

Wi-Fi& Bluetooth Internet of Things Module

RIGEL

Datasheet

Including:

W11261889



Version 1.3
Espressif Systems
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About This Document

This document introduces the specifications of RIGEL REV C.

Release Notes

Date	Version	Release notes
2018.05	V1.0	First release.
2018.10	V1.1	Updated the part numbers; Updated Table 4-4. Wi-Fi Radio Characteristics; Updated Schematics.
2018.08	V1.2	Updated the flash size from 8 MB to 16 MB; Upgraded REV B to REV C.
2018.10	V1.3	Added information on IPEX/U.FL antenna in Chapter 1; Added notes on storage temperature range and operating temperature range in Chapter 4; Updated Figure 6-1. Dimensions of RIGEL REV C.
2018.11	V1.4	Added information on PCB antennas in Chapter 1.

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1.

Overview

RIGEL REV C is an ESP32-based customized module developed by Espressif for Whirlpool.

- W11261889, which features two PCB antennas plus one IPEX/U.FL antenna.

RIGEL REV C features an 16 MB external flash. The ordering information of RIGEL REV C is listed in Table 1-1.

Table 1-1. Ordering Information of RIGEL REV C

Part number	Embedded chip	Flash	Antenna
W11261889	ESP32-D0WD	16 MB	2 × PCB antennas, 1 × IPEX/U.FL antenna

At the core of the module is ESP32-D0WD chip, one of the SoCs among the ESP32 series. The chip contains two low-power Xtensa® 32-bit LX6 microprocessors that can be individually controlled, and the CPU clock frequency is adjustable from 80 MHz to 240 MHz. The user may also power off the CPU and make use of the low-power co-processor to constantly monitor the peripherals for changes or crossing of thresholds. The chip integrates a rich set of peripherals, ranging from capacitive touch sensors, Hall sensors, SD card interface, Ethernet, high-speed SPI, UART, I²S and I²C.

ESP32-D0WD's internal memory includes:

- 448 KB of ROM for booting and core functions.
- 520 KB of on-chip SRAM for data and instructions.
- 8 KB of SRAM in RTC, which is called RTC FAST Memory and can be used for data storage; it is accessed by the main CPU during RTC Boot from the Deep-sleep mode.
- 8 KB of SRAM in RTC, which is called RTC SLOW Memory and can be accessed by the co-processor during the Deep-sleep mode.
- 1 Kbit of eFuse: 256 bits are used for the system (MAC address and chip configuration) and the remaining 768 bits are reserved for customer applications, including flash-encryption and Chip-ID.

Note:

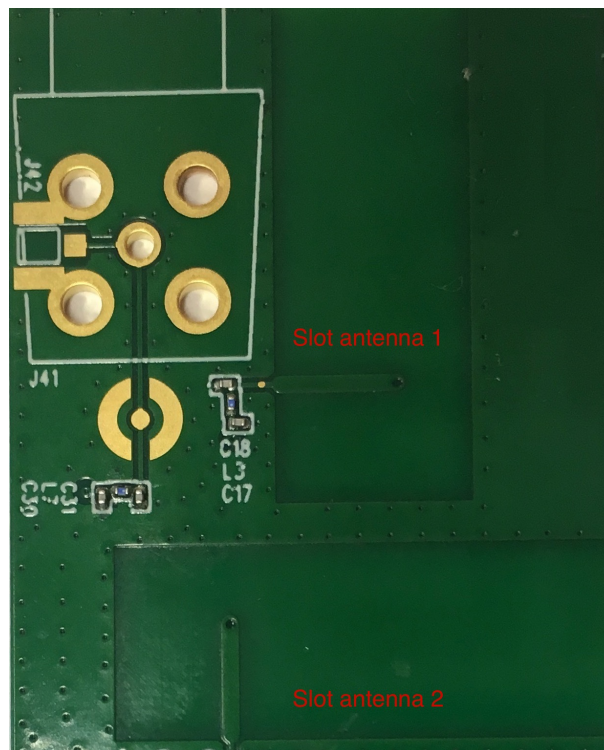
For more information on ESP32, please refer to [ESP32 Datasheet](#).

The two PCB (slot) antennas supported on RIGEL REV C have the following specifications listed in Table 1-2:

Table 1-2. Specifications of Slot Antennas

Description	Slot antenna 1	Slot antenna 2
Storage temperature range		-40 °C ~ +150 °C
Operating temperature range		-40 °C ~ +85 °C
Frequency range		2.4 GHz ~ 2.5 GHz
Peak gain	3.56 dBi	4.20 dBi
Total efficiency	71.91%	87.43%

Figure 1-1 shows the two slot antennas.





The IPEX/U.FL antenna supported on the W11261889 has the following specifications listed in Table 1-2:

Table 1-2. Specifications of IPEX/U.FL Antenna

Description	Specifications
Cable length	100 mm
Storage temperature range	-40 °C ~ +95 °C
Operating temperature range	-30 °C ~ +85 °C
Frequency range	2.4 GHz ~ 2.5 GHz
Peak gain	3.0 dBi
Total efficiency	>75%
Return loss	<-10 dB
Polarization	Linear
Input impedance	50 Ohms

The figure below shows the IPEX/U.FL antenna.

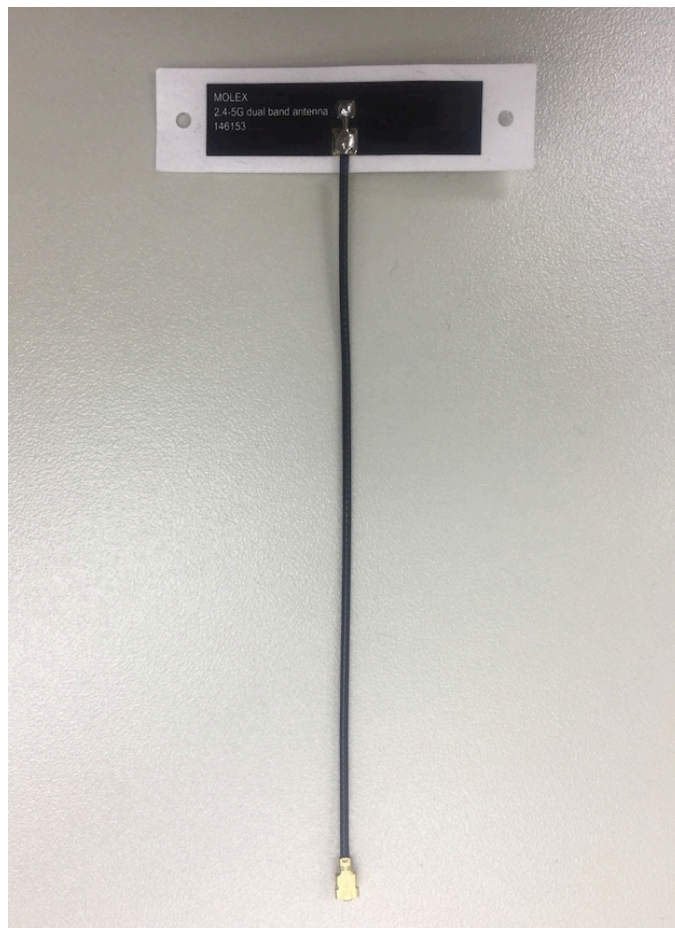


Figure 1-1. IPEX/U.FL Antenna (Top View)



2. Pin Description

2.1. Pin Layout

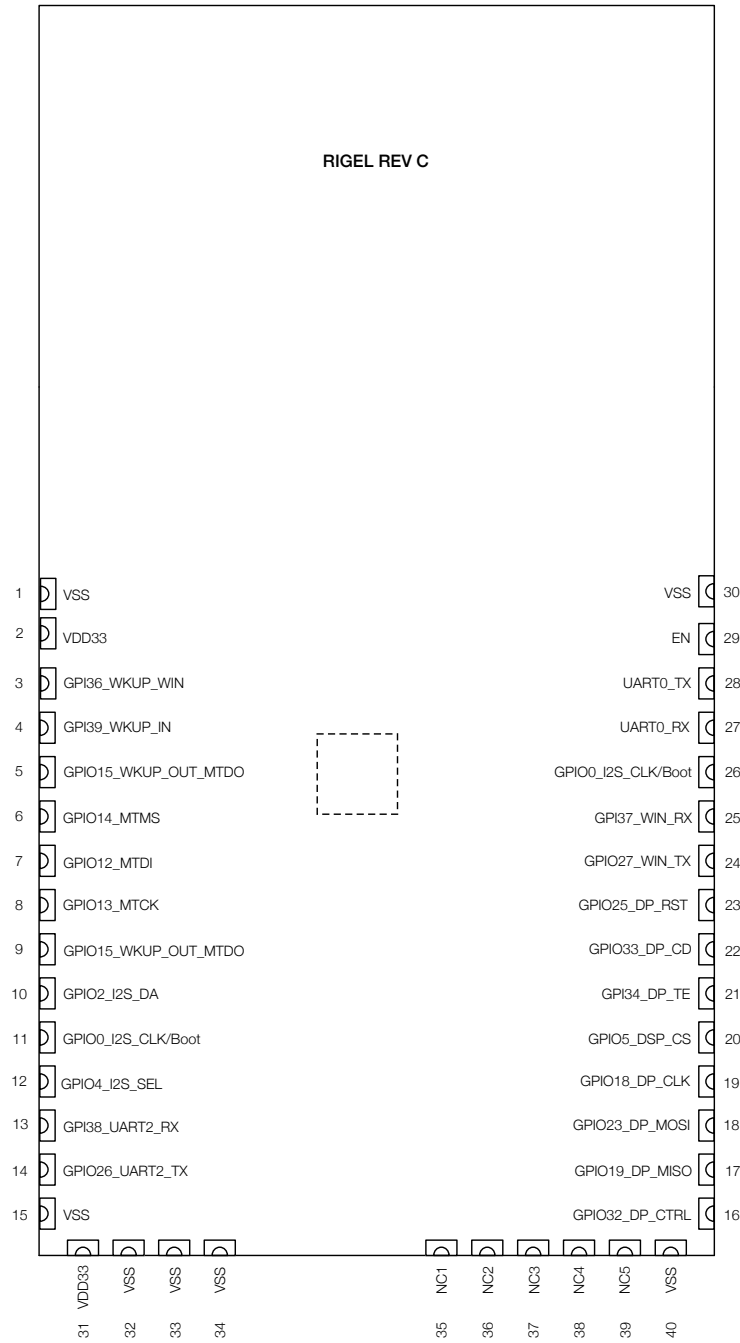


Figure 2-1. RIGEL REV C Pin Layout (Top View)



2.2. Pin List

RIGEL REV C has 40 pins. Please see the pin definitions in Table 2-1.

Table 2-1. RIGEL Pin Definitions

Solder No.	Pin No.	Pin Name	Type	Functional Description
J1	1	VSS	Power	Ground
J2	2	VDD33	Power	3.3 V input
J3	3	GPI36_WKUP_WIN	GPIO	Interrupt input from WIN bus
J4	4	GPI39_WKUP_IN	GPIO	Input from class B micro to SoC
J5	5	GPIO15_WKUP_OUT_MTDO	GPIO	Output from SOC to class B micro
J6	6	GPIO14_MTMS	JTAG	JTAG for debugging only
J7	7	GPIO12_MTDI	JTAG	JTAG for debugging only
J8	8	GPIO13_MTCK	JTAG	JTAG for debugging only
J9	9	GPIO15_WKUP_OUT_MTDO	JTAG	JTAG for debugging only
J10	10	GPIO2_I2S_DA	I ² S	I ² S data to class D amplifier
J11	11	GPIO0_I2S_CLK/Boot	I ² S	I ² S clock to class D amplifier
J12	12	GPIO4_I2S_SEL	I ² S	I ² S select to class D amplifier
J13	13	GPI38_UART2_RX	UART	UART TX of class B to RX of SoC
J14	14	GPIO26_UART2_TX	UART	UART RX of class B to TX of SoC
J15	15	VSS	Power	Ground
J16	16	GPIO32_DP_CTRL	GPIO	PWM signal from SoC to back light for dimming
J17	17	GPIO19_DP_MISO	SPI	SPI data out from display to SoC
J18	18	GPIO23_DP_MOSI	SPI	SPI data in to display from SoC
J19	19	GPIO18_DP_CLK	SPI	SPI CLK
J20	20	GPIO5_DSP_CS	SPI	SPI chip select
J21	21	GPI34_DP_TE	GPIO	Interrupt line input from display to SoC
J22	22	GPIO33_DP_CD	GPIO	SPI - command or data between SoC & display
J23	23	GPIO25_DP_RST	GPIO	SPI- reset output from SoC to display
J24	24	GPIO27_WIN_TX	UART	UART RX of WIN host to TX to SoC
J25	25	GPI37_WIN_RX	UART	UART TX of WIN host to RX of SoC



Solder No.	Pin No.	Pin Name	Type	Functional Description
J26	26	GPIO0_I2S_CLK/Boot	GPIO	Boot / ESP32 only
J27	27	UART0_RX	UART	UART programming - RX ESP32
J28	28	UART0_TX	UART	UART programming - TX ESP32
J29	29	EN	GPIO	Enable / ESP32 only
J30	30	VSS	Power	Ground
J31	31	VDD33	Power	3.3 V input
J32	32	VSS	Power	Ground
J33	33	VSS	Power	Ground
J34	34	VSS	Power	Ground
J35	35	NC	-	Reserved
J36	36	NC	-	Reserved
J37	37	NC	-	Reserved
J38	38	NC	-	Reserved
J39	39	NC	-	Reserved
J40	40	VSS	Power	Ground



3. Peripherals and Interfaces

3.1. Radio/SOC & Class B Micro

UART should be used to interface between the Radio/SOC and the class B micro. The Radio/SOC provides a wake-up input line (GPIO39_WKUP_IN) and an interrupt output line (GPIO15_WKUP_OUT_MTDO) to the class B micro.

3.2. Radio/SOC & WIN Bus

The Radio/SOC provides UART communication (GPIO27_WIN_TX/GPI37_WIN_RX) to the WIN bus for optional use. Flow control is not required.

3.3. Interface—Display

The Radio/SOC provides eight signal lines (a 4-line SPI and 4 GPIOs) to display:

- Display reset
- SPI data out from display
- SPI SS
- SPI CLK
- SPI data in to display
- Display CD
- Display TE
- Display control for back-light driver

3.4. Interface—JTAG

The Radio/SOC provides a JTAG interface for debugging. However, this interface should only be used during the development.

3.5. Interface—Programming

The Radio/SOC provides a standalone programming interface, which includes UART0_RX, UART0_TX, GPIO0_I2S_CLK/Boot, EN, VDD and GND.



3.6. Interface—Audio

The Radio/SOC provides an I²S interface for driving the external digital audio.



4. Electrical Characteristics

4.1. Absolute Maximum Ratings

Stresses beyond the absolute maximum ratings listed in the table below may cause permanent damage to the device. These are stress ratings only, and do not refer to the functional operation of the device.

Table 4-1. Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDD33	-	-0.3	3.6	V
T _{store} ¹	Storage temperature	-40	150	°C

⚠ Notice:

1. The storage temperature range for the module that uses IPEX/U.FL antenna is -40 °C ~ +95 °C.

4.2. Recommended Operating Conditions

Table 4-2. Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VDD33	-	2.7	3.3	3.6	V
I _{VDD}	Current delivered by external power supply	0.5	-	-	A
T ¹	Operating temperature	-40	-	85	°C

⚠ Notice:

1. The operating temperature range for the module that uses IPEX/U.FL antenna is -30 °C ~ +85 °C.

4.3. DC Characteristics (3.3 V, 25 °C)

Table 4-3: DC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
C _{IN}	Pin capacitance	-	2	-	pF
V _{IH}	High-level input voltage	0.75×VDD ¹	-	VDD ¹ +0.3	V



Symbol	Parameter	Min	Typ	Max	Unit
V _{IH}	High-level input voltage	0.75×VDD ¹	-	VDD ¹ +0.3	V
V _{IL}	Low-level input voltage	-0.3	-	0.25×VDD ¹	V
I _{IH}	High-level input current	-	-	50	nA
I _{IL}	Low-level input current	-	-	50	nA
V _{OH}	High-level output voltage	0.8×VDD ¹	-	-	V
V _{OL}	Low-level output voltage	-	-	0.1×VDD ¹	V
I _{OH}	High-level source current (VDD ¹ = 3.3 V, V _{OH} ≥ 2.64 V, PAD_DRIVER = 3)	-	40	-	mA
I _{OL}	Low-level sink current (VDD ¹ = 3.3 V, V _{OL} = 0.495 V, PAD_DRIVER = 3)	-	28	-	mA
R _{PU}	Pull-up resistor	-	45	-	kΩ
R _{PD}	Pull-down resistor	-	45	-	kΩ
V _{IL_nRST}	Low-level input voltage of EN to reset the module	-	-	0.6	V

1. VDD is the I/O voltage for a particular power domain of pins. More details can be found in Appendix IO_MUX of [ESP32 Datasheet](#).

4.4. Wi-Fi Radio Characteristics

Table 4-4. Wi-Fi Radio Characteristics

Parameter	Condition	Min	Typ	Max	Unit
Input frequency	-	2412	-	2462	MHz
Output impedance*	-	-	*	-	Ω
RF power		20.09	-	21.21	dBm
Sensitivity	11b, 1 Mbps	-	-98	-	dBm
	11b, 11 Mbps	-	-89	-	dBm
	11g, 6 Mbps	-	-92	-	dBm
	11g, 54 Mbps	-	-74	-	dBm
	11n, HT20, MCS0	-	-91	-	dBm
	11n, HT20, MCS7	-	-71	-	dBm
	11n, HT40, MCS0	-	-89	-	dBm



Parameter	Condition	Min	Typ	Max	Unit
	11n, HT40, MCS7	-	-69	-	dBm
Adjacent channel rejection	11g, 6 Mbps	-	31	-	dB
	11g, 54 Mbps	-	14	-	dB
	11n, HT20, MCS0	-	31	-	dB
	11n, HT20, MCS7	-	13	-	dB

*For the module that uses an IPEX/U.FL antenna, the output impedance is 50 Ω.

5.0 BLE Radio

5.0.1 Receiver

Table 8: Receiver Characteristics – BLE

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity @30.8% PER	-	-	-97	-	dBm
Maximum received signal @30.8% PER	-	0	-	-	dBm
Co-channel C/I	-	-	+10	-	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	-	-5	-	dB
	F = F0 - 1 MHz	-	-5	-	dB
	F = F0 + 2 MHz	-	-25	-	dB
	F = F0 - 2 MHz	-	-35	-	dB
	F = F0 + 3 MHz	-	-25	-	dB
	F = F0 - 3 MHz	-	-45	-	dB
Out-of-band blocking performance	30 MHz ~ 2000 MHz	-10	-	-	dBm
	2000 MHz ~ 2400 MHz	-27	-	-	dBm
	2500 MHz ~ 3000 MHz	-27	-	-	dBm
	3000 MHz ~ 12.5 GHz	-10	-	-	dBm
Intermodulation	-	-36	-	-	dBm

5.0.2 Transmitter

Table 9: Transmitter Characteristics – BLE

Parameter	Conditions	Min	Typ	Max	Unit
Gain control step	-	-	3	-	dBm
RF power control range	-	-1.73	-	-0.23	dBm
Adjacent channel transmit power	F = F0 ± 2 MHz	-	-52	-	dBm
	F = F0 ± 3 MHz	-	-58	-	dBm
	F = F0 ± > 3 MHz	-	-60	-	dBm
Δ f1avg	-	-	-	265	kHz
Δ f2max	-	247	-	-	kHz
Δ f2avg/Δ f1avg	-	-	-0.92	-	-
ICFT	-	-	-10	-	kHz
Drift rate	-	-	0.7	-	kHz/50 μs
Drift	-	-	2	-	kHz



5.

Dimensions

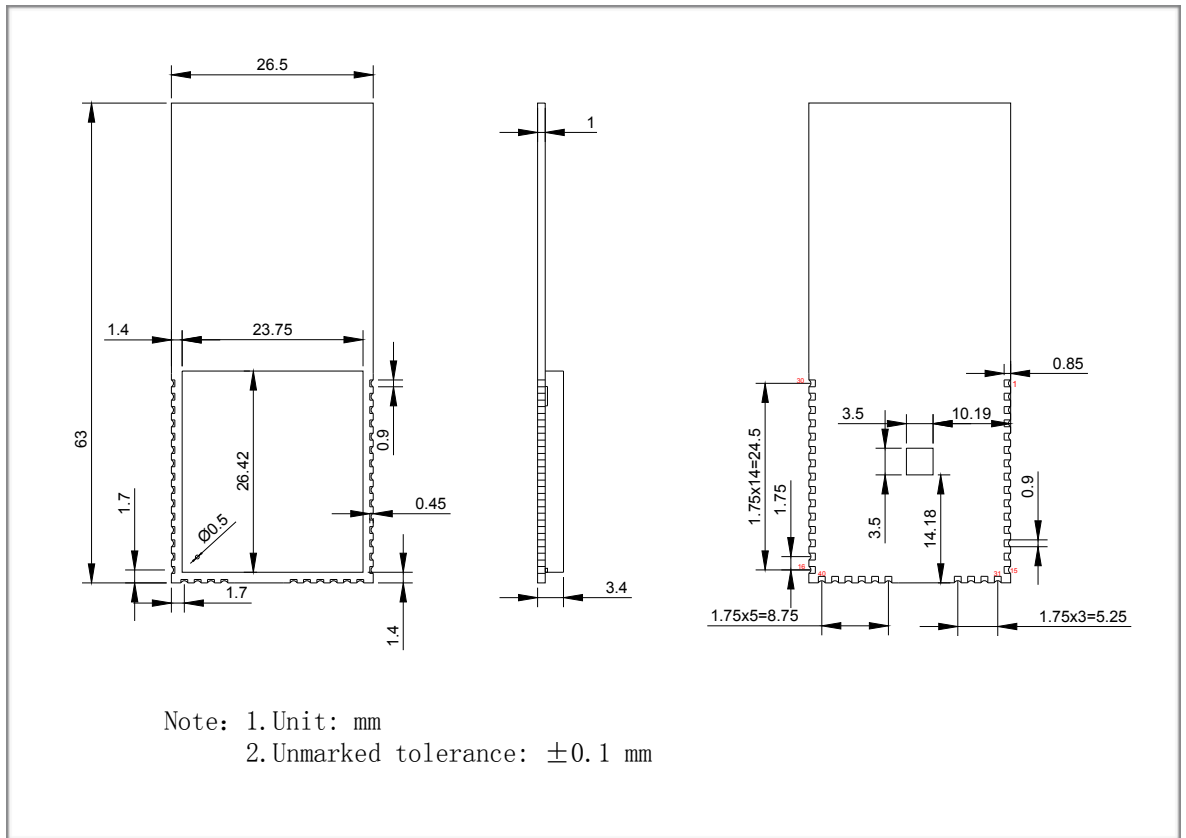


Figure 6-1. Dimensions of RIGEL REV C

FCC Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

FCC Label Instructions

The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as:

"Contains Transmitter Module FCC ID:2AC7Z-RIGEL" or "Contains FCC ID:2AC7Z-RIGEL" Any similar wording that expresses the same meaning may be used.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate 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 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 into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



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