

# **AMERITRON RCS-10**

REMOTE  
COAX SWITCH

**INSTRUCTION MANUAL**

**PLEASE READ THIS MANUAL BEFORE OPERATING THIS EQUIPMENT !**

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**AMERITRON**

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## **Ameritron RCS-10**

### **INTRODUCTION**

The RCS-10 is a versatile antenna switch designed for 50-ohm systems. It handles high power, and sealed relays offer excellent life and connection reliability. It requires only three small isolated control wires, plus a ground return that can even be the coaxial cable shield. The relay box can be mounted indoors or outdoors.

**The RCS-10 Remote Antenna Switch selects one-of-eight “antenna” connectors or “ports”, and connects those ports directly to a single common port for a feedline.** The RCS-10 will work well in nearly any system requiring switching of unbalanced or coaxial lines, especially those requiring good quality 50-ohm RF switches. The RCS-10 is a remote controlled switch using relay contacts. The control head can be conveniently located and only requires use of small low-voltage low-current telephone-type four-conductor control cable. Any switch port can be used as either an input or output, so you can select one-of-eight radios to one feedline or one-of-eight antennas to a radio.

**The Main Advantages of the RCS-10 are wiring cost, appearance, and convenience.** The RCS-10 uses low voltage and low current, and can use inexpensive and easy-to-route control cables. Bulky and expensive coaxial and control cables are not required, and wiring is very simple. Since all cables route through one common point that can be grounded, lightning protection is almost always significantly better than conventional wiring methods using multiple coaxial lines into the operating position.

**The RCS-10 Relay Unit reliably handles power levels of 5,000 watts below 30MHz, and power levels of 2.5kW at 50MHz.** Port-to-port isolation is typically in the 40dB range, but varies with frequency and the ports being used. Loss is very low, and this switch can be considered lossless below 30MHz. More performance details are in the Remote Relay Unit section of this manual. The RCS-10 Relay Unit can be used with any BCD (binary coded decimal) 12-16 volt dc 400mA control system. The relay box is available with or with out lightning protection. The RCS-10L uses the same RCS-10 control box. The relay box is labeled RCS-10L for lightning protection. Each antenna port is protected.

**The RCS-10 Indoor Unit (shipped with this unit) has antenna indicator LED’s and a manual rotary selector switch.** We have included an area where you can label each antenna. It normally operates from +12 to +16 volt dc power supplies, and consumes less than 600mA. When used with other relay systems, the RCS-10 (and RCS-12C) control units are capable of switching up to 25 volts with one ampere of relay current.

**The RCS-10 Indoor Unit can be used as an interface to convert standard 1-of-8 control input to a BCD output suitable for driving the RCS-10 remote relay box.** The control head also outputs standard 1-of-8 control signals, like the RSC-8V system uses. Control *inputs* must be 12 to 16 volts dc positive and capable of supplying at least 400mA. This feature allows other multi-wire control systems, like the RCS-8V system, to interface with the RCS-10 controller. In all cases, zero input or output voltage selects antenna 1. The same output occurs when voltage is applied to serial port one. Applying voltage to terminal one illuminates the position one LED, but the BCD output remains 000. See the Control Logic Table on page 3 for switching details.

## FEATURES

### Outdoor Unit Features

**Inexpensive and Simple Wiring:** Selects up to eight antennas using one four-conductor telephone-type control line.

**High Power Capability:** The RCS-10 Relay box will handle 5kW into matched loads below 30 MHz.

**Long Relay Life:** UL/CSA/VDE approved sealed relays with 16-ampere switching current rating. Tested to withstand 1200v.

**Flexible Mounting:** The RCS-10 hardware accepts mast sizes from 1 inch to 2-1/4 inches.

**Compact:** Approximately 5-1/4" W x 6-7/8" D x 3"H and weighs 3 lbs.

**Reliable Connectors:** Teflon UHF-style SO-239 females, internal barrier strip for control lines.

**Low voltage:** Requires 10-15 volts at less than 300mA.

**Wide Frequency Range:** Covers DC to over 100 MHz with low SWR, negligible loss, and good unused port isolation.

**Highly Weather Resistant:** Sealed relays, stainless hardware, and U-V resistant cover.

## **Control Box Features**

**Battery or Line Operated:** Operates from any filtered 12-16 Vdc supply capable of supplying 500mA continuous.

**Easy-to-Read Antenna Indicators:** Eight wide-spaced LED's indicate the selected antenna.

**Wide Profile:** 6-1/4" W x 4-5/8" D x 3-1/4 H helps prevent unwanted movement when turning selector switch.

**Flexible Interface:** Accepts and outputs one-of-eight control signals, and outputs three-line BCD data.

## **REMOTE RELAY UNIT**

### **Typical Electrical Characteristics**

Maximum Loss:

30MHz (and lower) negligible, 60MHz under 0.1dB, 150MHz under .25dB

	15 MHz	30MHz	60MHz	150MHz
Worse Ports	Negligible	Negligible	Under 0.1dB	Under 0.25 dB

Maximum 50-ohm VSWR:

Below 30MHz under 1.25:1, below 60MHz under 1.3:1, below 150MHz under 1.8:1

	15 MHz	30MHz	60MHz	150MHz
Worse Ports	Negligible	Under 1.25:1	Under 1.3:1	Under 1.8:1

60dB Port-to-port Isolation at 150MHz (unused port terminated into 50 ohms) in -dB. Isolation improves greatly at lower frequencies.

150 MHz Port-to-port crosstalk:

Worse case -19dB, typical -30dB, best case -60dB Port-to-port Isolation at 150 MHz (unused port terminated into 50 ohms) in -dB. Isolation improves greatly at lower frequencies.

The horizontal row is the “through ports”; the vertical row is “unwanted ports”:

Ports	1	2	3	4	5	6	7	8
1	X	25.8	23.7	39	24.1	43.5	42	56
2	19.8	X	31.1	24	37.9	23.5	56	42.4
3	19.8	37	X	25.5	38.7	58	24.3	44.4
4	30.8	19.5	19.4	X	54	37.5	37.3	24.1
5	19.4	40.1	38.4	52	X	25.4	23.3	39.6
6	32.5	18.9	46	38.8	19.8	X	30.7	23.5
7	35	51	19.6	40.2	19.7	37.4	X	25.2
8	46	32.4	32.4	19.1	30.6	19.4	19.3	X

### **Description**

The remote relay unit is designed for indoor or outdoor mounting. It has a UV resistant ABS weather cover and corrosion resistant metal parts. The mounting bracket assembly is designed to accept masts from 1 inch up to 2-1/4 inch outside diameter, but can also be attached to flat surfaces.

The remote relay switch section is designed for 50-ohm systems, and operates from dc to 60 MHz with very good performance. The RCS-10 can be used to 150 MHz, but only in non-critical applications. Examples of non-critical applications are switching antennas for local repeater or simplex operation. Examples of critical applications where the RCS-10 could cause problems would include long-distance weak-signal work or SWR critical systems. SWR of the RCS-10 can be as high as 1.8:1 on 150MHz, and port-to-port isolation can be as low as 19dB.

The RCS-10 relay switch section is normally supplied with high-quality UHF-type connectors, although N-connector models are available. 16-ampere sealed contactors easily handle power levels exceeding 1500 watts on frequencies below 60MHz, and over 500 watts at 150MHz. Typical power handling below 30 MHz exceeds 5kW.

### **IMPORTANT NOTE ABOUT CONNECTORS!**

Although type-N connectors improve weather sealing, they will *not* improve loss or SWR performance of this switch. Standard UHF connectors have negligible loss, and have immeasurable affect on system SWR below upper VHF. Type-N connectors may reduce power-handling capabilities of this switch.

Control signals use a three-wire system (plus ground). The control signals are BCD encoded. In this system control wires are labeled A, B and C, and operate using an assigned value of A=1, B=2, and C=4. By using this system, three wires can count from zero to seven. The relay box selects up to eight antennas using the following scheme:

Logic Table

	Ant 1	Ant 2	Ant 3	Ant 4	Ant 5	Ant 6	Ant 7	Ant 8	
A (1)	Off	On	Off	On	Off	On	Off	On	160mA
B (2)	Off	Off	On	On	Off	Off	On	On	80mA
C (4)	Off	Off	Off	Off	On	On	On	On	40mA

Note that Ant 1= BCD 0 (0+0+0=0) counting up to Ant 8 which is BCD 7 (1+2+4=7).

**LIGHTNING PROTECTION NOTE!**

Antenna port “ANT 1” is selected anytime control box voltage is removed, regardless of selector switch position. If you do not need all eight ports, antenna port “ANT 1” can be shorted directly to ground to improve lightning protection. You can ground port “ANT 1” by installing a PL-259 with the center pin shorted to the connector shell. If you use all ports, try to put the smallest and lowest antenna on port 1. This will minimize risk of lightning damage.

See Lighting Protection on page 8 for more details.

The control cable can use relatively small size wires. Large rotor cables are unnecessary, maximum control current is less than 160mA per conductor and voltage is less than 15 volts. The ground connection carries a maximum current of 280mA, but ground current also flows over the coax shields and other paths without harmful effects. Standard outdoor-rated 24-gauge or heavier telephone wire is adequate even with cable runs of 500 feet or longer. The main considerations are cable life when exposed to the weather, rather than current carrying. Control cable conductor resistance must be under 20 ohms for reliable switching.

**INSTALLATION GUIDELINES**

**The relay unit can be installed either indoors or outdoors. Wherever the unit is installed, heed the following guidelines:**

Always mount this unit with the connectors facing down.

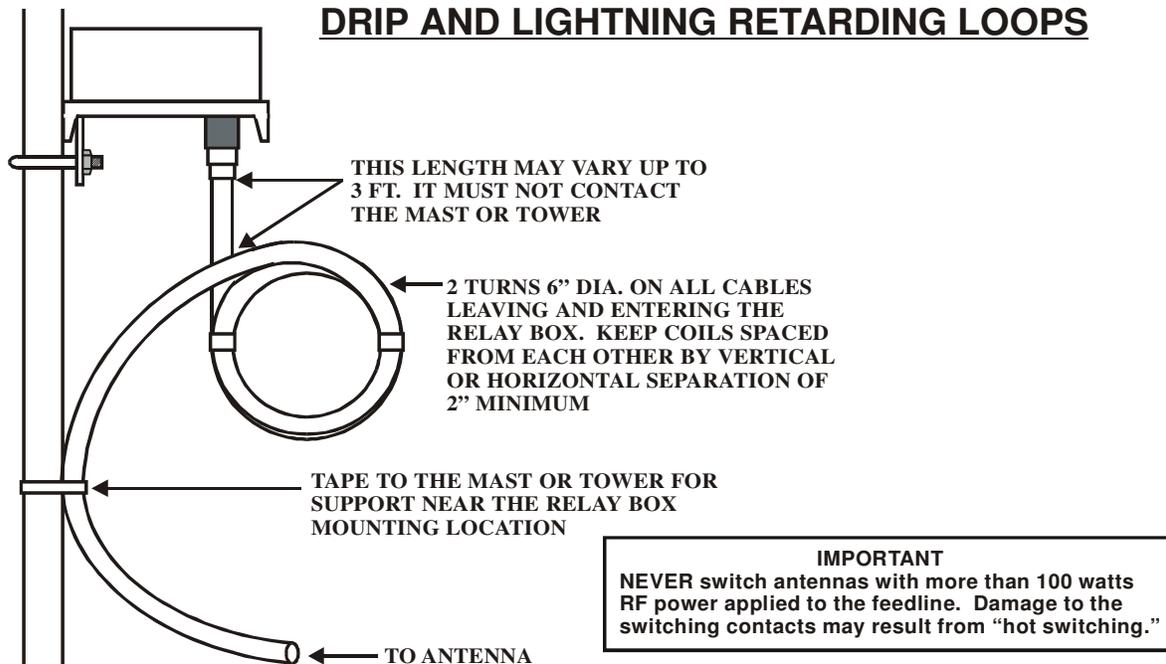
Do not attempt to seal the cover. This unit must be allowed to exchange air through imperfect sealing, or it may collect moisture.

Avoid mounting locations that have an unnecessary concentration of water, such as corners of buildings under water runoff. Never mount the switch lower than the maximum expected height of snow or water.

Ground the mounting bracket by clamping it directly to a tower or mast, or running wide copper flashing from it to a good earth ground.

When possible coil all cables near this unit, and always use drip loops. See figure 1.

Connect the lowest and smallest antenna to port one, or short port one and use ports 2-8 for antennas if possible. See the Lightning Protection section of this manual.



**Figure 1**

## **Wiring**

Wiring is very simple. Be sure any wire you use is suitable for the environment it will be placed in. Do not bury above-ground rated wires, and do not use indoor non-UV resistant wires in direct sunlight.

Three insulated wires should connect terminals A, B, and C on the relay box to terminals A, B, and C on the indoor control head. The ground return can either be made through the coaxial cable shield, or through additional conductor(s) in the control wire.

We recommend following a standard resistor color code format for wiring. Use brown for A, red for B, and orange for C if possible. Otherwise, start with the lowest standard color and work upwards. If you do this with all cables, you will rarely need to keep wiring notes.

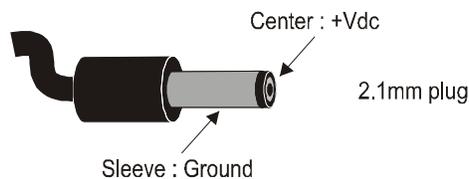
Wire gauge is not important, as long as the total resistance of the control wire used is less than 20 ohms. This means very long small-gauge wires will normally work fine. Normal telephone-type #24 wires will work at distances well over 500 feet. The largest concern related to wire selection is mechanical life rather than electrical characteristics.

If you use another brand of control head, ports A, B and C are encoded with BCD 1,2, and 4 respectively. Antenna 1 is BCD zero, while antenna 8 is BCD 7. The switch requires 12 volts DC of either positive or negative polarity.

### **Indoor Control Unit**

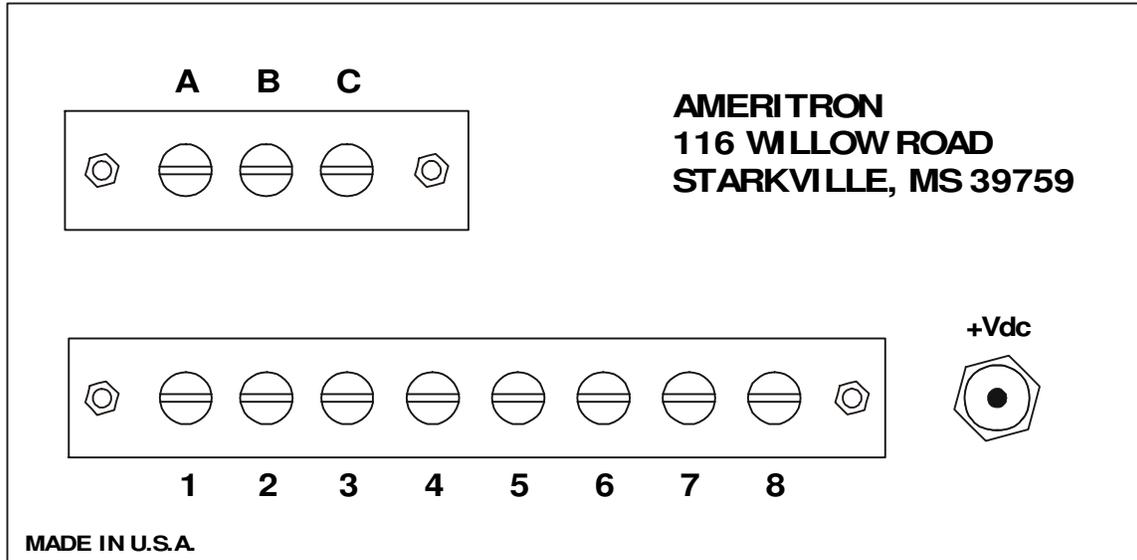
The indoor unit can be located at any convenient location, as long as it is not exposed to moisture. It should be grounded to the station ground, and preferably powered from a separate wall adaptor. Current draw is approximately 300mA maximum, but we recommend a 500mA power supply for headroom.

This unit is polarity sensitive. It requires the following power connection:



The sleeve is negative, and can be grounded or floated at the power supply. The center pin is positive, and **MUST** be ground isolated. The supply must be capable of supplying 300mA continuous at 12-15 volts dc, when using the standard RCS-10 outdoor relay box. To ensure the supply meets these requirements, we recommend using 500mA or larger power adaptors (“wall-warts”). This unit will accept voltages of 25 volts if you want to use it with other relay systems.

The rear-panel connections (figure 2) are labeled A through C for BCD control outputs used with the RCS-10 remote relay box, and 1 through 8 for one-of-eight inputs or outputs (such as used with RCS-8 and other switching systems). Maximum current capability is one ampere.



**Figure 2**

The RCS-10 is internally fused with a standard auto-glass (3AG) style 1-ampere fuse. If your power supply is capable of supplying significantly more than one ampere, you should also fuse the power lead at the power supply with a low-current fuse. Installing a fuse at the power supply eliminates safety hazards associated with overheated power leads, if the leads should become shorted.

Terminals A, B, and C are BCD encoded outputs for the relay unit. Terminal "A" is BCD 1, terminal "B" BCD 2, and terminal "C" is BCD 4. This provides a numerical total of zero through seven for selecting relays. Antenna port one on the relay box is selected with all BCD outputs zero, port 2 with only BCD "A" high, and so on until port eight is selected with all BCD ports high.

When antenna position one is selected, voltage on A, B and C is zero volts. This is the same voltage as when the control head power is turned off. Because of that, antenna port 1 is selected whenever the switch is off or has no power.

There is an internal 2-pin jumper on the left side (rear view) of the front-panel printed circuit board. When these pins are NOT jumpered, the LED's are dim. When these pins are jumpered, the LED's are brighter. When using voltages over 20 volts, you must be sure these pins are not jumped.

## LIGHTNING PROTECTION

Proper grounding and cable routing is the single most important aspect of lightning protection and RFI (radio frequency interference) reduction. We recommend reading technical books or articles written by knowledgeable experts on grounding, rather than relying on hearsay or folklore. As a general rule, anything done to improve lightning protection also improves RF grounding and reduces unwanted RF interference.

Each piece of equipment at the operating position should connect to a common ground point, or common ground buss.

The ground connection from the station should be made with wide smooth copper flashing or tubing to a good earth ground.

The outside ground should be connected to the power line ground and telephone company ground with the shortest-possible heavy conductor.

The outside ground should use multiple ground rods, and ideally should include several buried wires to spread lightning current out over a large surface area.

All leads leaving a tower or mast should come down to ground level and exit the area of the tower at or below ground level.

The tower or mast should be properly grounded.

The RCS-10 outdoor unit should be mounted directly to the tower or mast on grounded tower or masts, or to a well-grounded metal post when tower mounting is not desirable or practical.

The best protection is to disconnect antennas leads, although that is generally not necessary with proper installation and grounding.

**NOTE:** Good lightning protection requires use of wide, smooth, copper flashing or large, round, smooth conductors for ground leads. Avoid using braided or woven conductors for ground leads, unless the lead has to be repeatedly flexed.

If you desire additional lightning protection, you can ground the “ANT 1” port of the RCS-10 Relay Box by attaching a shorted connector. This connects the feedline center conductor to the shield whenever power is removed, and opens all other antenna leads. The main drawback is this reduces available antenna ports to seven. While it is impossible to guarantee immunity from lightning damage, grounding position one will be a large step towards that goal.

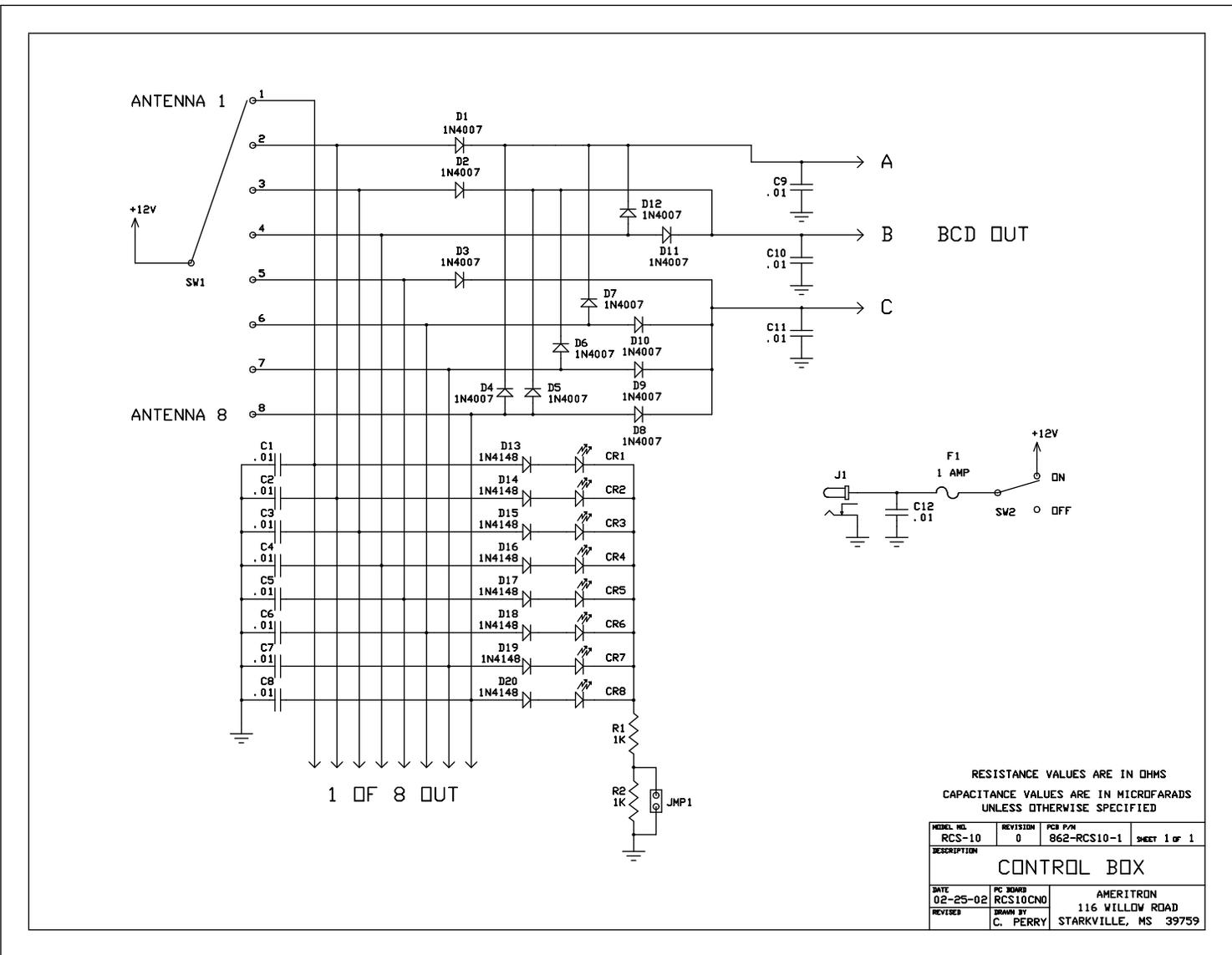
## **TECHNICAL ASSISTANCE**

If you have any problem with this unit first check the appropriate section of this manual. If the manual does not reference your problem or reading the manual does not solve your problem, call *Ameritron* at 662-323-8211. We can only help if you have your RCS-10 manual, radio manual, and information about your station available during the call.

*We strongly recommend calling Ameritron with any questions, but questions can be mailed directly to Ameritron at 116 Willow Road, Starkville, MS 39759 or faxed to 662-323-9810. Be sure to send a complete description of the problem, explain how this unit is being used, and include a complete description of your station.*

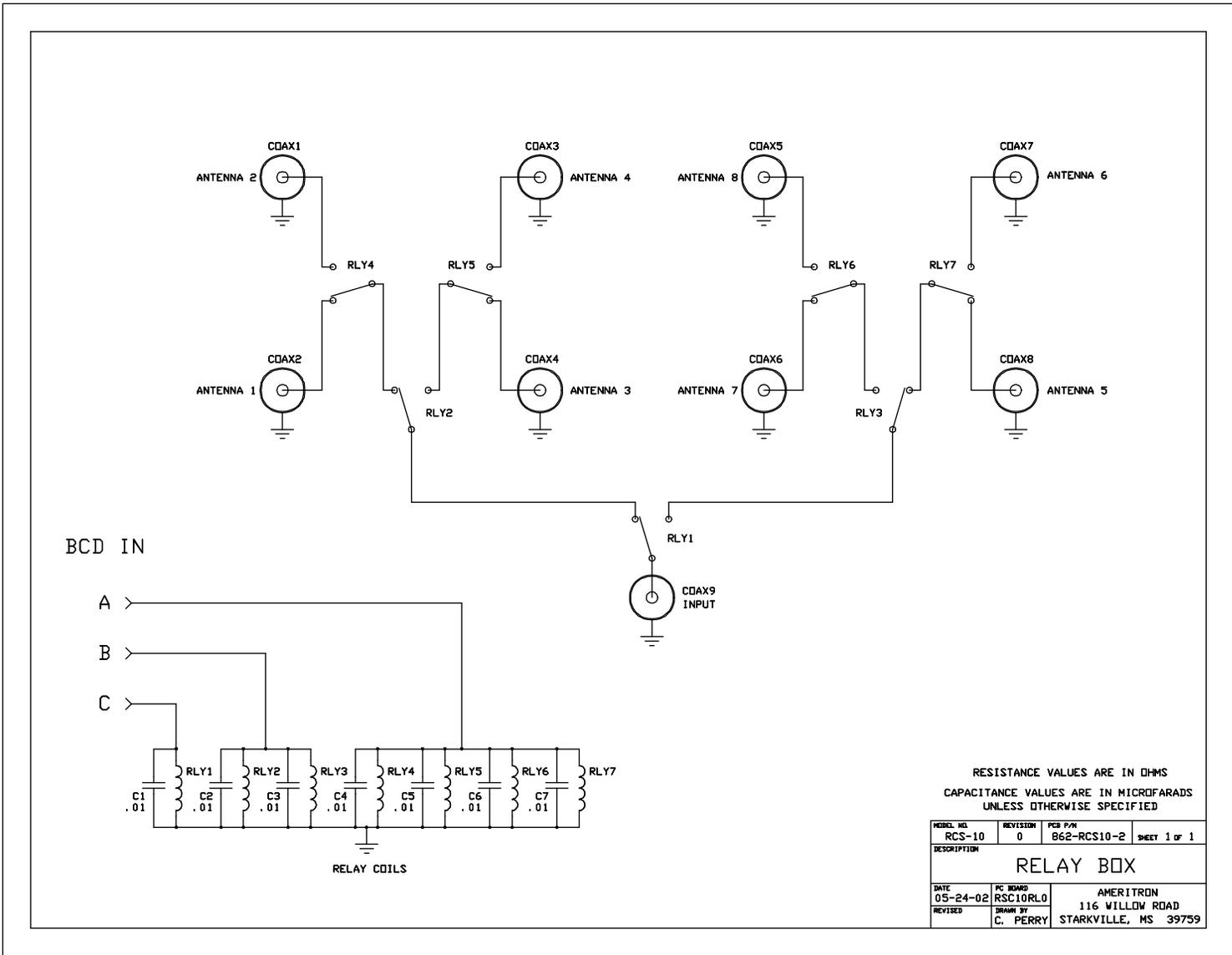
## **NOTES**

**SCHEMATIC**



RESISTANCE VALUES ARE IN OHMS  
CAPACITANCE VALUES ARE IN MICROFARADS  
UNLESS OTHERWISE SPECIFIED

MODEL NO. RCS-10	REVISION 0	PCB P/N 862-RCS10-1	SHEET 1 OF 1
DESCRIPTION <b>CONTROL BOX</b>			
DATE 02-25-02	PC BOARD RCS10CNO	AMERITRON 116 WILLOW ROAD STARKVILLE, MS 39759	
REVISED	DRAWN BY C. PERRY		



## DISCLAIMER

Information in this manual is designed for **user purposes only** and is *not* intended to supersede information contained in customer regulations, technical manuals/documents, positional handbooks, or other official publications. The copy of this manual provided to the customer will *not* be updated to reflect current data.

Customers using this manual should report errors or omissions, recommendations for improvements, or other comments to Ameritron 116 Willow Road, Starkville, MS 39759. Phone: (662) 323-8211; FAX: (662) 323-6551. Business hours: M-F 8-4:30 CST.

**AMERITRON**  
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662-323-8211

### LIMITED WARRANTY

Ameritron warrants to the original purchaser that this product shall be free from defects in material or workmanship for one year from the date of original purchase. During the warranty period, Ameritron (or an authorized Ameritron service facility) will provide free of charge both parts and labor necessary to correct defects in material or workmanship.

To obtain such warranty service, the original purchaser must:

- (1) Complete and send in the Warranty Registration Card.
- (2) Notify Ameritron or its nearest authorized service facility, as soon as possible after discovery of a possible defect, of:
  - (a) The model number and serial number, if any;
  - (b) The identity of the seller and the approximate date of purchase;
  - (c) A detailed description of the problem, including details on the equipment.
- (3) Deliver the product to the Ameritron or the nearest authorized service facility, or ship the same in its original container or equivalent, fully insured and with shipping charges prepaid.

Correct maintenance, repair, and use are important to obtain proper performance from this product. Therefore, carefully read the Instruction Manual. This warranty does not apply to any defect that Ameritron determines is due to:

- (1) Improper maintenance or repair, including the installation of parts or accessories that do not conform to the quality and specifications of the original parts.
- (2) Misuse, abuse, neglect or improper installation.
- (3) Accidental or intentional damage.

**All implied warranties, if any, terminate one (1) year from the date of the original purchase.**

The foregoing constitutes Ameritron's entire obligation with respect to this product, and the original purchaser and any user or owner shall have no remedy and no claim for incidental or consequential damages. Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damage, so the above limitation and exclusion may not apply to you.

This warranty gives specific legal rights and you may also have other rights, which vary from state to state.

