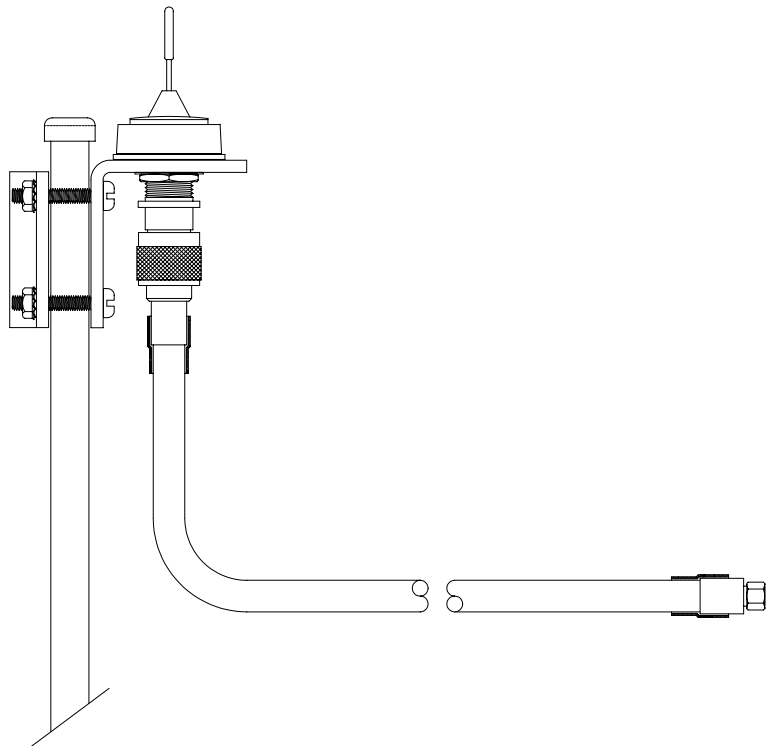


Installation Guide

DCM-200 External Antenna Kit



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CHAPTER ONE

INTRODUCTION, LIST OF MATERIALS

- 1.1 Purpose behind development of the antenna kit.
- 1.2 Standard items included in the kit.
- 1.3 Items that must be supplied by the Customer.
- 1.4 Recommended list of hand tools.
- 1.5 Selecting the optimum antenna installation site.

Section 1.1 Purpose behind development of the antenna kit.

Provision was made from the very beginning of the DCM-200 product to enable a convenient method for attachment of an external antenna. Although the vast majority of installation sites are served well by the internal rectangular antenna, it is acknowledged that there will always be circumstances that demand an external antenna to achieve reliable operation. It is for this reason that a 0.25 inch diameter hole was provided (sealed via a black plug) on the left side of the DCM-200 enclosure.

Section 1.2 Standard items included in the kit.

A number of standard items are provided with each antenna kit as detailed below:

- Antenna mounting bracket with stainless steel nut and bolt hardware.
- Cellular antenna element, tuned for the frequency band 1850-1990 MHz.
- Antenna base equipped with a female type 'N' fitting connector.
- Coaxial cable with an SMA connector on one end and an 'N' type connector on the opposite end. Both connectors are of the male gender. Length of the cable is typically 10, 15, or 20 feet depending on the configuration that was ordered by the Customer.
- A short (six inch) coaxial cable assembly consisting of an SMA female bulkhead connector on one end and an MMCX plug on the opposite end.
- This installation guide, document number MAN-900341. Normally only one document is provided with each order, unless otherwise specified.

Section 1.3 Items that must be supplied by the Customer.

As would be expected, some of the field installation materials will be provided by the Customer to complete the installation. These items are listed below:

- PVC pipe or equivalent to serve as a mounting structure for the antenna bracket. In some cases the antenna bracket will be able to bolt directly onto the side of a suitable structure, eliminating the need for a vertical pipe configuration.
- Silicon rubber type sealant for application on the coaxial cable connector threads. This is intended to provide some degree of protection against corrosion / damage from moisture.
- Nylon tie wraps for securing the coaxial cable. Some of the sites may be better served by running the coaxial cable through a length of PVC pipe for protection. This will vary

depending on specific circumstances at the site, as well as company standards regarding installations.

Section 1.4 Recommended list of hand tools.

As should be expected with any field installation process, a number of tools will be required to complete the job. The listing below is not comprehensive, and is only intended to serve as a starting point.

- Wrench set including the 15/16", 7/16", and 3/4" sizes.
- Electric drill with various drill bits.
- Diagonal wire cutters.
- Long nose and slip joint pliers.
- Hacksaw and a set of files.

Section 1.5 Selecting the optimum antenna installation site.

The best possible field-site installation consists of an external antenna that is mounted with the highest possible elevation, and in an area that has no obstructions (trees, buildings, hills, etc.) to block the signal path. Real-world installations are always a compromise on some of these principles. When possible however, the following guidelines should be observed:

- Use the shortest piece of coaxial cable run to minimize losses that occur within the cable itself. A ten foot length of cable is preferred over a twenty foot cable.
- Mount the antenna away from obstructions that might block the signal path. This includes buildings or any structures with a significant metallic content.
- Locate the antenna outside of a building rather than inside. Although the environmental protection offered by an internal installation offers some benefits, the maximum radio performance can only be achieved with the antenna outdoors.
- Elevate the antenna to the extent possible. Typically an antenna sitting at an eight foot elevation will have superior performance compared to a three foot elevation.
- Consideration must also be given to security concerns such that the equipment will not be stolen, vandalized, or inadvertently damaged by a lawn cutting service.

CHAPTER TWO

ASSEMBLY OF THE ANTENNA KIT COMPONENTS

- 2.1 Removing the original internal antenna.
- 2.2 Installing the SMA bulkhead cable assembly.
- 2.3 Assembling the antenna kit components.
- 2.4 Running the length of coaxial cable.

Section 2.1 Removing the original internal antenna.

Figure 2-1 below illustrates the DCM-200 in the standard configuration with the internal antenna. This antenna must be removed to permit attachment to the external antenna. The connector type used on the cellular radio is known as an ‘MMCX’ connector, and is a press-fit attachment rather than a threaded fitting. Some care must be observed to avoid potential damage to the delicate miniaturized connector on the cellular radio.

Removal of the antenna is best accomplished by grabbing both edges of the antenna circuit board using two hands, and pulling away from the cellular radio in a vertical direction. A steady application of force in a direction away from the radio will eventually result in the antenna releasing from the attachment. It is advisable to retain the internal antenna in case of the possibility that it might be required in the future.

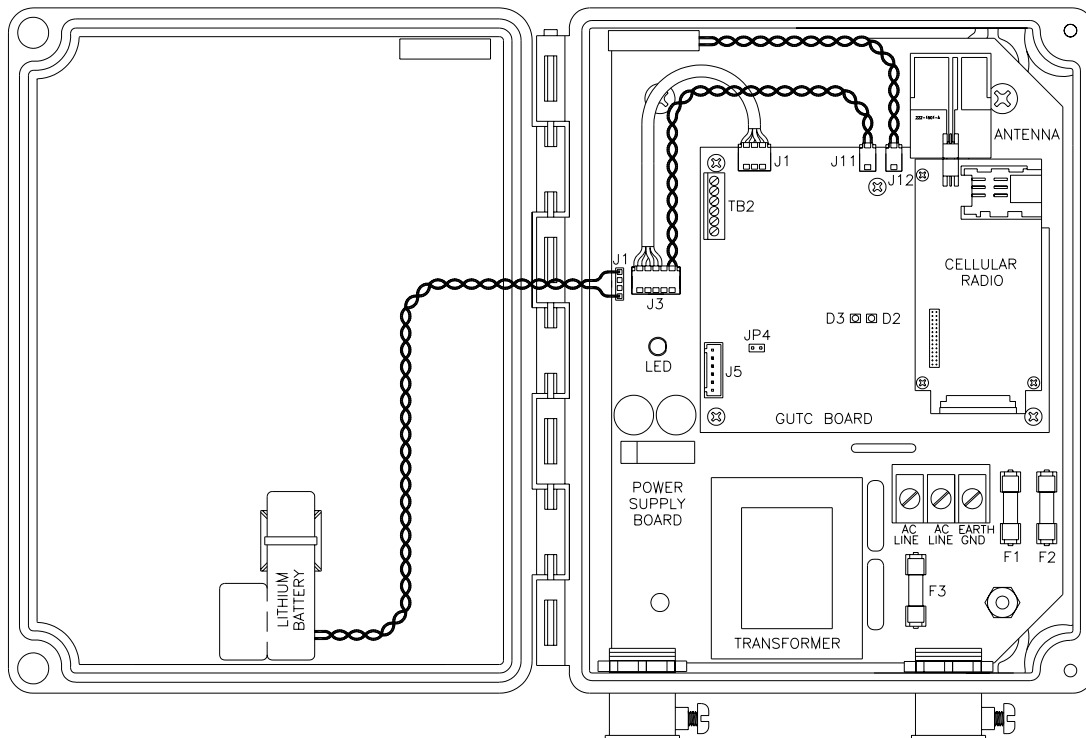


Figure 2-1
DCM-200 with the standard internal antenna.

Section 2.2 Installing the SMA bulkhead cable assembly.

With the internal circuit board antenna removed, it is now possible to install the SMA bulkhead cable assembly. Figure 2-2 provides a simplified illustration of the arrangement used for routing the slender coaxial cable. It is necessary to first press-out the black plug occupying the hole on the left side of the enclosure. Assemble the SMA bulkhead connector using the nut and washer hardware that is provided. The end with the MMCX connector presses into the mating connector on the cellular radio. In most cases, a positive snap will provide some feedback that the connector has been fully inserted.

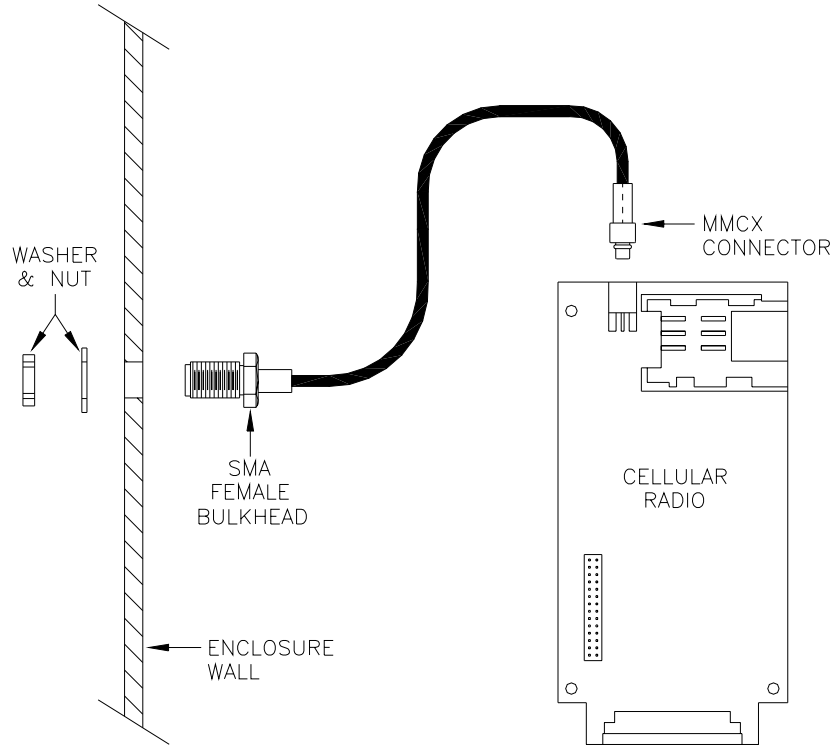


Figure 2-2
Installing the SMA bulkhead coaxial cable.

Figure 2-3 illustrates a DCM-200 with the new coaxial cable installed. The enclosure door is not shown in the drawing for reasons of clarity.

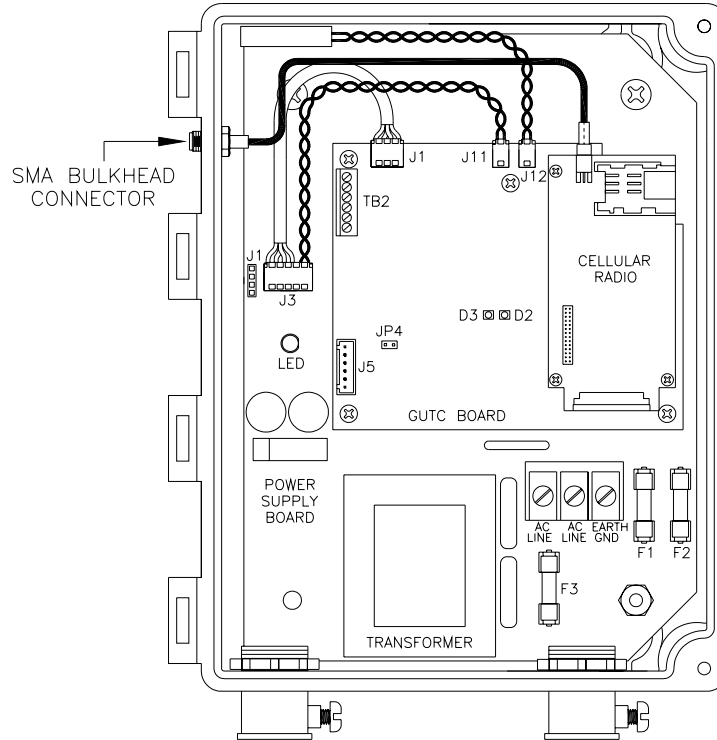


Figure 2-3
DCM-200 with the SMA coax cable installed.

Section 2.3 Assembling the antenna kit components.

Selecting a suitable field site location (already discussed in Section 1.5) is necessary so that the antenna itself can be mounted and assembled. Figure 2-4 provides an exploded view of the antenna components. The basic assembly sequence is as follows:

- 1) Spin the hex nut onto the long threaded portion of the electrical connector component. The hex nut should be located approximately midway on the threads.
- 2) Set the lock-washer on top of the previously positioned hex nut.
- 3) Feed the electrical connector through the hole of the mounting bracket.
- 4) Position the rubber o-ring to fit into the machined groove of the brass threaded base. Then spin the brass threaded base onto the threads of the electrical connector.
- 5) After the proper positioning has been achieved with respect to the protrusion of the electrical connector through the brass threaded base, the hex nut can be tightened securely.
- 6) Position the large rubber washer to sit at the perimeter of the brass threaded base. It should be sitting flat against the top of the mounting bracket.
- 7) Set the antenna element on top of the brass threaded base.
- 8) Complete the assembly by screwing the antenna housing onto the mating threads of the brass threaded base. Use a reasonable, but not excessive amount of torque when performing the final assembly.

It will now be possible to clamp the mounting bracket onto a mounting pipe or other suitable structure.

The partially assembled antenna kit should appear similar to the illustration in Figure 2-5.

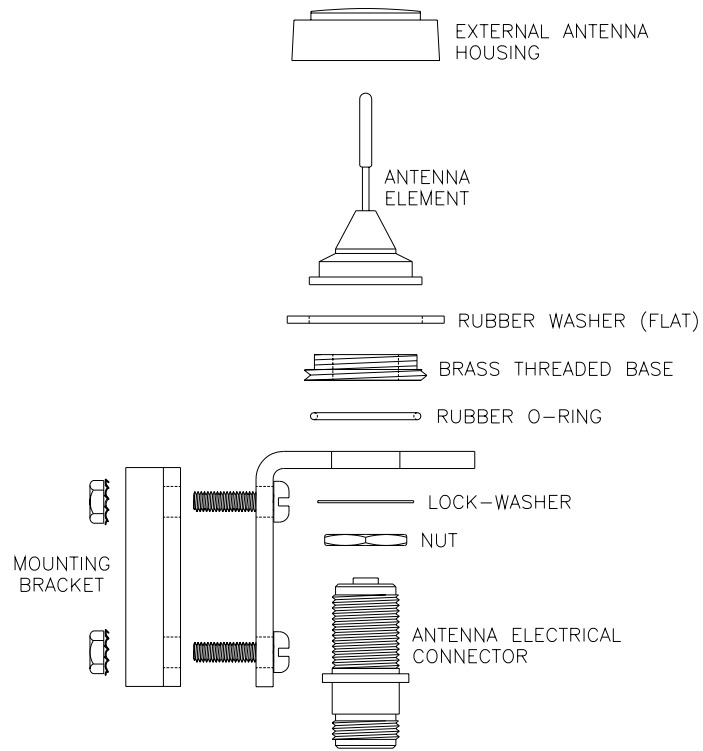


Figure 2-4
Antenna kit components prior to assembly.

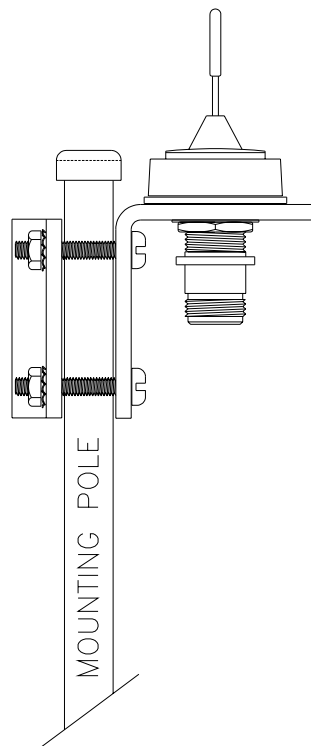


Figure 2-5
Partially assembled antenna.

Section 2.4 Running the length of coaxial cable.

At the time that the order was placed, it should have been possible to select between a number of different coaxial cable lengths. Standard lengths that are offered include 10, 15, and 20 feet, although custom lengths are also available upon request. This coaxial cable is unique due to its low signal loss characteristics. One drawback to obtaining low loss performance however is that the diameter of the cable tends to increase, which makes routing the cable overall a bit more cumbersome. In addition, the cable is rather stiff and rigid compared to other common cables such as RG-58.

Routing of the coaxial cable itself is a simple matter of attaching the 'N' type fitting to the base of the antenna, and the SMA connector onto the mating connector on the side of the DCM-200 unit. Figure 2-6 illustrates the fully assembled configuration. Due to the special watertight outdoor characteristics of the cable, special concern is not necessary when routing the cable in the outdoor environment. Some basic suggestions for cable routing are provided below.

- After the RF connectors are secured on both ends, silicon rubber sealant should be generously applied to prevent any potential for water damage.
- The coaxial cable should be fastened using tie wraps, or else run through PVC pipe. This will vary depending on the specifics of the field site however. PVC pipe is recommended whenever there is potential for damage from weed trimmers or similar equipment.
- Bends in the coaxial cable must not be any smaller than a 2 inch diameter. Larger bends are typically preferred to provide assurance that the cable won't be internally damaged.
- Any conditions that may impose heavy strain loads or crushing action against the cable should be avoided. This is especially true for vehicular traffic.

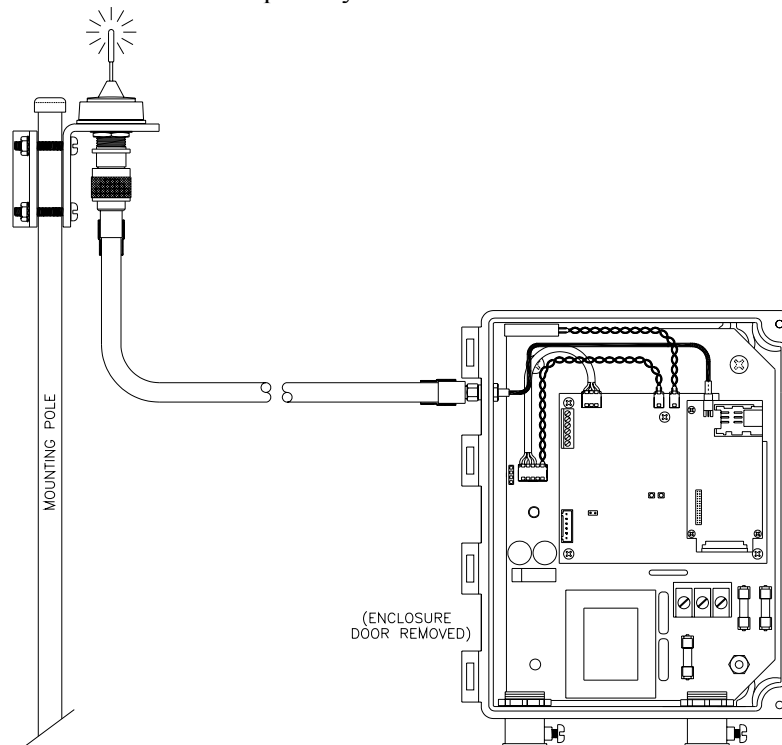


Figure 2-6
Fully assembled external antenna kit.

NOTES

CHAPTER THREE FINAL TESTING AND SEALING PROCESS

- 3.1 Sealing the coaxial cable connectors against water ingress.
- 3.2 Final verification of operation and performance.
- 3.3 Long term maintenance recommendations.

Section 3.1 Sealing the coaxial cable connectors against water ingress.

As with any device installed in an outdoors environment, consideration must be given to methods for limiting the damaging effects of moisture. Although the coaxial cable itself is of a special watertight construction, the RF connectors present an opportunity for corrosion. One possibility is for water to accumulate at the base of the antenna, and then work down via ‘spiral action’ on the threads until reaching the ‘N’ type connector. The suggested solution is to apply silicon rubber sealant on the threads at the location indicated in Figure 3-1. Sealing of the SMA connector at the side of the DCM-200 unit is also recommended if the DCM-200 is installed outdoors.

Where in doubt, it is probably advisable to cover the area with “excessive” quantities of sealant rather than risking any potential damage caused by water penetration.

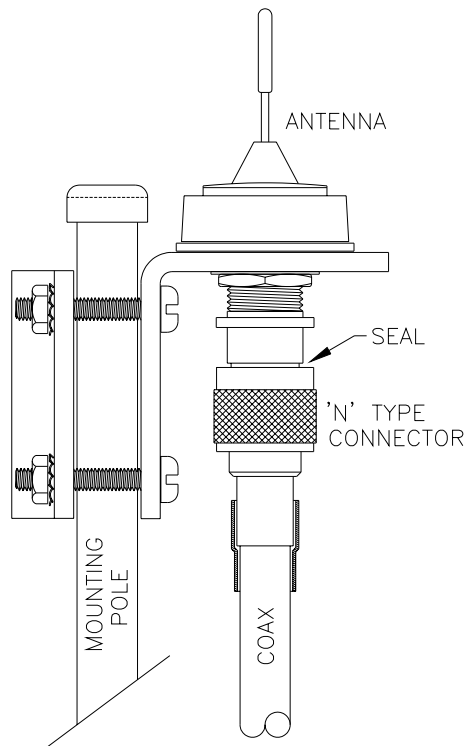


Figure 3-1
Recommended application point for silicon rubber sealant.

Section 3.2 Final verification of operation and performance.

If power is first being applied to the DCM-200 unit, the green LED will light steadily for several seconds, and then should start flashing slowly. If the DCM-200 has been configured to originate a call, it will attempt to make a call to the primary phone number that has been programmed into the GUTC EEPROM memory. The reason for this initial call attempt is to report a “reset” alarm.

- First, the DCM-200 applies power to the cellular radio and will initialize the radio for data communications. During this time the green LED will flash very slowly. When the radio is ready, the green LED will flash more rapidly.
- The cellular radio will attempt to “register” with the cellular network. If the radio is able to register with the network, the signal strength is checked. If the signal strength is very good, the green LED will flash very rapidly. If the signal strength is weak, the LED will flash at a somewhat slower rate.

NOTE: If the radio cannot register with the network within 60 seconds, the DCM-200 will attempt to call again at a later time.

- When a GPRS connection is established, the following sequence will be observed on the red LED:
 - Slow Rate = Looking for GPRS service.
 - Moderate Rate = GPRS service found, requesting attachment.
 - Fast Rate = Attached to GPRS service, requesting PPP connection.
 - Very Fast Rate = PPP established, requesting TCP connection.
 - Solid = TCP connection is established, online with server.
- When a CSD connection is established, the following sequence will be observed on the red LED:
 - Slow Rate = Dialing the phone number.
 - Fast Rate = Receiving an incoming phone call.
 - Very Fast Rate = Receiving an incoming message (SMS).
 - Solid = Online with destination Modem.
- At the end of a successful call both the red and green LED’s will illuminate for a period of 3 seconds after the call. If the call was not successful due to data errors or the loss of a connection, the DCM-200 will attempt to call again at a later time.

Additional detailed information concerning the DCM-200 configuration and setup can be found in the DCM-200 owners manual 900333. Section 3.2 is intended only to provide a basic reference concerning the activity that can be expected from the LED indicators on the GUTC board.

Section 3.3 Long term maintenance recommendations.

Long-term exposure to the outdoor elements will result some limited aging effects to the antenna kit components. Corrosion to the metal components should be minimal due to their stainless steel and aluminum construction. It is likely that the black polyethylene jacket on the coaxial cable will eventually fade to a gray color after extended sunlight exposure.

Maintenance requirements will typically be minimal for sites that were installed with due care. The following checklist is recommended for an annual maintenance visit.

- Check that the antenna mounting bracket is still attached securely to the support structure or mounting pole.
- Inspect the length of the coaxial cable for any evidence of nicks, cuts, or impact damage.
- Check the RF connectors at both ends to ensure that they are still tightly secured.
- Visually inspect both RF connectors for evidence of corrosion. If any corrosion does exist that is visible, it will likely have either a brown rust or green color.
- A final inspection within the DCM-200 enclosure is also advised in case of damage caused by water leakage or insect penetration.

NOTES

APPENDIX - A SAFETY & ESD PRECAUTIONS

Safety

Do not operate your cellular module when a person is within 8 inches (20 centimeters) of the antenna. A person or object within 8 inches of the antenna could impair call quality and may cause the phone to operate at a higher power level than necessary. It may also expose that person to RF energy in excess of that established by the FCC RF Exposure Guidelines.



This product must be installed in a manner that provides a minimum separation distance of 8" (21 cm) or more between the antenna and persons to satisfy FCC RF exposure requirements for mobile transmitting devices.

Important: To comply with the FCC RF exposure limits and satisfy the categorical exclusion requirements for mobile transmitters, the transmitter effective radiated power must be less than 3.0 Watts ERP (4.9 Watts or 36.9dBm EIRP). This requires that the combination of antenna gain and feed line loss does not exceed 16 dBi.

ESD Handling Precautions

Most of the circuit boards within this product contain electronics components that are sensitive to ESD (electrostatic discharge). For example, people experience up to 35kV ESD, typically while walking on a carpet in low humidity environments. In the same manner, many electronic components can be damaged by less than 1000 volts of ESD. For this reason, you must observe the following handling precautions when servicing this equipment:

- Always wear a conductive wrist strap.
- Eliminate static generators (plastics, Styrofoam, and so on) in the work area.
- Remove nylon or polyester jackets, roll up long sleeves, and remove or tie back loose hanging neckties, jewelry, and long hair.
- Store and transport all static sensitive components in ESD protective containers.
- Disconnect all power from the unit before ESD sensitive components are removed or inserted, unless noted.
- Use a static safeguarded workstation, which can be set up by using an anti-static kit (Motorola part number 0180386A82). This kit includes a wrist strap, two ground cords, a static control tablemat, and a static control floor mat.

The Motorola part number for a replacement wrist strap that connects to the tablemat is 4280385A59.

When anti-static facilities are unavailable, use the following technique to minimize the chance of damaging the equipment:

- Let the static sensitive component rest on a conductive surface when you are not holding it.

- When setting down or picking up the static sensitive component, make skin contact with a conductive work surface first and maintain this contact while handling the component.
- If possible, maintain relative humidity of 70-75% in development labs and service shops.

The above ESD handling precautions were extracted from the Motorola Cellular Modem Integration and Application Developers Guide version 1.0, Manual number 6887968L01.

APPENDIX - B

TECHNICAL SPECIFICATIONS

Coaxial Cable (LMR-400) Specifications:

Impedance: 50 ohms
Capacitance: 23.9pF/ft
Inductance: 0.060uH/ft
Velocity of propagation: 85%
Environmental rating: Outdoor rated, watertight cable.
Temperature range: -40 to +185 Fahrenheit
Minimum bend diameter: 2 inches

<u>Frequency</u>	<u>Attenuation</u> (per 100ft)
150 MHz	1.5 dB
450 MHz	2.7 dB
900 MHz	3.9 dB
1500 MHz	5.1 dB
1800 MHz	5.7 dB
2000 MHz	6.0 dB (most relevant for the PCS band cellular)

Motorola g18 Cellular Radio Specifications:

Dimensions: 40.5mm x 80.2mm x 7.5mm
Weight: 22 grams
Operating temperature range: -30° to +60° Celsius
Power consumption in sleep mode: <11mA
Power consumption when awake: <50mA
Power consumption when calling: 300mA average
Antenna connector: MMCX jack (female), 50 ohm impedance.
PCS band transmit frequencies: 1850-1910 MHz
PCS band receive frequencies: 1930-1990 MHz

Cellular Antenna Specifications:

VSWR at resonant point: <1.5:1
Nominal impedance: 50 ohms
Maximum input power: 100 watts
Frequency range: 1850-1990 MHz

NOTES

APPENDIX – C WARRANTY INFORMATION

The seller warrants its hardware to be free from defects in material and workmanship under normal and proper use for a period of 12 months from the date the hardware is shipped from Metrotek, Incorporated. The seller's sole liability and the buyer's sole remedy for any breach of the foregoing provision is, at the seller's option, the timely no-charge repair or replacement of any defective hardware or part that Metrotek inspects and finds reasonable evidence that a defect in material or workmanship exists. The buyer shall provide the labor required to remove the defective hardware and install its replacement at no charge to the seller. The equipment will be shipped to the seller at the buyer's expense. The replacement or repaired equipment will be shipped to the buyer at the seller's expense.

Warranty claims to be honored under this warranty must be made promptly. Such claims shall specify the nature and details of the claim, the date that the cause of the claim was first observed, and the affected equipment's unit serial number. Defective equipment shall not be returned to the seller's factory without prior authorization from the seller. A copy of the claim's documentation must be attached to the defective equipment and sent to the seller's manufacturing facility. Defective components replaced under this warranty shall become the property of the seller.

The seller makes no representation or warranty other than those set forth in this agreement. THE WARRANTY STATED HEREIN IS EXPRESSLY IN LIEU OF ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY EXPRESSED OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. SUCH WARRANTY CONSTITUTES THE ONLY WARRANTY MADE BY THE SELLER WITH RESPECT TO THIS AGREEMENT, THE EQUIPMENT UNITS, OR THE SERVICES TO BE SUPPLIED HEREBY. THE SELLER SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND.

This warranty will not extend to equipment subjected to accident, to misuse, or to alterations/repair not made and documented in writing by Metrotek.

RETURNS PROCEDURE

If it has been determined through troubleshooting that the problem cannot be resolved without returning the equipment for repair, then a return authorization (RA) number will need to be obtained. Please call **1-800-327-8559** to contact the repairs department for obtaining the RA number as well as the return form document that should be filled out. When filling out the repair return form, it is beneficial to provide a description of the problem with as much detail as is necessary to fully characterize the symptom(s). This will assist our technicians in being able to narrow in on the problem, and reduces the possibility that a unit will be returned to the customer with "no problem found". Intermittent type problems can be especially difficult to troubleshoot without a detailed description of the symptoms.

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