



M2 Antenna Systems, Inc.

Model No: RC2800PXEL



SPECIFICATIONS

MODEL NUMBER	RC2800PXEL
POWER REQUIREMENTS	115 / 230 VAC @ 5A / 3A, Switchable
ENCLOSURE SIZE	W=8.5" / H=5.5" / D=9"
COLOR	Gray Powder Coat
POINTING ACCURACY	>0.1°
READOUT ACCURACY	>0.5°
MINIMUM COMMANDED MOTION	>1.0°
DIGIT SIZE	0.5" Heading / .375" Mode / Speed
CONTROL SWITCHES	Tactile 0.5" Diameter
MICROPROCESSOR TYPE	"Microchip" PIC16F876/20-SP
CONTROLS	Power Switch, ON / OFF Speed Buttons, Increments 1-9 Clockwise & Counterclockwise Buttons Up & Down Mode Buttons
MODES	(3) Operational / Run Modes and 17 Programs
STANDARD OUTPUT VOLTAGE	32-35 VDC @ 3A
COMPUTER INTERFACE	RS232 Port

FEATURES

The **M2 RC2800PXEL** is our Economy Grade single axis controller. The **RC2800PXEL** was developed for the M2 Elevation Motor Models ([MT-1000](#) & [MT-3000A](#)) and our "Commercial Grade" AZ/EL Pedestal Models ([AZEL1000](#) & [AZEL1000CB](#)).

The **M2 RC2800PXEL** uses a Microchip PIC16F876/20-SP for Micro processing user commands, M2 software and EEPROM for memory. User modes include: (3) Operational / Run Modes and (17) configurable modes including (10) programmable presets.

A manual selectable power input allows for either 115VAC or 230VAC applications.

The **M2 RC2800PXEL** uses **PWM** (Pulse Width Modulation) for speed control, allowing for full torque at the slowest input speed. Location heading from the motor assembly is supplied via an Open Loop Circuit to the controllers' microprocessor.

Many off the shelf software packages are available that support the **M2 Software Protocol**, including [Ham Radio Deluxe](#), [DX4WIN](#), [SATPC32](#) and [NOVA for Windows](#).

Computer interface to the **RC2800PXEL** is via RS232.

Preparation

Basic Operations

Advanced Operations

Trouble Shooting

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RC2800PXEL ULTRA CONTROLLER



FEATURES

Our ALL NEW, GREEN LED, PIC rotator controller is packed with new features including AUTO-CALIBRATE, AUTO SLOW DOWN as limits are approached, ONE STEP PROGRAMMING saving all changes by exiting the program mode. SOFTWARE UPDATES directly from our "m2inc.com" website Also included is increased circuitry and reed switch protection. Of course computer control has also been improved. The new RC2800PXEL now accepts fractional inputs like 138.7 degrees and the Auto-calibrate command from a computer or remote site. What we did not change is front and back panel layout so it doesn't require re-learning the controls and the actual operation is almost identical to the old units. Everything is just a bit smoother and easier. The new PIC microprocessor lends itself to easier custom programming for special rotator control functions. This custom program can be downloaded directly through the RS-232 port on your RC2800PXEL from our site on the WEB. Of course this new controller works with any of our older OR2800DC rotators. It can also be easily modified to work with MOST of our older AC (OR2800AC) units as well. By ordering an RC2800PXEL controller this design can control a Prop Pitch Rotator with all the same features. If you have a very custom rotator system using a large AC or DC motor of almost any voltage or phase (like 3 phase 240 AC) the RC2800PXEL design can control your rotator system. This same controller also controls our line of Elevation rotators (Positioners) like the MT-1000AEL, MT-3000AEL, MT-4000 and the largest, MT-5000. The Elevation controller can be linked to the AZ controller and both then can be controlled by computer through a single RS-232 line. We also have a Dual controller (RC2800PRK) in one rack mount case to control an AZ-EL system. The new RC2800PXEL controller it can handle any gear ratio from 1000 to over 50,000:1

GETTING STARTED WITH YOUR NEW ELEVATION SYSTEM

We highly recommend that upon receiving the rotator and controller, you hook it up on the bench and get used to the operation. The MT-1000AEL, MT-3000AEL and the MT-5000 are similar in operation. They do have different gear ratios so that will be the first thing you will do after turning on the controller. Using your final control cable or temporary wires, do the following.

NOTE: The colors used are just a suggestion

1. Connect a black lead in the cable to terminal #1 on the back of the control box.
2. Connect the White wire to terminal #2.
3. Connect the Orange wire to terminal #5.
4. Connect the Blue wire to terminal #6

1. Now on the MT Series end connect the black wire to the first terminal with the black motor lead
2. Connect the white wire to the next terminal with the other motor lead, (usually red).
3. Connect the orange and blue wire to the terminal strip with the small white reed switch leads.
5. Unwrap the AC power cord and plug in the RC2800PXEL controller.
6. Turn on the controller. The NEW green display should come up and read "0 9 0.2 or similar.

You can now run the rotator. Go UP first to get away from the lower limit. If it just goes a little, stops, and displays and "E" you probably are not getting digital pulses back from the reed switch. Check wiring. Once it runs and counts, go on to step 7 or to the following pages .

7. Push and hold in the UPPER mode button. "P20 0.0" should come up. "P" stands for "program mode" Nothing moves, you just input numbers to make your system work the way you want. P20 through P29 are PRESET DIRECTIONS. The default is 10 degrees steps to 90.
8. Bump the LOWER mode button once to get to P6. Later you will use P6 to calibrate your actual heading using the up / down buttons. P6 must be saved anytime you make a change.
9. Bump the lower mode button again and see P5 1 come up this is your minimum speed and starting speed for your ramp. It can be set from 1 to 9. For now leave it at 1
10. Bump the LOWER mode button again and P4 13200 may come up. Use the up / down buttons to input the correct gear ratio for your particular MT Series Unit MT-1000AEL = 13,200, MT-3000AEL = 19200 and MT-5000 = 30,314.
11. Bump the Lower mode button again see P3 0.0 P3 is used in Azimuth mode to set North or South stop. It is NOT USED in an "ELEVATION" system. Leave P3 at 0.0.
12. Bump down again to P2 and see 90.0 This is the default upper limit. If you want to invert the array for assembly or maintenance, reset P2 to 180.0
13. Bump down again and see P1 14.0. This is your lower limit and indicates you can go 14 degrees below the horizon. Use the up / down buttons to set in your desired lower limit. A setting of 2.0 means you can go 2 degrees below zero (0) the horizon.
14. Bump down again and see P0 CAL. P0 is only used if you have a limit switch kit on your MT'. **IF YOU HAVE NO LIMIT SWITCHES, DO NOT USE THIS PROGRAM MODE.**

TO SAVE YOUR CHANGES, OR JUST RETURN TO OPERATE MODES:

Bump The UPPER MODE button once or more to leave P0. CAL Then PRESS AND HOLD the LOWER mode button. 0 9 0.2 will come up unless you PROGRAMMED something in P6, P5, P2 or P1.

The following pages will give much more detail on all operation.

RC2800PXEL PROGRAMMABLE ELEVATION CONTROL UNIT WITH RS232 PORT

FRONT PANEL CONTROLS

“PWR” ROCKER SWITCH

Located in the lower left hand corner of the front panel, this button controls AC power to the unit.

DIGITAL DISPLAY

The digital display panel shows (from left to right): **MODE, SPEED, and HEADING / PROGRAMMING** data.

Display Digit:

#1: (full left): shows the selected MODE for operation or programming.

#2: Indicates the positioner travel SPEED in relative numbers from 0 to 9.

#3, Indicates, an "L" for a Limit zone or a digit when programming in a high gear ratio.

#4, 5, 6, 7: Indicates HEADINGS, Azimuth or Elevation, in degrees and programming data.



MODE BUTTONS

The Mode buttons are used to cycle through and select among 3 operational or "RUN" modes, and 17 "PROGRAM" mode positions. See RUN MODES and PROGRAM MODE details following this section.

“SPEED” BUTTONS

The speed buttons control the positioner's rate of speed in relative increments. "1" is the slowest speed, "9" is the fastest. '0' IS DISPLAYED WHEN THE ROTATOR IS NOT MOVING. The top button increases the speed, the lower button decreases speed. Lowest speed available DEFAULTS TO 1 but can be set to any number between 1 and 9 in program mode P5. Speeds can be altered for travel in any of the run modes, but must be returned to speed 9 for full speed and full ramp functions.

“CW” (“UP”) and "CCW" (“DOWN”) BUTTONS

The "CW" and "CCW" buttons activate the positioner directly in Mode 0, Mode 1 and Mode 2. These buttons also are used in the PROGRAMMING MODE to make changes to factory defaults and for selecting preset headings.

NOTE: Throughout this manual you will see different words for the same item. Some common terms would be: Sometimes we just get tired saying the same old thing.

RC2800PXEL = Controller, Control box, box or unit.

DISPLAY = Readout, Heading,

ROTATOR = Positioner, Rotor

RUN MODE DESCRIPTION AND EXPLANATION

RUN MODES: Modes 0, 1, AND 2 are RUN modes that activate the positioner with manual or pre-set commands. Momentarily push either MODE button to cycle through Modes 0, 1, and 2.

MODE 0: Manual operation mode. Pushing the CCW or DOWN button activates the rotator in the COUNTER-CLOCKWISE direction and the HEADING count will go down. Pushing the CW or UP button activates the rotator in the CLOCKWISE or UP direction and the HEADING count will go up. The positioner runs while "CCW" or "CW" button is depressed, ramping up from minimum programmed speed to the maximum (9) and stopping, WITHOUT ramp down, when the button is released. **When reversing direction there is a 2-3 second delay before positioner activation.** This delay reduces stress on your antennas, tower and guy system.

NOTE:

Rotation direction, *i.e.*, CW / UP or CCW / DOWN is defined as if you are looking down on the rotator / antenna from above. There is **no** automatic **speed ramp down** when operating in Mode 0 EXCEPT AS YOU APPROACH A LIMIT. Small movements of positioner may not allow full speed to be reached.

(Special programming will soon be available at our web site (www.m2inc.com) that can be downloaded directly into your RC-2800PXEL to reduce the 'reverse delay' to .1 sec for special applications). General updating will be available from the web site as well.

MODE 1: Computer control or Manual preset mode. When computer control is activated, a "1" automatically appears in the MODE # location on the display. Manually the "CW" / UP and "CCW" / DOWN buttons can be used to select a heading on the display from the full range of rotation. AFTER the button is released, there is a short delay before positioner activation, allowing time to adjust or "bump" your selection. As the positioner begins to run, the speed ramps up from the minimum programmed speed to the maximum. As the target heading is approached, the speed ramps down to stop. The positioner may then "bump" several times until within about .5 degrees of preset. To STOP or cancel a preset ANY TIME, TOUCH either mode button.

MODE 2: Programmable preset mode. Press the "CW" / UP and "CCW" / DOWN buttons to cycle through 10 PRESET headings you program into Modes 20-29. Heading selections are shown on display. After a short pause, allowing you to confirm you selection, the positioner will proceed to the displayed heading the same as in MODE #1. Typically, these presets are programmed for frequently used headings and / or stow positions for parking or extreme weather. TO STOP OR CANCEL A PRESET IN MID TRAVEL TOUCH EITHER MODE BUTTON.

PROGRAM MODE DEFINITIONS AND EXPLANATIONS

PROGRAM MODES: Modes P1-P6 are PROGRAM modes that permit entering, changing, or reviewing programmed system parameters. PROGRAM modes P20 through P29 are reserved for 10 preset headings.

TO CYCLE THROUGH THE VARIOUS PROGRAMMABLE MODES, depress and hold the **UPPER** mode button in for 3-5 seconds. The display will change automatically to mode P20. P20 is the first of your 10 PRESET headings. More on these later. Bump the **LOWER** mode button down through modes P6, P5, P4, P3, P2, P1, AND **P0 CAL**. Go back up by bumping the **UPPER** mode button. The display will show current mode setting. The FACTORY DEFAULTS are listed below. Most of the time these will never be changed. To program or change any setting, depress the "CW" / UP or "CCW" / DOWN buttons until the desired setting is displayed. Change anything or everything in the program mode except P6 and SAVE just once. NOTE: THIS IS DIFFERENT FROM OLDER VERSIONS OF RC2800's. (NOTE: DURING PROGRAMMING, THE NUMBERS CHANGE SLOWLY AT FIRST THEN SPEED UP. RELEASING THE BUTTON AND PRESSING IT AGAIN RESETS THE PROCESS OF SLOW TO FAST NUMBER CHANGE)

TO ENTER "PROGRAM MODE": Press and hold the upper Mode button until P20 appears. P20 through P29 contain preset headings. We put in our favorites but you can choose your 10 favorite directions or presets and change the default settings anytime. One or all can be changed and then saved as described below.

Bump the lower mode button once and **Mode P6** appears. For use with the OR2800 **P6 is used only to correct your heading if the antenna system was not clamped perfectly at the time of installation or if your mast or antenna slips slightly in a high wind..** To change to a new heading. touch the CW button. 0.0 should appear. Touch CW again. If the digits count up (.1, .2 .3 etc.) continue until you near the corrected heading. Let off and press again. IF THE NUMBER WON'T GO UP, WHEN CW IS PRESSED, then press the CCW button and proceed until you approach the corrected heading. Let up and press again. If you overshoot, press the other button until you get to the corrected heading. SAVE by pressing and holding the LOWER MODE BUTTON until MODE 0 appears along with the current speed setting and your new, corrected heading; example (0 8 23.5).

PROGRAM MODES, P5, P4, P3, P2, AND P1. THE DEFAULTS ARE SHOWN.

TO SAVE ANY OR ALL NEW PROGRAMMED SETTINGS AT THE SAME TIME EXCEPT FOR P6: Depress the **lower** mode button UNTIL MODE 0 APPEARS. P6 must be saved as soon as it is set.

P5 = 1 This is the minimum SPEED and RAMP setting. A '1' gives you full speed and ramp control. (NOTE: When trouble shooting a faulty operation, to get good motor voltage and reed switch readings, it is helpful to temporarily set the speed to 9. This eliminates motor pulses and give a steady DC reading for your DVM.)

P4 = 19200 This is the number of pulses from a MT-3000AEL motor/gear assembly. The RC2800PXEL can handle pulse counts or gear ratios of up to 40,000! The more pulse counts, the more accurate the rotation control and readout becomes. **See the "Getting started" section** for setup of other types of motor / gear systems like prop pitch rotators or MT-1000AEL series elevation mechanisms.

P3 = '0' This program is not used when a MT-1000AEL, MT-3000AEL or MT-5000 is in use.

PROGRAM MODE DEFINITIONS AND EXPLANATIONS

P2 = 'L14' This is the CW limit that matches the physical limit switches inside the OR-2800. The L14 would change automatically to 'L194' if you had set your RC2800PXEL up for SOUTH stop. See "Getting Started" section for MT Series elevation mechanisms.

P1 = '14' This is the CCW limit that matches the physical limit switches inside the OR-2800. The '14' would change automatically to '166' if you had set your RC2800PXEL for SOUTH stop in P3. In actual operation, as you rotate CCW below 00.0 degrees or below 180.0 degrees, the display will show an 'L' before the true heading. When you turn the unit on after a few days or even a few hours it is helpful to know you are in a limit zone and can't go much further in that direction. See "Getting Started" section for MT Series elevation mechanisms.

TO CALIBRATE YOUR OR-2800 CORRECTLY:

Push and hold in the UPPER mode button. "P20 0.0" should come up. Bump the LOWER mode button SEVEN (7) times until you see "P0 CAL" Push in the LOWER mode button and you will see the SEGMENTS of the digit to the left of the "C" start to rotate counterclockwise at the same time the rotator is moving Counterclockwise (CCW). Release the LOWER mode button and the rotator will continue going CCW by itself at half speed. Soon the rotator will stop and the display will change to read "0 9 L346". The rotator and the control box are now IN SYNC and CALIBRATED. THIS PROCEDURE CAN BE REPEATED ANYTIME IF YOUR CALIBRATION IS LOST, CHANGED OR SUSPECT. It can also be done remotely from a computer. Normally, the only thing that can keep your RC2800PXEL from displaying the correct heading is IF your mast or antenna has slipped.

Now push the CW button and rotate the OR2800 until the display reads TRUE NORTH (0.00) or close. The "antenna system" should be pointed at TRUE NORTH and clamped using the OR2800 mast clamps. **YOU ARE NOW CALIBRATED**

TO CALIBRATE YOUR MT-1000AEL, MT-3000AEL OR MT-5000 CORRECTLY: This part assumes you have already set P4 to the proper gear ratio for your unit.

Press and hold the upper mode button until P20 appears. Bump the Lower mode button once down to P6. Your 00.0 degrees of elevation can be set anywhere on the MT-1000AEL since it can rotate continuously through 360 degrees. Run the display count down to 0.1 and save by pressing and holding the lower mode button until 0 9 00.0 appears. The speed digit may be different. **MT-3000AEL** and **MT-5000** units typically set the array at 0 degrees as the array is "looking at" the motor. This is very near one end of the chain on the D ring. Again in mode P6, use the UP / DOWN buttons to set the display to 00.1 and save by pressing and holding the lower mode button until 0 9 00.0 appears. The speed digit may be different.

PRESET MODE DESCRIPTION AND EXPLANATION

MODE P20-P29 = Reserved for entering 10 programmable 'PRESET' headings.

TO PROGRAM YOUR FAVORITE HEADINGS NOW, CONTINUE WITH THIS STEP OR DO IT LATER.

TO PUT YOUR FAVORITE HEADINGS IN NOW , DO THE FOLLOWING:

PUSH AND HOLD THE UPPER MODE BUTTON. "P20 10.0" WILL APPEAR UNLESS THE UNIT HAS A PRESET NUMBER ALREADY IN P20. NO MATTER WHAT APPEARS, PUSH THE CW OR CCW BUTTON AND HOLD UNTIL YOU GET NEAR YOUR FIRST FAVORITE HEADING; SAY IT'S 30.0 RELEASE THE BUTTON AND THEN PUSH EITHER CW OR CCW TO GET TO EXACTLY 30.0 DEGREES. (NOTE THE NUMBERS CHANGE SLOWLY AT FIRST THEN SPEED UP.)

NOW BUMP THE UPPER MODE BUTTON AGAIN AND "P21 00.0 SHOULD APPEAR. PROGRAM AS BEFORE TO YOUR NEXT CHOICE.

CONTINUE UNTIL ALL 10 PRESET POSITIONS ARE FILLED.

NOW SAVE YOUR SETTING BY PRESSING AND HOLDING THE LOWER MODE BUTTON UNTIL MODE '0' APPEARS.

YOU CAN CHANGE ANY OF THESE SETTINGS ANYTIME BY GOING BACK INTO THE PROGRAM MODE, BUMPING UP TO THE "P" NUMBER YOU WANT TO CHANGE. THEN CHANGE THE READOUT TO THE NEW HEADING. IT WILL BE SAVE WHEN YOU EXIT THE PROGRAM MODE BY PRESSING AND HOLDING THE LOWER MODE BUTTON UNTIL MODE '0' APPEARS.

REAR PANEL

TERMINAL STRIP

This 6 terminal strip at left serves as cable interface to the rotator unit. The cable supplies power to and data from the rotator. Your multi-conductor cable from the rotator connects here. A ground stud is provided at right end of terminal for shielded cables. DISCONNECT AC POWER CORD WHEN CONNECTING CABLE LEADS.

“RS232”

This is a 9 pin female (DB9) connector for linking to computer RS232 port.

“VAC SELECT”

A flush mounted voltage selection switch for 115 or 230 VAC. At the factory, we set this switch to “115”.

“FUSE”

Provides electrical protection to components. Replace with a 3 Amp / 250V type. Units designed for use with special or prop-pitch motors may require a different fuse, usually a 5 amp. Match factory installed fuse. A second high current fuse may be present on some units controlling large prop pitch and 1/3 hp and up motors.

“AC IN”

The AC cord plugs in here. Connect to a reliable 115 VAC or 230 VAC source. Power is filtered to protect components.



TERMINAL ASSIGNMENTS

TERMINAL	FUNCTION	RECOM. COLOR	MIN WIRE GAGE
#1	MOTOR	BLACK	AWG 16
#2	MOTOR	WHITE	AWG 16
#3 *	3 WIRE MOTOR ONLY	RED	AWG 16
#4	NOT USED		
#5	REED SW. DC+	ORANGE	AWG 24
#6	REED RETURN	BLUE	AWG 24
STUD	CASE GND	BARE	NA

* THREE WIRE MOTORS INCLUDE: AC AND PROP PITCH MOTORS.

TERMINAL # 1 BECOME MOTOR COMMON. FOR A MT-1000, MT-3000 OR MT-5000 USE ONLY TERM. 1 AND 2.

INSTALLATION HINTS: Poor quality wiring or cable AND wiring errors are the major cause of operational failure. Occasionally this even causes rotator or control box failure.

For short runs of 100 feet or less, the wire sizes listed above are adequate. For runs over 100 feet, multi conductor cable like Belden 9405 is fine. Since only four total conductors are required, and only two of those conductors carry any current, 3 wires can be put in parallel for each motor lead. The danger here is that you mix up the wire colors from one end to the other. Results can be disastrous so be very careful with this paralleling technique. Sometimes so much capacitance exists in between the cable wires in long runs that the nice SQUARE WAVE pulses formed by the reed switch and rotating magnets at the motor are distorted and contaminated to the point that the microprocessor cannot count them accurately. A very positive FIX for this condition is to use a shielded wire for the pulse / reed switch line. RG58 is great for this application. It is made for outdoor use and it is reasonably rugged and tough and can withstand abuse and still get the job done. If you want the KILLER CABLE for all applications, the WIREMAN makes an 8 conductor plus one shielded conductor that will operate your OR2800 AC or DC reliably from over 850 feet from the RC2800PXEL. It is about the size of RG-213. We highly recommend it for those LOOONG runs! Another way to handle a long run is to use two large #8 wires and a run of RG58. Run this way to the base of the tower and then convert to Belden 9405 or Wireman cable for up the tower to the rotator.

OPERATION BY COMPUTER

1. Connect appropriate cable from your computer to Control Unit's DB9 connector on rear panel.
2. Most computers have a 'HYPER TERMINAL' or equivalent capability. To get into Hyper terminal click on your computers 'Start' box and go to 'Programs'. Then slide to 'Accessories' and then to 'Communications'
Then slide over to "Hyper Terminal"

Double click on Hypertrm.exe (execute file)

The next screen is called "Connection Description"

It will ask you to enter a 'Name' (ie OR2800P) and choose an icon. Then click 'OK'

The next screen says "Connect to". Go to the last box and click on "Connect Using". Choose direct to 'Com 1' and click 'OK'

The next screen will bring up your Port Settings as follows:

baud rate	9600
bits	8
stop bits	1
parity	none
handshake	present, but not used

Click 'OK' and your terminal is now set up and accessible from your desk top icon.

If computer control is desired and a program like NOVA or SKYMOON is used, their instructions cover the interface to the RC2800PXEL. Logging programs like CT and others are compatible as well. If you are using a program that currently does not work with the RC2800PXEL, send the author of that program a copy of this page and the following two pages regarding writing software.

HYPER TERMINAL OPERATION:

A. Commands in upper or lower case are acceptable.

B. All commands are followed by an ENTER (carriage return / cr).

C. Remote operation (Mode 1) is initiated automatically from the terminal. Once terminal is attached to the RC2800PXEL, TURN ON THE RC2800PXEL. IF IT HAS BEEN ON, TURN IT OFF. WAIT 5 SECONDS, AND TURN IT BACK ON. Display will look something like this:

M2AZ1 2.2 KO6YD The 2.2 is the version software and KO6YD is the author.
A=25.4 S=9 S Note: early units may not have the decimal point. S = top
speed setting and 'S' means the unit is stopped.

D. To go to a new heading say 180.5, type that number in and hit 'enter'. The readout will stream down the monitor during rotation. It will look something like this:

A=26.7 S=1 M ('M' indicates the rotator is moving)
A=32.8 S=3 M
A=37.3 S=6 M
A=45.2 S=9 M
and finally;
A=180.6 S=9 S

If you turn the unit off, the last message would be: A=180.6 ERR=05. ERR=05 means the unit has saved all volatile data and is experiencing "Low 12 volts". Other ERR messages can be found in the 'SOFTWARE PROGRAMMING' section.

E. You can now increment (0.5 deg or less) quickly back and forth with no delay. Type + and 'enter' for CW or UP and - and 'enter' for CCW or DOWN. This feature is currently Keyboard entry only.

USING RC2800PXEL FOR DUAL CONTROL OF AZMUTH AND ELEVATION POSITIONER

3. The RC2800PXEL Elevation Controller circuit board has an additional port to interface with another RC2800PXEL for dual control of and MT series Elevation Positioner (Rotator). This is necessary if you plan to control your antenna array in both the azimuth and elevation axes via a computer. If you have purchased an M² MT-Series Elevation Rotator and wish to control it simultaneously with the RC2800PXEL Azimuth Controller the following steps must be made:

- A. Contact us to order the MT- Series Jumper Cable or how to make one yourself (wired 1:1, 2:2, etc).
- B. Remove the top covers of the azimuth and elevation RC2800PXEL.
- C. Attach the MT-Series Jumper Cable to the 10 pin socket labeled J41, with the RED STRIPE DOWN, on the RC2800PXEL AZIMUTH Controller circuit board. J41 is located just right above RS232 Port cable. Now feed the jumper cable through the rectangular hole in the back plate of the controller.
- D. Next insert the jumper cable through the same square hole on the back side of the of the RC2800PXEL ELEVATION unit. Attach the jumper cable to the 10 pin socket labeled J41 on the circuit board, with the RED STRIPE UP.
- E. Bring up the desired control program (SKYMOON, NOVA or Hyper Terminal).
- F. Turn on both units simultaneously or the AZIMUTH CONTROLLER first, then the ELEVATION CONTROLLER.
- G. SKYMOON AND NOVA operation is handled in those programs. When just using the Hyper Terminal mode from the computer keyboard, you must select A or E and then type the desired heading. The system will default to the 'A' (Azimuth) control when first turned on.

USING THE RC2800PRK (Rack mount dual controller)

The RC2800PRK contains two almost identical RC2800PXEL printed circuit boards. The only difference is the Micro processor programming. The AZ chip is slightly different from the EL chip in that the AZ chip controls the final data stream to and from the computer and sets up the time share between the AZ and EL units. There is a 10 wire jumper between the two board running from J41 to J41. All operation is identical to the details described in the individual AZ and EL manuals.

SKYMOON AND NOVA operation is handled in those programs. When just using the Hyper Terminal mode from the computer keyboard, you must select A or E and then type the desired heading. The system will default to the 'A' (Azimuth) control when first turned on.

SUMMARY OF CONTROLLER COMMANDS

USE THE FOLLOWING INFORMATION TO WRITE YOUR OWN CONTROL SOFTWARE

Typed commands in lower or upper case, cr = ENTER or carriage return, # = real number including tenths.

FUNCTION	COMMAND	DESCRIPTION
SELECT:	A or E cr	where A = Azimuth, E = Elevation
SPEED:	S# cr	where S = 1 (minimum speed) through 9 (maximum)
GO TO:	# cr	where # = a number within your programmed parameters. Numbers less than 1.0 must be preceded by a 0.#, (0.3)
INCREMENT	+ cr	where + = bump + approximately .5 degree
DECREMENT	- cr	where - = bump - approximately .5 degree
STOP	S cr	where S = stop movement
UPDATE	cr	where cr gives one line of Position, Speed, and Movement Status
CALIBRATE	CAL NA cr	Where 'cal' starts the positioner moving slowly CCW to the physical limit switch in the positioner and then automatically resets readout to L346.0.

HOW THE COMMANDS WORK

The RC2800PXEL is always in a continuous update mode.

A=135 S=5 M

Meaning: Selected controller (A or E) heading and other status is continually streaming down the HYPER-TERMINAL screen while positioner is moving. Once (A) azimuth or (E) elevation is selected, the A or E command is no longer needed. All commands that follow will affect only the selected positioner.

TO SELECT AZIMUTH OR ELEVATION CONTROL

Type one of the commands below and follow with an ENTER (cr):

-for Azimuth, type: A

-for Elevation, type: E

Once azimuth or elevation is selected, the A or E command is no longer needed. All commands that follow will affect only the selected positioner.

TO INCREASE OR DECREASE SPEED (assumes A or E has been entered)

Type the command and follow with an ENTER (cr). Speed changes may be entered while positioner is stopped or moving.

-for minimum speed, type: S1

-for maximum speed, type: S9

Commands S1 through S9 are available. For instance, S4 will set speed to 40% of maximum. Positioner will return a confirmation with "S=4" and update status at time of command. For example, command "S8" might return:

E=60.5 S=8 S

Meaning: E (elevation mode), position = 180 degrees, S (speed)=8 (80%), S (stopped) (or M -moving).

SUMMARY OF CONTROLLER COMMANDS

TO SELECT A POSTION (assumes A or E has been entered)

Type the command and follow with an ENTER (cr). Positions below 0 or above 360 degrees will cause the display to flash:

-select recognized Azimuth and Elevation positions from within your programmed parameters.

Positioner will return a confirmation with "P=XXX" and update status. For example, the command "135" might return:

A=135 S=5 M

Meaning: A (azimuth mode), to 135 degrees, S (speed)=5 (50%), M (moving).

RETURNED VALUES

All strings, including updates and error conditions, returned to the terminal by the controller are followed by a line feed (OA) and a cr (OD). No echoes are returned.

ERROR CODES:

There are a number of error conditions, returned by the controller to the terminal, as shown below (assume Azimuth):

A ERR=03

"Unexpected character" - returned when the received command is unknown.

A ERR=04

"Unexpected byte" - returned when the number of bytes received exceeds the buffer space.

A ERR=05

"Low 12 volts" - returned when the controller has detected a low 12 volt condition and has saved the current position and speed in a non-volatile memory. If the positioner was moving when this condition occurred, pulses counts could be lost, causing a slight error in the saved position.

RC2800PX/MT SERIES TROUBLE SHOOTING

SYMPTOM:

When rotator is wired to RC2800PXEL, the rotator runs just for a second and then stops. And 'E' will appear in the mode column of the display. To reset, hit either mode key.

Why does this happen? Most commonly, The microprocessor will not let the motor run more than a second if the micro' sees no pulses coming in from the reed switch in the rotator. If the rotator moves slightly, it means your motor and motor wires are probably OK.

POSSIBLE CAUSES:

This usually means that the RC2800PXEL is not getting pulses back from the rotator.

First remove the pulse wires from terminal 5 and 6 from the back of the control box.

Using a digital volt meter or equivalent, measure the voltage that is present between terminal 5 and 6 for about 1 second when you command the unit to go.. You should have 11.3 VDC. If this voltage does not appear briefly, turn off the control box and measure the resistance between terminal 5 and 6. If the resistance is less than 5000 Ohms, it means the protective MOV across terminal 5 and 6 inside the box is leaky or shorted. If the MOV is damaged it means it took a voltage spike over about 25 volts. It failed but protected the internal circuitry. Unplug the box, remove the cover, and using diagonal cutters, cut one lead of the red MOV soldered between terminal 5 and 6.

Now turn on the box and check for the 11.3 VDC between terminals 5 and 6. If the voltage is present, turn off the box, replace the cover and reattach the wires to terminal 5 and 6. Turn on the box and press DOWN or UP to see if the motor now operates properly. Recalibrate the unit and Call M2 and order a new MOV. The system can be operated without the MOV but during this time you have no voltage spike protection. When all else fails, call M2 at 559 432 8873 and we will help you trouble shoot the system.

If the above appears OK, then the missing pulses maybe caused by a control cable problem or a damaged. Again, turn off the box and remove the wires from terminal 5 and 6. Attach your meter in the resistance mode across the two leads just removed. Two states can exist. Your reading will either be a total open 10 meg Ohms or more OR a total short measuring only the resistance of the wires running to the rotator. Now with the meter leads still connected and measuring Ohms, turn on the box and press DOWN or UP and make the rotator move. Watch the meter to see the state of the reed switch changes. Each motor revolution will open and close the reed switch twice so you should see the meter change from open to shorted. This may take a few tries as the reed switch is open normally about 60% of the time. If you see no change of state, you either are not on the reed wires, or there is a break in the wires between the motor and the box or you have a faulty reed switch. The later is very unlikely. **Most of the time this problem is due to a wiring or connection problem somewhere between the rotator and the control box.** Use common sense trouble shooting your wiring.

SYMPTOM:

Motor operates but readout is erratic or consistently reads higher or lower than where the antenna system is actually pointing.

This is also an indication of wiring problem. Long runs of cable that have a cut in the jacket can fill with water and significantly increase the inter-wire capacity. This can allow motor spikes to be picked up by the pulse (reed switch lines) and add extra pulses to the count. It can also cause such distortion of the square wave from the reed switch, that the microprocessor can't read the actual pulse count. Replace the cable or run a separate RG-58U or equivalent line for the reed switch. This is not usually an indication that the reed switch itself is faulty. Don't remove the motor until you are absolutely sure the problem is in the motor.

RC2800PXL/MT SERIES TROUBLE SHOOTING

SYMPTOM: Rotator runs immediately after control box is turned on: This can mean that one of your motor control wires on terminal #1 or #2 is grounded. When one of your motor wires is grounded it completes the path to one side of the power supply. The microprocessor normally turns on a Darlington that in turn turns on the Mosfet that closes the circuit to ground and powers the motor.

To test this, remove the motor wire from terminals #1. Using your ohm meter, see if this wire is shorted to ground. If not, then the problem may be in the control box. The mosfet could be shorted or the Darlington could have failed allowing 10 volts of drive to appear on the gate of the mosfet, turning it on all the time. To confirm that the box is faulty, remove the motor wires. Using your volt meter, measure from terminal #1 to #2. 35 to 45 vdc will be present if the box is faulty. Call M2 for an RA (Return Authorization) number so we can be ready for your unit when it arrives.

Send it to:

M2 Antenna Systems Inc.
4402 N. Selland Av
Fresno, CA 93722

We NOW INCLUDE a copy of the power supply and conditioning and the motor control schematic if you prefer to do the repair . Here are some helpful details.

The Dual Darlington chip is an eight lead package SN75452 and may be available at local electronic parts stores in your area. Digikey and other large suppliers also would stock this device. The mosfet is a IRFI 530 (International Rectifier, Insulated case) device and it can be crossed to several devices with equivalent or higher voltage and current. The Dual Darlington is in a socket for easy replacement. The mosfet is bolted to the chassis so the board must be removed to replace it.

Input from the micro to the Dual Darlington is pins 1 and 2 for motor control and the output is pin 3. When the unit is in standby, the input is high (5 vdc) and the output is low (under 1 vdc). When and UP or DOWN button is pressed, the input goes low, allowing the output to go high (10 vdc) driving the mosfet on and closing the circuit to ground on the motor.

The Dual Darlington also controls the motor direction relay. Input pins are 6 and 7, output is pin 5 so if your motor will not reverse, perhaps this half of the Dual Darlington is faulty.

SIMPLIFIED THEORY OF OPERATION

The positioner will not run if it receives no pulses back from the reed switch.

The system works like this: terminal #5 on the back panel is supplied voltage from the internal 12 VDC supply. This 12 volts passes through a 2.2k Ohm resistor and then through an opto-isolator and out to terminal #5. The opto-isolator is basically an LED and an optical pickup that isolates our system from the outside world of voltage spikes etc up to 2500 volts. The 11.3 vdc and the ground return runs through a DPDT relay K1, which when closed, places the 11.3 and ground return on terminal 5 and 6 on the back of the box. Terminal #6 is now only grounded when K1 is closed. (ONLY when the positioner has been activated and is moving and pulses are still coming in). We did this to remove the ground potential from the cable and thereby reduce the potential for lightning or nearby impulses to find a path to ground in the cable. We feel this will further protect the reed switch circuit beyond the internal MOV and the opto-isolator.

When you 'command' the RC2800PXEL to run the positioner in MODE '0' by pushing the CW button, it knows to count up and by pushing the CCW button it knows to count down. The command to count one way or the other comes from the buttons on the front panel.

When you 'command' the RC2800PXEL to run the positioner, the internal 'direction' relay opens or closes, the reed switch relay closes, and the microprocessor opens its gate to any pulses coming in on terminal #5. It also turns on a power mosfet that closes the motor circuit. It then pulses the motor on a few times and watches for some returning pulses. If no pulses come back, **the micro shuts down the mosfet which turns off the motor.**

The 11.3 volt square wave pulses are formed when the reed switch closes and shorts the 11.3 V to ground (remember the 2.2K Ohm resistor?). The 11.3 V drops to essentially 0 VDC. The internal magnets mounted on the motor shaft, rotate past the reed switch causing it to close and open and close and open as they swing by. There are up to four magnets on the shaft and they go by the reed switch many times.

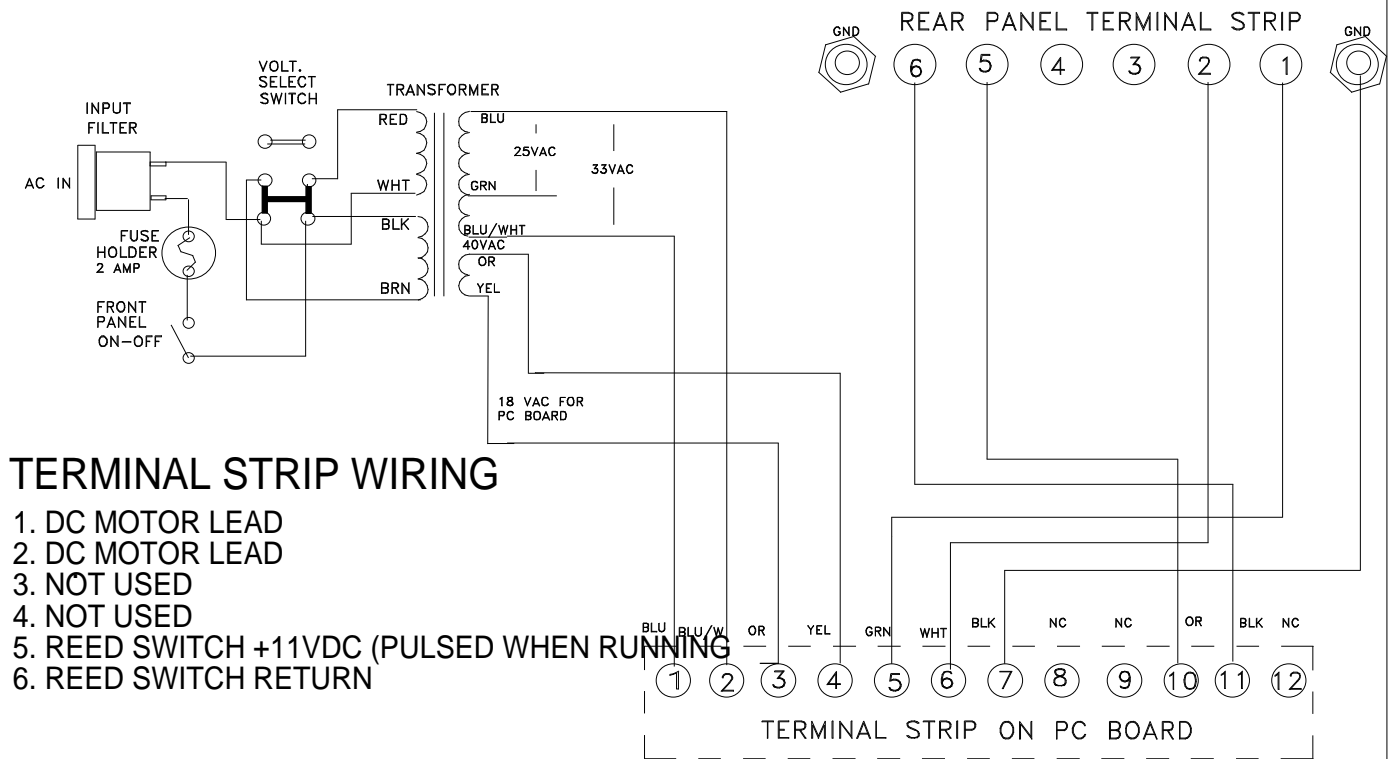
Look in PROGRAM MODE #4 and you will find the number MT-1000AEL=13200, MT-3000AEL=19200. The microprocessor uses this number to mathematically make sure your readout shows the correct heading.

FOR PROP PITCHES AND OTHER MOTOR GEAR BOXES

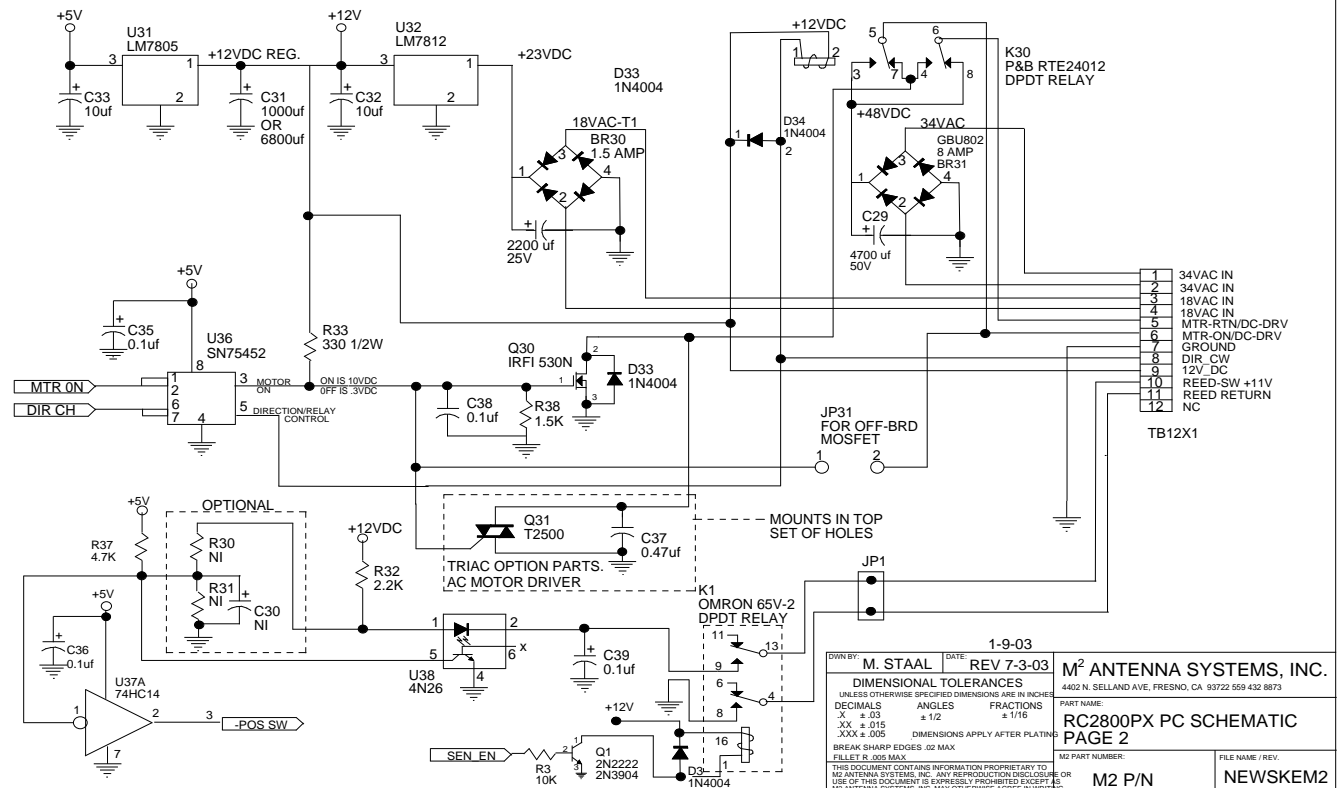
You can use the RC2800PXEL to determine an unknown gear ratio. First program mode #4 to 10,000 and save it. Next use the RC2800PXEL to rotate the system exactly 360 degrees physically. Now check the readout. It may say 280.0

Set up a ratio equation: $10000/280 = X/360$. Cross multiply to get $280X = 360,000$. Solve for X by essentially dividing both sides of the equation by 280 and you find the gear ratio (X) is actually 12857:1. The RC2800PXEL can now be re-programmed in MODE #4 from 10000 to 12857 and saved. Your readout will now be 360.0 for 360 degrees of rotation.

RC2800PXEL ELEVATOIN OX WIRING



RC 2800PX PC BOARD SCHEMATIC PAGE 2 POWER CONDITIONING, MOTOR CONTROL AND REED SWITCH PULSE CONDITIONING



12 MONTH LIMITED WARRANTY

RC2800PXEL RS232 CONTROLLER



This warranty gives you specific legal rights. You may also have other rights which will vary from state to state or province to province.

M2 warrants RC2800PXEL Control unit against defects in material and workmanship for a **period of 12 months** from date of purchase. During the warranty period, **M2** will, at its option, either repair or replace products or components which prove to be defective. The warranty shall not apply to defects or damage resulting from:

- Improper or inadequate maintenance by user
- Improperly prepared installation site
- Unauthorized modifications or misuse
- Accident, abuse, or misapplication
- Normal wear

M2 specifically does not warrant this product for any direct, indirect, consequential, or incidental damages arising from the use or inability to use the product. Some state or provinces do not allow the exclusion or limitation of liability for consequential or incidental damages so the above limitation may not apply.

In the event repair or replacement are necessary, purchaser shall contact M2 for return authorization. In many cases this contact can simplify and expedite the repair / replacement process and help reduce costs and downtime.

The purchaser shall be responsible for packing the product properly for return and for charges to ship the product to **M2**. Always include with the shipment, a statement detailing the problem / failure and any other pertinent observations. Insuring the product for shipment is recommended. Use the original packing materials whenever possible. **M2** is responsible for charges (**in the United States**) to return the repaired / replacement product only where warranty service is involved.

M2 ANTENNA SYSTEMS, INC. 4402 N. SELLAND AVE. FRESNO, CA 93722