Dark Eyes 7010 Intrusion Detection Radar[1]

Operator's Manual

[1]Before operating the unit, please read this manual thoroughly, and retain it for future reference.

1 Safety Information

Follow the guidelines in this section to ensure proper operation and safe use of this equipment.

CAUTION

You are cautioned that any changes or modifications to the system not expressly described and approved in this manual could void your authority to operate this equipment.

1.1 FCC Safety Compliance Statement

The FCC, with its action in ET Docket 96-8, has adopted a safety standard for human exposure to RF electromagnetic energy emitted by FCC-certified equipment. When used with the approved and provided antennas, the Dark Eyes 7010 Intrusion Detection Radar will meet the uncontrolled environmental limits found in OET-65 and ANSI C95.1, 1991. **Proper operation of this radio device according to the instructions in this publication results in user exposure substantially below the FCC recommended limits.**

CAUTION: Antenna Installation Requirement:

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 120 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

"This is a professionally installed device with a fixed power level. Only antennas listed on the grant must be used. Shorter cable lengths or cable types with less gain must not be substituted as a replacement other than those tested and listed in the user manual."

Note:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 Subpart B of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial, industrial, or business environment. 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 this 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 for the radio or television being interfered with.
- Increase the separation between the radar equipment and the receiver being interfered with.
- Connect the radar equipment into an outlet on a circuit different from that to which the receiver is connected.

The supplied interface cables must be used with the equipment in order to comply with the limits for a Class A digital device pursuant to Subpart B of Part 15 of FCC Rules, per the Code of Federal Regulations (CFR).

Warning: This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. This symbol is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.

Warning: To prevent fire or shock hazard and damage to the radar system, do not open the unit. There are no user-serviceable parts inside. Refer servicing to qualified service personnel.

Warning: Only trained and qualified personnel should be allowed to install, replace, or service this equipment.

1.2 Safety Precautions

Warning: Do not locate the antenna near overhead power lines or other electric light or power circuits, or where it can come into contact with such circuits. When installing the antenna, take extreme care not to come into contact with such circuits, as they may cause serious injury or death.
For proper installation and grounding of the antenna, please refer to the manufacturer who will handle installation according to the national and local codes (e.g. U.S.:NFPA 70, National Electrical Code, Article 810, in Canada: Canadian Electrical Code, Section 54).
For mobile applications, the manufacturer will provide instructions for setup and grounding of the antenna according to these codes.[2]

[2] We need to determine what these codes are, and if we must ground the antenna given our hardware configuration

Each year hundreds of people are killed or injured when attempting to install an antenna. In many of these cases, the victim was aware of the danger of electrocution, but did not take adequate steps to avoid the hazard.

For your safety, and to help you achieve a successful installation, please read and follow these safety precautions. Coordinate all installation efforts with the manufacturer and the local power company. The instructions and cautionary information may save your life:

1. If you are installing an antenna for the first time, for your own safety as well as others, you are required to seek professional assistance from the manufacturer.

2. Select your installation site with safety and performance in mind. Electric power lines and phone lines can look similar. For your safety, assume that any overhead line can kill you. The manufacturer reserves the right to request adjustments to a chosen installation site based on safety and performance measures.

3. Notify the electric power service provider. Advise them of installation plans and verify that it adequately considers potential hazards. Coordinate this effort with the manufacturer of the system.

4. Plan your installation carefully and completely before you begin. Successful installation is largely a matter of coordination.

5. When installing your antenna, remember that it must be installed with the coordination and direction of the manufacturer and that the coordinated effort must follow certain guidelines:

a. Do not use a metal ladder.

b. Do not work on a wet or windy day.

c. Do dress properly—shoes with rubber soles and heels, rubber gloves, long sleeved shirt or jacket.

6. If the assembly starts to drop, get away from it and let it fall. Remember, the antenna, mast, cable, and metal guy wires are all excellent conductors of electrical current. Even the slightest touch of any of these parts to a power line will complete an electrical path through the antenna and any personnel in the vicinity.

7. If any part of the antenna system should come in contact with a power line, don't touch it or try to remove it yourself. Call your local power company. They will remove it safely.

If an accident should occur with the power lines call for qualified emergency help immediately.

1.3 Manufacturer Safety Statement

For fixed site applications, the manufacturer will set the system up, connect the radar control cables and perform necessary tests to verify operation. The user should not need to change any connections, therefore this guide is provided only to confirm that all connections are made. No changes to the connections should be made at any time by the user, at risk of damaging the system or violating FCC licensing regulations

2 Table of Contents

3 Required and Optional Components List

Object	Dimensions (L or D xWxH)	Required/Optional
Radar Enclosure (with components)	0.552m x 0.46m x 0.217m	Required
Antenna Baseplate	21.875" = 0.56m Diameter	Required
Antenna, Positioner & Mount (excluding baseplate)	12" x 14" x 16" (0.3m x 0.36m x 0.41m)	Required
Radome (PRI-120502-P)	19" Diam. X 19" H (0.48m Diam. X 0.48m H)	Required[3]
Cables:		
1 or 2 positioner control cables	6' long (1.83 m) – J3 and J6[4]	1 Req., 1 opt. req.
1 display cable (adapter)	1-2' long (0.3-0.6m) – J7	1 Required
1 USB Pigtail cable	1' long (0.3m) – J8	1 Required
1 System Power cable	6' long (1.83m) – J1	1 Required
1 LNA Power cable	4' long (1.22m) – J2 to antenna baseplate LNA box	1 Required
2 RF cables	4' long (1.22m) – J4-J13, J5-J14 (radar to ant. baseplate)	2 Required
1 RF cable	1' long (0.3m) – J12 (LNA) to antenna baseplate base	1 Required
1 or 2 Tripods (closed to smallest size) load capacity 40 lbs. (18.2 kg)	41" x 8" (1.04 x 0.20m)	Optional required[5]
Tripod (open to full size)	68" Diam. x 76" H (1.73m Diam. x 1.93m H)	Optional required
Camera Baseplate	21.875" = 0.56m Diameter	Optional required
Camera's Positioner & Mount	5" x 3" x 6.5" or 7.5" (0.12m x 0.076m x 0.165 or 0.19m)	Optional required
Camera – Color CCD, for example	Less than 2 lbs. (1 kg) in weight	Opt. recommended
12 VDC Output Power Supply	115/230 VAC, 47-63 Hz input, 5 A RMS max; 12.0 VDC Output	Optional required
Cables:		
1 Ethernet cable	Variable length (J9)	Optional required
1 BNC/TNC cable (various use)	Variable length (J10)	Optional required
3 BNC 50Ω test cables	Variable length (TP1-3)	Optional required
2 SMA RF test cables	Variable length (TP4-5)	Optional required
Gas-powered Generator: 2kW, 3.5 HP	~20" x 12" x 17", 50 lbs. ~(0.51 x 0.3 x 0.43, 110 kg)	Optional required

[3] Except under special circumstances to be determined later
[4] Connection on face of radar enclosure
[5] Optional required indicates that if the user chooses the option of purchasing a tripod with the system, that the particular item is a required accessory – alternate tripods, for example, cannot be selected from the manufacturer.

4 Hardware Setup for a Fixed Site Application

For fixed site applications, the manufacturer will set the system up, connect the radar control cables and perform necessary tests to verify operation. The user should not need to change any connections, therefore this guide is provided only to confirm that all connections are made. No changes to the connections should be made at any time by the user, at risk of damaging the system or violating FCC licensing regulations

Warning: Read the installation instructions before connecting the system to its power source.

Warning: Do not work on the system or connect or disconnect cables during periods of lightning activity.

4.1 Mounting the Radar Control Box

The radar control box must be mounted within 4 feet of the antenna mounting position,. The cable that connects the control box to the amplifier at the antenna's baseplate has been provided at that length to minimize signal loss in the system[6]. A longer cable will introduce significant losses to the system (by a factor of 4 per doubling of the cable's length in two-way losses) and this will impact system performance for detections and can potentially increase the incidence of false alarms.

The radar control box sends signals to the antenna and to the antenna positioner. All of the cables attaching the radar control box to other components must be provided by the manufacturer. The system may fail to properly operate if other cables are used and the system will not comply with FCC regulations if it is operated with cables other than those supplied with it. Similarly, if the system is powered on and certain connections have not been made, some components can be damaged. Cable connection instructions follow this section, and can be found in Section 3.4.

The radar control box should not be vulnerable to wind (and potential falls), to electrical shocks (from lightning or nearby power lines) or to submersion in water. It is weatherized for rain, but it is not waterproof if set in standing water.

The radar control box should not stand upright on its front end as cables attached will be broken. It can stand upright on its rear but this does not result in the greatest stability as it is standing on two handles without a third locus of support and stability. The box can stand on either side, or its bottom, but should not be operated while lying upside-down. It is rack-mountable.

[6] The 4 foot cable between the radar control box and the antenna's amplifier box results in the maximum allowable power output as tested for. Any shorter cable will fail to comply with the FCC's measurements of output power and will be a violation of FCC requirements and the warranty on this system. No shorter cables will be provided by the manufacturer.

Any fixed site installation requires that the supplier coordinates the installation effort and makes measurements to verify compliance with FCC regulations regarding RF (Radio Frequency) emissions. Additionally, the user must receive an operating license for each site from FCC prior to installation at that site.[7]

4.2 Mounting the Antenna

The antenna, as provided, is attached to a mounting bracket, placed on its positioner system, and mounted on its baseplate. For fixed site applications, it is strongly recommended that the customer mount the antenna's baseplate on a pole, not to exceed 6 meters in height.[8] The baseplate is designed to work with the mounting structure of the optionally supplied tripods. Any tripod or mounting structure used should be rated to support a load of 40 pounds (18.2 kg) to accommodate wind effects as well as the weights of the antenna and baseplate structure.

In mounting the antenna and its baseplate, the user should set up the mounting structure on a level surface, if possible. The antenna and baseplate should then be installed on that structure.

The user should remove the antenna's radome, if one is present, and verify that the baseplate is level (a bull's-eye level is helpful for this). It is highly recommended that the user select an initial pointing direction for the antenna based on the area that must be protected. If the user wishes for the antenna's "home" direction to be due north, for example, he should point the antenna in that direction prior to its first use.

The antenna's positioning system will automatically be in its "home" position, with the antenna pointing at (0,0) in pan and tilt angle when the system is turned off. This will allow easy set-up and quicker auto-calibration of the positioner. The system will automatically calibrate the positioner when it is turned on and will send the positioner home if it is not already there. The positioner's pointing direction can be discerned by inspection of the hardware:

Figure 1: Antenna positioner from side, rear

[7] Verify this statement with RheinTech, FCC

[8] The antenna cannot be mounted at a height greater than 6 meters according to FCC regulations. In exceptional cases that limitation may be exceeded with approval from FCC, for which the customer must apply.

The leftmost picture in the sequence in Figure 1 shows the antenna positioner from the side. The front faces of the two motors line up (as seen on the right of the photo, circled in red). From the rear, the second and fourth pictures in the sequence show the positioner off-center, to the left and right respectively. The third picture shows the positioner in its centered, "home" position, as circled in blue.

The antenna receives its signal from the amplifier mounted under the baseplate. It in turn receives its signals from the radar control box through a 4 foot cable and thus the baseplate must be mounted within 6 feet of the radar control box. If the antenna and baseplate are mounted high on a tripod, the customer must either purchase longer cables, and accept performance losses accordingly, or mount the radar control box on a sturdy surface within 4 feet of the antenna's baseplate.

The antenna is not weatherproof without its radome. If it is operated in the rain without the radome, it is likely that connections will fail and components may be damaged. A radome is also required for mounting the antenna at heights greater than 2 meters, or in environments where there will be a significant effect from wind shear. Failure to use a radome when necessary will have extreme effects on the antenna and positioner, potentially requiring factory refurbishment of the positioner. The radome must be furnished by the manufacturer as different materials can affect system performance and will not fit the system's design.

4.3 Setting up an Optional Camera

A camera can be provided as an accessory. It can be fixed in position, or it can scan the area of interest in conjunction with the radar's scan, in a variety of usage scenarios.

4.3.1 Optional Rotating Camera

Any optional rotating camera (or cameras) system provided with the radar system will use a positioner of the same model as the one on which the antenna is mounted. Likewise, a base plate and any appropriate mounting brackets will be required accessories. The camera's positioner will receive control signals from the radar control box and its Graphical User Interface[9] (GUI) via a cable which must be connected between the two, and must be provided by the manufacturer.

The camera's baseplate can be mounted on a tripod, like the antenna, or on a pole or tower, but must be safely secured and located close enough to the radar control box for the 6 foot-long control cable to reach. The camera(s) should be covered with a transparent radome if it (they) are to be weatherproof. The camera positioner, like that of the antenna, is not weatherized and can be damaged by rain or snow; the camera positioner is also vulnerable to wind shear.

The camera's video output can be relayed via standard 75 ohm video cabling to a monitor provided by the user. The baseplate for cameras is designed to handle up to two cameras simultaneously and has two BNC connections on the bottom for video signal output to a monitor or other device.

[9] See accessory list for the optional (required) positioner and cable, as well as some optional, recommended cameras.

4.3.2 Optional Independent Camera

Alternatively, the user may choose to add a camera with an independent control mechanism, in which case there are no requirements vis-à-vis integrating the camera system with the radar, except that control cables for an independent camera should not physically or mechanically interfere with the cabling of the radar and its components.

4.4 Connecting the Radar Control Cables

All cables connecting the radar control box with other system devices must be those provided by the manufacturer. Use of other cables is not permitted. The system may fail to properly operate if other cables are used and the system will not comply with FCC regulations if it is operated with cables other than those supplied with it.

Warning: Read all installation instructions carefully before connecting the system to its power source.

The very last cable that should be attached is the power cable (to **J1** on the radar control box). All other cables (required and optional) must be properly connected to the bulkhead of the radar control box prior to start-up. Failure to comply may damage the equipment.

For fixed site applications, the manufacturer will set the system up, connect the radar control cables and perform necessary tests to verify operation. The user should not need to change any connections, therefore this guide is provided only to confirm that all connections are made. No changes to the connections should be made at any time by the user, at risk of damaging the system or violating FCC licensing regulations.

4.4.1 Required Connection Steps:

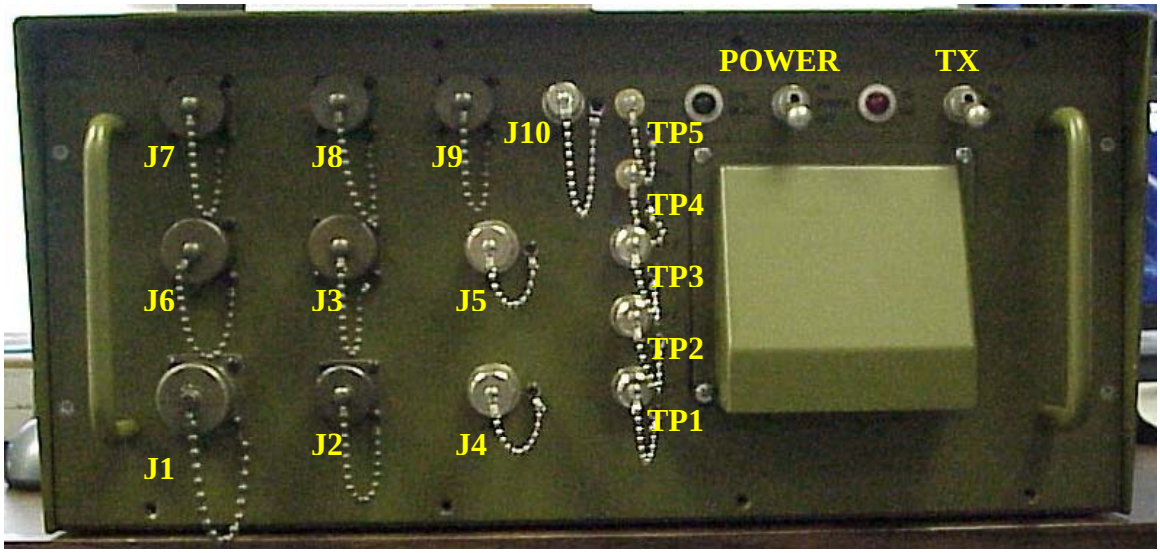

Figure 2: Radar Enclosure Faceplate with Connections Marked

1. Verify that the two switches on the front of the box, labeled "Power" and "TX" are in their "OFF" positions:

Figure 3: TX and POWER switches

2. Connect the cable for the antenna positioner to the **J3** bulkhead connector on the radar control box. Connect the other end of the cable to the bulkhead connector on the bottom of the baseplate of the antenna.
3. Connect the power cable for the amplifier box to the **J2** bulkhead connector on the radar control box. Connect the other end of the cable to the **J11** connector on the back of the amplifier box, underneath the antenna's baseplate.

4. Connect the transmit cable to the **J4** bulkhead connector on the radar control box. Connect the other end of the cable to the **J13** connector on the front of the amplifier box, underneath the antenna's baseplate.
5. Connect the receive cable to the **J5** bulkhead connector on the radar control box. Connect the other end of the cable to the **J14** connector on the front of the amplifier box, underneath the antenna's baseplate.
6. Verify that the antenna cable to the **J12** bulkhead connector on the front of the amplifier box, underneath the antenna's baseplate, is connected to the feed-through at the bottom of the baseplate. This connection should be left in place for packing and transporting the system.
7. Connect the monitor cable to the **J7** bulkhead connector on the radar control box. Connect the other end of the monitor cable to a monitor for viewing the radar's GUI.
8. Connect the USB pigtail cable to the **J8** bulkhead connector on the radar control box. Connect any USB devices to the two USB cables on this pigtail. If more than two USB devices are needed, a hub can be used. It is recommended that the keyboard and mouse used with this radar's PC be attached via USB connections as there are no PS2 ports provided.

4.4.2 Optional Connection Steps:

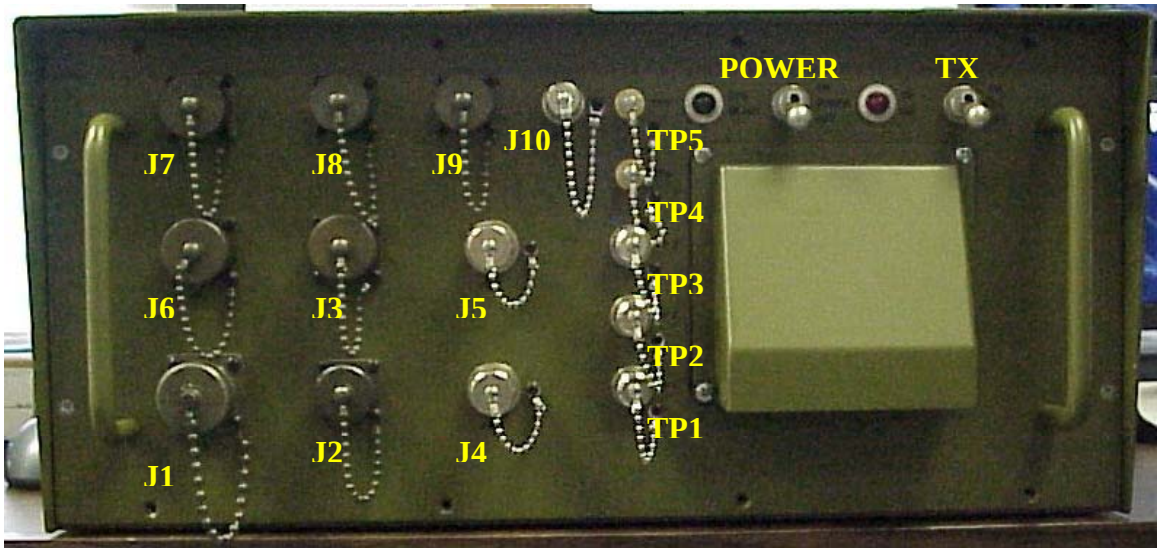

Figure 4: Radar Enclosure Faceplate with Connections Marked

1. Connect the positioner cable for the (optional, rotating) camera to the **J6** bulkhead connector on the radar control box. Connect the other end of the cable to the bulkhead connector on the bottom of the baseplate of the camera. **If an optional camera has been provided, but will not be used, the connection must still be made or the positioner's control box could be damaged when it attempts to automatically calibrate at power-up.** An "optional" camera system becomes a requirement for system operation once the system is modified to include that camera. It is only optional insofar as

the customer does not have to purchase the system originally with a camera. It is not an intermittent connection. Any damage caused by disconnecting the positioner cable is not a warrantee service item.

2. Connect the Ethernet cable to the **J9** bulkhead connector on the radar control box. Connect the other end to the chosen Ethernet device.
3. Connect the BNC/TNC cable to the **J10** bulkhead connector on the radar control box. This can be used to attach an external antenna for an approved wireless modem (inside the radar box) or with other approved devices.
4. Connect any test cables to the various test ports on the radar control box. They are labeled **TP1**, **TP2**, **TP3**, **TP4**, **TP5**:
    a. TP1: Trigger signal
    b. TP2: Q (quadrature portion of received signal)
    c. TP3: I (in-phase portion of received signal)
    d. TP4: STALO signal (STAble Local Oscillator)
    e. TP5: COHO signal (COHerent Oscillator)

4.4.3 Final Connection Step:

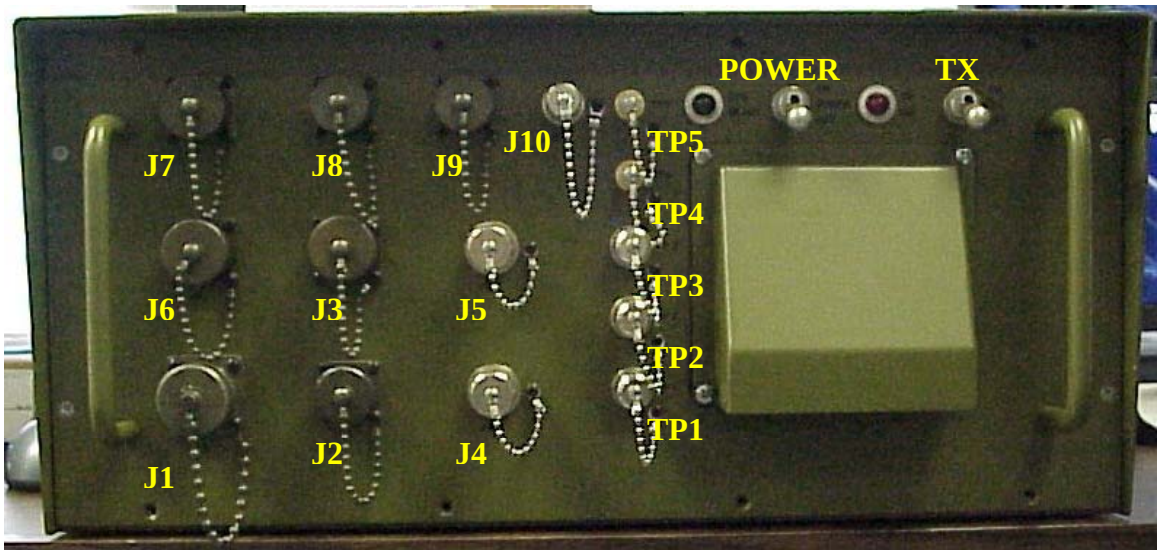

Figure 5: Radar Enclosure Faceplate with Connections Marked

1. Connect the cable for the radar's power to the **J1** bulkhead connector on the radar control box. Connect the other end of the cable to the power supply, as described in Section 4.5.

4.5 Setting up Power for the Radar

The "POWER" switch should be in its "OFF" position prior to hooking the radar control box up to a power source. The "TX" switch should also be switched to "OFF".

The radar requires 12 VDC at 20 amps. A power cable is provided with a bulkhead connector at one end and forks on the other. The forks must be connected to the appropriate terminals of a 12 V power supply.

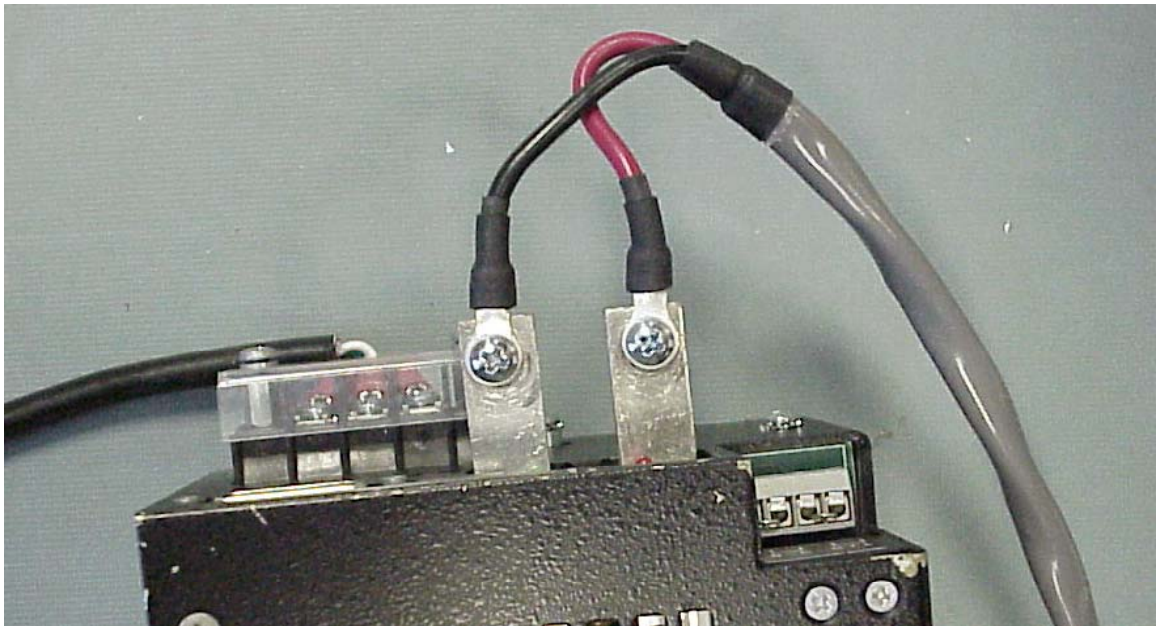

Figure 6: Example of Power Supply Hook-up

The system does not include a power supply to which those forks can be connected. Ares recommends using a DC-12VDC or AC-12VDC power supply with at least 20 Amps at its output. The power supply and connections to it must be sealed from weather effects.

4.6 Verifying System Operation on Start-up

The radar enclosure's "POWER" switch should still be in its "OFF" position; the "TX" switch should also be in its "OFF" position. The power source should now be hooked up, per instructions in Section 4.5, and all cabling should be firmly attached between the radar control box and the various other system devices prior to powering the system on.

Flip the "POWER" switch to its "ON" position by pulling outward and flipping up.[10] Upon powering the radar control box, the antenna mounting apparatus should run through a calibration sequence. Additionally, the green LED on the front of the radar control box, labeled "SYS READY," should light up. The "TX" switch should still be in its "OFF" position and the "TX ON" LED (red) should not be lit.

The monitor should show a normal PC startup sequence into a Windows® Operating System. Sections 6 and 7 detail the various operational modes for the software control of the radar.

[10] The "POWER" and "TX" switches are designed to not flip on casual bumping but instead must be pulled outward and then flipped – this is a safety feature.

5 Hardware Setup for a Mobile Site Application

Warning: Read the installation instructions before you connect the system to its power source.

Warning: Do not work on the system or connect or disconnect cables during periods of lightning activity.

5.1 Mounting the Radar Control Box

The radar control box must be mounted within 4 feet of the antenna mounting position. The cable that connects the control box to the amplifier at the antenna's baseplate has been provided at that length to minimize signal loss in the system[11]. A longer cable will introduce significant losses to the system (by a factor of 4 per doubling of the cables' length in two-way losses) and this will impact system performance for detections and can potentially increase the incidence of false alarms.

The radar control box sends signals to the antenna and to the antenna positioner. All of the cables attaching the radar control box to other components must be provided by the manufacturer. The system may fail to properly operate if other cables are used and the system will not comply with FCC regulations if it is operated with cables other than those supplied with it. Similarly, if the system is powered on and certain connections have not been made, some components can be damaged. Cable connection instructions follow this section, and can be found in Section 4.4.

The radar control box should not be vulnerable to wind (and potential falls), to electrical shocks (from lightning or nearby power lines) or to submersion in water. It is weatherized for rain, but it is not waterproof if set in standing water.

The radar control box should not stand upright on its front end as cables attached will be broken. It can stand upright on its rear but this does not result in the greatest stability as it is standing on two handles without a third locus of support and stability. The box can stand on either side, or its bottom, but should not be operated while lying upside-down. It is rack-mountable.

Additionally, the user must receive an operating license for mobile operations from FCC in conjunction with the purchase of this equipment.[12]

5.2 Mounting the Antenna

[11] The 4 foot cable between the radar control box and the antenna's amplifier box results in the maximum allowable power output as tested for. Any shorter cable will fail to comply with the FCC's measurements of output power and will be a violation of FCC requirements and the warranty on this system. No shorter cables will be provided by the manufacturer.

[12] Verify this statement with RheinTech, FCC

The antenna, as provided, is attached to a mounting bracket, placed on its positioner system, and mounted on its baseplate. For mobile site applications, it is strongly recommended that the customer mount the antenna's baseplate on a tripod[13]. The baseplate is designed to work with the mounting structure of the optionally supplied tripods. Any tripod or mounting structure used should be rated to support a load of 40 pounds (18.2 kg) to accommodate wind effects as well as the antenna's and baseplate structure's weights.

In mounting the antenna and its baseplate, the user should set up the mounting structure on a level surface, if possible. The antenna and baseplate should then be mounted on that structure (on a tripod, by sliding onto the tripod's mounting head, for example).

The user should remove the antenna's radome, if one is present, and verify that the baseplate is level (a bull's-eye level is helpful for this). It is highly recommended that the user select an initial pointing direction for the antenna based on the area that must be protected. If the user wishes for the antenna's "home" direction to be due north, for example, he should point the antenna in that direction prior to start-up.

The antenna's positioning system should always be in its "home" position, with the antenna pointing at (0,0) in pan and tilt angle when the system is turned off. This will allow easy set-up and quicker auto-calibration of the positioner. The system will automatically calibrate the positioner when it is turned on and will send the positioner home if it is not already there. The positioner's pointing direction can be discerned by inspection of the hardware:

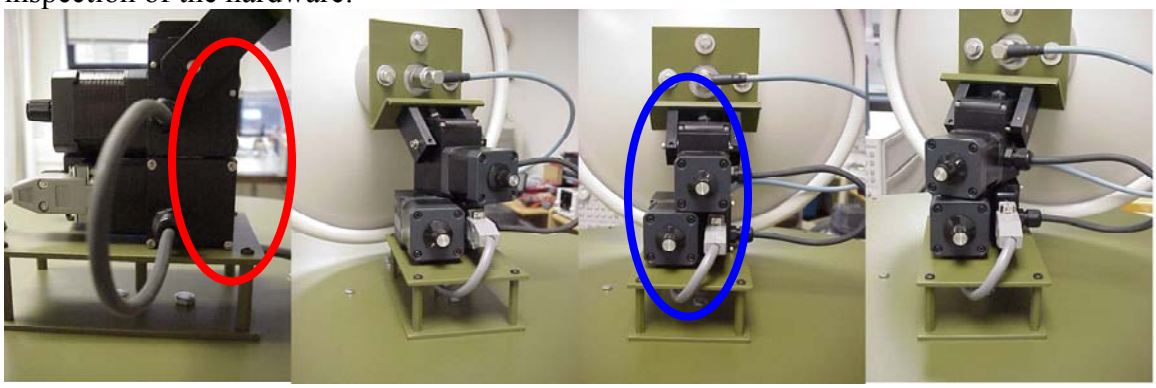

Figure 7: Antenna positioner from side, rear

The leftmost picture in the sequence in Figure 7 shows the antenna positioner from the side. The front faces of the two motors line up (as seen on the right of the photo, circled in red). From the rear, the second and fourth pictures in the sequence show the positioner off-center, to the left and right respectively. The third picture shows the positioner in its centered, "home" position, as circled in blue.

The antenna receives its signal from the amplifier mounted under the baseplate. It in turn receives its signals from the radar control box through a 4 foot cable and thus the baseplate must be mounted within 6 feet of the radar control box. If the antenna and baseplate are mounted high on a tripod, the customer must either purchase longer cables,

[13] No antenna may be mounted at heights greater than 6 meters according to FCC regulations. In exceptional cases that limitation may be exceeded with approval from FCC, for which the customer must apply.

and accept performance losses accordingly, or mount the radar control box on a sturdy surface within 4 feet of the antenna's baseplate.

The antenna is not weatherproof without a radome. If it is operated in the rain without the radome, it is likely that connections will fail and components may be damaged. A radome is also required for mounting the antenna at heights greater than 2 meters, or in environments where there will be a significant effect from wind shear. Failure to use a radome when necessary will have extreme effects on the antenna and positioner, potentially requiring factory refurbishment of the positioner. The radome must be furnished by the manufacturer as different materials can affect system performance and will not fit the system's design.

5.3 Setting up an Optional Camera

A camera can be provided as an accessory. It can be fixed in position, or it can scan the area of interest in conjunction with the radar's scan, in a variety of usage scenarios.

5.3.1 Optional Rotating Camera

Any optional rotating camera (or cameras) system provided with the radar system will use the same positioner as the one on which the antenna is mounted. Likewise, a base plate and any appropriate mounting brackets will be required accessories. The camera's positioner will receive control signals from the radar control box and its GUI[14] via a cable which must be connected between the two.

The camera's baseplate can be mounted on a tripod, like the antenna, or on a pole or tower, but must be safely secured and located close enough to the radar control box for the 6 foot-long cable to reach. The camera(s) should be covered with a transparent radome if they are to be weatherproof. The camera(s) should be covered with a transparent radome if it (they) are to be weatherproof. The camera positioner, like that of the antenna, is not weatherized and will be damaged by rain; the camera positioner is also vulnerable to wind shear.

The camera's video output can be relayed via standard 75 ohm video cabling to a monitor provided by the user. The baseplate for cameras is designed to handle up to two cameras simultaneously and has two BNC connections on the bottom for video signal output to a monitor or other device.

5.3.2 Optional Independent Camera

Alternatively, the user may choose to add a camera with an independent control mechanism, in which case there are no requirements vis-à-vis integrating the camera system with the radar, except that control cables for an independent camera should not physically or mechanically interfere with the cabling of the radar and its components.

[14] See accessory list for the optional (required) positioner and cable, as well as some optional, recommended cameras.

5.4 Connecting the Radar Control Cables

All cables connecting the radar control box with other system devices must be those provided by the manufacturer. Use of other cables is not permitted. The system may fail to properly operate if other cables are used and the system will not comply with FCC regulations if it is operated with cables other than those supplied with it.

Warning: Read all installation instructions carefully before you connect the system to its power source.

The very last cable that should be attached is the power cable (to **J1** on the radar control box). All other cables (required and optional) must be properly connected to the bulkhead of the radar control box prior to start-up. Failure to comply may damage the equipment.

5.4.1 Required Connection Steps:

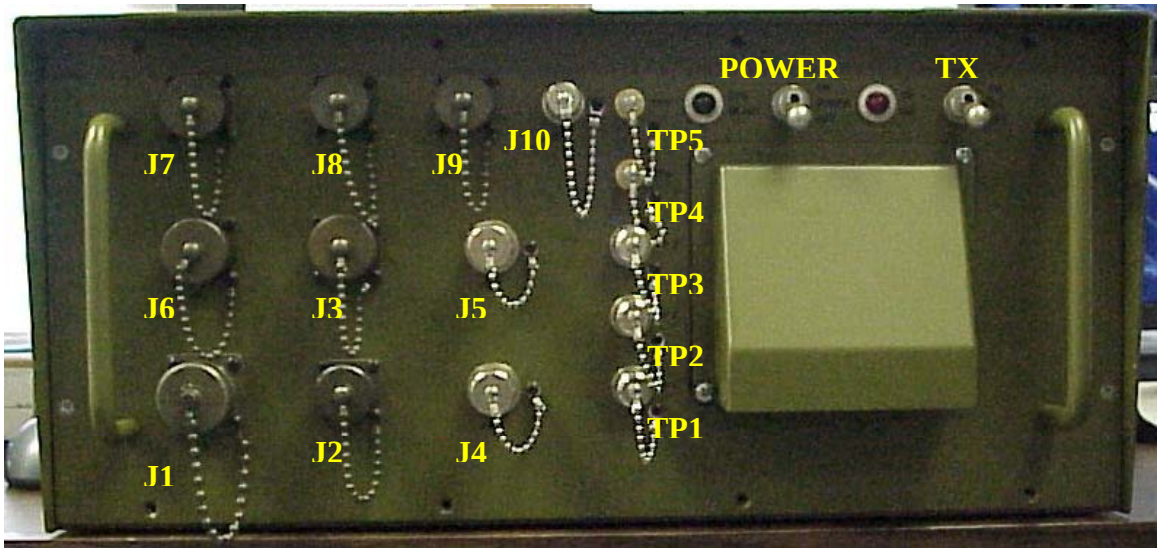

Figure 8: Radar Enclosure Faceplate with Connections Marked

1. Verify that the two switches on the front of the box, labeled “POWER” and “TX” are in their “OFF” positions:

Figure 9: TX and POWER switches

2. Connect the cable for the antenna positioner to the **J3** bulkhead connector on the radar control box. Connect the other end of the cable to the bulkhead connector on the bottom of the baseplate of the antenna.
3. Connect the power cable for the amplifier box to the **J2** bulkhead connector on the radar control box. Connect the other end of the cable to the **J11** connector on the back of the amplifier box, underneath the antenna's baseplate.
4. Connect the transmit cable to the **J4** bulkhead connector on the radar control box. Connect the other end of the cable to the **J13** connector on the front of the amplifier box, underneath the antenna's baseplate.
5. Connect the receive cable to the **J5** bulkhead connector on the radar control box. Connect the other end of the cable to the **J14** connector on the front of the amplifier box, underneath the antenna's baseplate.
6. Verify that the antenna cable to the **J12** bulkhead connector on the front of the amplifier box, underneath the antenna's baseplate, is connected to the feed-through at the bottom of the baseplate. This connection should be left in place for packing and transporting the system.
7. Connect the monitor cable to the **J7** bulkhead connector on the radar control box. Connect the other end of the monitor cable to a monitor for viewing the radar's GUI.
8. Connect the USB pigtail cable to the **J8** bulkhead connector on the radar control box. Connect any USB devices to the two USB cables on this pigtail. If more than two USB devices are needed, a hub can be used. It is recommended that the keyboard and mouse used with this radar's PC be attached via USB connections as there are no PS2 ports provided.

5.4.2 Optional Connection Steps:

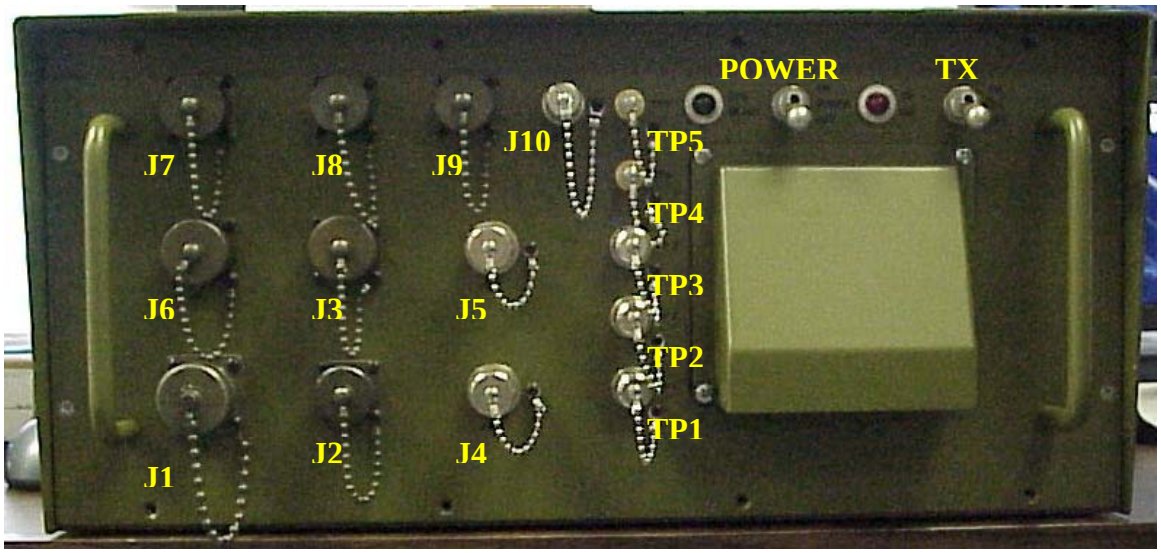

Figure 10: Radar Enclosure Faceplate with Connections Marked

1. Connect the positioner cable for the (optional, rotating) camera to the **J6** bulkhead connector on the radar control box. Connect the other end of the cable to the bulkhead connector on the bottom of the baseplate of the camera. **If an optional camera has been provided, but will not be used, the connection must still be made or the positioner's control box could be damaged when it attempts to automatically calibrate at power-up.** An "optional" camera system becomes a requirement for system operation once the system is modified to include that camera. It is only optional insofar as the customer does not have to purchase the system originally with a camera. It is not an intermittent connection. Any damage caused by disconnecting the positioner cable is not a warrantee service item.
2. Connect the Ethernet cable to the **J9** bulkhead connector on the radar control box. Connect the other end to the chosen Ethernet device.
3. Connect the BNC/TNC cable to the **J10** bulkhead connector on the radar control box. This can be used to attach an external antenna for an optional approved wireless modem (inside the radar box) or with other approved devices per options.
4. Connect any test cables to the various test ports on the radar control box. They are labeled **TP1**, **TP2**, **TP3**, **TP4**, **TP5**:
    a. TP1: Trigger signal
    b. TP2: Q (quadrature portion of received signal)
    c. TP3: I (in-phase portion of received signal)
    d. TP4: STALO signal (STAble Local Oscillator)
    e. TP5: COHO signal (COHerent Oscillator)

5.4.3 Final Connection Step:

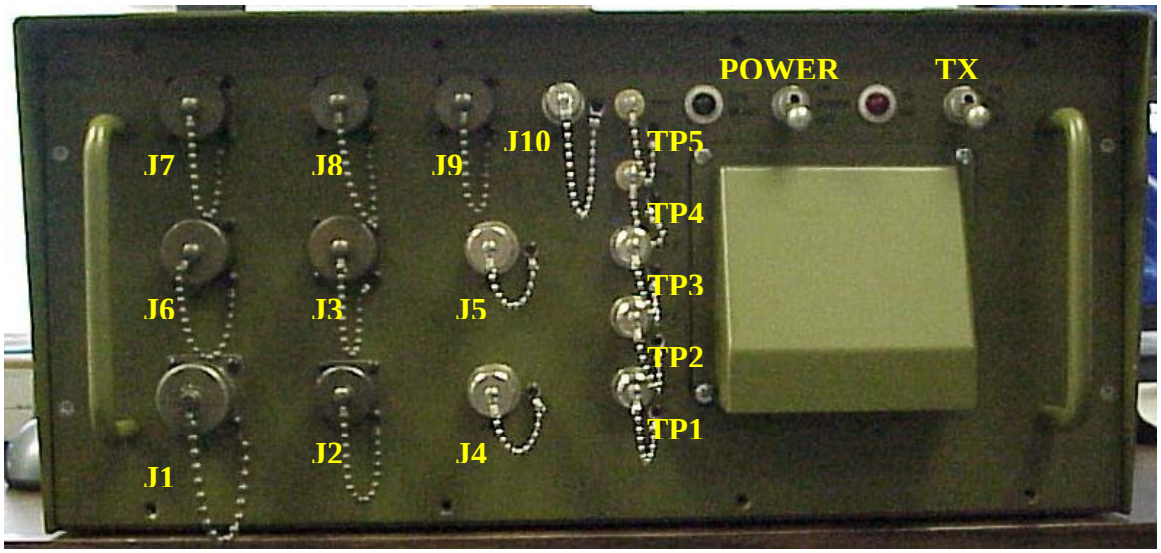

Figure 11: Radar Enclosure Faceplate with Connections Marked

1. Connect the cable for the radar's power to the **J1** bulkhead connector on the radar control box. Connect the other end of the cable to the power supply, as described in Section 4.5.

5.5 Setting up Power for the Radar

The "POWER" switch should be in its "OFF" position prior to hooking the radar control box up to a power source. The "TX" switch should also be switched to "OFF".

The radar requires 12 VDC at 20 amps. A power cable is provided with a bulkhead connector at one end and forks on the other. The forks must be connected to the appropriate terminals of a 12 V power supply.

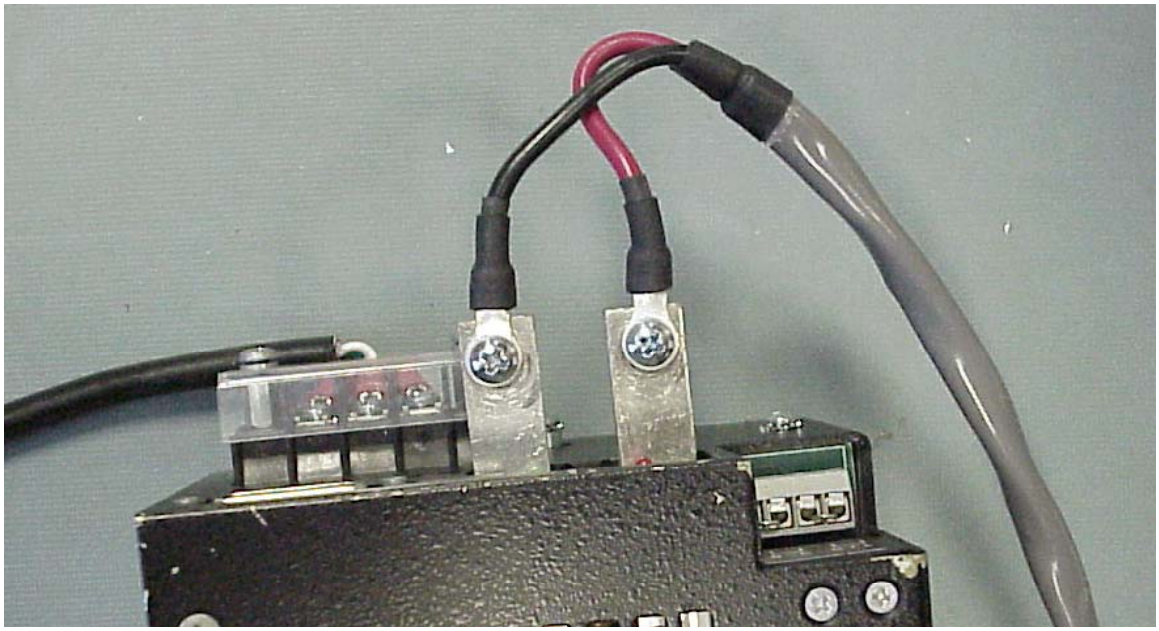

Figure 12: Example of Power Supply Hook-up

The system does not include a power supply to which those forks can be connected. Ares recommends using a DC-12VDC or AC-12VDC power supply with at least 20 Amps at its output. The power supply and connections to it must be sealed from weather effects.

5.6 Verifying System Operation on Start-up

The radar enclosure's "POWER" switch should still be in its "OFF" position; the "TX" switch should also be in its "OFF" position. The power source should now be hooked up, per instructions in Section 4.5, and all cabling should be firmly attached between the radar control box and the various other system devices prior to powering the system on.

Flip the "POWER" switch to its "ON" position by pulling outward and flipping up.[15] Upon powering the radar control box, the antenna mounting apparatus should run through a calibration sequence. Additionally, the green LED on the front of the radar control box, labeled "SYS READY," should light up. The "TX" switch should still be in its "OFF" position and the "TX ON" LED (red) should not be lit.

The monitor should show a normal PC startup sequence into a Windows® Operating System. Sections 6 and 7 detail the various operational modes for the software control of the radar.

[15] The "POWER" and "TX" switches are designed to not flip on casual bumping but instead must be pulled outward and then flipped – this is a safety feature.

6 Software Settings for Perimeter Protection

6.1 Starting the Radar Control Software

On the desktop of the Radar PC there is a program shortcut entitled "DarkEyesRadar.exe". Double-click on this icon to start the radar control software. The GUI will appear:

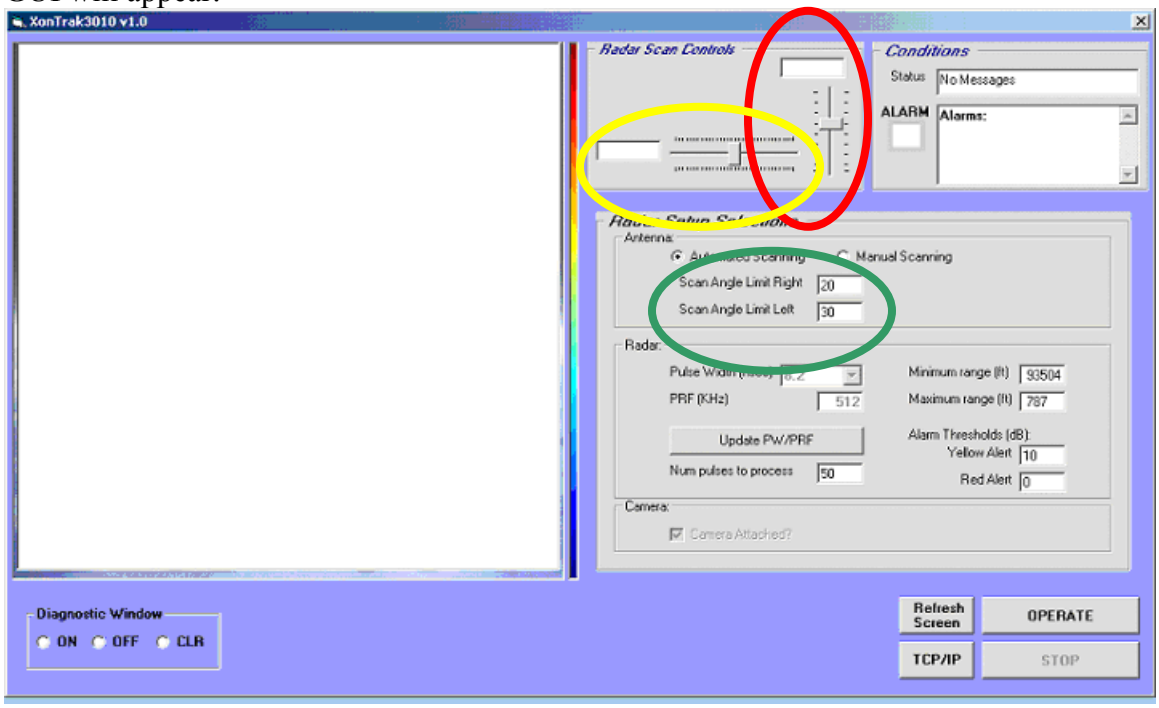

Figure 13: The Dark Eyes Radar GUI (Graphical User Interface)

6.2 Setting up the Angular Coverage Pattern

As shown in Figure 13 above, there are a limited number of controls available to the user. The user can select "Manual scanning" and control the radar's pointing direction with the "Radar Scan Controls" at the top of the GUI. Using the mouse to pull the scroll bars left and right[16] or up and down[17] will scan the antenna in those directions. The current pan (azimuthal) position and tilt (elevational) position will be indicated in degrees in the boxes to the left of, or above, the respective scroll bars.

-OR-

The user can also set up an automatic scan pattern by selecting "Automated Scanning" in the frame entitled "Radar Setup Selections." To use the automatic scan pattern, the user must set the "Scan Angle Limit Right" and "Scan Angle Limit Left" (circled in green in Figure 13) to be positive-valued integers (for example, 45 and 155). These values are degrees from the "home" direction to the right and left respectively. Using 45 and 155 as in the example will result in a scan of 190 degrees, starting 45 degrees from the right of home and moving to 155 degrees to the left of home and then returning.

[16] Circled in yellow in Figure 13
[17] Circled in red in Figure 13

6.3 Setting up the Range Coverage

The user can set the "Minimum range" and "Maximum range"[18], in feet, for the desired detection coverage in range. These values will set the inside and outside ranges that will be used to determine detections that are reported in the "Diagnostic Window" frame which appears in Figure 14 as a large white box on the GUI.

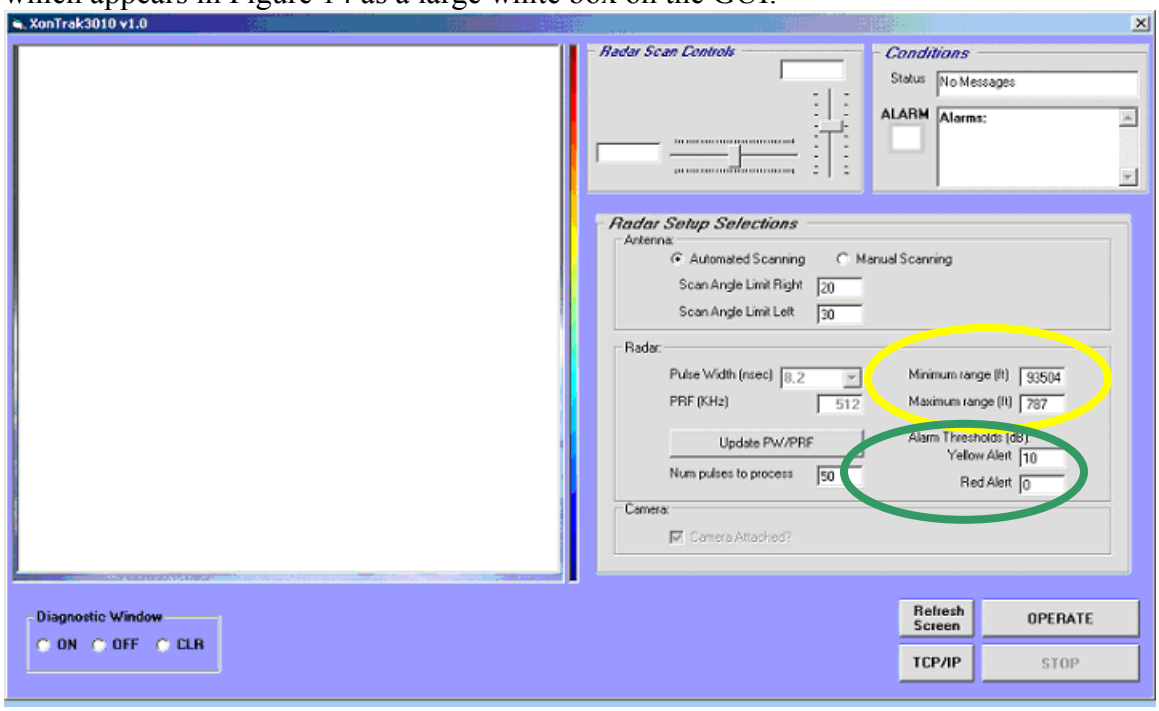

Figure 14: The Dark Eyes 7010 GUI (Graphical User Interface)

6.4 System Settings for Detections

As shown in Figure 14, the user can change the "Alarm Thresholds"[19] for "Yellow Alert" and "Red Alert". These levels should be set in order to maximize alarms on real targets (displayed in the "Alarms" text box above the "Radar Setup Selections" frame) while minimizing alarms on false targets. The value set for "Yellow Alert" should typically be 5 or 10 (dB) less than the value shown for "Red Alert".

Additional settings for the radar, shown in the "Radar Setup Selections" frame include "Pulse Width", "PRF" and "Num pulses to process". The first two settings are relevant to the RF (Radio Frequency) signal generated by the radar. (And for the user, those are the only settings that affect that signal.)

The pulse width is an indicator of range resolution and total range. A smaller pulse width will resolve between two targets that are closer together. A longer pulse width will

[18] Circled in yellow in Figure 14
[19] Circled in green in Figure 14

resolve on targets that are somewhat farther apart. A longer pulse width is necessary to obtain detections on targets at longer distances, so there is a tradeoff between resolving between multiple targets in distance, and detecting targets at greater ranges.

The "PRF" or Pulse Repetition Frequency, determines how many times to send pulses, within a one second interval. A higher PRF will help to detect a faster moving target. A PRF of 8.2 kHz (8.2 entered into the "PRF" textbox) is generally considered an acceptable PRF for human and ground-based vehicular traffic detections. It is not recommended that the number be increased or decreased from 8.2 kHz, except in the case of a highly knowledgeable user of radar systems.[20]

The number of pulses to process determines how many pulses to sum coherently for each processing interval. This allows the user to increase or decrease the number of pulses, which increases or decreases the signal levels returned by any target. It is recommended that the user continue to use 512 pulses to start with, and change the value only as needed to obtain the desired detection performance (for more on this topic, see Section 6.6).

[20] A smaller PRF will affect the speeds resolved for targets, and if the PRF is reduced low enough, a vehicle may appear to travel the same speed as a human target, due to aliasing beyond the Nyquist frequency for the Doppler velocity of the target. (This is technical terminology that may be beyond the scope and understanding of the typical user.)

6.5 Starting the Radar Scan

After the appropriate selections have been made in the "Radar Setup Selections" frame of the GUI, select an operating mode – "Automated Scanning" or "Manual Scanning". Manual scanning controls are provided primarily for testing the system on known targets in order to set thresholds and determine detection performance, or for a quick, user-controlled re-scan of an area. Automated scanning is the primary mode of operation.

Hit "Operate" and the radar will begin an automated scan, if that is selected. Otherwise, in "Manual Scanning" mode, the manual scan controls in the "Radar Scan Controls" frame will be activated and the user can drag the slider with the mouse to pan (the horizontal slider bar) or tilt (the vertical slider bar) with the radar.

The camera will not scan along with the radar. It will scan to the location of the first alarm (detection) and remain pointed there until a subsequent alarm occurs.

In the "Conditions" frame, there is a "Status" text box that will alert the user to any anomalous event in the radar's performance. In the "Alarms" textbox, the radar will report the time of any alarms. There is also a small box (circled in red in Figure 15) that will show the type of alarm, should a return's magnitude surpass a threshold. This box will light up yellow for a yellow alert of red for a red alert. Additionally, the alarm data will appear in the Diagnostic Window at the left of the GUI as seen in Figure 15 (circled in yellow). Alarms (detections) will appear in the diagnostic window with the following information listed (showing example values for angles and range):

"Alarm

Azimuth: 44.99 Range: 18 (in meters)

Longitude: 77.996 Latitude: 38.650"

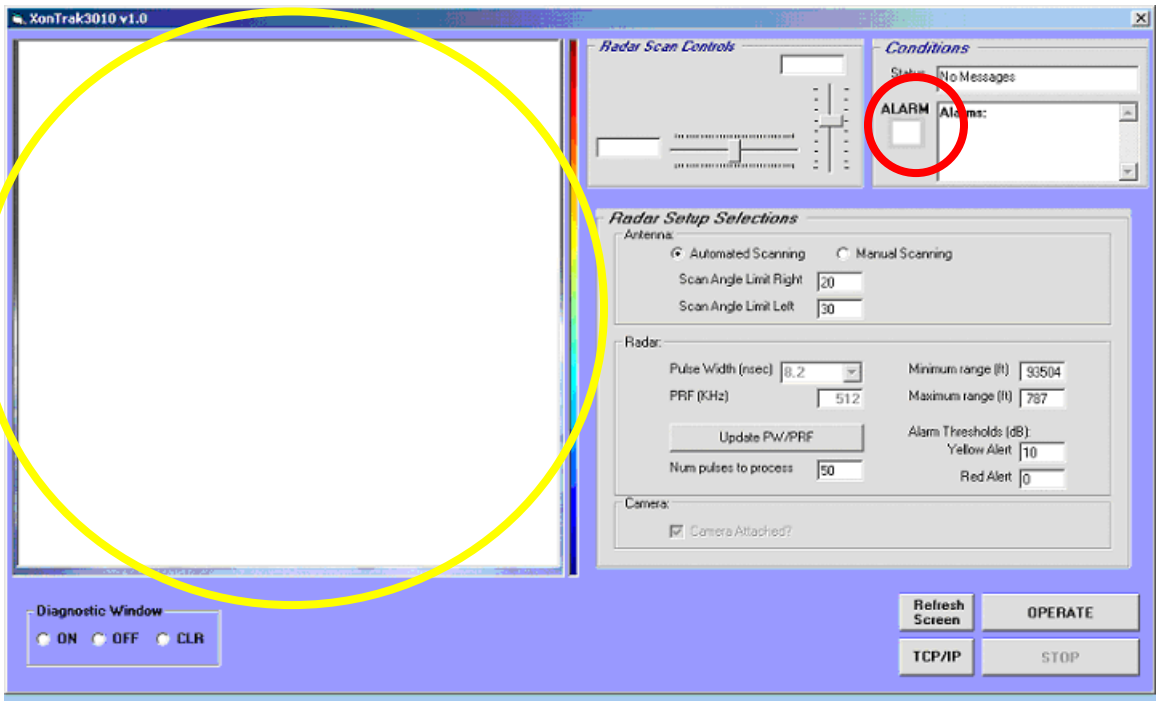

Figure 15: The Dark Eyes 7010 GUI (Graphical User Interface)

6.6 Performance Enhancement Techniques

If no detections are occurring, and a known target is moving in the radar's field of view, the user may reduce the threshold values for "Yellow Alert" or "Red Alert". Alternatively, the user can increase the number of pulses to process – this may raise the target's returns above the threshold and produce a detection. A combination of the two approaches can be used in an extreme situation, but this is more likely to result in false alarms, and the user should proceed with caution, testing under known conditions with known targets in the environment prior to relying on the settings for reliable detections.

7 Other Operational Modes (for Software)

These other operational modes are not currently available to the user. Functionality for these operating modes is being developed, or is developed but not accessible to the user at this time. These modes will not affect in any way the RF (Radio Frequency) capabilities of the radar, but will leave as-is, or limit the user's access more than is currently allowed by the GUI.

7.1 Data Collection Mode (for non-Real-Time Analysis)

(Not available at this time)

7.2 Testing Modes

(Not available at this time)

7.3 Plan Position Indicator (PPI)

This is a bird's eye view of a site to be protected, with a map underlay. It will show detections geographically situated with respect to the radar.
(Not available at this time)

8 System Shut-Down

8.1 Shutting down the Radar Control Software

Hit the “STOP” button on the GUI. The radar’s antenna positioner should begin to return the antenna to its home position. Hit the standard window “Close” button in the GUI window:

Figure 16: Windows® "Close" button

The positioner will continue to move until it reaches home even as the software is shutting down.

8.2 Shutting down the Radar Hardware

As the radar control software shuts down, the user should turn off the transmitter in the radar enclosure by flipping the “TX” switch on the front of the radar to its “OFF” position (pull the switch out, then flip the switch downward):

Figure 17: TX and POWER switches

Once the radar control software has completely shut down, and the antenna has returned to its home position, the radar PC may be shut down. Using the mouse or pointing device, click on the Windows® “Start” button. Click on “Shut Down”. The following window will appear with a pull-down menu:

Figure 18: Windows® Shut Down Sequence

Choose "Shut down" and wait for the computer to complete its shut down sequence. Once the monitor shows a blank screen or other message that there is no input signal, the radar PC is off. Turn the Radar's POWER switch off.

Unhook the power cable from the **J1** connection. The radar is now completely shut down and disconnected from power. This should be done at any time that the radar is not operational, for storage purposes, or for shipping.

9 Storage and Transportation of System

9.1 Storing and Shipping the Hardware Components

The hardware must be stored in a dry location, at temperatures between 40°F and 80°F. It is preferable for the hardware to be stored in padded hard-case containers which are also appropriate for shipping. Shipping cases are not provided with the system.

9.2 Overseas Transportation

The U.S. Government restricts the transportation of certain types of equipment overseas. In order to use this radar in any country other than the United States, an export license must be obtained from the U.S. Government.

10 Tune Up Procedure

There is no tune up procedure for the 7010. Transmit frequencies are generated by fixed quartz oscillators. If the transmit carrier frequency drifts from its original value, the Dark Eyes Radar will cease to operate correctly, because the transmit signal will fall outside the limits of the frequency band of filters within the RF system. The Dark Eyes Radar must then be returned to the Ares Corporation for repair.

Appendix A: RF Exposure Compliance

FCC Rules and Regulations Part 1.1307, 1.1310, 2.1091, 2.1093:

Using FCC 1.1310 Table 1B as guidance, the maximum permissible RF exposure is 1 mW/cm^2 for an uncontrolled environment and 5 mW/cm^2 for a controlled environment for the frequencies used in this device (8,750 to 10,038 MHz). The worst case power at the center frequency of the band of operation is used for the calculation below.

Environment: Occupational/Controlled Exposure
Device category: Mobile per Part 2.1091
Modulation Type/Mode: Pulsed
Antenna Type(s):

Antenna	Type	Gain(dBi)	Numeric Gain
9.1 to 9.5 GHz Mini Splashplate	14" reflector	27.9	617

The actual power density for the EUT calculated as shown below, using the manufacturer's peak rated power:

$$S = (P \times G)/(4 \times \Pi \times d^2)$$

Where:
S = power density
P = transmitter conducted power in (W)
G = antenna numeric gain
D = distance to radiation center (m)

Frequency (MHz)	Antenna Gain (dBi)	Peak Conducted Power (mW)	Separation Distance (cm)	Power Density (mW/cm^2)
9,394	27.9	1,000	100	1
9,394	27.9	1,000	222	5

Conclusion:

For uncontrolled environments, the device must use a 222 cm separation distance to comply with the MPE requirements of 1 mW/cm^2 exposure to the end user.

For controlled environments, the device must use a 100cm separation distance to comply with the MPE requirements of 5 mW/cm^2 exposure to the end user. The manufacturer has selected a more conservative safe distance of 120 cm.

Notice:

Radiation Exposure Statement

For controlled environments, the required separation distance for this equipment is 120 cm. All users that meet the definition of occupational users must be kept 120 cm away from the antenna.

For uncontrolled environments, the required separation distance for this equipment is 222 cm. All users must be kept 222 cm away from the antenna.