REGULATION

Automatic Synchronizer for Generator

NPRG860 & NPRG870 perform synchronization and paralleling of generators with electrical network. NPRG860 features a speed adjustment function. NPRG870 adds a voltage adjustment function. These two devices also include CB time compensation allowing paralleling without phase shift.

As well as the usual protection functions, NP800 relays provide monitoring, measurement and recording of the electrical quantities of the network.
The relays can be set by the RS232 port, or remotely using the RS485 port.
Reading, measurement and recording are all available locally or remotely.

- Multifunction
- Measurement
- Recording / event log
- Disturbance recording
- Local MMI

NPRG860
NPRG870

Protection & Control ice

Common functions

- Regulating device - **[90]**
- Synchrocheck for manual paralleling - **[25]**
- Anticipated closing time of the paralleling circuit breaker **[TA]**
- Dead Busbar paralleling
- Adjustment of the phase shift between GE and BB measurements (Step up transformer adaptation)
- Network & Generator rated voltage

Speed adjustment (NPRG860-NPRG870)

- ± speed order
- Boost pulsing
- "Black-start" mode from V1.50

Voltage adjustment (NPRG870)

- ± U order

Multi-groups management function (NPRG870)

- 4 settings tables available for management of 4 generators

CHARACTERISTICS NPRG860 - NPRG870

Auxiliary Supply

• Auxiliary supply ranges	19 to 70 – 85 to 255 / Vdc or Vac 50 or 60 Hz
• Typical burden	6 W (CC), 6 VA (CA)
• Memory backup	72 hours

Analogue Inputs

• Phase voltage inputs	Un: 55 to 120 V input impedance > 80 KΩ continuous rating 240 V, short duration withstand 275V - 1 min measurement from 3 to 240 V VT setting: primary value from 100 V to 30 kV
• Frequency (50Hz or 60Hz)	measurement: 45-55 Hz or 55-65 Hz measurement: 30-70 Hz *(from V1.50)*

Digital Inputs (4 for NPRG860, 8 for NPRG870)

• Polarizing voltage	20 to 70 Vdc, range 19 to 70 V 37 to 140 Vdc, range 85 to 255 V
• Level 0	< 10Vdc range 19 to 70 V – < 33Vdc range 85 to 255 V
• Level 1	> 20Vdc range 19 to 70 V – > 37Vdc range 85 to 255 V
• Burden	< 15 mA

Relay Outputs (3* for NPRG860 + 1 WD, 7 for NPRG870 + 1 WD)

• Relays A*, B*, E, F	double contact NO, permanent current 8 A closing capacity 12 A / 4 s short circuit current withstand 100 A / 30 ms breaking capacity DC with L/R = 40 ms: 50 W breaking capacity AC with cos φ = 0.4: 1250 VA
• Relays C*, WD, D, G	changeover contact, permanent current 16 A closing capacity 25 A / 4 s short circuit current withstand 250 A / 30 ms breaking capacity DC with L/R = 40 ms: 50 W breaking capacity AC with cos φ = 0.4: 1250 VA

Characteristics of the function [90]

• Accuracy of voltage measures	3% of Un
• Setting of voltage difference: ±ΔU	thresholds +/- : 1% to 15% Un, with step of 1% Un
• Voltage difference accuracy	± 5% of the set value
• Setting of angular difference: Δφ	thresholds +/- : 1° to 20°, with step of 1°
• Angular difference accuracy	± 2%
• Setting of frequency difference: ±ΔF	thresholds +/- : 0.01 to 1.5 Hz, with step of 0.01 Hz
• Frequency difference accuracy	± 2%
• Setting of rate of frequency change: ΔF/dt	thresholds +/- : 0.01 to 0.2 Hz/s, with step of 0.01 Hz/s
• Rate of frequency change accuracy	± 2%
• Threshold of amplitude U GE mini	50 to 100% Un, with step of 1%
• Threshold accuracy	2% of Un
• Closing time of the paralleling CB (TA)	0 ms to 600 ms, with step of 10 ms
• Anticipatory max (limitation / TA)	1 to 20°, with step of 1°
• Accuracy of the time delays	± 2% or 20 ms
• Accuracy of displayed measures	3% from 3 to 240 V

Characteristics of the function [25]

• Accuracy of voltage measures	3% of Un
• Setting of voltage difference: ±ΔU	thresholds +/- : 1% to 15% Un, with step of 1% Un
• Voltage difference accuracy	± 5% of the set value
• Setting of angular difference: Δφ	thresholds +/- : 1° to 20°, with step of 1°
• Angular difference accuracy	± 2%
• Setting of frequency difference: ±ΔF	thresholds +/- : 0.01 to 1.5 Hz, with step of 0.01 Hz
• Frequency difference accuracy	± 2%
• Setting of rate of frequency change: ΔF/dt	thresholds +/- : 0.01 to 0.2 Hz/s, with step of 0.01 Hz/s
• Rate of frequency change accuracy	± 2%
• Time lag before authorisation	0 ms to 1 s, with step of 0.1 s
• Accuracy of the time delays	± 2% or 20 ms
• Accuracy of displayed measures	3% from 3 to 240 V

CHARACTERISTICS NPRG860 - NPRG870

Adjustment of the phase shift between GE and BB measurements

• GE voltage / BB voltage	0 to 360°, with step of 1°

Network rated voltage configuration

• Setting range	100 V to 30 kV

Speed adjustment (NPRG 860/NPRG 870)

• Interval of the pulses ±f	0 to 30 s ; 0 to 250 s *(from V1.50)*, with step of 1 s
• Mini duration time of the pulses ±f	0 to 0.5 s, with step of 0.1 s or 0.01 s *(from V1.50)*
• Pulses width +f *(from V1.50)*	0 to 100% of interval of pulses ±f, with step of 1%
• Proportional gain *(KFP±*)* ±f	0 to 200, with step of 1
• Derivative gain for *(KFD±**)* ±f	0 to 100, with step of 1
• Boost pulsing time-delay	10 to 200 s, with step of 1 s
• Accuracy of the time delay	± 2% or 20 ms
• Duration of the pulses +f (boost pulsing)	0.5 to 10 s ; 0.01 to 2 s *(from V1.50)*, with step of 0.5 s
• Orders stop if paralleling ok	YES/NO

**: 5 Hz correspond to 20 s*
***: 1 Hz/s correspond to 200 s*
***: 1 Hz/s correspond to 2 s (from V1.50)*

Voltage adjustment (NPRG870)

• Interval of the pulses ±U	0 to 30 s ; 0 to 250 s *(from V1.50)*, with step of 1 s
• Mini duration time of the pulses ±U	0 to 0.5 s, with step of 0.1 s or 0.01 s *(from V1.50)*
• Pulses width +f *(from V1.50)*	0 to 100% of interval of pulses ±U, with step of 1%
• Proportional gain *(KUP±*)* ±U	0 to 100, with step of 1

**: 10% de U correspond to 5 s*

Dead Busbar paralleling (NPRG 870)

• Dead busbar paralleling enabled	by dedicated DI or setting software
• Info dead busbar paralleling enabled	HMI, dedicated DI, communication and setting software
• Busbar voltage detection threshold	10% to 50% Un, with step of 1% Un
• Threshold accuracy	2% of Un
• Setting of frequency difference	thresholds F< and F>: 0 to 1 Hz, with step of 0.1 Hz
• Angular accuracy / frequency difference	± 2%
• Setting of voltage difference	thresholds U< and U>: 1 to 10% Un, with step of 1% Un
• Voltage difference accuracy	± 5% of the set value
• Time lag before paralleling	1 to 5 s, with step of 0.5 s
• Accuracy of the time delay	± 2% or 20 ms

Digital inputs assignment

• Input 1	paralleling of dead bus line
• Input 2	auto mode
• Input 3	order function enabled
• Input 4	synchrocheck mode
• Input 5 (NPRG870 only)	selection generator 1
• Input 6 (NPRG870 only)	selection generator 2
• Input 7 (NPRG870 only)	selection generator 3
• Input 8 (NPRG870 only)	selection generator 4

Digital output assignment

• Relay A	+f order
• Relay B	- f order
• Relay C	paralleling order
• Relay D (NPRG870 only)	generator selection fault
• Relay E (NPRG870 only)	+U order
• Relay F (NPRG870 only)	- U order
• Relay G (NPRG870 only)	paralleling of dead bus line enabled

Signalling LEDs assignment

• LED 1	auto mode activated
• LED 2	paralleling of dead bus mode activated
• LED 3	slip control
• LED 4	paralleling order

Setting

• Display	English, French, Spanish, Italian
• Configuration and operating software	compatible with Windows® 2000, XP, Vista and 7 English, French, Spanish, Italian

CHARACTERISTICS NPRG860 - NPRG870

MODBUS® Communication (option)

• Transmission	asynchronous series, 2 wires
• Interface	RS 485
• Transmission speed	300 to 115 200 bauds

Disturbance recording

• Number of recordings	4
• Total duration	170 cycles per recording (12 samples / cycle)
• Pre fault time	adjustable from 0 to 170 cycles

Climatic withstand in operation

• Cold exposure	IEC / EN 60068-2-1: class Ad, -10 °C
• Dry heat exposure	IEC / EN 60068-2-2: class Bd, +55 °C
• Damp heat exposure	IEC / EN 60068-2-3: class Ca, 93 % HR, 40 °C, 56 days
• Temperature variation with specified variation rate	IEC / EN 60068-2-14: class Nb, -10 °C à +55 °C, 3 °C/min

Storage

• Cold exposure	IEC / EN 60068-2-1: class Ad, -25 °C
• Dry heat exposure	IEC / EN 60068-2-2: class Bd, +70 °C

Electrical safety

• Ground bond test current	IEC / EN 61010-1: 30 A
• Impulse voltage withstand	IEC / EN 60255-5: 5 kV MC, 5 kV MD except outputs TOR, 1 kV MD except RS485, 3 kV MC
• Dielectric withstand: 50Hz	IEC / EN 60255-5: common mode 2 kV_{rms} – 1 min differential outputs mode TOR 1 kV_{rms} – 1 min (open contact type)
• Insulation resistance	IEC / EN 60255-5: 500 Vcc - 1 s: > 100 MΩ
• Clearances and creepage distances	IEC / EN 60255-5: rated insulation voltage: 250 V pollution degree: 2 overvoltage category: III

Enclosure safety

• Degrees of protection provided by	IEC / EN 60529: IP51, with front face enclosures (IP code)

Immunity – Conducted disturbances

• Immunity to RF conducted disturbances	IEC / EN 61000-4-6: class III, 10 V
• Fast transients	IEC / EN 60255-22-4 / IEC / EN 61000-4-4: class IV
• Oscillatory waves disturbance 1 MHz	IEC / EN 60255-22-1: class III, 2.5 kV MC, 1 kV MD except RS485, class II, 1 kV MC
• Surge immunity	IEC / EN 61000-4-5: class III
• Supply interruptions	IEC / EN 60255-11: 100% 20 ms

Immunity – Radiated disturbances

• Immunity to RF radiated fields	IEC / EN 60255-22-3 / IEC / EN 61000-4-3: class III, 10 V/m
• Electrostatic discharges	IEC / EN 60255-22-2 / IEC / EN 61000-4-2: class III, 8 kV air / 6 kV contact
• Power frequency magnetic field and immunity test	IEC / EN 61000-4-8: class IV, 30 A/m permanent, 300 A/m 1 to3 s

Mechanical robustness - energised

• Vibrations	CEI / EN 60255-21-1: class 1, 0.5 Gn
• Shocks	IEC / EN 60255-21-2: class 1, 5 Gn / 11 ms

Mechanical robustness - not energised

• Vibrations	IEC / EN 60255-21-1: class 1, 1 Gn
• Shocks	IEC / EN 60255-21-2: class 1, 15 Gn / 11 ms
• Bumps	IEC / EN 60255-21-2: class 1, 10 Gn / 16 ms
• Free falls	IEC / EN 60068-2-32: class 1, 250 mm

CHARACTERISTICS NPRG860 - NPRG870

Electromagnetic compatibility (EMC)

• Radiated field emissivity	EN 55022: class A
• Conducted disturbance emissivity	EN 55022: class A

Presentation

• Height	4U
• Width	¼ 19"
• Brackets 19” rack mounting	option (see drawing D37739)
• Display	2 lines of 16 characters

Case

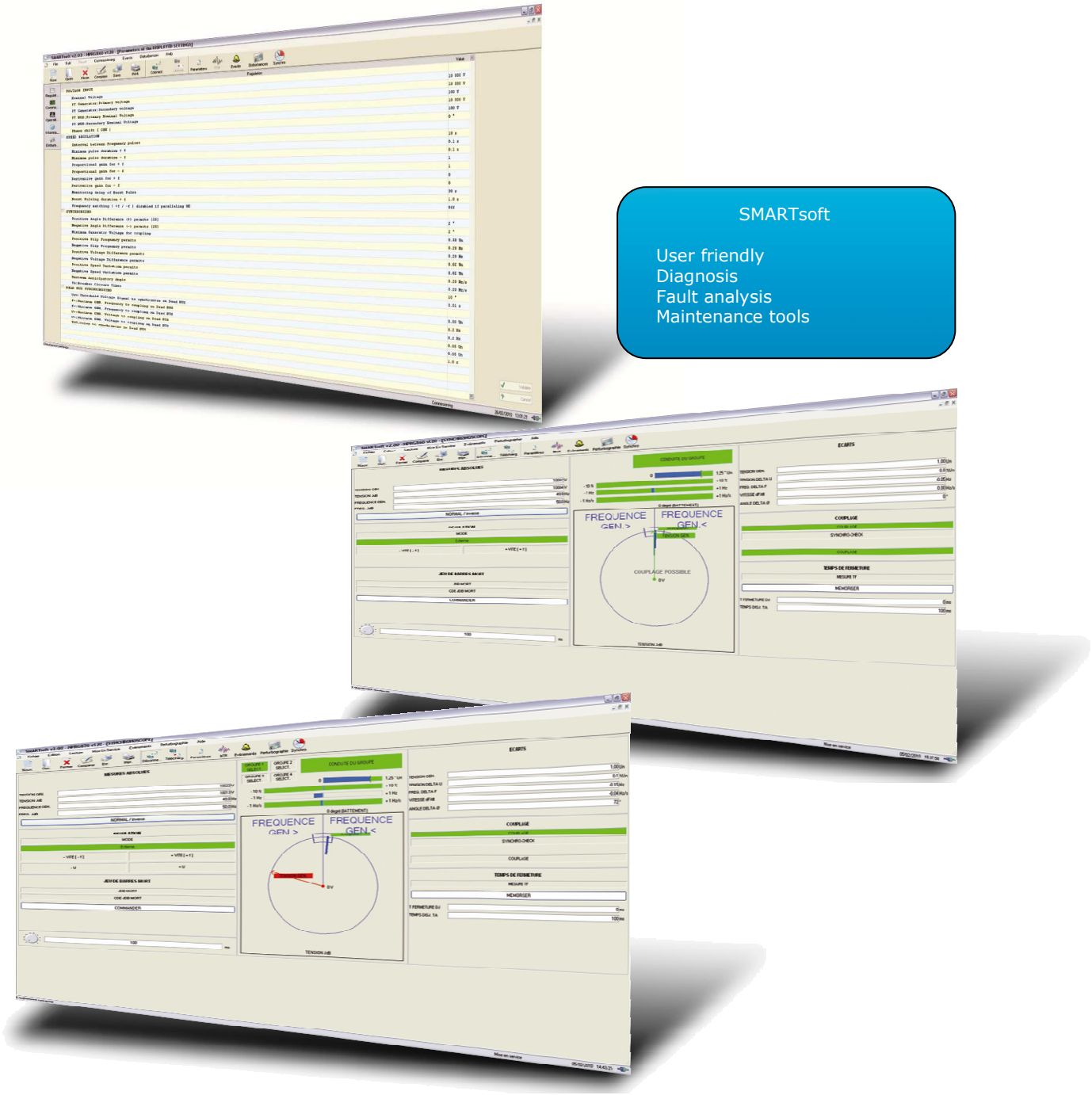
• H, W, D without connectors	173 x 106.3 x 250 mm (see drawing D37739)
• Net weight	3.6 kg

Connection - codification

• NPRG860	see diagram S38894
• NPRG870	see diagram S38895

SMARTsoft

SMARTsoft, integrated software for the Industry, Railway and Transmission ranges, helps the User get the best from NP800 series relays.



Functionalities

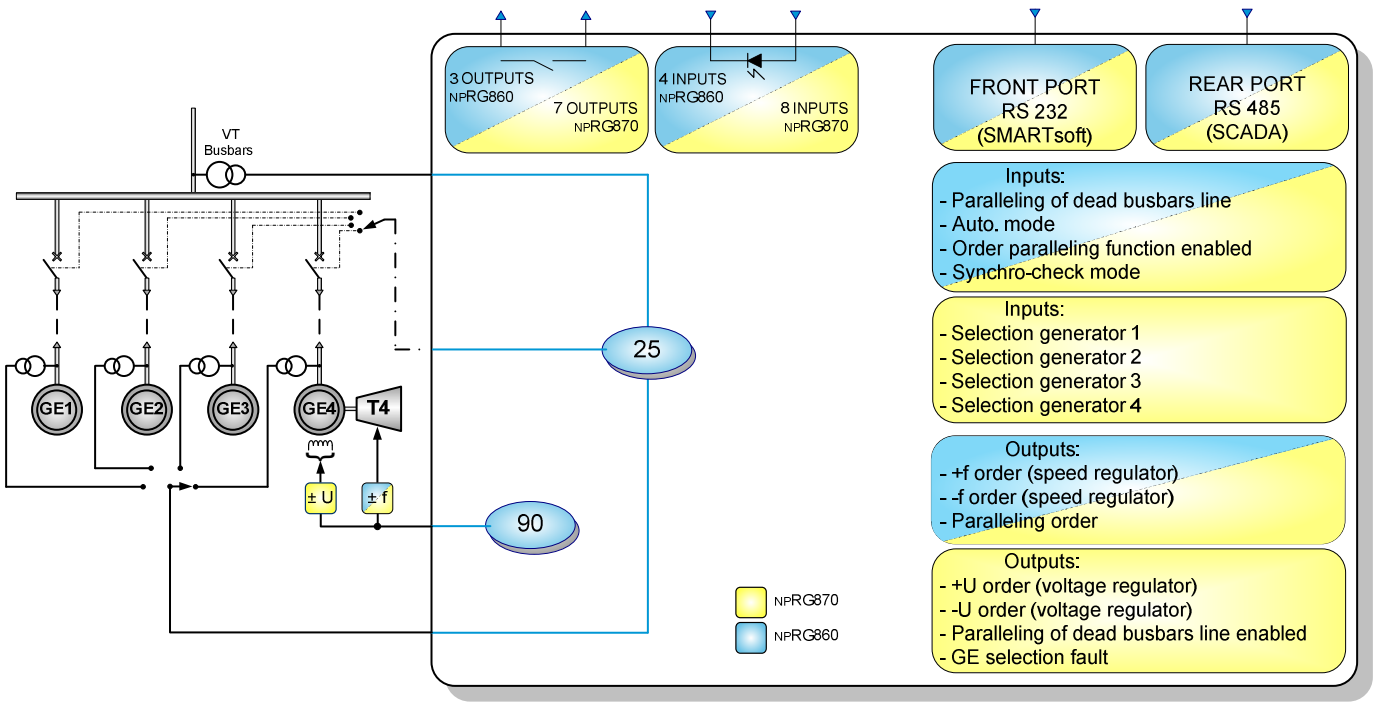
- 2 ranges of auxiliary supply
- Storage of lack and the restoration of the auxiliary voltage (events recorded)
- Configuration and parameter setting by off-line / on-line PC
- Reading and recording of configuration by PC
- Measurement of electrical quantities:
  - Phase voltages U_{GE}, U_{BB}
  - Frequency F_{GE}, F_{BB}
  - Voltage difference ΔU ($U_{GE} - U_{BB}$)
  - Angular difference $\Delta\phi$
  - Angular difference $\Delta\phi$ compensate (NPRG870)
  - Frequency difference ΔF ($F_{GE} - F_{BB}$)
  - Rate of frequency change $\Delta F/dt$ (Hz / s)
  - CB closing time (ms)
  - Phi anticipatory (°)
- Display expressed in primary values
- 4 setting groups for management of several selectable groups remotely by logical input (NPRG870 only)
- "Black-start" mode for starting with no speed
- Setting software compatible with Windows® 2000, XP, Vista and 7
- User interface with access to all functions
- Time stamping of internals events with 10ms resolution
- Time stamping of digital inputs with 10ms resolution
- Event recording: 250 locally recorded events, 200 saved in case of loss of the auxiliary supply
- Local / remote events acknowledgment
- Disturbance recording according to Comtrade® format: storage of 4 recordings of 170 periods.
- Remote setting, remote reading of measurements, alarms and parameters settings
- Remote reading of disturbance recording and events log
- Self-diagnosis: Memories, output relays, A/D converters, auxiliary supply, cycles of execution of the software, hardware anomaly

Options

- Communication by Modbus® RS 485
- Communication by Modbus® RS 485 with redundancy (NPRG870 only)

Functional diagram

(For Synchrocheck and manual paralleling, Dead Busbar paralleling and Multi-groups management function, see NP800 application guide)



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