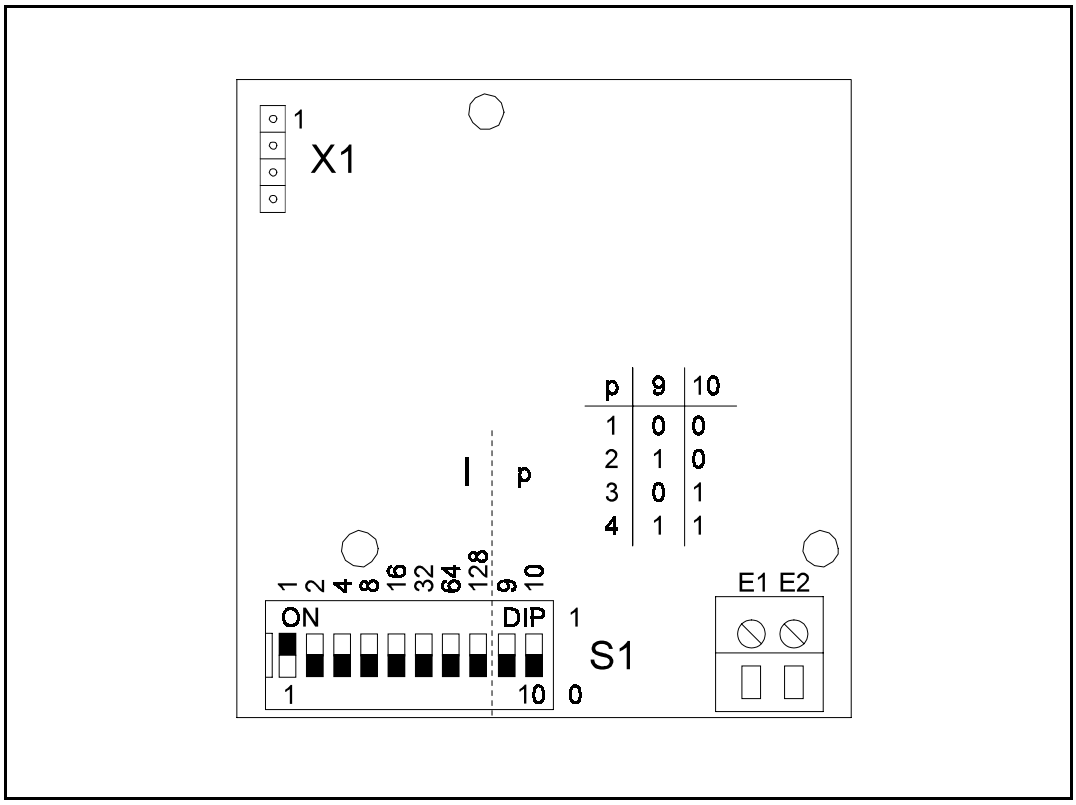
WOODWARD

DB1 - Speed Module for AMF Controller Types NC3 and NB2



Inhalt

1 Application and features

The speed module *DB1* records and monitors speeds. In this process it records random, speed-dependent frequencies which may originate from a tachogenerator or a pick-up. As additional module for automatic controllers types *NC3* and *NB2* it can be installed at any later date.

When the ignition speed (via *DB1*) has been achieved, the automatic controller completes the starting process. From this time onwards, the unit achieves the rated speed automatically.
In addition, the *DB1* is used for recording overspeeds.

The speed module *DB1* is adapted to the relevant tachogenerator via an 8-pole DIP switch.
The *DB1* features very precise coding for units which do not have a reduction or transmission gear. If gears are used between unit and generator, Chapter 3.4 must be adhered to as impermissible deviations from the rated frequency may occur on account of the binary coding. In the case of the *NC3* controller the deviations can be corrected via software *NC3-Soft*, in the case of the *NB2* via *NB2-Soft*.

2 Working principle

Connection of the *DB1* module to the *NC3* or the *NB2* activates the circuits for speed supervision of the automatic controller. The default settings of the tresholds for ignition speed and overspeed are 25 % and 100 % of the rated speed or the rated generator frequency, respectively.
The thresholds of the automatic controller *NC3* and *NB2* can be parameterised via the parameterising software *NC3-Soft* and *NB2-Soft*, respectively.

The speed module *DB1* serves to determine the speed and compare it with the set thresholds.
If the speed exceeds the threshold "Ignition speed", the signal "Motor running" is transmitted and the start-up process is ended (starter switched off).

If the speed exceeds the set value for "Overspeed" the automatic controller reacts with a direct shut-down of the unit. The alarm is indicated via alarm indication 3.

3 Commisioning

Note !
Before and during installation appropriate precaution measures must be taken to prevent electrostatic discharges.

3.1 Installation of the *DB1* module

The speed module is mounted directly on the automatic controller. Of course, installation on the rear side of the automatic controller at a later stage is also possible.
Every automatic controller, whether *NC3* or *NB2* is equipped for this purpose. Installation is to be carried out as follows:

- switch automatic controller to dead
- remove protection screen on the rear side of the automatic controller by carefully pressing the lateral brackets outwards
- now push the speed module onto the provided position of the contact strip of the automatic controller
- now fasten speed module (fastening materials included in the scope of delivery).
- coding of the speed module is done as described in Chapter 3.3
- finally, break out the pre-punched opening for the protection screen and press protection screen back into the bracket.

3.2 Connection of the tachogenerator

Connect tachogenerator to terminals E1 and E2.
In order to prevent interference effects we recommend the use of a double-core shielded cable. The shield of the cable must be earthed one-sided near the source of the interference. Double-sided earthing of the shield is only recommendable with good potential compensation.

Caution !
The input of the speed module must not be connected directly to the generator voltage !

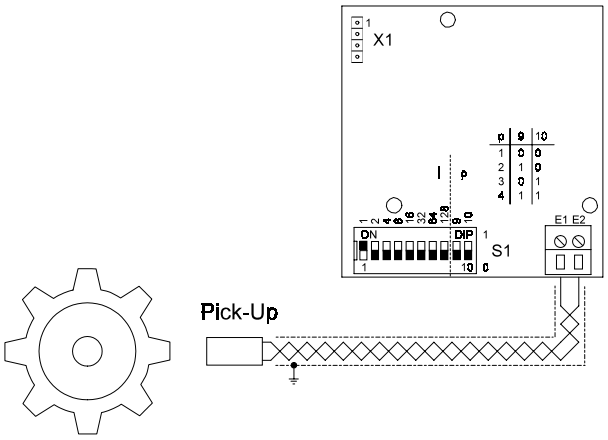


Figure 3.1: Connection of the DB1 if a pick-up is used

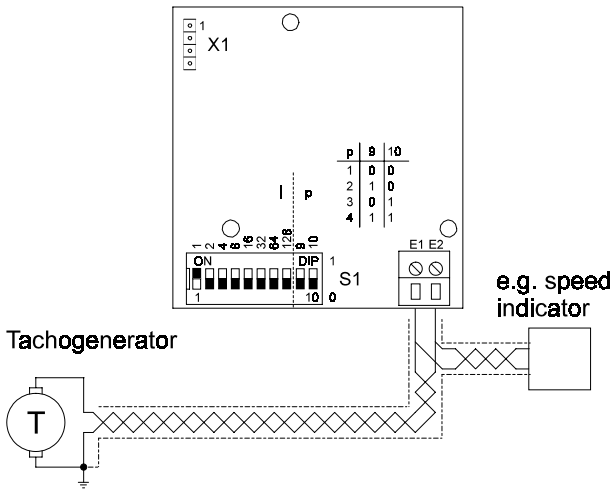


Figure 3.2: Connection of the DB1 if a tachogenerator is used

3.3 Coding of the speed module

The setting of the DIP switch S1 always refers to the set rated frequency of the automatic controller, the rated speed as well as the number of pulses per rev.

If a pick-up is used, the pulses per rev. equal the number of teeth of the starter gearwheel.

Example:

fn = 50 Hz

n (rpm)	Pulses per rev. I	Pole pair p	DIP-switch 9	10
750	40	4	1	1
1000	40	3	0	1
1500	40	2	1	0
3000	40	1	0	0

I = 40
p = 3

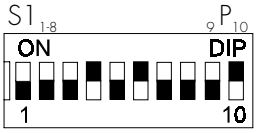


Figure 3.3: DIP-switch settings for example

The setting value of DIP-switch $S1_{1-8}$ amounts to:

DIP-switch	Value
$S1_1$ ON	1
$S1_2$ ON	2
$S1_3$ ON	4
$S1_4$ ON	8
$S1_5$ ON	16
$S1_6$ ON	32
$S1_7$ ON	64
$S1_8$ ON	128

The setting value in figure 3.3 amounts to:
32+8 = 40 (pulses per rev.)

3.3.1 Setting of a pick-up

Example 1:

fn = 60 Hz

n (rpm)	Pulses per rev. I	Pole pair p	DIP-switch 9	10
900	71	4	1	1
1200	71	3	0	1
1800	71	2	1	0
3600	71	1	0	0

I = 71
p = 2

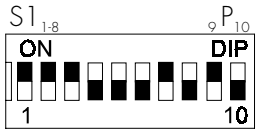


Figure 3.4: DIP-switch settings for example 1

Calculation of the settings

$$S1_{1\text{-}8} = \frac{p \cdot n_{Rated}}{60 \cdot f_{Rated}} \cdot I$$

with:

$S1_{1\text{-}8}$	Setting value DIP switch 1-8
n	Rated speed of the protected unit
f_{Rated}	Rated frequency in Hz
I	Pulses per rev. (number of teeth of the starter gearwheel) in min^{-1}
p	Number of pole pairs of the generator

The number of pole pairs of the generator is determined by the design of the rotor. It describes the ratio of the rated generator speed to the rated frequency.

$$p = \frac{n_{Rated}}{f_{Nenn} \cdot 60}$$

Set rated speed:

$$N_{Rated} = \frac{60 \cdot f_{Rated}}{I \cdot P} \cdot S1_{1-8}$$

with:

N_{Rated}	Set rated speed

Deviations in case of units with reduction or transmission gearing

Example 3:
fn = 50 Hz
n_{Rated} = 1720 rpm
I = 31
p = 2

New parameterizing

$$S1_{1-8} = \frac{p \cdot n}{60 \cdot f_{Rated}} \cdot I = \frac{p \cdot 1720}{60 \cdot 50} \cdot 31 \text{ and}$$

$$N_{Rated} = \frac{60 \cdot f_{Rated}}{I \cdot p} \cdot S1_{1-8} = \frac{60 \cdot 50}{31 \cdot p} \cdot S1_{1-8}$$

p	$S1_{1-8}$	N_{Rated}	n_{zd} (25% of n)	$n_{Üd}$ (110% of n)
1	18	1742	435 (25,3%)	1916 (111,4%)
2	36	1742	435 (25,3%)	1916 (111,4%)
3	53	1710	427 (24,8%)	1880 (109,3%)
4	71	1718	429 (24,96%)	1890 (109,8%)

n_{Zd} Ignition speed
$n_{Üd}$ Overspeed

A higher setting of the pole wheel number results in a more precise, but also slower speed recognition. It is therefore recommendable to set the pole pairs as low as possible. In this case that would be p=1 with $S1_{1-8}$ = 18.
But this coding may only be set if a slightly increased overspeed treshold is permissible.

In the case of the *NC3* the deviation can be corrected via the *NC3-Soft*. In the case of the *NB2* the correction is made via *NB2-Soft*. In that case the setting p = 1 is recommended.

I = 18
p = 1

Figure 3.5: DIP-switch settings for example 2

3.3.2 Setting of a tachogenerator

$$S1_{1-8} = \frac{p}{f_{Rated}} \cdot f_{TRated}$$

Set rated speed:

$$N_{Rated} = \frac{n_{Rated}}{f_{TRated}} \cdot \frac{f_{Rated}}{p} \cdot S1_{1-8}$$

$S1_{1-8}$ Setting value DIP-switch 1 - 8
n_{Nenn} Rated speed of the protected unit
f_{Nenn} Rated frequency
I Pulses per rev. (number of teeth of the starter gearwheel)
p Number of pole pairs of the generator
N_{Rated} Set rated speed
f_{TRated} Rated tacho frequency dependent on the rated speed n_{Rated}

Example 1
f_{Rated} = 50 Hz
n_{Rated} = 1500 rpm
f_{TRated} = 0,1 x n =150 Hz

$$S1_{1-8} = \frac{p}{f_{Rated}} \cdot f_{TRated} = \frac{2}{50} \cdot 150 = 6$$

I = 6
p = 2

Figure 3.6: DIP-switch settings for example 1

Example 2

A tachogenerator is installed on the transmission drive shaft of the protected unit.

f_n = 50 Hz
n_{Rated} = 1860 rpm
p = 2
f_{Tacho} = 186 Hz

The equation results in the following setting:

$$S1_{1-8} = \frac{p}{f_{Rated}} \cdot f_{TRated} = \frac{2}{50} \cdot 186 = 7{,}44 \approx 7$$

Rounding off from 7.44 to 7 causes a relative fault F_R in the indicated speed.

$$N_{Rated} = \frac{n_{Rated}}{f_{TRated}} \cdot \frac{f_{Rated}}{p} \cdot S1_{1-8} = \frac{1860}{186} \cdot \frac{50}{2} \cdot 7 = 1750$$

$$F_R = \frac{N_{Rated} - n_{Rated}}{n_{Rated}} \cdot 100\% = -5{,}9\%$$

This can be corrected by chosing a higher setting value p. If p = 3 and $S1_{1-8}$ = 11, the indicated rated speed is 1833.3 with a relative fault of -1.4 %. The overspeed threshold rises from 110 % to 111.5 %. As a rule, this fault rate is tolerable. Precise settings can be achieved with the help of *NC3-Soft* and *NB2-Soft.* The speed module can be preciseby adjusted via the parameter "Speed adjustment" on the "Unit" side. In order to achieve fast reaction, select p=1 and I=4. The default setting of the parameter "Speed adjustment" is 1.000.

The input value is calculated as follows:

$$N_{Rated} = \frac{n_{Rated}}{f_{TRated}} \cdot \frac{f_{Rated}}{p} \cdot S1_{1-8} = \frac{1860}{186} \cdot \frac{50}{1} \cdot 4 = 2000$$

$$F_R = \frac{N_{Rated} - n_{Nenn}}{n_{Rated}} \cdot 100\% = 7{,}53\%$$

$$\text{Adjustment} = 1{,}000 - \frac{F_R}{100\%} = \frac{N_{Rated}}{n_{Rated}} = \frac{2000}{1860} = 1{,}0753$$

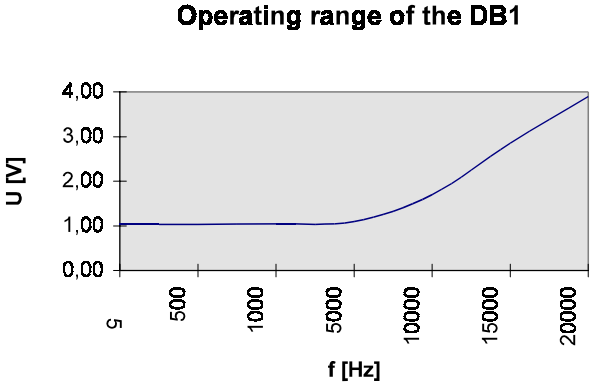
After the adjustment factor has been fed in, the indicated speed corresponds to the speed of the protected unit.

3.4 Operating range

The setting range of the DIP switch permits frequency coding from 1 ... 1024 pulses/rev.With fn = 50 Hz that corresponds to a range from 12.5 Hz to 12750 Hz.
With 60 Hz the setting range is 15 Hz to 15300 Hz.

The speed module has an operating range from 5 Hz to 20 kHz. Dependent on the frequency, the input signal must have a required minimum voltage in order to ensure perfect functioning of the *DB1*.

The minimum voltage shown in the following diagram is equal to the effective value:



The amplitude of the input signal may not exceed $Umax_{eff}$: 90 V AC.

4 Technical data

Standards:	EN 50082-2:	EMV generic standard, industrial sector Part 2 interference resistance
	EN 61000-4-8	EMV basic standard interference resistance against magnetic fields with power technology frequencies
	EN 61000-4-4	EMV basic standard interference resistance against fast transient interference factors (burst)
	ENV 50142	EMV basic standard interference resistance against voltage surges
	EN 50081-1	EMV generic standard, dometisc sector Part 1 interference signal
	EN 50178	Electronic operating equipment for power installations

Operating mode:	continuous
Design:	Additional module for *NC3* and *NB2*
Dimensions:	48 x 53 x 30 mm
Maintenance:	no maintenance required
Installation position:	fixed on account of mounting on *NC3* and/or *NB2*
Voltage range:	Umin dependent on frequency $Umax_{eff}$: 90 V AC
Case fastening:	fastened with screws, fastening material included in scope of delivery
Weight:	40 g
Coding:	10-pole DIP switch for pre-selection of frequency divider and pole pair number

Note: As the speed module *DB1* is an additional module for the *NC3* and the *NB2*, refer to the *NC3* and/or the *NB2* with regard to the technical data for tests, protection types. etc. (see Description *NC3* and *NB2*, Technical Data)

Technical or design modifications are possible in the interest of continuous further development.

5 Order form

When ordering preset/coded speed modules please use the prepared form below.

If the module is ordered without detailed specification for coding, the standard setting is Position 1 of the DIP switch so that the signal Overspeed is always transmitted if no setting has been carried out.

If coding is required the following data for the speed sensor should be provided:

- If a tachogenerator is used:
  - frequency of the tachogenerator with reference to the rated motor speed
  - rated mains frequency
  - rated speed

- If a pick-up is used:
  - pulses per rev.
  - rated mains frequency
  - rated speed

Speed module	***DB1***	
Tachogenerator	Tachogenerator frequency	Hz
	Main frequency	Hz
	Rated speed	rpm
Pick-up	Pulses per rev.	
	Rated mains frequency	Hz
	Rated speed	rpm

Woodward Kempen GmbH
Krefelder Weg 47 · D – 47906 Kempen (Germany)
Postfach 10 07 55 (P.O.Box) · D – 47884 Kempen (Germany)
Phone: +49 (0) 21 52 145 1

Internet
www.woodward.com

Sales
Phone: +49 (0) 21 52 145 216 or 342 · Telefax: +49 (0) 21 52 145 354
e-mail: salesEMEA_PGD@woodward.com

Service
Phone: +49 (0) 21 52 145 614 · Telefax: +49 (0) 21 52 145 455
e-mail: SupportEMEA_PGD@woodward.com