

EASi 4.5 Meter Antenna Installation Kit

1 Introduction

This document describes an installation kit that is used in conjunction with the RC2K90INT-2E interface box which allows an RC2000 antenna controller to operate an EASi 4.5m meter antenna. Efficient Antenna Systems inc. (EASi) may be contacted at WWW.EASiSat.COM. The EASi antenna uses 1 ½ HP 90 VDC motors, so the larger version of the interface box is used. The heater option is normally included in this version. The following issues are addressed in this paper:

- The AC power requirements of the interface box.
- Recommended types of cable that may be used to connect the RC2000 antenna controller to the interface box.
- A controller - interface box - antenna wiring diagram.
- RC2000EASi software configuration parameters.
- A conduit/wiring schedule.
- A Bill of Materials.

2 AC Power

The interface box is housed in a NEMA 4 weatherproof enclosure. In the Standard configuration, 120 Volt AC power must be provided at the antenna pad. All ungrounded AC line supply conductors must be fused or protected with circuit breakers, do not fuse neutral or grounded conductors. A 25 or 30 amp circuit breaker is sufficient. In addition, an AC emergency disconnect conforming to the NEC (National Electric Code) and other applicable electrical codes must be provided at the antenna and be readily accessible to personnel in the vicinity of the antenna.

The AC line input of the interface box will be pre-wired with 10 feet of 12/3 cable. The interface box has a straight 1/2" conduit fitting appropriate for flexible steel reinforced liquid tight conduit of which 8 feet is supplied. The user should make provisions to accept this type of conduit on the electrical box which houses the emergency disconnect. Alternatively, the user can replace the liquid tight conduit fitting with a different type of conduit fitting. The interface box is punched with a 7/8" diameter hole for the liquid tight conduit fitting.

3 Antenna Controller to Interface Box Interconnect Cable

The user must supply the cable to connect the RC2000 to the interface box. On the interface box there is a CN-GY-RB-3704 RACO 1 inch cable compression fitting reserved for mechanically connecting the interconnect cable to the interface box. The conduit fitting has a 0.85" to 1.00" diameter opening which the interconnect cable must pass through to enter the interface. Make sure that the interconnect cable(s) selected will fit through the opening. Alternatively, the user can replace the liquid tight cable fitting with a different type of conduit fitting. The interface box is punched with a 1.37" diameter hole for the cable fitting. This hole is appropriate for 1 inch conduit.

The cable must have 2 pairs of 20 AWG (or heavier) conductors to carry the motor control signals (forward - stop - reverse). Shielded conductors are not necessary for these signals but if shielded conductors are available the shield can be used. For shielded motor control conductors, follow the rules given below for the shielded sensor cables. In addition to the motor control signals a pair of individually shielded triples with drain wires are necessary for the sensor connections.

Please note the following concerning the interconnect cable and sensor connections ...

- Always use shielded cables for the sensors.
- The shield drain wire should only be connected at the RC2000.
- If the cable is spliced, be sure to splice the drain wire.
- Don't allow the shield or drain wire to come in contact with ground anywhere. If the cable insulation is cut at a splice put a piece of heat shrink over the frayed shield to keep it from coming in contact with ground.
- When splicing the sensor cables please refer to figure 7 in the RC2K90INT manual.

Belden 1083A cable has been successfully used to interconnect the RC2000 to the RC2K90INT-1 interface box. This cable consists of 4 individually shielded triples (or triads). The conductor size is 20 AWG and the shields are equipped with a drain wire. A similar product is available from Olympic Wire and Cable Corp. (part number 9883).

It also possible to use a pair of satellite TVRO 'actuator cables' to connect the RC2000 to the interface box. Actuator cable typically consists of a pair 16 AWG unshielded conductors and a shielded 22 AWG triple with drain wire. This cable is inexpensive and is available from Research Concepts, Inc. and EASi.

The RC2000 to interface box interconnect cable carries DC voltages of 40 volts or less. In the US a direct burial type cable may be used.

4 Making the Connections

The installation kit includes steel reinforced liquid tight flexible conduit and cabling for connection of the interface box to the antenna motors, sensors, limit switches and AC power. There are five straight conduit fittings, one cable-compression fitting, and two multi-cable clamp fittings on the bottom of the interface box. From the left, these fittings are used for: AC power, the RC2000 interconnect cable, the elevation motor conduit run, the azimuth motor conduit run, the azimuth sensor conduit run, and the elevation sensor conduit run.

There are six conduit runs that are used to connect the interface box to the antenna. The following table describes the conduit fitting types, conduit lengths, and cable types and lengths

| Description of Conduit Run | Conduit Run Starting Point and Conduit Fitting Type | Conduit Length and Type | Cable Type/Length | Conduit Run Termination Point and Fitting Type |
|----------------------------|---|-----------------------------|--|--|
| Azimuth Motor | Interface Box, CN-GY-4Q50 Straight Fitting | CDT-M-0_5 LQT 276 Inches | CBL-3_16-SJOW 300 Inches | Azimuth Motor, CN-GY-4Q50 Straight Fitting |
| Elevation Motor | Interface Box, CN-GY-4Q50 Straight Fitting | CDT-M-0_5 LQT 276 Inches | CBL-3_16-SJOW 300 Inches | Azimuth Motor, CN-GY-4Q950 90 Degree Fitting |
| Azimuth Sensor | Interface Box, CN-GY-4Q50 Straight Fitting | CDT-M-0_5 LQT 276 Inches | CBL-2_18-SJO 300 Inches, CBL-3_20-SHLD 300 Inches | Azimuth Sensor, CN-GY-4Q950 90 Degree Fitting |
| Azimuth Limit | Azimuth Sensor, | CDT-P-0_5 LQT | The Continuation of CBL-2_18-SJO | Azimuth LimitSW, CN-GY-4Q950 |

| | | | | |
|------------------------|---|-----------------------------|---|--|
| Switch | 90 Degree Fitting | 24 Inches | Described in the Previous Entry. | Straight Fitting. Note: A 1/2" to 3/4" Conduit Bushing is Required at the Limit Switch |
| Elevation Sensor | Interface Box, CN-GY-4Q50 Straight Fitting | CDT-M-0_5 LQT 276 Inches | CBL-2_18-SJO 300 Inches, CBL-3_20-SHLD 300 Inches | Azimuth Sensor, CN-GY-4Q950 90 Degree Fitting |
| Elevation Limit Switch | Elevation Sensor, Straight Fitting | CDT-P-0_5 LQT 24 Inches | The Continuation of CBL-2_18-SJO Described in the Previous Entry. | Azimuth LimitSW, CN-GY-4Q950 Straight Fitting. Note: A 1/2" to 3/4" Conduit Bushing is Required at the Limit Switch |

The antenna will be shipped with five flexible conduit runs (with wire pulled through the conduit) to the AC Disconnect, elevation motor, elevation sensor, azimuth sensor, and azimuth motor attached to the interface box. The installer will have to attach these conduit runs to the elevation motor, elevation sensor, azimuth sensor, and azimuth motor. The two other conduit runs (elevation sensor to elevation limit switch conduit run and the azimuth sensor to the azimuth limit switch conduit run) will be included with the interface box but not attached to anything - the installer will have to place these. The Teflon tape included with the installation kit can be used on any conduit fitting which cannot accept a sealing gasket or O ring (such as the 1/2" to 3/4" bushing used on the limit switches).

Once the conduit has been attached the wiring connections can be made.

The installer must make the following connections (please refer to figures E1 and E2).

7. The RC2000 to Interface Box Interconnect cable must be installed. Make the connections at the RC2000. Refer to Chapter 3 in the RC2000 manual for more information on the connection at the RC2000.
8. The motor control signals on the RC2000 to Interface Box interconnect cable must be attached to the AZ1_CTL, AZ2_CTL, EL1_CTL, and EL2_CTL terminals on the circuit board in the interface box.
9. The sensor cables in the RC2000 to Interface Box interconnect cable will have to be spliced to the CBL-3_20-SHLD in the interface box. Please reread section 3 of this manual and refer to figure 7 in the RC2K90INT-1 interface box manual before making the splice. Use the appropriate terminal block points to make the splice. Proper connection of the sensors is critical to the operation of the antenna controller.
10. Connect the sensor cables to the sensors (refer to figure E1). At the sensors, cut off the drain wire and place a piece of heat shrink tubing over the sensor cable where the insulation is cut so that the shield does not come in contact with the sensor housing. Use the 3M Scotchlok connectors to make the connections.
11. At the azimuth and elevation motor terminal boxes, connect the 16/3 cables to the motor lead wires (refer to figure E1). Use the butt type crimp connectors to make the connections. The motor input leads are labeled A1 and A2. The green wire is the motor ground wire.
12. At the azimuth and elevation limit switches connect the 18/2 cables to the limit switches (refer to figure E2). The diodes and the jumper should be installed. Use the spaded terminals for these connections.

Figure E1

Figure E2

When all this has been completed connect the interface box to AC power. Please refer to section 2 for information concerning the AC hookup.

5.0 RC2000 Software Configuration

The RC2000 stores certain parameters and configuration data in non-volatile memory. These parameters are viewed and modified via the controller's CONFIG mode and are referred to as CONFIG mode items. Some CONFIG mode items contain information which optimize the controller's auto move algorithms to the electromechanical drive system employed by the antenna. Other CONFIG mode items signal the controller as to what type of equipment the RC2000 is interfaced with. The values assigned to the following CONFIG mode items are appropriate for the EASi 4.5 meter. For more information on the purpose of these CONFIG mode items please consult the RC2000 antenna controller manual.

| CONFIG Mode Item | Required Value for Operation with the EASi 4.5 m antenna | Comments |
|----------------------------|--|---|
| AutoPol Enable | 0 - DISABLE | AutoPol disabled. |
| Simultaneous Az/EI Enable | 1 - ENABLE | The RC2K90INT-2E supports simultaneous azimuth and elevation movement. |
| Azim Slow Speed | 254 | A slow speed value of 254 disables the RC2000's pulse width modulation based slow speed system. Failure to properly configure this CONFIG mode item can result in damage to the interface box. |
| Elev Slow Speed | 254 | A slow speed value of 254 disables the RC2000's pulse width modulation based slow speed system. Failure to properly configure this CONFIG mode item can result in damage to the interface box. |
| Rotating Feed Present | 1 - YES | When this CONFIG mode item is set to one, the controller assumes that a 3 wire servo type polarization control device is not present and the former polarotor output become the FAST/SLOW speed control. The RC2K90INT-2E system assumes the use of a 24VDC-type rotating feed with potentiometer position feedback. The RC2000 must have the RC2KPOL option installed. |
| Az/EI Drive Options Enable | 1 - ENABLE | When this CONFIG mode item is enabled the user has access to the Az/EI Fast Slow Threshold, 'Auto Retry Attempts, 'Fast and Slow Deadband, Azim and Elev Coast Thresholds, and Azim and Elev Max Position Error CONFIG Mode items. |
| Az/EI Auto Retry Attempts | X | The controller will make this number of attempts to get within 'Max Position Error counts of a target position. |
| Az/EI Fast Deadband | X milliseconds | The controller will allow this number of milli-Seconds for the antenna to coast to a stop. If RUNAWAY errors occur the value of this parameter can be set to this number plus 1 to disable the accumulation of counts when the antenna is not commanded to move or is not coasting to a stop. This will |

| | | |
|---|---------------------|---|
| | | disable the RUNAWAY error. |
| Az/El Slow Deadband | X milliseconds | The controller will allow this number of milli-Seconds for the antenna to coast to a stop. For Inclined-orbit tracking operations, the last two digits (nnMM) tell the controller to not schedule a pickup when Step Tracking within MM0 seconds of a time corresponding to a Program Track table entry. This prevents 'holes' from occurring in the program track table. See the troubleshooting section of the RC2000 manual for more information. |
| Azim Coast Threshold and Elev Coast Threshold | X position counts | When moving towards a target position in either azimuth or elevation, the controller will turn off the motors when the position reaches a point this number of counts away from the target position. The idea is that the antenna will coast into position. |
| Azim Max Position Error and Elev Max Position Error | X position counts | This parameter is used when the controller is attempting to automatically move the antenna in azimuth or elevation to a target position. If (after a move) the resting position of the antenna is greater than 8 counts from the target position the controller will initiate another auto move to attempt to hit the target position if the number of retry attempts initiated so far is not greater than that specified by the Az/El Auto Move Retry Attempts CONFIG mode item. |
| Antenna Size | 450 cm | Appropriate for RC2000C only |
| Azim Constant | X counts per radian | This is the approximate number of position counts per radian of antenna azimuth movement. |
| Elev Constant | X counts per radian | This is the approximate number of position counts per radian of antenna elevation movement. |
| Max Track Error | X tenths of a dB | Appropriate for RC2000C only |
| Search Enable | 1-ENABLE | Appropriate for RC2000C only. For transmit applications the search feature should be disabled. Please see the description of TRACK mode in the RC2000 manual for more information. |

6 Bill Of Materials

| Quan | Model/Description | Manufacturer | Comments (Ref Designators) |
|------|------------------------|----------------------|--|
| 50' | LA11-50 | Electri-Flex | 1/2" Liquid Tight Steel Core Flexible Conduit |
| 8 | GY-4Q-50 | Oz/Gedney | 1/2" Straight Conduit Connector |
| 5 | GY-4Q-950 | Oz/Gedney | 1/2" 90 Degree Conduit Connector |
| 1 | GY-4Q-450 | Oz/Gedney | 1/2" 45 Degree Conduit Connector |
| 2 | KKR-21 | Killark | 3/4" to 1/2" Conduit Bushing |
| 1 | | | 1/2" Teflon Tape (for conduit fittings) |
| 24' | 8772 cable | Belden | 3 conductor shielded cable with drain 20 AWG |
| 25' | 01306 | Carol | 16/3 Motor Connect Cable |
| 32' | 13002 | Carol | 18/2 Limit Switch Connect Cable |
| 6 | Butt Connector | | Crimp Type, Insulated, 16-14 AWG for Motor Connections |
| 16 | Spade Terminal | | Crimp Type, Insulated, 22-16 AWG for Limit Switch Connections |
| 14 | UR Connector | 3M | Red Scotchlok with dielectric grease |
| 16" | FIT-221-3/64 | Alpha | 3/64" heat shrink - Covers Drain Wire at Sensor Cable Splice |
| 8" | FIT-221-1/4 | Alpha | 1/4" heat shrink - Covers the Break in the Insulation at the Sensor Cable (Belden 8772) Splice |
| 6" | FIT-221-3/8 | Alpha | 3/8" heat shrink - Covers the Break in the Insulation at the Sensor Cable (user supplied) Splice |
| 8 | 4" cable tie | | Tie for Sensor Cable Splice |
| 10 | 6" cable tie | | Tie for General Use Inside Interface Box |
| 10 | 8" cable tie | | Tie Used to Join Azim/Elev Motor and Sensor/Limit Conduits (Weather Proof and Ultraviolet Resistant) |
| 12 | 9772 | Dell City Wire Co. | Adhesive Cable Tie Point |
| 2 | GI752 | General Instrument | High Current Steering Diode for Limit Switches |
| 2 | 2 1/2" Jumpers, 16 AWG | | For Use in Limit Switches |
| 1 | Tube of RTV Sealer | | Used for Misc. Sealing |
| 4 | 314 025 | Littlefuse | 25 Amp Ceramic AC Line and Motor Fuse for KBPB [1] |
| 1 | 9850 | KB Electronics, Inc. | 0.006 ohm Plug-In Horsepower Resistor for KBPB-125 Motor Drive Module. This appropriate for use with 1 1/2 HP 1750 RPM 90 volt DC motors used. |

Note:

1. These fuses are equivalent the Buss type ABC (normal blow, ceramic).

7 Installation Checklist

Before the installation, the following items should be addressed....

4. Fused AC power with a local disconnect must be present at the antenna pad. The installation should conform to the NEC (National Electric Code) or any other applicable codes. Please refer to section 2 - AC Power. The user is responsible for getting the AC power to the interface box - make provisions for any conduit or fittings which may be needed.
5. The installer must obtain and route the RC2000 to interface box interconnect cable. The RC2000 is designed for rack mounting indoors and can be powered by either 110 or 220/240 VAC. Please refer to section 3 for the specification of the interface cable. The user is responsible for any conduit or fittings required to route the interface cable to the interface box.
6. The RC2000C Az/El Inclined Orbit Satellite Tracking Antenna Controller requires an analog voltage input which is proportional to the satellite signal strength. The range of the AGC input voltage is 0 to 10 volts. The RC2000 can accept two channels of AGC signal strength information and has gain and offset pots for each channel. This allows the RC2000 to work with any analog voltage which swings over any part of the 0 to 10 volt input range. The controller can be configured via software to accept negative polarity AGC inputs (i.e. a strong received signal corresponds to a smaller analog voltage).

8 Tools and Materials Required For Installation

- Wiring Tools: wire cutters, wire stripper, crimp connector crimp tool.
- Heat gun or a lighter for use with heat shrink tubing.
- Hack saw for cutting liquid tight steel reinforced conduit.
- A fine straight bladed screwdriver for use with the AGC GAIN and OFFSET pots and the screw terminals on the circuit board in the interface box (tip 0.1" inch wide x .03" thick). A jewelers screw driver set may include these sizes.
- Phillips and straight bladed screwdrivers for gaining access to the interface box , the terminal boxes on the sensors, limit switches, and motors.
- A 12" Crescent wrench for working with the conduit fittings.
- Channel Lock pliers for working with conduit fittings. A regular set of pliers for use with the 3M Scotchlok connectors.

9 Attachments

Pulse Sensor Data Sheet (Dart CF-H1 or Powermation DTK-056M1)

Limit Switch Data Sheet (Elevation Limit Switch - Gemco 2006-402L60C, Azimuth Limit Switch - 2006-402L30C)

A Note

Thank you for your support of our products. We appreciate your comments. If you find errors or omissions in this manual or any deficiencies in our products please contact us. We are Research Concepts, (913) 422-0210 WWW.ResearchConcepts.COM . We are located in Shawnee, Kansas.