



Dimensioni *Dimensions* *Dimensions* *Abmessungen* *Dimensiones*

STAR3 & STAR3 SWITCHING



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Energy & Harmonics Analyser

USER MANUAL

1 - STANDARDS and REGULATIONS - CE Conformity declaration - The STAR3 family conforms to directive IEC 1010-1 430 V for Cat. III and protection level 2 according to IEC 664-664 A. regarding the safety of the operators. It conforms to EN55011 ; EN61000-3-2 ; EN61000-3-3 ; EN61000-4-2 ; EN61000-4-3 ; EN61000-4-4 extension 4kV ; EN61000-4-5 ; EN61000-4-6 ; EN61000-4-8 ; EN61000-4-11 (EMC) .

1.1 - USER SAFETY - In order to preserve these safety conditions and ensure safe operation, the user must observe all instructions and marks specified in this user manual. All maintenance and repair operations requiring the opening of the instrument must be carried out only by suitably qualified and authorised personnel. The instrument was shipped from the manufacturing plant in perfect technical safety conditions.



1.2 - SYMBOLS -

Please read carefully the instructions with this symbol before installing and using the instrument.

1.3 - PRELIMINARY INSPECTIONS - Before installation, check that the instrument is in good conditions and was not damaged during transport. Check that the network voltage and the rated voltage coincide. This instrument does not require an earth connection.

1.4 - PRECAUTIONS IN THE EVENTS OF MALFUNCTIONS - When safe operation is no longer possible, put the instrument out of service and ensure that it cannot be operated accidentally. Safe operation cannot be guaranteed in the following circumstances:

- When the instrument appears clearly damaged.
- When the instrument no longer works.
- After long storage in unsuitable conditions.
- After being damaged in transit.

2 - POWER SUPPLY - The power supply connections terminals are located on the rear side and are clearly indicated with the label POWER SUPPLY. Use cables having a maximum section of 2.5 mm². Earth connection is not required. Follow the connection diagram at the end of the manual.

2.1 - CONNECTING VOLTAGE MEASUREMENT CABLES - These cables, having a maximum section of 2.5 mm², are to be connected to the terminals labelled VOLTAGE INPUT as indicated in the diagrams at the end of the manual.

2.2 - CONNECTING CURRENT MEASUREMENT CABLE - Connect the secondary windings of the external CT's to the 2.5 mm² terminals labelled CURRENT INPUT as shown in the included diagrams. Use 3 CT's with 5A secondary. Use cables having a section appropriate to the length of the connection and the rated power of the CT's used. Follow the connection diagram at the end of the manual.

NOTE 1: For safety reasons, never leave the CT secondary open.

NOTE 2: To guarantee correct measurements, ensure that the voltage measurement cables and the current measurement cables are connected in the same order of phases

3 - PROGRAMMING THE INSTRUMENT

The instrument can be fully programmed by means of the SETUP menu. Press at the same time the PAG and the SEL keys to enter the SETUP. The complete description of the setup is available at chapter 5.

4 - MEASUREMENT PAGES

At power on, the STAR3 displays the last page selected before power off.

Use the PAG key to scroll through the different measurement pages and the SEL key to see the details.

The presence of several pages is depending on the connection mode selected into the setup .

3 PH-N:	Three phases with neutral, i.e. Star , 4 wires system
3 PH:	Three phases without neutral, i.e. Delta, 3 wires system
2 PH:	Two phases and neutral
1 PH:	Single phase and neutral

- **Page M1** (page and subpages not available in 1PH mode)

Phase-neutral voltages	$V_{L1-N}, V_{L2-N}, V_{L3-N}$	(3 PH-N, 3 PH)
Phase-neutral voltages	V_{L1-N}, V_{L2-N}	(2 PH)

 - **Page M1-S1** (page appearing only in 3PH-N and 2 PH)

Phase to Phase Voltage	V_{L1-L2}
------------------------	-------------
 - **Page M1-S2** (page appearing only in 3 PH-N)

Phase to Phase Voltage	V_{L2-L3}
------------------------	-------------
 - **Page M1-S3** (page appearing only in 3 PH-N)

Phase to Phase Voltage	V_{L3-L1}
------------------------	-------------
 - **Page M1-S4** (page appearing only in STAR HARMO. VL1 has to be connected)

Harmonics Voltages	$VL1_h, VL2_h, VL3_h$
--------------------	-----------------------

 Use the key SEL to scroll all the harmonics orders h .
 The maximum order is depending on the fundamental. It is the 25th at 50 Hz
 The voltage input are not connected the harmonics menu does not appear.
 - **Page M2** (page and sub pages not available in 1PH)

Phase currents	A_{L1}, A_{L2}, A_{L3}	(3 PH-N, 3 PH)
Phase currents	A_{L1}, A_{L2}	(2 PH)
 - **Page M2-S1** (present only in three 3PH-N; 3PH)

Neutral current	$A_{neutral}$
-----------------	---------------
 - **Page M2-S2**

Average Phase currents	$AL1_{Avg}, AL2_{Avg}, AL3_{Avg}$
------------------------	-----------------------------------

 The integration time is the same used for the Average power and it is adjustable into the setup menu.
 - **Page M2-S3**

Phase current peaks	$AL1_{peak}, AL2_{peak}, AL3_{peak}$
---------------------	--------------------------------------

 maximum average currents.
 - **Page M2-Sh** (Page appearing only in STAR3 HARMO)

Harmonics Currents	$AL1_h, AL2_h, AL3_h$
--------------------	-----------------------

 Use the key SEL to scroll all the harmonics orders h .
 The maximum order is depending on the fundamental. It is the 25th at 50 Hz
- **Page M3** (page not available in 1PH)

Phase active powers (kW)	P_{L1}, P_{L2}, P_{L3}	(3 PH-N, 3 PH)
Phase active powers	P_{L1}, P_{L2}	(2 PH)
- **Page M4** (page not available in 1PH)

Phase Apparent powers (kVA)	S_{L1}, S_{L2}, S_{L3}	(3 PH-N, 3 PH)
Phase apparent powers	S_{L1}, S_{L2}	(2 PH)
- **Page M5** (not available in 1PH)

Phase reactive powers (kVar)	Q_{L1}, Q_{L2}, Q_{L3}	(3 PH-N, 3 PH)
Phase reactive powers	Q_{L1}, Q_{L2}	(2 PH)
- **Page M6** (not available in 1PH)

Phase Power Factor	$PF_{L1}, PF_{L2}, PF_{L3}$	(3 PH-N, 3 PH)
Phase reactive powers	PF_{L1}, PF_{L2}	(2 PH)

- Page M7**
 Average Total Harmonic Distortion Factors

$$\text{Avg THDV} = \frac{(\text{THDV}_{L1} + \text{THDV}_{L2} + \text{THDV}_{L3})}{3} ;$$

$$\text{Avg THDA} = \frac{(\text{THDA}_{L1} + \text{THDA}_{L2} + \text{THDA}_{L3})}{3}$$
 These special parameters allow to identify immediately if one of the phases is distorted
- Page M7-S1** (not available in 1PH mode)
 Phase THD V THDV1, THDV2 ; THDV3 (3 PH-N, 3 PH)
 THDV1, THDV2 (2 PH)

$$\text{e.g.: THDV1} = \frac{\sqrt{\left(\sum_{h=2}^{25} V_{1h}^2\right)}}{V_{1\text{rms}}} = \frac{\sqrt{(V_{1\text{rms}}^2 - V_{1\text{fund}}^2)}}{V_{1\text{rms}}}$$
- Page M7-S2** (not available in 1PH mode)
 Phase THD A THDA1, THDA2 ; THDA3 (3 PH-N, 3 PH)
 THDA1, THDA2 (2 PH)

$$\text{e.g.: THDA1} = \frac{\sqrt{\left(\sum_{h=2}^{25} A_{1h}^2\right)}}{A_{1\text{rms}}} = \frac{\sqrt{(A_{1\text{rms}}^2 - A_{1\text{fund}}^2)}}{A_{1\text{rms}}}$$
- Page M8**
 Equivalent three-phase voltage $V = (V_{L1-N} + V_{L2-N} + V_{L3-N}) / \sqrt{3}$ (3 PH-N)
 Equivalent three-phase voltage $V = (V_{L1-L2} + V_{L2-L3} + V_{L3-L1}) / 3$ (3 PH)
 Phase to phase voltage $V = V_{L1-N} + V_{L2-N}$ (2 PH)
 Phase-Neutral voltage $V = V_{L1-N}$ (1 PH)

 Equivalent. three-phase current $A = S / (\sqrt{3} V)$ (3 PH-N, 3 PH)
 $A = S / V$ (2 PH)
 $A = A_{L1}$ (1 PH)

 Total Active power (kW) $P = P_{L1} + P_{L2} + P_{L3}$ (3 PH-N, 3P)
 $P = P_{L1} + P_{L2}$ (2 PH)
 $P = P_{L1}$ (1 PH)
- Page M9**
 Total Apparent power (kVA) $S = \sqrt{(P^2 + Q^2)}$
 Power factor $P.F. = P / S$
 Frequency (of V_{L1}) f (Hz)
- Page M10**
 Apparent power S= repeated as page M9
 Total Reactive power (kVar) $Q = Q_{L1} + Q_{L2} + Q_{L3}$ (3 PH-N, 3 PH)
 Total reactive power $Q = Q_{L1} + Q_{L2}$ (2 PH)
 Total Active Power P= repeated as page M8
- Page M10-S1**
 1- Average apparent power S avg
 2- Average reactive power Q avg
 3- Average active power P avg
 The integration time can be adjusted into the Setup menu
 The average values can be reset into the Setup menu
- Page M10-S2**
 1-Maximum demand apparent power S peak
 2-Maximum demand reactive power Q peak
 3-Maximum demand active power P peak
 The peaks values can be reset into the Setup menu

- Page M11**
 Total apparent energy counter kVAh
 Total active energy counter kWh
 range 0,000,000.00-99,999,999.9 kWh.
 When the upper limit is reached, the counter restarts from 00,000,000.0 kWh.
 One decimal disappear definitively after the first roll-over. Reset the counter to display it again
- Page M12**
 Total reactive energy counter kVarh
 Total active energy counter kWh
 range 0,000,000.00-99,999,999.9 kWh.
 When the upper limit is reached, the counter restarts from 00,000,000.0 kWh.
 One decimal disappear definitively after the first roll-over. Reset the counter to display it again
- Page M12-S1**
 Cogeneration counters. This page is available only if the COG is enabled into the SETUP.
 Total capacitive reactive energy kVarh
 Total exported active energy kWh

To measure properly the cogeneration counters it is strictly necessary to connect the CTs oriented in the same direction. This is not required if the Cogeneration is OFF

5 - SETUP PAGES

To access the SETUP open the front door and press the PAG and the SEL keys at the same time:
 Use the SEL key to select a digit or a setting. Use the SET key to adjust it.
 The setup can be protected with a password (see next chapter)

- Page S1** Programming the Primary and Secondary ratio of a PT.
 Use a ratio equal to 1 (e.g. 100/100) in case of direct measurement without voltage transformer is not used. Select a digit with the SEL key; change its value using the SET key.
- Page S2** Programming the Primary and Secondary Windings of a Current Transformer
 Select a digit with the SEL key; change its value with the SET key.
- Page S3** : Integration time for Power and current averages, range 00-99min.
 Select a digit with the SEL key; change its value with the SET key.
- Page S4** Reset energy counters.
 If you select Y with the SET key, all the counters will be reset as soon you confirm by pressing the PAG. key.
- Page S5** Reset Averages and Maximum Demands, Power and current averages.
 If you select Y with the SET key, all the Averages and maximum demand values will be reset as soon you confirm by pressing the PAG. key.
- Page S6** Enable Cogeneration counters.
 Select ON or Off to enable the measures and confirm with PAG
 To measure properly the cogeneration counters it is strictly necessary to connect the CTs oriented in the same direction. This is not required if the Cogeneration is OFF
- Page S7** Programming connection type
 Select the type of system which you want to measure using the SET key.
 - Page S7a** 3 PH Three phases without neutral (i.e. Delta)
 - Page S7b** 3 PH And n Three phases with neutral (i.e. Star)
 - Page S7c** 2 PH Two-phases with neutral
 - Page S7d** 1 PH Single phase with neutral
- Page S8** : RS485 communication parameters setup
 Baud Rate: (3 top digits) can have the following values: 2.4, 4.8, 9.6, 19.2 (kbaud)
 The Parity (central) value can be : N (none), O (odd), E (even).
 The type of communication protocol Modbus (3 bottom digits) can be:
 ASCII = Modbus ASCII. This format is limited to simulate the same data frame of the Vip Energy.
 BCD = Modbus BCD. It allows the full control of the instrument
 IEEE = Modbus IEEE standard, INTEL format

- **Page S9** Rs485 instrument address
The Modbus address of the instrument can be set in this page.
The permitted address field ranges between 1 and 247.

The page S9 is the last one of the basic model STAR3 family.
Other pages will follow only if the STAR3 is equipped with the options HARMO, ALM, 4-20mA

6 - SET-UP PAGE PROTECTION CODE

By default, the access code to set-up pages is not enabled. To enable it, keep the PAG + SEL keys pressed simultaneously for 30 sec. The display will show the page on which the access code must be entered.

- **Page S0 enter setup password**
By means of the SEL + SET keys, every digit can be changed and the code can be entered. The initial factory code, that must be entered the first time is 000000.
Confirm and exit from this page by pressing the PAG key.
- **Page S0a – modify password**
Now a second page (with "COD" blinking), identical to the first one, is displayed:
From this page, the access code can be permanently changed, if wished.
In this case remember or make a safe note of the new code somewhere you can find it later on.
To exit from the second page press the PAG key.

IMPORTANT: After the first access to the password page, the request of the code will become permanent. From that moment on the code must be always entered to access the set-up page.
Avoid to recall the password page, for test purposes, if the code request is not permanently desired.

SETUP PASSWORD MEMO	
STAR3 SERIAL #	
INSTALLED AT	
FACTORY PASSWORD	000000
DATE	
NEW PASSWORD	
DATE	
NEW PASSWORD	
DATE	
NEW PASSWORD	

7 – ADDITIONAL SETUP PAGES FOR MODELS STAR3 HARMO and ALM

To access Programming Mode, open the front door and press the PAG and the SEL keys at the same time. Use the SEL key to select a digit or a setting. Use the SET key to adjust it.
The setup can be protected with a password (see chapter 6)

- **Page S10- Pulses with length 100 msec**
Enable Pulse mode with pulse length of 100 msec
Press PAG to confirm. Press SET for selection, 20 msec (S11). RLY (S12).
- **Page S11 - Pulses with length 20 msec**
Enable Pulse mode with pulse length of 20 msec.
Press PAG to confirm. Press SET for the next selection (go to S16)
- **Page S12-ALM**
The confirmation of this page enable the remote relay control or the alarm mode.
Press PAG to confirm
Press SET to go to the pulse mode (go to S10).

PULSE OUTPUT

- **Page S13- Measure corresponding to output 1.**
Pressing the SET key enables to select the measure corresponding to output 1:
kWh tot
kWh tot COG
kVArh tot
kVArh tot COG
kVAh tot
- **Page S14 - Measure corresponding to output 2.**
Pressing the SET key enables to select the measure corresponding to output 2.
The measure available are the same of page S12 for output 1.
- **Page S15 - Weight of 1 pulse output 1**
Number of kWh corresponding to 1 pulse.
E.g.: 1 pulse = 0.01 kWh
Pressing the SEL key to select the digit to modify.
Pressing the SET key to adjust the selected digit to modify.
Pressing the PAG key enables to go to output 2 pulse weight set-up.
- **Page S16 - Weight of 1 pulse output 2.**
Same as S14 for output 2.
This is the last page of the setup. Press PAG to return to the measure pages

RELAYS or ALARM OUTPUT

- **Page S17-Measure for Alarm 1**
Association of the output 1 with a measures for alarm controlling. Press the SET key to choose one the following measures. The following list is available in 3PH-N mode.
Some of the measures are not carried out in 1PH, 2PH and 3PH mode and therefore can not be found in the setup of the alarm.
V total ; VL1 ; VL2 ; VL3
A total ; AL1 ; AL2 ; AL3
kW total ; kWL1 ; kWL2 ; kWL3
kVA total ; kVAL1 ; kVAL2 ; kVAL3
kVArh total ; kVArhL1 ; kVArhL2 ; kVArhL3
PF total ; PFL1 ; PFL2 ; PFL3
THDV tot ; THDV L1 ; THDV L2 ; THDV L3
THD A tot ; THDA L1 ; THDA L2 ; THDA L3
RLY = relay 1 controlled remotely, via RS485, instead of locally as an alarm (go to S18)

Pressing the PAG key enables to go to one of the following pages:
set-up of the upper threshold of output 1 if one of the measures has been selected; (S19)
set-up of the relay output 2 if the remote mode has been selected for output 1 (S24)

- **Page S18-Remote Rs485 relay 1 control**
if RLY is confirmed in S17 (see above) the position of the relay 1 is decided by the Rs485 master device (PC , PLC, etc) Press PAG to accept the RLY selection and enter the setup of relay 2 (go to S23) Press SET to enable the alarm mode (go to S17).
- **Page S19- Alarm 1 High threshold**
Set-up of the upper threshold (H) of the selected measure. When the measure remain above the threshold + hysteresis , for a time longer than the requested delay, the relay 1 is closed, range 000-999 x 10⁶
Press the SEL key to select the digit or exponent to be modified.
Press the SET key to modify the selected digit or exponent.
Press the PAG key to go to the output 1 lower threshold set-up page.
- **Page S20- Alarm 1 Low threshold**
Set-up of the lower threshold (L) of the selected measure. When the measure remain below the threshold - hysteresis , for a time longer than the requested delay, the relay 1 is closed, range 000-999 x 10⁶
Press the SEL key to select the digit or exponent to be modified.
Press the SET key to modify the selected digit or exponent.
Press the PAG key to go to the relay 1 hysteresis set-up page.
- **Page S21 –Alarm 1 hysteresis**
A value between 00 and 99 can be set in the 3 bottom digits, expressed as a % (percentage) of the alarm threshold. The alarm condition is aknowledged only if the measure become higher than Threshold*(1+hysteresys%)
Pressing the SEL key enables to select the digit to modify.
Pressing the SET key enables to modify the selected digit.
E.g.: Hysteresis = 02%
Pressing the PAG key enables to go to the relay 1 operation delay time set-up page.
- **Page S22 Alarm 1 Delay**
Relay 1 operation delay time set-up
A delay figure between 000 and 999 can be set in the 3 bottom digits, expressed in seconds.
The alarm will toggle only if the new alarm condition persist for a time longer than the delay
Press the SEL key enables to select the digit to modify.
Press the SET key enables to modify the selected digit.
Press the PAG key to go to set-up of the output 2
- **Page S23 Measure for Alarm 2**
Similar to S17 for relay 2.
- **Page S24 Remote RS485 relay 2 control**
Similar to S18 for relay 2.
- **Page S25- Alarm 2 High threshold**
Similar to S19 for relay 2.
- **Page S26- Alarm 2 Low threshold**
Similar to S20 for relay 2.
- **Page S27 –Alarm 2 hysteresis**
Similar to S21 for relay 2.
- **Page S28 Alarm 2 Delay**
Similar to S22 for relay 2.

8 – ADDITIONAL SETUP PAGES FOR MODEL STAR3 4-20mA

To access Programming Mode, open the front door and press the PAG and the SEL keys at the same time. Use the SEL key to select a digit or a setting. Use the SET key to adjust it.
The setup can be protected with a password (see chapter 6)

- **Page S10 4-20mA – Analogue output range**
By pressing the SET key, the type of output (either 4-20mA or 0-20mA) can be selected.
Pressing the PAG key enables to go to the measure selection page corresponding to output 1.

- **Page S11 4-20mA – Measure for output 1**
Output 1 measure selection
By pressing the SET key one of the following measures can be selected for output 1:
V total (3 PH, 2 PH or 1 PH according to the instrument set-up)
A total (3 PH, 2 PH or 1 PH according to the instrument set-up)
Hz
kW total (3 PH, 2 PH or 1 PH according to the instrument set-up)
kVAr total (3 PH, 2 PH or 1 PH according to the instrument set-up)
kVA total (3 PH, 2 PH or 1 PH according to the instrument set-up)
PF total (3 PH, 2 PH or 1 PH according to the instrument set-up)
Pressing the PAG key enables to go to the measure selection page corresponding to output 2.
- **Page S12 4-20mA – Measure for output 2**
Similar to the previous page for output 1
Press PAG to go to the output 1 end value set-up page.
- **Page S13 4-20mA Output 1 full scale value set-up**
Press the SEL key to select the exponent or the digit to modify.
Press the SET key to modify the selected exponent or digit.
Press the PAG key to go to the output 2 end value set-up page.
- **Page S14 4-20mA - Output 2 full scale value set-up**
The programming procedure is the same as the output 1 full scale value.
The PAG key enables to return to the measurement page.

9 - TECHNICAL CHARACTERISTICS

Maximum dimensions (mm): instrument: 96 x 96 x115.4. Cut-out template: 91 x 91

Power supply:

- **STAR3:** from network 230 V or 115 V +15%-20% @ 35÷400 Hz (4 VA).
- **STAR3 SWITCHING:** from 90 to 230 V AC/DC ± 15% @ 0÷400 Hz (4 VA).

Display: reverse red LCD with LED backlight

Voltmeter inputs: VL1, VL2, VL3, N up to 430 V phase-neutral, 750 V phase-to-phase, 35÷400 Hz

Voltmeter input impedance: 2 MΩ

Voltage input overload: max 850 V phase-neutral

Current inputs: AL1, AL2, AL3, COM. Consumption 1 VA..3 or 2 external curr.transf 5A required.

Measuring range: 0-120% In

Sensitivity: current 20 mA ; voltage 10 V

Over current : withstand 50 amps for 1 sec.

Number of scales: 1 voltage scale, 2 current scales

Measurements: True R.M.S. up to 25th harmonic = 1250Hz with fundamental @50 Hz

Sampling frequency: 2.5 kHz.

Accuracy: < 0.5% for Voltage and current and Power

Connection: Single phase or three phase star, three phase delta, or diphas systems

Weight : 0.6 Kg

Protection level: instrument IP20, front panel IP40

Temperature range: -10°C ÷ + 50°C

Relative humidity range: (R.H.): from 20% to 90%.

Condensation: non condensing

Relay output: V 250 max 120 mA A.C. max