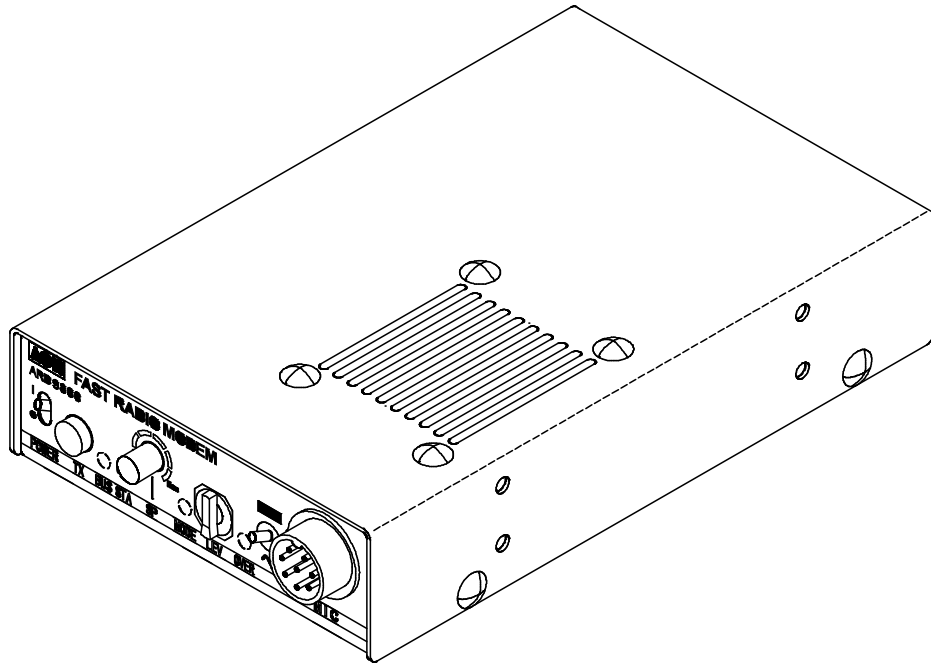




ARD9900

FAST RADIO MODEM



Multi-Mode and Digital Voice Interface

Operating manual

AOR, LTD.

Thank you for purchasing the AOR ARD9900 Multimode and Digital Voice Interface.

The ARD9900 is designed to convert your HF radio equipment to a multi mode and digital voice capable radio without performing any modifications to your transceiver.

Please read through this instruction manual and familiarize yourself with the operation of the ARD9900.

We suggest you keep this instruction manual for future reference.

We believe the ARD9900 will become a powerful tool to your communication capabilities.

AOR, LTD.

Features:

- *Digital voice communications using existing analog 2 way radios with encryption.*

The ARD9900 uses the same audio frequencies (300 Hz ~ 2500 Hz) as microphone audio to modulate the voice signal. This allows you to use an analog radio as a digital voice transceiver.
- *Digital voice communications in the Single Side Band (SSB) mode.*

The automatic frequency clarifier function adjusts frequency drift automatically in the SSB mode. (Approximately up to +/- 125 Hz).
- *Utilizes the ODFM (Multi Carrier Modulation) circuit that is effective against Multi-path or Selective Fading.*
- *Automatic digital receive*

Automatic voice signal detector recognizes the received signal as analog or digital, automatically switching to the appropriate mode.
- *Digital Slow Scan TV (SSTV)*
- *Built-in video-capture function (NTSC or PAL depending on version)*

Compresses the signal into our original adaptive JPEG format. Send and receive images in the Digital mode. Built-in video output connector allows viewing the picture on an external monitor.
- *Built-in high grade Vocoder (AMBE)*

Utilizing high grade digital voice compression; delivers quality digital voice communications.
- *Built-in FEC error correction*

A powerful error correction circuit delivers stable and reliable communications.
- *Data communications on the HF band*

Data communication is possible on the HF (High frequency) bands at no extra cost. (Speed may be limited by regulations in certain jurisdictions.)
- *Small and compact unit. Easy to operate.*

Simply connect the ARD9900 to the microphone jack and the speaker out jack. No complicated or risky radio modifications are necessary.
- *Utilizes a uniquely designed high performance DSP (Digital Signal Processor) engine*
- *Battery operation for field use.*

Information to the Digital Device user

This equipment uses and can generate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer for technical assistance.

Precautions

To prevent fire, personal injury, or unit damage, please observe the following precautions:

- Do not attempt to adjust this unit unless instructed to do so by this manual.
- Do not expose the unit to direct sunlight or place the unit close to heating appliances.
- Do not place the unit in excessively dusty, humid, wet areas.

We are not responsible for any damages to the radio equipment due to improper settings or interface.

We are not responsible for any loss of communications due to an unexpected change of propagation or operating environment.

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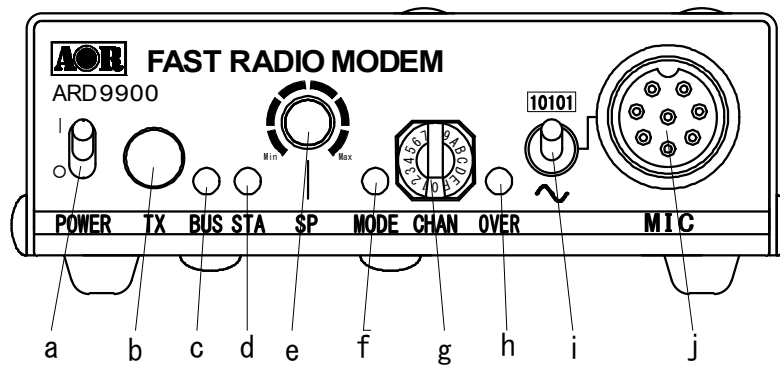
Supplied Accessories

The following items are provided in the box:

Accessory	Quantity
Microphone	1
PC interface cable	1
Speaker Cable	1
DC Power cable	1
Microphone Connector	1
Instruction manual	1

Controls and functions

Front Panel



- a. Power on/off switch
- b. TX switch
 - There are two (2) functions with this switch.
 1. Digital Image Communication mode

Set the mode switch to [10101] (digital mode). Press this switch to capture and send an image.

Note: When the Video Through Function is activated (AVT command is ON), pressing this switch will enable output of the video signal connected to the Video Input to also be sent to the video output port, so that you can monitor the transmitted video image.

Press this switch again to capture and send the image through the radio equipment. When the Video Through Function is de-activated (AVT command is OFF), pressing this switch will automatically capture the video image and then transmit it through the radio equipment.

(Refer to: Operation -- Digital Image Communication at page 18 for details.)

2. Digital Voice Communication mode (non encryption or fixed scramble code mode)

Set the mode switch to [~] (analog mode). Press and hold this switch to force the ARD9900 to decode digital voice signals.

Caution: Frequency tolerance for both parties must be in the range of +/-125 Hz.

(Refer to: Operations -- Digital Voice Communication force receive at page 17 for details.)

- c. BUS LED (Busy LED)
 - Steady red
 - The unit is in the transmit mode
 - Flashing red
 - Flashes red while the header information is being sent, when in the digital communication mode. (Approximately one second).
 - Green
 - The unit is in the receive mode
 - Not lit
 - The unit is in the standby receive mode or in the analog voice receive mode.
- d. STA LED (Status LED)
 - In the data communication mode, lit while unsent data is in the memory. It displays orange when the Video Through Function is activated (Digital Image Communication mode). When the Video Through Function is deactivated (AVT command is OFF), this LED will not be lit.
- e. Speaker volume adjustment
 - Adjustment for the internal speaker output level (or the external speaker output level when it is connected.)
- f. MODE LED (Operation Mode LED)
 - Indicates the current operation mode:
 - Lit in green ---- Digital Voice mode
 - Lit in red ---- Analog Voice mode
 - Lit in orange ---- Data Communication mode
 - Not lit ---- Digital Image Communication mode
- g. CHANNEL switch
 - Select preloaded encryption code.

 - (Refer to: Channel Switch Setting at page 15 for details.)
- h. Overload indicator
 - Lit when the microphone input is overloaded (too high).
 - A proper microphone input level will cause the LED to flash from time to time when speaking into the microphone at a normal level.
 - The microphone level can be adjusted with the microphone level controller.

 - (Refer to: Level Adjustment at page 13 for details.)

i. Mode switch

Select the Digital voice mode [10101] or the Analog voice mode [~].

When the Analog voice mode [~] is selected, ordinary analog voice communications will be made. In the receive mode, however, the ARD9900 will automatically detect the mode of the incoming signal and decode signals accordingly. The LED indicates the respective operation mode.

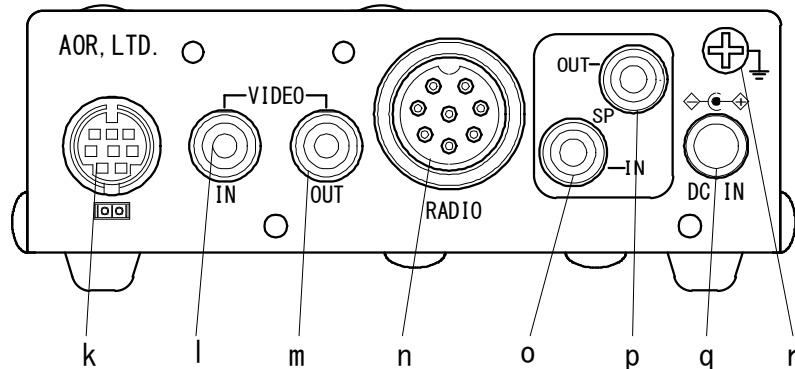
j. Microphone connector

Connect the supplied microphone to this connector.

Below are the pin assignments of the connector.

1. Speaker output -- Monitor output signal is present at this pin.
2. BIAS -- Power source for an electret condenser type of microphone. 5V DC through 2.2K Ω resistor.
3. GND -- Chassis ground
4. TX -- Grounding this pin will enable the transmit mode.
(Same operation as the TX switch on the front panel.)
5. D/A -- Grounding this pin will force the unit to the digital voice communication mode. When this pin is left open, the operation mode will be set by the mode switch on the front panel.
6. MIC PTT -- PTT (Push To Talk) input.
7. MIC GND -- Microphone ground signal
8. MIC IN -- Microphone signal input

Rear Panel



k. Communication Connector (mini DIN 8 pin) for PC (RS-232C)

<u>Pin Number</u>	<u>Signal</u>	<u>Signal Direction</u>
1	TX	ARD9900 → PC
2	DTR	ARD9900 → PC
3	DSR	ARD9900 ← PC
4	GND	GND
5	RX	ARD9900 ← PC
6	RTS	ARD9900 → PC
7	CTS	ARD9900 ← PC
8	NC	No Connection
Shell	FG	Frame ground

Baud Rate:	9600
Data bit:	8
Start bit:	1
Stop bit:	1
Parity:	None
Synchronization:	Asynchronous
Flow control:	Hardware

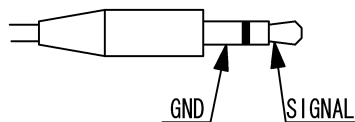
- l. VIDEO - IN connector (75 Ω) (RCA type connector)
Connect a video signal source such as a digital camera.
- m. VIDEO – OUT connector (75 Ω) (RCA type connector)
Connect a video monitor to this connector to monitor a received image or a picture to be sent.
- n. RADIO Connector
Using the supplied 8 pin connector, connect the ARD9900 to your radio equipment. You will need to wire a cable according to the microphone connector specifications of your radio.

Below are the pin assignments of the connector on the ARD9900.

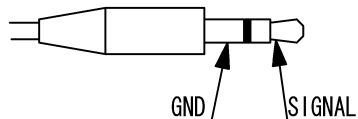
<u>Pin number</u>	<u>Signal</u>	<u>Details</u>
1	MIC GND	Microphone ground
2	MIC OUT	Microphone Output
3	PTT	PTT (Push To Talk) output
4	GND	PTT ground
5	NC	No connection
6	NC	No connection
7	GND	Ground
8	NC	No connection

Caution: MIC GND and GND must not be connected together in the ARD9900 connector, or RF feedback will result.

- o. SP IN Connector (3.5 mm mono jack)
Connect to the radio equipment's external speaker jack.
(Input level: 0.5 V – 5 V p-p)



- p. SP OUT Connector (3.5 mm mono jack)
Connect an external speaker to this jack to disable internal speaker.



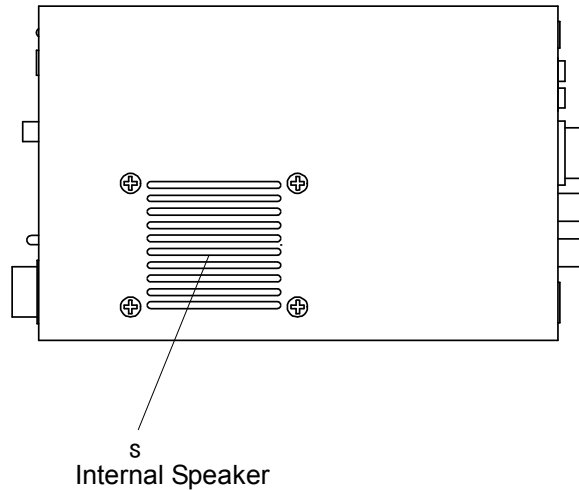
- q. DC IN Connector (EIAJ Type 4)
Connect to a regulated power supply. (10.7 ~ 16.0 V DC, Center pin – positive)
For lower voltage battery operation, set the internal jumper terminal for battery operation, and then connect external batteries .

(Caution): If you have changed the internal jumper for low-voltage battery operation, battery voltage must be within the range of 5.6 ~6.5 VDC. DO NOT apply 12.0V or severe damage will result, and the warranty will be void!)

(Note): No low battery voltage detector is built-in the ARD9900.

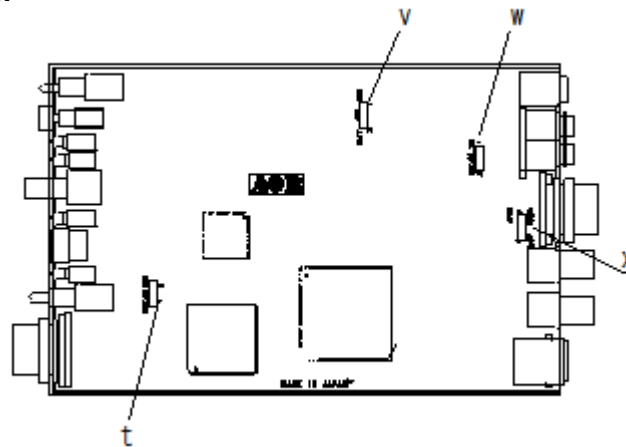
- r. FG
Frame ground

Top Panel



Internal View

(PCB design subject to changes.)



- t. Factory setting jumper
Must be set between 2-3. (Do not change this setting at any time.)
- v. Battery operation selector
Place the jumper between 1 – 2 (NOR) for normal operation.
Change it between 2-3 (BATT) for battery operation.
If you have changed the internal jumper for low-voltage battery operation, battery voltage must be within the range of 5.6 ~6.5 VDC.

DO NOT apply 12.0V or severe damage will result, and the warranty will be void!

(Note): No low battery voltage detector is built-in the ARD9900.)

w. Internal speaker setting

Jumper setting

1 – 2 Activates internal speaker (default)

2 – 3 Disable internal speaker

Speaker output is also available from the pin #1 of the microphone connector.

(Note: *The SP OUT (external speaker output) has priority regardless of the above jumper setting.*

x. Output level setting

Jumper setting

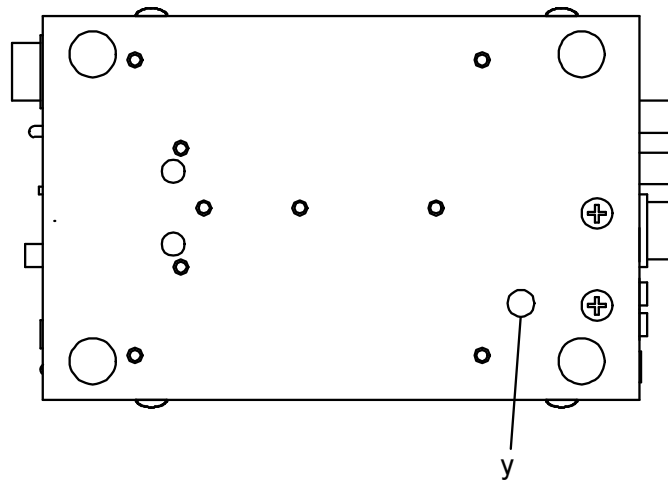
1 – 2 Normal level (default) (LOW)

2 – 3 High level (HIGH)

In case the microphone output level is too low to drive your radio equipment, place the jumper to the 2-3 position.

(Refer to: *Microphone Level Adjustment at page 13 for details.*)

Bottom View



y. Microphone output (Radio Input) level

(Refer to: Setting - Level Adjustment for Radio Input at 19 for details.)

Interfacing the ARD9900

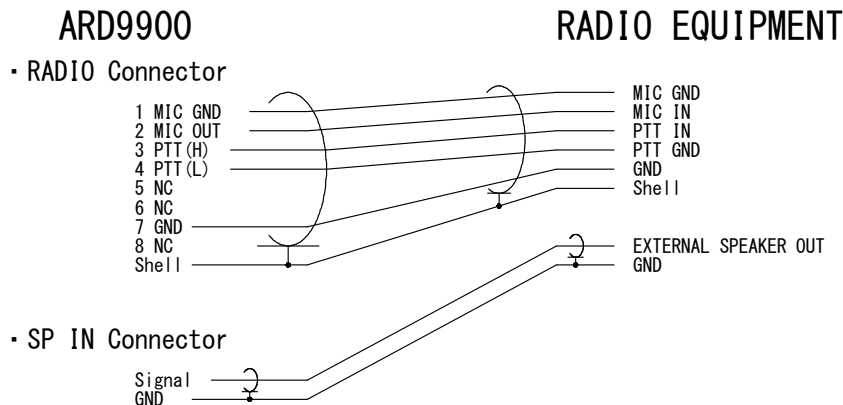
Connection to a Radio

Before using your ARD9900, you will first need to wire the cable between your radio equipment and the ARD9900.

For your convenience, an 8-pin of a microphone connector for the ARD9900 is included. You will need to prepare, however, your own microphone connector for your radio equipment.

Below are the pin assignments of the 8-pin RADIO connector on the rear panel of the ARD9900.

<u>Pin number</u>	<u>Signal</u>	<u>Details</u>
1	MIC GND	Microphone ground
2	MIC OUT	Microphone output
3	PTT (H)	PTT (Push To Talk) output
4	PTT (L)	PTT (Push To Talk) ground
5	NC	No connection
6	NC	No connection
7	GND	Ground
8	NC	No connection



(Note: MIC GND and GND must not be connected together in the ARD9900 connector, or RF feedback will result.)

Connection to a Microphone

A speaker microphone is included with your ARD9900. However, if you wish to use your own microphone with the ARD9900, you may do so by wiring your microphone to correlate with the input jack of the ARD9900. Below are the pin assignments of the Microphone connector of the ARD9900.

1. Speaker output
Monitor output signal is present at this pin when the internal speaker Jumper is set to 2 – 3.
2. BIAS
Power source for an electric condenser type of microphone. 5V DC through 2.2K Ω resistor.
3. GND
Chassis ground

4. TX
Taking this pin to the ground will enable to transmit.
(Same operation as the TX switch on the front panel.)
5. D/A
Taking this pin to the ground will force the ARD9900 to the Digital voice communication mode. When this pin is left open, the operation mode will be set by the mode switch on the front panel.
6. PTT
PTT (Push To Talk) input.
7. MIC GND
Microphone ground signal
8. MIC IN
Microphone signal input

Connection to a PC

A PC interface cable is included with the ARD9900.
Parameter settings can be made by using terminal software.
(Refer to: *Control Commands* at page 27 for details.)

Connection to a Power Supply

To operate your ARD9900, use a regulated power supply.
The operating voltage must be in the range of 10.7 ~ 16.0 V DC (approximately 200mA).
A DC power cable is also included with the ARD9900.

Color	Polarity
=====	=====
RED	Positive (+)
BLACK	Negative (-)

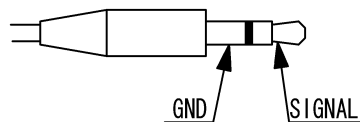
If you have changed the internal jumper for low-voltage battery operation, supplied voltage must be in the range of 5.6 ~ 6.5 VDC.

DO NOT apply 12.0 V or severe damage will result, and the warranty will be void!

Note: There is no low battery voltage detector built-in to the ARD9900.)

Connection to an External Speaker

If an external speaker is desired, connect it to the SP OUT jack. This will also disable the internal speaker.



Level Adjustment

Microphone Level

The microphone level has been properly adjusted at the factory with the provided microphone. Therefore, no further adjustment is needed for normal operation.

If you wish to use your own microphone rather than the included one, you will need to wire your microphone connector to match the pins of the ARD9900, and then adjust the microphone level as described in the following steps:

1. Power off the ARD9900.
2. Connect your microphone to the Microphone connector of the ARD9900.
3. Set the mode switch to [10101] (digital mode.)
4. Set the CHANNEL selector to [0].
5. Press and hold the TX switch, and power on the ARD9900. The STA LED starts blinking indicating the ARD9900 is in the microphone level adjustment mode.
6. While holding the PTT switch of the microphone, speak into microphone normally.
7. Slowly turn the [CHANNEL] selector clockwise until the overload indicator flashes occasionally, with the peaks of your voice signal.
8. Press the TX switch to set the digital voice level.
9. Release the PTT switch and set the mode switch to [~] (analog mode).
10. While holding the PTT switch of the microphone, speak into microphone normally.
11. While monitoring your analog voice signal with a receiver, slowly turn the [CHANNEL] selector clockwise until the same amount of voice level as in the digital mode is obtained.
12. Press the TX switch to set the analog voice level.
13. Power off the ARD9900 to complete the microphone level setting process.

Radio Input Level

Perform the following steps to adjust the radio input level of your radio equipment:

1. Connect the microphone to the ARD9900, and then connect the ARD9900 to your radio equipment. Finally, Connect the ARD9900 to a power supply.
2. Turn the output level adjustment on the bottom of the ARD9900 fully counterclockwise.
3. Turn the power on to the ARD9900.
4. Turn the power on to your radio equipment.
5. Set the mode switch to [10101] (digital mode.)
6. Press the [PTT] switch of the microphone to transmit from the radio equipment.
7. Adjust the microphone gain of the radio equipment until the ALC function just activates.
8. If the microphone gain is too low, readjust the output level on the bottom of the ARD9900.
9. In case the microphone gain is still too low after adjustment, turn off the ARD9900. Remove the top cover of the ARD9900, and set the output level setting jumper to [2-3] (high level).

Code Setting

Master Key code setting

A master key code is a password to allow the authorized operator access to System Management for maintenance. For your security, our factory default setting code MUST be changed with your own code prior to operation.

To change the Master Key code, type the [AMS] command using a PC.

```
CMD>AMA_123456789012 [CR]    (← Enter the factory default code.)  
                               ( _ : space key)
```

```
CMD>AMA OK                    (Response from PC)
```

```
CMD>AMS_***** [CR]        (Enter a new master key code.)
```

Note: The master key code consists of 12 digits of numeric code (0 ~ 9)
[Refer to: Control commands at page 27 for details.]

[Warning !]

The master key code MUST be kept in a secure place. Without a master key code, no code changes can be made.

If you made an entry error during an initial setting, correct it under the above entry screen. Once you exit from the master key code setting screen with a wrong code, neither you nor our factory can change it!

User ID code Setting

The User ID code is a unique code for individual ARD9900 units.

To change the ID code, first type the [AMA] command to allow the user to go into the Data management Menu.

```
CMD>AMA_***** [CR]    (← Enter the master key code.)
```

```
CMD>AMA OK                    (Response from PC)
```

```
CMD>AUI_***** [CR]    (Enter a new user ID code.)
```

Note: The user ID code consists of 5 digits of numeric code (0 ~ 9)
Default: 7777

[Refer to: Control commands at page 27 for details.]

Air Key code Setting

The Air Key code is a string of encryption code information that is attached to the front of the transmitted data packet.

To set the Air Key code, first type the [AMA] command to allow the user into the Data management Menu.

```
CMD>AMA_***** [CR]    (← Enter the master key code.)
```

```
CMD>AMA OK                (Response from PC)
```

```
CMD>AAK_**** [CR]        (Enter a new Air Key code.)
```

[Note]: The Air Key code consists of 4 digits of numeric code (0 ~ 9)
Default: 0000

[Refer to: Control command at page 27 for details.]

Channel Switch Setting

There are 16 different channel settings for the ARD9900. By simply rotating the channel switch on the front panel of the ARD9900 to the desired setting, a pre-programmed encryption mode can be easily recalled from the memory.

To set the Channel Switch setting, first type the [AMA] command to allow the user into the Data management Menu.

Rotate and select the desired channel switch position. (0 ~ F)

```
CMD>                        (Stand by for command)
```

```
CMD>AMA_##### [CR]    (Enter the master key code.)
```

```
CMD>AMA OK                (Response)
```

```
CMD>ACP_**** [CR]        (Enter a new Air Key code.)
```

[Note]: The Air Key code consists of 4 digits of numeric code (0 ~ 9)
Default: 0000

[Refer to: Control commands at page 27 for details.]

```
CMD>ACP [CR]              (Display current channel)
```

```
CH: $ _ ID: %%%_% _ NM: &&&& _ MD: $
```

(Setting for the current channel data)

```
CMD>                        (Stand by for command)
```

```
CMD>ACP_!!!!_@@@@_XX ZZ (Set current channel data)
```

```
CH: $ _!!!!_ NM: @@@@_ MD: $ (Response)
```

[Note: [\$], [%], [&], [!], [@], [X], [Z] --- Parameters]

Master code (12 digits of numeric code)
Default: 123456789012

CR Carriage Return (Press the Enter key of the PC keyboard)

\$ Channel number (Selected by the front channel switch)

_ Space (Press the space key of the PC keyboard)

%%%% Other party's ID (Other party's ID)

&&&&& Netmask (Current netmask)
 F: Netmask valid
 0: Netmask invalid
 \$ Communication mode
 (Displays the communication mode on the channel)
 0: Non encryption mode
 1: Digital squelch mode
 2: Fixed encryption mode
 3: Random encryption mode
 !!!!! Other party's ID (Set other party's ID)
 ID: 00000 ~ 99999
 @@@@@ Netmask (Set netmask valid / invalid)
 Enter "1" or "0" to each digit.
 1: Netmask valid
 0: Netmask invalid

[Note:] On the PC screen, "1" will be displayed as "F."

X X Setting mode 80: Non encryption mode
 00: Fixed encryption mode
 40: Fixed airkey random encryption mode
 50: Random encryption mode
 Z Z Algorithm Set communication algorithm

[Note:] When the communication mode is set to Non Encryption mode (80), then the algorithm must be set to either [0 0] or [01].
 00: Non encryption mode (default)
 01: Digital squelch mode

[Note:] When the communication mode is set to Fixed Encryption mode (00) or Random Encryption mode (40, 50), then the algorithm must be set as follows:
 00 ~ 79: Fixed Scramble Code
 80 ~ 99: Variable Scramble Code (every 20 mS)

[Note:] When you execute the ACP command, it will not display detailed communications settings or algorithm values. If you wish to adjust detailed settings, use the ADS command in the system management mode.

Operations

[**Note**: All adjustments must be properly performed before operation.]

Voice Communication

Your ARD9900 is capable of Digital or Analog Voice Communications. In the receive mode, the ARD9900 will automatically recognize the type of communication, and set itself to the appropriate mode. In the transmit mode, the desired operating mode can be selected by using the front panel Mode switch.

Digital Voice Communication

Set the mode switch [10101 ~] upward to the digital mode position [10101]. Rotate the Channel switch on the front panel to select the desired communication code setting. Press and hold the PTT switch on the microphone. The STA (Status) LED will flash for about One (1) second while sending a data header signal. When the LED stops flashing, speak into the microphone normally.

Analog Voice Communication

Set the mode switch [10101 ~] downward to the analog mode position [~]. Press and hold the PTT switch on the microphone, and speak into the microphone normally.

[**Note**: The front Channel switch setting will be ignored in the Analog Voice Communication mode.]

Force Receive

While in the Non Encryption mode (80) or Fixed code encryption mode (00) and a Header signal is not properly received during communication, you can “force” the ARD9900 to receive in the digital voice under following conditions:

- The communication mode is in the Non Encryption mode (80) or the Fixed Encryption mode (00).
- The frequency difference between both parties is within +/- 125 Hz.
- Both parties must have the same communication settings.

[Procedures]

1. Set the mode switch [10101 ~] upward to the analog mode position [~].
2. Press and hold the TX switch for about 5 ~ 10 seconds until an audio signal is heard from the speaker.
3. Once an audio signal is obtained, release the TX switch.

Data Communication

Run a terminal software program to control the ARD9900, and enter control commands.

[Refer to: Control Commands at page 27 for details.]

Two different types of data, ASCII or binary data, can be used. Both data types can be mixed as communication data.

Receive

Enter the command [ACO] to go into the converse mode. The received valid data will be decoded and displayed on the PC screen. If received data is missing, (which may occur during poor propagation conditions) “garbage” data may be displayed on the PC screen.

Transmit

Enter the command [ACO] to enter the converse mode.
Type text from the keyboard, when you have finished, hit the enter key.

NNNNNNNN [CR]

NNNNNNNN: ASCII character
[CR] : Carriage Return
[Note]: Maximum data length is 2046 bytes per packet.]

To send binary data, add [FE] (hexadecimal) to a header and footer with the data.

FE BBBBBBBBBBBBBBBB FE

BBBBBBBBBBBBBBBB: Binary data
FE : ID as a binary data
[Note]: If you need to insert the data [FE] in hexadecimal in the middle of the text, convert it into two (2) bytes of hexadecimal data.]

FE → FDD8
If you need to insert the data [FD] in hexadecimal in the middle of the text, convert it to two (2) bytes of hexadecimal data.

FD → FDDD
[Note]: Maximum data length is 2046 bytes per packet.]

At the receive side, the data will be automatically decoded and displayed on the PC screen.

If the [ALF] command is set ON, the LF (line feed) code will be added at the end of received data.

Digital Image Communication

Receive

When valid digital image data is received, it will be decoded and output as a video image from the VIDEO OUT connector.

If received data is missing during a transmission, that portion will be displayed as invalid (like noise).

Transmit

When pin - 4 of the microphone connector is grounded, the ARD9900 starts sending an image.

When the Video Through Function is activated (AVT command is ON), pressing the TX switch will enable output of the video signal connected to the Video Input also be sent to the video output port, so that you can monitor the video image. Press the TX switch again to capture the image and then transmit it through the radio equipment.

When the Video Through Function is de-activated (AVT command is OFF), pressing the TX switch will automatically capture the video image and then transmit it through the radio equipment.

A progress indicator will display on the monitor during image transmission.

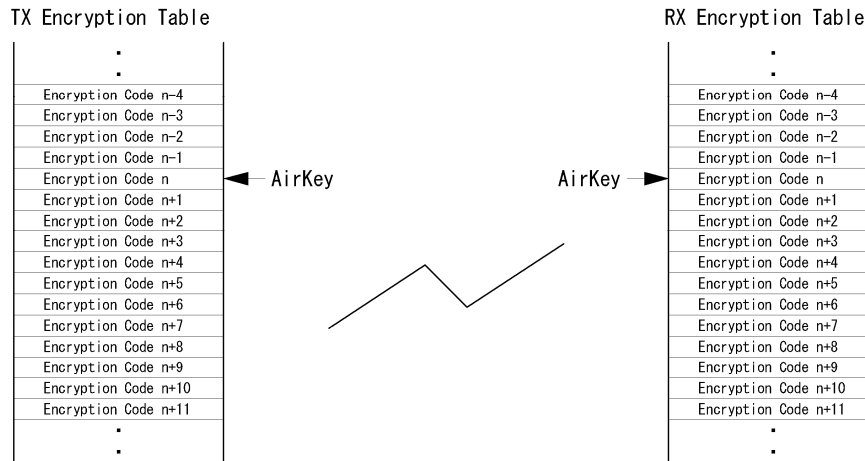
Specifications

Modulation Method	OFDM	Band Width: 300 Hz ~ 2.5 KHz, 36 carriers
	Symbol Rate	20 mS (50 Baud)
	Guard Interval	4 mS
	Tone Space	62.5 Hz
	Individual Tone Modulation Method	36 carriers: DQPSK(3.6K)
Frequency Offset	+/- 125 Hz AFC	
Error Correction	Data: Reed Solomon + Vitabi Decoder Voice: Golay + Hamming	
Header	1 second, 3 tone + BPSK training pattern for synchronization	
Digital Audio	AMBE ® 2020 Coder/Decoder	
Mode Selection	Receive: Automatic selection Transmit: <ul style="list-style-type: none"> ● Data communication mode: Automatic exchange according to TX request from PC. ● Digital voice mode: Manually selected by the mode switch ● Digital Image mode: Manually selected by pressing the TX switch ● Analog voice mode: Manually selected by the mode switch 	
Video Compression	AOR original JPEG format	
Video Input/output	NTSC or PAL depending on version	
Power Requirement	10.7 ~ 16 V DC (Approximately 200 mA @ 12 V DC) 6.0 V DC with battery operation (5.6 ~ 6.5 V DC)	
Communication	RS-232C Asynchronous, 9600 bps (setting / data) 115.2 kbps (image)	
I/O Connectors	Microphone: 8 – pin metal Radio: 8 – pin metal PC interface: Mini 8 – pin DIN Video In/Out: RCA Speaker In/Out: 3.5 mm mono jack Power: EIAJ type 4	
Dimensions	100 (w) x 32 (h) x 156 (d) (mm) 4 (w) x 1.3 (h) x 6.2 (d) (inches) Projections not included Weight: Approximately 600 g (1 lb – 5 oz)	

Specifications subject to change without prior notice for product improvement or modification.

Type of Communications and their respective features

Encryption Method



- Using the Master key and algorithm, the encryption table for the data encode is created. Therefore, the Master key and algorithm must be set to the same values for both the transmit and the receive units.
- The actual encryption code is selected from the encryption table by the Air Key.
- In the Fixed Encryption mode (Flag: 00), the transmit data does not contain the Air Key. At the receive end, therefore, the same Air Key must be obtained in advance to select the encryption code and decode the signals.
- In the Random Encryption Mode 1, 2 (Flag: 40), the Air Key selected at the transmit end is sent along with transmit data. At the receive end, the received data will be decoded by selecting the encryption table using the received Air Key.
- In the Random Encryption Mode 3, 4 (Flag: 50), the random number coded Air Key is sent along with transmit data. At the receive end, the received data will be decoded by selecting the encryption table using the received Air Key.
- In the Random Encryption Mode 2, 4 (algorithm 80 – 99), the encryption code will be changed in every 20 mSec. At the receive end, the received data will be decoded by changing the encryption code in every 20 mSec. in synchronization with the original Air Key.

Communication Selection Guidance

- The following is a list of communication modes for the ARD9900. Choose the most suitable communication mode for your applications.
- Factory default setting is the non encryption mode (Communication mode: 0).

Communication Mode	Mode	Setting		Function				
		Flag	Algorithm	Encript.	SQ	Air Key at RX	Air Key TX	Scramble
Non Encryption Mode	0	80	00	No	No	---	---	---
Digital Squelch Mode	1	80	01	No	Yes	---	---	---
Fixed Encryption Mode	2	00	00-79	Yes	No	Preset	No	Fixed
Random Encryption Mode 1	3	40	00-79	Yes	Yes	Received Air Key	Preset	Fixed
Random Encryption Mode 2	3	40	80-99	Yes	No	Received Air Key	Preset	Variable
Random Encryption Mode 3	3	50	00-79	Yes	Yes	Received Air Key	Random number	Fixed
Random Encryption Mode 4	3	50	80-99	Yes	Yes	Received Air Key	Random number	Variable

(Note: Encript: Encryption SQ: Squelch RX: Transmission)

- When the flag value is set to [80], enter the algorithm value for either [00] or [01] only. No other value must be entered.
- When the flag value is set to [00], enter algorithm value between [00] to [79]. No other value must be entered.

Scramble function will be valid only in the random encryption mode when the algorithm is set to between [80 – 99]. During the communication, the encryption code will be changed in every 20 mSec according to the algorithm

Communication Mode Setting

The communication setting is set into discrete channels.

[Procedures]

1. Using the AMA command, enter the System Management Screen.
2. Select the desired channel on the front panel.
3. Using the ACP command, set the desired communication mode setting.

To verify details of the setting, use the ACP command.

ACP [CR]

To verify details of the communication channel, use the ADS command.

ADS [CR]

[Example]

ACP [CR]

CH: 5 ID: 12345 NM: FFFFF MD: 0

CH: 5

Channel 5 is selected

ID: 12345

Destination ID is set to 12345

NM: FFFFF

Displays the nest mask setting. [F] is indicating the digit is valid.

MD: 0

Communication mode is [0] (Non encryption mode).

Detailed function of communication mode

[Caution: Communication mode must be set to the same for transmit end and receive end.]

Mode		Non encryption mode
Features		Non encryption. Factory default setting. Force receiving available
Setting	Flag	80
	Algorithm	00
Functions	Encription	No
	Squelch	No
	Air Key at RX end	---
	Air Key TX	---
	Rolling Code	---
Mode Code		0
Remarks		Factory default setting Non encryption

Mode		Digital Squelch mode
Features		Digital Squelch is available
Setting	Flag	80
	Algorithm	01
Functions	Encription	No
	Squelch	No
	Air Key at RX end	---
	Air Key TX	---
	Rolling Code	---
Mode Code		1
Remarks		Squelch will open or close by comparing the destination ID and value of the net mask with the receiver's user ID.

Mode		Fixed Encryption mode
Features		Effective against noise. Force receiving is available
Setting	Flag	00
	Algorithm	00-79
Functions	Encription	Yes
	Squelch	No
	Air Key at RX end	Use the Air Key set at the receive end
	Air Key TX	No
	Rolling Code	Fixed
Mode Code		2
Remarks		Air Key, Flag, Algorithm must be set to the same for both parties prior to communication

[Note]: A value of algorithm must be set between [00 ~ 79].

Mode		Random Encryption mode 1
Features		Communication can be made with the station that has Flag 40 or Flag 50. (The Master key and algorithm must be set to the same value.)
Setting	Flag	40
	Algorithm	00-79
Functions	Encryption	Yes
	Squelch	Yes
	Air Key at RX end	Use the Air Key in the transmit data
	Air Key TX	Send the preset code from the transmit end
	Rolling Code	Fixed
Mode Code		3
Remarks		Once algorithm is set to the same, communication can be made with the station that has Flag 40 or Flag 50. Since the Air Key is sent from the transmit end, it is not necessary to have the same Air Key at the receive end.

Mode		Random Encryption mode 2
Features		Communication can be made with the station that has Flag 40 or Flag 50. (The Master key and algorithm must be set to the same value.)
Setting	Flag	40
	Algorithm	80-99
Functions	Encryption	Yes
	Squelch	No
	Air Key at RX end	Use the Air Key in the transmit data
	Air Key TX	Send the preset code from the transmit end
	Rolling Code	Will change in every 20 mSec according to the algorithm
Mode Code		3
Remarks		Once algorithm is set to the same, communication can be made with the station that has Flag 40 or Flag 50. Since the Air Key is sent from the transmit end, it is not necessary to have the same Air Key at the receive end. The code will be scrambled and will change every 20 mSec.

Mode		Random Encryption mode 3
Features		Communication can be made with the station that has Flag 40 or Flag 50. (The Master key and algorithm must be set to the same value.)
Setting	Flag	50
	Algorithm	00-79
Functions	Encryption	Yes
	Squelch	Yes
	Air Key at RX end	Use the Air Key in the transmit data
	Air Key TX	Send the random coded Air Key from the transmit end
	Rolling Code	Fixed
Mode Code		3
Remarks		Once algorithm is set to the same, communication can be made with the station that has Flag 40 or Flag 50. Since the Air Key is sent from the transmit end, it is not necessary to have the same Air Key at the receive end. The code will be scrambled and will change every 20 mSec.

Mode		Random Encryption Mode 4
Features		Communication can be made with the station that has Flag 40 or Flag 50. (The Master key and algorithm must be set to the same value.)
Setting	Flag	50
	Algorithm	80-99
Function	Encryption	Yes
	Squelch	Yes
	Air Key at RX end	Use the Air Key in the transmit data
	Air Key TX	Send the random coded Air Key from the transmit end
	Rolling Code	Will change in every 20 mSec according to the algorithm
Mode Code		3
Remarks		Once algorithm is set to the same, communication can be made with the station that has Flag 40 or Flag 50. Since the Air Key is sent from the transmit end, it is not necessary to have the same Air Key with the receive end. The code will be scrambled and will change in every 20 mSec.

Control Commands

Interfacing to a PC

Using the supplied PC interface cable, connect between the COM connector at the rear panel (marked as [10101]) to the serial port of a PC.

[NOTE]: Be sure your PC's serial port is active. Check for correct hardware and software settings!]

Below are the pin assignments of the COM connector of the ARD9900.

ARD9900 COM connector

Pin #

1

2

3

4

5

6

7

8

GND

Serial connector of a PC (D-Sub 9 – pin)

Pin #

2

6

4

5

3

8

7

1

GND

Terminal Settings

Communication Speed:

Data Length:

Start Bit:

Stop Bit:

Parity:

Flow Control:

Local Echo:

Specifications:

9600 bps

8 bit

1

1

None

Hardware

None

RS-232C compatible

Command Format

Run a terminal software program, and then turn the power of the ARD9900 on.
The following message should appear on the PC screen:

```
CMD>
```

This indicates the ARD9900 is ready to accept commands from the PC.

Each command consists of three (3) alphabetical characters.

```
CMD>CCC_NN [CR]
```

CCC: Command (Must be a capital letter)
_: Space
NN: Parameter
[CR]: Carriage Return

Entering a command without a parameter will display the current parameter (value) setting.

```
CMD>CCC[CR]
```

If an invalid parameter or command is entered, the ARD9900 will respond as follows:

```
CMD>  
?  
CMD>
```

Entering the System Management Screen

Using the AMA command with the master key code, you can enter the System Management Screen.

```
CMD>AMA_***** [CR] (← Enter the master key code.)  
( _ : space key)
```

```
CMD> (Response from PC)
```

[Note] The master key code consists of 12 digits of numeric code (0 ~ 9).
The factory default is 123456789012]

[Warning !]

The master key code MUST be kept in a secure place. Without the proper master key code, no code changes can be made.

If you made an entry error entering a setting, correct it in the above entry screen.
If you exit from the master key code setting screen with a wrong code, neither you nor our factory can change it.

Each command consists of three (3) alphabetical characters.

```
CMD>CCC_NN [CR]
```

CCC: Command (Must be a capital letter)
_: Space
NN: Parameter
[CR]: Carriage Return

Entering a command without a parameter will display the current parameter (value) setting.

CMD>CCC[CR]

If an invalid parameter or command is entered, the ARD9900 will respond:

CMD>
?
CMD>

Operator's Command List

Command	Function
AAQ	Send VIDEO In signal to VIDEO OUT (to a monitor screen) Capture image into memory of the ARD9900
ACD	Display the last received sender's ID
ACN	Display the last received net mask
ACO	Enter the Converse mode
ACS	Display the last received sender's ID
ADC	List the current commands
ADS	Display current settings
AMA	Entering the System Management Screen
ATX	Send digital image
AVR	Display the current firmware version

Operator's command details

AAQ	
Function	Send VIDEO In signal to the VIDEO OUT (to the monitor screen) Capture image into memory of the ARD9900
Default	None
Format	AAQ {0 / 1} [CR]
Parameter	1: Send VIDEO In signal to the VIDEO OUT (to the monitor screen) 0: Capture image into memory of the ARD9900
Details	While AVT command is OFF, [AAQ 0] will be accepted. Entering AAQ[CR] will respond with the current status. AAQ ON --- Video signal is passed to the VIDEO OUT port AAQ OFF --- Video signal is not passed to VIDEO OUT
Example	AAQ_0 [CR]

ACD	
Function	Display the last received sender's ID
Default	12356
Format	ACD [CR]
Parameter	None
Details	Display the last received sender's ID
Example	ACD [CR]

ACN	
Function	Display the last received net mask
Default	FFF00
Format	ACN [CR]
Parameter	None
Details	Display the last received net mask
Example	ACN [CR]

ACO	
Function	Enter the Converse mode
Default	None
Format	ACO [CR]
Parameter	None
Details	Change from the command mode (displaying [CMD>] on the screen) to the converse mode. In the converse mode, characters and/or binary data can be sent. To return to the command mode, press the "C" key while holding the "Ctrl" (control) key.
Example	ACO [CR]

ACS	
Function	Display the last received sender's ID
Default	12356
Format	ACS [CR]
Parameter	None
Details	Display the last received sender's ID
Example	ACS [CR]

ADC	
Function	List the current commands
Default	None
Format	ADC [CR]
Parameter	None
Details	List the current commands
Example	ADC [CR]

ADS	
Function	Display current settings
Default	Headerlen: 1.00 AFC = ON Analog: ON UserID: 77777 CH: X ID: 00000 NM: 00000 MD: 0 X: Currently selected channel number
Format	ADS [CR]
Parameter	None
Details	Display current settings
Example	ADS [CR]

AMA	
Function	Entering to the System Management Screen
Default	123456789012
Format	AMA_ {000000000000 – 999999999999} [CR]
Parameter	000000000000 - 999999999999
Details	Entering the System Management Screen by entering the master key code.
Example	AMA_123456789012 [CR]

[Warning !]

The master key code MUST be kept in a secure place. Without a master key code, no code change can be made.

If you made an entry error during an initial setting, correct it under the above entry screen. Once you exit from the master key code setting screen with a wrong code, neither you or our factory can change it.

ATX	
Function	Send digital image
Default	None
Format	ATX [CR]
Parameter	None
Details	An image must be captured and stored into memory before it can be sent.
Example	ATX [CR]

AVR	
Function	Display the current firmware version
Default	None
Format	AVR [CR]
Parameter	None
Details	Displays the current firmware version
Example	AVR [CR]

Command List for the System Manager

- Note:** 1. The following commands are available under the system management screen only.
2. After any of the following commands have been changed, the ARD9900 must be turned power off, and then turned back on to reinitialize.]

Command	Function
AAK	Set an Air Key code
ACP	Set the transmit channel
ADC	Display the current commands
ADS	List the current commands
AFC	Set AFC on/off
AHL	Set the duration of the synchronous header signal
ALF	Select to add the LF code followed by the CR to the terminal
AMS	Change the master code key
APR	Reset the unit to the factory's default setting
ARA	Select to monitor digital voice/analog voice or digital voice
ATT	Set the output level of the ARD9900 to the radio
AUI	Set user ID
AVT	Activate/deactivate the video through function

Command details for the System Manager

AAK	
Function	Set an Air Key code
Default	0000
Format	AAK {0000 – 9999} [CR]
Parameter	{0000 – 9999}
Details	Set an Air Key code
Example	AAK_1111 [CR]

ACP	
Function	Set the transmit channel
Default	CH: X ID: 00000 NM: 00000 MD: 0 X: The current selected channel
Format	ACP _ {00000 – 99999} _ {each digit 1/0} _ {80/00/40/50}{00 – 99}[CR]
Parameter	<p>00000 – 99999 Other party's ID (Do not enter any character)</p> <p>Each digit 1/0 Net mask setting 0: Net mask / squelch invalid 1: Net mask / squelch valid (Note: the "1" will be displayed as "F" on the screen.)</p> <p>80/00/40/50 Flag setting 80: Non encryption communication mode 00: Fixed encryption communication mode 40: Random encryption communication mode 1 or 2 50: Random encryption communication mode 3 or 4 (Note: When the flag is set to [40], then the Random encryption mode 1 or 2 will be selected according to the value of algorithm.) When the flag is set to [50], then the Random encryption mode 3 or 4 will be selected according to the value of algorithm.</p> <p>00 – 99 Algorithm setting When the flag is set to [80], the algorithm MUST be set to 00 (Non encryption mode) or 01(Digital squelch mode.) When the flag is set to [00], the algorithm MUST be set between 00 – 79. When the flag is set to [40] or [50], the algorithm MUST be 00 – 79 (Fixed rolling code mode) or 80 – 99 (Variable rolling code in every 20 mSec.)</p>
Details	<p>Each channel can select any desired setting In the factory default setting, type ACP [CR] will display the following setting parameters.</p> <p>CH:0 ID:00000 NM:00000 MD:0 - - - - - - - - Communication mode - - - - [0] Non encryption mode - - - - [1] Digital squelch mode - - - - [2] Fixed encryption mode - - - - [3] Random encryption mode - - - - Net mask setting [1] valid, [0] invalid - Other party's ID {00000 – 99999} Channel switch number</p> <p>[Note: Using the ACP command will NOT display the algorithm Value. Use the ADS command instead.</p>
Example	<p>Channel: 8, ID: 12345, Net mask: 11100, Fixed encryption mode, algorithm: 20</p> <p>Set the channel switch to [8]. ACP_12345_11100_0020 [CR]</p>

ADC	
Function	Display the current commands
Default	None
Format	ADC [CR]
Parameter	None
Details	Display the current commands
Example	ADC [CR]

ADS	
Function	List the current commands
Default	Flag: 80 Algorithm: 00 Air Key: 0000 User ID: 77777 CH: X ID: 00000 NM: 00000 MD: 0 X: The current selected channel
Format	ADS [CR]
Parameter	None
Details	List the current commands
Example	ADS [CR]

AFC	
Function	Set AFC on/off
Default	ON
Format	AFC {ON/OFF} [CR]
Parameter	ON: AFC valid OFF: AFC invalid
Details	Set the AFC (Automatic Frequency Control) function on/off. In the SSB mode, the AFC function must be set to be valid. In the FM mode, the AFC function may be set to be invalid
Example	AFC_ON [CR]

AHL	
Function	Set the duration of the synchronous header signal
Default	1.00 (1 second)
Format	AHL {050 – 198} [CR]
Parameter	050 – 198 (0.02 incremental)
Details	Set the duration of the synchronous header signal. {100} means 1.00 second of duration.
Example	AHL_146 [CR] - - - Set AHL to 1.46 seconds

ALF	
Function	Select to add the LF code followed by the CR to the terminal
Default	ON
Format	ALF {ON/OFF} [CR]
Parameter	ON: Add LF after CR OFF: Does not add LF after CR
Details	Select to add the LF (Line Feed) code followed by the CR (Carriage Return) to the terminal
Example	ALF_ON [CR]
AMS	
Function	Change the master code key
Default	123456789012
Format	AMS_ {000000000000 – 999999999999} [CR]
Parameter	000000000000 - 999999999999
Details	Change the master code key
Example	AMS_111333444555 [CR]

[Warning !]

The master key code MUST be kept in a secure place. Without a master key code, no code change can be made.

If you made an entry error entering a setting, correct it in the above entry screen. Once you exit from the master key code setting screen with a wrong code, neither you nor our factory can change it.

APR	
Function	Reset the unit to the factory's default setting
Default	None
Format	APR [CR]
Parameter	None
Details	Reset the unit to the factory's default setting
Example	APR [CR]

ARA	
Function	Select to monitor digital voice/analog voice or digital voice
Default	ON
Format	ARA_ {ON/OFF} [CR]
Parameter	ON: Monitor digital voice and analog voice signal OFF: Only analog voice signal can be monitored
Details	Select to monitor digital voice/analog voice or digital voice
Example	ARA_ON [CR]

ATT	
Function	Set the output level of the ARD9900 to the radio
Default	ON
Format	ATT_{ON/OFF} [CR]
Parameter	ON: Select low level signal output to the radio OFF: Select high level signal output to the radio
Details	Set the output level of the ARD9900 to the radio
Example	ATT_OFF [CR] - - - Select high level output

AUI	
Function	Set user ID
Default	77777
Format	AUI_{00000 – 99999} [CR]
Parameter	00000 – 99999
Details	Set user ID. The user ID is used in the digital squelch mode
Example	AUI_12345 [CR]

AVT	
Function	Activate/deactivate the video through function
Default	ON
Format	AVT_{ON/OFF}[CR]
Parameter	ON: Activate the video through function OFF: Deactivate the video through function
Details	When the AVT is set to ON, pressing the TX switch will display the “live” image on the screen. Pressing the TX switch again will capture the image and send it from the ARD9900. When the AVT is set to OFF, pressing the TX switch will automatically capture the image and send it from the ARD9900.
Example	AVT_ON [CR]

Manufacturer: AOR, LTD.
2-6-4, Misuji, Taito-Ku,
Tokyo, 111-0055, Japan
URL: www.aorja.com

US distributor: AOR USA, INC.
20655 S. Western Ave. Suite 112
Torrance, CA 90501
Phone: 310-787-8615
Fax: 310-787-8619
URL: www.aorusa.com
e-mail: info@aorusa.com

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