



**Vibration equipment division**

# **CUBE: 3 Axes Vibration & Machine Efficiency Measure**

**User and Maintenance Manual**



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# 1 OVERVIEW



Cube is a high performance multiband 3-Axes Vibration with advanced measure capability to detect machine performance and efficiency.

Cube combines in a single device:

- **Stand-alone machine protection** via integrated analog and binary output,

- **2 wire Ethernet with Modbus** communication for long range direct connection to condition monitoring systems, either traditional PLC/DCS or advanced IoT systems, with data storage and AI algorithms.

Cube is designed for heavy duty IP68 environment, with AISI316 stainless steel body, rugged integrated cable or connector

# 2 HIGHLIGHTS

Cube measures the vibration over 3 Axes, elaborates the raw data to provide multiple measures related to the machine status and efficiency, it protects the machine by activating its outputs and it communicates the measures to the condition monitoring system:

<p style="text-align: center;"><b>Measure</b></p> <p>16 bit @ 30KHz sampling rate Synchronous on 3 axes</p>	<p>3 axes vibration: 1Hz – 5KHz</p> <p>Velocity and Acceleration measure (each with configurable UoM)</p> <p>Configurable filters for Velocity and Acceleration</p> <p>Configurable response time (measure averaging)</p> <p>Rotation speed or Pulse frequency measure (e.g. blade passing)</p> <p>Unbalance measure</p> <p>Misalignment measure</p> <p>Coupling defect measure</p> <p>Bearing status detection</p> <p>Surface Temperature Measure</p> <p>Raw vibration data one each axis for custom analysis &amp; AI</p>
<p style="text-align: center;"><b>Protect</b></p>	<p>4-20mA output (configurable: Measure, Range, Axis)</p> <p>ON/OFF output (configurable: Type, Measure, Threshold, Delay, Axis)</p>
<p style="text-align: center;"><b>Communicate</b></p>	<p>2-wire twisted pair Ethernet</p> <p>10 Mbit/s @ 1km range</p> <p>MODBUS Protocol (for both configuration and measure reading)</p> <p>HTTP protocol (for raw data reading)</p>

### 3 APPLICATIONS

Cube is fully configurable to fit the need of any machine type, either low speed, high speed, variable speed, and any industrial application such as:

<b>Machines:</b>	Motors	Generators	Gearboxes
	Hydro Turbines	Wind turbines	Evaporators
	Fans	Compressors	Pumps
	Centrifuges	Mixers	Mills
	Paper rolls	CNC machines	Electrospindles
<b>Industries:</b>	Recycling & Milling	Water & Waste	Steel
	Energy	Pulp & Paper	Oil & Gas
	Chemicals & Pharma	Food & Beverage	Cemeteries
	Packaging	Process	Automotive

### 4 MODELS




#### 4.1 OUTPUT CONFIGURATION

Cube is available in 4 different models, each one with different output capability.

	<b>CUBE/0</b>	<b>CUBE/1</b>	<b>CUBE/2</b>	<b>CUBE/3</b>
Communication	2-wire twisted pair Ethernet			
Output 1	--	4-20 mA	4-20 mA	4-20 mA
Output 2	--	--	4-20 mA	ON/OFF

#### 4.2 CABLES & CONNECTORS

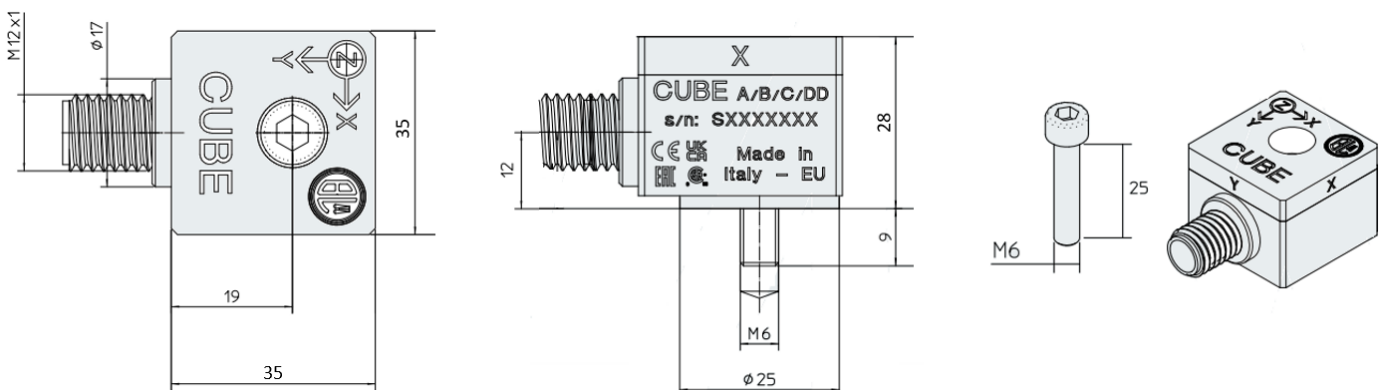
Each model is available in 3 different connection (see chapter 6, ordering code param. "B")

<b>Type of connection</b>	 <p>M12 connector</p>	 <p>Integral Cable</p>	 <p>Armoured Integral Cable</p>
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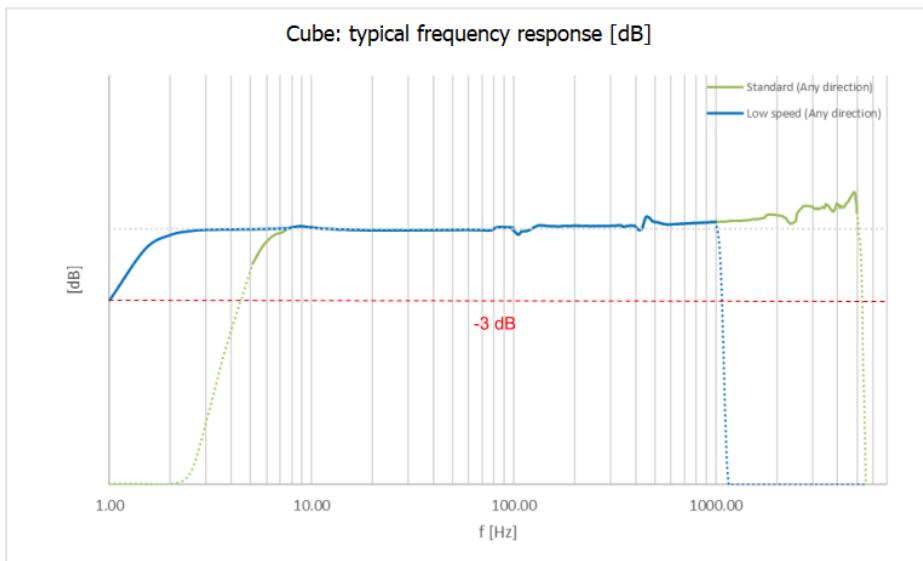
## 5 TECHNICAL SPECIFICATION

Material	Stainless steel AISI316
Body Size:	35x35x28mm – lateral exit mating surface: 25mm diameter
Power supply	24 Vdc nominal (10÷35Vdc): 200mA max Binary Output load: 50mA resistive
Operating conditions	- 50°C ÷ +100°C, IP 68
Vibration measure	3 Axes: XYZ Seismic (absolute vibrations)
Bandwith (@ 3dB)	Configurable: Standard: 5 Hz - 5 kHz on each Axis Low speed: 0.9Hz – 1 KHz on each Axis
Linearity	± 5% (range 5 Hz – 4.5 KHz @ 25°C) on each Axis
Dynamic Range	32 g pkpk
Measure resolution	16 bit
Sampling rate	Standard: 12.8KHz/Axis – synchronous on XYZ Low speed: 2.56 kHz/axis – synchronous on XYZ
Temperature Measure	+20°C ÷ +100°C @ ± 5%
Communication	Ethernet SPE (Single Pair Ethernet) – 10Base-T1L
Communication speed	10Mbit/s @ 300 m (on twisted pair)
Communication Protocols/	Modbus TCP/IP MQTT, HTTP API
IoT & configurability	100% online configurable via ethernet
Storage conditions	- 60°C ÷ + 120°C non condensing
Screwing torque	5÷10 Nm
Shock resistance	100 g
Periodic Maintenance/calibration	Not required

### 5.1 DRAWINGS & SIZE



## 5.2 FREQUENCY RESPONSE



## 6 ORDERING CODES

The hardware ordering code is composed as follows: **CUBE / A / B / C / DD**

This code is laser marked on the device body and on regulatory declaration of standards.

### **/A: Model**

**0:** SPE only

**1:** SPE + AO1: 4-20mA

**2:** SPE + AO1: 4-20mA + AO2: 4-20mA (not available yet)

**3:** SPE + AO1: 4-20mA + AO2: ON/OFF contact (configurable PNP, NPN, PUSH/PULL)

### **/B: Connection**

**0:** M12 connector

**1:** Integrated cable

**2:** Integrated armoured Cable

**3:** reserved

### **/C: Certifications**

**0:** Safe Area

**2:** ATEX (not available yet)

**4:** CSA/UL (not available yet)

**5:** IECEX (not available yet)

### **/DD: Length of integrated cable**

**0:** no integrated cable (B=0)

**1-30:** length of integrated cable [m]

# 7 APPLICATION EXAMPLES

CUBE can be installed in different ways to fulfill a great number of applications: here below we describe different possibilities to address different installation scenarios and customer requirements.

## 7.1 ADVANCED MACHINE PROTECTION

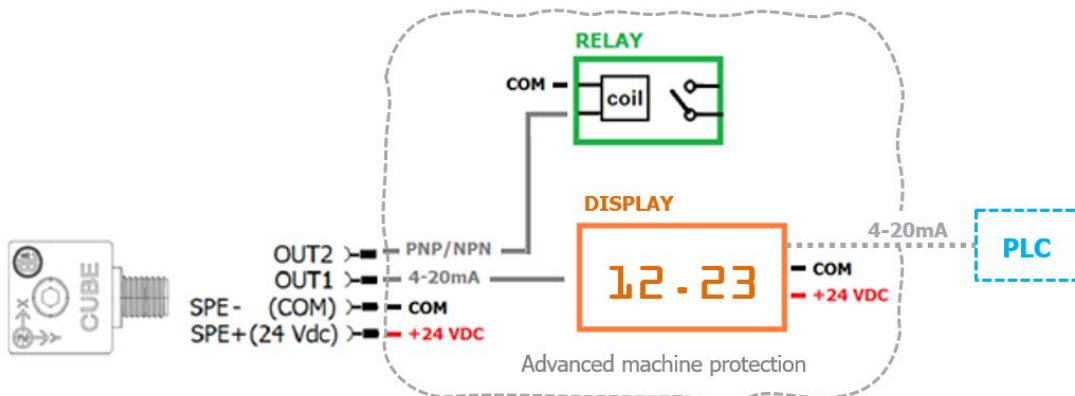
In this application scenario the outputs of Cube are connected to local devices (PLCs, relays, local display) primarily devoted to measure and protect the machine where Cube is installed.

The paragraphs below provide examples of cube installations in various applications.

### 7.1.1 CUBE as standalone machine protection (e.g. Relay + Display)

For applications where it is necessary to provide a local display in addition to a simple protection loop, you can envision the possibility to connect the 4-20mA output (Out1) to a small low cost panel display and the second output (Out2) to a PLC or to a simple relay.

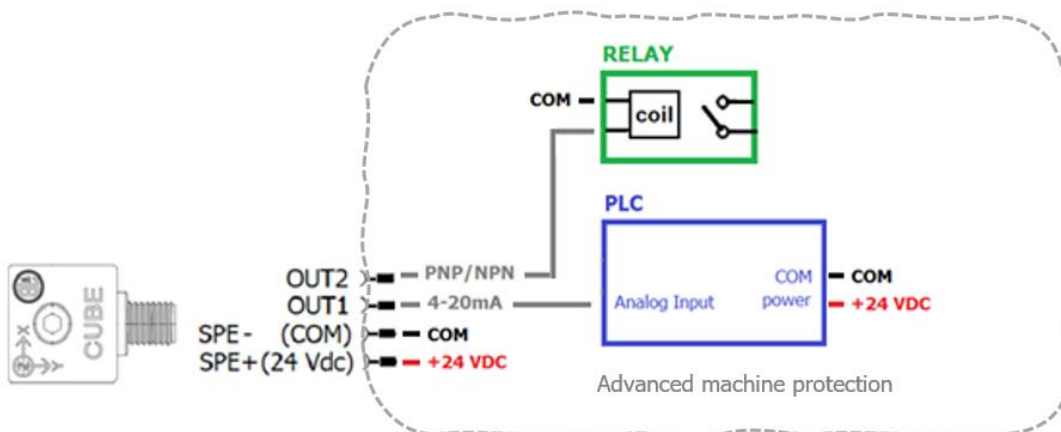
See the schematics below as a reference.



### 7.1.2 CUBE connection for redundant protection loop (Relay + PLC)

CUBE/3 has both binary and analog output and it is suitable for a redundant protection mode that include a standard protection/measuring loop (e.g. based on PLC connected to OUT1) + a fast protection loop (e.g. based on a relay connected to OUT 2).

See the schematics below as a reference.

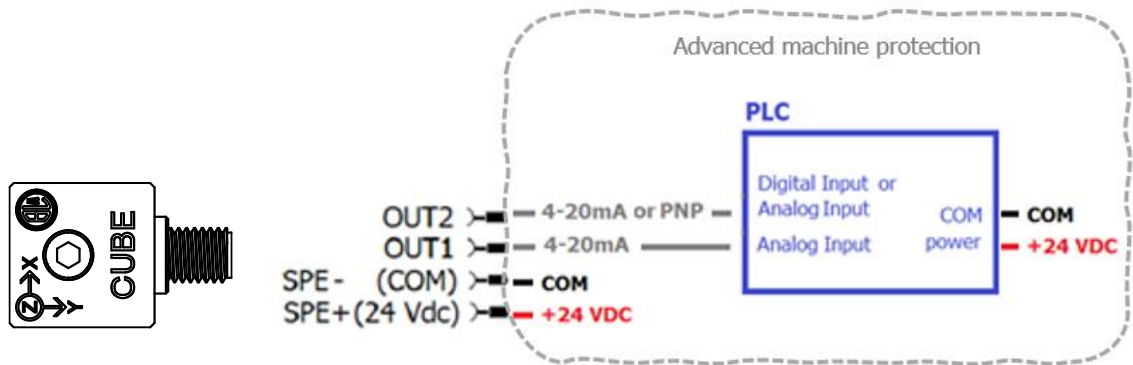




### 7.1.3 CUBE connection for standard protection loop (PLC)

Both OUT1 and OUT2 of Cube can be connected to a PLC - as described below - for real time machine protection.

See the schematics below as a reference.

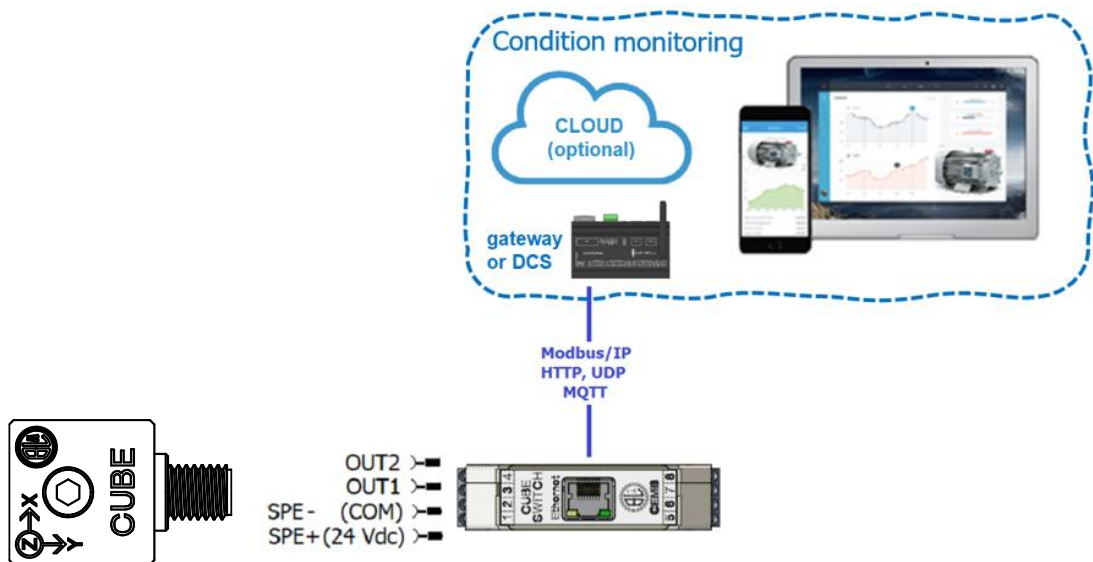


## 7.2 CONDITION MONITORING

It is possible to use Cube for conditioning monitoring only either in conjunction with DCS or CLOUD via its Ethernet port, without using its output dedicated to machine protection.

In such configuration Cube continuously transmits over Ethernet 24/7/365 all the vibration and diagnostic information of the monitored machine.

Cube implements natively open standard communication protocols over ethernet, like Modbus TCP/IP or HTTP, therefore it does not require proprietary network infrastructure to communicate to PLC or DCS: just a simple SPE to RJ45 Ethernet adapter is required. (\*)



(\*) For this purpose you can use either the single port bridge by CEMB (39IN056741) or any off-the-shelf SPE switch with PoDL. See Chapter 12.1 for more information



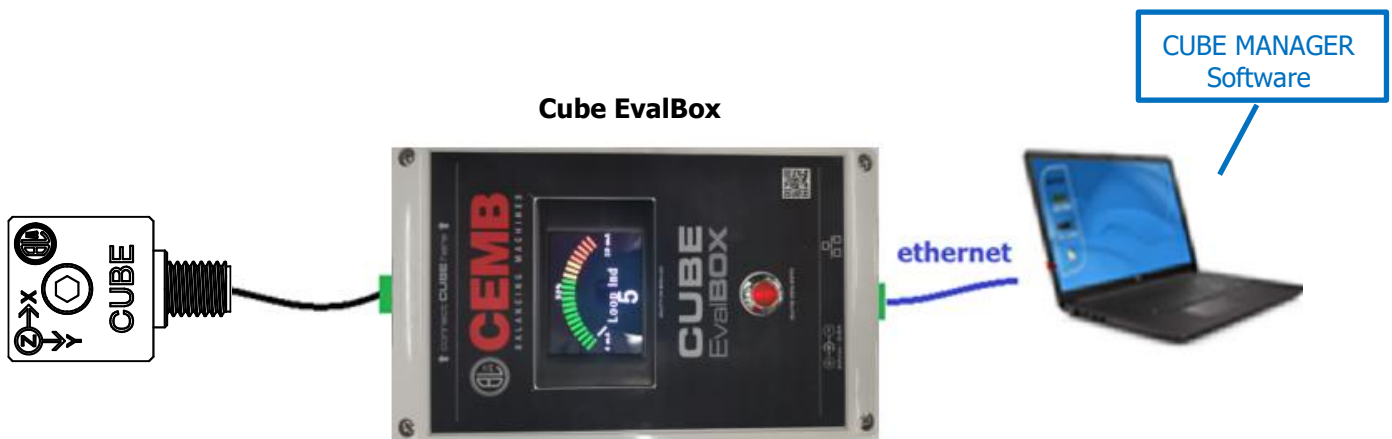
## 8 HOW TO CONFIGURE CUBE

It is possible to configure Cube at any moment till commissioning by properly setting the modbus registers as described into the CUBE MODBUS Manual.

### 8.1 CUBE CONFIGURATION TOOLKIT

Indeed, to facilitate the configuration, CEMB also provides a CUBE\_Configuration\_Toolkit composed by:

- Cube EvalBox
- CUBE MANAGER Software, running on any laptop



#### 8.1.1 CUBE MANAGER Software

It is a very simple and intuitive application that allows the following basic operations:

- Read/Write Settings from/to device
- Display Measures from device
- Save/Load Settings to file
- Export Settings to .PDF file for reporting/printout

#### 8.1.2 Configure the device: set CUBE parameters

When the application is launched, the user can discover the device(s) on the network, select the device to connect (one at a time) and read current settings and real-time measures.

With few simple steps the user can manually configure the device or download an existing configuration and make sure it properly fits the application.

Once configured, it is possible to save and export the configuration for backup or reporting purposes.

#### 8.1.3 Display Measures from device

CUBE MANAGER software allows to view in real-time the measure to make sure the device is working and setup properly; it shows also the diagnostic info of the device.

To learn more, please refer to CUBE MANAGER manual.

## 8.2 CUBE CONFIGURATION

Cube is delivered with a predefined configuration that covers the most common applications.

Indeed Cube can be easily configured to fit any customer requirement: here below a brief summary of what you can configure:

### MEASURE Configuration:

- Mode (e.g. RMS, Pk) & unit of measure: (e.g. mm/s, in/s; g, m/s<sup>2</sup>; °C, °F)
- Measuring Band (Standard Vs Low Speed machines)
  - o Standard: 5Hz -5KHz
  - o Low speed: 0.8Hz – 1KHz
- Band filters of the Acceleration vibr. measure (fully selectable inside the Measuring band range)
- Band filters of the Velocity vibr. measure (fully selectable inside the Measuring band range)
- Reactivity of the response: Low-Medium-High: how fast the sensor reacts to the vibration
- Raw data type (Velocity or Acceleration) – for FFT and advanced elaboration
- The rotation speed of the machine to perform advanced machine diagnosis

### OUTPUT Configuration:

For each output you can select:

- the measure driving the output: X, Y, Z, Max of (X,Y,Z) , T
- the range and unit of measure;

For Binary output you can additionally configure:

- the Alarm condition triggering the output
- The type of the contact (PNP, NPN, Push-Pull)

### DEVICE Configuration:

- The IP address of the sensor
- The alphanumeric TAG of the sensor

### ALARM Configuration for condition monitoring and alarm management over cloud

- The Measure associated to the alarm: X, Y, Z, Max of (X,Y,Z) , T
- The setpoint and delay triggering the alarm
- Logic combination of alarms
- Self Diagnostic alarms

It is possible to configure Cube at any moment till commissioning by properly setting the modbus registers as described into the CUBE MODBUS Manual.

Indeed, to further facilitate the setting of CUBE, CEMB provides a software toolkit as described in chapter 8.1.

### 8.2.1 Factory Settings

Each model of Cube is preloaded with specific settings (see chapter 13).

It is also possible – upon OEM agreement - to define specific custom settings to be preloaded at factory.

## 9 CUBE MEASURES

Cube is a 16 bit high performance digital sensor that acquires - in real time – vibration data along 3 axes and have internal memory and very fast processing capacity to elaborate the measures, save them and send over the ethernet.

In addition to XYZ vibration, Cube also reads the Temperature of the support where it is fastened.

Here below a list of Real Time measures you can read from Cube via Ethernet SPE.

### 9.1 SCALAR MEASURES

“Scalar” are all the measures that can be represented by a single numeric value, like the TEMPERATURE expressed in °C or the VIBRATION expressed in mm/s RMS or G pk.

Here below the scalar measures that can be read from Cube:

Measure	Type	Parameters of the measure
X Vibr - Vel	Vibration - Velocity	Velocity Bandpass filters, Mode (RMS, Pk, PkPk) Uom (mm/s, In/s)
Y Vibr - Vel		
Z Vibr - Vel		
MAX (X,Y,Z) Vibr - Vel		
X Vibr - Acc	Vibration - Acceleration	Acceleration Bandpass filters Mode (RMS, Pk, PkPk) Uom (G, mm/s2)
Y Vibr - Acc		
Z Vibr - Acc		
MAX (X,Y,Z) Vibr - Acc		
Temp	Temperature	UoM (°C, °F)
Rotation speed (*)	RPM	Nominal Rotation Speed Rotation estimated upper limit
Machine_Diag_Unbalance (**)	Vibration – Velocity RMS	AxisDirection, RotationSpeed (*) UoM
Machine_Diag_Misalignment (**)		
Machine_Diag_Looseness (**)		
Machine_Diag_Other (**)		

Cube refreshes the measures every:

- Standard mode: 1 sec.
- Low speed mode: 5 sec.

Scalar measures can be read from Cube via Modbus/IP protocol, please refer to CUBE MODBUS MANUAL Chapter 8 to see how these measures are mapped into modbus registers.

(\*) See Rotation speed paragraph below

(\*\*) these measures are used for the advanced machine diagnosis.

## 9.2 ROTATION SPEED

Cube is able to provide advanced machine diagnosis based on FFT analysis algorithms.

This is made possible because Cube can calculate/measure the rotation speed of the machine in different ways as described below.

**Fixed Rotation Speed:** it is used for fixed speed rotors: It is possible to set the speed by writing a dedicated configuration parameter called "Nominal Rotation Speed";

**Estimated Rotation Speed:** This is the value of the rotation speed that cube can calculate based on specific algorithms in the domain of frequency.

It can be used for variable speed rotors where it is possible – by design - to detect a specific harmonic (typically 1x) inside a specified band.

**Read From Other Device:** the rotation speed is measured by another device (e.g. a tachometer PNP sensor or an inverter) and it's written in real time to a specific modbus register of Cube;

**Unavailable:** In case none of the above applies.

It is possible to select any of the modes above by properly set the configuration parameter called "Rotation Speed detection mode".

To learn more about this feature please contact the technical service of CEMB – STR division.

## 9.3 VECTORIAL MEASURES

"Vectors" are all the advanced measurements that can be represented by a buffer of values, like the raw vibration samples acquired in a defined period of time or the FFT of a defined signal.

Vectorial measures are very useful for advanced machine diagnosis: they are at the basis of predictive maintenance, and they allow the implementation of custom advanced protection algorithm.

Here below the vectorial measures that can be read from Cube:

Vectorial measure	Type	Parameters of the measure	note
X Vibr raw data	Velocity or Acceleration	Raw Data Type (Vel. or Acc.) Uom (mm/s, In/s, g, mm/s <sup>2</sup> )	Sampling rate: Standard: 12.8 KHz/Axis Low speed: 2.56 kHz/axis Resolution: 16 bit Sample size: 4096/Axis
Y Vibr raw data			
Z Vibr raw data			

Cube refreshes the measures every:

- Standard mode: 1 sec.
- Low speed mode: 5 sec.

The raw vibration data are acquired synchronously on the 3 axes and this grant the possibility to apply advanced algorithms for machine diagnoses, in addition to simple FFTs.

The data of the buffer can be either expressed in Acceleration or Velocity (a specific configuration parameter is used to specify each of the two) and this identifies also the unit of measure of the buffer.

The raw vibration data buffer can be read from Cube downloading the file by HTTP at its IP address (by default: [http:// 10.10.10.101/rawdata.cbor](http://10.10.10.101/rawdata.cbor))

## 9.4 SELF DIAGNOSTIC INFO

Cube is able to provide an advanced self diagnostic information to enable the system to detect any anomaly of the device itself and its measuring channels.

the table below describes the major self diagnostic information provided by Cube.

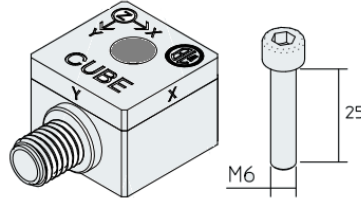
Self Diagnostic Info	Note
Device fault	Device sensing element is broken
X, Y, Z, T measure saturated	Vibration exceeding sensing range

Diagnostic Info can be read via Modbus TCP/IP protocol; please refer to CUBE MODBUS MANUAL chapter 10 and 11 to see how this info is mapped into Modbus registers.

# 10 HOW TO INSTALL CUBE

## 10.1 BASIC RECOMMENDATIONS

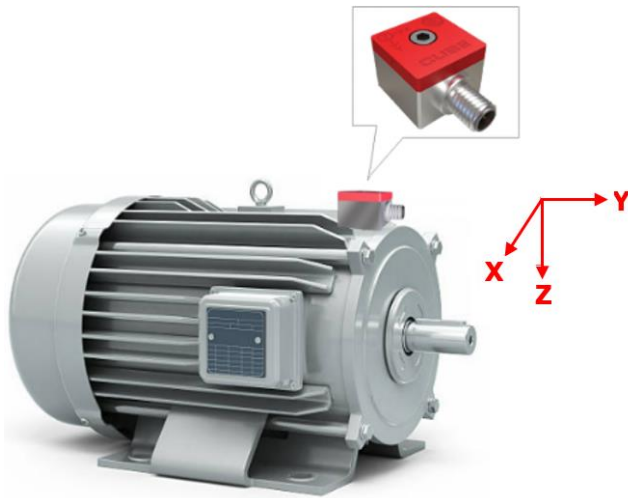
Cube is delivered with its M6x1 screw as described below:



Alternatively, in case of holes with 1/4" - 28 UNF female threads, Cube can host natively a 1/4" - 28 UNF screw of similar length.

CUBE must be screwed on the machine in the closest possible area where the vibration must be measured: typically on the bearing support of the machine. See picture below.

CUBE can be mounted either vertically or horizontally (either radially or axially) and the vibration is always measured along the 3 Axes according to the screwing direction.

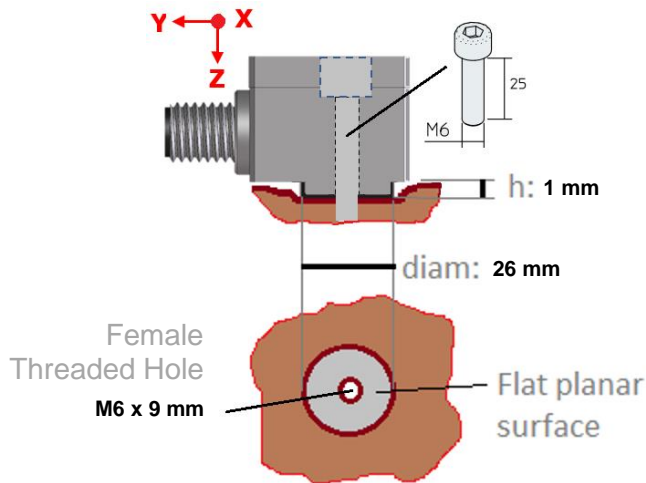


Note: in this configuration cube is mounted on vertical radial direction with the Z axis radial vertical

Even if the measuring precision of Cube is the same along the 3 axes, the way Cube is coupled to the machine might affect the precision of the measure: if the mating surface is not regular, or the screwing force is too loose, the measure of the vibration might be inaccurate.

In order to grant the best coupling between the machine and Cube, prepare a flat surface of minimum 25 mm diameter, max depth 2 mm (suggested: diameter 26mm, depth 1mm) around the hole where Cube is screwed as per picture below.





The measure which is most sensitive to poor coupling conditions is the measure in acceleration, especially at highest frequencies (above 2.5 KHz), especially on the X-Y direction.

The direction of the screwing (Z) is the direction where the precision of the measure is the most accurate, because this is the direction where the screwing torque might be precisely controlled.

**Note:** Use a coupling torque on the range of 7-9 Nm.

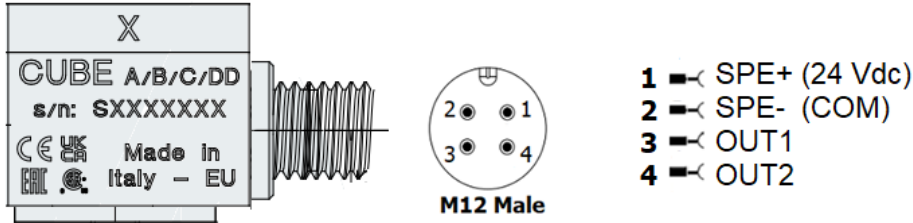
## 10.2 INSTALLATION WITH THREAD ADAPTERS

In case the threaded hole in the machine is different from M6x1, the following thread adapters shall be ordered to install Cube as described below.

Ordering code	Thread	Reference picture
<b>440A056946</b>	M10 x 1.5	
<b>440A056945</b>	M10 x 1	
<b>440A056944</b>	M8 x 1.25	
<b>440A056943</b>	M8 x 1	
<b>440A057135</b>	M6 x 1 (used as spacer in case of need)	
<b>440A057136</b>	1/4" - 28 UNF	
<b>440A056947</b>	1/4" - 18 NPT	

# 11 HOW TO CONNECT CUBE

## 11.1 M12 CONNECTOR (ORDERING CODE B=0)



Two models of cable with M12 female integrated connector are available:

**CBL-CUBE/H4/xx** (4 wire cables , where "xx" is the length of cable in meters)

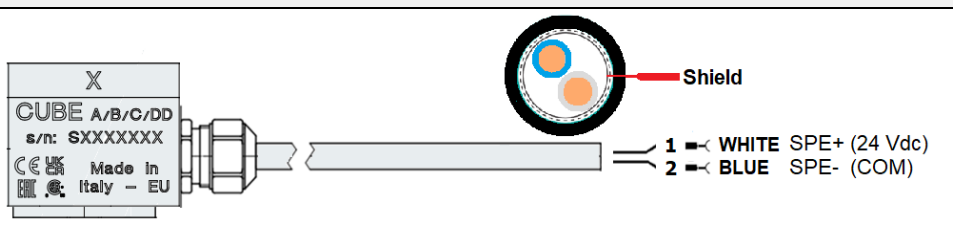

Description (H4)	Terminal side	Connector side
Double shielded 2 separate twisted couples PUR Jacket Colour: water blue (RAL 5021) High mechanical/chemical resistance Type: 2 x 2 x AWG 24 Outdoor Diameter (OD): 5.8 mm Bending radius: 8x OD Approvals: UL, CE, UKCA Other: Self extinguish, Alogen free Insulation: 1000V UL rating Cable: LAPP Etherline 2170281 or equivalent	<ul style="list-style-type: none"> <li>1 -&gt; GREEN SPE+ (24 Vdc)</li> <li>2 -&gt; GREEN-WHITE SPE- (COM)</li> <li>3 -&gt; ORANGE OUT1</li> <li>4 -&gt; ORANGE-WHITE OUT2</li> </ul> <p style="text-align: right;"><b>Shield</b></p> <p><u>Note: this cable is mandatory for CUBE/A/0/x/x (A=1,2,3)</u></p>	<p style="text-align: center;">M12 FEMALE</p>

**CBL-CUBE/H2/xx** (2 wire cables , where "xx" is the length of cable in meters)

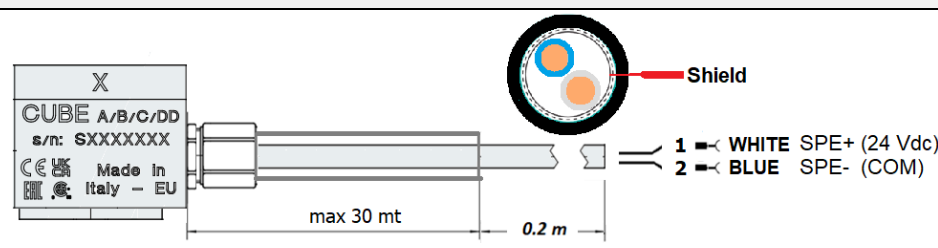
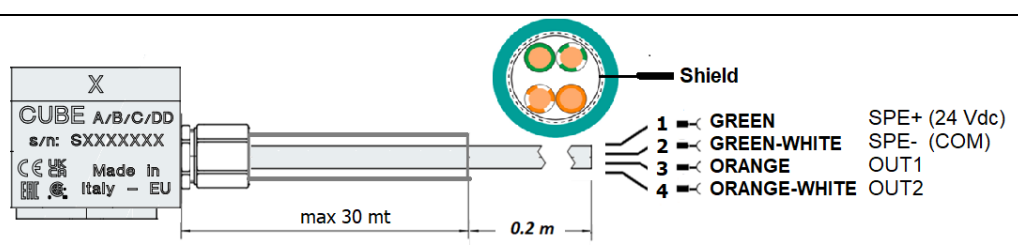
Description (H2)	Terminal side	Connector side
Double shielded 1 twisted couple PVC Jacket Colour: Black Type: 1 x 2 x AWG 22 Outdoor Diameter (OD): 5.1 mm Bending radius: 8x OD Approvals: UL, CE, UKCA Other: Self extinguish, Alogen free Insulation: 300V (non UL rating) Cable: Belden 74041E or equivalent	<ul style="list-style-type: none"> <li>1 -&gt; WHITE SPE+ (24 Vdc)</li> <li>2 -&gt; BLUE SPE- (COM)</li> </ul> <p style="text-align: right;"><b>Shield</b></p> <p><u>Note: this cable must be used only for CUBE/A/0/x/x (A=0)</u></p>	<p style="text-align: center;">M12 FEMALE</p>

Both cables are compliant to Eth. 10BASE-T1L (CLASS 12) - distance 300mt @ 10 Mbit/s.

## 11.2 INTEGRAL CABLE (ORDERING CODE B=1)

Cube code:	CUBE/A/1/x/x
<b>A=0</b>	 <p><b>Cable description:</b> see 12.1 Description (H2)</p>
<b>A=1,2,3</b>	 <p><b>Cable description:</b> see 12.1 Description (H4)</p>

## 11.3 INTEGRAL ARMoured CABLE (ORDERING CODE B=2)

Cube code:	CUBE/A/2/x/x
<b>A=0</b>	 <p><b>Cable description:</b> see 12.1 Description (H2)</p>
<b>A=1,2,3</b>	 <p><b>Cable description:</b> see 12.1 Description (H4)</p>

### Armour Description:

Armoured Outer Diameter (AOD) 11mm

Armoured Inner Diameter (AID) 7mm

## 11.4 GENERAL WARNINGS ABOUT WIRING

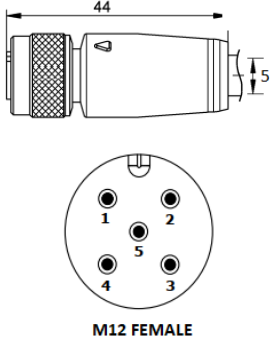
**Note1:** make sure that the cables do not cross nor share the same conduit of power lines.

**Note2:** make sure that the cables do not stay in close proximity of power inverters.

Note: The usage of other standard cables from CEMB - like the ones described in the table below – or other third parties cable is also possible, even if not suggested.

The cables described in the table below are not twisted nor shielded, therefore they can be used for application where the SPE communication is not required, but only the analog or binary outputs of Cube are used in conjunction with 24Vdc power supply.

We do not guarantee EMI/EMC immunity if with such cables - or other types of cables - are adopted.

CEMB Ordering Code	Length	Connector side	Terminal side															
<b>65800B050</b>	5 m		<table> <tr> <td>1</td> <td><b>BROWN</b></td> <td>24 Vdc (SPE+)</td> </tr> <tr> <td>2</td> <td><b>WHITE</b></td> <td>COM (SPE -)</td> </tr> <tr> <td>3</td> <td><b>BLUE</b></td> <td>OUT1</td> </tr> <tr> <td>4</td> <td><b>BLACK</b></td> <td>OUT2</td> </tr> <tr> <td>5</td> <td><b>GRAY</b></td> <td>Not connected</td> </tr> </table>	1	<b>BROWN</b>	24 Vdc (SPE+)	2	<b>WHITE</b>	COM (SPE -)	3	<b>BLUE</b>	OUT1	4	<b>BLACK</b>	OUT2	5	<b>GRAY</b>	Not connected
1	<b>BROWN</b>			24 Vdc (SPE+)														
2	<b>WHITE</b>	COM (SPE -)																
3	<b>BLUE</b>	OUT1																
4	<b>BLACK</b>	OUT2																
5	<b>GRAY</b>	Not connected																
<b>65800B150</b>	15 m																	
<p><b>Description:</b>            PUR Jacket            Colour: Black            High mechanical/chemical resistance            Type: 5 x AWG 28            Outdoor Diameter (OD): 5 mm            Bending radius: 8x OD            Approvals: CE, UKCA            Other: Self extinguish, Alogen free            Insulation: 500V</p> <p>Note: the cable is NOT shielded NOR Twisted and it is not suitable for SPE ethernet communication or in applications requiring high EMI/EMC immunity</p>																		

# 12 ETHERNET SPE TO RJ45


## 12.1 CUBE BRIDGE: SINGLE PORT SPE TO RJ45 ETHERNET ADAPTER

This bridge is a single port Ethernet converter from Ethernet SPE to Ethernet RJ.

It allows the possibility to connect Cube to any ethernet switch that has standard RJ-45 connector.

The bridge is required in field applications such as the ones described in Chapters 7.2 or 7.3 that involve ethernet communication of Cube.

The bridge is not required for field applications where CUBE is used as an advanced Vibration transmitters, e.g. as the ones described in Chapter 7.1

<b>Ordering code: 39IN056741</b>	
SPE-RJ45 Ethernet adapter for Cube	
<p>It converts 10Base-T1L (SPE) to Ethernet RJ45 standard cable.</p> <p>No configuration is required: this converter does not require a dedicated IP address and it passes thru the IP address of CUBE Itself.</p> <p>If your PLC/DCS does not yet support 10Base-T1L, just install this module and connect a standard ethernet cable.</p> <p>Power supply: 24 Vdc - 200mA max (including Cube)</p>	

<b>Pinout:</b>	<b>to PLC/DCS (top)</b>	<b>to CUBE (bottom)</b>
	1: Out1	5: Out1
	2: Out2	6: Out2
	3: COM	7: SPE-
	4: POWER 24Vdc	8: SPE+

Note1: the shield of cable coming from Cube must be connected to ground inside the cabinet/JB where bridge is located

Note2: In applications where multiple cubs need to be monitored, it might be economically convenient to use, instead of this single port bridge 39IN056741, a multi port SPE switch with PoDL, like the model FL SWITCH 2303-8SP1 by Phoenix Contact (or equivalent).

# 13 FACTORY CONFIGURATION

Cube is delivered with preloaded factory settings.

These settings are described in the table below and are stored into the permanent memory of the device.

During the installation or commissioning, it is possible to modify the settings of Cube to best fit the application; this operation overrides the factory settings.

It is always possible to restore the factory settings by downloading the factory configuration file as described in the "Cube Manager" user manual.

Model	Factory settings			
	Cube/0	Cube/1	Cube/2	Cube/3
Mode of Vibration Velocity	RMS	RMS	RMS	RMS
Mode of Vibration Acceleration	Pk-Pk	Pk-Pk	Pk-Pk	Pk-Pk
Unit of Measure of Vibration Velocity	mm/s	mm/s	mm/s	mm/s
Unit of Measure of Vibration Acceleration	g	g	g	g
Unit of Measure of Temperature	°C	°C	°C	°C
Measuring band (Standard vs Low speed)	standard	standard	standard	standard
Band filters of Vibration Velocity	5Hz to 1KHz	5Hz to 1KHz	5Hz to 1KHz	5Hz to 1KHz
Band filters of Vibration Acceleration	1KHz to 5KHz	1KHz to 5KHz	1KHz to 5KHz	1KHz to 5KHz
reactivity of the response	Medium	Medium	Medium	Medium
FFT Data Type (Velocity vs Acceleration)	velocity	velocity	velocity	velocity
Vibr Acceleration measure range	0-32 Pk-Pk	0-32 Pk-Pk	0-32 Pk-Pk	0-32 Pk-Pk
Vibr Velocity measure range	0-20 mm/s RMS	0-20 mm/s RMS	0-20 mm/s RMS	0-20 mm/s RMS
Temperature measure range	20-100°C	20-100°C	20-100°C	20-100°C
Primary Axes for machine diagnosys	Z	Z	Z	Z
Rotation Speed detection mode	Nominal	Nominal	Nominal	Nominal
Nominal Rotation speed (for fixed speed rotors)	1500 RPM	1500 RPM	1500 RPM	1500 RPM
Max rotation speed	3000 RPM	3000 RPM	3000 RPM	3000 RPM
Upper limit for Rotation speed estimation	3000 RPM	3000 RPM	3000 RPM	3000 RPM
Out1 - measure		MAX (X,Y,Z) Vel	Max(X,Y,Z) Vel	MAX (X,Y,Z) Vel
Out2 Analog - measure			Max(X,Y,Z) Acc	
Out2 Binary – triggering condition				MAX (X,Y,Z) Vel
Out2 Binary – type of contact				PUSH-PULL
Acc MAX (XYZ) - setpoint	16g	16g	16g	16g
Acc X - setpoint	16g	16g	16g	16g
Acc Y - setpoint	16g	16g	16g	16g
Acc Z - setpoint	16g	16g	16g	16g
Vel MAX (XYZ) - setpoint	7.1 mm/s	7.1 mm/s	7.1 mm/s	7.1 mm/s
Vel X - setpoint	7.1 mm/s	7.1 mm/s	7.1 mm/s	7.1 mm/s
Vel Y - setpoint	7.1 mm/s	7.1 mm/s	7.1 mm/s	7.1 mm/s
Vel Z - setpoint	7.1 mm/s	7.1 mm/s	7.1 mm/s	7.1 mm/s
TEMP - setpoint	90°C	90°C	90°C	90°C
Acc MAX (XYZ) – trip	Enabled	Enabled	Enabled	Enabled
Acc X - trip	Enabled	Enabled	Enabled	Enabled
Acc Y - trip	Enabled	Enabled	Enabled	Enabled
Acc Z - trip	Enabled	Enabled	Enabled	Enabled
Vel MAX (XYZ) - trip	Enabled	Enabled	Enabled	Enabled
Vel X - trip	Enabled	Enabled	Enabled	Enabled
Vel Y - trip	Enabled	Enabled	Enabled	Enabled
Vel Z - trip	Enabled	Enabled	Enabled	Enabled
TEMP - trip	Enabled	Enabled	Enabled	Enabled
Trip delay time	3s	3s	3s	3s
IP Address	10.10.10.101	10.10.10.101	10.10.10.101	10.10.10.101
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Default Gateway	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0
Tag	-----	-----	-----	-----

## 14 TROUBLESHOOTING

This chapter describes actions to be taken in case of anomalous behavior.

Item	Description of the problem	Actions to be taken
1	The device does not communicate over ethernet	Verify the power supply.
		Verify the IP address is correct.
		Verify if the device responds to automatic find by using "Cube Manager software "
		Verify the integrity of cable. Replace the cable (for models without integral cable) or replace the device
2	The Analog output is always at 0 mA	Verify the power supply.
		Verify the communication over ethernet (if available in field or by using "SPE-Ethernet Interface box with Cube Manager software" )
		Verify the diagnostic status of the device (eventually by using "SPE-Ethernet Interface box with Cube Manager software")
		Verify the settings of the Analog output. Verify the integrity of cable. Replace the cable (for models without integral cable) or replace the device
3	The Analog output of the device is fixed at 2.5mA (+/- 0.5)	The machine is vibrating too much and it is saturating the accelerometer reading. Verify that the device is properly installed and fixed on the machine and the thread is not loose. Unscrew the device to the machine, place it on a non vibrating surface and see if the value goes to 4mA or little above. Switch-Off and On again the device to see if the values becomes valid (4-20mA) Verify the diagnostic status of the device (eventually by using "SPE-Ethernet Interface box with Cube Manager software") Replace the device.
4	The Analog output of the device is fixed at 4mA	The machine is not vibrating. Shake manually the device on the 3 axes to simulate the vibration and see if the current increases above 4 mA.
5	The device has occasional spikes that trip the machine	Verify the vibration of the machine to make sure that the trip is not caused by anomaly vibratory state of the machine itself. Verify that the device is properly installed and fixed on the machine and the thread is not loose. Verify that the cable or the connector are not deteriorated over time. Verify the power supply. Replace the device.

## 15 MAINTENANCE, REPAIR, DISPOSAL

Cube is maintenance free and does not require periodical calibration.

In case of malfunctioning it is not possible to repair the device.

Dispose the device in accordance with the national environmental regulation.