



HiKey970

User Guide

Issue **01**

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Change History

Changes between document issues are cumulative. The latest document issue contains all the changes made in earlier issues.

Issue 01 (2018-03-11)

The first version.



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User Guide

1.1 Introduction

The HiKey970 board is a 96Boards compliant community board based on HiSilicon Kirin 970 series of SOC's.

The following table lists its key features:

1.1.1 Board overview

Figure 1-1 Top side view of the HiKey PCB

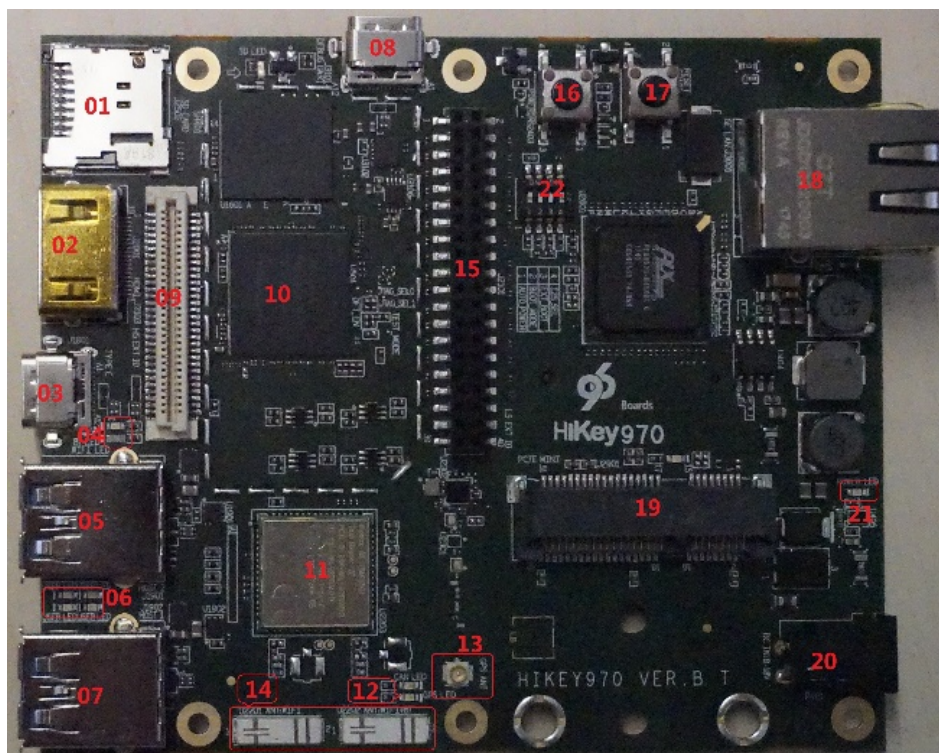
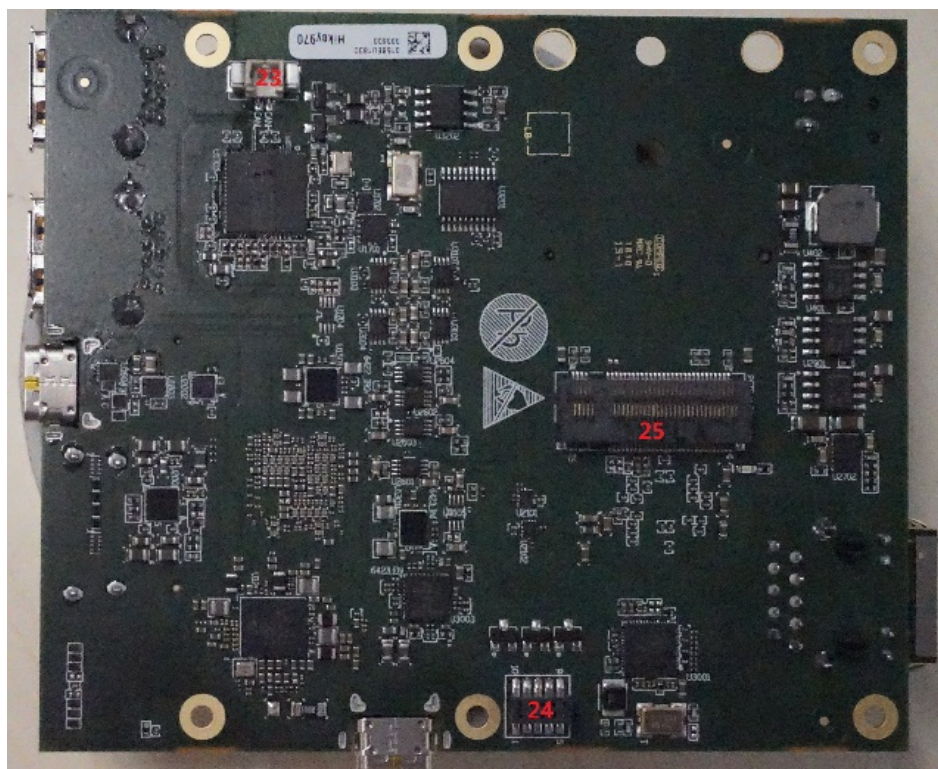




Figure 1-2 Bottom side view of the HiKey PCB



| Number | Description |
|--------|--|
| 01 | (J2502)Micro SD Card Socket |
| 02 | (J2001)HDMI Type A Port |
| 03 | (J1801)USB Type C |
| 04 | (D3305)LED, (D3306) WIFI LED |
| 05 | (J1901)USB Type A |
| 06 | (D3301~D3304)User LED |
| 07 | (J1902) USB Type A |
| 08 | (J3101) UART Debug |
| 09 | (J2103) High Speed Expansion Connector |
| 10 | (U501) Kirin970 Processor |
| 11 | (U2203)WLAN |
| 12 | (D3307)CAN LED, (D3308)GPS LED |
| 13 | (J2301)GPS Antenna Connector |
| 14 | (U2201, U2202)WIFI Antenna |



| Number | Description |
|--------|--------------------------------------|
| 15 | (J2101)Low Speed Expansion Connector |
| 16 | (S2403)Power Button |
| 17 | (S2402)Reset Button |
| 18 | (J3001) Ethernet Connector |
| 19 | (J2901)PCIE MINI Connector |
| 20 | (P401)Power Jack |
| 21 | (D404)Power LED's |
| 22 | (SW2402)Boot Switches |
| 23 | (J3201)CAN Connector |
| 24 | (J2501)JATG Connector |
| 25 | (J2801)PCIE M.2 Connector |



1.1.2 Key features

| | |
|-----------------------|---|
| Processor | HiSilicon Kirin 970 ARM Cortex-A73 MPCore*4 @up to2.36GHz ARM Cortex-A53 MPCore*4 @up to1.8GHz ARM Mali-G72 MP12 GPU HiAI Architecture Dedicated NPU |
| Memory | 6GB LPDDR4X 1866MHz |
| Storage | 64GB UFS 2.1 Micro SD |
| Video | 1080p@60Hz HDMI 4 line MIPI/LCD port |
| Camera Support | 4 line MIPI port 2 line MIPI port |
| Connectivity | WIFI(DFS band not support) |
| I/O Interfaces | One 40-pin Low Speed (LS) expansion connector • UART, SPI, I2S, I2C x2, GPIO x12, DC power One 60-pin High Speed (HS) expansion connector • 4L-MIPI DSI, USB, I2C x2, 2L+4L-MIPI CSI |
| User Interface | Power/Reset 8 LED indicators • 4 -user controllable • 3 -for radios • 1 – for CAN |
| OS-support | Android Linux |
| Power | DC Power: +8V to +18V |
| Mechanical | Dimensions: 105.26mm by 100mm meeting 96Boards™ Consumer Edition standard dimensions specifications. |
| Environmental | Operating Temp: 0°C to +70°C RoHS and Reach compliant |



1.2 Getting started

1.2.1 Prerequisites

Before you power up your HiKey970 board for the first time you will need the following:

- HiKey970 board.
- A 96Boards compliant power supply.
- A HDMI LCD Monitor that supports a resolution of 1080P/60Hz.
- HDMI-HDMI cable to connect the board to the Monitor.
- A computer keyboard with USB interface
- A computer mouse with USB interface.

1.2.2 Starting the board for the first time

To start the board, follow these simple steps:

Step 1. Connect the HDMI cable to the HiKey970 HDMI connector (marked J2001) and to the LCD Monitor.

Step 2. Connect the keyboard to the boards USB connector marked J1901(or J1902) and the mouse to the USB connector marked J1902(or J1901).

Step 3. Ensure that the boot switches SW2402 are set to '1000', on/off/off/off position.

Step 4. Connect the power supply to power connector J401.

Once you plug the power supply into a power outlet the board will start the booting process, and you should see Android boot up.

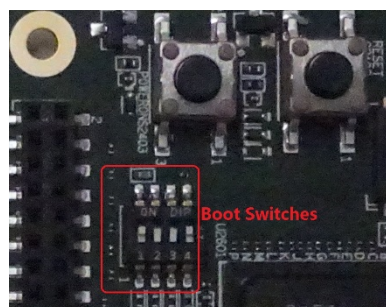
Please note that the first boot takes several minutes due to Androids initialization. Subsequent boot times should be faster.

1.3 HiKey970 Overview

1.3.1 Boot switches and UART debug

The HiKey board has multiple boot options that are user selectable in hardware which can be set via Switch SW2402.

Figure 1-3 Boot switches





| | SW2402 |
|---|------------|
| 1 | AUTO_POWER |
| 2 | BOOT_MODE |
| 3 | EXT_BOOT |
| 4 | I2S_SEL |

- Auto Power Switch

ON: system will boot up automatically when the power supply is applied.

OFF : Pressing the power switch is required to boot up the system.

- Boot Setting Switch

ON: the will attempt to program the UFS flash from USB OTG source. This should ONLY be used if the first stage bootloader is corrupted or needs to be replaced.

OFF : the unit boots from the first stage bootloader installed in the onboard UFS device.

- User Jumper

Connected to GPIO_055 on the SoC and UEFI mode

ON : GPIO_055 will be pulled low, the board will boot up UEFI mode

OFF: GPIO_055 will be pulled High, the board will boot up the system

- I2S SEL

ON: I2S0 will connect Low Speed Expansion Connector

OFF: I2S0 will connect other channel.

The HiKey board also has an option for a Debug UART Type C J3101. This is normally used by the first stage bootloader developers, and is connected to the UART6 port of the SoC.

1.3.2 POWER on button /reset button

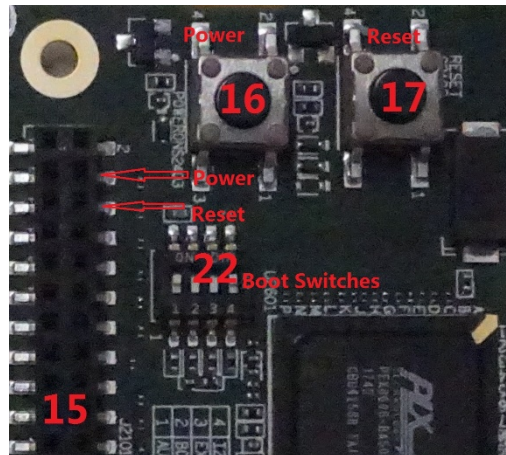
The power button S2403 can be used to power up, power down the system.

- A simple press and release powers ON the board provided the Auto Power Jumper is not installed.
- A press and release will then power OFF the board

The Reset button S2402 can be used to reset the system.



Figure 1-4 Powr/Reset



It is also possible to connect external switches for power on/off . This is implemented by routing the specific power signals to the low speed bus connector J2101.4(PWRON_N) and J2401.6(EXP_RSTOUT_N).

1.3.3 DC in jack

DC Power is provided via the DC jack at P401. This is a CUI PJ-041H connector with a center pin diameter of 1.65mm configured with positive polarity (center +). An 8V up to 18V power supply at a minimum of 2A rating can be used to provide sufficient board power for on system requirements as well as external devices. Additional current rating may be required for mezzanine boards or modules. DC Power can also be supplied via the SYS_DCIN pins on the low speed expansion J2101.

NOTE: Power should not be supplied simultaneously from multiple sources

1.3.4 Low speed expansion connector

The HiKey board features two expansion connectors: one low speed expansion connector and one high speed. The low speed expansion connector carries GPIO and other low speed interfaces. The connector is a low profile 40 pin female 2mm receptacle (20x2) of a specified height of 4.5mm height.

The low speed expansion brings out 1.8V level SoC signals such as UART2 and UART3, I2C0 and I2C1, GPIO signals as well as SPI, Audio, Reset, 1.8V and Ground. The complete list of SoC signals is shown in Table 1 below:

| 96Boards Signals | HiKey970 Signals | Pin | Pin | HiKey970 Signals | 96Boards Signals |
|------------------|------------------|-----|-----|------------------|------------------|
| GND | GND | 1 | 2 | GND | GND |
| UART0_CTS | UART2_CTS_N | 3 | 4 | PWRON_N | PWR_BTN_N |
| UART0_TxD | UART2_RXD | 5 | 6 | EXP_RSTOUT_N | RST_BTN_N |
| UART0_RxD | UART2_RXD | 7 | 8 | SPI2_CLK | SPI0_SCLK |
| UART0_RTS | UART2_RTS_N | 9 | 10 | SPI2_DI | SPI0_DIN |



| 96Boards Signals | HiKey970 Signals | Pin | Pin | HiKey970 Signals | 96Boards Signals |
|------------------|---------------------|-----|-----|--------------------|------------------|
| UART1_TxD | DEBUG_UART6_TXD | 11 | 12 | SPI2_CS0_N | SPI0_CS |
| UART1_RxD | DEBUG_UART6_RXD | 13 | 14 | SPI2_DO | SPI0_DOUT |
| I2C0_SCL | I2C0_SCL | 15 | 16 | EXT_I2S0_XFS | PCM_FS |
| I2C0_SDA | I2C0_SDA | 17 | 18 | EXT_I2S0_XCLK | PCM_CLK |
| I2C1_SCL | I2C2_SCL | 19 | 20 | EXT_I2S0_DO | PCM_DO |
| I2C1_SDA | I2C2_SDA | 21 | 22 | EXT_I2S0_DI | PCM_DI |
| GPIO-A | GPIO_208_WAKEUP_SOC | 23 | 24 | GPIO_171 | GPIO-B |
| GPIO-C | GPIO_169 | 25 | 26 | GPIO_052 | GPIO-D |
| GPIO-E | GPIO_170 | 27 | 28 | LCD_BL_PWM | GPIO-F |
| GPIO-G | LCD_TE0 | 29 | 30 | GPIO_029_LCD_RST_N | GPIO-H |
| GPIO-I | GPIO_013_CAM0_RST_N | 31 | 32 | GPIO_053 | GPIO-J |
| GPIO-K | GPIO_032_CAM1_RST_N | 33 | 34 | GPIO_031 | GPIO-L |
| +1V8 | VOUT4_1V8 | 35 | 36 | SYSDC_IN | SYS_DCIN |
| +5V | SYS_5V | 37 | 38 | SYSDC_IN | SYN_DCIN |
| GND | GND | 39 | 40 | GND | GND |

The HiKey board can also drive 5V or 12V cooling fans. The power for these is available on the low speed Expansion connector and can be supplied through a 2-pin 2mm male header inserted at pins J2101.37-J2101.39 or J2101.38-J2101.40, respectively

1.3.5 High speed expansion connector

The HS Expansion connector is a board to board low profile 60 pin receptacle TE part.

| 96Boards Signals | HiKey970 Signals | Pin | Pin | HiKey970 Signals | 96Boards Signals |
|-------------------|------------------|-----|-----|------------------|------------------|
| SD_DAT0/SPI1_DOUT | SPI3_DO | 1 | 2 | CSI0_CLK_P | CSI0_C+ |
| SD_DAT1 | UART0_RXD | 3 | 4 | CSI0_CLK_N | CSI0_C- |
| SD_DAT2 | UART0_TXD | 5 | 6 | GND | GND |
| SD_DAT3/SPI1_CS | SPI3_CS0_N | 7 | 8 | CSI0_DATA0_P | CSI0_D0+ |
| SD_SCLK/SPI1_SCLK | SPI3_CLK | 9 | 10 | CSI0_DATA0_N | CSI0_D0- |



| 96Boards Signals | HiKey970 Signals | Pin | Pin | HiKey970 Signals | 96Boards Signals |
|------------------|--------------------|-----|-----|------------------|------------------|
| SD_CMD/SPI1_DIN | SPI3_DI | 11 | 12 | GND | GND |
| GND | GND | 13 | 14 | CSI0_DATA1_P | CSI0_D1+ |
| CLK0/CSI0_MCLK | ISP_CCLK0_MCAM | 15 | 16 | CSI0_DATA1_N | CSI0_D1- |
| CLK1/CSI1_MCLK | ISP_CCLK1_SCAM | 17 | 18 | GND | GND |
| GND | GND | 19 | 20 | CSI0_DATA2_P | CSI0_D2+ |
| DSI_CLK+ | DSI2_CLK_P | 21 | 22 | CSI0_DATA2_N | CSI0_D2- |
| DSI_CLK- | DSI2_CLK_N | 23 | 24 | GND | GND |
| GND | GND | 25 | 26 | CSI0_DATA3_P | CSI0_D3+ |
| DSI_D0+ | DSI2_DATA0_P | 27 | 28 | CSI0_DATA3_N | CSI0_D3- |
| DSI_D0- | DSI2_DATA0_N | 29 | 30 | GND | GND |
| GND | GND | 31 | 32 | ISP_SCL0 | I2C2_SCL |
| DSI_D1+ | DSI2_DATA1_P | 33 | 34 | ISP_SDA0 | I2C2_SDA |
| DSI_D1- | DSI2_DATA1_N | 35 | 36 | ISP_SCL1 | I2C3_SCLL |
| GND | GND | 37 | 38 | ISP_SDA1 | I2C3_SDA |
| DSI_D2+ | DSI2_DATA2_P | 39 | 40 | GND | GND |
| DSI_D2- | DSI2_DATA2_N | 41 | 42 | CSI1_DATA0_P | CSI1_D0+ |
| GND | GND | 43 | 44 | CSI1_DATA0_N | CSI1_D0- |
| DSI_D3+ | DSI3_DATA3_P | 45 | 46 | GND | GND |
| DSI_D3- | DSI3_DATA3_N | 47 | 48 | CSI1_DATA1_P | CSI1_D1+ |
| GND | GND | 49 | 50 | CSI1_DATA1_N | CSI1_D1- |
| USB_D+ | USB_DP_HUB_DN4_CON | 51 | 52 | GND | GND |
| USB_D- | USB_DM_HUB_DN4_CON | 53 | 54 | CSI1_CLK_P | CSI1_C+ |
| GND | GND | 55 | 56 | CSI1_CLK_N | CSI1_C- |
| HSIC_STR | NA | 57 | 58 | GND | GND |
| HSIC_DATA | NA | 59 | 60 | VOUT4_1V8 | RESERVED |

1.3.6 Antenna connector

The HiKey board is equipped with a TI WL1835MOD WLAN Baseband Processor and RF Transceiver which supports IEEE 802.11a, 802.11b, 802.11g and 802.11n WiFi.



A PCB chip antenna is available onboard by default but also an external antenna socket option is provided via J201&J2202 footprint. A Hirose U.FL-R-SMT connector can be soldered at J2201&J2202 location.

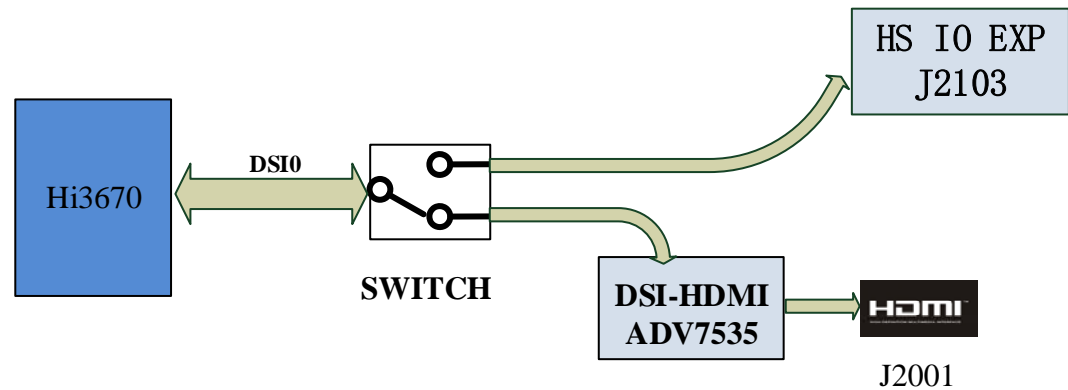
The HiKey board is equipped with a Broadcom BCM4753 GPS Baseband Processor and RF Transceiver. A Hirose U.FL-R-SMT connector can be soldered at J2301 location.

1.3.7 Display interfaces

The on board HDMI is provided via the Analog Devices ADV7535 multifunction video interface chip is available on the Type A HDMI connector mounted at J2001. This connector is ESD protected with TI protection diodes.

A 4 lane MIPI/DSI port is provided on the HS Expansion bus interface. Below is a block diagram of the HiKey implementation.

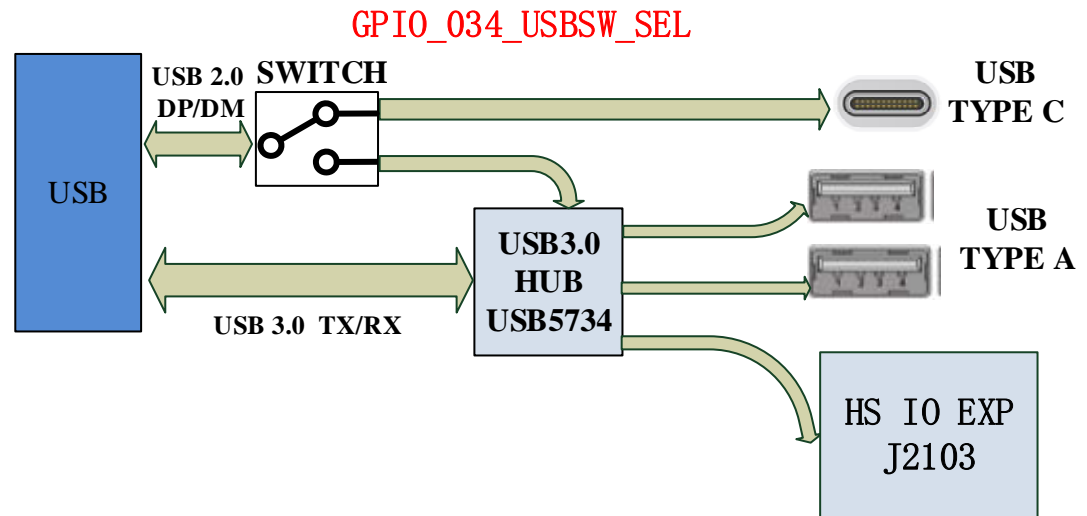
Figure 1-5 HDMI&LCD



1.3.8 USB interfaces

There are a total of 4 USB ports on the HiKey board. Two Type-A USB 3.0 host ports at J1901 and J1902, one type C 2.0 host/slave port at P1801 and one USB host port available on the High Speed Expansion bus.

Figure 1-6 USB



The HiKey board utilizes a single SoC USB interface without USB protocol hardware split transfer support. The USB interfaces are therefore subject to the following restrictions:

- The type C or the Type A/Mezzanine board interfaces may be used depending on the state of GPIO_034_USBSW_SEL. Both interfaces may not be used at the same time.
- The type C port supports a single attached device with USB slave operations or USB host high speed, full speed or low speed operations.
- The Type A/Mezzanine board interfaces cannot support mixed speed devices. All attached devices must be of the same type – high speed, full speed or low speed. Furthermore, the HiKey board must be configured in software to support either full speed/low speed devices (default) or high/super speed devices on these ports.

1.3.9 System and user LEDs

There are four status LEDs and four User LEDs on the HiKey board. The user LEDs can be programmed by the SoC directly.

- D3305 – WiFi LED

The WiFi activity LED is a Yellow type surface mount 0603 LED.

- D3306- LED

The activity LED is a Blue Type surface mount 0603 LED .

- D3301-D3304 – USER LEDs

The four user LEDs are surface mount Green Type 0603 LED .

- D3308-GPS LED
- D3307-CAN LED

1.3.10 JTAG header

The HiKey board includes the option for soldering a 10 pin header that brings out the SoC signals for JTAG debug. A FTSH-105-01-F-DV header can be populated at J2501.



1.3.11 Ethernet

Hikey970 board reserved an Ethernet connector, but Ethernet function is not supported by current software.

1.4 FCC Regulations:

- 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.
- 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.
- Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

FCC RF Radiation Exposure Statement



This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. To comply with FCC RF Exposure compliance requirements, this grant is applicable to only Mobile Configurations. The antennas used for the transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.