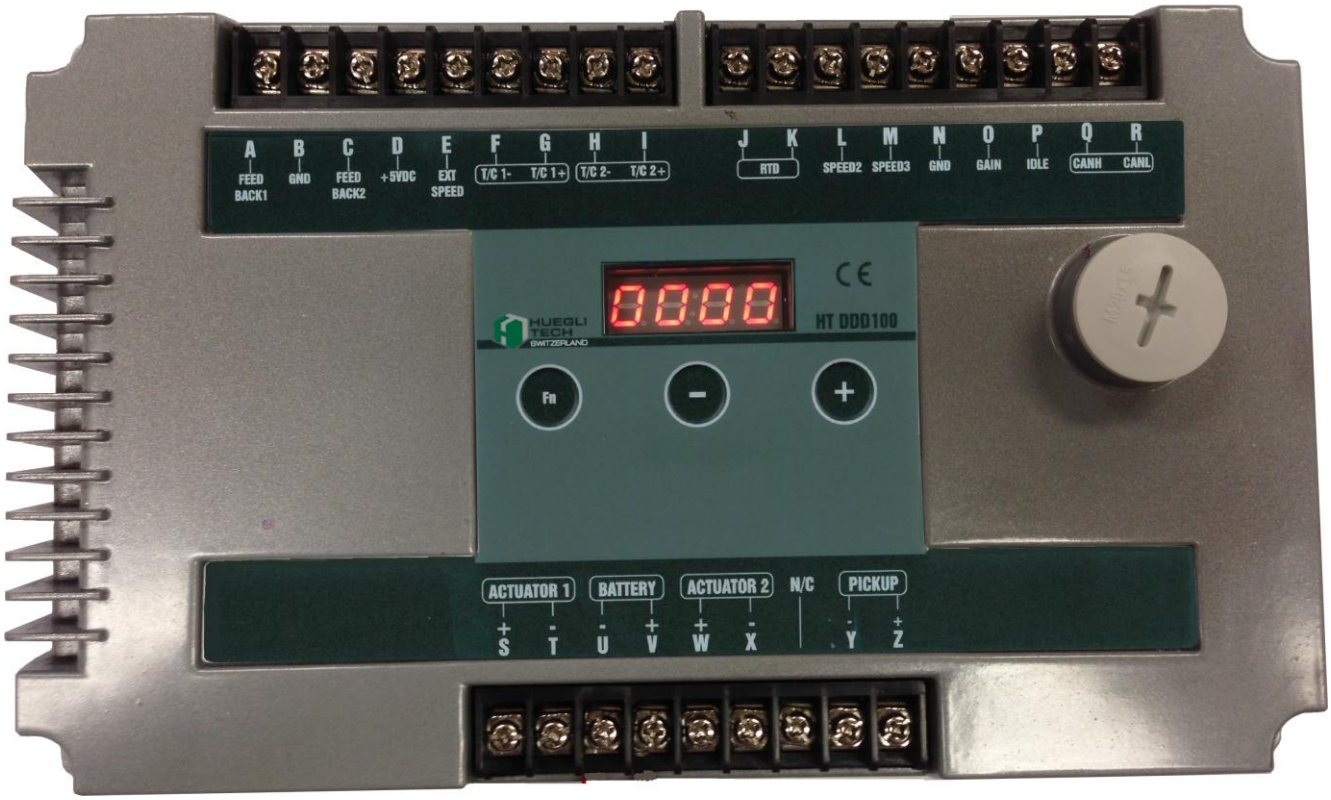
# HT-DDD100

# Digital Dual Driver Governor

# Instruction manual




Doc. No.: HT-DDD100_MN_DE_02.12.2015
Version: 1.2
Edition: 02.12.2015

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# Installation declaration (for an incomplete machine)

## Installation declaration

**(Directive 2006/42/EC, Appendix II B)**

The manufacturer, Huegli-Tech AG, hereby declares that the incomplete machinery:

General description:

**DDD100** complies with the basic health and safety requirements of machinery directive 2006/42/EC Appendix I.

The special technical documents in compliance with Appendix VII part B have been produced.

The incomplete machine corresponds with the following other EC directives:
Low tension directive 2006/95/EC

The following harmonised norms were applied:

EN ISO 12100-1; EN ISO 12100-2; EN ISO 14121-1;

The special technical documents are transmitted in electronic form as required by individual state offices.

**Operating the incomplete machine is not permitted until the incomplete machine is built into a machine that conforms to the provisions of the machinery directive and an EC conformity declaration in compliance with Appendix II A is provided.**

# 1 General

## 1.1 Introduction

The DDD100 is a Digital Dual Driver Governor for controlling motor rotation speed on single engines that require dual fuel pumps or throttle body actuators. The governor features fast and precise reaction to load changes.

DDD100 utilizes feedback from the Master and Slave Actuators and also the EGT (Exhaust Gas Temperature) via thermocouple to achieve optimum fuel equalization in each cylinder bank. The feedback from the Actuators allows the DDD100 to know if there is any fuel supply imbalance to each of the cylinder banks. The EGT feedback provides an indication of the power produced from each cylinder, which further eliminates any possibility of fuel supply imbalance resulting from mechanical tolerances and friction. Any fuel imbalance will be compensated by the DDD100 intelligent software algorithm to ensure that fuel supplies to each cylinder banks are always identical and balanced.

A closed control circuit using two actuators (Master and Slave), two temperature sensors (Master and Slave) and magnetic RPM sensor can be operated for a large number of motors in both an isochronous and static fashion. High precision and robust construction makes it possible to use in the harshest motor use conditions.

The microcontroller design provides precise and user-specific performance and functionality. The DDD100 enables exact (<0.25%) isochronous rotation speed control. The permanent memory saves the settings even if the power supply is interrupted and thanks to a wide voltage range of 12-24VDC.

## 1.2 Safety instructions and Warnings

Before installing and starting the device, please read the operating instructions. These contain important notes for safety and use.
No liability can be accepted for damage arising from failure to follow the instructions or any inappropriate use.
The governor may only be used for the manner of operation prescribed in the operating instructions and only in connection with third-party devices and components recommended or installed by us or software supplied by us. Any other use shall be considered inappropriate use and will result in the voiding of all liability and warranty claims against the manufacturer.
Interventions and alterations that influence the safety technology and the functionality of the governor may be carried out only by the manufacturer. Fault-free and safe operation is conditional upon competent transport, assembly and installation as well as qualified use and correct maintenance.
All relevant accident prevention regulations and other generally recognised technical safety and health and safety at work rules are to be observed. Fault-free functioning of the machinery and its peripheral components is only guaranteed with original accessory parts and spare parts.

The DDD100 digital dual driver governor is robust enough to be placed in a control cabinet with other operating control devices or installed on the motor. If water, mist or condensation can come into contact with the controller, it should be mounted vertically, allowing the liquid to flow away from the controller. Extremes of heat should be avoided.

***Overspeed protection***

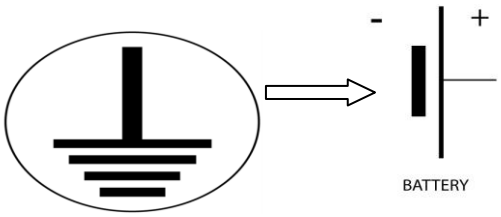
**IMPORTANT**

- An overspeed shut down mechanism must be installed separately from the control system as a safety measure, to prevent motor faults that may result in damage or injury to machinery or persons.
- A secondary shut down device (fuel valve) must be installed.

***Safety protection***

**IMPORTANT**

- Protective Earth (PE) must be connected with Battery Minus terminal always.




## 1.3 Guarantee terms and conditions

***Correct use***

The device is intended for exclusive use under the conditions described in the "Technical Data" rubric. Other uses are potentially dangerous. Huegli-Tech AG cannot accept liability for damage which results from incorrect use or application other than that for which it was intended.

***Use of Accessories***

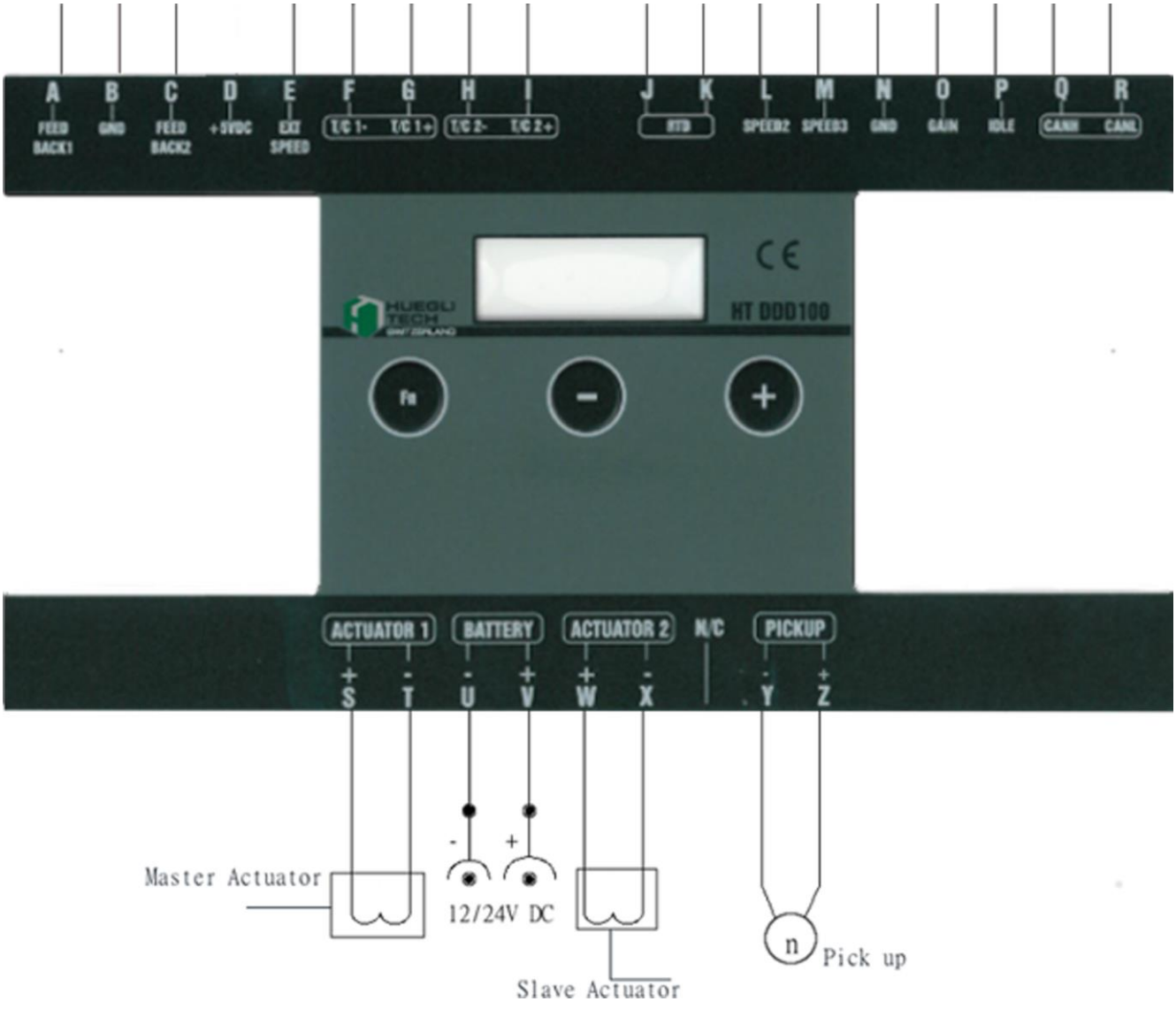
Accessory parts may be installed or added only when they have been explicitly authorised by Huegli-Tech AG. Any claims under guarantee, warranty or product liability shall be void if other parts are used.

The general guarantee terms and conditions of Huegli-Tech AG shall apply.

# 2 Installation and connection

## 2.1 General information

The pickup cable should be shielded to guarantee that no electromagnetic interference can reach the engine speed governor. The shield should be on-side on the battery negative.
To maintain the correct distance between the flywheel and the RPM sensor, the sensor must be rotated in until the flywheel clicks and then rotated out again for ¾ of a rotation. This achieves the correct spacing between flywheel and sensor. To be able to start the motor, the RPM sensor must generate at least 1V AC RMS during the start.



Cross-section of the battery and actuator cable at terminals S, T, U, V, W and X: 1.5 $mm^2$ for 24 VDC or 2.5 $mm^2$ for 12 VDC
For longer cables (>5m) the cable cross-section is to be increased appropriately to keep the voltage drop low.

- Battery positive (+) input, connection V, should be fused 8 A.
- The governor should be installed such that the housing has a connection with the chassis of the control cabinet.
- The cable of the actuator must be shielded along its entire length.
- The cable of the magnetic engine speed sensor must be shielded along its entire length.
- The cable of the variable RPM speed input can be up to 5m long. For longer runs, a shielded cable must be used.
- The shielding must always be grounded such that it does not come into contact with the chassis of the machine. This is to prevent scatter signals from entering the governor and causing interference. The shield must be grounded at one end.

## 2.2 Connection terminals

| Connection terminal | Description | Definition |
|---|---|---|
| A | FEED BACK1 | Master Actuator position |
| B | GND | Ground/chassis |
| C | FEED BACK2 | Slave Actuator position |
| D | +5VDC | Master and Slave actuator feedback supply |
| E | EXT SPEED | Load distribution / synchronisation |
| F | T/C 1- | Master engine temperature input (Thermo couple input+) |
| G | T/C 1+ | Master temperature input (Thermo couple input-) |
| H | T/C 2- | Slave temperature input (Thermo couple input+) |
| I | T/C 2+ | Slave temperature input (Thermo couple input-) |
| J | RTD | Cold junction temperature input +ve |
| K | RTD | Cold junction temperature input -ve |
| L | SPEED2 | RPM2 |
| M | SPEED3 | RPM3 |
| N | GND | Ground/chassis |
| O | GAIN | GAIN parameter set 1 or 2 |
| P | IDLE | Idle speed selection |
| Q | CANH | CAN bus high |
| R | CANL | CAN bus low |
| S | S+ | Master Actuator (Plus) |
| T | T- | Master Actuator (Minus) |
| U | U- | Battery (Minus) |
| V | V+ | Battery (Plus) |
| W | W+ | Slave Actuator (Plus) |
| X | X- | Slave Actuator (Minus) |
| Y | Y- | Pickup (Ground) (Mass) |
| Z | Z+ | Pickup (Plus) |

## 2.3 Electrical connection

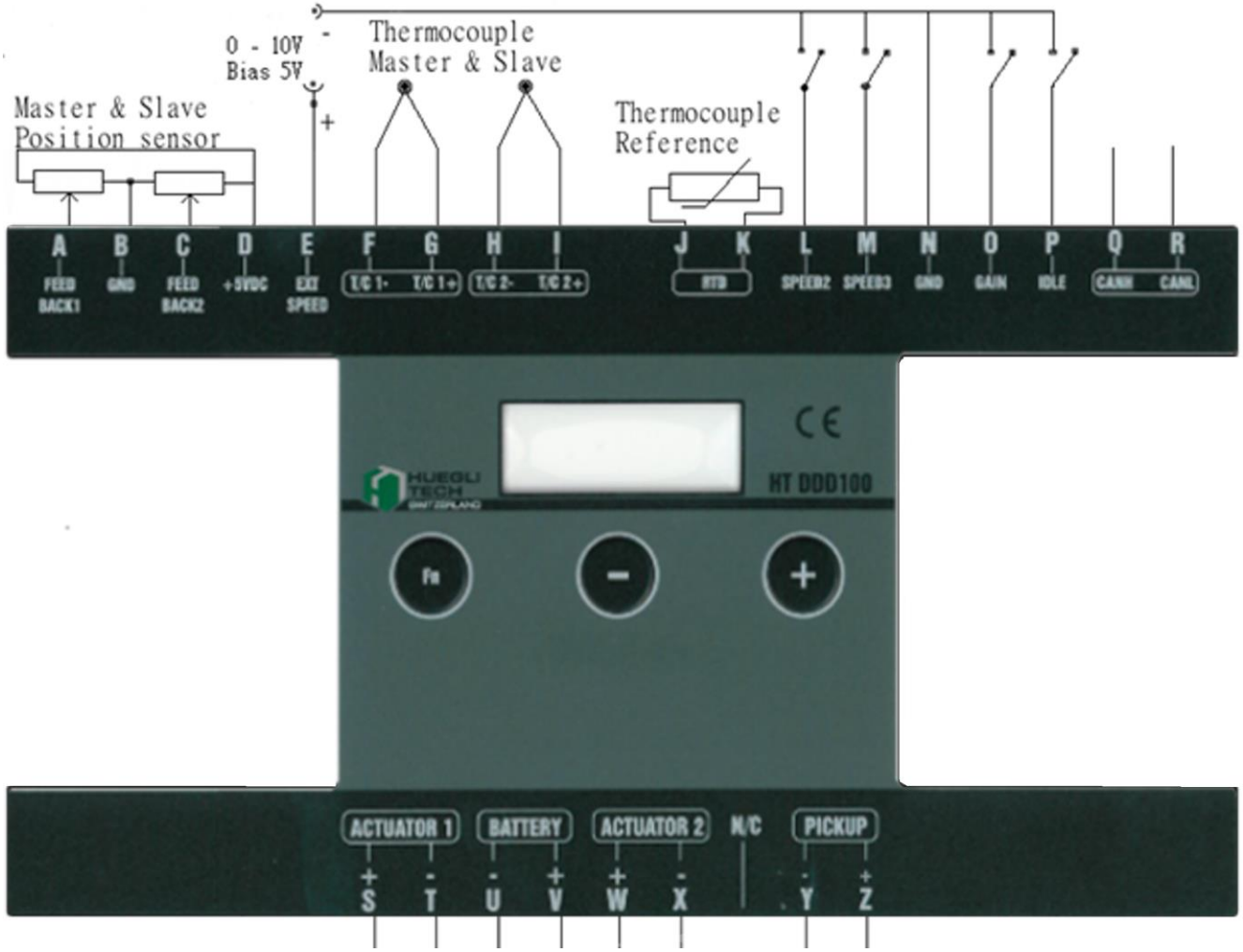
The DDD100 has a range of different connection options for various applications. The following describes the applications and relevant connection configurations

### 2.3.1 Fixed RPM, optional with load distribution or for parallel operation with the mains

With this application, up to three fixed RPM speeds can be selected by wiring in inputs Speed 2(L) and Speed 3 (M). The RPM settings can be set using the *Speed Governor Setup* PC software.
The rule here is:

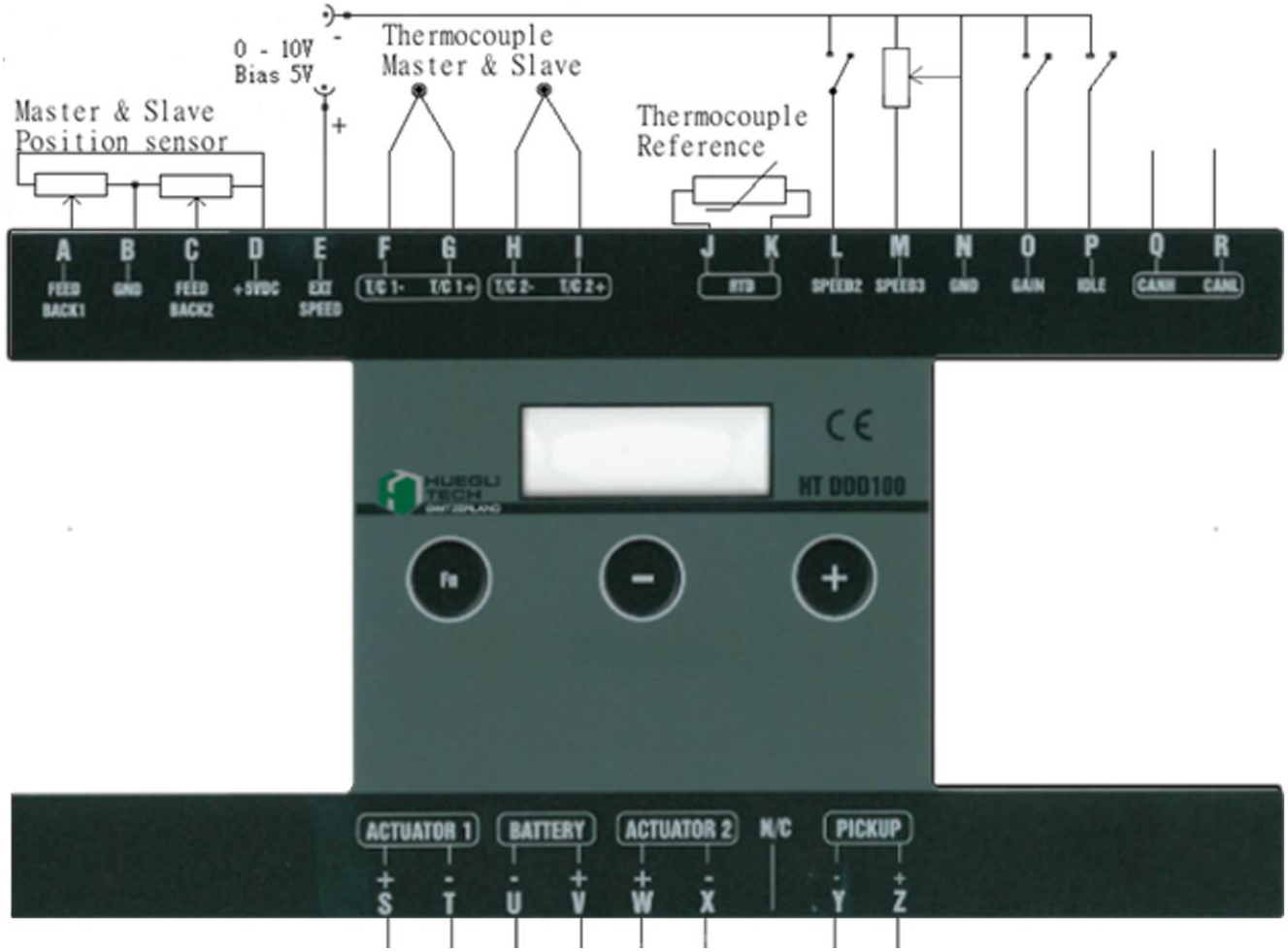
| | |
|---|---|
| Switch Speed 2 open /Speed 3 open | Speed 1 active |
| Switch Speed 2 closed /Speed 3 open | Speed 2 active |
| Switch Speed 2 open/Speed 3 closed | Speed 3 active |
| Switch Speed 2 closed/Speed 3 closed | Speed 3 active |

If a load distribution and/or synchronisation/load control (for parallel operation with the mains) is additionally required, this can be achieved by wiring in the input EXT SPEED. Here a signal of 0 – 10 V DC (zero point = 5 V) is required. The DDD100 works on a negative principle, i.e. if the input voltage is < 5 V the nominal speed rises, at a voltage of > 5 the nominal speed drops. The Sync/Load Sharing functions must be activated using the Speed Governor Setup software!



### 2.3.2 Variable RPM with external potentiometer

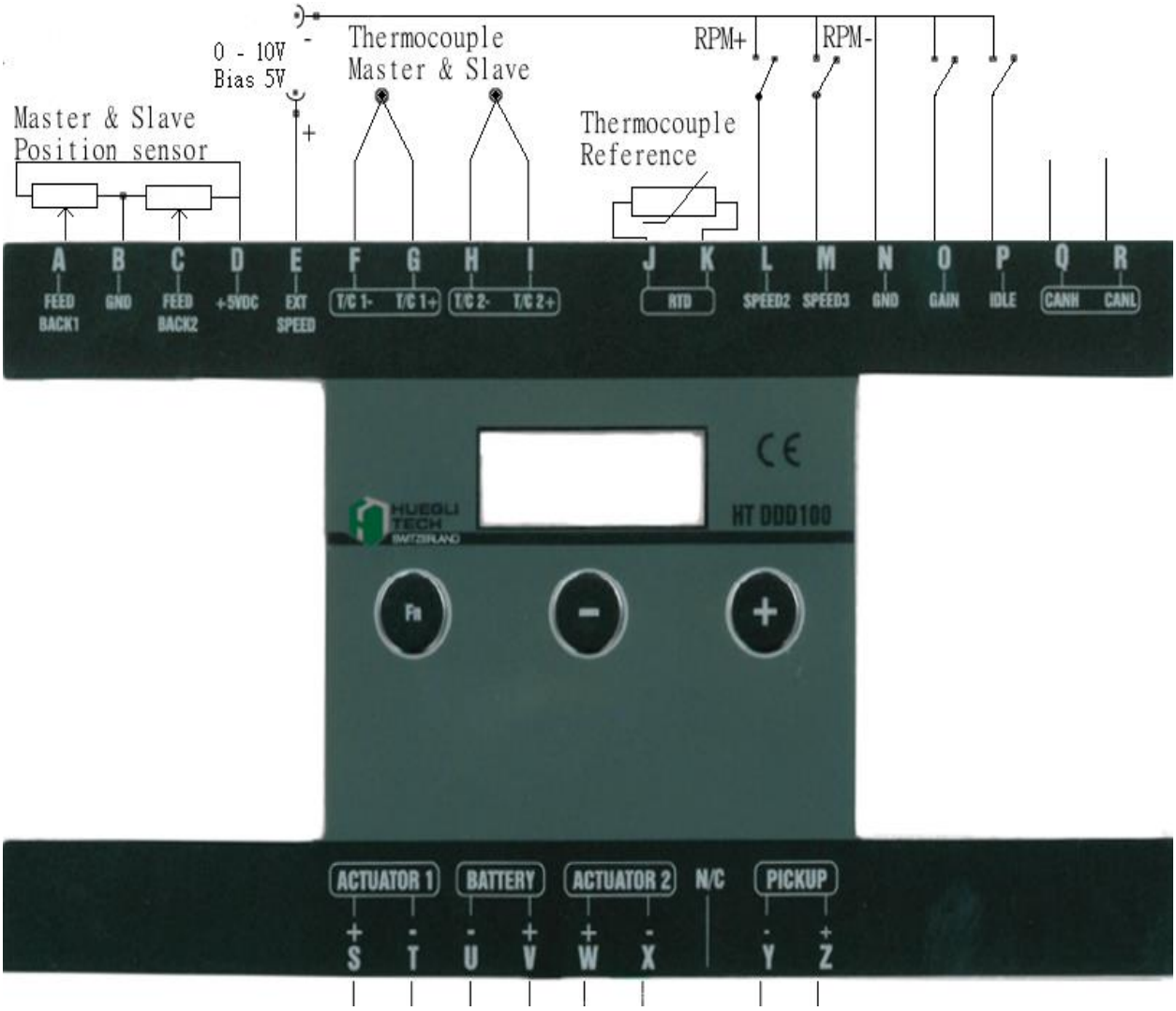
If the motor has to be run with a variable Speed setting, this can be achieved with an external potentiometer (10 kOhm). This is to be connected according to the following diagram.
The External Speed Trim function must be activated in the Speed Governor Setup software. In addition, the Speed Trim DS and Speed Trim FS parameters of the desired settings can also be set here.
Example: If *Speed Trim DS* 1400 RPM and *Speed Trim FS* 1800 RPM are required, these settings can be achieved variably with the external potentiometer.




### 2.3.3 RPM adjustment via digital signal

If the speed setting is required to be set via a digital signal, this is also possible with the DDD100. This may for example be necessary during parallel operation with the mains if the motor control only delivers digital signals for synchronisation and/or load control. The Binary Speed Up-Down function in the Speed Governor Setup software must be activated. In such cases, the Speed1 value is set as standard RPM (Speed 2 and Speed 3 are inactive). The nominal speed can be altered using inputs Speed 2 = RPM + and Speed 3 = RPM –. The Speed Min and Speed Max parameters define the limits of the adjustable RPM. The *Bin Speed Rate* parameter sets the adjustment of the RPM in milliseconds.

If a value of 200ms is set here with closed contact Speed 2 and/or Speed 3, the nominal speed changes with a speed of 1 rpm per 200ms. If the contact is closed for only a second, the nominal speed changes by 5 rpm.



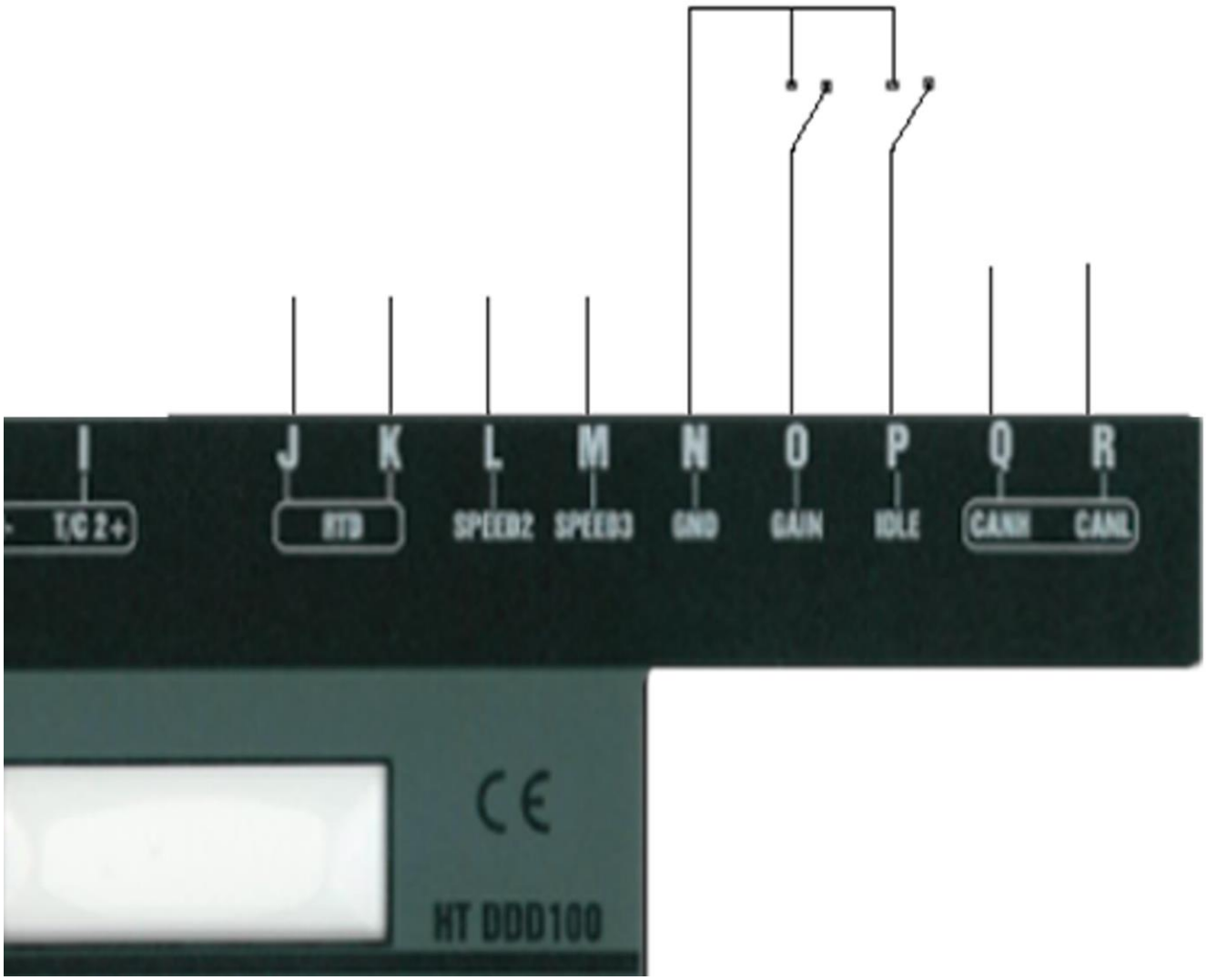

### 2.3.4 Optional inputs

#### 2.3.4.1 Idle

If this contact is closed, the motor runs at the set idle speed.

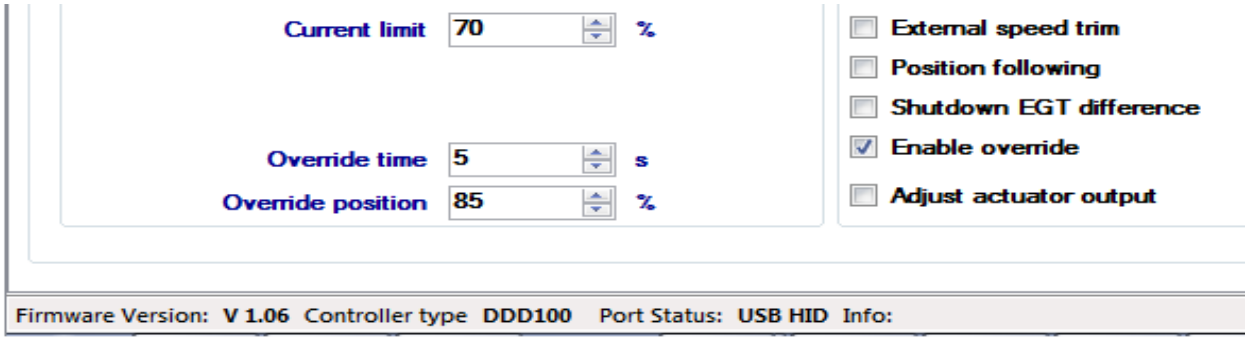
### 2.3.4.2 Gain

The DDD100 has two parameter sets for the PID governor. If the contact is open, parameter set 1 is active, when the contact is closed, parameter set 2. For some applications it may be necessary to use other parameters in idle than under load.



## 2.4 Current Limit Override

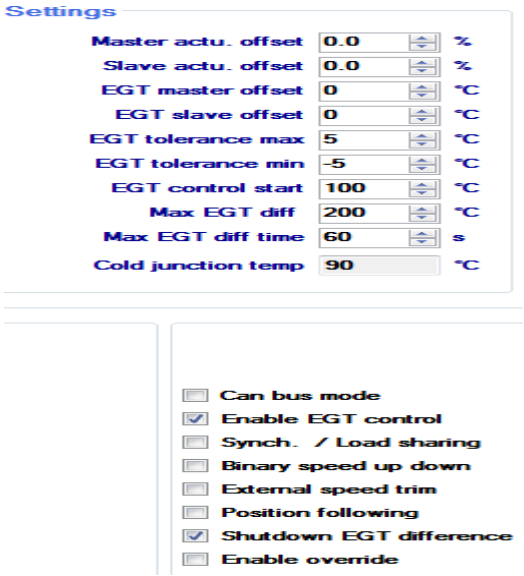
This feature is to supply more fuel to the engine during loading to protect the engine from under speed.




Override feature will start to work if the engine needed more fuel to compensate the sudden change in load of Genset in that case actuator opened up to override Position for set override time period after that come back to normal position within Current limit set value.

## 2.5 EGT Shutdown

This feature is to shut down the engine when the difference between Master and Slave banks EGTs are exceed the set value(Max EGT diff).



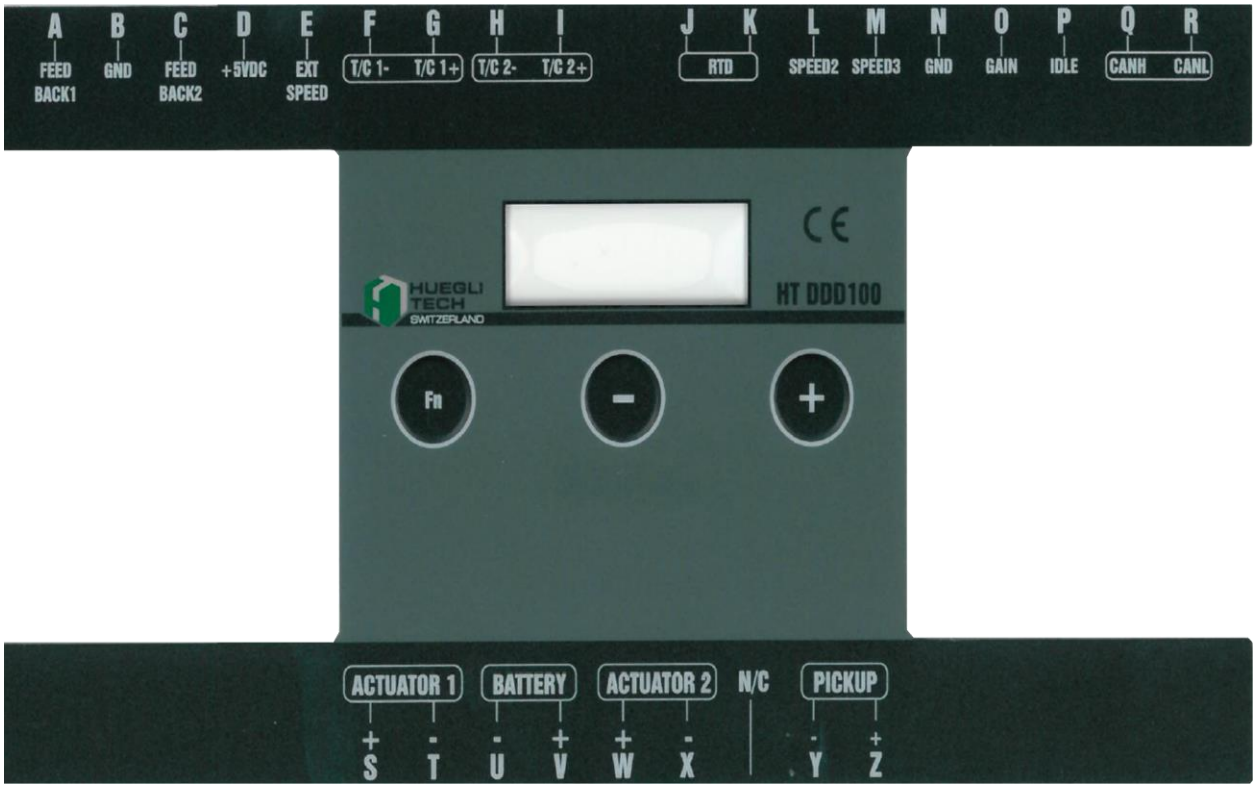

➔ Enable EGT control
➔ Shutdown EGT difference

Enable these options and set the allowable EGT difference between Master and Slave bank value in Maximum EGT difference.

Set the allowable Maximum EGT difference time

# 3 Hardware use (Keypad)

The DDD100 has three menu buttons, with which all parameters can be set locally. The set values are indicated on the LED display. In normal operating mode, the RPM is indicated on the display.




## 3.1 Accessing the functions

In SETUP mode, the functions listed below can be accessed using the SETUP/SCROLL button.
Press and hold SETUP&'+' button simultaneously for 5 seconds then enter the correct password after that press and hold SETUP&'+' button simultaneously for 3 seconds to validate the password and then Each press of the SETUP/SCROLL button makes the next menu active.
The active menu is shown on the LED display for 2 seconds, after which the relevant value of this function appears.

Settings are changed with the arrow keys [+] [-] and raise/lower the value by 1.
If the arrow keys [+] [-] are held down longer, the value increases at a greater rate.

| | | | |
|---|---|---|---|
| Normal operating mode | 0000 | RPM | e.g. 1500 rpm |
| Password entry | PA5d | Password | e.g. 1234 |
| SETUP/SCROLL button: 1x press | GAI/5020 | P value* | e.g. 50.20 |
| SETUP/SCROLL button: 2x press | Int/2192 | I value* | e.g. 21.92 |
| SETUP/SCROLL button: 3x press | Der/0700 | D value* | e.g. 7.00 |
| SETUP/SCROLL button: 4x press | Gear/0170 | Number of teeth | e.g. 170 teeth |
| SETUP/SCROLL button: 5x press | cran/0500 | Crankspeed | e.g. 500 rpm |
| SETUP/SCROLL button: 6x press | fura/3 | Fuel ramp | e.g. 3 secs. |
| SETUP/SCROLL button: 7x press | spra/10 | Speed ramp | e.g. 10 secs. |
| SETUP/SCROLL button: 8x press | stpo/0050 | Start Position | e.g. 50 % |
| SETUP/SCROLL button: 9x press | ospd/2000 | Overspeed | e.g. 2000 rpm |
| SETUP/SCROLL button: 10x press | 0000 | RPM display | e.g. 1500 rpm |
| + button: 1x press | 2000 → 2001 | Increase value by 1 | for all parameters |
| - button: 1x press | 2000 → 1999 | Reduce value by 1 | for all parameters |

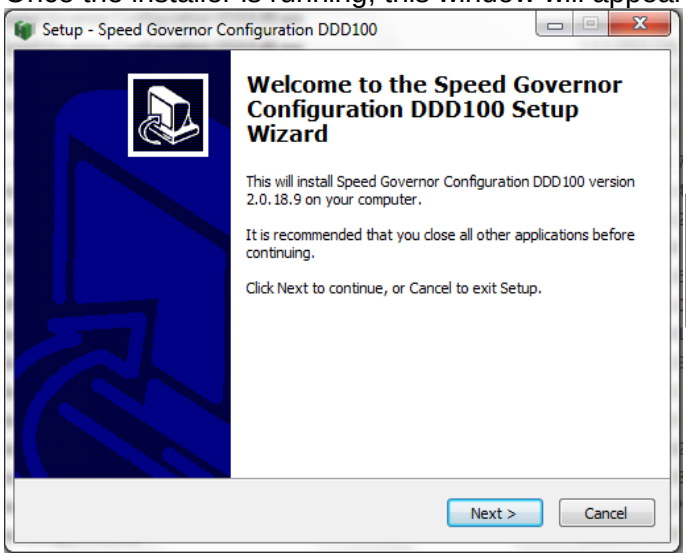
*Display of the values is dependent on input G (Gain). If this is open, parameter set 1 (Gain 1, Int 1 and Der 1) is shown; if the input is closed, parameter set 2 (Gain 2, Int 2 and Der 2) is shown.

# 4 Installation of PC software

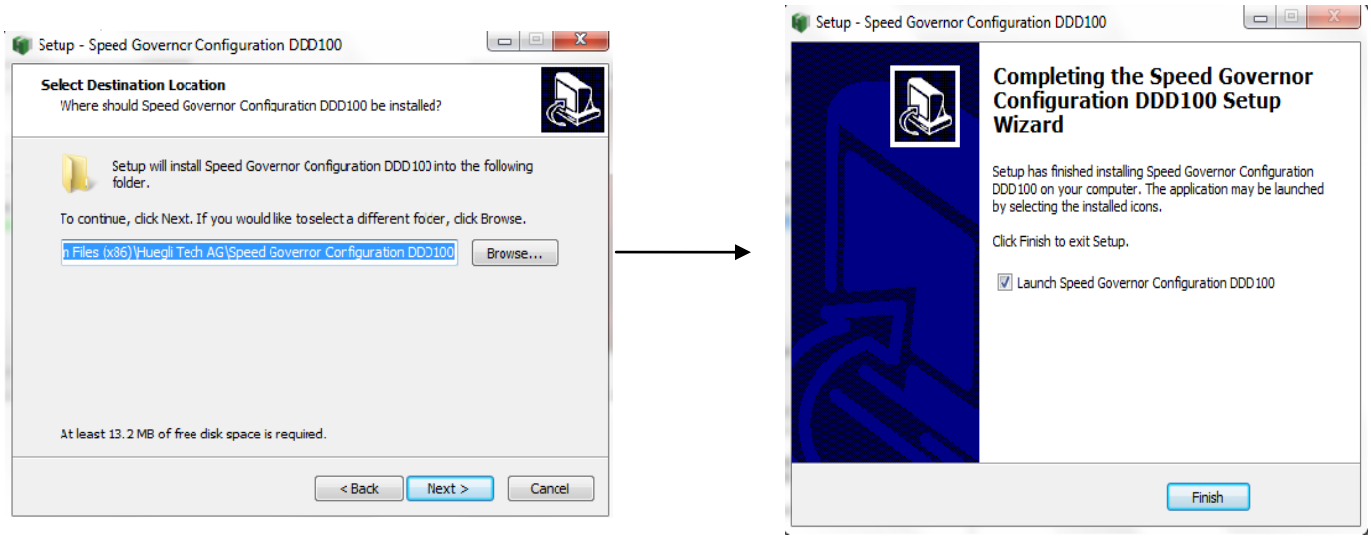
Operating system Windows XP or later

Installation of the software is carried out by running the *Speed Governor Setup_V1.x.x w FW4.exe* installer and/or *Speed Governor Setup_V1.x.x.exe*.
File Speed Governor Setup_V1.6.0 w FW4.exe may only be used if MS Framework 4.0 Full is not installed on your machine (Client Version is not sufficient).

Once the installer is running, this window will appear first




✓ click “Next” to continue and follow the instructions




## Click Finish to complete the installation!!

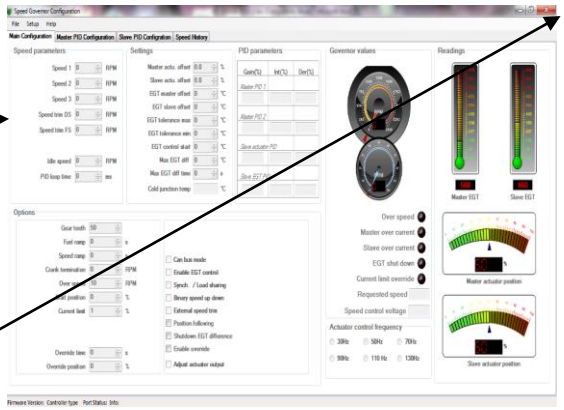
## Click  from Desktop to start use of software!!

# 5 Software use

Before using the motor for the first time, the basic parameters of the DDD100 must be configured. The factory settings must be checked.

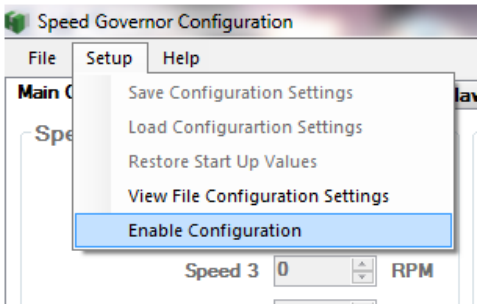
## 5.1 Start window

After the program has started, a screen appears in which several areas are shaded red. This means that the PC is not yet connected to the DDD100.

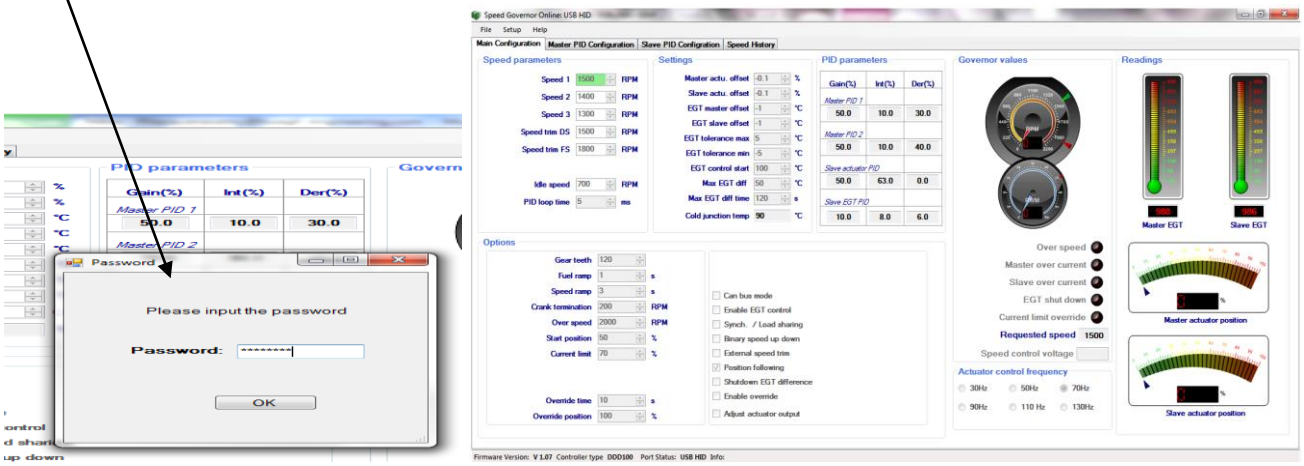


If the DDD100 was connected to the PC via a USB cable, a connection with the DDD100 will be created automatically. After the connection has been made successfully, the current DDD100 values will be displayed.

The program is closed by pressing the *Exit* button




The values displayed can now be altered by Click at the Setup menu -> Enable Configuration then key in the right password. Now all the parameters is enabled to accept the new values.



### 5.1.1 Speed Values

| | |
|---|---|
| Speed 1: | First fixed RPM, input Speed 2 open/Speed 3 open |
| Speed 2: | Second fixed RPM, input Speed 2 closed/Speed 3 open |
| Speed 3: | Third fixed RPM, input Speed 2 open/Speed 3 closed |
| Speed Trim DS*: | Lowest RPM for external potentiometer |
| Speed Trim FS*: | Highest RPM for external potentiometer |
| Idle Speed: | Idle RPM, must be set to 600 – 700 rpm even if this function is not used; higher where required. |
| PID loop: | Interrogation cycle for PID governor |

***only active when External Speed Trim not selected**

### 5.1.2 Options

Gear Teeth: Number of teeth on the flywheel. This parameter is used by the DDD100 to calculate the current RPM.

Fuel Ramp: The start amount determines how long the actuator needs when starting the motor to reach the starting position.

Speed Ramp: The speed ramp determines the time that the motor requires after starting to reach the nominal speed.

Crank Termination: This value is used by the DDD100 to determine if the motor is starting or running. As soon as the motor RPM exceeds this limit, the governor switches from the start routine to PID regulation. As a guide value, an RPM of 200 – 300 rpm should be entered here.
**This value must be smaller than the IDLE SPEED.**

Overspeed: If the overspeed value is exceeded, the engine speed governor is switched off to cut the motor. The digital display of the DDD100 will show - - - -. After restarting, the current RPM will be shown again.

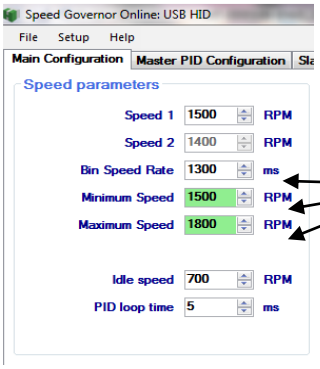
Start Position: Position of the actuator when the motor starts. The actuator remains in this position as long as the Crank Termination value (starter cut-out) is not exceeded.

Current Limit: This is the current limit of the actuator, so that under full load the actuator does not consume excessive amounts of electricity. The current limit should be set such that e.g. with a Current Limit of 80, the actuator still draws at full load. If this is not the case, the Current Limit must be increased.

Override time: Time period to override the current limit setting during loading of the engine.

Synch/Load Sharing: Activates analogue input for load distribution and/or a synchronisation/load control, see 2.3.1

Binary Speed Up/Down: Activates digital mode for speed setting, see 2.3.3




When this mode is activated, the Speed Values are altered. The values for *Bin Speed Rate*, *Speed MIN* and *Speed MAX* can then be entered

External Speed Trim: Speed setting by potentiometer, see 2.3.2

Adjust Actuator Output: This function is only active when the motor is not running. If this function is activated, the Start Position value is transmitted directly to the actuator. A visual inspection can then determine how far the actuator actually moves during the start without having to actually start the motor.

EGT control enable: Activates **E**xhaust **G**as **T**emperature control.

Position following: Activates the position PID for slave actuator to follow the Master actuator position.

Shutdown EGT difference: Shuts down the engine If the EGT difference between Master and Slave bank exits the set value for set period.

Enable override: Override the current limit setting for supplying more fuel during Loading up to set period (Override time).

### 5.1.3 Settings

Master actuator offset: To adjust the displacement of Master actuator position. Set the displacement value as offset to get '0' as the start position.

Slave actuator offset: To adjust the displacement of Slave actuator position. Set the displacement value as offset to get '0' as the start position.

EGT master offset: To adjust the temperature readings of Master EGT. Set the difference of actual and measured value as offset to get actual temperature readings.

EGT slave offset: To adjust the temperature readings of Slave EGT. Set the difference of actual and measured value as offset to get actual temperature readings.

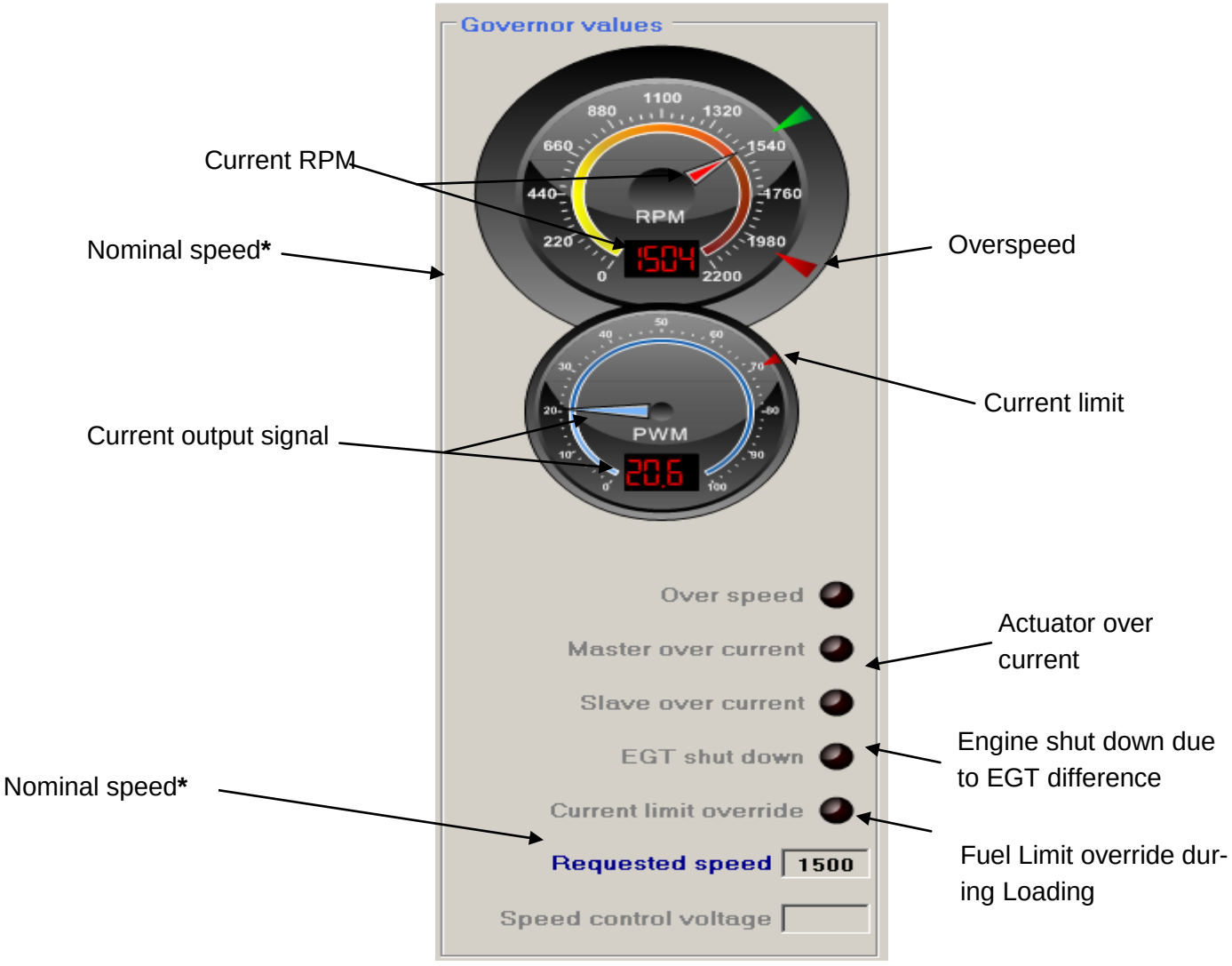
EGT Tolerance minimum: The minimum tolerance level for the set temperature. If the EGT control enable option is selected and slave temperature falls below this value (master – tolerance) then temperature balancing will start to work.

EGT Tolerance maximum: The maximum tolerance level for the set temperature. If the EGT control enable option is selected and slave temperature rises above this value (master + tolerance) then temperature balancing will start to work.

| | |
|---|---|
| EGT control start: | If the EGT control enable option is selected and actual temperature rises above this value then temperature compensation will get enable otherwise disabled. |
| Max EGT difference: | Master and Slave EGT difference acceptable limit. |
| Max EGT diff time: | Allowable time period for Master and Slave EGT difference. |

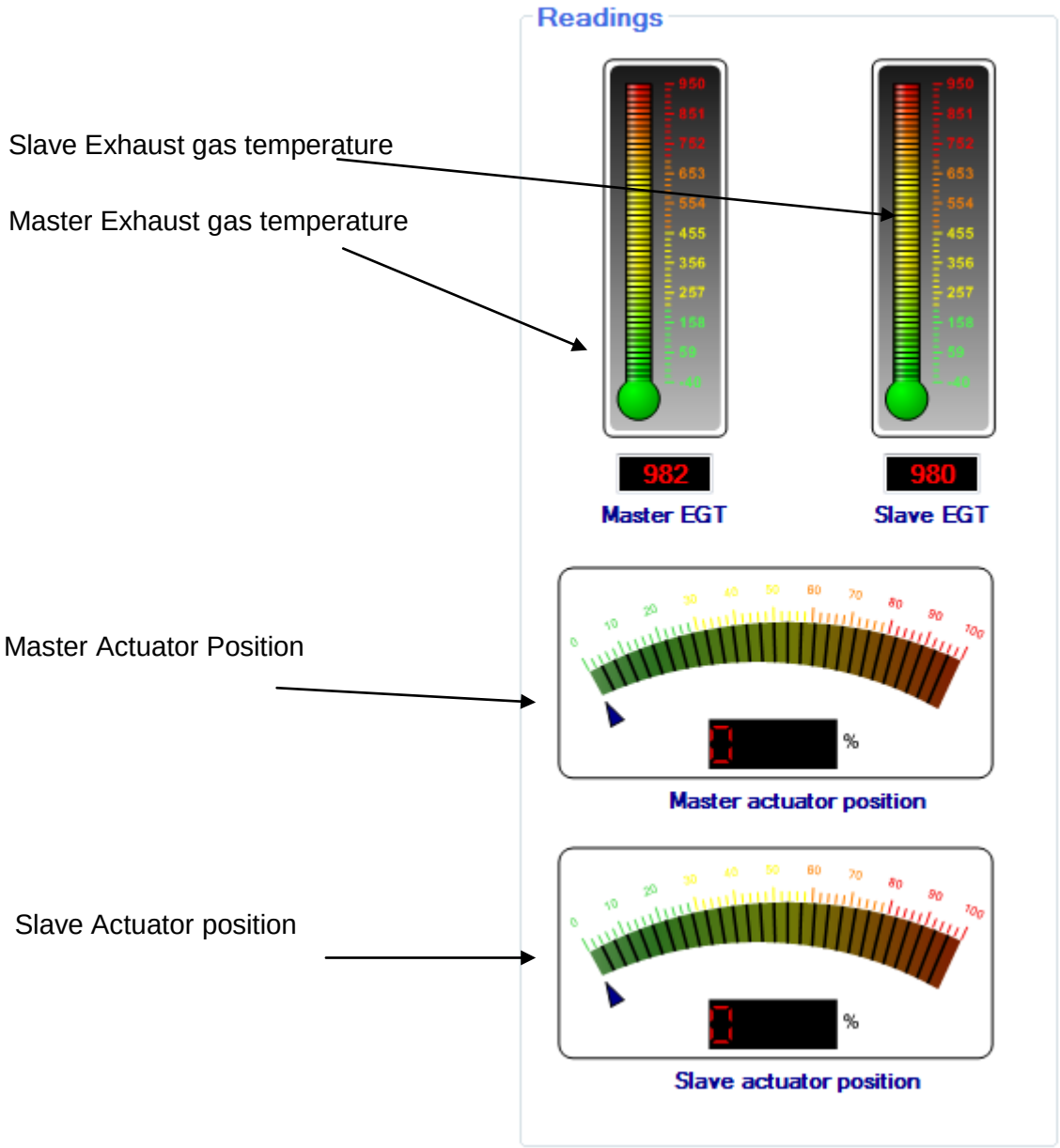
### 5.1.4 Governor Values

Various values are represented both graphically and numerically in the start window and the Controller Values window.



*If the Synch./Load Sharing, Binary Speed Up Down or External Speed Trim function was activated, the value changes using the current Speed setting. This allows monitoring of whether the external signals are functioning without fault. This is especially helpful with the Synch/Load Sharing function to monitor the corresponding signal from the motor controls.

### 5.1.5 Master and Slave Readings



### 5.1.6 Controller Values

In client-specific DDD100 versions, all PID parameters are factory-set for the best motor operation characteristics. Depending on the individual dynamics of each motor, subsequent adjustments may be required.
For new applications, these parameters must be defined before starting the motor.

| | |
|---|---|
| Gain 1: | P value parameter set 1 (input Gain (G) open) |
| Int 1: | I value parameter set 1 (input Gain (G) open) |
| Der 1: | D value parameter set 1 (input Gain (G) open) |
| Gain 2: | P value parameter set 2 (input Gain (G) closed) |
| Int 2: | I value parameter set 2 (input Gain (G) closed) |
| Der 2: | D value parameter set 2 (input Gain (G) closed) |

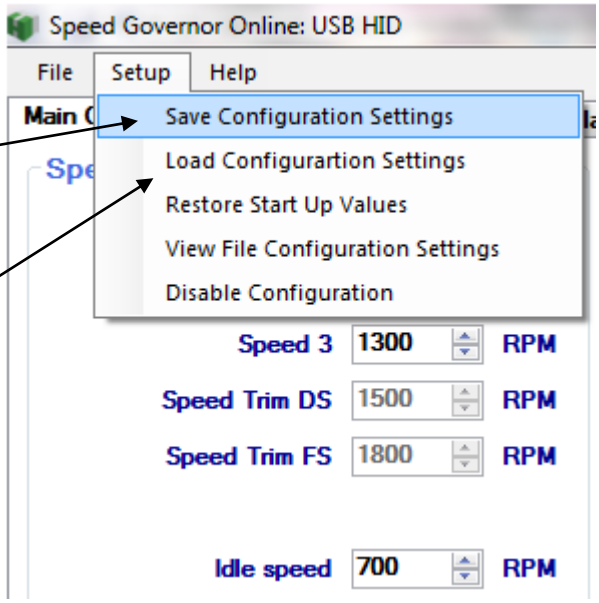
**These values cannot be altered in the start window!**
**The currently selected parameter set is highlighted green!**

### 5.1.7 Loading/saving settings

**The following functions are only available when the DDD100 is connected to the PC!**

A configuration can be saved on the computer by clicking on the “Save Configuration Settings” menu.

If you wish to transfer a saved configuration to another DDD100, click on the “Load configuration settings” menu and select the desired configuration file. The configuration will then be loaded onto the DDD100.




A particular and very helpful function is offered by the Start Up Values button. If you have adjusted the governor and cannot reproduce the original values (and have not stored these) this function can be used to retrieve them. The PC software saves the settings that were stored at the time the connected was established with the DDD100.

## 5.2 Parameters menu

To open this window, Click “Master PID Configuration” tab.
The currently active parameter set is indicated in a green font. In the adjacent illustration, this is currently parameter set 1


### 5.2.1 General use

P, I and D parameters may be changed using the – and + arrow keys and the green bar when the motor is active or idle.
The motor RPM and the output signal are visible on the display.
You can return to the start window using the Exit button.

| Action | Display | Description | Information |
|---|---|---|---|
| + arrow key : 1x short press | 1 0.0 → 1 0.1 | Increase value by 0.1 | for all P, I, D parameters |
| - arrow key : 1x short press | 1 0.0 → 9.9 | Decrease value by 0.1 | for all P, I, D parameters |
| + arrow key : 1x hold down | 1 0.0 → 1 0.1 | Continue to increase value by 0.1 | for all P, I, D parameters |
| - arrow key : 1x hold down | 1 0.0 → 9.9 | Continue to decrease value by 0.1 | for all P, I, D parameters |
| hold down green bar | 2 3.7 → 2 3.7 | Value remains unchanged | for all P, I, D parameters |
| hold down green bar and move | 2 3.7 → 2 3.7 | Value remains unchanged | for all P, I, D parameters |
| release green bar | 2 3.7 → 4 1.8 | Value changes | for all P, I, D parameters |

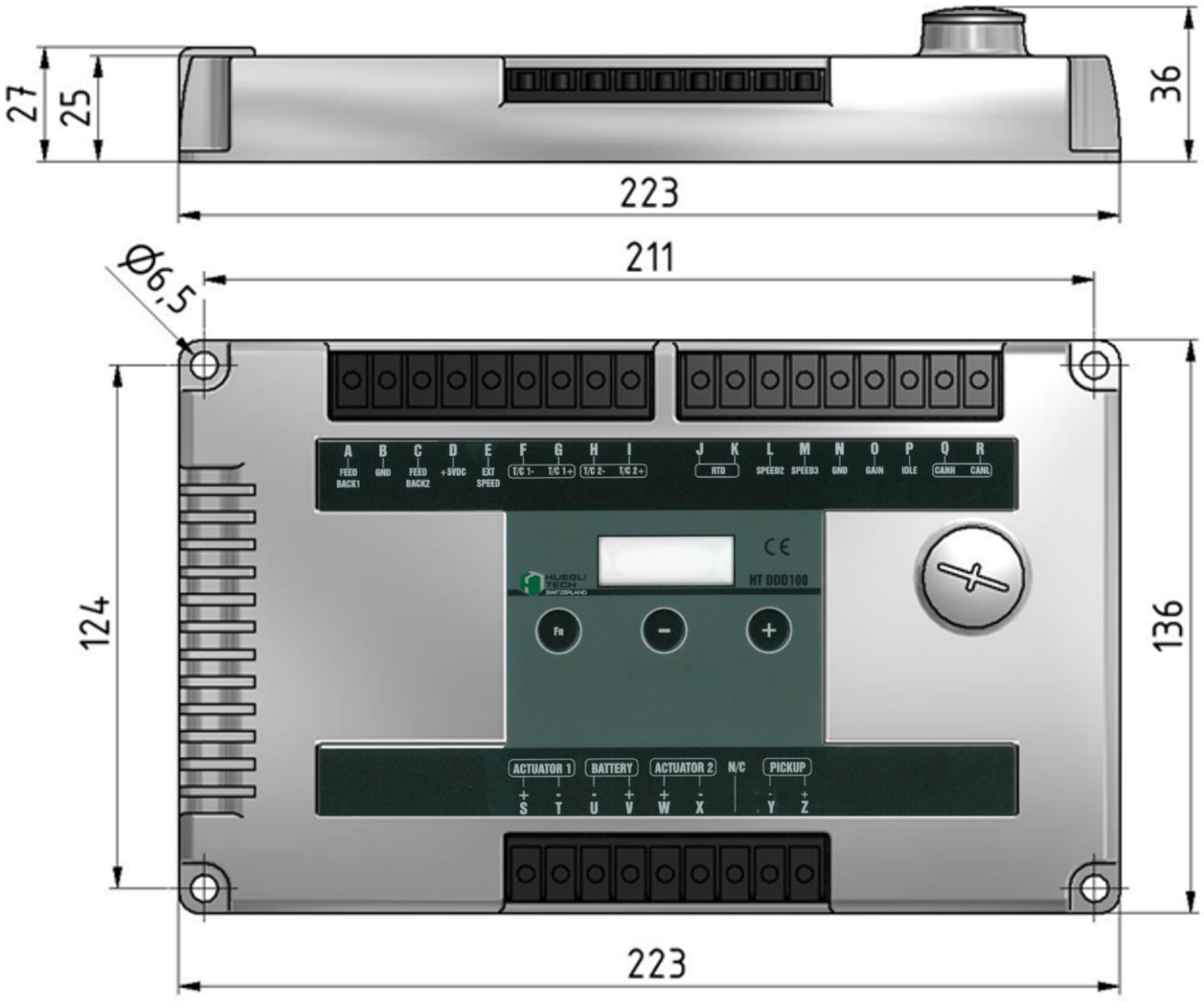
### 5.2.2 Parameters 1

Gain 1: P value parameter set 1 (input Gain (G) open)
Int 1: I value parameter set 1 (input Gain (G) open)
Der 1: D value parameter set 1 (input Gain (G) open)

### 5.2.3 Parameters 2

Gain 2: P value parameter set 2 (input Gain (G) closed)
Int 2: I value parameter set 2 (input Gain (G) closed)
Der 2: D value parameter set 2 (input Gain (G) closed)

# 6 Dimensions




# 7 Starting the motor

## 7.1 Checking the parameter settings

Before starting the motor with the DDD100, follow this procedure:

a) Switch on voltage, do not start motor.
b) Check all the important parameters for correct values in SETUP mode:
Number of teeth, Overspeed, RPM settings, starter cut-out and start position.

## 7.2 Starting and motor tuning

The fuel supply to the motor is pre-set by the actuator according to the start FUEL parameter (default is maximum fuel supply). The speed ramp (Fuel Ramp) controls the rate at which fuel is increased to start the motor.
If the motor fails to run in a stable fashion after starting, set the GAIN, stability and Derivative with appropriate parameters until the motor is stable.

In client-specific DDD100 versions, all PID parameters are factory-set for the best motor operation characteristics. Depending on the individual dynamics of each motor, subsequent adjustments may be required.
In the case of devices which are not pre-set, these parameters must be entered before starting the motor.

GAIN: 10 %
INTEGRAL: 10 %
DERIVATIVE: 1 %

Activate starter.

The motor will run at the set idle RPM or nominal RPM. If instability is detected, reduce GAIN and INTEGRAL, and DERIVATIVE where required.

## 7.3 Optimisation of dynamics settings (Tuning)

Increase the GAIN by pressing the + button until the motor oscillates, then slowly ease back by pressing the – button until the motor runs smoothly. Set Integral in the same manner.
The reaction of the governor can be controlled with short manual taps of the actuator control. GAIN and INT are to be set to the shortest possible reaction times.
In some cases it can be necessary to adapt the speed compensation (DER) as well.
If the motor oscillates quickly, even if the GAIN is set low, the DER can be reduced by pressing the – button.
If the motor oscillates very slowly, the DER can be increased by pressing the + button.

# 8 Configurable parameters, values in [ ] = factory settings

| Description | Term | Definition | Range |
|---|---|---|---|
| Speed 1 | Fixed RPM 1 | Speed setting 1,<br>Input Speed 2 open, Speed 3 open | 0 – Overspeed rpm [1500] |
| Speed 2 | Fixed RPM 2 | Speed setting 2,<br>Input Speed 2 closed, Speed 3 open | 0 – Overspeed rpm [1400] |
| Speed 3 | Fixed RPM 3 | Speed setting 3,<br>Input Speed 2 open, Speed 3 closed | 0 – Overspeed rpm [1300] |
| Speed Trim DS | RPM MIN | Minimum nominal speed when function *External Speed Trim* is activated | 0 – (Speed Trim FS - 10) [1500] |
| Speed Trim FS | RPM MAX | Maximum nominal speed when function *External Speed Trim* is activated | 0 – Overspeed rpm [1800] |
| Bin Speed Rate | P-proportion | Update time for nominal speed adjustment when function *Binary Speed Up Down* is activated | 0 – 1500 ms [1300] |
| Speed MIN | RPM MIN | Minimum nominal speed when function *Binary Speed Up Down* is activated | 0 – (Speed MAX -10) [1500] |
| Speed MAX | RPM MAX | Maximum nominal speed when function *Binary Speed Up Down* is activated | 0 – Overspeed rpm [1800] |
| Idle Speed | idle | RPM of *motor* when idle input is closed | 0 – 3000 rpm [700] |
| PID Loop | PID update | Update time of the PID governor | 0 – 255 ms [10] |
| Gear Teeth | Number of teeth | Number of teeth on flywheel | 50 – 255 [120] |
| Fuel Ramp | Fuel ramp | Time to reach start position after switching on motor | 0 – 20,<br>0 = no ramp<br>[1] |
| Speed Ramp | Speed ramp | Ramp from start to nominal speed | 0 – 100, 0 = no ramp [3] |
| Crank Termination | Starter cut-out | RPM at which the **DD100** switches from start mode to control mode | 0 – 2000 rpm [200] |
| Overspeed | overspeed | Maximum RPM of the motor | 0 – 4000 rpm [2000] |
| Start Position | Start Position | Position of actuator when switching on motor | 0 – 100 % [50] |
| Current Limit | Current limit | Current limit for actuator | 0 – 100 % [70] |
| Override Time | Current limit Override Time | Current limit override allowed for this period | 0 – 999 seconds[5] |
| Override position | Override actuator position | Maximum override position allowed during current limit override | 0 – 100% [100] |
| Gain 1 | Proportional value 1 | Parameter set 1 for Proportional value of the engine speed governor, input GAIN (G) open | 0 – 100 % [50.0] |
| Int 1 | Integral value 1 | Parameter set 1 for Integral value of the engine speed governor, input GAIN (G) open | 0 – 100 % [10.0] |
| Der 1 | Differential value 1 | Parameter set 1 for Differential value of the engine speed governor, input GAIN (G) open | 0 – 100 % [40.0] |
| Gain 2 | Proportional value 2 | Parameter set 2 for Proportional value of the engine speed governor, input GAIN (G) closed | 0 – 100 % [50.0] |
| Int 2 | Integral value 2 | Parameter set 2 for Integral value of the engine speed governor, input GAIN (G) closed | 0 – 100 % [10.0] |
| Der 2 | Differential value 2 | Parameter set 2 for Differential value of the engine speed governor, input GAIN (G) closed | 0 – 100 % [40.0] |

| Description | Term | Definition | Range |
|---|---|---|---|
| Gain for Slave Actuator | Proportional value | Parameter set for Proportional value of the slave actuator position | 0 – 100 % [30.0] |
| Integrator For Slave Actuator | Integral value | Parameter set for Integral value of the slave actuator position | 0 – 100 % [56.0] |
| Derivative For Slave Actuator | Differential value | Not used | 0 – 100% [0] |
| Gain for Slave EGT | Proportional value | Parameter set for Proportional value of the slave actuator position | 0 – 100 % [54.0] |
| Integrator For Slave EGT | Integral value | Parameter set for Integral value of the slave actuator position | 0 – 100 % [40.0] |
| Derivative For Slave EGT | Differential value | Parameter set for Differential value of the slave actuator position | 0 – 100 % [18.0] |
| Master Actuator offset | Position offset value | Set the master actuator displacement value as offset to get '0' as the start position. | 0 – 100 % [0] |
| Slave Actuator offset | Position offset value | Set the slave actuator displacement value as offset to get '0' as the start position. | 0 – 100 % [0] |
| Master EGT offset | Master exhaust gas temperature offset | Set the difference of actual and measured value as offset to get actual temperature readings. | -50 – 850 $^{o}$c [0] [0] |
| Slave EGT offset | Slave exhaust gas temperature offset | Set the difference of actual and measured value as offset to get actual temperature readings. | -50 – 850 $^{o}$c [0] [0] |
| EGT Tolerance minimum | EGT tolerance low | The minimum tolerance setting for the set temperature | 0 - -100 $^{o}$c [-5] [-5] |
| EGT Tolerance maximum | EGT tolerance high | The maximum tolerance setting for the set temperature | 0 - +100 $^{o}$c [5] [5] |
| EGT control start | EGT control enable temperature | The minimum temperature set to start the EGT control | 0 - 850 $^{o}$c [100] [100] |
| Max EGT diff | Maximum EGT difference | Maximum allowable EGT difference between Master and Slave Bank | 0 - 850 $^{o}$c [100] [50] |
| Max EGT diff time | Maximum EGT difference time | Maximum EGT difference between Master and Slave bank allowable period after that Engine will get shutdown If EGT shutdown enabled | 0 - 900 seconds [60] [120] |

# 9 Correction system faults

**WARNING**
Disconnect the connector cable to the actuator only when power is off.

## 9.1 Motor does not start

| Fault, LED signal | Possible cause | Check | Action |
|---|---|---|---|
| No Display (unit dead) | Voltage too low | Check voltage between connection V(+) and U(-) | Adjust power supply and polarity (min.17 V for 24V system) |
| | Battery and wiring | Check battery voltage during start procedure; check wiring. | Voltage drop to large because of small cable cross-section or low battery. |
| Display shows 0000 | No signal from magnetic RPM sensor. | Measurement of voltage between terminals Y and Z (during start-up) | Should be min. 1.0 VRMS during start-up |
| | Actuator fault | Check wiring. Measure voltage at terminals S and T for Master actuator W and X for slave actuator. Measure resistance. | See connection diagram. Note actuator specification. **Do not separate cables when the actuator is under power!** |
| | Fuel supply | Check fuel | Correct fuel supply |

| Fault, LED signal | Possible cause | Check | Action |
|---|---|---|---|
| Speed selection not working (Speed1,Speed2&Speed3) | Terminals L and M are not connected correctly. | Check wiring | If neither 'L' nor 'M 'are connected, the DDD100 is configured for speed1 |
| | Incorrect number of teeth | Check Gear teeth settings in PC software | Correct setting |
| | Incorrect Speed setting | Check settings in PC software | Correct setting |

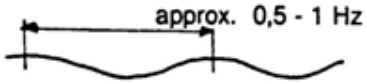
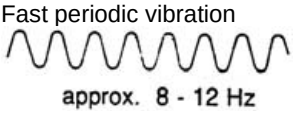
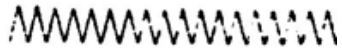
## 9.2 Motor does not run in External Speed Trim mode (Variable speed mode)

| Fault | Possible cause | Check | Action |
|---|---|---|---|
| Motor does not run in External Speed Trim mode | Terminals M,N are not connected correctly to potentiometer | Check wiring. | See connection diagram |
| | Incorrect number of teeth | Check settings in PC software | Adjust setting |
| | Incorrect configuration | Check settings in PC software | Select External speed trim in PC software |

## 9.3 Overspeed during start process

| Fault, LED display | Possible cause | Check | Action |
|---|---|---|---|
| display - - - - | Overspeed limit value set too low | Check overspeed set value | Adjust value |
| | Tuning sub-optimal | Check PID set value | Increase GAIN, INT. and speed ramp where required. |
| | Starter cut-out set too high | Check start fuel %setting | Adjust value |

## 9.4 Engine unstable

| Fault, LED signal | Possible cause | Check | Action |
|---|---|---|---|
| Slow periodic vibration   | Friction on connection shaft or control rod | Check mechanical parts. | Remove friction |
| | Battery voltage too weak | Check battery and wiring: Min. 20V for 24V system | Replace battery, Adapt wiring |
| | Actuator too weak | Check Actuator | Use stronger actuator |
| | Too little speed compensation | Check PID setting | Increase DER |
| Fast periodic vibration   | GAIN too high | | Reduce GAIN |
| | Too much speed compensa-tion | Check PID setting | Reduce DER |
| | Fault in fuel supply | Check fuel supply | Remove fault in injection system |
| | Spongy or worn clutch | Check play in clutch | Correct fault |
| Governor is ok but actuator control (actuator lever)l vibrates approx. 1 mm  | Rotary oscillation caused by spongy clutch or too much play in clutch | | Correct fault |
| | Misfire of a cylinder | | Correct fault |

# 10 Technical Data

## 10.1 Performance

| | |
|---|---|
| Isochronous/stability | ±0.25% |
| RPM range | 300 - 8 KHz (112-4000 RPM for flywheel with 160 teeth) |
| RPM variation with temperature | ±0.25% max. |
| Idle adjustment | Full Range |
| Speed Trim | Programmable 0-100%, (default = 5%) |

## 10.2 Surroundings

| | |
|---|---|
| Temperature range | -40° to 85°C (-40 to +180°F) |
| Relative humidity | up to 95% |
| Surface finish | Fungus Proof and Corrosion Resistant |
| CE certificate | EN55011, EN61326-1 |

## 10.3 Input/output parameters

| | |
|---|---|
| Supply voltage | 12 or 24 VDC Battery, (6.5 VDC to 33 VDC) |
| Polarity | Negative Mass (housing insulated) |
| Current drain | 60 mA max. continuous, plus actuator current |
| Max permitted actuator current | 8 A continuous |
| Engine speed sensor signal | 1 – 120 V RMS |
| Output (terminal x an DDD100) | up to 20 mA |
| Load Share/Synchronizer Input | 0-10 VDC (5V nominal, reversed, 5 rpm/V) |
| Reverse Power Protection | Yes |
| Transient Voltage Protection | 60V |

## 10.4 Norms/standards

| | |
|---|---|
| Authorising office | CE and RoHS requirements |
| Communication | SAE J1939 (Option) |

## 10.5 Reliability

| | |
|---|---|
| Vibration | 7G, 20-100 Hz |
| Shock | 20G Peak |
| Inspection | 100% functionality inspection |

## 10.6 Mass and weight

| | |
|---|---|
| Dimensions | 223 x 136 x 36 mm |
| Weight | 1.000 kg |
| Installation | direct on motor chassis, preferably vertical, with rubber shock absorbers, insulated, or in control cabinet |

## 10.7 Configuration parameters

| | |
|---|---|
| Number of flywheel teeth, range | 50 -250 teeth |
| Overspeed protection | 4000 rpm |
| Starter cut-out speed | 50 - 1000 Hz |
| Fixed RPM | 400 – 8 000 Hz |
| Variable RPM | 400 – 8 000 Hz |
| Prescribed start quantity | 0 - 100 % |
| Start ramp | 0 – 20 secs. |
| Speed ramp | 0 - 100 secs. |