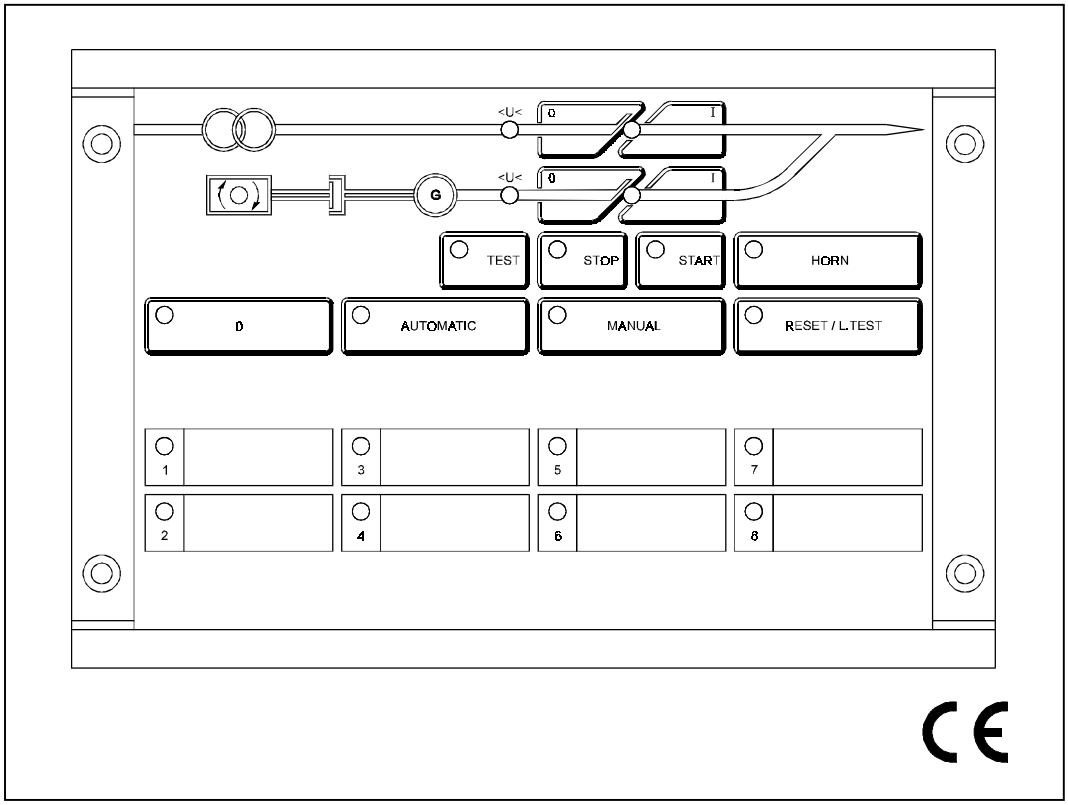
WOODWARD

NB2 - Automatic Controller for Emergency and Standby Power Systems



Contents

Controller *NB2* comprises electrostatic sensitive components. When removing the cover at the rear precautions against electrostatic discharges have to be taken and regulations of EN 100 015, part 1, to be observed.

This manual is valid for controller software version from P1.08 onwards (see type plate of controller).

1 General

The *NB2* is an efficient automatic controller for the use in emergency and standby power systems. Combustion engines can automatically be started, stopped and supervised. There is no programming involved for adaption to the different gensets, which is an advantage when compared to SPS controls.

Protection of the generator can also be realized by the integrated analogue value processing facility. Here this function provides supervision of mains and generator voltage and frequency as well as supervision of mains unbalance, ignition speed and overspeed, dynamo, speed sensor and battery voltage.

Dependent on the operational mode selected, the mains and generator CBs are controlled either manually or automatically.

For the diesel and gas engine start program a variety of adjustable time circuits is available. The basic parameter setting is in accordance with DIN 6280 or VDE 0108. By the EEPROM memory it is ensured that all set parameters are safeguarded.

Comprehensive supervision of mechanical and electrical components of the prime mover, the generators and the switchgear is guaranteed by the galvanically isolated binary alarm inputs of the controller.

The *NB2* is mainly designed for gensets in single operation, but a short-term parallel operation with load take over is also possible.
For long-term parallel operation our automatic controllers NP and NC can be recommended.
With only little alterations the *NB2* can be used as replacement for NB1 and NAE controllers, it is compatible with regard to installation and functions.

Features and Benefits:

- Housing designed for flush door mounting
- Vibration proof
- Oil and fuel proof
- Connection by plug-in and screw connectors
- Foil keyboard (in IP54)
- Symbolized diagram of the power part at the front (i.e. of Mains, Generator, CBs, Prime Mover, Consumers)
- Function and equipment according to DIN 6280-13 or VDE 0180
- Wide-range power supply (12V and 24V batteries)
- Of latest microprocessor technique
- SMD technique
- User-friendly adjustment by switches and coding plugs or parameter setting software
- Equipped with communication software „NB2-Soft" (RS232)
- Short-term memory of operational modes during aux. voltage failure
- Galvanical isolated input circuits
- 8 alarm indicators with first-up indication, 5 of which with freely useable inputs (function matrix) and 3 internal supervision circuits
- All control outputs are designed as high rated potential free contacts (16A or 2A)
- Extendable by speed module DB1 for speed detection via pick-up or dynamo
- Speed sensor failure and line fault are indicated by alarm

2 Operation of the *NB2*

All elements and indicators needed for operation of the *NB2* can be found on the foil keyboard at the front of the unit.

In the following chapter the operational elements are briefly explained.

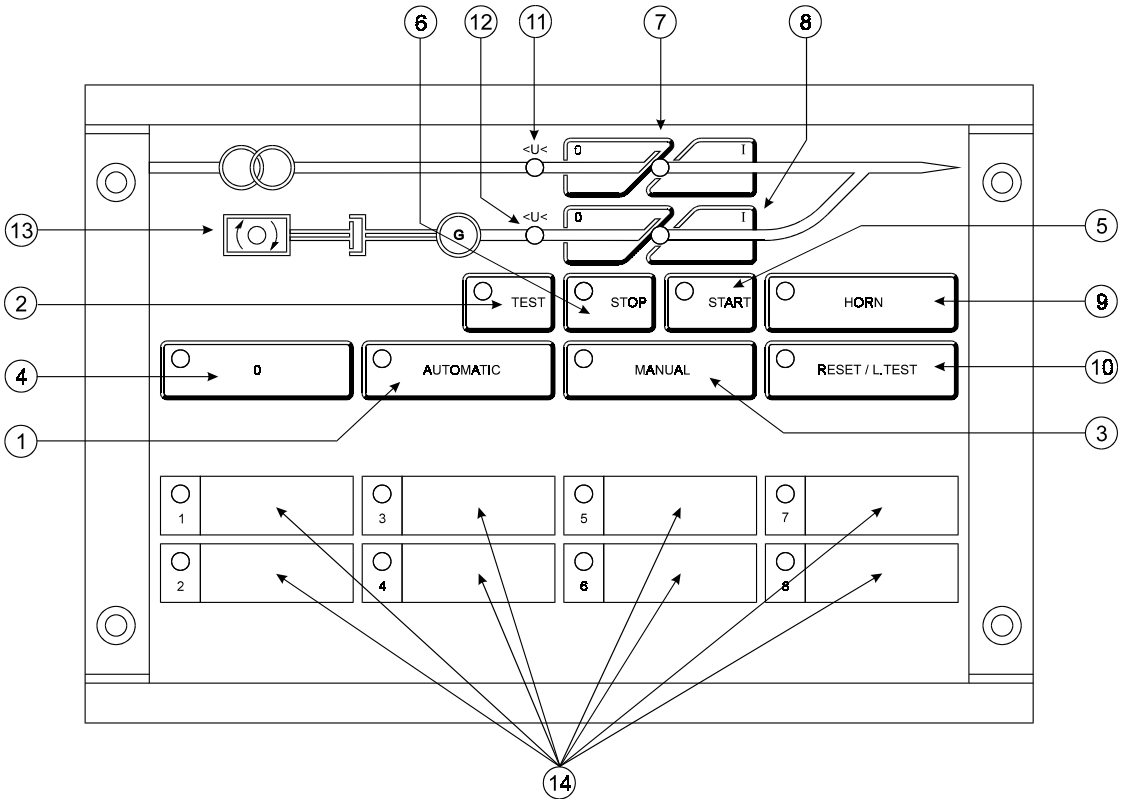


Figure 2.1: Front view

2.1 Key functions and operational modes

(1) AUTOMATIC

When mode AUTOMATIC is selected, the automatic emergency operation of the genset is activated. In case of mains failure the genset is started automatically, the mains CB is opened and the generator CB closed. The consumers are then supplied by the generator.
When the mains is restored, the consumers are changed over to the mains automatically, the mains CB is closed and the generator CB opened. Thereafter the consumers are supplied by the mains again. After a certain recooling time the genset is stopped.
Selection of a different operational mode can be blocked (see chapter 5.7.2).

(2) TEST

In this mode no-load and load test run of the genset is possible. In mode TEST, the engine is automatically started and supervised and it is checked whether the generator has reached its rated voltage. At first the generator runs without load, push-button I/O of the mains and generator CBs are avtive. The mains CB can manually be switched off and the generator CB switched on. The consumers are then supplied by the generator (load test). By pressing "Generator CB On " a load test can automatically be initiated and so there is no release of the mains CB; release of the generator CB is activated after the changeover period (0.5s). Whereas in load test operation release of the generator CB can be deactivated by pressing the "Mains CB On" push-button.

As soon as there is no "Generator CB On" check-back signal, the power supply of the consumers is interrupted for the changeover period and then release of the mains CB activated.
Should a mains failure occur during this time, the mains emergency operation is initiated automatically. After mains restoration, changeover to mains operation can either be made manually or by change to operational mode AUTOMATIC.

(3) MANUAL

By pressing push-button MANUAL, the manual operation is selected. In this operational mode the *NB2* does not react to mains failure or mains restoration. The genset can be started manually by push-button START and stopped by push-button STOP. Changeover from mains to generator power supply (switching off the mains CB and switching on the generator CB) can only be done manually.

(5) START

By pressing push-button START, the genset is started. This push-button is only activated in operational mode MANUAL" and has to be pressed until the start-up speed is reached. After reaching the dynamo threshold voltage or the ignition speed, or the generator undervoltage switching point, the starter relay de-energizes and the genset is started.

(6) STOP

By pressing push-button STOP, the generator CB opens and the genset is stopped immediately. The STOP push-button has precidence over the START push-button and is only activated in operational mode MANUAL. The STOP command remains active throughout the stopping time.

(7) Mains CB I/0

This push-button combination is active in operational modes MANUAL, TEST and OFF; push-buttons I and 0 are also active when mains voltage is not available. Interlocking of mains CB and generator CB is realized by software. From external the circuit breakers have additionally be interlocked by their check-back contacts.
The internal software interlocking function can be neutralized by applying L- to input B24.

(8) Generator CB I/0

This push-button combination is only active in operational modes MANUAL or TEST when generator voltage is available. Interlocking of generator CB and mains CB is realized by software. From external the circuit breakers have additionally be interlocked by their check-back contacts.
For short-term parallel operation, the internal software interlocking function can be neutralized by applying L- to input B24.

(4) 0 (Off Push-Button)

This push-button has precidence over all other push-buttons. If the consumers are supplied by the generator, they are switched over to mains supply upon pressing push-button 0. The mains CB is switched on automatically and can manually be switched on/off via push-buttons MAINS CB I/0. A STOP command is given to the genset. Push-button 0 is also used to cancel the acoustical signal and reset LED "HORN" after fault occurrences. Together with all shut-down and warning signals, the "RESET/L.TEST" LED is suppressed. Indicating signals remain active as long as the fault has not been cleared.

(9) HORN

By pressing this push-button, the horn is switched off. All warning and shut-down alarms as well as fault indications with warning or shut-down function are indicated by this acoustical signal. With the exception of the first-up indication, all existing alarms are indicated by continuous light after push-button HORN has been pressed. After 5 minutes the acoustical signal is switched off automatically.

(10) RESET/L.TEST

By this push-button all alarms as well as faults which have caused failure indication are reset. Shut-down and warning alarms which are still active cannot be reset. Reset of the first-up indication is only possible after all shut-down alarms have been reset. The HORN can also be switched off by this push-button. If this push-button is pressed for about 1s, test of all LEDs is initiated.

2.1.1 Table of operating signals

LED	LED off	LED flashes	LED on
0 (4)	Mode "0" not selected	Flashes slowly during Emergency Stop	Mode "0" selected
AUTOMATIC (1)	Mode "Automatic" not selected or Emergency Stop	Not applicable	Mode "Automatic" selected
TEST (2)	"Test" mode not selected or Emergency Stop	Not applicable	Mode "Test" selected
MANUAL (3)	Mode "Manual" not selected or Emergency Stop	Not applicable	Mode "Manual" selected
Mains <U< (11)	No mains voltage available	Flashing slowly: At mains failure until start delay has expired and at mains restoration until the mains restauration time has elapsed. Flashing quickly: At under/overfrequency and at under/overvoltage. At failure during switching back to the mains quickly alternately flashing in turn with mains CB LED (7). No mains restoration signal.	Mains voltage available, no mains failure.
Mains CB I/0 (7)	Mains CB switched off and check-back signal is received	Flashing slowly: Neither switched-on nor switched-off signal applied. At failure during switching back to the mains quickly alternately flashing in turn with LED (11). There is no mains CB check-back signal.	Mains CB switched on and check-back signal is received.
Engine running (13)	Engine is not running	Flashes slowly: for the time between reaching the ignition speed and elapse of the delayed supervision time. After stop command until falling below the ignition speed and elapse of the engine running reset delay.	Engine is running and time of the supervision delay has elapsed.
Gen. <U< (12)	No generator voltage present	Flashing slowly: After exceeding the under-voltage switching point at rising generator voltage until elapse of the generator CB release time. At stop command until falling below the undervoltage switching point. At generator voltage fault while the generator CB is still activated until switching off of the generator CB. Flashing quickly: At under/over- frequency and under/overvoltage in case of generator voltage fault.	Generator voltage available and generator CB release time has elapsed.

LED	LED off	LED flashes	LED on
Gen. CB I/0 (8)	The generator CB is switched off and the check-back OFF signal is received.	Flashing slowly: There is no switching on/off check-back signal.	The generator CB is switched on and the check-back ON signal is received.
START (5)	When start procedure is completed or the genset switched off.	Flashing slowly : During start intervals.	As long as the starter is activated.
STOP (6)	The genset is not in operation or the stopping time has elapsed.	Flashing slowly : During recooling time.	During genset stopping procedure
HORN (9)	There is no fault signalled or push-button HORN has alredy been pressed after a fault was signalled.	Does not flash.	In case of warning or shut-down signal, EMERGENCY STOP, or mains supervision fault, either until push-button HORN or RESET/L.TEST is pressed; otherwise for 5 minutes.
RESET/L.TEST (10)	There is no fault signalled or push-button RESET/L.TEST has already been pressed after fault clearance.	Does not flash.	Before RESET/L.TEST push button was pressed, a warning or shut-down alarm was signalled, or EMERGENCY STOP or failure during switching back to the mains.

Table 2.1: Overview of the operating signals

2.2 Connections

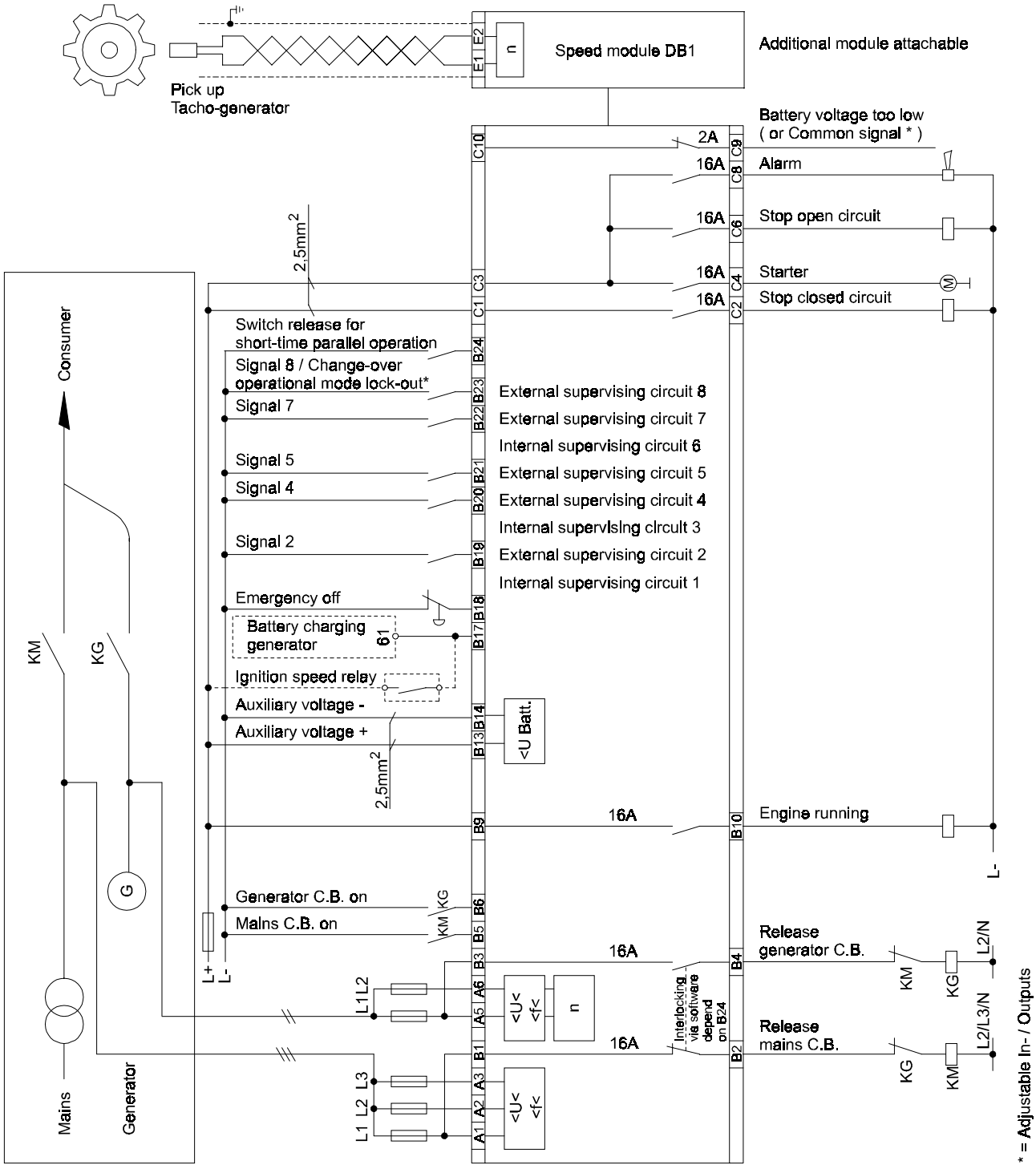


Figure 2.2: Connection diagram

2.3 Description of inputs and outputs

In the following table inputs and outputs are briefly described with explanation of special functions.

Terminal	Description	Remarks
A1 - A3 or A1 and A2	Input mains voltage L1, L2, L3 for 3-phase measuring of under/overvoltage, under/ overfrequency, detection of mains unbalance and phase loss. Three adjustable voltage ranges. Input A1 and A2 mains voltage L1, L2 2-phase measuring of under/overvoltage, under/ overfrequency and phase loss. One adjustable voltage range (230 V).	max. 500 V/AC 50/60 Hz
A4	Not used	
A5, A6	Generator voltage L1,L2 for single-phase measuring of under/overvoltage, under/overfrequency as well as ignition speed and overspeed. Voltage range in compliance with adjusted mains voltage.	max. 500 V/AC 50/60 Hz
B1, B2	Output for mains CB control. Internally used as potential-free NC contact, i.e. at aux.voltage failure the mains CB is closed. Control of mains reconnection failure in conjunction with input B5.	max. 16 A
B3, B4	Output for generator CB control. Internally used as potential-free NO contact.	max. 16 A
B5	Input for checking the mains CB status. Evaluation of failures during switching back to the mains.	L- (battery)
B6	Input for checking the generator CB status.	L- (battery)
B9, B10	Output for the potential-free NO contact for signal "Engine Running". Evaluation of the dynamo starting threshold value, or signal of an external speed relay, ignition speed threshold value and generator undervoltage switching point.	max. 16 A
B13, B14	Aux.voltage L+ (battery) at B13, L- (battery) at B14. Measuring input for the 3-stage battery undervoltage supervision.	L+/L- (battery)
B17	Input for speed detection via dynamo threshold voltage or for external signal of a speed relay. At the same time output for dynamo additional excitation. Failure detection of speed impulse transmitter.	0 - 40 V/DC L+ (battery)
B18	Input for EMERGENCY STOP command (closed-circuit principle). See chapter 5.6 EMERGENCY STOP	L- (battery)
B19 B20 B21 B22 B23	Fault signal 2 (shut-down, delayed supervision, adjustable) Fault signal 3 (intern.signal processing, shut-down, adjustable) Fault signal 4 (shut-down, adjustable) Fault signal 5 (shut-down with recooling, adjustable) Fault signal 6 (intern.signal processing, warning, adjustable) Fault signal 7 (warning, codable by DIP switch) Fault signal 8 (indicating, codable by DIP switch/change of operational mode is blocked) **Note:** When coding to open circuit principle, L- (battery) has to be applied at inputs in order to enable signalling.	L- (battery)
B24	Input for internally neutralizing CB inter-locking and activating auto CB control for short-term parallel operation.	L- (battery)
C1, C2	Output for ignition ON or speed regulator ON or connection of the operating magnet. Potential-free NO contact closes at start demand.	max. 16 A
C3, C4	L+ (battery) at C3, internal NO contact provides start signal to output C4 during the start procedure. To be connected to starter terminal 50. **Note:** For control of the starter an external aux.relay is recommended.	max. 16 A

Terminal	Description	Remarks
C3, C6	C3 at L+ (battery). Output for stop command in open circuit connection (latching 10 s). NO contact switches L+ to output C6. Note: This contact must not be used in safety critical circuits where fail-safe contacts must be used only.	max. 16 A
C3, C8	L+ (battery) at C3, output C8 to be connected to horn or to be used as common alarm. After 5 minutes the output is de-activated automatically (adjustable).	max. 16 A
C9, C10	Potential-free NC contact for signal "Battery voltage too low" or for common alarm (adjustable). Can also be used for self-test and signal "Aux. voltage failure".	max. 2 A
E1, E2	Measuring inputs for speed impulse transmitter signal from pickup or dynamo	max. 90 V/AC

Table 2.2: Inputs and outputs

2.4 Configuration of connection terminals and coding switches

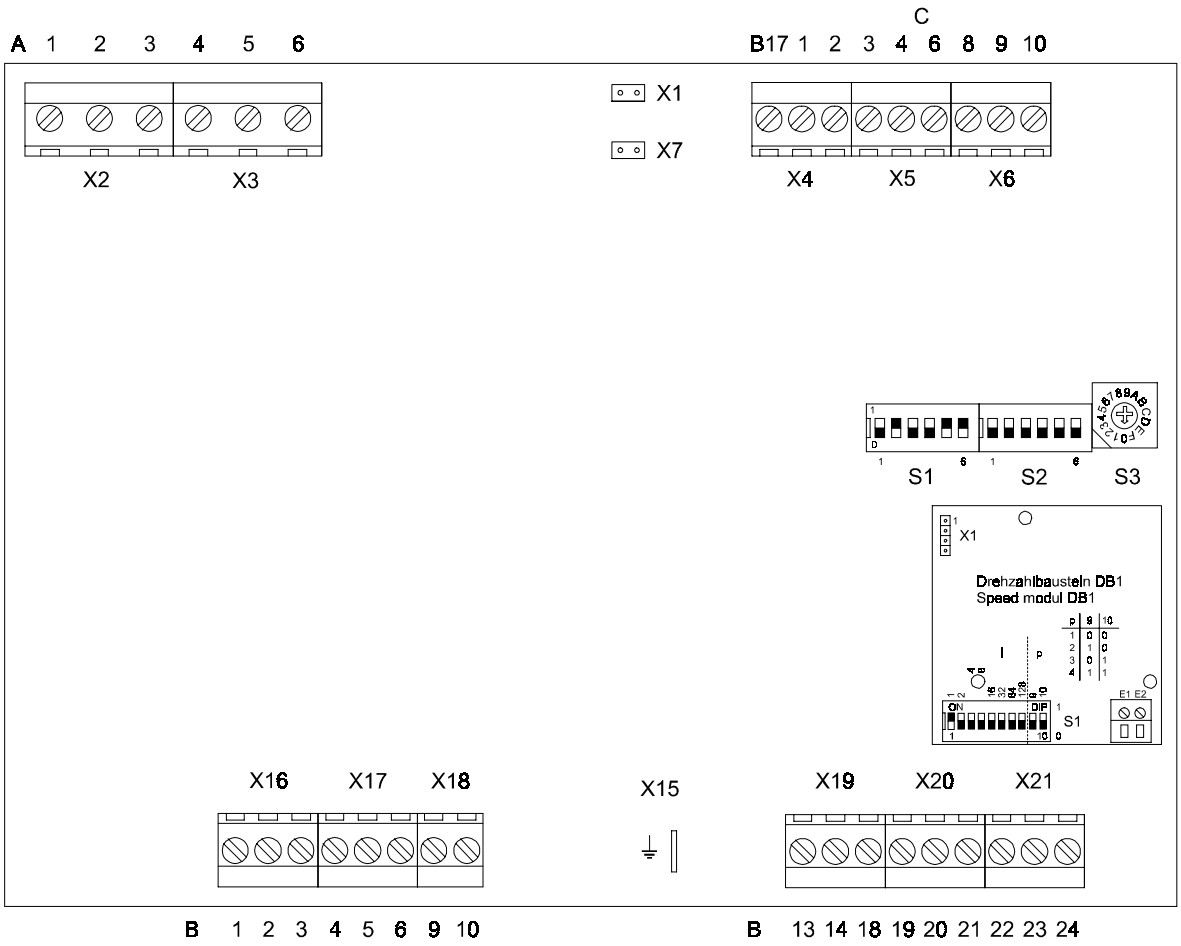


Figure 2.3: Rear view of NB2

S3 Selector switch for times and parameters
S1 1 - 3 coding for fault signal 7/Default setting: open circuit system,warning
4 - 6 coding for fault signal 8/Default setting: open circuit system,indicating (see Table 5.5)
S2 siehe Table 3.1, Table 3.2 und Table 5.1
X15 Earthing connection
X1/X7 Additional dynamo excitation

3 Mains supervision

The automatic control *NB2* supervises mains voltage and frequency of single-phase LV systems (input A1/A2) and additionally detects voltage unbalance of three-phase systems.
The mains voltage supervision controls circuit breakers of mains and generator as well as the program flow for starting and stopping the genset. By switching off the mains CB, the consumers are protected against mains failures.

3.1 Selection of the rated mains voltage

Switch S2 for selecting the rated mains voltage is at the rear of the *NB2*. Four rated voltages with fixed undervoltage and overvoltage switching points can be selected here. Default setting of the mains voltage is 400 V.

Switch S2		Rated voltage	Mains voltage tolerances
5	6		
0	0	400 V/3 phase	±10%
1	0	380 V/3 phase	±10%
0	1	415 V/3 phase	±10%
1	1	230 V/1 phase	±10%

Table 3.1: Rated voltages possible to be selected by DIP switch S2

Default setting

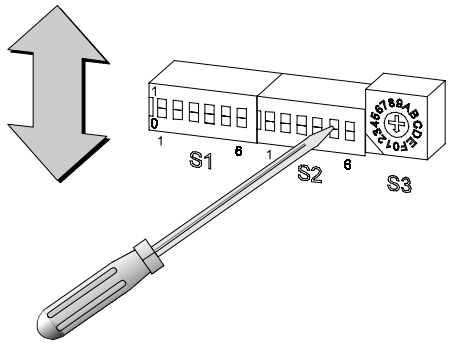


Figure 3.1: Setting of mains rated voltage

3.2 Overvoltage and undervoltage switching points of the mains voltage supervision

Tolerance of the mains undervoltage switching point is -10% and of the mains overvoltage switching point +10% from the rated value of the mains voltage (see Table 3.1). Mains overvoltage and undervoltage are regarded as mains failure, i.e. an emergency power operation is initiated in operational mode AUTOMATIC.

3.3 Function of the mains voltage supervision

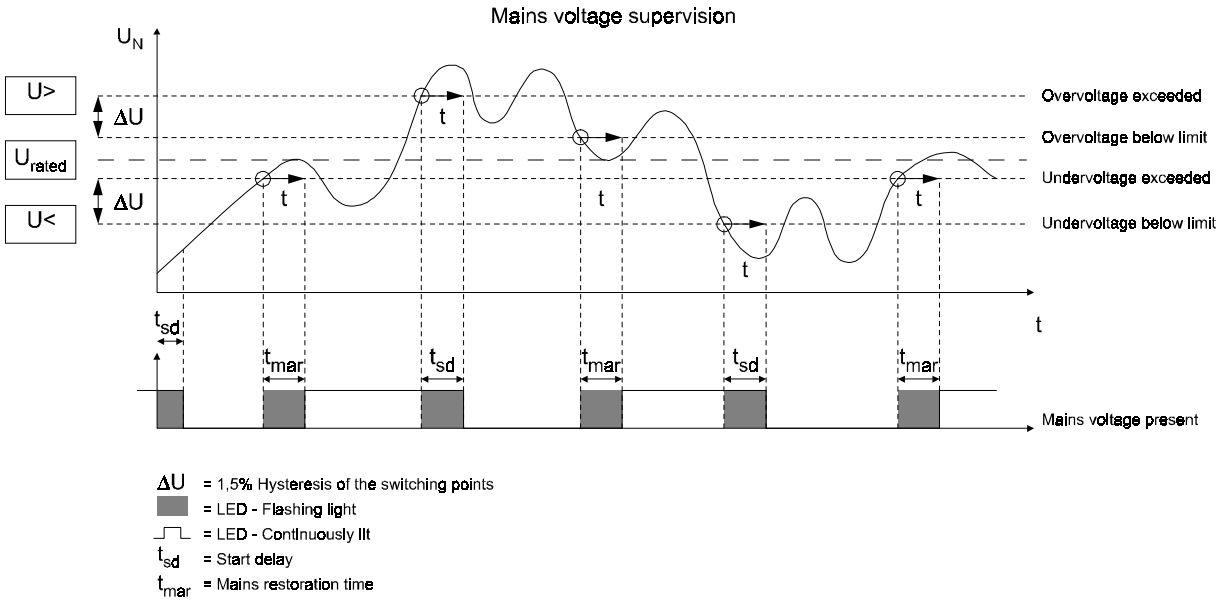


Figure 3.2: Function of the mains/generator voltage supervision

3.4 Mains frequency supervision

For controlling the mains frequency, the *NB2* is provided with a frequency supervision which can be deactivated by coding switch S2 in position 4. In this case any incorrect frequency is indicated by LED only. The rated frequency is set by coding switch S2, position 3.

Switch S2	Position		Function
Position	0	1	
3	50 Hz	60 Hz	Rated frequency
4	EIN	AUS	Frequency supervision

Table 3.2: Frequency settings

The minimal input voltage for evaluating the frequency is adjustable by parameter software (default setting = 40 V), but the frequency supervision is not operable if the input voltage is below 6 V.

When the frequency supervision is activated, incorrect frequency of the mains voltage is regarded as mains failure, i.e. an emergency power operation is initiated in operational mode AUTOMATIC.

The mains frequency supervision has to stages, each for under- and overfrequency. On frequency deviations between ±5% and ±10% (static frequency deviation $f_{nstat<}$ and $f_{nstat>}$) the operating time t_{na} is 5 s.

Frequency deviations of more than ±10% (dynamic frequency deviation $f_{ndyn<}$ and $f_{ndyn>}$) lead to a reaction of the frequency element immediately.

The frequency is regarded to be in the permissible range again if it does not deviate more than ±5% from the rated frequency for the duration of the release time (1 s).

Incorrect frequency is indicated by fast flashing "Generator Voltage" LED or "Mains Voltage" LED. In case of underfrequency, the generator CB will be opened after the shut-down delay has elapsed.

3.5 Function of the mains/generator frequency supervision

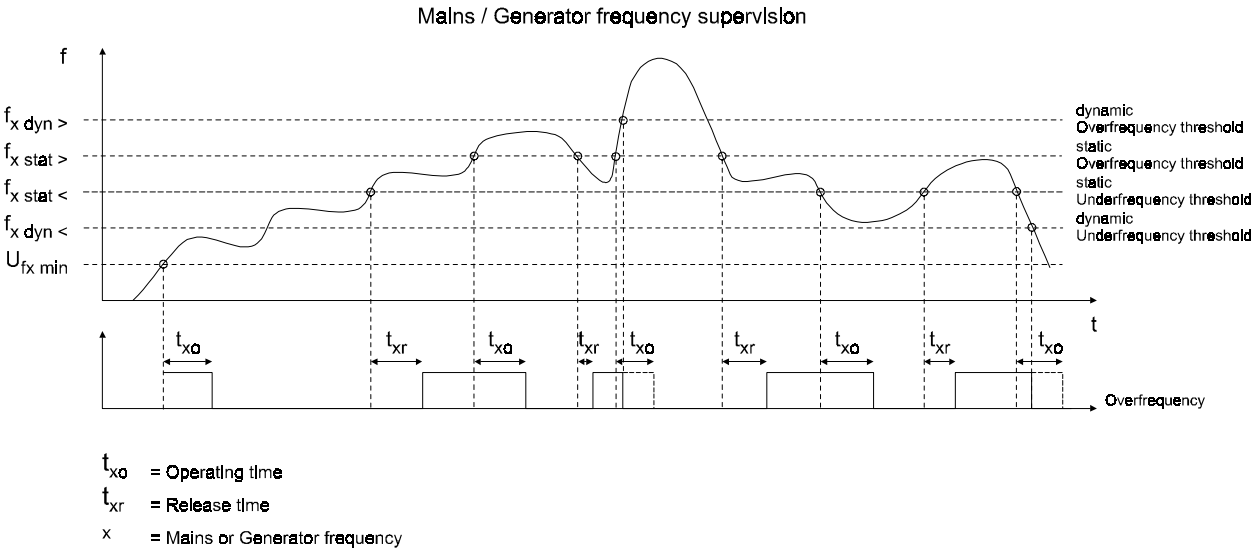


Figure 3.3: Function of the mains/generator frequency supervision

3.6 Supervision of mains voltage unbalance

This supervision element compares the three phase conductor voltages of the mains and is activated if the lowest phase conductor voltage differs more than 25% from the highest value (pickup value). The mains unbalance is in a tolerable range if the difference is not more than 12% (disengaging value). Any mains unbalance not within the permissible range is regarded as mains failure.

3.7 Circuit breaker supervision during mains recovering time

When the mains is revocering in emergency power operation, the consumers are automatically reconnected to the mains in operational mode AUTOMATIC. In order to ensure that the mains is stable at the time of changing over, the *Mains Recovering Time* has to elapse first before consumers are reconnected.
If there is anything wrong with the automatic changeover procedure, meaning the *NB2* has no duly checkback signal of the mains CB after 10 s (after elapse of the mains reconnection time), alarm "Mains Reconnection Failure" is given. This failure is indicated by alternately quick flashing LED (7) (Mains CB) and LED (11) (Mains Voltage Available) and additionally signalled to output C8 and the RESET/L.TEST LED (10) by LED HORN (9).

As soon a failure in mains reconnection becomes apparent, consumers are switched back to the running genset because power supply of consumers has first priority (e.g. hospitals).

Supervision of mains reconnection can be deactivated by the parameter setting software.

By pressing push-button RESET/L.TEST alarms can be cancelled and a new mains reconnection attempt be started.

3.8 Release of circuit breakers for short-term parallel operation (B24)

After mains recovery in emergency power operation, an uninterrupted changeover to mains supply can be achieved by short-term parallel operation. By applying L- (battery) to terminal B24, internal interlocking of mains CB and generator CB release is neutralized.

After elapse of the mains recovering time, the mains CB is released in operational mode AUTOMATIC. The generator CB remains switched on until closing of the mains CB is signalled by the aux. contact of the mains CB (terminal B5). Only then and after an overlapping time of about 0.08 s, the generator CB is opened and recooling period of the engine starts. If there is no check-back signal of the mains CB after synchronization, this is not detected by the *NB2*, i.e. a mains reconnection failure is not recognized.

Short-term parallel operation for load test purposes, i.e. starting and switching over to generator operation, is not possible in operational mode AUTOMATIC.

In operational modes, TEST and MANUAL only a changeover from mains to generator supply or vice versa can be realized without interruption during short-term parallel operation.

An uninterrupted changeover between mains and generator supply can be initiated by pressing push-button "Generator CB ON" or "Mains CB ON" whilst the genset is running and generator voltage available.

After mains recovery and elapse of the mains recovery time, an uninterrupted mains supply in emergency power operation can be initiated by pressing push-button "Mains CB ON". Here too the circuit breakers are automatically controlled.

IMPORTANT!
Synchronism of the generator voltages is not supervised by the *NB2*. A short-term parallel operation is always conditional on a suitable external synchronizing device. Asynchronous switching in parallel can result in severe damage of electrical and mechanical parts of the system. Synchronizing devices matching the different applications are available from our electronic device program.

The following circuit arrangement is recommended for an automatic short-term parallel operation. Outputs B2 and B4 have no direct effect on mains or generator CBs, only release of the circuit breakers is given from there. Asynchronous connection is prevented by external interlocking of the CBs. Synchronism of the voltage systems is checked by the synchronizing facility and by means of the synchronizing contact the external CB interlocking is bridged. Additionally a seal in circuit for the CBs is required.

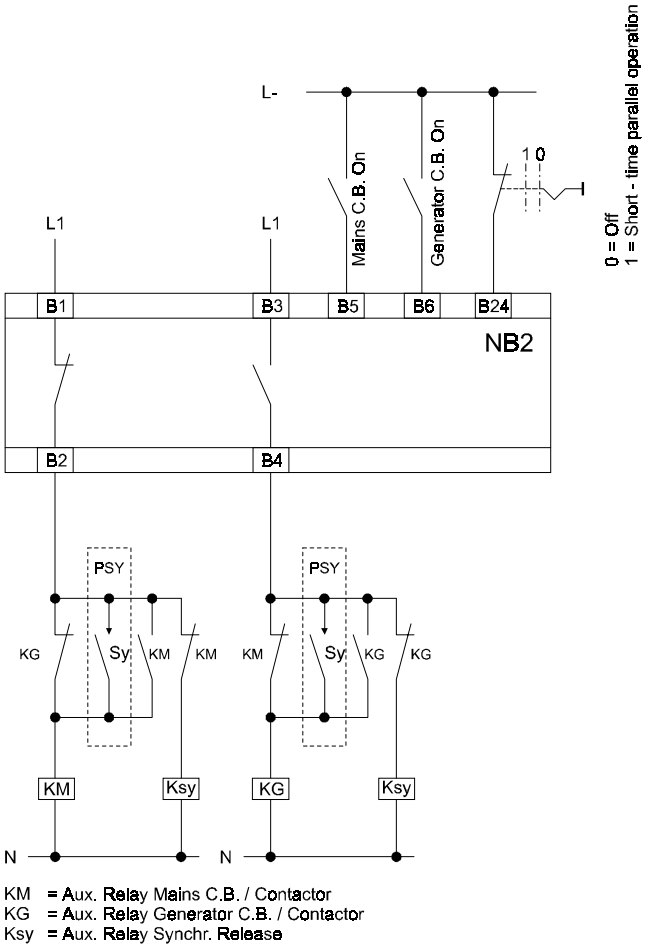


Figure 3.4: Recommended circuit arrangement for short-term parallel operation

4 Generator protection

The generator voltage supervision element protects the connected consumers against inadmissible generator voltage values or frequency values as well as supervises the speed of the genset. In emergency power operation this element controls closing of the generator CB. For measuring purposes two phases are used (L1, L2).

4.1 Rated generator voltage

The rated generator voltage cannot be selected separately, because it depends on the rated value of the mains voltage according to chapter 3.1. Default setting of the rated voltage is 400 V.

Switch S2		Rated voltage	Generator voltage tolerance
5	6		
0	0	400 V/3 phase	+10%/-15%
1	0	380 V/3 phase	+10%/-15%
0	1	415 V/3 phase	+10%/-15%
1	1	230 V/1 phase	+10%/-15%

Table 4.1: Rated values and tolerances of the generator voltage

Default setting

Overvoltage and undervoltage switching points of the generator voltage supervision element are fixed. The undervoltage switching point is -15% of the rated mains voltage value and the overvoltage switching point is +10%.
During generator overvoltage or undervoltage conditions the generator CB release is disabled, but the genset keeps on running (see also chapter 4.4). During undervoltage conditions disabling of the generator CB release is delayed (see chapter 5.5.1, para. "Generator Voltage Tripping Delay"). Overvoltage and undervoltage conditions are indicated by fast flashing mains voltage or generator voltage LEDs <U< (11) and (12).

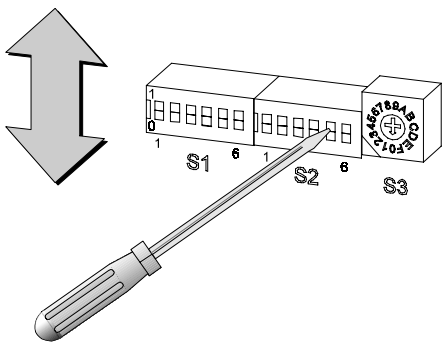


Figure 4.1: Setting of generator rated voltage

4.2 Function of the generator voltage supervision

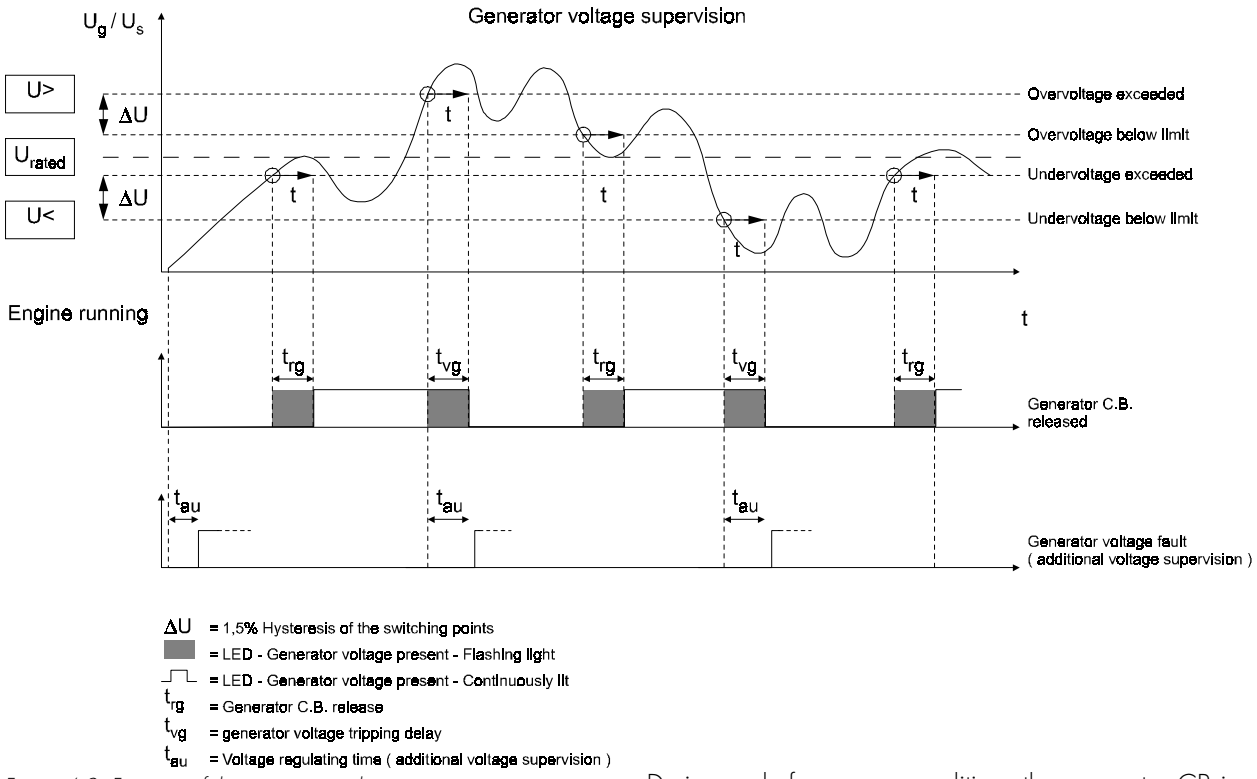


Figure 4.2: Function of the generator voltage supervision

4.3 Generator frequency supervision

Setting values of the rated generator frequency and for de-activating the frequency supervision element depend on the set values of the mains frequency supervision element, i.e. they cannot be set differently.

All other settings, such as min. voltage for evaluation of frequency, static and dynamic frequency deviations as well as activation and de-activation time which are in compliance with those of the mains frequency supervision element, can be adjusted by means of the parameter setting software.

The generator frequency supervision element either detects the frequency from the generator voltage or via the connected speed module DB1. Where voltages with high harmonic content are concerned, frequency measuring by the DB1 has proved to be far more exact, because it is not the generator voltage which is evaluated, but the signal from an external speed sensor. The optionally speed module DB1 has to be adjusted by the parameter setting software. Normally the frequency evaluation is based on the generator voltage.

Incorrect frequency is indicated by fast flashing "Generator Voltage" LED <U< (12)

During underfrequency conditions the generator CB is not released after the tripping delay has elapsed; the genset will not be stopped.
Generator overfrequency conditions are indicated only.

4.4 Additional generator voltage supervision

The *NB2* is provided with an additional generator voltage supervision element. In emergency power operation this element protects synchronous generators with auto excitation against inadmissible voltages values which, for instance, may be caused by interruption of the measuring line in the control circuit of the voltage regulator. Contrary to undervoltage and overvoltage functions, where in failure cases only release of the generator CB is prevented, this additional generator voltage supervision element stops the genset 30 s (= t_{au}, see Figure 4.2) after a generator voltage fault has occured, unless the generator voltage has regained values within permissible ranges. The incorrect generator voltage is indicated by the fast flashing "Generator Voltage" LED <U< (12) and can be reset by push-button RESET/L.TEST after the genset has stopped. The generator voltage supervision element becomes only effective after the supervision delay time has elapsed. Switching points for overvoltage and undervoltage are identical to those of normal voltage supervision element, i.e. +10% and -15%.

5 Genset control

In this chapter all parameters for adjusting the *NB2* to the wide range of diesel and gas gensets are explained.
The setting possibilities at the *NB2* are very wide ranging and so there is no extensive programming involved as this is the case e.g. with LPS controls.

5.1 Aux. Voltage supply

Due to the wide operational range of the *NB2* (from 8 - 35 V/DC), this unit can be fed directly from the starter battery (12 V or 24 V). This not only applies to conditions like start of the genset when the stress on the battery is considerable, but also at incresased output voltage of the battery charger, e.g. when boost charging is activated or the battery is disconnected.
When battery voltage is applied (terminals B13/B14), this initialization process is indicated by successive short flashing of all LEDs. After the initialization process is completed, the *NB2* changes to operational mode "0" and thereafter the desired mode can be selected.

5.1.1 Aux. Voltage failure

After failure of the aux. voltage, all cleared alarms are reset. When the aux. voltage is restored, all existing alarms of immediate shut-down function appear as first-up indication (fast flashing).
Basically it has to be distinguished between the following two possibilities:

Short-term failures of the auxiliary voltage (up to about 2s)
Operational mode AUTOMATIC as well as the actual status of CBs remain stored in AUTOMATIC mode. From operational modes TEST and MANUAL it is then changed to mode "0". After the aux. voltage is restored again, the mains CB is closed and the generator CB opened, provided the mains CB or generator CB was in operation before the failure. The mains CB, however, only closes if the generator CB has opened at the instant of aux. voltage recovery and that CB status has been duly confirmed.

Long-term failures of the aux. voltage (>2s)
After the aux. voltage was not available for a longer period, the *NB2* always changes to operational mode "0", irrespective of the mode selected before the interruption of aux. voltage.
When the aux. voltage is restored again, the mains CB is closed and the generator CB opened.

The EEPROM memory ensures that an aux. voltage failure does not effect the set parameters, they will not be changed.

5.1.2 Setting of the rated battery voltage and switching points

The rated battery voltage and respective switching points are adjusted at DIP switch S2, position 1 and 2.
The "High" setting applies to Pb batteries which cell voltage is rated in such a way that the values of the undervoltage and overvoltage switching points comply with DIN 6380-13. For batterie types with a lower cell voltage, position "Low" should be selected. If definite values are not shown in the relevant technical documentation of the battery, it is advisable to contact the battery manufacturer.

Switch S2	Position		Function
Position	0	1	
1	24V	12V	Battery voltage
2	High	Low	Battery voltage points

Table 5.1: Battery voltage and battery voltage switching points

☐ Default setting

5.1.3 Internal supervision of the battery voltage (B13/B14)

The *NB2* is provided with an internal three-stage battery voltage supervision element, assigned to supervision circuit no. 6. The input for the battery voltage supervision is rated for 8 - 35 V/DC, i.e. supervision and indication are not possible below 8 V. Output C9/C10 and indication of this supervision circuit with warning function are time delayed; dependent on the measuring value, its operating time is reduced in steps by factor 2. The first stage lies at 90% from the setting value and the second one at 80% from the setting value. For presettings according to DIN 6280-13 (stage 1) alarm "Battery Voltage Too Low" is activated after 15 minutes. Stage 2 becomes active after 7.5 minutes and stage 3 after 1 minute.

	12 V battery				24 V battery				Trip Delay
	High		Low		High		Low		
	AUS	EIN	AUS	EIN	AUS	EIN	AUS	EIN	
Stage 1	12.6 V	13.2 V	11.0 V	11.6 V	25.2 V	26.5 V	22.0 V	23.1 V	15 min
Stage 2	11.3 V	13.2 V	9.9 V	11.6 V	22.7 V	26.5 V	19.8 V	23.1 V	7.5 min
Stage 3	10.08 V	13.2 V	8.8 V	11.6 V	20.2 V	26.5 V	17.6 V	23.1 V	1 min

Table 5.2: Switching points of the battery voltage supervision element

☐ Default setting; switching points of stage 1 comply with DIN 6280-13

5.2 Dynamo XE and "Genset Running" signal (B17)

Start-up of the genset is signalled to the *NB2* via the dynamo voltage. If the dynamo voltage has reached 75% of the battery voltage within 10 s (starting time), the start-up is regarded as successful. The start relay (output C3/C4) de-energizes as soon as the closing threshold has been reached. If this threshold is not reached by the end of the starting time and the generator voltage is not available, a new start attempt follows.
Should the dynamo voltage drop below 50 % of the battery voltage (opening threshold) with the generator voltage intact, this is regarded as failure of the speed sensor, i.e. defect of the dynamo or V-belt. This is a warning fault and has a start blocking effect at the same time, i.e. running gensets will not be stopped. Only after reset of the alarm another genset start is possible.

5.2.1 Adjustment of the additional excitation

During the starting process of a genset, AC dynamos need an additional excitation and this excitation is provided by the *NB2*. Together with the start command, the battery voltage (L+) is connected to terminal B17 via resistor. Intensity of the additional excitation can be adapted to the different dynamo types at the rear of the *NB2* by means of coding plugs.

Coding-plug	Without coding plug	1 Coding plug	2 Coding plugs
X1 and X7	No add. excitation	low add. excitation 120 Ω	high add. excitation 60 Ω

Table 5.3: Additional dynamo excitation X1 and X7

IMPORTANT
If the additional excitation is set too high, e.g. when the internal resistance of the dynamo windings is considerably strong, it is possible that the voltage value at the windings exceeds the closing threshold (75%). This would result in an undesired interruption of the start procedure. In such a case a smaller additional excitation should be chosen. Should even then the add. excitation be too intense, it is possible to raise the closing threshold (recommendation is 90%) per software.
If the genset has no dynamo or in case the speed is detected by an external ignition speed relay, no coding plug must be applied to X1 or X7.
Incorrect coding results in indication "Genset Running" as soon as the start command is given. The start is then stopped and followed by a new start attempt (short energizing of the start relay).

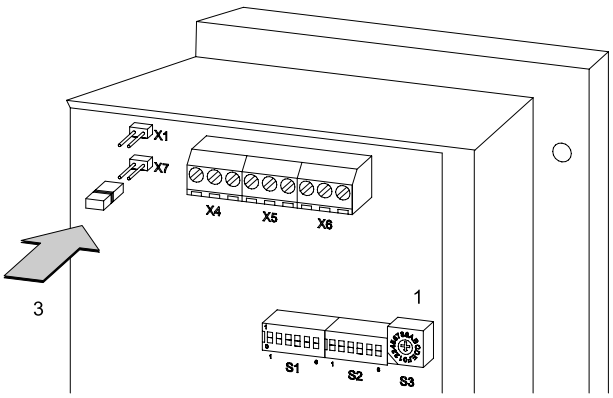


Figure 5.1: Codierung der Lichtmaschinenstützerregung

5.3 Speed supervision

The speed controller detects both ignition speed and overspeed.
Normally the speed is detected by measuring the generator frequency. Detection, however, via tacho generator or pick-up is far more reliable, because there is no measuring signal available when the generator is de-energized, e.g. due to excitation failure. For detection of the speed by an external speed sensor, installation of speed module DB1 is required (additional PCB).
Speed sensors with the following operation range are suitable: 1 - 1024 pulses, approx. 4 - 90 V. Calibration is possible by the parameter setting software.

5.3.1 Signal “Ignition Speed”/”Engine Running”

The speed is detected either by evaluating the generator frequency or optionally via pick-up or tacho generator by using speed module DB1. Normal setting of the ignitions speed switching point is 25% of the genset rated speed. When the ignition speed is reached, "Engine Running" is indicated by LED (13).
Another way of detecting start-up of the engine is evaluation of the dynamo voltage or generator voltage. "Engine Running" is also signalled if the dynamo threshold voltage or the undervoltage switching point of the generator is reached.

Together with the "Engine Running" indication, time circuit "Delayed Supervision" (10 s) is started.

If there is no speed information (dynamo voltage, or pick-up, or tacho generator) after this time, although the generator voltage is available, a speed sensor defect is signalled by slow flashing LED of the first supervision circuit.
The genset keeps on running. The speed in this case is detected over the generator frequency. This is a warning fault and has a start blocking effect at the same time, i.e. running gensets will not be stopped. Only after reset of the alarm another genset start is possible.

5.3.2 Overspeed protection

As a result of overspeed the genset is stopped at 110% of the rated speed. Alarm 3, Overspeed", has a direct stopping function.
Where module DB1 is used, the kind of speed detection (over generator frequency and DB1 or only over the DB1) has to be entered by the parameter setting software. Adjustment of the speed module DB1 for connection of the speed sensor is also realized by the software.

5.3.3 Total speed sensor defect

If there is no speed information neither from the dynamo nor the generator frequency, nor from the speed sensor, the genset is instantly stopped and the fault indicated by fast flashing LED. A new start is only possible after the fault has been cleared and the alarm cancelled by pressing push-button RESET/L.TEST.

5.4 Start repetition/Start failure

After three unsuccessful start attempts (normal adjustment), "Start Failure" is signalled. This is indicated by fast flashing LED of the first supervision circuit; at the same time the horn gives an acoustical alarm.

5.5 Time circuits

At the rear of *NB2* switch S3 is provided. With this switch 16 different time circuit combinations can be set and additionally, in switch position F, the time circuits can individually be set by means of the parameter setting software. In all other switch positions time circuit combinations are fixed. The specific time circuit combination for each of the switch positions can be gathered from Table 5.4. The pre-set parameters are in compliance with DIN 6280-13 (switch position 0 applies

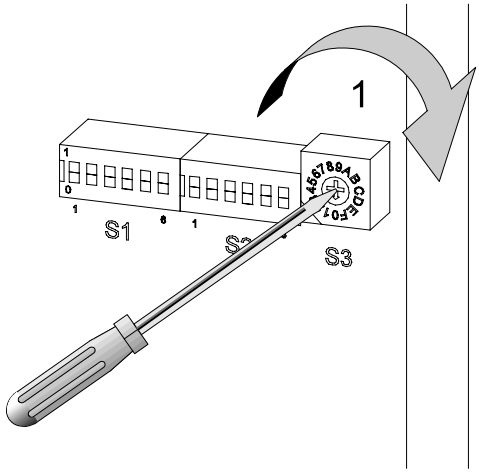


Figure 5.2: Selection of the time circuit combinations

Time	Switch positions S3															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Mains restoration time	30s	30s	30s	30s	30s	30s	60s*	60s*	60s*	60s*	60s*	60s*	180s*	180s*	180s*	180s*
Start delay	0,5s	0s*	0.5s	0s*	0.5s	0.5s	0.5s	0s*	0.5s	0s*	0.5s	0.5s	0.5s	0s*	0.5s	0s*
Starting time	10s															
Switching off delay	5s															
Delayed supervision	2s															
	10s															
Gen. CB Release	2s															
Recooling time	60s	60s	180s*	180s*	60s	300s*	60s	60s	180s*	180s*	60s	300s*	60s	60s	180s*	180s*
Stopping time	10 s															
Tripping delay	5s	5s	5s	5s	15s*	5s	5s	5s	5s	5s	15s*	5s	5s	5s	5s	5s

Table 5.4: Range of time parameters with switch S3

Default setting * Deviation of standard values

5.5.1 Explanation of the terms used

Mains restoration time
This is the time between mains recovery and changeover from generator to mains supply, i.e. release of the mains CB is present.

Start delay
Means the time between mains failure and initiation of the start procedure.

Starting time
In operational modes AUTOMATIC and TEST the max. on-period of the starter is limited by the starting time. If the genset reaches its ignition speed before the starting time has elapsed, the starter is switched off.

Start interval
This is the time between an unsuccessful start attempt and the next start possibility.

Engine running reset delay
If the ignition speed of the genset is exceeded during the start procedure, the genset should be accelerated up to the rated speed. If this is not the case and the ignition speed has dropped again, indication "Engine Running" remains active for the time of the engine running reset delay. After elapse of this delay, the start interval is initiated. A new start attempt follows in operational modes TEST and AUTOMATIC.

Delayed supervision
This function commences after the ignition speed has been exceeded. The delayed supervision circuits can only be activated after a start and when "Engine Running" is indicated, e.g. for oil pressure alarms.

Generator CB release
During this time the generator voltage and frequency must be within admissible tolerances, otherwise the generator CB will not be released.

Recooling time
For cooling down purposes the genset runs without load before it is stopped. This recooling function is not active if direct shut-down alarms occur or the genset is stopped by STOP push-button in operational mode MANUAL.

Shut down (time)
Stopping of the genset is initiated after a stop command, after the recooling time has elapsed, after the ignition speed has dropped below permissible limits or upon a direct shut-down alarm. In order to guarantee complete standstill of the genset, the shut down time elapses only after the ignition speed is below the switching point or the generator voltage below the undervoltage switching point and after elapse of the switching off delay.

Generator voltage tripping delay
Connection of high loads and squirrel-cage motors results in a short-term dip of the generator voltage. To avoid unintended tripping of the generator CB, the generator voltage supervision becomes delayed effective.

5.6 EMERGENCY STOP (B18)

To this input a permanent command has to be signalled from an external EMERGENCY STOP push-button. For the EMERGENCY STOP function the closed circuit principle is used, i.e. the signal will be activated when L- (battery) is disconnected from input B18. The EMERGENCY STOP command has a direct effect on the output relays which will then change into off-position (safe state), with the exception of the HORN relay, which will be activated.
The *NB2* changes into operational mode "0" (OFF). For the time the EMERGENCY STOP signal is active and not reset, LED "0" flashes slowly. If a present EMERGENCY STOP command is cacknowledged via the RESET/L.TEST push-button, only the horn is switched off.
If the EMERGENCY STOP command no longer present, the *NB2* switches back into the original operational mode after acknowledgement.

5.7 Supervision circuits

The *NB2* has 8 supervision circuits with LED indication and related message inscription labels. Five of these supervision circuits can be controlled from external by connecting L- (battery) to the input terminals. The other three are internal supervision circuits. The supervision circuits can be encoded for either *closed circuit principle* or *open circuit principle*.

Open circuit principle
A signal is activated when L-(aux. voltage) is connected to the supervision input (NO contact).

Closed circuit principle
A signal is activated when L- (aux. voltage) is disconnected from the input terminal (NC contact).

5.7.1 Internal supervision circuits (fault signals 1, 3, 6)

The first supervision circuit (signal 1) is reserved for alarms "Start Failure" and "Speed Sensor Fault". The third circuit is for alarm "Overspeed" and the sixth for alarm "Battery Voltage Failure".

5.7.2 External supervision circuits

Supervision circuits 2, 4 and 5 can be used for external alarms. For information about standard coding of the supervision circuits (default setting) please see Table 5.6. Supervision circuits 7 an 8 can be coded by means of DIP switch S1. Function of supervision circuits 2, 4 and 5 can only be changed by the parameter setting software.

The second supervision circuit has shut-down function and is delayed monitored after start of the engine, hence it is suitable e.g. for supervision of oil pressure.

The fourth circuit has a direct shut-down effect and is suitable e.g. for temperature supervision.

The fifth circuit has a shut-down function with coded recooling time which makes it suitable for signalling overload because at overload the genset is only stopped after a certain recooling time.

The seventh circuit has a warning function and can, for instance, be used for "Lack of Fuel" alarm

The eighth circuit has a double function and dependent on its coding is either be used as signal input or function input when change of operational modes has to be blocked (see chapter 5.8).

5.7.3 Putting in the inscription labels

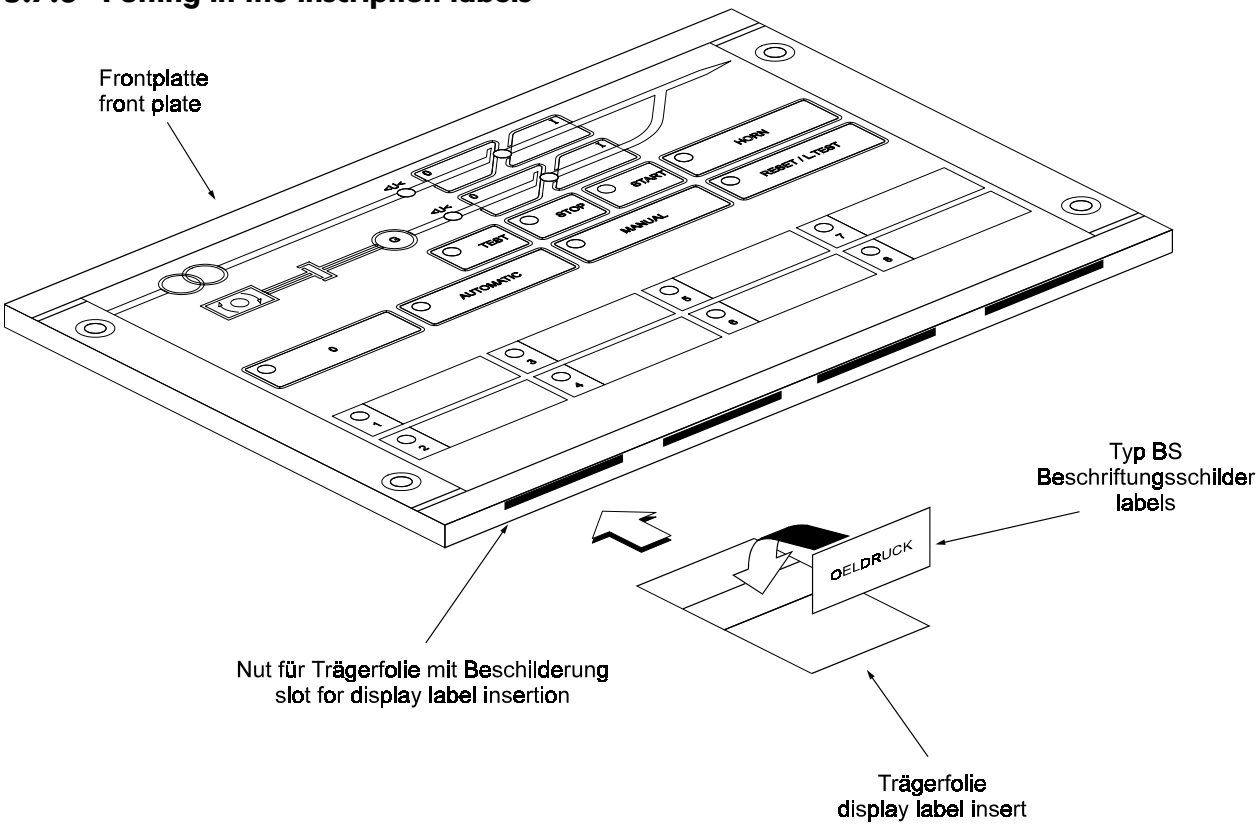


Figure 5.3: Putting in the inscription labels

5.8 Blocking the changeover to other operational modes

At input B23 (supervision circuit no.8) remote changeover of an operational mode can be blocked. For this purpose the supervision circuit must be coded with an indicating function and L- has to be connected to input B23 (default setting). In such a case all push-buttons related to operational modes are deactivated, function of all other push-buttons is maintained according to the previous selected operational mode.

Alarm	7			8		
Switch S1	1	2	3	4	5	6
Shut-down	-	0	0	-	0	0
Delayed shut-down	-	0	1	-	0	1
Warning	-	1	0	-	1	0
Indication only	-	1	1	-	1	1
Closed circuit	1	-	-	1	-	-
Open circuit	0	-	-	0	-	-

Table 5.5: Coding possibilities of the 7th and 8th supervision circuit

Default setting

In the following table coding of the supervision circuits is shown.

Function	Alarm						
	2	3	4	5	6	7	8
Open circuit	x		x	x		x	x
Closed circuit							
Indication							x
Warning					x	x	
Shut-down	x	x	x				
Shut-down with recooling				x			
Delayed supervision	x						

Table 5.6: Standard coding

Internal supervision circuits

The following functions can be assigned to the supervision circuits:

Indication
The LED assigned to a supervision circuit can also be used to indicate a function of the system, e.g. "Ventilator On". The indication extinguishes after there is no signal at the input. By changing over into operational mode "0", a still active indicating alarm will not be suppressed, the indication remains as long as the signal is applied to the input. Normally indicating alarms have a grey label.

Warning
The fault is indicated by a slow flashing LED. Push-buttons HORN and RESET/L.TEST are activated. After acknowledgement by either of these push-buttons, the LED changes into continuous light. Only after clearance of the fault, the indication can be reset by the RESET/L.TEST push-button. By changing over into operational mode "0", a still active indicating alarm will be suppressed. Normally warning alarms have a yellow label:

Direct shut-down
Appart from the first-up indication, the fault is indicated by a slow flashing LED. Push-buttons HORN and RESET/L.TEST are activated. LED "Engine Running" and LED "Generator Voltage Available" are flashing slowly. The generator CB opens and the engine is instantly stopped. The fault signal can only be reset when the fault is cleared and the stop procedure completed. Normally shut-down alarms have a red label.

Shut-down with recooling
This function is identical to that of a direct shut-down alarm, but here the genset is not stopped immediately. After the generator CB has been opened, the genset runs a certain time without load for recooling and is then stopped. Normally delayed shut-down alarms have a red label.

First-up indication
The first alarm with direct shut-down function or delayed shut-down function is called "first-up indication" and is indicated by a fast flashing LED; any following shut-down alarm is indicated by a slow flashing LED. When a signal is acknowledged by push-buttons HORN or RESET/L.TEST, the respective LEDs show a continuous light, except the first-up indication, this LED flashes quickly. The first-up indication can only be reset when all the other shut-down alarms are no longer active and were reset.

Indication of a new alarm after acknowledgement
After all active alarms and the first-up indication have been acknowledged by push-buttons HORN or RESET and the LEDs show continuous light, a new fault is indicated by a slow flashing LED.

5.9 Reset of alarm signals

Push-button HORN can only be used to cancel an acoustical alarm; the flashing indication then changes into continuous light. Shut-down and warning alarms can only be reset by push-button RESET/L.TEST if these alarms are not active at the signal inputs.

5.10 Alarm output

External warning and shut-down faults are signalled to output C8. Normally this output is used for connection of the horn, but it can also be utilized for controlling a common alarm relay.
The relay connected to output C8 can be reset by push-buttons HORN or RESET/L.TEST. If this output relay is not manually reset after 5 minutes, it is automatically reset. Any active alarms are still indicated.

Note:
A common alarm relay connected to this output should be provided with a latched contact.

5.11 Common alarm /Battery voltage too low

Potentialfree output C9/10 is intended for signalling common alarms. Which of the alarms should have an effect on this output can be defined by using the parameter setting sofware.

Normally alarm "Battery Voltage Too Low" is designated to this output. When the aux. voltage is availabe and the battery voltage trouble-free, the relay is energized; contact C9/C10 is open (closed circuit principle). In case the aux. voltage fails, the alarm is signalled (contact C9/C10 closed).

6 Survey of Parameters

A variety of applications is covered by the parameter setting facilities at the unit, e.g. by means of switches and coding plugs. Additionally the parameter setting software *NB2*-Soft can be used for specific solutions and more accurate adjustment to the genset.

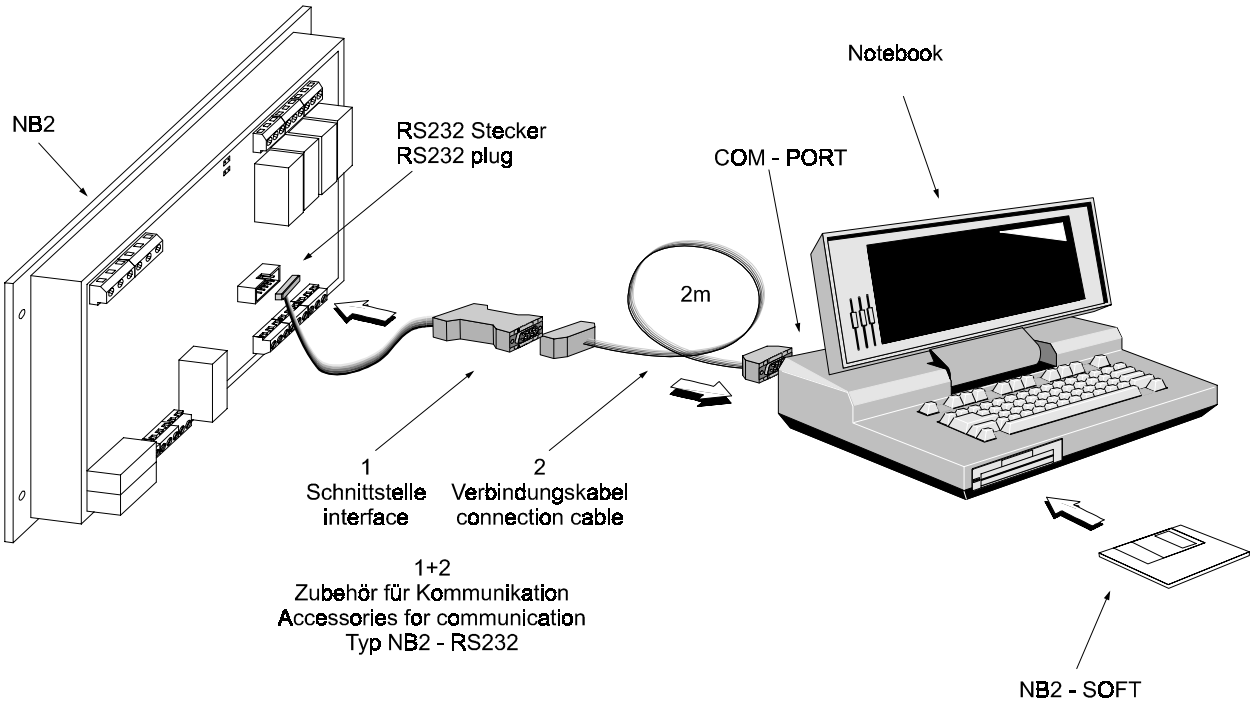


Figure 6.1: Parameter setting via notebook and Software NB2-Soft

6.1 Possibilities for parameter setting at the unit

The following parameters can be set direct at the unit:

Mains:
- Measuring methods 1-phase/3-phase
- Rated voltage
- Frequency supervision element ON/OFF
- Rated frequency

Generator:
- Measuring methods 1-phase/3-phase
- Rated voltage
- Frequency supervision element ON/OFF
- Rated frequency
- Generator voltage tripping delay
- Generator CB release

Genset:
- Battery voltage 12V/24V/Low/High
- Start delay
- Recooling time

Signals:
- Open circuit principle/Closed circuit principle
- Delayed supervision
- Direct stop
- Stop with recooling time
- Warning/Indication

6.2 Possibilities for parameter setting by means of software

The following parameters can be set by using parameter software *NB2*-Soft. Explanation of these parameters can be found in the Online guide of the parameter software.

Mains:
- Rated voltage
- Undervoltage
- Overvoltage
- Minimum voltage for evaluating the frequency
- Static and dynamic frequency deviations
- Operating and release time of the frequency supervision element
- Voltage unbalance supervision ON/OFF
- Operating and release time of the voltage unbalance supervision element
- Supervision of mains recovery (ON/OFF)
- Mains switching back time
- Switching over delay in TEST operation
- Overlapping time during short-term parallel operation

Generator:
- Measuring methods 1-phase/3-phase
- Rated voltage
- Undervoltage
- Overvoltage
- Frequency determined from the generator voltage or speed module DB1
- Minimum voltage for evaluating the frequency
- Static and dynamic frequency deviations
- Operating and release time of the frequency supervision element
- Release of generator CB and generator voltage tripping delay
- Additional voltage supervision element :
  - Voltage supervision ON/OFF
  - Voltage deviation
  - Voltage control time

Genset:
- Battery voltage switching points
- Tripping delays at battery undervoltage
- On and Off threshold of dynamo voltage
- Ignition speed
- Overspeed
- Overfrequency either determined by DB1 or both from generator frequency and by DB1
- Calibration of speed sensor (with DB1 only)
- Max. start attemps
- Start delay
- Start interval
- Switching off delay
- Delayed supervision
- Mains restoration time
- Recooling time
- Stopping time

Signals:
- Configuration of alarm signals:
  - Open circuit/closed circuit principle of signal inputs
  - Delayed supervision
  - Direct shut-down
  - Shut-down with recooling time
  - Warning/Indication
  - Common alarm
  - Energizing delay signals 2-8
- Internal signals can be allocated to common alarms
  - Start failure
  - Mains recovery fault
  - Generator voltage failure
  - V-belt rupture/Speed sensor defect
  - Total speed sensor defect
- Alarm duration

6.3 Indication of actual measuring values

In addition to parameter setting, the software *NB2*-Soft can also be used for indication of the following actual measuring values:

- Mains voltage
- Mains frequency
- Generator voltage
- Generator frequency
- Speed
- Battery voltage
- Dynamo voltage

6.4 Installation

The *NB2* is designed for flush-mounting in the switchgear panel. Any installation position is possible. The necessary screws are delivered together with the device.

Note:
If IP54 applies for the switchboard, a rubber sealing frame has to be placed under the front frame before the *NB2* is installed (see order form).

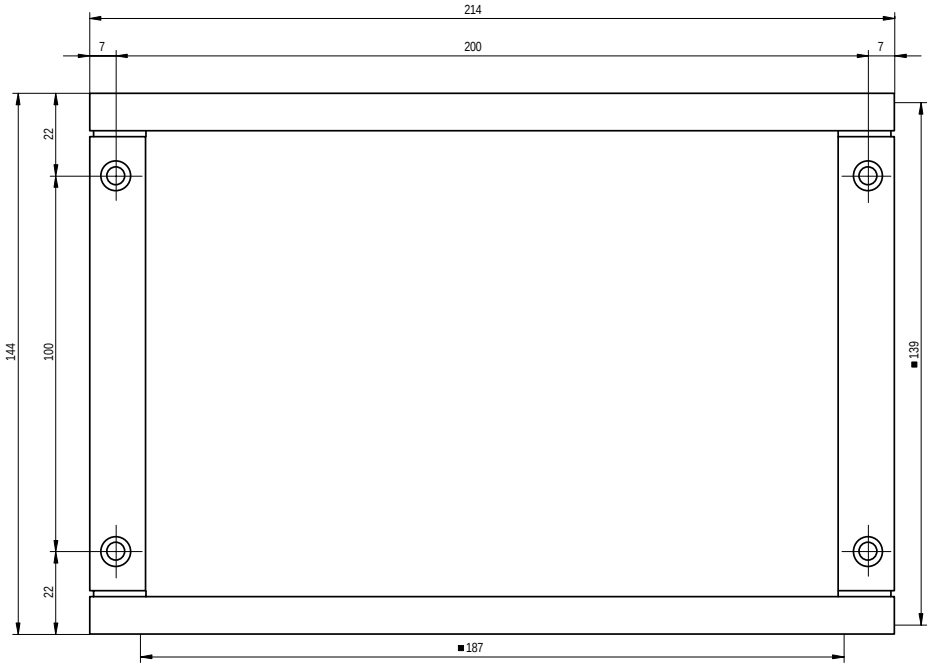


Figure 6.2: Dimensions of the NB2

Installation depth: 65 mm
■ Panel cut-out (w x h): 187 mm x 139 mm

6.5 Earthing scheme

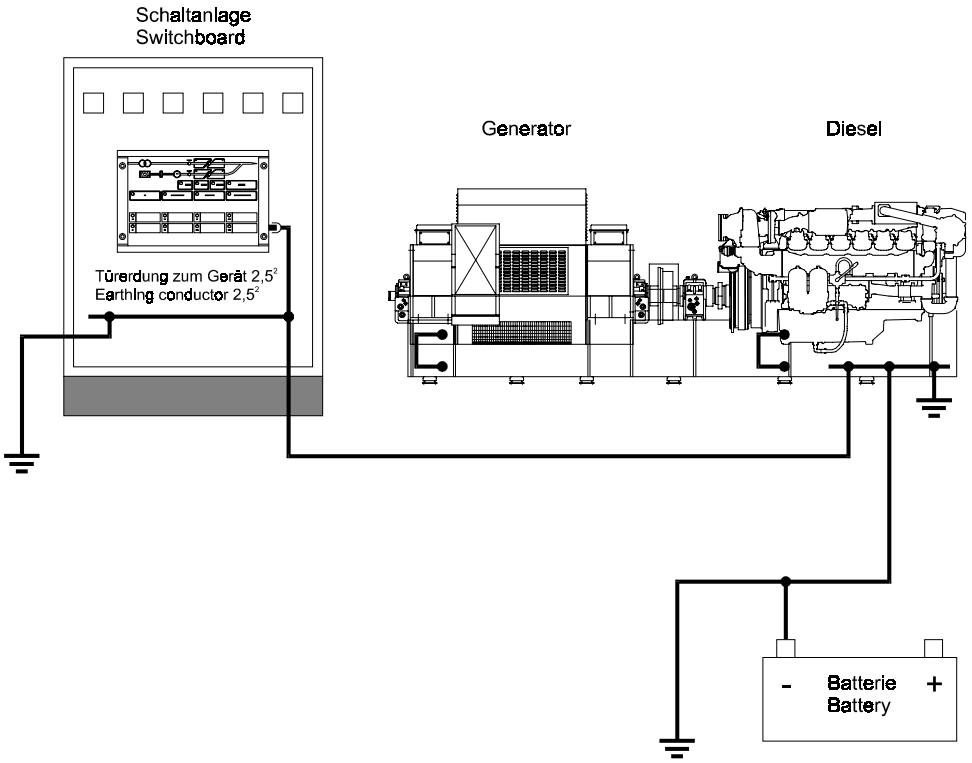


Figure 6.3: Earthing scheme

7 Technical Data

General Data

Type:	*NB2*
Design:	flush panel mounting
Duty:	continuous operation
Connecting terminals:	max. 2.5 mm^2
Maintenance:	none

Input circuits

Aux. voltage:	8 - 35 V/DC
Power consumption:	7.5 W at 24 V/DC
Generator voltage:	50 to 500 V/AC
Mains voltage:	50 to 500 V/AC
Rated frequency:	50/60 Hz codierbar
Voltage measuring tolerance:	2% from the rated voltage
Battery voltage supervision:	10 - 32 V/DC
Tolerance of battery voltage Supervision:	±2% at 24 V
Dynamo voltage:	0 - 40 V/DC Add. Excitation, strong (60 Ω)/weak (120 Ω) codable
Supervision circuits:	3 internal, 5 external

Output circuits

For the following relay contacts, the max. contact voltage is 40 V/DC:

C1/C2 - shut-down, closed circuit (16 A)
C3/C4 - starter (16 A)
C3/C6 - shut-down, open circuit (16 A)
C3/C8 - horn (16 A)
B9/B10 - genset running (16 A)
C9/C10 - battery voltage too low/common alarm (2 A)

For the following relay contacts, the max. contact voltage is 230 V/AC:

B1/B2 - mains CB (16 A)
B3/B4 - generator CB (16A)

Contact material: AgCdO

Tests and Design Standards:

- Radio interference suppression as per VDE 871, class B
- Impulse voltage test as per VDE435, part 303, class 3
- High frequency interference test as per VDE 435, part 303, class 3
- Creeping distance and clearance as per VDE 110, part 2
- Electrical fast transient (burst) test as per VDE 0834, part 4, intensity factor 4
- Electrostatic discharge test as per VDE 0834, part 3, intensity factor 3
- Radiated electromagnetic field test as per VDE 0843, part 3, intensity factor 3

Important!

Prior to voltage test of the switchboard the protective earthing conductor of the *NB2* has always to be disconnected from the protective earthing conductor of the switchboard, otherwise there is the danger of damaging the device.

Climatic Conditions

Min./Max. ambient temperatures	
when stored:	-40°C up to +75°C
In operation:	-20°C up to +70°C
Humidity resistance:	Class F acc. to DIN 40040, tested as per DIN IEC 68, part 2-3 (56 days 40°C and 93% r.h.)

Housing, Dimensions, Weight and Installation

Design:	for flush panel mounting
Front panel material:	aluminium with foil push buttons
Housing material:	Makrolon (self-extinguishing)
Dimensions (w x h x d):	(w x h x d) 214 x 144 x 65 mm
Panel cut-out:	(w x H) 187 x 139 mm
Housing installation:	fixed by screws
Installation position:	any
Weight:	ca. 1.2 kg
Protection class, front panel:	IP54

This manual is valid for controller software version from P1.08 onwards (see type plate of controller).

It is our endeavoure to provide a product always in line with the latest developments, i.e. technical or constructional changes are possible and are in the interest of our customers. They are not subject to notification.

8 Order form

When ordering the *NB2* please use the following form and mark according to your application.

If no specific information is given, the device is coded and labelled as per standard.

Language:

☐ German ☐ English ☐ French ☐ Spanish ☐ .....Other

☐ Standard labelling

1	STARTFAILURE	R G Gr	3	OVERSPEED	R G Gr	5		R G Gr	7		R G Gr
2		R G Gr	4		R G Gr	6	BATTERY VOLTAGE TOO LOW	R G Gr	8		R G Gr

(R = red, G = yellow, Gr = grey)

Internal signals are shown in the grey sections which cannot be assigned to other signals.
Additionally are supplied: 4 red, 2 yellow and 2 grey labels as well as 3 coding plugs.

☐ Labelling of fault signals acc. to DIN 6280-13 (extra charge)

1	STARTFAILURE	R G Gr	3	OVERSPEED	R G Gr	5	OVERLOAD SHORT CIRCUIT	R G Gr	7	LACK OF FUEL	R G Gr
2	OIL PRESSURE TOO LOW	R G Gr	4	OVER-TEMPERATURE	R G Gr	6	BATTERY VOLTAGE TOO LOW	R G Gr	8		R G Gr

(R = red, G = yellow, Gr = grey)
Additionally are supplied : 1 red, 1 yellow and 1 grey label as well as 3 coding plugs.

☐ Labelling according to specification (extra charge):

1		R G Gr	3		R G Gr	5		R G Gr	7		R G Gr
2		R G Gr	4		R G Gr	6		R G Gr	8		R G Gr

(R = red, G = yellow, Gr = grey)

If other than standard labels are required (additional price on request), please enter the text accordingly.
The section size is 34 x 13mm. Additionally are supplied: 4 red, 2 yellow and 2 grey labels as well as 3 coding plugs

Further Details:

Add. excitation ☐ strong ☐ weak ☐ No dynamo

Protect. class IP54: ☐ no ☐ Yes (rubber sealing frame will be provided)

☐ Standard coding; please mark the desired changes with a cross

Note:
If IP54 applies for the switchboard, a rubber sealing frame has to be placed under the front frame before the *NB2* is installed.

8.1 Order code

Automatic Controller	***NB2***	**-1**	**-8**	
With mains supervision				
8 Supervision circuit				
Without speed module				*
With speed module				**+DB1**

8.2 Accessories

Parameter setting software **NB2-Soft**

Interface adapter **NB2-RS232**

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