Manual
for Operation

Harmonic and Flicker Analyzer

Manual for
DPA 500N, DPA 500N1
DPA 503N, DPA 503S1

- IEC 61000-3-2
- IEC 61000-3-3
- IEC 61000-3-11
- IEC 61000-3-12
- IEC 61000-4-7
- IEC 61000-4-15
- JIS C 61000-3-2

Flicker impedance

- AIF 503, N16, N16.1, N16.2, N32.1, N63.1, N75.1
- AIF 500N32

AC Source

- ACS 500N6
- ACS 500N3
- ACS 503, N16, N30, N60, N90
- NetWave

the benchmark for emc

Version: 6.16 / 26.04.2019
Replaces: 6.15 / 23.11.2018
Filename: UserManual-DPA_ACS-E-V6.16.doc
Printdate: 26.06.19

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Foreword

Thank you for purchasing the NetWave generator. This user's manual lists precautions that must be taken during use and contains useful information about the functions and operating procedure of the device. To ensure correct use, please read this manual thoroughly before starting operation. After reading the manual, keep it in a convenient location for quick reference whenever a question arises during operation.

This manual contains a selection of typical system setup with the correct wiring diagram.
For information about using and handling with the software NetWave Control, see the manual for this product

Notes

The content of this manual is subject to change without prior notice because of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from those that appear on your display and screen.

Every effort has been made in the preparation of this manual to ensure the accuracy of these contents. Should you have any questions or find any errors, please contact your EM Test representative or send an email to EM Test.

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Version

This manual is written for NetWave Firmware version 7.00.00 and higher

Contents

1 Model Overview

The following manual is valid for the DPA 500 N and DPA 500 series. Equipment's with the new anthracite coloured cover have the additional "N". To simplify the manual we uses the names DPA 500 / ACS 500 / AIF 500 and do not use the additional "N".

1.1 DPA analyzer

Model	Phases		Picture
DPA 500N	1-phase	Single phase Harmonics & Flicker analyser with Flicker Impedance for 16A	
DPA 500N1	1-phase	Single phase Harmonics & Flicker analyser with Flicker Impedance for 26A	
DPA 503S1	1-phase	Single phase Harmonics & Flicker analyser with external current clamp Flicker Impedance external	
DPA 503N	3-phases	3 Phase Harmonics & Flicker analyser (6 channels) external 3 current clamps Flicker Impedance external	

1.2 ACS ac sources

Single phase AC sources

ACS 500N6	1-phase	AC Source 6kVA, 300V / 19A resistive	
ACS 500N2	1-phase	AC Source 2kVA, 300V / 6.2A resistive	

3- phase AC sources

Rack mounted; for IEC61000-3-2/3-3/3-11/3-12

System		Voltage / Imax resistive (per phase)	
ACS 503 ACS503 N30	3-phases 20kVA 3-phases 30kVa	3 x 300V / 22 A 3 x 300V / 33 A	
ACS 503 N60	3-phases 60kVA	3 x 300V / 60 A	
ACS 503 N90	3-phases 90kVA	3 x 300V / 91 A	

Power supply requirements

System		**Input for AC source lines** (installation side)		
ACS 503	20`kVA	3x 400V AC 50/60 Hz	72Amax	30kWmax
ACS 503N30	30`kVA	3x 400V AC 50/60 Hz	80Amax	45kWmax
ACS 503N60	60`kVA	3x 400V AC 50/60 Hz	160Amax	81kWmax
ACS 503N90	90`kVA	3x 400V AC 50/60 Hz	250Amax	111kWmax

1.3 AIF flicker impedances

1- phase flicker impedances

Model	**Description**	**Picture**
AIF 500N32	Artificial Flicker Impedance for 32A per phase, manual switch for bypass, no connection to DPA 503N	

3- phase flicker impedances

Model	**Description**	**Picture**
AIF 503N16	Artificial Flicker Impedance for 16A per phase, MRAC optional	
AIF 503N16.2	Artificial Flicker Impedance for 16A per phase, manual switch for bypass, no connection to DPA 503N	
AIF 503N16.1	Artificial Flicker Impedance for 16A per phase, incl. MRAC & system engineering	

AIF 503 N32.1	Flicker impedance, 32A, Zref&Ztest incl. MRAC & system engineering	
AIF 503 N63.1 AIF 503 N75.1	Flicker impedance, 63A or 75A, Zref& Ztest incl. MRAC & system engineering	

The text in the rest of the manual uses the new names for the devices.

2 Application and Standards

The system is used for measuring and analysing harmonic currents, voltages and flicker interference injected into the public supply system. Depending on the system configuration the testing of equipment with one or three phases is possible.

2.1 Standards

The tests are carried out according to the following standards

2.1.1 Harmonics Standards

EN / IEC 61000-3-2	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16A per phase) Specifies limits for harmonic current emissions applicable to electrical and electronic equipment having an input current up to and including 16 A per phase, and intended to be connected to public low-voltage distribution systems. The tests according to this standard are type tests. Test conditions for particular equipment are given in annex C. For systems with nominal voltages less than 220 V (line to neutral), the limits have not yet been considered.
JIS C 61000-3-2	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 20A per phase)
EN / IEC 61000-3-12	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤ 75 A per phase
EN / IEC 61000-3-12	Electromagnetic compatibility (EMC) - Part 3-12: Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current <- 75 A per phase and subject to restricted connection.

2.1.2 Flicker Standards

EN / IEC 61000-3-3	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection This section of IEC 61000-3 is concerned with the limitation of voltage fluctuations and flicker impressed on the public low-voltage system. It specifies limits of voltage changes which may be produced by equipment tested under specified conditions and gives guidance on methods of assessment. This section is applicable to electrical and electronic equipment having an input current up to and including 16 A per phase and intended to be connected to public low-voltage distribution systems of between 220 V and 250 V at 50 Hz line to neutral.
IEC / EN 61000-3-11	Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current <= 75 A and subject to conditional connection

2.1.3 Immunity Standards

IEC 61000-4-7
Electromagnetic compatibility (EMC) - Part 4-7: Testing and measurement techniques –

General guide on **harmonics and interharmonics measurements** and instrumentation, for power supply systems and equipment connected thereto

Applies to instrumentation intended for measuring spectral components in the frequency range up to 9 kHz which are superimposed on the fundamental of the power supply systems at 50 Hz and 60 Hz.
For practical considerations, this standard distinguishes between harmonics, interharmonics and other components above the harmonic frequency range, up to 9 kHz.
Defines the measurement instrumentation intended for testing individual items of equipment in accordance with emission limits given in certain standards (for example, harmonic current limits as given in IEC 61000-3-2) as well as for the measurement of harmonic currents and voltages in actual supply systems.

IEC 61000-4-15
Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 15:

Flickermeter - Functional and design specifications
Gives a functional and design specification for flicker measuring apparatus intended to indicate the correct flicker perception level for all practical voltage fluctuation waveforms. Information is presented to enable such an instrument to be constructed. A method is given for the evaluation of flicker severity on the basis of the output of flickermeters complying with this standard.

IEC/TR3 60725
Considerations on **reference impedances** for use in determining the disturbance characteristics of household appliances and similar electrical equipment

Records the information that was available and the factors that were taken into account in arriving at the reference impedance of 0.4+ j 0.25 ohm which has been incorporated in IEC 60555. Has the status of a technical report.

2.2 Test system description

The harmonic and flicker system has the following components.

PC Computer operating and control of the system with the software net.control for harmonic and flicker measuring. (Older system uses CIGUI software for the control of the AC sources HFS from CI).

Measuring system DPA
The **D**igital **P**ower **A**nalyser (DPA) is available in the following models. The measuring device is a single phase (**DPA 500N**, **DPA 503S1**) or for 3-phase measuring (**DPA 503**) system which measure voltage and current of each phase. The DPA is controlled by the net.control. The DPA is designed for measuring harmonics and flicker according the standards. After FFT calculation the DPA store the complete data on the internal hard disk. Evaluation is done after measuring at the computer.

DPA 500N

AC source
The AC sources **ACS500N** [6000VA], **ACS500N2** [2000VA] **NetWave 7.x** [7.5kVA] and **NetWave 3.1** [3kVA] generates the sinewave AC power for testing Harmonic and Flicker. The ACS 500N is a cost effective single phase source. A 3-phase system needs the **ACS 503** AC- source, **NetWave 20** [22.5kVA], **NetWave 30** [30kVA] and **NetWave 67** [67kVA]. The source can be used for other applications.

ACS 500N , NetWave 7

Flicker impedance
The **AIF 503N16.x** is an external Flicker impedance for 3-phase application. For single phase a built in lumped flicker impedance is inside the **DPA 500N.**

For fully standard-conform flicker measurement a flicker impedance between source and EUT has been incorporated in the system. A bypass switch briefly short circuit the flicker impedance when measuring harmonics, thereby ensuring a low impedance.

AIF 503

AIF 503N32.1 is an automatic 3-phase flicker impedance for 32A with two internal flicker impedances Zref and Ztest for testing according IEC 61000-3-11.

A automatic bypass switch briefly short circuit the flicker impedances when measuring harmonics, thereby ensuring a low impedance.

The AIF 503N30 has internal space for the harmonic and flicker analyser DPA 503.

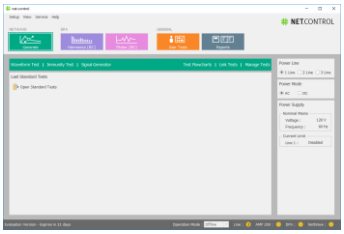
AIF 503N32 + ACS 503N30

Software

net.control is the control software for the harmonic and flicker measurement (The ACS 500N / 503N is controlled by the net.control).

CIGUI32 software must be used for remote control the HFS 500 / HFS 503

net.control and CIGUI32 software are independent



net.control

Current transformer CT

The DPA 503 and DPA 503S1 use current clamp for measuring. The clamps are factory calibrated with two turns. In a 3-phase system the current transformer are matched for minimal difference. Every CT is adjusted to one phase input and marked with a label for the dedicated phase.

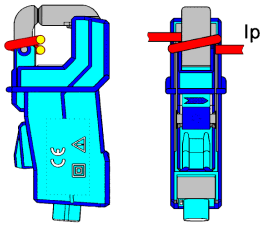
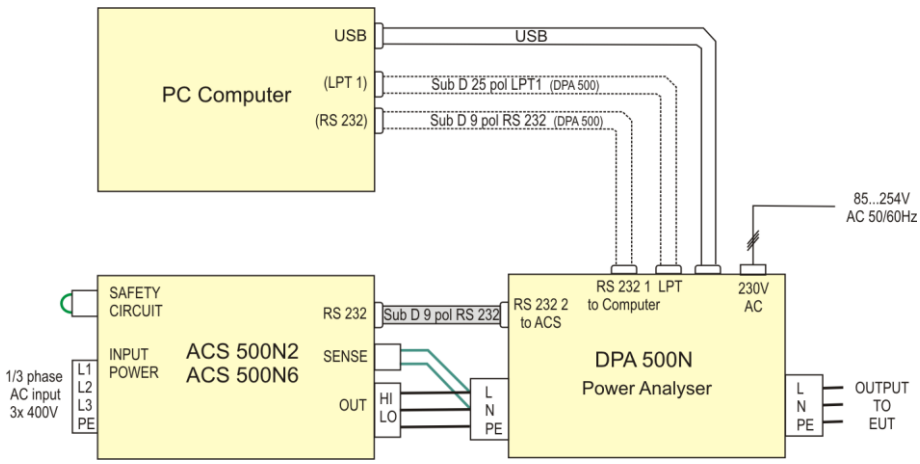


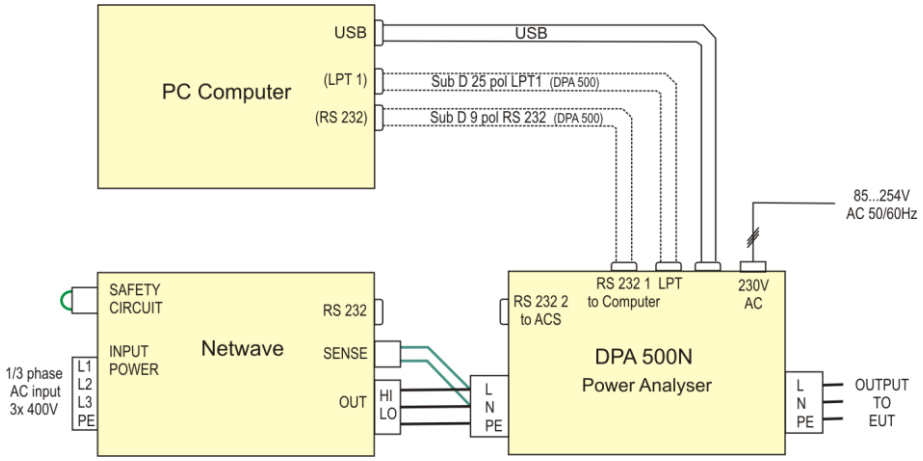
Figure 2.6. shows the fixing of the wire to the CT.

Models: M1.UB 1V / 5A Art No 109452
ZA 1015 200A/2V Art No 104583

2.3 Single phase system

For single phase wiring diagram see figure 2.7. The wiring size must be rated for the maximum excepted current and voltage. The DPA 500N is rated for current of 16A rms and 50A peak (1s)





Power supply requirements

System	**Fuses for AC source lines** (installation side)	
ACS 500N 5000VA	400V AC 50 Hz	32A L1-L2-L3 (16A), N (27A), PE
ACS 500N2 2000VA	230V AC 50 Hz	16A
DPA 500N / DPA 503S1	230V AC 50 Hz	10A
Netwave 3 3500VA	300V AC 50 Hz	32A L1-L2-L3 (16A)
Netwave 3.1 3000VA	300V AC 50 Hz	32A L1-L2-L3 (16A)
Netwave 5 4200VA	300V AC 50 Hz	32A L1-L2-L3 (16A)
Netwave 7 7500VA	300V AC 50 Hz	32A L1-L2-L3 (16A)

2.3.1 DPA 500N analyser

Frontside

Reset	Reset button for booting the DPA 500N
Test Supply	Output plug to EUT max. voltage 530V 16A nom.
Input Current	BNC Input for external current clamp max. 1.4V rms. The LED is enabled when used
Bypass	LED for Bypass indication (the internal flicker impedance is short circuited).
Flicker	LED for Flicker measurement with internal impedance. I max. rms 16A
Overload	Overload is indicated, when both LED Bypass & Flicker are lighting.

Rear side

Input power source	Input power from AC source max. 530V 16A nom
Mains	Mains input max. voltage 85V...254V Fuse 2A slow
USB from host	Serial port to the host computer
(LPT)	*LPT parallel bi-directional output to the host computer*
(Serial 1 from host)	*Serial port to the host computer*
Serial *(2)* **to ACS**	Serial control output to ACS 500N (AC source)

2.3.2 DPA 500N1 analyser

Frontside

Reset	Reset button for booting the DPA 500N1
Test Supply	Output plug to EUT max. voltage 530V 26A nom.
Input Current	This output is used for the internal current clamp. The LED is not used.
	Setting in Menu Setup Device parameter:

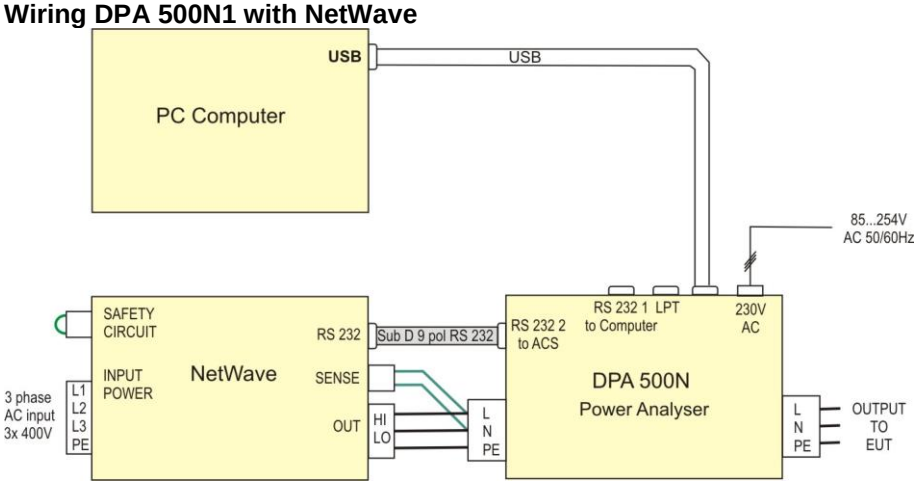
- current transformer	other
- Ratio [mV/A]	10.00mV/A
- Number of turns	2

Bypass LED for Bypass indication (the internal flicker impedance is short circuited).

Flicker LED for Flicker measurement with internal impedance. I max. rms 16A

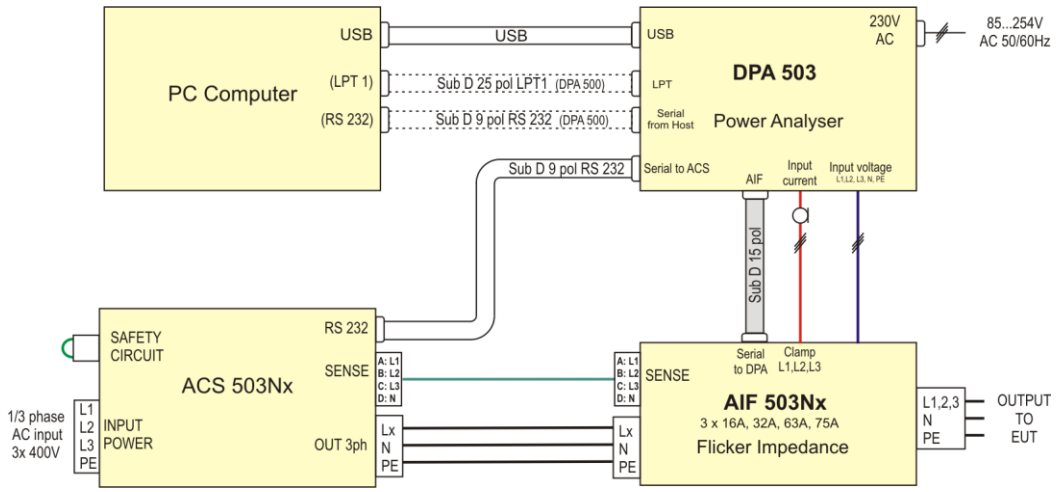
Overload Overload is indicated, when both LED Bypass & Flicker are lighting.

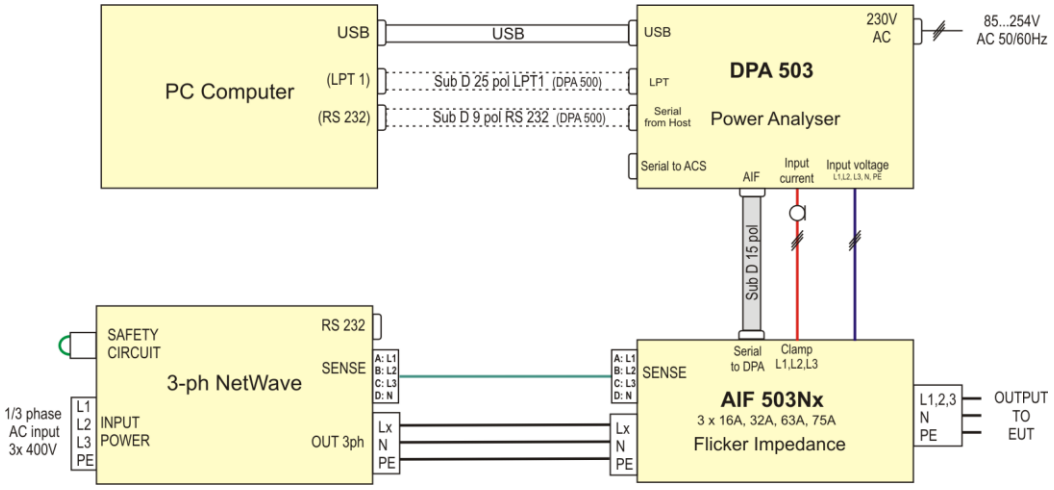
Wiring DPA 500N1 with NetWave

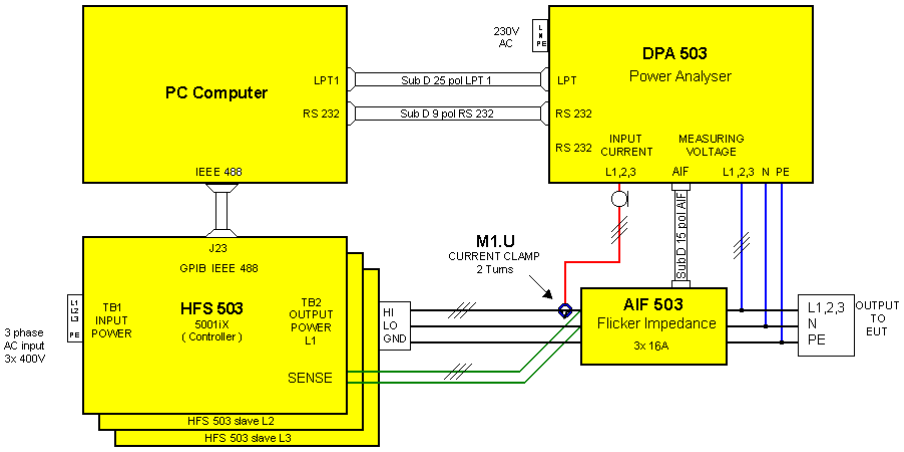


2.4 3-phase system

For 3-phase wiring diagram see figure 2.13 and figure 2.14. The wiring size must be rated for the maximum excepted current and voltage. The delivery in a Rack is the most comfortable solution.







At the EUT output the following connections are available:

1 - Phase System safety socket 16A

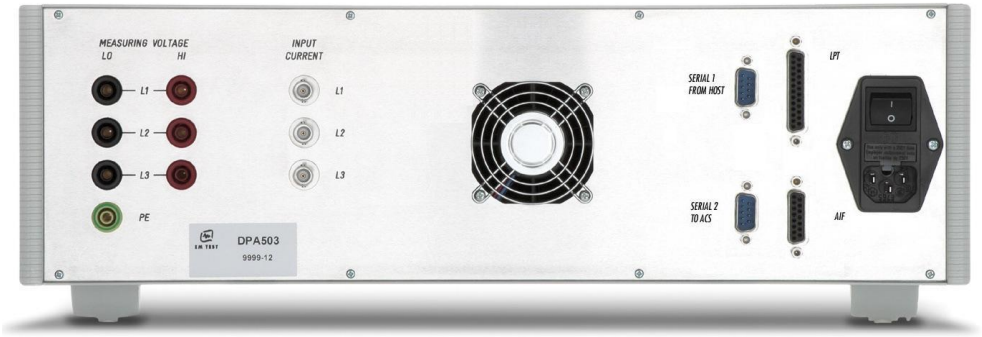
3 - Phase System 3 safety sockets 16A and one CEE socket with 3-phase connection 32A. + Multi Contact connector 80A

2.4.1 DPA 503N analyser

Frontside

Reset Reset button for booting the DPA 503

Rear side



Mains	Mains input max. voltage 85V...254V Fuse 2A slow
USB from host	Serial port to the host computer
(LPT)	*LPT parallel bi-directional output to the host computer*
(Serial 1 from host)	*Serial port to the host computer*
Serial 2 to ACS	Serial control output to ACS 500N or ACS 503 (AC source)
AIF	Output for the flicker impedance control
Measuring voltage	Input for voltage measuring max. 530V (HI - LO)
Input Current	BNC Input for external current clamp max. 1.4V rms

2.4.2 Flicker impedance AIF 503Nxx.1

The flicker impedance offers the following features

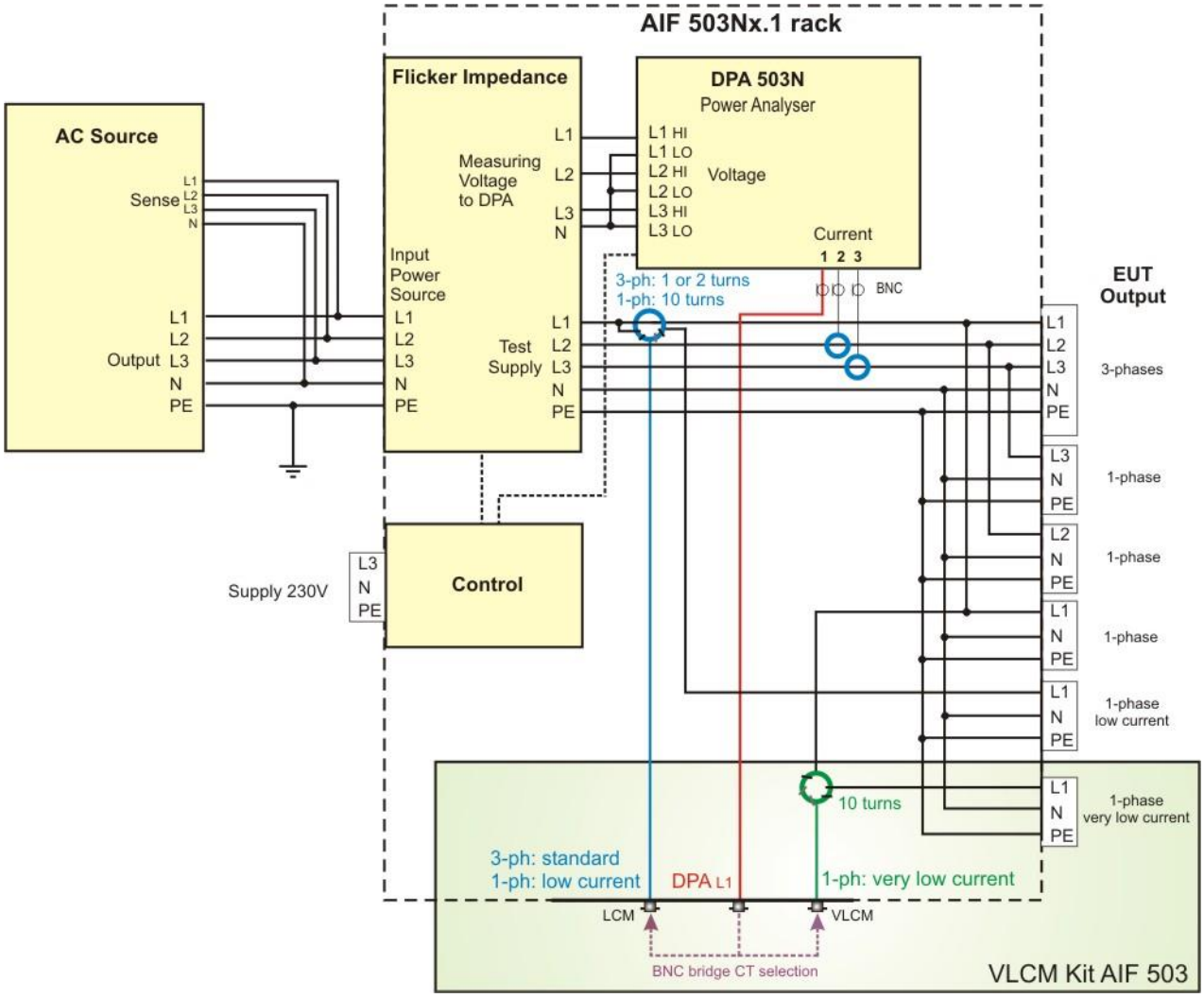
- Harmonic measurement with bypass of the Flicker impedance
- Output plugs for 3-phase and 1-phase for each Phase
- Single phase output for low current and very low current (option) measurement
- Flicker measurement with Zref and Ztest
- Remote control from software via DPA 503

AIF 503Nx.1 EUT output plugs:

- 3-phase plugs 100A (Multi Contact) for L1, L2, L3, N, PE
- CEE 3-phase connector (AIF 503N32.1)
- 3 x 1 Single phase output plugs for each phase (L1, L2, L3)
- 1 Single phase plug: L1 for low current measuring LCM (Current range 100mA < I < 10A)

Optional output with VLCM Kit AIF 503N:

- 1 Single phase plug: L1 for very low current measuring (Current range 5mA < I < 500mA)
- Output selector (BNC bridge)



Schematic AIF 503Nx.1 the green section shows the wiring with the VLCM Kit AIF 503

2.5 Interfaces

The computer is connected with the following interfaces to the DPA equipment:

2.5.1 Interface to DPA 500N / 503 series

Device			Interface
Computer	-	DPA 500N / 503 (with USB option)	USB A / B
DPA 500N	-	ACS 500N6 / ACS 500N2	RS 232
DPA 503	-	ACS 503Nx	RS 232

Figure. 3.7

2.5.2 Interface to DPA 500 / 503 series

Equipment			Interface
Computer	-	DPA 500 / 503	RS 232 / Parallel LPT
DPA 500	-	ACS 500 / ACS 500S1	RS 232
DPA 503	-	ACS 503 (S1-S4, N30 - N90)	RS 232
Computer	-	Controller HFS 500 / 503	IEEE 488

Parallel interface to DPA

For transfer the measuring data the program uses the parallel port. Select in menu PC-setup

Interface: LPT1, LPT2 or LPT3.

Mode: **ECP** or **ECP + EPP**. (adjust the BIOS setup of the PC).

Cable: Parallel for bi-directional data transfer (not crossed)

Wiring of the RS 232 interface to DPA

The communication from the PC to the DPA is assured by the serial interface RS 232. The connecting cable should be a special 9-pole female cable. Pin 2 and pin 3 are crossed. The data transfer depends on the performance of the computer and is between 19200 and 57600 baud.

The interface cable is a PC link cable with the pin connections as shown in Table 3.1. To achieve interference-free data transfer we propose to use a shielded cable.

Computer 9- Pol SubD	Signal		Signal	DPA 9- Pol SubD
1	CD	----		7
2	TxD	----	RxD	3
3	RxD	----	TxD	2
4	DTR	----		6 / 8
5	GND	----	GND	5
6	DSR	----		4
7	RTS	----		1
8	CTS	----		4
9	RI	----		9
	Schirm		Schirm	

RS 232 wiring for cable DPA - Computer and DPA - ACS

3 Calibration procedure

Measurement calibration is recommended on an annual basis to ensure the measurement results are within published specifications. All measurement calibrations can be performed without removing the covers. Measurement calibration coefficients are used to adjust each parameter.

3.1 Which devices must be calibrated

The following Flicker and harmonic devices are necessary to be calibrated periodically:
AMETEK CTS propose for the DPA 50x and AIF 50x an accredited calibration (example SCS in Switzerland).

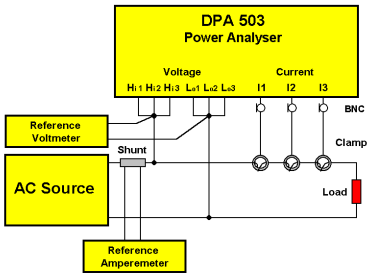
Device	Calibration	Remark
DPA 50x	Yes	Periodical calibration necessary
AIF 50x	Yes	Periodical calibration necessary
ACS 50x	No	Calibration not necessary. The DPA 50x checks the AC source during the harmonic measuring in each time window and report it after each measurement. For Flicker measuring is a separate AC source check available in the software. The accuracy and uncertainty of the DPA 50x is much higher than recommended for the AC source. A periodical function check of the THD and output voltage with the DPA 50x, performed by the user is proposed.

3.2 Calibration setup

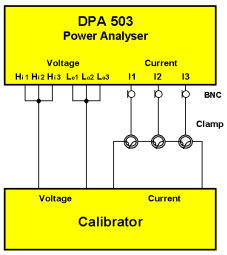
The following equipment is required to perform the measurement calibration procedure.
- A 6½ digital true rms AC multimeter (recommended is Keythley 2000)
- Amp current transformer, or suitable current shunt
- Load resistor that will produce about 80% of rated power.

A calibration with a calibrator like Fluke 5500A is a comfortable solution.

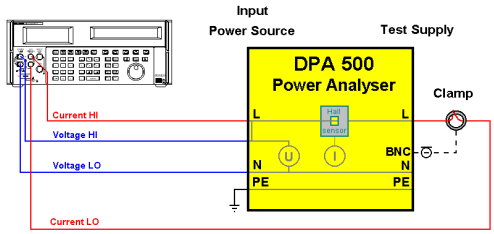
Using external instruments



Setup with AC multimeter



Using a calibrator



Setup with calibrator

With **Reset calibration** you erase all correction factors and the DPA measures with the factory setting.

4 Technical Data - Analyzer Type DPA

Measuring system:	**DPA 503**		**DPA 500N / DPA 503S1**
Input channels	6 (3 x current & voltage)	2	(1 x current & voltage)
EUT connection	1x3-phase EUT or 3x1-phase EUT at same time (harmonics only)		1x1-phase EUT
Frequency range	15 ... 2500Hz		
Sampling rate	6400 Hz		
A/D converter	16 Bit		
Controller	Embedded PC 104 Single Board Computer		
Signal processor	Motorola DSP		
Memory	Flash Card 4GByte		
Class of instrument	Class A acc. to EN / IEC 61000-4-7 Ed.1(1991) and Ed.2.1 (2009)		

Voltage Input :	
Input range	10...530V rms
Overload	4000V peak
Accuracy [% of reading]	0.2% <50V 0.1% 50V - 150V 0.05% 150V - 530V

Current Input :	depends on used CT model
Input range internal	50A (DPA 500N)
Input range external	140A (factory setting 2 turns 70A for EN / IEC 61000-3-2 up to 16A)
Accuracy	See chapter Measuring accuracy

Harmonic analysis:	acc. IEC / EN 61000-3-2 and EN / IEC 61000-4-7 and IEC / EN 61000-3-12
Harmonic range	1...50th harmonic
Synchronization	PLL
Measurement window	rectangular window
Algorithm	FFT
Smoothing filter	1st order 1,5 s digital low pass filter, selectable (on/off)
Anti-aliasing filter	> 90 dB
Measuring duration	> 30 h limited by harddisk approx. 1MB/min
Display	Urms, Irms, Ipeak, Upeak
Display Harmonic 2...50 order	U, I, Phase, P, Q, S,
Power information	P, Q, S, Power factor, THD(U), THD (I)

Flicker analysis:	Acc. IEC / EN 61000-3-3 and EN / IEC 61000-4-15 and IEC / EN 61000-3-11
Accuracy P_{ST} and P_{LT}	<5%
Accuracy dmax, dc, dt	0.15%
Flicker data	P_{ST} and P_{LT} Vrms, dmax, dc, dt P50%S, P10%S, P3%S, P1%S, P0.1%
Maximum values	P_{ST}, dmax, dc, dt
Observation period	selectable min 1min

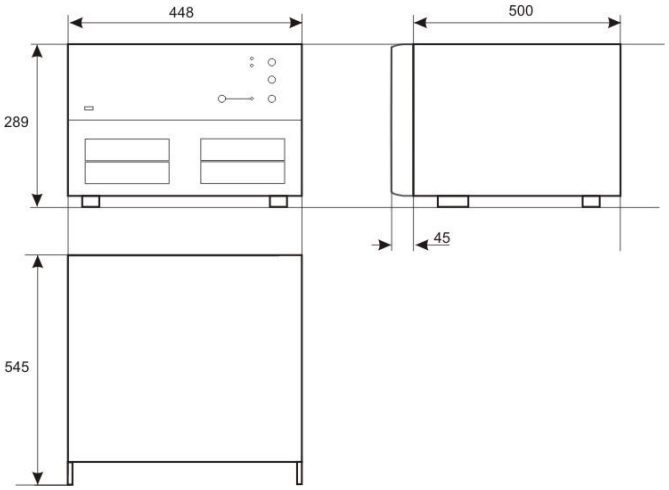
Flicker impedance:	DPA 500N only	DPA 500N1
Phase	0.24 +j 0.15Ω	
Neutral	0.16 +j 0.10Ω	
Accuracy	<3%	
Max. r.m.s. Current	16A	26A
Peak Current	50A 1s	

General Data		
Temperature operation	0...40°C	
Humidity	10%...90% non condensing	
Power supply	85V...255V , 47Hz...63Hz	
Power requirement	50W max.	
Fuse protection	2AT (slow blow)	
Insulation Input to case / input	3kV rms	
Interface	USB, RS 232 (Serial 1 to ACS/NetWave) , AIF	
Dimension 19” 3HU	**DPA 500N DPA 503N S1** 133 x 449 x 500 mm	**DPA 503N** 133 x 449 x 400 mm
Weight	12.7kg	12kg

DPA 500N1

The technical data are identical with the DPA 500N with the following exceptions:

Setting Device parameter:	
current transformer	other
Ratio [mV/A]	10mV/A
Number of turns	2
Max. r.m.s. Current	26A
Weight	26.6kg
Dimension 19" 6HU	



4.1 Measuring accuracy current

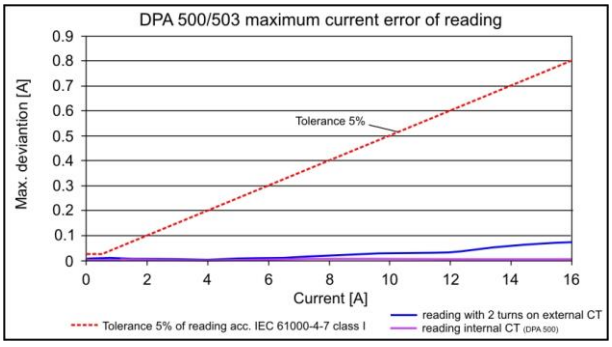
The standard IEC 61000-4-7 defines for measuring equipment of class I the following accuracy:

Conditions	**max. error**	
$I_m \geq 3\%\ I_{nom}$	$5\%\ I_m$	I_m = Measured values
$I_m < 3\%\ I_{nom}$	$0.15\%\ I_{nom}$	I_{nom} = Nominal current range of the measuring instrument (defined is 16A for the DPA)

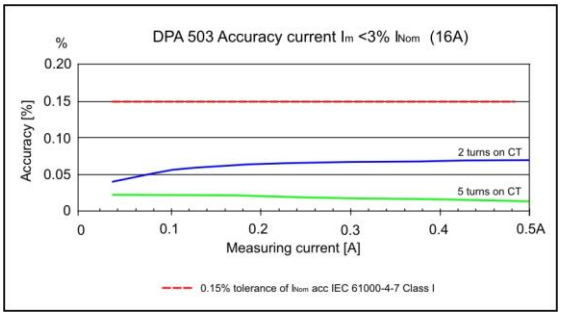
	External CT 2 turns	**External CT 5 turns**
Accuracy [%] related to 16A nominal current	0.1% 0 ... 1A	0.05 % 0 ... 1A
	0.4% 1 ... 5A	0.25 % 1 ... 5A
	0.8% >5A	0.6% >5A

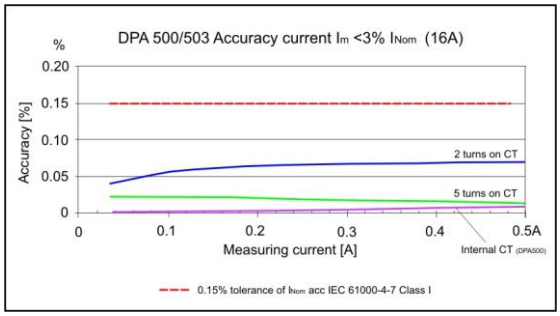
	[% of reading]	related to 16A nominal current
Accuracy DPA 500N internal current transformer	0.4% 0 ...1A	0.02 % 0 ...1A
	0.3% 1 ...10A	0.04 % 1... 10A
	0.15% >10A	0.05 % >10A

4.1.1 Measuring with standard current clamps



Measuring error with DPA





Detail measuring error [%] DPA with CT Universal and DPA 500N internal

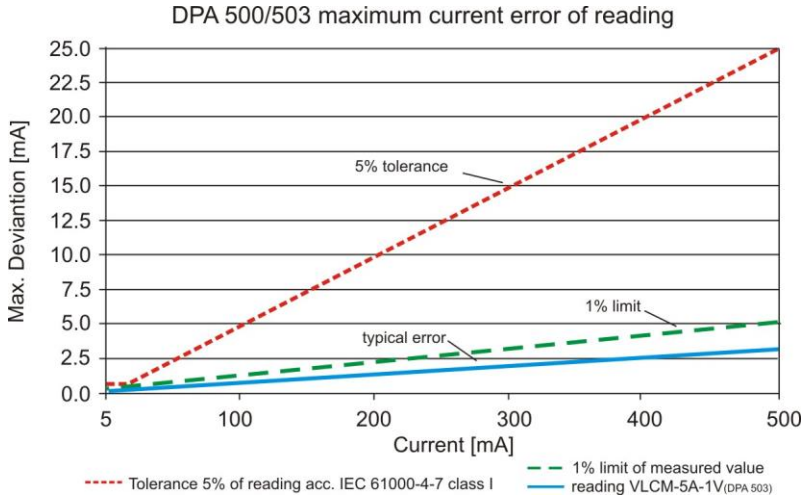
4.1.2 Measuring accuracy with Option VLCM (Very low current measuring)

With the option VLCM it is possible to measure very low current in the range of 5mA to 500mA

Measuring accuracy verification

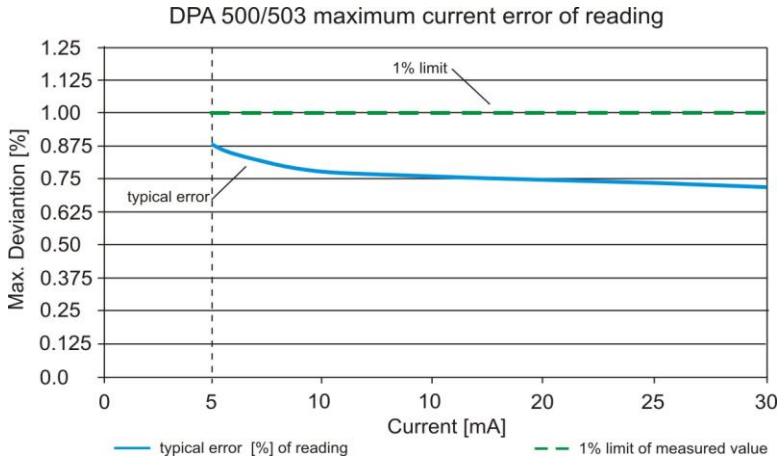
Measurement with DPA 503 and VLCM Kit using 10 turns on the CT.

A Fluke 5500A Calibrator is used for generate the 50 Hz current signal



DPA with option VLCM deviation [mA] 5 mA-500 mA

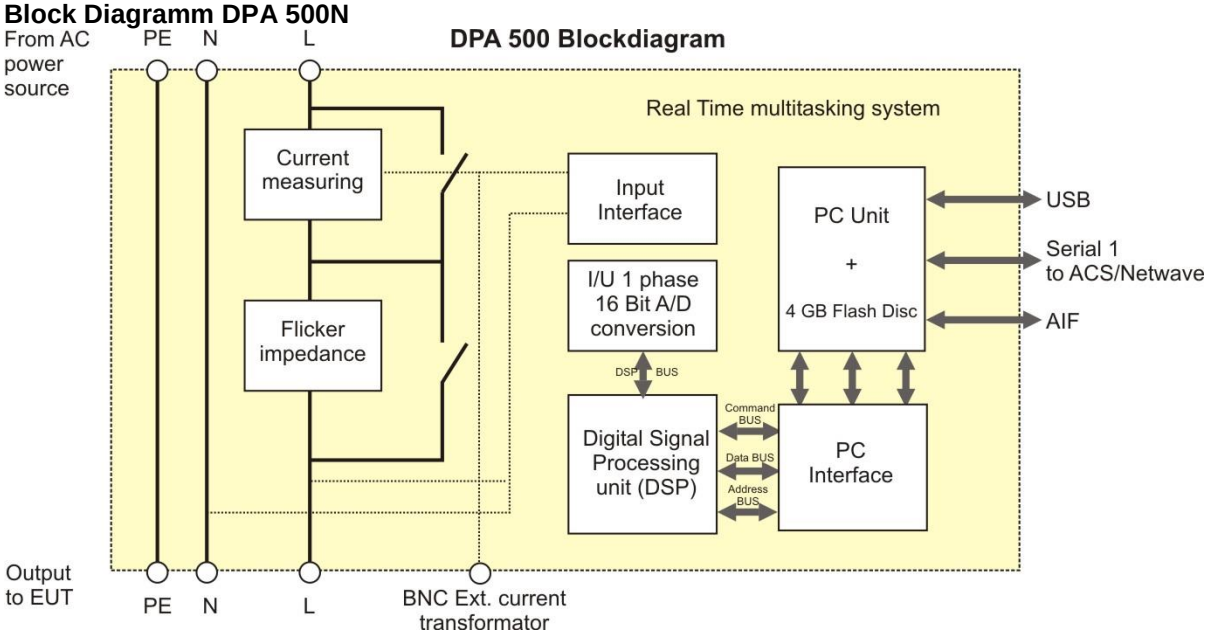
Detail of current measuring in the range of 5 mA to 30 mA.



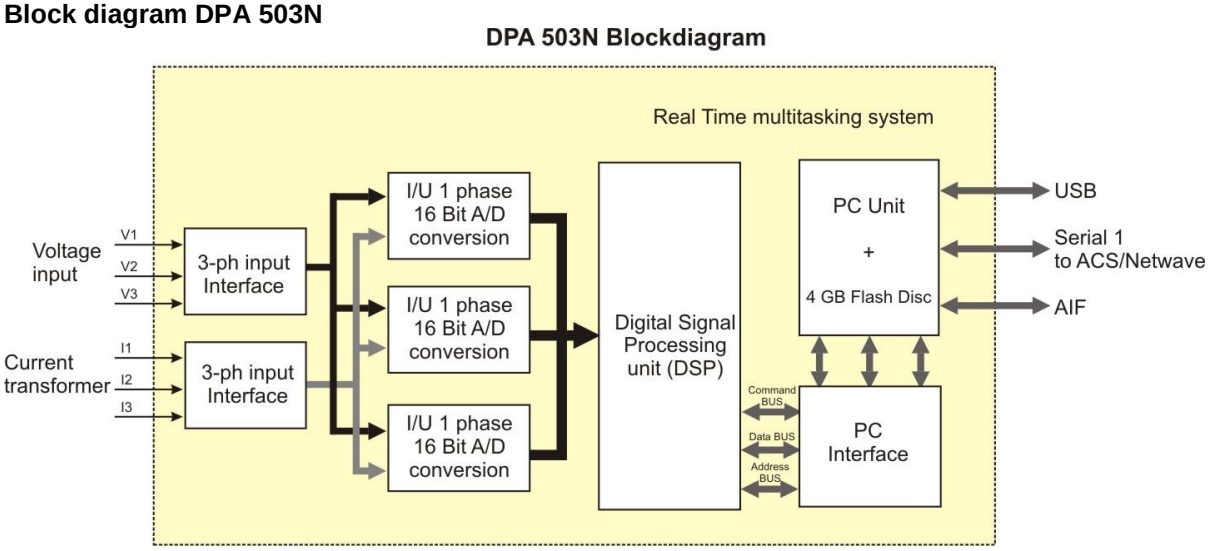
DPA with option VLCM deviation [%] 5 mA-30 mA

4.2 DPA Block diagram

Block Diagramm DPA 500N



Block diagram DPA 503N



5 AC source ACS 500N6 / ACS 500N3 / ACS 500N2 / ACS 503

5.1 General

ACS 500N are single phase AC source, specially designed for testing Harmonics and Flicker. It provides a perfect sinusoidal and stable voltage, adjustable both in frequency and amplitude. The specifications are in accordance with EN / IEC 61000-3-2 / -3.

The output voltage is adjustable with continuity from zero to full scale.

The output voltage is guaranteed to be perfectly sinusoidal, with a low distortion (THD) less than 0.1% regardless of the load. The value of output voltage is kept perfectly stable within 0.1% independent of the load.

With the two sense lines ACS 500N compensates a voltage drops along the output wires. Therefore the voltage on the load is exact the settled voltage.

The range of load can vary from the pure capacitive to the pure inductive and also up to non symmetrical current loads, as example a single half-wave rectifier.

ACS 500N provide the nominal power at full scales and there are no limitations on the output current over the full range.

Furthermore ACS 500N is able to keep the voltage stable with fluctuating loads, as for example the pulsating loads. In fact ACS 500N / NetWave recover the distortion of the waveform within 0.1% and the amplitude of the voltage within 0.1% in less than a half period.

Furthermore, ACS 500N can bear a short circuit for an indefinite time without suffering any consequence.

Attention	The output is isolated respected to the ground The output of the two phases can not be connected to the Ground

5.2 Operation

ACS 500N are controlled from the DPA 500N with the software. The output voltage is measured with the DPA 500N with a precision ≤ 0.1%.

In case of overcurrent obtainable by the ACS 500N, or in case of high loss in the wires, the voltage drop should not exceed 5% of the set voltage.

Please note that ACS 500N automatically limit the maximum allowed current, avoiding damages to the equipment. In this case the precision of the output waveform and the accuracy of the output voltage can not guaranteed.

The user can set the output voltage through the keyboard or with the preselected button for 230V 50 Hz.

Input range:
Voltage : 0...300V
Frequency : 10...80Hz

WARNING	Risk of electrical shock by touching the ACS output plugs For reduce the output voltage to low values it is necessary to set the voltage to **zero volt**.

WARNING	Risk of electrical shock by touching the ACS output plugs. The output voltage keeps on DPA 500N output plugs after exit the software. Please **switch off the ACS output voltage**.

5.3 Specifications

The models are different for the rated power, and type of supply (single phase or three phase with neutral).

=> Not relevant data for the standards can be changed by the manufacturer <=

5.3.1 Single phase AC sources

Parameter	ACS 500N2	ACS 500N3	ACS 500N6
			

Input

Line Voltage:	230V AC ±15%	230V AC ±15%	3x 400V AC ±15%
Line Current	16A	25A	16A / 27A neutral
Line Frequency	45 - 65Hz	45 - 65Hz	45 - 65Hz

Output

All the following features are valid within the range of the normal operating limits; they are not valid during the limitation of the output current.

Power [VA]	2'000VA	3'000VA	6'000VA
Voltage Range	0 to 300V		
Voltage Resolution	0.025% (12 bit)		
Waveform	Sine		
Output Frequency	10Hz to 80 Hz		
Frequency Resolution	0.02 Hz		
Frequency accuracy, stability	100ppm		
Output connector	Safety banana plug		
Phase synchronization	yes, with external synchronization signal on sync input		

Regulation

Voltage Sense	internal / external 4 wires
Total harmonic distortion	< 0.1%
Output voltage stability	< 0.1%
Output voltage accuracy	< 0.5%
Max. compensable drop on wires	5% f.s.
Protection	Overcurrent, Overtemperature, Overvoltage, Untervoltage

General specifications

Power [VA]	2'000VA	3'000VA	6'000VA
Dimensions [mm]	287x449x500	287x449x500	287x449x500
Weight ACS 500N	23kg	27.5kg	40.1kg
Operating temperature	0°C – 35°C		
Humidity	10% to 90% RH without condensation		

Unit protection

Input protection	Fuse 16A
Input under voltage	-15% of U nominal
Input overvoltage	+15% of U nominal
Output overcurrent	according table overcurrent
Overtemperature	more than 70°C

5.3.2 3- phase AC sources

Parameter	ACS503 (ACS503 N30)	ACS 503 N60	ACS 503N90
			

Input

Line Voltage:	3x 400V AC ±10%	3x 400V AC ±10%	3x 400V AC ±10%
Input power max.	30 kW (45 kW)	81 kW	103 kW
Line Current max.	72A (80A)	160A max	250A max
Line Frequency	50 - 60Hz	50 - 60Hz	50 - 60Hz

Output

All the following features are valid within the range of the normal operating limits; they are not valid during the limitation of the output current.

Power [VA]	20 kVA (30kVA)	60 kVA	90 kVA
Voltage Range	3x 0 to 300V		
Voltage Resolution	0.025% (12 bit)		
Waveform	Sine		
Output Frequency	40Hz to 80 Hz		
Frequency Resolution	0.02 Hz		
Frequency accuracy, stability	100ppm		
Output connector	3ph CEE connector		
Phase resolution	0.088° (12 Bit on 360°)		

Regulation

Voltage Sense	internal / external 4 wires
Total harmonic distortion	< 0.1%
Output voltage stability	< 0.1%
Output voltage accuracy	< 0.5%
Max. compensable drop on wires	5% f.s.
Protection	Overcurrent, Overtemperature, Overvoltage, Untervoltage

General specifications

Dimensions [mm]	1670x920x625	1800x1200x800	1800x1200x1000
Weight ACS 503	450kg	1000 kg	1200 kg
Operating temperature	0°C – 35°C	0°C – 35°C	0°C – 35°C

Unit protection

Input protection	3x 63A	3 x 160A	3 x 250A
Input undervoltage	-15% of U nominal		
Input overvoltage	+15% of U nominal		
Output overcurrent	according table overcurrent		
Overtemperature	more than 70°C		

5.3.3 Voltage Sense lines

The stabilization of the ACS 500N output voltage is realized with two sense lines, for eliminate the voltage drop influence of the cables.
Notice that ACS 500N corrects voltage drops on the cables until 5% of the set up voltage to avoid possible overheating of the same line, after exceeding this limit ACS 500N doesn't guarantee that the value of the output voltage is equal to the set up voltage and is visualized a signal of error.

5.3.4 Alarms from ACS

ACS 500N is able to operate a certain time with a relatively high overload.
Is the load to high the alarm in Figure 13.3. appears.
Are more than one alarm, a code appears. The table below shows the values of each alarm. The user must decode to know which alarms occur.

ACS 500N can work with line voltage variations of +/- 15%, if these limits are exceeded ACS 500N stops and an alarm occurred on the screen.
In this case ACS 500N can be unblocked by the button HARDWARE RESET or switching off and switching on the machine.

Code Alarm ACS

1 : Overvoltage AC line power supply
2 : Undervoltage AC line power supply
4 : Overtemperature > 70°C
8 : Inverter error
16 : Overcurrent EUT
32 : ΔU output voltage

Example:
Code value = 48 ⇒ 16 + 32
The occurred alarms :
- 16 : Overcurrent EUT
- 32 : ΔU output voltage

5.3.5 ACS 500N2 current limits

Continuous operation

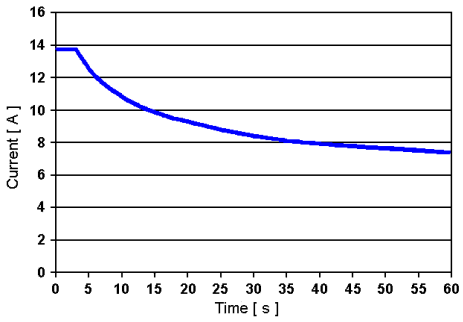
output current

Load	50 Hz	60 Hz
Resistive	6,2 A	6,1 A
Inductive	7,7 A	8,0 A
Capacitive	5,0 A	4,7 A

Short time operation (max. 3 seconds)

maximum current

Load	50 Hz	60 Hz
Resistive	13,7 A	13,7 A
Inductive	15,1 A	15,4 A
Capacitive	12,4 A	12,2 A



ACS 500N2

5.3.6 ACS 500N3 current limits

Continuous operation

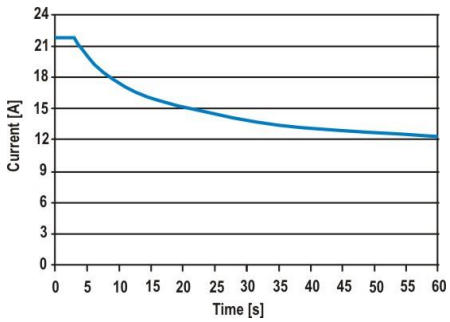
output current

Load	50 Hz	60 Hz
Resistive	12.1 A	12.5 A
Inductive	10.0 A	9.9 A
Capacitive	19,0 A	7.9 A

Short time operation (max. 3 seconds)

maximum current

Load	50 Hz	60 Hz
Resistive	21.8A	22.1 A
Inductive	20.4 A	20.3 A
Capacitive	19.0 A	18.7 A



ACS 500N3

5.3.7 ACS 500N6 current limits

Continuous operation

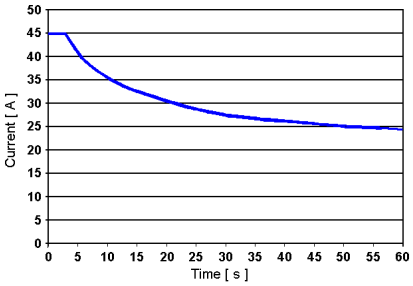
output current

Load	50 Hz	60 Hz
Resistive	19,0 A	18,8 A
Inductive	24,0 A	24,9 A
Capacitive	15,0 A	14,2 A

Short time operation (max. 3 seconds)

maximum current

Load	50 Hz	60 Hz
Resistive	42,3 A	42,2 A
Inductive	47,0 A	47,9 A
Capacitive	38,0 A	37,2 A



ACS 500N6

5.3.8 ACS 503 current limits 20kVA

Continuous operation

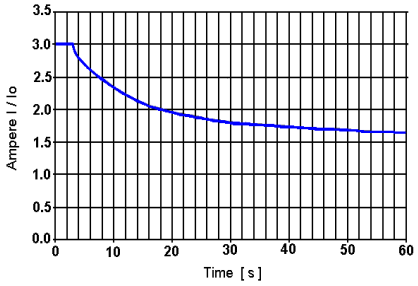
output current.

Load	**50 Hz**	**60 Hz**
Resistive	22 A	21 A
Inductive	34 A	36 A
Capacitive	14 A	12 A

Short time (max. 3 seconds)

maximum current

Load	**50 Hz**	**60 Hz**
Resistive	70 A	70 A
Inductive	81 A	83 A
Capacitive	61 A	59 A



ACS 503

5.3.9 ACS 503N30 current limits 30kVA

Continuous operation 300V range

maximum current.

Load	**50 Hz**	**60Hz**
Resistive	33 A	
Inductive	40 A	
Capacitive	27 A	

5.3.10 ACS 503 N60 current limits 60kVA

Continuous operation 300V range

maximum current.

Load	**50 Hz**	**60Hz**
Resistive	60 A	59 A
Inductive	75 A	78 A
Capacitive	47 A	44 A

5.3.11 ACS 503 N90 current limits 90kVA

Continuous operation 300V range

maximum current

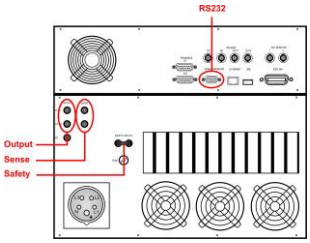
Load	**50 Hz**	**60Hz**
Resistive	91 A	90 A
Inductive	112 A	115 A
Capacitive	74 A	70 A

5.4 Notes for the installation

Connections ACS

Main Supply	3x400V (ACS 500N6) 230V AC (ACS 500N2) 208..230 LL (ACS 500N2, USA)
RS 232 to	DPA 500N
Output to	DPA input power source
Sense to	DPA input power source
Safety	Safety circuit (short circuit)
Sync	To Line – Neutral of reference AC signal. This function is for synchronize the output signal with an external AC line. The software does not support this function.

Connection NetWave



Main Supply	3x400V 208..230 LL
RS 232 to	DPA 500N
Output to	DPA input power source
Sense to	DPA input power source
Safety	Safety circuit (short circuit)

ACS 500N6, NetWave

For the ACS 500N6 power supply use the following connector model: (Figure 13.10.)
CEE type plug with flexible cable entry splash proof
5x32A 3P+N+PE

ACS 500N2

Connect the power cable to the ACS 500N2

Use a cord connector according IEC/EN 60320-1/C19 for 16A 250V

ACS 500N3

Connect the power cable to the ACS 500N3

Use the delivered connector for 32A 230V

ACS 503

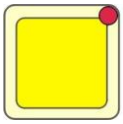
For the ACS 503 power supply use the following connector model: (Figure 13.13)
CEE type plug with flexible cable entry splash proof

ACS 503	20kVA	5x63A	3P+N+PE
ACS 503 N30	30kVA	5x100A	3P+N+PE
ACS 503 N60	60kVA	5x single wire	3P+N+PE
ACS 503 N90	90kVA	5x single wire	3P+N+PE

Safety circuit	Safety switch with cable approx. 2m

5.5 Switching on ACS 500N6 ACS 500N2

After switch on with the main switch on the front panel, the ACS 500N makes different cycles of test. The LED on the Reset button indicates that ACS 500N is ready to work.



Please respect this initialization phase before new setting with the software.
ACS 500N / 503 default power on output setting is 0 Volt, 50 Hz.

5.6 Switching on NetWave

After switching on, NetWave needs approx. 35s for booting. During this time the display is blank. NetWave is ready when the display shows NetWave and the current version.

Please respect this initialization phase before new setting with the software.

5.7 Test ON

After NetWave is ready the Button Test On must be pressed to enable the output.

Pressing this button will enable / disable the output voltage.
- TEST ON => LED is on
- TEST OFF => LED is off

NetWave default power on output setting is 230 Volt, 50 Hz.

6 Flicker impedance AIF 503

6.1 General

6.1.1 Power requirements

The AIF uses either 115 or 230 VAC to power the cooling fan. The user may select the desired input voltage using the range selector.
Note that attempting to operate the AIF from an input range that does not match the actual AC power voltage may cause permanent damage the unit.

6.1.2 Installation

The AIF has been designed for rack mounting in a standard 19 inch rack.
The cooling fan at the rear of the unit must be free of any obstructions that would interfere with the flow of air. A 100 mm clearance should be maintained between the rear of the unit and the rear panel of the mounting cabinet. Also the air intake holes on the chassis must not be obstructed.

6.1.3 Wiring of AIF 503

The AIF impedance network is wired in between the output of the power source or power sources systems and the EUT. Separate terminals are mounted for the connection to the DPA 503 measuring system.
The external sense wires of the power sources must be connected at the connectors INPUT POWER SOURCE and not at the output TEST SUPPLY.
If the external sense wires were connected at the load or the test supply output, the power source will compensate the flicker impedance and makes the system unsuitable for IEC 61000-3-3 flicker testing.
Refer to the figures in this section for examples of proper external wiring connections.

Note: The output voltage of the power sources into the AIF may be at hazardous potentials as high as 300V line to neutral or 600V line to line. Wiring used between the power sources and AIF must be insulated to withstand the potential and current.

6.2 Technical data AIF 503

6.2.1 Flicker impedance

	AIF 500N32	AIF 503N16/32 AIF 503N16.1	AIF 503 N32.1AIF 503 N63.1/75.1
			
Phase	1-phase	3-phases	3-phases
Z ref ± 3%	RA = 0.24 Ω XA = 0.15 Ω RN = 0.16 Ω XN = 0.10 Ω		
Z test ± 3%	not available		RA = 0.15 Ω XA = 0.15 Ω RN = 0.10 Ω XN = 0.10 Ω
Accuracy Zref, Ztest	3 %		

EUT Power supply

Line Voltage	1x 230 V ± 10%	3x 400 V ± 10%	3x 400V ± 10%
Line Current	AIF 503N16 16 A per phase AIF 503N32 32 A per phase		AIF 503 N32.1 32 A per phase AIF 503 N63.1 63 A per phase AIF 503 N75.1 75 A per phase
Line frequency	47- 63 Hz		

6.2.2 General data

Power mains supply

Voltage	230 V or 115 V +10%/- 15%	
Power	25 W	200W
Frequency	50/60 Hz	
Fuses	0.2 A slow blow (AIF503 / AIF500)	10A

Dimensions

	AIF 500N32, 503N16.2 / 32	AIF 503 N32.1	AIF 503 N63.1	AIF 503 N75.1
Housing	19“/ 3HU	19“/ 25 HU	19“/ 34 HU	19“/ 38 HU
Weight	AIF 503N32 19.4 kg AIF 500N32 20.1kg AIF 503N16.2 19.3kg	100kg	220kg	235kg
Dimensions mm	1800 x 600 x 800	1245 x 553 x 780	600 x 800 x1610	600 x 800 x1900
Position	Rack mounted	Transportable with castors		

Ambient

Temperature	operating 0° to 30°
Humidity	80% non condensing

Not relevant data for the standards can be changed by the manufacturer

6.3 Description AIF 503N16 / N16.1 / N16.2

The AIF 503N16.x impedance network adds resistive and inductive impedance to the output between the power sources and EUT. The Impedance that AIF 503N16.x adds may be shunted by a bypass contactor when measuring harmonics (low impedance).

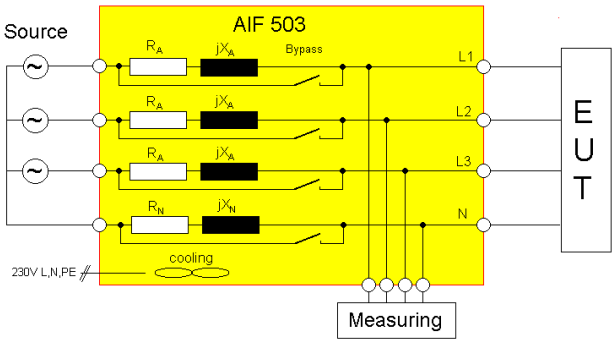
6.3.1 Block diagram AIF 503N16.x

Flicker impedance

R_A = 0,24 Ω jX_A = 0,15 Ω at 50Hz
R_N = 0,16 Ω jX_N = 0,10 Ω at 50Hz

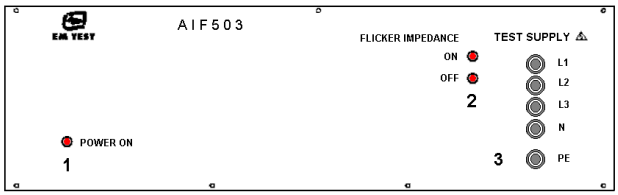
The built-in contactor makes a bypass across the flicker impedance. It toggles controlled by the DPA 503 between the bypass function (no added impedance) for harmonics measuring and flicker function.

Each inductor is designed as a non-saturable air coil and is matched manually to the specified value.

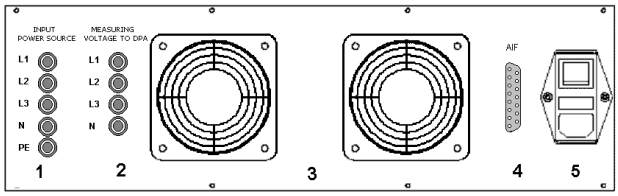


Blockdiagram AIF 503

6.3.2 Front- and rear side AIF 503N16 / N16.1



Front side AIF 503

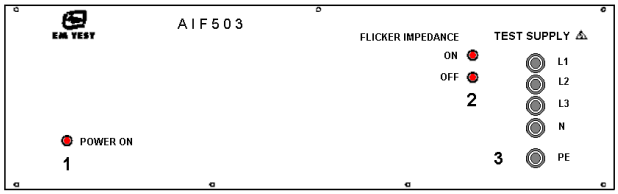


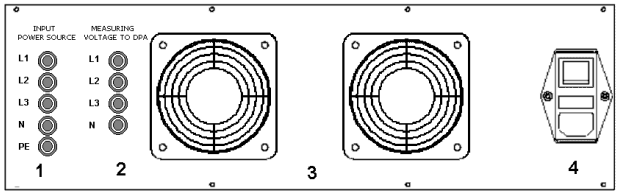
Rear side AIF 503

1 Power ON display
2 Display Flicker impedance ON / OFF (bypassed)
3 EUT Output (EUT)

1 Input Power Source
2 Measuring voltage to DPA
3 Fan for cooling
4 Remote plug to DPA 503
5 Power supply fuse 230V 0.5 A slow blow

6.3.3 Front- and rear side AIF 503N16.2



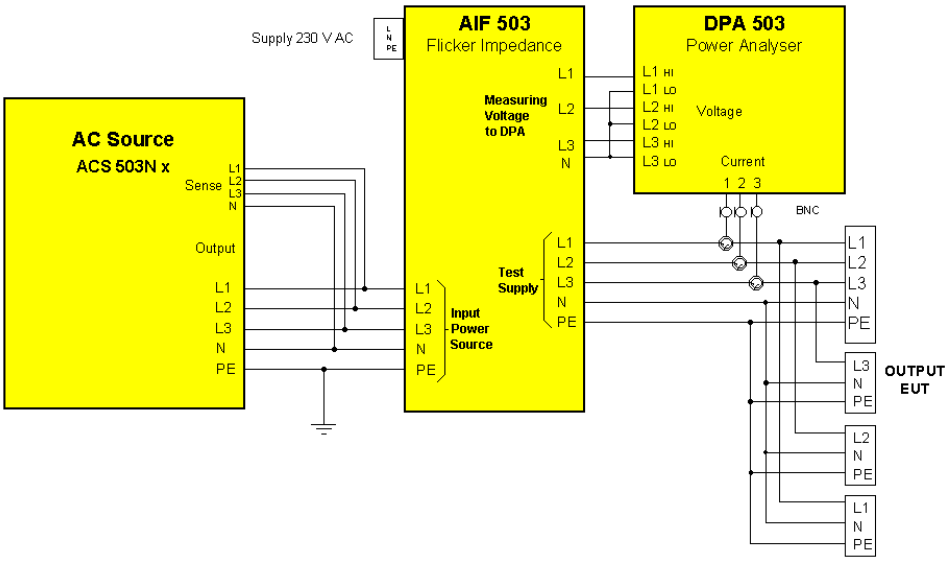


1 Power ON display
2 Display Flicker impedance ON / OFF (bypassed)
3 EUT Output (EUT)

1 Input Power Source
2 Measuring voltage to DPA
3 Fan for cooling
5 Power supply fuse 230V 0.5 A slow blow

Bypass is switched manually by the front panel switch. No connection to the DPA exists.

6.3.4 Example connection AIF 503N16.x



Wiring AIF 503N16.x in a 3-phase system

6.4 Description AIF 500N32

The AIF 500N32 impedance network adds resistive and inductive impedance to the output between the power sources and EUT. The impedance may be shunted by a bypass contactor when measuring harmonics (low impedance). The bypass is switched manually by the switch on the front panel (no control by the DPA possible).

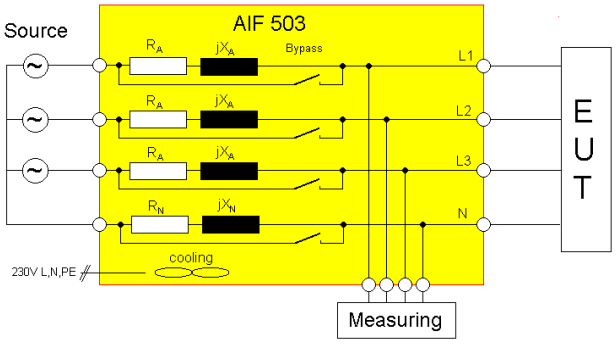
6.4.1 Block Diagramm

Flicker impedance

R_A = 0,24 Ω jX_A = 0,15 Ω at 50Hz
R_N = 0,16 Ω jX_N = 0,10 Ω at 50Hz

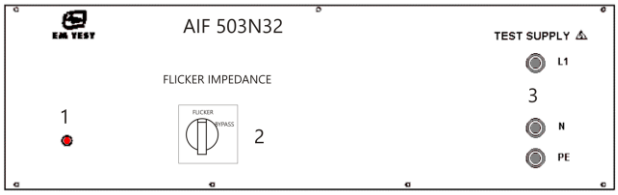
The built-in contactor makes a bypass across the flicker impedance. It toggles controlled by the DPA 503 between the bypass function (no added impedance) for harmonics measuring and flicker function.

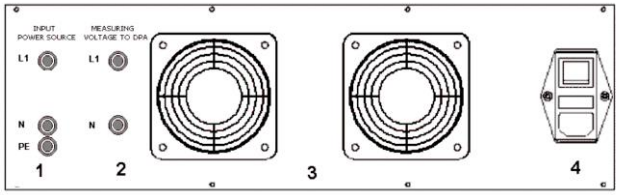
Each inductor is designed as a non-saturable air coil and is matched manually to the specified value.



Blockdiagram AIF 503

6.4.2 Front- and rear side





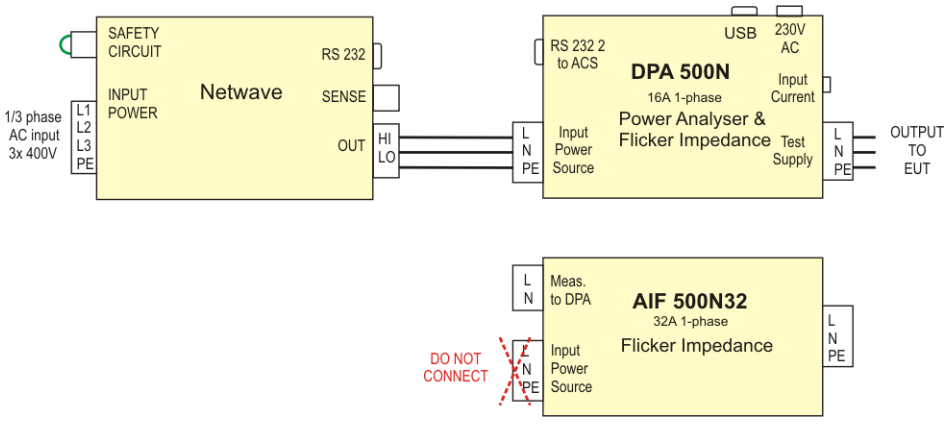
1 Power ON display
2 Switch for Flicker or Bypass
3 EUT Output (EUT)

1 Input Power Source
2 Measuring voltage to DPA
3 Fan for cooling
4 Power supply fuse 230V 0.5 A slow blow

6.4.3 Test setup

There are two different test setups depend on the current: 16 A and 32 A.

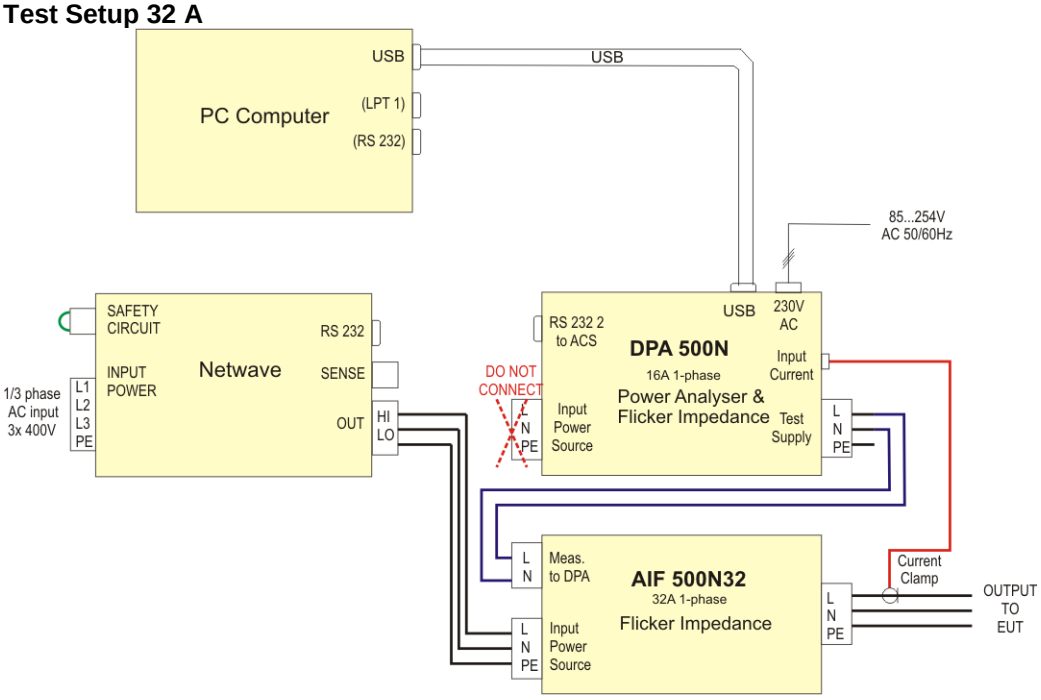
Test Setup 16 A



The impedance built-in the DPA 500N is used for measurements up to 16A. The additional impedance AIF 500N32 is not used.

The AIF 503N32 power input and the output must be disconnected. If not, the impedance of the test setup is changed which will lead to wrong measurement results.

Test Setup 32 A



The external impedance AIF 500N32 is used for measurements up to 32A.

The DPA 500N power input must be disconnected. If not, the impedance of the test setup is changed which will lead to wrong measurement results.

Notes:

- disconnect the DPA 500N “input power source”
- connection from “Meas. To DPA” to “Test Supply” on the front of the DPA 500N is required
- an external current clamp must be used for the current measurement

6.5 Description AIF 503N32.1 / N63.1 / N75.1

The Flicker Impedance AIF 503Nx is designed for Flicker and Harmonic test according IEC 61000-3-3 and IEC 61000-3-11 with built in Zref and Ztest.

Reference Impedance Zref
The conventional impedance specified in IEC 61000-3-3 with the value in accordance with IEC 60725 which is used in the measurement of relative voltage change dc, dmax, dt, PST and PLT values .

Test Impedance Ztest
The test impedance Ztest is lower than Zref and used for 3-phase or single phase equipment intended to connected to public low-voltage distribution systems having a service current supply with a capacity ≥ 100A.

6.5.1 Blockdiagram AIF 503N32.1 / N63.1 / N75.1

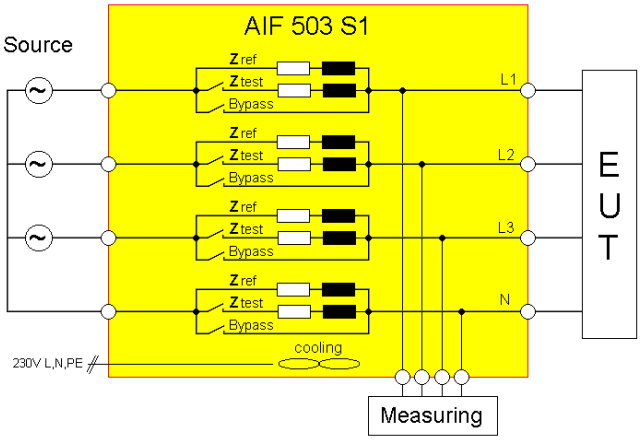
Flickerimpedance

Zref
R_A = 0,24 Ω jX_A = 0,15 Ω at 50Hz
R_N = 0,16 Ω jX_N = 0,10 Ω at 50Hz

Ztest
R_A = 0,14 Ω jX_A = 0,15 Ω at 50Hz
R_N = 0,10 Ω jX_N = 0,10 Ω at 50Hz

The built in contactor makes a bypass across the flicker impedance. It toggle controlled by the DPA 503 between the bypass function (no added impedance) for harmonics measuring and flicker function.

Each inductor is designed as a non satturable air coil and is matched manually to the specified value.



Block diagram AIF 503N32.1, N63.1, N75.1

6.5.2 Front- and rear side AIF 503N32.1

Front- and rear side AIF 503 N32.1

Details

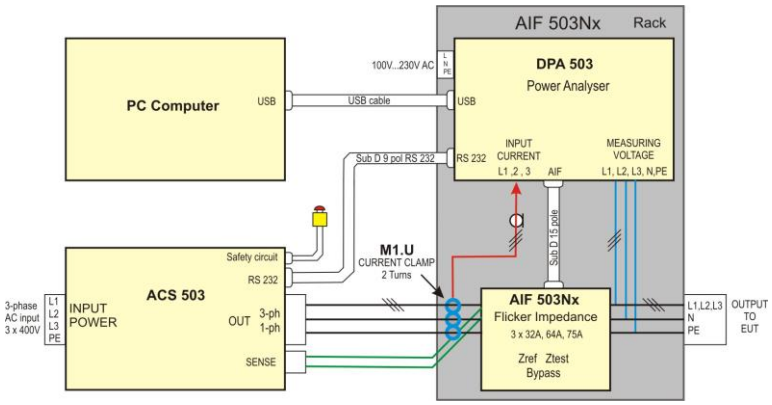
Indicator display for the used system setup like Bypass for harmonics, or the used flicker impedance Zref or Ztest.

Dual size 80A banana plug connector with 32A for 4mm banana connector.

6.5.3 Example connection AIF 503N32.1, N63.1, N75.1 rack

The DPA 503 measures the voltage and current for harmonic and flicker analysing. The flicker impedance Zref / Ztest is bypassed for the harmonic measurement.

The AIF 503N32.1...N75.1 is controlled from the DPA 503.



6.6 Accessories and options AIF 503N32.1 / N63.1 / N75.1

6.6.1 VLCM Kit AIF 503N (Option)

VLCM Kit AIF 503N
Output for very low current

Measuring output:	Separate output for very low current on phase L1
Current range:	5 mA – 500 mA
Accuracy :	<1% of measured value

6.6.2 Cable

Sense control cable ACS 503 – AIF 503N32.1 / N63.1 / N75.1

Length:	approx. 4m
Connectors:	Amphenol 4 pole
Control:	Sense signal
	A: L1
	B: L2
	C: L3
	D: N

Power cable ACS 503 – AIF 503Nx

Length:	approx. 3m
Current:	5 x 75A
Connector ACS:	Eyelet connector
Connector AIF:	Safety socket Multi Contact 100A type

Power cable AIF 503Nx – EUT

Length:	approx. 3m
Current:	5 x 75A
Connector AIF:	Safety socket Multi Contact 100A type
Connector EUT:	CEE 125A type

Power cable Building – ACS 503 N63.1 / N75.1 **Customer side**

Length:	approx. 4m
Current:	125A
Cross section:	4 x 120mm^2
Connector ACS:	Eyelet connector
Connector Building:	not specified

Note: Length and current rating of power cables are depending of the system current.

7 Maintenance

7.1 General

The equipment is maintenance-free.

7.2 Calibration and Verification

7.2.1 Factory calibration

Every AMETEK CTS generator is entirely checked and calibrated as per international standard regulations before delivery. A calibration certificate is issued and delivered along with a list of the equipment used for the calibration proving the traceability of the measuring equipment. All auxiliary equipment and accessories are checked to our internal manufacturer guidelines.

The calibration certificate and the certificate of compliance (if available) show the date of calibration.

The AMETEK CTS equipment are calibrated in the factory and marked with a calibration mark. The used measuring instruments are traceable to the Swiss Federal Office of Metrology.
The calibration date is marked. The validity of the calibration is to the responsibility of the user's quality system. Neither the certificate of calibration nor the corresponding label mark any due date for re-calibration.

Example: Calibration mark

7.2.2 Guideline to determine the calibration period of AMETEK CTS instrumentation

Our International Service Departments and our QA Manager are frequently asked about the calibration interval of AMETEK CTS equipment.

AMETEK CTS doesn't know each customer's Quality Assurance Policy nor do we know how often the equipment is used and what kind of tests is performed during the life cycle of test equipment. Only the customer knows all the details and therefore the customer needs to specify the calibration interval for his test equipment.

In reply to all these questions we like to approach this issue as follows:
AMETEK CTS make use of a solid-state semiconductor switch technique to generate high voltage transients. A precious advantage of this technique is the absolute lack of periodical maintenance effort. In consequence thereof, a useful calibration period has to be defined based on two criteria:

- The first one is the customer's Quality Assurance Policy. Any existent internal regulation has been applied at highest priority. In the absence of such internal regulation the utilization rate of the test equipment has been taken into consideration.

- Based on the experience and observation collected over the years **AMETEK CTS recommends a calibration interval of 1 year** for frequently used equipment. A 2-years calibration interval is considered sufficient for rarely used test generators in order to assure proper performance and compliance to the standard specifications.

7.2.3 Calibration of Accessories made by passive components only:

Passive components do not change their technical specification during storage. Consequently, the measured values and the plots stay valid throughout the storage time. The date of shipment shall be considered as the date of calibration.

7.2.4 Periodically In-house verification

Please refer to the corresponding standard before carrying out a calibration or verification. The standard describes the procedure, the tolerances and the necessary auxiliary means. Suitable calibration adapters are needed. To compare the verification results, AMETEK CTS suggests referring to the wave shape and values of the original calibration certificate.

8 Declaration of CE-Conformity

DECLARATION OF CONFORMITY

Manufacturer:	**AMETEK CTS GmbH**
Address:	Sternenhofstr. 15 CH 4153 Reinach Switzerland

declares, that under is sole responsibility, the product's listed below, including all their options, are conformity with the applicable CE directives listed below using the relevant section of the following EC standards and other normative documents.

Product name:	Power Analyser
Model Number(s)	DPA 500N, DPA 500N1, DPA 503N
Product name:	Flicker impedance
Model Number(s)	AIF 500N32, AIF 503N16, AIF 503N16.1, AIF 503N16.2, AIF 503N32.1, AIF 503 N60, AIF 503N90
Product name:	AC Source
Model Number(s)	ACS 500N2, ACS 500N6, ACS 503, ACS 503N30, ACS 503 N60, ACS 503 N90

Low Voltage Directive 2014/35/EU

Standard to which conformity is declared:

EN 61010-1:2011	Safety requirements for electrical equipment for measurement, control, and laboratory use.

EMC Directive 2014/30/EU

Standard(s) to which conformity is declared:

EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use (Requirements for devices to use in industrial area.)
EN 61000-3-2:2014	Limits for harmonic current emissions
EN 61000-3-3:2013	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

The purpose of this instrument is the generation of defined interferences signals for EMI immunity testing. Depending on the arrangement of the test rig, the configuration, the cabling and the properties of the EUT itself, a significant amount of electromagnetic radiation may result that could also affect other equipment and systems. The user himself or herself is ultimately responsible for the correct and controlled operation of the rig. In case of doubt, the tests should be carried out in a Faraday cage.

Manufacturer
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CH 4153 Reinach
Tel: +41 61-7179191
Fax: +41 61-7179199

By	A. Burger Business Manager Conducted EMC
Place	Reinach BL, Switzerland
Date	1. July 2017

9 Annex

9.1 Basic Calculations

In addition to the time graphs of current and voltage the text field at the bottom shows the active, reactive and apparent power, the power factor and the distortion factor THD(u), and THD(i) for voltage and current. The indicated power is calculated in consideration of the present harmonics as follows:

Active power

$P_{\cos(\varphi n)} = \sum P(i) = U_1 \cdot I_1 \cdot \cos(\varphi_1) + ... + U_n \cdot I_n \cdot$

Apparent power

$S = \sqrt{U_{eff}^2 . I_{eff}^2}$

Reactive power

$Q_1 = U_1 \cdot I_1 \cdot \sin(\varphi_1)$

(reactive power of the first harmonic)

$Q_v = \sqrt{S^2 - P^2 - Q_1^2}$

(distortion power)

$Q = \sqrt{Q_1^2 + Q_v^2}$

Power factor

$\lambda = \frac{P}{S}$

Distortion factor

Distortion factors are calculated as follows:

$THD(u) = \sqrt{\sum_{n=2}^{n=40} \left(\frac{Un^2}{U_1^2} \right)}$

$THD(i) = \sqrt{\sum_{n=2}^{n=40} \left(\frac{In^2}{I_1^2} \right)}$

IEC 61000-3-12 Ed.2

$THC = \sqrt{\sum_{n=2}^{n=40} \left(In^2 \right)}$

IEC 61000-3-12 Ed.2

$PWHC = \sqrt{\sum_{n=14}^{n=40} \left(n \times In^2 \right)}$

9.2 Rsce calculation

Short-circuit power (S_{sc})

$S_{sc} = U^2_{nominal} / Z$

Value of the three-phase short circuit power calculated from the nominal interphase system voltage $U_{nominal}$ and the line impedance Z of the network at the PCC (point of common coupling).

Z is the network impedance at the power frequency

Rated apparent power (S_{equ})

Value calculated from the rated r.m.s. line current I_{equ} of the piece of equipment stated by the manufacturer and the rated voltage U_p (single phase) or U_i (interphase).

In the case of a voltage range U_p or U_i shall be a nominal system voltage according to IEC 60038 (120V or 230V for single phase or 400V line - line for three phase).

$S_{equ} = U_p I_{equ}$ for single phase equipment and the single-phase part of hybrid equipment.

$S_{equ} = U_i I_{equ}$ for interphase equipment.

$S_{equ} = \sqrt{3}\, U_i\, I_{equ}$ for balanced three phase equipment and the three-phase part of hybrid equipment.

$S_{equ} = 3\, U_p\, I_{equ\,max}$ for unbalanced three phase equipment where $I_{equ\,max}$ is the maximum of the r.m.s currents flowing in any of the three phases.

$R_{sce} = S_{sc} / (3\ S_{equ})$ for single-phase equipment and the single-phase part of hybrid equipment

$R_{sce} = S_{sc} / (2\ S_{equ})$ for interphase equipment

$R_{sce} = S_{sc} / S_{equ}$ for all three-phase equipment and the three-phase part of hybrid equipment

Note: R_{sce} may be related directly to basic known quantities by means of the equations:

$R_{sce} = U / \sqrt{3}\ Z\ I_{equ}$ for single-phase equipment and the single-phase part of hybrid equipment

$R_{sce} = U / 2\ Z\ I_{equ})$ for interphase equipment

$R_{sce} = U / (\sqrt{3}\ Z\ I_{equ})$ for balanced three-phase equipment and the three-phase part of hybrid equipment

$R_{sce} = U / (\sqrt{3}\ Z\ I_{equ}\ \mathrm{max})$ for unbalanced three-phase equipment

where $U = U_{nominal}$, and is assumed to be eaqual to U_i or $\sqrt{3}U_p$ whichever is relevant.