HT-HSG100

Intelligent Hyper Speed Governor

Instruction manual

Doc. No.:	HT-HSG100_MN_EN-V1.3
Version:	1.3
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PC Software Version:	3.0.0.92
Firmware Version:	1.71

HUEGLI TECH AG (LTD) Switzerland

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1 Installation declaration (for an incomplete machine)

Installation declaration

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

The manufacturer: Huegli Tech Murgenthalstrasse 30 4900 Langenthal Switzerland

hereby declares that the incomplete machinery:

General description: HT-HSG100

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;

Authorised representative for creation of the technical documents:

E. Uzunlar Murgenthalstrasse 30 4900 Langenthal

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.

Langenthal 01.12.2014 Huegli Tech AG,

Uzunlar, Emrah Huegli, Daniel
Product Manager President

2 General

2.1 Introduction

The HT-HSG100 is an intelligent electronic engine speed governor for managing motor RPM that works hand in hand with the spring less version of HT-TM2200-75 rotary actuator to provide fast response, precise control and reliability when required to react to load changes.

A closed control circuit using an actuator, magnetic RPM sensor and the position feedback signal from the HT-TM2200-75, the HSG100 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 microprocessor design provides precise and user-specific performance and functionality. The HSG100 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 12-24 VDC the HSG100 has a wide range of uses.

2.2 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 HSG100 engine speed 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.

2.2.1 Over-speed protection

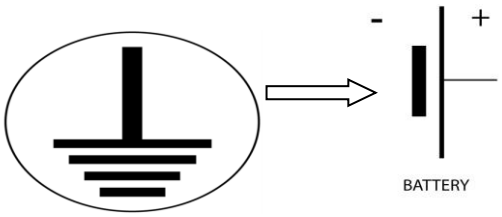
IMPORTANT

An over-speed 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.

2.2.2 Safety protection

IMPORTANT

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



2.3 Guarantee terms and conditions

2.3.1 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.

2.3.2 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.

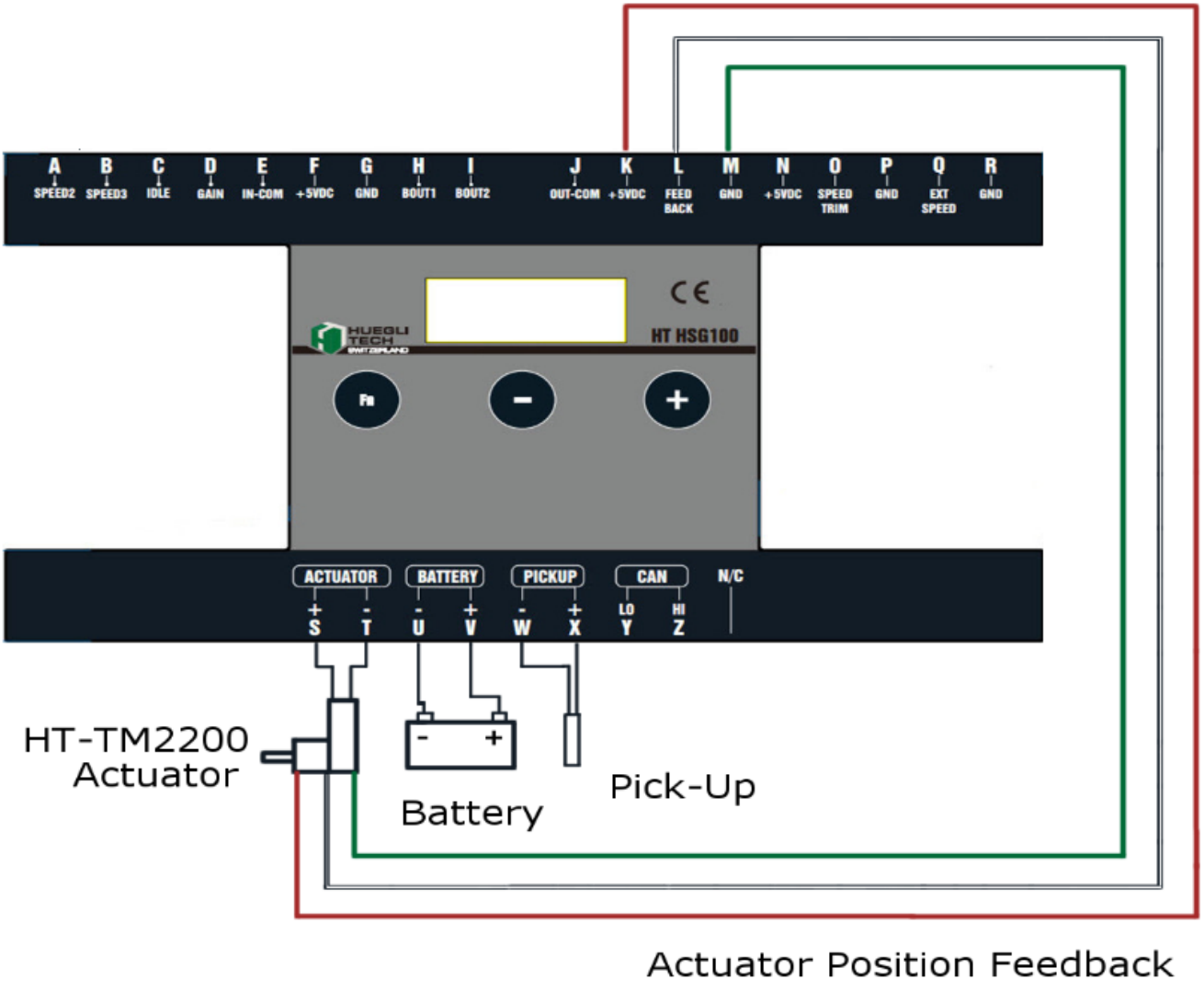
The general guarantee terms and conditions of Huegli Tech AG shall apply.

3 Installation and connection

3.1 General information

The magnetic RPM sensor cable should be shielded to guarantee that no electromagnetic interference can reach the engine speed governor. The shield should be on-sided on the battery negative.

To maintain the correct distance between the flywheel and the magnetic 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 sensor must generate at least 1V AC RMS during the start.



Cross-section of the battery and actuator cable at terminals S,T,U, and V:

1.5 mm^2 for 24 VDC or

2.5 mm^2 for 12 VDC

IMPORTANT

- The pick-up must be mounted so as to sense the teeth of a full gear. The flywheel ring-gear is suitable.
- Note: any missing teeth will negatively affect the pick-up signal.

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 6 A.
- The governor should be installed such that the housing has 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 cables, 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 stray signals from entering the governor and causing interference. The shield must be grounded at one end.

Important: The HSG100 is equipped with over-current protection on the (Terminal S & T) output to actuator. Please note that even through overcurrent protection is in place, repeatedly subjecting the actuator output to overcurrent or short circuit condition can result in permanent damage to the product. Overcurrent protection is activated when the digital display on the HSG100 shows = = = =.

3.2 Connection terminals

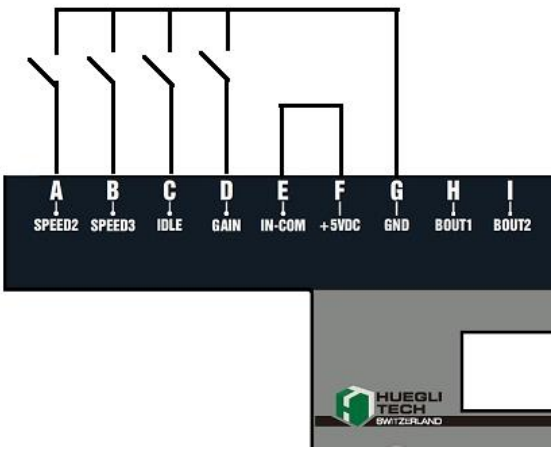
Connection Terminal	Description	Definition	Type
	SPEED2	Optional preconfigured speed selection	Binary Input
	SPEED3	Optional preconfigured speed selection	Binary Input
	IDLE	Idle	Binary Input
	GAIN	Preconfigured PID set2 selection	Binary Input
	IN-COM	Input Common Connection	Common Connection for Binary Input
	+5VDC	5VDC Power Supply	Power Supply
	GND	Ground / chassis	Ground
	BOUT1	Crank Termination Output	Binary Output
	BOUT2	Over-speed Output	Binary Output
	OUT-COM	Output Common Connection	Common Connection for Binary Output
	+5VDC	5VDC Power Supply(Feedback sensor)	Power Supply Output
	FEEDBACK	Feedback position signal input	Analog Input(0-5Vdc)
	GND	Ground / chassis	Ground
	+5VDC	5VDC Power Supply	Power Supply Output
	SPEED TRIM	Speed Trim input	Analog Input(0-5Vdc)
	GND	Ground	Ground
	EXT SPEED	Load distribution / synchronisation	Analog Input(0-10V)
	GND	Ground	Ground

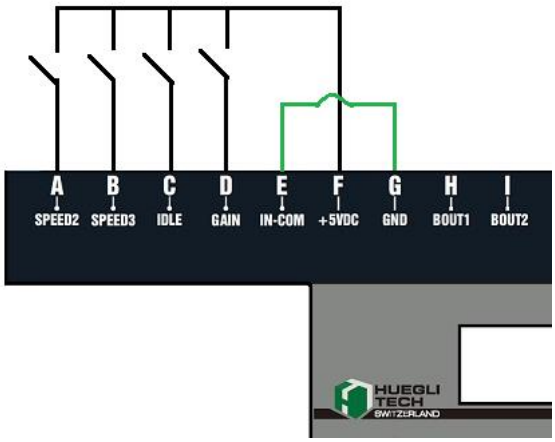
	ACTUATOR +	Actuator (Plus)	PWM Output
	ACTUATOR-	Actuator (Minus)	PWM Output
	BATTERY-	Battery (Minus)	Power Supply Input
	BATTERY+	Battery (Plus)	Power Supply Input
	PICKUP-	Pickup (Ground)	PWM Input
	PICKUP+	Pickup (Plus)	PWM Input
	CAN LO	CAN high	Communication Interface
	CAN HI	CAN high	Communication Interface
	DROOP	Droop	Droop enable signal

3.3 Electrical connection

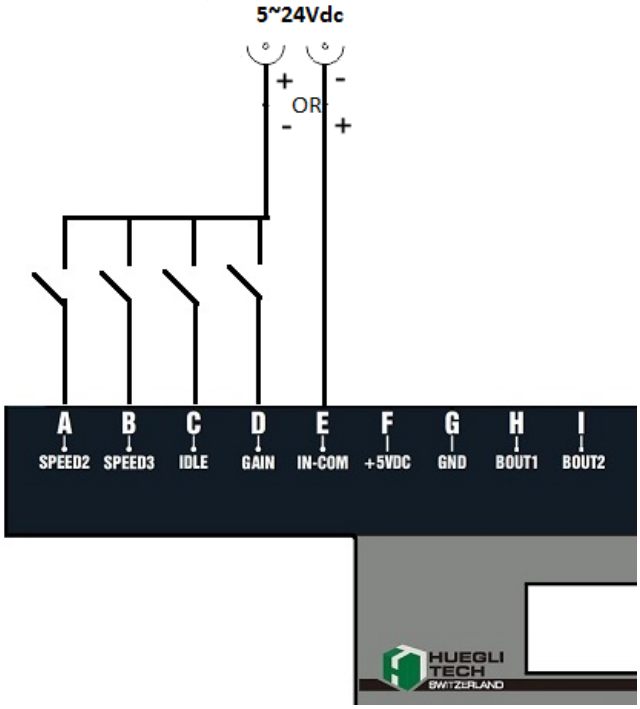
The HSG100 has a range of different connection options for various applications. The digital inputs and outputs of the HSG100 are galvanic isolated. Therefore you have option to connect the digital inputs and outputs in either galvanic isolated or non-galvanic isolated configuration depending on your application/system requirement.

Non-galvanic Isolated Binary Input Configuration



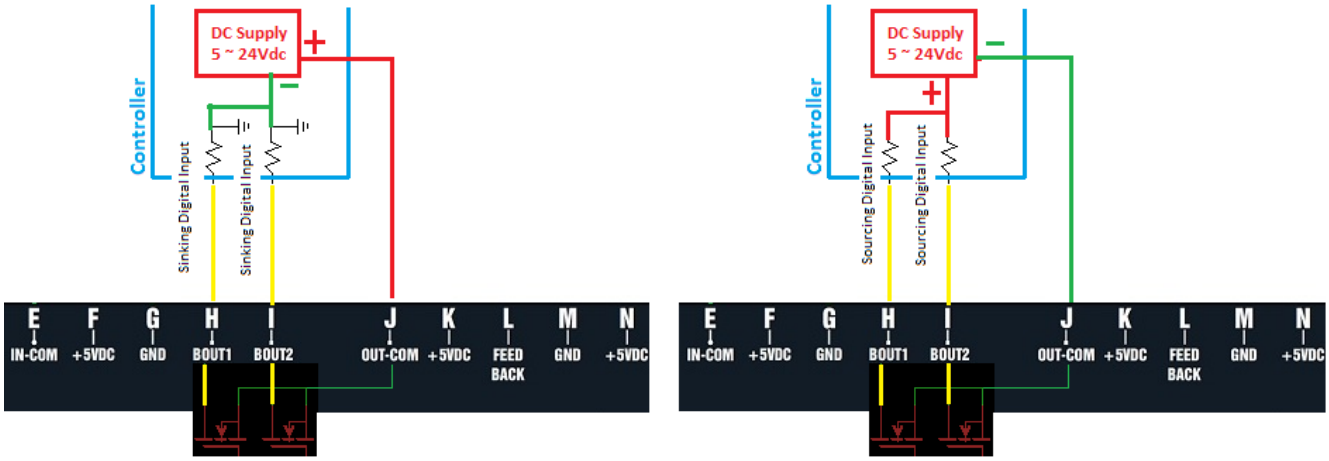


Galvanic Isolated Binary Input Configuration



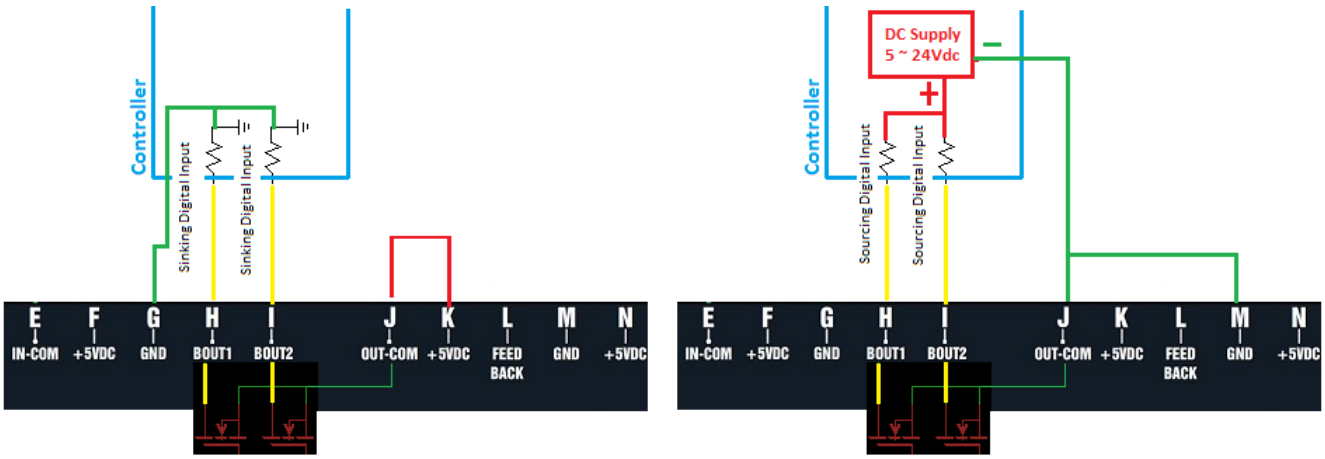
Important: To achieve galvanic isolation, grounding and power supply used by the HSG100 cannot be the same as that of the device that the input/output is interfaced with.

Galvanic Isolated Binary Output Configuration



Important: To achieve galvanic isolation, grounding and power supply used by the HSG100 cannot be the same as that of the device that the input/output is interfaced with.

Non-galvanic Isolated Binary Output Configuration

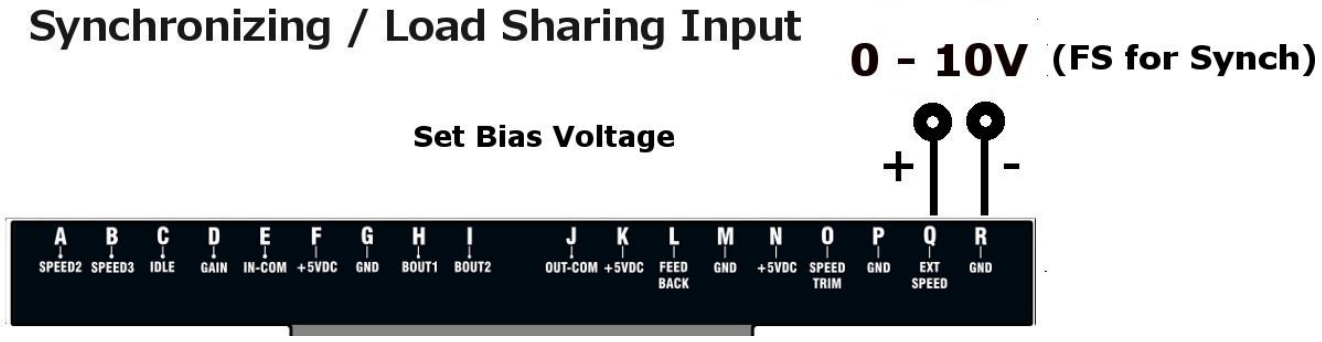


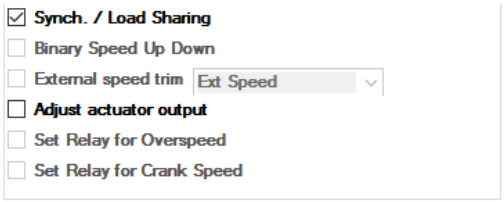
The following describes the applications and relevant connection configurations.

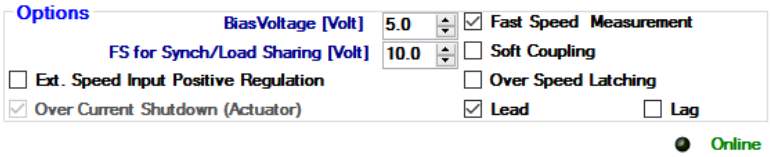
3.3.1 Fixed RPM, optional with load distribution or for parallel operation with the mains

With this application, up to three fixed RPM speeds can be selected by wiring in inputs Speed 2(A) and Speed 3 (B) as shown in section 3.3. The RPM settings can be set using the *HSG100* PC Configuration software.

Speed2 Input	Speed3 Input	Active Speed
Open	Open	Speed1
Close	Open	Speed2
Open	Close	Speed3
Close	Close	Speed3







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 = Bias voltage) is required. The HSG100 can work on both negative or positive principle depends on the configuration. The Sync/Load Sharing functions must be activated using the *HT Speed Governor Configuration* software.

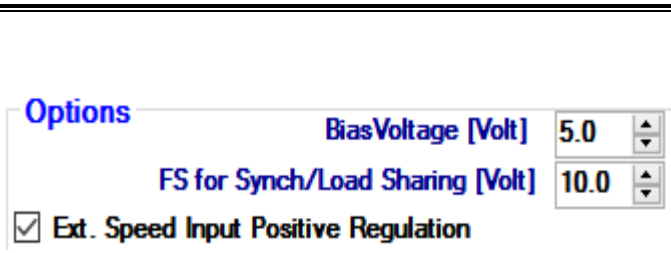
Example

1. **Negative speed regulation**

Input Voltage (Ext Speed)	Bias Voltage	Full Scale voltage	Requested Speed
0.0V	5.0V	10.0V	1550rpm
5.0V	5.0V	10.0V	1500rpm
10.0V	5.0V	10.0V	1450rpm

2. **Positive speed regulation**

Input Voltage (Ext Speed)	Bias Voltage	Full Scale voltage	Requested Speed
0.0V	5.0V	10.0V	1450rpm
5.0V	5.0V	10.0V	1500rpm
10.0V	5.0V	10.0V	1550rpm

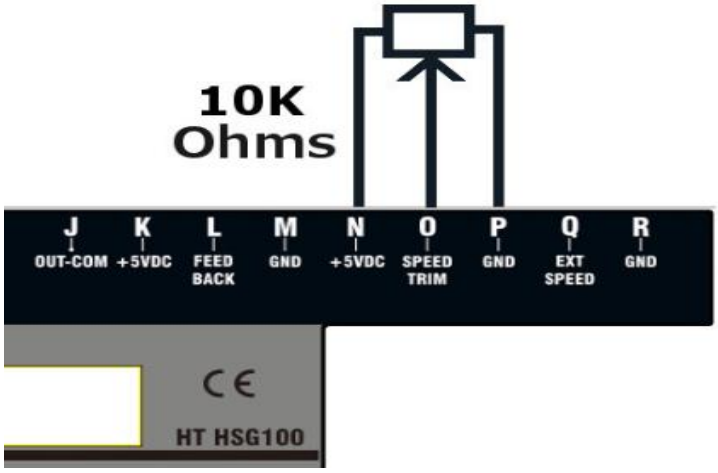


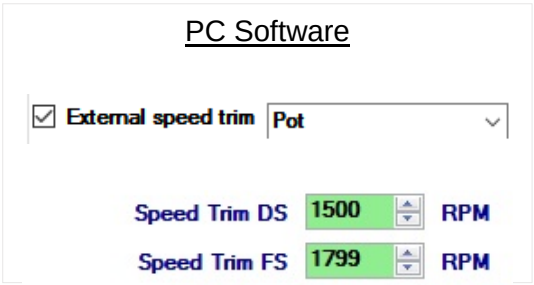
Note: This option only available on Firmware version>=1.51 and PC software >=3.0.0.81

3.3.2 Variable Speed

a. Potentiometer

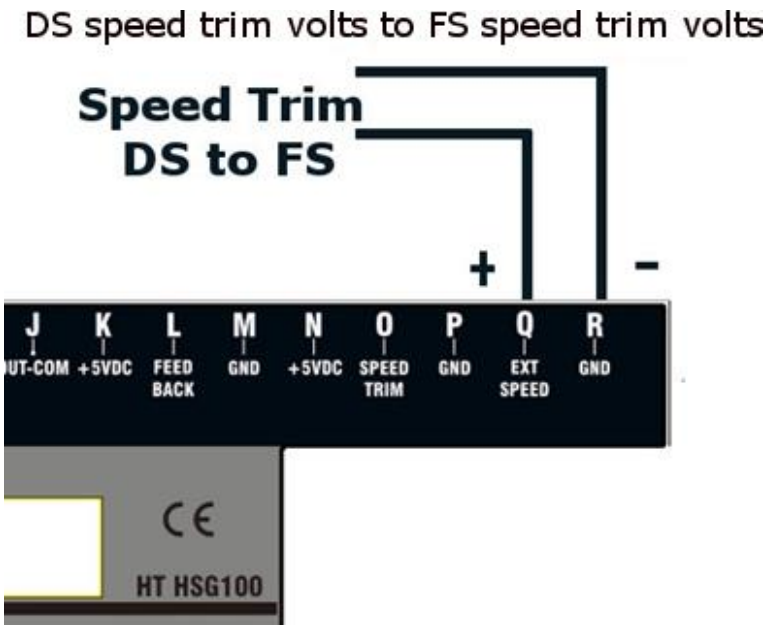
If the motor has to be run with a variable Speed setting, this can be achieved with an external potentiometer (5 or 10 kOhm type) using a 3 wire connection. This is to be connected according to the following diagram.

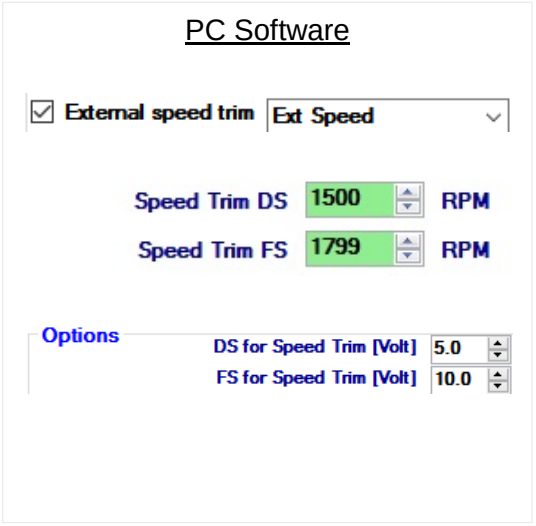




The External Speed Trim function must be activated in the *HT Speed Governor Configuration* software with the right input type chosen. In addition, the Speed Trim DS and Speed Trim FS parameters of the desired values can also be set

b. Voltage Input

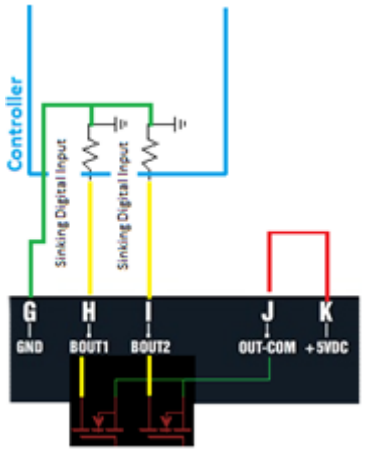
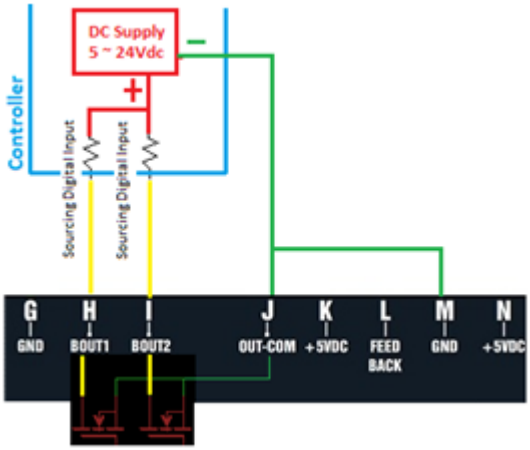




3.3.3 Crank and Over-speed output

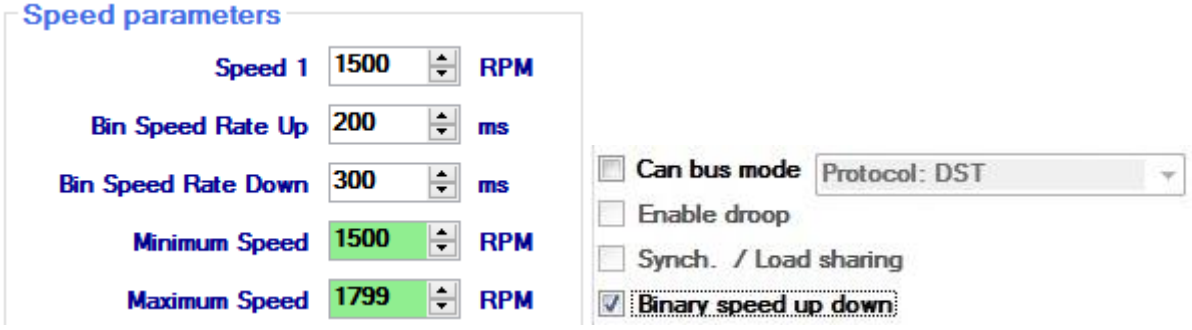
HSG100 has 2 binary output (can be set as sourcing or sinking output depending on the wiring configuration).

BOUT1 turns on when crank termination speed is reached and will turn off when engine speed reaches 0 rpm. BOUT2 turns on when over-speed event occurs and will turn off depends on over-speed latch setting

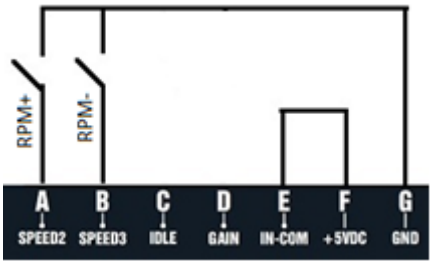
	
☐ Over Speed Latching	BOUT2 turn off during next crank
☑ Over Speed Latching	Press ‘Fn’ key or power ‘off’ and ‘on’ to turn off BOUT2

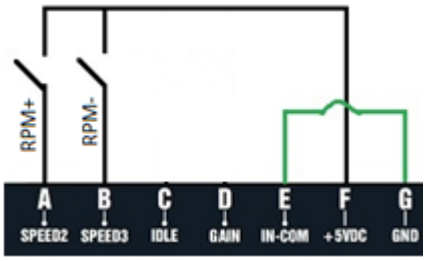
3.3.4 RPM adjustment via digital signal

If the speed setting is required to be set via a digital signal, this is also possible with the HSG-100. This may 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 Configuration software must be activated.

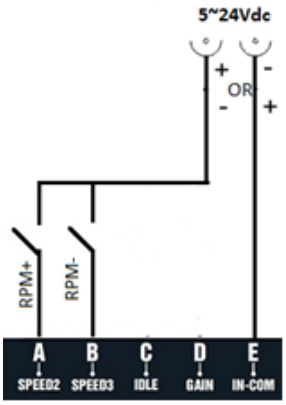


Non-Galvanic Isolated Configuration



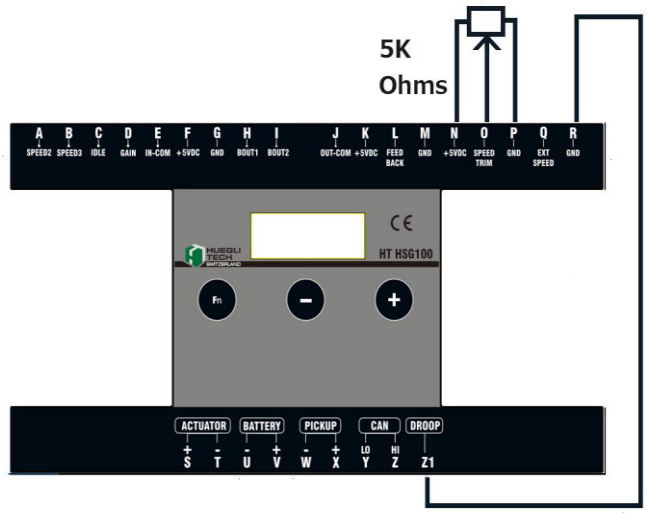


Galvanic Isolated Configuration



Speed2 Input	Speed3 Input	Bin Speed Rate Up (milliseconds)	Bin Speed Rate Down (milliseconds)	Requested Speed (rpm)
Open	Open	200	300	No Change in Requested speed
Close	Open	200	300	Requested speed + 1 for every 200 milliseconds
Open	Close	200	300	Requested speed -1 for every 300 milliseconds
Close	Close	200	300	No Change in Requested speed

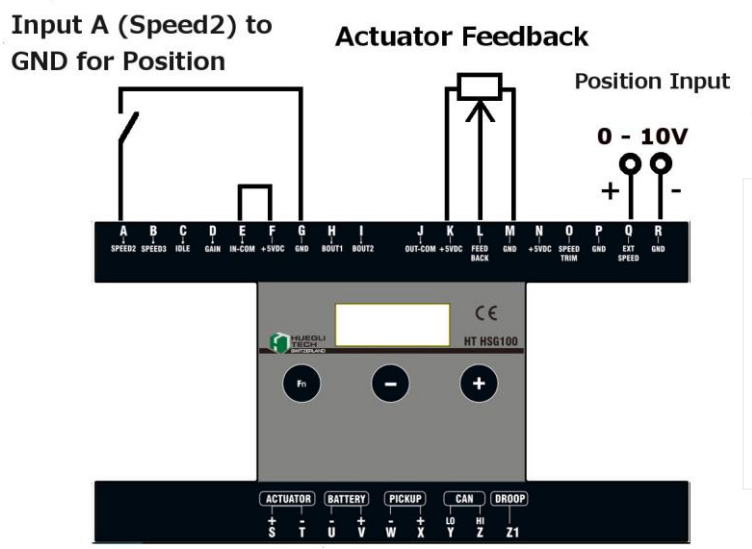
3.3.5 Droop Mode



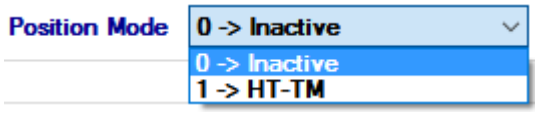
- Droop is for load sharing purpose. Droop function reduces the reference speed as load increases. It allows the engine to run at higher speed during no load and at rated speed at load. Droop mode can be enabled on HSG by Terminal Z1 (Droop) to GND (Terminal R).
- Depending on the software configuration, the requested speed can be change via a 5k ohms potentiometer or by a 0-10Vdc via the EXT Speed input.

Software configuration related to **Droop** can be found in section 5.3
(droop mode can work only in Hardware version ‘E‘ onwards)

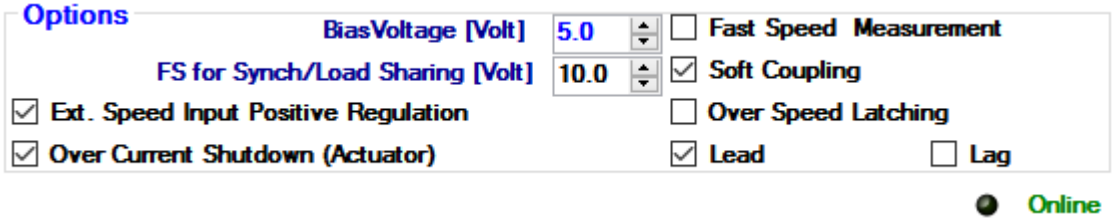
3.3.6 Position Mode



- HSG-100 provides a special function named position mode. When it use, it allows the HSG-100 to work like an electronic throttle control.



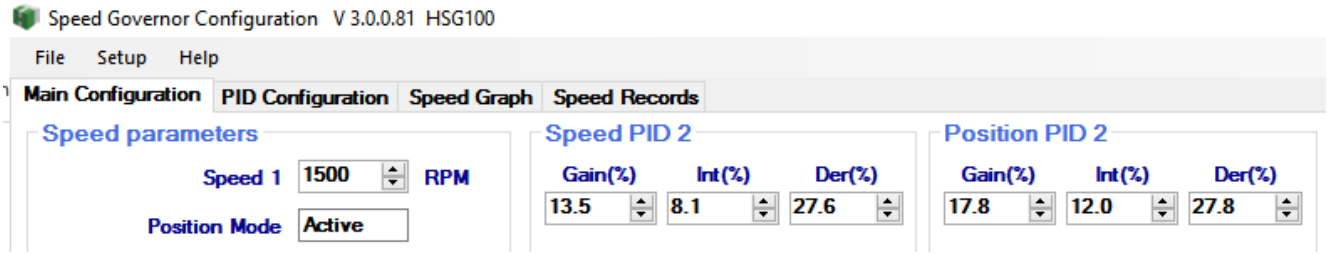
Position Voltage Configuration



Input Voltage vs Actuator Position

Input Voltage (volts)	Bias Voltage Setting	Full-scale Voltage Setting	Speed Regulation setting	Actuator Movement range
0.0 - 5.0	5.0V	10.0V	Positive	0%
5.0 - 10.0	5.0V	10.0V	Positive	0 to 100%
5.0 - 0.0	5.0V	10.0V	Negative	0 to 100%
5.0 - 10.0	5.0V	10.0V	Negative	0%

Once the position mode is activated, the PC software will show that the position mode feature is active and PID parameter 2 will be selected.



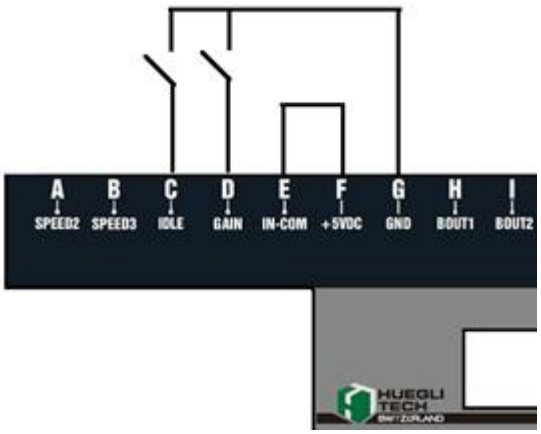
It is important to know that the PID Parameters determine the response of the actuator once the Position Mode is active.

The Position Mode function is mainly used for Parallel-To-Mains applications. Once the engine is Synchronized to the grid there is no longer a speed governing required because the engine is “pulled “by the grid frequency.

On Parallel-To-Mains application. The terminals Q + R (Ext. Speed) are connected to the speed regulation output of the genset controller (for example DST 4602). This signal must be set to a bias of 5 V with negative characteristic for speed regulation, it means signal < 5 V = Speed up, signal >5 V = Speed down.

As long the engine is not connected to the grid (GCB open) the HSG-100 works in normal speed governing mode (Input A open) with the signal at Q + R (Ext. Speed) coming from the genset controller the engine the engine is synchronized to the grid. Once the GCB is closed the HSG-100 must be set to position mode by switching input A (Speed 2) to GND. This can be done by a free feedback contact of the GCB.

3.3.7 Other inputs



3.3.7.1 Idle

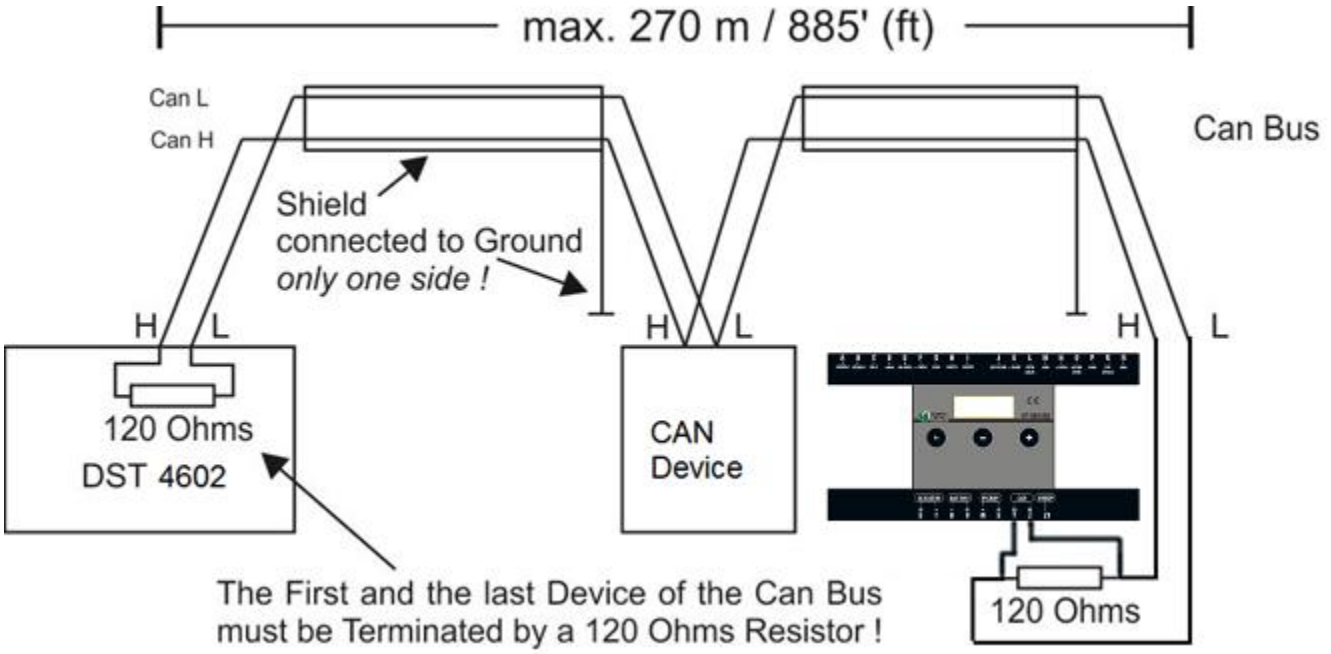
If this contact is closed, the motor runs at the configured idle speed.

3.3.7.2 Gain

HSG100 has two set of the PID. If the contact is open, parameter set 1 is active, when the contact is closed, parameter set 2 is active. For some applications it may be necessary to use other parameters in idle as under load.

3.4 CAN BUS Connection

Using the CAN Bus connection, the bus cable must be connected to the terminals Q (Can HI) and P (Can LO). If the HSG100 is the first or the last device in the bus, a termination resistor (120Ohms) is required. Shielded cable (for example, HELUKABEL CAN BUS 2x0.22) must be used for the CAN Bus connection.



3.5 Keypad

The HSG100 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.

The keypad are locked by default to prevent any accidental misconfiguration. To lock or unlock the keypad, Press & Hold [Fn] and [+] button for 3 seconds to lock/unlock.

The functions listed below can be accessed using the Fn (Function) button. Each press of the Fn 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 or 0.1 depending on configuration type. If the arrow keys [+] or [-] held down longer, the value increases or decreases at a greater rate.

Regular Mode			
Normal operating mode	1500	RPM	Default: 1500rpm
Press & Hold [Fn] and [+] button for 3 seconds to unlock			
After 3 seconds	SPd.1	Speed1,2,3/idle/FS/DS	Default: 1500
[Fn] button:1x press	GEAr/50	Number of teeth	Default: 50 teeth
[Fn] button:2x press	GAi./22.0	P value*	Default: 22.0%
[Fn] button:3x press	inT./10.0	I value*	Default: 10.0%
[Fn] button:4x press	dEr./15.0	D value*	Default: 15.0%
[Fn] button:5x press	L.tim	PID Loop time	Default: 15ms
[Fn] button:6x press	CrAn/200	Crankspeed	Default: 200 rpm
[Fn] button:7x press	FU.rA/3	Fuel Ramp	Default: 3 sec.
[Fn] button:8x press	SP.rA/1	Speed Ramp	Default: 1 sec.
[Fn] button:9x press	St.Po/50	Start Position	Default: 50%
[Fn] button: 10x press	FuE.L/100	Fuel limit	Default: 100%
[Fn] button: 11x press	o.SPd/2000	Overspeed	Default: 2000 rpm
[Fn] button: 12x press	Droo/3.0	Droop %	Default: 3.0%
[Fn] button: 13x press	1500	RPM display	Default: 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
Press & Hold [Fn] button for 3 seconds To select Quick mode if required	qui	To select quick mode display	to access only PID Menus
*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.			
Quick Mode			
Normal operating mode	1500	RPM	Default: 1500rpm
[Fn] button: 1x press	GAi./22.0	P value*	Default: 50.2 %
[Fn] button: 2x press	int./10.0	I value*	Default: 21.9 %
[Fn] button: 3x press	dEr./15.0	D value*	Default: 7.0 %
[Fn] button: 4x press	L.tim	PID Loop time	Default: 15ms
[Fn] button: 5x press	1500	RPM display	Default: 1500rpm
Press & Hold[Fn] button for 3 seconds To select Regular mode if required	rEG	To select regular mode display	to access all the Menus
General Features for all Types and Modes			
Press & Hold [+] and [-] button for 3 seconds to know the firmware version	V1.51	Working firmware version	Current version
Press [Fn] and [-] button to exit from Menu display	1500	RPM display	Default: 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
Press & Hold [Fn] and [+] button for 3 seconds to lock/unlock key pad			
*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

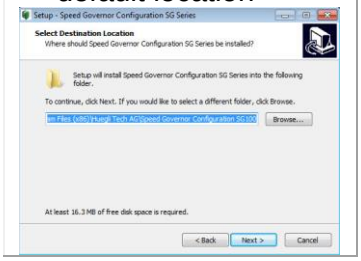
Operating system requirement is Windows XP or later. Please ensure that you have internet access during the entire software installation process to ensure that the necessary drivers are downloaded automatically. If not, please approach the Huegli Tech Support Team for the necessary additional installer software and drivers.

Prior to installation, please also ensure that you have Microsoft Framework Version 4.0 and above already installed. Installation of the software is carried out by running the
"HT Speed Governor Configuration Vx.x.x.xx.exe"

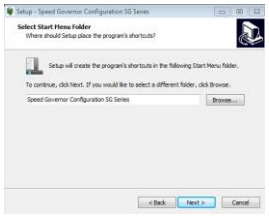
1. Choose the desired Language

2. Click 'Next'

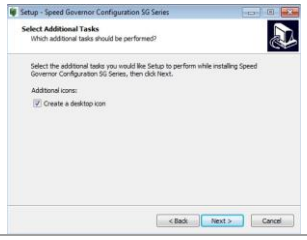
3. Don't change the default location



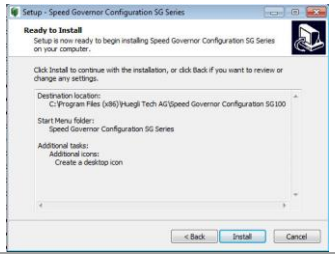
4. Click 'Next'



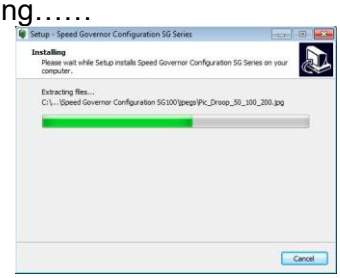
5. Click 'Next'



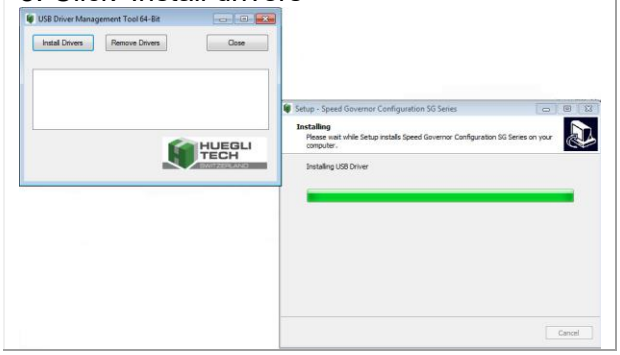
6. Click 'Install'



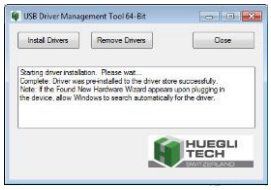
7. Installing……



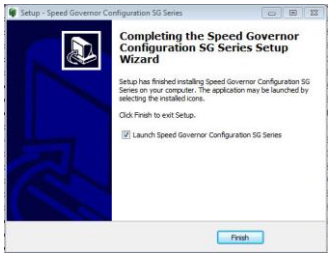
8. Click 'Install drivers'



9. Drivers are installed. Click 'close'

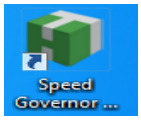


10. Click 'Finish'



11. Software Launched

12. Double click this icon for subsequent opening of software from desktop



Power up the HSG100 and connect up the USB cable. Windows will search for the latest driver online for the HSG100. Once it is completed, you will be notified either through a pop up message box or through a notification at the icon tray.

5 Software use

Before using the motor for the first time, the basic parameters of the HSG100 must be configured. The factory settings must be checked.

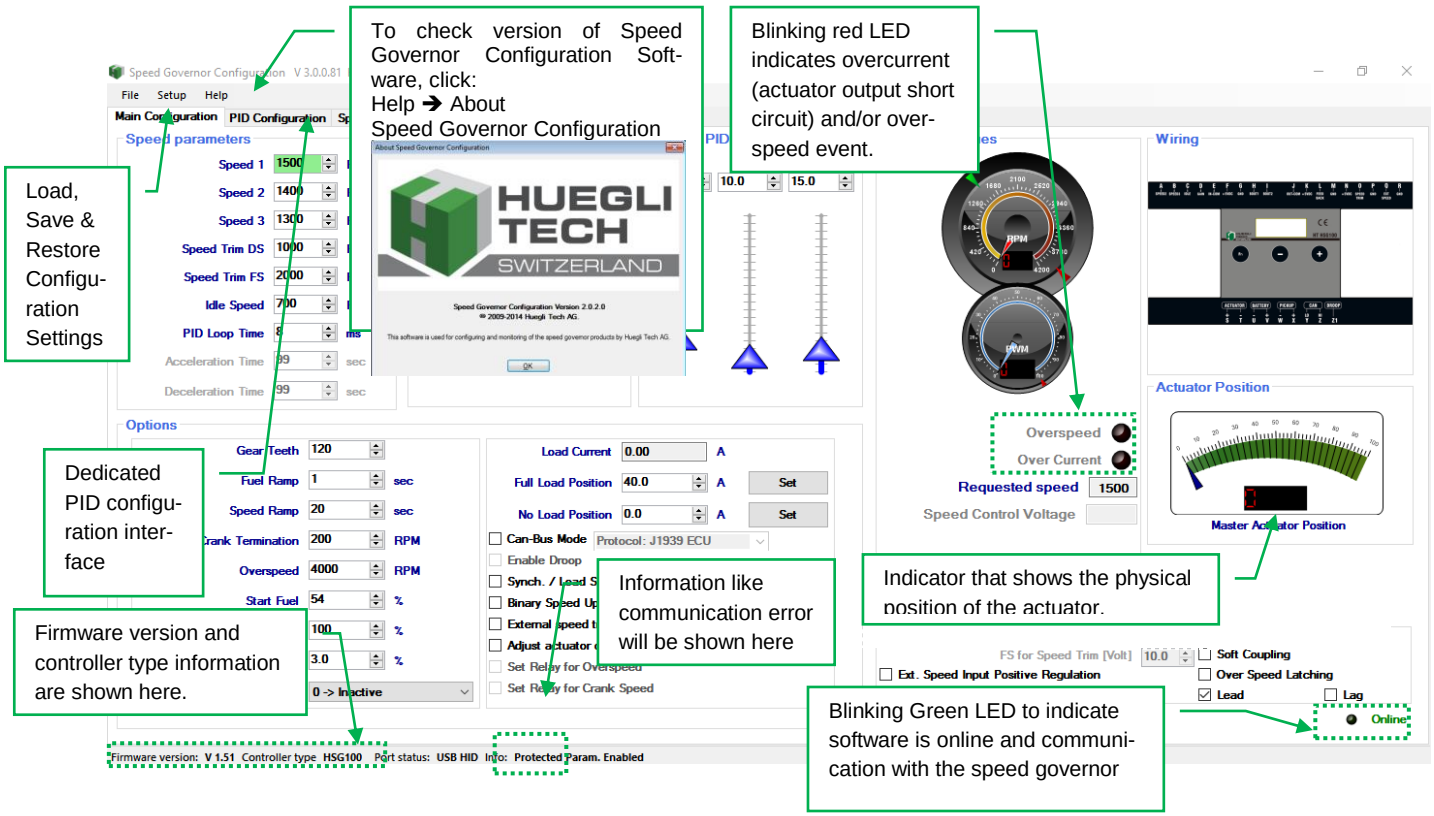
5.1 Main Screen

Start the software by click on the short cut icon created after installation. After the software has started, a screen appears which looks dull and faded out. This means that the PC is not yet connected to the HSG100.

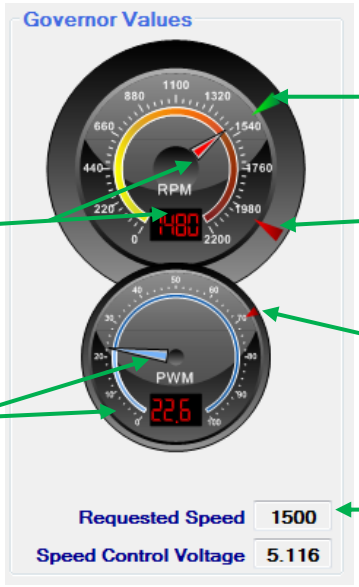
Offline Mode

If the HSG100 was connected to the PC via a USB cable, connection between the PC and HSG100 will be created automatically. When the connection is successful established, the screen will look vibrant. There is a onscreen LED Indicator at the bottom right hand of the screen to
Indicate that the software is now online.

The current HSG100 configurations values will also be displayed and the configuration values can also be altered. Click on the relevant input field (current value will then be displayed blue) and use the keypad to enter the new value. The type and firmware version of the speed governor is shown at the right bottom of the screen. To exit from the software, please click on File ➔ Exit.



Various values are represented both graphically and numerically in the start window and the Control-ler Values window.



Nominal speed*

Current RPM

Over-speed

Fuel/Current limit

Current % of output PWM for current/fuel

Nominal speed*

*If the Synch. /Load Sharing, Binary Speed Up Down or External Speed Trim function was activated, the value changes using the cur-rent Speed setting. This allows monitoring of whether the external sig-nals are functioning with-out fault. This is especial-ly helpful with the Synch/Load Sharing function to monitor the corresponding signal

5.1.1 Speed Parameters

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

Active only when External Speed Trim is selected

5.1.2 Options

Gear Teeth 50	Number of teeth on the flywheel. This parameter is used by the HSG100 to calculate the current RPM.
Fuel Ramp 1 sec	This parameter determines the timing required to reach start position. If the current speed exceeds the crank termination speed, the speed ramp feature will take over.
Speed Ramp 3 sec	The speed ramp determines the following: • Ramp up timing after crank termination speed to Requested Speed. • Ramp down timing Nominal(Requested) Speed to Idle Speed • Ramp up timing from Idle Speed to Nominal(Requested) Speed
Crank Termination 200 RPM	This value is to determine if the motor is starting or running. As soon as the motor RPM exceeds this limit, the HSG100 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 2000 RPM	If the over-speed value is exceeded, HSG will drive the actuator in reverse direction to stop the fuel to engine. The digital display of the HSG100 will show - - - -. After restarting, the current RPM will be shown again depends on ☑ Over Speed Latching
Start Fuel 100 %	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.
Fuel Limit 100 %	This is the fuel/current limit of the actuator, so that under full load the actuator does not consume excessive amounts of electricity and also limits the maximum about of fuel fed. The limit should be set such that e.g. with a limit of 80, the actuator still works properly under full load condition. If this is not the case, this limit must be increased.

Droop 3.0 %	Enabled when used for parallel application. Activated by external wiring.
Full Load Position 40.0 %	Actuator driving position under full load conditions during droop Operation.
No Load Position 20.0 %	Actuator driving position under no load conditions during droop Operation
☑ Can-Bus Mode Protocol: J1939 ECU Protocol: DST Protocol: J1939 ECU	Activates Can-Bus for communication with external controller.
☐ Synch. / Load Sharing	Activates analogue input for load distribution and/or a synchronisation/load control, see 3.3.1
☑ Ext. Speed Input Positive Regulation ☐ Ext. Speed Input Positive Regulation	This option is valid for position mode and Synch/load sharing. If this option is selected the requested speed will get increase for the corresponding voltage input in loadsharing mode. If this option is deselected the requested speed will get decrease for the corresponding voltage input in loadsharing mode.
BiasVoltage [Volt] 5.0	This parameter is valid only for Synch/load sharing and position mode. Load sharing requested speed zero point is decided by this setting.
FS for Synch/Load Sharing [Volt] 10.0	Full scale voltage setting for synch/loadsharing mode
DS for Speed Trim [Volt] 5.0	Down scale voltage setting for External speed trim voltage input mode(Ext Speed).
FS for Speed Trim [Volt] 10.0	Full scale voltage setting for External speed trim voltage input mode (Ext Speed).
☑ Binary Speed Up Down	Activates digital mode for speed setting, see 3.3.3 When this mode is activated, the Speed Values are altered. The values for Bin Speed Rate UP & DOWN, Minimum Speed and Maximum Speed can be set.
☑ External speed trim Ext Speed Speed3 Ext Speed	Variable Speed setting by potentiometer or 0-10Vdc, see 0
☐ 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.
☑ Over Current Shutdown (Actuator)	This option is to switch off the actuator output and stop the engine when over current or short circuit occurs on actuator output(always selected not changeable)

☑ Over Speed Latching	This option is to prevent cranking the engine after over-speed occurrence. User needs to press the "Fn" key or power on/Off to reset the error otherwise display toggle between the detected over-speed and over-speed symbol ----.
☐ Over Speed Latching	If this option is deselected and over-speed occurred then HSG-100 display toggle between the detected over speed and over-speed symbol ----. The next crank attempt will clear the error automatically.
☑ Lead ☐ Lag	PID for phase Lead compensation
☐ Lead ☑ Lag	PID for phase lag compensation
☑ Soft Coupling	Speed measurement configuration for 2 cylinder engines
☑ Fast Speed Measurement	Speed measurement configuration for all the engines except 2 cylinder

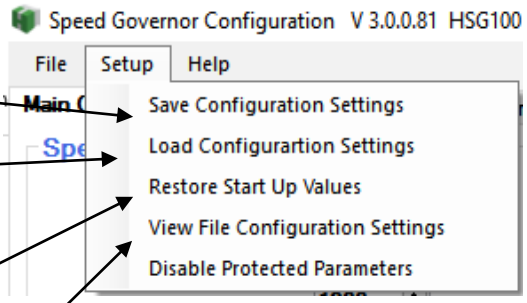
5.1.3 Loading/Saving Settings

The following functions are only available when the HSG100 is connected to the PC!

A configuration can be saved on the computer by clicking on the Setup button.

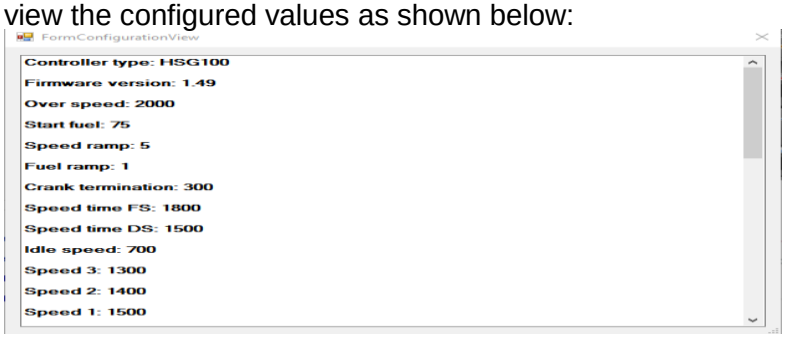
If you wish to transfer a saved configuration to another HSG100, click on the Load configuration menu and select the desired configuration file. The configuration will then be loaded onto the HSG100.

A particular and very helpful function is offered by the Restore Start Up Values. If you have adjusted the governor and cannot reproduce the original values (and have not stored them), this function can be used to retrieve them. The PC software saves the settings that were stored at the time the connection was established with the HSG100.



5.1.4 Viewing Configuration Settings File

To view the saved configuration file, click on View File configuration settings and you will be able to view the configured values as shown below:



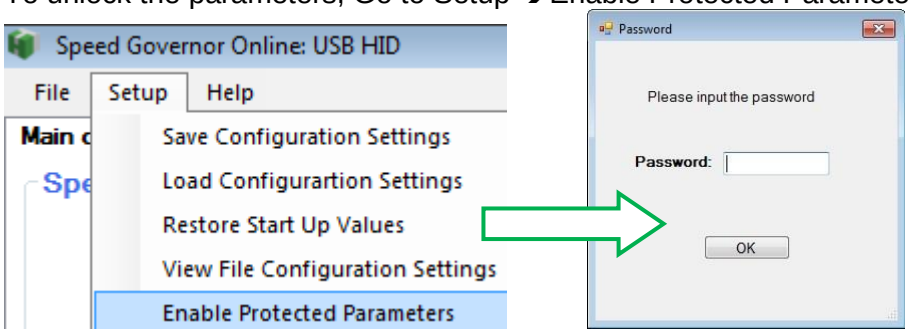
5.1.5 Password Protected Parameters

To prevent accidental misconfiguration, some of the parameters are password protected by default. These features are:

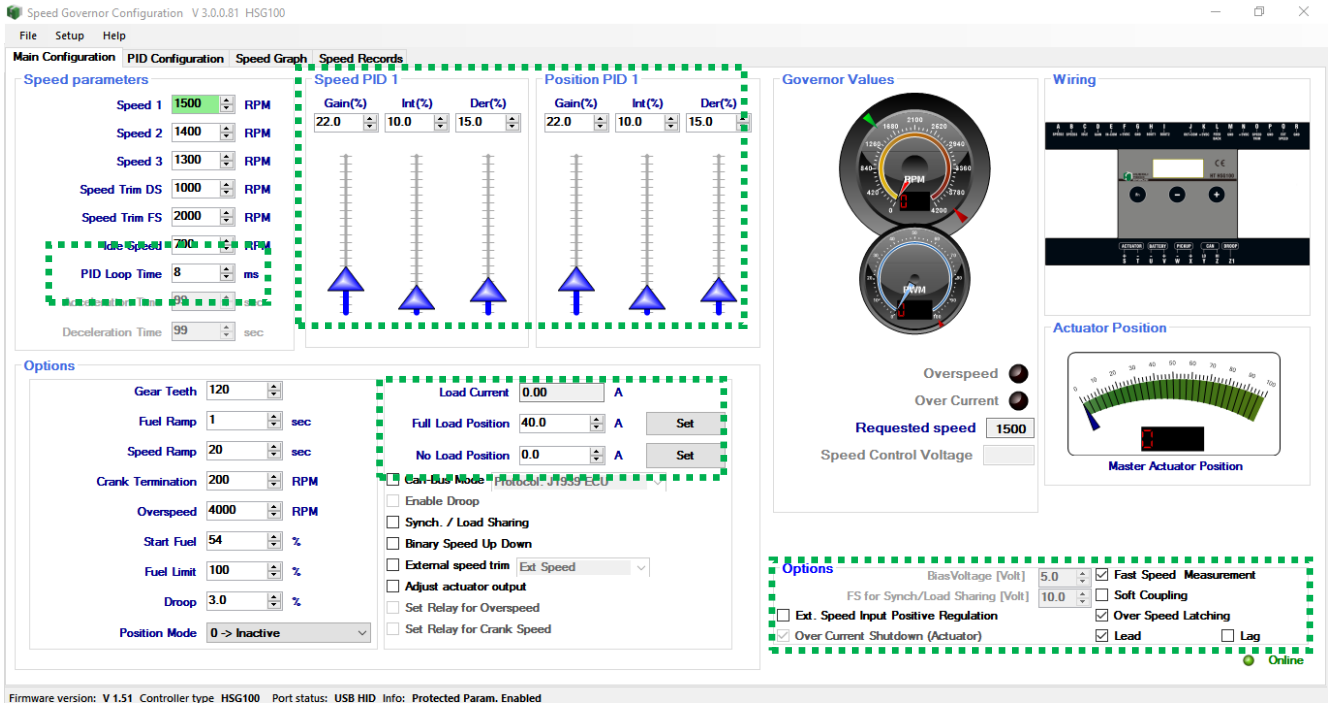
- Gain 2 / Int 2 / Der 2
- CAN Bus
- PID Loop Time
- Full/No Load Parameters

The password to unlock the parameters is **4900**

To unlock the parameters, Go to Setup ➔Enable Protected Parameters➔ Key in Password➔OK



Once the protected parameters are unlocked, the screen will look like the following:



To lock the parameters, -Go to Setup ➔Disable Protected Parameters.

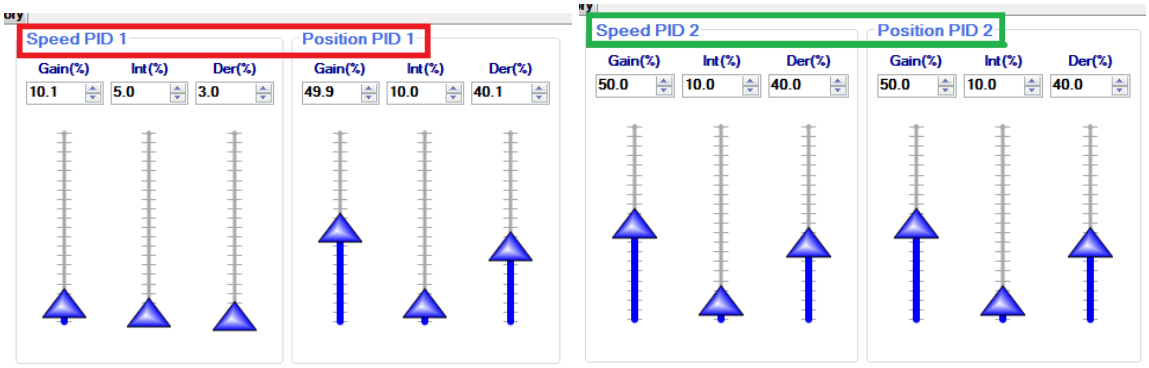
5.2 PID Parameters

In client-specific HSG100 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.

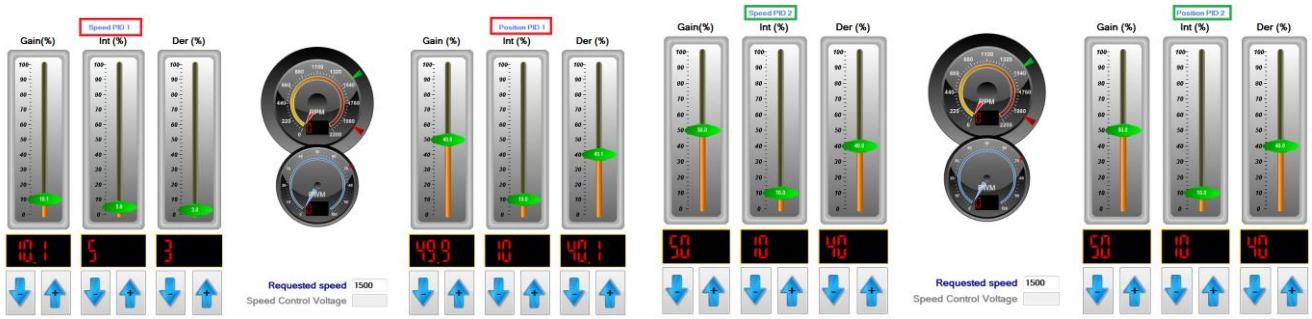
For new applications, these parameters must be defined before starting the motor.

Speed/Position Gain 1:	P value parameter set 1 (input Gain (G) open)
Speed/Position Int 1:	I value parameter set 1 (input Gain (G) open)
Speed/Position Der 1:	D value parameter set 1 (input Gain (G) open)
Speed/Position Gain 2:	P value parameter set 2 (input Gain (G) closed)
Speed/Position Int 2:	I value parameter set 2 (input Gain (G) closed)
Speed/Position Der 2:	D value parameter set 2 (input Gain (G) closed)

PID parameters from PID configuration tab



PID parameters from PID configuration tab



The currently active PID parameter Set(Speed/Position 1) is indicated by the set number displayed. If a dedicated interface for PID adjustment is required, please select the PID Configuration Tab.

Alteration of the P, I and D parameters can be done by the following methods when the motor is active or idle:

From Main Configuration tab

- Sliding the Arrow bars.
- Clicking on the up & down arrow key next to the PID values
- Keying in the values directly into the text box.

From PID Configuration tab

- Slide the green bars.
- Clicking on the + & - arrow key next to the PID values

The motor RPM and the output signal are visible on the display.

PID Parameters 1

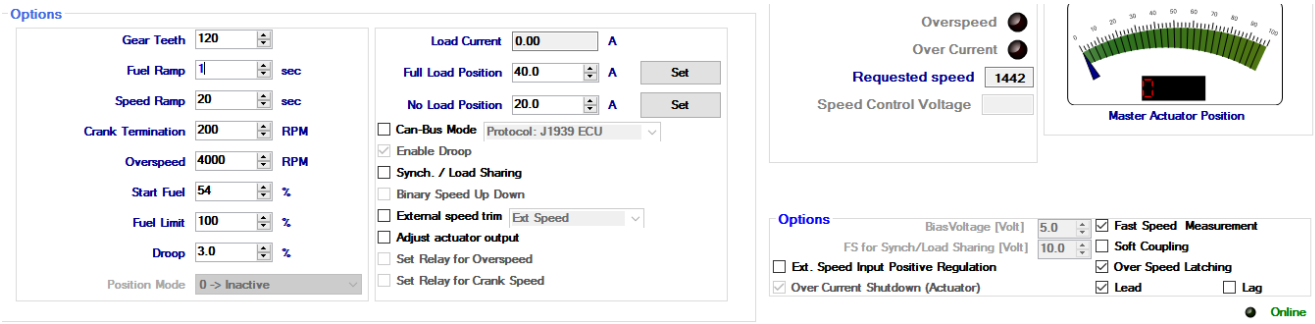
Speed/Position Gain 1:	P value parameter set 1 (input Gain (G) open)
Speed/Position Int 1:	I value parameter set 1 (input Gain (G) open)
Speed/Position Der 1:	D value parameter set 1 (input Gain (G) open)

PID Parameters 2

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

5.3 Droop

When the hardware connection required to activate droop (See section 3.3.5) is made, the Enable Droop box becomes checked. (droop mode can work only in Hardware version ‘E‘ onwards)



The Actuator Position box shows position of the actuator which acts as a feedback to allow the HSG100 to know the load being drawn.

Steps to setup HSG100 to run droop function (Assuming PID settings are now optimum)

1. Key in the required droop %(Typically 3%-default value).
2. Start the motor at no load condition. Once motor stabilizes, click on 'Set' for No load position.
3. Run the motor at full load condition. Once motor stabilizes, click on Set for Full load position.

Alternatively, you could also key in the full/no load position manually by observing the Actuator Position.

Droop function will also work with Loading Sharing and External Speed trim. If none of these 2 features are used, by default you can connect a 5K potentiometer to terminal N,O,P(refer section 3.3.5) for speed variation of +/-100rpm.

Here are some examples on what the requested speed will be at various running load:

Selected Reference-SPEED1	1500	RPM
Full Load Position Setting	45	%
No Load Position Setting	10	%
Actuator Position Reading	10	%
Droop	3.0	%
Requested Speed	**1545**	RPM

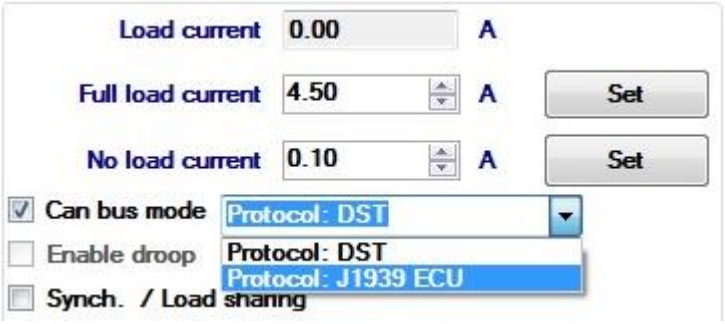
Selected Reference-SPEED1	1500	RPM
Full Load Position Setting	45	%
No Load Position Setting	10	%
Actuator Position Reading	45	%
Droop	3.0	%
Requested Speed	**1500**	RPM

Selected Reference-SPEED1	1500	RPM
Full Load Position Setting	45	%
No Load Position Setting	10	%
Actuator Position Reading	25	%
Droop	3.0	%
Requested Speed	**1525**	RPM

Note:
*droop mode can work only in Hardware version 'E' onwards

5.4 CAN Bus

The CAN bus protocol available on the HSG100 are J1939 ECU & DST. Click on the Can Bus Mode check box and select the required appropriate CAN Bus protocol.



5.4.1 Supported J1939 ECU CAN Bus Register

Communication Messages

CAN Communication **(Genset Controller ==> HSG100)**

PGN 0000

SG100 Designation	J1939 Designation	Byte	Data Range	Resolution	Offset	Unit	SPN
Requested Speed	Requested Speed	1 + 2	0 to 8031.875	0.125	0	RPM	898

CAN Communication **(HSG100 ==> Genset Controller)**

PGN F004

SG100 Designation	J1939 Designation	Byte	Data Range	Resolution	Offset	Unit	SPN
Engine Speed	Engine Speed	4 + 5	0 to 8031.875	0.125	0	RPM	190

PGN F003

SG100 Designation	J1939 Designation	Byte	Data Range	Resolution	Offset	Unit	SPN
PWM Output	Accelerator Pedal Position	1	0 - 100	0.004	0	%	91

CAN Communication from **HSG-100** *to Genset Controller(DM1 Messages)*

PGN FECA
HSG-100 Failure Designation: Overspeed
J1939 Designation: Engine Speed

Byte#	Bits assignment & description	Values(Dec)	Data Range	Resolution	Unit
1	bits 8-7 Malfunction Indicator Lamp Status	00			
	bits 6-5 Red Stop Lamp Status	01			
	bits 4-3 Amber Warning Lamp Status	00			
	bits 2-1 Protect Lamp Status	00			
2	bits 8-7 Reserved for SAE assignment Lamp Status	00			
	bits 6-5 Reserved for SAE assignment Lamp Status	00			
	bits 4-3 Reserved for SAE assignment Lamp Status	00			
	bits 2-1 Reserved for SAE assignment Lamp Status	00			
4 to 3	SPN (16 most significant bits)	701			
5	Bits 8-6 SPN (3 most significant bits)		0 - 524,287	1	SPN
	bits 5-1 FMI	3	0-31	1	FMI
6	bit 7-1 Occurance Count	Variable	0-126	1	count

PGN FECA
HSG-100 Failure Designation: Fuel Limit Reached
J1939 Designation: Engine Throttle Position

Byte#	Bits assignment & description	Values(Dec)	Data Range	Resolution	Unit
1	bits 8-7 Malfunction Indicator Lamp Status	00			
	bits 6-5 Red Stop Lamp Status	00			
	bits 4-3 Amber Warning Lamp Status	01			
	bits 2-1 Protect Lamp Status	00			
2	bits 8-7 Reserved for SAE assignment Lamp Status	00			
	bits 6-5 Reserved for SAE assignment Lamp Status	00			
	bits 4-3 Reserved for SAE assignment Lamp Status	00			
	bits 2-1 Reserved for SAE assignment Lamp Status	00			
4 to 3	SPN (16 most significant bits)	562			
5	Bits 8-6 SPN (3 most significant bits)		0 - 524,287	1	SPN
	bits 5-1 FMI	51	0-31	1	FMI
6	bit 7-1 Occurance Count	Variable	0-126	1	count

PGN FECA
HSG-100 Failure Designation: Pickup Fault
J1939 Designation: Engine Timing Sensor

Byte#	Bits assignment & description	Values(Dec)	Data Range	Resolution	Unit
1	bits 8-7 Malfunction Indicator Lamp Status	00			
	bits 6-5 Red Stop Lamp Status	00			
	bits 4-3 Amber Warning Lamp Status	01			
	bits 2-1 Protect Lamp Status	00			
2	bits 8-7 Reserved for SAE assignment Lamp Status	00			
	bits 6-5 Reserved for SAE assignment Lamp Status	00			
	bits 4-3 Reserved for SAE assignment Lamp Status	00			
	bits 2-1 Reserved for SAE assignment Lamp Status	00			
4 to 3	SPN (16 most significant bits)	637			
5	Bits 8-6 SPN (3 most significant bits)		0 - 524,287	1	SPN
	bits 5-1 FMI	7	0-31	1	FMI
6	bit 7-1 Occurance Count	Variable	0-126	1	count

5.4.2 Supported DST CAN Bus Register

The HSG100 can communicate with Huegli Tech Controller HT-DST4602 HT controller by CAN Bus through DST protocol.

The designated port to be used on the DST4602 is CAN_0 (J11, ECU Interface). The Engine Type 200 – HT gas must be selected in menu 7, P.700 on the DST 4602.

The following setting must be entered manually into the DST 4602:

- Gain1
- Int1
- Der1
- Gain2
- Int2
- Der2
- Start Position
- Speed Ramp

Once the values have been entered into the DST 4602, the CAN bus mode can be activated. When the CAN bus mode is activated, no further access to the Controller Settings menu is possible via the PC software, as the DST 4602 setting values will now be displayed.

DST 4602 values, address 234 (EAh)
The identifier has the following appearance: 1CFF50EA and/or 1CFF51EA

PGN FF50

Designation	Byte	Data Range	Resolution	Offset	Unit
Gain 1	0 + 1	0 - 100.0	0.1	0	%
Integration 1	2 + 3	0 - 100.0	0.1	0	%
Derivative 1	4 + 5	0 - 100.0	0.1	0	%
Speed Ramp	6 + 7	1 - 100	1	0	sec

PGN FF51

Designation	Byte	Data Range	Resolution	Offset	Unit
Gain 2	0 + 1	0 - 100.0	0.1	0	%
Integration 2	2 + 3	0 - 100.0	0.1	0	%
Derivative 2	4 + 5	0 - 100.0	0.1	0	%
Start Postion	6 + 7	0 - 100	1	0	

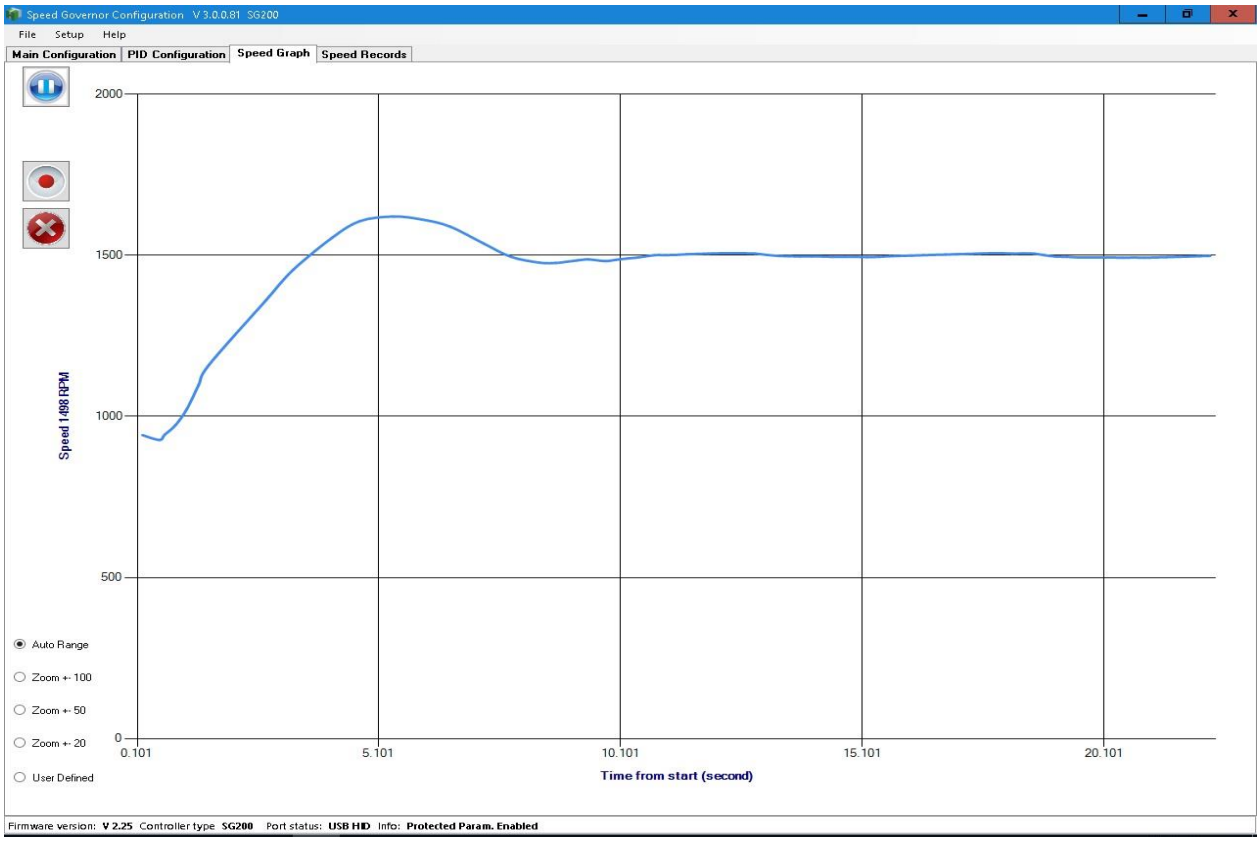
HSG100 values, address 0 (0h)
The identifier has the following appearance: 14FF2100

PGN FF21

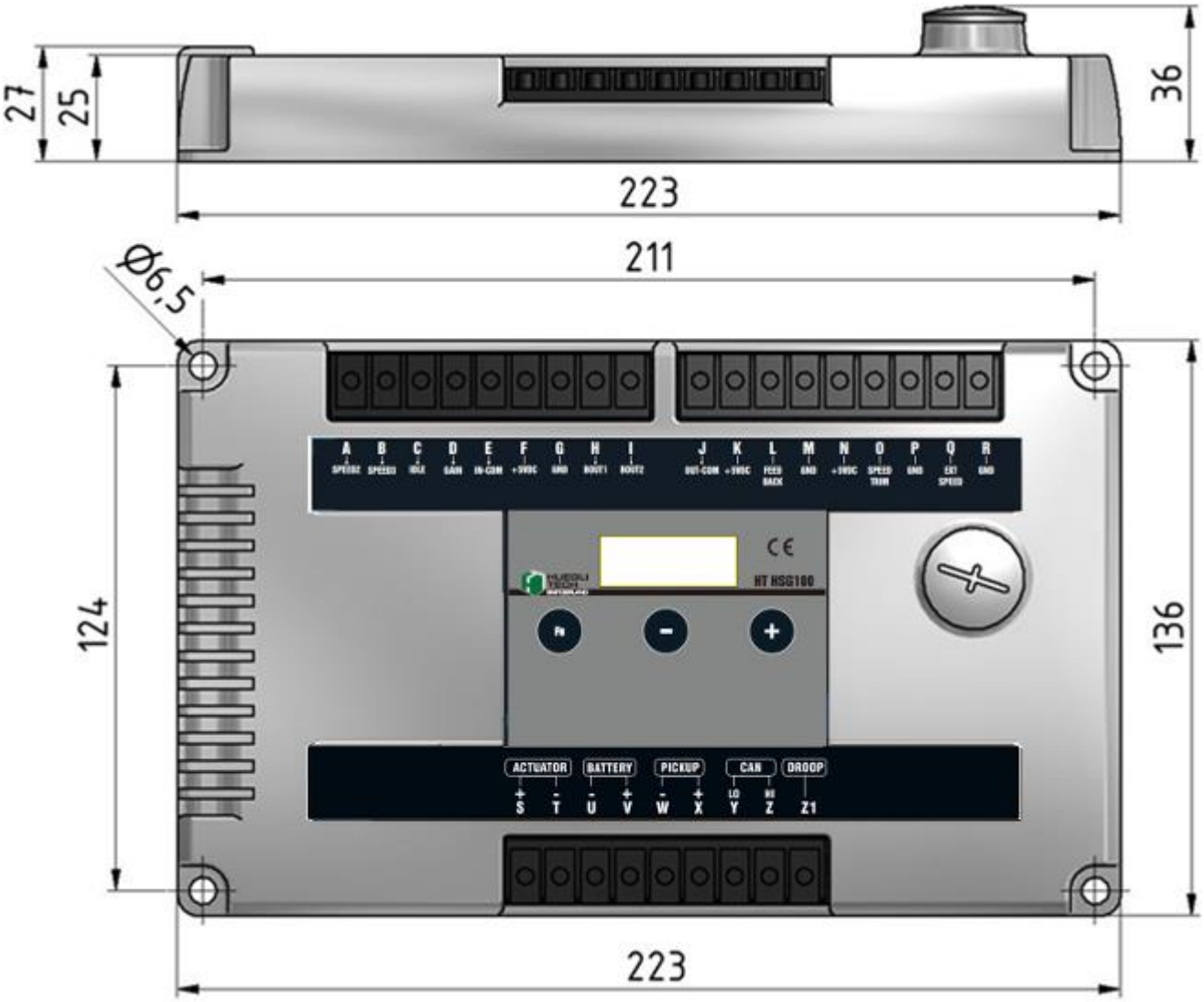
Designation	Byte	Data Range	Resolution	Offset	Unit
Speed	0 + 1	0 - 4000	1	0	RPM
Actuator Output	2 + 3	0.0 - 100.0	0.1	0	%
Speed Control Voltage	4 + 5	0 - 10000	0.001	0	V
Selected PID Set	6.0	0 - 1	1	0	
Idle Speed Selected	6.1	0 - 1	1	0	
Speed 1 Selected	6.2	0 - 1	1	0	
Speed 2 Selected	6.3	0 - 1	1	0	
Speed 3 Selected	6.4	0 - 1	1	0	
Over-speed	6.5	0 - 1	1	0	

5.5 Speed Graph

Click on the Speed Graph tab to view the RPM sensed by the pickup sensor for the past 40 seconds.



6 Dimensions



7 Starting the motor

7.1 Before starting the motor with the HSG100, follow this procedure:

a. Turn on the power supply to the HSG100 but do not start the motor.
b. Check all the important parameters for correct values in SETUP mode:
   Number of teeth, over speed, RPM settings, crank termination and start position.
c. Ensure that the feedback signal from the HT-TM2200-75 is connected to the HSG100.

d. Ensure that the feedback signal is correct. If the flap is opening, the signal should move towards 4.5V. If the flap is closing, the signal should move towards 0.5V.

7.2 Starting and motor tuning

The fuel supply to the motor is pre-set by the actuator according to the FUEL RAMP parameter (default is maximum fuel supply). The 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 HT-HSG100 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 stating the motor.

SPEED GAIN:	10 %	POSITION GAIN:	50 %
SPEED INTEGRAL:	5 %	POSITION INTEGRAL:	10 %
SPEED DERIVATIVE:	3 %	POSITION DERIVATIVE:	0 %

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 dynamic settings (Tuning)

Increase the SPEED 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 performance can be further optimized by monitoring the reaction time of the actuator after giving the lever several short manual taps. The SPEED GAIN and SPEED INT should be adjusted during this period to ensure the short possible reaction time is reached.
In some cases it can be necessary to adjust the speed compensation (SPEED DER) as well.

If the motor oscillates quickly, even if the SPEED GAIN is set low, the SPEED DER can be reduced by pressing the – button.

If the motor oscillates very slowly, the SPEED DER can be increased by pressing the + button.

7.4 Further optimisation of dynamic settings (Tuning)

If the optimization in section 7.3 still does not allow you to reach optimized performance, it would be necessary to achieve the POSITION GAIN & POSITION INT. The method to adjust the POSITION GAIN & INT is exactly the same as of the adjustment for SPEED GAIN & SPEED INT mentioned in section 7.3. For POSITION DER, for most application it is not required and therefore it is recommended to keep this setting to 0%.

8 Configurable parameters, values in [ ] = factory settings

Description	Term	Definition	Range
Speed 1	Fixed RPM 1	Speed setting 1, Input Speed 2 open, Speed 3 open	0 – Over-speed rpm [1500]
Speed 2	Fixed RPM 2	Speed setting 2, Input Speed 2 closed, Speed 3 open	0 – Over-speed rpm [1400]
Speed 3	Fixed RPM 3	Speed setting 3, Input Speed 2 open, Speed 3 closed	0 – Over-speed 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 – Over-speed rpm [1800]
Bin Speed Rate UP	Rate of change in speed(increase)	Update time for nominal speed adjustment when function *Binary Speed Up Down* is activated	0 – 1500 ms [1400]
Bin Speed Rate DOWN	Rate of change in speed(decrease)	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 – Over-speed 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 Sec, 0 = no ramp [1]
Speed Ramp	Speed ramp	Ramp from start to nominal speed	0 – 100 Sec [3]
Crank Termination	Starter cut-out	RPM at which the HSG100 switches from start mode to control mode	0 – 2000 rpm [200]
Over-speed	Over-speed	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]
Speed Gain1/ Gain 2	Speed Proportional value	Parameter for Proportional value of the engine speed governor,	0 – 100 % [10.0]
Speed Int 1/ Int 2	Speed Integral value	Parameter for Integral value of the engine speed governor,	0 – 100 % [5.0]

Speed Der 1/ Der 2	Speed Differential value	Parameter for Differential value of the engine speed governor.	0 – 100 % [3.0]
Position Gain 1/Gain 2	Position Proportional value	Parameter for Proportional value of the engine speed governor actuator position feedback.	0 – 100 % [50.0]
Position Int 1/Int 2	Position Integral value	Parameter for Integral value of the engine speed governor actuator position feedback.	0 – 100 % [10.0]
Position Der 1/Der 2	Position Differential value	Parameter for Differential value of the engine speed governor actuator position feedback.	0 – 100 % [0.0]
Droop	Droop %	Allowable droop % on requested speed in droop mode	0 – 25 % [3.0]
No Load Position	No Load position in droop mode	No Load position in droop mode for droop sped calculation	0 – 100 %[10]
Full Load Position	Full load position in droop mode	Full load position in droop mode for droop speed calculation	0 – 100 %[40]

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
Power supply?	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 too large because of small cable cross-section or low battery.
Display shows ▯▯▯▯	No signal from magnetic RPM sensor.	Measurement of voltage between terminals W and X (during start-up)	Should be min. 1.0 VRMS during start-up
	Actuator fault	Check wiring. Measure voltage at terminals S and T. Measure resistance.	See connection diagram. Note actuator specification. **Do not separate cables when the actuator is under power!**
	Fuel supply	Check if fuel is sufficient	Top up fuel if necessary
Configuration & wiring	Feedback position signal from actuator is in-correct	Check if feedback position signal voltage level is correct.	If flap is closing, it should move towards 0.5V. If flap is opening, it should move towards 4.5V. Replace actuator with correct type if signal feedback to HSG100 is not correct.
	Feedback position signal is not connected	Check if the feedback position signal from the TM2200-75 is connected to the HSG100.	If the wire is not connected, please ensure it is.
	Incorrect number of teeth	Check settings	Correct setting
	Incorrect Speed setting		

9.2 Motor does not run with the correct variable RPM

Fault	Possible cause	Check	Action
Potentiometer wiring	Terminals M,N, O not correctly connected	Check wiring.	see connection diagram
	Incorrect number of teeth		Adjust setting
Configuration	Incorrect configuration		
Wiring	Terminals A and B are not connected correctly.	Check wiring	If neither A nor B are connected, the HSG100 is configured for speed 1.

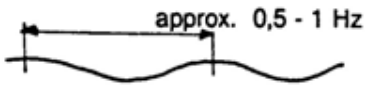
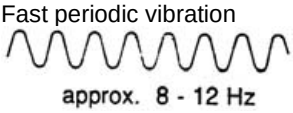
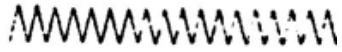
9.3 Over-speed during start process

Fault, LED display	Possible cause	Check	Action
display - - - -	Over-speed limit value set too low		Adjust value
	Tuning sub-optimal		Increase GAIN, INT. and speed ramp where required.
	Starter cut-out set too high		Adjust value
	Feedback signal position from actuator is in-correct	Check if feedback position signal voltage level is correct.	If flap is closing, it should move towards 0.5V. If flap is opening, it should move towards 4.5V. Replace actuator with correct type if signal feedback to HSG100 is not correct.

9.4 Overcurrent during start and/or engine running process

Fault, LED display	Possible cause	Check	Action
display = = = =	Terminal S, T short circuited or connected wrongly.	Check wiring	Rectify misconnection
	Actuator is damaged.	Check actuator resistance	Replace actuator.
	Actuator is not suitable for usage	Check actuator specification	Replace actuator.

9.5 Engine unstable

Fault, LED signal	Possible cause	Check	Action
Slow periodic vibration 	Friction on connection shaft or control rod	Check mechanical parts.	Remove source that is causing friction
	Battery voltage too weak	check battery and wiring: min. 20V for 24V system	Replace battery, Adapt wiring accordingly
	Actuator too weak		Use stronger actuator
	Too little speed compensation		Increase DER
Fast periodic vibration 	GAIN too high		Reduce GAIN
	Too much speed compensation		Reduce DER
	Fault in 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 ca. 1 mm 	Rotary oscillation caused by spongy clutch or too much clutch free play		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 Ground (housing isolated)
Current Consumption	90 mA max. Continuous, (Excluding actuator drawn current)
Max permitted actuator current	6 A continuous (at 25°C)
Engine speed sensor signal	1 – 120 V RMS
+5VDC Output (Terminal D)	up to 12 mA
Load Share/Synchronizer Input	0-10 VDC
Reverse Power Protection	Yes
Transient Voltage Protection	60V
Digital Input (Terminal A, B,C,D), Digital Output(Terminal H, I)	Galvanic Isolated
Digital Output (Terminal H, I)	75mA (max)

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 39 mm
Weight	0.9 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
Over-speed protection	max. 4000 rpm
Starter cut-out speed	4000 rpm*
Fixed & Variable RPM	4000 rpm*
Prescribed start quantity	0 - 100 %
Fuel ramp	0 – 20 secs.
Speed ramp	0 - 100 secs.

** Depending on Over-speed Protection. These values are always < Over-speed.*