Receive Antenna Phasing Controller

DXE-NCC-2

DXE-NCC-2-INS Rev 1d



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Introduction

The DX Engineering NCC-2 Receive Antenna Phasing System Controller is a two-channel receive signal phasing device with a special relay system that allows the user to combine and independently adjust the phase and level of two antenna inputs. This essentially creates a fully adjustable phased array. When combining two stationary antennas, an array pattern is created with signal peaks and dips, called nulls. Adjusting the phase control has the effect of electronically rotating or steering that pattern. The operator can steer the null direction to significantly weaken strong interfering signals or noise, local or distant, and dramatically enhance the reception of weaker signals from other directions. The NCC-2 is especially useful on low frequencies, where phase nulling with small receive antennas can provide amazing benefits for almost all types of radio operating enthusiasts: DXers, casual conversationalists, contesters, AM DXers and Short Wave Listeners (SWL) throughout HF.

The NCC-2 Controller includes the RTR Receive Transmit Relay, which expands the exciting benefits of antenna phasing for interference reduction in two ways. First, the NCC-2 can combine signals from an HF transmit antenna and a separate receive antenna. Almost any Amateur, even those with space-limitations for separating the receiving and transmitting antennas, can enjoy the benefits of antenna phasing and noise-nulling to effectively notch-out strong stations or noise. Second, the user of any standard HF transceiver, that does not have a separate receive antenna input, can enjoy the enhanced reception of signal and noise nulling. The NCC-2 has rear panel SO-239, F and BNC connectors, making it extremely versatile and easy to connect to almost any receiver or HF transceiver as well as transmit and receive antennas.



The NCC-2 now features three internal slots per input channel for optional Plug-In Modules that can also improve reception. Receive Preamplifier Plug-In Modules are crucial for low-signal conditions. Receiver Guard Plug-In Modules offer front-end protection for the NCC-2 and the receiver. Plus, the Impedance Transformer Plug-In Modules match the 75 ohm receive-antenna feedlines to the 50 ohm internal impedance of the NCC-2 and the Receive Preamp.

The NCC-2 is fully compatible with DX Engineering Active Receive Antennas for excellent, low-noise reception from 300 kHz to 30 MHz. A pair of Active Receive Verticals, **DXE-ARAV3-2P** separated by one-quarter wavelength on the lowest band provides a steerable, optimized unidirectional pattern with a single null. Operations on higher frequency bands results in a multiple null pattern that is very useful. The NCC-2 front panel controls provide repeatable directional pattern adjustments. Properly spaced Active Receive antennas are useable over a wide range of frequencies, offering the best possible nulling and peaking.

The NCC-2 is also fully compatible with the DX Engineering Active Magnetic Loop; model **DXE-RF-PRO-1B**, for phasing with a directional low-noise antenna. The NCC-2 can be used with many other combinations of receiving antennas including Single and Reversible Beverage and Beverage On the Ground Antennas, Receive Four-Square and Eight Circle Arrays, K9AY Loops, and more. The NCC-2 is primarily designed for 500 kHz to 15 MHz use, although the useful operating range extends from below 300 kHz to 30 MHz. Typical applications include:

- Combining two similar non-directional antenna elements to create a directional pattern
- Combining two similar directional antennas to produce an enhanced pattern
- Reducing overload or interference by removing or reducing a strong signal or noise
- Reducing interference from distant signals or noise

The NCC-2 has four main advantages over typical directional phased array systems:

- The NCC-2 array can be steered "electronically" even though the antennas are physically stationary
- The user can adjust the controls to obtain a null or a peak
- The phased response can often be changed from a perfect null to the perfect peak with a flip of a switch
- Front panel adjustments compensate for less-than-ideal installations, making a directional array possible in most situations

A very important new feature of the redesigned NCC-2 with RTR Receive Transmit Relay is its unique RTR failsafe system, which protects the unit and your receive antenna equipment when the NCC-2 is connected to a transceiver RF output. When the NCC-2 is off, the transceiver RF output (**RADIO**) is connected by the relay directly to the transmit antenna (**MAIN ANT**). This prevents internal RF damage and allows regular station operations when not using the NCC-2. Conversely, reception of the phased antenna signals on the **RADIO** is allowed ONLY when the NCC-2 is on, the RTR Switch is in the **NORM** position AND a transceiver amplifier keying line is connected from the dual-purpose dual conductor **RADIO PTT** connector, carrying the special **RX ENABLE** output signal on the keying line **shield** to the transceiver chassis and back on the coaxial cable shield. The keying cable is the failsafe interlock and the "Receive Enabled" conditions are confirmed by the RTR LED change to BLUE. When the transceiver is keyed to transmit, the transceiver amplifier keying line center conductor carries the typical "Ground on Transmit" to the **RADIO PTT** input. The RTR LED changes to RED and the high-speed RTR relay immediately connects the transceiver RF output to the transmit antenna. Simultaneously, if enabled by internal jumper, DC power is disabled on the receive feedlines to Active antennas. Toggling your transceiver to listen between phased antenna receive and the transmit antenna is easy with the RTR Switch **MAIN ON** momentary and set positions. Remember, the "no receive" **MAIN ANT** to **RADI**O transmit condition exists when the **RADIO PTT – RX ENABLE** keying line is ***NOT*** connected or if NCC-2 power is turned off. See more details in the manual sections entitled "***More on Radio PTT – RX Enable Failsafe Feature***" and "***NCC-2 Functions and Technical Description***."

DX Engineering NCC-2 Features

- RTR system supports phasing a transmit antenna with a separate receive antenna
- RTR system supports transceivers without a separate receive antenna input
- Enhanced Phase control – adjusts through 360 degrees within primary design frequency range 500 kHz to 15 MHz. Useable freq. range 300 kHz to 30 MHz.
- Improved Balance control with easier adjustment for deeper nulls
- Exceptional dynamic range – handles strong signals without overload
- Low noise floor - operational balance and phasing system optimized for low signals
- High Third Order Intercept – approaches, matches or exceeded many radios; +32 dBm per channel, +38 dBm both inputs combined
- Three internal option slots per channel for Plug-In Modules:
  Receive Preamplifier (**DXE-RPA-2-PM**)
  Receiver Guard (**DXE-RG5000HD-PM**)
  75 to 50 ohm Impedance Transformer (**DXE-IT-PM**)
- Internal 50 ohm impedance – rear panel SO-239 for **RADIO** and **MAIN ANT**
- Receive Antenna Input Channels – BNC for 50 ohm and F connector for 75 ohm feedlines (use 75 to 50 ohm Impedance Transformer Plug-In Modules - **DXE-IT-PM**)
- RTR system automatically switches from phased antenna reception to transmit antenna (when using a transceiver RF output)
- Handles up to 200 watts (CW) of transmitted RF
- Radio to amp keying line input RCA female (**RADIO PTT**) with RX Enable output supports RTR failsafe to prevent RF damage to NCC-2
- Accessory keying line output RCA female (**ACC PTT**) 'ground on transmit' Schottky diode isolated pass-through from **RADIO PTT** transceiver amp keying for Amplifier or Accessory
- Multi-Color Status Indicating LEDs for **Power**, **RTR Mode** and **Preamp Power CH A** and **CH B**
- Internal jumper to enable DC injection onto receive feedline for Active Vertical or Magnetic Loop Antennas
- Screw-on version of the DC Power connector is provided to prevent accidental power cable pull-out (any type 2.1 mm DC Power connector may be used)
- Operates on +13.8 Vdc nominal, accepts and operates on any voltage from +13 to +21 Vdc input to power the NCC-2. Input DC line should be fused at 3 amps to protect circuitry. For Active Verticals that are connected, the voltage may have to be +13.6 Vdc or higher. Some loops may require +21 Vdc.

> **Note:** Every radio manufacturer's accessory interconnection scheme is different. Consult your radio manufacturer's manual for details and requirements for receive signal inputs, outputs and switching voltages.

A new keying line cable assembly for most Kenwood transceivers with a 7-pin DIN Remote connector, is the **DXE-KWD-RTR.** This custom cable allows proper operation of a Kenwood transceiver with the NCC-2. See the section '***More on Radio PTT – RX Enable Fail Safe Feature***'.

NCC-2 Functions and Technical Description

The DX Engineering NCC-2 is a multi-purpose two-channel phasing controller that features high signal level handling and very low internal noise. Taking advantage of the time-delay of signal arrival between two antennas spaced by a significant fraction (1/10) of a wavelength or greater, the antenna array creates a directional pattern. Successful combinations of antennas and phasing adjustments create a direction-rotating effect of the resulting array pattern. Changing the phase can move the sharply reduced signal level of the pattern, known as the null, over the direction of an interfering noise or signal. The result is the ability to hear signals from other directions that may not have been heard otherwise.

Note: Effective and proper operation occurs when the *same* noise (for noise nulling) or the *same* signal (for signal nulling or peaking) is present on both **CH A** and **CH B** receive antenna inputs.

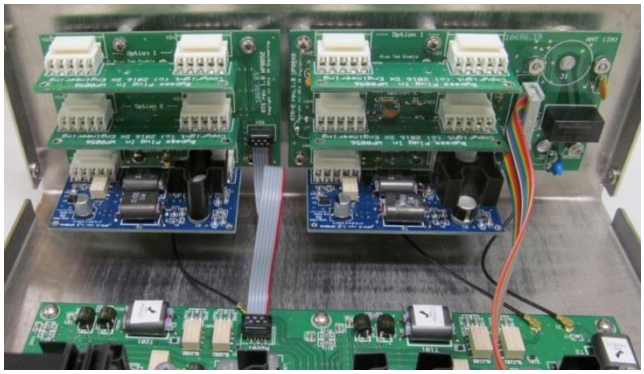
Directly connected to the **CH A** and **CH B** Inputs are the NCC-2 Option Slots. Bypass Plug-In boards are in place to carry input RF directly to the Channel A and Channel B phasing and combiner systems. The DX Engineering Plug-In Modules function exclusively for the NCC-2 operational protection and enhancements. There are three option slots for each input channel. The typical order of option installation is:

- **Option 1** - top slots are intended for 75 to 50 ohm Impedance Transformers (**DXE-IT-PM**) when 75 ohm receive antenna feedlines are connected to either the F connectors or the BNC connectors on the **CH A RX ANT INPUT** and **CH B RX ANT INPUT**s. Without these transformers, both inputs are 50 ohms, the internal impedance of the NCC-2.

- **Option 2** – middle slots may be used for the Receiver Guard Plug-In Modules (**DXE-RG5000HD-PM**) when high signal levels are anticipated to occur on an input.

- **Option 3** – bottom slots, switched and powered are reserved for Receive Preamplifier Plug-In Modules (**DXE-RPA-2-PM**) as controlled by **CH A** Option and **CH B** Option switches. When the NCC-2 is used with passive receive antennas or with Active Receive Verticals (**DXE-ARAV3-2P**), the installation of the RPA-2 plug-in modules is highly recommended to enhance low signal levels due to propagation.

See **Appendix A** for special information on removal of Bypass Plug-In boards and installation of Plug-In Modules.



NCC-2 Functions and Technical Description (continued)

Following the input modules slots, the NCC-2 maintains complete RF isolation between the two channels, beginning with dual, voltage controlled attenuators. They maintain high-stability phasing with low noise receive antennas, as the voltage controlled step attenuators and cross-channel Balance control offers consistent operation for repeatable settings. High dynamic range operational amplifiers buffer the input to the phasing system.

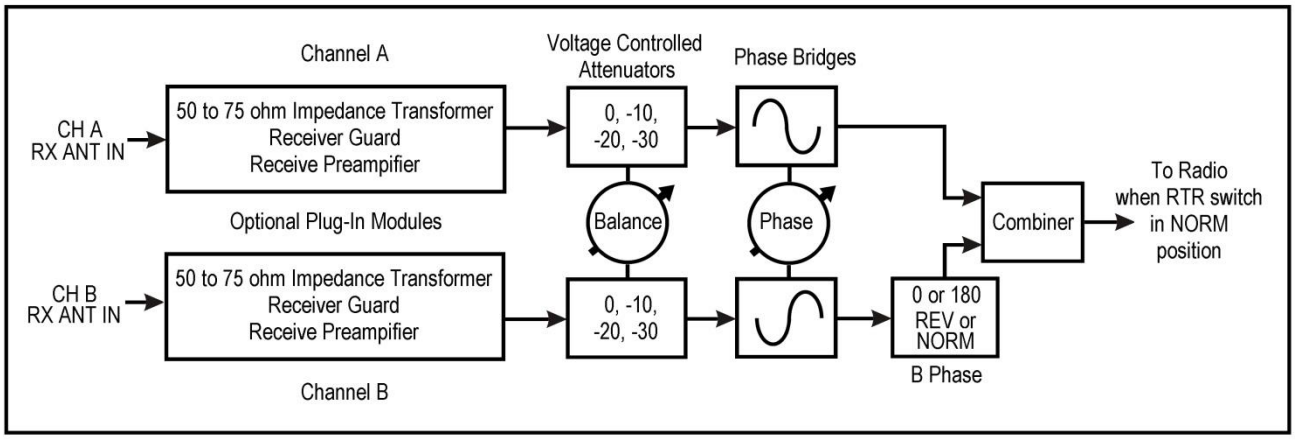
Voltages for phase adjustment are linearized through an active feedback system. Phase adjustment is spread over a wide linear control range. This gives the phase control a smooth feel and improves the ability to manually reset it.

The **NCC-2** uses two exceptionally flat-response phasing bridge systems and a unique system of mirrored bridges in each channel. When phase delay is increased in one channel, phase delay is simultaneously decreased in the other channel. Any level changes while adjusting phase are automatically compensated in the other channel. There is virtually no channel balance error over the entire range of the phase control.

The **NCC-2** has a dynamic range up to 30 dB (1000 times) better than other popular noise canceling systems. It also has provisions for further improvements in exceptionally strong signal environments.

The Channel B phase, normally at 180 degrees, can be inverted to 0 degrees with the **B PHASE** Switch, to cover all phasing possibilities. This switch typically inverts a perfect null to a perfect peak in signal response.

The phased signals from Channel A and Channel B are mixed in the final Signal Combiner. This phased receive output is delivered only via the **RADIO** connector, as protected by the RTR - Receive Transmit Relay.



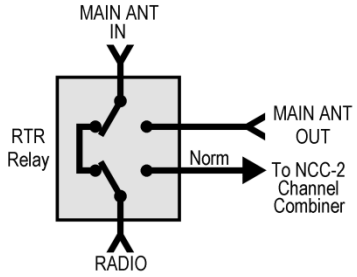
The NCC-2 **MAIN ANT IN** and **RADIO** connectors that handle transmit RF, and the Phase Combiner Output, are managed by the high-speed RTR relay. This is a reverse-logic relay which prevents reception of the phase receive signals unless certain connections are met, thereby preventing the transmitted signal from reaching the Phase Combiner.

In **Figure A**, the NCC-2 is in **MAIN ANT** mode or transmit mode, the **MAIN ANT IN** is internally connected to the **RADIO** when the power is turned **Off**.

The unit stays in the **MAIN ANT** mode and the RTR LED goes to Red when:

- An antenna is connected to **MAIN ANT IN**
- A coaxial cable is connected from the transceiver RF output to **RADIO**
- The **Power** switch is set to **On**
- The **RTR mode** switch is in **Main On** momentary or **On** position (not center position)
- There is a keying line cable from the transceiver to the **RADIO PTT – RX ENABLE** connector. Even when the NCC-2 is turned **On** the Red LED will be dark when no keying cable is connected. This is a reminder to install the keying cable.

Figure A



NOTE: No reception of the Phase Combiner output is possible when the keying line is not connected. **Exception*** - See page 9

When the NCC-2 is in the **MAIN ANT** mode, and even when independently jumper enabled, NCC-2 input DC voltage (+13.6 to +21 Vdc) is NOT fed onto either the **CH A RX ANT IN** and/or **CH B RX ANT IN** to operate Active antenna(s) – *See section on **Internal Jumpers***.

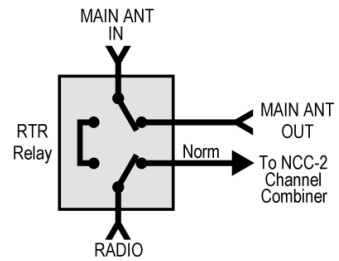
In **Figure B**, the NCC-2 is in **RX Enabled Mode** and the RTR LED turns to BLUE, allowing the **RADIO** to be connected to the **CH A** and **CH B** Phase Combiner output. This mode, the receive-enabled condition depends upon all of these items:

- A coaxial cable is connected from the transceiver RF output to **RADIO** (or from transceiver **RX ANT IN**)
- The **Power** switch is set to **On**
- The RTR mode switch is set to the **Norm** position
- The transceiver amp keying line is connected to **RADIO PTT/RX ENABLE**, shield to transceiver chassis, center NOT grounded
- The properly connected transceiver is NOT in the transmit mode

When the NCC-2 is RX Enabled Mode, the Phase Combiner signals are sent to the transceiver connected to **RADIO**. Also in RX Enabled Mode, these conditions are enabled, as shown in **Fig B.**

- The **MAIN ANT IN** signal is connected to the **MAIN ANT OUT**.
- When independently jumper enabled, NCC-2 input DC voltage (+13.6 to +21 Vdc) is fed onto the **CH A RX ANT IN** and/or **CH B RX ANT IN** to operate Active antenna(s)

Figure B



IMPORTANT NOTE:
There are three crucial uses of the NCC-2 **MAIN ANT OUT**:

1. When using the NCC-2 to phase the transmit antenna with a receive antenna, the included BNC patch cable **MUST** be installed to connect the **MAIN ANT OU**T into the **CH A RX ANT IN**. This is required to feed the transmit antenna received signal back in, to accomplish phasing of that signal with the receive antenna signal that is connected to **CH B RX ANT IN**. See the warning below.

2. When using the NCC-2 **MAIN ANT OUT** to send the transmit antenna received signal to a second receiver only, when phasing two receive antennas.

3. When using the NCC-2 **MAIN ANT OUT** to send the transmit antenna received signal to an external splitter to share it between a second receiver and **CH A RX ANT IN**, when phasing **MAIN ANT** with one receive antenna.

See the section ***System Connection Diagrams*** for details

Warning: When **CH A RX ANT IN** is used in this manner, **DO NOT** set "**BIAS TEE ENABLE**" jumper on RTR-2 PBC right board. *See section entitled **Internal Jumpers***.

The NCC-2 will immediately revert to **MAIN ANT** mode, **Figure A**, **RADIO** to **MAIN ANT IN** as soon as:

- The transceiver is keyed to transmit, with a ground on transmit on the keying line center conductor
- The keying line is removed
- The P**OWER** is turned **Off**

The **MAIN ANT** transmit mode cannot occur when the **Exception*** condition exists.

***Exception:** If a connection to an RF Transceiver **OUTPUT** is NEVER to be made, such as for NCC-2 applications where ONLY receive antennas are used, or for AM DX and SWL operations, the "Force Ground" internal jumper can permanently disable the **MAIN ANT** transmit and enable NORM.
*See the **Internal Jumpers** section.*

Important: When using the NCC-2, unexpected relay chattering sounds and flickering of the RTR Blue/Red LED during transmission is an indication of a failure of the ground on transmit signal. Cease operations immediately and check the keying cable center conductor and the transceiver amplifier keying settings and connection. Transceiver ground on transmit on the center conductor AND a transceiver chassis-grounded shield on the keying cable connected to RADIO PTT connector of the NCC-2 are required for proper RTR relay operation.

Understanding Noise and Interference

Before we can use the NCC-2, we need to understand the challenges for operations on HF. Noise limits our ability to hear a weak signal on the lower bands. Noise is often an accumulation of many unwanted signals. Noise from antennas is generally a mixture of local ground wave and ionosphere propagated noise sources, although many locations suffer with dominant local noise sources.

Noise is generated by randomly polarized sources. Noise polarization is filtered depending on the method of propagation:

- Noise arriving via the ionosphere is randomly polarized. Noise arrives with whatever polarization the ionosphere favors at the moment. Noise from a distant source has the same characteristics as a "good" signal.

- Sources within a few wavelengths of the antenna arrive randomly polarized. The noise does not have a dominant polarization and it can either be electric or magnetic field dominant. Local noise can also be random or directional in nature. Every effort must be made to locate sources of noise that could be eliminated at the source. Dimmer switches, electric timers, security lights, and many other items can be sources of unwanted noise. Plasma televisions are becoming more popular and are a known generator of unwanted noise interference.

- Ground wave noises arriving from a significant distance are vertically polarized. The path along the earth "filters out" and removes any horizontally polarized signals. Horizontal electric field components are "short circuited" by the conductive earth as they propagate and are eliminated.

With the exception of ground wave-propagated noise, receiving antenna polarization effects are not predictable. It is possible vertically polarized antennas may be quieter than horizontally polarized antennas. Either may be true at different times.

It may be difficult to remove noise with any device when:

- Noise and desired signals come from the same direction and elevation angle
- Both antennas don't hear the same noise
- The noise source is moving around, or noise sources are coming from several directions at the same time.

Reducing Noise and Interference

Unlike conventional noise blankers, the **NCC-2** is designed to reduce noise or interference before it gets to the receiver. The **NCC-2** can be effective on all types of noise, including interference (QRM) from unwanted signals. The **NCC-2** allows the user to continuously adjust both phase and amplitude when combining two antenna inputs. The signal output to the receiver is the addition or subtraction of signals from two separate antennas. Unwanted directional noise can be removed or unwanted signals can be cancelled. Desired signals can be peaked or enhanced.

The phasing method of signal enhancement or rejection has several advantages.

- Interference much stronger than a desired signal can be completely removed without affecting the signal.
- The **NCC-2** can be effective with all types of interference and all modes.
- Signals can be peaked instead of nulled.

The number of cases where phase nulling can reduce or eliminate interfering signals cannot be over-emphasized. The null can be steered to knock out overloading signals, stations with key-clicks, splatter and intentional jamming noises. There will also be a time when the interfering pile-up can be nulled to reveal the desired DX station signal coming from another direction.

Selecting Antennas

The **NCC-2** generally works best when both antennas have similar patterns, polarization, and Signal-to-Noise ratios. For the most effective nulling of noise, the antennas on both the A and B inputs must hear the same unwanted noise and should have similar polarization. You may have to experiment to find the best antenna, but successful operation more commonly occurs with similar antennas.

Reducing of distant interference: Close element spacing is more desirable. Close spacing produces a single null that is wider and more stable. Spacing of 1/4-wavelength or less is most desirable when nulling distant interference or peaking distant signals. Spacing larger than 1/4-wavelength can, at your operating frequency, causes multiple nulls in the patterns.

Reducing of a local noise source: Best performance occurs when the noise antenna "hears" the noise much louder than it hears desired signals. The noise antenna needs to pick up the largest amount of noise possible, so it should be located as close to the noise source as possible. In this case the polarization is unimportant; whatever polarization hears the noise best. The spacing between antennas, that are being phased together, can be any convenient distance within one wavelength.

Receiving Antennas

The performance of the **NCC-2** is largely dependent on the receiving antennas and their installation. Please carefully read this section and make adjustments or changes to your antennas before using the **NCC-2**.

The **NCC-2** will function with almost any combination of antennas but it works best when antennas have reasonably similar directional patterns. Optimum antenna spacing will vary with the frequency band and what you are trying to accomplish. There are two general rules for antenna spacing:

- If antennas are too close together (less than 1/10-wavelength), a very stable deep null can be produced but the system will lose gain or sensitivity.
- If the antennas are too far apart (generally more than 1-wavelength) the nulls and peaks in the pattern will become so sharp it might become impossible to maintain nulls or peaks on sky

wave signals. With very wide spacing, signals will fade in and out more rapidly with ionospheric changes.

- A deep stable null should be found in one of the **B PHASE** switch positions (**Norm** or **Rev**). Multiple nulls may be found in both positions depending upon antenna combinations and frequency

Antenna Polarization

It is ***generally*** not a good idea to mix polarization of antennas. Although this scheme can work when nulling a ground wave signal or noise, mixing polarizations generally makes nulls or peaks more difficult to find and maintain. When receiving skywave propagated signals, mixing a horizontal antenna with a vertical antenna almost always increases fading. Expect unpredictable results when combining transmit antennas with receive antennas.

Antenna Feedlines

It is not necessary to use any special length of feedline with antennas used in this system or for antennas to be "resonant" or physically large. The front panel controls will compensate for feedline lengths. You should still use a good feedline and make good connections.

The receive antenna inputs (**CH A RX ANT IN** and **CH B RX ANT IN**) are 50 ohm using either BNC or F Connectors.

The MAIN ANT IN and the RADIO connectors are 50 ohm SO-239 connectors.

DX Engineering carries 75 ohm CATV style cable and weather-tight connectors as well as 50 ohm BNC to BNC cable assemblies. 75 ohm antenna systems and feedlines are supported with the optional Internal 50 ohm to 75 ohm Transformer (**DXE-IT-PM**) module.

Antenna Sensitivity

Receiving antennas should not have excessive signal level or gain. They only need enough gain or signal level to have very weak signals limited by external noise. Too much signal level from antennas is actually not good. Normally we should just hear a slight increase in noise (or weak signal) from no antenna connected to having one connected. We would then clearly hear a noise floor increase. For best weak signal reception, background noise of antennas would ideally be around 5 dB, or about 1 S-Unit, above the **NCC-2** noise floor.

The **NCC-2** is a very good match for DX Engineering Active Receive Antenna arrays and closely matches their dynamic range. Higher noise floor antennas can be also be successfully used due to the built-in front panel adjustable attenuators. Phasing a transmit antenna and a receive antenna is often more difficult, but can be very productive for noise and signal nulling.

Antenna Bandwidth

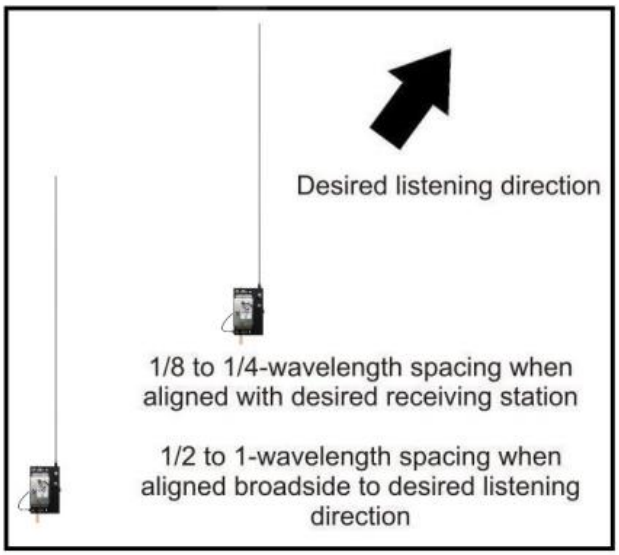
Wider bandwidth antennas produce the most stable and reliable performance. Very narrow bandwidth antennas do not work as well. A small resonant loop will be very narrow in response and will shift phase rapidly with frequency changes. This means temperature changes and frequency changes will both require more frequent readjustment of the **NCC-2** controls. (Exceptionally wide spaced antennas also produce a similar effect, as will mixing of antenna polarizations in one system.)

Combining Antennas to Improve Signal-to-Noise Ratio

If your location is limited by noise coming from many directions, you can still use the **NCC-2** to enhance desired or null interfering signals. The following guidelines apply when *enhancing* signals:

- Both antennas must hear the signal with similar signal-to-noise ratios. *Don't combine an antenna that hears the signal with one that can't hear it at all.* Adding signals from a "quiet antenna" to a "noisy antenna" only makes the quiet antenna noisy.

- The most reliable and consistent performance occurs with antenna spacing less than 1/4-wavelength when antennas are in line with the desired direction, and less than 1-1/2-wavelengths apart when antennas are spaced at right angles to desired directions.



Two Active Receive Verticals - DXE-ARAV3-2P

- Best sensitivity occurs when antennas are more than 1/10-wavelength apart when the antennas are in line with the desired direction, and more than 1/2-wave apart when broadside to the desired direction

- When enhancing or nulling signals, it is preferable to locate both **CH A** and **CH B** INPUT antennas as far from local noise sources as possible.

- Using a vertically polarized antenna in combination with a horizontally polarized antenna almost always increases fading over an ionospheric path.

Note: *In cases where one antenna is significantly noisier than the other, it is often possible to use the quieter antenna for the signal and cancel noise with the noisy antenna. The same noise must appear on both antennas.*

The **NCC-2** generally works best when both antennas have similar patterns, polarization, and S/N ratios. You may have to experiment to find the best antenna, but successful operation occurs more often with similar antennas.

The best system is often found by planning, although it is often worth experimenting.

When using any of these directional phased antenna arrays you may record phase settings to null stations from known directions. It is then possible to make a direction chart. With optimal antenna spacing it is possible to tell direction within several degrees.

Use with a Receive Loop or Other Low Noise Antennas

The **NCC-2** is probably most useful when used to enhance reception on lower frequencies. The **NCC-2** is often useful even if the station already employs low noise directional receiving arrays.

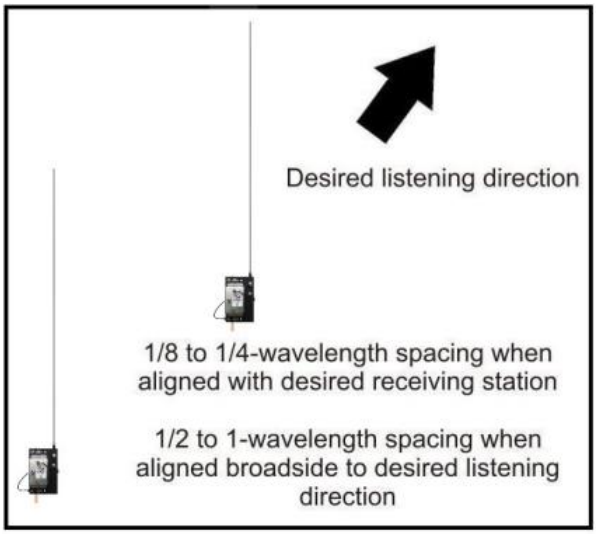
A suggested method follows:

- Connect one **DXE-RF-PRO-1B** Magnetic Loop or other similar low noise receiving antenna to **CH A**
- Connect another **DXE-RF-PRO-1B** Magnetic Loop or another low noise receiving array to **CH B**
- Connect the **NCC-2 RADIO** connector to the receiver's antenna input line or transceiver **RX ANT INPUT**

Phased Verticals and Beverage Systems

The NCC-2 is an adjustable phasing network that combines two antenna input ports. Antennas can be combined to change or improve directional patterns. Pattern changes can be used to improve signal-to-noise ratio even in the absence of strong noise.

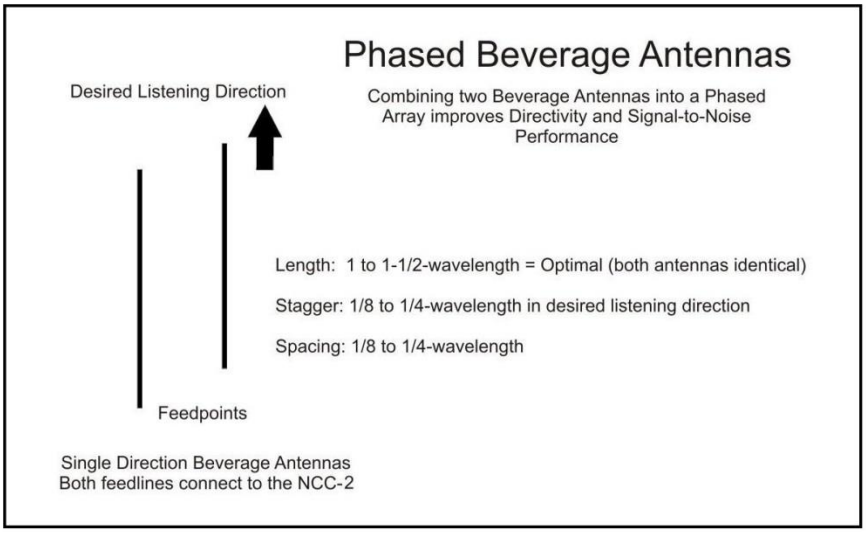
It is possible to combine almost any type of receiving antennas into a large array.



Two Active Receive Verticals - DXE-ARAV3-2P

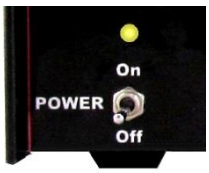
For example:

- Two verticals can be combined to produce a steerable array capable of peaking or nulling signals.
- Two parallel Beverage antennas spaced an eighth to quarter wave apart with an eighth to quarter wave stagger in the desired direction can be combined to improve front-to-back ratio or steer nulls to the direction of unwanted signals or noise.

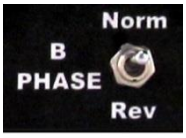


Front Panel Controls and Switches



	**POWER:** Turns power ON and OFF. LED is Yellow when the **POWER** switch is **Off** but the NCC-2 is connected to an active power supply LED is Green when **POWER** switch is turned **On**
	**RTR Switch:** When the RTR functionality is used and **POWER** is **On**: LED is Blue with the **RADIO PTT** line is properly connected to the radio for RX Enable and switch in **Norm** position LED is RED when radio is in transmit mode and when switched to **Main On** to listen to **MAIN ANT** Three switch positions: **Main On Up**: Switches the RADIO to listen to the MAIN ANT input **NORM**: Center position on switch - connects RADIO to phased antennas (RX Enable) **Main On Down**: Momentarily switches RADIO to listen to MAIN ANT input
	**On/Off Power Switch for Channel A - Option 3** (bottom) **Slot** (When the **DXE-RPA2-PM** is used, it must be in Option 3 slot)
	**On/Off Power Switch for Channel B - Option 3 Slot** (When the **DXE-RPA2-PM** is used, it must be in Option 3, the bottom slot). See **Appendix A**
	Two rotary **Attenuator** switches reduce gain in ten dB steps. The steps are 0, -10, -20, and –30 dB. The left switch sets **CH A RX ANT IN** attenuation (primary antenna), the right switch sets **CH B RX ANT IN** (secondary antenna) attenuation.

Front Panel Controls and Switches (continued)

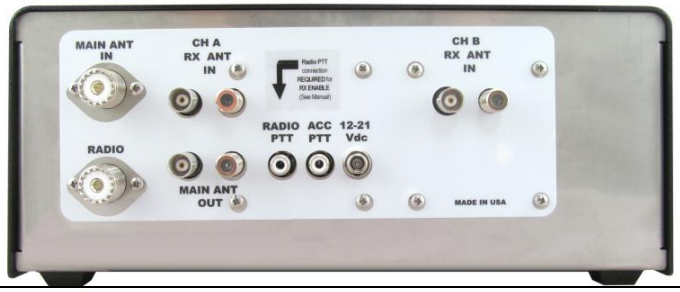
	**BALANCE:** Provides fine adjustment of opposite channel attenuation. It is used to balance or equalize signal levels from **CH A** and **CH B**. The **BALANCE** control provides anywhere from zero to 8 dB attenuation on either **A** or **B.** This control has the similar "feel" and operation as the balance controls on conventional stereo systems. Maximum gain on both channels occurs when the **BALANCE** control is positioned in the center of the range, and gain is reduced as the knob is rotated away from a particular channel. If you rotate the **BALANCE** control clockwise, the gain of **INPUT A** is reduced. Precise signal or noise level balancing between INPUTS A and B is required for optimal noise or signal canceling.
	**PHASE:** Changes the phase delay relationship between **CH A** and **B**. The resulting phase shift will change the directional position of antenna pattern null or peak signal response. Note: Progressive adjustments of **PHASE** and **BALANCE** produce the best null
	**B PHASE:** Moves **B INPUT** phase by exactly 180 degrees. **NORM** is 180 Degrees or no phase reverse, **REV** is 0 Degrees.
	**BAND:** Optimizes phase range. "**L**" selects the low. "**H**" selects the high. Use **L** when operating below 7 MHz. Use **H** when operating above 7 MHz.

For those that want a slightly larger switch handle on the RTR switch, a black switch cap has been included with the NCC-2. Push this cap fully in place as shown below.





Rear Panel Connections



	**MAIN ANT IN:** SO-239 connector. Connects to primary transmit antenna. 50 ohm impedance, nominal. This connector goes to a linear amplifier RF Input, if one is used.
	**RADIO:** SO-239 connector. Connects NCC-2 to Transceiver. 50 ohm impedance, nominal. Is used for connection to **RX ANT INPUT** when NCC-2 is not used for transmit antenna phasing.
	**CH A RX ANT IN**: Primary Receive Antenna – 50 ohm BNC and F style connectors in parallel. *BNC and F style connectors are used to prevent accidental connections to transmitting equipment.* When connecting to a 75 ohm systems, ideally the use of the optional 50 ohm to 75 ohm transformer plug-in option (**DXE-IT-PM**) is suggested for the Channel A Option 1 (top) slot. See appendix A
	**CH B RX ANT IN**: Secondary Receive Antenna – 50 ohm BNC and F style connectors in parallel. *BNC and F style connectors are used to prevent accidental connections to transmitting equipment.* When connecting to a 75 ohm systems, ideally the use of the optional 50 ohm to 75 ohm transformer plug-in option (**DXE-IT-PM**) is suggested for the Channel B Option 1 (top) slot. See appendix A
	**MAIN ANT OUT**: Receive Signal output to second receiver or to **CH A RX ANT IN** for RTR phasing of the **MAIN ANT**. BNC and Type F connector. *These types of connections work well with most transceiver and receiver RX ANT Inputs. Impedances are not critical.* Do not use both connectors at the same time; use a splitter to share signals - see Diagram 4
	**RADIO PTT RX ENABLE:** RCA connector - The transmitter amplifier keying line connection from transceiver or sequencer (ground on transmit). This two-conductor connection to the transceiver keying output **MUST BE CONNECTED** to enable radio reception of phased antennas. This connection is master to the **ACC PTT and is NOT INTERCHANGEABLE with ACC PTT**. See section *More on Radio PTT-RX ENABLE*
	**ACC PTT:** RCA shielded connector - Keying line pass-through connection for amplifier or sequencer (grounding keying line only) for automatic relay switching of an accessory. This connection is a diode protected pass through of the ground on transmit from the **RADIO PTT and is NOT INTERCHANGEABLE with RADIO PTT**. There is no delay in this signal. See section *More on Radio PTT-RX ENABLE*
	**12-21 Vdc:** The **NCC-2** operates on +13.8 Vdc 2A and accepts well-filtered, +13.8 to +21 Vdc for normal NCC-2 operation. Input DC line should be fused at 3 amps to protect circuitry. A 2.1 mm screw on plug, center positive power plug is included with the **NCC-2** which is intended to prevent accidental disconnection (a standard 2.1 mm plug will also work). Most external active antennas are supported with +13.6 Vdc or higher input voltages from the **NCC-2** as required. The NCC-2 will accept up to +21 Vdc input. *The use of most switching power supplies is discouraged due to the presence of noise in their output.*

More On RADIO PTT – RX ENABLE Failsafe Feature



The proven design of the **RADIO PTT-RX ENABLE** failsafe feature used in the RTR-1 and is now improved for the NCC-2 and the RTR-2.

In the NCC-2, the purpose of the RTR failsafe circuit is to allow phasing of a transmit antenna and a receive antenna while reducing, to nearly zero, the chances of accidentally transmitting into the phase combiner (the receive side of the NCC-2). Therefore, the RTR relay is wired so that when the NCC-2 is turned off, the transceiver (**RADIO**) is connected to the transmit antenna or amplifier (**MAIN ANT IN**). When the unit is off, you can use your station normally. See **Figure A** on page 8.

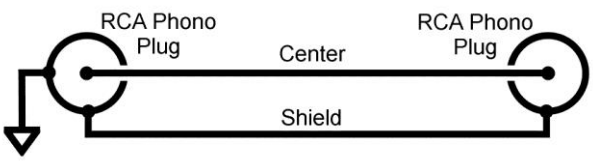
When the NCC-2 is turned on, **RADIO** to **MAIN ANT IN** is the same connection we want when the transceiver is keyed to transmit, or when we want to listen only to the transmit antenna (**MAIN ON**). Okay, let's tell the NCC-2 when it is safe to switch to receive mode. Well, unfortunately, we can't because transceivers don't put out an "Okay to Receive" signal, they only send out a "Hey, I'm transmitting signal" on the amplifier keying line (**RADIO PTT**).

So when we want to switch the NCC-2 to the receive mode (**NORM**), and **RADIO** is connected to the Phase Combiner (**Figure B** on page 8), we have to be absolutely certain that the transceiver amplifier keying signal, which automatically switches the **RADIO** back to the **MAIN ANT**, is always there, **OR ELSE!** That transceiver amplifier keying cable **MUST** be installed. But, how can the NCC-2 know that it is safe to go to the receive **NORM** mode? It does it with the **RX ENABLE** signal, which is sent on the **shield** of the **RADIO PTT** keying cable to the chassis of the transceiver, and back on the RF coaxial cable shield. **No keying cable? No receive! Only transmit.**

How can that work? Simple; the shield of the **RADIO PTT** connector is **NOT** at NCC-2 chassis ground. It carries the **RX ENABLE** voltage that is looking for the chassis ground. The keying cable **MUST** be there. **This is the failsafe interlock**.

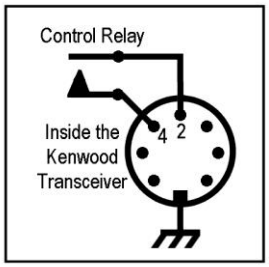
Let us say it another way: The **RX ENABLE** signal travels from the **RADIO PTT** on the shield of the keying cable to the transceiver chassis ground. The transceiver amplifier keying signal on the center conductor takes the NCC-2 out of the receive mode, sending the **RADIO** back to the **MAIN ANT IN**. Of course, the amplifier keying signal is sent on to your amplifier without delay, through a Schottky-diode for isolation, via the **ACC PTT** connector. (See the caution on the next page).

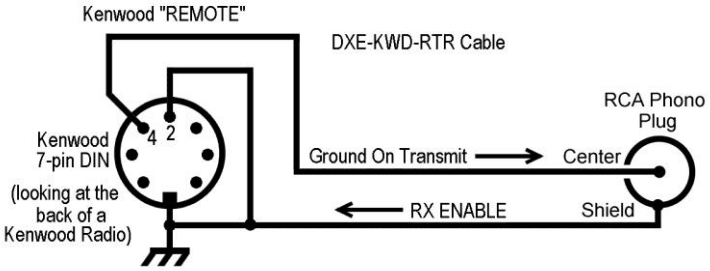
The **RADIO PTT – RX ENABLE** keying cable can be as simple as a common RCA audio patch cable connection from certain transceivers that have an RCA keying connector that has its shell at chassis ground. On other transceivers with special connectors it may not be quite so simple, but at least the amp keying line shield is chassis ground.



However, on many **Kenwood** transceivers, the amp keying relay common is not chassis ground. So you need a special cable that takes the shield to chassis ground. The **DXE-KWD-RTR** is available from DX Engineering.







The DX Engineering special RTR to Kenwood cable assembly for Kenwood transceivers adds the shield to the chassis ground connection on the 7-pin DIN shell. Ground On Transmit and RX ENABLE are thereby both functional for the NCC-2, RTR-2 and RTR-1 units with the **DXE-KWD-RTR** cable. Note: The **DXE-KWD-RTR** cable does not provide ALC line due to its lack of need or use.

The following Kenwood radios are known to have the 7-pin DIN REMOTE connector for amplifier keying line connection and can use the **DXE-KWD-RTR** cable:

TS-120, TS-130, TS-140S,TS-2000, TS-2000X, TS-B2000,TS-430S, TS-440S, TS-450S, TS-50S, TS-530S, TS-570D, TS-570DG,TS-570S, TS-570SG, TS-590S, TS-590SG, TS-680S, TS-690, TS-690S,TS-850S, TS-870S, TS-930S (Some early unmodified TS-930 models are not supported), TS-950S, TS-950SDX, TS-890S, TS-990S

For the Kenwood TS-480SAT or TS-480HX use the cable **DXE-KWD-8P-RCA**

<u>KEYING LINE CONNECTION WARNING</u>:

<u>MAKE ABSOLUTELY CERTAIN</u> that the KEYING LINE from the TRANSCEIVER is connected ONLY to the NCC-2 RADIO PTT connector. The keying line to the amplifier must be connected ONLY to ACC PTT "pass through".

Do Not reverse the RADIO PTT and ACC PTT keying line connectors. These connections are <u>NOT</u> interchangeable.

When the NCC-2 RADIO connector is used to carry transmitted RF, if these keying connectors are accidently reversed, PERMANENT INTERNAL DAMAGE will occur to the NCC-2 and potentially to other receive antenna devices.

INTERNAL DAMAGE TO THE NCC-2 DUE TO REVERSAL OF KEYING LINES IS NOT COVERED UNDER WARRANTY.

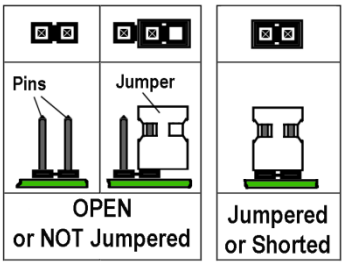
Important: When using the NCC-2, unexpected relay chattering sounds and flickering of the RTR Blue/Red LED during transmission is an indication of a failure of the ground on transmit signal. Cease operations immediately and check the keying cable center conductor and the transceiver amplifier keying settings and connection. Transceiver ground on transmit on the center conductor AND a transceiver chassis-grounded shield on the keying cable connected to RADIO PTT connector of the NCC-2 are required for proper RTR relay operation.

Internal Jumpers

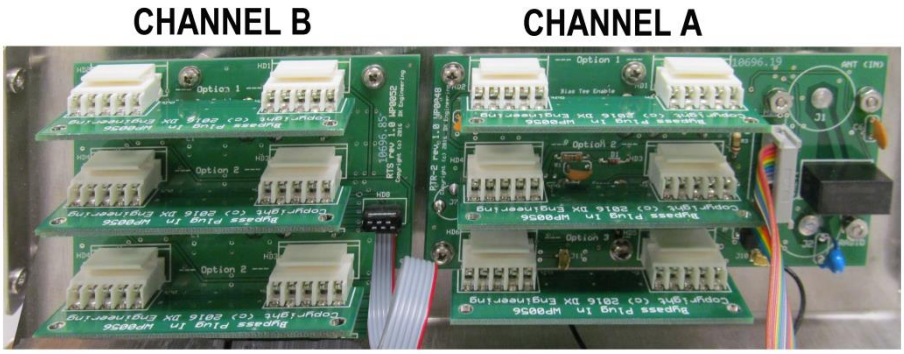
The NCC-2 has internal jumpers that configure the placement of DC power onto **CH A RX ANT IN** and **CH B RX ANT IN** independently. As delivered from DX Engineering, the NCC-2 internal jumpers are positioned for normal operation with no DC power on the antenna input connectors.

With the unit unplugged and no power connected, remove the four screws on each side of the cover and lift the cover off.

The jumpers are small plugs that fit over and connect two of the pins on the associated header. The jumper is removed by pulling straight out and installed by aligning with two pins and pushing straight in to fully seat the jumper. When a jumper is not used and to avoid losing it, push the jumper on so it only connects to one pin on the header.



Looking inside the NCC-2 toward the rear of the unit are two printed circuit boards. The PCB on the left is sometimes called the RTS Board or Channel B Board. The board on the right is sometimes called the RTR Board or Channel A Board.



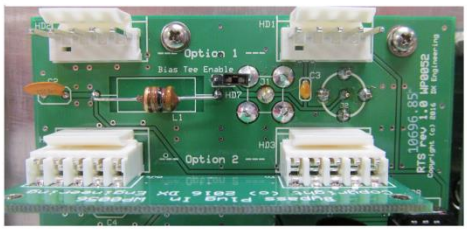
Looking inside toward the rear of the NCC-2

It may be easier to remove the Option 1 and Option 2 By-Pass Plug In boards to have a clear view and easily check/change the jumpers. Refer to "**Appendix A**" for removal or installation of these boards.

Bias Tee Enable

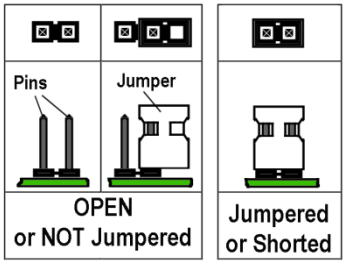
In between the Option 1 and Option 2 areas of both boards there are headers with jumpers labeled "**Bias Tee Enable**" (one on both the Channel B and Channel A boards. **The factory default for these two jumpers is <u>open</u> (NOT jumpered together).**

Channel B - Bias Tee Enable



Channel A - Bias Tee Enable





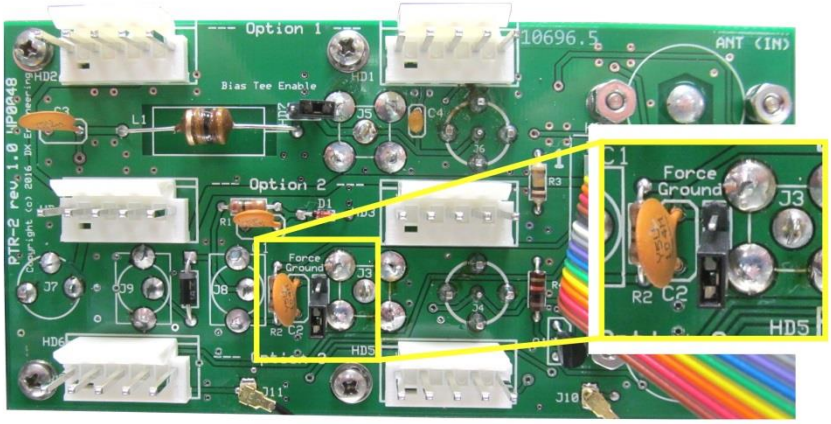
For passive receive antennas both of the "Bias Tee Enable" jumpers are open (factory default).

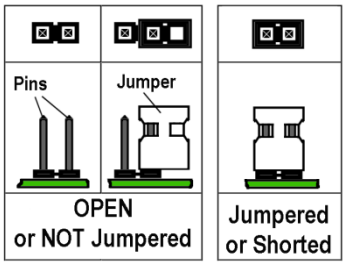
When both "Bias Tee Enable" jumpers are in place (both pins of the header are connected together with the jumper), the Bias Tee voltage is connected to the **CH A RX ANT IN** and **CH B RX ANT IN** receiver antenna input connectors (BNC and F).

CAUTION: DO NOT JUMPER the Bias Tee Enable headers on the RTR-2 (Channel A Board) when **CH A RX ANT IN** is connected to **MAIN ANT OUT** for transmit antenna phasing.
If this jumper is connected in error, internal damage will result.

Force Ground

On the Channel A or RTR Board between the Option 2 and Option 3 By-Pass Plug In boards there is one header with a jumper called "**Force Ground**". This jumper is normally left open (factory default).





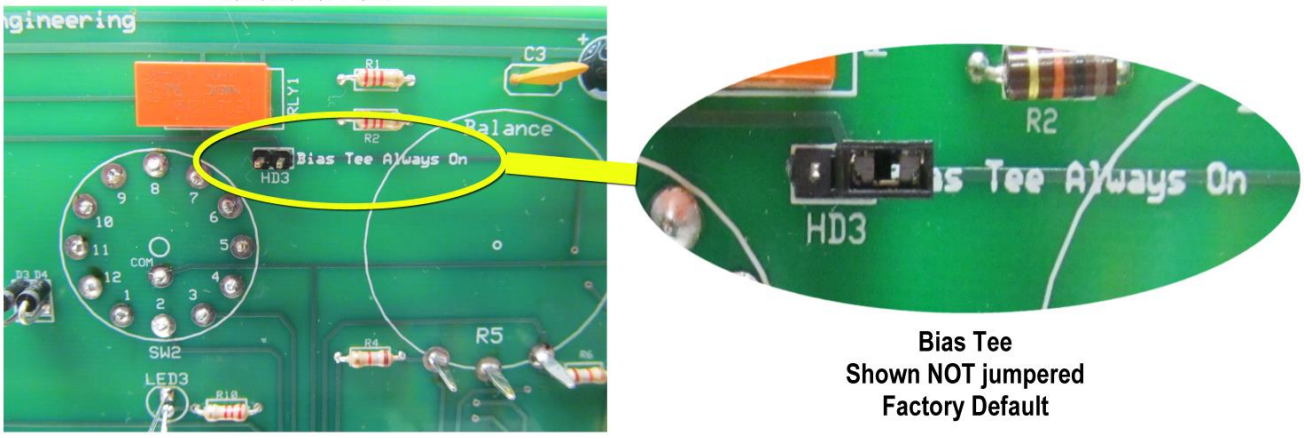
NOTE: If this jumper is installed (header pins are connected to each other with a jumper) the internal safety mechanism is defeated. This safety mechanism is intended to protect the NCC-2 from transmit energy. <u>DO NOT use this jumper for typical amateur radio transmit functions.</u>

This jumper is only used for applications where the NCC-2 is going to be used only with receive antennas and any transceiver RF output is never connected to the NCC-1. **<u>Never use with any type of TRANSMIT antennas when the "Force Ground" jumper is installed.</u>**

Bias Tee Always On

The front panel on the NCC-2 has one header with a jumper labeled "**Bias Tee Always On**" as shown below. The factory default for this jumper is open - the header pins are NOT connected together).

Front Panel PCB



Bias Tee
Shown NOT jumpered
Factory Default

When this jumper is connected (both pins on the header are shorted together with the jumper), Bias Tee voltage is present regardless of transmit and receive keying. This jumper should only be installed for non-RTR, receive only use of the NCC-2. Keyed Bias Tee voltage on the receive feedlines is normally desired.

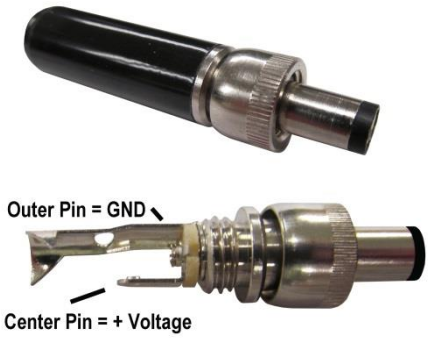
Installation

Please read the following section carefully.

The best location for this unit is at the operating position with easy access to the controls since you will be using the S-Meter and listening to your receiver while adjusting the **NCC-2**.

Connections

Make connections to the **NCC-2** as follows:



- Connect a fused power source of +13.8 to +21 Vdc 2A minimum, well filtered and fused to the 2.1 mm center is positive **MAIN PWR** jack using the included 2.1 mm screw-in plug. Well filtered and fused station power is recommended. For most operations (no loops or special receive antennas) using your shack power of +13.8 Vdc is adequate. Input DC line should be fused at 3 amps to protect circuitry. **Be aware that any voltage used as an input to the NCC-2 (+13.8 to +21 Vdc) will be fed through the Bias Tee circuitry on both A and B Ports when individually enabled.** Some active antennas may require specific voltage levels to work properly. You may have to account for line loss over long distances as well. Depending on your installation, you may need external voltage inserters (Bias Tee) externally to provide different voltage.

- Connect a receiving antenna to the **CH A RX ANT IN** BNC or F Connector. If phasing with transmit antennas, connect the included BNC patch cable between **MAIN ANT OUT** and **CH A RX ANT IN**.

- Connect a second receiving antenna (or local noise source antenna) to the **CH RX B ANT IN** BNC or F Connector.

- Connect a standard shielded audio style cable between the **RADIO PTT** Phono connector and a transceiver.
    - The **NCC-2** is set to switch the **MAIN ANT** relay and remove enabled Bias Tee voltage when the **RADIO PTT** line is pulled LOW. Some modern transceivers have a rear panel amplifier control jack typically labeled as "TX", "AMP", "Send", "Control" or "TX GND" that pulls low when the transceiver is keyed. (Check the user manual for your radio).
      Note: Kenwood transceivers have a 7-pin DIN labeled "REMOTE". You must use the **DXE-KWD-RTR** cable (see page 20).
    - **ACC PTT** connector on the **NCC-2** is a keying pass-through used for keying another accessory such as an amplifier or sequencer.

- The **DX Engineering TVSU-1A** programmable sequencer can also be used to provide the proper transmit/receive switching for an amplifier, transceiver, and the **NCC-2**. Refer to Interconnection Diagram 6 for the high power installation connection diagram.

- Connect the **RADIO** jack to a transceiver antenna jack for use on radios that lack a RX ANT IN or the transceiver receive-only antenna port, or receiver antenna input.

- Connect **MAIN ANT OUT** to **CH A RX ANT IN** only if phasing the transmit antenna with a receive antenna.

NEVER connect the **MAIN ANT OUT** connector of the NCC-2 to a transceiver RF output!

Operation

For two antennas with approximately equal desired signal levels, or for two antennas with approximately equal undesired signals or noise levels.

1. Connect the **NCC-2** to your station and a suitable power source.
2. Set the front panel controls as follows:

   A. **POWER On**
   B. Both **A** and **B** attenuator switches to the **0** dB position, unless one antenna requires more preset attenuation
   C. **BALANCE** control to top dead center (line pointing straight up)
   D. **PHASE** control rotated to top dead center (#5 on the dial)
   E. **OPTION** switches to **ON** supplies power to the internal Option 3 slot (bottom slot) - only for the optional **DXE-RPA-2-PM** Preamplifier modules.
   F. **B PHASE NORM-REV** switch set to **NORM**
   G. **BAND** switch to **L** for operation below 7 MHz or **H** for operation above 7 MHz.
   H. **RTR to Norm** (center) to phase **CH A RX ANT** and **CH B RX ANT** inputs. **RTR** LED changes color to Blue when all cables are installed correctly.



To get the best rejection of unwanted signals or noise, rotate the **PHASE** control until the noise or interference is at the lowest level. If a null cannot be found, change the **PHASE NORM/REV** switch to the **REV** position. The null might be shallow until levels are balanced.

Adjust the **BALANCE** control to further reduce noise or interference. It will be necessary to go back and forth between **PHASE** and **BALANCE** controls a few times. If the **BALANCE** control is not within 110 degrees of the center position, apply attenuation to the opposite channel that the **BALANCE** pointer is on. This should center the **BALANCE** control indicator line, or it may reset the balance point to the opposite side of the control if the antenna's signal difference is between 3 to 9 dB. If one antenna is always 3 to 12 dB different than the other, then either the weaker antenna should be improved, or the stronger antenna may be attenuated with a 3 or 6 dB pad to provide a better balance between sources. Without precise signal or noise level balancing between antenna **CH A** and **CH B** input nulling will not be as deep as possible.

Often a little experimentation is required to get the best performance using different selections of available antennas and phase relationships.

The **PHASE NORM-REV** switch will normally turn a *NULL* point into a *PEAK* point. Adjust for a null as above, and then reverse the **B PHASE** switch. Multiple nulls may be found in either switch position depending upon antenna combinations and frequency.

- Unwanted signals or noise can only be nulled if present on both A and B antennas.
- Desired signals can only be peaked if they have about the same S/N ratio on both antennas and when spacing is correct.
- Different fading rates and times between dissimilar or wide spaced antenna can make control adjustment tedious.
- The most stable and reliable nulls occur when antennas are moderately close together (between 1/10 and 1/4-wavelength apart), oriented in the same direction, and sharing the same polarization.

Using the NCC-2

The **PHASE** control changes the phase relationship between **A** and **B INPUT**s, effectively changing the direction of a peak or null. When the phase control is fully counterclockwise, **INPUT A** has minimum phase shift and **INPUT B** has maximum phase shift. As the PHASE control is rotated clockwise phase shift in **INPUT A** increases while phase shift in INPUT B decreases.

The **PHASE NORM-REV** switch inserts zero (**REV**) or 180-degree (**NORM**) phase inversion in **INPUT B**. This switch has the effect of changing a peak to a null, or a null to a peak. If a signal is nulled with the **NORM-REV** switch in one position, changing the position will result in a peak.

It is best to know the approximate level from both antennas. If you are using greatly dissimilar antenna levels dial in enough attenuation on the stronger antenna to approximately level signals.

If you have a general coverage receiver, select a strong steady signal between 1.5 and 30 MHz. The ideal signal would be ground wave, although the time and frequency standards on 5 and 10 MHz are good alternatives. Try to use a signal that does not have excessive or rapid fading.

If you know the signals from two antennas are not the same level:

A. Connect antennas, **BALANCE** control in center, Set both **A dB** and **B dB** attenuators on **0 dB**.
B. Tune in a strong clear station
C. Dial **-30 dB** of attenuation in on **B dB**. The S meter reading is the level from **A dB**.
D. Note this level.
E. Before the signal has a chance to fade, remove attenuation from **B dB** (set to zero dB) and put select **-30 dB** of attenuation on **A dB**.
F. Note level. This is the level from **B dB**.
G. The higher the S meter reading, more attenuation will be required. One S unit is typically around 5 dB, although that number can range from 1-8 dB depending on the receiver and the exact signal level. Set attenuators so the HIGHEST signal level port has the MOST attenuation.
H. Adjust **PHASE** control for a null or minimum signal.
I. Adjust the **BALANCE** for lowest reading

J. Change **PHASE Norm-Rev** to opposite position. The signal should now be strong.

Note: Any signal being nulled or peaked **must** be adjusted to the same level as seen at the receiver from both channels or the **NCC-2** Phase Control will not work as expected.

MAXIMUM Transmit power through the NCC-2 is 200 watts

Phase Nulling with a Transmit Antenna

As described throughout this manual, the primary advantage of using receiving antennas for phase nulling of unwanted signals is to enhance the signal to noise ratio (S/N) of the desired weak signal.

Wherever possible, the use of low signal, low noise receiving antennas will generally produce superior results, especially with the NCC-2.

HF and Low Band (160, 80, 40 meters) transmitting antennas usually receive high levels of noise and when used for phasing, the result is a noisy signal.

However, there are cases where phasing with a transmit antenna is desired. Some fortunate Amateur Radio Operators reside in locations where the ambient noise levels on their transmit antenna is low enough that their benefits from phase nulling and peaking will be maximized.

Many radio enthusiasts live in areas where some type of noise or strong signal interference is preventing normal or weak signal DX receive operations. Due to space limitations, some Amateur Radio operators must use a transmit antenna for nulling out undesired signals, especially when receive only antennas will not 'hear' the desired signal. However the low noise advantages of the NCC-2 may be hidden by strong ambient noise when a transmit antenna is used as a receive antenna for the NCC-2.

Normally, a receive antenna cannot be mounted on the same support or tower as the transmit antenna. If a non-powered, passive receive antenna is used, Bias Tee Enable jumpers should be in the default (open) position as supplied. When the NCC-2 is keyed, and when the internal Bias Tee jumpers are in the Bias Tee Enable (Shorted or connected) position, power only the Active Receive Antenna(s) is turned off. Refer to the section on '***Internal Jumpers***'.

As shown in **Diagram 1**, for phasing a transmit antenna with a receive antenna, RTR functionality is enabled by connecting the **MAIN ANT IN** to the transmit antenna (or amplifier) and connecting the included BNC Patch Cable from the **MAIN ANT OUT** to the **CH A RX ANT IN**. Plus, the transceiver amplifier keying line (refer to the Connection Diagrams) **must** be connected to the **RADIO PTT** phono jack on the NCC-2. If an HF amplifier is used, connect an RCA patch cord from **ACC PTT** to the amplifier RELAY connector. The NCC-2 front panel RTR switch in the **Norm** position connects **RADIO** to phasing result of **MAIN ANT** with **RX ANT**. When the NCC-2 RTR switch is in the **Main On** position, this allows listening of the **MAIN ANT** only.

Interconnection Diagrams

Diagram 1 - Phasing a Transmit Antenna with a single Active Receive Antenna using the RTR function

Diagram 1 shows connections for phasing a Transmit antenna signal with a single Active Receive Antenna using the RTR function on a transceiver that does not have a RX ANT INPUT. When the NCC-2 front panel RTR switch is in the **Norm** position, the RADIO is connected to listen to the phasing of the **MAIN ANT** and the **RX Antenna**. The RTR switch position **Main On**, allows direct listening of the **MAIN ANT** only.

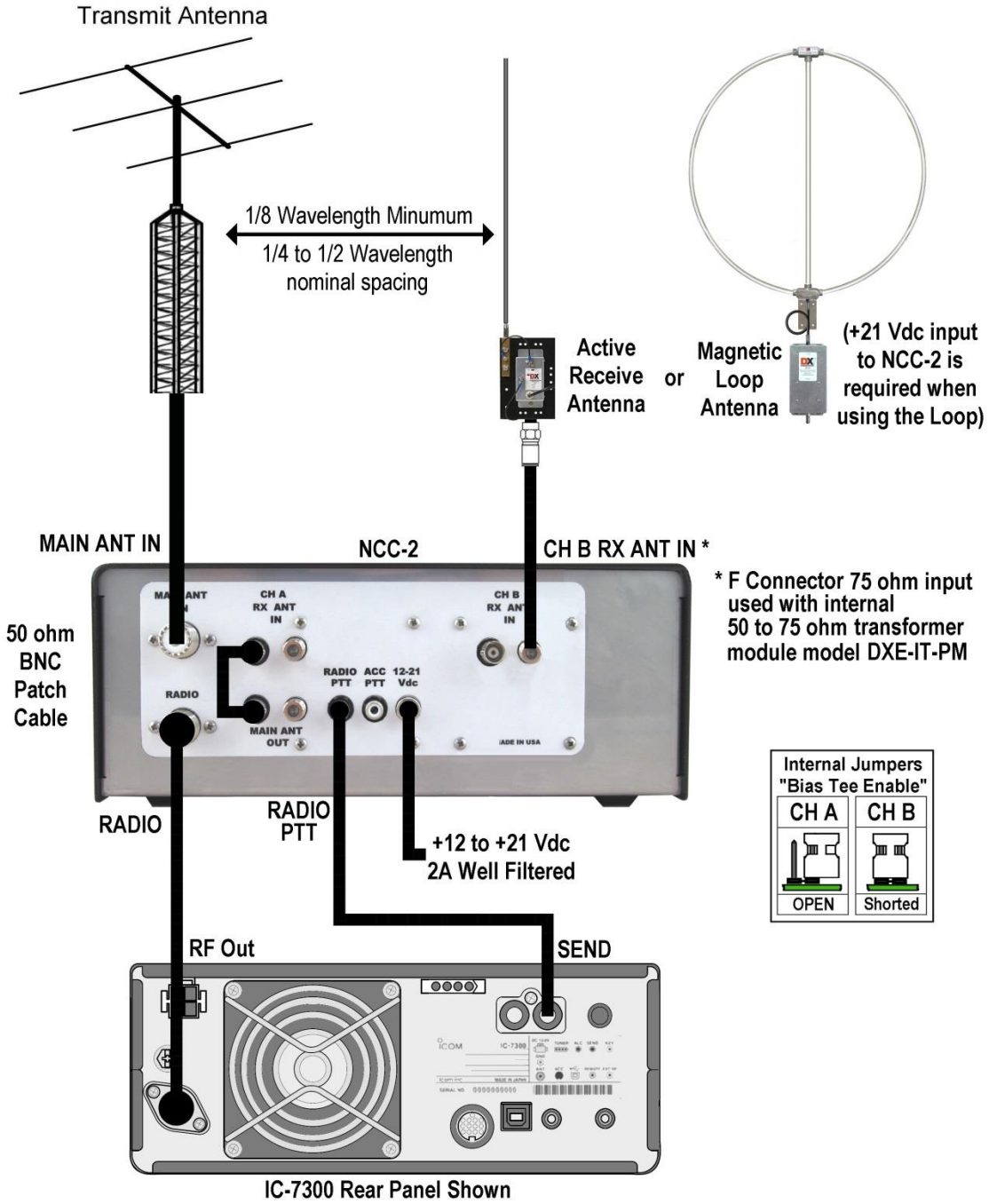


Diagram 2 - Phasing a Transmit Antenna with a single Active Receive Antenna not using the RTR function

Diagram 2 shows connections for phasing a received signal from a transmit antenna signal that is available at the **RX ANT OUT** of transceivers so equipped. NCC-2 front panel RTR switch is in the **Norm** position for the **RADIO** to listen to the phased combination of the transmit antenna and the CH A receive antenna. The RTR **Main On** is not used. The transceiver antenna switching is used to change to listening to the transmit antenna.

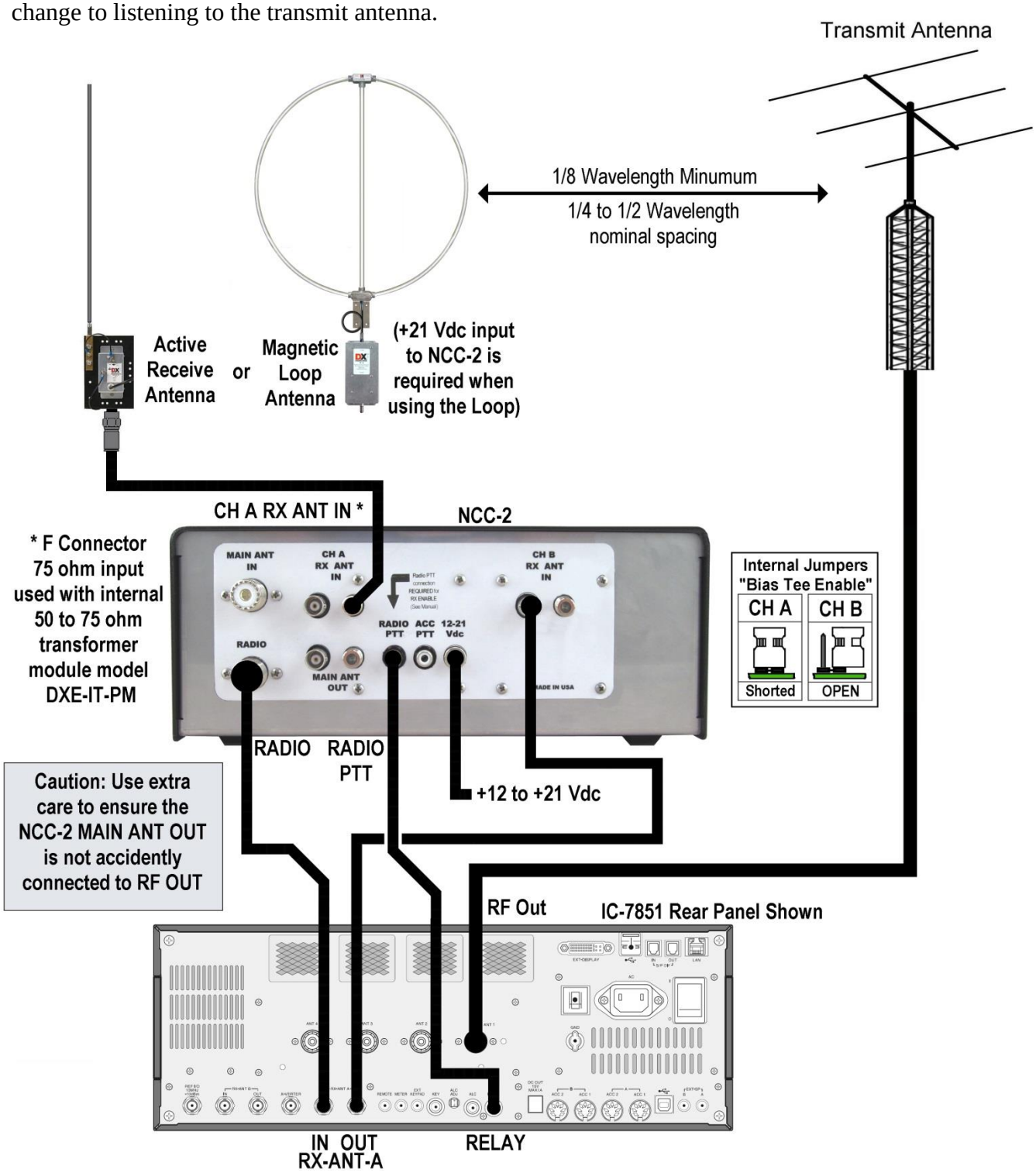


Diagram 3 - Phasing Two Active Receive Antennas not using the RTR function

Diagram 3 shows connections for two Active Receive Antennas not using the **RTR Main** Ant In. Connections are direct phased receive antenna only, fed into **RX ANT IN** on the transceiver so equipped. NCC-2 front panel switch is **Norm** position for **RADIO** to listen to phased combination. RTR Main On is not used. The transceiver antenna switching is used to listen to the transmit antenna.

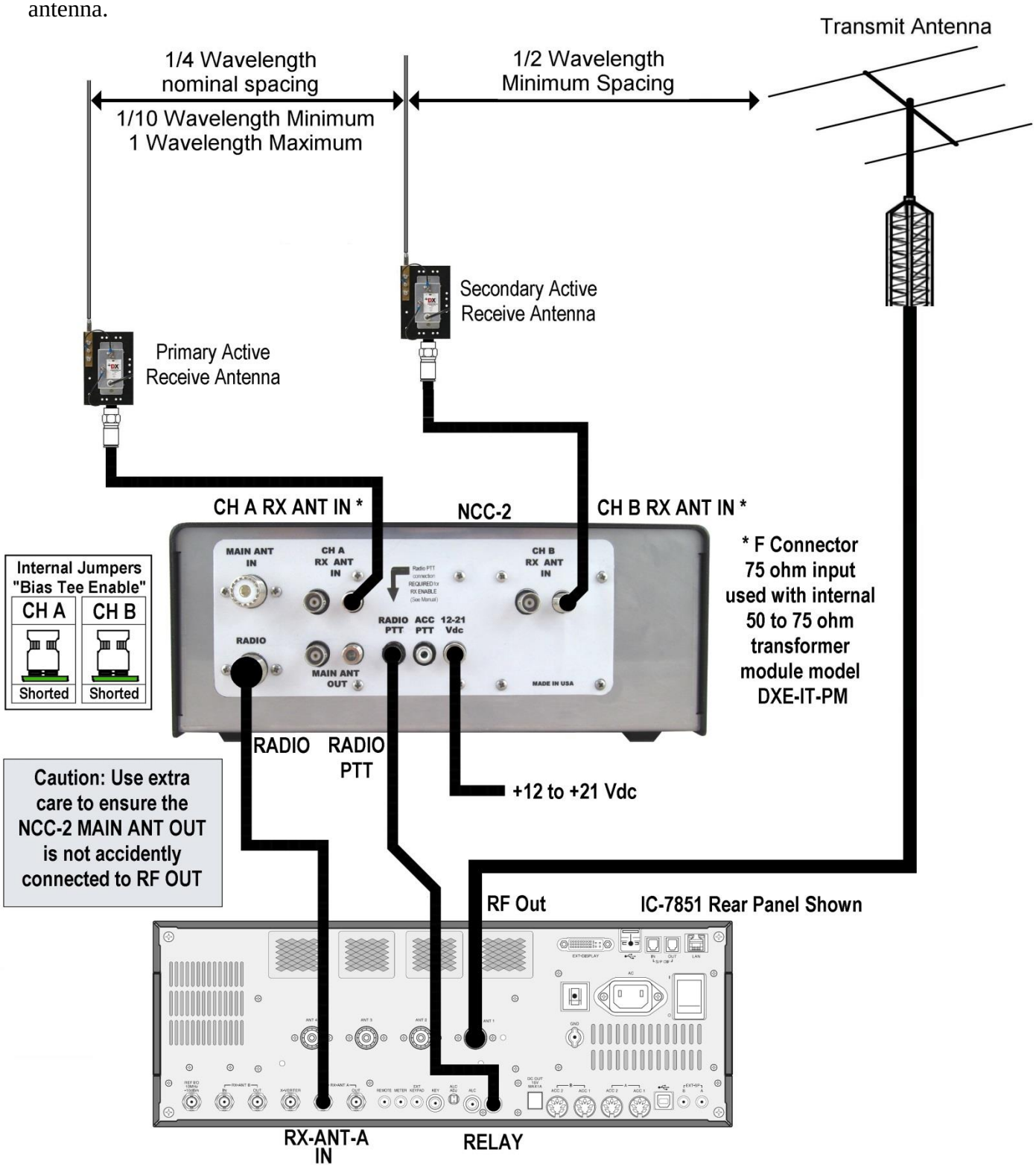


Diagram 4 - Phasing a Transmit Antenna with a single Active Receive Antenna using the RTR function and sharing transmit signals with a SDR

Diagram 4 shows connections for phasing a Transmit Antenna with a single Active Receive Antenna using the RTR function and sharing transmit signals with a second receiver. **RX ANT IN** on transceiver is not used so that an external splitter can share transmit antenna signals with a second receiver for SDR/panadapter display and NCC-2 **CHA A RX ANT** for simultaneous phased reception on **RADIO** with the RTR switch in the **Norm** position. Toggling the RTR switch to **Main On** cuts off the SDR receive and allows **RADIO** reception on **MAIN ANT** only. **(DXE-KWD-RTR - See Page 20)**

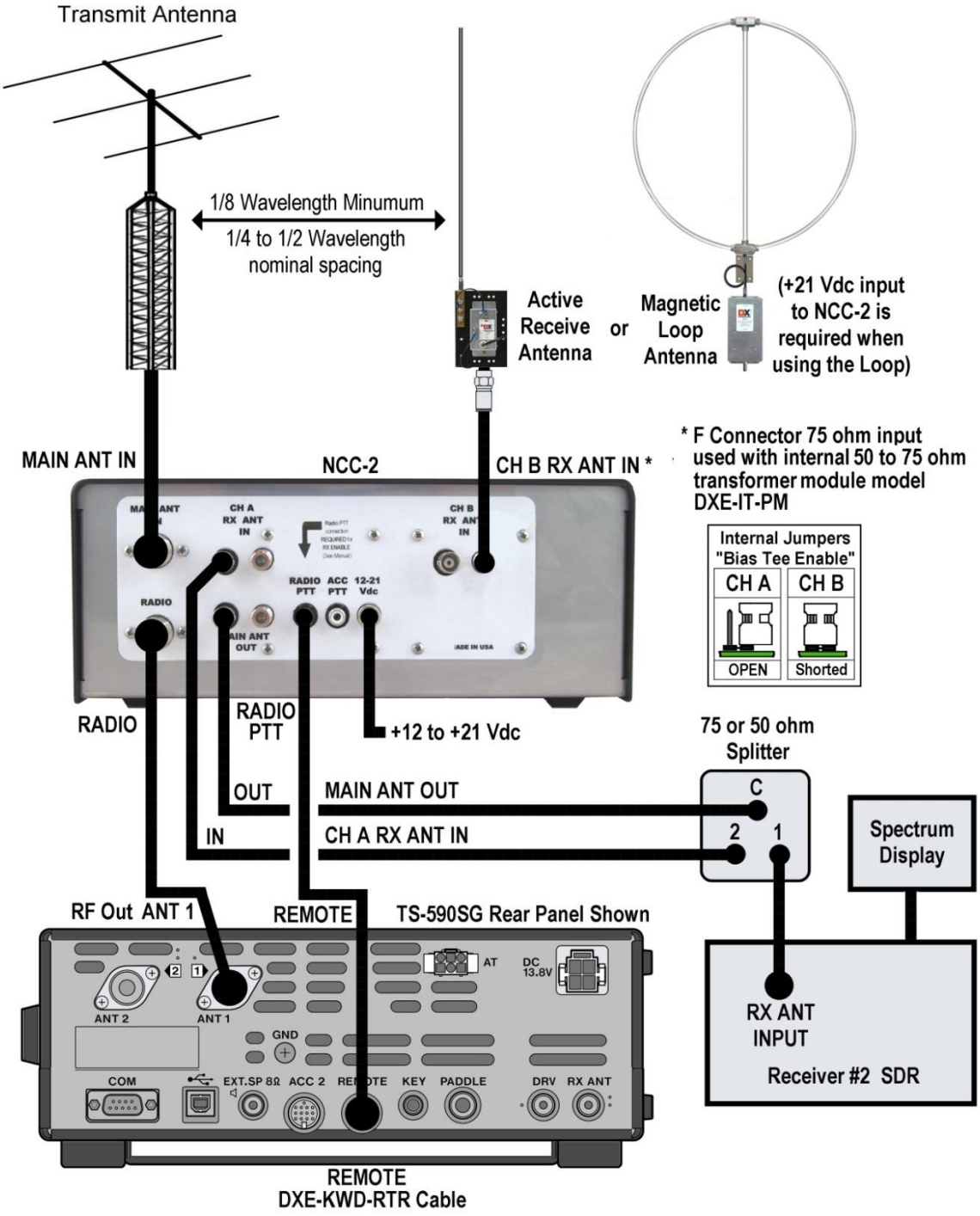


Diagram 5 - Phasing a Two Active Receive Antennas using the RTR function and Amplifier

Diagram 5 shows the connections for a transceiver without **RX ANT INPUT**. The NCC-2 front panel RTR switch is in the **Norm** position and connects **RADIO** to the phasing of only the receive antennas. RTR switch to **Main On** allows direct listening of **MAIN ANT** only. Transceiver amplifier keying line to **RADIO PTT - RX ENABLE** is passed through to ACC PTT with Schottky diode protection for amplifier (RLY) relay keying connection.

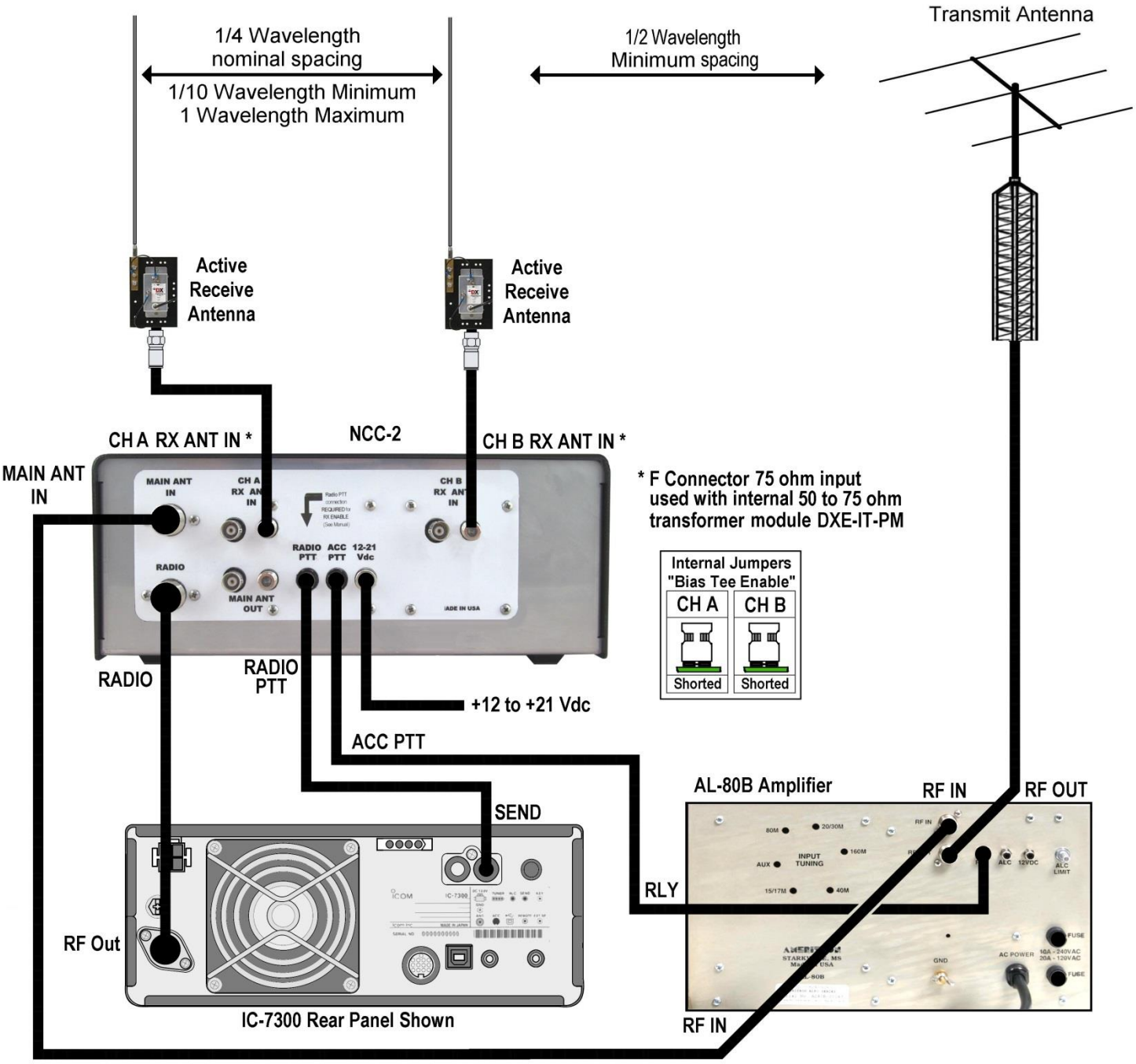
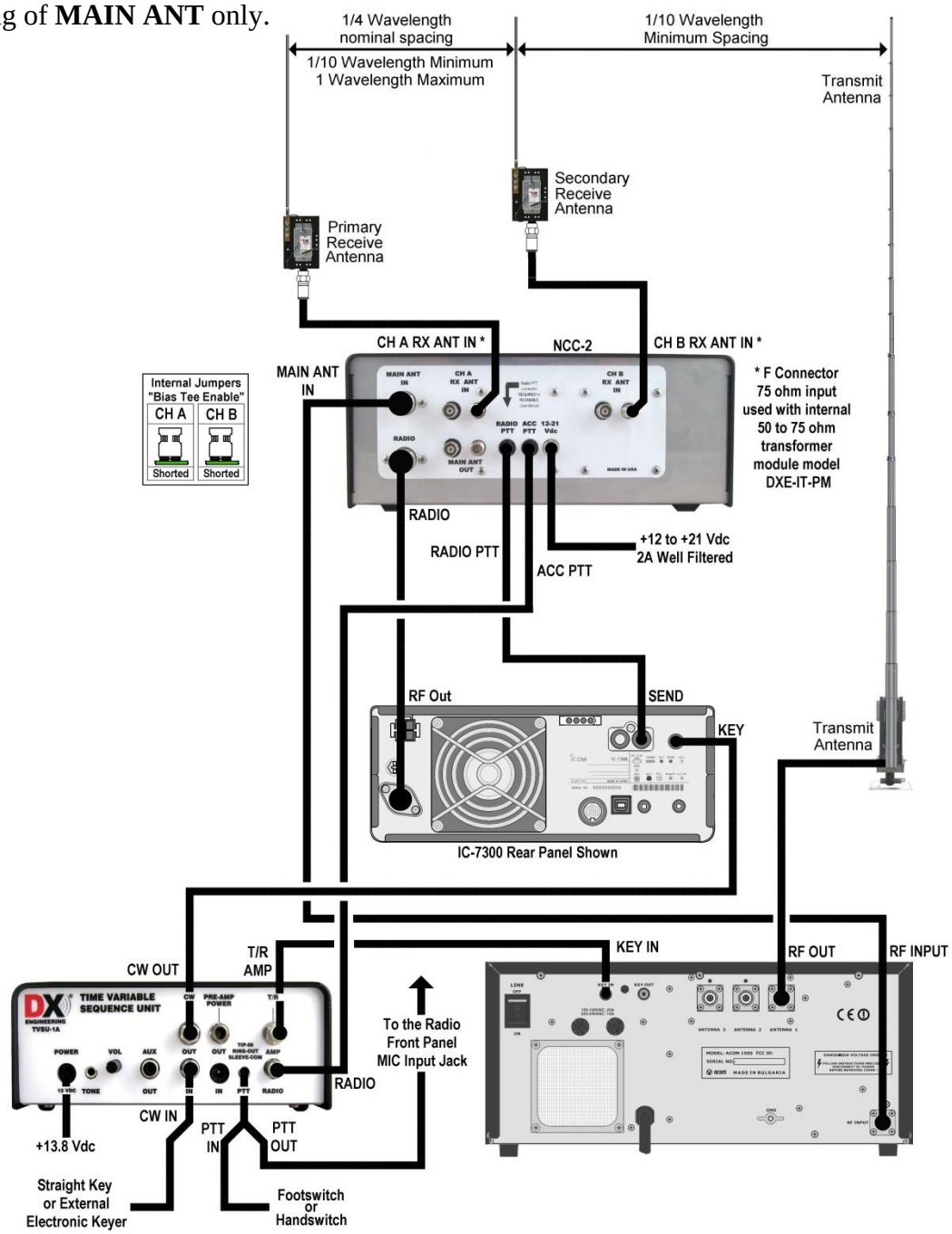


Diagram 6 - Phasing dual Active Receive Antennas on a system with a Transmit Antenna, Sequencer and an Amplifier

Diagram 6 shows the **DXE-NCC-2** for phasing two Active Receive Vertical antennas in a high power transmit system using the RTR function on a transceiver that does not have an **RX ANT INPUT**. The NCC-2 front panel RTR switch in the **Norm** position connects the **RADIO** to the phasing of the two active receive antennas. The RTR switch position **Main On** allows direct listening of **MAIN ANT** only.

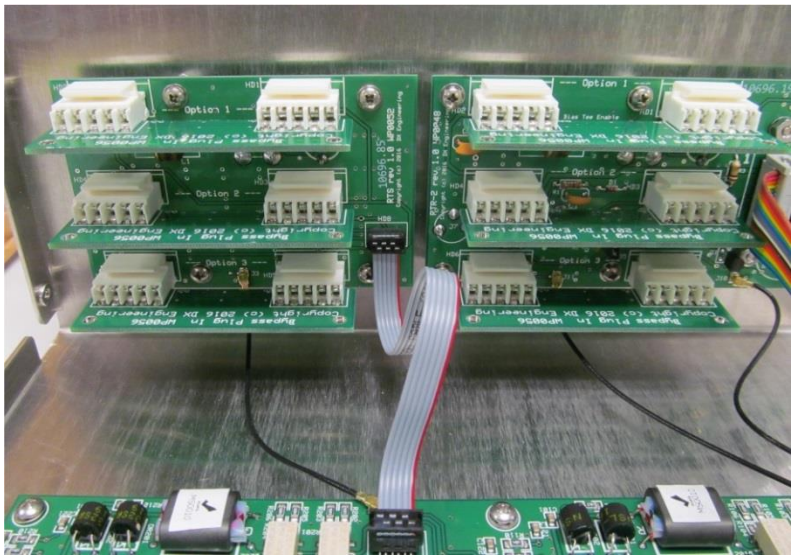


Keying by the **DXE-TVSU-1A** Sequencer of the **DXE-NCC-2** and the amplifier before keying the radio provides appropriate timing delay to prevent the active antennas being damaged from transmit RF. Refer to the **DXE-TVSU-1A** for more details.

Appendix A

Internal Optional Modules

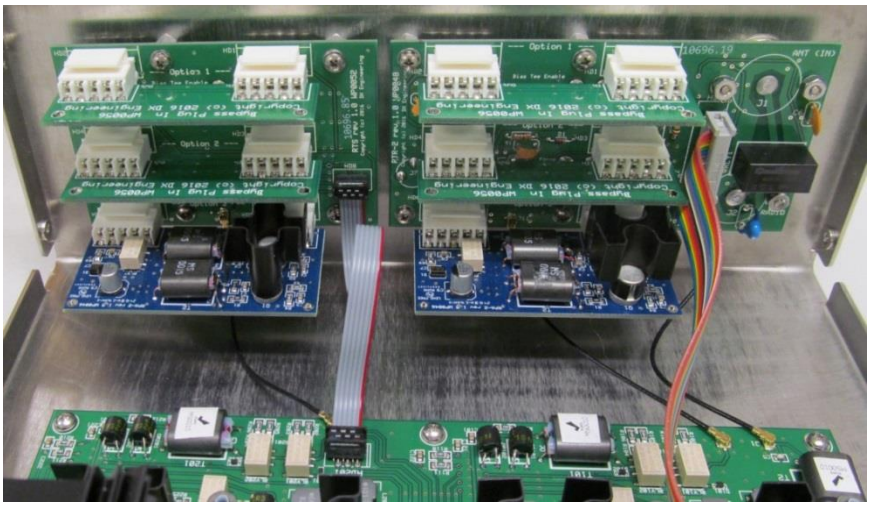
The NCC-2 has positions for optional modules (Receiver Guard, Pre Amp, 50-75 ohm Transformer) for each **RX ANT CH A** and **RX ANT CH B**. Remove the cover from the NCC-2. Looking at the rear of the unit from the inside, you will see the three Bypass Plug-In boards installed in each channel as shown below. When an optional board or boards are not installed, the jumper boards (labeled as "Bypass Plug In") must be in place as shown below.



Option 1 - The Top position is where the 50-75 ohm Transformer Module **DXE-IT-PM** is installed.
Option 2 - The Middle position is where the Receiver Guard **DXE-RG5000HD-PM** is installed.
Option 3 - The Bottom position is where the Receive Preamplifier **DXE-RPA-2-PM** is installed.

Note: Because of the power and switching requirements, the Receive Preamplifier **DXE-RPA-2-PM** must be installed in only the Bottom position.

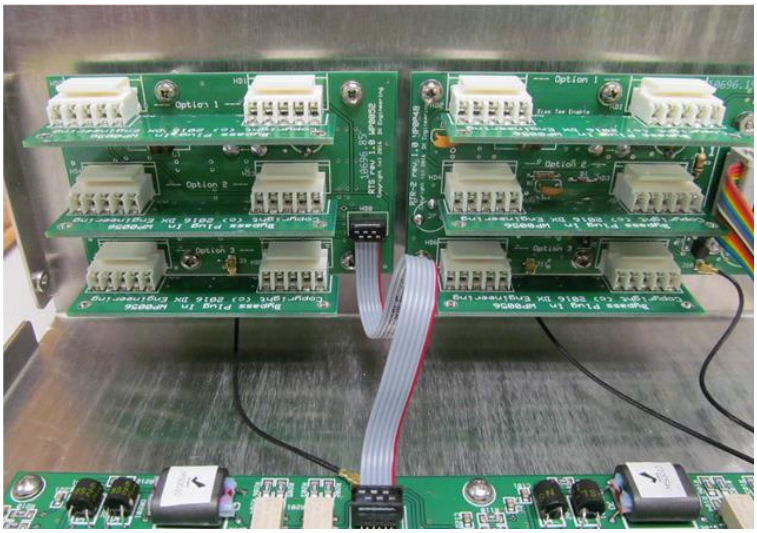
The photo shown below shows two of the Receive Preamplifiers (**DXE-RPA-2-PM)** installed for Channel A and Channel B.



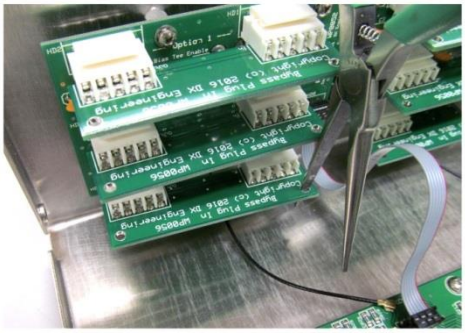
Removing - Installing Optional Modules or Bypass Plug-in Boards

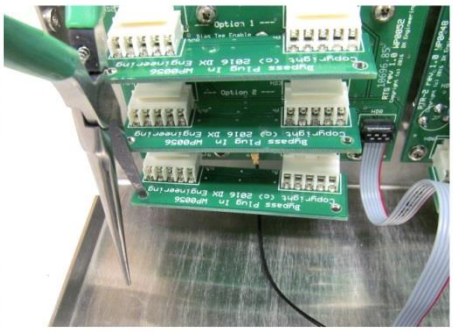
The NCC-2 has Bypass Plug-In Boards installed at the factory. When installing the optional modules, the Bypass Plug-In boards must be removed.

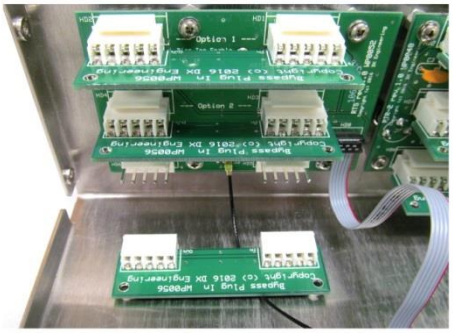
Remove the cover from the NCC-2. Looking at the rear of the unit from the inside, you will see the three Bypass Plug-In boards installed in each channel as shown below.



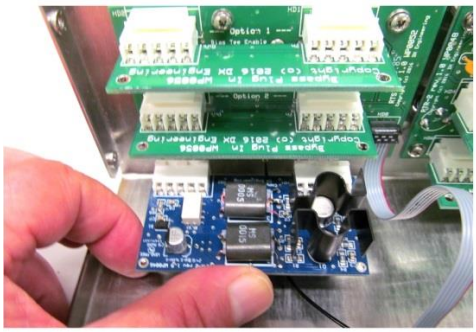
To remove the Bypass Plug-In board, use one prong on a Needle Nose Plier. Put the prong through the hole on the corner of the board to be removed and gently pry it slightly outward. Move the prong to the other corner of the board to be removed and repeat the prying action. The board will come loose from the board connectors and be able to be easily removed. See the photos below.

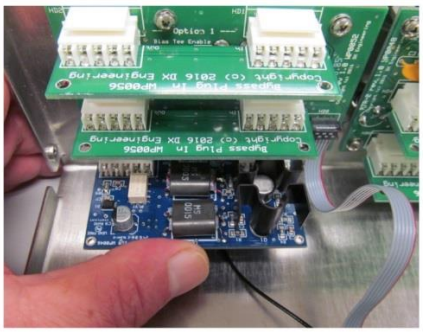


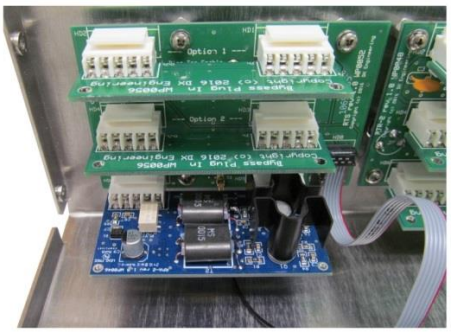




When installing the optional modules ensure the pins on both connectors are properly aligned and push the optional module board completely in as shown below.







Specifications

- **Useable Frequency Range:** 300 kHz to 30 MHz
  *The **NCC-2** is primarily designed for 500 kHz to 15 MHz use, although useful operating range extends from below 300 kHz to above 30 MHz.*
- **Third Order Output Intercept:** +32 dBm each Input, +38 dBm both inputs combined
- **Gain Flatness:** +/- 1 dB Over Complete Phase Rotation
- **Gain:** Adjustable from 0 dB to –40 dB
- **Available Phase Rotation:** >360 degrees between 500 kHz and 15 MHz
- **Power : NCC-2** +13.8 Vdc 2A and accepts well-filtered, +13.6 to +21 Vdc for normal NCC-2 operation. Input DC line should be fused at 3 amps to protect circuitry. (See text for information about various input voltages used with some active receive or loop antennas).

Note: Every radio manufacturer's accessory interconnection scheme is different, you should consult your radio manufacturer's manual for details and requirements for receive signal inputs/outputs and switching voltages.



User Notes:

User Diagram

Use this page to draw in your set up for future reference.



Technical Support

If you have questions about this product, or if you experience difficulties during the installation, contact DX Engineering at (330) 572-3200. You can also e-mail us at:

DXEngineering@DXEngineering.com

For best service, please take a few minutes to review this manual before you call.

Manual Updates

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