IT'S NOT A CONTROLLER, IT'S AN

OptimizIR

SDA 2000 OPTIMIZIR CONTROLLER MANUAL

stepp**IR**
COMMUNICATION SYSTEMS

Table of Contents

Table of Illustrations

Introduction (John Mertel WA7IR)

The SDR 2000 OptimizIR controller is the latest in SteppIR's innovative line of products that bring enjoyment and high-performance to the amateur radio service. For many, this controller is an upgrade from either the original controller, or the SDA 100. The OptimizIR is also being upgraded on a large quantity of new antenna purchases, so this may be the first time these users have had experience with any SteppIR controller. We have created this instruction manual to address the needs of both users.

 The OptimizIR provides a new way to interact with the SteppIR antenna. We have spent significant time developing this product, and have had extensive feedback from customers on the design. We also worked with a team of beta testers to make sure we have a first-class antenna controller to be used seamlessly with your SteppIR antenna.

Many of the features that are standard in the OptimizIR controller have been around for a while in our other controllers, available for purchase. The primary difference is that in the OptimizIR, these options are now included as standard features:

- Transceiver Interface; This enables automatic adjustment of each antenna element of as the radio tunes. Wherever the radio tunes to, the SteppIR faithfully follows!

- Tuning Relay. The lock-out relay connects via a PTT cable to a RF power amplifier and prevents transmitting high level RF while the SteppIR antenna is being tuned. When operating with over 200 watts, it is prudent to not hit your antenna with that RF while it is in a mismatch.

- Advanced Lightning Protection (ALP). Each driver chip inside the OptimizIR has an isolation relay ahead of it to protect against lightning and dead shorts. The ALP board also offers enhanced troubleshooting parameters.

    Other features inherent to all SteppIR Yagis, Dipoles and Verticals:

- 180-Degree Mode. The **180** mode allows users to electrically "rotate" the antenna 180 degrees opposite forward direction beam heading. So if your antenna is pointing North, with a click of a button you will be beaming South.

- Bi-Directional Mode. The **BI 3/4** functions in a similar manner to 180-degree mode, except when enabled, the antenna operates as a hybrid Yagi with forward gain occurring in opposite directions, simultaneously.

- Element Retract Mode. With Element Retract Mode, user can retract all elements on a SteppIR antenna to home position. Optionally, the controller will then power down automatically. Retracting elements is an extremely valuable option in cases of inclement weather like high winds, snow or radial icing. During lightning events, a retracted antenna greatly reduces conductive area of the antenna platform. NOTE: The user is not required

to retract the antenna, it is there as a feature in case it is needed. There is no problem at all with leaving the antenna extended, even when not in use.

The SDA 2000 OptimizIR controller hosts a number of new features – color screen, large display and simplified user interface are what you will first notice when turning on the controller.

With the SDA 100 controller and the Original Controller, the user has always had the ability to create, modify and change the antenna. But the process was not simple, and it was buried inside the setup mode of the antenna software, only to be used by the more motivated SteppIR owner. With the OptimizIR, we have brought that technology to the "front" of the interface, and embraced the technology of creating and modifying antennas.

New antennas you will see on the OptimizIR are: maximum forward gain, maximum front to rear, and wide beamwidth antennas. Visually you can see what type of antenna is being utilized with the full color bar indicator that is always visible on the controller. Also new to the OptimizIR – every antenna (including DB32 and MonstIR) is included in the firmware, so you can operate multiple antennas (one at a time, you will still need to switch control cable) without having to modify the controller.

In addition, the user can create their own antennas using EZ-NEC or the many other antenna modeling progams, and then upload those models into the OptimizIR, using the included mini-SD card. There are some sites that are creating their own antenna models for SteppIR owners, such as Dan Maguire's Auto-EZ. You can check out Dan's software (available for $79) at www.AC6LA.com. Dan worked very closely with us in the computer modeling of the OptimizIR antennas.

The OptimizIR is the first of a series of new controllers that will make the SteppIR antennas "smart", and give the user the ability to fully employ the advantages of a remotely tunable antenna!

73

John Mertel
President/CEO

Warning

The OptimizIR has voltage present on control cable wires, even when **POWER** button has been pushed to off. Unplug power supply and disconnect 25-pin D-sub connector before making any connections or cutting or splicing cable wires. The driver chips inside the controller will be damaged if the power and control wires short out.

We highly recommend grounding controller chassis to station ground. An 8-32 ground stud is provided for this purpose. SteppIR recommends a short length of at least ¼" wide tin-copper braid.

Do not transmit while antenna is adjusting when operating with over 200 watts.

Purpose

The OptimizIR provides the optimal configuration of antenna hardware based on frequency, antenna model, and desired pattern.

New features include:

1. Ability to change antennas (from vertical to DB42 Yagi) without firmware reload or hardware changes
2. Remembers last frequency used per band (Manual mode)
3. Frequency adjust knob with selectable step-size (Manual mode)
4. Band buttons for all available bands.(Manual mode)
5. Up to 16 patterns per band, NORM, 180 degrees, BI 3/4, Max-Gain, Max Front-to-back and others defined by the user.
6. Pattern select knobs and pattern buttons
7. Autotrack mode with frequency step-size adjustment per band
8. Autotrack mode will only change frequency if band changes
9. Enhanced Create/Modify mode allow creation of new patterns
10. Micro-SD card to transfer and save antenna configuration files
11. Can load saved antenna file from SD card
12. Large TFT color display
13. Tuning relay – standard feature
14. Transceiver interface – standard feature
15. ALP driver board – standard feature.

Release History

April 2018: Public Version 1.0

Initial Controller Checkout

Perform following steps in listed order. For this initial controller checkout, the controller cable can be disconnected.

1. Connect power cord from universal power supply into controller.
2. Plug power cord from universal controller into a 100-240 Vac, 50-60 Hz outlet.
3. Power/Tuning LED should glow amber.
4. Turn on controller by pressing POWER button.
5. **Power/Tuning** LED should now glow green.
6. **NORM** LED should glow green.
7. Verify screen shows "SteppIR" logo for about 6 seconds and then shows the startup screen similar to front page shown in this manual.

Theory

Yagi antennas are basically single frequency devices that work well only over a very narrow range, typically 0.5% change in frequency. Fixed length yagis compensate by using a variety of techniques, all of which result in serious degradation of performance, especially in Front to Rear rejection, and added complexity, size, and weight. Dipoles have a much broader bandwidth but still cannot cover the entire 80m and 40m bands and maintain a low SWR (<1.5:1). Our patented solution is to simply adjust the all of the antenna elements to the optimal length for the desired frequency with none of the compromises in performance that all fixed antennas require. This is accomplished remotely using an electronic controller that can even automatically follow the radios' frequency. SteppIR antennas enjoy optimal performance on all frequencies within their specified frequency range (varies by model) = and that includes non-ham radio frequencies as well!

The OptimizIR takes frequency and pattern input, applies those quantities to an antenna model and commands antenna hardware to set element lengths to those values.

Using the OptimizIR is as simple as making the controller frequency match the radio frequency using the front panel buttons, and then waiting for the **Power/Tuning** LED to stop flashing. This function is automatic when connected to a radio using the Autotrack feature.

Remember that SWR is not the only factor important for high performance antennas. Minimum SWR does not always align with best antenna performance. Our antennas have better than 1.4:1 SWR in normal operating modes on almost all models, with 6M and 30M being exceptions on some models.

Rain and ice accumulation can influence antenna matching and performance. Either can cause resonant frequency to shift lower by a small amount. Under most circumstances, it can be ignored. Unlike conventional antennas, such loading can be corrected for by

simply shifting antenna frequency higher using manual mode. Using **Global Correction** in options menu can be used to correct for performance shift.

Operate Mode

Power-On Screen

When controller is first powered on, the SteppIR logo, controller model and copyright information are displayed for about 6 seconds, and then controller enters operate state.

Initial Power-On Screen

The check fault enunciator will display if no control cable is connected or if controller detects an error. The controller then displays status screen for Operate mode.

Menu Screen

Modes of Operation

NORM Mode

The **NORM** mode is used when manually operating controller and primary intended use for the ham bands. When in **NORM** mode, tune through bands simply by using frequency band buttons. Controller will simultaneously adjust length of each element to the chosen frequency band. The display shows what frequency antenna is tuning to, plus **Power/Tuning** LED will blink amber/green. Frequencies outside ham bands can also be selected.

When controller is in **NORM** mode, selectable bands are pre-programed to get antenna close to desired frequency. Most SteppIR antennas work very well over a 100 KHz frequency range (minimum) except on 80 m. Bandwidth will depend on the antenna model.

180 Mode

The **180** degree mode is one of the most popular among SteppIR users. The 180 mode allows the user to electrically "rotate" antenna 180 degrees from the current **NORM** direction beam heading. This is done by simply pressing a button. In 2-1/2 seconds, (shorter on higher frequencies, longer on lower frequencies) transformation is complete. The existing reflector becomes a director and director becomes a reflector. The antenna will now have a completely opposite pattern. With a two element Yagi, director becomes a reflector. In addition to greatly reducing rotator use, many SteppIR users report the 180 function is an excellent tool for short path / long path operation or for picking up elusive multipliers in the heat of a contest.

BI 3/4 Mode

The **BI 3/4** (BI stands for bi-directional) mode operates in a similar manner to 180 except when enabled, gain occurs in both directions. There is approximately 2 dB less gain than normal, but now gain occurs in both forward and reverse directions. This feature can be very handy for those who are involved with net operation or contests where hearing (or sending) signals from two directions are advantageous.

Main Screen

The display in the normal operate state depends on the antenna state and which antenna is selected. The screen will contain:

- Currently selected pattern
- Antenna type
- Bar graph displaying relative signal strength.

- Selected patterns Front to Back, Forward Gain and Beam Width
- Frequency setting
- Fault message if there is a problem needing attention.

```
Pattern = Normal DB-18E

   ┌┬┬┬┬┬┬┬┬┐
   └┴┴┴┴┴┴┴┴┘
 Front to back Forward gain

     0.0dB      00      0.0dBi
```
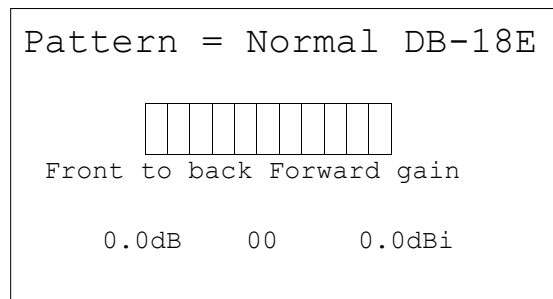
Screen After First-Time Power-On

There are pushbuttons surrounding the TFT full-color display. The buttons are labeled **NORM**, **180** and **BI 3/4**. **RETRACT** and **POWER** always have the same function. Buttons without labels have on-screen messages. These messages change depending on controller's operating mode.

When a button with an on-screen message is pressed, the color will change indicating selection. For example, if **AutoTrk** button is pressed, it will illuminate green indicating the Autotrack mode is enabled. In the case of Autotrack, it will not illuminate unless the transceiver interface is ON, Refer to setup mode's **"**Autotrack Setting" to configure the controller for automatic frequency tracking.

The **K2 knob** adjusts displayed frequency by step-size displayed in upper right of frequency window. The step-size can be changed by pressing **K2 knob**.   If Autotrack is enabled, frequency will change to radio frequency every time there is an update. This will over-ride any changes made with **K2 knob** or band buttons.

The **K1 knob** will select antenna pattern from available list for selected band.

There are different patterns available for **NORM**, **180**, and **BI 3/4**. For instance, if a maximum front-to-back antenna is desired, select **NORM**, then use **K1 knob** to select Fwd-MaxFB.

Across bottom of display there are band buttons plus a set of "<<" which indicate there are more bands to the left. For example with a DB18, if display shows there are buttons for 20 meter through 6 meter bands, pressing "<<" will shift buttons so 40 meter through 12 meter bands are displayed.

During antenna length changes, both affected band button and **Power/Tuning** LED located below **POWER** button will blink at one second intervals. When tuning is done, band button will have a steady green border.

OptimizIR Buttons in Operate Mode
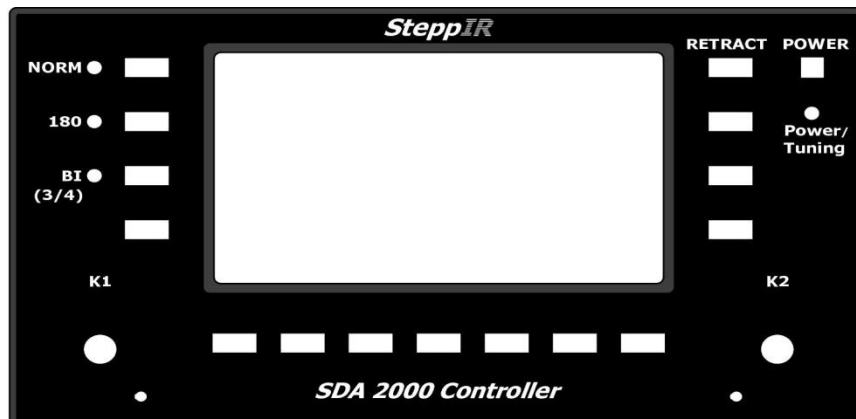
OptimizIR Front Panel

The **NORM** button selects the Forward antenna patterns used in conjunction with the **K1 knob**. The LED next to it will light when pressed.

The **180** button selects reverse, opposite of **NORM**, antenna patterns used in conjunction with **K1 knob**. The LED next to it will light when pressed.

The **BI 3/4** button selects Bidirectional antenna patterns, the ones that defeat front-to-back ratio of the antenna used in conjunction with **K1 knob**. The LED next to it will light when pressed.

The **K1 knob**, **NORM**, **180** and **BI 3/4** buttons all control selectable patterns. The number of sub-patterns selected with **K1 knob** can be 0 to 15 depending on the antenna and band selected.

The **K2 knob** controls frequency by rotating knob and step-size by pressing the knob. When **K2 knob** is pressed, it cycles through five possible frequency step sizes of 5 kHz, 10 kHz, 25 kHz, 50 kHz and 100 kHz. Turning **K2 knob** will adjust frequency by step-size. The antenna will start tuning immediately upon changing frequency.   As long as frequency is within band limits (can be changed from setup menu) and antenna is allowed to finish tuning to new frequency, it will be saved as default band frequency. The last used frequency for each band is saved separately so controller will always return to last frequency used on a given band.

For single-element vertical antennas, pattern is omnidirectional.   Hence, **180** button is unsupported. When **BI 3/4** is pushed, the vertical become a ¾ wavelength antenna instead of the normal ¼ wavelength on frequencies above 21 MHz where physical dimensions of antenna hardware allow this to occur. Pressing an unsupported direction sets controller to **NORM** and lights the LED.

The **AutoTrk** button toggles controller between Manual mode and Autotrack mode. The on-screen button is green when enabled. In Autotrack mode, controller responds to frequency updates sent from a transceiver or computer to the OptimizIR over the transceiver interface. When under control of radio, antenna will be re-optimized and will follow radio to any frequency within range of antenna. Frequency spacing during re-optimization depends on band step size.

For proper operation of Autotrack mode, transceiver setup menu parameters must be set to match transceiver type and baud settings. To prevent controller from updating each time frequency is changed, Autotrack step-size can be programmed individually for each band.

The manual tune buttons are still active in Autotrack mode, but operation depends on selected radio, step-size and or source of frequency data.

Precautionary Note: When used in Autotrack Mode, some radios send display frequency via serial interface. When radio is in split-mode, frequency change displayed between transmit and receive frequencies may cause frequent and inconvenient antenna tuning. One remedy is to temporarily disable Autotrack mode. Another cure is to set Autotrack step-size to be large enough to encompass transmit and frequency difference. The third solution is to set Autotrack to Band Mode to allow automatically tuning only if band changes. When using Autotrack Mode, it is prudent to have a transmitter lockout to make sure there is no RF being generated while antenna is tuning. Although the radio alone (<200 Watts) cannot damage the SteppIR antenna, driving an amplifier and transmitting with high power levels while antenna elements are moving is very stressful and will cause premature aging of the movable contacts in the SteppIR antenna EDU. With SteppIR antennas, it is ALWAYS good practice at any power level to wait for tuning to stop before transmitting.

The **RETRACT** button has two modes of operation. By default, pressing **RETRACT** button will cause antenna elements to be homed. This action is immediately followed by an elements home message. If Setup Options menu item "Power off Retract" is selected, after elements are homed, controller display will switch off and controller will go to sleep.

Setup Mode

Pressing **SETUP** button opens the OptimizIR Setup Menu.

```
SETUP Menu

K1 for next item

Options Menu
```

Setup Main Menu

The Setup Menu comprises sub-menus some of which are optional depending on antenna type. Scroll through list of menu items with **K1** or **K2 knobs**. The list does not loop. The items will change rapidly so turn knob slowly.

There are 2 soft keys, **Select** and **Exit**. **Select** will enter a sub-menu and **Exit** will exit sub-menu or setup menu if no sub-menu is selected. **RETRACT** will also exit setup menu. Pressing **K2 knob** is same as pressing **Select**.

Press **Setup** once to enter setup mode. Even though soft key for setup is not present when in setup menu, button is still active. Pressing setup button while in setup menu will exit current menu. To select setup options. Use **K1 knob** to find desired sub menu and press **K1 knob**.

The selections available are 1) Options Menu, 2) Calibrate Antenna, 3) Retract Elements, 4) Autotrack Settings, 5) Band Limit Settings, 6) Transceiver Setup, 7) Motors Test, 8) Relays Test, 9) Software Version, 10) Antenna Selection, 11) Reset User Data, 12) Fault Code Menu, 13) Create/Modify, 14) LCD Display Setup, 15) Flash File Menu.

Options Menu

The **K1 knob** will cycle through possible options. The **K2 knob** is used to change option value. **Select** is used to confirm change to option. When pressing **Select** button, entire display will briefly flash on and off to verify change has been accepted. Change is immediate when **Select** is pressed. Global offset does not change element lengths until **Select** is pressed.

This option does not enable 6 meter band. It is used to tell controller that antenna has optional 6 meter passive element. If 6 meter Passive Element Kit is installed on antenna, select "Yes" with **K2 knob** and press **Select** button. The lengths for the 6m passive element will be active for the **NORM** and **180** positions in the frequency range of 50 through 51 MHz. On 6 meters with the aluminum element kit installed, the **180** mode will not function on that band. The **BI 3/4** mode will dramatically reduce the front to back, but the antenna will still have some forward gain. This does not affect any other band.

Remote Driver Option

This option requires optional remote driver board kit. If using optional remote driver board it must be enabled by selecting "Yes". This tells controller to use remote CAT-5 port at rear of controller to communicate with driver board instead of board inside controller. The driver board in controller housing is still required to power controller and to communicate with remote driver board. The OptimizIR can be used in normal stand-alone mode just by turning off remote driver option.

Power Off Retract

This option determines whether or not controller will automatically power off after elements are retracted when **RETRACT** button on controller front panel is pressed.

Display Metric

This option sets units to be metric or not when displaying element lengths. This only affects Create/Modify menu item.

Global Correction Factor

This option allows changing element lengths over a range of +/-2.0% and affects element lengths on all bands and modes (**NORM**, **180**, **BI 3/4**). If a correction factor is only needed on some bands, there is a per-band setting available in **Create/Modify Mode**.

To change correction factor, use **K1 knob** to adjust value of correction factor. Use **K2 knob** to select which setting to change. Press the Save button to store new setting and make antenna tune to new lengths.

In some weather conditions (e.g. ice freezing on fiberglass tubes), it may be necessary to change default lengths for elements by a small correction factor to bring antenna tuning and SWR back into normal range. Any water, snow or ice on elements is going to make elements act electrically longer, moving antenna's resonant frequency down. Since all elements are affected equally simply applying

a negative correction factor (making elements shorter) until SWR is low will allow antenna to operate normally. When water, snow or ice is gone, put antenna correction back to original setting. This feature allows the user to use antenna in any weather conditions with no performance degradation, as opposed to fixed element length Yagi's which may be unusable for as long as elements have water, snow or ice on them. It can also be useful in some cases of interaction or low antenna height situations.

Calibrate Antenna

Selecting **Calibrate** causes an antenna calibration to be performed. Whenever antenna is not acting as it should, activating **Calibrate Antenna** function is recommended before exploring other potential problems. This is the first thing to try if antenna is exhibiting higher than usual SWR or decreased performance. The main reason for "uncalibrated antenna situation" is loss of power while elements are extended. This is because there is a small holding voltage present at all times to keep elements from moving when it is not being tuned. Note that it is not necessary to calibrate for each band.

Calibrating antenna ensures element lengths are accurately reported by controller. The controller does not know where antenna element is unless it is started from a "known" place. Even if elements are fully retracted, controller still retracts full length of tape plus some extra length. The stepper motors will continue to over-step for a short period of time after elements have reached the stop. In doing this, controller is making sure there is no doubt each element is fully retracted and back to a known starting point. Retraction is performed at low motor power levels and doesn't cause any damage to EHU. The calibration procedure usually remedies most cases of elements being off in their length. The elements are then re-deployed to appropriate length for operating frequency when calibrate was initiated. Calibration can take two minutes or more depending on selected frequency and antenna model and cannot be aborted. A **Calibrate** operation can be executed at any time in any mode. It doesn't matter what frequency the user is on when calibrating. When calibration is completed, antenna is calibrated at all frequencies.

Upon delivery, the EHU initially has each element fully retracted and controller is set to home. If controller is powered up and it says elements home and antenna control cable is connected with elements physically retracted, system is calibrated and ready to go. Always calibrate when in doubt - it is easy, and doesn't hurt a thing.

Retract Elements

To retract antenna elements, press **RETRACT**. The **Power/Tuning** LED will flash amber and green. When LED stops flashing, antenna elements are now fully retracted inside EHU. To put antenna back on air, simply press antenna segment desired. Controller will adjust to that segment.

Selecting **RETRACT** causes all antenna elements to be retracted to their home (minimum length) position. Retracting can take two minutes or more depending on selected frequency and antenna model and cannot be aborted. If optional "Power Off Retract" is selected, controller will go to sleep when retraction is done.

Before taking a SteppIR antenna down, always first **RETRACT** elements. To protect antenna and connected equipment during periods of non-use, lightning storms or harsh winter conditions, use **RETRACT** feature. This greatly reduces conductive area of antenna platform. In ice storms, retracting elements greatly reduces potential for mechanical damage in case of a catastrophic failure. Don't confuse "retracting" with "calibration". A calibration guarantees element is brought home and then extended from a known starting point. Retracting assumes proper amount of tape is extended and simply reels same amount to home position and leaves it. When retracting elements, the copper beryllium conductive strip is "safe and sound" inside EHU, leaving only telescoping fiberglass poles extended. These poles are easy to replace so even if the telescoping fiberglass support elements (pole) are damaged, the most valuable part of antenna is safe.

Autotrack Settings

Use **K1 knob** to select step-size. Use **K2 knob** to select band. Press **Select** key to save changes. If band is changed or exit is pressed without pressing **Select** first, changes will not be saved. The Autotrack settings determine how much the radio frequency must be changed before antenna will retune when Autotrack has been enabled on front panel. The available settings are 1, 5, 10, 15, 20, 25, 50, 75, 100, 150, 200, 250 kHz, and BAND. The BAND selection instructs the controller to only retune the antenna when it sees frequency change to a different ham band.

Using the other modes of **NORM**, **180** and **BI 3/4** can all still be used while in the Autotrack mode. To use the transceiver interface, the user must put the controller into Autotrack mode so the **Autotrk** annunciator lights green. To disable automatic tracking simply select the Autotrack mode so the annunciator goes out.

The band buttons are active when in this mode and will cause the antenna to change frequency until the controller sees another command from the radio. This could take up to 2 seconds. Avoid accidentally hitting the band buttons while using the transceiver interface to control the antenna. The transceiver interface will update the frequency if it is enabled with the radio or computer on overriding the band buttons almost immediately. If using the **RETRACT** button to home the antenna, the controller will override the tranceiver interface. If "Power Off Retract" is enabled, it will go through an automatic shut down once the elements are completely home.

Band Limit Settings

To adjust upper and lower frequency limit of a Band, first use **K1 knob** to select desired band. Next press ether of the **Lower limit** buttons or **Upper limit** buttons. Then use **K2 knob** to adjust limit frequency. Repeat for the other band limit. Then press **Select** to save. The display will blink. If band is changed or exit is pressed without pressing **Select** first, changes will not be saved. Band Limit is used to set frequency limits used in Autotrack Mode and other band sensitive options. It does not affect how element lengths are calculated or how Create/Modify works.
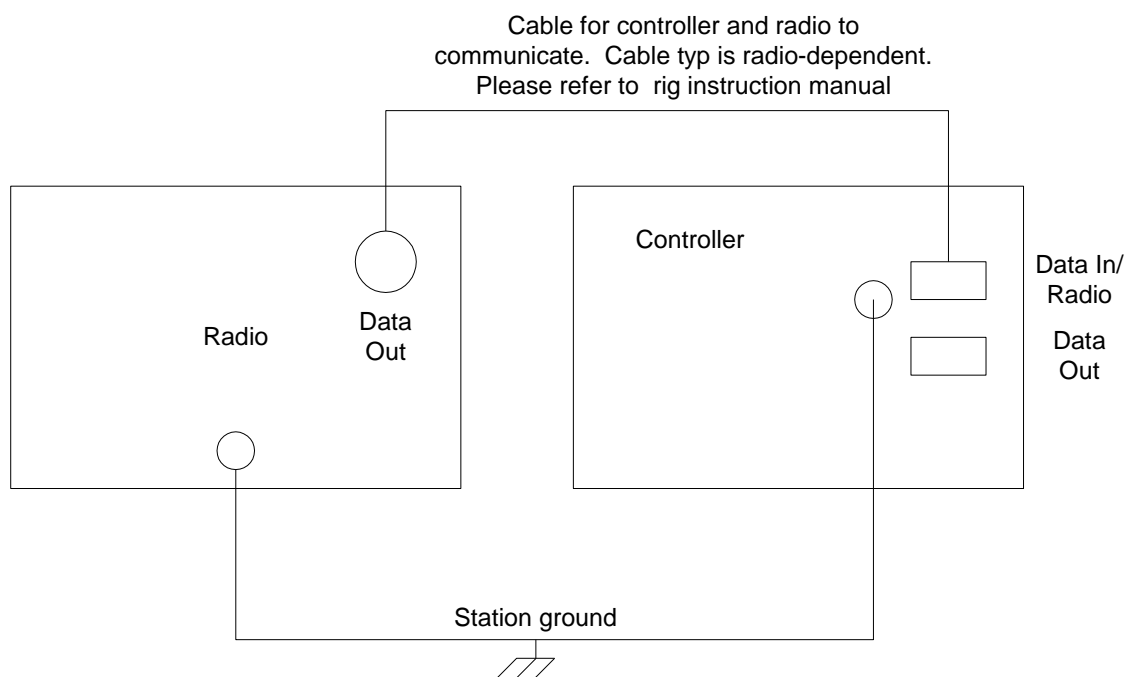
Transceiver Setup

This feature is used to link a radio, computer or another SteppIR controller to the OptimizIR. To use the transceiver interface, the rig needs to have computer interfacing capability. Rigs with these options were manufactured from 1990 and beyond. When enabled, the transceiver interface on the SteppIR controller will "listen" to the rig through its computer port, and will automatically re-adjust as the user tunes through the bands.
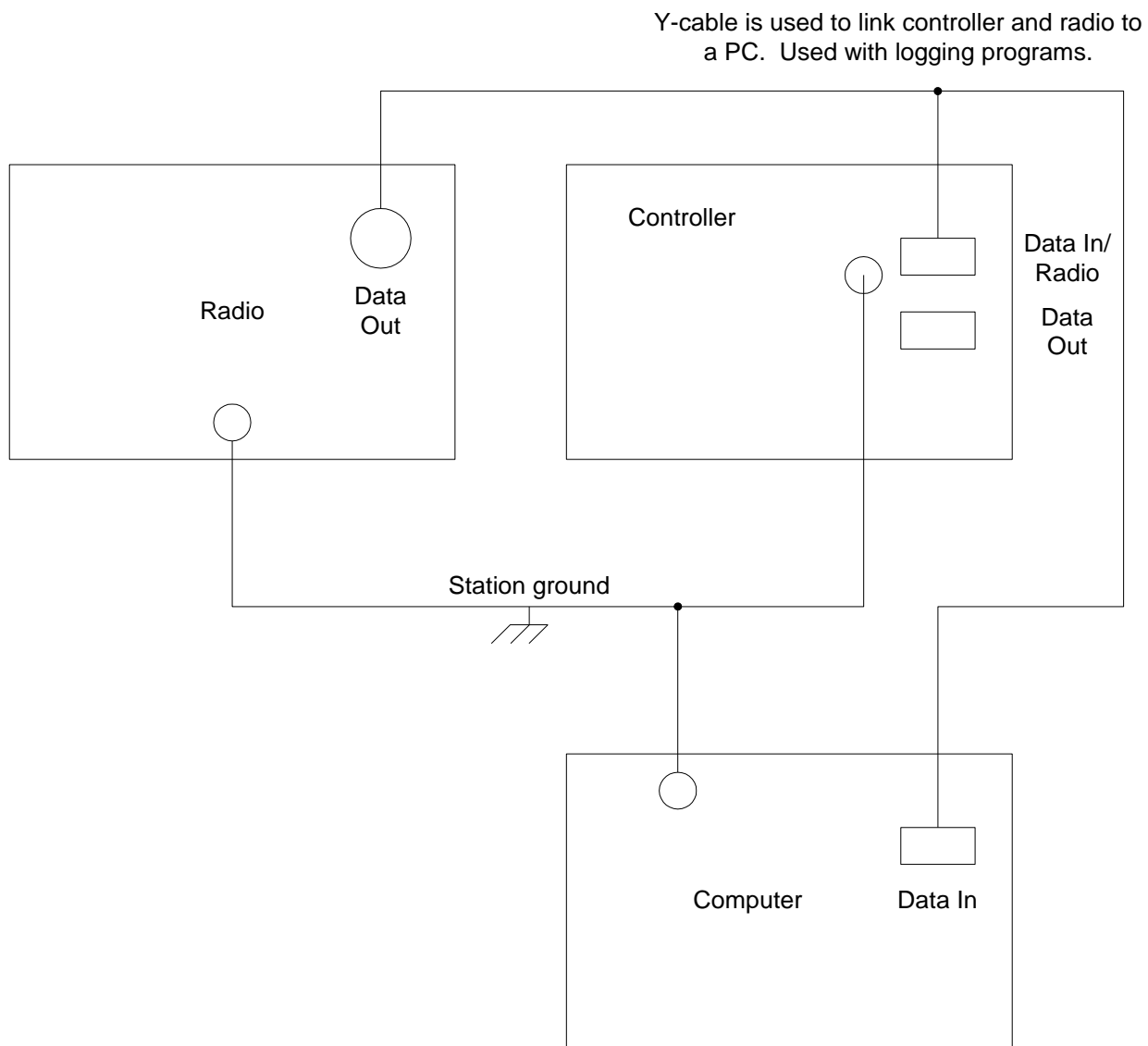
The user will also need an optional interface cable for the specific rig, which has a 9 pin female D-sub connector on one end that hooks up to the top "Data In / Radio" port on the back of the controller. The other end will go to your rigs interface. There is a second 9 pin D-sub connector below the first D-sub called "Data Out". This D-sub connector is used if the user desires to stack two SteppIR horizontal antennas. It allows the two controllers to communicate to each other, so when any change in frequency occurs on one controller, the other will follow. It also allows the user to connect the SteppIR directly to a PC. An optional "Y" cable is available from SteppIR that allows the user to run a logging program concurrently with the SteppIR controller. (Not required for ICOM radios).

Use **K1 knob** to select which item to adjust. Use **K2 knob** to change the value. Press **Select** to save changes. The transceiver Interface menu allows selection of radio brand and baud rate of the two ports at the rear of controller. The baud rate is the speed in which information is exchanged between the SteppIR controller and the radio. See operating manual for the radio to determine the proper baud rate. This setting must be the same as the setting in your radio, or the interface will not function. Note that ICOM radios require CI-V transceiver mode enabled. The data input and data output ports can be set to different baud rates. Adjust the three settings to the desired value and press **Select** key. The display will blink indicating settings have been saved. Selecting OFF for radio type will disable the transceiver interface and **AutoTrk** button. The data out port is always active as long as OFF is not selected for a radio type. This port is intended for daisy chaining controllers and computer control. See Transceiver Interface manual for details.

More than one radio may work for a given radio setting. For example, the Kenwood setting works for Elecraft and the FT9000 setting works for the FT3000 and FT6000. If radio model is not listed, check transceiver interface manual. Finally, some radios require settings to be changed to get their CAT port to work.

Cable for controller and radio to communicate. Cable typ is radio-dependent. Please refer to rig instruction manual

Controller

Data In/
Radio

Data
Out

Radio

Data
Out

Station ground

Transceiver Interface to Radio

Y-cable is used to link controller and radio to a PC. Used with logging programs.
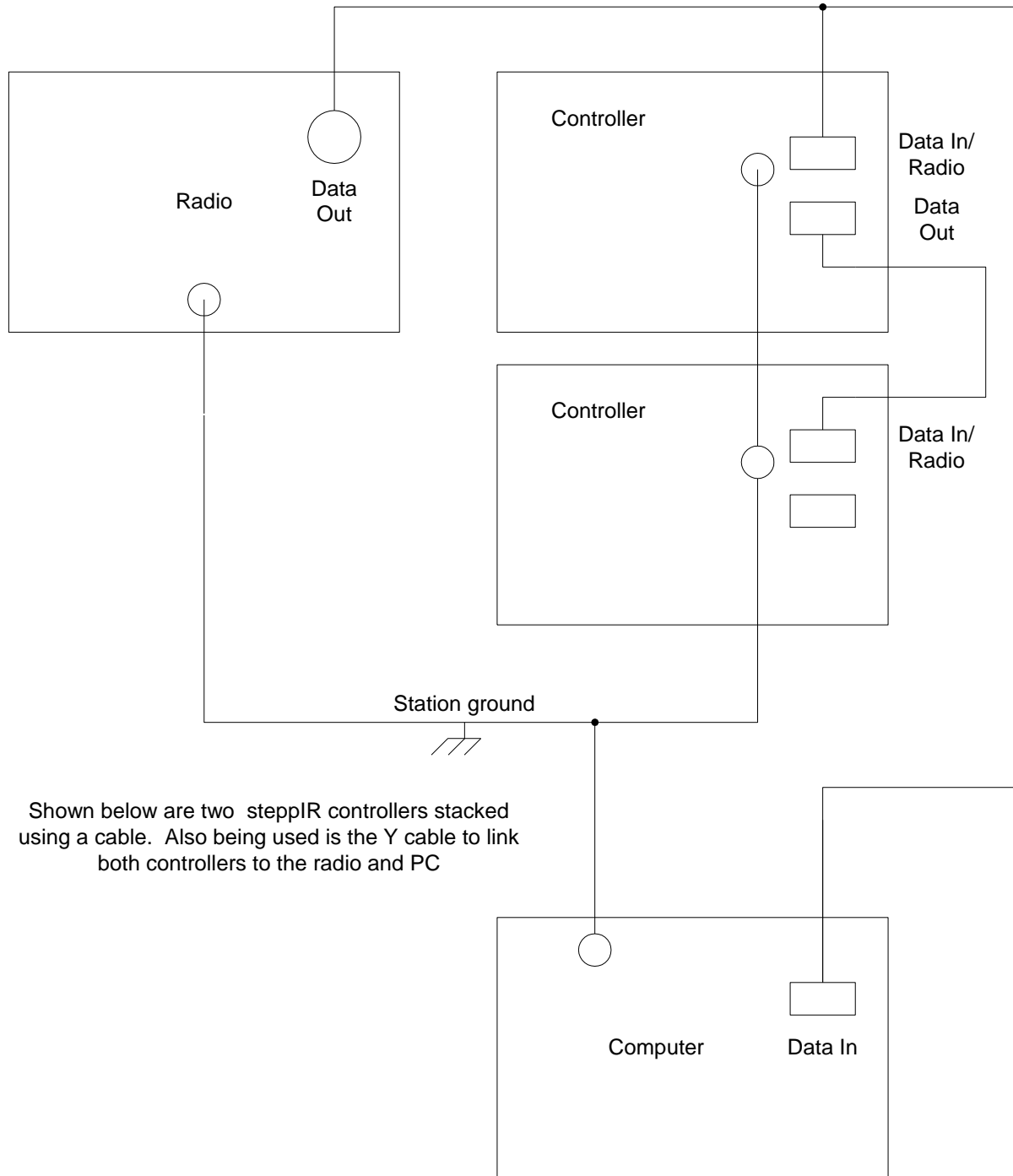
Controller

Data In/
Radio

Radio

Data
Out

Data
Out

Station ground

Computer

Data In

Transceiver Interface with Y-cable

Y-cable is used to link controller and radio to a PC. Used with logging programs.

Radio   Data
               Out

Controller   Data In/
                              Radio
                              Data
                              Out

Controller   Data In/
                              Radio

Station ground

Shown below are two steppIR controllers stacked using a cable. Also being used is the Y cable to link both controllers to the radio and PC

Computer   Data In

Controllers Stacked with Y-cable

Controller

Data In/
Radio

Data
Out

Station ground

Computer   Data In
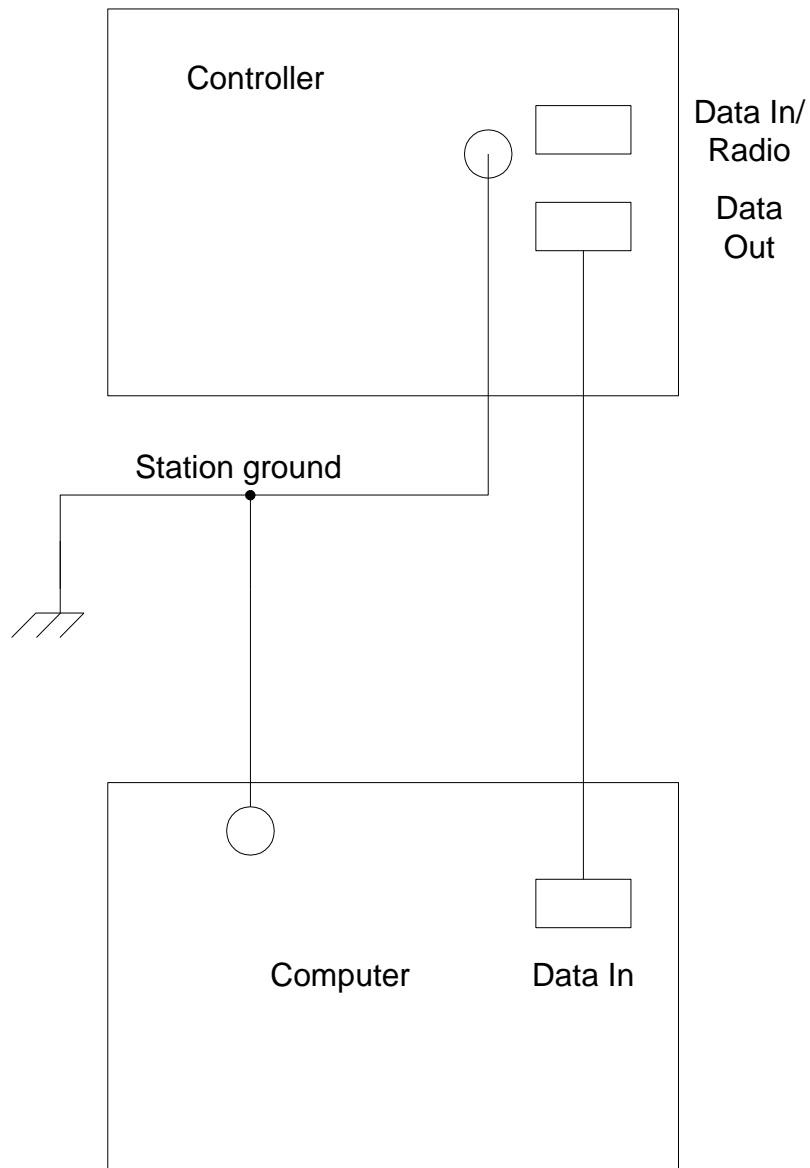
This configuration shows the controller linked to the PC with a cable.
This can be done if station has many different radios linked to PC.
This will allow user to control everything from the PC

Transceiver Interface to PC only

Motors Test

This feature is intended for testing the antenna on the ground for a new install or maintenance. When performing the "Motors Test", none of the18' telescoping poles should be installed at this point or the user won't see the tape extend out approximately 1" to 4". This test allows verification that each element is indeed the one the controller thinks it is and that it is wired correctly and not running backwards. If there is copper sticking out at the end of testing any element, the motor for that element is incorrectly wired. The stepper motors will run backwards if you swap the wires on either one of the motor windings.

Before connecting the 25 pin connector on the control cable to the controller, plug in the controller and turn it on. The screen should read "Elements Home". If it does not run the **RETRACT** function. The screen will indicate that it is homing the elements and finish with "Elements Home". It is now safe to connect the 25 pin connector on the control cable to the controller.

In the case of the "Remote Driver Board Option", the element can be tested while the antenna is on the ground. With the provided crossover cable that comes with the Remote Driver Board Option, plug the controller into the remote driver board at the base of the tower via the "Remote" CAT 5 plug. Refer to Remote Driver Board section for more information.

WARNING: Do NOT select any of the band buttons at this time. Without the 18' poles installed, if any of the band buttons are selected, the copper tape will come out of all the element housings onto the ground. This could result in damage to the copper tape requiring factory repair. Check to see if there is any copper tape sticking out of any of the element housings. If there is copper sticking out run the "Calibrate" function and this will bring the tape home.

If you are raising the antenna with the control cable attached, it is an excellent way to verify all of the element cables are connected correctly. The purpose is to verify the elements are wired correctly and correct element is moving. Also, some SteppIR antennas have assembly tests that require probing element for a continuity test. If element makes a chattering noise and doesn't move, but then after a few seconds extends out a few inches, motor may be wired incorrectly. If element doesn't move at all, it is either not plugged in, miswired, or controller has a bad driver chip. There is additional troubleshooting information available on SteppIR website for these situations

Selecting Test Motors will first **RETRACT** all elements. Use the Element buttons to select which element to test. There are two options: 1) cycle the element(s) or 2) send it out and hold. Press the **Out** button to send element out and hold until **In** button is pressed. Press **Cycle** buttons to cause motor to send element out a few inches then back in automatically. **Exit** will leave menu.

Select the **SETUP** button, and turn **K2 knob** to select "Motors Test". Press **SELECT** and the controller will automatically send any of the elements home before doing any of the test. This will be shown by the amber/green light flashing. Use the **"Element"** button to select individual elements or all of the elements for the antenna. The amber/green LED will begin flashing and the controller will feed out about four inches of copper out each side of the 20 meter element housing and 17 feet on the MonstIR elements.
To test a specific element simply press "**SELECT**" when the desired element is flashing. Verify that the element is in the right location and the copper tape is extending properly.
To exit the test, press the **SETUP** button.

Note: If the user is not going to connect the control cable and test it on the ground, make sure element control cables are positively identified and well-marked (DIR2, DVR, REF etc.). If the elements get mixed up on the terminal block, very confusing results will occur such as, high SWR, low performance, etc. Mark the cables coming from each element box with colored electrical tape. Mark them before you tape them along the boom, it is very easy to get two parallel wires mixed up. When the user is on the tower, it will be easy to identify each element control cable.

Relays Test

This option will only work with antennas equipped with relays. Test Relays will not change length of elements. It will only activate relay signals. There are 6 buttons. The **"O"** will open the relay and the **"C"** buttons will close the relay. Only one relay can be active at a time. The names correspond to relay names on switch box. This mode is provided to allow easy testing of relays on the DB series of antennas. Refer to antenna's User's Manual for details on how to perform these model-specific tests. This test must be performed on a newly built antenna to ensure it is wired correctly. **Exit** will leave the menu. When exiting this menu, all three relays are opened.

Software Version

This menu item displays the 1) Main Controller Board firmware revision, 2) Xcvr and 3) Driver board revisions.

Antenna Selection

From the menus, the **K1** or **K2 knobs** will scroll through list of available antennas. Press **Select** button or **K2 knob** to select new antenna. When controller is switched on for first time, this menu will come up automatically. When selecting antenna, any modified antenna data will be lost unless data is saved to flash card first. If the newly selected antenna is not in the current master antenna file, an error message will be generated and antenna will be set to a very basic mode. To correct problem, reload the correct saved

user antenna file or master antenna file and use the default menu to reload the antenna data.

Reset User Data

Press **Master Reset** to reset all saved values in Nov-Ram. The antenna type will not be reset. Press **Default Length** to reset element lengths. There will be a warning if element length data does not match default data.

Multiple master antennas are necessary because the boom length looks longer electrically as frequency is increased. SteppIR has judiciously broken the frequencies up and modeled a unique antenna for each range. This coupled with a smart software algorithm allows an optimal antenna at every frequency without having to model hundreds of antennas. If an antenna is created anywhere within the frequency range of a master antenna, the new antenna will be scaled by the software algorithm so the user has an antenna with the same performance characteristics throughout that range. To ensure the absolute best performance in the ham bands (any master segment where a ham band occurs) SteppIR modeled the master antenna at a frequency near the center of each ham band. So if the user is changing a model and creates the new antenna near the center of the frequency range, that antenna will then be replicated throughout the entire segment.

Fault Code Menu

Use the **K1** or **K2 knob** to scroll through fault codes. When there is a problem with antenna, a message will flash on upper right of screen "**Check Fault"**. This menu will display more information about the problem. It could be as simple as a disconnected control cable to as complex as a problem with antenna.

There are several messages but they fall into 3 categories:

No Response: Error message can be intermittent and indicate controller is having trouble communicating with device. In the case of the remote driver, this can be caused by cable and ground problems.

Antenna Cable Open: Indicates one of the antenna elements may not be working. The numbers refer to pin on the 25-pin connector on back of controller. A driver chip can also cause this error.

Driver Chip Error: This is a fatal error. It must be fixed before controller can be used. The "U" number refers to the reference designator for the damaged IC on the driver board.

Create/Modify

The factory default antennas programmed into the controller have been modeled and field tested to provide very good gain, without sacrificing front-to-rear performance. The **Create/Modify** menu allows the user to change the length of any SteppIR elements for each master antenna segment. This feature can be used to try out custom antenna designs, or to "tune out" potential objects that are causing interaction or SWR problems.

The driven element can be changed up to +/- 5% in length to obtain a better match with no appreciable change in gain or front to back performance. It is always best to just tune the driven element to correct SWR problems. This feature is especially good for those users who experiment with modeling programs such as EZ-NEC. When finished changing respective lengths, the user can save the new antenna to memory. This will override the factory default antenna for any given ham band or frequency range.

If at any point the user desires to go back to the factory default antennas, this can be done by pressing **SETUP**, select "Reset User Data" with the **K2 knob**, press **SELECT** then press **Master Reset** or **Default Length,** then press **SELECT**.

Computer modeling has dramatically simplified antenna design. With this technology, the average ham can create his/her own antennas and have a very accurate idea how the antenna will perform before it is built.

While the availability of antenna modeling software has been a giant leap forward in antenna design, to fully exploit it you need to be able to modify the elements length with the antenna mounted in its operational position. We are able to change the elements length in the air while on an antenna range and determine very closely our electrical element length. For typical Yagi antennas, the user must just estimate it, thus leading to less than optimum performance. With the SteppIR adjustable antennas, design technology has been advanced one step further. The user can now model and build as many different antennas they want, without ever leaving the ham shack.

Remember that modeling programs output the electrical length of the element, not the physical length. The controller indicates the physical length. The electrical length is from 2 -3.5% longer due to the conductor diameter, mounting hardware and dielectric loading due to the telescoping fiberglass poles. This data is accounted for and programmed into the factory default antennas.

The element names used refer to their location on the boom, not their function. See antenna manual for the location of each element.

The antenna can be created at any frequency within the ham band or general frequency segment. For the very best results, model the new antenna in the middle of the band or frequency segment and set the controller to that frequency before creating the antenna.

The frequency coverage range of each of the antennas is broken up into numerous blocks for each direction (**NORM, 180,** and **BI 3/4**). Each covered by a different antenna model.

Using the "Create/Modify" mode, the user can modify and save any of the master antennas in each of these frequency ranges. The frequency range is identical for the all three direction modes of the antenna (**NORM**, **180**, and **BI 3/4**). If you select "NO", no changes will be made and your antenna segment will be just as it was before.

The **K1 knob** is used to adjust value highlighted in RED. The **K2 knob** is used to select what to adjust. This also moves RED highlight. The software will not allow the user to adjust an element that does not exist. Only elements that are included in the selected antenna will be highlighted in RED. The buttons across bottom have many functions, depending on what is selected. The Create/Modify mode enables user to 1) customize antenna element lengths, 2) change relay settings and 3) control special antenna modes. All changes made in "Create/Modify" mode will immediately update the antenna. However, none of the changes are saved unless SAVE button is pressed. This allows experiments to be conducted without concerns about misconfiguring antenna.

The following items can be adjusted:

> **Select Pattern:** The **K2 knob** scrolls through a list of all patterns for the selected band, up to 16.

> **Adjust Element:** Highlight element to adjust with **K2 knob** and change length with **K1 knob**. Press **K1 knob** to change step increment from 0.1, 1 or 10 units.

> **Adjust Frequency:** The **K2 knob** will adjust through segment range only. It stops at the segment boundary. Pressing the **K2 knob** will change the step-size 10 kHz, 100 kHz, 1 MHz.

> **Select Segment:** The **K1 knob** will change current segment. Frequency will be set to bottom frequency of the segment. This is useful on bands with more than one segment like 6 m, 10 m and 80 m (and other antennas with loading coils).

> **Band Correction:**   The **K1 knob** will scale element lengths (ranging from 0.0% to 9.9%) for current band. This is useful for correcting for interference, or correcting for fiberglass loading when trying a new antenna model or tuning the 80 meter dipole.

> **Multi-Element Adjust:** This allows the user to select more than one element to adjust at a time. Use buttons to select elements to be adjusted and adjust **K1 knob** to change the setting. This can also be used to scale the 80 meter dipole.

> **Reset Pattern to Default:** This will reset current pattern (Direction) to default values. This does not reset saved values to Default. Save must be performed separately to make it permanent.

The **Clear**, **Copy, Save** and **Exit** buttons are active for 1) Select Pattern, 2) Adjust Element, 3) Adjust Frequency, 4) Select Segment and 5) Band Correction settings.

> **Clear**: Press this to remove currently selected pattern from this band. This will not clear Normal or 180.

> **Copy**: This will make a new pattern copied from currently selected pattern. It will allow the user to select a name for the new pattern from list of names associated with current direction, **Norm**, **180** or **Bl 3/4**.

> **Save**: Will save current pattern to EE-prom memory and will be used for tuning antenna in normal mode.

> **Exit**: Will check for modified patterns and ask is user wants to save changes for each modified pattern. It will then restore saved values and exit **Create/Modify** mode.

Any correction factors made using **Global Correction Factor** options will also be added to element length. Dipoles like on DB36 and DB42 use the End 2 elements to tune dipole, reflector and last director. There are three ways to tune the wire dipole namely, 1) adjusting the band correction, 2) multi-element adjusts or 3) individually adjust the elements. The 80 meter dipole has a segment every 100 kHz. To trim the dipole across entire band, segments need to be corrected individually. The vertical coil has more than one segment for a given band, they each must be tuned separately.

LCD Display Setup

The **K2 knob** scrolls through the changeable items**.** The **K1 knob** is used to change value. The **Select** button will save new value. Care should be taken when changing colors. It is possible to change settings too much and cause a black display. Color adjust will show how it will look before pressing **Select** button. Be careful with background, some colors cannot be changed.

> **LCD Brightness:**   Range is 0 to 32 with 0 being brightest and 32 being dimmest
> **Background Color:** Range is 0 to 80 cycling through a rainbow of colors
> **Foreground Color:** Range is 0 to 80 cycling through a rainbow of colors
> **Text Color:** Range is 0 to 80 cycling through a rainbow of colors
> **Button Text Color:** Range is 0 to 80 cycling through a rainbow of colors
> **Button Panel Color:** Range is 0 to 80 cycling through a rainbow of colors
> **Button Top Color:** Range is 0 to 80 cycling through a rainbow of colors
> **Button Bottom Color:** Range is 0 to 80 cycling through a rainbow of colors
> **Bottom Select Color:** Range is 0 to 80 cycling through a rainbow of colors
> **Custom Color 80:** Allows setting of custom colors
> **LCD Default:** Adjust the **K1 knob** to display **Yes**, then press **Select**.

Flash File Menu

The **K1 or K2 knobs** allow the user to select **Read Antenna File** or **Save User Antenna File**. The **Select** button selects highlighted item in RED.

Read Antenna File

Selecting this option will load a file from the Micro-SD card. This file can be a 1) master antenna file, 2) saved antenna file or 3) custom antenna file.

Master Antenna File

The master antenna file is stored in internal non-volatile memory. Antenna select and default antenna data access this file to get the data for the currently selected antenna. The Master Antenna File is loaded from the compact flash card using Flash File menu. The file can be saved as an antenna file or as the stepper supplied file that contains all versions of antenna manufactured by SteppIR.

Saved Antenna File

A file that was created when using the Save User Antenna File menu.

Custom Antenna File

A custom antenna file is one that was created and saved by the user.

Save User Antenna File

Selecting this option will write current antenna data saved in internal EE-prom to the Micro-SD card. The name will be automatically generated using current antenna name. Example DB-42/80 antenna will generate a file named DB4280.SAV. The controller will not check if file already exists. Hence, it will overwrite any previously saved file with same antenna name.

Here are a couple of possible reasons to use compact flash card:

Updated Master File Available

The procedure is:

1. Insert compact flash card into controller
2. Go to Flash File Menu
3. Select Read Antenna File
4. Select new Master Antenna File
5. Exit Flash File Menu
6. Select Reset User Data menu
7. Press Default lengths
8. Press **Select**

Using Controller for More Than One Antenna

To use controller for more than one antenna, but not lose the custom settings, do the following:

1. Save current antenna data using Flash File Menu Save User Antenna File menu.
2. A file will be saved with a name based on currently selected antenna with a file extension of .sav. Special characters cannot be part of file name.
3. **RETRACT** antenna elements.
4. The controller is now ready for a different antenna
5. When ready to restore controller, be sure to also save the currently selected antenna file.
6. Go to Flash File Menu and select "Read Antenna File".
7. Locate saved antenna file and select it.
8. Exit Flash file menu.
9. Select antenna selection menu and select antenna.

How to Update Firmware

To update firmware, obtain the following items:

1. USB Type A cable to USB Type B Mini cable (Amazon B00NH11N5A)
2. OptimizIR update programmer (available from SteppIR)

The firmware can be updated using the PC via a standard USB connection. The programmer and firmware are provided as a zip file entitled "OptimizIR programmer.zip". Download and unzip the zip file to PC.

The firmware update process is:

1. Install firmware update programmer to PC (AvrOspII).
2. Connect USB Type A to Type B cable from controller back panel to PC
3. Plug controller in and turn it OFF
4. The PC should recognize a FTDI serial device
5. Select correct com port so programmer auto detects the controller
6. Load cobra.hex file.
7. Start Update program
8. Press connect button
9. Press program button
10. Wait for Done
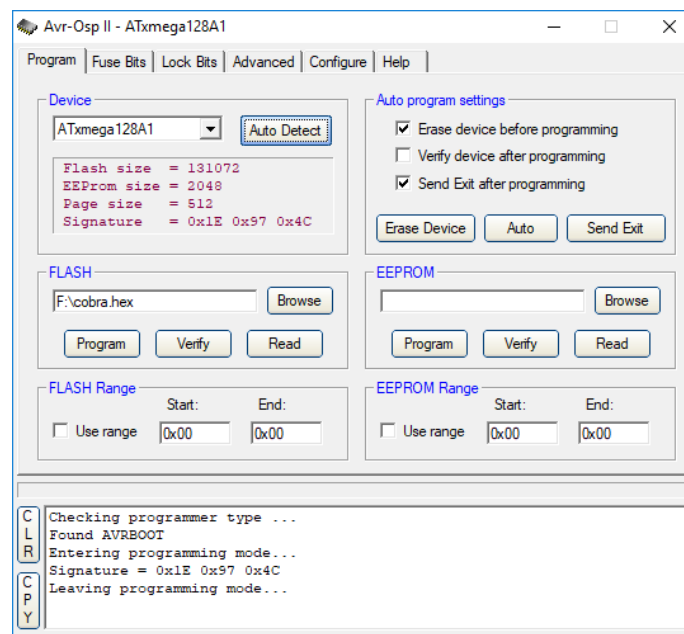
Screen Capture - AVR-Osp II ATxmega129A1 Programmer Panel

Tuning Relay

To prevent application of unintended, excessive RF power while the SteppIR antenna is tuning, the OptimizIR controller provides an isolated pair of contacts from a 3.5 mm stereo jack to interrupt the PTT relay signal to a linear amplifier. The cable is not provided, but a standard 3.5 mm stereo plug to two RCA plug cable sold for audio applications works well in most cases. Some more modern amplifier relay control schemes are different and may not accommodate an RCA plug. Older amplifiers may use high voltage in their PTT circuit which may be a problem for some transceivers. Please read your amplifier and transceiver manuals carefully. The 3.5 mm plug tip and ring connect to isolated relay contacts inside the controller that interrupt the PTT circuit. The sleeve connection serves as a ground/shield.
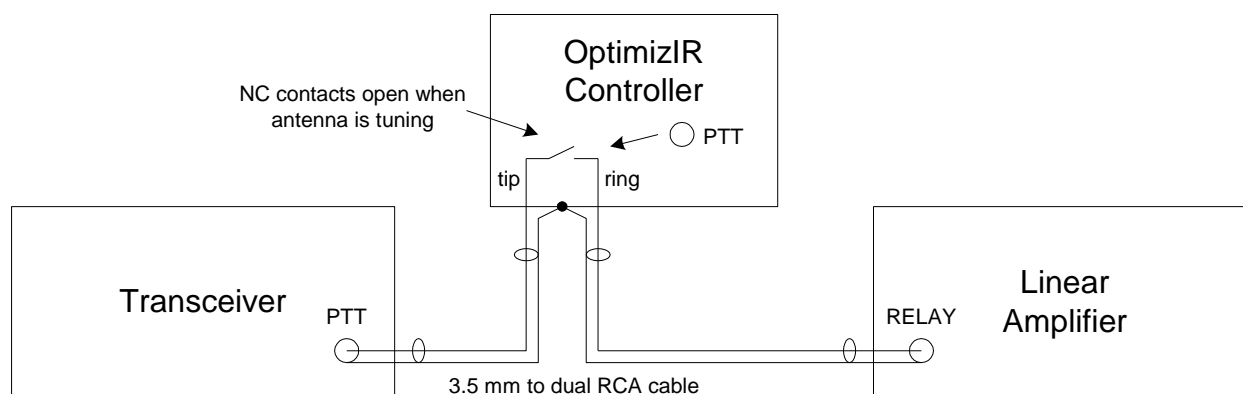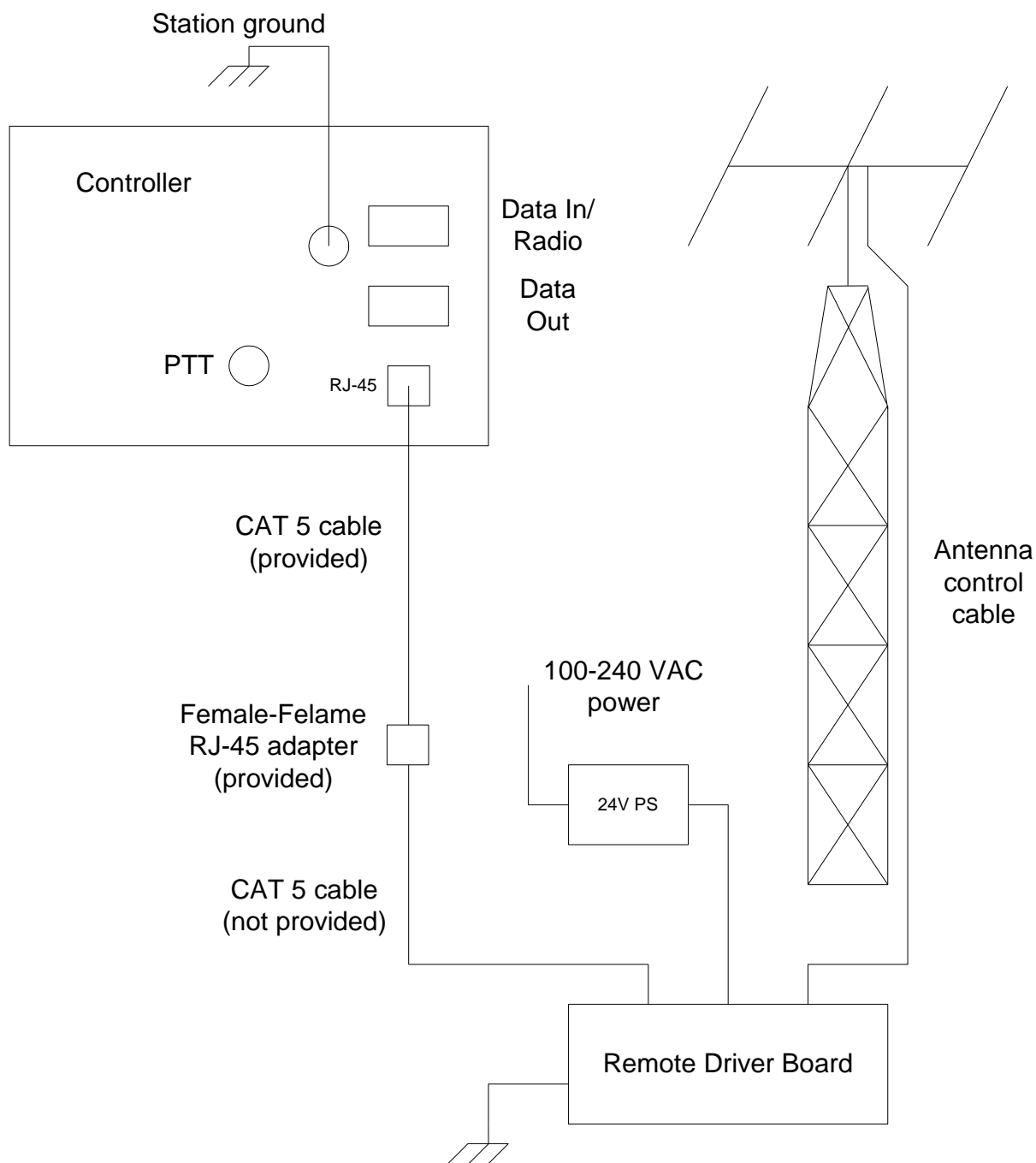

Tuning Relay Wiring

Remote Driver

This feature is for the user that needs to have the tower a considerable distance from the shack and controller. The problem this creates is line loss due to cable lengths over 500 ft. This feature solves that problem by placing another driver board at the base of the tower and connecting it remotely to the controller in the shack by use of CAT 5 cable. Now the user only needs to run the control cable up the tower. This option allows the user to have the shack and the remote driver board up to 2000 ft. away from each other without any problem with line loss.

This option allows for more flexibility for antenna placement, but it requires a 100-240V power source at the tower. The capability to talk to the remote driver is built into the controller, but to utilize this feature, an optional kit is required. This kit includes the remote driver board, a 24V power supply used to power the remote board at the tower and a

mounting plate for mounting the driver board in dry location out by the tower. This will also act as a grounding plate and should be connected to a good ground.

Station ground

Controller

Data In/
Radio

Data
Out

PTT

RJ-45

CAT 5 cable
(provided)

Antenna
control
cable

Female-Felame
RJ-45 adapter
(provided)

100-240 VAC
power

24V PS

CAT 5 cable
(not provided)

Remote Driver Board

Remote Driver Board Wiring

Advanced Lightning Protection (ALP)

The OptimizIR includes passive circuitry to protect the controller antenna interface against lightning or static. When ALP is activated, relays open to electrically disconnect the stepper motor driver circuits from the antenna. The protection is ready as soon as controller is powered up. This option does not 100% guarantee controller is protected. However, the added circuitry greatly reduces the probability of damaging a driver chip.

Driver Chip Replacement

If a driver chip fails, they are readily available from SteppIR at www.steppir.com.
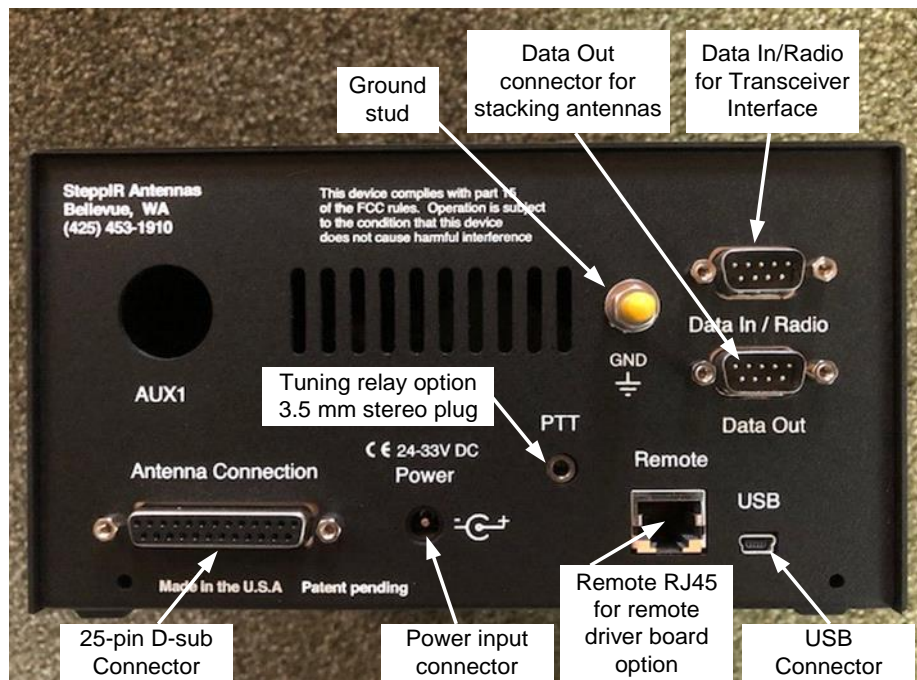
Memory Card Operations

Location of memory card and illustration showing removal and installation of memory card is shown below. Important note: Early units will require the removal of top cover to access memory card. New covers with an SD card access hole will be available April 2018.
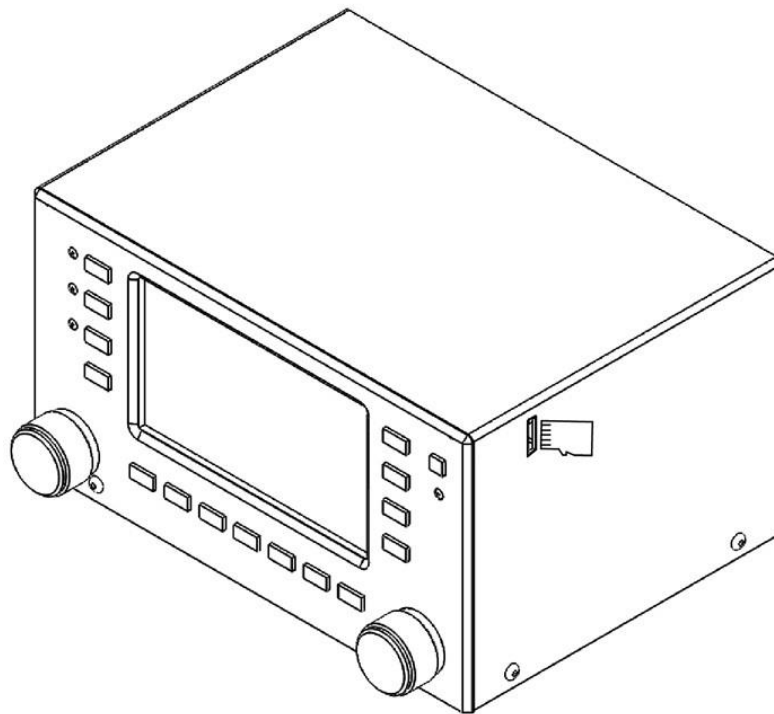
View of Memory Card Location
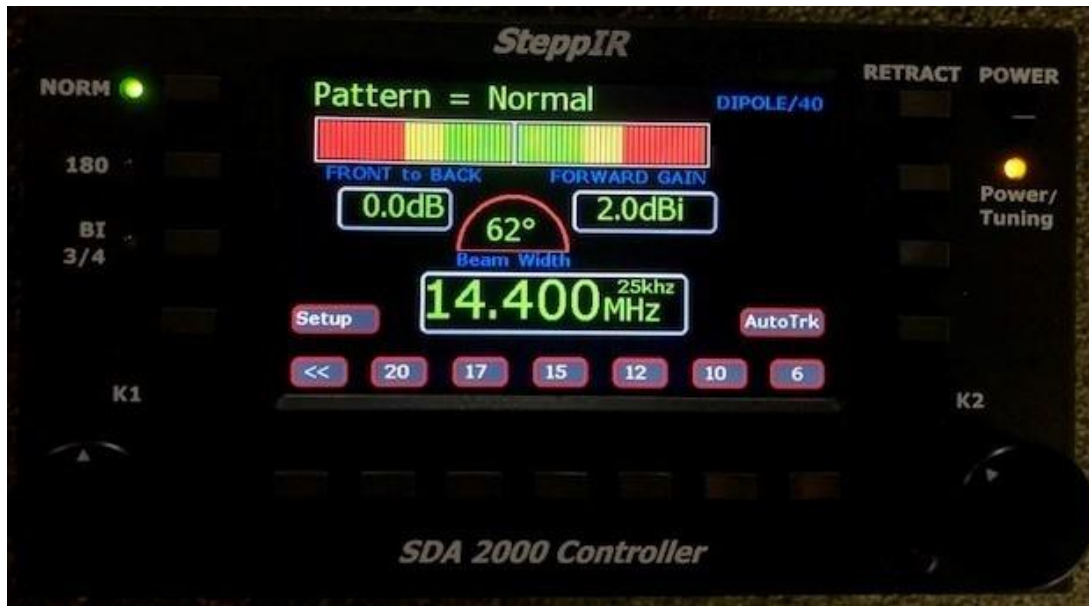
Front View of OptimizIR

Rear View of OptimizIR

Customer Support

Tel: 425.453.1910 extension 150 or extension 400

Email: support@steppir.com

Hours of operation are 9:00 – 4:30 PM

For troubleshooting tips you can visit our website at www.steppir.com

Links to troubleshooting:

Support overview:

https://www.steppir.com/support/

Frequently asked questions:

https://www.steppir.com/support/faq-frequently-asked-questions/

Troubleshooting tips:

https://www.steppir.com/support/troubleshooting-tips/

Manuals and Brochures:

https://www.steppir.com/support/manuals/

Expanded troubleshooting:

https://www.steppir.com/support/expanded-troubleshooting-guides/

RMA Repair form:

https://www.steppir.com/support/return-repair-form/

SteppIR IO Group (replaces the Yahoo group)

https://groups.io/g/steppir

IT'S NOT A CONTROLLER, IT'S AN