HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

75 years

Solutions for combustion engines, that work right from the beginning.

protect

communicate

monitor

control

govern

start

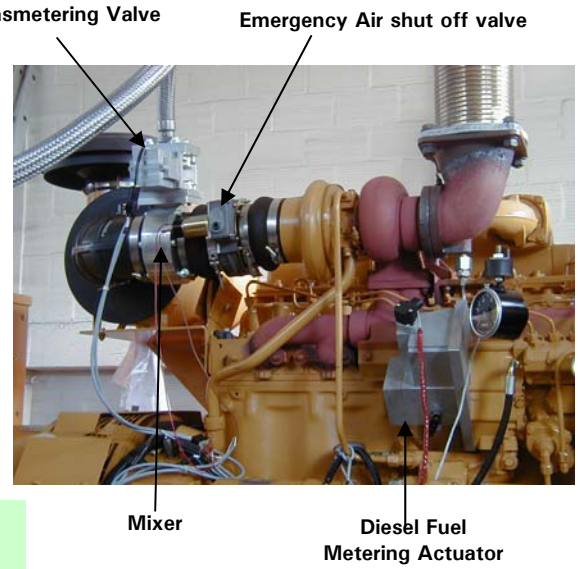
Huegli Tech AG (LTD)
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35
www.huegli-tech.com

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

DUAL FUEL CONVERSION FOR HIGH SPEED ENGINES



Indroduction

HUEGLI TECH LTD offers an innovative retrofit technology to convert your diesel engine to operate reliably and efficiently in dual fuel mode, i.e. typically with 30% diesel fuel and 70% natural gas, or other gaseous fuel. No internal changes in the diesel engine, like compression ratio, or pistons etc. are required.

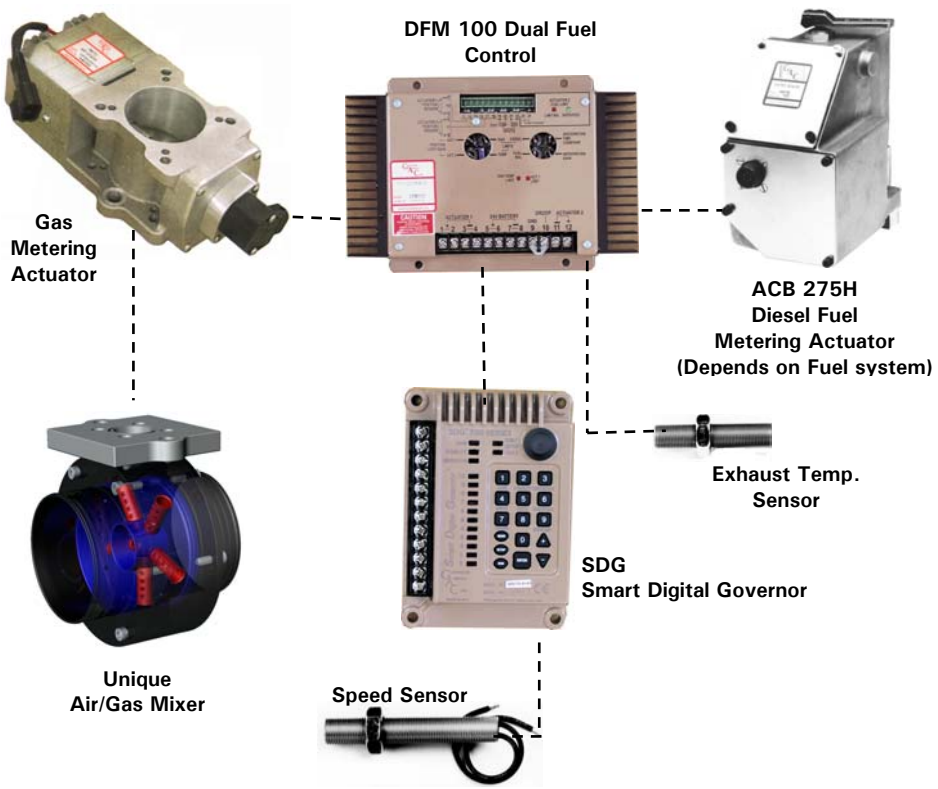
Note: Our system positively controls the amount of injected diesel fuel.

Each System can be tailored to meet individual customer requirements.

Return of Investment: Can be less than 6 Months

This kit is a relatively low cost method to get your existing high speed diesel engine running on dual fuel. Taking advantage of inexpensive natural gas as a primary fuel, you will also retain the ability to run your engine on full diesel without losing horsepower. A normal replacement rate of diesel-to-gas is approximately 70% of the diesel fuel.

The Kit: 7 Components comprise the basic Kit



HIGHLIGHTS

- ☞ **Save money with cheaper fuel**
- ☞ **Simple conversion is cost effective**
- ☞ **Low pressure gas compatible**
- ☞ **100% power with diesel or dual fuel**
- ☞ **Fast response time**
  Improved dynamic performance

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

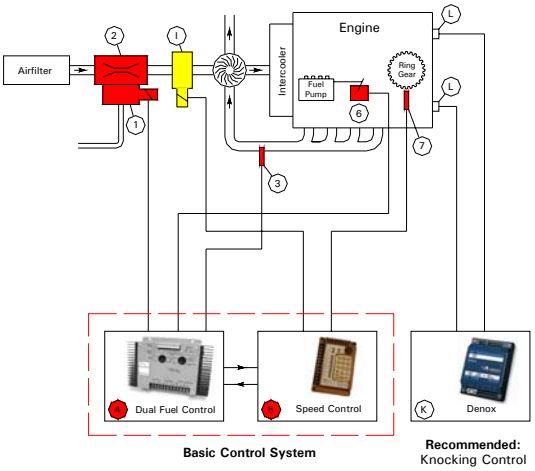
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

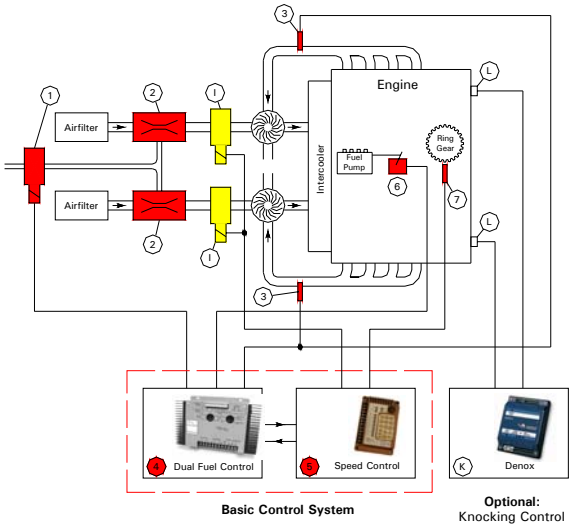
HT DUAL FUEL SYSTEM

Block Diagram – Target – Operating Principle

Lay Out for Inline Engines



Lay Out for "V" Engines with 2 Turbochargers



Basic System
Optional on request
Recommended

More detailed Layouts with optional gas supply line components are attached.

Target

The target was to combine simplicity with high tech components to **safely operate** the engine at an optimised diesel fuel/gas ratio, e.g. 30/70, or even better, and maintain the **same power output**, and the same **fast response times** or better as with 100% diesel fuel.

Operating Principle

The DFM Dual Fuel Control ④ sets the amount of injected diesel fuel via the diesel fuel metering actuator⑥ (with position sensor). This actuator is linked to the fuel pump. Via the gas metering actuator①, the DFM control also regulates the amount of gas into the special air/gas blender②.The air air/gas mixture then passes through the turbo charger, through the intercooler into the engine. The requested engine speed is controlled by the governor control⑤, which measures the engine speed at the engine ring gear via speed sensor . Both, isochronous or droop mode are possible.

Dynamic Performance

The DFM 100 controls the fast responding electric actuators in such a way that improved steady state and dynamic performance during load steps result.

Protection and Safety

The system protects the engine against harmful situations.

The exhaust temperature is monitored via sensor③. If the temperature should exceed the set (safe) limit, the DFM control reduces the gas portion, and increases the diesel fuel portion.

All combustion engines are subject to harmful knocking (Detonation). We strongly recommend the use of an antiknocking control system. Depending on the number of cylinders, a number of knock sensors (L) signal the Antiknock Control (K) to adapt the air/fuel ratio to safe limits

As an option, and as an additional protection against overspeed, etc, one, or two solenoid operated air/fuel intake shutoff valves (I) can be adapted.

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

HT DUAL FUEL SYSTEM

Quality

Whilst looking at lowest possible conversion costs, no compromise was made regarding quality.
All components are of top quality and offer utmost reliability, all at affordable price!

Fuel Economy

A DFM 100 conversion is a perfect investment for power users who are looking to upgrade their current system to alternative fuel technology, without revamping their entire system. As a retrofit technology, the DFM 100 system provides an economically attractive alternative instead of buying costly new generators.

With the ability to operate both fuels, the engine will never be down due to a lack of adequate gas fuel supply. Another distinct advantage of dual fuel is the decreased engine wear that comes with the use of cleaner fuel. Due to a reduction of carbon soot build-up and cleaner lube oil, longer intervals between service maintenance can be expected, sometimes doubled. This means a longer economic life for the engine and a better overall return on your investment.

Savings

To determine approximate cost savings you will need to be aware of your present fuel cost. The fuel replacement percentage and replacement cost with natural gas is in the ration of approx: 30 / 70, but also can be lower. Be sure to apply any losses of efficiency and always estimate on the safe side.

Ask a Huegli Tech representative to help you in determining your annual cost savings including fuel and maintenance.

When considering the cost of natural gas also consider your contract options with your gas supplier. Many suppliers are willing to give better rates if they are able to interrupt your fuel supply. An interruptible rate is exactly why the Dual Fuel system is a desirable option.

! Uninterrupted power supply around the clock save cost for production and investment!

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for CAT 3412

Scope of Supply:

Diesel Fuel Control:

- ACB 225F-HT — Diesel Actuator with Position Feedback

Gas Fuel Control:

- ATB-552 T2F-24 — Gas Actuator with Position Feedback

Air / Gas Mixer:

- TCT-XXX — Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:

- ESD-5221 — Engine Speed Control
- DFM-100 — Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C — Magnetic Speed Pick Up Sensor
- Denox 16/ 8-DF — Anti Knocking Module

Sensors:

- 0261231006 — Knocking Sensor
- T 2472 — Exhaust Temp. Sensor including Harness

Protection:

- SVX-XXX — Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for CAT 3516DITA and CAT 3508DITA

Scope of Supply:

Diesel Fuel Control:

- ACB 2001F-HT — Diesel Actuator with Position Feedback

Gas Fuel Control:

- ATB-753 T3F-24 — Gas Actuator with Position Feedback

Air / Gas Mixer:

- TCT-XXX — Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:

- ESD-5221 — Engine Speed Control
- DFM-100 — Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C — Magnetic Speed Pick Up Sensor
- Denox 16/ 8-DF — Anti Knocking Module

Sensors:

- 0261231006 — Knocking Sensor
- T 2472 — Exhaust Temp. Sensor including Harness

Protection:

- SVX-XXX — Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for Cummins 6CTA 8.3 G2
Scope of Supply:

Diesel Fuel Control:

- XACD-175 AF-24 Diesel Actuator with Position Feedback

Gas Fuel Control:

- ATB-452 T2F-24 Gas Actuator with Position Feedback

Air / Gas Mixer:

- TCT-XXX Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:

- ESD-5221 Engine Speed Control
- DFM-100 Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C Magnetic Speed Pick Up Sensor
- Denox 8-DF Anti Knocking Module

Sensors:

- 0261231006 Knocking Sensor
- T 2472 Exhaust Temp. Sensor including Harness

Protection:

- SVX-XXX Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for Cummins KTA 19 J4

Scope of Supply:

Diesel Fuel Control:

- ADB-120 E4 HT-F-24 Diesel Actuator with Position Feedback

Gas Fuel Control:

- ATB-552 T2F-24 Gas Actuator with Position Feedback

Air / Gas Mixer:

- TCT-XXX Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:

- ESD-5221 Engine Speed Control
- DFM-100 Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C Magnetic Speed Pick Up Sensor
- Denox 16-DF Anti Knocking Module

Sensors:

- 0261231006 Knocking Sensor
- T 2472 Exhaust Temp. Sensor including Harness

Protection:

- SVX-XXX Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for Cummins VTA 28

Scope of Supply:

Diesel Fuel Control:

- ADB 120 E4 HT-F — Diesel Actuator with Position Feedback

Gas Fuel Control:

- ATB-552 T2F-24 — Gas Actuator with Position Feedback

Air / Gas Mixer:

- TCT-XXX — Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:

- ESD-5221 — Engine Speed Control
- DFM-100 — Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C — Magnetic Speed Pick Up Sensor
- Denox 8-DF — Anti Knocking Module

Sensors:

- 0261231006 — Knocking Sensor
- T 2472 — Exhaust Temp. Sensor including Harness

Protection:

- SVX-XXX — Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for Volvo 1631G

Scope of Supply:

Diesel Fuel Control:

- ACE 275 KS — Diesel Actuator with Position Feedback

Gas Fuel Control:

- ATB-552 T2F-24 — Gas Actuator with Position Feedback

Air / Gas Mixer:

- TCT-XXX — Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:

- ESD-5221 — Engine Speed Control
- DFM-100 — Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C — Magnetic Speed Pick Up Sensor
- Denox 8-DF — Anti Knocking Module

Sensors:

- 0261231006 — Knocking Sensor
- T 2472 — Exhaust Temp. Sensor including Harness

Protection:

- SVX-XXX — Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for Jinan V12 190

Scope of Supply:

Diesel Fuel Control:

- ACB 2001F-HT — Diesel Actuator with Position Feedback

Gas Fuel Control:

- ATB-953 T3F-24 — Gas Actuator with Position Feedback

Air / Gas Mixer:

- TCT-XXX — Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:

- ESD-5330-DFM — Engine Speed Control
- DFM-100 — Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C — Magnetic Speed Pick Up Sensor
- Denox 16/ 8-DF — Anti Knocking Module

Sensors:

- 0261231006 — Knocking Sensor
- T 2472 — Exhaust Temp. Sensor including Harness

Protection:

- SVX-891 — Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for Perkins 4008 TAG

Scope of Supply:
Diesel Fuel Control:

- ACB-2001 F-HT — Diesel Actuator with Position Feedback

Gas Fuel Control:

- ATB-652 T2F-24 — Gas Actuator with Position Feedback

Air / Gas Mixer:

- TCT-XXX — Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:

- ESD-5221 — Engine Speed Control
- DFM-100 — Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C — Magnetic Speed Pick Up Sensor
- Denox 16-DF — Anti Knocking Module

Sensors:

- 0261231006 — Knocking Sensor
- T 2472 — Exhaust Temp. Sensor including Harness

Protection:

- SVX-XXX — Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dual Fuel System for Ruston 12 RKC 2350 kW

Scope of Supply:

Diesel Fuel Control:
- ACB 2001F-HT — Diesel Actuator with Position Feedback

Gas Fuel Control:
- ATB-953 T3F-24 — Gas Actuator with Position Feedback

Air / Gas Mixer:
- TCT-XXX — Air Gas Mixer Dimension according tube diameter

Electronic Control Modules:
- ESD-5330-DFM — Engine Speed Control
- DFM-100 — Dual Fuel Module, controlling 2 Actuators independently
- MSP-6728C — Magnetic Speed Pick Up Sensor
- Denox 16/ 8-DF — Anti Knocking Module

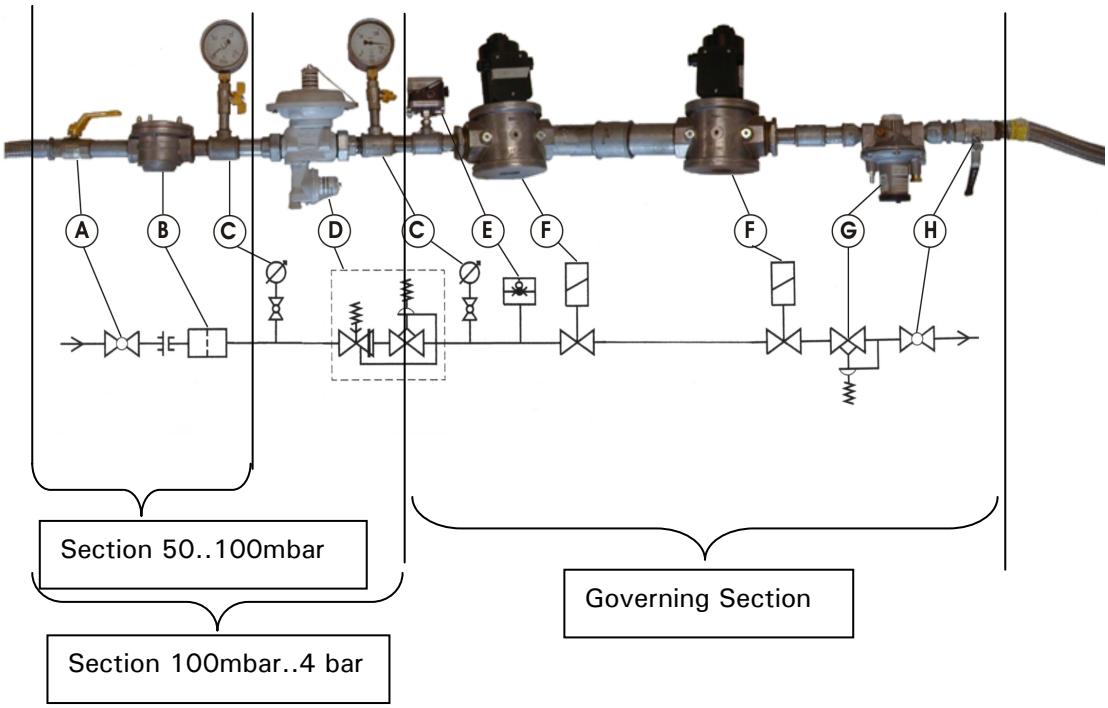
Sensors:
- 0261231006 — Knocking Sensor
- T 2472 — Exhaust Temp. Sensor including Harness

Protection:
- SVX-891 — Air Shut Off Valve including Hose adaptors

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35
e-mail: sales@huegli-tech.com
www.huegli-tech.com

Explanation:
Select in the right column the **Main inlet pressure**. Then select the quantity of Gas needed for the engine in the **Qn** column: (per 10kw = approx 1Nm3 of Gas) Therefore a engine with 2500kW electrical assumed a ratio of 30%Diesel and **70% Gas**, the quantity of Gas will be: 2500kW, 70% = 1750kW / 10 = 175
Qn = 175 Nm3/h therefore select Qn = 130...200Nm3/h

Option: Gas street assembled and pressure tested and certificated: US$ net. 250.-
Gas Street explanation:



Pos. A, H : These are manual ball valves for manual shut off of the gas supply

Pos. B : This is the gas filter for filtering out contamination.

Pos. C : These pressure gauges, with a manual shut off valve, allow to measure the gas pressure before, and after the first pressure regulator, pos. D.

Pos. D : This particular first stage pressure regulator accepts inlet pressures up to 1 bar and reduces the outlet pressure to 50mbar

Pos. E : This pressure switch monitors the presence of correct gas pressure and signals loss of gas pressure.

Pos. F : Safety regulations request two solenoid gas valves to protect against failures in the operating systems.

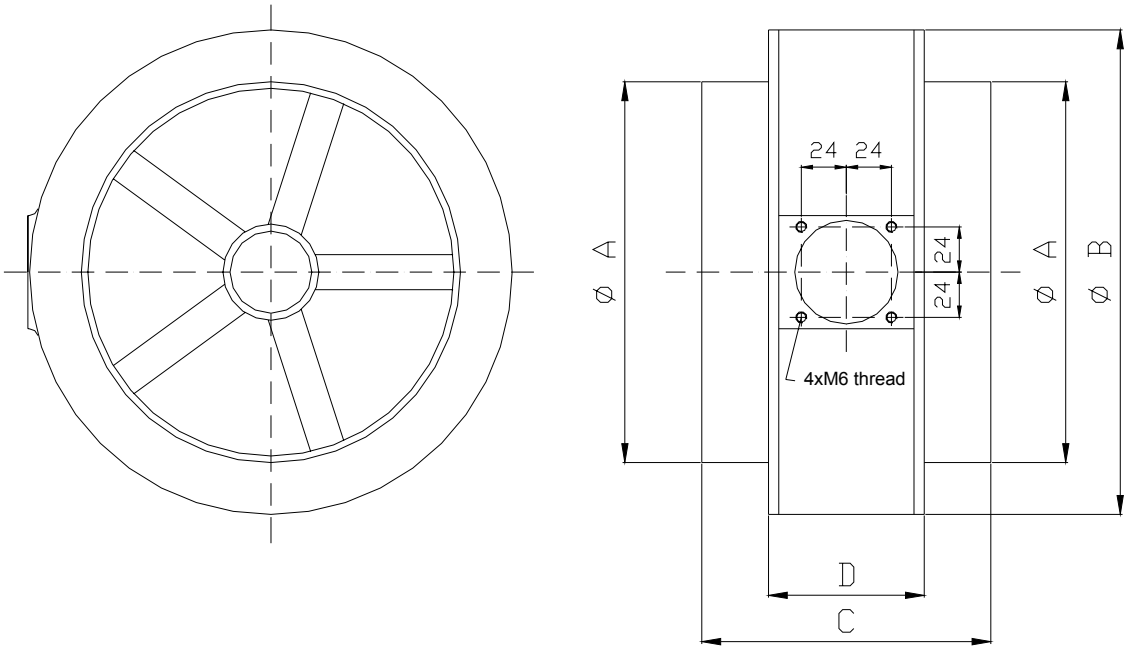
Pos. G : The "Zero" pressure regulator maintains a constant gas pressure, adjustable between 0.5 to 100mbar

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Venturi Air / Gas Mixer



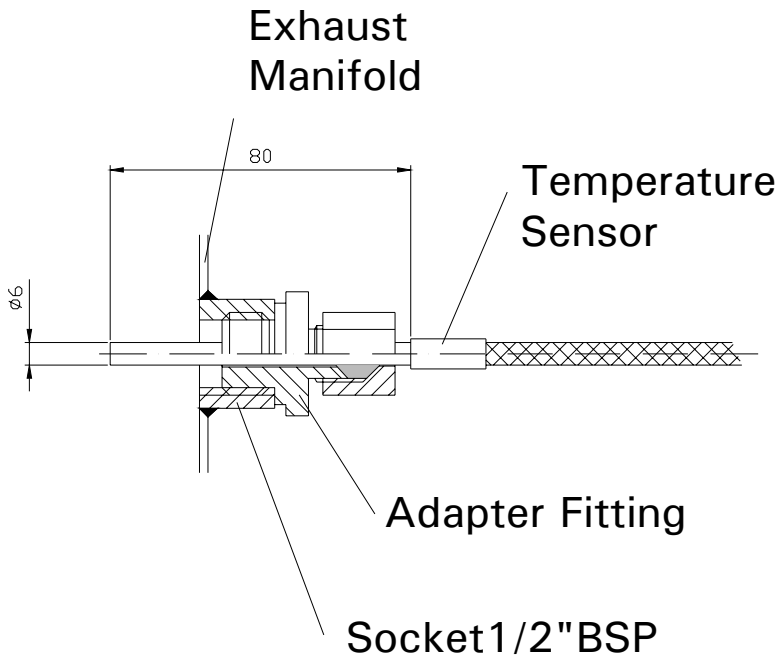
Dimensions in mm				
Mixer Type	∅ A	∅ B	C	D
TCT-120	120	170	140	50
TCT-140	140	175	140	50
TCT-180	180	175	166	50
TCT-XXX	>180	XXX	XXX	XXX

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Exhaust Temperature Sensor



Specifications

Art. Number:	T2472
Sensor type:	Thermocouple 1 NiCr-Ni K
Max. Temperature:	1000 °C
Diameter:	6 mm
Length:	80 mm
Material (jacket):	Inconel 600
Cable insulation:	Glass fiber/steel netting
Cable length:	1.5 m
Adapter fitting:	Stainless steel 316L

Output Voltage in mV for NiCr-Ni, Type K

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

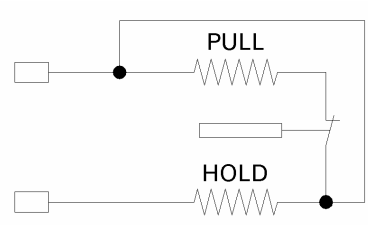
SVX-XXX Engine Solenoid Air Shut Down Valves

These valves protect the engine from reaching dangerous speeds and in case gaseous fuel gets in to the engine by any means of uncontrolled situation.
The solenoid contains a pull and a hold coil. The pull in coil is internally cut off as the valve is in full open position, i.e. in less than 0.5 seconds. If non energised the valve is closed. The solenoid must be energised at the first starting attempt and should be energised during repetitive starting attempts.

This valve may be installed either horizontally or vertically.

If hose adapters are used, the mating hose should be of a re-inforced type, provide adequate support for the valve end prevent excessive vibration. If necessary, additional support brackets mounted from the engine should be considered.

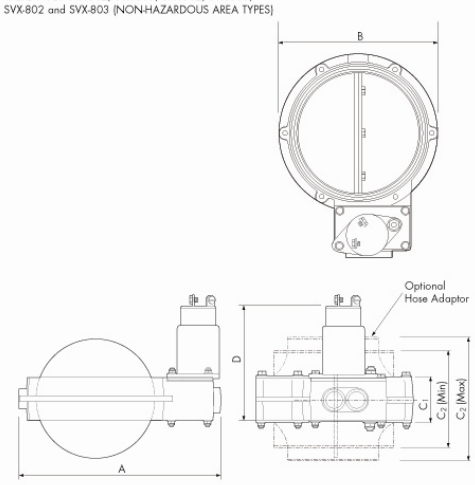
Electrical Connection:



Currents:
Pull current 25 A
Hold current 0.5 A

Wire sizes:
up to 10 m: 2.5 mm^2
10 to 16 m: 4.0 mm^2

VALVE TYPES SVX-302, SVX-303, SVX-502, SVX-503, SVX-802 and SVX-803 (NON-HAZARDOUS AREA TYPES)



Main Dimensions (mm)

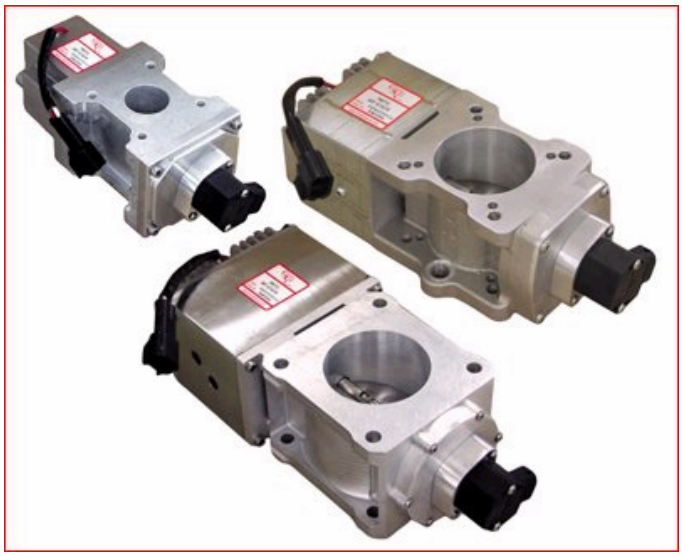
Valve Type	Nominal Bore Dia.	A	B	C_1	C_2 (min & max)	D
SVX-302 SVX-303	76 (3")	161.0	111.5	37.5	82.5 to 112.5	118.5
SVX-502 SVX-503	127 (5")	217.0	167.5	45.5	102.0 to 157.5	122.5
SVX-802 SVX-803	203 (8")	317.5	257.0	56.0	136.5 to 185.5	127.5

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

ATB Series Gas Actuator



- Low-Cost, Compact Design.
- Precise, Real-Time Engine Speed Control.
- Flexibility of Design for Engine, Manifold and Fuel
- Mixer Considerations.
- Adaptability to Corrosive Environmental Conditions.
- Rapid Response to Transient Load Conditions.
- Optional Throttle Position Feedback Sensor.

Introduction

The ATB SERIES integral throttle body electric actuator is designed to control the air or an air/fuel mixture to a gaseous-fueled engine. They are typically used to control an engine by working in tandem with a conventional fuel mixer. The design baseline for the ATB SERIES incorporates fast response, multi-voltage usage, and proven reliability to allow for efficient and more precise control. The ATB SERIES actuator directly drives the throttle plate. Two internal return springs provide for a normally closed valve for fail-safe operation. This insures that the throttle plate returns to the minimum fuel position when the actuator becomes de-energized. ATB SERIES actuators are also designed to accept system battery voltages of either 12 or 24 VDC and are available with a throttle position feedback sensor.

Description

ATB Series actuators are proportional electromagnetic devices designed for precise, efficient metering of airflow to a gaseous-fueled engine. When coupled with a GAC speed control unit and GAC speed sensor, a basic closed-loop governor system is established. Operation of this closed loop governor system is as follows: The magnetic speed sensor, mounted strategically on the engine, will generate real-time electrical pulses, which are directly proportional to engine RPM. The electronic speed control unit monitors these pulses and compares them to a preset engine speed setting. If these pulses differ from the preset engine speed setting, the speed control unit will initiate a calculated response. This response is an increase or decrease in current flow to the actuator, which in turn changes the throttle plate's positioning. As the throttle plate's position changes, the amount of air and fuel is increased/decreased as necessary to cause the engine speed to return to the preset engine speed setting. The throttle plate's shaft rotation is proportional to the amount of actuator current and is counterbalanced by the internal return springs.

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

The ATB SERIES design uses steel, precision grade radial ball bearings to provide low friction support to the throttle shaft. Therefore, no maintenance is necessary. The results are a rapid, proportional response to actuator positional changes and outstanding reliability consistent with GAC expectations.
GAC offers five different electronic speed controls for use with the ATB SERIES, all of which are field proven and 100% tested. The ESD2401, ESD5525E and ESD5330 are compatible with all 12V and 24V ATB SERIES throttle bodies. The ESD5403 control is recommended for all ATB SERIES throttle bodies with feedback. For more information on these

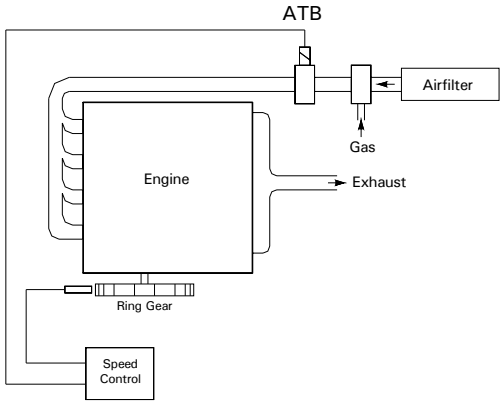
controls visit the GAC website or call us at Governors America Corporation.

Installation

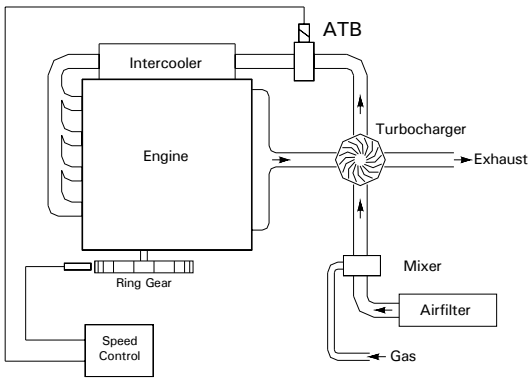
The actuator is mounted rigidly between the engine's intake manifold and the gas mixer. Normal vibration from the engine will not affect the operation of the actuator. The ATB SERIES are designed to provide an exact fit to the various manifolds and mixers available. The Selection
Chart on page 4 shows the flexibility of design.

Possible arrangements of the ATB

Naturally Aspirated Engines



Turbocharged-Intercooled Engines



Note:
In turbocharged intercooled engines, the ATB may be installed after the turbocharger. The hot air gas mixture will increase the operating temperature of the ATB. In such applications it is recommended to use an ATB with finned cooling sink.
When uncertain, please consult GAC or your nearest GAC distributor for correct version.

Wiring

All throttle body actuators are pre-wired for either 12 or 24 VDC systems. Use the included wiring harness CH-112 (loose wires 1.8m) to connect the actuator to the speed control unit's output terminals. Prior to connecting the actuator cable, twist it so that there is about one complete twist per inch along the entire length of the cable. This will substantially reduce EMI effects on the control system. For applications where EMI is still a concern, shielded cable for the actuator is recommended.

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Optional Idle Adjustment

An adjustable Idle Stop setscrew is provided to set a fixed fuel opening if desired. Using the appropriate Hex wrench, you must completely remove the first 'locking' setscrew. This will give you access to the inner Idle Adjustment setscrew for adjustment using the same Hex wrench.
Turning the wrench clockwise will increase the fixed throttle opening. Typically, the engine speed should be set by unplugging the actuator or by turning off the governor power once the engine is running and then setting the engine speed to the desired setting. Adjustment is complete once you have replaced the locking setscrew. The locking setscrew should only be tightened to snug plus a ¼ turn.

WARNING

An overspeed shutdown device, independent of the governor system, should be provided to prevent loss of engine control, which may cause personal injury or equipment damage.

Specifications

Performance
Maximum Throttle Plate Rotation ..... 65° ± 1°

Power Input
Operating Voltage ..... 12 or 24 VDC
Normal Operating Current .....2 Amps @ 12 VDC
..... 1 Amps @ 24 VDC
Maximum Current – Continuously Rated ..... 6 Amps @ 12 VDC
..... 3 Amps @ 24 VDC

Environmental
Operating & Storage Temperature Range ..... -40° to +200° F (-40° to + 95° C)
Relative Humidity ..... SAE J1455
Salt Spray .....ASTM B 117-97
All Surface Finishes.....Fungus and Corrosion Resistant

Reliability
Vibration ..... 25 to 100 Hz, ± 4g
Shock..... 20g, 11 msec.
Testing ..... 100 % Functionally Tested
Rated Life..... >40 million cycles

Troubleshooting

Please Note

These tests are to check for proper operation of the actuator only. If the actuator passes these tests, the problem is more than likely elsewhere in the system. Refer to the speed control unit technical publication, troubleshooting section or contact GAC or an authorized service agent.

If the governor system fails to operate, the following test can be performed:

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Shut engine down, disconnect the actuator cable and measure the resistance through the wires while rotating the throttle plate.

Next, check resistance from each wire to actuator housing again while rotating the throttle plate (See values below).
The resistance will fluctuate when you manually rotate the plate, but the reading should settle back to a fixed value based on the table below. This test is only to insure that there is no obstruction, wire breakage or metal-on-metal contact inside the throttle body.

Measure the resistance from:
- Red to White (12 VDC) .....2 Ω
- Red to White (24 VDC) .....8 Ω
- Red to Actuator Housing .....< 5 MΩ
- White to Actuator Housing..... < 5 MΩ

Make sure to reconnect the actuator cable.
Next, energize the actuator to full fuel (follow steps in the speed control publication) and manually move the actuator throttle plate to the de-energized position. You should feel no binding or sticking of the throttle plate.

ATB Selection Chart

ATB – xxxTx – a – y – vv

Actuator Throttle Body

Bore ∅ mm
45
55
65
75
85
95

Throttle Housing Size
2 (medium bore)
3 (large bore) .

Electric Actuator Model
T2
T3

a = Electrical Options	
N	Standard version
N1	With finned heat sink for high temperature
F	With position feed back sensor

y = Mechanical Options	
blank	Standard
2	Corrosive Environment

vv = Operating Voltage	
12	12 VDC
24	24 VDC

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Examples for Ordering:

ATB-552T2-F-2-12
or
ATB-652T2-N-24 (no mechanical options)

Optional Connectors and Cables:

EC-1300 Mating Connector for Actuator
CH-1220-Lxx Cable 2x1 mm^2 with mating connector (xx = length in m)

EC-1800 Mating Connector for Feedback Sensor
CH-1209AB-Lxx Cable 3x $mm^{2,}$ shielded, with mating connector (xx = length in m)

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

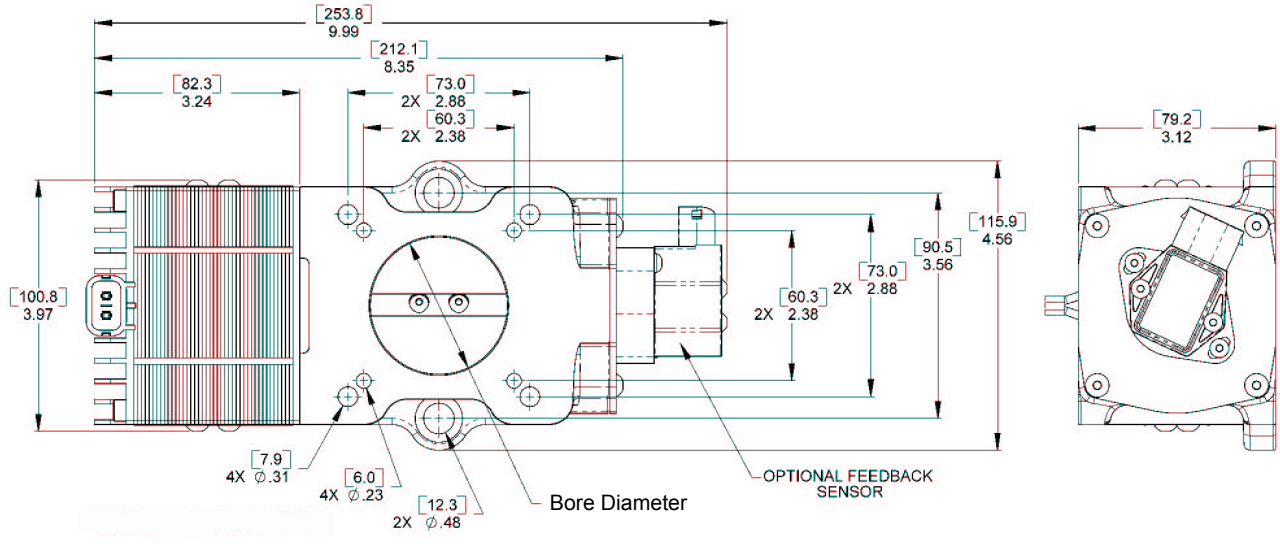
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Dimensions

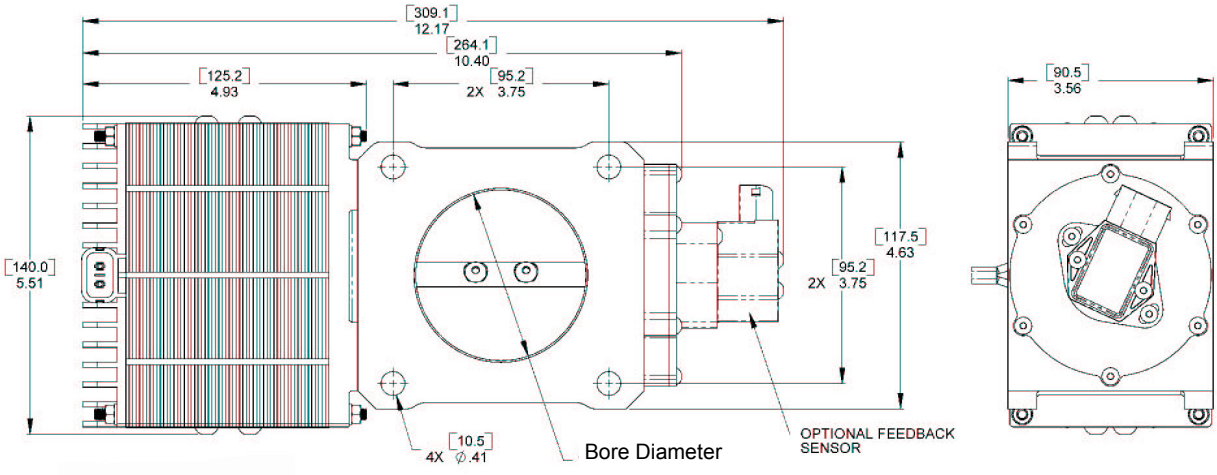
Throttle Housing Size 2 (Medium Bore) Diameters 45, 55, 65 mm, Voltage 12 or 24 VDC

Bore diameter	ATB without Position Sensor	ATB with Position Sensor
45 mm	ATB-452T2-N-vv	ATB-452T2-F-vv
55 mm	ATB-552T2-N-vv	ATB-552T2-F-vv
65 mm	ATB-652T2-N-vv	ATB-652T2-F-vv
65 mm	ATB-652T3-N-vv *)	ATB-652T3-F-vv *)
*) with el. actuator of size T3		



Throttle Housing Size 3 (Large Bore) Diameters 65, 75, 85, 95 mm, Voltage 12 or 24 VDC

Bore diameter	ATB without Position Sensor	ATB with Position Sensor
65 mm	ATB-653T3-N-vv	ATB-653T3-F-vv
75 mm	ATB-753T3-N-vv	ATB-753T3-F-vv
85 mm	ATB-853T3-N-vv	ATB-853T3-F-vv
95 mm	ATB-953T3-N-vv	ATB-953T3-F-vv

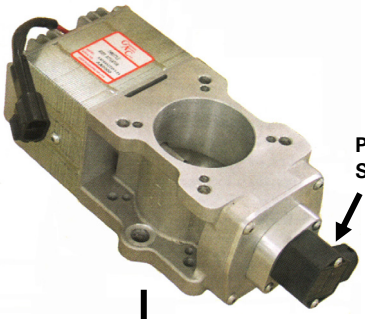


HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

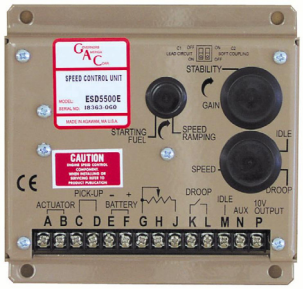
Selection of suitable GAC Control Units for ATB series Electric Throttles



12 Volt or 24 Volt

ESD 2401 – Economic Control

- For single, isochronous operation
- Measures actuator current for enhanced control
- Low cost – Precise speed control
- Extremely rugged, hard potted packaging
- Easy installation and adjustment



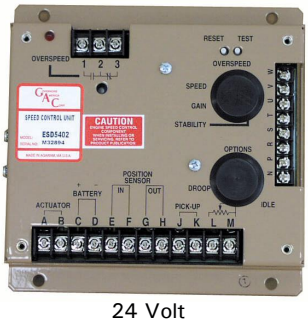
12 Volt and 24 Volt

ESD 5525E – Universal Control

- For single and parallel operation
- Isochronous and Droop speed regulation
- Fixed and All speed control. Adjustable Idle Speed
- Internal overspeed shut off with integral 10 Amp relay.
- Inputs for Autosynchroniser, load sharing, sped ramp. etc.
- Starting smoke limitation, soft ramping
- Resonant frequency suppression (soft coupling)

SDG 735-01-01

- Microprozessor based design
- Password protected for greater security
- No tool required for adjusting
- SMARTTOUCH® 16 character keypad for easy set-up / programming (No computer required
- LED bar graph for set-up and troubleshooting
- Non-volatile E^2 memory
- Overspeed protection
- Engine crank control



24 Volt

ESD 5403 Series – Position Sensor Control

- Incorporates all ESD 5525 E functions
- Works with ATB ...F versions for closed Loop position control
- Adjustable speed ramping

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

DFM 100 Dual Actuator Control Module

Introduction

The DFM100 is an accessory module whose function is to drive two independent feedback equipped electric actuators from one GAC speed control. This module is primarily installed where two fuel systems are used on a single engine. This may be two independent fuel pumps or a diesel fuel pump and a gaseous supply to the engine (Dual Fuel application).

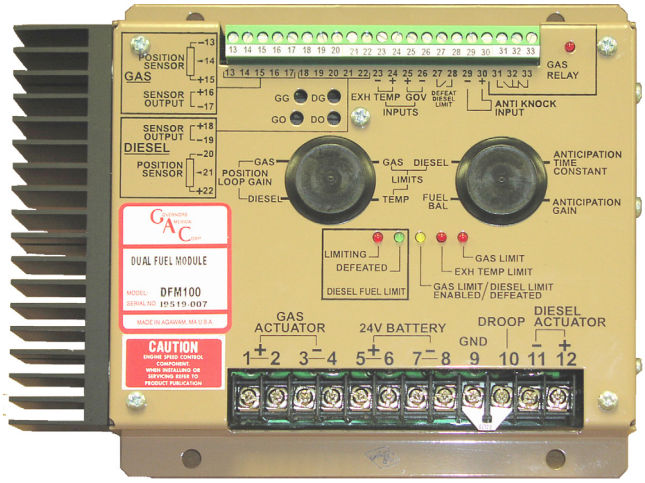
DESCRIPTION

In a Dual Fuel Pump application, the desire is to drive the two fuel pump racks equally so that all cylinders receive equal fuel levels. The actuators should be similar types with similar position sensors and equal outputs. To equalize both fuel systems, a FUEL BALANCE adjustment in the DFM100 is provided to correct for any unbalance in the fuel systems and equalize the fuel from both pumps. Any differences noted by these accurate actuator position sensors will be cancelled out by the electronics so that the position sensors will track equally throughout the range, unless the balance adjustment is used to compensate otherwise. Some mechanical calibration of the actuator linkage and the fuel rack will be required to assure that the systems are nearly alike at one fuel delivery point. This can be idle fuel or any mid point of load control. The FUEL BALANCE adjustment is then used to set equal engine cylinder power at near 100% engine load.

Each actuator driver circuit has its own actuator POSITION LOOP GAIN adjustment to optimize the feedback control loop response.

In Dual Fuel mode, two different actuator systems are typically used. One can be a standard diesel fuel pump actuator with feedback, and the other a gaseous fuel control valve with feedback.

When in Dual Fuel operation, the diesel function is usually limited to a specific level of fuel to start combustion in the engine. The lower the diesel fuel level limit, the more gaseous fuel that can be put into the engine. Too low a fuel level on the diesel side can cause serious engine problems such as high exhaust temperatures and poor combustion, so the diesel



percentage is usually set to 10-15%. To set the diesel fuel limit, a DIESEL LIMIT adjustment is provided which holds the diesel fuel constant even though the governor may be requesting more fuel. Any additional fuel must then come from the gaseous side. An LED on the unit indicates when the diesel fuel is being limited.

CONTROL FUNCTION DESCRIPTION

Defeat Diesel Limit

If for any reason it is desired to remove the diesel fuel limit, closing Terminals 27 & 28 will defeat this function and the diesel fuel will then rise to the level necessary to support the engine load.

Exhaust Temperature Measurements

The DFM100 has provisions to sense exhaust gas temperature when a Type K thermocouple is connected at Terminals 23 & 24. It is mandatory that a thermocouple be connected to the unit or these two terminals must be shorted together. An open thermocouple is considered a fault and automatically removes any fuel limiting on the diesel side. The range of exhaust temperature limit is adjustable from about 350°C to 750°C (14.2mV to 31.2mV) with the TEMP LIMIT adjustment at

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

50% of internal calibration adjustment. CW adjustment raises the temperature limit. The thermocouple is cold junction compensated inside the DFM100 so the thermocouple wire must be used all the way from the exhaust end of the thermocouple to the DFM100 terminals. An internal calibration adjustment for the thermocouple is also provided for factory setting of the Max Temperature setting, 700° (29 mV). Normal factory settings is 450°C (18.5mV)

Gas and Diesel Throttle Sensor Outputs

Terminals 16 (+) & 17 (-) and Terminals 18 (+) & 19 (-) of the DFM100 are provided for external monitors of Gas Throttle and Diesel rack positions with 0 to 1V of output range.

INSTALLATION

Refer to the Wiring Diagram for proper connections. It is suggested that the DFM100 be mounted along side the speed control. When mounting the unit, attach it to a vertical surface to prevent any moisture from collecting on the circuit board. The normal precautions outlined in the speed control literature should be followed for the DFM100 as well.

Governor Connections

The electronic control unit used with the DFM100 must be of the voltage driver type with a PWM output and not a current driver type. The ESD5111, ESD5131 and ESD5221 are the three top GAC choices to be used with the DFM100. The ESD2210, ESD2100 and ESD1000 can also be used, but since these units do not have droop functions, they cannot provide that feature. In normal actuator usage with a GAC speed control, one side of the actuator is typically at near ground level voltage. Connect Terminal B of the ESD5000 Series speed control unit, which is the low side of the actuator drive, to Terminal 26 of the DFM100. Connect Terminal A of the speed control unit, which is the high side output of the actuator, to Terminal 25 of the DFM100.

Actuator Connections

The next three paragraphs detail actuator connections based on either:

a) No Droop
b) Droop to Gas Actuator
c) Droop to Diesel Actuator

Before wiring the actuators to the DFM100 the customer must decide whether droop operation is required in the application.

No Droop

If no droop is required then connect the actuators as shown in the Wiring Diagram directly to the DFM100. Also, a jumper must be added between Terminals 9 & 10.

Droop to Gas Actuator (Actuator 1)

If your application requires droop, then the actuator used for gaseous fuel control, Gas Actuator, is best used for the droop signal. To utilize this signal, disconnect Terminal 26 of the DFM100 from Terminal B of the speed control unit. Connect the minus (-) of Gas Actuator (connection that would normally go to Terminals 3 and 4 of the DFM100) to Terminal B of the speed control unit. Also, connect Terminals 3 & 4 of the DFM100 to Terminal E of the speed control unit. Since these two cables are both handling full actuator current to the gaseous side, they must be a large wire size to handle that current. Droop may be adjusted at the speed control unit and it will be proportional to the current in Actuator 1.

Droop to Diesel Actuator (Actuator 2)

If the application requires that droop be proportional to Actuator 2, the diesel side, remove the jumper from Terminals 9 & 10 and disconnect Terminal 26 of the DFM100 from Terminal B of the speed control unit. Connect Terminal 10 of the DFM100 to Terminal B of the ESD5000 Series speed control unit. Also, connect Terminal 9 of the DFM100 to Terminal E of the speed control unit. Since these two cables are both handling full actuator current for the diesel side they must be of a large enough wire size for that current.

Other Wiring Issues

It is suggested that each position sensor cable be of a three wire shielded type with the shields connected to the case of the DFM100. Case ground (right corner screw) should be connected to battery minus (Terminal 8) with a separate cable for best EMC ratings.

The terminals labeled GAS ACTUATOR and 24V BATTERY on the DFM100 have dual connections. These dual connections are needed because the current rating for the Gas Actuator driver is over 20 Amps and the total DC current consumption for both actuators could reach as high as 30 amps. These values are larger than the rating of a single

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

terminal on the connector. Depending on the choice of actuators, the current consumption will likely be much lower. Refer to actuator publications to determine the total current consumption and appropriate wire size for the battery and actuators.

ADJUSTMENTS

Preset the adjustments on the DFM100 as follows:

- Anticipation Gain ……..……0
- Anticipation Time Constant ……..……100
- Gas Act Position Loop Gain …… 40% CW
- Diesel Act Position Loop Gain …… …… 40% CW
- Diesel Limit ……..……100
- Gas Limit ……..……100
- Temp Limit {Factory setting} ……450°C@18.5mV
- Fuel Balance …… 40
- Gas Gain (GG)……..…… 75
- Gas Offset (GO)…… ……50
- Diesel Gain (DG)……..…… 75
- Diesel Offset (DO)…… 50

For a Dual Fuel application, it best to first run the system with 100% diesel to preset the speed control system.

Start the engine and set the speed and performance adjustments per the literature for the specific speed control used. It's helpful to record the rack position on an external monitor (via Terminals 18(+) & 19(-)) vs. engine load on the diesel actuator. This will provide information on the quantity of diesel fuel vs. total power produced when in dual fuel operation.

Each actuator driver circuit has its own actuator POSITION LOOP GAIN adjustment to optimize the feedback control loop response. Adjust the Actuator Gain as high as possible without engine or actuator instability.

Note: the Speed Gain adjustment in the governing module and the Actuator Gain adjustment can interact some. It is possible to turn one up and the other down and get similar results. The Speed Loop Gain must not be turned too low or the speed control performance could suffer. Mid range or higher for both GAIN adjustments is preferable.

Once the system is proven to run well on diesel, shut down the system, leave the diesel defeat switch open, and restart the engine. With no load or a light load on the engine, the engine should run stable.

Apply greater load to the system. When the load level is above 40%, adjust the DIESEL LIMIT CCW until the diesel fuel level reaches not less than 15% as determined by the data taken above from the position sensors signal when the engine was run on diesel only.

Caution

The exhaust temperature can run very hot on some diesel engines with dual fuel, which can ruin the engine with excessive heat. Monitoring the exhaust temperature is mandatory. Also, note that the exhaust temperature may vary from cylinder to cylinder and where the temperature is taken in the exhaust steam could be a cooler than normal spot and provide false security.

Continue to apply load, noting that the diesel fuel should be holding at a fixed level (DIESEL ACTUATOR FUEL LIMIT LIMITING LED ON). As the load increases, the gas valve will be opening more and more. If the exhaust temperature rises too high, or the engine does not accept higher amounts of gas, adjust the diesel limit higher to stay out of the high exhaust temperature operating area. If the EXH TEMP LIMIT is reached, the Diesel Limit will be automatically defeated.

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Maximum Gas Limit

If it is desirable to limit the maximum gas supply (opening of the gas controlling actuator) to the engine, the GAS LIMIT adjustment may be turned CCW until the GAS ACT LIMIT LED comes ON. Once the Gas Limit has been reached (Gas Act Limit LED turns ON) the Diesel Limit is then defeated and any further load applied to the engine will be supplied via the diesel fuel system up to the maximum of the engine's capacity.

Anticipation Adjustments

Two adjustments are provided which affect the load dynamics on the diesel side of the fuel control. The purpose of the anticipation feature is to defeat the Diesel Limit when a sudden load change occurs. The magnitude and time constant of the anticipation signal to defeat the limit is adjustable.

Apply a step load of at least 50%. Adjust the ANTICIPATION GAIN adjustment CW so that the diesel fuel increases during the transient. A higher setting will reduce the off-speed load transient. Next, adjust the ANTICIPATION TIME CONSTANT so that the off-speed transient has the shortest time off-speed. Between these two controls, it should be possible to provide a near optimum transient response with the diesel fuel or operation that approaches diesel fuel performance alone.

Gas and Diesel rack position-monitoring calibration

With power applied to the DFM100 before start the engine voltage at the Terminals 16(+) & 17(-) should be adjusted to zero Volts by the Gas Offset (GO) for the Gas rack position and at Terminals 18(+) & 19(-) by the Diesel Offset (DO). At maximum Gas and Diesel rack positions the voltage at the above-mentioned terminals should be 1 Volt and can be adjusted by Gas Gain (GG) and Diesel Gain (DG) respectively.

SPECIFICATIONS

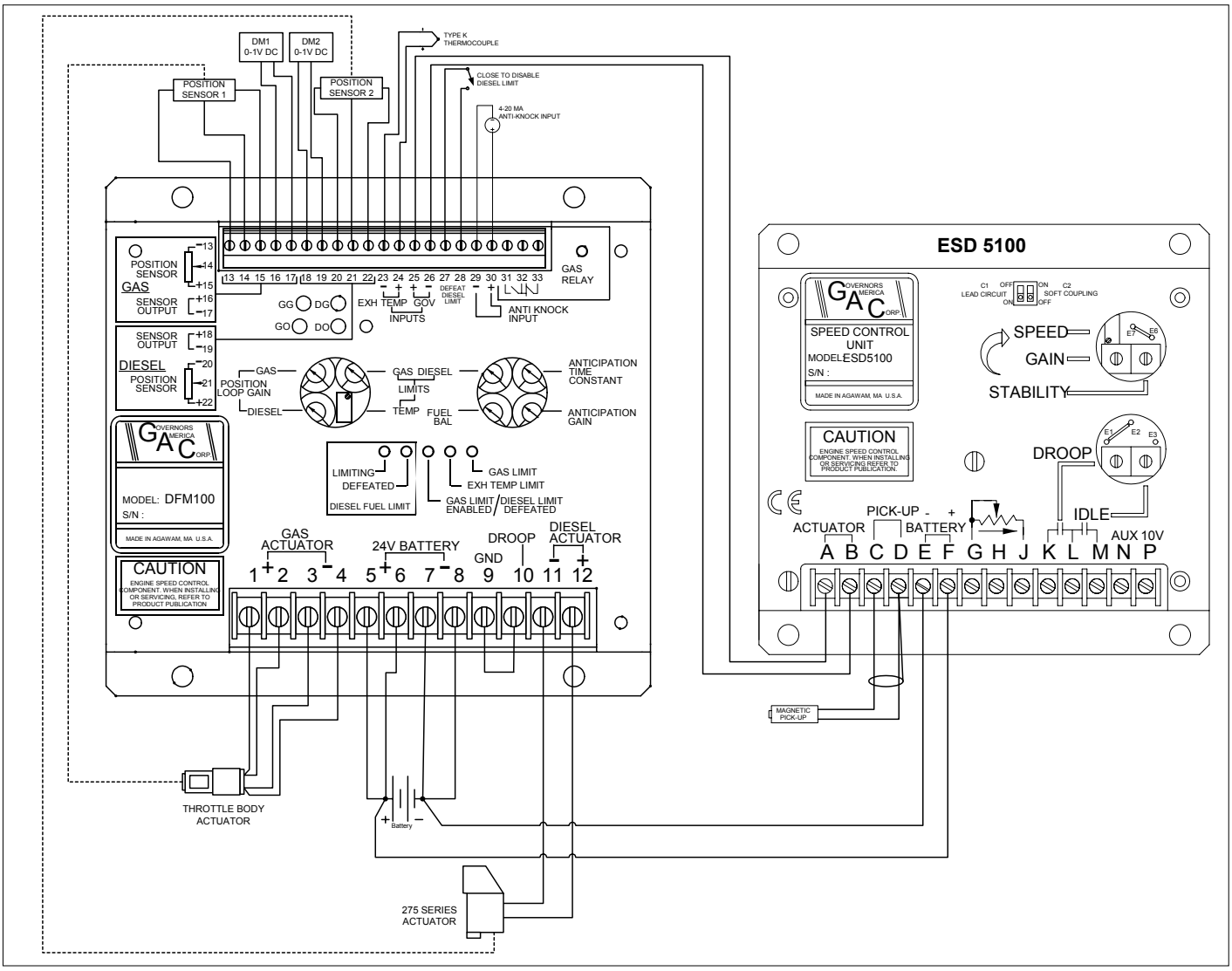
DC Input Voltage…… 18 - 32 Volts DC (Nominal 24V DC)
…… Transient protected to +/-250V DC
Actuator 1 Current…… up to 25 Amps, Short Circuit protected
Actuator 2 Current……up to 15 Amps, Short Circuit protected
PWM Drive from Governors …… 550 Hz from 12-32 VDC, Max amplitude
Actuator Position Sensors…….. 5V DC excitation, 1 to 4V DC outputs

Thermocouple…… Type K, i.e. 1.0 mV = 25°C, 22.3 mV= 540°C (1000°F)
…… Cold junction compensated above 0°C
Operating Temperature…… - 40°C to +85°C
Humidity…… up to 100%
Vibration…… TBD
Shock…… …… TBD
EMC …… Meets GAC specifications

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com



Wiring Diagram

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

KNOCK MONITORING SYSTEM

DENOX 8
DENOX 16

DESCRIPTION
USER MANUAL

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

1 Table of Contents

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

2 Features

- Knock monitoring
- Useful especially for gas engines running on fuel with unstable quality
- It is possible to connect up eight (DENOX8) or sixteen (DENOX16) knock sensors
- support for IN-LINE a V-ENGINES
- Analog outputs to ignition unit for timing regulation
- Binary output - engine knocking
- Binary output - load reduction
- Binary output - trip (emergency stop)
- Mechanical ruggedness

WARNING!!!

Caution high Voltage!
Danger to life!

In no event should the ignition sensor be touched, removed or disconnected whilst the engine is running!!!

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35
e-mail: sales@huegli-tech.com
www.huegli-tech.com

3 DENOX Function Description

Principle of Knocking Detection

During detonating combustion vibrations are generated. Their frequency is typical for specific engine type. DENOX measures vibration energy in narrow frequency band, where knocking is expected. This energy correspond to knocking level. Measurement is executed only during specific section of working cycle, where detonating combustion is possible. This increases sensitivity and improves immunity against random noise.

Control Function:

DENOX has three binary outputs:

TRIP

ENGINE KNOCKING

UNLOAD

and two analog outputs for TIMING REDUCTION:

0 – 5 V voltage output
and 4 – 20 mA current loop

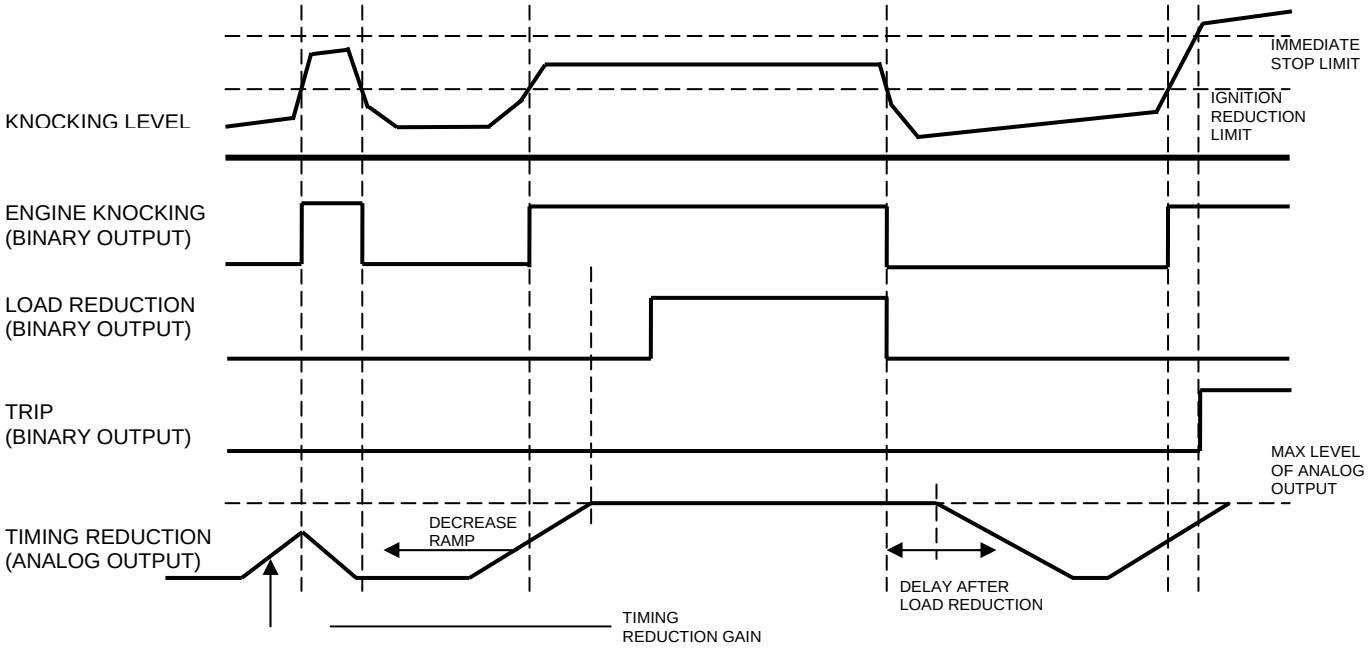
Both analog outputs work concurrently. User should choose relevant output according to ignition unit input for timing reduction (please consult manufacturer of ignition unit).

Measured knocking energy in every working cycle is compared against adjustable limit - "IGNITION REDUCTION LIMIT". If the limit is reached, output "ENGINE KNOCKING" is activated. At the same time analog outputs increases its value. When knocking energy falls under the limit, value of analog outputs decreases. Decreasing rate is depended on "DECREASE RAMP" parameter.

If full scale of analog outputs is reached and engine is still knocking, "LOAD REDUCTION" output is activated. It should be connected to controller and used as command for power reduction.

When engine stops knocking, output "LOAD REDUCTION" is deactivated, but analog outputs remain at full scale for another period which can be set BY "DELAY AFTER LOAD REDUCTION" parameter and begin decrease after this period elapses. This period should be longer than time engine require to reach full load again.

The last binary output "TRIP" is activated when knocking energy is greater then "IMMEDIATE STOP LIMIT" It should be used as emergency stop signal.



HUEGLI TECH AG (LTD)
The Engine & Genset Control Company
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35
e-mail: sales@huegli-tech.com
www.huegli-tech.com

4 Installation

Custom installation is possible only for these engine types for which configurations files exist, as well as photo or drawing for sensor(s) location.

Denox16 connection should be done according to wiring diagram in appendix A1

Denox16 connection should be done according to wiring diagram in appendix A2

Binary output can be connected in either polarity. They are galvanic separated.

Ignition sensor shielding should be connected only at DENOX side.

Acceleration sensor(s) mounting should be done according to fig. 5.4. Their location should be done according to photos and/or drawing for specific engine type.

Monitor software configuration

Please run SETUP to install monitor program on your computer. Program requires win95/98 or NT4.0 operation system. Setup creates shortcut in Programs group. Launch DENOX16 to run the program (same version for both DENOX8 and DENOX16 units).

Connect DENOX unit with PC via null-serial modem cable. Choose appropriate COM a press Connect button.

If connection is successful virtual LED "connected to DENOX must lit and firmware version should be viewed. If Discon button is pressed COM port is released.

When connection is established, all parameters from denox unit are read and all software controls are updated to current values. It is possible to save them to file via SAVE PAR button.

New parameters can be loaded to denox unit from file via LOAD PAR button.

VERRIFY PAR button allow to check current denox parameters with previously saved parameters. Current parameters are not modified in any way.

When particular parameter is changed it is immediately written to denox16 unit EEPROM and valid till changed again.

Please refer to appendix B for detailed program function description a parameters meaning.

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35
e-mail: sales@huegli-tech.com
www.huegli-tech.com

5 Technical Specification

5.1 DENOX – Knock sensor

DENOX – Knock sensor	
Parameter	**Specification**
Knock sensor	Piezoelectric acceleration transducer
Frequency range	1 kHz – 20 kHz
Resonance frequency	> 20 kHz
Temperature range	-40 ÷ +130°C
Dimension - sensor	45 x 20 x 21 mm
Sensor mounting	M8 x 25 (cast iron) M8 x 30 (aluminium)

5.2 DENOX 8/16 – Electronic unit

DENOX CU – Electronic unit	
Parameter	**Specification**
Binary outputs	all three outputs have one common terminal, max. voltage is 33V, max. load current is 50mA
Analog outputs	1) 0 to 5V, max. load current 2mA 2) current loop 4-20mA max. voltage 30V.
Temperature range	-25 ÷ +70°C
Power supply	9 to 36 V DC
Degree of protection	IP 20
Dimension – electronic unit	160 x 200 x 46 mm (including DIN rail clamp)
Weight	1 kg
Electronic unit mounting	DIN rail mounting

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35
e-mail: sales@huegli-tech.com
www.huegli-tech.com

5.3 DENOX – ISU Ignition Sensor

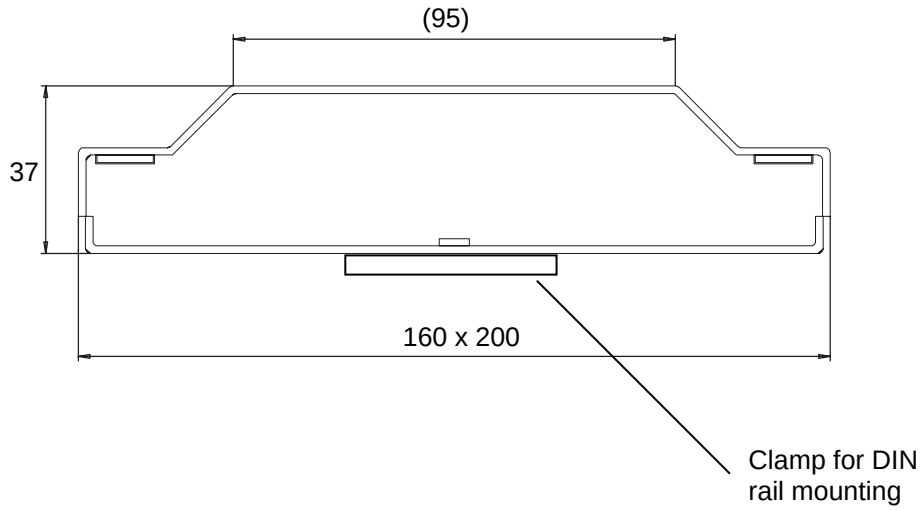
DENOX – ISU Ignition Sensor	
Parameter	**Specification**
Ignition sensor unit	Ignition coil current sensor
Temperature range	-25 ÷ +70°C
Dimension	70 x 46 x 48 mm (including DIN rail clamp)
Weight	0.1 kg
ISU mounting	DIN rail (supplied)

HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

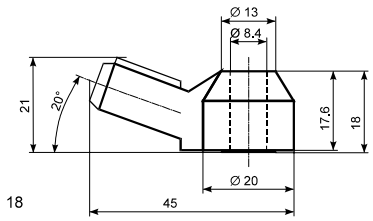
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

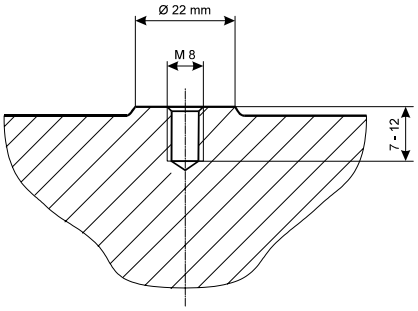
e-mail: sales@huegli-tech.com
www.huegli-tech.com

5.4 Denox Dimension



5.5 Sensor mounting





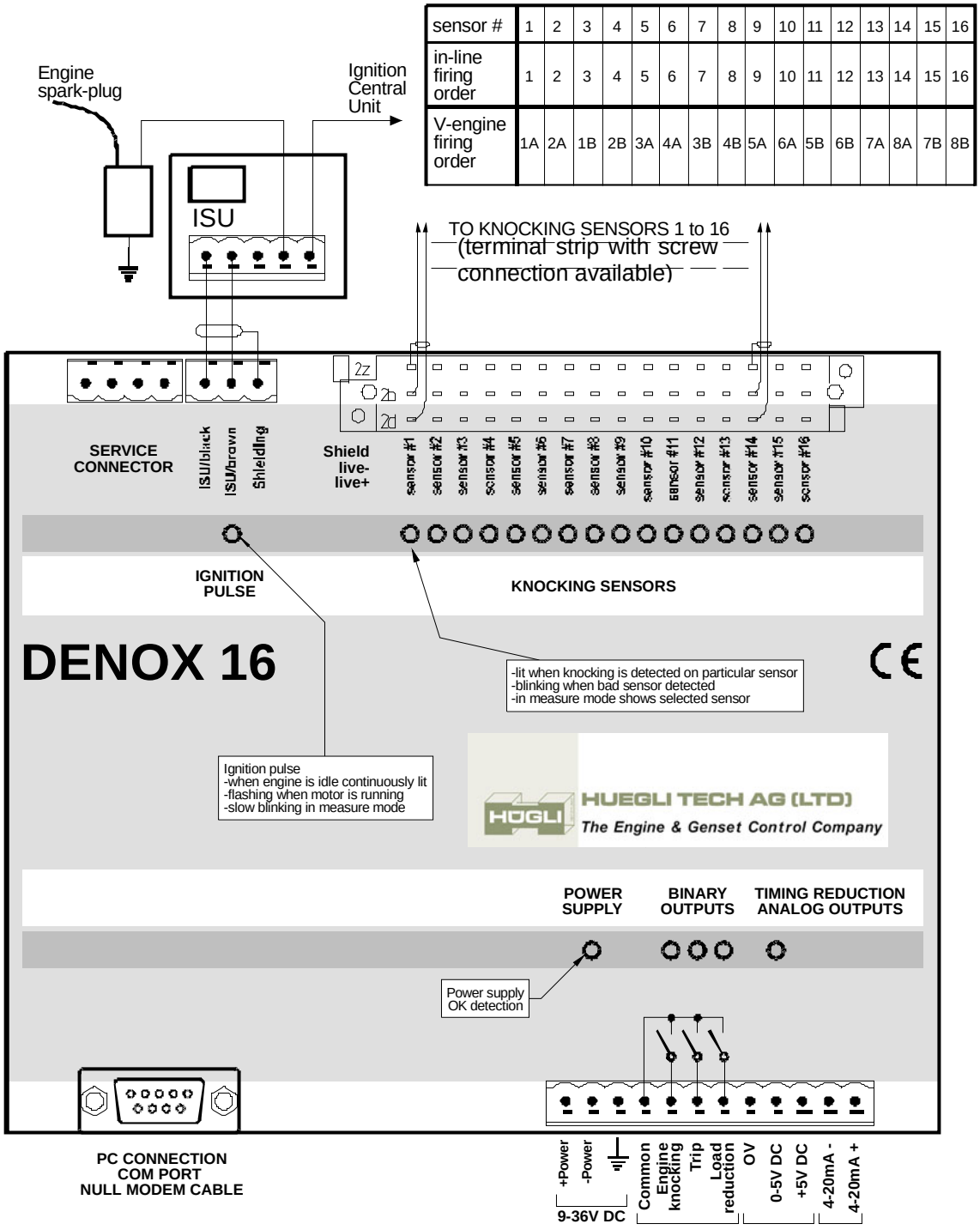
HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

A1 DENOX 16 WIRING DIAGRAM

sensor #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
in-line firing order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
V-engine firing order	1A	2A	1B	2B	3A	4A	3B	4B	5A	6A	5B	6B	7A	8A	7B	8B



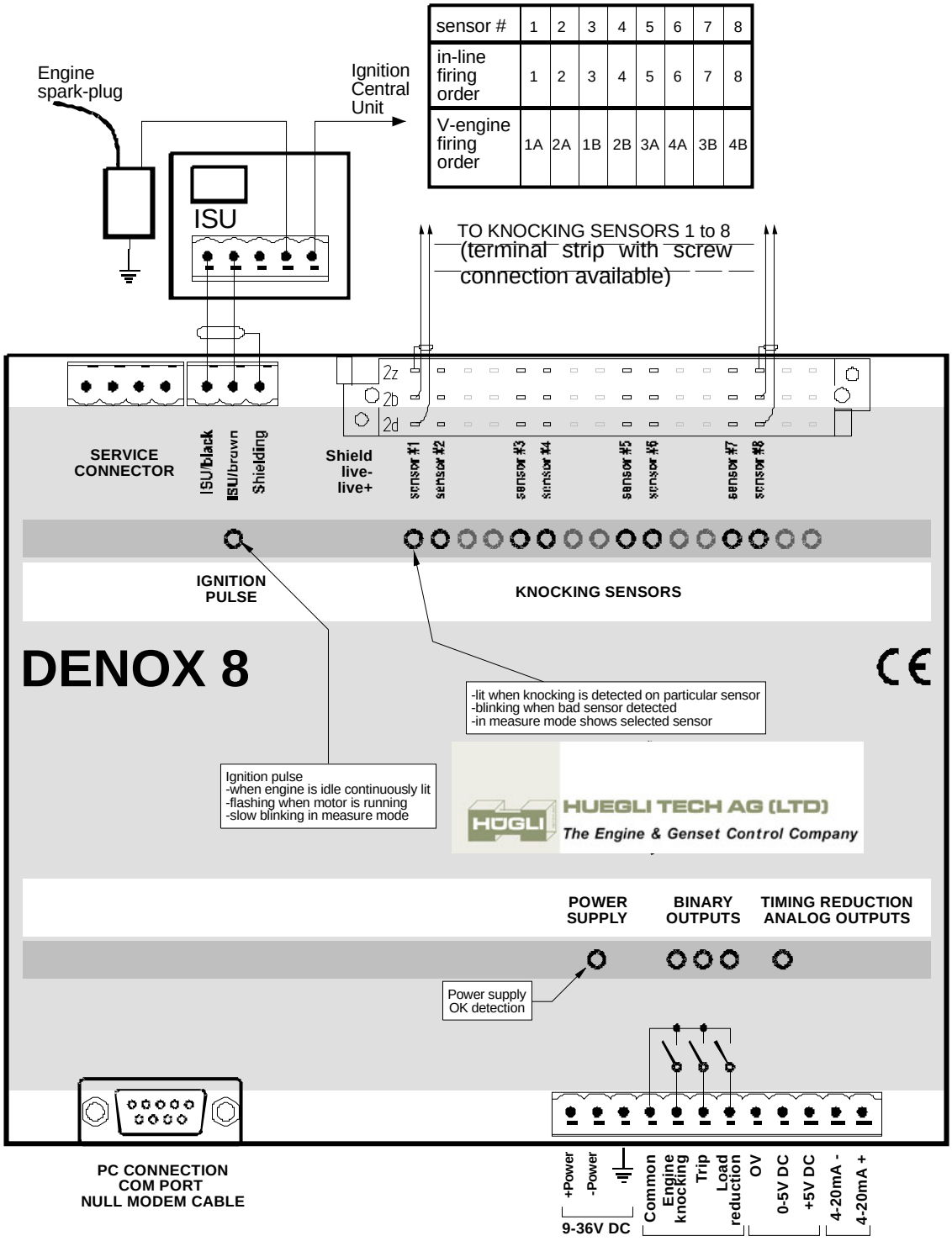
HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

A2 DENOX 8 WIRING DIAGRAM

sensor #	1	2	3	4	5	6	7	8
in-line firing order	1	2	3	4	5	6	7	8
V-engine firing order	1A	2A	1B	2B	3A	4A	3B	4B

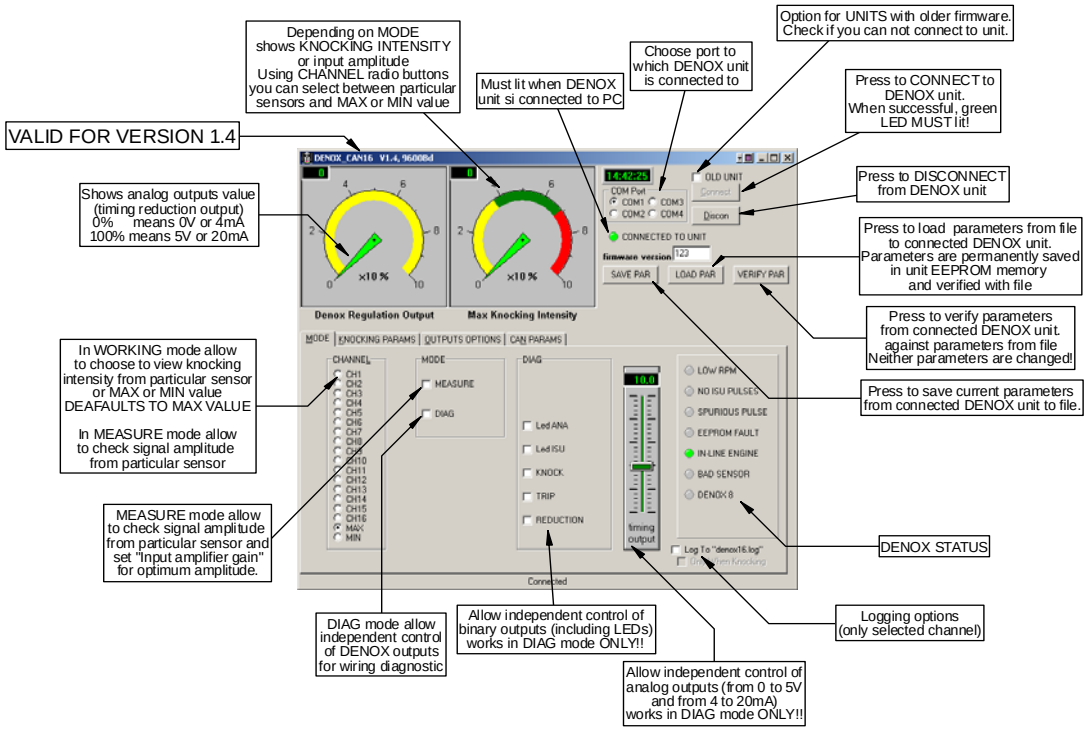


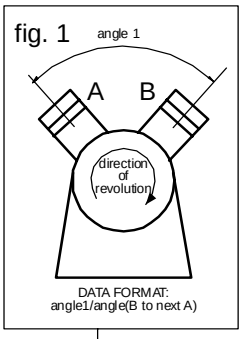
HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

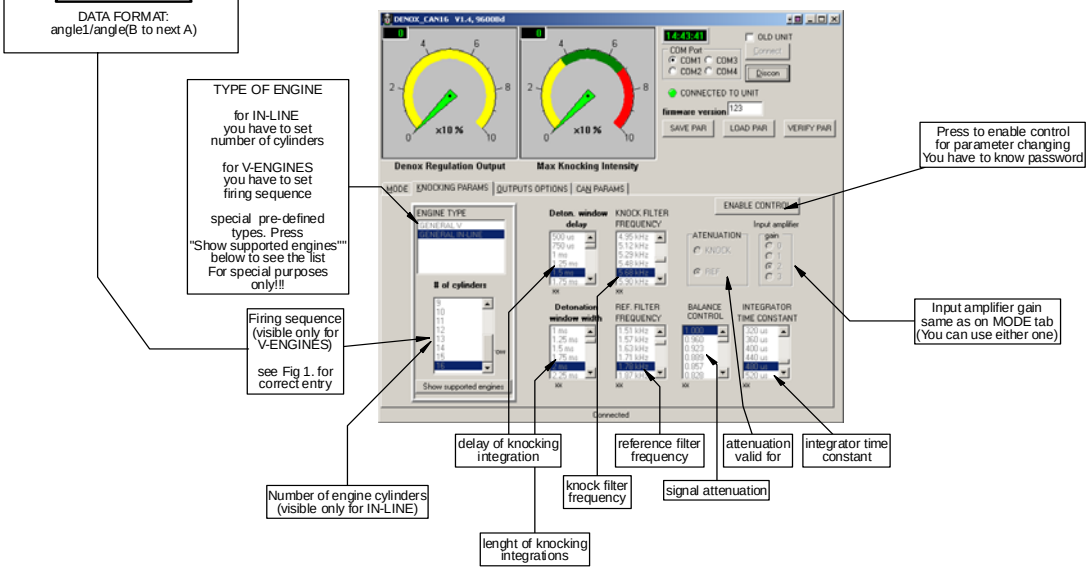
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

B. DENOX MONITOR SOFTWARE



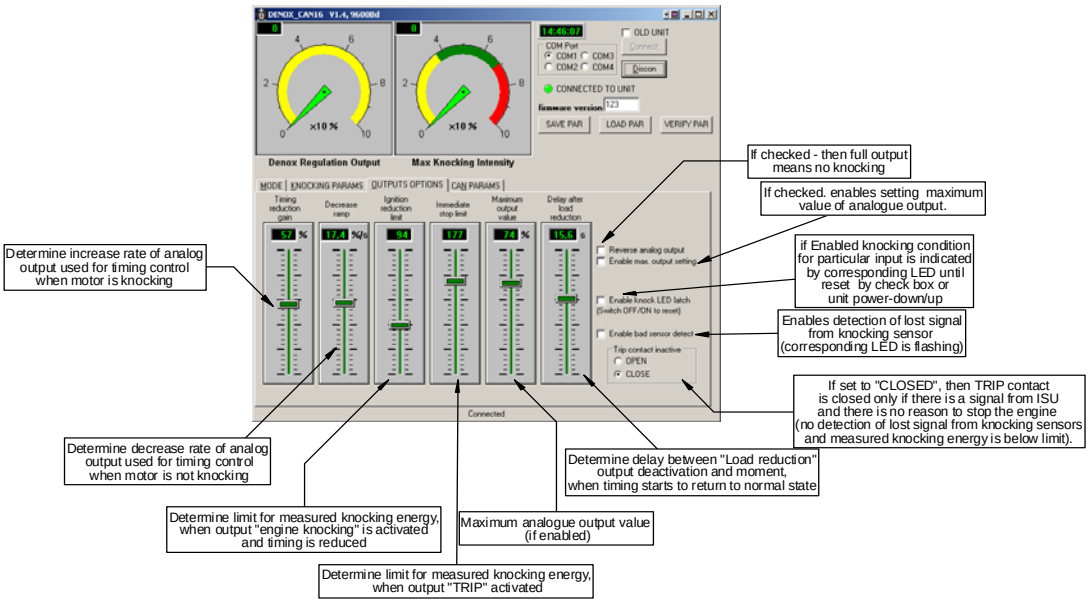




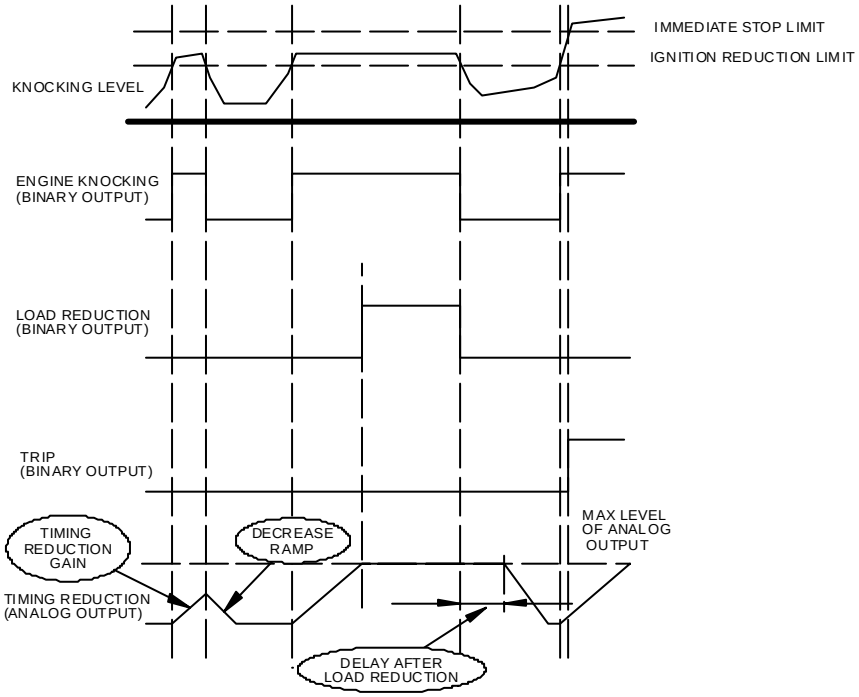
HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com



note: CAN specific options are described in separate manual



HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

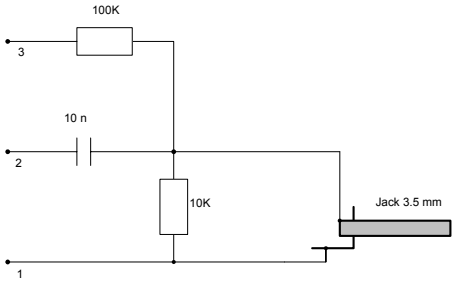
e-mail: sales@huegli-tech.com
www.huegli-tech.com

Knock analysis via PC Sound visualisation Software:

Denox provides a feature to monitor the engine sound and reccord this via a PC monitoring sound software. Any sound software can be used which allows frequency analysis with the Blackmann-Harris filter. *(A Blackman-Harris full window is applied in frequency domain. This results in an attenuation of both the lower and higher frequencies, while the mid-band frequencies are not attenuated.)*

Therefore the service connector from Denox is connected via a special cable (see Pic:1 below) to the Lap Top microphone input port. With the sound software it is possible to reccord the sound of the engine and also detect the knocking frequency.

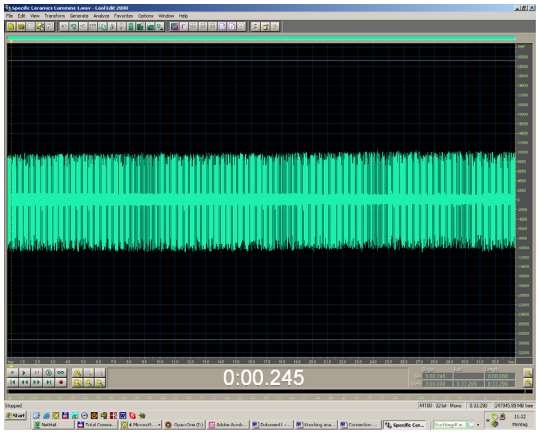
Pic:1



In order to analyse the knocking frequency, it will be necessary to reccord the engine not knocking and knocking in order to have a comparison. The best way of doing this is to start the engine and switch to dual fuel at 100% load with the Diesel Limit set to FCW.

Once the DFM 100 is in dual fuel mode, start to reccord via the sound software and turn the Diesel Limit slowly CCW. The engine temperature will start to raise than more diesel is substituted by gas. Turn the Diesel Limit so far CCW until the engine starts to knock. Remain there for half a second and then turn the Diesel Limit back to full fuel.
In Pic:2 a reccord is shown which has been recorded as mentionied above.

Pic:2



HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

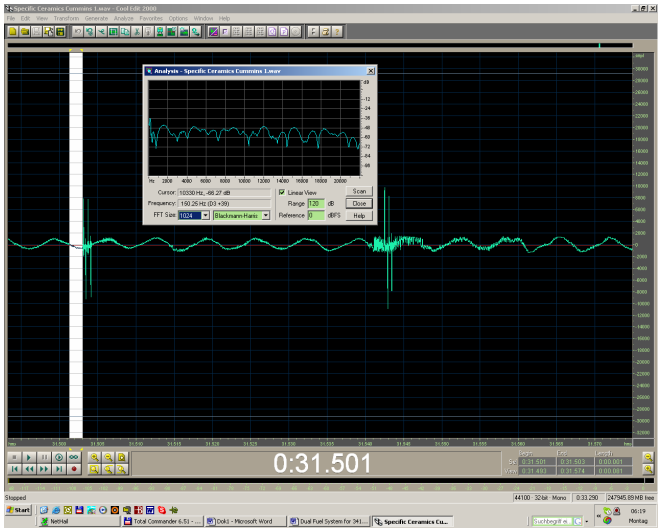
Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

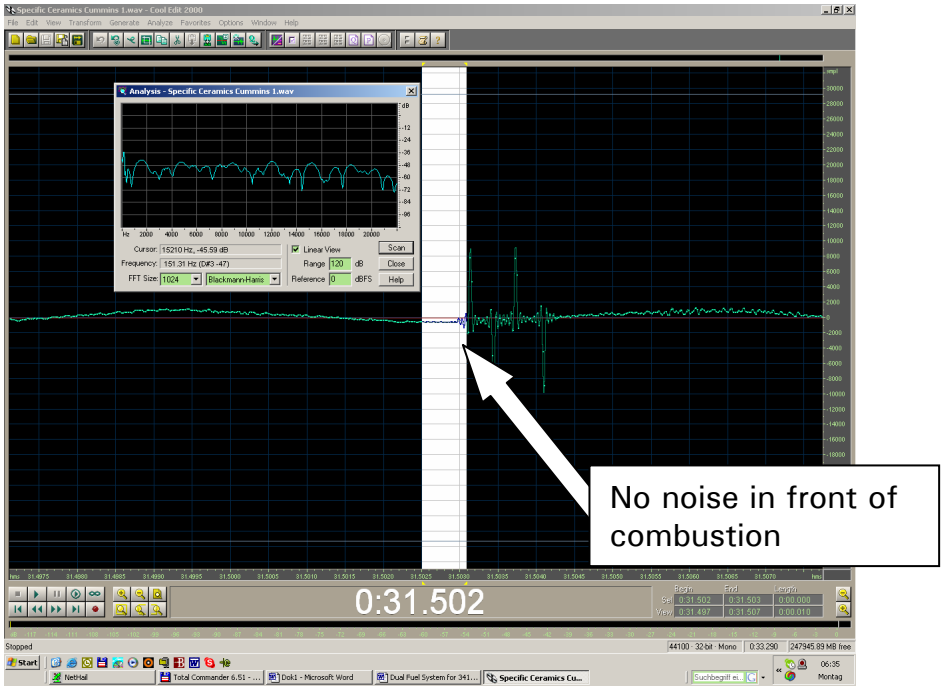
Stop recording in the sound software just after the Diesel Limit is turned back to FCW. Safe the file to your hard drive for later use and reccord.

Now it will is possioble to analyse the knocking frequency via Blackmann-Harris filter. Therefore select a part of the file reccorded where the engine is not knocking and analyse the frequency just in fornt of combustion.
Picture 3 shows a normal combustion with frequency analysis. The higlighted area is a few degrees beofre the actual combustion takes place.

Pic:3



Zoom of Pic:3



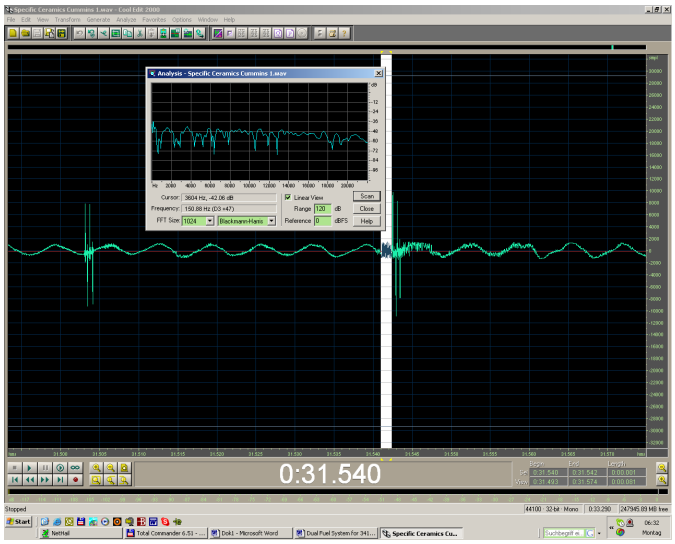
HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

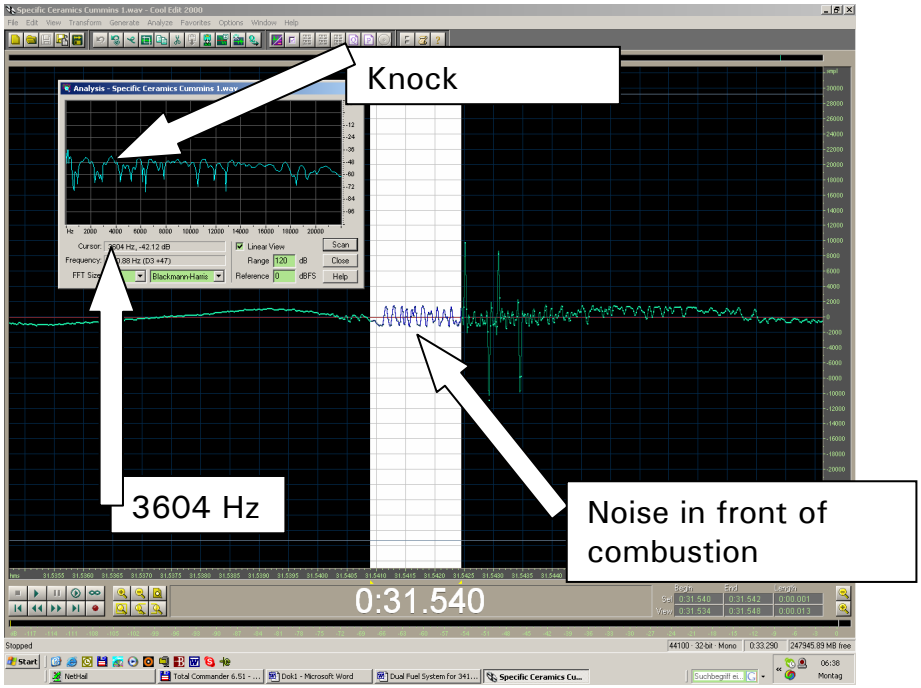
e-mail: sales@huegli-tech.com
www.huegli-tech.com

Picture 4 shows at the highlighted area that before the actual combustion, some smaller detonations exist, before the real combustion takes place. This frequency is determined as knocking frequency. In the frequency analysis made by Blackmann-Harris indicates that the knocking frequency is at approx: 3604 Hz.

Pic:4



Zoom of Pic:4



HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Reference List

Pakistan: Year of installation: 2003-2004
R.A. Engineering Karachi. Mr. Qazi Rashid
Cummins NTA 855, KTA 19, 38 and 50, all engines operating with 30% Diesel 70 % Gas. Total sets converted, 15 pcs.

India: Year of Installation 2004-2005
Madhura Int. Pune, Mr. Ram Shinde and Hi-Tech Ahmedabad Mr. Rajuh
CAT 3412, 1 engine converted, brand new. Ratio 30 % Diesel 70 % Gas

India: Year of Installation 2004-2005
Madhura Int. Pune, Mr. Ram Shinde
KTA 19 Total sets converted, 2pcs. Diesel 35 % Gas 65 %

India: Year of Installation 2004-2005
Madhura Int. Pune, Mr. Ram Shinde
Volvo TD 710 6 Cylinder, 1 pcs. 30% Diesel 70 % Gas.

China: 2005
Jones Engineering Hong Kong, Mr. Dennis Chung
Jinan 12 Cylinder 190, 1 pcs, order in hand for 4 more sets within 2005. Engine is operating with 20 % Diesel 80 % Gas.

Egypt: 2005
Power House, Mr. Ahmed Taher
CAT 3406 1pcs, engine operating at 28% Diesel, 72 % Gas

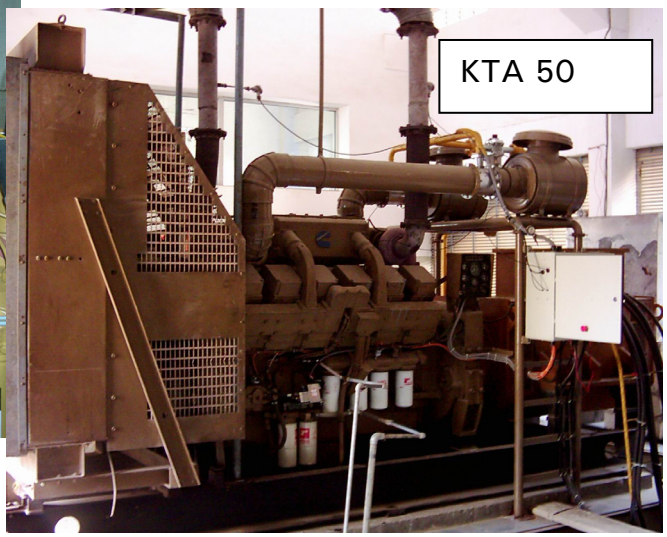
Germany: 2004
Nutsen, Mr. Steinmeier Reinhard
MAN 2840 1 pcs, engine operating with Bio Gas at 8 % Diesel, 82 % Gas.

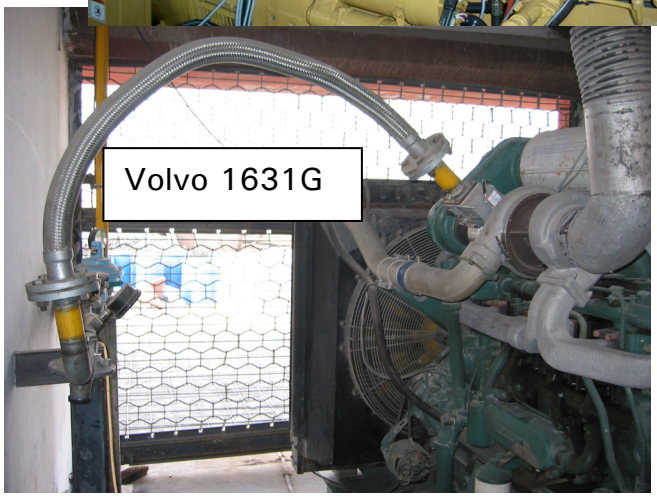
HUEGLI TECH AG (LTD)
The Engine & Genset Control Company

Murgenthalstrasse 30
4900 Langenthal Switzerland
Phone: +41 (0)62 916 50 30
Fax: +41 (0)62 916 50 35

e-mail: sales@huegli-tech.com
www.huegli-tech.com

Photo Gallery of various applications





and many more.....