

# VM3D 3D Volumetric Laser Scanner System

Measurement made easy

Automatic stockpile inventory management with 3D volumetric laser scanner Level products



### Automated stockpile management

The 3D volumetric scanner system measures the volume of material stockpiles stored out in the open or in large structures like silos, bunkers, domes and sheds. By integrating accurate laser technology into a network of scanning instruments, complex surfaces can be mapped accurately.

### User benefits of inventory management

- Manage filling / reclaiming
- Prevent overfilling
- Prevent running too low / no stock
- Prevent / reveal stock discrepancies
- Optimize inventory – minimum stock

### User benefits compared to manual measure

- More accurate manual estimation
- Unmanned measurement (safety, cost)
- Flexible scan time
- Measurement Frequency

### Increased precision compared to others methods

- No cumulative error like when weighing
- Detailed surface rendering compared to single point level

### System architecture to suit Customer preferences

To suit Customer needs two system architectures are available. The same scanner and the same computation algorithm

can be used in different data flow architectures. They have the same measurement capabilities and the same accuracy. They are :

- Cloud based architecture
- Stand-alone architecture

### Cloud based architecture specifics

- Remote access (cellular network) eases commissioning and troubleshooting
- No user intervention to operate scanners
- WEB access
- Secure server and network
- Scheduled measurement

### Stand-alone architecture specifics

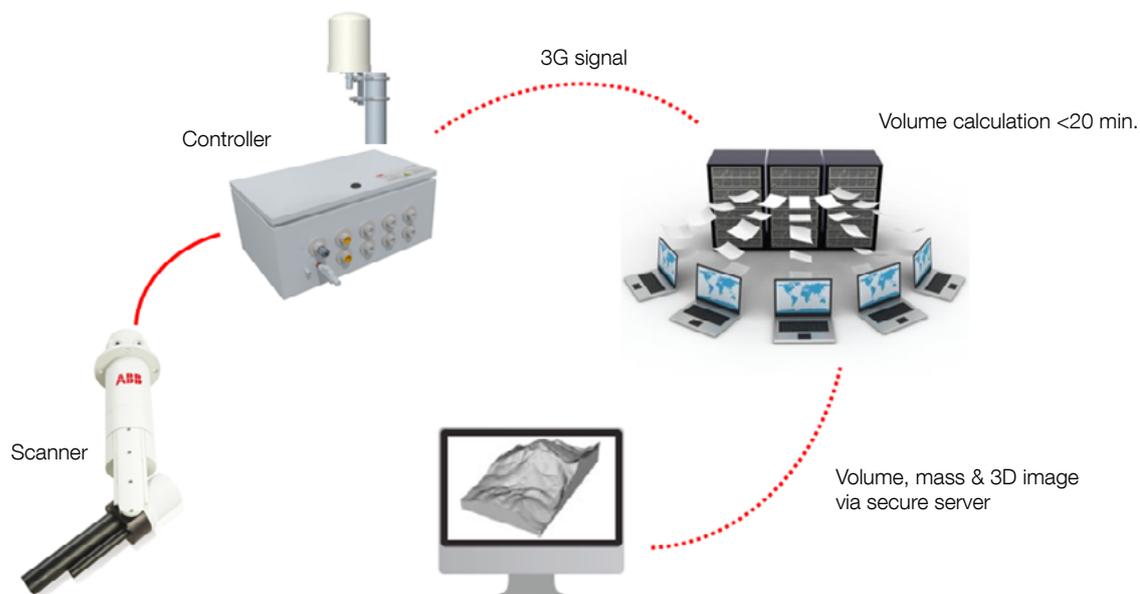
- User operated scan-on-demand
- Scheduled measurement
- No data leaves Customer site for normal operations
- No need for cell phone access (data)
- User provided computer to install VM3D SW

### System attributes

- On-demand measurement
- Scheduled measurement
- Maintenance free, non-contact laser scanner
- Regular scheduled surface mapping for granular solid material stockpiles

# VM3D

## Volumetric Laser Scanner



- Auto-ranging to measure points from 0.5 m to 93 m (1.64 ft to 305 ft)
- Scanning motion covers a complete hemisphere
- Heated optics prevent condensation issues
- Rugged and robust powder coated aluminum enclosure can be used in any environment

### A convenient solution

- No calibration or maintenance required (permanently sealed and lubricated bearings)
- CSA, ATEX and IECEx potentially explosive atmosphere ratings
- Easy to install and configure without filling or emptying the vessel

### High performance

- Performs a complete high resolution scan in under 45 minutes
- Less than 0.3° beam divergence for precision targeting
- Collects thousands of points per scan
- Artifact removal provides dependable inventory information
- Can penetrate moderate dust

### Many different materials

- Measures all clearly visible surfaces irrespective of texture, granularity, slope and / or color
- Accurately measures to the surface of mineral ores, grains, and synthetic materials
- Examples include: gold and metal ores, sugar, fertilizers, coal, corn, rice, coffee and plastic pellets

### Many different structures

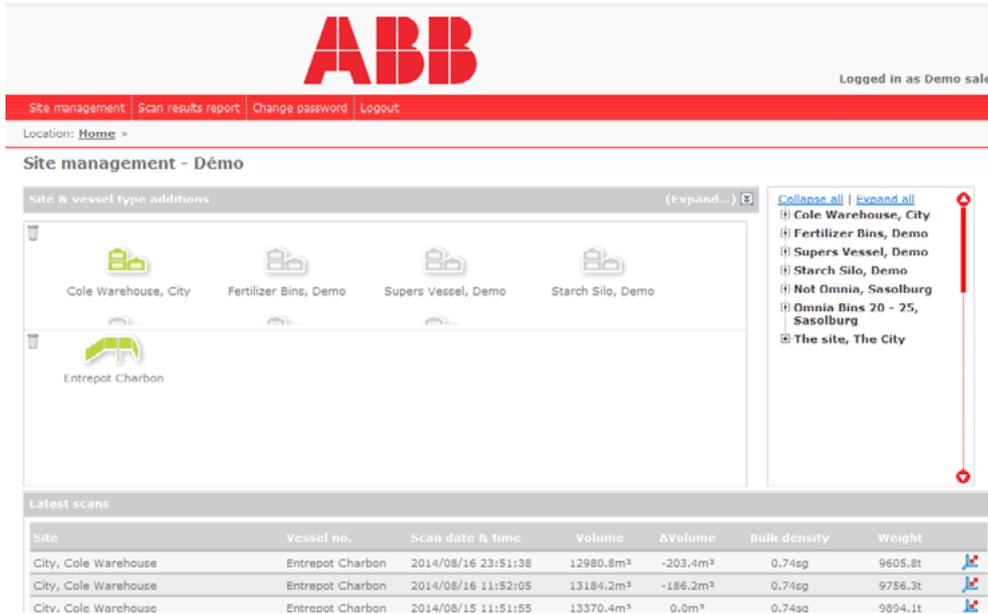
- Works in all types of storage buildings including silos, tanks, bunkers, sheds and domes
- Can provide volume estimation for open air stockpiles
- Provides volume estimates with less than 2% error (full vessel, vessel greater than 100 m<sup>3</sup>).

### Overview

The Volumetric Laser Scanner (VM3D) is a non-contact, volume measuring instrument designed for granular solid materials. Based on pulsed laser technology, the VM3D embodies speed and accuracy in a single, easy to use and install product. The characteristic narrow beam divergence of the laser coupled with a precise mechanical scanning system that covers a complete hemisphere permits direct aiming to the target surface and building a tight point cloud from which to derive a surface map. Because the VM3D system computes the shape and volume of stockpiles from a point cloud it is possible to merge the data from any number of scanners to obtain the shape and volume of even the largest stockpiles. Whether measuring a few meters into the confined space of a small silo, or to the bottom of the largest warehouse, the VM3D with its long range, wide angular sweep and ability to function as a scanner network is the solution to stockpile volume measurement.

### Distance measurement with laser technology

The VM3D uses a high speed laser pulse to measure distance. The laser light is emitted towards the surface



and some of it reflects back to the instrument where it is detected by a sensitive optical receiver. The time it takes for the light to travel to the surface and back to the instrument is directly proportional to the distance between the instrument and the surface. Using a time-of-flight calculation the VM3D accurately measures the distance to the target surface.

The unique characteristics of laser light give the VM3D significant performance advantages over other technologies in terms of resolution and immunity from parasite reflections. The narrow, long range beam can measure both near and far distances and obstacles can be measured around by placing multiple scanners at different vantage points.

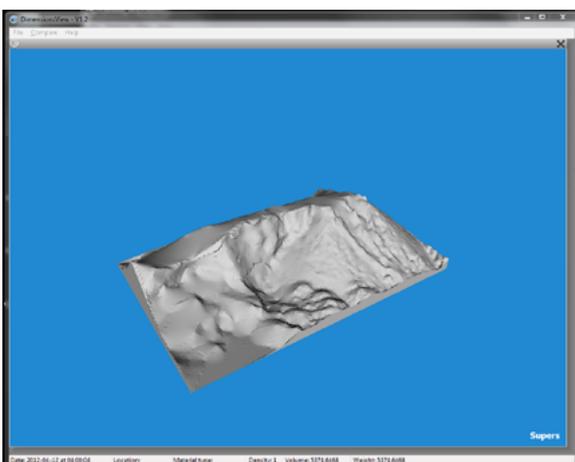
### Volume estimation using Cloud Based system

The VM3D transmits the raw point cloud over a secure network to a FTP server where the data is automatically processed to produce a picture of the stockpile and an estimate of the volume and mass it contains. The results are obtained within 20 minutes once the scan is done. The analysis makes use of the building blueprints to determine the depth of the stockpile and avoid having to empty the building to baseline the scanner system. This analysis also eliminates artifacts like machinery and visible building structures from the volume estimate even if they move from scan to scan.

The complete data transmission chain uses highly secure encrypted data communications, and ABB will enter into a legally binding agreement with the end user not to reveal any of their confidential inventory information.

To access saved data, go to: [www.abb.com/myvm3d](http://www.abb.com/myvm3d) and enter your login details as provided by ABB.

Upon successful secured login, the 'Site Management' page is displayed where site information can be accessed/managed as well as Individual stockpile information. The website allows user to visualize computed data and download a 3D representation of the pile (requires a viewer provided for free by ABB).



# VM3D

## Volumetric Laser Scanner



### Volume estimation using stand-alone system

The VM3D transmits the raw point cloud over a local network to a controller software running on the customer computer. The data is automatically processed to produce a picture of the stockpile and an estimate of the volume and mass it contains. The results are obtained within minutes once the scan is done. Just like the cloud based architecture, the analysis makes use of the building blueprints to determine the depth of the stockpile and avoid having to empty the building to baseline the scanner system. This analysis also eliminates artifacts like machinery and visible building structures from the volume estimate even if they move from scan to scan. No data is automatically sent outside Customer premises. It is kept locally on the controller/computer and made accessible to Customer for internal use. Resulting files can be extracted and distributed at user discretion.

Just like the Cloud based system, a computation model tailored to customer premises is required to provide an accurate measurement of the material. In the case of the Stand-alone system, the Customer participation is needed to provide raw data to ABB for the computation model development. During normal operation, no data is required by ABB.

### Range Guide

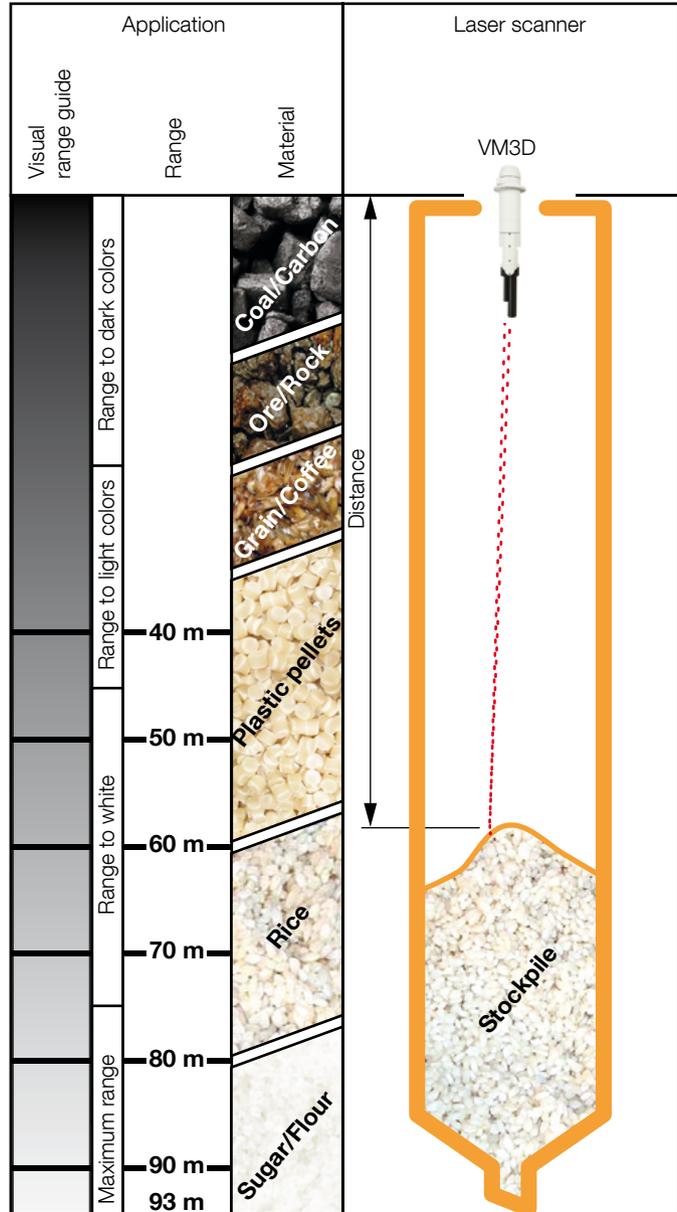
The VM3D is mounted inside storage vessels aiming downwards towards stockpiled materials. The ability to scan over a complete hemisphere and auto ranging from 0.5 m to 93 m allows the scanner to cover large surface areas with significant depth variations. A dust tube prevents dust from settling on the lens and standard heated optics prevent any condensation.

### Range Explained

The VM3D is able to measure the height of surfaces in large structures because of the inherent long distance capability of laser technology. The laser has a natural advantage because it gets strong, clear signals from most types of granular solid materials. As the laser beam doesn't spread out and lose strength as it travels, there is little signal loss with increased distance.

### Ultimate range

The ultimate limit of range for the VM3D depends on the reflectivity of the material being measured. Dark colored materials can be measured over a shorter range than light colored materials. Using the chart on the left, a visual comparison between the graded "Visual range guide" strip and the surface to be measured tells you what range is practically possible.



# VM3D

## Volumetric Laser Scanner

### Specifications

| <b>Measurements</b>                                |   |
|--|---|
| Single point range                                 | 0.5 m (1.5 ft) to 93 m (305 ft)   |
| Single point resolution                            | ±10 mm (0.4 in)   |
| Single point Accuracy                              | ±30 mm (1.2 in)   |
| Coverage   | Complete hemisphere scan<br>Nominal surface coverage 65m radius circle (90° cone, scanner 65 m above stockpile)   |
| Accuracy   | Less than 2% error on volumes greater than 100 m3   |
| Update rate  | Complete scan in under 45 minutes   |
| Scanner per control box                            | Maximum 4   |
| Scanner operating temperature                      | -20 °C to +60 °C (-4.6 °F to +140 °F); extended low temperature operation possible using thermal pad (optional)   |
| Scanner survival temperature                       | -40 °C to +70 °C (-40 °F to +158 °F)  |
| Control box operating temperature                  | -20 °C to +60 °C (-4 °F to +140 °F); extended low temperature operation possible using optional thermal control unit  |
| Control box survival temperature                   | -40 °C to +70 °C (-40 °F to +158 °F)  |
| Pressure   | Atmospheric   |
| <b>Outputs</b>                                     |   |
| Analog / Digital                                   | None  |
| Scanner network                                    | Ethernet cat 5e industrial, max distance from scanner to control box 100 m  |
| Control box  | 3G / GSM encrypted cellular connection with APN or internet connection over ethernet  |
| Data service                                       | Analysis shall be completed and available within 20 minutes following the scan on a daily basis   |
| Secure website                                     | Analysis of scan data provided on a secure password protected web site by ABB data center. Result includes visual representation of stockpile, total volume of stockpile, change in volume since last measurement, total mass of stockpile and change in mass of stockpile using density provided by end user |
| <b>Electrical specifications - control box</b>     |   |
| Voltage  | 115 - 230 VAC   |
| Voltage fluctuation                                | maximum 10% of nominal line voltage   |
| Frequency  | 47 - 63 Hz  |
| Rated power  | 500 VA  |
| Fuse type (output)                                 | 2A/250V fast (5 x 20 mm; 0.2 x 0.79 in)   |
| Output rating                                      | 24 V DC, 1A (4x)  |
| <b>Electrical specifications - scanner</b>         |   |
| Rated input voltage                                | 24 V DC   |
| Current  | 1A; 2.2 A in-rush at start-up (< 100 ms)  |
| <b>Computer requirement for stand-alone system</b> |   |
| OS   | Windows® 7 SP   |
| RAM  | 6 GB or more  |
| Free disk space                                    | 10 GB or more   |
| Network  | Ethernet dedicated port   |

Note: the control box provides power to scanner, 3G remote access and controller software. It is required for Cloud based systems. For stand-alone systems, the customer provides 24Vdc power to the scanner and a computer. For this reason, the control-box is not required.

## Specifications

| <b>Mechanical - scanner</b>  |  |  |  |
|--|--|--|--|
| Diameter   | 129 mm (5 in)  |  |  |
| Length   | 884 mm (34.8 in)   |  |  |
| Weight   | 12 kg (26.5 lbs)   |  |  |
| Enclosure material   | Powder coated aluminum   |  |  |
| Mounting flange / process connection   | flange diameter 190 mm (7.48 in)<br>4 holes, 16.5 mm (0.65 in) diameter on 160 mm (6.3 in) diameter circle   |  |  |
| <b>Mechanical - control box</b>  | <b>General Purpose</b>   | <b>Hazardous area<br/>(dust ignition protection)</b> | <b>Hazardous area<br/>(dust ignition protection)</b> |
| Width  | 304 mm (12 in)   | 388 mm (15.28 in)                                    | 388 mm (15.28 in)                                    |
| Height   | 508 mm (20 in)   | 500 mm (19.69 in)                                    | 500 mm (19.69 in)                                    |
| Depth  | 224 mm (8.8 in)  | 205 mm (8.07 in)                                     | 205 mm (8.07 in)                                     |
| Weight (approx.)   | 16 kg (35 lb)  | 17.2 kg (38 lb)                                      | 17.2 kg (38 lb)                                      |
| Enclosure  | Mild steel, left hinged door   | Painted steel, left hinged door                      | Stainless steel, left hinged door                    |
| Mounting   | Wall mount   | Wall mount   | Wall mount   |
| <b>Optical</b>   |  |  |  |
| Total optical aperture   | 90 mm (3 in)   |  |  |
| Measuring laser lens diameter  | 25 mm (1 in)   |  |  |
| Receiver lens diameter   | 50 mm (1.97 in)  |  |  |
| Lens material  | Glass  |  |  |
| Lens impact resistance   | Impact tested at 4 joule   |  |  |
| Beam divergence  | $\Delta < 0.3^\circ$   |  |  |
| Beam spot diameter   | Approx. 15 cm at 30 m (6.2" at 100')   |  |  |
| <b>Laser</b>   |  |  |  |
| Measuring laser  | 905 nm near infrared pulsed semiconductor laser<br>12 mW average power output<br>20 W peak power output  |  |  |
| Measuring laser life expectancy  | 25 years typical MTBF  |  |  |
| Measuring laser safety   | Always on IEC60825-1 class 1M laser<br>A class 1M laser is safe for all conditions of use except when passed through magnifying optics. This means the maximum permissible exposure cannot be exceeded when viewing the laser with the naked eye without the aid of magnifying optics. |  |  |
|  |  |  |  |
| <b>Environmental</b>   |  |  |  |
| Enclosure rating (scanner & control box)   | IP66/Nema 4 (Dust proof, can be washed down with high pressure hose)   |  |  |
| Dust rating  | This equipment can be used in dusty areas including metallic and nonmetallic dust particles.   |  |  |

# VM3D

## Volumetric Laser Scanner

### Approvals

|   |  |   |
|---|--|---|
| <p>CE</p>      | <p>Quality standard : ISO9001:2008</p> <p>Electromagnetic compatibility directive: 2004/108/EC</p> <p>Low voltage directive 2006/95/EC</p> <p>CE marking directive 93/68/EEC</p> <p>Radio and telecommunications terminal equipment 1999/5/EC*</p> | <p>Harmonized standards applied:</p> <p>EN 61326-1 electrical equipment for measurement, control and laboratory use - EMC requirements EN 301 489-1 and EN 301 489-24</p> <p>Electromagnetic compatibility and Radio spectrum Matters (ERM): Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1 and 24.</p> <p>EN/IEC 60825-1 safety of laser products - part 1: equipment classification and requirements</p> |
| <p>ATEX</p>    | <p>Notified body: SIRA Certification service, Rake Lane, Eccleston, Chester, CH4 9JN, England</p> <p>II 2D Ex tb IIIC T85 °C Db (-40 °C ≤ Tamb ≤ +60 °C)**</p>   |   |
| <p>CSA</p>     | <p>Electrical safety</p> <p>Potentially explosive atmospheres: Class II, Division 1, Groups E, F and G; Class III;</p> <p>Ex tb IIIC T85 °C; Zone 21, AEx tb IIIC T85 °C (-40 °C &lt; Tamb &lt; +60 °C)**</p>                                      |   |
| <p>IECEX</p>  | <p>Potential explosive atmospheres</p> <p>Ex tb IIIC T85 °C Db (-40 °C ≤ Tamb ≤ +60 °C)**</p>  |   |
| <p>TUV</p>   | <p>Electrical safety</p> <p>CAN/CSA C22.2 No. 61010-1:2004</p> <p>UL 61010-1:2004</p> <p>EN 61010-1:2004</p>   |   |

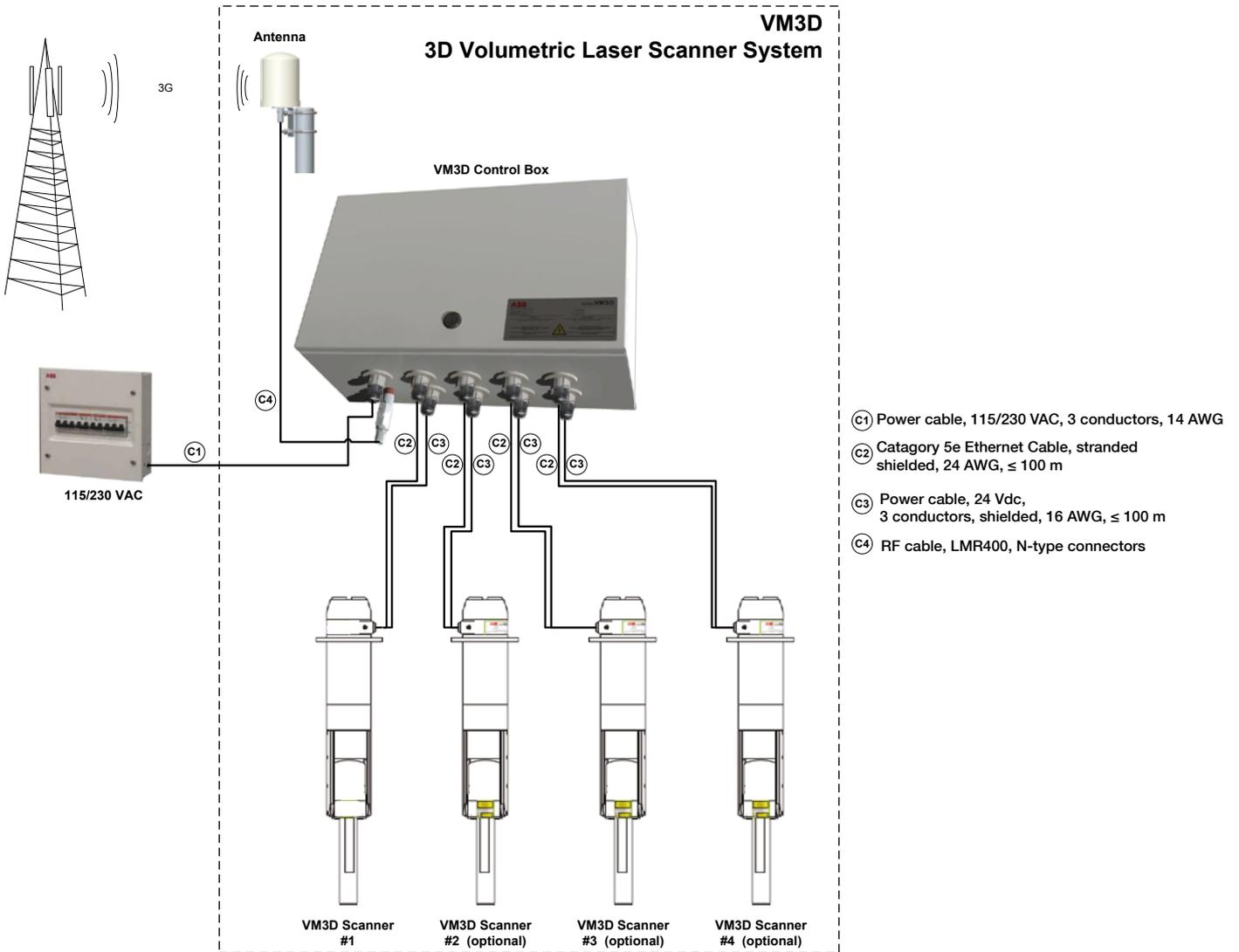


**\*Warning**

This is a class A (industrial) product that meets EN 55022:2010 - Emissions Class A limits for installation in Telecom Center or equivalent environment.

\*\*For the control box, ATEX certificate valid only with the ATEX certified VM3D Control Boxes that are certified-Ex type.

VM3D cloud based topology



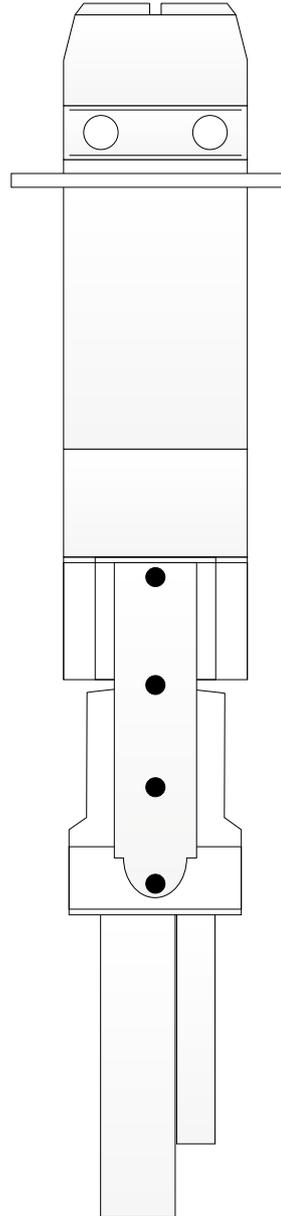
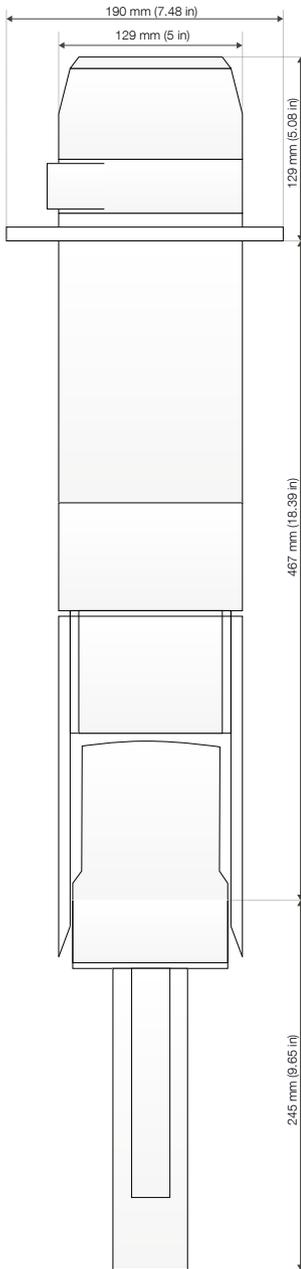
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## Volumetric Laser Scanner

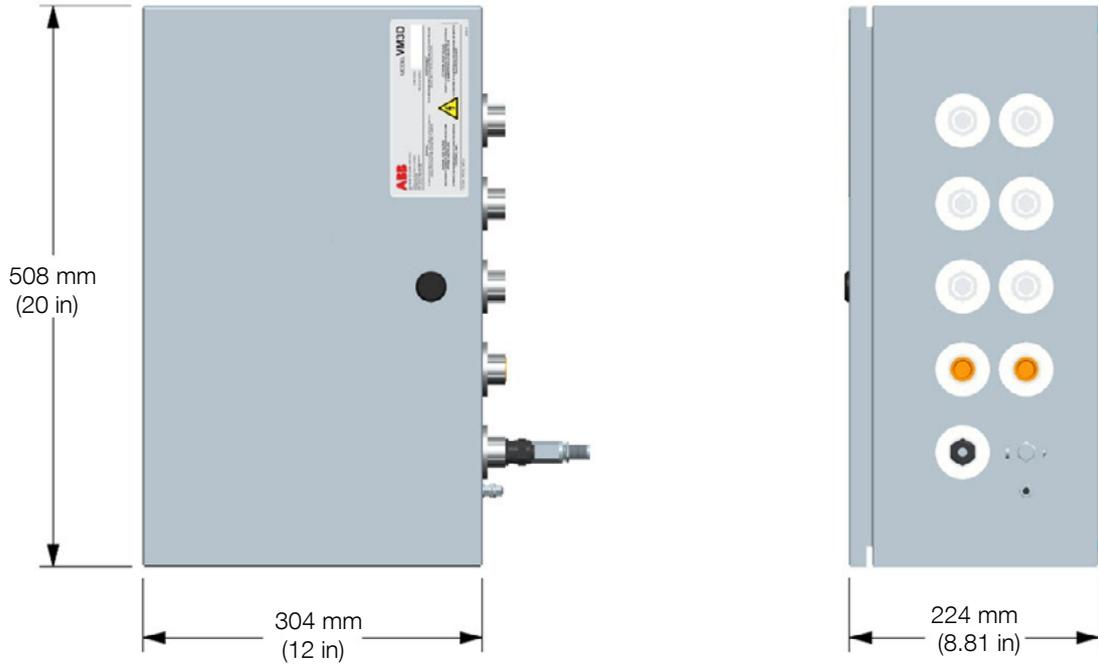
### Dimensions

½ inch NPT  
cable gland  
part GCK

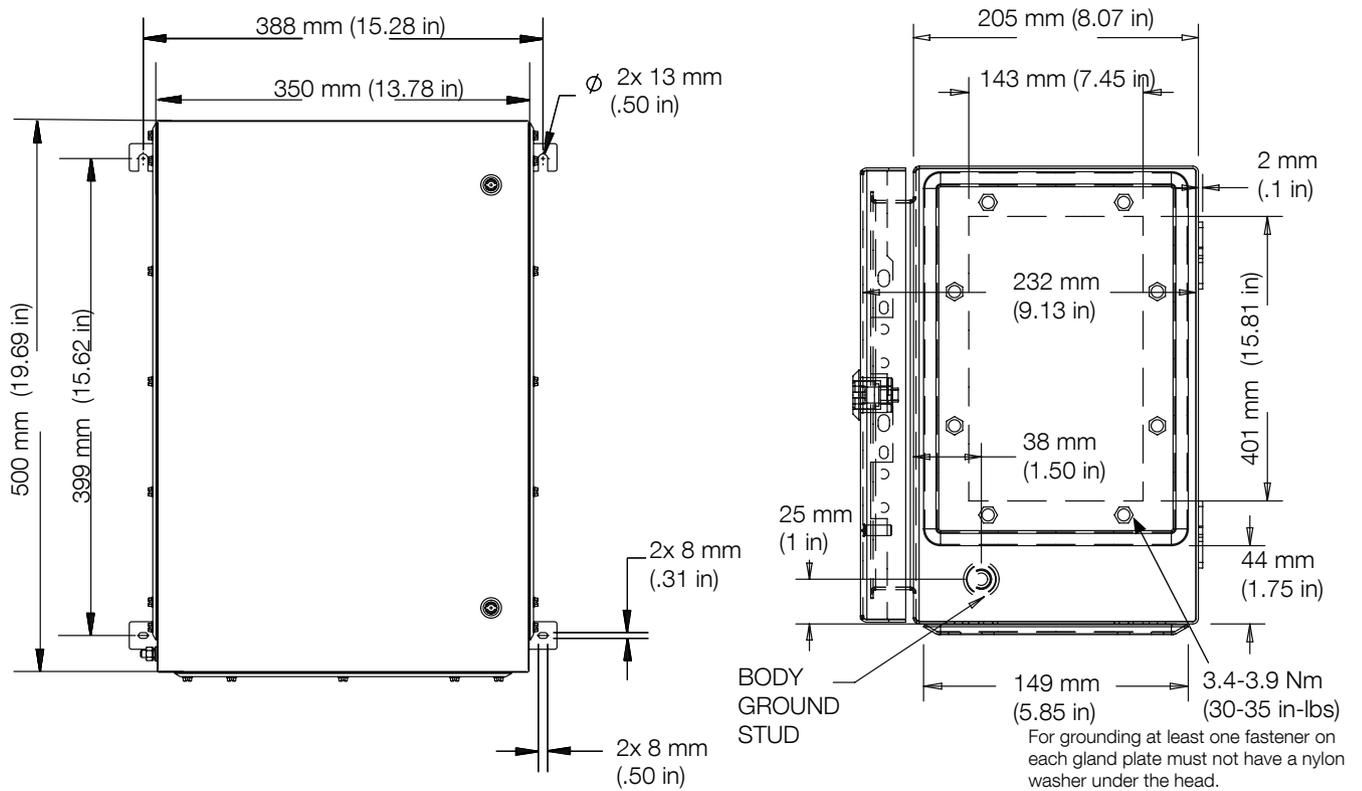
Imperial ½ inch NPT  
to M20 metric adapter  
part GC1



Control box - Aluminum for general purpose



Control box - Painted Aluminum or Stainless Steel for hazardous area



# VM3D

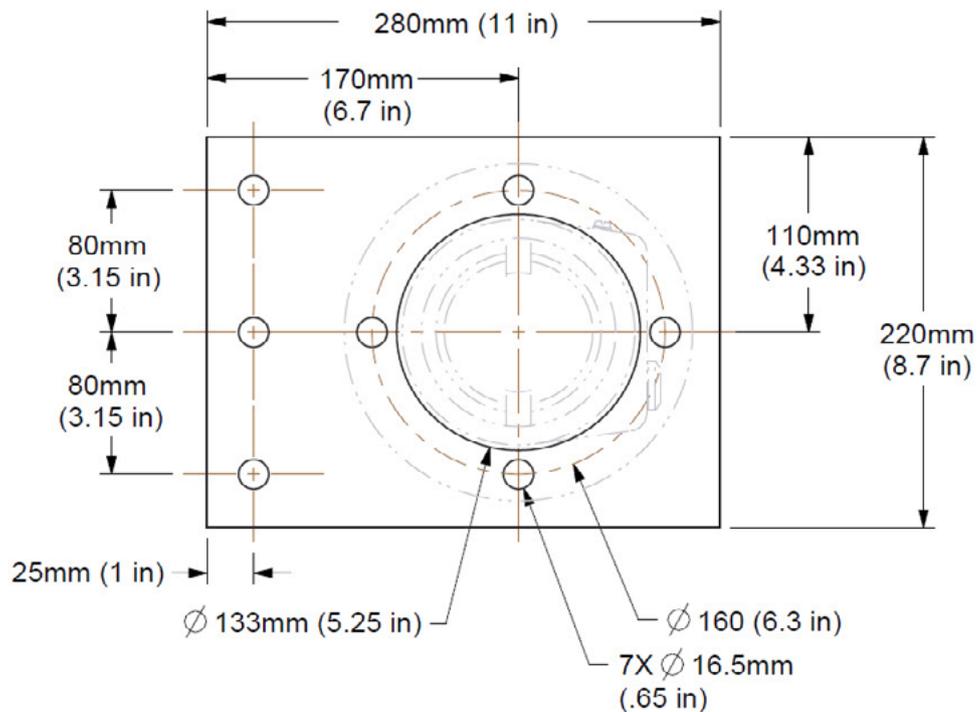
## Volumetric Laser Scanner



### Mounting plate

ABB does not supply standard mounting hardware for the VM3D as each installation is different. However mounting brackets should be based on the following suggested mounting plate design.

The VM3D control box comes with hardware for standard wall mounting.



### Standard precautions

The VM3D is designed to withstand many industrial environmental conditions. However, a few precautions will ensure reliable operation of the unit for extended periods of time:

- Read safety manual and refer to certifications for operation in potentially explosive atmospheres
- Do not drop the instrument.
- Do not open the terminal compartment lid when an explosive dust or gas atmosphere may be present.
- Do not expose the internal electronics to water or dirt.
- Do not install or connect with the power on.
- Use appropriate insulated lugs or ferrules for connections to the terminal block and grounding screws
- Always keep the terminal compartment lid seal clean and lightly lubricated with Vaseline® Petroleum Jelly.
- Ensure that the terminal compartment lid is tight after connections have been made.
- If using cable glands, only use glands that have been suitably certified by a notified body for cable entry into the enclosure. If in doubt use cable glands supplied by ABB.
- Ensure that the cable glands are tight after connecting the external cable.
- Do not install conduit so that it can drain into the VM3D terminal compartment.
- Remove dirt from the lenses with a clean, damp cloth only.
- Do not point the instrument at the sun.

# VM3D

## Volumetric Laser Scanner

### Notes

Notes

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