

# **SEM 2410**

# **Wireless Ethernet**

# **Modem/Bridge**

**User's Manual**

**August 30, 2002**



---

**CIRRONET™**

**5375 Oakbrook Parkway  
Norcross, Georgia 30093**

[www.cirronet.com](http://www.cirronet.com)

**+ 1 (678) 684-2000**

## Important Regulatory Information

### Cirronet Product FCCID: HSW-SEM2410

---

**Note:** This unit has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their expense.

---

#### Maximum Permissible Exposure (MPE) Limits

- ***Notice to users/installers using the 24 dBi parabolic dish antenna in conjunction with all Cirronet RF products.***

*FCC rules limit the use of this antenna, when connected to Cirronet RF products for **point-to-point applications only**. It is the responsibility of the installer to ensure that the system is prohibited from being used in point-to-multipoint applications, omni-directional applications, and applications where there are multiple co-located intentional radiators transmitting the same information. Any other mode of operation using this antenna is forbidden.*

- ***Information to user/installer regarding FCC's Maximum Permissible Exposure (MPE) limits.***
- ***Notice to users/installers using the following fixed antennas, with Cirronet RF products:***

*Andrews 24dBi parabolic dish,  
Andrews 18dBi parabolic dish,  
Cushcraft 15dBi Yagi,  
Mobile Mark 14dBi Corner Reflector,  
Mobile Mark 9dBi Corner Reflector*

*The field strength radiated by any one of these antennas, when connected to Cirronet RF products, may exceed FCC mandated RF exposure limits. FCC rules require*

*professional installation of these antennas in such a way that the general public will not be closer than 2 m from the radiating aperture of any of these antennas. End users of these systems must also be informed that RF exposure limits may be exceeded if personnel come closer than 2 m to the apertures of any of these antennas.*

- ***Notice to users/installers using the following mobile antennas, with Cirronet RF products:***

*Mobile Mark 12dBi omni-directional,  
Mobile Mark 9dBi omni-directional,  
MaxRad 5dBi whip,  
Cirronet Patch antenna,  
Ace 2dBi dipole,  
Mobile Mark 2dBi Stub*

*The field strength radiated by any one of these antennas, when connected to Cirronet RF products, may exceed FCC mandated RF exposure limits. FCC rules require professional installation of these antennas in such a way that the general public will not be closer than 20 cm from the radiating aperture of any of these antennas. End users of these systems must also be informed that RF exposure limits may be exceeded if personnel come closer than 20 cm to the apertures of any of these antennas.*

**End of Regulatory Information**

## Table of Contents

Introduction .....	1
Getting Started.....	2
Connecting the SEM .....	2
SEM Status Indicators .....	3
Configuring the SEM.....	3
SEM Operation .....	6
Overview .....	6
Point-to-Point Mode .....	6
Point-to-Multipoint Mode .....	6
TCP/IP Addresses .....	8
BOOTP .....	8
DHCP.....	9
SEM Command Set .....	10
Ethernet Commands .....	10
SEM/Radio Commands .....	11
SEM System Commands.....	13
Radio Modem Configuration .....	14
Radio Commands .....	14
Distance Optimization .....	15
Specifications.....	17
Radio Specifications .....	17
Connectors .....	17
Indicators .....	17
Power.....	17
Troubleshooting .....	18
Technical Support.....	18
Warranty .....	19

## Introduction

The SEM2410 family of products from Cirronet™ Incorporated provides wireless Ethernet connectivity between networks located more than 5 miles apart. Built around the WIT2410 frequency hopping spread spectrum data modem, SEM products provide a 10BaseT connection to Ethernet networks. SEM products operate in a point-to-point mode or a point-to-multipoint mode using a star configuration. The center of the “star” is the Master device and the remote SEMs are Slave devices. Peer-to-peer communication is accomplished by using the master SEM device to relay datagrams from one slave SEM device to another slave SEM device.

Contained in ruggedized enclosures, SEM products are designed for factory and industrial applications. The communication between SEM products is performed using the WIT2410 over-the-air protocol. Thus the SEM products are 802.3 compatible but not 802.11 compatible and provide 460Kbps data throughput. Certified by the FCC and ETSI, and CE marked, SEM products can be deployed license-free around the world.

The SEMs enjoy the same benefits of frequency-hopping spread spectrum technology that the WIT2410s do. Namely, the immunity to multipath fading and resistance to jamming that is provided by changing frequency every few milliseconds. Operating in the 2.4GHz ISM band, SEMs can be used license-free worldwide and are not subject to the congestion in the 900MHz band caused by cordless telephones.

The radios in SEM products include a robust over-the-air protocol. This protocol insures error-free data through the use of a 24-bit CRC and ARQ to detect errors and to automatically request a retransmission. All of this is transparent to the network which just sees complete error-free data.

## Getting Started

The SEM family of wireless Ethernet modems are easy to install and operate. In most instances, the only installation steps will be setting IP addresses, selecting one modem as the master and connecting the antenna, power and Ethernet cable.

## Connecting the SEM

Figure 1 identifies the various connectors on the rear of the SEM.

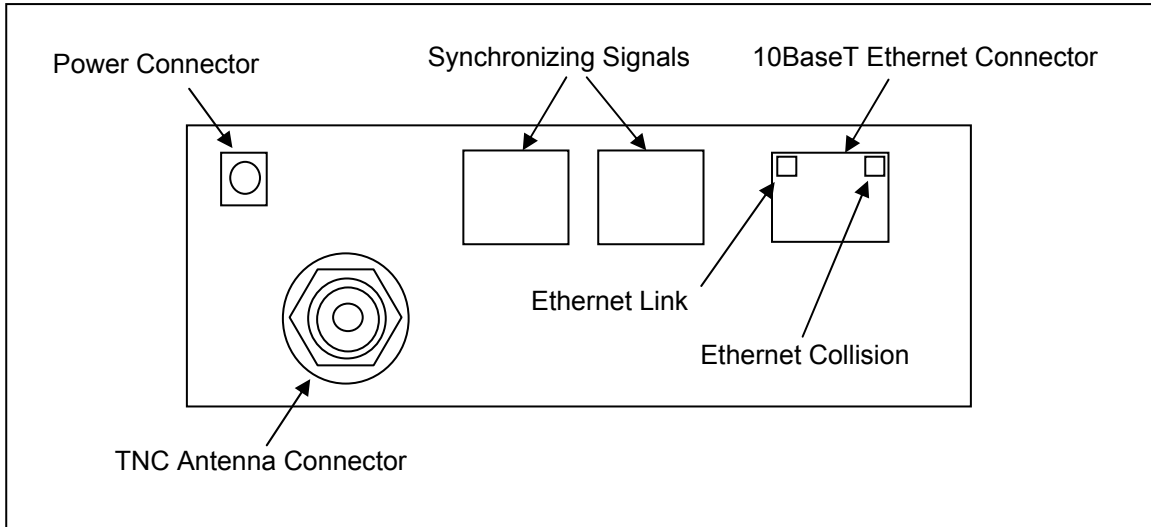


Figure 1. SEM Rear Panel Diagram

The antenna connector is a TNC type connector. An antenna may be connected directly to this connector. Alternatively, an antenna may be located away from the SEM using RF cable to connect the SEM to the antenna. Cirronet does not recommend using RF cables longer than 5 feet. If more distance is required between the SEM and the antenna, high-quality, low-loss RF feed line must be used. Alternatively, the SEM2410X has a remote radio assembly that is mounted next to the antenna. The remote radio assembly is connected to the SEM through a baseband cable that can be ordered in 50 foot increments up to 250 feet in length. The SEM2410X has a 12 pin connector in place of the TNC connector on the SEM2410.

The 10BaseT Ethernet connector is the standard RJ-45 connector. The connector is wired to be able to connect directly to an Ethernet device using a straight-through cable without having to connect through a hub. If it is desired to connect the SEM to a hub, the SEM must be connected to the Uplink port of the hub to use a straight-through cable. Otherwise a cross-over cable is needed to connect a SEM to a hub. The Ethernet connector has two LEDs built in. The green LED on the left indicates a good Ethernet connection. The yellow LED on the right indicates network collisions. When the yellow LED is on continuously, it indicates that there is sufficient network congestion to impact data throughput.

The synchronizing signals are provided for special applications where multiple master SEMs are co-located. The synchronizing signals are RS-485 levels and may be connected

using an RJ-11 connector. If the sync signals are required, one of the master SEMs must be designated as the sync master. See the section *SEM/Radio* Commands for details. If there are no co-located master SEMs, sync should be left disabled.

The power connector is a 2-pin DIN type connector. The provided AC adapter provides a 9 volt power level to the SEM. The SEM can accept DC voltages ranging between 7VDC and 26VDC if alternative power supplies are to be used.

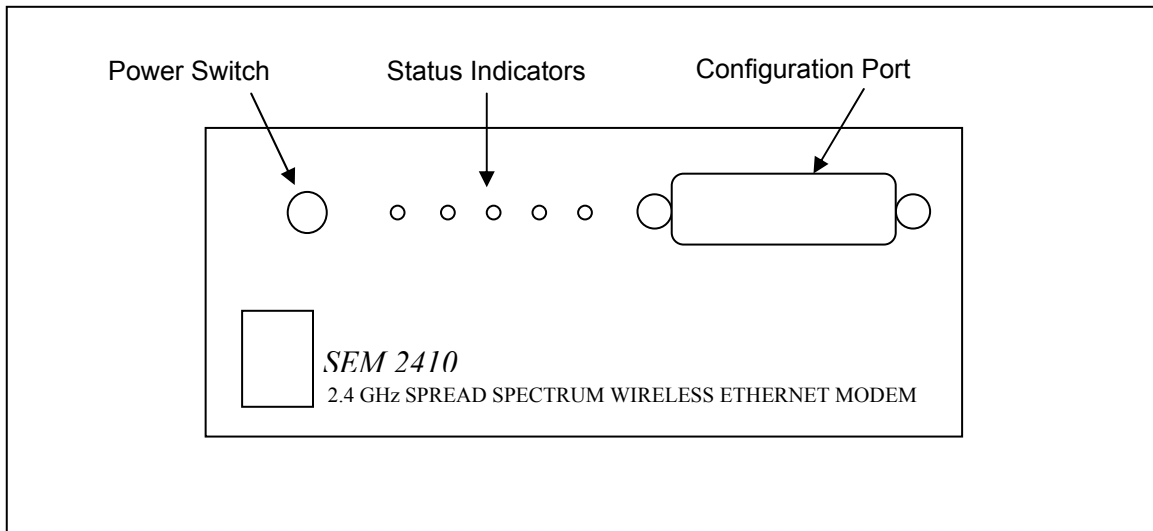


Figure 2. SEM Front Panel Diagram

The Configuration Port is an RS-232 serial port that may be used to configure the SEM. This is useful when the default IP address of the SEM cannot be used with the existing network preventing configuration through a telnet session. See the section *Configuring the SEM* for details of using this port.

### SEM Status Indicators

The PWR indicator on the front panel indicates that power is applied to the SEM and that the power switch is in the ON position.

TXD and RXD are indicators of data activity. They indicate the transmission and reception of data over the Ethernet connection. Note that these LEDs can be active even when the SEM is not communicating with another SEM.

On a slave SEM, the Link A LED indicates the SEM has established a connection with the master SEM. When a slave SEM is powered on, it will take a few seconds for this LED to turn on. On a master SEM the Link A LED is always on. The Link B LED is not used.

### Configuring the SEM

SEMs are shipped from the factory with default settings that include a default IP address of 0.0.0.0 and a default configuration as a slave bridge. In order to set up a wireless link, alternate IP addresses need to be assigned and one of the SEMs must be configured as a master device. If a BOOTP or DHCP server is not present a different IP address must be assigned to the SEM. If a DHCP server is present on the network, the IP address can be set up through it. See the sections *BOOTP* and *DHCP* for details.

The network that the SEM is connecting to must be compatible with 10BaseT products. The SEM **will not** work if the network only supports 100BaseT or half duplex 10BaseT products. Before connecting a default configured SEM to an active network that does not have a BOOTP or DHCP server, ask the network system for an IP address for the SEM that will not cause any problems on the network.

The SEM can be configured two ways. The first is through the serial port. The settings for the serial port are 38400 baud, 8 data bits, 1 stop bit, and no parity. SEMcom will automatically find the appropriate serial port and configure the serial port settings for you. The software will inform you of its progress and any problems that arise. After a few seconds the SEM firmware version is displayed followed by the **SEM>** prompt.

To set the IP number of the SEM, use the *ip* command.

```
ip <xxx.xxx.xxx.xxx> {yyy.yyy.yyy.yyy}
```

Where x is the new IP address, and y is the optional netmask number.

Once a valid IP address has been entered in the SEM, a second method to configure the SEM is through a telnet session. Most telnet programs work with the SEM. Windows 95/98/NT/2000/ME have a telnet program that works with the SEM. A telnet session can be started by clicking on Start->Run if you have Windows 95/98/NT/2000 and the TCP/IP client has been installed. For a SEM with an IP address of 192.168.0.254, enter the following information in the dialog box:

```
telnet 192.168.0.254
```

A telnet window will open up. The first line is the version of the SEM firmware followed by the prompt:

```
SEM>
```

If the SEM is to transmit data to devices not on its subnet, a default router must be specified. To enter the default routing address use the *route* command.

```
route add default <xxx.xxx.xxx.xxx> {yyy.yyy.yyy.yyy}
```

Where x is the IP address of the gateway device and y is the optional netmask number.

To configure a SEM as a master device, use the *bridge* command:

```
bridge master<CR>
```

The SEM2410 includes provision for filtering of multicast and broadcast packets. In many networks, there is sufficient multicast and/or broadcast packets to slow the overall performance of the SEM. By turning filtering on, the SEM will ignore these packets and limit transmission to packets with specific device addresses. In some instances, it will be desired to have the SEM transmit the multicast and broadcast packets; in this instance filtering should be disabled. Note that filtering broadcast packets also filters multicast packets but filtering multicast packets does not filter broadcast packets. To filter broadcast and multicast packets use the bridge filter command:

```
bridge filter bcast<CR>
```

Refer to the section *SEM/Radio Commands* for details of the filter commands.



Store the changed configuration parameters in non-volatile memory with the *save* command:

```
save<CR>
```

The SEM will report back the time it took to save the information. Reset the SEM by typing:

```
reset<CR>
```

The SEM can also be reset by cycling power. Whenever a reset is executed on the SEM, the telnet session will be lost. It will take the SEM about 30 seconds to reinitialize after a reset or after cycling power.

**Note: Failure to save and reset will result in the factory defaults being used.**

## **SEM Operation**

### **Overview**

SEM devices are wireless Ethernet modems that perform bridging functions in point-to-point or point-to-multipoint configurations. SEM products are designed to connect remote network segments together while keeping the data traffic between the network segments to a minimum. SEM products use MAC-layer addresses to learn on which network segment a device is located.

A master SEM can connect up to 5 remote slave SEMs. The SEM2410 is a single channel device with an over-the-air data rate of 460Kbps providing 230Kbps data throughput. The radio modems in the SEMs are factory configured with optimum settings for typical point-to-point applications. The radio parameters can be configured to optimize data throughput, latency and range for whatever the application. In addition, the radios in the SEMs can be configured to allow multiple SEM networks to be co-located.

### **Point-to-Point Mode**

In point-to-point operation, one SEM is configured as the Master and the other is configured as a Slave. While this is necessary for operation, it does not matter which SEM is the master and which is the slave. The radio in the master operates as the base radio. Configuring the SEM as the master automatically configures the radio in the master as a base radio. Similarly, configuring a SEM as a slave automatically configures the slave radio as a remote radio.

When a master SEM is powered on, it becomes active immediately, even if no slave SEMs are detected. It will attempt to send packets addressed to devices that it thinks are not on its local network. When a slave SEM is powered on, it listens for a master SEM and attempts to register with the radio in the master. This detection and registration process can take up to 2 seconds. During this time, no packets will be sent or received over the RF link by the slave.

If the application is such that more than one point-to-point link needs to be located in the same area, each master/slave pair must be assigned different network numbers. This will allow the SEMs to identify the appropriate other SEM to which they should communicate. Because different network numbers have different hopping sequences, this also allows various pairs to operate in the same area without interfering with each other. Refer to the section on radio commands for details on setting network numbers.

### **Point-to-Multipoint Mode**

In point-to-multipoint mode multiple slave SEMs link with a single master SEM. Similar to the point-to-point mode, each slave must register with the master, a process that can take up to 2 seconds. All of the radio addressing and registration occurs automatically and is transparent to the application. A maximum of 5 slave SEMs can be connected to a master SEM. The amount of data a slave can transmit depends on the number of slaves connected and the hop duration of the radio network. Because packets from one slave that are intended for another slave must pass through the master SEM, the master SEM should

always be configured for maximum data throughput, even at the expense of some throughput for the slaves. This is the factory default configuration.

In frequency hopping technology, the shorter the hop duration, the lower the data latency but the lower the throughput. This is because the overhead required is the same regardless of the hop duration. Thus at shorter hop durations, the overhead is a larger percentage of the hop time. Longer hop durations provide more throughput but have a higher data latency. If data from a slave appears just after the slave's designated transmit time, the slave will have to wait one hop duration before it can transmit the data. As the hop durations of the SEM products are very short, ranging from 3.3ms to 17.7ms, the better approach is to pick the hop duration to maximize data throughput without unnecessarily penalizing latency.

The maximum number of bytes that can be transmitted on a single hop by either a master or a slave is 208 bytes. The factory configuration is set up that the master will always be able to transmit 208 bytes per hop. The slave devices split the remaining time equally and transmit as much as they can each hop. The amount of time remaining will depend on the hop duration. The table below gives data throughputs for multiple slaves based on the default hop duration for a SEM.

<b>Slaves</b>	<b>Hop Duration</b>	<b>Slave Throughput</b>	<b>Master Throughput</b>	<b>Aggregate Throughput</b>
1	10ms	208Kbps	208Kbps	416Kbps
2	10ms	118.6Kbps	208Kbps	445.2Kbps
3	10ms	69.5Kbps	208Kbps	416.5Kbps
4	10ms	44.8Kbps	208Kbps	387.2Kbps

If the application has more slave devices, or if it is desirable to increase the throughputs of the slaves at the expense of the master SEM, contact Cirronet technical support for more details.

## TCP/IP Addresses

Each SEM must be configured with a unique IP address that is appropriate for the network where the SEM will be used. The default IP address is 0.0.0.0. The IP address can be set using the *ip* command through the serial-port interface or automatically by a BOOTP or DHCP server. The *ip* command takes one or two parameters. The first parameter specifies the IP address for the SEM, and the second optional parameter, if present, specifies the netmask for the SEM. If the second parameter is not used, the netmask is set to the default netmask for the IP address specified. For example, the command:

```
ip 192.168.0.1
```

will set the SEM's IP address to 192.168.0.1 and the netmask will remain 255.255.255.0. The command:

```
ip 192.168.1.164 255.255.255.192
```

will set the SEM's IP address to 192.168.1.164 and will change the netmask to 255.255.255.192. The *ip* command without any parameters will display the current setting of the IP address and netmask. The SEM includes a simple *ping* command that can be used to test the IP address and routing table settings.

The *route* command is used to modify and display the IP routing table entries in environments where the SEM must send data to devices not on its subnet. To display the routing table, use the *route list* command. There will always be one entry in the routing table that corresponds to the IP address in the SEM. For most applications, if any routing table entries are required, it will be sufficient to set a default route. To set the default route, use the command:

```
route add default <gwaddr>
```

where <gwaddr> is the IP address of the default gateway (usually a router or routing host). To remove the default route, use the command "route del default". To add a route to a particular network or host, use the command "route add <dest> <gw> [<netmask>]", where "<dest>" is the destination network or host IP address, "<gw>" is the IP address of the gateway, and the optional "<netmask>" is the netmask which defines the destination network.

## Filtering

On typical networks a fair amount of traffic can be made up of multicast or broadcast packets that do not need to be transmitted over the entire network.

## BOOTP

The SEM can also obtain its IP address from a BOOTP server if one is present in the network. The BOOTP server will require the Ethernet hardware MAC address to be able to assign the IP address to the SEM. The Ethernet hardware MAC address of the SEM is configured as 00:30:66:XX:YY:ZZ, where XX:YY:ZZ is the unique ID of the SEM's "radio A". The MAC address can be found on the bottom of the unit.

## **DHCP**

A DHCP server also can be used to set the SEM IP address as well as the default route IP address. This is accomplished by setting the desired default route IP address in the DHCP server using Option 3. A DHCP server will not overwrite a previously entered default router IP address in the SEM. If a DHCP server is not used to set the default router IP address, one must be entered using the *route* command. See the previous section for details of the route command.

## SEM Command Set

The SEM supports a series of commands that allow for configuring the Ethernet interface as well as the radio parameters of the on-board WIT2410. These commands can be entered during a telnet session or by using the WinSEM24 utility when the SEM> prompt is displayed. The commands are summarized here with detailed explanations following.

### Ethernet Commands

Command	Description
arp -a -d <ipaddr> -s <ipaddr> <eaddr>	Displays arp table Deletes arp entry Adds arp entry
ip [ <ipaddr> <netmask>]	Displays current SEM IP address Sets SEM IP address and optionally the netmask
password <pwd>	Sets password for telnet sessions
ping <ipaddr>	Pings TCP/IP host
route [ help add <default> <gwaddr> <netmask> del <ipaddr> list ]	Displays help screen for command Adds IP address and netmask to route list Deletes IP address from route list Lists route IP addresses
socks	Displays network socket information

**arp** Manipulates the address resolution procedure table. This command is provided primarily as a debugging tool for setting up networks. **ipaddr** is the device IP address and **eaddr** is the physical Ethernet address of the device

**ip** Sets the IP address of the SEM. The default IP address is 0.0.0.0. When specified **netmask** sets the netmask number. The default netmask is 255.255.255.0.

**password** Allows a password to be set to restrict the ability to initiate telnet sessions with the SEM.

**ping** sends inquiry packets to TCP/IP host specified in <ipaddr> and displays the amount of time that elapsed before a response was received. Continuously sends requests until a key is pressed.

**route** Displays and manipulates gateway IP addresses to route IP traffic off the subnet. *Default* sets the first gateway attempted.

**socks** Displays the network socket information.

## SEM/Radio Commands

Command	Description
<pre>bridge [help         filter [disable, mcast,                 bcast, show]         master         slave]</pre>	<p>Displays help screen for command</p> <p>Selects filtering operation and level.</p> <p>Sets bridge as a master</p> <p>Sets bridge as a slave</p>
<pre>hop [help      length &lt;hoplen&gt;      sequence [75 25]</pre>	<p>Displays help screen for command</p> <p>Sets/displays hop dwell time in radio and SEM</p> <p>Informs SEM of number of frequencies in radio hop pattern</p>
<pre>remote [help         list]</pre>	<p>Displays help screen for command</p> <p>Displays remotes currently registered with the SEM</p>
<pre>sync [help       disable       ether       master       override       settings       slave       wire]</pre>	<p>Displays help screen for command</p> <p>Turns sync off (default)</p> <p>Sets synchronization mode to use Ethernet packets</p> <p>Sets SEM as sync master</p> <p>Toggles master backup override</p> <p>Displays synchronization settings</p> <p>Sets SEM as sync slave</p> <p>Sets synchronization mode to use RJ-11 wire ports</p>

**bridge**      Selects filtering mode and sets master/slave status.

`filter disable` turns filtering off. `filter bcast` filters out broadcast and multicast packet while `filter mcast` filters out just multicast packets. `filter show` displays the filter settings.

`master/slave` sets the bridge as either a master or a slave. One bridge must set as the master and all others must be set as slaves. The default setting is slave.

**hop**            Used to set the hop dwell time or the number of frequencies in the hop pattern of the radio in the SEM.

The parameter entered for **length** is the decimal value of the number of 625  $\mu$ sec ticks in the desired dwell time. A value of **16** corresponds to a hop dwell time of 10 msec and is the default. **6** is the minimum value and **28** is the maximum value. The dwell time is changed to optimize the data throughput for a given installation.

The **sequence** is the number of hop frequencies in the hop pattern in the radio in the SEM. The default is 75 for US/ETSI operation. All other frequency bands, as set in the radio by the **pe** command, have 25 frequencies in their hop patterns. This value is entered as a decimal number. The sequence needs to be modified only if modified in the radio in the SEM.

- remote Displays the serial numbers of the radios in the SEMs that are currently registered with the SEM.
- sync These commands set the operation of the synchronization signal used in co-located SEM networks. The default mode is the sync OFF. Sync is enabled by selecting a synchronization method. **ether** and **wire** are mutually exclusive commands and set the synchronization to occur over the Ethernet or over the RS-485 signal lines. When sync is enabled, the default mode of the SEM is slave. One SEM must be configured as the sync master. If sync has been enabled, the slave SEMs will listen for a sync signal from the master. If no sync is heard, a slave SEM will make itself a master and provide a sync signal. This is called the master backup override mode. **override** toggles the master backup override on and off. In standalone SEM installations, synchronization is not required and should be left disabled.
- remote Displays the serial numbers of the radios in the SEMs that are currently registered with the master SEM.



## SEM System Commands

Command	Description
echo	Toggles user screen echo mode
help	Displays command help screen
reset	Resets the SEM activating changed configuration parameters
save	Stores current configuration to memory
sys [help outmax [1..208]	Displays help screen for command Sets the maximum packet length
version	Displays SEM firmware version

- echo Toggles the user screen mode to echo characters typed by the user. Default is on. If echo is turned off, characters typed will not be displayed on the screen unless echoed by the terminal program.
- help Displays a list of all the SEM commands. Most commands that require a parameter also have a help mode that displays the help screen for that command.
- reset Resets the SEM and loads saved parameters into active memory. Also causes the SEM to reinitialize which can take 30 seconds. If reset is issued before the save command, the new parameters are lost and the last saved parameters are used.
- save Saves changed parameters in non-volatile memory to be loaded on power up. Must be issued before the reset command or cycling power to have changed parameters take effect. (An exception is the sys outmax command which becomes active immediately after it is entered.)
- sys outmax Sets the length in bytes of the packets the processor in the master SEM will send to the internal radio. Setting this parameter in a slave device has no effect.
- version Displays the SEM firmware version.

## Radio Modem Configuration

The “radio” command provides access to several sub-commands that are useful in configuring the WIT2410 in the SEM. The format for the radio commands is **radio** {**A|B**} <**sub-cmd**> [**<sub-cmd-args>**], where the {**A|B**} is either of the letters ‘A’ or ‘B’ used to specify to which radio the sub-command should be applied. The SEM uses only the radio ‘A’ designation; the ‘B’ designation is for future use. The command **radio** {**A|B**} **banner** can be used to display the banner from the radio. This is useful in determining the unique ID of the radio and the version of firmware running in the radio.

### Radio Commands

The radios in the SEM devices are set with factory defaults which should be sufficient for most applications. For other applications, the following radio commands can be used to fine tune the performance of the SEM.

Command		Description
radio a	help	Displays command list
	banner	Displays power on banner for the radio in the SEM
	defaults	Resets the radio parameters to the factory shipped values
	maxremotes [ 0..5]	Displays value currently in use  Sets the maximum number of subscribers the SEM will allow to register.  Default = 5
	network [ 0..63]	Displays current SEM network number  Sets the network number for the SEM  Default = 0
	param <rcmd> [arg0, arg1...]	Sets other radio parameters. Should not be used unless instructed to by Cirronet Technical Support
	show	Displays radio parameters that have been modified from factory settings

help            Displays list of sub-commands under the *radio* command.

banner            Displays the power on banner of the radio inside the SEM.

defaults            Replaces any modified parameters with the factory default values.

maxremotes        Sets a limit to the number of remotes SEMS that a master SEM can have registered simultaneously. The default is 5 but the parameter can range from 1 to 5. If more than *maxremotes* remote SEMs attempt to connect to the access point, they will be denied.

- network** The radio in the SEM has 64 preprogrammed hopping patterns or network numbers. By using different network numbers, nearby co-located networks can avoid interfering with each other's transmissions. Even if both networks tried to use the same frequency, on the next hop they would be at different frequencies. *nwt* can range from 0 to 63.
- param** This command allows certain special radio parameters to be modified. These are only useful in debugging circumstances and should not be used unless directed to by Cirronet Technical Support. Modifying these parameters without direction by Cirronet may render the equipment inoperable.
- show** This command displays a list of the current radio parameters including the network number, maxremotes and the sys outmax value.

### Distance Optimization

In installations where the distance between SEMs will be more than 1/10 of a mile, the distance optimization parameter should be set in the remote SEMs. This parameter is set using the **radio a param** command with **dx** as the sub-command. The dx sub-command has a single argument that is a hexadecimal value between 0 and FF. The default setting of 00H is suitable for ranges of 0 to 0.8 miles (1287 m), with optimal performance at 0.1 miles (162m). Each increment of this parameter adds 0.1 miles (162 m) to the working range. Thus the optimal and max ranges are determined by:

$$\begin{aligned} \text{optimal} &= 0.1\text{mi} + 0.1\text{mi} \times \mathbf{dx} = 0.162\text{km} + 0.162\text{km} \times \mathbf{dx} \\ \text{max} &= 0.8\text{mi} + 0.1\text{mi} \times \mathbf{dx} = 1.33\text{km} + 0.162\text{km} \times \mathbf{dx} \end{aligned}$$

The following table presents various values of dx and the associated optimal and max ranges.

<i>dx setting</i>	range: <i>min</i>	<i>optimal</i>	<i>max</i>
00H	0mi/0km	0.1mi/0.2km	0.8mi/1.3km
01H	0mi/0km	0.2mi/0.3km	0.9mi/1.5km
04H	0mi/0km	0.5mi/0.8km	1.2 mi/2.0km
06H	0.1mi/0.2km	0.7mi/1.2km	1.4mi/2.3km
09H	0.4mi/0.7km	1.0mi/1.6km	1.8 mi/3.0km
13H	1.4mi/2.3km	2.0mi/3.3km	2.8mi/4.7km
31H	4.4mi/7.3km	5.0mi/8.3km	5.8 mi/9.7km
45H	6.4mi/10.7km	7.0mi/11.7km	7.8mi/13.0km
64H	9.4mi/15.7km	10.0mi/16.7km	10.8mi/18.0km
C8H	9.4mi/32.3km	20.0mi/33.3km	20.8mi/34.7km
FAH	4.4mi/40.7km	25.0mi/41.7km	25.8mi/43.0km

For example, where SEMs are deployed one-half mile apart, a dx value of 04 should be entered. To enter this value, at the SEM> prompt type:

```
radio a param dx 04<CR>
```

Save this value by issuing the save command:

```
save<CR>
```

The dx value will take effect immediately. It is not necessary to issue a reset command. Note that it is possible to set a dx value for a range longer than what is supported by the antennas in use. To obtain the longest possible ranges outdoors, high-gain directional antennas are required.

## Specifications

### Radio Specifications

<b>Model</b>	<b>SEM2410</b>
<b>Data Throughput</b>	230.4Kbps
<b>Total over-the-air bandwidth</b>	460.8Kbps
<b>Network Interface</b>	10BaseT
<b>SEM Network Topologies</b>	Point-to-Point or Multipoint
<b>Repeater</b>	Use Cirronet HN-2010
<b>RF Output Power</b>	10/100mW with included whip antenna, 400W EIRP with gain antenna
<b>RF Modulation</b>	Frequency hopping, up to 64 user selectable hopping patterns
<b>Frequency Range</b>	2400MHz to 2483.5MHz
<b>Operating Voltage Range</b>	7VDC to 26VDC
<b>Enclosure</b>	Ruggedized Aluminum
<b>Dimensions</b>	201 x 144 x 53 mm 7.9" x 5.7" x 2.1"
<b>Operating Temperature</b>	0°C to +70°C 0 to 95% humidity, non-condensing
<b>Licensing</b>	Type certified for Worldwide License-free operation under FCC Part 15.247 and ETS 300.328

### Connectors

<b>Power</b>	2-Pin DIN
<b>Ethernet</b>	RJ-45
<b>Configuration Port</b>	DB-9
<b>Antenna</b>	TNC Male
<b>Sync (2)</b>	RJ-11

### Indicators

<b>Power</b>
<b>Ethernet Transmit Data</b>
<b>Ethernet Receive Data</b>
<b>Ethernet Link Status</b>
<b>Ethernet Collision</b>

## Troubleshooting

### **Ethernet Link LED is not on.**

Check the power LED on the SEM. Check the Ethernet cable, making sure that it is fully connected. Check the gender of the Ethernet cable. The SEM can drive CAT5 cable to a maximum length of 100 meters. If a longer cable length is needed a signal regenerating device must be placed in line.

### **Cannot telnet to SEM.**

Check the power LED on the SEM. Check the Ethernet cable, making sure that it is fully connected. Make sure the SEM has a valid, unique IP number on the network. If you are attempting to telnet to the SEM through a router, make sure that the correct address has been entered in the routing table.

### **The SEM does not respond through the Configuration Port.**

Check that a straight through serial cable is being used if connected to a PC. If you are not using WinSEM24, verify that the host serial port is set for 38.4Kbps, 8 data bits, 1 stop bit and no parity. If you are using a terminal program, make sure that it is set up to transmit carriage returns when entered from the keyboard.

### **Bridges do not link (Link A LED is not on).**

Check that one bridge is configured as a master. Also check that the bridges are set to the same network number.

## **Technical Support**

Technical Support is available from Cirronet from 8:30am to 5:30pm Eastern Time, Monday through Friday. Contact Technical Support at (678) 684-2000 or by email at [tech\\_sup@cirronet.com](mailto:tech_sup@cirronet.com).

## Warranty

Seller warrants solely to Buyer that the goods delivered hereunder shall be free from defects in materials and workmanship, when given normal, proper and intended usage, for twelve (12) months from the date of delivery to Buyer. Seller agrees to repair or replace at its option and without cost to Buyer all defective goods sold hereunder, provided that Buyer has given Seller written notice of such warranty claim within such warranty period. All goods returned to Seller for repair or replacement must be sent freight prepaid to Seller's plant, provided that Buyer first obtain from Seller a Return Goods Authorization before any such return. Seller shall have no obligation to make repairs or replacements which are required by normal wear and tear, or which result, in whole or in part, from catastrophe, fault or negligence of Buyer, or from improper or unauthorized use of the goods, or use of the goods in a manner for which they are not designed, or by causes external to the goods such as, but not limited to, power failure. No suit or action shall be brought against Seller more than twelve (12) months after the related cause of action has occurred. Buyer has not relied and shall not rely on any oral representation regarding the goods sold hereunder, and any oral representation shall not bind Seller and shall not be a part of any warranty.

**THE PROVISIONS OF THE FOREGOING WARRANTY ARE IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL (INCLUDING ANY WARRANTY OR MERCHANT ABILITY OR FITNESS FOR A PARTICULAR PURPOSE). SELLER'S LIABILITY ARISING OUT OF THE MANUFACTURE, SALE OR SUPPLYING OF THE GOODS OR THEIR USE OR DISPOSITION, WHETHER BASED UPON WARRANTY, CONTRACT, TORT OR OTHERWISE, SHALL NOT EXCEED THE ACTUAL PURCHASE PRICE PAID BY BUYER FOR THE GOODS. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, LOSS OF DATA OR LOSS OF USE DAMAGES ARISING OUT OF THE MANUFACTURE, SALE OR SUPPLYING OF THE GOODS. THE FOREGOING WARRANTY EXTENDS TO BUYER ONLY AND SHALL NOT BE APPLICABLE TO ANY OTHER PERSON OR ENTITY INCLUDING, WITHOUT LIMITATION, CUSTOMERS OF BUYERS.**