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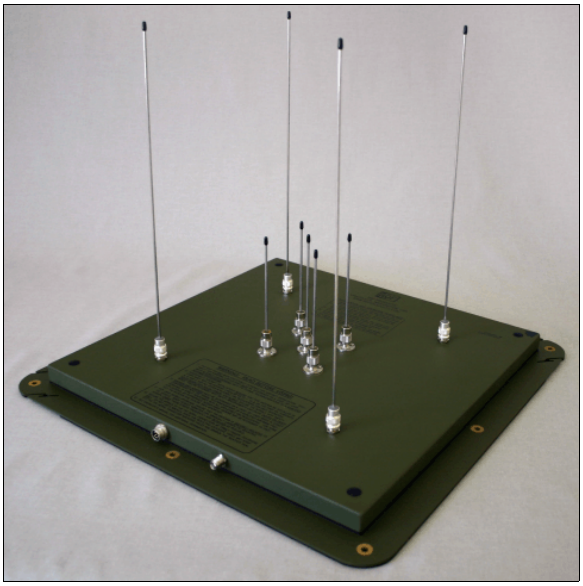
Since 1979
Serving Our Customers

OPERATOR'S MANUAL
DMA-SERIES MOBILE ADCOCK
RADIO DIRECTION FINDING ANTENNAS



Rev B01/01-14/dma_opm_01

Original Writing: October 2008

WARNING

Please comply with the following basic rules of safety and common sense to ensure safe installation and operation:

1. **SAFE DRIVING ISSUES** - *Two* people (a driver and DF operator) are required to safely run a mobile DF mission. It is essential that the driver be required *only to drive the vehicle*. One person cannot simultaneously operate the DFP-1000B and safely drive. *Failure to observe this two-person rule can result in traffic accidents causing property damage, injury, and even death.*

2. **DF ANTENNA MOUNTING ISSUES** - *It is solely the user's responsibility to verify that a mobile DF antenna is securely mounted to the vehicle so that it won't fall off while the vehicle is in motion.* It is likewise solely the user's responsibility to verify that the aerials (elements) are securely attached to the antenna aerial connectors.

   RDF Products DF antenna models designed for in-vehicle mounting (e.g., the DMA-1286B2 and DMA-1325B3; see photo) cannot safely be mounted on a vehicle without a protective cover due to wind-loading issues. These antennas must be installed either underneath a vehicle canopy (i.e., a truck bed shell), or inside a shroud capable of providing full wind protection.

3. **AIRCRAFT OPERATION ISSUES** - If DF antennas are to be aircraft mounted, *the installation must be done and formally approved by an FAA certified aircraft mechanic for reasons of public safety*. In addition, it is *imperative* that the pilot be assigned no duties other than safely flying the aircraft.

Check the RDF Products website at www.rdfproducts.com for updates and bulletins.
Can we improve this manual? Contact us at mail@rdfproducts.com to offer suggestions.

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SECTION I - GENERAL DESCRIPTION

A. INTRODUCTION

The RDF Products DMA-Series of mobile DF antennas comprise a family of VHF/UHF monopole Adcock single-channel radio direction finding antennas covering one or more bands in the 20-1,000 MHz range. These rugged, compact, light-weight, weather-sealed units are specifically designed for mobile DF applications and are easily installed on cars, vans, aircraft, or any platform having a sizeable metallic ground plane. A foam pad on the underside prevents marring or scratching of cosmetic surfaces. Typical single- and multi-band DMA-Series mobile DF antennas are illustrated in Figures 1-3 below.

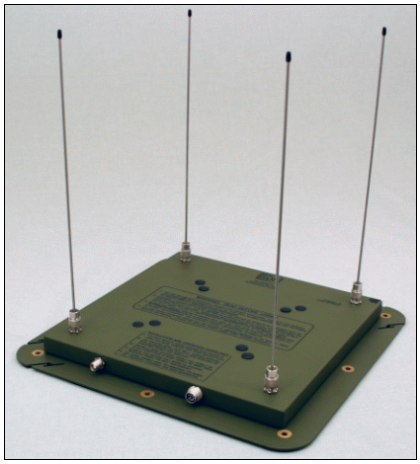

Figure 1 - DMA-1310B1 75-300 MHz Mobile Adcock

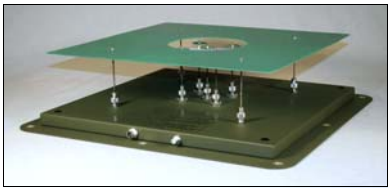

Figure 2 - DMA-1325B3 75-1,000 MHz Mobile Adcock

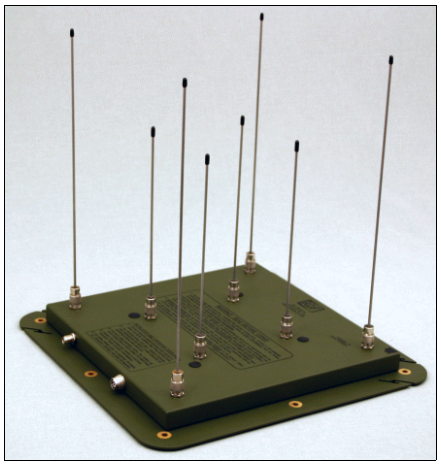

Figure 3 - DMA-1276B1 27-520 MHz Mobile Adcock

All DMA-Series DF antennas have been designed with superb signal handling capability for reliable performance in the dense signal environments typically encountered in urban areas.

Although this manual is focused on the current DMA “B”-series models, the earlier “R-series” models are also discussed.

B. EQUIPMENT SUPPLIED

Although the equipment supplied is model-dependent, the following DMA-1315B2 deliverable items list is representative (see also Figure 4 below):

1. DMA-1315B2 Main Chassis (P/N A315-6002; 1 ea.)

2. DMA-045B 4.5 Meter Interface Cable Set (P/N S058-6001; 1 ea.)

3. DAB-061B UHF Aerials (P/N S024-0061; 4 ea.)

4. DAB-155B VHF Aerials (P/N S024-0155; 4 ea.)

5. Car-top Mounting Hooks (P/N 605-028; 4 ea.)

6. Car-top Mounting Straps (P/N 613-015); 4 ea.)

7. DMA-Series DF Antenna Operator's Manual (P/N A900-9001; 1 ea.)

The equipment supplied for other DMA-series DF antennas is similar, but with the appropriate main chassis and aerials. Detailed shipping lists for all RDF Products antenna models can be found in the "Shipping Documents" subfolder of the RDF Products Publications CD.

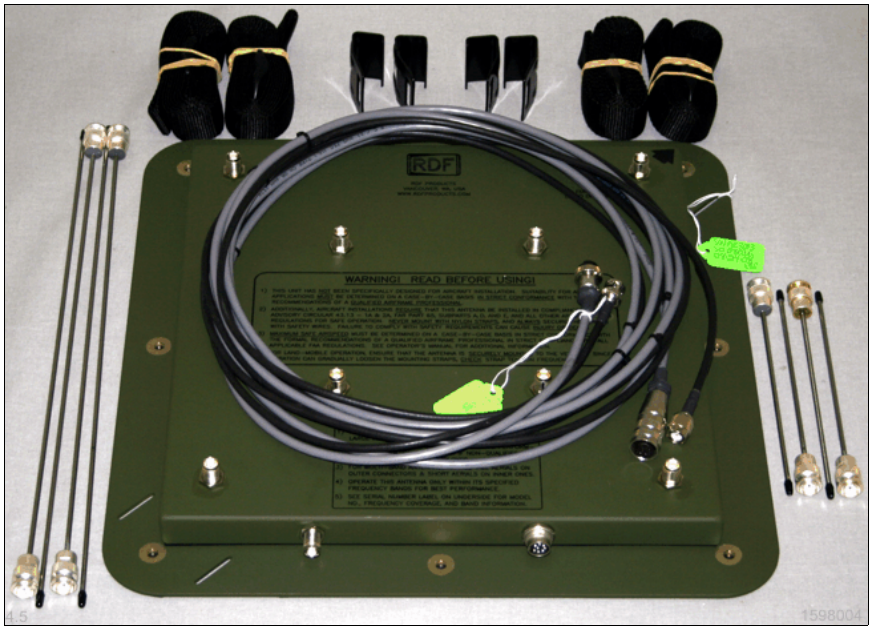

Figure 4 - DMA-1315B2 Deliverable Items

The DMA-045B 4.5 meter (15') detachable interface cable set comprises an 8-conductor (#22 AWG) antenna control cable and an RG-58/U coaxial RF output cable. The antenna control cable provides the necessary 11-16 VDC operating voltage and band selection data (for multi-band models). This cable is terminated at the antenna end by an IP-67 rated waterproof multiconductor connector at the antenna end and a non-waterproof 8-pin mobile radio connector at the DF processor end.

The RF cable is terminated at the antenna end by a waterproof TNC connector and a non-waterproof BNC connector at the DF processor end. The two cables are laced together at 18" intervals using nylon cable ties.

For mobile DF antenna models that operate above 520 MHz, the DMA-045C cable set is supplied in lieu of the DMA-045B. The DMA-045C is identical in length and appearance to the DMA-045B, but employs RG-223/U double-shielded coaxial cable rather than the single-shielded RG-58/U coaxial cable employed in the DMA-045B. (Premium double-shielded coaxial cable is necessary above 520 MHz to prevent undesired signal pick-up that can degrade DF antenna performance.)

The aerials are cut from 1/8" diameter stainless-steel stock with one end fitted into a TNC male connector. The rod is secured into the TNC connector using a premium-grade 2-part epoxy compound. Black plastic safety tips are likewise fastened to the opposite ends using 2-part epoxy.

The car-top mounting hooks and nylon straps are supplied so that the DF antenna can be conveniently mounted atop the vehicle. For more permanent installations, the DF antenna can also be mounted using the 8 (1/4" diameter) flange mounting holes.

C. EQUIPMENT REQUIRED BUT NOT SUPPLIED

RDF Products DMA-series mobile DF antennas are not useful by themselves and must be used with a suitable DF receiver/processor. Also, depending upon specific installation requirements, additional mounting hardware and extension cables may be necessary.

D. ASSEMBLY

Aside from the detachable aerials, cable set, and nylon mounting straps, DMA-series mobile DF antennas are shipped fully assembled. As per the installation instructions below, for dual-array antennas install the four *taller* aerials at the *outer* TNC connectors and the *shorter* aerials at the *inner* TNC connectors.

In the case of low-profile models designed for in-vehicle mounting (e.g., the DMA-1325B3 illustrated in Figure 5), the aerials may be shipped attached to or detached from the chassis depending upon how the shipment is packed. In cases where the aerials are detached, install them to the main chassis as per Figure 5.

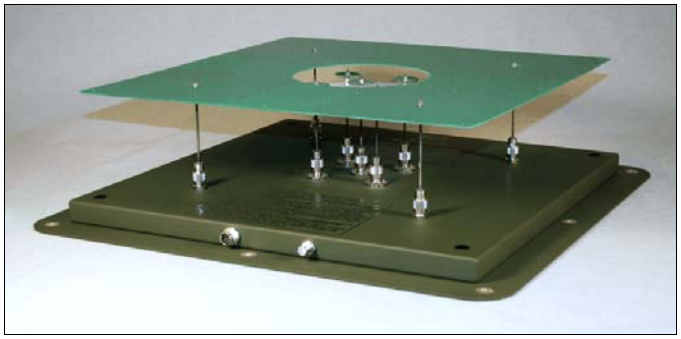

Figure 5 - DMA-1325B3 Low-Profile Mobile Adcock DF Antenna

Note that these low-profile aerials employ printed circuit board “capacitive hats”. These hats serve as top loading elements that allow the vertical rods to be much shorter than would otherwise be the case. ***These capacitive hats have been carefully fitted onto their supporting threaded stainless-steel rods. These rods must not be removed.***

Also, the protective foam pad normally attached to the baseplate underside (to protect vehicle roof-top finishes) is supplied separately (unattached) for these models. This is done both to a) minimize the antenna height; and b) provide the user the option of making direct electrical contact between the unpainted baseplate underside and the user-supplied ground plane. For applications where users would prefer having the protective foam pad, it is easily installed.

To do so:

1. Remove the aerials.

2. Clean the baseplate underside so that it is free of debris and dirt. Also wipe it so that is completely dry.

3. Set the antenna chassis upside down on a flat horizontal surface.

4. Carefully remove the protective backing from the foam pad to expose the adhesive surface.

5. Carefully position the foam pad over the baseplate so that its holes match those of the chassis and that the two corner foam pad tongues are aligned with those of the baseplate.

6. When proper alignment has been achieved and verified, carefully lower the foam pad onto the baseplate and apply pressure to ensure a good bond.

E. MAINTENANCE

RDF Products mobile DF antennas are weather-sealed units that contain no user-serviceable parts. Opening these antennas without our written authorization voids the warranty.

These antennas are mostly maintenance free aside from normal cleaning. In this regard we particularly recommend that the aerials be inspected periodically and wiped off to remove soot and debris, especially at the exposed gray epoxy surface where the stainless-steel rod enters the connector shell. If wiping alone is insufficient, use alcohol or acetone as required.

We also recommend that the bottom-plate mounting screws be checked for tightness prior to installing the unit for the first time so as to counteract possible gasket “cold-flow” during shipment and storage that might loosen these screws. We further recommend that these screws be rechecked for tightness periodically in the event that they vibrate loose during operation. Tighten with a #2 Phillips screwdriver as required.

If an antenna is to be left outdoors, be sure that the aerials are appropriately installed on their mating connectors to ensure weather sealing. Similarly, be sure that the two interface cables are likewise installed.

SECTION II - SPECIFICATIONS

DF Technique -	Single-channel 2-phase Adcock.
Sense Technique -	Derived or central aerial (model dependent).
Frequency Coverage -	Model dependent.
Bearing Accuracy -	Model dependent.
Polarization -	Vertical.
Output Impedance -	50 ohms nominal.
2nd Order Intercept -	Model dependent.
3rd Order Intercept -	Model dependent.
Power Requirements -	11-16 VDC (negative ground). Current consumption is model dependent varying between 90 and 450 mA.
Operating Temperature -	-40 to + 60 degrees C.
Storage Temperature -	-40 to +70 degrees C.
Humidity -	0-100%.
Weight & Dimensions -	Model dependent.
Required Axis Encoding - Tone Input Voltages	0.95 - 1.05 volt peak-to-peak sinusoidal. (See Note 1)
Permissible Axis Encoding - Tone Frequency Range	100-2000 Hz. (See Note 2)
Permissible Axis Encoding - Tone Driver Output Resistance	0-150 ohms.
Band Switch Protocol -	4-line static parallel code. (See Note 3)
Band Switch Logic Levels -	Standard +5V CMOS (logic “0"=0V, logic “1"=+5V).
Interface Cable Set Length -	4.5 meters (standard; custom lengths available).
Chassis Mating Multiconductor - Connector	Amphenol-Tuchel Electronics C091 31D008 100 1.
Chassis Mating RF Connector -	Standard TNC male.

Notes:

1. Although the antenna can accept axis encoding tone amplitudes within 5% of the 1.00 volt p-p nominal specification, the two tones should be very closely matched in voltage amplitude for best bearing accuracy.

2. Users should avoid axis encoding tone frequencies that fall on (or very close to) harmonics of AC power line frequencies (i.e., 50/60 Hz)

3. See Appendix B for antenna band code table.

4. Since certain specifications are model-dependent, users should also refer to the appropriate product data sheets.

SECTION III - INSTALLATION

A. UNPACKING AND INSPECTION

Carefully examine the shipping carton for damage before it is opened. If damage is evident, have the carrier's agent present, if possible, when the equipment is unpacked. If the carrier's agent cannot be present, retain the cartons and packing material for the carrier's inspection if the equipment is subsequently found to be damaged after unpacking.

To ensure that the shipment has been received complete, inventory all items against the packing list. If a discrepancy is found, immediately notify us.

The equipment was thoroughly inspected and factory adjusted for optimum performance prior to shipment and is therefore ready for immediate use. If evidence of damage during shipment is found, immediately notify us.

B. INSTALLATION

1. STANDARD VEHICLE ROOF-TOP MOUNTING

For standard car/truck/van vehicle roof-top mounts, center the DF antenna on the metallic portion of the vehicle roof and align it so that the black reference arrow points "dead ahead". Secure the antenna to the vehicle rain gutters using the provided rain gutter hooks and nylon mounting straps, looping the straps through the captive slots on the antenna baseplate as well as the slots on the rain gutter hooks. **Note:** If the vehicle cannot accommodate the supplied rain gutter hooks, check local automotive supply stores for styles more suitable.

Be sure to orient the plastic strap buckles so that they are *right side up* and positioned on the *upper segment* of the strap loop. Also be sure that they are positioned so that the excess (the "tail" that is pulled to tighten the strap) runs *away from* the antenna (i.e., when the straps are correctly installed, they are tightened by pulling the "tail" *away from* the antenna). Tighten each strap in succession until the antenna is both securely mounted and still correctly positioned. If antenna misalignment occurs, loosen and re-tighten the straps as required to re-establish correct alignment. Wrap the excess tails around the tightened straps so that they won't flap around when the vehicle is in motion. If the antenna is not likely to be installed on a vehicle with a wider roof, cut the tails to 6" or so.

Next, install the aerials at the antenna TNC aerial connectors. For single-array antennas, four (or sometimes five) identical aerials are used. For dual-array antennas, always install the four *taller* aerials at the *outer* TNC connectors and the *shorter* aerials at the *inner* TNC connectors. When installing the aerials, *firmly finger-tighten only*. *Using pliers or a wrench is not necessary and the resulting excess force will likely rotate the TNC connectors and damage the weather-seal.*

Mobile DF antennas are supplied with a cable set consisting of two detachable cables (a power/control cable and an RF signal output cable). Attach the signal output cable (with the TNC male connector) to the mating TNC female connector on the side of the antenna chassis. Similarly, attach the power/control cable (with the 8-pin female connector) to the mating 8-pin male connector. **Note:** This connector sometimes does not fully insert into the mating connector without significant resistance. To ensure that the connector is fully inserted, wiggle the body side-to-side slightly as the connector threaded ring is tightened.

Finally, directly route the antenna cables into the vehicle through the most convenient passenger-side window. Do not leave slack in the portion of the cables between the vehicle entry point and the DF antenna as this may cause the wind to batter the cables against the roof-top when the vehicle is in motion. Once this slack has been taken out, the cables can be held in place by *gently* closing the passenger-side window to the point where it clamps the cables. *Be sure not to close the window so tightly that it crushes or severs either cable.* A typical mobile DF antenna installation is illustrated in Figure 6 below.

***** DANGER *****

> An improperly secured DF antenna can result in injuries and property damage if the antenna falls off the vehicle. It is the user's responsibility to properly secure the DF antenna to vehicle for safe operation. *Be sure to inspect the installed antenna periodically during the course of a DF mission to verify that the nylon straps remain tight.*

If the vehicle has other roof-top antennas (e.g,. for entertainment or communications radios), we strongly recommend that these be removed for best DF performance. Similarly, roof-top lights, flashers, and sirens should also be removed.

Installation Hint - When installing the antenna, twist each strap approximately three turns. This greatly reduces “strumming” noise that is frequently experienced as a result of wind-induced strap vibration when the vehicle is in motion.

De-installation Hint - If the antenna is to be temporarily de-installed, loosen the two straps *on the driver’s side only*. When the antenna is re-installed on the same vehicle, the passenger-side straps will already be pre-adjusted to their correct length, and it is only necessary to retighten the driver’s side straps to complete reinstallation. With this time-saving shortcut, there is no need to loosen and re-tighten straps as discussed above to restore alignment. Since the antenna strap slots are captive, the straps will not fall off the antenna during storage.

2. CUSTOM VEHICLE INSTALLATION

Mobile DF antennas can also be installed on vehicles by other means. If a semi-permanent installation is desired, the antenna can be directly mounted to the vehicle roof-top via the eight mounting holes provided on the antenna baseplate flange using 1/4" diameter bolts. Some users have concealed antennas in roof-top luggage carriers as well. Other users have installed bulk-head aerial connectors on the roof of the vehicle (with the correct spacing and orientation) that were then connected to the antenna box (located *inside* the vehicle) via phase-matched cables. Contact us if you have special antenna installation requirements.

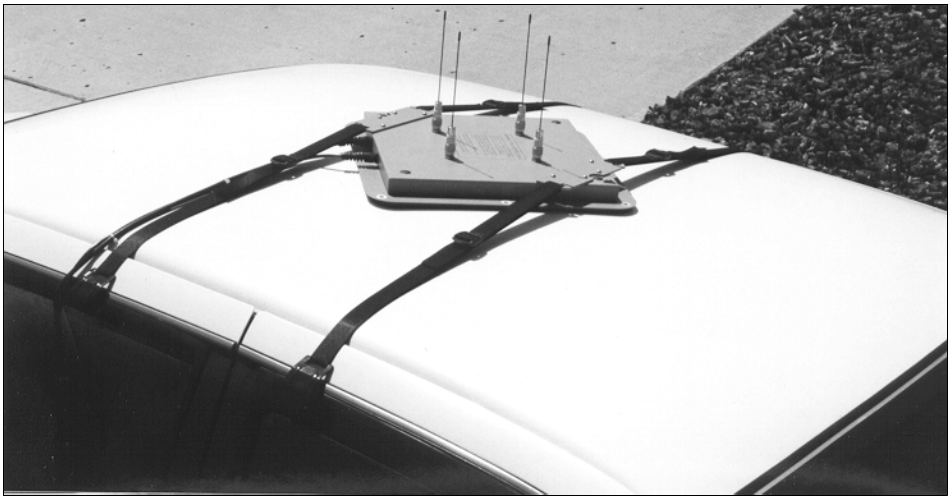

Figure 6 - Car-Top Mobile DF Antenna Installation (front to the right)

3. AIRCRAFT INSTALLATION

Mobile DF antennas can also be installed on aircraft *but since RDF Products mobile DF antennas have not been designed for aircraft installation, the installation must be done and formally approved by an FAA certified aircraft mechanic for reasons of public safety.*

***** DANGER *****

Unauthorized and improper DF antenna installations on aircraft can result in property damage, injury, and even death. It is mandatory for aircraft installations that the DF antenna be installed in full compliance with FAA advisory circular 43.13 - 1A & 2A, FAR part 65, sub-parts A, D, and E, and all other applicable FAA regulations for safe operation. Never mount the DF antenna with nylon straps. Always use the appropriate aircraft aerials (equipped with safety wires to prevent aerials from rotating loose) and ensure that the installation is in strict conformance with FAA regulations. Maximum safe airspeed must be determined on a case-by-case basis in strict conformance with the formal recommendations of a qualified airframe professional in strict compliance with all applicable FAA regulations.

Aircraft installations frequently require special mounts and radomes in order to be in compliance with all applicable regulations.

When mounting mobile DF antennas upside down on the underside of an aircraft, the DFP-1000B **GND/AIR** configuration setup dip-switch must be set to **AIR** as discussed in the DFP-1000B Operator's Manual to compensate for an east-west axis bearing reversal that would otherwise occur.

4. GROUND PLANE REQUIREMENTS

Mobile DF antennas designed for vehicle roof-top or aircraft mounting must be installed on sizeable metal ground planes to function properly. The metal roofs of most compact cars are usually adequate. The larger metal roofs of full-sized cars and vans are even better. Do not

attempt to install the antenna atop a vehicle having a roof constructed of fiberglass or other non-conductive material as this will result in poor and erratic DF antenna performance. Also keep in mind that the imperfect ground planes provided by vehicle roof-tops do not permit the DF antenna to achieve the same bearing accuracy as can be obtained on an ideal site (although the resulting accuracy is nearly always good enough for most mobile DF missions). Mast-mounted DF antennas should be used in applications where best bearing accuracy is required as discussed below. Most fixed-wing aircraft having aluminum fuselages provide excellent ground planes. Aircraft with fiberglass or other non-metallic undersides (many helicopters, for example), do not easily accommodate mobile DF antennas. In addition, landing struts, searchlights, landing skids, and navigation/communication antennas all tend to degrade DF performance.

5. CONNECTING THE DF ANTENNA TO THE DF PROCESSOR & HOST RECEIVER

First, locate the two antenna cables (normally tied together with nylon cable ties). Connect the RF cable (the one with the BNC male connector) to the RF input jack of the host receiver. If the host receiver does not employ a BNC female connector, an appropriate adaptor must be used. Next, connect the antenna control cable (the one with the 8-pin female mobile radio plug) to the DF processor mating 8-pin male mobile radio connector (labeled "**ANTENNA CONTROL**") immediately to the left of the **SIGNAL INPUT** connector.

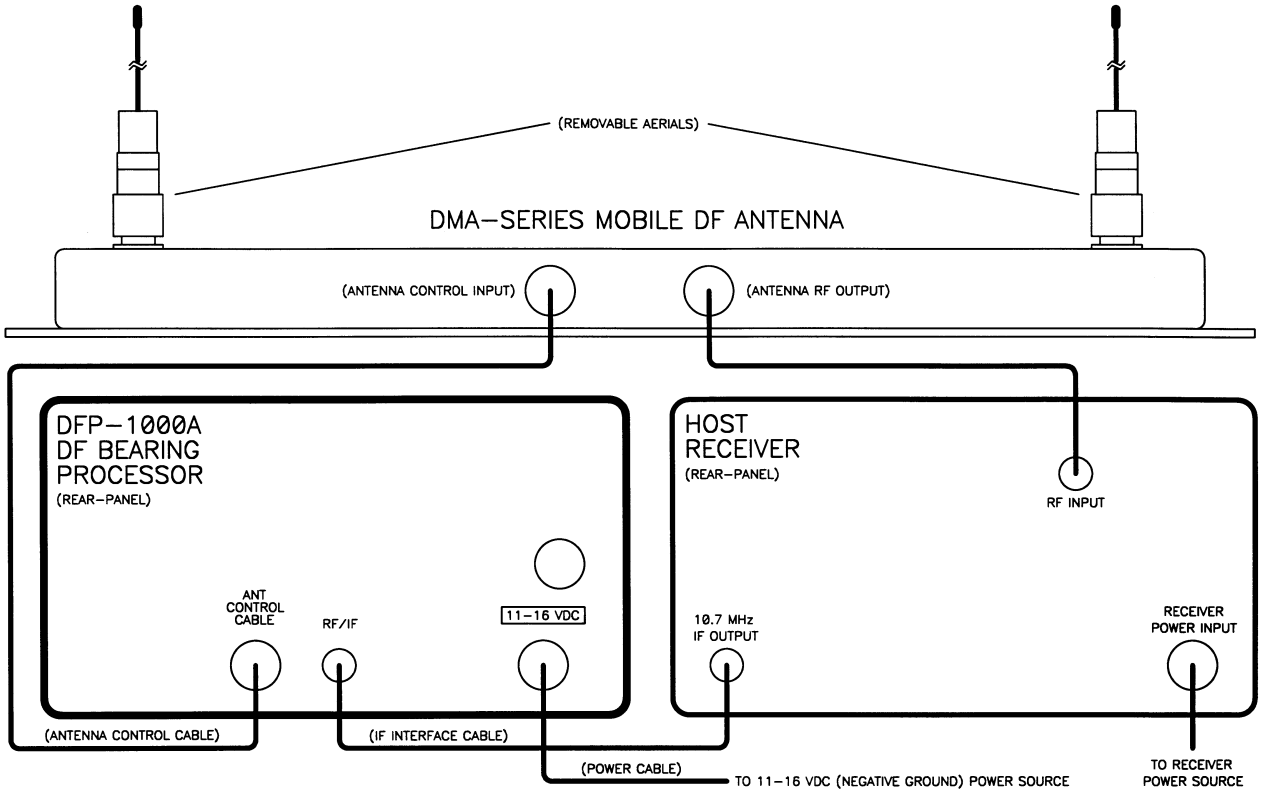

Figure 7 - DF System Functional Interconnect Diagram (10.7 MHz IF signal interface)

6. MOUNTING TWO OR MORE DF ANTENNAS ON THE SAME VEHICLE

Although some DF vendors instruct their customers to mount two mobile DF antennas atop the same vehicle for wider frequency coverage, this is usually bad practice. Unless the vehicle roof-top is very large so that there can be wide separation, the proximity of the two DF antennas will invariably cause interaction and degraded performance. In most cases, using a single wide-coverage dual-array unit is the best performing, lowest cost, and most convenient overall approach.

7. ELEVATING MOBILE DF ANTENNAS ON MASTS

Although some vendors claim that their mobile DF antennas can be elevated atop towers or masts with the help of special ground plane extenders, this is very bad practice that will result in poor performance. The reasons for this are discussed in depth in our 1999 Application Note AN-005 ("An Introduction to Dipole Adcock Fixed-Site DF Antennas"). For fixed-site applications that require the DF antenna to be elevated, dipole Adcock models that are specifically designed for mast-mounting must be employed.

8. REMOVING OR CUTTING-DOWN AERIALS

All aerials must be installed on a mobile DF antenna if the unit is to meet its published specifications. Even if the user intends to operate a dual-array antenna only in the frequency range covered by the inner array, it is still necessary that the outer array be installed. Although this may seem counter-intuitive, the user should keep in mind that the two arrays interact with each other and that this interaction has been compensated for in the design process. Removing an "unused" array will therefore upset this compensation and result in degraded performance over portions of the frequency range of interest.

Similarly, cutting-down aerials will change their electrical characteristics and thus also upset this compensation.

9. ENVIRONMENTAL CONSIDERATIONS

DMA-series mobile DF antennas are ruggedized, weather-sealed units built for permanent outdoor installation. *However, the weather seal is maintained only if the DMA-045B/C cable set plugs are firmly attached to their mating antenna chassis connectors.*

NOTES

SECTION IV - EXTENDED INTERFACE CABLE LENGTHS

Although DMA-series mobile DF antennas are supplied with a standard DMA-045B or DMA-045C 4.5 meter long interface cable set (which is sufficiently long for the vast majority of mobile DF applications), there are instances where a longer cable set is necessary. Although this can be accommodated, there are some cautions and caveats that the user must consider. Addressing first the issues associated with the RF coaxial signal cable:

1. RF Coaxial Cable Signal Loss - All RF coaxial cables introduce signal loss that increases in proportion to both cable length and operating frequency. If the cable is to be significantly longer than 4.5 meters (the standard supplied cable length), the user must be sure that the added cable loss is acceptable and will not noticeably reduce system sensitivity. In most instances, the additional cable loss should be no more than 6 dB.

   Tables of coaxial cable signal loss as a function of frequency and cable length are readily available and are often published in coaxial cable manufacturers' catalogs. As a convenience for users, the RDF Products Publications CD includes a utility program (RDFUTIL1.EXE) that has a coaxial cable loss calculator for many commonly-used coaxial cable types.

   For long cable runs, it is often necessary to use a premium-grade coaxial cable such as RG-214/U.

2. RF Coaxial Signal Pick-Up - Longer coaxial cables are more prone to undesired signal pick-up. If the magnitude of this pick-up is not very low compared to the magnitude of the desired signal pick-up from the DF antenna aerials, performance degradation will result. We therefore recommend that extension cables be premium-grade double-shielded types (e.g., RG-223/U or the lower-loss RG-214/U).

3. In-Line Cable Amplifier - For very long cable runs, the only practical solution to offsetting high cable losses may be to employ an in-line cable amplifier. This amplifier must be installed prior to the long cable run and be of good quality (i.e., it must have a reasonably low noise figure and excellent strong signal-handling capability). In addition, it must be fully enclosed in a weather-sealed box with good RF shielding to prevent signal pick-up.

Although extending the multi-conductor antenna control cable length results in fewer ill effects than those associated with extending the length of the RF cable, the user must verify that the voltage drop along the DC power conductors is not sufficient to cause the DC voltage applied to the DF antenna power input pins to drop below 11 volts. (If this happens, the internal DC voltage regulators can drop out of regulation resulting in degraded performance.)

Fortunately, this DC voltage drop can be accurately calculated since the DF antenna current drain and DC power conductor resistance are known. Since the multi-conductor cable wires are #22 AWG, we find from the copper wire tables that the resistance of #22 AWG wire at 25° C is 16.46 ohms per 1,000 feet. Since the DF antenna current drain is also known, DC voltage drop can be calculated by multiplying the total (2-way) wire resistance by the antenna current drain.

To illustrate by example, assume that a DMA-1265B1 is to be operated using a cable with a total length (supplied DMA-045C cable plus extension) of 15 meters. First, referring to the DMA-1265B1 product data sheet, we find its current drain to be 0.44 ampere. Next, we compute the 1-way #22 AWG wire resistance by first converting 15 meters into feet (49.2') and then computing its resistance as 49.2/1,000 x 16.46 = 0.81 ohms.

Although at first thought it would seem that the 2-way wire resistance should be 2 x 0.81 = 1.62 ohms, this neglects the fact that the #22 AWG negative power wire is in parallel with the coaxial cable shield, thus resulting in a much lower composite resistance. For RG-223/U coaxial cable, the shield resistance is only 2.27 ohms per 1,000'. The shield resistance for a 49.2' cable length is thus 49.2/1,000 x 2.27 = 0.11 ohms. The parallel combination of 0.11 and 0.81 ohms can be computed using the formula (R1 x R2)/(R1 + R2) = 0.097 ohms. The actual 2-way wire resistance is then 0.81 + 0.097 = 0.91 ohms.

The line voltage drop is then computed as V = I x R, or 0.44 x 0.91 = 0.40 volts. Provided that the DC supply voltage as measured at the DF processor antenna control output jack *under full load* is at least 11.40 VDC, the voltage appearing at the DMA-1265B1 power input pins will be no less than the required 11.00 VDC minimum.

If an in-line cable amplifier is employed that is powered through the antenna control cable, its current drain must be added to the DF antenna current drain for the purpose of this calculation.

*** CAUTION ***

> The combined current drain of the mobile DF antenna and in-line cable amplifier must not exceed the DMA-045B/C 1.0 ampere maximum current rating.

In cases where the line voltage drop is too high, it is often possible to correct this by raising the DF processor DC supply voltage. If an AC-operated DC power supply is employed, there is likely an internal adjustment that can be used to raise the DC output voltage to the necessary level. Of course, this voltage must not be set so high that it exceeds the 16 VDC maximum rated DF processor input. If this same power supply is also used to run the host receiver or other equipment, its output voltage must not be set so high that it exceeds the ratings of this equipment.

RDF Products can supply custom length antenna interface cable sets on special order. Alternatively, custom extension cable sets can be supplied. We do not recommend interface cables longer than 100 meters.

SECTION V - TECHNICAL OVERVIEW

Since a detailed technical description of the DF technique employed by RDF Products DF equipment is far beyond the scope of this document, this technical overview by necessity is abbreviated and summary in nature. Those interested in a fuller technical discussion should read RDF Products' application literature, the DFP-1000B operator's manual, and relevant publications from other sources.

RDF Products mobile DF antennas are all single-channel, 2-phase Adcock designs. Unlike classical 3-channel Adcock designs that require three phase/gain-matched phase-coherent receivers, single-channel Adcock DF antennas require only a single receiver. The single-channel Adcock DF technique is thus very economical by comparison. This economical advantage can be even further enhanced by the use of readily available modestly-priced consumer-market communications receivers. In practical terms, a single-channel Adcock DF system sells for a fraction of the cost of a comparable 3-channel unit.

All 2-phase Adcock DF antennas have three outputs (N-S bi-directional, E-W bi-directional, and sense omni-directional) that must be passed along to the DF receiver/processor. Since directly summing these signals together would result in a loss of essential information, the single-channel Adcock employs an axis encoding (modulation) technique. This modulation technique allows these three outputs to be summed into a single composite output that can be separated in the DF receiver/processor without loss of essential information.

In RDF Products mobile DF antennas, the N-S bi-directional and E-W bi-directional outputs are tone amplitude modulated to provide this necessary encoding. Different modulation tone frequencies are employed for these two outputs so that they can be separated at the DF receiver/processor. The composite DF antenna output is thus a dual-tone amplitude modulated signal with the omni-directional sense output as the common AM carrier signal. The information necessary for the DF processor is provided by the relative modulation index of the two tones.

This composite DF antenna output is fed directly to the receiver. This receiver can be of conventional design with no special requirements other than being able to demodulate an AM signal without distortion.

The DF processor then accepts the two demodulated tones from the receiver and converts them into proportional DC voltage levels by means of synchronous demodulation. In modern DF processors, these two DC voltage levels are digitized and mapped into a bearing (azimuth) using a 4-quadrant arc-tangent algorithm. This bearing can then be displayed in various formats (typically as a numeric read-out, azimuth ring, or a real-time polar bearing display).

NOTES

APPENDIX A - INTERFACE CABLES & CONNECTORS

RDF Products mobile DF antennas are supplied with a standard 4.5 meter detachable cable set comprising one RF output cable and one antenna control cable.

The RF output cable is a 50 ohm coaxial cable (RG-58/U or RG-223/U) with a waterproof TNC male termination at the DF antenna end and a BNC male termination at the DF receiver/processor end. RG-58 cable is satisfactory for operation up to 520 MHz and where the cable length does not exceed 4.5 meters. For operation above 520 MHz or where a longer cable is required, we recommend RG-223/U double-shielded cable. If the cable length is sufficiently long to induce significant cables losses, we recommend a premium double-shielded cable such as RG-214/U.

The antenna control cable is a sheathed 8-conductor type with #22 AWG stranded wires. The antenna end is terminated with an Amphenol P/N C091 31D008 100 2 8-pin female DIN plug, which mates the Amphenol P/N C091 31C008 100 2 male antenna chassis receptacle. Both of these connectors are waterproof.

The other end of the antenna control cable is terminated with an 8-pin mobile radio plug. This plug is available from a number of different sources including Philmore/LKG (P/N T700-B).

The cable is wired “straight-thru” (i.e., pin 1 to pin 1, pin 2 to pin 2, etc.), but the pin numbering conventions on the two connectors are different (see Figures 8 and 9).

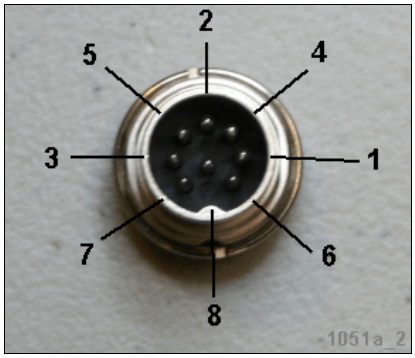

Figure 8 - DF Antenna Chassis Connector Pin Assignments

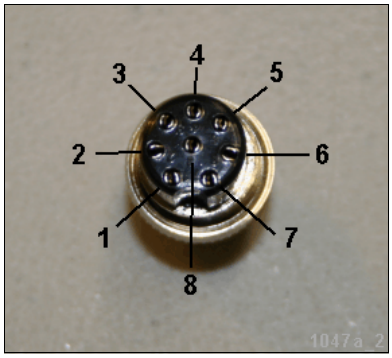

Figure 9 - Mobile Radio Connector Pin Assignments

Antenna control cable pin/wire assignments are as follows:

Pin #	Function	Wire Color
Pin 1 -	X-tone out (1 VPP)	BRN
Pin 2 -	Y-tone out (1 VPP)	RED
Pin 3 -	AntBand (bit-1)	ORN
Pin 4 -	AntBand (bit 2)	YEL
Pin 5 -	AntBand (bit-4)	GRN
Pin 6 -	11-16 VDC	BLU
Pin 7 -	AntBand (bit-3)	BLK
Pin 8 -	Ground	WHT

APPENDIX B - "B"- SERIES DF PROCESSOR ANTENNA BAND CODES

RDF Products DF antennas employ the following DF antenna band code protocol:

BAND	B1	B2	B3	B4	BAND	B1	B2	B3	B4
01	1	0	0	0	09	1	0	0	1
02	0	1	0	0	10	0	1	0	1
03	1	1	0	0	11	1	1	0	1
04	0	0	1	0	12	0	0	1	1
05	1	0	1	0	13	1	0	1	1
06	0	1	1	0	14	0	1	1	1
07	1	1	1	0	15	1	1	1	1
08	0	0	0	1					

Notes:

1. "0" and "1" logic levels are 0 and +5V, respectively.
2. Band 00 (all four bits low) is reserved for polling the DF antenna for its model/band information as per the discussion in Appendix C.

For the RDF Products "B-series" DF antennas, band selection always begins with Band 01 for the lowest frequency band, followed by Band 02 for the next higher band, Band 03 for the next higher band, etc. To illustrate this convention by example, consider the DMA-1265B1, which covers 20-75/75-200/200-512/512-1,000 MHz in four bands. The band assignments are as follows:

DMA-1265B1 Band	Band Selection
20-75 MHz	Band 01
75-200 MHz	Band 02
200-512 MHz	Band 03
512-1,000 MHz	Band 04

If the user inadvertently selects a band higher than the highest valid antenna band, the DF antenna will default to its highest band. Again using the above example, band codes 05-15 will be read by the DMA-1265B1 as Band 04.

Single-band antennas require no band code selection. They will function normally regardless of the selected antenna band.

If Band 00 (all four bits low) is selected, the DF antenna "personality module" will return a 300N81 serial data bit stream reporting the DF antenna model and its frequency/band assignments. This can be a very useful feature, particularly in applications where automatic antenna band selection is desired. The data protocol associated with this personality module is presented in detail in Appendix C.

APPENDIX C - ANTENNA PERSONALITY MODULE

A. OVERVIEW

All RDF Products "B"-series DF antennas contain a "personality module" located on the Antenna Switch Board (ASB2). This personality module, when appropriately interrogated by the DFP-1000B or DFP-1010B DF processor (or DFP for short), returns a 300N81 serial ASCII text identification string that provides the DF antenna model number and band list. The following example illustrates the identification string sent by the single-band DFA-1310B1:

DFA-1310B-1, 75-300<CR><LF>

This string identifies the DF antenna as the DFA-1310B1 covering 75-300 MHz in a single band.

The following example illustrates the identification string sent by the multi-band DMA-1276B1:

DMA-1276B-1, 27-88, 88-250, 250-520<CR><LF>

This string identifies the DF antenna as the DMA-1276B1 covering 27-88MHz, 88-250 MHz, and 250-520 MHz in three bands.

Note that the frequency band fields are "comma space" delimited, and that the bands are listed in ascending order. Also, no commas are used in the band edge frequencies (i.e., "1000" would be used rather than "1,000").

The personality module provides valuable information to the DFP that helps prevent the user from inadvertently tuning the host receiver outside the selected antenna band. This Appendix documents the various aspects of the protocol associated with the personality module for the benefit of DF system designers who wish to employ RDF Products DF antennas in their systems.

B. ANTENNA PERSONALITY MODULE CONSIDERATIONS

1. U1 (a PIC 16F628) reads the four DF antenna band code lines (bit-1, bit-2, bit-3, and bit-4; corresponding respectively to pins 3, 4, 7, and 5 of the Antenna Control cable connector).

2. Up to 15 DF antenna bands can be decoded (Bands 01-15, corresponding to codes 1000-1111, respectively, where bit-1 is LSB and bit-4 is MSB).

3. Code 0000 (all band code lines low) is interpreted by the PIC as an interrogation request to report the DF antenna band information (which is hard-coded into the PIC firmware and is non-volatile) back to the DFP.

4. The PIC loop period is 230 milliseconds. Thus, this is the maximum reaction time required for the PIC to read the antenna band code lines when the PIC is not being interrogated (i.e., when the codes are 1000-1111).

5. If an interrogation request is sent from the DFP, (i.e., code 0000), the actual time required for the PIC to recognize the request can vary from 0-230 milliseconds (depending upon where the PIC program pointer happens to be in the 230 millisecond loop cycle at the instant code 0000 is received).

6. Once the PIC recognizes the interrogation request, it will immediately declare the band code input ports as outputs, raise the band code lines for bits-2, 3, and 4 high and set bit-1 low, followed by a 366 millisecond pause. This action signals the DFP that the DF antenna has recognized the interrogation request (and also confirms that all four band code lines are functional). This 366 millisecond pause also gives the DFP time to reconfigure the antenna control bit-1 interface port as a serial input so that it will be able to receive the serial data string sent from the PIC as discussed below.

7. At the completion of the 366 millisecond pause, the PIC initiates the 300N81 response serial ASCII text identification string discussed above, which is returned on the bit-1 code line, followed by a 732 millisecond pause to prevent multiple model ID strings from the same request.

8. The time required for the PIC to transmit the ASCII text string will vary considerably, depending upon the specific DF antenna model (or more specifically, the length of the text string).

C. DFP (DF PROCESSOR) CONSIDERATIONS

1. For normal operation, the DFP DF antenna control interface ports for all 4 DF antenna band bits will be configured as outputs.

2. To initiate an antenna model interrogation request, all 4 DF antenna band bits must be simultaneously set low (code 0000). Once this occurs, the read-back string from the antenna will commence approximately 366-596 milliseconds later (i.e., 366+0 to 366+230 milliseconds as per the above discussion regarding the DF antenna PIC).

3. The DFP must therefore hold these 4 lines low for a sufficient length of time to guarantee that this state will be detected by the DF antenna personality module PIC, but not so long as to interfere with the subsequent 300N81 read-back string. Since the PIC loop period is 230 ms, this is the minimum period of time the 4 lines must be held low. Since the read-back string will occur at some point between T=366 ms and T=596 ms as discussed above, these 4 lines should be held low for no more than 366 milliseconds. For most reliable performance, the PIC should release the 4 lines midway between 230 ms and 366 ms, or T=298 ms.

4. After 298 milliseconds, the DFP will immediately reconfigure the antenna band bit-1 control line as an input so that it can receive the 300N81 read-back string from the DF antenna. Concurrently, the DFP will also reconfigure the bit-2, 3, and 4 control lines as

inputs.

5. To validate the DF antenna, the DFP will first examine the bit-2, -3, and -4 control lines to verify that these are high (i.e., the acknowledgment signal from the DF antenna PIC that it has recognized the interrogation request). If any of these 3 lines are not high, the DFP antenna control PIC will interpret this as an “unknown antenna”.

6. The DFP antenna control PIC will then apply a parsing routine to confirm that the model ID string is legitimate. An illegitimate ID string is interpreted as an “unknown antenna”.

7. Once the DFP antenna control PIC has received this read-back string, it will revert the antenna band bit-1, 2, 3, and 4 control ports to outputs and set the antenna to Band 01 (code 1000).

APPENDIX D - RDF PRODUCTS "R"- SERIES MOBILE DF ANTENNAS

Although the earlier RDF Products "R"-series DF antennas (e.g., the DMA-1315R0, DMA-1418R0, etc.) have been out of production since 2002, they can also be used with current RDF Products "B"-series DF processors with the following adaptations and caveats:

1. The 7-pin mobile radio connector terminating the antenna control cable must be replaced with an 8-pin version (or an adapter must be used - see below) for compatibility with the DFP-1000B and other current DF processors. See the table below for the 7-pin connector pin/wire assignments.

2. Since the earlier antennas do not contain personality modules, "B"-series DF processors will not be able to take advantage of this feature.

3. The band selection information listed on the serial number labels of these earlier antennas is not valid when these antennas are used with "B"-series DF processors as discussed below.

To address this latter issue, the user must select different band numbers when using an "R"-series DF antenna with "B"-series DF processors. The correct band numbers are listed below:

"R"-series Antenna Band	"B"-series DF Processor Band Selection
Band 03	Band 01
Band 04	Band 02
Band 05	Band 03
Band 06	Band 04
Band 07	Band 05
Band 08	Band 06
Band 09	Band 07

Similarly, if a "B"-series antenna is used with an earlier DFP-1000A:

"B"-series Antenna Band	DFP-1000A Band Selection
Band 01	Band 03
Band 02	Band 04
Band 03	Band 05
Band 04	Band 06
Band 05	Band 07
Band 06	Band 08
Band 07	Band 09

For single-band DF antennas, of course, band selection is irrelevant.

“R”- series 7-pin mobile radio connector/antenna control cable pin/wire assignments are as follows:

Pin 1 - X-tone out (1 VPP)
Pin 2 - Y-tone out (1 VPP)
Pin 3 - AntBand (bit-1)
Pin 4 - AntBand (bit 2)
Pin 5 - Unused (grounded in most “R”-series antennas)
Pin 6 - 11-16 VDC
Pin 7 - AntBand (bit-3)
Shell - Ground

The RDF Products DCA-078 cable adaptor (see Figure 10) provides users a convenient means by which to connect “R”-series DF antennas to the current “B”-series DF processors. For users wishing to connect a “B”-series DF antenna to earlier model DF processors, RDF Products can supply the DCA-087 cable adaptor (which is very similar in appearance to the DCA-078).

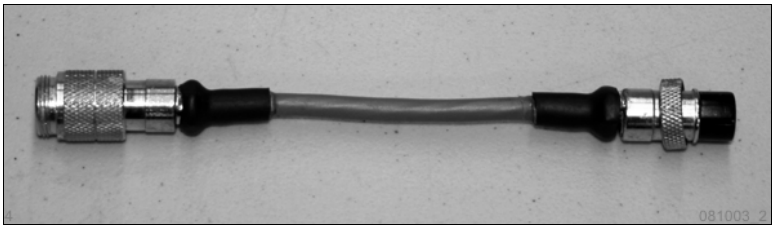

Figure 10 - DCA-078 Antenna Cable Adaptor

APPENDIX E - CURRENT RDF PRODUCTS MOBILE DF ANTENNA MODELS

The following RDF Products mobile DF antenna models are currently in production as of this writing. Product data sheets for these models can be obtain from RDF Products' website and Publications CD.

Model	Description	Baseplate Dimensions
DMA-1248B1	20-174 MHz Mobile Adcock	22" x 22"
DMA-1254B1	20-470 MHz Mobile Adcock	22" x 22"
DMA-1265B1	20-1,000 MHz Mobile Adcock	22" x 22"
DMA-1270B1	27-220 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1272B1	27-300 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1276B1	27-520 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1276B2	27-520 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1286B2	30-1,000 MHz Mobile Adcock	22" x 22"
DMA-1290B1	65-200 MHz Mobile Adcock	22" x 22"
DMA-1306B1	65-1,000 MHz Mobile Adcock	22" x 22"
DMA-1309B1	75-220 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1310B1	75-300 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1310B2	75-300 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1315B1	80-520 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1315B2	75-520 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1325B3	75-1,000 MHz Mobile Adcock	22" x 22"
DMA-1349B1	148-470 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1366B1	220-520 MHz Mobile Adcock	15-7/8" x 15-7/8"
DMA-1376B1	240-1,000 MHz Mobile Adcock	15-7/8" x 15-7/8"

APPENDIX F - MOBILE DF ANTENNA BASEPLATE HOLE LOCATION DRAWINGS

As discussed in Section III-B-2, RDF Products DMA-series mobile DF antennas have eight baseplate flange holes intended for applications where the unit is to be permanently or semi-permanently mounted. These baseplates are either 15-7/8" x 15-7/8" for the smaller models or 22" x 22" for the larger ones (see Appendix E).

Mounting hole location drawings for both of these baseplates are provided in Figures 11 and 12 below. These 0.265" (6.73 mm) diameter holes are intended to accommodate 1/4" or 6 mm diameter mounting bolts.

To gain access to the mounting holes, it will first be necessary to drill or burn-through the protective underside foam pad at the locations where it blocks these holes.

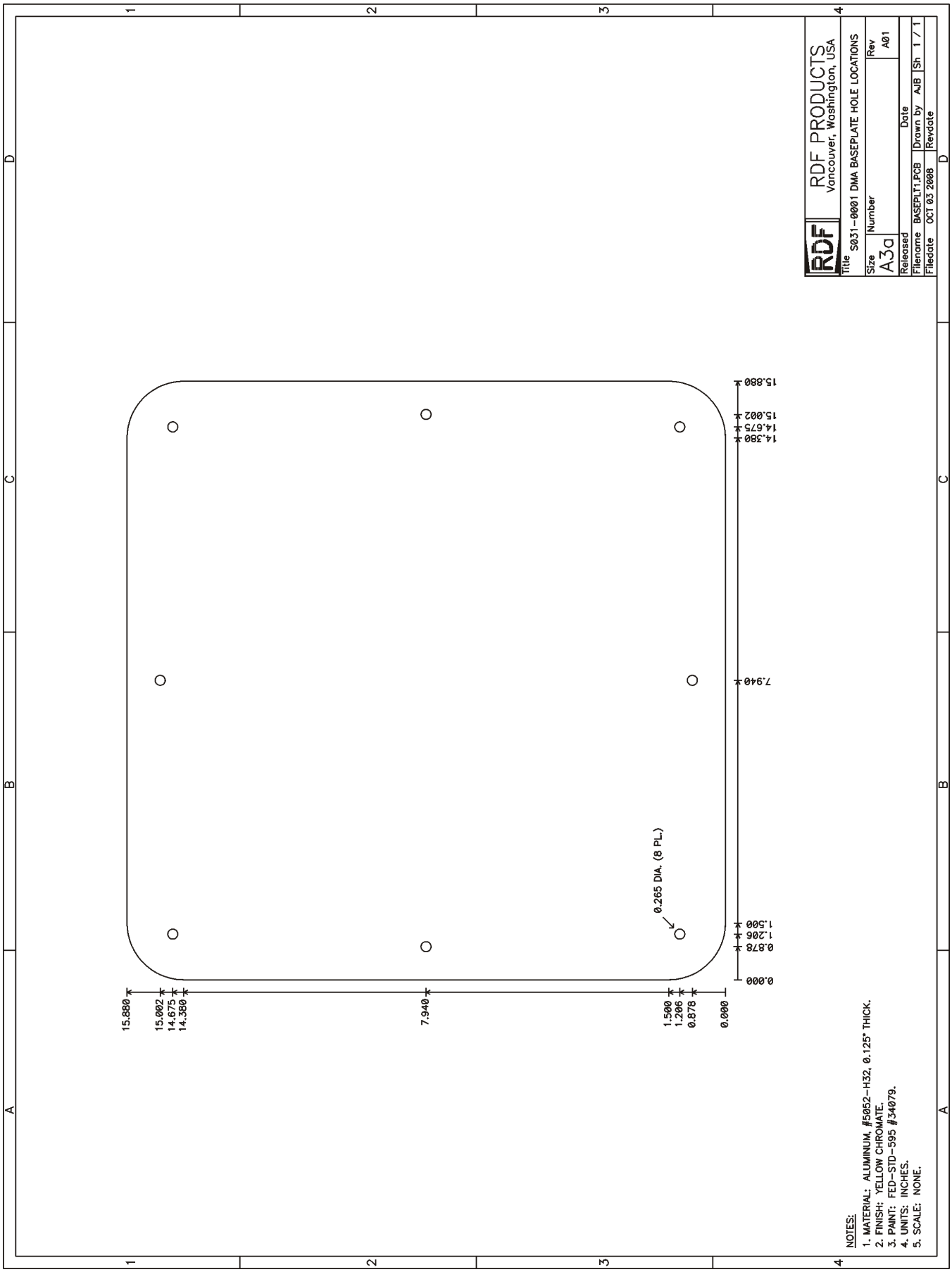

Figure 11 - Hole Location Drawing (small baseplate)

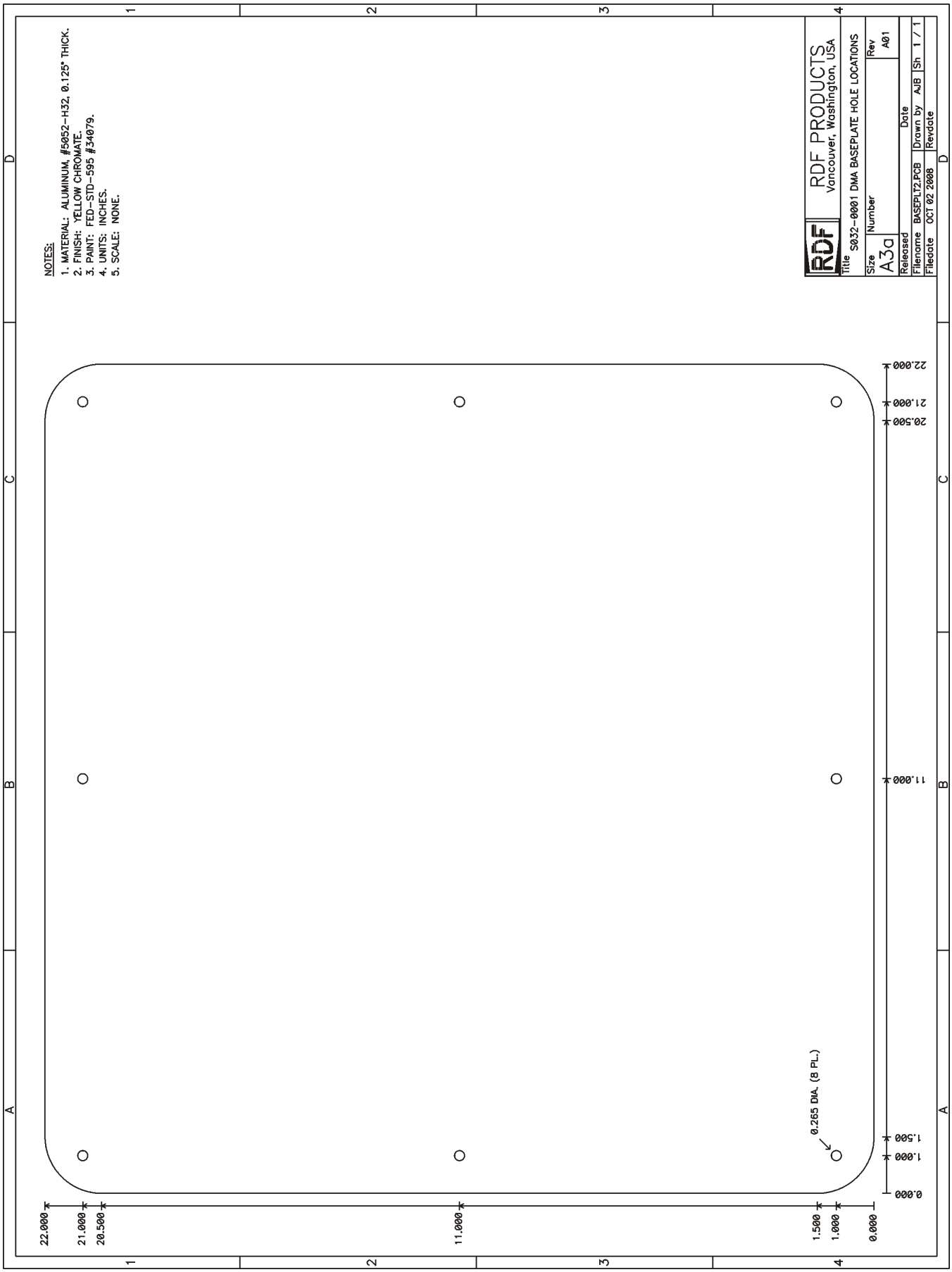

Figure 12 - Hole Location Drawing (large baseplate)