

DRIVE CONTROL MODES

## PROTECTIONS

Built-in drive protections:

1. Drive blocked
2. Drive overheated
3. Drive overloaded
4. Under voltage
5. Over voltage
6. Over current
7. Internal Drive failure

## MOTOR CONTROL INTERFACE

8 different interface control strategies for flexible and smart motor control

| Mode description               | Mode | +D | -D | PWM* / E* | A      | Pins |
|--------------------------------|------|----|----|-----------|--------|------|
| On / off to minus              | 1    | +  |    | -         | +      | 4    |
| On / off to plus               | 2    |    | -  | -         | +      | 4    |
| On / off with enable low       | 3    | +  | -  |           | +      | 4    |
| Analog control 1               | 4    | +  |    | -         | analog | 4    |
| Analog control 2               | 5    |    | -  | -         | analog | 4    |
| Analog control with enable low | 6    | +  | -  |           | analog | 4    |
| Digital control                | 7    | +  | -  | PWM       | n.c.   | 3    |
| Mixed analog / digital control | 8    | +  | -  | PWM       | analog | 4    |

- +D : Drive positive supply
- D : Drive negative supply
- PWM\* / E\* : PWM input / low active enable input
- A : analog input
- +
- : connected to minus
- analog : analog voltage signal
- PWM : PWM signal
- n. c. : not connected
- : switch of the Drive positive supply to plus
- : switch of the Drive negative supply to minus / GND
- : switch active low enable input to minus / GND

## INTERFACE MODE 1: ON / OFF TO MINUS

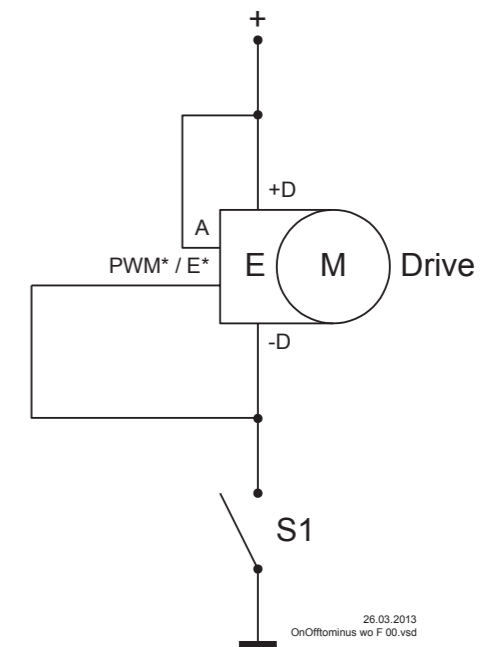
To realize the mode On / off to minus with the Drive Interface for Catalog Product 12-24V it is necessary to put

- A to +D and
- PWM\* / E\* to -D.

When the switch S1 is switched on the Drive goes after the initialization of the electronics to full speed.

This mode can be used if the CCU which controls the Drive has limited capabilities or does not even exist. The Drive is just switched on and off via any power switch like a relay, MOS FET, or even just a switch.

The appropriate current rating for this “switch” has to be dimensioned according to the current consumption of the Drive.



## INTERFACE MODE 2: ON / OFF TO PLUS

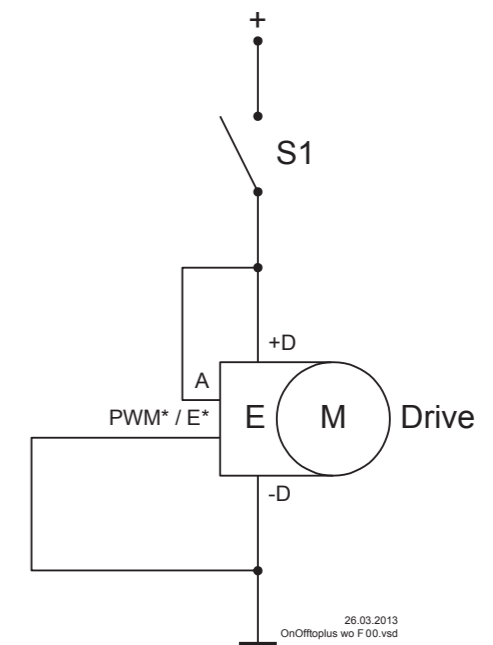
To realize the mode On / off to plus with the Drive Interface for Catalog Product 12-24V it is necessary to put

- A to +D and
- PWM\* / E\* to -D.

When the switch S1 is switched on the Drive goes after the initialization of the electronics to full speed.

This mode can be used if the CCU which controls the Drive has limited capabilities or does not even exist. The Drive is just switched on and off via any power switch like a relay, MOS FET, or even just a switch.

The appropriate current rating for this “switch” has to be dimensioned according to the current consumption of the Drive.

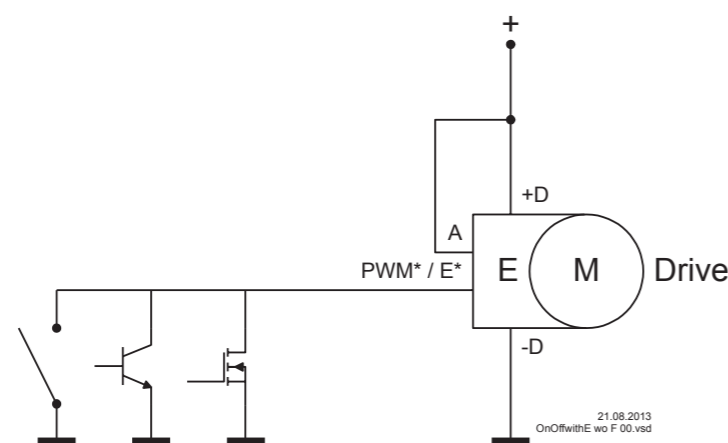


### INTERFACE MODE 3: ON / OFF WITH ENABLE LOW

To realize the mode On / off with enable low with the Drive Interface for Catalog Product 12-24V it is necessary

- A to +D and
- to use PWM\* / E\* as an low active enable.

In mode 3 the Drive can stay always on supply voltage and is controlled by a low current enable input which can be driven by simple low cost low side signal driver in the CCU. When the enable input PWM\* / E\* goes to high, the Drive goes after a short time into the quiescent current mode. When the enable pin PWM\* / E\* is driven low, the Drive goes to full speed after the initialization of the electronics. This mode can be used if the CCU which controls the Drive has limited capabilities or does not even exist. The appropriate sink current rating of the driver for the enable pin PWM\* / E\* has to be dimensioned according to the current consumption of the pin PWM\* / E\*. The circuit structure to drive the pin PWM\* / E\* can be any active low "open collector" Typical circuitry.

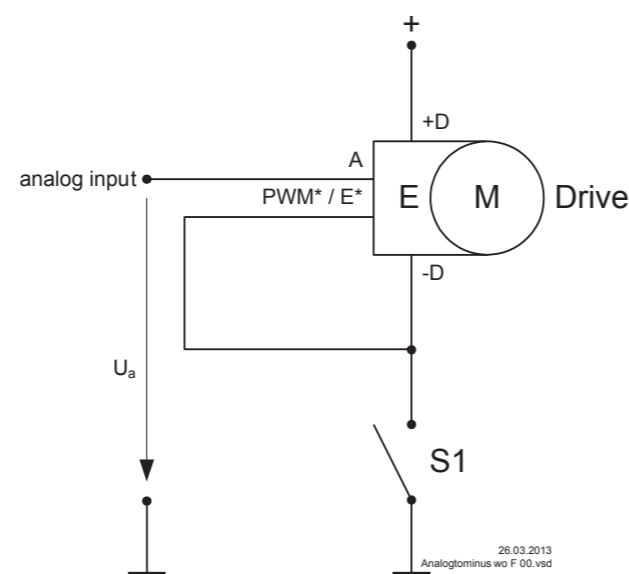


### INTERFACE MODE 4: ANALOG CONTROL 1

To realize the mode Analog control 1 with the Drive Interface for Catalog Product 12-24V it is necessary

- to use A as an analog input and
- to put PWM\* / E\* to -D.

When the switch S1 is switched on the Drive goes after the initialization of the electronics to the speed requested by the analog input A. The appropriate current rating for this "switch" has to be dimensioned according to the current consumption of the Drive.



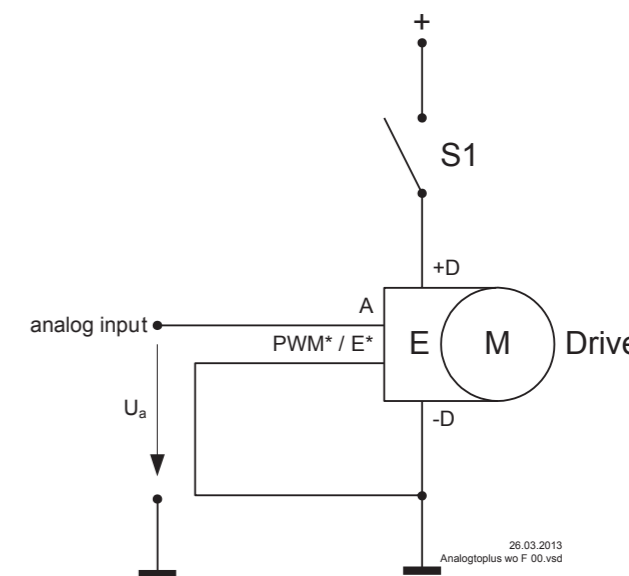
### INTERFACE MODE 5: ANALOG CONTROL 2

To realize the mode Analog control 2 with the Drive Interface for Catalog Product 12-24V it is necessary

- to use A as an analog input and
- to put PWM\* / E\* to -D.

When the switch S1 is switched on the Drive goes after the initialization of the electronics to the speed requested by the analog input A.

The appropriate current rating for this "switch" has to be dimensioned according to the current consumption of the Drive.



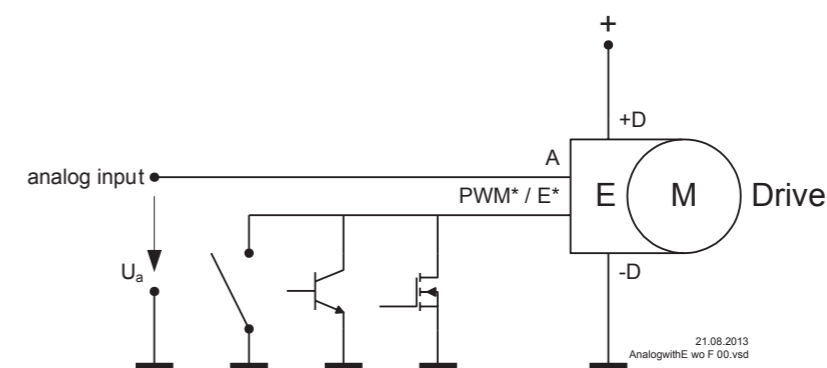
### INTERFACE MODE 6: ANALOG CONTROL WITH ENABLE LOW

To realize the mode Analog control with enable low with the Drive Interface for Catalog Product 12-24V it is necessary

- to use A as an analog input and
- to use PWM\* / E\* as a low active enable.

In mode 6 the Drive can stay always on supply voltage and is controlled by a low current enable input which can be driven by simple low cost low side signal driver in the CCU. When the enable input PWM\* / E\* goes to high, the Drive goes after a short time into the quiescent current mode. When the enable pin PWM\* / E\* is driven low, the Drive goes to the speed requested by the analog input A after the initialization of the electronics. The appropriate sink current rating of the driver for the enable pin PWM\* / E\* has to be dimensioned according to the current consumption of the pin PWM\* / E\*.

The circuit structure to drive the pin PWM\* / E\* can be any active low "open collector" Typical circuitry In this operating mode the supply voltage plus is usually connected permanently. To run the Drive first the pin PWM\* / E\* has to be connected to supply voltage minus and afterwards the Drive speed can be then controlled with an analog voltage on the pin A.

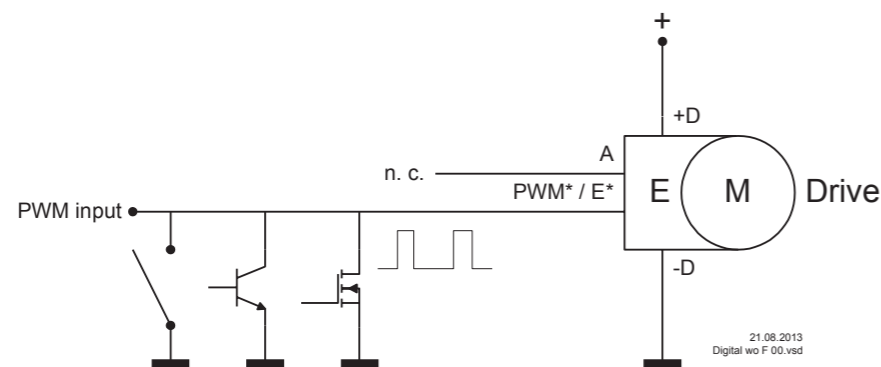


## INTERFACE MODE 7: DIGITAL CONTROL

To realize the mode Digital control with the Drive Interface for Catalog Product 12-24V it is necessary  
- to apply a PWM signal on the pin PWM\* / E\*.

In mode 7 the Drive can stay always on supply voltage and is controlled by a low current PWM and enable PWM\* / E\* input which can be driven by simple low cost low side signal driver in the CCU. When the enable input PWM\* / E\* goes to high, the Drive goes after a short time into the quiescent current mode. When the enable pin PWM\* / E\* is driven with PWM, the Drive goes to the speed requested by the duty cycle after the initialization of the electronics. The appropriate sink current rating of the driver for the enable pin PWM\* / E\* has to be dimensioned according to the current consumption of the pin PWM\* / E\*.

The circuit structure to drive the pin PWM\* / E\* can be any active low "open collector" Typical circuitry In this operating mode the supply voltage plus is usually connected permanently. To run the Drive on the pin PWM\* / E\* a PWM signal has to be applied and with the duty cycle of the PWM signal the Drive speed can be then controlled.

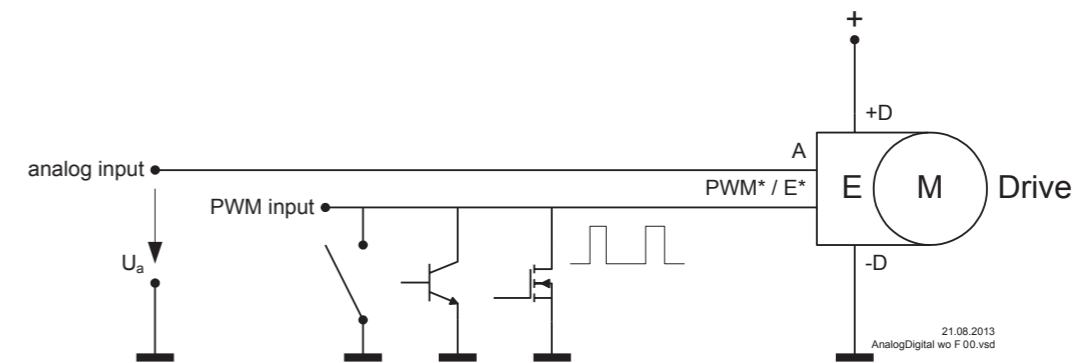


## INTERFACE MODE 8: MIXED ANALOG / DIGITAL CONTROL

To realize the mode Mixed analog / digital control with the Drive Interface for Catalog Product 12-24V it is necessary

- to use A as an analog input and
- to apply a PWM signal on the pin PWM\* / E\*.

In mode 8 the Drive can stay always on supply voltage and is controlled by a low current PWM and enable PWM\* / E\* input which can be driven by simple low cost low side signal driver in the CCU. When the enable input PWM\* / E\* goes to high, the Drive goes after a short time into the quiescent current mode. When the enable pin PWM\* / E\* is driven low (switched to supply voltage minus), the Drive goes to the speed requested by the analog input A after the initialization of the electronics (if the electronics is not already activated). When the enable pin PWM\* / E\* is driven with PWM, the Drive goes to the speed requested by the duty cycle after the initialization of the electronics (if the electronics is not already activated). The appropriate sink current rating of the driver for the enable pin PWM\* / E\* has to be dimensioned according to the current consumption of the pin PWM\* / E\*. The circuit structure to drive the pin PWM\* / E\* can be any active low "open collector" Typical circuitry.



In this operating mode the supply voltage plus is usually connected permanently. To run the Drive on the pin PWM\* / E\* a PWM signal has to be applied and with the duty cycle of the PWM signal the Drive speed can be then controlled. If the pin PWM\* / E\* is switched to supply voltage minus the Drive speed can be then controlled with an analog voltage on the pin A.

So a mixed control with either digital or analog input is possible. The priority has the digital PWM signal.

## FUSE PROTECTION

An automotive fuse according ISO8820 part 3 must be applied in the vehicle/system wire harness. Depending on the application of the fan, it is customer responsibility to define and verify the correct fuse value (due to the length of the vehicle cable harness, cross section of the power wires, fuse type).

## POWER SUPPLY RESIDUAL RIPPLE

The maximum acceptable value of power supply rms ripple for the Drive is 1%. In case of application with high residual ripple values, please contact SPAL in order to find the suitable solution for your specific requirements.

## STANDARDS AND DIRECTIVES

The product complies with the following standard / directives

| Standard Code              | Description   |
|----------------------------|---|
| 72/245/EC and updates      | Automotive EMC directive  |
| ECE Reg. 10-03 and updates | Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility |
| 2002/95/EC RoHS            | Restriction of Hazardous Substances Directive   |
| 2000/53/EC and updates     | End-of Life Vehicle 2000/53/EC  |

## SEALING

Motors certified **IP6K9K** and **IP68**