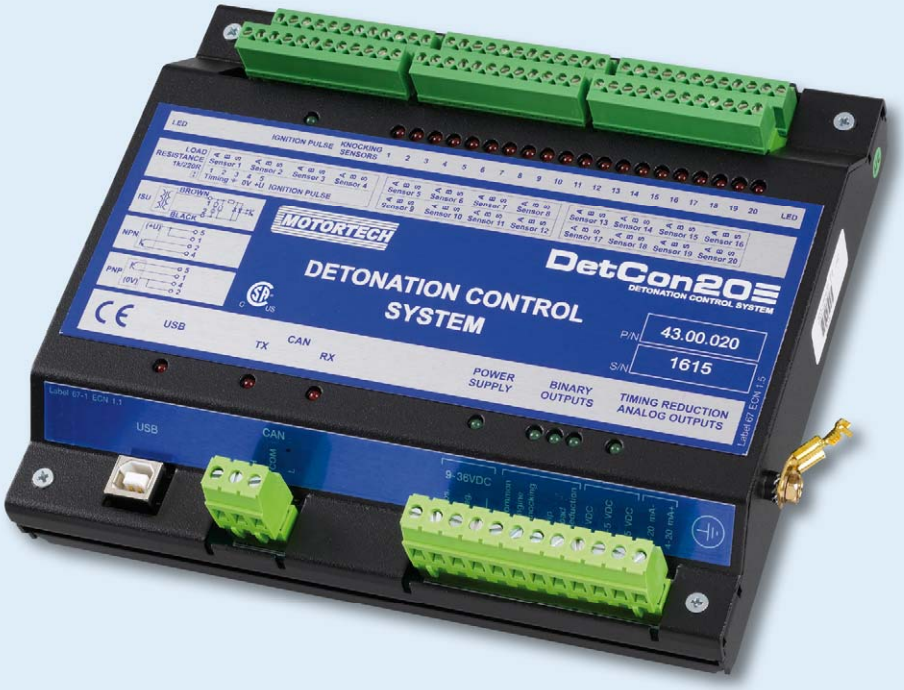
DETCON – DETONATION CONTROL SYSTEM

OPERATING MANUAL



DetCon
MOTORTECH DETONATION CONTROL SYSTEM

MOTORTECH Gas Engine Management
P/N 01.30.002 | Rev. 07/2014

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TABLE OF CONTENTS

1 GENERAL INFORMATION

Read through this operating manual carefully before use and become familiar with the machine. 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 set-up, 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 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
CAN Bus	Controller Area Network Bus	Bus for control devices / networks	Asynchronous serial connection system for networking control devices
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.
EMI	Electromagnetic Interference		
EMC	Electromagnetic Compatibility		Compatibility of electrical or electronic equipment items with their surroundings
HV	High Voltage		
ISU	Ignition Sensor Unit		
°KW	Crankshaft angle in degrees		Unit for the rotation angle of the crankshaft

Abb.	Term	Description	Explanation
LED	Light Emitting Diode		Light emitting electronic semi-conductor
MIC	MOTORTECH Ignition Controller		
USB	Universal Serial Bus		Serial wiring system to connect a computer to external equipment

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 damages can occur, if the following instructions are not complied with:

- The gas engine must only be operated by trained and authorized personnel.
- 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 power supply and secured against unintentional restarting.
- Perform only such maintenance and repair work as is described in this operating manual, and follow the instructions given while working. For maintenance of the equipment, only use spare parts supplied by MOTORTECH. 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 lead to an explosion hazard. 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.

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 control system, the modules, and the work environment 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 must therefore 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 loosen the wiring

Operational safety

The DetCon detonation control system detects knocking as far as possible, but its results are not binding.

Operational safety

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

Operational safety

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

Operational safety

Please note that the knocking sensors must be mounted according to the firing order of the cylinders. Refer to the pertinent section *Wiring of the Knocking Sensors* on page 37.

Risk of damage

The knocking sensor attachment screws must not be tightened too firmly, as otherwise the sensors will be damaged and no longer function properly. Please observe the prescribed tightening torques:

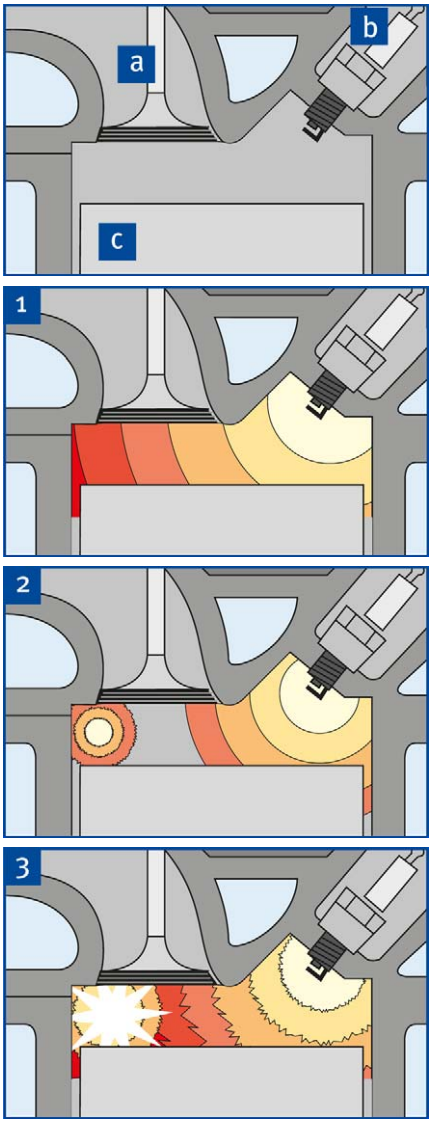
- Cast iron: 30 Nm (20.1 lb-ft) at M8 x 25 mm (0.98")
- Aluminum: 20 Nm (14.8 lb-ft) at M8 x 30 mm (1.18")

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 INTENDED USE

3.1 Functional Description



Pos.	Designation
a	Valve
b	Spark plug
c	Piston

Normal Combustion

The graphics 1 show 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 2. This system does not detect so-called early 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

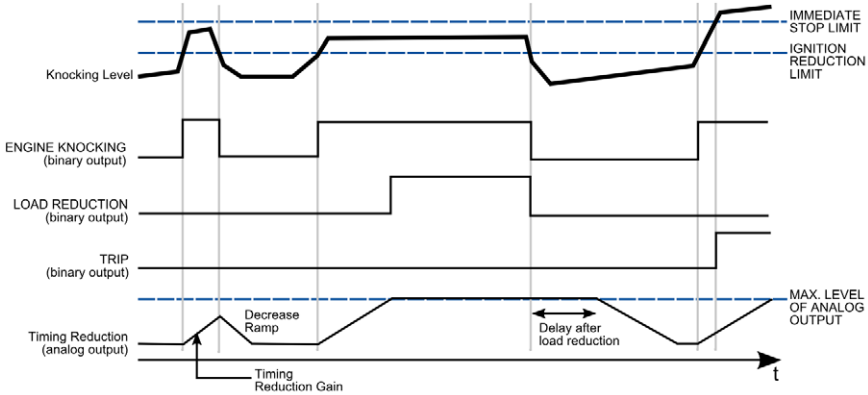
Detonation Control System

The task of the DetCon detonation control system is to avoid engine damage from 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.

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

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



Term used in diagram	Explanation
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 upon which an ignition timing reduction is performed
ENGINE KNOCKING (binary output)	Signal on the binary output indicating knocking.
LOAD REDUCTION (binary output)	Signal on the binary output effecting load reduction.

Term used in diagram	Explanation
TRIP (binary output)	Signal on the binary output indicating that the IMMEDIATE STOP LIMIT has been exceeded.
Timing Reduction (analog output)	Curve of the analog signal for timing reduction
MAX. LEVEL OF ANALOG OUTPUT	Maximum value of the timing reduction
Timing Reduction Gain	Speed of the timing reduction
Decrease Ramp	Speed of the timing reduction
Delay after load reduction	Delay time following a load reduction

The measured knocking energy (*Knocking Level* curve) is compared in every cycle with a 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 values at the analog outputs are also reduced. The rate of this reduction is adjusted according to the preset value *Decrease Ramp*.

If the ignition timing 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 (e.g. ALL-IN-ONE) can control load reduction via this output.

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 must be longer than required for reaching full load.

The third binary output, i.e. *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.

3 INTENDED USE

3.2 Applications

The DetCon detonation control system 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 knocking sensors
- DetCon20 for up to 20 knocking sensors

Both device types are available as a built-in device for a control cabinet or with a CSA certified enclosure. The following manual applies to both device types. Any differences between the two versions are clearly identified.

In order to define the time frame for potential knocking, the detonation control system must know the ignition timing of the first cylinder in the firing sequence. 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.

4 PRODUCT DESCRIPTION

4.1 Technical Data

4.1.1 Certifications

The detonation control systems of the DetCon series are certified as per the following regulations:

CSA

The DetCon detonation control system can be supplied in a CSA certified enclosure, thereby fulfilling the following directives/regulations:

- Class I, Div. 2, Group C,D; T4
- CSA Std. C22.2 No. 0-10
- CSA Std. C22.2 No. 142-M1987 (R 2004)
- CSA Std. C22.2 No. 231-M1987 (R 2004)
- ANSI/ISA 12.12.01, Ed. 1 (2007)
- UL Std. No. 916, Ed. 3 (1998)

The corresponding guidelines are also met if the DetCon detonation control system is installed in a correspondingly certified switch cabinet.

CE

- EMC Directives
  - Safety regulations for electrical measuring, control, and laboratory equipment according to DIN EN 61010-1:2003
  - Interference emission - residential, business, and commercial environments and small enterprises according to DIN EN 61000-6-1 and DIN EN 61000-6-3
  - Emission standard for industrial environments as per DIN EN 61000-6-2 and DIN EN 61000-6-4

CSA INTERNATIONAL

Certificate of Compliance

Certificate: 1401608 (LR 211392) **Master Contract:** 211392

Project: 2341446 **Date Issued:** December 24, 2010

Issued to: **Motortech GmbH**

Hogrevestrasse 21-23
Celle, 29223
Germany
Attention: Claus Schulze

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

C US

Marin Banu

Issued by: Marin Banu, P. Eng.

PRODUCTS

CLASS 2258 02 - PROCESS CONTROL EQUIPMENT - For Hazardous Locations
CLASS 2258 82 - PROCESS CONTROL EQUIPMENT - For Hazardous Locations - Certified to US Standards

Class I, Div 2, Group C, D; T4:

- Det Con Knock Detection System-Control Unit Assembly Series, P/N 43.10.xxxN. Electrical ratings 9-36 VDC/2A max. Maximum ambient temperature -40°C to 70°C (-40°F to 158°F).

X – To indicate different Control Unit size

N – To indicate Customer brand labeled name

Notes:

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CSA INTERNATIONAL

Certificate: 1401608 (LR 211392) **Master Contract:** 211392

Project: 2341446 **Date Issued:** December 24, 2010

- This product is to be used in conjunction with CSA Certified Ignition Systems
- The unit is certified to be installed on a Control Panel in accordance to the CEC and NEC wiring method.
- The final installation of the DetCon2 or DetCon20 on Control Panel shall meet the requirements for IP65/ Type 4 Encl.
- The USB interface connectors are only to be used in areas known to be non-hazardous.

APPLICABLE REQUIREMENTS

CSA Std C22.2 No. 0 -10 - General Requirements – Canadian Electrical Code – Part II

CSA Std C22.2 No. 142-M1987 (R 2004) - Process Control Equipment

CSA Std C22.2 No. 213-M1987 (R 2004) - Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations

ANSI/ISA 12.12.01, Ed. 1 (2007) - Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Division 1 and 2Hazardous (Classified) Locations

UL Std No. 916, Ed 3 (1998) - Energy Management Equipment

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CSA INTERNATIONAL

Supplement to Certificate of Compliance

Certificate: 1401608 **Master Contract:** 211392

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Product Certification History

Project	Date	Description
2341446	December 24, 2010	Update to report 1401608 to include CSA/US certification.
History		
1401608	July 15, 2003	Original Certification

Page: 1

CE DECLARATION OF CONFORMITY

The company:	**MOTORTECH GmbH** **Hogrevestrasse 21-23** **29223 Celle**
declares that the products:	**DetCon detonation control system**
intended purpose:	**Application on engines**

complies with the provisions of the following EC Directives:

EMC Directive 2004/108/EC

Low Voltage Directive 2006/95/EC

under consideration of the following standards:

DIN EN 61010-1:2003
DIN EN 61000-6-1, DIN EN 61000-6-2
DIN EN 61000-6-3, DIN EN 61000-6-4

The marking of the product is: **P/N 43.00.002**
P/N 43.00.020

This declaration is submitted by:

Name: Florian Virchow

Position in company: Managing Director

Celle, dated 04/01/2011

Place, date

Legally binding signature

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 x 147 x 52 mm (6.3 x 7.36 x 2.05") (length x width x height) **DetCon20** 160 x 187 x 52 mm (6.3 x 5.78 x 2.05") (length x width x height) **Enclosure version** 400 x 300 x 125 mm (15.75 x 11.81 x 4.92") (length x width x height) For details, see chapter *Overview Drawings* on page 24
Mounting for 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 chapter *Overview Drawings* on page 24
Mechanical Environmental Conditions	Protection: IP 20
Climatic Environmental Conditions	**Operation** -10 °C to 60 °C max. (14 °F to 140 °F) **Storage** -40 °C to 70 °C max. (-40 °F to 158 °F) max. 95% humidity without condensation

4.1.3 Warning Notices on the Device

Warning notice on front cover – Outside

WARNING! Read and understand the installation instructions and operating manual prior to installing or making any adjustments. Keep covers tight while circuits are live.

Warning on device

WARNING– EXPLOSION HAZARD – Substitution of components may impair suitabilty for Class I, Division 2. Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

4.1.4 Electrical Data

The DetCon has the following electrical characteristics:

Feature	Value
Power consumption	0,1 A at 24 V 0.1 A at 36 V 0.3 A at 9 V
Supply voltage	9 to 36 V DC

Electrical Data for Inputs and Outputs

The inputs and outputs have the following electrical data:

Inputs and outputs	Values
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
Knocking sensor input	Input resistance › 1 MΩ
4-20 mA output	Max. voltage 30 V Current accuracy ± 2%
0-5 V output	Max. current 2 mA Voltage accuracy ± 2% Auxiliary power 5 V DC required
Binary outputs	All three outputs share a single connection and are potential-free (galvanically separated optocouplers). Max. voltage 33 V Max. current 50 mA

4.1.5 Interfaces

USB Interface

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

CAN Bus Interface

- Galvanically isolated
- Baud rate 250 kBd

4.1.6 Technical Data of the Knocking Sensors

Use MOTORTECH knocking sensors

DetCon detonation control systems are parameterized for operation with MOTORTECH knocking sensors (piezoelectric acceleration transducers). The use of other sensors entails a new calibration of the engine.

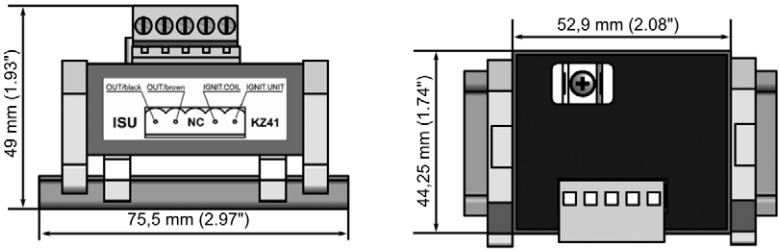
The MOTORTECH knocking sensors have the following technical data:

Feature	Value
Sensor principle	Piezoelectric acceleration transducer
Sensor type	MOTORTECH
Frequency range	1 kHz to 20 kHz
Resonance frequency	› 20 kHz
Temperature range	-40 to +130 °C (-40 to +266 °F)
Dimensions, Sensor	45 x 20 x 21 mm (1,77 x 0,79 x 0,83'') (see *Mounting the Knocking Sensors* on page 30)
Sensor mount	Cast iron: M8 x 25 mm (0.98") Aluminum: M8 x 30 mm (1.18") tightening torque: 20 ± 5 Nm (14.8±3.7 lb-ft) (Take the material of the cylinder head screw on which the sensor is mounted into account where applicable.)

4.1.7 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
Voltage supply	90 to 300 V DC
Temperature range	-25 to +70 °C (-13 to +158 °F)
Dimensions, Sensor	75.5 x 44.25 x 49 mm (2.97 x 1.74 x 1.93") incl. DIN rail (see *Mounting the Ignition Sensor Unit (ISU)* on page 34)
Sensor mount	DIN rail mounting



4.1.8 Technical Data of the Camshaft Sensor

The camshaft sensor has the following technical data:

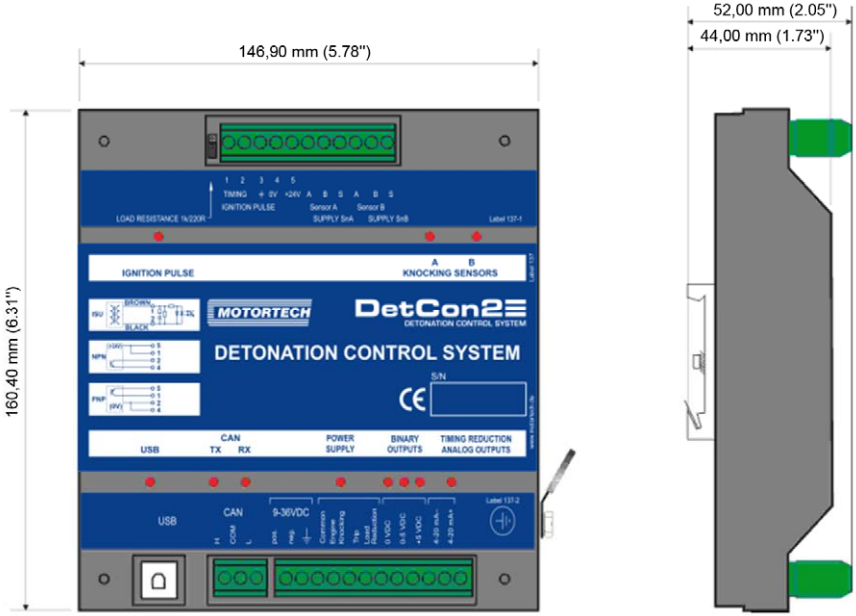
Feature	Value
Sensor principle	active, inductive proximity switching sensor
Sensor type	MOTORTECH
Voltage supply	15 to 34 V DC
Temperature range	-25 to +85 °C (-13 to +185 °F)
Dimensions, Sensor	M12 x 1 thread; length 60 mm (2.36") or 100 mm (3.94")
Sensor mount	Nut M12 x 1

4.1.9 Requirements for External Equipment

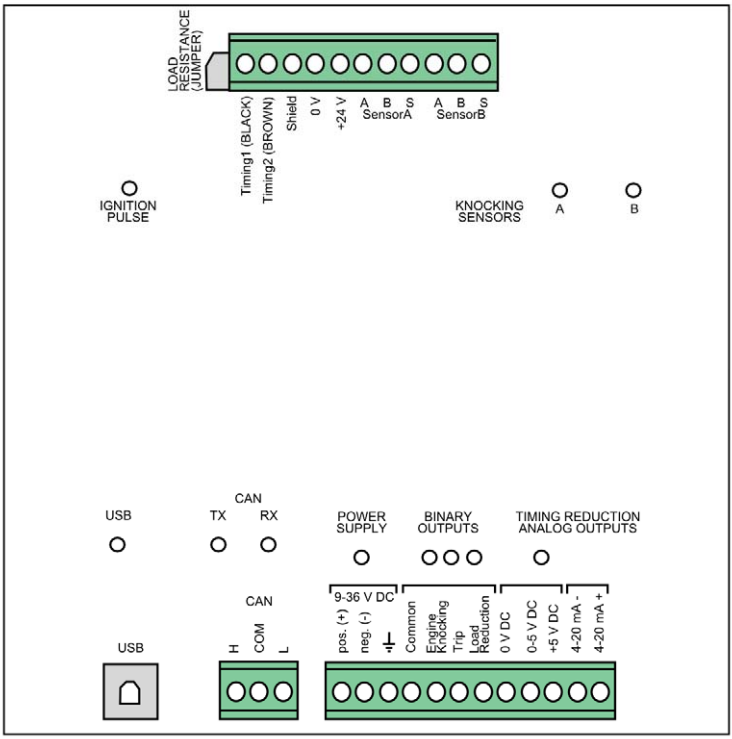
External equipment shall fulfill the input and output specifications of the DetCon.

4.1.10 Overview Drawings

DetCon2 – Dimensions



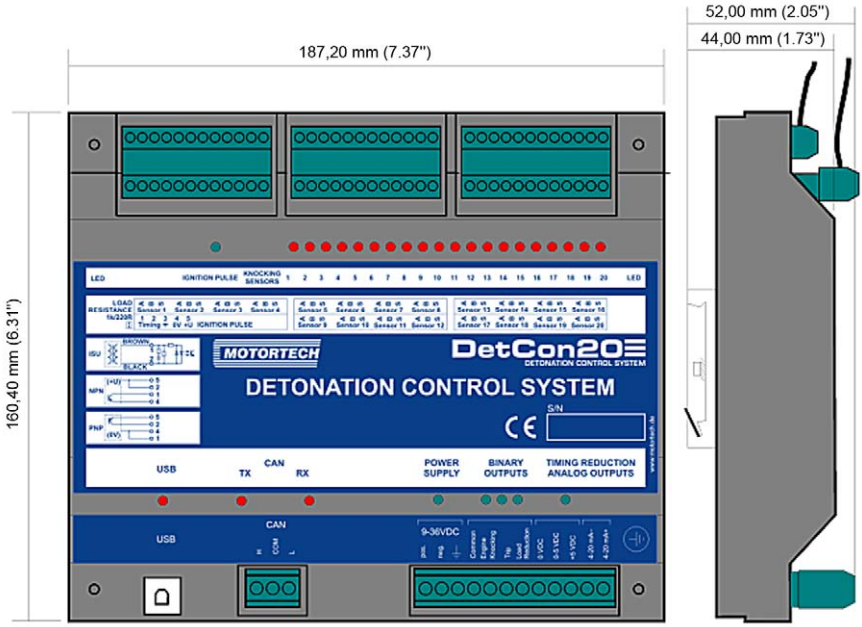
DetCon2 – Ports/Connections and LEDs



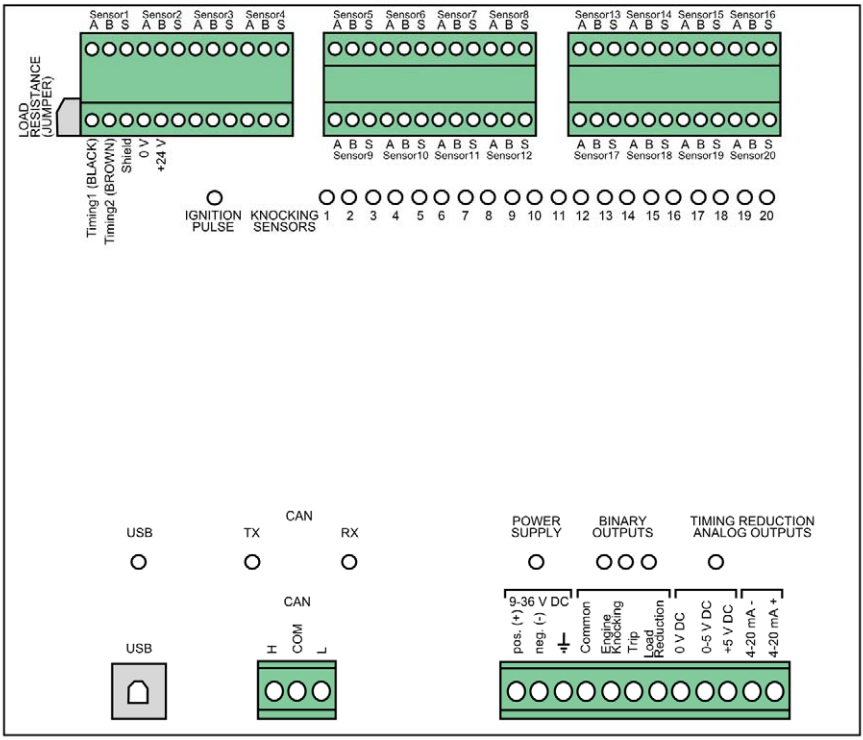
For the functions of the individual ports/connections and LEDs, please refer to the table following the drawings accompanying the DetCon20.

4 PRODUCT DESCRIPTION

DetCon20 – Dimensions



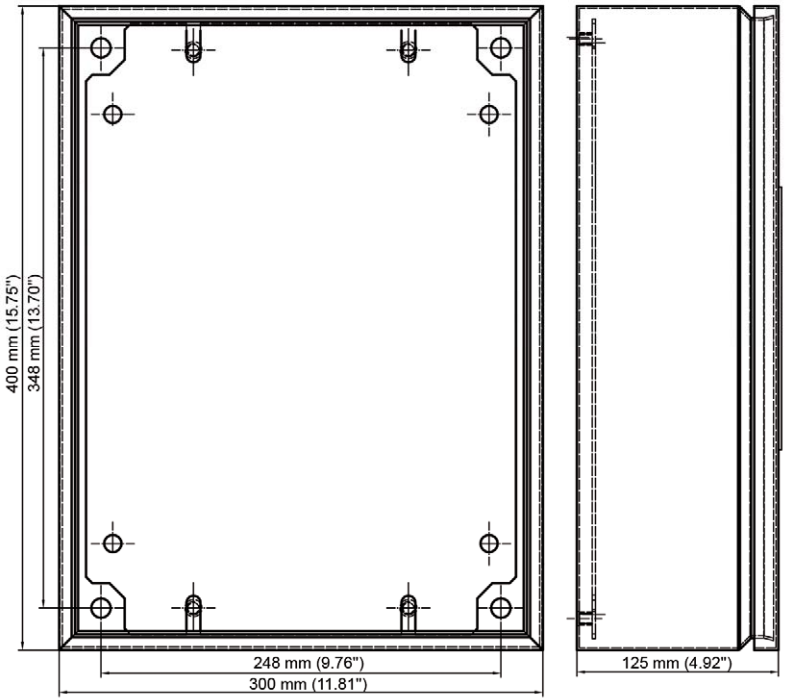
DetCon20 – Ports/Connections and LEDs



Labeling	Function
LOAD RESISTANCE	Jumper which must be removed if no ignition sensor unit (ISU) is used (when using a camshaft sensor or MOTORTECH ignition controllers with ASO output)
Sensor A-B (DetCon2) Sensor 1-20 (DetCon20)	Connections of the knocking sensors (A=white, B=brown, S=shield) (see *Wiring of the Knocking Sensors* on page 37)
Timing1, Timing2, Shield 0 V, +24 V	Connections for the ignition sensor unit (ISU) or the camshaft sensor (see *Wiring of the Ignition Sensor Unit (ISU)* on page 39 or *Wiring of the Camshaft Sensor (for Diesel and Pilot Injection Engines Only)* on page 42)
IGNITION PULSE (LED)	This LED flashes when an ignition pulse is transmitted to the DetCon.

Labeling	Function
KNOCKING SENSORS (LEDs)	These 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 *Output options*, the LEDs will stay lit instead of flashing. In this case, the LEDs must also be reset manually (see *Tab: Output Options* on page 61)
USB (LED)	This LED flashes when data is being transferred via the USB connection.
CAN TX and RX (LEDs)	These LEDs flash when data is being transferred via the CAN bus (RX=data is being received, TX=data is being transmitted).
POWER SUPPLY (LED)	This LED lights up if the supply voltage is available.
BINARY OUTPUTS (LEDs)	These LEDs light up if the respective binary output (Engine Knocking, Trip, Load Reduction) has been activated.
TIMING REDUCTION ANALOG OUTPUTS (LED)	This LED lights up if an ignition timing reduction has been executed via one of the two analog outputs (0-5 V or 4-20 mA).
USB	Port for the data transmission to the PC.
CAN (H, COM, L)	Port for communication via CAN bus with master control devices (such as ALL-IN-ONE).
9-36 V DC (pos., neg., ground)	Connection for the voltage supply
Common	Reference potential for the binary outputs (+ or –)
Engine Knocking, Trip, Load Reduction	Connections of the binary outputs
0 V DC, 0-5 V DC, +5 V DC	Connections of the analog 0-5 V output (see *Wiring of the Analog Outputs for Ignition Timing Reduction* on page 45)
4-20 mA-, 4-20 mA+	Connections of the analog 4-20 mA output (see *Wiring of the Analog Outputs for Ignition Timing Reduction* on page 45)

DetCon Model in Enclosure– Dimensions (CSA Certified)



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 supply scope of the device consists of the following components:

- DetCon detonation control system
- CD-ROM with software for configuring the device
- USB interface cable for connecting the device to a PC/laptop
- Operating Manual
- additionally provided for the model with enclosure: screw set and screw joints

Installation locations where strong vibrations or ambient temperatures of below -40 °C (-40 °F) or above +70 °C (+158 °F) are present are not permissible and result in the warranty being voided.

Risk of damage!

The device must not be installed directly on or at the engine, as vibration and heat may cause damage to electronic components.

5.1 Mounting the Knocking Sensors

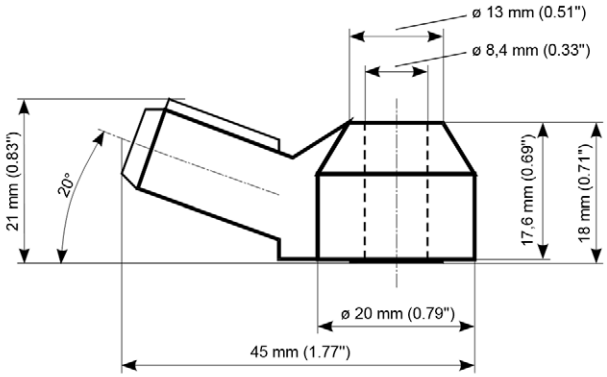
Use MOTORTECH knocking sensors

DetCon detonation control systems are parameterized for operation with MOTORTECH knocking sensors (piezoelectric acceleration transducers). The use of other sensors entails a new calibration of the engine.

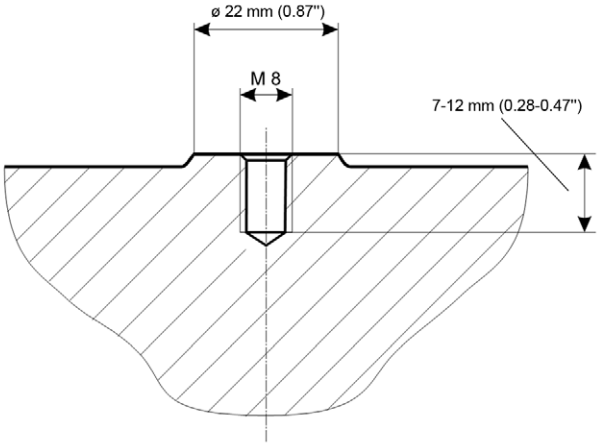
Observe notes of the engine manufacturer

The following mounting notes should be understood as orientation. Please observe at all events the notes of the particular engine manufacturers for the mounting of knocking sensors and the installation of a detonation control system.

Dimensions of the Sensor



Dimensions of the Required Bore



An M6 screw can also be used as an alternative to M8 screw for the mounting of the knocking sensor. In this case, however, an adapter sleeve must be used in the sensor to close in the resultant hollow space, thus ensuring optimal signal transmission.

Installation

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

– There must be a direct connection to the engine block.

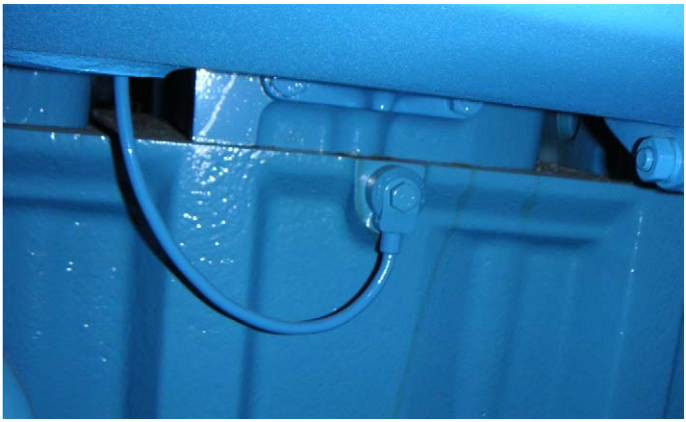
- Installations without a direct connection to the engine block (e. g. with sealings) are unsuitable.
- Only the metal surface of the sensor may rest on the engine.
- Do not use washers, spring washers, or toothed washers.
- The knocking sensors may not come into contact with liquids (e. g. oil, coolant,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

The torque for mounting in the case of mounting with M8 screws (strength 8.8) is 20±5 Nm (14.8±3.7 lb-ft) and with M6 screws (strength 12.9) with sleeve 15±3 Nm (11±2,2 lb-ft).

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.

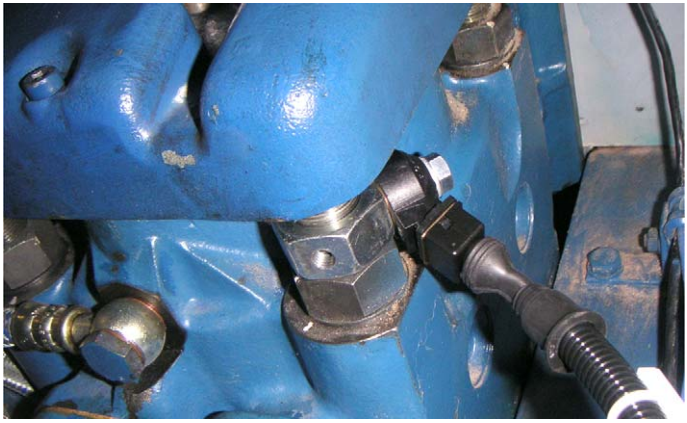
The required mounting of the knocking sensors may vary depending on the engine type used. The following locations are, in principle, possible for fitting the knocking sensors taking into account the aforementioned specifications:

- On the engine block
  For mounting on the engine block use screws of the type M 8x30-8.8 (AL-engine block) or M 8x25-8.8 (CI-engine block).



– On the cylinder head screws
  Especially when it comes to engine conversions, it has proven to be worthwhile to attach the knocking sensors on cylinder head screws or -bolts.
  Drill an M6-hole with a maximum depth of 12 mm (0.47") in the cylinder head screw and fix the knocking sensor with a screw of type M 6x25-12.9 and an adapter 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 is suitable for the installation.

5.2 Mounting the Ignition Sensor Unit (ISU)

The ignition sensor unit is mounted 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 knocking sensor or in the vicinity of the ignition controller.

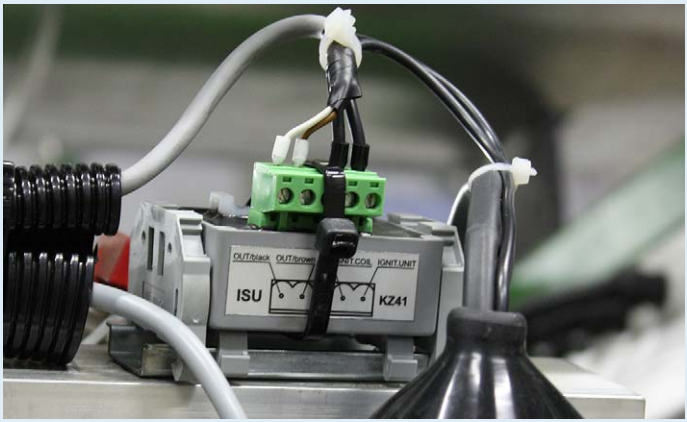
For information on wiring connections, please refer to section *Wiring of the Ignition Sensor Unit (ISU)* on page 39.

For diesel and pilot injection engines, a camshaft sensor is used instead of an ignition sensor unit (ISU). Refer to the section *Mounting the Camshaft Sensor* on page 35. No ignition sensor unit is needed when using a MOTORTECH ignition sensor unit with ASO (e. g. MIC4) output either. You can find information in the section *Wiring for Ignition Controller with ASO Output* on page 38.

NOTICE

Mounting on the engine

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



Please note that the contacts of the connector are bare and must be protected against moisture and contamination. If the engine should be in such a location, the ignition sensor unit can be, for example, mounted 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 must use the ignition sensor unit (ISU) and when the jumper *Load Resistance* on the DetCon device must 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

5.3 Mounting 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 must be prepared in such a way that the inductive camshaft sensor receives the rising signal at the injection point (+/- 5°). Mounting 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 wheel.

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

NOTICE

Calibration for diesel and pilot injection engines

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

5.4 Installation of the DetCon Model With Enclosure

The DetCon model with housing is CSA certified. In order to prevent the certificate from losing validity, all installation work must be performed according to the regulations specified in the certificate. Refer to the section *Certifications* on page 15. It is especially important that you use the screw sets for the cable bushings contained in the scope of supply.

6 WIRING OF THE DEVICE

6.1 Wiring of the Knocking Sensors

Mount the knocking sensors in accordance with the firing order of the cylinders. To do this, 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.

If all cylinders are not fitted with knocking sensors, the first knocking 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 knocking sensors, the first knocking sensor is mounted on the 3rd cylinder and the first knocking sensor input is connected to the DetCon.

Sensor/ Input on DetCon	Firing order of cylinders
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
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 identified with *Load Resistance* must be removed.

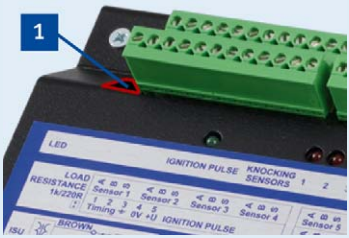
NOTICE

Position Load Resistance Jumper

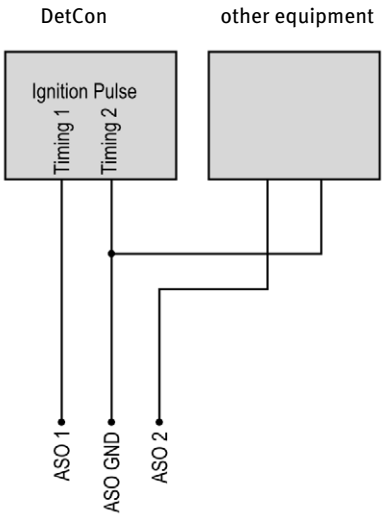
The jumper *Load Resistance* changes the input resistance of the ignition input.

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

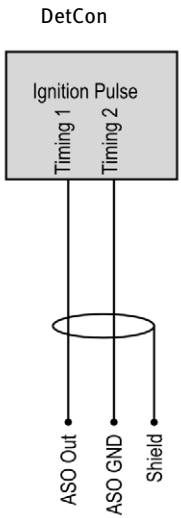
It is on the upper left of the device 1.



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



MIC850 connection



MIC3, MIC4, MIC5 connection

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)

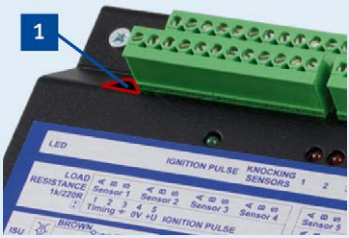
In order to transfer the ignition pulse of the first cylinder in the firing order to the ignition input of the DetCon, the ignition sensor unit (ISU) is installed between the ignition output of the first cylinder and the primary side of the ignition coil of the first cylinder. The jumper with the designation *Load Resistance* must not have been removed.

Position Load Resistance Jumper

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

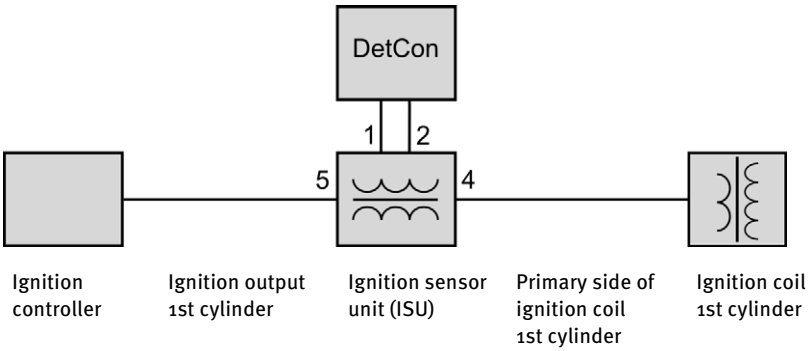
– Jumper set: 220 Ω
– Jumper removed: 1 kΩ

It is on the upper left of the device 1.

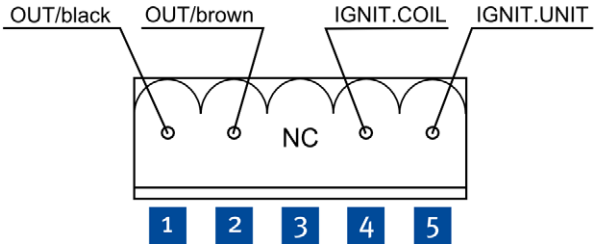


If not all cylinders are fitted with knocking sensors, the ignition sensor unit is mounted on the cylinder on which the first knocking sensor is mounted.

Principle Circuit Diagram



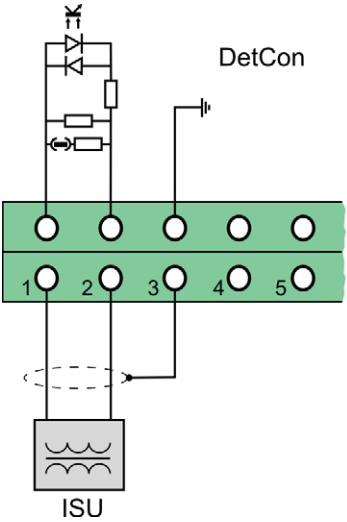
Connections on the Ignition Sensor Unit



No.	Connection
1	DetCon ignition input (Timing1, black)
2	DetCon ignition input (Timing2, brown)
3	Not used
4	Primary side of ignition coil of first cylinder
5	Ignition controller ignition output of the first cylinder

Connections on the DetCon

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



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

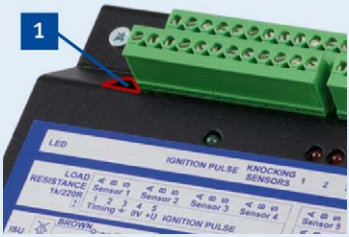
When using a camshaft sensor, the jumper with the designation *Load Resistance* must be removed.

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.



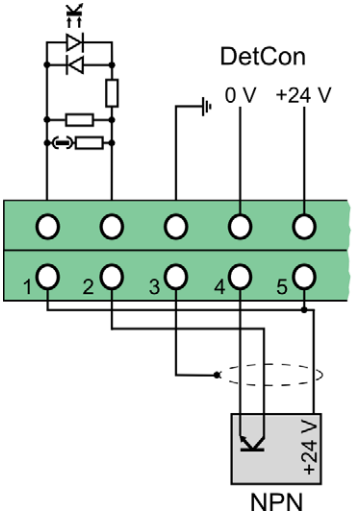
Calibration for diesel and pilot injection engines

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

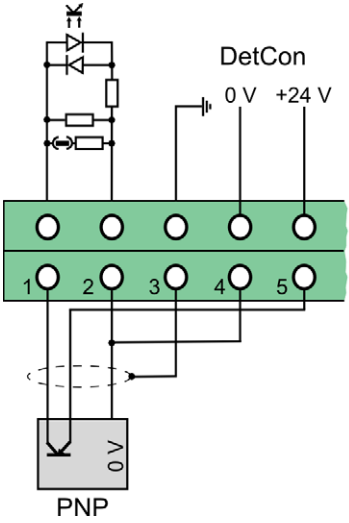
Connections on the DetCon

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

– NPN sensor connection

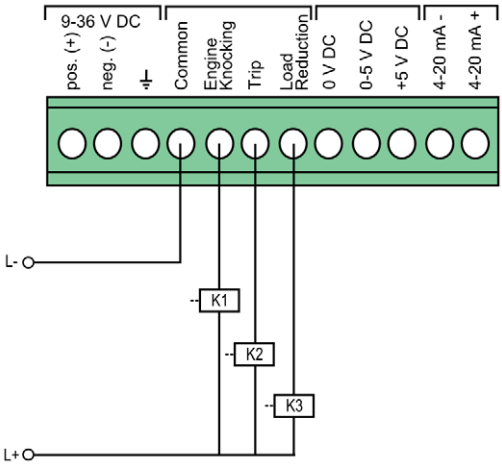


– PNP sensor connection



6.5 Wiring of the Binary Outputs

Example Configuration

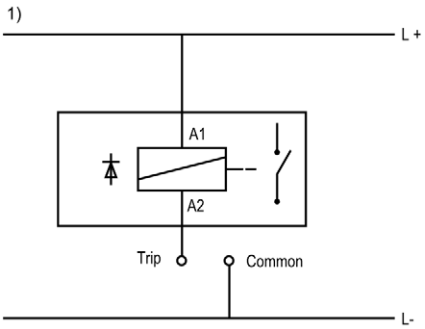


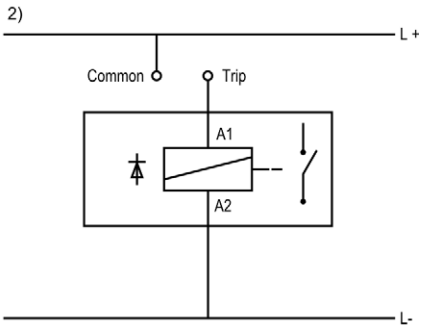
K1 = Relay *Engine Knocking* (Knocking Warning)

K2 = Relay *Trip* (Engine Stop)

K3 = Relay *Load Reduction*

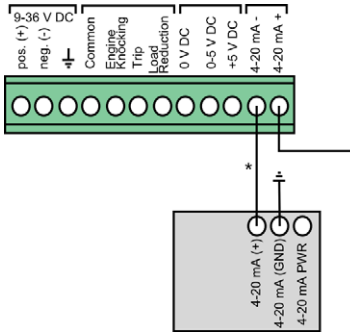
The following illustrations show examples of two alternatives for wiring the output *Trip*.





6.6 Wiring of the Analog Outputs for Ignition Timing Reduction

4-20 mA



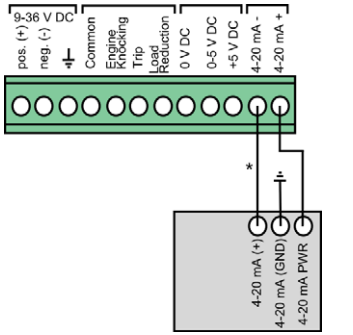
Output connector on the DetCon

+24 V DC supply voltage

Connection on the Ignition Controller

* 4-20 mA signal

Alternative

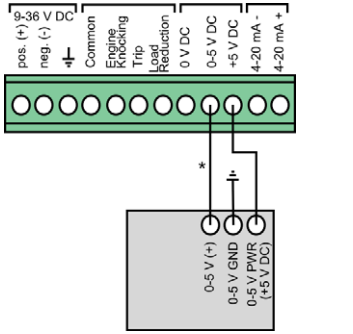


Output connector on the DetCon

Connection on the Ignition Controller

* 4-20 mA signal

0-5 V



Output connector on the DetCon

Connection on the Ignition Controller

* 0-5 V signal

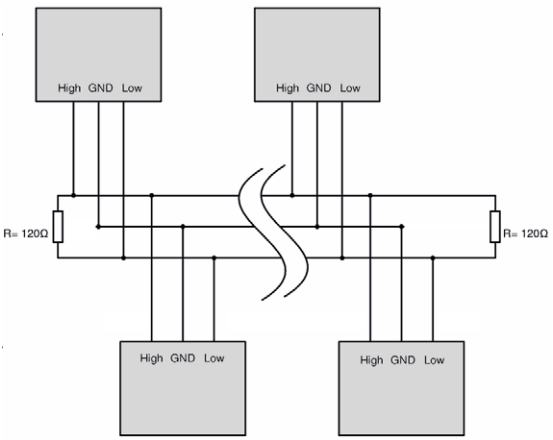
6 WIRING OF THE DEVICE

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

First device

Second-to-last device



Second device

Last device

CAN bus wiring

Note the following when connecting the CAN bus:

- There can be a maximum of 110 devices connected to one CAN bus.
- The maximum wire length is 250 m (820') depending on the transfer rate.
- Each bus end must be fitted with a terminating resistor of 120 Ω (see drawing).

7 FUNCTIONS

7.1 Ignition Timing Reduction

The DetCon has two analog outputs for ignition timing reduction:

– 4-20 mA current loop

– 0-5 V voltage output

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

The analog outputs change their values and thereby retards 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 retarded (*Timing reduction gain*) and how quickly the ignition timing retarding is reset when knocking is not longer detected (*Decrease ramp*). The retarding of the ignition timing can be limited using the analog outputs via the *Maximum output value*.

7.2 Load Reduction

If the ignition timing 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 (e.g. ALL-IN-ONE) can control the engine power via this output.

LOAD REDUCTION is deactivated again if the engine knocking stops.

7.3 Engine Stop

The binary output *TRIP* is activated when engine 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.

8 DENEDIT SETTINGS

You can configure the DetCon detonation control system and display the current knocking values of the engine using the DenEdit software application. 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 only required for engine types for which a parameter file has not yet been created and is executed 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 control system. After synchronization, the signals of the knocking sensors are analyzed and output signals are generated accordingly for the binary and analog outputs. The condition of the outputs are indicated via LEDs and the signals of the knocking sensors are displayed in the tabs for process monitoring. Error monitoring is also performed, for example, for registering faulty knocking sensor signals.

8.1 DenEdit System Requirements

For the installation of DenEdit, the following minimum requirements must be fulfilled:

– Operating system: Microsoft Windows 2000, XP, or Vista
– Approx. 10 MB free disc 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 software you need for installing DenEdit is located on the CD-ROM included with the device.

To install the program, proceed as follows:

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

Set up the Virtual Communication Port

The PC 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

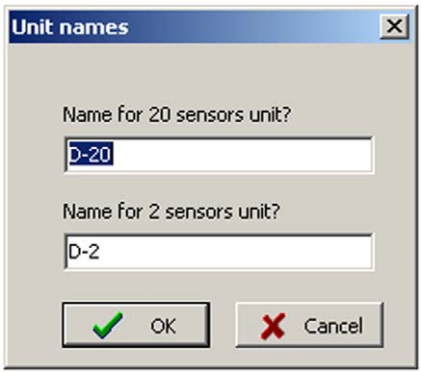
– the DetCon has been connected to the PC via USB and turned on and

– 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.

Set the dDevice Name

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



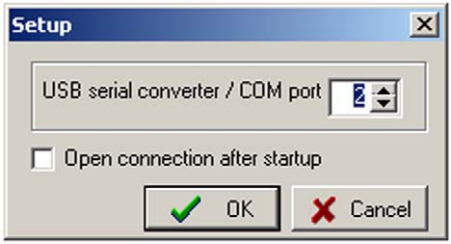
1. Set the name for your device by changing the entry in the field corresponding to your device type.
2. Accept the input with *OK*.
   - ► The name is now displayed in the status bar of the software.

Assign the Communication Port

In order to establish communication between the PC and the device, you must first set the communication port to be assigned to the USB interface.

Proceed as follows:

1. Open the device manager of your PC 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 -› Setup*.



6. In the field *USB serial converter / COM port*, enter the number of the COM port set on the PC.
7. If you activate the checkbox *Open connection after startup*, the software automatically connects with the connected device after startup if the USB connection is active.
8. Accept the input with *OK*.

Establish a Connection to the Device and Load the Parameter File

The parameter file of the respective engine must be loaded to the device prior to start-up. The CD-ROM 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 must be performed. This can only be carried out by MOTORTECH service personnel.

Calibration for diesel and pilot injection engines

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

Proceed as follows:

1. Connect the device to the PC 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

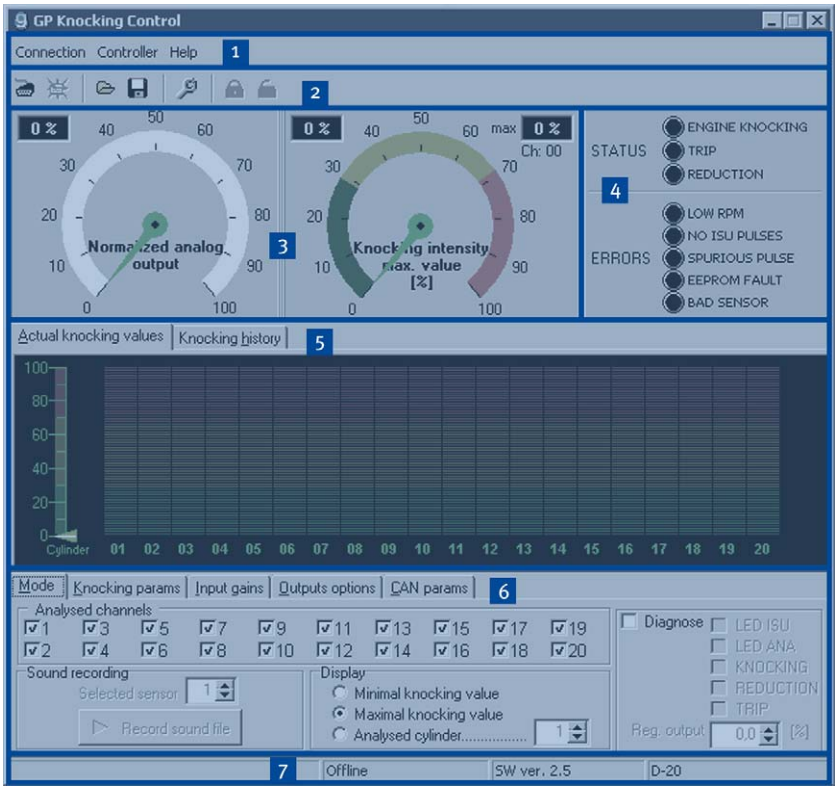
The file name of the parameter file indicates the engine associated with the file. The file extension indicates the DetCon device type for which the file must be used. For example:

– File: 0824.de2
  Engine: MAN E0824E
  DetCon: DetCon2

– File: 2842E.den
  Engine: MAN E2842E
  DetCon: DetCon20

8.3 User Interface Overview

The user interface is divided into different areas:



No.	Area
1	Menu bar
2	Toolbar
3	Display area of the analog output signal and the knocking intensity
4	Error and status displays
5	Tabs for process monitoring
6	Tabs for the Process Parameters
7	Status bar

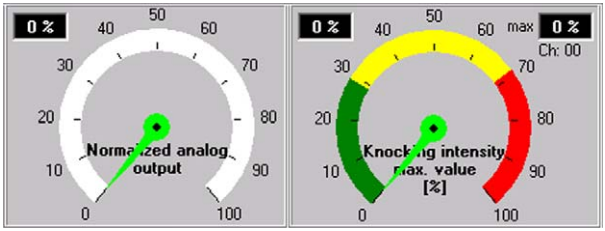
8.4 Menu Bar and Toolbar

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*	Establishes connection between DetCon and the PC.
	*Connection -› Disconnect*	Disconnects DetCon from the PC.
	*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 -› Setup*	Opens a dialog in which the communication port (COM) settings can be made.
	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.

Symbol	Menu	Function
	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

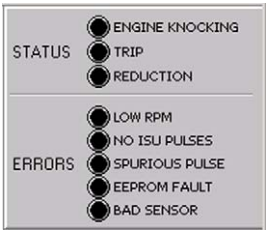
The left display shows the value of the signal currently present at the analog outputs. The value is displayed as a percentage of the output range (0-5 V / 4-20 mA). In addition, the displayed value is indicated numerically on the upper left.

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 58.

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 cylinder this value was measured.

8.6 Error and Status 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 control device. 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 reduction via the analog output signals has been exhausted. The value *Maximum output value* has been exceeded. The binary output *Trip* 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 control unit 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 PC and the device. Try to reload the parameters. If this is not successful, the control device must be repaired.

– BAD SENSOR
  A faulty knocking 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 knocking sensor is loose, a wire has a loose connection, or the knocking sensor is not flush against the surface. You can see which knocking sensor is causing the problem on the tab *Actual knocking values*. The number of the failed knocking sensor is displayed in red.

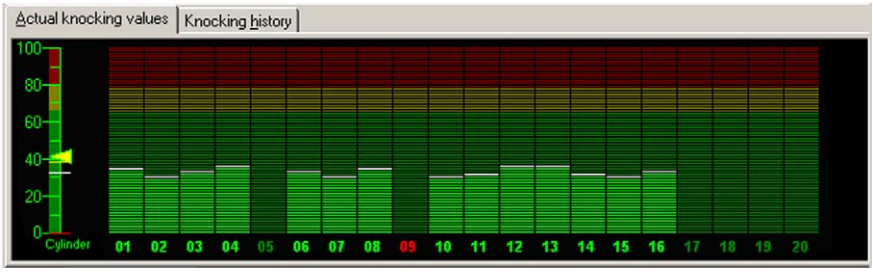
8.7 Tabs for Process Monitoring

The following tabs are available for process monitoring:

– Actual knocking values
  This tab shows the current knocking intensities detected by all knocking sensors.

– Knocking history
  In this tab, you can see the curve of the knocking intensities registered over the last minute.

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 knocking sensor is also marked in color. The colors of the sensor number indicate the following:

– Green: The knocking sensor is active.

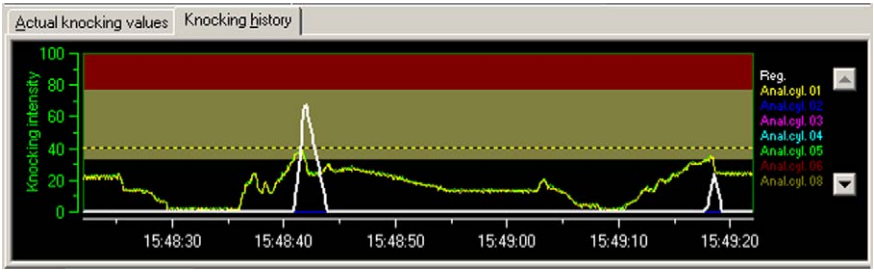
– Grayed out: The knocking sensor is not in use.

– Red: The knocking 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 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:

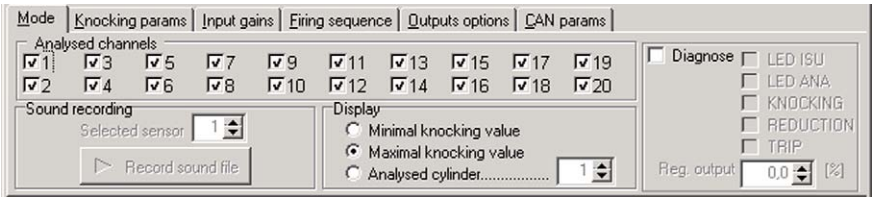
– Mode
  In this tab, you can enter general display and diagnostics settings. This is also where you can start sound recordings of knocking signals.

– 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 calibration. In order to ensure the correct functioning of the detonation control system, these values may not be altered.

– Input gains
  In this tab, you can amplify or attenuate signals for individual channels in order to compensate for signals similar to knocking signals.

– 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 knocking sensors that you want displayed in the tabs *Actual knocking value* and *Knocking history*. If the display of a sensor is deactivated, the signal of the knocking sensor still continues to be monitored.

Sound recording

If the device is connected to the running engine, you can make sound recordings of the signal of a knocking sensor. This is generally executed by MOTORTECH service personnel and should only be performed upon their request.
Proceed as follows:

1. Set the desired knocking sensor in the field *Selected sensor*.
2. Then click on the button *Record sound file*.
   ▸ An input window opens.
3. 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.
4. Click on *Stop* to stop the recording.

Display

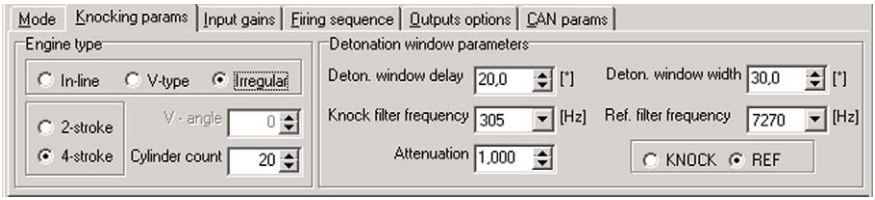
You can select which value is displayed in the knocking intensity pointer instrument via the following settings:

– 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).

Diagnosis

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 Diagnostics must be deactivated again for operations.

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:

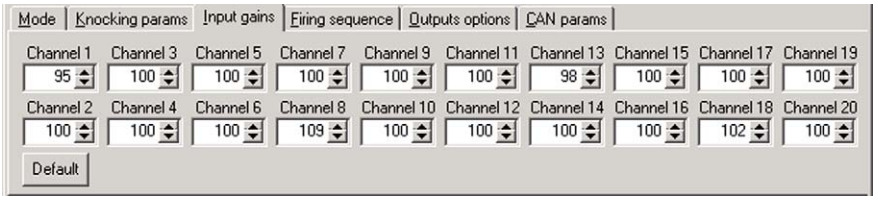
– In-line, V-type, Irregular
  Select the engine type. Select *In-line* for an in-line engine and *V-type* for a V engine. The setting *Irregular* allows you to define an individual firing sequence in the tab *Firing sequence*.
– 2-, 4-stroke
  Select the operating mode of the engine: *2-stroke* or *4-stroke*.
– 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 calibration. In order to ensure the correct functioning of the detonation control system, these values may not be altered.

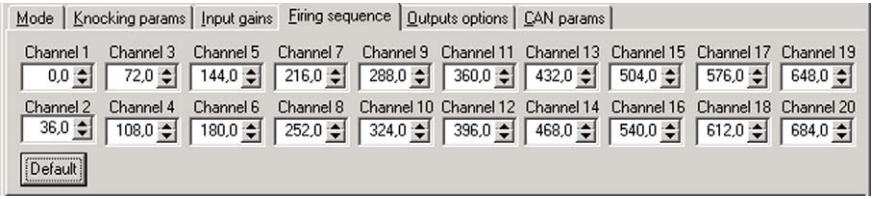
- Deton. window delay
  Delay of the first cylinder ignition measured by the interval following the ignition pulse. The basis is the rising edge of the synchronization pulse.
- Deton. window width
  Window of time for knock analysis.
- Knock filter frequency
  Characteristic knocking frequency.
- Ref. 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.
- 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



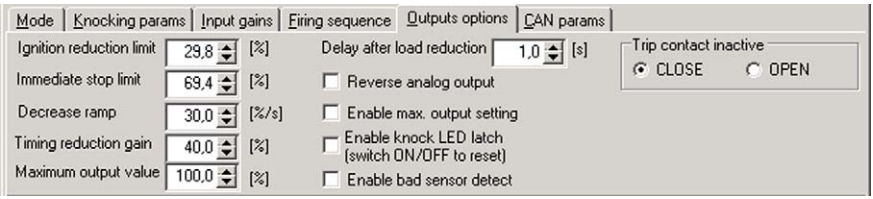
This tab is only available to you if the selected device software is version 2.0 (firmware, see status line) or higher (menu *Controller*). The settings in this tab allow you either to amplify the input signals of the individual knocking sensors or to attenuate them (values <100) in order to suppress 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 status line) or higher (menu*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: Output Options



Settings made in this tab influence the signals of the analog and binary outputs. Please refer to the section *Functional Description* on page 11 for more information on the limits you can set here.

Ignition reduction limit

Enter the limiting value 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 limiting value beyond which the binary output *TRIP* is activated. This causes the engine to shut down 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 timing reduction signal (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 timing reduction signal (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 timing reduction signal 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.

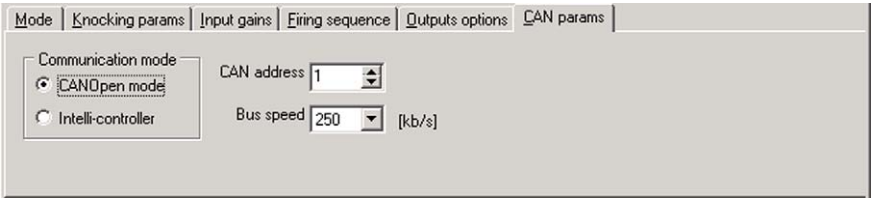
Enable bad sensor detect

Activate the checkbox so that defective knocking 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).

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 gas engine controller:

- 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 control system, 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 knocking sensors been wired in accordance with the firing order of the engine?
- Has the ignition sensor unit (ISU) or the camshaft sensor been wired correctly?

9.2 Shutdown

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

Knocking Sensor Errors

If the checkbox *Enable bad sensor detect* is activated in the tab *Output Options*, defective knocking 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.

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.

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* .

12 INDEX

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