, all transmitters intended to send their signals via the WRP-600 must transmit a system code combination in which the 8th (most significant) bit is OFF.

The repeater programmed for operation at LEVEL 0 (the one closest to the target receiver) rejects any system code in which the 8th bit is ON. On the other hand, it accepts any system code in which the 8th bit is OFF, but inverts the 8th bit upon retransmission (the 8th bit in the retransmitted code becomes ON).

In order to receive the retransmitted code, the target receiver should be set to the same code as that retransmitted by LEVEL 0 repeater (with the 8th bit ON).

Transmitters deployed in close proximity to the target receiver must be set to the same code as that of the receiver. Since the 8th bit of their code is ON, their signals will be rejected by any repeater but not by the target receiver.

Repeaters programmed to operate at any level above LEVEL 0 do not invert the 8th bit - they retransmit the received code "as is".

In multi-repeater networks, each repeater adds its own 4-bit LEVEL TAG to any incoming code, and the expanded data string is retransmitted. The level tag is important for inter-repeater communications, since it permits each repeater to distinguish between original and retransmitted codes, and to determine whether the signal is coming from a higher or a lower level (see Section 8). However, the last repeater in the chain (the one at LEVEL 0) retransmits the code without adding any level tag.

## 3.2 Interfacing with PowerCode Systems

PowerCode transmitters use 24-bit ID codes, randomly selected in the factory from over 16 million available combinations. When a PowerCode transmitter is keyed on, its code is received by the repeater and retransmitted to the target receiver.

Each WRP-600 repeater has its own unique, factory determined 24-bit PowerCode ID. However, this ID code is only utilized for reporting the repeater's own service alerts (see Section 7).

When a WRP-600 repeater is placed into service in a PowerCode system, its PowerCode identity must be "revived" (see Para. 6.2 for detailed procedure). If this isn't done, the repeater will retransmit PowerCode messages but will not send out its own service alerts.

## 3.3 Single Repeater Links

### A. What is "LEVEL 0" ?

In many cases, a single repeater is enough to bridge the communication gap between the deployed transmitters and the target receiver. In a single repeater setup, all 4 levers of the on-board DIP switch level selector must be set to OFF - i.e. LEVEL 0. Multi-repeater networks are dealt with in Section 5.

### B. LEVEL 0 in 12-bit Systems

In 12-bit systems, LEVEL 0 means that the repeater will retransmit any received message, without adding a LEVEL TAG (the level tag is only significant in multi-repeater networks).

At LEVEL 0, the repeater will retransmit a received message with inversion of the 8th bit of the system code - ON instead of OFF. This feature is important for systems in which repeater-dependent and repeater-independent transmitters operate together.

### C. LEVEL 0 in PowerCode Systems

In PowerCode systems, a repeater at LEVEL 0 will simply retransmit any received message, without adding its own level tag (which is only significant in multi-repeater networks - see Sec. 3.5). Refer to Para. 5.1 for detailed communication routine at LEVEL 0.

## 3.4 Multi Repeater Network

### A. The Multi-Level Concept

An auxiliary repeater positioned along the communication path retransmits data received from any higher level repeater to any lower level repeater, but may also be used to retransmit data received from transmitters deployed near it, in its local coverage area (see Figure 2).

Data flows from the highest level repeater through intermediate repeater links to the lowest level repeater (LEVEL 0) and finally reaches the target receiver.

By virtue of differences in message format and the level tag (see Figure 3), each repeater in a multi-level network can distinguish between signals coming from nearby transmitters and signals coming from higher or lower level repeaters. The repeater's response is based on this distinction.

At all levels except for level 0, messages are retained in the repeater's memory until they are taken care of by the next repeater. Detection of the same message being forwarded further down the communication path serves as an acknowledgement for the higher level repeaters. Upon detection of a "downgoing" message, the higher level repeater stops its attempts to forward the specific message and deletes the message from its memory.

### B. Selecting Level Tags

The 4-position DIP switch on the repeater's PCB allows the installer to select the desired level by setting its 4 switch levers to 16 different combinations, as shown in Figure 3.

All repeaters leave the factory with the 4 level selection switches set to OFF (Level 0 is selected).



| LEVEL | Switch Settings | LEVEL | Switch Settings |
|-------|-----------------|-------|-----------------|
| LEVEL 0 | | LEVEL 8 | |
| LEVEL 1 | | LEVEL 9 | |
| LEVEL 2 | | LEVEL 10 | |
| LEVEL 3 | | LEVEL 11 | |
| LEVEL 4 | | LEVEL 12 | |
| LEVEL 5 | | LEVEL 13 | |
| LEVEL 6 | | LEVEL 14 | |
| LEVEL 7 | | LEVEL 15 | |

*Figure 3. Selecting the LEVEL Number*

## 3.5 Service Alert

### A. Service Codes in 12-bit Systems

Visonic Ltd. 12-bit transmitters use the 4-bit CHANNEL code (bits 9 -12) to determine which output channel (from possible 16) will be activated by the receiver. Channels 0 and 2 are reserved for reporting low battery and tamper alerts, so only 14 output channels are in fact available.

When operating in a 12-bit system, the repeater must be "taught" the system code in order to be able to send out service alerts (see Para. 6-2 for details). Having learned the system code, the repeater can send out two types of service alert:

**AC FAILURE** - The CHANNEL 0 code informs of a power supply problem in the repeater.

**TAMPER** - The CHANNEL 2 code informs that the repeater is being tampered with.

***Note:*** *Since in a 12-bit system the receiver does not indicate which repeater (or transmitter) sent the service message, each repeater or transmitter has to be inspected until the faulty unit is found.*

### B. Service Codes in PowerCode Systems

Each WRP-600 has its own 24-bit ID just like any other transmitter in the system. When operating in a PowerCode system, the repeater's ID must be "revived" in order to be able to send out service alerts (see Para. 6.3). With the repeater's ID active, the repeater can generate 3 kinds of service message:

- Tamper alert
- AC failure warning
- Once-per-hour test report

If the TAMPER or AC FAILURE states last for a long time, the respective codes will be sent out again with each test report.

When the repeater transmits a service message in a PowerCode system, the repeater ID is automatically included in the outgoing message to identify the specific repeater to the receiver. Service personnel therefore know exactly where the problem lies.

# 4. THE COMMUNICATION PROCESS

Once the repeater is powered up, its receiver section stands by for incoming messages and its transmitter section is inactive.

## 4.1 Single Repeater Routine

**A.** The repeater checks received messages sent by transmitters deployed in its coverage area. Messages are rejected in the following cases:

- **In 12-bit systems** - if they are incorrectly formatted and/or if the 8th bit is set to ON.
- **In PowerCode systems** - if they do not include the proper 24-bit ID format and/or do not pass the checksum test.
- **B.** Valid messages are saved in the message buffer, for retransmission as soon as transmission is allowed.

*Note: Before transmission, the repeater checks whether the RF channel is free - it is programmed to transmit on a free channel only. However, in case of continuous interference or uninterrupted stream of incoming messages, a 30 second timeout will cause the repeater to stop receiving, retransmit the contents of its message buffer and then revert to the receive mode.*

**C.** Once transmission is allowed, the repeater retransmits all the messages stored in its buffer, "last in, first out". Each message is retransmitted repeatedly for two seconds.

**D.** A message which has already been retransmitted to the receiver is deleted from the repeater's transmission queue.

## 4.2 Multi-Repeater Routine

In multi-level networks, an intermediate level repeater must be located within communication range with at least one higher level repeater (for relaying messages) and at least one lower level repeater (for receiving acknowledgements). A message recognized as coming from a higher level repeater or a local transmitter will be accepted and retransmitted. A message received from a higher level repeater or from a local transmitter, retransmitted and then received again from a lower level repeater is understood to be forwarded further down the chain of repeaters. Transmission of the same message serves as an acknowledge signal for the higher level repeater, which will delete the message from its retransmission list.

**A.** Repeaters at all levels collect and save messages from transmitters deployed in their respective coverage areas and also from repeaters in the next higher level. Messages are rejected in the following cases:

- In 12-bit systems - if they are incorrectly formatted and/or if the 8th bit is ON.
- In PowerCode systems - if they do not include the proper 24-bit ID format and/or do not pass the checksum test.

**B.** Valid messages are saved in the message buffer, for retransmission as soon as transmission is allowed.

*Note: Before retransmission, the repeater checks whether the RF channel is free - it is programmed to transmit on a free channel only. However, In case of continuous interference or uninterrupted stream of incoming messages, a 30 second timeout will cause the repeater to stop receiving, retransmit the contents of its message buffer and then revert to the receive mode.*

**C.** Once transmission is allowed, each repeater retransmits all messages stored in its buffer, using the "last in, first out" method.

*Note: To prevent collision of messages transmitted by repeaters of various levels, a different REPEAT INTERVAL (inter-message interval) is programmed for each level. This interval is determined automatically as a function of the repeater's LEVEL.*

**D.** Upon retransmission, messages are picked up by a **lower level repeater** for further transmission towards the target receiver. Reception of the lower level retransmission by the **upper level repeater** serves as an acknowledgement which stops further repetitions of the same message by the upper level repeater.

**E.** Once a certain repeater (Level 1 and up) receives a message from a lower level repeater and identifies it as one it had previously handled, it will remove the message from its message buffer.

**F.** Without acknowledgement from a lower level repeater, the higher level repeater will transmit the message again after the "repeat interval" (which depends on the repeater's level). A maximum of 8 repetitions is allowed, before the repeater "gives up" and passes on to the next message.

# 5. INSTALLATION

## 5.1 Selecting the Repeater's Location

**A.** In a single repeater setup, install the repeater where good communication is assured with the target receiver and with the transmitters deployed in the repeater's coverage area. In multi-repeater networks, good communication must be assured with the deployed transmitters and the repeaters at the next higher and next lower levels.

**B.** Do not stretch the coverage area to its utmost limit, because this can disrupt your communication link. It is better to add repeaters than to rely on marginal reception.

**C.** Mount the repeater as high as possible above the floor and well away from metal chimneys, large metal cabinets, metal doors and reinforced concrete walls, all of which may reduce the communication range.
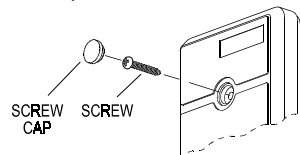


***Figure 4.** Front cover Assembly*

## 5.2 Mounting Procedure

**A.** Remove the screw and the front cover (see Fig. 4). The round plastic cap is supplied separately in a small nylon bag.

**B.** Mount the base (equipped with the printed circuit board) in the selected location, using the mounting knockouts (see Fig. 5).

**C.** Make sure the antenna wires hang down vertically (do not allow them to bend close together). Tape them to the wall if necessary.

**D.** Snap the battery clip onto the battery and place the battery in the open space above the P.C. board.

**E.** Plug the AC adaptor into an uninterruptible mains outlet and connect the low voltage wires to the repeater's 14 V terminals.

*Note: Any standard DC power supply or AC stepdown transformer would do, provided that it delivers 12 Volts AC or DC / 100 mA. (Refer to Section 2 for input voltage limits)*
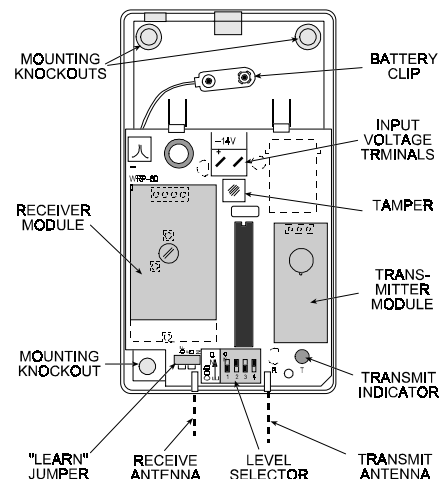


***Figure 5.** WRP-600, Cover Removed*

# 6. PROGRAMMING

## 6.1 Level Tagging

The first programming step is to select the repeater's level with the 4-position LEVEL SELECTOR (see Fig. 3 and 5).

If your WRP-600 is the only repeater in the system, verify that all 4 switch levers are set to OFF, thus selecting LEVEL 0.

If your WRP-600 is part of a multi-repeater network, select the level at which the repeater will operate, as instructed in Para 6.2

## 6.2 Imparting an 8-bit Code to the Repeater

The repeater can be shared by 12-bit and PowerCode systems, but can be programmed to send out its own service alerts to only one type of receiver. If you decide to send service alerts to a 12-bit receiver, you will have to teach the repeater the system code used by that receiver, as instructed below:

**A.** Prepare a compatible transmitter with its 8-position DIP switch set to the system code that you wish the repeater to use for its own service alerts.

*Note: Remember to set the 8th switch lever of the transmitter's code selector to OFF, or else the repeater will ignore the transmitter!*

**B.** Mount the repeater's jumper (identified as the "LEARN" jumper in Figure 5) across the two ON pins. Any previously programmed system code will be erased, and the repeater's PowerCode ID will "go to sleep".

**C.** Within 10 seconds from mounting the jumper, initiate a short transmission with the transmitter prepared in Step A above.

**D.** The repeater will adopt the transmitted system code.

*Note: Failing to transmit within 10 seconds will leave the repeater without an 8-bit code, and with an idle PowerCode ID.*

**E.** Return the jumper to the OFF position.

## 6.3 Activating the Repeater's PowerCode ID

The repeater can be shared by 12-bit and PowerCode systems, but can be programmed to send out its own service alerts to only one type of receiver. To send service alerts to a PowerCode receiver, you will have to "revive" the repeater's memory-resident PowerCode ID, as instructed below:

**A.** Prepare a PowerCode transmitter. Any unit would do, regardless of its ID code.

**B.** Mount the jumper (the "LEARN" jumper in Figure 5) across the two ON pins.

Any previously programmed system code will be erased, and the repeater's PowerCode ID will "go to sleep".

**C.** Within 10 seconds from mounting the jumper, initiate a short transmission with the transmitter prepared in Step A above.

*Note: Failing to transmit within 10 seconds will leave the repeater's PowerCode ID idle. In addition, any previously learned 8-bit code will be abandoned.*

**D.** After Step C above, the repeater will be able to generate and transmit its own service alerts, in which its PowerCode ID will be used.

**E.** Return the jumper to the OFF position.

## 6.4 Testing

**A.** Position the front cover hole over the LED. Secure the front cover with the screw and mount the plastic cap (see Figure 4).

**B.** Refer to the operating instructions for the transmitter(s) and receiver being used. Test the receiver with each transmitter in the system for range and proper reception.

**C.** Verify operation of the appropriate channel output relay(s) of the target receiver (12-bit systems).

**D.** Should you have a problem with signal reception, change the location of the transmitter(s), repeater(s) and/or receiver to improve reception.

**E.** Disconnect the power supply and verify that the repeater functions correctly on battery power only.

**F.** Reconnect the power supply, remove the battery and verify that the repeater functions correctly.

**G.** Reinstall the battery.

# 7. MISCELLANEOUS COMMENTS

Visonic Ltd. wireless systems are very reliable and are tested to high standards. However, due to their low transmitting power and limited range (required by FCC and other regulating authorities), there are some limitations to be considered:

**A.** Receivers may be blocked by radio signals occurring on or near their operating frequencies, regardless of the code selected.

**B.** A repeater can only respond to one transmitter signal at a time.

**C.** Wireless equipment should be tested regularly to determine whether there are sources of interference and to protect against faults.

**The user is cautioned that changes or modifications to the unit, not expressly approved by Visonic Ltd., could void the user's FCC or other authorities to operate the equipment.**