## Table of revisions

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<th>Date</th>
<th>Changed</th>
<th>Rev</th>
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<tr>
<td>June 2017</td>
<td>Updated to Engineering Tomorrow design; updated connector pin assignments table</td>
<td>0201</td>
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<td>August 2015</td>
<td>Corrected Resolution in Specifications table</td>
<td>BC</td>
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<td>Corrected Resolution in Specifications table</td>
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<td>Mar 2014</td>
<td>Various updates</td>
<td>BB</td>
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<tr>
<td>Feb 2014</td>
<td>First edition, Danfoss layout-DITA CMS</td>
<td>AA</td>
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</table>
## Contents

### Product overview
- WMSS1000 Wireless Multi-Sonic Sensor
- WMSS1000 Features and options

### User liability and safety statements
- OEM responsibility
- Inspect sensing elements daily
- Machine wiring guidelines
- Machine welding guidelines

### Conformance and compliance
- WMSS1000 compliance statement
- WMSS1000 conformance declaration

### Theory of operation
- WMSS1000 sensors theory of operation
- Modes of operation
  - Ground mode
  - String line mode
  - Ranges for string line and ground sensing

### Ordering information
- WMSS1000 Ordering Information

### Product installation
- WMSS1000 Dimensions
- Sensor mounting instructions
- Power switch
- WMSS1000 quick mount and release
- WMSS1000 capped connector
- LEDs
- WMSS1000 battery indication
- WMSS1000 wireless indication
- Deviation indication
- WMSS1000 parameters configuration

### Accessories
- Multi-sonic sensors temperature bail
- WMSS1000 internal rechargeable battery
- Multi-sonic sensors battery charger

### Connector
- WMSS1000 Connector pin assignments

### Specifications
- WMSS1000 electrical
- WMSS1000 environmental
- WMSS1000 mechanical
- Ultrasonic performances
- Multi-sonic sensors battery charger
WMSS1000 Wireless Multi-Sonic Sensor

The WMSS1000 Wireless Multi-Sonic Sensor is a wireless elevation sensor designed for superior performance and flexibility in grade control applications. The WMSS1000 must be used in conjunction with the Danfoss CWH1000 Wireless Hub which provides a gateway for up to 10 sensors. Refer to the CWH1000 Wireless Hub Technical Information, L1321661, for more information.

The WMSS1000 incorporates six ultrasonic sensors set to an optimized frequency that results in high precision output signals. The width of the six sensors allows for implementation of a string line sensing mode for steering and elevation control.

The sensor has LED panels on two sides that give the operator a visual indication of where the sensor is in relation to the active set point of the application. An LED panel mounted on one end of the sensor includes a wireless indicator, battery gauge, and a power switch. A rechargeable internal battery provides for 16 hours of continuous use.

A reference bail for optimum temperature and wind compensation is included. The bail is firmly held in place by magnets and designed to safely release upon contact rather than break or bend. The bail can be easily removed and stored in an alternate position when the sensor is not in use.

The WMSS1000 is IP67 rated, and features an innovative quick mount. This quarter-turn, cam lock mount allows for a one handed installation/removal of the sensor that requires no tools. Embedded in the quick mount is an RFID tag that allows for the source addressing of each mount location in the controller application.

WMSS1000 Features and options

- Ultrasonic sensing technology
- 802.15.4 2.4GHz wireless communication
- Multiple sensors
- PLUS+1® Compliant
- Capable of string line or ground sensing
- String line sensing range: 20 to 40 cm height, 15 cm steering
- Ground sensing range: 20 to 100 cm
- CAN 2.0 B compliant
- Supports 11 bit and 29 bit message ID
- Data height resolution 0.1 mm
- Temperature bail for temperature and wind compensation
- LED grade indicators for high/on/low operator feedback
- Power switch and LED indicators for wireless operation and battery level
- Internal battery capable of up to 16 hours of continuous operation
User liability and safety statements

OEM responsibility

The OEM of a machine or vehicle in which Danfoss products are installed has the full responsibility for all consequences that might occur. Danfoss has no responsibility for any consequences, direct or indirect, caused by failures or malfunctions.

- Danfoss has no responsibility for any accidents caused by incorrectly mounted or maintained equipment.
- Danfoss does not assume any responsibility for Danfoss products being incorrectly applied or the system being programmed in a manner that jeopardizes safety.
- All safety critical systems shall include an emergency stop to switch off the main supply voltage for the outputs of the electronic control system. All safety critical components shall be installed in such a way that the main supply voltage can be switched off at any time. The emergency stop must be easily accessible to the operator.

Inspect sensing elements daily

⚠️ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. Foreign materials inside or damage to the sensing element could impede proper machine operation, inspect the sensing elements daily. To protect against unintended movement, secure the machine.

Machine wiring guidelines

⚠️ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. Improperly protected power input lines against over current conditions may cause damage to the hardware. Properly protect all power input lines against over-current conditions. To protect against unintended movement, secure the machine.

⚠️ Caution

Unused pins on mating connectors may cause intermittent product performance or premature failure. Plug all pins on mating connectors.

- Protect wires from mechanical abuse, run wires in flexible metal or plastic conduits.
- Use 85˚C (185˚F) wire with abrasion resistant insulation and 105˚C (221˚F) wire should be considered near hot surfaces.
- Use a wire size that is appropriate for the module connector.
- Separate high current wires such as solenoids, lights, alternators or fuel pumps from sensor and other noise-sensitive input wires.
- Run wires along the inside of, or close to, metal machine surfaces where possible, this simulates a shield which will minimize the effects of EMI/RFI radiation.
- Do not run wires near sharp metal corners, consider running wires through a grommet when rounding a corner.
- Do not run wires near hot machine members.
- Provide strain relief for all wires.
- Avoid running wires near moving or vibrating components.
- Avoid long, unsupported wire spans.
- Ground electronic modules to a dedicated conductor of sufficient size that is connected to the battery (-).
User liability and safety statements

- Power the sensors and valve drive circuits by their dedicated wired power sources and ground returns.
- Twist sensor lines about one turn every 10 cm (4 in).
- Use wire harness anchors that will allow wires to float with respect to the machine rather than rigid anchors.

Machine welding guidelines

⚠️ Warning

High voltage from power and signal cables may cause fire or electrical shock, and cause an explosion if flammable gasses or chemicals are present. Disconnect all power and signal cables connected to the electronic component before performing any electrical welding on a machine.

The following is recommended when welding on a machine equipped with electronic components:

- Turn the engine off.
- Remove electronic components from the machine before any arc welding.
- Disconnect the negative battery cable from the battery.
- Do not use electrical components to ground the welder.
- Clamp the ground cable for the welder to the component that will be welded as close as possible to the weld.
Conformance and compliance

WMSS1000 compliance statement

IC: 3934C-WMSS1000; FCC ID: 2AA5L-WMSS1000

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.

“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 technician for help.”

“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 Industry Canada licence-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.

Battery: " Manual of Tests and Criteria, Part III, Subsection 38.3 (Test T1-T8) November 1, 2006" IEC 62133
Conformance and compliance

WMSS1000 conformance declaration

Scan of declaration

DECLARATION OF CONFORMANCE

Manufacturer’s name: Danfoss Power Solutions
Manufacturer’s address: Danfoss Power Solutions
3500 Annapolis Ln. N.
Minneapolis, MN 55447
USA
Tel: +1 763 509 2000

Declares that the product:

WMSS1000, p/n 11135819; CWH1000, p/n 11138885

Conform to the following harmonised standards or technical specifications:

EMC:
EN 13809 EMC Compatibility of Construction Machinery
ISO 14982 EMC Compatibility of Agricultural and Forestry Machinery
ISO 11436 EMC Compatibility of Earth Moving Machinery
EN 61000-4-2 ESD
ISO 7637-2 Pulse 1,2,B,3,4,5 (Pulse 1 limited to -200V)
EN 301 536-2 V1.5.1 ETSI Short Range Devices and Inductive Loop Systems
EN 301 328 V1.8.1 ERM Wideband transmission systems (2.4 GHz)
EN 301 489-1 V1.9.2 ERM Electromagnetic Compatibility – Radio Equipment Common
EN 301 489-3 V1.4.1 ERM Electromagnetic Compatibility – Short Range Devices
EN 301 489-17 V2.2.1 ERM Electromagnetic Compatibility – Broadband Data Transmission Systems
IEC 62133 Battery Pack

☑ The equipment conforms completely with the above stated harmonised standards or technical specifications.

OR

☐ The equipment conforms only partly with the above stated harmonised standards or technical specifications but complies with good engineering practice in safety matters in force within the EEA.

Additional information:
The product meets the EMC requirements of 2004/108/EC.
The product was tested in typical configurations.

We declare that the equipment in question complies with the safety requirements stated above:

Date 19 December 2013

Controller Engineering manager

Signature

Michael Olson
Theory of operation

WMSS1000 sensors theory of operation

The WMSS1000 wireless multi-sonic sensors provides and responds to messages under control of the CWH1000 wireless hub. The system employs an encrypted proprietary protocol optimized to minimize signal latency, prevent signal tampering, and provide robustness.

Each sensor has six transducers that are used to achieve optimal elevation and steering control. Each transducer takes two measurements at each sample cycle:

- Temperature compensation
- Target measurement

Ultrasonic transducer signals are affected by temperature. To compensate for temperature errors, these sensors use a temperature bail mounted in the path of the transducer that runs the entire length of the sensor. This makes it accessible to each individual transducer and allows for excellent temperature compensation and allows the sensor to respond to fluctuations caused by wind gusts and vehicle exhaust. This also allows for an overall faster sensor response time since no breaks in measurements are needed to account for temperature compensation readings. When the transducer sends out a signal, the signal first hits the temperature bail and provides an echo that is reflected back to the transducer. The signal then continues on to the target and a second echo is reflected back to the transducer. Because the distance to the target is constant, it is used to compensate the second echo for temperature errors.

The sensor detects when the temperature bail is not present and sends a message to the system application that temperature compensation is not available and accuracy of the sensor may be compromised. When the temperature bail is replaced and the operator’s hand is removed from the temperature bail echo region, the sensor automatically recalibrates for temperature compensation.

After each ultrasonic transducer completes a measurement, target distance is calculated using one of two methods:

- Running average: If the sensor has not received a survey command from either a CAN message or wireless beacon, the target distance is calculated using the average of all valid ultrasonic transducer measurements. This mode provides the smoothest step response transition for ideal targets.
- Outlier filtering: If a Survey command has been received, the average of all valid ultrasonic transducers is stored as the set point. Each ultrasonic transducer is compared with the set point, and the target distance is calculated using the average of the three transducer measurements closest to the set point. This mode provides better filtering of target abnormalities.

The set point can be adjusted up or down using the Offset CAN message.

Modes of operation

Ground mode

When the multi-sonic sensor is configured to operate in ground mode, the sensor measures distance from the sensor to the target. To accurately measure height, the sensor must be placed perpendicular to the target at a distance between 20cm and 100cm.

String line mode

When the multi-sonic sensor is configured to operate in string line mode, the sensor measures distance from the sensor to the string (string height), and where the string is relative to one edge of the sensor (string position).

To accurately measure height, and position, the sensor must be placed perpendicular to the string at a distance between 20 cm and 40 cm. Also, the string must be at least one inch off the ground.

The string height is calculated by triangulating the distance from the two ultrasonic transducers sensing the shortest distance. This approach allows for a much better accuracy due to trigonometric errors inherent when only the height measurement from a single sensor with the shortest distance is used.

The string position is calculated using a weighted average algorithm which allows the sensor to determine the position of the string with much better resolution. The string position is transmitted in two different formats:
**Theory of operation**

- High resolution format transmits a number between 0 and 1500 which corresponds to 0 to 150.0 mm.
- Low resolution format transmits a number between 0 and 11 which indicates the string is either under a ultrasonic transducers, or between two transducers.

**Ranges for string line and ground sensing**

*WMSS1000 ranges for string line (left drawing) and ground sensing (right drawing)*

Stringline must be at least 25.4 mm (1 in) above the ground.
Ordering information

WMSS1000 Ordering Information

<table>
<thead>
<tr>
<th>Ordering information</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>WMSS1000</td>
<td>11135819</td>
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Related products part numbers

<table>
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<tr>
<th>Related products part numbers</th>
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</thead>
<tbody>
<tr>
<td>CWH1000 CAN Wireless Hub</td>
<td>11138885</td>
</tr>
<tr>
<td>CG150 CAN/USB Gateway</td>
<td>11153051</td>
</tr>
<tr>
<td>Temperature Bail</td>
<td>11125810</td>
</tr>
<tr>
<td>Battery Charging Kit</td>
<td>11135113</td>
</tr>
<tr>
<td>Quick Mount with RFID</td>
<td>11143888</td>
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</table>
Product installation

WMSS1000 Dimensions

<table>
<thead>
<tr>
<th>Dimension (mm)</th>
<th>Dimension (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>264.00</td>
<td>10.39</td>
</tr>
<tr>
<td>108.00</td>
<td>4.25</td>
</tr>
<tr>
<td>Ø 39.3</td>
<td>1.55</td>
</tr>
<tr>
<td>Ø 10.00</td>
<td>0.39</td>
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<tr>
<td>22.60</td>
<td>0.89</td>
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<tr>
<td>20.80</td>
<td>0.82</td>
</tr>
<tr>
<td>113.10</td>
<td>4.45</td>
</tr>
<tr>
<td>224.90</td>
<td>8.85</td>
</tr>
</tbody>
</table>

**Caution**

Warranty will be voided if device is opened.
Device is not field serviceable. Do not open the device.

Sensor mounting instructions

Sensor should be rigidly mounted to the machine, placed so the target surface is not obstructed. Care should be taken to place sensor parallel to the target surface and in the working range of the sensor.

Power switch

To turn on the CMSS1000 CAN multi-sonic sensor: Press the power switch. All LEDs flash once to indicate power up.
To turn off the sensor: Press and hold the switch until the LEDs turn off.
Product installation

WMSS1000 quick mount and release

The sensors are designed for quick mounting and removal.

- Quick mount and release - requires no tools to remove the sensor from the mount.
- Locking tab prevents the sensor from falling off if the release lever is inadvertently opened.
- RFID (Radio Frequency Identification) tag is built into the machine mounted assembly to provide sensor source address information.

Locking tab and RFID tag location

<table>
<thead>
<tr>
<th>Callout</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RFID tag</td>
</tr>
<tr>
<td>2</td>
<td>Locking tab</td>
</tr>
</tbody>
</table>

Keep quick mount assembly free of dirt to prevent excessive wear.

WMSS1000 capped connector

During normal operation, the connector on the wireless sensor is capped, as shown.

Capped connector on the WMSS1000

Remove the cap to attach the battery charger or to attach the connector for the PLUS+1 Service Tool.
LEDs

All LEDs provide visual indication of sensor status for the machine operators.

**WMSS1000 battery indication**

The battery indicators consist of four green LEDs and one red LED. Each green LED indicates 25% battery life. The red LED indicates less than 10% battery life remains. As the battery discharges, the green LEDs turn off sequentially. The green LEDs scroll in sequence to indicate the charging of the battery. When the battery is fully charged all four green LEDs blink until the charging cable is removed.

**LEDs chart**

<table>
<thead>
<tr>
<th>LED Description</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrolling green LED</td>
<td>Charging</td>
</tr>
<tr>
<td>4 flashing LED</td>
<td>Fully charged</td>
</tr>
<tr>
<td>4 green LED</td>
<td>100%</td>
</tr>
<tr>
<td>3 green LED</td>
<td>75%</td>
</tr>
<tr>
<td>2 green LED</td>
<td>50%</td>
</tr>
<tr>
<td>1 green LED</td>
<td>25%</td>
</tr>
<tr>
<td>1 red LED</td>
<td>10%</td>
</tr>
</tbody>
</table>

**WMSS1000 wireless indication**

The blue LED blinks to indicate the sensor is communicating with the Wireless Hub.

**Wireless indication LEDs**

1. Battery life indicator
2. Wireless communication indicator
3. On/Off button

**Deviation indication**

LEDs on both sides of the CMSS1000 multi-sonic sensor provide a visual indication of sensor position and status for the machine operators. The deviation LEDs consist of three sections: up arrow, on grade, and down arrow. These LEDs are under software control and each section is controlled by the LED Command CAN message.
Product installation

Deviation indication LEDs

1. Down arrow
2. On grade
3. Up arrow

WMSS1000 parameters configuration

Some of the WMSS1000 parameters can be set up using the PLUS+1® Service Tool. This table defines the allowable values for each of the WMSS1000 parameters that can be modified using the PLUS+1® Service Tool.

WMSS1000 parameters allowable values

<table>
<thead>
<tr>
<th>PLUS+1® Service Tool signal (sensor parameter)</th>
<th>Allowable values</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pwr_save_Mode</td>
<td>0,1</td>
<td>0 = disabled (all LEDs functional) (factory default), 1 = enabled (only wireless LED functional), overwritten by CWH1000 every beacon update</td>
</tr>
<tr>
<td>Snsr_Op_Mode</td>
<td>0,1</td>
<td>0 = ground mode (factory default), 1 = string line mode, overwritten by CWH1000 every beacon update</td>
</tr>
<tr>
<td>Height Damping</td>
<td>0 to 100</td>
<td>Damping factor for elevation distance measurement 0 = fastest response, 100 = slowest response, 75 = factory default</td>
</tr>
<tr>
<td>Steer_Damping</td>
<td>0 to 100</td>
<td>Damping factor for elevation distance measurement 0 = fastest response, 100 = slowest response, 75 = factory default</td>
</tr>
<tr>
<td>PLID</td>
<td>1 to 10</td>
<td>Programmable location ID = programmed by the CWH1000</td>
</tr>
<tr>
<td>deleteRFID</td>
<td></td>
<td>Push button click resets RFID tag data values to factory defaults</td>
</tr>
</tbody>
</table>
Multi-sonic sensors temperature bail

The temperature bail is designed to magnetically lock in place when in use and is easily removed in the presence of a physical obstruction that could potentially bend or break the bail. If an object runs into the bail, the bail will detach from the sensor to prevent damage.

The sensor has cutouts on the underside for the bail to be repositioned from normal use into a flat position for storage. The magnets retain the bail during storage.

A reference bail for optimum temperature and wind compensation is included. The bail is firmly held in place by magnets and designed to safely release upon contact rather than break or bend. The bail can be easily removed and stored in an alternate position when the sensor is not in use.

Temperature bail in use, stored, removed

WMSS1000 internal rechargeable battery

Each WMSS1000 has an internal rechargeable battery installed. This Lithium Iron Phosphate (LiFePO4) battery is capable of providing up to 16 hours of continuous use. Charging of the battery takes up to 3 hours and is completed by connecting each sensor to a charging kit, Danfoss part number 11135113.

In an emergency, the sensor can be connected directly to a 9 to 36 Vdc power source for charging and/or operation.

Replacement of the battery pack should only be completed by a Danfoss authorized service center.

Multi-sonic sensors battery charger

The battery charger provides a means for recharging the sensor’s internal battery. Each kit includes multiple AC adaptors.
Accessories

Battery charger and multiple AC adaptors

Charge battery at room temperature for optimum battery life.
Connector

WMSS1000 Connector pin assignments

Use care when wiring mating connector. Pinouts are for device pins.

5 pin connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Controller Function</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAN Shield</td>
<td>There is a 0.68 uF capacitor and a 1 Ohm resistor in series to ground on this input for CAN shield termination.</td>
</tr>
<tr>
<td>2</td>
<td>Power Input</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Power Ground</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CAN HI</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CAN LO</td>
<td></td>
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</tbody>
</table>
Specifications

WMSS1000 electrical

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>9 to 36 Vdc</td>
</tr>
<tr>
<td>Current consumption</td>
<td>200 mA operational</td>
</tr>
<tr>
<td></td>
<td>2 A charging</td>
</tr>
</tbody>
</table>

Internal battery

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>LiFePO4</td>
</tr>
<tr>
<td>Power</td>
<td>20 watt hours</td>
</tr>
</tbody>
</table>

WMSS1000 environmental

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>-5˚ C to 70˚ C</td>
</tr>
<tr>
<td></td>
<td>(23˚ F to 158˚ F)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-20˚ C to 70˚ C</td>
</tr>
<tr>
<td></td>
<td>(4˚ F to 158˚ F)</td>
</tr>
<tr>
<td>Charging temperature</td>
<td>0˚ C to 55˚ C</td>
</tr>
<tr>
<td></td>
<td>(32˚ F to 131˚ F)</td>
</tr>
<tr>
<td>Ingress Protection rating</td>
<td>IP 67</td>
</tr>
<tr>
<td>(IP) with connector installed</td>
<td></td>
</tr>
<tr>
<td>EMI/RFI rating</td>
<td>100 V/m</td>
</tr>
</tbody>
</table>

WMSS1000 mechanical

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>1.317 kg (2.904 lbs)</td>
</tr>
<tr>
<td>Vibration</td>
<td>IEC 60068-2-64</td>
</tr>
<tr>
<td>Shock</td>
<td>IEC 60068-2-27</td>
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</tbody>
</table>

Ultrasonic performances

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground sense range</td>
<td>200 mm to 1000 mm</td>
</tr>
<tr>
<td></td>
<td>(7.87 in to 39.37 in)</td>
</tr>
<tr>
<td>Linearity</td>
<td>± 1%</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1 mm (0.004 in)</td>
</tr>
<tr>
<td>String line height range</td>
<td>200 to 400 mm</td>
</tr>
<tr>
<td></td>
<td>(7.87 in to 15.75 in)</td>
</tr>
<tr>
<td>String line steer range</td>
<td>150 mm (5.91 in)</td>
</tr>
<tr>
<td>String line digital steer resolution</td>
<td>15 mm (0.59 in)</td>
</tr>
<tr>
<td>String line analog steer resolution</td>
<td>3 mm (0.12 in)</td>
</tr>
</tbody>
</table>
## Technical Information

**WMSS1000 Wireless Multi-Sonic Sensor**

### Specifications

#### Multi-sonic sensors battery charger

<table>
<thead>
<tr>
<th><strong>Battery charger</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input voltage</strong></td>
<td>100-240 Vac 50/60 Hz</td>
</tr>
<tr>
<td><strong>Input current</strong></td>
<td>1 A</td>
</tr>
<tr>
<td><strong>Output power</strong></td>
<td>Maximum 30 watts</td>
</tr>
<tr>
<td><strong>Output voltage</strong></td>
<td>12 Vdc</td>
</tr>
<tr>
<td><strong>Output current</strong></td>
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