AOR®

MULTI-DIGITAL VOICE DECODER
ARD300

User Manual

AOR Ltd.
Authority On Radio Communications

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1. Introduction

Thank you for purchasing the ARD300 MULTI-DIGITAL VOICE DECODER.

AOR proudly brings a solution to a common problem the listening enthusiasts are facing: There are less and less signals to listen to with a traditional analog receiver, as digital communication slowly but surely is replacing analog communication. This is where ARD300 comes in place!

ARD300 is a digital voice decoder to be connected to a radio receiver's I.F output.
This powerful device offers many great features as follows:

- Decodes popular amateur digital voice modes from Icom (D-Star), Alinco and Yaesu[*1].

- Decodes popular commercial digital voice modes dPMR[*2] and NXDN[*3], as well as APCO 25 (Phase 1, conventional mode) used by U.S military and diplomatic services around the world.

- Compatible with AOR legacy receivers AR8600MK2, AR5000(A/+3)[*4], AR-ONE[*4] and newer AR2300, AR5001D, AR6000.

- Even supports any other brand's receiver[*4], featuring a 10.7MHz or 45.05MHz I.F output. [*5]

- When connected to the receiver's audio-out, its internal speaker can output both the analog signals and the decoded digital voice.

*1 V/D mode only.
*2 dPMR446 and Tier 1 modes only.
*3 6.25kHz mode only.
*4 ARD300 needs to be powered by a (non supplied) external power source.
*5 Not all 3rd party receivers have been tested. Some receivers might be incompatible for unknown reasons. AOR support strictly limited to use with AOR receivers.

To obtain best possible results from your ARD300, we strongly recommend that you read this manual before use and familiarize yourself with ARD300.

Every effort has been made to make this manual correct and up to date. Due to continuous development of this device, we acknowledge that there might be some errors or omission anomalies.

> CAUTION: The interception and decoding of some digital voice modes might be restricted by law in some countries. Be sure to check this matter with your local authorities.

Other company and product names mentioned in this manual are the property of their respective owners.

2. To read before use

Supplied accessories

1. DC cable For power sharing, when the receiver used is either AR8600MK2, or AR2300/5001D/6000.	1
2. DC cable (open-end) Use this cable to connect ARD300 to your own power supply; in case ARD300 cannot share power with the receiver.	1
3. IF cable	1
4. Audio cable	1
5. Printed user manual	1

Compatible AOR receivers

AR8600MK2
AR5000
AR5000A
AR5000A+3
AR-ONE
AR2300
AR5001D
AR6000

Compatibility with non-AOR receivers

ARD300 supports any other brand's receiver featuring a 10.7MHz or 45.05MHz I.F output, under following conditions:

-I.F carrier-to-noise floor ratio must be sufficient for good quality decoding. Ideal value approximately 100dBc/sec.
-Receiver step size should be set at 6.25kHz to avoid frequency mismatch.
-Tuned frequency should not be more distant than 1kHz from received signal, for error free decoding.

Not all 3rd party receivers have been tested. Some receivers might be incompatible for unknown reasons.
The quality of the digital voice decoding does depend on the receiver's sensitivity.
AOR support is limited to use with AOR receivers.

Power supply

ARD300 requires a (non-supplied) 12V DC power supply of minimum 450mA.
Use the supplied "open-end" DC cable to connect ARD300 to your power supply.

However, when used in combination with the AOR AR8600MK2、AR2300、AR5001D、

AR6000 receivers, the supplied DC cable allows ARD300 to share the receiver's AC adapter. In that case ARD300 is able to detect the receiver's ON/OFF state and switches itself ON whenever the receiver is ON.

CAUTION when sharing the AR5001D/6000 power supply:

To switch the receiver ON or OFF, be sure to use the receiver's FRONT PANEL power switch, rather than the back panel's main power switch. ARD300 could be damaged by the important power fluctuations when the back panel's main power switch is used.

ARD300 device settings back-up:

Device settings such as receiver, volume level, digital mode and confidential code selection are saved in the device's internal memory. ARD300 will be in the same state when switched ON, as it was before being switched OFF.

CAUTION: Settings might not be saved correctly when ARD300 is not powered OFF in the proper way, such as when the power supply is suddenly interrupted.

LCD display

At lower temperatures, the LCD might respond slower than usual, this is not a malfunction.

3. Digital voice mode compatibility chart

DIGITAL MODE	BANDWIDTH	MODE	VARIOUS	COMPATIBLE VOCODER	ARD300 VOICE DECODING
D-STAR	12.5kHz			AMBE	O
ALINCO DIGITAL	12.5kHz			AMBE	O
YAESU DIGITAL	12.5kHz	V/D mode		AMBE+2	O
	12.5kHz	Voice FR mode			X
DIGITAL CR	6.25kHz		NON-ENCRYPTED	AMBE+2	O
	6.25kHz		ENCRYPTED	AMBE+2	X
NXDN	6.25kHz	REGULAR MODE	NON-ENCRYPTED	AMBE+2	O
		REGULAR MODE	SCRAMBLED	AMBE+2	O
			ENCRYPTED		X
			TRUNKING		X
	12.5kHz				X
DPMR	6.25kHz	dPMR446		AMBE+2	O
	6.25kHz	TIER 1		AMBE+2	O
		TIER 2			X
		TIER 3			X
P25	6.25kHz & 12.5kHz	PHASE 1	NON-ENCRYPTED	IMBE	O
		PHASE 1	ENCRYPTED		X
		PHASE 2			X

ARD300 might sometimes misinterpret white noise as a digital mode and try to decode it. This does not represent a device malfunction.

The D-Star call-sign might sometimes not appear on the LCD screen. The most likely reasons are:

-ARD300 did not receive the header at the beginning of each transmission, as the header contains the call-sign data. This is likely to happen during receiver SCAN or SEARCH.
-Poor quality of the received signal.

The D-Star call-sign information might sometimes disappear in the middle of a transmission. The cause for this is sudden interruption of the signal, due to poor reception conditions. Whenever this happens, ARD300 will indicate "BSY D-STAR" and wait for the next valid transmission header containing the call-sign information.

The ARD300 decoding being based on the receiver's IF OUT signal, the receiver's reception mode setting does not matter. Nevertheless for SCAN and SEARCH, the receiver's squelch has to be set properly in order to correctly stop on the desired signal.

4. Panels

Front panel

①	PHONE socket	Φ3.5mm stereo jack for earphones and head phones. Left & right channels identical.
②	LCD display	Alphanumeric display, 8 characters x 2 lines
③	▲ UP key	Volume up or menu selection change
④	▼ DOWN key	Volume down or menu selection change
⑤	ENTER key	To access the set-up menu and validate a selection. Press and hold to enter Digital CR ID code.
⑥	ESC Escape key	Exit the present selection. Access the receiver selection menu.

Rear panel

①	IF IN IF signal input	BNC connector (50Ω) Receiver's IF signal must be either 10.7MHz or 45.05MHz.
②	SP IN Speaker input	Φ3.5mm jack, mono (input resistance 2kΩ, maximum voltage 10V p-p) Connect to receiver's speaker output with supplied audio cable.
③	SP OUT Speaker output	Φ3.5 mm jack, mono (8Ω, 1W) for external speaker.
④	SERVICE Service socket	D-SUB 9pin, male. For factory maintenance and firmware upgrade.
⑤	DC12V OUT Power output	Used to power the receiver when ARD300 and the receiver share the same power source. (12V@2A max.)
⑥	DC12V IN Power input	Connect a (non-supplied) power source. Open-end DC cable supplied.

⑦	Power switch	When ARD300 and receiver share the same power source:
		  OFF (0): Receiver is powered while ARD300 switches on/off automatically in synch with the receiver.
		  ON (I): Both receiver and ARD300 are powered.
		When ARD300 has its own power source:
		  OFF (0): ARD300 is off.
		  ON (I): ARD300 is on.

5. Connect ARD300 to AR8600MK2

Use the supplied IF, DC and audio cables.

The power supply used is the AR8600MK2 AC adapter, which will power both units simultaneously.

- Connect one end of the supplied IF cable to the IF output of the receiver, and the other end to the IF IN socket of ARD300.

- Connect one end of the supplied DC cable to the DC 12V socket of the receiver. And the other end to the DC 12V OUT socket of ARD300.

- If you would like the ARD300 internal speaker to output both the analog signal audio and the decoded digital audio, connect the supplied audio cable to the receiver's EXT SP socket and the SP IN socket of ARD300.

- At last, plug in the AC adapter's DC plug into the DC12V IN socket of ARD300.

Proceed to chapter 10 "Receiver menu setup of ARD300".

Known issues with the AR8600MK2 IF signal output

- By design, the AR8600MK2 IF signal's center frequency might fluctuate +/-10kHz from its center frequency 10.7MHz. Fortunately ARD300 is able to compensate for this shifting by searching for and locking to the IF signal peak. Nevertheless it has been noticed that in some cases of a strong signal close to the tuned frequency, ARD300 might wrongly lock to the adjacent signal rather than on the IF center signal, and therefore miss the digital signal to decode.

- Specificity to D-STAR decoding: Whenever ARD300 has to search for the IF peak to lock onto, it might in some cases miss the call-sign information which is located in the signal header, at the very beginning of each transmission.

- By factory default, the IF signal of AR8600MK2 is output in WFM mode only to minimize the effects of internal spurii. Using SEARCH to find narrow-band digital transmissions in WFM mode can produce unexpected results as the receiver might not to stop on the signal's exact frequency. This is not an issue when using the SCAN function or simple VFO reception.

  Fortunately there are 2 workaround solutions to obtain IF in ALL MODES, by applying simple hardware modifications to the receiver:

Receiver status	IF OUT frequency & mode	ARD300 selection	Operating characteristics
1. Factory default	10.7MHz WFM only	AR86 10	SEARCH results unreliable due to too wide mode.
2. Hardware modified for all mode IF out.	10.7MHz All modes	AR86 10	NFM can be used for SEARCH
3. Hardware modified to change IF to 45.05MHz	45.05MHz All modes	AR86 45	NFM can be used for SEARCH but receiver sensitivity decreased by 9dBm.

How to enable 10.7MHz IF output in all modes

Level of difficulty: Intermediate (soldering required)

Only apply the following hardware modification if you have some experience in soldering on a PCB. <u>Proceed at your own risk</u>! AOR should not be held responsible for any receiver damage. If you don't feel confident, it is strongly advised to get help from a qualified technician.

By factory default, the WFM heterodyne is used to generate a 10.7MHz IF output. IF output is enabled in WFM mode only, but to use the IF output in all modes, a zero Ohm link needs to be moved inside the radio, this requires the use of a soldering iron. This arrangement is designed to minimize the potential for internally generated spurii when the 10.7MHz IF output is not going to be used.

To enable the output on all modes, simply remove resistor R218 (0 Ohm jumper) and fit R219 (0 Ohm jumper). These resistor positions are located on the large main receive board on the underside of the set.

To gain access, remove the top and bottom covers.

Then remove the top and bottom chassis covers (three screws down each edge of both covers and three black threaded screws through the board. Don't forget to unplug the speaker wire (it plugs in J7, the other socket is for the optional battery).

With the set upside down and the front panel facing you R218 and 219 are located in the front left hand corner about 13mm back from the left hand 9 wire connector and 15mm in from the side.

The components are too small to illustrate in the diagram below but it gives a general idea of where to look. R218 is marked as 000 and is fitted to the board. R219 is located alongside R218 (two solder pads are visible and it is not fitted). Both are located directly behind a small feed through hole in the board.
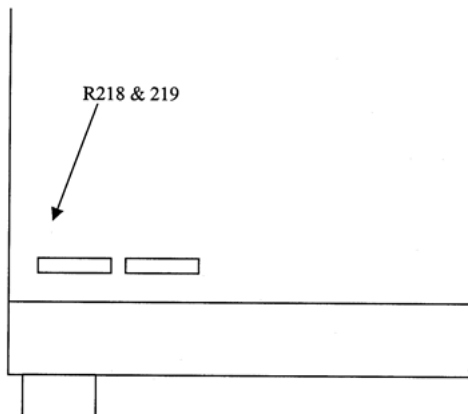
How to change the IF output from 10.7MHz to 45.05MHz

Level of difficulty: Easy (no soldering required)

Only apply the following hardware modification if you have some experience in opening a receiver and manipulating a coaxial cable. <u>Proceed at your own risk</u>! AOR should not be held responsible for any receiver damage. If you don't feel confident, it is strongly advised to get help from a qualified technician.

By factory default, IF output is set at 10.7MHz but functions in WFM mode only.

Nevertheless there is the possibility to change the IF out frequency from 10.7MHz to 45.05MHz where ALL MODE is supported. To do this, a coaxial cable needs simply to be unplugged and plugged into another socket, as pictured below.

Drawback of this method: Receiver overall sensitivity is reduced by 9dBm, which can be an issue for reception of weak signals.

To gain access to the PCB, remove the top cover.

Remove the top chassis cover (three screws down each edge of the cover).

With the back panel facing you, just unplug and relocate the coaxial cable as pictured below.
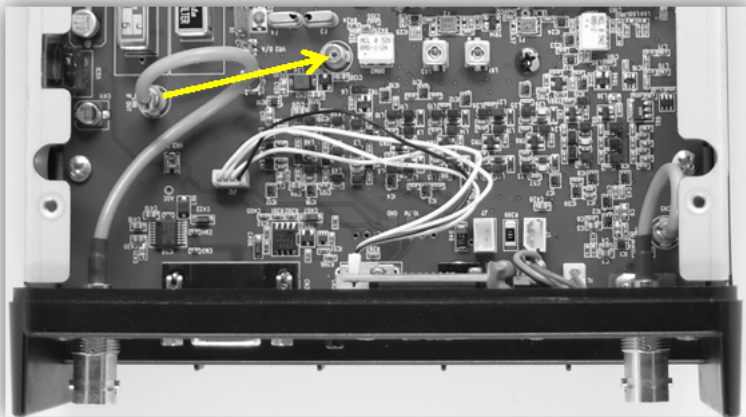
6. Connect ARD300 to AR5000/5000A/5000A+3

Use the supplied IF, (open-end) DC and audio cables.

First, the receiver's IF filter needs to set properly:

- Press the FUNC key followed by the kHz key.
- Press the UP key twice.
- Rotate the sub dial to select EXT-IF 1.
- Validate with the ENT key.

Each unit needs its own power source; therefore you will need to supply the power source for ARD300. If you happen to own the AR8600MK2 receiver, you can use its AC adapter AA8600. (The AA2300 adapter of AR2300/5001D/6000 can be used as well)

- Connect ARD300 to your power supply by using the supplied "open-end" DC cable.
- Connect one end of the supplied IF cable to the IF OUT socket of the receiver, and the other end to the IF IN socket of ARD300.
- If you would like the ARD300 internal speaker to output both the analog signal audio and the decoded digital audio, connect the supplied audio cable to the receiver's EXT SP socket and the SP IN socket of ARD300.

Proceed to chapter 10 "Receiver menu setup of ARD300".

7. Connect ARD300 to AR2300

Use the supplied IF, DC and audio cables.

The power supply used is the AR2300 AC adapter, which will power both units simultaneously.

- Connect one end of the supplied IF cable to the IF OUT socket of the receiver, and the other end to the IF IN socket of ARD300.

- Connect one end of the supplied DC cable to the DC 12V socket of the receiver. And the other end to the DC 12V OUT socket of ARD300.

- If you would like the ARD300 internal speaker to output both the analog signal audio and the decoded digital audio, connect the supplied audio cable to the receiver's SP OUT socket and the SP IN socket of ARD300.

- At last, plug in the AC adapter's DC plug into the DC12V IN socket of ARD300.

Proceed to chapter 10 "Receiver menu setup of ARD300".

8. Connect ARD300 to AR5001D/6000

Use the supplied IF, DC and audio cables.

The power supply used is the AR5001D/6000 AC adapter, which will power both units simultaneously.

- Connect one end of the supplied IF cable to the IF OUT socket of the receiver, and the other end to the IF IN socket of ARD300.

- Connect one end of the supplied DC cable to the DC 12V socket of the receiver. And the other end to the DC 12V OUT socket of ARD300.

- If you would like the ARD300 internal speaker to output both the analog signal audio and the decoded digital audio, connect the supplied audio cable to the receiver's SP OUT socket and the SP IN socket of ARD300.

- At last, plug in the AC adapter's DC plug into the DC12V IN socket of ARD300.

Proceed to chapter 10 "Receiver menu setup of ARD300".

9. Connect to non-AOR receivers

Compatibility with receivers of other brands

ARD300 supports any receiver featuring a 10.7MHz or 45.05MHz I.F output, under following conditions:

-I.F carrier-to-noise floor ratio must be sufficient for good quality decoding. Ideal value approximately 100dBc/sec.
-Receiver step size should be set at 6.25kHz to avoid frequency mismatch.
-Tuned frequency should not be more distant than 1kHz from received signal, for error free decoding.

Not all 3rd party receivers have been tested. Some receivers might be incompatible for unknown reasons.
The quality of the digital voice decoding does depend on the receiver's sensitivity.
AOR support is limited to use with AOR receivers.

The supplied IF, DC and audio cables are designed to be used with AOR receivers.
If your non-AOR receiver is equipped with sockets of different types, the supplied AOR cables will be incompatible. You will need to prepare your own cables.

- Make sure that your receiver is set properly in order to output either a 10.7MHz or 45.05MHz IF signal.
- Connect ARD300 to your power supply by using the supplied "open-end" DC cable.
- Connect one end of the supplied IF cable to the IF OUT socket of the receiver, and the other end to the IF IN socket of ARD300.
- If you would like the ARD300 internal speaker to output both the analog signal audio and the decoded digital audio, connect the supplied audio cable to the receiver's EXT SP socket and the SP IN socket of ARD300.

Proceed to chapter 10 "Receiver menu setup of ARD300".

10. Receiver menu setup of ARD300

1）The radio receiver is switched OFF.

2）Switch ARD300 ON. The switch is located on the rear panel.
The firmware version will be displayed.

```
ARD300
Ver.309F
```

The start-up procedure is complete when a white dot is flashing slowly at the lower right corner.

3）Press the ESC key for 2 seconds to enter the receiver selection menu.

```
RECEIVER
>AR86 10
```

4） With the ▲ or ▼ key, scroll through the receiver selection menu until the name corresponding to you receiver is displayed, and validate with the ENTER key.

ARD 300 display	Receiver type
AR86 10	AR8600MK2 (set to 10.7MHz IF)
AR86 45	AR8600MK2 (modified for 45.05MHz IF)
AR5000A	AR5000, AR5000A, AR5000A+3
AR5001D	AR5001D
AR6000	AR6000
AR2300	AR2300
AR8200	For Japanese AR8200MK3 model only
IF 10.7	For non-AOR receiver with 10.7MHz IF output
IF 45.05	For non-AOR receiver with 45.05MHz IF output

The LCD will display "NOW WRITING" while saving your settings.

5）The saving procedure is complete when a white dot is flashing slowly at the lower right corner.
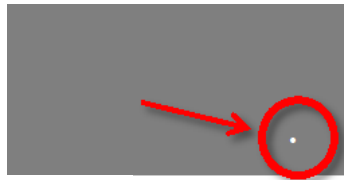
Volume control

Press the ▲ key to increase, or ▼ key to decrease the decoded digital sound volume. Volume adjustable from 0 to 9.

This volume control operates only for the decoded digital transmission. Volume of analog signals is unaffected and should be adjusted on the receiver side.

11. Digital mode selection menu

While in stand-by mode…

(slowly flashing dot)

…press the ENTER key to access the digital mode format selection menu.

MODE
>AUTO

Use the ▲ or ▼ key to scroll through the digital format list and validate your choice with the ENTER key.

To leave this menu without making any changes, press the ESC key.

Following digital voice modes can be decoded by ARD300:

Digital modes	Digital format
AUTO	Auto detection of digital format
P-25	APCO 25
D-CR	Japanese Digital CR or NXDN
YAESU	YAESU digital
D-STAR	D-STAR
ALINCO	ALINCO digital
dPMR	dPMR (Digital Private Mobile Radio)

While AUTO is the most convenient mode when you don't know what kind of signals to expect, it is the slowest mode since ARD300 needs some time to analyze the signal and decide which mode to apply.

Whenever it has detected a compatible digital signal to decode, BSY (for BUSY) is displayed on the upper line (while it is reading the signal header information) and the digital format on the lower line.

BSY
P-25

Presetting a particular mode can be interesting to shorten that detection time, providing that you know in advance what kind of digital format will be received.

If you manually selected a specific digital format to be decoded, its name will be displayed, as follows (example for Digital CR mode):

12. Decoding D-STAR

To find active D-STAR frequencies in your area, you may want to check the very informative and worldwide D-Star Repeater Directory site at http://dstarusers.org/repeaters.php.
When scanning the listed repeater frequencies, we definitively advise that you manually select "D-STAR" in the mode selection menu of ARD300.

When a D-STAR signal is being decoded, ARD300 does display the call-sign name and other user information as follows. The information appears in a looped cycle until the next transmission.

Fr (Station 1 call sign with the first six characters)
All eight characters displayed on following screen.

Fr(ABCDEF)

Station 1 call sign, eight characters

(ABCDEFGH)

Call sign 2, four characters

/(JKLM)

To (Other station's call sign with the first six characters)
All eight characters displayed on following screen.

To(DEFGHI)

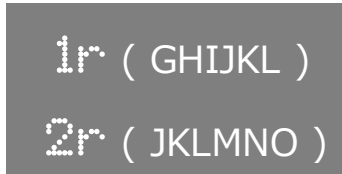Other station's call sign 1, eight characters

(DEFGHIJK)

1r (Repeater 1 call sign with the first six characters)

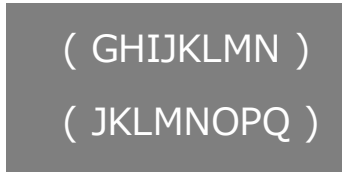All eight characters displayed on following screen.

2r (Repeater 2 call sign with the first six characters)

All eight characters displayed on following screen.

Repeater 1 call sign, eight characters

Repeater 2, eight characters

1r (GHIJKL)

2r (JKLMNO)

(GHIJKLMN)

(JKLMNOPQ)

Going back to **Fr** display and looping the same information until the next transmission.

Whenever a new transmission is detected, ARD300 will first complete its current display loop cycle, before starting a new display cycle with information of the new transmission.

13. Encryption code setting (Digital CR only)

Digital CR (also called "Digital Convenience Radio") is a digital standard used at 351MHz and is limited to Japan.
This standard exists in both unencrypted and encrypted modes, although there are only 32767 different encryption codes, from 00001 to 32767.
If you know the encryption code, it is possible to set this code into ARD300 to allow decoding of the encrypted Digital CR signal.

Note: In case of a non-encrypted transmission, ARD300 will simply decode it, no matter what code you have set.

When the received signal is unencrypted, the LCD will display "D-CR",
When the received signal is encrypted, the LCD will display "D-CR E". ARD300 can only decode this encrypted digital signal if you have set the correct encryption code.

How to manually set the encryption code:

① Press the ENTER key for 2 seconds. The currently set 5 digit encryption code will appear as follows:

The arrow represents the cursor location.

```
00001
∴
```

② With the ▲ and ▼ keys, move the cursor to the desired digit.

③ Press ENTER to select that digit. The arrow will change to a star.

```
00001
✳
```

④ Change the value of that digit by using the ▲ and ▼ keys.

```
00901
✳
```

⑤ Validate your choice with ENTER. The star has now become an arrow again.

To change the other digits, repeat steps ② to ⑤.

When you have finished entering the entire code, press ESC.

14. Firmware update

Whenever a new firmware is released, the new firmware file and the update utility will be made available on our website at http://www.aorja.com/support/software.html

A device RESET is necessary after performing a firmware update.

15. Device RESET

If you need to reset the device to its default settings, proceed as follows:

Power ON the device while pressing and holding the ENTER and ESC keys for about 5 seconds, until the firmware version is displayed.

16. Specifications

Item name: ARD300 Multi-Digital Voice Decoder

Supported modes／modulations／vocoders

         D-STAR／GMSK／AMBE

         ALINCO／GMSK／AMBE [*1]

         YAESU／C4FM／AMBE+2 [*2]

         DIGITAL CR／C4FM／AMBE+2 [*3]

         NXDN／C4FM／AMBE+2 [*4]

         dPMR／C4FM／AMBE+2 [*5]

         P25 (Phase1)／C4FM／IMBE [*6]

Signal input	10.7MHz or 45.05MHz @50Ω
Power requ.	10.7～16V DC
Power cons.	At 12V DC, 300mA in stand-by.　Max. 450mA.
Audio output	Internal speaker: 0.2W @12V DC.
	External speaker:1W 10% THD (8Ω)@12V DC.
Operat. temp.	0 ～ 50℃
Dimensions	103(W)×45(H)×180 (D)mm　(projections excluded)
Weight	Approx. 720g

(*1)	Only with digital unit EJ-47U(voice mode F1E).
(*2)	V/D mode only.
(*3)	Japanese "Digital Convenience Radio" standard (351MHz).
	AMBE+2 system only.
(*4)	6.25kHz mode only.
(*5)	dPMR446 and Tier1 mode only.
(*6)	Non-encrypted, conventional mode only.

AOR is a member of the dPMR (Digital Private Mobile Radio) Association.

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