

Features and Operation of Buckeye's A/C Radio Controlled Switch (RCS)

Comverge Adaptive Algorithm RCS

Buckeye Power, Inc. - May 2008

1. By definition, a control cycle occurs during a 30 minute period (i.e. two periods per hour) for an A/C unit equipped with a specially designed Comverge Adaptive Algorithm RCS.
2. The RCS senses and archives a rolling one hour average previous run-time (PRT) for the controlled A/C unit. If archived information is incomplete or times are less than 15 minutes, then PRT is assumed to be 60 minutes.
3. The amount of load control is designated by the percentage of control (POC) applied to the PRT during each 30 minute control cycle, rather than specifying the amount of "**OFF**" time and "**ON**" time. The allowable run time **ON** and controlled time **OFF** during each 30 minute control cycle can be computed as explained by the following examples:
 - a. $(1-POC) \times PRT/2 =$ allowable run-time **ON** for each 30 minutes. (e.g. 40% POC and PRT of 60 minutes computes: $(1-.4) \times (60 \text{ minutes}/2) = 18 \text{ minutes ON}$.)
 - b. For computing the amount of controlled time **OFF**, simply subtract the amount computed in the example above in 3.a from 30 minutes. $30 \text{ minutes} - 18 \text{ minutes} = 12 \text{ minutes OFF}$.
 - c. The application of the Comverge Adaptive Algorithm Feature affects the amount of **ON** and **OFF** times which will vary relative to the amount of the A/C unit's rolling one hour average previous run-time (PRT)
 - d. The above calculation using the POC and PRT is applied only once for the start of control and those results are used throughout the control session.
 - e. Refer to the table on the next page for a run-time matrix detailing the affect of the adaptive algorithm feature of the Comverge RCS. The figures shown are run-times **ON**; subtract these figures from 30 minutes to derive controlled time **OFF**.
4. Depending upon the amount of peak load reduction needed, Buckeye will use either a 25% or 40% POC cycle.
5. The start time for load control (when the **OFF** time begins) is randomized with all RCS. Thus applying the information in item (4) above, this can occur anytime from the beginning of the hour to 18 minutes past the hour in order to achieve the POC example as illustrated in item 4.b. above.
6. If load control starts at the beginning of an hour, there will be one **OFF** cycle followed by one **ON** cycle during the first and any subsequent 30 minute control period. If load control starts after beginning of a 30 minute period, there will be two **ON** cycles and one **OFF** cycle. In this case, the **ON** cycle will occur before and after the designated **OFF** cycle.
7. The cycled **OFF** times are never contiguous between consecutive 30 minute control periods.
8. The Comverge adaptive algorithm RCS provides cyclic equality among A/C control participants by applying the same POC to each controlled A/C PRT. It provides the desired amount of peak load shedding relief while minimizing the degree of discomfort experienced by the consumer member. In addition, the disturbance of load diversity among all controlled A/C units is minimized which is very important for overall peak load reduction.

Comverge Radio Control Switch (RCS) Adaptive Algorithm Allowable Run-Time Matrix (RCS controlling A/C Systems)

		Previous Run Time (PRT) rolling average for last hour (minutes)													
		0	5	10	15	20	25	30	35	40	45	50	55	60	
Percentage of Control (POC)	0%	0.0	0.0	0.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0	30.0	30.0	
	5%	0.0	0.0	0.0	7.1	9.5	11.9	14.2	16.6	19.0	21.4	23.7	30.0	30.0	
	10%	0.0	0.0	0.0	6.7	9.0	11.2	13.5	15.7	18.0	20.2	22.5	24.7	30.0	
	15%	0.0	0.0	0.0	6.4	8.5	10.6	12.7	14.9	17.0	19.1	21.2	23.4	30.0	
	20%	24.0	24.0	24.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	
	25%	22.5	22.5	22.5	5.6	7.5	9.4	11.2	13.1	15.0	16.9	18.7	20.6	22.5	
	30%	21.0	21.0	21.0	5.2	7.0	8.7	10.5	12.2	14.0	15.7	17.5	19.2	21.0	
	35%	19.5	19.5	19.5	4.9	6.5	8.1	9.7	11.4	13.0	14.6	16.2	17.9	19.5	
	40%	18.0	18.0	18.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0	16.5	18.0	
	45%	16.5	16.5	16.5	4.1	5.5	6.9	8.2	9.6	11.0	12.4	13.7	15.1	16.5	
	50%	15.0	15.0	15.0	3.7	5.0	6.2	7.5	8.7	10.0	11.2	12.5	13.7	15.0	
	55%	13.5	13.5	13.5	3.4	4.5	5.6	6.7	7.9	9.0	10.1	11.2	12.4	13.5	
	60%	12.0	12.0	12.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	
	65%	10.5	10.5	10.5	2.6	3.5	4.4	5.2	6.1	7.0	7.9	8.7	9.6	10.5	
	70%	9.0	9.0	9.0	2.2	3.0	3.7	4.5	5.2	6.0	6.7	7.5	8.2	9.0	
	75%	7.5	7.5	7.5	1.9	2.5	3.1	3.7	4.4	5.0	5.6	6.2	6.9	7.5	
	80%	6.0	6.0	6.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	
85%	4.5	4.5	4.5	1.1	1.5	1.9	2.2	2.6	3.0	3.4	3.7	4.1	4.5		
90%	3.0	3.0	3.0	0.7	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0		
95%	1.5	1.5	1.5	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.4	1.5		
100%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Note: Buckeye Power uses 25% and 40% POC for its load control strategies. These cells are highlighted in yellow for quick reference.

The figures shown in the matrix where the POC intersects with the previous run time (PRT) is the run time (in minutes) that the controlled A/C unit will be allowed to operate during a 30 minute control period. As an example, for 40% POC and a PRT of 60 minutes, the actual allowed run time for the controlled A/C unit will be 18 minutes per 30-minute control period. In this example the remaining time of the 30 minutes will result in 12 minutes of controlled off time.

A/C Radio Controlled Switch (RCS) Installation Guide

Buckeye Power, Inc. - May 2008

1. Assess the overall condition of the A/C unit scheduled for the RCS installation.
 - a. If possible test run the A/C unit prior to RCS installation to evaluate its operating condition. Install a Buckeye RCS only on known working A/C units.
 - b. Do not install a Buckeye radio switch on sub-standard A/C systems.
 - c. When there is any doubt about the A/C unit condition, **AVOID FUTURE PROBLEMS AND DON'T INSTALL A RCS DEVICE IF THE CONDITION OF THE A/C IS QUESTIONABLE.**
2. Once the A/C unit is determined to qualify for a Buckeye radio switch installation, select a location to securely mount the radio switch and that will allow for the shortest possible routing of conduit and cabling. **Keep all aspects of the installation free of interference with the A/C unit.**
3. Suggested RCS mounting locations:
 - a. Mount on side of house near the A/C condensing unit; or
 - b. Fasten to the safety disconnect switch via rigid conduit; or
 - c. Mount on A/C unit as the RCS is unaffected by vibration. However, when mounting switch to A/C unit, extreme care must be exercised to avoid damaging A/C Components (wiring, refrigeration lines, etc) or interfering with service access panels.

EXAMPLE INSTALLATIONS MOUNTED ON SIDE OF HOUSE



4. Turn **OFF** the electrical power to the A/C unit prior to beginning any installation work!
Remember...Safety First!
5. Follow all applicable local building codes and National Electric Code Rules and Regulations when making the radio switch installation.

- The Comverge A/C RCS requires a 240 volt AC supply to power the switch's electronic logic board. The RCS comes in a one-relay model or a two-relay model depending upon the need for controlling single-stage or two-stage cooling systems. The relays are form "C", normally closed contacts with a 5 ampere rating. The RCS enclosure has an integrated junction box for making wiring connections. In accordance with the national electric code, there is a divider in the junction box for maintaining separation of the low and high voltages that will be present in the box.

Single-Stage A/C RCS Control Device
(Notice one set of blue control leads)



Two-Stage A/C RCS Control Device
(Notice two sets of control leads yellow and blue)



Both models have the integral junction box with voltage divider panel and red & black power leads.

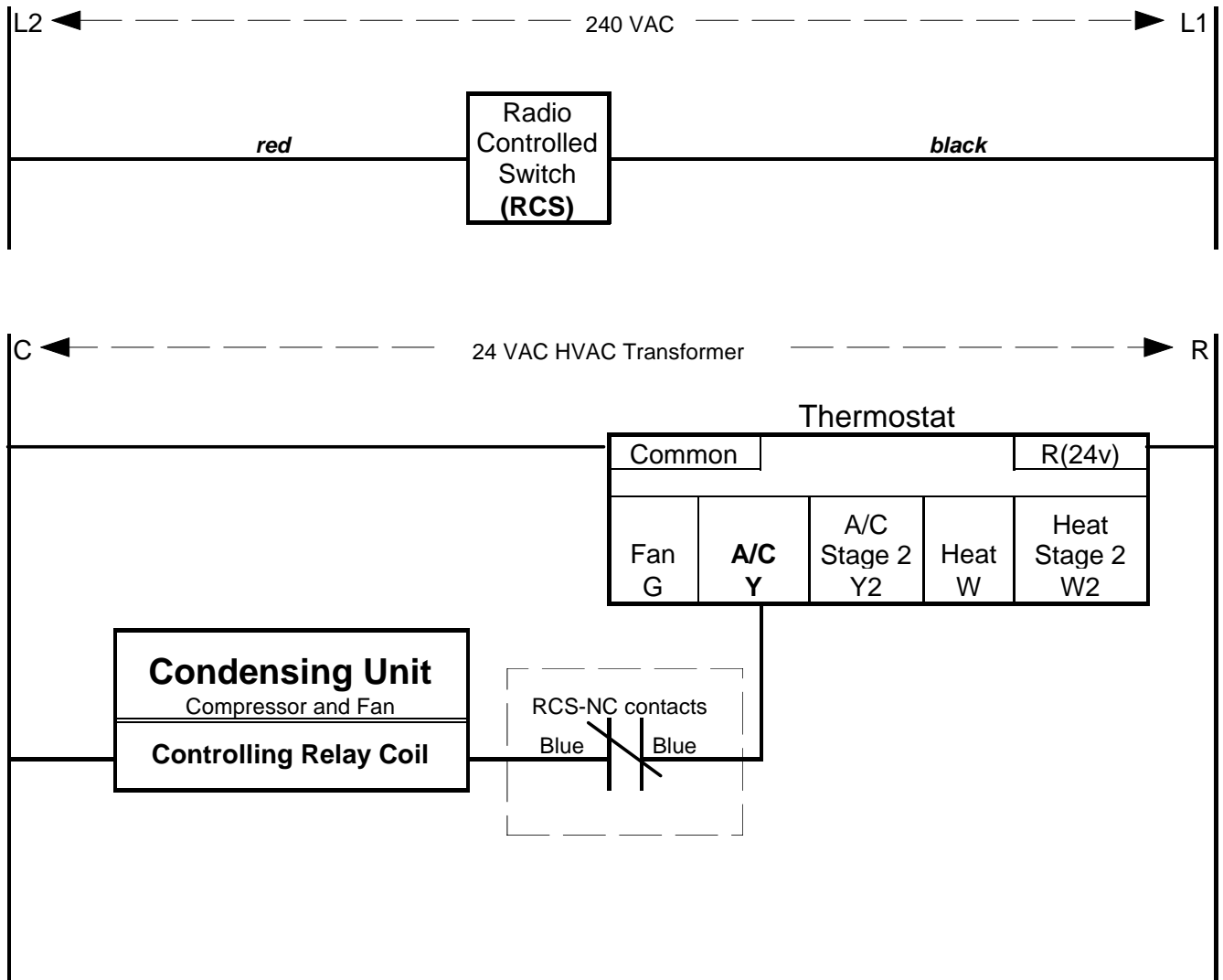
Refer to the two Block Diagram Schematics on the next two pages for connecting the RCS to 240 volt AC power source and 24 volt AC control circuit(s).

- All 240 volt AC wiring must be within approved conduit material. Since the RCS is typically mounted near the safety disconnect switch (where applicable) and/or the A/C condensing unit, the 240 volts AC power supply needed for the RCS can be obtained from either device. It is recommend that liquid-tight flex conduit be used for this application between the RCS enclosure and connecting device (e.g. safety disconnect switch or A/C unit).
- Low voltage thermostat wiring does not have to be within conduit. Standard PVC jacketed thermostat wiring can be used between the RCS and the A/C condensing unit control circuit.
- The RCS **will only control** the A/C outdoor condensing unit (compressor/fan) by switching the low voltage thermostat wiring. The indoor air handler will operate normally to circulate air for maintaining maximum comfort.
- All aspects of the installation must be completed in a craftsmanship like manner. Make sure to leave the site clean and free of any excess materials left-over as a result of the installation.

BLOCK WIRING SCHEMATIC

Radio Control Switch (RCS) for SINGLE-STAGE Air Conditioning Systems

May 2008



NOTES:

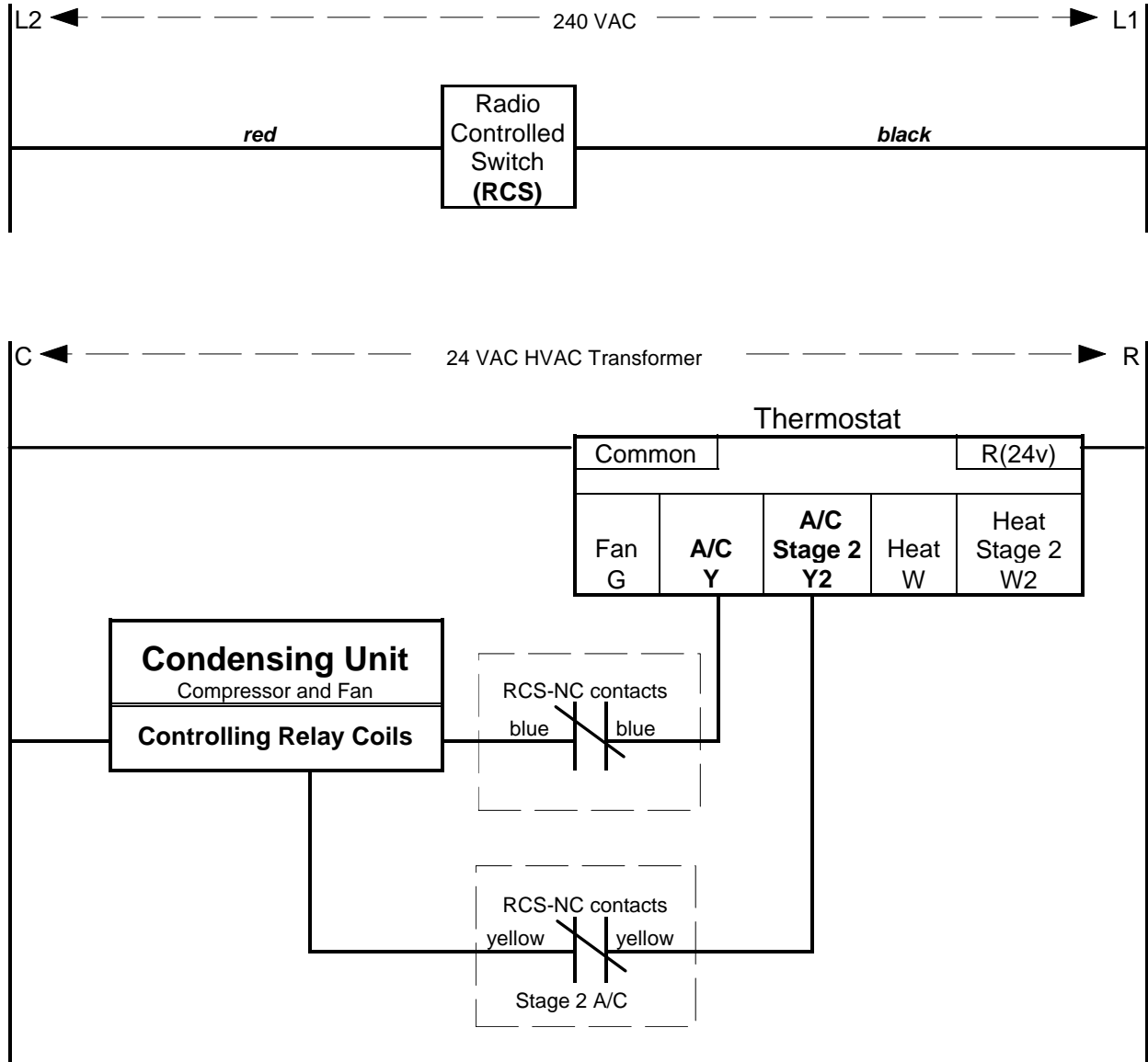
- 1) The Radio Controlled Switch (RCS) is powered by 240 VAC as shown above using the red and black leads in the RCS wiring harness.
- 2) RCS-NC (normally closed) relay contacts are shown in the de-energized state. Note that the RCS relay contacts will remain in their normal closed state when power is applied to the RCS.
- 3) A single stage A/C RCS is equipped with one set of normally closed (NC) contacts for controlling a single stage air conditioning unit. These contacts are connected to the blue wires in the RCS wiring harness and are to be wired in series with the Y thermostat lead (as shown above) to the controlling circuit of the condensing unit. These contacts are operated from the RCS F1 function.
- 4) Once the RCS is activated by the proper radio signal using a hand-held tester, the contacts will open for one period (7.5 minutes plus or minus 1.5), then will revert to a closed state unless additional radio signals are received.
- 5) The RCS may be activated by a radio signal via Cooperatives' radio base stations. The contacts will then open for the duration of a scheduled cyclic control session. CHECK WITH BUCKEYE POWER FOR THE EXPECTED LENGTH OF CONTROL IF REQUIRED (800-282-6962 x203 or 614-430-7845).

The above is for informational purposes only and Buckeye can not be held responsible for errors, omissions or any problems arising from its use. REFER TO BUCKEYE POWER FOR ANY QUESTIONS OR COMMENTS (800-282-6962 x203 or 614-430-7845).

BLOCK WIRING SCHEMATIC

Radio Control Switch (RCS) for TWO-STAGE Air Conditioning Systems

May 2008



NOTES:

- 1) The Radio Controlled Switch (RCS) is powered by 240 VAC as shown above using the red and black leads in the RCS wiring harness.
- 2) RCS-NC (normally closed) relay contacts are shown in the de-energized state. Note that the RCS relay contacts will remain in their normal closed state when power is applied to the RCS.
- 3) A two stage A/C RCS is equipped with two sets of NC isolated contacts for controlling two stages of air conditioning. In the RCS wiring harness, one set has blue wires and the other set has yellow wires. These are to be wired in series with the Y and Y2 thermostat leads (as shown above) to the controlling circuit for the condensing unit. Both relay contacts are operated simultaneously from RCS F1 function.
- 4) Once the RCS is activated by the proper radio signal using a hand-held tester, the contacts will open for one period (7.5 minutes plus or minus 1.5), then will revert to a closed state unless additional radio signals are received.
- 5) The RCS may be activated by a radio signal via Cooperatives' radio base stations. The contacts will then open for the duration of a scheduled cyclic control session. CHECK WITH BUCKEYE POWER FOR THE EXPECTED LENGTH OF CONTROL IF REQUIRED (800-282-6962 x203 or 614-430-7845).

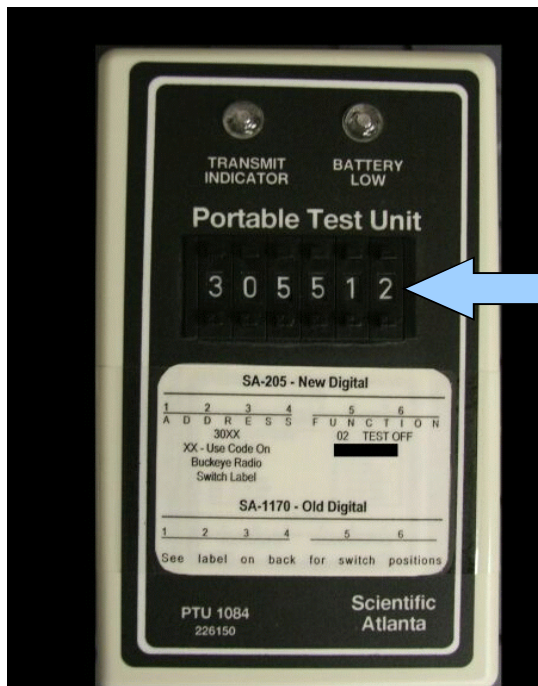
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Radio Controlled Switch (RCS) Testing Procedures for A/C Installations

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1. Double check all aspects of the installation before turning AC power “**ON**”; With the AC power “**ON**” lower the thermostat setting as needed to cause the A/C system to start-up resulting in the outdoor unit to activate.
2. Verify the installed RCS will control the A/C System by using a Buckeye Portable Test Unit (PTU). Use the corresponding RCS code (found on the face of the RCS) for the first four thumb wheel switch digits beginning from the left on the front of the PTU. (The following are valid codes: 3055, 3056, 3057, 3058 or 3059). The remaining two thumb wheel switch digits will be 12. Point the PTU towards the RCS at a distance of less than approximately three feet and press the transmit button on the left side of the PTU to send the radio signal. The RCS should then activate resulting in the A/C condensing unit to shut **OFF** for 5 to 10 minutes. A “**RED**” light in the window on the face of the RCS will illuminate while the RCS is activated indicating the unit is in load control. After the timeout the RCS will reset restoring the A/C system to normal operations.

Radio Controlled Switch PTU Tester



PTU Test Code Selector Switches
set for 305512

(i.e 3055 RCS address & relay
activation code 12)



PTU Transmit Button