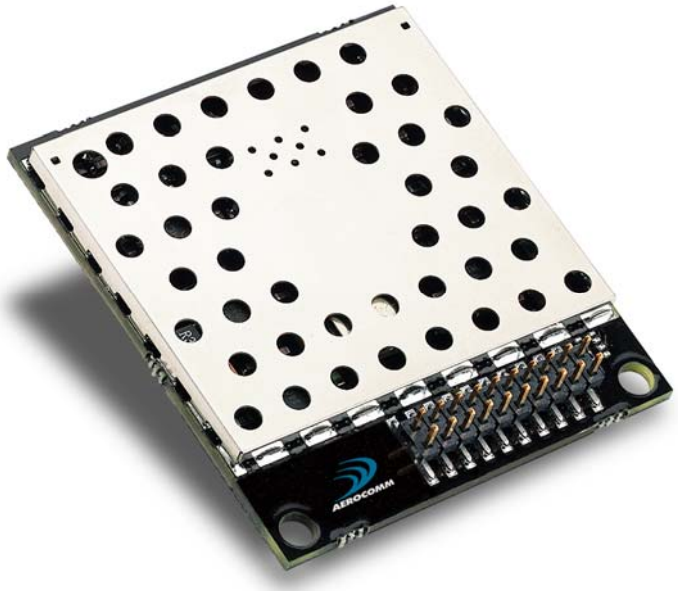
AC4868

868 MHz OEM TRANSCEIVERS

Specifications Subject to Change

User's Manual
Version 1.1



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DOCUMENT INFORMATION

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DOCUMENT INFORMATION

Revision	**Description**
Version 1.0	8/29/2005 – Initial Release Version
Version 1.1	10/7/2005 – Added Declaration of Conformity

Figures

Tables

AC4868 Features

- ✓ Drop-in replacement for AC4490 and AC4424 product families
- ✓ Two generic input and output digital lines and integrated DAC/ADC functions
- ✓ 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 AC4868 is a member of AeroComm's ConnexRF OEM transceiver family. The AC4868 is designed for integration into OEM systems operating under European ETSI regulations for the 868 - 870 MHz band.

The AC4868 is a cost-effective, high performance, 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 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.

AC4868 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 AC4868 transceiver and an OEM Host. Information includes the theory of operation, specifications, interface definition, configuration information and mechanical drawings.

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

2. AC4868 Specifications

GENERAL	
20 Pin Interface Connector	Samtec TMM-110-01-L-D-SM, mates with Samtec SMM-110-02-S-D
RF Connector	Telegärtner J01341C0081, mates with any manufacturer's MMCX style plug
Serial Interface Data Rate	Baud rates from 1200 bps to 57600 bps
Power Consumption (typical)	**Duty Cycle (TX=Transmit; RX=Receive)** **10%TX 50%TX 100%TX 100%RX Pwr-Down Deep Sleep** AC4868-250: 54mA 138mA 240mA 36mA TBD 24mA
Channels	Single Channel
Security	One byte System ID. 56 bit DES encryption key.
Interface Buffer Size	Input/Output: 256 bytes each
TRANSCEIVER	
Frequency Band	Europe 500mW: 869.4 – 869.65 MHz
RF Data Rate	19200bps or 28800bps dependant on interface baud rate
RF Technology	Single Frequency FSK
Output Power	Conducted (no antenna) 186mW EIRP (2.5dBi gain antenna) 250mW
Supply Voltage	Pin 10: 3.3 – 5.5V ±50mV ripple Pin 11: 3.3 ±3%, ±100mV ripple
Sensitivity	-103dBm typical @ 28.8kbps RF Data Rate
Range, Line of Site (based on 2.5dBi gain antenna)	15Km (9.3 miles)
ENVIRONMENTAL	
Temperature (Operating)	-40°C to 80°C
Temperature (Storage)	-50°C to +85°C
Humidity (non-condensing)	10% to 90%
PHYSICAL	
Dimensions	Transceiver with MMCX Connector: 1.65" x 1.9" x 0.20" Transceiver with Integral Antenna: 1.65" x 2.65" x 0.20"
Weight	Less than 0.75 ounce

3. Specifications

3.1 INTERFACE SIGNAL DEFINITIONS

The AC4868 has a simple interface that allows OEM Host communications with the transceiver. The table below shows the connector pin numbers and associated functions. The I/O direction is with respect to the transceiver. All outputs and inputs are 3.3VDC levels and should never be driven with 5V levels. 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)[1]	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	VCC1	AC4868-250: 3.3 – 5.5V, ±50mV ripple
11	PWR	VCC2	AC4868-250: 3.3V ±3%, ±100mV ripple
12	I	9600_BAUD	9600_BAUD – When pulled logic Low and then 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	N/C	N/C	This pin has an internal connection and should be left disconnected.
14	I	GI1	Generic Input pin
15	I	UP_RESET	RESET – Controlled by the AC4868 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 transceiver 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

Pin	Type	Name	High Min.	High Max.	Low Min.	Low Max.	Unit
2,3	I/O	RS485A/B	N/A	12	-7	N/A	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 – 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	3.3 @ 1/8 Unit Load	N/A	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
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 AND LATENCY

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 9,600 bps to 57,600 bps. **Note: Enabling Parity Mode cuts throughput in half and the Interface Buffer size in half.** The following asynchronous serial data formats are supported:

Table 4 – Supported Serial Formats

Data Bits	Parity	Stop Bits	Transceiver Programming Requirements
9	N	1	Parity Mode enabled
8	N	1	Parity Mode disabled
8	N	2	Parity Mode enabled
8	E,O,M,S	1	Parity Mode enabled
7	E,O,M,S	2	Parity Mode enabled
7	N	2	Parity mode disabled
7	E,O,M,S	1	Parity Mode disabled

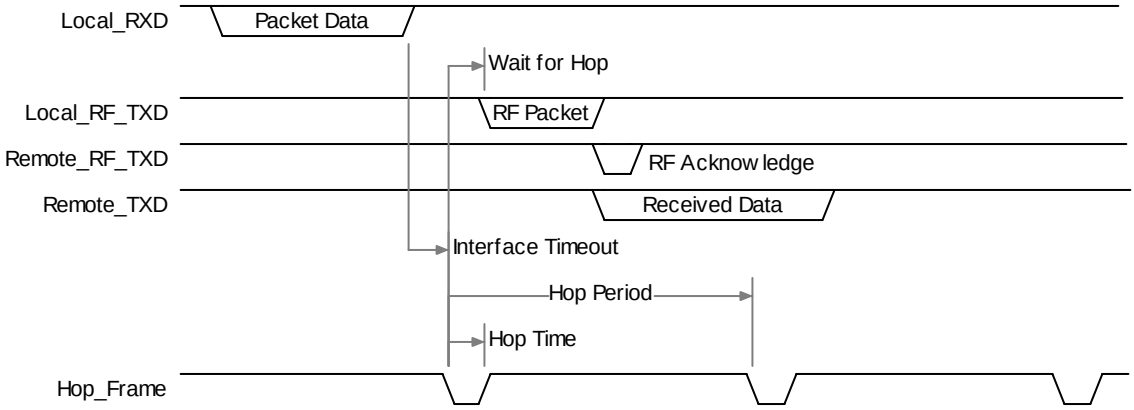
3.3.2 Latency

The transceiver will use Interface Timeout in conjunction with Fixed Packet Length (whichever condition occurs first) to determine a complete packet to be sent over the RF. If Full Duplex is enabled, the transceiver must wait for its appropriate hop (even numbered hops for the Server and odd numbered hops for the Client). Upon doing this, the transceiver will calculate the amount of time until the next hop to ensure that it has time to send the packet. If there is enough time, it will send the packet: if not, it will wait until its next appropriate hop. Transmit Retries and Broadcast Attempts are handled in the same manner.

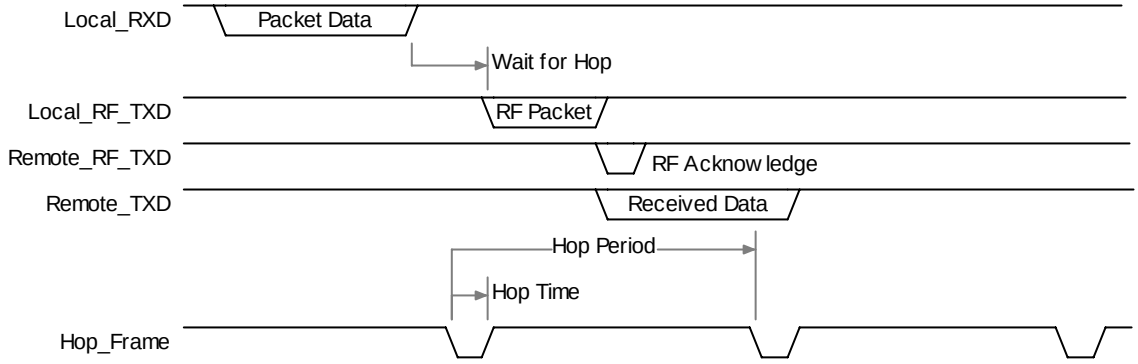
Note about Timing: The AC4868 is a single frequency radio design. Though it does not hop from one frequency to another, packet delivery timing is based on a fictitious hop, which occurs approximately every 53ms. This maximizes the use of the AC4868 resources and makes timing much more deterministic. For ease of understanding, the documentation will still refer to a hop. The Server will still send a timing beacon out every 1.2s to provide Clients with its MAC Address.

3.3.3 Timing Diagrams

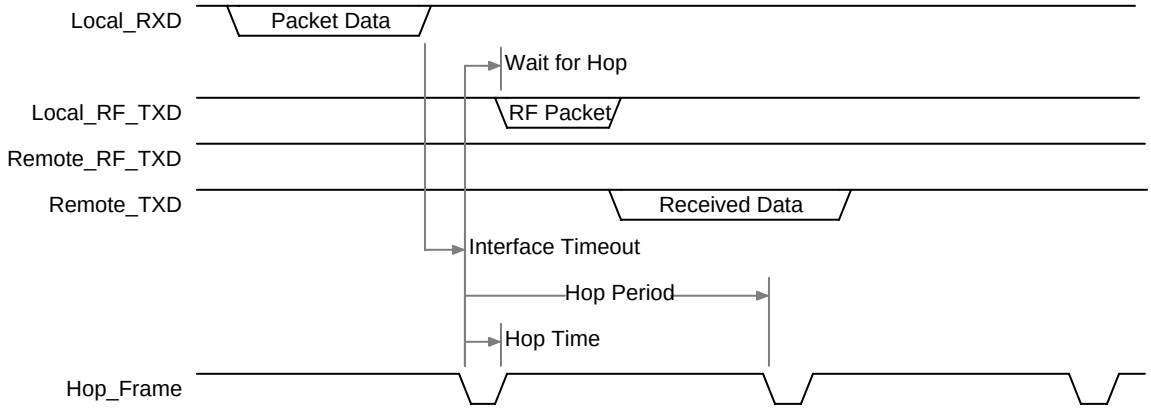
Addressed Acknowledge Mode with Interface Timeout:



Addressed Acknowledge Mode with Fixed Packet Length:



Broadcast Acknowledge Mode with Interface Timeout:



Broadcast Acknowledge Mode with Fixed Packet Length:

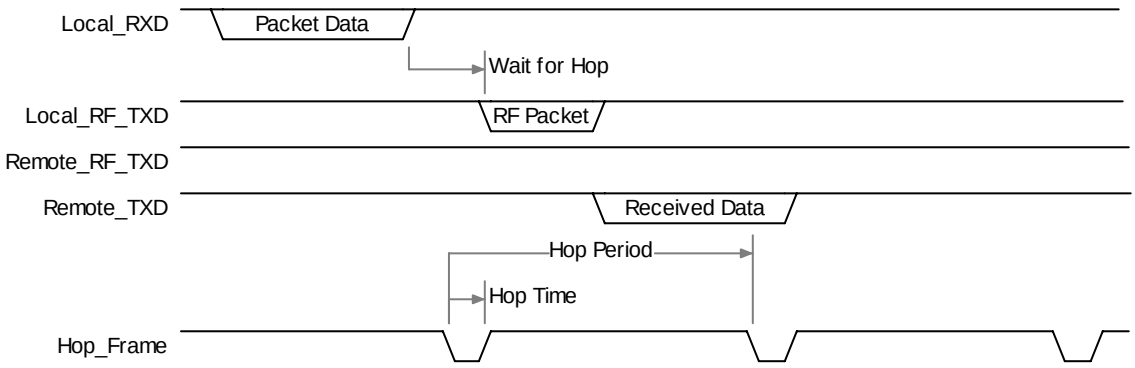


Table 5 – Timing Parameters

Parameter	Typical Time (ms)
Hop Time	1
Hop Period	53
Beacon Period	1200

3.3.4 Maximum Overall System Throughput

When configured as shown in the table below, an AC4868 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. These calculations assume that no retries were required to deliver the packet. **NOTE: The OEM is responsible for limiting the transmit duty cycle of the transceiver to a maximum of 10% amortized over the period of one hour.**

Table 6 – Maximum Overall System Throughputs

RF Mode	RF Baud Rate (controlled by Interface Baud Rate)	Throughput (bps) Half Duplex	Throughput (bps) Full Duplex
Addressed Delivery	28,800	15k	7.5k
Addressed Delivery	19,200	6.8k	3.4k
Broadcast Delivery	28,800	18k	9k
Broadcast Delivery	19,200	12k	6k

4. Configuring the AC4868

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 7 – EEPROM Parameters

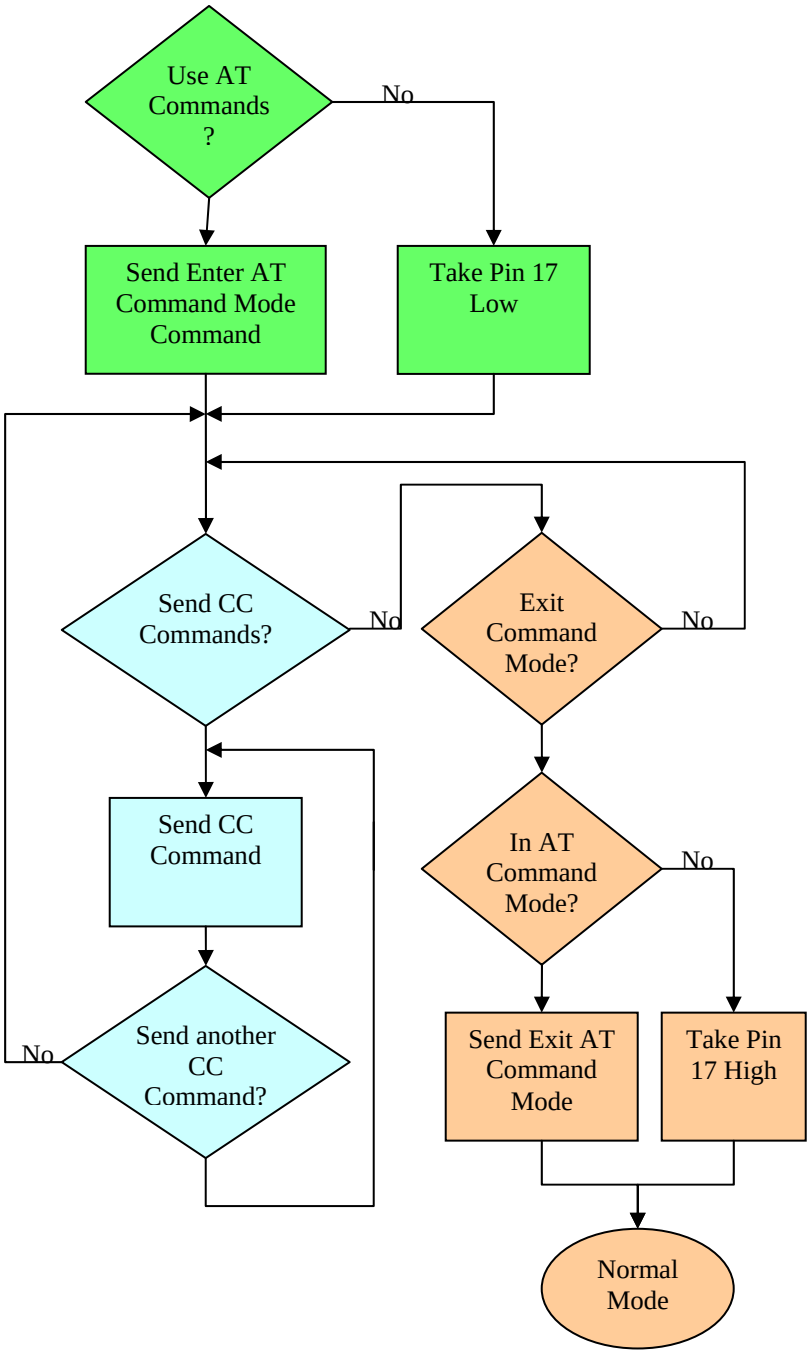
Parameter	EEPROM Address	Length (Bytes)	Range	Default	Description
Product ID	00h	40			40 bytes - Product identifier string. Includes revision information for software and hardware.
Beacon Period	3Ch	1	1 – FFh	14h	Specifies the number of hop periods between Server beacon transmissions (equal to hop period * value). Note that each transceiver should only transmit 10% of the time and beacons count as transmissions.
Range Refresh	3Dh	1	1 – FFh	80h	This byte specifies the maximum amount of time a transceiver will report In Range without having heard a beacon (equal to hop period * value). Do not set to 0h.
Stop Bit Delay	3Fh	1	0 – FFh	FFh	For systems using the RS-485 interface or Parity Mode, the serial stop bit might come too early (especially at slower interface baud rates). Stop Bit Delay controls the width of the last bit before the stop bit occurs. FFh = Disable Stop Bit Delay (12us) 00h = (256 * 1.6us) + 12us 1 – FEh = (value * 1.6us) + 12us
Channel Number	40h	1	38h	38h	
Server/Client Mode	41h	1	1 – 02h	02h	01h = Server 02h = Client
Baud Rate Low	42h	1	0 – FFh	FCh	Low Byte of the interface baud rate. Default baud rate is 57,600.
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 – **AeroComm Use Only** Bit 6 – DES Enable 0 = Disable Encryption 1 = Enable Data Encryption Bit 5 – **AeroComm Use Only** Bit 4 – **AeroComm Use Only** Bit 3 – **AeroComm Use Only** Bit 2 – **AeroComm Use Only** Bit 1 – RF Delivery 0 = Addressed 1 = Broadcast Bit 0 – **AeroComm Use Only**
Transmit Retries	4Ch	1	1 – FFh	04h	Maximum number of times a packet is sent out in Addressed Acknowledge mode.
Broadcast Attempts	4Dh	1	1 – 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 Addressed and Broadcast packets 1 = Only receive Addressed packets Bit 4 – Auto Destination 0 = Use Destination Address 1 = Automatically 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	2 – 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).

Ordering Information

Parameter	EEPROM Address	Length (Bytes)	Range	Default	Description
RF Packet Size	5Bh	1	1 – FFh	24h	Used in conjunction with Interface Timeout, specifies the maximum size of an RF packet. When Auto Config is enabled, this value is overridden based on Interface Baud Rate and RF Delivery mode.
CTS On	5Ch	1	1 – FFh	C0h	CTS will be deasserted (High) when the transmit buffer contains at least this many characters.
CTS On Hysteresis	5Dh	1	0 – FEh	B0h	Once CTS has been deasserted, CTS will be reasserted (Low) when the transmit buffer contains this many or less characters.
Max Power	63h	1	0 – A0h	Set in production and can vary	Used to increase or decrease transmit power output. The AC4868 is shipped at the maximum permissible power and this value should never be increased beyond factory default.
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 **Note: Enabling Parity Mode cuts throughput in half and the Interface Buffer size in half.**
RS-485 DE	7Fh	1	E3h, FFh	FFh	E3h = GO0 is active High DE for control of external RS-485 hardware. FFh = Disable RS-485 DE mode.
Destination ID	70h	6		FF, FF, FF, FF, FF, FFh	Specifies destination for RF packets.
System ID	76h	1	0 – FFh	01h	Similar to a network password.
MAC ID	80h	6			Factory programmed unique IEEE MAC Address.
DES Key	D0h	7	0 – FFh	0D, 1D, 2D, 3D, 4D, 5D, 6Dh	56 bit Data Encryption key

4.2 CONFIGURATION FLOW OF THE AC4868[3]



[3] Any mode can be exited by resetting the transceiver; however static changes will be lost.

4.3 COMMAND QUICK REFERENCE

Below is a command reference and further information on each individual command can be found in the text following. It is strongly recommended that all the information be read on each command prior to using as some commands have caveats.

Command Name	Command (All Bytes in Hex)						Return (All Bytes in Hex)			
AT Enter Command Mode	41h	54h	2Bh	2Bh	2Bh	0Dh	CCh	43h	4Fh	4Dh
Exit AT Command Mode	CCh	41h	54h		4Fh	0Dh	CCh	44h	41h	54h
Status Request	CCh	00h	00h		-		CCh	Firmware Version	00h: Server 01h: Client	-
Server/Client Command	CCh	03h	00h: Server 01h: Client		-		CCh	Firmware Version	00h: Server 01h: Client	-
Sleep Walk Power-Down	CCh	06h	-		-		CCh	Channel	-	-
Sleep Walk Wake-Up	CCh	07h	-		-		CCh	Channel	-	-
Write Destination Address	CCh	10h	Byte 4 of destination's MAC		Byte 5	Byte 6	CCh	Byte 4 of destination's MAC	Byte 5	Byte 6
Read Destination Address	CCh	11h	-		-		CCh	Byte 4 of destination's MAC	Byte 5	Byte 6
Auto Destination	CCh	15h	Bit 0 : Auto Destination Bit 4 : Enable Auto Destination				CCh	Bit 0: Auto Destination Bits 1 – 7: 0		
Read Digital Inputs	CCh	20h	-		-		CCh	Bit 0: GI0 Bit 1: GI1	-	-
Read ADC	CCh	21h	00h: AD In 01h: Temp		-		CCh	MSB of 10 bit ADC	LSB of 10 bit ADC	-
Report Last Valid RSSI	CCh	22h	-		-		CCh	RSSI	-	-
Write Digital Outputs	CCh	23h	Bit 0: GO0 Bit 1: GO1		-		CCh	Bit 0: GO0 Bit 1: GO1	-	-
Write DAC	CCh	24h	Update Period		Duty Cycle		CCh	Update Period	Duty Cycle	-
Set Max Power	CCh	25h	New Setting		-		CCh	New Setting	-	-
Transmit Buffer Empty	CCh	30h	-		-		CCh	00h	-	-
Deep Sleep Mode	CCh	86h	-		-		CCh	Channel	-	-
Read Temperature	CCh	A4h	-		-		CCh	Temp (°C)	-	-
EEPROM Byte Read	CCh	C0h	Starting Address		Length (0 : 256 bytes)		C0h	Starting Address	Length	Data at those addresses
EEPROM Byte Write	CCh	C1h	Starting Address	Length (1 – 80h)	Data bytes to be written		Starting Address		Length	Data written to last byte
Soft Reset	CCh	FFh	-		-		-	-	-	-

4.4 AC4868 AT COMMANDS

The AT Command mode implemented in AC4868 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 Enter AT Command mode command response is sent to the host.

4.4.1 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

4.4.2 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

4.5 ON-THE-FLY CONTROL COMMANDS (CC COMMAND MODE)

The AC4868 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. The transceiver uses **Interface Timeout/Fixed Packet Length** 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. If an invalid command is sent to the transceiver, it will ignore the command and issue no response to the OEM Host.

While in CC Command mode (using pin 17, Command/Data), the RF interface of the transceiver is still active. Therefore, it can receive packets from remote transceivers and forwards these to the OEM Host. Note: 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.

While in CC Command mode (using AT Commands), the RF interface of the transceiver is active, but packets sent from other transceivers will not be received.

4.5.1 *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
01 for Client

4.5.2 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

4.5.3 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 transceivers.

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

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

4.5.4 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

4.5.5 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

4.5.6 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

4.5.7 Auto Destination

The Host issues this command to change the settings for Auto Destination. When issuing this command, the Auto Destination setting will only be changed if the corresponding enable bit is set.

Host Command:
Byte 1 = CCh
Byte 2 = 15h
Byte 3 = Data1

Where:
Data1 =
Bit 0: Auto Destination
Bit 4: Enable Auto Destination Modification

Transceiver Response:
Byte 1 = CCh
Byte 2 = Data1

Where:
Data1 =
Bit 0: New Auto Destination Setting
Bits 1 – 7: 0

4.5.8 Read Digital Inputs

The Host issues this command to read the state of 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

4.5.9 Read ADC

The Host issues this command to read any of the three 10 bit onboard A/D converters. Because the RF is still active in on-the-fly mode, the transceiver will not process the command until there is no activity on the network. The equations for converting these 10 bits into analog values 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

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

4.5.10 Report Last Valid RSSI

As RSSI values are only valid when the local transceiver is receiving a RF packet from a remote transceiver, 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. The Host issues this command to read the last valid RSSI:

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.

Signal Strength (dBm)	Approximate Last Good RSSI Value (hex)
-45 and greater	C0 – C2
-46 to -55	C2 – D2
-56 to -65	D2 – D9
-66 to -75	D9 – DF
-76 to -85	DF – E5
-86 to -95	E5 – E7
-96 and less	E7 and greater

Note: RSSI becomes saturated at signal levels above -45dBm.

4.5.11 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

4.5.12 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

4.5.13 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

4.5.14 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

4.5.15 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

4.5.16 Read Temperature

The Host issues this command to read the onboard temperature sensor. The transceiver reports the temperature in °C where 0 – 80h corresponds to 0 – 80°C and where D8 – 0h corresponds to -40 – 0°C.

Host Command:
Byte 1 = CCh
Byte 2 = A4h

Transceiver Response:
Byte 1 = CCh
Byte 2 = Data1

Where:
Data1 = D8 – 80h

4.5.17 EEPROM Byte Read

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

Host Command:
Byte 1 = CCh
Byte 2 = C0h
Byte 3 = Address
Byte 4 = Length (01…FFh = 1…255 bytes; 00h = 256 bytes)

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

4.5.18 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 = CCh
Byte 2 = C1h
Byte 3 = Address
Byte 4 = Length (01 – 80h)
Byte 5…n = Data to store at Address

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

4.5.19 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 AC4868.

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 AC4868 accepts 3.3 or 5VDC TTL level asynchronous serial data (the 500mW/ 1000mW transceiver 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, at 3.3V levels, 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 (RS485A) and RXD is a mirror image of TXD (RS485B). The transceiver will still use RTS (if enabled) in this mode.

5.1.3 Hop Frame (pin 6)

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 AC4868 is a single frequency transceiver, though it still generates a Hop Frame signal every time it transmits a timing beacon.

5.1.4 CTS Handshaking (pin 7)

The AC4868 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 256 byte 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 UP_Reset (pin 15)

UP_Reset provides a direct connection to the reset pin on the AC4868 microprocessor and is used to force a soft reset. For a valid reset, reset must be High for a minimum of 10ms.

5.1.8 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)**.

5.1.9 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.

5.1.10 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 AC4868.

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 transceivers to the Server. Client-to-Client communications are possible when there is no Server present. However, the Clients will report out-of-range as they are not receiving Server beacons.

Each network should consist of only one Server. If two networks are in the same area, they will interfere with each other if transceivers from each network are transmitting at the same time. However, due to the 10% transmit duty cycle limitation, it is expected that there is enough bandwidth for each network to function properly. Collocated networks should be programmed to use different **System ID's**.

The AC4868 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

RF Delivery Overview

All packets are sent out over the RF as either addressed or broadcast packets. Addressed packets are only received by the transceiver specified by **Destination Address**. If addressed packets are desired, the Destination Address should be programmed with the **MAC ID** of the destination transceiver. 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.

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.

5.2.3 Duplex Mode

In Half Duplex mode, the AC4868 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 (although there is technically only one frequency bin, the Server still maintains a bin count for the purpose of handling Full Duplex mode). Though the RF hardware is still technically half duplex, it makes the transceiver 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.**

5.2.4 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 0.5ms increments and has a tolerance of ±0.5ms. Therefore, the Interface Timeout should be set to a minimum of 2. The default value for Interface Timeout is 4 (2ms).

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, the transceiver will not be able to send any packets because the AC4868 transceiver requires the entire RF packet to be sent in the same hop period. The RF Packet size programmed in EEPROM is automatically optimized when **Auto Config** is enabled. It is strongly recommended that Auto Config be left enabled to maximize the efficiency of the transceiver.

5.2.5 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 the baud rates supported by the AC4868. For a baud rate to be valid, the 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. Baud rates not listed on this table are not supported. If an invalid baud rate is programmed into the transceiver, the interface baud rate will be forced to 9600 baud.**

Table 8 – Baud Rate/Interface Timeout

Baud Rate	BaudL (42h)	BaudH (43h)	RF Baud Rate (Not Adjustable)	Minimum Interface Timeout (58h)	Stop Bit Delay (3Fh)
57,600[4]	FCh	00h	28,800	02h	03h
38,400	FAh	00h	19,200	02h	08h
28,800	F8h	00h	28,800	02h	0Eh
19,200	F4h	00h	19,200	03h	19h
14,400	F0h	00h	28,800	04h	23h
9,600	E8h	00h	19,200	05h	39h

5.2.6 Network Topology

RF Channel Number – RF Channel Number selects the operational frequency band of the transceiver. The AC4868 provides one channel of operation. **The OEM is responsible for limiting the transmit duty cycle of the transceiver to a maximum of 10% amortized over the period of one hour.** This information is provided in the chart below:

Table 9 – US and International RF Channel Number Settings

RF Channel Number (40h)	Frequency Details and Regulatory Requirements	Countries
38h	869.4 – 869.65MHz (Single frequency. Up to 500mW EIRP at 10% maximum transmit vs. receive duty cycle)	Europe

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

[4] 57,600 is the default baud rate.

DES (Data Encryption Standard) – Encryption is the process of encoding an information bit stream to secure the data content. The DES algorithm is a common, simple and well-established encryption routine. An encryption key of 56 bits is used to encrypt the packet. The receiver must use the exact same key to decrypt the packet; otherwise garbled data will be produced.

The 7 byte (56 bits) Encryption/Decryption Key is located in EEPROM Bytes D0 – D6. It is highly recommended that this Key be changed from the default. In addition to setting the value of the Encryption/Decryption Key in the EEPROM, the OEM can change this key in the transceiver static memory during system operation by using the Write Static Bank #2 Byte command to modify addresses D0 – D6h.

5.2.7 Auto Config

The AC4868 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 predetermined values (values are all in hexadecimal format). When Auto Config is disabled, these values must be programmed in the transceiver EEPROM for the corresponding mode of operation.

Table 10 – Auto Config Parameters

Parameter	EEPROM Address	Default	RF Baud = 19,200		RF Baud = 28,800	
			Addressed	Broadcast	Addressed	Broadcast
RF Packet Size	5Bh	24h	24h	40h	50h	60h

5.2.8 Range Refresh

The Server sends out timing beacons at regular intervals (controlled by **Beacon Period**) to maintain Client synchronization. Upon hearing a beacon, a Client 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. Even when the Client is out-of-range of a Server, it can still send packets to other Clients that it is within range of. Range Refresh specifies the maximum amount of time a Client can go without hearing a Server beacon before reporting out-of-range. Range Refresh is equal to the number of hop periods (approximately 53ms) * value. **Note: Range Refresh should not be set to 0h.**

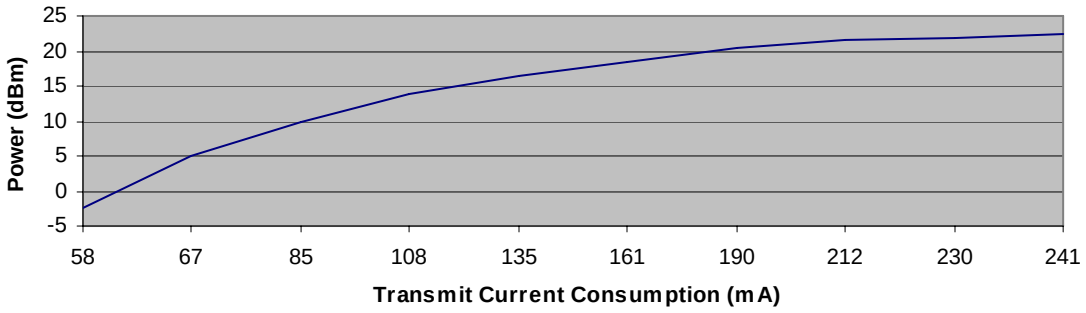
5.2.9 Max Power

Max Power provides a means for controlling the RF transmit output power of the AC4868. Output power and current consumption can vary by as much as ±10% per transceiver for a particular Max Power setting. Contact Aerocomm for assistance in adjusting Max Power. The following graph shows current consumption versus output power. Transmit power can be represented in dBm (decibels per meter) and mW (milliwatts). The equations for converting between the two are shown below:

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

$$\text{Power (mW)} = 10^{\wedge(\text{Power (dBm)} / 10)}$$

Table 11 – Max Power Settings for AC4868-250 Transmitter



5.2.10 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 Configuration Mode is entered 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 modem interfaces are shown below.

Table 12 – Transceiver Interface to DCE (Server Transceiver)

When Interfacing the AC4868 to a DCE (Data Communications Equipment):				
DCE Pin Number	**DCE Pin Name**	**Direction with Respect to Transceiver**	**AC4868 Pin Name**	**AC4868 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 13 – Transceiver Interface to DTE (Client Transceiver)

When Interfacing the AC4868 to a DTE (Data Terminal Equipment):				
DTE Pin Number	**DTE Pin Name**	**Direction with Respect to Transceiver**	**AC4868 Pin Name**	**AC4868 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 High, send the data to the host, and take GO0 Low.

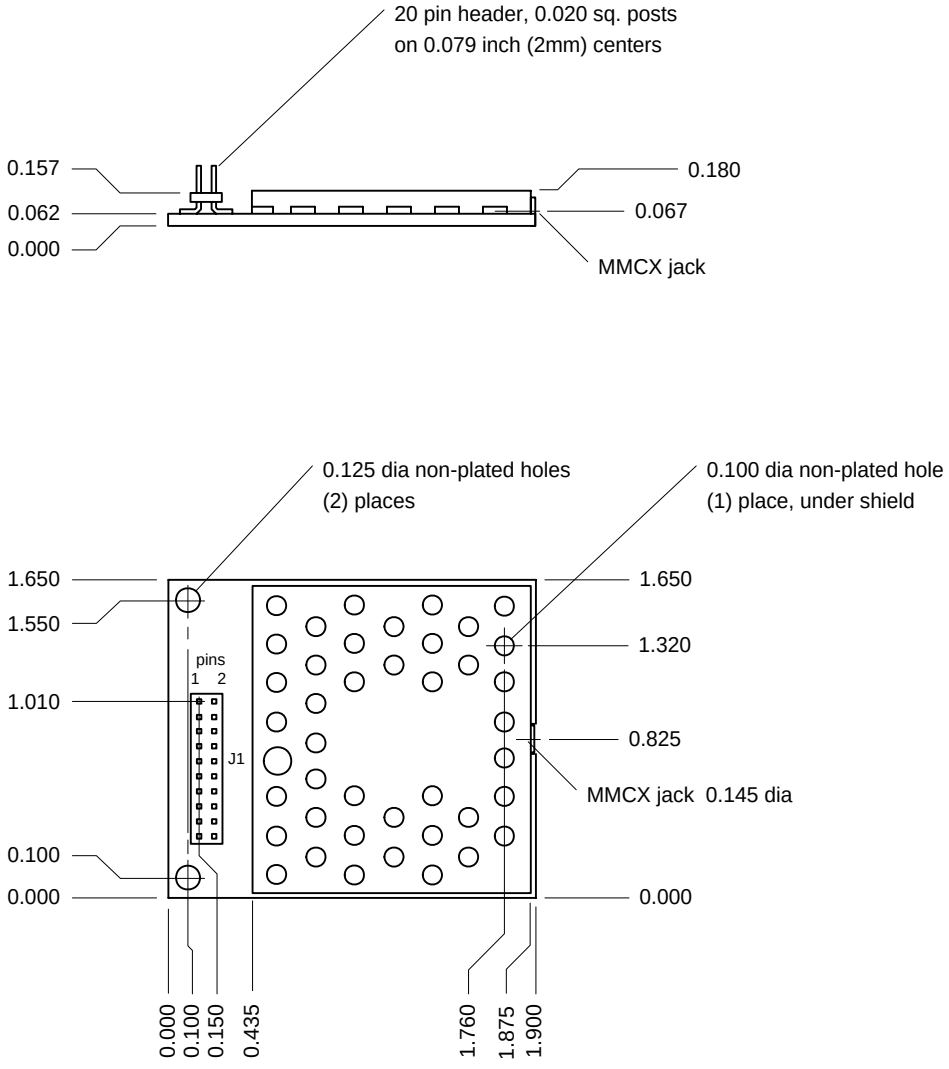
6. Dimensions

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 1 - AC4868 (with MMCX Connector) Mechanical



7. Ordering Information

7.1 Product Part Numbers

The AC4868 is available in the following part numbers; **AC4868-250M and AC4868-250M-485**. The only difference between the two is that the AC4868-250M-485 consists of a half-duplex 485 interface.

7.2 Developer Kit Part Numbers

All the above part numbers can be ordered as a development kit by prefacing the part number with "SDK-". As an example, part number AC4868-250M can be ordered as a development kit using the following part number: SDK-AC4868-250M.

All Developer Kits include (2) transceivers, (2) Serial Adapter Boards, (2) 6VDC unregulated power supplies, (2) Serial cables, (2) USB cables, (2) S467FL-6-RMM-868S dipole antennas with 6" pigtail and MMCX connector, configuration/testing software, and integration engineering support.

8. Agency Compliancy Information

Agency compliancy is a very important requirement for any product deployment. AeroComm obtains modular approval for its products so the OEM only has to meet a few requirements to be eligible to use that approval.

Table 14 – CE Approval Status

Part Number	EUR/EN
AC4868-250	Approved

8.1 Approved Antenna List

The following antennas are approved for operation with the AC4868 as identified. **The OEM is free to choose another vendor's antenna of equal or lesser gain and similar type as an antenna appearing in the table and still maintain compliance.**

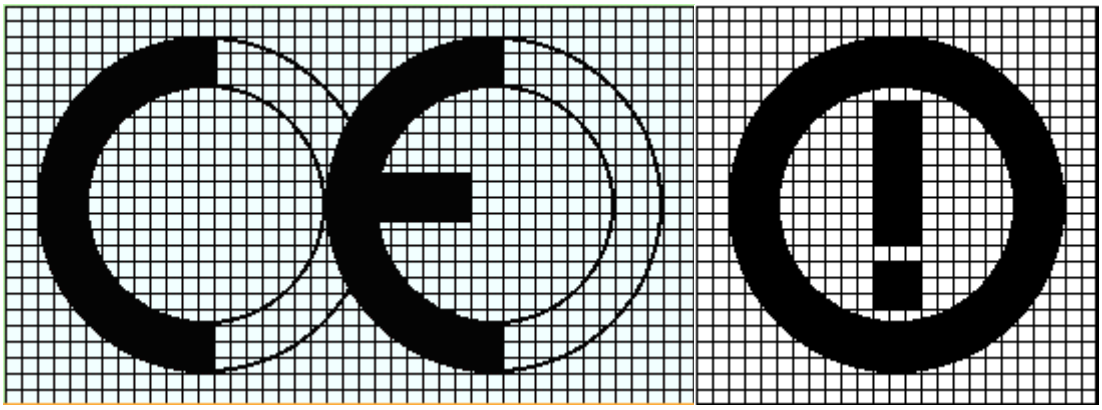
Table 15 – AC4868 Approved Antenna List

AeroComm Part Number	Manufacturer Part Number	Manufacturer	Type	Gain (dBi)	AC4868-250M
0600-00020	S467FL-6-RMM-868S	Nearson	¼ Wave Dipole	2	M

8.2 OEM Equipment Labeling Requirements

Following are the requirements for labeling equipment:

1. If the CE marking is reduced or enlarged, the proportions given in the following graduated drawing must be respected.
2. The CE marking must have a height of at least 5 mm except where this is not possible on account of the nature of the apparatus.
3. The CE marking must be affixed to the product or to its data plate. Additionally it must be affixed to the packaging, if any, and to the accompanying documents.
4. The CE marking must be affixed visibly, legibly and indelibly.
5. The exclamation point must be included with the CE mark (as shown below) to alert the user to the fact that there are restrictions placed on usage in certain countries. It must have the same height as the CE mark.



8.3 COUNTRY RESTRICTIONS

The exclamation point included with the CE mark denotes that the equipment has restrictions in certain countries. Following is a list of countries having restrictions on the AC4868 and a description of those restrictions. The OEM is responsible for insuring that these restrictions are met.

Table 16 – Restrictions

AC4868 Channel	Country	Restriction	Reason/Remarks
38h (Band I)	All Countries (unless otherwise noted)	Maximum ERP of 500mW and maximum transmit duty cycle of 10% (amortized over one hour)	
	Bulgaria	Not Implemented	
	Finland	Audio and voice not allowed	
	Germany	Audio and voice not allowed	
	Italy	Max 25mW ERP	Military Applications
	Slovak Republic	Not Implemented	Military

8.4 COUNTRY NOTIFICATION

The OEM is responsible for notifying ANY country of the intent to ship product to that country containing the AC4868 four weeks prior to shipping.

8.5 DECLARATION OF CONFORMITY

The Declaration of Conformity is a document that lists the product name and band of use and must appear in the OEM user's manual.

DECLARATION OF CONFORMITY

APPPLICATION OF COUNCIL DIRECTIVE(S):	**R&TTE Directive 1999/5/EC** **EMC Directive 89/336/EEC**
MANUFACTURER'S NAME:	**Aerocomm Inc.** 11160 Thompson Ave. Lenexa, Kansas USA, 66219
EUROPEAN REPRESENTATIVE'S NAME/ADDRESS:	
PRODUCT UNDER TEST:	868 MHz OEM Transceiver
MODEL NO.:	AC4868-250M
RF OUTPUT POWER:	186mW Peak
FREQUENCY RANGE:	869.4 – 869.65 MHz
TEST LABORATORIES:	Senton GmBH Test Center Aeussere Fruehlingstrasse 45 D-94315 Straubing Germany

STANDARD(S) TO WHICH CONFORMITY IS DECLARED:

Protection requirements concerning electromagnetic compatibility (EMC) pursuant to Article 3.1.b of the EMC directive:
Standards applied: **EN 301 489-1 V1.4.1 (2002-08), EN 301 489-3 V1.4.1 (2002-08)**

Standards (Harmonized) applied: EN 300 220-1 V1.3.1 (2000-09), EN 300 220-3 V1.1.1 (2000-09)

I, the undersigned, hereby declare that the equipment as tested is representative within manufacturing tolerance to units.

Manufacturer	**Legal Representative in Europe**
Signature	**Signature**
John Eckart	Michael Schröttle
Full Name	Full Name
Vice President, Sales	Geschäftsführer
Position	Position
11160 Thompson Ave., Lenexa, KS	Kirchstrasse 28, 8574 Lengwil-Oberhofen
Place	Place
Aug 25, 2005	30. Aug. 2005
Date	Date