WOODWARD

SG 2D
Speed Governor

Operation Manual
Software Version 3.3xx

Manual 37132B

WARNING

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety procedures and precautions. Failure to follow safety procedures and precautions may result in personal injury and/or property damage.

The engine, turbine, or other type of prime mover should be equipped with an overspeed (overtemperature, or overpressure, where applicable) shutdown device(s) that operates independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover resulting in possible personal injury or loss of life should the mechanical-hydraulic governor(s) or electric control(s), the actuator(s), fuel control(s), the driving mechanism(s), the linkage(s), or the control device(s) fail.

CAUTION

To prevent damage to control systems that uses an alternator or battery-charging device, ensure the charging device is turned off before disconnecting the battery source from the system.

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch components or conductors of a printed circuit board with bare hands or conductive devices.**

Important definitions

WARNING

Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, could result in damage to equipment.

NOTE

Provides other helpful information that does not fall under the warning or caution categories.

Revision History

Rev.	Date	Editor	Change
NEW	03-01-20	Tr	Release
A	05-07-28	TP	New format, minor corrections, inactive units deleted
B	06-01-24	TP	Minor corrections; parameter description and list updated; communication settings and wire size conversion chart added

Content

Figures and Tables

Figures

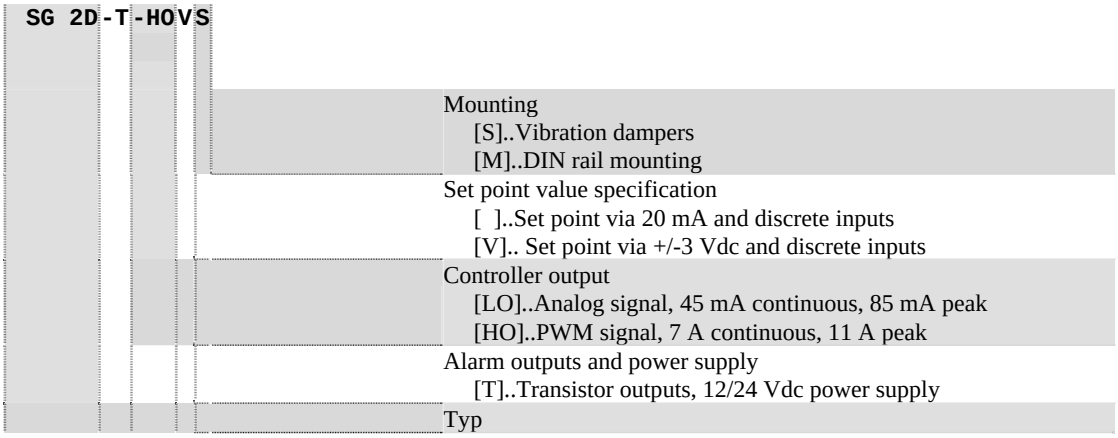
Tables

Chapter 1.
General Information

Introduction

The SG 2D is a universal digital speed governor for combustion engines, which is able to control an actuator via PWM or analog signal. The set point value may be specified with various methods. The actual speed will be measured via an MPU input, which may either be switching or inductive. The actuator will be controlled accordingly depending on the actual and target values.

The SG 2D is available in various versions. The designation is as follows:



Examples: see below

Intended Use The unit must only be operated in the manner described by this manual. The prerequisite for a proper and safe operation of the product is correct transportation, storage, and installation as well as careful operation and maintenance.

NOTE

This manual has been developed for a unit fitted with all available options. Inputs/outputs, functions, configuration screens, and other details described, which do not exist on your unit, may be ignored.

The present manual has been prepared to enable the installation and commissioning of the unit. Due to the large variety of parameter settings, it is not possible to cover every combination. The manual is therefore only a guide. In case of incorrect entries or a total loss of functions, the default settings may be taken from the list of parameters at the end of this manual.

This manual includes the following versions:

No.	Type		PWM [continuous]	PWM [peak]	Power supply	Analog set point specification	Control outputs
/1	SG 2D-	`-LOV	45 mA	85 mA	12/24 Vdc	+/-3 Vdc	Transistor
/2		`-HO	7 A	11 A	12/24 Vdc	0/4 to 20 mA	Transistor
/3		`-HOV	7 A	11 A	12/24 Vdc	+/-3 Vdc	Transistor

Chapter 2.
Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as easily as synthetics.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, etc.) away from the control, modules, and work area as much as possible.

4. **Opening the control cover may void the unit warranty.**
   Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:

   - Ensure that the device is completely voltage-free (all connectors have to be disconnected).
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, connectors, or components with conductive devices or with bare hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

Chapter 3.
Connection of the Unit

Wiring Diagrams

SG 2D-T-LOV

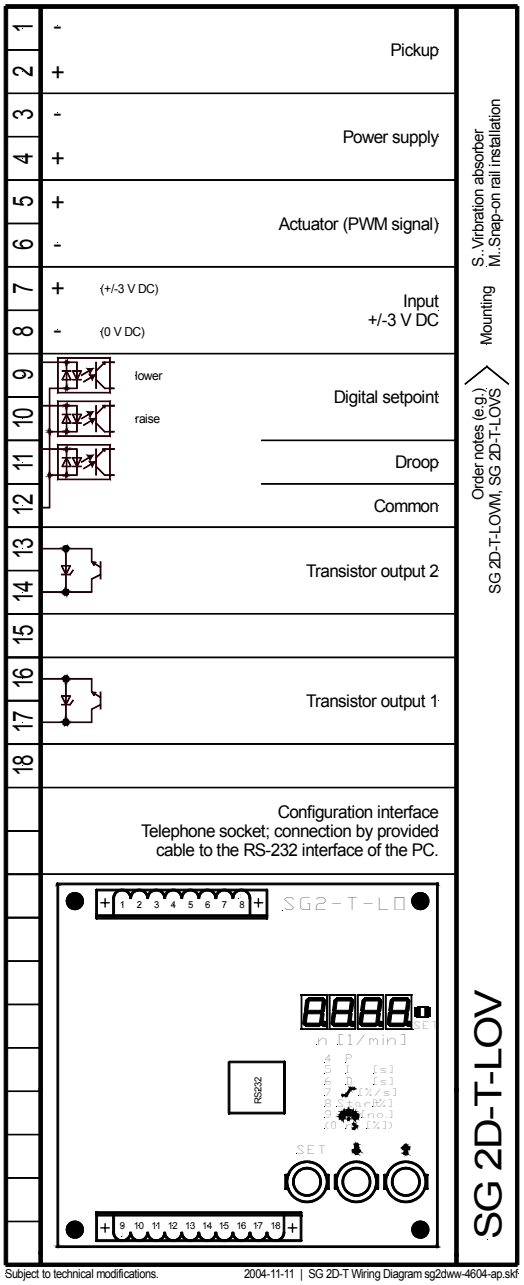


Figure 3-1: Wiring diagram SG 2D-T-LOV

SG 2D-T-HO / HOV

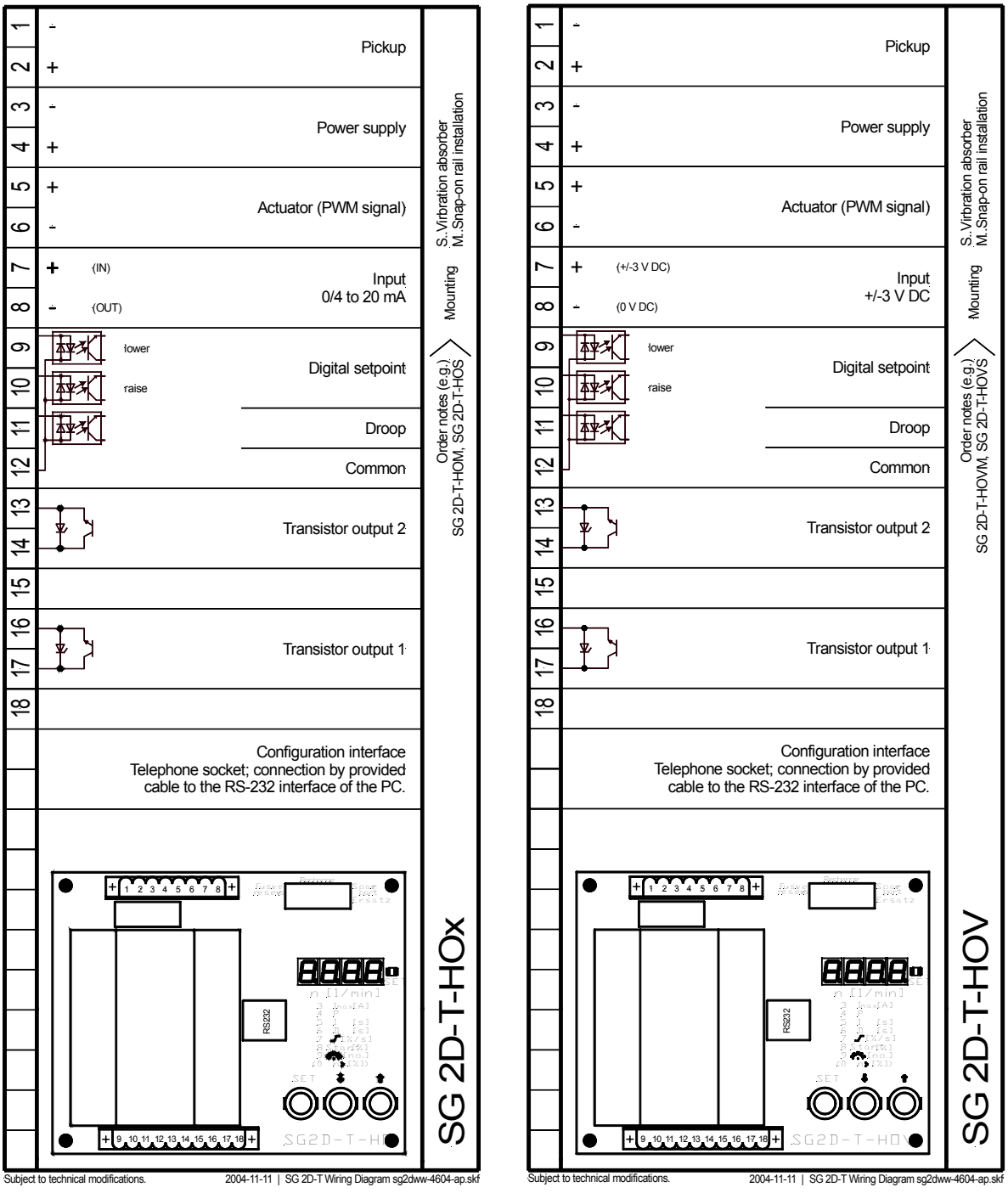


Figure 3-2: Wiring diagram SG 2D-T-HO / HOV

WARNING

A circuit breaker must be provided near the engine and in a position easily accessible for the operator. This must also bear a sign identifying it as an isolating switch for the engine.

NOTE

Connected inductors (e.g. operating current coils or undervoltage trips, auxiliary or power contactors) must include a suitable interference suppressor in their circuit.

The following chart may be used to convert square millimeters [mm²] to AWG and vice versa:

AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²
30	0.05	21	0.38	14	2.5	4	25	3/0	95	600MCM	300
28	0.08	20	0.5	12	4	2	35	4/0	120	750MCM	400
26	0.14	18	0.75	10	6	1	50	300MCM	150	1000MCM	500
24	0.25	17	1.0	8	10	1/0	55	350MCM	185		
22	0.34	16	1.5	6	16	2/0	70	500MCM	240		

Table 3-1: Conversion chart - wire size

Power Supply

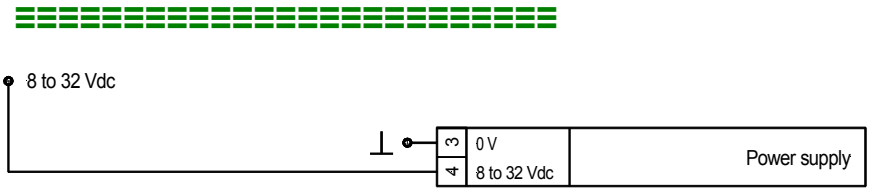


Figure 3-3: Power supply

Terminal	Description	A_{max}
3	0 Vdc reference potential	2.5 mm²
4	8 to 32 Vdc (rated voltage range 12/24 Vdc)	2.5 mm²

Table 3-2: Power supply

MPU Input

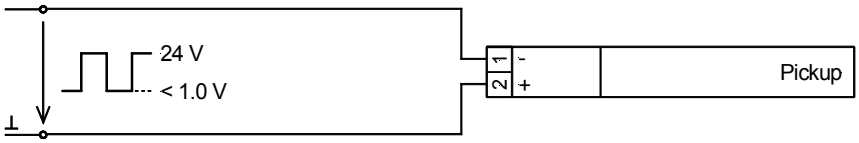


Figure 3-4: MPU

Terminal	Description		A_{max}
2	MPU	switching/inductive	2.5 mm²
1		GND	2.5 mm²

Table 3-3: MPU

Specification of the input circuit for inductive speed sensors
Ambient temperature: 25 °C

Signal form	sinusoidal
Minimum input voltage from 200 to 10,000 Hz	< 0.5 V_{eff}
Minimum input voltage from 300 to 5,000 Hz	< 0.3 V_{eff}

Table 3-4: MPU - minimum input voltage

NOTE

As the ambient temperature increases, the minimum input voltage increases at a rate of approximately 0.3 V/°C.

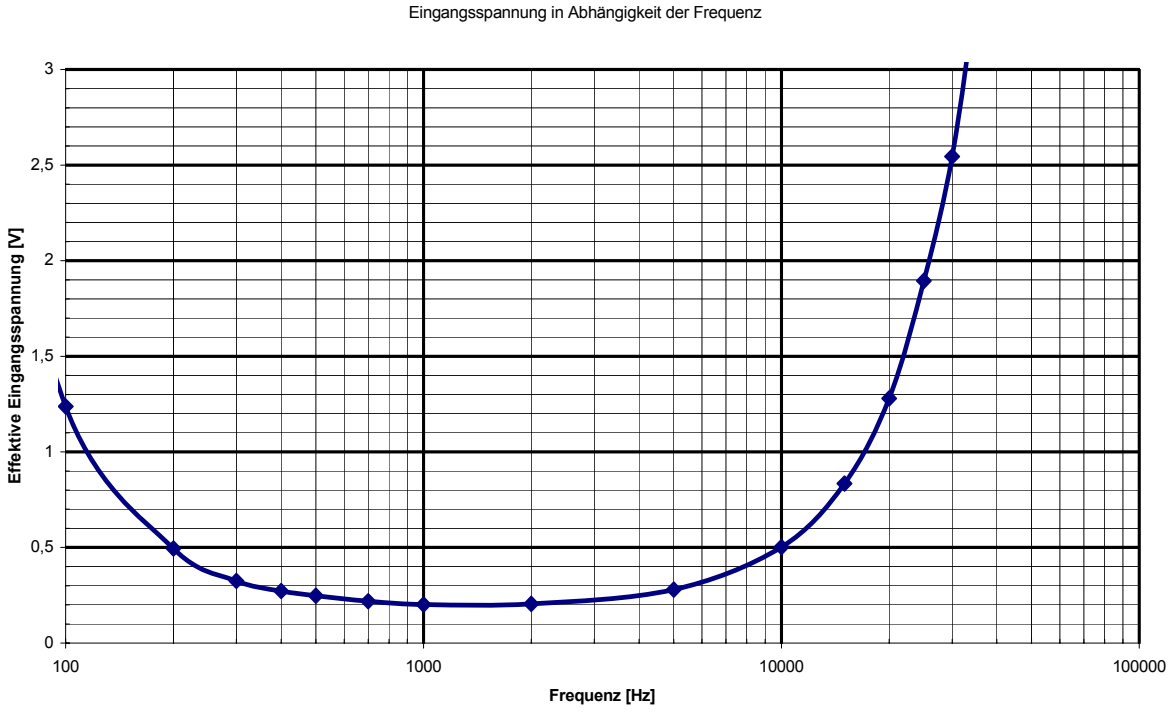


Figure 3-5: MPU - Minimum necessary input voltage depending on frequency

Discrete Inputs

CAUTION

Please note that the maximum voltages, which can be applied to the discrete inputs, are defined as follows. Higher voltages than this destroy the units!

Maximum input range: 4 to 40 Vdc.

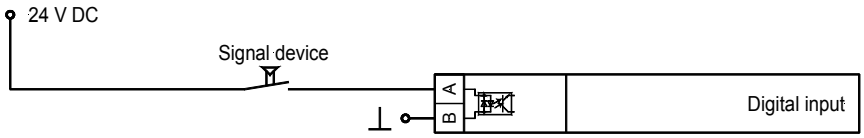


Figure 3-6: Discrete inputs

Terminal	Associated common	Description (in compliance with DIN 40 719 part 3, 5.8.3)	A_{max}
A	***B***		
9	12	Set point lower	2.5 mm²
10		Set point raise	2.5 mm²
11		Droop	2.5 mm²

Table 3-5: Discrete inputs - positive logic

Analog Input

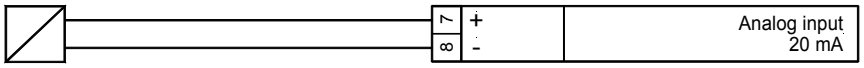


Figure 3-7: Analog input - Set point specification

Terminal	Description	A_{max}
7	20 mA-analog input for set point specification	2.5 mm²
8	0 mA	2.5 mm²

Table 3-6: Analog input - Set point specification

Alarm Outputs

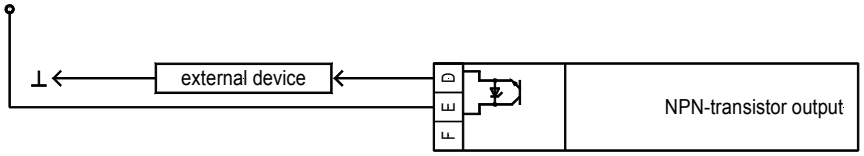


Figure 3-8: Transistor outputs - SG 2D-T

			Description	A_{max}
	Transistor			
Collector ***D***	Emitter ***E***	N.C. ***F***		
13	14		Transistor 1	2.5 mm²
16	17		Transistor 2	2.5 mm²

Table 3-7: Transistor outputs - SG 2D-T

Controller Output

NOTE

The maximum current may must not be exceeded in any operating state. The rated current is decisive for continuous operation. Refer to chapter Technical Dat starting page 37 for detailed information.

If actuators with a higher current consumption are used, the actuator's upper limit (starting state and initial state) must be set using the LeoPC1 configuration software in that way that the maximum actuator current is not exceeded. Take into account the current consumption of the actuator when it is cold. This current flows at nominal power directly after starting and immediate operation of the engine. If the unit is being operated at rated output and the actuator has reached its operating temperature, the SG 2D has to be operated at no more than rated actuator current.

The definition of the upper limit in terms of control engineering is not considered here. It may also be below the above limit.

SG 2D-T-HO / SG 2D-T-HOV: Both the SG 2D-T-HO and the SG 2D-T-HOV have an adjustable current restriction, which permits a continuous current of 7 A and higher for a short time. Actuators with a continuous load less than this value can be operated.

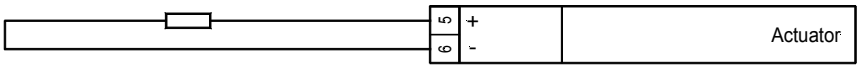


Figure 3-9: Actuator control

Terminal	Description	Amax
5	Actuator control	2.5 mm²
6		2.5 mm²

Table 3-8: Actuator control

Interface

NOTE

To carry out configuration via the side plug (direct configuration), a direct configuration cable (order code "DPC" P/N: 5417-557) is required, the LeoPC1 program (supplied with the cable) and the corresponding configuration files. Please consult the online help when the program is installed for a description of the LeoPC1 PC program and its setup.

Chapter 4.
Functional Description

Introduction

The SG 2D is an engine speed governor used to control a fuel feed actuator on an internal combustion engine. The SG 2D can operate both as a standalone frequency controller and as a subordinate controller in conjunction with a superordinate controller, such as a synchronizer or load control. Control is provided by a PID control algorithm where the P, I and D components can be adjusted separately.

Set Point Value Specification

Depending on the choice of operating mode (standalone or subordinate controller), the speed reference of the control is determined by one of three means. When operating in stand alone mode, the speed reference is determined by the Fixed set point value setting. A variable speed reference is used when working as a subordinate controller. The SG 2D will adjust the speed reference based on the analog input or via the raise/lower digital inputs.

The set point value is stored in a non-volatile memory (FRAM) for operation as a standalone controller. Where the SG 2D operates as a subordinate controller, the superordinate control unit specifies the set point value. If the digital set point value specification is selected, the starting value is always the configured fixed set point value.

The analog input for specifying the set point value is alternatively a 0/4 to 20 mA or a +/-3 Vdc input.

There is one digital input for RAISE and one for LOWER for the set point value specification.

The DROOP digital input activates droop behavior on the controller. The droop characteristics can be configured with the LeoPC1 software.

Speed Measurement

The actual speed is measured by a Pickup input; switching or inductive Pickups may be used for this.

Depending on the value of the rated speed, the minimum measurable speed is within a measuring range of 6 to 12 % of the rated speed. The maximum measurable speed also depends on the value of the rated speed and is within a measuring range of 133 to 266 %.

Control Variable Output

NOTE

The actuator must have a mechanical resetting.

The governor's control variable is output by the actuator output. A pulse width modulated (PWM) output signal generated by the microprocessor is issued to a power transistor. This activates the negative terminal of the actuator. A pulse width modulated control voltage is thus generated as the control variable for the actuator.

The output signals depend on the utilized type:

No.	Type	PWM [continuous]	PWM [peak]	Power supply	Analog set point specification	Control outputs
/1	SG 2D- `-LOV	45 mA	85 mA	12/24 Vdc	+/-3 Vdc	Transistor
/2	`-HO	7 A	11 A	12/24 Vdc	0/4 to 20 mA	Transistor
/3	`-HOV	7 A	11 A	12/24 Vdc	+/-3 Vdc	Transistor

Actuator Current Restriction (only SG 2D-T-HO and SG 2D-T-HOV)

The SG 2D continually monitors the current flowing through the actuator. If this actuator current is higher than the adjusted limit value, an internal counter will be raised by a rate proportional to the overcurrent. If the actuator current is below this limit value, the counter will be dropped by a proportional rate. If the counter passes over a certain value, the actuator signal will be halved for minimum 10 ms and maximum 40 ms. If the actuator current increases nevertheless, the signal will be stopped.

By summarizing the actual actuator current the SG 2D permits an overcurrent for an appointed time. The overcurrent has to be compensated by a corresponding negative current deviation.

If there is a permanent overcurrent the SG 2D will try, after the restriction has tripped, to keep the current on the rated limit value.

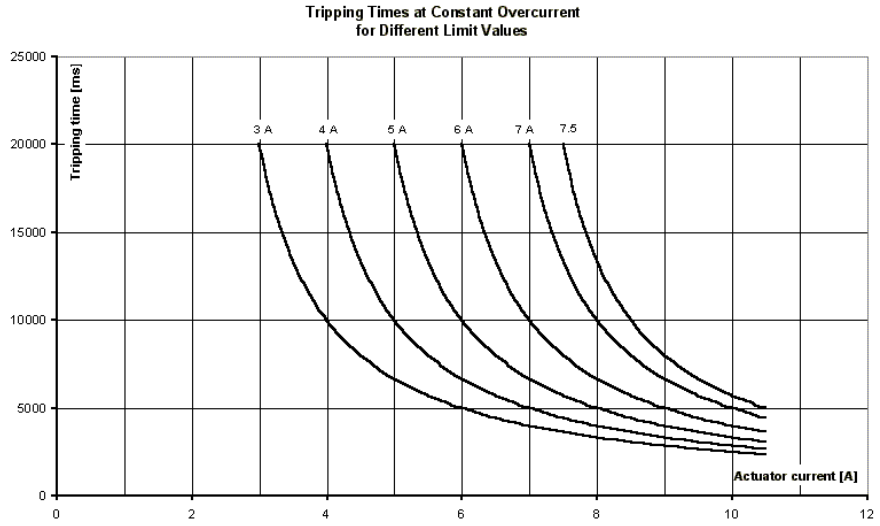


Figure 4-1: Actuator current restriction

Actuator Current Short-Cut Protection (only SG 2D-T-HO and SG 2D-T-HOV)

The SG 2D continually monitors the actuator current. If this value is larger than the allowed maximum actuator current (peak value, see technical data), the actuator signal is stopped immediately for minimum 20 ms and maximum 40 ms.

Control Outputs

The SG 2D-T speed governors provide 2 transistor outputs, output 1 and output 2.

Output 1 is always configured as N.C. output, and output 2 is always configured as N.O. output. However, it is possible to change the output logic in the configuration.

Combination 1: (Parameter: Output logic 1 "YES")

Output 1: Ready for operation relay; energized, if processor is operating.
Output 2: Overspeeed protection; the overspeed threshold may be configured.

Combination 2: (Parameter: Output logic 1 "NO")

Output 1: Ready for operation relay with superimposed overspeed protection
(tripping is combined with a logical OR)
Output 2: freely configurable, speed-dependent thresholds.

Wire Break Monitoring

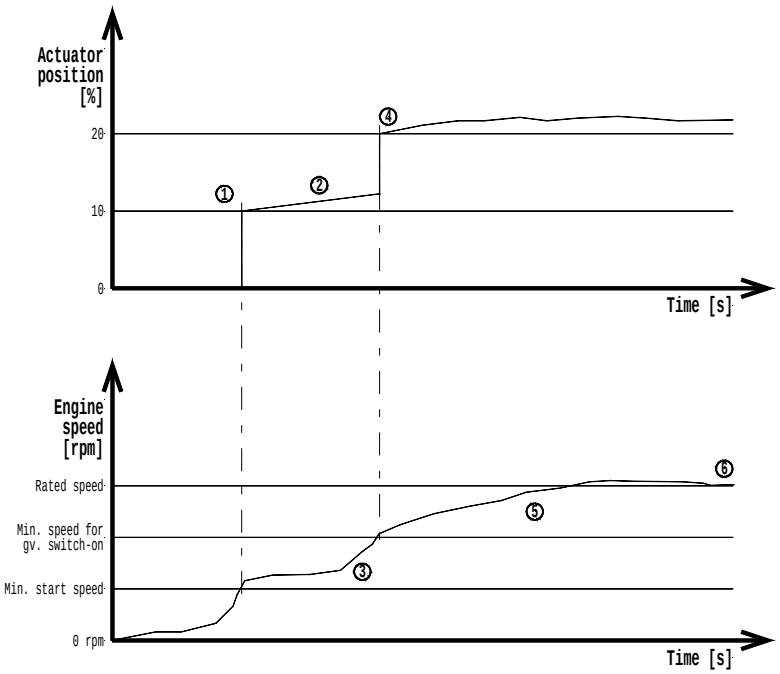
Open circuit detection is implemented for an analog set point value specification above 4 to 20 mA. An open circuit is detected if the measured value falls below 2 mA. The set point value configured for 4 mA will be approached.

Operation Sequence

The start-up sequence of the engine can be divided into four sections according to the speed:

Condition	Effect
The speed is lower than the configured switch-on speed for the starting state.	No control variable output (STOP operating condition).
The speed has reached the Minimal Speed for Start-up.	Output of the actuator's starting state (configured starting state) with subsequently adjustable increase in the starting state.
The speed is higher than the Minimal Speed for Governor switch-on.	Control mode is activated: The controller starts at the "set point value for controller switch-on". This set point value then increases in relation to the "set point value ramp at start-up" up to the actual set point value.
The set point value has reached the fixed set point value or the corresponding adjustable set point value set by the analog input.	Transition to controller mode.

Table 4-1: Operation sequence



① Engine cranks and speed becomes higher than the minimum start speed; actuator opens to starting state of the actuator setting.

② The actuator will open further according to the ramp of starting state setting.

③ Engine starts and begins to accelerate.

④ Engine speed reaches the minimum speed for governor switch-on, the speed control PID takes over and will adjust the actuator as needed to control the engine speed at the speed set point.

⑤ The engine speed is ramped at the set point ramp during start-up.

⑥ The engine speed reaches its rated speed set point and is controlled at that speed.

The transition to the STOP operating condition from any phase is only possible if the switch-on speed again falls below that required for the starting state. If the switch-on speed for the starting state has been configured below the minimum measurable speed (< 12.5 %), transition will occur as soon as engine rotation is detected. If a higher switch-on threshold is configured, a start signal will be issued once the switch-on speed has been reached.

Droop

The controller can be switched to droop behavior; the slope of the droop characteristic curve can be modified by means of the Droop Characteristic parameter. Droop deals with the fact that the set point value at any given time is affected as a function of the actuator setting (which can be equated with the power output). This means that the speed set point value is reduced as the power output of the unit increases.

If, for example, 3 % is specified as the droop characteristic curve (values between 3 % and 8 % are common), the speed set value is reduced by approximately 1.5 % if the actuator setting has increased by 50 %. In the inverse situation the speed increases similarly as the load on the engine is reduced.

This characteristic is very beneficial to operation in parallel with the mains or isolated operation in parallel with other gensets. A stable operating point can now be set to the mains or another generator. The controller can thus be operated in PID control algorithm mode at any time. The droop behavior is commonly activated by feedback from the power circuit breakers.

Controller Settings

The analog PID controller forms a closed-loop control loop together with the controlled system (usually a first-order lag element). The parameters of the PID controller (proportional-action coefficient K_{PR}, derivative-action time T_V and reset time T_n) can be adjusted individually.

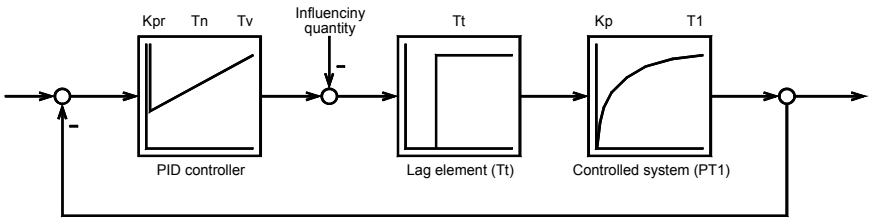


Figure 4-2: Control loop

If an abrupt disturbance variable is applied to the control loop, the reaction of the controlled system can be recorded at the output as a function of time (step response).

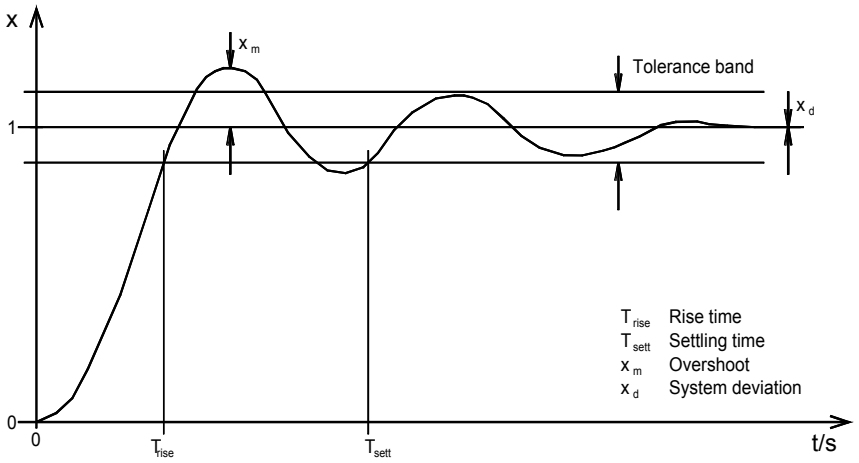


Figure 4-3: Step response (example)

Various values can be obtained from the step response; these are required for adjusting the controller to its optimum setting:

Rise time T_{rise}: Period starting when the value of the controlled variable leaves a predefined tolerance range for the control variable following a step in the disturbance variable or reference input variable and ending the first time the value re-enters this range.

Settling time T_{sett}: Period starting when the value of the control variable leaves a predefined tolerance range for the control variable following a step in the influencing quantity or reference input variable and ending when the value re-enters this range permanently.

Overshoot x_m: Highest transient set point value deviation during the transition from one steady-state condition to a new steady-state condition following modification of the disturbance variable or reference input variable ($x_{m\ optimum} \leq 10$ %).

System deviation x_d: Permanent deviation from the final value (PID controller: $x_d = 0$).

The values K_{PR}, T_n and T_V can be determined from these values by applying various conversion factors. It is also possible to determine the optimum controller setting by performing various calculations, such as compensation or adaptation of the time constant, the T-sum Rule, Symmetrical Optimum, Bode diagram. Other setting procedures and information may be obtained from current literature.

Procedure for Determining PID Settings

CAUTION

The following must be observed regarding the controller setting:

- **Ensure that the emergency shut-down system is ready for use.**
- **Note the amplitude and frequency during the determination of the critical frequency.**
- **If the two values alter uncontrollably:**

➔ EMERGENCY SHUTDOWN ←

The procedure described below only serves as an example. Whether this method is suitable for setting a particular controlled system has not been and cannot be taken into account as each controlled system behaves uniquely.

There are various methods of setting a controller. The rules according to the Ziegler and Nichols method are explained below (determination for abrupt disturbances on the system input); this method assumes a pure lag element connected in series with a first-order lag system.

1. Controller operated as a P-only controller
   (where $T_n = \infty$ [screen setting: T_n =0], $T_V = 0$).
2. Increase gain K_{PR} (P-gain) until the control loop oscillates continuously at $K_P = K_{Pcrit}$.

CAUTION

If the unit starts to oscillate uncontrollably (see the Incorrect controller setting in the following figure), carry out an emergency shut-down and alter the K_{PR} setting accordingly.

3. At the same time: measure the critical cycle duration T_{crit} (in seconds) of the continuous oscillation.
4. Set the parameters:

PID Controller

$K_{PR} = 0.6 \times K_{Pcrit}$
$T_n = 0.5 \times T_{crit}$
$T_V = 0.125 \times T_{crit}$

PI Controller

$K_{PR} = 0.45 \times K_{Pcrit}$
$T_n = 0.83 \times T_{crit}$

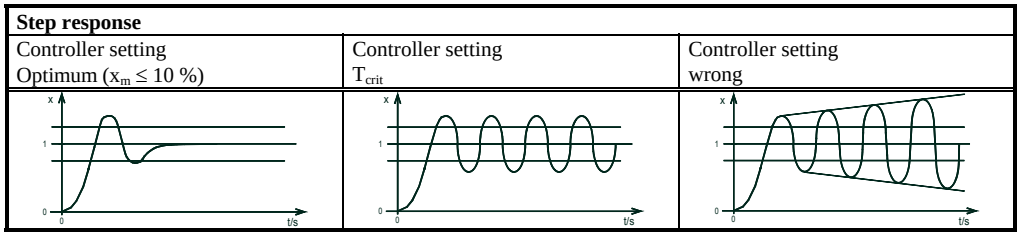


Figure 4-4: Step response - controller setting

--- **P gain** (K_{PR}) Proportional-action coefficient **1 to 240**

The proportional-action coefficient K_{PR} indicates the closed-loop control system gain. By increasing the gain, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value

--- **Reset time** (T_n) **0.2 to 60.0 s**

The reset time T_n represents the I-component of the PID controller. The reset time corrects for any offset (between set point and process variable) automatically over time by shifting the proportioning band. Reset automatically changes the output requirements until the process variable and the set point are the same. This parameter permits the user to adjust how quickly the reset attempts to correct for any offset. The reset time constant must be greater than the derivative time constant. If the reset time constant is too small, the engine will continually oscillate. If the reset time constant is too large, the engine will take to long to settle at a steady state.

--- **Derivative-action time** (T_V) **0.00 to 6.00 s**

The derivative-action time T_V represents the D-component of the PID controller. By increasing this parameter, the stability of the system is increased. The controller will attempt to slow down the action of the actuator in an attempt to prevent excessive overshoot or undershoot. Essentially this is the brake for the process. This portion of the PID loop operates anywhere within the range of the process unlike reset.

Chapter 5.
LEDs and Interfaces

LEDs

The LEDs on the circuit board serve for visualization of the unit's state.

LED "MPU input" Color: GREEN
The status of the LED on the Pickup input changes with each Pickup sensor pulse so that the presence of a valid signal can be checked.

LED "SET" Color: YELLOW
The "SET" LED illuminates to indicate that you are in entry mode and the values displayed on the 7-segment display can be altered.

Seven-Segment Display

The 7-segment display indicates the speed in revolutions per minute and the following adjustable control parameters. The first flashing digit in each adjustable parameter indicates that parameter's meaning:

3[#1] .....Imax [A]..... adjustable maximum continuous actuator current .....0 to 7.0
4[#2] .....P ..... Proportional component of the KP controller (P-component).....0 to 99.9
5[#2] .....I [s]..... Reset time of the TN component (I-component)..... 0 to 12.0 s
6[#2] .....D [s] ..... Derivative-action time of the TV controller (D-component) ..... 0 to 3.00 s
7.....[%/s]..... Start-up ramp of the controller .....0 to 99.9 %/s
8.....Start [%]..... Starting state of the actuator upon reaching the minimum speed..... 0 to 99.9 %
9.....[no.]..... Number of teeth on the Pickup.....50 to 500
0[#3] .....n> [%] ..... Overspeed in % ..... 0 to 130 %

[#1] only for the versions SG 2D-T-HO and SG 2D-T-HOV
[#2] if digital input "droop" (terminal 11) is set the parameters for the parallel operation are displayed and can be changed
[#3] the display of the overspeed level (blinking zero) can be activated/de-activated in the configuration

If all four digits flash the internal fixed set point can be set in RPM. If no buttons are pressed for 20 seconds the display will return to the speed display.

SG 2D-T-HO/SG 2D-T-HOV: If the SG 2D limits the actuator current, the decimal points of the second and third digit of the 7-segment display flash.

NOTE

A detailed description of these parameters can be found in chapter "Configuration".

Push Buttons

Push button "SET" The "SET" button is used to switch between displays.

Push buttons "↑/↓" The "↑" (raise) and "↓" (lower) buttons are used to adjust the values.

Interfaces

The SG 2D is equipped with a communication interface operating at the following baudrate:

Direct configuration 300 Baud (8 Bit, no parity, 1 stop bit)

The parameters can be configured using the service interface. A direct configuration cable, one end of which is connected to the PC/laptop and the other end of which is connected to the item, is required to do this.

There are two files required for configuration, which can be opened by LeoPC1 (name of the file xxxx-xxxx-yyy-zz.cfg and xxxx-xxxx-yyy-zz.asm). The parameters described in the chapter "Configuration" can be identified and changed by this file.

Chapter 6.
Configuration

Configuration may be performed by the user directly with a PC and the program LeoPC1 via the serial configuration interface.

Parametrierung über Direktparametrierung = 300 Baud

WARNING

Please observe that the unit must not be configured during operation of the system.

The parameters may be configured using the PC program LeoPC1 (refer to the respective manual for a description).

NOTE

Please refer also to the parameter list at the end of this manual.

NOTE

The following parameter description contains the texts for the direct configuration via the serial RS-232 service interface.

The configuration of the SG 2D is performed using a PC with the software LeoPC1. The most important controller parameters may be configured using the push button on the unit.

The parameters see divided into five groups.

Version Parameter

Software version — **Output of the software version**

The software version is indicated with four digits "x.xxx".

Dynamics Parameter

The parameters described in this block increase the dynamic response of the controller.

Fixed setpoint value — **Fixed set point value** — **12.50 to 130.00 %**

If the SG 2D is operated as a standalone controller, the set point value must be set here as a percentage of the rated speed. In most cases this item will be set for 100 %, which will be the rated speed. If the controller is operated by an external set point, this value is only necessary in a special case: If the controller was operated with a digital fixed set point in droop operation (digital input "droop" was set) and returns to the standard operation this value will be taken over as set point. After the controller has returned to the standard operation, this value will be ignored. This parameter can also be modified using the three buttons and the 7-segment display.

Idle setpoint value — **Idle set point value** — **12.50 to 100.00 %**

If the SG 2D is operating in Idle mode, the idle speed set point value must be set here as a percentage of the rated speed.

NOTE

Activating the Idle mode is described in the section Engine Parameters.

Controller Parameters [Dynamics Set 1]

These parameters can be changed in every version.

Gain factor Kp — **Gain factor K_P** — **0 to 100.00**

Proportional gain of the controller (P-component). This parameter can also be modified using the three buttons and the 7-segment display.

Reset time TN — **Reset time T_N** — **0 to 12.00 s**

Reset time of the controller (I-component). Setting the value "Tn=0" causes the integral component (reset time) to be stopped. This parameter can also be modified using the three buttons and the 7-segment display.

Derivative-action time TV — **Derivative-action time T_V** — **0 to 3.00 s**

Derivative-action time of the controller (D-component). Setting the value "T_V =0" causes the derivative component to be stopped. This parameter can also be modified using the three buttons and the 7-segment display.

Controller Parameters [Dynamics Set 2]

If the digital input "droop" is set, a second set of parameters will be activated. In the 7-segment display these parameters are displayed and can be changed. With the LeoPC1 software, both sets of parameters can be changed independently of each other. The second set of parameters is used for example to define a different control action in operation in parallel with the mains or to operate with two types of fuel (Gas or Diesel).

Normal -> Droop / Droop -> Normal: To change isolated operation (normal operation) to droop operation the following three parameters will be adjusted via a ramp. To change from droop operation to isolated operation (normal operation) these parameters will be switched without a ramp.

Gain Kp droop

Gain factor K_P — **0 to 100.00**

Proportional gain of the controller (P component). This parameter can also be modified using the three buttons and the 7-segment display. Therefore the digital input "droop" has to be set.

Reset time Tn droop

Reset time TN — **0 to 12.00 s**

Reset time of the controller (I-component). Setting the value "Tn=0" causes the integral part (reset time) to be stopped. This parameter can also be modified using the three buttons and the 7-segment display. Therefore the digital input "droop" has to be set.

Derivative-action time Tv droop

Derivative-action time TV — **0 to 3.00 s**

Derivative-action time of the controller (D component). Setting the value "T_V =0" causes the derivative component to be stopped. This parameter can also be modified using the three buttons and the 7-segment display. Therefore the digital input "droop" has to be set.

General Parameters

Setpoint ramp at normal operat.

Slope of set point value ramp in normal operation — **0 to 100.0 %/s**

The slope of the set point value ramp in normal operation is specified as a percentage of the rated speed per second.

Setpoint ramp during start-up

Slope of set point value ramp during start-up — **0 to 100.0 %/s**

The slope of the set point value ramp during start-up is specified as a percentage of the rated speed per second. This parameter can also be modified using the three buttons and the 7-segment display.

Starting state of the actuator

Start position of the actuator — **0 to 99.99 %**

The starting state is the actuator setting at which the unit is started. The actuator is brought to this state if an adjustable minimum speed has been exceeded. This parameter can also be modified using the three buttons and the 7-segment display.

Hinweis:
The actuator's starting state can be configured such that this state increases over the time. (see Ramp for starting state).

Minimal speed for start-up

Minimum speed for enabling the start position **0 to 120.00 %**

The actuator will be opened to the start position setting described above when this speed is reached allowing the unit to be started. This speed is set as a percentage of the rated speed.

Note:
It must be ensured that this speed is achieved by the engine's starter.

Minimal speed for gov.switch-on

Enable controller speed **12.50 to 120.00 %**

The controller is enabled when this speed is reached. The controller adopts the actuator setting previously issued as the starting state. The controller then begins its starting ramp using a set point value that can be adjusted. This speed is set as a percentage of the rated speed.

Note:
The enable controller speed must correspond to the speed achieved when the starting state is issued to ensure continuous starting.

Setpoint value at gov.switch-on

Set point value when controller is enabled **12.50 to 120.00 %**

The set point value (speed reference) at which the controller starts when switched on is specified here. This set point value runs at an adjustable ramp (see set point value ramp at start-up) to the fixed set point value or the corresponding adjustable set point value set by the analog input.

Note:
This set point value must correspond to the enable controller speed to ensure continuous staring.

Droop characterisitic

Controller droop characteristic curve **0.00 to 20.00 %**

The speed set point value is governed by a droop characteristic curve when the "droop" digital input is set. If, for example, a 5 % droop is specified, the set point value will decrease by 2.5 % of the rated value if the actuator signal increases by 50 % (i.e. by approximately half the nominal power). If the value is set to 0 % the integrated component (reset time) of the controller will be stopped as soon as the digital input "droop" is set.

Ramp for starting state

Ramp for start position **0 to 100**

This dimensionless figure determines how rapidly the starting state output must increase. This setting is useful if a unit must be started from cold. The control output will begin at the Starting state of the actuator and then increase constantly during the starting procedure as a function of this slope, until the engine speed reaches the Minimum speed for governor switch on, at which point the actuator signal will be varied to control at the correct speed.

Note:
This behavior may be undesirable on a gas engine since "preliminary purging process" is performed on gas engine. The slope is set to zero in such cases.

Engine Parameters

Engine related parameters are configured in this group.

Rated speed at rated frequency

Rated speed at rated frequency	**10 to 3,600 min^{-1}**

Rated speed of the engine in revolutions per minute. This parameter can also be changed via the three buttons and via the 7-segment display.

Number of cogs (Pickup)

Number of teeth at MPU	**2 to 500**

Number of teeth on the sensor disc for the MPU. This parameter can also be changed via the three buttons and via the 7-segment display.

Min. control signal at actuator

Minimum actuator control signal	**0.00 to 100.00 %**

The control signal issued by the controller during control mode can be limited to a minimum control signal if, for example, you wish to eliminate dead times in the control loop. The control signal limitation is specified as a percentage of the maximum modulation.

Example:
A dead time would arise if, for instance, the fuel supply were already completely stopped at 10 % of the control signal, i.e. further reduction of the control signal would have no additional effect on the speed of the engine.

Max. control signal at actuator

Maximum actuator control signal	**0 to 100.00 %**

An upper limit can be placed on the control signal in exactly the same way as a lower limit, specified as a percentage of the maximum modulation.

Overspeed prot., threshold

Overspeed threshold	**0.00 to 130.00 %**

If the overspeed relay has tripped and the speed of the unit has fallen below the starting speed, this time delay would occur before the relay is reset.

Overspeed prot., resetting time

Overspeed resetting time	**1 to 30 s**

Hat das Überdrehzahlrelais ausgelöst und der Motor hat die Startdrehzahl unterschritten, wird diese Zeit gewartet ehe das Relais wieder abfällt.

Overspeed prot., enable

Release overspeed setting	**YES / NO**

This setting determines whether it should be possible to change the Overspeed threshold parameter using the buttons (parameter 7).
YES..... The ability to set the overspeed threshold is released.
NO ..... The ability to set the overspeed threshold is not released and does not appear on the 7-segment display.

Enable switch to idle mode

Enable switch to idle mode **YES / NO**

This setting activates the digital Input 'frequency low' (terminal 9) for the Idle mode.
YES.....The ability to set the idle mode is enabled.
NO.....The ability to set the idle mode is disabled.

NOTE

To initiate the Idle mode the discrete input 'frequency lower' has to be used.

With switching the discrete input 'Set point lower' (terminal 9) during the running engine for 5 seconds the SG 2D reacts than with ramp down to Idle speed. With leaving that DI the SG 2D ramps immediately back to the rated speed.

With switching the discrete input 'Set point lower' before and during engine start, the SG 2D ramps the engine up to Idle speed. With leaving that DI the SG 2D guides the engine to rated speed.

This function is independent from the currently activated set point input.

Current limit control
[only SG 2D-T-HO and SG 2D-T-HOV]

Current limit control **0.00 to 7.50 A**

This parameter determines the value of the actuator current which starts the SG 2D for current limit control. The function is described in Chapter 4 "Actuator **Current Restriction (only SG 2D-T-HO and SG 2D-T-HOV)**".

System Parameters

Parameters concerning the set point value specification are configured in this group.

Source of set-point

Set point value specification **intern / digital / analog**

The set point value of the control is set by one of three possible choices.
intern ... the internal fixed set point value
digital .. the digital inputs "raise" and "lower"
analog .. the analog input (0/4 to 20 mA or +/-3 V DC)

Parameter Set point value	Parameter Idle Mode	Discrete input 'set point low'	Discrete input 'set point raise'	Function
intern	0	X	X	Internal set point
	1	'1' longer than 5 seconds	0	Idle speed set point
	1	0	X	Internal set point
analog	0	X	X	Analog set point
	1	'1' longer than 5 seconds	0	Idle speed set point
	1	0	X	Analog set point
digital	0	0	0	The current active digital set point
	0	1	0	Digital set point Decrease
	0	0	1	Digital set point Increase
	0	1	1	Analog set point
	1	0	0	The current active digital set point
	1	'1' (less than 5 seconds)	0	Digital set point Decrease
	1	0	1	Digital set point Increase
	1	1	1	Analog set point

Slope of the digital setp.val.

Slope of the digital potential **0.0 to 100.0 %/s**

The rate of change can be set for the case of digital set point value specification. The rate of change is specified as %/s of the rated speed.

Minimum speed at setpoint val.

Minimum speed set point value specification **0.00 to 100.00 %**

When the external analog set point value is selected, this parameter will set the minimum speed that would correspond to either an input of 0 or 4 mA depending on how the analog input is configured. The lower speed set value limit is specified as a percentage of the rated speed.

Maximum speed at setpoint val.

Maximum speed set point value specification **50.00 to 150.00 %**

The upper speed set value limit must be configured in the same way as the lower speed set value limit when the external analog set point is selected.

Example set point value specification:
Analog set point value, 4 to 20 mA, MIN speed = 50 %, MAX speed = 120 %, thus an external set point value specification of 4 mA corresponds to a set point value of 50 % of the rated speed, 20 mA corresponds to 120 % of the rated speed.

Analog input 4-20 mA

Analog input 4 to 20 mA **YES / NO**

A distinction is drawn here between a 0 to 20 mA signal or a 4 to 20 mA signal on the analog input. If 4 to 20 mA is set, an open circuit is detected at an input current of < 2 mA.
YES .....Set point value as a 4 to 20 mA signal.
NO.....Set point value as a 0 to 20 mA signal.

Note:
The units SG 2D-T-LOV and SG 2D-T-HOV include this parameter, but it should be configured to "NO".

Output Parameters

Parameters affecting the output are configured in this group.

Type 1 relay logic (standard)

Selection of logic **YES / NO**

Two switching output combinations are possible (refer to Chapter 4, "**Fehler! Verweisquelle konnte nicht gefunden werden.**").
YES ... Combination 1:
- Output 1 = "Ready for operation" - idle current tripping (NC).
- Output 2 = "Overpseed" - operating current tripping (NO).

NO ..... Combination 2:
- Output 1 = "Ready for operation" or "Overpseed protection" with idle current tripping (NC; logical OR).
- Output 2 = Output "Speed threshold reached" with operating current tripping (NO).

Threshold relay 2 set

Enable output 2 threshold **0.00 to 130.00 %**

If "NO" is selected at the parameter above, this parameter sets the speed value where the relay will trip. The threshold is set as a percentage of the rated speed. The output can be deactivated with enable threshold = 0 irrespective of the enable threshold.

Threshold relay 2 reset

Disable output 2 threshold **0.00 to 130.00 %**

The disable threshold is also freely selectable. It is also specified as a percentage of the rated speed. The disable threshold must always be configured so that it is lower than or equal to the enable threshold.

Chapter 7.
Commissioning

DANGER – HIGH VOLTAGE

When commissioning the control, please observe the safety rules which apply to the handling of live equipment. Make sure that you know how to provide first aid in current-related accidents and that you know where the first-aid kit and the nearest telephone are. Never touch any live components of the system or on the back of the system:

LIFE THREATENING

WARNING

The unit may only be commissioned by a qualified technician. Before commissioning the unit, make sure that the EMERGENCY STOP function works properly and independently of the control.

For a successful commissioning of the SG 2D please work through this procedure step by step.

Configuration and Connection

Connect the SG 2D according to the connection diagram. Please take care that you use the connection diagram according to the unit type. A difference is made between:

No.	Type	PWM [continuous]	PWM [peak]	Power supply	Analog set point specification	Control outputs
/1	SG 2D- `-LOV	45 mA	85 mA	12/24 Vdc	+/-3 Vdc	Transistor
/2	`-HO	7 A	11 A	12/24 Vdc	0/4 to 20 mA	Transistor
/3	`-HOV	7 A	11 A	12/24 Vdc	+/-3 Vdc	Transistor

Continuing the commissioning you have to differ between two different set point values:

1. The SG 2D controls a speed, measured via the integrated Pickup to a predefined value (isolated operation).
2. The SG 2D controls a speed, measured via the integrated Pickup to an external controlled set point value. Therefore the SG 2D receives a set point value of the subordinated control (isolated operation, synchronization, operation in parallel to the mains). In that case the set point value can be fed in different ways:
   - as a digital set point value via signals to the raise/lower inputs via an external speed governor
   - as an analog set point value via the 0/4 to 20 mA analog input
   - as an analog set point value via the +/-3 Vdc analog input (only -HOV/-LOV)

Commissioning the SG 2D for the First Time

With the engine standing still, connect the SG 2D to a PC/laptop using the DPC configuration cable (the configuration cable is the one with the black box between the COM connector and the RJ12 connector, which you plug into the socket of the SG 2D). Note that the SG 2D must be connected to the power supply for configuration. On the PC, start the LeoPC1 program. If this program has not yet been set up, carry out the setup as described in the supplied documentation. Select the "direct configuration driver". The corresponding setting is "Direct".

Having started the LeoPC1 program, load configuration file xxxx-xxxx-yyy-zz.*cfg* (file / open), making sure that the associated file xxxx-xxxx-yyy-zz.*asm* is located in the *TOOLS* directory. Now proceed as described in the manual and the LeoPC1 online help.

If you can not establish a connection, check the following points:

- Is the connection correct?
- Is the power supply to the SG 2D connected?
- Are the settings correct (menu Devices -> Settings...)?
  - The following settings have proved to work properly:
    Tab "General Options"
    - Remote control: not activated
    - Displays: not activated

    Button "Settings..."
    - Port: COM port, to which the DPC is connected
    - Baud: 300
    - Parity: None
    - Data Bits: 8
    - Stop Bits: 1

    Button "Options..."
    - Number of repetitions to send a command: 8
    - Timeout after writing a command: 500
    - Delay between writing a command: 150
    - Timeout after reading an incorrect answer (CAN-Error): 0
    - Number of repetitions to read the answer: 8
    - Timeout for reading the answer: 300
    - Timeout, if no answer was received: 200

If the connection was established successfully, read and save the default parameter set with the "Read all" function. If you already have a functional parameter set, load it into the item. You can now change the parameters to modify the default values for your application.

Even if you are using a master controller that specifies the set point value, it is advisable to start the SG 2D up for the first time with the internal, fixed set point value specification. This prevents the master controller (for example the GCP) from affecting the control behavior of the SG 2D, which makes it easier to set the parameters for the SG 2D speed governor.

Starting with the default values, look at each parameter in turn and check whether the value can be used as it stands or whether it needs to be changed. For details about each parameter, see chapter 4 of this manual.

Before the initial start, configure the following:

- Set point value specification fixed = "YES"
- Desired fixed set point value
- Number of cogs of the ring gear (teeth on the flywheel) for the Pickup

Before starting the engine for the first time, make sure that the EMERGENCY STOP circuit is working correctly and does not depend on another controller.

- Crank the engine with the fuel supply off.
- Verify that the SG-2 is reading the correct speed.
- Verify that the cranking speed of the engine is greater than the Minimum speed for startup. The actuator should open to the Starting state of the actuator setting. If the Ramp for starting state setting is greater than zero, the actuator should continue to open at this rate.
- Adjust the Ramp for starting state to achieve the desired rate of movement.
- Turn the fuel supply on.
- Attempt to start the engine.

- If the engine does not start, increase the Starting state of the actuator setting. This causes the actuator to be opened further during the start. Once the engine has started and ramped to its Fixed set point value set the PID algorithm. For setting the governor, we recommend the Ziegler and Nichols method (described earlier). In general, you can also use the following rule:
  - Set the Kp, Tv and Tn values as suggested (see below)
  - Start the engine
  - If the engine does not start, increase the Kp value in small steps.
  - If the engine was started successfully, increase the Kp value in steps.
  - Observe the actuator for an oscillation.
  - When the actuator linkage arm starts to oscillate, reduce Kp to 2/3 of its last value. The governor's Kp value is now set correctly.
  - Now, set the Tn value. To do this, reduce the Tn value each time to half of its previous value. After each change, carry out a set point value jump from 100 % to 90 %, observing the control behavior. The governor's 7-segment display (actual speed) can be used to change the speed set point. It can be helpful for this type of test to use an oscilloscope and a measuring transducer, which converts the speed/frequency into an analog signal to visualize the control process.
  - If the actual speed oscillates either side of the set point speed, increase the Tn value until the speed is steady.
  - Tv is now calculated from Tn: Tv = Tn / 4 to Tn / 8

When a satisfactory control behavior has been achieved, a master controller (for example the GCP) can now be activated. Set parameter "Setpoint value " to "digital" or "analog".

If you have selected set point value "analog", adjust the range for a 0/4 to 20 mA signal. Initially, scale the analog input to between 85 % and 115 %. If a 0 to 20 mA signal is used for the set point value specification, continue as follows:

- Switch off speed/frequency control in the master controller. Set the analog bias signal in the master control to mid position and start the engine. Then check the operation of the master controller by manually raising and lowering the speed set point.
- Now activate the master controller. The master controller should be set up for PI control (Tv value = 0). The master controller does not have to be set for an especially fast response, since this unit only provides a set point value specification for the SG 2D and does not directly control the engine speed. Always make sure that the set point value transmission from the master control is slower than the control response of the SG 2D, since oscillations may otherwise be generated between the two controllers. The SG 2D should always be operated with the PID algorithm, with a choice of two control modes:
  1. Isochronous operation (digital input "droop" = 0)
     The controller aims for the specified set point value at all actuator positions. This control mode is selected in isolated operation. Note: To operate in isochroous mode with two sets of dynamics, the droop digital input is used to switch between the dynamic sets and the Droop characteristic setting should be set to zero.
  2. Droop operation (digital input "droop" = 1)
     The controller adjusts the set point value depending on its actuator position, i.e. the droop characteristic parameter specifies the amount by which the set point value is reduced at maximum actuator position. This control mode is used in isolated parallel operation and in mains parallel operation.

     Mains parallel operation: If the GCP is used as master controller, observe the following. Do supply the set point values in mains parallel operation, active power control is activated in the GCP, which has its own parameters. Here, too, note that active power control uses the PI algorithm (Tv = 0).

Having successfully commissioned the governor, save the contents of the configuration window as default parameter set with "Tools/Default values/Save".

Standard parameter set: Suggestion for a speed/frequency controller in isolated and mains parallel modes with a set point value specification from the GCP:

Dynamics Parameter

Fixed setpoint value	100.00 %
Gain factor Kp	5.00
Reset time Tn	1.5s
Derivative-action time Tv	0 s
Setpoint ramp at normal operat.	20 to 25 %/s
Setpoint ramp during start-up	20.00 %/s
Starting state of the actuator (at least the position required for starting the warm motor)	30.00 %
Minimal speed for start-up	5.00 %
Minimal speed for gov.switch-on	40.00 %
Setpoint value at gov.switch-on	45.00 %
Droop characteristic	5.00 %
Ramp for starting state	25

Parameters "Engine"

Rated speed at rated frequency ..... 1,500 RPM
Depends on controlled engine
Number of cogs (Pickup) ..... xxx cogs
of the sensor
Min. control signal at actuator ..... 0.00 %
To utilize the governor's full dynamics
Max. control signal at actuator ..... 100.00 %
Overspeed prot., threshold ..... 120.00 %
Depending on the permissible motor overspeed
Overspeed prot., resetting time ..... 15 s
Overspeed prot., enable ..... NO
Current limit control ..... 7.0 A

Parameters "System"

Set point value ..... ANALOG
(INTERN on initial start, carry out first test with fixed setpoint value)
Slope of the digital setp.val. ..... 2.50 %
Minimum speed at setpoint val. ..... 85.00 %
Maximum speed at setpoint val. ..... 115.00 %
Analog input 4 to 20 mA ..... NO

Parameters "Output"

Type 1 relay logic (standard) ..... YES
Threshold relay 2 set ..... 0.00 %
Threshold relay 2 reset ..... 0.00 %

Droop characteristic
The droop characteristic is used to stabilize the frequency controller in parallel operation.

Example: Assumption: The mains frequency is 49.95 Hz. Because the speed governor aims for a fixed speed of, for example, 1,500 rpm. (50 Hz), it would try to increase the speed/frequency in parallel mains operation until it reached 50 Hz. Because the mains has a fixed frequency, it cannot reach this frequency. The droop function prevents this effect by reducing the set point value as a percentage of the actuator position (50 % in the above example would be 1.5 % or 22 rpm.) The system balances out at a low power output, i.e. the frequency controller is now in a balanced state.

Appendix A.
Dimensions

Housing	Um 108 extrusion profile	M4×6 vibration dampers
Dimensions	W × H × D (mm)	W × H × D (mm)
SG 2D-T-LOV	115 × 126 × 54	113 × 108 × 41
SG 2D-T-HO/HOV	137 × 126 × 56	135 × 108 × 43

Connection	1.5 mm² or 2.5 mm² screw terminals depending on the plug connector
Protection class	IP 00
Weight	
SG 2D-T-LOV	approx. 200 g
SG 2D-T-HO/HOV	approx. 350 g

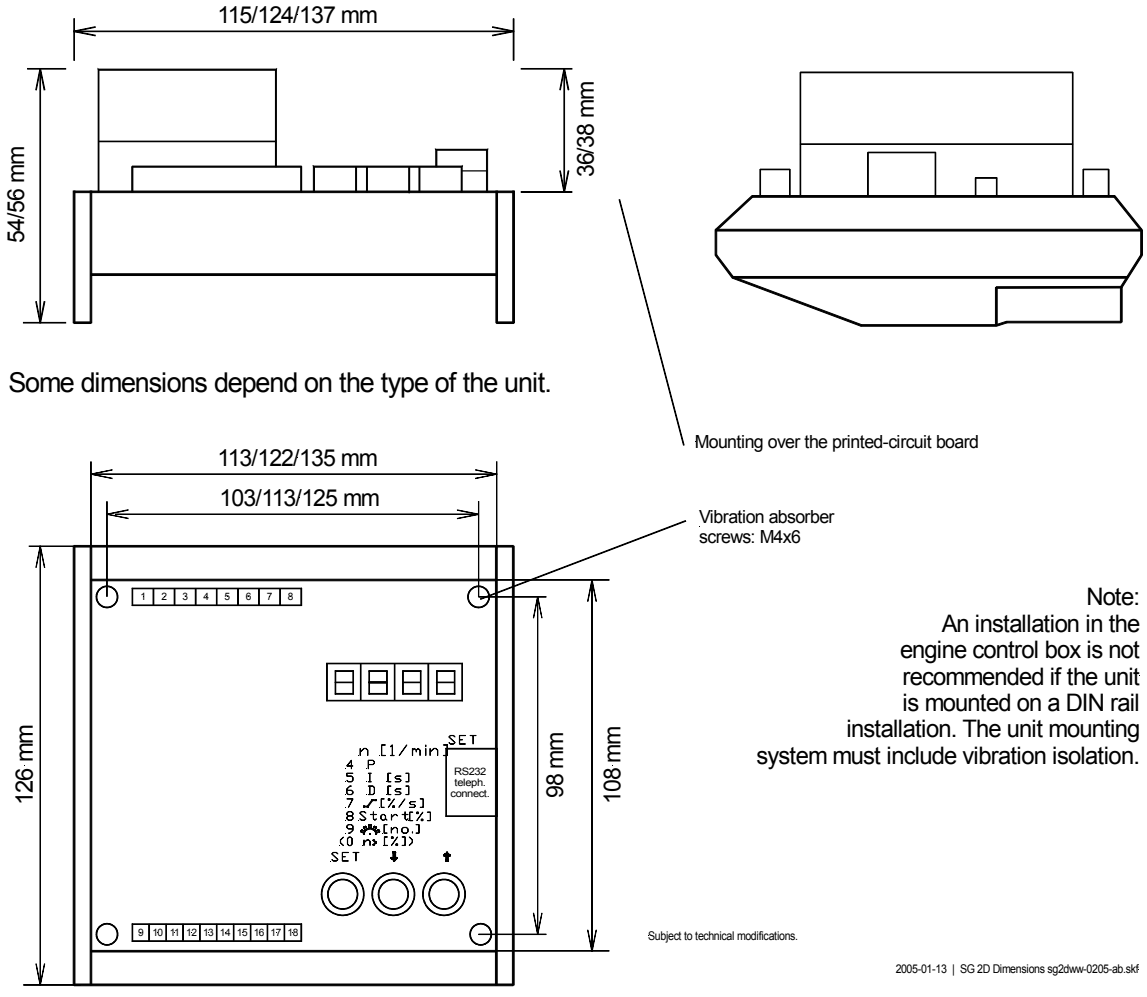


Figure 7-1: Dimensions

Appendix B.
Technical Data

Measured variables----------

- Pickup signal ..... isolated
- Minimum amplitude (sinusoidal) ..... 0.5 V_{eff} (300 Hz to 8.0 kHz)
- Maximum amplitude (sinusoidal) ..... 75 V_{eff} (DC to 1.5 kHz)
  75 to 150 V_{eff} (1.5 to 8.0 kHz)
- Minimum input impedance ..... 18.8 kΩ (300 Hz to 8.0 kHz)
- Accuracy (measured) ..... ±0.12 % to ±0.25 % (dep. on pos. in the meas. range)

Actuator control----------

Version SG 2D-T-LOV

- PWM signal (non-volatile)
- Amplitude ..... depending on power supply 8 to 32 Vdc
- Continuous duty ..... max. 45 mA

Versions SG 2D-T-HO, SG 2D-T-HOV

- PWM signal
- Amplitude ..... depending on power supply 8 to 32 Vdc
- Continuous duty ..... max. 7 A
- Peak duty ..... max. 11 A
- Current limitation ..... configurable

Ambient variables ----------

- Power supply ..... 8 to 32 Vdc
- Power source ..... Battery
- Length of supply line (light plastic-coated cable) .. max. 25 m (only SG 2D-T-HO / HOV)

- Intrinsic consumption ..... (with/without RS-232)
  (without power electronic; all versions) ..... max. 1.5 W/1.0 W
- Ambient temperature ..... -20 to 70 °C
- Ambient humidity ..... maximum 95 %, non-condensing

Discrete inputs----------**isolated**

- Input range ..... 8 to 32 V DC
- Input resistance ..... approx. 6.7 kΩ

Outputs ----------

- NPN switching transistor ..... isolated
- Rated switching voltage ..... 24 Vdc
- Current load (ohmic load) ..... 200 mA

Analog input ----------

Version SG 2D-T-HO

- Input ..... 0/4 to 20 mA
- Load ..... 250 Ω
- Resolution ..... 10 Bit

Versions SG 2D-T-LOV, SG 2D-T-HOV

- Input ..... differential measuring, +/-3 Vdc
- Input resistance ..... approx. 40 kΩ
- Synchronism input voltage (to B-) ..... approx. +/-15 Vdc
- Resolution ..... 10 Bit

Housing ----------

Version SG 2D-T-LOV

Extrusion profile for fastening onto a DIN rail ..... Um 108

- Dimensions ..... 115 × 126 × 54 mm

Vibration dampers ..... M4×6

- Dimensions ..... 113 × 108 × 41 mm
- Connection ..... 1.5 mm² or 2.5 mm² screw terminal depending on the plug connector
- Weight ..... approx. 200 g

Versions SG 2D-T-HO, SG 2D-T-HOV

Extrusion profile for fastening onto a DIN rail ..... Um 108

- Dimensions ..... 137 × 126 × 56 mm

Vibration dampers ..... M4×6

- Dimensions ..... 135 × 108 × 43 mm
- Connection ..... 1.5 mm² or 2.5 mm² screw terminal depending on the plug connector
- Weight ..... approx. 350 g

Protection ---------- tested in accordance with valid EN codes of practice

- Protection class ..... IP 00

Appendix C.
Parameter List

Version _____

Project _____

Item number _____ Date _____

Option	Parameter	Setting range	Standard setting	% value refers to	Customer setting	Level
VERSION PARAMETER						
	Software version	-	-			1
DYNAMICS PARAMETER						
	Fixed setpoint value	12.50 to 130.00 %	100.00 %	Speed		
	Idle setpoint value	12.50 to 100.00 %	50.00 %	Speed		
CONTROLLER PARAMETERS						
Grp.1	Gain factor Kp	0 to 100.00	12.00			1
..	Reset time Tn	0 to 12.00 s	1.00 s			1
Grp.1	Derivative-action time Tv	0 to 3.00 s	0.08 s			1
Grp.2	Gain Kp droop	0 to 100.00	11.2			1
..	Reset time TN droop	0 to 12.00 s	0.90 s			1
Grp.2	Derivative-action time TV droop	0 to 3.00 s	0.05 s			1
GENERAL PARAMETERS						
	Setpoint ramp at normal operation	0 to 100.0 %/s	30.00 %/s	Speed		1
	Setpoint ramp during start-up	0 to 100.0 %/s	15.00 %/s	Speed		1
	Starting state of the actuator	0 to 99.99 %/s	40.00 %	PWM signal		1
	Minimal speed for start-up	0 to 120.00 %	8.00 %	Speed		1
	Minimal speed for gov.switch-on	12.50 to 120.00 %/s	25.00 %	Speed		1
	Setpoint value at gov.switch-on	12.50 to 120.00 %/s	30.00 %	Speed		1
	Droop characteristic	0 to 20.00 %	10.00 %	Speed		1
	Ramp for starting state	0 to 100	30			1
ENGINE PARAMETERS						
	Rated speed at rated frequency	10 to 3,600 1/min	1,800 1/min			1
	Number of cogs (Pickup)	2 to 500	118			1
	Min.control signal at actuator	0 to 100.00 %	0.00 %	PWM signal		1
	Max.control signal at actuator	0 to 100.00 %	100.00 %	PWM signal		1
	Overspeed protection threshold	0 to 130.00 %	115.00 %	Speed		1
	Overspeed prot., resetting time	1 to 30 s	30 s			1
	Overspeed prot., display	YES / NO	YES		☐ Y ☐ N	1
	Enable switch to idle mode	YES / NO	NO		☐ Y ☐ N	
HO(V)	Current limit control	0 to 7.50 A	7.50 A			1
SYSTEM PARAMETERS						
	Source of setpoint	intern / digital / analog	intern		☐ i ☐ d ☐ a	1
	Slope of the digital setp.val.	0 to 100.0 %/s	10.0 %/s	Speed / digital		1
	Minimum speed at setpoint val.	0 to 100.00 %	80.00 %	Speed / analog		1
	Maximum speed at setpoint val.	50 to 150.00 %	120.00 %	Speed / analog		1
	Analog input 4 - 20 mA	YES / NO	NO		☐ Y ☐ N	1
OUTPUT PARAMETERS						
	Type 1 relay logic (standard)	YES / NO	NO		☐ Y ☐ N	1
	Threshold relay 2 set	0 to 130.00 %	110.00 %	Speed		1
	Threshold relay 2 reset	0 to 130.00 %	100.00 %	Speed		1

Appendix D.
Service Options

Product Service Options

The following factory options are available for servicing Woodward equipment, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is purchased from Woodward or the service is performed. If you are experiencing problems with installation or unsatisfactory performance of an installed system, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In most cases, your problem can be resolved over the phone. If not, you can select which course of action you wish to pursue based on the available services listed in this section.

Returning Equipment For Repair

If a control (or any part of an electronic control) is to be returned to Woodward for repair, please contact Woodward in advance to obtain a Return Authorization Number. When shipping the unit(s), attach a tag with the following information:

- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part numbers (P/N) and serial number (S/N);
- description of the problem;
- instructions describing the desired repair.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

Packing A Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

Return Authorization Number RAN

When returning equipment to Woodward, please telephone and ask for the Customer Service Department in Stuttgart [+49 (0) 711 789 54-0]. They will help expedite the processing of your order through our distributors or local service facility. To expedite the repair process, contact Woodward in advance to obtain a Return Authorization Number, and arrange for issue of a purchase order for the unit(s) to be repaired. No work can be started until a purchase order is received.

NOTE

We highly recommend that you make arrangement in advance for return shipments. Contact a Woodward customer service representative at +49 (0) 711 789 54-0 for instructions and for a Return Authorization Number.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part numbers P/N (XXXX-XXX) that is on the enclosure nameplate;
- the unit serial number S/N, which is also on the nameplate.

How To Contact Woodward

Please contact following address if you have questions or if you want to send a product for repair:

Woodward Governor Company
Leonhard-Reglerbau GmbH
Handwerkstrasse 29
70565 Stuttgart - Germany

Phone: +49 (0) 711 789 54-0 (8.00 - 16.30 German time)
Fax: +49 (0) 711 789 54-100
eMail: sales-stuttgart@woodward.com

For assistance outside Germany, call one of the following international Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Facility	Phone number
USA	+1 (970) 482 5811
India	+91 (129) 230 7111
Brazil	+55 (19) 3708 4800
Japan	+81 (476) 93 4661
The Netherlands	+31 (23) 566 1111

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (**www.woodward.com**) for the name of your nearest Woodward distributor or service facility. [For worldwide directory information, go to **www.woodward.com/ic/locations**.]

Engineering Services

Woodward Industrial Controls Engineering Services offers the following after-sales support for Woodward products. For these services, you can contact us by telephone, by e-mail, or through the Woodward website.

- Technical support
- Product training
- Field service during commissioning

Technical Support is available through our many worldwide locations, through our authorized distributors, or through GE Global Controls Services, depending on the product. This service can assist you with technical questions or problem solving during normal business hours. Emergency assistance is also available during non-business hours by phoning our toll-free number and stating the urgency of your problem. For technical engineering support, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference technical support.

Product Training is available on-site from several of our worldwide facilities, at your location, or from GE Global Controls Services, depending on the product. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability. For information concerning training, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***customer training***.

Field Service engineering on-site support is available, depending on the product and location, from our facility in Colorado, or from one of many worldwide Woodward offices or authorized distributors. Field engineers are experienced on both Woodward products as well as on much of the non-Woodward equipment with which our products interface. For field service engineering assistance, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***field service***.

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Contact

Your company_____

Your name_____

Phone number _____

Fax number _____

Control (see name plate)

Unit no. and revision: P/N:_____ REV: _____

Unit type SG 2D _____

Serial number S/N _____

Description of your problem

_____

_____

_____

_____

_____

_____

Please be sure you have a list of all parameters available. You can print this using LeoPC1. Additionally you can save the complete set of parameters (standard values) and send them to our Service department via e-mail.

We appreciate your comments about the content of our publications.

Please send comments to: stgt-documentation@woodward.com

Please include the manual number from the front cover of this publication.

Woodward Governor Company
Leonhard-Reglerbau GmbH
Handwerkstrasse 29 - 70565 Stuttgart - Germany
Phone +49 (0) 711 789 54-0 • Fax +49 (0) 711 789 54-100
sales-stuttgart@woodward.com

Homepage

http://www.woodward.com/power

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address/phone/fax/e-mail information for all locations is available on our website (www.woodward.com).

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