T Square 6.1 Meter
Dual Axis Tracking Antenna
Motorization Kit

Installation and Operation Manual

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Revision A

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1 Introduction

This document describes an installation kit which allows an RC2000 antenna controller to interface with a T Square 6.1 meter antenna. The RC2000 is a dual axis antenna controller designed for use with 36 volt DC motors and pulse type position sensors. The controller does not directly support limit switch inputs but positive electrical limits are implemented via limit switches and steering diodes which interrupt current flow to the motors when a limit is reached.

The interface kit consists of a NEMA 4 junction box (which is mounted on the antenna kingpost), 36 volt DC motors, Hall effect sensors, steering diodes for the actuator limit switches, cabling and conduit.

The following issues are addressed in this document ...

- Recommended types of cable which may be used to connect the RC2000C antenna controller to the interface box.
- A controller - junction box - antenna wiring diagram.
- RC2000C software configuration parameters.
- A conduit/wiring schedule.
- A Bill of Materials.

2 Installation

This section describes ...

- the installation of the motors, sensors, conduit, and junction box,
- the specification of interconnect cabling between the antenna controller and the interface box,
- and the connections which the user must make in the interface box, at the motor terminal box, at the sensor, and at the limit switches.

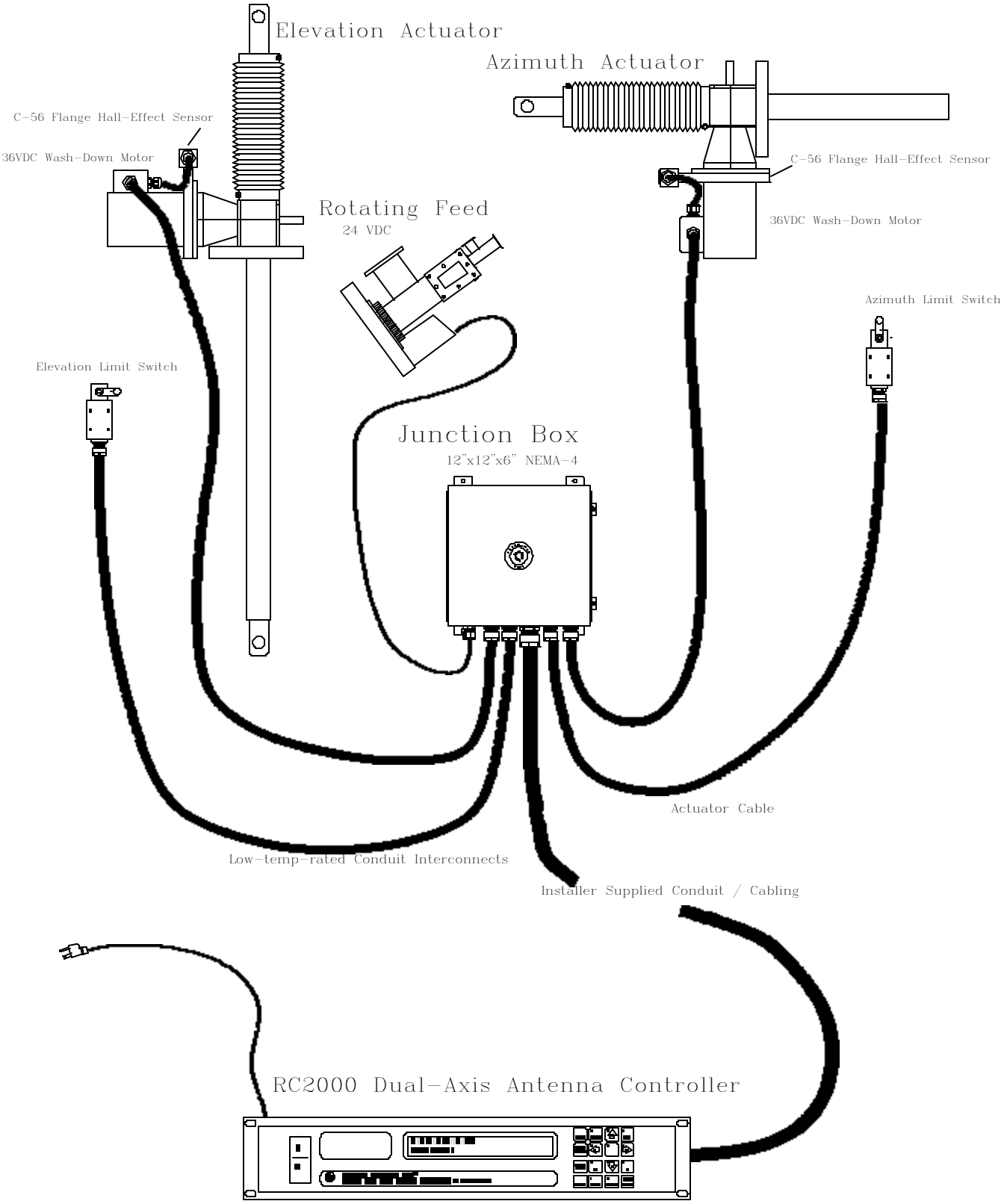
Figure 1 is a pictorial depiction of the antenna controller, the controller - junction box interconnect cable, the junction box, the limit switches, and the antenna actuator assemblies with motors and position sensors. Figure 2 is a schematic showing all system interconnects.

2.1 Motor and Sensor Installation

The motor and sensor are mounted on the actuator 56C motor mounting flange. The sensor consists of a magnet wheel which is attached to the motor shaft via set screws and a pickup coil housed in the body of the sensor. The magnet wheel must be affixed to the motor shaft so that the magnet wheel rotates directly under the sensor pickup.

The motor and the sensor should ideally be mounted so that their electrical junction boxes are facing upward. This will prevent water from collecting in the terminal boxes. If the sensor is mounted such that its terminal box is not facing upward note that water can collect in cutouts in the body of the sensor. If this is the case the installer can drill a small hole in the bottom the sensor body so that any moisture which collects inside the sensor body can drain. **Note that four tapped, condensate drains are present in the motor endshields (at the three, six, nine, and twelve o'clock positions). Make sure that the drain hole(s) closest to the lowest point on the motor are open and all other drain holes are plugged.** A tube of RTV adhesive/sealer is included in the installation kit.

Motion Kit for Tekno T5000 6.1m Antenna



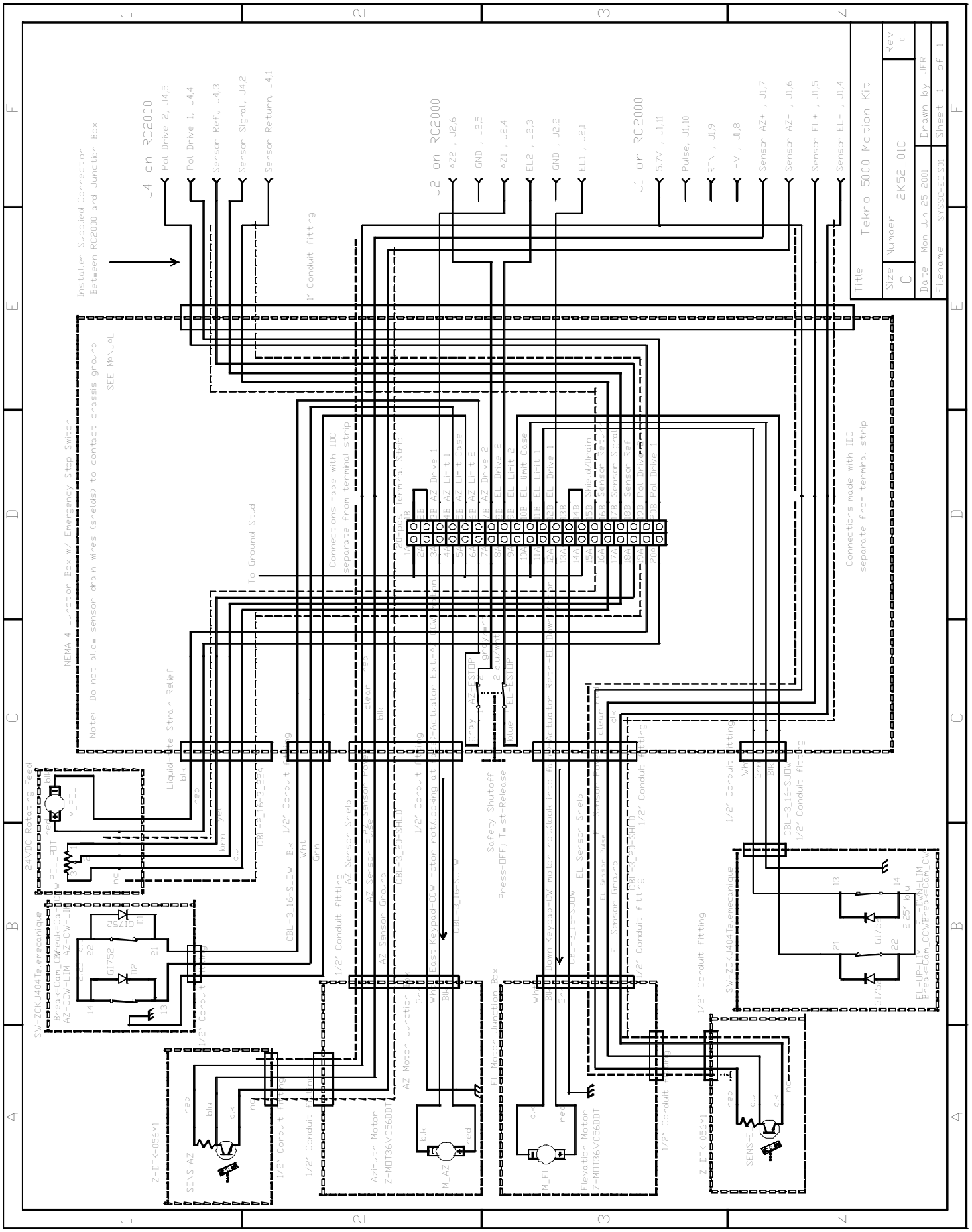
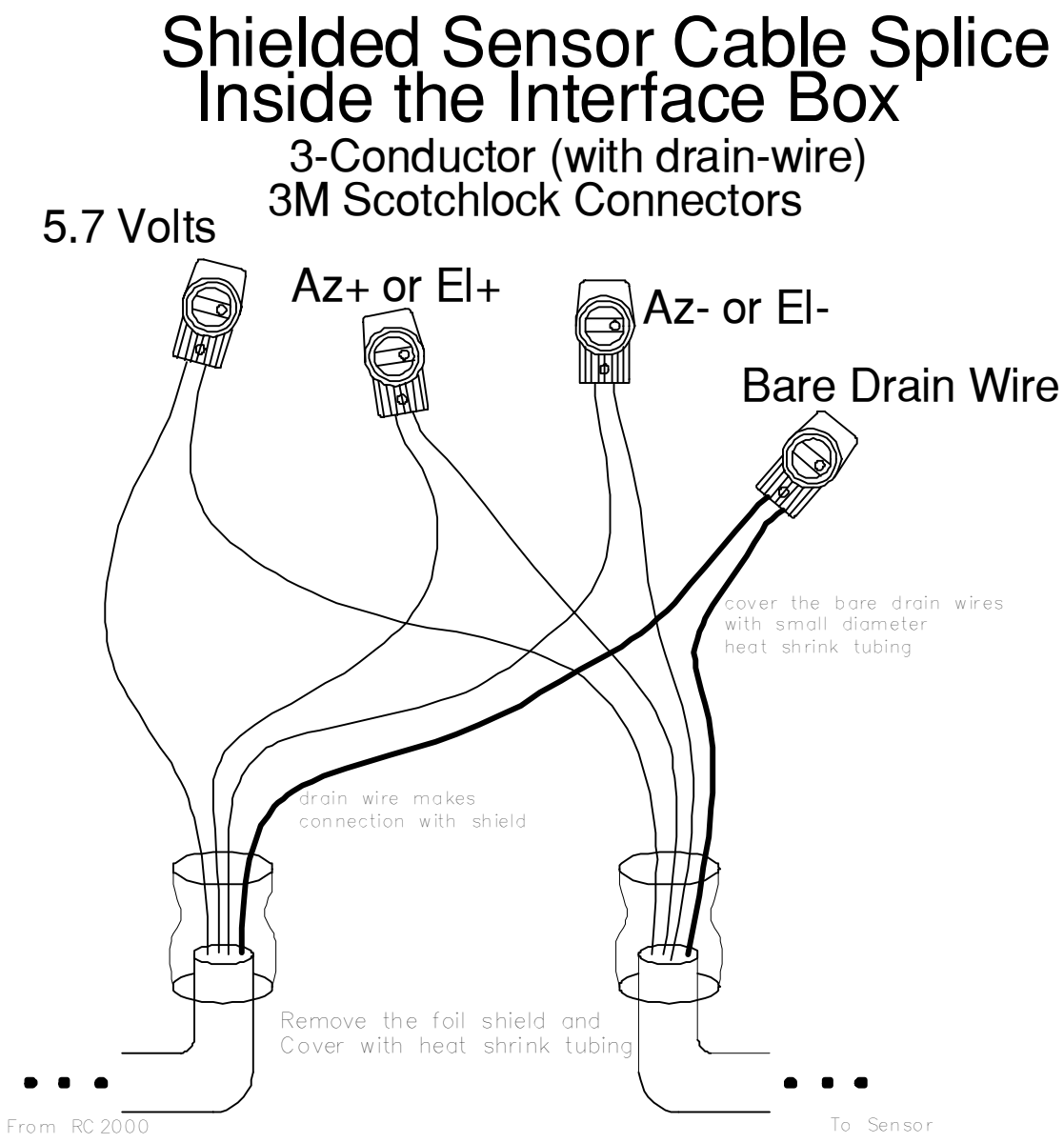


Figure 2 - Wiring Schematic



Notes:

1. Make sure that the drain wires are spliced.
2. Do not allow the drain wire or foil to come into contact with ground.
3. Remove the foil shield and drain wire on the sensor end of the cable. Cover the break in the cable so that the shield cannot come into contact with the ground.
4. Use a cable tie for strain relief and to hold the conductors together to minimize the EMI loop area.

Figure 3 - Junction Box Sensor Pigtail Connections

2.2 Junction Box

The junction box is a 12” x 12” x 6” (H x W x D) NEMA 4 weatherproof enclosure which is mounted vertically on the antenna kingpost. The conduit runs from the antenna actuator assemblies terminate at the junction box where the antenna controller interconnect cable (or cables) are electrically connected to the actuator assemblies. The junction box is equipped with a red push-button ‘twist to release’ type emergency disconnect switch. When the switch is activated twist the switch cap counter-clockwise to reset the switch.

The junction box has a hinged cover (on the left side as seen when looking into the junction box) and has conduit fittings on the bottom. The azimuth and elevation motors, sensors, and limit switches interface to the junction box via 1/2” liquid tight, steel reinforced conduit. If a rotating feed is present in the system a liquid tight strain relief in the bottom of the junction box will restrain the cable which interfaces the junction box to the rotating feed.

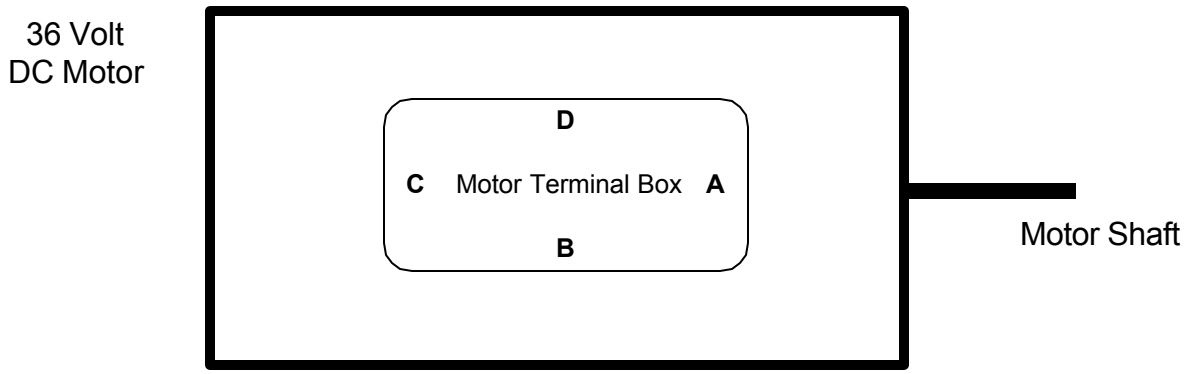
The installation kit includes all of the conduit, cables, and conductors required to interface the actuator assemblies to the junction box. The installation kit does not include the any cable or conduit to connect the controller to the junction box. A 1 3/8” diameter hole appropriate for a 1” conduit fitting is punched in the bottom of the junction box. One inch conduit should be used to interface the controller cable to the junction box.

The junction box mounting hole pattern is 10” wide and 12 3/4” high. The mounting holes in the junction box are suitable for 1/4” screws.

2.3 Conduit/Wiring Schedule

This section describes the conduit runs as well as the cable and wire used to connect the various components together. Wiring to the azimuth and elevation motors and limit switches is enclosed in 1/2” steel reinforced, liquid tight conduit. The plastic conduit which is not steel reinforced is used to connect the motor terminal boxes to the sensors. Note the the sensor terminal box has two 1/2” conduit fittings. **Do not route the motor conductors through the sensor terminal box.** Noise pickup caused by current spikes on the motor power conductors could occur on the sensor conductors at the point where the sensor shield terminates inside the sensor terminal box.

Several of the conduit runs terminate on the motor terminal box. The motor terminal box has four 1/2” NPT fittings. The following diagram identifies the conduit fittings on the terminal box.



36 Volt DC Motor Terminal Box Conduit Fitting
Legend (as seen looking down on the motor)

Description of Conduit Run	Conduit Run Starting Point, Conduit Fitting Type, and Electrical Connection	Conduit Length	Cable Type/Length	Conduit Run Termination Point, Fitting Type, and Electrical Connection
Azimuth Motor	Junction Box, Straight Fitting, Terminal Strip (Motor), Pigtail (Sensor)	10 feet	16/3 – 12 feet, Belden 8772 - 12 feet	Azimuth Motor C, 90 Degree Fitting, Crimp Style Butt Connector
Azimuth Sensor	Azimuth Motor D, Straight Fitting,	24 Inches	Continuation of the Belden 8772 Cable..	Azimuth Sensor, Straight Fitting, Scotchlok Connectors. Note: To avoid noise pickup, use a piece of 3/8” heat shrink tubing to keep the shield of the sensor cable from coming in contact with the sensor terminal box at the sensor cable splice
Azimuth Limit Switch	Junction Box, Straight Fitting, Terminal Strip	5 feet	16/3 8 feet	Azimuth Limit Switch, Straight or 90 Degree Fitting, Limit Switch Terminal Strip
Elevation Motor (option)	Junction Box, Straight Fitting, Terminal Strip (Motor), Pigtail (Sensor)	11 feet	16/3 - 13 feet, Belden 8772 - 13 feet	Elevation Motor C, 90 Degree Fitting, Crimp Style Butt Connector
Elevation Sensor	Elevation Motor D, Straight Fitting,	24 Inches	Continuation of the Belden 8772 Cable	Elevation Sensor, Straight Fitting, Scotchlok Connectors. Note: To avoid noise pickup, use a piece of 3/8” heat shrink tubing to keep the shield of the sensor cable from coming in contact with the sensor terminal box at the sensor cable splice
Elevation Limit Switch (option)	Junction Box, Straight Fitting, Terminal Strip	10 feet	16/3 14 feet	Azimuth Limit Switch, Straight or 90 Degree Fitting, Limit Switch Terminal Strip

From figure 2, note that there is a diode in parallel across each limit switch. These diodes are located in the limit switch itself. The polarity of the diode must be correct for the limit switches to operate properly. The schematic symbol for a diode is shown in figure 2 next to the limit switches. The symbol consists of an arrowhead pointing towards a ‘bar’. The diode itself has a cylindrical body. One end of the diode is marked with a band. The end with the band corresponds to the ‘bar’ shown on the symbol.

The chassis of the azimuth and elevation motors are grounded at the junction box to a grounding lug. It is assumed that the antenna kingpost is connected to earth ground via a grounding strap.

For installation kits designed for use with the optional rotating feed, 30 feet of actuator cable will be included to connect the feed assembly to the junction box. Actuator cable is described in the following section.

2.4 Antenna Controller to Interface Box Interconnect Cable

The user must supply the cable to connect the RC2000C to the interface box. On the bottom of the interface box there is a 1 3/8" hole suitable for a 1" conduit fitting. The cable must have 2 pairs of 16 AWG (or heavier) conductors to carry the azimuth and elevation motor current. The maximum controller motor drive current is 8 amps (at 30 volts). Shielded conductors are not required for the motor drive. If shielded motor drive cables are desired the cables should be equipped with a bare drain wire and the shields must be connected in the same manner as is described in the next paragraph for the sensor cables.

In addition to the motor drive current conductors a pair of individually shielded triples with drain wires are necessary for the azimuth and elevation sensor connections. The sensor is powered by 5.7 volts produced by the controller. The sensor cables carry about 20 ma of current.

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

- Always use shielded cables with bare drain wires 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.

It is possible to use multi-core satellite TVRO 'actuator' cable to connect the RC2000 to the junction box. Actuator cable typically consists of a pair 16 or 14 AWG unshielded conductors and a shielded 22 AWG triple with drain wire. This cable is available from Research Concepts. It is not necessary to use multi-core cable - Belden 8772 is a shielded triple (20 AWG) with bare drain wire which is suitable for the sensor connection.

Actuator cable is also suitable for the optional rotating feed. Five conductors are required to interface the RC2000 (equipped with the optional RC2KPOL rotating feed control daughterboard) to the rotating feed. The rotating feed is powered by a 24 volt DC motor (350 ma locked rotor current). A potentiometer provides position sense feedback. Two conductors are required for the motor and three conductors are required for the potentiometer. The potentiometer conductors do not have to be shielded. If they are, however, the techniques described in proceeding paragraphs detailing the treatment of the azimuth and elevation sensor cable shields should be exercised.

2.5 Junction Box Connections

The junction box contains a terminal strip. The motor current conductors in the controller to junction box interconnect cable and the actuator assemblies are connected via the terminal strip. The sensor connections are made via a 'pigtail' type splice shown in figure 3. The connectors, heat shrink tubing, and wire ties referenced in figure 3 are provided in the installation kit. The schematic diagram shown in figure 2 details the connections which must be made.

The azimuth and elevation axis each require 9 connections: two motor drive conductors (at the terminal strip), one motor ground connection (at the junction box ground lug), 2 limit switch connections (at the terminal strip), three sensor conductor connections (in the sensor pigtail), and one sensor drain wire connection (in the sensor pigtail).

If a motorized rotating feed is present in the system the junction box will include a liquid tight cable clamp and about 30 feet of actuator cable. The actuator cable will be connected to the terminal strip. The installer should connect the cable from the RC2000 rotating feed control daughter-board to the terminal strip - 5 connections are required: 2 for polarization motor power and 3 for the polarizaiton sensor.

2.6 Controller Checkout

After the electrical connections have been made verify the operation of the antenna. When the controller is in LIMITS mode the user can manually jog the antenna in azimuth and elevation. If the AZ CCW key is depressed the antenna should move counter-clockwise in azimuth as seen by an observer located above the antenna. Similarly, if the AZ CW key is depressed the antenna should move in a clockwise direction. Elevation up and down movement is self explanatory.

The installer should also verify that the antenna limit switches function properly for each direction of movement about both the azimuth and elevation axis. For example, to verify the operation of the azimuth counter-clockwise limit, motor the antenna counter-clockwise until the limit is reached. Once the limit is reached check to make sure that the antenna can be motored clockwise in azimuth out of the limit.

In RC2000 Antenna Controller's LIMITS mode, as the antenna is moved about a given axis the position count associated with that axis should change unless the displayed position has reached 0 or 65535. As the antenna moves counter-clockwise in azimuth or down in elevation the antenna position count will decrease until 0 is reached. As the antenna moves clockwise in azimuth or up in elevation the position count will increase up to a maximum value of 65535 - the display will not wrap back to 0 when 65535 is reached.

If the antenna does not operate as described above check the wiring. If the wiring is correct refer to the following section, 'Theory of Operation', to troubleshoot the problem - the internal actuator wiring may be incorrect. When the sense of azimuth and elevation movement, limit switch operation, and sensor operation have been verified - set the controller's azimuth and elevation limits as described in the RC2000 manual.

If a rotating feed is present in the system please refer to section 3.3 of the RC2000 manual for information concerning the installation, RC2000 configuration, and checkout of the polarization control system.

3 Theory of Operation

The operation of the antenna is straight forward. The antenna is equipped with 36 volt DC motors, limit switches, and Hall effect position sensors. This section describes the operation of each of these components.

3.1 36 Volt DC Motors

The RC2000 is designed to interface directly with antennas powered by 36 volt DC, permanent magnet (PM) motors on the antenna azimuth and elevation axis.

Permanent magnet DC motors have the following characteristics ...

- The speed of the motor is dependent on the voltage applied to the motor.
- The torque produced by the motor is a linear function of current supplied to the motor.
- The direction of motor rotation can be reversed by reversing the polarity of the voltage applied to the motor.
- If the motor is being driven by the load the motor acts as a generator and produces a voltage across its terminals. When this occurs, an electrical load placed across the motor terminals acts as a brake. This is referred to as dynamic braking.

The RC2000 controls the azimuth and elevation motors via a solid state H bridge circuit. The speed of the motors is controlled via pulse width modulation of the motor drive voltage. See the description of the slow speed system in the RC2000 manual. Dynamic braking is also supported.

The motor drive terminals are located on the back panel of the controller and are labeled AZ1, AZ2, EL1, and EL2. When the AZ CCW key is depressed the voltage on the AZ1 terminal will be higher than that on the AZ2 terminal. When the AZ CW key is depressed the polarity is reversed and the AZ2 terminal is at the higher voltage. Similarly, when down elevation movement is specified the voltage on the EL1 terminal will be higher than that on the EL2 terminal and when elevation up movement is specified the voltage on the EL2 terminal will be higher than that on the EL1 terminal.

The motor terminals must be connected to the controller AZ1, AZ2, EL1, and EL2 terminals so that the sense of azimuth and elevation movement is correct.

3.2 Limit Switches

The RC2000 does not directly interface to limit switches. Electrical limit switches can be utilized, however, for a given axis by placing normally closed limit switches in series with the motor terminals. A 'steering' diode is connected in parallel with each limit switch - the polarity of the diode is critical. In this case, a normally closed limit switch refers to a limit switch that is closed when the antenna is not at the limit. When the antenna is at the limit associated with that limit switch the limit switch's contacts open. Note that two limit switches are required for each axis, one for each direction of movement, i.e. an azimuth counter-clockwise limit switch and an azimuth clockwise limit switch. Note also that both limit switches associated with a given axis may be located in the same physical package.

The limit switches are connected in series between the actuator motor and the controller. When the antenna is not at a limit both limit switches are closed and current can flow in either direction so the antenna can move in either direction. If the antenna is motored to a limit, say the azimuth counter-clockwise limit, the azimuth counter-clockwise limit switch opens. The steering diode in parallel across the azimuth counter-clockwise limit switch must be oriented so that it blocks the flow of current from AZ1 to AZ2 (AZ1 is at a higher potential than AZ2 when the controller wants to move the antenna in the azimuth counter-clockwise direction) when the switch is open. Note that when the steering diode is oriented as described above current can flow from AZ2 to AZ1 (corresponding to azimuth clockwise movement) when the azimuth counter-clockwise limit switch is open which will allow the antenna to be motored clockwise out of the azimuth counter-clockwise limit. Figure 2 shows the wiring of the limit switches.

The polarity of the steering diode must be correct for the limit switches to operate properly. The schematic symbol for a diode is shown in figure 2 next to the limit switches. The symbol consists of an arrowhead pointing towards a 'bar'. Current flows in the direction that the arrowhead is pointing - current flow in the opposite direction is blocked. The diode itself has a cylindrical body. One end of the diode is marked with a band. The end with the band corresponds to the 'bar' shown on symbol.

3.3 Azimuth and Elevation Position Sensors

The antenna actuators use Hall effect sensors for position sensing. The sensor is sandwiched between the motor and the actuator on the actuator's motor mounting flange. The Hall effect sensor consists of a disk shaped magnet wheel which is attached to the motor shaft via set screws and a pickup module. The pickup module has three wires attached to it - power, ground, and pulse output. The pickup is powered by 5.7 volts which is available at the back panel of the controller and has on open collector type output. As the magnet wheel rotates in the proximity of the pickup module pulses are produced. The controller records as a position count each rising and falling edge of the pulse train produced by the position sensor.

The RC2000 maintains logical azimuth and elevation limits. When the controller azimuth counter-clockwise limit (or elevation down limit) is set the azimuth position count (or elevation position count) is reset to 30. As the controller moves the antenna clockwise in azimuth (up in elevation) position pulses produced by the azimuth (elevation) pulse sensor causes the controller to increment the azimuth (elevation) position count. Similarly, when counter-clockwise azimuth or down elevation movement occurs, the azimuth or elevation position count is decremented.

Erratic operation of the sensor can be caused by the magnet wheel not being aligned with the pickup unit. The most common problem associated with the position sensors is the accumulation of extra pulses due to noise pickup. Be sure to follow the sensor cable shielding guidelines described in section 2.2 and figure 3.

4 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 T Square 6.1 meter antenna. For a complete description of these CONFIG mode items please consult the RC2000 antenna controller manual. In the table below, note that items marked with a '*' are present only in the RC2000C Inclined Orbit Satellite tracking antenna controller.

CONFIG Mode Item	Value For T Square 6.1 Meter Antenna	Comments
AutoPol Enable	0 - DISABLE	AutoPol disabled.
Simultaneous Az/El Enable	0 - DISABLE	The current requirements of the 36 volt DC motors used in the actuators does not permit simultaneous azimuth and elevation operation.
Azim Slow Speed		This value has been found to be appropriate for the T Square 6.1 meter antenna fitted with Leeson 36 volt DC motors. If adjustments are required please refer to the RC2000 operator's manual.
Elev Slow Speed		This value has been found to be appropriate for the T Square 6.1 meter antenna fitted with Leeson 36 volt DC motors. If adjustments are required please refer to the RC2000 operator's manual.
Rotating Feed Present	0 - NO (if a rotating feed is not present in the system) - OR - 1 - YES (if a rotating feed is present in the system)	When this CONFIG mode item is set to zero the controller assumes that a 3 wire servo type polarization control device is present. This is also the correct setting when there is no polarization control device. A servo type polarization control device provides no position feedback to the controller - the controller cannot tell whether a servo type polarization control device is connected or not. Note that the controller will prompt the user to specify H and V polarizations in SETUP and AUTO modes. In SETUP mode just use the CW/CCW keys to adjust the polarization position to 50, hit the H key and then the V key. In AUTO mode select either H or V - it makes no difference which one is selected. - OR - See section 3.3 or the RC2000 Operator's Manual for more information on the CONFIG mode settings required to configure the RC2000 for operation with the rotating feed.
Az/El Drive Options Enable	1 - ENABLE	When this CONFIG mode item is enabled the user has access to the Az/El 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/El Auto Retry Attempts	2	The controller will make 2 attempts to get within 'Max Position Error' counts of a target position.

CONFIG Mode Item	Value For T Square 6.1 Meter Antenna	Comments
Az/El Fast Deadband	3000 milliseconds	The controller will allow 3 seconds for the antenna to coast to a stop. If RUNAWAY errors occur the value of this parameter can be set to 3001 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	3023 milliseconds	The controller will allow 3 seconds for the antenna to coast to a stop. The last two digits ('23') tell the controller to not schedule a peakup when Step Tracking within 230 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	__ position counts	When moving to a target position in either azimuth or elevation, the controller will turn off the motors when the position reaches a point 14 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	__ 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*	610 centimeters	
Azim Constant*	_____ counts per radian	This is the approximate number of position counts per radian of antenna azimuth movement. This corresponds to ___ azimuth position counts per degree.
Elev Constant*	_____ counts per radian	This is the approximate number of position counts per radian of antenna elevation movement. This corresponds to ___ elevation position counts per degree.
Max Track Error*	5 tenths of a dB	
Search Enable*	0-DISABLE	For transmit applications the search feature should be disabled. Please see the description of TRACK mode in the RC2000 manual for more information.

5 Bill Of Materials

In the Model/Description column the RCI part designation is in parentheses.

Quan	Model/Description (RCI Part Number)	Manufacturer	Description
1	A-1212CHNF (M-N4_12_12_6)	Hoffman	12" x 12" x 6" NEMA 4 Enclosure
1	A-12P12 (M-12_12_PNL)	Hoffman	Panel for NEMA Enclosure
1	44-06562 (SW-PANIC-22_5)	Switches Plus/AEO	Emergency Stop Switch, Maintained Operation, Twist to Release
1	44-91200	Switches Plus/AEO	Legend for Emergency Stop Switch

Quan	Model/Description (RCI Part Number)	Manufacturer	Description
	(Z-PANIC_LEGEND)		
2	TS6/12WP (CN-TS6_12WP)	Altech	'Euro' Style 12 Position Terminal Strip
5	Insulated Ring Terminal (CN-ME159-1610)		Crimp Type, #10 Stud, 14-16 AWG (Blue) - For Motor Chassis Ground Connection
1	(Z-LBLMODEL)	RCI	RCI Model Number / Serial Number / Date Label
1	(Z-LAM-SCHMETAC)	RCI	Laminated Schematic / System Interconnect Diagram
2 (option)	C42D9NVC1 (Z-DDT-MOTOR)	Leeson	36 VDC Motor, 1000 RPM, 1/4 HP
2 (option)	DTK-056M1 (Z-DTK-056M1)	Power/Mation	Pulse Sensor for C56 Flange Mounting with 1 Pulse per Revolution Magnet Wheel
2 (option)	ZCKJ-404H7 (SW-ZCKJ04)	Telemecanique	Limit Switch
2 (option)	ZCK Y41 (SW-ZCKY-41)	Telemecanique	Limit Switch Lever
60'	LA11-50 (Z-M-0_5 CNDT)	Electri-Flex	1/2" Liquid Tight Steel Core Flexible Conduit
8	3/8"x2" Bolt, 16 TPI Stainless Steel (HD-3/8-16X2 SS)		Motor and Sensor Attachment
8	3/8" Lock Washer Stainless Steel (HD-3/8 L/W SS)		Motor and Sensor Attachment
8	GY-4Q-50 (CN-GY_4Q50)	Oz/Gedney	1/2" Straight Conduit Connector
2	GY-4Q-950 (CN-GY-4Q950)	Oz/Gedney	1/2" 90 Degree Conduit Connector
4	Bushing	Payless Cashways	Use with 90 Degree Conduit Fitting to Obtain Proper Orientation. 1/32" Thick, 13/16" ID, 15/16" OD. Payless Cashways Cap Thread Gasket #24
4	Bushing	Payless Cashways	Use with 90 Degree Conduit Fitting to Obtain Proper Orientation. 1/16" Thick, 13/16" ID, 15/16" OD. Payless Cashways Cap Thread Gasket #1
4	Bushing	Ace	Use with 90 Degree Conduit Fitting to Obtain Proper Orientation. 1/8" Thick, 5/8" ID, 1" OD, Ace Rubber Hose Washer #45383
(1) [1]	CN-NN-13-BK (CN-3224)	Heyco	1/2" NPT Liquid Tight Cable Strain Relief, Note: Only used with the pol control option
1	(Z-TEFLFONTP-3_8)		3/8" Teflon Tape (for conduit fittings)
35'	8772 cable (CBL-3_20-SHLD)	Belden	3 conductor shielded cable with drain 20 AWG
40'	01306 (CBL-3_16-SJOW)	Carol	16/3 Motor Connect Cable
35' [1]	(CBL-2_16-3_22A)	Research Concepts	Junction Box to Feed Actuator/Sensor Cable. Note: Only used with pol control option.
4	GI752 (D-GIS752)	General Instrument	High Current Steering Diode for Limit Switches
2	2 1/2" Jumpers, 16 AWG		For Use in Limit Switches

Quan	Model/Description (RCI Part Number)	Manufacturer	Description
4	6-32 5/8" Machine Screws (HD-6-32x5/8)		Hardware to Attach the Terminal Strip to the Junction Box Panel
4	6-32 Nut (HD-6-32-SM)		Hardware to Attach the Terminal Strip to the Junction Box Panel
4	#6 Lock Washers (HD-#6SL)		Hardware to Attach the Terminal Strip to the Junction Box Panel
27	9772 (HD-TIEDOWN)	Dell City Wire Co.	Adhesive Cable Tie Point
16 (20)	UR Connector (CN-JIZR)	3M	Red Scotchlok with Dielectric Grease, Note: A total of 20 connectors are required for the pol control option.
8"	Butt Connector (CN-ME-159-1614)		Crimp Type, Insulated, 14-16 AWG (Blue) for Motor Connections, Note: A total of 7 connectors are required for the pol control option.
16"	FIT-221-3/64 HS-221-_046	Alpha	3/64" Heat Shrink - Covers Drain Wire at Sensor Cable Splice
8"	FIT-221-1/4 HS-221-_250	Alpha	1/4" Heat Shrink - Covers the Break in the Insulation at the Sensor Cable (Belden 8772) Splice
8"	FIT-221-3/8 HS-221-_375	Alpha	3/8" heat shrink - Covers the Break in the Insulation at the Sensor Cable (user supplied) Splice
6	4" cable tie (NY-C-TIE 3-75)		Cable Tie for Sensor Cable Splice
12	6" cable tie (NY-C-TIE 6)		Cable Tie for General Use Inside Interface Box
10	8" cable tie NY-C-TIE 2-25		General Purpose Cable Ties (Weather Proof and Ultraviolet Resistant). Note: A total of 24 ties are required for the pol control option.
1	4QFW-50	Oz-Gedney	Ferrule Wrench used to Screw the Conduit Fitting Ferrule into the Conduit.
1	(ADH-1700)	GE	RTV Sealer Adhesive
12	33" cable tie (NY-C-TIE 33)		General Purpose Cable Ties (Weather Proof and Ultraviolet Resistant)

[1] - This part is only required if the pol control option is specified.

6 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.
- 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, and limit switches.
- 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.
- Hacksaw or reciprocating saw for cutting metal reinforced liquid tight conduit.

- Razor knife for cutting non-metallic liquid tight conduit.
- A T20 Torx head screwdriver for gaining access to the motor terminal boxes and drain screws.

7 Attachments

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

Limit Switch Data Sheet (Telemecanique ZCKJ-404)

Limit Switch Wiring Diagram

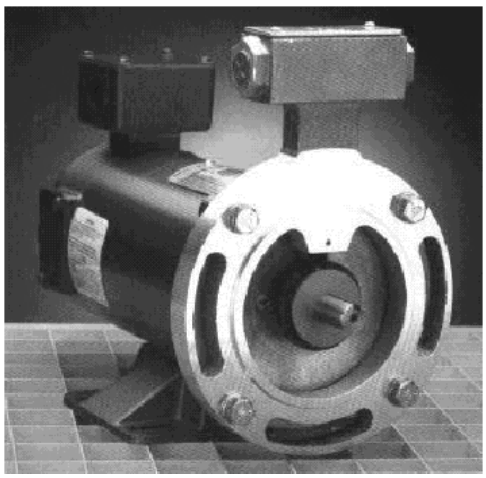
A Note

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. We are located in Shawnee, Kansas.

DIGITAL TACHOMETER SENSOR KITS

POWER/MATION

W238 N 1690 Rockwood Drive
Waukesha, WI 53188
Phone: (414)523-0600
800-242-2060
Fax: (414) 523-0611

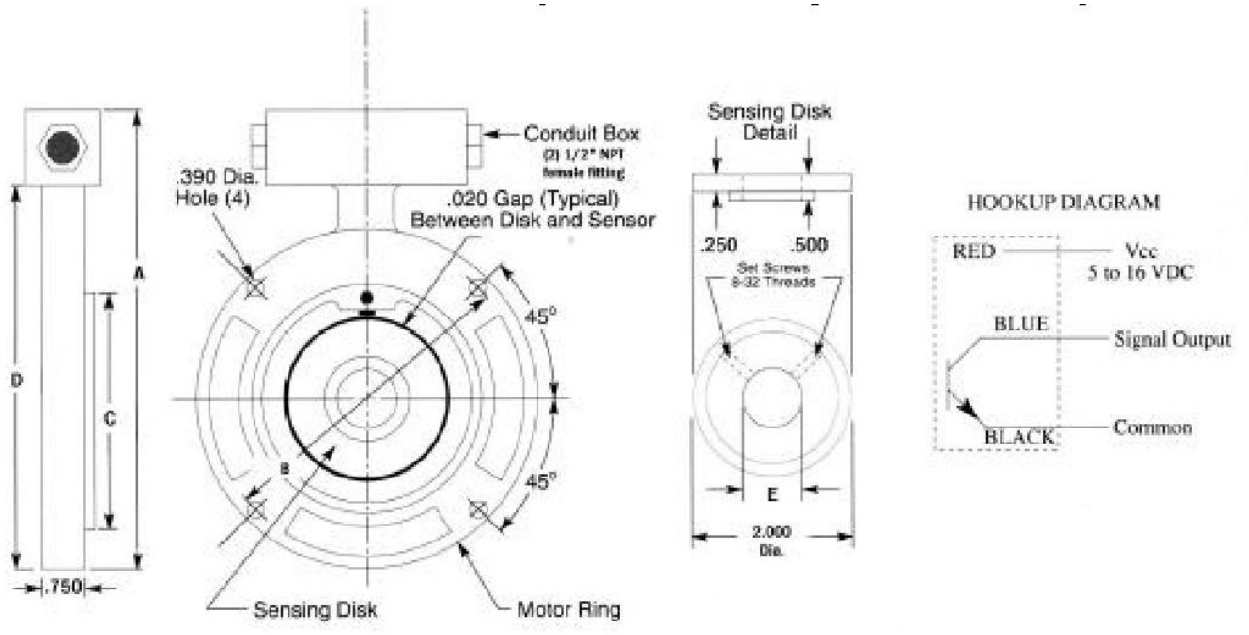


SPECIFICATIONS
INPUT: 5-16VDC
OUTPUT: NPN, 20ma
TEMPERATURE: Minus 40°F to plus 225°F
OUTPUT CONNECTION: Three Wire
PULSES PER REVOLUTION (ppr): 1 *
WAVE FROM: Square Wave
ENVIRONMENT: Impervious to dust, oil & water
* 2, 15 & 60 ppr models are available

ORDERING CHART

		DIMENSIONS				
MOTOR FRAME SIZE	KIT MODEL NUMBER	A	B	C	D	E
56C	DTK-056 M1	9.375	5.875	4.500	7.875	5/8"
143TC, 145TC, 182C & 184C	DTK-184 M1	9.375	5.875	4.500	7.875	5/8"
182TC, 184TC, 213C, 215C & 254C	DTK-215 M1	12.312	7.250	8.500	10	1-1/8"
213TC, 215TC, 254UC & 256UC	DTK-254 M1	12.312	7.250	8.500	10	1-3/8"
254TC & 256TC	DTK-256 M1	12.312	7.250	8.500	10	1-5/8"

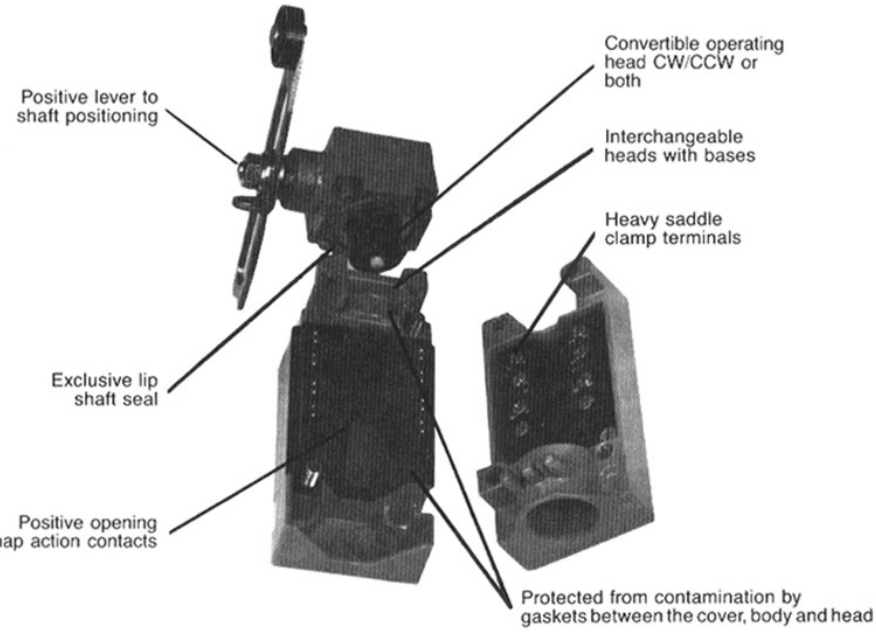
NOTE: Kits consist of motor face ring, sensor, mounting bolts and sensing wheel.



NOTE: To interface sensor to controller, use a shielded triple (18-22 AWG) with bare drain wire, such as Belden 8772.

Precision Limit Switches

Telemecanique



XCK-J

Heavy-duty precision industrial switch designed to meet international standards

Contacts:

SPDT, 2SPDT: NEMA A300 Meets IEC 947-5-1 for positive opening contacts

Enclosure

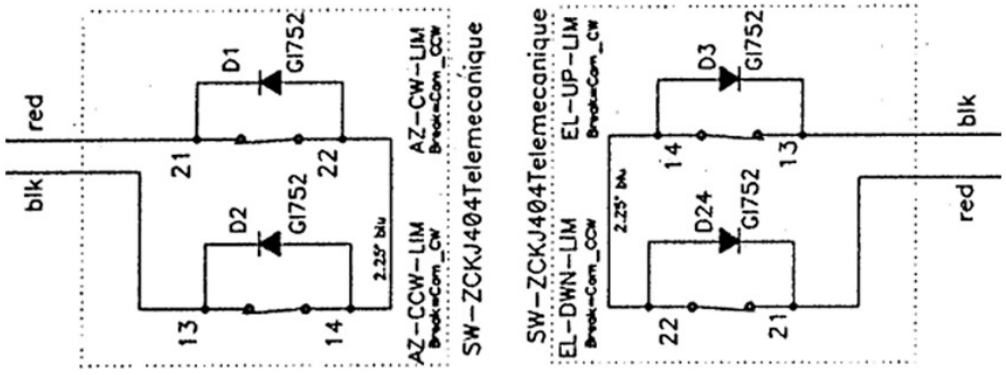
NEMA Types 1, 4, 6, 12, 13; IEC Type IP66

Description

The XCK-J is a precision Limit Switch. It features the latest design in plug-in capability in a sturdy diecast zinc alloy housing. Most application needs can be met by the large selection of heads, actuators, and contact configurations offered.

The interior of XCK-J switches is protected from contamination by gaskets between the cover, body and head. An exclusive lipshaft seal gives added protection for the head.

XCK-J limit switches are easy to install for several key reasons. The switch is bolt-hole compatible with all heavy duty limit switches on the market today. Plug-in and non plug-in versions are available. All contacts have captive riding saddle clamp terminals. Heads can be indexed to any of four positions.



Features

- 4 Position Indexing Head.
- Plug-in & Non Plug-in.
- Positive Opening Snap Action Contacts.
- Field convertible (See p. 6-24)
  - Clockwise
  - Counter-Clockwise
  - Or Both
- Captive saddle clamp terminals.
- NEMA 1, 3, 4, 13
- Single or double pole.
- Ground Terminal
- Zinc Alloy Housing
- International Approvals
- Slotted Mounting Holes

Options

- Gold contacts.
- Cable pre-wired and sealed.
- Receptacle connector.
- Low temperature.
- High temperature.
- Slow make and break
- Corrosive atmosphere
- Radio active atmosphere

UL LISTED
File No. 39281

CSA
File No. LR49123-1

THIS PRODUCT FEATURES POSITIVE OPENING SNAP ACTION CONTACTS