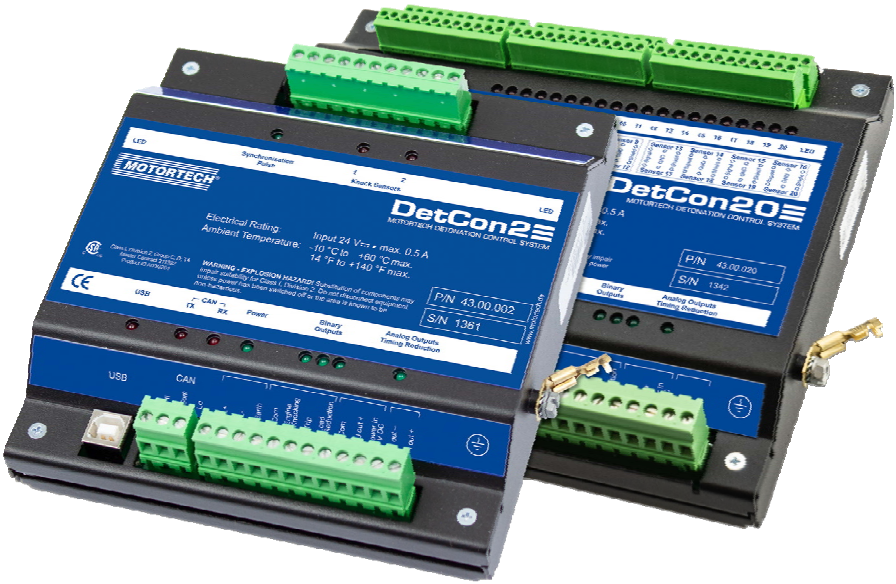
MOTORTECH®

DetCon – Detonation Controller

Operating Manual



P/N 01.30.002 | Rev. 10/2020

DetCon
MOTORTECH DETONATION CONTROL SYSTEM

Original instructions

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1 General Information

Read through this operating manual carefully before use and become familiar with the product. Installation and start-up should not be carried out before reading and understanding this document. Keep this manual readily available so that you can reference it as needed.

1.1 What Is the Purpose of this Operating Manual?

This manual serves as an aid for the installation and operation of the product and supports the technical staff with all operating and maintenance tasks to be performed. Furthermore, this manual is aimed at preventing dangers to life and health of the user and third parties.

1.2 Who Is this Operating Manual Targeted to?

The operating manual provides a code of conduct for personnel tasked with the setup, operation, maintenance, and repair of gas engines. A certain level of technical knowledge with respect to the operation of gas engines and basic knowledge of electronic ignition systems are necessary. Persons who are only authorized to operate the gas engine shall be trained by the operating company and shall be expressly instructed concerning potential hazards.

1.3 Which Symbols Are Used in the Operating Manual?

The following symbols are used in this manual and must be observed:

Example

This symbol indicates examples, which point out necessary handling steps and techniques. In addition, you receive additional information from the examples, which will increase your knowledge.

Notice

This symbol indicates important notices for the user. Follow these. In addition, this symbol is used for overviews that give you a summary of the necessary work steps.

Warning

This symbol indicates warnings for possible risks of property damage or risks to health. Read these warning notices carefully and take the mentioned precautionary measures.

Danger

This symbol indicates warnings for danger to life, especially due to high voltage. Read these warning notices carefully and take the mentioned precautionary measures.

1.4 Which Abbreviations/Acronyms Are Used in the Operating Manual?

In the operating manual or the user interface, the following abbreviations/acronyms are used.

Abb.	Term	Description	Explanation
ASO	Auxiliary Synchronization Output		Output of the MOTORTECH ignition controllers for synchronization with the DetCon
ATEX	Atmosphères Explosibles	Potentially explosive atmospheres	
CAN bus	Controller Area Network bus	Bus for control devices / networks	Asynchronous serial connection system for linking control units
CE	Conformité Européenne	Conformity with EU directives	Mark based on EU legislation for certain products in conjunction with product safety
CSA	Canadian Standards Association		Organization that defines standards, inspects products for safety compliance, and issues pertinent certifications.
DC	Direct Current		
DetCon	Detonation Control System		Serves to prevent major engine damage that can be caused by knocking combustion.
EMC	Electromagnetic Compatibility		Compatibility of electrical or electronic equipment items with their surroundings
ESD	Electrostatic Discharge		
IEC	International Electrotechnical Commission		

1 General Information

Abb.	Term	Description	Explanation
ISO	International Organization for Standardization		
ISU	Ignition Sensor Unit		
LED	Light Emitting Diode		Light emitting electronic semiconductor
MIC	MOTORTECH Ignition Controller		
MICT	MOTORTECH Integrated Configuration Tool		Software for configuring MOTORTECH ignition controllers
RoHS	Restriction of Hazardous Substances		
USB	Universal Serial Bus		Serial connection system to link a computer to external devices

2 Safety Instructions

2.1 General Safety Instructions

The following safety instructions must be followed in the area in which the device is operated:

High voltage! Danger to life!

While the engine is running, the area around the ignition system especially holds the risk of danger due to high voltage. The following parts should therefore not be touched or removed unless explicitly stated otherwise:

- Ignition coils and caps
- Wires of the high voltage circuit
- In- and output wiring of the ignition controller
- Pickups and their wiring

Danger to persons with pacemakers!

Electromagnetic impulses in the wiring of the ignition system may exceed the permissible limits of pacemakers. Persons with pacemakers must therefore not be present in the vicinity of the ignition system being operated. Mark the operating location of the ignition system with the corresponding standardized warning symbol.

MOTORTECH equipment is manufactured as state of the art and therefore safe and reliable to operate. Nevertheless the equipment can cause risks or damage can occur, if the following instructions are not complied with:

- The gas engine must only be operated by trained and authorized personnel.
- Observe all safety instructions of the system and all safety instructions of the system operator.
- Operate the equipment only within the parameters specified in the technical data.
- Use the equipment correctly and for its intended use only.
- Never apply force.
- For all work such as installation, conversion, adaptation, maintenance, and repair, all equipment must be disconnected from the mains and secured against unintentional reactivation.
- Perform only such maintenance and repair work as is described in this operating manual, and follow the instructions given while working.
- Only use spare parts supplied by MOTORTECH for the maintenance of the device.
- Further work must only be performed by personnel authorized by MOTORTECH. Non-compliance with the instructions will void any warranties for the proper function of the equipment as well as the responsibility for the validity of the certifications.

- Safety devices must not be dismounted or disabled.
- Avoid all activities that can impair the function of the equipment.
- Operate the equipment only while it is in proper condition.
- Investigate all changes detected while operating the gas engine or ignition system.
- Ensure compliance with all laws, directives, and regulations applicable to the operation of your system, including such not expressly stated herein.
- If the system is not entirely tight and sealed, gas may escape and result in explosion hazard. The inhalation of gas can also lead to death or severe health damages. Therefore, upon completion of all assembly works, always check the system's tightness.
- Always ensure adequate ventilation of the engine compartment.
- Ensure a safe position at the gas engine.
- There is a risk of burning on hot surfaces. Allow the gas engine to cool down before starting any work.
- Personal protective equipment (PPE), e.g. safety shoes and gloves, must be worn during all work on the gas engine.
- Noise from the system can cause permanent or temporary damage to your hearing. Wear suitable hearing protection at the system.
- Your behavior can reduce possible residual risks to a minimum. Observe responsible handling of the gas engine and the gas-carrying system.

2.2 Electrostatic Discharge Hazards

Electronic equipment is sensitive to static electricity. To protect these components from damage caused by static electricity, special precautions must be taken to minimize or prevent electrostatic discharge.

Observe these safety precautions while you work with the equipment or in its vicinity.

- Before performing maintenance or repair work, ensure that the static electricity inherent to your body is discharged.
- Do not wear clothing made from synthetic materials to prevent static electricity from building up. Your clothing should therefore be made of cotton or cotton mix materials.
- Keep plastics such as vinyl and Styrofoam materials as far away from the equipment as possible.
- Do not remove the circuit boards from the housing of the device.

2.3 Special Safety Instructions for the Device

High voltage! Danger to life!

There is danger to life while the engine is operating due to high voltage. The following safety instructions have to be observed when the engine is running:

- Do not touch the ignition sensor unit (ISU)
- Do not remove the ignition sensor unit (ISU)
- Do not disconnect the wiring

Risk of destruction due to electrostatic discharge!

The DetCon detonation controller may only be installed into a control cabinet by specialized personnel who has been trained in handling ESD sensitive components and with due regard to relevant ESD standards. It is necessary to comply the ESD standard IEC 61340-5-1:2016 during installation. Damage caused by electrostatic discharge is not covered by warranty.

Operational safety!

The DetCon detonation controller requires high voltage ignition wires with integrated 5 kΩ resistance, as otherwise interference in the detonation sensor signals may be caused. Any other ignition wires have to be replaced.

Operational safety!

Please note that the detonation sensors have to be wired according to the firing order of the cylinders. Refer to the section *Wiring of the Detonation Sensors* on page 51.

2 Safety Instructions

Risk of destruction!

The detonation sensor mounting screws have not to be tightened too firmly, as otherwise the sensors will be damaged and no longer function properly. Note the following specifications for sensor installation:

- Tightening torque: 20 Nm ± 5 Nm (14.8 lb-ft ± 3.7 lb-ft) for mounting screws:
  - Cast iron engine block: M8 x 25 mm (0.98"), property class 8.8
  - Aluminum engine block: M8 x 30 mm (1.18"), property class 8.8
- Tightening torque: 15 Nm ± 5 Nm (11 lb-ft ± 2.2 lb-ft) for mounting screws M6 x 30 mm (1.18"), property class 10.9 with sleeve

Also, lay the sensor cables in such a way that no resonance vibrations can occur on the cable. Otherwise, there is a risk of breakage.

Check parameter files

During the DetCon installation, it is necessary to check the settings in the parameter files. The knocking of the engine should also be checked in order to fine-tune the DenEdit settings. Especially the settings in the tab *Outputs options* have to be adjusted to on site specifications.

DetCon can only be used in single ignition operation

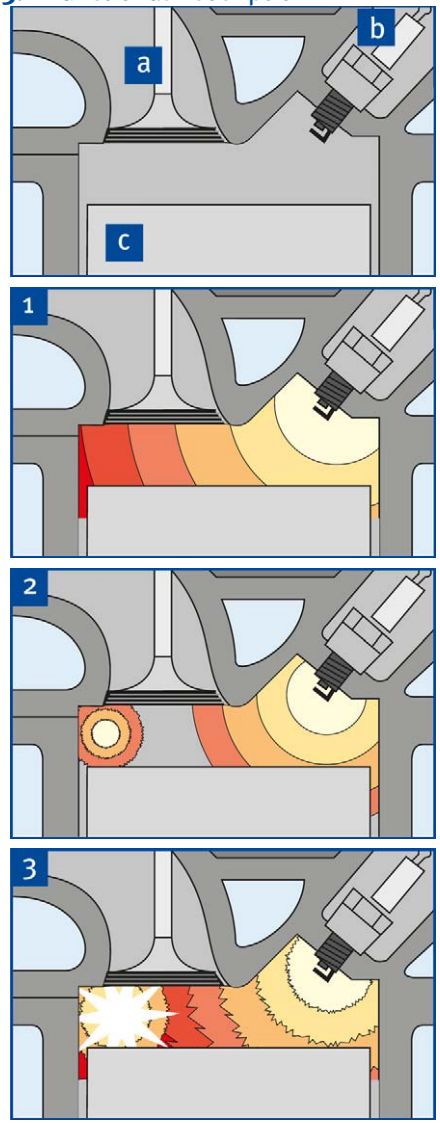
V engines can only use the DetCon detonation controller with single ignition, not in dual ignition operation.

The DetCon uses two time frames per cylinder to detect engine knocking. These time frames are opened in single ignition operation based on the ignition pulse. In dual ignition operation it is not possible to correctly assign the time frames to all cylinders.

2.4 Proper Disposal

After the expiration of its service life, MOTORTECH equipment can be disposed of with other commercial waste, or it may be returned to MOTORTECH. We will ensure its environmentally friendly disposal.

3.1 Functional Description



Pos.	Designation
a	Valve
b	Spark plug
c	Piston

Normal Combustion

The figure 1 shows the desired type of combustion of the gas/air mixture in the combustion chamber. The ignition spark ignites the gas/air mixture. The flame front spreads out evenly in the combustion chamber with the specific laminar flame speed of the gas/air mixture. The cylinder pressure increases slightly during combustion.

Knocking Combustion

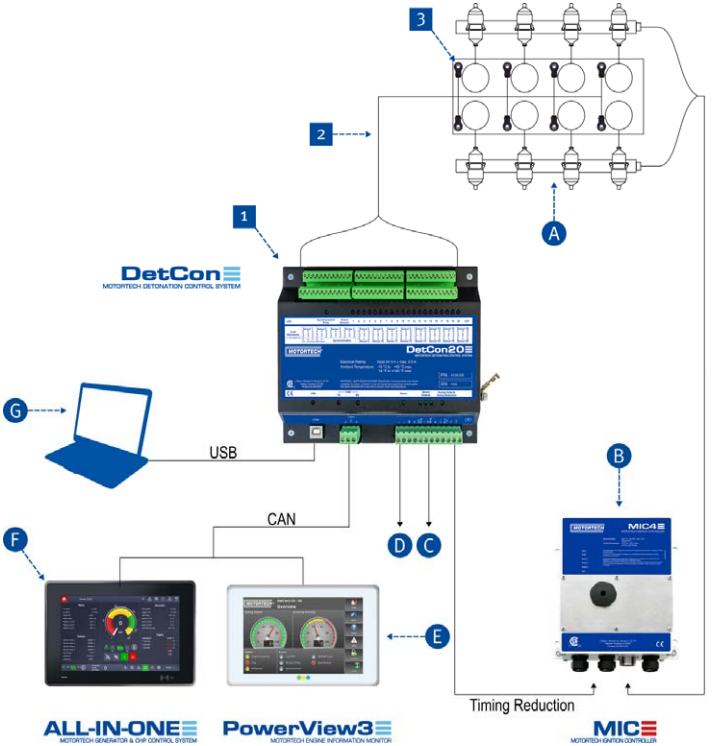
Knocking combustion arises if the gas/air mixture self-ignites before the actual flame front, but after the ignition pulse 2. This system does not detect so-called pre-ignition.

The reason for this is an excessive increase in pressure and temperature of the as yet non-combusted mixture due to the pressure and temperature fronts preceding the normal flame front. The pressure and temperature fronts arising from the self-ignition, in turn, make further self-ignitions possible. High-frequency pressure waves arise in the combustion chamber, which are introduced into the engine structure via the walls of the combustion chamber and released as air-borne noise into the environment. The knocking becomes audible in this way 3.

Compared to normal combustion, significantly higher peak pressures arise, which may lead to major engine damage in addition to the higher thermal load.

3 Intended Use

Detonation Controller – System Overview (Example)



Pos.	Designation	Pos.	Designation
1	DetCon detonation controller	C	Binary outputs (alarm, load reduction and engine stop)
2	Detonation sensor wiring	D	Power supply 9 V DC at 36 V DC
3	Detonation sensor	E	PowerView3 HMI module*
A	Wiring rail (ignition)	F	ALL-IN-ONE generator & CHP control system*
B	MIC ignition controller	G	Computer

*Visualization via the MOTORTECH PowerView3, alternatively via the MOTORTECH ALL-IN-ONE generator & CHP control system

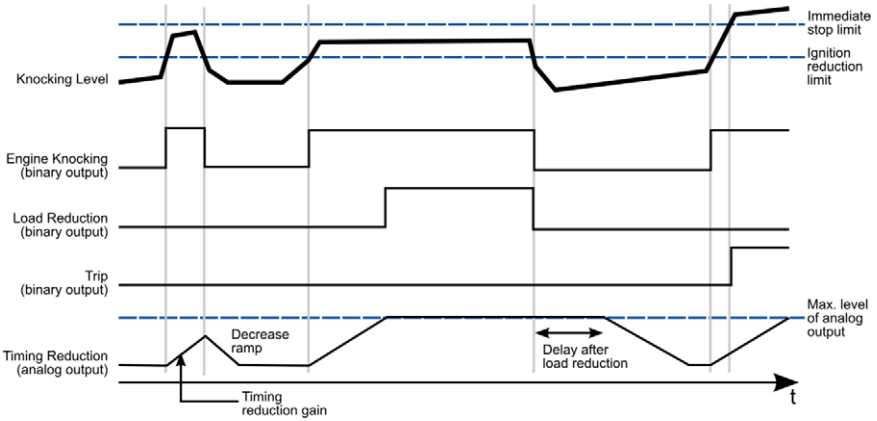
Detonation Controller

The function of the DetCon detonation controller is to prevent engine from damage caused by knocking combustion.

Vibration occurs in the engine compartment during the combustion process. These have a frequency which is characteristic for the engine type. The DetCon measures the vibratory energy within a narrow frequency range which is typical for the respective engine. The energy measured is proportional to the knocking level.

The measurement is only carried out within operating cycles in which combustion is possible. This increases the sensitivity of the measurement and minimizes the reaction to random noises. The operating cycles are determined according to application and the ignition controller used via an auxiliary synchronization output (ASO), an ignition sensor unit (ISU) or a camshaft sensor.

The following diagram and the description below it illustrate the basic control process of the system:



Term used in diagram	Description
Knocking Level	Example of the progression of knocking energy
Immediate stop limit	The maximum value at which the engine is stopped.
Ignition reduction limit	The maximum value at which an ignition timing adjustment is performed.
Engine Knocking (binary output)	Signal at the binary output indicating knocking.
Load Reduction (binary output)	Signal at the binary output effecting load reduction.
Trip (binary output)	Signal at the binary output indicating that the *Immediate stop limit* has been exceeded or a defective sensor detected.

3 Intended Use

Term used in diagram	Description
Timing Reduction (analog output)	Curve of the analog signal for ignition timing adjustment
Max. level of analog output	Maximum value of the ignition timing adjustment
Timing reduction gain	Speed of the ignition timing adjustment
Decrease ramp	Speed of reduction of the ignition timing adjustment
Delay after load reduction	Delay time after a load reduction

The measured knocking energy (*Knocking Level* curve) is compared in every cycle with an preset maximum value (*Ignition reduction limit*). If this maximum value is reached, the binary output *Engine Knocking* is activated. At the same time, the analog outputs change their values (*Timing Reduction* curve). The rate at which the value of the signal changes is specified by the setting *Timing reduction gain*. The analog signals are transmitted to the ignition controller, thus adjusting the ignition timing. If this causes the knocking energy to fall below the maximum value, the value at the analog outputs is also reduced. The rate of this reduction is adjusted according to the preset value *Decrease ramp*.

If the ignition timing adjustment can no longer be corrected via the analog outputs and the engine is still knocking, the binary output for load reduction (*Load Reduction*) is activated. A master control system (e.g. ALL-IN-ONE) can control load reduction via this output.

The load reduction (*Load Reduction*) is deactivated again if the engine knocking stops. However, the analog outputs remain active for a further period which is set via the function *Delay after load reduction*. This period has to be longer than required for reaching full load.

The binary output *Trip* is activated when the knocking exceeds the maximum value *Immediate stop limit*. This can be used as an emergency stop signal to force the engine to stop.

Checkbox Enable bad sensor detect

Activate the checkbox so that defective detonation sensors are indicated via the status display *BAD SENSOR*. This function only detects sensors which provide faulty signals. If a wire has ruptured or a sensor gives no signals for some other reason, it is not indicated on this display. If a defective sensor is detected, the binary output *Trip* is also activated.

3.2 Applications

The DetCon detonation controller can analyze two-stroke and four-stroke engines with up to 20 cylinders and up to a maximum 1 kHz ignition frequency. The device is available in two versions:

- DetCon2 for two detonation sensors
- DetCon20 for up to 20 detonation sensors

Both device types are available as a built-in device for a control cabinet or with a CSA certified enclosure. The DetCon20 detonation controller is also available in an ATEX certified enclosure. The following manual applies to all device types. Any differences between the versions are clearly identified.

In order to define the time frame for potential knocking, the detonation controller has to know the ignition timing of the first cylinder in the firing order. Depending on the application and the ignition controller used, this can be determined in different ways:

- Gas engines:
  - MOTORTECH ignition controllers with auxiliary synchronization output (ASO, e.g. MIC4): The ignition timing is determined via the signal on the ASO output. No other sensor is required.
  - Ignition controllers without ASO output: The ignition timing is determined using a signal from the ignition sensor unit (ISU) connected between the ignition output and the ignition coil of the first cylinder.
- Diesel and pilot injection engines:
  - The fuel injection timing is determined using the signal from an inductive camshaft sensor.

Any use other than the one described in the operating manual shall be considered improper use and will result in the voiding of all warranties.

3.3 Use in Potentially Explosive Atmospheres

3.3.1 USA, Canada

The DetCon is certified by the CSA for use in a Class I, Division 2, Groups C and D, T4 hazardous location in the USA and Canada. For this, you must adhere to the information of the CSA certificate 70025871 (LR 211392), which is enclosed with the product.

The DetCon detonation controller can be delivered in a CSA-certified enclosure or installed in a correspondingly certified control cabinet and thus fulfills the directives mentioned in section *Certifications* on page 20.

3 Intended Use

3.3.2 European Union

The DetCon is certified in accordance with ATEX Directive for use in a potentially explosive atmosphere in the European Union:

II 3G Ex ec IIA T4 X

Labeling	Meaning
	Marking of explosion protection, the product complies with ATEX Directive
II	**Equipment group** II = Ex areas with the exception of mines susceptible to firedamp
3G	**Equipment category** 3 = Ex hazard infrequent and for a short period **Substance group** G = Gases
Ex	Ex protection in accordance with EN 60079-xx (-0, -7)
ec	**Type of protection** ec = Equipment protection by increased safety “e”
IIA	Subdivision into **explosion groups**: II = Gases A = Gases such as propane
T4	**Temperature class** T4 = max. surface temperature ≤ +135 °C (+275 °F)
X	X = Special conditions have to be observed when using the equipment

Notices for Handling the DetCon Detonation Controller in Potentially Explosive Atmospheres

Explosion hazard!

Only use detonation sensors approved by MOTORTECH for operation in potentially explosive atmospheres.

P/N	Description
43.20.001	Detonation sensor without sensor lead, two-pole
43.30.004-60	Detonation sensor lead, 18 m (59.06 ft)

3 Intended Use

Explosion hazard!

The USB interface may only be used in a non-explosive atmosphere. There is a risk of sparking.

Sealing of the enclosure to the enclosure cover

The sealing of the enclosure to the enclosure cover is done by a foamed seal. The overlapping of the foam bead (start point/end point) of the seal cannot be produced without a seam due to the material, but has no influence on the specified IP protection class.

Use MOTORTECH detonation sensors

The DetCon detonation controllers are parameterized for operation with MOTORTECH detonation sensors (piezoelectric acceleration transducers).

4 Product Description

4.1 Technical Data

4.1.1 Certifications

The DetCon detonation controllers are certified as follows:

CSA

The DetCon detonation controller can be delivered CSA certified in an enclosure and fulfills the following requirements:

- Class I, Div. 2, Group C, D; T4
- CSA Std. C22.2 No. 0-10
- CSA Std. C22.2 No. 142
- CSA Std. C22.2 No. 213
- ANSI/ISA 12.12.01, Ed. 1
- UL Std. No. 916, Ed. 3

The corresponding requirements are also fulfilled if the DetCon detonation controller is installed in a correspondingly certified control cabinet.

CE

EMC Directive

- EN 61000-6-1
  Electromagnetic compatibility (EMC) - Part 6-1: Generic standards — Immunity standard for residential, commercial and light-industrial environments
- EN 61000-6-2
  Electromagnetic compatibility (EMC) - Part 6-2: Generic standards — Immunity standard for industrial environments
- EN 61000-6-3
  Electromagnetic compatibility (EMC) - Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments
- EN 61000-6-4
  Electromagnetic compatibility (EMC) - Part 6-4: Generic standards — Emission standard for industrial environments

RoHS Directive

Further applied standards:

- EN 61010-1
  Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements

The DetCon detonation controller can be delivered ATEX certified in an enclosure and fulfills the following directives and standards:

ATEX Directive

- EN 60079-0
  Explosive atmospheres — Part 0: Equipment — General requirements
- EN 60079-7
  Explosive atmospheres — Part 7: Equipment protection by increased safety "e"

4.1.2 Mechanical Data

The DetCon has the following mechanical characteristics:

Feature	Value
Dimensions of the electric unit (incl. DIN rail clamps)	**DetCon2** 160.4 mm x 146.9 mm x 52 mm (6.31" x 5.78" x 2.05") (length x width x height) **DetCon20** 160.4 mm x 187.2 mm x 52 mm (6.31" x 7.37" x 2.05") (length x width x height) **Devices in certified enclosure (CSA, ATEX)** 300 mm x 300 mm x 120 mm (11.81" x 11.81" x 4.72") (length x width x height) Details refer to section *Overview Drawings* on page 30
Installation of the electric unit	DIN rail mounting
Weight	**DetCon2**: 0.59 kg (1.30 lbs) **DetCon20**: 0.74 kg (1.63 lbs)
Shape of device	See section *Overview Drawings* on page 30
Mechanical environmental conditions	Protection class without enclosure: IP20 Protection class in potentially explosive atmospheres (enclosure versions): IP66
Climatic environmental conditions	**DetCon without enclosure:** Ambient temperature: –10 °C to +60 °C (+14 °F to +140 °F) Storage temperature: –40 °C to +80 °C (–40 °F to +176 °F) **Devices in certified enclosure (CSA, ATEX)** Ambient temperature: –10 °C to +60 °C (+14 °F to +140 °F) Storage temperature (CSA): –20 °C to +80 °C (–4 °F to +176 °F) Storage temperature (ATEX): –30 °C to +80 °C (–22 °F to +176 °F) Max. 95 % humidity without condensation

4.1.3 Warning Notices on the Device

Validity of warning notices on device

The warning notices on the device are valid for the DetCon and all components connected to it.

CSA

The following marks are on the CSA certified detonation controller:

Warning notice on the device	German translation	French translation
WARNING – EXPLOSION HAZARD! Substitution of components may impair suitability for Class I, Division 2. Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.	WARNUNG – EXPLOSIONSGEFAHR! Der Austausch von Komponenten kann die Eignung für die Class I, Division 2 beeinträchtigen. Trennen Sie das Gerät nur, wenn die Stromversorgung unterbrochen wurde oder bekannt ist, dass der Bereich nicht explosionsgefährdet ist.	AVERTISSEMENT – RISQUE D'EXPOLOSION! L'échange de composants peut affecter l'aptitude de Classe 1, Division 2. Ne débranchez pas lorsque le cicuit est sous tension, sauf l'environnement n'est pas classé comme explosif.

Warning notice at the CSA enclosure	German translation	French translation
WARNING! Read and understand the installation instructions and operating manual prior to installing or making any adjustments.	WARNING! Lesen und verstehen Sie die Installations- und Betriebsanleitung vor der Installation und bevor Einstellungen vorgenommen werden.	ATTENTION! Avant d'installer ou d'effectuer une modification, lisez et comprenez le manuel d'utilisation et d'installation.
EXPLOSION HAZARD! Do not disconnect while circuit is live unless area is known to be non-hazardous. For wiring details please refer to operation manual.	EXPLOSIONSGEFAHR! Keine Verbindungen lösen, solange der Stromkreis aktiv ist, außer das Umfeld wird als nicht explosionsgefährdet eingestuft. Hinweise zur Verkabelung finden Sie in der Betriebsanleitung.	RISQUE D'EXPLOSION! Ne débranchez pas lorsque le circuit est sous tension, sauf l'environnement n'est pas classé comme explosif. Vous trouverez des informations sur le câblage dans le mode d'emploi.

Warning notice at the CSA enclosure	German translation	French translation
CAUTION! Do not pressure wash this enclosure. Damage to electronic components may result.	ACHTUNG! Das Gehäuse nicht mit Hochdruck reinigen. Es könnte zu Schäden an den elektronischen Bauteilen führen.	ATTENTION! Ne pas nettoyer le boîtier à haute pression. Les composants électriques peuvent être endommagés.

ATEX

The following marks are on the ATEX certified detonation controller:

Warning notice on the device	German translation	French translation
WARNING – EXPLOSION HAZARD! Substitution of components may impair suitability for Class I, Division 2. Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.	WARNUNG – EXPLOSIONSGEFAHR! Der Austausch von Komponenten kann die Eignung für die Class I, Division 2 beeinträchtigen. Trennen Sie das Gerät nur, wenn die Stromversorgung unterbrochen wurde oder bekannt ist, dass der Bereich nicht explosionsgefährdet ist.	AVERTISSEMENT – RISQUE D'EXPOLOSION! L'échange de composants peut affecter l'aptitude de Classe 1, Division 2. Ne débranchez pas lorsque le cicuit est sous tension, sauf l'environnement n'est pas classé comme explosif.

Warning notice at the ATEX enclosure	German translation	French translation
WARNING! Read and understand the installation instructions and operating manual prior to installing or making any adjustments.	WARNING! Lesen und verstehen Sie die Installations- und Betriebsanleitung vor der Installation und bevor Einstellungen vorgenommen werden.	ATTENTION! Avant d'installer ou d'effectuer une modification, lisez et comprenez le manuel d'utilisation et d'installation.

4 Product Description

Warning notice at the ATEX enclosure	German translation	French translation
EXPLOSION HAZARD! Do not open enclosure or disconnect while circuit is live unless area is known to be non-hazardous. For wiring details please refer to operation manual.	EXPLOSIONSGEFAHR! Gehäuse nicht öffnen und keine Verbindungen lösen, solange der Stromkreis aktiv ist, außer das Umfeld wird als nicht explosionsgefährdet eingestuft. Hinweise zur Verkabelung finden Sie in der Betriebsanleitung.	RISQUE D'EXPLOSION! Ne débranchez pas lorsque le circuit est sous tension, sauf l'environnement n'est pas classé comme explosif. Vous trouverez des informations sur le câblage dans le mode d'emploi.
The device must be installed and operated only in an environment that ensures a pollution degree 2 (or better) according to IEC/EN 60664-1.	The device may only be installed and operated in an environment that ensures pollution degree 2 (or better) according to IEC/EN 60664-1.	L'appareil ne peut être installé et utilisé que dans un environnement garantissant un degré de pollution 2 (ou supérieur) selon la norme IEC/EN 60664-1.
CAUTION! Do not pressure wash this device. Damage to electronic components may result.	ACHTUNG! Das Gerät nicht mit Hochdruck reinigen. Es könnte zu Schäden an den elektronischen Bauteilen führen.	ATTENTION! Ne pas nettoyer le boîtier à haute pression. Les composants électriques peuvent être endommagés.

4.1.4 Product Identification – Labeling on the Device

The necessary numbers for unique product identification are on the device:

- Part number of the detonation controller (P/N)
- Serial number of the detonation controller (S/N)
- Year of manufacture of the detonation controller (2019)

Example:
DetCon in ATEX certified enclosure

4.1.5 Electrical Data

The DetCon has the following electrical characteristics:

Feature	Value
Rated current	0.1 A to 0.3 A
Power consumption	0.1 A at 24 V 0.1 A at 36 V 0.3 A at 9 V
Power supply	9 V DC at 36 V DC
ATEX: Protective conductor cross-section	4 mm^2 to 35 mm^2, **EN 60079-0:2012 + A11:2013 section 15.3 has to be observed!**

Electrical Data for Inputs and Outputs

The inputs and outputs have the following electrical data:

Inputs and outputs	Value
Ignition pulse input	Input resistance: 220 Ω/1 kΩ Max. input voltage: 24 V at a load resistance of 220 Ω 36 V at a load resistance of 1 kΩ Max. frequency: 800 Hz
Detonation sensor input	Input resistance: › 1 MΩ
Analog current output	Output current: 4 mA to 20 mA Max. voltage: 30 V Current accuracy: ± 2 %
Analog voltage output	Output voltage: 0 V to 5 V Max. current: 2 mA Voltage accuracy: ± 2 % Auxiliary power 5 V DC required
Binary outputs	All three outputs have a common connection and have zero potential (galvanically separated optocouplers). Max. voltage: 33 V Max. current: 50 mA

4.1.6 Interfaces

USB Interface

Explosion hazard!

The USB interface may only be used in a non-explosive atmosphere. There is a risk of sparking.

- Compatible with USB 1.1
- Connector type B
- Transfer rate 1 MBit/s

CAN Bus Interface

- Galvanically isolated
- Baud rate 250 kBd

4.1.7 Technical Data of the Detonation Sensors

Use MOTORTECH detonation sensors

The DetCon detonation controllers are parameterized for operation with MOTORTECH detonation sensors (piezoelectric acceleration transducers).

Explosion hazard!

Only use detonation sensors approved by MOTORTECH for operation in potentially explosive atmospheres.

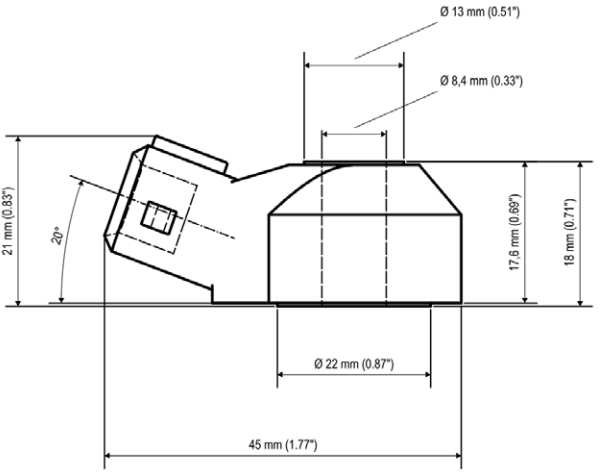
P/N	Description
43.20.001	Detonation sensor without sensor lead, two-pole
43.30.004-60	Detonation sensor lead, 18 m (59.06 ft)

4 Product Description

The MOTORTECH detonation sensors have the following technical data:

Feature	Value
Sensor principle	Piezoelectric acceleration transducer
Sensor type	MOTORTECH
Main resonance frequency	› 20 kHz
Temperature range	–40 °C to +130 °C (–40 °F to +266 °F)
Dimensions sensor	45 mm x 28 mm x 21 mm (1.77" x 1.10" x 0.83") (length x width x height)
Sensor installation	Tightening torque: 20 Nm ± 5 Nm (14.8 lb-ft ± 3.7 lb-ft) for mounting screws: – Cast iron engine block: M8 x 25 mm (0.98"), property class 8.8 – Aluminum engine block: M8 x 30 mm (1.18"), property class 8.8 Tightening torque: 15 Nm ± 5 Nm (11 lb-ft ± 2.2 lb-ft) for mounting screws M6 x 30 mm (1.18"), property class 10.9 with sleeve. If necessary, the material of the cylinder head screw on which the sensor is installed should also be considered (see section *Installation of the Detonation Sensors* on page 44).

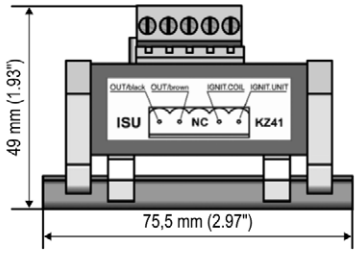
Dimensions of the Sensor

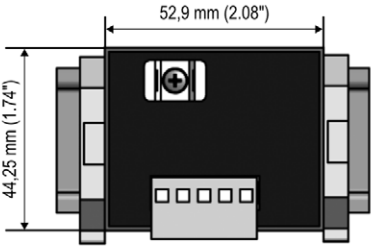


4.1.8 Technical Data of the Ignition Sensor Unit (ISU)

The ignition sensor unit has the following technical data:

Feature	Value
Sensor principle	Signal transducer
Sensor type	MOTORTECH
Power supply	15 V DC to 34 V DC
Temperature range	–25 °C to +85 °C (–13 °F to +185 °F)
Dimensions sensor	75.5 mm x 44.25 mm x 49 mm (2.97" x 1.74" x 1.93") incl. DIN rail (length x width x height)
Sensor installation	DIN rail mounting (see section *Installation of the Ignition Sensor Unit (ISU)* on page 48)





4.1.9 Technical Data of the Camshaft Sensor

The camshaft sensor has the following technical data:

Feature	Value
Sensor principle	Active, inductive proximity switching sensor
Sensor type	MOTORTECH
Power supply	10 V DC to 30 V DC
Temperature range	–25 °C to +125 °C (–13 °F to +257 °F)
Dimensions sensor	M12 x 1 thread; length 60 mm (2.36") or 100 mm (3.94")
Sensor installation	On the camshaft (see section *Installation of the Camshaft Sensor* on page 49)

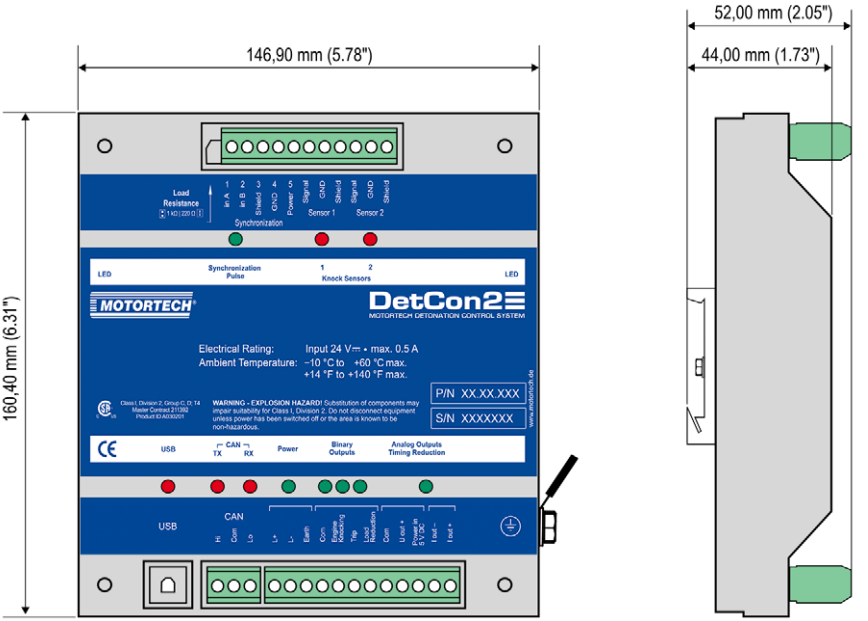
4 Product Description

4.1.10 Requirements for External Equipment

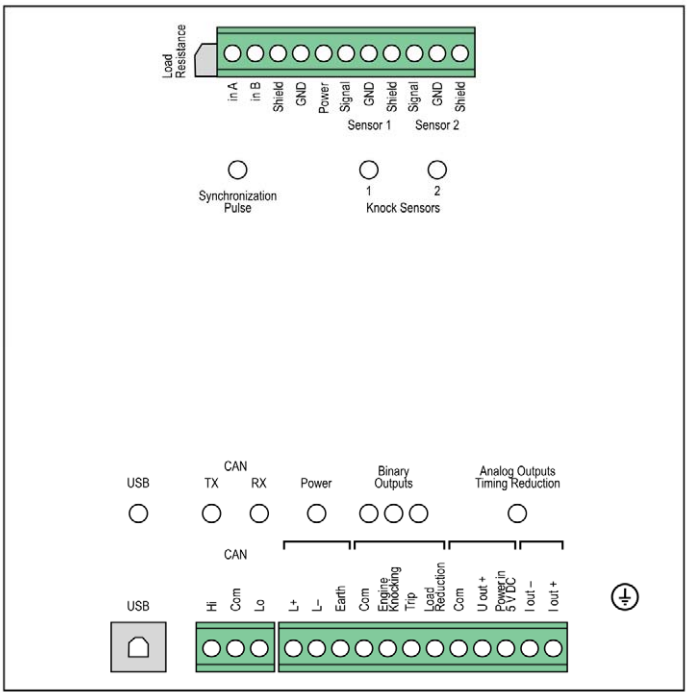
External equipment shall fulfill the input and output specifications of the DetCon.

4.1.11 Overview Drawings

DetCon2 – Dimensions



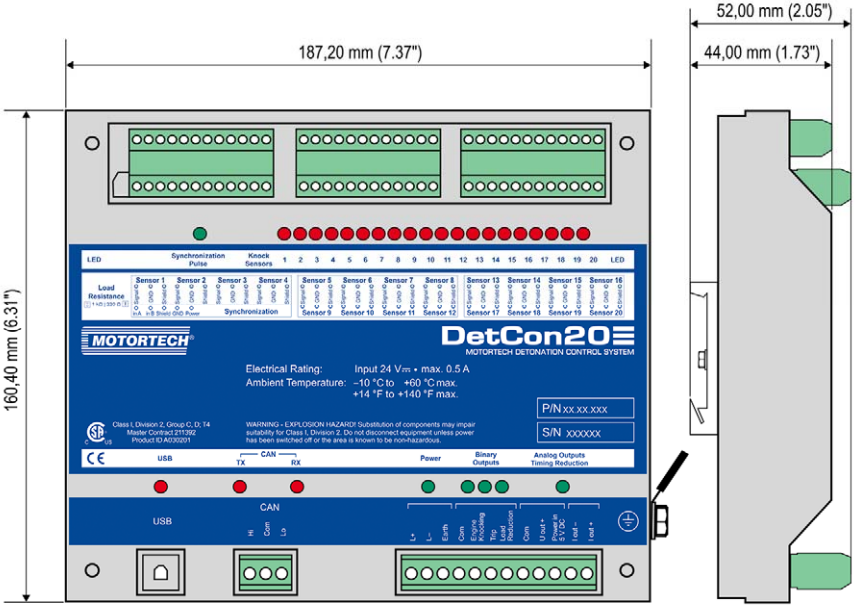
DetCon2 – Connections and LEDs



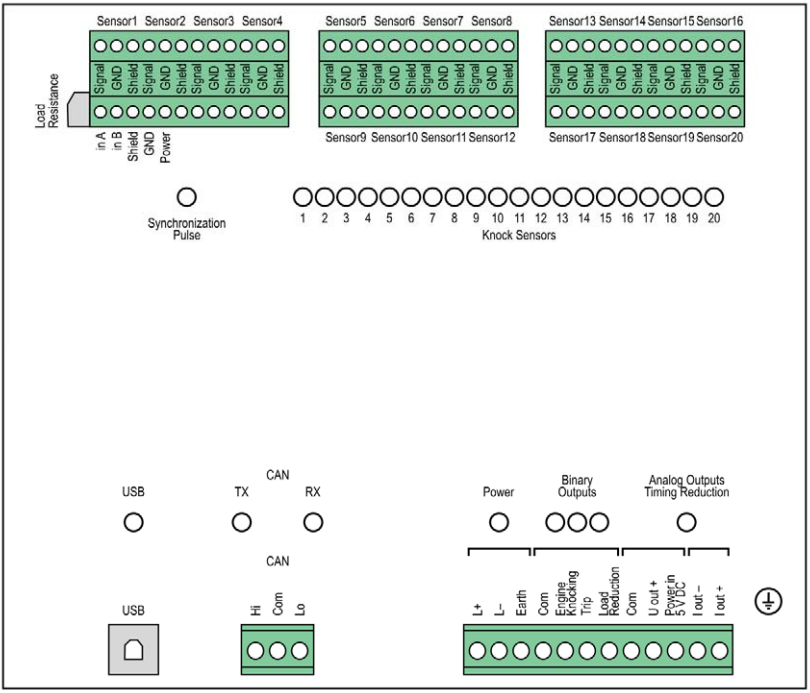
For the functions of the individual connections and LEDs, please refer to the table following the overview drawings of the DetCon20.

4 Product Description

DetCon20 – Dimensions



DetCon20 – Connections and LEDs



Labeling	Function
Load Resistance	Jumper which has to be removed if no ignition sensor unit (ISU) is used (when using a camshaft sensor or MOTORTECH ignition controllers with ASO output).
Sensor 1-2 (DetCon2) Sensor 1-20 (DetCon20)	Connections of the detonation sensors (Signal=white, GND=brown, Shield=shield) (see section *Wiring of the Detonation Sensors* on page 51)
in A, in B, Shield, GND, Power	Connections for the ignition sensor unit (ISU) or the camshaft sensor (see section *Wiring of the Ignition Sensor Unit (ISU)* on page 54 or *Wiring of the Camshaft Sensor (for Diesel and Pilot Injection Engines Only)* on page 57)
Synchronization Pulse (LED)	The LED flashes when an ignition pulse is transmitted to the DetCon.

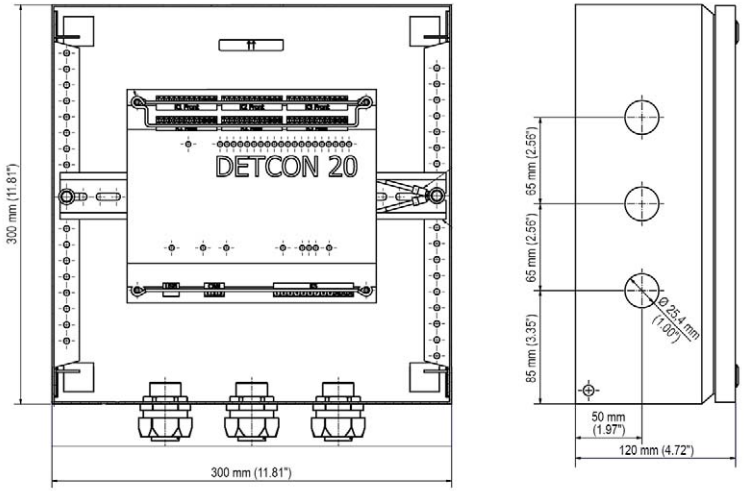
4 Product Description

Labeling	Function
Knock Sensors (LEDs)	The LEDs flash when knocking has been detected on the assigned cylinders. If the checkbox *Enable knock LED latch (switch ON/OFF to reset)* is activated in the tab *Mode* or in the tab *Output options*, the LEDs will light up instead of flashing. In this case, the LEDs have to be reset manually (see section *Tab: Mode* on page 75 or *Tab: Outputs Options* on page 79).
USB (LED)	The LED flashes when data is being transferred via the USB connection.
CAN TX and RX (LEDs)	The LEDs flash when data is being transferred via the CAN bus (TX=data is being transmitted, RX=data is being received).
Power (LED)	The LED lights up if the supply voltage is available.
Binary Outputs (LEDs)	The LEDs light up if the respective binary output (*Engine Knocking, Trip, Load Reduction*) has been activated.
Analog Outputs Timing Reduction (LED)	The LED lights up if an ignition timing adjustment has been executed via one of the two analog outputs (voltage or current).
USB	Connection for data transmission to the computer
CAN (Hi, Com, Lo)	Connections for communication via CAN bus with master control systems (such as ALL-IN-ONE)
L+, L–, Earth	Connections for the supply voltage
Com	Reference potential for the binary outputs (+ or –)
Engine Knocking, Trip, Load Reduction	Connections of the binary outputs
Com, U out +, Power in 5 V DC	Connections of the analog voltage output (see section *Wiring of the Analog Outputs for Ignition Timing Adjustment* on page 60)
I out –, I out +	Connections of the analog current output (see section *Wiring of the Analog Outputs for Ignition Timing Adjustment* on page 60)

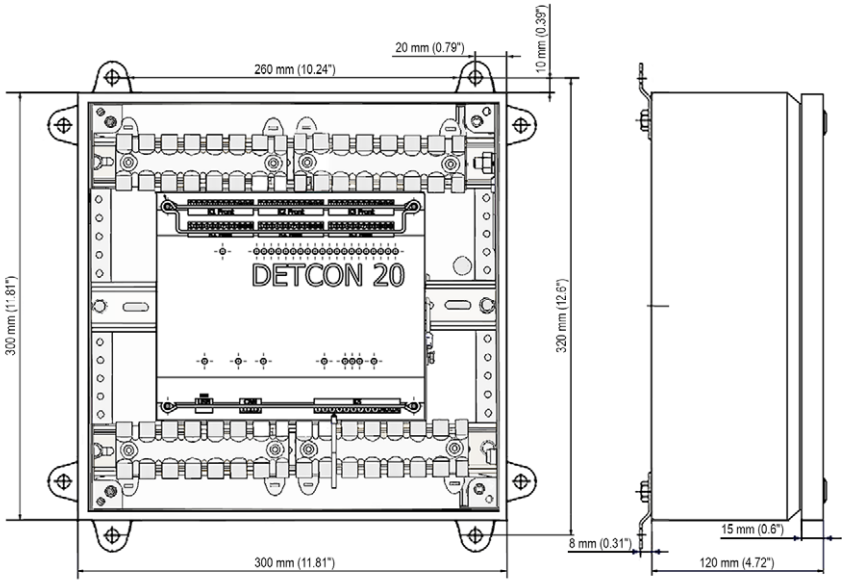
Signal transmission

Depending on the device version, the signals of the described LEDs are visualized via the DetCon itself or via a control system (e.g. ALL-IN-ONE).

DetCon Version in CSA Enclosure – Dimensions



DetCon Version in ATEX Enclosure – Dimensions



5 Installation Instructions

Unpack the equipment, taking care not to damage it, and ensure that the operating manual is always stored with the equipment and is easily accessible. Check the contents for completeness and verify that the device type meets your application requirements.

Scope of Supply

The scope of supply of the DetCon consists of the following components:

- DetCon detonation controller
- Storage device with software for configuration of the detonation controller
- USB interface cable for connecting the detonation controller to a computer
- Operating manual
- Additionally for enclosure version (CSA and ATEX certified): Screw joint set and screw joints

Installation locations where strong vibrations or ambient temperatures other than those specified in section *Mechanical Data* on page 21 are present are not permissible and result in the warranty being voided.

Explosion hazard!

In order to prevent the connection terminals from falling out or loosening, securing brackets have to be mounted on the DetCon detonation controller in potentially explosive atmospheres. There is a risk of sparking.

Explosion hazard!

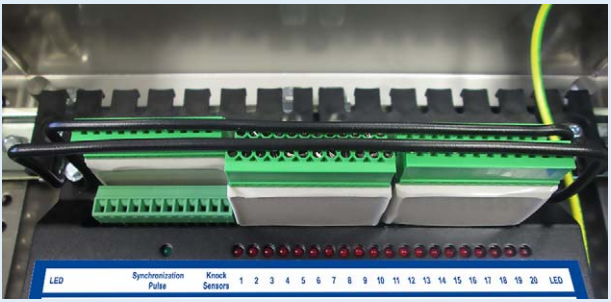
The device may in potentially explosive atmospheres only be installed and operated in an environment that ensures pollution degree 2 (or better, risk of leakage currents) according to IEC/EN 60664-1. There is a risk of sparking.

Explosion hazard!

Do not disconnect while circuit is live unless area is known to be non-hazardous. There is a risk of sparking. For information on wiring, please refer to the section *Wiring of the Device* on page 51.

Use in potentially explosive atmospheres!

Safety barriers are connected to the CAN bus connections, as well as the detonation sensors of the ATEX certified DetCon. Do not remove them, as they provide an additional explosion protection. In some DetCon versions the safety barrier of the CAN bus connection is directly installed on the board and thus not visible.



Risk of destruction!

On installation of the device, observe that no vibrations occur and temperatures are not exceeded during operation. Otherwise electronic components can be destroyed. Refer to the section *Mechanical Data* on page 21.

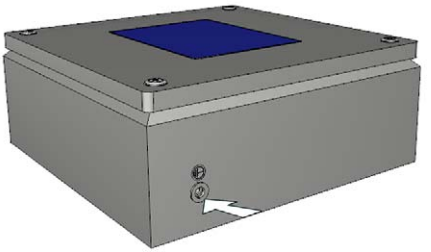
Use of ferrules

For connecting the leads to the DetCon detonation controller use ferrules to protect the stripped ends.

5 Installation Instructions

5.1 Protective Conductor Connection at the ATEX Enclosure

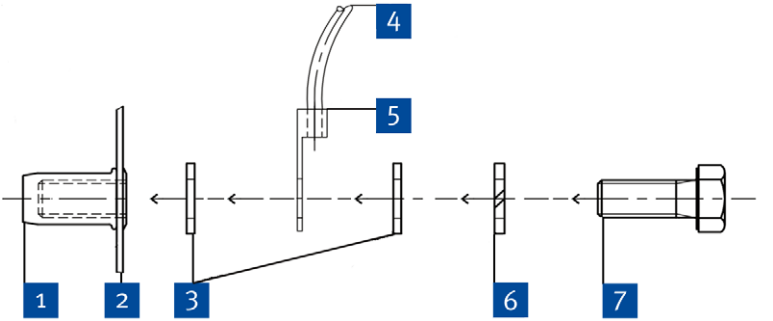
The external protective conductor connection is located outside the enclosure of the DetCon detonation controller.



Use in potentially explosive atmospheres!

The external protective conductor has to be connected always. Observe the requirements of EN 60439-1:1999 + A1:2004 section 7.4.3.1.

1. Connect the external protective conductor to the corresponding connection as shown in the following illustration.



Pos.	Description
1	Blind rivet nut for M8
2	Enclosure

Pos.	Description
3	Washer ISO 7092-8.4
4	External protective conductor, the minimum cross section is 4 mm², **EN 60079-0:2012 + A11:2013 section 15.3 has to be observed!**
5	Ring cable lugs DIN 46234, nominal cross section › 2.5 mm² to35 mm² Pipe cable lugs DIN 46235, nominal cross section 10 mm² to 35 mm²
6	Split washer DIN 127-B8
7	Hexagon nut ISO 4017 – M8 x 20 mm (0.79")

Protective conductor connection of the ATEX enclosure

All protective conductor connections of the ATEX enclosure are designed in M8.

Connection of external protective conductor

The external protective conductor is connected with the supplied stainless steel screws, nuts, washers and lock washers. The external protective conductor has to be provided with a standard cable lug with a suitable cross-section and ring diameter. The selected cable lugs have to correspond to one of the following standards:

- DIN 46234 for ring cable lugs
- DIN 46235 for pipe cable lugs

The cross-section for the protective conductor has to be dimensioned as follows:

Cross-section phase conductor S	Minimum cross-section of corresponding protective conductor Sp
S ≤ 16 mm²	S
16 mm² ‹ S ≤ 35 mm²	16 mm²
S › 35 mm²	0.5 mm² x S

5 Installation Instructions

Observe the requirements of EN 60439-1:1999 + A1:2004

- The protective conductor connection parts are designed for a minimum cross-section of 4 mm².
- When installing the external protective conductor connection, it has to be ensured that the conductors are secured against twisting and loosening. This is achieved by professional and fixed installation of the protective conductors close to the enclosure body.
- Applying a tightening torque of 10 Nm (7.38 lb-ft) to the screw joint ensures sufficient contact pressure in conjunction with the supplied split washer.
- The material selection for the protective conductor connection is such that electrochemical corrosion is not to be expected. Protective conductors have to be protected in a suitable way against mechanical, electrodynamic and thermodynamic influences and forces.
- Mechanical connections of protective conductors have to be accessible for inspection and testing.

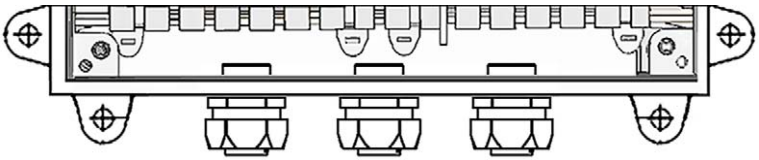
5.2 Lead Bushings at the ATEX Enclosure

Operational safety!

- All lead bushings have to be installed with a metallic counter nut.
- When using lead bushings with strain relief and bending protection, the number of possible standard screw joints is reduced.
- A mixed assembly of lead bushings can be used. Areas for intrinsically safe circuits have to be marked separately.
- Unused openings for lead bushings have to be closed with ATEX-certified closing plugs made of cold impact resistant plastic or metal.
- The lead bushings have to be mounted in such a way that they do not loosen automatically and a permanent sealing of the cable and lead entry points can be guaranteed. Cable ties are used to fix the cables.
- The distances between the lead bushings have to be selected so that a torque wrench can be used to tighten the lead bushings and the cap nuts.

5 Installation Instructions

In order to connect the DetCon detonation controller to other devices, you have to make suitable lead bushings. Observe the maximum number of cable and lead bushings for each side of the enclosure in order not to impair stability. Afterwards put the leads through the bushings in the enclosure wall and fasten them. Observe the tightening torques specified by the manufacturer.



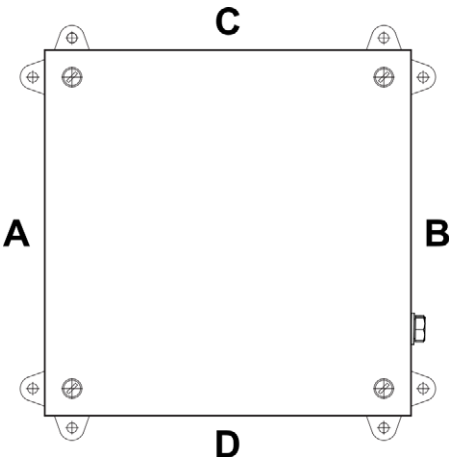
Maximum Number of Lead Bushings

The maximum number of lead bushings depends on their size.

The maximum number for each side of the enclosure is selected according to the following table so that the side walls are not weakened and the stability of the enclosure is not impaired.

Screw size	Side A	Side B	Side C	Side D
M12	33	31	33	33
M16	19	17	29	29
M20	16	14	16	16
M25	13	11	13	13
M32	4	2	9	9
M40	3	1	3	3
M50	2	1	2	2

5 Installation Instructions



Type examination certificate

All cable and lead bushings have to own a separate EC-type examination certificate.

The closing plugs used require a separate EC-type examination certificate.

Tightening Torques

When installing the lead bushings, the tightening torques have to be observed. If no specifications are available, the following values should be used.

Size	Tightening torque				Bore hole diameter
	Socket	Cap nut		Counter nut	
	Brass/ Polyamide	Brass	Polyamide	Brass/ Polyamide	
M12x1.5	2.5 Nm (1.8 lb-ft)	2.0 Nm (1.48 lb-ft)		2.5 Nm (1.8 lb-ft)	12.5 mm (0.49")
M16x1.5	4.0 Nm (2.95 lb-ft)	2.5 Nm (1.8 lb-ft)		4.0 Nm (2.95 lb-ft)	16.5 mm (0.65")
M20x1.5	4.0 Nm (2.95 lb-ft)	2.5 Nm (1.8 lb-ft)	3.5 Nm (2.58 lb-ft)	4.0 Nm (2.95 lb-ft)	20.5 mm (0.81")
M25x1.5	7.5 Nm (5.53 lb-ft)	12.0 Nm (8.85 lb-ft)	5.0 Nm (3.69 lb-ft)	7.5 Nm (5.53 lb-ft)	25.5 mm (1.00")
M32x1.5	7.5 Nm (5.53 lb-ft)	12.0 Nm (8.85 lb-ft)		7.5 Nm (5.53 lb-ft)	32.5 mm (1.28")
M40x1.5	7.5 Nm (5.53 lb-ft)	12.0 Nm (8.85 lb-ft)		7.5 Nm (5.53 lb-ft)	40.5 mm (1.59")
M50x1.5	7.5 Nm (5.53 lb-ft)	12.0 Nm (8.85 lb-ft)		7.5 Nm (5.53 lb-ft)	50.5 mm (1.99")

5 Installation Instructions

5.3 Installation of the Detonation Sensors

Explosion hazard!

Only use detonation sensors approved by MOTORTECH for operation in potentially explosive atmospheres.

P/N	Description
43.20.001	Detonation sensor without sensor lead, two-pole
43.30.004-60	Detonation sensor lead, 18 m (59.06 ft)

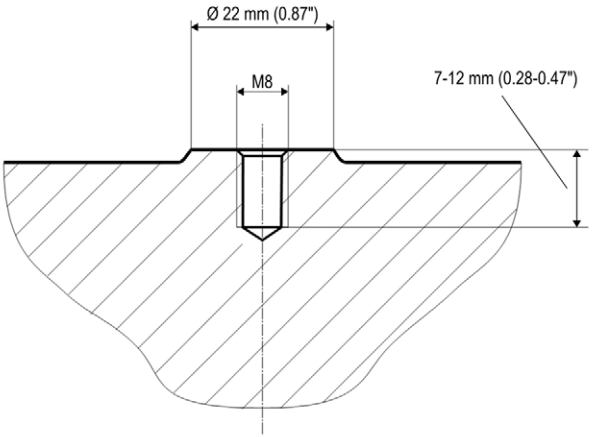
Use MOTORTECH detonation sensors

The DetCon detonation controllers are parameterized for operation with MOTORTECH detonation sensors (piezoelectric acceleration transducers).

Observe notes of the engine manufacturer

The following installation notes should be understood as orientation. Please observe in any case the notes of the respective engine manufacturers for the installation of the detonation sensors and the set up of a detonation controller.

Dimensions of the Required Bore



An M6 screw can also be used as an alternative to M8 screw for the installation of the detonation sensor. In this case, an adaptor sleeve has to be used in the sensor to close the resultant hollow space, thus ensuring optimal signal transmission.

Installation

In order to ensure the best functioning of the DetCon detonation controller, it is mandatory to install the sensors as follows:

- There has to be a direct connection to the engine block.
- Installations without a direct connection to the engine block (e.g. on seals) are unsuitable.
- Only the metal surface of the sensor may rest on the engine.
- Do not use washers, spring washers, or toothed washers.
- The detonation sensors may not come into contact with liquids (e.g. oil, coolant, water) over a long period of time.

5 Installation Instructions

Risk of destruction!

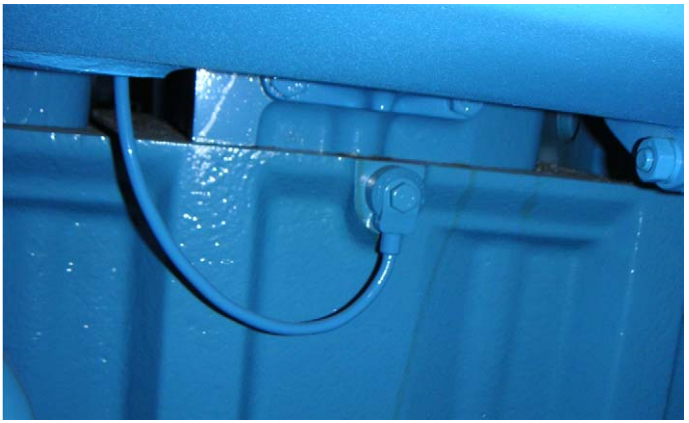
The detonation sensor mounting screws have not to be tightened too firmly, as otherwise the sensors will be damaged and no longer function properly. Note the following specifications for sensor installation:

- Tightening torque: 20 Nm ± 5 Nm (14.8 lb-ft ± 3.7 lb-ft) for mounting screws:
  - Cast iron engine block: M8 x 25 mm (0.98"), property class 8.8
  - Aluminum engine block: M8 x 30 mm (1.18"), property class 8.8
- Tightening torque: 15 Nm ± 5 Nm (11 lb-ft ± 2.2 lb-ft) for mounting screws M6 x 30 mm (1.18"), property class 10.9 with sleeve

Also, lay the sensor cables in such a way that no resonance vibrations can occur on the cable. Otherwise, there is a risk of breakage.

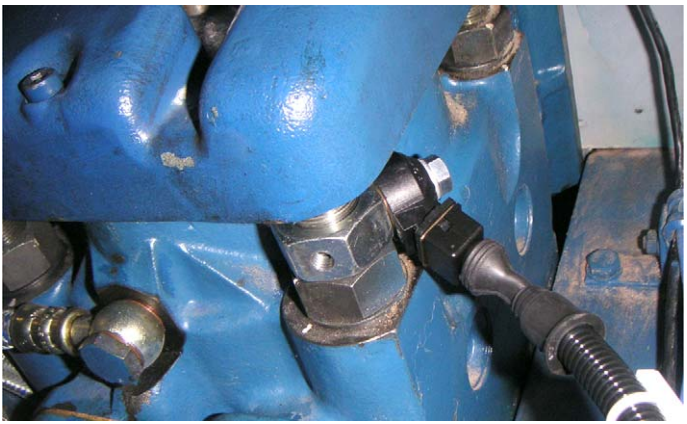
The required installation of the detonation sensors may vary depending on the engine type used. The following locations are, in principle, possible for fitting the detonation sensors taking into account the aforementioned specifications:

- On the engine block
  For installation on the engine block use screws of the type M8x25-8.8 (GG-engine block) or M8x30-8.8 (AL-engine block).



– On the cylinder head screws
  Especially when it comes to engine conversions, it has proven to be worthwhile to attach the detonation sensors on cylinder head screws or -bolts.
  Drill a M6-hole with a maximum depth of 12 mm (0.47") into the cylinder head screw and fix the detonation sensor with a screw type M6x30-10.9 and an adaptor sleeve to fill the hollow space.

– On the nuts of the cylinder head studs



Contact the engine manufacturer if you are not sure whether the cylinder head screw or the cylinder head screw is suitable for the installation.

5.4 Installation of the Ignition Sensor Unit (ISU)

The ignition sensor unit is installed on a DIN rail on the engine in direct proximity to the ignition coil of the first cylinder in the firing order, which is equipped with a detonation sensor or in the vicinity of the ignition controller.

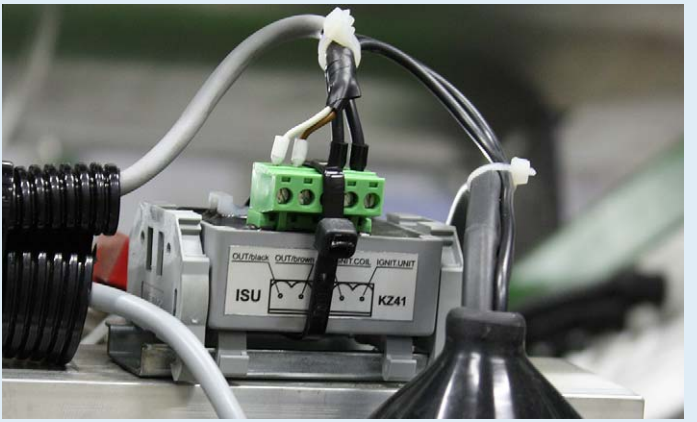
For information on wiring connections, please refer to section *Wiring of the Ignition Sensor Unit (ISU)* on page 54.

For diesel and pilot injection engines, a camshaft sensor is used instead of an ignition sensor unit (ISU). Refer to the section *Installation of the Camshaft Sensor* on page 49. No ignition sensor unit is needed when using a MOTORTECH ignition controller with ASO output (e.g. MIC4) either. You can find information in the section *Wiring for Ignition Controller with ASO Output* on page 52.

NOTICE

Installation on the engine

The ignition sensor unit is fully sealed and therefore resistant to vibrations. When installation on the engine or in an environment in which vibrations arise, only the connector has to be secured e.g. by means of a cable tie.



Please note that the contacts of the connector are bare and have to be protected against moisture and pollution. If the engine should be in such a location, the ignition sensor unit can be installed, for example, in a junction box or housed in a control cabinet.

No ignition sensor unit is required for the ASO output

If you use a MOTORTECH ignition controller (e.g. MIC4) with auxiliary synchronization output (ASO), you do not need any ignition sensor unit (ISU). In this case, the ignition pulse is transmitted to the DetCon via the ASO output.

Overview of use: ignition sensor unit and Load Resistance jumper

The following table provides an overview of the applications for which you have to use the ignition sensor unit (ISU) and when the jumper *Load Resistance* on the DetCon device has to be removed:

	Pilot injection or diesel engine	Gas engines	
		Without ASO output (e.g. MIC500)	With ASO output (e.g. MIC850, MIC4)
Ignition sensor unit (ISU) required	No	Yes	No
Jumper *Load Resistance*	Remove jumper	Jumper set	Remove jumper

5.5 Installation of the Camshaft Sensor

In diesel and pilot injection engines, camshaft sensors are used to determine the fuel injection timing instead of the ignition sensor units used for gas engines. The camshaft has to be prepared in such a way that the inductive camshaft sensor receives the rising signal at the injection point (± 5°). Installation possibilities allowing for the reception of the required signal differ according to the engine type. It may be necessary, for example, to insert a screw or drill a hole into the camshaft or install a trigger disc.

5 Installation Instructions

It is possible to install NPN and PNP sensors. In both cases, the input resistance has to be 1 kΩ (i.e. the jumper *Load Resistance* is removed). The following photo shows an example installation.

NOTICE

Calibration for diesel and pilot injection engines

For diesel and pilot injection engines, calibration has to be performed by MOTORTECH service personnel.

6 Wiring of the Device

Explosion hazard!

In order to prevent the connection terminals from falling out or loosening, securing brackets have to be mounted on the DetCon detonation controller in potentially explosive atmospheres. There is a risk of sparking.

Use of securing bracket set

If your DetCon version has a securing bracket set, you have to disassemble it before wiring the DetCon detonation controller. Assemble the securing bracket set again after completing the wiring.

– Tightening torque for the securing bracket set: 1.3 Nm (0.96 lb-ft)

Tightening torque of the connection terminals

The tightening torque for the connection terminals of the DetCon is 0.5 Nm (0.37 lb-ft).

6.1 Wiring of the Detonation Sensors

Install the detonation sensors in accordance with the firing order of the cylinders. Enter the firing order of your engine in the following table and connect the sensors with the assigned cylinders and the corresponding inputs on the DetCon according to the resulting sequence.

6 Wiring of the Device

If all cylinders are not fitted with detonation sensors, the first detonation sensor is assigned to the first cylinder used in the firing order. For example, if only the 3rd and 5th cylinders in the firing order are provided with detonation sensors, the first detonation sensor is installed on the 3rd cylinder and the first detonation sensor input is connected to the DetCon.

Firing order of a 6-cylinder engine

The firing order of a MAN® E2876 E/LE engine is:

1 – 5 – 3 – 6 – 2 – 4

The corresponding wiring of the detonation sensors for this engine is shown in the following table (column "Example MAN®").

Sensor/ Input	Example MAN®	Cylinder firing order	Sensor/ Input	Example MAN®	Cylinder firing order
1	1		11	–	
2	5		12	–	
3	3		13	–	
4	6		14	–	
5	2		15	–	
6	4		16	–	
7	–		17	–	
8	–		18	–	
9	–		19	–	
10	–		20	–	

6.2 Wiring for Ignition Controller with ASO Output

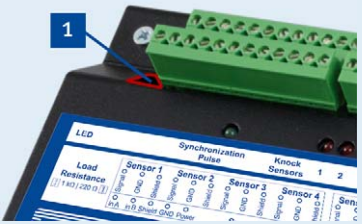
No ignition sensor unit (ISU) is required when you use the ignition controller with ASO output from MOTORTECH (e.g. MIC4). In this case, the ignition pulse is transmitted to the DetCon via the auxiliary synchronization output (ASO). The jumper with the designation *Load Resistance* has to be removed.

Position Load Resistance jumper

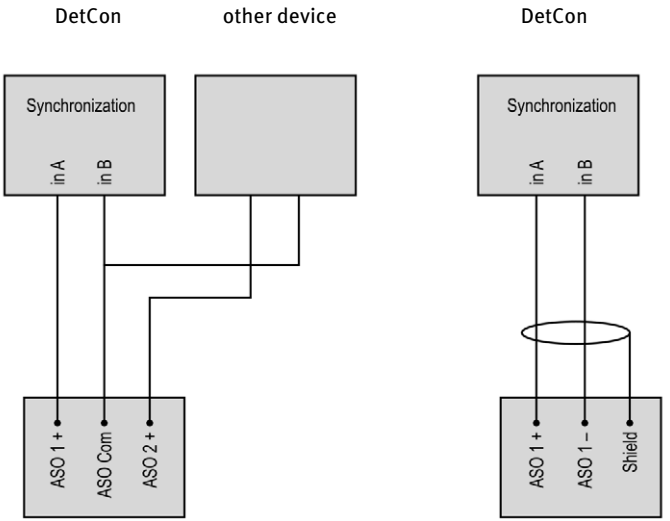
The jumper *Load Resistance* changes the input resistance of the ignition input.

- Jumper set: 220 Ω
- Jumper removed: 1 kΩ

It is on the upper left of the device 1.



The connection between DetCon and the ignition controllers with ASO output is established as follows:



MOTORTECH ignition controller connection

6 Wiring of the Device

Configuration of the ignition controller

In the configuration software (MICT) for the MOTORTECH ignition controllers with ASO output, the adjustments for the DetCon can be easily made using the button *Configuration for DetCon2/20*. This can be found on the configuration page *Input/Outputs – ASO1 (auxiliary synchronization output)*. Further information can be found in the operating manual of your ignition controller.

6.3 Wiring of the Ignition Sensor Unit (ISU)

The ignition pulse sensor (ISU) is connected in series between the ignition output of the first cylinder and the primary side of the ignition coil of the first cylinder. The ignition impulse of the first cylinder is transmitted in firing order to the DetCon ignition input.

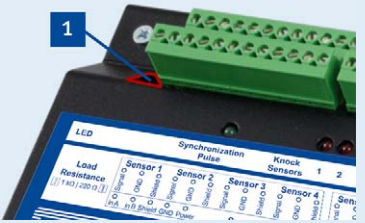
The jumper with the designation *Load Resistance* has not be removed.

Position Load Resistance jumper

The jumper *Load Resistance* changes the input resistance of the ignition input.

- Jumper set: 220 Ω
- Jumper removed: 1 kΩ

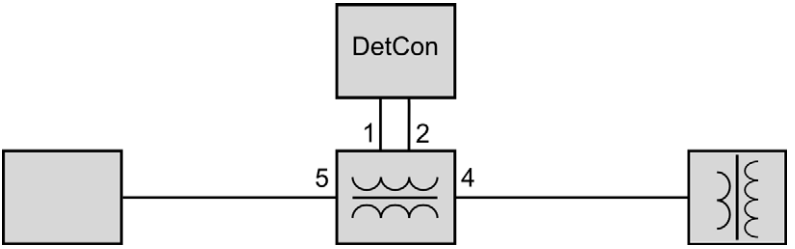
It is on the upper left of the device 1.



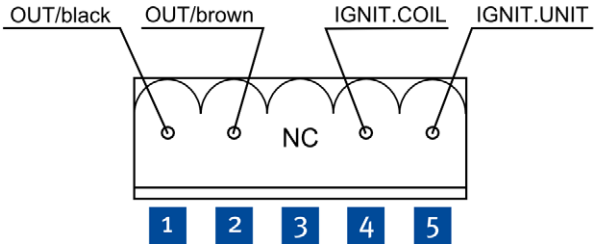
If not all cylinders are fitted with detonation sensors, the ignition sensor unit is installed on the cylinder on which the first detonation sensor is installed.

6 Wiring of the Device

Principle Circuit Diagram



Connections on the Ignition Sensor Unit

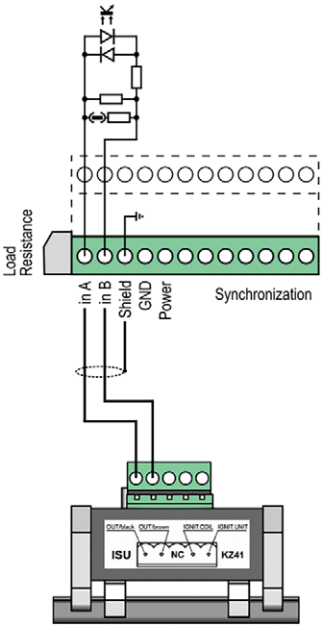


Pos.	Connection
1	DetCon ignition input (in A, black)
2	DetCon ignition input (in B, brown)
3	Not used
4	Primary side of ignition coil of first cylinder
5	Ignition controller ignition output of the first cylinder

6 Wiring of the Device

Connections on the DetCon

The ignition sensor unit is connected to the DetCon via the connector *Synchronization*.



6.4 Wiring of the Camshaft Sensor (for Diesel and Pilot Injection Engines Only)

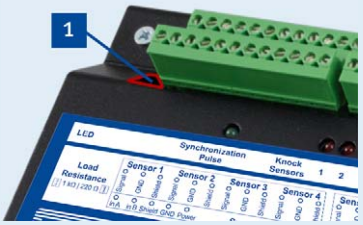
When using a camshaft sensor, the jumper with the designation *Load Resistance* has to be removed.

Position Load Resistance jumper

The jumper *Load Resistance* changes the input resistance of the ignition input.

- Jumper set: 220 Ω
- Jumper removed: 1 kΩ

It is on the upper left of the device 1.



Calibration for diesel and pilot injection engines

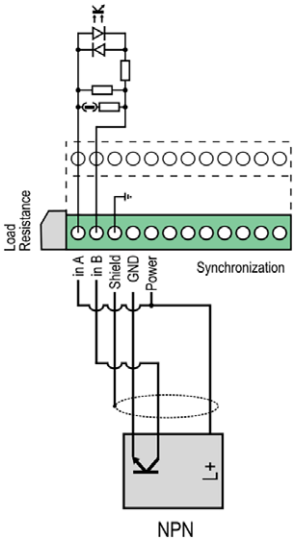
For diesel and pilot injection engines, calibration has to be performed by MOTORTECH service personnel.

6 Wiring of the Device

Connections on the DetCon

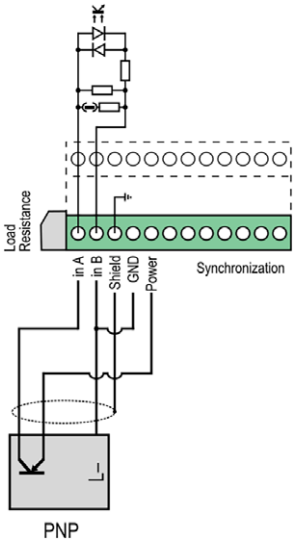
The ignition sensor unit is connected to the DetCon via the connector *Synchronization*.

– NPN sensor connection



NPN

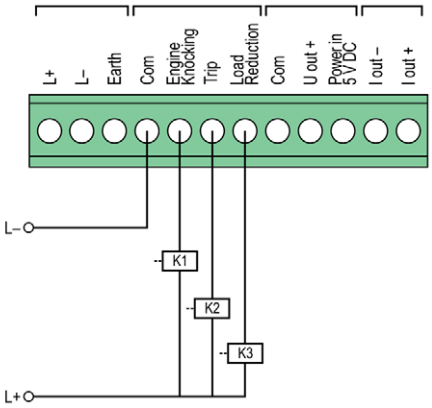
– PNP sensor connection



PNP

6.5 Wiring of the Binary Outputs

Example Configuration

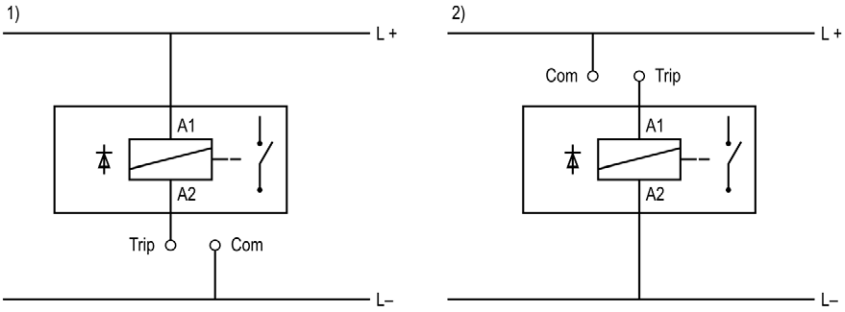


K1 = Relay *Engine Knocking* (Knocking warning)

K2 = Relay *Trip* (Engine stop)

K3 = Relay *Load Reduction*

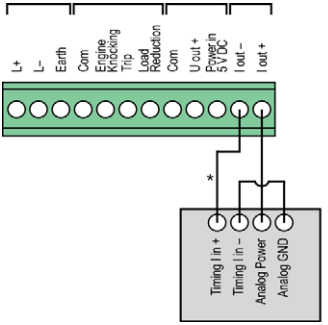
The following illustrations show examples of two alternatives for wiring the output *Trip*.



6 Wiring of the Device

6.6 Wiring of the Analog Outputs for Ignition Timing Adjustment

Analog current output

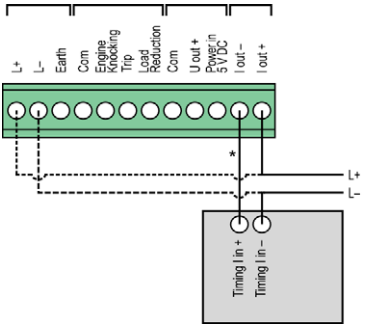


Output connector on the DetCon

Connection on the ignition controller

* Current signal

Alternative

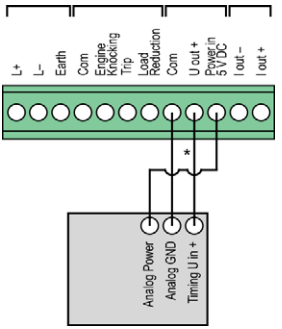


Output connector on the DetCon

Connection on the ignition controller

* Current signal

Analog voltage output



Output connector on the DetCon

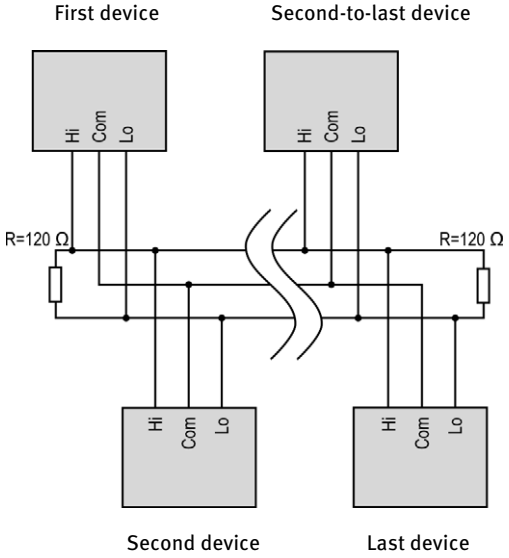
Connection on the ignition controller

* Voltage signal

6 Wiring of the Device

The precise connection assignment on the ignition controller can be found in section *Input Wiring – Ignition Timing & Safety Devices* in the operating manual for your MOTORTECH ignition controller.

6.7 Wiring CAN Bus



6 Wiring of the Device

CAN bus wiring

Note the following when connecting the CAN bus:

– Each bus end must be fitted with a terminating resistor of 120 Ω (see drawing).

– The maximum wire length depends on the bit rate:

Bit rate	Maximum wire length	Maximum length of a stub	Maximum length of all stubs
1 Mbit/s	25 m (82')	1.5 m (5')	7.5 m (25')
800 kbit/s	50 m (164')	2.5 m (8')	12.5 m (41')
500 kbit/s	100 m (328')	5.5 m (18')	27.5 m (90')
250 kbit/s	250 m (820')	11 m (36')	55 m (180')
125 kbit/s	500 m (1,640')	22 m (72')	110 m (360')
50 kbit/s	1,000 m (3,280')	55 m (180')	275 m (902')

– Only use cables that are specified by the manufacturer for use in the CAN bus.

7.1 Ignition Timing Adjustment

The DetCon has two analog outputs for the ignition timing adjustment:

- 4-20 mA current loop (I out)
- 0-5 V voltage output (U out)

Both analog outputs operate simultaneously. Use the output designated for ignition timing adjustment for the ignition controller you are using (if necessary, ask the manufacturer of the ignition system).

The analog outputs change their values and thereby retard the ignition timing as soon as the *Ignition reduction limit* has been exceeded. This limit is specified via the DenEdit software. In addition, the software is used to determine the extent to which the ignition timing is adjusted (*Timing reduction gain*) and how quickly the ignition timing adjustment is reset when knocking is no longer detected (*Decrease ramp*). The adjustment of the ignition timing can be limited using the analog outputs via the *Maximum output value*.

7.2 Load Reduction

If the ignition timing adjustment can no longer be corrected via the analog outputs and the engine is still knocking, the binary output for load reduction (*Load Reduction*) is activated. A master control system (e.g. ALL-IN-ONE) can control load reduction via this output.

The load reduction (*Load Reduction*) is deactivated again if the engine knocking stops.

7.3 Engine Stop

The binary output *Trip* is activated when the knocking exceeds the maximum value *Immediate stop limit*. This value is specified via the DenEdit software. The output can be used as an emergency stop signal to force the engine to stop.

Checkbox Enable bad sensor detect

Activate the checkbox so that defective detonation sensors are indicated via the status display *BAD SENSOR*. This function only detects sensors which provide faulty signals. If a wire has ruptured or a sensor gives no signals for some other reason, it is not indicated on this display. If a defective sensor is detected, the binary output *Trip* is also activated.

8 Settings via DenEdit

You can configure the DetCon detonation controller and display the current knocking values of the engine using the DenEdit software. The device can be operated via the software in three different basic modes:

- Measurement mode
- Interface diagnostics mode
- Knock detection mode

Measurement Mode

The measurement mode is used for engine calibration. Calibration is required for all engine types and is performed by MOTORTECH service personnel.

Interface Diagnostics Mode

The interface diagnostics mode can be used to test the output signals at the binary and analog inputs. The values set in the area *Diagnose* in the tab *Mode* are transmitted to the outputs of the device. Knocking analysis is not carried out.

Knock Detection Mode

Knock detection mode is the operation mode of the detonation controller. After synchronization, the signals of the detonation sensors are analyzed and output signals are generated accordingly for the binary and analog outputs. The condition of the outputs is indicated via LEDs and the signals of the detonation sensors are displayed in the tabs for process monitoring. Error monitoring is also performed, for example, for registering faulty detonation sensor signals.

8.1 DenEdit System Requirements

For the installation of the DenEdit software, the following minimum requirements have to be fulfilled:

- Operating system Microsoft Windows XP, Windows 7, Windows 8, or Windows 10
- Approx. 10 MB free disk space
- Interface compatible to USB 1.1, required minimum speed 90 kbit/s (44.1 kHz, 16 Bit), connector type B

8.2 Installation and First Steps in DenEdit

Install DenEdit

The installation file for the DenEdit software is on the storage device provided with the detonation controller.

To install the program, proceed as follows:

1. Start the installation.
   Copy the executable file *DenEdit.exe* to your computer. The installation is started by executing the file.
2. Run the installation.
   Follow the instructions of the installation routine. Note that the license agreement terms must be accepted before using the DenEdit. If the terms are not accepted, the installation cannot continue.

Set up the Virtual Communication Port

Explosion hazard!

The USB interface may only be used in a non-explosive atmosphere. There is a risk of sparking.

The computer communicates logically with the DetCon via the communication port (COM), but physically via USB. For this reason, it may be necessary with some operating systems to install the virtual communication port (VCP) and assign it to the USB port.

You automatically receive the command to install the driver if

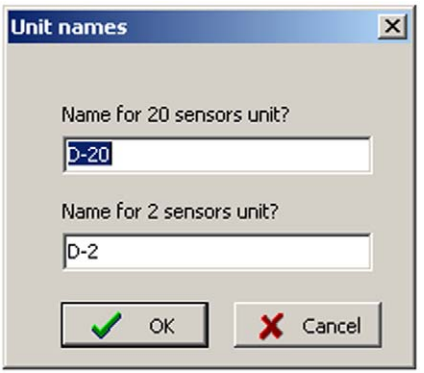
– the DetCon has been connected to the computer via USB and turned on and
– the virtual communication port (VCP) driver has not been installed already.

It is recommended first to download the driver from http://www.ftdichip.com/Drivers/VCP.htm and unpack it. As an alternative, you can install the driver offline according to your requirements.

8 Settings via DenEdit

Set the Device Name

When the program is first started, the window *Unit names* opens.



1. Set the name for your device by changing the entry in the field corresponding to your device type.
2. Confirm the input with *OK*.
   - ► The name is now displayed in the status bar of the software.

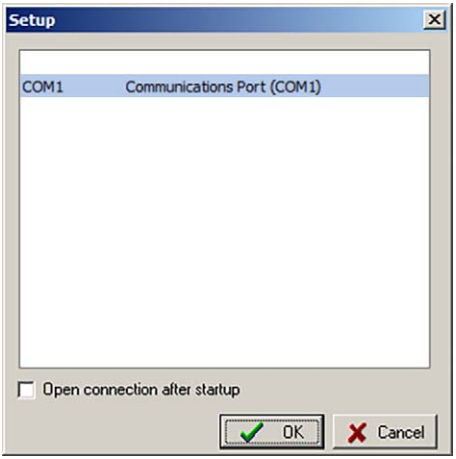
Assign the Communication Port

In order to establish communication between the computer and the detonation controller, you first have to set the communication port to be assigned to the USB interface.

Proceed as follows:

1. Open the device manager of your computer via the control panel.
2. You can see which COM port was assigned to the USB interface under the entry *Ports*.
3. Note that only COM ports 1-16 can be set in DenEdit. Change the port assignment if necessary.
4. Open DenEdit.

5. Open the window *Setup* via the menu entry *Connection -> Connect USB*.



6. In the *Setup* window, select the desired COM port to which the detonation controller is connected.
7. If you activate the checkbox *Open connection after startup*, the software automatically connects with the connected detonation controller after start-up if the USB connection is active. If the checkbox is not activated, the connection has to be established manually before each start-up.
8. Confirm the input with *OK*.

Establish a Connection to the Device and Load the Parameter File

The parameter file of the respective engine has to be loaded to the device prior to start-up. The storage device supplied with the device contains files for engines which have already been calibrated. If there is no parameter file for the desired engine, a calibration has to be performed. This can only be carried out by MOTORTECH service personnel.

Check parameter files

During the DetCon installation, it is necessary to check the settings in the parameter files. The knocking of the engine should also be checked in order to fine-tune the DenEdit settings. Especially the settings in the tab *Outputs options* have to be adjusted to on site specifications.

8 Settings via DenEdit

Calibration for diesel and pilot injection engines

For diesel and pilot injection engines, calibration has to be performed by MOTORTECH service personnel.

Proceed as follows:

1. Connect the device to the computer with the USB cable.
2. Start up DenEdit.
3. Establish a connection between the software and the device via the menu entry *Connection -› Connect USB*.
4. Load the parameter file corresponding to your engine via the menu entry *Connection -› Open parameters*.
   The file name indicates which file corresponds to which DetCon device type and to which engine. See also the following example.

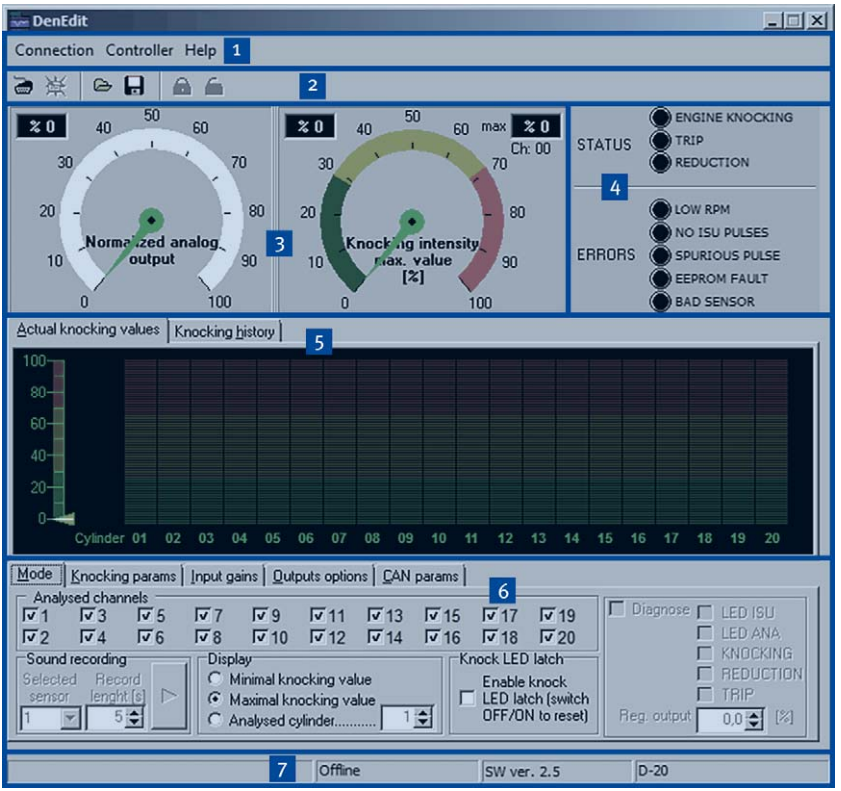
Name of the parameter file

The file name of the parameter file indicates the engine associated with the file. The file extension indicates the DetCon device type for which the file has to be used. For example:

- File: 0824.de2
  Engine: MAN® E2876LE
  DetCon: DetCon2
- File: 2842E.den
  Engine: MAN® E2842E
  DetCon: DetCon20

8.3 User Interface Overview

The user interface is divided into different areas:



Pos.	Area
1	Menu bar
2	Toolbar
3	Display area of the analog output signal and the knocking intensity
4	Status and error displays
5	Tabs for the process monitoring
6	Tabs for the process parameters
7	Status bar

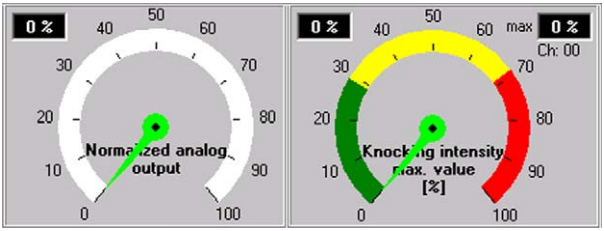
8 Settings via DenEdit

8.4 Menu Bar and Toolbar

The following functions are available to you via the symbols on the toolbar and the entries in the menu bar:

Symbol	Menu	Function
	*Connection -> Connect USB*	Opens the window *Setup*, where the communication port (COM) can be set in order to establish the connection between DetCon and computer.
	*Connection -> Disconnect*	Disconnects DetCon from the computer.
	*Connection -> Open parameters*	Opens a file dialog in which you can select a parameter file.
	*Connection -> Save as*	Saves the set values as a new parameter file.
	*Connection -> Exit*	Exits the program.
	*Controller -> Enter password*	Opens a window for entering a password. The password is required in order to change parameters. The default setting of the password is *o* (zero).
	*Controller -> Deactivate password*	If parameters secured by a password have been changed this function can be used to secure password protection for access to the software.
	Controller -> Change password	Opens a window in which you can change the password.
	Controller -> Get encrypted password	If you forget your password, you can receive an encrypted password with this function. Please contact MOTORTECH service personnel with this password and the serial number of the device.
	Controller -> Two sensors mode	Switches to two sensors mode in order to operate the DetCon2.
	Controller -> Device SW ver. ...	Select from the entries displayed the entry corresponding to the software version of your device (firmware). The software version used is indicated on the nameplate on the device.
	Controller -> Reset peak value	Resets the stored peak value of the knocking intensity displayed on the tab *Knocking history*.
	Help -> About	Opens version and contact information.

8.5 Display Area of the Analog Output Signal and the Knocking Intensity



The output signal of the analog outputs and the knocking intensity are displayed using two graphic indicating instruments.

Normalized analog output

The left display shows the value of the signal currently present at the analog outputs. The value is displayed as a percentage of the output range (0 V to 5 V or 4 mA to 20 mA). In addition, the displayed value is indicated numerically on the upper left.

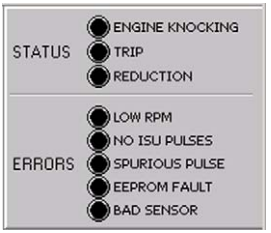
Knocking intensity

Various knocking intensity values can be indicated on the right display. The values are shown as a percentage of the maximum value. The selection of the displayed value is made in the tab *Mode*. Refer to the section *Tab: Mode* on page 75.

The current minimum and maximum values are also indicated numerically above the display. The numerical display for the maximum value (upper right) also indicates on which sensor input this value was measured.

8 Settings via DenEdit

8.6 Status and Error Displays



The status displays indicate the status of the binary outputs and the error displays show errors which arise during the internal diagnostics check of the detonation controller. The different lights of the displays indicate the following:

STATUS

– ENGINE KNOCKING
  The selected knocking level *Ignition reduction limit* has been exceeded in at least one cylinder. The binary output *Engine Knocking* is activated.

– TRIP
  The knocking level has exceeded the value *Immediate stop limit*. The binary output *Trip* is activated. The engine is shut down if properly wired.

– REDUCTION
  The maximum ignition timing adjustment via the analog output signals has been exhausted. The value *Maximum output value* has been exceeded. The binary output *Load Reduction* is activated. With proper wiring, a master control executes a load reduction.

ERRORS

– LOW RPM
  This LED indicates that the speed is low and therefore the detonation controller is not yet operative.

– NO ISU PULSES
  No pulses are detected at the ignition input (*Timing)*. Either the engine has not started or the ignition sensor unit (ISU) has been wired incorrectly.

– SPURIOUS PULSE
  The pulses at the ignition input (*Timing*) are faulty. This can have the following causes: defective ignition sensor unit (ISU), incorrect sensitivity of the ignition sensor unit (check jumper *Load Resistance*), electrical interference, or noise.
  Notice:
  With long wire lengths, this LED occasionally flashes as a result of interferences. This does not indicate an error.

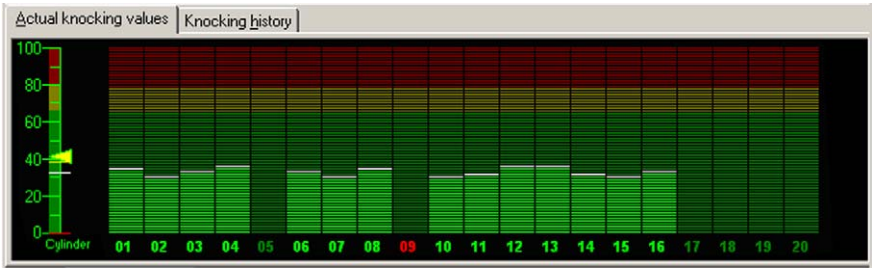
– EEPROM FAULT
  The parameters are incorrect as a result of an interference between the computer and the device. Try to reload the parameters. If this is not successful, the detonation controller has to be repaired.
– BAD SENSOR
  A faulty detonation sensor has been detected due to inconsistent signals. The display only lights up if the checkbox *Enable bad sensor detect* is activated in the tab *Output options*. This can have the following causes: The respective detonation sensor is loose, a wire has a loose connection, or the detonation sensor is not flush against the surface. You can see which detonation sensor is causing the problem on the tab *Actual knocking values*. The number of the failed detonation sensor is displayed in red.

8.7 Tabs for the Process Monitoring

The following tabs are available for process monitoring:

– Actual knocking values
  This tab shows the current knocking intensities detected by all detonation sensors.
– Knocking history
  In this tab, the curve of the knocking intensities in the last minute can be displayed.

8.7.1 Tab: Actual Knocking Values



Display Area

In the display area, the current knocking values for every cylinder are shown as bars. The color background indicates the set limits:

– *Ignition reduction limit*: the border between green and yellow
– *Immediate stop limit*: the border between yellow and red

The condition of the detonation sensor is also marked in color. The color of the sensor number indicates the following:

– Green: The detonation sensor is active.

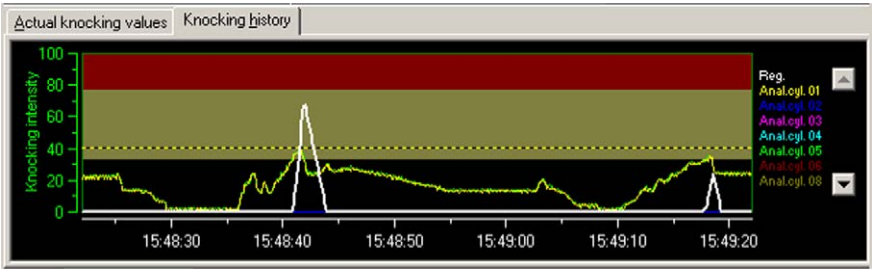
– Grayed out: The detonation sensor is not in use.

– Red: The detonation sensor is providing faulty signals or has failed entirely.

Left Column

The scale area on the left additionally indicates the minimum (red line), maximum (yellow line), and average (white line) knocking values of all cylinders. In addition, the yellow triangle indicates the highest knocking value detected during the measurement. This value is erased when the device is switched off or deleted manually via the menu entry *Reset peak value*.

8.7.2 Tab: Knocking History



The knocking history continuously shows the curve of the varying knocking intensities registered over the last minute. The color background indicates the set limits:

– *Ignition reduction limit*: the border between black and yellow

– *Immediate stop limit*: the border between yellow and red

The maximum knocking value is shown as a dotted line. The legend on the right indicates which color corresponds to which cylinder. The white curve (*Reg.* in the legend) maps the signal of the analog outputs.

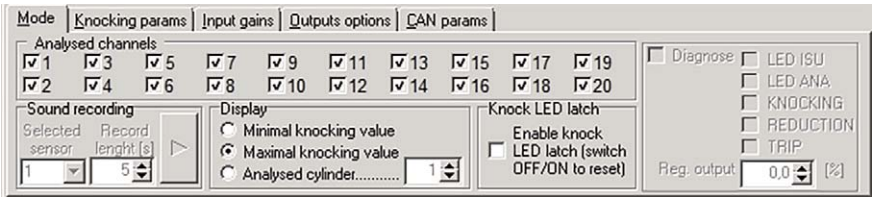
8.8 Tabs for the Process Parameters

The basic settings for the required engine and the device used are set when the parameter file is loaded. You can inspect and modify these settings as needed in the tabs for the process parameters.

The following tabs are available for the process settings:

- Mode
  In this tab, you can enter general display and diagnostics settings. This is also where you can start sound recordings of knocking signals.
- Knocking params
  This tab shows both engine settings and the parameters for knocking analysis. These settings are either specified by the parameter file or, if required, determined by MOTORTECH service personnel during engine calibration. In order to ensure the correct functioning of the detonation controller, these values may not be altered.
- Input gains
  In this tab you can set signal gains or attenuations for individual channels, the input signal sensitivity is adjusted here.
- Firing sequence
  In this tab, you can specify individual firing sequences for special engine types.
- Output options
  In this tab, you can enter settings for knocking detection limits and other analysis values.
- CAN params
  In this tab, you can enter settings for communication via the CAN bus.

8.8.1 Tab: Mode



Analysed channels

Activate the checkboxes of the detonation sensors which you want displayed in the tabs *Actual knocking values* and *Knocking history*. If the display of a sensor is deactivated, the signal of the detonation sensor still continues to be monitored.

8 Settings via DenEdit

Sound recording

If the device is connected to the running engine, you can make sound recordings of the signal of a detonation sensor. This is generally executed by MOTORTECH personnel and should only be performed upon their request (see *Customer Service Information* on page 83).

Proceed as follows:

1. Set the desired detonation sensor in the field *Selected sensor*.
2. Set the desired recording length in the field *Record length [s]*.
3. Then click on the button *Record sound file*.
   - ▸ An input window opens.
4. Select a save location for the sound file (*.au) and enter a filename.
   - ▸ The sound recording starts and is shown graphically in a separate window.
5. The recording ends automatically after the set recording length or you click *Stop* to stop the recording in advance.

Display

You can select which value is displayed in the knocking intensity pointer instrument via the following settings:

– Minimal knocking value
  The sensor with the lowest knocking intensity is automatically selected and displayed.

– Maximal knocking value
  The sensor with the highest knocking intensity is automatically selected and displayed.

– Analysed cylinder
  You can specify the cylinder whose knocking intensity should be displayed. The number entered corresponds to the position of the desired cylinder in the firing order (e.g. *2* for the second cylinder in the firing order).

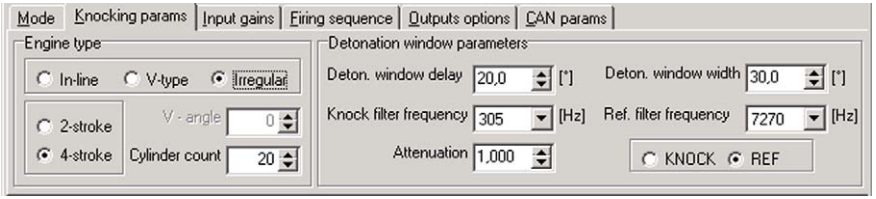
Knock LED latch – Enable knock LED latch (switch ON/OFF to reset)

Activate the checkbox so that the status display *ENGINE KNOCKING* remains lit when knocking is detected which falls below the *Ignition reduction limit*. With this setting, the cylinder which triggered the knocking can still be identified after the engine is shut off. In order to delete the status display, deactivate the checkbox and activate it again.

Diagnose

The binary and analog outputs can be tested via the settings in this area. Activate the checkbox to activate the respective output. You can simulate an analog output signal via the field *Reg. output* in order to test the connection to an ignition controller, for example. The checkbox *Diagnose* has to be deactivated again for the current operation.

8.8.2 Tab: Knocking Params



Engine type

In this area, you can select the engine settings suited to your application. In general, these values are contained in the parameter file and must not be manually adjusted:

- In-line, V-type, Irregular
  Select the engine type. Select *In-line* for an in-line engine and *V-type* for a V-engine. The setting *Irregular* allows you to define an individual firing sequence in the tab *Firing sequence*.
- 2-, 4-stroke
  Select the operating mode of the engine: 2-stroke or 4-stroke.
- V-angle
  Enter the firing angle for V-engines.
- Cylinder count
  Enter the number of cylinders.

Detonation window parameters

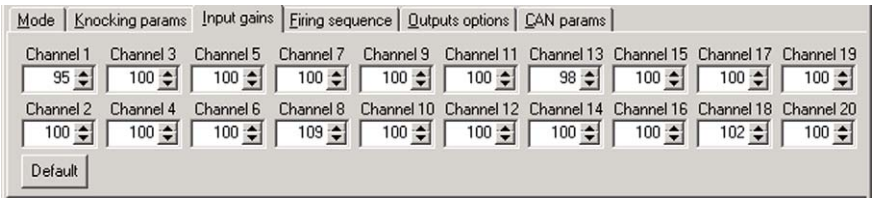
In this area, the values are entered for the frequency range in which knocking is likely to occur. These settings are either specified by the parameter file or, if required, determined by MOTORTECH service personnel during engine calibration. In order to ensure the correct functioning of the detonation controller, these values may not be altered.

- Deton. window delay
  Delay of the first cylinder ignition measured by the interval following the ignition pulse. The basis is the rising edge of the synchronization pulse.
- Deton. window width
  Time frame for knock analysis
- Knock filter frequency
  Characteristic knocking frequency
- Ref. filter frequency
  Normal frequency of the engine without knocking
- Attenuation
  Balance between the reference signal (background noises and normal engine vibration) and the knocking signal

8 Settings via DenEdit

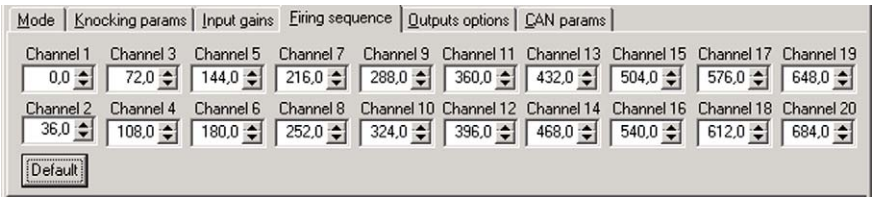
– KNOCK, REF
  Selection of whether the knocking signal (in %) or the reference signal (in %) should be shown on the knocking intensity display.

8.8.3 Tab: Input Gains



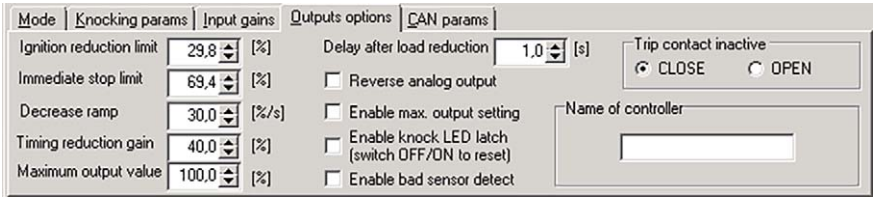
This tab is only available to you if the selected device software is version 2.0 (firmware, see section *Status Bar* on page 81) or higher (menu entry *Controller*). The settings in this tab allow you either to amplify the input signals of the individual detonation sensors or to attenuate them (values <100) in order to suppress signals similar to knocking signals. Values between 0 and 300 can be specified. The default setting is 100. This value can be restored via the button *Default*.

8.8.4 Tab: Firing Sequence



This tab is only available to you if you have selected the device software version 2.0 (firmware, see section *Status Bar* on page 81) or higher (menu entry *Controller*) and selected the setting *Irregular* as *Engine type* in the tab *Knocking params*. You have the option of entering a freely definable firing sequence. Via the button *Default*, settings are set to conform to an in-line engine. This basic setting can be a good starting point for entering your individual deviations.

8.8.5 Tab: Outputs Options



Settings made in this tab influence the signals of the analog and binary outputs. Please refer to the section *Functional Description* on page 13 for more information on the limits you can set.

Ignition reduction limit

Enter the limit beyond which the engine is considered to be knocking. If the value is exceeded, the binary output *Engine Knocking* is activated and the values assigned to the timing reduction are altered.

Immediate stop limit

Enter the limit beyond which the binary output *Trip* is activated. This causes the engine to switch off if properly wired.

Decrease ramp

Enter the value for the *Decrease ramp*. The value specifies the rate at which the timing reduction signal (analog outputs) is disabled as soon as knocking decreases below the *Ignition reduction limit*.

Timing reduction gain

Enter the value for the *Timing reduction gain*. This value influences the rate at which the signal of the ignition timing adjustment (analog outputs) is amplified when knocking is detected. This rate equals the mathematical product of the set value and the knocking intensity.

Maximum output value

Enter the value which the signal of the ignition timing adjustment (analog outputs) should be limited to. This setting only takes effect if the checkbox *Enable max. output setting* is activated.

Delay after load reduction

Enter the delay with which the signal of the ignition timing adjustment is to be reduced when the knocking value falls again below the *Ignition reduction limit* due to a load reduction.

Reverse analog output

Activate the checkbox to reverse the signal of the analog outputs. A maximum level then indicates no knocking and vice versa.

Enable max. output setting

Activate the checkbox to limit the signal of the analog outputs to the value in the field *Maximum output value*.

Enable knock LED latch (switch ON/OFF to reset)

Activate the checkbox so that the status display *ENGINE KNOCKING* remains lit when knocking is detected which falls below the *Ignition reduction limit*. With this setting, the cylinder which triggered the knocking can still be identified after the engine is shut off. In order to delete the status display, deactivate the checkbox and activate it again.

Enable bad sensor detect

Activate the checkbox so that defective detonation sensors are indicated via the status display *BAD SENSOR*. This function only detects sensors which provide faulty signals. If a wire has ruptured or a sensor gives no signals for some other reason, it is not indicated on this display. If a defective sensor is detected, the binary output *Trip* is also activated.

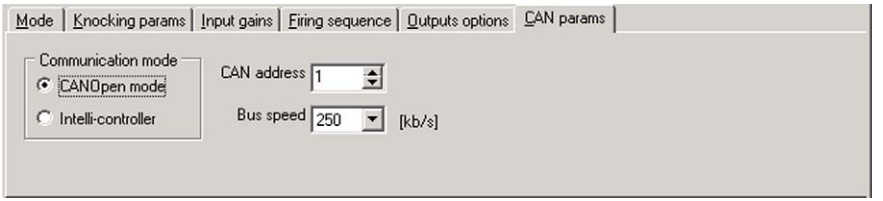
Trip contact inactive (CLOSE, OPEN)

Using this setting, you can specify whether the binary output *Trip* is open during normal operation and closed when the *Immediate stop limit* is exceeded (setting: *OPEN*) or vice versa (setting: *CLOSE*).

Name of controller

This setting allows you to specify an additional name that will be displayed in the title bar of the software.

8.8.6 Tab: CAN Params



Communication mode

Depending on the device connected, select the mode *CANOpen mode* or *Intelli-controller*.

CAN address

Enter the CAN address with which the device will be identified in the CAN bus.

Bus speed

Enter the transmission speed that was set for the CAN bus.

Communication with ALL-IN-ONE

Select the following settings for communication with the ALL-IN-ONE generator & CHP control system:

- Select *Intelli-controller*
- *CAN address*: 79
- *Bus speed*: 250 kBit/s

Communication with PowerView3

Select the following settings for communication with the HMI module PowerView3:

- Select *CANOpen mode*
- *CAN address*: freely selectable (set identical address in PowerView3)
- *Bus speed*: 250 kBit/s

8.9 Status Bar

The status bar shows the connection status (*Offline/Connected*), the selected device software version (firmware), and the assigned device name. If you move the cursor over the user interface, short help texts about the tabs, symbols, and menu entries appear in the status bar.

9 Operation

9.1 Start-up

Before you start up the DetCon detonation controller, take note of the following:

- Has the parameter file corresponding to the engine and the DetCon device type been loaded to the device?
- Have the detonation sensors been wired in accordance with the firing order of the engine?
- Has the ignition impulse sensor (ISU) or the camshaft sensor or the auxiliary synchronization output (ASO) of the ignition controller been correctly wired with the DetCon detonation controller?

Additionally observe the following points before you start up the DetCon detonation controller with an ATEX enclosure.

Start-up the DetCon Detonation Controller in ATEX Enclosure

The following points have to be ensured before first start-up:

- The enclosure has to be properly installed.
- The enclosure has to be without any damage, this applies especially to the seals.
- No foreign bodies have to be inside the enclosure.
- The terminal compartment has to be clean.
- The mounting and operating equipment screws have to be tightened firmly.
- The lead bushings have to be tightened firmly.
- All leads have to be installed in the bushings according to the protection class.
- Unused bore holes and lead bushings have to be sealed with ATEX-certified closing plugs.
- The external protective conductor connection has to be installed properly and close to the enclosure.

9.2 Shutdown

The device is shut down by disconnecting it from the power supply.

Detonation Sensor Errors

If the checkbox *Enable bad sensor detect* is activated in the tab *Output options*, faulty detonation sensors are indicated via the status display *BAD SENSOR*. This function only detects sensors which provide faulty signals. If a wire has ruptured or a sensor gives no signals for some other reason, it is not indicated on this display. If a defective sensor is detected, the binary output *Trip* is also activated.

10.1 Customer Service Information

You can reach our customer service during business hours at the following phone and fax number, or by email:

Phone: +49 5141 93 99 0

Fax: +49 5141 93 99 99

Email: service@motortech.de

10.2 Returning Equipment for Repair / Inspection

To return the device for repair and inspection, obtain a return form from your MOTORTECH contact person (see *Customer Service Information* on page 83).

After you have completely filled out the return form and returned it to MOTORTECH, MOTORTECH will send you back the return form and a delivery note with RMA number specified. Enclose the return form with your device and attach the delivery note to the packaging so that it is clearly visible from the outside. This will ensure a speedy and smooth processing of your repair order.

Send the device with delivery note and return form to one of the two addresses below or to the nearest MOTORTECH representative:

MOTORTECH GmbH
Hogrevestr. 21–23
29223 Celle

Germany

Phone: +49 5141 93 99 0
Fax: +49 5141 93 99 98

www.motortech.de
motortech@motortech.de

MOTORTECH Americas, LLC
1400 Dealers Avenue, Suite A
New Orleans, LA 70123

USA

Phone: +1 504 355 4212
Fax: +1 504 355 4217

www.motortechamericas.com
info@motortechamericas.com

10.3 Instructions for Packaging the Equipment

For return shipment, equipment should be packaged as follows:

- Use packaging material that does not damage the equipment surfaces.
- Wrap the equipment with sturdy materials and stabilize it inside the packaging.
- Use sturdy adhesive film to seal the packaging.

11 Maintenance

Test the functioning of the system each time the engine is inspected. In particular, follow the following steps:

- Check the functioning of the analog outputs.
- Check the functioning of the digital outputs.
- Ensure that the sensors and wires are firmly connected.

Maintenance of the Enclosure

Please observe the following maintenance instructions:

- Check especially the components on which the type of protection depends. This includes the seals, the closing system and the lead bushings.
- Select the maintenance intervals depending on the operating conditions and operating time.
- Investigate all components and surfaces for external damage.
- Investigate the enclosure for damage to the paint and signs of corrosion.

Additionally observe the following instructions for maintenance of the ATEX enclosure:

- Repair and maintenance work on the ATEX enclosure has to be performed by authorized and trained personnel.
- Maintenance of the ATEX enclosure has to be carried out in accordance with EN 60079-17.
- When using the ATEX enclosure, the applicable national provisions of the country of use have to be observed.

11.1 Spare Parts and Accessories

For spare parts and accessories, please refer to our current Product Guide, which is available for you to download on the internet at *www.motortech.de*.

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Fax: +1 (504) 355 4217
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Jing'An District, 200070 Shanghai
China

Phone: +86 (21) 6380 7338
E-Mail: info@motortechshanghai.com
Web: www.motortechshanghai.com

GAS ENGINE TECHNOLOGY

- Ignition Systems
- Spark Plugs & Accessories
- Gas Engine Control Systems
- Sensor Systems
- Air/Fuel Ration Control Systems
- Exhaust Gas Aftertreatment
- Gas Engine Accessories