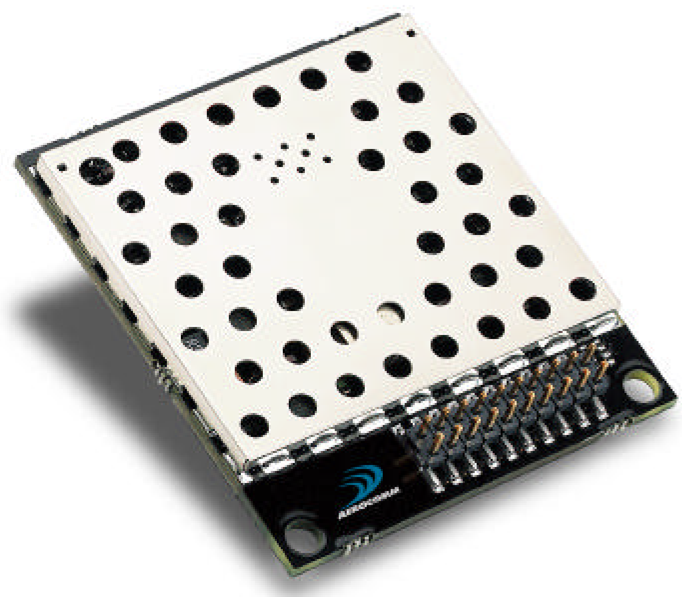
AC4490

900 MHz OEM TRANSCEIVERS

Specifications Subject to Change

User's Manual
Version 1.6



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AC4490/AC4486 Features

- ✍✍ Available in either 3.3V or 5V TTL level serial interface for fast integration
- ✍✍ Drop-in replacement for AC4424 2.4GHz product family
- ✍✍ Two generic input and output digital lines and integrated DAC/ADC functions
- ✍✍ Frequency Hopping Spread Spectrum for security and interference rejection
- ✍✍ Cost Efficient for high volume applications
- ✍✍ Very low power consumption for battery powered implementations
- ✍✍ Small size for portable and enclosed applications
- ✍✍ Very Low latency and high throughput
- ✍✍ All modules are qualified for Industrial temperatures (-40°C to 80°C)

1. Overview

The AC4490/AC4486 and AC4486 are members of AeroComm's ConnexRF OEM transceiver family. The AC4490 is designed for integration into OEM systems operating under FCC part 15.247 regulations for the 900 MHz ISM band. The AC4486 is designed for integration into OEM systems operating under European ETSI regulations for the 868 MHz band.

The AC4490 is a cost-effective, high performance, frequency hopping spread spectrum transceiver. It provides an asynchronous TTL/RS-485 level serial interface for OEM Host communications. Communications include both system and configuration data. The Host supplies system data for transmission to other Host(s). Configuration data is stored in an on-board EEPROM. All frequency hopping, synchronization, and RF system data transmission/reception is performed by the transceiver.

These transceivers can be used as a direct serial cable replacement – requiring no special Host software for operation. They also feature a number of On-the-Fly Control Commands providing the OEM with a very versatile interface for any network.

AC4490/AC4486 transceivers operate in a Point-to-Point or Point-to-Multipoint, Client-Server or Peer-to-Peer architecture. One transceiver is configured as a Server and there can be one or many Clients. To establish synchronization between transceivers, the Server emits a beacon. Upon detecting a beacon, a Client transceiver informs its Host and a RF link is established.

This document contains information about the hardware and software interface between an AeroComm AC4490/AC4486 transceiver and an OEM Host. Information includes the theory of operation, specifications, interface definition, configuration information and mechanical drawing.

The OEM is responsible for ensuring the final product meets all FCC and/or appropriate regulatory agency requirements listed herein before selling any product.

2. AC4490/AC4486 Specifications

GENERAL	
Interface	20 pin mini-connector
Serial Interface Data Rate	PC baud rates from 1200 bps to 115,200 bps
Power Consumption (typical)	**Duty Cycle (TX=Transmit; RX=Receive)** **10%TX 50%TX 100%TX 100%RX Pwr-Down Deep Sleep** AC4490-200: 43mA 95mA 106mA 30mA 19mA 6mA AC4490-1000: 126mA 508mA 985mA 30mA 19mA 6mA
Channels	5 Channel Sets comprising 58 total channels
Security	One byte System ID.
Interface Buffer Size	Input/Output: 256 bytes each
RADIO	
Frequency Band	US/Canada: 902 – 928 MHz Australia: 915 – 928 MHz
RF Data Rate	76.8kbps
Radio Type	AC4490: Frequency Hopping Spread Spectrum
Output Power (conducted, no antenna)	AC4490-200: 100mW typical AC4490-1000: 1000mW
Effective Isotropic Radiated Power (EIRP with 3dBi gain antenna)	AC4490-200: 200mW typical AC4490-1000: 1000mW
Supply Voltage	AC4490-200: 3.3 or 3.45 - 6V ±2%, ±50mV ripple AC4490-1000: 3.3 ±2%, ±50mV ripple
Sensitivity	-100dBm typical @ 76.8kbps
Range, Line of Site (based on 3dBi gain antenna)	AC4490-200: 4 miles AC4490-1000: 20 miles
ENVIRONMENTAL	
Temperature (Operating)	-40?C to 80?C
Temperature (Storage)	-50?C to +85?C
Humidity (non-condensing)	10% to 90%
PHYSICAL	
Dimensions	1.65” x 1.9” x 0.20”
Antenna	AC4490-200: MMCX Connector or integral antenna AC4490-1000: MMCX Connector
Weight	Less than 0.75 ounce

3. Specifications

3.1 Interface Signal Definitions

The AC4490/AC4486 has a simple interface that allows OEM Host communications with the transceiver. **Table 1 – Pin Definitions**, shows the connector pin numbers and associated functions. The I/O direction is with respect to the transceiver. All outputs are 3.3VDC levels and inputs are 5VDC TTL (with the exception of 500mW radios which are 3.3V inputs) with the exception of RSSI, AD In and DA Out, which are all analog. All inputs are weakly pulled High and may be left floating during normal operation.

Table 1 – Pin Definitions

Pin	Type	Signal Name	Function
1	O	GO0	Generic Output pin
2	O	TXD	Transmitted data out of the transceiver
	I/O	RS485 A (True)[1]	Noninverted RS-485 representation of serial data
3	I	RXD	Data input to the transceiver
	I/O	RS485 B (Invert)[2]	Mirror image of RS-485 A
4	I	GI0	Generic Input pin
5	GND	GND	Signal Ground
6	O	Hop Frame	Pulses Low when the transceiver is hopping.
7	O	CTS	Clear to Send – Active Low when the transceiver is ready to accept data for transmission.
8	I	RTS	Request to Send – When enabled in EEPROM, the OEM Host can take this High when it is not ready to accept data from the transceiver. NOTE: Keeping RTS High for too long can cause data loss.
9	O	GO1	Generic Output pin
10	PWR	VCC	3.3 or 3.45 – 6V (depends on model) ± 2%, ± 50mV ripple
11	PWR	VCC	3.3 or 3.45 – 6V (depends on model) ± 2%, ±50 mV ripple
12	I	9600_BAUD	9600_BAUD – When pulled logic Low before applying power or resetting the transceiver's serial interface is forced to a 9600, 8, N, 1 rate. To exit, transceiver must be reset or power-cycled with 9600_Baud logic High.
13	O	RSSI	Received Signal Strength - An analog output giving an instantaneous indication of received signal strength. Only valid while in Receive Mode.
14	I	GI1	Generic Input pin
15	I	UP_RESET	RESET – Controlled by the AC4490/AC4486 for power-on reset if left unconnected. After a Stable power-on reset, a logic High pulse will reset the transceiver.
16	GND	GND	Signal Ground
17	I	Command/Data	When logic Low, the transceiver interprets Host data as command data. When logic High, the transceiver interprets Host data as transmit data.
18	I	AD In	10 bit Analog Data Input
19	O	DA Out	10 bit Analog Data Output
20	O	IN_RANGE	In Range – Active Low when a Client radio is in range of a Server on same Channel with the same System ID. Always Low on a Server.

I = Input to the transceiver   O = Output from the transceiver

[1] When ordered with a RS-485 interface.

3.2 Electrical Specifications

Table 2 – Input Voltage Characteristics (AC4490/AC4486 500mW)

Pin	Type	Name	High Min.	High Max.	Low Min.	Low Max.	Unit
2,3	I/O	RS485A/B					V
3	I	RXD	2.31	3.3	0	0.99	V
4	I	GI0	2.31	3.3	0	0.99	V
8	I	RTS	2.31	3.3	0	0.99	V
12	I	9600_Baud	2.31	3.3	0	0.99	V
14	I	GI1	2.31	3.3	0	0.99	V
15	I	UP_RESET	0.8	3.3	0	0.6	V
17	I	Command/Data	2.31	3.3	0	0.99	V
18	I	AD In	N/A	3.3	0	N/A	V

Table 3 – Input Voltage Characteristics (All Others)

Pin	Type	Name	High Min.	High Max.	Low Min.	Low Max.	Unit
2,3	I/O	RS485A/B					V
3	I	RXD	2	5.5	0	0.8	V
4	I	GI0	2	5.5	0	0.8	V
8	I	RTS	2	5.5	0	0.8	V
12	I	9600_Baud	2	5.5	0	0.8	V
14	I	GI1	2	5.5	0	0.8	V
15	I	UP_RESET	0.8	5	0	0.6	V
17	I	Command/Data	2	5.5	0	0.8	V
18	I	AD In	N/A	3.3	0	N/A	V

Table 4 – Output Voltage Characteristics (All)

Pin	Type	Name	High Min.	Low Max.	Unit
1	O	GO0	2.5 @ 8mA	0.4 @ 8mA	V
2	O	TXD	2.5 @ 2mA	0.4 @ 2mA	V
2,3	I/O	RS485A/B			V
6	O	Hop Frame	2.5 @ 2mA	0.4 @ 2mA	V
7	O	CTS	2.5 @ 2mA	0.4 @ 2mA	V
9	O	GO1	2.5 @ 2mA	0.4 @ 2mA	V
13	O	RSSI	See Figure 1	See Figure 1	V
19	O	AD Out	N/A	N/A	V[2]
20	O	IN_RANGE	2.5 @ 2mA	0.4 @ 2mA	V

[2] AD Out is an unbuffered, high impedance output and **must be buffered** by the OEM Host when used.

3.3 SYSTEM TIMING

Care should be taken when selecting transceiver architecture as it can have serious effects on data rates, latency timings, and overall system throughput. The importance of these three characteristics will vary from system to system and should be a strong consideration when designing the system.

3.3.1 Serial Interface Data Rate

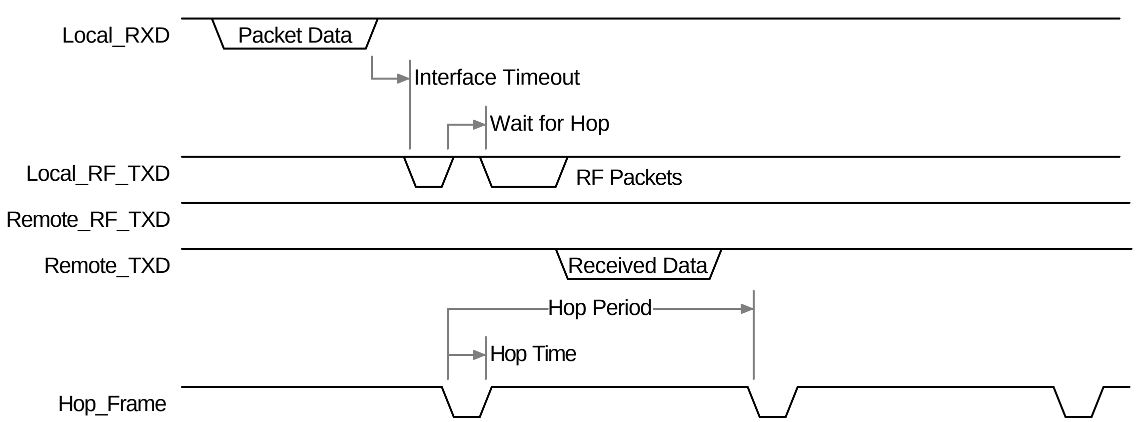
The Serial Interface Data Rate is programmable by the Host. This is the rate the Host and transceiver communicate over the serial bus. Possible values range from 1200 bps to 115,200 bps. The following asynchronous serial data formats are supported:

Table 5 – Supported Serial Formats

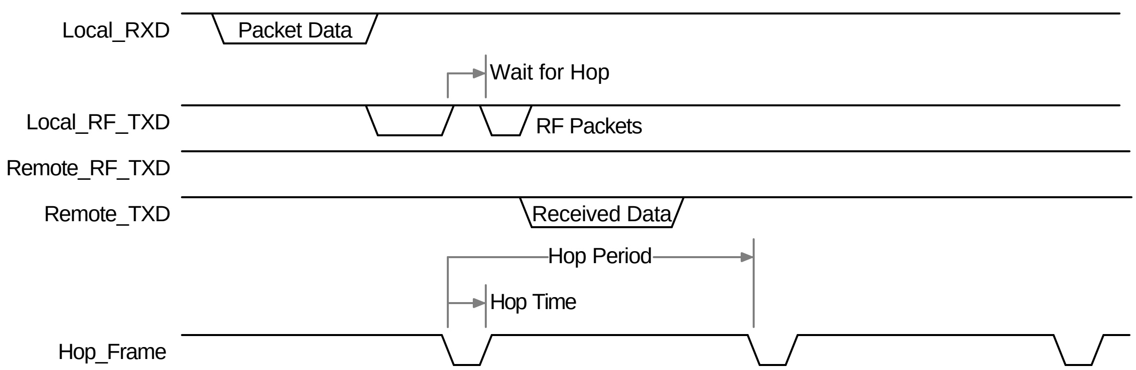
Data Bits	Parity	Minimum Stop Bits Required	Radio Programming Requirements
8	N	1	Parity Mode disabled
8	E,O,M,S	1	Parity Mode enabled
7	E,O,M,S	1	Parity Mode disabled

3.3.2 Timing Diagrams

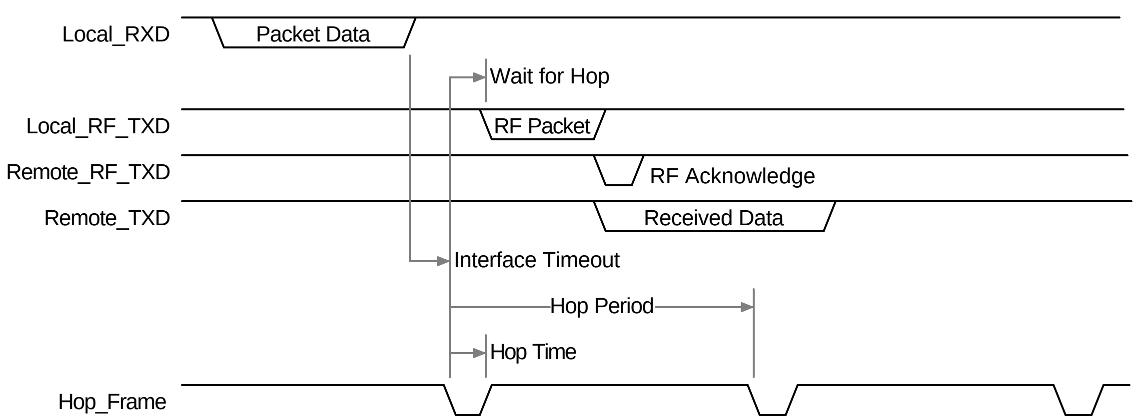
Stream Mode with Interface Timeout:



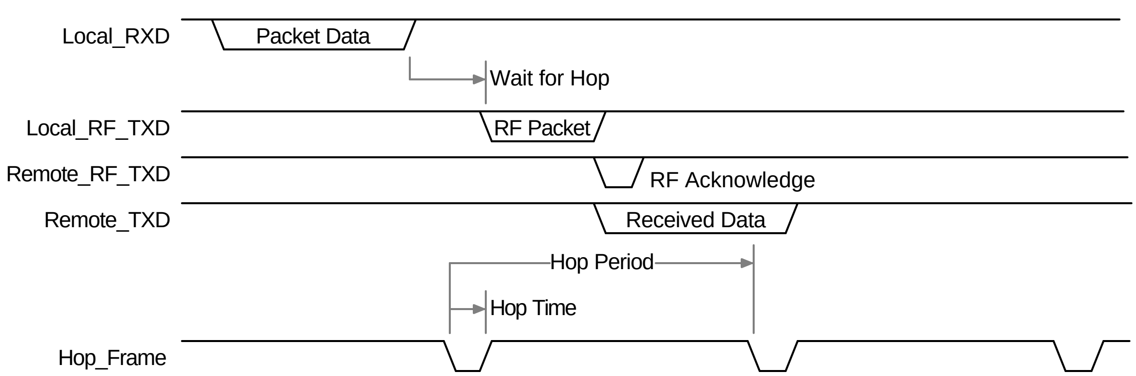
Stream Mode with Fixed Packet Length:



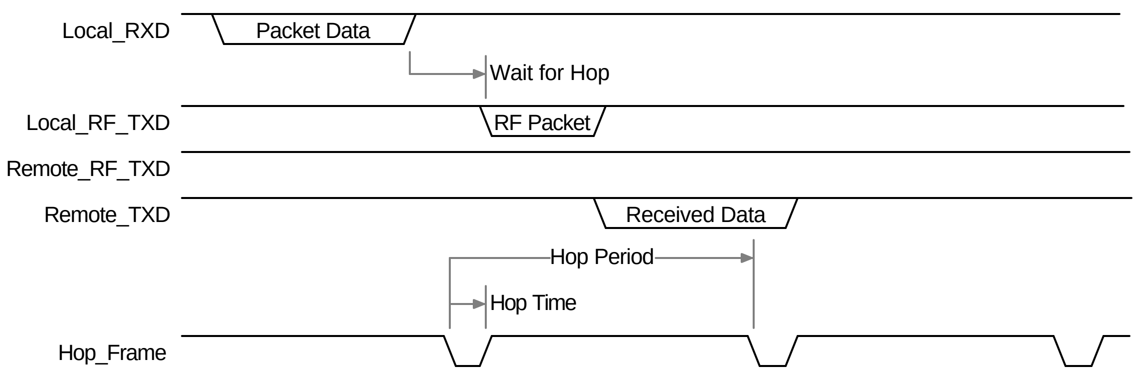
Addressed Acknowledge Mode with Interface Timeout:



Addressed Acknowledge Mode with No Interface Timeout:



Broadcast Acknowledge Mode with No Interface Timeout:



Broadcast Acknowledge Mode with Interface Timeout:

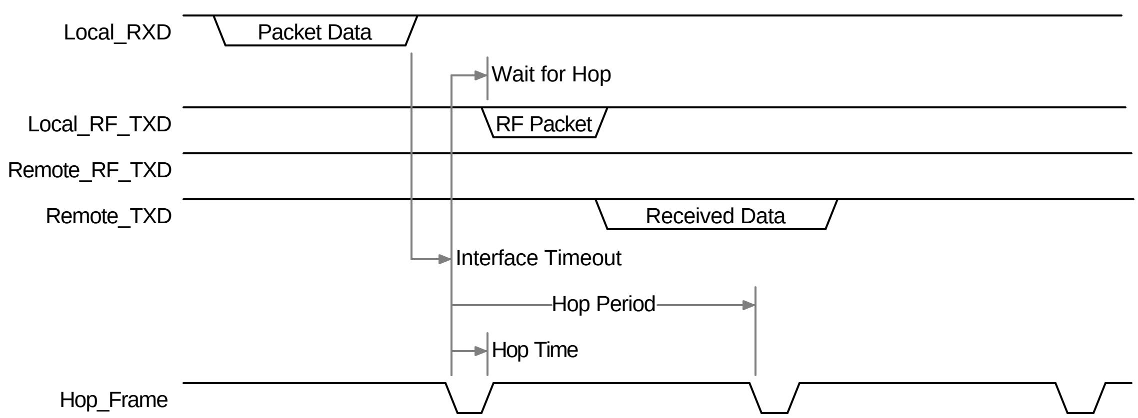


Table 6 – Timing Parameters

Parameter	Typical Time (ms)
Hop Time	1
Hop Period	20

3.3.3 Maximum Overall System Throughput

When configured as shown in the table below, an AC4490/AC4486 transceiver is **capable** of achieving the listed throughput. However, in the presence of interference or at longer ranges, the transceiver might not be able to meet these specified throughputs.

Table 7 – Maximum Overall System Throughputs

RF Mode	One Beacon Mode	Throughput (bps) Half Duplex	Throughput (bps) Full Duplex
Stream	Disabled	57.6k	N/A
Acknowledge	Enabled	48k	24k
Acknowledge	Disabled	38k	19k

4. Configuring the AC4490

4.1 EEPROM PARAMETERS

A Host can program various parameters that are stored in EEPROM and become active after a power-on reset. **Table 7 - EEPROM Parameters**, gives the locations and descriptions of the parameters that can be read or written by a Host. Factory default values are also shown. **Do not write to any EEPROM addresses other than those listed below. Do not copy a transceiver's EEPROM data to another transceiver. Doing so may cause the transceiver to malfunction.**

Table 8 – EEPROM Parameters

Parameter	EEPROM Address	Length (Bytes)	Range	Default	Description
Product ID	00h	40			40 bytes - Product identifier string. Includes revision information for software and hardware.
Sub Hop Adjust	36h	1	00 – FFh	66h	This value should only be changed when recommended by Aerocomm
Range Refresh	3Dh	1	00 – FFh	18h	This byte specifies the maximum amount of time a transceiver will report In Range without having heard a beacon (320ms per increment). 0h is actually 256 * 320ms.
Channel Number	40h	1	00 – 39h	00h	Set 0 = 00 – 0Fh (US/Canada) – AC4490 Set 1 = 10 – 2Fh (US/Canada) – AC4490 Set 2 = 30 – 37h (Australia) – AC4490 Set 3 = 38h (Europe 500mW) – AC4486 Set 4 = 39h (Europe 5mW) – AC4486
Server/Client Mode	41h	1	01 – 02h	02h	01h = Server 02h = Client
Baud Rate Low	42h	1	00 – FFh	FCh	Low Byte of the interface baud rate.
Baud Rate High	43h	1	00h	00h	Always 00h

Parameter	EEPROM Address	Length (Bytes)	Range	Default	Description
Control 0	45h	1		00010100b (14h)	Settings are: Bit 7 – One Beacon 0 = Beacon every hop 1 = Beacon once per hop cycle Bit 6 – **AeroComm Use Only** Bit 5 – Sync to Channel 0 = Don't Sync to Channel 1 = Sync to Channel Bit 4 – **AeroComm Use Only** Bit 3 – **AeroComm Use Only** Bit 2 – RF Mode 0 = RF Stream Mode 1 = RF Acknowledge Mode Bit 1 – RF Delivery 0 = Addressed 1 = Broadcast Bit 0 – **AeroComm Use Only**
Frequency Offset	46h	1	00 – FFh	01h	Protocol parameter used in conjunction with Channel Number.
Transmit Retries	4Ch	1	01 – FFh	10h	Maximum number of times a packet is sent out in Addressed Acknowledge mode.
Broadcast Attempts	4Dh	1	01 – FFh	04h	Number of times a packet is sent out in Broadcast Acknowledge mode.
API Control	56h	1		01000011b (43h)	Settings are: Bit 7 – **AeroComm Use Only** Bit 6 – **AeroComm Use Only** Bit 5 – Unicast Only 0 = Receive Unicast and Broadcast packets 1 = Only receive Unicast packets Bit 4 – Auto Destination 0 = Use Destination Address 1 = Set Destination to Server Bit 3 – **AeroComm Use Only** Bit 2 – RTS Enable 0 = RTS Ignored 1 = Transceiver obeys RTS Bit 1 – Duplex Mode 0 = Half Duplex 1 = Full Duplex Bit 0 – Auto Config 0 = Use EEPROM values 1 = Auto Configure Values
Interface Timeout	58h	1	02 – FFh	04h	Specifies a byte gap timeout, used in conjunction with RF Packet Size, to determine when a packet is complete (0.5ms per increment).
Sync Channel	5Ah	1	00 – 3Fh	01h	Used to synchronize the hopping of collocated systems to minimize interference.

Parameter	EEPROM Address	Length (Bytes)	Range	Default	Description
RF Packet Size	5Bh	1	01 – FFh	46h	Specifies the maximum size of an RF packet.
CTS On	5Ch	1	01 – FFh	D2h	CTS will be deasserted (High) when the transmit buffer contains at least this many characters.
CTS On Hysteresis	5Dh	1	00 – FEh	ACh	Once CTS has been deasserted, CTS will be reasserted (Low) when the transmit buffer contains this many or less characters.
Max Power	63h	1	00 – FFh	60h	Used to increase or decrease transmit power output.
Modem Mode	6Eh	1	E3h, FFh	FFh	E3h = Enable Modem Mode FFh = Disable Modem Mode
Parity Mode	6Fh	1	E3h, FFh	FFh	E3h = Enable Parity Mode FFh = Disable Parity Mode
RS-485 DE	7Fh	1	E3h, FFh	FFh	E3h = GO0 is active Low DE for control of external RS-485 hardware. FFh = Disable RS-485 DE mode
Destination ID	70h	6			Specifies destination for RF packets.
System ID	76h	1	00 – FFh	01h	Similar to a network password.
MAC ID	80h	6			Unique IEEE MAC Address.

4.2 EEPROM CONFIGURATION COMMANDS

The configuration set allows the Host to modify the operation of the transceiver. If the Command/Data pin (Pin 17) is pulled logic Low, a transceiver will interpret incoming Host data as Command Data. The Host can then read and write parameters using the various configuration commands listed below. To exit Configuration Mode, the Host must perform a hardware or power-on reset or issue an Exit Command Mode command to the transceiver. While in Configuration Mode, the RF circuitry will be disabled.

4.2.1 EEPROM Byte Read

Upon receiving this command, a transceiver will transmit the desired data from the address requested by the Host.

Host Command:
Byte 1 = C0h
Byte 2 = Address
Byte 3 = Length (01…FFh = 1…255 bytes; 00h = 256 bytes)

Transceiver Response:
Byte 1 = C0h
Byte 2 = Address
Byte 3 = Length
Byte 4…n = Data at requested address(s)

4.2.2 EEPROM Byte Write

Upon receiving this command, a transceiver will write the data byte to the address specified but will not echo it back to the Host until the EEPROM write cycle is complete. The write can take as long as 10ms to complete. Following the write cycle, a transceiver will transmit the data byte to the Host. Multiple byte EEPROM writes are allowed up to a length of 128 bytes. An EEPROM boundary exists between addresses 7Fh and 80h. No single EEPROM write command shall write to addresses on both sides of that EEPROM boundary.

Host Command:
Byte 1 = C1h
Byte 2 = Address
Byte 3 = Length (01 – 80h)
Byte 4…n = Data to store at Address

Transceiver Response:
Byte 1 = C1h
Byte 2 = Address
Byte 3 = Length (01 – 80h)
Byte 4 = Last data byte written by this command

4.2.3 EEPROM Exit Configuration Mode Command

The OEM Host can cause the transceiver to exit Configuration Mode by issuing the Exit Configuration Mode command to the transceiver. **However, the transceiver will not reflect any of the changes programmed into the EEPROM until the transceiver is reset.**

Host Command:
Byte 1 = 56h

Transceiver Response:
Byte 1 = 56h

4.3 AC4490 AT COMMANDS

The AT Command mode implemented in AC4490 firmware version 3.2 and higher creates a virtual version of the Command/Data line. The Enter AT Command mode command asserts this virtual line Low (to signify Command mode) and the Exit AT Command mode command asserts this virtual line High (to signify Data mode). Once this line has been asserted Low, all on-the-fly CC Commands documented in the manual are supported.

When in AT Command mode, the transceiver will maintain synchronization with the network, but RF packets will not be received. However, an ambiguity of approximately 10ms exists where, if the Enter AT Command mode command has been sent to the transceiver at the same time an RF packet is being received, the RF packet could be sent to the OEM Host before the AT Command mode command response is sent to the host.

4.3.1 Enter AT Command Mode

Prior to sending the Enter AT Command mode command to the transceiver, the host must ensure that the RF transmit buffer of the transceiver is empty (if the buffer is not empty, the Enter AT Command Mode command will be interpreted as packet data and transmitted out over the RF). This can be accomplished by waiting up to one second between the last transmit packet and the AT Command. The host must also ensure that the Fixed Packet Length for the transceiver is set to a minimum of six. The Enter AT Command Mode command is as follows:

Host Command:
AT+++?

Hexadecimal Representation of the Command:
41h, 54h, 2Bh, 2Bh, 2Bh, 0Dh

Transceiver Response:
CCh COM

Hexadecimal Representation of the Command:
CCh, 43h, 4Fh, 4Dh

4.3.2 Exit AT Command Mode

To exit AT Command mode, the OEM host should send the following command to the transceiver:

Host Command:

CCh ATO?

Hexadecimal Representation of the Command:

CCh, 41h, 54h, 4Fh, 0Dh

Transceiver Response:

CCh DAT

Hexadecimal Representation of the Command:

CCh, 44h, 41h, 54h

4.4 ON-THE-FLY CONTROL COMMAND REFERENCE (CC COMMAND MODE)

The AC4490/AC4486 transceiver contains static memory that holds many of the parameters that control the transceiver operation. Using the "CC" command set allows many of these parameters to be changed during system operation. Because the memory these commands affect is static, when the transceiver is reset, these parameters will revert back to the settings stored in the EEPROM. **Note: Do not to modify undocumented static addresses as undesired operation may occur. All "CC" commands must be issued from the Host to the transceiver with Command/Data (Pin 17) pulled logic Low. To exit "CC" mode, simply take the Command/Data pin High.**

While in CC Command mode, the RF interface of the radio is still active. Therefore, it can receive packets from remote radios while in CC Command mode and forwards these to the OEM Host. The transceiver uses **Interface Timeout** to determine when a CC Command is complete. Therefore, there should be no delay between each character as it is sent from the OEM Host to the transceiver or the transceiver will not recognize the command and will enter Configuration Mode by default. If the OEM Host has sent a CC Command to the transceiver and a RF packet is received by the transceiver, the transceiver will send the CC Command response to the OEM Host before sending the packet. However, if a RF packet is received before the Interface Timeout expires on a CC Command, the transceiver will send the packet to the host before sending the CC Command response.

4.4.1 Status Request

The Host issues this command to request the status of the transceiver.

Host Command:

Byte 1 = CCh
Byte 2 = 00h
Byte 3 = 00h

Transceiver Response:

Byte 1 = CCh
Byte 2 = Firmware version number
Byte 3 = Data1

Where:

Data1 =
- 00 for Server in Normal Operation
- 01 for Client in Normal Operation
- 02 for Server in Acquisition Sync
- 03 for Client in Acquisition Sync

4.4.2 Change Channel without Forced Acquisition Sync

The Host issues this command to change the channel of the transceiver. The transceiver will not begin acquisition sync until its Range Refresh timer expires; therefore it is recommended that the host uses the Change Channel with Forced Acquisition Sync Command.

Host Command:

Byte 1 = CCh
Byte 2 = 01h
Byte 3 = RF Channel Number (Hexadecimal)

Transceiver Response:

Byte 1 = CCh
Byte 2 = RF Channel Number (Hexadecimal)

4.4.3 Change Channel with Forced Acquisition Sync

The Host issues this command to change the channel of the transceiver and force the transceiver to immediately begin synchronization.

Host Command:

Byte 1 = CCh
Byte 2 = 02h
Byte 3 = RF Channel Number (Hexadecimal)

Transceiver Response:

Byte 1 = CCh
Byte 2 = RF Channel Number (Hexadecimal)

4.4.4 Server/Client Command

The Host issues this command to change the mode (Server or Client) of the transceiver and can force the transceiver to actively begin synchronization. The transceiver will not begin acquisition sync until its Range Refresh timer expires; therefore it is recommended that the host uses the commands which force acquisition sync.

Host Command:

Byte 1 = CCh
Byte 2 = 03h
Byte 3 = Data1

Where:

Data1 =
- 00 for Server in Normal Operation
- 01 for Client in Normal Operation
- 02 for Server in Acquisition Sync
- 03 for Client in Acquisition Sync

Transceiver Response:

Byte 1 = CCh
Byte 2 = Software Version Number
Byte 3 = Data1

Where:

Data1 = Data1 from Host Command

4.4.5 Sync to Channel Command

The Host issues this command to change the **Sync Channel** byte and enable **Sync to Channel**.

Host Command:

Byte 1 = CCh
Byte 2 = 05h
Byte 3 = Data1

Where:

Data1 = New Sync Channel

Transceiver Response:

Byte 1 = CCh
Byte 2 = 05h
Byte 3 = Data1

Where:

Data1 = Data1 from Host Command

4.4.6 Sleep Walk Power-Down Command

After the Host issues the power-down command to the transceiver, the transceiver will de-assert the In_Range line after entering power-down. A Client transceiver in power-down will remain in sync with a Server for a minimum of 2 minutes. To maintain synchronization with the Server, this Client transceiver should re-sync to the Server at least once every 2 minutes. This re-sync is accomplished by issuing the **Power-Down Wake-Up Command** and waiting for the In Range line to go active. Once this occurs, the Client transceiver is in sync with the Server and can be put back into power-down. This command is only valid for Client radios.

Host Command:
Byte 1 = CCh
Byte 2 = 06h

Transceiver Response:
Byte 1 = CCh
Byte 2 = RF Channel Number

4.4.7 Sleep Walk Power-Down Wake-Up Command

The Power-Down Wake-Up Command is issued by the Host to bring the transceiver out of power-down mode.

Host Command:
Byte 1 = CCh
Byte 2 = 07h

Transceiver Response:
Byte 1 = CCh
Byte 2 = RF Channel Number

4.4.8 Broadcast Mode

The Host issues this command to change the transceiver operation between **Addressed Mode** and **Broadcast Mode**. If addressed mode is selected the transceiver will send all packets to the radio designated by the **Destination Address** programmed in the transceiver.

Host Command:
Byte 1 = CCh
Byte 2 = 08h
Byte 3 = 00 for addressed mode, 01 for broadcast mode

Transceiver Response:
Byte 1 = CCh
Byte 2 = 00 for addressed mode, 01 for broadcast mode

4.4.9 Read Static Bank #1 Byte

The OEM Host issues this command to the transceiver to read Static Bank #1 Bytes. Static Bank #1 is a bank of memory that holds many of the parameters that control the radio. Using the Read/Write Static Bank #1 command allows these parameters to be changed dynamically. Because the memory bank is static, when the radio is reset, these parameters will revert back to the settings stored in EEPROM. Be careful not to change undocumented Static Bank addresses as undesired operation may occur.

Host Command:
Byte 1 = CCh
Byte 2 = 0Ah
Byte 3 = 00 – FFh corresponding to a valid Static Bank #1 address

Transceiver Response:
Byte 1 = CCh
Byte 2 = 00 – FFh corresponding to a valid Static Bank #1 address

4.4.10 Write Static Bank #1 Byte

The Host issues this command to the transceiver to write Static Bank #1 Bytes. Static Bank #1 is a bank of memory that holds many of the parameters that control the radio. Using the Read/Write Static Bank #1 command allows these parameters to be changed dynamically. Because the memory bank is static, when the radio is reset, these parameters will revert back to the settings stored in EEPROM. Be careful not to change undocumented Static Bank addresses as undesired operation may occur.

Host Command:
Byte 1 = CCh
Byte 2 = 0Bh
Byte 3 = 00 – FFh corresponding to a valid Static Bank #1 address
Byte 4 = 00 – FFh corresponding to new value for address specified by Byte 3

Transceiver Response:
Byte 1 = CCh
Byte 2 = 00 – FFh corresponding to a valid Static Bank #1 address
Byte 3 = 00 – FFh corresponding to new value for address specified by Byte 2

4.4.11 Read Static Bank #2 Byte

The Host issues this command to the transceiver to read Static Bank #2 Bytes. Static Bank #2 is a bank of memory that holds many of the parameters that control the radio. Using the Read/Write Static Bank #2 command allows these parameters to be changed dynamically. Because the memory bank is static, when the radio is reset, these parameters will revert back to the settings stored in EEPROM. Be careful not to change undocumented Static Bank addresses as undesired operation may occur.

Host Command:
Byte 1 = CCh
Byte 2 = 0Ch
Byte 3 = 00 – FFh corresponding to a valid Static Bank #2 address

Transceiver Response:
Byte 1 = CCh

Byte 2 = 00 – FFh corresponding to a valid Static Bank #2 address

4.4.12 Write Static Bank #2 Byte

The Host issues this command to the transceiver to write Static Bank #2 Bytes. Static Bank #2 is a bank of memory that holds many of the parameters that control the radio. Using the Read/Write Static Bank #2 command allows these parameters to be changed dynamically. Because the memory bank is static, when the radio is reset, these parameters will revert back to the settings stored in EEPROM. Be careful not to change undocumented Static Bank addresses as undesired operation may occur.

Host Command:
Byte 1 = CCh
Byte 2 = 0Dh
Byte 3 = 00 – FFh corresponding to a valid Static Bank #2 address
Byte 4 = 00 – FFh corresponding to new value for address specified by Byte 3

Transceiver Response:
Byte 1 = CCh
Byte 2 = 00 – FFh corresponding to a valid Static Bank #2 address
Byte 3 = 00 – FFh corresponding to new value for address specified by Byte 2

4.4.13 Write Destination Address

The Host issues this command to the transceiver to change the Destination Address. This is a **very powerful** command that provides the OEM Host with a means for ad-hoc networking. **Only the three Least Significant Bytes of the MAC Address are used for packet delivery.**

Host Command:
Byte 1 = CCh
Byte 2 = 10h
Bytes 3 – 5 = 00 – FFh corresponding the three LSB's of the destination MAC Address

Transceiver Response:
Byte 1 = CCh
Bytes 2 – 4 = 00 – FFh corresponding the three LSB's of the destination MAC Address

4.4.14 Read Destination Address

The Host issues this command to the transceiver to read the Destination Address. This is a **very powerful** command that provides the OEM Host with a means for ad-hoc networking. **Only the three Least Significant Bytes of the MAC Address are used for packet delivery.**

Host Command:
Byte 1 = CCh
Byte 2 = 11h

Transceiver Response:
Byte 1 = CCh
Bytes 2 – 4 = 00 – FFh corresponding the three LSB's of the destination MAC Address

4.4.15 Read Digital Inputs

The Host issues this command to read both digital input lines.

Host Command:
Byte 1 = CCh
Byte 2 = 20h

Transceiver Response:
Byte 1 = CCh
Byte 2 = Data1

Where:
Data1 = bit 0 – GI0, bit 1 – GI1

4.4.16 Read ADC

The Host issues this command to read any of the three onboard A/D converters. The equations for converting these 10 bits into an analog value and subsequent temperature are as follows:

Analog Voltage = (10 bits / 3FFh) * 3.3V

Temperature (°C) = ((Analog Voltage - 0.3) / 0.01) - 30

Host Command:
Byte 1 = CCh
Byte 2 = 21h
Byte 3 = Data1

Where:
Data1 = 00h – AD In, 01h – Temperature (if equipped), 02h – RSSI

Transceiver Response:
Byte 1 = CCh
Byte 2 = Data1
Byte 3 = Data2

Where:
Data1 = MSB of requested 10 bit ADC value
Data2 = LSB of requested 10 bit ADC value

4.4.17 Report Last Valid RSSI

As RSSI values are only valid when the local radio is receiving a RF packet from a remote radio, instantaneous RSSI can be very tricky to use. Therefore, the transceiver stores the most recent valid RSSI value. The Host issues this command to request that value. Note: This value will default to FFh on a Client and 00h on a Server if no valid RSSI measurement has been made since power-up. To convert this byte into an analog voltage, the following equation should be used:

8 bit RSSI Voltage = (8 bits / FFh) * 3.3V

Host Command:
Byte 1 = CCh
Byte 2 = 22h

Transceiver Response:
Byte 1 = CCh
Byte 2 = Data1

Where:
Data1 = Most significant 8 bits of last valid RSSI reading.

4.4.18 Write Digital Outputs

The Host issues this command to write both digital output lines to particular states.

Host Command:
Byte 1 = CCh
Byte 2 = 23h
Byte 3 = Data1

Where:
Data1 = bit 0 – GO0, bit 1 – GO1

Transceiver Response:
Byte 1 = CCh
Byte 2 = Data1

Where:
Data1 = Data1 from Host command

4.4.19 Write DAC

The Host issues this command to write DA Out to a particular voltage. NOTE: DA Out is an unbuffered, high impedance output and **must be buffered** by the OEM Host when used. The transceiver uses a PWM (Pulse Width Modulator) to generate the analog voltage. The theory behind PWM is that a binary pulse is generated with a fixed duty cycle and rate. As such, this pin toggles between High and Low. This signal is filtered via an onboard R-C circuit and an analog voltage is generated. Duty Cycle specifies the ratio of time in one cycle that the pulse spends High proportionate to the amount of time it spends Low. So, with a duty cycle of 50% (80h), the pulse is High 50% of the time and Low 50% of the time; therefore the analog voltage would be half of 3.3V or 1.15V. A broad filter has been implemented on the transceiver and there is no advantage to using a slower update period. Generally, a faster update period is preferred.

Host Command:

Byte 1 = CCh
Byte 2 = 24h
Byte 3 = Data1
Byte 4 = Data2

Where:

Data1 = Update Period where: T_{Update} = (255 * (Data1 + 1)) / 14.7256^{+06}
Data2 = Duty Cycle where: Vout = (Data2 / FFh) * 3.3V

Transceiver Response:

Byte 1 = CCh
Byte 2 = Data1
Byte 3 = Data2

Where:

Data1 = Data1 from Host Command
Data2 = Data2 from Host Command

4.4.20 Set Max Power

The Host Issues this command to limit the maximum transmit power emitted by the transceiver. This can be useful to minimize current consumption and satisfy certain regulatory requirements.

Host Command:

Byte 1 = CCh
Byte 2 = 25h
Byte 3 = Data1

Where:

Data1 = New **Max Power**

Transceiver Response:

Byte 1 = CCh
Byte 2 = Data1

Where:

Data1 = Data1 from Host Command

4.4.21 Transmit Buffer Empty

The Host issues this command to determine when the RF Transmit buffer is empty. The Host will not receive the transceiver response until that time.

Host Command:
Byte 1 = CCh
Byte 2 = 30h

Transceiver Response:
Byte 1 = CCh
Byte 2 = 00h

4.4.22 Disable Sync to Channel

The Host issues this command to disable Sync to Channel mode.

Host Command:
Byte 1 = CCh
Byte 2 = 85h

Transceiver Response:
Byte 1 = CCh
Byte 2 = RF Channel Number

4.4.23 Deep Sleep Mode

The Host issues this command to put the transceiver into Deep Sleep mode. Once in Deep Sleep, the transceiver disables all RF communications and will not respond to any further commands until being reset or power cycled. This command is valid for both Servers and Clients.

Host Command:
Byte 1 = CCh
Byte 2 = 86h

Transceiver Response:
Byte 1 = CCh
Byte 2 = RF Channel Number

4.4.24 Reset Command

The Host issues this command to perform a soft reset of the transceiver. Any transceiver settings modified by CC Commands will be overwritten by values stored in the EEPROM.

Host Command:
Byte 1 = CCh
Byte 2 = FFh

Transceiver Response:
There is no response from the transceiver

5. Theory of Operation

5.1 HARDWARE INTERFACE

Below is a description of all hardware pins used to control the AC4490.

5.1.1 GIn (Generic Inputs 0 and 1) (pins 4 and 14 respectively) and GOn (Generic Outputs 0 and 1) (pins 1 and 9 respectively)

Both GIn pins serve as generic input pins. Both GOn pins serve as generic output pins. Reading and writing of these pins can be performed using CC Commands (details can be found in the ***On-the-Fly Control Command Reference***). These pins alternately serve as control pins when Modem Mode is enabled in the EEPROM.

5.1.2 TXD (Transmit Data) and RXD (Receive Data) (pins 2 and 3 respectively)

Serial TTL

The AC4490/AC4486 accepts 3.3 or 5VDC TTL level asynchronous serial data (the 500mW radio ONLY accepts 3.3V level signals) on the RXD pin and interprets that data as either Command Data or Transmit Data. Data is sent from the transceiver to the OEM Host via the TXD pin.

RS-485

When equipped with an onboard RS-485 interface chip, TXD and RXD become the half duplex RS-485 pins. In this mode, the transceiver will be in listen mode except when it has data to send to the OEM host. TXD is the noninverted representation of the data and RXD is a mirror image of TXD. The transceiver will still use RTS (if enabled) in this mode.

5.1.3 Hop Frame (pin 6)

The AC4490 is a frequency hopping spread spectrum radio. Frequency hopping allows the system to hop around interference in order to provide a better wireless link. Hop Frame transitions logic Low at the start of a hop and transitions logic High at the completion of a hop. The OEM Host is not required to monitor Hop Frame. The AC4486 is a single frequency radio, though it still generates a Hop Frame signal every time it transmits a timing beacon.

5.1.4 CTS Handshaking (pin 7)

The AC4490/AC4486 has an interface buffer size of 256 bytes. If the buffer fills up and more bytes are sent to the transceiver before the buffer can be emptied, data loss will occur. The transceiver prevents this loss by asserting CTS High as the buffer fills up and taking CTS Low as the buffer is emptied. **CTS On** in conjunction with **CTS On Hysteresis** control the operation of CTS. CTS On specifies the amount of bytes that must be in the buffer for CTS to be disabled (High). Even while CTS is disabled, the OEM Host can still send data to the transceiver, but it should do so carefully. Once CTS is disabled, it will remain disabled until the buffer is reduced to the size specified by CTS On Hysteresis.

5.1.5 RTS Handshaking (pin 8)

With **RTS Mode** disabled, the transceiver will send any received packet to the OEM Host as soon as the packet is received. However, some OEM Hosts are not able to accept data from the transceiver all of the time. With RTS Mode Enabled, the OEM Host can keep the transceiver from sending it a packet by disabling RTS (logic High). Once RTS is enabled (logic Low), the transceiver can send packets to the OEM Host as they are received. **Note: Leaving RTS disabled for too long can cause data loss once the transceiver's receive buffer fills up.**

5.1.6 9600 Baud (pin 12)

9600_BAUD – When pulled logic Low before applying power or resetting, the transceiver's serial interface is forced to a 9600, 8-N-1 (8 data bits, No parity, 1 stop bit) rate. To exit, the transceiver must be reset or power-cycled with 9600_Baud logic High. This pin is used to recover transceivers from unknown baud rates only. It should not be used in normal operation. Instead the transceiver Interface Baud Rate should be programmed to 9600 baud if that rate is desired for normal operation.

5.1.7 RSSI (pin 13)

Instantaneous RSSI

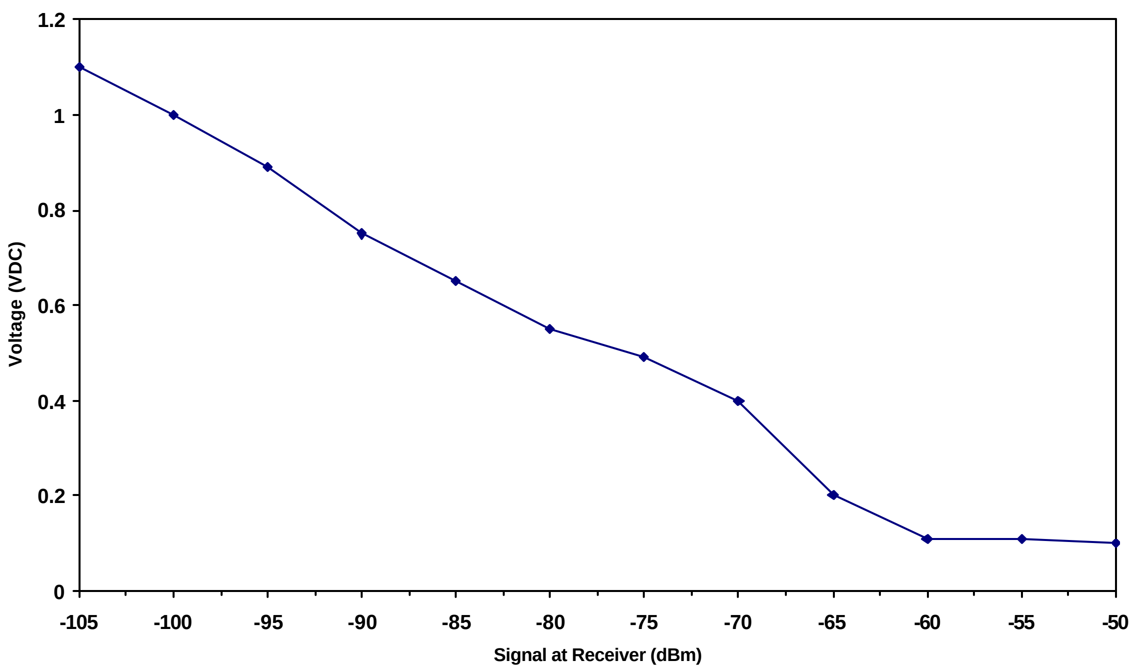
Received Signal Strength Indicator is used by the Host as an indication of instantaneous signal strength at the receiver. The Host must calibrate RSSI without a RF signal being presented to the receiver. Calibration is accomplished by following the steps listed below to find a minimum and maximum voltage value.

1) Power up only one Client (no Server) transceiver in the coverage area.
2) Measure the RSSI signal to obtain the minimum value with no other signal present.
3) Power up a Server. Make sure the two transceivers are in close proximity and measure the Client's peak RSSI once the Client reports In Range to obtain a maximum value at full signal strength.

Validated RSSI

As RSSI values are only valid when the local radio is receiving a RF packet from a remote radio, instantaneous RSSI can be very tricky to use. Therefore, the transceiver stores the most recent valid RSSI value. The Host issues the ***Report Last Good RSSI*** command to request that value (details can be found in the ***On-the-Fly Control Command Reference***). Validated RSSI is not available at the RSSI pin.

Figure 1 – RSSI Voltage vs. Received Signal Strength



5.1.8 UP_Reset (pin 15)

UP_Reset provides a direct connection to the reset pin on the AC4490/AC4486 microprocessor and is used to force a soft reset. To guarantee a valid power-up reset, this pin should never be tied Low on power-up. For a valid power-on reset, reset must be High for a minimum of 10ms.

5.1.9 Command/Data (pin 17)

When logic High, the transceiver interprets incoming Host data as transmit data to be sent to other transceivers and their Hosts. When logic Low, the transceiver interprets Host data as command data **(see section 4)**.

5.1.10 AD In and DA Out (pins 18 and 19 respectively)

AD In and DA Out can be used as a cost savings to replace Analog-to-Digital and Digital-to-Analog converter hardware. Reading and writing of these two pins locally can be performed using commands found in the ***On-the-Fly Control Command Reference***. Note: DA Out is an unbuffered, high impedance output and **must be buffered** by the OEM Host when used.

5.1.11 In Range (pin 20)

The IN_RANGE pin at the connector will be driven logic Low when a Client is in range of a Server on the same **RF Channel** and **System ID**. If a Client cannot hear a Server for the amount of time specified by **Range Refresh**, it will drive the IN_RANGE pin logic High and enter a search mode looking for a Server. As soon as it detects a Server, the IN_RANGE pin will be driven logic Low. A Server Host can determine which Clients are in range by the Server's Host software polling a Client's Host. IN_RANGE will always be Low on the Server.

5.2 Software Parameters

Following is a description of all software parameters used to control the AC4490.

5.2.1 RF Architecture (Unicast/Broadcast)

The Server controls the system timing by sending out regular beacons (transparent to the transceiver Host) which contain system timing information. This timing information synchronizes the Client radios to the Server.

Each network should consist of only one Server. There should never be two Servers on the same **RF Channel Number** in the same coverage area as the interference between the two Servers will severely hinder RF communications.

The AC4490/AC4486 runs a Peer-to-Peer type architecture where all transceivers, whether Servers or Clients, can communicate with all other transceivers. To prohibit transceivers from receiving broadcast packets, **Unicast Only** can be enabled.

5.2.2 RF Mode

All radios located on the same network must use the same RF Mode.

RF Delivery Overview

All packets are sent out over the RF as either addressed or broadcast packets. Addressed packets are only received by the radio specified by **Destination Address**. If addressed packets are desired, the Destination Address should be programmed with the **MAC ID** of the destination radio. To simplify EEPROM programming, **Auto Destination** can be enabled in Clients which allows the Client to automatically set its Destination Address to the address of the Server. Broadcast packets are sent out to every eligible transceiver on the network. If broadcast packets are desired, **RF Delivery** should be set to Broadcast.

Acknowledge Mode

In Addressed Acknowledge Mode, the RF packet is sent out to the receiver designated by the **Destination Address**. **Transmit Retries** is used to increase the odds of successful delivery to the intended receiver. Transparent to the OEM Host, the sending transceiver will send the RF packet to the intended receiver. If the receiver receives the packet free of errors, it will tell the sender. If the sender does not receive this acknowledge, it will assume the packet was never received and retry the packet. This will go on until the packet is successfully received or the transmitter exhausts all of its retries. The received packet will only be sent to the OEM Host if and when it is received free of errors.

In Broadcast Acknowledge Mode, the RF packet is broadcast out to all eligible receivers on the network. **Broadcast Attempts** is used to increase the odds of successful delivery to the intended receiver(s). Transparent to the OEM Host, the sending transceiver will send the RF packet to the intended receiver. If the receiver detects a packet error, it will throw out the packet. This will go on until the packet is successfully received or the transmitter exhausts all of its attempts. Once the receiver successfully receives the packet it will send the packet to the OEM Host. It will throw out any duplicates caused by further Broadcast Attempts. The received packet will only be sent to the OEM Host if it is received free of errors.

Stream Mode

In Broadcast Stream mode, the RF packet is broadcast out to all eligible receivers on the network. In Addressed Stream Mode, the RF packet is sent out to the receiver designated by the **Destination Address**. The sending transceiver will send each RF packet out once. There are no retries on the packet. Whether or not the packet contains errors, the receiver(s) will send the packet to the OEM Host. In fact, if only part of the packet is able to be received, the transceiver will still send the partial packet to the OEM Host. **Note: Stream Mode is incompatible with Full Duplex Mode.**

5.2.3 Sub Hop Adjust

Sub Hop Adjust is an AC4490/AC4486 protocol parameter and should only be modified at the recommendation of Aerocomm.

5.2.4 Duplex Mode

In Half Duplex mode, the AC4490/AC4486 will send a packet out over the RF when it can. This can cause packets sent at the same time by a Server and a Client to collide with each other over the RF. To prevent this, Full Duplex Mode can be enabled. This mode restricts Clients to transmitting on odd numbered frequency "bins" and the Server to transmitting on even frequency bins. Though the RF hardware is still technically half duplex, it makes the radio seem full duplex. This can cause overall throughputs to be cut in half. **Note: All transceivers on the same network must have the same setting for Full Duplex. Full Duplex mode is incompatible with Stream RF mode.**

5.2.5 Interface Timeout/RF Packet Size

Interface Timeout, in conjunction with **RF Packet Size**, determines when a buffer of data will be sent out over the RF as a complete RF packet based on whichever condition occurs first.

Interface Timeout – Interface Timeout specifies a maximum byte gap between consecutive bytes. When that byte gap is exceeded, the bytes in the transmit buffer are sent out over the RF as a complete packet. Interface timeout is adjustable in 1ms increments and has a tolerance of ?1ms. Therefore, the Interface Timeout should be set to a minimum of 2. The default value for Interface Timeout is 4 or 4ms.

RF Packet Size – When the amount of bytes in the transceiver transmit buffer equals RF Packet Size, those bytes are sent out as a complete RF packet. Every packet the transceiver sends over the RF contains extra header bytes not counted in the RF Packet Size. Therefore, it is much more efficient to send a few large packets than to send many short packets. However, if RF Packet size is set too large and Acknowledge Mode is enabled, the transceiver will not be able to send any packets because Acknowledge Mode requires the entire RF packet to be sent in the same hop whereas Stream Mode packets can span multiple hops.

5.2.6 Serial Interface Baud Rate

This two-byte value determines the baud rate used for communicating over the serial interface to a transceiver. **Table 8 - Baud Rate/Timeout** lists values for some common baud rates. Baud rates below 1200 baud are not supported. For a baud rate to be valid, the calculated baud rate must be within ?3% of the OEM Host baud rate. **If the 9600_BAUD pin (Pin 12) is pulled logic Low at reset, the baud rate will be forced to 9,600.** For Baud Rate values other than those shown in **Table 5 - Baud Rate**, the following equation can be used:

BAUD = 100h - (14.7456E^{+06} / (64 * desired baud rate))

BaudH= Always 0
BaudL = Low 8 bits of BAUD (base16)

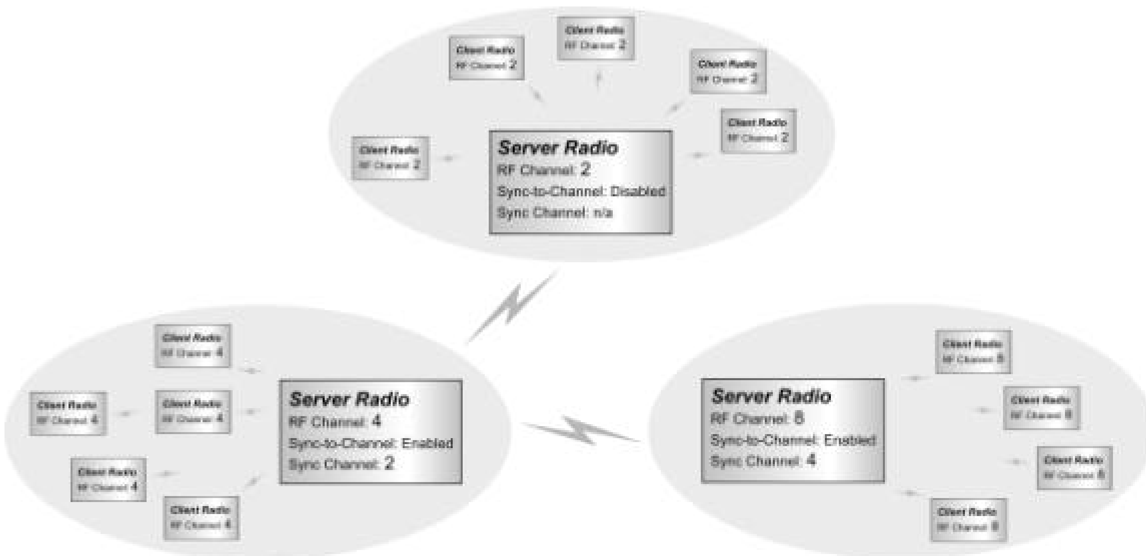
Table 9 – Baud Rate/Interface Timeout

Baud Rate	BaudL (42h)	BaudH (43h)	Minimum Interface Timeout (58h)
115,200	FEh	00h	02h
57,600	FCh	00h	02h
38,400	FAh	00h	02h
28,800	F8h	00h	02h
19,200	F4h	00h	02h
14,400	F0h	00h	03h
9,600	E8h	00h	03h
4800	D0h	00h	05h
2400	A0h	00h	09h
1200	40h	00h	11h

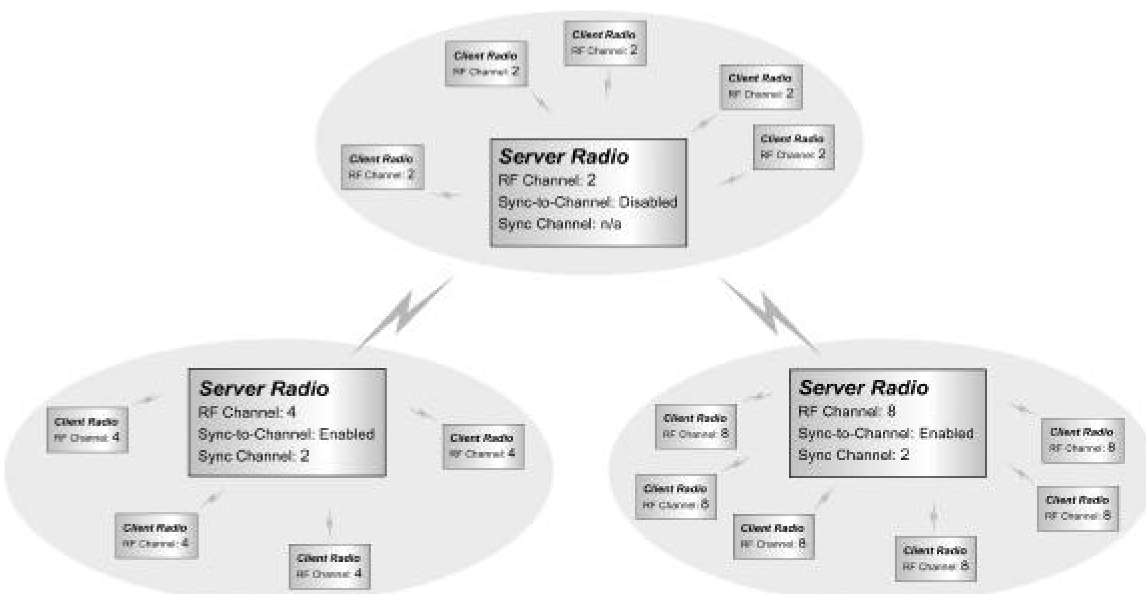
5.2.7 Network Topology

RF Channel Number – RF Channel Number provides a physical separation between collocated networks. The AC4490 is a spread spectrum frequency hopping radio with a fixed hopping sequence. Without synchronizing the different networks to each other, collocated systems on different channel numbers can interfere with each other. To avoid this kind of interference, collocated networks can use **Sync-to-Channel**. A Server radio with Sync-to-Channel enabled must have its **Sync Channel** set to another Server's RF Channel Number. It is required that a Server with Sync-to-Channel enabled must have its Sync Channel set to a value less than its RF Channel Number. **Collocated networks must use the same Channel Set.** See the Diagrams below:

Daisy-Chain Network Configuration



Centralized Network Configuration



Frequency Offset – Frequency Offset is an AC4490/AC4486 protocol parameter used in conjunction with RF Channel Number.

Table 10 – US and International RF Channel Number Settings

Channel Set	RF Channel Number Range (40h)	Frequency Details and Regulatory Requirements	Countries	Frequency Offset (46h)
0 (AC4490)	0 – 0Fh	902 – 928MHz (26 hop bins)	US/Canada	1
1 (AC4490)	10 – 2Fh	902 – 928MHz (50 hop bins)	US/Canada	N/A
2 (AC4490)	30 – 37h	915 – 928MHz	Australia	0
3 (AC4486)	38h	869.4 – 869.65MHz (Up to 500mW at 10% maximum transmit vs. receive duty cycle)	Europe	0
4 (AC4486)	39h	869.7 – 870MHz (Up to 5mW with no duty cycle requirement)	Europe	0

System ID – System ID is similar to a password character or network number and makes network eavesdropping more difficult. A receiving radio will not go in range of or communicate with another radio on a different System ID.

5.2.8 Auto Config

The AC4490/AC4486 has several variables that control its RF performance and vary by **RF Mode** and **RF Architecture**. Enabling Auto Config will bypass the value for these variables stored in EEPROM and use predetermined values for the given mode. Below is a list containing all of the variables affected by Auto Config and their respective values (values are all in hexadecimal format). When Auto Config is disabled, these values must be programmed in the radio EEPROM for the corresponding mode of operation.

Table 11 – Auto Config Parameters

Parameter (those not named are undocumented protocol parameters)	EEPROM Address	Default	Stream Mode	Acknowledge Mode	
				One Beacon Mode Disabled	One Beacon Mode Enabled
Sub Hop Adjust	36	66	A0	A0	A0
	47	0E	0E	0E	0E
	48	90	90	90	90
	4E	09	08	09	09
	53	80	N/A[3]	80	80
	54	07	07	07	07
RF Packet Size	5B	46	90	50	68
CTS On	5C	D2	C0	DC	DC
CTS On Hysteresis	5D	AC	BE	B0	B0
	5E	23	10	23	23
	5F	08	08	08	08

5.2.9 One Beacon Mode

The beacon, which is sent by the Server and contains system timing information, takes approximately 1ms to send. Due to the protocol built into the AC4490, the transceiver can maintain perfect synchronization even if it only hears a beacon once every two minutes. Normally the Server will send a beacon once every hop. Enabling One Beacon mode causes the beacon to only be sent once per complete hop cycle. Using this feature can make initial synchronization take slightly longer and can make communications more difficult if operating on the fringe but can increase net throughput.

Range Refresh – The Server sends out timing beacons at regular intervals to maintain Client synchronization. Upon hearing a beacon, a Client will be in range of the Server and will assert its IN_RANGE pin Low. Each time the Client hears a Server beacon, it resets the Range Refresh timer. If the timer ever expires the Client will be out of range, will take the IN_RANGE pin High and will enter acquisition mode trying to find the Server again. Therefore, Range Refresh specifies the maximum amount of time a Client can go without hearing a Server beacon. This variable is particularly useful when operating on fringe coverage areas. The Range Refresh timer is equal to 320ms * the value of Range Refresh. When One Beacon mode is enabled, it is recommended that Range Refresh be increased from its default setting (testing might be required to determine the appropriate setting).

[3] N/A: This parameter is not affected by Auto Config and the EEPROM value is used instead.

5.2.10 Max Power

Max Power provides a means for controlling the RF transmit output power of the AC4490/AC4486. The following table lists some common values for Max Power and their current consumption. Output power and current consumption can vary by as much as ?10% per radio. Transmit power is shown here in dBm (decibels per meter) and mW (milliwatts). The equations for converting between the two are shown below:

Power (dBm) = 10 $\log_{10}$ Power (mW)

Power (mW) = 10 ^ (Power (dBm) / 10)

able 12 – Max Power Settings for 100mW Transmitter

Max Power (Address 63h)	100% Transmit Current (mA)	Transmit Power Output(dBm)	Transmit Power Output (mW)
00h	47	-20	0.01
01h	50	-10	0.1
02h	50.5	-3	0.5
03h	52	1	1.26
04h	55	4	2.51
05h	58.5	7	5.01
06h	63.5	9	7.94
07h	69	10.5	11.22
08h	76	12	15.85
09h	83	13.5	22.39
0Ah	90.5	14.5	28.18
0Bh	97.5	15.5	35.48
0Ch	105	16.5	44.67
0Dh	111.5	17	50.12
0Eh	118	17.5	56.23
0Fh	123.5	18	63.1
1Eh	140.5	19	79.43
60h	156	20	100

Table 13 – Max Power Settings for 1000mW Transmitter

Max Power (Address 63h)	100% Transmit Current (mA)	Transmit Power Output(dBm)	Transmit Power Output (mW)
00h	310	-4.5	0.35
01h	320	6	3.98
02h	335	11.5	14.13
03h	345	14.5	28.18
04h	365	16.5	44.67
05h	395	18	63.1

06h	440	19.5	89.13
07h	485	20.5	112.2
08h	525	22.5	177.83
09h	580	23.5	223.87
0Ah	620	24	251.19
0Bh	665	24.5	281.84
0Ch	695	25	316.23
0Dh	745	25.5	354.81
0Eh	810	26	398.11
0Fh	850	26.5	446.68
1Eh	880	27	501.19
60h	985	29.5	891.25

5.2.11 Interface Options

Modem Mode – Full modem handshaking is supported by the transceivers when enabled in EEPROM. Modem Mode is incompatible with RS-485 DE mode. Because Command/Data performs an alternate function when this mode is enabled, CC on-the-fly commands cannot be used and the only way to enter Configuration Mode is by forcing 9600 baud through the 9600_BAUD pin. Therefore, modem mode, though enabled in EEPROM, will be ignored when 9600 baud is forced. Both interfaces are shown below.

Table 14 – Transceiver Interface to DCE (Server Radio)

When Interfacing the AC4490/AC4486 to a DCE (Data Communications Equipment):				
DCE Pin Number	**DCE Pin Name**	**Direction with Respect to Radio**	**AC4490/AC4486 Pin Name**	**AC4490/AC4486 Pin Number**
1	DCD	In	GI1	14
2	RXD	In	RXD	3
3	TXD	Out	TXD	2
4	DTR	Out	GO0	1
5	GND			5
6	DSR	In	Command/Data	17
7	RTS	Out	CTS	7
8	CTS	In	RTS	8
9	RI	In	GI0	4

Table 15 – Transceiver Interface to DTE (Client Radio)

When Interfacing the AC4490/AC4486 to a DTE (Data Terminal Equipment):				
DTE Pin Number	**DTE Pin Name**	**Direction with Respect to Radio**	**AC4490/AC4486 Pin Name**	**AC4490/AC4486 Pin Number**
1	DCD	Out	GO0	1
2	RXD	Out	TXD	2
3	TXD	In	RXD	3
4	DTR	In	GI0	4
5	GND			5
6	DSR	Out	Hop Frame	6
7	RTS	In	RTS	8
8	CTS	Out	CTS	7
9	RI	Out	GO1	9

RS-485 DE Control – When enabled in EEPROM, the transceiver will use the GO0 pin to control the DE pin on external RS-485 circuitry. If enabled, when the transceiver has data to send to the host, it will assert GO0 Low, send the data to the host, and take GO0 High.

6. Dimensions

Critical parameters are as follows:

- **Interface Connector** – 20 pin OEM interface connector (Samtec TMM-110-01-L-D-SM, mates with Samtec SMM-110-02-S-D)
- **MMCX Jack** – Antenna connector (Telegartner P/N J01341C0081) mates with any manufacturer's MMCX plug

Figure 2 - AC4490/AC4486 (with MMCX Connector) Mechanical