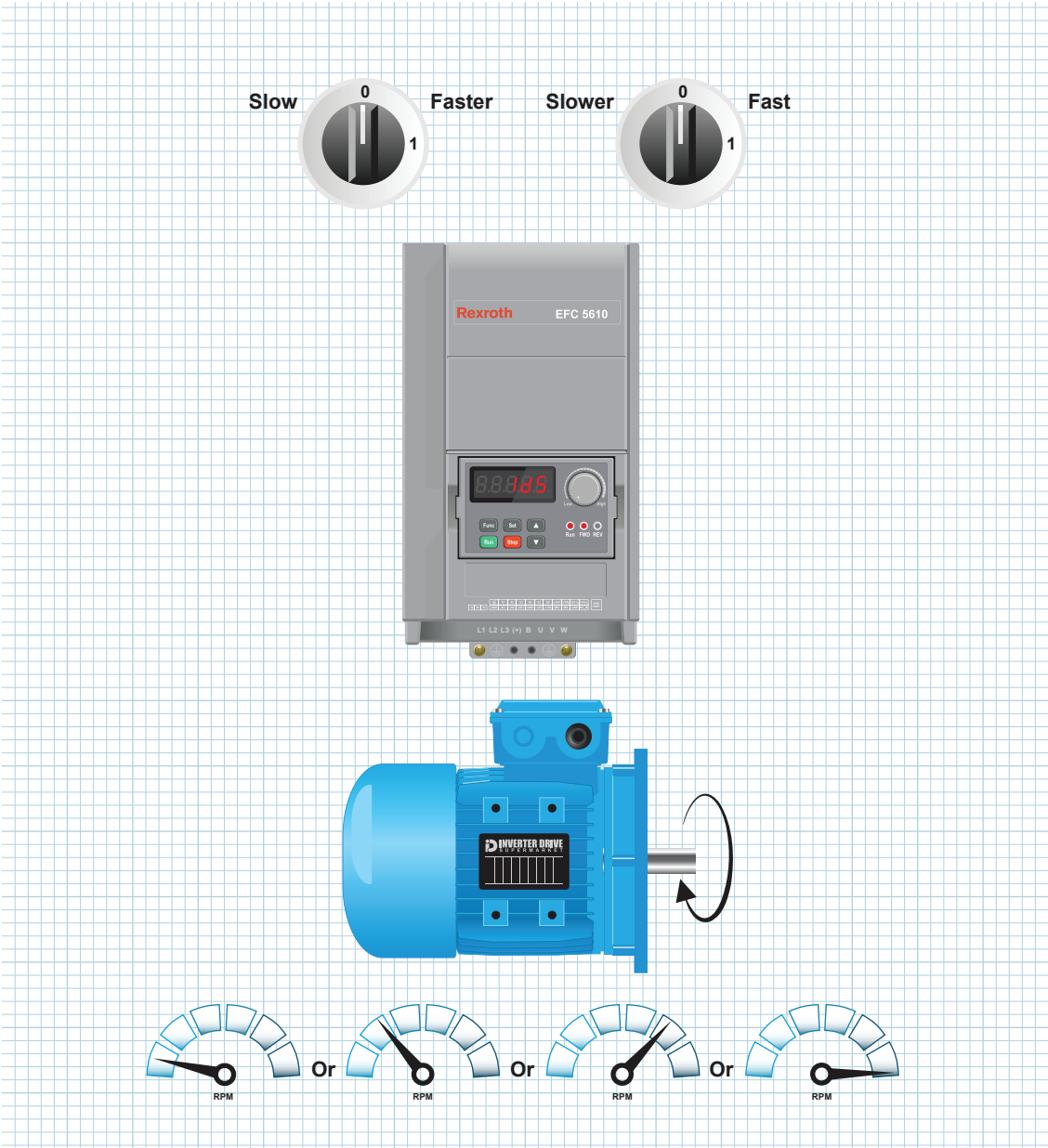
INVERTER DRIVE® SUPERMARKET

Easy Application Guide
Preset Speeds



A Preset Speed function sets the speed reference of an AC Inverter using digital inputs. The Bosch Rexroth EFC3610 / EFC5610 (EFCx610) AC Inverter featured in this guide has 16 preset speeds (multi-speeds).

If you are familiar with preset speed functionality, product specific details are given from page 4.

This guide is intended to complement the user manual provided by the manufacturer. It is provided as a basic introduction to the product for Inverter Drive Supermarket customers. It should not be used as a replacement for the manual issued by the manufacturer.

Basic Considerations

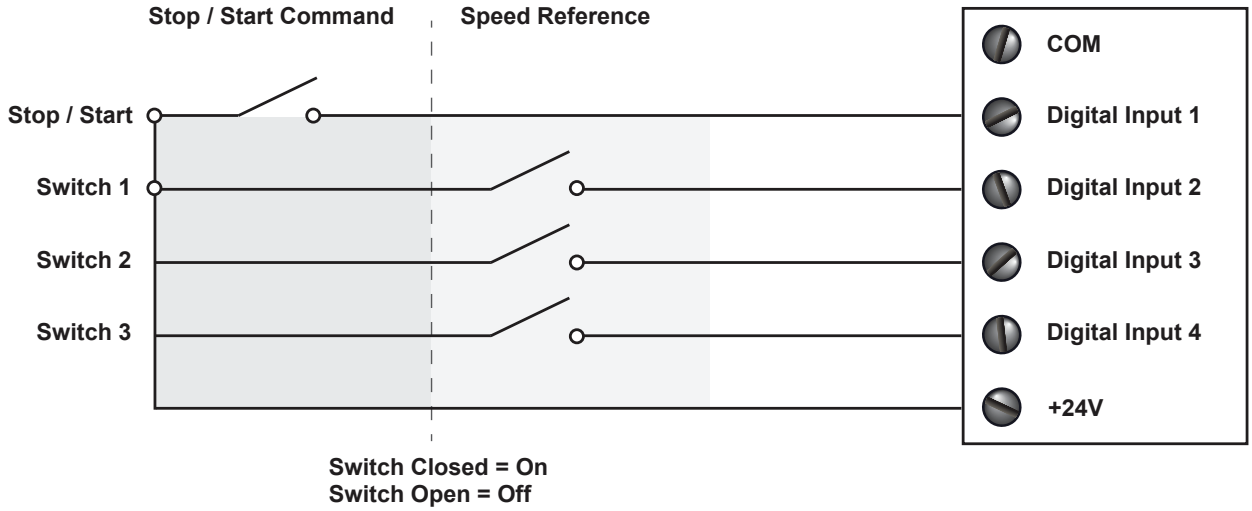
Using switches (SW) or a digital signal from a PLC (for example) an AC Inverter can be programmed to run at fixed predetermined speeds.

Almost all AC Inverters have preset speed functionality, but to ensure product selection meets your application needs there are some basic considerations. You must ensure that:

1) There are sufficient preset speeds available on the AC Inverter. This is product dependent and varies from 4 to 16. You can use fewer than are available, but not more.

2) There are sufficient digital inputs available on the AC Inverter. This is product dependent. In addition to the preset speed inputs a “start / stop” input is always required. Provision for any other inputs must also be considered. For example for 3-wire control, 2 digital inputs are required to stop and start the AC Inverter.

In the example below the requirement is for 8 preset speeds that will use 4 digital inputs. We will use this example to explain preset speed functionality.



Programming the AC Inverter will also be required; the preset speed function is rarely a default configuration. The AC Inverter needs to know:

1) Its speed reference is from a digital input. The default setting for the speed reference will be the keypad or an analogue input.

2) The individual preset speeds required.

3) How to behave for a zero value input (when all inputs are open / off). Some AC Inverters are able to revert to an alternative speed signal in this instance. This feature is not available on all products.

Example Operation

When correctly programmed, with the “start / stop” contact closed, the AC Inverter will run at a speed determined by Switch 1, Switch 2 and Switch 3.

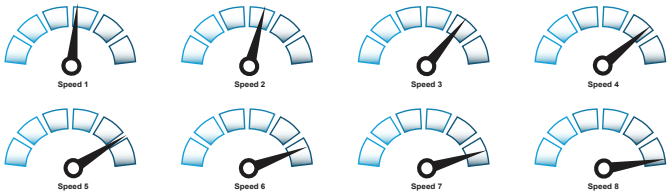
If the “start / stop” contact is open, the AC Inverter will remain stopped regardless of the status of Switch 1, Switch 2 and Switch 3.

Digital inputs 2, 3 and 4 function independently of each other and can select up to 8 different preset speeds.

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Introduction

On page 1 we show 3 switches and tell you that this gives 8 different speeds. Confusing? Let us explain.

Number of Switches	Number of Speeds	Possible Combinations
Switch 1		2
Switch 2 Switch 1		4
Switch 3 Switch 2 Switch 1		8

Note: For 4 switches, 16 preset speeds are possible.

There are more speeds than switches because the AC Inverter looks at the combination of the digital inputs; 1 switch is NOT 1 speed.

1 switch has 2 states; open and closed. 1 digital input can read both states. Reading both states of all 3 inputs gives 8 possibilities.

3 Switch Example

Switch 3	Switch 2	Switch 1	Speed
Off	Off	Off	Speed 1
Off	Off	On	Speed 2
Off	On	Off	Speed 3
Off	On	On	Speed 4
On	Off	Off	Speed 5
On	Off	On	Speed 6
On	On	Off	Speed 7
On	On	On	Speed 8

In our 3 switch example, setting the preset speed parameters (Speed 1 to Speed 8) to individual values will allow you to run at 8 different speeds depending on the combination of Switch 1, Switch 2 and Switch 3.

The default preset speed values are often 0 Hz so it is important that these values are correctly set otherwise it can appear that the AC Inverter is not running.

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Bosch Rexroth EFCx610 Product Overview

Rexroth refers to preset speeds as multi-speeds; there is no standard industry term.

The EFC3610 and EFC5610 (EFCx610) use the same preset speed parameters, so this guide applies to both products. It has a maximum of 16 preset speeds using 4 digital inputs.

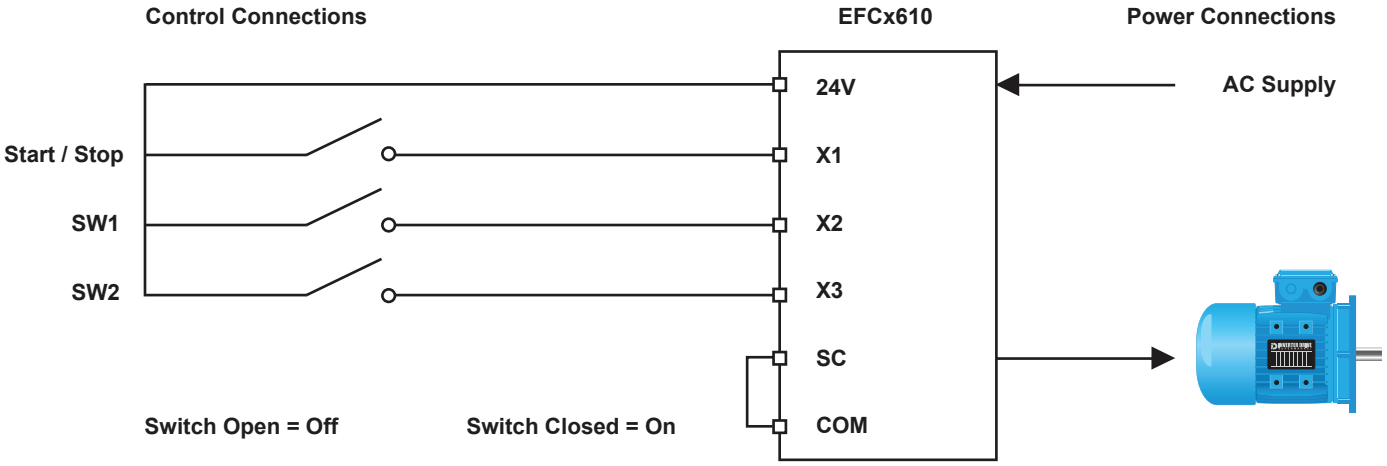
The EFCx610 has some advanced preset speed features which are explained on page 6 as they may be useful for your application.

It is assumed that our Easy Start Guide has been followed before using this guide.

This is essential as it explains how to set important motor parameters as well as how to change a parameter, which is required in this guide.

In the example for the EFCx610 we are using 2 switches to select 4 preset speeds.

The EFCx610 has 5 digital inputs and 16 preset speeds, so it's suitable for this example.



Start / Stop (X1)	Switch 2 (X3)	Switch 1 (X2)	Parameter
Off	* Run not selected - will not run *		
On	Off	Off	Multi-Speed Frequency 0
On	Off	On	Multi-Speed Frequency 1
On	On	Off	Multi-Speed Frequency 2
On	On	On	Multi-Speed Frequency 3

Important:

The EFCx610 will only run when the run switch is closed.

The above diagram is the wiring ONLY. Additional parameters need to be set for operation. See page 4.

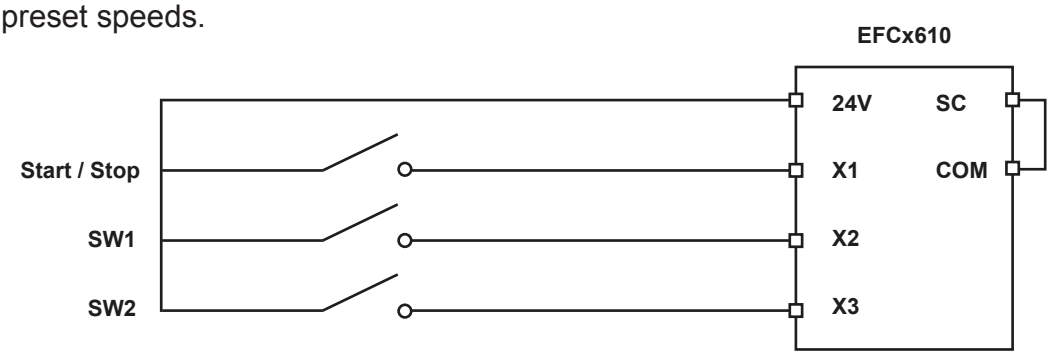
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Bosch Rexroth EFCx610 Basic Wiring and Parameters

For the EFCx610 to operate, parameter values need to be set.

This example is for 1 digital input for “start / stop” control and 2 digital inputs to select 4 preset speeds.

Preset speed values have been used for context but can be set to any value between minimum and maximum speed.



Parameter	Description	How to Set
b0.00	Access to all Parameters	Default is 0, basic parameters. Set to **2** to enable advanced parameters.
E0.00	Frequency Setting Source	Default is 0, keypad dial. Set to **21** for multi-speed.
E1.15	Control Mode	Default is 0. Set to **4** for multi-speed operation.
E1.00	X1 Input Function	Default is **35**, run forward. Default is required in this example.
E1.01	X2 Input Function	Default is 36, reverse run. Set to **1**, multi-speed input **1**.
E1.02	X3 Input Function	Default is 0, no function. Set to **2**, multi-speed input **2**.
E3.59*	Stage 0 Frequency Source	Default is 0, digital frequency. Default is required in this example.
E0.07	Digital Frequency (Multi-Speed Frequency 0)	Default is 50 Hz. Set to required value, e.g. 15 Hz.
E3.40	Multi-Speed Frequency 1	Default is 0 Hz. Set to required value, e.g. 25 Hz.
E3.41	Multi-Speed Frequency 2	Default is 0 Hz. Set to required value, e.g. 10 Hz.
E3.42	Multi-Speed Frequency 3	Default is 0 Hz. Set to required value, e.g. 30 Hz.
E0.26	Acceleration Time	Default is rating dependent, default suits most applications.
E0.27	Deceleration Time	Default is rating dependent, default suits most applications.

*This parameter determines what happens when all the preset digital inputs are off. In our example the speed is determined by the value of E0.07, however other options are available.

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Bosch Rexroth EFCx610 Operation

With the EFCx610 wired and the parameters set as detailed on page 4 the AC Inverter will operate as follows:

Switch 2	Switch 1		Parameter Name	Parameter Ref
Off On	**Off** On	15 Hz	Multi-Speed Frequency 0	E0.07
Off On	Off **On**	25 Hz	Multi-Speed Frequency 1	E3.40
Off **On**	**Off** On	10 Hz	Multi-Speed Frequency 2	E3.41
Off **On**	Off **On**	30 Hz	Multi-Speed Frequency 3	E3.42

With Switch 1 on and Switch 2 off the drive will remain stopped until the “start / stop” switch is on.

When “start / stop” is on the drive will accelerate to 25 Hz at a rate determined by the acceleration time (E0.26). The EFCx610 will continue to run at this speed until the digital inputs change.

If you close Switch 2 the drive will accelerate from 25 Hz to 30 Hz at a rate determined by the acceleration time (E0.26). Again the EFCx610 will continue to run at this speed until the digital inputs change.

If you open Switch 1 the drive will decelerate from 30 Hz to 10 Hz at a rate determined by the deceleration time (E0.27).

If you open the “start / stop” switch at any time the EFCx610 will ramp to stop in a time determined by the deceleration time (E0.27).

Please note that the acceleration and deceleration times are the time taken to ramp between 0 Hz and maximum speed (E0.08), it is not the time taken between preset speeds. If you need differing acceleration and deceleration times then this is possible and is covered on page 6 (Advanced Settings).

To see a graph of this example please see page 7.

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Bosch Rexroth EFCx610 Advanced Settings

So far the example we have given is a simple 2 switch control for 4 preset speeds in the same direction and with the same acceleration and deceleration times (ramp rates).

The EFCx610 is able to operate in the reverse direction without the addition of another digital input. Up to 8 different acceleration and deceleration times are also available.

The feature that controls ramp rates (acceleration and deceleration) and direction is called ‘stage action’. There are 16 stage action settings, 1 for each multi-speed value.

“Stage 0 action” (E3.60) is an instruction for “multi-speed 0” (E0.07).

“Stage 1 action” (E3.62) is an instruction for “multi-speed 1” (E3.40).

“Stage 2 action” (E3.64) is an instruction for “multi-speed 2” (E3.41) ...

... “Stage 15 action” (E3.90) is an instruction for “multi-speed 15” (E3.54).

16 different instructions for 16 preset speeds (multi-speeds).

The default parameter value of all stage action parameters is 011; each digit is an individual instruction.

Direction	0	0 = Forward, 1 = Reverse.
Acceleration Time	1	1 = Default Acceleration Time (E0.26). Setting from 1 to 8.
Deceleration Time	1	1 = Default Deceleration Time (E0.27). Setting from 1 to 8.

A selection of different stage action values is given below; there are 128 variations available:

Stage Action	Direction	Acceleration Time	Parameter	Deceleration Time	Parameter
134	Reverse	Acceleration Time 3	(E3.12)	Deceleration Time 4	(E3.15)
051	Forward	Acceleration Time 5	(E3.16)	Deceleration Time (default)	(E0.27)
133	Reverse	Acceleration Time 3	(E3.12)	Deceleration Time 3	(E3.13)

There are 8 different acceleration and deceleration times available including the default.

The acceleration and deceleration parameters are not limited to any specific stage action parameters and can be used multiple times if required.

Example: Set “stage 2 action” E3.64 to 134. The stage 2 action is linked to multi-speed 2 (see above). This means:

With multi-speed 2 selected (Switch 2 on, Switch 1 off) the EFCx610 would run in the reverse direction at the speed set by “multi-speed 2” parameter E3.41.

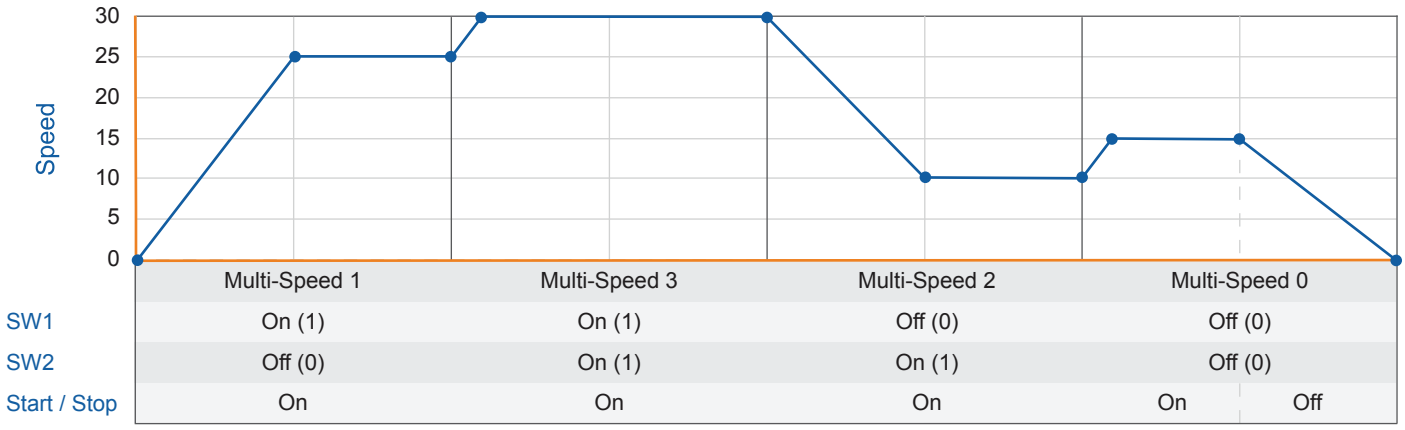
The acceleration rate is set by “acceleration time 3” parameter E3.12, and the deceleration rate is set by “deceleration time 4” parameter E3.15.

Please see page 7 which gives a further example of the stage action parameter along with a graph.

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Bosch Rexroth EFCx610 Example

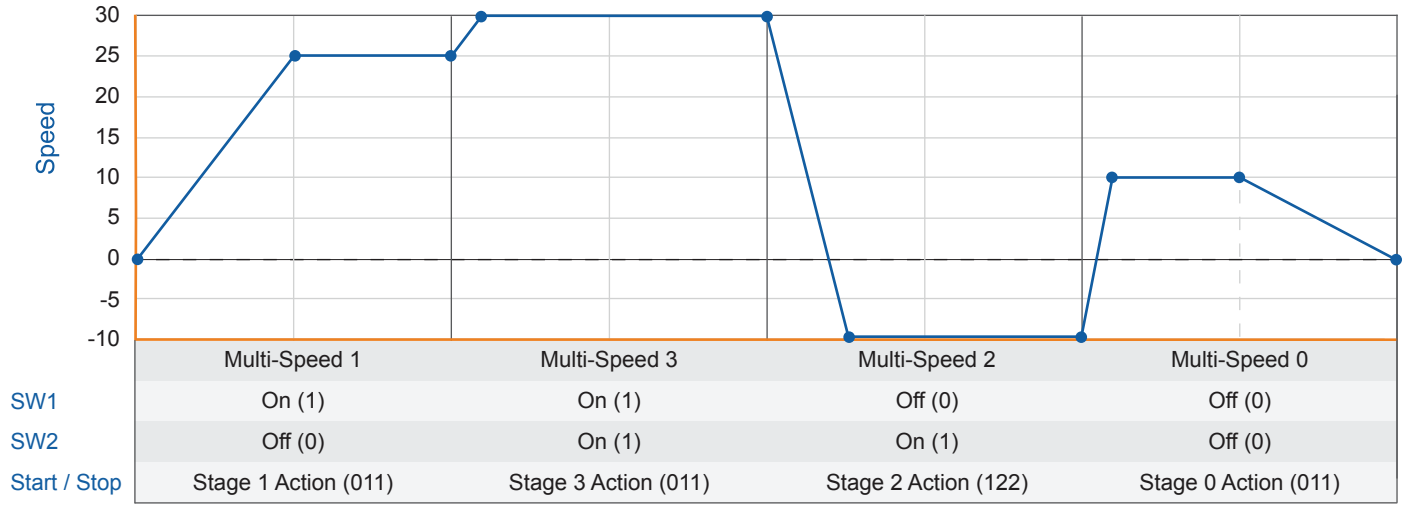
Below is a graph showing output speed and switch combination against time when the EFCx610 is programmed as given on page 4.



Using the advanced features on page 6 this can be easily changed. It uses the same wiring and the same original parameters, but with 3 additional parameters.

Parameter	Description	Setting
E3.64	Stage Action 2	Default is 011. Change to **122**.
E3.10	Acceleration Time 2	Default is 10 secs. Set to **20** secs for this example.
E3.11	Deceleration Time 2	Default is 10 secs. Set to **20** secs for this example.

Below is a graph showing output speed and switch combination against time when the EFCx610 is programmed as given on page 4 with the additional parameters E3.64, E3.10 and E3.11 as shown above.



The stage action feature extends the preset speed functionality significantly with minimal parameter changes.

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