Installation and operating instructions
Version 0.7 (draft)

Document history

Version	Date	Change
V0.8	23.11.99	Add statement on the minimum separation between transmit antenna and personnel
V0.7	15.11.99	Release planning procedure
V0.6	27/10/99	Various changes
V0.5	16/07/99	Clarification in regulatory notice section
V0.4	16/07/99	Add front page + cosmetic changes
V3	01/07/99	Second iteration (BM/VF)
V2	18/06/99	First iteration (BM, DS, PS,VF
DRAFT		

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Contents

Introduction.

The CellTrackIT Manual is designed to provide both the "Trainer" and the "Installer" a basis from which a CellTrackIT system can be effectively and efficiently planned and installed. It is assumed that the end user has limited to no knowledge of radio frequency application. The Manual covers all the essential and basic procedures that a system designer/installer must follow to design an efficient system. It also provides the basis from which the installer can implement the design plan. In most cases, the individual designing the network will also install the system at the submetering site.

CellTrackIT System Concept.

RAMAR Technology's product entry into the submetering market consists of the CellTrackIT system. With this new technology RAMAR plans to capitalize on the growing need within the utilities market to submeter apartment complexes.

The CellTrackIT is a cost effective entry product designed to operate as a cell network with up to 500 TransPondIT meter interface units (MIUs). It consists of three types of functional components: the transponders, repeaters, and node receiver unit connected to a Personal Computer (figure 1).

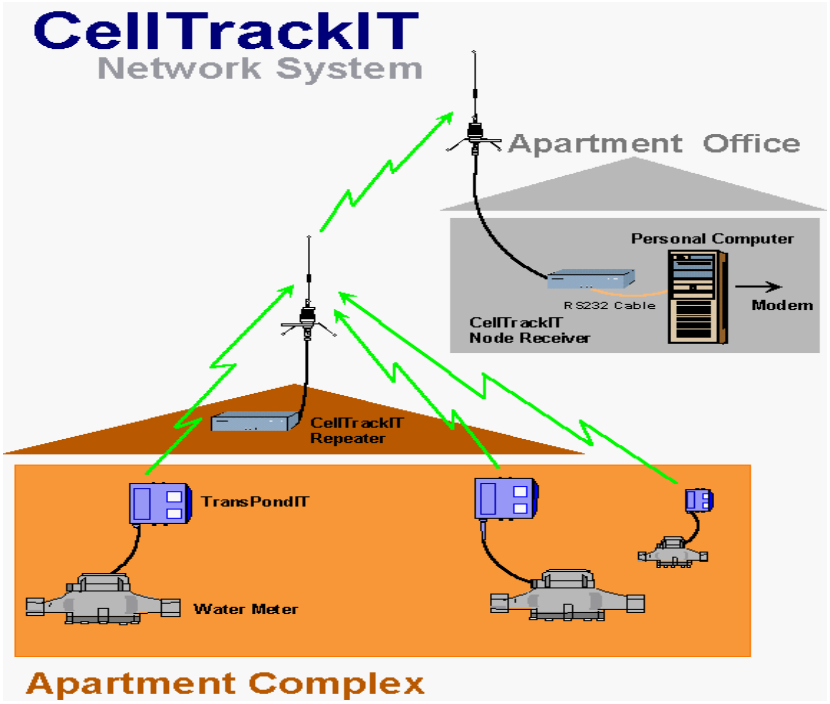


Figure 1. CellTrackIT Cell Network

Operation. The complete system is modeled as a self-contained cell network adaptable to a variety of submetering applications. The number of units and the terrain makeup of area covered determine the size of the network.

The CellTrackIT is a two tier, one way radio system based on an improved transponder technology and Spread Spectrum methodology for radio wave propagation. The two-tier approach offers flexibility and robustness while ensuring data integrity from the MIUs to the data collection computer within the network. With the two-tier approach the range of the transponders is also increased allowing for large site coverage. The system uses an open architecture approach for data integration with existing billing systems.

The first tier comprises of transponders transmitting to a repeater. Each repeater receives the transponder's signals and then retransmits them to the Node Receiver-computer combination. This back link from repeater to computer is the second tier of the network. The data is transmitted using a spread spectrum transmission scheme. The Node Receiver converts the signals to ASCII data and sends it via a COMM cable to the Personal Computer.

The node receiver is also able to directly receive Transponders. In smaller apartment complexes a CellTrackIT with only a node receiver and no repeater could be sufficient to cover the area. In larger apartment properties the network will contain repeaters. Number of repeater will depend mainly on the size of the site.

The CellTrackIT Transceiver can be set up as repeater or a node receiver. The transceiver configures itself as a node whenever it is connected to a PC running CellTrackIT software, via an RS232 cable. The node receiver function is automatic upon the CellTrackIT transceiver sensing the connection and doesn't require any further action on the part of the installer.

The data that resides within the PC can be accessed by telephone line for remote management or locally through the on screen program.

Regulatory Notice.

Federal Communications Commission (FCC) notice

The following notice is valid for CellTrackIT transceiver when operated as a node receiver.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and

can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.
-- Increase the separation between the equipment and receiver.
-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-- Consult the dealer or an experienced radio/TV technician for help.

WARNINGS!

- Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

- The equipment is only authorized for use with the antenna and special accessories specified in Appendix 3 of this User Manual.

- The equipment must be professionally installed. The equipment is only authorized for use provided it is installed by qualified installers that have received the RAMAR certified training in the design and installation of the system.

- The CellTrackIT is solely industrial and commercial in nature, therefore it can not be sold to the general public.

- The minimum separation between transmitter antenna and personnel is 20 cm (6 inches) to ensure that the public or the system installer are not exposed to the radio frequency energy levels in excess of the FCC guidelines.

Label Requirements. RAMAR complies with FCC and Underwriters Laboratory (UL) requirements. The label attached to the CellTrackIT unit specifies this compliance. *If the label is missing, please contact RAMAR before installing the system.*

Safety Warning. The CellTrackIT unit is a self-contained product with no serviceable user parts within. For safety reasons do not open or modify the unit from its original usage. If the unit is defective please refer to the warranty for disposition or call RAMAR customer service. Under no circumstances

should the unit be opened for inspection or troubleshooting. The power cord receptacle is designed for standard AC power of 110-125 VAC at 10 amps. It is strongly recommended that the power source outlet be protected against overloads, short circuits, or surges in accordance with local and national wiring code regulations.

Warranty. Opening the CellTrackIT voids the warranty and may result in the user paying for all costs normally covered under warranty.

Planning and designing the CellTrackIT Site.

The CellTrackIT system installation consists of two phases:

PHASE 1: Planning where the network is conceptualized and designed prior to an actual visit on site
PHASE 2: *Installation* phase where CellTrackIT components are installed in the site according to the plan.

Both phases are essential in ensuring proper installation of the RAMAR CellTrackIT system.

Basic concept is to reduce time and effort spent on site for installation by designing the CellTrackIT system implementation before actually visiting the site. The objective is to reduce uncertainty associated with any site by properly planning installation and having the site prepared for installer venue.

The planning aspect of the installation is geared towards making the connection radio-wise from the transponders to the Node Receiver by effectively placing the node and repeaters, and determining the economical viability of the cost per point projection.
Planning is important in that it sets the parameters, assumptions, and basic layout of the installation.

- **Planning Procedure Overview.** The goal of an efficient site planning is to minimize the number of repeaters per system while maximizing the reception of each transponder signal. The following outlines the procedure:
    1. Gathering Data to characterize the site
    2. Define the RF Range for First and Second Tiers
    3. Place Node Receiver and Repeaters
    4. Optimize for Network Efficiency
    5. Calculate Costs per Point

1. Gathering Information.

It is critical to gather pertinent data to properly design the system. The data gathered will be used for determining typical radio range. It will also be used for determining potential locations for repeaters and node receiver.
Without the correct site characterization, the whole design process is compromised and the installation of the CellTrackIT will be less efficient. Poor efficiency translates to an increase to overhead costs.

The following checklist details information to be gathered

❒ Site name and address
❒ Detailed site map showing all buildings (numbered) with scale
❒ Length and width of the property
❒ Length and height of each building
❒ Outer wall construction materials
❒ Location of transponders in/on buildings
❒ Potential locations to consider for installing repeaters if:
    Accessible, dry
    Length of cable to externally mounted antenna at roof height < 20 feet
    Permanent mains point available or can be installed
❒ Potential locations to consider for installing node receiver and computer if:
    Accessible for installation, dry
    Central location on the site if possible
    office environment where the ambient temperatures are within the 32 to 104 degrees Fahrenheit
    Length of cable to externally mounted antenna at roof height < 10 m
    Permanent mains point available or can be installed
    Permanent telephone connection available or can be installed
    If multiple locations are suitable, indicate preference order.

And, if possible:
❒ Description of site terrain
❒ Description and location of radio obstructions not shown on map: trees, structures, terrain
❒ Identify potential radio interference eg. proximity radio towers etc.
Scale on the map is critical. Planning methodology based on range and distance requires a reasonable accuracy of distances or dimensions given on the map.

The following chart is a tool for assisting in characterizing the site, building by building.

Building no.	Number of	Height (floors)	Loft space suitable for	Roof construction	Outer wall construction	Inner wall construction

	meters		Repeater	materials	materials	materials
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Figure 2. Data Gathering Input Form

Planning Factors.

Certain factors influence the range of the CellTrackIT. These factors effects are discussed and illustrated in this section. The 1st tier range is particularly sensitive to these factors. The effects are then illustrated in a suggested range table at the end of the section.

Height. The location of the antenna determines how well the antenna is capable of receiving the transponder signals. As the higher the antenna the greater number of buildings that the antenna will have unobstructed radio path to. Normally, the higher the antenna the further the distance allowed. See diagram at end of section. Antenna heights of less than 5 m (15 feet) in any environment should generally be avoided.

Obstructions. Any obstacle between the transponders and the repeater antenna will result in an attenuated signal. The obvious obstacle of the inner and outer building walls around the transponder will be unavoidable. The best that can be achieved is attempt to get line of sight to the exterior of the apartment. There may be other buildings in the line of sight, or trees and shrubs associated with the site that will reduce the radio signal.
A site with many of these unavoidable obstacles will require that the repeater to transponder distances be reduced to compensate for signal loss.

Building Construction. Building types have to be considered when determining the range of the installed transponders. The type of construction will determine, among other things, how much attenuation the signal will receive. The increased attenuation of the transponder signal due to reinforced concrete, concrete, stucco(with metal reinforcement) construction leads to a reduced range. Wood, particleboard or vinyl construction will allow further range. Identify the construction type of the site buildings as part of the information gathering process. It will be the basic information to define the typical range for the site.

Distribution of buildings The range will be affected by the site's density. Buildings close together such as a courtyard setting will cause the range to be

reduced (obstructions). However, this could be compensated for, as the reduced range will include more apartments and more transponders than a less dense site.

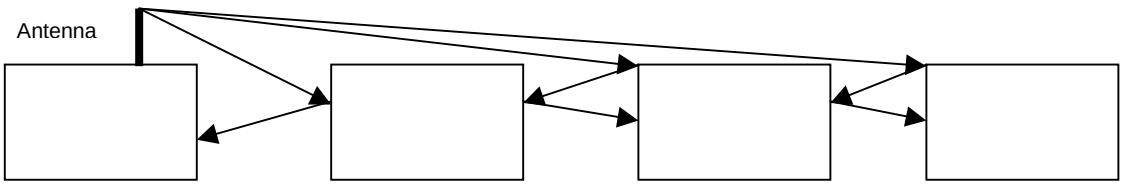
Landscaping. Trees and shrubs when blocking the line of sight to the transponder can cause scattering of radio signals and therefore must be included when planning the network. The terrain plays an important part in determining how many repeaters are needed. A reduced RF range can result if hills and valleys cause large variations in the building heights or if hills obscure the line of sight, resulting in an increased ratio of repeaters to transponders.

RF Interference. Very strong external radio signals nearby, operating at the same or near same frequencies as the CellTrackIT system can create interference that will reduce the range to the Transponder and if present will need to be compensated for. Potential RF interference sources are Cellular telephone base stations at a distance of less than 800ft and Paging towers at a distance of less than 5000ft, or other 900Mhz ISM band AMR systems that are located close to the repeaters on the site. Many radio systems operate at peak output during the daylight hours with diminished signal trafficking during the night. Planning must take into account the operational hours of these various radio systems to ensure that the system is designed for maximum efficiency with the minimum number of repeaters.

RF self interference The minimum antenna to CellTrackIT or PC distance should be greater than 1m. The minimum line of sight distance, repeater to Node should be 45m.

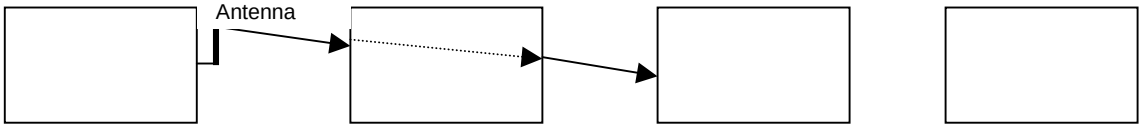
Cable length
It should be noted that longer RF cable runs will cause the range to be reduced, the node therefore will typically be used with a longer cable to site the PC and in such cases will have reduced range.

Aesthetics. This is one factor that may require some negotiating with the apartment owner or supervisor. In most cases the placing of antennas on roofs or under eaves will not be an issue. However, it pays to first ask or to explain the extent of change to the outward appearance of the building(s). The supervisor or owner will definitely appreciate the consideration. Placing the antenna inside buildings will reduce first and second tier ranges, as roof and inner walls will attenuate radio signal.



Repeater site Apartment A Apartment B Apartment C

A. Illustration of roof mounted antenna, arrows indicate strongest signal path (In reverse)



Repeater site Apartment A Apartment B Apartment C

B. Illustration of below roof mounted antenna, arrows indicate strongest signal path (In reverse)

The advantage of high mounted antennas is shown in case A above. In case B, for below average roof height antenna, if the buildings are of concrete or stucco then apartment block B will have only a 50% chance of all Transponders being read whereas the probability of all Transponders being read in apartment B is much higher with wood or plastic clad construction.

2. Define the RF Range for first and second Tiers

RF range is defined as the maximum distance between transmitter and receiver so that RF signal transmitted is reliably received. For planning purpose, ranges to be used are typical ranges. It is possible that actual range on the site is higher if RF path loss is lower than typical (e.g. transmitter line of sight with receiver, no obstacles between transmitter and receiver).

Determine the RF range for the first tier. The first tier, which consists of the transponder to repeater link, has a transponder signal path that must travel through the building construction material of both inner and outer walls. Those units that are in the lower furthermost apartments must also transmit their signals through the various floors. The following chart provides estimated ranges of signals that have been attenuated by the construction material of the buildings.

Building construction		**Typical range**
Stucco with metallic mesh frame	(apartment complex)	240ft / 75 m
Reinforced concrete	(courtyard apartment)	240ft / 75 m
Concrete	(apartment complex)	320ft / 100 m
Wood	(apartment complex)	420ft / 130 m
Plastic	(apartment complex)	420ft / 130 m

Figure 3. Transponder to Repeater Ranges

This typical range can be reduced according to several factors, (only use the worst two factors), it assumes a 20ft, ½ inch diameter, cable to the antenna:

Planning factors	**Typical range reduction**
Landscape	
Dense vegetation (trees, shrubs)	-5 %
Relief (hilly, ridges, valleys)	-10% to 20%
Antenna location	
Lower than average roof height	- 30%
Inside building	- 30%
RF environment	
Paging transmitter within 1500m (If antenna inside building)	-20% -10%
60ft cable to antenna	-25%

First tier range for a site will be determined by reducing typical range of the total of the planning factor reductions associated with this site.

Determining the RF Range for the Second Tier. The second tier ranges, which consists of repeater to node receiver link, are influenced more by landscape than by construction materials. Obstacles such as trees, tall buildings, and terrain contours contribute to the signal path loss experienced by each retransmitted transponder signal. The following charts illustrates range based on two typical deployments.

Line of sight

Both antennas at average roof height
typical range 5000ft

Not line of sight

one antenna at average roof height
other antenna at 5m height externally wall mounted
and obscured behind 1 building
typical range 1600ft

Figure 5. Repeater to Node Receiver Ranges

3. Determine location of Node Receiver and Repeaters

Node Location. Network designing on the site map requires that the designer first identify the node receiver location. Ideally, the node receiver will be centrally placed on the site. This would allow for more site area coverage which will ensure more transponders will be within range. However, in some cases placing the node receiver in a central location may not be feasible. Additionally, the only location available may be the clubhouse or the main office of which neither may be centrally located. The designer then must be flexible whenever placing the node receiver. Regardless of choice, the node receiver possible locations need to be identified first. When placing the node receiver consider where the Personal Computer will be located since it is attached directly to the node receiver.

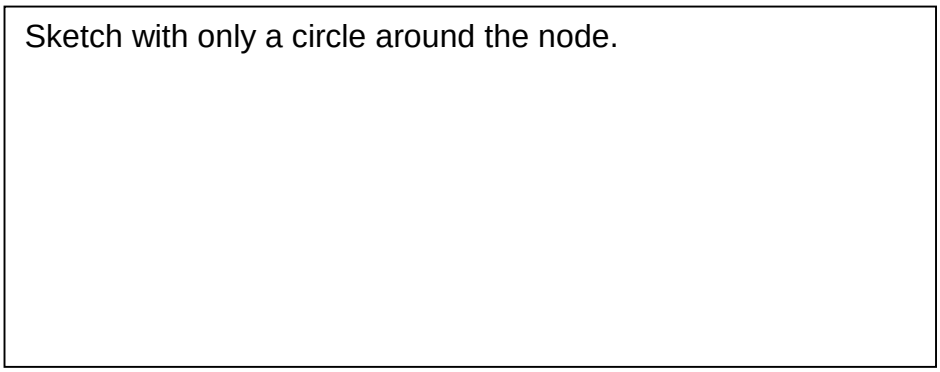
Node receiver location specification:

Accessible for installation, dry
Central location on the site if possible
Office environment, ambient temperatures within 32 °F to 104 °F
Length of cable to externally mounted antenna at roof height < 60 feet
Permanent mains point available or can be installed
Permanent dedicated telephone connection available or can be installed

The node receiver is able to receive both transponders and repeaters, by alternating automatically between these 2 modes. Therefore, the node receiver can be used as a transponder receiver.

Once node is located on the site map, draw a circle with node location as the center and 75% of the first tier range determined in stage 2 for this site as the radius. Reason for using only 75% of the first tier range, is the assumption to use a 60 feet antenna cable, which introduces more attenuation than a 20 feet one used for repeaters. If the node antenna cable can be 20 feet long, use full range.

When drawing the circle, verify the scale on the map. Incorrect scale will lead to wrong distance, therefore wrong planning. Transponders could be out of range.



The node will receive all transponders inside the circle. Transponders outside the circle will need repeaters to be received.

Repeater Location.

Repeaters must be located in attic/loft space in buildings.

Repeater location specification:

Accessible, dry
Length of cable to externally mounted antenna at roof height < 20 feet
Permanent mains point available or can be installed

Determining Repeater Location.

Once the transponders received by the node receiver are determined, repeaters must be added to cover remaining parts of the site. It is then a matter of placing circles on the map, with typical range determined for the site as a radius, to have all the transponders within the range of at least one repeater. This can be achieved by using a compass, placing the pin on a possible repeater location and drawing a circle. Check then if some transponders have been left outside the circle.

The easiest way is probably to cut circles at the right scale in transparent or thin paper, locating the center with a cross, then place and reposition the circles on the map until all the transponders are within a repeater range. When repositioning ensure that the buildings are still maintained within the RF circle of each repeater. When doing the RF circles take the liberty to reposition the repeaters to cover areas more efficiently. In some cases, by moving two repeaters slightly, a third repeater can be eliminated.

When all the repeaters are located, mark the center and remove the paper circles. Then draw final circles with the compass on the map.

NOTE: A transponder signal may repeated by several repeaters without diminishing the efficiency of the network. The system is designed to handle simultaneous reads.

4. Optimize for Network Efficiency

It is critical to verify at this stage that repeaters can actually be placed where they have been located on the map. Checking in information gathered or calling the site manager would be helpful at this stage to avoid having to cancel the plan at arrival on site for installation. This includes access to attic space or utility room, possibility to use a 20 feet cable between the repeater and the antenna and possibility to install a power line (115 V AC).

Optimizing goal is to reduce the number of repeaters to be installed on the site by reducing overlapping or moving repeaters to have a better coverage. This is achieved by moving circles around the map.

While optimizing the design it is recommended to check furthermost transponders to the repeaters (closer to the circle lines). They are the most critical. It is recommended to check for factors that could reduce the range (buildings, trees, height compared with repeater antenna). Refer to planning factors table (figure 4).

It is also recommended to check lines of sight to verify the number and the nature of obstacles between Transponders and Repeaters. For example 2 concrete buildings between a Transponder and a repeater will induce a high risk not to receive the transponder.

NOTE: The idea is to eliminate repeaters while maintaining adequate coverage of the transponder points.

Determining Cost Analysis.

The cost of the CellTrackIT system can be determined once the placement of the repeaters is completed on the site map. Our sample in Figure 7 shows that two repeaters were needed for the entire system to function properly. Figuring total cost per point is a matter of identifying the various costs associated with a CellTrackIT System installation.

CellTrackIT System Cost. The total CellTrackIT System cost is directly tied to the number of repeaters used within the site. When designing the network it becomes important that the number of CellTrackIT transceivers be minimized.

The CellTrackIT transceiver antennas will need a bracket or possibly a metal pipe for its installation. Depending on how each repeater is installed, the antennas may also need brackets or metal pipe for setup.

The antennas also should be wired against lightning strikes, which would require grounding wire.

Electrical Costs. The cost of installing power conduit in attics or along walls per repeater has to be factored into the cost per point determination. The installation of the AC power must comply with standard building codes. Normally, a licensed electrician will be required to install the electrical wiring. If the CellTrackIT PC is being located in a secluded place then a power source will be needed for both the PC and the node receiver.

Telephone Costs. For each CellTrackIT PC a **dedicated and direct** telephone line will be required. The cost of installing the line and the various hookup charges need to be considered. The monthly cost of renting the telephone line needs to be included in the operating costs of the site and not in determining installation cost per point.

Man-Hour Costs. Included in this is the hours spent in planning and coordinating the site or any additional hours associated with the installation process.

Figuring Costs. Figuring cost per points is as simple as adding the costs and dividing by the number of apartment units at the site location. Once the cost per point is determined then a decision to proceed with the installation can be made.

Site preparation

The objective of site preparation is to reduce the time spent on site to physically install the components of a CellTrackIT system. Making sure every person involved and every piece of equipment are available, is critical to a successful implementation.

The result of the planning phase is a list of locations where repeaters, the node receiver and the PC have to be installed. Verifying the plan is applicable will secure an efficient installation. Here again, the easiest way is to phone the site owner or site maintenance manager and review the plan with him.

Site preparation is a critical element of the CellTrackIT installation procedures. There are tasks that must be accomplished prior to installing any component at the apartment site.

- The installer needs to procure all parts not included in the CellTrackIT system. This means that a certain amount of lead-time is needed to ensure that parts arrive prior to the actual on site installation.

- External subcontract work such as the AC power conduit installation for the repeaters and the telephone line installation for the PC needs to be scheduled and completed.

- Proper tools need to be identified so that there will not be on site delays due to improper or missing tools. In particular, determine how the repeaters and the antennas will be installed on/in the apartment roofs. In some cases, special ladders will be needed that can reach more then two stories.

- When installing the water meters with attached transponders track serial numbers to apartment address or account numbers to minimize confusion later on. It is very easy to mistake a read from one apartment when it belongs to another due to wrong record keeping.

Before proceeding to the installation, it is recommended to check the following items:

❒ Equipment, tools and installation materials are available.
❒ Site owner and site maintenance manager are aware and agree with installation operations that will be performed.
❒ All the locations where repeaters and node are planned to be installed will be easily accessible.
❒ Power and phone lines have been installed or their installation is planned to match with the requirement to leave the site with a fully installed CellTrackIT system.
❒ All the transponders will be installed before completion of the CellTrackIT installation
❒ A matching list of transponders ID and meter (or apartment) number is available.

Any missing item in that list will imply to be addressed on site. That could delay CellTrackIT installation.

Installing the CellTrackIT System.

Installing the Node Receiver. Installing the Node Receiver consist of plugging a CellTrackIT transceiver to a 115 VAC power outlet and connecting the RS232 cable between the COMMS Port of the CellTrackIT unit and the PC. The Com1 on the PC is normally where the cable is connected. Once this is done, then the antenna with the associated coaxial wiring is installed.

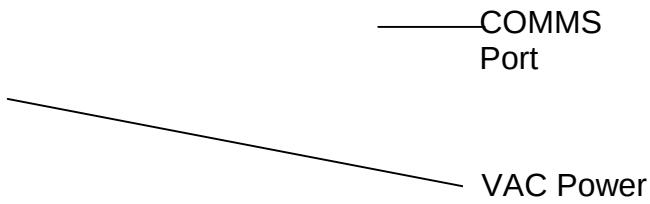


Figure 12. Node Receiver Connections.

Installing the Node Receiver Antenna. The coaxial cable that connects the antenna to the Node Receiver is in the Node accessories box. It is 60 feet long. One end of the cable requires an N type Male connector that is then screwed on the antenna. The other end requires a male TNC connector that attaches to the RX/TX connection on the CellTrackIT unit. Appendix 2 covers in detail the cable assembly and antenna mounting procedures.

Important: Do not handle the antenna when connected to a powered CellTrackIT transceiver, or make sure the minimum separation between antenna and personnel is 20 cm (6 inches). Locate the antenna in a manner that ensures that the public will not be exposed within this separation distance for purpose of FCC RF exposure compliance.

The Node Receiver antenna should be installed so that it clears the roof and isn't obstructed by any part of the building. The antenna should be at least 6 inches away from any metal object along its length and tip. The standard practice is to attach a 1-inch x 10 feet conduit pipe (normally found at home improvement stores) to the roof element. If the antenna pole needs to be longer, use a thicker pipe to compensate for wind velocity or add guide wires to secure the pole (Check local ordinances for compliance requirements). The antenna with its attachment bracket is then connected to the pole. Most CB radio and electronics stores have mounting brackets for mounting antennas and antenna poles. Run the coaxial cable down the inside of the pipe if possible.

The coaxial cable that comes out from the end of the antenna pole will need to be placed in conduit (PVC pipe) or attached to the wall*. Avoid damaging the coaxial cable when attaching it to the wall. Make sure that the attachment nails do not puncture the black plastic covering or any portion of the cable.* The antenna that is provided with the CellTrackIT transceiver has been FCC compliance certified and approved and can't be replaced with any other antenna. Contact RAMAR Technical Support if the antenna needs replacing or is not available at the time of installation.

- **Verifying Node Receiver Operation.** Once the node receiver is installed and the connections are completed check the two red LEDs for activity. The POWER LED should be on while the DATA LED will be

flickering in an on-off mode. If either malfunction check the AC power source for the POWER LED and the antenna for the DATA LED. The best approach would be to replace the CellTrackIT transceiver with another. If that doesn't solve the problem then check the power source by simply turning the PC on and checking operation. The antenna check will require attaching the HandTrackIT to determine if transponder transmissions are being received.

Configuring the Node Receiver. The CellTrackIT transceiver will automatically configure itself to function in a receiver capacity whenever an RS232 cable is connected to it. The node receiver will be ready for use when the power cord is plugged into an AC source and the RS232 cable is attached between the receiver and the PC. The installer will, however, have to provide aliases for each repeater for identifying the repeaters during maintenance..

Configuring the CellTrackIT PC.

- **Hardware.** Once the PC has power, plug in the telephone line into the LINE in jack on the modem card. The system should already have Windows software installed. Test the phone line by having someone dial in from their computer once the CellTrackIT system has been installed and is operational.

  The connection between the PC and the CellTrackIT unit will require an RS232 cable with 9 pin male connector on one end and a 9 pin female connector on the other. This cable is included in the Node accessories box.

- **Software.** Refer to CellTrackIT software installation manual.

Installing the Repeater. The CellTrackIT transceiver is designed to be installed in lofts or roof spaces and *not for external installation*. When installing the repeater write down the 10 digit serial number and building it is associated with. This information will later be used for configuring the network.

The unit must be connected to 115 V AC for it to operate correctly. The AC power should include ground for proper repeater operation. **When installing the power source, ensure that applicable building codes are adhered to.**

The repeater accessories box includes a 20 feet of coaxial cable for antenna installation. The antenna should be installed just under the roof eaves using the recommended antenna-mounting bracket (see Appendix 2). As in the Node Receiver antenna, the repeater antenna can't be substituted for a different kind. When placing the antenna, make sure that it is located on the side of the building closest to the transponders it is servicing.

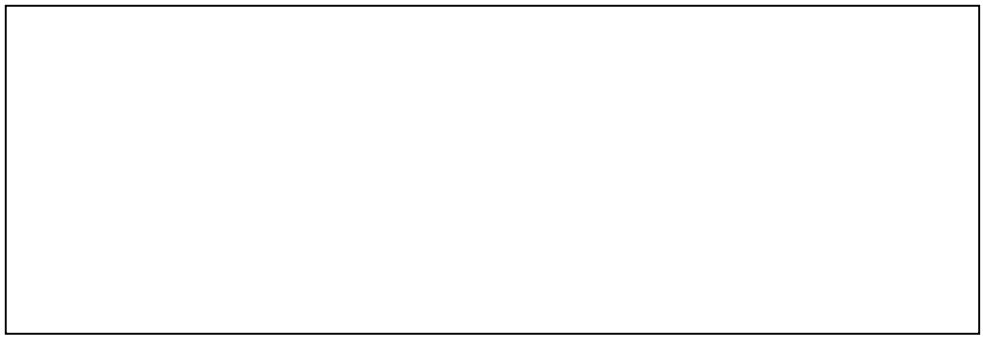


Figure 15. Proper Mounting of CellTrackIT Repeater.

Plug in the power cord and attach the antenna coaxial cable with the male TNC connector end to the RX/TX TNC hookup. **Do not connect the antenna to the RX connector. Only the RX/TX connector must be used.** The other end of the cable should have a male N Type connector that screws to the antenna (Appendix 2).

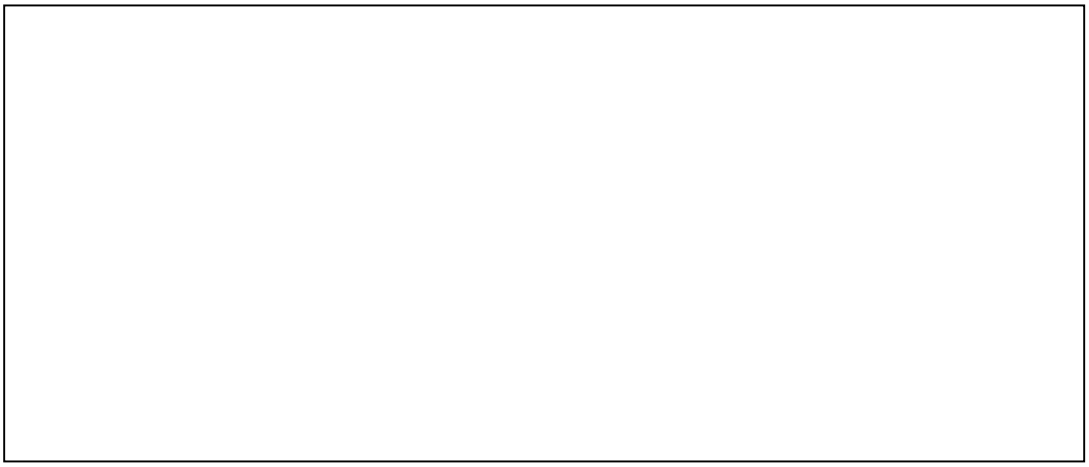


Figure 16. CellTrackIT Repeater Connections.

Both the Node Receiver and repeater antenna connections at the N Type end should be wrapped in water proof tape to prevent corrosion due to water seepage (ACE Rubber Splicing Tape --ACE 30986).

- **Verifying Repeater Operation.** Once the repeater is installed in the attic and the connections are completed check the two red LEDs for activity. The POWER LED should be on while the DATA LED will be flickering in an on-off mode. This flickering shows some Transponder signals are received.

Trouble shooting

Observe LED lights. The repeater will not transmit if power isn't applied to it or if it doesn't receive any signals from the transponders.

The POWER LED should be on. Check the power cord is properly connected. Check the power source by simply plugging in any AC device (plug in light or power drill) and checking operation.
If the power source is working, try a new power cord or replace the CellTrackIT transceiver.

The DATA LED should be flickering in an on-off mode. Check that the antenna cable is properly connected. Then check the antenna. The antenna check will require attaching the HandTrackIT to determine if transponder transmissions are being received.
If transponder transmissions are received, replace the CellTrackIT transceiver.

GLOSSARY

Recommended Parts List & Suppliers

Appendix 3

The following parts (with asterisk) have been determined to comply with the necessary FCC 15 Rule and have been approved by RAMAR for use in the CellTrackIT system. Use of any other component may result in an FCC violation and could result in the CellTrackIT system being permanently disconnected or its operation temporarily suspended. Using components other then those specified by RAMAR voids the system warranty.

All the basic components needed to install a CellTrackIT system are contained in CellTrackIT accessories boxes.

PART	PART NO.	REMARKS
Antenna*	B8965C	Antenex 1-800-323-3757
Antenna Base*	MBC800	Antenex 1-800-323-3757
Antenna Mount		Right angle iron appr. 11” X 8.5” X 1”
Antenna Pole		1.5” X 10” Conduit Pipe
Antenna Pole Mount		Check local electronics store for kit
Copper wire		Standard lightning arresting wire
Copper rod		Standard lightning rod

Lesson Plan For CellTrackIT Installation Training

Appendix 4