

## Socket Radio CC-900W

### Features

---

- Self-contained 30K baud wireless modem
- 902 – 928 MHz ISM band
- Point-to-point or point-to-multipoint communications
- RF connector or integrated antenna
- 500 Feet line-of-sight Range
- FCC 15.249 compliant (certified as module)
- Automatic channel selection via carrier sense
- Wide dynamic range receiver for harsh environments
- AT command set
- Serial host interface
- Footprint and protocol compatible with all Copeland Communications high speed socket modems
- Internal UART with flow control
- World Modem™ compatible
- Low power consumption – 3.3 V operation
- Low Power Standby Mode
- Small footprint – 1.045” X 2.54”

### Applications

---

- Global Embedded applications
- Point-of-sale terminals
- Set-top boxes
- Vending & gaming machines
- Security Systems
- Remote monitoring & control
- Remote telemetry and SCADA
- OEM applications

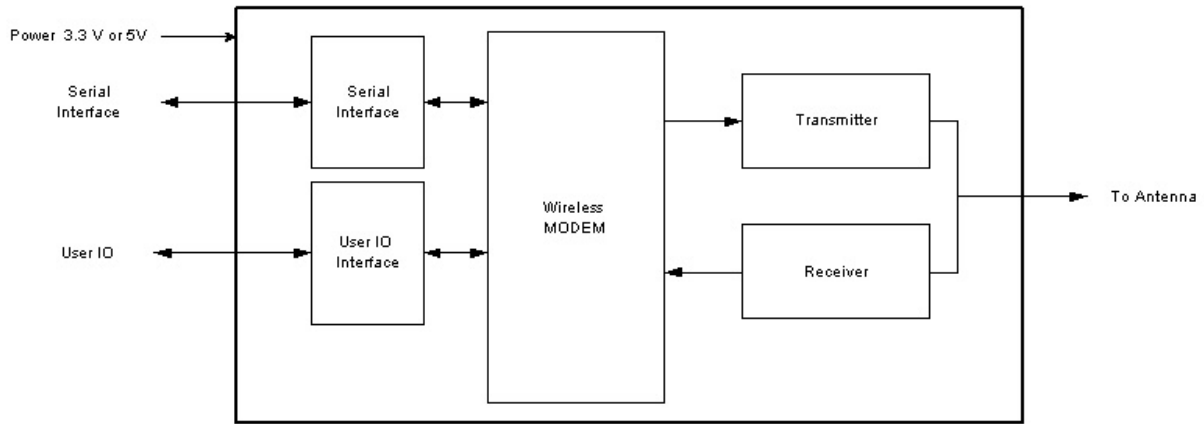
### Description

---

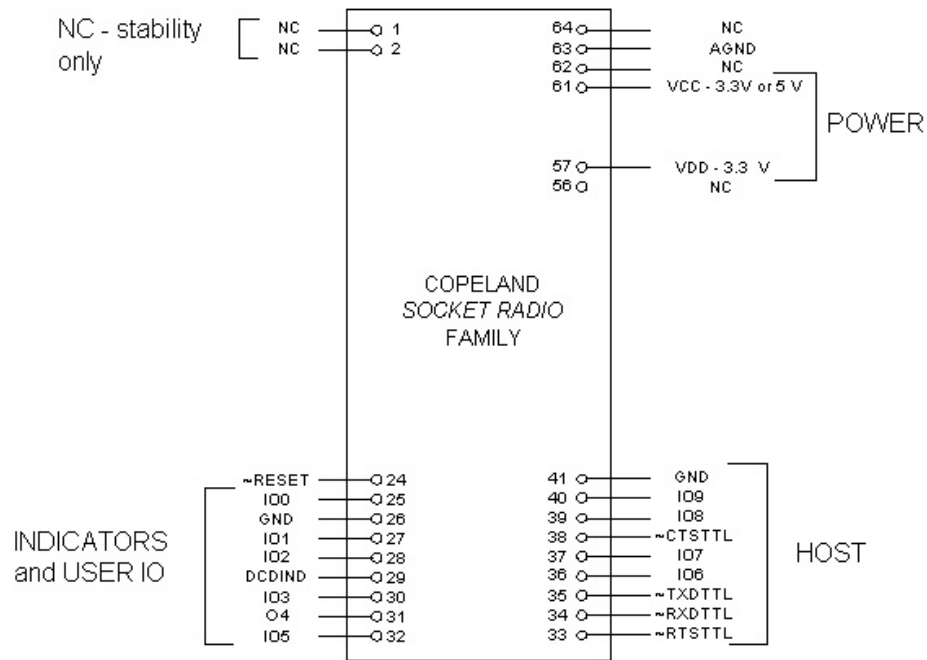
The Socket Radio is a complete embedded wireless modem. The Socket Radio accepts standard modem AT commands and provides connect rates up to 30 kbps half-duplex. The Socket Radio provides numerous additional features for embedded modem applications. This device is ideal for embedded modem applications due to its small size and low power consumption. The Socket Radio allows for rapid integration into existing modem applications by providing a serial interface that can directly communicate to a microcontroller via a UART interface. The development kit comes with a USB adapter that will appear as a serial port to the PC. This interface allows for PC evaluation of the modem immediately upon power up via the AT commands using standard terminal software.

The Socket Radio is a bi-directional data communications radio to be used for two-way communication to another Socket Radio. The radio emulates a standard Hayes compatible telephone modem in a socket modem physical format. Each radio has a permanent unique Identification Number (user programmable). This allows multiple radios to coexist on the same channel. The radios operate in a peer to peer switched network while providing the appearance of a switched phone line network.

## Block Diagram



## Host Interface



Note: Signals on pins 24,27,33-40 are TTL.

### Serial Host Interface



The serial interface on the 3.3V Socket Radio is not 5V tolerant.



The USER IO signals on the 3.3V Socket Radio are not 5V tolerant.

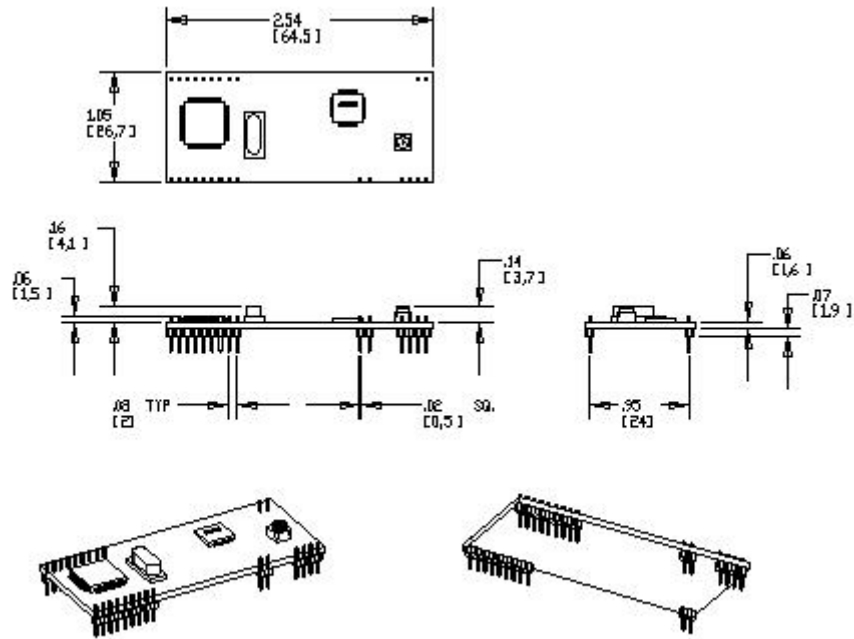
Socket Radio modems can be directly connected into 3.3 volt systems with 3.3 volt or 5 volt power supplies. The default host speed of 19.2 Kb and 8N1 format (8 data bits, no parity bit and 1 stop bit). The defaults can be changes after initialization by using standard AT commands. A true RS-232 interface is available on the Socket Radio Evaluation Kit.

The Asynchronous Serial Interface is a complete UART consisting of Receive and Transmit signals as well as RTS/CTS, control is supported.

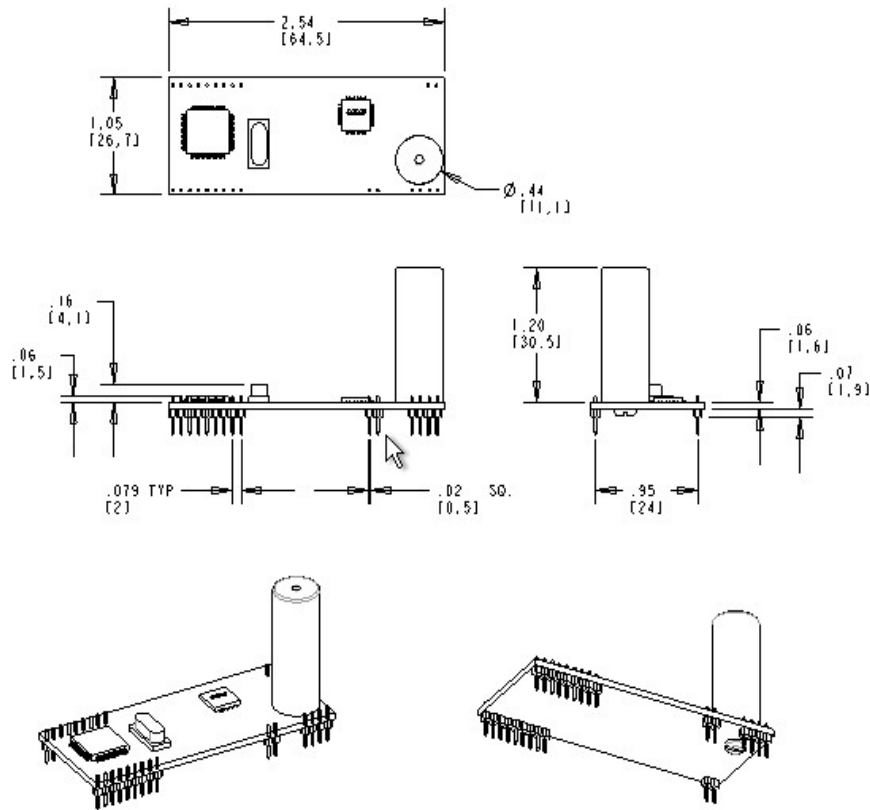
The UART is programmable to support a number of baud rates and data formats. Supported data rates and formats are:

Data Bits: 8  
Stop Bits: 1  
Parity Bits: None  
Baud Rates: 9600, 19200, 38400, 57600, 115200

**Mechanical Outline**



**Figure 1 - CC-900W MMCX model (-B)**



**Figure 2 - CC-900W Integrated antenna model (-A)**

## Mechanical

The modem module is on an 0.062 thick FR-4 PC board. The module has two rows of 2mm pins located 24mm on center. The module is designed to plug into 2 mm sockets with the same 24 mm spacing. The modules can also be ordered without the 2mm headers (N suffix).

Due to the low mass of the board, no retention is required aside from the sockets. A large tie-wrap may be used to insure retention in high shock or vibration environments, if desired.

## Detailed Specifications

Item	Specification
<b>Data Rate</b>	
30K bps <sup>1</sup>	
<b>Data Format</b>	
Bit format	Selectable 8 bits per character
Compatibility	
Control	AT command set
<b>Host Interface</b>	
Serial	TTL - 8,9,10 & 11 bit asynchronous data @ 9600, 19200, 38400, 57600, or 115200kbps rate
Flow Control	CTS, RTS, DCD
<b>Features</b>	
	Frequency diversity
	Local and remote IO control
	Over the air channel changing
	Over the air data rate changing
	Low power
<b>Power Requirements</b>	
Voltage	3.3 V or 5.0V)
Current	40 mA Operating 1 mA Standby
<b>Environmental</b>	
Temp Range	Commercial 0C-70C Industrial -40C – 85C
<b>Compliance</b>	FCC part 15.249 module approval

<sup>1</sup>Modem must be run at 115200 to achieve 30kbps.

## Serial Communications

The Socket Radio operates in one of two distinct modes that mimic the operation of a Telecom modem, offline and online. The offline states is entered upon power up. It is used for radio configuration, testing and to establish a link with another radio. It can also be used to send over-the-air commands to peripherals on another socket radio. The online state is entered when a pair of Socket Radios are linked and passing data. It is exited using an escape sequence, receiving a disconnect command from the remote user, or an RF link loss.

## Serial Data Format

---

### Line Settings

The data format is N81 with a software selectable rates of 9600, 19,200 38,400 57,600 and 115,200. The power up default rate is 19200.

### Escape Sequence

The escape sequence is used to change from online mode to offline mode. The Escape Sequence is three pluses preceded and followed by 1 second of no character transmission. <1sec> +++ <1sec>.

### Online Mode Allowable Characters

All characters 0x00 through 0xFF are permitted in online mode. However, note the escape sequence of <1sec> +++ <1sec> will cause the socket radio to transition from online to offline mode.

### Online Incoming Character String Termination

While in the Online state, a character string coming from the host is terminated in one of the following two ways. No local echo is provided to the host.

**Timeout.** The incoming character string is automatically terminated and flow control asserted after a 14 millisecond listening period with no other termination. Characters are then transmitted over the link.

**Buffer Full.** The incoming character string is automatically terminated and flow control asserted when the string reaches 47 characters in length. Characters are then transmitted over the link.

### Online Outbound Character String Transmission

While in the Online state, a character string sent by the Socket Radio to its host is sent exactly as it was received for RF transmission. No characters are added, deleted or changed.

### Offline Incoming Character String Termination

While in the Offline state, a character string coming from the host is terminated in one of the following three ways. Echo is provided if ATE=1.

**<CR>.** The incoming character string from the host may be terminated with a <CR>. The command is then executed.

**Timeout.** The incoming character string is automatically terminated and flow control asserted when no character is sent for a duration of 30 seconds. The Socket Radio then attempts to execute the command.

**Buffer Full.** The incoming character string is automatically terminated and flow control asserted when the string reaches 23 characters in length. The Socket Radio then attempts to execute the command.

## Hardware Flow Control.

---

CTS low (flow control not asserted) indicates that the Socket Radio is ready to accept data. CTS high (flow control asserted) indicates that the Socket Radio is not ready to accept data. RTS low (flow control not asserted) indicates that the Socket Radio may send data to the host. RTS high (flow control asserted) indicates that the Socket Radio may not send data to the host. The Socket Radio shall be capable of handling a maximum of 17 characters after the flow control has been asserted. Flow control is used in both online and offline modes.

## RS232/UART Output Timeout

---

The Socket Radio shall attempt to output data via RS232/UART to its host for 30 seconds. If the host flow control prevents transmission for more than 10 seconds, the RS232/UART data is discarded.

## RF Link

---

### RF General Description

The RF transmission is based on packetizing the RS232 data and transmitting the packet of data using source (Source ID) and destination identification (Destination ID).

### Socket Radio ID

Each Socket Radio has a 32-bit identification number that is comprised of a single-byte Group ID and a three-byte unique Individual ID. The Group ID is used to set up common groups of radios that can be addressed without limiting the transmission to a specific Socket Radio. Group 0 is reserved for over the air configuration of Group and Destination IDs. The group ID will be used in future product enhancements.

### RF Packet Transmission

A radio will attempt to transmit the payload data until it is acknowledged by the destination radio. The RF packet transmission is acknowledged when it is correctly received. There shall be a variable re-transmit delay when the first transmission is not acknowledged. The radio will continue to transmit and look for an acknowledgement for a maximum of fifty times with a variable time delay between packet retransmissions. The resulting period is a maximum of 12 seconds for the low speed RF data and 5 seconds for the high speed RF data.

### Connection

A connection is a one to one link established between two socket radios. The format of the connection is a switched circuit configuration. A radio may not be linked to more than one radio at a time. A connection is established by using the ATDT command to call a specific radio and attempt to connect to that radio. If the called radio receives the call and is not hard connected to a radio, it will auto answer and connect to the called radio. Once the connection is established, those two radios maintain that connection. The connection has two forms, a hard connection and a soft connection. The hard connection may not be broken by a third radio. The soft connection can be broken by a third radio. A hard connection is defined by a successful RF transmission in the previous minute while a soft connection is defined by previous link, no unsuccessful RF packet transmission since link inception and greater than 1 minute since the last successful RF transmission. When there is a valid soft or hard connection, the Carrier Detect indicator will be active.

### RF Data Rate

The normal air link data rate shall be 9.6 kbps. A shorter range RF transmission rate of 92.15 kbps is also available. After 20 seconds past the last data received, the modem reverts back to low data rate.

### RF Channels

There shall be 16 RF channels. Each Channel shall consist of three frequencies. This provides frequency diversity. Switching between the three channel frequencies shall be transparent to the user. Generally, only one frequency will be used. However, two other frequencies are available. The channel frequencies are shown in Table 1.



## Frequency Diversity

The socket radio frequency diversity is three separated frequencies in low end, middle and high end of the band. During offline unlinked mode, the radios listen for an RF packet on one of the three channels. After a the RF receive timeout period, the radio moves on to the next frequency and listens for a valid RF packet on the that frequency. The process continues cycling through all three diversity frequencies. If a valid packet is addressed to the radio, it replies on the same frequency. The receive timeout is restarted with the reception of a valid packet addressed the receiving radio.

If a socket radio has an RF packet to transmit, it transmits the packet on the current receive frequency. If a valid ACK is received in the RF ACK timeout, the radio stays on the same frequency and resets the receive time out. If no response is received the radio attempts to transmit on the next diversity frequency.

Channel	Frequency 0	Frequency 1	Frequency2
00	902.75	910.75	918.75
01	903.25	911.25	919.25
02	903.75	911.75	919.75
03	904.25	912.25	920.25
04	904.75	912.75	920.75
05	905.25	913.25	921.25
06	905.75	913.75	921.75
07	906.25	914.25	922.25
08	906.75	914.75	922.75
09	907.25	915.25	923.25
0A	907.75	915.75	923.75
0B	908.25	916.25	924.25
0C	908.75	916.75	924.75
0D	909.25	917.25	925.25
0E	909.75	917.75	925.75
0F	910.25	918.25	926.25

**Table 1 Channel Frequencies**

## Over the Air Channel Change Operation

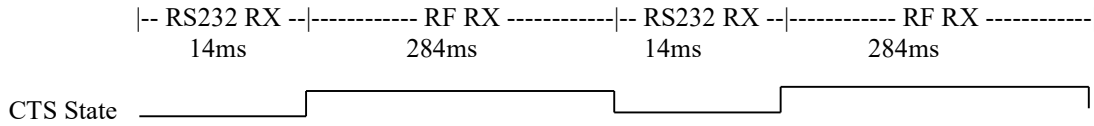
The Over the Air Channel Change command is sent from the Initiating radio to the Subject Radio. After the command has been sent and acknowledged, both radios will then change to the new channel. If a link is not reestablished on the new channel, both radios return to the original channel.

## Time Slot Architecture

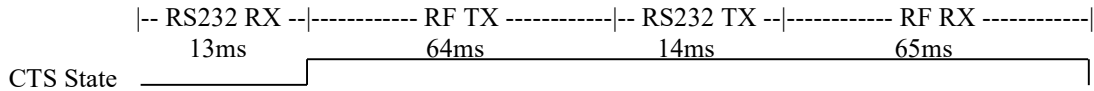
There are four basic functions of the software: RS232 Receive, RF Transmit, RS232 Transmit and RF Receive. The functions are performed sequentially in a timeslot structure that varies, depending on the activity.

## Time Slots During Idle State

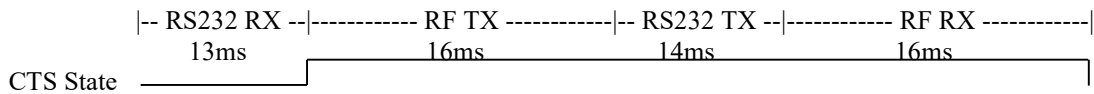
When the Socket Radio is idle, it monitors both the incoming RS232 and the incoming RF input. The Socket Radio will respond as directed by either the RS232 input or a RF transmission. While idle, the timeslot timing is shown in Figure 1.



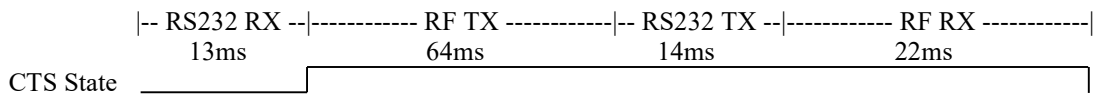
**Figure 1. Idle State Time Slots**



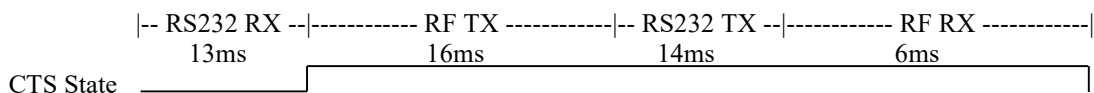
**Figure 2. Low Speed Bi-Directional Communications Time Slots**



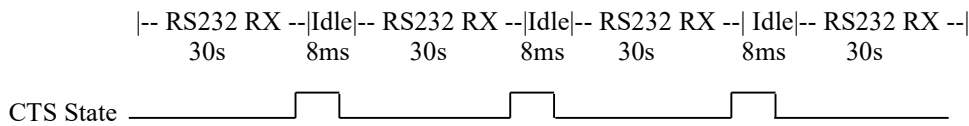
**Figure 3. High Speed Bi-Directional Communications Time Slots**



**Figure 4. Low Speed Uni-Directional Communications Time Slots**



**Figure 5. High Speed Uni-Directional Communications Time Slots**



**Figure 6. Offline State Time Slots**

## Commands

---

All commands are performed in the Offline State.

### Offline State Entry

The Offline state is entered when the Escape Sequence is received by the Socket Radio via the RS232 interface. The radio will respond with "OK<CR><LF>". When the Escape Sequence is received, any pending data to be sent over the RF link is discarded. Any pending ACKs or NAKs are also discarded.

### Offline Command Format

The Offline is a command with or without data as defined by the command. The maximum input length is 23 characters including the terminating <CR>. Concatenated commands are not supported. The command is terminated by a <CR>, 30 second time-out, or entry of the maximum number of characters. The command will have a response as determined by the ATQ and ATV settings.

### Command Validation

Valid commands return the two character command followed by the Return value for the command. When an invalid command is received, one or two unspecified characters are returned followed by "ERROR". The command data values are not checked. The host application is responsible for the validation of command data.

### General Commands

These AT Commands are general purpose commands to configure the socket radio, setup and manage a link. They are available in the Offline state.

Commands in [blue](#) are only for use with an active connection.

Command Line	Command Name	Command Data Values (hexadecimal)	Return value (Verbose form)
AT.CL=xx	Local Channel change	channel change 00 to 0F hexadecimal channel .Cl? reads the channel <b>Default in flash</b>	= OK ? Group number in Hexadecimal format
AT.ID=xxxxxx	Set Radio ID	Sets the "phone number" of the radio. AT.ID? to read the value Must be 6 hex characters long <b>Default in flash</b>	= OK ? Group number in Hexadecimal format
AT.CP=xx	Pair Channel change	=linked pair channel change 00 to 0F hexadecimal channel	OK or ERROR, NO CARRIER
AT.GP=xx	Pair Group change	xx is the new channel number .GC? reads the group <b>Default in flash</b>	OK or ERROR
AT.GL=xx Default in flash	Group local change	xx is the new channel number .GL? reads the group <b>Default in flash</b>	= OK or ERROR ? Group number
AT.Tn	Set baud rate to host	n=6 9600 Baud to host <b>9 19.2 kBaud</b> 10 38.4 kBaud 11 57.6 kBaud 12 115.2 kBaud	OK or ERROR
ATDTxxxxxx	Dial	xxxxxx is the hexadecimal address of the radio to be dialed	CONNECT or NO CARRIER
ATEn	DTE Offline Echo	n=0 DTE Offline echo off <b>n=1 DTE Offline echo on</b>	OK or ERROR
ATH	Hangup	-	OK
AT.IR	Read Local ID	-	Returns ID of the unit
AT.PI	Ping		1 linked radio reply 0 no reply
ATI0	Software Version	-	Returns Software version
ATO	Online	-	Current channel 00,01,02
ATQn	Result codes	<b>n= 0 Result codes on</b> n=1 Result codes off	OK or ERROR
ATRLxn	Local RF data rate	x:? Inquiry : = Set <b>n=0 Low RF data rate</b> n=1 High RF date rate	= OK or ERROR ? n=0 Low RF data rate n=1 High RF date rate
ATRPxn	Linked Pair RF data rate	x:? Inquiry : = Set <b>n=0 Low RF data rate</b> n=1 High RF date rate ? query	OK or ERROR
ATVn	Verbose results	n= 0 Sets numeric results <b>n=1 Set verbose results</b>	OK or ERROR
AT&Z	Sleep	-	OK or ERROR

All commands will return result code, verbose or nothing depending upon the settings of ATV, ATE and ATQ.

	ATV0	ATV1
ATQ0	No command response	Numeric results
ATQ1	No command response	Verbose results

## I/O Commands

These AT Commands access and control the digital I/O. The I/O is managed on a bit wise basis. The I/Os are numbered 0 through 8. The commands are available in the Offline state. The remote I/O commands require a current link. The local commands do not require a current link.

Socket Pin	Bit	Type
25	0	Input/Output
27	1	Input/Output
28	2	Input/Output
30	3	Input/Output
31	4	Output
32	5	Input/Output
36	6	Input/Output
37	7	Input/Output
39	8	Input/Output
40	9	Input/Output

Command Line	Command Name	Command Data Values (hexadecimal)	Return value (Verbose form)
ATLDxyz	Set the direction of the local I/O	x 0-9 I/O bit number y ? inquiry = set z 0 input 1 output <b>Default input except Bit4</b>	= OK or ERROR ? 0 input 1 output X ERROR
ATLix?	Reads the local I/O Value	X 0-9 I/O bit number y ? inquiry = set Z 0 low 1 high	= OK or ERROR ? 0 low 1 high X ERROR
ATLOx=y	Sets the local I/O value	X 0-9 I/O bit number y value 0 or 1 <b>Default 0</b>	OK or ERROR
ATRDxy	Set the direction of the remote I/O	X 0-9 I/O bit number y ? inquiry = set z 0 input 1 output <b>Default input except Bit4</b>	= OK or ERROR, NO CARRIER ? 0 input 1 output X ERROR
ATRIx?	reads the remote I/O Value	X = 0-9 I/O bit number	= OK or ERROR ? 0 low 1 high X ERROR
ATROx=y	Sets the remote I/O value	X 0-9 I/O bit number y value 0 or 1 <b>Default 0</b>	OK or ERROR

**Result Codes**

---

The are the result codes to the AT commands.

<b>Numeric Result</b>	<b>Description</b>	<b>Verbose Result</b>
0	Command Success	OK
1	Link established	CONNECT
3	Link ended	DISCONNECT
4	Error	ERROR
8	No connection made	NO CONNECT

## Non-Volatile Storage

---

The following items are stored in non-volatile memory storage:

- Socket Radio ID
- Group ID
- Channel

## Ordering

---

Part Number	Description
CC-900W-CA	0 - 70° C
CC-900W-CB	0 - 70° C
CC-900W-CA5	0 - 70° C
CC-900W-CB5	0 - 70° C

C = Commercial temperature  
I = Industrial temperature

A = On board Antenna  
B = MMCX connector

Blank = 3.3V power supply  
5 = 5V power supply

Contact factory for special configurations.

## Contact Information

---

**Copeland Communications, Inc.**

440 Colony Place  
Gahanna, OH 43230  
Tel: (614) 475-1690  
Fax: (614) 882-6062

Email: [info@copelandcommunications.com](mailto:info@copelandcommunications.com)  
Internet: [www.copelandcommunications.com](http://www.copelandcommunications.com)

## Legal

---

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Copeland Communications, Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Copeland Communication's products as critical components in life support systems is not authorized except with express written approval by Copeland Communications. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights.