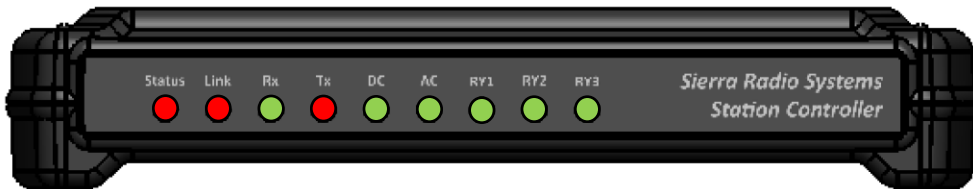


# Sierra Radio Systems



## SC1 Station Controller



## Reference Manual

Version 1.0

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- Introduction
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# Introduction

The Sierra Radio Systems Station Controller is used to remotely monitor and control two-way radio systems. The station controller provides the following features:

- High current latching DC radio power relay
- Measure input DC voltage, output DC voltage and DC current
- +5v switched DC voltage output to control optional external AC power relay modules
- Digital temperature probe input
- Forward and reflected RF power using an optional Elecraft directional coupler
- 2x opto-isolated digital inputs
- 3x 0-30v DC analog voltage inputs
- 3x 2A dry contact SPDT user relays

Typical applications include remotely controlled ham radio stations, remote computer rebooting, repeater site monitoring, and remote alarm monitoring. In most remotely controlled radio systems, the system already has a way to control the main functions. For example in a remote HF station, the radio can be controlled by a dedicated controller (Pignology) or computer system using a program (Ham Radio Deluxe). Audio can be streamed using a dedicated VOIP/ROIP system (Pignology) or a computer (Skype). Beyond these capabilities, the remote station environment must be monitored and controlled. The Sierra Radio Station Controller provides the most commonly needed features to get your remote system up and running.

The Station Controller communicates over the Sierra Radio Device Control Network (DCN) to a PC running the control system user interface or to a gateway system, which in turn, communicates to the end user control app running on a PC, Mac, IOS or Android device.

## Theory of Operation

### DC power switching and measurement

The main DC power path flows current into one Anderson power pole and out the other. The power is switched using a latching relay. The Station Controller is supplied with NO DC power relay installed. The system includes a relay capable of handling up to 10 amps of current at 13.8 VDC. If you choose to use this default relay, you will need to solder it in place. If you need to switch higher current, up to 20A, you can install the optional high current relay instead. The high current relay will actually handle up to 30A but the PCB traces can only handle a maximum of 20A. If you need to run 20-30 amps, you can add additional heavy duty wire to the bottom of the PCB.

The switched DC power flows through a current sensor that measures DC amps and will report the value back to the master in 1A increments. Input and output DC voltages are also measured and reported back to the user.

### AC power switching

We use an optional external AC power relay and AC pigtail assembly. This power switch pigtail simply plugs in series between the wall outlet and the AC load.

The Station Controller uses a low voltage (+5v) signal to turn the AC power relay on and off. The AC power switch is opto-isolated.



### Temperature probe

The digital temperature probe is a 6' cable with a digital temperature sensor housed in a metal cylinder suitable for mounting to a surface or hanging in free space to measure ambient room temperature.

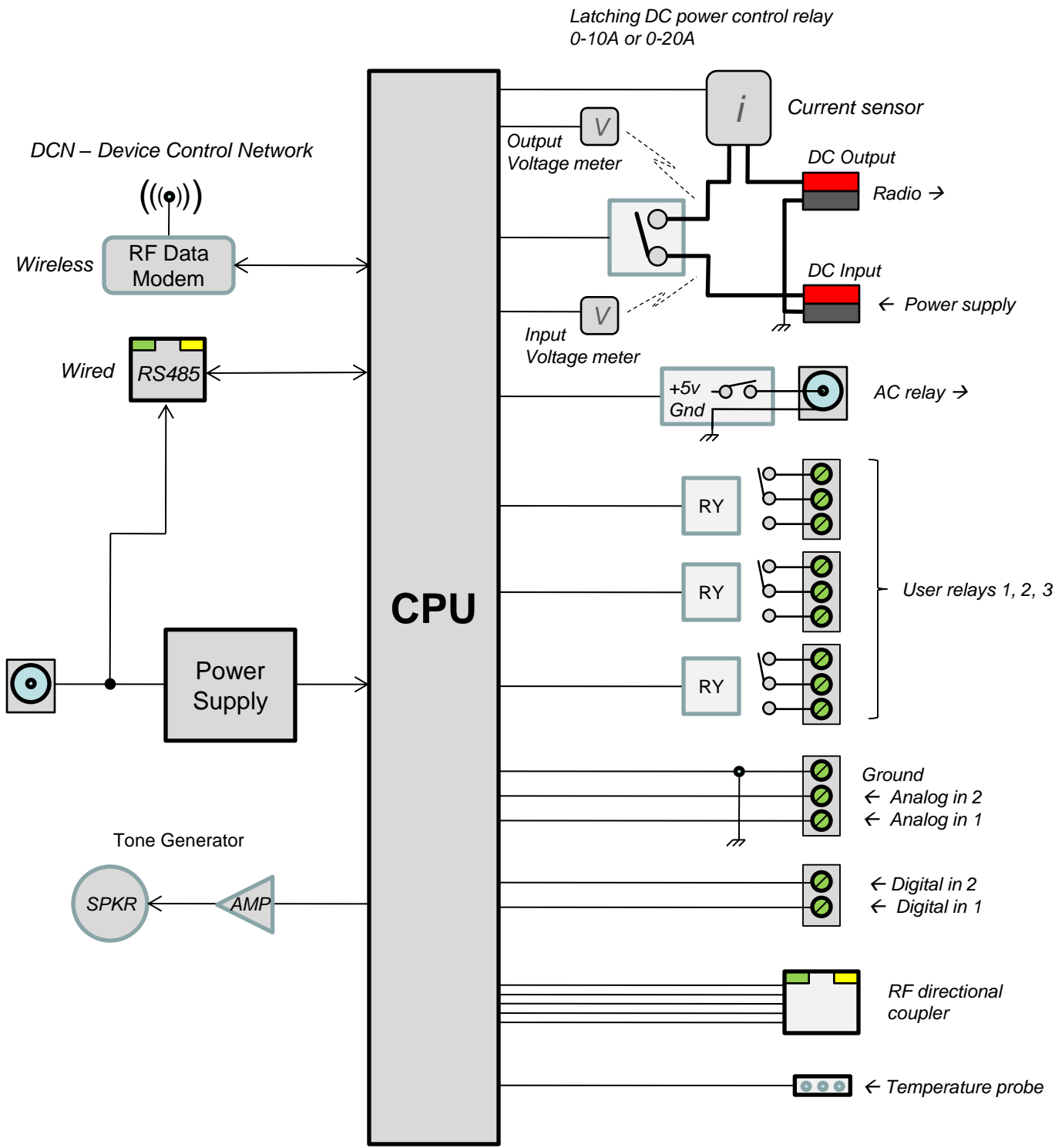


### RF directional Coupler

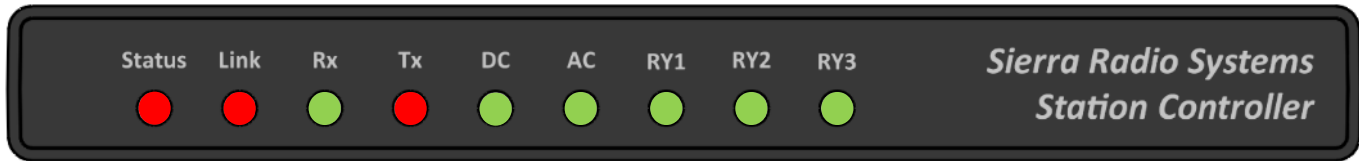
The Elecraft directional coupler measures forward and reflected RF power. The station controller reads the forward and reflected voltage from the coupler and calculates the value in RF watts.



# Block Diagram



# Front Panel Indicators



## Status

The status indicator indicates the general condition of the station controller and doubles as the power indicator. In normal operation, the status LED is on. When the system is powered on and starts up, the status LED may be off or blink a few times. This is normal. Once the system is fully operational, the LED will remain on. If the status LED continues to blink, this indicates an error condition in the controller.

## Link

When the station controller is connected to a master station control system, the link LED will be turned on. When the station controller is operating on its own, the link LED will be off.

## Rx & Tx

These LEDs will blink when data is being received and transmitted through the RS485 Device Control Network (DCN). Data transmitted or received through the wireless DCN will not cause the Rx and Tx LEDs to blink.

## DC

This LED shows the state of the high current DC power relay.

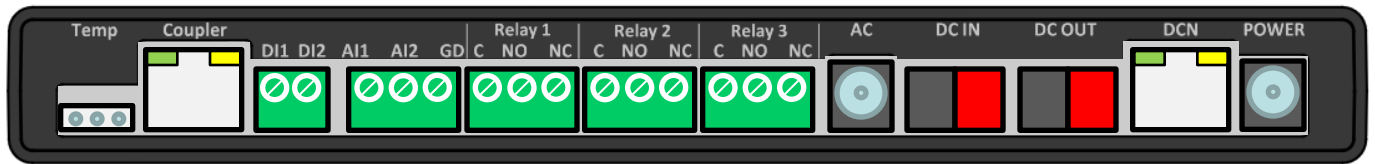
## AC

This LED shows the state of the AC control line that controls an external AC power relay.

## RY1, RY2, RY3

This LED shows the state of the three user definable low current (2A) SPDT relays.

# Rear Panel Connections



## Temp

Temperature probe jack. This jack supports the Sierra Radio Digital Temperature Probe (#411). The probe contains a DS18B20 digital temperature sensor in a metal case.

## Coupler

This RJ45 connector is used to connect to an Elecraft directional coupler using common 8 wire cable. The coupler measures forward and reflected RF power.

## DI1 & DI2

Digital input 1 and 2. These inputs are opto-isolated and active pull to ground. These pins are internally pulled up to 5VDC.

## AI1, AI2, GD

Analog voltage input 1, 2 and a ground reference. The analog voltage inputs can measure 0-30 volts DC. The GD pin is connected to system ground. The ground pin provides the ground reference for both the analog and digital inputs.

## Relay 1, Relay 2, Relay 3

These are user programmable dry relay contacts that can support up to 2 amps.

## AC

This 2.1 mm coaxial connector applies +5 VDC to the center pin, referenced to the ground shell pin. This +5v DC output is used to switch the external AC power relay.

## DC In

Connect the output of your 12 VDC power supply to this connector.

## DC Out

Connect the DC output connector to the power input of your radio.

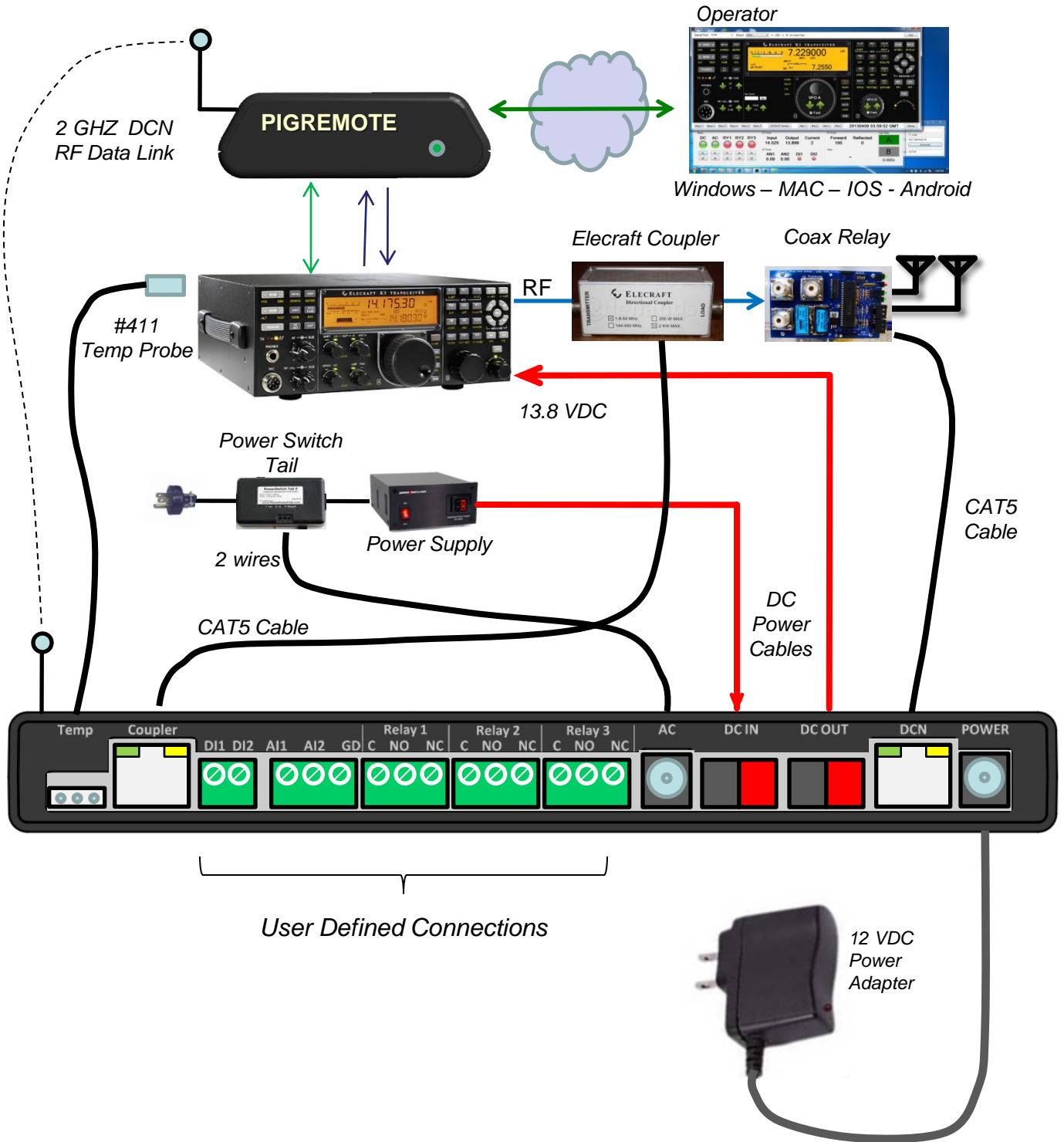
## DCN

Device Control Network. Used to connect additional station control devices. Pins 1 & 2 are data, pins 4 & 5 are ground and pins 7 & 8 are +12 VDC.

## Power

2.1mm DC power input coaxial jack. Apply +12 to +13.8 VDC to this input.

# Typical Remote Controlled Station





# Device Control Network

## Baud Rate

The DCN protocol sends ASCII data at 9600 baud, non-inverted, 8 bits, no parity.

## Command Packet

A command packet is a string of text that is sent between the master PC or gateway device and the station accessory. A command packet is a string of ASCII characters that contains the payload to be transmitted from point A to point B and the additional characters necessary to provide synchronization, packet type identification, addressing, and error checking.

The DCN control protocol defines 3 packet formats. In each case, the command payload, is identical. The only difference is the characters around the command payload that route the payload to the right destination.

## Packet Types

1. Fully addressed packet `/A09:STATE:89`  
Sends the payload to a specific address with error checking. Typically used on a wired or wireless network with multiple target devices to be controlled.
2. Fully addressed w/o error checking `/009:STATE:XX`  
Note: the second character "0" is a zero.  
Sends the payload to a specific address but ignores the error checking field. The packet must contain two characters in this position and they can be any arbitrary characters.  
Typically used on a wired or wireless network with multiple target devices to be controlled.  
This is a convenient way to manually send a command with a dumb terminal program to a specific device without having to calculate the CRC error check value.
3. Direct packet `//STATE`  
Typically used in a direct connection between one master (PC or control head) and one target device to be controlled. This greatly simplifies the code on both ends and is also a convenient way to manually send commands from a dumb terminal. If multiple devices, even with different network addresses, are connected to the network, all devices will decode and execute this command. This can be a quick way to reset all devices on a network. Avoid using this command with multiple devices that will automatically generate a response to eliminate packet collisions on the network.

# DCN COMMAND SYNTAX

## Fully Addressed Packet Format

A fully addressed packet typical packet looks like this...

```
/A09:STATE:82<13>
```

```
-----  
| Start | Packet | From   | To     | : | Payload | : | CRC | End   |  
| of    | Type   | Address| Address|   |         |   | Value| of    |  
| Packet|        |        |        |   |         |   |      | Packet|  
-----
```

## Start of Packet

A forward slash character / is reserved for the start of packet framing indication. When a slave device sees the slash, it knows there is a new packet.

## Packet Type

The packet type character defines the format of the packet and instructions for how the packet is to be interpreted.

```
//          Direct          IE: //reset  
/A          Addressed      IE: /A02:reset:99  
/0          Addressed no error checking IE: /002:reset:XX
```

## From Address / To Address

The device address is a single printable ASCII character. While any character will work, by convention, the following characters are recommended and used for default values.

```
0    System master  
1    Station controller  
2    GPIO board  
3    Remote coax relay  
4    Radio router  
5-9  Unassigned  
A-Z  User assigned devices  
*    Broadcast to all devices.
```

We do not recommend using lower case letters or punctuation.

## Payload

The payload is the command to be delivered to the target device. Payload contents are application dependent and will vary from device to device. There are commands typically found on all SRS devices including PING, STATUS, SETADDR, etc. in addition to application specific commands. Payloads may contain multiple arguments separated by commas. For example //LCD,2,5,Hello. In this case, the payload is "LCD,2,5,Hello".

## **DCN COMMAND SYNTAX**

### **End of Packet**

The end of packet character is a carriage return, ASCII byte value 013 (decimal). When an end of packet character is encountered, the input buffer is evaluated.

The evaluation process identifies a packet by finding the start of packet synchronizing character / and extracts the buffer contents up to the end of packet character.

The command parser then extracts the packet type, addresses, error check value and payload.

The error check value is calculated and compared to the packet's error check value. If the values do not match, the buffer is flushed.

If the packet is good, then the "to address" is examined. If the to address is the same value as the devices address, the payload will be dropped into the command decoding subroutine in the target device for evaluation and execution, if not, the packet is ignored and flushed from the buffer.

If the payload is not recognized by the target device's command decoding subroutine, the command payload is flushed.

## DEVICE SPECIFIC COMMANDS - Station Controller

### Get Station Controller Status

Command STATE

Example //STATE

Will return the state of the station controller

Return payload format

UPDATE,1,SC1,RY,DI,Vin,Vout,current,Fwd,Rev,Max,Sense,RefVoltage,AN1,AN2,temp

1 Device address 1

SC1 Device type SC1 (Station Controller 1)

RY Relay state 10101 (Relay 1...Relay 5)

DI Digital inputs 1 and 2

Vin DC power relay voltage input

Vout DC power relay voltage output

Current DC current flowing through the DC power relay

Fwd Forward RF power

Rev Reflected RF power

Max Max voltage from directional coupler

Sense Directional coupler sense voltage

RefV Reference voltage to be calibrated out of the RF power measurements

AN1,2 User analog voltage input 0-30VDC each

Temp Temperature in degrees F from the digital temperature probe

Example

UPDATE,1,SC1,11111,00,13.8,13.7,14,55,0,2.5,2.0,0.14,13.8,6.0,68

### Turn on / off Relays

Command RYx,y

Example //RY1,1

Will turn relays on or off where x is the relay number 1...5 and y is the state (1=on, 0=off)

Relay number (x)

Relay 1 – DC power control

Relay 2 – AC power control

Relay 3 – User relay 1

Relay 4 – User relay 2

Relay 5 – User relay 3

Relay state (y)

1 or "on" – Relay on

0 or "off" – Relay off

P – Pulse relay for 250 ms.

T – Toggle state

## DEVICE SPECIFIC COMMANDS - RadioRouter

### RX mixer channel control

Command MIX,<mask>

Example //MIX,10X00000

Will turn on port 1, and turn off ports 2,4,5,6,7,8

Regardless of the current state port 3 will be unchanged

Argument definition

<mask> is a string of 8 characters that turn each mixer channel 1...8 on or off.

1 = port on

0 = port off

X = do not change the current state of the channel

### Master receiver audio mixer volume

Command VOL, <value>

Example //VOL,100

Argument definition

<value> is a number between 0 and 255 which will set the master volume.

0 = off and 255 is maximum volume.

The default is typically 100 which is close to mid scale. Individual channel volume is set with the radio's volume control.

### Transmitter selection

Command TXn (TX1, TX2, TX3, TX4)

Example //TX1

Argument definition: none.

Sets the focus of the transmitter board to transmitter 1 or 2 when using one transmitter board or between 1, 2, 3, or 4 when using two transmitter boards.

### Speaker control

Command SPEAKER,<value>

Example //SPEAKER,ON

Definition Enable / disable speaker output.

<value> can be one of the following strings

ON or 1 = speaker enabled

OFF or 0 = speaker disabled

## DEVICE SPECIFIC COMMANDS - RadioRouter

### Operating Mode Selection

Command    MODE,<value>

Example     //MODE,1

            Sets operating mode of the RadioRouter.

Argument definition

<value> is one of the following options

1 = Mode 1. Control head or PC virtual control head control (default)

2 = Mode 2. OTRSP SO2R compatible mode.

### Notes on Mode Usage

#### Mode 1 – StationStack Control Head or Control Head Software

This is typically used with a PC virtual control head program or a hardware control head using the StationStack Control Protocol where the packets are either fully addressed (/A) type or direct (//) type. For example a direct command to turn on Rx port 1 would be //MIX,1XXXXXXX

#### Mode 2 – OTRSP Logging Computer Program

This is used when the RadioRouter is being controlled from a contesting program such as WinTest or WriteLog using the Open Two Radio Switching Protocol (OTRSP). This format does not use any packet framing characters, like /A01:.... The OTRSP commands are sent in “raw” form. A command payload of TX1 to select transmitter 1 is simply sent as “TX1” from the logging program.

### Setting the Mode Manually with the Reset and Mode buttons

The mode can also be set at boot time with the “Reset” and “Mode” buttons found on the CPU or Tx boards. When the RadioRouter powers up, it will flash the Status LED a few times indicating that power has been applied and it is going through its boot process. After about 5 seconds, the RadioRouter is booted and ready to be used. At this point the Status LED goes to a solid green indicating the normal “on condition”.

To set the mode manually with these buttons, hold the Mode button down, then press the Reset button briefly, still holding the Mode button. After the Status LED initially flashes, a few seconds later the Status LED will then blink once. If you want to boot in mode 1, you have two seconds to let go of the Mode button at that point. If you want to boot in mode 2, continue holding down the Mode button. After the Status LED blinks twice, let go of the mode button. In a few seconds, the Status LED will send either the number 1 (. - - -) or the number two (. . - -) in CW indicating which mode was selected. Timing is critical. If you bounce you finger on one of the buttons or hold it down too long, you may set the wrong mode. Repeat the process to set it to the mode you want. Every time the mode is set, it will be stored in flash memory and when the device is re-booted, it will come up in the mode that was last set.

## DEVICE SPECIFIC COMMANDS - RadioRouter

### Headphone output control

Command PHONES,<value>

Example //PHONES,ON

Definition Enable / disable headphone output.  
<value> can be one of the following strings  
ON or 1 = headphones enabled  
OFF or 0 = headphones disabled

### OTRSP Compatible Commands

This is an open standard protocol used to control hardware devices in an SO2R contest station. OTRSP is the Open Two Radio Switching Protocol. The RadioRouter supports the most common basic OTRSP commands that are used on popular logging programs including WinTest, W1MM and WriteLog.

#### Supported OTRSP commands

RX1	Listen to radio 1
RX1S	Listen to radio 1
RX2	Listen to radio 2
RX2S	Listen to radio 2
RX1R	Listen to both 1 & 2
RX2R	Listen to both 1 & 2
?RX	Returns the mode set
TX1	Set tx focus to radio 1
TX2	Set tx focus to radio 2
?TX	Returns radio with focus
?NAME	Sets the name of the device to TEXT (up to 32 chars)
?FW	Returns the firmware version

Command PHONES,<value>

Example //PHONES,ON

Definition Enable / disable headphone output.  
<value> can be one of the following strings  
ON or 1 = headphones enabled  
OFF or 0 = headphones disabled

## DEVICE SPECIFIC COMMANDS - All Devices

### Administrative Commands

Command     SETADDR,<string>

Example     //SETADDR,5

Definition   Sets the network address for the RadioRouter to <string>, where <string> is a single, printable ASCII character.

The default address for the RadioRouter is 9

While the address character can be any single character we recommend the following guidelines for address programming.

0	Reserved for the controlling PC
1	Reserved for a hardware control head
2...9	Recommended for all user devices
A...Z	Also available for user devices
*	Reserved for broadcast
All others	Punctuation is reserved for system use. Avoid lower case letters to prevent confusion and accidental upper case translation.

Command     REBOOT

Example     //REBOOT

Definition   This is a soft reboot command will re-start the RadioRouter.

Command     PING

Example     //PING

Definition   This will return the name, address and type of connected device.

Command     ROLLCALL

Example     //ROLLCALL

Definition   This will return the name, address and type of connected device from all devices on the network. Each device will wait for a short period of time before sending its response. The delay time is calculated based on the device address. For example an address of 5 will wait  $5 * 100 \text{ ms} = 500 \text{ ms}$ . This will minimize or avoid collisions.

Command     STATUS

Example     //STATUS

Definition   This will return useful status information about the connected device.



## DEVICE SPECIFIC COMMANDS - Control Head

### Control Head Commands

These are commands that the master controlling device will respond to. The control head can be a physical control head or a virtual control head implemented in software on a PC. In either case, they should behave the same way.

Command LCD,<row>,<column>,<string>

Example //LCD,2,5,W1AW

Definition The RadioRouter assumes an LCD of at least 2 rows and 20 columns. This command displays the text string W1AW <string> on row 2 starting at character position 5.  
The LCD command also responds to a special command CLS in the format //LCD,CLS  
The CLS argument will clear the LCD display screen

Command LED,<led\_mask>

Example //LED, 1100XXGGRRYY

Definition This command will set the state of the control head LEDs. The RadioRouter assumes 12 LED are available.  
The <led\_mask> is a 12 character string that represents the state of each LED from #1 to #12. Each character can be one of the following values.

Character	Meaning	What is displayed
1	On	Green
0 <zero>	Off	Off
G	On	Green
O <letter O>	Off	Off
R	Red	Not used
Y	Yellow	Not used
X	No change	What ever the previous state was

#### Examples

LED,111100001111 Turn on LEDs 1-4 and 9-12, turn off 5-8  
LED,GGRRRRYYOOO Set LED 1-3 Green, 4-6 Red, 7-9 Yellow, 10-12 off  
LED,XXXGXXXXXXX Set LED 5 on, don't touch the others.

Note, trailing X's can be left off and the control head will assume they are X.

#### Example

LED,XX1 is the same as LED,XX1XXXXXXXXXX