



V301 User Manual

DC300P3618_V7



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1 Document Release History

Date	Document Reference	Reason
29 June 2015	DC300P3618_V1	Initial Release
8 July 2015	DC300P3618_V2	FCC Requirements added
10 July	DC300P3618_V3	Adjusted separation distance
7 July 2016	DC300P3618_V4	Updated FCC Part 15.247:2015 Subpart C
9 August 2016	DC300P3618_V5	Added Vector 301-IX variant
16 September 2016	DC300P3618_V6	Included FCC ID of IX
19 September 2016	DC300P3618_V7	Updated FCC ID image

Important

This guide is intended to provide advice and guidelines for OEM developers. Responsibility for how the information is used lies entirely with the developer. It is the developer's sole responsibility to install and use the instrument in a manner that will not cause accidents, personal injury or property damage.

The Global Positioning System (GPS) is operated by the US Government which is solely responsible for its operation, accuracy and maintenance. The GPS system is subject to changes which could affect the accuracy and performance of all GPS equipment anywhere in the world. To reduce the risk of misusing or misinterpreting this product, the developer must read and understand all aspects of this manual.

Communications coverage, availability, or grade of service provided, whether through a service provider or otherwise, are not provided by Imarda and therefore the responsibility of the developer.

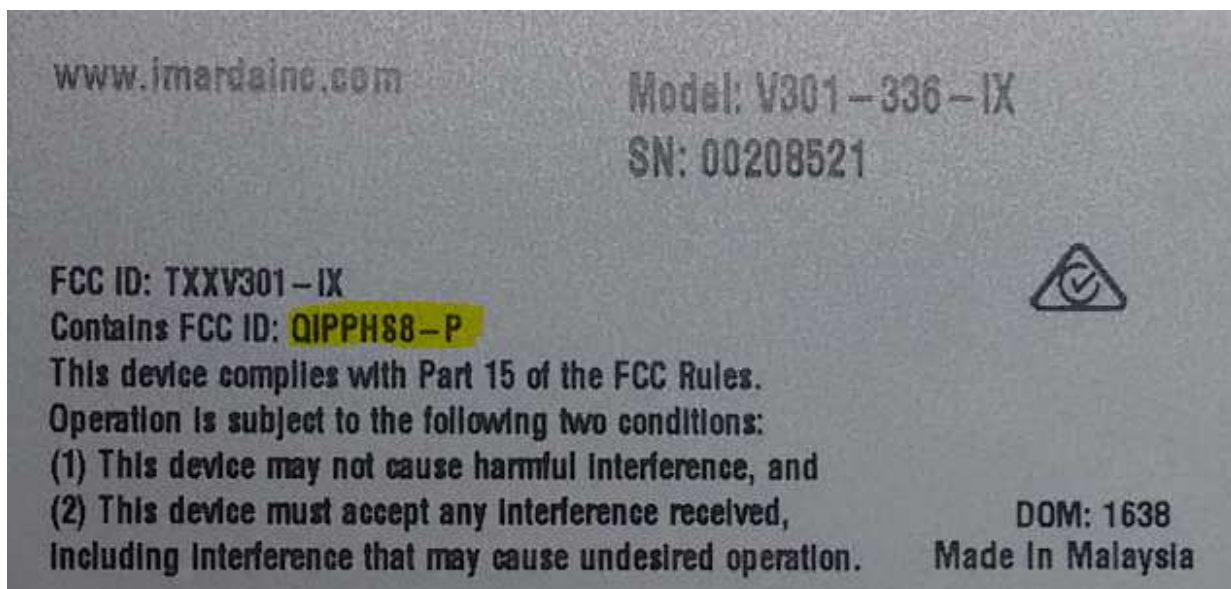
Any changes or modifications to the V301 not authorized by Imarda may void the users authority to operate it under the rules of the FCC.

Imarda disclaims all liability for any use of this product in a way that may cause accidents, direct or indirect damage or violate any laws. This manual represents the product as at the time of printing. Imarda reserves the right to make changes to specifications without notice.

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.**

V301-IW and V301-IX devices contain FCC ID: QIPPHS8-P this can be found on the bottom of the device as shown in the example image below, NOTE the model and FCC ID change depending on the variant:



WARNING: The antenna for these transmitters must be installed to provide a separation distance of at least 22cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Changes made to the V301 without the authority from Imarda may void the users right to operate the equipment.

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FEDERAL COMMUNICATIONS COMMISSION STATEMENT

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.

2 Introduction

Imarda's Vector family of Windows® CE hardware platforms are versatile, cost-effective solutions for a broad range of telematics and M2M applications, including:

- Data Logging
- Security
- Vehicle Tracking
- Fleet Management
- Asset Management

With variety of options, the Vector family offers solution developers, system integrators, VARs, ASPs and fleet managers a range of products that can easily be configured to provide the optimal hardware solution. Moreover the Windows CE operating system simplifies application software development and provides access to the many extended features of an industry standard operating system.

2.1 Vector 301-IW

The Vector 301-IW is a low cost in-vehicle device developed specifically for fleet management and vehicle location applications. It has been designed for extremely low power consumption and can be woken from standby modes by various external events - including incoming calls, ignition, auxiliary inputs and device movement.



Despite its small size and low power consumption, the Vector 301 IW exposes a rich set of hardware and protocol implementations including Bluetooth, MMC/SD Card, J1708, RS232, protected digital and analog inputs, protected driver outputs, Global Positioning System (GPS) and a GPRS Cellular modem. A rechargeable internal backup battery enables some degree of operation when main power is unavailable. With a wide range of flexible options, a Vector solution will fulfil your hardware requirements for almost any telematics or M2M project.

2.2 Vector 301-IX

The Vector 301-IX has all the functionality of a 301-IW except Wi-Fi functionality.



The endplate of 301-IX is different to cover the lack of Wi-Fi connectivity, note no Green FAKRA connector.

2.3 Vector 301-XWP

The Vector 301-XWP has all the functionality of a 301-IW with 2 exceptions:

1. PLC interface is included
2. There is no cellular modem fitted.



To accommodate the PLC interface the device has alternate plastics which are slightly taller than the Vector 301-IW.

3 External Ports

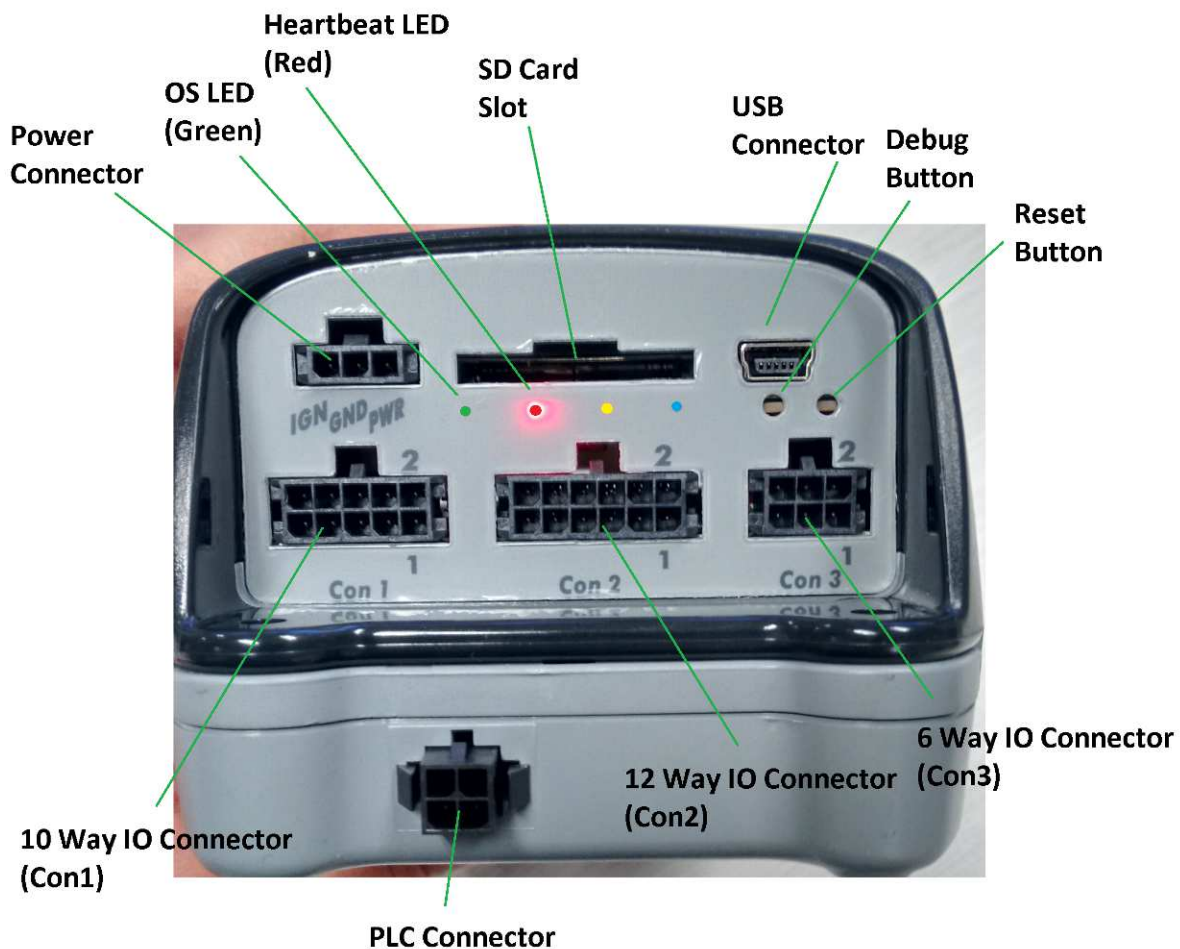
The Vector 301 has several connectors as illustrated below. The following restrictions/considerations apply when choosing installation locations and logistics for the Vector 301:.

WARNING: The antenna used for these transmitters must be installed to provide a separation distance of at least 22cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

- Access to the USB socket and the SD card slot
- Visibility of LEDs for status
- Allow at least 60 mm between the V301 and an obstacle for free cable access.
- Mount with 4 screws or bolts to a stable surface. Size is 140 x 89 x 45 (65 XWP) mm.
- Orientation - if required to be mounted vertically then orient so the antenna cable / SIM card slot are located on the top.

3.1 Front View

The front view of the Vector 301 contains a 3 prong power connector (from left, ignition [orange], ground [black] and power [red]), as well as the Secure Digital card slot, status LEDs (see below), USB type B connector (for Development), and several I/O connectors whose function and pinouts are specified below.



NOTE: The Vector 301 XWP is shown. The Vector 301 IW looks identical to the picture shown here, without the larger grey base holding the PLC Interface.

3.1.1 IO Connectors

The Vector 301 has three different IO connectors which serve a variety of purposes from serial to USB to audio, as illustrated in the following table:..

	CON1: 10-way				
Standard	CAN+	V_{USB}	USBH-	RS232 RxD	V_{BATT}
Upper	10	8	6	4	2
Lower	9	7	5	3	1
Standard	CAN-	GND	USBH+	RS232 TxD	GND

	CON2: 12-way					
Standard	Analog In	GND	HS Input	J1708+	Input 2	V_{BATT}
Upper	12	10	8	6	4	2
Lower	11	9	7	5	3	1
Standard	NA	GND	Input 5	J1708-	Input 1	GND

	CON3: 6-way		
Alternative	1-Wire	Input 10	Input 8
Standard	Out4	Out2	V_{BATT}
Upper	6	4	2
Lower	5	3	1
Standard	Out3	Out1	GND
Alternative	Input 9	Input 7	

	CON3: 6-way		
Standard	Ignition	GND	Power
Pin	3	2	1

3.1.2 Debug Button

The debug button allows you to retrieve debug codes from the device should there be a fault which is affecting the device.

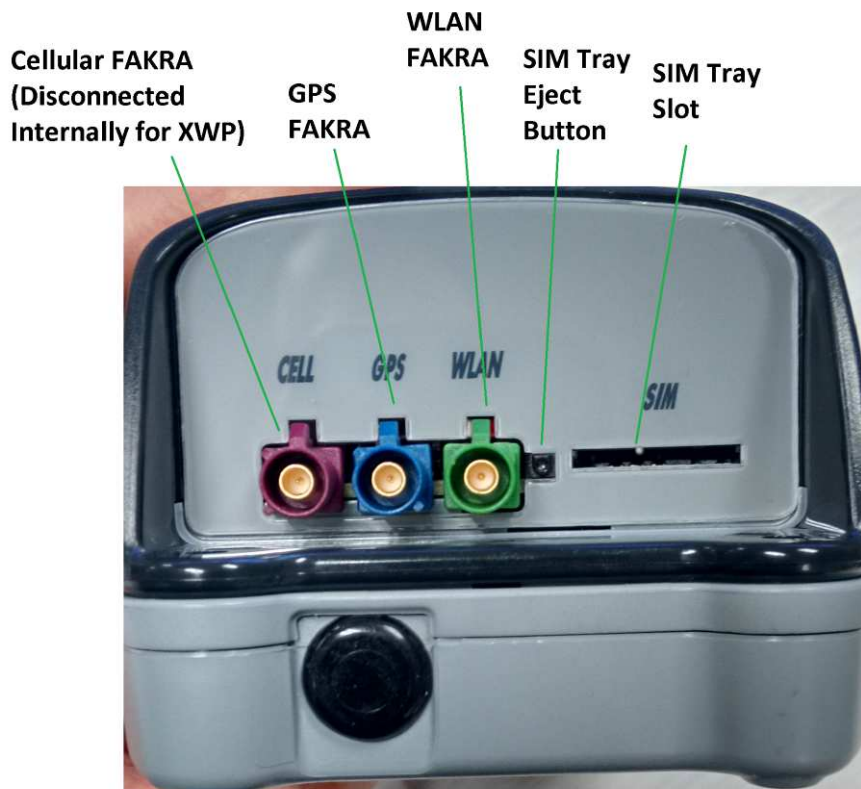
3.1.3 Reset Button

The reset button provides hard reset functionality to the device so that the device may be reset without unplugging the power *and* backup battery. To hard reset the device, hold this button down for at least 2 seconds with the power on. When the bootloader takes over, the green OS LED will stop blinking, which indicates the reset has taken effect.

The O/S LED will indicate the [steps](#) the device is taking as it proceeds through the boot process.

3.2 Back View

The back view of the Vector 301 contains three FAKRA antenna connectors. It also contains a GSM Subscriber Identity Module (SIM) card slot.



NOTE: The Vector 301 XWP model is pictured above. The Vector 301 IW model is not so tall.

3.2.1 SIM Card Orientation

The SIM card must be properly oriented in order to ensure correct operation. Fit the SIM to the SIM tray and then insert into the device as shown below the tray goes in upside down:



4 Operating System

The Vector series devices runs the Microsoft Windows CE 5.0 operating system. Windows CE is like traditional Windows operating systems in terms of look and feel; it has a Start button and exposes a graphical user interface like Windows, but in a compact fashion. Windows CE manages memory, processor, file system, etc. in scaled down ways as well.

Unlike Windows, Windows CE is built via customized operating system builds that Imarda provides -- think of these as firmware. It has a few other important differences that will be important to you as a consumer of the end product; they are outlined below.

4.1 Firmware

New firmware images are available from Imarda.

4.2 Bootloader

The bootloader handles the device operations from power on until Windows CE takes control. The boot process has different startup times and stages depending on the state of the device at last suspend / power off.

4.2.1 Cold Boot

"Cold boot" means that the device is starting from a hardware reset, or is being started from a no-power (power on) state. This process typically takes 15-30 seconds, depending on how many device drivers are loaded.

Simply cycling power by removing/replacing the Vehicle Battery lead is not sufficient for most units, since the on-board battery will keep the Vector 301 alive for at least short periods of time.

4.2.2 Soft Boot / Resume

A "soft boot" means that the device is resuming from a suspended, low power state back into full operation. Conditions which take the device in and out of this state vary depending on software configuration.

4.3 Power States

The Vector 301 has four system power states. The command line application power.exe allows control of these

For field applications these can be set programmatically via VAPI (Vector API built into OS), states are as below

- On - Everything is operating normally.
- Ship – Everything Off backup battery electrically isolated
- Off - processor powered down, minimum power consumption, can only be woken on ignition or movement
- Suspend - processor stopped, peripherals are powered on to enable wakeup
- Reset - this resets the V300 fully, i.e. does a "cold boot"

4.4 Backup Battery

The Vector 301 has a 2200mAh backup battery. The battery backup is provided for two reasons - firstly to let the operating system do an orderly shutdown in the event of power loss or deep voltage dips during starter motor cranking, and secondly to provide sufficient time to send notifications of power failure or accident in the event of power being suddenly removed.

As the usage of the backup battery during normal operation is minimal, one of the design trade-offs made in Vector 301 is a long recharge time (to minimise power supply requirements). A full recharge can take 15 Hours, as the charging current is limited to around 150mA. Charging time is also dependent on temperature. For example, battery charging is disabled below 0C as LiPo batteries cannot be charged below this temperature or above 45C

Operating time on the optional backup battery is up to 2 hours. This varies according to temperature.

4.5 Wakeup Sources

The Vector 301 can be placed into a suspend state or Off state

When in suspend, the following conditions will wake the Vector 301 back to the "On" state:

1. State change from low (0V) to high (>7V) on the ignition line
2. Accelerometer (if enabled, can be enabled via software)
3. Incoming calls/message from modem (if enabled)
4. 4 of the Digital Inputs (if enabled)
5. Real Time Clock (if enabled)
6. GPS Antenna Fault

The following conditions can be programmed to wake the Vector 301 from a "Off" state:

1. State change from low (0V) to high (>7V) on the ignition line
2. Accelerometer (if enabled, can be enabled via software,)
3. Real Time Clock (if enabled)

4.6 File System

The Vector 301 uses FLASH memory, which is persistent storage designed to retain data at power loss, but not meant for heavy amounts of I/O or large amounts of data transfer. The FLASH memory in the Vector 301 makes use of a file system manager specifically designed to minimize/distribute wear to the use-sensitive FLASH memory.

Although the underlying hardware implementation is different, the application developer will read and write to FLASH memory the same way they would on a traditional Windows machine with a hard drive. The .NET Compact Framework uses the same functions as the traditional framework to read and write from the file system.

READ FIRST: FLASH memory has a limited lifetime based on number of writes. The FLASH memory used in the Vector 301 has a minimum write threshold of 100,000 times; beyond that reliability and performance are not guaranteed. Applications should be designed/coded keeping this limitation in mind at all times.

For example, if planning for data logging on Vector 301, implement a simple buffer. Hold the data in memory for a period (eg. an hour or two), and then flush it to disk only on a schedule only as frequent as is required by your specifications. This practice will significantly extend the lifetime of the Vector 301's flash memory.

4.7 SDRAM

The Vector 301 uses SDRAM as its volatile working memory to run the operating system. SDRAM is inherently faster than FLASH memory and does not have write speed or lifetime limitations. The hardware implementation is again seamless to the developer; code to handle working memory can be written traditionally.

5 GPRS Modem

The Vector 301-IW and V301-IX are equipped with a Cinterion PHS-8 Cellular modem. The Vector 301-XWP is not equipped with a cellular modem.

Please see Imarda document DC300P0112_V1 for details on Cellular communication with Vector products

6 GPS Receiver

The following material assumes an appropriate antenna has been attached to your Vector 301's GPS antenna connector. The Vector 301 exposes its GPS communications a standard COM port interface. The specifications are as follows:

COM Port	COM8
Baud Rate	38400
Data bits	8
Parity	None
Stop Bits	1
Flow Control	Hardware

The GPS receiver defaults to NMEA mode, contact Imarda if you require assistance interpreting the GPS stream there are a number of GPS parsing utilities available to help interpret the NMEA messages.

7 Accelerometer

The Vector 301 has a built in Accelerometer independent of the GPS module that detects device movement in three dimensions. To access it programmatically, use VAPI interface, you can also test the available VAPI functionality via the built in test app Accelo.exe.

8 Programmers Reference

The Vector 301 may be programmed in either C++ or C# (.NET) environments. Imarda has a number of docs available which will help you get started, including:

- DC300P0108_V2 - OS and Application Deployment.pdf
- DC300P0109_V1 - Autorun and Autoexec Usage for Installs.pdf
- DC300P0110_V1 - Visual Studio Development over RNDIS.pdf
- DC300P0111_V1 - CLI Applications.pdf
- DC300P0112_V1 - Cellular Communications.pdf
- DC300P0106_V1 - Implementing Watchdogs.pdf

9 CAN bus

Imarda has developed high level access to the Vector 301's CAN controller (Microchip MCP2515) via our API. Expert knowledge is required to develop CAN protocols. Using the Imarda developed driver is strongly recommended. Contact Imarda for availability details.

10 J1708

Imarda has developed high level access to the Vector 301's J1708 controller via our API. Using the Imarda developed driver is strongly recommended. Contact Imarda for availability details.

11 Specifications

11.1 Vector 301 General

- Enclosure Dimensions 140 x 89 x 45 mm (V301-IW) 140 x 89 x 65 (V301-XWP)
- Weight 192 to 412 gm, depending on options
- Enclosure Flammability: UL V0
- Operating Temperature: Full function from -30°C to +70°C
 - o Capabilities are reduced down to -40°C and up to +85°C.
 - o Battery charging is disabled below 0°C. Rechargeable battery capacity below -10°C is impaired.
 - o Storage Temperature: -40°C to +85°C.
- Power Supply 9 to 32 V DC main power input (internally monitored) to suit cars and trucks with nominal 12/24V battery systems. **NOTE:** Current drawn depends on options and battery voltage. 12V battery assumed for the following:
 - o Operational current: 150-400mA, depending on hardware configuration
 - o Sleep mode: 10 to 20 mA.
 - o Deep Sleep Mode <4 mA (average)
- 32-bit CPU 312MHz

- RAM: 64MB clocked at 104MHz
- Flash ROM: 32MB
- MMC/SD Card interface
- 48 channel GPS receiver
 - o 48 channel operation, 1Hz update rate
 - o Positional Accuracy
 - Autonomous < 2.5m (typical) - 50%, 24 hr static, -130 dBm
 - o Velocity < 0.01 m/s - 50% @ 30 m/s
 - o Time to First Position
 - Hot start: < 1s average
 - Cold start: < 35s average
 - o Sensitivity: -
 - -163 dBm (Tracking)
 - -147 dBm (Autonomous) 15 dBHz except Cold start: 30dBHz
 - o Dynamic Conditions
 - ITAR limits: velocity greater than 514 m/s AND altitude above 18,288 m
 - - altitude: 24,000 m (max) or -500 m (min)
 - - velocity: 600 m/s (max)
 - - acceleration: 4 G (max)
 - - vehicle jerk: 5 m/s³ (max)
- Mobile Connectivity
 - o Cinterion PHS8, UMTS (850/800, 900, 1900 and 2100 MHz), GPRS (850/900/1800/1900 MHz)
- 1Mbps CAN (2.0) Interface
- Bluetooth V1.2 Class 2 interface with internal antenna
- WLAN 802.11 b/g
- USB client port for Development
- USB host port with 5V power feed
- Up to 8 protected Digital Inputs, one Analog Input
- Up to 4 protected 250mA low-side Relay Driver Output Lines
- Integrated real time clock
- Remotely upgradeable firmware image
- Standard 2200mAh rechargeable Lithium Polymer battery

11.2 Antenna

Imarda part number: ANTENNA-GPS-WIFI-3M (MPN: 2J426-300RG174- C96_C95_C627)

Note: The V301 must be fitted with the supplied antenna.

11.2.1 GSM Antenna

Environmental	
Temperature	-40°C to +85°C
Protection class	IP67
Mechanical	
Cable type and length	RG174, <3m
Connector	FAKRA Plug, code D
Electrical	
Frequency ranges	GSM850: 824MHz to 894MHz GSM900: 880MHz to 960MHz GSM1800: 1710MHz to 1880MHz GSM1900: 1850MHz to 1990MHz UMTS2100
VSWR	<2.0:1
Radiation pattern	Omni-directional
Gain	0dBi
Radiation efficiency	>50%
Impedance	50Ω

Polarisation	Horizontal
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11.2.2 GPS Antenna

Environmental	
Temperature	-40°C to +85°C
Protection class	IP67
Mechanical	
Cable type and length	RG174, <3m
Connector	FAKRA Plug, code C
Electrical	
Frequency range	1,57542 GHz $\pm$ 1.023 MHz, (L1-band)
VSWR	<2.0:1
Gain	>2dBi
Impedance	50 Ω
Polarisation	Right hand circular
Amplification	>25dB
Amplifier voltage requirement	<3V DC
Amplifier current requirement	<26mA
Amplifier noise figure (50 Ω)	1.15dB

11.4.3 WLAN Antenna

Environmental	
Temperature	-40°C to +85°C
Protection class	IP67
Mechanical	
Cable type and length	RG174, <3m
Connector	FAKRA Plug, code E
Electrical	
Frequency range	2.4 GHz
VSWR	<2.0:1
Power handling	35W
Gain	0dBi
Impedance	50 Ω
Polarisation	Horizontal

11.3 Regulatory Compliance

- **FCC Part 15.247:2015 Subpart C** - Code of Federal Regulations, Part 15.247 (47CFR15) (Intentional Radiators operating within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz)
- **FCC Part 15.209** RADIATED EMISSION LIMITS; GENERAL REQUIREMENTS.
- **EN60950-1** Information Technology Equipment – Safety – Part 1 General Requirements
- **EN 300 328 V1.7.1 (2006-05)** - Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive
- **ETSI EN 301 489-7** - Electromagnetic compatibility and Radio spectrum Matters ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
- **ISO 7637- Part 1 & 3** - Road vehicles -- Electrical disturbances from conduction and coupling -- **Part 2:** Electrical transient conduction along supply lines only

12 Contact Details:

Website - <http://www.imarda.com>

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