Data sheet DS/VM3D-EN Rev. C

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. The system makes use of remote monitoring and data processing services to guarantee data integrity to the level needed for confident stock management and precise auditing.

System attributes

- Maintenance free, non-contact laser scanner
- No calibration required
- Regular scheduled surface mapping for granular solid material stockpiles
- 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

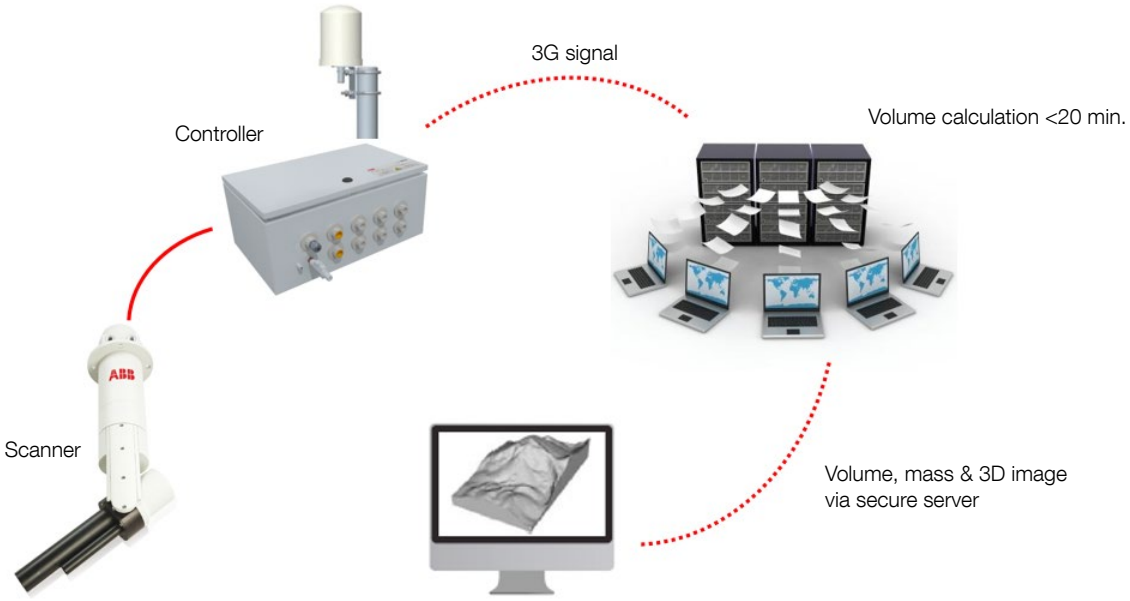
Many different materials

- 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 for volumes greater than 100 m^3 (3531 ft^3).

VM3D
Volumetric Laser Scanner



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 plug-and-play solution to stockpile volume measurement.

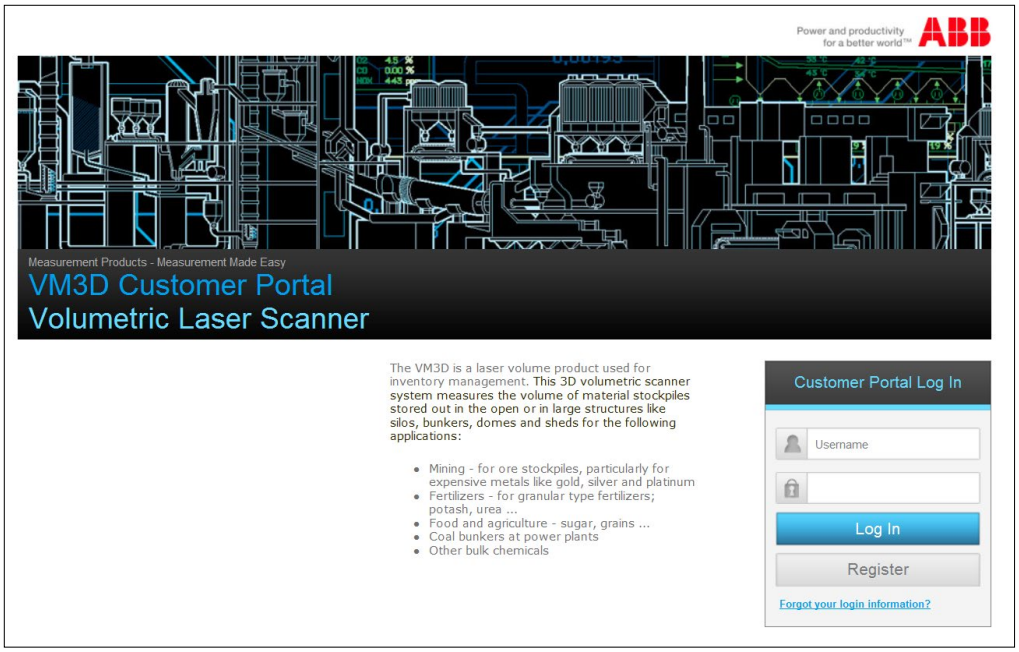
Distance measurement with laser technology

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 using the equation below:

$$\text{Distance} = \frac{\text{speed of light x time-of-flight}}{2}$$

$$\text{Level} = \text{height} - \text{distance}$$

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 ABB data center

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.

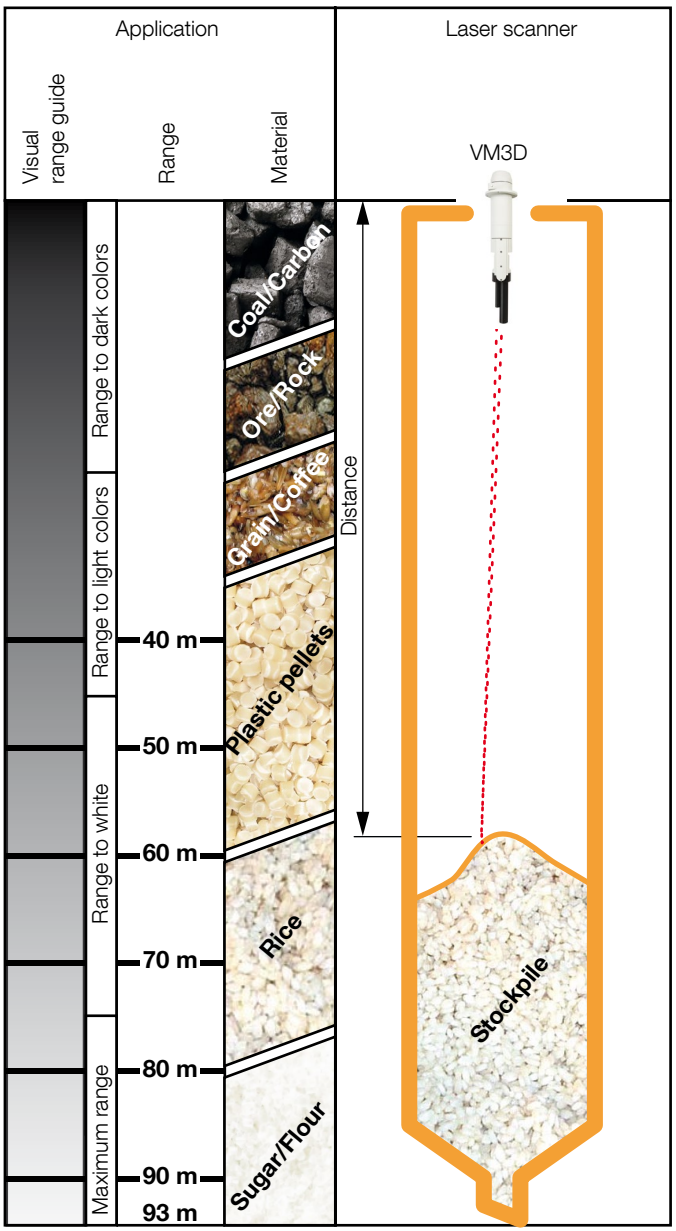
To access saved data, go to: www.abb.com/myvm3d and enter your login details as provided by ABB.
Upon successful login, the ‘Site Management’ page is displayed where site information can be accessed/managed as well as Individual stockpile information.

VM3D
Volumetric Laser Scanner

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.



Specifications

Measurements	
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 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	–32 °C to +60 °C (–89.6 °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
Outputs	
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
Electrical specifications - control box	
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)
Electrical specifications - scanner	
Rated intput voltage	24 V DC
Current	1A; 2.2 A in-rush at start-up (< 100 ms)

VM3D
Volumetric Laser Scanner

Specifications

Mechanical - scanner			
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) 4 holes, 16.5 mm (0.65 in) diameter on 160 mm (6.3 in) diameter circle		
Mechanical - control box	**General Purpose**	**Hazardous area (dust ignition protection)**	**Hazardous area (dust ignition protection)**
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

Optical	
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	$\Delta < 0.3°$
Beam spot diameter	$2R\ tan\left(\frac{\Delta}{2}\right)$ Where R is the range to the target and Δ is the beam divergence
Laser	
Measuring laser	905 nm near infrared pulsed semiconductor laser 12 mW average power output 20 W peak power output
Measuring laser life expectancy	25 years typical MTBF
Measuring laser safety 	Always on IEC60825-1 class 1M laser 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.
Environmental	
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.

Approvals

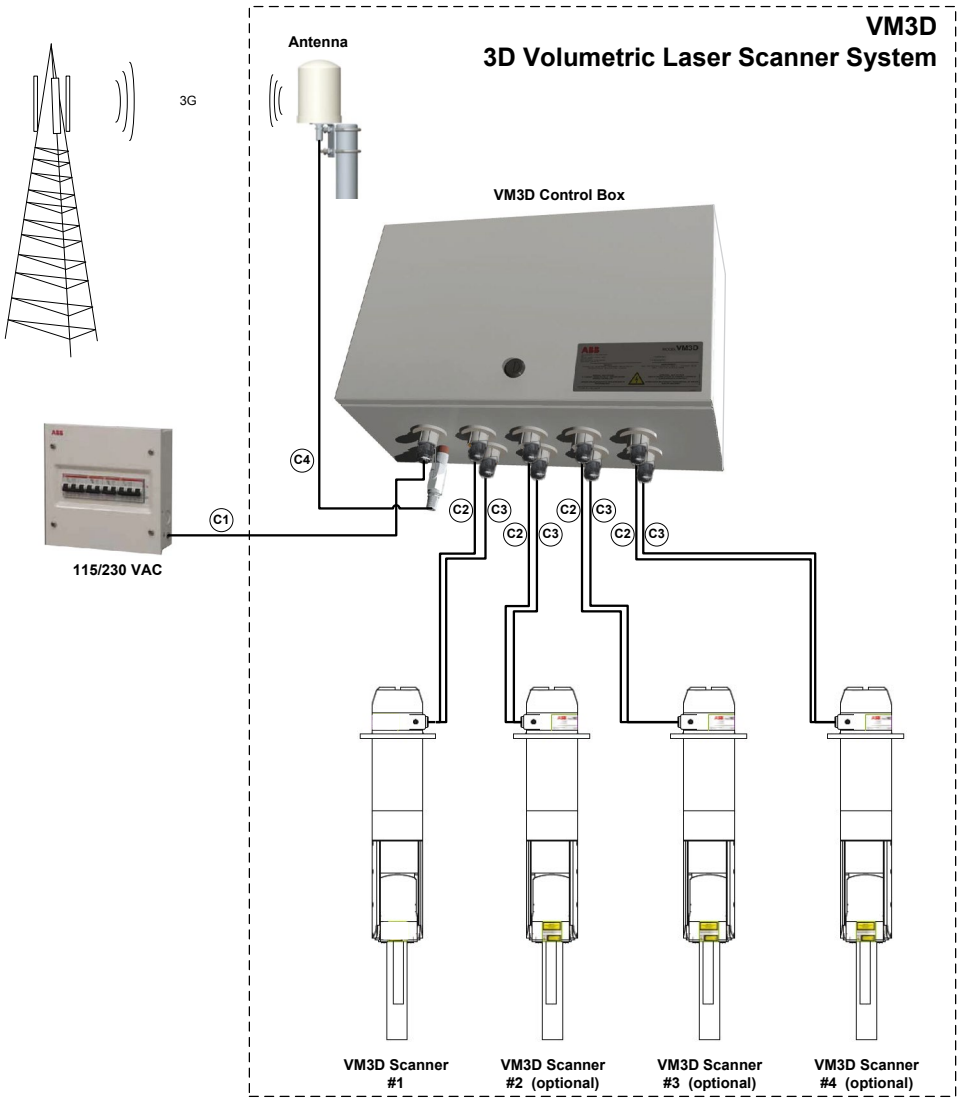
CE	Quality standard : ISO9001:2008 Electromagnetic compatibility directive 2004/108/EC Low voltage directive 2006/95/EC CE marking directive 93/68/EEC Radio and telecommunications terminal equipment 1999/5/EC*	Harmonized standards applied: EN 61326-1 electrical equipment for measurement, control and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

*__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
Volumetric Laser Scanner

VM3D Topology



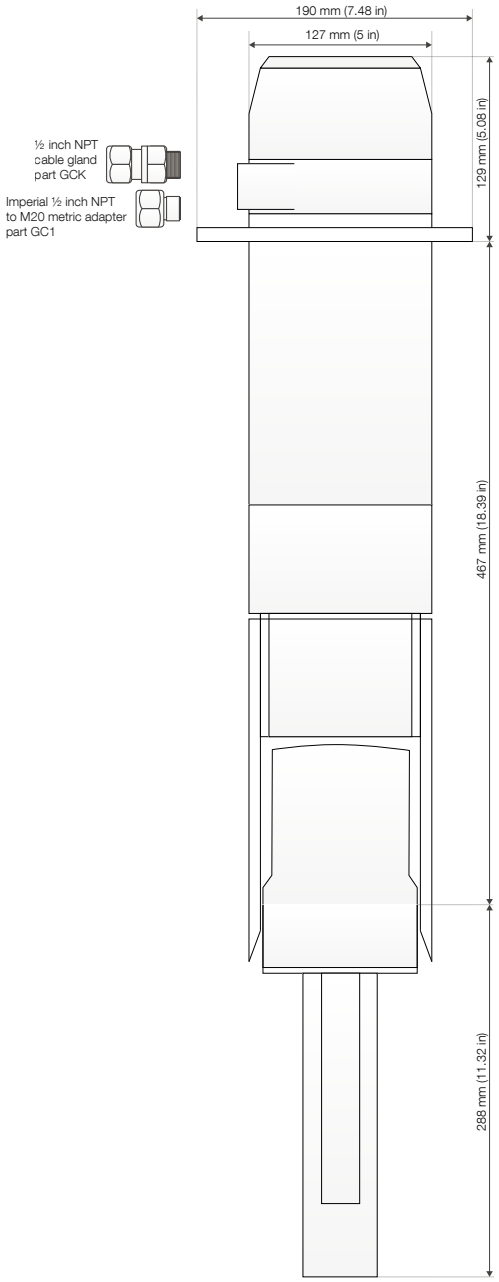
C1 Power cable, 115/230 VAC, 3 conductors, 14 AWG

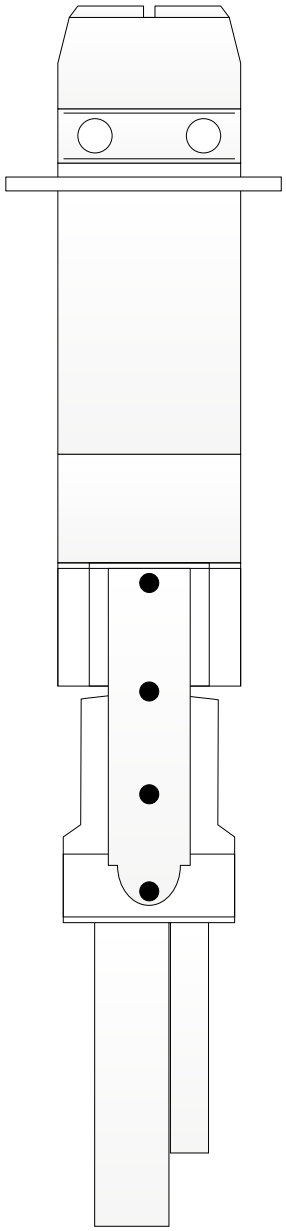
C2 Catagory 5e Ethernet Cable, stranded shielded, 24 AWG, ≤ 100 m

C3 Power cable, 24 Vdc, 3 conductors, shielded, 16 AWG, ≤ 100 m

C4 RF cable, LMR400, N-type connectors

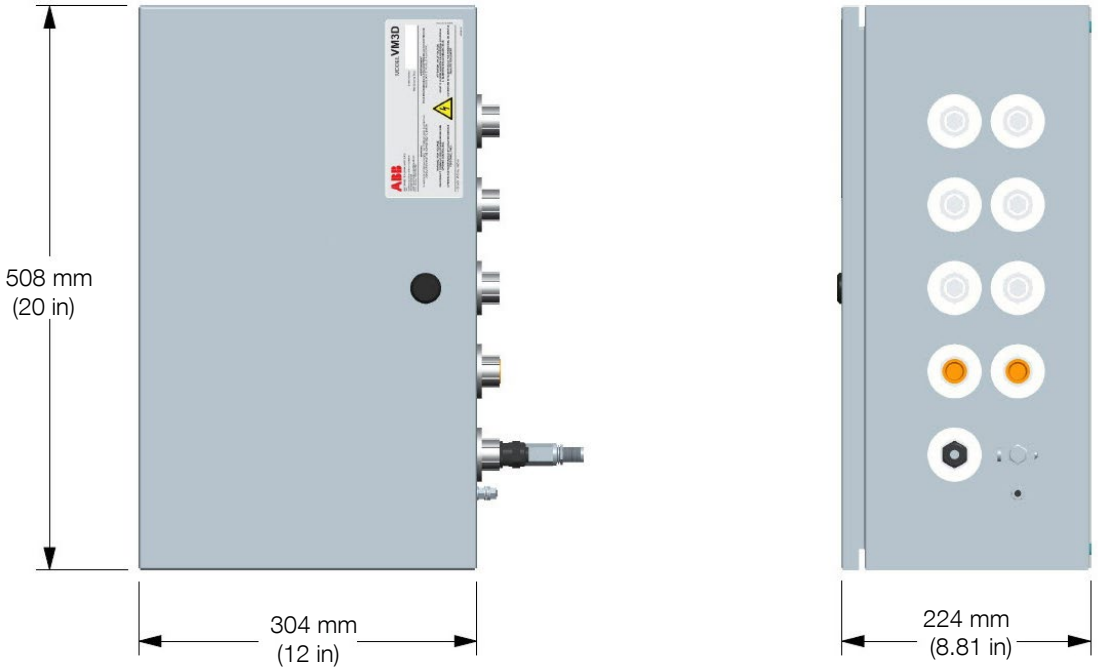
Dimensions


190 mm (7.48 in)
127 mm (5 in)
½ inch NPT
cable gland
part GCK
Imperial ½ inch NPT
to M20 metric adapter
part GC1
129 mm (5.08 in)
467 mm (18.39 in)
288 mm (11.32 in)

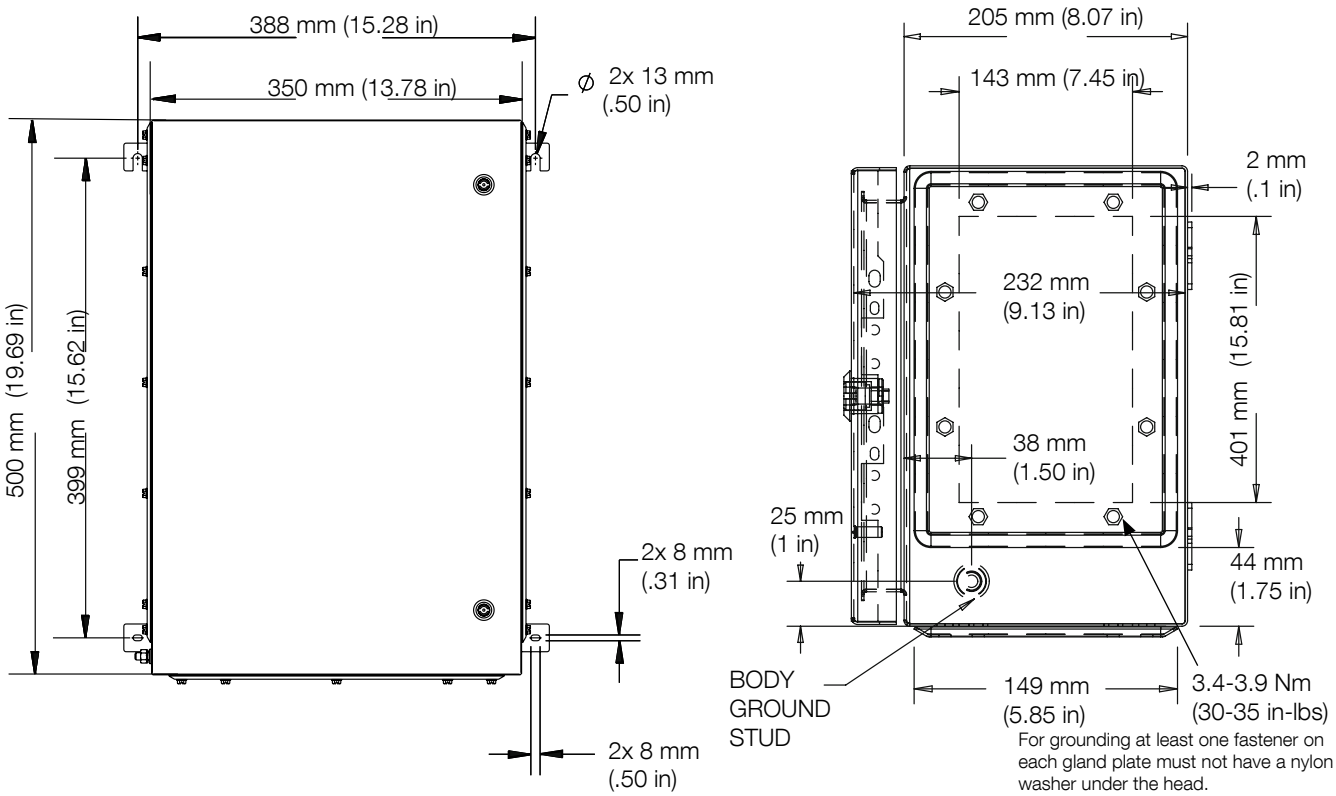


VM3D
Volumetric Laser Scanner

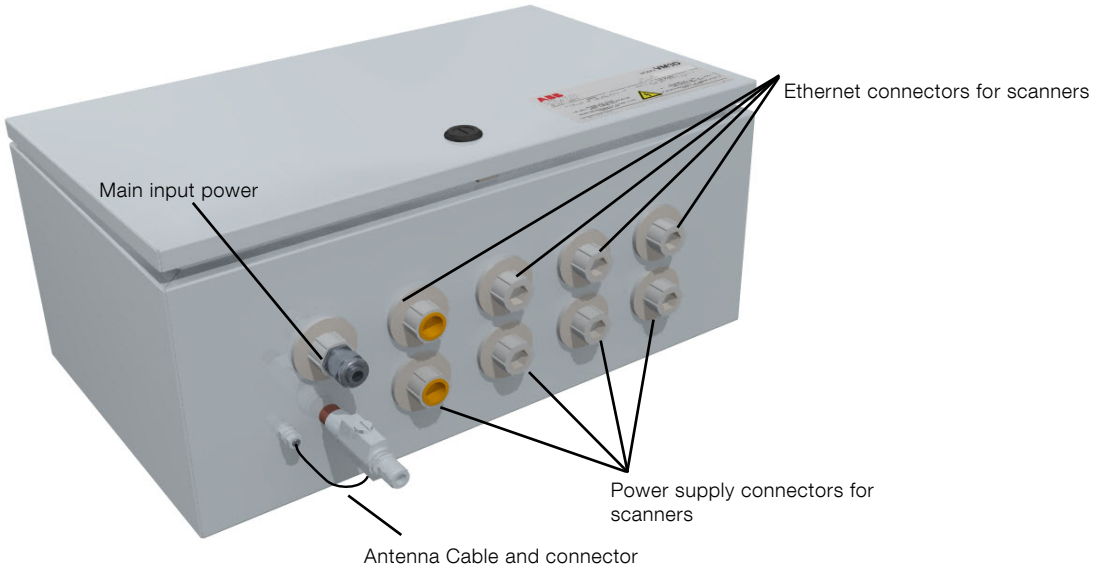
Control box - Aluminum for general purpose



Control box - Painted Aluminum or Stainless Steel for hazardous area

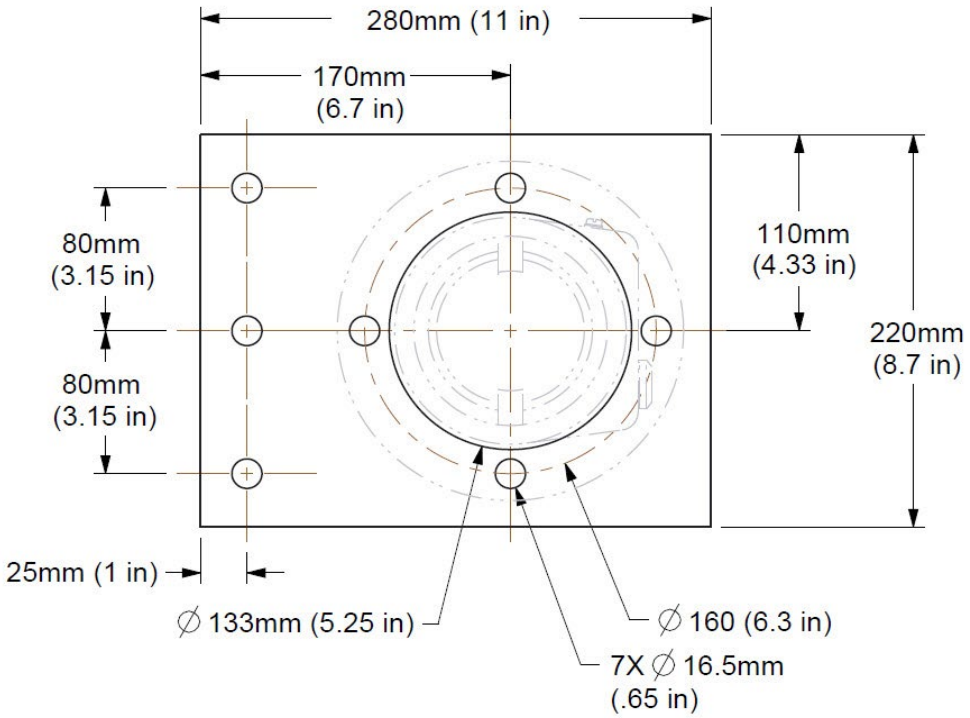


For grounding at least one fastener on each gland plate must not have a nylon washer under the head.



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.



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Volumetric Laser Scanner

Ordering Information

Volumetric Laser Scanner System	A	B	C	D	E	F
Control Box						
Mild steel for general purpose	CB.GP					
Painted mild steel for hazardous area (dust ignition protection)	CB.EX					
Stainless Steel for hazardous area (dustignition protection)	CB.EXSS					
Scanners						
VM3D scanner only		SO				
1 VM3D scanner with the control box		S1				
2 VM3D scanner with the control box		S2				
3 VM3D scanner with the control box		S3				
4 VM3D scanner with the control box		S4				
On Demand bundle						
Bundle of 10 scans to used over two years				DSB		
Miscellaneous accessories and spare parts						
Set of 2 Ex cable glands with 1/2 in. NPT thread; size 0 / 8 mm and size 00 / 12 mm					GCK	
Exd/e Flameproof imperial to metric adapter, ½ inch NPT to M20					GC1	
Extended warranty						
Extended warranty for 2 extra years - provides a total of 3 years warranty						EW
Replacement warranty - provides customer with new replacement unit instead of repair						RW

Documentation for VM3D volumetric laser scanner is available for download from www.abb.com/level

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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3KXL323002R1001

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