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Manual



MDC-2 User's Manual

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Regulatory Compliance



FCC STATEMENT:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to 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 generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

Changes or modifications not expressly approved by Cubic Global Tracking Solutions for compliance could void the user's authority to operate the equipment.

The antennas used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons during normal device operation and must not be located or operating in conjunction with any other antenna or transmitter.

Les antennes utilisées pour cet émetteur doivent être installés pour fournir une distance de séparation d'au moins 20cm de toutes les personnes en cours de fonctionnement normal du dispositif et ne doit pas être situé ou opérant dans conjointement avec une autre antenne ou émetteur.

Industry Canada

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

1 Introduction

Cubic Global Tracking Solutions' Mesh Dry Container (MDC-2) tag is a sensor node in a mist™ mesh network. The MDC-2 is one of a family of Managed Asset Tags (MAT). Tags such as the MDC-2 wirelessly communicate to a fixed or mobile mesh gateway using the mist™ protocol and the gateway forwards data from those tags through the internet to the Device Management Center (DMC) where the data is stored indefinitely.

The MDC-2 contains a mist™ radio and several optional sensors (temperature, acceleration, shock, light, door, magnetic, and compass).

While the MDC-2 is usable out of the box, it is user-configurable in order to allow for greater flexibility as circumstances demand. The MDC-2 is intended for un-attended operation.



Figure 1: MDC-2 mist™ Mesh Asset Tag

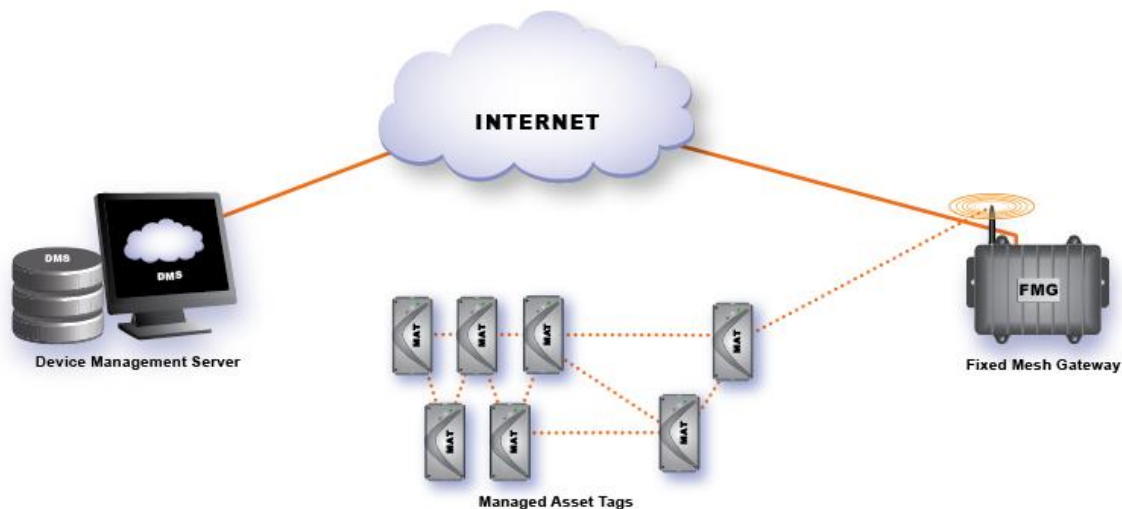


Figure 2: mist™ Mesh Network

1.1 Cubic GTS mist™ mesh network

Cubic GTS mist™ mesh network is an ad-hoc, self-forming, self-healing Mesh network formed by MATs and gateway devices. MATs and other node devices report status and location data to the DMC through gateways devices.

The Cubic GTS mist™ mesh network allows for multiple paths between the MATs and the gateways in the network. This allows the Cubic GTS mist™ mesh network to “heal” itself if a node or a number of nodes drop off of the network.

1.2 Managed Asset Tags

The Managed Asset Tags (MATs) are small asset tracking devices capable of joining with other MATs to form Cubic GTS mist™ mesh network through a fixed or mobile Gateway to the DMC. Most MATs come with a number of sensors to monitor location and routine conditions, and detect if it or its asset has been disturbed. MATs can also have a GPS receiver to track its location, as well as sensors to monitor other asset conditions, such as humidity, light intrusion, etc.

1.3 Mesh Gateways

A mesh gateway is an internet portal for Cubic GTS’s mist™ mesh network. Cubic GTS mist™ mesh network gateway devices include the FMG-3 (a fixed mesh gateway), the MGW-1 (a GSM based mobile mesh gateway), the GS-5L (an Iridium and GSM based mobile mesh gateway) and the GS-5B (a combined container security device and mobile mesh gateway with Iridium and GSM). A mesh gateway contains a mist™ radio for mesh communications and an Ethernet, cellular or satellite internet connection. The gateway forwards data from these devices to the DMC through its internet connection. The mesh gateway is also used to configure mesh devices using the mist™ mesh network.

The FMG-3 is the most full-featured gateway in terms gateway functions and mesh device configuration. The FMG-3 offers local and remote device administration and can configure devices, including loading new software and parameters.

1.4 The Device Management Center

The Device Management Center (DMC), sometimes called the Device Management Server, can be located at a Cubic GTS facility or at an authorized user’s site. When the FMG-3 forwards mesh data through the internet, that data’s final destination is the DMC. With the purchase of a Cubic GTS tracking device, the customer will be provided log-in credentials to the DMC.

The DMC provides the following services:

- Secure storage of data that is transmitted from Cubic GTS tracking devices.
- Secure system management and configuration of Cubic GTS tracking devices.
- Worldwide health monitoring of Cubic GTS tracking devices.
- Routine and Unscheduled/Unplanned Event notifications to authorized individuals via email or short messaging service (SMS).
- Software upgrade of deployed devices.

2 Features

2.1 Description

A MDC-2 is shown in Figures 3 and 4. The MDC-2 is packaged in a rugged IP66 production housing. It has several mounting options which include built-in self-tapping screws, glue-on mounting sled, strap holes, optional magnet mounts. The MDC-2 can include up to three A size 3.6V batteries, and has an integrated antenna. This battery type is rated to approximately 3600mAh under ideal conditions. A MAT sensor can measure temperature, humidity, motion, rotation, orientation (compass), altitude, light, magnetic switch and monitors the state of optical door proximity sensor. The battery life varies based upon the MDC-2 configuration, but a minimum battery life can be guaranteed for any specific configuration.

The MDC-2 is normally shipped powered on and configured for minimal battery consumption. Batteries are installed when the device is manufactured and normally on for its entire life since there is no power switch.

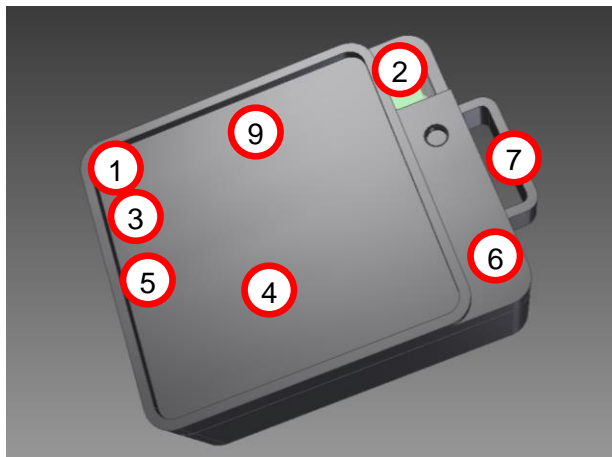


Figure 3: MDC-2 Features

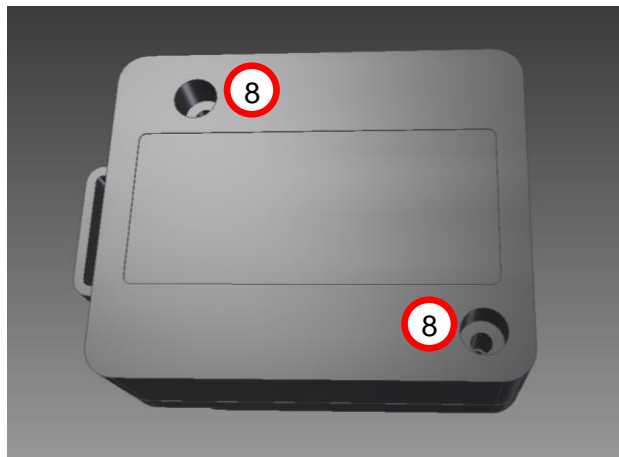


Figure 4: MDC-2 Features

MDC-2 features/functions:

- | | |
|---|---|
| 1. Indicator LED | 7. Mounting loop |
| 2. Door proximity sensor, external light sensor | 8. Mounting screws |
| 3. Temperature/Humidity sensor | 9. Optional mounting magnet |
| 4. Light/demount sensor | 10. Antenna (internal) |
| 5. Magnetic reed sensor | 11. 3-Axis motion/shock (internal) |
| 6. Container door alignment feature | 12. 9-axis motion, rotation, heading (internal) |

2.1.1 Indicators

There is a three color LED that is used to indicate mesh network status and other device operation.

The default MDC-2 LED function is:

- Short blink (~20ms) red every 2.5 seconds if not connected to a network.
- Short blink green every 2.5 seconds when connected to a network.
- Long red blink on magnet transition (1s).
- Orange blinking for 10 seconds indicates that a firmware integrity check failed.
- Continuous orange blinking every 0.5 second when a FIPS-140-2 security error occurs.

To control light pollution LED blinking can be slowed down and turned off.

2.2 Normal Operation

In normal use the MDC-2 is an unattended device. There are no user actions required to turn on or turn off the MDC-2. In normal operation, the green LED will blink every 2.5 Seconds.

2.2.1 Power-On Sequence

When batteries are installed the MDC-2 is always on. For some deployment configurations, the MDC-2 can be shipped from the factory in a dormant mode to minimize battery use. In the dormant mode the MDC-2 has no LED indications. A magnet touch will cause the MDC-2 to start normal operation. Network configuration commands are required to place the MDC-2 into the dormant state.

When batteries are initially installed the MDC-2 will perform an initial power on test. After the test is complete (several seconds) the LED will start blinking red and then blink green once a network is joined.

2.2.2 Sensor Sampling

The sensor sampling intervals are controlled by the device configuration. The sensors fall into two classes: periodically sampled and interrupt driven. The periodically sampled sensors are: Temperature, humidity and light. Interrupt driven sensors are: magnet, motion, proximity, external light.

The periodically sampled sensors have a default sample interval of 10 minutes.

2.2.3 Reporting Behavior

The MDC-2 sends periodic messages which contain sensor and battery status. The device will also send messages when sensor events such as magnet touch, proximity or motion occur. The device will also send a message when a sampled sensor such as temperature exceeds a configured threshold.

2.2.4 Magnet Touch

The MDC-2 responds to magnet touches near location 5 in the feature drawing. This can be used to manually generate messages. The magnet touch must be at least 2 seconds long to ensure success.

2.3 Batteries

The MDC-2 has holders for 3 A-size 3.6V Lithium Thionyl Chloride primary (non-rechargeable) batteries. The 3 cells are electrically and mechanically isolated. The MDC-2 conforms to DOT, UN and IATA Lithium shipping regulations and individual devices have no shipping restrictions.

The batteries are Saft LS-17500 or equivalent.

2.4 MDC-2 RF Performance

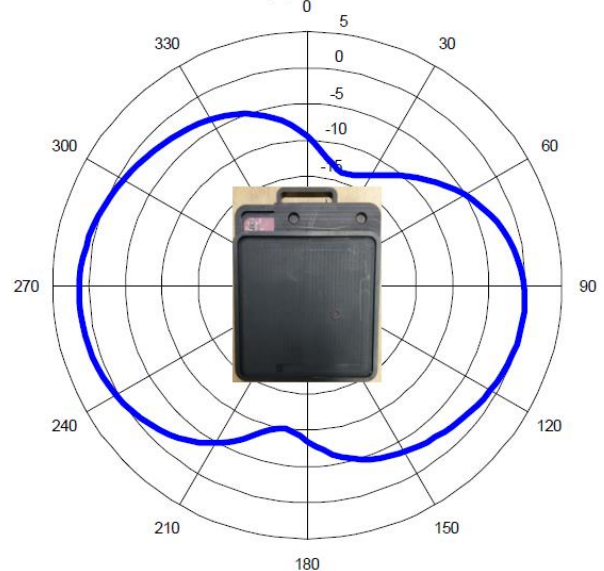
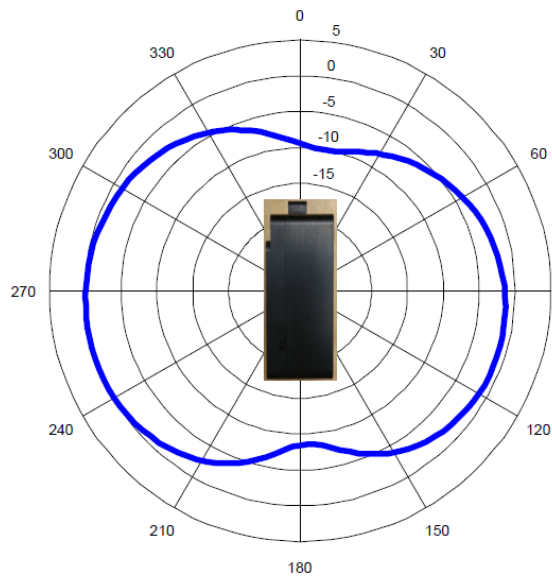
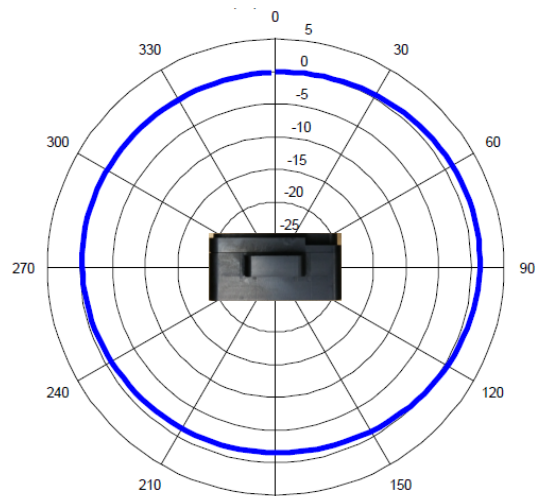
The MDC-2 contains an integrated antenna and is not intended for use with any other antenna.

The MDC-2 uses IEEE 802.15.4 Physical Layer at 2.4 GHz. Operation uses all 16 channels between 2.405 GHz and 2.48 GHz.

Typical range is 300 feet.

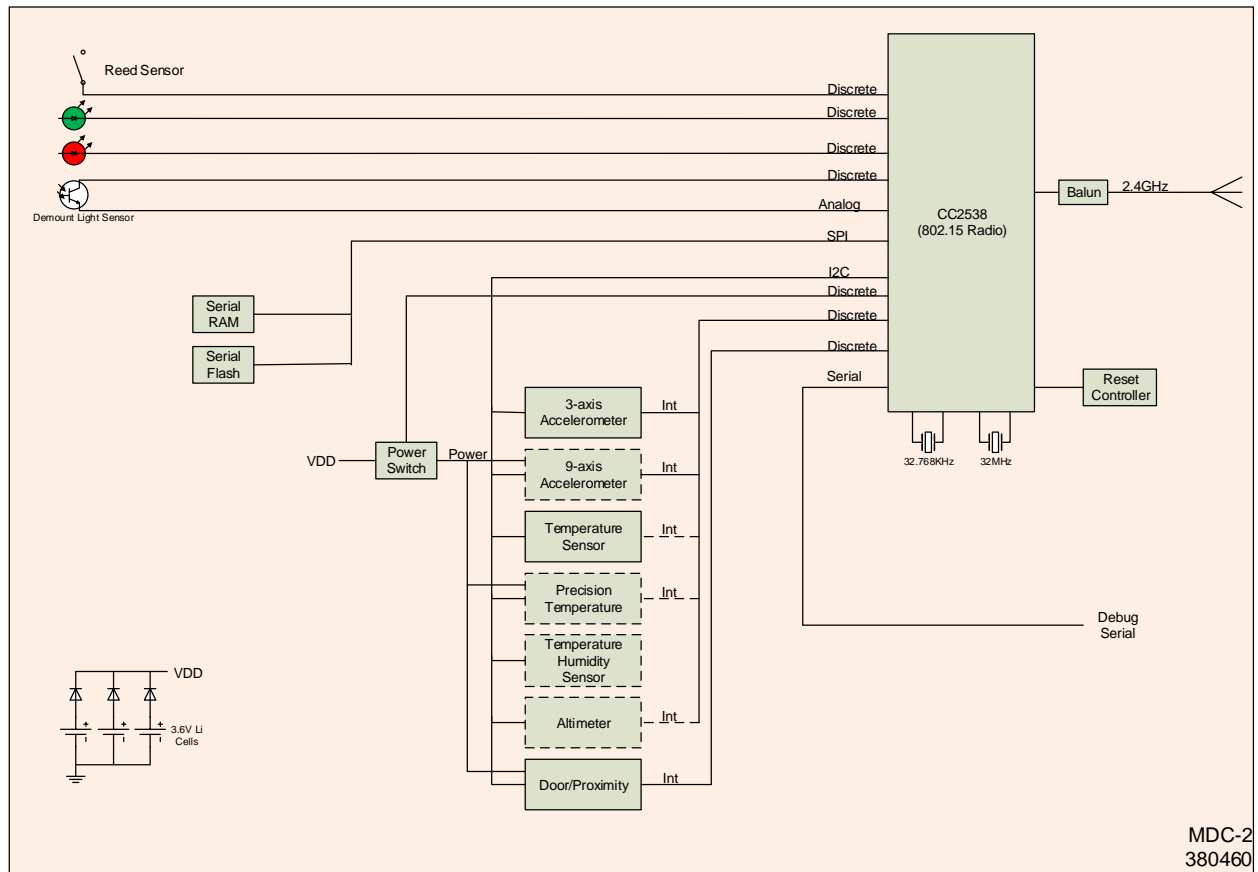
2.4.1 Antenna Pattern

Antenna gain is shown in dBi. The device ERP is 5 dBm.



2.5 MDC-2 Block Diagram

The MDC-2 subsystems are shown below:



The blocks shown in dotted lines are optional subsystems and are ordering options.

3 Physical Installation

There are a number of ways to mount an MDC-2 depending on the end application.

3.1 General Asset Use

1. For most applications the MDC-2 is attached using double-stick tape.
2. One side of the MDC-2 has a light sensor which can be used to detect demounting. For that to operate ensure that the mounting tape forms a light tight seal to the mounting surface.
3. Cable ties can also be attached through the mounting loop.

3.2 Magnetic Mounting

1. The MDC-2 can be ordered with an optional rubberized mounting magnet. The magnet has a hole for the demount sensor.
2. It is recommended that a cable tie or lanyard is used as a backup for magnetic mount applications.

3.3 Dry Container Mounting, Internal

1. The MDC-2 is designed to mount on the inside of a standard ISO dry container. That configuration includes the optional mounting magnet and the optional container door alignment feature.
2. The MDC-2 is mounted on the inside of the left door at the floor level. The alignment feature fits into the space between the two doors.
3. When the right door is closed, the MDC-2 door proximity sensor and light sensors can detect the opening of the left and right doors regardless of opening order.
4. With the MDC-2 mounting between the doors, the MDC-2 RF range is approximately 300 feet depending on the container height above ground.

3.4 Dry Container Mounting, External

1. The MDC-2 is designed to mount on the outside of a standard ISO dry container. That configuration includes the optional mounting magnet and the optional container door hanger bracket.
2. The MDC-2 hangs on the locking lever in such a manner that prevents the MDC-2 from being removed without make gross changes in the device orientation. This allows detection of door opening.
3. The MDC-2 also uses the mounting magnet for demount detection.

4 Configuring the MDC-2

The MDC-2 is normally shipped pre-configured for most applications. Actual device configuration is beyond the scope of this manual and is more properly covered in the mist™ Mesh Network Operator's Manual. Configuration is done using mist Network Management Protocol (MNMP) commands. MNMP is analogous to standard Internet Simple Network Management Protocol (SMNP).

Configuration and software upgrades are performed over-the-air using the mist™ Mesh Network.

4.1 Resetting Device Parameters

When a device is not joined to a mist™ mesh network, over-the-air configuration management is not possible. In some cases the node cannot rejoin the network because of prior erroneous configuration changes made using MNMP. Some MNMP variables might be preventing the device from joining. For this and all other cases where a device must be reset to factory parameters while off the network there is a manual method:

1. Apply the magnet to the side of the MAT for 4 seconds. There will be 1 second green LED blink in the beginning of these 4 seconds.
2. Remove magnet for 4 seconds. As soon as you remove the magnet you will see sub-second green and then orange blinks.
3. Reapply magnet for 1 second you will see sub-second green and then orange blinks again. Then after 1-2 seconds pause you will see orange LED going solid for ~10 seconds. This is an indication of the successful NVS reset.
4. If it did not work wait for 10 seconds and repeat the whole sequence.

This procedure restores all device parameters to their software defaults and it causes the device to reset. This procedure does not erase the persistence memory storage.

5 Troubleshooting

5.1 Mesh Network Issues

The majority of MDC-2 issues/questions are related to network connectivity. If the MDC-2 is blinking green, the device is seeing and has joined a valid, authenticated mesh network. But if messages from the device are not being received, this likely means that the gateway device that is operating the mesh network is not communicating to your Device Management Center (DMC). Remember that a MDC-2 joins the first network that it sees, but the tag will continually look for a "better" network. Also remember that messages pass from tag to tag on the way to the gateway. If tags are physically removed from the network they may carry messages with them.

The best way to resolve a mesh network connection issue is to remove the tag in question to an isolated, known good mesh network.

5.2 Battery Issues

The normal MDC-2 configuration will yield a battery life of at least 1 year per battery. The MDC-2 is normally equipped with 3 Lithium A-Cells and so a 3+ year battery is expected. Extended duration high temperature operation (50C or greater) will reduce battery life. Extended duration low temperature operation (0C or lower) will reduce battery life.

Excessive message reporting and rapid sensor sampling will significantly reduce the battery life.

6 Contact

For other questions or concerns, contact our applications group at: support.cgts@cubic.com

Appendix A: Specifications

Physical

- Dimensions 87mm x 71mm x 35mm
..... 3.4 in x 2.8 in x 1.4 in
- Weight 154 g (5.4 oz)
- Color(s) Black, Olive Drab, Tan
- Operating Temperature -40C to +85C
- Humidity 100% @ 40C
- Vibration 6Grms, all axis
..... SAE J1455
- Shock (survival) 1 meter drop 6-sided
- Ingress Protection Rating IP67

Mesh Network

- Radio Standard 802.15.4 Phy Only
- Operating Frequency 2.405GHz – 2.48GHz
- Max. Output Power +5dBm (ERP)
- Sensitivity -98dBm
- Modulation DSSS
- DSSS Chip Rate 2 Mchips/sec
- Data Rate 250 Kbps
- Channels 16
- Channel Bandwidth 3 MHz
- Encryption AES-128/CCM
- Range 100m (nominal)

Power (Internal Battery Only)

- Battery Type Lithium-Thionyl Chloride
LS-17500 (or equal)
- Battery Quantity 3 ea
- Consumption 400uA (average)
- Battery Life 3 yr

Interfaces

- Electrical None
- Display 1ea LED (red/green/yellow)

Sensors

- Magnetic Reed Relay
- Temperature (standard) -25C to +85C $\pm 2C$
..... -40C to +125C $\pm 3C$
- Temperature (optional) -40C to +125C $\pm 0.4C$
- Humidity 20 to 80%RH $\pm 3\%RH$
..... 0 to 100%RH $\pm 5\%RH$
- Motion configurable to ± 8 g
- Shock ± 8 g
- Orientation 3 axis ± 1 degree
- Compass 3 axis ± 1 degree
- Rotation 3 axis 250°/sec
- Altitude (Height) ± 1 m
- Demount Visible Light
- Ambient Light 0.01 to 7000 Lux
- Door (Distance) 0 to 40 mm

Functional

- Serial Flash (message storage) 1 Mbytes
- Serial RAM (message queue) 128 Kbytes
- Encryption All data encrypted at rest
- Upgrades Over the air updates

Certifications

- FCC Part 15B and 15C ID: YVDMDC2
- IC: 9336A-MDC2
- CE
 - ETSI EN 300 328 (Emissions)
 - ETSI EN 301 489-1 (Immunity)
- SAE J1455 2006
- IP-67/NEMA-4
- HERO (in test)
- HERF (in test)
- HERP (in test)