

**XE900S Smart Spread Spectrum Transceiver**

**Description**

The XE900S combines a spread spectrum transceiver and micro-controller into a single easy-to-use, FCC Part 15 Registered module. The embedded communications controller manages the Frequency Hopping Spread Spectrum (FHSS) link and the host system interface.

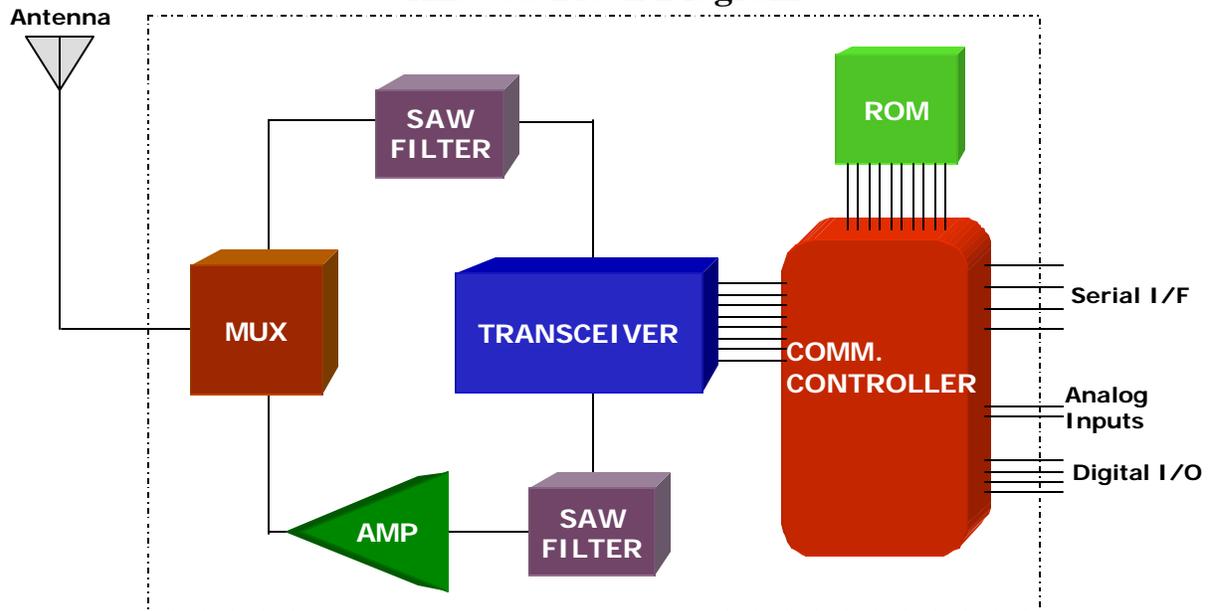
The XE900S supports two unique features to simplify wireless networking. Count-Off allows the network master to retrieve the status of 253 remote nodes in less than 10 seconds with a single broadcast command. SensorOnAir™ eliminates the need for an application micro-controller by utilizing the communications controller to directly manage analog inputs and digital control lines.

Xecom has two XE900S models. XE900S-10 supports a power output range of 0 to 10 mW; XE900S-500 has a power output range of 100 to 500 mW. The XE900S-10 costs less and uses less power; the XE900S-500 has greater range and signal penetration.

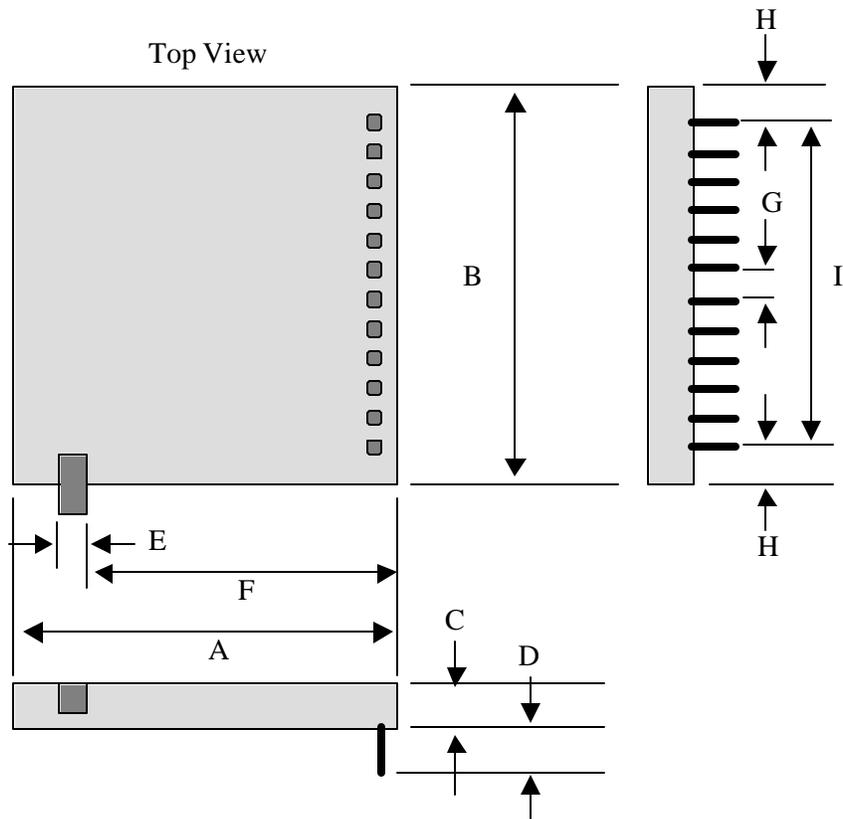
**Features**

- \* Small Size: 1.295" by 1.410" by 0.255"
- \* Serial Control and Configuration of the Wireless Link.
- \* Supports a 254 node point-to-multipoint network
- \* Programmable Transmit Power Output.  
XE900S-10 - 0 to 10 mW;  
XE900S-500 - 100 to 500 mW.
- \* Typical Receiver Sensitivity -100 dBm
- \* Obstructed signal range to 1500 feet (XE900S-500);
- \* Wireless Data Rate 76.8K bps, half-duplex
- \* Low power Consumption  
XE900S-10: 50 mA @ 3.3 Volts; 1 mW output power  
XE900S-500: 100 mA @ 3.3 Volts; 100 mW output power
- \* SensorOnAir™ allows direct connection of sensors to the Smart Transceiver
- \* Count Off allows the host node to download the status of all nodes in under 10 seconds.
- \* Operating Temperature Range of -40 to +85 C
- \* FCC Part 15 Registered

**XE900S Block Diagram**

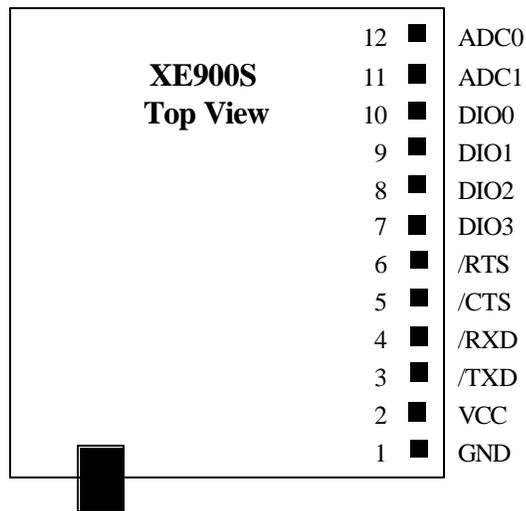


## XE900S MECHANICAL SPECIFICATIONS



Dimension	Description	Inches	MM
A	Module Width	1.295	32.89
B	Module Length	1.410	35.81
C	Module Thickness	0.255	6.48
D	Minimum Lead Length	0.100	2.54
E	Antenna Width	0.134	3.40
F	Edge to Antenna	0.995	25.27
G	Pin to Pin Spacing	0.100	2.54
H	Edge to End of Pin Row	0.155	3.94
I	Pin Row Length	1.100	27.94

## XE900S PIN CONFIGURATION



SIGNAL	PINS	DESCRIPTION
Ground	1	Common voltage reference for the XE900S.
VCC	2	3.3 Volt power for the XE900S.
/TXD	3	Transmit Data is the data input to the XE900S
/RXD	4	Received Data is the data output from the XE900S.
/CTS	5	Clear to Send provides hardware flow control from the XE900S. The XE900S drives /CTS high to signal the host to temporarily stop the flow of data on the /TXD.
/RTS	6	Request to Send provides hardware flow control from the host system. The host system drives /RTS high to signal the XE900S to temporarily stop the flow of data on /RXD.
DIO3	7	DIO0 may be programmed as either a digital input or digital output. It connects directly to the communications controller in the XE900S.
DIO2	8	DIO2 may be programmed as either a digital input or digital output. It connects directly to the communications controller in the XE900S.
DIO1	9	DIO1 may be programmed as either a digital input or digital output. It connects directly to the communications controller in the XE900S.
DIO0	10	DIO0 may be programmed as either a digital input or digital output. It connects directly to the communications controller in the XE900S.
ADC1	11	Analog Input 1 to the XE900S' communications controller. ADC1 connects to an internal 10-bit Analog to Digital Converter. ADC0 may also be configured as a digital input if no analog inputs are required. DIO0
ADC0	12	Analog Input 0 to the XE900S' communications controller. ADC0 connects to an internal 10-bit Analog to Digital Converter. ADC0 may also be configured as a digital input if no analog inputs are required.

## ABSOLUTE MAXIMUM RATINGS

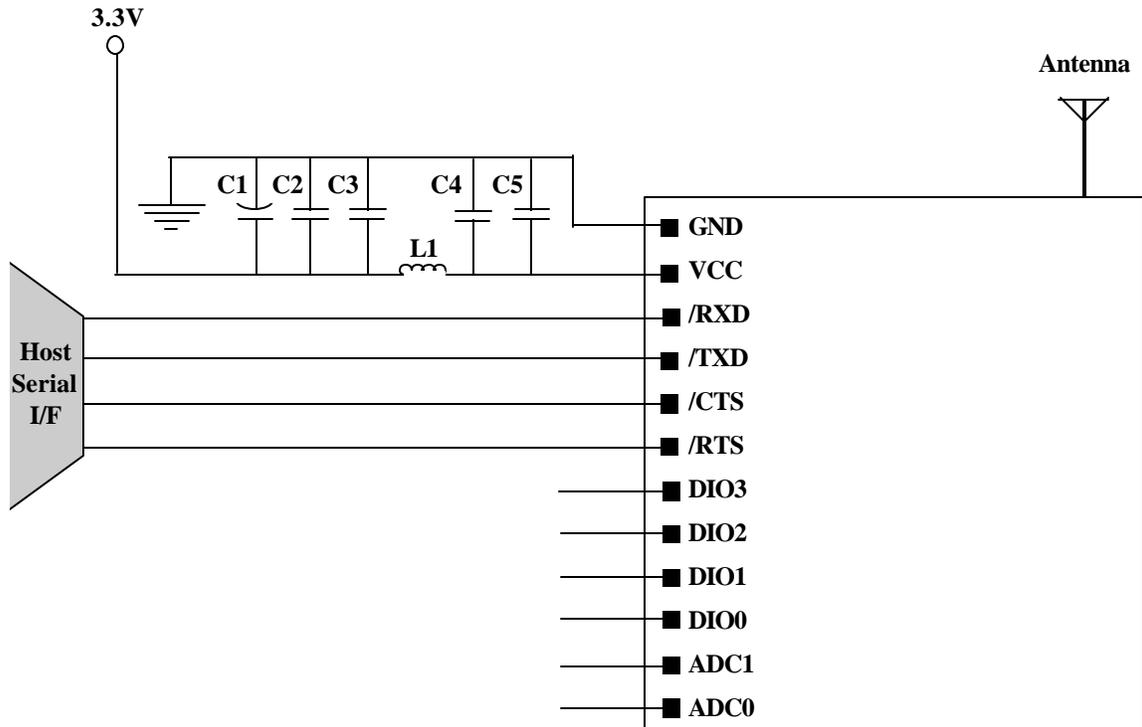
VCC	3.9 Volts
Storage Temperature	-55° C to +125° C
Operating Temperature Range	-40° C to +85° C

WARNING: Exceeding any of these ratings will void the warranty and may damage the device

## XE900S ELECTRICAL SPECIFICATIONS

Parameter	Min	Typ	Max	Units	Comments
VCC	2.7	3.3	3.6	Volts	Transceiver power
ICC	XE900S-10		50	mA	Transmit Mode (1 mW output)
	XE900S-500		100	mA	Transmit Mode (100 mW output)
	All		30	mA	Receive Mode
	All		15	mA	Idle Mode
	All			10	uA
Output Power:	XE900S-10	1	10	mW	50 Ohm Load
	XE900S-500	100	500	mW	50 Ohm Load
Wireless Receive Sensitivity		-100		dBm	76.8K bps
Range thru Physical Obstructions		1500			XE900S-500, 76,800 bps
Frequency Hopping Channels		63			
Frequency Band	902		928	MHz	
Antenna Output Impedance		50		Ohms	
Latency		TBD		mSec	
Voh	2.25			Volts	VCC =3.3 Volts
Vol			0.75	Volts	VCC =3.3 Volts
Vih	2.25			Volts	VCC =3.3 Volts
Vil			0.75	Volts	VCC =3.3 Volts

## XE900S TYPICAL CONNECTION DIAGRAM



### Parts List for XE900S Typical Connection Diagram

Reference Designation	Qty	Description
C1	1	Capacitor, Electrolytic, 100 ufd, 10 Volts
C2, C4	2	Capacitor 0.1 ufd, 10Volts
C3, C5	2	Capacitor 47 pfd, 10 Volts
L1	1	Coilcraft 0603HC-7N5XJB
Antenna *	1	50 Ohm, 1/4 Wave;

\* The Antenna connector on teh XE900S is a Male MMCX connector.  
An femle MMCZ to Female SMA adapter will be need for the antenna connection

## XE900S COMMUNICATIONS CONTROLLER

The XE900S uses an internal micro-controller to control communications. This micro-controller manages the interface to the host system, determines when the communications link is available, and formats data for the RF communications.

### HOST INTERFACE

The XE900S has two primary interfaces to the system host; the serial interface and the direct sensor interface supported by the SensorOnAir™ feature. Management of both interfaces is the responsibility of the communications controller.

### RS232 Interface

The XE900S supports a 4-signal serial interface. For most applications the XE900S will act as a DCE. Control and configuration of the XE900S takes place through the serial interface using modem-like AT commands. The serial data rate is configurable from 1200 bits per second to 115.2K bits per second. The supported serial interface signals are listed below.

/TXD - Transmit Data; the input to the XE900S for AT commands and Data to be transmitted on the wireless network.

/RXD - Received Data; the output from the XE900S for received RF data and responses to AT commands.

/RTS - Request to Send, provides the hardware flow control input to the XE900S. The DTE removes RTS to stop the XE900S from sending more data on the RXD line.

/CTS - Clear to Send, is the hardware flow control output from the XE900S. The XE900S deactivates Clear to Send to advise then host to stop inputting data on the TXD lead.

### XE900S AT Command Format

AT command issued to the XE900S follow a strict format. Each command begins with the prefix AT and ends with a carriage return. The XE900S communications controller accepts commands at data rates from 1200 to 115,200 bps.

**Command Prefix** - Each command, except the A/ command, begins with the AT prefix. The "A" and "T" may be either both upper case or both lower case but cannot be of different cases. The prefix identifies parity of the commands sent to the XE900S by comparing the parity bits of the "A" and the "T" characters.

**Command Line** - Commands may be strung together in a single command line of up to 36 characters. Commands in the command string are executed in the sequence they appear.

**Omitted Parameters** - Most commands include a parameter which determines the function setting. When the command parameter is omitted from the command string, it is assumed to be a 0.

**Result Codes** - A result code is normally issued after each action. Result codes may be provided as full words, one or two digit numeric codes, or may be disabled all together. Each result code ends with a carriage return when numeric result codes are chosen. When full word result codes are chosen, a Line Feed and Carriage Return precede and follow each result code.

**Disconnect Sequence** - A three character sequence initiates a disconnect of the wireless link. The sequence “~~~” is assigned to disconnect the link.

### DIRECT CONNECTION OF SENSORS:

#### SensorOnAir™

Sensors can be connected directly to the XE900S without requiring an applications controller. In this SensorOnAir™ configuration the XE900S communications controller controls the operation of the sensors.

#### Sensor I/O Lines

SensoronAir controls the operation of 6 I/O lines to the XE900S. This includes 2 analog inputs, ADC0 and ADC1, and 4 digital I/O lines, DIO0, DIO1, DIO2, and DIO3. ADC0 and ADC1 are connected to a 12-bit analog to digital converter and use a 2.5 volt reference derived from VCC as their reference voltage. The digital I/O lines can be programmed to act as either inputs or outputs.

#### Configuring the XE900S for Sensor Operation

All SensorOnAir control functions for the analog inputs and digital I/O's are performed by the communications controller within the XE900S. Modem-like AT commands loaded through the serial interface, program the functions of the analog and digital I/O lines. The AT commands used to program the SensorOnAir functions are then stored in the XE900S' Flash memory. This allows the XE900S to be first programmed and then installed in the application.

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## XE900S COMMUNICATIONS CONTROLLER

The communications controller uses the information stored in Flash memory to control the analog and digital I/O lines.

### SensorOnAir Commands™

Below is a list of the AT commands used to program the direct control of sensors using the communications controller in the XE900S.

**S107** - Defines the function of the programmable I/O lines. The two analog input lines, ADC0 and ADC1, can also be defined as digital I/O lines if needed. The four programmable digital I/O lines, DIO0, DIO1, DIO2, and DIO3; can be set as either inputs or outputs. The value of this command is stored in flash memory within the XE900S.

**AT&IAn?** - This command allows a local host to read the value of Analog Input “n.”

**AT&IDn?** - This command allows a local host to read the status of Digital I/O “n.”

**AT&IDn=z** - This command allows a local host equipment to set the condition of the local digital output “n.” When z=0 the output is set to a logic low; when z=1 the output is set to a logic high.

**AT#IxxxAn?** - This command allows the value of Analog Input “n” on node address “xxx” to be read remotely.

**AT#IxxxDn?** - This command allows the status of Digital I/O “n” on node address “xxx” to be read remotely

**AT#IxxxDn=z** - This command allows the condition of the local digital output “n” on node address “xxx” to be set remotely. When z=0 the output is set to a logic low; when z=1 the output is set to a logic high.

### WIRELESS COMMUNICATIONS

The communications controller manages the RF Link. This includes the frequency hopping algorithm for spread spectrum operation; collision avoidance, node addressing, and packetizing data. The communications controller allows support for point-to-point, point-to-multipoint or multipoint networks.

### Carrier Sense Multiple Access (CSMA)

To prevent collisions between network nodes the XE900S uses a Carrier Sense Multiple Access protocol for each network transceiver. In normal communications all nodes, including the Master node in a point-to-Multipoint network, listen for communications activity before initiating a session. If a wireless link already exists, the transceiver waits until that session is complete before initiating a wireless link.

### Data Packets

All data presented by the system host is placed into packets by the XE900S communications controller for transmission across the wireless link. These packets provide addressing and error correction for the wireless communications. The communications controllers in the place the data in packets only for the wireless link. The data is extracted from the packets before being sent out the serial interface.

### Multipoint Network

System designers using the XE900S can create a point-to-multipoint network with up to 253 remote nodes. The master node is assigned address 0. The remote nodes are assigned address from 1 to 253. To insure the network can be operated efficiently, Xecom created Count-Off. Count-Off allows the master node to poll the entire network in less than 10 seconds

# XE900S COMMUNICATIONS CONTROLLER

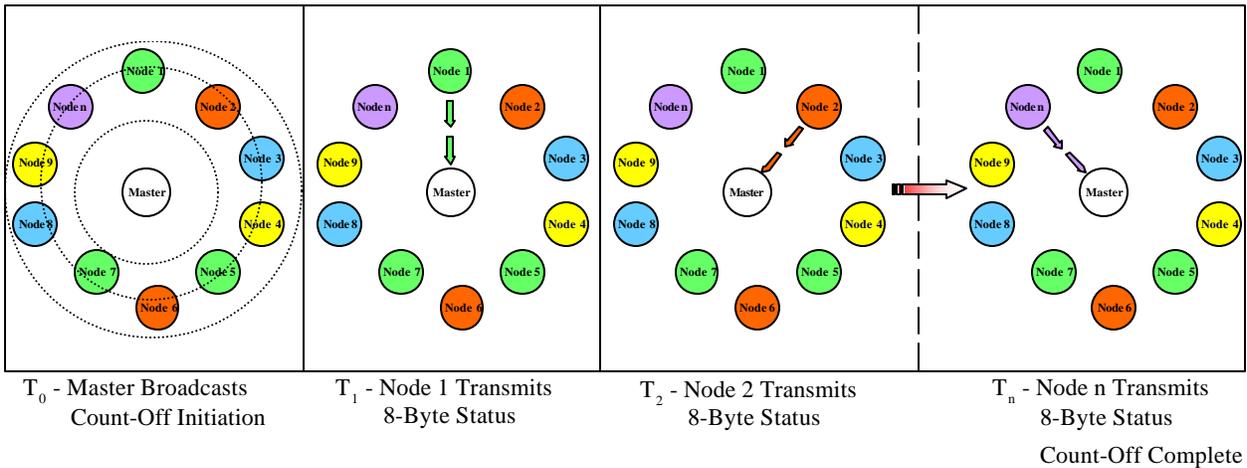
## Count-Off Function

The Count-Off function permits the master Node in a point-to-multipoint system to quickly check the status of all network nodes. It creates a temporary time division multiplexing scheme which permits each node to report its status without the handshaking sequence normally required for a wireless data exchange.

The Count-Off sequence is initiated by an AT command, AT#C: or AT#C=, from the host system. The Master node broadcasts the Count-Off command to all network nodes. Upon receipt of the Count-Off broadcast each remote node initializes an internal timer. Then in sequence by address each node sends an 8-byte status message to the Master. The status message is programmed with the AT#E: or AT#E= command. That status byte is passed to the host system.

Using Count-Off network reporting will be completed in less than 10 seconds. Based on the status information the host can then elect to service any of the remote nodes.

## COUNT-OFF SEQUENCE



## AT COMMANDS

### An asterisk indicates the factory default

- A** Answer Command - forces the smart transceiver respond to a summons from another wireless device.
- Dn** Initiate a Wireless Link - attempts to establish a connection with the transceiver at address n.
- En** Echo Characters - determines if the XE900S will echo the characters received on its serial interface during command mode.  
n=0 Characters not Echoed  
n=1 Characters Echoed \*
- In** Identification - displays product identification code.  
n=0 Display Product Code  
n=1 Display Product Name  
n=2 Display Model Number  
n=3 Display Copyright  
n=4 Display Firmware Revision
- Qn** Result Code Display - determines if results codes will be displayed.  
n=0 Display Result Codes \*  
n=1 Do not Display Result Codes
- Sn= Set Value of Register Sn**
- Sn? Read Value of Register Sn**
- Vn** Response Type - selects Full Word or Numeric responses  
n=0 Numeric Responses  
n=1 Full Word Responses \*
- Zn** Reset - executes a soft Reset  
n=0 Reset to Values Stored in User Profile 0 \*.  
n=1 Reset to Values Stored in User Profile 1
- &F** Restore Factory Settings - returns all configuration commands and registers to their factory default values.
- &IAn? Read Local Analog Input “n”** - This command allows the host equipment to read the values of the local analog inputs.  
n=0 Read input ADC0  
n=1 Read input ADC1

**&IDn? Read Local Digital Input “n”** - This command allows the host equipment to read the status of the local digital inputs.

- n=0 Read input DIO0  
n=1 Read input DIO1  
n=2 Read input DIO2  
n=3 Read input DIO3  
n=4 Read input DIO4 (pin shared with ADC0)  
n=5 Read input DIO5 (pin shared with ADC1)

**&IDn=z Set Local Digital Output “n”** - This command allows the host equipment to set the condition of the local digital outputs. When z=0 the output is set to a logic low; when z=1 the output is set to a logic high.

- n=0 Set output DIO0  
n=1 Set output DIO1  
n=2 Set output DIO2  
n=3 Set output DIO3  
n=4 Set output DIO4 (pin shared with ADC0)  
n=5 Set output DIO5 (pin shared with ADC1)

**&Kn** Flow Control - selects the type of flow control to be used between the system host and the XE900S

- n=0 Flow Control Disabled  
n=3 RTS/CTS, hardware Flow Control  
n=4 XON/XOFF, in-band Flow Control

**&V** View Active Configuration - sends the active configuration data to the system host.

**&Wn** Store Current Configuration - loads the current XE900S configuration into either User Profile 0 or User Profile 1.

- n=0 load configuration into User Profile 0  
n=1 load configuration into User Profile 1

**#B** Wireless Broadcast Mode - initiates wireless broadcast mode for diagnostic purposes.

**#C:** Count-Off Request (ASCII) - Initiates a “count-off” sequence in the network with node status to be reported in ASCII format.

**#C=** Count-Off Request (Hex) - Initiates a “count-off” sequence in the network with node status to be reported in hexadecimal format.

## AT COMMANDS

**#E:** Count-Off Response (ASCII) - Programs the nodes 8 byte response to a "count-off" request from the network hub in ASCII format.

**#E=** Count-Off Response (Hex) - Programs the nodes 8 byte response to a "count-off" request from the network hub in hexadecimal format.

**#IxxxAn?** Read Analog Input "n" at Node Address xxx - This command allows analog input values at any node to be read remotely.

n=0 Read input ADC0

n=1 Read input ADC1

**#IxxxDn?** Read Digital Input "n" at Node Address xxx - This command allows the status of the digital inputs at any node to be read remotely.

n=0 Read input DIO0

n=1 Read input DIO1

n=2 Read input DIO2

n=3 Read input DIO3

n=4 Read input DIO4 (pin shared with ADC0)

n=5 Read input DIO5 (pin shared with ADC1)

**#IxxxDn=z** Set Digital Output "n" at Node Address xxx

- This command allows the condition of the digital outputs to be modified remotely. When z=0 the output is set to a logic low; when z=1 the output is set to a logic high.

n=0 Set output DIO0

n=1 Set output DIO1

n=2 Set output DIO2

n=3 Set output DIO3

n=4 Set output DIO4 (pin shared with ADC0)

n=5 Set output DIO5 (pin shared with ADC1)

**#Ln** Check RSSI Level - Displays current Wireless received signal levels

n=0 Display a single value \*

n=1 Display 4 Values

n=2 Display continuous values

## XE900S Responses

<u>Numeric</u>	<u>Full Word</u>	<u>Description</u>
0	OK	Successfully executed command line
1	CONNECT RF	Wireless Connection Established
2	RING	Wireless Link Request Detected
3	DISCONNECT	Failed to Establish or Lost Wireless Link
4	ERROR	Error in command line
7	BUSY	Link Request Time Out has occurred
9	WAIT	Wireless Link is not available

## XE900S Configuration Registers

- S0 Answer Wireless Link Request:** S0 determines if the XE900S will automatically respond to a wireless link request.
- S0=0 No Automatic response to link requests  
S0=1 Automatically respond to link requests
- S2 Wireless Disconnect Character - S2** sets the ASCII character to be used in the link disconnect sequence. The default character is the tilde “~”.
- Range: 0-255  
Default: 126
- S12 Disconnect Guard Timer - S12** sets the guard timer in milliseconds before and after the disconnect sequence. If any characters other than the disconnect sequence are received within the window defined by S12 the disconnect request will be ignored..
- Range: 0-255  
Default: 40  
Units: Milliseconds
- S14 Bit-mapped Register - S14** stores the values of the ATE, ATQ and ATV commands.
- S21 Bit-mapped Register - S21** stores the values of the AT&D, AT&C and XY&S commands.
- S23 Serial Interface Data rate - S23** stores the serial interface data rate.
- Range 1-10
- 1 = Set serial data rate to 1200 BPS
  - 2 = Set serial data rate to 2400 BPS
  - 3 = Set serial data rate to 4800 BPS
  - 4 = Set serial data rate to 9600 BPS\*
  - 5 = Set serial data rate to 14400 BPS
  - 6 = Set serial data rate to 19200 BPS
  - 7 = Set serial data rate to 28800 BPS
  - 8 = Set serial data rate to 38400 BPS
  - 9 = Set serial data rate to 57600 BPS
  - 10 = Set serial data rate to 115200 BPS
- S39 Bit-mapped Register - S29** stores the value of the AT&K command.
- S105 XE900M ID Number - S105** sets the ID number for the XE900S. Each unit on the Base Access Network is required to have a unique ID number. The ID number of the Master Node should always be set to 1.
- Range: 2-254
- S106 Set Noise Threshold - S106**
- S107 I/O Configuration - S107** is a bit-mapped register which defines the local programmable I/O lines.
- Bit 0 = 0 - ADC0 and ADC1 used as Programmable I/O  
= 1 - ADC0 and ADC1 defined for Analog use
- Bit 1 = reserved
- Bit 2 = 0 - DIO0 used as an output  
= 1 - DIO0 used as an input
- Bit 3 = 0 - DIO1 used as an output  
= 1 - DIO1 used as an input
- Bit 4 = 0 - DIO2 used as an output  
= 1 - DIO2 used as an input
- Bit 5 = 0 - DIO3 used as an output  
= 1 - DIO3 used as an input
- Bit 6 = 0 - DIO4 used as an output (Bit 0 = 0)  
= 1 - DIO4 used as an input
- Bit 7 = 0 - DIO5 used as an output (Bit 0 = 0)  
= 1 - DIO5 used as an input
- Default: 193
- S108 Transmit Level Control - S108** sets the transmit level
- Range: 0-3
- |   | XE900S-500 | XE900S-10 |
|---|------------|-----------|
| 0 | 20 dBm     | -5 dBm    |
| 1 | 23 dBm     | 0 dBm     |
| 2 | 26 dBm     | 5 dBm     |
| 3 | 27 dBm     | 10 dBm    |
- Default: 0

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## FCC PART 15 REGULATIONS

### FCC Part 15 Certification

The XE900S-10 and XE900S-500 have been certified per FCC Part 15 rules for integration into OEM products without further testing or certification. This certification is your assurance that the XE900S will not cause harmful interference.

### Labeling Requirements

FCC rules require the Original Equipment Manufacturer using the XE900S to place an appropriate label on the outside of the finished equipment. The label must be clearly visible and include the information shown below.

**Contains Transmitter Module FCC ID: xxxxxxxxxx**

**WARNING:**

This device complies with Part 15 of the FCC Rules. Its operation is subject to the following conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any received interference including interference that may cause undesired operation.

### Limitations

Both models of the XE900S are registered under FCC Part 15 Rules. To utilize this registration on your OEM System you must follow the applications circuit provided in this data sheet and use one of the listed antennas. Any changes or modifications to the recommended circuit must be approved by Xecom. Failure to seek Xecom's approval for modifications could void certification of the end product.

### Warning: RF Exposure

The XE900S is approved for mobile, base station and portable applications. A minimum separation of 20 centimeters should be maintained between the antenna and the equipment operator. For portable applications check the minimum separation distances defined in the approved antenna list. To ensure compliance, operation at distances closer than those defined is not recommended.

The Warning message above must be included in the user Manual for the end product.

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**A Critical Component** is any component of a life support device or system whose failure to perform can be reasonably expected to cause failure of the life support device or system, or to affect its safety or effectiveness.

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