

SMARTDRIVE-S3 belongs to the bipolar stepper motor position controllers family. It is a complete ready-to-run unit, comprising a programmable positioning controller, the PWM power output stage, and all the necessary control interfaces. Predefined motion control sequences can be executed autonomously. Additional profiles can be specified via the serial bus whenever required. The output stage features two high performance sinusoidal current control loops. External interfaces comprises opto-isolated control I/Os, limit switch inputs, analog inputs, an incremental encoder interface and a serial communication port.

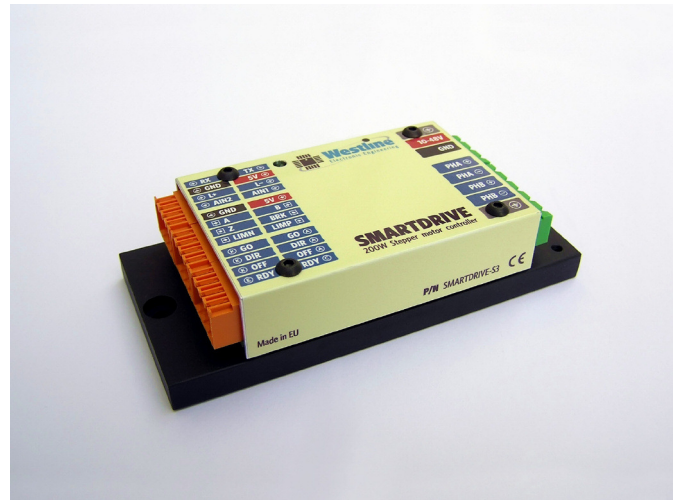
All parameters and controller firmware are accessible over the serial interface using a Windows-based software.

Advantages

- Integrated speed and positioning controller
- Integrated power driver with thermal and short-circuit protection
- Operation in micro-step mode
- Programmable idle, running and acceleration currents
- Programmable acceleration and speed limits
- Limit and home switches handling
- Autonomous operation or externally driven
- Accepts industry-standard step-and-direction control mode
- Small size and quiet operation

Applications

- Special machinery
- Simple positioning systems
- Pneumatic actuator replacement



Technical Specifications

Power supply	10 ÷ 48 V _{DC} [†]
Phase current	0 ÷ 3 A _{RMS}
Analog inputs/outputs	0 ÷ 5 V
Digital inputs/outputs	TTL
Encoder inputs	TTL
Isolated digital inputs	0 ÷ 24 V
Isolated digital outputs	0 ÷ 24 V / 100 mA max.
µStep resolution	1 ÷ 2048 µstep / full step
Position range	-2 ³¹ ÷ 2 ³¹ - 1 µstep
Speed range	0 ÷ 3000 rpm
Acceleration range	0 ÷ 30000 rpm/s
External clock frequency on A/B inputs	0 ÷ 12 MHz
External clock frequency on GO/DIR inputs	0 ÷ 200 kHz
Serial interface	RS232 [‡] and RS485
Weight	175 g

[†] 5V on request

[‡] 2 m maximum distance

Order Code

SMARTDRIVE-S3

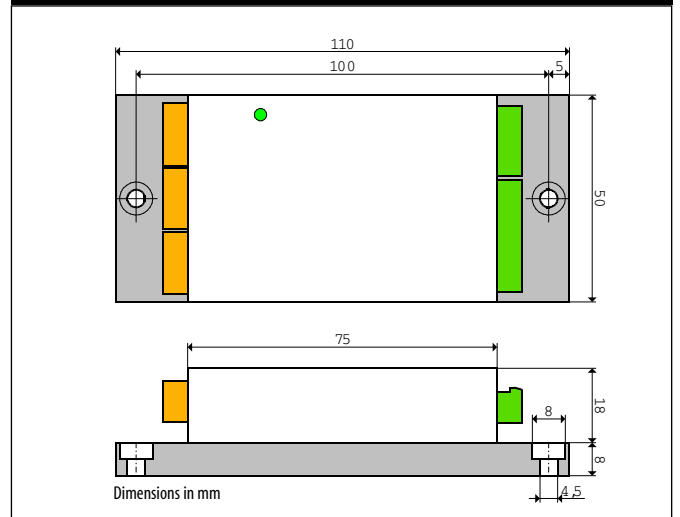
External Connections

RXD (RS232)	• RX • TX •	TXD (RS232)	• SHLD • shield
ground	• GND • +5V •	5V output / 100 mA	• +VS • power supply
L+ (RS485)	• L+ • L- •	L- (RS485)	• GND • ground
analog input	• AIN2 • AIN1 •	analog input (speed)	
ground	• GND • +5V •	5V output / 100 mA	
phase A encoder input	• A • B •	phase B encoder input	• PHA+ • A+ motor phase
index encoder input	• Z • BRK •	digital output	• PHA- • A- motor phase
negative limit switch input	• LIMN • LIMP •	positive limit switch input	• PHB+ • B+ motor phase
			• PHB- • B- motor phase
			• SHLD • shield
GO input cathode	• GOk • GOA •	GO input anode	
DIR input cathode	• DIRk • DIRA •	DIR input anode	
OFF input cathode	• OFFk • OFFA •	OFF input anode	
RDY output emitter	• RDYε • RDYc •	RDY output collector	

Recommended connectors

- Weidmüller B2L 3.5/8, 8 way socket block, RS 382-9602
- Phoenix Contact COMBICON MSTB 2.5/3-ST-5.08, 3 way straight plug, RS 189-6026
- Phoenix Contact COMBICON MSTB 2.5/5-ST-5.08, 5 way straight plug, RS 189-6048

Dimensions

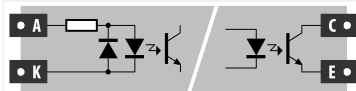


User's Guide

External connections

Opto-isolated I/Os

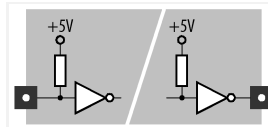
The A/K connections will drive the opto-isolator diode through the polarization circuit. The operating voltage on A input (related to K) is +5V to +24V without the need of an external limiting resistor. The C/E are the collector/emitter NPN transistor outputs of the opto-isolator.



OFF – when activated the power output of the controller is disabled, the trajectory generator and the GO/DIR inputs are off. Toggling the OFF input will clear the current alarms and the current selected operating mode is reloaded. OFF input can be left unconnected if unused.

GO and **DIR** operation is related to the actual operating mode. The operation is front or level sensitive depending the current operating mode.

RDY is activated when the controller is ready to operate. During the execution of an order RDY is deactivated and will be activated again when the displacement is finish.



Digital I/Os

The digital I/Os are TTL compatible with internal pull-ups on the inputs.

When activated **LIMN** will stop the movement in the negative direction. The current trajectory is discarded and the motor stops. The positive direction is not affected. LIMN can also be used as an origin input.

When activated **LIMP** will stop the movement in the positive direction. The current trajectory is discarded and the motor stops. The negative direction is not affected.

! Because of internal pull-ups, LIMP and LIMN will be activated when left unconnected. When not in use they have to be disabled in software or tied to GND externally.

BRK is a logical output reserved for special applications (driving a brake circuit for example). The internal preloaded modes don't make use of that output.

A, **B** and **Z** are inputs to the position feedback decoder. Special application software is needed to make use of these inputs. Typically A and B are quadrature inputs and Z is the zero index from an incremental encoder. Alternate function for A and B is pulse and sense inputs when this operating mode is selected.

Analog I/Os

AIN1 and **AIN2** are two analog inputs provided for special applications. AIN1 is used as an external speed limit by the majority of the pre-programmed modes. When connected to a potentiometer the maximum speed can be adjusted. When the AIN1 is left unconnected an internal pull-up will apply maximum speed as specified by software.

RS232 communication lines

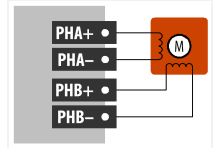
RX is a reception input and must be connected to TxD of the RS232 serial port. **TX** is a transmit output and must be connected to RxD of the RS232 serial port. An opto-isolated USB to RS232 adapter is available (P/N: *ISOBUS-232*).

RS485 communication lines

L+ and **L-** lines are used as a transmit/receive differential pair and must be connected to L+/L- of the RS485 bus adapter. An opto-isolated USB to RS485 adapter is available (P/N: *ISOBUS-485*).

Motor outputs

The two coils A and B of the stepper motor will be connected to the **PHA+/PHA-** and **PHB+/PHB-** respectively. If you need to change the rotation sense you just have to reverse the connections for one of the coils. The connector provide also one pin for the shield grounding of the motor cable.



Power Supply

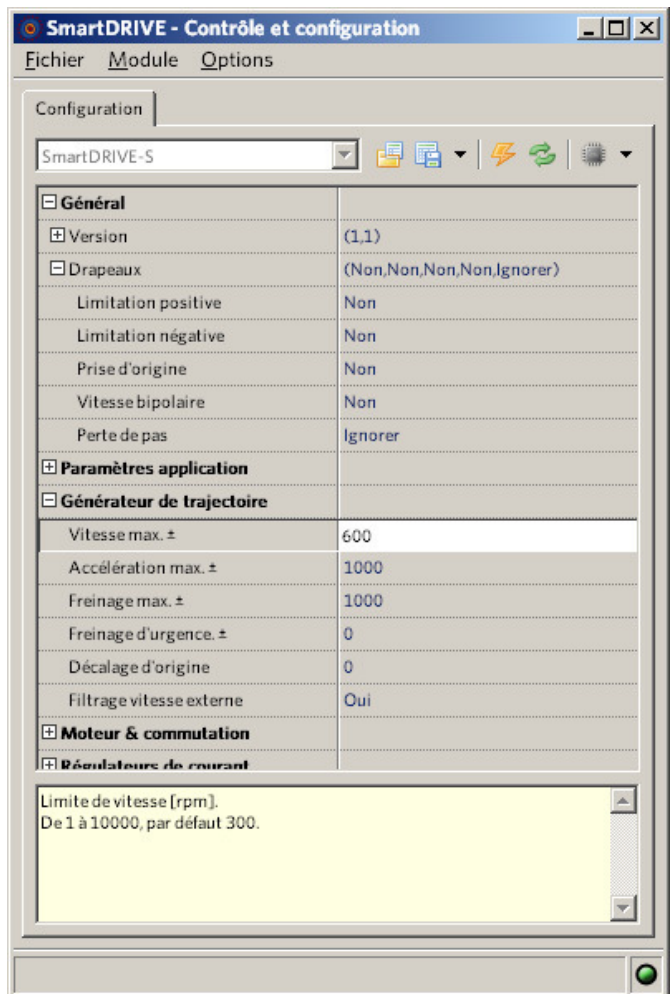
The controller needs a DC unregulated power supply. A dedicated connector is provided for **+VS**, **GND** and the cable shield connection **SHLD**. On signals side one **+5Vdc** output pin is provided to help the speed potentiometer connection or other conditioning circuitry. Another **+5Vdc** output pin is provided for the digital section. When an encoder or limit switch need power you can use that supply.

! The only opto-isolated signal pins are GO/DIR/OFF and RDY and they are provided for a PLC connection.

Configuration

The controller can be configured on the fly using an easy to use Windows 2000/XP software. First you have to connect the controller to the PC via the RS232 serial port or using an USB adapter. The available parameters are :

- current operation mode
- motor configuration : microstep resolution, current, PID constants
- trajectory parameters
- I/O polarities and limit switches configuration
- alarms trigger levels



Operating modes (applications)

The preloaded modes are controlled by the GO/DIR inputs. The RDY output can be used to monitor the status of the controller.

An internal pulse generator can replace the GO input. The on time and the period is user adjustable. This generator is useful for implementing plenty of simple applications without the need of an external PLC. The pulse generator can be used only with the modes making use of the trajectory generator (not in pulse input mode)

The trajectory generator will adjust the amplitude of the motor currents. When motor is stopped the hold current will maintain the rotor on the actual microstep position. During the acceleration and deceleration phases the acceleration current will be used and during the constant speed operation the work current will be used.

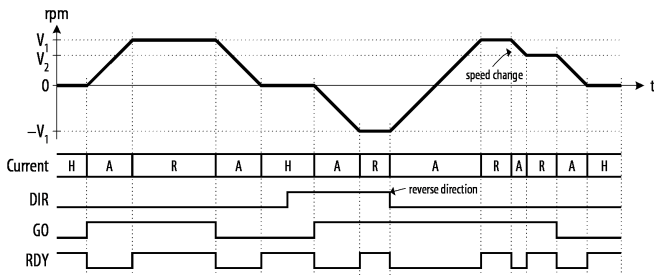
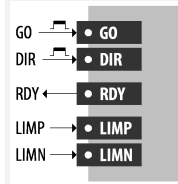
Available modes are:

- speed with level operated GO and DIR inputs
- speed with level operated GOCW and GOCCW inputs
- speed with front operated GO and DIR inputs (start/stop)
- speed with front operated GOCW and GOCCW inputs (start/stop)
- travel with GO and DIR inputs – act like an transport conveyor
- travel with GOCW and GOCCW inputs – act like an transport conveyor
- simple push-pull with GO/DIR inputs – act as an pneumatic jack
- push-pull with GO/DIR inputs and position zeroing on limit switch
- external quadrature clock with GO/DIR inputs
- external clock and direction with GO/DIR inputs
- serial bus operation for multi-axis synchronization

Custom operation modes can be created on request.

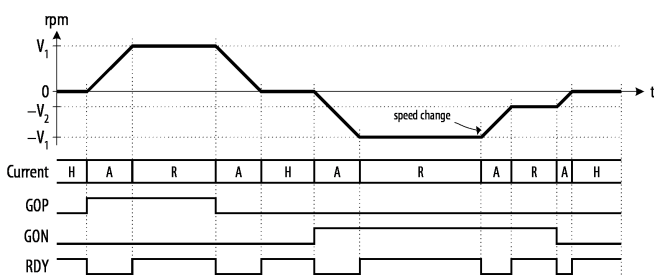
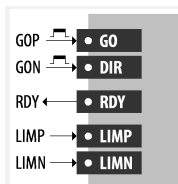
Speed GO/DIR

DIR input will select the spinning direction and GO will start the motor. When GO is activated the motor will spin at the specified speed or accelerate/decelerate to reach the specified speed. The motor speed will ramp linearly to the target speed.



Speed GOP/GON

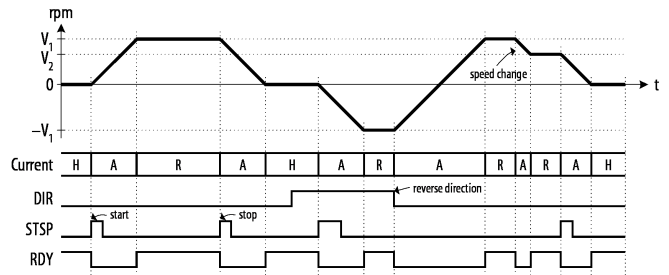
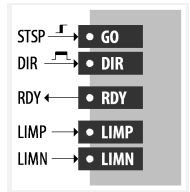
GOP input (GO) will spin the motor in positive direction and GON (DIR) will spin the motor in negative direction. The motor will operate at the specified speed or accelerate/decelerate to reach the specified speed. The motor



speed will ramp linearly to the target speed. The GOP input has priority over GON input.

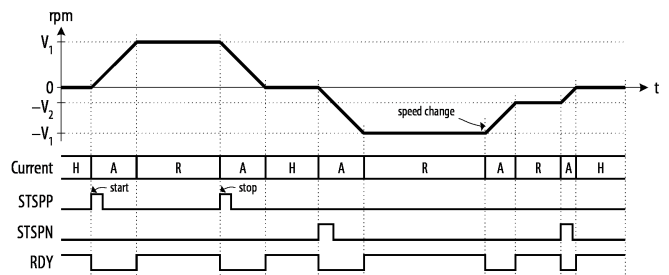
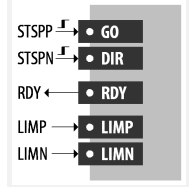
Speed STSP/DIR

When the motor is stopped the selected front on STSP input (GO) will start the operation taking DIR input into account. When the motor is spinning the selected front on the same input will stop-it. Changing the polarity of the input will change the active front.



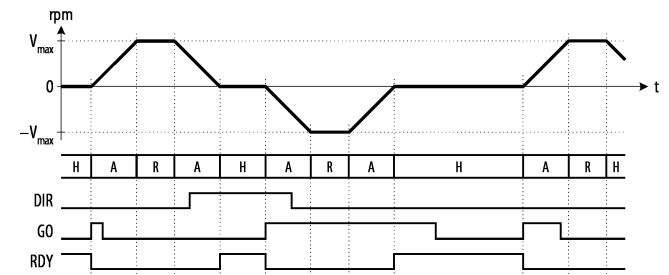
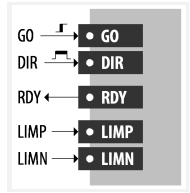
Speed STSPP/STSPN

When the motor is stopped the selected front on STSPP input (GO) will start the motor in positive direction and STSPN input (DIR) will start the motor in negative direction. If it is operating the selected front on any of the two inputs will stop the motor. The STSPP input has the priority over STSPN input. Changing the polarity of the GO input will change the active front.



Travel GO/DIR

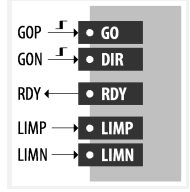
In this mode the motor is executing constant length movements. The DIR input will select the direction and the active front of the GO input will start the cycle. The movement length in micro steps is preloaded in the controller from the control panel on the PC and the profile is trapezoidal. If the limit switches are activated and one of them is reached the



movement is stopped. Changing the polarity of the GO input will change the active front.

Travel GOP/GON

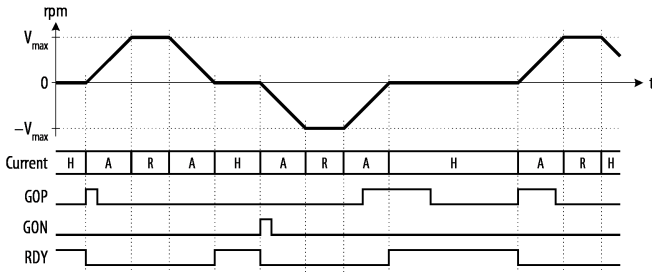
In this mode the motor is executing constant length movements. The GOP and GON inputs will start the cycle



SMARTDRIVE S Series – Intelligent Stepper Motor Controllers

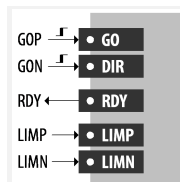
in positive or negative direction. The movement length in micro steps is preloaded in the controller from the control panel on the PC and the profile is trapezoidal. If the limit switches are activated and one of them is reached the movement is stopped. Changing the polarity of the input will change the active front. GOP input has the priority over the GON input.

! When the auto-GO timer is used only positive movements are possible.



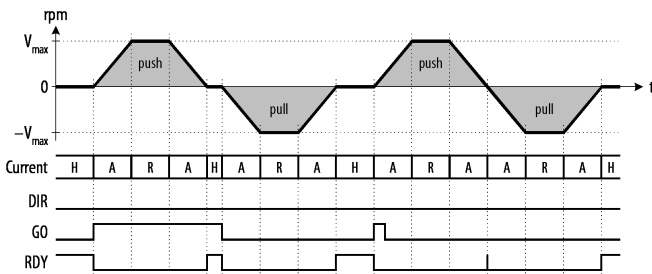
Simple jack (push-pull)

In this mode the motor will execute one push-pull movement over a preloaded distance like a pneumatic jack. The movement is decomposed in two phases: push and pull. The DIR input will select the direction of the movement and the selected front on the GO input will initiate the push phase. Once the push is executed the pull phase will be initiated only when the GO input is deactivated.



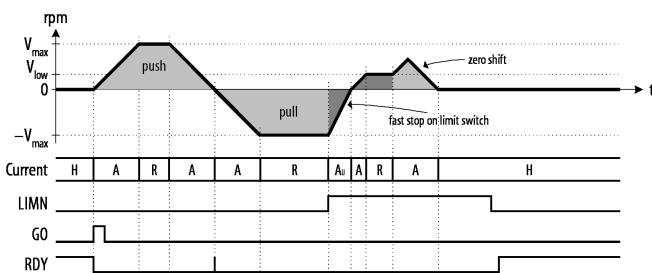
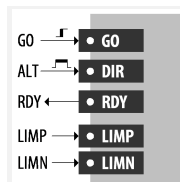
If one full cycle is executed the motor return to the initial position.

The movement length in micro steps is preloaded in the controller from the control panel on the PC and the profile is trapezoidal. If the limit switches are activated and one of them is reached the movement is stopped. Changing the polarity of the GO input will change the active front.



Push-pull with zeroing on LIMN switch

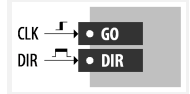
In this mode the motor will execute one positive movement over a user preloaded distance. By toggling the ALT input (DIR) the user has the choice of two preloaded distances. When GO is activated the push phase is initiated. The motor will initiate the pull phase only if the GO input is deactivated. In the pull phase the motor will spin in negative direction until the LIMN switch is reached and then it will reverse the direction at a lower speed to find the edge of the LIMN switch. The user has the possibility to preload a position offset relative to the edge of the limit switch. The push distance is preloaded from the PC but can be reduced by the use of LIMP switch. Changing the polarity of the



GO input will change the active front.

External clock with DIR

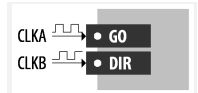
In this mode the motor advance one micro-step for every active front on the CLK input (GO). Changing the polarity of the GO input will change the active front. The DIR input will select the spinning direction.



- !** 1. Auto-GO, zeroing and limit switches are not operating in this mode.
- 2. You need to select a significant stop current in order to be able to maintain the the rotor micro-step position between two clocks.

External clock A quad B

In this mode the CLKA and CLKB inputs are two quadrature encoded clock inputs (90° out of phase). The inputs are decoded like for an incremental encoder in order to extract the clock and direction signals. The input resolution is multiplied by 4 in the decoding circuit so one micro-step is generated at each front of the A and B inputs. The spinning direction will depend on the phase relation between the inputs and can be changed by reversing the polarity of one of the A or B signals.



- !** 1. Auto-GO, zeroing and limit switches are not operating in this mode.
- 2. You need to select a significant stop current in order to be able to maintain the the rotor micro-step position between two clocks.

Special options

Different special functions can be applied to all or to some of the application modes. This functions can be activated or deactivated using the configuration software.

Position zeroing

This function can be executed each time when the current operating mode is activated, for example after power-up or after disabling the OFF input. This function is the same as described for the mode "Push-pull with zeroing on LIMN switch". The motor will go to the LIMN switch and will reset the position register. Offsetting the zero is also possible. The operation of this function ignores the selection status of the LIMN switch in software. Be sure the LIMN signal is long enough to allow the motor to stop inside the LIMN switch.

Auto-GO

All the operating modes except external clock can be started by the internal auto-GO timer. The on time and period of the timer can be programmed with 1 millisecond resolution. A 0 value in the period parameter will deactivate the auto-GO timer.

Limit switches

The limit switches can stop the movement in the corresponding direction when activated. When the switch is reached the motor will stop using a specified deceleration different of that used in the normal trajectories. If you enter 0 in that parameter the motor will stop abruptly with maximum deceleration.